

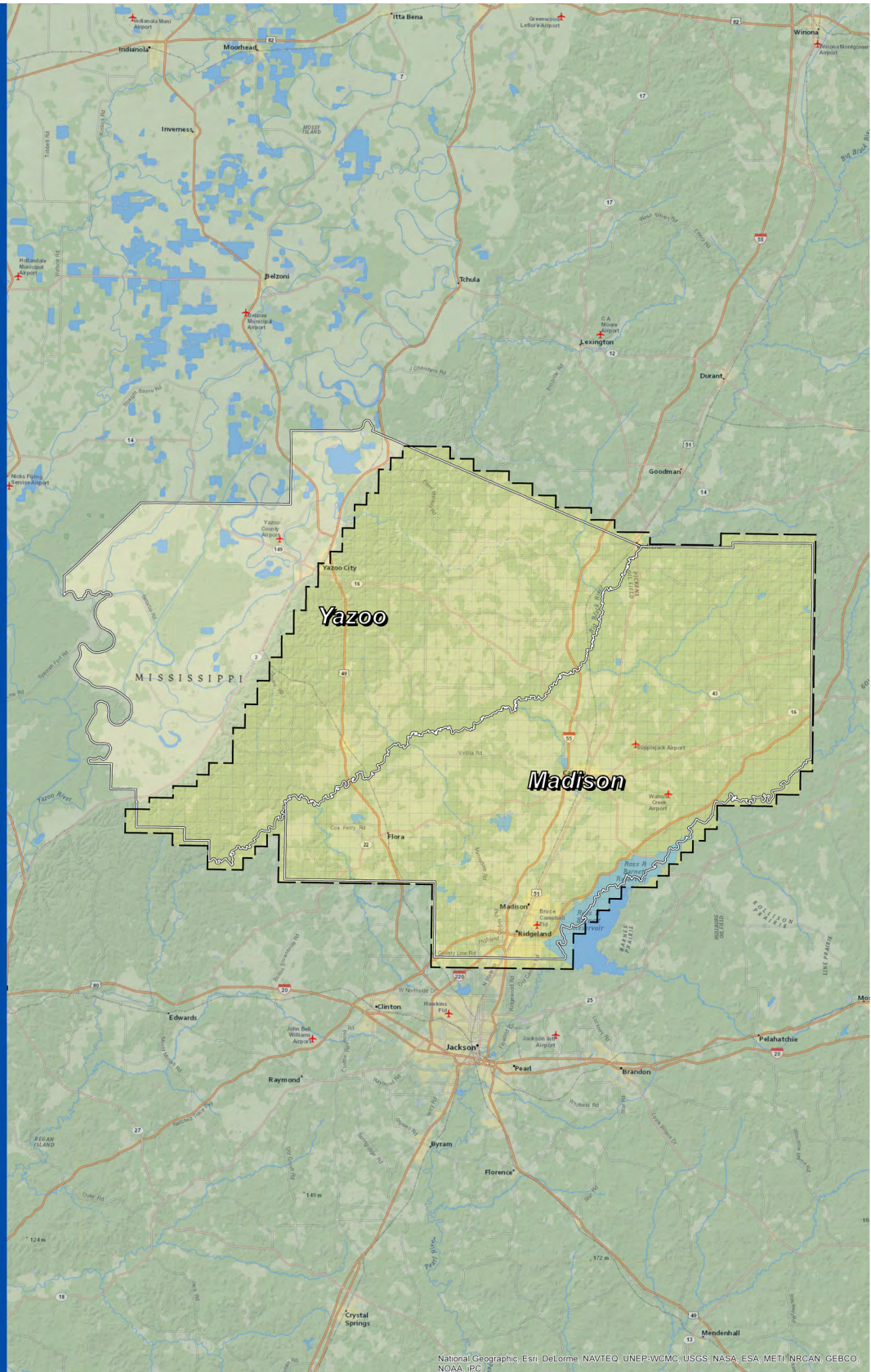


QUALITY CONTROL REPORT

October 15, 2012

Submitted To:
Mississippi Department of
Environmental Quality
Office of Geology
700 North State St.
Jackson, MS 39202

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Independent Quality Control Report

MADISON-YAZOO LIDAR

Work Order Number 109

1 Project Overview

1.1 Madison-Yazoo LiDAR

This report is an assessment of LiDAR acquired in Madison and a portion of Yazoo County, Mississippi. The project was tasked to MGI, LLC under contract to the Mississippi Department of Environmental Quality in support of FEMA’s RiskMAP program. All elements of this project were to follow specifications of FEMA’s Appendix A and Procedure Memorandum No. 61.

1.2 Project Description

The primary objective of this project was to collect and deliver high-density elevation point data derived from LiDAR. The data delivered from this project will support terrain analysis and flood plain mapping applications. The project area covered approximately 1,268 sq. miles in Central Mississippi, covering Madison and a portion of Yazoo County(Figure 1).

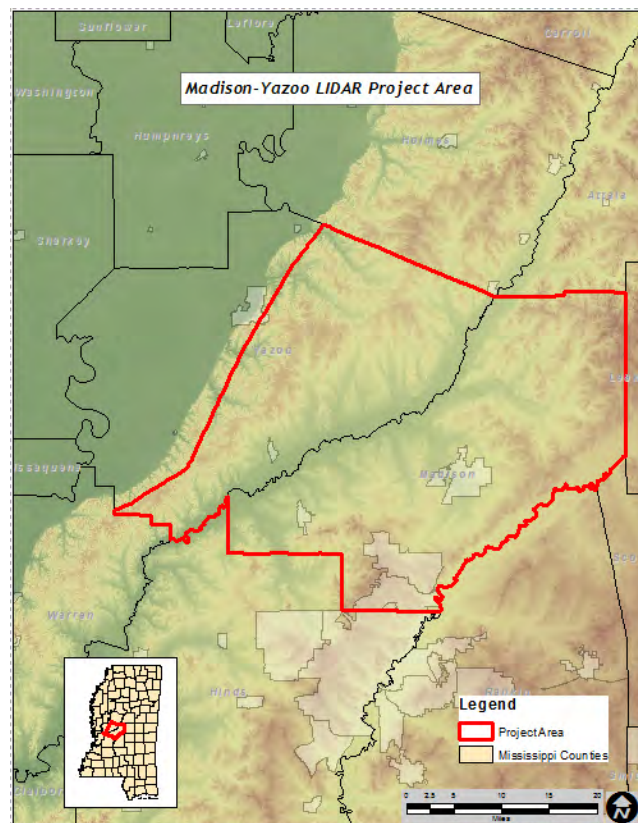


Figure 1- Madison-Yazoo LiDAR Project Area

Project deliverables received by Waggoner Engineering, Inc. for QA included the following items:

- Classified LiDAR data (LAS 1.2 format)
- Bare Earth Digital Elevation Model (GeoTiff format)
- Hydro breaklines (ESRI readable format)
- Intensity Imagery (GeoTiff format)
- FDGC compliant metadata (XML format)

The LiDAR classification followed FEMA's Appendix A and Procedure Memorandum No. 61 guidelines which recommend the following classes be utilized.

- Class 1 – processed, but unclassified
- Class 2 – bare-earth ground
- Class 7 – noise
- Class 9 – water
- Class 10 – ignored
- Class 11 – withheld

All project scope identified the georeferencing details as follows:

- Horizontal Datum – NAD83
- Project - Mississippi State Plane Zone 2302
- Vertical Datum – NAVD88
- Geoid – 2003
- Units-US Feet

1.3 Overview of QA Services

This document details the quality assurance review that was completed on the above project area. The report covers QA services on an initial data delivery to Waggoner Engineering, Inc.

The QA services were performed in two phases, a macro review and a micro review. The macro QA checks were performed on 100% of the deliverable tiles delivered and included the following checks:

- Verification of coverage compared to tasked AOI
- Readability of the data
- Data format and structure
- LAS header conformance to FDGC standards and specifications
- Correct tile name

- Correct georeferencing
- No data gaps
- Nominal post spacing conformance to project specification
- Gross anomaly identification
- Accuracy assessment review
- Metadata conformance to FGDC standards and specifications

The micro QA checks were performed on 25% of the deliverable tiles and included the following checks:

- Visual review for data anomalies and data gaps
- LiDAR classification checks
- Hydro breakline topology and completeness checks
- Bare Earth DEM review using manual and automated tools
- First return DEM review using manual and automated tools

The 25% data coverage to be reviewed as part of the micro QA process was selected by identifying every fourth tile within the deliverable tile layout(Figure 2).

