

**MAP ACCURACY REPORT
Countywide Imagery & DEM
Rice County**

Data Contact Person:	Michelle Trager	Department:	GIS Director
Type of Mapping:	DEM (LiDAR) & Ortho	Contractor:	Aero-Metric, Inc.
Independent Testing:	Mn/DOT Photo Unit	Contract Delivery Date:	19 Dec. 2007

The purpose of this report is to independently test (horizontal & vertical accuracies) orthophotos and a LiDAR derived digital elevation model data that was contracted for by Rice County. This project consisted of flights flown on 18 April 2007 for aerial imagery acquisition, using two separate planes and two digital cameras and on 18, 19 & 27 April 2007 for Light Detection and Ranging (LiDAR) and GPS/IMU technologies. 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 an Aero Commander 690 plane, a Z/I Imaging DMC camera, camera certificate dates are November 2003 and August & September 2006. Copies of the camera certificates are included in the delivery of this report but due to their size are not attached. 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 06SEN193 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 4920 feet AGL. The flights were controlled using Leica System SR9500 GPS receivers on the ground and by LN200 GPS/IMU equipment in the aircraft. Aero-Metric, 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 Rice 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 Rice 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 341,257 acres in area each.

ORTHOPHOTO & DEM

EAST BOUNDING COORDINATE: 93° 02' 08.74300" W. Long.
WEST BOUNDING COORDINATE: 93° 31' 44.41897" W. Long.
NORTH BOUNDING COORDINATE: 44° 32' 48.72877" N. Lat.
SOUTH BOUNDING COORDINATE: 44° 11' 36.48523" 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 AeroMetric, Inc. are attached to this report. Mn/DOT's District 6 Surveys report using the VRS system.

Aero-Metric, Inc. delivered the LiDAR and ortho-photos on a portable hard drive in TIFF with world files and MicroStation V8 format and the transmittal. The tiling scheme map used for both products are included as part of this report and the electronic file package.

The overall project area encompasses the entire county with flight strips extended to include a buffer of approximately 500 feet outside the county boundary.

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 Photogrammetric Unit tested a product that was a 5 foot post spacing grid.

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	1.10'	1.91' with 26 points

The test data was obtained by District 6 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 6 Surveys selected test points that geographically represent the various cover types as well as the general layout of the county. A few issues arose while testing the ortho-photo, they include a car parking over one of the test points, a test point taken at the top of a retaining wall and a few points where the image was not as distinct as the surveyors thought they might be.

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_z</u>	<u>NSSDA (Vertical)</u>
Open Terrain – L1O	0.25'	0.49' with 45 points.
Tall Weeds & Crops – L2T	0.32'	0.62' with 35 points.
Brush Lands & Low Trees – L3B	0.37'	0.73' with 35 points. *
Forested Areas with Canopy – L4F	0.48'	0.95' with 35 points. *
Urban Areas with Structures – L5U	0.30'	0.60' with 58 points. *
All Ground Cover	0.34'	0.68' with 208 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 responded to me in a telephone call and it was concluded that certain points needed reclassification and three needed to be removed.

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 horizontal accuracy as stated by the consultant is 1.64 feet. The outcome of the vertical testing results suggests that the horizontal accuracy is within reason for that claimed by the consultant. However it is slightly better than an often used industry rule of thumb of 1/2000th of the flying height which is $(4920 / 2000) = 2.46$ feet.

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

Peter Jenkins, LS
 Minnesota Department of Transportation
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 St. Paul, MN 55155

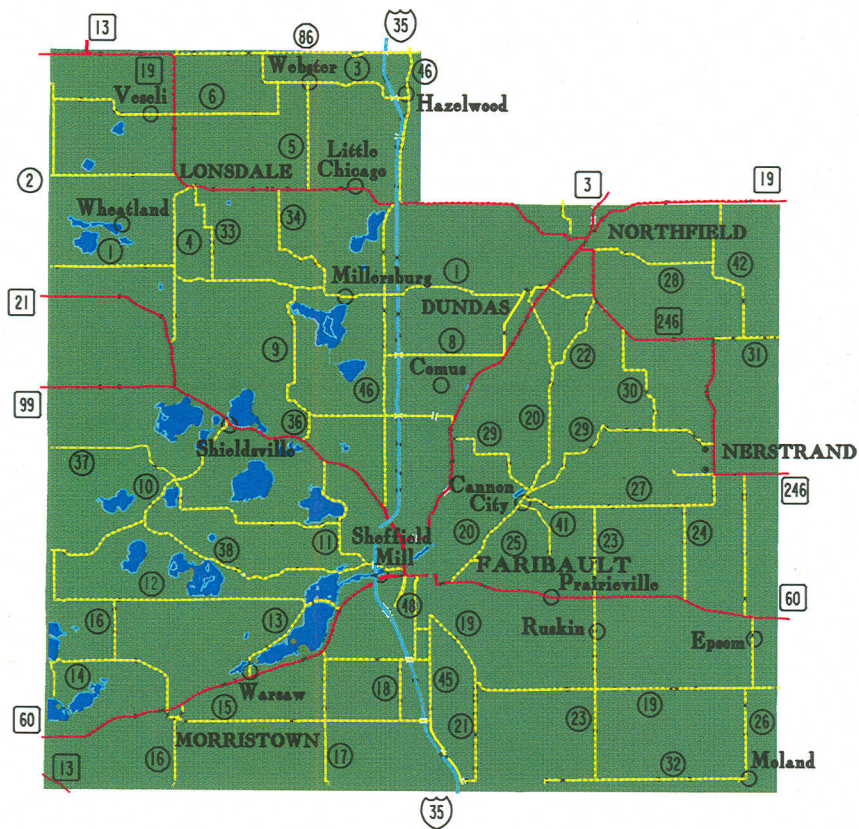
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 e-mail: peter.jenkins@dot.state.mn.us

I HEREBY CERTIFY THAT THIS SURVEY, PLAN OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A LICENSED LAND SURVEYOR UNDER THE LAWS OF THE STATE OF MINNESOTA.

Peter W. Jenkins

PETER W. JENKINS

DATE 9 May 08 REG. NO. 22683



S. P. : Rice County
 T.H. : TH 60
 COLLECTION DATE : May 2007
 LOCATION : RICE COUNTY
 MAPPING : LIDAR & ORTHO PHOTO
 CONSULTANT MAPPING : YES
 MAPPING COMPLETED : 3-26-08
 ARCHIVE INFO : 651.366.3466
 ARCHIVE TAPE : \\ad\co\public\LM\PHOTO\ARC\ LIDAR\Rice Co

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 Rice 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 0.68 FT. based on 208 test elevations.

The horizontal accuracy of this ORTHO PHOTO has been tested using NSSDA (June 1998) methods and computes to 1.91 Feet based on 26 test points.

MEMORANDUM OF UNDERSTANDING
between
MINNESOTA DEPARTMENT OF TRANSPORTATION
and
RICE COUNTY

WHEREAS, the Minnesota Department of Transportation (Mn/DOT) and Rice County wish to enter into agreement to exchange services with respect to County wide digital orthophotography and LiDAR derived digital elevation model (DEM) in Rice County.

NOW, THEREFORE, Mn/DOT and Rice County state the following:

1. This Memorandum of Understanding (MOU) is not a binding agreement, and any binding obligation will be made with written, properly executed and approved agreements.
2. Rice County will provide Mn/DOT with a copy of the digital data that the county acquired in the spring of 2007 by AERO-METRIC, Inc. – MN.
3. A meeting will be scheduled that include representative from Mn/DOT's Photogrammetric Unit, District Seven and Rice County to decide the number and location of survey shots that are necessary to adequately test the orthophotography. (approximately 40 to 80 shots will be needed)
4. Mn/DOT will do the surveying and processing of these test shots and will be collected using the ASPRS Vertical Accuracy Reporting Guidelines.
5. A sample of Mn/DOT's Map Accuracy Report will be shown to Rice County for their approval.
6. Mn/DOT will do the accuracy testing and write a report detailing the outcome of the test shots. A copy of the report will be provided to Rice County in any format requested.
7. The digital data provided by the County was developed pursuant to Minnesota Statutes §375.85. Mn/DOT is a licensee of such data only, and will have no ownership interest in the data. Pursuant to Minnesota Statutes §§375.86 and 13.37 (subd. 2), such data is classified as non-public "trade secret data". Mn/DOT will not disclose such data unless otherwise required by law or court order.

RICE COUNTY

By: 

DENNIS LUERBE
RICE COUNTY ENGINEER

Date: 4/9/07

MINNESOTA DEPARTMENT OF
TRANSPORTATION

By: 

