



QUALITY CONTROL REPORT

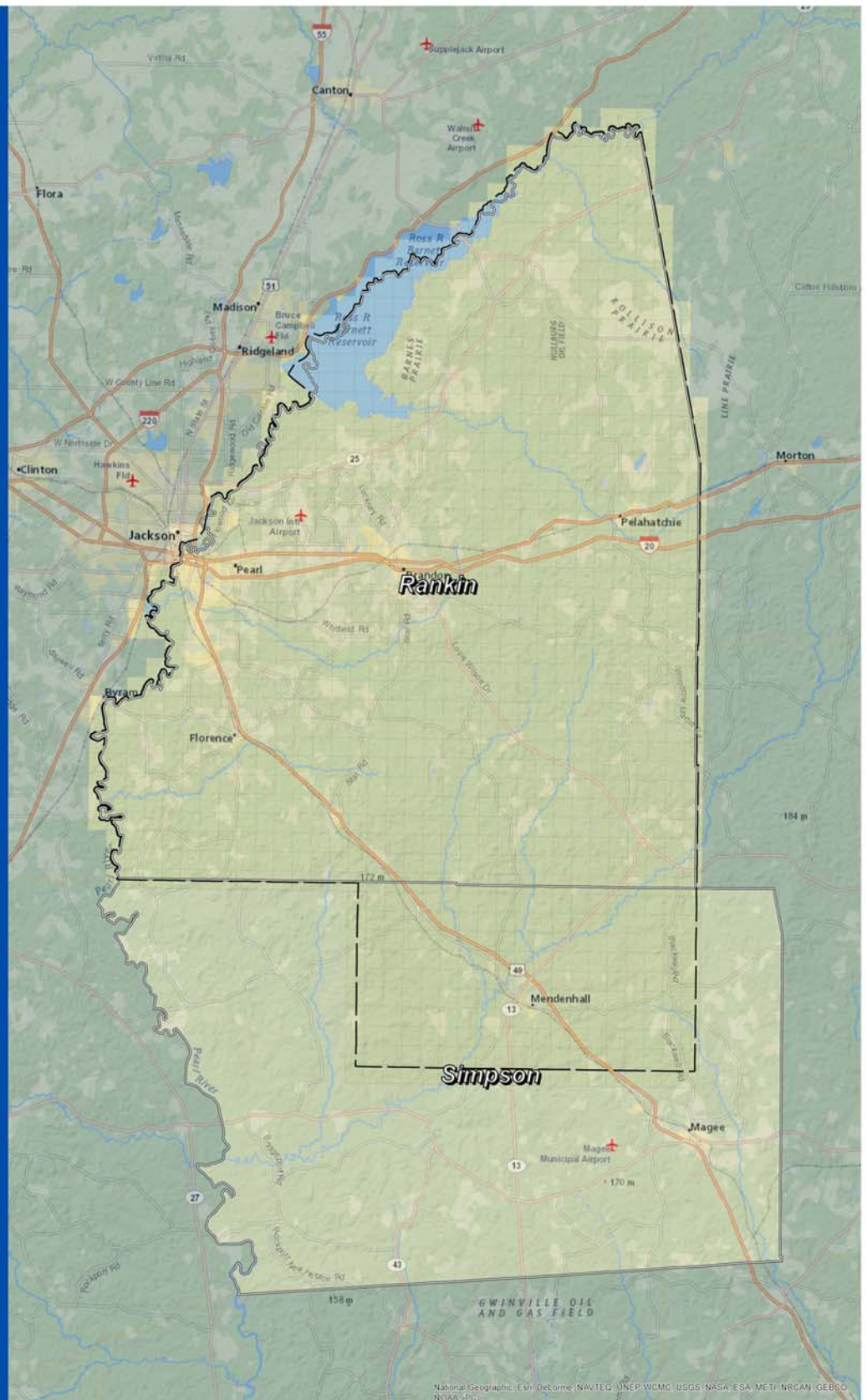
September 27, 2013

Submitted To:

Mississippi Department of
Environmental Quality
Office of Geology
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Independent Quality Control Report

MIDDLE PEARL-STRONG RIVER BASIN

Work Order Number 112

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PROJECT OVERVIEW

Project Overview

MIDDLE PEARL-STRONG RIVER BASIN LIDAR

This report is an assessment of LiDAR acquired in Rankin and a portion of Simpson 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.

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 973 sq. miles in Central Mississippi, covering Rankin and a portion of Simpson County (Figure 1).

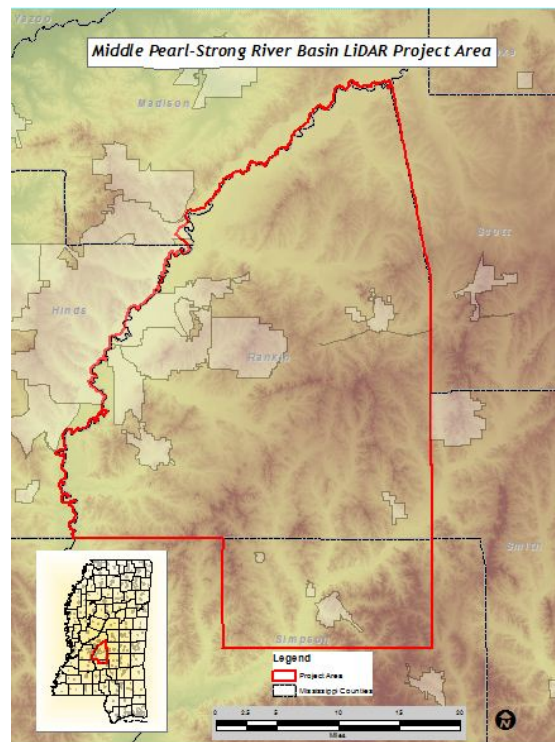


Figure 1- Middle Pearl-Strong River Basin LiDAR Project

PROJECT OVERVIEW

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

- 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 – NAD83-2011
- Project - Mississippi State Plane Zone 2302
- Vertical Datum – NAVD88
- Geoid – 2003
- Units-US Feet

OVERVIEW OF QA SERVICES

This document details the quality assurance review 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 performed on 100% of the deliverable tiles delivered included:

- Verification of coverage compared to tasked AOI
- Readability of the data
- Data format and structure

PROJECT OVERVIEW

- 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 performed on 25% of the deliverable tiles (Figure 2) included:

- 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

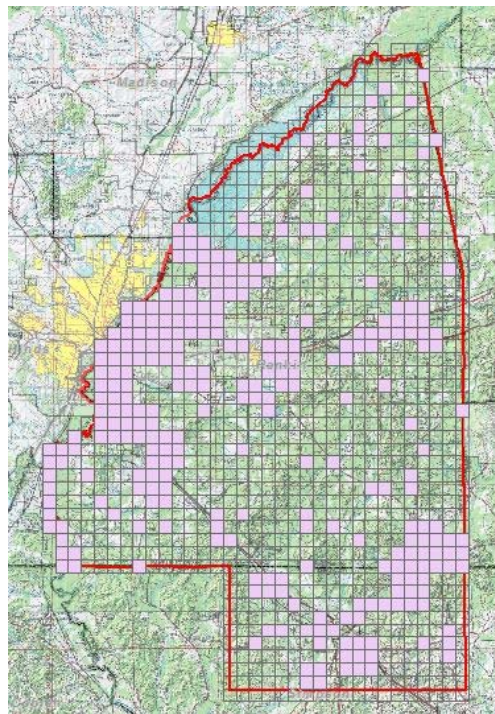


Figure 2 – 25% Tiles Selected for Micro QA Review

PROJECT OVERVIEW

EDIT CALLS

Bridges : Identified 5 bridges included in the DEM.

ACCURACY ASSESSMENT

Accuracy Assessment

Waggoner Engineering, Inc. used 100 QA/QC points for the project. These control points represented five distinct land cover categories as specified by FEMA Appendix A, bare earth, brush, forested, urban, and high grass (Figure 3).

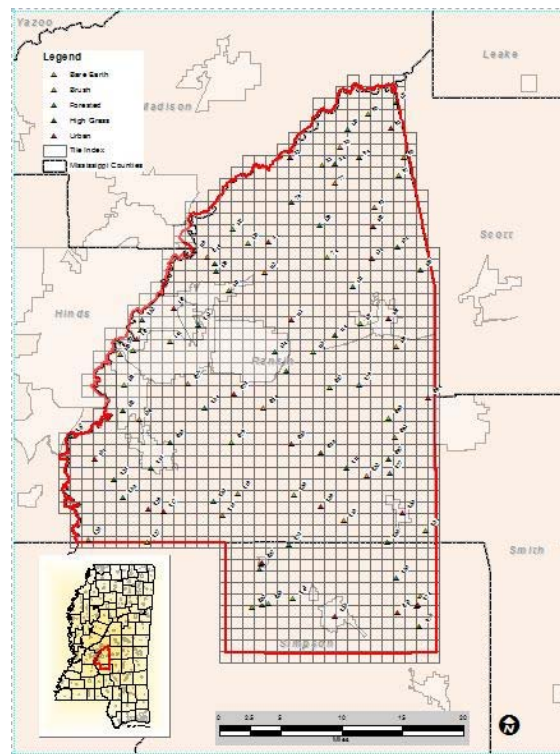


Figure 3 – QA/QC Point Locations

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 B is a report exported from the Topo Analyst software.

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

ACCURACY ASSESSMENT

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. Appendix A is a table for the results.

CONCLUSIONS

Conclusions

There were a handful of calls on the data, relating to bridges in the DEM and LAS deliverables. The calls were limited in number and revised efficiently by Fugro Earthdata and returned to Waggoner for re-delivery. Overall, the LiDAR had very clean editing and easily passed the accuracy assessment.

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 Middle Pearl-Strong deliverables meet the applicable project specifications as set forth in the contractual guidelines.

