



Lidar Accuracy Report

USGS CONTRACT: G16PC00029
CONTRACTOR: Merrick-Surdex JV
TASK ORDER NUMBER: G17PD00237
TASK NAME: MO_Saint_Louis Lidar Project

GOVERNMENT POINT-OF-CONTACT (POC):
POC Name: Gail Dunn
Address: USGS/NGTOC (USGS)
MS 663
1400 Independence Road
Rolla, MO 65401
Office Phone: (573) 308-3756
Fax: (573) 308-3810
E-mail: gdunn@usgs.gov

TOTAL AWARD: \$147,656.59 (Fixed Price)

CONTRACTOR PROJECT MANAGER:
PM Name: Doug Jacoby
Subcontractor Firm: Merrick-Surdex Joint Venture, LLP (JV)
Address: 5970 Greenwood Plaza Blvd.
Greenwood Village, CO 80111
Office Phone/Fax: (303) 353-3903
Cell Phone: (303) 521-6522
E-mail: doug.jacoby@merrick.com

CONTRACTOR JOB NUMBER: 2700110

Project Overview

The St. Louis District of the United States Army Corps of Engineers (USACE) contracted with Surdex Corporation in the winter of 2017 to collect high resolution Lidar elevation data over St. Louis City and St. Louis County as part of the MO Saint Louis Lidar Project. The project combines the varied interests of the USGS, the St. Louis Metropolitan Sewer District and some small City Governments totaling over 626 square miles of coverage. Processing of the Lidar data and bare-earth model followed USGS Base Lidar Specifications V1.2 standards. Surdex tested that the deliverables meet or exceed accuracy as stated in NDEP Guidelines for digital elevation data, Version 1.0 for NSSDA of 95% confidence for 1' contours and ASPRS Class I Standards. Non-vegetated (bare earth) survey control points were collected by Surdex in order to calibrate the swath LAS data, these values are listed in the table on page 3. In addition, independent survey check points were collected on non-vegetated (NVA) features such as concrete, asphalt and gravel along with vegetated (VVA) points in tall grass, brush & trees for each delivery area. The survey check points were compared to both the Unclassified swath LAS Lidar data & bare-earth DEM and the differences have been outlined on page 6.

In order to meet the project specifications the NVA of bare-earth points for swath and the DEM will meet or exceed 10.0 centimeters RMSEz or less. The RMSEz was calculated as the square root of the average of the set of squared differences between the bare-earth and the survey points collected for the NVA features. Also, 95 percent of the NVA features should be $\leq 1.96 \times \text{RMSEz}$, which equals 19.6 centimeters or less NSSDA. The VVA measured against the DEM data will be $\leq 29.4\text{cm}$ @ the 95th percentile. The final results for this delivery area are listed on the last page of this report.

Delivery Area

This report covers the collection and processing of Lidar elevation data over the St. Louis City and St. Louis County in Missouri. The project limits are presented in the graphics below. The project area consisted of approximately 626 square miles of elevation data.

