A detailed map of Walworth County, Wisconsin, serves as the background. It shows a network of roads, including US Highways 12, 20, 43, 50, 67, and 120, as well as local roads like La Grange, East Troy, and Spring Prairie. Numerous lakes are depicted, including Pleasant Lake, Green Lake, Middle Lake, Mill Lake, Silver Lake, Lake Wandaewaga, Lake Geneva, and Lake Como. The map also shows the locations of several municipalities: Troy, East Troy, Spring Prairie, Lyons, Geneva, and Elkhorn. A prominent orange vertical bar is overlaid on the map, passing through the center. The title text is superimposed on this bar and the map.

STATE PLANE COORDINATES OF U.S. PUBLIC LAND SURVEY CORNERS IN WALWORTH COUNTY REFERRED TO NAD 83 (2011) DATUM

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TECHNICAL REPORT NUMBER 55

**CONVERSION OF HORIZONTAL SURVEY
CONTROL NETWORK IN WALWORTH COUNTY
FROM LEGACY DATUM TO NEW FEDERAL DATUM**

Prepared by the

Southeastern Wisconsin Regional Planning Commission
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STATEMENT OF THE EXECUTIVE DIRECTOR

The Regional Planning Commission has, since 1964, recommended to the governmental agencies operating within the Region the creation and use of a unique system of survey control as a basis for the compilation of large scale topographic and cadastral maps; as a basis for the conduct of land and engineering surveys; and, as a basis for the development of automated, parcel based, land information and public works management systems within the Region. With the assistance of the constituent counties and municipalities, the recommended survey control system has been extended over the entire seven-county Region. All of the 11,753 U.S. Public Land Survey System corners within the Region have been monumented and the coordinate positions and elevations of the corners determined to a high level of survey accuracy. The survey control network has been widely used in the Region for over 50 years.

All of the horizontal survey control work within the Region has been referenced to the North American Datum of 1927. The Federal Government in 1983 created a new horizontal datum known as the North American Datum of 1983. To facilitate the use of the new datum within the Region by such agencies as may determine to do so, the Commission developed procedures for the conversion of the horizontal survey control network within the Region from the legacy datum to the new Federal datum. These procedures, and the issues concerned with datum conversion were addressed in a number of Commission publications, the latest being SEWRPC Memorandum Report No. 206, entitled, Estimate of the Costs of Converting the Foundational Elements of the Land Information and Public Works Management Systems in Southeastern Wisconsin from Legacy to New Datums, October 2012 and its August 2015 Addendum, respectively.

In 2016, the county land information council managers within the Region collegially determined to proceed with datum conversion, and to request Commission assistance in carrying out the conversion using the Commission-developed procedures to provide survey grade coordinates for all of the U.S. Public Land Survey System corners within the Region. On April 20, 2017, the Commission first entered into an agreement with Walworth County for nine of the sixteen Townships with the remaining Townships entered on April 1, 2018 governing the conversion of the horizontal conversion of the survey control network within the County from the legacy datum to the new Federal datum. Walworth County thus became the fifth county within the seven county Southeastern Wisconsin Region for which the Commission has completed a datum conversion—the other four counties being Kenosha, Milwaukee, Ozaukee and Racine.

This report describes the datum conversion completed under these agreements. Importantly, the results demonstrated that the procedure developed by the Commission provided the desired level of accuracy in the converted coordinate positions of the U.S. Public Land Survey System corners, a level of accuracy meeting the National Geodetic Survey, Third Order, Class I standards.

It is also important to note that the completed datum conversion provides two of the four foundational elements of the county and municipal land information and public works management systems within the Region, a datum and an attendant map projection. The other two foundational elements—large scale topographic maps and real property boundary—cadastral—maps will also require conversion, as will the attribute data contained in the land information and public works management systems within the Region.

Respectfully submitted,

Michael G. Hahn

Michael G. Hahn
Executive Director

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SEWRPC Technical Report No. 55
STATE PLANE COORDINATES OF U.S. PUBLIC LAND
SURVEY CORNERS IN WALWORTH COUNTY
REFERRED TO NAD 83 (2011) DATUM

INTRODUCTION AND BACKGROUND

Since early 1964, the Regional Planning Commission has recommended to the governmental agencies operating within the Southeastern Wisconsin Region the use of a unique system of survey control as a basis for the compilation of large-scale topographic and cadastral maps; as a basis for the conduct of land and engineering surveys; and, since 1985, as a basis for the development of an automated, parcel-based, land information and public works management system within the Region. The recommended survey control system requires the remonumentation of the U.S. Public Land Survey System (USPLSS) corners within the Region and the establishment of State Plane Coordinates for those corners. The system also includes the establishment of elevations for the monumented corners and for related auxiliary bench marks to provide a reliable vertical survey control network fully integrated with the horizontal network.

Through the cooperative efforts of the Commission and its constituent counties and municipalities, the recommended survey control system has been extended over the entire seven-county Region. All of the 11,985 USPLSS corners within the Region have been remonumented, and the coordinate positions, and elevations of the remonumented corners have been determined to a high level of accuracy. The resulting survey control network has been widely used for over 50 years in the preparation of large-scale topographic and cadastral maps, in the conduct of land and engineering surveys, and in the creation of parcel-based land information and public works management systems within the Region.

All of the coordinate positions of the remonumented stations of the survey control network within the Region have been referenced to the North American Datum of 1927 (NAD 27), a datum established and promulgated by the Federal government. The datum is based upon the Clarke Spheroid of 1866, a spheroid which fits the North American Continent and the Southeastern Wisconsin Region well. The elevations of the remonumented stations and of ancillary benchmarks have been referenced to the National Geodetic Vertical Datum of 1929 (NGVD 1929), a datum formerly known as the Sea Level Datum of 1929.

The Federal government in 1973 determined to undertake a readjustment of the national horizontal survey control network, and to adopt a new horizontal datum known as the North American Datum of 1983 (NAD 83), utilizing a new reference spheroid known as Geodetic Reference System of 1980 (GRS 80). The new horizontal datum was subsequently readjusted to create NAD 83 (2011). The Federal government in 1977 similarly determined to undertake a readjustment of the national vertical survey control network, and to adopt a new vertical datum known as the North American Vertical Datum of 1988 (NAVD 88).

REEVALUATION OF REGIONAL SURVEY CONTROL NETWORK

The Commission has long maintained that adoption and use of the new Federal datums within the Region does not provide any significant technical advantages over the continued use of the legacy datums. Nevertheless, in response to concerns raised by some practicing land surveyors and some county land information system managers about the continued use of the legacy datums within the Region, the Commission in October 2012 prepared SEWRPC Memorandum Report No. 206, *“Estimate of the Costs of Converting the Foundational Elements of the Land Information and Public Works Management Systems in Southeastern Wisconsin from Legacy to New Datums.”* In response to the specific requests of some county land information system managers, the report presented a procedure for converting the legacy datums within the Region to the newer datums and presented an estimate of the cost of such conversion meeting land and engineering survey accuracy standards. Given the high estimated cost of the envisioned conversion, and the lack of offsetting monetary benefits, the report recommended the continued use of the legacy datums within the Region. Despite this recommendation, some practicing land surveyors and some county land information system managers continued to express a desire to pursue datum conversion within the Region and to request Commission assistance in making the desired conversion. Given this continuing concern, and given the significant changes in surveying technology that had taken place since publication of Memorandum Report 206, the Commission in 2015 undertook a reevaluation of the findings and recommendations presented in that report. The findings of that reevaluation are set forth in an Addendum to Memorandum Report No. 206 entitled, *“Revised Estimate of the Costs of Converting the Foundational Elements of the Land Information and Public Works Management Systems in Southeastern Wisconsin from Legacy to New Datums,”* and published in August 2015.