APPENDIX A

Appendix A

Vertical Measurements/Calculations

Vertical Measurements/Calculations						
Point Number	Ground Cover Classification	MISSISSIPPI STATE PLANE- ZONE 2302 (NAD83-2011)		NAVD88 Survey Z (US Ft)	LiDAR-Z (US Ft)	ΔZ (cm)
		Easting-X	Northing-Y			
74	Brush	2437185.640	1050590.387	350.740	350.915	5.334
77	Bare Earth	2440347.165	1082461.190	382.113	381.767	10.54608
79	High Grass	2421674.950	1074227.596	392.335	392.501	5.05968
81	Urban	2411668.307	1057269.295	367.955	367.844	3.38328
82	Urban	2420770.570	1093537.529	299.928	299.633	8.9916
83	Brush	2434646.032	1090220.494	345.925	345.901	0.73152
84	High Grass	2440232.310	1091038.906	346.896	346.722	5.30352
85	Bare Earth	2442696.126	1098153.991	348.089	347.889	6.096
90	Brush	2454740.515	1112507.077	337.143	337.308	5.0292
93	Urban	2464863.658	1106572.999	364.948	364.840	3.29184
94	High Grass	2450863.182	1093537.408	340.046	339.960	2.62128
95	Bare Earth	2470174.837	1093598.683	334.279	333.977	9.20496
97	Brush	2467988.725	1086040.560	346.116	346.196	2.4384
98	Bare Earth	2457481.218	1072267.914	391.832	391.654	5.42544
101	High Grass	2467254.096	1055171.538	405.841	405.788	1.61544
102	Urban	2456715.700	1064149.034	391.466	391.145	9.78408
105	High Grass	2477547.414	1044998.896	417.431	417.480	1.49352
106	Bare Earth	2466658.546	1011805.459	425.080	424.817	8.01624
107	Brush	2451563.801	1021641.514	365.147	365.222	2.286
108	Urban	2463474.018	1024142.404	367.747	367.336	12.52728
112	Bare Earth	2409980.061	1044059.337	312.339	312.220	3.62712
113	Urban	2421572.672	1023702.625	432.577	432.372	6.2484
114	High Grass	2440364.715	1017034.201	383.475	383.327	4.51104
115	Brush	2431101.339	1009517.353	406.424	406.462	1.15824
119	Urban	2379599.133	1053235.562	274.789	274.573	6.58368
121	High Grass	2388416.768	1047594.978	332.598	332.522	2.31648
125	Forested	2445642.493	1105884.937	341.775	341.646	3.93192
127	High Grass	2466633.313	1117399.537	335.483	335.332	4.60248
129	Forested	2433616.108	1064636.587	366.085	365.938	4.48056
131	Urban	2456108.688	1050170.323	348.931	348.898	1.00584
133	Forested	2447849.590	1037945.806	356.397	356.304	2.83464
134	Forested	2414302.045	1009650.235	375.110	374.417	21.12264
135	Brush	2402418.613	1056569.959	321.206	321.668	14.08176
137	Brush	2395810.826	1062786.725	324.365	324.351	0.42672
138	Brush	2394084.015	1036359.901	393.774	393.967	5.88264
139	High Grass	2388906.954	1044289.037	315.635	315.852	6.61416
140	Urban	2370325.353	1028658.051	279.999	279.699	9.144
141	Bare Earth	2368683.793	1013961.118	300.876	300.779	2.95656
148	Brush	2352541.300	1010299.378	265.382	265.672	8.8392
149	Urban	2354161.363	1014895.326	267.868	267.857	0.33528
150	Bare Earth	2347089.940	1008461.875	268.737	268.618	3.62712
151	Urban	2336001.278	963273.348	288.367	288.263	3.16992
152	High Grass	2348570.548	983971.271	282.501	282.850	10.63752
153	Brush	2348770.474	995278.203	271.024	270.865	4.84632
154	Bare Earth	2355712.954	980167.179	343.967	343.849	3.59664
1077	Bare Earth	2376785.252	995820.926	309.525	309.345	5.4864
1078	Urban	2396642.768	991342.106	360.198	359.920	8.47344
1079	Brush	2395523.241	970515.923	338.432	338.619	5.69976
1080	High Grass	2369020.962	970093.998	338.158	338.118	1.2192
1084	Bare Earth	2409367.962	985011.194	419.213	419.112	3.07848

Vertical Measurements/Calculations						
Point	Ground Cover Classification	MISSISSIPPI STATE PLANE-		NAVD88 Survey Z	LiDAR-Z (US Ft)	ΔZ (cm)
		Easting-X	Northing-Y			
1085	Urban	2421510.202	969595.897	414.690	414.428	7.98576
1086	High Grass	2434304.180	966145.132	380.265	380.287	0.67056
1087	Brush	2438020.587	993978.239	485.144	485.698	16.88592
1090	Brush	2463607.640	980655.983	457.674	457.508	5.05968
1093	Bare Earth	2466265.638	972741.202	396.506	396.553	1.43256
1094	Urban	2480420.424	989966.223	419.656	419.395	7.95528
1097	High Grass	2463669.725	963012.342	414.649	415.075	12.98448
1100	Urban	2469428.287	939823.896	358.224	358.303	2.40792
1101	Brush	2479396.420	931973.520	318.601	318.693	2.80416
1102	Bare Earth	2453831.583	955786.432	427.159	426.971	5.73024
1105	High Grass	2462945.637	927044.017	334.819	334.632	5.69976
1106	Brush	2422467.549	947732.117	405.412	405.654	7.37616
1109	Urban	2433940.341	942634.713	340.911	340.693	6.64464
1110	Bare Earth	2444253.355	936278.414	426.836	426.706	3.9624
1111	High Grass	2445449.711	959444.216	378.198	378.258	1.8288
1116	Bare Earth	2391496.868	938885.131	477.142	476.886	7.80288
1117	Urban	2365766.234	940273.118	372.957	372.820	4.17576
1118	High Grass	2360314.098	959133.901	289.908	289.897	0.33528
1119	Brush	2398022.086	948362.751	514.342	514.375	1.00584
1126	Bare Earth	2333211.697	928469.373	302.261	301.982	8.50392
1127	Brush	2358567.074	927064.196	387.823	388.193	11.2776
1128	High Grass	2344609.635	954093.426	293.872	293.702	5.1816
1129	Urban	2359421.460	941291.967	328.661	328.721	1.8288
1135	Urban	2440077.794	894980.034	319.098	318.842	7.80288
1137	Bare Earth	2427559.523	882337.445	286.113	286.157	1.34112
1146	High Grass	2408954.401	900209.263	325.743	325.839	2.92608
1148	Brush	2422186.807	902833.944	348.372	348.512	4.2672
1150	Forested	2466839.056	911853.528	330.753	330.791	1.15824
1152	Forested	2356697.167	1023414.051	269.849	270.014	5.0292
1154	Forested	2383972.823	985429.674	300.752	300.622	3.9624
1156	Forested	2348395.514	946419.211	267.677	268.039	11.03376
1158	Forested	2387382.010	944708.299	419.923	420.097	5.30352
1163	Forested	2381058.083	1021253.427	350.260	350.348	2.68224
1167	Forested	2325604.663	972906.691	255.760	255.974	6.52272
1171	Forested	2407617.509	915753.133	333.948	333.814	4.08432
1173	Forested	2420097.204	926232.242	359.217	358.956	7.95528
1174	Urban	2476326.916	900154.795	481.822	481.440	11.64336
1175	High Grass	2476994.120	890750.481	523.084	522.883	6.12648
1177	Forested	2463982.377	957261.722	401.740	401.922	5.54736
1179	Forested	2450704.197	995201.985	544.680	544.903	6.79704
1181	Forested	2419035.372	1001439.804	370.973	370.763	6.4008
1201	Bare Earth	2408196.498	917927.081	350.032	350.054	0.667512
1202	Brush	2404404.783	899095.294	402.336	402.338	0.06096
1205	Brush	2411712.380	900718.560	319.718	319.760	1.28016
1207	Urban	2408540.779	918231.786	346.687	346.779	2.80416
1210	Urban	2467458.868	896517.546	522.918	523.205	8.74776
1211	High Grass	2475489.901	899447.621	499.214	498.739	14.478
1212	Brush	2477158.259	903701.142	517.293	517.189	3.16992
1214	Bare Earth	2384709.821	1050726.467	300.751	300.528	6.79704
1215	High Grass	2355874.118	1019049.272	269.276	269.385	3.32232
						12.550

Appendix B

Topo Analyst -LTE
Accuracy Assessment Report



Project Information

Prepared By: Jimmy Bradley
Project Name: Middle Pearl-Strong River Basin LiDAR
Sensor Info: ALS60 MPiA
Required Nominal Pulse Spacing: 1
Vendor Name: Fugro Earthdata
Units: US Survey Feet
Percent of Extent Tolerance: 10
Date of Aquisition: Start: 1/6/2013 Finish: 2/1/2013

Metadata Information

Tile Index:

Path: J:\MDEM_PL12118.000\LIDAR\Tile_Layout\MS_Layout_973SqMI_SP_NAD83_NSRS2011_Ft_Edited.shp
Number of Polys: 1175

Intensity:

Tile Index Attribute: DEM
Path to Data: J:\MDEM_PL12118.000\LIDAR\DEM
Number of Data Files Matching Attribute: 1175 out of 1175
Number of Data Files With Extent Matching Poly-Extent: 1175 out of 1175

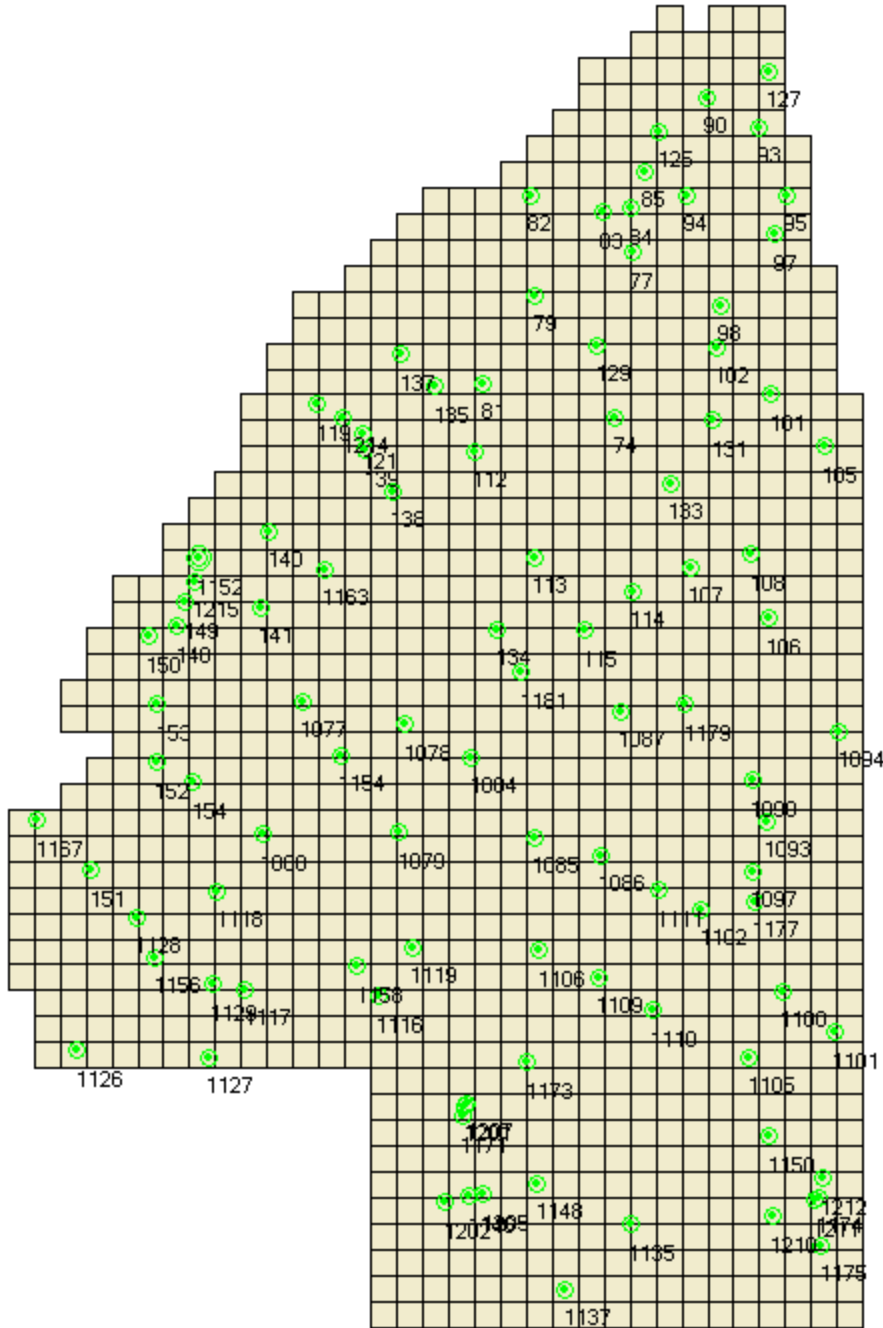
DEM:

Tile Index Attribute: DEM
Path to Data: J:\MDEM_PL12118.000\LIDAR\DEM
Number of Data Files Matching Attribute: 1175 out of 1175
Number of Data Files With Extent Matching Poly-Extent: 1175 out of 1175

LAS:

Tile Index Attribute: LAS
Path to Data: J:\MDEM_PL12118.000\LIDAR\LAS
Number of Data Files Matching Attribute: 1175 out of 1175
Number of Data Files With Extent Matching Poly-Extent: 1043 out of 1175

Tiled-Data Area





LiDAR Accuracy Assessment Summary

LC Type	# of Points	FVA	SVA	CVA
LAS				
ALL	100		0.446	0.446
Bare Earth	19	0.370	0.307	0.307
High Grass	21		0.461	0.461
Brush	22		0.521	0.521
Forested	16		0.472	0.472
Urban	22		0.391	0.391
Total	100			
DEM				
ALL	100		0.428	0.428
Bare Earth	19	0.368	0.306	0.306
High Grass	21		0.426	0.426
Brush	22		0.457	0.457
Forested	16		0.445	0.445
Urban	22		0.410	0.410
Total	100			

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"/> 77					
		2440347.165	1082461.19	382.113	381.767	381.792
				-0.346	-0.321	Bare Earth
2)	<input checked="" type="checkbox"/> 85					
		2442696.126	1098153.991	348.089	347.968	347.94
				-0.121	-0.149	Bare Earth
3)	<input checked="" type="checkbox"/> 95					
		2470174.837	1093598.683	334.279	333.977	334.026
				-0.302	-0.253	Bare Earth
4)	<input checked="" type="checkbox"/> 98					
		2457481.218	1072267.914	391.832	391.654	391.622
				-0.178	-0.21	Bare Earth
5)	<input checked="" type="checkbox"/> 106					
		2466658.546	1011805.459	425.08	424.817	424.775
				-0.263	-0.305	Bare Earth
6)	<input checked="" type="checkbox"/> 112					
		2409980.061	1044059.337	312.339	312.218	312.273
				-0.121	-0.066	Bare Earth
7)	<input checked="" type="checkbox"/> 141					
		2368683.793	1013961.118	300.876	300.78	300.79
				-0.096	-0.086	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
8)	<input checked="" type="checkbox"/>	150				
		2347089.94	1008461.875	268.737	268.618	268.616
				-0.119	-0.121	Bare Earth
9)	<input checked="" type="checkbox"/>	154				
		2355712.954	980167.179	343.967	343.849	343.824
				-0.118	-0.143	Bare Earth
10)	<input checked="" type="checkbox"/>	1077				
		2376785.252	995820.926	309.525	309.345	309.338
				-0.18	-0.187	Bare Earth
11)	<input checked="" type="checkbox"/>	1084				
		2409367.962	985011.194	419.213	419.112	419.132
				-0.101	-0.081	Bare Earth
12)	<input checked="" type="checkbox"/>	1093				
		2466265.638	972741.202	396.506	396.554	396.554
				0.048	0.048	Bare Earth
13)	<input checked="" type="checkbox"/>	1102				
		2453831.583	955786.432	427.159	426.971	427.035
				-0.188	-0.124	Bare Earth
14)	<input checked="" type="checkbox"/>	1110				
		2444253.355	936278.414	426.836	426.706	426.732
				-0.13	-0.104	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
15)	<input checked="" type="checkbox"/>	1116				
		2391496.868	938885.131	477.142	476.886	476.853
				-0.256	-0.289	Bare Earth
16)	<input checked="" type="checkbox"/>	1126				
		2333211.697	928469.373	302.261	301.982	301.969
				-0.279	-0.292	Bare Earth
17)	<input checked="" type="checkbox"/>	1137				
		2427559.523	882337.445	286.113	286.157	286.219
				0.044	0.106	Bare Earth
18)	<input checked="" type="checkbox"/>	1201				
		2408196.498	917927.081	350.032	350.054	349.952
				0.022	-0.08	Bare Earth
19)	<input checked="" type="checkbox"/>	1214				
		2384709.821	1050726.467	300.751	300.528	300.534
				-0.223	-0.217	Bare Earth
20)	<input checked="" type="checkbox"/>	79				
		2421674.95	1074227.596	392.335	392.501	392.439
				0.166	0.104	High Grass
21)	<input checked="" type="checkbox"/>	84				
		2440232.31	1091038.906	346.896	346.722	346.758
				-0.174	-0.138	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
22)	<input checked="" type="checkbox"/>	94				
		2450863.182	1093537.408	340.046	339.875	339.856
				-0.171	-0.19	High Grass
23)	<input checked="" type="checkbox"/>	101				
		2467254.096	1055171.538	405.841	405.788	405.754
				-0.053	-0.087	High Grass
24)	<input checked="" type="checkbox"/>	105				
		2477547.414	1044998.896	417.431	417.48	417.447
				0.049	0.016	High Grass
25)	<input checked="" type="checkbox"/>	114				
		2440364.715	1017034.201	383.475	383.327	383.417
				-0.148	-0.058	High Grass
26)	<input checked="" type="checkbox"/>	121				
		2388416.768	1047594.978	332.598	332.522	332.541
				-0.076	-0.057	High Grass
27)	<input checked="" type="checkbox"/>	127				
		2466633.313	1117399.537	335.483	335.332	335.295
				-0.151	-0.188	High Grass
28)	<input checked="" type="checkbox"/>	139				
		2388906.954	1044289.037	315.635	315.852	315.814
				0.217	0.179	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
29)	<input checked="" type="checkbox"/>	152				
		2348570.548	983971.271	282.501	282.85	282.839
				0.349	0.338	High Grass
30)	<input checked="" type="checkbox"/>	1080				
		2369020.962	970093.998	338.158	338.118	338.162
				-0.04	0.004	High Grass
31)	<input checked="" type="checkbox"/>	1086				
		2434304.18	966145.132	380.265	380.287	380.491
				0.022	0.226	High Grass
32)	<input checked="" type="checkbox"/>	1097				
		2463669.725	963012.342	414.649	415.075	415.231
				0.426	0.582	High Grass
33)	<input checked="" type="checkbox"/>	1105				
		2462945.637	927044.017	334.819	334.632	334.634
				-0.187	-0.185	High Grass
34)	<input checked="" type="checkbox"/>	1111				
		2445449.711	959444.216	378.198	378.258	378.277
				0.06	0.079	High Grass
35)	<input checked="" type="checkbox"/>	1118				
		2360314.098	959133.901	289.908	289.897	289.903
				-0.011	-0.005	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
36)	<input checked="" type="checkbox"/>	1128				
		2344609.635	954093.426	293.872	293.702	293.687
				-0.17	-0.185	High Grass
37)	<input checked="" type="checkbox"/>	1146				
		2408954.401	900209.263	325.743	325.84	325.74
				0.097	-0.003	High Grass
38)	<input checked="" type="checkbox"/>	1175				
		2476994.12	890750.481	523.084	522.884	522.878
				-0.2	-0.206	High Grass
39)	<input checked="" type="checkbox"/>	1211				
		2475489.901	899447.621	499.214	498.74	498.753
				-0.474	-0.461	High Grass
40)	<input checked="" type="checkbox"/>	1215				
		2355874.118	1019049.272	269.276	269.386	269.393
				0.11	0.117	High Grass
41)	<input checked="" type="checkbox"/>	74				
		2437185.64	1050590.387	350.74	350.915	350.935
				0.175	0.195	Brush
42)	<input checked="" type="checkbox"/>	83				
		2434646.032	1090220.494	345.925	345.901	345.787
				-0.024	-0.138	Brush



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"/>	90				
		2454740.515	1112507.077	337.143	337.308	337.208
				0.165	0.065	Brush
44)	<input checked="" type="checkbox"/>	97				
		2467988.725	1086040.56	346.116	346.196	346.204
				0.08	0.088	Brush
45)	<input checked="" type="checkbox"/>	107				
		2451563.801	1021641.514	365.147	365.054	365.151
				-0.093	0.004	Brush
46)	<input checked="" type="checkbox"/>	115				
		2431101.339	1009517.353	406.424	406.462	406.503
				0.038	0.079	Brush
47)	<input checked="" type="checkbox"/>	135				
		2402418.613	1056569.959	321.206	321.668	321.652
				0.462	0.446	Brush
48)	<input checked="" type="checkbox"/>	137				
		2395810.826	1062786.725	324.365	324.351	324.438
				-0.014	0.073	Brush
49)	<input checked="" type="checkbox"/>	138				
		2394084.015	1036359.901	393.774	393.967	393.938
				0.193	0.164	Brush



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"/>	148				
		2352541.3	1010299.378	265.382	265.672	265.682
				0.29	0.3	Brush
51)	<input checked="" type="checkbox"/>	153				
		2348770.474	995278.203	271.024	270.865	270.861
				-0.159	-0.163	Brush
52)	<input checked="" type="checkbox"/>	1079				
		2395523.241	970515.923	338.432	338.62	338.796
				0.188	0.364	Brush
53)	<input checked="" type="checkbox"/>	1087				
		2438020.587	993978.239	485.144	485.698	485.695
				0.554	0.551	Brush
54)	<input checked="" type="checkbox"/>	1090				
		2463607.64	980655.983	457.674	457.508	457.571
				-0.166	-0.103	Brush
55)	<input checked="" type="checkbox"/>	1101				
		2479396.42	931973.52	318.601	318.693	318.636
				0.092	0.035	Brush
56)	<input checked="" type="checkbox"/>	1106				
		2422467.549	947732.117	405.412	405.654	405.457
				0.242	0.045	Brush



