



**US Army Corps
of Engineers** ®
St Louis District

DATA PROCESSING REPORT

Buffalo River, Arkansas
Topographic LIDAR Data Survey



Map the present. Manage the future.

OPTIMAL GEOMATICS, INC.
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May 2009

LiDAR Data Processing Procedures Report

Data collection of the survey area resulted in a total of fifty-four flightlines, including four control lines, covering the project area. The range files, flight logs, raw air and ground GPS files were then taken to the office for data processing using DASHMap (Optech, Inc.).

For redundancy and accuracy purposes, the airborne GPS data were processed from two base stations using POSGPS from Applanix, Inc. The agreement between a minimum of two solutions checked or combined between a minimum of two stations was better than 10 cm in each of X, Y, and Z. These trajectories were used in the processing of the inertial data. The inertial data were processed using POSPac MMS from Applanix, Inc. This software produces an SBET (“smooth best estimate of trajectory”) using the GPS trajectory from POSGNSS and the roll, pitch and heading information recorded by the POS (Position Orientation System).

DASHMap uses the SBET to generate a set of data points for each laser return in the LAS file format. Each data point is assigned an echo value so it can be segregated based on the first and last pulse information. This project’s data were processed in strip form, meaning each flight line was processed independently. Processing the lines individually provides the data analyst with the ability to QC the overlap between lines.

The sensor calibration parameters derived for the flight were as follows:

JD105F01:

AltmSerialNo=04SEN155
ImuType=LN200A1
ImuRate=200
IMURoll=0.049800
IMUPitch=-0.004960
IMUHeading=0.014600
UserToImuEx=0.030000
UserToImuEy=-0.060000
UserToImuEz=0.000000
UserToImuDx=-0.090000
UserToImuDy=-0.008000
UserToImuDz=-0.096000
UserToRefDx=-0.051000
UserToRefDy=-0.030000
UserToRefDz=-0.488000
TimeLag=0.00001190
IntensityGainFor3070=20.000000
UseLeftDroopCorrection=5.000000
UseRightDroopCorrection=5.000000
Temperature=10.000000
Pressure=1025.060000
meteoCorrMethod=1
scannerAngleDiffThreshold=2.000000
ScannerAngleLimitingSmootherOn=0
[OpticalModel]
DX0=0.000000
DY0=0.000000
DZ0=0.000000
BEAM0_PITCH=0.000000
BEAM0_ROLL=0.000000
MIRROR_PITCH=0.000000
WINDOW_PITCH=0.000000
WINDOW_YAW=0.000000
[MeteoCrystalPolyCoeff]
CrystalFreq=100.000000
CrystalResolution=50.000000
DegreeOfPoly=-1
f0=0.0000000000000000
f1=0.0000000000000000
f2=0.0000000000000000
f3=0.0000000000000000
[ScannerPolynomialCoefficients]
DegreeOfPoly=4
a0=0.008562706990000
a1=1.0052033000000000
a2=-0.000091189490290
a3=0.000005049667587
a4=0.000000050095613
a5=0.0000000000000000

JD105F02:

AltmSerialNo=04SEN155
ImuType=LN200A1
ImuRate=200
IMURoll=0.049800
IMUPitch=-0.049600
IMUHeading=0.014600
UserToImuEx=0.030000
UserToImuEy=-0.060000
UserToImuEz=0.000000
UserToImuDx=-0.090000
UserToImuDy=-0.008000
UserToImuDz=-0.096000
UserToRefDx=-0.051000
UserToRefDy=-0.030000
UserToRefDz=-0.488000
TimeLag=0.00001190
IntensityGainFor3070=20.000000
UseLeftDroopCorrection=5.000000
UseRightDroopCorrection=5.000000
Temperature=10.000000
Pressure=1025.060000
meteoCorrMethod=1
scannerAngleDiffThreshold=2.000000
ScannerAngleLimitingSmootherOn=0
[OpticalModel]
DX0=0.000000
DY0=0.000000
DZ0=0.000000
BEAM0_PITCH=0.000000
BEAM0_ROLL=0.000000
MIRROR_PITCH=0.000000
WINDOW_PITCH=0.000000
WINDOW_YAW=0.000000
[MeteoCrystalPolyCoeff]
CrystalFreq=100.000000
CrystalResolution=50.000000
DegreeOfPoly=-1
f0=0.0000000000000000
f1=0.0000000000000000
f2=0.0000000000000000
f3=0.0000000000000000
[ScannerPolynomialCoefficients]
DegreeOfPoly=4
a0=0.008562706990000
a1=1.0052033000000000
a2=-0.000091189490290
a3=0.000005049667587
a4=0.000000050095613
a5=0.0000000000000000

JD106F01:

AltmSerialNo=04SEN155
ImuType=LN200A1
ImuRate=200
IMURoll=0.039000
IMUPitch=-0.046600
IMUHeading=0.014600
UserToImuEx=0.030000
UserToImuEy=-0.060000
UserToImuEz=0.000000
UserToImuDx=-0.090000
UserToImuDy=-0.008000
UserToImuDz=-0.096000
UserToRefDx=-0.051000
UserToRefDy=-0.030000
UserToRefDz=-0.488000
TimeLag=0.00001190
IntensityGainFor3070=20.000000
UseLeftDroopCorrection=5.000000
UseRightDroopCorrection=5.000000
Temperature=10.000000
Pressure=1025.060000
meteoCorrMethod=1
scannerAngleDiffThreshold=2.000000
ScannerAngleLimitingSmootherOn=0
[OpticalModel]
DX0=0.000000
DY0=0.000000
DZ0=0.000000
BEAM0_PITCH=0.000000
BEAM0_ROLL=0.000000
MIRROR_PITCH=0.000000
WINDOW_PITCH=0.000000
WINDOW_YAW=0.000000
[MeteoCrystalPolyCoeff]
CrystalFreq=100.000000
CrystalResolution=50.000000
DegreeOfPoly=-1
f0=0.0000000000000000
f1=0.0000000000000000
f2=0.0000000000000000
f3=0.0000000000000000
[ScannerPolynomialCoefficients]
DegreeOfPoly=4
a0=0.008562706990000
a1=1.005593300000000
a2=-0.000091189490290
a3=0.000005049667587
a4=0.00000050095613
a5=0.0000000000000000