PROCEDURES FOR DATUM CONVERSION

The procedure for the conversion of the horizontal control survey network within the Region from the legacy to the new datums as originally proposed in Memorandum Report No. 206, was based upon the technology available in 2012 to provide a high order of accuracy in control survey work. The originally proposed conversion procedure utilized a series of static Global Positioning System (GPS) observations¹ to provide new primary and secondary survey control networks within the Region. Based upon these higher order networks, new State Plane Coordinate positions on the North American Datum of 1983 (NAD 83) would then be obtained by occupying all of the stations comprising the network for further GPS observations. The procedure, while providing a high level of accuracy in the new position data, was costly – probably prohibitively so – considering the lack of known offsetting benefits.

Significant changes in surveying technology occurred after publication of SEWRPC Memorandum Report No. 206. These changes warranted reconsideration of the procedure originally proposed for datum conversion in that report. The changes in surveying technology included the completion by the Wisconsin Department of Transportation of a Continuously Operating Reference Stations (CORS) network within the State of Wisconsin, coupled with the development and acceptance of Virtual Reference Station (VRS) Technology.² This technology eliminated: 1) the

¹ In 2012 Global Positioning System observations intended to provide high orders of accuracy, known as static positioning surveys, utilized two or more receivers simultaneously receiving data from the system satellites. These data included dual-frequency carrier phase measurements that in effect represented distances. Post processing of the simultaneous observations provided precise vectors from which coordinate positions could be computed. The static survey procedure required stations in a network to be occupied and attendant data observed for significant periods of time—ranging from approximately 15 minutes to one hour.

² Virtual Reference Station technology consists of a system of hardware and software designed to facilitate real-time global positioning system measurements based on a network of reference stations known as continuously operating reference stations—performing in the role of the base stations in static global positioning surveys. The network of receivers is linked to a computation center, and each station contributes its raw data to help create network-wide models necessary to provide accurate positioning of the roving receiver. The primary benefit of the technology is that it permits real-time kinematic positioning using a single receiver in the field while achieving centimeter-level accuracy.

need to rely upon static GPS observations for the datum conversion work, and 2) the need for measurements to be made simultaneously by a roving GPS receiver and an attendant base station or stations. These two changes—while continuing to require occupation of all stations in the control survey network with a roving receiver—presented significant increases in the efficiency of the necessary field survey work, with attendant significant reductions in cost.

Importantly, the Commission staff working with its veteran consulting geodesist—Mr. Earl F. Burkholder, P.S., P.E.—developed a unique procedure for horizontal datum conversion which minimized the number of control survey stations that had to be occupied by a roving GPS receiver to accomplish the desired conversion work. This procedure combines GPS field observations on a carefully selected minimum number of control survey stations in a subarea of the Region—such as a USPLSS township—with measurement data collected in the original control surveys conducted within the Region to create the legacy survey control network. The procedure uses these legacy measurement data to compute the coordinate positions of the remaining unoccupied stations in the subarea. This unique procedure is more fully described in Appendix C of the Addendum to Memorandum Report No. 206. That Appendix C is reproduced as an appendix to this report.

REVISED COMMISSION RECOMMENDATION

The work accomplished in preparing the Addendum to MR No. 206 resulted in a change in the long-standing recommendation of the Commission to continue the use of the legacy survey datums within the Region. The Commission continued to recognize that the benefits of the conversion of the legacy datums to the new Federal datums remained largely intangible. However, the conversion using the procedure developed by the Commission staff would have one very important, although still intangible, benefit namely, the conversion procedure would retain the relative positions of all of the control survey stations within the Region as given by the legacy lengths and bearings of the quarter-section lines, thus preserving the integrity of the legacy horizontal control survey network within the Region. This benefit was considered sufficient to warrant incurring the relatively modest cost of a horizontal data conversion. The Addendum accordingly recommended that each of the individual county land information system managers within the Region determine whether or not their agency desired to proceed with the conversion of the horizontal datum in use within the Region from NAD 27 to NAD 83 (2011). If it was determined to proceed, it was indicated that the work could be accomplished by the Commission under contract with the counties concerned, the work being done on a county-by-county basis.

Similarly, the land information system managers would have to determine whether or not their agency desired to proceed with the conversion of the vertical datum in use within the Region from NGVD 29 to NAVD 88 (2012). However, in this case, the conversion would have to be carried out for the Region as a whole. Therefore, all seven county land information system agencies within the Region would have to agree to proceed, and would have to agree upon a distribution of the cost between the counties concerned. If it was determined to proceed, it was indicated that the work could be accomplished by the Commission under contract jointly with all seven county land information systems.

In considering the conversion of the horizontal datum within the Region, it was apparently understood by all concerned that such conversion would entail only two of the four foundational elements of a parcel-based land information or public works management system—the datum and related map projection and the control survey network. Each of the other two foundational elements—the topographic maps for ground truth, and the parcel based cadastral maps, together with the assembled attribute data, will require recompilation, or in the alternative, some form of adjustment if those elements are to be useable with coordinate positions on the new datum.

COUNTY ACTION

In a series of informal meetings held during the course of calendar year 2016, the seven county land information managers, acting on behalf of their agencies, unanimously agreed to proceed on a county-by-county basis with the conversion of the legacy horizontal datum in use within the Region to the new Federal datum. The managers similarly agreed unanimously to proceed cooperatively with the conversion of the vertical datum.

Accordingly, on April 20, 2017, Walworth County entered into an agreement with the Commission under which the Commission would convert nine of the sixteen township and on April 1, 2018, a second contract was entered to complete the remaining seven townships, thus permitting the conversion of the State Plane Coordinate positions of all 2,804 USPLSS corners within County from the legacy datum—NAD 27—to the new Federal datum—NAD 83 (2011). The conversion was to be accomplished by the procedure set forth in Appendix C of the Addendum to SEWRPC Memorandum Report No. 206. As already noted, a copy of Appendix C of the Addendum to Memorandum Report No. 206 is provided in an appendix to this report. The work was to be accomplished in a period of two years from the date of the agreement. The “deliverables” under the agreement were to include, in addition to the new coordinate positions of the USPLSS system corners, revised control survey station record sheets—commonly known as dossier sheets—for each corner, and new control survey summary diagrams, each diagram covering six USPLSS sections. This report documents the work accomplished and the products created and delivered under the agreement.

FIELD PROCEDURES

Following the procedure set forth in the appendix to this report, 357 remonumented USPLSS corners were recovered and occupied for GPS measurement. The location of these corners is shown on Figure 1. The State Plane Coordinates of the occupied stations referred to the new Federal horizontal datum are given in Table 1.

