NV5 GEOSPATIAL

April 19, 2024

Platte River, Nebraska Fall 2023

Topobathymetric Lidar Technical Data Report

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Cover Photo: A view looking southeast at the Platte River. The image was created from the lidar bare earth model overlaid with Virtual Earth satellite imagery.

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INTRODUCTION

This photo, taken by NV5 acquisition staff, shows a view of the Platte River at one of the bathymetric accuracy check points in the Platte River Fall 2023 ground survey.

In May 2020, NV5 Geospatial (NV5) was contracted by Headwaters Corporation to collect topobathymetric Light Detection and Ranging (lidar) data in the fall of 2023 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 delivered topobathymetric lidar data and documents contract specifications, data acquisition procedures, processing methods, and analysis of the final dataset including lidar accuracy, 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 3 with the coordinate reference system information for these deliverables 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 site

Project Site	Total Acres	Aerial Acquisition Dates	Data Type
Platte River, Nebraska Fall 2023	89,948	11/10/2023 – 11/14/2023	Topobathymetric - Lidar

Deliverable Products

Table 2: Deliverable product coordinate reference system information

Projection	Horizontal Datum	Vertical Datum	Units
Nebraska State Plane	NAD83 (2011)	NAVD88 (GEOID03)	US Survey Feet

Table 3: Lidar and imagery products delivered for the Platte River site

Product Type	File Type	Product Details
Points	LAS v.1.4 (*.las)	• All Classified Returns
Rasters	3.0 foot ERDAS Imagine Files (*.img)	• Void-Interpolated Topobathymetric Bare Earth Digital Elevation Model (DEM) • Void-Clipped Topobathymetric Bare Earth Digital Elevation Model (DEM) • Bare Earth and Water Surface Models with Hydroflattened Ponds (DEM) • Highest Hit Digital Surface Model (DSM) • Depth Raster
Rasters	1.5 foot GeoTIFFs (*.tif)	• Green Sensor Intensity Images • NIR Sensor Intensity Images
Vectors	Shapefiles (*.shp)	• Area of Interest • Tile Index • Flightlines • Ground Survey Data • Bathymetric Coverage Shape • Water's Edge Breaklines
Metadata	Extensible Markup Language (*.xml)	• Metadata
Reports	Adobe Acrobat (*.pdf)	• Lidar Technical Data Report

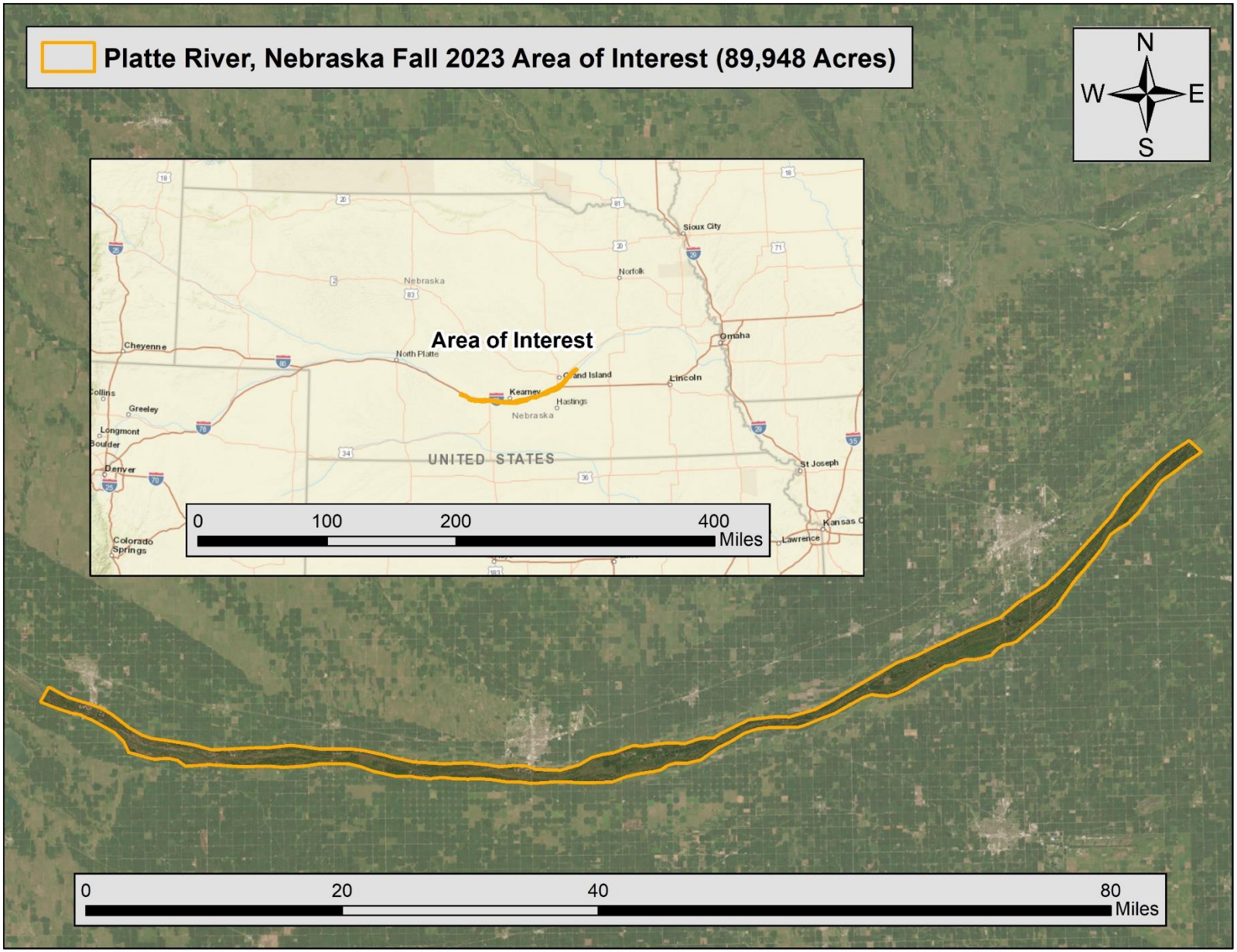


Figure 1: Location map of the Platte River site in Nebraska Fall 2023

ACQUISITION

NV5's ground acquisition equipment set up in the Platte River Lidar study area

Planning

In preparation for data collection, NV5 reviewed the project area and developed a specialized flight plan to ensure complete coverage of the Platte River Lidar study area at the target combined point density of at least 8 points/m^2 (0.74 points/ft^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. Figure 5 shows these optimized flight paths and dates.

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 the potential impact on the daily success of airborne and ground operations. Logistical considerations including private property access and potential air space restrictions were also reviewed. Channel flow rates and gage height (Figure 2 and Figure 3) as well as water clarity (Figure 4) were monitored in the area of interest in order to target data acquisition while channel flow rates were below 1,000 CFU.

Turbidity Measurements and Secchi Depth Readings

In order to assess water clarity conditions prior to and during lidar and digital imagery collection, NV5 collected turbidity measurements, Secchi depth readings, and wind speed measurements. Readings were collected at 13 locations throughout the project site between November 10th and November 14th, 2023. Turbidity was recorded three times to confirm measurements. Table 4 below provides turbidity and Secchi depth results per site on each day of data collection. A true Secchi depth reading is where the Secchi depth reaches extinction. However, because of safety concerns and accessibility, some Secchi depth readings were noted to have reached the bottom surface of the riverbed.

Table 4: 2023 Water clarity observations for lidar flights

Date	Location	Latitude	Longitude	Turbidity Read 1 (NTU)	Turbidity Read 2 (NTU)	Turbidity Read 3 (NTU)	Secchi Depth (m)	Wind Speed (knots)
11/10	Plum Creek Bridge	40° 44' 08.45560"	-99° 44' 37.50938"	12.6	12.4	13.7	0.55	2.8
11/10	Dogwood Wildlife Management Area	40° 41' 59.52145"	-99° 38' 06.63071"	12.5	10.9	10.3	*0.20	2.5
11/11	Highway 183 Bridge	40° 40' 57.81514"	-99° 22' 46.10940"	8.75	8.63	9.61	*0.40	3.7
11/11	Overton Restoration Site	40° 41' 11.65536"	-99° 20' 25.98758"	8.21	6.40	7.72	*0.50	3.4
11/11	Wildwood Recreation Area	40° 40' 07.90603"	-99° 09' 56.42591"	5.89	7.33	7.70	*0.85	1.8
11/12	Highway 44 Bridge	40° 39' 28.94212"	-99° 05' 11.69627"	8.68	9.31	8.85	*0.40	3.7
11/12	Highway 10 Bridge	40° 41' 01.79090"	-98° 57' 03.85456"	7.34	8.26	7.74	*0.30	3.2
11/12	Shelton Road Bridge	40° 42' 51.75875"	-98° 44' 25.34201"	9.45	8.87	10.13	*0.55	4.4
11/12	Lowell Road Bridge	40° 40' 31.98899"	-98° 50' 50.13642"	10.35	9.47	9.68	*0.20	4.6
11/13	Road 40 D Bridge	40° 44' 58.70854"	-98° 35' 06.40176"	5.32	4.41	4.25	*0.495	4.8
11/13	Alda Road Bridge	40° 46' 18.65723"	-98° 29' 34.40285"	6.79	7.05	6.70	*0.85	5.3
11/13	Highway 281 Bridge North Channel	40° 48' 54.32054"	-98° 22' 44.92145"	7.33	7.02	7.22	*0.95	4.3
11/13	Highway 281 Main Channel	40° 48' 10.53963"	-98° 22' 39.93970"	2.35	2.14	2.29	*0.15	3.3
11/14	Locust Street Bridge Middle Channel	40° 49' 47.57784"	-98° 20' 22.45894"	8.99	9.83	6.78	*0.50	4.8
11/14	Locust Street Bridge Main Channel	40° 49' 16.66959"	-98° 20' 22.84431"	3.13	3.50	3.43	*0.49	4.4
11/14	Highway 34 Bridge	40° 52' 26.20345"	-98° 16' 55.72657"	6.76	6.73	7.08	*0.495	2.3
11/14	Bader Park	40° 59' 07.96094"	-98° 08' 46.97763"	5.76	7.21	6.61	*0.55	2.7

** Measurement is depth to the bottom surface due to observational depth limitations*

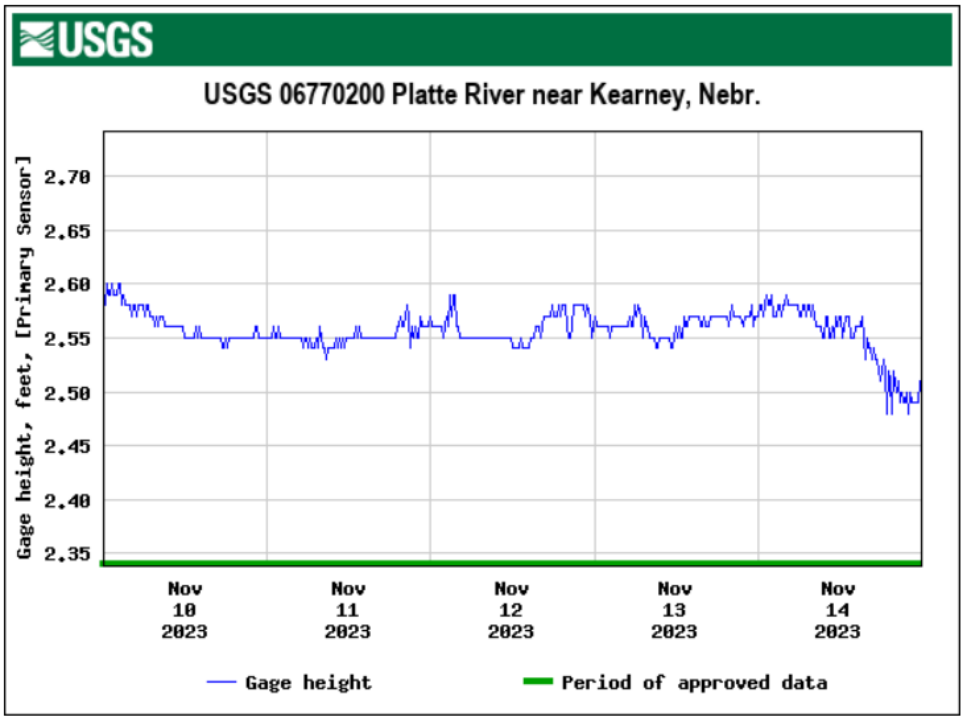


Figure 2: USGS Station 06770200 gage height along the Platte River near Kearney, Nebraska at the time of lidar acquisition.

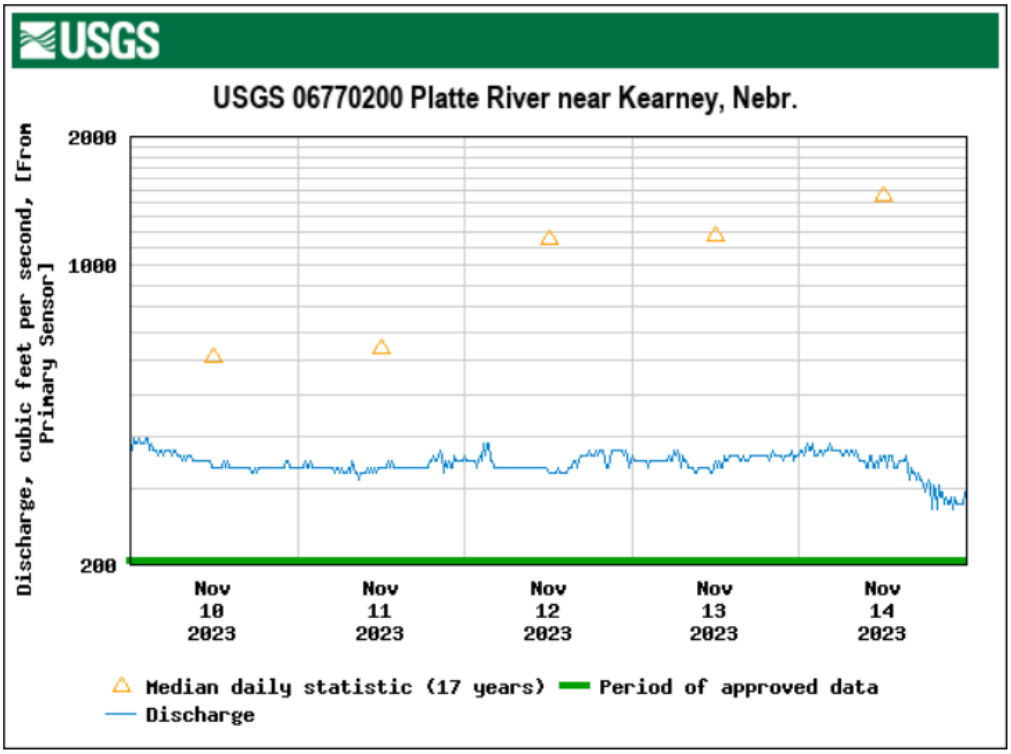


Figure 3: USGS Station 06770200 flow rates along the Platte River near Kearney, Nebraska at the time of lidar acquisition.

Figure 4: These photos taken by NV5 acquisition staff display water clarity conditions at four locations within the Platte River site.

Airborne Lidar Survey

The lidar survey was accomplished using a Riegl VQ-880-GII green laser system mounted in a Cessna Grand Caravan. The Riegl VQ-880-GII boasts a higher repetition pulse rate (up to 550 kHz), higher scanning speed, small laser footprint, and wide field of view which allows for seamless collection of high-resolution data of both topographic and bathymetric surfaces. The green wavelength (ʎ=532 nm) laser is capable of collecting high resolution topography data, as well as penetrating the water surface with minimal spectral absorption by water. The Riegl VQ-880-GII contains an integrated NIR laser (ʎ=1064 nm) that adds additional topography data and aids in water surface modeling. The Riegl VQ-880-GII laser system can record unlimited range measurements (returns) per pulse, however a maximum of 15 returns can be stored due to LAS v1.4 file limitations.

The recorded waveform enables range measurements for all discernible targets for a given pulse. The typical number of returns digitized from a single pulse range from 1 to 8 in the Platte River project dataset. 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. All discernible laser returns were processed for the output dataset. Table 5 summarizes the settings used to yield an average pulse density of at least 8 pulses/m^2 over the Platte River project area. Figure 5 shows the flightlines acquired using these lidar specifications.

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥120% 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 orientation of the aircraft to the horizon (attitude) 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, and 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 are indexed by GPS time.

Table 5: Lidar specifications and aerial survey settings

Parameter	Green Laser	NIR Laser
Acquisition Dates	11/10/2023 – 11/14/2023	11/10/2023 – 11/14/2023
Aircraft Used	Cessna Grand Caravan	Cessna Grand Caravan
Sensor	Riegl	Riegl
Laser Channel	VQ-880GII-Green	VQ-880GII-IR
Maximum Returns	14	13
Resolution/Density	Average 8 points/m^2	Average 8 points/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	13.5 cm
Central Wavelength	532 nm	1064 nm
Pulse Mode	MTA (multiple times around)	MTA (multiple times around)
Beam Divergence	0.7 mrad	0.3 mrad
Swath Width	328 m	345 m
Swath Overlap	60%	60%
Intensity	16-bit	16-bit
Vertical Accuracy	$RMSE_Z \leq 9.2$ cm	$RMSE_Z \leq 9.2$ cm
Horizontal Accuracy	$RMSE_{NE} \leq 60$ cm	$RMSE_{NE} \leq 60$ cm

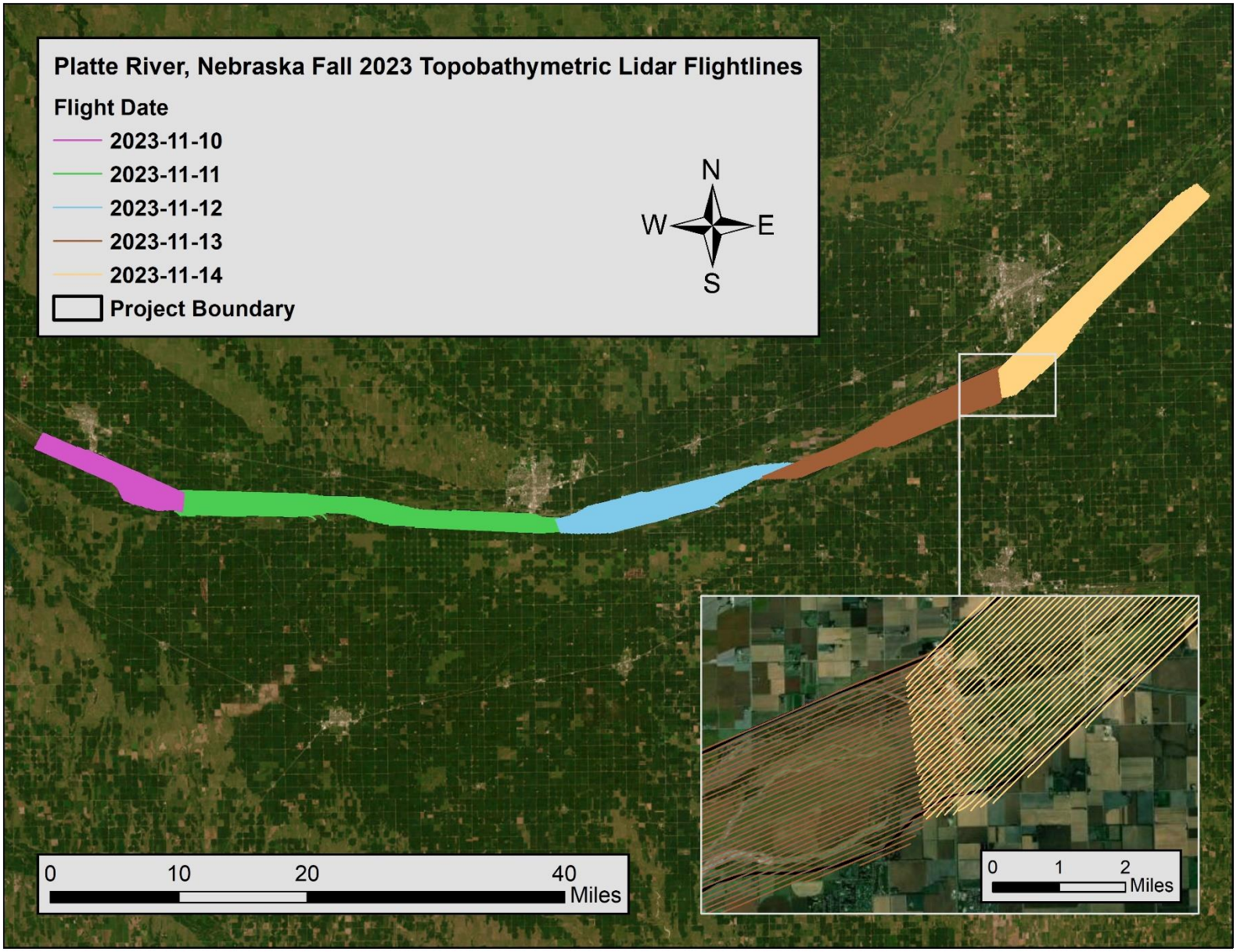


Figure 5: Flightlines map

Ground Survey

Ground control surveys, including monumentation and ground survey points (GSPs), were conducted to support the airborne acquisition. Previously acquired ground control data from Fall 2020 was used for calibration and to perform quality assurance checks on the final lidar data. Additional Fall 2023 ground control data were also used for quality assurance purposes.

Base Stations

Base stations were used for collection of ground survey points using real time kinematic (RTK) survey techniques.

