Cedar County Iowa

Countywide G.P.S. Survey Control Network

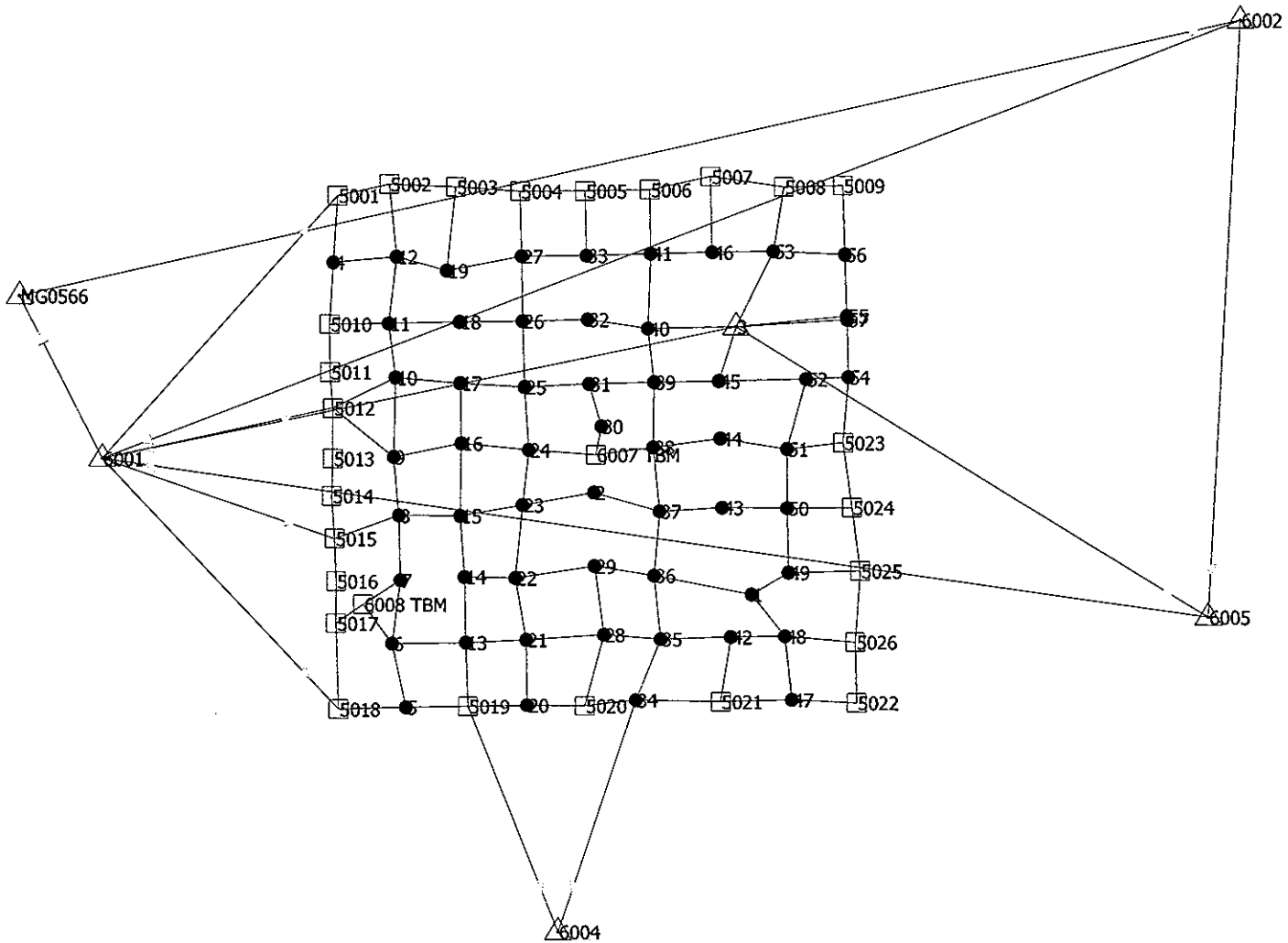
2008

Dan Corbin, Inc
28 River Ridge Lane
Cedar Falls, IA 50613

DC Inc.

Cell: (319) 231-7047
Fax: (319) 266-3398
E-Mail: dcorbin@cfu.net

Table of Contents



Field surveyor:
GGB & DBC
Computer operator:
GGB
Reference:

Scale 1" to 41667 ft
0 75000 sft
US survey feet

0°00'00"

Plot Scale: 1" to 41667 ft
Printed on 5/18/2008, at 6:21:40 PM

Printed from Trimble Geomatics Office

Site: Not selected, System: US State Plane 1983
Zone: Iowa South 1402, Datum: NAD 1983 (Conus)

Project: Cedar County
USFeet Template

INTRODUCTION

In 2008, the Cedar County Secondary Road Department contracted with the team of DC Inc. and GB Consulting to complete a high accuracy GPS control survey in Cedar County, Iowa for the purpose of establishing a county-wide survey control system and for future use in a county-wide GIS system.