The remonumented corners were recovered using the Record of U.S. Public Land Survey Control Station sheets – so called dossier sheets – on file with the Commission. To insure that the recovered monuments truly marked the corner locations concerned, a minimum of three tie distances to extant witness corners were measured, and the distances checked against those shown on the dossier sheets.

The equipment used in the field work included a Trimble R-8 Global Positioning System Receiver (GPS receiver) coupled with a Trimble TSC2 Data Collector.³ During the observations, the GPS receiver was linked to the CORS network created and operated by the Wisconsin Department of Transportation within, and adjacent to, the County by ordinary mobile telephones. This combination of equipment is known to be capable of obtaining National Geodetic Survey (NGS) Third Order, Class I network accuracy or better, equivalent to an accuracy of 1 part in 10,000 for the lengths of the quarter-section lines. The GPS equipment was supported by a TopCon Model GPT-3002LW total station instrument capable of obtaining NGS Third Order Survey accuracy, and by 200 foot long steel tapes required to measure tie distances to witness corners, and to make attendant miscellaneous angular and distance measurements.

³ *The first artificial satellite geodetic positioning and navigation system was developed by the U.S. Department of Defense (DOD) for military purposes and became operational in 1983. Initially the DOD deliberately degraded the satellite transmissions to limit the positional accuracy for civilian use. In 1996 the DOD ended the degradation policy and made the system available for civilian use in a fully accurate mode – thus promoting the use of the system in surveying applications. The DOD system is the satellite positioning system that has become known by the acronym GPS for the term Global Positioning System. The GPS instrumentation used by the Commission in the creation of portions of the legacy regional survey control network exclusively used the DOD system. Since the completion of the legacy survey control network in the Region, other satellite based positioning and navigation systems have been created, such as systems by the European Union, Russia, and China. State-of-the-art receiving instruments can utilize signals from all of these satellite systems. The systems in combination are identified as the Global Navigation Satellite System (GNSS). The receiving instrumentation used in the conduct of the field work for the Walworth County datum conversion project utilized the GNSS system and did so in order that the observations would be made in a manner consistent with the instrumentation used by the Wisconsin Department of Transportation in conjunction with its system of Continuously Operating Reference Stations (CORS) within the Region.*

OFFICE COMPUTATIONS

The procedure for the datum conversion envisions utilizing the legacy lengths of the quarter-section lines and the interior angles of the quarter-sections in combination with the measured NAD 83 (2011) coordinates of the selective corners occupied for GPS measurement. The initial step in the computation process involved a least squares adjustment of the recorded legacy data to identify any errors or blunders that may exist in the legacy data. This initial step was intended to provide an absolutely “clean” data set for use in subsequent computations. A small number of relatively minor errors in the existing network were found together with a very small number of blunders involving such issues as transposition of integers, and the errors and blunders were corrected.

The second step in the computation process involved combining the measured NAD 83 (2011) coordinate positions with the legacy lengths of the quarter-section lines and the legacy interior angles of the quarter-sections in a least squares adjustment to compute the NAD 83 (2011) coordinate positions of the 2,447 non-occupied corners within the County. The resulting NAD 83 (2011) State Plane Coordinates, and the lengths and bearings of the quarter-section lines were recorded on the six section control summary diagrams covering the County.

Analyses of the coordinate positions of the corners as determined from the legacy network indicated the existence of problems with respect to the relative positions of some of the corners as indicated by the distances and bearings to other corners in the surrounding network. These problems were found within two separate areas of the County that did not meet the required network accuracy. The area concerned are cross-hatched and shown on Figure 2. While the relative positions of the corners within these areas met the applicable survey network standards, the group of corners, as a block, did not meet the standards relative to the distances and bearings to corners in the surrounding network. As indicated in Table 2, the largest discrepancy found was 0.89 feet. The discrepancies were corrected by selective GPS observation of the position of the blocks of errant corners. The errant and correct coordinate positions of the corners concerned are also given in Table 2. The errors in the positions of the corners concerned may be attributed to a lack of sufficient ties to corners in the creation of the legacy network.

The analysis also indicated the existence of some troublesome errors in the legacy survey control network that present an extent problem for the use of the corners in the conduct of land and engineering surveys. This type of problem was found to exist with respect to 18 individual corners randomly located throughout the survey control network. The locations of the corners concerned are shown on Figure 2⁴. For these errant corners, the legacy coordinate values were found to differ significantly from the actual corner locations as monumented. As indicated in Table 3, the largest difference between the coordinate and monumented positions was 2.26 feet. These errors, when found, were corrected by occupying the monumented location of the corners for GPS observation to determine the correct coordinate value of the monumented locations. The errant and correct coordinate position values for these corners are given in Table 3. The errors concerned may be attributed to errors in the measurements and adjustments made in the creation of the legacy survey control network.

It is important to note that this type of error could be found in the datum conversion process only as monumented corners were occupied for GPS observations. Unfortunately, more corners that were not occupied may exhibit this type of discrepancy and, therefore, could have errors in the assigned NAD 83 (2011) coordinate values. Based on the number of GPS observations such discrepancies expected to be negligible.

The GPS measurements together with the positions of the stations in the surrounding network were used to adjust the position of the errant stations above. These adjusted positions referred to the legacy datum were entered on revised legacy six section survey control summary diagrams, and the adjusted positions referred to the new Federal datum were entered on new survey control summary diagrams prepared under the project.

⁴ Those corners are indicated on Figure 3 as green dots located outside of the cross-hatched problem areas.

In addition to the previously described problems, the field survey also found that four of the U.S. PLSS corners of the survey control network were incorrectly located. That is, the extent monumentation did not mark the true location of the corner. These corners are identified on Figure 3 and listed in Table 4 appended. The County Surveyor will have to remonument these corners in the correct locations with locations that have both new legacy and the latest Federal datum coordinate values.

FIELD VERIFICATION OF COMPUTED CORNER POSITIONS

To check the accuracy of the computed survey control station coordinates, an approximately 20 percent random sample of the stations—USPLSS corners—was selected within the County for which the coordinates were computed. The location of the 556 sample stations are shown on Figure 3. The monuments marking the USPLSS corners comprising the sample were recovered and occupied with GPS instrumentation to obtain independently measured coordinate values for the corners. The measured coordinate positions were then compared with the computed positions. The results are set forth in Table 5. Review of the data presented in Table 5 indicates that the largest difference between a measured and a computed northing was 0.22 feet, while the largest difference between a measured and a computed easting was 0.22 feet. The root mean square error between the measured and the computed northings was 0.09 feet and between the eastings was 0.09 feet. The test confirmed the validity of the NAD 83 (2011) coordinates as determined by the conversion procedure. It is interesting to note that the shift in the geographic positions of the legacy and new Federal horizontal datums within the Region, as measured by the spherical coordinate differences of a centrally located station within the County is about 0.062 seconds of latitude, and 0.349 seconds of longitude, equivalent to about 6.1 feet and 34.4 feet, respectively.

CONCLUSION

It may be concluded that the horizontal datum conversion procedure developed by the Commission staff provides an accurate and cost-effective means for the conversion of the legacy horizontal datum in use within the Region to the presently promulgated Federal datum. As described in this report, the extant horizontal survey control network within Walworth County was successfully converted from the legacy datum—NAD 27—to the presently promulgated Federal datum—NAD 83 (2011). Independent field observations demonstrated that the converted State Plane Coordinate positions of the monumented County survey control network met Third Order, Class 1 Standards—providing linear distance closures of 1 part in 10,000 or better. Importantly, the procedure preserves the validity of the survey control network referred to the legacy datum, the lengths of quarter-section lines being essentially identical under the two datums.

