

MAP ACCURACY REPORT
Countywide Imagery & DEM
McLeod County

Data Contact Person:	Christy Christenson	Department:	GIS Director
Type of Mapping:	DEM (LiDAR) & Ortho	Contractor:	Optimal Geomatics, Inc.
Independent Testing:	Mn/DOT Photo Unit	Contract Delivery date:	19 Dec. 2007

The purpose of this report is to independently test orthophotos and LiDAR derived digital elevation model data that was contracted for by McLeod County for horizontal and vertical accuracy. This project consisted of flights flown on 28 April, 1 & 2 May 2007 for aerial imagery acquisition and on 2, 9, 10, 11, 12, 14, & 17 May 2007 using Light Detection and Ranging (LiDAR) and GPS/IMU technologies. A supplemental acquisition flight was necessary and took place on 23 & 25 October 2007. The photographic flights were controlled using ground targets and by the GPS/IMU equipment onboard the aircraft. The specific equipment used for the aerial imagery collection was a Cessna 208B Grand Caravan plane, a Leica RC30 camera, serial number 5296, calibration date 27 March 2003. A copy of the calibration report is included in this report. For the aerial-triangulation, ISAT software was used and for the measurement and production a Z/I ImageStation softcopy stereoplotter. The specific equipment used for the DEM acquisition was the same plane with an Optech 3100 ALTM 70 kHz. laser system, serial number 04SEN155 and Realm Terrascan (Terrasolid), Geocue (NIIRS10) Survey processing software. The preflight mission was scheduled so that photography was flown at 5000 feet AGL and LiDAR were collected and flown at 2788 feet AGL. The flights were controlled using Leica System 500 GPS receivers on the ground and by LN200 GPS/IMU equipment in the aircraft. Optimal Geomatics, Inc. eliminated that portion of the data set that did not come in contact with the ground surface. There was no additional file manipulation or filtering done by McLeod County or Mn/Dot.

The vertical Datum used was the North American Vertical Datum of 1988 (NAVD 88) and the Horizontal Datum used was the North American Datum of 1983 (NAD 83). The products were delivered in the McLeod County Coordinate System, NAD 83 (1996 adj.) The Geoid model used was the GEOID 03. The Ortho and LiDAR portions of this project contain approximately 375,344 acres in area each.

ORTHOPHOTO

EAST BOUNDING COORDINATE: 93° 57' 34.93239" W. Long.
WEST BOUNDING COORDINATE: 94° 31' 03.37855" W. Long.
NORTH BOUNDING COORDINATE: 44° 59' 27.17488" N. Lat.
SOUTH BOUNDING COORDINATE: 44° 37' 12.11588" N. Lat.

DEM

EAST BOUNDING COORDINATE: 93° 57' 34.93239" W. Long.
WEST BOUNDING COORDINATE: 94° 31' 03.37855" W. Long.
NORTH BOUNDING COORDINATE: 44° 59' 27.17488" N. Lat.
SOUTH BOUNDING COORDINATE: 44° 37' 12.11588" N. Lat.

Geodetic monumentation used to control this project was published by Mn/DOT and can be found in the geodetic database online at www.olmweb.dot.state.mn.us. Data sheets, as reported by Optimal Geomatics, Inc. and Bolton & Menk, Inc. are attached to this report. Mn/DOT's District 8 Surveys report using the VRS system.

Optimal Geomatics, Inc. delivered the LiDAR and ortho-photos on a portable hard drive in MicroStation V8 format and the transmittal. The tiling scheme maps for both products are included as part of electronic file package.

The overall project area encompasses the entire county with flight strips extended to include portions of the Buffalo Creek Watershed.

The vertical accuracy test done for the DEM portion of this project were a direct comparison of the field surveyed elevations and the elevations derived from Geopak TIN model created from the LiDAR data at the surveyed X,Y coordinates. The contract called for 3.6' or 1.10m pre-process spacing as a deliverable product.

The horizontal accuracy test done on the orthophotos were a direct comparison of field surveyed features on the ground, such as sidewalk intersections, to the closest pixel location that an experienced technician could find. There is a certain amount of personal bias involved in this type of testing, knowing this, when the operator selected a pixel that was outside of the norm, a second technician was asked to see if they could replicate the results. The contract called for a 1" = 200 feet, 6" pixel size orthophoto to National Map Accuracy Standard (NMAS). The NMAS was and often is still used as the standard for testing hard copy or paper maps, where as digital data is tested against the current National Standard for Spatial Data Accuracy (NSSDA). The NSSDA for the horizontal (R) component or the combined X and Y coordinate for this project are:

<u>Photo Identifiable Points</u>	<u>RMSE_r</u>	<u>NSSDA (Horizontal)</u>
Urban Areas Only	0.74'	1.28' with 69 points

The test data was obtained by District 8 Survey personnel throughout the project area encompassing different ground cover types per the American Society for Photogrammetry and Remote Sensing (ASPRS) Guidelines for Vertical Accuracy Reporting for LiDAR Data, May 2004. The test data itself was collected by RTK methods for each cover type except the forested area where a total station was used. Each test point was collected twice to ensure that the independent test source was at least 3 times as accurate. The MultShot program was utilized for comparing the two independent test points and is a part of this report. When applying the test data to the elevation model produced the accuracy test results indicated below. District 8 Surveys selected test points that geographically represent the various cover types as well as the general layout of the county.

The National Standard for Spatial Data Accuracy (NSSDA) for the vertical (Z) component of the DEM by ground cover/type for this project is:

<u>Ground Cover/Type</u>	<u>RMSE_r</u>	<u>NSSDA (Vertical)</u>
Open Terrain – L1O	0.22'	0.43' with 40 points.
Tall Weeds & Crops – L2T	0.33'	0.64' with 20 points. *
Brush Lands & Low Trees – L3B	0.25'	0.50' with 20 points.
Forested Areas with Canopy – L4F	0.46'	0.91' with 20 points. *
Urban Areas with Structures – L5U	0.27'	0.53' with 20 points. *
All Ground Cover	0.30'	0.60' with 120 points.

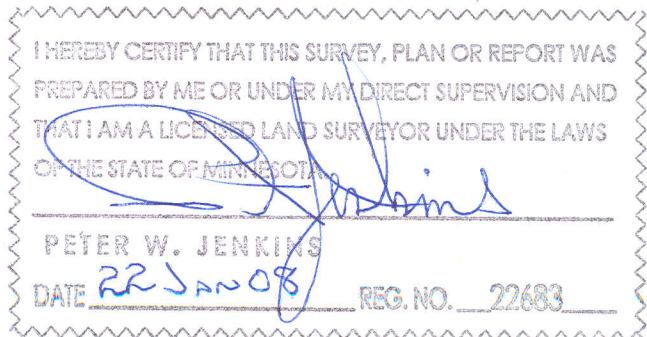
* Certain test points in this category fell outside of the norm and were reported to the contractor for further inspection and review of data and procedures. The contractor provided me a response and is included in this report.

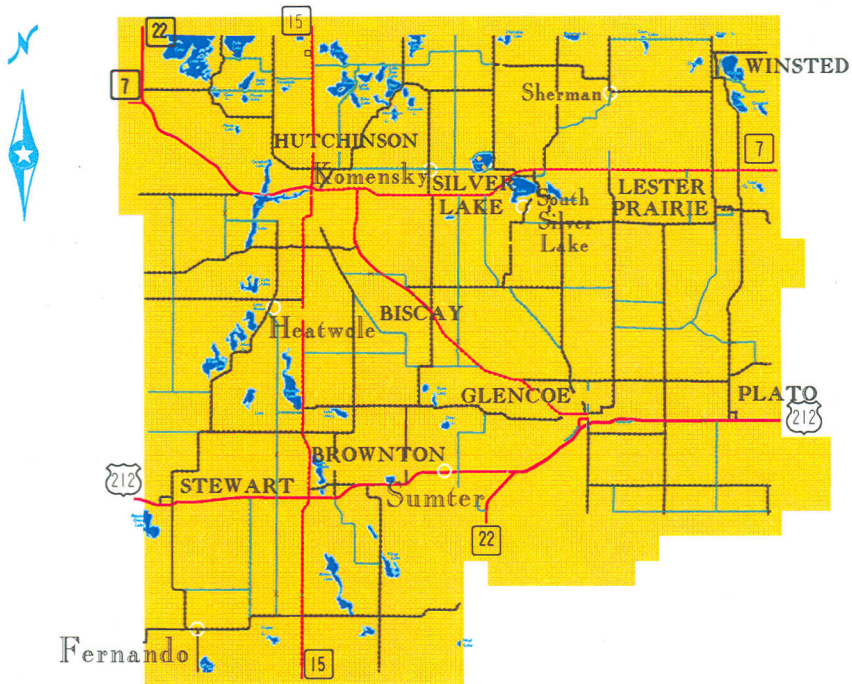
The horizontal accuracy of the DEM was not tested as part of this project due to the fact that the model does not contain distinct or well-defined topographical features but the expected horizontal accuracy as stated by the laser manufacturer is 1/2000th of the flying height which calculates to 3.0 feet. The outcome of the vertical testing results suggests that the horizontal accuracy is better than that claimed by the manufacturer.

The tabulated test results, correspondence, related notes and hard copies are attached to this report.

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S. P. : McLEOD COUNTY LIDAR
 T.H. : TH 212
 COLLECTION DATE : 07
 LOCATION : McLEOD COUNTY
 MAPPING : LIDAR
 CONSULTANT MAPPING : YES
 MAPPING COMPLETED : 01-23-08
 ARCHIVE INFO : 651.366.3457
 ARCHIVE TAPE : J:\ARC\LIDAR\ 2007-S\ MCLEOD COUNTY

MAP DATUM

The vertical datum of the TIN file associated with this map is based on the North American Vertical Datum of 1988 (NAVD 88).

The horizontal datum of this map is based on McLeod county coordinate system which is related to the Minnesota state plane coordinate system NAD 1983 (HARN 1996) adjustment south zone.

MAP ACCURACY

The vertical accuracy of the TIN file associated with this map has been tested using NSSDA (June 1998) methods and computes to 0.60 FT. based on 120 test elevations.

The horizontal accuracy of the orthophoto has been tested using NSSDA (June 1998) methods and computes to 1.28 FT. based on 69 test points.

McLeod County
Horizontal Accuracy Test

Point Number	Point Description	X From Survey	Y From Survey	X From Map	Difference in X	X-Difference Squared	Y From Map	Difference in Y	Y-Difference Squared	X-Diff. Sq. + Y-Diff. Sq.
701		573356.76	251942.88	573356.23	0.528	0.279	251942.85	0.027	0.001	0.280
702		575899.03	250061.33	575899.47	-0.445	0.198	250061.46	-0.132	0.017	0.215
703		572238.58	250231.78	572239.22	-0.638	0.407	250232.49	-0.708	0.501	0.908
704		574747.75	245788.91	574748.02	-0.268	0.072	245788.47	0.442	0.195	0.267
705		574257.69	244072.54	574257.27	0.421	0.177	244072.46	0.083	0.007	0.184
706		571427.41	244414.34	571428.07	-0.657	0.432	244414.92	-0.585	0.342	0.774
707		570630.67	248237.25	570630.75	-0.084	0.007	248237.07	0.176	0.031	0.038
708		568866.58	248532.19	568867.21	-0.628	0.394	248532.32	-0.131	0.017	0.412
709		567164.61	244761.20	567164.35	0.260	0.068	244761.64	-0.438	0.192	0.259
710		565776.94	247425.83	565777.62	-0.676	0.457	247426.13	-0.301	0.091	0.548
711		561532.70	243751.13	561532.83	-0.126	0.016	243751.30	-0.174	0.030	0.046
712		562239.30	248221.58	562239.67	-0.367	0.135	248221.35	0.234	0.055	0.189
713		561759.13	245746.68	561759.33	-0.203	0.041	245746.18	0.499	0.249	0.290
714		560757.53	248293.86	560757.48	0.046	0.002	248293.75	0.113	0.013	0.015
716		561176.94	249487.34	561176.90	0.040	0.002	249487.63	-0.295	0.087	0.089
718		557559.33	253422.45	557559.37	-0.044	0.002	253422.26	0.189	0.036	0.038
719		561837.05	253677.88	561837.05	-0.002	0.000	253677.57	0.311	0.097	0.097
720		566135.39	252596.34	566135.79	-0.402	0.162	252596.17	0.166	0.028	0.189
721		563675.92	251897.17	563675.58	0.336	0.113	251896.82	0.348	0.121	0.234
722		567224.74	249790.21	567224.62	0.116	0.013	249790.57	-0.356	0.127	0.140
723		571018.39	250045.70	571018.91	-0.516	0.266	250046.36	-0.656	0.430	0.697
724		569319.84	252665.17	569320.30	-0.461	0.213	252665.22	-0.048	0.002	0.215
725		641220.48	204129.93	641220.03	0.447	0.200	204129.98	-0.049	0.002	0.203
726		654887.19	215888.23	654886.54	0.649	0.421	215888.07	0.164	0.027	0.448
727		653629.36	217204.40	653629.01	0.345	0.119	217204.94	-0.549	0.302	0.421
728		631256.80	216120.67	631256.45	0.346	0.120	216120.18	0.486	0.236	0.356
729		624627.90	219427.86	624628.00	-0.096	0.009	219427.51	0.352	0.124	0.133
730		623492.37	211264.56	623493.00	-0.632	0.399	211264.04	0.522	0.273	0.672
732		601775.26	224747.23	601775.39	-0.123	0.015	224747.91	-0.682	0.465	0.480
733		578510.34	216225.37	578509.99	0.357	0.127	216225.03	0.338	0.114	0.241
734		573486.20	206423.95	573486.52	-0.319	0.102	206423.49	0.453	0.206	0.308
736		573877.95	198922.58	573878.56	-0.609	0.371	198922.01	0.568	0.323	0.694
737		585346.39	192620.10	585346.06	0.332	0.110	192620.47	-0.371	0.138	0.248
738		582584.07	168940.66	582584.01	0.060	0.004	168940.00	0.656	0.430	0.434
740		540580.16	190602.54	540580.49	-0.328	0.108	190602.47	0.075	0.006	0.113

Contractor: Optimal Geomatics
 Owner: McLeod County
 Independent Tester: Mn/DOT

Aerial Collection: Spring 2007
 Delivery: December 2007

McLeod County
Horizontal Accuracy Test

Point Number	Point Description	X From Survey	Y From Survey	X From Map	Difference in X	X-Difference Squared	Y From Map	Difference in Y	Y-Difference Squared	X-Diff. Sq. + Y-Diff. Sq.
741		539046.93	196813.65	539047.48	-0.545	0.297	196813.00	0.654	0.428	0.725
742		537627.14	198719.94	537627.48	-0.338	0.114	198718.99	0.958	0.918	1.032
743		556845.27	184809.70	556845.08	0.191	0.037	184809.38	0.319	0.102	0.138
744		564615.38	188528.69	564615.11	0.263	0.069	188527.93	0.758	0.575	0.644
745		551560.82	211484.74	551560.51	0.313	0.098	211484.43	0.308	0.095	0.193
747		560589.98	237637.24	560589.36	0.617	0.380	237636.87	0.376	0.142	0.522
748		542786.60	243018.43	542787.08	-0.478	0.228	243017.96	0.468	0.219	0.448
749		550980.49	250390.95	550981.06	-0.565	0.319	250391.97	-1.018	1.036	1.355
750		538116.75	259541.36	538118.07	-1.322	1.747	259541.42	-0.064	0.004	1.751
751		562059.43	274805.15	562060.50	-1.074	1.153	274804.46	0.690	0.476	1.629
752		534294.13	288151.30	534294.44	-0.303	0.092	288149.96	1.347	1.814	1.906
753		577674.61	285234.82	577676.00	-1.391	1.935	285234.99	-0.166	0.027	1.963
754		578496.68	269152.06	578495.98	0.697	0.486	269151.63	0.431	0.186	0.672
755		592525.50	275284.63	592525.47	0.027	0.001	275285.50	-0.871	0.758	0.759
756		598701.73	288304.79	598702.56	-0.838	0.702	288305.00	-0.211	0.044	0.747
757		615765.50	275025.29	615765.85	-0.350	0.122	275023.93	1.358	1.845	1.967
758		611069.94	264112.57	611070.56	-0.612	0.375	264112.01	0.558	0.312	0.686
759		629493.07	260363.43	629494.01	-0.939	0.882	260364.01	-0.582	0.338	1.220
760		657595.38	271159.08	657594.41	0.970	0.941	271159.48	-0.401	0.161	1.102
761		655851.91	286410.29	655852.09	-0.179	0.032	286411.02	-0.733	0.537	0.569
762		649070.94	286607.33	649070.85	0.088	0.008	286608.14	-0.805	0.648	0.656
763		623835.60	285071.16	623835.51	0.086	0.007	285070.91	0.256	0.065	0.073
764		655954.05	256922.03	655954.06	-0.008	0.000	256921.48	0.556	0.309	0.309
765		646846.18	233114.36	646845.99	0.196	0.038	233113.95	0.413	0.170	0.209
766		634904.73	240865.45	634904.78	-0.051	0.003	240864.71	0.735	0.540	0.542
767		635093.29	227209.74	635093.61	-0.325	0.106	227210.01	-0.269	0.073	0.178
768		617433.48	230553.95	617433.50	-0.023	0.001	230553.45	0.504	0.254	0.255
769		603328.93	245745.03	603329.38	-0.451	0.203	245745.43	-0.405	0.164	0.367
770		613669.61	243208.19	613670.04	-0.439	0.192	243207.99	0.195	0.038	0.231
771		592944.38	235304.89	592944.52	-0.133	0.018	235304.47	0.412	0.169	0.187
772		573283.40	235116.84	573283.95	-0.546	0.299	235116.94	-0.092	0.008	0.307
773		578051.72	243401.59	578052.93	-1.212	1.468	243401.50	0.092	0.009	1.477
774		587095.08	258918.29	587096.15	-1.074	1.154	258918.39	-0.101	0.010	1.164
775		568152.81	260578.73	568153.49	-0.681	0.463	260579.42	-0.693	0.480	0.943
									Sum	37.801