Fifty three (53) new control stations were added within Cedar County along with, three (3) existing Cedar County GPS control points one of which is also a NSRS2007 control station, one (1) existing Clinton County GPS control point, Nine (9) existing Johnson County GPS control points, Nine (9) existing Jones County GPS control points, four (4) existing Muscatine County GPS control points and four (4) existing Scott County GPS control points were recovered and tied into the GPS network. Five (5) additional existing NSRS 2007 position with first and second order vertical control was utilized in the survey. Additionally two (2) existing second order vertical control stations were included in the survey. All of the existing County control points have good third order control and were used in the adjustment. A total of ninety (90) points were measured and included in the network.

PROJECT REQUIREMENTS

The purpose of this survey was to establish new state plane control based upon the National Spatial Reference System 2007 (NSRS 2007) coordinate system throughout the project area, utilizing the new horizontal and vertical control network with GPS survey equipment and techniques. Vertically the network was referenced to the North American Vertical Datum of 1988 (NAVD88) All new point locations for control were selected with the needs of future multiple uses and GPS survey requirements in mind. In some instances, it was necessary to adjust locations because of physical obstructions or existing land features. In these instances, the network was constructed with the coverage of the county held as primary and the GPS survey needs satisfied secondly. Because both of these philosophies support good geometry the network structure was not compromised.

MONUMENTATION

To perpetuate the GPS control measurements, 53 new permanent monuments were set in Cedar County for this survey by DC Inc. BERNTSEN driven aluminum rod monuments were selected for the permanent monuments. Each BERNTSEN station monument consists of one three-foot smooth rod section and one three-foot top security fluted rod section with a stamped cap fastened to the top, all constructed of aluminum material. There is a permanent magnet mounted on the underside of the monument cap for future recovery with a magnetic locator. These monuments were driven to approximately 6" below the existing ground surface. For easy access and protection, a 24" long 6" diameter PVC pipe was placed over each rod monument along with a pre-cast aluminum access cover and backfilled with sand to facilitate drainage and to minimize frost movement. A steel fence post with an orange sleeve were placed as witness markers at each new permanent monument position.

The County Engineer's office handled the One Call coordination for marking the various underground utility locations for each new permanent monument site.

RECONNAISSANCE

The most important criterion for GPS observations at any given location is a clear view to the sky. In terms of network design, it is desirable that the horizontal control be located near the perimeter and also throughout the project site if possible. The existing NSRS 2007 horizontal stations were recovered in and/or near Cedar County. All positions in and near the county were chosen to be included in the network.

Vertical control was selected to provide as much coverage as possible, both at the periphery and in the interior of the project area.

FIELD SURVEY

Five Trimble dual frequency Geodetic GPS receivers with Everest multi-path mitigation and high performance low elevation satellite tracking were used in this survey. GPS observations were made during daylight hours from Monday May 12, 2008, through Wednesday May 14, 2008.

Rapid static GPS techniques were utilized to minimize the time and cost of the survey. The satellite "window", where at least six satellites were observable, was open for much of the day with only a short period of unacceptable coverage because of the number of satellites or bad geometry. Each measurement period during which all receivers observe satellites simultaneously lasted from a minimum of 15 minutes to a maximum of 120 minutes, depending on the distance being measured and the geometry of the satellite constellation.

DATA ADJUSTMENT

A total of 325 vectors were observed and processed. Based on statistical indicators from the Trimble Geomatics Office processing software, there were no vectors flagged as outliers. After the removal of trivial vectors the final network is comprised of 90 stations and 157 baselines. All data adjustment was performed using the Trimble Geomatics Office least squares adjustment software. An initial free adjustment was performed in NAD 1983 (NSRS 2007) to check the overall quality of the GPS data and the nature of the control. The initial unconstrained (free) adjustment yielded baseline precisions which ranged from 1:45,000 for a 800' baseline to 1:9,678,315 with the 3 mile baselines falling in the 1:600,000 to 1:1,000,000 range. Once the horizontal and vertical control was verified, subsequent adjustments were performed to arrive at the optimal solutions for each datum.