JD106F02:

AltmSerialNo=04SEN155
ImuType=LN200A1
ImuRate=200
IMURoll=0.047000
IMUPitch=-0.051600
IMUHeading=0.014600
UserToImuEx=0.030000
UserToImuEy=-0.060000
UserToImuEz=0.000000
UserToImuDx=-0.090000
UserToImuDy=-0.008000
UserToImuDz=-0.096000
UserToRefDx=-0.051000
UserToRefDy=-0.030000
UserToRefDz=-0.488000
TimeLag=0.00001190
IntensityGainFor3070=20.000000
UseLeftDroopCorrection=5.000000
UseRightDroopCorrection=5.000000
Temperature=10.000000
Pressure=1025.060000
meteoCorrMethod=1
scannerAngleDiffThreshold=2.000000
ScannerAngleLimitingSmootherOn=0
[OpticalModel]
DX0=0.000000
DY0=0.000000
DZ0=0.000000
BEAM0_PITCH=0.000000
BEAM0_ROLL=0.000000
MIRROR_PITCH=0.000000
WINDOW_PITCH=0.000000
WINDOW_YAW=0.000000
[MeteoCrystalPolyCoeff]
CrystalFreq=100.000000
CrystalResolution=50.000000
DegreeOfPoly=-1
f0=0.0000000000000000
f1=0.0000000000000000
f2=0.0000000000000000
f3=0.0000000000000000
[ScannerPolynomialCoefficients]
DegreeOfPoly=4
a0=0.008562706990000
a1=1.005183300000000
a2=-0.000091189490290
a3=0.000005049667587
a4=0.00000050095613
a5=0.0000000000000000

Each strip was then imported into a project using TerraScan (Terrasolid, Ltd.) and the project management tool GeoCue (GeoCue Corp.). By creating a project the various flightlines are combined while breaking the dataset as a whole into manageable pieces. This process also converts the dataset from geographic coordinates to the UTM Zone 15N (NAD83), meters, utilizing NADCON. The ellipsoid height values were converted to NAVD88, meters, orthometric values using Geoid03, provided by NGS.

Individual lines were then checked against adjacent lines to ensure a cohesive dataset. Optimal Geomatics, Inc. delivered calibrated LiDAR flights to Merrick in LAS 1.2 format, classified to ASPRS class 1 (unclassified) by flightline.

Upon receipt of the unclassified data, Merrick ran a control report as an independent QC step to validate the calibration process. The resulting RMSEz was 0.04 meters. A copy of this report can be seen in Table 1 below.

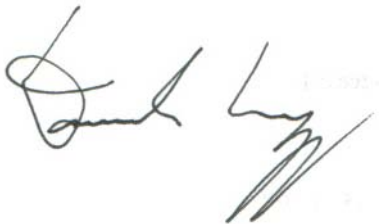
The unclassified LiDAR data set was run through automated filtering routines by Merrick using Merrick Advanced Remote Sensing (MARS®) software. These routines classify 80% to 85% of the data into bald earth and canopy classifications. The LiDAR data was then hand edited by an operator using MARS® to classify the remaining 15% to 20% and clean up any mistakes the automated routines could have made. The resulting RMSEz is 0.04 meters. A copy of this report can be seen in Table 2 below.

The final edited bare-earth (ground) pulses were exported using MARS® as an ESRI float grid (.flt), which was then imported into ArcGIS and converted to an ESRI grid with a 1 meter cell size.

The bare-earth (ground) pulses, the first return pulses and the last return pulses were exported individually using MARS® as .las files. The .las files were then imported into an ESRI file geodatabase version 9.3 to create the bare-earth multipoint feature class, first return multipoint feature class and last return multipoint feature class products.

The LiDAR intensity data was exported using MARS® as an ESRI float grid (.flt), which was then imported into ArcGIS and converted to a 16-bit GeoTiff file.

Respectfully Submitted,
Optimal Geomatics, Inc.



Darrick L. Wagg, P.Geo.
27May2009



TABLE 1:

Project Unit	Meter	
Date	Friday	May 15, 2009
Vertical Accuracy Objective		
Requirement Type	RMSE(z)	
RMSE(z) Objective		0.67
Control Points in Report		170
Elevation Calculation Method		Interpolated from TIN
Control Points with LiDAR Coverage		170
Average Control Error Reported		0.0056
Maximum (highest) Control Error Reported		0.0873
Median Control Error Reported		0.0101
Minimum (lowest) Control Error Reported		-0.197
Standard deviation (sigma) of Z for sample		0.0404
RMSE of Z for sample (RMSE(z))	0.0407	PASS
NSSDA Achievable Contour Interval		0.2
ASPRS Class 1 Achievable Contour Interval		0.2
NMAS Achievable Contour Interval		0.2

