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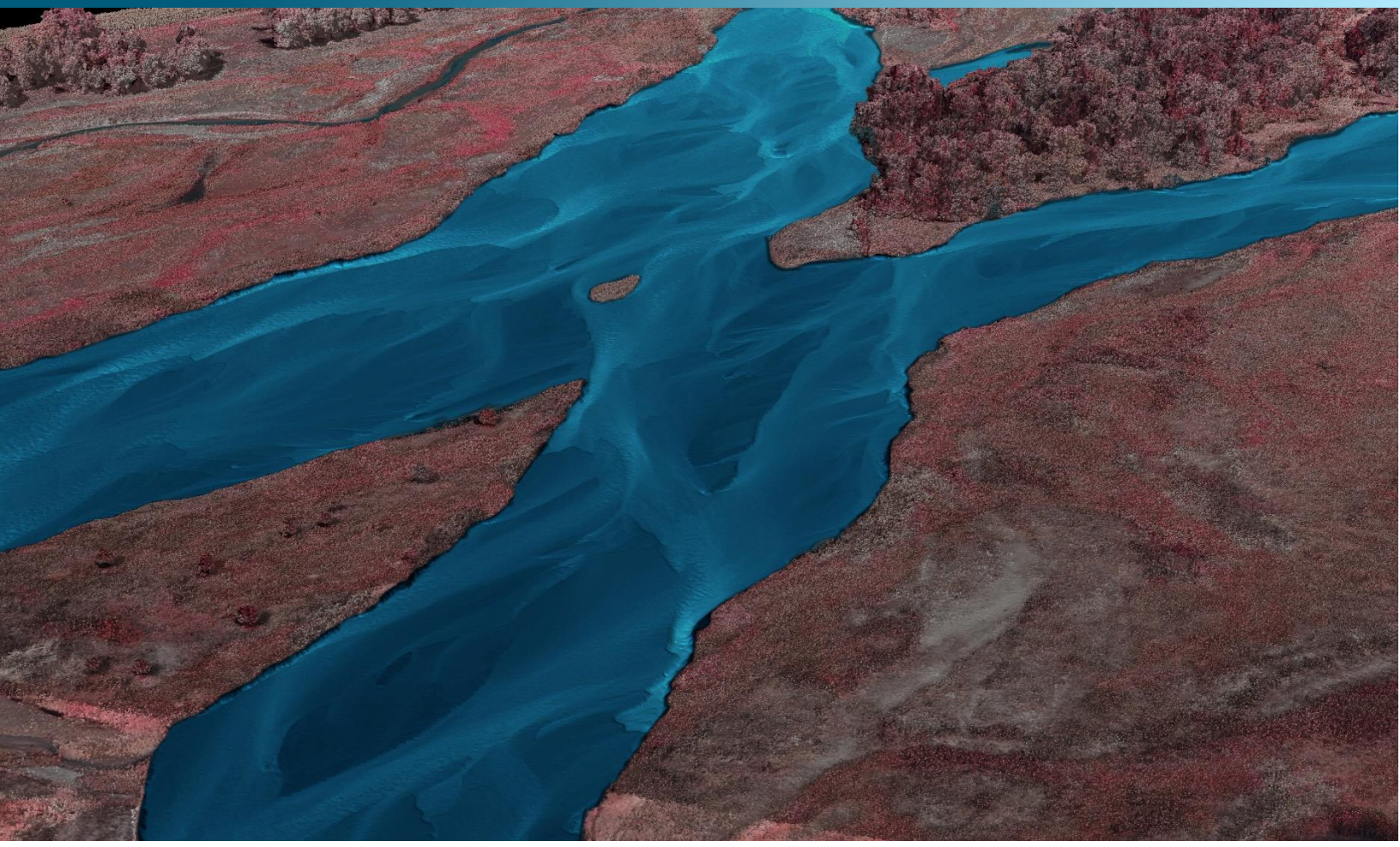

Platte River, Nebraska Fall 2021

Topobathymetric Lidar Technical Data Report

Prepared For:

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Table of Contents

Cover Photo: A view of the Platte River topobathymetric model overlayed with above ground point cloud colored by NIR orthoimagery.

INTRODUCTION

A scenic photo taken by NV5 Geospatial acquisition staff shows a view of the Platte River in Nebraska (taken in November 2021).

In May 2020, NV5 Geospatial (NV5) was contracted by Headwaters corporation to collect topobathymetic lidar data and digital imagery in the fall of 2021 as part of a multi-year (2020-2023) contract over the Platte River in central Nebraska. This data collection is part of NV5 Geospatial's ongoing partnership with Headwaters Corporation to provide data aiding in the Platte River Recovery Implementation Program. The Program is aimed at enhancing, restoring, and protecting the habitat for endangered species associated with the river system, specifically targeting the whooping crane, least tern, piping plover, and pallid sturgeon species. Traditional near-infrared (NIR) lidar was fully integrated with green wavelength (bathymetric) lidar in order to provide a seamless topobathymetric lidar dataset for analysis. This type of lidar data is well-suited for use in riverine locations, and is useful for assessing channel morphology and accurately modeling the topobathymetric surface inside of the study area.

This report accompanies the final delivered topobathymetric lidar data and documents contract specifications, data acquisition procedures, processing methods, and analysis of the final dataset including accuracy assessments, depth penetration, and density. Acquisition dates and acreage are shown in Table 1, a complete list of contracted deliverables provided to Headwaters corporation is shown in Table 2, and the project extent is shown in Figure 1.

Table 1: Acquisition dates, acreage, and data types collected on the Platte River Fall 2021 site

Project Site	Total Acres	Acquisition Dates	Data Type
Platte River Fall 2021, Nebraska	89,948	11/04/2021 – 11/09/2021	Topobathymetric Lidar

Deliverable Products

Table 2: Products delivered to Headwaters corporation for the Platte River Fall 2021 site

Platte River Fall 2021 Lidar Products Projection: Nebraska State Plane Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: US Survey Feet	
Topobathymetric Lidar	
Points	LAS v 1.4 • All Classified Returns
Rasters	3.0 Foot ERDAS Imagine files (*.img) • Unclipped Topobathymetric Bare Earth Digital Elevation Models (DEM) • Clipped Topobathymetric Bare Earth Digital Elevation Models (DEM) • Bare Earth & Water Surface Models with Hydroflattened Ponds (DEM) • Highest Hit Digital Surface Model (DSM) • Depth Raster (Water Surface Model – Topobathymetric DEM) 1.5 Foot GeoTiffs • Green Sensor Intensity Images • NIR Sensor Intensity Images
Vectors	Shapefiles (*.shp) • Project Boundary • Lidar Tile Index (1,500 ft x 1,500 ft) • RasterTile Index • Bathymetric Coverage Polygon • Hydroflattened Pond Breaklines with Z values • Water's Edge Breaklines without Z values (used for bathymetric refraction correction) • Ground Survey Shapes

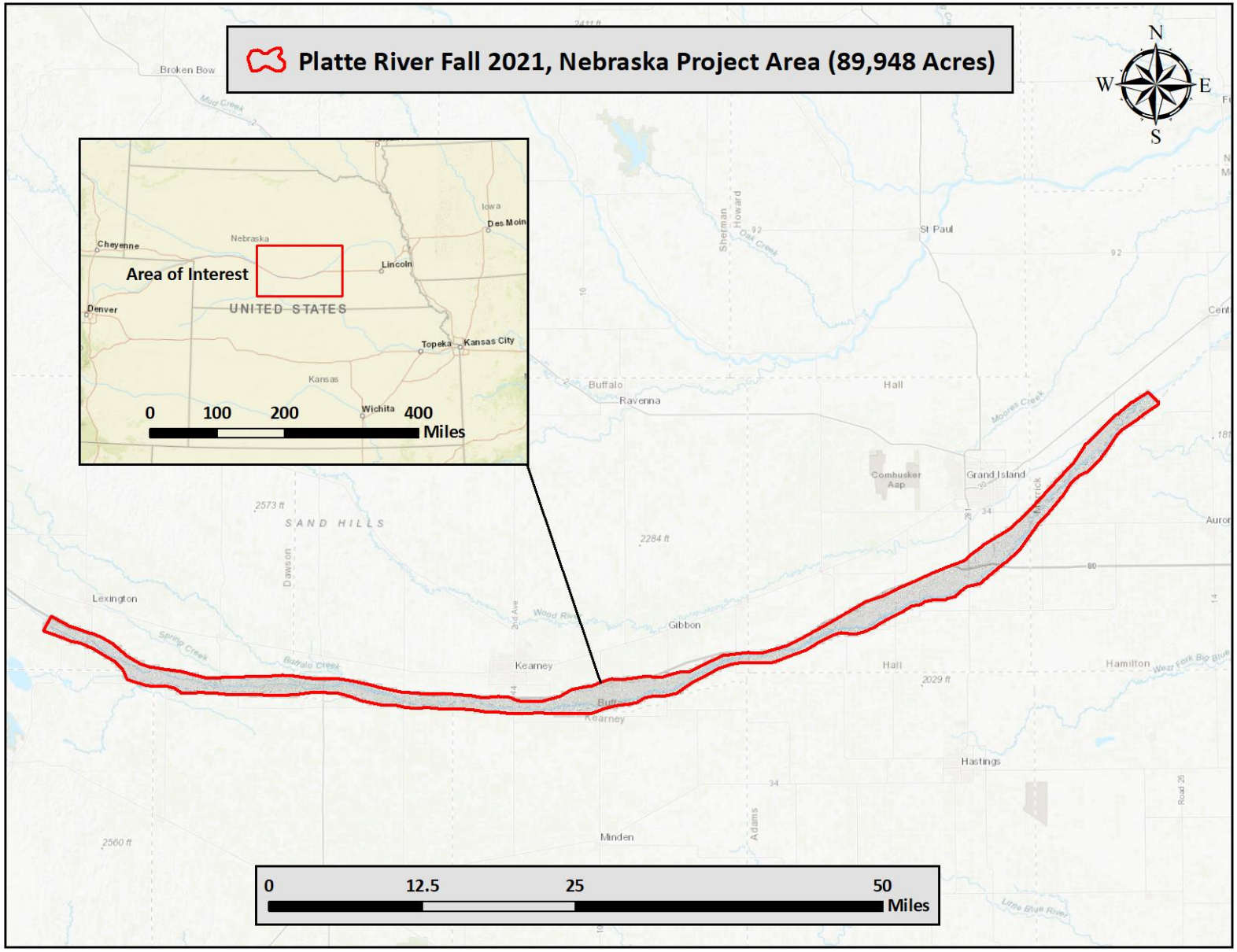


Figure 1: Location map of the Platte River Fall 2021 site in Nebraska

ACQUISITION

NV5 Geospatial's ground survey equipment set up in the Platte River Fall 2021 Lidar study area.

Planning

In preparation for data collection, NV5 Geospatial reviewed the project area and developed a specialized flight plan to ensure complete coverage of the Platte River Fall 2021 Lidar study area at the target combined point density of ≥8 points/m^2. Acquisition parameters including; orientation relative to terrain, flight altitude, pulse rate, scan angle, and ground speed were adapted to optimize flight paths and flight times while meeting all contract specifications.

Factors such as satellite constellation availability and weather windows must be considered during the planning stage. Any weather hazards or conditions affecting the flight were continuously monitored due to their potential impact on the daily success of airborne and ground operations. In addition, logistical considerations including private property access, potential air space restrictions, and water clarity were reviewed. Channel flow rates and gage heights were continually monitored to target an acquisition when flow rates, within the area of interest, were below 1,000 CFS (Figure 2, Figure 3).

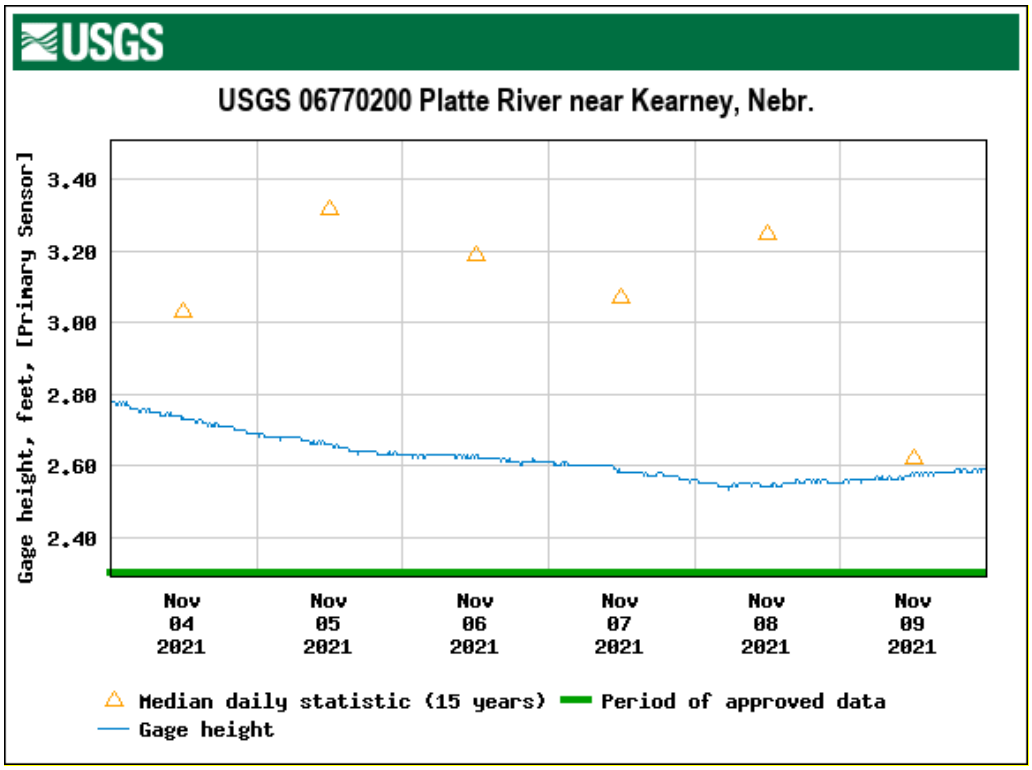


Figure 2: USGS Station 06770200 gage height along the Platte River at the time of Fall 2021 Lidar acquisition.

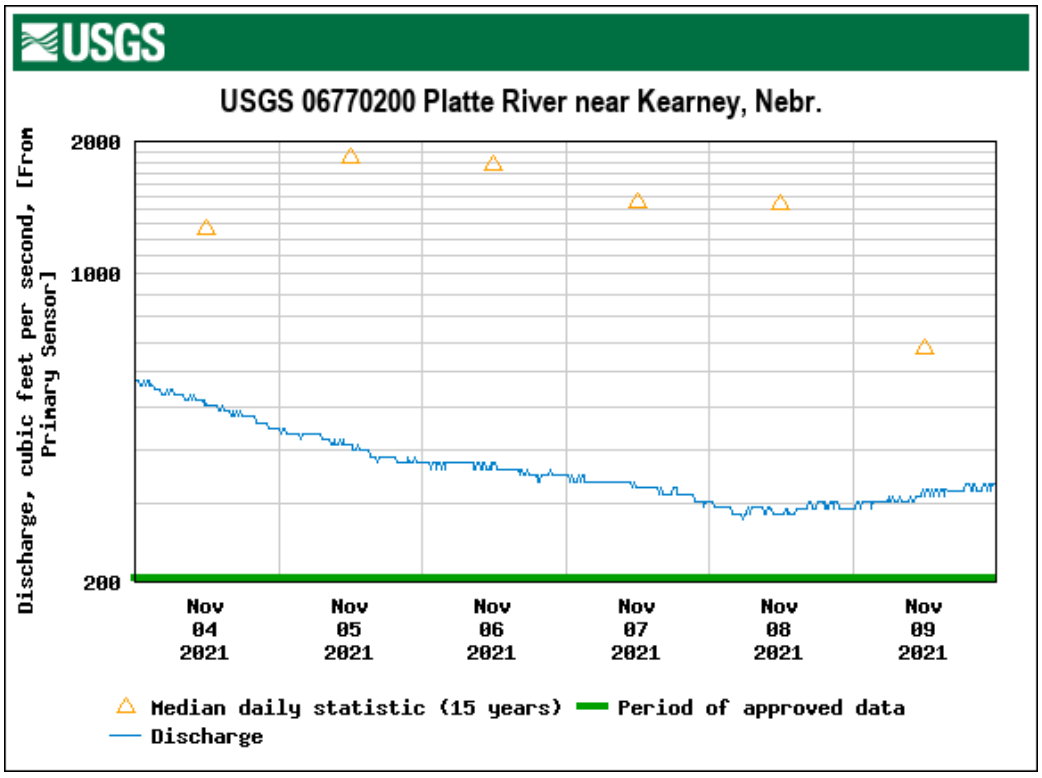


Figure 3: USGS Station 06770200 flow rates along the Platte River at the time of Fall 2021 Lidar acquisition.

Turbidity Measurements

In order to assess water clarity conditions during lidar collection, NV5 Geospatial collected turbidity measurements and secchi depth readings at 14 locations within the project site between November 5th and November 9th, 2021. Turbidity observations were recorded three times to confirm measurements. NV5 Geospatial field survey teams made every attempt to collect secchi depth readings, but access constraints and safety concern limited observations. Observed water clarity conditions can be seen in Figure 4 below, while the following Table 3 provides turbidity results per site on each day of data collection.

Figure 4: Water clarity photos taken by NV5's ground survey staff, along the Platte River in November, 2021.

Table 3: Water Clarity Observations for lidar flights

Turbidity Observations						
Date	**Location**	**Time (GMT)**	**Secchi Depth**	**Turbidity Sample 1 (NTU)**	**Turbidity Sample 2 (NTU)**	**Turbidity Sample 3 (NTU)**
11/5/2021	Sample Site 1	14:30	0.82 m	21.5	21.3	21.3
11/5/2021	Sample Site 2	15:30	0.67 m	21.4	23.1	22.1
11/5/2021	Sample Site 3	16:30	0.55 m	22.4	22.3	22.1
11/6/2021	Sample Site 4	09:00	0.40 m	34.9	28.7	27.3
11/6/2021	Sample Site 5	11:15	0.51 m	20.4	20.6	20.4
11/6/2021	Sample Site 6	13:00	0.51 m	22.8	22.2	22.0
11/7/2021	Sample Site 7	09:30	0.59 m	21.9	21.7	22.2
11/7/2021	Sample Site 8	11:15	0.46 m	20.9	21.2	20.9
11/7/2021	Sample Site 9	13:00	0.64 m	22.5	22.2	22.3
11/7/2021	Sample Site 10	14:30	0.70 m	22.6	22.5	22.7
11/8/2021	Sample Site 11	11:00	0.26 m	24.7	25.4	25.3
11/8/2021	Sample Site 12	13:15	0.57 m	25.4	26.4	26.0
11/9/2021	Sample Site 13	13:15	0.62 m	24.4	24.4	25.2
11/9/2021	Sample Site 14	14:15	0.45 m	23.	21.6	22.4

Airborne Lidar Survey

The lidar survey was accomplished using a Riegl VQ-880-GII green laser system mounted in a Cessna Caravan. The Riegl VQ-880-GII's integrated NIR laser (λ=1064 nm) adds additional topography data and aids in water surface modeling. The recorded waveform enables range measurements for all discernible targets for a given pulse. The typical number of returns digitized from a single pulse ranges from 1 to 15 for the Platte River Fall 2021 project area. It is not uncommon for some types of surfaces (e.g., dense vegetation or water) to return fewer pulses to the lidar sensor than the laser originally emitted. The discrepancy between first return and overall delivered density will vary depending on terrain, land cover, and the prevalence of water bodies. Table 4 summarizes the settings used to yield an average pulse density of ≥8 pulses/m^2 over the Platte River Fall 2021 project area.

Table 4: Lidar specifications and survey settings

Lidar Survey Settings & Specifications		
Acquisition Dates	11/04/2021 – 11/09/2021	11/04/2021 – 11/09/2021
Aircraft Used	Cessna Caravan	Cessna Caravan
Sensor	Riegl	Riegl
Laser	VQ-880-GII	VQ-880-GII-IR
Maximum Returns	15	15
Resolution/Density	Average 8 pulses/m^2	Average 8 pulses/m^2
Nominal Pulse Spacing	0.35 m	0.35 m
Survey Altitude (AGL)	450 m	450 m
Survey speed	135 knots	135 knots
Field of View	40 °	42 °
Mirror Scan Rate	80 Lines Per Second	Uniform Point Spacing
Target Pulse Rate	200 kHz	300 kHz
Pulse Length	1.5 ns	3 ns
Laser Pulse Footprint Diameter	31.5 cm	9 cm
Central Wavelength	532 nm	1,064 nm
Pulse Mode	Multiple Times Around (MTA)	Multiple Times Around (MTA)
Beam Divergence	0.7 mrad	0.2 mrad
Swath Width	328 m	345.5 m
Swath Overlap	55%	55%
Intensity	16-bit	16-bit
Accuracy	$RMSE_Z \leq 9.2$ cm Horizontal $Accuracy_r \leq 60$ cm	$RMSE_Z \leq 9.2$ cm Horizontal $Accuracy_r \leq 60$ cm

All areas were surveyed with an opposing flight line side-lap of ≥55% (≥110% overlap) in order to reduce laser shadowing and increase surface laser painting. To accurately solve for laser point position (geographic coordinates x, y and z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the lidar data collection mission. Position of the aircraft was measured twice per second (2 Hz) by an onboard differential GPS unit; aircraft attitude was measured 200 times per second (200 Hz) as pitch, roll and yaw (heading) from an onboard inertial measurement unit (IMU). To allow for post-processing correction and calibration, aircraft and sensor position and attitude data were indexed by GPS time.