NAD83 (NSRS2007)

The initial free adjustment was performed holding NSRS2007 point 57-27 (MG0566) fixed horizontally with the vertical adjustment disabled. Coordinate values on the other NSRS2007 control stations were then checked against the published values. The network fit the published NSRS2007 values within a few hundredths of a foot. Because all of the horizontal data fit so well, the NSRS2007-referenced stations were added to the network and a new adjustment performed. After each adjustment a comparison of adjusted coordinates vs. published values was made. By

holding all of the remaining existing NSRS2007 stations fixed the precision of the adjustment degraded very little as compared to the unconstrained adjustment.

Once we were satisfied with the horizontal adjustment, we locked the horizontal positions and concentrated on the vertical adjustment. The Geoid 03 Conus was utilized to provide a model of the height of the Geoid. Adjustments were then performed locking on to the orthometric vertical control stations one at a time beginning with 57-27 (MG0566). Vertical control was added station by station with the elevations on the benchmarks being then checked against the published values. All vertical control fit extremely well. New horizontal data is being published for all adjoining County control points.

A final adjustment of both horizontal and vertical was then performed. All of the horizontal control points were held fixed in x and y and all vertical control were held fixed in z. This fully constrained adjustment solved for scale and rotation. In the final adjusted network, 100% of the adjusted vectors have an estimated error of x, y and z baseline precision between 1:28,746 for the 800' baseline and 1:260,307 to 1:2,836,622, with the 3 mile baselines again falling in the 1:400,000 range or better. All of the processed data and error factors were computed using a 95% confidence level factor.

On line user positioning (OPUS) service was utilized to calculate solutions at 4 sites within the network. The final adjusted NSRS 2007 positions fit within a few hundreths of a foot in northing and easting and within less than 0.20' in elevation to these solutions. This result indicates a strong network adjustment and an excellent fit to CORS stations

CONCLUSION

The results are well in excess of Order C class 1 (first-order precision) on short baselines (less than 3 miles) and between Order C class 1 and Order B on longer baselines (3 to 4 miles in length). The control point locations are within $\pm$ 0.04 ft horizontal position and within $\pm$ 0.08 ft. vertically for benchmark use.

Network Adjustment Report

Project : CedarCoFinal

User name	Gary Brown	**Date & Time**	5:53:47 PM 5/18/2008
Coordinate System	US State Plane 1983(NSRS2007)	**Zone**	Iowa South 1402
Project Datum	NAD 1983 (Conus)		
Vertical Datum	NAVD88	**Geoid Model**	GEOID03 (Conus)
Coordinate Units	US survey feet		
Distance Units	US survey feet		
Height Units	US survey feet		

Adjustment Style Settings - 95% Confidence Limits

Residual Tolerances

To End Iterations : 0.000033sft
Final Convergence Cutoff : 0.016404sft

Covariance Display

Horizontal
Propagated Linear Error [E] : U.S.
Constant Term [C] : 0.00000000sft
Scale on Linear Error [S] : 1.96

Three-Dimensional
Propagated Linear Error [E] : U.S.
Constant Term [C] : 0.00000000sft
Scale on Linear Error [S] : 1.96

Elevation Errors were used in the calculations.

Adjustment Controls

Compute Correlations for Geoid : True

Horizontal and Vertical adjustment performed

Set-up Errors

GPS
Error in Height of Antenna : 0.015sft
Centering Error : 0.015sft

Statistical Summary

Successful Adjustment in 1 iteration(s)

Network Reference Factor : 0.99
Chi Square Test (α=95%) : PASS
Degrees of Freedom : 243.00

GPS Observation Statistics

Reference Factor : 0.98
Redundancy Number (r) : 214.85

Geoid Model Statistics

Reference Factor : 1.00
Redundancy Number (r) : 28.15

Weighting Strategies

GPS Observations
User-defined Scalar Applied to All Observations

Scalar : 0.25

Geoid Observations
User-defined Scalar Applied to All Observations

Scalar : 0.41

Adjusted Coordinates

Adjustment performed in NAD 1983 (NSRS2007) (Conus)

Number of Points : 90
Number of Constrained Points : 34
Elevation Only : 28
Horizontal and Elevation Only : 6

Adjusted Grid Coordinates

Errors are reported using 1.96σ.