Base station locations were selected with consideration for satellite visibility, field crew safety, and optimal location for GSP coverage. For the Fall 2023 ground survey, NV5 Geospatial utilized two permanent real-time network (RTN) base stations each from the Trimble VRSNow and the Hexagon SmartNet networks for the Platte River Fall 2023 lidar project (Table 6, Figure 6). Each of these base stations was also represented in the Fall 2020 ground survey (Table 7). NV5's professional land surveyor, Steven J. Hyde (NEPLS#769), oversaw and certified the ground survey.

Table 6: Base station positions for the Platte River Fall 2023 acquisition. Coordinates are on the NAD83(2011) datum, epoch 2010.00

Monument ID	Latitude	Longitude	Ellipsoid (meters)	Owner
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 7: Base station positions for Platte River Fall 2020 acquisition. Coordinates are on the NAD83(2011) datum, epoch 2010.00

Monument ID	Latitude	Longitude	Ellipsoid (meters)	Owner
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

NV5 Geospatial utilized static Global Navigation Satellite System (GNSS) data collected at 1 Hz recording frequency for each base station. During post-processing, the static GNSS data was triangulated with nearby Continuously Operating Reference Stations (CORS) using the Online Positioning User Service (OPUS[1]) for precise positioning. Multiple independent sessions over the same monument were processed to confirm antenna height measurements and to refine position accuracy.

Ground Survey Points (GSPs)

Ground survey points were collected using real time kinematic (RTK) survey techniques for both the Fall 2020 and Fall 2023 surveys. 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. They 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 8 for NV5 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 monument locations and may not be equably distributed throughout the study area (Figure 6).

Table 8: 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	2023

[1] OPUS is a free service provided by the National Geodetic Survey to process corrected monument positions: OPUS website

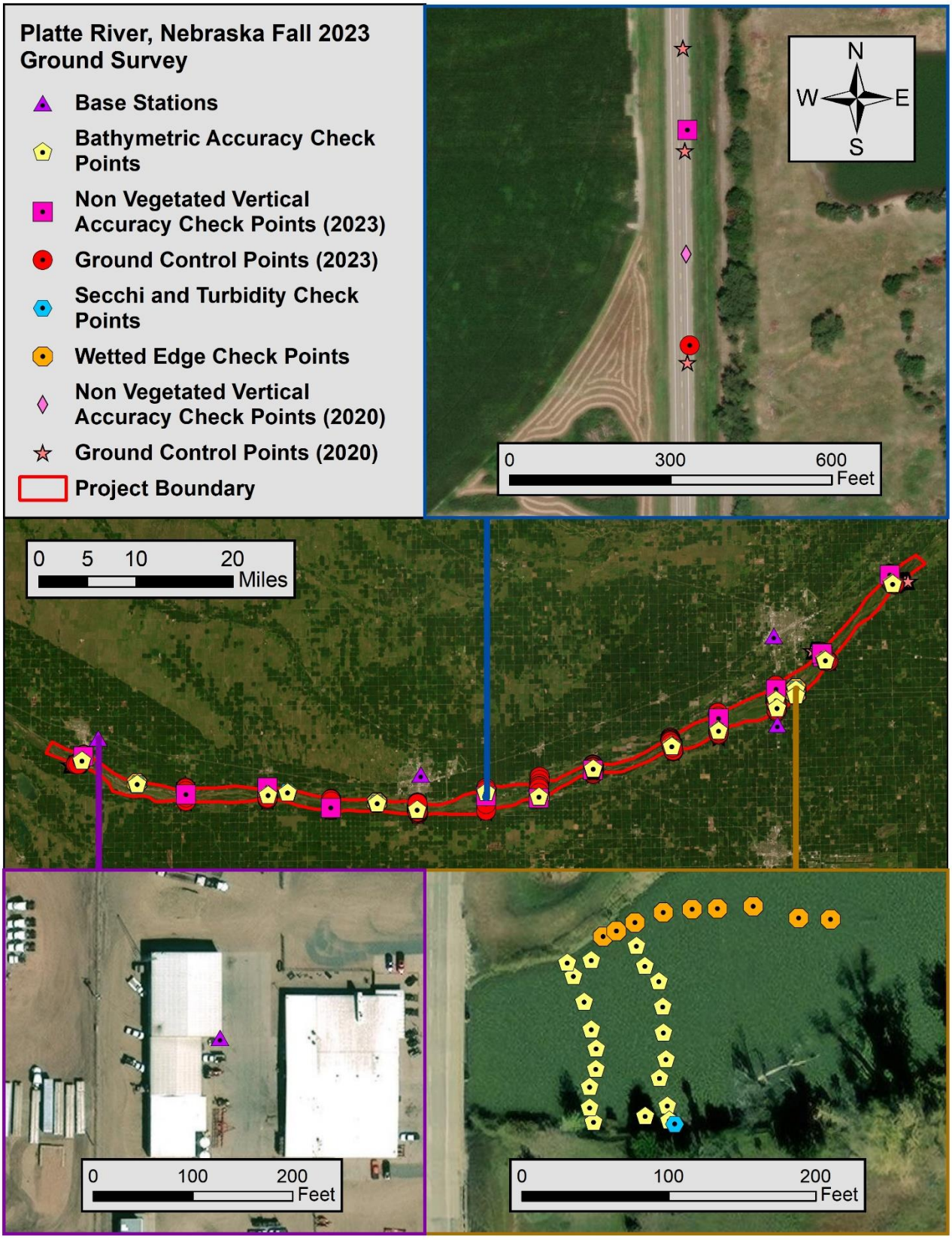
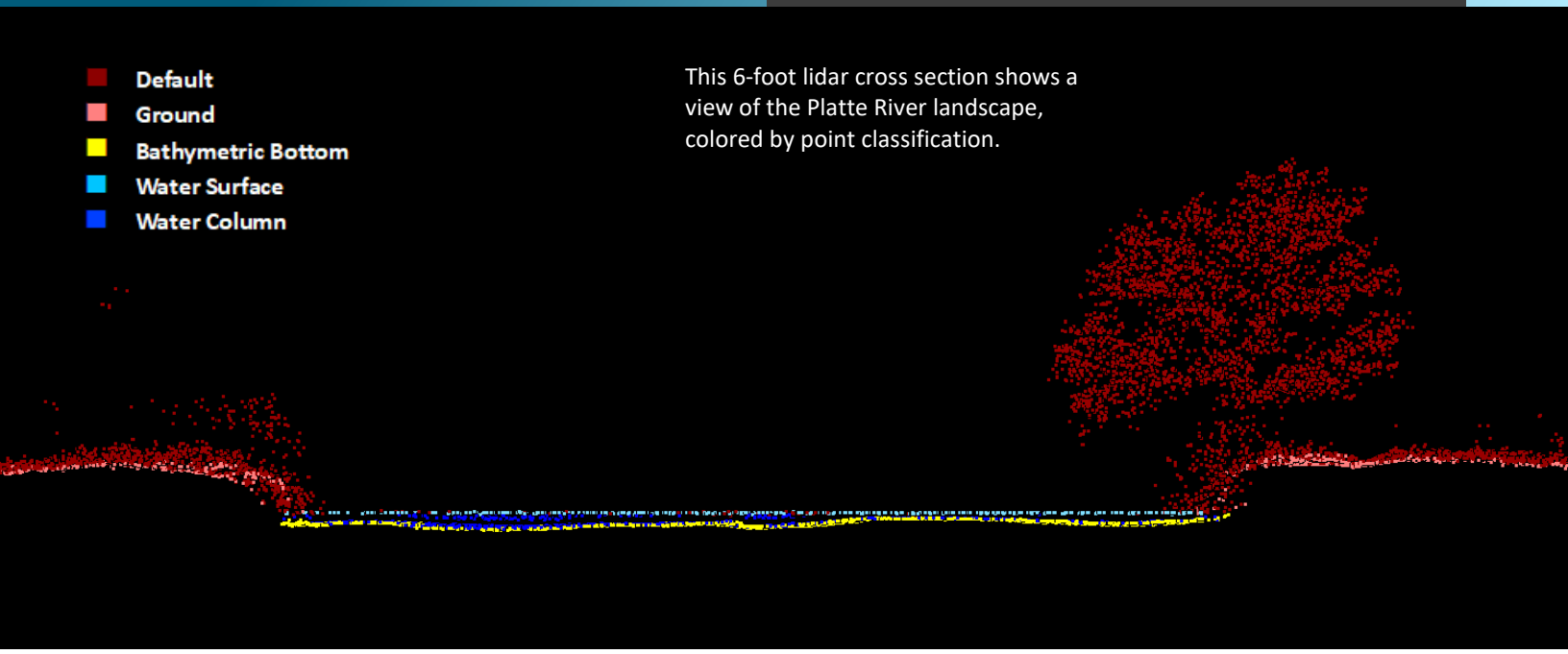


Figure 6: Ground survey location map



This 6-foot lidar cross section shows a view of the Platte River landscape, colored by point classification.

Topobathymetric Lidar Data

Upon completion of data acquisition, NV5 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 9).

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 refracted water column points using NV5's proprietary LAS processing software, Las Monkey. The resulting point cloud data was classified using both manual and automated techniques. Processing methodologies were tailored for the landscape. Brief descriptions of these tasks are shown in Table 10.

Table 9: ASPRS LAS classification standards applied to the Platte River 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	Edge Clip/Overlap	Laser returns at the outer edges of flightlines or in a flightline or swath within the boundary of another flightline 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	Laser returns that are determined to be water using automated and manual cleaning algorithms
40	Bathymetric Bottom	Refracted green laser 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 2023 topobathymetric lidar dataset. The decision to match Fall 2023'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 2023 ground survey. During the QA/QC process, NV5 created difference rasters between the Fall 2020 and Fall 2023 datasets to check for alignment and to verify results after shifting the data to the Fall 2020 control (Figure 7). Comparisons between the Fall 2020 control with the Fall 2021 and Fall 2022 data are also shown.

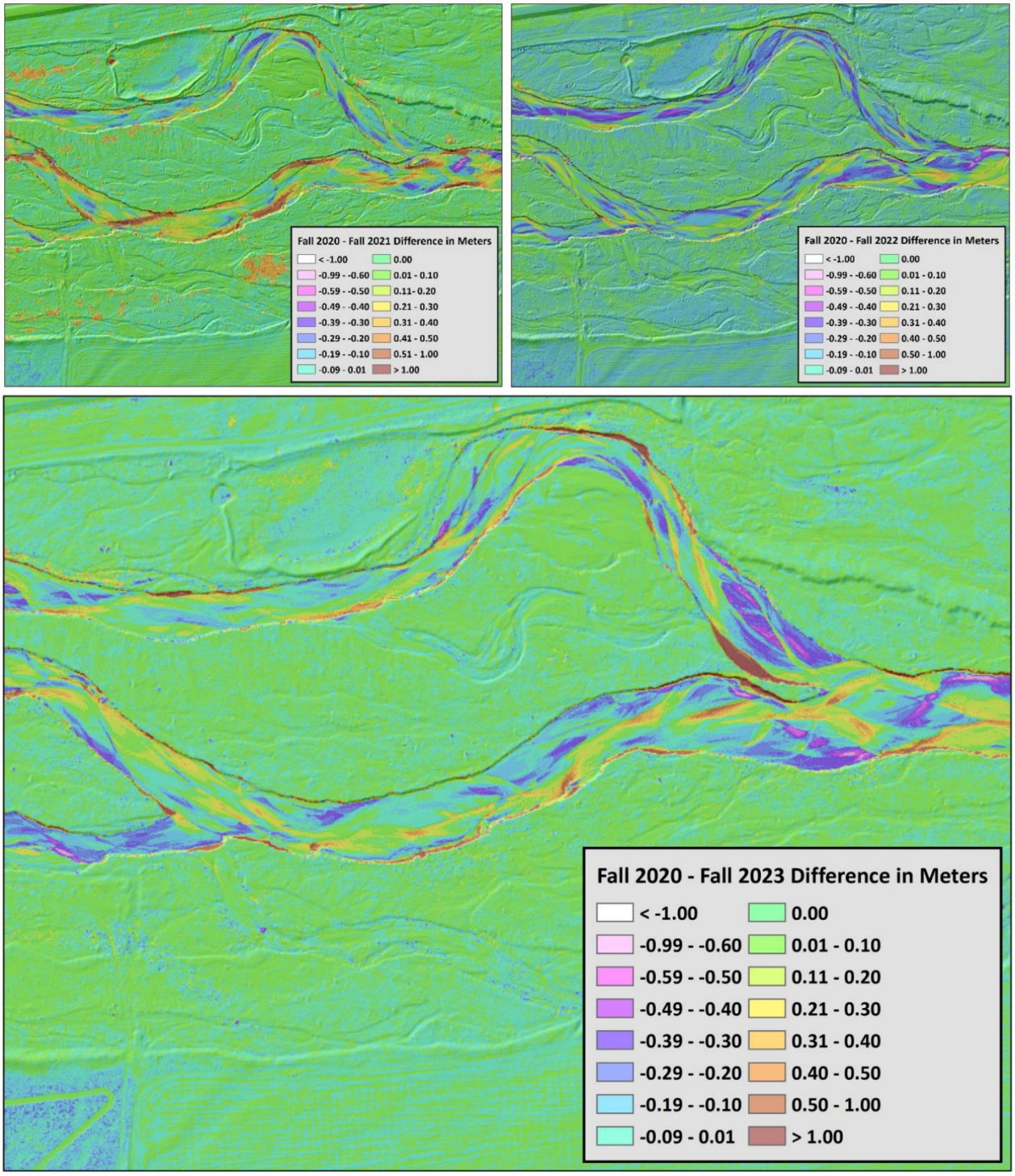


Figure 7: Raster model displaying the difference in meters for the Fall 2020 to Fall 2021, Fall 2020 to Fall 2022, and Fall 2020 to Fall 2023 data.

Table 10: 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.8.9
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.	RiUnite v1.0.5
Import raw laser points into manageable blocks to perform manual relative accuracy calibration and filter erroneous points. Classify ground points for individual flight lines.	TerraScan v.19.005
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), mirror flex (scale) 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.	StripAlign v.2.24
Apply refraction correction to all subsurface returns.	Las Monkey v.2.6.9 (NV5 proprietary software)
Classify resulting data to ground and other client designated ASPRS classifications (Table 9). Assess statistical absolute accuracy via direct comparisons of ground classified points to ground control survey data.	TerraScan v.19.005 TerraModeler v.19.003
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 4.0 (NV5 proprietary software) ArcMap v.10.8
Export intensity images as cloud optimized GeoTIFFs at a 1.5 foot pixel resolution.	ArcMap v.10.8 Las Product Creator 4.0 (NV5 proprietary software)

Bathymetric Refraction

Green lidar pulses that enter the water column must have their position corrected for refraction of the light beam as it passes through the water and its resulting decreased speed. NV5 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) covering all submerged returns within the project boundary. The water surface model used for refraction is generated from points within the wetted edge breaklines that include NIR points representing the water surface as well as elevations sampled from the ground at 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 in obtaining 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 checkpoints 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 section 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. Although the predicted depth penetration range of the Riegl VQ-880-GII sensor is 1.5 Secchi depths on brightly reflective surfaces, 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 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 without bathymetric bottom returns.

Intensity Images

The first returns of all valid point classes were used for both the green and NIR sensors in order to create intensity images. 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 2023 project, NV5 created one set of intensity images from NIR laser first returns and one set of intensity images from green laser returns (Figure 8).

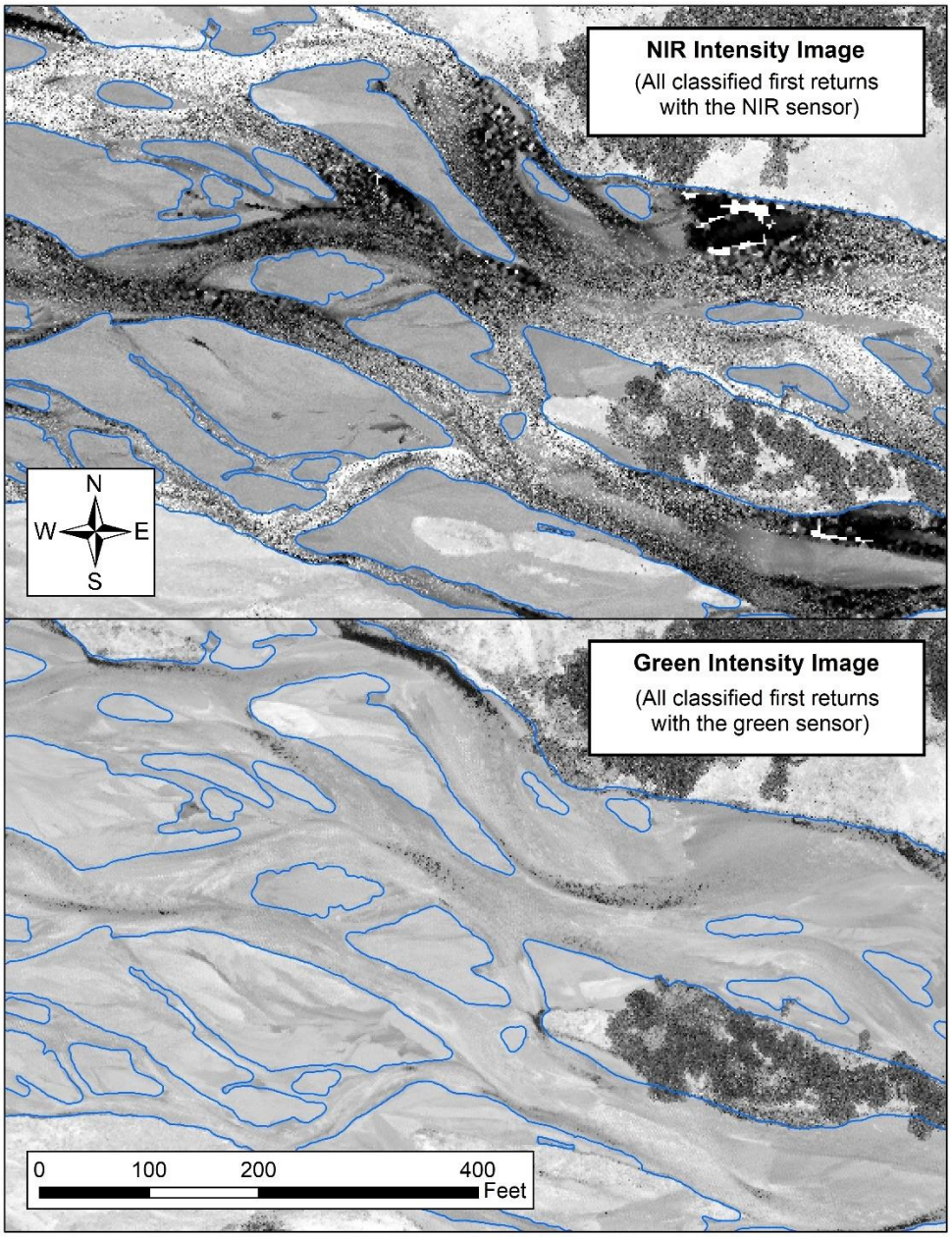


Figure 8: A comparison of intensity images from green and NIR first returns in the Platte River area

Hydroflattening and Water's Edge Breaklines

Lakes and ponds with a surface area greater than 2 acres surrounding the Platte River were flattened to a consistent water level. The hydroflattening process eliminates artifacts in the digital terrain model caused by increased variability in ranges or dropouts in laser returns due to the low reflectivity of water.

Hydroflattening 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.

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. Lakes were assigned a consistent elevation for an entire polygon while rivers were assigned consistent elevations on opposing banks and smoothed to ensure downstream flow through the entire river channel.

Water boundary breaklines were then incorporated into the hydroflattened 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 hydroflattened model (Figure 9).