Control	Control Point								
Id	Control Point X	Control Point Y	Cover	Z	Z from LiDAR	Z Error	Min Z	Med Z	Max Z
38	484245.9454	4003086.905	Yes	358.7538	358.8411	0.0873	358.79	358.84	358.87
83	485892.9828	4004180.345	Yes	350.9571	351.0363	0.0792	350.97	351.04	351.1
1002	487608.6088	3993212.329	Yes	255.7227	255.8017	0.079	255.69	255.8	255.84
26	484243.4558	4003064.405	Yes	358.2646	358.3433	0.0787	358.31	358.36	358.44
1001	487608.3162	3993211.107	Yes	255.5781	255.6564	0.0783	255.42	255.46	255.69
84	485895.517	4004183.552	Yes	350.8285	350.901	0.0725	350.89	350.92	350.98
107	485895.7398	4004195.536	Yes	351.0676	351.1399	0.0723	351.13	351.15	351.16
1	483817.1074	4005115.479	Yes	394.5323	394.6045	0.0722	394.49	394.53	394.68
33	484245.0834	4003079.233	Yes	358.629	358.6914	0.0624	358.66	358.69	358.73
86	485897.907	4004189.882	Yes	350.9266	350.9849	0.0583	350.97	350.98	350.99
40	484246.6461	4003089.804	Yes	358.7955	358.8535	0.058	358.83	358.89	358.92
BRNW-									
SG	483816.9662	4005115.911	Yes	394.582	394.6381	0.0561	394.55	394.57	394.68
44	484247.7729	4003095.584	Yes	358.9167	358.9715	0.0548	358.93	358.98	358.99
85	485897.2253	4004186.613	Yes	350.9107	350.9608	0.0501	350.92	350.93	350.97
57	485884.7446	4004185.946	Yes	351.3012	351.3508	0.0496	351.33	351.34	351.38
94	485906.2467	4004211.726	Yes	350.3047	350.3541	0.0494	350.32	350.33	350.42
90	485900.9794	4004201.559	Yes	350.7278	350.7772	0.0494	350.75	350.75	350.81
1027	487622.0884	3993192.222	Yes	256.602	256.65	0.048	256.65	256.65	256.65
27	484243.7433	4003066.554	Yes	358.3192	358.3658	0.0466	358.33	358.34	358.41
82	485891.9473	4004177.732	Yes	351.047	351.0931	0.0461	351.08	351.09	351.16
37	484245.741	4003085.479	Yes	358.7387	358.7842	0.0455	358.71	358.79	358.81
29	484244.2917	4003071.258	Yes	358.4333	358.4779	0.0446	358.43	358.43	358.51
103	485900.8639	4004210.747	Yes	350.7072	350.7518	0.0446	350.73	350.77	350.83
92	485904.3593	4004207.329	Yes	350.4681	350.5103	0.0422	350.46	350.49	350.56
87	485898.3401	4004192.499	Yes	350.9476	350.989	0.0414	350.93	350.95	351.02
43	484247.5436	4003094.088	Yes	358.8517	358.8915	0.0398	358.82	358.93	358.96
35	484245.4013	4003082.395	Yes	358.725	358.7643	0.0393	358.72	358.77	358.77
HARP									
72	487608.2022	3993211.407	Yes	255.642	255.6813	0.0393	255.64	255.69	255.71
72	485853.8057	4004174.254	Yes	351.7955	351.8343	0.0388	351.81	351.83	351.84
1008	487623.4948	3993210.297	Yes	256.2633	256.3017	0.0384	256.2	256.28	256.33
1007	487615.7029	3993209.137	Yes	256.3315	256.3698	0.0383	256.14	256.37	256.39

9	484263.2791	4003099.626	Yes	359.564	359.6	0.036	359.6	359.6	359.6
32	484244.9313	4003077.536	Yes	358.5939	358.6293	0.0354	358.6	358.61	358.64
42	484247.2724	4003092.874	Yes	358.8417	358.877	0.0353	358.82	358.88	358.89
80	485889.1893	4004173.751	Yes	351.1724	351.2072	0.0348	351.17	351.23	351.26
56	485885.7663	4004188.149	Yes	351.3005	351.3353	0.0348	351.3	351.33	351.34
91	485902.724	4004204.147	Yes	350.592	350.6259	0.0339	350.61	350.61	350.68
41	484246.9546	4003091.438	Yes	358.8567	358.8898	0.0331	358.85	358.9	358.92
28	484243.9698	4003068.97	Yes	358.3849	358.4179	0.033	358.35	358.39	358.44
75	485846.6374	4004174.55	Yes	351.9605	351.9933	0.0328	351.95	351.97	352.05
62	485874.2608	4004176.063	Yes	351.4439	351.4756	0.0317	351.47	351.48	351.48
66	485864.8698	4004174.471	Yes	351.5526	351.5835	0.0309	351.55	351.57	351.59
59	485881.4206	4004181.011	Yes	351.3668	351.3975	0.0307	351.36	351.41	351.42
36	484245.6064	4003083.824	Yes	358.7297	358.7597	0.03	358.74	358.77	358.79
98	485909.8356	4004217.93	Yes	350.0985	350.1278	0.0293	350.11	350.13	350.15
1021	487617.7348	3993206.044	Yes	256.4066	256.4355	0.0289	256.39	256.4	256.47
70	485856.9942	4004174.195	Yes	351.7283	351.7569	0.0286	351.75	351.76	351.78
100	485904.5056	4004220.718	Yes	350.3793	350.4078	0.0285	350.36	350.4	350.42
1004	487611.6312	3993211.906	Yes	256.0083	256.0366	0.0283	255.99	256.03	256.12
25	484243.2236	4003062.18	Yes	358.223	358.2509	0.0279	358.19	358.3	358.31
52	485888.8107	4004198.292	Yes	351.2747	351.3025	0.0278	351.27	351.28	351.31
1058	487609.5505	3993220.341	Yes	255.9394	255.9667	0.0273	255.93	255.98	255.99
39	484246.2899	4003088.34	Yes	358.7772	358.8044	0.0272	358.74	358.79	358.81
1046	487602.552	3993224.243	Yes	254.1432	254.1695	0.0263	254.1	254.16	254.17
101	485902.867	4004217.711	Yes	350.4835	350.5094	0.0259	350.41	350.51	350.54
105	485898.0281	4004203	Yes	351.0011	351.0264	0.0253	350.97	350.98	351.05
1042	487605.8936	3993177.336	Yes	255.1091	255.1342	0.0251	255.12	255.13	255.19
89	485899.5697	4004198.263	Yes	350.863	350.8878	0.0248	350.79	350.86	350.92
81	485890.8248	4004175.628	Yes	351.1183	351.1431	0.0248	351.13	351.15	351.17
106	485896.838	4004199.142	Yes	351.0861	351.1107	0.0246	351.07	351.09	351.23
60	485879.1661	4004178.736	Yes	351.3927	351.417	0.0243	351.34	351.44	351.46
61	485876.8759	4004177.145	Yes	351.4365	351.4605	0.024	351.41	351.47	351.5
8	484263.7491	4003102.615	Yes	359.6279	359.6514	0.0235	359.65	359.65	359.66
108	485894.5806	4004192.032	Yes	351.0925	351.1159	0.0234	351.07	351.12	351.17
93	485905.4566	4004209.945	Yes	350.375	350.3982	0.0232	350.37	350.38	350.44
96	485908.2801	4004214.961	Yes	350.189	350.2116	0.0226	350.2	350.21	350.26
1014	487627.7339	3993196.425	Yes	256.4808	256.5028	0.022	256.47	256.49	256.57
30	484244.5435	4003073.624	Yes	358.4961	358.518	0.0219	358.48	358.54	358.56
34	484245.2522	4003081.023	Yes	358.7019	358.7236	0.0217	358.7	358.72	358.78
99	485910.1567	4004219.905	Yes	350.1017	350.1229	0.0212	350.04	350.11	350.13
97	485909.3797	4004216.63	Yes	350.1137	350.1329	0.0192	350.12	350.12	350.25
63	485871.8068	4004175.27	Yes	351.4608	351.48	0.0192	351.4	351.45	351.5
102	485901.6969	4004213.687	Yes	350.6099	350.629	0.0191	350.6	350.62	350.73
53	485888.4062	4004195.948	Yes	351.2826	351.3009	0.0183	351.28	351.29	351.31
88	485899.0515	4004195.214	Yes	350.9207	350.9388	0.0181	350.93	350.93	350.96
76	485844.3916	4004174.646	Yes	352.0021	352.02	0.0179	351.97	351.99	352.05
19	484259.1119	4003072.59	Yes	358.9809	358.9986	0.0177	358.99	358.99	359.02
67	485862.46	4004174.303	Yes	351.6135	351.6305	0.017	351.6	351.61	351.64
45	484247.9331	4003096.726	Yes	358.9285	358.9453	0.0168	358.94	358.94	358.98
1013	487626.448	3993200.377	Yes	256.4349	256.4514	0.0165	256.41	256.47	256.48
10	484262.8367	4003096.534	Yes	359.4988	359.5141	0.0153	359.47	359.48	359.53
95	485907.194	4004213.182	Yes	350.2362	350.2496	0.0134	350.24	350.27	350.28
1045	487603.622	3993184.431	Yes	255.0166	255.0285	0.0119	254.99	255.02	255.07
11	484262.3875	4003093.679	Yes	359.4439	359.4545	0.0106	359.42	359.46	359.46
78	485839.9544	4004174.83	Yes	352.106	352.1161	0.0101	352.05	352.12	352.14
58	485883.1839	4004183.439	Yes	351.3304	351.3405	0.0101	351.32	351.33	351.35
2	484266.1082	4003118.799	Yes	359.975	359.9849	0.0099	359.98	359.99	359.99