Contractor: Optimal Geomatics
 Owner: McLeod County
 Independent Tester: Mn/DOT

Aerial Collection: Spring 2007
 Delivery: December 2007

McLeod County
Horizontal Accuracy Test

Point Number	Point Description	X From Survey	Y From Survey	X From Map	Difference in X	X-Difference Squared	Y From Map	Difference in Y	Y-Difference Squared	X-Diff. Sq. + Y-Diff. Sq.		
										Average	0.548	
										RMSEr	0.740	
										NSSDA	1.281	
69	Total Number of Points											

McLeod County
DEM Vertical Test

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
802	L1O	1024.01	1024.23	-0.22	0.0499
805	L1O	1019.39	1019.76	-0.37	0.1383
806	L1O	1059.67	1059.81	-0.14	0.0204
812	L1O	1057.78	1057.72	0.05	0.0030
814	L1O	1048.67	1048.81	-0.15	0.0213
821	L1O	1027.56	1027.73	-0.17	0.0286
825	L1O	1061.17	1061.62	-0.45	0.2055
828	L1O	1070.02	1070.07	-0.06	0.0032
833	L1O	1079.76	1079.68	0.08	0.0064
837	L1O	1129.96	1130.23	-0.27	0.0703
840	L1O	1060.54	1060.57	-0.03	0.0009
844	L1O	1059.71	1059.71	0.00	0.0000
848	L1O	1033.62	1033.66	-0.04	0.0016
854	L1O	1013.14	1013.21	-0.07	0.0053
859	L1O	1014.10	1014.42	-0.32	0.1035
862	L1O	1035.85	1036.10	-0.25	0.0612
865	L1O	1062.66	1062.84	-0.18	0.0327
868	L1O	1006.55	1006.18	0.37	0.1374
872	L1O	992.01	991.66	0.36	0.1262
878	L1O	1011.31	1011.42	-0.10	0.0105
880	L1O	994.30	994.48	-0.17	0.0303
881	L1O	1013.80	1013.54	0.26	0.0674
882	L1O	1028.17	1028.32	-0.15	0.0224
883	L1O	1030.73	1030.98	-0.26	0.0665
884	L1O	1058.33	1058.36	-0.04	0.0013
885	L1O	1048.15	1048.16	-0.01	0.0001
886	L1O	1071.14	1071.29	-0.15	0.0224
887	L1O	1043.41	1043.41	0.00	0.0000
888	L1O	1024.69	1024.86	-0.16	0.0266
889	L1O	1071.80	1072.19	-0.39	0.1525
890	L1O	1062.29	1062.63	-0.34	0.1158
891	L1O	1046.13	1046.36	-0.23	0.0544
892	L1O	1005.38	1005.59	-0.22	0.0483
893	L1O	999.07	999.16	-0.10	0.0090
894	L1O	1039.58	1039.19	0.40	0.1567
895	L1O	1020.11	1020.17	-0.06	0.0039
896	L1O	1062.71	1062.71	-0.01	0.0001
897	L1O	1091.75	1091.48	0.26	0.0696
898	L1O	1074.18	1074.03	0.15	0.0221
899	L1O	1107.08	1107.16	-0.08	0.0062
800	L2T	1040.72	1041.01	-0.29	0.0835
804	L2T	1011.83	1012.15	-0.32	0.1039
807	L2T	1051.06	1051.43	-0.37	0.1378
813	L2T	1028.80	1029.28	-0.48	0.2320
818	L2T	1052.69	1053.19	-0.50	0.2482
819	L2T	1026.75	1027.13	-0.38	0.1452
826	L2T	1078.70	1079.18	-0.48	0.2297
829	L2T	1068.29	1068.60	-0.31	0.0962
835	L2T	1117.11	1117.08	0.02	0.0006
846	L2T	1074.84	1074.76	0.08	0.0060

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LiDAR Collection Spring 2007
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McLeod County
DEM Vertical Test

847	L2T	1041.91	1042.51	-0.60	0.3555
853	L2T	1012.64	1012.45	0.19	0.0362
838	L2T	1080.72	1081.07	-0.36	0.1271
841	L2T	1061.51	1061.77	-0.26	0.0696
857	L2T	981.86	981.99	-0.13	0.0171
861	L2T	988.54	988.84	-0.30	0.0924
863	L2T	997.65	997.88	-0.24	0.0563
870	L2T	1010.95	1010.79	0.16	0.0260
871	L2T	989.76	989.93	-0.17	0.0282
867	L2T	1017.77	1017.55	0.22	0.0490
801	L3B	1030.73	1031.04	-0.31	0.0935
803	L3B	1019.70	1020.11	-0.41	0.1698
808	L3B	1049.53	1049.70	-0.16	0.0272
811	L3B	1056.72	1056.95	-0.23	0.0533
817	L3B	1016.09	1016.29	-0.19	0.0380
820	L3B	1026.94	1027.40	-0.46	0.2104
824	L3B	1061.10	1061.44	-0.34	0.1138
827	L3B	1058.32	1058.80	-0.48	0.2301
834	L3B	1084.81	1085.03	-0.22	0.0469
836	L3B	1079.12	1079.12	-0.01	0.0001
839	L3B	1082.64	1082.66	-0.02	0.0006
845	L3B	1042.16	1042.21	-0.05	0.0025
852	L3B	995.46	995.43	0.03	0.0011
858	L3B	1003.73	1003.97	-0.24	0.0573
860	L3B	1032.48	1032.69	-0.22	0.0473
864	L3B	1011.45	1011.62	-0.17	0.0304
866	L3B	1040.65	1040.49	0.16	0.0255
849	L3B	1025.66	1025.60	0.06	0.0036
869	L3B	988.62	988.40	0.21	0.0456
879	L3B	969.99	970.30	-0.31	0.0967
900	L4F	1003.12	1003.01	0.11	0.0118
901	L4F	1012.48	1012.73	-0.25	0.0623
902	L4F	1026.94	1027.80	-0.87	0.7531
903	L4F	1027.69	1028.46	-0.77	0.5972
904	L4F	1054.61	1054.92	-0.31	0.0958
905	L4F	1052.60	1053.15	-0.55	0.3079
906	L4F	1035.03	1035.23	-0.20	0.0391
907	L4F	1043.38	1044.16	-0.78	0.6079
908	L4F	1040.23	1040.44	-0.21	0.0445
909	L4F	1041.96	1041.96	0.01	0.0001
910	L4F	1021.14	1021.51	-0.37	0.1358
911	L4F	996.04	996.26	-0.22	0.0485
912	L4F	991.70	992.43	-0.74	0.5438
913	L4F	1035.11	1034.60	0.51	0.2585
914	L4F	1041.48	1041.73	-0.25	0.0649
915	L4F	1046.47	1046.70	-0.23	0.0508
916	L4F	1096.92	1097.67	-0.75	0.5646
917	L4F	1111.95	1112.15	-0.20	0.0401
918	L4F	1097.33	1097.40	-0.07	0.0043
919	L4F	1073.75	1074.05	-0.30	0.0873
809	L5U	1066.67	1066.84	-0.16	0.0266
810	L5U	1065.62	1065.83	-0.22	0.0465

Contractor: Optimal Geomatics
Owner: McLeod County
Independent Tester: Mn\DOT

LiDAR Collection Spring 2007
Delivery December 2007

McLeod County
DEM Vertical Test

815	L5U	1024.58	1024.75	-0.18	0.0307
816	L5U	1027.93	1028.01	-0.08	0.0061
822	L5U	1026.05	1026.14	-0.09	0.0088
823	L5U	1025.09	1025.29	-0.20	0.0398
830	L5U	1064.35	1064.39	-0.03	0.0011
831	L5U	1052.15	1052.14	0.01	0.0001
832	L5U	1069.67	1069.70	-0.03	0.0009
842	L5U	1065.71	1065.70	0.01	0.0002
843	L5U	1051.47	1051.53	-0.05	0.0029
850	L5U	1013.50	1013.14	0.36	0.1322
851	L5U	1031.20	1030.74	0.45	0.2069
855	L5U	979.57	979.64	-0.07	0.0048
856	L5U	980.04	980.13	-0.09	0.0088
873	L5U	997.12	996.67	0.46	0.2084
874	L5U	999.53	999.05	0.47	0.2248
875	L5U	1014.44	1013.83	0.61	0.3721
876	L5U	999.72	999.36	0.36	0.1323
877	L5U	1021.83	1021.94	-0.10	0.0105

Total Number of Points =
User-Defined Tolerance =
Chi Square Test :

120
1.19

Sum	11.1180
Average	0.0926
RMSEr	0.3044
NSSDA	0.5966

McLeod County
DEM Vertical Test

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
802	L10	1024.01	1024.23	-0.22	0.0499
805	L10	1019.39	1019.76	-0.37	0.1383
806	L10	1059.67	1059.81	-0.14	0.0204
812	L10	1057.78	1057.72	0.05	0.0030
814	L10	1048.67	1048.81	-0.15	0.0213
821	L10	1027.56	1027.73	-0.17	0.0286
825	L10	1061.17	1061.62	-0.45	0.2055
828	L10	1070.02	1070.07	-0.06	0.0032
833	L10	1079.76	1079.68	0.08	0.0064
837	L10	1129.96	1130.23	-0.27	0.0703
840	L10	1060.54	1060.57	-0.03	0.0009
844	L10	1059.71	1059.71	0.00	0.0000
848	L10	1033.62	1033.66	-0.04	0.0016
854	L10	1013.14	1013.21	-0.07	0.0053
859	L10	1014.10	1014.42	-0.32	0.1035
862	L10	1035.85	1036.10	-0.25	0.0612
865	L10	1062.66	1062.84	-0.18	0.0327
868	L10	1006.55	1006.18	0.37	0.1374
872	L10	992.01	991.66	0.36	0.1262
878	L10	1011.31	1011.42	-0.10	0.0105
880	L10	994.30	994.48	-0.17	0.0303
881	L10	1013.80	1013.54	0.26	0.0674
882	L10	1028.17	1028.32	-0.15	0.0224
883	L10	1030.73	1030.98	-0.26	0.0665
884	L10	1058.33	1058.36	-0.04	0.0013
885	L10	1048.15	1048.16	-0.01	0.0001
886	L10	1071.14	1071.29	-0.15	0.0224
887	L10	1043.41	1043.41	0.00	0.0000
888	L10	1024.69	1024.86	-0.16	0.0266
889	L10	1071.80	1072.19	-0.39	0.1525
890	L10	1062.29	1062.63	-0.34	0.1158
891	L10	1046.13	1046.36	-0.23	0.0544
892	L10	1005.38	1005.59	-0.22	0.0483
893	L10	999.07	999.16	-0.10	0.0090
894	L10	1039.58	1039.19	0.40	0.1567
895	L10	1020.11	1020.17	-0.06	0.0039
896	L10	1062.71	1062.71	-0.01	0.0001
897	L10	1091.75	1091.48	0.26	0.0696
898	L10	1074.18	1074.03	0.15	0.0221
899	L10	1107.08	1107.16	-0.08	0.0062

Total Number of Points =
User-Defined Tolerance =
Chi Square Test :

40
1.19

Sum	1.9018
Average	0.0475
RMSEr	0.2180
NSSDA	0.4274

McLeod County
DEM Vertical Test

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
800	L2T	1040.72	1041.01	-0.29	0.0835
804	L2T	1011.83	1012.15	-0.32	0.1039
807	L2T	1051.06	1051.43	-0.37	0.1378
813	L2T	1028.80	1029.28	-0.48	0.2320
818	L2T	1052.69	1053.19	-0.50	0.2482
819	L2T	1026.75	1027.13	-0.38	0.1452
826	L2T	1078.70	1079.18	-0.48	0.2297
829	L2T	1068.29	1068.60	-0.31	0.0962
835	L2T	1117.11	1117.08	0.02	0.0006
846	L2T	1074.84	1074.76	0.08	0.0060
847	L2T	1041.91	1042.51	-0.60	0.3555
853	L2T	1012.64	1012.45	0.19	0.0362
838	L2T	1080.72	1081.07	-0.36	0.1271
841	L2T	1061.51	1061.77	-0.26	0.0696
857	L2T	981.86	981.99	-0.13	0.0171
861	L2T	988.54	988.84	-0.30	0.0924
863	L2T	997.65	997.88	-0.24	0.0563
870	L2T	1010.95	1010.79	0.16	0.0260
871	L2T	989.76	989.93	-0.17	0.0282
867	L2T	1017.77	1017.55	0.22	0.0490

Total Number of Points =
User-Defined Tolerance =
Chi Square Test :

20
1.19

Sum	2.1403
Average	0.1070
RMSEr	0.3271
NSSDA	0.6412

McLeod County
DEM Vertical Test

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
801	L3B	1030.73	1031.04	-0.31	0.0935
803	L3B	1019.70	1020.11	-0.41	0.1698
808	L3B	1049.53	1049.70	-0.16	0.0272
811	L3B	1056.72	1056.95	-0.23	0.0533
817	L3B	1016.09	1016.29	-0.19	0.0380
820	L3B	1026.94	1027.40	-0.46	0.2104
824	L3B	1061.10	1061.44	-0.34	0.1138
827	L3B	1058.32	1058.80	-0.48	0.2301
834	L3B	1084.81	1085.03	-0.22	0.0469
836	L3B	1079.12	1079.12	-0.01	0.0001
839	L3B	1082.64	1082.66	-0.02	0.0006
845	L3B	1042.16	1042.21	-0.05	0.0025
852	L3B	995.46	995.43	0.03	0.0011
858	L3B	1003.73	1003.97	-0.24	0.0573
860	L3B	1032.48	1032.69	-0.22	0.0473
864	L3B	1011.45	1011.62	-0.17	0.0304
866	L3B	1040.65	1040.49	0.16	0.0255
849	L3B	1025.66	1025.60	0.06	0.0036
869	L3B	988.62	988.40	0.21	0.0456
879	L3B	969.99	970.30	-0.31	0.0967

Total Number of Points =
User-Defined Tolerance =
Chi Square Test :