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"/>	1119				
		2398022.086	948362.751	514.342	514.375	514.364
				0.033	0.022	Brush
58)	<input checked="" type="checkbox"/>	1127				
		2358567.074	927064.196	387.823	388.193	388.348
				0.37	0.525	Brush
59)	<input checked="" type="checkbox"/>	1148				
		2422186.807	902833.944	348.372	348.512	348.612
				0.14	0.24	Brush
60)	<input checked="" type="checkbox"/>	1202				
		2404404.783	899095.294	402.336	402.338	402.359
				0.002	0.023	Brush
61)	<input checked="" type="checkbox"/>	1205				
		2411712.38	900718.56	319.718	320.061	319.841
				0.343	0.123	Brush
62)	<input checked="" type="checkbox"/>	1212				
		2477158.259	903701.142	517.293	517.189	517.21
				-0.104	-0.083	Brush
63)	<input checked="" type="checkbox"/>	125				
		2445642.493	1105884.937	341.775	341.646	341.635
				-0.129	-0.14	Forested



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"/>	129				
		2433616.108	1064636.587	366.085	365.939	366.054
				-0.146	-0.031	Forested
65)	<input checked="" type="checkbox"/>	133				
		2447849.59	1037945.806	356.397	356.304	356.294
				-0.093	-0.103	Forested
66)	<input checked="" type="checkbox"/>	134				
		2414302.045	1009650.235	375.11	374.417	374.421
				-0.693	-0.689	Forested
67)	<input checked="" type="checkbox"/>	1150				
		2466839.056	911853.528	330.753	330.792	330.759
				0.039	0.006	Forested
68)	<input checked="" type="checkbox"/>	1152				
		2356697.167	1023414.051	269.849	270.014	269.995
				0.165	0.146	Forested
69)	<input checked="" type="checkbox"/>	1154				
		2383972.823	985429.674	300.752	300.622	300.423
				-0.13	-0.329	Forested
70)	<input checked="" type="checkbox"/>	1156				
		2348395.514	946419.211	267.677	268.039	268.077
				0.362	0.4	Forested



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"/>	1158				
		2387382.01	944708.299	419.923	420.098	420.238
				0.175	0.315	Forested
72)	<input checked="" type="checkbox"/>	1163				
		2381058.083	1021253.427	350.26	350.348	350.354
				0.088	0.094	Forested
73)	<input checked="" type="checkbox"/>	1167				
		2325604.663	972906.691	255.76	255.974	255.997
				0.214	0.237	Forested
74)	<input checked="" type="checkbox"/>	1171				
		2407617.509	915753.133	333.948	333.814	333.826
				-0.134	-0.122	Forested
75)	<input checked="" type="checkbox"/>	1173				
		2420097.204	926232.242	359.217	358.956	358.918
				-0.261	-0.299	Forested
76)	<input checked="" type="checkbox"/>	1177				
		2463982.377	957261.722	401.74	401.922	401.918
				0.182	0.178	Forested
77)	<input checked="" type="checkbox"/>	1179				
		2450704.197	995201.985	544.68	544.903	544.824
				0.223	0.144	Forested



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"/>	1181				
		2419035.372	1001439.804	370.973	370.763	370.824
				-0.21	-0.149	Forested
79)	<input checked="" type="checkbox"/>	81				
		2411668.307	1057269.295	367.955	367.844	367.818
				-0.111	-0.137	Urban
80)	<input checked="" type="checkbox"/>	82				
		2420770.57	1093537.529	299.928	299.633	299.657
				-0.295	-0.271	Urban
81)	<input checked="" type="checkbox"/>	93				
		2464863.658	1106572.999	364.948	364.84	364.775
				-0.108	-0.173	Urban
82)	<input checked="" type="checkbox"/>	102				
		2456715.7	1064149.034	391.466	390.79	391.246
				-0.676	-0.22	Urban
83)	<input checked="" type="checkbox"/>	108				
		2463474.018	1024142.404	367.747	367.336	367.352
				-0.411	-0.395	Urban
84)	<input checked="" type="checkbox"/>	113				
		2421572.672	1023702.625	432.577	432.372	432.329
				-0.205	-0.248	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
85)	<input checked="" type="checkbox"/>	119				
		2379599.133	1053235.562	274.789	274.573	274.681
				-0.216	-0.108	Urban
86)	<input checked="" type="checkbox"/>	131				
		2456108.688	1050170.323	348.931	348.899	348.946
				-0.032	0.015	Urban
87)	<input checked="" type="checkbox"/>	140				
		2370325.353	1028658.051	279.999	279.699	279.694
				-0.3	-0.305	Urban
88)	<input checked="" type="checkbox"/>	149				
		2354161.363	1014895.326	267.868	267.857	267.894
				-0.011	0.026	Urban
89)	<input checked="" type="checkbox"/>	151				
		2336001.278	963273.348	288.367	288.263	288.265
				-0.104	-0.102	Urban
90)	<input checked="" type="checkbox"/>	1078				
		2396642.768	991342.106	360.198	359.921	359.889
				-0.277	-0.309	Urban
91)	<input checked="" type="checkbox"/>	1085				
		2421510.202	969595.897	414.69	414.428	414.455
				-0.262	-0.235	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

	ID					
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
92)	<input checked="" type="checkbox"/>	1094				
		2480420.424	989966.223	419.656	419.395	419.417
				-0.261	-0.239	Urban
93)	<input checked="" type="checkbox"/>	1100				
		2469428.287	939823.896	358.224	358.304	358.241
				0.08	0.017	Urban
94)	<input checked="" type="checkbox"/>	1109				
		2433940.341	942634.713	340.911	340.693	340.66
				-0.218	-0.251	Urban
95)	<input checked="" type="checkbox"/>	1117				
		2365766.234	940273.118	372.957	372.82	372.817
				-0.137	-0.14	Urban
96)	<input checked="" type="checkbox"/>	1129				
		2359421.46	941291.967	328.661	328.721	328.734
				0.06	0.073	Urban
97)	<input checked="" type="checkbox"/>	1135				
		2440077.794	894980.034	319.098	318.842	318.867
				-0.256	-0.231	Urban
98)	<input checked="" type="checkbox"/>	1174				
		2476326.916	900154.795	481.822	481.44	481.398
				-0.382	-0.424	Urban



Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				ΔZ DEM	ΔZ LAS	LC Type
99)	<input checked="" type="checkbox"/>	1207				
		2408540.779	918231.786	346.687	346.78	346.7
				0.093	0.013	Urban
100)	<input checked="" type="checkbox"/>	1210				
		2467458.868	896517.546	522.918	523.206	523.236
				0.288	0.318	Urban