68	485860.8763	4004174.181	Yes	351.6593	351.669	0.0097	351.65	351.66	351.69
1018	487630.8552	3993186.46	Yes	256.7048	256.7144	0.0096	256.62	256.64	256.77
1032	487626.1566	3993179.426	Yes	256.8295	256.8385	0.009	256.81	256.82	256.89
1003	487610.1104	3993212.254	Yes	255.8667	255.875	0.0083	255.84	255.88	255.9
1059	487608.6327	3993219.369	Yes	255.7693	255.7761	0.0068	255.72	255.86	255.93
1039	487608.1622	3993170.801	Yes	255.1927	255.1989	0.0062	255.16	255.2	255.22
49	484248.6999	4003101.37	Yes	359.057	359.062	0.005	358.99	359.09	359.11
6	484264.6333	4003108.449	Yes	359.7646	359.7693	0.0047	359.76	359.77	359.78
79	485837.6684	4004174.998	Yes	352.1468	352.151	0.0042	352.13	352.13	352.18
51	485889.1516	4004200.826	Yes	351.2678	351.27	0.0022	351.26	351.28	351.29
4	484265.4004	4003114.337	Yes	359.8899	359.8917	0.0018	359.86	359.89	359.91
31	484244.7782	4003075.408	Yes	358.5721	358.5738	0.0017	358.5	358.57	358.59
1047	487602.2789	3993226.491	Yes	254.0725	254.074	0.0015	254.05	254.07	254.15
65	485867.0052	4004174.534	Yes	351.506	351.507	0.001	351.47	351.5	351.56
1011	487625.2909	3993204.348	Yes	256.3492	256.3486	-0.0006	256.29	256.37	256.37
50	484249.0207	4003102.712	Yes	359.1024	359.1017	-0.0007	359.03	359.07	359.16
71	485855.4288	4004174.177	Yes	351.7656	351.7645	-0.0011	351.76	351.76	351.78
1012	487625.8927	3993202.475	Yes	256.3896	256.388	-0.0016	256.38	256.39	256.41
64	485869.2979	4004174.766	Yes	351.4774	351.4754	-0.002	351.44	351.5	351.52
73	485850.8363	4004174.331	Yes	351.8636	351.8611	-0.0025	351.85	351.87	351.88
1034	487627.54	3993174.842	Yes	256.933	256.9299	-0.0031	256.89	256.92	256.95
1009	487624.1668	3993208.059	Yes	256.2963	256.2928	-0.0035	256.22	256.29	256.33
1051	487600.8329	3993235.466	Yes	254.3406	254.337	-0.0036	254.29	254.33	254.35
104	485899.4294	4004206.866	Yes	350.8827	350.8789	-0.0038	350.85	350.88	351.03
69	485859.2491	4004174.173	Yes	351.6957	351.6914	-0.0043	351.65	351.7	351.7
1037	487630.2207	3993166.715	Yes	257.0399	257.0354	-0.0045	257.03	257.03	257.05
1005	487613.3647	3993211.371	Yes	256.2115	256.2067	-0.0048	256.19	256.21	256.3
1050	487601.2274	3993233.387	Yes	254.2612	254.2562	-0.005	254.23	254.25	254.4
54	485887.7845	4004193.577	Yes	351.2914	351.286	-0.0054	351.26	351.28	351.29
1052	487600.6107	3993237.241	Yes	254.399	254.3933	-0.0057	254.36	254.39	254.41
1025	487620.492	3993197.33	Yes	256.5251	256.5189	-0.0062	256.47	256.5	256.54
1017	487629.9568	3993189.354	Yes	256.6432	256.6363	-0.0069	256.56	256.67	256.71
46	484248.1238	4003097.926	Yes	358.9593	358.9508	-0.0085	358.92	358.94	359
74	485848.7667	4004174.445	Yes	351.9045	351.8952	-0.0093	351.87	351.9	351.92
12	484261.8705	4003090.472	Yes	359.3725	359.3627	-0.0098	359.35	359.38	359.38
7	484264.2117	4003105.531	Yes	359.6905	359.6789	-0.0116	359.65	359.66	359.69
1006	487614.8066	3993210.331	Yes	256.3253	256.3134	-0.0119	256.28	256.31	256.45
3	484265.8088	4003116.837	Yes	359.9399	359.9272	-0.0127	359.92	359.93	359.94
1041	487606.5332	3993175.166	Yes	255.1158	255.1025	-0.0133	255.08	255.1	255.11
18	484259.3957	4003074.668	Yes	359.037	359.0231	-0.0139	358.94	359.01	359.03
55	485886.8161	4004190.79	Yes	351.3036	351.2893	-0.0143	351.28	351.29	351.3
1060	487607.4147	3993218.701	Yes	255.6493	255.6344	-0.0149	255.59	255.64	255.66
23	484257.542	4003062.58	Yes	358.7568	358.7393	-0.0175	358.73	358.74	358.74
13	484261.4093	4003087.489	Yes	359.2977	359.2797	-0.018	359.23	359.27	359.29
21	484258.3024	4003067.687	Yes	358.8695	358.8504	-0.0191	358.84	358.9	358.93
1053	487600.3202	3993239.522	Yes	254.4504	254.4297	-0.0207	254.4	254.44	254.45
15	484260.6158	4003082.022	Yes	359.2067	359.1859	-0.0208	359.18	359.18	359.19
1035	487628.5169	3993172.048	Yes	256.9574	256.9358	-0.0216	256.93	256.94	256.97
1024	487619.9075	3993199.302	Yes	256.5085	256.4863	-0.0222	256.47	256.5	256.51
48	484248.5291	4003100.148	Yes	359.0371	359.0146	-0.0225	358.93	359.02	359.03
24	484257.2082	4003060.161	Yes	358.7068	358.6839	-0.0229	358.61	358.68	358.71
5	484265.0992	4003111.592	Yes	359.831	359.8068	-0.0242	359.79	359.8	359.81
1031	487625.341	3993181.948	Yes	256.8326	256.8084	-0.0242	256.79	256.82	256.82
1010	487624.773	3993206.067	Yes	256.3167	256.2925	-0.0242	256.24	256.3	256.38
1036	487629.3064	3993169.423	Yes	256.9971	256.9701	-0.027	256.95	257	257.02
1054	487599.9658	3993241.451	Yes	254.5174	254.4849	-0.0325	254.41	254.48	254.5