20
1.19

Sum	1.2935
Average	0.0647
RMSEr	0.2543
NSSDA	0.4985

McLeod County
DEM Vertical Test

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
900	L4F	1003.12	1003.01	0.11	0.0118
901	L4F	1012.48	1012.73	-0.25	0.0623
902	L4F	1026.94	1027.80	-0.87	0.7531
903	L4F	1027.69	1028.46	-0.77	0.5972
904	L4F	1054.61	1054.92	-0.31	0.0958
905	L4F	1052.60	1053.15	-0.55	0.3079
906	L4F	1035.03	1035.23	-0.20	0.0391
907	L4F	1043.38	1044.16	-0.78	0.6079
908	L4F	1040.23	1040.44	-0.21	0.0445
909	L4F	1041.96	1041.96	0.01	0.0001
910	L4F	1021.14	1021.51	-0.37	0.1358
911	L4F	996.04	996.26	-0.22	0.0485
912	L4F	991.70	992.43	-0.74	0.5438
913	L4F	1035.11	1034.60	0.51	0.2585
914	L4F	1041.48	1041.73	-0.25	0.0649
915	L4F	1046.47	1046.70	-0.23	0.0508
916	L4F	1096.92	1097.67	-0.75	0.5646
917	L4F	1111.95	1112.15	-0.20	0.0401
918	L4F	1097.33	1097.40	-0.07	0.0043
919	L4F	1073.75	1074.05	-0.30	0.0873

Total Number of Points =
User-Defined Tolerance =
Chi Square Test :

20
1.19

Sum	4.3180
Average	0.2159
RMSEr	0.4646
NSSDA	0.9107

McLeod County
DEM Vertical Test

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
809	L5U	1066.67	1066.84	-0.16	0.0266
810	L5U	1065.62	1065.83	-0.22	0.0465
815	L5U	1024.58	1024.75	-0.18	0.0307
816	L5U	1027.93	1028.01	-0.08	0.0061
822	L5U	1026.05	1026.14	-0.09	0.0088
823	L5U	1025.09	1025.29	-0.20	0.0398
830	L5U	1064.35	1064.39	-0.03	0.0011
831	L5U	1052.15	1052.14	0.01	0.0001
832	L5U	1069.67	1069.70	-0.03	0.0009
842	L5U	1065.71	1065.70	0.01	0.0002
843	L5U	1051.47	1051.53	-0.05	0.0029
850	L5U	1013.50	1013.14	0.36	0.1322
851	L5U	1031.20	1030.74	0.45	0.2069
855	L5U	979.57	979.64	-0.07	0.0048
856	L5U	980.04	980.13	-0.09	0.0088
873	L5U	997.12	996.67	0.46	0.2084
874	L5U	999.53	999.05	0.47	0.2248
875	L5U	1014.44	1013.83	0.61	0.3721
876	L5U	999.72	999.36	0.36	0.1323
877	L5U	1021.83	1021.94	-0.10	0.0105
				Sum	1.4645
				Average	0.0732
				RMSEr	0.2706
				NSSDA	0.5304

Total Number of Points =
 User-Defined Tolerance =
 Chi Square Test :

From: "Steve Ashbee" <sjashbee@optimalgeo.com>
To: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
Date: 1/18/2008 12:04:54 PM
Subject: Part of my Project Summary Report

Pete,

Attached is an excerpt that deals with the testing and our review at the 7 points.
Please give it a read and let me know if you are OK with it.

Steve

Spatial Accuracy Testing by Minnesota Department of Transportation (MNDOT)

Third-party data spatial accuracy testing of the output mapping data was performed by MNDOT. Orthophotography was tested by selecting features which can be readily and accurately identified on the orthophotography and comparing their X, Y coordinates with those observed using a field survey methods. Topographic mapping was tested using RTK and total-station methodologies. Five different categories of land cover throughout the County were tested. These included:

L1O - Open areas; plowed fields, low grass, lawns, & other un-observed bare-earth surfaces

L2T - Tall grass & weeds; longer grasses, crops, weedy areas, low mixed vegetation

L3B - Brush; Brush and bushes, low scattered trees

L4F - Forest; Forest and wooded areas, woodlots

L5U - Urban; Areas with an abundance of man-made structures

The field collected elevations were then compared to surface elevations interpolated from the DEM (Digital Elevation Model) or TIN (Triangular Irregular Network). The TIN was derived by combining the supplied bare-earth classified LIDAR returns and breaklines compiled from LIDAR synthetic stereo pairs.

Testing for both orthophotography and topographic mapping came up positive, meeting or exceeding the targeted accuracy standards.

Orthophotography Test Results:

The targeted accuracy for orthophotography was to meet 1"=100' ASPRS Class 1 Standards for Large-Scale Mapping. (Horizontal) This is quoted in terms of maximum allowable RMSE (Root Mean Square Error) in X or Y of 1'. Equivalent given in RMSEr and NSSDA 95% confidence.

	RMSE in X or Y	RMSEr
NSSDA - 95% Confidence		
Target Accuracy 1.45'	1'	1.414'
Tested Accuracy 1.28'	0.52'	0.74'

The results came in exceeding the targeted accuracy. No test points were selected for review.

DEM Data Test Results:

The targeted accuracy for topographic mapping was to meet ASPRS Class 1 Standards for Large-Scale Mapping with 1' contours. This is quoted in terms of maximum allowable RMSE (Root Mean Square Error) 1/3 of the contour interval. Equivalent is also provided expressed in terms of NSSDA 95% confidence level.

	RMSE in el.	NSSDA - 95% Confidence
Target Accuracy	0.33'	0.65'
Tested Accuracy	0.30'	0.60

None of the test points differences exceed one contour interval (1'). Of the

one-hundred and twenty (120) test points, seven (7) test points exhibiting the highest deltas were selected for review in order to determine whether any procedural or systematic issues were affecting the data set. Of the seven points selected, one was classified as L2T, five as L4F and one as L5U. Following review of the data set, observations at the selected locations were as follows:

847 - L2T

Field survey at this point location indicated an elevation 0.6' lower than that interpolated from the mapping. Review of the location confirmed land cover description "L2T", long grass or crops. It was one of twenty collected in this land cover description. No systematic error or omission of data was observed during review. Analysis of the test results for this land cover type suggests that the DEM is such areas exhibit a slightly higher mean deviation with respect to the field survey elevations. In theory, the affect of the vegetation would be to influence a higher elevation in the data set as some last-return data that was classified as ground may actually be slightly elevated from the ground. Test results appear to support this idea as the average of elevation deltas is 14/100ths of a foot higher than that observed in the open land cover area.

902, 903, 907, 912, 916 - L4F

Field surveys at these point locations indicated elevations between 0.74' to 0.87' lower than that interpolated from the mapping. Review of the location confirmed land cover description "L4F", forest or woodland. These were five of twenty points field surveyed in this land cover type. No systematic error or omission of data was observed during review at any of the locations. As was the case for the land cover type described above, vegetation could be expected to influence a higher elevation in the data set as some last-return data that was classified as ground may actually be slightly elevated from the ground. In forest, this could include the bottoms of trunks and debris as well as low vegetation. Analysis of the field survey test point elevations against those taken from the map data identifies this land cover type as having the lowest accuracy compared to the remainder of the project area. It exhibits the highest mean deviation, 0.37', compared to other land covers, and with a RMSE of 0.46', it is the only land cover type that does not meet or exceed the target accuracy for the overall project when examined in isolation. The result is consistent with expectations that lower accuracy might be expected in areas obscured by vegetation than open and urban land cover categories. In terms of degree to which the accuracy was affected, the result is slightly better than anticipated for this land cover type.

875 - L5U

Field surveys at these point location indicated an elevation 0.61' higher than that interpolated from the mapping. Review of the location confirmed land cover description "L5U", urban. This was one of twenty points field surveyed in this land cover type. No systematic error or omission of data was identified here. No solid explanation could be determined for the elevation difference. Some higher elevations were noted in the data set within a few feet of the test point. It may be speculated that with application of the horizontal accuracy tolerance radius around the point that a better elevation match may be observed. Analysis of test results for this land cover type in isolation show the lowest mean deviation and an RMSE of 0.27', second to the open land cover type. Given the results observed for this land cover type when analyzed in isolation, confidence should remain that elevation accuracy requirements will be met or exceeded in urban areas.

Testing Conclusion

While MNDOT's testing for elevation accuracy showed slightly different results from our OPTIMAL's, (0.3' RMSE compared to 0.2'). Variance in testing approach account for the different results. OPTIMAL tested more points, (1,041) however a much higher proportion of points were collected in open and urban areas and no test data was collected in forested areas. OPTIMAL's testing served well as a quality control providing confidence in sensor performance. MNDOT test locations while fewer, were better distributed across the project area and provided sufficient test point information at all land cover types found in the project area, thereby providing an analysis basis for the effects of those land covers. Therefore, only the third-party MNDOT results should be used to populate any "tested accuracy" fields in the metadata.

Steve Ashbee C.P. (ASPRS #999)
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Optimal Geomatics, Inc.
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Huntsville, AL 35805
PH: 256-882-7788
FX: 256-882-7774
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United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION of Aerial Mapping Camera

May 17, 2005

Camera type:	Wild RC30*	Camera serial no.:	5296
Lens type:	Wild Universal Aviogon /4-S	Lens serial no.:	13433
Nominal focal length:	153 mm	Maximum aperture:	f/4
		Test aperture:	f/4

Submitted by: MD Atlantic Technologies, Inc.
Huntsville, Alabama

Reference: MD Atlantic Technologies, Inc. purchase order No. 05P0115,
dated May 18, 2005.

These measurements were made on Agfa glass plates, 0.19 inch thick, with spectroscopic emulsion type APX Panchromatic, developed in D-19 at 68° F for 3 minutes with continuous agitation. These photographic plates were exposed on a multicollimator camera calibrator using a white light source rated at approximately 5200K.

I. Calibrated Focal Length: 153.758 mm

II. Lens Distortion

Field angle:	7.5°	15°	22.7°	30°	35°	40°
Symmetric radial (µm)	-2	-3	-3	-1	1	3
Decentering (µm)	0	0	1	2	3	4

Symmetric radial distortion parameters	Decentering distortion parameters	Calibrated principal point
$K_0 = 0.8279 \times 10^{-4}$	$P_1 = -0.1152 \times 10^{-6}$	$x_p = -0.001$ mm
$K_1 = -0.1193 \times 10^{-7}$	$P_2 = -0.1923 \times 10^{-6}$	$y_p = -0.009$ mm
$K_2 = 0.3419 \times 10^{-12}$	$P_3 = 0.0000$	
$K_3 = 0.0000$	$P_4 = 0.0000$	
$K_4 = 0.0000$		

The values and parameters for Calibrated Focal Length (CFL), Symmetric Radial Distortion (K_0, K_1, K_2, K_3, K_4), Decentering Distortion (P_1, P_2, P_3, P_4), and Calibrated Principal Point (point of symmetry) (x_p, y_p) were determined through a least-squares Simultaneous Multiframe Analytical Calibration (SMAC) adjustment. The x and y-coordinate measurements utilized in the adjustment of the above parameters have a standard deviation (σ) of ± 3 microns.

* Equipped with Forward Motion Compensation

III. Lens Resolving Power in cycles/mm

Area-weighted average resolution: 111

Field angle:	0°	7.5°	15°	22.7°	30°	35°	40°
Radial lines	113	134	134	134	113	113	95
Tangential lines	113	134	113	113	113	95	80

The resolving power is obtained by photographing a series of test bars and examining the resultant image with appropriate magnification to find the spatial frequency of the finest pattern in which the bars can be counted with reasonable confidence. The series of patterns has spatial frequencies from 5 to 288 cycles/mm in a geometric series having a ratio of the 4th root of 2. Radial lines are parallel to a radius from the center of the field, and tangential lines are perpendicular to a radius.

IV. Filter Parallelism

The two surfaces of the Wild S25 No. 7834 filter accompanying this camera are within 10 seconds of being parallel. This filter was used for the calibration.

V. Shutter Calibration

Indicated time (sec)	Rise time (μ sec)	Fall Time (μ sec)	% width time (ms)	Nom. Speed (sec.)	Efficiency (%)
1/125	1880	1871	8.73	1/130	87
1/250	901	891	4.25	1/270	87
1/500	464	462	2.13	1/540	87
1/1000	228	229	1.08	1/1070	87

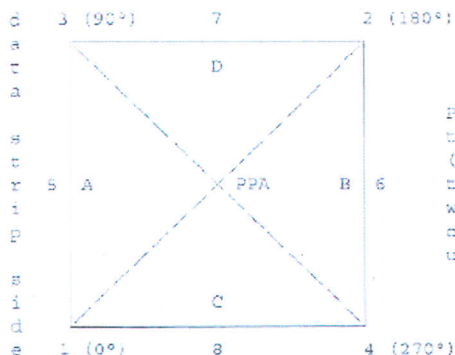
The effective exposure times were determined with the lens at aperture f/4. The method is considered accurate within 3 percent. The technique used is described in International Standard ISO 516:1999(E).

VI. Film Platen

The film platen mounted in Wild RC30 drive unit No. 5296-569 does not depart from a true plane by more than 13 μ m (0.0005 in).

This camera is equipped with a platen identification marker that will register "669" in the data strip area for each exposure.

VII. Principal Points and Fiducial Coordinates



Positions of all points are referenced to the principal point of autocollimation (PPA) as origin. The diagram indicates the orientation of the reference points when the camera is viewed from the back, or a contact positive with the emulsion up. The data strip is to the left.

	X coordinate	Y coordinate
Indicated principal point, corner fiducials	0.004 mm	-0.009 mm
Indicated principal point, midside fiducials	0.002	-0.006
Principal point of autocollimation (PPA)	0.0	0.0
Calibrated principal point (pt. of sym.) x_p, y_p	-0.001	-0.009

Fiducial Marks

Fiducial Mark	X coordinate	Y coordinate
1	-105.953 mm	-105.007 mm
2	106.001	105.990
3	-105.994	105.989
4	106.003	-106.007
5	-111.997	-0.006
6	111.001	-0.007
7	0.000	111.992
8	0.003	-112.023

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2: 299.807 mm 3-4: 299.809 mm

Lines joining these markers intersect at an angle of 89° 59' 59"

Midside fiducials

5-6: 223.998 mm 7-8: 224.015 mm

Lines joining these markers intersect at an angle of 90° 00' 03"

Corner fiducials (perimeter)

1-3: 211.996 mm 2-3: 211.996 mm
1-4: 211.996 mm 2-4: 211.997 mm

The method of measuring these distances is considered accurate within 0.003 mm

Note: For GPS applications, the nominal entrance pupil distance from the focal plane is 277 mm.

MN / DOT Geodetic Database Station # 41254



STATION NAME: 4307 AQ

NGS QUAD / STA # 44094113/

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/252

NGS ACRN # DF9257

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
SW	6	115 N	27 W	444724.65	940749.49	2	C	GLENCOE

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	2000	2007	GOOD	YES			RECESSED 2 IN.

<u>MONUMENT TYPE</u>	<u>DISK TYPE</u>	<u>MAGNETIC PROPERTIES</u>
ALUMINUM ALLOY ROD (DEPTH 20 FT)	SURVEY DISK	MARKER W/BAR MAGNET

DESCRIPTION (2000) STAMPING: 4307 AQ 2000

1.5 MILES NORTHEAST OF GLENCOE, 2.60 MILES NORTHWEST ALONG TRUNK HIGHWAY 22 FROM JUNCTION OF TRUNK HIGHWAY 22 AND COUNTY ROAD 3 AT NORTHWEST EDGE OF GLENCOE, TO TRUNK HIGHWAY 22 MILEPOINT 110.6, THENCE 3.65 MILES EAST ON COUNTY ROAD 3, 257 FEET EAST OF COUNTY ROAD 15, 38 FEET NORTH OF COUNTY ROAD 3, 5.3 FEET WEST OF POWER POLE, 2.7 FEET EAST OF WITNESS POST.