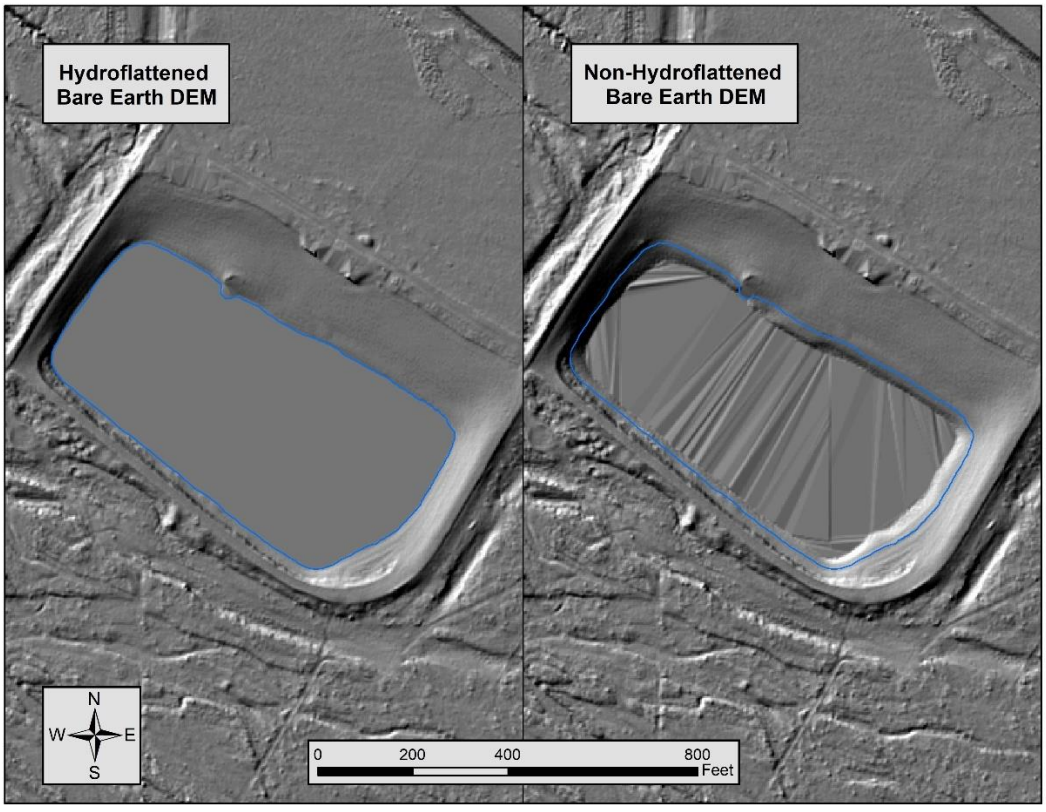
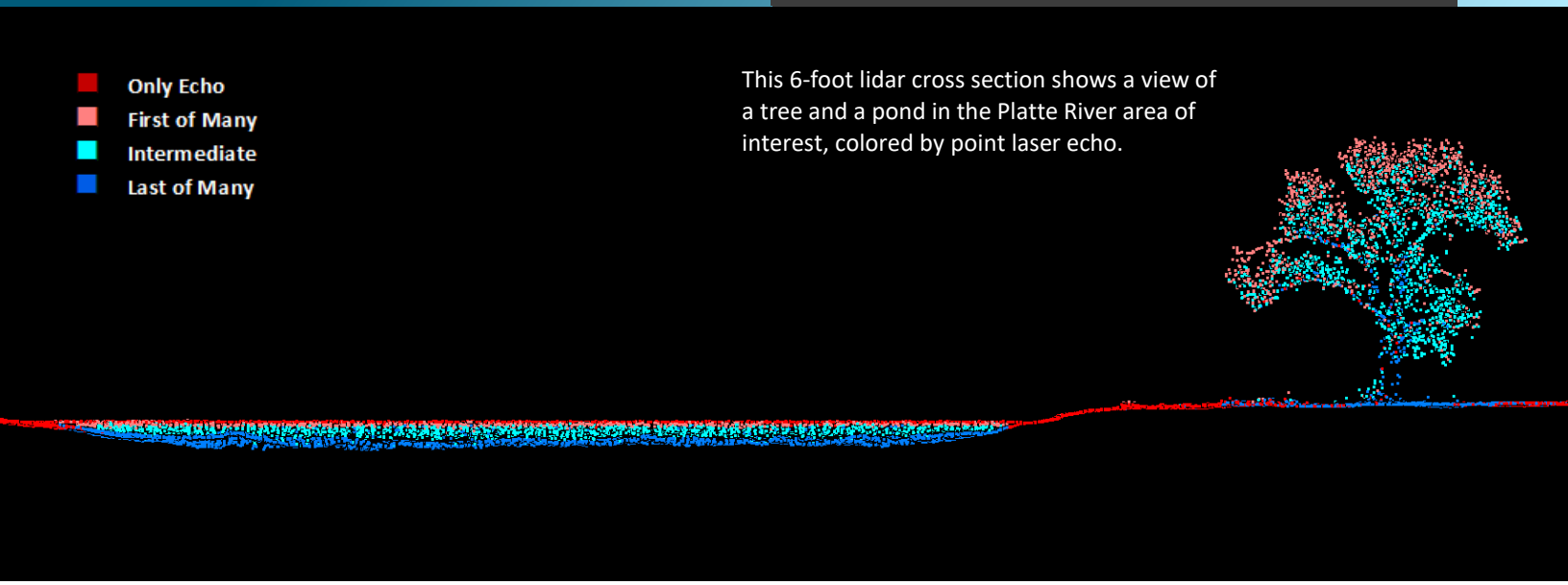


Figure 9: Example of hydroflattening in the Platte River lidar dataset



This 6-foot lidar cross section shows a view of a tree and a pond in the Platte River area of interest, colored by point laser 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. The capability and effectiveness of the bathymetric lidar is impacted by several parameters including depth penetrations below the water surface, bathymetric return density, and spatial accuracy.

Mapped Bathymetry and Depth Penetration

The specified depth penetration range of the Riegl VQ-880-GII sensor is 1.5 Secchi depths; therefore, bathymetry data below 1.5x Secchi depth at the time of acquisition is not to be expected. To assist in evaluating performance results of the sensor, a polygon layer was created to delineate areas where bathymetry was successfully mapped.

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. Insufficiently mapped areas were identified by triangulating bathymetric bottom points with an edge length maximum of 15.2 feet. This ensured all areas of no returns (> 96.88 ft^2), were identified as data voids. Overall NV5 Geospatial successfully mapped 81.04% of the bathymetric areas in the Platte River AOI. Of the areas successfully mapped, 13.17% had a calculated depth of 0 to 0.10 feet, 69.14% had a calculated depth of 0.11 to 1.00 feet, 12.69% had a calculated depth of 1.01 to 2.00 feet, 2.22% had a calculated depth of 2.01 to 3.00 feet, 0.99% had a calculated depth of 3.01 to 4.00 feet, 0.56% had a calculated depth of 4.01 to 5.00 feet, and the remaining 1.22% had a calculated depth greater than 5.00 feet. These values are compared to previous years' bathymetric coverage and depth results in Table 11, Table 12, and Figure 10, and is visualized in Figure 11.

Table 11: Depth coverage comparison between Fall 2020, 2021, 2022, and 2023 acquisitions

Depth (feet)	Fall 2020 Percent Mapped	Fall 2021 Percent Mapped	Fall 2022 Percent Mapped	Fall 2023 Percent Mapped
Shallow (< 0.10)	21.1%	17.9%	25.87%	13.17%
0.11 – 1.00	69.5%	64.2%	59.85%	69.14%
1.01 – 2.00	7.4%	11.7%	6.50%	12.69%
2.01 – 3.00	1.1%	2.4%	2.58%	2.22%
3.01 – 4.00	0.4%	1.0%	1.54%	0.99%
4.01 – 5.00	0.1%	0.7%	0.96%	0.56%
> 5.00	0.3%	2.1%	2.71%	1.22%

Table 12: 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	8,691.98	7,319.71	1,372.27	84.21%	15.79%
2022	5,396.61	3,955.78	1,440.83	73.33%	26.70%
2023	8,137.36	6,594.79	1,542.57	81.04%	18.96%

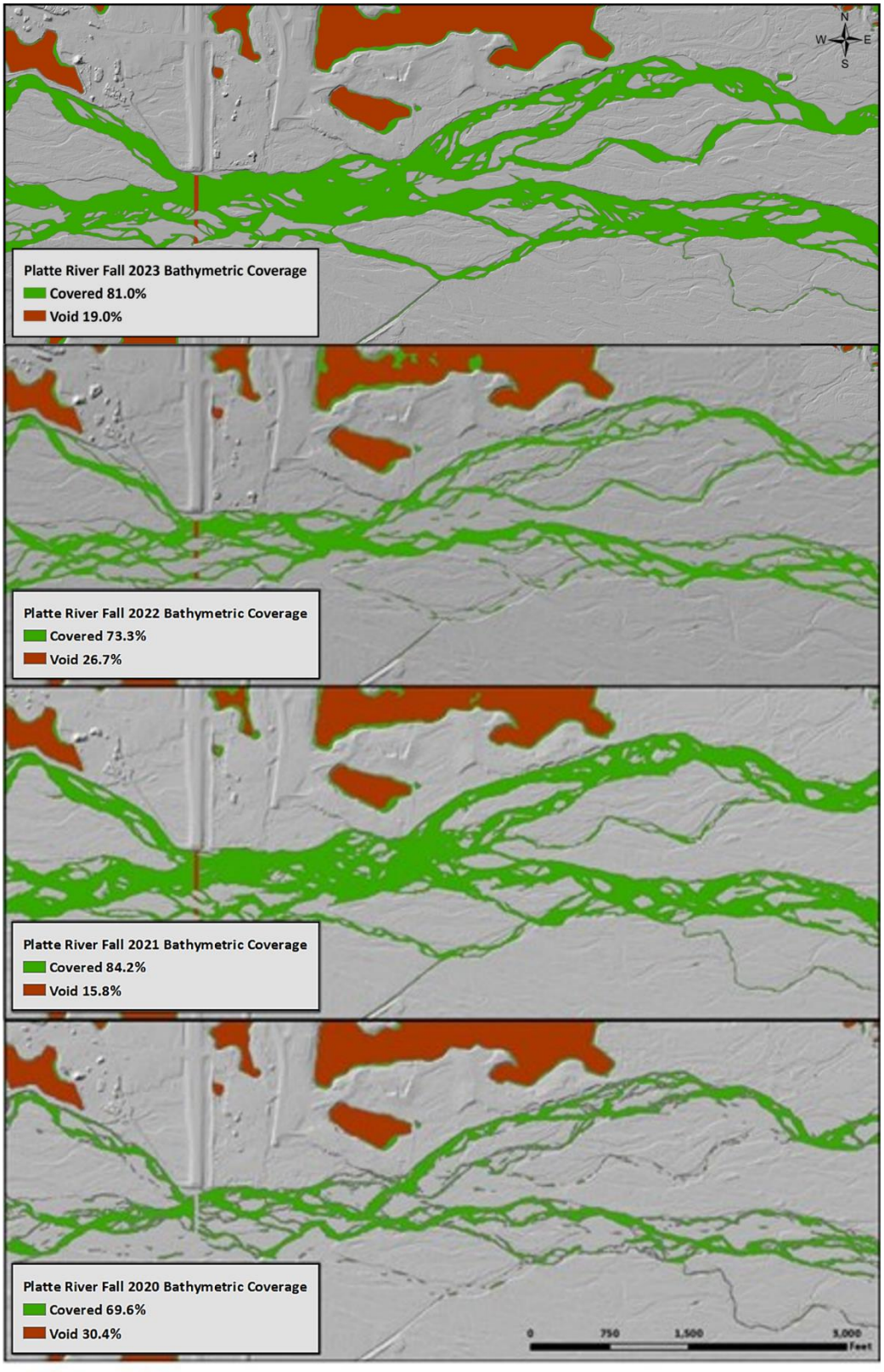


Figure 10: Comparison of the bathymetric coverage for the Fall 2020, 2021, 2022, and 2023 datasets

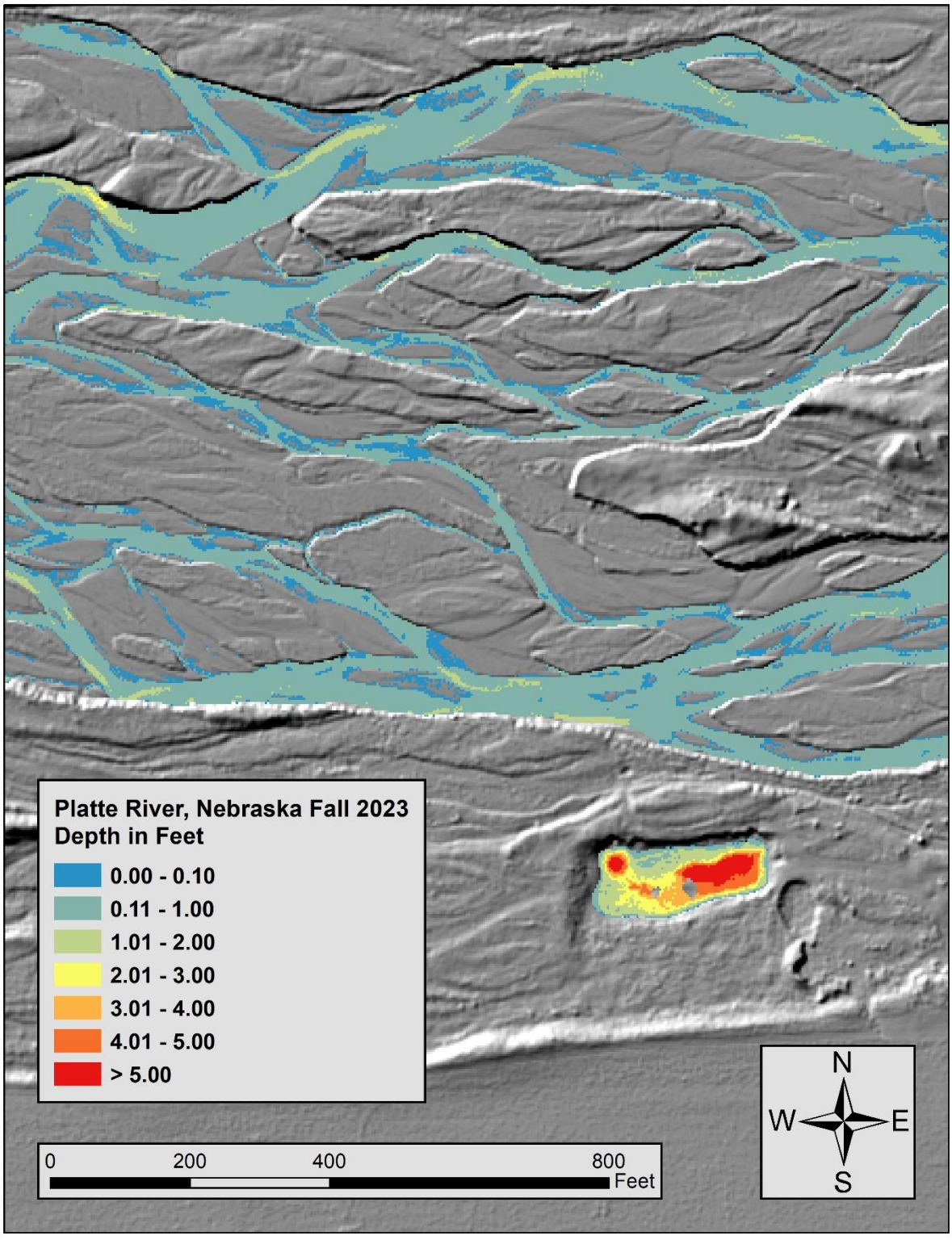


Figure 11: Depth model of the Platte River

Lidar Point Density

First Return Point Density

The acquisition parameters were designed to acquire an average first-return density of 8 points/m^2 (0.74 points/ft^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 Lidar project was 2.93 points/ft^2 (31.56 points/m^2) (Table 13). The statistical and spatial distributions of all first return densities per 100 m x 100 m cell are portrayed in Figure 12 and Figure 14.

Bathymetric and Ground Classified 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 project was 1.36 points/ft^2 (14.66 points/m^2) (Table 13). The statistical and spatial distributions per 100 x 100 m cell of the ground and bathymetric bottom classified return densities are shown in Figure 13 and Figure 14.

Additionally, for the Platte River 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 1.12 points/ft^2 (12.05 points/m^2) was achieved.

Table 13: Average lidar point densities

Density Type	Point Density
First Returns	31.56 points/m² 2.93 points/ft²
Ground and Bathymetric Bottom Classified Returns	14.66 points/m² 1.36 points/ft²
Bathymetric Bottom Classified Returns	12.05 points/m² 1.12 points/ft²

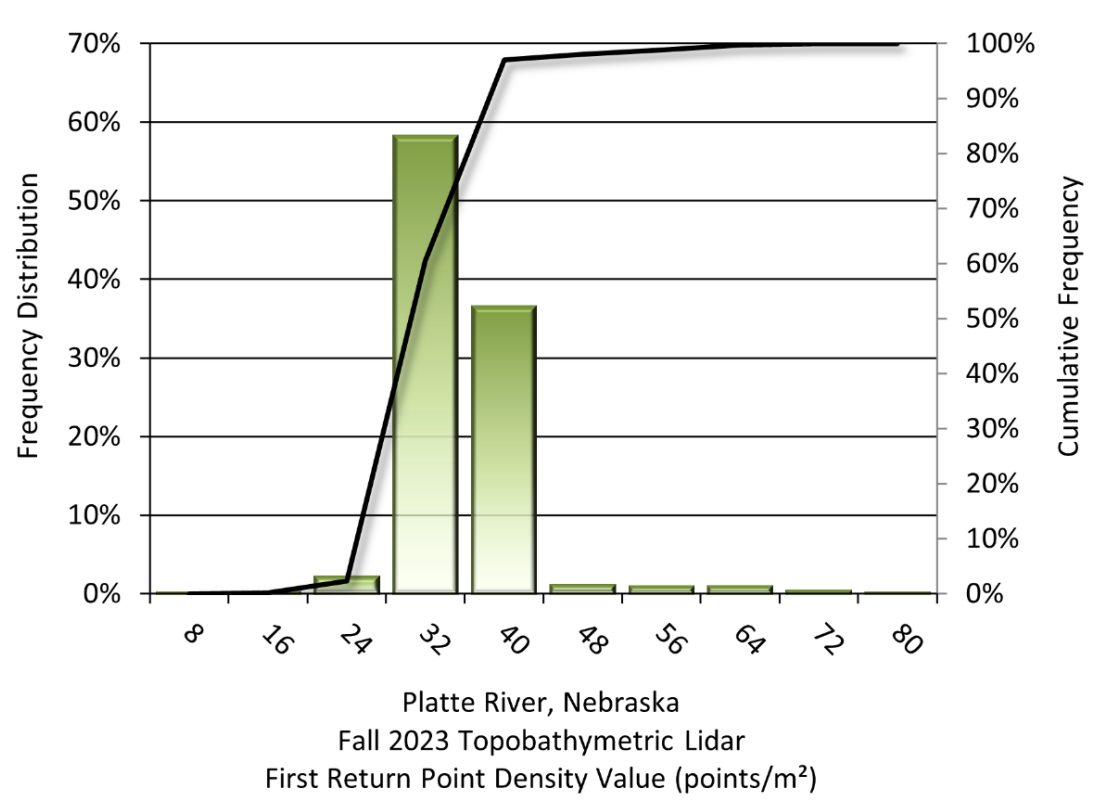


Figure 12: Frequency distribution of first return densities per 100 m x 100 m cell

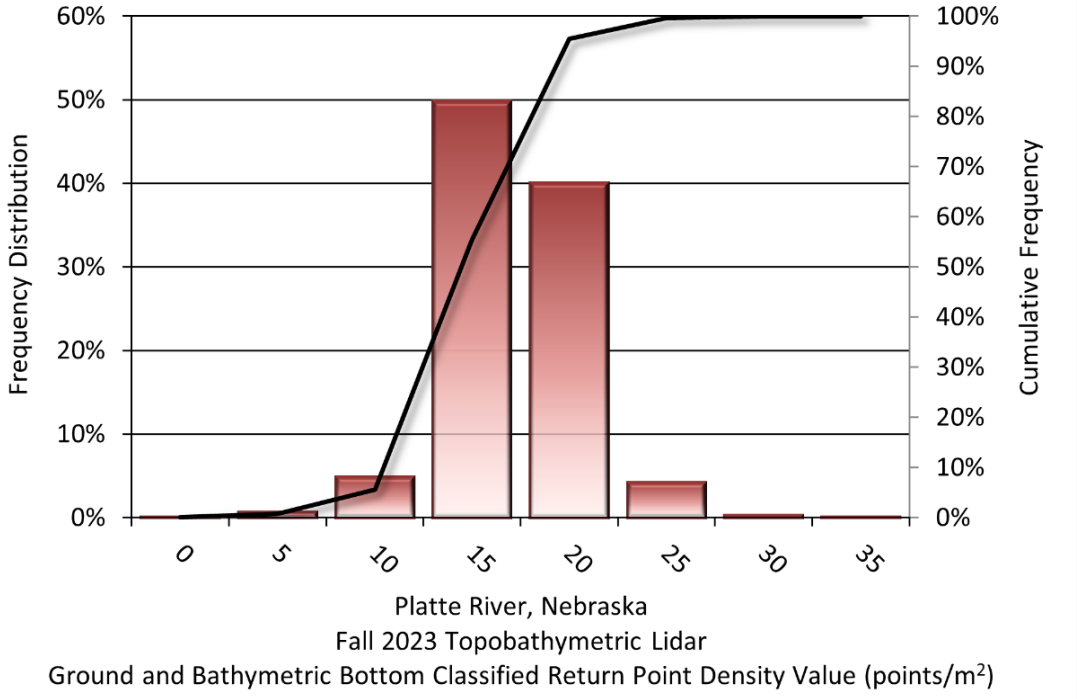


Figure 13: Frequency distribution of ground and bathymetric bottom classified return densities per 100 m x 100 m cell

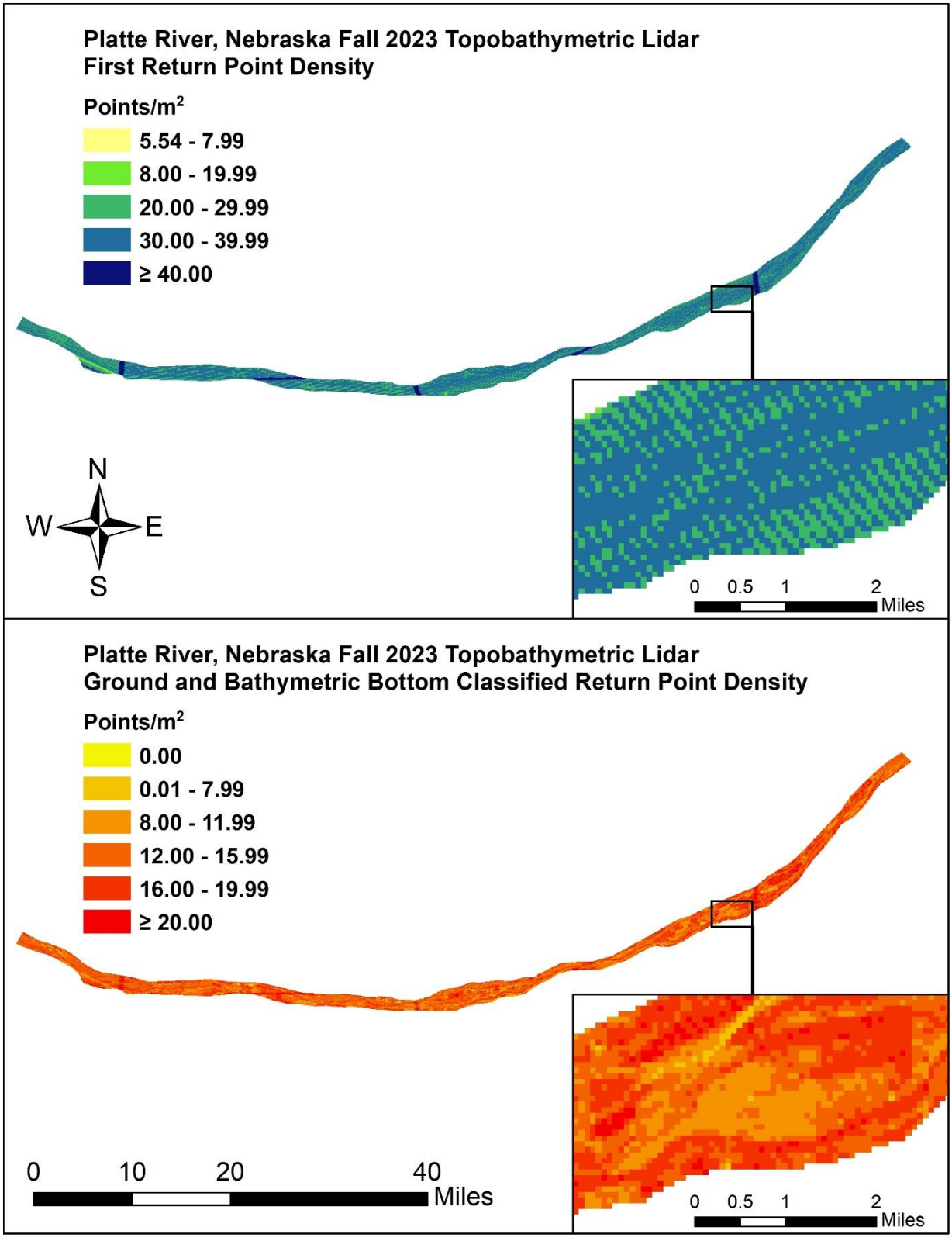


Figure 14: First return and ground and bathymetric bottom density map for the Platte River site (100 m x 100 m cells)

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[2]. 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 classified lidar point cloud as well as the derived gridded bare earth DEM. 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 15.