LAS

Fundamental Vertical Accuracy

LandCover Type: Bare Earth

Minimum DZ: -0.321

Maximum DZ: 0.106

Mean DZ: -0.151

Mean Magnitude DZ: 0.409

Number Observations: 19

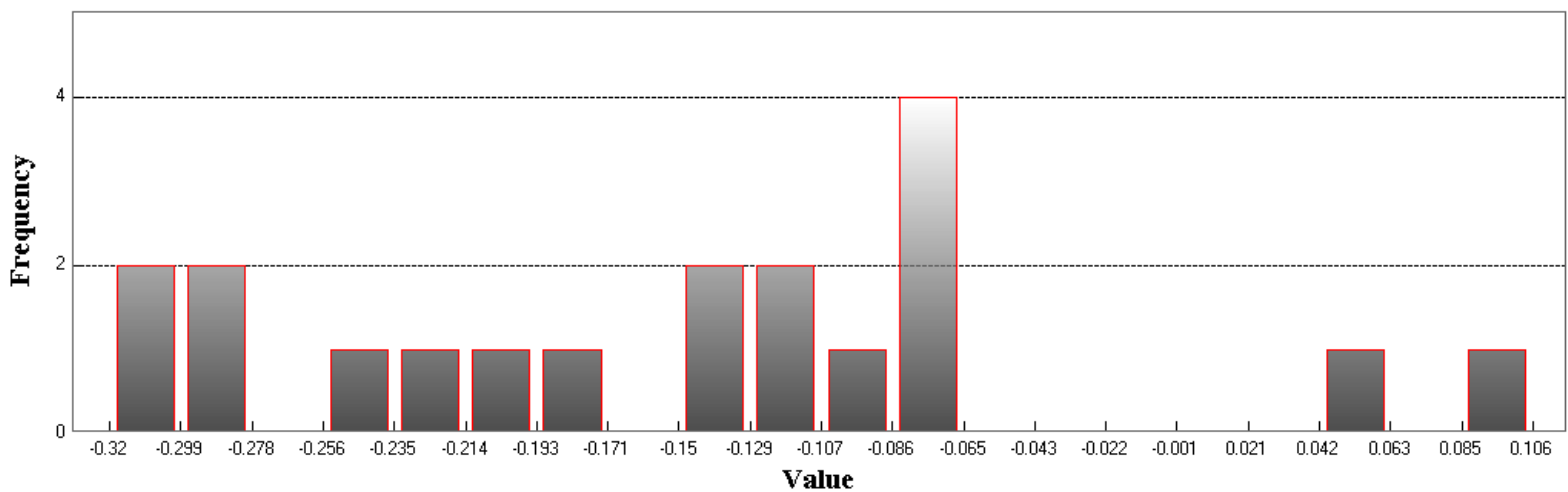
Standard Deviation DZ: 0.116

RMSE Z: 0.189

95% Confidence Level Z: 0.37

Units: US Survey Feet

Histogram



Min: -0.321

Max: 0.106

Number Of Bins: 20

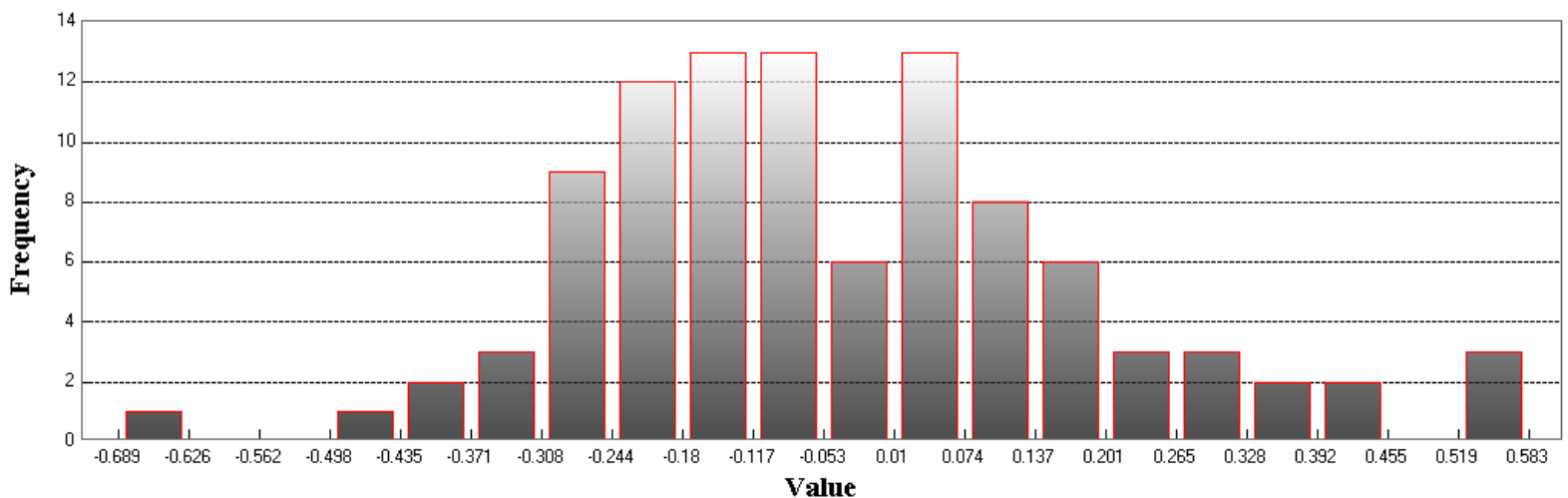
Bin Interval: 0.021

LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: ALL
 Minimum DZ: -0.689
 Maximum DZ: 0.582
 Mean DZ: -0.038
 Mean Magnitude DZ: 0.425
 Number Observations: 100
 Standard Deviation DZ: 0.225
 RMSE Z: 0.227
 95th Percentile: 0.446
 Units: US Survey Feet

Histogram



Min: -0.689

Max: 0.582

Number Of Bins: 20

Bin Interval: 0.064



LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: Bare Earth

Minimum DZ: -0.321

Maximum DZ: 0.106

Mean DZ: -0.151

Mean Magnitude DZ: 0.409

Number Observations: 19

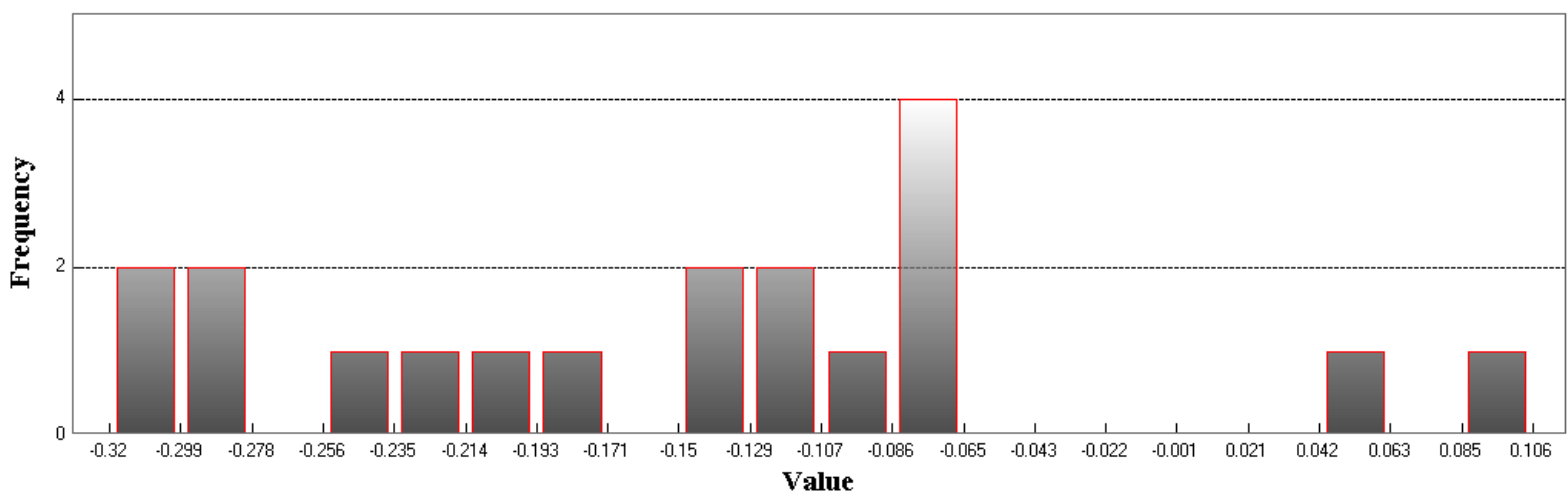
Standard Deviation DZ: 0.116

RMSE Z: 0.189

95th Percentile: 0.307

Units: US Survey Feet

Histogram



Min: -0.321

Max: 0.106

Number Of Bins: 20

Bin Interval: 0.021

LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: High Grass

Minimum DZ: -0.461

Maximum DZ: 0.582

Mean DZ: -0.006

Mean Magnitude DZ: 0.403

Number Observations: 21

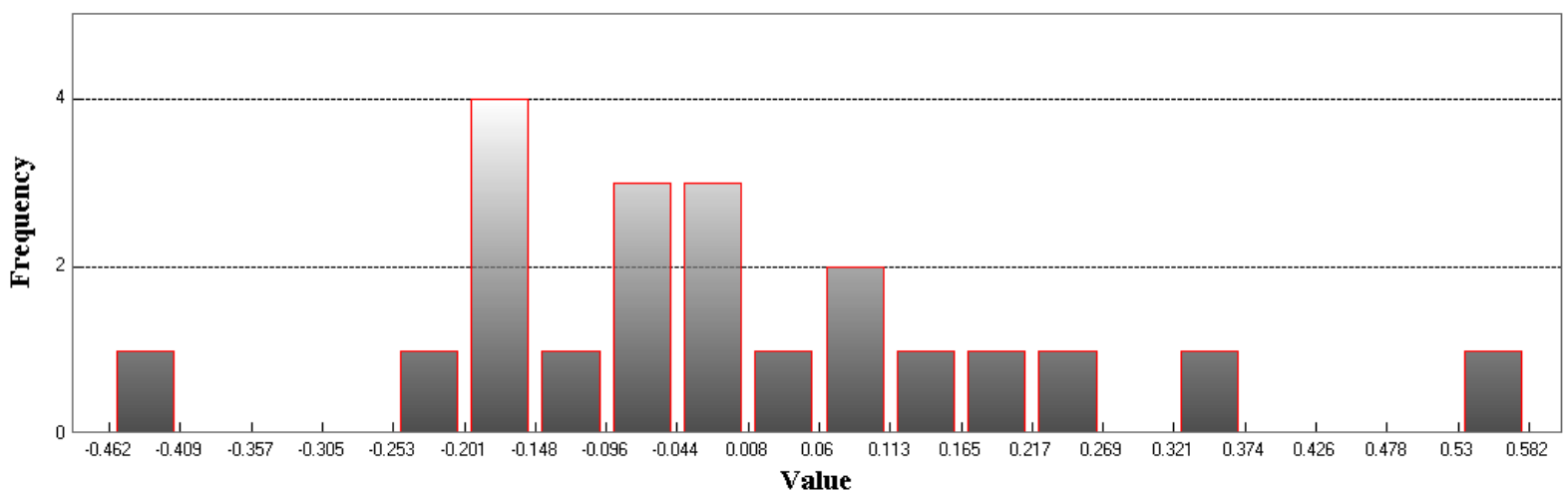
Standard Deviation DZ: 0.223

RMSE Z: 0.218

95th Percentile: 0.461

Units: US Survey Feet

Histogram



Min: -0.461

Max: 0.582

Number Of Bins: 20

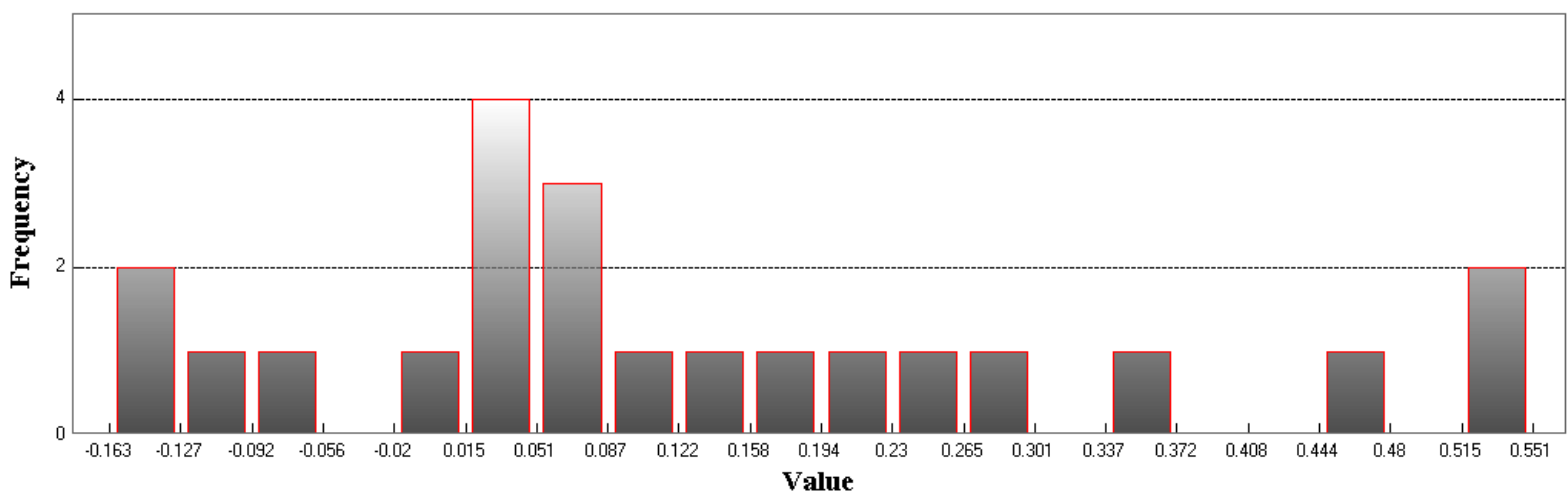
Bin Interval: 0.052

LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: Brush
 Minimum DZ: -0.163
 Maximum DZ: 0.551
 Mean DZ: 0.13
 Mean Magnitude DZ: 0.417
 Number Observations: 22
 Standard Deviation DZ: 0.202
 RMSE Z: 0.236
 95th Percentile: 0.521
 Units: US Survey Feet