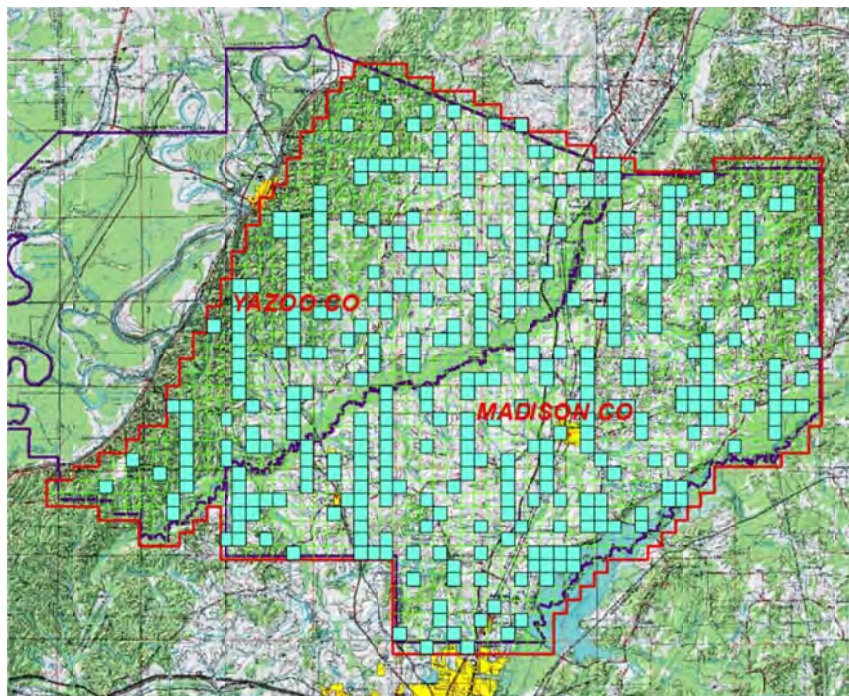


Figure 2 – 25% Tiles Selected for Micro QA Review

1.3 Edit Calls

Breakline Topology – The topology check identified 358 topology errors, including breaklines with dangles and multi-part features.

Missing breaklines-

Metadata – Redelivered metadata passes USGS parser. However, some comments on metadata (attached as word documents) should be addressed.

2 Accuracy Assessment

Waggoner Engineering, Inc used 78 QA/QC points for the project. These control points represented three distinct land cover categories as specified by FEMA Appendix A, bare earth, urban, and high grass(Figure 3).

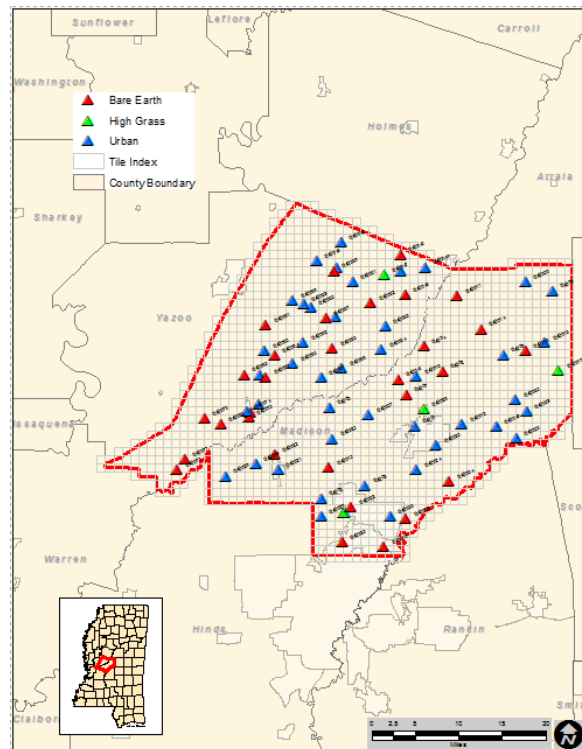


Figure 3 – QA/QC Point Locations

Waggoner Engineering, Inc. performed the accuracy assessment using Topo Analyst and the LiDAR Testing Extension (LTE) plugin. Each QA point was analyzed against corresponding points in the LAS and Bare Earth DEM. Appendix A is a report exported from the Topo Analyst software.

In order to be fully accepted the LiDAR data set was contractually obligated to meet a Fundamental Vertical Accuracy (FVA), Consolidated Vertical Accuracy (CVA), and a

Supplemental Vertical Accuracy (SVA) as defined by the National Digital Elevation Program (NDEP) and the American Society of Photogrammetry (ASPRS). The NDEP defines the FVA, CVA, and the SVA in the following manner.

The fundamental vertical accuracy of a dataset must be determined with check points located only in open terrain, where there is a very high probability that the sensor will have detected the ground surface. The fundamental accuracy is the value by which vertical accuracy can be equitably assessed and compared among datasets. Fundamental accuracy is calculated at the 95-percent confidence level as a function of vertical RMSE. – NDEP Guidelines for Digital Elevation Data, Version 1.0, Section 1.5.3.1 In addition to the fundamental accuracy, supplemental or consolidated accuracy values may be calculated for other ground cover categories or for combinations of ground cover categories. Because elevation errors often vary with the height and density of ground cover, a normal distribution of error cannot be assumed and, therefore, RMSE cannot be used to calculate the 95-percent accuracy value. Consequently a nonparametric testing method (95th Percentile) is employed for supplemental and consolidated accuracy tests. – NDEP Guidelines for Digital Elevation Data, Version 1.0, Section 1.5.3.2.

Waggoner conducted an analysis using the QA checkpoints and the LiDAR DEM data and returned the following accuracy assessment results.

Vertical Measurements/Calculations						
Point Number	Ground Cover Classification	MISSISSIPPI STATE PLANE-ZONE 2302 (NAD83)		NAVD88 Survey Z (US Ft)	LIDAR-Z (US Ft)	ΔZ (cm)
		Eastings-X (US Ft)	Northing-Y (US Ft)			
		QAQC1	Urban			
QAQC2	Bare Earth	2403627.899	1166601.022	331.472	330.85	18.95856
QAQC3	Urban	2334821.136	1144958.444	213.535	213.53	0.1524
QAQC4	Bare Earth	2392225	1181965.816	260.100	260.63	16.1544
QAQC5	Urban	2329677.398	1089254.152	303.972	304.02	1.46304
QAQC6	Urban	2440818.428	1176802.63	283.224	283.22	0.12192
QAQC7	Bare Earth	2381464.849	1152755.35	230.344	230.27	2.25552
QAQC8	Urban	2356345.848	1097341.014	287.178	287.16	0.54864
QAQC9	Urban	2470542.43	1215582.818	423.631	423.62	0.33528
QAQC10	Bare Earth	2367851.263	1059893.49	323.920	324.26	10.3632
QAQC11	Bare Earth	2412590.932	1212853.672	273.366	273.51	4.38912
QAQC12	Urban	2415462.91	1134374.86	318.126	318.11	0.48768
QAQC13	Bare Earth	2334412.857	1108301.826	365.458	365.42	1.15824
QAQC14	Bare Earth	2427290.68	1192555.012	244.204	244.4	5.97408
QAQC15	Urban	2465848.209	1184131.482	337.878	338.07	5.85216
QAQC16	Bare Earth	2454287.789	1179294.291	299.252	299.53	8.47344
QAQC17	High Grass	2474277.797	1167550.823	399.602	399.18	12.86256
QAQC18	Urban	2387675.593	1163717.138	305.098	304.88	6.64464
QAQC19	Urban	2289765.942	1110579.609	207.208	207.29	2.49936
QAQC20	Urban	2271527.112	1102998.015	255.388	255.36	0.85344
QAQC21	Urban	2303312.463	1106972.791	245.747	245.92	5.27304
QAQC22	Bare Earth	2301419.766	1115950.395	215.044	215.4	10.85088
QAQC23	Urban	2336482.044	1125799.41	237.984	237.93	1.64592
QAQC24	Urban	2387563.673	1106937.481	255.328	255.44	3.41376
QAQC25	Urban	2399853.343	1121766.027	251.862	251.89	0.85344
QAQC26	High Grass	2392356.57	1143711.306	263.748	263.85	3.10896
QAQC27	Urban	2329525.671	1078227.772	313.548	313.17	11.52144
QAQC28	Bare Earth	2342350.012	1063046.521	381.882	381.97	2.68224
QAQC29	Bare Earth	2381172.5	1076863.158	344.478	344.43	1.46304
QAQC30	Urban	2344124.732	1080853.855	439.072	439	2.19456
QAQC31	High Grass	2343711.062	1080914.095	430.690	430.69	0
QAQC32	Bare Earth	2347827.47	1084222.644	394.395	394.38	0.4572
QAQC33	Urban	2447976.399	1149391.607	285.076	285.06	0.48768
QAQC34	Bare Earth	2407459.184	1099840.503	314.505	314.14	11.1252
QAQC35	Urban	2448361.403	1125811.076	306.527	306.56	1.00584
QAQC36	Urban	2453877.915	1221122.562	388.884	389.28	12.07008
QAQC37	Urban	2358423.083	1140079.293	212.747	212.73	0.51816
QAQC38	Urban	2371459.231	1078495.462	328.153	328.02	4.05384
QAQC39	Urban	2455041.767	1142706.851	350.931	351.05	3.62712