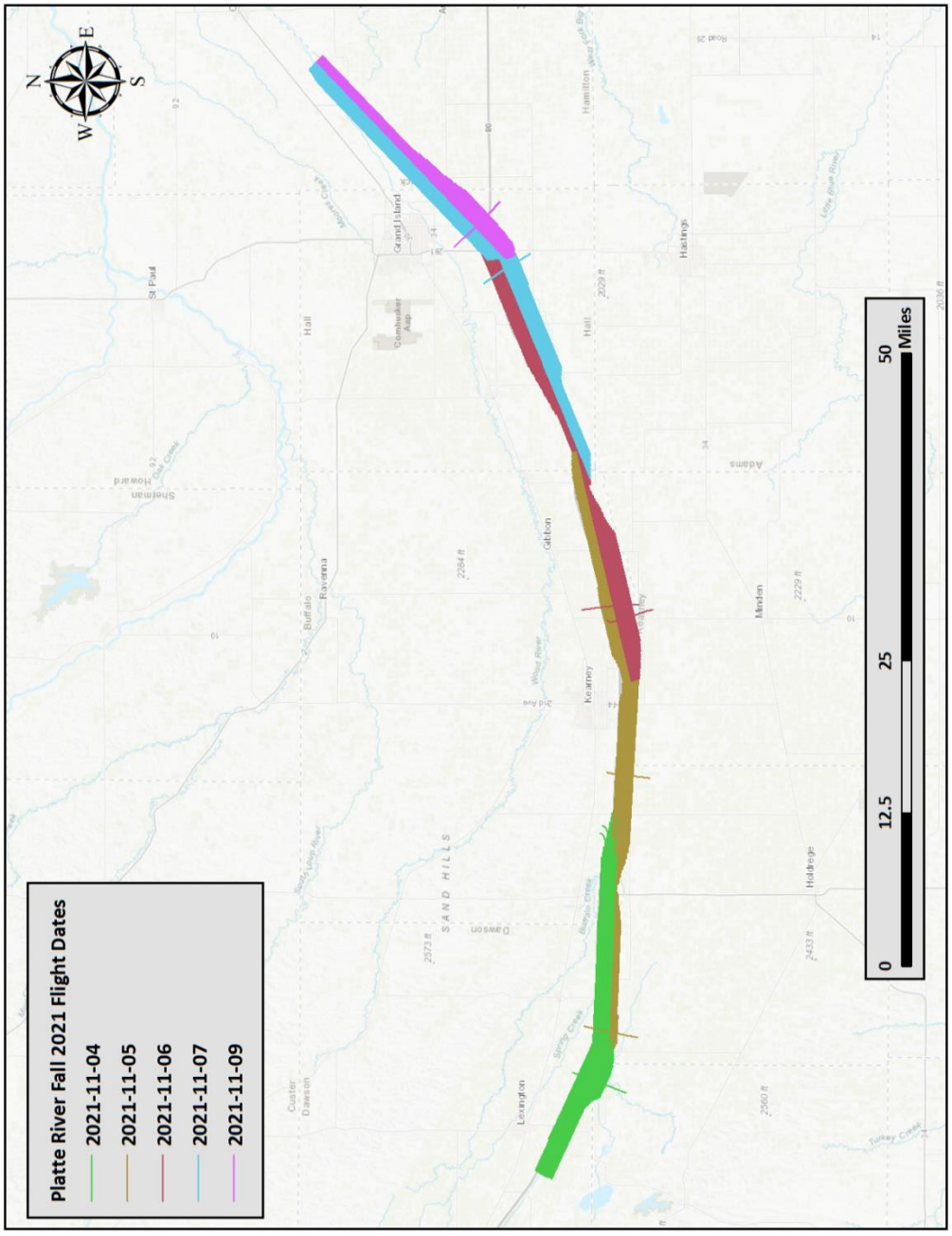


Figure 5: Flightline Survey Map

Ground Survey

Ground control surveys, including monumentation and ground survey points (GSPs), were conducted to support the airborne acquisition. Previously acquired ground control from Fall 2020 was used for calibration and to perform quality assurance checks on final lidar, while additional Fall 2021 ground control data were also used for quality assurance checks.

Base Stations

Base stations were used for collection of ground survey points using real time kinematic (RTK), and post-processing kinematic (PPK) survey techniques.

Base station locations were selected with consideration for satellite visibility, field crew safety, and optimal location for GSP coverage. For the Platte River Fall 2021 ground survey NV5 utilized two VRSNow reference stations, and two HxGN SmartNET reference stations (Table 5, Figure 6). For the Fall 2020 ground survey NV5 utilized two existing HxGN SmartNET reference stations, and three existing Trimble VRSNow reference stations (Table 6). NV5's professional land surveyor, Steven J. Hyde (NEPLS#769) oversaw and certified the ground survey.

Table 5: Nebraska CORS positions utilized for the Platte River Fall 2021 acquisition. Coordinates are on the NAD83 (2011) datum, epoch 2010.00

CORS ID	Latitude	Longitude	Ellipsoid (meters)	Network
NEDO	40° 46' 39.11703"	-98° 22' 36.49354"	576.962	VRSNow
NELN	40° 46' 05.66516"	-99° 42' 43.38894"	708.806	VRSNow
NEGN	40° 54' 37.07491"	-98° 22' 51.42422"	555.418	SmartNET
NEKY	40° 42' 38.93413"	-99° 04' 44.99783"	647.052	SmartNET

Table 6: Nebraska CORS positions utilized for the Platte River Fall 2020 ground survey. Coordinates are on the NAD83 (2011) datum, epoch 2010.00

CORS ID	Latitude	Longitude	Ellipsoid (meters)	Network
NEAA	40° 07' 56.78007"	-99° 22' 13.81927"	612.413	VRSNow
NEDO	40° 46' 39.11703"	-98° 22' 36.49354"	576.962	VRSNow
NELN	40° 46' 05.66516"	-99° 42' 43.38894"	708.806	VRSNow
NEGN	40° 54' 37.07491"	-98° 22' 51.42422"	555.418	SmartNET
NEKY	40° 42' 38.93413"	-99° 04' 44.99783"	647.052	SmartNET

To correct the continuously recorded onboard measurements of the aircraft position, NV5 Geospatial utilized static Global Navigation Satellite System (GNSS) data collected at a 1 Hz recording frequency by the base station. During post-processing, the static GPS data were triangulated with nearby Continuously Operating Reference Stations (CORS) using the Online Positioning User Service (OPUS) to verify and update record positions as needed to align with the National Spatial Reference System (NSRS).

Ground Survey Points (GSPs)

For the Fall 2020 survey, ground survey points were collected using real time kinematic (RTK) survey techniques. For the Fall 2021 survey, ground survey points were collected using real time kinematic (RTK) and Post-processing Kinematic (PPK) survey techniques. For RTK surveys, a roving receiver receives corrections from a nearby base station or Real-Time Network (RTN) via radio or cellular network, enabling rapid collection of points with relative errors less than 1.5 cm horizontal and 2.0 cm vertical. RTK and PPK surveys record data while stationary for at least five seconds, calculating the position using at least three one-second epochs. All GSP measurements were made during periods with a Position Dilution of Precision (PDOP) of ≤ 3.0 with at least six satellites in view of the stationary and roving receivers. See Table 7 for NV5 Geospatial ground survey equipment information.

GSPs were collected in areas where good satellite visibility was achieved on paved roads and other hard surfaces such as gravel or packed dirt roads. GSP measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads due to the increased noise seen in the laser returns over these surfaces. GSPs were collected within as many flightlines as possible; however, the distribution of GSPs depended on ground access constraints and base station locations and may not be equably distributed throughout the study area.

Table 7: NV5 Geospatial ground survey equipment identification

Receiver Model	Antenna	OPUS Antenna ID	Use	Year
Trimble R8	Integrated Antenna	TRM_R8_GNSS	Rover	2020
Trimble R12	Integrated Antenna	TRMR12	Rover	2021

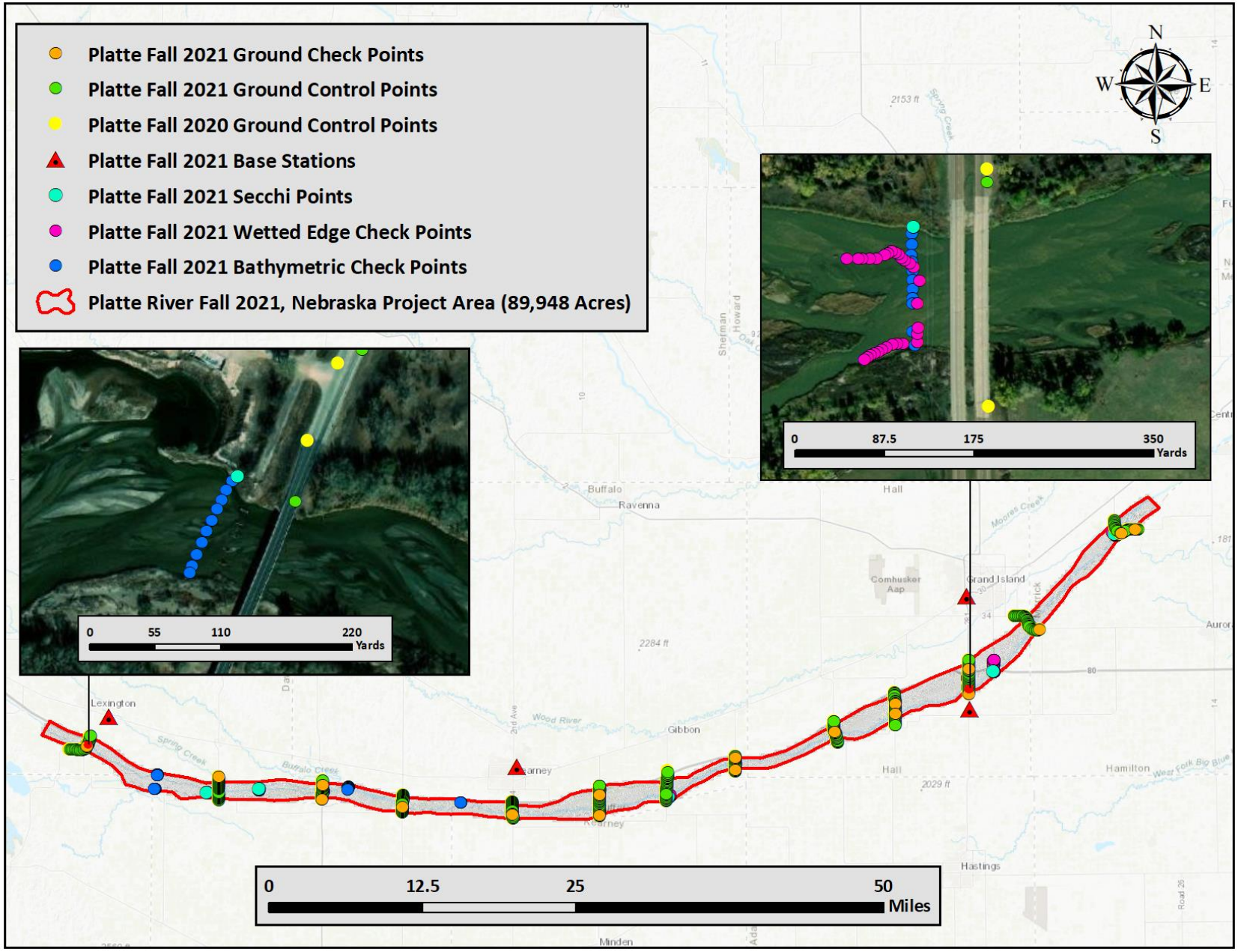
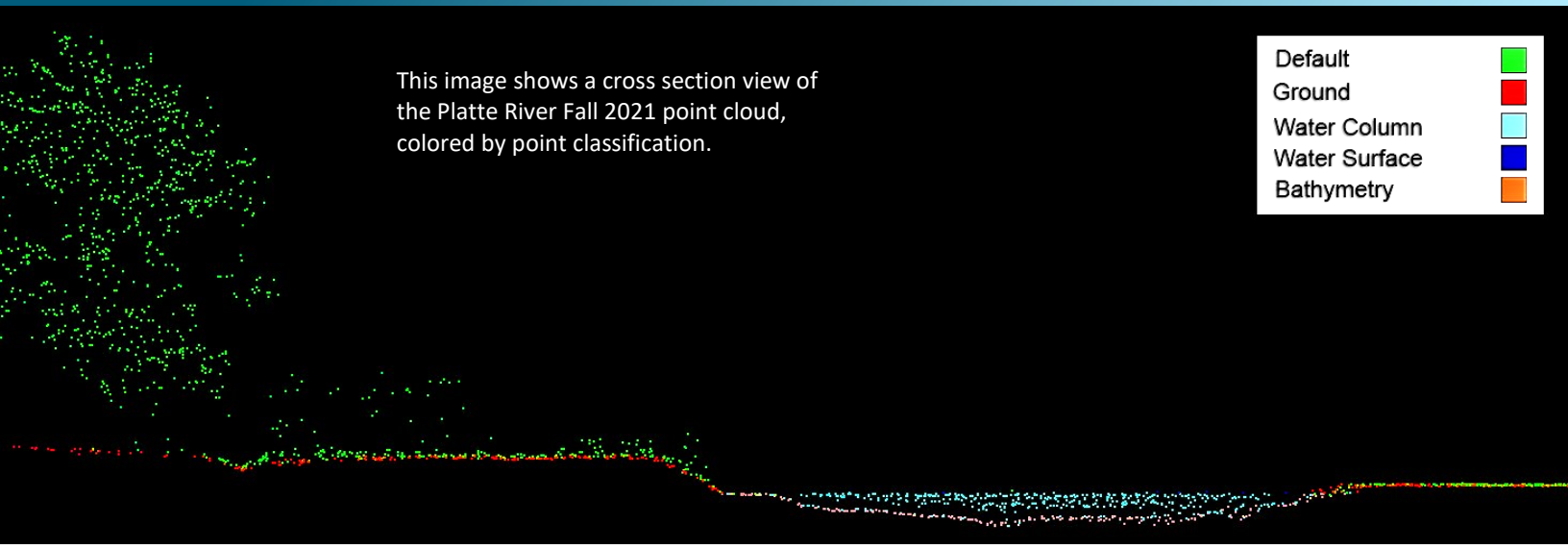


Figure 6: Ground Survey Location Map

LIDAR PROCESSING



This image shows a cross section view of the Platte River Fall 2021 point cloud, colored by point classification.

Upon completion of data acquisition, NV5 Geospatial processing staff initiated a suite of automated and manual techniques to process the data into the requested deliverables. Processing tasks included GPS control computations, smoothed best estimate trajectory (SBET) calculations, kinematic corrections, calculation of laser point position, sensor and data calibration for optimal relative and absolute accuracy, and lidar point classification (Table 8).

Riegl's RiProcess software was used to facilitate bathymetric return processing. Once bathymetric points were differentiated, they were spatially corrected for refraction through the water column based on the angle of incidence of the laser. NV5 Geospatial applied this refraction correction to water column points using NV5 Geospatial's proprietary LAS processing software, LAS Monkey. The resulting point cloud data were classified using both manual and automated techniques. Processing methodologies were tailored for the landscape. Brief descriptions of these tasks are shown in (Table 9).

Table 8: ASPRS LAS classification standards applied to the Platte River Fall 2021 dataset

Classification Number	Classification Name	Classification Description
1	Default/Unclassified	Laser returns that are not included in the ground class, composed of vegetation and anthropogenic features
1-O	Overlap/Edge Clip	Laser returns at the outer edges of flightlines that are geometrically unreliable
2	Ground	Laser returns that are determined to be ground using automated and manual cleaning algorithms
7	Noise	Laser returns that are often associated with birds, scattering from reflective surfaces, or artificial points below the ground surface
9	Water	NIR Laser returns that are determined to be water using automated and manual cleaning algorithms
22	Temporal Exclusion	Laser returns that are determined to be due to temporal differences in flightlines and are excluded.
40	Bathymetric Bottom	Refracted green sensor returns that fall within the water's edge breakline which characterize the submerged topography.
41	Water Surface	Green laser returns that are determined to be water surface points using automated and manual cleaning algorithms.
45	Water Column	Refracted green sensor returns that are determined to be water using automated and manual cleaning algorithms.

Lidar Calibration to Control Survey

The Platte River site experiences many geographical changes from year to year. Because the primary goal of the project is to map the changes within steam channel areas, it was determined that a single year of survey collection should be used as a primary reference dataset, in conjunction with the most current survey for both calibration and calculating accuracy statistics.

In accordance with NV5's change detection rework plan for the Platte River project, the Fall 2020 dataset and supporting ground survey control data were utilized as the primary control for the Platte River Fall 2021 topobathymetric lidar dataset. The decision to match Fall 2021's lidar data to the Fall 2020 "gold standard" survey control was based on Headwaters Corporation's paramount need to be able to compare the river's surface year-to-year relative to itself.

Lidar data was calibrated to the reference Fall 2020 dataset, and then compared to the Fall 2020 and Fall 2021 ground surveys. During the QA/QC process, NV5 created difference rasters between the Fall 2020 and Fall 2021 datasets to check for alignment and to verify results after shifting the data to the Fall 2020 control (Figure 5).

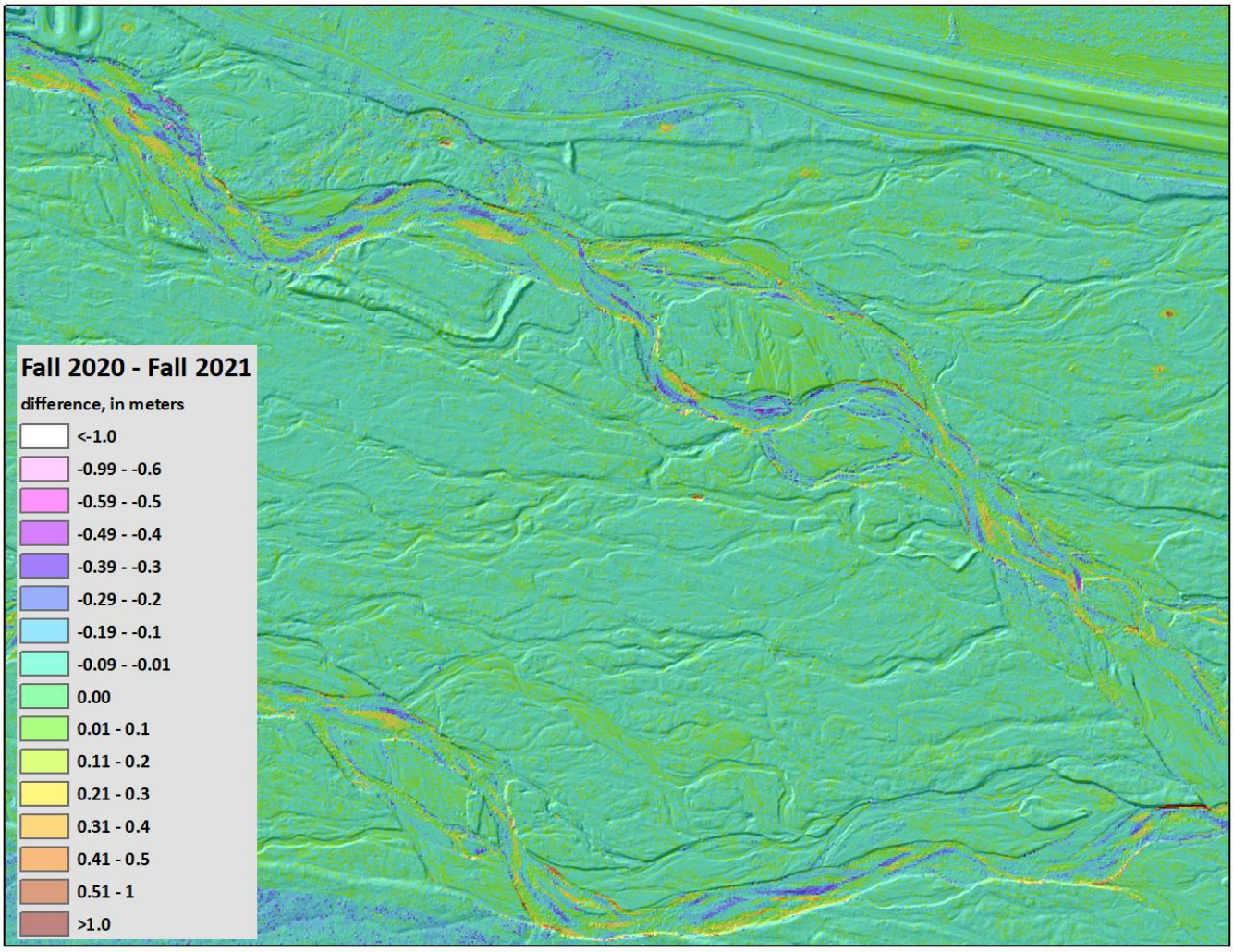


Figure 5: Raster Model Displaying the Difference, in meters, of the Fall 2020 Bare Earth – Fall 2021 Bare Earth Surfaces

Table 9: Lidar processing workflow

Lidar Processing Step	Software Used
Resolve kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data. Develop a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with sensor head position and attitude recorded throughout the survey.	POSPac MMS v.8.5
Calculate laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Create raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.4) format. Convert data to orthometric elevations by applying a geoid correction.	RiProcess v1.8.5
Using ground classified points per each flight line, test the relative accuracy. Perform automated line-to-line calibrations for system attitude parameters (pitch, roll, heading), and GPS/IMU drift. Calculate calibrations on ground classified points from paired flight lines and apply results to all points in a flight line. Use every flight line for relative accuracy calibration. Calibrate Fall 2021 Green channel to Fall 2020 reference data, and then Fall 2021 NIR to Fall 2021 Green data.	Bays-StripAlign v2.19
Import calibrated laser points into manageable blocks.	TerraScan v.19.005
Apply refraction correction to all subsurface returns.	Las Monkey 2.6.3 (NV5 proprietary software)
Classify resulting data to ground and other client designated ASPRS classifications (Table 8). Assess statistical absolute accuracy via direct comparisons of ground classified points to ground control survey data.	TerraScan v.19.005 TerraModeler v.19.002
Generate bare earth models as triangulated surfaces. Generate highest hit models as a surface expression of all classified points. Export all surface models in ERDAS Imagine (.img) format at a 3.0 foot pixel resolution.	Las Product Creator 3.5 (NV5 proprietary software) ArcMap v. 10.3.1
Export intensity images as GeoTIFFs at a 1.5 foot pixel resolution.	Las Product Creator 3.5 (NV5 proprietary software) ArcMap v. 10.3.1

Bathymetric Refraction Correction

Green lidar pulses refract as they enter the water column resulting in decreased speed of the light beam, which means that the position of the pulses needs to be corrected by accounting for this refraction. NV5 Geospatial has developed proprietary software (Las Monkey) to perform this processing based on Snell's law. The first step is to develop a water surface model (WSM) from the NIR lidar water surface returns. The water surface model used for refraction is generated using NIR points within the breaklines defining the water's edge. Points are filtered and edited to obtain the most accurate representation of the water surface and are used to create a water surface model TIN. A TIN model is preferable to a raster based water surface model to obtain the most accurate angle of incidence during refraction.

Once the WSM is generated, the Las Monkey refraction software then intersects the partially submerged green pulses with the WSM to determine the angle of incidence with the water surface and the submerged component of the pulse vector. This provides the information necessary to correct the position of underwater points by adjusting the submerged vector length and orientation. After refraction, the points are compared against bathymetric check points to assess accuracy.

Lidar Derived Products

Because hydrographic laser scanners penetrate the water surface to map submerged topography, this affects how the data should be processed and presented in derived products from the lidar point cloud. The following discusses certain derived products that vary from the traditional (NIR) specification and delivery format.

Topobathymetric DEMs

Bathymetric bottom returns can be limited by depth, water clarity, and bottom surface reflectivity. Water clarity and turbidity affects the depth penetration capability of the green wavelength laser with returning laser energy diminishing by scattering throughout the water column. Additionally, the bottom surface must be reflective enough to return remaining laser energy back to the sensor at a detectable level. It is not unexpected to have no bathymetric bottom returns in turbid or non-reflective areas.

As a result, creating digital elevation models (DEMs) presents a challenge with respect to interpolation of areas with no returns. Traditional DEMs are "unclipped", meaning areas lacking ground returns are interpolated from neighboring ground returns (or breaklines in the case of hydro-flattening), with the assumption that the interpolation is close to reality. In bathymetric modeling, these assumptions are prone to error because a lack of bathymetric returns can indicate a change in elevation that the laser can no longer map due to increased depths. The resulting void areas may suggest greater depths, rather than similar elevations from neighboring bathymetric bottom returns. Therefore, NV5 Geospatial created a water polygon with bathymetric coverage to delineate areas with successfully mapped bathymetry. This shapefile was used to control the extent of the delivered clipped topobathymetric model to avoid false triangulation (interpolation from TIN'ing) across areas in the water with no bathymetric returns.

Intensity Images

The difference in emitted wavelengths of the NIR (1064 nm) and Green (532 nm) lasers results in variation of the intensity information returned to the sensor for each laser. Additionally, the near-infrared wavelength is subject to spectral absorption by water, which can result in no returns over water surfaces. Due to these factors, NV5 Geospatial created one set of intensity images from NIR laser first returns, as well as one set of intensity images from green laser first returns.