Peter Jenkins
Photogrammetric Engineer

Date: 10 Dec. 07

Rice County
Ortho-photo 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.
10014	n/a ret wall	418464.322	111718.209							
10012		409848.373	106082.928	409848.84	-0.47	0.22	106083.30	-0.37	0.13	0.36
10015		419830.211	113038.072	419831.52	-1.30	1.70	113038.38	-0.31	0.09	1.80
10178		419180.788	201294.076	419181.90	-1.12	1.25	201294.37	-0.30	0.09	1.33
10016		419688.806	112717.435	419689.39	-0.58	0.34	112717.17	0.27	0.07	0.41
10171		427856.828	203445.429	427857.90	-1.07	1.15	203446.03	-0.60	0.36	1.51
10093		491295.252	195938.949	491295.32	-0.06	0.00	195940.36	-1.41	1.98	1.99
10165		429791.000	198383.582	429791.21	-0.21	0.04	198384.29	-0.71	0.51	0.55
10091		482190.842	183151.373	482192.06	-1.22	1.49	183151.93	-0.55	0.30	1.79
10146		432709.600	165661.575	432709.42	0.18	0.03	165662.14	-0.57	0.32	0.36
10088		508516.904	161384.700	508517.02	-0.11	0.01	161385.31	-0.61	0.37	0.39
10132		426969.330	162067.449	426970.22	-0.89	0.80	162067.27	0.18	0.03	0.83
10080	n/a	524423.530	176817.302							
10116	n/a car	485825.960	187934.295							
10070		516916.685	153629.944	516917.59	-0.90	0.81	153630.23	-0.29	0.08	0.89
10013		418397.066	108664.973	418397.74	-0.67	0.45	108665.48	-0.51	0.26	0.71
10172		425910.882	204117.315	425912.04	-1.16	1.34	204117.27	0.04	0.00	1.34
10166		429906.799	203348.426	429907.29	-0.49	0.24	203349.03	-0.61	0.37	0.61
10147	n/a	433506.841	167885.322							
10145		431068.167	161983.051	431067.95	0.22	0.05	161983.08	-0.03	0.00	0.05
10120		471693.735	174853.465	471695.02	-1.29	1.66	174854.05	-0.58	0.34	2.00
10115	n/a	480983.946	184389.381							
10113		497875.235	188411.077	497875.29	-0.06	0.00	188412.30	-1.23	1.51	1.51
10068		517753.276	154704.179	517754.21	-0.93	0.87	154704.81	-0.63	0.40	1.27
10060		509679.052	177541.488	509679.32	-0.26	0.07	177542.11	-0.62	0.39	0.46
10051		470240.094	138479.386	470242.12	-2.03	4.11	138479.77	-0.39	0.15	4.26
10042		458794.998	137613.148	458796.04	-1.04	1.08	137613.65	-0.51	0.26	1.33
10040		460762.645	152532.439	460763.84	-1.19	1.43	152533.08	-0.64	0.41	1.83
10038		458143.906	164171.286	458145.27	-1.36	1.86	164170.91	0.38	0.14	2.00
10035		455896.941	150223.909	455898.23	-1.29	1.65	150224.28	-0.37	0.14	1.79
10179		412743.539	217151.821	412743.82	-0.28	0.08	217152.09	-0.27	0.07	0.15
Sum										31.51
Average										1.21
RMSEr										1.10
NSSDA										1.91

26 Total Number of Points

TOTAL-RICE_Verical Accuracy Statistic Worksheet.xls

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
10000	L1O	1022.32	1021.98	0.35	0.12
10003	L1O	1045.50	1045.14	0.36	0.13
10010	L1O	1094.22	1093.98	0.24	0.06
10022	L1O	1045.84	1045.96	-0.12	0.01
10025	L1O	1101.20	1100.95	0.25	0.06
10034	L1O	1049.18	1049.16	0.02	0.00
10040	L1O	1003.96	1004.04	-0.09	0.01
10041	L1O	1017.36	1016.92	0.44	0.19
10044	L1O	973.01	972.91	0.10	0.01
10047	L1O	1084.47	1084.55	-0.08	0.01
10048	L1O	1115.59	1115.70	-0.11	0.01
10049	L1O	1177.03	1177.15	-0.12	0.02
10062	L1O	966.98	967.35	-0.37	0.14
10066	L1O	1178.23	1178.07	0.15	0.02
10074	L1O	1117.72	1117.99	-0.27	0.07
10077	L1O	992.37	992.55	-0.18	0.03
10081	L1O	1046.62	1046.74	-0.12	0.01
10088	L1O	1103.47	1103.65	-0.18	0.03
10091	L1O	929.44	929.36	0.07	0.01
10097	L1O	993.64	993.99	-0.35	0.12
10103	L1O	981.62	981.89	-0.27	0.07
10108	L1O	1144.58	1144.74	-0.16	0.03
10110	L1O	1021.28	1021.38	-0.10	0.01
10113	L1O	993.97	994.12	-0.15	0.02
10114	L1O	1093.81	1093.87	-0.06	0.00
10121	L1O	1095.01	1095.04	-0.03	0.00
10128	L1O	1134.59	1134.68	-0.09	0.01
10131	L1O	1129.04	1129.14	-0.10	0.01
10132	L1O	1109.34	1109.20	0.13	0.02
10137	L1O	1111.44	1111.57	-0.14	0.02
10138	L1O	1057.69	1057.69	-0.01	0.00
10145	L1O	1100.87	1100.66	0.21	0.04
10150	L1O	1064.32	1064.89	-0.57	0.33
10156	L1O	1092.10	1092.80	-0.70	0.49
10158	L1O	1178.52	1178.81	-0.28	0.08
10162	L1O	1081.97	1082.46	-0.50	0.25
10166	L1O	1161.13	1161.27	-0.14	0.02
10168	L1O	1101.86	1101.97	-0.12	0.01
10172	L1O	1076.23	1076.36	-0.14	0.02
10178	L1O	1068.43	1068.62	-0.19	0.04
15015	L1O	970.07	969.82	0.25	0.06
15016	L1O	971.77	971.50	0.28	0.08
15017	L1O	970.68	970.39	0.28	0.08
15018	L1O	972.02	971.79	0.23	0.05
15019	L1O	971.90	971.77	0.13	0.02
10001	L2T	1051.85	1051.97	-0.12	0.02
10004	L2T	1048.14	1048.12	0.01	0.00
10005	L2T	1081.14	1081.08	0.06	0.00
10008	L2T	1043.20	1043.88	-0.69	0.47
10011	L2T	1073.96	1074.07	-0.11	0.01

TOTAL-RICE_Vertical Accuracy Statistic Worksheet.xls

10032	L2T	1052.05	1051.96	0.09	0.01
10037	L2T	1050.63	1050.69	-0.06	0.00
10039	L2T	1023.13	1023.34	-0.21	0.04
10046	L2T	988.79	988.67	0.12	0.02
10057	L2T	1125.52	1125.70	-0.18	0.03
10061	L2T	1003.28	1003.56	-0.28	0.08
10063	L2T	1019.79	1020.06	-0.27	0.07
10067	L2T	1130.10	1130.26	-0.17	0.03
10076	L2T	1049.76	1049.76	0.01	0.00
10083	L2T	960.94	961.11	-0.17	0.03
10099	L2T	1010.81	1011.14	-0.34	0.11
10101	L2T	1014.16	1014.34	-0.18	0.03
10104	L2T	964.89	964.99	-0.10	0.01
10106	L2T	1127.88	1128.42	-0.53	0.28
10111	L2T	980.18	980.39	-0.21	0.04
10122	L2T	1052.61	1053.26	-0.65	0.42
10124	L2T	1074.31	1074.47	-0.16	0.03
10130	L2T	1126.19	1126.38	-0.19	0.04
10136	L2T	1093.24	1093.48	-0.24	0.06
10140	L2T	1170.60	1170.64	-0.04	0.00
10148	L2T	1050.95	1051.19	-0.25	0.06
10151	L2T	1113.02	1113.64	-0.62	0.39
10152	L2T	1042.72	1042.98	-0.27	0.07
10153	L2T	1118.21	1118.53	-0.33	0.11
10161	L2T	1063.16	1063.79	-0.64	0.41
10167	L2T	1110.27	1110.82	-0.55	0.30
15010	L2T	1055.88	1055.61	0.26	0.07
15011	L2T	1057.39	1056.97	0.42	0.18
15012	L2T	1058.91	1059.08	-0.17	0.03
15014	L2T	1065.00	1065.16	-0.16	0.02
10002	L3B	1044.51	1045.00	-0.49	0.24
10009	L3B	1087.36	1087.51	-0.16	0.02
10024	L3B	1062.90	1062.69	0.21	0.04
10027	L3B	1067.66	1068.09	-0.44	0.19
10028	L3B	1064.67	1064.57	0.09	0.01
10030	L3B	1018.87	1019.04	-0.17	0.03
10031	L3B	1002.17	1002.52	-0.34	0.12
10033	L3B	1057.61	1057.97	-0.35	0.13
10036	L3B	1056.60	1056.59	0.00	0.00
10050	L3B	1188.91	1188.83	0.07	0.01
10064	L3B	1051.27	1051.91	-0.64	0.42
10075	L3B	1028.38	1028.62	-0.23	0.05
10082	L3B	1011.24	1011.62	-0.38	0.15
10084	L3B	938.25	938.76	-0.51	0.26
10086	L3B	1101.61	1102.38	-0.77	0.60
10098	L3B	985.20	985.37	-0.17	0.03
10100	L3B	994.90	995.17	-0.27	0.07
10102	L3B	1023.13	1023.32	-0.19	0.04
10107	L3B	1088.13	1088.35	-0.22	0.05
10112	L3B	1011.99	1012.04	-0.05	0.00
10126	L3B	1095.29	1095.52	-0.23	0.05
10129	L3B	1125.90	1126.04	-0.15	0.02

