



TOPOGRAPHIC – BATHYMETRIC LIDAR SURVEY REPORT

LIDAR (TOPOGRAPHY & BATHYMETRY) AND IMAGE
DATA COLLECTION AND PROCESSING

CO UPPER COLORADO TOPOBATHY
LOT 5 PILOT

Prepared For:



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1. EXECUTIVE SUMMARY

Woolpert Inc. (Woolpert) was contracted by the United States Geological Survey (USGS) to provide processed topographic-bathymetric lidar data and four (4)-band true-color and near-infrared (RGBN) digital imagery for two rivers in Colorado, identified as Upper Colorado and Gunnison.

Woolpert collected lidar using their Leica Chiroptera 4X topo-bathy lidar sensor, to provide high density topo lidar to meet USGS Lidar Base Specification 2020 rev. A QL1 standards as required for the topographic lidar, while simultaneously acquiring bathymetric lidar to meet the QL2b “National Coastal Mapping Strategy (NCMS) for Bathymetric Lidar” v1.0 standards.

Woolpert also collected ground control and check points within the project area.

This report details the data acquisition, processing and quality control conducted for the survey.

1.1. SURVEY AREA

The survey area covers two areas of interest to be surveyed with topo-bathy lidar. Survey areas are provided in Table 1 and shown in Figure 1.

Woolpert conducted a simultaneous collect of topographic lidar and bathymetric lidar using its Leica Chiroptera 4X sensor. All topo lidar data were collected to meet United States Geological Survey, Quality Level 1 (USGS QL1) with a minimum of 8 pts per square meter at an accuracy of 10cm RMSEz. A minimum of 2 points per square meter were acquired for bathymetric lidar data. Imagery data was collected at 10-cm for use in point cloud editing and classification.

Table 1: Survey Areas

Location	Survey Area (square kilometers/square miles)
Gunnison	90.6 / 35
Upper CO	38.8 / 15

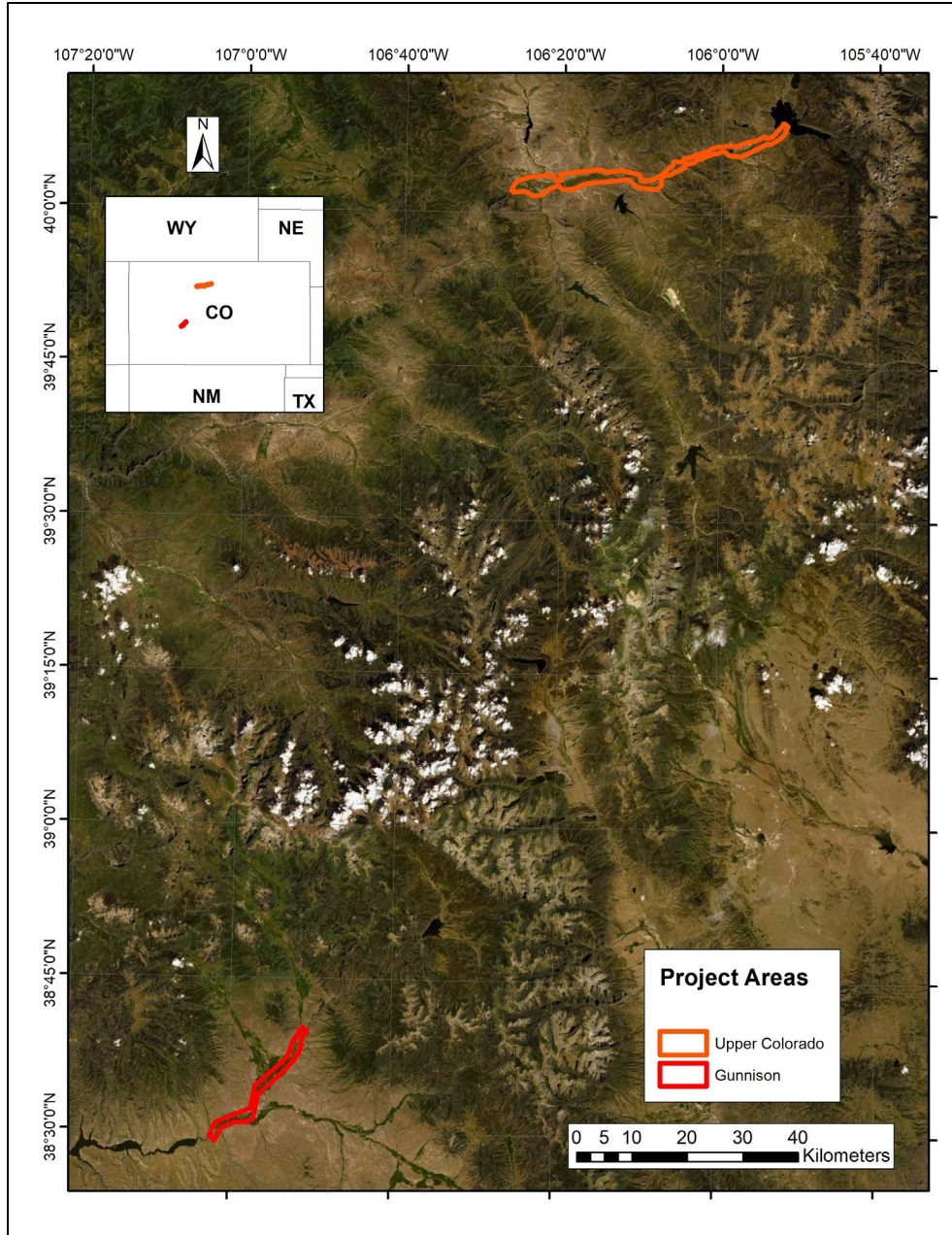


Figure 1: Planned Topo-Bathy (Chiroptera 4X) Flight

2. DATA ACQUISITION

All lidar data were acquired using a Chiroptera 4X (CH4X) sensor. The CH4X sensor was mounted in a Leica PAV100 gyro-stabilized mount integrated with a NovAtel SPAN GNSS and LCI-100C IMU. Real time navigation and GNSS/IMU data logging was provided by Leica FlightPro software. Lidar data were logged on the Airborne Hydrography, AB (AHAB) operator console.

Below are the details of the lidar collection and processing.

2.1. MOBILIZATION

This project consisted of one mobilization to acquire all lidar data. The CH4X system was installed in Woolpert’s Cessna 404 (N532NM) aircraft (Figure 2). A calibration flight was collected over Sidney, OH on October 13, 2020. Eight survey flights were performed in the project area from October 3 to October 10, 2020.



Figure 2: Mobilized Survey Aircraft

2.1.1. AIRCRAFT OFFSET SURVEY

Physical mounting offsets between the GNSS antenna, IMU and gyro-stabilized mount were determined through a combination of manual measurements and iterative processing in NovAtel Inertial Explorer software.

Manual measurements were taken from the GNSS antenna to the reference point on the IMU in the CH4X sensor head. These measurements are added to the known offset between the IMU reference point and the rotation center of the gyro-stabilized mount to calculate the preliminary offset between the GNSS antenna and sensor reference point. This preliminary value was then used to seed the post-processing software which, through an iterative computation, uses the dynamic accelerations and rotations during flight to refine the offsets. Once the solution converges, the final offsets are entered into the flight management software and used in subsequent post-processing of the GNSS/IMU data for final trajectories.

Final offsets, shown in the Leica reference frame, are presented in Table 2.

Table 2: Aircraft Offsets

Sensor Head	Lever Arm	X (forward)	Y (right)	Z (down)
CH4x (Topo and Shallow Channel)	Reference to GNSS Antenna L1 Phase Center	0.042 m	0.023 m	-1.226 m
	Reference to IMU	-0.003 m	-0.006 m	-0.296 m
	Reference to IMU Rotation	0°	180°	0°

2.2. LIDAR CALIBRATION

Field calibration of the CH4X system is carried out to eliminate systematic errors by calculating corrections for boresight errors, scanner angle errors, remaining IMU angle errors and any necessary internal timing errors. In order to verify or compute the field calibration, the following lines are flown (Figure 3):

- a. 2 x Line A over mixed terrain with flat or gentle slopes and features such as peaked roof buildings (1 x each direction)
- b. 1 x Line B offset +50% from Line A in one direction
- c. 1 x Line C offset -50% from Line A in the same direction as Line B
- d. 2 x Line D orthogonal to previous lines (1 x each direction)

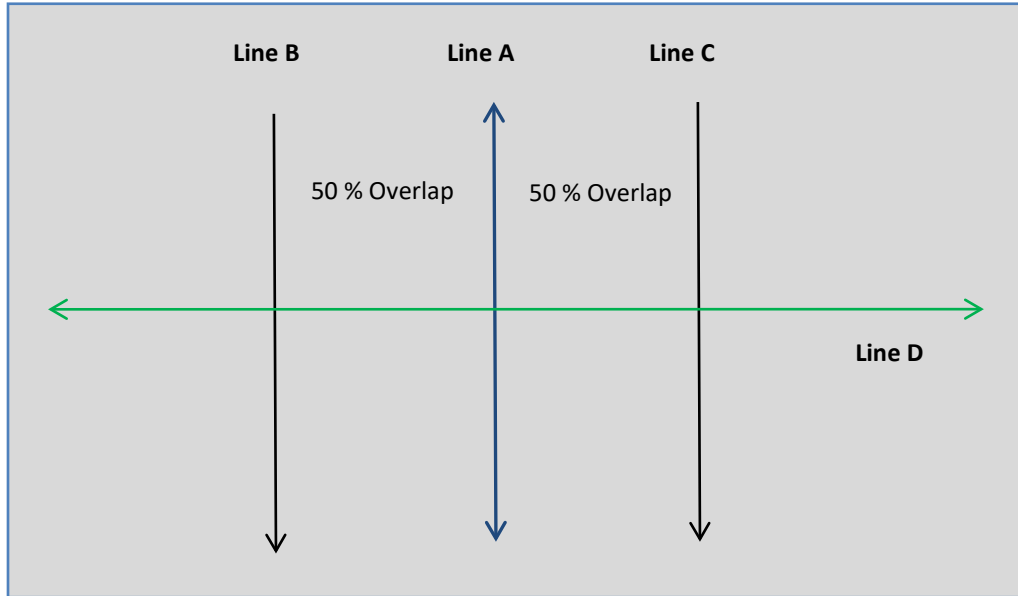


Figure 3: Schematic of CH4x Calibration Lines

A set of calibration lines were acquired at 1000m, 500m, and 400m altitude. All sets of lines are used to calibrate and verify the topographic lidar, while the 500m and 400m lines are used for the bathymetric lidar.

Calibration values are calculated using the automatic calibration routine within the Leica Lidar Survey Studio (LSS) software. This utility first identifies patches or areas of gentle slope within the overlap region of all the lines to use for calibration. Patch selection prevents areas of vegetation, sides of cars, or buildings from being used in the calibration process. Next, the utility compares the front side and back side of the elliptical scan within the same line, as well as comparing all lines to each other, to identify suitable calibration parameters such that data within the patches match. The procedure is iterative and continues until the best possible solution is computed.

Calibration for each channel (topo and shallow) is done independently. Topo channel calibration was computed using 1000m altitude lines. The 500m and 400m lines were then used for verification. Calibration of the shallow channel was computed using 500m altitude lines, and the 400m data was used for verification.

At each step of the calibration process, quality assurance is conducted to ensure values being calculated are valid. This is done using the Leica LSS Quality Control Utility. Two types of checks are done: first, the front scan is compared to the back scan for every line. Then a single line is chosen as a baseline and is compared to every other line. We would expect the average errors from both of these checks to be small; less than 2cm (Table 4 and Table 5). In addition, the data are visually reviewed. In particular, features are studied to ensure lines from different directions show structures in the same position, in other words, verifying horizontal accuracy is maintained. These tests all provide assurance of relative accuracy.

Ground truth is not used within the automatic calibration routine; however, ground truth was used to verify absolute accuracy.

For this project, calibration lines were acquired over Sidney, OH. Woolpert acquired GNSS RTK ground truth data over hard surface areas. To provide accurate coordinates for comparison a control point (SIDN) served as the base for RTK observations. GNSS observations were collected over multiple sessions on multiple days and the data

uploaded to Trimble’s RTX service to compute an accurate coordinate for the control point. These coordinates were compared to the published NGS coordinate as a QC check. The final coordinate is listed below (Table 3).

Table 3: Control Point Coordinate (SIDN)

Control Point	Latitude	Longitude	Height	Datum
SIDN	40° 18’ 37.26523” N	84° 10’ 15.90683” W	293.415 m	NAD83(2011)

Table 4: Calibration QA Results

Test		Topo 1000m	Topo 500m	Topo 400m	Shallow 500m	Shallow 400m
Front to Back Scan Comparison	Average Error (m)	-0.0049	-0.0006	-0.0012	-0.0003	-0.0009
	Std. Dev. of Error	0.0004	0.0008	0.0008	0.0002	0.0003
Line to Line Comparison	Average Error (m)	-0.0037	-0.0079	-0.0073	-0.008	-0.0071
	Std. Dev. of Error	0.0019	0.0016	0.0015	0.0013	0.0013

A comparison to the ground truth was also conducted to verify absolute accuracy. Results presented in Table 5 show data are well within required accuracy specifications.

Table 5: Calibration Ground Truth Comparisons

	Topo			Shallow	
	1000m	500m	400m	500m	400m
Average dz (m)	0.0098	-0.0088	-0.0027	-0.0010	0.0022
Root Mean Square (m)	0.0134	0.0119	0.0110	0.0071	0.0110

The resulting data are also analyzed visually. Results can be seen in the figures below. Figure 4 shows the elevation and intensity data of the Sidney, OH calibration site. Figure 5 and Figure 6 show representative profiles from another area to demonstrate the concept and show the differences between uncalibrated and calibrated data for both channels.

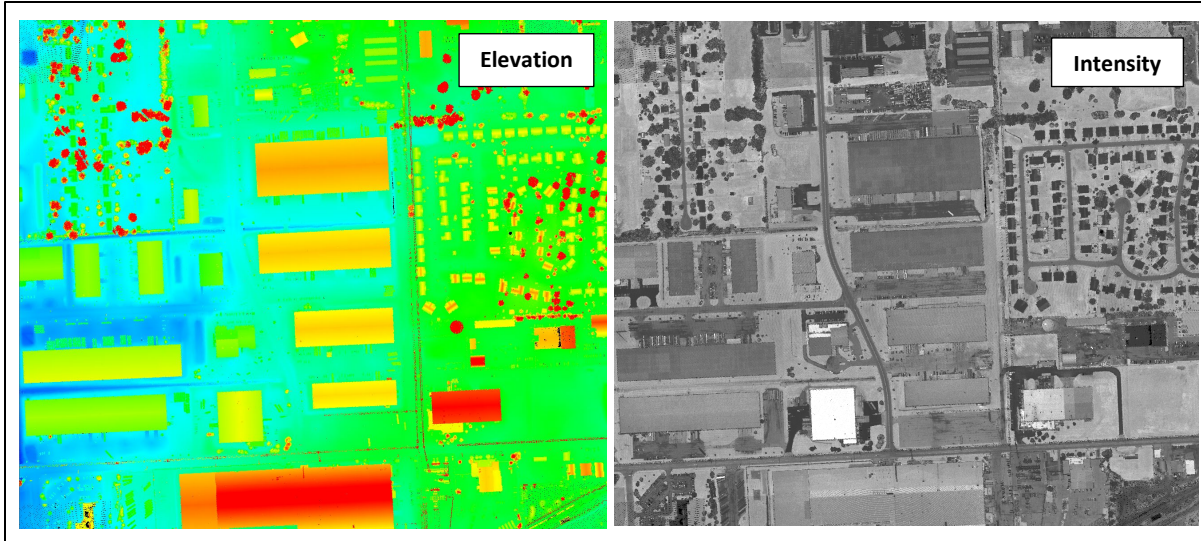


Figure 4: Calibration Site in Sidney, OH

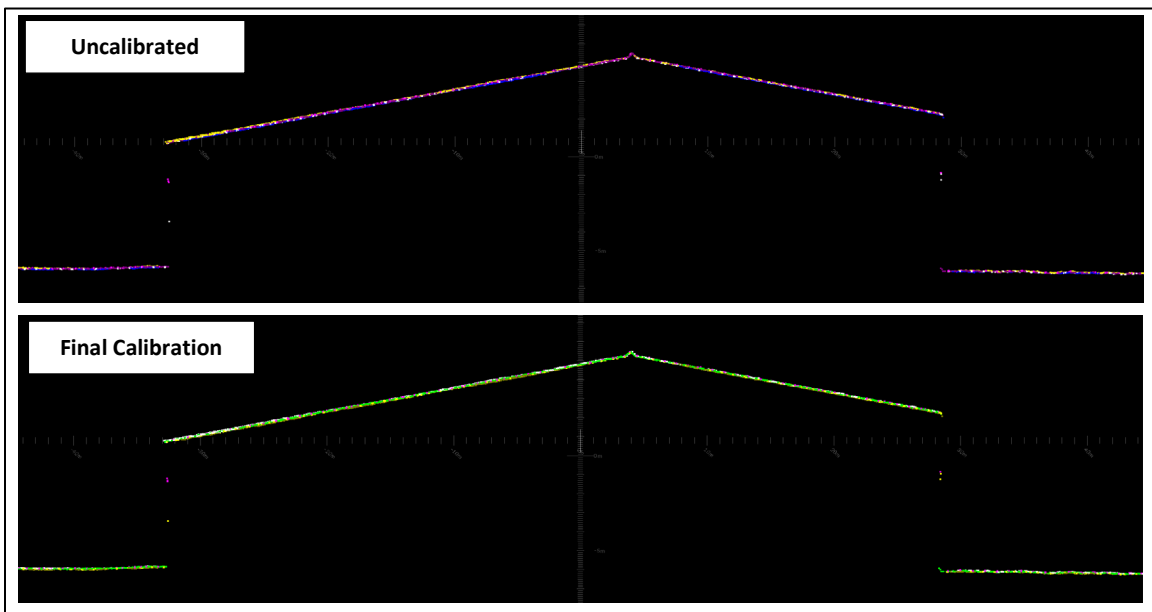


Figure 5: Profile View Colored by Flight Line - Topo Channel Calibration

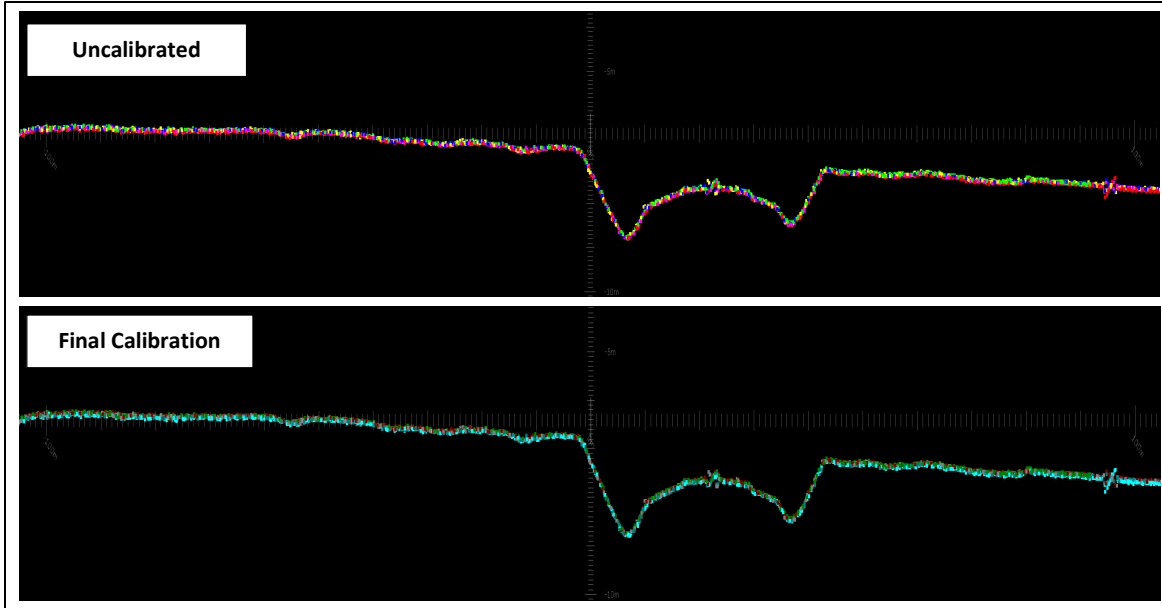


Figure 6: Profile View Colored by Flight Line - Shallow Channel Calibration

2.3. AERIAL SURVEY OPERATIONS

Actual flight lines flown, including start and end date and unique line ID, are provided in the swath polygon footprints included with the project deliverables. A summary of the daily operations is shown in Table 6. Detailed Flight Logs for each day are provided in Appendix A.

Table 6: Summary of Daily Operations

Flight	Engine Time	Air Time	Flown		Reflown		Comments
			km	%	km	%	
2020-10-02A	3:20:00	3:02:00					Test/Calibration Flight/Not Used
2020-10-03A	1:46:00	1:00:00	55.0				BL02
2020-10-03B	2:34:00	2:17:00	185.1		17.4		BL01, BL02
2020-10-05A	3:41:00	3:07:00	204.6				BL03, BL04
2020-10-06A	5:10:00	4:56:00	356.1		45.1		BL03, BL04
2020-10-09A	3:33:00	3:18:00			103.7		BL03, FI03, FI04
2020-10-09B	1:13:00	0:57:00			46.8		BL01, BL02, FI01, FI02
2020-10-10A	0:48:00	0:19:00			5.7		FI01, FI02
2020-10-13A	2:12:00	1:54:00					Calibration Flight
TOTAL	20:57:00	17:48:00	801	98.7%	219	26.9%	

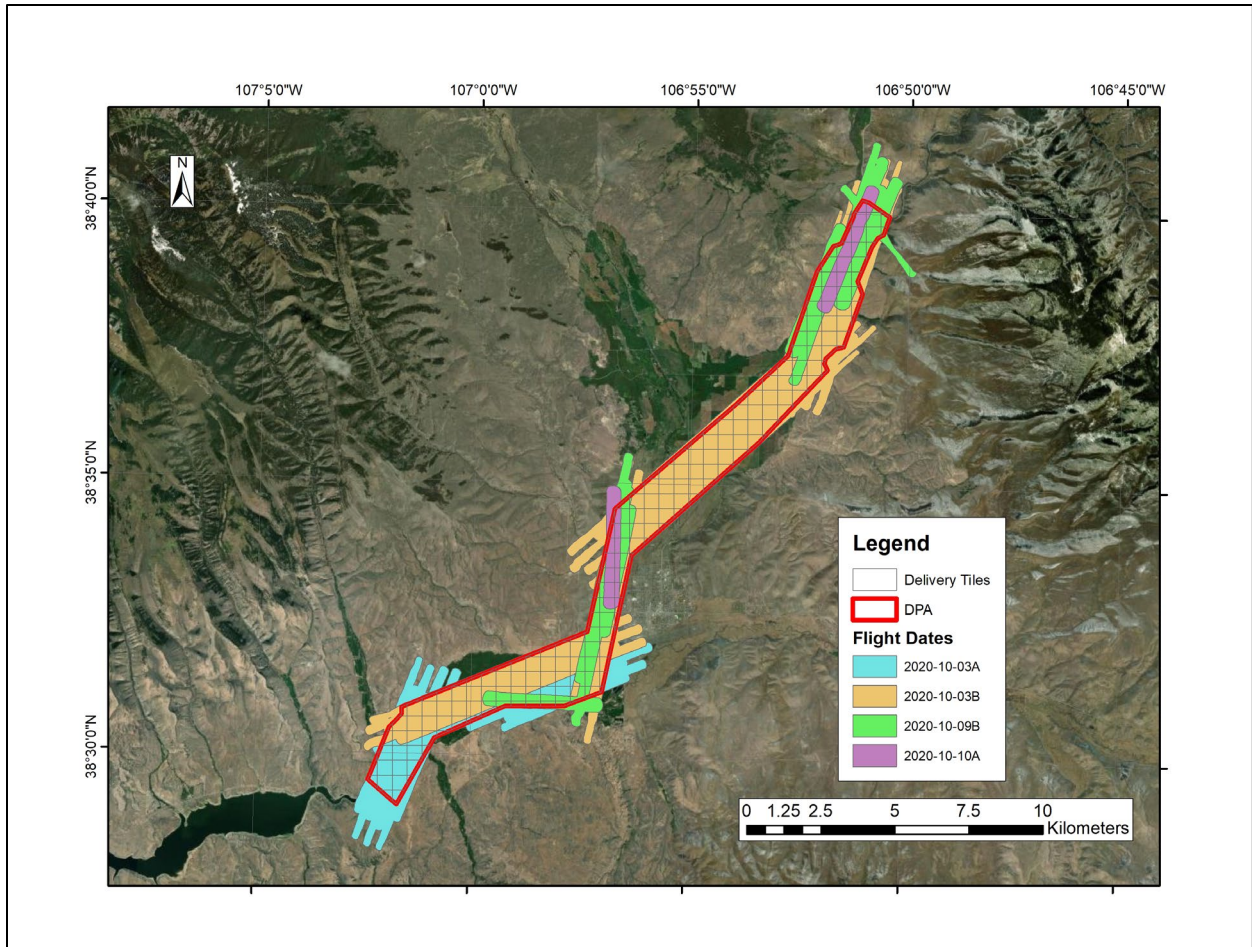


Figure 7: Gunnison Flight Coverage

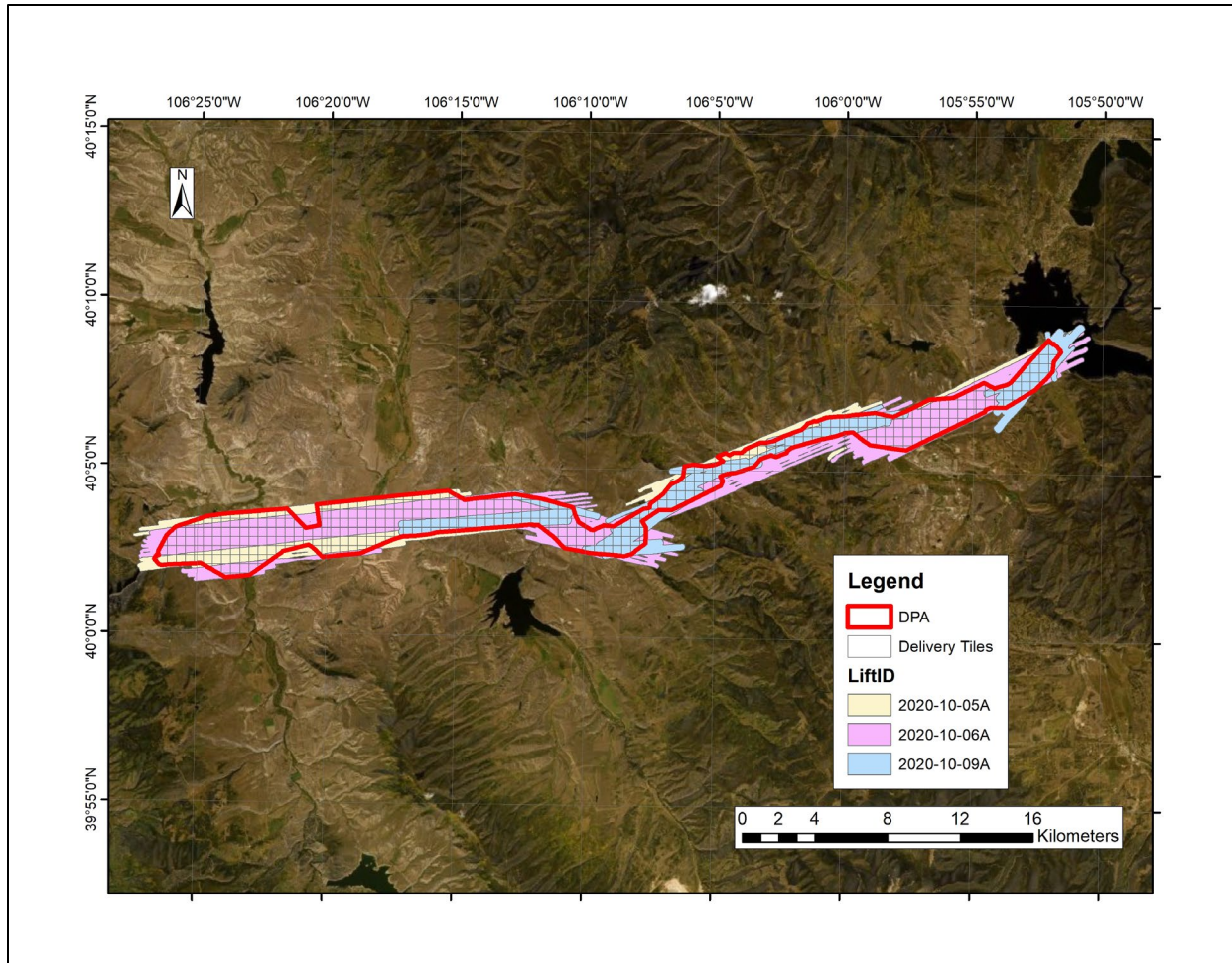


Figure 8: Upper Colorado Flight Coverage

2.3.1. THE CHIROPTERA 4X SENSOR

All lidar and imagery data were acquired using a CH4X sensor (Figure 9). The CH4X is a 1.5x secchi depth system and is the latest generation topographic and bathymetric lidar sensor commercially available. The system provides denser data than previous traditional bathymetric lidar systems. It is unique in its ability to acquire bathymetric lidar, topographic lidar and 4-band multi spectral digital camera imagery simultaneously. Therefore, any land data will always be illuminated by the topographic laser, and any water data will be illuminated with the bathymetric laser during any single flight line.

The CH4X is a two channel lidar system with independent lasers that collect topographic and shallow bathymetric data. The CH4X provided 500 kHz topographic data and an effective 140 kHz shallow bathymetric data. 4-band 80 MP digital camera imagery was also collected simultaneously with the sensor’s RCD-30 camera.

The bathymetric and topographic lasers are independent and do not share an optical chain or receivers, so they are optimized for their specific function. As with any bathymetric lidar, maximum depth penetration is a function of water clarity and seabed reflectivity. The CH4X is designed to penetrate to approximately 1.5 times the secchi depth. This is also represented as $D_{max} = 2.44/K$, where K is the diffuse attenuation coefficient, and assuming K is between 0.1 and 0.3, a normal sea state and 15% seabed reflectance.

Both the topographic and bathymetric sub-systems use a palmer scanner to produce an elliptical scan pattern of laser points with a degree of incidence ranging from +/-14° (front and back) to +/-20° (sides), providing a 40° field of

view. This has the benefit of providing multiple look angles on a single pass and helps to eliminate shadowing effects. This can be of particular use in urban areas, where all sides of a building are illuminated, or for bathymetric features such as the sides of narrow water channels or features on the seafloor such as smaller objects and wrecks. It also assists with penetration in the surf zone where the back scan passes the same ground location a couple of seconds after the front scan, allowing the areas of whitewater to shift.

The bathymetric lasers are diode pumped class 4 lasers which operate in the green spectrum. Full waveform data is acquired for every pulse. The topographic laser operates in the near infra-red spectrum at 1064nm. Up to 4 returns per pulse are acquired from each laser.



Figure 9: Chiroptera 4X Bathymetric Lidar Sensor Installation

For this project, the flight parameters shown in Table 7 were used. Flight lines were planned to provide 100% coverage using a 20% sidelap and meet the USGS Lidar Base Specification Version 2020 Revision A requirements and the SOW document for Quality Level 1 (QL1) topographic data.

During acquisition, flight lines are shown on a pilot's display, and the aircraft is controlled by the pilots at all times. The CH4X system includes a NovAtel SPAN GNSS system with an LCI-100C IMU for aircraft position and orientation. The IMU is in the main Chiroptera sensor head, which includes the topo channel, shallow channel and RCD30 camera. Information from this IMU is also used in real-time by the PAV100 gyro-stabilized mount to compensate for deviations in pitch and roll. Aircraft bank angles were restricted to 20° to avoid any potential GNSS dropouts. No flights were planned if the PDOP was expected to go above 3.0.

Data were monitored for quality during acquisition using the Operators Console running on the AHAB collection computer. The operator monitored system status of the scanners and receivers, waveforms, camera images, data coverage, flight lines and the health of the navigation system.

All data were recorded to a removable solid-state hard disk. At the end of the flight the hard disk was removed and taken to the field office where data was copied on to backup disks for transmittal back to the main processing office. Data is reviewed daily in the field for quality and coverage to ensure that voids due to gaps between data swaths, instrument malfunction, insufficient return amplitude, or cloud cover/ground fog are re-captured. However,

unavoidable voids due to exceptionally low reflectivity (composition roofing; wet asphalt paving; and shadowing by forest canopy) may occur.

Table 7: Survey Flight Parameters

System	
Aerial System	Leica Chiroptera 4X (topo-bathy)
Nominal Survey Altitude	480m (1,575 feet)
Nominal Survey Speed	130 knots
Lidar	
Scan Angle	≤ 40° (+/-20° from Nadir)
Nominal Swath Width	350m (1148 ft)
PRF (Topo)	500 kHz
Effective PRF (Bathy)	140 kHz
Pulse Density (Topo)	≥ 8 pulses/m ² (≤ 0.35 m NPS)
Pulse Density (Bathy)	≥ 2 pulses/m ² (≤ 0.71 m NPS)
Returns Collected Per Laser Pulse (Topo)	Up to 4
Returns Collected Per Laser Pulse (Bathy)	Up to 4
Intensity Range	0 – 65535 (16-bit)

2.3.2. POSITIONING

Position and orientation data were acquired in the aircraft using a NovAtel SPAN with LCI-100C IMU. All data were post-processed using NovAtel Inertial Explorer software to provide a tightly coupled position and orientation solution.

Two base stations were used to control trajectory processing providing all final trajectories on NAD83 (2011), Epoch 2010.0. GUCD and TCP2 were occupied with a Trimble GNSS receiver by Woolpert.

Logs for the trajectory processing are provided in Appendix B.

Table 8: GNSS Base Stations Used for Trajectory Processing

GNSS Base Station	Latitude	Longitude	Height (m)	Datum
GUCD	38° 32' 16.49132"	106° 55' 40.71976"	2324.125	NAD83-MA11 (Epoch 2010.0)
TCP2	40° 03' 59.74944"	106° 12' 26.35205"	2286.211	NAD83-MA11 (Epoch 2010.0)

2.4. TURBIDITY SURVEY

Turbidity was measured in both the Gunnison and Upper Colorado Rivers at multiple locations to quantify the water clarity during the project. Measurements were made prior to the lidar data collection during a reconnaissance on the Gunnison on September 27, 2020 then at the Upper Colorado on October 4, 2020. Additional measurements were also collected during the acquisition of bathymetric check points which occurred from September 30 to October 3 on the Gunnison, then from October 5 to 7 on the Upper Colorado.

AML Oceanographic Tu-Xchange auto-ranging sensors were used, with data measured at approximately 10s intervals for at least 5 minutes. Readings were logged to the sensor body internal memory and downloaded as text files daily. At each location, two separate sensors were deployed into the rivers in different locations logging data concurrently for comparison. Outliers from the data were removed and the remaining readings were then averaged. Results are presented in the following tables.

Table 9: Gunnison River Turbidity Measurements

Date/Time (UTC)	Latitude	Longitude	Average Turbidity	Standard Deviation
09/27/2020 23:22	N38°39'48.1"	W106°50'50.7"	0.8 NTU	0.1 NTU
09/28/2020 00:00	N38°34'49.9"	W106°55'19.2"	1.1 NTU	0.3 NTU
09/28/2020 00:38	N38°31'04.3"	W106°59'38.7"	1.1 NTU	0.2 NTU
09/30/2020 22:51	N38°34'49.9"	W106°55'19.2"	2.1 NTU	0.2 NTU
10/03/2020 00:04	N38°31'04.3"	W106°59'38.7"	1.3 NTU	0.1 NTU
10/03/2020 15:49	N38°29'20.9"	W107°02'04.5"	1.6 NTU	0.2 NTU
10/03/2020 17:16	N38°31'59.5"	W106°56'56.9"	1.1 NTU	0.1 NTU
10/03/2020 19:41	N38°36'38.0"	W106°53'07.4"	1.7 NTU	0.3 NTU
10/04/2020 00:05	N38°39'16.0"	W106°51'19.4"	1.2 NTU	0.2 NTU

Table 10: Upper Colorado River Turbidity Measurements

Date/Time (UTC)	Latitude	Longitude	Average Turbidity	Standard Deviation
10/04/2020 17:27	N40°03'14.6"	W106°17'22.8"	4.6 NTU	0.1 NTU
10/04/2020 18:09	N40°04'26.1"	W106°06'26.4"	4.7 NTU	0.1 NTU
10/04/2020 19:00	N40°06'30.0"	W106°00'10.9"	6.6 NTU	0.2 NTU
10/04/2020 19:53	N40°07'58.2"	W105°52'32.7"	1.9 NTU	0.1 NTU
10/04/2020 21:27	N40°02'30.3"	W106°23'40.3"	3.6 NTU	0.4 NTU
10/04/2020 21:40	N40°02'36.2"	W106°23'46.2"	4.5 NTU	0.1 NTU
10/05/2020 16:28	N40°03'02.0"	W106°10'22.2"	4.4 NTU	0.4 NTU
10/05/2020 18:05	N40°03'04.4"	W106°07'53.6"	5.3 NTU	0.2 NTU
10/05/2020 21:09	N40°06'24.3"	W105°57'22.6"	8.6 NTU	0.4 NTU
10/05/2020 22:11	N40°06'30.0"	W106°00'10.9"	8.6 NTU	0.7 NTU
10/06/2020 14:14	N40°03'46.5"	W106°11'47.6"	4.1 NTU	0.1 NTU
10/06/2020 15:33	N40°03'54.8"	W106°13'50.9"	3.9 NTU	0.2 NTU
10/06/2020 16:56	N40°03'14.6"	W106°17'22.8"	4.5 NTU	0.1 NTU
10/06/2020 19:18	N40°02'39.0"	W106°22'14.4"	4.0 NTU	0.6 NTU
10/06/2020 21:29	N40°02'33.4"	W106°23'49.3"	3.0 NTU	0.1 NTU
10/06/2020 22:21	N40°02'36.2"	W106°23'46.2"	4.0 NTU	0.1 NTU
10/07/2020 17:44	N40°02'33.6"	W106°23'59.1"	5.3 NTU	0.2 NTU

2.5. GROUND SURVEY OPERATIONS

Ground control surveys were conducted to support the airborne acquisition. Ground control surveys were conducted to assist with final point cloud calibration and to perform quality assurance checks on the final lidar data point cloud. See Appendix C for a discussion of ground survey operations.

3. DATA PROCESSING

An overview of Woolpert's established CH4x processing workflow is presented in Figure 10. Initial data coverage analysis and quality checks to ensure there were no potential system issues were carried out in the field prior to demobilization of the sensor. Final processing was conducted in Woolpert's offices.

In general, data were initially processed in Leica's Lidar Survey Studio (LSS) using final processed trajectory information. LAS files from LSS were then imported to a Terrascan project where spatial algorithms were used to remove noise and classify bare earth/ground. Manual review was conducted in both Terrascan and LP360 prior to product creation.

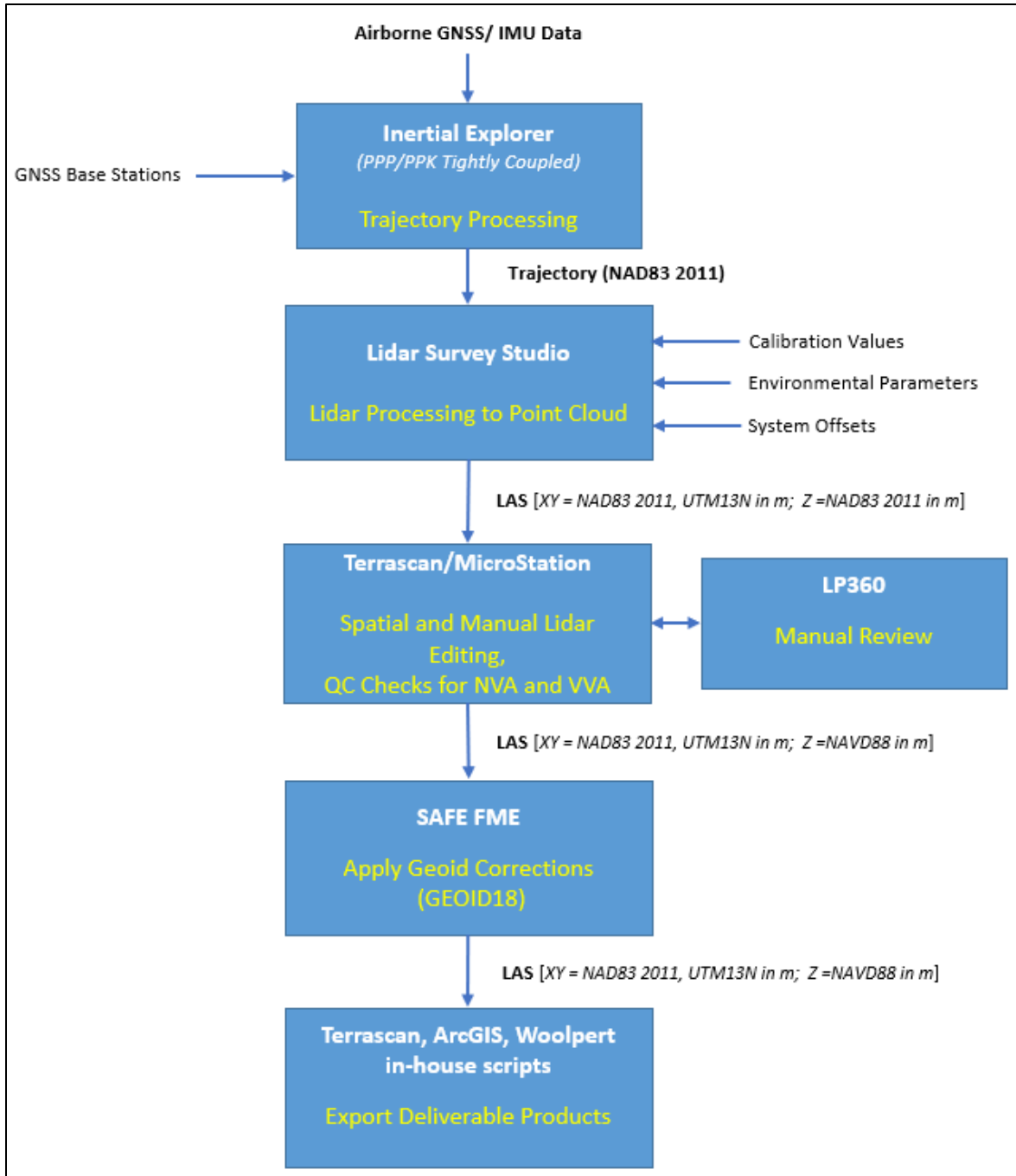


Figure 10: Overview of Processing Workflow

3.1. POSITION

Final trajectory data were post processed in NovAtel Inertial Explorer. Lever arms, shown in the NovAtel reference frame, are presented in Table 11. Inertial Explorer accounts for the fixed offset between the reference point and IMU and uses a multi-pass algorithm to compute a tightly coupled solution. Two GNSS base stations were used for processing, as described in Section 2.3.2. Trajectory processing logs are provided in Appendix B. Average Forward and Reverse Separation RMS for the project was 0.006m in Easting, 0.010m in Northing, and 0.021m in Height.