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>			<u>ADJUSTMENT</u>	
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
	1013.466		2	VERTICAL CONTROL SURVEY	2007	VOTAY
	1013.482	923.013		GPS - STATIC	2007	HMCLD
		922.849		ADJUSTMENT	2007	GPS2300
	1013.449	923.013		GPS - STATIC	2003	HGLEN
	1013.466		2	VERTICAL CONTROL SURVEY	2001	VGLBP

Geoid 2003 Separation: -90.42

GEODETTIC POSITION NAD83 (1996)

<u>ZONE</u>	<u>X</u>	<u>Y</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ADJUSTMENT</u>
					<u>YEAR</u> <u>REFERENCE</u>
STATE PLANE: SOUTH	2590810.378 ft	980703.501 ft	444724.64808	940749.48605	2007 HMCLD
COUNTY:	630575.304 ft	222203.326 ft			
UTM: 15	1347049.670 ft	16273799.382 ft			

Meters = U. S. Survey feet * (1200/3937)

MN / DOT Geodetic Database Station # 18230



STATION NAME: HALVA MNDT

NGS QUAD / STA # 44094141/

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/200

NGS ACRN # DF6197

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
NE	1	116 N	29 W	445320.03	941511.58	2	C	HUTCHINSON EAST

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	1989	2007	GOOD	YES			RECESSED 2 IN.

MONUMENT TYPE

ALUMINUM ALLOY ROD (DEPTH 23 FT)

DISK TYPE

HORIZONTAL CONTROL DISK

MAGNETIC PROPERTIES

MARKER W/BAR MAGNET

DESCRIPTION (1989)

STAMPING: HALVA 1989

2.5 MILES WEST ON TRUNK HIGHWAY 7 FROM JUNCTION OF TRUNK HIGHWAY 7 AND COUNTY ROAD 16 AT WEST EDGE OF SILVER LAKE TO TRUNK HIGHWAY 7 MILEPOINT 147.8 THEN 0.3 MILES SOUTH ON COUNTY ROAD 71, 22.5 FEET EAST OF COUNTY ROAD 71, 8.0 FEET NORTH OF FIELD ENTRANCE, 107.0 FEET NORTHEAST OF POWER POLE, 104.2 FEET NORTHEAST OF WITNESS POST, 69.4 FEET EAST-SOUTHEAST OF WITNESS POST, 104.5 FEET NORTHEAST OF HALVA REFERENCE MARK 1, 69.1 FEET EAST OF HALVA REFERENCE MARK 2, 14.5 FEET SOUTHWEST OF WITNESS POST

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>			<u>ADJUSTMENT</u>	
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
	1057.708	967.724		GPS - STATIC	2007	HMCLD
		967.596		ADJUSTMENT	2007	GPS2300
	1057.698		2	ADJUSTMENT	2005	00000472
	1057.675	967.724		GPS - STATIC	2002	HLEST
	1057.685		2	VERTICAL CONTROL SURVEY	2001	VSILV
1057.255			2	VERTICAL CONTROL SURVEY	1990	VSILV

Geoid 2003 Separation: -89.95

GEODETTIC POSITION NAD83 (1996)

<u>ZONE</u>	<u>X</u>	<u>Y</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ADJUSTMENT YEAR</u>	<u>REFERENCE</u>
STATE PLANE: SOUTH	2559040.637 ft	1016768.154 ft	445320.03431	941511.58497	2007	HMCLD
COUNTY:	598523.108 ft	258023.664 ft				
UTM: 15	1315733.937 ft	16310244.359 ft				

GEODETTIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2559040.860 ft	1016767.644 ft	445320.02928	941511.58186	1989	HSILV
COUNTY:	598523.334 ft	258023.155 ft				
UTM: 15	1315734.153 ft	16310243.846 ft				

Meters = U. S. Survey feet * (1200/3937)

MN / DOT Geodetic Database Station # 18297



STATION NAME: OTAY MN085

NGS QUAD / STA # 44094124/

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/

NGS ACRN # AC4882

1/4	SEC	TWP	RNG	LATITUDE	LONGITUDE	VERT ORDER	HORZ ORDER	USGS QUAD MAP
SW	30	115 N	27 W	444404.46	940753.76	2	B	NEW AUBURN

AGENCY	YR-SET	YR-REC	CONDITION	GPSABLE	PHOTOS	BRDG NO	F/P/R
MN-085	1993	2007	GOOD	YES	YES		RECESSED 2 IN.

MONUMENT TYPE	DISK TYPE	MAGNETIC PROPERTIES
ALUMINUM ALLOY ROD (DEPTH 25 FT)	SURVEY DISK	MARKER W/BAR MAGNET

DESCRIPTION (2003) **STAMPING:** OTAY

2.5 MILES SOUTH AND 1.0 MILES EAST OF GLENCOE, 2.55 MILES SOUTH ALONG COUNTY ROAD 2 FROM JUNCTION OF COUNTY ROAD 2 AND TRUNK HIGHWAY 22 IN GLENCOE THEN 1.0 MILES EAST ALONG COUNTY ROAD 10, THEN 0.2 FEET NORTH ON FALCON AVENUE, 21 FEET EAST OF FALCON AVENUE, 9 FEET SOUTH OF FIELD ENTRANCE, 43.8 FEET SOUTH-SOUTHWEST OF NORTHERN STATE POWER POLE NUMBER 30, 41.4 FEET SOUTH-SOUTHWEST OF WITNESS POST

STATION NOTES

THREADED TYPE CAP WAS FOUND LOOSE. TIGHTENED AGAIN 7-18-2006 KMS

ELEVATIONS (ft)		ELLIPSOID			ADJUSTMENT	
NGVD 29	NAVD 88	HEIGHT	ORDER	METHOD	YEAR	REFERENCE
	1018.272	927.688		GPS - STATIC	2007	HSIBL
	1018.276		2	VERTICAL CONTROL SURVEY	2007	VOTAY
	1018.272	927.688		GPS - STATIC	2007	HMCLD
	1018.239	927.688		GPS - STATIC	2006	HGAYL
	1018.239	927.688		GPS - STATIC	2005	GPS2243
	1018.272	927.688		GPS - STATIC	2005	GPS2036
	1018.239	927.688		GPS - STATIC	2004	HHAMB
	1018.174	927.688		GPS - STATIC	2003	HWINT
	1018.272	927.688		GPS - STATIC	2003	HGLEN
	1018.207	927.688		GPS - STATIC	1996	GPS0805
1018.108				GPS - STATIC	1993	HORZ

Geoid 2003 Separation: -90.61

GEODETTIC POSITION NAD83 (1996)

ZONE	X	Y	LATITUDE	LONGITUDE	ADJUSTMENT YEAR	REFERENCE
STATE PLANE: SOUTH	2590469.842 ft	960431.048 ft	444404.45687	940753.75569	2005	GPS2243
COUNTY:	630392.320 ft	201926.695 ft				
UTM: 15	1346459.986 ft	16253537.391 ft				

GEODETTIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2590469.737 ft	960430.446 ft	444404.45092	940753.75713	1993	CO43
COUNTY:	630392.220 ft	201926.092 ft				
UTM: 15	1346459.873 ft	16253536.790 ft				

Meters = U. S. Survey feet * (1200/3937)

MN / DOT Geodetic Database Station # 18341



STATION NAME: STED MNDT

NGS QUAD / STA # 44094114/

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/219

NGS ACRN # DF6203

1/4	SEC	TWP	RNG	LATITUDE	LONGITUDE	VERT ORDER	HORZ ORDER	USGS QUAD MAP
NE	30	117 N	27 W	445425.23	940804.60	2	C	SILVER LAKE

AGENCY	YR-SET	YR-REC	CONDITION	GPSABLE	PHOTOS	BRDG NO	F/P/R
MNDT	1989	2007	GOOD	YES	YES		RECESSED 1 IN.

MONUMENT TYPE	DISK TYPE	MAGNETIC PROPERTIES
ALUMINUM ALLOY ROD (DEPTH 23 FT)	HORIZONTAL CONTROL DISK	MARKER W/BAR MAGNET

DESCRIPTION (2007) **STAMPING:** STED 1989

3.6 MILES EAST ON TRUNK HIGHWAY 7 FROM JUNCTION OF TRUNK HIGHWAY 7 AND COUNTY ROAD 16 AT WEST EDGE OF SILVER LAKE, IN NORTHEAST QUADRANT OF JUNCTION OF TRUNK HIGHWAY 7-FALCON AVENUE AND COUNTY ROAD 15 (SOUTH), AT TRUNK HIGHWAY 7 MILEPOINT 153.9, 129.2 FEET NORTH OF TRUNK HIGHWAY 7, 19.0 FEET EAST OF FALCON AVENUE, 41.0 FEET NORTH OF FIELD ENTRANCE, 81.0 FEET NORTHEAST OF POWER POLE 285 WITH TRANSFORMER, 8.6 FEET WEST OF WITNESS POST, 30.9 FEET NORTH OF STED REFERENCE MARK 1, 40.4 FEET EAST-NORTHEAST OF STED REFERENCE MARK 2

STATION NOTES

ELEVATIONS (ft)		ELLIPSOID			ADJUSTMENT	
NGVD 29	NAVD 88	HEIGHT	ORDER	METHOD	YEAR	REFERENCE
	1042.091	951.931		GPS - STATIC	2007	HMCLD
		951.796		ADJUSTMENT	2007	GPS2300
	1042.085		2	ADJUSTMENT	2005	00000472
	1042.058	951.931		GPS - STATIC	2002	HLEST
	1042.045		2	VERTICAL CONTROL SURVEY	2001	VSILV
1041.586			2	VERTICAL CONTROL SURVEY	1990	VSILV

Geoid 2003 Separation: -90.11

GEODETTIC POSITION NAD83 (1996)

ZONE	X	Y	LATITUDE	LONGITUDE	ADJUSTMENT YEAR	REFERENCE
STATE PLANE: SOUTH	2589790.836 ft	1023297.468 ft	445425.22761	940804.59670	2007	HMCLD
COUNTY:	629224.614 ft	264792.336 ft				
UTM: 15	1346555.052 ft	16316392.365 ft				

GEODETTIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2589791.102 ft	1023296.884 ft	445425.22184	940804.59300	1989	HSILV
COUNTY:	629224.883 ft	264791.754 ft				
UTM: 15	1346555.310 ft	16316391.777 ft				

Meters = U. S. Survey feet * (1200/3937)

STATION PHOTOS

TYPE	FILE NAME	DIR	DATE
LOCATION:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/STED-DF6203-3E-05OCT2005.jpg	E	Oct-5-05
MONUMENT:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/STED-DF6203-2-05OCT2005.jpg		Oct-5-05
DISK:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/STED-DF6203-1-05OCT2005.jpg		Oct-5-05

** All images can be viewed at: <ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos> **

MN / DOT Geodetic Database Station # 18344



STATION NAME: STEW MNDT

NGS QUAD / STA # 44094134/

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/194

NGS ACRN # DF8436

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
SE	31	115 N	30 W	444322.39	942903.57	2	C	STEWART

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	1990	2007	GOOD	YES	YES		RECESSED 2 IN.

MONUMENT TYPE

ALUMINUM ALLOY ROD (DEPTH 23 FT)

DISK TYPE

HORIZONTAL CONTROL DISK

MAGNETIC PROPERTIES

MARKER W/BAR MAGNET

DESCRIPTION (2001)

STAMPING: STEW 1990

AT STEWART, AT JUNCTION OF HERBERT STREET AND POWERS STREET, 154.5 FEET NORTH OF POWERS STREET, 3.0 FEET WEST OF HERBERT STREET EXTENDED, 19.2 FEET SOUTH OF SOUTH RAIL OF MAIN RAILROAD TRACKS, 15.4 FEET NORTH OF WITNESS POST

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>			<u>ADJUSTMENT</u>	
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
		973.131		ADJUSTMENT	2007	GPS2300
	1063.449	973.236		GPS - STATIC	2003	HOLIV
	1063.462		2	VERTICAL CONTROL SURVEY	2001	VBIRD
1062.980			2	VERTICAL CONTROL SURVEY	1990	VBIRD

Geoid 2003 Separation: -90.25

GEODETTIC POSITION NAD83 (1996)

<u>ZONE</u>	<u>X</u>	<u>Y</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ADJUSTMENT YEAR</u>	<u>REFERENCE</u>
STATE PLANE: SOUTH	2498787.110 ft	956516.001 ft	444322.38561	942903.56892	2003	HOLIV
COUNTY:	538732.845 ft	197299.480 ft				
UTM: 15	1254754.124 ft	16250750.800 ft				

GEODETTIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2498787.226 ft	956515.696 ft	444322.38260	942903.56730	1993	CO43
COUNTY:	538732.965 ft	197299.176 ft				
UTM: 15	1254754.236 ft	16250750.493 ft				

Meters = U. S. Survey feet * (1200/3937)

STATION PHOTOS

<u>TYPE</u>	<u>FILE NAME</u>	<u>DIR</u>	<u>DATE</u>
LOCATION:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/STEW-DF8436-3N-27MAR2007.jpg	N	Mar-27-07
MONUMENT:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/STEW-DF8436-2-27MAR2007.jpg		Mar-27-07
DISK:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/STEW-DF8436-1-27MAR2007.jpg		Mar-27-07

** All images can be viewed at: <ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos> **

MN / DOT Geodetic Database Station # 18348



STATION NAME: SUMTER

NGS QUAD / STA # 44094131/1017

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/137

NGS ACRN # PQ0634

1/4	SEC	TWP	RNG	LATITUDE	LONGITUDE	VERT ORDER	HORZ ORDER	USGS QUAD MAP
NE	25	115 N	29 W	444423.11	941533.37	2	C	BROWNTON

AGENCY	YR-SET	YR-REC	CONDITION	GPSABLE	PHOTOS	BRDG NO	F/P/R
NGS	1956	2007	GOOD	YES	YES		RECESSED 2 IN.

MONUMENT TYPE
CONCRETE MONUMENT

DISK TYPE
TRIANGULATION STATION DISK

MAGNETIC PROPERTIES
STEEL SPIKE ADJ TO MON

DESCRIPTION (2007) STAMPING: SUMTER 1956

5 MILES SOUTHWEST OF GLENCOE, 4.5 MILES EAST OF BROWNTON, 5.85 MILES EAST OF JUNCTION OF TRUNK HIGHWAY 15 AND TRUNK HIGHWAY 212, 189 FEET SOUTH OF SOUTH RAIL OF RAILROAD TRACKS, 49 FEET NORTH OF TRUNK HIGHWAY 212, 155.7 FEET NORTHWEST OF MILEPOST 114, 25 FEET WEST OF ENTRANCE 13256, 31.36 FEET SOUTHWEST OF SUMTER REFERENCE MARK 4, 37.47 FEET SOUTHEAST OF SUMTER REFERENCE MARK 5, 2.1 FEET SOUTH OF WITNESS POST

STATION NOTES

THE DISTANCE BETWEEN REFERENCE MARK 4 AND REFERENCE MARK 5 IS 45.45 FEET

ELEVATIONS (ft)		ELLIPSOID			ADJUSTMENT	
NGVD 29	NAVD 88	HEIGHT	ORDER	METHOD	YEAR	REFERENCE
	1032.249	941.721		GPS - STATIC	2007	HMCLD
		941.619		ADJUSTMENT	2007	GPS2300
	1032.249	941.721		GPS - STATIC	2006	HGAYL
	1032.249	941.691		GPS - STATIC	2003	HOLIV
	1032.249	941.770		ADJUSTMENT	1999	G17648
	1032.239		2	ADJUSTMENT	1995	00000135
1031.812			2	VERTICAL CONTROL SURVEY	1986	VHUCH

Geoid 2003 Separation: -90.57

GEODETTIC POSITION NAD83 (1996)

ZONE	X	Y	LATITUDE	LONGITUDE	ADJUSTMENT YEAR	ADJUSTMENT REFERENCE
STATE PLANE: SOUTH	2557299.984 ft	962399.005 ft	444423.10698	941533.36815	2007	HMCLD
COUNTY:	597204.608 ft	203637.078 ft				
UTM: 15	1313324.131 ft	16255912.512 ft				

GEODETTIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2557299.872 ft	962398.478 ft	444423.10177	941533.36969	1991	H1991
COUNTY:	597204.498 ft	203636.551 ft				
UTM: 15	1313324.012 ft	16255911.987 ft				

Meters = U. S. Survey feet * (1200/3937)

STATION PHOTOS

TYPE	FILE NAME	DIR	DATE
LOCATION:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/SUMTER-PQ0634-3N-01MAR2006.jpg	N	Mar-1-06
MONUMENT:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/SUMTER-PQ0634-2-01MAR2006.jpg		Mar-1-06
DISK:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/mcleod/SUMTER-PQ0634-1-01MAR2006.jpg		Mar-1-06