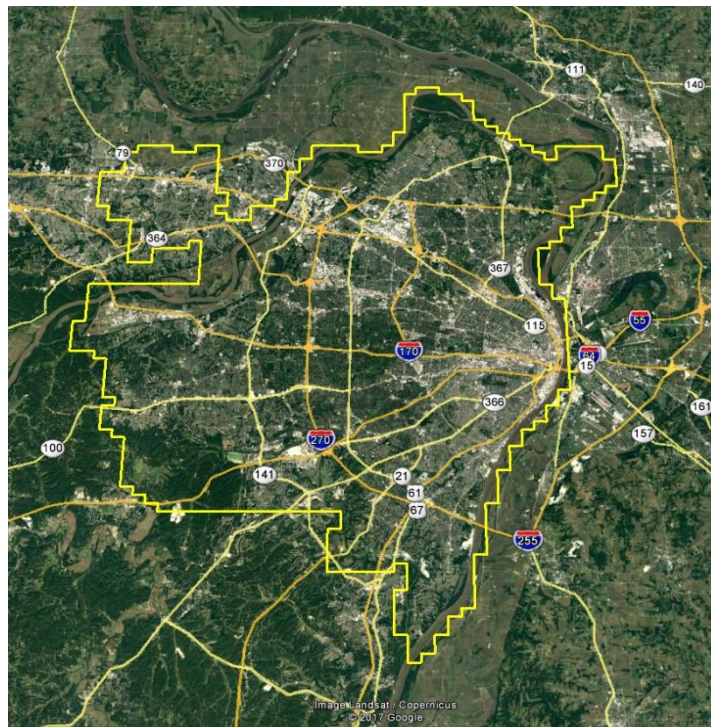


Figure 1 St. Louis City and St. Louis Co. Project Area

Lidar Data Collection

The Lidar elevation data for this project was collected with an Optech Galaxy Aerial Lidar sensor system. The project design called for acquisition of Lidar data with lines flown north-south. The nominal collection scenario called for the acquisition of nominal point spacing of 0.71 meter on the ground.

Swath Lidar Control

The field survey control for this delivery consisted of 35 NVA control points used for calibrating the unclassified Lidar swath data. The graphic below presents these control points on the delivery area map.

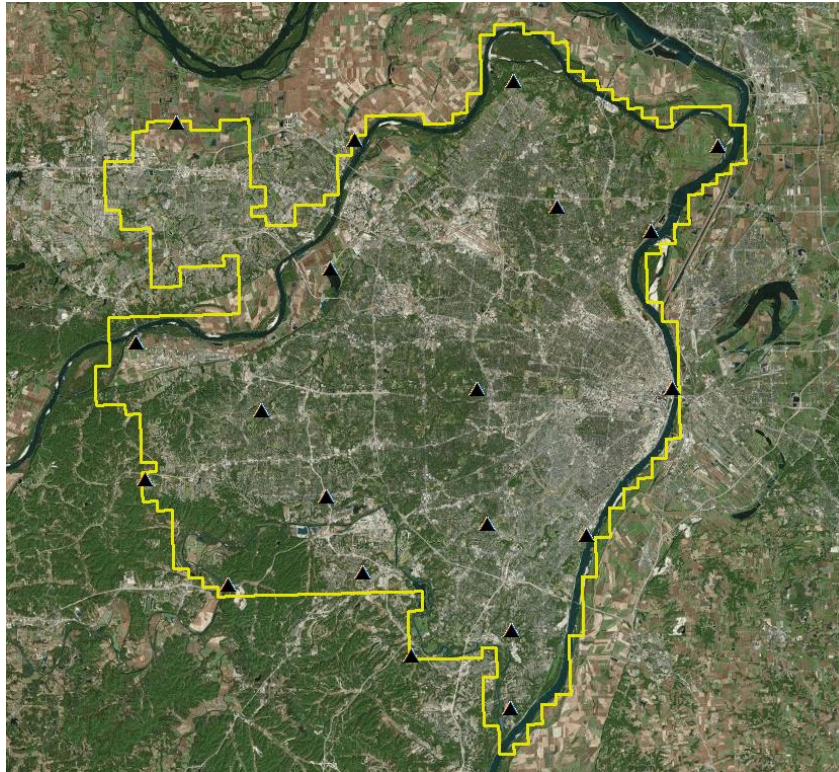


Figure 2 St. Louis City and St. Louis Co. Swath Lidar Control

Swath Lidar Control Accuracy Results

The table below presents the results of the control accuracy analysis for the St. Louis City and St. Louis County unclassified swath LAS data.

Stat	NVA
Count	20
RMSEz (meters)	0.020
95% Confidence Level (meters)	0.035

Lidar QC Check

An additional set of survey check points were collected for an independent QC of the unclassified swath LAS & DEM deliverable tiles. The following check points were collected: 35 non-vegetated & 25 vegetated. The graphic below presents these QC check points on the delivery area map.