Histogram



Min: -0.163

Max: 0.551

Number Of Bins: 20

Bin Interval: 0.036



LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: Forested

Minimum DZ: -0.689

Maximum DZ: 0.4

Mean DZ: -0.021

Mean Magnitude DZ: 0.46

Number Observations: 16

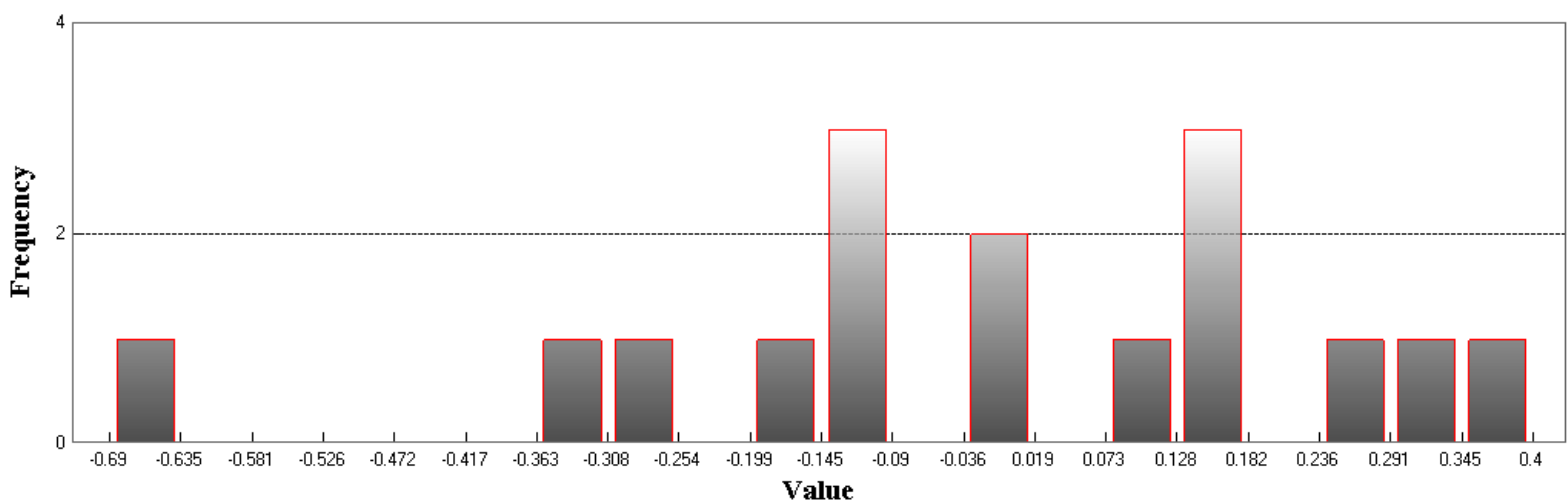
Standard Deviation DZ: 0.275

RMSE Z: 0.267

95th Percentile: 0.472

Units: US Survey Feet

Histogram



Min: -0.689

Max: 0.4

Number Of Bins: 20

Bin Interval: 0.054



LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: Urban

Minimum DZ: -0.424

Maximum DZ: 0.318

Mean DZ: -0.151

Mean Magnitude DZ: 0.44

Number Observations: 22

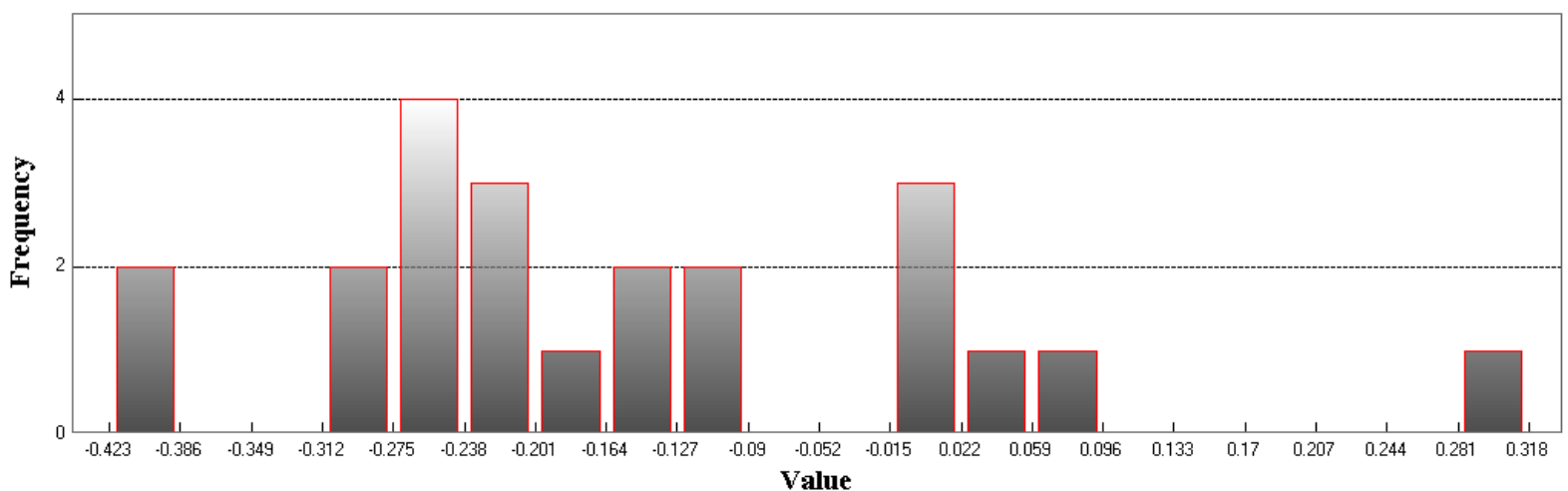
Standard Deviation DZ: 0.173

RMSE Z: 0.227

95th Percentile: 0.391

Units: US Survey Feet

Histogram



Min: -0.424

Max: 0.318

Number Of Bins: 20

Bin Interval: 0.037

LAS (Continued)

Consolidated Vertical Accuracy

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

Minimum DZ: -0.689

Maximum DZ: 0.582

Mean DZ: -0.038

Mean Magnitude DZ: 0.425

Number Observations: 100

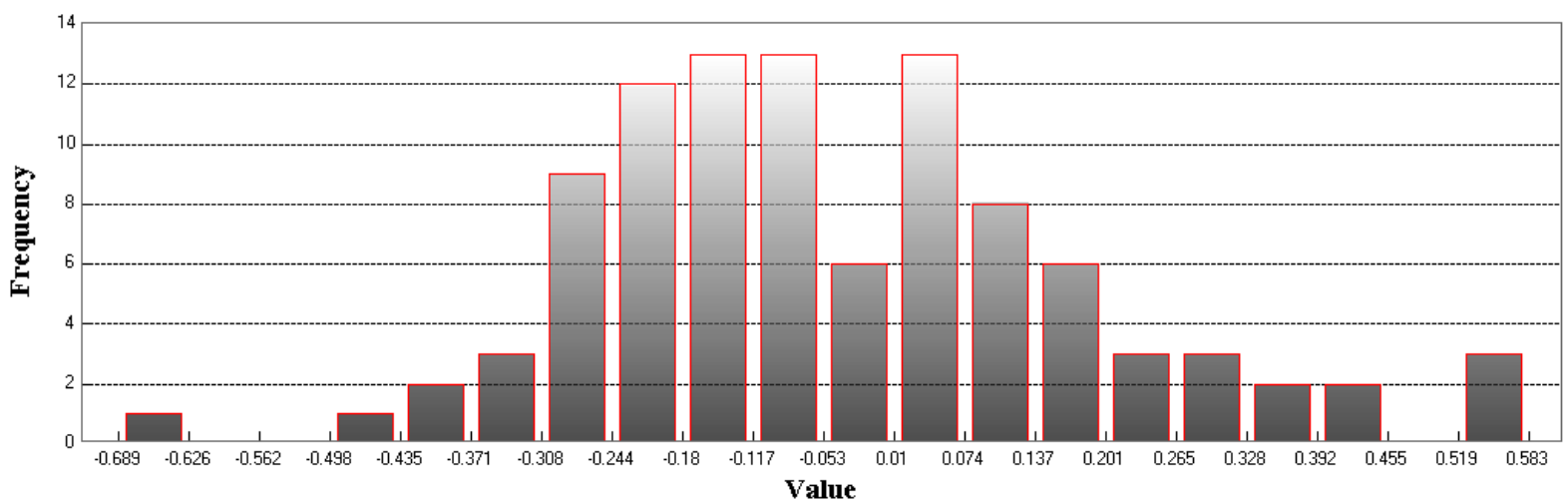
Standard Deviation DZ: 0.225

RMSE Z: 0.227

95th Percentile: 0.446

Units: US Survey Feet

Histogram



Min: -0.689

Max: 0.582

Number Of Bins: 20

Bin Interval: 0.064

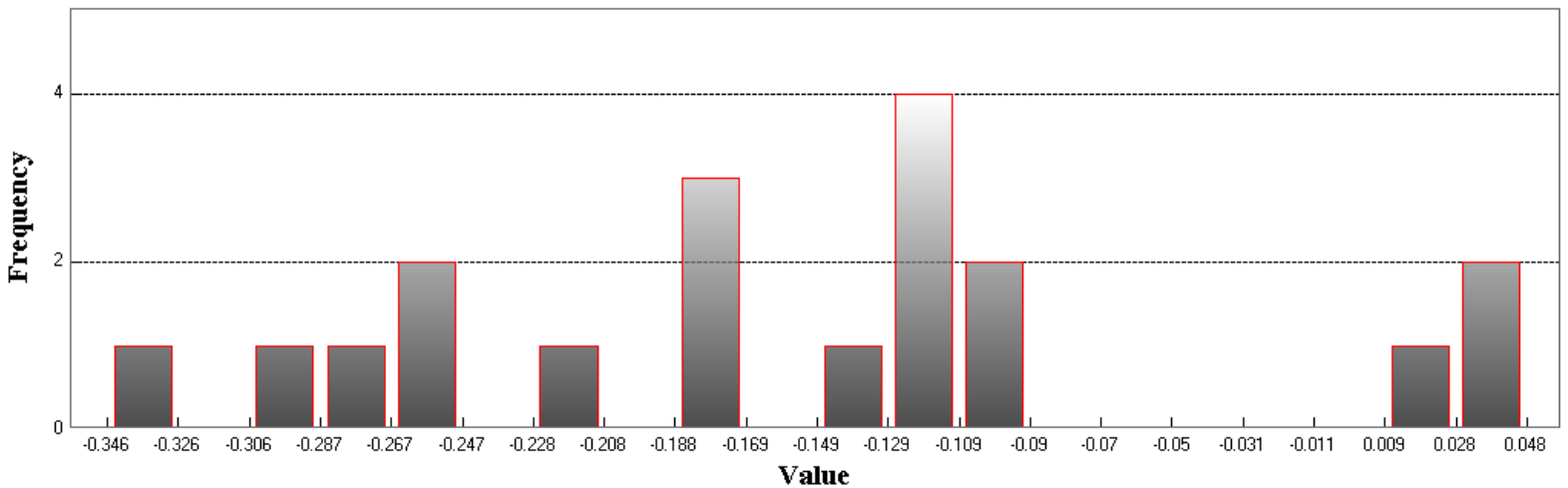


DEM

Fundamental Vertical Accuracy

LandCover Type: Bare Earth
Minimum DZ: -0.346
Maximum DZ: 0.048
Mean DZ: -0.153
Mean Magnitude DZ: 0.406
Number Observations: 19
Standard Deviation DZ: 0.112
RMSE Z: 0.188
95% Confidence Level Z: 0.368
Units: US Survey Feet