With bathymetric lidar a more detailed and informative intensity image can be created by using all or selected point classes, rather than relying on return number alone. If intensity information of the bathymetry is the primary goal, water surface and water column points can be excluded. However, water surface and water column points often contain potentially useful information about turbidity and submerged but unclassified features such as vegetation. For the Platte River Fall 2021 project, NV5 Geospatial created one set of intensity images from NIR laser first returns, as well as one set of intensity images from green laser returns. Green laser intensity images were created using first returns over terrestrial areas only, as well as all water column and bathymetric bottom points in order to display more detail in intensity values (Figure 6).

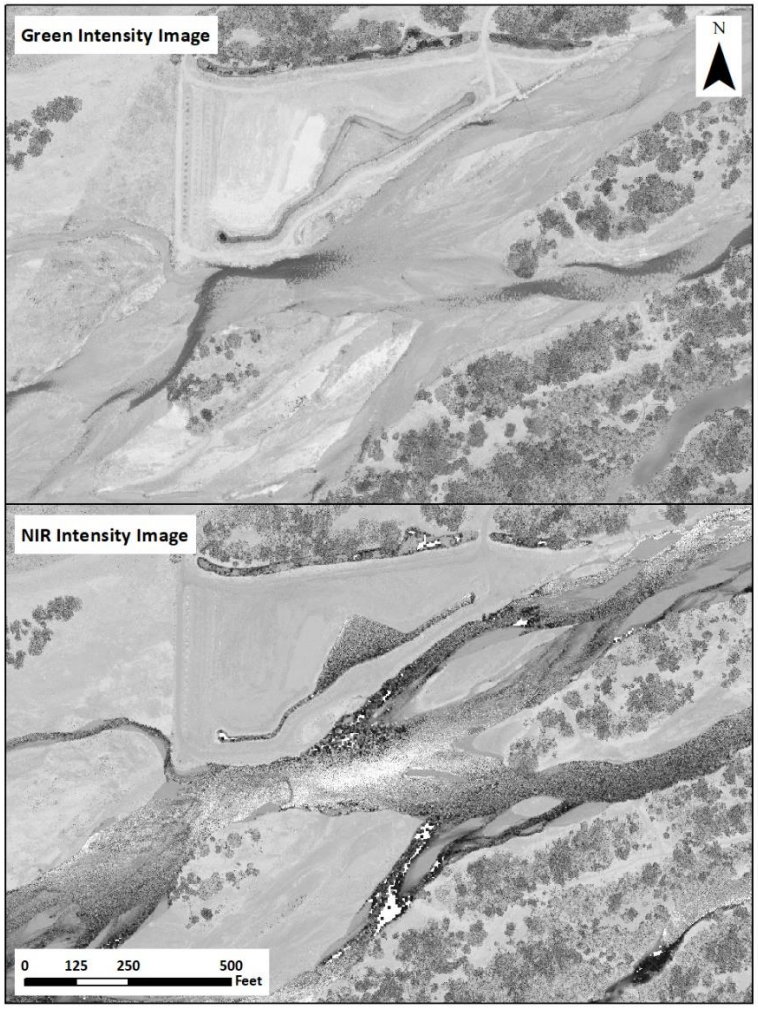


Figure 6: A comparison of Intensity Images from Green and NIR returns in the Platte River area

Hydro-flattening and Water's Edge Breaklines

Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify water boundaries and water levels. Boundary polygons were developed using an algorithm which weights lidar-derived slopes, intensities, and return densities to detect the water's edge. The water edges were then manually reviewed and edited as necessary.

For the Platte River Fall 2021 project area, all off channel waterbodies greater than 2 acres were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water. Once polygons were developed, the initial ground classified points falling within water polygons were reclassified as water points to omit them from the final ground model. Elevations were then obtained from the filtered lidar returns to create the final breaklines.

Water boundary breaklines were then incorporated into the hydro-flattened DEM by enforcing triangle edges (adjacent to the breakline) to the elevation values of the breakline. This implementation corrected interpolation along the hard edge. Water surfaces were obtained from a TIN of the 3-D water edge breaklines resulting in the final hydro-flattened model.

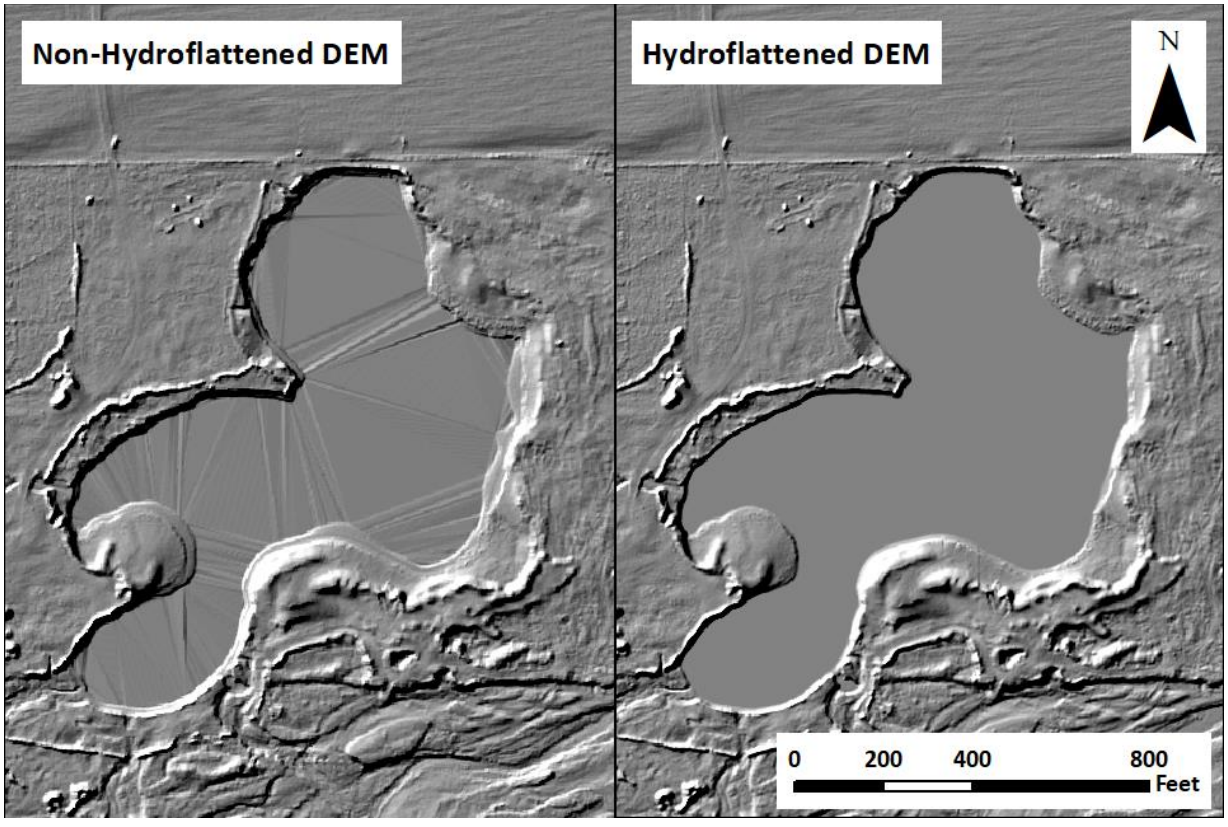
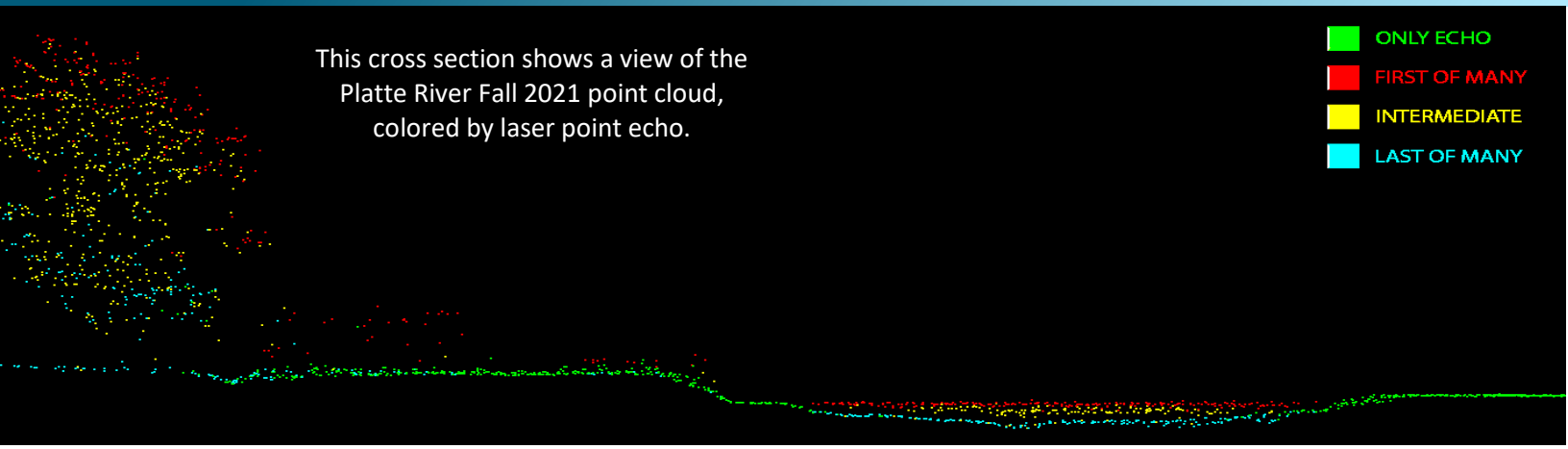


Figure 7: Example image of hydroflattening done for the Platte River Fall 2021 Lidar dataset



This cross section shows a view of the Platte River Fall 2021 point cloud, colored by laser point echo.

Bathymetric Lidar

An underlying principle for collecting hydrographic lidar data is to survey near-shore areas that can be difficult to collect with other methods, such as multi-beam sonar, particularly over large areas. In order to determine the capability and effectiveness of the bathymetric lidar, several parameters were considered including bathymetric return density, mapped depth, and spatial accuracy.

Mapped Bathymetry, Coverage and Depth

The specified depth penetration range of the Riegl VQ-880-GII sensor is 1.5 secchi depths. For the Fall 2021 data collection, the minimum secchi depth recorded as accessible locations was 26.0 centimeters (0.85 feet) while themaximum secchi depth recorded was 82.0 centimeters (2.69 feet). The maximum depth recorded for the Platte River Fall 2021 survey was 809.2 centimeters (26.55 feet).

This shapefile was used to control the extent of the delivered clipped topobathymetric model and to avoid false triangulation across areas in the water with no returns. Areas with no bathymetric bottom returns (voids), were identified by triangulating bathymetric bottom points with an edge length maximum of 15.2 feet. This ensured all areas of no returns (> 97 ft^2), were identified as data voids.

In total, 84.2% of the Platte River Fall 2021 topobathy project area was mapped as “covered”. Table 10 shows the percent coverage by depth for Fall 2021 along with Fall 2020 for year-to-year comparison purposes.

Table 10: Depth coverage Comparizon between Fall 2020 and Fall 2021 Acquisitions

Percent Mapped		
Depth (feet)	**Fall 2020 Depth Mapped**	**Fall 2021 Depth Mapped**
Shallow	21.1%	17.9%
0.11 – 1.00	69.5%	64.2%
1.01 – 2.00	7.4%	11.7%
2.01 – 3.00	1.1%	2.4%
3.01 – 4.00	0.4%	1.0%
4.01 – 5.00	0.1%	0.7%
> 5.00	0.3%	2.1%

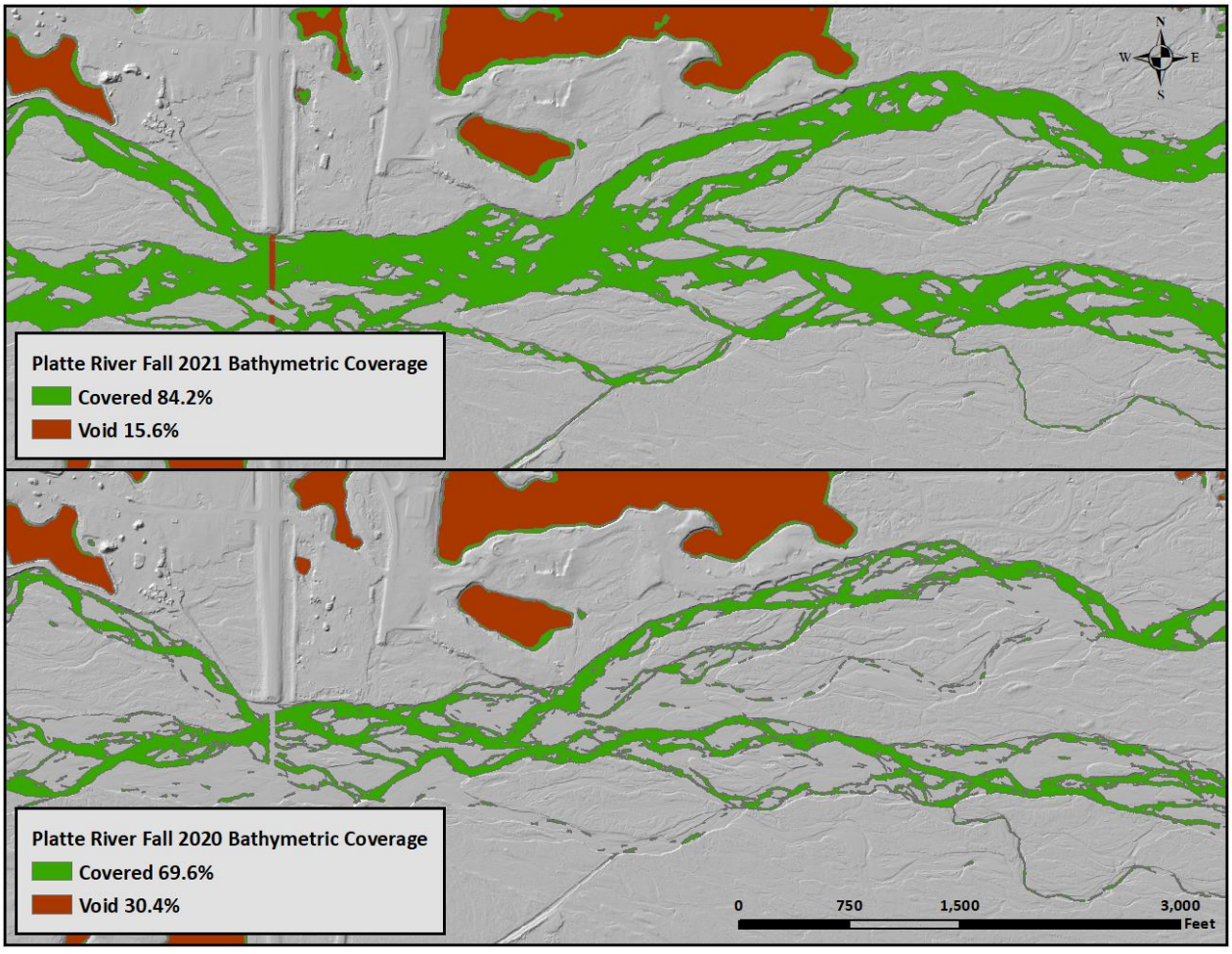


Figure 8: Comparison image of bathymetric coverage of the Platte River Fall 2020 and Fall 2021 datasets.

Table 11: Bathymetric Coverage by Year

Data Collection Year	Total Water (acres)	Covered (acres)	Void (acres)	Covered (%)	Void (%)
2016	7,668.15	6,182.83	1,485.32	80.63%	19.37%
2017	7,465.07	5,816.21	1,648.86	77.91%	22.09%
2018	6,940.51	5,292.10	1,648.41	76.25%	23.75%
2019	12,610.03	10,996.20	1,613.83	87.20%	12.80%
2020	5,369.20	3,735.98	1,633.22	69.58%	30.42%
2021	8691.98	7,319.71	1,372.27	84.21%	15.79%

First Return Lidar Point Density

The acquisition parameters were designed to acquire an average first-return density of 8 points/m^2. First return density describes the density of pulses emitted from the laser that return at least one echo to the system. Multiple returns from a single pulse were not considered in first return density analysis. Some types of surfaces (e.g., breaks in terrain, water and steep slopes) may have returned fewer pulses than originally emitted by the laser.

First returns typically reflect off the highest feature on the landscape within the footprint of the pulse. In forested or urban areas the highest feature could be a tree, building or power line, while in areas of unobstructed ground, the first return will be the only echo and represents the bare earth surface.

The average first-return density of the Platte River Fall 2021 lidar project was 2.89 points/ft^2 (31.08 points/m^2) (Table 12). The statistical and spatial distributions of all first return densities per 100 m x 100 m cell are portrayed in Figure 9 and Figure 11.

Bathymetric and Ground Classified Lidar Point Densities

The density of ground classified Lidar returns and bathymetric bottom returns were also analyzed for this project. Terrain character, land cover, and ground surface reflectivity all influenced the density of ground surface returns. In vegetated areas, fewer pulses may have penetrated the canopy, resulting in lower ground density. Similarly, the density of bathymetric bottom returns was influenced by turbidity, depth, and bottom surface reflectivity. In turbid areas, fewer pulses may have penetrated the water surface, resulting in lower bathymetric density.

The ground and bathymetric bottom classified density of lidar data for the Platte River Fall 2021 project was 1.21 points/ft^2 (13.04 points/m^2) (Table 12). The statistical and spatial distributions for ground classified and bathymetric bottom return densities per 100 m x 100 m cell are portrayed in Figure 10 and Figure 11.

Additionally, for the Platte River Fall 2021 project, density values of only bathymetric bottom returns were calculated for areas containing at least one bathymetric bottom return. Areas lacking bathymetric returns (voids)were not considered in calculating an average density value. Within the successfully mapped area, a bathymetric bottom return density of 1.21 points/ft^2 (13.05 points/m^2) was achieved.

Table 12: Average Lidar point densities

Density Type	Point Density
First Returns	2.89 points/ft² 31.08 points/m²
Ground and Bathymetric Bottom Classified Returns	1.21 points/ft² 13.04 points/m²
Bathymetric Bottom Classified Returns	1.21 points/ft² 13.05 points/m²

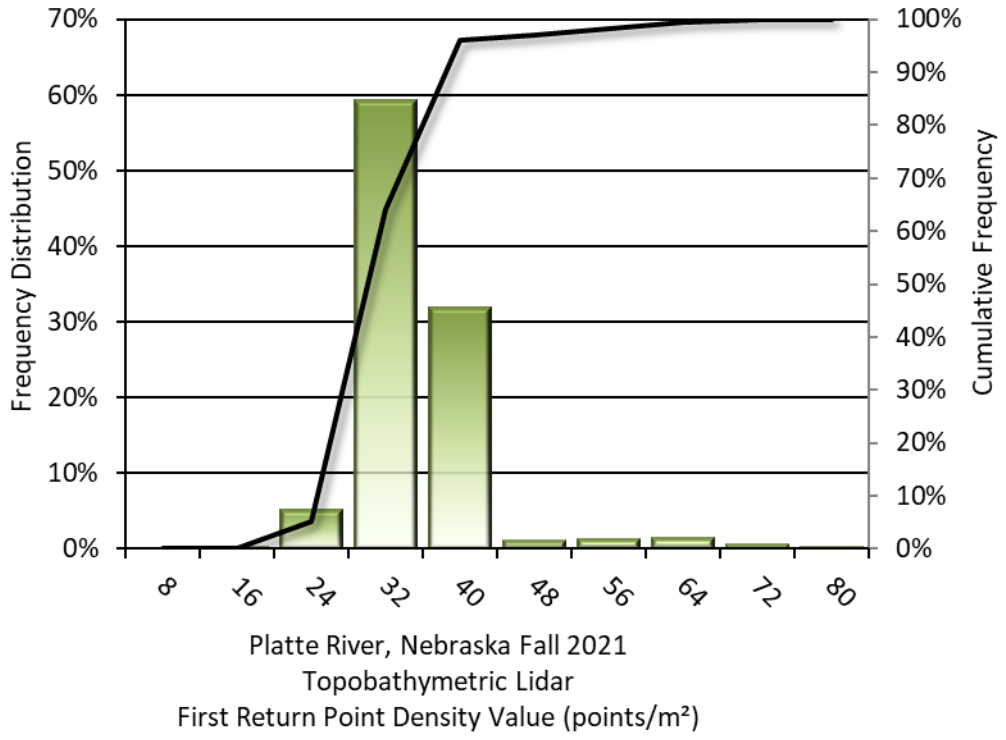


Figure 9: Frequency distribution of first return densities per 100 x 100 m cell

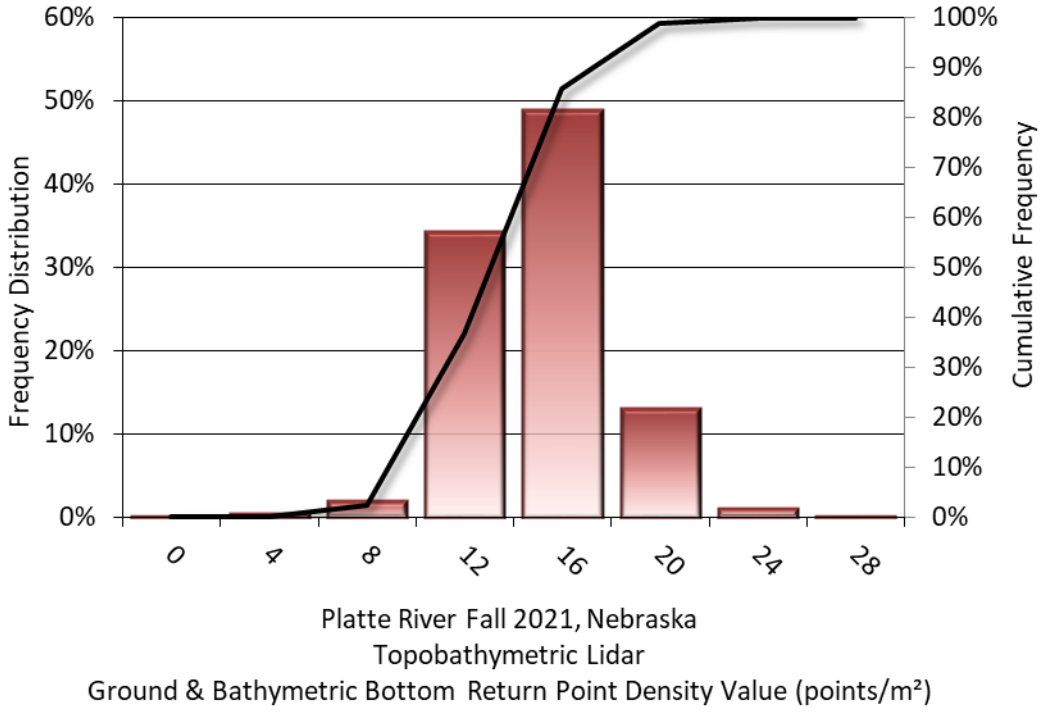


Figure 10: Frequency distribution of ground and bathymetric bottom classified return densities per 100 x 100 m cell