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 2023 project, absolute accuracy statistics derived from the Fall 2020 and Fall 2023 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 2023 data was calibrated to the Fall 2020 lidar dataset and ground survey. This approach helps ensure year-over-year consistency between bathymetric and topographic lidar returns for accurately modeling temporal changes to the Platte River channel.

[2] 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.

Absolute Accuracy – Fall 2020 Ground Survey

Using the Fall 2020 ground survey to assess the Fall 2023 lidar data, 13 ground check points were withheld from the calibration and post-processing of the lidar point cloud, with resulting NVA of 0.153 feet (0.047 meters) as compared to the classified LAS, with 95% confidence (Figure 15, Table 14).

NV5 also assessed absolute accuracy using 694 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 14 and Figure 16.

Appendix B details the point offsets for the Platte Fall 2023 lidar as compared to the Fall 2020 ground survey data (Table 19).

Table 14: Absolute accuracy results – Fall 2023 lidar data compared to Fall 2020 ground survey

Parameter	NVA, as compared to Classified LAS	Ground Control Points
Sample	13 points	694 points
95% Confidence (1.96*RMSE)	0.153 ft 0.047 m	0.177 ft 0.054 m
Average	-0.048 ft -0.015 m	-0.029 ft -0.009 m
Median	-0.026 ft -0.008 m	-0.033 ft -0.010 m
RMSE	0.078 ft 0.024 m	0.090 ft 0.028 m
Standard Deviation (1σ)	0.068 ft 0.021 m	0.086 ft 0.026 m

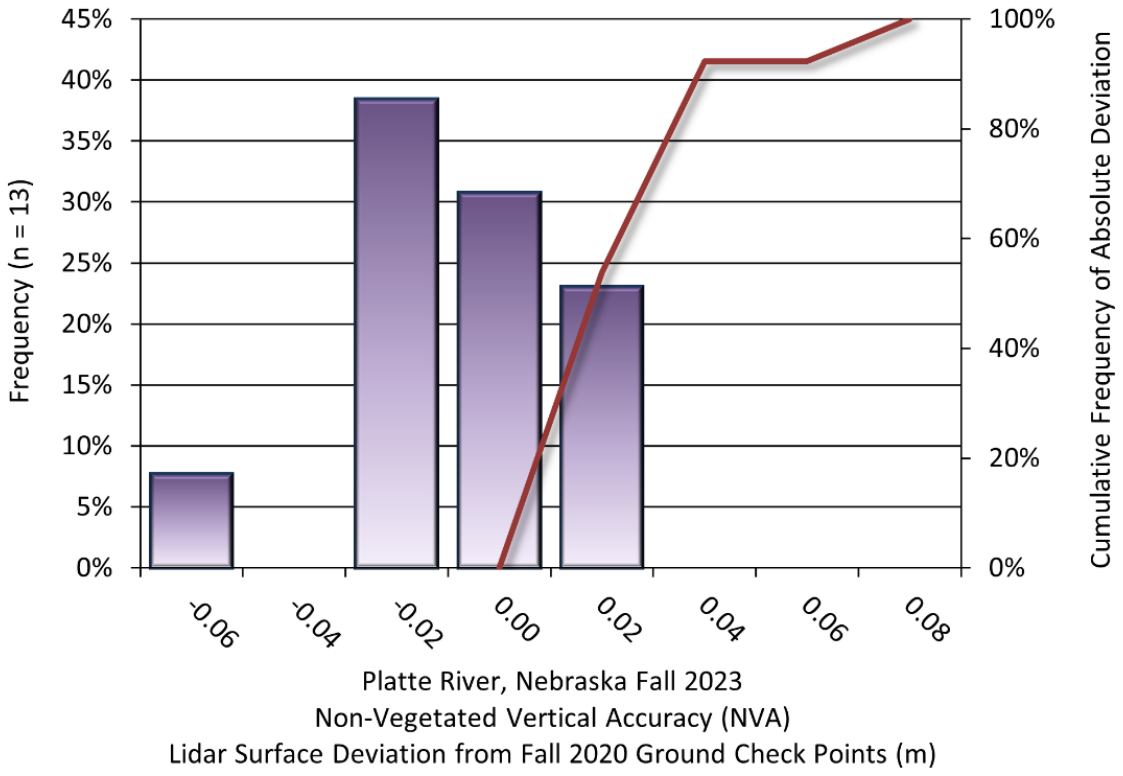


Figure 15: Frequency histogram for unclassified LAS deviation from ground check point values

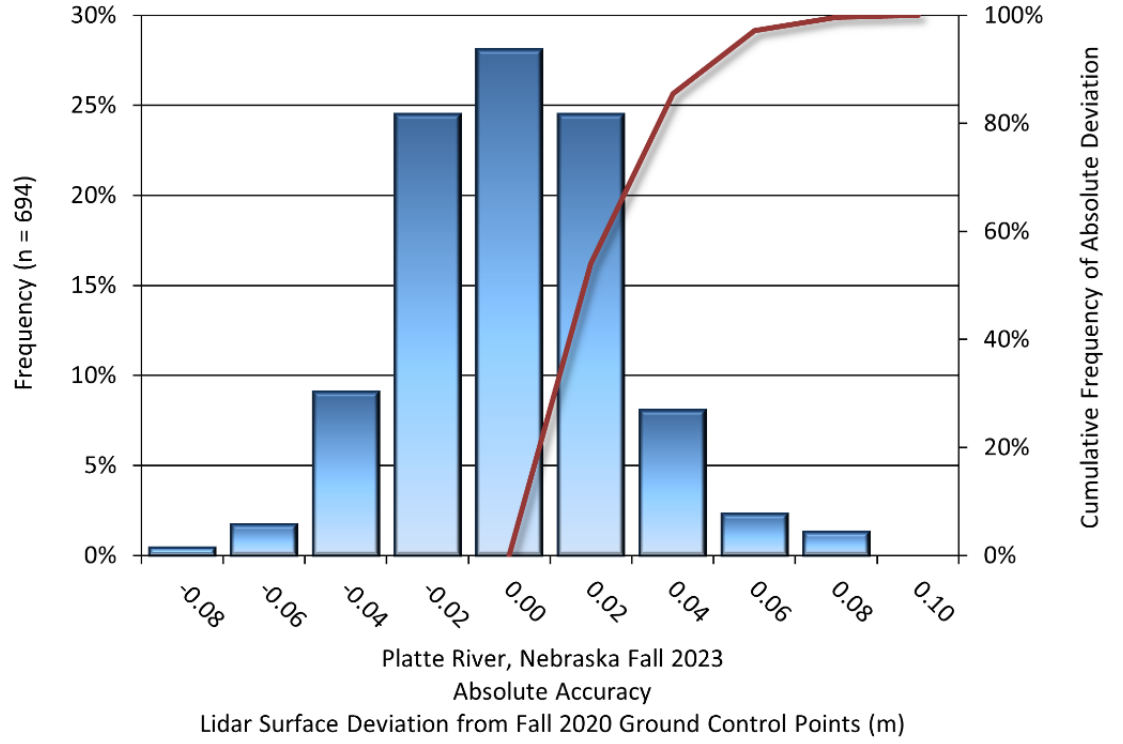


Figure 16: Frequency histogram for lidar surface deviation ground check point values

Absolute Accuracy – Fall 2023 Ground Survey

For the Platte River Fall 2023 survey, 13 ground checkpoints were withheld from the calibration and post-processing of the lidar point cloud, with resulting non-vegetated vertical accuracy of 0.203 feet (0.062 meters) as compared to the classified LAS, and 0.240 feet (0.073 meters) against the bare earth DEM, with 95% confidence (Table 15, Figure 17, and Figure 18). NV5 also assessed absolute accuracy using 334 ground control points with a resulting accuracy of 0.182 feet (0.055 meters) at the 95% confidence level (Table 15, Figure 19).

Appendix C details the point offsets for the Platte Fall 2023 lidar as compared to the Fall 2023 ground survey data (Table 20).

Table 15: Absolute accuracy results – Fall 2023 lidar data compared to Fall 2023 ground survey

Parameter	NVA, as compared to Classified LAS	NVA, as compared to Bare Earth DEM	Ground Control Points
Sample	13 points	13 points	334 points
95% Confidence (1.96*RMSE)	0.203 ft 0.062 m	0.240 ft 0.073 m	0.182 ft 0.055 m
Average	-0.052 ft -0.016 m	-0.062 ft -0.019 m	-0.035 ft -0.011 m
Median	-0.026 ft -0.008 m	-0.030 ft -0.009 m	-0.033 ft -0.010 m
RMSE	0.103 ft 0.032 m	0.123 ft 0.037 m	0.093 ft 0.028 m
Standard Deviation (1σ)	0.098 ft 0.030 m	0.116 ft 0.035 m	0.086 ft 0.026 m

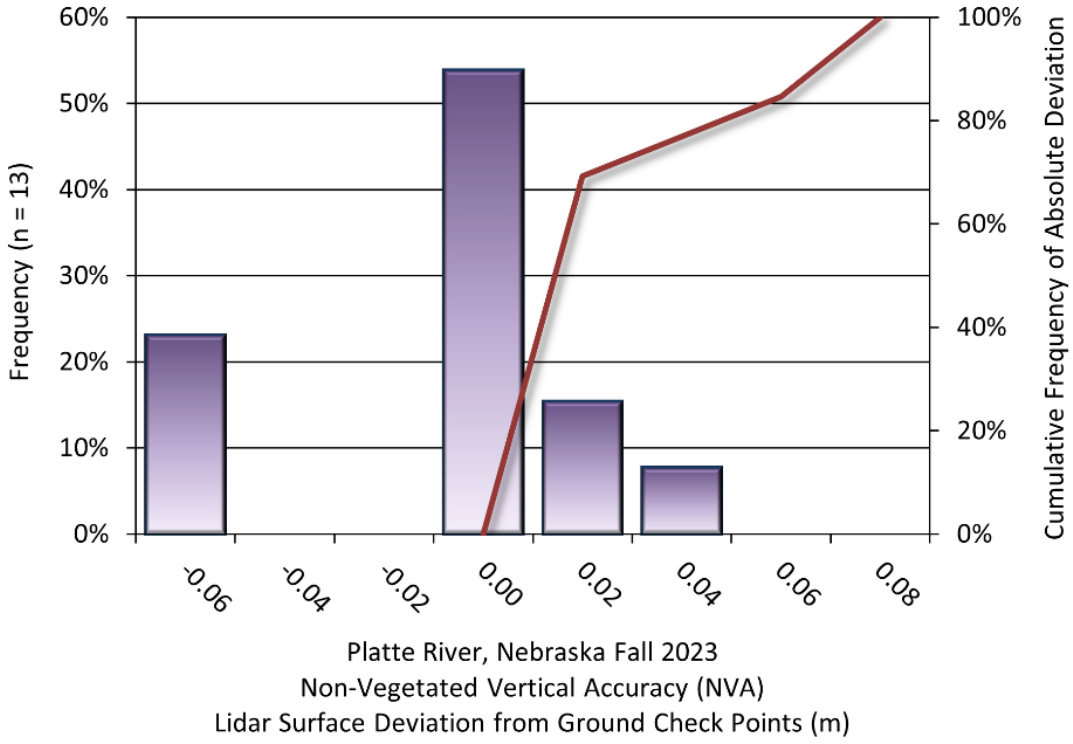


Figure 17: Frequency histogram for classified LAS deviation from ground check point values

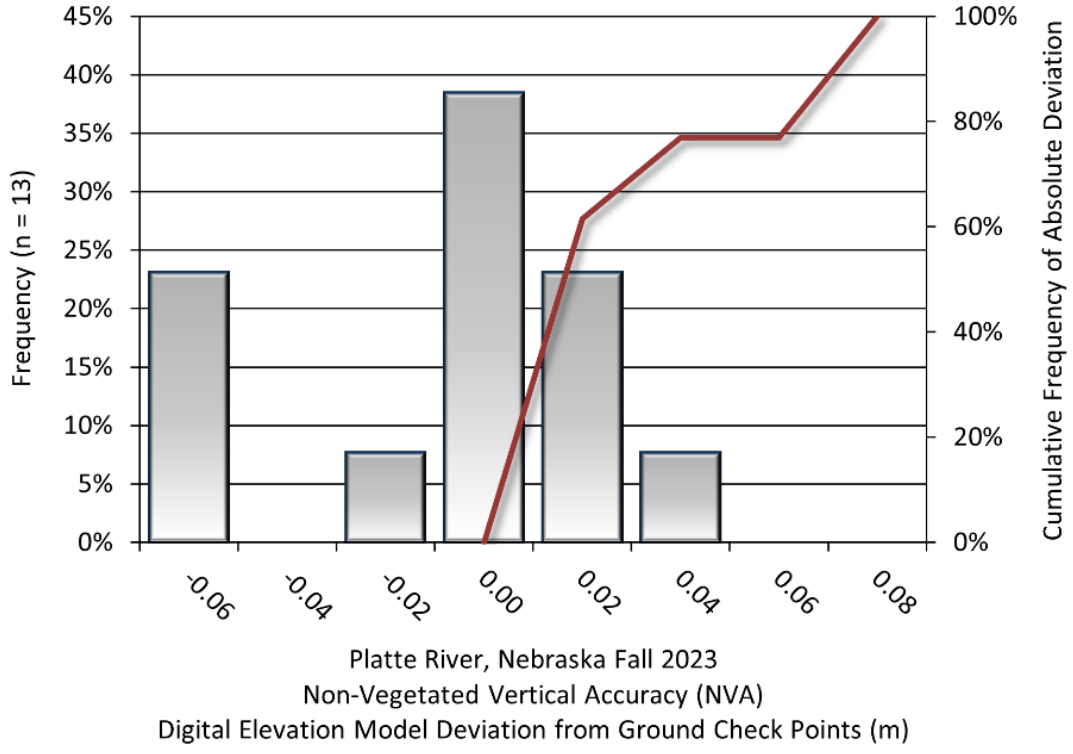


Figure 18: Frequency histogram for lidar bare earth DEM deviation from ground check point values

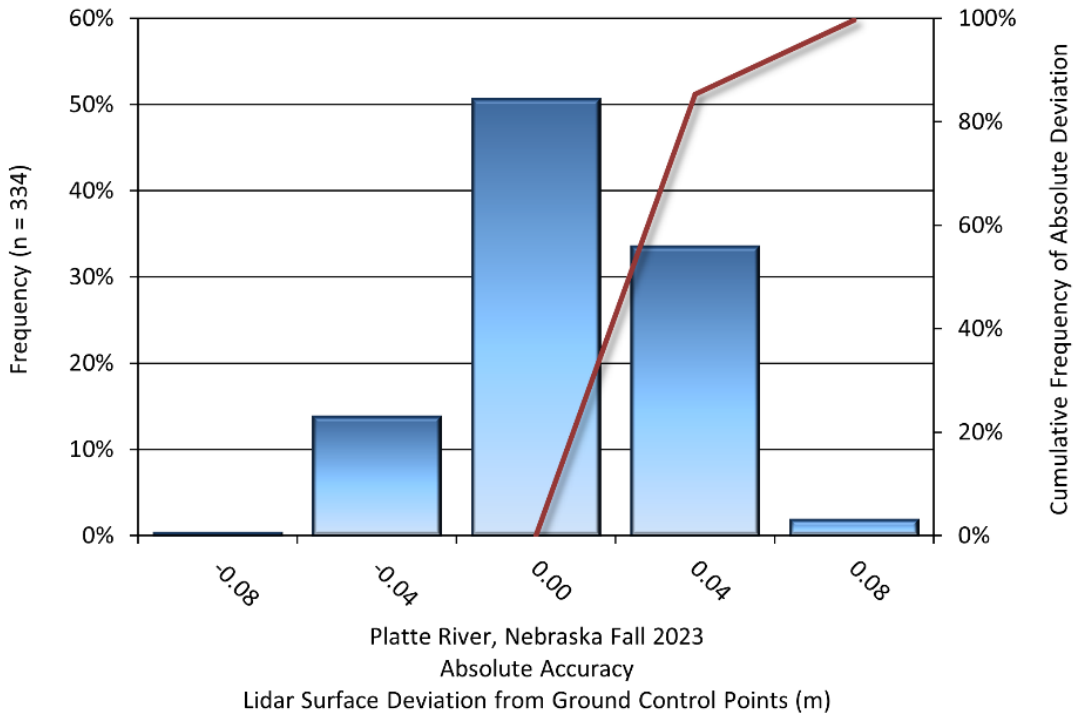


Figure 19: Frequency histogram for lidar surface deviation ground control point values

Lidar Bathymetric Vertical Accuracies

Bathymetric (submerged or along the water's edge) checkpoints were also collected in order to assess the submerged surface vertical accuracy. Assessment of 291 submerged bathymetric checkpoints resulted in a vertical accuracy of 0.285 feet (0.087 meters), while assessment of 199 wetted edge checkpoints resulted in a vertical accuracy of 0.283 feet (0.086 meters), evaluated at 95% confidence interval(Table 16, Figure 20, and Figure 21).