Point Name	Northing	N error	Easting	E error	Elevation	e error	Fix
3	684581.490sft	0.000sft	2321835.390sft	0.000sft	828.320sft	0.000sft	N E e
6001	651433.820sft	0.000sft	2165589.230sft	0.000sft	781.630sft	0.000sft	N E e
6002	761048.760sft	0.000sft	2445795.940sft	0.000sft	885.110sft	0.000sft	N E e
6005	612990.780sft	0.000sft	2438115.610sft	0.000sft	780.100sft	0.000sft	N E e
MG0566	691549.720sft	0.000sft	2145057.690sft	0.000sft	810.720sft	0.000sft	N E e
53	703320.497sft	0.030sft	2330945.910sft	0.030sft	795.902sft	0.083sft	
5008	719347.729sft	0.038sft	2333493.209sft	0.038sft	833.940sft	0.000sft	e
5005	718112.037sft	0.040sft	2284557.324sft	0.040sft	829.700sft	0.000sft	e
33	702078.441sft	0.038sft	2284953.260sft	0.038sft	839.663sft	0.091sft	
5011	672981.634sft	0.040sft	2221751.375sft	0.040sft	732.930sft	0.000sft	e
5012	664122.164sft	0.028sft	2222507.848sft	0.028sft	710.870sft	0.000sft	e
5009	719688.622sft	0.043sft	2347998.349sft	0.043sft	720.450sft	0.000sft	e
5006	718492.992sft	0.038sft	2300488.187sft	0.038sft	863.690sft	0.000sft	e
5003	718994.866sft	0.040sft	2252736.603sft	0.040sft	852.840sft	0.000sft	e
5002	719635.119sft	0.038sft	2236341.142sft	0.038sft	884.990sft	0.000sft	e
5001	716721.827sft	0.032sft	2223558.868sft	0.032sft	897.250sft	0.000sft	e
5010	684865.711sft	0.038sft	2221638.281sft	0.038sft	736.350sft	0.000sft	e
5014	642419.094sft	0.041sft	2222246.116sft	0.041sft	830.870sft	0.000sft	e
5013	651628.697sft	0.041sft	2222471.859sft	0.041sft	825.170sft	0.000sft	e
5018	589420.712sft	0.031sft	2223931.595sft	0.031sft	736.960sft	0.000sft	e

5017	610693.982sft	0.036sft	2223282.429sft	0.036sft	778.410sft	0.000sft	e
46	703025.026sft	0.036sft	2315872.650sft	0.036sft	845.695sft	0.084sft	
27	701853.749sft	0.035sft	2268957.774sft	0.035sft	856.707sft	0.091sft	
12	701612.938sft	0.035sft	2238137.722sft	0.035sft	856.547sft	0.087sft	
5016	621214.793sft	0.039sft	2223323.531sft	0.039sft	758.340sft	0.000sft	e
40	684107.732sft	0.023sft	2300076.170sft	0.023sft	855.430sft	0.096sft	
19	698184.689sft	0.039sft	2250529.030sft	0.039sft	911.343sft	0.096sft	
56	702598.859sft	0.035sft	2348569.832sft	0.035sft	713.685sft	0.093sft	
41	702628.300sft	0.033sft	2300762.151sft	0.033sft	797.778sft	0.087sft	
57	686501.415sft	0.029sft	2349152.242sft	0.029sft	727.508sft	0.103sft	
5007	721803.734sft	0.039sft	2315448.190sft	0.039sft	822.120sft	0.000sft	e
5004	717944.601sft	0.040sft	2268574.952sft	0.040sft	801.880sft	0.000sft	e
4	700149.388sft	0.037sft	2222539.015sft	0.037sft	846.195sft	0.079sft	
5015	631804.215sft	0.029sft	2222939.772sft	0.029sft	816.570sft	0.000sft	e
55	687380.502sft	0.029sft	2349069.115sft	0.029sft	727.956sft	0.103sft	
2	643501.408sft	0.040sft	2286894.707sft	0.040sft	808.956sft	0.085sft	
37	638884.960sft	0.035sft	2303069.789sft	0.035sft	750.332sft	0.102sft	
17	670377.316sft	0.035sft	2253917.074sft	0.035sft	834.768sft	0.109sft	
10	671701.727sft	0.031sft	2237959.774sft	0.031sft	749.654sft	0.090sft	
26	685797.682sft	0.033sft	2269230.091sft	0.033sft	879.652sft	0.108sft	
25	669510.718sft	0.031sft	2269767.688sft	0.031sft	868.459sft	0.105sft	
44	656950.281sft	0.041sft	2317970.310sft	0.041sft	812.339sft	0.102sft	
51	654413.981sft	0.036sft	2334397.118sft	0.036sft	814.723sft	0.085sft	
54	672251.388sft	0.035sft	2349464.116sft	0.035sft	790.368sft	0.093sft	
45	671166.191sft	0.029sft	2317584.697sft	0.029sft	831.101sft	0.087sft	
39	670820.219sft	0.029sft	2301670.789sft	0.029sft	827.579sft	0.095sft	
5	589919.051sft	0.032sft	2240559.581sft	0.032sft	670.739sft	0.078sft	
24	653966.059sft	0.031sft	2270844.045sft	0.031sft	773.525sft	0.095sft	
38	654703.303sft	0.033sft	2301469.225sft	0.033sft	754.949sft	0.089sft	
18	685544.821sft	0.041sft	2253702.012sft	0.041sft	885.207sft	0.109sft	
11	685105.958sft	0.034sft	2236238.436sft	0.034sft	822.349sft	0.088sft	
7	621540.538sft	0.036sft	2239168.893sft	0.036sft	782.757sft	0.080sft	

