

MAP ACCURACY REPORT
Southern Minnesota Ortho Project
Multi-Agency Project

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| Data Contact Person: | Chris Cialek | Department: | MnGEO |
| Type of Mapping: | Ortho-photo & Stereo Imagery | Contractor: | Surdex Corporation |
| Independent Testing: | MnDOT Photo Unit | Contract Delivery date: | 30 December 2011 |

The purpose of this report is to independently test, for horizontal accuracy the digital ortho quarter quads (DOQQ's) produced by Surdex in half meter resolution. Also delivered were one foot resolution DOQQ's and compressed county mosaics (CCM) as part of the contract deliverable items and these products was not tested. The DOQQ's are the deliverables which were contracted for by the Minnesota Geospatial Information Office or MnGEO, Department of Administration as part of their association with the Minnesota Department of Natural Resources. The project area consisted of the following counties: Big Stone, Blue Earth, Brown, Chippewa, Cottonwood, Dodge, Faribault, Fillmore, Freeborn, Goodhue, Houston, Jackson, Kandiyohi, Lac Qui Parle, Le Sueur, Lincoln, Lyon, Martin, McCleod, Mower, Murray, Nicollet, Nobles, Olmsted, Pipestone, Redwood, Renville, Rice, Steele, Swift, Wabasha, Waseca, Watonwan, Winona and Yellow Medicine. Goodhue and Rice Counties were collected during the 2011 season but was actually part of the East Central Minnesota Ortho Project. This project consisted of flights flown between the April 12 and May 16, 2011. The flights were controlled using GPS/IMU equipment onboard the aircraft and supplemented with ground targets. Surdex used three Cessna Conquests with the following tail numbers; N440EH, N441EH and N449LC and one Cessna 404-N442EH. The altitude was different for each of the two products, 10,000 feet AGL for the 1 foot pixel resolution and 16,500 feet AGL for the ½ meter product. The aerial cameras used in these missions were Intergraph DMC (01) digital mapping cameras with serial numbers 0144, 0146, 0148 and 0149. Surdex used Intergraph Image Station (ISAT) version, 6.2.0.6 for the aerial triangulation (AT). A combination of Intergraph PPS version 6.1.1 software was used for the raw data processing and Surdex's own in-house software for all other radiometric/ortho-rectification processes.

The Horizontal Datum used was the North American Datum of 1983 (NAD 83). All products were delivered in either UTM Zone 15 coordinates (meters). The Geoid model used was the GEOID 09.

ORTHOPHOTO

EAST BOUNDING COORDINATE: 91° 11' 08.690" W. Long.
WEST BOUNDING COORDINATE: 96° 52' 46.774" W. Long.
NORTH BOUNDING COORDINATE: 45° 37' 37.432" N. Lat.
SOUTH BOUNDING COORDINATE: 43° 26' 12.922" N. Lat.

Geodetic monumentation used to control this project was published by Mn/DOT and can be found in their geodetic database online at <http://www.dot.state.mn.us/surveying/Geodetics/geodetics.html>. The test data was collected as part of a partnership effort from the 2008 FSA Aerial Imagery Project, where 74 Counties and 9 Mn/DOT District offices participated. The targets covering the project area were repainted but not resurveyed. A general map showing the distribution of these targets is included in this report. Because of a previous agreement with the Aerial Photography Field Office in Salt Lake City; the data sheets showing the statistical analysis was only delivered to MnGEO. The test data itself was collected by various GPS methods including Static, VRS, RTK and Opus Static Solutions.

The horizontal accuracy test done on the ortho-photos were a direct comparison of field surveyed coordinates for the center of the targets that were set previous to flight operations with 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 6 inch pixel resolution product was not tested as a part of this project.

The contract called for a 0.30 meter (1 foot) ground sample distance (GSD) with a horizontal accuracy of +/- 1.5 meters and the 0.50 meter GSD with an accuracy requirement of +/- 2.4 meters. The technicians identified all targets where the sum of the x and y differences squared is at or above 1.0 meters and these points are double checked. This value was chosen because the horizontal error in any one direction would be just less than 2 pixels. I

felt that this would be the allowable tolerance in the human visual acuity. All test points that had a $dx^2 + dy^2$ value of greater than 3.5 were checked against the 2008 FSA targets to see if a pattern emerged for the purpose of identifying possible survey errors. Big Stone County Targets No. 601 and 602, Cottonwood County Target No. 601 and Rock County Target No. 601 were identified as having large errors in this data set only. I do not have a specific recommendation for these targets.

Additionally, Surdex reported that the DEM used in the ortho-rectification process was a combination of 10 meter USGS/NED data and some photogrammetrically derived data supplied by the client.

The NSSDA for the horizontal (r) component or the combined X and Y coordinate for this project are:

| <u>Photo Targets</u> | <u>RMSE_r</u> | <u>NSSDA (Horizontal)</u> |
|----------------------|-------------------------|---------------------------|
| 35 County Combined | 0.819m | 1.418m with 171 targets |

The test data was obtained by various groups ranging from County Engineers, County Surveyors, County GIS Personnel and MnDOT's Metro District Surveyors and their personnel. Two hundred (200) targets were used from an original set of targets for the Farm Service Agency imagery collect of 2008. For the 35 county project area only one hundred seventy-one (171) targets were used. Three (3) targets were obscured due to reasons stated above. Twenty-six (26) targets were destroyed or paved over.

Accuracy testing was not done of the one foot pixel resolution products that the individual counties contracted for because this was not something that MnGEO was going to host and distribute publically.

The National Elevation Dataset (NED) contains high resolution data in many portions of the state but not in the Southern Minnesota rural area. The State did perform a LiDAR survey for the region and although it was available, Surdex used the 10 meter DEM which contains little lidar data. Overall, high resolution elevation data should help horizontal accuracy with respect to this type of ortho-photo product. The issue at this time is that the state will be performing a LiDAR collect for the northern part of the state some time past 2011 but that data will be added to the NED based on the schedule determined by USGS.

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

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