** All images can be viewed at: <ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos> **

MN / DOT Geodetic Database Station # 18354



STATION NAME: THOMAS MNDT

NGS QUAD / STA # 44094131/

COUNTY: MCLEOD, MN

MAP SHT / INDEX # 1/241

NGS ACRN # DG9351

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
SW	31	114 N	29 W	443749.95	942224.44	2	C	BROWNTON

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	1992	2007	GOOD	YES			FLUSH

<u>MONUMENT TYPE</u>	<u>DISK TYPE</u>	<u>MAGNETIC PROPERTIES</u>
ALUMINUM ALLOY ROD (DEPTH 20 FT)	HORIZONTAL CONTROL DISK	MARKER W/BAR MAGNET

DESCRIPTION (1992) STAMPING: THOMAS 1992

5.95 MILES NORTH OF TRUNK HIGHWAY 19 IN WINTHROP, AT TRUNK HIGHWAY 15 MILEPOINT 83.00, 0.1 MILES EAST OF TRUNK HIGHWAY 15, 28.5 FEET NORTH OF COUNTY ROAD 58, 124.9 FEET WEST OF STOP AHEAD SIGN POST, 8 FEET WEST OF ENTRANCE, 6.8 FEET EAST OF WITNESS POST

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>		<u>ADJUSTMENT</u>		
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
	1028.443	937.620		GPS - STATIC	2003	HBROWN
	1028.456		2	VERTICAL CONTROL SURVEY	2001	VBROW
1028.108			2	VERTICAL CONTROL SURVEY	1993	VBROW

Geoid 2003 Separation: -90.87

GEODETIC POSITION NAD83 (1996)

<u>ZONE</u>	<u>X</u>	<u>Y</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ADJUSTMENT YEAR</u>	<u>REFERENCE</u>
STATE PLANE: SOUTH	2527448.496 ft	922700.600 ft	443749.94848	942224.44401	2003	HBROWN
COUNTY:	567658.925 ft	163703.695 ft				
UTM: 15	1282992.995 ft	16216591.492 ft				

GEODETIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2527448.490 ft	922700.098 ft	443749.94352	942224.44406	1993	H1993
COUNTY:	567658.924 ft	163703.193 ft				
UTM: 15	1282992.983 ft	16216590.990 ft				

Meters = U. S. Survey feet * (1200/3937)

MN / DOT Geodetic Database Station # 3469



STATION NAME: 1003 A

NGS QUAD / STA # 44094111/

COUNTY: CARVER, MN

MAP SHT / INDEX # 1/

NGS ACRN # PQ0067

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
NW	31	117 N	26 W	445420.00	940042.00	2		WINSTED

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	1968	1971	DESTROYED				

<u>MONUMENT TYPE</u>	<u>DISK TYPE</u>	<u>MAGNETIC PROPERTIES</u>
CONCRETE MONUMENT	SURVEY DISK	SEE DESCRIPTION

DESCRIPTION (1971) STAMPING: 1003 A 1968

STA WAS DESTROYED AND BM 1003 A RESET WAS SET

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>			<u>ADJUSTMENT</u>	
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
	991.182		2	ADJUSTMENT	1991	00000025
990.904			2	VERTICAL CONTROL SURVEY	1972	L114 MINN
990.904			2	VERTICAL CONTROL SURVEY	1971	L22187

Geoid 2003 Separation: -89.98

Meters = U. S. Survey feet * (1200/3937)

MN / DOT Geodetic Database Station # 19545



STATION NAME: MILLS MNDT

NGS QUAD / STA # 44094411/

COUNTY: MEEKER, MN

MAP SHT / INDEX # 1/173

NGS ACRN # PQ0850

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
NE	13	117 N	31 W	445641.89	943008.19	2	B	CEDAR MILLS

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	1976	2007	GOOD	YES	YES		FLUSH

MONUMENT TYPE
CONCRETE MONUMENT

DISK TYPE
HORIZONTAL CONTROL DISK

MAGNETIC PROPERTIES
STEEL ROD IMBED IN MON

DESCRIPTION (2003) STAMPING: MILLS 1976

1.0 MILES EAST OF CEDAR MILLS, AT JUNCTION OF TRUNK HIGHWAY 7 AND TRUNK HIGHWAY 22, AT TRUNK HIGHWAY 22 MILEPOINT 130.20, THE MARK IS 86.5 FEET WEST OF TRUNK HIGHWAY 22, 0.1 MILES NORTH OF TRUNK HIGHWAY 7, 115 FEET SOUTH OF POWER POLE, 111.98 FEET SOUTH OF REFERENCE MARK 1, 86.5 FEET WEST OF TRUNK HIGHWAY 22, 50.27 FEET NORTH OF REFERENCE MARK 2, 24.5 FEET SOUTH-SOUTHWEST OF TELEPHONE CABLE PEDESTAL K4 16 2, 2.7 FEET EAST OF WITNESS POST

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>			<u>ADJUSTMENT</u>	
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
	1111.218	1022.573		GPS - STATIC	2007	HMCLD
		1022.495		ADJUSTMENT	2007	GPS2300
	1111.202		2	VERTICAL CONTROL SURVEY	2006	VBLOM
	1111.218	1022.573		GPS - STATIC	2006	HBLOM
	1111.185	1022.573		GPS - STATIC	2005	GPS2036
	1111.185	1022.573		GPS - STATIC	2004	HMEEK
	1111.218	1022.573		GPS - STATIC	2003	HWAVE
	1111.218	1022.573		GPS - STATIC	2003	HGLEN
	1111.218	1022.573		GPS - STATIC	2002	HLEST
	1111.218	1022.613		ADJUSTMENT	1999	G17648
	1111.185	1022.573		GPS - STATIC	1996	GPS0805
	1111.202		2	ADJUSTMENT	1995	00000135
1110.703			2	VERTICAL CONTROL SURVEY	1980	L24530

Geoid 2003 Separation: -88.63

GEODETTIC POSITION NAD83 (1996)

<u>ZONE</u>	<u>X</u>	<u>Y</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>ADJUSTMENT</u>	
					<u>YEAR</u>	<u>REFERENCE</u>
STATE PLANE: SOUTH	2494619.074 ft	1037508.063 ft	445641.88602	943008.19243	2005	GPS2036
COUNTY:	564147.079 ft	119634.526 ft				
UTM: 15	1251586.615 ft	16331774.509 ft				

GEODETTIC POSITION NAD83 (1986)

STATE PLANE: SOUTH	2494619.515 ft	1037507.396 ft	445641.87946	943008.18624	1991	H1991
COUNTY:	564147.527 ft	119633.862 ft				
UTM: 15	1251587.048 ft	16331773.837 ft				

Meters = U. S. Survey feet * (1200/3937)

MN / DOT Geodetic Database Station # 50628



STATION NAME: CASIB MNDT RM 1

NGS QUAD / STA # 44093434/

COUNTY: SIBLEY, MN

MAP SHT / INDEX # 1/217

NGS ACRN # DI9687

<u>1/4</u>	<u>SEC</u>	<u>TWP</u>	<u>RNG</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>VERT ORDER</u>	<u>HORZ ORDER</u>	<u>USGS QUAD MAP</u>
SW	5	114 N	26 W	444230.80	935907.90	2	C	HAMBURG

<u>AGENCY</u>	<u>YR-SET</u>	<u>YR-REC</u>	<u>CONDITION</u>	<u>GPSABLE</u>	<u>PHOTOS</u>	<u>BRDG NO</u>	<u>F/P/R</u>
MNDT	1988	2007	GOOD	YES	YES		FLUSH

<u>MONUMENT TYPE</u>	<u>DISK TYPE</u>	<u>MAGNETIC PROPERTIES</u>
ALUMINUM ALLOY ROD (DEPTH 18 FT)	REFERENCE MARK DISK	MARKER W/BAR MAGNET

DESCRIPTION (2003) STAMPING: CASIB NO 1 1988

2.0 MILES SOUTHWEST OF HAMBURG, 1.75 MILES SOUTHWEST ALONG TRUNK HIGHWAY 5 FROM THE JUNCTION OF TRUNK HIGHWAY 5- TRUNK HIGHWAY 25 AND COUNTY ROAD 50 AT HAMBURG, AT TRUNK HIGHWAY 25 MILEPOINT . 16.85, 89.0 FEET SOUTHEAST OF TRUNK HIGHWAY 5, 54.0 FEET NORTHWEST OF WEST RAIL OF RAILROAD TRACK, 40.0 FEET NORTHEAST OF FIELD ENTRANCE, 53.9 FEET NORTHEAST OF REFERENCE MARK 2, 31.6 FEET NORTHWEST OF WITNESS POST.

STATION NOTES

<u>ELEVATIONS (ft)</u>		<u>ELLIPSOID</u>			<u>ADJUSTMENT</u>	
<u>NGVD 29</u>	<u>NAVD 88</u>	<u>HEIGHT</u>	<u>ORDER</u>	<u>METHOD</u>	<u>YEAR</u>	<u>REFERENCE</u>
	1003.312	913.010		GPS - STATIC	2007	HSIBL
	1003.312	913.010		GPS - STATIC	2007	HMCLD
	1003.305		2	VERTICAL CONTROL SURVEY	2004	VBELL

Geoid 2003 Separation: -90.34

<u>GEODETTIC POSITION NAD83 (1996)</u>						<u>ADJUSTMENT</u>	
<u>ZONE</u>	<u>X</u>	<u>Y</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>YEAR</u>	<u>REFERENCE</u>	
STATE PLANE: SOUTH	2628429.142 ft	950919.085 ft	444230.79588	935907.89874	2007	HSIBL	
COUNTY:	668428.561 ft	192709.179 ft					
UTM: 15	1384290.381 ft	16243562.257 ft					

Meters = U. S. Survey feet * (1200/3937)

STATION PHOTOS

<u>TYPE</u>	<u>FILE NAME</u>	<u>DIR</u>	<u>DATE</u>
LOCATION:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/sibley/CASIB_RM_1-3S-18JUL2006.jpg	S	Jul-18-06
MONUMENT:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/sibley/CASIB_RM_1-2-18JUL2006.jpg		Jul-18-06
DISK:	ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos/sibley/CASIB_RM_1-1-18JUL2006.jpg		Jul-18-06

** All images can be viewed at: <ftp://ftp.olmweb.dot.state.mn.us/geod/StationPhotos> **



Minnesota Department of Transportation

Transportation Building

395 John Ireland Boulevard
Saint Paul, Minnesota 55155-1899

Christy Christensen
McLeod County
830 East 11th Street
Glencoe, Minnesota 55336

Date: November 21, 2006

In reference to: Mn/DOT Agreement No. 90136

Dear Mr. Christensen:

Enclosed is your executed copy of the above referenced Agreement. This Agreement is to prepare a Request for Proposal (RFP) for LiDAR and Orthophoto acquisition flights scheduled to begin in the spring of 2007.

November 20, 2006 is your authorization to proceed. Please coordinate this project with Peter Jenkins, State's Project Manager, at (651) 296-1079.

If you have any questions regarding this Agreement, please contact me.

Sincerely,

A handwritten signature in black ink that reads 'Ashley Hartfiel'.

Ashley Hartfiel
Contract Administrator

Cc:

File (Original)

Peter Jenkins, Mail Stop 640 (Copy)

Project Accounting, Mail Stop 215 (2 Copies)

**STATE OF MINNESOTA
JOINT POWERS AGREEMENT
FOR PROFESSIONAL/TECHNICAL SERVICES**

Project Identification: McLeod County LiDAR and Orthophoto Project

This Agreement is between the State of Minnesota, acting through its Commissioner of Transportation ("State") and McLeod County ("Governmental Unit").

Recitals

1. Minnesota Statutes §15.061 authorizes State to engage such assistance as deemed necessary.
2. Minnesota Statutes §471.59 authorizes State and Governmental Unit to enter into this Agreement.
3. State is in need of the Governmental Unit to prepare a Request for Proposal (RFP) for LiDAR and Orthophoto acquisition flights scheduled to begin in the spring of 2007. This project will have countywide coverage and the Governmental Unit will be seeking partners for support of this project. State will be providing partnership dollars and some in-kind services to include surveying (test shot collection), independent accuracy report and expertise (RFP selection committee).
4. Governmental Unit may use the results of the work to create computer software products or systems, which may be protected from disclosure and sold commercially as provided by Minnesota Statutes §375.85.
5. Governmental Unit represents that it is duly qualified and agrees to perform all services described in this Agreement to the satisfaction of State.

Agreement

1 Term of Agreement; Survival of Terms; Incorporation of Exhibits

- 1.1 **Effective date:** This Agreement will be effective on the date State obtains all required signatures under Minnesota Statutes Section §16C.05, subdivision 2.
- 1.2 **Expiration date:** This Agreement will expire on **January 31, 2008**, or when all obligations have been satisfactorily fulfilled, whichever occurs first.
- 1.3 **Survival of Terms:** All clauses which impose obligations continuing in their nature and which must survive in order to give effect to their meaning will survive the expiration or termination of this Agreement, including, without limitation, the following clauses: 6. Liability; 7. State Audits; 8. Government Data Practices; 9. Intellectual Property Rights; and 10. Venue.
- 1.4 **Exhibits:** Exhibit A is attached and incorporated into this Agreement.

2 Scope of Work and Deliverables

This entire scope of work falls under Activity Code 1018

- 2.1 The Governmental Unit is planning to publish an RFP to do orthophotography and a LiDAR collection to create a Digital Elevation Model (DEM). State's cooperation in this multi-government partnership will assure State a copy of the complete data set that can be utilized by both State's Central Office and District 8. This data will be most valuable for pre-design, pre-engineering, hydraulic studies and mapping professionals. The total number of Control Sections covered partially or in whole is nine.
- 2.2 The Governmental Unit will provide the following services with respect to this Agreement:
 - The creation and publication of the RFP in accordance with Minnesota State Statutes
 - Establishment of the vendor selection committee – which will include one member designated by State
 - Project Management – from acquisition through final delivery
 - Invoice payment services to the selected vendor
 - **Data storage and dissemination**
 - Notification to State should there be an unsatisfactory response to the RFP

- 2.3 State will provide in-kind services to supplement this project by collecting test point data through its District 8 Surveys Office. The test point data will be within the vicinity of the Trunk Highway system throughout McLeod County. State will also provide an accuracy report and test point analysis through its Photogrammetric Unit. Should the Governmental Unit require specific areas to be tested which fall outside the Trunk Highway vicinity; the Governmental Unit will collect that data and supply it to State's Photogrammetric Unit with a request that the data be included in the accuracy report.

3 Payment

- 3.1 **Consideration.** State will pay for all services performed by Governmental Unit under this Agreement as follows:

3.1.1 **Compensation.** State will pay Governmental Unit on a Lump Sum basis. The Governmental Unit will submit an invoice, using the format set forth in Exhibit A, for work performed prior to June 30, 2007. Mn/DOT must receive this invoice prior to August 1, 2007.

3.1.2 **Total Obligation.** The total obligation of State for all compensation and reimbursements to Governmental Unit will be \$25,000.00.

3.2 Terms of Payment

3.2.1 **Invoices.** State will promptly pay Governmental Unit after Governmental Unit presents an invoice for the services actually performed and State's Authorized Representative accepts the invoiced services. Governmental Unit will use the format set forth in Exhibit A when submitting Invoices. Invoices must be submitted timely and according to the following schedule:
Prior to August 1, 2007

3.2.2 **Retainage.** Under Minnesota Statutes Section §16C.08, subdivision 5(b), no more than 90% of the amount due under this Agreement may be paid until the final product of this Agreement has been reviewed by State's agency head. The balance due will be paid when State's agency head determines that Governmental Unit has satisfactorily fulfilled all the terms of this Agreement.

3.2.3 **Federal funds.** If federal funds are used Governmental Unit is responsible for compliance with all federal requirements imposed on these funds and accepts full financial responsibility for any requirements imposed by Governmental Unit's failure to comply with federal requirements.

- 3.3 **License to State.** In consideration of the monetary contribution and in-kind services provide by State, Governmental Unit will provide a license to certain data, and the DEM, as further specified in Article 9.

