MAP ACCURACY REPORT
NAIP/FSA Program
Statewide Imagery

Data Contact Person:	Chris Cialek	**Department:**	LMIC
Type of Mapping:	Ortho-photo	**Contractor:**	Surdex Corporation
Independent Testing:	Mn/DOT Photo Unit	**Contract Delivery date:**	2 April 2008

The purpose of this report is to independently test, for horizontal accuracy the compressed county mosaic (CCM) and digital ortho quarter quads (DOQQ's) that was contracted for by the Land Management Information Center, Department of Administration. The DOQQ testing results will be provided as a supplement to this report due to the timing of the delivery of the final product. This project consisted of flights flown between May and September 2008. The flights were controlled using GPS/IMU equipment onboard the aircraft and flown at an altitude of 31,000 feet MSL. The specific equipment used for the aerial imagery collection was a Cessna 402B twin engine plane, an Intergraph DMC digital mapping camera.

The Horizontal Datum used was the North American Datum of 1983 (NAD 83). All products were delivered in either UTM Zones 14 or 15 coordinates (meters); the following counties were delivered in Zone 14 coordinates: Big Stone, Clay, Grant, Kittson, Lac Qui Parle, Lincoln, Marshall, Norman, Pipestone, Pennington, Polk, Red Lake, Rock, Stevens, Traverse and Wilkin. The Geoid model used was the GEOID 03.

ORTHOPHOTO

EAST BOUNDING COORDINATE: 89° 28' 07.500" W. Long.
WEST BOUNDING COORDINATE: 97° 14' 59.090" W. Long.
NORTH BOUNDING COORDINATE: 49° 24' 22.492" N. Lat.
SOUTH BOUNDING COORDINATE: 43° 28' 07.496" N. Lat.

Geodetic monumentation used to control this project was published by Mn/DOT and can be found in their geodetic database online at www.olmweb.dot.state.mn.us. The data was collected as part of a partnership effort, where 74 Counties and 8 Mn/DOT District offices participated. The data sheets which were created by the partners and submitted to the Aerial Photography Field Office, Salt Lake City, UT are not part of this report and deemed proprietary. The test data itself was collected by various GPS methods including Static, VRS, RTK and Opus Static Solutions. Surdex Corporation reported using airborne GPS-IMU technologies with 42 ground control points.

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 contract called for a 1 meter ground sample distance (GSD) with a horizontal accuracy of +/- 6 meters, the technicians identified all targets where the sum of the x and y differences squared is at or above 3.0 meters and these points are double checked. This value was chosen because the horizontal error in any one direction would be approximately 1½ 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 3.0 were plotted against a state map showing the boundaries of the various acquisition dates. The purpose of this was to see if there was a correlation between the larger horizontal errors and the boundaries of the mosaic. A copy of this map is attached.

Additionally, Surdex reported that the ortho-rectification process only included the center of the image frame so there is some error that pushed out to the edge. Surdex also reported 80% of the horizontal error can be accounted for in the digital elevation model. They will be producing a DEM analysis and it is due out shortly, we will then be comparing the high errors against the results of that report.

In review of the horizontal data sheet the user will see that there are a number of test points that were not used. There are two reasons for this; one is the targets placed on the ground were not as distinctive as they should have been and second, the quality of the imagery is some areas is poor. The reasons for the lack of distinctiveness of any target can be attributed to a number of reasons.

- In some cases the bituminous surface was weathered, thus a lack of contrast.
- If a bituminous road intersected with a gravel or dirt road, mud and gravel would eventually discolor the target by simple road traffic.
- The targets were set long before the flight so the paint was beginning to wear in some circumstances.
- The targets were placed next to gravel piles (in Truck Stations and Shops) where general contrast became an issue.
- The target was not cardinal, thus a poor edge matching with the pixels.
- The target could have been larger by another 20% or more.

The state was divided up into three zones to give the user a better indication of the accuracy with respect to the various regions of the state. Initially the zones were created to mirror the state plane coordinate zone boundaries but some adjustments were made in order to make a more even distribution of the available targets. See the accompanying map for target distribution and zone boundaries (*).

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

Photo Targets	**$RMSE_r$**	**NSSDA (Horizontal)**
Statewide (CCM)	1.53m	2.66m with 409 points
North Zone (CCM)*	1.63m	2.82m with 103 points
Central Zone (CCM)*	1.55m	2.68m with 143 points
South Zone (CCM)*	1.46m	2.53m with 163 points

The test data was obtained by various groups ranging from County Engineers, County Surveyors, County GIS Personnel and each of Mn/DOT's 9 District Surveyors and their personnel. Five hundred twenty-three (523) targets were originally set as part of this project; four hundred nine (409) targets were eventually used. One hundred thirteen (113) targets were obscured due to reasons stated above. One (1) target was judged to be not acceptable because its placement was in a location where vertical displacement between the ground and the target caused a drastic difference in the horizontal distance.