Table 11: Inertial Explorer Offsets

Sensor Head	Lever Arm	X (right)	Y (forward)	Z (up)
Chiroptera (Topo, Shallow, Camera)	Reference to GNSS Antenna L1 Phase Center	0.028 m	0.045 m	0.930 m
	Reference to IMU Rotation	0 °	180 °	0 °

3.2. LIDAR

3.2.1. RAW DATA PROCESSING

Lidar processing was conducted using the Leica Lidar Survey Studio (LSS) software. Calibration information, along with processed trajectory information were combined with the raw laser data to create an accurately georeferenced lidar point cloud for the entire survey in LAS v1.4 format. All points from the topographic and bathymetric laser include 16-bit intensity values.

During this LSS processing stage, an automatic land/water discrimination is made for the bathymetric waveforms. This allows the bathymetric (green) pulses over water to be automatically refracted for the pulse hitting the water surface and travelling through the water column, producing the correct depth. Another advantage of the automatic land/water discrimination is that it permits calculation of an accurate water surface over smaller areas, allowing simple bathymetric processing of smaller, narrower streams and drainage channels. Sloping water surfaces are also handled correctly.

Prior to processing, the hydrographer can adjust waveform sensitivity settings dependent on the environment encountered and enter a value for the refraction index to be used for bathymetry. The index of refraction is an indication of the water type. A value 1.336 was used for the index of refraction, indicating fresh water.

In order to determine the optimal waveform sensitivity settings for final processing, sample areas were selected and processed with multiple different settings, to iteratively converge on the best possible settings. This is done by reviewing the processed point cloud and waveforms within sample areas. A sample waveform is provided in Figure 11. Settings affect which waveform peaks are classified as valid seabed, and which peaks are classified as noise. Optimal settings strike a balance between the amount of valid data that is classified as seabed bottom, and the amount of noise that is incorrectly classified due to peaks in the waveforms. Ideally all valid data is selected, while only a small amount of noise remains to be edited out. Once optimal threshold settings were chosen, these were used for the entire project.

It is important to note that all digitized waveform peaks are available to be reviewed by the hydrographer; both valid seabed bottom and peaks classed as noise. This allows the hydrographer to review data during Terrascan and LP360 editing for valid data such as objects that may have been misclassified as noise.

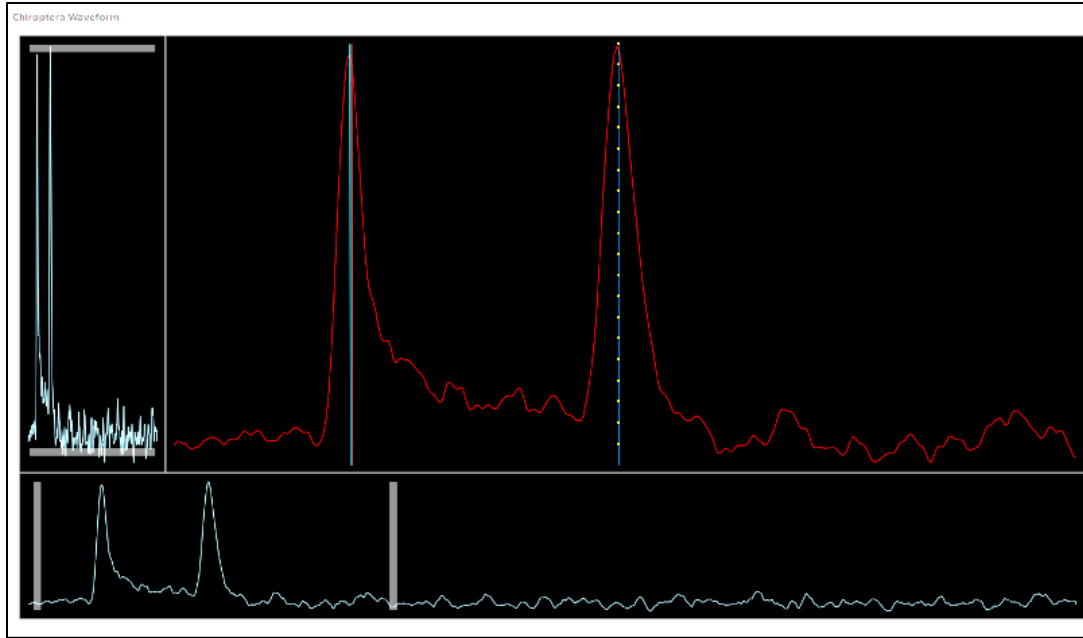


Figure 11: Sample Waveform in Shallow Water

LSS processing produced LAS files in 1.4 format.

Additional QC steps were performed prior to import to Terrascan using Woolpert in-house scripts. The derived water surface was reviewed to ensure a water surface was correctly calculated for all bathymetry channels. No significant issues were apparent.

Spot checks were also made on the data to ensure the front and back of the scans remained in alignment and no calibration or system issues were apparent prior to further data editing in Terrascan.

LSS stores data in multiple LAS files for a single flight line. Each file corresponds to a single .dat file from the raw airborne data. Woolpert merged these multiple files into a single file per flight line and moved data into a standard class definition in preparation for data editing using proprietary scripts.

3.2.2. LIDAR DATA EDITING

After data were processed in LSS and the data integrity reviewed, data were organized into tiles within a Terrascan project. The tile layout is the same as that used for the imagery and is provided with the project deliverables.

Data classification and spatial algorithms were applied in Terrasolid's Terrascan software. Customized spatial algorithms, such as isolated points and low point filters, were run to remove gross fliers in the topographic and bathymetric data. A grounding algorithm was also run on the topographic data to distinguish between points representing the bare earth, and other valid topo lidar points representing features such as vegetation, buildings, and so forth. Algorithms were run on the entire dataset. But only the data inside the survey area polygons were manually reviewed for final edits and product creation.

Data were reviewed manually to reclassify any valid bathy points incorrectly identified by the automated routines in LSS as invalid, and vice versa. In addition, any topo points over the water were reclassified to Water to correct the ground representation. Manual editing was conducted both in Terrascan. Steps for manual editing included:

- Re-class any topo unclassified laser data and bathy seabed data from the water surface to a water surface class
- Review bathymetry in cross section.
 - Re-class suitable data to Seabed (Class 40).
 - Re-class any noise in the bathy ground class to bathy noise (Class 47).

- Review topo ground points in areas of gaps or spikes.
 - Add points to ground (Class 2) from the topo laser if points are available to fill gaps in the ground model.
 - Re-class any noise in the ground class to Topo Unclassified (Class 1) if valid vegetation or other feature, or Noise if the point is not valid (Low Noise (Class 7) or High Noise (Class 18)).
 - Re-class suitable data to Bridge Deck (Class 17).

Once editing was completed in TerraScan, SAFE FME was then used to apply GEOID18 to the LAS files, and then hydrologic flattening was performed on the data. After a final QC, deliverable products were exported.

4. QUALITY CONTROL

Quality control is carried out through every phase of the project. Several checks were used to ensure data integrity and quality was maintained. Specific statistics were generated from lidar check points and image air targets.

4.1. CALIBRATION

This is fundamental to good data accuracy. Calibration is discussed in detail in Section 2.2.

4.2. ONLINE CHECKS

The airborne operator monitored system status of the scanners and receivers, waveforms, camera images, data coverage, flight lines and health of the navigation system during data acquisition. Flight logs are maintained during data acquisition. Logs not only track lines acquired, but also any relevant information on weather or water clarity, instances when sensor issues occur, and so on. These logs are a valuable resource during processing. They are provided in Appendix A.

4.3. POSITIONING

During acquisition, aircraft bank angles were restricted to 20° to avoid any potential GNSS dropouts. No flights were planned if the PDOP was expected to go above 3.0. Separation plots and additional statistics were reviewed for each flight trajectory processed.

4.4. RELATIVE ACCURACY

Throughout data editing adjacent survey lines of data are compared to ensure there are no data busts, or system artifacts. During processing Terrasolid’s TMatch software is run to examine the Delta Z differences between overlapping lines, then a simple Z correction is applied per flight line to remove any vertical differences between flight lines. TMatch can then be run again once all corrections are applied to ensure adjacent lines agree within specification. This provides a measure of inter-swath accuracy.

Interswath or overlap consistency for the topographic laser was assessed at multiple locations within overlap areas containing only single returns and located in areas with slopes of less than 10 degrees. The topographic relative accuracy of the lidar data is listed in Table 12 below. All differences are within QL1 specification (RMSDz ≤ 0.08m).

Table 12: Topographic Lidar Interswath Results

	Required by Spec	Gunnison AOI	Upper CO AOI
Count	—	2530002	5422080
Minimum (m)	—	-0.989	-0.994
Maximum (m)	—	0.998	0.964
RMSDz (m)	≤ 0.08	0.023	0.021

Interswath or overlap consistency for the bathymetric laser was assessed at multiple locations within overlap areas using last returns and located in areas with slopes of less than 10 degrees. The bathymetric relative accuracy of the lidar data is listed in Table 13 below. All differences are within specification (RMSDz ≤ 0.148m +/- 0.296m).

Table 13: Bathymetric Lidar Interswath Results

	Required by Spec	Gunnison AOI	Upper CO AOI
Count	—	8202	16162
Minimum (m)	—	-0.184	-0.244
Maximum (m)	—	0.165	0.186
RMSDz (m)	≤ 0.148 +/- 0.296	0.032	0.032

Intraswath precision (or smooth surface precision) was performed on hard surfaces such as parking lots containing only single return lidar points. Sample areas were selected where full width of the swath(s) (left, center, and right) were represented to the extent the data allowed.

The topographic intraswath accuracy of the lidar data is listed in Table 14 below. All differences are within QL1 specification (RMSDz ≤ 0.06m).

Table 14: Topographic Lidar Intraswath Results

	Required by Spec	Gunnison AOI	Upper CO AOI
Count	—	850	2560
Minimum (m)	—	-0.097	-0.034
Maximum (m)	—	0.127	0.107
RMSDz (m)	≤ 0.06	0.051	0.041

4.5. ABSOLUTE VERTICAL ACCURACY CHECKS

Absolute vertical accuracy checks were carried out using check points acquired during the ground survey. Check points were organized by NVA (Non-Vegetated Vertical Accuracy) and VVA (Vegetated Vertical Accuracy) groups based on the ground conditions. No check points were used to adjust the lidar data.

4.5.1. TOPOGRAPHIC POINT CLOUD ACCURACY

Absolute vertical accuracy for the lidar points was calculated using the NVA and VVA check points. For each known location, a small TIN was created from the surrounding lidar points and the elevation difference from the TIN plane to the point computed. Data shows good agreement with the NVA and VVA check points. Table 15 shows the results of the checks along with the required standards that must be met. Results meet the required accuracy for QL1 lidar data based on the guidelines developed by the National Digital Elevation Program (NDEP) and the American Society for Photogrammetry and Remote Sensing (ASPRS).

Table 15: Topographic Lidar to NVA and VVA Check Point Results

	Required by Spec	Gunnison AOI		Upper CO AOI	
		Project Results	Check Points	Project Results	Check Points
RMSEz NVA (m)	≤ 0.010	0.027	10	0.034	12
NVA at 95% confidence interval (m)	≤0.196	0.053		0.063	
VVA at 95 th Percentile (m)	≤0.30	0.231	7	0.102	5

4.5.2. BATHYMETRIC POINT CLOUD ACCURACY

Absolute vertical accuracy for the lidar points was calculated using the NVA check points collected with a singlebeam sonar platform. For each known location, a small TIN was created from the surrounding lidar points and the elevation difference from the TIN plane to the point computed. Data shows good agreement with the NVA check points. Table 16 shows the results of the checks along with the required standards that must be met. Results meet the required accuracy for QL2b lidar data in accordance with the “National Coastal Mapping Strategy (NCMS) for Bathymetric Lidar” v1.0 standards.

Table 16: Bathymetric Lidar to NVA Check Point Results

	Required by Spec	Gunnison AOI		Upper CO AOI	
		Project Results	Check Points	Project Results	Check Points
RMSEz NVA (m)	≤ 0.186	0.062	1459	0.070	2319

4.5.3. TOPOGRAPHIC DEM ACCURACY

The accuracy of the DEM was assessed by comparing the NVA and VVA check points to the DEM in ArcGIS. Table 17 shows the results of the checks along with the required standards that must be met.

Results meet the required accuracy for QL1 based on guidelines developed by the National Digital Elevation Program (NDEP) and the American Society for Photogrammetry and Remote Sensing (ASPRS).

Table 17: DEM to NVA and VVA Check Point Results

	Required by Spec	Gunnison AOI		Upper CO AOI	
		Project Results	Check Points	Project Results	Check Points
RMSEz NVA (m)	≤ 0.010	0.032	10	0.034	12
NVA at 95% confidence interval (m)	≤ 0.196	0.064		0.066	
VVA at 95 th Percentile (m)	≤ 0.30	0.217	7	0.108	5

5. DELIVERABLES

All data are provided in the project datum and coordinate system provided in Table 18.

Table 18: Project Datum and Projection

Horizontal Datum	NAD83 (2011)
Vertical Datum	NAVD88 (Geoid 18)
Projection	UTM 13N
Units (Horizontal and Vertical)	Meters

All deliverables listed in Table 19 and Table 20 are provided on a USB3 hard drive. All deliverables meet the required accuracy specifications.

All products are accompanied by FGDC compliant metadata, verified using the USGS Metadata Parser. Metadata includes required data accuracy statements, while lidar metadata includes USGS lidar fields.

Table 19: Image Product Deliverables

Imagery Product Deliverables					
Del. #	Item	Format	Cell Size	Tiled	Note
1	Digital orthophotos	Geotiff	10 cm	✓	

Table 20: Lidar Product Deliverables

Del. #	Item	Format	Location	Note
1	Classified Point Cloud	LAS 1.4	.\point_cloud\tilecls	USGS QL1 Spec
2	Hydro-Flattened Bare Earth DEM	32-bit Floating Point Geotiff	.\bare_earth\be_rasters	
3	Topo-Bathy Bare Earth DEM	32-bit Floating Point Geotiff	.\bare_earth\be_rasters_topobathy	
4	Intensity Imagery	16bit Geotiff	.\other\intensity	
5	Digital Orthophotos	Geotiff	.\other\imagery	
5	Topo Swath Separation Images	8-bit Geotiff	.\metadata\spatial_metadata\contractor_provided\swath_separation_images\topo	
6	Bathy Swath Separation Images	8-bit Geotiff	.\metadata\spatial_metadata\contractor_provided\swath_separation_images\bathy	
7	Maximum Surface Height Rasters	32-bit Geotiff	.\metadata\spatial_metadata\contractor_provided\maximum_surface_height_rasters	
8	Hydro-flattening Breaklines	ArcGIS File GDB	.\bare_earth\breaklines	
9	Land-water mask	ArcGIS File GDB	.\other\landwatermask	
10	Interswath and intraswath Results	SHP	.\vertical_accuracy	
11	Control and Checkpoints (NVA, VVA)	ArcGIS File GDB	.\vertical_accuracy	
12	Additional Checkpoints	SHP, TXT	.\other\fieldsurvey	Edge of water, single beam, upland, wading
13	Swath Polygon	ArcGIS File GDB	.\metadata\spatial_metadata\contractor_provided	
14	Defined Project Area (DPA)	ArcGIS File GDB	.\metadata\spatial_metadata\contractor_provided	
15	Tile Index	ArcGIS File GDB	.\metadata\spatial_metadata\contractor_provided	
16	Low Confidence Polygons	SHP	.\other\lowconfidencepolygons	

5.1. DELIVERED LAS FILES

The classified point cloud files are delivered in LAS 1.4 PDRF 6 according to USGS Lidar Base Specification 2020 rev. A standard as follows:

Table 21: LAS Classes

Class Number	Class Name	Description
1	Unclassified	Processed, but not classified.
2	Ground	Bare earth
W7	Low Point (Noise)	Spurious high/low point returns from topographic laser. Set withheld bit.
9	Water	Water surface returns from topographic laser.
17	Bridge Deck	Bridges and Permanent Piers
W18	High Noise	Spurious high/low point returns from bathymetric laser, typically over land. Set withheld bit.
20	Ignored Ground	Breakline proximity
40	Bathymetric Point	Submerged topography
41	Water Surface	Water surface returns from bathymetric laser.
S42	Derived Water Surface	Synthetic water surface returns used in computing refraction at water surface. Set synthetic bit.
W45	No Bottom At	Neither surface or bottom. Set withheld bit.
W46	Unclassified Land from Bathy	Processed, but not classified from the bathymetric laser. Set withheld bit.

Scanner numbers in the delivered LAS files are as follows:

Table 22: Scanner Numbers

Scanner	Source
1	Topographic Laser
2	Bathymetric Laser

APPENDIX A : FLIGHT LOGS

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL02B, BL02C	DATE:	3 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	GUCD	WIND:	Calm

ENGINE START:	14:34	ENGINE OFF:	16:20	ENGINE TIME:	01:46
GNSS START:	14:47	GNSS START:	16:14		
TAKEOFF:	15:10	TOUCHDOWN:	16:10	AIR TIME	01:00

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR	CHII PWR	REMARKS
		15:13:39				DS: BL02_20201003_151354
000_FL20	0220	15:13:54	15:15:24	500	12	295
001_FL19	0219	15:17:41	15:19:12	500	12	295
002_FL18	0218	15:21:35	15:23:13	500	12	295
003_FL17	0217	15:25:47	15:27:18	500	12	295
004_FL16	0216	15:29:48	15:31:21	500	12	295
005_FL15	0215	15:33:53	15:35:25	500	12	295
006_FL14	0214	15:37:47	15:39:19	500	12	295
007_FL13	0213	15:41:34	15:42:56	500	12	295
008_FL12	0212	15:45:06	15:46:35	500	12	295
009_FL11	0211	15:49:10	15:50:47	500	12	295
010_FL10	0210	15:53:07	15:55:27	500	12	295
011_FL9	0209	15:57:38	16:00:01	500	12	295
		16:02:00				Ended survey to restart system

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL01A, BL01B, BL02A, BL02B	DATE:	3 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	GUCD	WIND:	10 kts @ 220

ENGINE START:	16:21	ENGINE OFF:	18:55	ENGINE TIME:	02:34
GNSS START:	16:23	GNSS START:	18:48		
TAKEOFF:	16:29	TOUCHDOWN:	18:46	AIR TIME	02:17

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR	CHII PWR	REMARKS
		16:34:47				DS: BL02_20201003_163502
000_FL9	0209	16:35:02	16:37:32	500	12	295
001_FL8	0208	16:39:56	16:42:18	500	12	295
002_FL7	0207	16:44:38	16:47:17	500	12	295
003_FL6	0206	16:49:33	16:52:09	500	12	295
004_FL5	0205	16:54:31	16:57:12	500	12	295
005_FL4	0204	16:59:55	17:02:15	500	12	295
006_FL3	0203	17:04:33	17:06:47	500	12	295
007_FL2	0202	17:09:19	17:11:39	500	12	295
008_FL1	0201	17:13:56	17:16:12	500	12	295
009_FL1	0201	17:18:19	17:20:27	500	12	295
		17:21:00				Completed BL02
		17:23:29				DS: BL01_20201003_172344
000_FL15	0115	17:23:44	17:26:50	500	12	295
001_FL14	0114	17:28:50	17:32:09	500	12	295
002_FL13	0113	17:34:02	17:37:15	500	12	295
003_FL12	0112	17:39:35	17:42:44	500	12	295
004_FL11	0111	17:44:45	17:47:48	500	12	295
005_FL10	0110	17:50:06	17:53:04	500	12	295
006_FL9	0109	17:55:05	17:58:04	500	12	295
007_FL8	0108	18:01:43	18:03:54	500	12	295
008_FL7	0107	18:05:59	18:08:17	500	12	295
009_FL6	0106	18:10:34	18:12:51	500	12	295
010_FL5	0105	18:15:01	18:17:21	500	12	295
011_FL4	0104	18:19:37	18:21:57	500	12	295
012_FL3	0103	18:24:03	18:26:26	500	12	295
013_FL2	0102	18:28:49	18:31:02	500	12	295
014_FL1	0101	18:33:56	18:34:21	500	12	295
						BAD: Offline
015_FL1	0101	18:34:35	18:35:54	500	12	295
016_FL1	0101	18:38:21	18:40:25	500	12	295

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL01A, BL01B, BL02A, BL02B	DATE:	3 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	GUCD	WIND:	10 kts @ 220

ENGINE START:	16:21	ENGINE OFF:	18:55	ENGINE TIME:	02:34
GNSS START:	16:23	GNSS START:	18:48		
TAKEOFF:	16:29	TOUCHDOWN:	18:46	AIR TIME	02:17

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR	CHII PWR	REMARKS
		18:41:00				Completed BL01

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL03A, BL03B, BL04B	DATE:	5 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	TCP2	WIND:	15 kts @ 260

ENGINE START:	16:05	ENGINE OFF:	19:46	ENGINE TIME:	03:41
GNSS START:	16:26	GNSS START:			
TAKEOFF:	16:36	TOUCHDOWN:	19:43	AIR TIME	03:07

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR	CHII PWR	REMARKS
		17:12:00				Initialized GNSS over TCP2
		17:22:09				DS: BL03_20201005_172224
000_FL1	0301	17:22:24	17:26:25	500	12	295
001_FL2	0302	17:28:25	17:29:12	500	12	295
		17:43:02				DS: BL03_20201005_174317
000_FL10	0310	17:43:17	17:46:11	500	12	295
001_FL11	0311	17:48:36	17:52:05	500	12	295
002_FL12	0312	17:54:10	17:57:46	500	12	295
003_FL13	0313	18:00:01	18:03:58	500	12	295
		18:05:00				Moved to BL04; turbulence
		18:06:47				DS: BL04_20201005_180702
000_FL22	0422	18:07:02	18:10:15	500	12	295
001_FL11	0411	18:12:24	18:16:44	500	12	295
002_FL21	0421	18:20:15	18:26:48	500	12	295
003_FL20	0420	18:35:50	18:42:44	500	12	295
004_FL12	0412	18:43:39	18:48:23	500	12	295
005_FL19	0419	18:51:42	18:58:26	500	12	295
006_FL13	0413	18:59:10	19:03:58	500	12	295
		19:04:00				Closed GNSS over TCP2
		19:05:00				Ended Survey due to turbulence

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL03A, BL03B, BL04A, BL04B	DATE:	6 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	TCP2	WIND:	Calm

ENGINE START:	13:32	ENGINE OFF:	18:42	ENGINE TIME:	05:10
GNSS START:	13:36	GNSS START:			
TAKEOFF:	13:43	TOUCHDOWN:	18:39	AIR TIME	04:56

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR	CHII PWR	REMARKS
		14:20:00				Initialized GNSS over TCP2
		14:30:38				DS: BL03_20201006_143053
000_FL2	0302	14:30:53	14:34:37	500 12	295	
001_FL3	0303	14:36:44	14:40:37	500 12	295	
002_FL4	0304	14:42:46	14:46:35	500 12	295	
003_FL5	0305	14:48:30	14:48:40	500 12	295	BAD: Offline
004_FL5	0305	14:48:40	14:52:20	500 12	295	
005_FL6	0306	14:54:12	14:57:47	500 12	295	
006_FL7	0307	14:59:28	15:02:57	500 12	295	
007_FL8	0308	15:05:00	15:08:07	500 12	295	
008_FL9	0309	15:10:00	15:12:49	500 12	295	
009_FL14	0314	15:16:04	15:20:07	500 12	295	
010_FL15	0315	15:22:11	15:26:50	500 12	295	
011_FL16	0316	15:28:48	15:33:18	500 12	295	
012_FL17	0317	15:35:29	15:40:12	500 12	295	
013_FL18	0318	15:42:09	15:46:46	500 12	295	
014_FL19	0319	15:48:50	15:53:33	500 12	295	
		15:54:00				Completed BL03
		15:57:47				DS: BL04_20201006_155802
000_FL18	0418	15:58:02	16:04:35	500 12	295	
001_FL17	0417	16:13:35	16:20:04	500 12	295	
002_FL23	0423	16:21:48	16:24:58	500 12	295	
003_FL16	0416	16:29:42	16:36:10	500 12	295	
004_FL24	0424	16:37:03	16:38:32	500 12	295	
005_FL15	0415	16:44:24	16:50:36	500 12	295	
006_FL25	0425	16:51:48	16:53:03	500 12	295	
007_FL14	0414	16:58:35	17:04:28	500 12	295	
008_FL13	0413	17:11:57	17:17:11	500 12	295	
009_FL10	0410	17:22:41	17:24:05	500 12	295	
010_FL9	0409	17:26:27	17:28:21	500 12	295	

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL03A, BL03B, BL04A, BL04B	DATE:	6 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	TCP2	WIND:	Calm

ENGINE START:	13:32	ENGINE OFF:	18:42	ENGINE TIME:	05:10
GNSS START:	13:36	GNSS START:			
TAKEOFF:	13:43	TOUCHDOWN:	18:39	AIR TIME	04:56

FL #	LINE #	START TIME	END TIME	TOPO		CHII PWR	REMARKS
				PRF	PWR		
011_FL8	0408	17:30:29	17:32:39	500	12	295	
012_FL7	0407	17:34:16	17:36:23	500	12	295	
013_FL6	0406	17:38:23	17:40:40	500	12	295	
014_FL5	0405	17:42:26	17:44:36	500	12	295	
015_FL4	0404	17:46:39	17:48:55	500	12	295	
016_FL3	0403	17:50:45	17:52:55	500	12	295	
017_FL2	0402	17:55:06	17:57:18	500	12	295	
018_FL1	0401	17:59:13	18:01:14	500	12	295	
		18:03:00					Completed BL04
		18:04:00					Closed GNSS over TCP2

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)
LOCATION / AREA:	Gunnison, CO / BL03B, FI03, FI04	DATE:	9 October 2020
AIRCRAFT:	N532NM	PILOT:	Ray L.
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.

MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies
BASE STATION:	TCP2	WIND:	5 kts @ 215

ENGINE START:	14:40	ENGINE OFF:	18:13	ENGINE TIME:	03:33
GNSS START:	14:43	GNSS START:			
TAKEOFF:	14:51	TOUCHDOWN:	18:09	AIR TIME	03:18

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR	CHII PWR	REMARKS
		15:26:00				Initialized GNSS over TCP2
		15:30:18				DS: BL03_20201009_153033
000_FL14	0314	15:30:33	15:34:47	500 12	295	
001_FL22	0322	15:36:10	15:37:22	500 12	295	
002_FL21	0321	15:39:43	15:40:48	500 12	295	
003_FL20	0320	15:42:52	15:43:45	500 12	295	
004_FL23	0323	15:46:35	15:48:16	400 20	295	
005_FL24	0324	15:50:27	15:52:04	400 20	295	
006_FL25	0325	15:54:26	15:56:14	400 22	295	
007_FL26	0326	15:58:29	16:00:04	400 22	295	
008_FL27	0327	16:03:14	16:04:30	400 22	295	
009_FL28	0328	16:07:04	16:08:34	400 22	295	
010_FL29	0329	16:11:07	16:12:43	400 22	295	
011_FL30	0330	16:14:47	16:16:00	400 22	295	
012_FL31	0331	16:18:25	16:19:38	400 22	295	
013_FL32	0332	16:21:58	16:23:36	400 22	295	
014_FL33	0333	16:25:40	16:26:48	400 22	295	
015_FL33	0333	16:27:04	16:27:20	400 22	295	BAD: System Issue
		16:39:23				DS: BL03_20201009_163938
000_FL33	0333	16:39:38	16:41:33	400 22	295	
001_FL34	0334	16:43:53	16:45:40	400 22	295	
002_FL35	0335	16:48:13	16:49:49	400 22	295	
		16:50:00				Completed BL03 reflights
		16:51:46				DS: BL04_20201009_165201
000_FL26	0426	16:52:01	16:53:12	400 22	295	
001_FL27	0427	16:55:16	16:56:36	400 22	295	
002_FL28	0428	16:58:55	17:00:25	400 22	295	
003_FL29	0429	17:03:52	17:06:31	400 22	295	
		17:15:31				DS: BL04_20201009_171546

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar		BASE AIRPORT:	Gunnison (KGUC)	
LOCATION / AREA:	Gunnison, CO / BL03B, FI03, FI04		DATE:	9 October 2020	
AIRCRAFT:	N532NM		PILOT:	Ray L.	
SYSTEM:	Chiroptera 4X		OPERATOR:	Andrew B.	
MISSION ID:	81201_USGS_UpperCO		CLOUDS:	Clear Skies	
BASE STATION:	TCP2		WIND:	5 kts @ 215	
ENGINE START:	14:40	ENGINE OFF:	18:13	ENGINE TIME:	03:33
GNSS START:	14:43	GNSS START:			
TAKEOFF:	14:51	TOUCHDOWN:	18:09	AIR TIME	03:18

FL #	LINE #	START TIME	END TIME	TOPO		CHII	REMARKS
				PRF	PWR		
000_FL30	0430	17:15:46	17:18:22	400	22	295	
		17:19:00					Completed BL04 reflights
		17:21:00					Closed GNSS over TCP2

PROJECT NAME:	2020-81201 - Upper CO - TopoBathy Lidar	BASE AIRPORT:	Gunnison (KGUC)		
LOCATION / AREA:	Gunnison, CO / BL01A, BL02A, FI01, FI02	DATE:	9 October 2020		
AIRCRAFT:	N532NM	PILOT:	Ray L.		
SYSTEM:	Chiroptera 4X	OPERATOR:	Andrew B.		
MISSION ID:	81201_USGS_UpperCO	CLOUDS:	Clear Skies		
BASE STATION:	GUCD	WIND:	5 kts @ 230		
ENGINE START:	18:14	ENGINE OFF:	19:27	ENGINE TIME:	01:13
GNSS START:	18:16	GNSS START:	19:21		
TAKEOFF:	18:23	TOUCHDOWN:	19:20	AIR TIME	00:57

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR		CHII PWR	REMARKS
		18:28:14					DS: BL02_20201009_182829
000_FL21	0221	18:28:29	18:29:40	500	12	295	
001_FL2	0202	18:32:44	18:35:00	500	12	295	
002_FL1	0201	18:37:05	18:39:17	500	12	295	
003_FL24	0224	18:42:10	18:43:15	400	20	295	
004_FL23	0223	18:46:02	18:47:19	400	22	295	
005_FL22	0222	18:49:31	18:50:54	400	22	295	
		18:51:00					Completed BL02 reflights
		18:54:00					DS: BL01_20201009_185415
000_FL20	0120	18:54:15	18:55:38	400	22	295	
001_FL19	0119	18:58:02	18:59:32	400	22	295	
002_FL18	0118	19:01:49	19:03:12	400	22	295	
003_FL17	0117	19:05:43	19:07:49	400	22	295	
004_FL16	0116	19:10:28	19:11:36	500	12	295	
005_FL3	0103	19:14:10	19:16:33	500	12	295	
		19:17:00					Completed BL01 reflights

PROJECT NAME: 2020-81201 - Upper CO - TopoBathy Lidar
LOCATION / AREA: Dayton, OH / BL04A
AIRCRAFT: N532NM
SYSTEM: Chiroptera 4X

BASE AIRPORT: Dayton (KDAY)
DATE: 13 October 2020
PILOT: Ray L.
OPERATOR: Andrew B.

MISSION ID: 81201_USGS_UpperCO
BASE STATION: SIDN

CLOUDS: Clear Skies
WIND: Calm

ENGINE START: 13:05 **ENGINE OFF:** 15:17 **ENGINE TIME:** 02:12
GNSS START: 13:10 **GNSS START:** **GNSS START:**
TAKEOFF: 13:20 **TOUCHDOWN:** 15:14 **AIR TIME** 01:54

FL #	LINE #	START TIME	END TIME	TOPO PRF PWR		CHII PWR	REMARKS
		13:30:00					Initialized GNSS over SIDN
		13:35:45					DS: 1000m_20201013_133600
000_FL1	1001	13:36:00	13:38:20	250	35	295	
001_FL2	1002	13:40:47	13:43:03	250	35	295	
002_FL3	1003	13:46:26	13:48:46	250	35	295	
003_FL4	1004	13:51:08	13:53:31	250	35	295	
004_FL5	1005	13:55:40	13:58:01	250	35	295	
005_FL6	1006	14:02:58	14:05:14	250	35	295	
		14:10:07					DS: 500m_20201013_141022
000_FL1	0501	14:10:22	14:11:50	500	13	55	
001_FL2	0502	14:14:08	14:15:41	500	13	55	
002_FL3	0503	14:18:25	14:20:03	500	13	55	
003_FL4	0504	14:22:06	14:23:35	500	13	55	
004_FL5	0505	14:25:42	14:27:18	500	13	55	
005_FL6	0506	14:31:21	14:32:52	500	13	55	
		14:36:05					DS: 400m_20201013_143620
000_FL1	0401	14:36:20	14:37:35	300	10	45	
001_FL2	0402	14:39:56	14:41:16	300	10	45	
002_FL3	0403	14:43:51	14:45:09	300	10	45	
003_FL4	0404	14:47:21	14:48:36	300	10	45	
004_FL5	0405	14:50:57	14:52:14	300	10	45	
005_FL6	0406	14:56:28	14:57:42	300	10	45	
		14:58:00					Completed Calibration
		15:00:00					Closed GNSS over SIDN

APPENDIX B : PROCESSING LOGS

PROJECT NAME: 2020-81201 Upper Colorado River
LOCATION: Gunisson, CO
AIRCRAFT: Cessna 404 (N532NM)
SYSTEM: Chiroptera 4X

MISSION ID: 2020-81201_UpperCO **LINES:** 79
SURVEY BLOCKS: BL01-04 **LINE KM:** 811

Flight	Engine Time	Air Time	Flown km %		Reflown km %		Comments
2020-10-02A	3:20:00	3:02:00					Test / Calibration Flight
2020-10-03A	1:46:00	1:00:00	55.0				BL02
2020-10-03B	2:34:00	2:17:00	185.1		17.4		BL01, BL02
2020-10-05A	3:41:00	3:07:00	204.6				BL03, BL04
2020-10-06A	5:10:00	4:56:00	356.1		45.1		BL03, BL04
2020-10-09A	3:33:00	3:18:00			103.7		BL03, FI03, FI04
2020-10-09B	1:13:00	0:57:00			46.8		BL01, BL02, FI01, FI02
2020-10-10A	0:48:00	0:19:00			5.7		FI01, FI02
2020-10-13A	2:12:00	1:54:00					Calibration Flight
TOTAL	20:57:00	17:48:00	801	98.7%	219	26.9%	

PROJECT NAME: 2020-81201 Upper Colorado River
LOCATION: Gunisson, CO
AIRCRAFT: Cessna 404 (N532NM)
SYSTEM: Chiroptera 4X

Axis	Ref to IMU In the system	Ref to GNSS In the system	IMU to Gimble Inertial Explorer	IMU to GNSS Inertial Explorer	Gimble to GNSS Inertial Explorer	Differences from Previous	Differences from Start
Start Values						Flight Pro	Inertial Explorer
X	-0.003	0.006	0.005	0.042	0.037	+ tve forward	+ tve stbd
Y	-0.006	0.000	0.003	0.016	0.013	+ tve stbd	+ tve forward
Z	-0.296	-1.305	-0.296	0.937	1.233	+ tve down	+ tve up
Lever Arm Estimate in Inertial Explorer - Test 1							
X		0.034	0.005	0.031	0.026	-0.011	-0.011
Y		0.026	0.003	0.037	0.034	0.021	0.021
Z		-1.227	-0.296	0.931	1.227	-0.006	-0.006
Lever Arm Estimate in Inertial Explorer - Test 2							
X		0.040	0.005	0.028	0.023	-0.003	-0.014
Y		0.023	0.003	0.043	0.040	0.006	0.027
Z		-1.226	-0.296	0.930	1.226	-0.001	-0.007
Lever Arm Estimate in Inertial Explorer - Test 3							
X		0.042	0.005	0.028	0.023	0.000	-0.014
Y		0.023	0.003	0.045	0.042	0.002	0.029
Z		-1.226	-0.296	0.930	1.226	0.000	-0.007
Lever Arm Estimate in Inertial Explorer - Test 4							
X	-0.003	0.042	0.005	0.028	0.023	0.000	-0.014
Y	-0.006	0.023	0.003	0.045	0.042	0.000	0.029
Z	-0.296	-1.226	-0.296	0.930	1.226	0.000	-0.007



GNSS BASE SUMMARY

PROJECT NAME: 2020-81201 Upper Colorado River
LOCATION: Gunisson, CO
AIRCRAFT: Cessna 404 (N532NM)
SYSTEM: Chiroptera 4X

PID	Project Name	Latitude			Longitude			Height (m)	XY Datum	Z Datum	Source	Comments
		Deg	Min	Sec	Deg	Min	Sec					
AE7515	GUCD	38	32	16.49132	106	55	40.71976	2324.125	NAD83(2011)	NAD83(2011)	NGS	
	TCP2	40	03	59.74944	106	12	26.35205	2286.211	NAD83(2011)	NAD83(2011)	Network	Constrained Adjustment in TBC

PROJECT NAME: 2020-81201 Upper Colorado River
LOCATION: Gunisson, CO
AIRCRAFT: Cessna 404 (N532NM)
SYSTEM: Chiroptera 4X

Project Name	Download Airborne Data	Create IE Project Directory	Copy Data to IE Project /Raw	Run Project Wizard	Base Station			Check Base Coordinate & Datum	Check Lever Arms	Process Time Window		Process TC	Review QC Plots	Separation			Solution Status	Comments
					Station ID	Receiver Type	Antenna (ARP) Height (m)			Start Time (GPS Week Time)	End Time (GPS Week Time)			East RMS (m)	North RMS (m)	Up RMS (m)		
2020-10-02A_CH4X	DA	DA	DA	DA	1V6C	R10	1.800	DA	DA	494000	499575	DA	DA	0.011	0.019	0.020	Final	
2020-10-03A_CH4X	DA	DA	DA	DA	GUCD	R10	1.800	DA	DA			DA	DA	0.004	0.005	0.017	Final	
2020-10-03B_CH4X	DA	DA	DA	DA	GUCD	R10	1.800	DA	DA			DA	DA	0.003	0.015	0.011	Final	
2020-10-05A_CH4X	DA	DA	DA	DA	TCP2	R10	1.800	DA	DA	148315	155125	DA	DA	0.007	0.022	0.012	Final	
2020-10-06A_CH4X	DA	DA	DA	DA	TCP2	R10	1.800	DA	DA	224433	237775	DA	DA	0.010	0.008	0.027	Final	
2020-10-09A_CH4X	DA	DA	DA	DA	TCP2	R10	1.800	DA	DA	487540	494500	DA	DA	0.006	0.009	0.025	Final	
2020-10-09B_CH4X	DA	DA	DA	DA	GUCD	R10	1.800	DA	DA			DA	DA	0.006	0.004	0.024	Final	
2020-10-10A_CH4X	DA	DA	DA	DA	GUCD	R10	1.800	DA	DA	575000	576759	DA	DA	0.002	0.006	0.014	Final	
2020-10-13A_CH4X	DA	DA	DA	DA	SIDN	NETR9	0.000	DA	DA	221395	226875	DA	DA	0.005	0.004	0.035	Final	

PROJECT NAME: 2020-81201-Upper Co
LOCATION: Gunnison, CO
AIRCRAFT: Cessna 404 - N532NM
SYSTEM: Chiroptera 4X