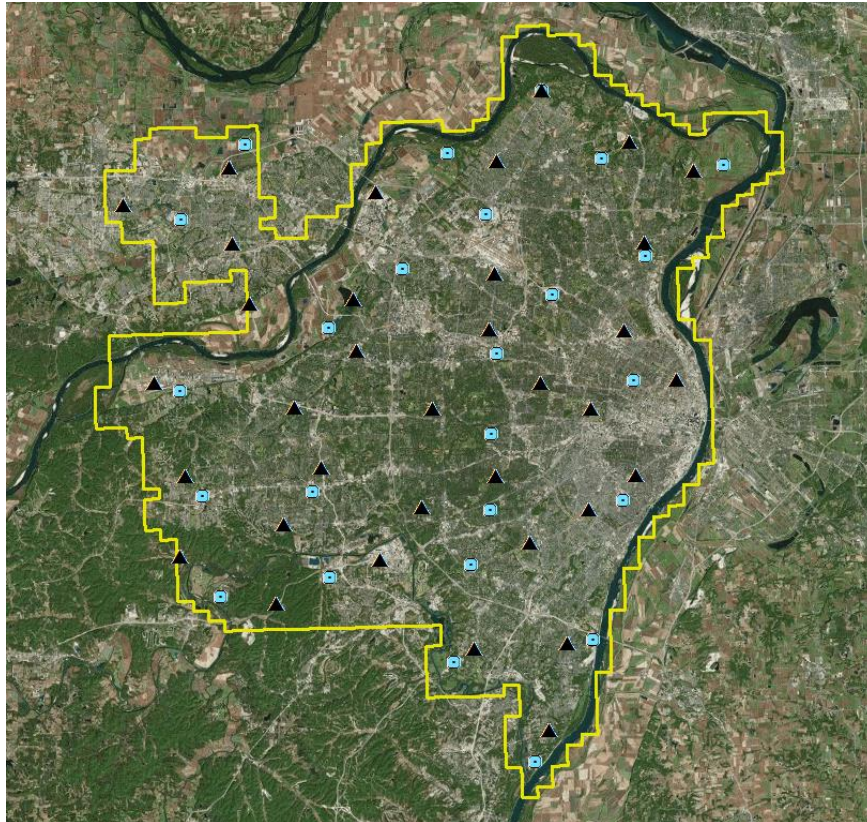


Figure 3 St. Louis City and St. Louis Co. Lidar QC Check

Unclassified Swath LAS QC Accuracy Results

The table below presents the results of the QC accuracy analysis for the unclassified swath LAS data.

Stat	NVA (Bare Earth, Short Grass)
Count	35
RMSEz (meters)	0.033
95% Confidence Level (meters)	0.064

As indicated above the LAS Lidar surface meets Non-vegetated Vertical Accuracy (NVA) project specifications of RMSEz less than or equal to 10.0 cm, with an RMSEz of 3.3 cm. The 95% confidence level of 19.6 cm or less was also meet with a value of 6.4 cm.

DEM QC Accuracy Results

The table below presents the results of the QC accuracy analysis for the derived bare-earth DEM data.

Stat	Overall	NVA (Bare Earth, Short Grass)	VVA(tall grass, brush, trees)
Count	60	35	25
RMSEz (meter)	0.040	0.037	0.044
95% Confidence Level (meter)	0.078	0.072	0.086
95 th Percentile (meter)	0.079	0.079	0.080

As indicated above the derived DEM Lidar surface meets NVA of 10.0 cm, with an RMSEz of 3.7 cm & VVA project specifications of 95th Percentile less than or equal to 29.4 cm.

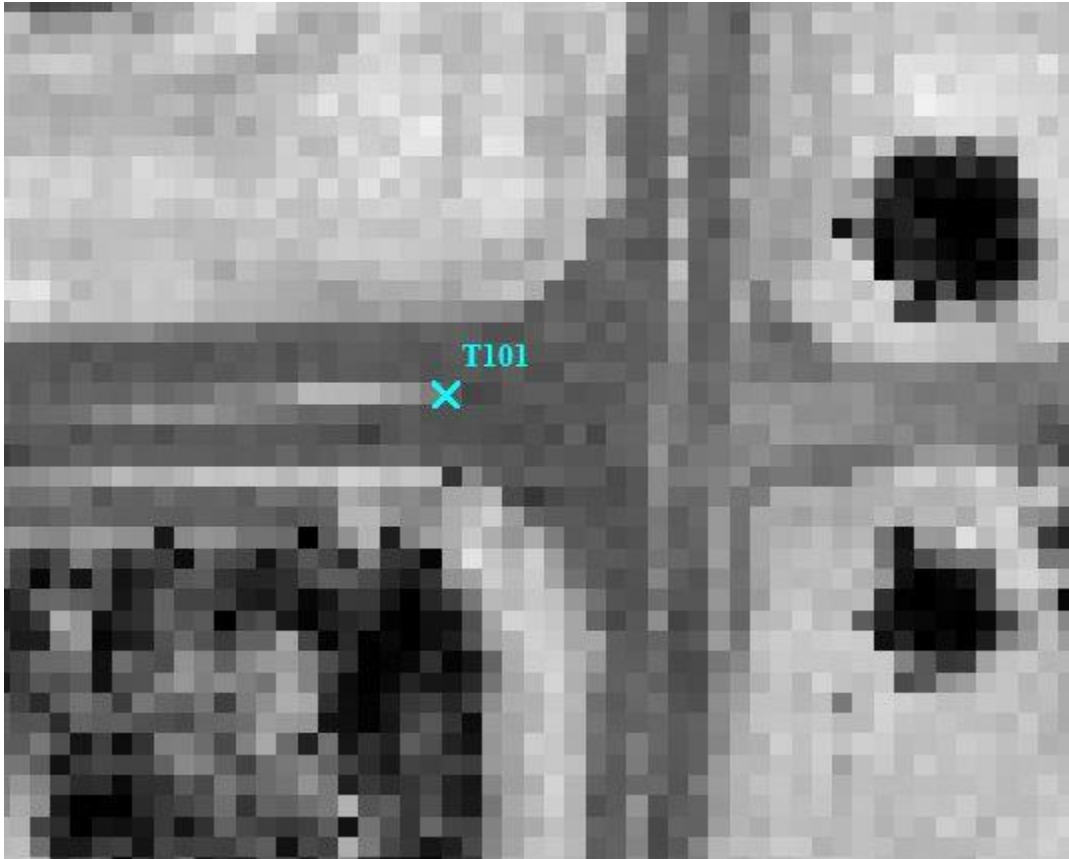
Horizontal Check for Ground Point matching Lidar points