6	605705.640sft	0.032sft	2237138.668sft	0.032sft	769.403sft	0.075sft	
43	639862.620sft	0.043sft	2318467.429sft	0.043sft	754.029sft	0.107sft	
32	686264.223sft	0.037sft	2285257.865sft	0.037sft	833.140sft	0.107sft	
23	640323.548sft	0.031sft	2269324.679sft	0.031sft	817.269sft	0.103sft	
31	670354.435sft	0.036sft	2285669.808sft	0.036sft	833.165sft	0.097sft	
52	671735.228sft	0.035sft	2339098.501sft	0.035sft	768.381sft	0.089sft	
8	637604.863sft	0.030sft	2238824.630sft	0.030sft	737.299sft	0.089sft	
15	637557.046sft	0.031sft	2253948.457sft	0.031sft	815.767sft	0.105sft	
30	659834.079sft	0.043sft	2288691.413sft	0.043sft	829.353sft	0.074sft	
16	655516.775sft	0.032sft	2254210.823sft	0.032sft	768.582sft	0.106sft	
9	652066.296sft	0.031sft	2237555.538sft	0.031sft	824.977sft	0.089sft	
5023	656037.828sft	0.037sft	2348166.386sft	0.037sft	757.560sft	0.000sft	e
6008 TBM	615455.373sft	0.035sft	2230002.614sft	0.035sft	709.490sft	0.000sft	e
6007 TBM	652807.919sft	0.037sft	2287359.120sft	0.037sft	812.590sft	0.000sft	e
5024	639983.032sft	0.040sft	2350413.086sft	0.039sft	797.780sft	0.000sft	e
50	639791.180sft	0.038sft	2334460.094sft	0.038sft	784.684sft	0.089sft	
13	606026.624sft	0.031sft	2255335.450sft	0.031sft	760.116sft	0.088sft	
21	606779.400sft	0.033sft	2270211.438sft	0.033sft	770.152sft	0.095sft	
20	590536.453sft	0.035sft	2270443.659sft	0.035sft	714.987sft	0.076sft	
35	607096.134sft	0.034sft	2303315.847sft	0.034sft	737.794sft	0.096sft	
36	622905.384sft	0.034sft	2301686.699sft	0.034sft	797.941sft	0.107sft	
48	607919.294sft	0.041sft	2333879.709sft	0.041sft	748.565sft	0.087sft	
47	592176.974sft	0.044sft	2335630.896sft	0.044sft	687.539sft	0.080sft	
34	591938.655sft	0.030sft	2297231.352sft	0.030sft	685.272sft	0.079sft	
6004	534513.340sft	0.000sft	2278067.870sft	0.000sft	741.890sft	0.000sft	N E e
5022	591444.111sft	0.050sft	2351592.114sft	0.050sft	684.640sft	0.000sft	e
5025	624252.506sft	0.043sft	2352408.260sft	0.043sft	776.120sft	0.000sft	e
22	622170.852sft	0.032sft	2267526.302sft	0.032sft	792.831sft	0.106sft	
5019	590240.936sft	0.028sft	2255861.481sft	0.028sft	675.250sft	0.000sft	e
42	607689.068sft	0.040sft	2320616.753sft	0.040sft	731.740sft	0.092sft	
1	618252.654sft	0.040sft	2325706.158sft	0.040sft	765.404sft	0.100sft	
49	623777.226sft	0.041sft	2334777.605sft	0.041sft	776.400sft	0.092sft	

28	608128.455sft	0.034sft	2289343.014sft	0.034sft	718.035sft	0.096sft	
29	625186.875sft	0.035sft	2287062.939sft	0.035sft	758.548sft	0.106sft	
5020	590473.003sft	0.035sft	2284651.924sft	0.035sft	736.520sft	0.000sft	e
5026	606504.973sft	0.045sft	2351205.647sft	0.045sft	726.410sft	0.000sft	e
5021	591620.273sft	0.040sft	2318092.910sft	0.040sft	694.700sft	0.000sft	e
14	622352.464sft	0.035sft	2254986.191sft	0.035sft	803.173sft	0.103sft	

Adjusted Geodetic Coordinates

Errors are reported using 1.96σ.