Mission	Copied to Disk	Nav Session	Nav Type	Calibration File	Cal Type	Processing Parameters	Check Processing Parameters	Processing Session	Number of FL	Process Topo	Process Shallow	Process Deep	Run QC Stats in FME	Comments
Cal-FremontCO_1000m_20201002_172032	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r0	Initial	ProcessingCal_20170628_1000	MC	20201003_024803	6	6	--	--	MC	Topo
Cal-FremontCO_500m_20201002_175538	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r0	Initial	ProcessingCal_20201003_500	MC	20201003_024922	6	6	6	--	MC	Topo, Shallow
								Calibration_2020-10-05_21.54.16						Topo - Update Angles and Slant Range (r1)
								Calibration_2020-10-05_21.55.59						Shallow - Update Angles and Slant Range (r1)
Cal-FremontCO_400m_20201002_182117	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r0	Initial	ProcessingCal_20170628_400	MC	20201003_025050	6	6	6	--	MC	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r1)
Cal-FremontCO_1000m_20201002_172032	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r1	Interim	ProcessingCal_20170628_1000	MC	20201005_224209	6	6	--	--	MC	Topo
Cal-FremontCO_500m_20201002_175538	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r1	Interim	ProcessingCal_20201003_500	MC	20201005_224304	6	6	6	--	MC	Topo, Shallow
								Calibration_2020-10-05_23.23.40						Topo - Update Angles and Slant Range (r2)
								Calibration_2020-10-05_23.23.49						Shallow - Update Angles and Slant Range (r2)
Cal-FremontCO_400m_20201002_182117	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r1	Interim	ProcessingCal_20170628_400	MC	20201005_224418	6	6	6	--	MC	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r2)
Cal-FremontCO_1000m_20201002_172032	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r2	Interim	ProcessingCal_20170628_1000	MC	20201006_002736	6	6	--	--	MC	Topo
Cal-FremontCO_500m_20201002_175538	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r2	Interim	ProcessingCal_20201003_500	MC	20201006_002752	6	6	6	--	MC	Topo, Shallow
								Calibration_2020-10-06_01.07.58						Topo - Update Angles and Slant Range (r3)
								Calibration_2020-10-06_01.08.20						Shallow - Update Angles and Slant Range (r3)
Cal-FremontCO_400m_20201002_182117	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r2	Interim	ProcessingCal_20170628_400	MC	20201006_002810	6	6	6	--	MC	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r3)
Cal-FremontCO_1000m_20201002_172032	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r3	Interim	ProcessingCal_20170628_1000	MC	20201006_012633	6	6	--	--	MC	Topo
Cal-FremontCO_500m_20201002_175538	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r3	Interim	ProcessingCal_20201003_500	MC	20201006_012654	6	6	6	--	MC	Topo, Shallow
								Calibration_2020-10-06_02.31.09						Topo - Update Angles and Slant Range (r4)
								Calibration_2020-10-06_02.31.35						Shallow - Update Angles and Slant Range (r4)
Cal-FremontCO_400m_20201002_182117	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r3	Interim	ProcessingCal_20170628_400	MC	20201006_012725	6	6	6	--	MC	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r4)
Cal-FremontCO_1000m_20201002_172032	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r4	Interim	ProcessingCal_20170628_1000	MC	20201006_024712	6	6	--	--	MC	Topo
								20201006_155745_MirrorCalibration						Topo - Mirror Cal
Cal-FremontCO_500m_20201002_175538	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r4	Interim	ProcessingCal_20201003_500	MC	20201006_024827	6	6	6	--	MC	Topo, Shallow
								20201006_034117_MirrorCalibration						Shallow - Mirror Cal
Cal-FremontCO_400m_20201002_182117	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r4	Interim	ProcessingCal_20170628_400	MC	20201006_025028	6	6	6	--	MC	Topo, Shallow
														Topo Angles and Slant Range are updated. Shallow Mirror Cal
Cal-FremontCO_1000m_20201002_172032	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r5	Final	ProcessingCal_20170628_1000		20201006_165025	6	6	--	--	MC	Topo
Cal-FremontCO_500m_20201002_175538	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r5	Final	ProcessingCal_20201003_500		20201006_165101	6	6	6	--	MC	Topo, Shallow
Cal-FremontCO_400m_20201002_182117	AB	2020-10-02A	Final	CAL_TS_Prelim_20201002_r5	Final	ProcessingCal_20170628_400		20201006_165132	6	6	6	--	MC	Topo, Shallow
Not Used for Processing														

PROJECT NAME: 2020-81201-Upper Co
LOCATION: Gunnison, CO
AIRCRAFT: Cessna 404 - N532NM
SYSTEM: Chiroptera 4X

Mission	Copied to Disk	Nav Session	Nav Type	Calibration File	Cal Type	Processing Parameters	Check Processing Parameters	Processing Session	Number of FL	Process Topo	Process Shallow	Process Deep	Run QC Stats in FME	Comments
October 13, 2020 Calibration														
Cal-SidneyOH_1000m_20201013_133600	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r0	Initial	ProcessingCal_20170628_1000	MW	20201019_121519	6	6	--	--	MW	Topo
Cal-SidneyOH_500m_20201013_141022	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r0	Initial	ProcessingCal_20201003_500	MW	20201019_113714	6	6	6	--	MW	Topo, Shallow
								Calibration_2020-10-20_10.29.19						Topo - Update Angles and Slant Range (r1)
								Calibration_2020-10-20_11.27.38						Shallow - Update Angles and Slant Range (r1)
Cal-SidneyOH_400m_20201013_143620	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r0	Initial	ProcessingCal_20170628_400	MW	20201019_113712	6	6	6	--	MW	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r1)
Cal-SidneyOH_1000m_20201013_133600	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r1	Interim	ProcessingCal_20170628_1000	MW	20201020_170003	6	6	--	--	MW	Topo
Cal-SidneyOH_500m_20201013_141022	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r1	Interim	ProcessingCal_20201003_500	MW	20201020_170001	6	6	6	--	MW	Topo, Shallow
								Calibration_2020-10-20_20.21.49						Topo - Update Angles and Slant Range (r2)
								Calibration_2020-10-20_19.02.23						Shallow - Update Angles and Slant Range (r2)
Cal-SidneyOH_400m_20201013_143620	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r1	Interim	ProcessingCal_20170628_400	MW	20201020_170005	6	6	6	--	MW	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r2)
Cal-SidneyOH_1000m_20201013_133600	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r2	Interim	ProcessingCal_20170628_1000	MW	20201021_080725	6	6	--	--	MW	Topo
Cal-SidneyOH_500m_20201013_141022	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r2	Interim	ProcessingCal_20201003_500	MW	20201021_080717	6	6	6	--	MW	Topo, Shallow
								Calibration_2020-10-21_09.23.56						Topo - Update Angles and Slant Range (r3)
								Calibration_2020-10-21_09.24.05						Shallow - Update Angles and Slant Range (r3)
Cal-SidneyOH_400m_20201013_143620	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r2	Interim	ProcessingCal_20170628_400	MW	20201021_080724	6	6	6	--	MW	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated.
														Updated Cal File for Topo, Shallow Angles and Slant Range (r3)
Cal-SidneyOH_1000m_20201013_133600	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r3	Interim	ProcessingCal_20170628_1000	MW	20201021_102913	6	6	--	--	MW	Topo
Cal-SidneyOH_500m_20201013_141022	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r3	Interim	ProcessingCal_20201003_500	MW	20201021_102904	6	6	6	--	MW	Topo, Shallow
								20201021_123106_MirrorCalibration						Topo - Mirror Cal
								20201021_123107_MirrorCalibration						Shallow - Mirror Cal
Cal-SidneyOH_400m_20201013_143620	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r3	Interim	ProcessingCal_20170628_400	MW	20201021_102849	6	6	6	--	MW	Topo, Shallow
														Topo, Shallow Angles and Slant Range are updated and Mirror Cal
Cal-SidneyOH_1000m_20201013_133600	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r4	Final	ProcessingCal_20170628_1000		20201021_132531	6	6	--	--	MW	Topo
Cal-SidneyOH_500m_20201013_141022	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r4	Final	ProcessingCal_20201003_500		20201021_132532	6	6	6	--	MW	Topo, Shallow
Cal-SidneyOH_400m_20201013_143620	AB	2020-10-13A	Final	CAL_TS_Prelim_20201013_r4	Final	ProcessingCal_20170628_400		20201021_134152	6	6	6	--	MW	Topo, Shallow
Copy CAL_TS_Prelim_20201013_r4 to CAL_TS_Survey_20201002_r0.xml for processing														

PROJECT NAME: 2020-81201-Upper Co
LOCATION: Gunnison, CO
AIRCRAFT: Cessna 404 - N532NM
SYSTEM: Chiroptera 4X

RCD30 Dataset	HXMAP					IPAS CO+				Estimate Misalignment										Comments			
	Ingest RCD30 Data	Assign Radio Corrections	Export Images	Export IPAS Files	Bits	IPAS Solution	Camera File	PPO X (mm)	PPO Y (mm)	Camera File Status	APM	Run AT	Sigma0	PPA X (mm)	PPA Y (mm)	Misalign X (arcmin)	Misalign Y (arcmin)	Misalign Z (arcmin)	Misalign X RMS (arcmin)		Misalign Y RMS (arcmin)	Misalign Z RMS (arcmin)	Accept / Reject
2020-10-13A	CG	1.6b	CG	CG	8	2020-10-13A	IPAS_RCD30_82521.txt	0.0000	0.0000	Initial	5x5	CG	2.4	0.0000	0.0000	0.0400	-0.470	-0.180	0.040	0.030	0.080	Accept	1000m
								0.0000	0.0000	Initial	5x5	CG	2.4	0.0000	0.0000	0.000	0.000	0.010	0.040	0.040	0.060	Could not improve sigma0, reject	
Exported to: RCD30_Geometry_CameraHead-82521-E-798528_LensSystem-50187-A-785422_DateTime-20201027-185429.xml																							

PROJECT NAME: 2020-81201-Upper Co
LOCATION: Gunnison, CO
AIRCRAFT: Cessna 404 - N532NM
SYSTEM: Chiroptera 4X

RCD30 Dataset	HXMAP						FOR LSS		OrthoVista			FME	Comments	
	Ingest	QC Radio Profile	Assign Radio Profile	Correction Type	DTM Ready	Create Block	Export Ortho	Export IPAS	Export Aerial Images	Mosaic by Flight Session (10cm)	Mosaic Tiles (10cm)	Stretched Tiles		ECW Created
2020-10-02A	--	--	--	--	--	--	--	--	--	--	--	--	BL11 - Lines 1-3 (not used, test)	
2020-10-03A	CG	1.4	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL02 - Lines 9-20
2020-10-03B	CG	1.2b	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL01 - Lines 1-15
2020-10-03B	CG	1.2	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL02 - Lines 1-9
2020-10-05A	CG	1.2b	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL03 - Lines 0-1, 10-13
2020-10-05A	CG	1.4	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL04 - Lines 11-13, 19-22
2020-10-06A	CG	1.7	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL03 - Lines 2-9, 14-19
2020-10-06A	CG	1.2b	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL04 - Lines 1-10, 13-17, 23-25
2020-10-09A	CG	1.5	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL03 - Lines 14, 20-35
2020-10-09A	CG	1.2b	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL04 - Lines 26-30
2020-10-09B	CG	1.2b	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL01 - Lines 3, 16-20
2020-10-09B	CG	1.2b	CG	CAL	X	CG	CG	--	--	--	CG	--	CG	BL02 - Lines 1, 2, 21-24
2020-10-13A	CG	CG	CG	CAL	CG	CG	CG	CG	CG	--	--	--	--	Calibration

APPENDIX C : GROUND CONTROL SURVEY REPORT

Ground Control Survey Report



Upper Colorado and Gunnison Rivers Ground Control

CO Upper Colorado Topobathy 2020 D20

Contract Number: G16PC00022
Task Order Number: 140G0220F0244

Contractor: Woolpert, Inc.
Woolpert Project # 81201

January 2021

Ground Control Survey Report

Upper Colorado and Gunnison Rivers Ground Control

CO Upper Colorado Topobathy 2020 D20

Contract Number: G16PC00022
Task Order Number: 140G0220F0244

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Section 1: Survey Report

Introduction

This report contains a comprehensive outline of the Ground Control Survey that supported the topographic and bathymetric LiDAR collected by Woolpert, Inc. for the U.S. Geological Survey (USGS) along sections of the Upper Colorado and Gunnison rivers in Colorado. This project was issued under Contract Number G16PC00022, as task order number 140G0220F0244. All surveys were performed in such a way as to achieve ground control accuracies that meet or exceed the National Mapping Accuracy Standards.

Project Area

The project area consists of two Areas of Interest (AOI) in Colorado, identified as Upper Colorado and Gunnison, totaling approximately 45 square miles.

Purpose

The purpose of this survey was to establish three-dimensional coordinates for approximately 45 ground points uniformly dispersed over the task order AOIs. Approximately 20 of the points will be used for the topographic lidar data calibration while 20 Non-Vegetated Vertical Accuracy (NVA) points and 5 Vegetated Vertical Accuracy (VVA) points were collected for accuracy assessment.

Additional bathymetric check points were collected for accuracy assessment of the submerged areas. These points are not used to control the bathymetric data. Approximately 5 areas of bathymetric ground truth were collected per AOI. Within the Upper Colorado river AOI, Woolpert also collected an additional 6 cross sections provided by the USGS that have been historically observed.

Date of Survey

Ground control field operations took place September 28th thru October 9th of 2020.

Monumentation

Prior to aerial imagery acquisition, Woolpert field crews performed a field reconnaissance to verify the existence and suitability of pre-selected existing National Geodetic Survey (NGS) control stations. These existing National Spatial Reference System (NSRS) control stations were utilized as checks to ensure that quality x, y, and z coordinate values were computed for each of the newly established control stations. Recovery information sheets for the existing NGS control stations can be found in Section 4 of this report. A control diagram showing the ground control stations used to support this mapping project can be found in Section 5 of this report.

Accuracy Standards

This task order specifies LiDAR data and derivative products are based on the U.S. Geological Survey “National Geospatial Program Lidar Base Specification Version 2.1” and consists of two components: topographic and bathymetric LiDAR. The topographic LiDAR dataset and derivatives were acquired to meet at an aggregate nominal pulse spacing (ANPS) of 0.35 meters (8 ppsm), Quality Level 1 (QL1); and the submerged bathymetric LiDAR data were acquired to meet at an aggregate nominal pulse spacing (ANPS) of 0.71 meters (2 ppsm), Quality Level 2 (QL2) in shallow water.

The relative vertical accuracy of the topographic LiDAR data is specified to be 6 cm RMSDz with a swath overlap difference (between adjacent swaths) of 8 cm RMSDz and an absolute vertical accuracy of 10 cm RMSEz in non-vegetated areas.

GNSS Equipment

Woolpert utilized 3 Trimble Navigation R10 GNSS dual-frequency GNSS receivers, and 1 TSC3 data collector for this project to collect ground points and shallow water (wading) bathymetric points.

Sonar Equipment

In areas of the river that were too deep to wade, Woolpert utilized sonar to measure bathymetric points. Single beam sonar was collected from a small, portable unmanned survey vessel (USV) remotely operated from shore. A CEE HydroSystems ECHO 200kHz survey grade echosounder was used to collect soundings. The survey platform was positioned using a Trimble Navigation dual-frequency GNSS with data time tagged and logged digitally on the echosounder. Sound speed through the water column was measured using an AML MinosX profiler.

Methodology

Static GNSS

The field crew utilized Static GNSS surveying throughout the ground control data collection process to establish base station coordinates. Using Static GNSS techniques, observations were performed on a total of 9 base station points, 3 check points and 2 lidar control points. The survey was conducted using a 1-second epoch rate, in a fixed solution, with each observation lasting at least 20 minutes.

Real-Time Kinematic (RTK) GNSS

The field crew utilized Real-Time Kinematic (RTK) GNSS surveying throughout the ground control data collection process. Using RTK GNSS techniques, observations were performed on a total of approximately 18 LiDAR control points, and 34 LiDAR check points. The survey was conducted using a 1-second epoch rate, in a fixed solution RTK mode, with each observation lasting 180 seconds. Each station was occupied twice to insure the necessary horizontal and vertical accuracies were being met for this LiDAR project.

RTK GNSS was also used to collect bathymetric check points. Bathymetric check points were collected in cross-sections, generally perpendicular to the flow of the river, in open areas away from vegetation where the banks are relatively flat. The cross-sections were extended from bank to bank where possible, with data collected in upland areas on each side of the river. A shot was also taken at the edge of water (EOW) to record the water level at the time of the survey. A shorter occupation time of 3-epochs

(meeting point tolerances) was used for the RTK bathymetric check points as it would be impractical to observe for long periods of time in the swift river.

In some areas, access to the other side of the river was not possible, restricting the upland coverage. Points were collected out to a safe wading depth, in many cases across the entire river. Where it was not possible to wade across, sonar was used to complete the deeper sections.

Single Beam Sonar

In deeper areas of the rivers, single beam sonar was used to connect the waded edges of the bathymetric check point cross-sections. Additional lines running along, and parallel to the approximate thalweg were also collected at each cross-section sample area to provide quality control. The full echo envelope, or echogram, was recorded for use in post processing to facilitate the removal of vegetation from the final dataset. Raw GNSS observables were also logged on the base station and vessel for later post-processing. The vessel was navigated in real-time by the operator using Teledyne PDS2000 data acquisition software. Data were collected in native CEE HydroSystems format on the vessel to avoid timing errors and data gaps common in wireless data transmission.

GNSS Data Analysis and Processing

The field crew chief processed all session baselines each day using Trimble Navigation's Trimble Business Center (TBC) Version 5.21 baseline processor with the accompanying broadcast ephemeris. Daily processing ensured the integrity of the network as it was constructed and allowed the field crews to immediately reschedule observations of poor baselines.

Where possible, existing NGS control points with published, high accuracy 3-d coordinates on project datum were used for GNSS base stations. Additional temporary control points were set using multiple baseline static GNSS methods. The results were adjusted in a constrained network with the published NGS points held fixed.

OPUS was used to verify the existing NGS control point coordinates as well as the computed temporary control point coordinates. Results are presented in Section 4 of this report.

Sonar Data Analysis and Processing

Raw GNSS observables were post-processed in NovaTel Inertial Explorer version 8.70 software using Post Processed Kinematic (PPK) methods. Base station observables with finalized positions were used with the vessel data to enhance the accuracy of the vessel trajectory from the RTK positions. The PPK algorithms run forward and reverse through time then generate a blended solution which can reduce periods of higher uncertainty due to poor satellite tracking or loss of telemetry radio data. The final time stamped trajectory data were exported for each cross section in ASCII format relative to Universal Coordinated Time (UTC) and the geodetic datum (latitude, longitude and ellipsoid height).

Raw sonar data were converted from CEE HydroSystems native format to Hypack .RAW and .BIN format for import into Caris HIPS version 11.3 software. The PPK trajectory data were imported and the soundings were corrected to the project vertical datum using the measured antenna height above water level and the GEOID12B model. Sound speed profiles recorded at each cross-section were applied to the data and soundings were manually edited to remove noise. The echogram was displayed with the digitized depths allowing the hydrographer to reject soundings based on the acoustic signature.

Accepted soundings were thinned and exported to ASCII format for import into TBC. The data were then merged with the RTK points.

Datum Reference and Final Coordinates

The spatial reference system for the Upper Colorado and Gunnison river AOIs is UTM 13N. The horizontal datum is NAD83 (2011) Epoch 2010.0 with orthometric heights referenced to NAVD88 using the GEOID18 model. Units for both the horizontal and vertical datums will be expressed in Meters to three (3) decimal places.

Quality Assurance

Existing NGS published bench marks were surveyed to assure that there were no discrepancies in the field observation data. Close examinations of the residuals showed no distortions in orientation or scale. The ground control data meets positional accuracies necessary to support 1.0 point per 0.3 meters squared (1' GSD) data at 95% confidence level as outlined in the Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy (NSSDA), published by the Federal Geographic Data Committee (FGDC-STD-007.3-1998).

Several methods were employed to assure the quality of the sonar data. Prior to data collection, a bar check was completed to verify the draft and sound speed application of the single beam sonar. This was done by manually measuring the depth in a deep, flat location with a tape measure. Then, the same location was observed with the USV system. Adjustments to the measured sonar draft were made until the results agreed within 1cm. At each cross-section location, this was further verified, along with the full datum reduction, by collecting a point in the river with RTK, then occupying it with the USV. Further verification of the relative accuracy of the sonar data was accomplished by comparing areas where sonar data crosses itself (cross lines) as well as junctions with wading RTK shots.

All sonar bathymetric check point data was collected in accordance with the U.S. Army Corps of Engineers "Hydrographic Surveying Specifications for Inland Surveys" (EM-1110-2-1003, November 30, 2013). Data collection and processing was completed by a THSOA/NSPS Certified Hydrographer. Bathymetric checkpoint accuracy will satisfy a vertical accuracy of 10-centimeters at the 95% confidence level.

Section 2: Ground Control / Geodetic Control Coordinate Listings

Coordinate System: World wide/UTM

HORIZONTAL DATUM: NAD 1983 (2011)

PROJECTION: 13 North

VERTICAL DATUM: NAVD88

GEOID MODEL: GEOID18 (Conus)

UNITS: METER

Ground Control

Point No.	UTM 13 North		Ortho Height GEOID 18 (Meters)	Description
	Northing (Meters)	Easting (Meters)		
1001_2020_CO	4434204.148	384882.556	2263.543	LCP
1002_2020_CO	4434591.647	381942.041	2248.042	LCP
1003_2020_CO	4434335.988	383010.213	2249.920	LCP
1008_2020_CO	4441139.182	422608.793	2431.182	LCP
1009_2020_CO	4442857.250	425366.041	2448.542	LCP
1010_2020_CO	4438523.953	417854.262	2400.822	LCP
1011_2020_CO	4440299.677	416357.182	2393.665	LCP
1012_2020_CO	4437662.048	408036.121	2355.059	LCP
1013_2020_CO	4439375.779	412115.727	2379.896	LCP
1014_2020_CO	4434119.885	403345.737	2316.193	LCP
1015_2020_CO	4436565.157	405470.272	2338.923	LCP
1016_2020_CO	4265028.240	324054.558	2303.459	LCP
1017_2020_CO	4264305.558	323431.484	2306.691	LCP
1018_2020_CO	4266811.892	330146.286	2332.150	LCP
1019_2020_CO	4281143.874	339636.770	2451.864	LCP
1020_2020_CO	4280035.773	338306.348	2441.322	LCP
1021_2020_CO	4278997.361	337533.646	2437.567	LCP
1022_2020_CO	4275785.381	335820.770	2408.504	LCP
1023_2020_CO	4272599.808	332560.274	2370.785	LCP
1024_2020_CO	4272600.907	332559.839	2370.765	LCP
2001_2020_CO	4434866.313	386778.595	2252.602	NVA

Point No.	UTM 13 North		Ortho Height GEOID 18 (Meters)	Description
	Northing (Meters)	Easting (Meters)		
2002_2020_CO	4433616.233	383037.016	2236.389	NVA
2003_2020_CO	4432881.915	381411.373	2237.691	NVA
2004_2020_CO	4434227.578	389693.313	2252.295	NVA
2005_2020_CO	4434067.933	399992.931	2288.231	NVA
2006_2020_CO	4440165.896	420677.804	2416.623	NVA
2007_2020_CO	4441704.855	423224.945	2434.545	NVA
2008_2020_CO	4442613.599	425054.775	2443.712	NVA
2009_2020_CO	4439846.384	418448.872	2400.317	NVA
2010_2020_CO	4440244.467	416420.211	2392.260	NVA
2011_2020_CO	4438004.646	408467.850	2368.345	NVA
2012_2020_CO	4440216.079	414563.336	2378.852	NVA
2013_2020_CO	4266060.933	328436.787	2324.658	NVA
2014_2020_CO	4263641.159	323345.297	2298.653	NVA
2015_2020_CO	4265193.296	326112.804	2308.999	NVA
2016_2020_CO	4265811.534	329407.199	2325.721	NVA
2017_2020_CO	4266770.719	330126.953	2332.321	NVA
2018_2020_CO	4281205.695	339354.789	2447.667	NVA
2019_2020_CO	4279245.792	337620.007	2441.948	NVA
2020_2020_CO	4275209.813	335837.055	2398.587	NVA
2021_2020_CO	4272158.023	332596.577	2368.783	NVA
2022_2020_CO	4271070.792	331733.107	2362.009	NVA
3001_2020_CO	4433602.178	383067.032	2235.815	VVA
3002_2020_CO	4434252.205	389740.174	2250.910	VVA
3003_2020_CO	4434063.240	399968.178	2287.791	VVA
3004_2020_CO	4441730.605	423213.440	2433.562	VVA
3005_2020_CO	4440204.080	414621.916	2379.950	VVA
3006_2020_CO	4265667.880	327597.762	2314.984	VVA
3007_2020_CO	4265810.839	329445.229	2325.343	VVA
3008_2020_CO	4266809.827	330185.699	2331.880	VVA
3009_2020_CO	4281122.587	339363.093	2444.220	VVA
3010_2020_CO	4275765.463	335808.717	2407.451	VVA
3011_2020_CO	4273257.130	333017.659	2381.526	VVA
3012_2020_CO	4272173.760	332545.929	2368.051	VVA

Geodetic Control:

Point No.	UTM 13 North		Ortho Height GEOID 18 (Meters)	Description
	Northing (Meters)	Easting (Meters)		
AE7515	4267262.240	331965.439	2338.455	GUC D
AI5954	4434683.298	383142.274	2256.625	20V-C
JL0212	4267355.577	332081.576	2340.987	Y8-1926
JL0521	4265030.610	324067.907	2302.920	A424
JL0523	4266022.368	328384.194	2323.677	Y423
JL0527	4267941.219	333290.949	2341.383	X423
JL0714	4276388.003	336611.394	2415.385	ROAD
LL0732	4440133.447	420671.369	2416.340	E361
LL0793	4439547.002	417008.418	2398.451	WINDY-GAP
LM0189	4435356.431	389816.523	2243.800	Q138
LM0192	4435900.094	397077.302	2299.810	T138
LM0207	4434852.827	383089.928	2256.671	J297
MP74	4277831.728	337109.906	2429.135	CO-DOT
TCP1	4273229.911	333002.395	2381.971	TCP1
TCP2	4435847.168	397042.390	2299.040	SPIKE

Coordinate System: Geodetic

HORIZONTAL DATUM: NAD 1983 (2011)

Epoch:2010.00

Ellipsoid: GRS80

UNITS: Meter

Ground Control

Point No.	Geodetic Coordinates: NAD 1983 (2011)		Ellipsoid Height (Meters)	Description
	Latitude (N)	Longitude (W)		
1001_2020_CO	N40°03'00.80825"	W106°20'58.50029"	2250.708	LCP
1002_2020_CO	N40°03'11.90923"	W106°23'02.82440"	2235.251	LCP
1003_2020_CO	N40°03'04.15542"	W106°22'17.58652"	2237.110	LCP
1008_2020_CO	N40°07'01.22392"	W105°54'29.49686"	2418.624	LCP
1009_2020_CO	N40°07'57.83931"	W105°52'33.74143"	2436.055	LCP
1010_2020_CO	N40°05'34.78841"	W105°57'49.13542"	2388.174	LCP
1011_2020_CO	N40°06'31.84434"	W105°58'53.17800"	2381.021	LCP
1012_2020_CO	N40°05'03.18242"	W106°04'43.26295"	2342.308	LCP
1013_2020_CO	N40°06'00.32630"	W106°01'51.86328"	2367.198	LCP
1014_2020_CO	N40°03'06.42405"	W106°07'59.37918"	2303.444	LCP
1015_2020_CO	N40°04'26.58871"	W106°06'31.01253"	2326.174	LCP
1016_2020_CO	N38°30'58.55140"	W107°01'05.27325"	2289.094	LCP
1017_2020_CO	N38°30'34.67559"	W107°01'30.33014"	2292.322	LCP
1018_2020_CO	N38°32'00.64515"	W106°56'55.42628"	2317.811	LCP
1019_2020_CO	N38°39'51.71932"	W106°50'35.51528"	2437.654	LCP
1020_2020_CO	N38°39'14.91744"	W106°51'29.60996"	2427.091	LCP
1021_2020_CO	N38°38'40.73740"	W106°52'00.68843"	2423.322	LCP
1022_2020_CO	N38°36'55.45142"	W106°53'08.77922"	2394.222	LCP
1023_2020_CO	N38°35'09.96589"	W106°55'20.77333"	2356.476	LCP
1024_2020_CO	N38°35'10.00126"	W106°55'20.79225"	2356.456	LCP
2001_2020_CO	N40°03'23.20413"	W106°19'38.91556"	2239.739	NVA
2002_2020_CO	N40°02'40.83026"	W106°22'15.98791"	2223.577	NVA
2003_2020_CO	N40°02'16.20224"	W106°23'24.08956"	2224.901	NVA
2004_2020_CO	N40°03'03.88338"	W106°17'35.52786"	2239.420	NVA
2005_2020_CO	N40°03'03.33150"	W106°10'20.83096"	2275.441	NVA
2006_2020_CO	N40°06'29.01226"	W105°55'50.63375"	2404.024	NVA

Point No.	Geodetic Coordinates: NAD 1983 (2011)		Ellipsoid Height (Meters)	Description
	Latitude (N)	Longitude (W)		
2007_2020_CO	N40°07'19.77233"	W105°54'03.71189"	2422.004	NVA
2008_2020_CO	N40°07'49.83783"	W105°52'46.79099"	2431.219	NVA
2009_2020_CO	N40°06'17.88327"	W105°57'24.62820"	2387.686	NVA
2010_2020_CO	N40°06'30.07645"	W105°58'50.49023"	2379.616	NVA
2011_2020_CO	N40°05'14.46189"	W106°04'25.21037"	2355.597	NVA
2012_2020_CO	N40°06'28.48437"	W106°00'08.90167"	2366.195	NVA
2013_2020_CO	N38°31'35.11498"	W106°58'05.33125"	2310.309	NVA
2014_2020_CO	N38°30'13.07202"	W107°01'33.28284"	2284.279	NVA
2015_2020_CO	N38°31'05.35903"	W106°59'40.47834"	2294.635	NVA
2016_2020_CO	N38°31'27.69991"	W106°57'25.05721"	2311.370	NVA
2017_2020_CO	N38°31'59.29684"	W106°56'56.18830"	2317.981	NVA
2018_2020_CO	N38°39'53.53990"	W106°50'47.22899"	2433.453	NVA
2019_2020_CO	N38°38'48.84989"	W106°51'57.32671"	2427.706	NVA
2020_2020_CO	N38°36'36.79922"	W106°53'07.61751"	2384.304	NVA
2021_2020_CO	N38°34'55.66572"	W106°55'18.89168"	2354.473	NVA
2022_2020_CO	N38°34'19.82510"	W106°55'53.61619"	2347.697	NVA
3001_2020_CO	N40°02'40.38949"	W106°22'14.71242"	2223.003	VVA
3002_2020_CO	N40°03'04.70403"	W106°17'33.56565"	2238.035	VVA
3003_2020_CO	N40°03'03.16874"	W106°10'21.87286"	2275.000	VVA
3004_2020_CO	N40°07'20.60365"	W105°54'04.20893"	2421.020	VVA
3005_2020_CO	N40°06'28.11665"	W106°00'06.42187"	2367.294	VVA
3006_2020_CO	N38°31'21.78685"	W106°58'39.61386"	2300.628	VVA
3007_2020_CO	N38°31'27.70361"	W106°57'23.48689"	2310.992	VVA
3008_2020_CO	N38°32'00.60528"	W106°56'53.79746"	2317.540	VVA
3009_2020_CO	N38°39'50.85048"	W106°50'46.81634"	2430.005	VVA
3010_2020_CO	N38°36'54.79753"	W106°53'09.26043"	2393.168	VVA
3011_2020_CO	N38°35'31.58959"	W106°55'02.44513"	2367.219	VVA
3012_2020_CO	N38°34'56.14162"	W106°55'20.99749"	2353.741	VVA

Geodetic Control:

Point No.	Geodetic Coordinates: NAD 1983 (2011)		Ellipsoid Height (Meters)	Description
	Latitude (N)	Longitude (W)		
AE7515	N38°32'16.49132"	W106°55'40.71976"	2324.125	GUCD
AI5954	N40°03'15.48313"	W106°22'12.23990"	2243.816	20V-C
JL0212	N38°32'19.59673"	W106°55'36.00595"	2326.659	Y8-1926
JL0521	N38°30'58.63773"	W107°01'04.72450"	2288.556	A424
JL0523	N38°31'33.82802"	W106°58'07.46801"	2309.327	Y423
JL0527	N38°32'39.40527"	W106°54'46.58089"	2327.068	X423
JL0714	N38°37'15.51729"	W106°52'36.61277"	2401.115	ROAD
LL0732	N40°06'27.95774"	W105°55'50.89119"	2403.742	E361
LL0793	N40°06'07.66728"	W105°58'25.32469"	2385.802	WINDY-GAP
LM0189	N40°03'40.54638"	W106°17'31.02033"	2230.927	Q138
LM0192	N40°04'01.48106"	W106°12'24.90887"	2286.981	T138
LM0207	N40°03'20.95410"	W106°22'14.55882"	2243.864	J297
MP74	N38°38'02.66105"	W106°52'17.22518"	2414.874	CO-DOT
TCP1	N38°35'30.69668"	W106°55'03.05226"	2367.665	TCP1
TCP2	N40°03'59.74944"	W106°12'26.35205"	2286.211	SPIKE



Section 3: Ground/Geodetic Control Logs and Photos

This section contains the station recovery information sheets and photographs regarding the ground control positions established for the project. The stations appear as they are ordered in the final coordinate listing of Section 2.

The data is assembled on the following pages.



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1001_2020_CO	Northing (m) 4434204.148	Easting (m) 384882.556	Elevation (m) 2263.543	
Point Type LCP	Latitude N40°03'00.80825"	Longitude W106°20'58.50029"	Ellipsoid Height (m) 2250.708	
Location Photo  NORTH				



1001_2020_CO_3W_20201007



1001_2020_CO_3S_20201007





1001_2020_CO_3N_20201007



1001_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1002_2020_CO	Northing (m) 4434591.647	Easting (m) 381942.041	Elevation (m) 2248.042	
Point Type LCP	Latitude N40°03'11.90923"	Longitude W106°23'02.82440"	Ellipsoid Height (m) 2235.251	
Location Photo  NORTH				



1002_2020_CO_3W_20201007



1002_2020_CO_3S_20201007




1002_2020_CO_3N_20201007



1002_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1003_2020_CO	Northing (m) 4434335.988	Easting (m) 383010.213	Elevation (m) 2249.920	
Point Type LCP	Latitude N40°03'04.15542"	Longitude W106°22'17.58652"	Ellipsoid Height (m) 2237.110	
Location Photo ↑ NORTH				



1003_2020_CO_3SE_20201007



1003_2020_CO_3S_20201007




1003_2020_CO_3NW_20201007



1003_2020_CO_3NE_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1008_2020_CO	Northing (m) 4441139.182	Easting (m) 422608.793	Elevation (m) 2431.182	
Point Type LCP	Latitude N40°07'01.22392"	Longitude W105°54'29.49686"	Ellipsoid Height (m) 2418.624	
Location Photo ↑ NORTH				



1008_2020_CO_3W_20201008



1008_2020_CO_3S_20201008





1008_2020_CO_3N_20201008



1008_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1009_2020_CO	Northing (m) 4442857.250	Easting (m) 425366.041	Elevation (m) 2448.542	
Point Type LCP	Latitude N40°07'57.83931"	Longitude W105°52'33.74143"	Ellipsoid Height (m) 2436.055	
Location Photo  NORTH				



1009_2020_CO_3W_20201008



1009_2020_CO_3S_20201008





1009_2020_CO_3N_20201008



1009_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1010_2020_CO	Northing (m) 4438523.953	Easting (m) 417854.262	Elevation (m) 2400.822	
Point Type LCP	Latitude N40°05'34.78841"	Longitude W105°57'49.13542"	Ellipsoid Height (m) 2388.174	
Location Photo  NORTH				



1010_2020_CO_3W_20201008



1010_2020_CO_3S_20201008



1010_2020_CO_3N_20201008



1010_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1011_2020_CO	Northing (m) 4440299.677	Easting (m) 416357.182	Elevation (m) 2393.665	
Point Type LCP	Latitude N40°06'31.84434"	Longitude W105°58'53.17800"	Ellipsoid Height (m) 2381.021	
Location Photo ↑ NORTH				



1011_2020_CO_3W_20201008



1011_2020_CO_3S_20201008





1011_2020_CO_3N_20201008



1011_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1012_2020_CO	Northing (m) 4437662.048	Easting (m) 408036.121	Elevation (m) 2355.059	
Point Type LCP	Latitude N40°05'03.18242"	Longitude W106°04'43.26295"	Ellipsoid Height (m) 2342.308	
Location Photo  NORTH				



1012_2020_CO_3W_20201008



1012_2020_CO_3S_20201008





1012_2020_CO_3N_20201008



1012_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1013_2020_CO	Northing (m) 4439375.779	Easting (m) 412115.727	Elevation (m) 2379.896	
Point Type LCP	Latitude N40°06'00.32630"	Longitude W106°01'51.86328"	Ellipsoid Height (m) 2367.198	
Location Photo  NORTH				



1013_2020_CO_3W_20201008



1013_2020_CO_3S_20201008





1013_2020_CO_3N_20201008



1013_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1014_2020_CO	Northing (m) 4434119.885	Easting (m) 403345.737	Elevation (m) 2316.193	
Point Type LCP	Latitude N40°03'06.42405"	Longitude W106°07'59.37918"	Ellipsoid Height (m) 2303.444	
Location Photo  NORTH				



1014_2020_CO_3W_20201007



1014_2020_CO_3S_20201007




1014_2020_CO_3N_20201007



1014_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1015_2020_CO	Northing (m) 4436565.157	Easting (m) 405470.272	Elevation (m) 2338.923	
Point Type LCP	Latitude N40°04'26.58871"	Longitude W106°06'31.01253"	Ellipsoid Height (m) 2326.174	
Location Photo ↑ NORTH				



1015_2020_CO_3W_20201008



1015_2020_CO_3S_20201008





1015_2020_CO_3N_20201008



1015_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1016_2020_CO	Northing (m) 4265028.240	Easting (m) 324054.558	Elevation (m) 2303.459	
Point Type LCP	Latitude N38°30'58.55140"	Longitude W107°01'05.27325"	Ellipsoid Height (m) 2289.094	
Location Photo  NORTH				



1016_2020_CO_3W_20200928



1016_2020_CO_3S_20200928



1016_2020_CO_3N_20200928



1016_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1017_2020_CO	Northing (m) 4264305.558	Easting (m) 323431.484	Elevation (m) 2306.691	
Point Type LCP	Latitude N38°30'34.67559"	Longitude W107°01'30.33014"	Ellipsoid Height (m) 2292.322	
Location Photo ↑ NORTH				



1017_2020_CO_3W_20200928



1017_2020_CO_3S_20200928





1017_2020_CO_3N_20200928



1017_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1018_2020_CO	Northing (m) 4266811.892	Easting (m) 330146.286	Elevation (m) 2332.150	
Point Type LCP	Latitude N38°32'00.64515"	Longitude W106°56'55.42628"	Ellipsoid Height (m) 2317.811	
Location Photo  NORTH				



1018_2020_CO_3W_20200928



1018_2020_CO_3S_20200928





1018_2020_CO_3N_20200928



1018_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1019_2020_CO	Northing (m) 4281143.874	Easting (m) 339636.770	Elevation (m) 2451.864	
Point Type LCP	Latitude N38°39'51.71932"	Longitude W106°50'35.51528"	Ellipsoid Height (m) 2437.654	
Location Photo  NORTH				



1019_2020_CO_3W_20200929



1019_2020_CO_3S_20200929





1019_2020_CO_3N_20200929



1019_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1020_2020_CO	Northing (m) 4280035.773	Easting (m) 338306.348	Elevation (m) 2441.322	
Point Type LCP	Latitude N38°39'14.91744"	Longitude W106°51'29.60996"	Ellipsoid Height (m) 2427.091	
Location Photo  NORTH				



1020_2020_CO_3W_20200929



1020_2020_CO_3S_20200929



1020_2020_CO_3N_20200929



1020_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1021_2020_CO	Northing (m) 4278997.361	Easting (m) 337533.646	Elevation (m) 2437.567	
Point Type LCP	Latitude N38°38'40.73740"	Longitude W106°52'00.68843"	Ellipsoid Height (m) 2423.322	
Location Photo ↑ NORTH				



1021_2020_CO_3W_20200929



1021_2020_CO_3S_20200929



1021_2020_CO_3N_20200929



1021_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1022_2020_CO	Northing (m) 4275785.381	Easting (m) 335820.770	Elevation (m) 2408.504	
Point Type LCP	Latitude N38°36'55.45142"	Longitude W106°53'08.77922"	Ellipsoid Height (m) 2394.222	
Location Photo ↑ NORTH				



1022_2020_CO_3W_20200929



1022_2020_CO_3S_20200929



1022_2020_CO_3N_20200929



1022_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1023_2020_CO	Northing (m) 4272599.808	Easting (m) 332560.274	Elevation (m) 2370.785	
Point Type LCP	Latitude N38°35'09.96589"	Longitude W106°55'20.77333"	Ellipsoid Height (m) 2356.476	
Location Photo ↑ NORTH				