The initial distribution of the compressed county mosaics (CCM) was delivered in 20:1 compression ratio. This compression error was discovered about half way through the delivery process. Horizontal testing was keeping pace with delivery until the error was noticed and then was halted until the entire state was delivered in the proper 15:1 compression ratio. When making comparisons between the values achieved using the 20:1 CCM's and the 15:1 CCM's, we were detecting only slight differences. In the effort to save time and reduce needless re-work it was decided to visually display by way of a map which CCM's were tested for each of the compression ratio's.

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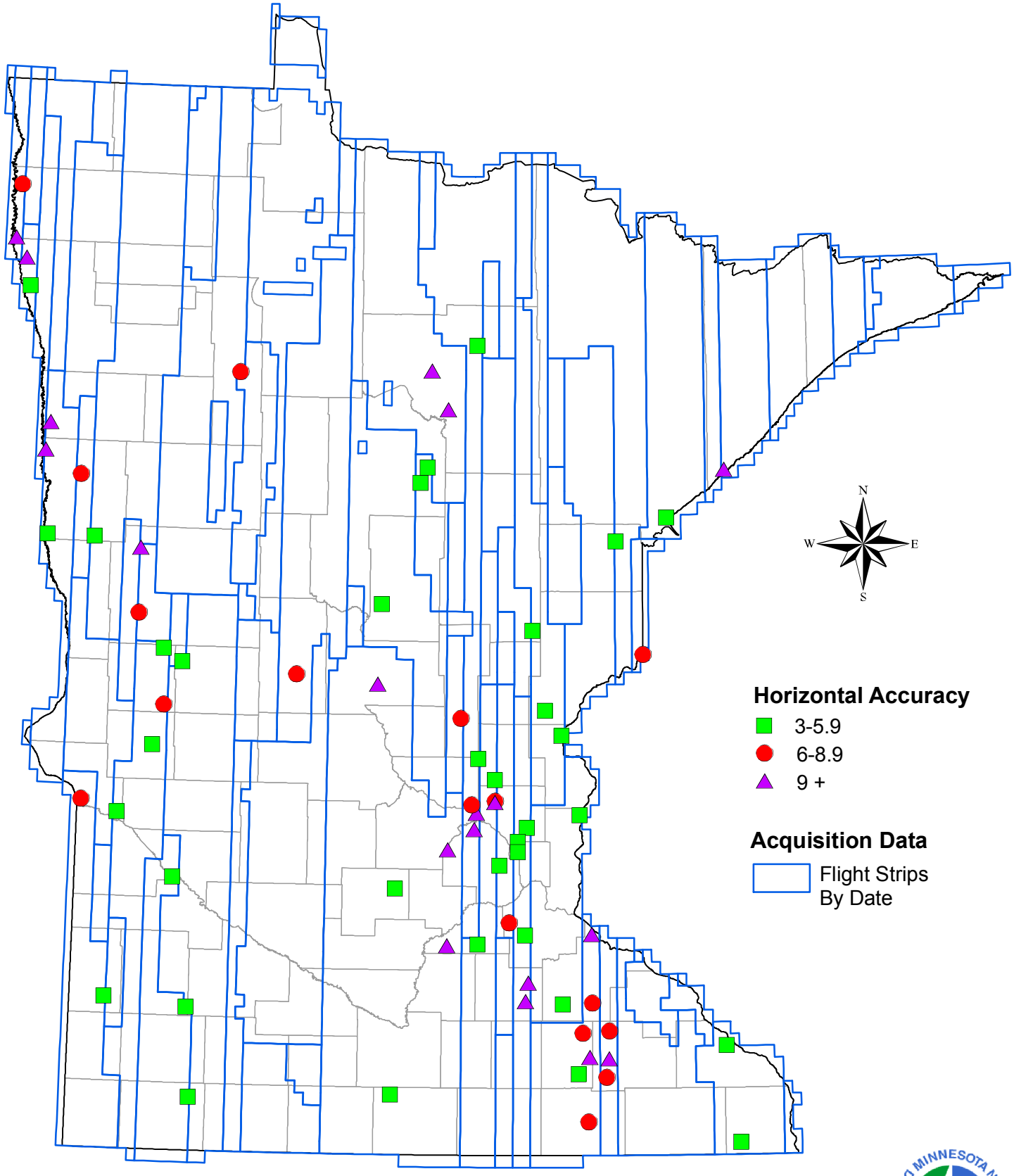
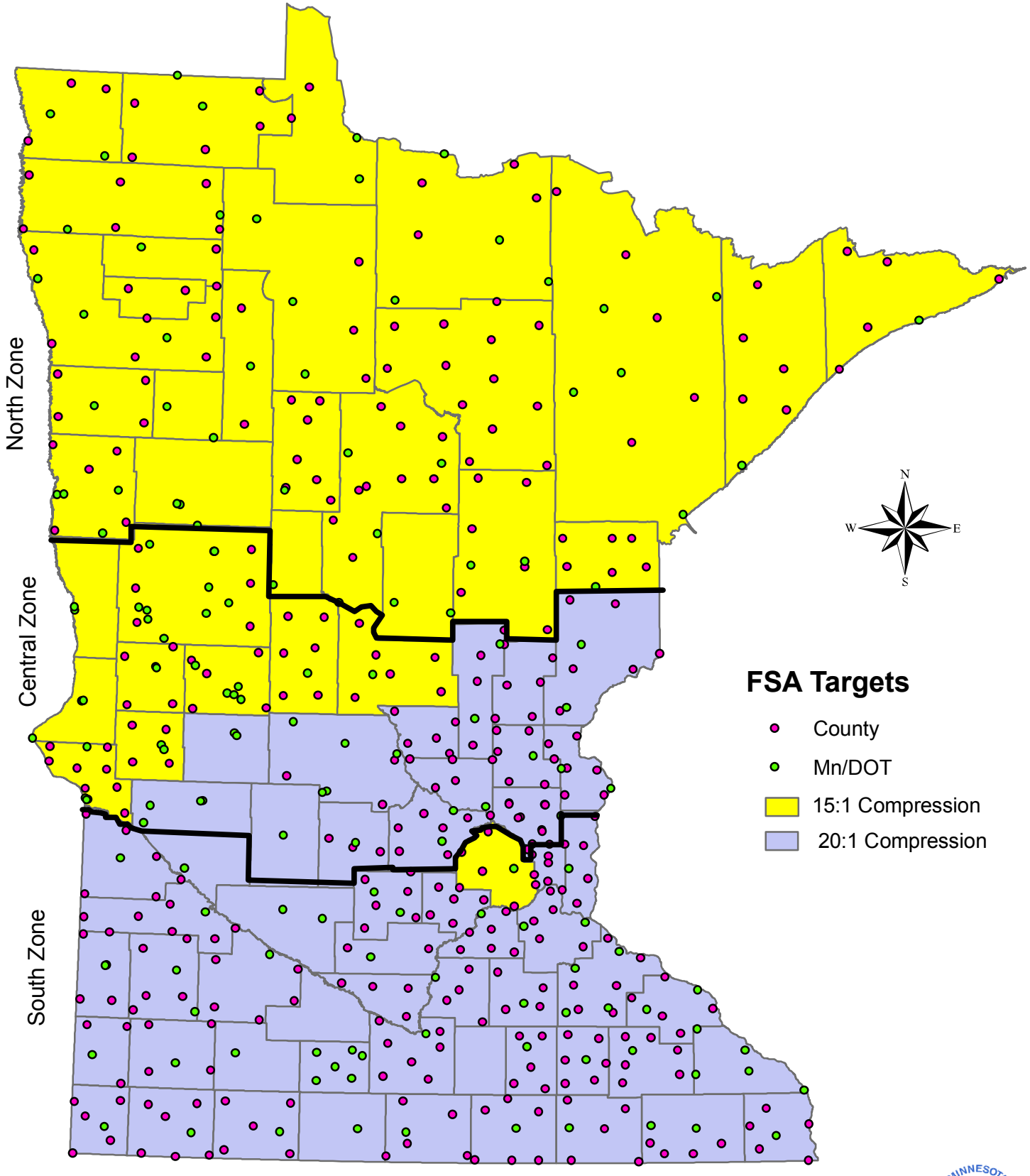
2008 FSA Horizontal Error Vs Acquisition Date



Only those targets where $dx^2 + dy^2 >= 3.0$ are shown.

2008 FSA Target Distribution And Zone Map



Final: Date 12-03-2008

MINNESOTA DEPARTMENT OF TRANSPORTATION