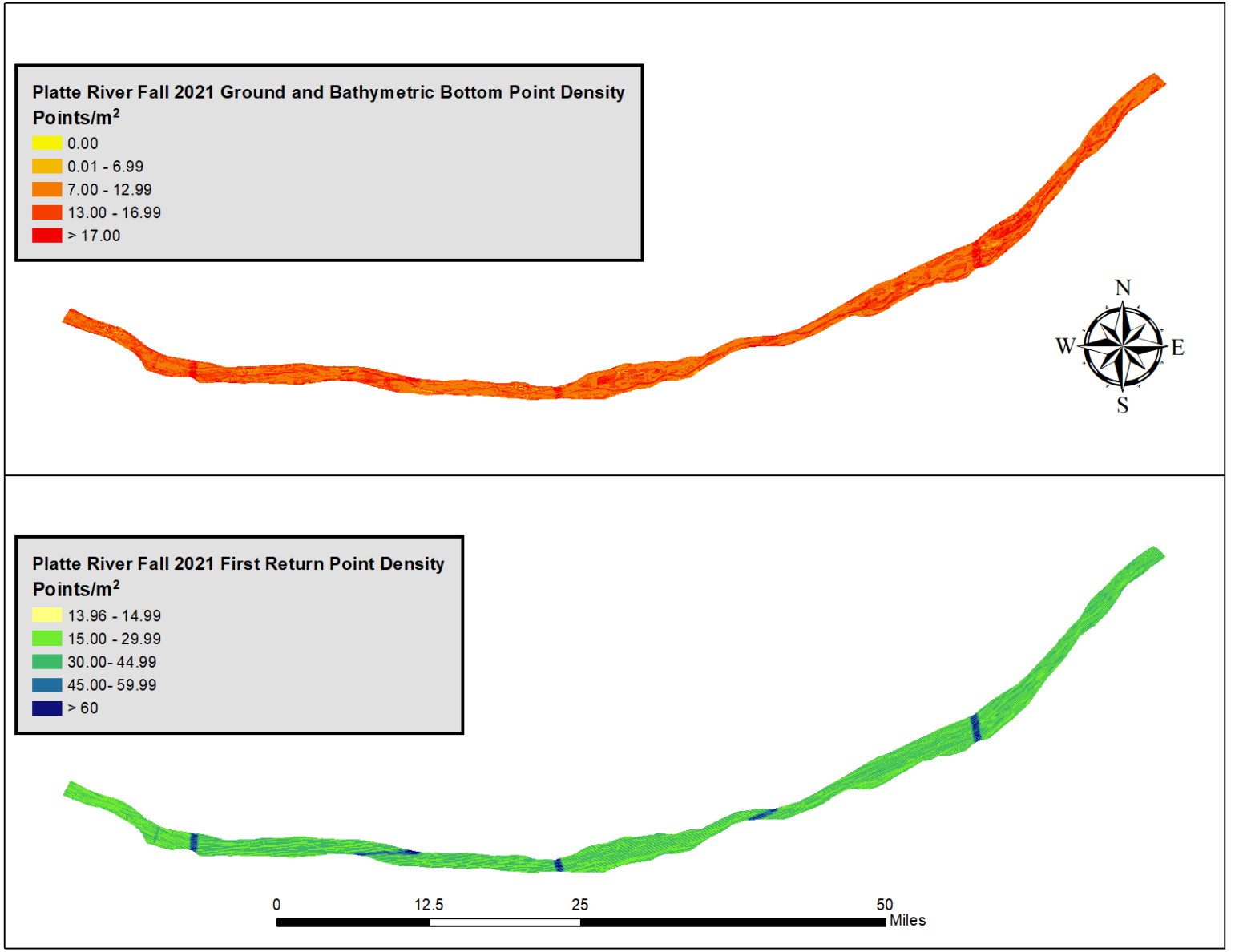


Figure 11: First return and ground and bathymetric bottom density map for the Platte River Fall 2021 lidar site (100 m x 100 m cells)

Lidar Accuracy Assessments

The accuracy of the lidar data collection can be described in terms of absolute accuracy (the consistency of the data with external data sources) and relative accuracy (the consistency of the dataset with itself). See Appendix A for further information on sources of error and operational measures used to improve relative accuracy.

Lidar Non-Vegetated Vertical Accuracy

Absolute accuracy was assessed using Non-vegetated Vertical Accuracy (NVA) reporting designed to meet guidelines presented in the FGDC National Standard for Spatial Data Accuracy[1]. NVA compares known ground check point data that were withheld from the calibration and post-processing of the lidar point cloud to the triangulated surface generated by the unclassified lidar point cloud. NVA is a measure of the accuracy of lidar point data in open areas where the lidar system has a high probability of measuring the ground surface and is evaluated at the 95% confidence interval (1.96 * RMSE), as shown in Table 13.

The mean and standard deviation (sigma σ) of divergence of the ground surface model from ground check point coordinates are also considered during accuracy assessment. These statistics assume the error for x, y and z is normally distributed, and therefore the skew and kurtosis of distributions are also considered when evaluating error statistics.

For the Platte Fall 2021 project, absolute accuracy statistics derived from the Fall 2020 and Fall 2021 ground surveys were assessed independently due to variations observed in the multi-year ground surveys, as discussed at the end of this section. The Fall 2021 data was calibrated to the Fall 2020 lidar dataset and ground survey. This approach will help ensure year-over-year consistency between bathymetric and topographic lidar returns for accurately modeling temporal changes to the Platte River channel; however, this approach also led to some accuracy statistics displaying higher than usual deviations between the lidar data and survey points.

Absolute Accuracy – Fall 2020 Ground Survey

Using the Fall 2020 ground survey to assess the Fall 2021 lidar data, 14 ground check points were withheld from the calibration and post-processing of the lidar point cloud, with resulting NVA of 0.171 feet (0.052 meters) as compared to the classified LAS, and 0.142 feet (0.043 meters) as compared to the bare earth DEM, with 95% confidence (Figure 12, Figure 13 , and Table 13).

NV5 also assessed absolute accuracy using 718 ground control points. Although these points were used in the calibration and post-processing of the lidar point cloud, they still provide a good indication of the overall accuracy of the lidar dataset, and therefore have been provided in Table 13 and Figure 14. Appendix B details the point offsets for the Platte Fall 2021 lidar as compared to the Fall 2020 ground survey data (Table 18 through Table 20).

[1] Federal Geographic Data Committee, ASPRS POSITIONAL ACCURACY STANDARDS FOR DIGITAL GEOSPATIAL DATA EDITION 1, Version 1.0, NOVEMBER 2014. https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf.

Table 13: Absolute vertical accuracy results

Absolute Vertical Accuracy - 2020 Survey			
	NVA, as compared to Classified LAS	**NVA, as compared to Bare Earth DEM**	**Ground Control Points**
Sample	14 points	14 points	718 points
95% Confidence (1.96*RMSE)	0.171 ft 0.052 m	0.142 ft 0.043 m	0.160 ft 0.049 m
Average	-0.044 ft -0.013 m	-0.023 ft -0.007 m	-0.026 ft -0.008 m
Median	-0.036 ft -0.011 m	-0.041 ft -0.012 m	-0.030 ft -0.009 m
RMSE	0.087 ft 0.027 m	0.073 ft 0.022 m	0.081 ft 0.025 m
Standard Deviation (1σ)	0.078 ft 0.024 m	0.071 ft 0.022 m	0.077 ft 0.024 m

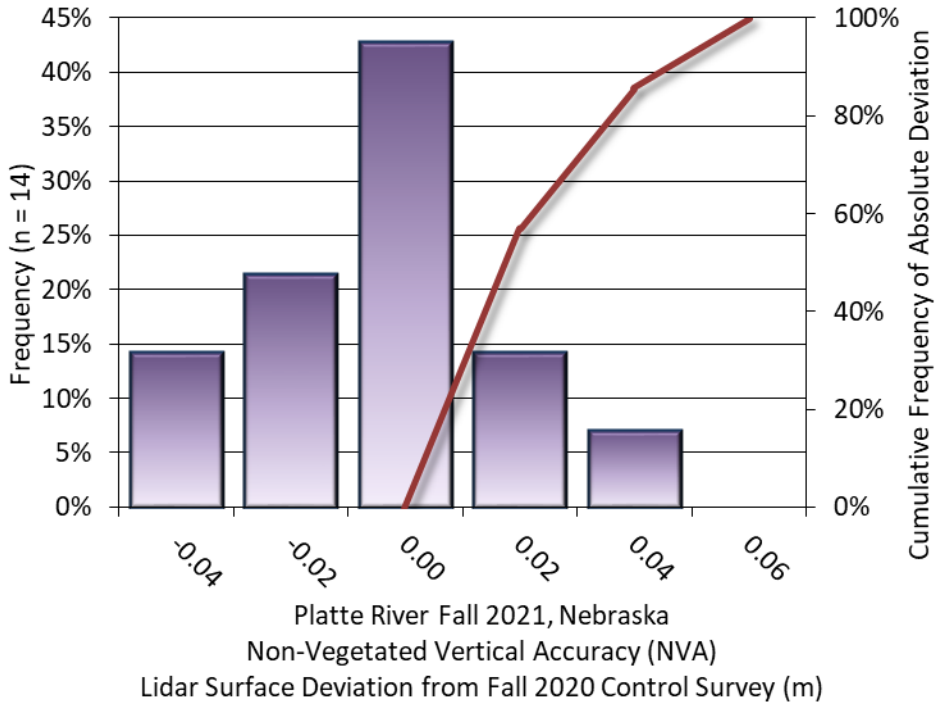


Figure 12: Frequency histogram for unclassified LAS deviation from ground check point values

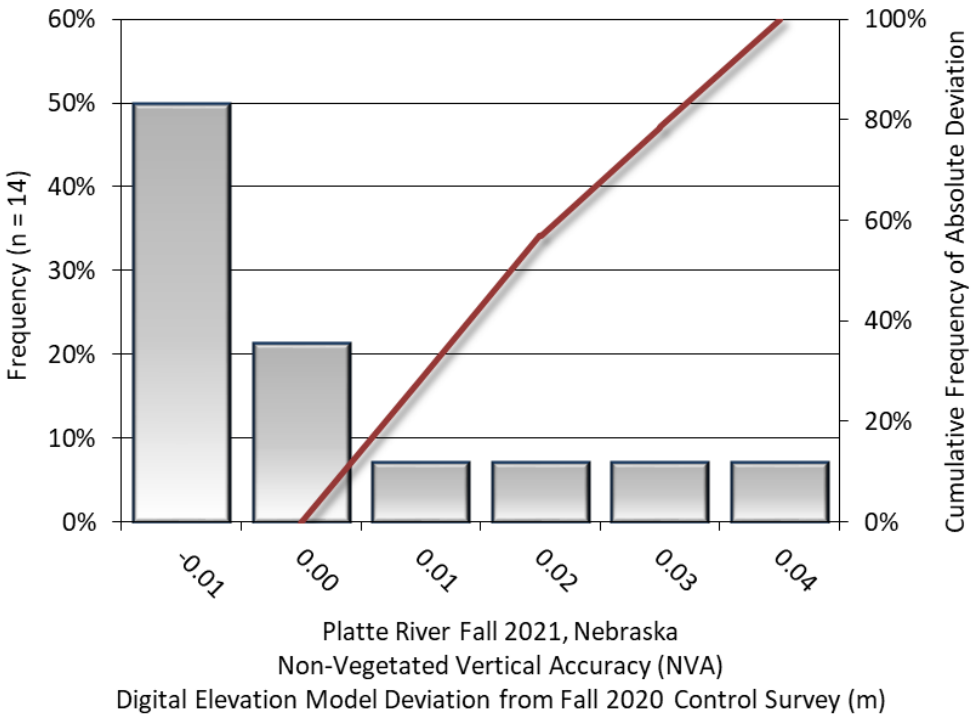


Figure 13: Frequency histogram for lidar surface deviation ground check point values

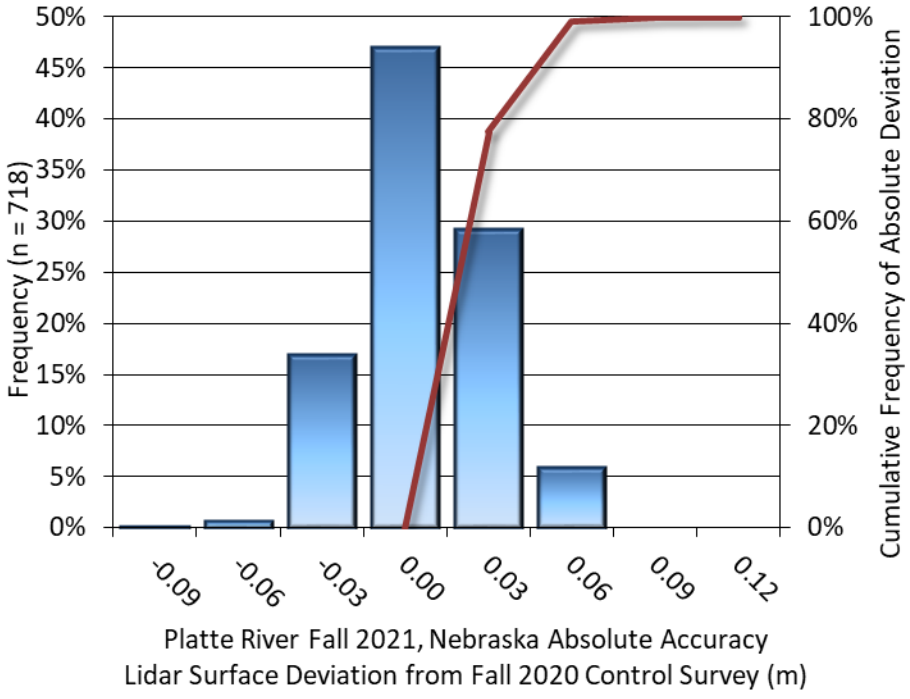


Figure 14: Frequency histogram for lidar surface deviation ground check point values

Absolute Accuracy – Summer 2021 Ground Survey

Absolute accuracy of the Fall 2021 lidar data was also assessed against the Fall 2021 ground survey control points and check points. These points were not used for the calibration of the Fall 2021 data and provide a good assessment of the data relative to current conditions.

For the Fall 2021 ground survey, 20 ground check points were evaluated, with resulting NVA of 0.152 feet (0.046 meters) as compared to the classified LAS, and 0.113 feet (0.034 meters) as compared to the bare earth DEM, with 95% confidence (Table 14, Figure 15 through Figure 16) NV5 also assessed absolute accuracy using 321 ground control points (Table 14, Figure 17), with resulting absolute accuracy of 0.184 feet (0.056 meters).

Appendix C details the point offsets for the Platte Fall 2021 lidar as compared to the Fall 2021 ground survey data (Table 21 through Table 23).

Table 14: Absolute accuracy results - Fall 2021 lidar collection compared to Fall 2021 Survey

Absolute Vertical Accuracy - 2021 Survey			
	NVA, as compared to Classified LAS	**NVA, as compared to Bare Earth DEM**	**Ground Control Points**
Sample	18 points	18 points	321 points
95% Confidence (1.96*RMSE)	0.152 ft 0.046 m	0.113 ft 0.034 m	0.184 ft 0.056 m
Average	0.039 ft 0.012 m	0.027 ft 0.008 m	0.020 ft 0.006 m
Median	0.048 ft 0.015 m	0.023 ft 0.007 m	0.023 ft 0.007 m
RMSE	0.078 ft 0.024 m	0.057 ft 0.018 m	0.094 ft 0.029 m
Standard Deviation (1σ)	0.069 ft 0.021 m	0.052 ft 0.016 m	0.092 ft 0.028 m

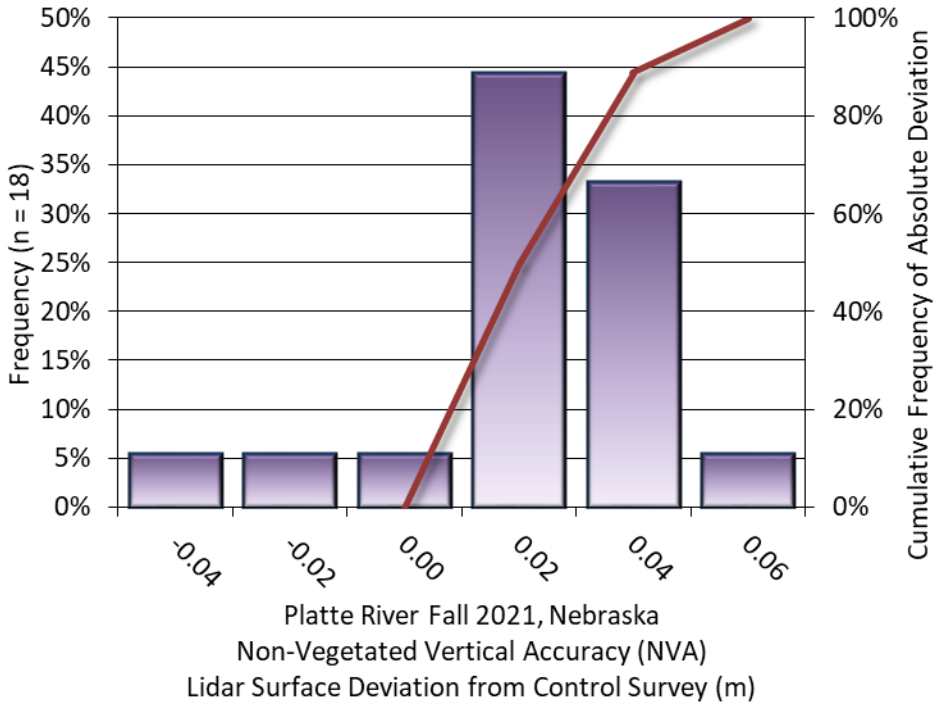


Figure 15: Frequency histogram for classified LAS deviation from ground check point values

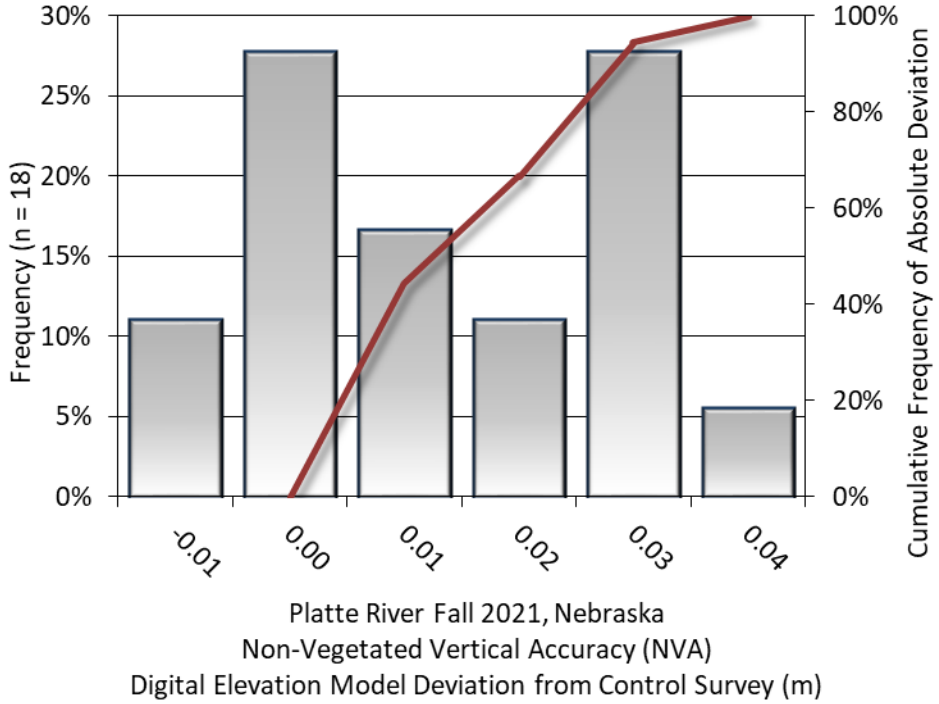


Figure 16: Frequency histogram for lidar bare earth DEM deviation from ground check point values

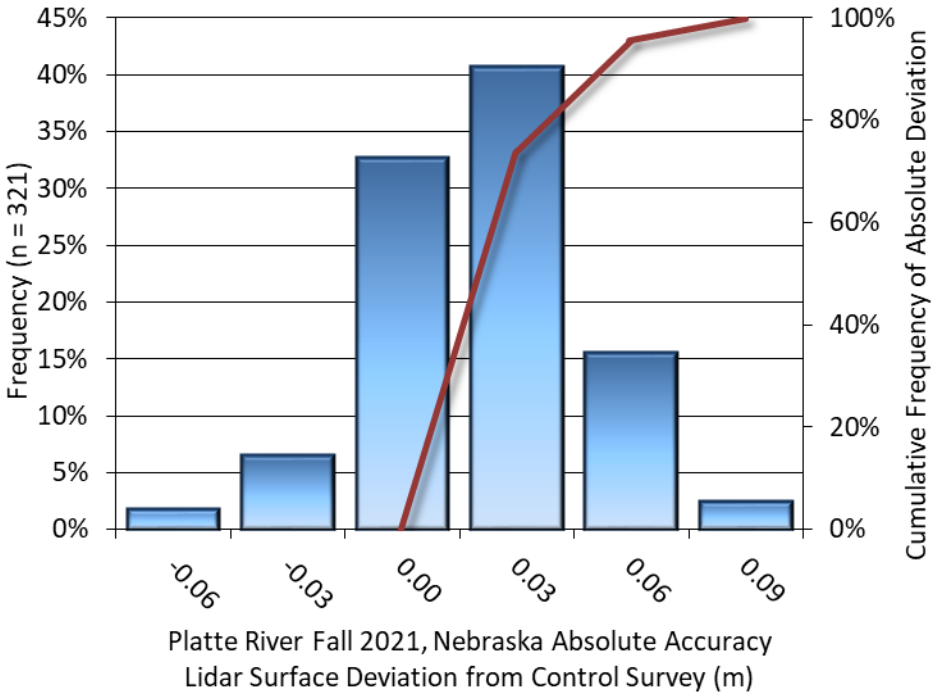


Figure 17: Frequency histogram for lidar surface deviation ground control point values

Lidar Bathymetric Vertical Accuracies

Bathymetric (submerged or along the water's edge) check points were also collected in order to assess the submerged surface vertical accuracy. Assessment of 340 submerged bathymetric check points resulted in a vertical accuracy of 0.247 feet (0.075 meters), while assessment of 308 wetted edge check points resulted in a vertical accuracy of 0.218 feet (0.067 meters), evaluated at 95% confidence interval (Table 15, Figure 18 and Figure 19).