1023_2020_CO_3W_20200929



1023_2020_CO_3S_20200929





1023_2020_CO_3N_20200929



1023_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 1024_2020_CO	Northing (m) 4272600.907	Easting (m) 332559.839	Elevation (m) 2370.765	
Point Type LCP	Latitude N38°35'10.00126"	Longitude W106°55'20.79225"	Ellipsoid Height (m) 2356.456	
Location Photo  NORTH				



1024_2020_CO_3W_20200930



1024_2020_CO_3S_20200930





1024_2020_CO_3N_20200930



1024_2020_CO_3E_20200930



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2001_2020_CO	Northing (m) 4434866.313	Easting (m) 386778.595	Elevation (m) 2252.602	
Point Type NVA	Latitude N40°03'23.20413"	Longitude W106°19'38.91556"	Ellipsoid Height (m) 2239.739	
Location Photo  NORTH				



2001_2020_CO_3W_20201007



2001_2020_CO_3S_20201007





2001_2020_CO_3N_20201007



2001_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2002_2020_CO	Northing (m) 4433616.233	Easting (m) 383037.016	Elevation (m) 2236.389	
Point Type NVA	Latitude N40°02'40.83026"	Longitude W106°22'15.98791"	Ellipsoid Height (m) 2223.577	
Location Photo  NORTH				



2002_2020_CO_3W_20201007



2002_2020_CO_3S_20201007





2002_2020_CO_3N_20201007



2002_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2003_2020_CO	Northing (m) 4432881.915	Easting (m) 381411.373	Elevation (m) 2237.691	
Point Type NVA	Latitude N40°02'16.20224"	Longitude W106°23'24.08956"	Ellipsoid Height (m) 2224.901	
Location Photo  NORTH				



2003_2020_CO_3W_20201007



2003_2020_CO_3S_20201007





2003_2020_CO_3N_20201007



2003_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2004_2020_CO	Northing (m) 4434227.578	Easting (m) 389693.313	Elevation (m) 2252.295	
Point Type NVA	Latitude N40°03'03.88338"	Longitude W106°17'35.52786"	Ellipsoid Height (m) 2239.420	
Location Photo  NORTH				



2004_2020_CO_3SW_20201007



2004_2020_CO_3S_20201007





2004_2020_CO_3NW_20201007



2004_2020_CO_3NE_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2005_2020_CO	Northing (m) 4434067.933	Easting (m) 399992.931	Elevation (m) 2288.231	
Point Type NVA	Latitude N40°03'03.33150"	Longitude W106°10'20.83096"	Ellipsoid Height (m) 2275.441	
Location Photo  NORTH				



2005_2020_CO_3W_20201007



2005_2020_CO_3S_20201007





2005_2020_CO_3N_20201007



2005_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2006_2020_CO	Northing (m) 4440165.896	Easting (m) 420677.804	Elevation (m) 2416.623	
Point Type NVA	Latitude N40°06'29.01226"	Longitude W105°55'50.63375"	Ellipsoid Height (m) 2404.024	
Location Photo  NORTH				



2006_2020_CO_3W_20201008



2006_2020_CO_3S_20201008





2006_2020_CO_3N_20201008



2006_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2007_2020_CO	Northing (m) 4441704.855	Easting (m) 423224.945	Elevation (m) 2434.545	
Point Type NVA	Latitude N40°07'19.77233"	Longitude W105°54'03.71189"	Ellipsoid Height (m) 2422.004	
Location Photo  NORTH				



2007_2020_CO_3W_20201008



2007_2020_CO_3S_20201008





2007_2020_CO_3N_20201008



2007_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2008_2020_CO	Northing (m) 4442613.599	Easting (m) 425054.775	Elevation (m) 2443.712	
Point Type NVA	Latitude N40°07'49.83783"	Longitude W105°52'46.79099"	Ellipsoid Height (m) 2431.219	
Location Photo  NORTH				



2008_2020_CO_3W_20201008



2008_2020_CO_3S_20201008





2008_2020_CO_3N_20201008



2008_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2009_2020_CO	Northing (m) 4439846.384	Easting (m) 418448.872	Elevation (m) 2400.317	
Point Type NVA	Latitude N40°06'17.88327"	Longitude W105°57'24.62820"	Ellipsoid Height (m) 2387.686	
Location Photo  NORTH				



2009_2020_CO_3W_20201008



2009_2020_CO_3S_20201008





2009_2020_CO_3N_20201008



2009_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2010_2020_CO	Northing (m) 4440244.467	Easting (m) 416420.211	Elevation (m) 2392.260	
Point Type NVA	Latitude N40°06'30.07645"	Longitude W105°58'50.49023"	Ellipsoid Height (m) 2379.616	
Location Photo  NORTH				



2010_2020_CO_3W_20201008



2010_2020_CO_3S_20201008





2010_2020_CO_3N_20201008



2010_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2011_2020_CO	Northing (m) 4438004.646	Easting (m) 408467.850	Elevation (m) 2368.345	
Point Type NVA	Latitude N40°05'14.46189"	Longitude W106°04'25.21037"	Ellipsoid Height (m) 2355.597	
Location Photo  NORTH				



2011_2020_CO_3W_20201008



2011_2020_CO_3S_20201008





2011_2020_CO_3N_20201008



2011_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2012_2020_CO	Northing (m) 4440216.079	Easting (m) 414563.336	Elevation (m) 2378.852	
Point Type NVA	Latitude N40°06'28.48437"	Longitude W106°00'08.90167"	Ellipsoid Height (m) 2366.195	
Location Photo  NORTH				



2012_2020_CO_3W_20201008



2012_2020_CO_3S_20201008





2012_2020_CO_3N_20201008



2012_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2013_2020_CO	Northing (m) 4266060.933	Easting (m) 328436.787	Elevation (m) 2324.658	
Point Type NVA	Latitude N38°31'35.11498"	Longitude W106°58'05.33125"	Ellipsoid Height (m) 2310.309	
Location Photo  NORTH				



2013_2020_CO_3W_20200928



2013_2020_CO_3SN_20200928





2013_2020_CO_3N_20200928



2013_2020_CO_3EN_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2014_2020_CO	Northing (m) 4263641.159	Easting (m) 323345.297	Elevation (m) 2298.653	
Point Type NVA	Latitude N38°30'13.07202"	Longitude W107°01'33.28284"	Ellipsoid Height (m) 2284.279	
Location Photo  NORTH				



2014_2020_CO_3W_20200928



2014_2020_CO_3S_20200928





2014_2020_CO_3N_20200928



2014_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2015_2020_CO	Northing (m) 4265193.296	Easting (m) 326112.804	Elevation (m) 2308.999	
Point Type NVA	Latitude N38°31'05.35903"	Longitude W106°59'40.47834"	Ellipsoid Height (m) 2294.635	
Location Photo  NORTH				



2015_2020_CO_3W_20200928



2015_2020_CO_3S_20200928





2015_2020_CO_3N_20200928



2015_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2016_2020_CO	Northing (m) 4265811.534	Easting (m) 329407.199	Elevation (m) 2325.721	
Point Type NVA	Latitude N38°31'27.69991"	Longitude W106°57'25.05721"	Ellipsoid Height (m) 2311.370	
Location Photo  NORTH				



2016_2020_CO_3W_20200928



2016_2020_CO_3S_20200928





2016_2020_CO_3N_20200928



2016_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2017_2020_CO	Northing (m) 4266770.719	Easting (m) 330126.953	Elevation (m) 2332.321	
Point Type NVA	Latitude N38°31'59.29684"	Longitude W106°56'56.18830"	Ellipsoid Height (m) 2317.981	
Location Photo  NORTH				



2017_2020_CO_3W_20200928



2017_2020_CO_3S_20200928





2017_2020_CO_3N_20200928



2017_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2018_2020_CO	Northing (m) 4281205.695	Easting (m) 339354.789	Elevation (m) 2447.667	
Point Type NVA	Latitude N38°39'53.53990"	Longitude W106°50'47.22899"	Ellipsoid Height (m) 2433.453	
Location Photo  NORTH				



2018_2020_CO_3W_20200929



2018_2020_CO_3S_20200929





2018_2020_CO_3N_20200929



2018_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2019_2020_CO	Northing (m) 4279245.792	Easting (m) 337620.007	Elevation (m) 2441.948	
Point Type NVA	Latitude N38°38'48.84989"	Longitude W106°51'57.32671"	Ellipsoid Height (m) 2427.706	
Location Photo  NORTH				



2019_2020_CO_3W_20200929



2019_2020_CO_3S_20200929





2019_2020_CO_3N_20200929



2019_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2020_2020_CO	Northing (m) 4275209.813	Easting (m) 335837.055	Elevation (m) 2398.587	
Point Type NVA	Latitude N38°36'36.79922"	Longitude W106°53'07.61751"	Ellipsoid Height (m) 2384.304	
Location Photo  NORTH				



2020_2020_CO_3W_20200929



2020_2020_CO_3S_20200929





2020_2020_CO_3N_20200929



2020_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2021_2020_CO	Northing (m) 4272158.023	Easting (m) 332596.577	Elevation (m) 2368.783	
Point Type NVA	Latitude N38°34'55.66572"	Longitude W106°55'18.89168"	Ellipsoid Height (m) 2354.473	
Location Photo  NORTH				



2021_2020_CO_3W_20200930



2021_2020_CO_3S_20200930





2021_2020_CO_3N_20200930



2021_2020_CO_3E_20200930



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 2022_2020_CO	Northing (m) 4271070.792	Easting (m) 331733.107	Elevation (m) 2362.009	
Point Type NVA	Latitude N38°34'19.82510"	Longitude W106°55'53.61619"	Ellipsoid Height (m) 2347.697	
Location Photo  NORTH				



2022_2020_CO_3W_20200930



2022_2020_CO_3S_20200930





2022_2020_CO_3N_20200930



2022_2020_CO_3E_20200930



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3001_2020_CO	Northing (m) 4433602.178	Easting (m) 383067.032	Elevation (m) 2235.815	
Point Type VVA	Latitude N40°02'40.38949"	Longitude W106°22'14.71242"	Ellipsoid Height (m) 2223.003	
Location Photo  NORTH				



3001_2020_CO_3W_20201007



3001_2020_CO_3S_20201007





3001_2020_CO_3N_20201007



3001_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3002_2020_CO	Northing (m) 4434252.205	Easting (m) 389740.174	Elevation (m) 2250.910	
Point Type VVA	Latitude N40°03'04.70403"	Longitude W106°17'33.56565"	Ellipsoid Height (m) 2238.035	
Location Photo  NORTH				



3002_2020_CO_3W_20201007



3002_2020_CO_3S_20201007





3002_2020_CO_3N_20201007



3002_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3003_2020_CO	Northing (m) 4434063.240	Easting (m) 399968.178	Elevation (m) 2287.791	
Point Type VVA	Latitude N40°03'03.16874"	Longitude W106°10'21.87286"	Ellipsoid Height (m) 2275.000	
Location Photo  NORTH				



3003_2020_CO_3W_20201007



3003_2020_CO_3S_20201007





3003_2020_CO_3N_20201007



3003_2020_CO_3E_20201007



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3004_2020_CO	Northing (m) 4441730.605	Easting (m) 423213.440	Elevation (m) 2433.562	
Point Type VVA	Latitude N40°07'20.60365"	Longitude W105°54'04.20893"	Ellipsoid Height (m) 2421.020	
Location Photo  NORTH				



3004_2020_CO_3W_20201008



3004_2020_CO_3S_20201008





3004_2020_CO_3N_20201008



3004_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3005_2020_CO	Northing (m) 4440204.080	Easting (m) 414621.916	Elevation (m) 2379.950	
Point Type VVA	Latitude N40°06'28.11665"	Longitude W106°00'06.42187"	Ellipsoid Height (m) 2367.294	
Location Photo  NORTH				



3005_2020_CO_3W_20201008



3005_2020_CO_3S_20201008





3005_2020_CO_3N_20201008

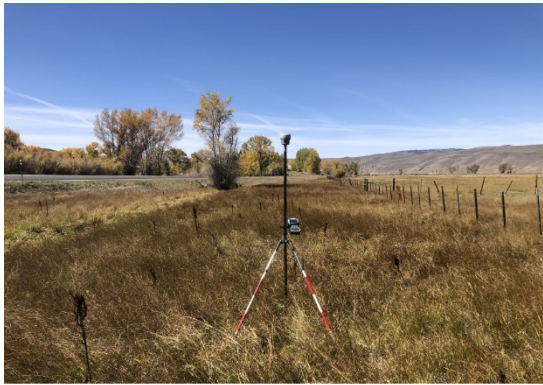


3005_2020_CO_3E_20201008



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3006_2020_CO	Northing (m) 4265667.880	Easting (m) 327597.762	Elevation (m) 2314.984	
Point Type VVA	Latitude N38°31'21.78685"	Longitude W106°58'39.61386"	Ellipsoid Height (m) 2300.628	
Location Photo  NORTH				



3006_2020_CO_3W_20200928



3006_2020_CO_3S_20200928





3006_2020_CO_3N_20200928



3006_2020_CO_3E_20200928



GCP OBSERVATION LOG

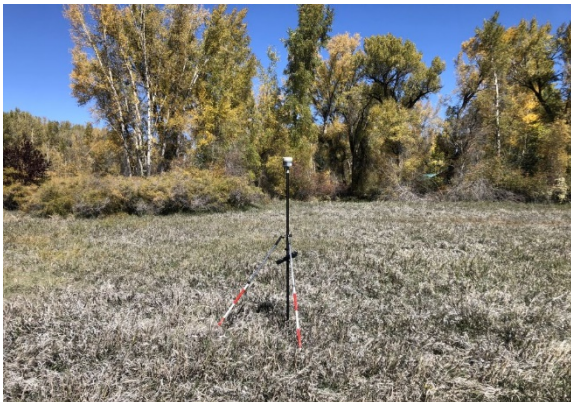
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Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3007_2020_CO	Northing (m) 4265810.839	Easting (m) 329445.229	Elevation (m) 2325.343	
Point Type VVA	Latitude N38°31'27.70361"	Longitude W106°57'23.48689"	Ellipsoid Height (m) 2310.992	
Location Photo  NORTH				



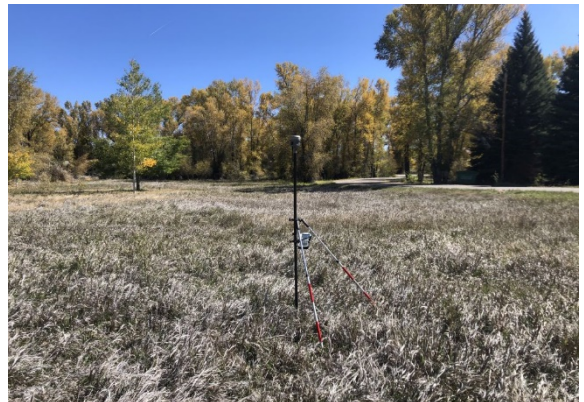
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3007_2020_CO_3S_20200928



3007_2020_CO_3N_20200928



3007_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3008_2020_CO	Northing (m) 4266809.827	Easting (m) 330185.699	Elevation (m) 2331.880	
Point Type VVA	Latitude N38°32'00.60528"	Longitude W106°56'53.79746"	Ellipsoid Height (m) 2317.540	
Location Photo ↑ NORTH				



3008_2020_CO_3W_20200928



3008_2020_CO_3S_20200928





3008_2020_CO_3N_20200928



3008_2020_CO_3E_20200928



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3009_2020_CO	Northing (m) 4281122.587	Easting (m) 339363.093	Elevation (m) 2444.220	
Point Type VVA	Latitude N38°39'50.85048"	Longitude W106°50'46.81634"	Ellipsoid Height (m) 2430.005	
Location Photo  NORTH				



3009_2020_CO_3W_2020092



3009_2020_CO_3S_2020092





3009_2020_CO_3N_20200929



3009_2020_CO_3E_2020092



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3010_2020_CO	Northing (m) 4275765.463	Easting (m) 335808.717	Elevation (m) 2407.451	
Point Type VVA	Latitude N38°36'54.79753"	Longitude W106°53'09.26043"	Ellipsoid Height (m) 2393.168	
Location Photo  NORTH				



3010_2020_CO_3W_20200929



3010_2020_CO_3S_20200929




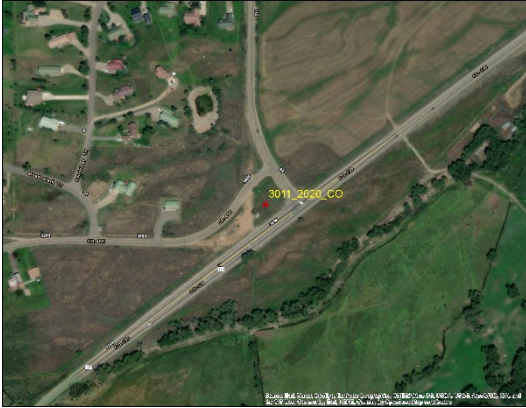
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3010_2020_CO_3E_20200929



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3011_2020_CO	Northing (m) 4273257.130	Easting (m) 333017.659	Elevation (m) 2381.526	
Point Type VVA	Latitude N38°35'31.58959"	Longitude W106°55'02.44513"	Ellipsoid Height (m) 2367.219	
Location Photo  NORTH				



3011_2020_CO_3W_20200930



3011_2020_CO_3S_20200930





3011_2020_CO_3N_20200930



3011_2020_CO_3E_20200930



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID 3012_2020_CO	Northing (m) 4272173.760	Easting (m) 332545.929	Elevation (m) 2368.051	
Point Type VVA	Latitude N38°34'56.14162"	Longitude W106°55'20.99749"	Ellipsoid Height (m) 2353.741	
Location Photo  NORTH				



3012_2020_CO_3W_20200930



3012_2020_CO_3S_20200930




3012_2020_CO_3N_20200930



3012_2020_CO_3E_20200930




GCP OBSERVATION LOG

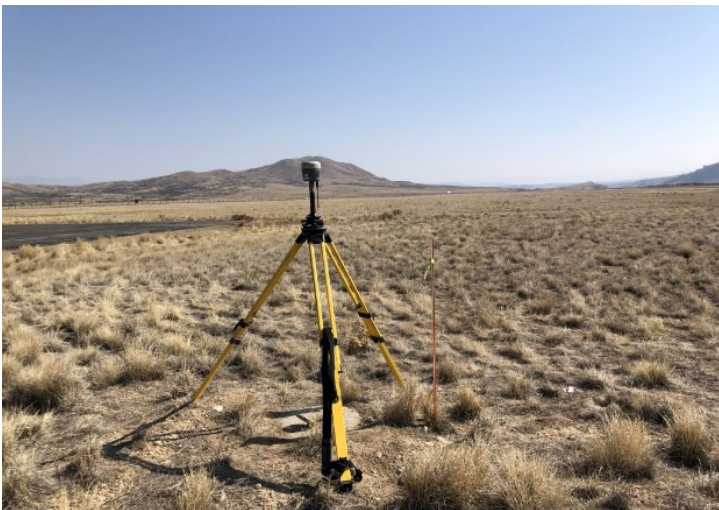
Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID AE7515	Northing (m) 4267262.240	Easting (m) 331965.439		Elevation (m) 2338.455
Point Type GUCD	Latitude N38°32'16.49132"	Longitude W106°55'40.71976"		Ellipsoid Height (m) 2324.125
 <p>AE7515_GUC D_1_20201006</p>				



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID AI5954	Northing (m) 4434683.298	Easting (m) 383142.274	Elevation (m) 2256.625	
Point Type 20V-C	Latitude N40°03'15.48313"	Longitude W106°22'12.23990"	Ellipsoid Height (m) 2243.816	
				

AI5954_20V C_1_20201006




AI5954_20V C_3E_20201006



AI5954_20V C_3N_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID JL0212	Northing (m) 4267355.577	Easting (m) 332081.576	Elevation (m) 2340.987	
Point Type Y8-1926	Latitude N38°32'19.59673"	Longitude W106°55'36.00595"	Ellipsoid Height (m) 2326.659	
 <p>JL0212_Y8_1_20201006</p>				




JL0212_Y 8_3E_20201006



JL0212_Y 8_3N_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID JL0521	Northing (m) 4265030.610	Easting (m) 324067.907	Elevation (m) 2302.920	
Point Type A424	Latitude N38°30'58.63773"	Longitude W107°01'04.72450"	Ellipsoid Height (m) 2288.556	
 <p>JL0521_A 424_1_20V C_1_20201006</p>				




JL0521_A 424_3E_20V C_1_20201006



JL0521_A 424_3N_20V C_1_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID JL0523	Northing (m) 4266022.368	Easting (m) 328384.194	Elevation (m) 2323.677	
Point Type Y423	Latitude N38°31'33.82802"	Longitude W106°58'07.46801"	Ellipsoid Height (m) 2309.327	
 <p>JL0523_Y 432_1_20201006</p>				




JL0523_Y 432_3E_20201006



JL0523_Y 432_3N_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID JL0527	Northing (m) 4267941.219	Easting (m) 333290.949	Elevation (m) 2341.383	
Point Type X423	Latitude N38°32'39.40527"	Longitude W106°54'46.58089"	Ellipsoid Height (m) 2327.068	
 <p>JL0527_X 423_1_20201006</p>				




JL0527_X 423_3E_20201006



JL0527_X 423_3S_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID JL0714	Northing (m) 4276388.003	Easting (m) 336611.394	Elevation (m) 2415.385	
Point Type ROAD	Latitude N38°37'15.51729"	Longitude W106°52'36.61277"	Ellipsoid Height (m) 2401.115	
				

JL0714_ROAD_1_20201006




JL0714_ROAD_3E_20201006



JL0714_ROAD_3N_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID LL0732	Northing (m) 4440133.447	Easting (m) 420671.369	Elevation (m) 2416.340	
Point Type E361	Latitude N40°06'27.95774"	Longitude W105°55'50.89119"	Ellipsoid Height (m) 2403.742	
				

LL0732_E 361_1_20201006




LL0732_E 361_3NE_20201006



LL0732_E 361_3NW_20201006




GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID LL0793	Northing (m) 4439547.002	Easting (m) 417008.418	Elevation (m) 2398.451	
Point Type WINDY-GAP	Latitude N40°06'07.66728"	Longitude W105°58'25.32469"	Ellipsoid Height (m) 2385.802	
				
LL0793_Windy Gap_1_20201006				





GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID LM0189	Northing (m) 4435356.431	Easting (m) 389816.523	Elevation (m) 2243.800	
Point Type Q138	Latitude N40°03'40.54638"	Longitude W106°17'31.02033"	Ellipsoid Height (m) 2230.927	
 <p>LM0189_Q 138_1_20201006</p>				




LM0189_Q 138_3E_20201006



LM0189_Q 138_3S_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID LM0192	Northing (m) 4435900.094	Easting (m) 397077.302	Elevation (m) 2299.810	
Point Type T138	Latitude N40°04'01.48106"	Longitude W106°12'24.90887"	Ellipsoid Height (m) 2286.981	
				

LM0192_T 138_1_20201006




LM0192_T 138_3E_2020100



LM0192_T 138_3N_20201006



GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID LM0207	Northing (m) 4434852.827	Easting (m) 383089.928	Elevation (m) 2256.671	
Point Type J297	Latitude N40°03'20.95410"	Longitude W106°22'14.55882"	Ellipsoid Height (m) 2243.864	
 <p>LM0207_J 297_1_20201006</p>				




LM0207_J 297_3E_20201006



LM0207_J 297_3N_20201006




GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID MP74	Northing (m) 4277831.728	Easting (m) 337109.906	Elevation (m) 2429.135	
Point Type CO-DOT	Latitude N38°38'02.66105"	Longitude W106°52'17.22518"	Ellipsoid Height (m) 2414.874	
				






GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID TCP1	Northing (m) 4273229.911	Easting (m) 333002.395	Elevation (m) 2381.971	
Point Type SPIKE	Latitude N38°35'30.69668"	Longitude W106°55'03.05226"	Ellipsoid Height (m) 2367.665	
				





GCP OBSERVATION LOG

Project Number 81201	Project Name Upper Colorado LiDAR Control		Company Woolpert	Field Operator Ben Hocker
Coordinate System World wide/UTM	Hor. Datum NAD 1983 (2011)	Ver. Datum NAVD88	Zone 13 North	Geoid GEOID18 (Conus)
Station ID TCP2	Northing (m) 4435847.168	Easting (m) 397042.390	Elevation (m) 2299.040	
Point Type RPC	Latitude N40°03'59.74944"	Longitude W106°12'26.35205"	Ellipsoid Height (m) 2286.211	
				



Section 4: Geodetic Control Information and Resources

This section contains the published NGS datasheets and solutions returned from Online Positioning User Service (OPUS) for the base stations occupied during this project. The OPUS solutions were used to verify published and computed 3-dimensional coordinates. Temporary control point coordinates were computed in Trimble Business Center using static GNSS baseline processing as described in this report.

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

```

1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
AI5954 *****
AI5954 PACS          - This is a Primary Airport Control Station.
AI5954 DESIGNATION - 20V C
AI5954 PID          - AI5954
AI5954 STATE/COUNTY- CO/GRAND
AI5954 COUNTRY     - US
AI5954 USGS QUAD   - JUNCTION BUTTE (2019)
AI5954
AI5954                      *CURRENT SURVEY CONTROL
AI5954
AI5954* NAD 83(2011) POSITION- 40 03 15.48313(N) 106 22 12.23990(W) ADJUSTED
AI5954* NAD 83(2011) ELLIP HT- 2243.816 (meters) (06/27/12) ADJUSTED
AI5954* NAD 83(2011) EPOCH   - 2010.00
AI5954* NAVD 88 ORTHO HEIGHT - 2256.64 (meters) 7403.7 (feet) GPS OBS
AI5954
AI5954 NAVD 88 orthometric height was determined with geoid model GEOID99
AI5954 GEOID HEIGHT - -12.740 (meters) GEOID99
AI5954 GEOID HEIGHT - -12.810 (meters) GEOID18
AI5954 NAD 83(2011) X - -1,378,353.030 (meters) COMP
AI5954 NAD 83(2011) Y - -4,692,291.152 (meters) COMP
AI5954 NAD 83(2011) Z - 4,084,046.376 (meters) COMP
AI5954 LAPLACE CORR - -2.37 (seconds) DEFLEC18
AI5954
AI5954 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
AI5954 Standards:
AI5954          FGDC (95% conf, cm)          Standard deviation (cm)          CorrNE
AI5954          Horiz Ellip                  SD_N   SD_E   SD_h          (unitless)
AI5954 -----
AI5954 NETWORK    0.95   1.16                0.38   0.40   0.59          0.09620718
AI5954 -----
AI5954 Click here for local accuracies and other accuracy information.
AI5954
AI5954
AI5954.This mark is at Mc Elroy Airfield Airport (20V)
AI5954
AI5954.The horizontal coordinates were established by GPS observations
AI5954.and adjusted by the National Geodetic Survey in June 2012.
AI5954
AI5954.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
AI5954.been affixed to the stable North American tectonic plate. See
AI5954.NA2011 for more information.
AI5954
AI5954.The horizontal coordinates are valid at the epoch date displayed above
AI5954.which is a decimal equivalence of Year/Month/Day.
AI5954

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AI5954.The orthometric height was determined by GPS observations and a AI5954.high-resolution geoid model.

AI5954

AI5954.GPS derived orthometric heights for airport stations designated as AI5954.PACS or SACS are published to 2 decimal places. This maintains AI5954.centimeter relative accuracy between the PACS and SACS. It does AI5954.not indicate centimeter accuracy relative to other marks which are AI5954.part of the NAVD 88 network.

AI5954

AI5954.Significant digits in the geoid height do not necessarily reflect accuracy. AI5954.GEOID18 height accuracy estimate available [here](#).

AI5954

AI5954.Click [photographs](#) - Photos may exist for this station.

AI5954

AI5954.The X, Y, and Z were computed from the position and the ellipsoidal ht.

AI5954

AI5954.The Laplace correction was computed from DEFLEC18 derived deflections.

AI5954

AI5954.The ellipsoidal height was determined by GPS observations

AI5954.and is referenced to NAD 83.

AI5954

AI5954. The following values were computed from the NAD 83(2011) position.

AI5954

AI5954;		North	East	Units	Scale Factor	Converg.
AI5954;SPC CO N	-	385,213.760	840,166.329	MT	0.99996269	-0 33 43.8
AI5954;SPC CO N	-	1,263,822.14	2,756,445.70	sFT	0.99996269	-0 33 43.8
AI5954;UTM 13	-	4,434,683.298	383,142.274	MT	0.99976811	-0 52 54.3

AI5954

AI5954! Elev Factor x Scale Factor = Combined Factor

AI5954!SPC CO N - 0.99964812 x 0.99996269 = 0.99961082

AI5954!UTM 13 - 0.99964812 x 0.99976811 = 0.99941631

AI5954

AI5954_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TCE8314234683(NAD 83)

AI5954

AI5954	-----			AI5954
AI5954	PID	Reference Object	Distance	Geod. Az
AI5954				ddmmss.s
AI5954	LM0207	J 297	177.468 METERS	34158
AI5954	-----			AI5954

AI5954

AI5954 SUPERSEDED SURVEY CONTROL

AI5954

AI5954	NAD 83(2007)-	40 03 15.48282(N)	106 22 12.24023(W)	AD(2002.00)	0
AI5954	ELLIP H (02/10/07)	2243.846 (m)		GP(2002.00)	
AI5954	ELLIP H (10/21/02)	2243.863 (m)		GP()	5 1
AI5954	NAD 83(1992)-	40 03 15.48271(N)	106 22 12.24024(W)	AD()	B
AI5954	ELLIP H (06/30/00)	2243.836 (m)		GP()	1 1

AI5954

AI5954.Superseded values are not recommended for survey control.

AI5954

AI5954.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

AI5954.See file [dsdata.pdf](#) to determine how the superseded data were derived.

AI5954

AI5954_MARKER: I = METAL ROD
 AI5954_SETTING: 59 = STAINLESS STEEL ROD IN SLEEVE (10 FT.)
 AI5954_STAMPING: 20V C 1999
 AI5954_MARK LOGO: NGS
 AI5954_PROJECTION: FLUSH
 AI5954_MAGNETIC: I = MARKER IS A STEEL ROD
 AI5954_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 AI5954_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
 AI5954+SATELLITE: SATELLITE OBSERVATIONS - 1999
 AI5954_ROD/PIPE-DEPTH: 3.2 meters
 AI5954_SLEEVE-DEPTH : 0.9 meters

AI5954	HISTORY	- Date	Condition	Report By
AI5954	HISTORY	- 1999	MONUMENTED	NGS

AI5954

AI5954 STATION DESCRIPTION

AI5954

AI5954'DESCRIBED BY NATIONAL GEODETIC SURVEY 1999 (RSC)
 AI5954'THE STATION IS LOCATED ABOUT 3.7 MI (6.0 KM) WEST-SOUTHWEST OF
 AI5954'TROUBLESOME, 1 MI (1.6 KM) EAST OF KREMMLING AND AT THE MCELROY
 AI5954'AIRFIELD IN KREMMLING, IN THE NORTHWEST 1/4 OF SECTION 16, T 1 N, R 80
 AI5954'W. ACCESS TO THE AIRPORT IS NOT CONTROLLED. PERMISSION TO USE THIS
 AI5954'STATION MUST BE OBTAINED FROM THE AIRPORT MANAGER. OWNERSHIP--MCELROY
 AI5954'FIELD, KREMMLING AIRPORT, P.O. BOX 264, HOT SULPHUR SPRING, CO 80451.
 AI5954'COUNTY MANAGER--LURLINE CURRAN, TELEPHONE--970-725-3347
 AI5954'TO REACH THE STATION FROM THE POST OFFICE IN KREMMLING, GO EAST ON U.
 AI5954'S. HIGHWAY 40 FOR 0.8 MI (1.3 KM) TO A SIDE ROAD RIGHT, ENTRANCE TO
 AI5954'THE AIRPORT. TURN RIGHT, SOUTHEAST, FOR 0.15 MI (0.24 KM) ON COUNTY
 AI5954'ROAD 384 TO TERMINAL. CONTACT THE AIRPORT MANAGER OR TERMINAL OFFICE
 AI5954'FOR ACCESS TO THE FLIGHT OPERATIONS AREA. FROM THE TERMINAL RAMP IN
 AI5954'FROM OF THE TERMINAL, GO SOUTH-SOUTHWEST, ON RAMP A/3 FOR 0.075 MI
 AI5954'(0.121 KM) TO THE STATION ON THE LEFT
 AI5954'THE MARK IS A PUNCH HOLE, TOP CENTER ON A 3.2 M (10.5 FT) LONG
 AI5954'STAINLESS STEEL ROD DRIVEN TO REFUSAL, ENCASED IN A 0.9 M (3.0 FT)
 AI5954'LONG GREASED PVC PIPE, ENCLOSED IN A 5-INCH PVC PIPE WITH LOGO LID,
 AI5954'SURROUNDED BY A CONCRETE COLLAR FLUSH WITH THE GROUND. IT IS 63.1 M
 AI5954'(207.0 FT) NORTHEAST FROM THE CENTER OF SIGN A/3, 60.2 M (197.5 FT)
 AI5954'NORTH FROM THE EDGE OF PAVEMENT FOR THE RUNWAY 9/27, 53.8 M (176.5 FT)
 AI5954'EAST FROM THE CENTER LINE FOR TAXIWAY A/3, 42.3 M (138.8 FT) EAST FROM
 AI5954'A SIGN --A3 27-9--, 16.1 M (52.8 FT) SOUTH FROM THE SOUTHERN EDGE OF
 AI5954'PAVEMENT FOR A PARKING PAD AND 0.7 M (2.3 FT) NORTH FROM A WITNESS
 AI5954'POST. THIS STATION IS DESIGNATED A PRIMARY AIRPORT CONTROL STATION
 AI5954'FOR THE ANA PROJECT.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
JL0521 *****
JL0521 DESIGNATION - A 424
JL0521 PID - JL0521
JL0521 STATE/COUNTY- CO/GUNNISON
JL0521 COUNTRY - US
JL0521 USGS QUAD - MCINTOSH MOUNTAIN (2019)
JL0521
JL0521 *CURRENT SURVEY CONTROL
JL0521
JL0521* NAD 83(2011) POSITION- 38 30 58.63773(N) 107 01 04.72450(W) ADJUSTED
JL0521* NAD 83(2011) ELLIP HT- 2288.556 (meters) (06/27/12) ADJUSTED
JL0521* NAD 83(2011) EPOCH - 2010.00
JL0521* NAVD 88 ORTHO HEIGHT - 2302.921 (meters) 7555.50 (feet) ADJUSTED
JL0521
JL0521 GEOID HEIGHT - -14.364 (meters) GEOID18
JL0521 NAD 83(2011) X - -1,462,988.400 (meters) COMP
JL0521 NAD 83(2011) Y - -4,779,854.456 (meters) COMP
JL0521 NAD 83(2011) Z - 3,951,869.434 (meters) COMP
JL0521 LAPLACE CORR - -3.10 (seconds) DEFLEC18
JL0521 DYNAMIC HEIGHT - 2300.134 (meters) 7546.36 (feet) COMP
JL0521 MODELED GRAVITY - 979,335.3 (mgal) NAVD 88
JL0521
JL0521 VERT ORDER - FIRST CLASS II
JL0521
JL0521 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
JL0521 Standards:
JL0521 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
JL0521 Horiz Ellip SD_N SD_E SD_h (unitless)
JL0521 -----
JL0521 NETWORK 0.80 1.90 0.37 0.27 0.97 0.01261921
JL0521 -----
JL0521 Click here for local accuracies and other accuracy information.
JL0521
JL0521
JL0521.The horizontal coordinates were established by GPS observations
JL0521.and adjusted by the National Geodetic Survey in June 2012.
JL0521
JL0521.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
JL0521.been affixed to the stable North American tectonic plate. See
JL0521.NA2011 for more information.
JL0521
JL0521.The horizontal coordinates are valid at the epoch date displayed above
JL0521.which is a decimal equivalence of Year/Month/Day.
JL0521
JL0521.The orthometric height was determined by differential leveling and

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JL0521.adjusted by the NATIONAL GEODETIC SURVEY
 JL0521.in June 1991.

JL0521

JL0521.Significant digits in the geoid height do not necessarily reflect accuracy.
 JL0521.GEOID18 height accuracy estimate available [here](#).

JL0521

JL0521.Click [photographs](#) - Photos may exist for this station.

JL0521

JL0521.The X, Y, and Z were computed from the position and the ellipsoidal ht.

JL0521

JL0521.The Laplace correction was computed from DEFLEC18 derived deflections.

JL0521

JL0521.The ellipsoidal height was determined by GPS observations

JL0521.and is referenced to NAD 83.

JL0521

JL0521.The dynamic height is computed by dividing the NAVD 88

JL0521.geopotential number by the normal gravity value computed on the

JL0521.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

JL0521.degrees latitude (g = 980.6199 gals.).

JL0521

JL0521.The modeled gravity was interpolated from observed gravity values.

JL0521

JL0521. The following values were computed from the NAD 83(2011) position.

JL0521

JL0521;		North	East	Units	Scale Factor	Converg.
JL0521;SPC CO C	-	381,719.882	782,021.943	MT	0.99998763	-0 57 26.5
JL0521;SPC CO C	-	1,252,359.31	2,565,683.66	sFT	0.99998763	-0 57 26.5
JL0521;UTM 13	-	4,265,030.610	324,067.907	MT	0.99998118	-1 15 25.2

JL0521

JL0521! - Elev Factor x Scale Factor = Combined Factor

JL0521!SPC CO C - 0.99964104 x 0.99998763 = 0.99962868

JL0521!UTM 13 - 0.99964104 x 0.99998118 = 0.99962223

JL0521

JL0521_U.S. NATIONAL GRID SPATIAL ADDRESS: 13SCC2406765030 (NAD 83)

JL0521

JL0521 SUPERSEDED SURVEY CONTROL

JL0521

JL0521	NAD 83(2007)-	38 30 58.63746(N)	107 01 04.72476(W)	AD(2002.00)	0
JL0521	ELLIP H (02/10/07)	2288.591 (m)		GP(2002.00)	
JL0521	ELLIP H (12/03/02)	2288.628 (m)		GP()	4 2
JL0521	NAD 83(1992)-	38 30 58.63727(N)	107 01 04.72404(W)	AD()	1
JL0521	ELLIP H (03/07/01)	2288.572 (m)		GP()	4 2
JL0521	NAVD 88	2302.92 (m)	7555.5 (f)	LEVELING	3

JL0521

JL0521.Superseded values are not recommended for survey control.

JL0521

JL0521.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

JL0521.See file [dsdata.pdf](#) to determine how the superseded data were derived.

JL0521

JL0521_MARKER: I = METAL ROD

JL0521_SETTING: 49 = STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)

JL0521_STAMPING: A 424 1984

JL0521_MARK LOGO: NGS

JL0521_PROJECTION: FLUSH
 JL0521_MAGNETIC: I = MARKER IS A STEEL ROD
 JL0521_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 JL0521_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
 JL0521+SATELLITE: SATELLITE OBSERVATIONS - February 17, 2000
 JL0521_ROD/PIPE-DEPTH: 6.1 meters

JL0521
 JL0521 HISTORY - Date Condition Report By
 JL0521 HISTORY - 1984 MONUMENTED NGS
 JL0521 HISTORY - 20000217 GOOD CODOT

JL0521
 JL0521 STATION DESCRIPTION

JL0521
 JL0521'DESCRIBED BY NATIONAL GEODETIC SURVEY 1984
 JL0521'8.8 KM (5.45 MI) WEST FROM GUNNISON.
 JL0521'8.8 KM (5.45 MI) WESTERLY ALONG U.S. HIGHWAY 50 FROM ITS JUNCTION WITH
 JL0521'STATE HIGHWAY 135 IN GUNNISON, 14.9 M (48.9 FT) SOUTHEAST OF THE
 JL0521'CENTERLINE OF THE HIGHWAY, 12.5 M (41.0 FT) NORTHEAST OF THE
 JL0521'CENTERLINE OF THE ENTRANCE TO THE NEVERSINK PICNIC AREA, 0.3 M
 JL0521'(1.0 FT) NORTHEAST OF THE NORTH LEG OF THE NEVERSINK PICNIC AREA SIGN.
 JL0521'NOTE=ACCESS TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.
 JL0521'THE MARK IS 0.3 METERS N FROM A WITNESS POST
 JL0521'THE MARK IS 0.5 M BELOW THE HIGHWAY.

JL0521
 JL0521 STATION RECOVERY (2000)

JL0521
 JL0521'RECOVERY NOTE BY COLORADO DEPARTMENT OF TRANSPORTATION 2000 (RSC)
 JL0521'THE STATION IS LOCATED ABOUT 5.2 MI (8.4 KM) WEST-SOUTHWEST FROM
 JL0521'GUNNISON, 1 MI (1.6 KM) NORTH OF WHERE THE GUNNISON RIVER ENTERS BLUE
 JL0521'MESA RESERVOIR AND AT THE NEVERSINK PICNIC AREA, IN THE SOUTHWEST 1/4
 JL0521'OF SECTION 7, T 49 N, R 1 W, AT U.S. HIGHWAY 50 MILEPOST 151.85.
 JL0521'OWNERSHIP--COLORADO DEPT. OF TRANSPORTATION RIGHT-OF-WAY
 JL0521'TO REACH THE STATION FROM THE INTERSECTION OF U.S. HIGHWAY 50 AND
 JL0521'STATE HIGHWAY 135 IN GUNNISON, GO WEST ON U.S. HIGHWAY 50 FOR 5.45 MI
 JL0521'(8.77 KM) TO THE STATION ON THE LEFT AT THE ENTRANCE TO THE NEVERSINK
 JL0521'PICNIC AREA
 JL0521'THE MARK IS A PUNCH HOLE, TOP CENTER ON A 6.1 M (20.0 FT) LONG
 JL0521'STAINLESS STEEL ROD DRIVEN TO REFUSAL, ENCLOSED IN A 5-INCH PVC PIPE
 JL0521'WITH LOGO LID, SURROUNDED BY A CONCRETE COLLAR FLUSH WITH THE GROUND.
 JL0521'IT IS 14.9 M (48.9 FT) SOUTHEAST FROM THE CENTER LINE OF THE HIGHWAY,
 JL0521'12.5 M (41.0 FT) NORTHEAST FROM THE CENTER LINE TO THE ROAD TO THE
 JL0521'NEVERSINK PICNIC AREA, 0.3 M (1.0 FT) NORTHEAST FROM THE NORTH LEG OF
 JL0521'THE NEVERSINK PICNIC AREA SIGN, 0.3 M (1.0 FT) NORTH FROM A WITNESS
 JL0521'POST AND ABOUT 0.5 M (1.6 FT) BELOW THE HIGHWAY.

*** retrieval complete.
 Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
LL0732 *****
LL0732 DESIGNATION - E 361
LL0732 PID - LL0732
LL0732 STATE/COUNTY- CO/GRAND
LL0732 COUNTRY - US
LL0732 USGS QUAD - GRANBY (2019)
LL0732
LL0732 *CURRENT SURVEY CONTROL
LL0732
LL0732* NAD 83(2011) POSITION- 40 06 27.95794(N) 105 55 50.89115(W) ADJUSTED
LL0732* NAD 83(2011) ELLIP HT- 2403.689 (meters) (06/27/12) ADJUSTED
LL0732* NAD 83(2011) EPOCH - 2010.00
LL0732* NAVD 88 ORTHO HEIGHT - 2416.295 (meters) 7927.46 (feet) ADJUSTED
LL0732
LL0732 GEOID HEIGHT - -12.600 (meters) GEOID18
LL0732 NAD 83(2011) X - -1,341,323.017 (meters) COMP
LL0732 NAD 83(2011) Y - -4,699,161.127 (meters) COMP
LL0732 NAD 83(2011) Z - 4,088,693.251 (meters) COMP
LL0732 LAPLACE CORR - 2.36 (seconds) DEFLEC18
LL0732 DYNAMIC HEIGHT - 2413.634 (meters) 7918.73 (feet) COMP
LL0732 MODELED GRAVITY - 979,437.6 (mgal) NAVD 88
LL0732
LL0732 VERT ORDER - FIRST CLASS II
LL0732
LL0732 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
LL0732 Standards:
LL0732 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
LL0732 Horiz Ellip SD_N SD_E SD_h (unitless)
LL0732 -----
LL0732 NETWORK 0.26 0.82 0.12 0.09 0.42 -0.00251158
LL0732 -----
LL0732 Click here for local accuracies and other accuracy information.
LL0732
LL0732
LL0732.The horizontal coordinates were established by GPS observations
LL0732.and adjusted by the National Geodetic Survey in June 2012.
LL0732
LL0732.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
LL0732.been affixed to the stable North American tectonic plate. See
LL0732.NA2011 for more information.
LL0732
LL0732.The horizontal coordinates are valid at the epoch date displayed above
LL0732.which is a decimal equivalence of Year/Month/Day.
LL0732
LL0732.The orthometric height was determined by differential leveling and

```


LL0732.adjusted by the NATIONAL GEODETIC SURVEY
LL0732.in June 1991.