4 Agreement Personnel

- 4.1 State's Authorized Representative will be:

Name: Ashley Hartfiel, Contract Administrator
Address: Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
395 John Ireland Boulevard, St. Paul, Minnesota 55155-1899
Telephone: 651-296-3558
Fax: 651-282-5127
E-Mail: ashley.hartfiel@dot.state.mn.us

State's Authorized Representative, or his/her successor, will monitor Governmental Unit's performance and has the authority to accept or reject the services provided under this Agreement.

- 4.2 State's Project Manager will be:

Name: Peter Jenkins, Photogrammetric Engineer
Address: Minnesota Department of Transportation
Office of Land Management, Mail Stop 640
395 John Ireland Boulevard, St. Paul, Minnesota 55155-1899

Telephone: 651-296-1079
Fax: 651-297-1521
E-Mail: peter.jenkins@dot.state.mn.us

State's Project Manager, or his/her successor, has the responsibility to monitor Governmental Unit's performance and progress. State's Project Manager will sign progress reports, review billing statements, make recommendations to State's Authorized Representative for acceptance of Governmental Unit's goods or services and make recommendations to State's Authorized Representative for certification for payment of each Invoice submitted for payment.

4.3 Governmental Unit's Authorized Representative will be:

Name: Christy Christensen, GIS Director
Address: McLeod County
830 East 11th Street, Glencoe, Minnesota 55336
Telephone: 320-864-3156
Fax: 320-864-1302
E-Mail: christy.christensen@co.mcleod.mn.us

5 Assignment, Amendments, Waiver and Contract Complete

- 5.1 **Assignment.** Governmental Unit may neither assign nor transfer any rights or obligations under this Agreement without the prior consent of State and a fully executed Assignment Agreement, executed and approved by the same parties who executed and approved this Agreement, or their successors in office.
- 5.2 **Amendments.** Any Amendment to this Agreement must be in writing and will not be effective until it has been executed and approved by the same parties who executed and approved the Original Agreement, or their successors in office.
- 5.3 **Waiver.** If State fails to enforce any provision of this Agreement, that failure does not waive the provision or its right to subsequently enforce it.
- 5.4 **Contract Complete.** This Agreement contains all prior negotiations and agreements between State and Governmental Unit. No other understanding regarding this Agreement, whether written or oral, may be used to bind either party.

6 Liability

- 6.1 Governmental Unit will indemnify, save and hold State, its agents and employees harmless from any claims or causes of action, including attorney's fees incurred by State, arising from the performance of this Agreement by Governmental Unit, its agents or employees. This clause will not be construed to bar any legal remedies Governmental Unit may have for State's failure to fulfill its obligations under this Agreement.

7 State Audits

- 7.1 Under Minnesota Statutes §16C.05, subdivision 5, Governmental Unit's books, records, documents and accounting procedures and practices relevant to this Agreement are subject to examination by the State and/or the State Auditor or Legislative Auditor, as appropriate, for a minimum of six years from the end of this Agreement.

8 Government Data Practices

- 8.1 Governmental Unit and State must comply with the Minnesota Government Data Practices Act, Minnesota Statutes Chapter 13, as it applies to all data provided by State under this Agreement, and as it applies to all data created, collected, received, stored, used, maintained or disseminated by Governmental Unit under this Agreement. The civil remedies of Minnesota Statutes §13.08 apply to the release of the data referred to in this clause by either Governmental Unit or State.

9 Intellectual Property Rights; License to State

9.1 **Intellectual Property Rights.** Governmental Unit will own all rights, title and interest in all of the intellectual property rights, including copyrights, patents, trade secrets, trademarks and service marks in the Works and Documents created and paid for under its contract with its contractor.

9.2 License

9.2.1 **Grant.** Governmental Unit grants to State a perpetual, irrevocable, non-exclusive, non-transferable and non-assignable license to use the digital orthophotos, lidar data and DEM (collectively the "Licensed Data"). State may grant access to the Licensed Data to its employees, consultants and agents, as necessary for transportation purposes. State will not reproduce or duplicate the Licensed Data for sale licensing or distribution in any manner (except that State may make a reasonable number of backup copies for internal use) and will inform its employees, agents and consultants of such restriction. State, and its employees, agents and consultants, may combine the Licensed Data with other different data to create new and original electronic or hardcopy products that State can use without limitation.

9.2.2 **Governmental Unit's Rights in Data Limited.** Due to changes in land use, the commercial value of the Licensed Data declines over time. At a date that is five years from the date the Licensed Data was delivered to State, the Licensed Data will be deemed "Historical Data". The restrictions on the use of Licensed Data by State, as detailed in Article 9.2.1, will not apply to Historical Data.

9.2.3 **"As Is"; Non-Infringement.** The Licensed Data is provided "as is" and without representation or warranty of accuracy or completeness of the data, or fitness for a particular purpose. Governmental Unit will have no responsibility for State's use of the Licensed Data or Historical Data. Notwithstanding the foregoing, Governmental Unit represents and warrants that the Licensed Data does not infringe upon the intellectual property of another party. If the Licensed Data is determined to infringe upon the intellectual property of another party, Governmental Unit will either replace the data at issue, secure for State the right to use the data despite the infringement, or refund the money paid by State under this Agreement. Governmental Unit's indemnification obligation, as set forth in Article 6, applies to this warranty of non-infringement.

10 Venue

10.1 Venue for all legal proceedings arising out of this Agreement, or its breach, must be in the appropriate state or federal court with competent jurisdiction in Ramsey County, Minnesota.

11 Termination; Suspension

11.1 **Termination.** State or the Commissioner of Administration may terminate this Agreement at any time, with or without cause, upon 30 days' written notice to Governmental Unit.

11.2 **Termination by State for Insufficient Funding.** State may immediately terminate this Agreement if it does not obtain funding from the Minnesota Legislature, or other funding source; or if funding cannot be continued at a level sufficient to allow for the payment of the services covered here. Termination must be by written or fax notice to Governmental Unit. State is not obligated to pay for any services that are provided after notice and effective date of termination. However, Governmental Unit will be entitled to payment, determined on a pro rata basis, for services satisfactorily performed to the extent that funds are available. State will not be assessed any penalty if the agreement is terminated because of the decision of the Minnesota Legislature, or other funding source, not to appropriate funds. State must provide Governmental Unit notice of the lack of funding within a reasonable time of State's receiving that notice.

11.3 **Termination by Governmental Unit for Insufficient Funding.** Governmental Unit's participation is based on a preliminary budget for fiscal year 2007. Governmental Unit may terminate this Agreement if the McLeod County Board does not appropriate sufficient funding to perform the LiDAR and Orthophotography work.

11.3 **Suspension.** State may immediately suspend this Agreement in the event of a total or partial government shutdown due to failure to have an approved budget by the legal deadline. Work performed by Governmental Unit during a period of suspension will be deemed unauthorized and undertaken at risk of non-payment.

12 Additional Provisions

NONE

STATE ENCUMBRANCE VERIFICATION

Individual certifies that funds have been encumbered as required by Minn. Stat. §16A.15 and §16C.05.

Signed: John Kille
Date: 11-14-2006
CFMS Contract No. A- 93712

DEPARTMENT OF TRANSPORTATION

By: ORIGINAL SIGNED BY
(with delegated authority)
Title: Robert C. Winter
Date: Division Director 11-14-06

GOVERNMENTAL UNIT*

Governmental Unit certifies that the appropriate person(s) have executed the Agreement on behalf of Governmental Unit as required by applicable articles, bylaws or resolutions

By: Frank A. Swanson
Title: Board Vice Chair
Date: Nov. 7, 2006

COMMISSIONER OF ADMINISTRATION

As delegated to Materials Management Division

By: Original signed
Date: NOV 20 2006

By Paul R. Stembler

By: Nan Crang
Title: McLeod County Administrator
Date: Nov. 8, 2006

* INCLUDE COPY OF RESOLUTION APPROVING THE AGREEMENT

FINAL INVOICE

To: Ashley Hartfiel, Authorized Representative
 Minnesota Department of Transportation
 Consultant Services, Mail Stop 680
 395 John Ireland Boulevard, St. Paul, Minnesota 55155

Estimated Completion: _____%

Copy: Peter Jenkins, Project Manager
 Minnesota Department of Transportation
 Office of Land Management, Mail Stop 640
 395 John Ireland Boulevard, St. Paul, Minnesota 55155-1899

Period Ending: _____

Invoice Date: _____

Re: Mn/DOT Agreement No. 90136
 Agreement Expiration Date: January 31, 2008
 Project Description: McLeod County LiDAR and Orthophoto Project



	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Lump Sum Amount:	\$25,000.00		0	25,000
Net Earnings Totals:	\$25,000.00		0	25,000
Total Amount Due This Invoice:				25,000

Activity Code	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1018			
Total*			

*Must Match Net Earnings Total Above

For Consultant Services Use Only

I certify that the above statement is correct and payment has not been received.

Signature: *Christian Christensen*

Print Name: Christian Christensen

Title: GIS DIRECTOR

Billing Address: McLeod County
 830 East 11th Street
 Glencoe, Minnesota 55336

Telephone: 320-864-3156

Approved for Payment: *[Signature]*

Date: 15 MAY 07

ORTHO TEST SHOTS

MnMultShotPP2.txt

MnMultShot (2.2.4) Photo Control English Report 11/05/2007 Page 1
 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODPP2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

RENUMBERED
701-775

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
725	CONC. CORNER	641220.461	204129.971	1014.105
725	CONC. CORNER	641220.498	204129.894	1014.244
	Mean Computed Coordinate	641220.480	204129.932	1014.175
	Mean Closure Error:	Horizontal = 0.043	Vertical = 0.070	
726	CONC. CORNER	654887.194	215888.217	994.397
726	CONC. CORNER	654887.185	215888.242	994.380
	Mean Computed Coordinate	654887.190	215888.230	994.388
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.009	
727	CONC. CORNER	653629.358	217204.385	997.998
727	CONC. CORNER	653629.361	217204.406	997.974
	Mean Computed Coordinate	653629.360	217204.395	997.986
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.012	
728	CONC. CORNER	631256.870	216120.622	1020.514
728	CONC. CORNER	631256.729	216120.714	1020.470
	Mean Computed Coordinate	631256.800	216120.668	1020.492
	Mean Closure Error:	Horizontal = 0.084	Vertical = 0.022	
729	CONC. CORNER	624627.884	219427.890	1018.159
729	CONC. CORNER	624627.916	219427.831	1018.189
	Mean Computed Coordinate	624627.900	219427.860	1018.174
	Mean Closure Error:	Horizontal = 0.034	Vertical = 0.015	
730	CONC. CORNER	623492.354	211264.546	992.493
730	CONC. CORNER	623492.390	211264.573	992.605
	Mean Computed Coordinate	623492.372	211264.560	992.549
	Mean Closure Error:	Horizontal = 0.022	Vertical = 0.056	
731	CONC. CORNER	598794.103	202609.109	1023.996
731	CONC. CORNER	598794.129	202609.002	1023.978
	Mean Computed Coordinate	598794.116	202609.056	1023.987
	Mean Closure Error:	Horizontal = 0.055	Vertical = 0.009	
732	CONC. CORNER	601775.288	224747.229	1023.491
732	CONC. CORNER	601775.240	224747.230	1023.571
	Mean Computed Coordinate	601775.264	224747.230	1023.531
	Mean Closure Error:	Horizontal = 0.024	Vertical = 0.040	
733	CONC. CORNER	578510.385	216225.380	1051.197
733	CONC. CORNER	578510.304	216225.359	1051.209
	Mean Computed Coordinate	578510.344	216225.370	1051.203
	Mean Closure Error:	Horizontal = 0.042	Vertical = 0.006	
734	CONC. CORNER	573486.228	206423.953	1042.539
734	CONC. CORNER	573486.176	206423.942	1042.645

MnMultShotPP2.txt

Mean Computed Coordinate 573486.202 206423.948 1042.592
 Mean Closure Error: Horizontal = 0.027 Vertical = 0.053 □
 MnMultShot (2.2.4) Photo Control English Report 11/05/2007 Page 2
 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODPP2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
735	CONC. CORNER	572953.298	201060.871	1029.322
735	CONC. CORNER	572953.258	201060.868	1029.242
	Mean Computed Coordinate	572953.278	201060.870	1029.282
	Mean Closure Error:	Horizontal = 0.020	Vertical = 0.040	
736	CONC. CORNER	573877.988	198922.602	1040.258
736	CONC. CORNER	573877.914	198922.552	1040.275
	Mean Computed Coordinate	573877.951	198922.577	1040.267
	Mean Closure Error:	Horizontal = 0.045	Vertical = 0.009	
737	CONC. CORNER	585346.380	192620.101	1029.899
737	CONC. CORNER	585346.395	192620.091	1029.935
	Mean Computed Coordinate	585346.388	192620.096	1029.917
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.018	
738	CONC. CORNER	582584.070	168940.628	1025.439
738	CONC. CORNER	582584.068	168940.685	1025.454
	Mean Computed Coordinate	582584.069	168940.656	1025.446
	Mean Closure Error:	Horizontal = 0.029	Vertical = 0.007	
739	CONC. CORNER	573477.871	169986.346	1037.918
739	CONC. CORNER	573477.914	169986.346	1037.940
	Mean Computed Coordinate	573477.893	169986.346	1037.929
	Mean Closure Error:	Horizontal = 0.021	Vertical = 0.011	
740	CONC. CORNER	540580.154	190602.532	1051.741
740	CONC. CORNER	540580.173	190602.551	1051.715
	Mean Computed Coordinate	540580.164	190602.542	1051.728
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.013	
741	CONC. CORNER	539046.923	196813.631	1062.747
741	CONC. CORNER	539046.945	196813.671	1062.563
	Mean Computed Coordinate	539046.934	196813.651	1062.655
	Mean Closure Error:	Horizontal = 0.023	Vertical = 0.092	
742	CONC. CORNER	537627.105	198719.884	1060.879
742	CONC. CORNER	537627.178	198720.004	1060.812
	Mean Computed Coordinate	537627.141	198719.944	1060.846
	Mean Closure Error:	Horizontal = 0.070	Vertical = 0.034	
743	CONC. CORNER	556845.220	184809.753	1047.594
743	CONC. CORNER	556845.314	184809.643	1047.439
	Mean Computed Coordinate	556845.267	184809.698	1047.517
	Mean Closure Error:	Horizontal = 0.072	Vertical = 0.077	
744	CONC. CORNER	564615.353	188528.688	1038.159

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744 CONC. CORNER 564615.404 188528.685 1037.991
 Mean Computed Coordinate 564615.378 188528.686 1038.075
 Mean Closure Error: Horizontal = 0.026 Vertical = 0.084 □
 MnMultShot (2.2.4) Photo Control English Report 11/05/2007 Page 3
 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODPP2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
745	CONC. CORNER	551560.767	211484.747	1053.608
745	CONC. CORNER	551560.873	211484.732	1053.990
	Mean Computed Coordinate	551560.820	211484.740	1053.799
	Mean Closure Error:	Horizontal = 0.054	Vertical = 0.191*	
746	CONC. CORNER	559273.077	222161.739	1050.749
746	CONC. CORNER	559273.039	222161.775	1050.883
	Mean Computed Coordinate	559273.058	222161.757	1050.816
	Mean Closure Error:	Horizontal = 0.026	Vertical = 0.067	
747	CONC. CORNER	560590.010	237637.143	1067.506
747	CONC. CORNER	560589.942	237637.345	1067.690
	Mean Computed Coordinate	560589.976	237637.244	1067.598
	Mean Closure Error:	Horizontal = 0.107	Vertical = 0.092	
748	CONC. CORNER	542786.706	243018.292	1078.785
748	CONC. CORNER	542786.500	243018.562	1078.933
	Mean Computed Coordinate	542786.603	243018.427	1078.859
	Mean Closure Error:	Horizontal = 0.170*	Vertical = 0.074	
749	CONC. CORNER	550980.505	250390.974	1077.965
749	CONC. CORNER	550980.482	250390.934	1077.808
	Mean Computed Coordinate	550980.494	250390.954	1077.886
	Mean Closure Error:	Horizontal = 0.023	Vertical = 0.078	
750	CONC. CORNER	538116.718	259541.395	1102.240
750	CONC. CORNER	538116.783	259541.325	1102.218
	Mean Computed Coordinate	538116.751	259541.360	1102.229
	Mean Closure Error:	Horizontal = 0.048	Vertical = 0.011	
751	CONC. CORNER	562059.376	274805.123	1104.787
751	CONC. CORNER	562059.475	274805.172	1105.170
	Mean Computed Coordinate	562059.426	274805.148	1104.979
	Mean Closure Error:	Horizontal = 0.055	Vertical = 0.192*	
752	CONC. CORNER	534294.115	288151.263	1099.095
752	CONC. CORNER	534294.152	288151.340	1098.967
	Mean Computed Coordinate	534294.134	288151.302	1099.031
	Mean Closure Error:	Horizontal = 0.043	Vertical = 0.064	
753	CONC. CORNER	577674.644	285234.812	1091.342
753	CONC. CORNER	577674.576	285234.837	1091.287
	Mean Computed Coordinate	577674.610	285234.824	1091.314
	Mean Closure Error:	Horizontal = 0.036	Vertical = 0.028	