In accordance with the agreement entered into between the County and the Commission governing the horizontal datum conversion, the following survey control data and materials were delivered in digital format to the County together with copies of this report:

- A revised copy of the “Record of U.S. Public Land Survey Control Station”—so called dossier sheet—for each of the 2,804 survey control stations—monumented USPLSS corners—within the County. The revised dossier sheets provide the State Plane Coordinates of the corner concerned referred to both the—NAD 27 and NAD 83 (2011) datums. An example of a revised dossier sheet is provided in Figure 4.
- New six-section survey control summary diagrams covering the County. These 96 diagrams show the monumented USPLSS corners, the State Plane Coordinates of those corners referred to NAD 83 (2011), the grid and ground level lengths of the quarter-section lines, the interior angles of the quarter-sections and the bearings of the quarter-section lines, and the ground level area of the quarter-sections. An example of a survey control summary diagram is provided in Figure 5.

TABLES AND FIGURES

Table 1

**MONUMENTED USPLSS CORNERS RECOVERED AND OCCUPIED FOR GPS OBSERVATIONS TO
CONTROL DATUM CONVERSION COMPUTATIONS – COORDINATES GIVEN ARE REFERRED TO NAD 83 (2011)**

Corner Number	Northing	Easting
1	310695.61	2362128.69
2	310715.91	2364768.91
3	310740.73	2367404.46
4	310833.33	2375328.23
5	310692.71	2380517.80
6	311419.38	2404176.19
7	311485.59	2406820.15
8	311607.99	2414764.94
9	308555.41	2391160.99
10	304170.99	2304561.12
11	304948.00	2338512.82
12	305898.54	2380512.50
13	306038.46	2398952.13
14	306270.06	2414818.90
15	301033.83	2417489.51
16	300717.92	2393778.44
17	300677.30	2375277.92
18	300412.67	2362142.42
19	299407.69	2325303.98
20	299061.39	2309753.34
21	296671.29	2320116.48
22	297131.08	2343589.29
23	295757.87	2414878.59
24	295559.89	2399020.32
25	294968.77	2385898.74
26	295305.78	2367402.42
27	295143.01	2362129.31
28	294914.96	2354196.78
29	293895.29	2312289.41
30	290704.74	2296481.66
31	291044.83	2306909.82
32	291661.62	2333171.32
33	292397.00	2359494.03
34	292627.10	2364708.36
35	292738.34	2372658.74

Corner Number	Northing	Easting
36	292753.61	2375310.35
37	290500.92	2420209.48
38	290434.53	2406962.41
39	289781.35	2359458.93
40	289268.99	2348909.71
41	288929.66	2327955.57
42	287258.51	2361995.19
43	287518.25	2391200.65
44	285194.69	2414959.51
45	283898.64	2343557.31
46	283716.59	2333090.58
47	283455.71	2320072.53
48	283293.28	2312188.85
49	282939.98	2301633.16
50	282200.21	2377946.67
51	282226.81	2385931.18
52	282335.21	2396412.75
53	282604.56	2420264.05
54	279830.59	2407051.90
55	279623.14	2391215.53
56	279187.84	2356885.93
57	278318.09	2354269.20
58	278884.06	2350975.47
59	278588.07	2343710.29
60	278386.54	2327907.44
61	277993.22	2312153.25
62	276012.99	2338602.06
63	276879.28	2375519.97
64	277310.55	2415090.09
65	274466.34	2396659.75
66	274317.78	2383530.42
67	274195.04	2364964.54
68	273481.63	2354538.31
69	272767.78	2320137.16
70	272229.99	2301670.90

Table 1 (continued)

Corner Number	Northing	Easting
71	270674.07	2336186.72
72	272010.57	2407394.83
73	269102.80	2391605.69
74	268822.43	2362458.72
75	267739.89	2325638.69
76	264549.78	2312516.67
77	264727.08	2317819.34
78	265687.74	2344327.45
79	266763.85	2418131.53
80	263996.76	2402385.68
81	263799.21	2383865.53
82	263172.26	2349662.46
83	262786.15	2336480.52
84	259027.49	2302182.05
85	261004.28	2368105.12
86	261463.50	2413079.15
87	258772.73	2407843.39
88	258576.47	2392047.74
89	258408.96	2373520.72
90	258122.43	2357793.42
91	257753.42	2344550.36
92	257298.73	2328663.52
93	256622.96	2312813.85
94	255709.47	2368320.60
95	255848.03	2381542.67
96	256144.23	2410606.10
97	253550.36	2415988.18
98	253516.65	2413351.15
99	253500.66	2410705.55
100	253483.98	2408053.56
101	253471.80	2405418.35
102	253409.25	2397493.62
103	252528.01	2347413.00
104	251657.51	2320983.48
105	248461.63	2302643.98
106	249485.10	2334279.13
107	250832.75	2405524.56
108	248249.64	2410908.71
109	248206.22	2405630.30
110	248005.68	2392491.88

Corner Number	Northing	Easting
111	247884.28	2376626.73
112	247628.81	2360805.09
113	247158.10	2344953.46
114	246783.08	2329137.97
115	246067.59	2313325.64
116	240503.73	2305384.50
117	241202.10	2323908.75
118	241550.39	2331811.39
119	242603.39	2387354.39
120	242742.89	2400516.97
121	240011.00	2392728.56
122	239844.23	2376886.11
123	239787.83	2366132.55
124	235680.73	2316119.07
125	236546.25	2345187.32
126	237307.29	2387488.96
127	234812.38	2400646.69
128	234619.83	2374329.16
129	233328.68	2324111.67
130	231108.07	2334643.87
131	231474.89	2349953.55
132	232374.64	2419133.53
133	229430.12	2376991.94
134	229275.03	2369063.92
135	228584.09	2343915.24
136	227633.52	2313619.36
137	227298.94	2305712.78
138	225408.53	2324295.37
139	226481.45	2361308.94
140	227011.62	2411301.37
141	224205.00	2392927.41
142	224030.76	2371811.90
143	223183.91	2337487.85
144	222013.28	2305844.81
145	220023.36	2321757.21
146	220356.94	2329670.21
147	220744.10	2345552.90
148	221023.80	2353445.13
149	221535.76	2390321.57
150	221589.84	2398203.32

Table 1 (continued)