Table 15: Bathymetric Vertical Accuracy for the Platte River Fall 2021 Project

Bathymetric Vertical Accuracy (VVA)		
	Submerged Bathymetric Check Points	**Wetted Edge Bathymetric Check Points**
Sample	340 points	308 points
95% Confidence (1.96*RMSE)	0.247 ft 0.075 m	0.218 ft 0.067 m
Average Dz	-0.026 ft -0.008 m	-0.047 ft -0.014 m
Median	-0.036 ft -0.011 m	-0.061 ft -0.019 m
RMSE	0.126 ft 0.038 m	0.111 ft 0.034 m
Standard Deviation (1σ)	0.124 ft 0.038 m	0.101 ft 0.031 m

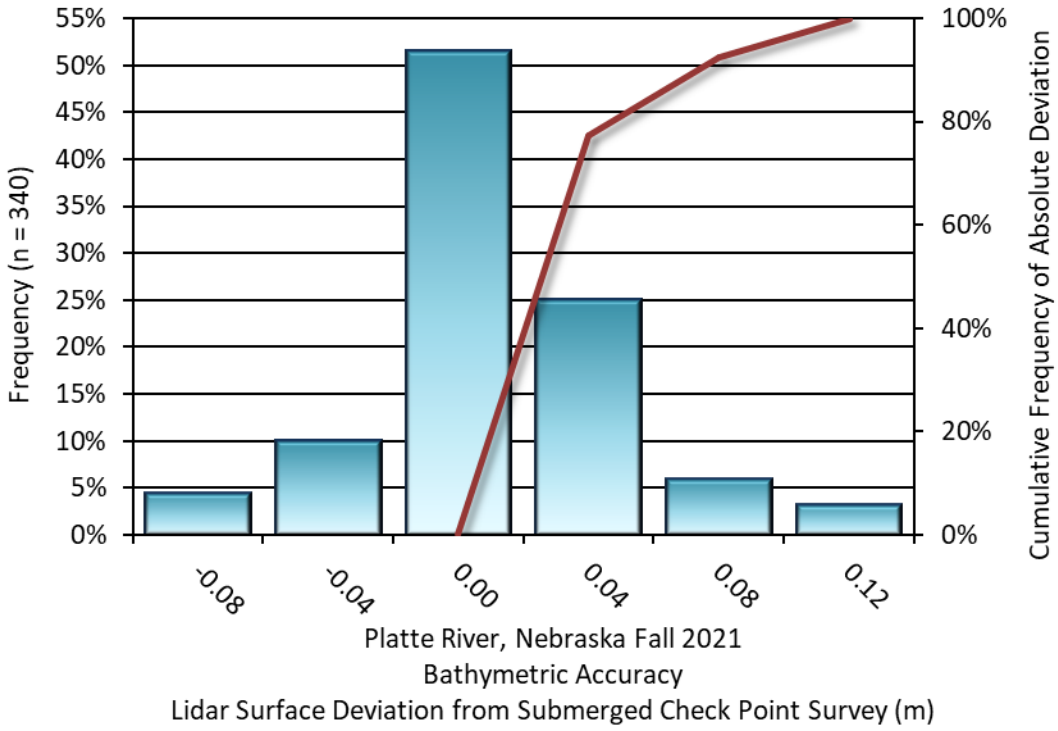


Figure 18: Frequency histogram for lidar surface deviation from submerged check point values

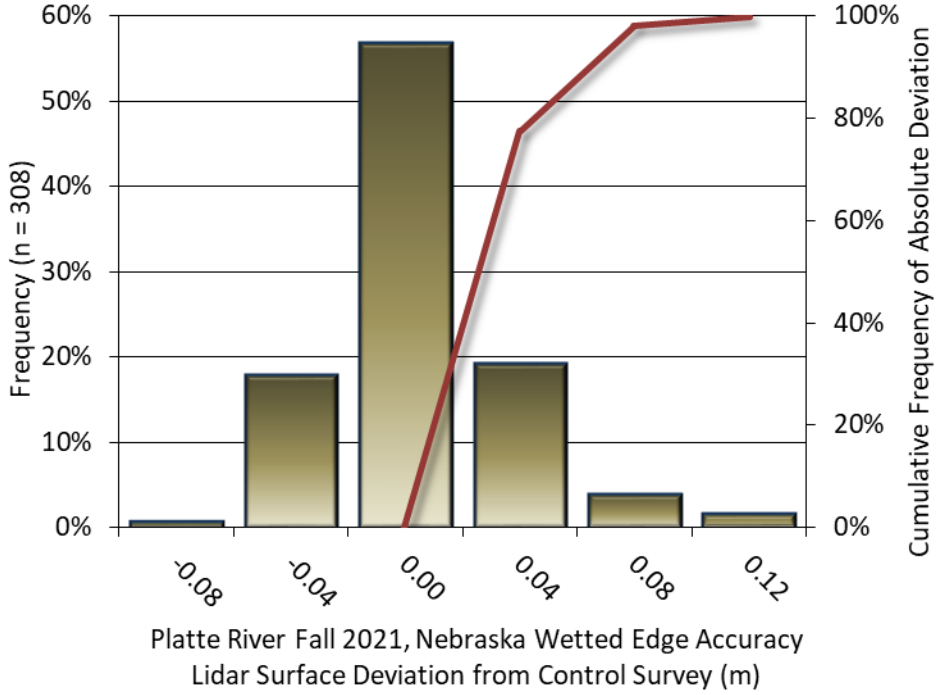


Figure 19: Frequency histogram for lidar surface deviation from wetted edge check point values

Lidar Relative Vertical Accuracy

Relative vertical accuracy refers to the internal consistency of the data set as a whole: the ability to place an object in the same location given multiple flight lines, GPS conditions, and aircraft attitudes. When the lidar system is well calibrated, the swath-to-swath vertical divergence is low (<0.10 meters). The relative vertical accuracy was computed by comparing the ground surface model of each individual flight line with its neighbors in overlapping regions. The average (mean) line to line relative vertical accuracy for the Platte River Fall 2021 lidar project was 0.046 feet (0.014 meters) (Table 16, Figure 20).

Table 16: Relative accuracy results

Relative Accuracy	
Sample	328 flight line surfaces
Average	0.046 ft 0.014 m
Median	0.046 ft 0.014 m
RMSE	0.045 ft 0.014 m
Standard Deviation (1σ)	0.004 ft 0.001 m
1.96σ	0.007 ft 0.002 m

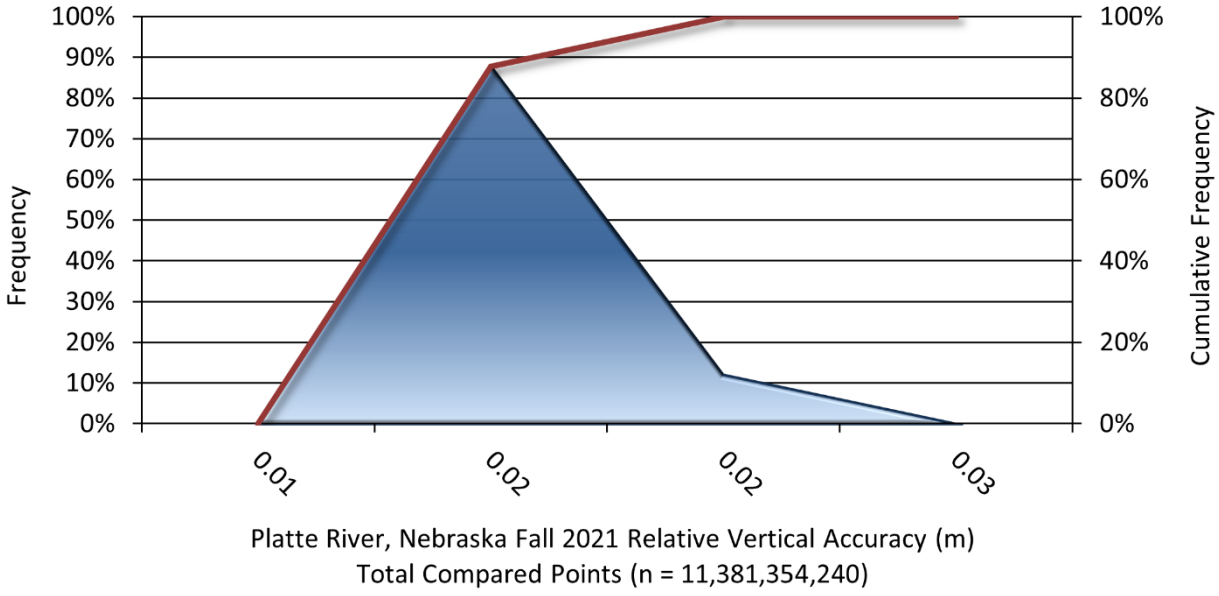


Figure 20: Frequency plot for relative vertical accuracy between flight lines

Lidar Horizontal Accuracy

Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained $RMSE_r$ value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial Data Accuracy (NSSDA) reporting standard where a theoretical point will fall within the obtained radius 95 percent of the time. Based on a flying altitude of 450 meters, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters, this project was produced to meet 0.19 feet (0.06 m) horizontal accuracy at the 95% confidence level.

Table 17: Horizontal Accuracy

Horizontal Accuracy	
$RMSE_r$	0.11 ft 0.03 m
ACC_r	0.19 ft 0.06 m

CERTIFICATIONS

NV5 Geospatial provided lidar services for the Platte River Fall 2021 project as described in this report.

I, Steven Miller, have reviewed the attached report for completeness and hereby state that it is a complete and accurate report of this project.

Apr 22, 2022

Steven Miller
Project Manager
NV5 Geospatial

I, Steven J. Hyde, PLS, being duly registered as a Professional Land Surveyor in and by the state Nebraska, hereby certify that the methodologies, static GNSS occupations used during airborne flights and ground survey point collection were performed using commonly accepted Standard Practices. Work for the Fall 2021 airborne survey was conducted between November 4th through November 9th, 2021. Field work for the Fall 2021 ground survey was conducted between November 5th through November 15th, 2021. Field work for the Fall 2020 ground survey was conducted on October 9-19, 2020.

Accuracy statistics shown in the Accuracy Section of this Report have been reviewed by me and found to meet the "National Standard for Spatial Data Accuracy".

04/21/2022

GLOSSARY

1-sigma (σ) Absolute Deviation: Value for which the data are within one standard deviation (approximately 68th percentile) of a normally distributed data set.

1.96 * RMSE Absolute Deviation: Value for which the data are within two standard deviations (approximately 95th percentile) of a normally distributed data set, based on the FGDC standards for Non-vegetated Vertical Accuracy (FVA) reporting.

Accuracy: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma σ) and root mean square error (RMSE).

> **Absolute Accuracy:** The vertical accuracy of Lidar data is described as the mean and standard deviation (sigma σ) of divergence of LiDAR point coordinates from ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y and z are normally distributed, and thus we also consider the skew and kurtosis of distributions when evaluating error statistics.
>
> **Relative Accuracy:** Relative accuracy refers to the internal consistency of the data set; i.e., the ability to place a laser point in the same location over multiple flight lines, GPS conditions and aircraft attitudes. Affected by system attitude offsets, scale and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the Lidar system is well calibrated, the line-to-line divergence is low (<10 cm).
>
> **Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

Data Density: A common measure of Lidar resolution, measured as points per square meter.

Digital Elevation Model (DEM): File or database made from surveyed points, containing elevation points over a contiguous area. Digital terrain models (DTM) and digital surface models (DSM) are types of DEMs. DTMs consist solely of the bare earth surface (ground points), while DSMs include information about all surfaces, including vegetation and man-made structures.

Intensity Values: The peak power ratio of the laser return to the emitted laser, calculated as a function of surface reflectivity.

Nadir: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

Overlap: The area shared between flight lines, typically measured in percent. 100% overlap is essential to ensure complete coverage and reduce laser shadows.

Pulse Rate (PR): The rate at which laser pulses are emitted from the sensor; typically measured in thousands of pulses per second (kHz).

Pulse Returns: For every laser pulse emitted, the number of wave forms (i.e., echoes) reflected back to the sensor. Portions of the wave form that return first are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

Real-Time Kinematic (RTK) Survey: A type of surveying conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

Post-Processed Kinematic (PPK) Survey: GPS surveying is conducted with a GPS rover collecting concurrently with a GPS base station set up over a known monument. Differential corrections and precisions for the GNSS baselines are computed and applied after the fact during processing. This type of ground survey is accurate to 1.5 cm or less.

Scan Angle: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

Native Lidar Density: The number of pulses emitted by the Lidar system, commonly expressed as pulses per square meter.

Relative Accuracy Calibration Methodology:

Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.

Automated Attitude Calibration: All data was tested and calibrated using TerraMatch or StripAlign automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.

Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

Lidar accuracy error sources and solutions:

Type of Error	Source	Post Processing Solution
GPS (Static/Kinematic)	Long Base Lines	None
	Poor Satellite Constellation	None
	Poor Antenna Visibility	Reduce Visibility Mask
Relative Accuracy	Poor System Calibration	Recalibrate IMU and sensor offsets/settings
	Inaccurate System	None
Laser Noise	Poor Laser Timing	None
	Poor Laser Reception	None
	Poor Laser Power	None
	Irregular Laser Shape	None

Operational measures taken to improve relative accuracy:

Low Flight Altitude: Terrain following was employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (about 1/3000th AGL flight altitude).

Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return (i.e., intensity) is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.

Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±20^{o} from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.

Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1 second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 13 nm at all times.

Ground Survey: Ground survey point accuracy (<1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey points are distributed to the extent possible throughout multiple flight lines and across the survey area.

50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the nadir portion of one flight line coincides with the swath edge portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.

Opposing Flight Lines: All overlapping flight lines have opposing directions. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

APPENDIX B – FALL 2020 GROUND SURVEY POINT TABLES

Table 18: NVA – Platte River Fall 2021 Lidar vs. Fall 2020 survey points

Fall 2020 NVA Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
1	552437.14	4518923.85	581.458	581.44	-0.018	-0.059
2	552439.75	4518280.48	576.321	576.31	-0.011	-0.036
5	552449.71	4516859.59	577.059	577.03	-0.029	-0.095
6	534825.46	4511518.17	599.286	599.28	-0.006	-0.020
7	542793.32	4515402.87	587.832	587.81	-0.022	-0.072
8	542809.77	4513993.17	587.814	587.77	-0.044	-0.144
9	504094.87	4502807.44	640.061	640.08	0.019	0.062
11	492733.14	4501319.21	654.291	654.29	-0.001	-0.003
12	478341.54	4501137.55	673.478	673.47	-0.008	-0.026
13	504117.07	4504235.31	638.944	638.95	0.006	0.020
16	467848.88	4502436.06	686.588	686.62	0.032	0.105
17	454319.90	4504478.51	707.616	707.56	-0.056	-0.184
19	454357.82	4502541.91	703.888	703.85	-0.038	-0.125
20	454361.56	4502367.97	703.281	703.27	-0.011	-0.036

Table 19: NVA – Platte River Fall 2021 Bare Earth DEM vs. Fall 2020 survey points

Fall 2020 NVA Points vs. Fall 2021 Bare Earth DEM Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**DEM Z**	**Dz (meters)**	**Dz (feet)**
1	454319.90	4504478.51	707.616	707.579	-0.037	-0.121
2	454357.82	4502541.91	703.888	703.863	-0.025	-0.082
5	454361.56	4502367.97	703.281	703.263	-0.018	-0.059
6	467848.88	4502436.06	686.588	686.612	0.024	0.079
7	478341.54	4501137.55	673.478	673.470	-0.008	-0.026
8	492733.14	4501319.21	654.291	654.290	-0.001	-0.003
9	504094.87	4502807.44	640.061	640.100	0.039	0.128
11	504117.07	4504235.31	638.944	638.954	0.010	0.033
12	534825.46	4511518.17	599.286	599.296	0.010	0.033
13	542793.32	4515402.87	587.832	587.815	-0.017	-0.056
16	542809.77	4513993.17	587.814	587.794	-0.020	-0.066
17	552437.14	4518923.85	581.458	581.427	-0.031	-0.102
19	552439.75	4518280.48	576.321	576.319	-0.002	-0.007
20	552449.71	4516859.59	577.059	577.036	-0.023	-0.075

Table 20: GCP Accuracy - Platte River Fall 2021 Lidar vs. Fall 2020 survey points

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
1	504094.11	4502983.83	640.008	640.06	0.052	0.171
2	535185.4	4510332.88	597.851	597.9	0.049	0.161
3	534764.29	4512441.62	603.834	603.88	0.046	0.151
4	535246.38	4510077.99	597.664	597.71	0.046	0.151
5	504094.09	4503102.31	639.935	639.98	0.045	0.148
6	573480.86	4537741.81	542.455	542.5	0.045	0.148
7	535226.39	4510160.78	597.707	597.75	0.043	0.141
8	504094.35	4502924.51	640.028	640.07	0.042	0.138
9	504095.95	4502215.08	640.098	640.15	0.052	0.171
10	504096.61	4501870.9	640.158	640.2	0.042	0.138
11	504099.46	4500602.72	640.368	640.41	0.042	0.138
12	504099.2	4500541.79	640.368	640.41	0.042	0.138
13	534772.7	4512309.57	598.569	598.61	0.041	0.135
14	504094.92	4502746.15	640.099	640.14	0.041	0.135
15	504094.05	4503041.74	640.02	640.06	0.04	0.131
16	573844.38	4537753.79	544.961	545	0.039	0.128
17	572747.37	4537419.57	542.221	542.26	0.039	0.128
18	535195.66	4510288.8	597.871	597.91	0.039	0.128
19	535266.21	4509993.4	597.731	597.77	0.039	0.128
20	504096.05	4502275.34	640.062	640.1	0.038	0.125
21	535256.08	4510035.92	597.643	597.68	0.037	0.121
22	534765.7	4512266.19	598.253	598.29	0.037	0.121
23	534763.53	4512177.23	598.054	598.09	0.036	0.118
24	535175.6	4510374.43	597.824	597.86	0.036	0.118

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
25	535205.62	4510246.31	597.784	597.82	0.036	0.118
26	504095.79	4502391.15	640.034	640.07	0.036	0.118
27	478378.04	4502089.74	673.524	673.56	0.036	0.118
28	573173.18	4537692.42	541.494	541.53	0.036	0.118
29	467858.04	4503043.99	686.535	686.57	0.035	0.115
31	535216.1	4510203.25	597.735	597.77	0.035	0.115
32	478389.89	4502859.33	679.115	679.15	0.035	0.115
33	478349.62	4501354.36	673.505	673.54	0.035	0.115
34	573626.952	4537746.421	542.666	542.700	0.034	0.112
35	573407.610	4537739.302	542.346	542.380	0.034	0.112
36	504096.123	4502101.175	640.106	640.140	0.034	0.112
37	535056.285	4510827.051	599.197	599.230	0.033	0.108
38	478390.082	4502905.049	677.667	677.700	0.033	0.108
39	572686.045	4537370.552	542.198	542.230	0.032	0.105
40	478340.263	4501049.855	673.458	673.490	0.032	0.105
41	573553.153	4537744.293	542.378	542.410	0.032	0.105
42	572925.985	4537545.425	541.689	541.720	0.031	0.102
43	478340.218	4500920.712	673.459	673.490	0.031	0.102
44	574561.367	4537779.751	567.530	567.560	0.030	0.098
45	552416.243	4520607.308	573.090	573.120	0.030	0.098
46	572488.845	4537272.801	542.251	542.280	0.029	0.095
47	535235.952	4510120.848	597.701	597.730	0.029	0.095
48	467852.549	4502689.746	686.571	686.600	0.029	0.095
49	571502.214	4538968.971	539.742	539.770	0.028	0.092
50	573107.208	4537663.830	541.232	541.260	0.028	0.092

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
51	504095.968	4502156.533	640.152	640.180	0.028	0.092
52	513045.169	4505949.626	626.862	626.890	0.028	0.092
53	574202.697	4537766.508	553.653	553.680	0.027	0.089
54	504096.332	4501931.818	640.153	640.180	0.027	0.089
55	478340.404	4500963.185	673.463	673.490	0.027	0.089
56	572290.164	4537197.051	542.133	542.160	0.027	0.089
57	572359.791	4537217.550	541.883	541.910	0.027	0.089
58	504096.742	4502332.024	640.024	640.050	0.026	0.085
59	504097.277	4501576.773	640.254	640.280	0.026	0.085
60	504096.662	4500214.238	640.134	640.160	0.026	0.085
61	534767.035	4512222.552	597.985	598.010	0.025	0.082
62	534757.838	4512092.395	598.095	598.120	0.025	0.082
63	572985.467	4537589.534	541.465	541.490	0.025	0.082
64	535069.194	4510787.718	598.845	598.870	0.025	0.082
65	478392.400	4502717.962	678.105	678.130	0.025	0.082
66	478391.876	4502672.644	676.085	676.110	0.025	0.082
69	535276.395	4509950.087	597.786	597.810	0.024	0.079
70	572420.705	4537243.540	542.046	542.070	0.024	0.079
71	535117.295	4510623.360	598.766	598.790	0.024	0.079
72	560165.749	4525572.083	560.836	560.860	0.024	0.079
73	504093.937	4503161.441	639.996	640.020	0.024	0.079
74	504096.138	4502045.825	640.126	640.150	0.024	0.079
75	573918.222	4537756.556	546.367	546.390	0.023	0.075
76	571505.026	4538511.343	539.607	539.630	0.023	0.075
77	573769.832	4537751.369	544.337	544.360	0.023	0.075

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
78	478346.672	4501267.587	673.507	673.530	0.023	0.075
79	504098.487	4500845.575	640.677	640.700	0.023	0.075
80	521913.278	4506732.184	616.087	616.110	0.023	0.075
81	521917.085	4506086.759	616.297	616.320	0.023	0.075
82	560375.321	4525098.196	562.948	562.970	0.022	0.072
83	560275.548	4525240.446	562.058	562.080	0.022	0.072
84	478340.341	4501006.482	673.468	673.490	0.022	0.072
85	512874.989	4503216.217	628.348	628.370	0.022	0.072
86	467849.682	4502486.241	686.608	686.630	0.022	0.072
87	573698.958	4537748.827	543.778	543.800	0.022	0.072
88	535090.741	4510706.320	598.508	598.530	0.022	0.072
89	513048.667	4505833.149	630.018	630.040	0.022	0.072
90	572554.510	4537304.746	542.309	542.330	0.021	0.069
91	504095.267	4502509.680	640.059	640.080	0.021	0.069
92	504097.258	4501636.854	640.199	640.220	0.021	0.069
95	572622.614	4537335.819	542.339	542.360	0.021	0.069
97	504096.848	4501813.750	640.149	640.170	0.021	0.069
98	478340.313	4500878.564	673.369	673.390	0.021	0.069
99	454309.793	4505193.157	704.759	704.780	0.021	0.069
100	534765.459	4512353.310	600.170	600.190	0.020	0.066
101	504096.282	4501986.404	640.160	640.180	0.020	0.066
102	573336.906	4537733.281	542.020	542.040	0.020	0.066
104	521913.196	4506779.670	616.161	616.180	0.019	0.062
105	534762.689	4512527.199	604.571	604.590	0.019	0.062
106	535165.619	4510416.907	597.841	597.860	0.019	0.062

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
108	492734.292	4501188.669	654.381	654.400	0.019	0.062
109	504093.270	4503448.149	640.201	640.220	0.019	0.062
110	467856.289	4502944.225	686.581	686.600	0.019	0.062
111	467851.081	4502587.412	686.601	686.620	0.019	0.062
112	572808.707	4537460.093	542.442	542.460	0.018	0.059
113	552417.005	4520547.019	573.062	573.080	0.018	0.059
114	535155.645	4510458.893	597.862	597.880	0.018	0.059
115	513048.567	4505775.141	632.452	632.470	0.018	0.059
116	478353.451	4501438.821	673.442	673.460	0.018	0.059
117	504099.026	4500662.651	640.412	640.430	0.018	0.059
118	504099.932	4500356.233	640.212	640.230	0.018	0.059
119	467857.346	4502994.071	686.542	686.560	0.018	0.059
120	574636.857	4537781.998	567.303	567.320	0.017	0.056
121	534761.825	4512572.586	603.783	603.800	0.017	0.056
122	504095.135	4502568.759	640.053	640.070	0.017	0.056
123	504097.007	4503563.198	640.353	640.370	0.017	0.056
124	534757.573	4512617.558	602.023	602.040	0.017	0.056
125	512861.674	4502871.095	629.454	629.470	0.016	0.052
126	534761.295	4512133.413	598.094	598.110	0.016	0.052
127	521908.936	4507365.963	617.154	617.170	0.016	0.052
128	467854.109	4502789.053	686.594	686.610	0.016	0.052
129	573044.663	4537629.565	541.295	541.310	0.015	0.049
131	542818.918	4514760.378	587.765	587.780	0.015	0.049
132	571513.135	4538357.059	539.876	539.890	0.014	0.046
133	571503.165	4538817.764	539.786	539.800	0.014	0.046