Point Name	Latitude	N error	Longitude	E error	Height	h error	Fix
3	41°51'07.34274"N	0.000sft	90°59'54.93859"W	0.000sft	721.708sft	0.353sft	Lat Long e
6001	41°46'19.24963"N	0.000sft	91°34'28.67647"W	0.000sft	675.050sft	0.408sft	Lat Long e
6002	42°03'03.88815"N	0.000sft	90°32'03.50654"W	0.000sft	777.813sft	0.427sft	Lat Long e
6005	41°38'44.62278"N	0.000sft	90°34'51.08750"W	0.000sft	672.583sft	0.406sft	Lat Long e
MG0566	41°52'59.87119"N	0.000sft	91°38'48.29311"W	0.000sft	704.692sft	0.427sft	Lat Long e
53	41°54'09.78037"N	0.030sft	90°57'47.38903"W	0.030sft	689.260sft	0.359sft	
5008	41°56'47.30644"N	0.038sft	90°57'07.51166"W	0.038sft	727.275sft	0.365sft	e
5005	41°56'48.76292"N	0.040sft	91°07'55.26428"W	0.040sft	723.065sft	0.366sft	e
33	41°54'10.32320"N	0.038sft	91°07'55.80180"W	0.038sft	733.050sft	0.360sft	
5011	41°49'39.12464"N	0.040sft	91°22'00.74788"W	0.040sft	626.169sft	0.376sft	e
5012	41°48'11.44349"N	0.028sft	91°21'53.63120"W	0.028sft	604.049sft	0.374sft	e
5009	41°56'46.43192"N	0.043sft	90°53'55.52246"W	0.043sft	613.761sft	0.368sft	e
5006	41°56'48.18807"N	0.038sft	91°04'24.39828"W	0.038sft	757.133sft	0.364sft	e
5003	41°57'05.82651"N	0.040sft	91°14'55.89331"W	0.040sft	746.218sft	0.374sft	e
5002	41°57'16.28449"N	0.038sft	91°18'32.58222"W	0.038sft	778.394sft	0.380sft	e
5001	41°56'50.65998"N	0.032sft	91°21'22.64413"W	0.032sft	790.681sft	0.385sft	e
5010	41°51'36.52025"N	0.038sft	91°21'58.39098"W	0.038sft	629.633sft	0.377sft	e
5014	41°44'37.16004"N	0.041sft	91°22'04.10947"W	0.041sft	724.011sft	0.375sft	e
5013	41°46'08.06307"N	0.041sft	91°21'58.15251"W	0.041sft	718.324sft	0.375sft	e
5018	41°35'53.30389"N	0.031sft	91°21'59.02939"W	0.031sft	629.743sft	0.389sft	e
5017	41°39'23.57324"N	0.036sft	91°22'00.70524"W	0.036sft	671.370sft	0.381sft	e
46	41°54'11.15749"N	0.036sft	91°01'06.74289"W	0.036sft	739.117sft	0.358sft	
27	41°54'12.35193"N	0.035sft	91°11'27.32533"W	0.035sft	750.080sft	0.363sft	
12	41°54'17.85725"N	0.035sft	91°18'14.83400"W	0.035sft	749.900sft	0.373sft	