LL0732

LL0732.Significant digits in the geoid height do not necessarily reflect accuracy.
LL0732.GEOID18 height accuracy estimate available [here](#).

LL0732

LL0732.Click [photographs](#) - Photos may exist for this station.

LL0732

LL0732.The X, Y, and Z were computed from the position and the ellipsoidal ht.

LL0732

LL0732.The Laplace correction was computed from DEFLEC18 derived deflections.

LL0732

LL0732.The ellipsoidal height was determined by GPS observations

LL0732.and is referenced to NAD 83.

LL0732

LL0732.The dynamic height is computed by dividing the NAVD 88

LL0732.geopotential number by the normal gravity value computed on the

LL0732.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

LL0732.degrees latitude (g = 980.6199 gals.).

LL0732

LL0732.The modeled gravity was interpolated from observed gravity values.

LL0732

LL0732. The following values were computed from the NAD 83(2011) position.

LL0732

LL0732;		North	East	Units	Scale	Factor	Converg.
LL0732;SPC CO N	-	390,875.125	877,673.403	MT	0.99995994	-0 16	42.1
LL0732;SPC CO N	-	1,282,396.14	2,879,500.16	sFT	0.99995994	-0 16	42.1
LL0732;UTM 13	-	4,440,133.453	420,671.370	MT	0.99967747	-0 35	58.8

LL0732

LL0732! - Elev Factor x Scale Factor = Combined Factor

LL0732!SPC CO N - 0.99962306 x 0.99995994 = 0.99958302

LL0732!UTM 13 - 0.99962306 x 0.99967747 = 0.99930065

LL0732

LL0732_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TDE2067140133(NAD 83)

LL0732

LL0732 SUPERSEDED SURVEY CONTROL

LL0732

LL0732	NAD 83(2007)-	40 06 27.95793(N)	105 55 50.89159(W)	AD(2002.00)	1
LL0732	ELLIP H (03/13/12)	2403.716 (m)		GP(2002.00)	4 1
LL0732	NAD 83(2007)-	40 06 27.95823(N)	105 55 50.89228(W)	AD(2002.00)	0
LL0732	ELLIP H (02/10/07)	2403.727 (m)		GP(2002.00)	
LL0732	ELLIP H (12/03/02)	2403.730 (m)		GP()	4 2
LL0732	NAD 83(1992)-	40 06 27.95741(N)	105 55 50.89142(W)	AD()	1
LL0732	ELLIP H (05/02/00)	2403.805 (m)		GP()	4 1
LL0732	NAVD 88	2416.30 (m)	7927.5 (f)	LEVELING	3
LL0732	NGVD 29 (??/??/92)	2414.923 (m)	7922.96 (f)	ADJ UNCH	1 2

LL0732

LL0732.Superseded values are not recommended for survey control.

LL0732

LL0732.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LL0732.See file [dsdata.pdf](#) to determine how the superseded data were derived.

LL0732

LL0732_MARKER: DB = BENCH MARK DISK

LL0732_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
 LL0732_STAMPING: E 361 1954
 LL0732_MARK LOGO: CGS
 LL0732_PROJECTION: PROJECTING 8 CENTIMETERS
 LL0732_MAGNETIC: O = OTHER; SEE DESCRIPTION
 LL0732_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
 LL0732+STABILITY: SURFACE MOTION
 LL0732_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
 LL0732+SATELLITE: SATELLITE OBSERVATIONS - April 15, 2011

LL0732
 LL0732 HISTORY - Date Condition Report By
 LL0732 HISTORY - 1954 MONUMENTED CGS
 LL0732 HISTORY - 19980303 GOOD CODOT
 LL0732 HISTORY - 20000113 GOOD SLSS
 LL0732 HISTORY - 20060329 GOOD INDIV
 LL0732 HISTORY - 20110415 GOOD CVLART

LL0732
 LL0732 STATION DESCRIPTION
 LL0732

LL0732'DESCRIBED BY COAST AND GEODETIC SURVEY 1954
 LL0732'3.2 MI N FROM GRANBY.

LL0732'1.25 MILES WEST ALONG U.S. HIGHWAY 40 FROM THE POST OFFICE AT
 LL0732'GRANBY, THENCE 2.0 MILES NORTHEAST ALONG U.S. HIGHWAY 34, 48 FEET
 LL0732'SOUTHEAST OF THE CENTER LINE OF THE HIGHWAY, 11 FEET NORTHEAST OF
 LL0732'THE CENTER OF A WIRE GATE, 19 FEET NORTHEAST OF A FENCE CORNER, 52
 LL0732'FEET SOUTHWEST OF A POWER POLE, 2.2 FEET NORTHWEST OF A FENCE, 1.9
 LL0732'FEET NORTHEAST OF A WITNESS POST, SET IN THE TOP OF A CONCRETE POST
 LL0732'WHICH PROJECTS 0.8 FOOT ABOVE THE GROUND.

LL0732
 LL0732 STATION RECOVERY (1998)
 LL0732

LL0732'RECOVERY NOTE BY COLORADO DEPARTMENT OF TRANSPORTATION 1998 (DU)
 LL0732'RECOVERED AS DESCRIBED.

LL0732
 LL0732 STATION RECOVERY (2000)
 LL0732

LL0732'RECOVERY NOTE BY STEPHENSON LAND SURVEYING SERVICES 2000 (GFS)
 LL0732'THE STATION IS LOCATED ABOUT 12 MI (19.3 KM) SOUTH-SOUTHWEST FROM
 LL0732'GRAND LAKE, 2 MI (3.2 KM) NORTHEAST FROM GRANBY AND 1 MI (1.6 KM)
 LL0732'NORTH FROM THE GRANBY AIRPORT, IN THE NORTHWEST 1/4 OF SECTION 29, T 2
 LL0732'N, R 76 W, AT U.S. HIGHWAY 34 MILEPOST 1.95. OWNERSHIP--COLORADO
 LL0732'DEPT. OF TRANSPORTATION RIGHT-OF-WAY
 LL0732'TO REACH THE STATION FROM THE INTERSECTION OF U.S. HIGHWAY 34 AND
 LL0732'U.S. HIGHWAY 40 JUST WEST OF GRANBY, GO NORTHEAST ON U.S. HIGHWAY 34
 LL0732'FOR 1.95 MI (3.14 KM) TO THE STATION ON THE RIGHT
 LL0732'THE MARK IS STANDARD DISK SET INTO THE TOP OF A ROUND 30 CM CONCRETE
 LL0732'POST FLUSH WITH THE GROUND. IT IS 11.7 M (38.4 FT) SOUTHEAST FROM THE
 LL0732'CENTERLINE OF THE HIGHWAY, 5.8 M (19.0 FT) NORTH-NORTHEAST FROM A
 LL0732'NORTH-SOUTH FENCE LINE, 0.7 M (2.3 FT) NORTHWEST FROM THE RIGHT-OF-WAY
 LL0732'FENCE AND 0.375 M (1.230 FT) NORTHWEST FROM THE WITNESS POST.

LL0732
 LL0732 STATION RECOVERY (2006)
 LL0732

LL0732'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2006 (HPB)

LL0732'RECOVERD AS DESCRIBED
LL0732
LL0732 STATION RECOVERY (2011)
LL0732
LL0732'RECOVERY NOTE BY CIVILARTS 2011 (FND)
LL0732'RECOVERED AS DESCRIBED.

*** retrieval complete.
Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
AE7515 *****
AE7515 PACS          - This is a Primary Airport Control Station.
AE7515 DESIGNATION - GUC D
AE7515 PID          - AE7515
AE7515 STATE/COUNTY- CO/GUNNISON
AE7515 COUNTRY     - US
AE7515 USGS QUAD   - GUNNISON (2019)
AE7515
AE7515                      *CURRENT SURVEY CONTROL
AE7515
AE7515* NAD 83(2011) POSITION- 38 32 16.49132(N) 106 55 40.71976(W) ADJUSTED
AE7515* NAD 83(2011) ELLIP HT- 2324.125 (meters) (06/27/12) ADJUSTED
AE7515* NAD 83(2011) EPOCH   - 2010.00
AE7515* NAVD 88 ORTHO HEIGHT - 2338.46 (meters) 7672.1 (feet) GPS OBS
AE7515
AE7515 NAVD 88 orthometric height was determined with geoid model GEOID99
AE7515 GEOID HEIGHT - -14.360 (meters) GEOID99
AE7515 GEOID HEIGHT - -14.330 (meters) GEOID18
AE7515 NAD 83(2011) X - -1,455,050.865 (meters) COMP
AE7515 NAD 83(2011) Y - -4,780,742.227 (meters) COMP
AE7515 NAD 83(2011) Z - 3,953,770.313 (meters) COMP
AE7515 LAPLACE CORR - 0.76 (seconds) DEFLEC18
AE7515
AE7515 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
AE7515 Standards:
AE7515          FGDC (95% conf, cm)          Standard deviation (cm)          CorrNE
AE7515          Horiz Ellip                SD_N   SD_E   SD_h          (unitless)
AE7515 -----
AE7515 NETWORK      0.53   1.18                0.24   0.19   0.60          0.00882583
AE7515 -----
AE7515 Click here for local accuracies and other accuracy information.
AE7515
AE7515
AE7515.This mark is at Gunnison County Airport (GUC)
AE7515
AE7515.The horizontal coordinates were established by GPS observations
AE7515.and adjusted by the National Geodetic Survey in June 2012.
AE7515
AE7515.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
AE7515.been affixed to the stable North American tectonic plate. See
AE7515.NA2011 for more information.
AE7515
AE7515.The horizontal coordinates are valid at the epoch date displayed above
AE7515.which is a decimal equivalence of Year/Month/Day.
AE7515

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AE7515.The orthometric height was determined by GPS observations and a
 AE7515.high-resolution geoid model.

AE7515

AE7515.GPS derived orthometric heights for airport stations designated as
 AE7515.PACS or SACS are published to 2 decimal places. This maintains
 AE7515.centimeter relative accuracy between the PACS and SACS. It does
 AE7515.not indicate centimeter accuracy relative to other marks which are
 AE7515.part of the NAVD 88 network.

AE7515

AE7515.Significant digits in the geoid height do not necessarily reflect accuracy.
 AE7515.GEOID18 height accuracy estimate available [here](#).

AE7515

AE7515.Click [photographs](#) - Photos may exist for this station.

AE7515

AE7515.The X, Y, and Z were computed from the position and the ellipsoidal ht.

AE7515

AE7515.The Laplace correction was computed from DEFLEC18 derived deflections.

AE7515

AE7515.The ellipsoidal height was determined by GPS observations

AE7515.and is referenced to NAD 83.

AE7515

AE7515. The following values were computed from the NAD 83(2011) position.

AE7515

AE7515;		North	East	Units	Scale Factor	Converg.
AE7515;SPC CO C	-	383,992.916	789,907.842	MT	0.99998388	-0 54 02.2
AE7515;SPC CO C	-	1,259,816.76	2,591,555.98	sFT	0.99998388	-0 54 02.2
AE7515;UTM 13	-	4,267,262.240	331,965.439	MT	0.99994772	-1 12 05.3

AE7515

AE7515! Elev Factor x Scale Factor = Combined Factor

AE7515!SPC CO C - 0.99963547 x 0.99998388 = 0.99961935

AE7515!UTM 13 - 0.99963547 x 0.99994772 = 0.99958321

AE7515

AE7515:		Primary Azimuth Mark	Grid Az
AE7515:SPC CO C	-	AIRWAY 2	222 49 21.2
AE7515:UTM 13	-	AIRWAY 2	223 07 24.3

AE7515

AE7515_U.S. NATIONAL GRID SPATIAL ADDRESS: 13SCC3196567262 (NAD 83)

AE7515

AE7515	-----		
AE7515	PID	Reference Object	Distance
AE7515			Geod. Az
AE7515			dddmss.s
AE7515	AE7514	AIRWAY 2	457.906 METERS 2215519.0
AE7515	-----		

AE7515

AE7515 SUPERSEDED SURVEY CONTROL

AE7515

AE7515	NAD 83(2007)-	38 32 16.49108(N)	106 55 40.72002(W)	AD(2002.00)	0
AE7515	ELLIP H (02/10/07)	2324.150 (m)		GP(2002.00)	
AE7515	ELLIP H (10/21/02)	2324.144 (m)		GP()	5 1
AE7515	NAD 83(1992)-	38 32 16.49121(N)	106 55 40.71983(W)	AD()	B
AE7515	ELLIP H (06/30/00)	2324.161 (m)		GP()	4 1
AE7515	NAD 83(1992)-	38 32 16.49075(N)	106 55 40.71935(W)	AD()	1
AE7515	ELLIP H (02/27/98)	2324.165 (m)		GP()	4 1
AE7515	NAVD 88 (02/27/98)	2338.47 (m)	GEOID96 model used	GPS OBS	

AE7515

AE7515.Superseded values are not recommended for survey control.

AE7515

AE7515.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

AE7515.See file [dsdata.pdf](#) to determine how the superseded data were derived.

AE7515

AE7515_MARKER: I = METAL ROD

AE7515_SETTING: 15 = METAL ROD DRIVEN INTO GROUND. SEE TEXT FOR ADDITIONAL

AE7515+WITH SETTING: INFORMATION.

AE7515_STAMPING: GUC D 1996

AE7515_MARK LOGO: NGS

AE7515_PROJECTION: FLUSH

AE7515_MAGNETIC: N = NO MAGNETIC MATERIAL

AE7515_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

AE7515_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

AE7515+SATELLITE: SATELLITE OBSERVATIONS - September 10, 2014

AE7515_ROD/PIPE-DEPTH: 1.50 meters

AE7515_SLEEVE-DEPTH : 0.90 meters

AE7515

AE7515	HISTORY	- Date	Condition	Report By
AE7515	HISTORY	- 1996	MONUMENTED	NGS
AE7515	HISTORY	- 19990520	GOOD	MSAM
AE7515	HISTORY	- 20000829	GOOD	NGS
AE7515	HISTORY	- 20140910	GOOD	WOOLPT

AE7515

AE7515 STATION DESCRIPTION

AE7515

AE7515'DESCRIBED BY NATIONAL GEODETIC SURVEY 1996 (RSC)

AE7515'THE STATION IS LOCATED AT THE GUNNISON COUNTY AIRPORT IN GUNNISON,
AE7515'COLORADO, IN THE NORTHWEST 1/4 OF SECTION 1, T 49 N, R 1 W.

AE7515'OWNERSHIP--GUNNISON COUNTY AIRPORT TO REACH THE STATION FROM THE
AE7515'INTERSECTION OF U. S. HIGHWAY 50 AND STATE HIGHWAY 135 IN GUNNISON,
AE7515'GO WEST ON U. S. HIGHWAY 50 (TOMICHI AVENUE) FOR 0.05 MI (0.08 KM)
AE7515'TO THE INTERSECTION OF WISCONSIN STREET. TURN LEFT, SOUTH, ON
AE7515'WISCONSIN STREET FOR 0.35 MI (0.56 KM) TO THE INTERSECTION OF RIO
AE7515'GRANDE AVENUE AND THE STATION JUST INSIDE THE AIRPORT FENCE. TO USE
AE7515'THIS STATION, PERMISSION MUST BE GOTTEN FROM AIRPORT ADMINISTRATION.
AE7515'AT THIS TIME, THE TRIPOD COULD BE SET UP INSIDE THE AIRPORT AND THE
AE7515'TRUCK CAN REMAIN OUTSIDE THE AIRPORT THE MARK IS A PUNCH HOLE TOP
AE7515'CENTER OF A 1.5 M (4.9 FT) LONG STAINLESS STEEL ROD DRIVEN DRIVEN TO
AE7515'REFUSAL, ENCASED IN A 0.9 M (3.0 FT) LONG GREASED 1-INCH PVC PIPE,
AE7515'ENCLOSED IN A 5-INCH PVC PIPE WITH LOGO LID, SURROUNDED BY A CONCRETE
AE7515'COLLAR FLUSH WITH THE GROUND. IT IS 49.4 M (162.1 FT) SOUTHEAST FROM
AE7515'THE INTERSECTION OF RIO GRANDE AVENUE AND WISCONSIN STREET, 38.5 M
AE7515'(126.3 FT) NORTH-NORTHEAST FROM THE CENTER LINE OF TAXIWAY 24-6, 22.5
AE7515'M (73.8 FT) EAST-SOUTHEAST FROM THE CENTER OF CRASH GATE NUMBER 5,
AE7515'20.6 M (67.6 FT) EAST FROM THE CENTER OF DIRT ROAD (EXTENSION OF
AE7515'WISCONSIN STREET) TO TAXI WAY, 14.8 M (48.6 FT) EAST FROM A FENCE
AE7515'CORNER AND 13.7 M (44.9 FT) EAST-SOUTHEAST FROM A WITNESS POST.

AE7515

AE7515 STATION RECOVERY (1999)

AE7515

AE7515'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1999 (KCH)

AE7515'DESCRIBED BY MOUNTAIN SURVEYING AND MAPPING, INC. 1999 (KCH) THE

AE7515'STATION IS LOCATED ABOUT 45 KM (27.95 MI) SOUTH-SOUTHEAST OF CRESTED
 AE7515'BUTTE AND IN THE SOUTH SECTION OF GUNNISON, AT THE GUNNISON COUNTY
 AE7515'AIRPORT. IT IS NORTH OF TAXIWAY A AND SOUTHEAST OF AIRPORT GATE 4, IN
 AE7515'THE NORTHWEST QUARTER OF SECTION 1, T 49 N, R 1 W. THE AIRPORT IS NOT
 AE7515'CONTROLLED. THE USE OF THIS MARK REQUIRES AN ESCORT. TO SCHEDULE AN
 AE7515'ESCORT CONTACT THE AIRPORT MANAGER MR REX TIPPETTS AT 711 RIO GRANDE
 AE7515'AVENUE, GUNNISON, COLORADO, 81230, TELEPHONE 970-641-2304.

AE7515'OWNERSHIP--GUNNISON COUNTY

AE7515'TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAY 50 (TOMICHI
 AE7515'AVENUE) AND STATE HIGHWAY 135 (MAIN STREET) IN THE CENTRAL SECTION OF
 AE7515'GUNNISON, GO WEST, ON HIGHWAY 50 FOR 0.5 MI (0.8 KM) TO AN
 AE7515'INTERSECTION. TURN LEFT, SOUTH, ON SOUTH 11TH FOR 0.45 MI (0.72 KM)
 AE7515'TO AN INTERSECTION. CONTINUE SOUTH, ACROSS RIO GRANDE AVENUE AND THE
 AE7515'AIRPORT PARKING LOT, KEEP RIGHT, PAST THE WEST END OF THE TERMINAL
 AE7515'BUILDING FOR 0.1 MI (0.2 KM) TO AIRPORT GATE 1 ON THE LEFT. YOUR
 AE7515'ESCORT WILL OPEN THE GATE, PROCEED SOUTH, ACROSS THE APRON FOR 0.1 MI
 AE7515'(0.2 KM) TO TAXIWAY A. TURN LEFT, EAST, ON TAXIWAY A FOR 0.7 MI (1.1
 AE7515'KM) TO THE STATION ON THE LEFT

AE7515'THE MARK IS A PUNCH HOLE, TOP CENTER ON A STAINLESS STEEL ROD DRIVEN
 AE7515'TO A DEPTH OF 1.5 METERS, (4.9 FT) ENCASED IN A 0.9 M (3.0 FT) LONG
 AE7515'GREASED PVC PIPE, ENCLOSED IN A 5-INCH PVC PIPE WITH LOGO LID,
 AE7515'SURROUNDED BY A CONCRETE COLLAR FLUSH WITH THE GROUND. IT IS 49.4 M
 AE7515'(162.1 FT) SOUTHEAST OF THE INTERSECTION OF RIO GRANDE AVENUE AND
 AE7515'WISCONSIN STREET, 38.5 M (126.3 FT) NORTH-NORTHEAST OF THE CENTER LINE
 AE7515'OF TAXIWAY A, 22.5 M (73.8 FT) EAST-SOUTHEAST FROM THE CENTER OF
 AE7515'AIRPORT GATE 4, 20.6 M (67.6 FT) EAST FROM THE CENTER OF DIRT ROAD
 AE7515'(EXTENSION OF WISCONSIN STREET) TO TAXIWAY, 14.8 M (48.6 FT) EAST FROM
 AE7515'A FENCE CORNER AND 13.7 M (44.9 FT) EAST-SOUTHEAST FROM A WITNESS
 AE7515'POST. THIS STATION IS DESIGNATED AS A PRIMARY AIRPORT CONTROL
 AE7515'STATION.

AE7515

AE7515 STATION RECOVERY (2000)

AE7515

AE7515'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 2000 (AJL)

AE7515'RECOVERED AS DESCRIBED. THIS STATION IS DESIGNATED AS THE PRIMARY

AE7515'AIRPORT CONTROL STATION.

AE7515'

AE7515

AE7515 STATION RECOVERY (2014)

AE7515

AE7515'RECOVERY NOTE BY WOOLPERT CONSULTANTS 2014 (DJK)

AE7515'RECOVERED IN GOOD CONDITION

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
LM0207 *****
LM0207 DESIGNATION - J 297
LM0207 PID - LM0207
LM0207 STATE/COUNTY- CO/GRAND
LM0207 COUNTRY - US
LM0207 USGS QUAD - JUNCTION BUTTE (2019)
LM0207
LM0207 *CURRENT SURVEY CONTROL
LM0207
LM0207* NAD 83(2011) POSITION- 40 03 20.95410(N) 106 22 14.55882(W) ADJUSTED
LM0207* NAD 83(2011) ELLIP HT- 2243.864 (meters) (06/27/12) ADJUSTED
LM0207* NAD 83(2011) EPOCH - 2010.00
LM0207* NAVD 88 ORTHO HEIGHT - 2256.685 (meters) 7403.81 (feet) ADJUSTED
LM0207
LM0207 GEOID HEIGHT - -12.808 (meters) GEOID18
LM0207 NAD 83(2011) X - -1,378,375.176 (meters) COMP
LM0207 NAD 83(2011) Y - -4,692,171.467 (meters) COMP
LM0207 NAD 83(2011) Z - 4,084,175.613 (meters) COMP
LM0207 LAPLACE CORR - -2.39 (seconds) DEFLEC18
LM0207 DYNAMIC HEIGHT - 2254.273 (meters) 7395.89 (feet) COMP
LM0207 MODELED GRAVITY - 979,475.9 (mgal) NAVD 88
LM0207
LM0207 VERT ORDER - SECOND CLASS 0
LM0207
LM0207 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
LM0207 Standards:
LM0207 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
LM0207 Horiz Ellip SD_N SD_E SD_h (unitless)
LM0207 -----
LM0207 NETWORK 1.42 1.92 0.54 0.62 0.98 0.04624577
LM0207 -----
LM0207 Click here for local accuracies and other accuracy information.
LM0207
LM0207
LM0207.This mark is at Mc Elroy Airfield Airport (20V)
LM0207
LM0207.The horizontal coordinates were established by GPS observations
LM0207.and adjusted by the National Geodetic Survey in June 2012.
LM0207
LM0207.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
LM0207.been affixed to the stable North American tectonic plate. See
LM0207.NA2011 for more information.
LM0207
LM0207.The horizontal coordinates are valid at the epoch date displayed above
LM0207.which is a decimal equivalence of Year/Month/Day.

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LM0207
 LM0207.The orthometric height was determined by differential leveling and
 LM0207.adjusted by the NATIONAL GEODETIC SURVEY
 LM0207.in June 1991.
 LM0207
 LM0207.Significant digits in the geoid height do not necessarily reflect accuracy.
 LM0207.GEOID18 height accuracy estimate available [here](#).
 LM0207
 LM0207.Click [photographs](#) - Photos may exist for this station.
 LM0207
 LM0207.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 LM0207
 LM0207.The Laplace correction was computed from DEFLEC18 derived deflections.
 LM0207
 LM0207.The ellipsoidal height was determined by GPS observations
 LM0207.and is referenced to NAD 83.
 LM0207
 LM0207.The dynamic height is computed by dividing the NAVD 88
 LM0207.geopotential number by the normal gravity value computed on the
 LM0207.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 LM0207.degrees latitude (g = 980.6199 gals.).
 LM0207
 LM0207.The modeled gravity was interpolated from observed gravity values.
 LM0207
 LM0207. The following values were computed from the NAD 83(2011) position.
 LM0207
 LM0207;

	North	East	Units	Scale Factor	Converg.
LM0207;SPC CO N	- 385,383.028	840,113.028	MT	0.99996260	-0 33 45.3
LM0207;SPC CO N	- 1,264,377.48	2,756,270.83	sFT	0.99996260	-0 33 45.3
LM0207;UTM 13	- 4,434,852.827	383,089.928	MT	0.99976826	-0 52 55.9

LM0207!	Elev Factor	x	Scale Factor	=	Combined Factor
LM0207!SPC CO N	- 0.99964811	x	0.99996260	=	0.99961073
LM0207!UTM 13	- 0.99964811	x	0.99976826	=	0.99941645

 LM0207_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TCE8308934852(NAD 83)
 LM0207

LM0207	PID	Reference Object	Distance	Geod. Az
LM0207				dddmmss.s
LM0207	AI5954	20V C	177.468 METERS	16158

 LM0207
 SUPERSEDED SURVEY CONTROL
 LM0207

LM0207	NAD 83(2007)-	40 03 20.95398(N)	106 22 14.55912(W)	AD(2002.00)	0
LM0207	ELLIP H (02/10/07)	2243.896 (m)		GP(2002.00)	
LM0207	ELLIP H (10/21/02)	2243.912 (m)		GP()	5 1
LM0207	NAD 83(1992)-	40 03 20.95389(N)	106 22 14.55912(W)	AD()	1
LM0207	ELLIP H (06/30/00)	2243.884 (m)		GP()	1 1
LM0207	NAD 83(1992)-	40 03 20.95291(N)	106 22 14.55902(W)	AD()	3
LM0207	ELLIP H (01/07/93)	2243.841 (m)		GP()	4 2
LM0207	NAD 83(1986)-	40 03 20.94929(N)	106 22 14.55385(W)	AD()	3
LM0207	NAD 27	- 40 03 21.00002(N)	106 22 12.44550(W)	AD()	3

LM0207 NAVD 88 2256.69 (m) 7403.8 (f) LEVELING 3
 LM0207 NGVD 29 (??/??/92) 2255.370 (m) 7399.49 (f) ADJ UNCH 2 0
 LM0207 NGVD 29 (04/21/89) 2255. (m) RAPSU86 model used GPS OBS

LM0207

LM0207.Superseded values are not recommended for survey control.

LM0207

LM0207.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LM0207.See file [dsdata.pdf](#) to determine how the superseded data were derived.

LM0207

LM0207_MARKER: DB = BENCH MARK DISK

LM0207_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

LM0207_STAMPING: J 297 1951

LM0207_MARK LOGO: CGS

LM0207_MAGNETIC: O = OTHER; SEE DESCRIPTION

LM0207_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

LM0207+STABILITY: SURFACE MOTION

LM0207_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

LM0207+SATELLITE: SATELLITE OBSERVATIONS - July 31, 2012

LM0207

LM0207	HISTORY	- Date	Condition	Report By
LM0207	HISTORY	- 1951	MONUMENTED	CGS
LM0207	HISTORY	- 19880609	GOOD	NGS
LM0207	HISTORY	- 19980303	GOOD	NGS
LM0207	HISTORY	- 19990518	GOOD	NGS
LM0207	HISTORY	- 20120731	GOOD	NGS

LM0207

LM0207 STATION DESCRIPTION

LM0207

LM0207'DESCRIBED BY COAST AND GEODETIC SURVEY 1951

LM0207'1.3 MI E FROM KREMMLING.

LM0207'1.2 MILES EAST ALONG U.S. HIGHWAY 40 FROM THE POST OFFICE AT
 LM0207'KREMMLING, THENCE 0.1 MILE SOUTHEAST TO MCELROY AIR FIELD, 147 FEET

LM0207'EAST OF THE CENTER LINE OF A GRAVELED ROAD, 5 FEET WEST OF THE
 LM0207'NORTHWEST CORNER OF THE HANGAR, SET IN THE TOP OF A CONCRETE POST
 LM0207'WHICH PROJECTS 0.3 FOOT ABOVE THE GROUND.

LM0207

LM0207 STATION RECOVERY (1988)

LM0207

LM0207'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1988

LM0207'THE STATION IS LOCATED ABOUT 1.6 KM (1.00 MI) EAST OF KREMMING,

LM0207'BETWEEN THE COLORADO RIVER AND U.S. HIGHWAY 40, AT THE MC ELROY

LM0207'AIRFIELD AIRPORT, IN THE WEST CENTRAL SECTION 16. OWNERSHIP--MC

LM0207'ELROY AIRFIELD, C/O AIRPORT MANAGER, HOWARD MOODY, GRAND COUNTY

LM0207'COURTHOUSE, KREMMING, COLORADO 80459. TELEPHONE 303-725-3347. FBO

LM0207'MANAGER, KAREN WHEATELY, TLELPHONE 303-724-9481.

LM0207'TO REACH THE STATION FROM THE POST OFFICE IN KREMMING, WHICH IS 0.16

LM0207'KM (0.10 MI) EAST OF THE JUNCTION OF U.S. HIGHWAY 40 AND STATE

LM0207'HIGHWAY 9, GO EAST ON U.S. HIGHWAY 40 FOR 1.37 KM (0.85 MI) TO THE

LM0207'AIRPORT ENTRANCE ON THE RIGHT. TURN RIGHT, SOUTH FOR 0.08 KM

LM0207'(0.05 MI) TO A GRAVEL ROAD LEFT. TURN LEFT, EAST, FOR 30.48 M

LM0207'(100.0 FT) TO A CURVE IN THE ROAD RIGHT. TURN RIGHT, SOUTH, ON THE

LM0207'ROAD TO A RED HANGER BUILDING AND THE MARK ON THE RIGHT.

LM0207'THIS STATION WAS USED AS THE AZIMUTH MARK FOR STATION KREMPORT 1988

LM0207'AND IS A STANDARD CGS BENCH MARK DISK STAMPED---J 297 1951---, SET IN

LM0207'THE TOP OF A 30 CM ROUND CONCRETE POST, RECESSED 5 CM BELOW THE
 LM0207'GROUND, SROUNDED BY A STEEL SLEEVE WITH A WATER METER COVER ATTACHED
 LM0207'AND FLUSH WITH THE GROUND. LOCATED 13.4 M (44.0 FT) EAST-NORHTEAST
 LM0207'OF A 10 CM VENT PIPE PROJECTING 1 M (3.3 FT) ABOVE THE GROUND, 10.5 M
 LM0207'(34.4 FT) NORHTEAST OF THE NORTHEAST CORNER OF A HANGER, 2.1 M
 LM0207'(6.9 FT) NORTH-NORTHWEST OF THE NORTHWEST CORNER OF THE TARMAC AND ON
 LM0207'LINE WITH THE WEST EDGE OF THE TARMAC, AND 0.4 M (1.3 FT) SOUTH OF A
 LM0207'CARSONITE WITNESS POST.

LM0207'UT-CO-WY-ID FAA AND VERNAL NCMN, JUNE 1988.

LM0207'DESCRIBED BY GEORGE R. HEID.

LM0207

LM0207 STATION RECOVERY (1998)

LM0207

LM0207'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1998 (RSC)

LM0207'RECOVERED AS DESCRIBED.

LM0207

LM0207 STATION RECOVERY (1999)

LM0207

LM0207'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1999 (RSC)

LM0207'THE STATION IS LOCATED ABOUT 4.3 MI (6.9 KM) WEST-SOUTHWEST OF
 LM0207'TROUBLESOME, 1.0 MI (1.6 KM) EAST OF KREMMLING AND AT THE MCELROY
 LM0207'AIRFIELD IN KREMMLING, IN THE NORTHWEST 1/4 OF SECTION 16, T 1 N, R 80
 LM0207'W, OWNERSHIP--MCELROY FIELD, KREMMLING AIRPORT, P.O. BOX 264, HOT
 LM0207'SULPHUR SPRING, CO 80451. COUNTY MANAGER--LURLINE CURRAN,
 LM0207'TELEPHONE--970-725-3347

LM0207'TO REACH THE STATION FROM THE POST OFFICE IN KREMMLING, GO EAST ON U.
 LM0207'S. HIGHWAY 40 FOR 0.8 MI (1.3 KM) TO A SIDE ROAD RIGHT, ENTRANCE TO
 LM0207'THE AIRPORT. TURN RIGHT, SOUTH, FOR 0.05 MI (0.08 KM) TO A GRAVEL
 LM0207'ROAD LEFT. TURN LEFT, EAST, FOR ABOUT 30 M (98.4 FT) TO A CURVE IN
 LM0207'THE ROAD TO THE RIGHT. TURN RIGHT, SOUTH, FOR ABOUT 40 M (131.2 FT)
 LM0207'ON THE ROAD TO A HANGAR AND THE STATION ON THE RIGHT, JUST BEFORE THE
 LM0207'HANGAR

LM0207'THE MARK IS A STANDARD DISK SET INTO THE TOP OF A ROUND 25 CM CONCRETE
 LM0207'POST RECESSED 5 CM BELOW THE GROUND, SURROUNDED BY A STEEL SLEEVE WITH
 LM0207'A WATER METER COVER ATTACHED AND FLUSH WITH THE GROUND. IT IS 13.4 M
 LM0207'(44.0 FT) EAST-NORTHEAST FROM A 10 CM VENT PIPE PROJECTING 1 M (3.3
 LM0207'FT) ABOVE THE GROUND, 10.5 M (34.4 FT) NORTHEAST FROM THE NORTHEAST
 LM0207'CORNER OF A HANGAR, 2.1 M (6.9 FT) NORTH-NORTHWEST FROM THE NORTHWEST
 LM0207'CORNER OF THE TARMAC AND ON THE WEST EDGE OF THE TARMAC AND 0.4 M (1.3
 LM0207'FT) EAST FROM A WITNESS POST.