Table 16: Bathymetric vertical accuracy for the Platte River project

Parameter	Submerged Bathymetric Checkpoints	Wetted Edge Bathymetric Checkpoints
Sample	291 points	199 points
95% Confidence (1.96*RMSE)	0.285 ft 0.087 m	0.283 ft 0.086 m
Average Dz	0.030 ft 0.009 m	-0.044 ft -0.014 m
Median	0.013 ft 0.004 m	-0.030 ft -0.009 m
RMSE	0.145 ft 0.044 m	0.144 ft 0.044 m
Standard Deviation (1σ)	0.143 ft 0.043 m	0.138 ft 0.042 m

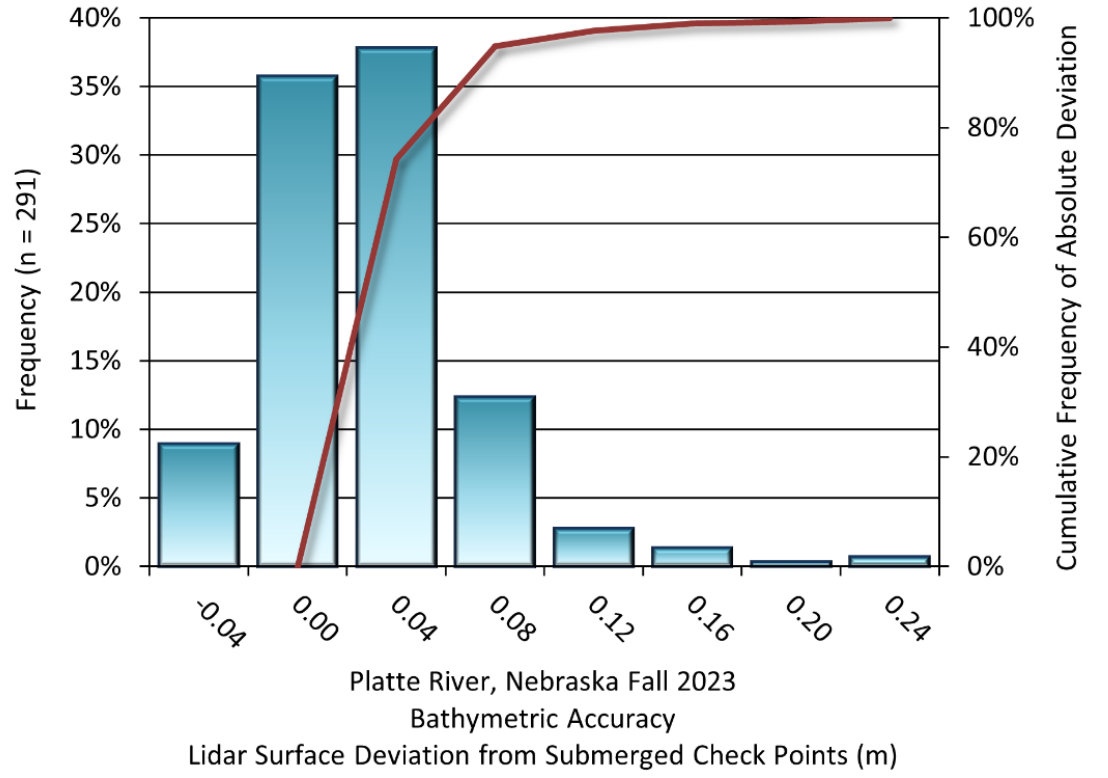


Figure 20: Frequency histogram for lidar surface deviation from submerged check point values

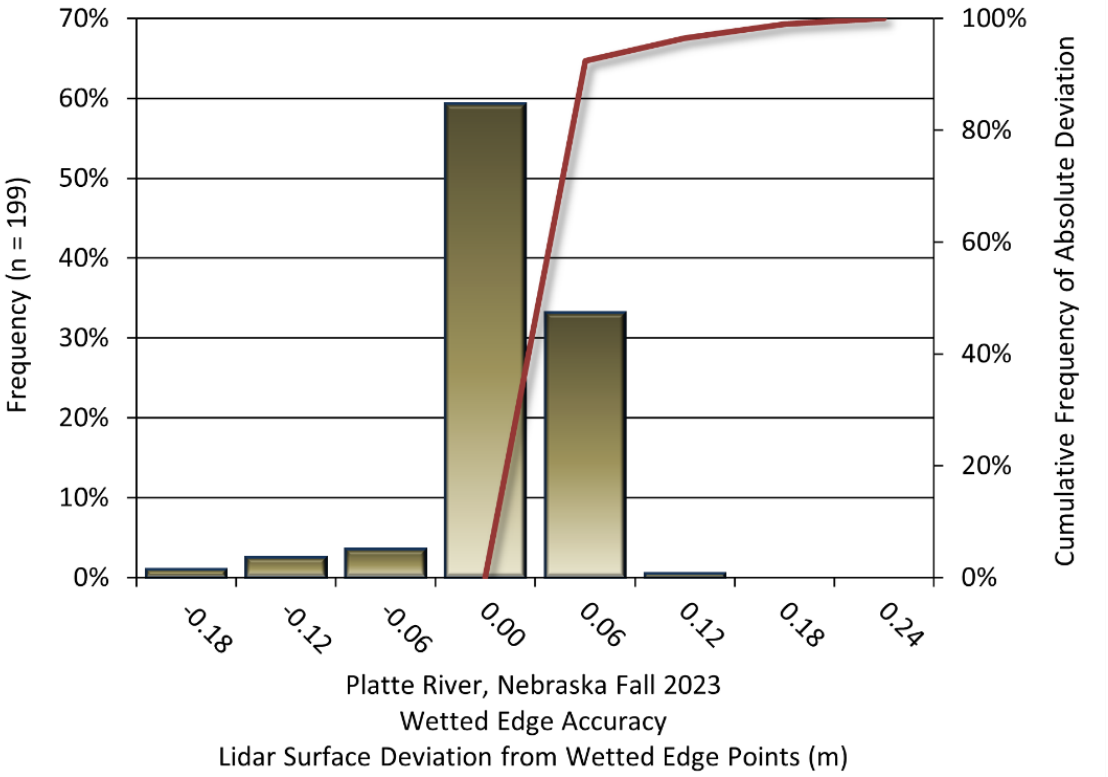


Figure 21: Frequency histogram for lidar surface deviation from wetted edge check point values

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 lidar project was 0.048 feet (0.015 meters) (Table 17, Figure 22).

Table 17: Relative accuracy results

Parameter	Relative Accuracy
Sample	370 surfaces
Average	0.048 ft 0.015 m
Median	0.046 ft 0.014 m
RMSE	0.048 ft 0.015 m
Standard Deviation (1σ)	0.009 ft 0.003 m
1.96σ	0.017 ft 0.005 m

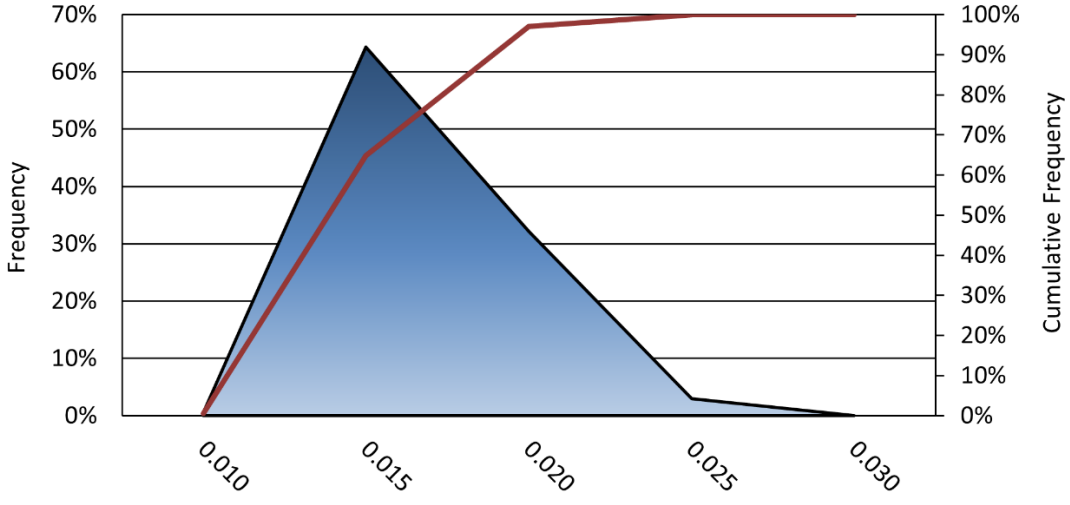


Figure 22: Frequency plot for relative vertical accuracy between flight lines

Lidar Horizontal Accuracy

Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and inertial navigation system (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 0.023 meters, this project was produced to meet 0.206 feet (0.063 meters) horizontal accuracy at the 95% confidence level (Table 18).

Table 18: Horizontal accuracy

Parameter	Horizontal Accuracy
$RMSE_r$	0.119 ft 0.036 m
ACC_r	0.206 ft 0.063 m

CERTIFICATIONS

NV5 Geospatial provided lidar services for the Platte River 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 19, 2024

Steven Miller
Project Manager
NV5 Geospatial

I, Steven J. Hyde, PLS, being duly registered as a Professional Land Surveyor in and by the state of 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. Field work conducted for this report was conducted between November 10 and November 14, 2023.

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”.

Steven J. Hyde

Digitally signed by Steven J. Hyde
Date: 2024.04.19 13:41:09 -04'00'

NEBRASKA REGISTERED LS-769 LAND SURVEYOR STEVEN J. HYDE

Steven J. Hyde
NE PLS #769
NV5 Geospatial

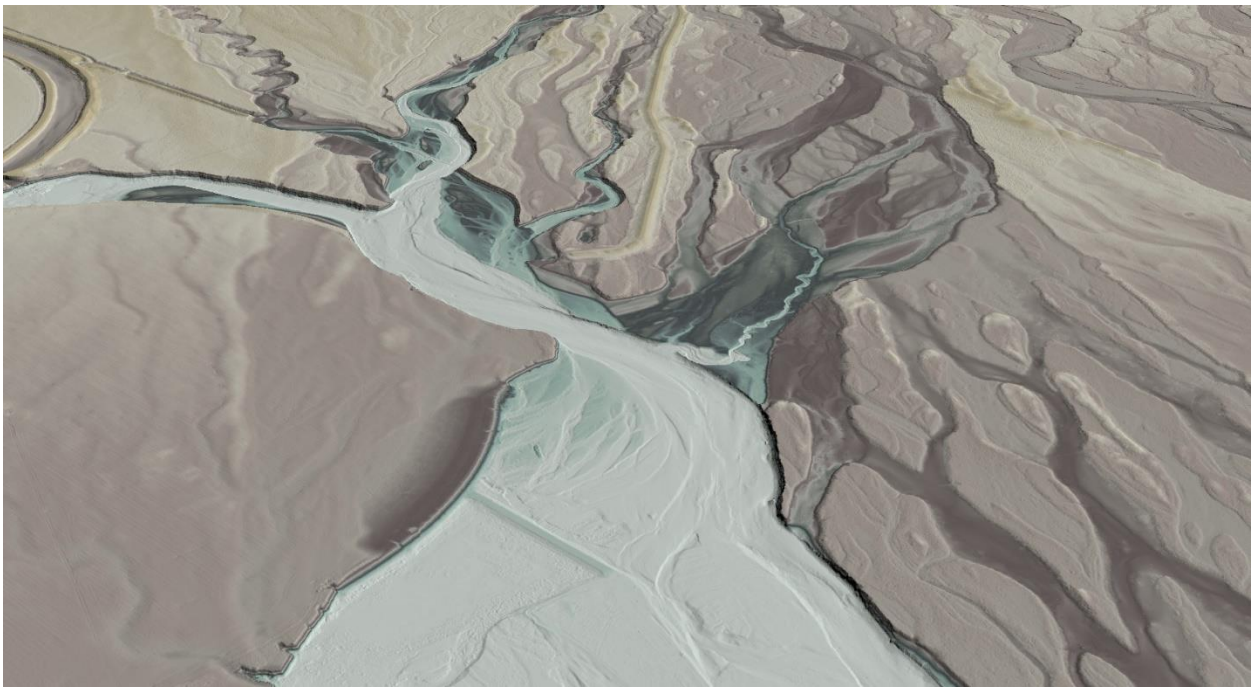


Figure 23: View looking northwest over Platte River. The image was created from the lidar bare earth model colored by elevation.

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 (NVA) 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 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:

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

Operational measures taken to improve relative accuracy:

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° to ±21o for the green and NIR lasers, respectively, 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.

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 19: Non-vegetated vertical accuracy – Fall 2023 lidar data vs. Fall 2020 ground survey points

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
1	534735.878	4511910.447	598.112	598.080	-0.032	-0.105
2	571885.587	4537569.270	541.926	541.930	0.004	0.013
4	534740.848	4511954.338	598.018	598.000	-0.018	-0.059
6	571830.946	4537617.791	541.749	541.760	0.011	0.036
7	552433.797	4518864.599	580.831	580.810	-0.021	-0.069
8	552434.296	4518804.720	579.933	579.910	-0.023	-0.075
9	571777.009	4537666.455	541.450	541.450	0.000	0.000
10	534746.118	4511998.005	598.010	598.000	-0.010	-0.033
13	571721.796	4537716.138	541.068	541.070	0.002	0.007
14	552437.356	4518746.728	578.683	578.650	-0.033	-0.108
15	574705.228	4537784.055	566.213	566.240	0.027	0.089
16	552435.501	4518687.921	577.514	577.500	-0.014	-0.046
17	571669.756	4537770.546	540.526	540.520	-0.006	-0.020
18	574636.857	4537781.998	567.303	567.320	0.017	0.056
21	571622.269	4537831.997	540.613	540.600	-0.013	-0.043
22	552440.790	4518648.060	576.849	576.810	-0.039	-0.128
23	574561.367	4537779.751	567.530	567.550	0.020	0.066
24	552440.309	4518587.355	576.771	576.740	-0.031	-0.102
26	571597.198	4537903.227	540.169	540.190	0.021	0.069
27	574489.319	4537779.754	565.541	565.540	-0.001	-0.003
28	552440.854	4518525.523	576.677	576.650	-0.027	-0.089
29	571581.726	4537976.907	539.959	539.970	0.011	0.036
31	574417.385	4537777.046	562.471	562.480	0.009	0.030
32	571567.686	4538052.373	540.013	540.000	-0.013	-0.043
33	534763.320	4512484.240	604.565	604.610	0.045	0.148

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
34	552438.249	4518461.889	576.561	576.540	-0.021	-0.069
35	574345.368	4537774.508	558.972	558.950	-0.022	-0.072
36	571554.151	4538124.197	539.999	539.990	-0.009	-0.030
37	534764.285	4512441.618	603.834	603.860	0.026	0.085
38	552438.793	4518401.321	576.467	576.450	-0.017	-0.056
39	574273.505	4537768.714	556.207	556.190	-0.017	-0.056
40	571539.971	4538200.017	540.080	540.070	-0.010	-0.033
41	574202.697	4537766.508	553.653	553.650	-0.003	-0.010
42	552439.374	4518341.012	576.427	576.400	-0.027	-0.089
43	534764.577	4512397.644	602.170	602.180	0.010	0.033
44	574132.815	4537763.845	551.224	551.230	0.006	0.020
46	534765.459	4512353.310	600.170	600.170	0.000	0.000
47	534772.700	4512309.570	598.569	598.620	0.051	0.167
48	574061.511	4537761.117	549.284	549.300	0.016	0.052
49	571513.135	4538357.059	539.876	539.900	0.024	0.079
50	552440.303	4518218.633	576.214	576.190	-0.024	-0.079
51	534765.701	4512266.192	598.253	598.280	0.027	0.089
52	552440.592	4518166.069	576.151	576.120	-0.031	-0.102
53	573989.944	4537758.612	547.997	548.000	0.003	0.010
54	571509.625	4538434.669	539.647	539.650	0.003	0.010
55	552440.951	4518104.224	576.173	576.160	-0.013	-0.043
56	573918.222	4537756.556	546.367	546.360	-0.007	-0.023
57	534767.035	4512222.552	597.985	598.000	0.015	0.049
58	571505.026	4538511.343	539.607	539.610	0.003	0.010
59	573844.378	4537753.786	544.961	544.980	0.019	0.062
60	552441.559	4518043.218	576.303	576.290	-0.013	-0.043
61	534763.531	4512177.230	598.054	598.060	0.006	0.020
62	571504.441	4538589.935	539.712	539.720	0.008	0.026
63	571503.954	4538664.070	539.730	539.730	0.000	0.000
64	573769.832	4537751.369	544.337	544.350	0.013	0.043

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
65	552441.892	4517983.504	576.522	576.500	-0.022	-0.072
66	534761.295	4512133.413	598.094	598.110	0.016	0.052
67	552442.222	4517923.516	576.741	576.730	-0.011	-0.036
68	534757.838	4512092.395	598.095	598.100	0.005	0.016
69	573698.958	4537748.827	543.778	543.790	0.012	0.039
70	571503.579	4538742.167	539.760	539.770	0.010	0.033
71	573626.952	4537746.421	542.666	542.680	0.014	0.046
72	552442.478	4517875.871	576.895	576.870	-0.025	-0.082
73	534752.392	4512048.288	598.035	598.040	0.005	0.016
74	571503.165	4538817.764	539.786	539.810	0.024	0.079
75	573553.153	4537744.293	542.378	542.390	0.012	0.039
76	571502.748	4538894.607	539.762	539.790	0.028	0.092
77	552421.010	4520227.850	574.911	574.870	-0.041	-0.135
78	571502.214	4538968.971	539.742	539.760	0.018	0.059
79	573480.861	4537741.811	542.455	542.470	0.015	0.049
80	552421.926	4520166.881	575.367	575.340	-0.027	-0.089
81	573407.610	4537739.302	542.346	542.360	0.014	0.046
82	552422.572	4520107.313	575.681	575.670	-0.011	-0.036
84	573336.906	4537733.281	542.020	542.030	0.010	0.033
85	552423.285	4520046.934	575.880	575.850	-0.030	-0.098
87	573241.650	4537714.010	541.656	541.610	-0.046	-0.151
88	552423.554	4520015.040	575.875	575.890	0.015	0.049
91	573173.181	4537692.421	541.494	541.520	0.026	0.085
92	572134.726	4537344.780	542.160	542.160	0.000	0.000
93	573107.208	4537663.830	541.232	541.240	0.008	0.026
94	552424.695	4519895.700	575.897	575.890	-0.007	-0.023
95	572190.685	4537293.610	541.985	542.000	0.015	0.049
96	573044.663	4537629.565	541.295	541.300	0.005	0.016
97	552425.474	4519834.145	575.978	575.950	-0.028	-0.092
98	572245.880	4537244.451	541.703	541.710	0.007	0.023

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
99	552426.082	4519773.308	575.976	575.950	-0.026	-0.085
100	572985.467	4537589.534	541.465	541.480	0.015	0.049
101	572925.985	4537545.425	541.689	541.710	0.021	0.069
102	552426.625	4519710.139	575.999	575.990	-0.009	-0.030
103	572290.164	4537197.051	542.133	542.150	0.017	0.056
104	552427.022	4519650.394	575.978	575.990	0.012	0.039
105	572359.791	4537217.550	541.883	541.890	0.007	0.023
106	572420.705	4537243.540	542.046	542.040	-0.006	-0.020
108	572488.845	4537272.801	542.251	542.260	0.009	0.030
109	552428.118	4519531.171	575.969	575.980	0.011	0.036
110	552429.999	4519469.682	575.939	575.910	-0.029	-0.095
111	572554.510	4537304.746	542.309	542.320	0.011	0.036
112	572622.614	4537335.819	542.339	542.360	0.021	0.069
113	552429.532	4519408.400	575.981	575.950	-0.031	-0.102
114	572686.045	4537370.552	542.198	542.230	0.032	0.105
115	552430.720	4519354.150	576.302	576.260	-0.042	-0.138
116	552433.290	4519291.960	577.088	577.050	-0.038	-0.125
117	572747.367	4537419.574	542.221	542.240	0.019	0.062
118	572808.707	4537460.093	542.442	542.450	0.008	0.026
119	552433.850	4519232.510	578.304	578.260	-0.044	-0.144
120	552431.053	4519175.325	579.683	579.650	-0.033	-0.108
121	552433.599	4519113.856	580.749	580.720	-0.029	-0.095
122	552433.561	4519051.929	581.486	581.450	-0.036	-0.118
124	552415.604	4520665.568	573.122	573.110	-0.012	-0.039
125	552416.243	4520607.308	573.090	573.100	0.010	0.033
126	552417.005	4520547.019	573.062	573.070	0.008	0.026
127	552417.817	4520486.782	573.140	573.110	-0.030	-0.098
128	552418.474	4520426.773	573.339	573.310	-0.029	-0.095
129	552419.327	4520365.852	573.707	573.680	-0.027	-0.089
130	552419.970	4520307.238	574.209	574.180	-0.029	-0.095

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
131	552420.670	4520254.870	574.677	574.630	-0.047	-0.154
134	542807.604	4513357.922	588.879	588.860	-0.019	-0.062
136	542821.360	4512184.640	589.454	589.400	-0.054	-0.177
137	542817.140	4512255.130	589.186	589.120	-0.066	-0.217
138	542816.330	4512323.870	588.582	588.530	-0.052	-0.171
139	542816.130	4512393.040	588.359	588.310	-0.049	-0.161
140	542815.610	4512463.876	588.347	588.310	-0.037	-0.121
141	542814.940	4512532.960	588.137	588.090	-0.047	-0.154
142	542814.560	4512600.560	588.254	588.210	-0.044	-0.144
143	542814.120	4512669.940	588.177	588.130	-0.047	-0.154
144	542813.550	4512738.180	588.287	588.230	-0.057	-0.187
145	542812.660	4512800.230	588.417	588.370	-0.047	-0.154
146	542812.230	4512869.330	588.387	588.340	-0.047	-0.154
147	542811.260	4512935.200	588.399	588.360	-0.039	-0.128
148	542810.715	4512997.449	588.336	588.310	-0.026	-0.085
149	542810.126	4513068.685	588.517	588.490	-0.027	-0.089
150	542809.324	4513138.001	588.622	588.600	-0.022	-0.072
151	542809.020	4513208.050	588.716	588.670	-0.046	-0.151
152	542808.374	4513276.182	588.682	588.650	-0.032	-0.105
153	542807.405	4513353.232	588.824	588.790	-0.034	-0.112
154	535030.558	4510904.512	600.237	600.240	0.003	0.010
155	535043.095	4510866.468	599.727	599.730	0.003	0.010
156	535056.285	4510827.051	599.197	599.210	0.013	0.043
157	535069.194	4510787.718	598.845	598.840	-0.005	-0.016
158	535082.079	4510748.393	598.684	598.660	-0.024	-0.079
159	535090.741	4510706.320	598.508	598.510	0.002	0.007
160	535105.755	4510665.963	598.667	598.660	-0.007	-0.023
161	535117.295	4510623.360	598.766	598.770	0.004	0.013
162	535126.923	4510581.676	598.551	598.540	-0.011	-0.036
163	535137.114	4510539.207	598.203	598.180	-0.023	-0.075