Vertical Measurements/Calculations						
Point Number	Ground Cover Classification	MISSISSIPPI STATE PLANE- ZONE 2302,(NAD83)		NAVD88 Survey Z (US Ft)	LIDAR-Z (US Ft)	ΔZ (cm)
		Easting-X (US Ft)	Northing-Y (US Ft)			
QAQC40	Urban	2436256.288	1133296.02	367.205	367.26	1.6764
QAQC41	Bare Earth	2376812.074	1162044.396	215.985	215.97	0.4572
QAQC42	Urban	2341645.244	1245329.538	284.874	285.1	6.88848
QAQC43	Bare Earth	2378133.297	1238039.602	314.238	314.31	2.19456
QAQC44	Urban	2392999.504	1230241.691	278.157	278.37	6.49224
QAQC45	Urban	2378129.888	1227720.204	264.887	265.01	3.74904
QAQC46	Bare Earth	2381061.651	1213539.689	283.237	283.61	11.36904
QAQC47	High Grass	2367974.086	1225611.802	318.003	318.42	12.71016
QAQC48	Urban	2326802.31	1234229.385	333.870	334.26	11.8872
QAQC49	Urban	2339142.568	1230237.501	296.689	297.12	13.13688
QAQC50	Bare Earth	2337584.282	1228126.884	285.346	285.61	8.04672
QAQC51	Urban	2348960.074	1221339.185	327.484	327.76	8.41248
QAQC52	Bare Earth	2359853.292	1208696.063	274.087	274.24	4.66344
QAQC53	Urban	2368872.062	1194395.743	279.487	279.68	5.88264
QAQC54	Urban	2366269.431	1180374.401	226.330	226.61	8.5344
QAQC55	Bare Earth	2336549.356	1181137.949	235.102	235.57	14.26464
QAQC56	Urban	2338430.611	1199809.407	280.973	280.82	4.66344
QAQC57	Bare Earth	2332496.946	1199504.045	245.697	245.96	8.01624
QAQC58	Urban	2323445.756	1205898.662	335.298	335.57	8.29056
QAQC59	Urban	2319099.111	1208144.741	335.581	335.85	8.19912
QAQC60	Urban	2312409.031	1210150.067	371.236	371.47	7.13232
QAQC61	Bare Earth	2296007.341	1195256.265	348.074	348.35	8.41248
QAQC62	Urban	2318831.649	1184561.538	267.277	267.15	3.87096
QAQC63	Urban	2295336.425	1179140.332	356.100	356.24	4.2672
QAQC64	Bare Earth	2301489.414	1176458.371	314.402	314.43	0.85344
QAQC65	Urban	2312228.937	1171563.736	264.927	265.22	8.93064
QAQC66	Urban	2342245.138	1168776.911	205.759	206.01	7.65048
QAQC67	Urban	2329693.457	1163199.958	202.749	202.34	12.46632
QAQC68	Bare Earth	2282704.072	1164842.521	332.849	333.02	5.21208
QAQC69	Urban	2292434.954	1164519.821	307.951	307.77	5.51688
QAQC70	Bare Earth	2295953.361	1163401.381	231.652	231.86	6.33984
QAQC71	Urban	2291436.147	1147059.451	202.063	201.76	9.23544
QAQC72	Bare Earth	2286678.184	1142098.549	195.590	195.54	1.524
QAQC73	Bare Earth	2285845.419	1139114.283	187.204	187.57	11.15568
QAQC74	Urban	2284135.524	1142272.365	196.467	196.58	3.44424
QAQC75	Bare Earth	2268560.213	1134376.507	220.038	220.08	1.28016
QAQC76	Bare Earth	2258593.27	1137898.538	308.331	308.5	5.15112
QAQC77	Bare Earth	2246489.092	1113200.677	165.339	164.72	17.34312
QAQC78	Bare Earth	2242004.99	1106748.547	157.234	156.7	16.27632

3 Conclusions

Although there were a handful of macro and micro data calls on this project, they were easily corrected. The breakline calls were limited in number and not unexpected given the size of the AOI. Overall, the LiDAR had very clean editing and easily passed the accuracy assessment. The Atlantic Group addressed all edit calls and returned corrected data to Waggoner Engineering, Inc.

Based on the 100% macro and 25% micro assessment conducted by Waggoner Engineering, Inc on the initial data delivered, as well as all redeliveries, the Madison-Yazoo deliverables meet the applicable project specifications as set forth in the contractual guidelines.

Appendix A
Topo Analyst -LTE
Accuracy Assessment Report

Appendix A
Topo Analyst -LTE
Accuracy Assessment Report



Project Information

Prepared By: Waggoner Engineering
Project Name: Madison-Yazoo
Sensor Info: Optech 3100
Required Nominal Pulse Spacing: 0.89
Vendor Name: The Atlantic Group, LLC
Units: US Survey Feet
Percent of Extent Tolerance: 10
Date of Aquisition: Start: 2/22/2012 Finish: 2/29/2012

Metadata Information

Tile Index:

Path: J:\MDEM_PL11095.000\LIDAR\Index\Index.shp
Number of Polys: 1527

Intensity:

Tile Index Attribute: Name
Path to Data: J:\MDEM_PL11095.000\LIDAR\Intensity_Ortho
Number of Data Files Matching Attribute: 1527 out of 1527
Number of Data Files With Extent Matching Poly-Extent: 1527 out of 1527

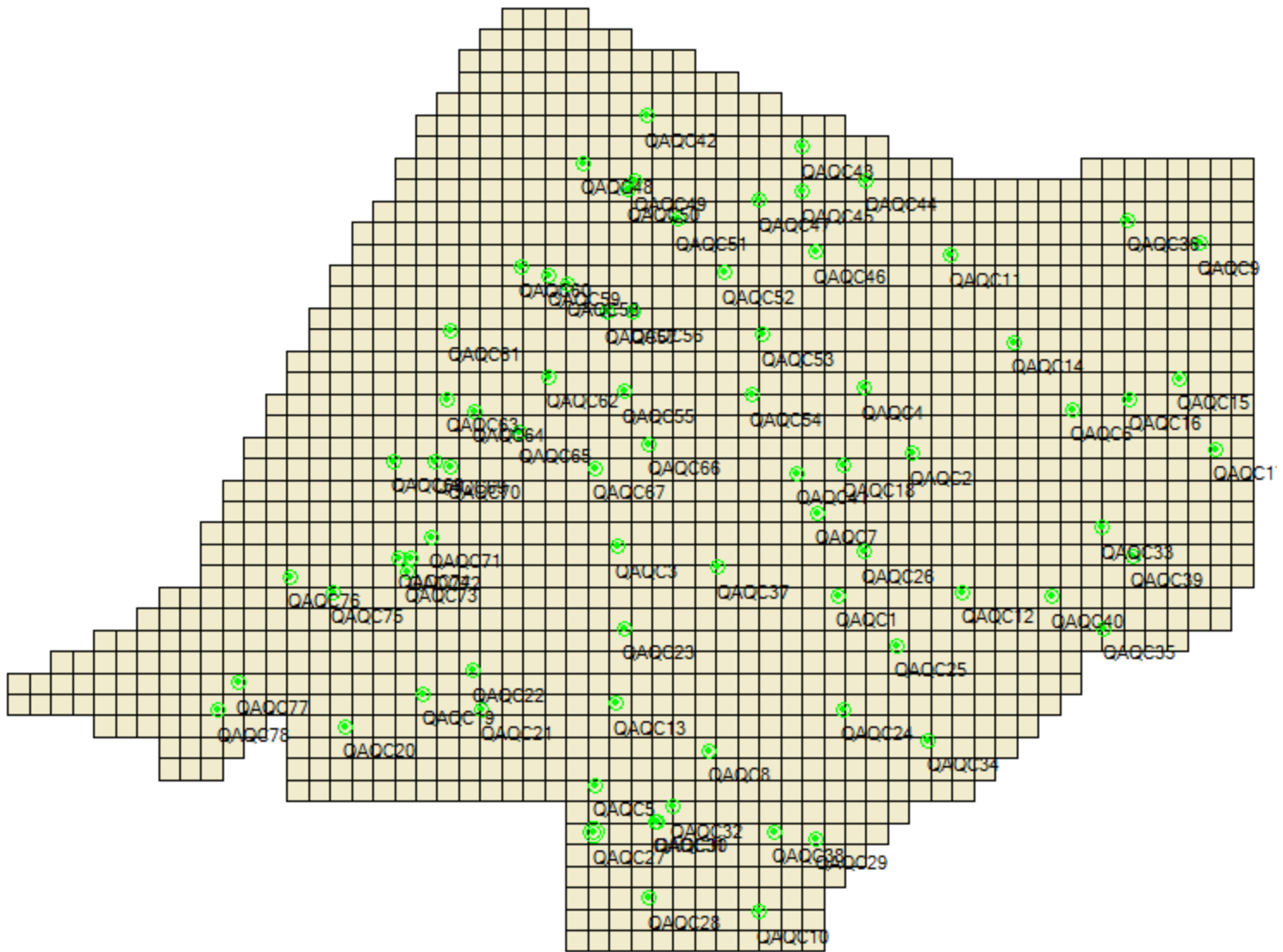
DEM:

Tile Index Attribute: Name
Path to Data: J:\MDEM_PL11095.000\LIDAR\Dem
Number of Data Files Matching Attribute: 1527 out of 1527
Number of Data Files With Extent Matching Poly-Extent: 1527 out of 1527

LAS:

Tile Index Attribute: LAS_File
Path to Data: J:\MDEM_PL11095.000\LIDAR\LAS
Number of Data Files Matching Attribute: 1527 out of 1527
Number of Data Files With Extent Matching Poly-Extent:1522 out of 1527

Tiled-Data Area





LiDAR Accuracy Assessment Summary

LC Type	# of Points	FVA	SVA	CVA
LAS				
ALL	77	0.639	0.436	0.436
Urban	43	0.409	0.376	0.376
Bare Earth	30	0.871		0.866
High Grass	4	0.601	0.433	0.433
Total	77			
DEM				
ALL	78	0.502	0.427	0.427
Urban	44	0.412	0.385	0.385
Bare Earth	30	0.599		0.558
High Grass	4	0.594	0.425	0.425
Total	78			

Units: US Survey Feet



Coordinates and Offsets of Analyzed Locations

ID						
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
1)	<input checked="" type="checkbox"/> QAQC1					
		2386365.252	1133555.166	229.873	229.998	229.999
				0.125	0.126	Urban
2)	<input checked="" type="checkbox"/> QAQC10					
		2367851.263	1059893.49	323.92	324.054	324.126
				0.134	0.206	Bare Earth
3)	<input checked="" type="checkbox"/> QAQC11					
		2412590.932	1212853.672	273.366	273.51	273.509
				0.144	0.143	Bare Earth
4)	<input checked="" type="checkbox"/> QAQC12					
		2415462.91	1134374.86	318.126	318.163	318.159
				0.037	0.033	Urban
5)	<input checked="" type="checkbox"/> QAQC13					
		2334412.857	1108301.826	365.458	365.39	365.376
				-0.068	-0.082	Bare Earth
6)	<input checked="" type="checkbox"/> QAQC14					
		2427290.68	1192555.012	244.204	244.416	244.39
				0.212	0.186	Bare Earth
7)	<input checked="" type="checkbox"/> QAQC15					
		2465848.209	1184131.482	337.878	338.07	338.077
				0.192	0.199	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
	Survey X	Survey Y	Z1	Z DEM	Z LAS	
			ΔZ DEM	ΔZ LAS	LC Type	
8)	<input checked="" type="checkbox"/> QAQC16					
	2454287.789	1179294.291	299.252	299.527	299.507	
			0.275	0.255	Bare Earth	
9)	<input checked="" type="checkbox"/> QAQC17					
	2474277.797	1167550.823	399.602	399.175	399.174	
			-0.427	-0.428	High Grass	
10)	<input checked="" type="checkbox"/> QAQC18					
	2387675.593	1163717.138	305.098	304.879	304.914	
			-0.219	-0.184	Urban	
11)	<input checked="" type="checkbox"/> QAQC19					
	2289765.942	1110579.609	207.208	207.292	207.298	
			0.084	0.09	Urban	
12)	<input checked="" type="checkbox"/> QAQC2					
	2403627.899	1166601.022	331.472	331.446	331.443	
			-0.026	-0.029	Bare Earth	
13)	<input checked="" type="checkbox"/> QAQC20					
	2271527.112	1102998.015	255.388	255.119	255.217	
			-0.269	-0.171	Urban	
14)	<input checked="" type="checkbox"/> QAQC21					
	2303312.463	1106972.791	245.747	245.919	245.942	
			0.172	0.195	Urban	



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
	Survey X	Survey Y	Z1	Z DEM	Z LAS	
			ΔZ DEM	ΔZ LAS	LC Type	
15)	<input checked="" type="checkbox"/> QAQC22					
	2301419.766	1115950.395	215.044	215.398	215.303	
			0.354	0.259	Bare Earth	
16)	<input checked="" type="checkbox"/> QAQC23					
	2336482.044	1125799.41	237.984	237.935	237.968	
			-0.049	-0.016	Urban	
17)	<input checked="" type="checkbox"/> QAQC24					
	2387563.673	1106937.481	255.328	255.435	255.423	
			0.107	0.095	Urban	
18)	<input checked="" type="checkbox"/> QAQC25					
	2399853.343	1121766.027	251.862	251.886	251.833	
			0.024	-0.029	Urban	
19)	<input checked="" type="checkbox"/> QAQC26					
	2392356.57	1143711.306	263.748	263.768	263.814	
			0.02	0.066	High Grass	
20)	<input checked="" type="checkbox"/> QAQC27					
	2329525.671	1078227.772	313.548	313.172	313.207	
			-0.376	-0.341	Urban	
21)	<input checked="" type="checkbox"/> QAQC28					
	2342350.012	1063046.521	381.882	381.969	381.97	
			0.087	0.088	Bare Earth	



Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
22)	<input checked="" type="checkbox"/>	QAQC29				
		2381172.5	1076863.158	344.478	344.429	344.398
				-0.049	-0.08	Bare Earth
23)	<input checked="" type="checkbox"/>	QAQC3				
		2334821.136	1144958.444	213.535	213.483	213.484
				-0.052	-0.051	Urban
24)	<input checked="" type="checkbox"/>	QAQC30				
		2344124.732	1080853.855	439.072	439.002	439.072
				-0.07	0	Urban
25)	<input checked="" type="checkbox"/>	QAQC31				
		2343711.062	1080914.095	430.69	430.806	430.718
				0.116	0.028	High Grass
26)	<input checked="" type="checkbox"/>	QAQC32				
		2347827.47	1084222.644	394.395	394.37	394.307
				-0.025	-0.088	Bare Earth
27)	<input checked="" type="checkbox"/>	QAQC33				
		2447976.399	1149391.607	285.076	285.046	285.072
				-0.03	-0.004	Urban
28)	<input checked="" type="checkbox"/>	QAQC34				
		2407459.184	1099840.503	314.505	314.135	314.145
				-0.37	-0.36	Bare Earth



Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
29)	<input checked="" type="checkbox"/>	QAQC35				
		2448361.403	1125811.076	306.527	306.561	306.549
				0.034	0.022	Urban
30)	<input checked="" type="checkbox"/>	QAQC36				
		2453877.915	1221122.562	388.884	389.284	389.315
				0.4	0.431	Urban
31)	<input checked="" type="checkbox"/>	QAQC37				
		2358423.083	1140079.293	212.747	212.618	212.656
				-0.129	-0.091	Urban
32)	<input checked="" type="checkbox"/>	QAQC38				
		2371459.231	1078495.462	328.153	328.245	328.232
				0.092	0.079	Urban
33)	<input checked="" type="checkbox"/>	QAQC39				
		2455041.767	1142706.851	350.931	350.928	350.961
				-0.003	0.03	Urban
34)	<input checked="" type="checkbox"/>	QAQC4				
		2392225	1181965.816	260.1	260.193	260.197
				0.093	0.097	Bare Earth
35)	<input checked="" type="checkbox"/>	QAQC40				
		2436256.288	1133296.02	367.205	367.055	367.061
				-0.15	-0.144	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
	Survey X	Survey Y	Z1	Z DEM	Z LAS	
			ΔZ DEM	ΔZ LAS	LC Type	
36)	QAQC41					
	2376812.074	1162044.396	215.985	215.796	215.78	
			-0.189	-0.205	Bare Earth	
37)	QAQC42					
	2341645.244	1245329.538	284.874	285.242	285.253	
			0.368	0.379	Urban	
38)	QAQC43					
	2378133.297	1238039.602	314.238	314.306	314.267	
			0.068	0.029	Bare Earth	
39)	QAQC44					
	2392999.504	1230241.691	278.157	278.366	NaN	
			0.209	NaN	Urban	
40)	QAQC45					
	2378129.888	1227720.204	264.887	265.006	265.192	
			0.119	0.305	Urban	
41)	QAQC46					
	2381061.651	1213539.689	283.237	283.607	283.57	
			0.37	0.333	Bare Earth	
42)	QAQC47					
	2367974.086	1225611.802	318.003	318.417	318.436	
			0.414	0.433	High Grass	