LM0207

LM0207 STATION RECOVERY (2012)

LM0207

LM0207'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 2012 (DW)

LM0207'RECOVERED IN GOOD CONDITION.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

```

1      National Geodetic Survey,   Retrieval Date = NOVEMBER 30, 2020
LM0189 *****
LM0189 DESIGNATION - Q 138
LM0189 PID - LM0189
LM0189 STATE/COUNTY- CO/GRAND
LM0189 COUNTRY - US
LM0189 USGS QUAD - JUNCTION BUTTE (2019)
LM0189
LM0189 *CURRENT SURVEY CONTROL
LM0189
LM0189* NAD 83(1986) POSITION- 40 03 39. (N) 106 17 33. (W) SCALED
LM0189* NAVD 88 ORTHO HEIGHT - 2243.806 (meters) 7361.55 (feet) ADJUSTED
LM0189
LM0189 GEOID HEIGHT - -12.873 (meters) GEOID18
LM0189 DYNAMIC HEIGHT - 2241.378 (meters) 7353.59 (feet) COMP
LM0189 MODELED GRAVITY - 979,463.5 (mgal) NAVD 88
LM0189
LM0189 VERT ORDER - SECOND CLASS 0
LM0189
LM0189.The horizontal coordinates were scaled from a map and have
LM0189.an estimated accuracy of +/- 6 seconds.
LM0189.
LM0189.The orthometric height was determined by differential leveling and
LM0189.adjusted by the NATIONAL GEODETIC SURVEY
LM0189.in June 1991.
LM0189
LM0189.Significant digits in the geoid height do not necessarily reflect accuracy.
LM0189.GEOID18 height accuracy estimate available here.
LM0189
LM0189.Click photographs - Photos may exist for this station.
LM0189
LM0189.The dynamic height is computed by dividing the NAVD 88
LM0189.geopotential number by the normal gravity value computed on the
LM0189.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
LM0189.degrees latitude (g = 980.6199 gals.).
LM0189
LM0189.The modeled gravity was interpolated from observed gravity values.
LM0189
LM0189; North East Units Estimated Accuracy
LM0189;SPC CO N - 385,880. 846,790. MT (+/- 180 meters Scaled)
LM0189
LM0189_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TCE897353(NAD 83)
LM0189
LM0189 SUPERSEDED SURVEY CONTROL
LM0189
LM0189 NGVD 29 (??/??/92) 2242.466 (m) 7357.16 (f) ADJ UNCH 2 0

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LM0189

LM0189.Superseded values are not recommended for survey control.

LM0189

LM0189.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LM0189.See file [dsdata.pdf](#) to determine how the superseded data were derived.

LM0189

LM0189_MARKER: DB = BENCH MARK DISK

LM0189_SETTING: 9 = SET IN PREFABRICATED CONCRETE POST IMBEDDED IN GROUND

LM0189_STAMPING: Q 138 1934

LM0189_MARK LOGO: CGS

LM0189_MAGNETIC: O = OTHER; SEE DESCRIPTION

LM0189_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

LM0189

HISTORY	- Date	Condition	Report By
HISTORY	- 1934	MONUMENTED	CGS
HISTORY	- 19931019	GOOD	CODOT

LM0189

LM0189 STATION DESCRIPTION

LM0189

LM0189'DESCRIBED BY COAST AND GEODETIC SURVEY 1934

LM0189'IN TROUBLESOME.

LM0189'AT TROUBLESOME, GRAND COUNTY, ON THE DENVER AND SALT LAKE RAILWAY, 230

LM0189'FEET SOUTHEAST OF THE SWITCH TO A CROSSOVER, 210 FEET SOUTH OF RAILWAY

LM0189'RESIDENCE 3, 107 FEET SOUTHWEST OF THE CENTER OF THE CROSSING OF THE

LM0189'ROAD LEADING TO LONE RIFFLE WITH THE MAIN TRACK, 100 FEET SOUTH OF THE

LM0189'CENTERLINE OF THE TRACK, 60 FEET WEST OF THE CENTERLINE OF THE ROAD,

LM0189'AND AT THE HOWE PROPERTY FENCE CORNER. A STANDARD DISK, STAMPED Q 138

LM0189'1934 AND SET IN THE TOP OF A CONCRETE POST.

LM0189

LM0189 STATION RECOVERY (1993)

LM0189

LM0189'RECOVERY NOTE BY COLORADO DEPARTMENT OF TRANSPORTATION 1993 (ELI)

LM0189'THE MARK WAS RECOVERED IN GOOD CONDITION WITH A NEW DESCRIPTION GIVEN.

LM0189'TO REACH THE STATION FROM THE INTERSECTION OF U. S. HIGHWAY 40 AND

LM0189'STATE HIGHWAY 9 IN KREMMLING, GO EAST ON U. S. HIGHWAY 40 FOR 5.45

LM0189'MI (8.77 KM) TO THE INTERSECTION OF GRAND COUNTY ROAD 39 AT U. S.

LM0189'HIGHWAY 40 MILEPOST 189.8. TURN RIGHT, SOUTHEAST, ON GRAND COUNTY

LM0189'ROAD 39 FOR 0.2 MI (0.3 KM) TO THREE SETS OF RAILROAD TRACKS TO THE

LM0189'MARK ON THE RIGHT. THE MARK IS A STANDARD DISK SET INTO THE TOP OF A

LM0189'6-INCH SQUARE CONCRETE POST, PROJECTING 10 CM ABOVE THE GROUND. IT IS

LM0189'98 FT (29.9 M) SOUTHEAST OF THE SOUTH RAIL OF THE TRACKS, 83 FT (25.3

LM0189'M) SOUTHWEST OF A POWER POLE, 62 FT (18.9 M) SOUTHWEST OF THE

LM0189'CENTERLINE OF COUNTY ROAD 39, 1.5 FT (0.5 M) EAST OF A CORNER POST OF

LM0189'A RAILROAD CROSS FENCE AND ALONG A FENCE LINE.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
JL0714 *****
JL0714 DESIGNATION - ROAD
JL0714 PID - JL0714
JL0714 STATE/COUNTY- CO/GUNNISON
JL0714 COUNTRY - US
JL0714 USGS QUAD - GUNNISON (2019)
JL0714
JL0714 *CURRENT SURVEY CONTROL
JL0714
JL0714* NAD 83(2011) POSITION- 38 37 15.51729(N) 106 52 36.61277(W) ADJUSTED
JL0714* NAD 83(2011) ELLIP HT- 2401.115 (meters) (06/27/12) ADJUSTED
JL0714* NAD 83(2011) EPOCH - 2010.00
JL0714* NAVD 88 ORTHO HEIGHT - 2415.4 (meters) 7925. (feet) GPS OBS
JL0714
JL0714 NAVD 88 orthometric height was determined with geoid model GEOID96
JL0714 GEOID HEIGHT - -14.182 (meters) GEOID96
JL0714 GEOID HEIGHT - -14.271 (meters) GEOID18
JL0714 NAD 83(2011) X - -1,449,130.665 (meters) COMP
JL0714 NAD 83(2011) Y - -4,776,592.310 (meters) COMP
JL0714 NAD 83(2011) Z - 3,961,029.142 (meters) COMP
JL0714 LAPLACE CORR - 2.19 (seconds) DEFLEC18
JL0714
JL0714 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
JL0714 Standards:
JL0714 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
JL0714 Horiz Ellip SD_N SD_E SD_h (unitless)
JL0714 -----
JL0714 NETWORK 1.12 3.51 0.51 0.39 1.79 -0.02214231
JL0714 -----
JL0714 Click here for local accuracies and other accuracy information.
JL0714
JL0714
JL0714.The horizontal coordinates were established by GPS observations
JL0714.and adjusted by the National Geodetic Survey in June 2012.
JL0714
JL0714.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
JL0714.been affixed to the stable North American tectonic plate. See
JL0714.NA2011 for more information.
JL0714
JL0714.The horizontal coordinates are valid at the epoch date displayed above
JL0714.which is a decimal equivalence of Year/Month/Day.
JL0714
JL0714.The orthometric height was determined by GPS observations and a
JL0714.high-resolution geoid model.
JL0714

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JL0714. Significant digits in the geoid height do not necessarily reflect accuracy.

JL0714. GEOID18 height accuracy estimate available [here](#).

JL0714

JL0714. Click [photographs](#) - Photos may exist for this station.

JL0714

JL0714. The X, Y, and Z were computed from the position and the ellipsoidal ht.

JL0714

JL0714. The Laplace correction was computed from DEFLEC18 derived deflections.

JL0714

JL0714. The ellipsoidal height was determined by GPS observations

JL0714. and is referenced to NAD 83.

JL0714

JL0714. The following values were computed from the NAD 83(2011) position.

JL0714

JL0714;		North	East	Units	Scale	Factor	Converg.
JL0714;SPC CO C	-	393,143.407	794,505.791	MT	0.99997078	-0 52 06.1	
JL0714;SPC CO C	-	1,289,837.99	2,606,641.08	sFT	0.99997078	-0 52 06.1	
JL0714;UTM 13	-	4,276,388.003	336,611.394	MT	0.99992875	-1 10 18.2	

JL0714

JL0714! - Elev Factor x Scale Factor = Combined Factor

JL0714!SPC CO C - 0.99962340 x 0.99997078 = 0.99959419

JL0714!UTM 13 - 0.99962340 x 0.99992875 = 0.99955218

JL0714

JL0714:		Primary Azimuth Mark	Grid Az
JL0714:SPC CO C	-	ROAD AZ MK	233 49 40.9
JL0714:UTM 13	-	ROAD AZ MK	234 07 53.0

JL0714

JL0714 U.S. NATIONAL GRID SPATIAL ADDRESS: 13SCC3661176388(NAD 83)

JL0714

JL0714	PID	Reference Object	Distance	Geod. Az
JL0714				dddmss.s
JL0714	CM7044	ROAD RM 1	10.582 METERS	03047
JL0714	CM7045	ROAD RM 2	19.301 METERS	13602
JL0714	JL0715	GUNNISON MTN STS TT CO MST 30	APPROX. 6.9 KM	2045405.2
JL0714	CM7043	ROAD AZ MK		2325734.8

JL0714

JL0714

SUPERSEDED SURVEY CONTROL

JL0714

JL0714	NAD 83(2007)-	38 37 15.51704(N)	106 52 36.61306(W)	AD(2002.00)	0
JL0714	ELLIP H (02/10/07)	2401.141 (m)		GP(2002.00)	
JL0714	ELLIP H (12/03/02)	2401.152 (m)		GP()	4 2
JL0714	NAD 83(1992)-	38 37 15.51680(N)	106 52 36.61240(W)	AD()	1
JL0714	ELLIP H (02/27/98)	2401.136 (m)		GP()	4 1
JL0714	NAD 83(1992)-	38 37 15.51784(N)	106 52 36.61667(W)	AD()	2
JL0714	NAD 83(1986)-	38 37 15.51640(N)	106 52 36.62757(W)	AD()	2
JL0714	NAD 27	38 37 15.54780(N)	106 52 34.48540(W)	AD()	2
JL0714	NGVD 29 (07/19/86)	2415.2 (m)	7924. (f)	VERT ANG	

JL0714

JL0714. Superseded values are not recommended for survey control.

JL0714

JL0714. NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

JL0714. See file [dsdata.pdf](#) to determine how the superseded data were derived.

JL0714

JL0714_MARKER: DS = TRIANGULATION STATION DISK

JL0714_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

JL0714_STAMPING: ROAD 1958

JL0714_MARK LOGO: CGS

JL0714_MAGNETIC: O = OTHER; SEE DESCRIPTION

JL0714_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

JL0714+STABILITY: SURFACE MOTION

JL0714_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

JL0714+SATELLITE: SATELLITE OBSERVATIONS - June 13, 1996

JL0714

JL0714	HISTORY	- Date	Condition	Report By
JL0714	HISTORY	- 1958	MONUMENTED	CGS
JL0714	HISTORY	- 1977	GOOD	NGS
JL0714	HISTORY	- 19960613	GOOD	MSAM

JL0714 HISTORY - 1958 MONUMENTED CGS

JL0714 HISTORY - 1977 GOOD NGS

JL0714 HISTORY - 19960613 GOOD MSAM

JL0714

JL0714 STATION DESCRIPTION

JL0714

JL0714'DESCRIBED BY COAST AND GEODETIC SURVEY 1958 (OSR)

JL0714'THE STATION IS LOCATED 5-1/2 MILES NORTH AND 3 MILES EAST OF

JL0714'GUNNISON, 3-1/2 MILES SOUTH-SOUTHWEST OF ALMONT, AT A POINT

JL0714'WHERE THE HIGHWAY CURVES AND IN A RATHER LARGE, FLAT, OPEN

JL0714'AREA BETWEEN THE HIGHWAY AND A NARROW FARM ROAD THAT BEARS

JL0714'EASTERLY.

JL0714'

JL0714'TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAY 50 AND

JL0714'STATE HIGHWAY 135 IN GUNNISON, GO NORTHERLY ON NO. 135 FOR 3.5

JL0714'MILES TO A PAVED SIDE ROAD ON THE LEFT. CONTINUE NORTHERLY ON

JL0714'NO. 135 FOR 2.55 MILES TO A REVERSE Y INTERSECTION (GRAVELED

JL0714'SIDE ROAD ON THE LEFT). CONTINUE NORTHERLY ON NO. 135 FOR 0.15

JL0714'MILE TO THE AZIMUTH MARK ON THE LEFT. CONTINUE NORTHERLY FOR

JL0714'0.3 MILE TO THE STATION ON THE RIGHT.

JL0714'

JL0714'THE STATION MARK IS A STANDARD DISK STAMPED ROAD 1958, SET IN THE

JL0714'TOP OF AN 11-INCH SQUARE CONCRETE POST THAT PROJECTS 8

JL0714'INCHES. THE UNDERGROUND DISK IS SET IN AN IRREGULAR MASS OF

JL0714'CONCRETE 32 INCHES BELOW THE GROUND SURFACE. IT IS 36 FEET

JL0714'SOUTH OF A POWERLINE POLE, 71 FEET EAST OF THE CENTER OF HIGHWAY

JL0714'135, 61 FEET WEST OF THE CENTER OF A STEEL GATE AND 58 FEET

JL0714'NORTHWEST OF THE CENTER OF THE FARM ROAD. A 4 IN X 4 IN WHITE

JL0714'WITNESS POST WAS SET 4 FEET SOUTH OF THE MARK.

JL0714'

JL0714'REFERENCE MARK NO. 1 IS A STANDARD DISK STAMPED ROAD NO 1 1958,

JL0714'SET IN THE TOP OF AN 11-INCH SQUARE CONCRETE POST THAT PROJECTS

JL0714'4 INCHES. IT IS 75 FEET EAST OF THE CENTER OF THE HIGHWAY, 37

JL0714'FEET WEST OF A WIRE FENCE AND 4 FEET EAST-SOUTHEAST OF THE

JL0714'POWERLINE POLE.

JL0714'

JL0714'REFERENCE MARK NO. 2 IS A STANDARD DISK STAMPED ROAD NO 2 1958,

JL0714'SET IN THE TOP OF AN 11-INCH SQUARE CONCRETE POST THAT PROJECTS

JL0714'6 INCHES. IT IS 84 FEET SOUTHEAST OF THE POWERLINE POLE, 23

JL0714'FEET SOUTH OF THE CENTER OF THE STEEL GATE AND 8 FEET NORTH OF

JL0714'THE CENTER OF THE FARM ROAD.

JL0714'

JL0714'THE AZIMUTH MARK IS A STANDARD DISK STAMPED ROAD 1958, SET IN
 JL0714'THE TOP OF AN 11-INCH SQUARE CONCRETE POST THAT PROJECTS
 JL0714'8 INCHES. IT IS 53 FEET SOUTHWEST OF A POWERLINE POLE, 38
 JL0714'FEET NORTHWEST OF THE CENTER OF HIGHWAY 135 AND 1 FOOT SOUTHEAST
 JL0714'OF A WIRE FENCE. A 4 IN X 4 IN WHITE WITNESS POST WAS SET 2
 JL0714'FEET SOUTHWEST OF THE MARK.

JL0714

JL0714

STATION RECOVERY (1977)

JL0714

JL0714'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1977 (CLN)

JL0714'STATION RECOVERED AND ALL MARKS ARE IN GOOD CONDITION. THE 1958
 JL0714'ROUTE AND LOCATION ARE ADEQUATE. A METAL WITNESS POST WITH A METAL
 JL0714'WITNESS SIGN ATTACHED WAS PLACED 2 FEET WEST OF THE STATION MARK AT
 JL0714'THIS TIME.

JL0714

JL0714

STATION RECOVERY (1996)

JL0714

JL0714'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1996 (RSC)
 JL0714'THE STATION IS LOCATED ABOUT 6 MI (9.7 KM) NORTHEAST OF GUNNISON, 4 MI
 JL0714'(6.4 KM) SOUTHWEST OF ALMONT AND 0.5 MI (0.8 KM) WEST OF THE GUNNISON
 JL0714'RIVER, IN THE SOUTHEAST 1/4 OF SECTION 5, T 50 N, R 1 E, AT STATE
 JL0714'HIGHWAY 135 MILEPOST 6.45. OWNERSHIP--COLORADO DEPT. OF
 JL0714'TRANSPORTATION RIGHT-OF-WAY TO REACH THE STATION FROM THE
 JL0714'INTERSECTION OF U. S. HIGHWAY 50 AND STATE HIGHWAY 135 IN GUNNISON,
 JL0714'GO NORTHEASTERLY ON STATE HIGHWAY 135 FOR 6.15 MI (9.90 KM) TO THE
 JL0714'AZIMUTH MARK ON THE LEFT. CONTINUE AHEAD, NORTHEASTERLY, FOR 0.3 MI
 JL0714'(0.5 KM) TO THE STATION ON THE RIGHT AT A CURVE THE MARK IS A
 JL0714'STANDARD DISK SET IN A 30 CM SQUARE CONCRETE POST PROJECTING 6 CM
 JL0714'ABOVE THE GROUND. IT IS 22.3 M (73.2 FT) NORTH-NORTHEAST FROM THE
 JL0714'INTERSECTION OF A SIDE ROAD RIGHT AND THE EASTERN EDGE OF THE HIGHWAY,
 JL0714'21.8 M (71.5 FT) EAST FROM THE CENTER LINE OF STATE HIGHWAY 135, 20.7
 JL0714'M (67.9 FT) WEST FROM THE CENTER OF A GATE WITH A TOP BAR WITH
 JL0714'ADDRESSES FOR 6460, 6464 AND 6466, 11.0 M (36.1 FT) SOUTH-SOUTHWEST
 JL0714'FROM A POWER POLE, 0.95 M (3.12 FT) SOUTH-SOUTHEAST FROM A WITNESS
 JL0714'POST, 0.9 M (3.0 FT) NORTHWEST FROM A WITNESS POST, 0.65 M (2.13 FT)
 JL0714'WEST FROM A WITNESS POST AND ABOUT 1.3 M (4.3 FT) BELOW THE HIGHWAY.
 JL0714'THE AZIMUTH MARK AND REFERENCE MARK 2 WERE RECOVERED IN GOOD
 JL0714'CONDITION. REFERENCE MARK 1 MAYBE BURIED UNDER A PILE OF DIRT BY A
 JL0714'POWER POLE.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,   Retrieval Date = NOVEMBER 25, 2020
LM0192 *****
LM0192 DESIGNATION - T 138
LM0192 PID - LM0192
LM0192 STATE/COUNTY- CO/GRAND
LM0192 COUNTRY - US
LM0192 USGS QUAD - PARSHALL (2019)
LM0192
LM0192 *CURRENT SURVEY CONTROL
LM0192
LM0192* NAD 83(1986) POSITION- 40 04 01.48 (N) 106 12 24.91 (W) HD_HELD1
LM0192* NAVD 88 ORTHO HEIGHT - 2299.829 (meters) 7545.36 (feet) ADJUSTED
LM0192
LM0192 GEOID HEIGHT - -12.829 (meters) GEOID18
LM0192 DYNAMIC HEIGHT - 2297.314 (meters) 7537.10 (feet) COMP
LM0192 MODELED GRAVITY - 979,450.0 (mgal) NAVD 88
LM0192
LM0192 VERT ORDER - SECOND CLASS 0
LM0192
LM0192.The horizontal coordinates were determined by differentially corrected
LM0192.hand held GPS observations or other comparable positioning techniques
LM0192.and have an estimated accuracy of +/- 3 meters.
LM0192.
LM0192.The orthometric height was determined by differential leveling and
LM0192.adjusted by the NATIONAL GEODETIC SURVEY
LM0192.in June 1991.
LM0192
LM0192.Significant digits in the geoid height do not necessarily reflect accuracy.
LM0192.GEOID18 height accuracy estimate available here.
LM0192
LM0192.Click photographs - Photos may exist for this station.
LM0192
LM0192.The dynamic height is computed by dividing the NAVD 88
LM0192.geopotential number by the normal gravity value computed on the
LM0192.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
LM0192.degrees latitude (g = 980.6199 gals.).
LM0192
LM0192.The modeled gravity was interpolated from observed gravity values.
LM0192
LM0192; North East Units Estimated Accuracy
LM0192;SPC CO N - 386,508.6 854,097.3 MT (+/- 3 meters HH1 GPS)
LM0192
LM0192_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TCE9707735900(NAD 83)
LM0192
LM0192 SUPERSEDED SURVEY CONTROL
LM0192

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LM0192 NGVD 29 (??/??/92) 2298.462 (m) 7540.87 (f) ADJ UNCH 2 0

LM0192

LM0192.Superseded values are not recommended for survey control.

LM0192

LM0192.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LM0192.See file [dsdata.pdf](#) to determine how the superseded data were derived.

LM0192

LM0192_MARKER: DB = BENCH MARK DISK

LM0192_SETTING: 9 = SET IN PREFABRICATED CONCRETE POST IMBEDDED IN GROUND

LM0192_STAMPING: T 138 1934

LM0192_MARK LOGO: CGS

LM0192_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY

LM0192

LM0192	HISTORY	- Date	Condition	Report By
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LM0192	HISTORY	- 1934	MONUMENTED	CGS
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LM0192

LM0192 STATION DESCRIPTION

LM0192

LM0192'DESCRIBED BY COAST AND GEODETIC SURVEY 1934

LM0192'1.9 MI W FROM PARSHALL.

LM0192'1.9 MILES WEST ALONG THE DENVER AND SALT LAKE RAILWAY FROM THE STATION

LM0192'AT PARSHALL, GRAND COUNTY, 55 FEET SOUTHWEST OF MILEPOST 93, 300 FEET

LM0192'NORTH OF THE CROSSING OF A COUNTY ROAD AND U.S. HIGHWAY 40, 60 FEET

LM0192'SOUTHEAST OF THE CENTER OF THE CROSSING OF THE SAME COUNTY ROAD WITH

LM0192'THE TRACK, 50 FEET NORTH OF POLE 3673, 45 FEET EAST OF THE CENTERLINE

LM0192'OF THE COUNTY ROAD, 39 FEET SOUTH OF THE CENTERLINE OF THE TRACK, 18

LM0192'FEET EAST OF A FENCE CORNER, AND 1 FOOT NORTH OF A FENCE. A STANDARD

LM0192'DISK, STAMPED T 138 1934 AND SET IN THE TOP OF A CONCRETE POST.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
LL0793 *****
LL0793 DESIGNATION - WINDY GAP
LL0793 PID - LL0793
LL0793 STATE/COUNTY- CO/GRAND
LL0793 COUNTRY - US
LL0793 USGS QUAD - GRANBY (2019)
LL0793
LL0793 *CURRENT SURVEY CONTROL
LL0793
LL0793* NAD 83(2011) POSITION- 40 06 07.66728(N) 105 58 25.32469(W) ADJUSTED
LL0793* NAD 83(2011) ELLIP HT- 2385.802 (meters) (06/27/12) ADJUSTED
LL0793* NAD 83(2011) EPOCH - 2010.00
LL0793* NAVD 88 ORTHO HEIGHT - 2398.459 (meters) 7868.94 (feet) ADJUSTED
LL0793
LL0793 GEOID HEIGHT - -12.650 (meters) GEOID18
LL0793 NAD 83(2011) X - -1,344,948.196 (meters) COMP
LL0793 NAD 83(2011) Y - -4,698,530.124 (meters) COMP
LL0793 NAD 83(2011) Z - 4,088,202.869 (meters) COMP
LL0793 LAPLACE CORR - 3.13 (seconds) DEFLEC18
LL0793 DYNAMIC HEIGHT - 2395.816 (meters) 7860.27 (feet) COMP
LL0793 MODELED GRAVITY - 979,437.9 (mgal) NAVD 88
LL0793
LL0793 VERT ORDER - FIRST CLASS II
LL0793
LL0793 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
LL0793 Standards:
LL0793 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
LL0793 Horiz Ellip SD_N SD_E SD_h (unitless)
LL0793 -----
LL0793 NETWORK 0.29 0.98 0.13 0.10 0.50 0.01689737
LL0793 -----
LL0793 Click here for local accuracies and other accuracy information.
LL0793
LL0793
LL0793.The horizontal coordinates were established by GPS observations
LL0793.and adjusted by the National Geodetic Survey in June 2012.
LL0793
LL0793.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
LL0793.been affixed to the stable North American tectonic plate. See
LL0793.NA2011 for more information.
LL0793
LL0793.The horizontal coordinates are valid at the epoch date displayed above
LL0793.which is a decimal equivalence of Year/Month/Day.
LL0793
LL0793.The orthometric height was determined by differential leveling and

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LL0793.adjusted by the NATIONAL GEODETIC SURVEY
 LL0793.in June 1991.
 LL0793
 LL0793.Significant digits in the geoid height do not necessarily reflect accuracy.
 LL0793.GEOID18 height accuracy estimate available [here](#).
 LL0793
 LL0793.Click [photographs](#) - Photos may exist for this station.
 LL0793
 LL0793.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 LL0793
 LL0793.The Laplace correction was computed from DEFLEC18 derived deflections.
 LL0793
 LL0793.The ellipsoidal height was determined by GPS observations
 LL0793.and is referenced to NAD 83.
 LL0793
 LL0793.The dynamic height is computed by dividing the NAVD 88
 LL0793.geopotential number by the normal gravity value computed on the
 LL0793.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 LL0793.degrees latitude (g = 980.6199 gals.).
 LL0793
 LL0793.The modeled gravity was interpolated from observed gravity values.
 LL0793
 LL0793. The following values were computed from the NAD 83(2011) position.
 LL0793

LL0793;	North	East	Units	Scale	Factor	Converg.
LL0793;SPC CO N	- 390,267.976	874,012.776	MT	0.99996019	-0 18 21.9	
LL0793;SPC CO N	- 1,280,404.18	2,867,490.25	sFT	0.99996019	-0 18 21.9	
LL0793;UTM 13	- 4,439,547.002	417,008.418	MT	0.99968479	-0 37 38.1	

LL0793!	Elev Factor	x	Scale Factor	=	Combined Factor
LL0793!SPC CO N	- 0.99962586	x	0.99996019	=	0.99958607
LL0793!UTM 13	- 0.99962586	x	0.99968479	=	0.99931077

LL0793:	Primary Azimuth Mark	Grid Az
LL0793:SPC CO N	- WINDY GAP AZ MK	332 45 00.1
LL0793:UTM 13	- WINDY GAP AZ MK	333 04 16.3

 LL0793_U.S. NATIONAL GRID SPATIAL ADDRESS: 13TDE1700839547(NAD 83)
 LL0793

LL0793	PID	Reference Object	Distance	Geod. Az
LL0793				dddmmss.s
LL0793	LL0794	WINDY GAP RM 1	15.412 METERS	07100
LL0793	LL0792	WINDY GAP RM 2	14.186 METERS	32741
LL0793	CP9384	WINDY GAP AZ MK		3322638.2

 LL0793
 LL0793
 LL0793

SUPERSEDED SURVEY CONTROL					
LL0793	NAD 83(2007)-	40 06 07.66727(N)	105 58 25.32525(W)	AD(2002.00)	1
LL0793	ELLIP H (03/13/12)	2385.826 (m)		GP(2002.00)	4 1
LL0793	NAD 83(2007)-	40 06 07.66758(N)	105 58 25.32555(W)	AD(2002.00)	0
LL0793	ELLIP H (02/10/07)	2385.848 (m)		GP(2002.00)	
LL0793	ELLIP H (12/03/02)	2385.852 (m)		GP()	4 2

LL0793 NAD 83(1992)- 40 06 07.66675(N) 105 58 25.32463(W) AD() 1
 LL0793 ELLIP H (05/02/00) 2385.928 (m) GP() 4 1
 LL0793 NAD 83(1992)- 40 06 07.66587(N) 105 58 25.32501(W) AD() 2
 LL0793 NAD 83(1986)- 40 06 07.65907(N) 105 58 25.32124(W) AD() 2
 LL0793 NAD 27 - 40 06 07.71000(N) 105 58 23.26000(W) AD() 2
 LL0793 NAVD 88 2398.46 (m) 7868.9 (f) LEVELING 3
 LL0793 NGVD 29 (??/??/92) 2397.084 (m) 7864.43 (f) ADJ UNCH 1 2
 LL0793 NGVD 29 2397.08 (m) 7864.4 (f) LEVELING 3

LL0793

LL0793.Superseded values are not recommended for survey control.

LL0793

LL0793.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LL0793.See file [dsdata.pdf](#) to determine how the superseded data were derived.

LL0793

LL0793_MARKER: DS = TRIANGULATION STATION DISK

LL0793_SETTING: 80 = SET IN A BOULDER

LL0793_STAMPING: WINDY GAP 1951

LL0793_MARK LOGO: CGS

LL0793_MAGNETIC: O = OTHER; SEE DESCRIPTION

LL0793_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

LL0793+STABILITY: SURFACE MOTION

LL0793_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

LL0793+SATELLITE: SATELLITE OBSERVATIONS - April 15, 2011

LL0793

LL0793	HISTORY	- Date	Condition	Report By
LL0793	HISTORY	- 1951	MONUMENTED	CGS
LL0793	HISTORY	- 1954	GOOD	CGS
LL0793	HISTORY	- 1954	GOOD	CGS
LL0793	HISTORY	- 20000113	GOOD	SLSS
LL0793	HISTORY	- 20060329	GOOD	INDIV
LL0793	HISTORY	- 20110415	GOOD	CVLART

LL0793

LL0793 STATION DESCRIPTION

LL0793

LL0793'DESCRIBED BY COAST AND GEODETIC SURVEY 1951 (WRH)

LL0793'STATION IS LOCATED, AIRLINE, ABOUT 2-1/2 MILES WEST NORTHWEST

LL0793'OF GRANBY, 0.1 MILE NORTHWEST OF THE HIGHWAY BRIDGE OVER THE

LL0793'COLORADO RIVER, 0.7 MILE SOUTHEAST OF THE JUNCTION OF STATE

LL0793'HIGHWAY 125 AND 1/4 MILE NORTH NORTHWEST OF THE CONFLUENCE OF

LL0793'THE COLORADO AND FRASER RIVERS. IT IS ON TOP OF A ROCKY HIGHWAY

LL0793'CUT EMBANKMENT ON THE NORTHEAST SIDE OF U.S. HIGHWAY 40.

LL0793'

LL0793'TO REACH THE STATION FROM THE U.S. POST OFFICE IN GRANBY,

LL0793'GO WEST ON U.S. HIGHWAY 40 FOR 2.1 MILES TO THE BRIDGE OVER

LL0793'THE COLORADO RIVER. CONTINUE ON THE HIGHWAY FOR 0.1 MILE

LL0793'TO THE STATION ON THE RIGHT SIDE OF THE HIGHWAY.

LL0793'

LL0793'STATION MARK, STAMPED WINDY GAP 1951, IS A STANDARD DISK

LL0793'CEMENTED IN A DRILL HOLE IN OUTCROPPING BEDROCK THAT PROJECTS

LL0793'2 INCHES. IT IS ABOUT 50 FEET EAST OF THE CENTERLINE OF THE

LL0793'HIGHWAY, 34 FEET WEST OF A FENCE LINE AND 8 FEET SOUTH OF

LL0793'A WITNESS POST.

LL0793'

LL0793'REFERENCE MARK NUMBER 1, STAMPED WINDY GAP NO 1 1951, IS

LL0793'A STANDARD DISK CEMENTED IN A DRILL HOLE IN A 1-1/2 BY 3 FOOT
 LL0793'BOULDER THAT PROJECTS 10 INCHES. IT IS 2 FEET HIGHER IN
 LL0793'ELEVATION THAN THE STATION AND 16.4 FEET EAST OF THE FENCE LINE.
 LL0793'

LL0793'REFERENCE MARK NUMBER 2, STAMPED WINDY GAP NO 2 1951, IS A
 LL0793'STANDARD DISK CEMENTED IN A DRILL HOLE IN OUTCROPPING BEDROCK
 LL0793'THAT IS FLUSH WITH THE GROUND AND 3 FEET HIGHER IN ELEVATION
 LL0793'THAN THE STATION. IT IS 3 FEET EAST OF THE EDGE OF THE CUT BANK.
 LL0793'

LL0793'AZIMUTH MARK, STAMPED WINDY GAP 1951, IS A STANDARD DISK
 LL0793'CEMENTED IN A DRILL HOLE IN A 2 BY 2 FOOT BOULDER THAT PROJECTS
 LL0793'1 FOOT. TO REACH FROM THE STATION, GO WEST ON U.S. HIGHWAY
 LL0793'40 FOR 0.7 MILE TO THE JUNCTION WITH STATE HIGHWAY 125 ON
 LL0793'THE RIGHT. FROM HERE THE AZIMUTH MARK IS ABOUT 0.1 MILE
 LL0793'NORTHEAST ON TOP OF THE THIRD LITTLE HILL TO THE RIGHT OF
 LL0793'STATE HIGHWAY 125.

LL0793'

LL0793'HEIGHT OF LIGHT ABOVE STATION MARK 1.4 METERS.

LL0793

STATION RECOVERY (1954)

LL0793

LL0793

LL0793'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1954
 LL0793'2.6 MILES WEST ALONG U.S. HIGHWAY 40 FROM THE POST OFFICE AT
 LL0793'GRANBY, 0.7 MILE EAST OF A JUNCTION WITH STATE HIGHWAY 125,
 LL0793'0.1 MILE WEST OF A BRIDGE OVER THE COLORADO RIVER, 45 FEET
 LL0793'NORTHEAST OF THE CENTER LINE OF THE HIGHWAY, 47 FEET SOUTHEAST
 LL0793'OF A POWER POLE, 35 FEET SOUTHWEST OF A FENCE, 6.8 FEET SOUTH
 LL0793'OF A WITNESS POST, 9 FEET ABOVE THE LEVEL OF THE HIGHWAY,
 LL0793'0.2 FOOT ABOVE THE GROUND, A TRIANGULATION STATION DISK SET
 LL0793'IN THE TOP OF A SMALL GRANITE BOULDER, STAMPED WINDY GAP 1951.
 LL0793'

LL0793'WINDY GAP R.M. 1 IS 50.5 FEET EAST OF TRIANGULATION STATION
 LL0793'WINDY GAP 1951, 94.4 FEET NORTHEAST OF THE CENTER LINE OF THE
 LL0793'HIGHWAY, 16.4 FEET NORTHEAST OF A FENCE, 62 FEET SOUTHEAST
 LL0793'OF A POWER POLE, 14 FEET ABOVE THE LEVEL OF THE HIGHWAY, 1
 LL0793'FOOT ABOVE THE GROUND, A REFERENCE MARK DISK SET IN THE TOP
 LL0793'OF A 2 X 4 FOOT GRANITE BOULDER, STAMPED WINDY GAP NO 1 1951.
 LL0793'

LL0793'WINDY GAP R.M. 2 IS 46.5 FEET NORTHWEST OF TRIANGULATION
 LL0793'STATION WINDY GAP 1951, 39 FEET NORTHEAST OF THE CENTER LINE
 LL0793'OF THE HIGHWAY, 12.5 FEET SOUTHWEST OF A POWER POLE, 39.5
 LL0793'FEET SOUTHWEST OF A FENCE, 12 FEET ABOVE THE LEVEL OF THE
 LL0793'HIGHWAY, 0.2 FOOT ABOVE THE GROUND, A REFERENCE MARK DISK
 LL0793'SET IN THE TOP OF A GRANITE OUTCROP, STAMPED WINDY GAP NO 2 1951.
 LL0793'

LL0793

LL0793

STATION RECOVERY (1954)

LL0793

LL0793'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1954

LL0793'2.6 MI W FROM GRANBY.

LL0793'2.6 MILES WEST ALONG U.S. HIGHWAY 40 FROM THE POST OFFICE
 LL0793'AT GRANBY, 0.7 MILE EAST OF A JUNCTION WITH STATE HIGHWAY 125,
 LL0793'0.1 MILE WEST OF A BRIDGE OVER THE COLORADO RIVER, 45 FEET
 LL0793'NORTHEAST OF THE CENTER LINE OF THE HIGHWAY, 47 FEET SOUTHEAST OF
 LL0793'A POWER POLE, 35 FEET SOUTHWEST OF A FENCE, 6.8 FEET SOUTH OF A

LL0793'WITNESS POST, 9 FEET ABOVE THE LEVEL OF THE HIGHWAY, 0.2 FOOT
 LL0793'ABOVE THE GROUND, SET IN THE TOP OF A SMALL GRANITE BOULDER.

LL0793

LL0793

STATION RECOVERY (2000)

LL0793

LL0793'RECOVERY NOTE BY STEPHENSON LAND SURVEYING SERVICES 2000 (GFS)

LL0793'THE STATION IS LOCATED ABOUT 2.6 MI (4.2 KM) WEST ALONG U.S. HIGHWAY

LL0793'40 FROM GRANBY, 0.7 MI (1.1 KM) EAST FROM THE INTERSECTION OF STATE

LL0793'HIGHWAY 125 AND U.S. HIGHWAY 40, 0.1 MI (0.2 KM) WEST FROM A BRIDGE

LL0793'OVER THE COLORADO RIVER, IN THE SOUTHWEST 1/4 OF SECTION 25, T 2 N, R

LL0793'77 W, AT U. S. HIGHWAY 40 MILEPOST 209.9. OWNERSHIP--COLORADO DEPT.

LL0793'OF TRANSPORTATION RIGHT-OF-WAY

LL0793'TO REACH THE STATION FROM THE INTERSECTION OF U. S. HIGHWAY 40 AND

LL0793'STATE HIGHWAY 125, GO EAST ON U. S. HIGHWAY 40 FOR 0.7 MI (1.1 KM)

LL0793'TO THE STATION ON THE LEFT

LL0793'THE MARK IS A STANDARD DISK IN A DRILL HOLE IN A BOULDER 30 CM BY 45

LL0793'CM, PROJECTING 3 CM ABOVE THE GROUND. IT IS 29.2 M (95.8 FT)

LL0793'NORTHEAST FROM THE CENTERLINE OF U. S. HIGHWAY 40, 10.4 M (34.1 FT)

LL0793'SOUTHWEST FROM A RIGHT-OF-WAY FENCE, 0.7 M (2.3 FT) NORTHEAST FROM A

LL0793'WITNESS POST, ABOUT 3 M (9.8 FT) ABOVE THE HIGHWAY AND 1 M (3.3 FT)

LL0793'FROM THE EDGE OF A ROAD CUT.

LL0793

LL0793

STATION RECOVERY (2006)

LL0793

LL0793'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2006 (HPB)

LL0793'RECOVERED AS DESCRIBED

LL0793

LL0793

STATION RECOVERY (2011)

LL0793

LL0793'RECOVERY NOTE BY CIVILARTS 2011 (FND)

LL0793'RECOVERED AS DESCRIBED.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
JL0527 *****
JL0527 DESIGNATION - X 423
JL0527 PID - JL0527
JL0527 STATE/COUNTY- CO/GUNNISON
JL0527 COUNTRY - US
JL0527 USGS QUAD - GUNNISON (2019)
JL0527
JL0527 *CURRENT SURVEY CONTROL
JL0527
JL0527* NAD 83(2011) POSITION- 38 32 39.40527(N) 106 54 46.58089(W) ADJUSTED
JL0527* NAD 83(2011) ELLIP HT- 2327.068 (meters) (06/27/12) ADJUSTED
JL0527* NAD 83(2011) EPOCH - 2010.00
JL0527* NAVD 88 ORTHO HEIGHT - 2341.398 (meters) 7681.74 (feet) ADJUSTED
JL0527
JL0527 GEOID HEIGHT - -14.316 (meters) GEOID18
JL0527 NAD 83(2011) X - -1,453,668.550 (meters) COMP
JL0527 NAD 83(2011) Y - -4,780,704.825 (meters) COMP
JL0527 NAD 83(2011) Z - 3,954,324.989 (meters) COMP
JL0527 LAPLACE CORR - 1.73 (seconds) DEFLEC18
JL0527 DYNAMIC HEIGHT - 2338.526 (meters) 7672.31 (feet) COMP
JL0527 MODELED GRAVITY - 979,317.7 (mgal) NAVD 88
JL0527
JL0527 VERT ORDER - FIRST CLASS II
JL0527
JL0527 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
JL0527 Standards:
JL0527 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
JL0527 Horiz Ellip SD_N SD_E SD_h (unitless)
JL0527 -----
JL0527 NETWORK 0.64 1.39 0.27 0.25 0.71 0.03101687
JL0527 -----
JL0527 Click here for local accuracies and other accuracy information.
JL0527
JL0527
JL0527.The horizontal coordinates were established by GPS observations
JL0527.and adjusted by the National Geodetic Survey in June 2012.
JL0527
JL0527.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
JL0527.been affixed to the stable North American tectonic plate. See
JL0527.NA2011 for more information.
JL0527
JL0527.The horizontal coordinates are valid at the epoch date displayed above
JL0527.which is a decimal equivalence of Year/Month/Day.
JL0527
JL0527.The orthometric height was determined by differential leveling and

```

JL0527.adjusted by the NATIONAL GEODETIC SURVEY
 JL0527.in June 1991.

JL0527

JL0527.Significant digits in the geoid height do not necessarily reflect accuracy.
 JL0527.GEOID18 height accuracy estimate available [here](#).

JL0527

JL0527.Click [photographs](#) - Photos may exist for this station.

JL0527

JL0527.The X, Y, and Z were computed from the position and the ellipsoidal ht.

JL0527

JL0527.The Laplace correction was computed from DEFLEC18 derived deflections.

JL0527

JL0527.The ellipsoidal height was determined by GPS observations

JL0527.and is referenced to NAD 83.

JL0527

JL0527.The dynamic height is computed by dividing the NAVD 88

JL0527.geopotential number by the normal gravity value computed on the

JL0527.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

JL0527.degrees latitude (g = 980.6199 gals.).

JL0527

JL0527.The modeled gravity was interpolated from observed gravity values.

JL0527

JL0527. The following values were computed from the NAD 83(2011) position.

JL0527

JL0527;		North	East	Units	Scale	Factor	Converg.
JL0527;SPC CO C	-	384,678.875	791,229.818	MT	0.99998280	-0 53 28.1	
JL0527;SPC CO C	-	1,262,067.28	2,595,893.16	sFT	0.99998280	-0 53 28.1	
JL0527;UTM 13	-	4,267,941.219	333,290.949	MT	0.99994226	-1 11 32.1	

JL0527

JL0527! - Elev Factor x Scale Factor = Combined Factor

JL0527!SPC CO C - 0.99963501 x 0.99998280 = 0.99961781

JL0527!UTM 13 - 0.99963501 x 0.99994226 = 0.99957729

JL0527

JL0527_U.S. NATIONAL GRID SPATIAL ADDRESS: 13SCC3329067941(NAD 83)

JL0527

JL0527 SUPERSEDED SURVEY CONTROL

JL0527

JL0527	NAD 83(2007)-	38 32 39.40503(N)	106 54 46.58116(W)	AD(2002.00)	0
JL0527	ELLIP H (02/10/07)	2327.094 (m)		GP(2002.00)	
JL0527	ELLIP H (10/21/02)	2327.106 (m)		GP()	5 1
JL0527	NAD 83(1992)-	38 32 39.40485(N)	106 54 46.58053(W)	AD()	1
JL0527	ELLIP H (02/27/98)	2327.076 (m)		GP()	4 1
JL0527	NAVD 88	2341.40 (m)	7681.7 (f)	LEVELING	3

JL0527

JL0527.Superseded values are not recommended for survey control.

JL0527

JL0527.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

JL0527.See file [dsdata.pdf](#) to determine how the superseded data were derived.

JL0527

JL0527_MARKER: I = METAL ROD

JL0527_SETTING: 49 = STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)

JL0527_STAMPING: X 423 1984

JL0527_MARK LOGO: NGS

JL0527_PROJECTION: FLUSH

JL0527_MAGNETIC: I = MARKER IS A STEEL ROD

JL0527_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

JL0527_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

JL0527+SATELLITE: SATELLITE OBSERVATIONS - April 13, 2011

JL0527_ROD/PIPE-DEPTH: 5.2 meters

JL0527

JL0527	HISTORY	- Date	Condition	Report By
JL0527	HISTORY	- 1984	MONUMENTED	NGS
JL0527	HISTORY	- 19960606	GOOD	MSAM
JL0527	HISTORY	- 19990520	GOOD	MSAM
JL0527	HISTORY	- 20030620	GOOD	USPSQD
JL0527	HISTORY	- 20110413	GOOD	INDIV

JL0527

JL0527 STATION DESCRIPTION

JL0527

JL0527'DESCRIBED BY NATIONAL GEODETIC SURVEY 1984

JL0527'1.2 KM (0.75 MI) EAST FROM GUNNISON.