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754 CONC. CORNER 578496.733 269152.212 1078.530
 754 CONC. CORNER 578496.627 269151.911 1078.466
 Mean Computed Coordinate 578496.680 269152.062 1078.498
 Mean Closure Error: Horizontal = 0.160* Vertical = 0.032 □

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODPP2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
755	CONC. CORNER	592525.478	275284.550	1067.027
755	CONC. CORNER	592525.522	275284.709	1066.982
	Mean Computed Coordinate	592525.500	275284.630	1067.004
	Mean Closure Error:	Horizontal = 0.082	Vertical = 0.023	
756	CONC. CORNER	598701.736	288304.755	1113.320
756	CONC. CORNER	598701.715	288304.826	1113.293
	Mean Computed Coordinate	598701.726	288304.790	1113.306
	Mean Closure Error:	Horizontal = 0.037	Vertical = 0.014	
757	CONC. CORNER	615765.501	275025.280	1066.323
757	CONC. CORNER	615765.498	275025.304	1066.116
	Mean Computed Coordinate	615765.500	275025.292	1066.220
	Mean Closure Error:	Horizontal = 0.012	Vertical = 0.104*	
758	CONC. CORNER	611069.945	264112.598	1049.104
758	CONC. CORNER	611069.942	264112.544	1048.985
	Mean Computed Coordinate	611069.944	264112.571	1049.044
	Mean Closure Error:	Horizontal = 0.027	Vertical = 0.060	
759	CONC. CORNER	629493.068	260363.477	1039.156
759	CONC. CORNER	629493.073	260363.376	1039.077
	Mean Computed Coordinate	629493.070	260363.426	1039.117
	Mean Closure Error:	Horizontal = 0.051	Vertical = 0.039	
760	CONC. CORNER	657595.383	271159.090	1001.679
760	CONC. CORNER	657595.371	271159.069	1001.699
	Mean Computed Coordinate	657595.377	271159.080	1001.689
	Mean Closure Error:	Horizontal = 0.012	Vertical = 0.010	
761	CONC. CORNER	655851.906	286410.256	1004.989
761	CONC. CORNER	655851.915	286410.319	1005.074
	Mean Computed Coordinate	655851.910	286410.288	1005.032
	Mean Closure Error:	Horizontal = 0.032	Vertical = 0.042	
762	CONC. CORNER	649070.962	286607.376	1016.014
762	CONC. CORNER	649070.916	286607.288	1015.982
	Mean Computed Coordinate	649070.939	286607.332	1015.998
	Mean Closure Error:	Horizontal = 0.050	Vertical = 0.016	
763	CONC. CORNER	623835.574	285071.137	1053.577
763	CONC. CORNER	623835.616	285071.186	1053.571
	Mean Computed Coordinate	623835.595	285071.162	1053.574
	Mean Closure Error:	Horizontal = 0.032	Vertical = 0.003	

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764 CONC. CORNER 655954.020 256921.995 976.757
 764 CONC. CORNER 655954.083 256922.073 976.755
 Mean Computed Coordinate 655954.052 256922.034 976.756
 Mean Closure Error: Horizontal = 0.050 Vertical = 0.001 □

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODPP2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
765	CONC. CORNER	646846.177	233114.353	989.865
765	CONC. CORNER	646846.187	233114.375	989.939
	Mean Computed Coordinate	646846.182	233114.364	989.902
	Mean Closure Error:	Horizontal = 0.012	Vertical = 0.037	
766	CONC. CORNER	634904.722	240865.425	1024.867
766	CONC. CORNER	634904.742	240865.469	1024.856
	Mean Computed Coordinate	634904.732	240865.447	1024.862
	Mean Closure Error:	Horizontal = 0.024	Vertical = 0.005	
767	CONC. CORNER	635093.287	227209.760	1021.891
767	CONC. CORNER	635093.291	227209.728	1021.861
	Mean Computed Coordinate	635093.289	227209.744	1021.876
	Mean Closure Error:	Horizontal = 0.016	Vertical = 0.015	
768	CONC. CORNER	617433.518	230553.926	1038.709
768	CONC. CORNER	617433.441	230553.975	1038.698
	Mean Computed Coordinate	617433.480	230553.950	1038.704
	Mean Closure Error:	Horizontal = 0.046	Vertical = 0.005	
769	CONC. CORNER	603328.932	245745.018	1052.896
769	CONC. CORNER	603328.926	245745.035	1052.979
	Mean Computed Coordinate	603328.929	245745.026	1052.938
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.042	
770	CONC. CORNER	613669.574	243208.176	1033.653
770	CONC. CORNER	613669.639	243208.203	1033.578
	Mean Computed Coordinate	613669.606	243208.190	1033.615
	Mean Closure Error:	Horizontal = 0.035	Vertical = 0.038	
771	CONC. CORNER	592944.399	235304.927	1024.315
771	CONC. CORNER	592944.368	235304.846	1024.525
	Mean Computed Coordinate	592944.384	235304.886	1024.420
	Mean Closure Error:	Horizontal = 0.043	Vertical = 0.105*	
772	CONC. CORNER	573283.396	235116.865	1067.420
772	CONC. CORNER	573283.407	235116.821	1067.477
	Mean Computed Coordinate	573283.401	235116.843	1067.448
	Mean Closure Error:	Horizontal = 0.023	Vertical = 0.029	
773	CONC. CORNER	578051.677	243401.591	1051.959
773	CONC. CORNER	578051.756	243401.593	1052.018
	Mean Computed Coordinate	578051.717	243401.592	1051.988

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Mean Closure Error: Horizontal = 0.040 Vertical = 0.029

774 CONC. CORNER 587095.091 258918.299 1071.654
774 CONC. CORNER 587095.068 258918.272 1071.631
Mean Computed Coordinate 587095.080 258918.286 1071.642
Mean Closure Error: Horizontal = 0.018 Vertical = 0.011 □

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S.P.:4300 Desc:McLeod County LIDAR
Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
Files:MCLEODPP2.txt
(Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
775	CONC. CORNER	568152.859	260578.694	1045.544
775	CONC. CORNER	568152.763	260578.761	1045.551
	Mean Computed Coordinate	568152.811	260578.727	1045.548
	Mean Closure Error:	Horizontal = 0.059	Vertical = 0.003	

Statistical Summary Of Closure Errors For All Shots:

Horizontal (102 shots): Mean = 0.041 Std. Deviation = 0.053

Vertical (102 shots): Mean = 0.042 Std. Deviation = 0.059

* Mean Point Errors Over Photo Max: Horizontal = 2 Vertical = 4

LIDAR TEST SHOTS

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S.P.:4300 Desc:McLeod County LIDAR
Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
Files:MCLEODLIDARXYZ2.txt
(Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
800		561471.991	192179.819	1040.695
800		561472.002	192179.819	1040.752
	Mean Computed Coordinate	561471.996	192179.819	1040.724
	Mean Closure Error:	Horizontal = 0.005	Vertical = 0.029	
801		561915.057	170129.946	1030.656
801		561915.014	170129.932	1030.806
	Mean Computed Coordinate	561915.036	170129.939	1030.731
	Mean Closure Error:	Horizontal = 0.023	Vertical = 0.075	
802		581830.467	169268.360	1023.940
802		581830.390	169268.335	1024.075
	Mean Computed Coordinate	581830.428	169268.347	1024.008
	Mean Closure Error:	Horizontal = 0.040	Vertical = 0.067	
803		575251.721	174506.389	1019.750
803		575251.686	174506.402	1019.651
	Mean Computed Coordinate	575251.704	174506.395	1019.700
	Mean Closure Error:	Horizontal = 0.019	Vertical = 0.050	
804		587945.513	176293.837	1011.787
804		587945.549	176293.804	1011.872
	Mean Computed Coordinate	587945.531	176293.820	1011.830
	Mean Closure Error:	Horizontal = 0.024	Vertical = 0.042	
805		590897.456	192902.939	1019.438
805		590897.479	192902.881	1019.346
	Mean Computed Coordinate	590897.468	192902.910	1019.392
	Mean Closure Error:	Horizontal = 0.031	Vertical = 0.046	
806		545413.567	171471.228	1059.594
806		545413.593	171471.281	1059.742
	Mean Computed Coordinate	545413.580	171471.254	1059.668
	Mean Closure Error:	Horizontal = 0.030	Vertical = 0.074	
807		538657.266	179197.066	1050.994
807		538657.250	179197.101	1051.124
	Mean Computed Coordinate	538657.258	179197.084	1051.059
	Mean Closure Error:	Horizontal = 0.019	Vertical = 0.065	
808		556139.951	190092.816	1049.623
808		556139.947	190092.832	1049.445
	Mean Computed Coordinate	556139.949	190092.824	1049.534
	Mean Closure Error:	Horizontal = 0.008	Vertical = 0.089	
809		538341.187	197567.377	1066.757
809		538341.182	197567.398	1066.589

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Mean Computed Coordinate 538341.184 197567.388 1066.673

Mean Closure Error: Horizontal = 0.011 Vertical = 0.084

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S.P.:4300 Desc:McLeod County LIDAR

Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88

Files:MCLEODLIDARXYZ2.txt

(Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
810		537554.697	197157.212	1065.727
810		537554.751	197157.205	1065.503
	Mean Computed Coordinate	537554.724	197157.208	1065.615
	Mean Closure Error:	Horizontal = 0.027	Vertical = 0.112*	
811		552107.032	226531.033	1056.746
811		552107.007	226531.018	1056.690
	Mean Computed Coordinate	552107.019	226531.026	1056.718
	Mean Closure Error:	Horizontal = 0.015	Vertical = 0.028	
812		548333.002	211955.644	1057.706
812		548333.017	211955.668	1057.847
	Mean Computed Coordinate	548333.009	211955.656	1057.776
	Mean Closure Error:	Horizontal = 0.014	Vertical = 0.071	
813		545430.203	208056.633	1028.748
813		545430.215	208056.655	1028.854
	Mean Computed Coordinate	545430.209	208056.644	1028.801
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.053	
814		566196.127	197929.696	1048.631
814		566196.138	197929.668	1048.706
	Mean Computed Coordinate	566196.133	197929.682	1048.668
	Mean Closure Error:	Horizontal = 0.015	Vertical = 0.037	
815		572450.227	200738.976	1024.589
815		572450.196	200739.025	1024.567
	Mean Computed Coordinate	572450.212	200739.000	1024.578
	Mean Closure Error:	Horizontal = 0.029	Vertical = 0.011	
816		573432.020	201096.904	1027.938
816		573431.975	201096.892	1027.928
	Mean Computed Coordinate	573431.998	201096.898	1027.933
	Mean Closure Error:	Horizontal = 0.023	Vertical = 0.005	
817		567886.523	209292.547	1016.049
817		567886.521	209292.551	1016.137
	Mean Computed Coordinate	567886.522	209292.549	1016.093
	Mean Closure Error:	Horizontal = 0.002	Vertical = 0.044	
818		566998.688	224762.261	1052.668
818		566998.685	224762.241	1052.711
	Mean Computed Coordinate	566998.687	224762.251	1052.690
	Mean Closure Error:	Horizontal = 0.010	Vertical = 0.022	
819		587778.592	207286.616	1026.796

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819 587778.594 207286.620 1026.707
 Mean Computed Coordinate 587778.593 207286.618 1026.752
 Mean Closure Error: Horizontal = 0.002 Vertical = 0.044 □
 MnMultShot (2.2.4) Photo Control English Report 11/05/2007 Page 3
 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
820		586891.438	198102.592	1026.933
820		586891.481	198102.618	1026.947
	Mean Computed Coordinate	586891.460	198102.605	1026.940
	Mean Closure Error:	Horizontal = 0.025	Vertical = 0.007	
821		590443.384	220989.432	1027.604
821		590443.410	220989.451	1027.525
	Mean Computed Coordinate	590443.397	220989.442	1027.564
	Mean Closure Error:	Horizontal = 0.016	Vertical = 0.039	
822		593297.278	235066.839	1026.055
822		593297.313	235066.881	1026.041
	Mean Computed Coordinate	593297.296	235066.860	1026.048
	Mean Closure Error:	Horizontal = 0.027	Vertical = 0.007	
823		593075.701	235468.382	1025.107
823		593075.713	235468.458	1025.066
	Mean Computed Coordinate	593075.707	235468.420	1025.086
	Mean Closure Error:	Horizontal = 0.038	Vertical = 0.020	
824		592988.198	250887.686	1061.086
824		592988.208	250887.618	1061.120
	Mean Computed Coordinate	592988.203	250887.652	1061.103
	Mean Closure Error:	Horizontal = 0.034	Vertical = 0.017	
825		582370.048	246964.524	1061.245
825		582370.084	246964.505	1061.091
	Mean Computed Coordinate	582370.066	246964.514	1061.168
	Mean Closure Error:	Horizontal = 0.020	Vertical = 0.077	
826		569866.794	235381.800	1078.728
826		569866.755	235381.766	1078.673
	Mean Computed Coordinate	569866.774	235381.783	1078.700
	Mean Closure Error:	Horizontal = 0.026	Vertical = 0.028	
827		551118.489	230785.792	1058.314
827		551118.475	230785.781	1058.330
	Mean Computed Coordinate	551118.482	230785.786	1058.322
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.008	
828		545437.832	252768.746	1070.086
828		545437.824	252768.715	1069.949
	Mean Computed Coordinate	545437.828	252768.730	1070.018
	Mean Closure Error:	Horizontal = 0.016	Vertical = 0.068	

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829 551373.653 237824.348 1068.311
 829 551373.697 237824.293 1068.276

Mean Computed Coordinate 551373.675 237824.320 1068.294
 Mean Closure Error: Horizontal = 0.035 Vertical = 0.017

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
830		562262.174	256473.651	1064.419
830		562262.237	256473.660	1064.289
	Mean Computed Coordinate	562262.205	256473.656	1064.354
	Mean Closure Error:	Horizontal = 0.032	Vertical = 0.065	
831		568285.526	258284.481	1052.179
831		568285.542	258284.442	1052.117
	Mean Computed Coordinate	568285.534	258284.462	1052.148
	Mean Closure Error:	Horizontal = 0.021	Vertical = 0.031	
832		572357.977	260213.366	1069.734
832		572357.975	260213.350	1069.602
	Mean Computed Coordinate	572357.976	260213.358	1069.668
	Mean Closure Error:	Horizontal = 0.008	Vertical = 0.066	
833		544529.285	269524.718	1079.619
833		544529.277	269524.725	1079.902
	Mean Computed Coordinate	544529.281	269524.722	1079.760
	Mean Closure Error:	Horizontal = 0.005	Vertical = 0.142*	
834		544775.971	281819.663	1084.817
834		544775.954	281819.670	1084.803
	Mean Computed Coordinate	544775.962	281819.666	1084.810
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.007	
835		534328.240	278018.393	1117.051
835		534328.290	278018.394	1117.167
	Mean Computed Coordinate	534328.265	278018.394	1117.109
	Mean Closure Error:	Horizontal = 0.025	Vertical = 0.058	
836		565737.923	264372.777	1079.159
836		565737.958	264372.775	1079.072
	Mean Computed Coordinate	565737.940	264372.776	1079.116
	Mean Closure Error:	Horizontal = 0.018	Vertical = 0.044	
837		560469.769	290372.627	1129.967
837		560469.756	290372.620	1129.957
	Mean Computed Coordinate	560469.762	290372.624	1129.962
	Mean Closure Error:	Horizontal = 0.007	Vertical = 0.005	
838		566878.380	274763.727	1080.688
838		566878.367	274763.768	1080.742
	Mean Computed Coordinate	566878.374	274763.748	1080.715
	Mean Closure Error:	Horizontal = 0.022	Vertical = 0.027	