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
134	478391.142	4502534.863	673.436	673.450	0.014	0.046
135	504095.268	4502450.063	640.056	640.070	0.014	0.046
136	478379.379	4502133.510	673.546	673.560	0.014	0.046
137	492735.027	4501230.800	654.256	654.270	0.014	0.046
138	467860.180	4503191.970	687.136	687.150	0.014	0.046
139	573989.944	4537758.612	547.997	548.010	0.013	0.043
140	535030.558	4510904.512	600.237	600.250	0.013	0.043
141	535105.755	4510665.963	598.667	598.680	0.013	0.043
142	504093.965	4503221.515	639.987	640.000	0.013	0.043
143	513048.440	4506007.907	626.847	626.860	0.013	0.043
144	492745.780	4501839.171	656.427	656.440	0.013	0.043
145	521917.329	4506070.554	616.307	616.320	0.013	0.043
146	512898.230	4503804.380	628.077	628.090	0.013	0.043
147	454310.300	4505152.841	704.697	704.710	0.013	0.043
148	454327.658	4504043.586	704.597	704.610	0.013	0.043
149	512919.307	4504344.029	628.647	628.660	0.013	0.043
150	571721.796	4537716.138	541.068	541.080	0.012	0.039
151	561521.237	4524585.704	572.168	572.180	0.012	0.039
152	561170.947	4524541.665	564.548	564.560	0.012	0.039
153	504095.075	4502687.532	640.088	640.100	0.012	0.039
154	504097.192	4501695.751	640.168	640.180	0.012	0.039
155	492736.410	4501274.169	654.228	654.240	0.012	0.039
156	521916.211	4506223.020	616.168	616.180	0.012	0.039
158	560321.725	4525166.289	562.518	562.530	0.012	0.039
159	504093.724	4503332.425	640.028	640.040	0.012	0.039

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
160	571597.198	4537903.227	540.169	540.180	0.011	0.036
161	504094.869	4502866.140	640.049	640.060	0.011	0.036
162	535286.658	4509907.599	597.839	597.850	0.011	0.036
163	560438.299	4525033.717	563.219	563.230	0.011	0.036
164	478392.752	4502762.962	679.339	679.350	0.011	0.036
165	513044.597	4506069.021	626.719	626.730	0.011	0.036
166	478351.730	4501396.672	673.469	673.480	0.011	0.036
167	478345.057	4501223.613	673.499	673.510	0.011	0.036
168	492741.828	4501795.064	655.469	655.480	0.011	0.036
169	521901.402	4507815.470	615.779	615.790	0.011	0.036
170	521916.900	4506132.991	616.219	616.230	0.011	0.036
171	467850.339	4502537.682	686.619	686.630	0.011	0.036
172	435385.780	4508950.056	729.779	729.790	0.011	0.036
173	534764.577	4512397.644	602.170	602.180	0.010	0.033
174	552455.159	4516306.749	575.930	575.940	0.010	0.033
175	571503.954	4538664.070	539.730	539.740	0.010	0.033
176	571503.579	4538742.167	539.760	539.770	0.010	0.033
177	478384.576	4502351.596	673.590	673.600	0.010	0.033
178	504097.980	4501157.500	640.770	640.780	0.010	0.033
179	478340.119	4500784.891	673.200	673.210	0.010	0.033
180	454310.939	4505074.884	704.510	704.520	0.010	0.033
181	574489.319	4537779.754	565.541	565.550	0.009	0.030
182	574417.385	4537777.046	562.471	562.480	0.009	0.030
183	535126.923	4510581.676	598.551	598.560	0.009	0.030
185	560121.904	4525746.086	560.741	560.750	0.009	0.030

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
186	513052.536	4505658.160	633.241	633.250	0.009	0.030
187	478376.406	4502046.803	673.521	673.530	0.009	0.030
188	478354.379	4501563.454	673.631	673.640	0.009	0.030
189	478340.423	4501093.337	673.471	673.480	0.009	0.030
190	492749.578	4502103.831	660.231	660.240	0.009	0.030
191	521914.826	4506552.453	615.991	616.000	0.009	0.030
192	504093.511	4503390.482	640.091	640.100	0.009	0.030
193	454310.499	4505114.568	704.621	704.630	0.009	0.030
194	571504.441	4538589.935	539.712	539.720	0.008	0.026
195	552415.604	4520665.568	573.122	573.130	0.008	0.026
196	492817.696	4499962.125	654.292	654.300	0.008	0.026
197	492726.738	4500935.808	655.932	655.940	0.008	0.026
198	492729.905	4501020.863	655.322	655.330	0.008	0.026
199	512909.197	4503986.843	628.082	628.090	0.008	0.026
200	535145.999	4510499.868	598.032	598.040	0.008	0.026
201	492719.820	4500530.989	655.392	655.400	0.008	0.026
202	454342.347	4503732.234	705.662	705.670	0.008	0.026
203	572245.880	4537244.451	541.703	541.710	0.007	0.023
204	535137.114	4510539.207	598.203	598.210	0.007	0.023
205	558565.138	4526431.198	562.313	562.320	0.007	0.023
206	492737.175	4501362.217	654.183	654.190	0.007	0.023
208	504099.230	4500480.798	640.323	640.330	0.007	0.023
209	560190.054	4525486.027	561.143	561.150	0.007	0.023
210	504099.115	4500723.825	640.503	640.510	0.007	0.023
211	454331.549	4503966.047	704.743	704.750	0.007	0.023

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
212	435328.739	4508954.075	729.743	729.750	0.007	0.023
213	535082.079	4510748.393	598.684	598.690	0.006	0.020
214	504099.007	4502625.105	639.944	639.950	0.006	0.020
215	492740.377	4501577.795	654.204	654.210	0.006	0.020
216	574132.815	4537763.845	551.224	551.230	0.006	0.020
218	504093.157	4503506.501	640.394	640.400	0.006	0.020
219	521915.256	4506411.989	615.994	616.000	0.006	0.020
220	521911.686	4506434.383	615.964	615.970	0.006	0.020
221	454309.166	4505233.082	704.784	704.790	0.006	0.020
223	504100.082	4503911.485	644.435	644.440	0.005	0.016
224	572190.685	4537293.610	541.985	541.990	0.005	0.016
225	542812.619	4514181.587	587.835	587.840	0.005	0.016
226	513044.162	4505891.452	627.645	627.650	0.005	0.016
227	492741.403	4501533.275	654.215	654.220	0.005	0.016
228	492742.765	4501707.285	654.285	654.290	0.005	0.016
229	521898.910	4508042.801	616.755	616.760	0.005	0.016
230	521913.586	4506687.430	616.075	616.080	0.005	0.016
231	512877.148	4503275.710	628.205	628.210	0.005	0.016
232	435674.164	4508945.809	729.365	729.370	0.005	0.016
233	571913.913	4537539.027	542.056	542.060	0.004	0.013
235	492727.903	4500978.705	655.606	655.610	0.004	0.013
237	492746.136	4501887.744	657.826	657.830	0.004	0.013
238	512844.922	4502333.680	628.796	628.800	0.004	0.013
239	512900.414	4503860.009	628.026	628.030	0.004	0.013
240	534840.489	4511473.057	598.916	598.920	0.004	0.013

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
241	542788.131	4515468.661	587.916	587.920	0.004	0.013
242	534766.794	4512706.867	598.447	598.450	0.003	0.010
243	535043.095	4510866.468	599.727	599.730	0.003	0.010
244	558739.696	4526435.314	562.307	562.310	0.003	0.010
245	560238.552	4525317.711	561.687	561.690	0.003	0.010
247	513048.729	4506193.723	626.727	626.730	0.003	0.010
248	492739.376	4501489.947	654.197	654.200	0.003	0.010
249	571509.625	4538434.669	539.647	539.650	0.003	0.010
250	478381.474	4502264.772	673.527	673.530	0.003	0.010
251	492731.464	4501062.341	655.078	655.080	0.002	0.007
252	492746.882	4501932.890	659.098	659.100	0.002	0.007
253	467853.242	4502739.644	686.568	686.570	0.002	0.007
254	552452.456	4516582.039	575.528	575.530	0.002	0.007
255	559105.391	4526435.011	562.278	562.280	0.002	0.007
256	542819.213	4514825.577	587.738	587.740	0.002	0.007
257	504099.526	4500419.604	640.268	640.270	0.002	0.007
258	521914.840	4506504.770	616.008	616.010	0.002	0.007
259	454329.572	4504002.853	704.668	704.670	0.002	0.007
260	454344.076	4503693.685	705.748	705.750	0.002	0.007
261	534757.541	4512662.297	599.959	599.960	0.001	0.003
262	571581.726	4537976.907	539.959	539.960	0.001	0.003
263	492741.150	4501620.330	654.209	654.210	0.001	0.003
264	467859.344	4503144.045	686.829	686.830	0.001	0.003
265	454308.833	4505272.335	704.829	704.830	0.001	0.003
266	542807.604	4513357.922	588.879	588.880	0.001	0.003

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
267	561609.025	4524603.972	571.389	571.390	0.001	0.003
268	512852.497	4502631.345	629.139	629.140	0.001	0.003
270	571539.971	4538200.017	540.080	540.080	0.000	0.000
271	542708.582	4516158.225	586.790	586.790	0.000	0.000
272	504097.245	4503277.433	639.900	639.900	0.000	0.000
273	478390.248	4502444.022	673.530	673.530	0.000	0.000
274	478386.255	4502396.991	673.600	673.600	0.000	0.000
275	504096.897	4501754.723	640.170	640.170	0.000	0.000
276	492742.138	4501664.656	654.200	654.200	0.000	0.000
278	512854.502	4502692.005	629.340	629.340	0.000	0.000
279	521914.949	4506459.599	615.970	615.970	0.000	0.000
280	454308.234	4505311.378	704.870	704.870	0.000	0.000
281	435618.137	4508946.621	729.360	729.360	0.000	0.000
282	434805.049	4508959.888	730.910	730.910	0.000	0.000
283	552433.797	4518864.599	580.831	580.830	-0.001	-0.003
284	552442.222	4517923.516	576.741	576.740	-0.001	-0.003
285	492738.742	4501447.765	654.201	654.200	-0.001	-0.003
286	504097.821	4501218.664	640.551	640.550	-0.001	-0.003
287	436269.365	4508942.025	728.731	728.730	-0.001	-0.003
288	435790.756	4508947.466	729.081	729.080	-0.001	-0.003
289	435105.027	4508957.258	730.161	730.160	-0.001	-0.003
290	571502.748	4538894.607	539.762	539.760	-0.002	-0.007
291	542817.201	4515084.021	587.742	587.740	-0.002	-0.007
292	513048.616	4506136.213	626.742	626.740	-0.002	-0.007
294	478343.156	4501180.385	673.482	673.480	-0.002	-0.007

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
295	492750.272	4502147.361	659.552	659.550	-0.002	-0.007
296	513056.124	4505591.262	631.092	631.090	-0.002	-0.007
297	512868.413	4503043.889	629.222	629.220	-0.002	-0.007
298	521910.764	4506623.396	616.002	616.000	-0.002	-0.007
299	467861.899	4503290.451	687.952	687.950	-0.002	-0.007
301	434849.856	4508962.080	730.682	730.680	-0.002	-0.007
302	512927.177	4504452.767	629.032	629.030	-0.002	-0.007
303	478348.428	4501312.542	673.542	673.540	-0.002	-0.007
304	512850.359	4502571.458	628.892	628.890	-0.002	-0.007
305	552434.296	4518804.720	579.933	579.930	-0.003	-0.010
307	513036.200	4505160.379	627.683	627.680	-0.003	-0.010
308	513051.618	4505402.703	627.063	627.060	-0.003	-0.010
309	467860.910	4503240.015	687.553	687.550	-0.003	-0.010
310	435054.532	4508954.920	730.313	730.310	-0.003	-0.010
311	571622.269	4537831.997	540.613	540.610	-0.003	-0.010
312	534957.292	4511115.835	600.283	600.280	-0.003	-0.010
313	534801.040	4511593.561	599.873	599.870	-0.003	-0.010
314	560143.585	4525659.786	560.763	560.760	-0.003	-0.010
315	492720.824	4500614.370	656.003	656.000	-0.003	-0.010
316	521908.000	4507454.539	616.663	616.660	-0.003	-0.010
317	521912.830	4506248.067	616.153	616.150	-0.003	-0.010
318	521909.998	4506829.307	616.243	616.240	-0.003	-0.010
319	512917.392	4504291.818	628.403	628.400	-0.003	-0.010
320	521905.887	4507684.437	615.834	615.830	-0.004	-0.013
321	574061.511	4537761.117	549.284	549.280	-0.004	-0.013

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
322	552440.303	4518218.633	576.214	576.210	-0.004	-0.013
323	552454.157	4516418.864	575.764	575.760	-0.004	-0.013
324	560853.839	4524666.706	562.754	562.750	-0.004	-0.013
326	504097.907	4503799.380	640.724	640.720	-0.004	-0.013
327	512896.175	4503750.251	628.104	628.100	-0.004	-0.013
328	534752.392	4512048.288	598.035	598.030	-0.005	-0.016
329	561262.360	4524539.306	567.375	567.370	-0.005	-0.016
330	492751.191	4502190.469	658.495	658.490	-0.005	-0.016
331	504107.599	4504058.741	644.195	644.190	-0.005	-0.016
332	521915.262	4506362.190	616.045	616.040	-0.005	-0.016
333	521908.233	4506988.397	617.035	617.030	-0.005	-0.016
334	467858.681	4503093.980	686.655	686.650	-0.005	-0.016
335	467855.692	4502894.152	686.605	686.600	-0.005	-0.016
336	436597.198	4508967.391	728.625	728.620	-0.005	-0.016
337	435444.750	4508949.292	729.695	729.690	-0.005	-0.016
338	434952.112	4508956.942	730.505	730.500	-0.005	-0.016
339	571669.756	4537770.546	540.526	540.520	-0.006	-0.020
341	558846.043	4526438.045	562.266	562.260	-0.006	-0.020
342	542801.255	4515341.576	587.716	587.710	-0.006	-0.020
343	560209.575	4525401.143	561.466	561.460	-0.006	-0.020
344	542815.869	4514429.352	587.856	587.850	-0.006	-0.020
345	492779.701	4500132.690	654.136	654.130	-0.006	-0.020
346	492733.609	4501145.570	654.536	654.530	-0.006	-0.020
347	504097.727	4501279.418	640.456	640.450	-0.006	-0.020
348	467892.260	4504287.962	692.576	692.570	-0.006	-0.020

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
349	435907.635	4508942.417	729.026	729.020	-0.006	-0.020
351	434897.894	4508961.125	730.516	730.510	-0.006	-0.020
352	454357.114	4502456.189	703.746	703.740	-0.006	-0.020
353	492809.641	4500005.385	654.296	654.290	-0.006	-0.020
354	552438.793	4518401.321	576.467	576.470	0.003	0.010
355	552455.694	4516250.718	576.007	576.000	-0.007	-0.023
356	561698.733	4524622.501	570.607	570.600	-0.007	-0.023
357	478391.499	4502581.455	673.437	673.430	-0.007	-0.023
358	521909.882	4506758.468	616.127	616.120	-0.007	-0.023
359	552440.854	4518525.523	576.677	576.670	-0.007	-0.023
360	492734.229	4501405.407	654.297	654.290	-0.007	-0.023
361	504092.519	4503741.217	640.527	640.520	-0.007	-0.023
364	454340.576	4503771.981	705.517	705.510	-0.007	-0.023
365	552452.968	4516532.075	575.578	575.570	-0.008	-0.026
366	558477.798	4526430.261	562.308	562.300	-0.008	-0.026
367	561434.331	4524569.698	572.098	572.090	-0.008	-0.026
368	492726.439	4500396.327	654.478	654.470	-0.008	-0.026
369	512847.999	4502453.107	628.828	628.820	-0.008	-0.026
370	521912.492	4506872.369	616.448	616.440	-0.008	-0.026
371	454311.402	4505035.536	704.468	704.460	-0.008	-0.026
372	454311.834	4504995.362	704.358	704.350	-0.008	-0.026
373	512933.289	4504701.836	628.138	628.130	-0.008	-0.026
374	521907.278	4507546.665	616.158	616.150	-0.008	-0.026
375	521902.799	4508084.208	616.378	616.370	-0.008	-0.026
376	512886.212	4503510.132	628.028	628.020	-0.008	-0.026

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
377	454312.726	4504915.851	704.298	704.290	-0.008	-0.026
378	561089.416	4524559.260	563.059	563.050	-0.009	-0.030
379	521915.638	4506313.999	616.069	616.060	-0.009	-0.030
380	521916.844	4506178.950	616.189	616.180	-0.009	-0.030
381	436966.801	4509166.283	729.059	729.050	-0.009	-0.030
382	571554.151	4538124.197	539.999	539.990	-0.009	-0.030
384	559440.610	4526437.280	562.129	562.120	-0.009	-0.030
385	492802.904	4500048.039	654.169	654.160	-0.009	-0.030
386	492739.030	4500307.833	654.179	654.170	-0.009	-0.030
387	521916.438	4506267.314	616.139	616.130	-0.009	-0.030
388	512879.667	4503336.511	628.139	628.130	-0.009	-0.030
389	467895.352	4504340.354	693.599	693.590	-0.009	-0.030
390	436818.543	4509046.592	729.169	729.160	-0.009	-0.030
391	435734.284	4508944.997	729.249	729.240	-0.009	-0.030
392	435003.552	4508955.909	730.419	730.410	-0.009	-0.030
393	434754.128	4508964.239	730.859	730.850	-0.009	-0.030
394	454360.589	4502752.852	703.869	703.860	-0.009	-0.030
395	454359.960	4502711.395	703.909	703.900	-0.009	-0.030
396	454356.599	4502412.719	703.619	703.610	-0.009	-0.030
397	561349.443	4524548.844	570.560	570.550	-0.010	-0.033
398	571777.009	4537666.455	541.450	541.440	-0.010	-0.033
399	534746.118	4511998.005	598.010	598.000	-0.010	-0.033
400	572134.726	4537344.780	542.160	542.150	-0.010	-0.033
401	535293.422	4509864.203	597.890	597.880	-0.010	-0.033
402	534856.114	4511425.101	598.710	598.700	-0.010	-0.033

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
403	534751.138	4511735.244	599.680	599.670	-0.010	-0.033
404	534741.795	4511779.710	599.330	599.320	-0.010	-0.033
405	542818.213	4514681.838	587.890	587.880	-0.010	-0.033
406	492748.081	4500263.682	654.090	654.080	-0.010	-0.033
407	478368.043	4501915.177	673.710	673.700	-0.010	-0.033
408	512903.234	4503930.992	628.070	628.060	-0.010	-0.033
409	454312.369	4504956.008	704.350	704.340	-0.010	-0.033
410	436142.107	4508943.365	728.730	728.720	-0.010	-0.033
411	454361.375	4503240.614	705.230	705.220	-0.010	-0.033
412	454359.051	4502933.570	704.190	704.170	-0.020	-0.066
415	542715.362	4516286.188	586.451	586.440	-0.011	-0.036
416	521914.051	4506643.339	616.021	616.010	-0.011	-0.036
417	521914.195	4506597.573	615.991	615.980	-0.011	-0.036
418	435501.394	4508948.293	729.631	729.620	-0.011	-0.036
419	435269.427	4508951.603	729.931	729.920	-0.011	-0.036
420	574345.368	4537774.508	558.972	558.960	-0.012	-0.039
421	542809.324	4513138.001	588.622	588.610	-0.012	-0.039
422	534914.507	4511246.432	598.982	598.970	-0.012	-0.039
423	492762.714	4500221.341	653.972	653.960	-0.012	-0.039
425	504112.036	4504175.130	639.692	639.680	-0.012	-0.039
427	512887.803	4503449.614	628.012	628.000	-0.012	-0.039
428	467901.870	4504489.678	693.622	693.610	-0.012	-0.039
429	467875.186	4504044.130	687.132	687.120	-0.012	-0.039
430	436551.314	4508954.332	728.572	728.560	-0.012	-0.039
431	454333.064	4503927.693	704.882	704.870	-0.012	-0.039

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
433	552441.892	4517983.504	576.522	576.510	-0.012	-0.039
434	552453.604	4516475.529	575.662	575.650	-0.012	-0.039
435	561787.048	4524641.152	570.922	570.910	-0.012	-0.039
436	492789.645	4500091.092	654.152	654.140	-0.012	-0.039
437	492732.678	4501104.540	654.782	654.770	-0.012	-0.039
438	492743.485	4501750.914	654.672	654.660	-0.012	-0.039
439	512911.335	4504140.826	628.052	628.040	-0.012	-0.039
440	454321.998	4504163.399	704.522	704.510	-0.012	-0.039
441	534928.543	4511203.708	599.353	599.340	-0.013	-0.043
442	558390.863	4526429.505	562.333	562.320	-0.013	-0.043
443	478354.561	4501475.805	673.443	673.430	-0.013	-0.043
445	435560.407	4508947.494	729.473	729.460	-0.013	-0.043
446	454359.848	4502976.401	704.233	704.220	-0.013	-0.043
447	454360.700	4502795.300	703.973	703.960	-0.013	-0.043
448	571567.686	4538052.373	540.013	540.000	-0.013	-0.043
449	552440.951	4518104.224	576.173	576.160	-0.013	-0.043
450	552431.053	4519175.325	579.683	579.670	-0.013	-0.043
451	558934.821	4526434.529	562.423	562.410	-0.013	-0.043
452	542743.525	4515781.436	587.803	587.790	-0.013	-0.043
453	542815.124	4514368.538	587.893	587.880	-0.013	-0.043
454	492824.343	4499919.197	654.293	654.280	-0.013	-0.043
455	521899.478	4507983.697	615.493	615.480	-0.013	-0.043
456	467875.057	4503994.914	687.043	687.030	-0.013	-0.043
458	454307.973	4505348.885	704.944	704.930	-0.014	-0.046
459	552435.501	4518687.921	577.514	577.500	-0.014	-0.046

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
460	552444.151	4517672.820	577.004	576.990	-0.014	-0.046
461	560929.071	4524623.501	562.664	562.650	-0.014	-0.046
462	504097.419	4501460.145	640.394	640.380	-0.014	-0.046
463	512937.535	4504821.095	628.044	628.030	-0.014	-0.046
464	521902.144	4507727.749	615.874	615.860	-0.014	-0.046
465	454338.561	4503810.687	705.374	705.360	-0.014	-0.046
466	552423.554	4520015.040	575.875	575.860	-0.015	-0.049
467	534767.536	4511694.377	599.875	599.860	-0.015	-0.049
468	542711.121	4516032.466	587.105	587.090	-0.015	-0.049
469	560783.338	4524716.145	562.965	562.950	-0.015	-0.049
470	478369.613	4501958.078	673.565	673.550	-0.015	-0.049
471	512940.586	4504879.541	628.115	628.100	-0.015	-0.049
472	512909.456	4504089.663	628.095	628.080	-0.015	-0.049
473	512916.692	4504187.040	628.035	628.020	-0.015	-0.049
474	512915.306	4504238.268	628.165	628.150	-0.015	-0.049
475	467851.811	4502637.652	686.615	686.600	-0.015	-0.049
476	437031.535	4509269.329	728.725	728.710	-0.015	-0.049
477	436397.000	4508940.535	728.775	728.760	-0.015	-0.049
478	542810.715	4512997.449	588.336	588.320	-0.016	-0.052
479	552451.790	4516637.452	575.616	575.600	-0.016	-0.052
480	558652.448	4526432.372	562.346	562.330	-0.016	-0.052
481	504111.720	4504116.557	641.786	641.770	-0.016	-0.052
482	467869.748	4503845.193	687.286	687.270	-0.016	-0.052
484	454307.549	4505386.938	704.986	704.970	-0.016	-0.052
485	436504.503	4508945.510	728.596	728.580	-0.016	-0.052