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
	Survey X	Survey Y	Z1	Z DEM	Z LAS	
			ΔZ DEM	ΔZ LAS	LC Type	
43)	<input checked="" type="checkbox"/> QAQC48					
	2326802.31	1234229.385	333.87	334.257	334.314	
			0.387	0.444	Urban	
44)	<input checked="" type="checkbox"/> QAQC49					
	2339142.568	1230237.501	296.689	297.119	296.933	
			0.43	0.244	Urban	
45)	<input checked="" type="checkbox"/> QAQC5					
	2329677.398	1089254.152	303.972	304.024	303.963	
			0.052	-0.009	Urban	
46)	<input checked="" type="checkbox"/> QAQC50					
	2337584.282	1228126.884	285.346	285.61	285.61	
			0.264	0.264	Bare Earth	
47)	<input checked="" type="checkbox"/> QAQC51					
	2348960.074	1221339.185	327.484	327.756	327.817	
			0.272	0.333	Urban	
48)	<input checked="" type="checkbox"/> QAQC52					
	2359853.292	1208696.063	274.087	274.237	274.26	
			0.15	0.173	Bare Earth	
49)	<input checked="" type="checkbox"/> QAQC53					
	2368872.062	1194395.743	279.487	279.679	279.594	
			0.192	0.107	Urban	



Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
50)	<input checked="" type="checkbox"/>	QAQC54				
		2366269.431	1180374.401	226.33	226.61	226.593
				0.28	0.263	Urban
51)	<input checked="" type="checkbox"/>	QAQC55				
		2336549.356	1181137.949	235.102	235.574	235.53
				0.472	0.428	Bare Earth
52)	<input checked="" type="checkbox"/>	QAQC56				
		2338430.611	1199809.407	280.973	280.82	280.856
				-0.153	-0.117	Urban
53)	<input checked="" type="checkbox"/>	QAQC57				
		2332496.946	1199504.045	245.916	245.963	245.886
				0.047	-0.03	Bare Earth
54)	<input checked="" type="checkbox"/>	QAQC58				
		2323445.756	1205898.662	335.298	335.566	335.561
				0.268	0.263	Urban
55)	<input checked="" type="checkbox"/>	QAQC59				
		2319099.111	1208144.741	335.581	335.853	335.869
				0.272	0.288	Urban
56)	<input checked="" type="checkbox"/>	QAQC6				
		2440818.428	1176802.63	283.224	283.403	283.311
				0.179	0.087	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
57)	<input checked="" type="checkbox"/> QAQC60					
		2312409.031	1210150.067	371.236	371.467	371.402
				0.231	0.166	Urban
58)	<input checked="" type="checkbox"/> QAQC61					
		2296007.341	1195256.265	348.074	348.369	348.415
				0.295	0.341	Bare Earth
59)	<input checked="" type="checkbox"/> QAQC62					
		2318831.649	1184561.538	267.277	267.155	267.162
				-0.122	-0.115	Urban
60)	<input checked="" type="checkbox"/> QAQC63					
		2295336.425	1179140.332	356.1	356.244	356.295
				0.144	0.195	Urban
61)	<input checked="" type="checkbox"/> QAQC64					
		2301489.414	1176458.371	314.402	314.429	314.523
				0.027	0.121	Bare Earth
62)	<input checked="" type="checkbox"/> QAQC65					
		2312228.937	1171563.736	264.927	265.213	265.167
				0.286	0.24	Urban
63)	<input checked="" type="checkbox"/> QAQC66					
		2342245.138	1168776.911	205.759	206.011	206.021
				0.252	0.262	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
64)	<input checked="" type="checkbox"/> QAQC67					
		2329693.457	1163199.958	202.749	202.51	202.48
				-0.239	-0.269	Urban
65)	<input checked="" type="checkbox"/> QAQC68					
		2282704.072	1164842.521	332.849	333.02	333.045
				0.171	0.196	Bare Earth
66)	<input checked="" type="checkbox"/> QAQC69					
		2292434.954	1164519.821	307.951	307.772	307.617
				-0.179	-0.334	Urban
67)	<input checked="" type="checkbox"/> QAQC7					
		2381464.849	1152755.35	230.344	230.269	230.255
				-0.075	-0.089	Bare Earth
68)	<input checked="" type="checkbox"/> QAQC70					
		2295953.361	1163401.381	231.652	231.863	231.824
				0.211	0.172	Bare Earth
69)	<input checked="" type="checkbox"/> QAQC71					
		2291436.147	1147059.451	202.063	201.76	201.789
				-0.303	-0.274	Urban
70)	<input checked="" type="checkbox"/> QAQC72					
		2286678.184	1142098.549	195.59	195.538	195.568
				-0.052	-0.022	Bare Earth



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
71)	<input checked="" type="checkbox"/> QAQC73					
		2285845.419	1139114.283	187.204	187.567	187.649
				0.363	0.445	Bare Earth
72)	<input checked="" type="checkbox"/> QAQC74					
		2284135.524	1142272.365	196.467	196.584	196.581
				0.117	0.114	Urban
73)	<input checked="" type="checkbox"/> QAQC75					
		2268560.213	1134376.507	220.038	220.084	220.143
				0.046	0.105	Bare Earth
74)	<input checked="" type="checkbox"/> QAQC76					
		2258593.27	1137898.538	308.331	308.498	308.487
				0.167	0.156	Bare Earth
75)	<input checked="" type="checkbox"/> QAQC77					
		2246489.092	1113200.677	165.299	164.672	164.089
				-0.627	-1.21	Bare Earth
76)	<input checked="" type="checkbox"/> QAQC78					
		2242004.99	1106748.547	157.234	156.168	155.449
				-1.066	-1.785	Bare Earth
77)	<input checked="" type="checkbox"/> QAQC8					
		2356345.848	1097341.014	287.178	287.269	287.281
				0.091	0.103	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

ID						
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
78)	<input checked="" type="checkbox"/> QAQC9					
		2470542.43	1215582.818	423.631	423.623	423.73
				-0.008	0.099	Urban