Corner Number	Northing	Easting
151	219047.37	2408821.97
152	218730.67	2371902.92
153	214088.58	2306014.65
154	214532.54	2316584.50
155	215052.81	2329804.20
156	215647.24	2350878.54
157	215908.22	2361445.23
158	216172.66	2377233.28
159	216292.54	2393028.69
160	213991.88	2422208.36
161	213721.78	2408994.03
162	213645.63	2398442.05
163	213342.33	2374664.17
164	212917.37	2358859.89
165	208503.15	2306041.37
166	210724.62	2389633.49
167	209190.74	2377331.67
168	207290.16	2335228.23
169	206831.10	2324599.47
170	205629.28	2300797.70
171	204661.11	2345802.93
172	205231.53	2377423.97
173	205484.05	2393341.39
174	205754.07	2409248.94
175	202136.01	2353811.14
176	201810.40	2330003.22
177	200835.96	2311450.38
178	197566.30	2298219.18
179	197903.09	2306169.34
180	198877.65	2324710.34
181	199831.80	2372292.81
182	200137.41	2388149.72
183	200366.61	2401521.84
184	200458.63	2409443.14
185	196890.69	2353944.02
186	196762.90	2345971.67
187	196663.62	2335477.60
188	194921.42	2298272.55
189	192277.01	2298325.12
190	193070.94	2314209.78

Corner Number	Northing	Easting
207	181713.02	2298480.80
208	182476.58	2314390.13
209	183262.73	2330317.30
210	183609.16	2346245.61
211	183919.58	2367441.34
212	184275.20	2391292.79
301	297654.69	2359545.06
302	297775.93	2362135.78
303	295026.39	2359511.50
304	295260.71	2364769.13
305	295354.40	2370023.55
306	292722.24	2370024.53
307	292674.74	2367371.48
308	292510.53	2362072.84
309	289978.01	2364655.24
310	290033.98	2367340.53
311	290089.84	2370025.30
312	290102.67	2372665.61
401	309542.95	2296474.41
402	309551.40	2298950.79
403	309595.93	2301591.91
404	309647.86	2304243.98
405	309690.13	2306882.06
406	309733.93	2309520.00
407	309779.30	2312168.47
408	309819.09	2314806.98
409	309860.72	2317452.47
410	309895.13	2320100.01
411	309915.94	2322751.11
412	309941.07	2325393.07
413	309986.30	2328038.03
414	309991.99	2330571.50
415	310036.67	2333240.57
416	310076.36	2335880.27
417	310114.58	2338531.72
418	310167.17	2341158.09
419	310228.04	2343785.31
420	310288.71	2346421.12
421	310372.39	2349056.00
422	310433.19	2351698.49

Table 1 (continued)

Corner Number	Northing	Easting
423	310494.03	2354340.75
424	310571.81	2356989.61
425	310668.49	2359635.36
501	184952.44	2425732.98
502	192912.86	2425500.82
503	195559.05	2425436.07
504	198206.66	2425370.22
505	200808.73	2425299.79
506	200928.69	2425296.48
507	201528.47	2425279.96
508	203480.34	2425203.17
509	204612.57	2425158.63
510	206089.46	2425135.68
511	208730.24	2425055.93
512	211390.58	2424983.45
513	214050.54	2424868.20
514	216696.21	2424760.68
515	219342.46	2424700.94
516	221972.51	2424633.71
517	224616.80	2424580.81
518	227240.35	2424515.53
601	229881.61	2424437.27
602	232525.07	2424389.46
603	235168.50	2424341.55
604	237811.92	2424293.68
605	237729.92	2421654.79
606	237647.40	2419034.19
607	240305.46	2418997.69
608	240376.82	2421637.55
609	240450.84	2424256.94
610	243084.33	2424200.73
611	243023.68	2421588.69
612	242969.53	2418962.52
613	245624.63	2418913.22
614	245671.97	2421529.96
615	245719.05	2424158.08
616	248369.64	2424115.83
617	248338.57	2421471.51
618	248312.59	2418825.03
619	250947.22	2418726.60

Corner Number	Northing	Easting
620	250975.36	2421372.08
621	251002.39	2424006.31
622	253643.52	2423905.03
623	253615.42	2421271.90
624	253585.16	2418631.42
625	256222.21	2418535.21
626	256254.53	2421169.78
627	256286.41	2423805.93
628	258916.60	2423701.80
629	258885.69	2421067.79
630	258856.34	2418436.43
631	261550.18	2423596.64
632	264186.97	2423498.15
633	266823.79	2423399.65
634	269460.56	2423308.13
635	272093.73	2423215.10
636	274725.98	2423108.59
637	277355.95	2423016.75
638	279986.08	2422922.12
639	282624.71	2422909.11
640	285248.06	2422896.17
641	287880.25	2422874.71
642	290501.39	2422864.25
643	293126.23	2422844.13
644	295775.33	2422823.72
645	298406.15	2422788.78
646	301042.24	2422783.90
647	303676.69	2422758.35
648	306317.80	2422721.86
649	308956.60	2422725.00
650	311540.57	2422706.82
701	186994.72	2298398.13
702	200214.22	2298180.26
703	202866.52	2298157.87
704	205519.13	2298134.81
705	208159.60	2298120.58
706	210814.57	2298113.11
707	216508.00	2298091.68
708	219145.92	2298063.38
709	221805.79	2298043.16

Table 1 (continued)

Corner Number	Northing	Easting	Corner Number	Northing	Easting
710	224441.47	2297976.28	725	266836.35	2296853.71
711	227093.75	2297923.33	726	269476.14	2296776.12
712	232376.32	2297787.86	727	272116.01	2296698.38
713	235017.13	2297714.01	728	274789.85	2296580.57
714	237667.97	2297637.63	729	277483.46	2296463.28
715	240328.50	2297604.71	730	280125.41	2296437.85
716	242965.55	2297575.84	731	282769.27	2296447.96
717	245716.47	2297549.82	732	285412.06	2296455.23
718	248351.99	2297445.52	733	288054.67	2296462.42
719	250994.76	2297339.48	734	293355.45	2296500.43
720	253640.91	2297233.99	735	295988.62	2296531.33
721	256286.26	2297128.04	736	298632.54	2296540.71
722	258925.44	2297051.56	737	301276.46	2296549.99
723	261560.76	2296975.29	738	303924.36	2296522.22
724	264196.86	2296911.72	739	306568.62	2296500.00

CORNER IDENTIFICATION NUMBER LOCATION GIVEN ON FIGURE 1.

Source: SEWRPC.

Table 2

**MONUMENTED USPLSS CORNERS IN AREAS IN THE TOWN OF TROY AND NEAR THE CITY OF BURLINGTON
RECOVERED AND OCCUPIED FOR GPS OBSERVATIONS BUT THE COORDINATES OF WHICH WERE FOUND TO
DISAGREE WITH LEGACY COORDINATES**

COORDINATES ARE REFERRED TO NAD27

Corner Number		Northing	Easting
6	Readjusted	297494.85	2396312.91
	Original	297494.69	2396312.92
	Difference	0.16	-0.01
7	Readjusted	297857.58	2395630.24
	Original	297857.52	2395630.29
	Difference	0.06	-0.05
8	Readjusted	297766.09	2393673.26
	Original	297765.87	2393673.31
	Difference	0.22	-0.05
9	Readjusted	297644.94	2391082.55
	Original	297644.68	2391082.65
	Difference	0.26	-0.10
10	Readjusted	295016.63	2391048.98
	Original	295016.07	2391049.40
	Difference	0.56	-0.42
11	Readjusted	295133.18	2393666.79
	Original	295132.65	2393666.86
	Difference	0.53	-0.07
12	Readjusted	295250.88	2396306.59
	Original	295250.72	2396306.68
	Difference	0.16	-0.09
13	Readjusted	295295.94	2398939.87
	Original	295295.76	2398939.81
	Difference	0.18	0.06
15	Readjusted	292712.40	2401561.95
	Original	292711.99	2401562.10
	Difference	0.41	-0.15
16	Readjusted	292664.89	2398908.92
	Original	292664.92	2398908.96
	Difference	-0.03	-0.04
17	Readjusted	292617.24	2396245.82
	Original	292616.81	2396245.86
	Difference	0.43	-0.04