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
164	535145.999	4510499.868	598.032	598.010	-0.022	-0.072
165	535155.645	4510458.893	597.862	597.860	-0.002	-0.007
166	535165.619	4510416.907	597.841	597.850	0.009	0.030
167	535175.597	4510374.426	597.824	597.840	0.016	0.052
169	535185.401	4510332.883	597.851	597.860	0.009	0.030
170	535195.656	4510288.800	597.871	597.870	-0.001	-0.003
173	535205.622	4510246.311	597.784	597.790	0.006	0.020
174	535216.097	4510203.254	597.735	597.750	0.015	0.049
175	552449.178	4516914.008	577.348	577.320	-0.028	-0.092
176	535226.392	4510160.783	597.707	597.730	0.023	0.075
177	552450.304	4516804.605	576.649	576.640	-0.009	-0.030
178	535235.952	4510120.848	597.701	597.730	0.029	0.095
179	552452.242	4516748.233	576.259	576.250	-0.009	-0.030
180	535246.383	4510077.988	597.664	597.690	0.026	0.085
181	535256.082	4510035.921	597.643	597.670	0.027	0.089
182	552451.296	4516693.187	575.880	575.890	0.010	0.033
183	535266.214	4509993.400	597.731	597.760	0.029	0.095
184	552451.790	4516637.452	575.616	575.600	-0.016	-0.052
185	535276.395	4509950.087	597.786	597.800	0.014	0.046
186	552452.456	4516582.039	575.528	575.530	0.002	0.007
187	535286.658	4509907.599	597.839	597.840	0.001	0.003
188	552452.968	4516532.075	575.578	575.570	-0.008	-0.026
189	535293.422	4509864.203	597.890	597.890	0.000	0.000
190	552453.604	4516475.529	575.662	575.670	0.008	0.026
192	552454.157	4516418.864	575.764	575.750	-0.014	-0.046
194	552454.572	4516362.690	575.850	575.820	-0.030	-0.098
200	552442.430	4517844.610	576.991	576.950	-0.041	-0.135
202	552443.058	4517786.360	577.071	577.040	-0.031	-0.102
203	552445.770	4517724.654	577.023	576.990	-0.033	-0.108
204	534957.292	4511115.835	600.283	600.270	-0.013	-0.043

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
205	552444.151	4517672.820	577.004	576.970	-0.034	-0.112
206	534942.909	4511160.962	599.815	599.790	-0.025	-0.082
207	534928.543	4511203.708	599.353	599.320	-0.033	-0.108
208	552444.281	4517617.473	576.829	576.800	-0.029	-0.095
209	534914.507	4511246.432	598.982	598.950	-0.032	-0.105
210	552444.892	4517561.911	576.566	576.540	-0.026	-0.085
211	534899.460	4511292.140	598.777	598.730	-0.047	-0.154
212	552445.110	4517505.770	576.280	576.240	-0.040	-0.131
213	534885.194	4511335.985	598.727	598.690	-0.037	-0.121
214	552445.509	4517451.032	576.003	575.970	-0.033	-0.108
215	552446.110	4517395.220	575.746	575.700	-0.046	-0.151
216	534870.782	4511379.919	598.683	598.660	-0.023	-0.075
217	534856.114	4511425.101	598.710	598.690	-0.020	-0.066
218	552446.181	4517353.299	575.705	575.670	-0.035	-0.115
219	552446.540	4517302.910	575.801	575.760	-0.041	-0.135
220	534840.489	4511473.057	598.916	598.910	-0.006	-0.020
221	552446.760	4517261.780	576.043	576.000	-0.043	-0.141
222	534814.641	4511563.638	599.683	599.660	-0.023	-0.075
223	552447.070	4517213.950	576.413	576.360	-0.053	-0.174
224	534801.040	4511593.561	599.873	599.870	-0.003	-0.010
225	552444.660	4517164.980	576.891	576.850	-0.041	-0.135
226	552447.630	4517126.110	577.099	577.060	-0.039	-0.128
228	534767.536	4511694.377	599.875	599.870	-0.005	-0.016
229	534751.138	4511735.244	599.680	599.680	0.000	0.000
230	534741.795	4511779.710	599.330	599.330	0.000	0.000
231	534734.266	4511824.180	598.955	598.930	-0.025	-0.082
232	534731.006	4511870.522	598.569	598.550	-0.019	-0.062
233	558390.863	4526429.505	562.333	562.300	-0.033	-0.108
234	542717.865	4516411.310	590.737	590.730	-0.007	-0.023
235	558477.798	4526430.261	562.308	562.290	-0.018	-0.059

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
236	542719.776	4516350.225	587.909	587.880	-0.029	-0.095
237	542715.362	4516286.188	586.451	586.460	0.009	0.030
238	558565.138	4526431.198	562.313	562.290	-0.023	-0.075
239	542709.966	4516221.887	586.745	586.720	-0.025	-0.082
240	558652.450	4526432.370	562.346	562.300	-0.046	-0.151
241	542708.582	4516158.225	586.790	586.790	0.000	0.000
242	558739.700	4526435.310	562.307	562.270	-0.037	-0.121
243	558846.043	4526438.045	562.266	562.240	-0.026	-0.085
244	542707.983	4516093.812	586.646	586.620	-0.026	-0.085
245	558934.821	4526434.529	562.423	562.390	-0.033	-0.108
246	542711.121	4516032.466	587.105	587.100	-0.005	-0.016
247	542718.346	4515969.964	587.636	587.620	-0.016	-0.052
248	559020.640	4526434.720	562.363	562.320	-0.043	-0.141
250	559105.391	4526435.011	562.278	562.260	-0.018	-0.059
252	559192.100	4526435.728	562.222	562.200	-0.022	-0.072
253	542743.525	4515781.436	587.803	587.790	-0.013	-0.043
254	559278.467	4526436.242	562.171	562.150	-0.021	-0.069
255	542754.895	4515721.816	587.638	587.640	0.002	0.007
256	559366.170	4526436.809	562.126	562.090	-0.036	-0.118
257	559440.610	4526437.280	562.129	562.090	-0.039	-0.128
258	542763.130	4515659.224	587.722	587.710	-0.012	-0.039
259	542771.828	4515594.631	587.769	587.760	-0.009	-0.030
260	559524.254	4526436.257	562.314	562.280	-0.034	-0.112
261	560438.299	4525033.717	563.219	563.190	-0.029	-0.095
262	542779.602	4515532.485	587.842	587.830	-0.012	-0.039
263	542788.131	4515468.661	587.916	587.920	0.004	0.013
264	560375.321	4525098.196	562.948	562.950	0.002	0.007
265	560321.725	4525166.289	562.518	562.520	0.002	0.007
266	542801.255	4515341.576	587.716	587.710	-0.006	-0.020
267	560275.548	4525240.446	562.058	562.070	0.012	0.039

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
268	560238.552	4525317.711	561.687	561.690	0.003	0.010
269	542810.039	4515277.667	587.860	587.850	-0.010	-0.033
270	560209.575	4525401.143	561.466	561.460	-0.006	-0.020
271	542816.550	4515215.850	587.852	587.820	-0.032	-0.105
272	542817.380	4515148.920	587.989	587.930	-0.059	-0.194
273	560190.054	4525486.027	561.143	561.150	0.007	0.023
274	542817.201	4515084.021	587.742	587.710	-0.032	-0.105
275	560165.749	4525572.083	560.836	560.850	0.014	0.046
276	560143.585	4525659.786	560.763	560.770	0.007	0.023
277	542816.921	4515018.794	587.791	587.770	-0.021	-0.069
278	560121.904	4525746.086	560.741	560.730	-0.011	-0.036
279	542816.370	4514954.390	587.759	587.720	-0.039	-0.128
280	560100.650	4525830.670	560.741	560.700	-0.041	-0.135
281	542819.660	4514888.890	587.799	587.730	-0.069	-0.226
282	542819.213	4514825.577	587.738	587.740	0.002	0.007
283	560078.779	4525917.466	560.716	560.690	-0.026	-0.085
284	542818.918	4514760.378	587.765	587.760	-0.005	-0.016
285	559591.460	4526429.930	562.221	562.180	-0.041	-0.135
286	542818.213	4514681.838	587.890	587.880	-0.010	-0.033
287	559676.710	4526409.900	562.120	562.080	-0.040	-0.131
288	559759.100	4526377.190	561.980	561.920	-0.060	-0.197
289	542817.785	4514616.872	587.871	587.850	-0.021	-0.069
290	559833.750	4526333.140	561.874	561.830	-0.044	-0.144
291	542817.470	4514555.070	587.923	587.850	-0.073	-0.240
292	542816.848	4514492.063	587.956	587.930	-0.026	-0.085
293	559902.090	4526277.750	561.709	561.660	-0.049	-0.161
294	542815.869	4514429.352	587.856	587.840	-0.016	-0.052
295	559968.900	4526203.000	561.587	561.540	-0.047	-0.154
296	542815.124	4514368.538	587.893	587.870	-0.023	-0.075
297	560014.875	4526131.952	561.410	561.390	-0.020	-0.066

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
298	542814.421	4514307.154	587.882	587.870	-0.012	-0.039
299	560053.500	4526044.460	561.299	561.250	-0.049	-0.161
300	560072.970	4525979.500	561.044	560.990	-0.054	-0.177
301	542813.527	4514245.204	587.793	587.770	-0.023	-0.075
302	542812.619	4514181.587	587.835	587.840	0.005	0.016
305	542811.969	4514119.090	587.750	587.730	-0.020	-0.066
306	542811.035	4514055.753	587.837	587.810	-0.027	-0.089
308	561521.237	4524585.704	572.168	572.160	-0.008	-0.026
309	542806.100	4513930.450	587.872	587.830	-0.042	-0.138
310	561434.331	4524569.698	572.098	572.090	-0.008	-0.026
311	561349.443	4524548.844	570.560	570.550	-0.010	-0.033
312	542805.340	4513866.920	588.019	587.960	-0.059	-0.194
313	561262.360	4524539.306	567.375	567.370	-0.005	-0.016
314	542804.608	4513802.932	588.129	588.100	-0.029	-0.095
315	561170.947	4524541.665	564.548	564.560	0.012	0.039
316	542807.400	4513739.310	588.438	588.400	-0.038	-0.125
317	542804.220	4513672.150	588.529	588.490	-0.039	-0.128
318	561089.416	4524559.260	563.059	563.030	-0.029	-0.095
319	561009.156	4524587.066	562.650	562.630	-0.020	-0.066
320	542804.920	4513608.410	588.734	588.690	-0.044	-0.144
321	560929.071	4524623.501	562.664	562.640	-0.024	-0.079
322	560853.839	4524666.706	562.754	562.730	-0.024	-0.079
323	560783.338	4524716.145	562.965	562.950	-0.015	-0.049
324	560715.043	4524773.027	563.242	563.210	-0.032	-0.105
325	560675.620	4524810.340	563.250	563.200	-0.050	-0.164
329	492824.343	4499919.197	654.293	654.270	-0.023	-0.075
330	478390.810	4502997.560	673.555	673.510	-0.045	-0.148
331	504097.245	4503277.433	639.900	639.900	0.000	0.000
332	504093.965	4503221.515	639.987	639.980	-0.007	-0.023
333	478390.557	4502952.216	675.500	675.490	-0.010	-0.033

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
334	492817.696	4499962.125	654.292	654.290	-0.002	-0.007
335	492809.641	4500005.385	654.296	654.270	-0.026	-0.085
336	504093.937	4503161.441	639.996	639.990	-0.006	-0.020
337	478390.082	4502905.049	677.667	677.690	0.023	0.075
338	492802.904	4500048.039	654.169	654.140	-0.029	-0.095
339	478389.892	4502859.334	679.115	679.130	0.015	0.049
340	504094.091	4503102.307	639.935	639.960	0.025	0.082
341	504094.046	4503041.740	640.020	640.040	0.020	0.066
342	492789.645	4500091.092	654.152	654.130	-0.022	-0.072
343	478392.752	4502762.962	679.339	679.350	0.011	0.036
344	504094.110	4502983.831	640.008	640.020	0.012	0.039
345	492779.701	4500132.690	654.136	654.120	-0.016	-0.052
346	478392.400	4502717.962	678.105	678.130	0.025	0.082
347	492768.977	4500175.983	654.172	654.160	-0.012	-0.039
348	478391.876	4502672.644	676.085	676.090	0.005	0.016
349	504094.348	4502924.506	640.028	640.040	0.012	0.039
350	492762.714	4500221.341	653.972	653.970	-0.002	-0.007
351	478391.440	4502626.853	674.218	674.210	-0.008	-0.026
352	504094.869	4502866.140	640.049	640.040	-0.009	-0.030
353	478391.499	4502581.455	673.437	673.430	-0.007	-0.023
354	492748.081	4500263.682	654.090	654.070	-0.020	-0.066
355	504094.917	4502746.151	640.099	640.110	0.011	0.036
356	478391.142	4502534.863	673.436	673.440	0.004	0.013
357	492739.030	4500307.833	654.179	654.160	-0.019	-0.062
358	478390.800	4502487.640	673.608	673.570	-0.038	-0.125
359	492731.785	4500352.310	654.299	654.280	-0.019	-0.062
360	504095.075	4502687.532	640.088	640.090	0.002	0.007
361	492726.439	4500396.327	654.478	654.470	-0.008	-0.026
362	478390.248	4502444.022	673.530	673.530	0.000	0.000
363	504099.007	4502625.105	639.944	639.960	0.016	0.052

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
364	504095.135	4502568.759	640.053	640.060	0.007	0.023
365	492722.402	4500441.356	654.723	654.720	-0.003	-0.010
366	478386.255	4502396.991	673.600	673.600	0.000	0.000
367	478384.576	4502351.596	673.590	673.590	0.000	0.000
368	504095.267	4502509.680	640.059	640.070	0.011	0.036
369	492720.018	4500486.745	655.056	655.050	-0.006	-0.020
370	504095.268	4502450.063	640.056	640.060	0.004	0.013
371	492719.820	4500530.989	655.392	655.400	0.008	0.026
372	478383.035	4502307.841	673.580	673.560	-0.020	-0.066
373	504095.788	4502391.154	640.034	640.050	0.016	0.052
374	492720.633	4500572.292	655.760	655.750	-0.010	-0.033
375	478381.474	4502264.772	673.527	673.540	0.013	0.043
376	504096.742	4502332.024	640.024	640.040	0.016	0.052
377	492720.824	4500614.370	656.003	656.010	0.007	0.023
378	478380.058	4502220.861	673.551	673.530	-0.021	-0.069
379	504096.048	4502275.335	640.062	640.080	0.018	0.059
380	478381.337	4502176.378	673.519	673.520	0.001	0.003
383	504095.945	4502215.084	640.098	640.130	0.032	0.105
384	478379.379	4502133.510	673.546	673.560	0.014	0.046
385	478378.040	4502089.740	673.524	673.570	0.046	0.151
387	504095.968	4502156.533	640.152	640.170	0.018	0.059
388	513052.536	4505658.160	633.241	633.250	0.009	0.030
389	513052.568	4505719.021	633.547	633.540	-0.007	-0.023
391	478376.406	4502046.803	673.521	673.540	0.019	0.062
392	504096.120	4502101.18	640.106	640.150	0.044	0.144
393	478371.347	4502001.220	673.510	673.490	-0.020	-0.066
395	513048.567	4505775.141	632.452	632.470	0.018	0.059
396	504096.138	4502045.825	640.126	640.140	0.014	0.046
397	504096.282	4501986.404	640.160	640.170	0.010	0.033
398	513048.667	4505833.149	630.018	630.030	0.012	0.039

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
399	478369.613	4501958.078	673.565	673.560	-0.005	-0.016
400	492726.738	4500935.808	655.932	655.940	0.008	0.026
401	478368.043	4501915.177	673.710	673.700	-0.010	-0.033
402	513044.162	4505891.452	627.645	627.650	0.005	0.016
403	504096.332	4501931.818	640.153	640.180	0.027	0.089
404	492727.903	4500978.705	655.606	655.600	-0.006	-0.020
405	513045.169	4505949.626	626.862	626.870	0.008	0.026
406	504096.612	4501870.895	640.158	640.190	0.032	0.105
408	492729.905	4501020.863	655.322	655.310	-0.012	-0.039
410	513048.440	4506007.907	626.847	626.850	0.003	0.010
411	504096.848	4501813.750	640.149	640.160	0.011	0.036
413	504096.897	4501754.723	640.170	640.180	0.010	0.033
414	513044.597	4506069.021	626.719	626.700	-0.019	-0.062
415	492731.464	4501062.341	655.078	655.080	0.002	0.007
416	513048.694	4506077.275	626.779	626.760	-0.019	-0.062
418	492732.678	4501104.540	654.782	654.770	-0.012	-0.039
419	504097.192	4501695.751	640.168	640.170	0.002	0.007
420	513048.616	4506136.213	626.742	626.740	-0.002	-0.007
421	492733.609	4501145.570	654.536	654.560	0.024	0.079
422	504097.258	4501636.854	640.199	640.200	0.001	0.003
425	492734.292	4501188.669	654.381	654.390	0.009	0.030
427	504097.277	4501576.773	640.254	640.250	-0.004	-0.013
428	513048.729	4506193.723	626.727	626.720	-0.007	-0.023
429	492735.027	4501230.800	654.256	654.260	0.004	0.013
430	513049.182	4506228.357	626.715	626.690	-0.025	-0.082
433	504097.530	4501517.390	640.358	640.320	-0.038	-0.125
434	504097.419	4501460.145	640.394	640.360	-0.034	-0.112
435	478354.379	4501563.454	673.631	673.620	-0.011	-0.036
436	492736.410	4501274.169	654.228	654.240	0.012	0.039
437	512919.430	4504365.366	628.790	628.800	0.010	0.033

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
439	512922.491	4504424.265	628.949	628.970	0.021	0.069
440	504097.532	4501398.551	640.374	640.360	-0.014	-0.046
441	478353.320	4501519.340	673.512	673.47	-0.042	-0.138
443	478354.561	4501475.805	673.443	673.430	-0.013	-0.043
445	512927.177	4504452.767	629.032	629.030	-0.002	-0.007
446	504097.523	4501339.315	640.438	640.410	-0.028	-0.092
447	492737.175	4501362.217	654.183	654.200	0.017	0.056
448	492734.229	4501405.407	654.297	654.310	0.013	0.043
451	504097.727	4501279.418	640.456	640.450	-0.006	-0.020
452	478353.451	4501438.821	673.442	673.470	0.028	0.092
454	492738.742	4501447.765	654.201	654.190	-0.011	-0.036
455	512928.472	4504583.295	628.918	628.950	0.032	0.105
456	478351.730	4501396.672	673.469	673.480	0.011	0.036
457	504097.821	4501218.664	640.551	640.540	-0.011	-0.036
458	492739.376	4501489.947	654.197	654.200	0.003	0.010
459	478349.621	4501354.364	673.505	673.530	0.025	0.082
460	512930.529	4504643.504	628.426	628.440	0.014	0.046
461	521908.936	4507365.963	617.154	617.170	0.016	0.052
462	504097.980	4501157.500	640.770	640.770	0.000	0.000
464	512933.290	4504701.840	628.138	628.200	0.062	0.203
465	492741.403	4501533.275	654.215	654.200	-0.015	-0.049
466	478348.428	4501312.542	673.542	673.540	-0.002	-0.007
467	521908.285	4507410.500	616.858	616.860	0.002	0.007
468	492740.377	4501577.795	654.204	654.210	0.006	0.020
469	512935.490	4504760.820	628.043	628.080	0.037	0.121
470	478346.672	4501267.587	673.507	673.520	0.013	0.043
471	521908.000	4507454.539	616.663	616.650	-0.013	-0.043
472	492741.150	4501620.330	654.209	654.230	0.021	0.069
473	478345.057	4501223.613	673.499	673.510	0.011	0.036
474	512937.540	4504821.100	628.044	628.100	0.056	0.184

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
476	521907.464	4507500.078	616.413	616.390	-0.023	-0.075
477	492742.138	4501664.656	654.200	654.220	0.020	0.066
479	478343.156	4501180.385	673.482	673.470	-0.012	-0.039
480	521907.278	4507546.665	616.158	616.130	-0.028	-0.092
481	512940.590	4504879.540	628.115	628.170	0.055	0.180
482	512949.193	4504938.078	628.096	628.130	0.034	0.112
483	521906.964	4507591.402	615.986	615.970	-0.016	-0.052
484	504098.487	4500845.575	640.677	640.660	-0.017	-0.056
485	492742.765	4501707.285	654.285	654.290	0.005	0.016
486	521906.390	4507635.120	615.891	615.810	-0.081	-0.266
487	512966.130	4504996.640	627.997	628.040	0.043	0.141
488	478340.423	4501093.337	673.471	673.480	0.009	0.030
489	492743.485	4501750.914	654.672	654.670	-0.002	-0.007
490	504098.830	4500783.222	640.497	640.460	-0.037	-0.121
491	512991.970	4505048.430	627.817	627.860	0.043	0.141
492	478340.263	4501049.855	673.458	673.470	0.012	0.039
493	492741.828	4501795.064	655.469	655.460	-0.009	-0.030
494	521905.887	4507684.437	615.834	615.820	-0.014	-0.046
495	504099.115	4500723.825	640.503	640.510	0.007	0.023
496	513016.732	4505103.705	627.766	627.770	0.004	0.013
497	521902.144	4507727.749	615.874	615.860	-0.014	-0.046
498	492745.780	4501839.171	656.427	656.440	0.013	0.043
499	478340.341	4501006.482	673.468	673.490	0.022	0.072
500	504099.026	4500662.651	640.412	640.430	0.018	0.059
501	478340.400	4500963.190	673.463	673.500	0.037	0.121
502	504099.464	4500602.721	640.368	640.400	0.032	0.105
503	492746.136	4501887.744	657.826	657.830	0.004	0.013
504	513036.200	4505160.380	627.683	627.750	0.067	0.220
505	521901.541	4507772.027	615.702	615.670	-0.032	-0.105
506	478340.218	4500920.712	673.459	673.470	0.011	0.036