LAS

Fundamental Vertical Accuracy

LandCover Type: ALL, Urban, Bare Earth, High Grass

Minimum DZ: -1.785

Maximum DZ: 0.445

Mean DZ: 0.041

Mean Magnitude DZ: 0.46

Number Observations: 77

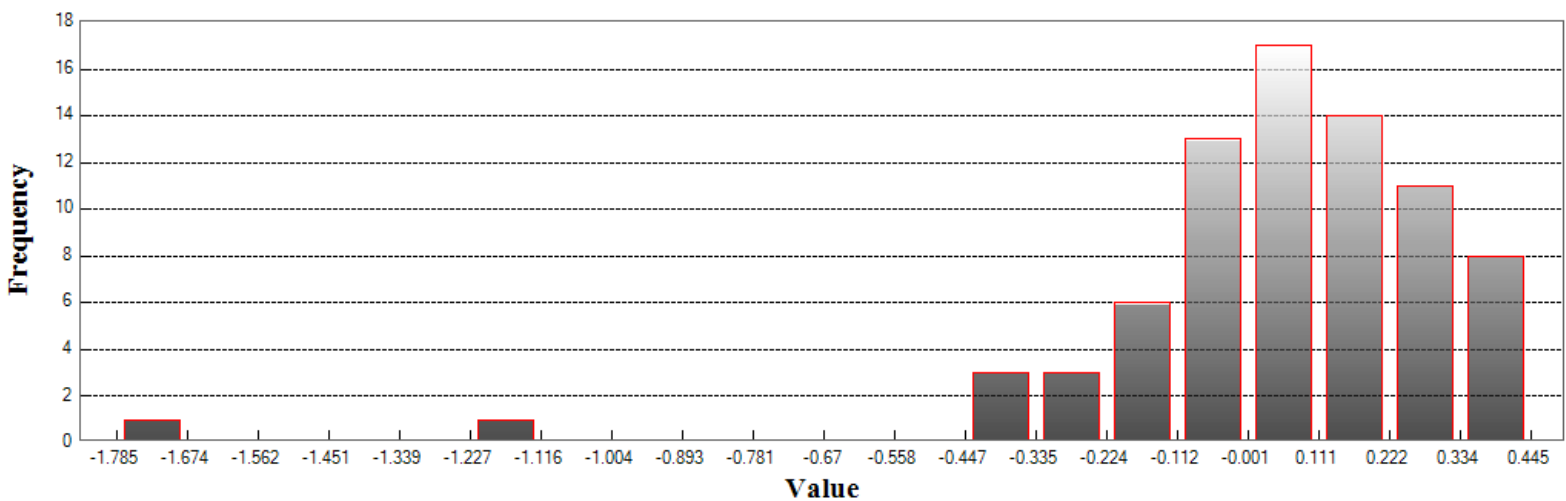
Standard Deviation DZ: 0.325

RMSE Z: 0.326

95% Confidence Level Z: 0.639

Units: US Survey Feet

Histogram



Min: -1.785

Max: 0.445

Number Of Bins: 20

Bin Interval: 0.112

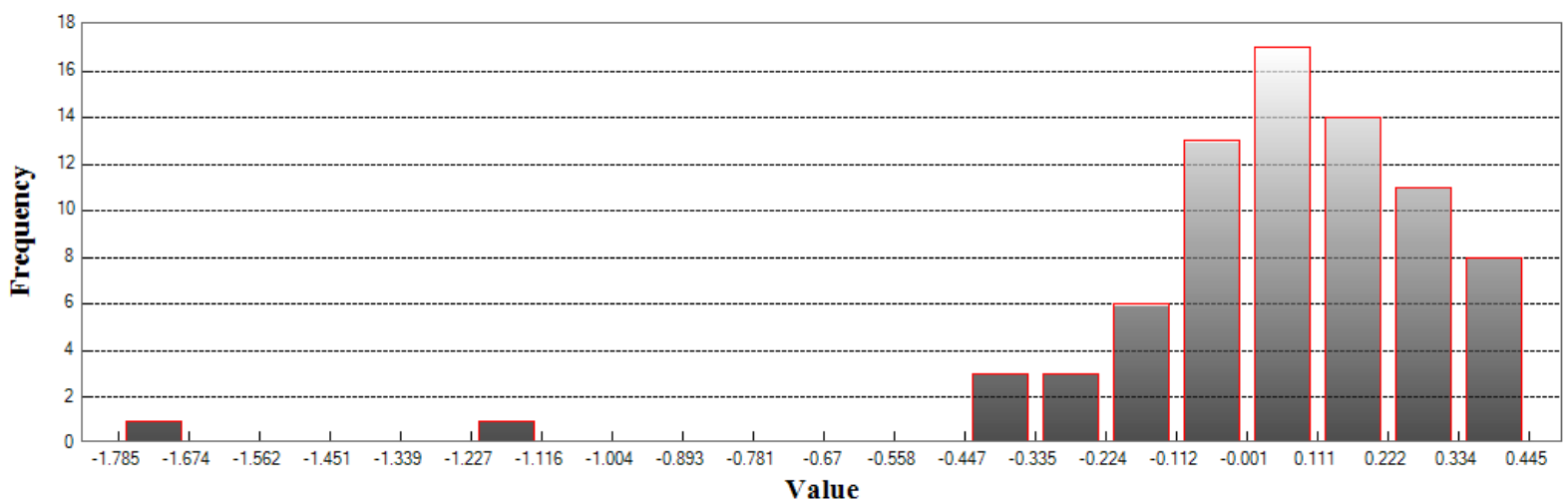


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: ALL
Minimum DZ: -1.785
Maximum DZ: 0.445
Mean DZ: 0.041
Mean Magnitude DZ: 0.46
Number Observations: 77
Standard Deviation DZ: 0.325
RMSE Z: 0.326
95th Percentile: 0.436
Units: US Survey Feet

Histogram



Min: -1.785
Max: 0.445
Number Of Bins: 20
Bin Interval: 0.112



LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: Urban

Minimum DZ: -0.341

Maximum DZ: 0.444

Mean DZ: 0.071

Mean Magnitude DZ: 0.413

Number Observations: 43

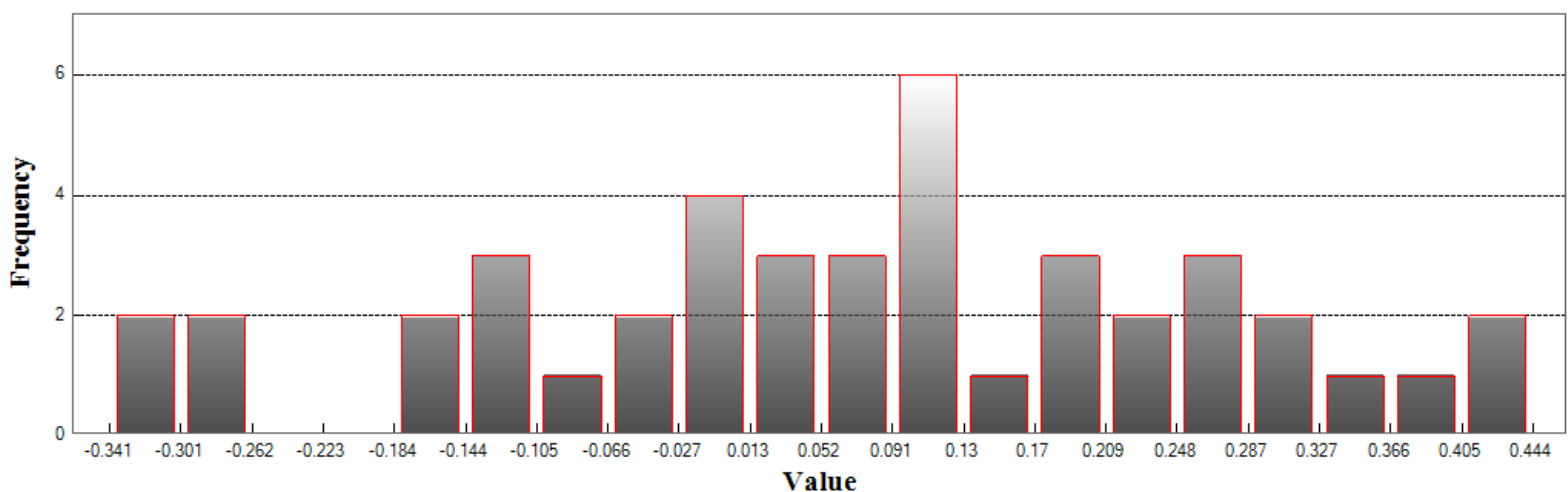
Standard Deviation DZ: 0.199

RMSE Z: 0.209

95th Percentile: 0.376

Units: US Survey Feet

Histogram



Min: -0.341

Max: 0.444

Number Of Bins: 20

Bin Interval: 0.039

LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: High Grass

Minimum DZ: -0.428

Maximum DZ: 0.433

Mean DZ: 0.025

Mean Magnitude DZ: 0.489

Number Observations: 4

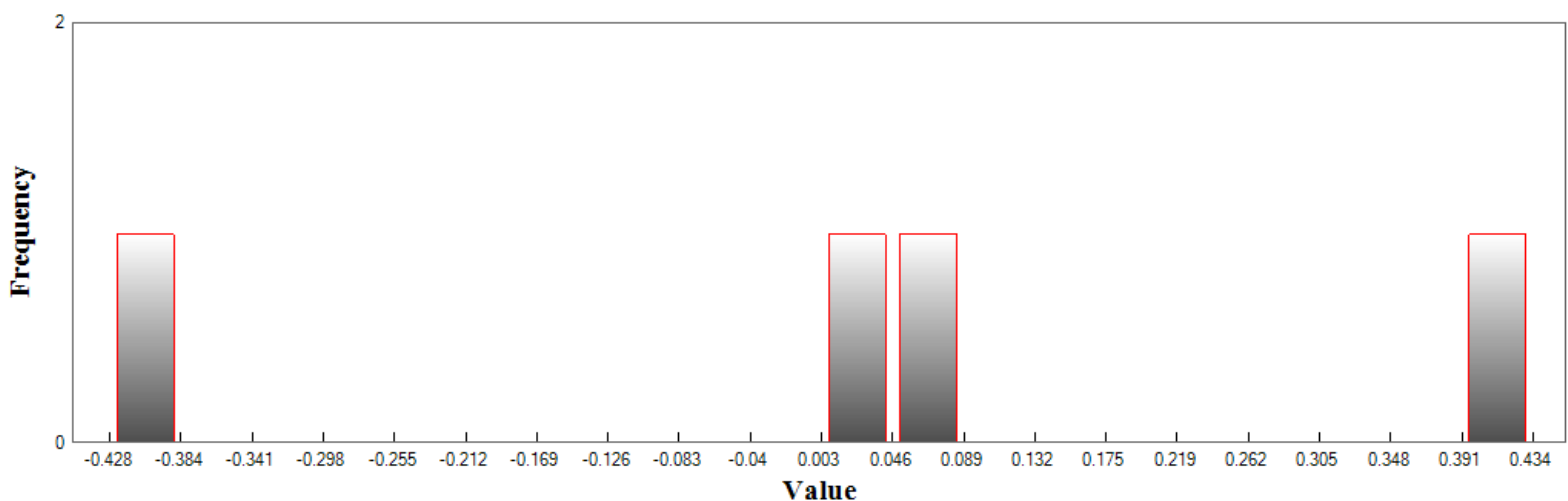
Standard Deviation DZ: 0.353

RMSE Z: 0.307

95th Percentile: 0.433

Units: US Survey Feet

Histogram



Min: -0.428

Max: 0.433

Number Of Bins: 20

Bin Interval: 0.043



LAS (Continued)