TOTAL-RICE_Vertical Accuracy Statistic Worksheet.xls

10139	L3B	1074.17	1074.71	-0.54	0.29
10141	L3B	1103.59	1104.06	-0.47	0.22
10144	L3B	1127.41	1127.64	-0.23	0.05
10149	L3B	1069.63	1070.38	-0.76	0.57
10154	L3B	1140.75	1141.20	-0.45	0.20
10155	L3B	1091.00	1091.50	-0.50	0.25
10159	L3B	1141.15	1141.75	-0.60	0.36
10164	L3B	1068.46	1068.92	-0.46	0.21
15025	L3B	1005.18	1005.30	-0.12	0.01
15026	L3B	1006.54	1006.49	0.05	0.00
15027	L3B	1005.73	1005.87	-0.14	0.02
15028	L3B	1002.47	1002.73	-0.27	0.07
15029	L3B	999.32	999.58	-0.26	0.07
10006	L4F	1074.94	1075.12	-0.18	0.03
10023	L4F	1031.47	1032.00	-0.52	0.27
10026	L4F	1091.52	1091.48	0.04	0.00
10029	L4F	1055.33	1055.02	0.31	0.10
10045	L4F	995.16	994.94	0.22	0.05
10051	L4F	1210.76	1210.55	0.22	0.05
10056	L4F	1095.62	1095.27	0.35	0.12
10058	L4F	1169.46	1169.52	-0.07	0.00
10059	L4F	1076.31	1075.56	0.75	0.57
10065	L4F	1071.74	1071.64	0.10	0.01
10071	L4F	1180.61	1180.74	-0.13	0.02
10078	L4F	999.92	999.69	0.23	0.05
10085	L4F	1196.86	1196.58	0.28	0.08
10087	L4F	1163.32	1164.92	-1.60	2.57
10105	L4F	943.53	943.41	0.12	0.01
10109	L4F	992.77	992.74	0.03	0.00
10117	L4F	957.70	958.55	-0.85	0.73
10118	L4F	1040.71	1041.15	-0.44	0.19
10119	L4F	992.99	993.08	-0.09	0.01
10123	L4F	1085.39	1085.59	-0.20	0.04
10125	L4F	1075.16	1075.28	-0.11	0.01
10127	L4F	1092.00	1092.07	-0.07	0.00
10142	L4F	1087.83	1087.68	0.15	0.02
10143	L4F	1083.12	1083.28	-0.16	0.03
10147	L4F	1129.94	1129.49	0.45	0.20
10157	L4F	1170.91	1171.48	-0.57	0.33
10160	L4F	1128.90	1129.83	-0.93	0.87
10163	L4F	1102.29	1103.03	-0.74	0.55
10169	L4F	1100.93	1101.09	-0.16	0.02
10170	L4F	1102.21	1102.71	-0.50	0.25
15050	L4F	1027.67	1027.89	-0.23	0.05
15051	L4F	1020.64	1020.93	-0.29	0.09
15052	L4F	1018.23	1019.13	-0.90	0.81
15053	L4F	1058.92	1059.11	-0.19	0.04
15054	L4F	1062.65	1062.72	-0.07	0.00
10013	L5U	1038.52	1038.26	0.26	0.07
10015	L5U	1009.95	1009.79	0.17	0.03
10017	L5U	1003.71	1003.58	0.13	0.02
10018	L5U	1004.44	1004.05	0.39	0.15

TOTAL-RICE_Vertical Accuracy Statistic Worksheet.xls

10019	L5U	1004.40	1003.89	0.51	0.26
10020	L5U	1003.56	1003.11	0.46	0.21
10021	L5U	1004.06	1003.74	0.33	0.11
10035	L5U	1043.00	1043.01	-0.01	0.00
10042	L5U	975.77	975.32	0.44	0.20
10043	L5U	995.11	994.93	0.18	0.03
10052	L5U	998.35	997.89	0.47	0.22
10053	L5U	992.05	991.65	0.40	0.16
10054	L5U	977.48	977.46	0.02	0.00
10055	L5U	996.31	995.79	0.53	0.28
10060	L5U	1025.42	1025.22	0.20	0.04
10068	L5U	1200.94	1201.13	-0.19	0.04
10069	L5U	1196.24	1196.18	0.06	0.00
10070	L5U	1195.18	1195.15	0.02	0.00
10072	L5U	1191.86	1191.84	0.02	0.00
10073	L5U	1182.03	1182.18	-0.15	0.02
10079	L5U	971.34	971.29	0.05	0.00
10080	L5U	969.13	969.08	0.05	0.00
10089	L5U	1194.82	1194.81	0.01	0.00
10090	L5U	933.16	933.28	-0.12	0.01
10092	L5U	929.64	929.85	-0.20	0.04
10093	L5U	954.02	954.08	-0.06	0.00
10094	L5U	926.56	926.63	-0.07	0.00
10095	L5U	921.07	921.37	-0.30	0.09
10096	L5U	923.17	923.43	-0.26	0.07
10115	L5U	923.99	923.99	0.01	0.00
10116	L5U	934.35	933.44	0.90	0.82
10120	L5U	1007.50	1007.54	-0.04	0.00
10133	L5U	1101.73	1101.67	0.06	0.00
10134	L5U	1081.93	1081.90	0.02	0.00
10135	L5U	1098.31	1098.12	0.19	0.04
10146	L5U	1112.84	1112.19	0.65	0.42
10165	L5U	1133.71	1133.90	-0.19	0.03
10171	L5U	1124.09	1124.59	-0.50	0.25
10173	L5U	1091.48	1091.66	-0.18	0.03
10174	L5U	1108.89	1108.69	0.20	0.04
10175	L5U	1096.99	1097.15	-0.16	0.03
10176	L5U	1094.38	1094.24	0.14	0.02
10177	L5U	1095.23	1095.62	-0.39	0.15
10179	L5U	1101.72	1101.81	-0.09	0.01
10180	L5U	1090.70	1090.89	-0.19	0.04
10181	L5U	1096.62	1096.80	-0.18	0.03
15000	L5U	975.80	975.12	0.67	0.45
15001	L5U	981.51	981.50	0.01	0.00
15002	L5U	1073.32	1073.19	0.13	0.02
15003	L5U	974.69	974.11	0.58	0.34
15004	L5U	971.78	971.25	0.53	0.28
15005	L5U	983.34	982.83	0.51	0.26
15006	L5U	1057.52	1057.61	-0.09	0.01
15020	L5U	974.78	974.68	0.09	0.01
15021	L5U	974.22	974.22	-0.01	0.00
15022	L5U	973.85	973.74	0.11	0.01

TOTAL-RICE_Vertical Accuracy Statistic Worksheet.xls

15023	L5U	973.39	973.48	-0.09	0.01
15024	L5U	972.98	972.84	0.14	0.02

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

208

Sum	24.58
Average	0.12
RMSEr	0.34
NSSDA	0.68

L10-RICE_Vertical Accuracy Statistic Worksheet.xls

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
10000	L10	1022.32	1021.98	0.35	0.12
10003	L10	1045.50	1045.14	0.36	0.13
10010	L10	1094.22	1093.98	0.24	0.06
10022	L10	1045.84	1045.96	-0.12	0.01
10025	L10	1101.20	1100.95	0.25	0.06
10034	L10	1049.18	1049.16	0.02	0.00
10040	L10	1003.96	1004.04	-0.09	0.01
10041	L10	1017.36	1016.92	0.44	0.19
10044	L10	973.01	972.91	0.10	0.01
10047	L10	1084.47	1084.55	-0.08	0.01
10048	L10	1115.59	1115.70	-0.11	0.01
10049	L10	1177.03	1177.15	-0.12	0.02
10062	L10	966.98	967.35	-0.37	0.14
10066	L10	1178.23	1178.07	0.15	0.02
10074	L10	1117.72	1117.99	-0.27	0.07
10077	L10	992.37	992.55	-0.18	0.03
10081	L10	1046.62	1046.74	-0.12	0.01
10088	L10	1103.47	1103.65	-0.18	0.03
10091	L10	929.44	929.36	0.07	0.01
10097	L10	993.64	993.99	-0.35	0.12
10103	L10	981.62	981.89	-0.27	0.07
10108	L10	1144.58	1144.74	-0.16	0.03
10110	L10	1021.28	1021.38	-0.10	0.01
10113	L10	993.97	994.12	-0.15	0.02
10114	L10	1093.81	1093.87	-0.06	0.00
10121	L10	1095.01	1095.04	-0.03	0.00
10128	L10	1134.59	1134.68	-0.09	0.01
10131	L10	1129.04	1129.14	-0.10	0.01
10132	L10	1109.34	1109.20	0.13	0.02
10137	L10	1111.44	1111.57	-0.14	0.02
10138	L10	1057.69	1057.69	-0.01	0.00
10145	L10	1100.87	1100.66	0.21	0.04
10150	L10	1064.32	1064.89	-0.57	0.33
10156	L10	1092.10	1092.80	-0.70	0.49
10158	L10	1178.52	1178.81	-0.28	0.08
10162	L10	1081.97	1082.46	-0.50	0.25
10166	L10	1161.13	1161.27	-0.14	0.02
10168	L10	1101.86	1101.97	-0.12	0.01
10172	L10	1076.23	1076.36	-0.14	0.02
10178	L10	1068.43	1068.62	-0.19	0.04
15015	L10	970.07	969.82	0.25	0.06
15016	L10	971.77	971.50	0.28	0.08
15017	L10	970.68	970.39	0.28	0.08
15018	L10	972.02	971.79	0.23	0.05
15019	L10	971.90	971.77	0.13	0.02