Histogram



Min: -0.346
Max: 0.048
Number Of Bins: 20
Bin Interval: 0.02

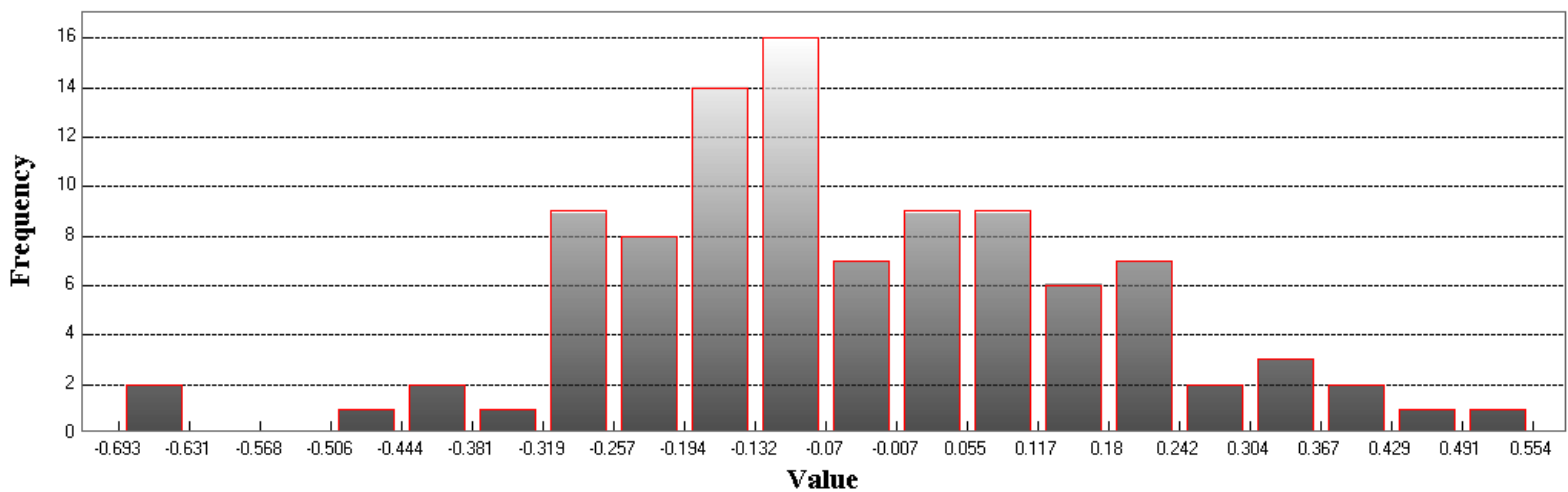


DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: ALL
Minimum DZ: -0.693
Maximum DZ: 0.554
Mean DZ: -0.045
Mean Magnitude DZ: 0.429
Number Observations: 100
Standard Deviation DZ: 0.225
RMSE Z: 0.228
95th Percentile: 0.428
Units: US Survey Feet