Corner Number		Northing	Easting
18	Readjusted	292500.71	2393610.33
	Original	292500.59	2393610.70
	Difference	0.12	-0.37
19	Readjusted	292387.15	2391031.54
	Original	292386.85	2391031.59
	Difference	0.30	-0.05
20	Readjusted	287248.77	2393532.59
	Original	287248.44	2393532.54
	Difference	0.33	0.05
21	Readjusted	258845.69	2449972.66
	Original	258845.60	2449972.58
	Difference	0.09	0.08
22	Readjusted	256133.89	2442142.68
	Original	256133.60	2442142.58
	Difference	0.29	0.10
23	Readjusted	256153.74	2444798.24
	Original	256153.62	2444798.27
	Difference	0.12	-0.03
24	Readjusted	256177.76	2447435.47
	Original	256177.58	2447435.51
	Difference	0.18	-0.04
25	Readjusted	256211.54	2450071.60
	Original	256211.43	2450071.60
	Difference	0.11	0.00
26	Readjusted	256243.75	2452706.10
	Original	256243.48	2452705.88
	Difference	0.27	0.22
27	Readjusted	253604.52	2452808.30
	Original	253604.00	2452808.04
	Difference	0.52	0.26
28	Readjusted	253574.35	2450167.83
	Original	253573.68	2450167.70
	Difference	0.67	0.13

Table 2 (continued)

Corner Number		Northing	Easting
29	Readjusted	253539.67	2447524.65
	Original	253538.93	2447524.60
	Difference	0.74	0.05
30	Readjusted	253506.10	2444887.68
	Original	253505.43	2444887.67
	Difference	0.67	0.01
31	Readjusted	253490.27	2442242.14
	Original	253489.70	2442242.06
	Difference	0.57	0.08
32	Readjusted	253473.64	2439590.18
	Original	253473.45	2439589.99
	Difference	0.19	0.19
33	Readjusted	250842.39	2439699.05
	Original	250842.31	2439698.98
	Difference	0.08	0.07
34	Readjusted	250858.68	2442341.84
	Original	250858.40	2442341.90
	Difference	0.28	-0.06
35	Readjusted	250881.79	2444986.30
	Original	250881.50	2444986.36
	Difference	0.29	-0.06
36	Readjusted	250881.84	2444991.56
	Original	250881.55	2444991.62
	Difference	0.29	-0.06
37	Readjusted	250871.49	2444991.92
	Original	250871.19	2444991.98
	Difference	0.30	-0.06
38	Readjusted	250905.55	2447622.69
	Original	250905.18	2447622.74
	Difference	0.37	-0.05
39	Readjusted	250936.28	2450263.04
	Original	250935.81	2450263.02
	Difference	0.47	0.02
40	Readjusted	250964.37	2452908.57
	Original	250963.98	2452908.49
	Difference	0.39	0.08

Corner Number		Northing	Easting
41	Readjusted	248327.51	2453008.14
	Original	248327.27	2453008.04
	Difference	0.24	0.10
42	Readjusted	248301.43	2450361.49
	Original	248301.33	2450361.53
	Difference	0.10	-0.04
43	Readjusted	248268.33	2447721.69
	Original	248268.26	2447721.79
	Difference	0.07	-0.10
44	Readjusted	248268.31	2447718.91
	Original	248268.23	2447719.01
	Difference	0.08	-0.10
45	Readjusted	248244.38	2445084.25
	Original	248244.35	2445084.36
	Difference	0.03	-0.11
46	Readjusted	248244.37	2445078.97
	Original	248244.34	2445079.08
	Difference	0.03	-0.11
47	Readjusted	248239.00	2442451.17
	Original	248238.97	2442451.28
	Difference	0.03	-0.11
48	Readjusted	248238.99	2442445.32
	Original	248238.96	2442445.43
	Difference	0.03	-0.11
49	Readjusted	248220.09	2439824.00
	Original	248220.06	2439824.07
	Difference	0.03	-0.07
50	Readjusted	248220.01	2439813.44
	Original	248219.98	2439813.51
	Difference	0.03	-0.07
51	Readjusted	243273.30	2339575.63
	Original	243272.41	2339575.97
	Difference	0.89	-0.34
52	Readjusted	245613.57	2450449.87
	Original	245613.58	2450449.68
	Difference	-0.01	0.19

Table 2 (continued)

Corner Number		Northing	Easting
53	Readjusted	245661.00	2453066.72
	Original	245660.88	2453066.48
	Difference	0.12	0.24
54	Readjusted	243012.82	2453125.53
	Original	243012.74	2453125.38
	Difference	0.08	0.15

Corner Number		Northing	Easting
59	Readjusted	240294.59	2450534.59
	Original	240294.83	2450534.33
	Difference	-0.24	0.26
60	Readjusted	240366.01	2453174.47
	Original	240366.04	2453174.35
	Difference	-0.03	0.12

CORNER IDENTIFICATION NUMBER LOCATION GIVEN ON FIGURE 2

Source: SEWRPC.

Table 3

**RANDOMLY FOUND MONUMENTED USPLSS CORNERS RECOVERED AND OCCUPIED FOR GPS OBSERVATIONS
BUT THE COORDINATES OF WHICH WERE FOUND TO DISAGREE WITH LEGACY COORDINATES**

COORDINATES ARE REFERRED TO NAD27

Corner Number		Northing	Easting
1	Readjusted	309686.22	2338691.32
	Original	309686.27	2338691.32
	Difference	-0.05	0.00
2	Readjusted	309725.62	2341057.47
	Original	309726.14	2341057.09
	Difference	-0.52	0.38
3	Readjusted	309729.73	2341298.20
	Original	309730.21	2341297.83
	Difference	-0.48	0.37
4	Readjusted	310562.41	2388526.74
	Original	310562.47	2388526.83
	Difference	-0.06	-0.09
5	Readjusted	310563.13	2388546.43
	Original	310563.19	2388546.53
	Difference	-0.06	-0.10
14	Readjusted	295393.95	2422718.45
	Original	295394.19	2422720.99
	Difference	-0.24	-2.54
51	Readjusted	243273.30	2339575.63
	Original	243272.41	2339575.97
	Difference	0.89	-0.34
55	Readjusted	240892.07	2342214.28
	Original	240891.93	2342214.03
	Difference	0.14	0.25
56	Readjusted	240737.60	2342213.20
	Original	240737.45	2342212.94
	Difference	0.15	0.26

Corner Number		Northing	Easting
57	Readjusted	240730.23	2342047.86
	Original	240730.08	2342047.59
	Difference	0.15	0.27
58	Readjusted	240619.70	2339567.90
	Original	240619.64	2339567.80
	Difference	0.06	0.10
61	Readjusted	234934.47	2442703.65
	Original	234934.29	2442704.63
	Difference	0.18	-0.98
62	Readjusted	213982.00	2453745.24
	Original	213982.00	2453745.04
	Difference	0.00	0.20
63	Readjusted	205510.88	2329672.12
	Original	205510.60	2329672.71
	Difference	0.28	-0.59
64	Readjusted	202126.89	2385348.48
	Original	202127.19	2385348.72
	Difference	-0.30	-0.24
65	Readjusted	193062.38	2345747.02
	Original	193060.58	2345749.28
	Difference	1.80	-2.26
66	Readjusted	190249.70	2457106.66
	Original	190249.70	2457106.40
	Difference	0.00	0.26
67	Readjusted	187596.36	2457183.87
	Original	187596.09	2457183.68
	Difference	0.27	0.19

CORNER IDENTIFICATION NUMBER LOCATION GIVEN ON FIGURE 2

Source: SEWRPC.