Consolidated Vertical Accuracy

LandCover Type: ALL, Urban, Bare Earth, High Grass

Minimum DZ: -1.785

Maximum DZ: 0.445

Mean DZ: 0.041

Mean Magnitude DZ: 0.46

Number Observations: 77

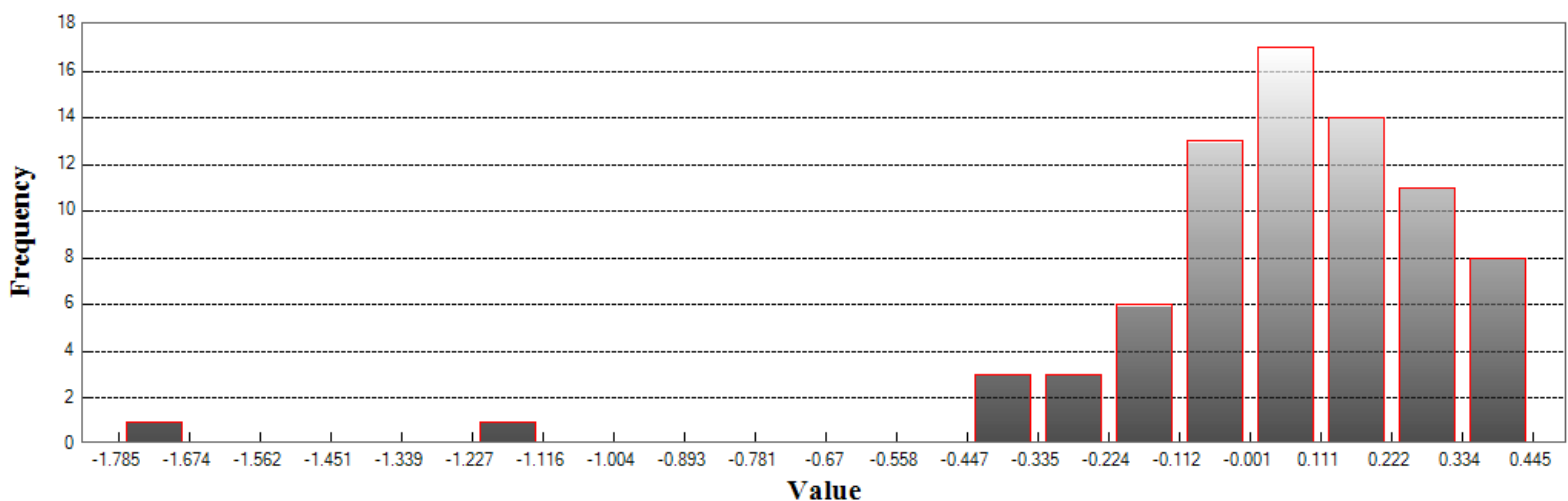
Standard Deviation DZ: 0.325

RMSE Z: 0.326

95th Percentile: 0.436

Units: US Survey Feet

Histogram



Min: -1.785

Max: 0.445

Number Of Bins: 20

Bin Interval: 0.112



DEM

Fundamental Vertical Accuracy

LandCover Type: ALL, Urban, Bare Earth, High Grass

Minimum DZ: -1.066

Maximum DZ: 0.472

Mean DZ: 0.059

Mean Magnitude DZ: 0.442

Number Observations: 78

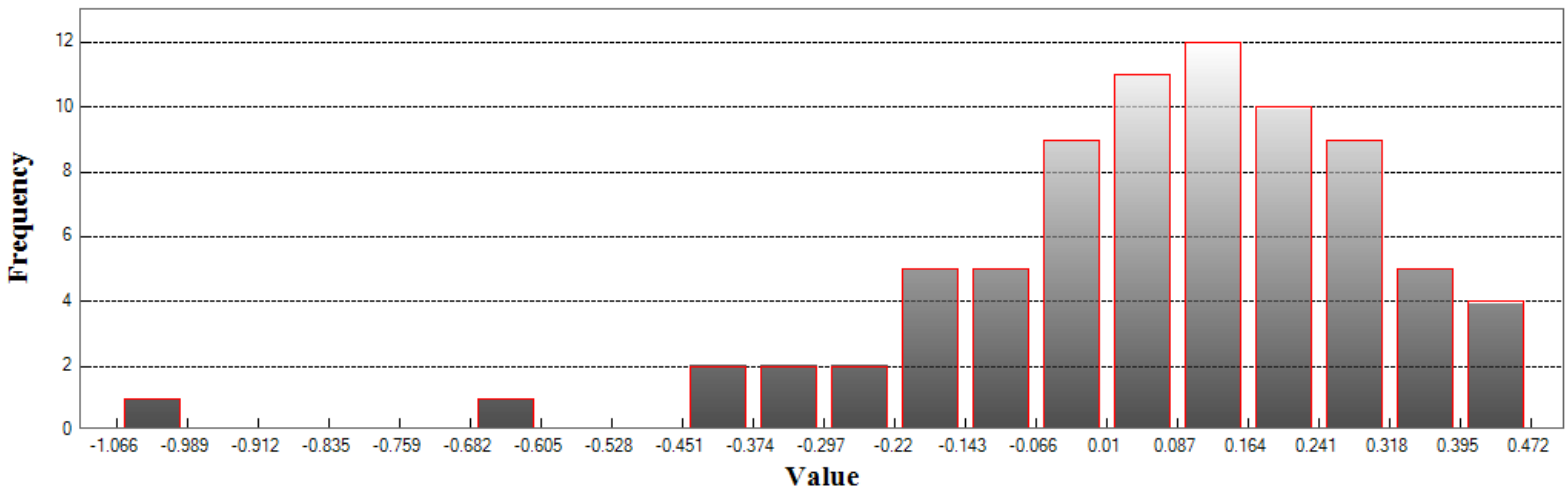
Standard Deviation DZ: 0.251

RMSE Z: 0.256

95% Confidence Level Z: 0.502

Units: US Survey Feet

Histogram



Min: -1.066

Max: 0.472

Number Of Bins: 20

Bin Interval: 0.077

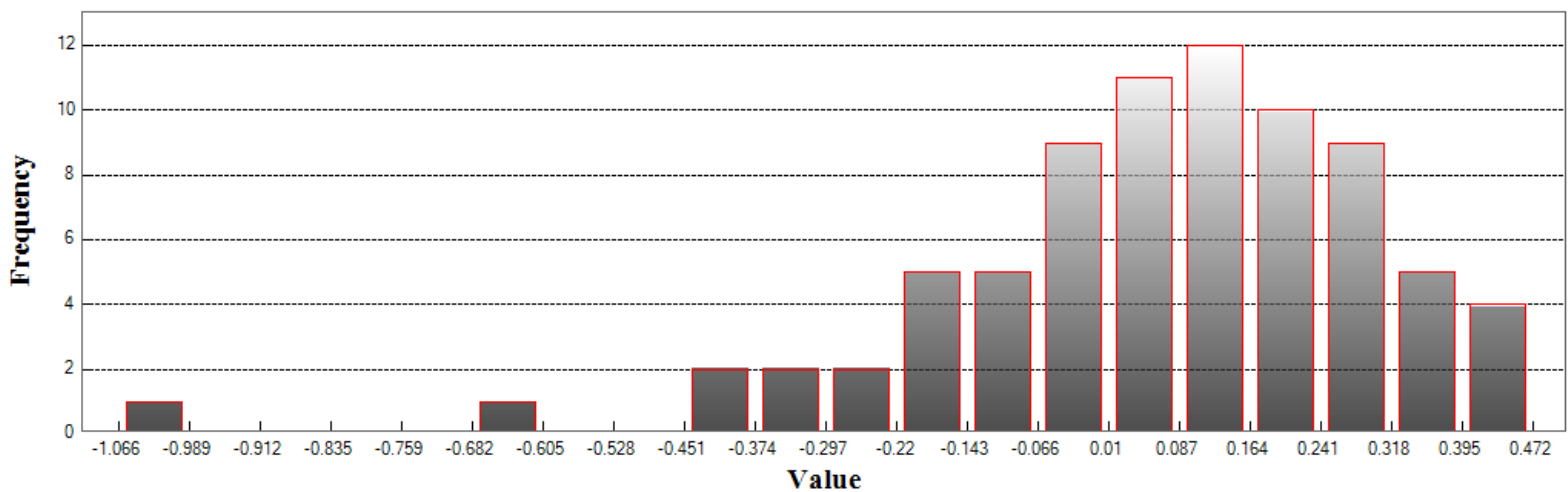


DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: ALL
Minimum DZ: -1.066
Maximum DZ: 0.472
Mean DZ: 0.059
Mean Magnitude DZ: 0.442
Number Observations: 78
Standard Deviation DZ: 0.251
RMSE Z: 0.256
95th Percentile: 0.427
Units: US Survey Feet