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

45

Sum	2.70
Average	0.06
RMSEr	0.25
NSSDA	0.49

L5U-RICE_Vertical Accuracy Statistic Worksheet.xls

Point Number	Point Description	Z (Survey)	Z (Map)	Difference in Z	Z-Difference Squared
10013	L5U	1038.52	1038.26	0.26	0.07
10015	L5U	1009.95	1009.79	0.17	0.03
10017	L5U	1003.71	1003.58	0.13	0.02
10018	L5U	1004.44	1004.05	0.39	0.15
10019	L5U	1004.40	1003.89	0.51	0.26
10020	L5U	1003.56	1003.11	0.46	0.21
10021	L5U	1004.06	1003.74	0.33	0.11
10035	L5U	1043.00	1043.01	-0.01	0.00
10042	L5U	975.77	975.32	0.44	0.20
10043	L5U	995.11	994.93	0.18	0.03
10052	L5U	998.35	997.89	0.47	0.22
10053	L5U	992.05	991.65	0.40	0.16
10054	L5U	977.48	977.46	0.02	0.00
10055	L5U	996.31	995.79	0.53	0.28
10060	L5U	1025.42	1025.22	0.20	0.04
10068	L5U	1200.94	1201.13	-0.19	0.04
10069	L5U	1196.24	1196.18	0.06	0.00
10070	L5U	1195.18	1195.15	0.02	0.00
10072	L5U	1191.86	1191.84	0.02	0.00
10073	L5U	1182.03	1182.18	-0.15	0.02
10079	L5U	971.34	971.29	0.05	0.00
10080	L5U	969.13	969.08	0.05	0.00
10089	L5U	1194.82	1194.81	0.01	0.00
10090	L5U	933.16	933.28	-0.12	0.01
10092	L5U	929.64	929.85	-0.20	0.04
10093	L5U	954.02	954.08	-0.06	0.00
10094	L5U	926.56	926.63	-0.07	0.00
10095	L5U	921.07	921.37	-0.30	0.09
10096	L5U	923.17	923.43	-0.26	0.07
10115	L5U	923.99	923.99	0.01	0.00
10116	L5U	934.35	933.44	0.90	0.82
10120	L5U	1007.50	1007.54	-0.04	0.00
10133	L5U	1101.73	1101.67	0.06	0.00
10134	L5U	1081.93	1081.90	0.02	0.00
10135	L5U	1098.31	1098.12	0.19	0.04
10146	L5U	1112.84	1112.19	0.65	0.42
10165	L5U	1133.71	1133.90	-0.19	0.03
10171	L5U	1124.09	1124.59	-0.50	0.25
10173	L5U	1091.48	1091.66	-0.18	0.03
10174	L5U	1108.89	1108.69	0.20	0.04
10175	L5U	1096.99	1097.15	-0.16	0.03
10176	L5U	1094.38	1094.24	0.14	0.02
10177	L5U	1095.23	1095.62	-0.39	0.15
10179	L5U	1101.72	1101.81	-0.09	0.01
10180	L5U	1090.70	1090.89	-0.19	0.04
10181	L5U	1096.62	1096.80	-0.18	0.03
15000	L5U	975.80	975.12	0.67	0.45
15001	L5U	981.51	981.50	0.01	0.00
15002	L5U	1073.32	1073.19	0.13	0.02
15003	L5U	974.69	974.11	0.58	0.34

L5U-RICE_Vertical Accuracy Statistic Worksheet.xls

15004	L5U	971.78	971.25	0.53	0.28
15005	L5U	983.34	982.83	0.51	0.26
15006	L5U	1057.52	1057.61	-0.09	0.01
15020	L5U	974.78	974.68	0.09	0.01
15021	L5U	974.22	974.22	-0.01	0.00
15022	L5U	973.85	973.74	0.11	0.01
15023	L5U	973.39	973.48	-0.09	0.01
15024	L5U	972.98	972.84	0.14	0.02

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

58

Sum	5.35
Average	0.09
RMSEr	0.30
NSSDA	0.60

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 Files:Rice County Photo.txt

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
TT 65 MC cs		211819.303	419302.042	1105.377
1	Tgt	227432.003	398102.650	1029.645
1	TGT	227431.976	398102.627	1029.619
	Mean Computed Coordinate	227431.990	398102.638	1029.632
	Mean Closure Error:	Horizontal = 0.018	Vertical = 0.013	
2	Tgt	227394.844	424559.733	1124.553
2	TGT	227394.846	424559.773	1124.543
	Mean Computed Coordinate	227394.845	424559.753	1124.548
	Mean Closure Error:	Horizontal = 0.020	Vertical = 0.005	
3	Tgt	222196.269	445452.988	1101.070
3	TGT	222196.307	445452.947	1101.160
	Mean Computed Coordinate	222196.288	445452.968	1101.115
	Mean Closure Error:	Horizontal = 0.028	Vertical = 0.045	
4		227355.579	461720.384	1095.008
4	TGT	227355.623	461720.403	1094.971
	Mean Computed Coordinate	227355.601	461720.394	1094.990
	Mean Closure Error:	Horizontal = 0.024	Vertical = 0.019	
5	Tgt	206418.060	403216.003	1121.632
5	TGT	206418.056	403215.967	1121.738
5	TGT	206418.058	403215.968	1121.724
	Mean Computed Coordinate	206418.058	403215.979	1121.698
	Mean Closure Error:	Horizontal = 0.016	Vertical = 0.044	
6		203716.708	429771.348	1162.886
6	TGT	203716.735	429771.347	1162.915
	Mean Computed Coordinate	203716.722	429771.348	1162.900
	Mean Closure Error:	Horizontal = 0.014	Vertical = 0.014	
7	Tgt	197170.560	413839.996	1080.695
7	TGT	197170.613	413839.996	1080.638
	Mean Computed Coordinate	197170.586	413839.996	1080.666
	Mean Closure Error:	Horizontal = 0.027	Vertical = 0.029	
8	TGT	195825.307	455967.938	1041.456
8	TGT	195825.307	455967.911	1041.469
	Mean Computed Coordinate	195825.307	455967.924	1041.463
	Mean Closure Error:	Horizontal = 0.014	Vertical = 0.007	
9		195549.154	498051.034	960.969
9	TGT	195549.162	498051.055	960.902
	Mean Computed Coordinate	195549.158	498051.044	960.936
	Mean Closure Error:	Horizontal = 0.011	Vertical = 0.034	
10		201054.670	524505.355	924.153
10	TGT	201054.674	524505.400	924.111

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Mean Computed Coordinate 201054.672 524505.377 924.132

Mean Closure Error: Horizontal = 0.023 Vertical = 0.021 □

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Files:Rice County Photo.txt

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
11	TGT	185227.911	471781.591	995.824
11	tgt	185227.862	471781.572	995.829
	Mean Computed Coordinate	185227.886	471781.582	995.826
	Mean Closure Error:	Horizontal = 0.026	Vertical = 0.002	
12	TGT	180089.389	440125.248	1021.347
12	TGT	180089.382	440125.235	1021.351
	Mean Computed Coordinate	180089.386	440125.242	1021.349
	Mean Closure Error:	Horizontal = 0.007	Vertical = 0.002	
13	TGT	169552.669	397695.706	1141.160
13	TGT	169552.664	397695.647	1141.175
	Mean Computed Coordinate	169552.666	397695.676	1141.168
	Mean Closure Error:	Horizontal = 0.030	Vertical = 0.007	
14	TGT	174698.162	408313.185	1137.228
14	TGT	174698.236	408313.187	1137.190
	Mean Computed Coordinate	174698.199	408313.186	1137.209
	Mean Closure Error:	Horizontal = 0.037	Vertical = 0.019	
15	TGT	169576.355	434756.833	1089.327
15	TGT	169576.364	434756.820	1089.273
	Mean Computed Coordinate	169576.360	434756.826	1089.300
	Mean Closure Error:	Horizontal = 0.008	Vertical = 0.027	
16	TGT	164225.556	450567.161	1079.314
16	TGT	164225.555	450567.099	1079.298
	Mean Computed Coordinate	164225.556	450567.130	1079.306
	Mean Closure Error:	Horizontal = 0.031	Vertical = 0.008	
17	TGT	158882.859	466241.706	974.453
17	tgt	158882.780	466241.646	974.606
	Mean Computed Coordinate	158882.819	466241.676	974.530
	Mean Closure Error:	Horizontal = 0.050	Vertical = 0.077	
18	TGT	169468.668	487627.411	1160.726
18	TGT	169468.734	487627.434	1160.757
	Mean Computed Coordinate	169468.701	487627.422	1160.742
	Mean Closure Error:	Horizontal = 0.035	Vertical = 0.015	
19	TGT	171891.152	501946.247	1140.565
19	TGT	171891.072	501946.264	1140.604
	Mean Computed Coordinate	171891.112	501946.256	1140.584
	Mean Closure Error:	Horizontal = 0.041	Vertical = 0.019	
20	TGT	177324.719	513837.549	961.902
20	TGT	177324.705	513837.606	962.017
	Mean Computed Coordinate	177324.712	513837.578	961.960
	Mean Closure Error:	Horizontal = 0.029	Vertical = 0.058	

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21 Tgt 148105.183 419641.117 1128.025
 21 TGT 148105.184 419641.090 1128.051
 Mean Computed Coordinate 148105.183 419641.104 1128.038
 Mean Closure Error: Horizontal = 0.014 Vertical = 0.013 □
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 Files:Rice County Photo.txt

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
22	Tgt	142994.509	461053.252	976.644
22	TGT	142994.506	461053.266	976.750
	Mean Computed Coordinate	142994.508	461053.259	976.697
	Mean Closure Error:	Horizontal = 0.007	Vertical = 0.053	
23	TGT	148238.644	497881.101	1205.682
23	TGT	148238.669	497881.070	1205.709
	Mean Computed Coordinate	148238.656	497881.086	1205.696
	Mean Closure Error:	Horizontal = 0.020	Vertical = 0.014	
24	TGT	153679.739	524294.676	1176.867
24	TGT	153679.766	524294.638	1176.971
	Mean Computed Coordinate	153679.752	524294.657	1176.919
	Mean Closure Error:	Horizontal = 0.023	Vertical = 0.052	
25	Tgt	132370.634	402651.438	1119.492
25	TGT	132370.730	402651.487	1119.643
	Mean Computed Coordinate	132370.682	402651.462	1119.568
	Mean Closure Error:	Horizontal = 0.054	Vertical = 0.076	
26	Tgt	132432.794	429173.357	1065.535
26	TGT	132432.686	429173.382	1065.618
	Mean Computed Coordinate	132432.740	429173.370	1065.577
	Mean Closure Error:	Horizontal = 0.055	Vertical = 0.041	
27	TGT	126971.357	476684.563	1045.907
27	TGT	126971.425	476684.603	1045.804
	Mean Computed Coordinate	126971.391	476684.583	1045.856
	Mean Closure Error:	Horizontal = 0.039	Vertical = 0.051	
28	TGT	132482.017	492535.000	1196.165
28	TGT	132482.053	492534.977	1196.212
	Mean Computed Coordinate	132482.035	492534.988	1196.188
	Mean Closure Error:	Horizontal = 0.021	Vertical = 0.024	
29	TGT	132458.131	518968.070	1181.018
29	TGT	132458.213	518968.035	1180.874
	Mean Computed Coordinate	132458.172	518968.052	1180.946
	Mean Closure Error:	Horizontal = 0.045	Vertical = 0.072	
30	Tgt	121862.583	413302.217	1087.307
30	TGT	121862.638	413302.201	1087.355
	Mean Computed Coordinate	121862.611	413302.209	1087.331
	Mean Closure Error:	Horizontal = 0.029	Vertical = 0.024	
31		111276.051	450172.795	1109.164