Table 4

**INCORRECTLY MONUMENTED USPLSS CORNERS
RECOVERED AND THE COORDINATES OF WHICH WERE
FOUND TO DISAGREE**

COORDINATES GIVEN ARE REFERRED TO NAD 83 (2011)

Corner Number		Northing	Easting
1	Readjusted	279572.45	2380705.86
	Original	279572.70	2380705.88
	Difference	-0.25	-0.02
2	Readjusted	229735.56	2297868.60
	Original	229743.33	2297868.55
	Difference	-7.77	0.05
3	Readjusted	216528.45	2416812.71
	Original	216528.95	2416812.76
	Difference	-0.50	-0.05
4	Readjusted	184354.09	2298439.26
	Original	184348.39	2298459.76
	Difference	-5.70	20.50

CORNER IDENTIFICATION NUMBER LOCATION GIVEN ON
FIGURE 2.

Source: SEWRPC.

Table 5

**MONUMENTED USPLSS CORNERS RECOVERED AND OCCUPIED FOR GPS OBSERVATIONS
TO VERIFY COMPUTED COORDINATE POSITION**

Corner Number		Northing	Easting
1	Computed	309782.36	2312371.05
	GPS Observed	309782.23	2312371.18
	Difference	-0.13	0.13
2	Computed	309915.43	2322686.64
	GPS Observed	309915.29	2322686.66
	Difference	-0.14	0.02
3	Computed	310166.55	2341126.94
	GPS Observed	310166.58	2341126.95
	Difference	0.03	0.01
4	Computed	310371.97	2349042.82
	GPS Observed	310371.97	2349042.93
	Difference	0.00	0.11
5	Computed	310716.00	2364778.85
	GPS Observed	310715.87	2364778.90
	Difference	-0.13	0.05
6	Computed	310740.50	2367379.59
	GPS Observed	310740.40	2367379.65
	Difference	-0.10	0.06
7	Computed	310832.65	2375273.52
	GPS Observed	310832.64	2375273.47
	Difference	-0.01	-0.05
8	Computed	311419.44	2404178.54
	GPS Observed	311419.41	2404178.49
	Difference	-0.03	-0.05
9	Computed	311485.78	2406828.14
	GPS Observed	311485.83	2406828.04
	Difference	0.05	-0.10
10	Computed	308906.40	2414792.17
	GPS Observed	308906.45	2414792.26
	Difference	0.05	0.09
11	Computed	308565.44	2372619.98
	GPS Observed	308565.38	2372620.08
	Difference	-0.06	0.10
Corner Number		Northing	Easting
12	Computed	308323.36	2362141.69
	GPS Observed	308323.27	2362141.69
	Difference	-0.08	0.00
13	Computed	308179.54	2356985.37
	GPS Observed	308179.54	2356985.27
	Difference	0.00	-0.10
14	Computed	307962.13	2351686.22
	GPS Observed	307962.21	2351686.24
	Difference	0.08	0.02
15	Computed	307700.14	2343667.80
	GPS Observed	307700.33	2343667.72
	Difference	0.19	-0.08
16	Computed	307586.29	2338557.32
	GPS Observed	307586.39	2338557.32
	Difference	0.10	0.00
17	Computed	307292.44	2322662.71
	GPS Observed	307292.26	2322662.74
	Difference	-0.18	0.03
18	Computed	307220.31	2317647.83
	GPS Observed	307220.13	2317647.96
	Difference	-0.18	0.13
19	Computed	306730.39	2301968.08
	GPS Observed	306730.43	2301968.12
	Difference	0.04	0.04
20	Computed	304005.78	2299287.96
	GPS Observed	304005.77	2299288.00
	Difference	-0.01	0.04
21	Computed	304367.46	2309800.45
	GPS Observed	304367.44	2309800.47
	Difference	-0.02	0.02
22	Computed	304336.26	2327987.43
	GPS Observed	304336.28	2327987.37
	Difference	0.02	-0.05

Table 5 (continued)

Corner Number		Northing	Easting
23	Computed	305548.41	2359604.81
	GPS Observed	305548.59	2359604.68
	Difference	0.18	-0.13
24	Computed	305687.78	2362120.65
	GPS Observed	305687.84	2362120.49
	Difference	0.06	-0.16
25	Computed	305873.92	2367339.09
	GPS Observed	305873.97	2367338.92
	Difference	0.05	-0.17
26	Computed	305967.09	2385816.02
	GPS Observed	305967.06	2385816.12
	Difference	-0.03	0.10
27	Computed	305927.53	2391156.15
	GPS Observed	305927.67	2391156.07
	Difference	0.14	-0.08
28	Computed	305947.07	2393708.58
	GPS Observed	305947.23	2393708.54
	Difference	0.16	-0.04
29	Computed	306254.84	2406883.12
	GPS Observed	306254.93	2406883.14
	Difference	0.09	0.02
30	Computed	303653.11	2414827.65
	GPS Observed	303653.00	2414827.65
	Difference	-0.11	0.00
31	Computed	303332.86	2393743.56
	GPS Observed	303332.95	2393743.63
	Difference	0.09	0.07
32	Computed	303294.78	2380544.12
	GPS Observed	303294.77	2380544.24
	Difference	-0.01	0.12
33	Computed	302879.86	2356927.97
	GPS Observed	302880.02	2356927.80
	Difference	0.16	-0.17
34	Computed	302420.78	2343663.35
	GPS Observed	302420.88	2343663.29
	Difference	0.10	-0.06

Corner Number		Northing	Easting
35	Computed	302307.67	2338468.65
	GPS Observed	302307.70	2338468.63
	Difference	0.03	-0.02
36	Computed	301929.83	2317623.92
	GPS Observed	301929.70	2317624.10
	Difference	-0.13	0.18
37	Computed	298807.64	2301861.23
	GPS Observed	298807.65	2301861.22
	Difference	0.01	-0.01
38	Computed	299286.49	2317595.71
	GPS Observed	299286.36	2317595.89
	Difference	-0.13	0.18
39	Computed	299667.41	2338424.53
	GPS Observed	299667.40	2338424.47
	Difference	-0.01	-0.06
40	Computed	300655.43	2380560.61
	GPS Observed	300655.43	2380560.61
	Difference	0.00	0.00
41	Computed	301014.12	2414836.25
	GPS Observed	301014.08	2414836.39
	Difference	-0.04	0.14
42	Computed	298018.95	2380574.26
	GPS Observed	298018.93	2380574.25
	Difference	-0.02	-0.01
43	Computed	298016.02	2372643.79
	GPS Observed	298016.06	2372643.85
	Difference	0.04	0.06
44	Computed	297592.94	2356876.73
	GPS Observed	297592.97	2356876.76
	Difference	0.03	0.03
45	Computed	297014.44	2338409.69
	GPS Observed	297014.38	2338409.70
	Difference	-0.06	0.01
46	Computed	296696.77	2322659.51
	GPS Observed	296696.68	2322659.57
	Difference	-0.09	0.06