Histogram



Min: -1.066

Max: 0.472

Number Of Bins: 20

Bin Interval: 0.077

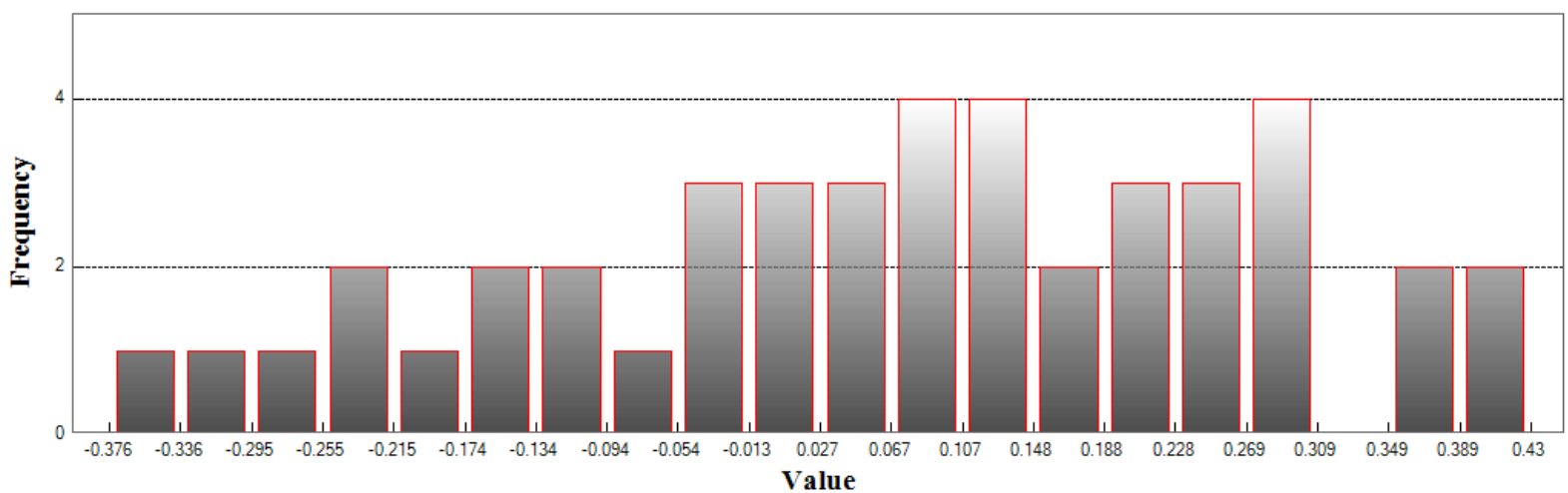


DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: Urban
Minimum DZ: -0.376
Maximum DZ: 0.43
Mean DZ: 0.07
Mean Magnitude DZ: 0.42
Number Observations: 44
Standard Deviation DZ: 0.201
RMSE Z: 0.21
95th Percentile: 0.385
Units: US Survey Feet

Histogram



Min: -0.376

Max: 0.43

Number Of Bins: 20

Bin Interval: 0.04



DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: High Grass

Minimum DZ: -0.427

Maximum DZ: 0.414

Mean DZ: 0.031

Mean Magnitude DZ: 0.494

Number Observations: 4

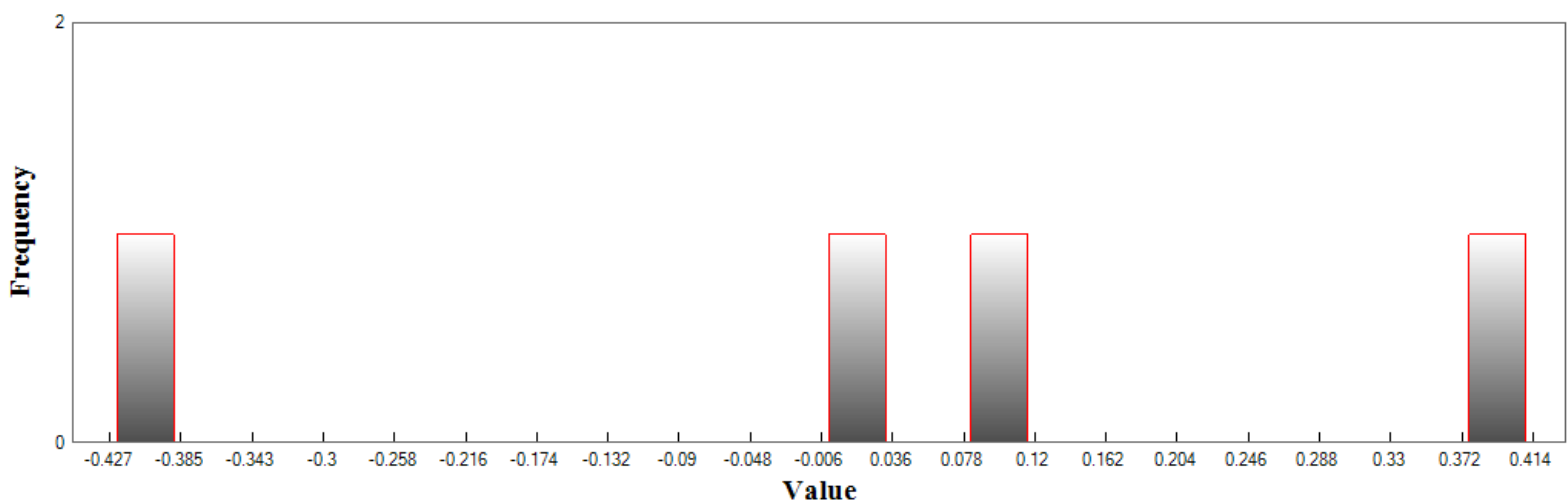
Standard Deviation DZ: 0.348

RMSE Z: 0.303

95th Percentile: 0.425

Units: US Survey Feet

Histogram



Min: -0.427

Max: 0.414

Number Of Bins: 20

Bin Interval: 0.042



DEM (Continued)

Consolidated Vertical Accuracy

LandCover Type: ALL, Urban, Bare Earth, High Grass

Minimum DZ: -1.066

Maximum DZ: 0.472

Mean DZ: 0.059

Mean Magnitude DZ: 0.442

Number Observations: 78

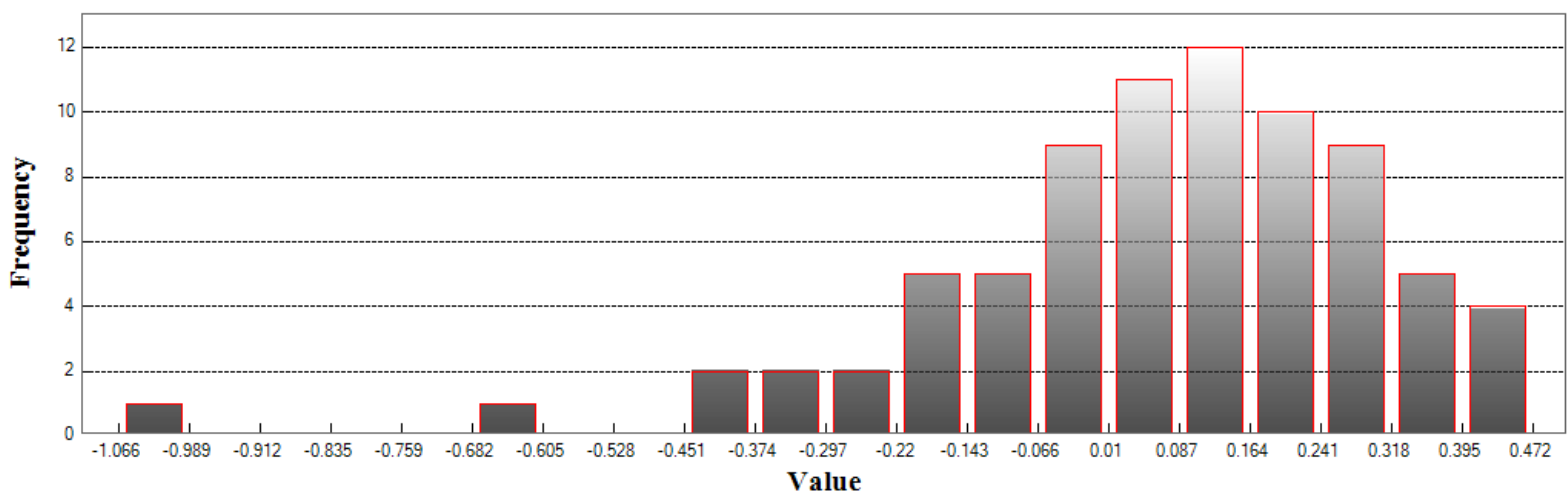
Standard Deviation DZ: 0.251

RMSE Z: 0.256

95th Percentile: 0.427

Units: US Survey Feet

Histogram



Min: -1.066

Max: 0.472

Number Of Bins: 20

Bin Interval: 0.077