To perform a horizontal check on the lidar data, several Non-vegetated Vertical Accuracy (NVA) points are collected by the surveyors on photo identifiable features. At these locations the lidar data is viewed by intensity with the lidar checkpoint and a horizontal quality check can be done.

Surveyor Field Picture of point T101



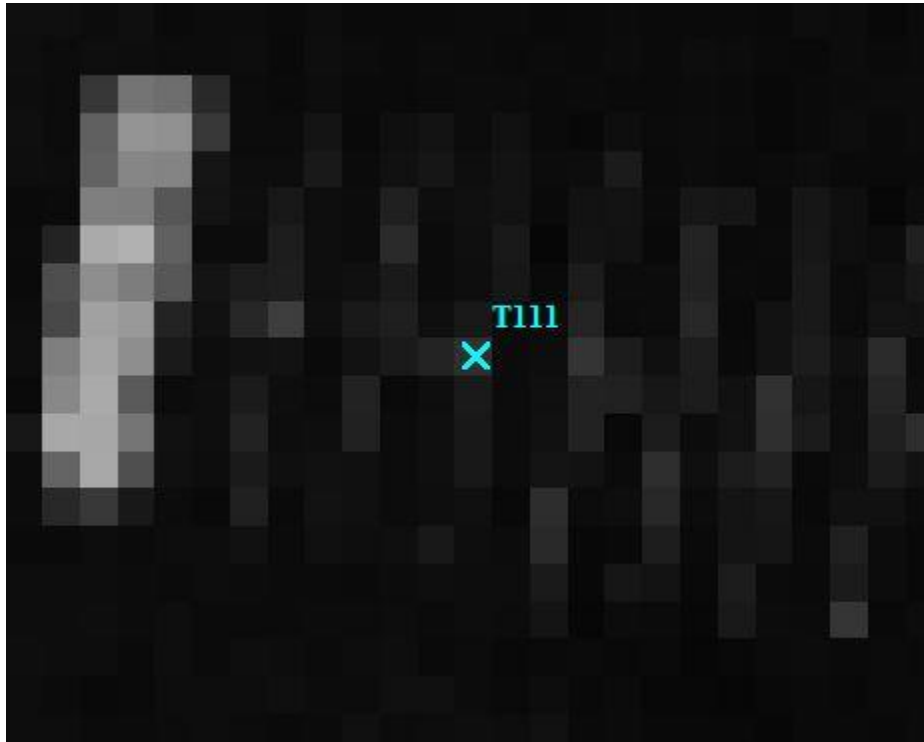
Horizontal Check for Ground Point T101 matching Lidar Intensity



Surveyor Field Picture of point T111



Horizontal Check for Ground Point T111 matching Lidar Intensity



Surveyor Field Picture of point T113



Horizontal Check for Ground Point T111 matching Lidar Intensity