5016	41°41'07.47393"N	0.039sft	91°21'56.76359"W	0.039sft	651.397sft	0.378sft	e
40	41°51'08.74652"N	0.023sft	91°04'42.51354"W	0.023sft	748.805sft	0.353sft	
19	41°53'40.87937"N	0.039sft	91°15'32.19232"W	0.039sft	804.698sft	0.368sft	
56	41°53'57.51289"N	0.035sft	90°53'54.72602"W	0.035sft	606.947sft	0.362sft	
41	41°54'11.45017"N	0.033sft	91°04'26.62860"W	0.033sft	691.193sft	0.358sft	
57	41°51'18.38632"N	0.029sft	90°53'53.39428"W	0.029sft	620.722sft	0.358sft	
5007	41°57'16.71155"N	0.039sft	91°01'05.26912"W	0.039sft	715.609sft	0.365sft	e
5004	41°56'51.35383"N	0.040sft	91°11'26.73759"W	0.040sft	695.256sft	0.369sft	e
4	41°54'07.24248"N	0.037sft	91°21'41.52641"W	0.037sft	739.557sft	0.380sft	
5015	41°42'52.15425"N	0.029sft	91°21'58.39655"W	0.029sft	709.669sft	0.376sft	e
55	41°51'27.09151"N	0.029sft	90°53'54.14484"W	0.029sft	621.174sft	0.358sft	
2	41°44'31.32509"N	0.040sft	91°07'51.23305"W	0.040sft	702.123sft	0.355sft	
37	41°43'41.32868"N	0.035sft	91°04'19.64962"W	0.035sft	643.440sft	0.354sft	
17	41°49'05.39739"N	0.035sft	91°14'56.92365"W	0.035sft	728.022sft	0.362sft	
10	41°49'22.50317"N	0.031sft	91°18'27.15545"W	0.031sft	642.873sft	0.367sft	
26	41°51'33.71978"N	0.033sft	91°11'29.35986"W	0.033sft	773.000sft	0.359sft	
25	41°48'52.73520"N	0.031sft	91°11'27.97054"W	0.031sft	761.750sft	0.357sft	
44	41°46'35.57567"N	0.041sft	91°00'56.41465"W	0.041sft	705.550sft	0.353sft	
51	41°46'05.83892"N	0.036sft	90°57'20.68494"W	0.036sft	707.859sft	0.354sft	
54	41°48'57.57983"N	0.035sft	90°53'54.90570"W	0.035sft	683.514sft	0.357sft	
45	41°48'56.06946"N	0.029sft	91°00'56.14379"W	0.029sft	724.411sft	0.352sft	
39	41°48'57.08995"N	0.029sft	91°04'26.34759"W	0.029sft	720.893sft	0.352sft	
5	41°35'54.13920"N	0.032sft	91°18'20.07667"W	0.032sft	563.548sft	0.382sft	
24	41°46'18.93753"N	0.031sft	91°11'19.21553"W	0.031sft	666.742sft	0.356sft	
38	41°46'17.98443"N	0.033sft	91°04'34.93806"W	0.033sft	648.169sft	0.352sft	
18	41°51'35.24316"N	0.041sft	91°14'54.57860"W	0.041sft	778.528sft	0.364sft	
11	41°51'35.31063"N	0.034sft	91°18'45.43123"W	0.034sft	715.640sft	0.370sft	
7	41°41'06.79831"N	0.036sft	91°18'27.88655"W	0.036sft	675.803sft	0.372sft	
6	41°38'30.90865"N	0.032sft	91°18'59.87352"W	0.032sft	662.337sft	0.377sft	
43	41°43'46.68876"N	0.043sft	91°00'56.29674"W	0.043sft	647.113sft	0.355sft	
32	41°51'34.07175"N	0.037sft	91°07'57.46615"W	0.037sft	726.504sft	0.356sft	
23	41°44'04.60363"N	0.031sft	91°11'44.02897"W	0.031sft	710.411sft	0.358sft	
31	41°48'56.84509"N	0.036sft	91°07'57.74565"W	0.036sft	726.474sft	0.354sft	
52	41°48'55.52261"N	0.035sft	90°56'11.93568"W	0.035sft	661.587sft	0.355sft	
8	41°43'45.54165"N	0.030sft	91°18'27.08632"W	0.030sft	630.409sft	0.368sft	
15	41°43'41.25611"N	0.031sft	91°15'07.70926"W	0.031sft	708.878sft	0.363sft	