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31 TGT 111276.062 450172.885 1109.178
 Mean Computed Coordinate 111276.056 450172.840 1109.171
 Mean Closure Error: Horizontal = 0.045 Vertical = 0.007

32 TGT 116600.657 487110.839 1165.006
 32 TGT 116600.696 487110.825 1165.030
 Mean Computed Coordinate 116600.676 487110.832 1165.018
 Mean Closure Error: Horizontal = 0.021 Vertical = 0.012 □

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 Files:Rice County Photo.txt

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
33	TGT	111278.988	508310.651	1230.461
33	TGT	111279.011	508310.640	1230.424
	Mean Computed Coordinate	111279.000	508310.646	1230.442
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.019	
34	Tgt	100856.892	397499.185	1070.948
34	TGT	100856.927	397499.181	1070.879
	Mean Computed Coordinate	100856.910	397499.183	1070.914
	Mean Closure Error:	Horizontal = 0.018	Vertical = 0.035	
35	Tgt	100806.165	423641.099	1064.459
35	TGT	100806.278	423640.999	1064.440
	Mean Computed Coordinate	100806.222	423641.049	1064.450
	Mean Closure Error:	Horizontal = 0.075	Vertical = 0.010	
36	TGT	100674.917	481863.821	1123.847
36	TGT	100674.974	481863.764	1123.909
	Mean Computed Coordinate	100674.946	481863.792	1123.878
	Mean Closure Error:	Horizontal = 0.040	Vertical = 0.031	
37	TGT	100745.423	524169.843	1265.631
37	TGT	100745.491	524169.744	1265.634
	Mean Computed Coordinate	100745.457	524169.794	1265.633
	Mean Closure Error:	Horizontal = 0.060	Vertical = 0.001	
151	TGT	216967.314	413960.848	1056.039
151	tgt	216967.282	413960.867	1055.955
	Mean Computed Coordinate	216967.298	413960.858	1055.997
	Mean Closure Error:	Horizontal = 0.019	Vertical = 0.042	
152	TGT	211639.932	442836.818	1161.727
152	tgt	211639.945	442836.824	1161.725
	Mean Computed Coordinate	211639.938	442836.821	1161.726
	Mean Closure Error:	Horizontal = 0.007	Vertical = 0.001	
153	tgt	195638.423	479657.005	1034.636
153	tgt	195638.402	479656.990	1034.685
	Mean Computed Coordinate	195638.412	479656.998	1034.660
	Mean Closure Error:	Horizontal = 0.013	Vertical = 0.024	
154	TGT	156273.541	397604.203	1119.856
154	tgt	156273.537	397604.225	1119.920
	Mean Computed Coordinate	156273.539	397604.214	1119.888

Rice County Photo MnMultShot 050207

Mean Closure Error: Horizontal = 0.011 Vertical = 0.032

155 tgt 150883.525 439828.319 1071.971
 155 tgt 150883.528 439828.294 1071.979
 Mean Computed Coordinate 150883.526 439828.306 1071.975
 Mean Closure Error: Horizontal = 0.013 Vertical = 0.004

156 tgt 140249.682 450317.282 1018.456
 156 tgt 140249.617 450317.270 1018.600
 Mean Computed Coordinate 140249.650 450317.276 1018.528
 Mean Closure Error: Horizontal = 0.033 Vertical = 0.072 □

MnMultShot (2.2.3) Standard Mode English Report 05/02/2007 Page 5
 Files:Rice County Photo.txt

Point Num	Point Description	X-Coord (f)	Y-Coord (f)	Elev (f)
157	TGT	149095.425	479610.866	1207.915
157	tgt	149095.471	479610.856	1207.759
	Mean Computed Coordinate	149095.448	479610.861	1207.837
	Mean Closure Error:	Horizontal = 0.024	Vertical = 0.078	
158	TGT	161384.750	508516.887	1103.506
158	tgt	161384.733	508516.917	1103.527
	Mean Computed Coordinate	161384.742	508516.902	1103.517
	Mean Closure Error:	Horizontal = 0.017	Vertical = 0.010	
159	TGT	108664.929	418397.118	1038.500
159	tgt	108665.000	418397.062	1038.382
	Mean Computed Coordinate	108664.964	418397.090	1038.441
	Mean Closure Error:	Horizontal = 0.045	Vertical = 0.059	
160		121798.122	460839.681	1108.803
160	TGT	121798.126	460839.674	1108.816
160	tgt	121798.191	460839.676	1108.777
	Mean Computed Coordinate	121798.146	460839.677	1108.799
	Mean Closure Error:	Horizontal = 0.030	Vertical = 0.014	
DdgC		38891.833	577563.415	1330.288
LChi		203426.995	458493.084	1002.703
Wsca		52702.386	403278.263	1172.329
ZITA	TGT	134496.800	458843.860	993.949
Zumb		135324.410	618381.255	1071.971
Epsom		132441.998	523012.290	1204.804
union	tgt	200260.934	458689.609	1047.908
6602 R		204085.898	450709.381	1068.384
ILLSLEY	TGT	166790.660	474947.320	1123.108
6602 RCS		204085.812	450709.393	1068.411

Rice County Photo MnMultShot 050207

DENNISON TGT 176039.536 524680.462 968.618

Epsom cs 132442.026 523012.265 1204.836

TT 65 MC US 211819.275 419301.963 1105.388

6602 R cs 204085.842 450709.407 1068.333

PRS31072185 203426.995 458493.084 1002.703

PRS53778218 38891.833 577563.415 1330.288 □

MnMultShot (2.2.3) Standard Mode English Report 05/02/2007 Page 6

Files:Rice County Photo.txt

Point Num Point Description X-Coord (f) Y-Coord (f) Elev (f)

PRS95887633 52702.386 403278.263 1172.329

Statistical Summary Of Closure Errors For All Shots:

Horizontal (96 shots): Mean = 0.027 Std. Deviation = 0.031

Vertical (96 shots): Mean = 0.028 Std. Deviation = 0.036

Rice County Photo.txt

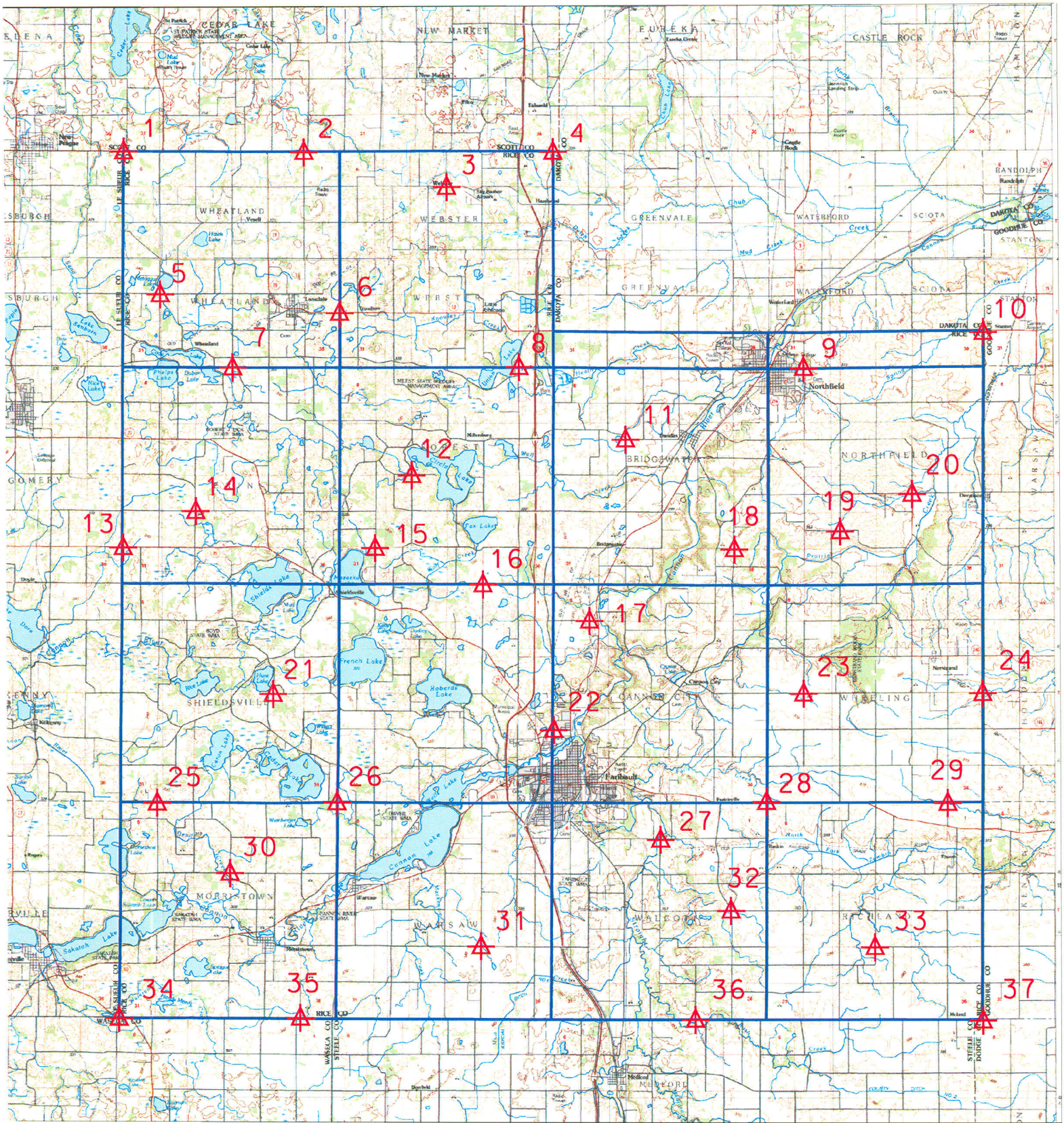
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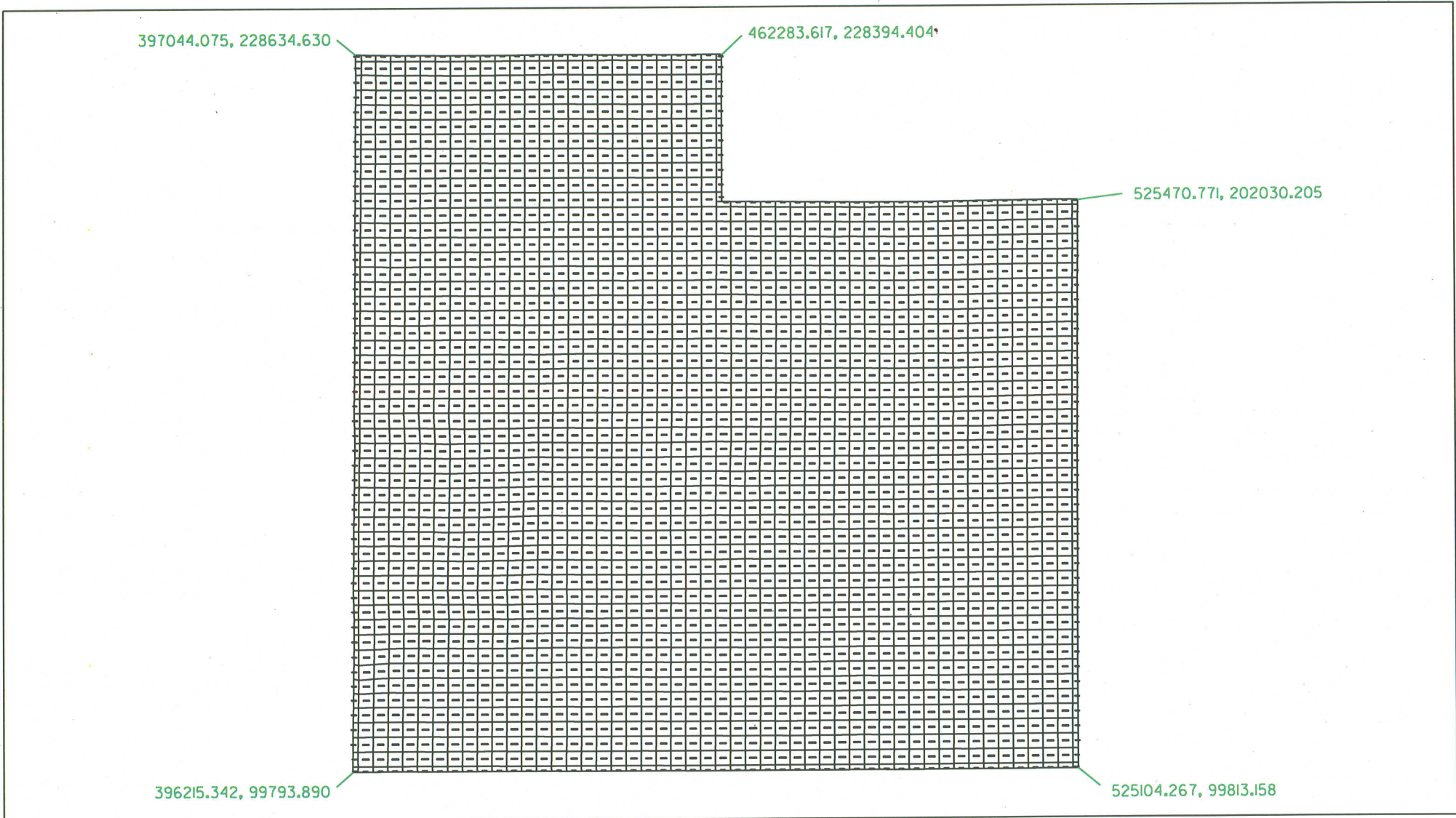
Rice County Photo.txt

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Rice County Photo.txt

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From: "Dave Luecke" <d_luecke_lclp@qwest.net>
To: "Peter Jenkins" <peter.jenkins@dot.state.mn.us>
Date: 3/9/2007 9:25:54 AM
Subject: Rice County Lidar Project

Pete

The March 21st meeting at 9:00am will work just fine. We can meet at the Rice County Highway Department building located at 610 NW 20th Street, Faribault, MN.
We would be happy to have Tim Loesch attend also.
I did receive your e-mail with the sample contracts.
Thanks for all your help!
See you on the 21st.

Dave

From: "Michelle Trager" <mtrager@co.rice.mn.us>
To: "Miles Strain" <mstrain@aerometric-mn.com>, "Dennis Luebbe" <dluebbe@co.rice.mn.us>, "Stefan Gantert" <sgantert@co.rice.mn.us>, "Dave Luecke (E-mail)" <dluecke_lclp@qwest.net>
Date: 4/2/2007 10:38:26 AM
Subject: RE: Meeting

OK. Let's schedule a meeting tomorrow at 1:00 at the Rice County Highway Department (610 20th Street NW, Faribault).
Michelle

Michelle Trager, GIS Planner
Rice County Information Technology Dept.
320 3rd Street NW, Suite 8
Faribault, MN 55021
Phone- (507) 332-5950
Fax- (507) 332-5967

-----Original Message-----

From: Miles Strain [mailto:mstrain@aerometric-mn.com]
Sent: Sunday, April 01, 2007 12:04 PM
To: Michelle Trager
Subject: Re: Meeting

Hi Michelle,

Sorry for the delay, I was out Friday. Tuesday at 1:00 is fine with me. If everybody decides to meet at our shop, I'll drop Pete Jenkins (MNDOT) a line to see if he can join in. Keep me posted Monday.

Thanks,
Miles

Miles Strain, C.P.
Project Manager
AERO-METRIC, Inc.
13400 68th Ave. North
Maple Grove, MN 55311-3515
Tel: (763)420-9606 x34
Fax: (763)420-9584
E-mail: mstrain@aerometric-mn.com

----- Original Message -----

From: Michelle <mailto:mtrager@co.rice.mn.us> Trager
To: Miles Strain (E-mail) <mailto:mstrain@markhurd.com>
Sent: Friday, March 30, 2007 2:17 PM
Subject: Meeting

Miles-

I have heard back from the surveyor and the highway department and Tuesday afternoon works for them. They haven't told yet where they would like to meet though.

Does Tuesday afternoon sometime, maybe 1:00 work for you?

From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Dave Luecke" <dluecke_lcp@qwest.net>
Date: 4/5/2007 12:14:24 PM
Subject: Rice Co. targets

Dave,

Attached is the requested target locations. As mentioned in our meeting, these are not set in stone and can be moved (preferably north/south) if hard surface is an issue. Preference is to paint as many (if not all) as possible. This will allow you to not have to worry about checking them to be sure they're not damaged, missing, etc. I did the best I could to pick them on section corners, but some may be on half section corners (which is fine with us). Picking them on hard surfaces proved more difficult than I anticipated. I mis-judged how many non-paved surfaces there are in the rural areas. Target #'s 14, 17, 18, 19, 27 & 35 may have to be moved or set as soft targets in the ditches (per your hard surface map you left with me). I believe I picked the majority of your 2005 target positions. I think there are only 3 or 4 I didn't pick.

In regards to the QC targets you have the option of setting - a few areas that would be good positions to check are between French and Roberds Lake's, in the town of Cannon City, and on the South or Southwest side of Faribault. Not necessary and just a suggestion, but those areas are more open or sparse in our requested position layout.

As always, please let me know if you have any questions or concerns.

Thanks,
Miles

Miles Strain, C.P.
Project Manager
AERO-METRIC, Inc.
13400 68th Ave. North
Maple Grove, MN 55311-3515
Tel: (763)420-9606 x34
Fax: (763)420-9584
E-mail: mstrain@aerometric-mn.com

CC: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>, "Michelle Trager" <mtrager@co.rice.mn.us>, "Stefan Gantert" <sgantert@co.rice.mn.us>

From: Peter Jenkins
To: mstrain@aerometric-mn.com
Date: 4/10/2007 2:50:51 PM
Subject: Rice County Project

Miles:

Below is the web link to the CORS/VRS station map, there is a pdf available so that you can read the station names. For Rice County I would recommend using: LITTLE CHICAGO, WASECA, LE SUEUR & ZUMBRO. Please call or e-mail Blaine McKeever at 651.366.3770 or at blaine.mckeever@dot.state.mn.us . If you want to use this service in helping to control or quality control your flights let Blaine know when you plan to be in Minnesota a week prior to and 24 hours before mission. Call or e-mail and he will make sure the files get to the FTP site.

<http://www.olmweb.dot.state.mn.us/CORS.GPS/cors.html>

Thanks
Pete

Peter W. Jenkins, LS
Administrative Land Surveyor
Photogrammetric Unit
Minnesota Department of Transportation
395 John Ireland Boulevard, MS 640
St. Paul, MN 55155-1899

Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

CC: blaine mckeever; dlobbe@co.rice.mn.us; dlobecke_lclp@quest.net;
mtrager@co.rice.mn.us

From: "Dave Luecke" <dluecke_lcp@qwest.net>
To: "John Barke" <john.barke@dot.state.mn.us>
Date: 4/17/2007 10:14:45 AM
Subject: Rice County Photo Control Project

John and Pete

Thalked with Miles Strain of Aero-Metric this morning. He would like coordinates for control points around end of first week or beginning of second week in May. We can have a crew available on short notice to help collect data. Let me know.