16	484260.288	4003080.076	Yes	359.1618	359.1289	-0.0329	359.09	359.13	359.18
22	484257.8698	4003064.948	Yes	358.8229	358.7892	-0.0337	358.76	358.79	358.81
1056	487610.8005	3993222.65	Yes	256.1704	256.134	-0.0364	256.01	256.15	256.21
1057	487610.4344	3993221.565	Yes	256.082	256.0453	-0.0367	255.99	256	256.15
1033	487626.9245	3993176.825	Yes	256.8894	256.8519	-0.0375	256.78	256.88	256.96
1015	487628.3913	3993194.411	Yes	256.5928	256.555	-0.0378	256.53	256.57	256.59
1049	487601.6343	3993231.305	Yes	254.2123	254.1706	-0.0417	254.14	254.18	254.23
1044	487604.3292	3993181.995	Yes	255.0629	255.0181	-0.0448	254.97	255.08	255.13
20	484258.7254	4003070.441	Yes	358.932	358.8863	-0.0457	358.83	358.86	358.93
1038	487630.9234	3993164.358	Yes	257.0569	257.0106	-0.0463	257	257.08	257.1
1048	487601.9473	3993228.99	Yes	254.126	254.0776	-0.0484	254.07	254.1	254.16
1023	487619.1727	3993201.54	Yes	256.4768	256.4268	-0.05	256.4	256.43	256.51
47	484248.3324	4003099.091	Yes	358.9992	358.9485	-0.0507	358.93	358.96	359.02
1022	487618.4974	3993203.802	Yes	256.466	256.4151	-0.0509	256.4	256.43	256.44
1028	487622.8046	3993190.035	Yes	256.7116	256.6591	-0.0525	256.57	256.68	256.7
1019	487616.667	3993209.588	Yes	256.3751	256.3222	-0.0529	256.28	256.32	256.34
77	485842.2061	4004174.801	Yes	352.0706	352.0161	-0.0545	352.01	352.02	352.08
14	484261.0749	4003085.296	Yes	359.2601	359.2019	-0.0582	359.16	359.21	359.25
1043	487605.1023	3993179.651	Yes	255.1526	255.0905	-0.0621	255.08	255.08	255.1
1040	487607.3508	3993172.885	Yes	255.1853	255.1227	-0.0626	255.11	255.12	255.14
1026	487621.3276	3993194.79	Yes	256.5988	256.5326	-0.0662	256.51	256.53	256.62
17	484259.8209	4003077.351	Yes	359.0979	359.0259	-0.072	358.98	359.03	359.08
1020	487617.1661	3993207.905	Yes	256.3851	256.3051	-0.08	256.27	256.36	256.4
1055	487599.4672	3993243.415	Yes	254.5689	254.48	-0.0889	254.41	254.54	254.54
1016	487629.161	3993191.76	Yes	256.6594	256.5498	-0.1096	256.54	256.59	256.65
1029	487623.5482	3993187.501	Yes	256.8075	256.682	-0.1255	256.67	256.68	256.77
1030	487624.4743	3993184.685	Yes	256.8865	256.6892	-0.1973	256.66	256.71	256.72

TABLE 2:

Date	9-Jun	2009
Vertical Accuracy Objective		
Requirement Type	Accuracy(z)	
Accuracy(z) Objective	0.3	
Confidence Level	95%	
Control Points in Report	170	
Elevation Calculation Method	Interpolated from TIN	
Control Points with LiDAR Coverage	170	
Control Points with Required Accuracy (+/- 0.30)	170	
Percent of Control Points with Required Accuracy (+/- 0.30)	100	
Average Control Error Reported	0	
Maximum (highest) Control Error Reported	0.09	
Median Control Error Reported	0.01	
Minimum (lowest) Control Error Reported	-0.2	
Standard deviation (sigma) of Z for sample	0.04	
RMSE of Z for sample (RMSE(z))	0.04	PASS
FGDC/NSSDA Vertical Accuracy (Accuracy(z))	0.08	PASS
NSSDA Achievable Contour Interval	0.2	
ASPRS Class 1 Achievable Contour Interval	0.2	
NMAS Achievable Contour Interval	0.2	



Control Id	Control Point X	Control Point Y	Cover	Control Point Z	Z from LiDAR	Z Error	Min Z	Med Z	Max Z
1030	487624.47	3993184.69	Yes	256.89	256.69	-0.2	256.66	256.71	256.72
1029	487623.55	3993187.5	Yes	256.81	256.68	-0.13	256.67	256.68	256.77
1016	487629.16	3993191.76	Yes	256.66	256.55	-0.11	256.54	256.59	256.65
1040	487607.35	3993172.88	Yes	255.19	255.09	-0.09	255.04	255.1	255.12
20	484258.73	4003070.44	Yes	358.93	358.85	-0.08	358.83	358.86	358.86
1020	487617.17	3993207.9	Yes	256.39	256.31	-0.08	256.27	256.36	256.4
1044	487604.33	3993182	Yes	255.06	254.98	-0.08	254.97	254.99	255.05
14	484261.07	4003085.3	Yes	359.26	359.18	-0.08	359.16	359.19	359.24
1011	487625.29	3993204.35	Yes	256.35	256.28	-0.07	256.16	256.29	256.34
17	484259.82	4003077.35	Yes	359.1	359.03	-0.07	358.98	359.03	359.08
22	484257.87	4003064.95	Yes	358.82	358.75	-0.07	358.72	358.76	358.8
1009	487624.17	3993208.06	Yes	256.3	256.23	-0.07	256.22	256.22	256.25
1026	487621.33	3993194.79	Yes	256.6	256.53	-0.07	256.51	256.53	256.62
47	484248.33	4003099.09	Yes	359	358.94	-0.06	358.92	358.93	359.02
77	485842.21	4004174.8	Yes	352.07	352.02	-0.05	352.01	352.02	352.08
1019	487616.67	3993209.59	Yes	256.38	256.32	-0.05	256.28	256.32	256.34
1028	487622.8	3993190.04	Yes	256.71	256.66	-0.05	256.57	256.68	256.7
1022	487618.5	3993203.8	Yes	256.47	256.42	-0.05	256.4	256.43	256.44
1023	487619.17	3993201.54	Yes	256.48	256.43	-0.05	256.4	256.43	256.51
1045	487603.62	3993184.43	Yes	255.02	254.97	-0.05	254.94	254.96	254.99
1043	487605.1	3993179.65	Yes	255.15	255.1	-0.05	255.08	255.1	255.12
1057	487610.43	3993221.56	Yes	256.08	256.04	-0.05	256	256.01	256.15
1038	487630.92	3993164.36	Yes	257.06	257.01	-0.05	257	257.08	257.1
1051	487600.83	3993235.47	Yes	254.34	254.3	-0.04	254.27	254.29	254.33
1049	487601.63	3993231.31	Yes	254.21	254.17	-0.04	254.14	254.18	254.23
1041	487606.53	3993175.17	Yes	255.12	255.08	-0.04	255.03	255.03	255.11
1015	487628.39	3993194.41	Yes	256.59	256.55	-0.04	256.53	256.57	256.59
1033	487626.92	3993176.83	Yes	256.89	256.85	-0.04	256.78	256.88	256.96
1056	487610.8	3993222.65	Yes	256.17	256.13	-0.04	256.01	256.15	256.21
10	484262.84	4003096.53	Yes	359.5	359.46	-0.04	359.44	359.48	359.49