JL0527'1.2 KM (0.75 MI) EASTERLY ALONG U.S. HIGHWAY 50 FROM ITS JUNCTION WITH

JL0527'STATE HIGHWAY 135 IN GUNNISON, 12.5 M (41.0 FT) SOUTH OF THE

JL0527'CENTERLINE OF THE HIGHWAY, 5.5 M (18.0 FT) WEST OF THE CENTER OF A

JL0527'FIELD ENTRANCE, AND 0.6 KM (2.0 MI) WEST OF A HIGHWAY RIGHT-OF-WAY

JL0527'MARKER. NOTE=ACCESS TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.

JL0527'THE MARK IS 0.3 METERS E FROM A WITNESS POST

JL0527'THE MARK IS 1.5 M BELOW THE HIGHWAY.

JL0527

JL0527 STATION RECOVERY (1996)

JL0527

JL0527'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1996 (RSC)

JL0527'THE STATION IS LOCATED ON THE EASTERN EDGE OF GUNNISON ON U. S.

JL0527'HIGHWAY 50, IN THE NORTHWEST 1/4 OF SECTION 6, T 1 E, R 49 N, AT U. S

JL0527'HIGHWAY 50 MILEPOST 158.2. OWNERSHIP--COLORADO DEPT. OF

JL0527'TRANSPORTATION RIGHT-OF-WAY TO REACH THE STATION FROM THE

JL0527'INTERSECTION OF U. S. HIGHWAY 50 AND STATE HIGHWAY 135 IN GUNNISON,

JL0527'GO EAST ON U. S. HIGHWAY 50 FOR 0.8 MI (1.3 KM) TO THE STATION ON

JL0527'THE RIGHT THE MARK IS A PUNCH HOLE, TOP CENTER ON A STAINLESS STEEL

JL0527'ROD DRIVEN TO REFUSAL, ENCLOSED IN A 5-INCH PVC PIPE WITH LOGO LID,

JL0527'SURROUNDED BY A CONCRETE COLLAR RECESSED 15 CM BELOW THE GROUND. IT

JL0527'IS 15.0 M (49.2 FT) SOUTH FROM THE CENTER LINE OF U. S. HIGHWAY 50,

JL0527'6.3 M (20.7 FT) WEST FROM THE CENTER OF A FIELD ROAD AND GATE, 0.5 M

JL0527'(1.6 FT) WEST FROM A CONCRETE RIGHT-OF-WAY MARKER, 0.4 M (1.3 FT) EAST

JL0527'FROM A WITNESS POST, 0.1 M (0.3 FT) NORTH FROM THE SOUTHERN

JL0527'RIGHT-OF-WAY FENCE, ABOUT 0.1 MI (0.2 KM) EAST OF THE EASTERN MOST

JL0527'CORNER OF A CHAINLINK FENCE AROUND THE HISTORICAL MUSEUM, ABOUT 1.3 M

JL0527'(4.3 FT) BELOW THE HIGHWAY AND ABOUT OPPOSITE OF THE ADAMS RANCH SIGN

JL0527'ON THE NORTH SIDE OF THE HIGHWAY.

JL0527

JL0527 STATION RECOVERY (1999)

JL0527

JL0527'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1999 (KCH)

JL0527'RECOVERED AS DESCRIBED.

JL0527

JL0527 STATION RECOVERY (2003)

JL0527

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
JL0212 *****
JL0212 FBN          -   This is a Federal Base Network Control Station.
JL0212 DESIGNATION -   Y 8
JL0212 PID          -   JL0212
JL0212 STATE/COUNTY- CO/GUNNISON
JL0212 COUNTRY      -   US
JL0212 USGS QUAD    -   GUNNISON (2019)
JL0212
JL0212                      *CURRENT SURVEY CONTROL
JL0212
JL0212* NAD 83(2011) POSITION- 38 32 19.59673(N) 106 55 36.00595(W) ADJUSTED
JL0212* NAD 83(2011) ELLIP HT- 2326.659 (meters) (06/27/12) ADJUSTED
JL0212* NAD 83(2011) EPOCH   - 2010.00
JL0212* NAVD 88 ORTHO HEIGHT - 2340.988 (meters) 7680.39 (feet) ADJUSTED
JL0212
JL0212 GEOID HEIGHT   -          -14.328 (meters) GEOID18
JL0212 NAD 83(2011) X   - -1,454,924.810 (meters) COMP
JL0212 NAD 83(2011) Y   - -4,780,720.278 (meters) COMP
JL0212 NAD 83(2011) Z   -  3,953,846.818 (meters) COMP
JL0212 LAPLACE CORR    -           0.90 (seconds) DEFLEC18
JL0212 DYNAMIC HEIGHT -          2338.141 (meters) 7671.05 (feet) COMP
JL0212 MODELED GRAVITY -          979,328.4 (mgal) NAVD 88
JL0212
JL0212 VERT ORDER      -   FIRST      CLASS II
JL0212
JL0212 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
JL0212 Standards:
JL0212          FGDC (95% conf, cm)      Standard deviation (cm)      CorrNE
JL0212          Horiz Ellip              SD_N   SD_E   SD_h      (unitless)
JL0212 -----
JL0212 NETWORK    0.49   1.04              0.22   0.18   0.53      0.02254938
JL0212 -----
JL0212 Click here for local accuracies and other accuracy information.
JL0212
JL0212
JL0212.The horizontal coordinates were established by GPS observations
JL0212.and adjusted by the National Geodetic Survey in June 2012.
JL0212
JL0212.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
JL0212.been affixed to the stable North American tectonic plate. See
JL0212.NA2011 for more information.
JL0212
JL0212.The horizontal coordinates are valid at the epoch date displayed above
JL0212.which is a decimal equivalence of Year/Month/Day.
JL0212

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JL0212.The orthometric height was determined by differential leveling and
 JL0212.adjusted by the NATIONAL GEODETIC SURVEY
 JL0212.in June 1991.

JL0212

JL0212.Significant digits in the geoid height do not necessarily reflect accuracy.
 JL0212.GEOID18 height accuracy estimate available [here](#).

JL0212

JL0212.Click [photographs](#) - Photos may exist for this station.

JL0212

JL0212.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 JL0212

JL0212.The Laplace correction was computed from DEFLEC18 derived deflections.
 JL0212

JL0212.The ellipsoidal height was determined by GPS observations
 JL0212.and is referenced to NAD 83.

JL0212

JL0212.The dynamic height is computed by dividing the NAVD 88
 JL0212.geopotential number by the normal gravity value computed on the
 JL0212.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 JL0212.degrees latitude (g = 980.6199 gals.).

JL0212

JL0212.The modeled gravity was interpolated from observed gravity values.

JL0212

JL0212. The following values were computed from the NAD 83(2011) position.

JL0212

JL0212;		North	East	Units	Scale Factor	Converg.
JL0212;SPC CO C	-	384,086.865	790,023.492	MT	0.99998373	-0 53 59.2
JL0212;SPC CO C	-	1,260,124.99	2,591,935.41	sFT	0.99998373	-0 53 59.2
JL0212;SPC CO S	-	513,533.643	790,018.586	MT	1.00002095	-0 52 30.3
JL0212;SPC CO S	-	1,684,818.29	2,591,919.31	sFT	1.00002095	-0 52 30.3
JL0212;UTM 13	-	4,267,355.577	332,081.576	MT	0.99994724	-1 12 02.4

JL0212

JL0212!		Elev Factor	x	Scale Factor	=	Combined Factor
JL0212!SPC CO C	-	0.99963507	x	0.99998373	=	0.99961881
JL0212!SPC CO S	-	0.99963507	x	1.00002095	=	0.99965601
JL0212!UTM 13	-	0.99963507	x	0.99994724	=	0.99958233

JL0212

JL0212:		Primary Azimuth Mark	Grid Az
JL0212:SPC CO C	-	Y 8 AZ MK	069 27 56.2
JL0212:SPC CO S	-	Y 8 AZ MK	069 26 27.3
JL0212:UTM 13	-	Y 8 AZ MK	069 45 59.4

JL0212

JL0212_U.S. NATIONAL GRID SPATIAL ADDRESS: 13SCC3208167355 (NAD 83)

JL0212

JL0212	PID	Reference Object	Distance	Geod. Az
JL0212				dddmmss.s
JL0212	JL0715	GUNNISON MTN STS TT CO MST 30	APPROX. 3.2 KM	0263718.7
JL0212	CM6927	Y 8 AZ MK		0683357.0
JL0212	JL0213	Y 8 RM 1	19.094 METERS	08221
JL0212	AE7515	GUC D	149.003 METERS	23001
JL0212	CM6053	Y 8 RM 2	20.660 METERS	34335

JL0212

JL0212 SUPERSEDED SURVEY CONTROL
 JL0212
 JL0212 NAD 83(2007)- 38 32 19.59648(N) 106 55 36.00621(W) AD(2002.00) 0
 JL0212 ELLIP H (02/10/07) 2326.687 (m) GP(2002.00)
 JL0212 ELLIP H (09/24/02) 2326.692 (m) GP() 3 1
 JL0212 NAD 83(1992)- 38 32 19.59626(N) 106 55 36.00565(W) AD() B
 JL0212 ELLIP H (05/26/92) 2326.682 (m) GP() 4 1
 JL0212 NAD 83(1986)- 38 32 19.59593(N) 106 55 36.01749(W) AD() 2
 JL0212 NAD 27 - 38 32 19.63560(N) 106 55 33.86260(W) AD() 2
 JL0212 NAVD 88 2340.99 (m) 7680.4 (f) LEVELING 3
 JL0212 NGVD 29 (??/??/92) 2339.462 (m) 7675.38 (f) ADJ UNCH 1 2
 JL0212 NGVD 29 2339.46 (m) 7675.4 (f) LEVELING 3

JL0212

JL0212.Superseded values are not recommended for survey control.

JL0212

JL0212.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

JL0212.See file [dsdata.pdf](#) to determine how the superseded data were derived.

JL0212

JL0212_MARKER: DB = BENCH MARK DISK

JL0212_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

JL0212_STAMPING: Y 8 1926 7675.335

JL0212_MARK LOGO: CGS

JL0212_PROJECTION: FLUSH

JL0212_MAGNETIC: O = OTHER; SEE DESCRIPTION

JL0212_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

JL0212+STABILITY: SURFACE MOTION

JL0212_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

JL0212+SATELLITE: SATELLITE OBSERVATIONS - June 20, 2003

JL0212

JL0212	HISTORY	- Date	Condition	Report By
JL0212	HISTORY	- 1926	MONUMENTED	CGS
JL0212	HISTORY	- 1958	GOOD	CGS
JL0212	HISTORY	- 1959	GOOD	USGS
JL0212	HISTORY	- 1960	GOOD	CGS
JL0212	HISTORY	- 1973	GOOD	NGS
JL0212	HISTORY	- 1976	GOOD	LOCENG
JL0212	HISTORY	- 1977	GOOD	NGS
JL0212	HISTORY	- 1984	GOOD	NGS
JL0212	HISTORY	- 19910628	GOOD	NGS
JL0212	HISTORY	- 19960123	GOOD	MSAM
JL0212	HISTORY	- 20000216	GOOD	CODOT
JL0212	HISTORY	- 20030620	GOOD	USPSQD
JL0212	HISTORY	- 20090718	MARK NOT FOUND	GEOCAC

JL0212

JL0212

JL0212

STATION DESCRIPTION

JL0212'DESCRIBED BY COAST AND GEODETIC SURVEY 1958 (OSR)

JL0212'THE STATION IS IN THE SOUTH CENTRAL EDGE OF GUNNISON, ON THE EAST

JL0212'SIDE OF MAIN STREET AND EAST OF THE RAILWAY EXPRESS AGENCY

JL0212'AND RIO GRANDE MOTORWAY FREIGHT OFFICE.

JL0212'

JL0212'TO REACH THE STATION FROM THE STOP AND GO LIGHT AND THE JUNCTION

JL0212'OF U.S. HIGHWAY 50 AND STATE HIGHWAY 135 IN GUNNISON, GO SOUTH

JL0212'ON MAIN STREET FOR 0.4 MILE TO THE STATION ON THE LEFT. TO

JL0212'REACH THE AZIMUTH FROM THE JUNCTION OF U.S. HIGHWAY 50 AND
 JL0212'STATE HIGHWAY 135 IN GUNNISON, GO EAST ON HIGHWAY 50 FOR 0.95
 JL0212'MILE TO THE MARK ON THE RIGHT.

JL0212'

JL0212'THE STATION MARK IS A STANDARD U.S. COAST AND GEODETIC SURVEY
 JL0212'BENCH MARK DISK, STAMPED Y 8 1926, SET IN THE TOP OF A 12 X 12
 JL0212'INCH SQUARE, CONCRETE POST PROJECTING 1 INCH. IT IS 120.5
 JL0212'FEET EAST-SOUTHEAST OF THE NORTHEAST CORNER OF THE RAILWAY
 JL0212'EXPRESS AGENCY BUILDING, 71 FEET EAST OF THE CENTER OF SOUTH
 JL0212'MAIN STREET, 54 FEET NORTH OF THE CENTER OF AN OLD RAILROAD BED,
 JL0212'19 FEET EAST OF THE SOUTH GATE POST IN A NORTH-SOUTH FENCE
 JL0212'AND 3.2 FEET SOUTH OF AN EAST-WEST FENCE.

JL0212'

JL0212'REFERENCE MARK 1 IS A STANDARD DISK, STAMPED BENCH MARK Y 8 NO
 JL0212'1 1958, SET IN THE TOP OF AN 11-INCH SQUARE, CONCRETE POST
 JL0212'FLUSH WITH THE GROUND SURFACE. IT IS 183 FEET EAST-SOUTHEAST
 JL0212'OF THE NORTHEAST CORNER OF THE EXPRESS OFFICE BUILDING, 81
 JL0212'FEET EAST OF THE SOUTH GATE POST, 134 FEET EAST OF THE CENTER
 JL0212'OF SOUTH MAIN STREET AND 60 FEET NORTH OF THE CENTER OF THE OLD
 JL0212'RAILROAD BED.

JL0212'

JL0212'REFERENCE MARK 2 IS A STANDARD DISK, STAMPED BENCH MARK Y 8
 JL0212'NO 2 1958, SET IN THE TOP OF AN 11-INCH SQUARE, CONCRETE POST
 JL0212'FLUSH WITH THE GROUND SURFACE. IT IS 121.5 FEET NORTHEAST OF
 JL0212'THE NORTHEAST CORNER OF THE EXPRESS OFFICE BUILDING, 48 FEET
 JL0212'EAST OF THE CENTER OF SOUTH MAIN STREET, 66 FEET NORTH OF THE
 JL0212'SOUTH GATE POST AND 1.5 FEET EAST OF A RIGHT-OF-WAY FENCE.
 JL0212'A WHITE WITNESS POST WAS SET 2 FEET NORTHWEST OF THE MARK.

JL0212'

JL0212'THE AZIMUTH MARK IS A STANDARD DISK, STAMPED BENCH MARK Y 8
 JL0212'1958, SET IN THE TOP OF AN 11-INCH SQUARE, CONCRETE POST
 JL0212'PROJECTING 6 INCHES. IT IS 48 FEET SOUTH OF THE CENTER OF
 JL0212'HIGHWAY 50, 31.5 FEET WEST OF A T-FENCE CORNER BETWEEN TWO
 JL0212'GATES, 2.5 FEET NORTHWEST OF TELEPHONE LINE POLE NO. 6 AND IN
 JL0212'AN EAST-WEST RIGHT-OF-WAY FENCE LINE. THE T-FENCE CORNER
 JL0212'MENTIONED ABOVE IS BETWEEN TWO GATES.

JL0212

STATION RECOVERY (1959)

JL0212

JL0212'RECOVERY NOTE BY US GEOLOGICAL SURVEY 1959

JL0212'STATION MARK - STANDARD NGS BENCH MARK DISK SET IN TOP OF CONCRETE
 JL0212'POST PROJECTING 0.5 FT. ABOVE GROUND AND STAMPED ---Y-8 1926---

JL0212

JL0212 STATION RECOVERY (1960)

JL0212

JL0212'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1960

JL0212'IN GUNNISON.

JL0212'AT GUNNISON, GUNNISON COUNTY, 123 FEET EAST OF THE EAST SIDE OF THE
 JL0212'DENVER AND RIO GRANDE WESTERN RAILROAD STATION, 0.3 MILE WEST OF
 JL0212'MILEPOST D-288, 55 FEET EAST OF THE CENTERLINE OF SOUTH MAIN STREET,
 JL0212'48 FEET NORTH OF THE CENTERLINE OF THE TRACK, 3 FEET SOUTH OF THE
 JL0212'RIGHT-OF-WAY FENCE, AND ABOUT 3 FEET HIGHER THAN THE TRACK. A
 JL0212'STANDARD DISK, STAMPED 7675.385 Y 8 1926 AND SET IN THE TOP OF A
 JL0212'CONCRETE POST PROJECTING 6 INCHES ABOVE GROUND. NOTE-- THE RAILROAD

JL0212'HAS BEEN ABANDONED BUT THE OLD BED IS STILL IN EVIDENCE.
 JL0212
 JL0212 STATION RECOVERY (1973)
 JL0212
 JL0212'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1973
 JL0212'RECOVERED IN GOOD CONDITION.
 JL0212
 JL0212 STATION RECOVERY (1976)
 JL0212
 JL0212'RECOVERY NOTE BY LOCAL ENGINEER (INDIVIDUAL OR FIRM) 1976 (GG)
 JL0212'Y8-1926 7675.385 RECOVERED EXCELLENT - BENCH MARK.
 JL0212'
 JL0212'BENCH MARK Y8 NO. 1 1958 RECOVERED EXCELLENT - REFERENCE MARK NO. 1.
 JL0212'
 JL0212'BENCH MARK Y8 NO. 2 1958 RECOVERED EXCELLENT - REFERENCE MARK NO. 2,
 JL0212'UNDER 1 FT. OF MANURE.
 JL0212'
 JL0212'WE SET A STEEL POST 1 FOOT EAST OF BM Y-8 AND ONE 1 FOOT WEST OF BM
 JL0212'Y-8.
 JL0212'
 JL0212'WE SET A STEEL POST 1 FOOT EAST OF RM NO. 1 AND ONE 1 FOOT WEST OF
 JL0212'RM NO. 1. WE SET A STEEL POST 1 FOOT WEST OF RM NO. 2, SAID POST
 JL0212'PROTRUDING 3 FEET. WE FOUND AN EXISTING 4 INCH X 4 INCH WHITE WOOD
 JL0212'POST, LEANING AND UNDER FENCE LINE, 2 FT. NW OF RM NO. 2.
 JL0212'
 JL0212'DISTANCE AND DIRECTION FROM NEAREST TOWN--AT THE SO. CENTRAL OF
 JL0212'GUNNISON, COLORADO.
 JL0212
 JL0212 STATION RECOVERY (1977)
 JL0212
 JL0212'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1977 (CLN)
 JL0212'STATION RECOVERED AND ALL MARKS ARE IN GOOD CONDITION. THE 1958
 JL0212'ROUTE AND LOCATION IS STILL ADEQUATE. METAL WITNESS POSTS ARE ON TWO
 JL0212'SIDES OF THE STATION MARK.
 JL0212
 JL0212 STATION RECOVERY (1984)
 JL0212
 JL0212'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1984
 JL0212'RECOVERED IN GOOD CONDITION. NOTE=THE OLD RAILROAD BED IS NOW RIO
 JL0212'GRANDE AVENUE. ADD=0.3 M (1.0 FT) SOUTH OF A WITNESS POST AND FENCE.
 JL0212'STAMPING--Y 8 1926 7675.335.
 JL0212
 JL0212 STATION RECOVERY (1991)
 JL0212
 JL0212'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1991
 JL0212'STATION IS LOCATED ON THE SOUTH EDGE OF GUNNISON, IN A YARD AREA
 JL0212'FILLED WITH BROKEN SECTIONS OF HIGHWAY PAVEMENT, ON THE SOUTH SIDE OF
 JL0212'THE SOUTH FENCE OF A CORRAL, ACROSS THE STREET FROM AN OLD RAILROAD
 JL0212'STATION BUILDING, JUST NORTH OF THE PERIMETER FENCE FOR THE COUNTY
 JL0212'AIRPORT, IN THE NORTHWEST 1/4 OF SECTION 1, T 49 N, R 1 W.
 JL0212'OWNERSHIP--JOHN ADAMS WILSON, 143 SOUTH MAIN STREET, GUNNISON, CO.
 JL0212'PHONE IS 303-641-6042 OR 0205.
 JL0212'TO REACH FROM THE JUNCTION OF US HIGHWAY 50 AND STATE HIGHWAY 135
 JL0212'(MAIN STREET) IN GUNNISON, GO SOUTH ON MAIN STREET FOR 0.35 MI

JL0212' (0.56 KM) TO THE STATION ON THE LEFT, JUST BEFORE REACHING ROAD END.
 JL0212'STATION MARK IS SET IN THE TOP OF A 30-CM SQUARE CONCRETE POST
 JL0212'PROJECTING 2 CM ABOVE GROUND. IT IS 16.6 M (54.5 FT) EAST OF THE
 JL0212'CENTER OF MAIN STREET, 5.7 M (18.7 FT) EAST OF A BOARD T-FENCE
 JL0212'CORNER, 0.8 M (2.6 FT) SOUTH OF A BOARD FENCE, 0.3 M (1.0 FT) SOUTH
 JL0212'OF A FIBERGLASS WITNESS POST, 0.3 M (1.0 FT) EAST OF A METAL WITNESS
 JL0212'POST AND 0.3 M (1.0 FT) WEST OF A METAL WITNESS POST.

JL0212'DESCRIBED BY G.R.HEID

JL0212

JL0212

STATION RECOVERY (1996)

JL0212

JL0212'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1996 (RSC)

JL0212'RECOVERED AS DESCRIBED.

JL0212

JL0212

STATION RECOVERY (2000)

JL0212

JL0212'RECOVERY NOTE BY COLORADO DEPARTMENT OF TRANSPORTATION 2000 (RSC)

JL0212'RECOVERED AS DESCRIBED.

JL0212

JL0212

STATION RECOVERY (2003)

JL0212

JL0212'RECOVERY NOTE BY US POWER SQUADRON 2003 (AFA)

JL0212'

JL0212'

JL0212'FOUND THE STATION MARK AND RM 1. RM2 AND THE AZIMUTH MARK NOT FOUND.

JL0212

JL0212

STATION RECOVERY (2009)

JL0212

JL0212'RECOVERY NOTE BY GEOCACHING 2009 (TFW)

JL0212'MARK NOT FOUND.

*** retrieval complete.

Elapsed Time = 00:00:02

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.5.10

Starting Datasheet Retrieval...