Histogram



Min: -0.693

Max: 0.554

Number Of Bins: 20

Bin Interval: 0.062



DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: Bare Earth

Minimum DZ: -0.346

Maximum DZ: 0.048

Mean DZ: -0.153

Mean Magnitude DZ: 0.406

Number Observations: 19

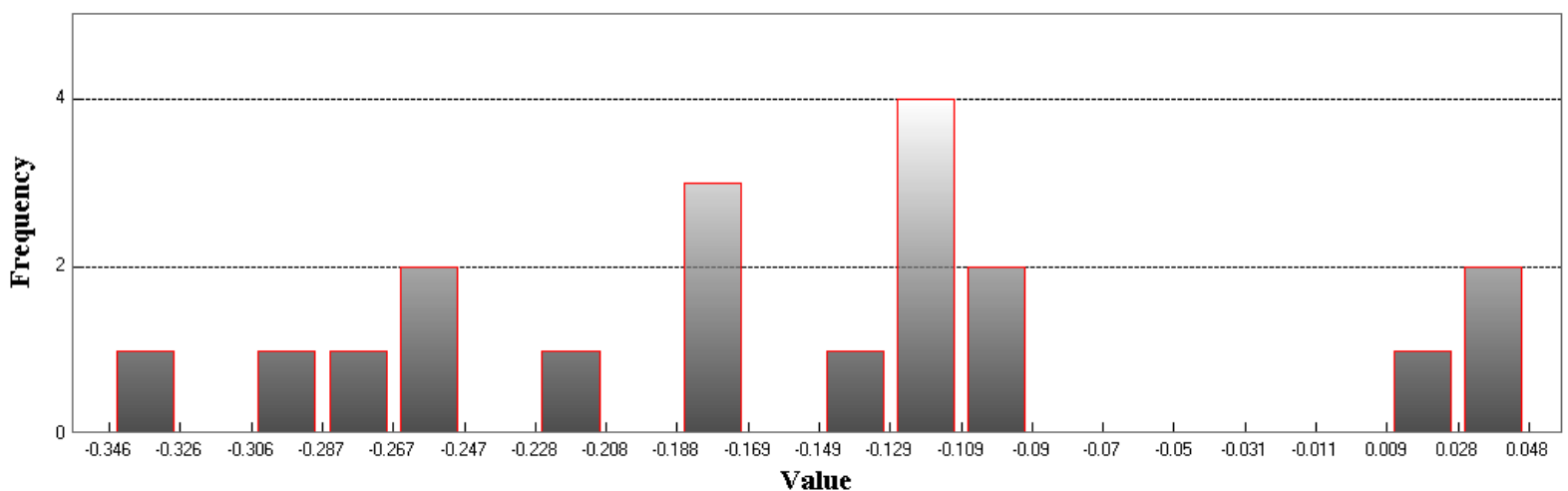
Standard Deviation DZ: 0.112

RMSE Z: 0.188

95th Percentile: 0.306

Units: US Survey Feet

Histogram



Min: -0.346

Max: 0.048

Number Of Bins: 20

Bin Interval: 0.02



DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: High Grass

Minimum DZ: -0.474

Maximum DZ: 0.426

Mean DZ: -0.017

Mean Magnitude DZ: 0.399

Number Observations: 21

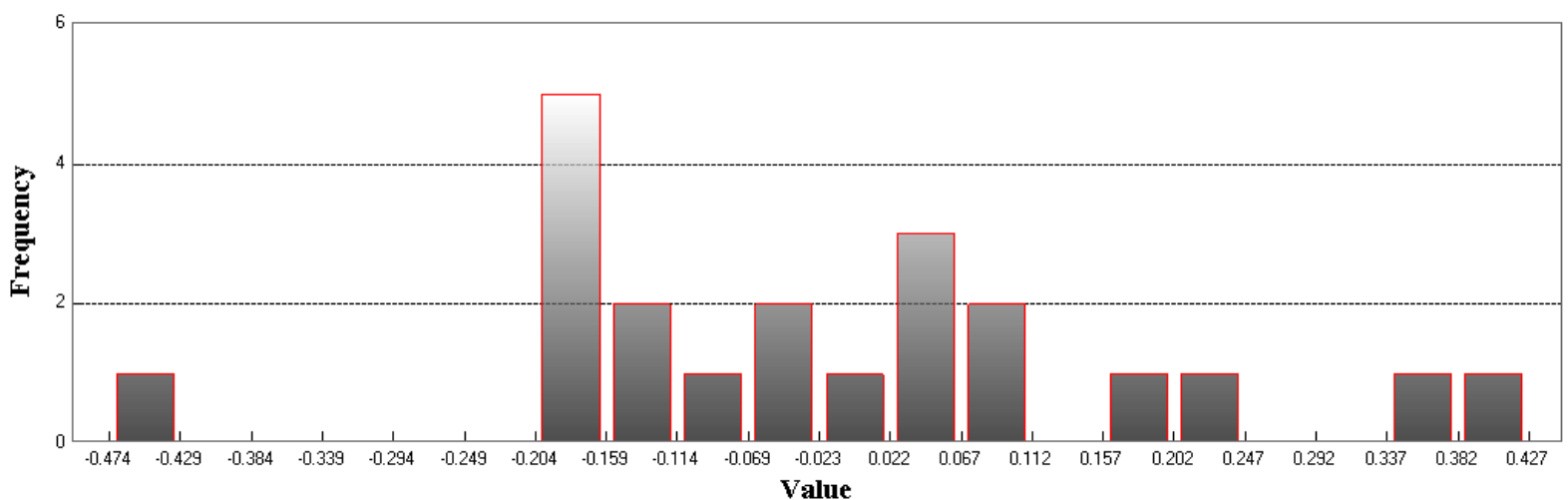
Standard Deviation DZ: 0.205

RMSE Z: 0.201

95th Percentile: 0.426

Units: US Survey Feet

Histogram



Min: -0.474

Max: 0.426

Number Of Bins: 20

Bin Interval: 0.045

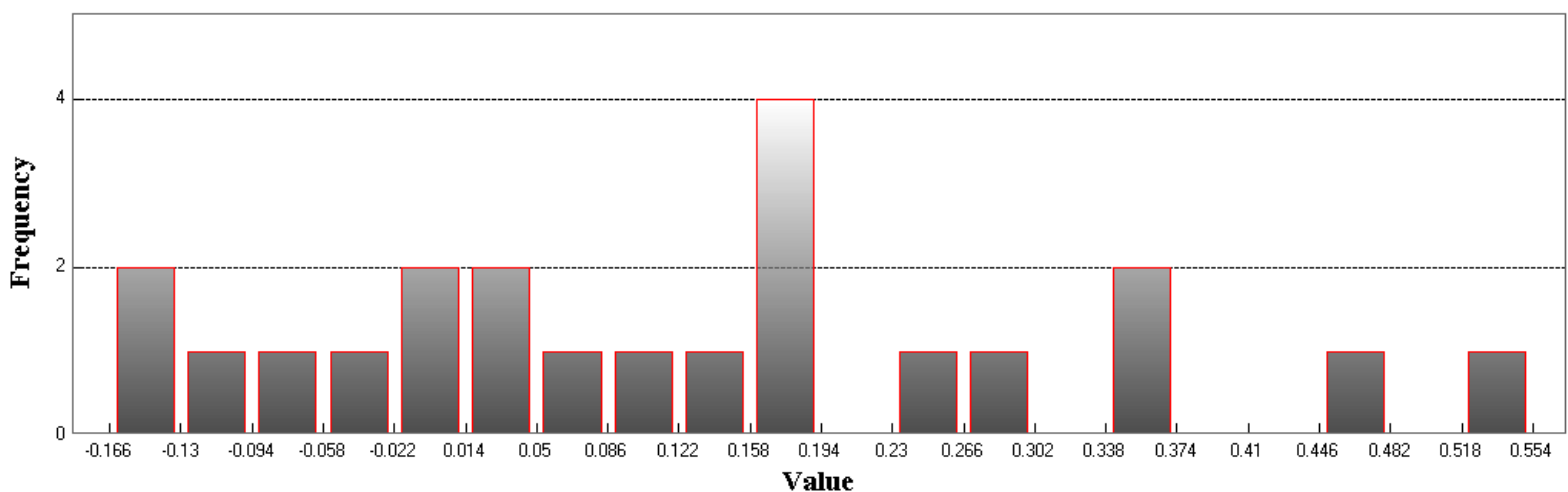


DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: Brush
Minimum DZ: -0.166
Maximum DZ: 0.554
Mean DZ: 0.128
Mean Magnitude DZ: 0.422
Number Observations: 22
Standard Deviation DZ: 0.195
RMSE Z: 0.229
95th Percentile: 0.457
Units: US Survey Feet

Histogram



Min: -0.166

Max: 0.554

Number Of Bins: 20

Bin Interval: 0.036



DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: Forested

Minimum DZ: -0.693

Maximum DZ: 0.362

Mean DZ: -0.022

Mean Magnitude DZ: 0.45

Number Observations: 16

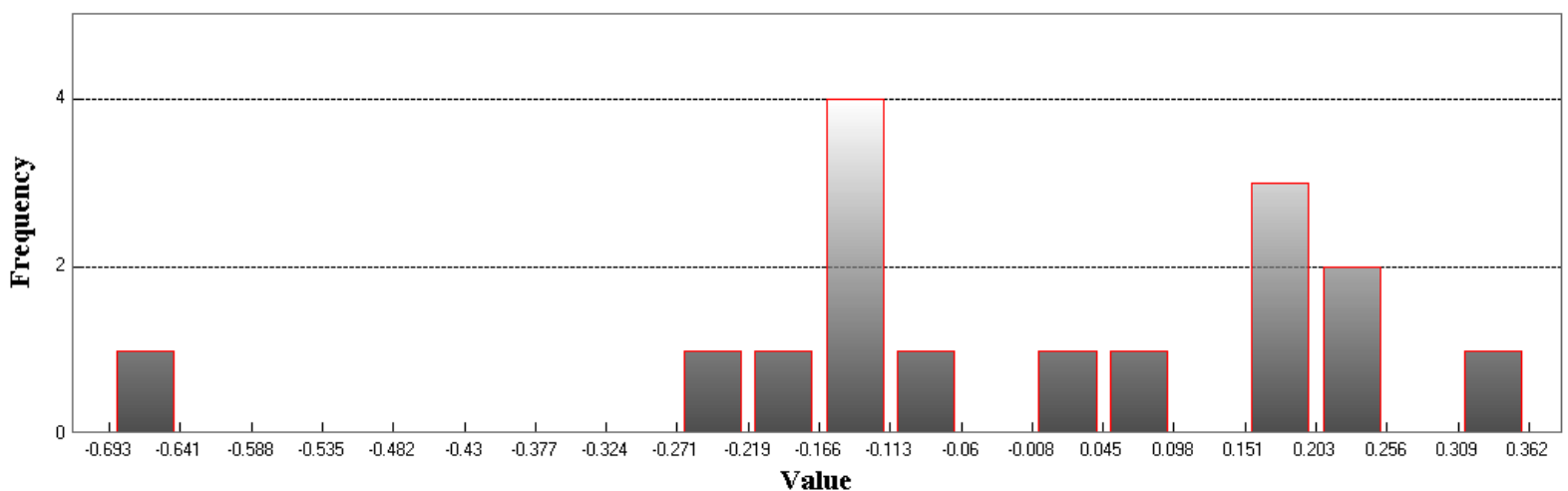
Standard Deviation DZ: 0.257

RMSE Z: 0.25

95th Percentile: 0.445

Units: US Survey Feet

Histogram



Min: -0.693

Max: 0.362

Number Of Bins: 20

Bin Interval: 0.053

DEM (Continued)

Supplemental Vertical Accuracy

LandCover Type: Urban

Minimum DZ: -0.676

Maximum DZ: 0.288

Mean DZ: -0.17

Mean Magnitude DZ: 0.466

Number Observations: 22

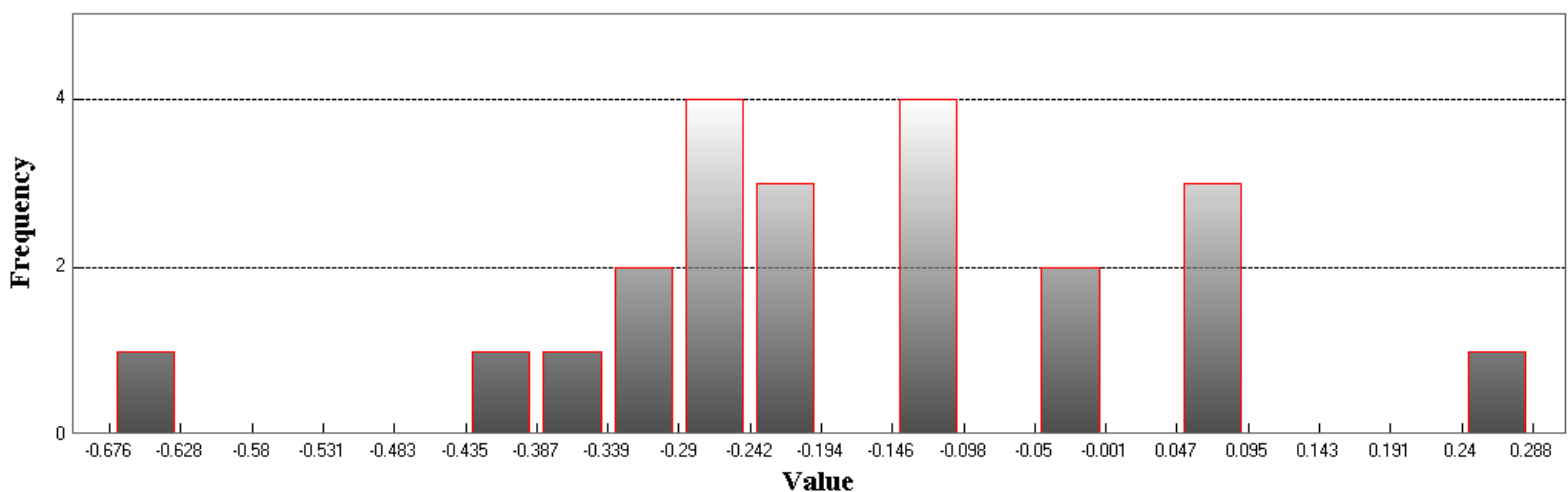
Standard Deviation DZ: 0.205

RMSE Z: 0.263

95th Percentile: 0.41

Units: US Survey Feet

Histogram



Min: -0.676

Max: 0.288

Number Of Bins: 20

Bin Interval: 0.048



DEM (Continued)

Consolidated Vertical Accuracy

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

Minimum DZ: -0.693

Maximum DZ: 0.554

Mean DZ: -0.045

Mean Magnitude DZ: 0.429

Number Observations: 100

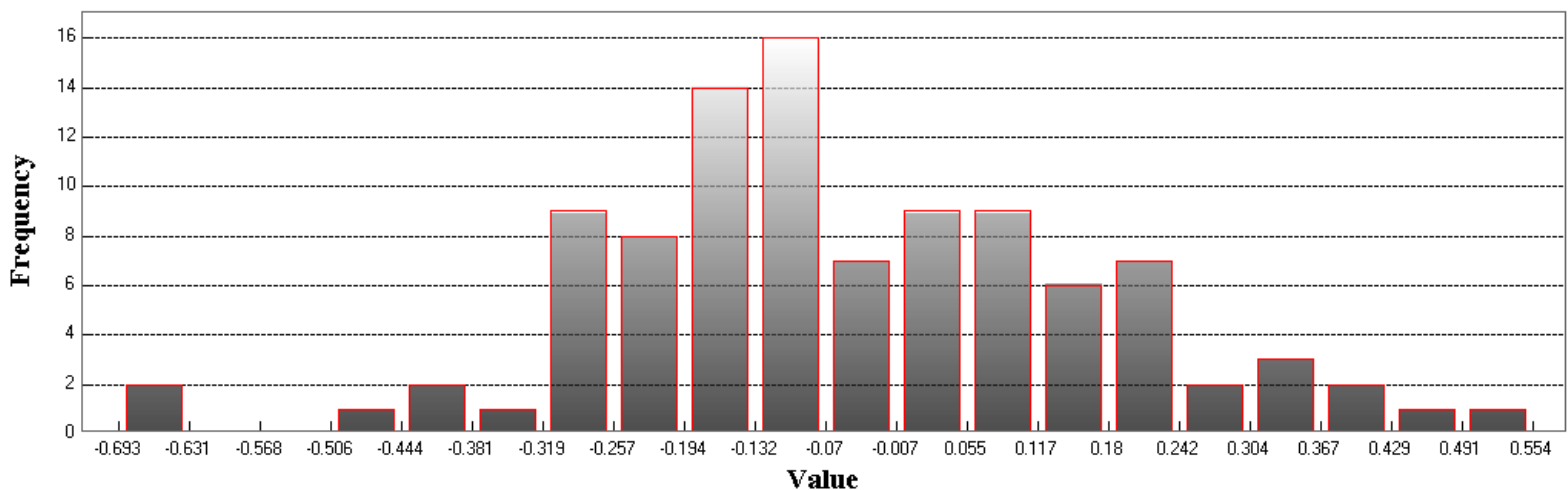
Standard Deviation DZ: 0.225

RMSE Z: 0.228

95th Percentile: 0.428

Units: US Survey Feet

Histogram



Min: -0.693

Max: 0.554

Number Of Bins: 20

Bin Interval: 0.062