Thanks
Dave

CC: "Peter Jenkins" <peter.jenkins@dot.state.mn.us>

From: "Michelle Trager" <mtrager@co.rice.mn.us>
To: "Miles Strain (E-mail)" <mstrain@markhurd.com>, "Peter W. Jenkins (E-mail)" <peter.jenkins@dot.state.mn.us>
Date: 4/18/2007 9:45:31 AM
Subject: Pilot Area

Here's a PDF of the Pilot Project Area we would like to use. It is sections 17, 18, 19 and 20 of Cannon City Township (T110N R20W). Let me know if you see any problems with using this area. Miles, can you let me know when you have dates figured out for the delivery date of the pilot project area, and ortho, DEM and LiDAR delivery dates, so I can pass them on to Pete?
Thanks!
Michelle

Michelle Trager, GIS Planner
Rice County Information Technology Dept.
320 3rd Street NW, Suite 8
Faribault, MN 55021
Phone- (507) 332-5950
Fax- (507) 332-5967
<<LiDAR Pilot Project Area Map.pdf>>

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From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
Date: 4/20/2007 10:31:26 AM
Subject: Re: Rice Co. targets

Pete,
Sorry for the delay - usual fire drills at this time of year.

The attached coordinates are tgt#,x,y in NAD83, UTM Zone 15 (meters). To state the obvious, these are approximate coordinates only. Dave and I may have adjusted the position a bit on some and I can't recall if I repositioned them in the .dgn file I created this from. Dave's crews will know where the actual targets are located in the field if there's any questions on actual target placement.

On another subject, any luck with the previous camera report on that AT solution giving you problems? And/or, any resolve?

Thanks,
Miles

Miles Strain, C.P.
Project Manager
AERO-METRIC, Inc.
13400 68th Ave. North
Maple Grove, MN 55311-3515
Tel: (763)420-9606 x34
Fax: (763)420-9584
E-mail: mstrain@aerometric-mn.com

----- Original Message -----

From: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
To: <mstrain@aerometric-mn.com>
Sent: Wednesday, April 18, 2007 1:59 PM
Subject: Re: Rice Co. targets

Miles:

Do you have a coordinate or Lat./Long. on the targets as you show them on your layout? If so, my survey crew would like to use them when training Dave Luecke's crews.
Pete

Peter W. Jenkins, LS
Administrative Land Surveyor
Photogrammetric Unit
Minnesota Department of Transportation
395 John Ireland Boulevard, MS 640
St. Paul, MN 55155-1899

Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

>>> "Miles Strain" <mstrain@aerometric-mn.com> 4/5/2007 11:57 AM >>>

Dave,

Attached is the requested target locations. As mentioned in our meeting, these are not set in stone and can be moved (preferably north/south) if hard surface is an issue. Preference is to paint as many (if not all) as possible. This will allow you to not have to worry about checking them to be sure they're not damaged, missing, etc. I did the best I could to pick them on section corners, but some may be on half section corners (which is fine with us). Picking them on hard surfaces proved more difficult than I anticipated. I mis-judged how many non-paved surfaces there are in the rural areas. Target #'s 14, 17, 18, 19, 27 & 35 may have to be moved or set as soft targets in the ditches (per your hard surface map you left with me). I believe I picked the majority of your 2005 target positions. I think there are only 3 or 4 I didn't pick.

In regards to the QC targets you have the option of setting - a few areas that would be good positions to check are between French and Roberds Lake's, in the town of Cannon City, and on the South or Southwest side of Faribault. Not necessary and just a suggestion, but those areas are more open or sparse in our requested position layout.

As always, please let me know if you have any questions or concerns.

Thanks,
Miles

Miles Strain, C.P.
Project Manager
AERO-METRIC, Inc.
13400 68th Ave. North
Maple Grove, MN 55311-3515
Tel: (763)420-9606 x34
Fax: (763)420-9584
E-mail: mstrain@aerometric-mn.com

From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Michelle Trager" <mtrager@co.rice.mn.us>
Date: 4/20/2007 1:49:11 PM
Subject: Flight status

Hi Michelle,

A quick update on your project:

We had the entire flight dept over last Wed. (4/18). Had both digital systems on the project Wed. AM and completed all the imagery. We only had one Optech (Lidar) unit in place and flew 2/3 of the county that afternoon and evening. We had cloud issues Thurs and Fri and weren't able to complete the lidar. Had to send the entire flight dept out to south-central Pennsylvania today and not sure when they'll be back to complete the lidar at this time. Will know more by mid week and let you know the plan at that time.

Thanks,
Miles

Miles Strain, C.P.
Project Manager
AERO-METRIC, Inc.
13400 68th Ave. North
Maple Grove, MN 55311-3515
Tel: (763)420-9606 x34
Fax: (763)420-9584
E-mail: mstrain@aerometric-mn.com

CC: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>

From: Peter Jenkins
To: Mstrain@aerometric-mn.com
Date: 5/3/2007 8:21:59 AM
Subject: Fwd: Rice County Targets

Miles:

Bud Jorgansen from CO's Survey Support helped Dave Luecke and his crew with some RTK/GPS equipment issues. They occupied each target twice using Mn/DOT's VRS System at different times so we are confident of these results. I looked over the Multi-shot report and the comparisons look good. There is an issue with the target numbering system, at Target 37 the numbering switches to 151 and continues to 160. I tried to talk to Bud this morning about this issue but he was out of the office. My suggestion would be to plot the points and then you may want to renumber the 100 series numbers. Also there are a number of Control Point checks that appear in the TXT file, you will need to remove them.

Any questions, please call.
Pete

Peter W. Jenkins, LS
Administrative Land Surveyor
Photogrammetric Unit
Minnesota Department of Transportation
395 John Ireland Boulevard, MS 640
St. Paul, MN 55155-1899

Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

>>> Bud Jorgenson 5/2/2007 11:59 AM >>>
Pete/John,

Attached is the text file of the targets we shot in Rice County. I also attached the Mult Shot Report.

Everything seemed to work out real nice.

The survey Crew was saying something about not giving the targets numbered 151-160 to somebody??? They were going to be used as a check for something. Pete I hope you know what they are talking about.

If you have any questions please call.

Bud

Bud Jorgenson
Survey Support Specialist
Minnesota Department of Transportation
Mail stop 643, 8th floor
395 John Ireland Boulevard
St.Paul, Mn. 55155-1899
Office Phone: 651 366 3459
Cell Phone 651-373-8693
Fax 651 366 3450
E-Mail : Bud.Jorgenson@dot.state.mn.us

CC: Bud Jorgenson; dluecke_lclp@qwest.net; mtrager@co.rice.mn.us

From: Peter Jenkins
To: mstrain@aerometric-mn.com
Date: 5/3/2007 8:51:04 AM
Subject: Rice County Targets

Miles:

This is a follow up on my first e-mail with the target information. The point numbers 151-160 were points that the county were using for some other purpose and wanted to collect because the timing was right.

Please strip them out of the file as well.

Pete

Peter W. Jenkins, LS
Administrative Land Surveyor
Photogrammetric Unit
Minnesota Department of Transportation
395 John Ireland Boulevard, MS 640
St. Paul, MN 55155-1899

Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

CC: dluecke_lclp@qwest.net; mtrager@co.rice.mn.uc

From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Stefan Gantert" <sgantert@co.rice.mn.us>, "Michelle Trager" <mtrager@co.rice.mn.us>, "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>, "Dave Luecke" <dluecke_lcp@qwest.net>, "Sherry Hiller" <shiller@co.rice.mn.us>
Date: 7/26/2007 9:48:11 AM
Subject: Rice Co. QC point results

All,

Attached are the results of our QC point comparison to the actual field coordinates. As you'll see, we're well within specs. The vertical is about what you'd expect from this scale of photography when you're utilizing airborne gps along with field control spread out over an entire county. Regarding the horizontal positioning - it's probably the best I've ever seen and I'm amazed at the accuracy achieved considering all the components involved. Factor in two planes (meaning two separate digital cameras) flying at 5000' above the ground, the timing of the cameras to the gps, satellite lock strength, the antennae offset measurements, flight banking limitations, etc., etc., and I'm as surprised as I am happy with our results.

I'm going to move ahead and have the actual QC point field values inserted into our overall A/T solution and finalize it. We lost a bit of time with our workstation drive crash and I need to keep this moving along. Please review and the attached document and if anybody has any questions or concerns, please contact me asap.

Thanks all,
Miles

Miles Strain, C.P.
Project Manager
AERO-METRIC, Inc.
13400 68th Ave. North
Maple Grove, MN 55311-3515
Tel: (763)420-9606 x34
Fax: (763)420-9584
E-mail: mstrain@aerometric-mn.com

From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Michelle Trager" <mtrager@co.rice.mn.us>, "Sherry Hiller" <shiller@co.rice.mn.us>, "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
Date: 7/23/2007 9:41:31 AM
Subject: Re: Rice County Pilot

Michelle and Sherry,

I talked with Pete a week or so back and want to bring everybody back into the fold. We had a work station drive crash on us a couple weeks back and ended up with a little set-back on the aerotriangulation run. We're back up and running now, but unfortunately (or should I state embarrassingly), we didn't back up the initial work we had into the a/t run and had to start over. We should have the QC points read by the end of this week and have them submitted for everybody's evaluation. Initial results show the horizontal positional accuracy to be very good and we're cleaning up some photogrammetry to firm up our vertical readings at this time.

The workstation crash has set up back slightly on our pilot submittal. We should be able to make up some time on the plotters following the a/t finalization. Will get the pilot area out n.l.t. end of August. Will do the best we can to get the pilot area out a.s.a.p., but n.l.t. end of August. We'll need a quick result turn-around on the a/t results. We need to insert the actual QC points as fixed field control prior to finalizing, but again, initial results are looking very good at this point so I don't foresee any major issues.

As always, please do not hesitate to call with any questions or concerns.