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1      National Geodetic Survey,      Retrieval Date = NOVEMBER 25, 2020
JL0523 *****
JL0523 DESIGNATION - Y 423
JL0523 PID - JL0523
JL0523 STATE/COUNTY- CO/GUNNISON
JL0523 COUNTRY - US
JL0523 USGS QUAD - GUNNISON (2019)
JL0523
JL0523 *CURRENT SURVEY CONTROL
JL0523
JL0523* NAD 83(2011) POSITION- 38 31 33.82802(N) 106 58 07.46801(W) ADJUSTED
JL0523* NAD 83(2011) ELLIP HT- 2309.327 (meters) (06/27/12) ADJUSTED
JL0523* NAD 83(2011) EPOCH - 2010.00
JL0523* NAVD 88 ORTHO HEIGHT - 2323.701 (meters) 7623.68 (feet) ADJUSTED
JL0523
JL0523 GEOID HEIGHT - -14.351 (meters) GEOID18
JL0523 NAD 83(2011) X - -1,458,687.665 (meters) COMP
JL0523 NAD 83(2011) Y - -4,780,478.859 (meters) COMP
JL0523 NAD 83(2011) Z - 3,952,731.632 (meters) COMP
JL0523 LAPLACE CORR - 2.92 (seconds) DEFLEC18
JL0523 DYNAMIC HEIGHT - 2320.866 (meters) 7614.37 (feet) COMP
JL0523 MODELED GRAVITY - 979,324.8 (mgal) NAVD 88
JL0523
JL0523 VERT ORDER - FIRST CLASS II
JL0523
JL0523 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
JL0523 Standards:
JL0523 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
JL0523 Horiz Ellip SD_N SD_E SD_h (unitless)
JL0523 -----
JL0523 NETWORK 0.64 1.49 0.29 0.23 0.76 -0.00358213
JL0523 -----
JL0523 Click here for local accuracies and other accuracy information.
JL0523
JL0523
JL0523.The horizontal coordinates were established by GPS observations
JL0523.and adjusted by the National Geodetic Survey in June 2012.
JL0523
JL0523.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
JL0523.been affixed to the stable North American tectonic plate. See
JL0523.NA2011 for more information.
JL0523
JL0523.The horizontal coordinates are valid at the epoch date displayed above
JL0523.which is a decimal equivalence of Year/Month/Day.
JL0523
JL0523.The orthometric height was determined by differential leveling and

```

JL0523.adjusted by the NATIONAL GEODETIC SURVEY
 JL0523.in June 1991.

JL0523

JL0523.Significant digits in the geoid height do not necessarily reflect accuracy.
 JL0523.GEOID18 height accuracy estimate available [here](#).

JL0523

JL0523.Click [photographs](#) - Photos may exist for this station.

JL0523

JL0523.The X, Y, and Z were computed from the position and the ellipsoidal ht.

JL0523

JL0523.The Laplace correction was computed from DEFLEC18 derived deflections.

JL0523

JL0523.The ellipsoidal height was determined by GPS observations

JL0523.and is referenced to NAD 83.

JL0523

JL0523.The dynamic height is computed by dividing the NAVD 88

JL0523.geopotential number by the normal gravity value computed on the

JL0523.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

JL0523.degrees latitude (g = 980.6199 gals.).

JL0523

JL0523.The modeled gravity was interpolated from observed gravity values.

JL0523

JL0523. The following values were computed from the NAD 83(2011) position.

JL0523

JL0523;		North	East	Units	Scale Factor	Converg.
JL0523;SPC CO C	-	382,734.237	786,333.044	MT	0.99998592	-0 55 34.8
JL0523;SPC CO C	-	1,255,687.24	2,579,827.66	sFT	0.99998592	-0 55 34.8
JL0523;UTM 13	-	4,266,022.368	328,384.194	MT	0.99996271	-1 13 35.7

JL0523

JL0523! - Elev Factor x Scale Factor = Combined Factor

JL0523!SPC CO C - 0.99963779 x 0.99998592 = 0.99962371

JL0523!UTM 13 - 0.99963779 x 0.99996271 = 0.99960051

JL0523

JL0523_U.S. NATIONAL GRID SPATIAL ADDRESS: 13SCC2838466022 (NAD 83)

JL0523

JL0523 SUPERSEDED SURVEY CONTROL

JL0523

JL0523	NAD 83(2007)-	38 31 33.82775(N)	106 58 07.46827(W)	AD(2002.00)	0
JL0523	ELLIP H (02/10/07)	2309.366 (m)		GP(2002.00)	
JL0523	ELLIP H (10/21/02)	2309.421 (m)		GP()	5 1
JL0523	NAD 83(1992)-	38 31 33.82759(N)	106 58 07.46760(W)	AD()	1
JL0523	ELLIP H (02/27/98)	2309.345 (m)		GP()	4 1
JL0523	NAVD 88	2323.70 (m)	7623.7 (f)	LEVELING	3

JL0523

JL0523.Superseded values are not recommended for survey control.

JL0523

JL0523.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

JL0523.See file [dsdata.pdf](#) to determine how the superseded data were derived.

JL0523

JL0523_MARKER: I = METAL ROD

JL0523_SETTING: 15 = METAL ROD DRIVEN INTO GROUND. SEE TEXT FOR ADDITIONAL

JL0523+WITH SETTING: INFORMATION.

JL0523_STAMPING: Y 423 1984

JL0523_MARK LOGO: NGS

JL0523_PROJECTION: FLUSH

JL0523_MAGNETIC: I = MARKER IS A STEEL ROD

JL0523_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

JL0523_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

JL0523+SATELLITE: SATELLITE OBSERVATIONS - August 28, 2004

JL0523_ROD/PIPE-DEPTH: 0.9 meters

JL0523

JL0523	HISTORY	- Date	Condition	Report By
JL0523	HISTORY	- 1984	MONUMENTED	NGS
JL0523	HISTORY	- 19960606	GOOD	MSAM
JL0523	HISTORY	- 19990520	GOOD	MSAM
JL0523	HISTORY	- 20000216	GOOD	CODOT
JL0523	HISTORY	- 20040828	GOOD	COMPDA

JL0523

JL0523 STATION DESCRIPTION

JL0523

JL0523'DESCRIBED BY NATIONAL GEODETIC SURVEY 1984

JL0523'4.4 KM (2.75 MI) WEST FROM GUNNISON.

JL0523'4.4 KM (2.75 MI) WESTERLY ALONG U.S. HIGHWAY 50 FROM ITS JUNCTION WITH

JL0523'STATE HIGHWAY 135 IN GUNNISON, 52.0 M (170.6 FT) SOUTHWEST OF THE

JL0523'CENTER OF COUNTRY ROAD 18, 29.6 M (97.1 FT) NORTHWEST OF THE CENTERLINE

JL0523'OF THE HIGHWAY, 6.8 M (22.3 FT) SOUTHEAST OF A FENCE, 6.7 M (22.0 FT)

JL0523'NORTHWEST OF THE CENTERLINE OF A FRONTAGE ROAD, AND 0.6 M (2.0 FT)

JL0523'SOUTHWEST OF UTILITY POLE NUMBER 7. NOTE=REFUSAL WAS REACHED AT 3.0

JL0523'FT. ACCESS TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.

JL0523'THE MARK IS 0.3 METERS NE FROM A WITNESS POST

JL0523'THE MARK IS ABOVE LEVEL WITH THE HIGHWAY.

JL0523

JL0523 STATION RECOVERY (1996)

JL0523

JL0523'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1996 (RSC)

JL0523'THE STATION IS LOCATED AT THE WESTERN EDGE OF GUNNISON, IN THE

JL0523'NORTHEAST 1/4 OF SECTION 9, T 1 W, R 49 N, AT U. S. HIGHWAY 50

JL0523'MILEPOST 154.3. OWNERSHIP--COLORADO DEPT. OF TRANSPORTATION

JL0523'RIGHT-OF-WAY TO REACH THE STATION FROM THE INTERSECTION OF U. S.

JL0523'HIGHWAY 50 AND STATE HIGHWAY 135 IN GUNNISON, GO WEST ON U. S.

JL0523'HIGHWAY 50 FOR 2.75 MI (4.43 KM) TO THE STATION ON THE RIGHT. IT IS

JL0523'JUST EAST OF THE RUSTIC MOTEL, NOW CLOSED THE MARK IS A PUNCH HOLE,

JL0523'TOP CENTER ON A STAINLESS STEEL ROD 0.9 M (3.0 FT) LONG DRIVEN TO

JL0523'REFUSAL, ENCLOSED IN A 5-INCH PVC PIPE WITH LOGO LID, SURROUNDED BY A

JL0523'CONCRETE COLLAR RESESSED 5 CM BELOW THE LEVEL OF THE GROUND. IT IS

JL0523'52.0 M (170.6 FT) SOUTHWEST OF THE CENTER OF COUNTY ROAD 18, 29.6 M

JL0523'(97.1 FT) NORTHWEST OF THE CENTER LINE OF U. S. HIGHWAY 50, 6.8 M

JL0523'(22.3 FT) SOUTHEAST OF A FENCE, 6.7 M (22.0 FT) NORTHWEST OF THE

JL0523'CENTER LINE OF THE NORTHERN FRONTAGE ROAD, 0.3 M (1.0 FT) NORTHEAST

JL0523'FROM A WITNESS POST AND ABOUT THE SAME LEVEL AS THE HIGHWAY.

JL0523

JL0523 STATION RECOVERY (1999)

JL0523

JL0523'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 1999 (KCH)

JL0523'RECOVERED AS DESCRIBED.

JL0523

JL0523 STATION RECOVERY (2000)

JL0523
JL0523'RECOVERY NOTE BY COLORADO DEPARTMENT OF TRANSPORTATION 2000 (RSC)
JL0523'RECOVERED AS DESCRIBED.
JL0523
JL0523 STATION RECOVERY (2004)
JL0523
JL0523'RECOVERY NOTE BY COMPASSDATA INC 2004 (RL)
JL0523'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:01

AE7515_OPUS-Precise_2020-10-03 - Copy.txt 11/27/2020

FILE: AE7515_20201003_5s.20o OP1606362954624

NGS OPUS SOLUTION REPORT

=====

USER: ben.hocker@woolpert.com DATE: November 26, 2020
 RINEX FILE: ae75277a.20o TIME: 03:57:31 UTC

SOFTWARE: page5 2008.25 master94.pl 160321 START: 2020/10/03 00:00:00
 EPHEMERIS: igs21256.eph [precise] STOP: 2020/10/03 23:59:00
 NAV FILE: brdc2770.20n OBS USED: 58951 / 64775 :
 91%
 ANT NAME: TRMR10 NONE # FIXED AMB: 327 / 349 :
 94%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.016(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7555)

X:	-1455050.852 (m)	0.006 (m)	-1455051.768 (m)	0.006 (m)
Y:	-4780742.236 (m)	0.012 (m)	-4780740.911 (m)	0.012 (m)
Z:	3953770.313 (m)	0.003 (m)	3953770.175 (m)	0.003 (m)

LAT:	38 32 16.49123	0.008 (m)	38 32 16.50793	0.008 (m)
E LON:	253 4 19.28086	0.009 (m)	253 4 19.22876	0.009 (m)
W LON:	106 55 40.71914	0.009 (m)	106 55 40.77124	0.009 (m)
EL HGT:	2324.129 (m)	0.006 (m)	2323.260 (m)	0.006 (m)
ORTHO HGT:	2338.459 (m)	0.043 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4267262.237	383992.913
Easting (X) [meters]	331965.454	789907.857
Convergence [degrees]	-1.20147222	-0.90061111
Point Scale	0.99994772	0.99998388
Combined Factor	0.99958321	0.99961935

US NATIONAL GRID DESIGNATOR: 13SCC3196567262 (NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	98890.5
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	102202.9
DL3478	R301 CRAWFORD CORS ARP	N383923.739	W1073527.367	59257.9

NEAREST NGS PUBLISHED CONTROL POINT

AE7515	GUC D	N383216.491	W1065540.719	0.0
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AE7515_OPUS-Precise_2020-10-04.txt

11/27/2020

FILE: AE7515_20201004_5s.20o OP1606362987872

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: ae75278a.20o

DATE: November 26, 2020
 TIME: 03:57:54 UTC

SOFTWARE: page5 2008.25 master70.pl 160321 START: 2020/10/04 00:00:00
 EPHEMERIS: igs21260.eph [precise] STOP: 2020/10/04 23:59:00
 NAV FILE: brdc2780.20n OBS USED: 58645 / 65529 :
 89%
 ANT NAME: TRMR10 NONE # FIXED AMB: 326 / 361 :
 90%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.018 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7582)

X:	-1455050.851 (m)	0.003 (m)	-1455051.767 (m)	0.003 (m)
Y:	-4780742.246 (m)	0.009 (m)	-4780740.921 (m)	0.009 (m)
Z:	3953770.318 (m)	0.011 (m)	3953770.180 (m)	0.011 (m)

LAT:	38 32 16.49116	0.005 (m)	38 32 16.50790	0.005 (m)
E LON:	253 4 19.28104	0.002 (m)	253 4 19.22894	0.002 (m)
W LON:	106 55 40.71896	0.002 (m)	106 55 40.77106	0.002 (m)
EL HGT:	2324.140 (m)	0.014 (m)	2323.271 (m)	0.014 (m)
ORTHO HGT:	2338.470 (m)	0.047 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4267262.235	383992.911
Easting (X) [meters]	331965.458	789907.861
Convergence [degrees]	-1.20147222	-0.90061111
Point Scale	0.99994772	0.99998388
Combined Factor	0.99958320	0.99961935

US NATIONAL GRID DESIGNATOR: 13SCC3196567262 (NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	102202.9
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	98890.5
DL3585	MC10 MONTROSE CORS ARP	N382720.137	W1075242.393	83445.1

NEAREST NGS PUBLISHED CONTROL POINT

AE7515	GUC D	N383216.491	W1065540.719	0.0
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AI5954_OPUS-Precise_2020-10-06.txt

11/27/2020

FILE: AI5954 TR8728989452859

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: ai59280s.20o

DATE: November 25, 2020
 TIME: 03:49:40 UTC

SOFTWARE: page5 2008.25 master52.pl 160321 START: 2020/10/06 18:06:00
 EPHEMERIS: igs21262.eph [precise] STOP: 2020/10/07 00:16:00
 NAV FILE: brdc2800.20n OBS USED: 17929 / 18883 :
 95%
 ANT NAME: TRMR10 NONE # FIXED AMB: 99 / 104 :
 95%
 ARP HEIGHT: 1.6069 OVERALL RMS: 0.013 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7647)

X:	-1378353.054 (m)	0.007 (m)	-1378353.977 (m)	0.007 (m)
Y:	-4692291.165 (m)	0.004 (m)	-4692289.857 (m)	0.004 (m)
Z:	4084046.389 (m)	0.007 (m)	4084046.262 (m)	0.007 (m)

LAT:	40 3 15.48302	0.005 (m)	40 3 15.50063	0.005 (m)
E LON:	253 37 47.75927	0.007 (m)	253 37 47.70638	0.007 (m)
W LON:	106 22 12.24073	0.007 (m)	106 22 12.29362	0.007 (m)
EL HGT:	2243.839 (m)	0.007 (m)	2242.996 (m)	0.007 (m)
ORTHO HGT:	2256.649 (m)	0.049 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4434683.295	385213.757
Easting (X) [meters]	383142.254	840166.310
Convergence [degrees]	-0.88175556	-0.56218056
Point Scale	0.99976811	0.99996269
Combined Factor	0.99941631	0.99961082

US NATIONAL GRID DESIGNATOR: 13TCE8314234683(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
	NIST			94795.3
DN2107	EC01 EAGLE CORS ARP	N393906.551	W1065051.732	60582.3
DQ7576	TMG2 TABLE MOUNTAIN 2 CORS ARP	N400747.834	W1051358.999	97356.3

NEAREST NGS PUBLISHED CONTROL POINT

AI5954	20V C	N400315.483	W1062212.239	0.0
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AI5954_OPUS-Precise_2020-10-07.txt

11/27/2020

FILE: AI5954 TR8729433744423

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: ai59281o.20o

DATE: November 25, 2020
 TIME: 03:50:03 UTC

SOFTWARE: page5 2008.25 master53.pl 160321 START: 2020/10/07 14:27:00
 EPHEMERIS: igs21263.eph [precise] STOP: 2020/10/08 00:55:00
 NAV FILE: brdc2810.20n OBS USED: 29129 / 31487 :
 93%
 ANT NAME: TRMR10 NONE # FIXED AMB: 141 / 152 :
 93%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.014 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7673)

X:	-1378353.053 (m)	0.008 (m)	-1378353.977 (m)	0.008 (m)
Y:	-4692291.179 (m)	0.002 (m)	-4692289.871 (m)	0.002 (m)
Z:	4084046.378 (m)	0.009 (m)	4084046.251 (m)	0.009 (m)

LAT:	40 3 15.48248	0.007 (m)	40 3 15.50009	0.007 (m)
E LON:	253 37 47.75948	0.007 (m)	253 37 47.70653	0.007 (m)
W LON:	106 22 12.24052	0.007 (m)	106 22 12.29347	0.007 (m)
EL HGT:	2243.842 (m)	0.004 (m)	2242.999 (m)	0.004 (m)
ORTHO HGT:	2256.652 (m)	0.045 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4434683.278	385213.740
Easting (X) [meters]	383142.259	840166.315
Convergence [degrees]	-0.88175556	-0.56218056
Point Scale	0.99976811	0.99996269
Combined Factor	0.99941631	0.99961082

US NATIONAL GRID DESIGNATOR: 13TCE8314234683 (NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
	NIST			94795.3
DN2107	EC01 EAGLE CORS ARP	N393906.551	W1065051.732	60582.2
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	66068.4

NEAREST NGS PUBLISHED CONTROL POINT

AI5954	20V C	N400315.483	W1062212.239	0.0
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AI5954_OPUS-Precise_2020-10-09.txt

11/27/2020

FILE: AI5954 TR8730087657151

NGS OPUS SOLUTION REPORT
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USER: ben.hocker@woolpert.com
 RINEX FILE: ai59283p.20o

DATE: November 25, 2020
 TIME: 03:54:28 UTC

SOFTWARE: page5 2008.25 master52.pl 160321 START: 2020/10/09 15:51:00
 EPHEMERIS: igs21265.eph [precise] STOP: 2020/10/09 22:34:00
 NAV FILE: brdc2830.20n OBS USED: 19487 / 20563 :
 95%
 ANT NAME: TRMR10 NONE # FIXED AMB: 93 / 100 :
 93%
 ARP HEIGHT: 1.6541 OVERALL RMS: 0.014 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7727)

X:	-1378353.040 (m)	0.007 (m)	-1378353.964 (m)	0.007 (m)
Y:	-4692291.150 (m)	0.006 (m)	-4692289.842 (m)	0.006 (m)
Z:	4084046.364 (m)	0.008 (m)	4084046.237 (m)	0.008 (m)

LAT:	40 3 15.48281	0.007 (m)	40 3 15.50038	0.007 (m)
E LON:	253 37 47.75966	0.005 (m)	253 37 47.70671	0.005 (m)
W LON:	106 22 12.24034	0.005 (m)	106 22 12.29329	0.005 (m)
EL HGT:	2243.809 (m)	0.008 (m)	2242.966 (m)	0.008 (m)
ORTHO HGT:	2256.619 (m)	0.049 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4434683.288	385213.750
Easting (X) [meters]	383142.263	840166.319
Convergence [degrees]	-0.88175556	-0.56218056
Point Scale	0.99976811	0.99996269
Combined Factor	0.99941631	0.99961082

US NATIONAL GRID DESIGNATOR: 13TCE8314234683(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
	NIST			94795.3
DQ7576	TMG2 TABLE MOUNTAIN 2 CORS ARP	N400747.834	W1051358.999	97356.3
DQ7574	COBK BRECKENRIDGE CO CORS ARP	N393146.861	W1060251.646	64490.0

NEAREST NGS PUBLISHED CONTROL POINT

AI5954	20V C	N400315.483	W1062212.239	0.0
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JL0523_OPUS-Precise_2020-09-28.txt

11/27/2020

FILE: JL0523 TR8705140415400

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: jl05272p.20o

DATE: November 25, 2020
 TIME: 03:43:17 UTC

SOFTWARE: page5 2008.25 master92.pl 160321 START: 2020/09/28 15:43:00
 EPHEMERIS: igs21251.eph [precise] STOP: 2020/09/28 23:11:00
 NAV FILE: brdc2720.20n OBS USED: 19775 / 20789 :
 95%
 ANT NAME: TRMR10 NONE # FIXED AMB: 94 / 96 :
 98%
 ARP HEIGHT: 1.8396 OVERALL RMS: 0.015 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7427)

X:	-1458687.676 (m)	0.004 (m)	-1458688.591 (m)	0.004 (m)
Y:	-4780478.877 (m)	0.013 (m)	-4780477.552 (m)	0.013 (m)
Z:	3952731.630 (m)	0.008 (m)	3952731.492 (m)	0.008 (m)

LAT:	38 31 33.82756	0.012 (m)	38 31 33.84426	0.012 (m)
E LON:	253 1 52.53179	0.007 (m)	253 1 52.47970	0.007 (m)
W LON:	106 58 7.46821	0.007 (m)	106 58 7.52030	0.007 (m)
EL HGT:	2309.341 (m)	0.007 (m)	2308.473 (m)	0.007 (m)
ORTHO HGT:	2323.692 (m)	0.047 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4266022.354	382734.223
Easting (X) [meters]	328384.189	786333.039
Convergence [degrees]	-1.22656944	-0.92631944
Point Scale	0.99996271	0.99998592
Combined Factor	0.99960051	0.99962371

US NATIONAL GRID DESIGNATOR: 13SCC2838466022 (NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DQ3900	RG21 RG21FREEMNCO2006 CORS ARP	N374604.231	W1070633.057	85092.1
DL3478	R301 CRAWFORD CORS ARP	N383923.739	W1073527.367	56129.8
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	99355.9

NEAREST NGS PUBLISHED CONTROL POINT

JL0523	Y 423	N383133.828	W1065807.468	0.0
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JL0523_OPUS-Precise_2020-10-01.txt

11/27/2020

FILE: JL0523 TR8706001697236

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: jl05275r.20o

DATE: November 25, 2020
 TIME: 03:43:45 UTC

SOFTWARE: page5 2008.25 master93.pl 160321 START: 2020/10/01 17:12:00
 EPHEMERIS: igs21254.eph [precise] STOP: 2020/10/02 00:02:00
 NAV FILE: brdc2750.20n OBS USED: 17796 / 18721 :
 95%
 ANT NAME: TRMR10 NONE # FIXED AMB: 80 / 82 :
 98%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.016(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7510)

X:	-1458687.674 (m)	0.002 (m)	-1458688.590 (m)	0.002 (m)
Y:	-4780478.869 (m)	0.019 (m)	-4780477.544 (m)	0.019 (m)
Z:	3952731.650 (m)	0.007 (m)	3952731.512 (m)	0.007 (m)

LAT:	38 31 33.82824	0.006 (m)	38 31 33.84491	0.006 (m)
E LON:	253 1 52.53175	0.006 (m)	253 1 52.47966	0.006 (m)
W LON:	106 58 7.46825	0.006 (m)	106 58 7.52034	0.006 (m)
EL HGT:	2309.347 (m)	0.018 (m)	2308.479 (m)	0.018 (m)
ORTHO HGT:	2323.698 (m)	0.052 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4266022.375	382734.244
Easting (X) [meters]	328384.188	786333.038
Convergence [degrees]	-1.22656944	-0.92631944
Point Scale	0.99996271	0.99998592
Combined Factor	0.99960051	0.99962371

US NATIONAL GRID DESIGNATOR: 13SCC2838466022(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	99355.8
DQ3900	RG21 RG21FREEMNCO2006 CORS ARP	N374604.231	W1070633.057	85092.1
DL3478	R301 CRAWFORD CORS ARP	N383923.739	W1073527.367	56129.8

NEAREST NGS PUBLISHED CONTROL POINT

JL0523	Y 423	N383133.828	W1065807.468	0.0
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JL0523_OPUS-Precise_2020-10-03.txt

11/27/2020

FILE: JL0523 TR8707825208911

NGS OPUS SOLUTION REPORT
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USER: ben.hocker@woolpert.com
 RINEX FILE: jl05277n.20o

DATE: November 25, 2020
 TIME: 03:44:03 UTC

SOFTWARE: page5 2008.25 master94.pl 160321 START: 2020/10/03 13:53:00
 EPHEMERIS: igs21256.eph [precise] STOP: 2020/10/03 18:41:00
 NAV FILE: brdc2770.20n OBS USED: 11931 / 13395 :
 89%
 ANT NAME: TRMR10 NONE # FIXED AMB: 94 / 107 :
 88%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.019(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7560)

X:	-1458687.665 (m)	0.010 (m)	-1458688.581 (m)	0.010 (m)
Y:	-4780478.895 (m)	0.009 (m)	-4780477.570 (m)	0.009 (m)
Z:	3952731.633 (m)	0.001 (m)	3952731.495 (m)	0.001 (m)

LAT:	38 31 33.82734	0.006 (m)	38 31 33.84404	0.006 (m)
E LON:	253 1 52.53244	0.007 (m)	253 1 52.48031	0.007 (m)
W LON:	106 58 7.46756	0.007 (m)	106 58 7.51969	0.007 (m)
EL HGT:	2309.354 (m)	0.010 (m)	2308.486 (m)	0.010 (m)
ORTHO HGT:	2323.705 (m)	0.054 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4266022.347	382734.216
Easting (X) [meters]	328384.204	786333.054
Convergence [degrees]	-1.22656944	-0.92631944
Point Scale	0.99996271	0.99998592
Combined Factor	0.99960051	0.99962371

US NATIONAL GRID DESIGNATOR: 13SCC2838466022(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	99056.4
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	99355.9
DL3585	MC10 MONTROSE CORS ARP	N382720.137	W1075242.393	79776.9

NEAREST NGS PUBLISHED CONTROL POINT

JL0523	Y 423	N383133.828	W1065807.468	0.0
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JL0523_OPUS-RS-Precise_2020-10-02.txt

11/27/2020

FILE: JL0523 TR8706321220438

NGS OPUS-RS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
RINEX FILE: jl05276w.20oDATE: November 25, 2020
TIME: 03:13:10 UTC

SOFTWARE: rsgps 1.38 RS93.prl 1.99.3 START: 2020/10/02 22:59:30
 EPHEMERIS: igs21255.eph [precise] STOP: 2020/10/03 00:57:50
 NAV FILE: brdc2760.20n OBS USED: 9423 / 11511 :
 82%
 ANT NAME: TRMR10 NONE QUALITY IND. 32.59/ 79.17
 ARP HEIGHT: 1.8 NORMALIZED RMS: 0.365

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
(EPOCH:2020.75410)

X:	-1458687.668 (m)	0.007 (m)	-1458688.584 (m)	0.007 (m)
Y:	-4780478.875 (m)	0.023 (m)	-4780477.550 (m)	0.023 (m)
Z:	3952731.626 (m)	0.016 (m)	3952731.488 (m)	0.016 (m)
LAT:	38 31 33.82756	0.007 (m)	38 31 33.84422	0.007 (m)
E LON:	253 1 52.53208	0.005 (m)	253 1 52.47995	0.005 (m)
W LON:	106 58 7.46792	0.005 (m)	106 58 7.52005	0.005 (m)
EL HGT:	2309.335 (m)	0.028 (m)	2308.467 (m)	0.028 (m)
ORTHO HGT:	2323.686 (m)	0.033 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4266022.353	382734.223
Easting (X) [meters]	328384.196	786333.046
Convergence [degrees]	-1.22656944	-0.92631944
Point Scale	0.99996271	0.99998592
Combined Factor	0.99960051	0.99962371

US NATIONAL GRID DESIGNATOR: 13SCC2838466022(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DN2107	EC01 EAGLE CORS ARP	N393906.551	W1065051.732	125457.0
DQ3903	RG23 RG23SANDNPCO2006 CORS ARP	N374437.922	W1052954.609	155464.9
DL3585	MC10 MONTROSE CORS ARP	N382720.137	W1075242.393	79776.8
DL3478	R301 CRAWFORD CORS ARP	N383923.739	W1073527.367	56129.8
DQ7574	COBK BRECKENRIDGE CO CORS ARP	N393146.861	W1060251.646	137073.8
DG7426	P037 FREEMONTAPCO2004 CORS ARP	N382518.293	W1050616.819	163122.5
DQ3900	RG21 RG21FREEMNCO2006 CORS ARP	N374604.231	W1070633.057	85092.1
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	99056.4
AI2151	DSRC BOULDER CORS ARP	N395929.130	W1051539.675	219573.9

NEAREST NGS PUBLISHED CONTROL POINT

JL0523	Y 423	N383133.828	W1065807.468	0.0
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LL0732_OPUS-Precise_2020-10-05.txt

11/27/2020

FILE: LL0732 TR8733592247209

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: 1107279u.20o

DATE: November 25, 2020
 TIME: 03:57:20 UTC

SOFTWARE: page5 2008.25 master55.pl 160321 START: 2020/10/05 20:44:00
 EPHEMERIS: igs21261.eph [precise] STOP: 2020/10/05 23:23:00
 NAV FILE: brdc2790.20n OBS USED: 7214 / 8287 :
 87%
 ANT NAME: TRMR10 NONE # FIXED AMB: 50 / 58 :
 86%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.018 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7621)

X:	-1341323.039 (m)	0.014 (m)	-1341323.963 (m)	0.014 (m)
Y:	-4699161.177 (m)	0.005 (m)	-4699159.868 (m)	0.005 (m)
Z:	4088693.301 (m)	0.006 (m)	4088693.174 (m)	0.006 (m)

LAT:	40 6 27.95803	0.006 (m)	40 6 27.97589	0.006 (m)
E LON:	254 4 9.10852	0.014 (m)	254 4 9.05585	0.014 (m)
W LON:	105 55 50.89148	0.014 (m)	105 55 50.94415	0.014 (m)
EL HGT:	2403.762 (m)	0.002 (m)	2402.912 (m)	0.002 (m)
ORTHO HGT:	2416.362 (m)	0.061 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4440133.456	390875.128
Easting (X) [meters]	420671.362	877673.395
Convergence [degrees]	-0.59968056	-0.27835556
Point Scale	0.99967747	0.99995994
Combined Factor	0.99930064	0.99958300

US NATIONAL GRID DESIGNATOR: 13TDE2067140133(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DQ7574	COBK BRECKENRIDGE CO CORS ARP	N393146.861	W1060251.646	64988.2
DG7429	P041 MARSHALL FIELD CORS ARP	N395658.150	W1051139.316	65304.7
DM5962	CTMC CDOT GOLDEN CORS ARP	N394317.493	W1051134.335	76315.0

NEAREST NGS PUBLISHED CONTROL POINT

LL0732	E 361	N400627.957	W1055550.891	0.0
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LL0732_OPUS-Precise_2020-10-08.txt

11/27/2020

FILE: LL0732 TR8734252241626

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: 1107282p.20o

DATE: November 25, 2020
 TIME: 03:58:31 UTC

SOFTWARE: page5 2008.25 master51.pl 160321 START: 2020/10/08 15:15:00
 EPHEMERIS: igs21264.eph [precise] STOP: 2020/10/09 00:09:00
 NAV FILE: brdc2820.20n OBS USED: 25351 / 27295 :
 93%
 ANT NAME: TRMR10 NONE # FIXED AMB: 104 / 120 :
 87%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.016(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7700)

X:	-1341323.034 (m)	0.004 (m)	-1341323.958 (m)	0.004 (m)
Y:	-4699161.153 (m)	0.007 (m)	-4699159.844 (m)	0.007 (m)
Z:	4088693.288 (m)	0.004 (m)	4088693.161 (m)	0.004 (m)

LAT:	40 6 27.95821	0.005 (m)	40 6 27.97607	0.005 (m)
E LON:	254 4 9.10844	0.005 (m)	254 4 9.05578	0.005 (m)
W LON:	105 55 50.89156	0.005 (m)	105 55 50.94422	0.005 (m)
EL HGT:	2403.735 (m)	0.005 (m)	2402.885 (m)	0.005 (m)
ORTHO HGT:	2416.335 (m)	0.048 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4440133.462	390875.134
Easting (X) [meters]	420671.360	877673.394
Convergence [degrees]	-0.59968056	-0.27835556
Point Scale	0.99967747	0.99995994
Combined Factor	0.99930064	0.99958301

US NATIONAL GRID DESIGNATOR: 13TDE2067140133(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
	NIST			58398.5
DG7429	P041 MARSHALL FIELD CORS ARP	N395658.150	W1051139.316	65304.7
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	91286.1

NEAREST NGS PUBLISHED CONTROL POINT

LL0732	E 361	N400627.957	W1055550.891	0.0
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LL0732_OPUS-Precise_2020-10-09.txt

11/27/2020

FILE: LL0732 TR8734952120442

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: 1107283s.20o

DATE: November 25, 2020
 TIME: 04:00:07 UTC

SOFTWARE: page5 2008.25 master73.pl 160321 START: 2020/10/09 18:09:00
 EPHEMERIS: igs21265.eph [precise] STOP: 2020/10/09 21:44:00
 NAV FILE: brdc2830.20n OBS USED: 10630 / 11331 :
 94%
 ANT NAME: TRMR10 NONE # FIXED AMB: 56 / 57 :
 98%
 ARP HEIGHT: 2.05 OVERALL RMS: 0.014 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7728)

X:	-1341323.043 (m)	0.003 (m)	-1341323.967 (m)	0.003 (m)
Y:	-4699161.160 (m)	0.007 (m)	-4699159.851 (m)	0.007 (m)
Z:	4088693.255 (m)	0.002 (m)	4088693.128 (m)	0.002 (m)
LAT:	40 6 27.95720	0.003 (m)	40 6 27.97506	0.003 (m)
E LON:	254 4 9.10816	0.003 (m)	254 4 9.05549	0.003 (m)
W LON:	105 55 50.89184	0.003 (m)	105 55 50.94451	0.003 (m)
EL HGT:	2403.721 (m)	0.006 (m)	2402.871 (m)	0.006 (m)
ORTHO HGT:	2416.321 (m)	0.055 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4440133.431	390875.102
Easting (X) [meters]	420671.353	877673.387
Convergence [degrees]	-0.59968056	-0.27835556
Point Scale	0.99967747	0.99995994
Combined Factor	0.99930065	0.99958301

US NATIONAL GRID DESIGNATOR: 13TDE2067140133(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
	NIST			58398.5
DG7429	P041 MARSHALL FIELD CORS ARP	N395658.150	W1051139.316	65304.7
DQ7576	TMG2 TABLE MOUNTAIN 2 CORS ARP	N400747.834	W1051358.999	59554.1

NEAREST NGS PUBLISHED CONTROL POINT

LL0732	E 361	N400627.957	W1055550.891	0.0
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MP74_OPUS-Precise_2020-09-29.txt

11/27/2020

FILE: MP7.4 TR8708632947209

NGS OPUS SOLUTION REPORT
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USER: ben.hocker@woolpert.com
RINEX FILE: mp7_273p.20o

DATE: November 25, 2020
TIME: 03:44:36 UTC

SOFTWARE: page5 2008.25 master55.pl 160321 START: 2020/09/29 15:22:00
EPHEMERIS: igs21252.eph [precise] STOP: 2020/09/29 22:23:00
NAV FILE: brdc2730.20n OBS USED: 14784 / 16632 :
89%
ANT NAME: TRMR10 NONE # FIXED AMB: 109 / 123 :
89%
ARP HEIGHT: 1.6049 OVERALL RMS: 0.018 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
(EPOCH:2020.7453)

X:	-1448421.329 (m)	0.008 (m)	-1448422.245 (m)	0.008 (m)
Y:	-4775870.038 (m)	0.004 (m)	-4775868.714 (m)	0.004 (m)
Z:	3962173.822 (m)	0.015 (m)	3962173.685 (m)	0.015 (m)

LAT:	38 38 2.66075	0.010 (m)	38 38 2.67756	0.010 (m)
E LON:	253 7 42.77510	0.008 (m)	253 7 42.72298	0.008 (m)
W LON:	106 52 17.22490	0.008 (m)	106 52 17.27702	0.008 (m)
EL HGT:	2414.875 (m)	0.011 (m)	2414.008 (m)	0.011 (m)
ORTHO HGT:	2429.135 (m)	0.056 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4277831.718	394589.803
Easting (X) [meters]	337109.912	794996.675
Convergence [degrees]	-1.16868611	-0.86496111
Point Scale	0.99992675	0.99996891
Combined Factor	0.99954802	0.99959016

US NATIONAL GRID DESIGNATOR: 13SCC3710977831(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	105228.3
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	90069.5
DL3478	R301 CRAWFORD CORS ARP	N383923.739	W1073527.367	62708.7

NEAREST NGS PUBLISHED CONTROL POINT

JL0246	F 160	N383833.000	W1065141.000	1281.7
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MP74_OPUS-Precise_2020-10-03.txt

11/27/2020

FILE: MP7.4 TR8709197391973

NGS OPUS SOLUTION REPORT
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USER: ben.hocker@woolpert.com
RINEX FILE: mp7_277v.20o

DATE: November 25, 2020
TIME: 03:44:44 UTC

SOFTWARE: page5 2008.25 master52.pl 160321 START: 2020/10/03 21:15:00
EPHEMERIS: igs21256.eph [precise] STOP: 2020/10/04 00:38:00
NAV FILE: brdc2770.20n OBS USED: 7182 / 7623 :
94%
ANT NAME: TRMR10 NONE # FIXED AMB: 54 / 56 :
96%
ARP HEIGHT: 1.8 OVERALL RMS: 0.019(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
(EPOCH:2020.7567)

X:	-1448421.315 (m)	0.009 (m)	-1448422.231 (m)	0.009 (m)
Y:	-4775870.068 (m)	0.004 (m)	-4775868.744 (m)	0.004 (m)
Z:	3962173.826 (m)	0.017 (m)	3962173.689 (m)	0.017 (m)

LAT:	38 38 2.66035	0.017 (m)	38 38 2.67716	0.017 (m)
E LON:	253 7 42.77600	0.008 (m)	253 7 42.72391	0.008 (m)
W LON:	106 52 17.22400	0.008 (m)	106 52 17.27609	0.008 (m)
EL HGT:	2414.897 (m)	0.007 (m)	2414.029 (m)	0.007 (m)
ORTHO HGT:	2429.157 (m)	0.063 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4277831.706	394589.791
Easting (X) [meters]	337109.934	794996.696
Convergence [degrees]	-1.16868611	-0.86496111
Point Scale	0.99992675	0.99996891
Combined Factor	0.99954802	0.99959016

US NATIONAL GRID DESIGNATOR: 13SCC3710977831(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DL2035	GSC1 GLENWOOD SPRINGS CORS ARP	N393249.050	W1071939.079	108792.1
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	90069.5
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	105228.3

NEAREST NGS PUBLISHED CONTROL POINT

JL0246	F 160	N383833.000	W1065141.000	1281.7
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TCP1_OPUS-Precise_2020-09-30.txt

11/27/2020

FILE: TCP1 TR8710585359757

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: tcp1274o.20o

DATE: November 25, 2020
 TIME: 03:45:11 UTC

SOFTWARE: page5 2008.25 master95.pl 160321 START: 2020/09/30 14:19:00
 EPHEMERIS: igs21253.eph [precise] STOP: 2020/09/30 23:56:00
 NAV FILE: brdc2740.20n OBS USED: 22792 / 25431 :
 90%
 ANT NAME: TRMR10 NONE # FIXED AMB: 163 / 179 :
 91%
 ARP HEIGHT: 1.6962 OVERALL RMS: 0.019(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7481)

X:	-1453100.946(m)	0.003(m)	-1453101.862(m)	0.003(m)
Y:	-4777467.491(m)	0.018(m)	-4777466.167(m)	0.018(m)
Z:	3958481.505(m)	0.007(m)	3958481.368(m)	0.007(m)

LAT:	38 35 30.69683	0.006(m)	38 35 30.71360	0.006(m)
E LON:	253 4 56.94848	0.002(m)	253 4 56.89639	0.002(m)
W LON:	106 55 3.05152	0.002(m)	106 55 3.10361	0.002(m)
EL HGT:	2367.639(m)	0.019(m)	2366.771(m)	0.019(m)
ORTHO HGT:	2381.946(m)	0.054(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4273229.915	389966.169
Easting (X) [meters]	333002.413	790913.422
Convergence [degrees]	-1.19636111	-0.89401111
Point Scale	0.99994344	0.99997514
Combined Factor	0.99957211	0.99960380

US NATIONAL GRID DESIGNATOR: 13SCC3300273229(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DL6159	SE01 CARBONDALE CORS ARP	N392401.241	W1071243.517	93343.0
DH6918	MC05 MESA CNTY 05 COOP CORS ARP	N384422.384	W1080422.684	101922.5
DL3585	MC10 MONTROSE CORS ARP	N382720.137	W1075242.393	85179.9

NEAREST NGS PUBLISHED CONTROL POINT

JL0248	H 160	N383514.000	W1065414.000	1293.9
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TCP1_OPUS-Precise_2020-10-03.txt

11/27/2020

FILE: TCP1 TR8711198673185

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
RINEX FILE: tcp1277s.20oDATE: November 25, 2020
TIME: 03:45:27 UTC

SOFTWARE: page5 2008.25 master96.pl 160321 START: 2020/10/03 19:00:00
 EPHEMERIS: igs21256.eph [precise] STOP: 2020/10/03 21:01:00
 NAV FILE: brdc2770.20n OBS USED: 6261 / 6484 :
 97%
 ANT NAME: TRMR10 NONE # FIXED AMB: 33 / 35 :
 94%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.013 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
(EPOCH:2020.7564)

X:	-1453100.959 (m)	0.005 (m)	-1453101.875 (m)	0.005 (m)
Y:	-4777467.543 (m)	0.024 (m)	-4777466.219 (m)	0.024 (m)
Z:	3958481.544 (m)	0.003 (m)	3958481.407 (m)	0.003 (m)

LAT:	38 35 30.69676	0.013 (m)	38 35 30.71350	0.013 (m)
E LON:	253 4 56.94859	0.011 (m)	253 4 56.89650	0.011 (m)
W LON:	106 55 3.05141	0.011 (m)	106 55 3.10350	0.011 (m)
EL HGT:	2367.705 (m)	0.018 (m)	2366.838 (m)	0.018 (m)
ORTHO HGT:	2382.012 (m)	0.068 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0502 CO C)
Northing (Y) [meters]	4273229.913	389966.167
Easting (X) [meters]	333002.416	790913.424
Convergence [degrees]	-1.19636111	-0.89401111
Point Scale	0.99994344	0.99997514
Combined Factor	0.99957210	0.99960379

US NATIONAL GRID DESIGNATOR: 13SCC3300273229(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DL3585	MC10 MONTROSE CORS ARP	N382720.137	W1075242.393	85179.9
DL3478	R301 CRAWFORD CORS ARP	N383923.739	W1073527.367	59102.9
DQ3900	RG21 RG21FREEMNCO2006 CORS ARP	N374604.231	W1070633.057	93032.3

NEAREST NGS PUBLISHED CONTROL POINT

JL0248	H 160	N383514.000	W1065414.000	1293.9
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TCP2_OPUS-Rapid_2020-10-05.txt

11/27/2020

FILE: TCP2_01122791_5s.20o OP1603130221141

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: tcp2279p.20o

DATE: October 19, 2020
 TIME: 17:59:41 UTC

SOFTWARE: page5 2008.25 master92.pl 160321 START: 2020/10/05 15:11:00
 EPHEMERIS: igr21261.eph [rapid] STOP: 2020/10/05 20:02:00
 NAV FILE: brdc2790.20n OBS USED: 13804 / 14898 :
 93%
 ANT NAME: TRMR10 NONE # FIXED AMB: 75 / 78 :
 96%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.016(m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7616)

X:	-1364782.919 (m)	0.009 (m)	-1364783.842 (m)	0.009 (m)
Y:	-4695374.432 (m)	0.013 (m)	-4695373.123 (m)	0.013 (m)
Z:	4085118.987 (m)	0.001 (m)	4085118.860 (m)	0.001 (m)

LAT:	40 3 59.74934	0.009 (m)	40 3 59.76702	0.009 (m)
E LON:	253 47 33.64739	0.005 (m)	253 47 33.59458	0.005 (m)
W LON:	106 12 26.35261	0.005 (m)	106 12 26.40542	0.005 (m)
EL HGT:	2286.193 (m)	0.012 (m)	2285.346 (m)	0.012 (m)
ORTHO HGT:	2299.022 (m)	0.057 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4435847.165	386455.477
Easting (X) [meters]	397042.377	854062.684
Convergence [degrees]	-0.77719444	-0.45702222
Point Scale	0.99973049	0.99996198
Combined Factor	0.99937206	0.99960347

US NATIONAL GRID DESIGNATOR: 13TCE9704235847(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	74730.0
DQ7574	COBK BRECKENRIDGE CO CORS ARP	N393146.861	W1060251.646	61188.2
	NIST			81054.4

NEAREST NGS PUBLISHED CONTROL POINT

LM0192	T 138	N400400001.	W1061200024.	63.4
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TCP2_OPUS-Rapid_2020-10-06.txt

11/27/2020

FILE: TCP2_01122800_5s.20o OP1603130285574

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: tcp2280m.20o

DATE: October 19, 2020
 TIME: 18:00:26 UTC

SOFTWARE: page5 2008.25 master94.pl 160321 START: 2020/10/06 12:52:00
 EPHEMERIS: igr21262.eph [rapid] STOP: 2020/10/06 20:04:00
 NAV FILE: brdc2800.20n OBS USED: 18317 / 19922 :
 92%
 ANT NAME: TRMR10 NONE # FIXED AMB: 116 / 128 :
 91%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.014 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7642)

X:	-1364782.930 (m)	0.006 (m)	-1364783.854 (m)	0.006 (m)
Y:	-4695374.459 (m)	0.006 (m)	-4695373.150 (m)	0.006 (m)
Z:	4085118.997 (m)	0.007 (m)	4085118.870 (m)	0.007 (m)
LAT:	40 3 59.74898	0.007 (m)	40 3 59.76666	0.007 (m)
E LON:	253 47 33.64724	0.006 (m)	253 47 33.59443	0.006 (m)
W LON:	106 12 26.35276	0.006 (m)	106 12 26.40557	0.006 (m)
EL HGT:	2286.221 (m)	0.006 (m)	2285.375 (m)	0.006 (m)
ORTHO HGT:	2299.050 (m)	0.051 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4435847.154	386455.466
Easting (X) [meters]	397042.374	854062.681
Convergence [degrees]	-0.77719444	-0.45702222
Point Scale	0.99973049	0.99996198
Combined Factor	0.99937206	0.99960347

US NATIONAL GRID DESIGNATOR: 13TCE9704235847(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DQ7574	COBK BRECKENRIDGE CO CORS ARP	N393146.861	W1060251.646	61188.2
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	74730.0
	NIST			81054.4

NEAREST NGS PUBLISHED CONTROL POINT

LM0192	T 138	N400400001.	W1061200024.	63.4
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TCP2_OPUS-Rapid_2020-10-07.txt

11/27/2020

FILE: TCP2_15782812_5s.20o OP1603130357768

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: tcp2281x.20o

DATE: October 19, 2020
 TIME: 18:01:16 UTC

SOFTWARE: page5 2008.25 master93.pl 160321 START: 2020/10/07 23:01:00
 EPHEMERIS: igr21263.eph [rapid] STOP: 2020/10/08 01:23:00
 NAV FILE: brdc2810.20n OBS USED: 5699 / 6063 :
 94%
 ANT NAME: TRMR10 NONE # FIXED AMB: 37 / 38 :
 97%
 ARP HEIGHT: 1.623 OVERALL RMS: 0.012 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7678)

X:	-1364782.924 (m)	0.002 (m)	-1364783.848 (m)	0.002 (m)
Y:	-4695374.432 (m)	0.005 (m)	-4695373.123 (m)	0.005 (m)
Z:	4085118.990 (m)	0.012 (m)	4085118.863 (m)	0.012 (m)

LAT:	40 3 59.74938	0.008 (m)	40 3 59.76706	0.008 (m)
E LON:	253 47 33.64717	0.002 (m)	253 47 33.59436	0.002 (m)
W LON:	106 12 26.35283	0.002 (m)	106 12 26.40564	0.002 (m)
EL HGT:	2286.196 (m)	0.011 (m)	2285.349 (m)	0.011 (m)
ORTHO HGT:	2299.025 (m)	0.064 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4435847.166	386455.478
Easting (X) [meters]	397042.372	854062.679
Convergence [degrees]	-0.77719444	-0.45702222
Point Scale	0.99973049	0.99996198
Combined Factor	0.99937206	0.99960347

US NATIONAL GRID DESIGNATOR: 13TCE9704235847 (NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
	NIST			81054.4
DG7429	P041 MARSHALL FIELD CORS ARP	N395658.150	W1051139.316	87499.4
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	74730.0

NEAREST NGS PUBLISHED CONTROL POINT

LM0192	T 138	N400400001.	W1061200024.	63.4
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TCP2_OPUS-Rapid_2020-10-08.txt

11/27/2020

FILE: TCP2_15782820_5s.20o OP1603130395447

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: tcp2282v.20o

DATE: October 19, 2020
 TIME: 18:01:24 UTC

SOFTWARE: page5 2008.25 master92.pl 160321 START: 2020/10/08 21:33:00
 EPHEMERIS: igr21264.eph [rapid] STOP: 2020/10/09 01:04:00
 NAV FILE: brdc2820.20n OBS USED: 8944 / 9702 :
 92%
 ANT NAME: TRMR10 NONE # FIXED AMB: 57 / 57 :
 100%
 ARP HEIGHT: 1.642 OVERALL RMS: 0.013 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7704)

X:	-1364782.906 (m)	0.002 (m)	-1364783.830 (m)	0.002 (m)
Y:	-4695374.431 (m)	0.004 (m)	-4695373.122 (m)	0.004 (m)
Z:	4085118.984 (m)	0.005 (m)	4085118.857 (m)	0.005 (m)

LAT:	40 3 59.74934	0.005 (m)	40 3 59.76706	0.005 (m)
E LON:	253 47 33.64789	0.002 (m)	253 47 33.59508	0.002 (m)
W LON:	106 12 26.35211	0.002 (m)	106 12 26.40492	0.002 (m)
EL HGT:	2286.187 (m)	0.002 (m)	2285.341 (m)	0.002 (m)
ORTHO HGT:	2299.016 (m)	0.058 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4435847.165	386455.477
Easting (X) [meters]	397042.389	854062.696
Convergence [degrees]	-0.77719167	-0.45702222
Point Scale	0.99973049	0.99996198
Combined Factor	0.99937207	0.99960347

US NATIONAL GRID DESIGNATOR: 13TCE9704235847 (NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	74730.0
DG7429	P041 MARSHALL FIELD CORS ARP	N395658.150	W1051139.316	87499.4
	NIST			81054.4

NEAREST NGS PUBLISHED CONTROL POINT

LM0192	T 138	N400400001.	W1061200024.	63.4
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TCP2_OPUS-Rapid_2020-10-09.txt

11/27/2020

FILE: TCP2_15782831_5s.20o OP1603130422778

NGS OPUS SOLUTION REPORT

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USER: ben.hocker@woolpert.com
 RINEX FILE: tcp2283o.20o

DATE: October 19, 2020
 TIME: 18:01:44 UTC

SOFTWARE: page5 2008.25 master90.pl 160321 START: 2020/10/09 14:07:00
 EPHEMERIS: igr21265.eph [rapid] STOP: 2020/10/09 22:10:00
 NAV FILE: brdc2830.20n OBS USED: 22366 / 24205 :
 92%
 ANT NAME: TRMR10 NONE # FIXED AMB: 112 / 118 :
 95%
 ARP HEIGHT: 1.8 OVERALL RMS: 0.014 (m)

REF FRAME: NAD 83 (2011) (EPOCH:2010.0000) ITRF2014
 (EPOCH:2020.7726)

X:	-1364782.927 (m)	0.003 (m)	-1364783.851 (m)	0.003 (m)
Y:	-4695374.459 (m)	0.010 (m)	-4695373.150 (m)	0.010 (m)
Z:	4085119.001 (m)	0.000 (m)	4085118.874 (m)	0.000 (m)

LAT:	40 3 59.74909	0.007 (m)	40 3 59.76677	0.007 (m)
E LON:	253 47 33.64739	0.002 (m)	253 47 33.59454	0.002 (m)
W LON:	106 12 26.35261	0.002 (m)	106 12 26.40546	0.002 (m)
EL HGT:	2286.223 (m)	0.008 (m)	2285.377 (m)	0.008 (m)
ORTHO HGT:	2299.052 (m)	0.051 (m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 13)	SPC (0501 CO N)
Northing (Y) [meters]	4435847.157	386455.469
Easting (X) [meters]	397042.377	854062.684
Convergence [degrees]	-0.77719444	-0.45702222
Point Scale	0.99973049	0.99996198
Combined Factor	0.99937206	0.99960347

US NATIONAL GRID DESIGNATOR: 13TCE9704235847(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DQ5297	STBT STEAMBOAT SPRINGS CORS ARP	N403045.775	W1065153.788	74730.0
	NIST			81054.4
DN2107	EC01 EAGLE CORS ARP	N393906.551	W1065051.732	71603.4

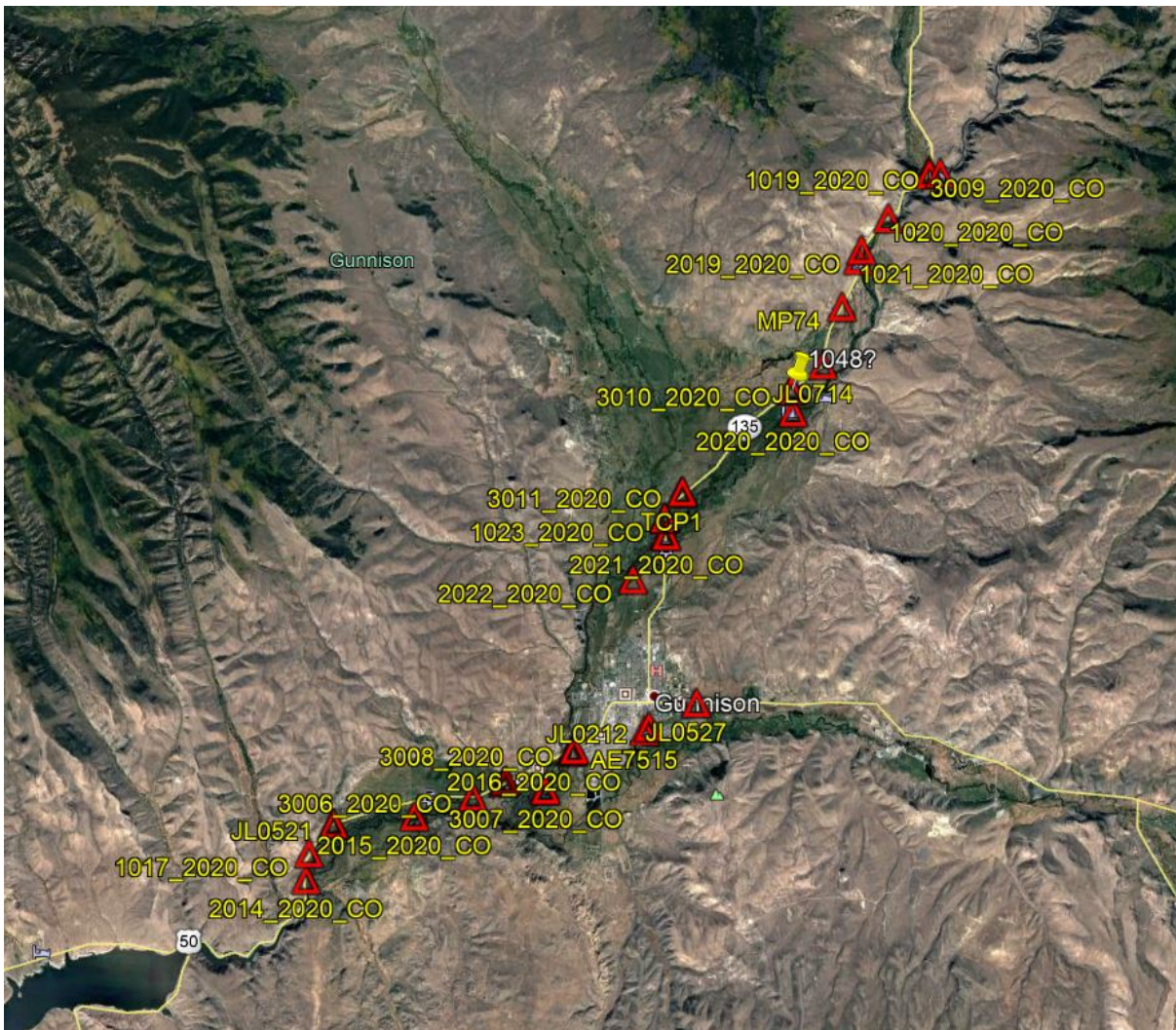
NEAREST NGS PUBLISHED CONTROL POINT

LM0192	T 138	N400400001.	W1061200024.	63.4
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Section 5: GPS Control Diagram

This section contains a graphical representation of the new and existing control stations used for the project.

Gunnison Control Network:

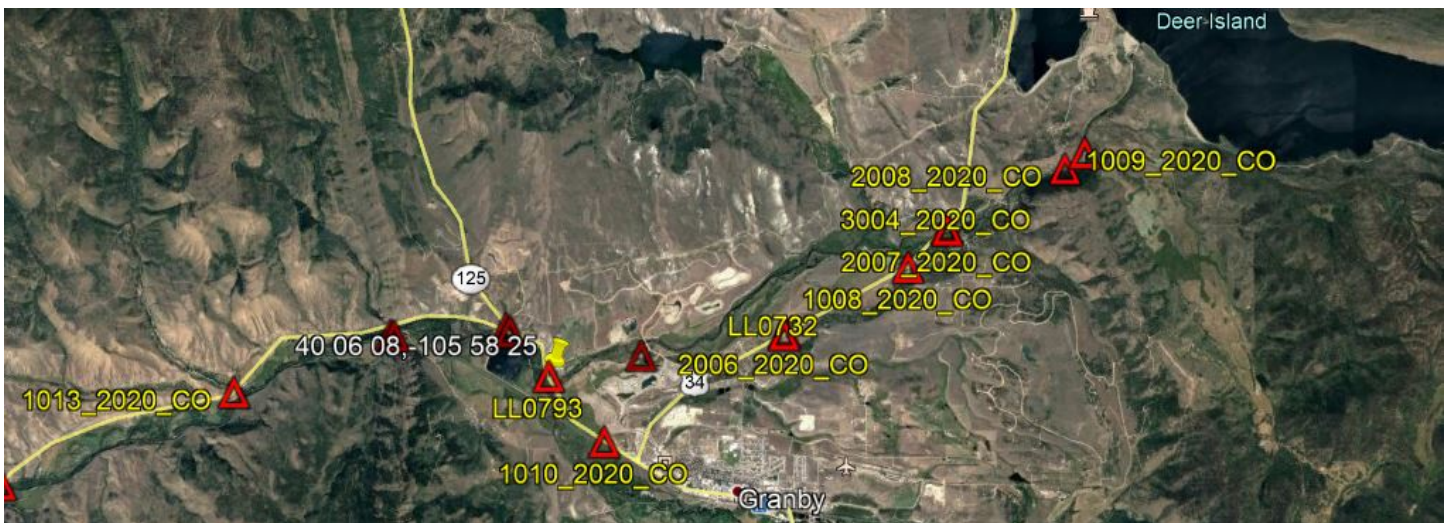


Upper Colorado West End Control Network:



Not to Scale

Upper Colorado East End Control Network:



Not to Scale