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839 583557.098 285511.019 1082.679
 839 583557.131 285511.033 1082.598
 Mean Computed Coordinate 583557.114 285511.026 1082.638
 Mean Closure Error: Horizontal = 0.018 Vertical = 0.041 □
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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
840		592513.373	264689.876	1060.552
840		592513.365	264689.901	1060.522
	Mean Computed Coordinate	592513.369	264689.888	1060.537
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.015	
841		585338.991	269735.072	1061.487
841		585338.970	269735.068	1061.525
	Mean Computed Coordinate	585338.981	269735.070	1061.506
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.019	
842		612470.946	263281.150	1065.716
842		612470.962	263281.144	1065.707
	Mean Computed Coordinate	612470.954	263281.147	1065.712
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.004	
843		613433.516	262861.962	1051.406
843		613433.517	262861.996	1051.541
	Mean Computed Coordinate	613433.516	262861.979	1051.474
	Mean Closure Error:	Horizontal = 0.017	Vertical = 0.067	
844		605674.170	274968.271	1059.719
844		605674.193	274968.329	1059.699
	Mean Computed Coordinate	605674.182	274968.300	1059.709
	Mean Closure Error:	Horizontal = 0.031	Vertical = 0.010	
845		618820.494	275765.752	1042.155
845		618820.434	275765.789	1042.157
	Mean Computed Coordinate	618820.464	275765.770	1042.156
	Mean Closure Error:	Horizontal = 0.035	Vertical = 0.001	
846		605857.468	285926.421	1074.776
846		605857.487	285926.374	1074.895
	Mean Computed Coordinate	605857.478	285926.397	1074.836
	Mean Closure Error:	Horizontal = 0.025	Vertical = 0.059	
847		629044.989	283070.499	1041.885
847		629044.980	283070.515	1041.942
	Mean Computed Coordinate	629044.984	283070.507	1041.914
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.029	
848		634396.599	273866.851	1033.594
848		634396.636	273866.867	1033.655
	Mean Computed Coordinate	634396.618	273866.859	1033.624

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Mean Closure Error: Horizontal = 0.020 Vertical = 0.030

849 645266.043 282912.050 1025.733
 849 645265.963 282912.063 1025.590
 Mean Computed Coordinate 645266.003 282912.056 1025.661
 Mean Closure Error: Horizontal = 0.041 Vertical = 0.072 □

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
850		650317.202	285756.340	1013.544
850		650317.155	285756.350	1013.454
	Mean Computed Coordinate	650317.178	285756.345	1013.499
	Mean Closure Error:	Horizontal = 0.024	Vertical = 0.045	
851		651846.705	286367.761	1031.136
851		651846.725	286367.727	1031.257
	Mean Computed Coordinate	651846.715	286367.744	1031.196
	Mean Closure Error:	Horizontal = 0.020	Vertical = 0.061	
852		658912.004	276279.105	995.519
852		658912.009	276279.139	995.400
	Mean Computed Coordinate	658912.006	276279.122	995.459
	Mean Closure Error:	Horizontal = 0.017	Vertical = 0.060	
853		655468.525	271185.932	1012.677
853		655468.445	271185.953	1012.601
	Mean Computed Coordinate	655468.485	271185.942	1012.639
	Mean Closure Error:	Horizontal = 0.041	Vertical = 0.038	
854		648610.674	264825.574	1013.136
854		648610.662	264825.564	1013.136
	Mean Computed Coordinate	648610.668	264825.569	1013.136
	Mean Closure Error:	Horizontal = 0.008	Vertical = 0.000	
855		654281.360	256207.432	979.577
855		654281.342	256207.434	979.556
	Mean Computed Coordinate	654281.351	256207.433	979.566
	Mean Closure Error:	Horizontal = 0.009	Vertical = 0.010	
856		653271.686	256733.997	980.067
856		653271.681	256733.970	980.013
	Mean Computed Coordinate	653271.684	256733.984	980.040
	Mean Closure Error:	Horizontal = 0.014	Vertical = 0.027	
857		659039.037	228994.362	981.923
857		659039.058	228994.360	981.802
	Mean Computed Coordinate	659039.048	228994.361	981.862
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.060	
858		638975.659	232494.103	1003.678
858		638975.638	232494.095	1003.774

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Mean Computed Coordinate 638975.648 232494.099 1003.726
 Mean Closure Error: Horizontal = 0.011 Vertical = 0.048

859 640511.330 252574.629 1014.049
 859 640511.335 252574.635 1014.156
 Mean Computed Coordinate 640511.332 252574.632 1014.102
 Mean Closure Error: Horizontal = 0.004 Vertical = 0.053

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
860		630025.986	251436.674	1032.479
860		630025.946	251436.607	1032.472
	Mean Computed Coordinate	630025.966	251436.640	1032.476
	Mean Closure Error:	Horizontal = 0.039	Vertical = 0.004	
861		628113.104	243601.219	988.570
861		628113.074	243601.193	988.503
	Mean Computed Coordinate	628113.089	243601.206	988.536
	Mean Closure Error:	Horizontal = 0.020	Vertical = 0.034	
862		617591.120	230485.960	1035.923
862		617591.119	230485.973	1035.773
	Mean Computed Coordinate	617591.120	230485.966	1035.848
	Mean Closure Error:	Horizontal = 0.007	Vertical = 0.075	
863		608584.111	240987.820	997.704
863		608584.050	240987.814	997.587
	Mean Computed Coordinate	608584.080	240987.817	997.646
	Mean Closure Error:	Horizontal = 0.031	Vertical = 0.058	
864		600621.309	234104.722	1011.463
864		600621.312	234104.810	1011.436
	Mean Computed Coordinate	600621.310	234104.766	1011.450
	Mean Closure Error:	Horizontal = 0.044	Vertical = 0.013	
865		603738.732	250017.485	1062.573
865		603738.793	250017.495	1062.747
	Mean Computed Coordinate	603738.762	250017.490	1062.660
	Mean Closure Error:	Horizontal = 0.031	Vertical = 0.087	
866		604130.817	215504.034	1040.691
866		604130.879	215504.068	1040.599
	Mean Computed Coordinate	604130.848	215504.051	1040.645
	Mean Closure Error:	Horizontal = 0.035	Vertical = 0.046	
867		606417.351	206928.912	1017.760
867		606417.322	206928.937	1017.784
	Mean Computed Coordinate	606417.336	206928.925	1017.772
	Mean Closure Error:	Horizontal = 0.019	Vertical = 0.012	
868		614409.738	203343.270	1006.552

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868 614409.712 203343.288 1006.546
 Mean Computed Coordinate 614409.725 203343.279 1006.549
 Mean Closure Error: Horizontal = 0.016 Vertical = 0.003

869 634151.966 214040.192 988.589
 869 634151.981 214040.183 988.644
 Mean Computed Coordinate 634151.974 214040.188 988.617
 Mean Closure Error: Horizontal = 0.009 Vertical = 0.027 □

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
870		639828.328	216723.606	1010.985
870		639828.309	216723.527	1010.917
	Mean Computed Coordinate	639828.318	216723.567	1010.951
	Mean Closure Error:	Horizontal = 0.041	Vertical = 0.034	
871		644248.669	201201.017	989.658
871		644248.740	201200.963	989.864
	Mean Computed Coordinate	644248.704	201200.990	989.761
	Mean Closure Error:	Horizontal = 0.045	Vertical = 0.103*	
872		656673.441	202512.685	992.026
872		656673.458	202512.670	991.998
	Mean Computed Coordinate	656673.450	202512.678	992.012
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.014	
873		654640.022	215933.273	997.141
873		654639.971	215933.219	997.103
	Mean Computed Coordinate	654639.996	215933.246	997.122
	Mean Closure Error:	Horizontal = 0.037	Vertical = 0.019	
874		653514.861	216867.634	999.572
874		653514.890	216867.628	999.485
	Mean Computed Coordinate	653514.876	216867.631	999.528
	Mean Closure Error:	Horizontal = 0.015	Vertical = 0.043	
875		629956.238	214457.822	1014.484
875		629956.287	214457.674	1014.391
	Mean Computed Coordinate	629956.262	214457.748	1014.438
	Mean Closure Error:	Horizontal = 0.078	Vertical = 0.047	
876		623513.548	214442.211	999.724
876		623513.559	214442.235	999.721
	Mean Computed Coordinate	623513.553	214442.223	999.723
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.002	
877		624935.747	218013.819	1021.870
877		624935.811	218013.696	1021.797
	Mean Computed Coordinate	624935.779	218013.758	1021.834
	Mean Closure Error:	Horizontal = 0.069	Vertical = 0.036	

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878 633443.779 222234.389 1011.325
 878 633443.846 222234.365 1011.303
 Mean Computed Coordinate 633443.812 222234.377 1011.314
 Mean Closure Error: Horizontal = 0.036 Vertical = 0.011

879 653965.628 227554.759 969.950
 879 653965.517 227554.736 970.026
 Mean Computed Coordinate 653965.572 227554.748 969.988
 Mean Closure Error: Horizontal = 0.057 Vertical = 0.038 □

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
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880		649062.583	222204.912	994.335
880		649062.561	222204.913	994.273
	Mean Computed Coordinate	649062.572	222204.912	994.304
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.031	

881		634442.708	200866.637	1013.818
881		634442.710	200866.658	1013.781
	Mean Computed Coordinate	634442.709	200866.648	1013.800
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.019	

882		612889.877	221150.539	1028.158
882		612889.859	221150.568	1028.175
	Mean Computed Coordinate	612889.868	221150.553	1028.166
	Mean Closure Error:	Horizontal = 0.017	Vertical = 0.009	

883		565976.515	215075.714	1030.754
883		565976.546	215075.717	1030.699
	Mean Computed Coordinate	565976.530	215075.716	1030.726
	Mean Closure Error:	Horizontal = 0.016	Vertical = 0.027	

884		536342.418	219536.207	1058.279
884		536342.377	219536.237	1058.373
	Mean Computed Coordinate	536342.397	219536.222	1058.326
	Mean Closure Error:	Horizontal = 0.025	Vertical = 0.047	

885		553502.259	198285.622	1048.112
885		553502.302	198285.614	1048.185
	Mean Computed Coordinate	553502.280	198285.618	1048.148
	Mean Closure Error:	Horizontal = 0.022	Vertical = 0.036	

886		540411.263	196437.854	1071.178
886		540411.243	196437.859	1071.109
	Mean Computed Coordinate	540411.253	196437.856	1071.144
	Mean Closure Error:	Horizontal = 0.010	Vertical = 0.035	

887		556460.839	171729.184	1043.354
887		556460.844	171729.142	1043.467
	Mean Computed Coordinate	556460.842	171729.163	1043.410
	Mean Closure Error:	Horizontal = 0.021	Vertical = 0.057	

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888 583207.232 187781.578 1024.683
 888 583207.205 187781.649 1024.701
 Mean Computed Coordinate 583207.218 187781.614 1024.692
 Mean Closure Error: Horizontal = 0.038 Vertical = 0.009

889 535197.758 239023.929 1071.786
 889 535197.732 239023.892 1071.821
 Mean Computed Coordinate 535197.745 239023.910 1071.804
 Mean Closure Error: Horizontal = 0.023 Vertical = 0.017

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 S.P.:4300 Desc:McLeod County LIDAR
 Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88
 Files:MCLEODLIDARXYZ2.txt
 (Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
890		577002.850	239669.377	1062.331
890		577002.838	239669.413	1062.250
	Mean Computed Coordinate	577002.844	239669.395	1062.290
	Mean Closure Error:	Horizontal = 0.019		Vertical = 0.040
891		619703.618	249042.279	1046.092
891		619703.592	249042.230	1046.160
	Mean Computed Coordinate	619703.605	249042.254	1046.126
	Mean Closure Error:	Horizontal = 0.028		Vertical = 0.034
892		633797.796	233387.613	1005.394
892		633797.808	233387.625	1005.356
	Mean Computed Coordinate	633797.802	233387.619	1005.375
	Mean Closure Error:	Horizontal = 0.008		Vertical = 0.019
893		648850.678	240193.479	999.067
893		648850.642	240193.511	999.071
	Mean Computed Coordinate	648850.660	240193.495	999.069
	Mean Closure Error:	Horizontal = 0.024		Vertical = 0.002
894		629363.977	266773.815	1039.547
894		629363.940	266773.780	1039.620
	Mean Computed Coordinate	629363.958	266773.798	1039.584
	Mean Closure Error:	Horizontal = 0.025		Vertical = 0.036
895		650309.106	275399.642	1020.076
895		650309.098	275399.642	1020.135
	Mean Computed Coordinate	650309.102	275399.642	1020.106
	Mean Closure Error:	Horizontal = 0.004		Vertical = 0.029
896		620927.154	285497.276	1062.713
896		620927.152	285497.280	1062.699
	Mean Computed Coordinate	620927.153	285497.278	1062.706
	Mean Closure Error:	Horizontal = 0.002		Vertical = 0.007
897		594924.492	280280.756	1091.676
897		594924.522	280280.791	1091.814
	Mean Computed Coordinate	594924.507	280280.774	1091.745

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Mean Closure Error: Horizontal = 0.023 Vertical = 0.069

898 579461.668 264622.999 1074.217
898 579461.701 264622.935 1074.147
Mean Computed Coordinate 579461.684 264622.967 1074.182
Mean Closure Error: Horizontal = 0.036 Vertical = 0.035

899 552471.994 275993.398 1107.041
899 552472.063 275993.391 1107.112
Mean Computed Coordinate 552472.028 275993.394 1107.077
Mean Closure Error: Horizontal = 0.035 Vertical = 0.036

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S.P.:4300 Desc:McLeod County LIDAR

Horizontal Datum:NAD83(96) McLeod County Vertical Datum:NAVD88

Files:MCLEODLIDARXYZ2.txt

(Photo Control Maximum Errors: Horizontal = 0.15 ft Vertical = 0.10 ft)

Statistical Summary Of Closure Errors For All Shots:

Horizontal (200 shots): Mean = 0.022 Std. Deviation = 0.026

Vertical (200 shots): Mean = 0.038 Std. Deviation = 0.047

* Mean Point Errors Over Photo Max: Horizontal = 0 Vertical = 3

APPENDIX A

NMAS Equivalent Contour Interval	NSSDA RMSE(z)	NSSDA Accuracy (z)	Required Accuracy for Reference Data for "Tested to Meet"
0.5	0.15 ft or 4.60 cm	0.30 ft or 9.10 cm	0.10 ft
1	0.30 ft or 9.25 cm	0.60 ft or 18.2 cm	0.20 ft
2	0.61 ft or 18.5 cm	1.19 ft or 36.3 cm	0.40 ft
4	1.22 ft or 37.0 cm	2.38 ft or 72.6 cm	0.79 ft
5	1.52 ft or 46.3 cm	2.98 ft or 90.8 cm	0.99 ft
10	3.04 ft or 92.7 cm	5.96 ft or 181.6 cm	1.98 ft

Table 1 Comparison of NMAS/NSSDA Vertical Accuracy

NMAS Mp Scale	NMAS CMAS 90%	NSSDA RMSE(r)	NSSDA Accuracy (r) 95% confidence level
1" = 100' or 1:1, 200	3.33 ft	2.20 ft or 67.0 cm	3.80 ft or 1.159 m
1" = 200' or 1: 2, 400	6.67 ft	4.39 ft or 1.339 m	7.60 ft or 2.318m
1" = 400' or 1: 4, 800	13.33 ft	8.79 ft or 2.678 m	15.21 ft or 4.635 m
1" = 500' or 1: 6,000	16.67 ft	10.98 ft or 3.348 m	19.01 ft or 5.794 m
1" = 1000' or 1: 12, 000	33.33 ft	21.97 ft or 6.695 m	38.02 ft or 11.588 m
1" = 2000' or 1: 24, 000*	40.00 ft	26.36 ft or 8.035m	45.62 ft or 13.906 m

Table 2 Comparison of NMAS/NSSDA Horizontal Accuracy