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
486	435211.495	4508952.527	730.036	730.020	-0.016	-0.052
487	571885.587	4537569.270	541.926	541.910	-0.016	-0.052
488	492720.018	4500486.745	655.056	655.040	-0.016	-0.052
489	454317.666	4504758.213	706.796	706.780	-0.016	-0.052
490	436776.027	4509024.923	729.176	729.160	-0.016	-0.052
491	435153.052	4508956.488	730.176	730.160	-0.016	-0.052
492	574273.505	4537768.714	556.207	556.190	-0.017	-0.056
493	552419.327	4520365.852	573.707	573.690	-0.017	-0.056
495	534885.194	4511335.985	598.727	598.710	-0.017	-0.056
496	542717.865	4516411.310	590.737	590.720	-0.017	-0.056
497	504098.830	4500783.222	640.497	640.480	-0.017	-0.056
498	467882.038	4504142.141	688.337	688.320	-0.017	-0.056
501	437484.713	4510533.215	731.177	731.160	-0.017	-0.056
503	552425.474	4519834.145	575.978	575.960	-0.018	-0.059
504	552427.022	4519650.394	575.978	575.960	-0.018	-0.059
505	552433.287	4519291.960	577.088	577.070	-0.018	-0.059
506	552449.178	4516914.008	577.348	577.330	-0.018	-0.059
507	478391.440	4502626.853	674.218	674.200	-0.018	-0.059
508	521908.285	4507410.500	616.858	616.840	-0.018	-0.059
509	478340.122	4500835.818	673.338	673.320	-0.018	-0.059
510	534740.848	4511954.338	598.018	598.000	-0.018	-0.059
511	542754.895	4515721.816	587.638	587.620	-0.018	-0.059
512	542807.404	4513739.306	588.438	588.420	-0.018	-0.059
514	504097.523	4501339.315	640.438	640.420	-0.018	-0.059
515	512928.472	4504583.295	628.918	628.900	-0.018	-0.059

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
516	467903.008	4504537.188	692.658	692.640	-0.018	-0.059
517	467884.753	4504190.183	689.528	689.510	-0.018	-0.059
518	454311.698	4504680.221	710.268	710.250	-0.018	-0.059
519	454337.156	4503849.469	705.158	705.140	-0.018	-0.059
520	552444.281	4517617.473	576.829	576.810	-0.019	-0.062
521	534731.006	4511870.522	598.569	598.550	-0.019	-0.062
522	571830.946	4537617.791	541.749	541.730	-0.019	-0.062
523	552429.999	4519469.682	575.939	575.920	-0.019	-0.062
524	552433.599	4519113.856	580.749	580.730	-0.019	-0.062
525	552418.474	4520426.773	573.339	573.320	-0.019	-0.062
526	552450.304	4516804.605	576.649	576.630	-0.019	-0.062
527	552452.242	4516748.233	576.259	576.240	-0.019	-0.062
528	542771.828	4515594.631	587.769	587.750	-0.019	-0.062
529	478381.337	4502176.378	673.519	673.500	-0.019	-0.062
530	513048.694	4506077.275	626.779	626.760	-0.019	-0.062
532	513047.854	4505518.394	628.139	628.120	-0.019	-0.062
534	467859.505	4503338.941	688.339	688.320	-0.019	-0.062
535	437257.879	4509808.470	728.749	728.730	-0.019	-0.062
536	436872.385	4509080.994	729.119	729.100	-0.019	-0.062
537	436083.294	4508940.816	728.799	728.780	-0.019	-0.062
538	552423.285	4520046.934	575.880	575.860	-0.020	-0.066
539	552417.817	4520486.782	573.140	573.120	-0.020	-0.066
540	552451.296	4516693.187	575.880	575.860	-0.020	-0.066
541	552454.572	4516362.690	575.850	575.830	-0.020	-0.066
542	478390.557	4502952.216	675.500	675.480	-0.020	-0.066

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
543	478383.035	4502307.841	673.580	673.560	-0.020	-0.066
544	492720.633	4500572.292	655.760	655.740	-0.020	-0.066
545	478371.347	4502001.220	673.510	673.490	-0.020	-0.066
546	521901.945	4508127.202	615.750	615.730	-0.020	-0.066
547	504096.200	4503854.904	642.240	642.220	-0.020	-0.066
548	436686.368	4509002.364	728.670	728.650	-0.020	-0.066
549	552440.309	4518587.355	576.771	576.750	-0.021	-0.069
550	552440.592	4518166.069	576.151	576.130	-0.021	-0.069
551	552429.532	4519408.400	575.981	575.960	-0.021	-0.069
552	552444.656	4517164.980	576.891	576.870	-0.021	-0.069
554	559591.462	4526429.928	562.221	562.200	-0.021	-0.069
556	513048.099	4505279.510	627.371	627.350	-0.021	-0.069
557	512893.392	4503694.883	628.091	628.070	-0.021	-0.069
558	454307.471	4505425.311	705.091	705.070	-0.021	-0.069
559	454313.484	4504875.326	704.151	704.130	-0.021	-0.069
560	437060.866	4509326.197	728.951	728.930	-0.021	-0.069
561	436642.053	4508984.416	728.661	728.640	-0.021	-0.069
562	552422.572	4520107.313	575.681	575.660	-0.021	-0.069
563	559278.467	4526436.242	562.171	562.150	-0.021	-0.069
564	478380.058	4502220.861	673.551	673.530	-0.021	-0.069
565	435849.178	4508943.465	729.061	729.040	-0.021	-0.069
566	542763.130	4515659.224	587.722	587.700	-0.022	-0.072
567	542814.421	4514307.154	587.882	587.860	-0.022	-0.072
568	560715.043	4524773.027	563.242	563.220	-0.022	-0.072
569	521901.541	4507772.027	615.702	615.680	-0.022	-0.072

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
570	454317.219	4504797.098	705.232	705.210	-0.022	-0.072
571	437086.381	4509387.059	729.082	729.060	-0.022	-0.072
572	437007.101	4509214.972	729.122	729.100	-0.022	-0.072
573	436920.040	4509120.758	729.012	728.990	-0.022	-0.072
574	552430.718	4519354.145	576.302	576.280	-0.022	-0.072
576	542808.374	4513276.182	588.682	588.660	-0.022	-0.072
577	492768.977	4500175.983	654.172	654.150	-0.022	-0.072
579	513047.884	4505464.838	627.182	627.160	-0.022	-0.072
580	492722.402	4500441.356	654.723	654.700	-0.023	-0.075
581	552437.356	4518746.728	578.683	578.660	-0.023	-0.075
582	552441.559	4518043.218	576.303	576.280	-0.023	-0.075
583	534870.782	4511379.919	598.683	598.660	-0.023	-0.075
584	552446.757	4517261.783	576.043	576.020	-0.023	-0.075
585	534814.641	4511563.638	599.683	599.660	-0.023	-0.075
586	559020.638	4526434.716	562.363	562.340	-0.023	-0.075
587	512935.486	4504760.824	628.043	628.020	-0.023	-0.075
588	521907.464	4507500.078	616.413	616.390	-0.023	-0.075
589	521900.949	4507859.157	615.793	615.770	-0.023	-0.075
590	512885.196	4503391.166	628.143	628.120	-0.023	-0.075
591	437468.279	4510472.311	733.013	732.990	-0.023	-0.075
592	437285.150	4509869.003	728.683	728.660	-0.023	-0.075
593	435964.997	4508941.858	728.903	728.880	-0.023	-0.075
594	552433.849	4519232.514	578.304	578.280	-0.024	-0.079
595	559524.254	4526436.257	562.314	562.290	-0.024	-0.079
596	504097.532	4501398.551	640.374	640.350	-0.024	-0.079

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
598	512907.386	4504038.542	628.124	628.100	-0.024	-0.079
599	552442.478	4517875.871	576.895	576.870	-0.025	-0.082
601	534734.266	4511824.180	598.955	598.930	-0.025	-0.082
602	542709.966	4516221.887	586.745	586.720	-0.025	-0.082
603	478390.807	4502997.555	673.555	673.530	-0.025	-0.082
605	467868.283	4503743.262	688.045	688.020	-0.025	-0.082
606	437489.724	4510600.273	728.915	728.890	-0.025	-0.082
607	454334.856	4503888.192	705.015	704.990	-0.025	-0.082
608	534942.909	4511160.962	599.815	599.790	-0.025	-0.082
609	454323.626	4504124.462	704.565	704.540	-0.025	-0.082
610	573241.653	4537714.006	541.656	541.630	-0.026	-0.085
611	542707.983	4516093.812	586.646	586.620	-0.026	-0.085
612	542718.346	4515969.964	587.636	587.610	-0.026	-0.085
613	559366.170	4526436.809	562.126	562.100	-0.026	-0.085
614	542816.848	4514492.063	587.956	587.930	-0.026	-0.085
615	521906.964	4507591.402	615.986	615.960	-0.026	-0.085
616	454319.913	4504243.513	704.506	704.480	-0.026	-0.085
617	436456.912	4508941.047	728.726	728.700	-0.026	-0.085
618	436023.958	4508941.278	728.806	728.780	-0.026	-0.085
619	552421.926	4520166.881	575.367	575.340	-0.027	-0.089
620	542815.610	4512463.876	588.347	588.320	-0.027	-0.089
621	542814.943	4512532.956	588.137	588.110	-0.027	-0.089
622	467854.877	4502844.706	686.597	686.570	-0.027	-0.089
623	552439.374	4518341.012	576.427	576.400	-0.027	-0.089
624	552420.665	4520254.874	574.677	574.650	-0.027	-0.089

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
625	542810.126	4513068.685	588.517	588.490	-0.027	-0.089
626	534899.456	4511292.138	598.777	598.750	-0.027	-0.089
627	512991.965	4505048.426	627.817	627.790	-0.027	-0.089
628	512874.045	4503098.722	628.817	628.790	-0.027	-0.089
629	467878.892	4504092.427	687.527	687.500	-0.027	-0.089
630	478390.800	4502487.639	673.608	673.580	-0.028	-0.092
631	504097.525	4501517.391	640.358	640.330	-0.028	-0.092
634	436333.184	4508941.444	728.768	728.740	-0.028	-0.092
635	552440.789	4518648.060	576.849	576.820	-0.029	-0.095
636	552426.625	4519710.139	575.999	575.970	-0.029	-0.095
637	542811.257	4512935.203	588.399	588.370	-0.029	-0.095
638	552447.633	4517126.107	577.099	577.070	-0.029	-0.095
639	512922.491	4504424.265	628.949	628.920	-0.029	-0.095
640	513048.009	4505339.662	627.409	627.380	-0.029	-0.095
641	437453.936	4510411.848	734.449	734.420	-0.029	-0.095
642	437234.963	4509748.959	728.949	728.920	-0.029	-0.095
643	552445.113	4517505.769	576.280	576.250	-0.030	-0.098
644	559759.101	4526377.188	561.980	561.950	-0.030	-0.098
645	560014.875	4526131.952	561.410	561.380	-0.030	-0.098
646	542811.969	4514119.090	587.750	587.720	-0.030	-0.098
647	561009.156	4524587.066	562.650	562.620	-0.030	-0.098
648	560675.621	4524810.337	563.250	563.220	-0.030	-0.098
649	521911.639	4507010.700	617.230	617.200	-0.030	-0.098
650	467864.429	4503693.821	688.390	688.360	-0.030	-0.098
651	467908.660	4504803.435	687.190	687.160	-0.030	-0.098

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
653	552442.430	4517844.610	576.991	576.960	-0.031	-0.102
654	560100.651	4525830.674	560.741	560.710	-0.031	-0.102
655	542817.785	4514616.872	587.871	587.840	-0.031	-0.102
656	454359.302	4502668.683	703.891	703.860	-0.031	-0.102
657	552443.058	4517786.360	577.071	577.040	-0.031	-0.102
659	436205.548	4508942.743	728.681	728.650	-0.031	-0.102
660	559192.100	4526435.728	562.222	562.190	-0.032	-0.105
661	454358.987	4502626.490	703.972	703.940	-0.032	-0.105
662	512872.598	4503156.554	628.442	628.410	-0.032	-0.105
663	454360.746	4503061.868	704.452	704.420	-0.032	-0.105
664	552445.770	4517724.654	577.023	576.990	-0.033	-0.108
665	552445.509	4517451.032	576.003	575.970	-0.033	-0.108
666	552447.072	4517213.950	576.413	576.380	-0.033	-0.108
667	542813.527	4514245.204	587.793	587.760	-0.033	-0.108
670	437307.030	4509927.195	728.553	728.520	-0.033	-0.108
671	542814.558	4512600.562	588.254	588.220	-0.034	-0.112
672	542807.405	4513353.232	588.824	588.790	-0.034	-0.112
673	542804.921	4513608.409	588.734	588.700	-0.034	-0.112
675	512846.581	4502393.517	628.854	628.820	-0.034	-0.112
676	437423.907	4510281.217	733.734	733.700	-0.034	-0.112
677	512889.47	4503587.57	628.035	628	-0.035	-0.115
678	437499.52	4510661.56	727.925	727.89	-0.035	-0.115
679	437410.32	4510223.04	731.995	731.96	-0.035	-0.115
680	454316.33	4504556.66	710.725	710.69	-0.035	-0.115
681	454358.293	4502584.891	704.015	703.980	-0.035	-0.115

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
682	454360.18	4503018.2	704.325	704.29	-0.035	-0.115
683	552426.08	4519773.31	575.976	575.94	-0.036	-0.118
684	552433.56	4519051.93	581.486	581.45	-0.036	-0.118
685	512949.19	4504938.08	628.096	628.06	-0.036	-0.118
686	467886.06	4504234.17	690.976	690.94	-0.036	-0.118
687	454318.13	4504717.98	708.726	708.69	-0.036	-0.118
688	454318.92	4504282.17	704.396	704.36	-0.036	-0.118
689	552444.89	4517561.91	576.566	576.53	-0.036	-0.118
691	512930.53	4504643.5	628.426	628.39	-0.036	-0.118
692	454362.82	4503193.2	705.056	705.02	-0.036	-0.118
694	542812.23	4512869.33	588.387	588.35	-0.037	-0.121
695	512966.13	4504996.64	627.997	627.96	-0.037	-0.121
696	467899.12	4504590.55	691.087	691.05	-0.037	-0.121
697	437350.56	4510040.91	728.227	728.19	-0.037	-0.121
698	552424.7	4519895.7	575.897	575.86	-0.037	-0.121
699	542812.66	4512800.23	588.417	588.38	-0.037	-0.121
700	437326.93	4509984.58	728.407	728.37	-0.037	-0.121
701	454307.97	4504400.1	704.687	704.65	-0.037	-0.121
702	512852.66	4502509.59	628.858	628.82	-0.038	-0.125
703	454358.02	4503327.41	705.608	705.57	-0.038	-0.125
704	467905.63	4504696.9	687.938	687.9	-0.038	-0.125
705	552428.12	4519531.17	575.969	575.93	-0.039	-0.128
706	552419.97	4520307.24	574.209	574.17	-0.039	-0.128
707	542719.78	4516350.23	587.909	587.87	-0.039	-0.128
708	542817.38	4515148.92	587.989	587.95	-0.039	-0.128

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
709	542816.37	4514954.39	587.759	587.72	-0.039	-0.128
710	559902.09	4526277.75	561.709	561.67	-0.039	-0.128
711	560053.5	4526044.46	561.299	561.26	-0.039	-0.128
712	542804.22	4513672.15	588.529	588.49	-0.039	-0.128
713	492731.79	4500352.31	654.299	654.26	-0.039	-0.128
715	467870.85	4503895.82	687.069	687.03	-0.039	-0.128
716	454357.38	4502500.07	703.799	703.76	-0.039	-0.128
717	542810.04	4515277.67	587.86	587.82	-0.04	-0.131
718	559676.71	4526409.9	562.12	562.08	-0.04	-0.131
719	512919.43	4504365.37	628.79	628.75	-0.04	-0.131
720	521900.47	4507904.95	615.77	615.73	-0.04	-0.131
721	521912.16	4506919.19	616.68	616.64	-0.04	-0.131
722	454321.11	4504204.67	704.51	704.47	-0.04	-0.131
723	454359.84	4503284.23	705.45	705.41	-0.04	-0.131
724	454361.17	4503108.1	704.661	704.62	-0.041	-0.135
725	542816.92	4515018.79	587.791	587.75	-0.041	-0.135
726	437372.65	4510098.35	728.451	728.41	-0.041	-0.135
727	534735.88	4511910.45	598.112	598.07	-0.042	-0.138
728	542779.6	4515532.49	587.842	587.8	-0.042	-0.138
729	542816.55	4515215.85	587.852	587.81	-0.042	-0.138
730	467907.02	4504644.81	689.342	689.3	-0.042	-0.138
731	467872.67	4503945.26	687.002	686.96	-0.042	-0.138
732	454319.85	4504516.8	709.372	709.33	-0.042	-0.138
733	454361.26	4502836.21	704.222	704.18	-0.042	-0.138
735	512891.94	4503645.52	628.052	628.01	-0.042	-0.138

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
736	467869.07	4503793.58	687.683	687.64	-0.043	-0.141
737	559833.75	4526333.14	561.874	561.83	-0.044	-0.144
738	560072.97	4525979.5	561.044	561	-0.044	-0.144
739	513044.4	4505217.2	627.395	627.35	-0.045	-0.148
740	437390.65	4510154.09	729.795	729.75	-0.045	-0.148
741	552446.18	4517353.3	575.705	575.66	-0.045	-0.148
742	552446.11	4517395.22	575.746	575.7	-0.046	-0.151
743	542809.02	4513208.05	588.716	588.67	-0.046	-0.151
744	560078.78	4525917.47	560.716	560.67	-0.046	-0.151
745	436731.53	4509006.11	728.946	728.9	-0.046	-0.151
746	542813.55	4512738.18	588.287	588.24	-0.047	-0.154
747	559968.9	4526203	561.587	561.54	-0.047	-0.154
748	542811.04	4514055.75	587.837	587.79	-0.047	-0.154
749	542817.83	4512119.82	589.598	589.55	-0.048	-0.157
750	521912.14	4506963.64	616.918	616.87	-0.048	-0.157
751	454356.41	4503366.27	705.738	705.69	-0.048	-0.157
752	542819.66	4514888.89	587.799	587.75	-0.049	-0.161
753	542804.61	4513802.93	588.129	588.08	-0.049	-0.161
754	512847.09	4502273.14	628.619	628.57	-0.049	-0.161
755	454318.57	4504320.76	704.169	704.12	-0.049	-0.161
756	552421.01	4520227.85	574.911	574.86	-0.051	-0.167
757	552438.25	4518461.89	576.561	576.51	-0.051	-0.167
758	552446.54	4517302.91	575.801	575.75	-0.051	-0.167
759	478353.32	4501519.34	673.512	673.46	-0.052	-0.171
760	542816.33	4512323.87	588.582	588.53	-0.052	-0.171

Fall 2020 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
761	542817.47	4514555.07	587.923	587.87	-0.053	-0.174
762	542821.36	4512184.64	589.454	589.4	-0.054	-0.177
763	454359.15	4502878.48	704.264	704.21	-0.054	-0.177
764	454318.32	4504361.47	704.175	704.12	-0.055	-0.180
765	467910.69	4504904.06	687.616	687.56	-0.056	-0.184
766	542817.14	4512255.13	589.186	589.13	-0.056	-0.184
767	521900.27	4507948.61	615.446	615.39	-0.056	-0.184
768	454363.82	4503149.7	704.857	704.8	-0.057	-0.187
769	542814.12	4512669.94	588.177	588.12	-0.057	-0.187
770	454325.94	4504085.38	704.597	704.54	-0.057	-0.187
771	542816.13	4512393.04	588.359	588.3	-0.059	-0.194
772	467907.84	4504753.07	687.239	687.18	-0.059	-0.194
773	454314.42	4504837	704.379	704.32	-0.059	-0.194
774	542806.1	4513930.45	587.872	587.81	-0.062	-0.203
775	542805.34	4513866.92	588.019	587.95	-0.069	-0.226
776	467908.86	4504853.83	687.439	687.37	-0.069	-0.226
777	454310.64	4504438.43	705.803	705.73	-0.073	-0.240
778	513016.73	4505103.71	627.766	627.69	-0.076	-0.249
779	521906.39	4507635.12	615.891	615.8	-0.091	-0.299

APPENDIX C – FALL 2021 GROUND SURVEY POINT TABLES

Table 21: NVA – Platte River Fall 2021 Lidar vs.Fall 2021 survey points

Fall 2021 NVA Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
1	552455.20	4516273.55	575.987	576	0.013	0.043
2	552429.35	4519508.14	575.934	575.95	0.016	0.052
3	542816.69	4514912.44	587.747	587.77	0.023	0.075
4	542805.19	4513610.12	588.684	588.69	0.006	0.020
6	534903.43	4511290.62	598.736	598.76	0.024	0.079
7	521912.33	4506305.90	616.069	616.07	0.001	0.003
8	521900.73	4507885.05	615.738	615.75	0.012	0.039
9	574129.60	4537766.05	551.171	551.16	-0.011	-0.036
10	572391.40	4537233.92	541.992	541.95	-0.042	-0.138
11	561700.98	4524623.27	570.611	570.59	-0.021	-0.069
12	492722.85	4500431.78	654.66	654.67	0.01	0.033
13	504100.31	4500329.97	640.226	640.26	0.034	0.112
14	504094.37	4503043.82	640.033	640.06	0.027	0.089
15	478353.86	4501451.60	673.42	673.45	0.03	0.098
16	467855.15	4502434.54	686.503	686.55	0.047	0.154
17	467907.02	4504302.51	692.887	692.91	0.023	0.075
19	454307.91	4505423.95	705.069	705.07	0.001	0.003
20	437088.53	4509363.06	728.99	729.01	0.02	0.066

Table 22: NVA – Platte River Fall 2021 Bare Earth DEM vs. Fall 2021 survey points

Fall 2021 NVA Points vs.Fall 2021 Bare Earth DEM Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**DEM Z**	**Dz (meters)**	**Dz (feet)**
1	552455.20	4516273.55	575.987	575.981	-0.006	-0.020
2	552429.35	4519508.14	575.934	575.940	0.006	0.020
3	542816.69	4514912.44	587.747	587.775	0.028	0.092
4	542805.19	4513610.12	588.684	588.686	0.002	0.007
6	534903.43	4511290.62	598.736	598.767	0.031	0.102
7	521912.33	4506305.90	616.069	616.062	-0.007	-0.023
8	521900.73	4507885.05	615.738	615.746	0.008	0.026
9	574129.60	4537766.05	551.171	551.152	-0.019	-0.062
10	572391.40	4537233.92	541.992	541.979	-0.013	-0.043
11	561700.98	4524623.27	570.611	570.609	-0.002	-0.007
12	492722.85	4500431.78	654.66	654.678	0.018	0.059
13	504100.31	4500329.97	640.226	640.253	0.027	0.089
14	504094.37	4503043.82	640.033	640.050	0.017	0.056
15	478353.86	4501451.60	673.42	673.441	0.021	0.069
16	467855.15	4502434.54	686.503	686.531	0.028	0.092
17	467907.02	4504302.51	692.887	692.881	-0.006	-0.020
19	454307.91	4505423.95	705.069	705.065	-0.004	-0.013
20	437088.53	4509363.06	728.99	729.011	0.021	0.069

Table 23: GCP Accuracy - Platte River Fall 2021 Lidar vs. Fall 2021 Control Points