Thanks again,
Miles

Miles Strain, C.P.
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----- Original Message -----

From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
Cc: "Sherry Hiller" <shiller@co.rice.mn.us>; "Michelle Trager" <mtrager@co.rice.mn.us>
Sent: Friday, June 22, 2007 9:30 AM
Subject: Re: Rice County Pilot

> Pete,
> Let's shoot for around the end of July for the pilot submittal. The close
> range schedule on our end is as follows:
> 1) Aero-Triangulation clean-up is nearing completion. We'll submit the QC
> checks for the 10 tgts to the County and DOT for evaluation the first week

- > of July.
- > 2) 3', 6' and 9' gridded lidar data set samples and associated contours will
- > be submitted first week of July for County finalization of desired grid
- > spacing. Will need the County's decision by first of the following week
- > (+-7/11/07).
- > 3) Import the final QC coords and finalize the Aero-Triangulation.
- > 4) Hydro and breakline enhancement of the pilot area completed by 7/27/07.
- > 5) Contour and ortho processing completed for pilot area submittal by
- > 8/3/07.

>
> I may be a bit aggressive with this schedule, but will do the best we can
> with it. Let me know if you have any questions or concerns.

>
> Thanks,
> Miles

>
> Miles Strain, C.P.
> Project Manager
> AERO-METRIC, Inc.
> 13400 68th Ave. North
> Maple Grove, MN 55311-3515
> Tel: (763)420-9606 x34
> Fax: (763)420-9584
> E-mail: mstrain@aerometric-mn.com

>
>
> ----- Original Message -----
> From: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
> To: <mstrain@aerometric-mn.com>
> Sent: Friday, June 22, 2007 8:58 AM
> Subject: Rice County Pilot

>
>
> Miles:
> I will be meeting with our District Surveyors next week and I would like
> to
> give them an update on when the Pilot area for Rice County. Do you have
> tentative completion dates for the ortho & Lidar pilot area's? I think
> that

> this would help with their scheduling of field crews.
> Thanks
> Pete

>
> Peter W. Jenkins, LS
> Administrative Land Surveyor
> Photogrammetric Unit
> Minnesota Department of Transportation
> 395 John Ireland Boulevard, MS 640
> St. Paul, MN 55155-1899
>
> Phone: 651.366.3457
> peter.jenkins@dot.state.mn.us

>
>

From: Peter Jenkins
To: mstrain@markhurd.com
Date: 7/31/2007 12:58:24 PM
Subject: Rice County Pilot Test Shots

Miles:

I have received the test shots for the Rice County pilot area. Rochester Surveys jumped on this as soon as I reminded them, so as far as Mn/DOT is concerned we are ready to go. As soon as your schedule allows, please submit the ortho and LiDAR files, if you need me to provide a portable hard drive let me know ASAP, if you are going to provide it, I will let everyone know the results and return the data and drive to you at my earliest convenience. I assume that you will be delivering TIF with world files and the DEM will be in a MicroStation format. If other, please let me know.

Thanks

Pete

Peter W. Jenkins, LS
Administrative Land Surveyor
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395 John Ireland Boulevard, MS 640
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Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

CC: Kallin, Keith; mtrager@co.rice.mn.uc

From: Peter Jenkins
To: mtrager@co.rice.mn.uc
Date: 9/11/2007 4:06:53 PM
Subject: Rice County Ortho & LiDAR Project

Michelle:

Here is some feed back regarding the pilot for the above referenced project. The ortho has been tested and the LiDAR will be tested tomorrow or the next day and I will forward you the results from that effort when they are available. As for the ortho, here is what we have -

8 points were collected and 6 points turned out to be acceptable for use due to the fact that in both cases something had covered up the spot at the time of photography.

The RMSE is 1.54' and the national standard for 1"=100' mapping is 2.20'. Now this has to be tempered with the fact that for a true statistical comparison you should have a minimum of 20 test points. What you can gain from a pilot program is that as far as accuracy is concerned is that we are on course for delivery of a good product from the contractor. Of the 6 points, none would give you an indication that there is a concern with the accuracy of the ortho.

More to come when the LiDAR data arrives in my office.

Pete

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Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

CC: mstrain@aerometric-mn.com

From: "Michelle Trager" <mtrager@co.rice.mn.us>
To: <peter.jenkins@dot.state.mn.us>
Date: 1/25/2008 1:55:14 PM
Subject: LiDAR Project

Pete-

Aero-Metric has completed our Orthophotography and 2 foot contours. They are working on finishing up the 1st return data. When that's complete they will that it with the DTM and the bare earth data to us. What data do you need to do the quality assurance checks? What would be the best way to get it to you?

Michelle

Michelle Trager, GIS Coordinator
Rice County Information Technology Dept.
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From: Peter Jenkins
To: mtrager@co.rice.mn.us
Date: 3/10/2008 10:29:58 AM
Subject: Rice County Data

Michelle:

There are a number of points that have issues but they are not accuracy issues. Many of these are coding issues with the urban areas. There is one horizontal point that is an outlier. There is also 1 forested and 1 urban shot that are outliers on the vertical side. We would like to do some additional checking. Saying this, I suspect that the overall values will not change much, but because the sample size is smaller under the specific cover categories, there could be a little more change with respect to the specific cover categories.

Here is the guide for you to work from.

0.5' contour interval RMSE = 0.15' NSSDA = 0.30'
1' contour interval RMSE = 0.30' NSSDA = 0.60'
2' contour interval RMSE = 0.61' NSSDA = 1.19'

There is no published data for 1' = 50' but you could extrapolate

1" = 100' mapping RMSE = 2.20' NSSDA = 3.80'
1" = 200' mapping RMSE = 4.39' NSSDA = 7.60'

NOT FINAL DATA

RICE COUNTY DATA - Vertical

L1O (open area) RMSE = 0.24' NSSDA = 0.48'
L2T (tall grass) RMSE = 0.32' NSSDA = 0.62'
L3B (brush land) RMSE = 0.37' NSSDA = 0.73'
L4F (forest area) RMSE = 0.49' NSSDA = 0.96'
L5U (urban area) RMSE = NSSDA =

Overall RMSE = 0.47' NSSDA = 0.92'

RICE COUNTY DATA - Horizontal

Urban areas only RMSE = 1.10' NSSDA = 1.91'

I hope to have my PM shift supervisor have this completed tonight. I suspect that he needed to contact Rochester Surveys on Friday and will not get his answer back until today, I hope.

Pete

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Phone: 651.366.3457
peter.jenkins@dot.state.mn.us

CC: mstrain@aerometric-mn.com

From: "Miles Strain" <mstrain@aerometric-mn.com>
To: "Peter Jenkins" <Peter.Jenkins@dot.state.mn.us>
Date: 4/2/2008 9:45:59 AM
Subject: RE: Rice County Information

Pete,

Answers to your questions are as follows. I had to go to a couple sources (hangar and geodetics) in Sheboygan for a lot of you questions. We're still waiting to hear back from the hangar for the plane type(s) for the LiDAR acquisition and the serial numbers for the two DMC cameras.

1. Dates of photography missions (all dates)
 - A. April 18, 2007 (one date - flown with 2 planes)

2. Dates of LiDAR missions
 - A. April 18, 19&27, 2007

3. Plane type
 - A. For DMC#1: Aero Commander 690
For DMC#2: Aero Commander 500-S
For LiDAR: ? waiting for flight's response - possibly two planes due to different dates

4. Camera type and serial number
 - A. We used two DMC cameras, waiting for flights' response for the serial numbers

5. Camera calibration date and copy of report
 - A. Calibration Dates:
DMC#1: Nov 09, 2003 (see attached "DMC#1_Rpt_ALL.pdf")
DMC#2: Sep 28, 2006 (see attached "DMC#1_Rpt_ALL.pdf")
No calibration for LiDAR unit.

6. AT software
 - A. Z/I ISAT

7. LiDAR processing software
 - A. Optech product: REALM Survey Suite 3.5.4
TerraSolid products: TerraScan, TerraMatch, TerraModeler

8. Photography AGL
 - A. 5000'

9. LiDAR AGL
 - A. 1500m

10. GPS Receiver type (model number)
 - A. For DMC#1: Leica SR9500
For DMC#2: POS AV-510
For LiDAR: Trimble BD950

11. IMU type (model number) * NOTE - IMU was not utilized for the DMC image capture
 - A. None for DMC#1
DMC#2: Litton LN200

LiDAR: AIMU

12. GEOID Model (GEOID 03 ?)

A. GEOID03

13. Photo Contract Specification (1"=200' ?, 6" Pixel resolution?)

A. 1"=100' / 2' contours from hydro enforced (photogrammetrically) 3' gridded LiDAR data set per FEMA guidelines and specifications / 0.5' res. b/w digital orthophotos

14. LiDAR (horizontal & vertical accuracy contract specification, post spacing ?)

A. Horiz - 0.5m (1.64') RMSE / Vert - 15cm (5.91") RMSE

I'll get the serial numbers for the two DMC's and the plane(s) used for the LiDAR acquisition to you as soon as the hangar reports back to me. Let me know if you need anything else, clarification, questions, etc.

Thanks,
Miles

-----Original Message-----

From: Peter Jenkins [mailto:Peter.Jenkins@dot.state.mn.us]

Sent: Monday, March 24, 2008 11:37 AM

To: Mstrain@aerometric-mn.com

Subject: Rice County Information

Miles:

I am in the process of preparing the Accuracy Report for Rice County and I have some questions. Could you answer the following:

1. Dates of photography missions (all dates)
2. Dates of LiDAR missions
3. Plane type
4. Camera type and serial number
5. Camera calibration date and copy of report
6. AT software
7. LiDAR processing software
8. Photography AGL
9. LiDAR AGL
10. GPS Receiver type (model number)
11. IMU type (model number)
12. GEOID Model (GEOID 03 ?)
13. Photo Contract Specification (1"=200' ?, 6" Pixel resolution?)
14. LiDAR (horizontal & vertical accuracy contract specification, post spacing ?)

Thanks, I will send you a pdf copy when I am done. See you tomorrow morning.

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