30	41°47'12.13685"N	0.043sft	91°07'21.65393"W	0.043sft	722.619sft	0.354sft	
16	41°46'38.56080"N	0.032sft	91°14'58.12273"W	0.032sft	661.766sft	0.361sft	
9	41°46'08.68228"N	0.031sft	91°18'39.01881"W	0.031sft	718.122sft	0.367sft	
5023	41°46'17.85652"N	0.037sft	90°54'18.42253"W	0.037sft	650.605sft	0.357sft	e
6008 TBM	41°40'08.96235"N	0.035sft	91°20'30.64635"W	0.035sft	602.503sft	0.377sft	e
6007 TBM	41°46'03.10845"N	0.037sft	91°07'41.76233"W	0.037sft	705.823sft	0.354sft	e
5024	41°43'38.65276"N	0.040sft	90°53'55.12154"W	0.039sft	690.816sft	0.360sft	e
50	41°43'41.41804"N	0.038sft	90°57'25.49478"W	0.038sft	677.737sft	0.356sft	
13	41°38'29.49789"N	0.031sft	91°15'00.17831"W	0.031sft	653.066sft	0.371sft	
21	41°38'33.08535"N	0.033sft	91°11'44.05705"W	0.033sft	663.099sft	0.367sft	
20	41°35'52.60375"N	0.035sft	91°11'46.66486"W	0.035sft	607.816sft	0.374sft	
35	41°38'27.32203"N	0.034sft	91°04'28.09479"W	0.034sft	630.652sft	0.363sft	
36	41°41'03.90003"N	0.034sft	91°04'43.74832"W	0.034sft	690.930sft	0.358sft	
48	41°38'26.83807"N	0.041sft	90°57'45.40562"W	0.041sft	641.348sft	0.366sft	
47	41°35'50.86817"N	0.044sft	90°57'28.40993"W	0.044sft	580.196sft	0.374sft	
34	41°35'59.29460"N	0.030sft	91°05'53.71214"W	0.030sft	578.032sft	0.370sft	
6004	41°26'37.28225"N	0.000sft	91°10'26.06786"W	0.000sft	634.115sft	0.409sft	Lat Long e
5022	41°35'38.96993"N	0.050sft	90°53'58.71336"W	0.050sft	577.297sft	0.378sft	e
5025	41°41'02.72204"N	0.043sft	90°53'35.03749"W	0.043sft	668.996sft	0.364sft	e
22	41°41'05.79612"N	0.032sft	91°12'14.05984"W	0.032sft	685.874sft	0.363sft	
5019	41°35'53.45612"N	0.028sft	91°14'58.63073"W	0.028sft	568.081sft	0.377sft	e
42	41°38'28.34979"N	0.040sft	91°00'40.10148"W	0.040sft	624.552sft	0.364sft	
1	41°40'11.22753"N	0.040sft	90°59'29.08666"W	0.040sft	658.298sft	0.361sft	
49	41°41'03.18351"N	0.041sft	90°57'27.48118"W	0.041sft	669.324sft	0.361sft	
28	41°38'41.32574"N	0.034sft	91°07'31.68558"W	0.034sft	610.941sft	0.364sft	
29	41°41'30.40846"N	0.035sft	91°07'55.59051"W	0.035sft	651.583sft	0.359sft	
5020	41°35'48.21786"N	0.035sft	91°08'39.74796"W	0.035sft	629.329sft	0.372sft	e
5026	41°38'07.81619"N	0.045sft	90°53'57.87205"W	0.045sft	619.137sft	0.370sft	e
5021	41°35'50.36971"N	0.040sft	91°01'19.35689"W	0.040sft	587.357sft	0.371sft	e
14	41°41'10.82710"N	0.035sft	91°14'59.21482"W	0.035sft	696.223sft	0.366sft	

Adjusted Observations

Adjustment performed in NAD 1983 (NSRS2007) (Conus)

GPS Observations

GPS Transformation Group: <GPS Default>

Deflection in Longitude : 0°00'00.0080" **(1.96σ)** : 0°00'00.2991"
Deflection in Latitude : -0°00'00.0369" **(1.96σ)** : 0°00'00.3366"
Azimuth Rotation : -0°00'00.0004" **(1.96σ)** : 0°00'00.0140"
Network Scale : 1.00000002 **(1.96σ)** : 0.00000007
Number of Observations : 157
Number of Outliers : 1

Observation Adjustment (Critical Tau = 3.86). Any outliers are in red.

Obs. ID	From Pt.	To Pt.		Observation	A-posteriori Error (1.96σ)	Residual	Stand. Residual
B78	5008	5007	Az.	279°25'45.1747"	0°00'00.3780"	-0°00'00.2312"	-1.61
			☐Ht.	-11.665sft	0.037sft	-0.157sft	-7.68
			Dist.	18210.771sft	0.033sft	-0.019sft	-1.52
B130	44	38	Az.	263°52'56.2742"	0°00'00.4244"	-0°00'00.0051"	-0.04
			☐Ht.	-57.380sft	0.035sft	-0.041sft	-3.46
			Dist.	16653.397sft	0.034sft	-0.015sft	-1.32
B117	44	51	Az.	100°24'48.1294"	0°00'00.4253"	0°00'00.0506"	0.35
			☐Ht.	2.309sft	0.035sft	0.041sft	3.46
			Dist.	16621.490sft	0.034sft	-0.015sft	-1.26
B54	6001	5001	Az.	42°52'09.9171"	0°00'00.0758"	0°00'00.0152"	0.49
			☐Ht.	115.618sft	0.032sft	0.039sft	2.97
			Dist.	87308.514sft	0.032sft	-0.001sft	-0.11
B21	53	5008	Az.	10°42'06.3882"	0°00'00.3896"	0°00'00.0845"	0.48
			☐Ht.	38.012sft	0.031sft	-0.040sft	-2.90
			Dist.	16227.941sft	0.031sft	0.000sft	-0.03
B2	3	6001	Az.	259°40'20.2947"	0°00'00.0140"	0°00'00.0710"	2.73
			☐Ht.	-46.647sft	0.027sft	0.027sft	1.67
			Dist.	159722.755sft	0.011sft	-0.006sft	-0.29