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
507	504099.197	4500541.790	640.368	640.400	0.032	0.105
508	521901.402	4507815.470	615.779	615.750	-0.029	-0.095
509	513044.403	4505217.203	627.395	627.430	0.035	0.115
510	492746.882	4501932.890	659.098	659.090	-0.008	-0.026
511	504099.230	4500480.798	640.323	640.340	0.017	0.056
512	478340.313	4500878.564	673.369	673.380	0.011	0.036
513	521900.950	4507859.160	615.793	615.740	-0.053	-0.174
514	513048.100	4505279.510	627.371	627.410	0.039	0.128
515	492749.578	4502103.831	660.231	660.240	0.009	0.030
516	478340.122	4500835.818	673.338	673.320	-0.018	-0.059
517	492750.272	4502147.361	659.552	659.540	-0.012	-0.039
518	504099.526	4500419.604	640.268	640.290	0.022	0.072
519	521900.470	4507904.950	615.77	615.710	-0.060	-0.197
520	513048.009	4505339.662	627.409	627.420	0.011	0.036
521	513051.618	4505402.703	627.063	627.070	0.007	0.023
522	492751.191	4502190.469	658.495	658.480	-0.015	-0.049
523	478340.119	4500784.891	673.200	673.200	0.000	0.000
524	504099.930	4500356.230	640.212	640.250	0.038	0.125
525	521900.270	4507948.610	615.446	615.390	-0.056	-0.184
526	521899.478	4507983.697	615.493	615.470	-0.023	-0.075
527	504096.660	4500214.240	640.134	640.190	0.056	0.184
528	513047.884	4505464.838	627.182	627.150	-0.032	-0.105
529	513047.850	4505518.390	628.139	628.100	-0.039	-0.128
530	521898.910	4508042.801	616.755	616.740	-0.015	-0.049
531	504112.036	4504175.130	639.692	639.680	-0.012	-0.039
532	521902.800	4508084.210	616.378	616.330	-0.048	-0.157
533	513056.124	4505591.262	631.092	631.070	-0.022	-0.072
534	504111.720	4504116.557	641.786	641.770	-0.016	-0.052
535	504107.599	4504058.741	644.195	644.190	-0.005	-0.016
536	512847.090	4502273.140	628.619	628.670	0.051	0.167

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
538	521911.639	4507010.700	617.230	617.210	-0.020	-0.066
539	504100.082	4503911.485	644.435	644.430	-0.005	-0.016
540	512844.920	4502333.680	628.796	628.860	0.064	0.210
541	512846.581	4502393.517	628.854	628.890	0.036	0.118
542	504096.200	4503854.904	642.240	642.240	0.000	0.000
543	521912.140	4506963.640	616.918	616.880	-0.038	-0.125
544	512848.000	4502453.110	628.828	628.900	0.072	0.236
545	504097.907	4503799.380	640.724	640.730	0.006	0.020
546	521912.163	4506919.189	616.680	616.650	-0.030	-0.098
547	454363.817	4503149.695	704.857	704.820	-0.037	-0.121
548	512852.663	4502509.593	628.858	628.890	0.032	0.105
549	521912.492	4506872.369	616.448	616.440	-0.008	-0.026
550	504092.519	4503741.217	640.527	640.540	0.013	0.043
552	512850.360	4502571.460	628.892	628.940	0.048	0.157
553	521913.196	4506779.670	616.161	616.170	0.009	0.030
555	512852.497	4502631.345	629.139	629.170	0.031	0.102
556	521913.278	4506732.184	616.087	616.100	0.013	0.043
557	521913.586	4506687.430	616.075	616.080	0.005	0.016
558	504097.007	4503563.198	640.353	640.360	0.007	0.023
559	512854.500	4502692.010	629.340	629.380	0.040	0.131
560	521914.051	4506643.339	616.021	616.020	-0.001	-0.003
562	504093.157	4503506.501	640.394	640.400	0.006	0.020
564	504093.270	4503448.149	640.201	640.210	0.009	0.030
565	521914.195	4506597.573	615.991	615.990	-0.001	-0.003
566	521914.826	4506552.453	615.991	616.000	0.009	0.030
567	504093.511	4503390.482	640.091	640.070	-0.021	-0.069
568	512861.674	4502871.095	629.454	629.470	0.016	0.052
570	504093.724	4503332.425	640.028	640.030	0.002	0.007
571	521914.840	4506504.770	616.008	616.010	0.002	0.007
572	521914.949	4506459.599	615.970	615.960	-0.010	-0.033

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
573	521915.256	4506411.989	615.994	615.990	-0.004	-0.013
574	512868.413	4503043.889	629.222	629.250	0.028	0.092
575	512874.045	4503098.722	628.817	628.840	0.023	0.075
576	521915.262	4506362.190	616.045	616.040	-0.005	-0.016
577	512872.600	4503156.550	628.442	628.480	0.038	0.125
578	521915.638	4506313.999	616.069	616.070	0.001	0.003
579	521916.438	4506267.314	616.139	616.140	0.001	0.003
580	512874.990	4503216.220	628.348	628.410	0.062	0.203
582	512877.150	4503275.710	628.205	628.260	0.055	0.180
583	512879.667	4503336.511	628.139	628.170	0.031	0.102
585	512885.196	4503391.166	628.143	628.180	0.037	0.121
587	512887.800	4503449.610	628.012	628.050	0.038	0.125
590	512886.212	4503510.132	628.028	628.060	0.032	0.105
591	512889.467	4503587.571	628.035	628.050	0.015	0.049
594	512891.937	4503645.524	628.052	628.080	0.028	0.092
596	521911.686	4506434.383	615.964	615.970	0.006	0.020
597	512893.392	4503694.883	628.091	628.110	0.019	0.062
598	521910.764	4506623.396	616.002	616.000	-0.002	-0.007
600	521909.882	4506758.468	616.127	616.120	-0.007	-0.023
601	467907.840	4504753.070	687.239	687.200	-0.039	-0.128
602	512896.180	4503750.250	628.104	628.150	0.046	0.151
603	521909.998	4506829.307	616.243	616.230	-0.013	-0.043
604	467905.631	4504696.902	687.938	687.910	-0.028	-0.092
605	512898.230	4503804.380	628.077	628.130	0.053	0.174
606	512900.410	4503860.010	628.026	628.090	0.064	0.210
607	521908.233	4506988.397	617.035	617.030	-0.005	-0.016
608	467907.020	4504644.807	689.342	689.330	-0.012	-0.039
609	467899.120	4504590.550	691.087	691.040	-0.047	-0.154
610	512903.230	4503930.990	628.070	628.110	0.040	0.131
611	467903.008	4504537.188	692.658	692.630	-0.028	-0.092

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
612	512909.200	4503986.840	628.082	628.120	0.038	0.125
613	467901.870	4504489.678	693.622	693.620	-0.002	-0.007
614	512907.386	4504038.542	628.124	628.160	0.036	0.118
615	512909.460	4504089.660	628.095	628.140	0.045	0.148
616	512911.340	4504140.830	628.052	628.090	0.038	0.125
618	512916.690	4504187.040	628.035	628.080	0.045	0.148
619	467895.352	4504340.354	693.599	693.580	-0.019	-0.062
620	467892.260	4504287.962	692.576	692.550	-0.026	-0.085
621	512915.310	4504238.270	628.165	628.230	0.065	0.213
622	467886.055	4504234.170	690.976	690.940	-0.036	-0.118
623	512917.390	4504291.820	628.403	628.470	0.067	0.220
624	512919.310	4504344.030	628.647	628.720	0.073	0.240
625	467884.753	4504190.183	689.528	689.510	-0.018	-0.059
626	467882.038	4504142.141	688.337	688.310	-0.027	-0.089
627	467878.892	4504092.427	687.527	687.500	-0.027	-0.089
628	467875.186	4504044.130	687.132	687.120	-0.012	-0.039
629	467875.057	4503994.914	687.043	687.040	-0.003	-0.010
630	467872.667	4503945.258	687.002	686.980	-0.022	-0.072
631	467870.851	4503895.822	687.069	687.050	-0.019	-0.062
632	467869.748	4503845.193	687.286	687.270	-0.016	-0.052
633	467869.070	4503793.580	687.683	687.640	-0.043	-0.141
634	467868.283	4503743.262	688.045	688.020	-0.025	-0.082
635	467864.429	4503693.821	688.390	688.360	-0.030	-0.098
642	467859.505	4503338.941	688.339	688.320	-0.019	-0.062
643	467861.899	4503290.451	687.952	687.950	-0.002	-0.007
644	467860.910	4503240.015	687.553	687.540	-0.013	-0.043
645	467860.180	4503191.970	687.136	687.110	-0.026	-0.085
646	467859.344	4503144.045	686.829	686.810	-0.019	-0.062
647	467858.681	4503093.980	686.655	686.630	-0.025	-0.082
648	467858.039	4503043.992	686.535	686.560	0.025	0.082

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
649	467857.346	4502994.071	686.542	686.530	-0.012	-0.039
650	467856.289	4502944.225	686.581	686.590	0.009	0.030
651	467855.692	4502894.152	686.605	686.590	-0.015	-0.049
652	467854.877	4502844.706	686.597	686.590	-0.007	-0.023
653	467854.109	4502789.053	686.594	686.610	0.016	0.052
654	467853.242	4502739.644	686.568	686.580	0.012	0.039
655	467852.549	4502689.746	686.571	686.590	0.019	0.062
656	467851.811	4502637.652	686.615	686.590	-0.025	-0.082
657	467851.081	4502587.412	686.601	686.620	0.019	0.062
658	467850.339	4502537.682	686.619	686.630	0.011	0.036
660	454307.471	4505425.311	705.091	705.080	-0.011	-0.036
661	437499.518	4510661.563	727.925	727.900	-0.025	-0.082
662	437489.724	4510600.273	728.915	728.890	-0.025	-0.082
663	454307.549	4505386.938	704.986	704.980	-0.006	-0.020
664	437484.713	4510533.215	731.177	731.140	-0.037	-0.121
665	454307.973	4505348.885	704.944	704.920	-0.024	-0.079
666	437468.279	4510472.311	733.013	732.980	-0.033	-0.108
667	454308.234	4505311.378	704.870	704.840	-0.030	-0.098
668	437453.940	4510411.850	734.449	734.400	-0.049	-0.161
669	454308.833	4505272.335	704.829	704.820	-0.009	-0.030
671	454309.166	4505233.082	704.784	704.770	-0.014	-0.046
672	437423.910	4510281.220	733.734	733.690	-0.044	-0.144
673	454309.793	4505193.157	704.759	704.760	0.001	0.003
674	437410.322	4510223.041	731.995	731.960	-0.035	-0.115
675	454310.300	4505152.841	704.697	704.680	-0.017	-0.056
676	454310.499	4505114.568	704.621	704.610	-0.011	-0.036
677	437390.650	4510154.090	729.795	729.750	-0.045	-0.148
678	454310.939	4505074.884	704.510	704.480	-0.030	-0.098
679	437372.646	4510098.352	728.451	728.430	-0.021	-0.069
680	437350.559	4510040.909	728.227	728.200	-0.027	-0.089

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
681	454311.402	4505035.536	704.468	704.440	-0.028	-0.092
682	454311.834	4504995.362	704.358	704.340	-0.018	-0.059
683	437326.931	4509984.583	728.407	728.380	-0.027	-0.089
684	454312.369	4504956.008	704.350	704.320	-0.030	-0.098
685	437307.030	4509927.200	728.553	728.510	-0.043	-0.141
686	454312.730	4504915.850	704.298	704.260	-0.038	-0.125
687	437285.150	4509869.003	728.683	728.650	-0.033	-0.108
688	437257.880	4509808.470	728.749	728.710	-0.039	-0.128
689	454313.480	4504875.330	704.151	704.110	-0.041	-0.135
690	437234.960	4509748.960	728.949	728.900	-0.049	-0.161
691	454314.420	4504837.000	704.379	704.340	-0.039	-0.128
692	454317.220	4504797.100	705.232	705.190	-0.042	-0.138
693	437086.381	4509387.059	729.082	729.060	-0.022	-0.072
694	454317.666	4504758.213	706.796	706.760	-0.036	-0.118
695	437060.870	4509326.200	728.951	728.900	-0.051	-0.167
696	454318.130	4504717.980	708.726	708.68	-0.046	-0.151
697	437031.535	4509269.329	728.725	728.690	-0.035	-0.115
698	454311.698	4504680.221	710.268	710.240	-0.028	-0.092
699	437007.101	4509214.972	729.122	729.100	-0.022	-0.072
700	454316.330	4504556.660	710.725	710.660	-0.065	-0.213
701	436966.801	4509166.283	729.059	729.040	-0.019	-0.062
702	454319.850	4504516.800	709.372	709.310	-0.062	-0.203
703	436920.040	4509120.758	729.012	729.000	-0.012	-0.039
704	436872.385	4509080.994	729.119	729.110	-0.009	-0.030
705	454310.640	4504438.430	705.803	705.710	-0.093	-0.305
706	436818.543	4509046.592	729.169	729.150	-0.019	-0.062
707	436776.0270	4509024.923	729.176	729.160	-0.016	-0.052
708	454307.970	4504400.100	704.687	704.620	-0.067	-0.220
709	454318.320	4504361.470	704.175	704.090	-0.085	-0.279
710	436731.529	4509006.111	728.946	728.920	-0.026	-0.085

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
711	454318.570	4504320.760	704.169	704.100	-0.069	-0.226
712	436686.368	4509002.364	728.670	728.660	-0.010	-0.033
713	454318.920	4504282.170	704.396	704.340	-0.056	-0.184
714	436642.053	4508984.416	728.661	728.650	-0.011	-0.036
715	436597.198	4508967.391	728.625	728.620	-0.005	-0.016
716	454319.910	4504243.51	704.506	704.460	-0.046	-0.151
717	454321.110	4504204.67	704.510	704.450	-0.060	-0.197
718	436551.314	4508954.332	728.572	728.550	-0.022	-0.072
719	454322.000	4504163.400	704.522	704.480	-0.042	-0.138
720	436504.503	4508945.510	728.596	728.580	-0.016	-0.052
721	454323.630	4504124.460	704.565	704.520	-0.045	-0.148
722	436456.912	4508941.047	728.726	728.710	-0.016	-0.052
723	454325.940	4504085.380	704.597	704.530	-0.067	-0.220
724	436397.000	4508940.535	728.775	728.760	-0.015	-0.049
725	454327.658	4504043.586	704.597	704.590	-0.007	-0.023
726	436333.184	4508941.444	728.768	728.750	-0.018	-0.059
727	454329.572	4504002.853	704.668	704.640	-0.028	-0.092
728	436269.365	4508942.025	728.731	728.720	-0.011	-0.036
729	436205.548	4508942.743	728.681	728.660	-0.021	-0.069
730	454331.549	4503966.047	704.743	704.730	-0.013	-0.043
731	436142.107	4508943.365	728.730	728.700	-0.030	-0.098
732	454333.060	4503927.690	704.882	704.840	-0.042	-0.138
733	436083.294	4508940.816	728.799	728.770	-0.029	-0.095
734	454334.860	4503888.190	705.015	704.970	-0.045	-0.148
735	454337.156	4503849.469	705.158	705.130	-0.028	-0.092
736	436023.958	4508941.278	728.806	728.790	-0.016	-0.052
737	454338.560	4503810.690	705.374	705.330	-0.044	-0.144
738	435964.997	4508941.858	728.903	728.880	-0.023	-0.075
739	454340.576	4503771.981	705.517	705.480	-0.037	-0.121
740	435907.635	4508942.417	729.026	729.010	-0.016	-0.052

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
741	454342.347	4503732.234	705.662	705.640	-0.022	-0.072
742	435849.178	4508943.465	729.061	729.070	0.009	0.030
743	454344.076	4503693.685	705.748	705.730	-0.018	-0.059
744	435790.756	4508947.466	729.081	729.080	-0.001	-0.003
746	435734.284	4508944.997	729.249	729.250	0.001	0.003
747	435674.164	4508945.809	729.365	729.350	-0.015	-0.049
749	435618.137	4508946.621	729.360	729.350	-0.010	-0.033
751	435560.407	4508947.494	729.473	729.450	-0.023	-0.075
753	435501.394	4508948.293	729.631	729.620	-0.011	-0.036
754	435444.750	4508949.292	729.695	729.690	-0.005	-0.016
756	435385.780	4508950.056	729.779	729.780	0.001	0.003
758	435328.739	4508954.075	729.743	729.750	0.007	0.023
760	454356.410	4503366.268	705.738	705.730	-0.008	-0.026
761	435269.427	4508951.603	729.931	729.930	-0.001	-0.003
762	454358.020	4503327.410	705.608	705.580	-0.028	-0.092
763	435211.495	4508952.527	730.036	730.020	-0.016	-0.052
764	454359.840	4503284.230	705.450	705.390	-0.060	-0.197
765	435153.052	4508956.488	730.176	730.160	-0.016	-0.052
766	454361.375	4503240.614	705.230	705.210	-0.020	-0.066
767	435105.027	4508957.258	730.161	730.150	-0.011	-0.036
768	454362.820	4503193.200	705.056	705.010	-0.046	-0.151
769	435054.532	4508954.920	730.313	730.290	-0.023	-0.075
770	435003.552	4508955.909	730.419	730.400	-0.019	-0.062
771	454361.166	4503108.103	704.661	704.630	-0.031	-0.102
773	454360.746	4503061.868	704.452	704.420	-0.032	-0.105
776	454360.184	4503018.202	704.325	704.290	-0.035	-0.115
777	454359.848	4502976.401	704.233	704.220	-0.013	-0.043
779	454359.051	4502933.570	704.190	704.170	-0.020	-0.066
781	454359.150	4502878.480	704.264	704.210	-0.054	-0.177
784	454361.258	4502836.213	704.222	704.220	-0.002	-0.007

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
785	454360.700	4502795.300	703.973	703.960	-0.013	-0.043
787	454360.589	4502752.852	703.869	703.880	0.011	0.036
788	454359.960	4502711.395	703.909	703.900	-0.009	-0.030
789	454359.302	4502668.683	703.891	703.900	0.009	0.030
790	454358.987	4502626.490	703.972	703.960	-0.012	-0.039
791	454358.293	4502584.891	704.015	704.000	-0.015	-0.049
792	454357.379	4502500.066	703.799	703.790	-0.009	-0.030
793	454357.114	4502456.189	703.746	703.750	0.004	0.013
794	454356.599	4502412.719	703.619	703.640	0.021	0.069

Appendix C – Fall 2023 Ground Survey Point Tables

Table 20: Non-vegetated vertical accuracy – Fall 2023 lidar data vs. Fall 2023 ground survey points

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
1	560112.870	4525782.990	560.741	560.710	-0.031	-0.102
2	560130.711	4525712.113	560.758	560.740	-0.018	-0.059
3	560153.618	4525621.904	560.835	560.820	-0.015	-0.049
4	560173.509	4525543.160	560.905	560.900	-0.005	-0.016
5	560197.892	4525447.794	561.297	561.290	-0.007	-0.023
6	560221.667	4525364.905	561.553	561.570	0.0170	0.056
7	560262.605	4525266.456	561.914	561.920	0.006	0.020
8	560321.227	4525168.018	562.492	562.510	0.018	0.059
9	560430.019	4525041.768	563.208	563.210	0.002	0.007
12	560704.963	4524783.251	563.236	563.230	-0.006	-0.020
13	560806.327	4524698.074	562.849	562.850	0.001	0.003
14	560899.708	4524640.178	562.688	562.670	-0.018	-0.059
15	561033.230	4524577.944	562.640	562.630	-0.010	-0.033
16	561097.080	4524557.770	563.141	563.100	-0.041	-0.135
17	561157.670	4524542.580	564.281	564.240	-0.041	-0.135
18	561213.780	4524540.440	565.684	565.660	-0.024	-0.079
19	560872.090	4524666.840	562.279	562.310	0.031	0.102
20	560769.190	4524739.680	562.530	562.570	0.040	0.131
21	560464.110	4525027.200	562.991	563.040	0.049	0.161
22	560449.510	4525036.920	563.136	563.080	-0.056	-0.184
23	560355.300	4525136.300	562.489	562.410	-0.079	-0.259
24	560282.730	4525245.850	561.759	561.700	-0.059	-0.194
25	572159.45	4537321.240	542.043	542.090	0.047	0.154
26	572120.200	4537357.180	542.132	542.180	0.048	0.157
31	571863.496	4537588.455	541.913	541.920	0.007	0.023

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
32	571810.922	4537635.335	541.655	541.660	0.005	0.016
33	571759.323	4537681.623	541.300	541.280	-0.020	-0.066
34	571691.299	4537745.313	540.785	540.770	-0.015	-0.049
35	571661.800	4537780.460	540.493	540.430	-0.063	-0.207
36	571637.467	4537821.171	540.214	540.200	-0.014	-0.046
37	571606.329	4537885.567	540.017	540.000	-0.017	-0.056
38	571586.867	4537965.634	539.919	539.910	-0.009	-0.030
39	571575.479	4538026.417	539.994	539.980	-0.014	-0.046
40	571563.625	4538089.112	540.021	540.000	-0.021	-0.069
41	571553.094	4538146.037	539.994	539.980	-0.014	-0.046
42	571538.859	4538218.975	540.086	540.070	-0.016	-0.052
44	571520.040	4538329.880	539.945	539.920	-0.025	-0.082
45	571510.370	4538411.370	539.688	539.660	-0.028	-0.092
46	571507.997	4538507.915	539.594	539.590	-0.004	-0.013
47	571507.430	4538601.420	539.740	539.710	-0.030	-0.098
48	571506.760	4538692.960	539.717	539.680	-0.037	-0.121
49	571505.726	4538859.434	539.800	539.790	-0.010	-0.033
50	571505.758	4538909.789	539.783	539.770	-0.013	-0.043
51	571505.410	4538963.870	539.804	539.780	-0.024	-0.079
52	534891.100	4511320.780	598.724	598.700	-0.024	-0.079
53	534917.577	4511239.597	599.036	599.030	-0.006	-0.020
54	534945.031	4511152.071	599.883	599.860	-0.023	-0.075
57	535049.790	4510831.800	599.287	599.250	-0.037	-0.121
58	535084.217	4510731.479	598.574	598.550	-0.024	-0.079
59	535117.724	4510606.489	598.657	598.660	0.003	0.010
60	535138.260	4510521.260	598.095	598.120	0.025	0.082
61	535160.690	4510417.920	597.798	597.830	0.032	0.105
62	535185.860	4510319.211	597.905	597.920	0.015	0.049
63	535208.989	4510223.108	597.801	597.810	0.009	0.030
64	535223.895	4510159.465	597.732	597.740	0.008	0.026