16	484260.29	4003080.08	Yes	359.16	359.13	-0.03	359.09	359.13	359.18
1054	487599.97	3993241.45	Yes	254.52	254.48	-0.03	254.41	254.48	254.5
50	484249.02	4003102.71	Yes	359.1	359.07	-0.03	359.02	359.03	359.11
1036	487629.31	3993169.42	Yes	257	256.97	-0.03	256.95	257	257.02
1055	487599.47	3993243.42	Yes	254.57	254.54	-0.03	254.53	254.54	254.57
1052	487600.61	3993237.24	Yes	254.4	254.37	-0.03	254.32	254.36	254.39
5	484265.1	4003111.59	Yes	359.83	359.81	-0.02	359.78	359.79	359.81
1050	487601.23	3993233.39	Yes	254.26	254.24	-0.02	254.23	254.25	254.29
11	484262.39	4003093.68	Yes	359.44	359.42	-0.02	359.41	359.42	359.42
1031	487625.34	3993181.95	Yes	256.83	256.81	-0.02	256.79	256.82	256.82
21	484258.3	4003067.69	Yes	358.87	358.85	-0.02	358.84	358.87	358.89
24	484257.21	4003060.16	Yes	358.71	358.68	-0.02	358.61	358.68	358.71
13	484261.41	4003087.49	Yes	359.3	359.27	-0.02	359.23	359.23	359.29
1024	487619.91	3993199.3	Yes	256.51	256.49	-0.02	256.47	256.5	256.51
1035	487628.52	3993172.05	Yes	256.96	256.94	-0.02	256.93	256.94	256.97
15	484260.62	4003082.02	Yes	359.21	359.19	-0.02	359.18	359.18	359.19
1053	487600.32	3993239.52	Yes	254.45	254.43	-0.02	254.4	254.44	254.45
1	483817.11	4005115.48	Yes	394.53	394.51	-0.02	394.49	394.53	394.57
23	484257.54	4003062.58	Yes	358.76	358.74	-0.02	358.71	358.74	358.74
31	484244.78	4003075.41	Yes	358.57	358.56	-0.02	358.5	358.56	358.59
1058	487609.55	3993220.34	Yes	255.94	255.92	-0.02	255.66	255.86	255.98
1060	487607.41	3993218.7	Yes	255.65	255.63	-0.01	255.59	255.64	255.66
55	485886.82	4004190.79	Yes	351.3	351.29	-0.01	351.28	351.29	351.3
48	484248.53	4003100.15	Yes	359.04	359.02	-0.01	358.99	359.02	359.03
18	484259.4	4003074.67	Yes	359.04	359.02	-0.01	358.94	359.01	359.03
12	484261.87	4003090.47	Yes	359.37	359.36	-0.01	359.35	359.36	359.38
3	484265.81	4003116.84	Yes	359.94	359.93	-0.01	359.92	359.93	359.97
1006	487614.81	3993210.33	Yes	256.33	256.31	-0.01	256.28	256.31	256.45
7	484264.21	4003105.53	Yes	359.69	359.68	-0.01	359.65	359.66	359.69
74	485848.77	4004174.44	Yes	351.9	351.9	-0.01	351.87	351.9	351.92
46	484248.12	4003097.93	Yes	358.96	358.95	-0.01	358.92	358.94	359
BRNW-SG	483816.97	4005115.91	Yes	394.58	394.57	-0.01	394.49	394.57	394.6
4	484265.4	4003114.34	Yes	359.89	359.88	-0.01	359.86	359.89	359.9
1017	487629.96	3993189.35	Yes	256.64	256.64	-0.01	256.56	256.67	256.71
1025	487620.49	3993197.33	Yes	256.53	256.52	-0.01	256.47	256.5	256.54
54	485887.78	4004193.58	Yes	351.29	351.29	-0.01	351.26	351.28	351.29
1005	487613.36	3993211.37	Yes	256.21	256.21	0	256.19	256.21	256.3
1037	487630.22	3993166.71	Yes	257.04	257.04	0	257.03	257.03	257.05
69	485859.25	4004174.17	Yes	351.7	351.69	0	351.65	351.7	351.7
104	485899.43	4004206.87	Yes	350.88	350.88	0	350.85	350.88	351.03
1034	487627.54	3993174.84	Yes	256.93	256.93	0	256.89	256.92	256.95
2	484266.11	4003118.8	Yes	359.98	359.97	0	359.95	359.98	359.99
73	485850.84	4004174.33	Yes	351.86	351.86	0	351.85	351.87	351.88
64	485869.3	4004174.77	Yes	351.48	351.48	0	351.44	351.5	351.52
1012	487625.89	3993202.48	Yes	256.39	256.39	0	256.38	256.39	256.41
71	485855.43	4004174.18	Yes	351.77	351.76	0	351.76	351.76	351.78
1010	487624.77	3993206.07	Yes	256.32	256.32	0	256.22	256.33	256.34
19	484259.11	4003072.59	Yes	358.98	358.98	0	358.93	358.96	358.99
65	485867.01	4004174.53	Yes	351.51	351.51	0	351.47	351.5	351.56
51	485889.15	4004200.83	Yes	351.27	351.27	0	351.26	351.28	351.29
49	484248.7	4003101.37	Yes	359.06	359.06	0	358.96	359.03	359.09
1008	487623.49	3993210.3	Yes	256.26	256.27	0	256.18	256.25	256.28
1003	487610.11	3993212.25	Yes	255.87	255.87	0	255.84	255.86	255.9
79	485837.67	4004175	Yes	352.15	352.15	0	352.13	352.13	352.18
6	484264.63	4003108.45	Yes	359.76	359.77	0	359.76	359.76	359.78
1039	487608.16	3993170.8	Yes	255.19	255.2	0.01	255.16	255.2	255.22