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
1	552453.65	4516440.15	575.72	575.73	0.01	0.033
2	552452.06	4516599.42	575.536	575.53	-0.006	-0.020
3	552454.01	4516753.21	576.226	576.21	-0.016	-0.052
4	552448.19	4517114.32	577.118	577.11	-0.008	-0.026
5	552446.97	4517253.9	576.058	576.06	0.002	0.007
6	552445.86	4517412.63	575.778	575.79	0.012	0.039
7	552444.63	4517569.09	576.571	576.57	-0.001	-0.003
8	552448.24	4517720.08	576.947	576.96	0.013	0.043
9	552442.1	4517903.5	576.758	576.81	0.052	0.171
10	552441.14	4518061.93	576.197	576.26	0.063	0.207
11	552440.26	4518223.46	576.172	576.21	0.038	0.125
12	552439.18	4518383.11	576.398	576.41	0.012	0.039
13	552440.79	4518527.23	576.667	576.68	0.013	0.043
14	552435.09	4518715.58	578.01	578.01	0	0.000
15	552433.74	4518861.69	580.783	580.8	0.017	0.056
16	552430.8	4519175.84	579.628	579.67	0.042	0.138
17	552432.72	4519341.37	576.36	576.37	0.01	0.033
18	552426.56	4519669.86	575.98	575.99	0.01	0.033
19	552425.11	4519832.2	575.954	575.97	0.016	0.052
20	552422.14	4520139.07	575.489	575.51	0.021	0.069
21	552423.08	4520286.27	574.294	574.3	0.006	0.020
22	552418.11	4520450.35	573.189	573.21	0.021	0.069
23	552415.49	4520661.88	573.091	573.13	0.039	0.128
24	542717.89	4516405.99	590.437	590.47	0.033	0.108

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
25	542711.62	4516306.68	586.799	586.82	0.021	0.069
26	542708.95	4516163.23	586.777	586.78	0.003	0.010
27	542712.06	4516020.83	587.223	587.24	0.017	0.056
28	542775.77	4515538.06	587.795	587.8	0.005	0.016
29	542756.88	4515683.5	587.648	587.68	0.032	0.105
30	542817.35	4515210.24	587.838	587.85	0.012	0.039
31	542797.53	4515372.01	587.743	587.76	0.017	0.056
32	542817.23	4515210.57	587.831	587.86	0.029	0.095
33	542817.82	4515043.91	587.728	587.76	0.032	0.105
34	512879.23	4503322.2	628.14	628.13	-0.01	-0.033
35	512884.95	4503465.14	628.004	628.05	0.046	0.151
36	512891.4	4503629.14	628.014	628.03	0.016	0.052
37	542818.55	4514719.01	587.812	587.83	0.018	0.059
38	542814.28	4514572.11	587.888	587.88	-0.008	-0.026
39	512900.5	4503793.91	628.102	628.1	-0.002	-0.007
40	512907.82	4503958.62	628.089	628.08	-0.009	-0.030
41	542812.17	4514398.1	587.851	587.85	-0.001	-0.003
42	512913.74	4504120.26	628.045	628.07	0.025	0.082
43	542812	4514397.99	587.845	587.84	-0.005	-0.016
44	512916.82	4504277.58	628.333	628.33	-0.003	-0.010
45	542812.53	4514250.31	587.788	587.77	-0.018	-0.059
46	542808.55	4514092.49	587.72	587.71	-0.01	-0.033
47	512923.02	4504437.87	628.966	629	0.034	0.112
48	512931.61	4504571.67	628.936	628.97	0.034	0.112
49	542806.61	4513921.98	587.858	587.84	-0.018	-0.059

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
50	512937.56	4504731.46	628.021	628.07	0.049	0.161
51	542804.83	4513770.16	588.313	588.31	-0.003	-0.010
52	512945.15	4504918.81	628.064	628.09	0.026	0.085
53	513002.77	4505071.52	627.701	627.72	0.019	0.062
54	542808.26	4513278.54	588.627	588.63	0.003	0.010
55	513045.77	4505204.44	627.543	627.55	0.007	0.023
56	542809.59	4513114.01	588.557	588.54	-0.017	-0.056
57	513056.58	4505364.66	627.082	627.14	0.058	0.190
58	542811.33	4512972.95	588.267	588.29	0.023	0.075
59	542813.12	4512799.25	588.353	588.38	0.027	0.089
60	513052.37	4505519.23	628.089	628.13	0.041	0.135
61	542814.73	4512636.71	588.15	588.15	0	0.000
62	513052.71	4505750.57	633.074	633.13	0.056	0.184
63	513052.33	4505653.33	633.146	633.16	0.014	0.046
64	542815.56	4512484.96	588.233	588.22	-0.013	-0.043
65	513052.65	4505861.23	628.691	628.75	0.059	0.194
66	542816.76	4512338.76	588.443	588.46	0.017	0.056
67	513052.08	4506007.03	626.848	626.88	0.032	0.105
68	542817.97	4512125.13	589.512	589.55	0.038	0.125
69	542817.97	4512125.14	589.518	589.55	0.032	0.105
70	535290.88	4509888.53	597.86	597.85	-0.01	-0.033
73	535272.65	4509966.19	597.74	597.8	0.06	0.197
74	535250.71	4510059.7	597.639	597.7	0.061	0.200
78	535163.25	4510426.16	597.795	597.86	0.065	0.213
79	535140.82	4510523.27	598.057	598.12	0.063	0.207

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
80	535110.58	4510646.73	598.684	598.74	0.056	0.184
81	535093.13	4510711.58	598.553	598.61	0.057	0.187
82	535059.27	4510826.73	599.084	599.16	0.076	0.249
83	535030.5	4510904.92	600.2	600.25	0.05	0.164
84	534960.15	4511118.01	600.255	600.29	0.035	0.115
85	534930.44	4511210.63	599.259	599.28	0.021	0.069
86	534868.41	4511399.11	598.651	598.66	0.009	0.030
87	534835.48	4511500.15	599.091	599.1	0.009	0.030
88	534807.26	4511584.68	599.806	599.83	0.024	0.079
89	534751.08	4511758.27	599.286	599.3	0.014	0.046
90	534742.05	4511797.37	598.937	598.97	0.033	0.108
91	534742.52	4511796.51	598.938	598.96	0.022	0.072
92	534736.28	4511914.43	598.05	598.07	0.02	0.066
93	534746.63	4512002.11	597.96	597.98	0.02	0.066
94	534757.75	4512094.11	598.088	598.11	0.022	0.072
95	534770.29	4512230.07	597.957	597.99	0.033	0.108
96	534771.9	4512324.21	598.898	598.96	0.062	0.203
97	534764.43	4512420.94	603.077	603.13	0.053	0.174
98	534761.7	4512615.7	602.047	602.12	0.073	0.240
99	534762	4512696.3	598.752	598.82	0.068	0.223
100	521917.31	4506080.19	616.297	616.33	0.033	0.108
101	521916.87	4506160.42	616.232	616.21	-0.022	-0.072
102	521916.53	4506236.37	616.215	616.17	-0.045	-0.148
103	521912.17	4506383.35	615.988	616.01	0.022	0.072
104	521911.62	4506461.93	615.972	615.97	-0.002	-0.007

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
105	521911.35	4506538.38	615.981	615.99	0.009	0.030
106	521914.31	4506612.06	615.959	616.01	0.051	0.167
107	521910.27	4506688.79	616.049	616.07	0.021	0.069
108	521909.78	4506764.33	616.11	616.13	0.02	0.066
109	521909.46	4506842.76	616.258	616.26	0.002	0.007
110	521909.03	4506920.18	616.64	616.64	0	0.000
111	521908.07	4506996.41	617.119	617.09	-0.029	-0.095
113	521908.86	4507365.68	617.193	617.18	-0.013	-0.043
114	521907.68	4507511.61	616.35	616.34	-0.01	-0.033
115	521908.11	4507439.26	616.767	616.73	-0.037	-0.121
116	521903.54	4507586.26	615.994	615.98	-0.014	-0.046
117	521906.33	4507668.78	615.846	615.83	-0.016	-0.052
118	521905.29	4507746.16	615.854	615.84	-0.014	-0.046
119	521901.24	4507818.14	615.77	615.79	0.02	0.066
120	521900.02	4507957.64	615.327	615.34	0.013	0.043
121	521898.43	4508105.78	615.978	615.99	0.012	0.039
122	521899.01	4508059.02	616.737	616.75	0.013	0.043
123	558432.03	4526420.11	562.34	562.32	-0.02	-0.066
124	571503.43	4538925.05	539.809	539.78	-0.029	-0.095
127	558510.12	4526420.77	562.323	562.3	-0.023	-0.075
128	571506.36	4538720.21	539.796	539.73	-0.066	-0.217
129	558684.17	4526421.2	562.369	562.34	-0.029	-0.095
130	574560.27	4537781.54	567.581	567.56	-0.021	-0.069
131	571507.87	4538522.16	539.684	539.65	-0.034	-0.112
132	574350.94	4537771.73	559.241	559.21	-0.031	-0.102

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
133	558864.03	4526421	562.364	562.34	-0.024	-0.079
134	571514.06	4538370.53	539.772	539.72	-0.052	-0.171
135	571545.647	4538184.838	540.069	540.050	-0.019	-0.062
136	558996.497	4526424.264	562.356	562.320	-0.036	-0.118
137	571580.512	4537999.739	539.978	539.920	-0.058	-0.190
138	559162.528	4526425.793	562.265	562.230	-0.035	-0.115
139	573940.550	4537758.489	546.985	546.940	-0.045	-0.148
140	571639.244	4537809.064	540.558	540.500	-0.058	-0.190
141	573744.964	4537751.843	544.282	544.260	-0.022	-0.072
142	559363.499	4526423.709	562.028	561.980	-0.048	-0.157
143	559525.571	4526426.651	561.748	561.700	-0.048	-0.157
144	571769.918	4537671.683	541.443	541.410	-0.033	-0.108
145	573487.056	4537744.890	542.537	542.510	-0.027	-0.089
146	571910.663	4537546.182	542.089	542.060	-0.029	-0.095
147	573233.881	4537715.189	541.699	541.670	-0.029	-0.095
148	559681.362	4526398.204	561.549	561.500	-0.049	-0.161
149	573042.113	4537631.123	541.361	541.330	-0.031	-0.102
151	559796.737	4526345.591	561.390	561.320	-0.070	-0.230
152	572233.801	4537251.546	541.846	541.780	-0.066	-0.217
153	559927.079	4526238.340	561.110	561.030	-0.080	-0.262
154	560007.994	4526124.065	560.838	560.830	-0.008	-0.026
155	572574.447	4537313.088	542.394	542.360	-0.034	-0.112
156	560064.226	4525974.232	560.839	560.760	-0.079	-0.259
157	560101.734	4525826.030	560.773	560.690	-0.083	-0.272
158	572738.044	4537412.272	542.257	542.230	-0.027	-0.089

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
159	572891.882	4537523.810	541.794	541.780	-0.014	-0.046
160	560142.314	4525665.780	560.813	560.760	-0.053	-0.174
161	560183.281	4525503.540	561.044	561.010	-0.034	-0.112
162	560233.764	4525330.047	561.679	561.650	-0.029	-0.095
163	560297.542	4525203.392	562.359	562.330	-0.029	-0.095
164	560409.115	4525062.953	563.223	563.200	-0.023	-0.075
165	560705.041	4524783.215	563.260	563.240	-0.020	-0.066
166	560876.489	4524653.415	562.716	562.720	0.004	0.013
167	561034.823	4524577.527	562.635	562.620	-0.015	-0.049
168	561168.569	4524540.710	564.545	564.540	-0.005	-0.016
169	561347.821	4524548.678	570.516	570.510	-0.006	-0.020
170	561494.142	4524580.671	572.338	572.310	-0.028	-0.092
171	492751.049	4502187.356	658.583	658.600	0.017	0.056
172	492749.576	4502104.407	660.227	660.220	-0.007	-0.023
173	492744.973	4502005.503	660.394	660.380	-0.014	-0.046
174	492746.569	4501915.159	658.635	658.640	0.005	0.016
175	492744.965	4501821.519	655.990	655.990	0.000	0.000
176	492743.347	4501742.041	654.567	654.540	-0.027	-0.089
177	492741.967	4501652.898	654.208	654.200	-0.008	-0.026
178	492740.289	4501562.487	654.200	654.200	0.000	0.000
179	492739.184	4501472.808	654.201	654.190	-0.011	-0.036
180	492737.492	4501383.178	654.200	654.210	0.010	0.033
181	492736.592	4501292.892	654.250	654.260	0.010	0.033
182	492734.484	4501203.525	654.337	654.340	0.003	0.010
183	492733.032	4501115.053	654.690	654.710	0.020	0.066

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
184	492730.256	4501028.192	655.279	655.290	0.011	0.036
185	492726.801	4500940.680	655.903	655.900	-0.003	-0.010
186	492720.859	4500602.105	655.943	655.930	-0.013	-0.043
187	492719.898	4500516.935	655.244	655.230	-0.014	-0.046
188	492729.986	4500365.179	654.329	654.340	0.011	0.036
189	492744.577	4500279.491	654.096	654.100	0.004	0.013
190	492764.094	4500196.440	654.148	654.150	0.002	0.007
191	492784.730	4500112.635	654.113	654.100	-0.013	-0.043
192	492805.816	4500042.609	654.157	654.140	-0.017	-0.056
193	492818.591	4499956.606	654.291	654.310	0.019	0.062
194	492827.414	4500090.203	654.110	654.100	-0.010	-0.033
195	492818.913	4500228.336	653.998	654.020	0.022	0.072
196	512847.189	4502275.337	628.600	628.580	-0.020	-0.066
197	512848.170	4502341.023	628.832	628.810	-0.022	-0.072
198	512852.233	4502503.184	628.834	628.830	-0.004	-0.013
199	512858.855	4502708.029	629.310	629.330	0.020	0.066
200	512857.401	4502670.717	629.255	629.250	-0.005	-0.016
201	512864.042	4502840.389	629.472	629.460	-0.012	-0.039
202	512871.294	4503032.426	629.295	629.250	-0.045	-0.148
203	512875.190	4503129.722	628.551	628.550	-0.001	-0.003
204	504103.580	4500225.888	640.070	640.090	0.020	0.066
205	504099.783	4500482.338	640.286	640.330	0.044	0.144
206	504099.773	4500647.479	640.352	640.380	0.028	0.092
207	504099.369	4500793.154	640.519	640.520	0.001	0.003
208	504101.692	4500862.955	640.690	640.700	0.010	0.033

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
209	504101.151	4501172.537	640.673	640.660	-0.013	-0.043
210	504098.138	4501305.243	640.456	640.430	-0.026	-0.085
211	504097.944	4501492.093	640.370	640.360	-0.010	-0.033
212	504096.923	4501775.578	640.194	640.180	-0.014	-0.046
213	504097.502	4501610.659	640.253	640.240	-0.013	-0.043
214	504096.464	4501934.119	640.168	640.190	0.022	0.072
215	504096.498	4502097.321	640.147	640.150	0.003	0.010
216	504096.111	4502260.964	640.093	640.100	0.007	0.023
217	504095.661	4502410.132	640.048	640.060	0.012	0.039
218	504095.363	4502585.016	640.051	640.070	0.019	0.062
219	504095.140	4502735.071	640.099	640.120	0.021	0.069
220	504094.838	4502896.012	640.065	640.070	0.005	0.016
221	504094.838	4502896.010	640.065	640.070	0.005	0.016
222	504087.096	4503212.145	639.947	639.920	-0.027	-0.089
223	504093.940	4503213.060	640.006	640.010	0.004	0.013
224	504097.267	4503364.586	639.979	639.980	0.001	0.003
225	504096.430	4503562.507	640.376	640.380	0.004	0.013
226	504096.044	4503716.413	640.477	640.480	0.003	0.010
227	504101.394	4503930.128	644.860	644.890	0.030	0.098
228	504109.790	4504034.366	644.803	644.790	-0.013	-0.043
229	504120.805	4504232.785	638.916	638.930	0.014	0.046
230	504120.881	4504228.874	638.922	638.930	0.008	0.026
231	478340.486	4500797.041	673.237	673.230	-0.007	-0.023
232	478340.430	4500880.927	673.418	673.400	-0.018	-0.059
233	478337.540	4500963.053	673.533	673.510	-0.023	-0.075

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
234	478339.958	4501044.362	673.520	673.490	-0.030	-0.098
235	478344.300	4501125.705	673.365	673.360	-0.005	-0.016
236	478341.562	4501207.880	673.527	673.510	-0.017	-0.056
237	478344.409	4501288.330	673.514	673.510	-0.004	-0.013
238	478347.722	4501370.641	673.494	673.480	-0.014	-0.046
239	478356.810	4501531.346	673.452	673.470	0.018	0.059
240	478355.724	4501590.782	673.913	673.940	0.027	0.089
241	478399.247	4502994.585	673.488	673.490	0.002	0.007
242	478394.202	4502906.881	677.620	677.620	0.000	0.000
243	478393.481	4502845.272	679.394	679.420	0.026	0.085
244	478392.825	4502751.867	679.110	679.110	0.000	0.000
245	478392.130	4502668.516	675.877	675.890	0.013	0.043
246	478394.644	4502588.926	673.402	673.420	0.018	0.059
247	478391.476	4502507.575	673.517	673.520	0.003	0.010
248	478390.223	4502425.872	673.564	673.540	-0.024	-0.079
249	478387.470	4502338.890	673.587	673.580	-0.007	-0.023
250	478381.024	4502256.417	673.536	673.530	-0.006	-0.020
251	478377.999	4502175.781	673.515	673.520	0.005	0.016
252	478374.971	4502090.310	673.567	673.560	-0.007	-0.023
253	478375.128	4502004.773	673.522	673.500	-0.022	-0.072
254	478372.020	4501923.955	673.648	673.650	0.002	0.007
255	478370.156	4501881.591	673.882	673.880	-0.002	-0.007
256	467855.832	4502470.300	686.505	686.540	0.035	0.115
257	467857.456	4502576.432	686.505	686.540	0.035	0.115
258	467858.888	4502675.222	686.484	686.540	0.056	0.184

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
259	467860.434	4502778.877	686.529	686.550	0.021	0.069
260	467862.022	4502886.981	686.533	686.510	-0.023	-0.075
261	467860.830	4502989.238	686.532	686.550	0.018	0.059
262	467862.946	4503091.878	686.633	686.640	0.007	0.023
263	467863.979	4503189.554	687.102	687.130	0.028	0.092
264	467868.523	4503298.183	687.975	687.970	-0.005	-0.016
265	467870.857	4503366.078	688.479	688.490	0.011	0.036
266	467874.329	4503678.700	688.508	688.500	-0.008	-0.026
267	467874.543	4503716.271	688.146	688.160	0.014	0.046
268	467872.738	4503780.383	687.726	687.740	0.014	0.046
269	467876.891	4503872.672	687.047	687.040	-0.007	-0.023
270	467878.871	4503986.687	687.008	687.000	-0.008	-0.026
271	467887.153	4504102.988	687.722	687.700	-0.022	-0.072
272	467900.202	4504207.761	690.073	690.090	0.017	0.056
272	467900.202	4504207.761	690.073	690.090	0.017	-0.013
273	467911.392	4504367.173	693.914	693.910	-0.004	0.092
274	467915.776	4504474.071	693.792	693.820	0.028	0.075
275	467916.633	4504525.206	692.887	692.910	0.023	-0.003
276	467922.490	4504594.154	690.951	690.950	-0.001	-0.043
277	467915.877	4504708.500	687.693	687.680	-0.013	-0.102
278	467920.324	4504823.874	687.161	687.130	-0.031	-0.043
279	467917.291	4504904.843	687.563	687.550	-0.013	0.056
280	454358.898	4502376.357	703.263	703.280	0.017	0.003
281	454357.721	4502536.877	703.839	703.840	0.001	0.046
282	454359.065	4502630.844	703.916	703.930	0.014	0.046

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
283	454360.038	4502716.439	703.866	703.880	0.014	0.059
284	454361.319	4502808.368	704.022	704.040	0.018	0.075
285	454359.255	4502921.988	704.167	704.190	0.023	0.085
286	454363.486	4503036.372	704.314	704.340	0.026	0.121
287	454364.223	4503130.246	704.673	704.710	0.037	0.161
288	454361.387	4503242.412	705.171	705.220	0.049	0.066
289	454357.753	4503336.659	705.590	705.610	0.020	0.085
291	454337.846	4503818.160	705.304	705.330	0.026	0.066
292	454332.724	4503932.747	704.830	704.850	0.020	0.128
293	454328.354	4504027.956	704.591	704.630	0.039	0.121
294	454323.969	4504117.774	704.503	704.540	0.037	0.095
295	454319.927	4504217.170	704.461	704.490	0.029	0.125
296	454322.107	4504324.495	704.012	704.050	0.038	0.066
297	454320.770	4504427.545	705.350	705.370	0.020	-0.020
298	454316.213	4504565.561	710.866	710.860	-0.006	-0.030
299	454315.695	4504650.265	710.919	710.910	-0.009	-0.010
300	454315.219	4504737.726	707.823	707.820	-0.003	0.013
301	454317.772	4504826.103	704.476	704.480	0.004	0.052
302	454315.963	4504926.788	704.174	704.190	0.016	0.105
303	454311.969	4505019.242	704.368	704.400	0.032	0.121
304	454310.634	4505120.167	704.603	704.640	0.037	0.085
305	454309.115	4505220.453	704.764	704.790	0.026	0.072
306	454308.360	4505334.466	704.868	704.890	0.022	0.108
309	434866.858	4508951.906	730.587	730.620	0.033	0.187
310	435042.405	4508948.515	730.173	730.230	0.057	0.128

Fall 2021 Control Points vs. Fall 2021 Classified LAS Projection: UTM 14 Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID03) Units: Meters						
Number	**Easting**	**Northing**	**Known Z**	**Laser Z**	**Dz (meters)**	**Dz (feet)**
311	435186.336	4508946.157	729.991	730.030	0.039	0.148
312	435345.782	4508943.879	729.695	729.740	0.045	0.072
313	435521.241	4508941.570	729.478	729.500	0.022	0.098
314	435661.440	4508939.281	729.230	729.260	0.030	0.115
315	435836.916	4508936.939	728.965	729.000	0.035	0.151
316	435980.855	4508935.316	728.724	728.770	0.046	0.141
317	436140.511	4508933.415	728.667	728.710	0.043	0.092
318	436300.243	4508931.935	728.742	728.770	0.028	0.052
319	436464.852	4508931.613	729.104	729.120	0.016	0.115
320	436636.255	4508968.502	728.955	728.990	0.035	0.138
321	436775.898	4509024.925	729.128	729.170	0.042	0.135
322	436916.678	4509117.203	728.959	729.000	0.041	0.075
323	437025.263	4509241.081	729.077	729.100	0.023	0.052
324	437105.883	4509414.183	729.364	729.380	0.016	0.039
325	437225.114	4509702.363	729.318	729.330	0.012	0.131
326	437276.577	4509818.514	728.700	728.740	0.040	0.082
327	437347.456	4509965.139	728.285	728.310	0.025	0.003
328	437402.075	4510122.580	729.409	729.410	0.001	0.059
329	437446.305	4510278.091	733.792	733.810	0.018	0.079
330	437452.996	4510304.739	734.266	734.290	0.024	0.046
331	437488.653	4510461.228	733.316	733.330	0.014	0.089
332	437518.833	4510630.693	728.583	728.610	0.027	0.085
333	437526.566	4510741.946	728.134	728.160	0.026	0.033