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
65	535237.008	4510105.128	597.714	597.710	-0.004	-0.013
66	535254.301	4510031.958	597.693	597.680	-0.013	-0.043
67	535274.820	4509946.480	597.849	597.820	-0.029	-0.095
68	535107.740	4510656.410	598.742	598.700	-0.042	-0.138
69	535069.830	4510782.900	598.867	598.820	-0.047	-0.154
70	559983.420	4526167.810	561.045	560.990	-0.055	-0.180
71	560007.370	4526126.750	560.932	560.880	-0.052	-0.171
72	560046.170	4526037.810	560.815	560.750	-0.065	-0.213
73	572280.950	4537214.390	542.017	541.950	-0.067	-0.220
74	572241.760	4537247.550	541.817	541.740	-0.077	-0.253
75	534756.830	4512231.580	598.051	598.000	-0.051	-0.167
76	534759.980	4512165.570	598.050	597.990	-0.060	-0.197
77	534755.470	4512097.800	598.058	598.010	-0.048	-0.157
78	534748.200	4512036.970	598.073	598.000	-0.073	-0.240
79	534739.990	4511972.130	598.080	598.040	-0.040	-0.131
80	534728.310	4511890.470	598.545	598.480	-0.065	-0.213
81	534734.630	4511827.460	598.897	598.860	-0.037	-0.121
82	534754.640	4511730.660	599.743	599.710	-0.033	-0.108
85	534822.327	4511530.471	599.410	599.390	-0.020	-0.066
86	534853.380	4511436.000	598.761	598.720	-0.041	-0.135
87	542710.982	4516256.159	586.574	586.570	-0.004	-0.013
88	542709.250	4516157.330	586.837	586.800	-0.037	-0.121
89	542707.190	4516070.650	586.770	586.730	-0.040	-0.131
90	542720.410	4515957.820	587.721	587.670	-0.051	-0.167
93	542752.672	4515717.160	587.657	587.650	-0.007	-0.023
94	542765.955	4515618.205	587.742	587.740	-0.002	-0.007
95	542783.742	4515482.076	587.933	587.910	-0.023	-0.075
96	542797.560	4515375.170	587.794	587.770	-0.024	-0.079
97	542817.890	4515141.790	587.954	587.910	-0.044	-0.144
98	542817.540	4515005.970	587.798	587.760	-0.038	-0.125

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
99	542815.890	4514844.870	587.770	587.710	-0.060	-0.197
100	542816.200	4514723.570	587.882	587.840	-0.042	-0.138
101	542814.030	4514593.840	587.914	587.880	-0.034	-0.112
103	542812.950	4514396.490	587.905	587.830	-0.075	-0.246
104	542811.820	4514312.560	587.925	587.890	-0.035	-0.115
105	542810.370	4514208.890	587.874	587.830	-0.044	-0.144
106	542808.320	4514031.850	587.827	587.790	-0.037	-0.121
107	542806.660	4513904.050	587.954	587.900	-0.054	-0.177
108	542805.220	4513797.150	588.194	588.140	-0.054	-0.177
109	542805.190	4513683.170	588.543	588.510	-0.033	-0.108
112	542809.643	4513208.243	588.714	588.700	-0.014	-0.046
113	542812.530	4512974.280	588.361	588.310	-0.051	-0.167
114	542814.090	4512805.300	588.446	588.400	-0.046	-0.151
115	542815.710	4512644.870	588.204	588.150	-0.054	-0.177
116	552386.681	4520658.732	573.111	573.090	-0.021	-0.069
117	552387.628	4520554.138	572.953	572.930	-0.023	-0.075
118	552388.500	4520459.470	573.083	573.050	-0.033	-0.108
119	552389.270	4520323.320	573.932	573.900	-0.032	-0.105
120	552392.290	4520171.750	575.203	575.160	-0.043	-0.141
122	552395.570	4519843.740	575.958	575.900	-0.058	-0.190
123	552394.710	4519743.650	575.943	575.910	-0.033	-0.108
125	552399.041	4519379.699	576.090	576.070	-0.020	-0.066
126	552401.862	4519219.653	578.687	578.670	-0.017	-0.056
127	552402.955	4519081.198	581.188	581.180	-0.008	-0.026
128	552401.141	4518910.275	581.415	581.420	0.005	0.016
129	552405.232	4518802.051	579.890	579.870	-0.020	-0.066
130	552407.340	4518599.740	576.789	576.800	0.011	0.036
132	552410.950	4518233.390	576.245	576.220	-0.025	-0.082
133	552412.236	4518047.681	576.320	576.310	-0.010	-0.033
134	552412.739	4517885.688	576.872	576.850	-0.022	-0.072

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
135	552412.603	4517710.742	577.066	577.050	-0.016	-0.052
136	552415.674	4517517.076	576.320	576.310	-0.010	-0.033
137	552416.940	4517359.750	575.710	575.660	-0.050	-0.164
138	552417.490	4517138.140	576.935	576.900	-0.035	-0.115
140	552420.550	4516876.730	577.040	577.000	-0.040	-0.131
141	552421.160	4516746.230	576.217	576.190	-0.027	-0.089
142	552423.056	4516618.190	575.566	575.550	-0.016	-0.052
143	552423.500	4516525.290	575.583	575.550	-0.033	-0.108
144	552424.460	4516420.610	575.749	575.720	-0.029	-0.095
245	504101.908	4500422.933	640.249	640.230	-0.019	-0.062
246	492827.310	4500051.940	654.076	654.050	-0.026	-0.085
247	492799.830	4500049.180	654.272	654.230	-0.042	-0.138
248	504101.126	4500501.091	640.367	640.360	-0.007	-0.023
249	504100.888	4500612.536	640.401	640.380	-0.021	-0.069
250	492786.720	4500099.970	654.180	654.150	-0.030	-0.098
251	492762.636	4500224.845	653.963	653.950	-0.013	-0.043
252	504100.740	4500707.780	640.495	640.460	-0.035	-0.115
253	504100.411	4500835.714	640.630	640.610	-0.020	-0.066
254	492728.480	4500305.481	654.488	654.500	0.012	0.039
256	492716.403	4500396.446	654.843	654.840	-0.003	-0.010
258	492709.929	4500499.713	655.451	655.470	0.019	0.062
259	492710.355	4500598.481	655.922	655.940	0.018	0.059
260	504100.282	4501171.229	640.692	640.670	-0.022	-0.072
262	504099.360	4501294.290	640.435	640.420	-0.015	-0.049
263	504099.325	4501379.556	640.330	640.320	-0.010	-0.033
265	504098.890	4501463.767	640.355	640.340	-0.015	-0.049
266	504098.884	4501595.749	640.219	640.220	0.001	0.003
267	492717.110	4501009.350	655.464	655.440	-0.024	-0.079
268	492713.096	4501096.990	654.924	654.920	-0.004	-0.013
269	504098.664	4501699.004	640.149	640.130	-0.019	-0.062

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
270	492710.027	4501164.890	654.765	654.750	-0.015	-0.049
271	504098.436	4501804.184	640.111	640.120	0.009	0.030
272	504097.836	4501914.653	640.136	640.150	0.014	0.046
273	492709.289	4501215.068	654.654	654.650	-0.004	-0.013
274	504097.801	4502015.990	640.131	640.150	0.019	0.062
275	492704.457	4501288.561	654.165	654.160	-0.005	-0.016
276	504097.607	4502131.524	640.107	640.130	0.023	0.075
277	492711.097	4501379.577	654.245	654.250	0.005	0.016
278	504097.503	4502273.049	640.033	640.040	0.007	0.023
279	492712.397	4501470.676	654.243	654.240	-0.003	-0.010
280	492707.470	4501531.949	654.069	654.060	-0.009	-0.030
281	504097.060	4502414.641	640.012	640.000	-0.012	-0.039
282	492686.852	4501612.111	654.009	654.000	-0.009	-0.030
283	504096.854	4502503.367	640.042	640.040	-0.002	-0.007
284	504098.135	4502625.342	639.993	639.980	-0.013	-0.043
285	492688.901	4501685.229	654.214	654.210	-0.004	-0.013
286	492714.736	4501734.682	654.433	654.420	-0.013	-0.043
287	504096.239	4502755.705	640.095	640.080	-0.015	-0.049
288	492716.472	4501815.785	655.879	655.880	0.001	0.003
289	504097.384	4503044.927	639.962	639.960	-0.002	-0.007
290	492713.637	4501856.281	656.866	656.860	-0.006	-0.020
291	492719.497	4501926.035	658.979	658.990	0.011	0.036
292	504095.850	4503203.720	639.955	639.930	-0.025	-0.082
293	504095.897	4503382.853	640.032	640.010	-0.022	-0.072
294	492720.321	4501995.150	660.233	660.220	-0.013	-0.043
295	504095.129	4503528.416	640.404	640.390	-0.014	-0.046
296	492734.984	4501434.696	654.310	654.300	-0.010	-0.033
297	492742.000	4501286.418	654.243	654.230	-0.013	-0.043
299	492729.749	4501131.665	654.726	654.710	-0.016	-0.052
300	504099.280	4503879.005	643.208	643.200	-0.008	-0.026

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
303	504119.439	4504153.487	640.299	640.280	-0.019	-0.062
305	492719.826	4500573.280	655.791	655.780	-0.011	-0.036
306	504122.764	4504219.630	638.895	638.910	0.015	0.049
307	513045.780	4506002.790	626.819	626.790	-0.029	-0.095
308	492719.626	4500477.006	655.010	655.020	0.010	0.033
309	492732.358	4500327.426	654.368	654.350	-0.018	-0.059
310	513045.510	4505939.840	626.941	626.890	-0.051	-0.167
311	492768.340	4500228.600	653.816	653.790	-0.026	-0.085
312	513047.050	4505808.760	631.191	631.150	-0.041	-0.135
313	492827.870	4500226.200	654.097	654.070	-0.027	-0.089
314	513047.060	4505596.880	631.437	631.400	-0.037	-0.121
315	492830.280	4500177.510	654.095	654.070	-0.025	-0.082
316	513046.210	4505457.900	627.116	627.090	-0.026	-0.085
317	492828.560	4500140.860	654.078	654.050	-0.028	-0.092
318	492827.840	4500101.430	654.119	654.090	-0.029	-0.095
319	513048.930	4505323.980	627.590	627.550	-0.040	-0.131
320	492827.690	4500072.980	654.120	654.090	-0.030	-0.098
321	513043.400	4505206.790	627.538	627.480	-0.058	-0.190
322	478335.836	4501054.366	673.469	673.470	0.001	0.003
323	512990.990	4505053.210	627.909	627.870	-0.039	-0.128
324	478340.234	4501008.445	673.477	673.500	0.023	0.075
325	512947.620	4504929.910	628.166	628.110	-0.056	-0.184
326	478340.680	4500962.636	673.482	673.490	0.008	0.026
327	512937.440	4504788.460	628.125	628.100	-0.025	-0.082
328	478340.160	4500911.990	673.479	673.450	-0.029	-0.095
329	512931.150	4504640.250	628.512	628.470	-0.042	-0.138
330	478339.930	4500870.770	673.416	673.380	-0.036	-0.118
332	478340.240	4500821.520	673.307	673.280	-0.027	-0.089
333	512924.256	4504454.728	629.051	629.030	-0.021	-0.069
334	512920.055	4504351.742	628.780	628.770	-0.010	-0.033

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
335	478339.123	4501143.495	673.458	673.470	0.012	0.039
336	512913.904	4504189.743	628.096	628.080	-0.016	-0.052
337	512909.317	4504067.888	628.156	628.160	0.004	0.013
338	478345.690	4501313.390	673.534	673.560	0.026	0.085
339	478347.953	4501377.621	673.486	673.490	0.004	0.013
340	512903.963	4503941.742	628.113	628.120	0.007	0.023
341	478351.670	4501469.750	673.448	673.420	-0.028	-0.092
342	512898.926	4503803.630	628.146	628.140	-0.006	-0.020
343	478355.390	4501574.610	673.777	673.750	-0.027	-0.089
344	512894.117	4503691.622	628.121	628.140	0.019	0.062
345	512890.361	4503586.259	628.046	628.060	0.014	0.046
347	512883.584	4503434.628	628.040	628.060	0.020	0.066
350	512878.182	4503281.305	628.263	628.260	-0.003	-0.010
351	512872.257	4503120.037	628.675	628.670	-0.005	-0.016
352	478367.770	4501896.541	673.817	673.820	0.003	0.010
354	478370.426	4501961.663	673.576	673.600	0.024	0.079
356	478374.146	4502064.704	673.529	673.550	0.021	0.069
357	478375.435	4502097.262	673.554	673.560	0.006	0.020
359	512852.350	4502613.990	629.142	629.110	-0.032	-0.105
360	478377.136	4502135.722	673.567	673.560	-0.007	-0.023
361	478380.250	4502223.960	673.513	673.540	0.027	0.089
362	512844.158	4502252.189	628.579	628.560	-0.019	-0.062
363	478383.643	4502316.304	673.570	673.570	0.000	0.000
364	521899.290	4507946.500	615.418	615.380	-0.038	-0.125
365	478387.150	4502413.860	673.621	673.590	-0.031	-0.102
366	478387.621	4502506.200	673.572	673.550	-0.022	-0.072
367	521900.490	4507897.480	615.762	615.720	-0.042	-0.138
368	521898.410	4507840.610	615.748	615.720	-0.028	-0.092
369	478385.017	4502610.437	673.729	673.730	0.001	0.003
370	478388.513	4502669.906	675.940	675.960	0.020	0.066

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
371	521898.615	4507781.742	615.659	615.640	-0.019	-0.062
372	478388.936	4502731.556	678.567	678.570	0.003	0.010
373	521901.800	4507703.810	615.879	615.830	-0.049	-0.161
374	521904.148	4507602.488	615.974	615.950	-0.024	-0.079
376	521904.466	4507551.809	616.139	616.120	-0.019	-0.062
377	478360.251	4501512.088	673.354	673.350	-0.004	-0.013
378	521904.802	4507481.882	616.508	616.490	-0.018	-0.059
379	478356.141	4501440.899	673.346	673.360	0.014	0.046
380	521906.010	4507391.100	617.039	617.030	-0.009	-0.030
384	521908.182	4507053.293	617.235	617.240	0.005	0.016
385	521909.810	4506931.048	616.733	616.710	-0.023	-0.075
386	521909.875	4506877.577	616.451	616.470	0.019	0.062
387	521910.082	4506831.751	616.233	616.240	0.007	0.023
388	521910.566	4506789.227	616.173	616.190	0.017	0.056
389	521910.964	4506731.163	616.094	616.100	0.006	0.020
390	521910.787	4506685.828	616.067	616.080	0.013	0.043
391	521911.678	4506621.342	615.997	616.010	0.013	0.043
392	521911.924	4506559.400	615.978	615.990	0.012	0.039
393	521911.875	4506515.351	615.987	616.000	0.013	0.043
394	521912.470	4506460.978	615.963	615.970	0.007	0.023
395	521912.842	4506411.432	615.974	615.990	0.016	0.052
396	521913.172	4506340.441	616.037	616.050	0.013	0.043
397	521913.443	4506294.447	616.097	616.080	-0.017	-0.056
399	454357.819	4502607.779	704.032	704.030	-0.002	-0.007
400	454358.969	4502706.612	703.916	703.910	-0.006	-0.020
401	454360.883	4502868.366	704.253	704.230	-0.023	-0.075
402	454363.810	4503019.860	704.328	704.300	-0.028	-0.092
403	454362.227	4503209.624	705.088	705.090	0.002	0.007
404	454359.449	4503278.719	705.382	705.370	-0.012	-0.039
405	454357.706	4503343.037	705.635	705.640	0.005	0.016

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
409	454340.311	4503757.473	705.556	705.560	0.004	0.013
410	454337.478	4503822.159	705.274	705.280	0.006	0.020
411	454334.992	4503878.006	705.018	705.000	-0.018	-0.059
412	454332.371	4503931.310	704.856	704.850	-0.006	-0.020
413	454328.835	4504008.124	704.646	704.650	0.004	0.013
414	454324.591	4504107.431	704.531	704.530	-0.001	-0.003
415	454321.890	4504157.620	704.514	704.480	-0.034	-0.112
416	454320.110	4504233.995	704.471	704.460	-0.011	-0.036
417	454322.888	4504311.142	704.100	704.100	0.000	0.000
418	454318.710	4504370.447	704.153	704.150	-0.003	-0.010
419	454321.530	4504412.970	704.935	704.890	-0.045	-0.148
420	454317.923	4504470.800	707.236	707.230	-0.006	-0.020
421	454319.114	4504518.139	709.391	709.380	-0.011	-0.036
422	454316.668	4504560.748	710.743	710.740	-0.003	-0.010
424	454315.790	4504647.950	710.952	710.820	-0.132	-0.433
425	454308.895	4504871.385	704.070	704.080	0.010	0.033
426	454307.390	4504808.650	704.843	704.870	0.027	0.089
427	454310.785	4504738.901	707.737	707.740	0.003	0.010
428	437478.785	4510511.452	731.755	731.750	-0.005	-0.016
429	437470.597	4510473.316	732.987	732.990	0.003	0.010
430	437461.450	4510437.448	733.906	733.910	0.004	0.013
432	437434.362	4510321.106	734.504	734.520	0.016	0.052
433	437405.838	4510197.430	731.238	731.240	0.002	0.007
434	437383.160	4510123.398	728.961	728.970	0.009	0.030
435	437357.634	4510053.574	728.223	728.230	0.007	0.023
436	437324.664	4509980.848	728.364	728.360	-0.004	-0.013
437	437294.811	4509900.478	728.522	728.530	0.008	0.026
438	437265.643	4509823.463	728.735	728.750	0.015	0.049
439	437236.120	4509748.927	728.957	728.960	0.003	0.010
441	437073.300	4509356.200	728.904	728.930	0.026	0.085

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
442	437034.717	4509271.054	728.799	728.820	0.021	0.069
443	436976.780	4509189.860	728.664	728.690	0.026	0.085
444	436934.470	4509145.310	728.592	728.620	0.028	0.092
445	436885.730	4509103.230	728.583	728.610	0.027	0.089
446	436824.710	4509062.770	728.572	728.600	0.028	0.092
447	436776.350	4509037.810	728.605	728.650	0.045	0.148
448	436715.370	4509012.210	728.706	728.740	0.034	0.112
449	436646.480	4508984.490	728.695	728.730	0.035	0.115
450	436582.620	4508961.550	728.629	728.660	0.031	0.102
451	436503.830	4508943.949	728.647	728.660	0.013	0.043
452	436444.510	4508939.180	728.788	728.830	0.042	0.138
453	436381.970	4508939.280	728.767	728.800	0.033	0.108
454	436312.560	4508939.940	728.772	728.810	0.038	0.125
455	436238.720	4508940.769	728.735	728.750	0.015	0.049
456	436109.540	4508942.230	728.728	728.760	0.032	0.105
457	467903.395	4504609.161	690.493	690.480	-0.013	-0.043
458	467902.645	4504512.339	693.167	693.180	0.013	0.043
460	467887.086	4504260.581	691.714	691.730	0.016	0.052
461	467882.194	4504113.320	687.852	687.870	0.018	0.059
462	467871.858	4504035.657	686.967	686.980	0.013	0.043
463	467864.373	4503870.529	686.882	686.890	0.008	0.026
464	467867.860	4503782.430	687.685	687.720	0.035	0.115
465	467864.880	4503710.440	688.209	688.250	0.041	0.135
470	467860.470	4503342.817	688.360	688.380	0.020	0.066
471	467859.833	4503286.446	687.855	687.870	0.015	0.049
472	467858.629	4503228.174	687.362	687.380	0.018	0.059
473	467857.238	4503147.995	686.784	686.770	-0.014	-0.046
474	467856.310	4503081.500	686.543	686.570	0.027	0.089
475	467855.230	4503000.168	686.511	686.510	-0.001	-0.003
476	467852.000	4502962.200	686.390	686.420	0.030	0.098

Number	Easting	Northing	Known Z	Laser Z	Dz (meters)	Dz (feet)
477	467853.843	4502902.263	686.527	686.550	0.023	0.075
478	467852.938	4502847.231	686.518	686.540	0.022	0.072
479	467852.258	4502795.995	686.540	686.560	0.020	0.066
480	467851.048	4502734.499	686.527	686.520	-0.007	-0.023
481	467859.863	4502818.698	686.547	686.570	0.023	0.075
482	467860.270	4502844.490	686.533	686.560	0.027	0.089
483	467860.417	4502874.810	686.552	686.550	-0.002	-0.007
484	467861.022	4502908.509	686.558	686.560	0.002	0.007
485	467858.300	4502758.850	686.553	686.580	0.027	0.089