1004	487611.63	3993211.91	Yes	256.01	256.02	0.01	255.99	256.03	256.07
1059	487608.63	3993219.37	Yes	255.77	255.78	0.01	255.66	255.72	255.86
1032	487626.16	3993179.43	Yes	256.83	256.84	0.01	256.81	256.82	256.89
1018	487630.86	3993186.46	Yes	256.7	256.71	0.01	256.62	256.64	256.77
68	485860.88	4004174.18	Yes	351.66	351.67	0.01	351.65	351.66	351.69
58	485883.18	4004183.44	Yes	351.33	351.34	0.01	351.32	351.33	351.35
78	485839.95	4004174.83	Yes	352.11	352.12	0.01	352.05	352.12	352.14
30	484244.54	4003073.62	Yes	358.5	358.51	0.01	358.42	358.44	358.56
45	484247.93	4003096.73	Yes	358.93	358.94	0.01	358.94	358.94	358.95
95	485907.19	4004213.18	Yes	350.24	350.25	0.01	350.24	350.27	350.28
1042	487605.89	3993177.34	Yes	255.11	255.12	0.01	255.08	255.12	255.13
56	485885.77	4004188.15	Yes	351.3	351.32	0.02	351.3	351.32	351.33
1013	487626.45	3993200.38	Yes	256.43	256.45	0.02	256.41	256.47	256.48
67	485862.46	4004174.3	Yes	351.61	351.63	0.02	351.6	351.61	351.64
76	485844.39	4004174.65	Yes	352	352.02	0.02	351.97	351.99	352.05
88	485899.05	4004195.21	Yes	350.92	350.94	0.02	350.93	350.93	350.96
53	485888.41	4004195.95	Yes	351.28	351.3	0.02	351.28	351.29	351.31
34	484245.25	4003081.02	Yes	358.7	358.72	0.02	358.7	358.75	358.78
102	485901.7	4004213.69	Yes	350.61	350.63	0.02	350.6	350.62	350.73
97	485909.38	4004216.63	Yes	350.11	350.13	0.02	350.12	350.12	350.25
63	485871.81	4004175.27	Yes	351.46	351.48	0.02	351.4	351.45	351.5
98	485909.84	4004217.93	Yes	350.1	350.12	0.02	350.11	350.12	350.15
HARP	487608.2	3993211.41	Yes	255.64	255.66	0.02	255.39	255.52	255.69
99	485910.16	4004219.9	Yes	350.1	350.12	0.02	350.04	350.11	350.13
8	484263.75	4003102.62	Yes	359.63	359.65	0.02	359.64	359.65	359.65
96	485908.28	4004214.96	Yes	350.19	350.21	0.02	350.2	350.21	350.24
1014	487627.73	3993196.42	Yes	256.48	256.5	0.02	256.47	256.49	256.57
36	484245.61	4003083.82	Yes	358.73	358.75	0.02	358.72	358.74	358.77
93	485905.46	4004209.94	Yes	350.38	350.4	0.02	350.37	350.38	350.44
61	485876.88	4004177.15	Yes	351.44	351.46	0.02	351.41	351.47	351.5
60	485879.17	4004178.74	Yes	351.39	351.42	0.02	351.34	351.44	351.46
106	485896.84	4004199.14	Yes	351.09	351.11	0.02	351.07	351.09	351.23
81	485890.82	4004175.63	Yes	351.12	351.14	0.02	351.13	351.15	351.17
89	485899.57	4004198.26	Yes	350.86	350.89	0.02	350.79	350.86	350.92
101	485902.87	4004217.71	Yes	350.48	350.51	0.03	350.41	350.51	350.54
1046	487602.55	3993224.24	Yes	254.14	254.17	0.03	254.07	254.17	254.25
105	485898.03	4004203	Yes	351	351.03	0.03	350.93	350.94	351.05
39	484246.29	4003088.34	Yes	358.78	358.8	0.03	358.74	358.79	358.81
52	485888.81	4004198.29	Yes	351.27	351.3	0.03	351.27	351.28	351.31
100	485904.51	4004220.72	Yes	350.38	350.41	0.03	350.32	350.4	350.42
9	484263.28	4003099.63	Yes	359.56	359.59	0.03	359.51	359.6	359.6
70	485856.99	4004174.19	Yes	351.73	351.76	0.03	351.75	351.76	351.78
1021	487617.73	3993206.04	Yes	256.41	256.44	0.03	256.39	256.4	256.47
59	485881.42	4004181.01	Yes	351.37	351.4	0.03	351.36	351.41	351.42
66	485864.87	4004174.47	Yes	351.55	351.58	0.03	351.55	351.57	351.59
62	485874.26	4004176.06	Yes	351.44	351.48	0.03	351.47	351.48	351.48
75	485846.64	4004174.55	Yes	351.96	351.99	0.03	351.95	351.97	352.05
28	484243.97	4003068.97	Yes	358.38	358.42	0.03	358.35	358.39	358.44
41	484246.95	4003091.44	Yes	358.86	358.89	0.03	358.85	358.9	358.92
108	485894.58	4004192.03	Yes	351.09	351.13	0.03	351.07	351.08	351.17
91	485902.72	4004204.15	Yes	350.59	350.63	0.03	350.61	350.61	350.68
1048	487601.95	3993228.99	Yes	254.13	254.16	0.03	254.1	254.17	254.18
80	485889.19	4004173.75	Yes	351.17	351.21	0.03	351.17	351.23	351.26
44	484247.77	4003095.58	Yes	358.92	358.95	0.04	358.93	358.95	358.99
42	484247.27	4003092.87	Yes	358.84	358.88	0.04	358.82	358.88	358.89
32	484244.93	4003077.54	Yes	358.59	358.63	0.04	358.6	358.61	358.64

1007	487615.7	3993209.14	Yes	256.33	256.37	0.04	256.14	256.37	256.39
72	485853.81	4004174.25	Yes	351.8	351.83	0.04	351.81	351.83	351.84
35	484245.4	4003082.4	Yes	358.73	358.76	0.04	358.72	358.77	358.77
43	484247.54	4003094.09	Yes	358.85	358.89	0.04	358.82	358.93	358.96
87	485898.34	4004192.5	Yes	350.95	350.99	0.04	350.93	350.95	351.02
92	485904.36	4004207.33	Yes	350.47	350.51	0.04	350.46	350.49	350.56
103	485900.86	4004210.75	Yes	350.71	350.75	0.04	350.66	350.77	350.83
37	484245.74	4003085.48	Yes	358.74	358.78	0.05	358.71	358.79	358.81
29	484244.29	4003071.26	Yes	358.43	358.48	0.05	358.43	358.46	358.51
82	485891.95	4004177.73	Yes	351.05	351.09	0.05	351.08	351.09	351.16
27	484243.74	4003066.55	Yes	358.32	358.37	0.05	358.33	358.34	358.41
1027	487622.09	3993192.22	Yes	256.6	256.65	0.05	256.65	256.65	256.65
90	485900.98	4004201.56	Yes	350.73	350.78	0.05	350.75	350.75	350.81
94	485906.25	4004211.73	Yes	350.3	350.35	0.05	350.32	350.33	350.42
57	485884.74	4004185.95	Yes	351.3	351.35	0.05	351.33	351.34	351.38
85	485897.23	4004186.61	Yes	350.91	350.96	0.05	350.92	350.93	350.97
40	484246.65	4003089.8	Yes	358.8	358.85	0.05	358.83	358.86	358.92
26	484243.46	4003064.4	Yes	358.26	358.32	0.06	358.26	358.34	358.36
86	485897.91	4004189.88	Yes	350.93	350.98	0.06	350.97	350.98	350.99
33	484245.08	4003079.23	Yes	358.63	358.69	0.06	358.64	358.66	358.73
25	484243.22	4003062.18	Yes	358.22	358.29	0.06	358.17	358.3	358.33
107	485895.74	4004195.54	Yes	351.07	351.13	0.06	351.12	351.13	351.15
1001	487608.32	3993211.11	Yes	255.58	255.64	0.07	255.08	255.39	255.69
84	485895.52	4004183.55	Yes	350.83	350.9	0.07	350.89	350.92	350.98
1047	487602.28	3993226.49	Yes	254.07	254.15	0.08	254.14	254.15	254.15
1002	487608.61	3993212.33	Yes	255.72	255.8	0.08	255.69	255.8	255.84
83	485892.98	4004180.35	Yes	350.96	351.04	0.08	350.97	351.04	351.1
38	484245.95	4003086.9	Yes	358.75	358.85	0.09	358.79	358.82	358.87