Table 5 (continued)

Corner Number		Northing	Easting
47	Computed	296414.78	2309696.34
	GPS Observed	296414.73	2309696.44
	Difference	-0.05	0.10
48	Computed	293514.25	2301749.65
	GPS Observed	293514.18	2301749.63
	Difference	-0.07	-0.02
49	Computed	293792.03	2309639.80
	GPS Observed	293791.95	2309639.92
	Difference	-0.08	0.12
50	Computed	293941.12	2314919.29
	GPS Observed	293941.20	2314919.35
	Difference	0.08	0.06
51	Computed	294545.50	2348890.72
	GPS Observed	294545.57	2348890.76
	Difference	0.07	0.04
52	Computed	295423.97	2388539.41
	GPS Observed	295423.90	2388539.37
	Difference	-0.07	-0.04
53	Computed	295403.59	2391181.34
	GPS Observed	295403.59	2391181.34
	Difference	0.00	0.00
54	Computed	295621.86	2401663.24
	GPS Observed	295622.01	2401663.05
	Difference	0.15	-0.19
55	Computed	295721.69	2412246.08
	GPS Observed	295721.72	2412246.07
	Difference	0.03	-0.01
56	Computed	293155.49	2420192.25
	GPS Observed	293155.56	2420192.16
	Difference	0.07	-0.09
57	Computed	293083.08	2412244.38
	GPS Observed	293082.90	2412244.19
	Difference	-0.18	-0.19
58	Computed	293072.67	2406945.95
	GPS Observed	293072.71	2406945.89
	Difference	0.04	-0.06

Corner Number		Northing	Easting
59	Computed	292977.92	2401671.83
	GPS Observed	292977.77	2401671.74
	Difference	-0.15	-0.09
60	Computed	292920.39	2399028.06
	GPS Observed	292920.44	2399027.94
	Difference	0.05	-0.12
61	Computed	292863.53	2396387.15
	GPS Observed	292863.36	2396387.07
	Difference	-0.17	-0.08
62	Computed	292773.73	2391192.14
	GPS Observed	292773.70	2391192.15
	Difference	-0.03	0.01
63	Computed	292811.04	2385904.79
	GPS Observed	292811.02	2385904.71
	Difference	-0.02	-0.08
64	Computed	292744.49	2380589.15
	GPS Observed	292744.38	2380589.10
	Difference	-0.11	-0.05
65	Computed	292302.99	2356830.94
	GPS Observed	292303.05	2356831.01
	Difference	0.07	0.07
66	Computed	291721.38	2338440.78
	GPS Observed	291721.25	2338440.76
	Difference	-0.13	-0.02
67	Computed	291381.29	2320118.27
	GPS Observed	291381.31	2320118.39
	Difference	0.02	0.12
68	Computed	288950.99	2330513.05
	GPS Observed	288950.99	2330513.03
	Difference	0.00	-0.02
69	Computed	289081.38	2338456.73
	GPS Observed	289081.29	2338456.74
	Difference	-0.09	0.01
70	Computed	289204.98	2343672.22
	GPS Observed	289204.95	2343672.27
	Difference	-0.03	0.05

Table 5 (continued)

Corner Number		Northing	Easting
71	Computed	287872.77	2420227.99
	GPS Observed	287872.75	2420228.04
	Difference	-0.02	0.05
72	Computed	287734.67	2404334.05
	GPS Observed	287734.73	2404333.98
	Difference	0.06	-0.07
73	Computed	287520.13	2385930.25
	GPS Observed	287520.07	2385930.28
	Difference	-0.06	0.03
74	Computed	287360.35	2364634.15
	GPS Observed	287360.49	2364634.23
	Difference	0.14	0.08
75	Computed	287159.97	2359444.85
	GPS Observed	287160.02	2359444.91
	Difference	0.05	0.06
76	Computed	286362.50	2333129.13
	GPS Observed	286362.44	2333129.10
	Difference	-0.06	-0.03
77	Computed	286293.58	2327956.15
	GPS Observed	286293.57	2327956.02
	Difference	-0.01	-0.13
78	Computed	285668.54	2304275.33
	GPS Observed	285668.60	2304275.42
	Difference	0.06	0.09
79	Computed	283413.99	2317454.38
	GPS Observed	283413.96	2317454.25
	Difference	-0.03	-0.13
80	Computed	283653.43	2327947.63
	GPS Observed	283653.41	2327947.54
	Difference	-0.02	-0.09
81	Computed	283683.67	2330439.64
	GPS Observed	283683.69	2330439.59
	Difference	0.02	-0.05
82	Computed	283778.78	2338377.50
	GPS Observed	283778.68	2338377.55
	Difference	-0.10	0.05

Corner Number		Northing	Easting
83	Computed	284165.57	2352065.89
	GPS Observed	284165.61	2352065.80
	Difference	0.04	-0.09
84	Computed	284531.73	2359463.29
	GPS Observed	284531.65	2359463.37
	Difference	-0.08	0.08
85	Computed	284893.15	2391206.35
	GPS Observed	284893.12	2391206.29
	Difference	-0.03	-0.06
86	Computed	285220.14	2417617.53
	GPS Observed	285220.13	2417617.59
	Difference	-0.01	0.06
87	Computed	285242.30	2420246.58
	GPS Observed	285242.29	2420246.55
	Difference	-0.01	-0.03
88	Computed	282482.43	2407019.87
	GPS Observed	282482.60	2407019.82
	Difference	0.17	-0.05
89	Computed	282258.17	2391210.89
	GPS Observed	282258.18	2391210.86
	Difference	0.01	-0.03
90	Computed	282210.08	2380601.27
	GPS Observed	282210.05	2380601.33
	Difference	-0.03	0.06
91	Computed	281913.10	2359488.41
	GPS Observed	281913.14	2359488.58
	Difference	0.04	0.17
92	Computed	280941.31	2325294.58
	GPS Observed	280941.20	2325294.50
	Difference	-0.11	-0.08
93	Computed	280647.90	2312171.20
	GPS Observed	280647.93	2312171.22
	Difference	0.03	0.02
94	Computed	277649.41	2301506.26
	GPS Observed	277649.41	2301506.38
	Difference	0.00	0.12

Table 5 (continued)

Corner Number		Northing	Easting
95	Computed	277652.60	2301603.16
	GPS Observed	277652.63	2301603.32
	Difference	0.03	0.16
96	Computed	277989.74	2312030.18
	GPS Observed	277989.81	2312030.21
	Difference	0.07	0.04
97	Computed	278312.26	2325230.73
	GPS Observed	278312.10	2325230.79
	Difference	-0.16	0.06
98	Computed	278313.42	2325270.97
	GPS Observed	278313.35	2325271.03
	Difference	-0.07	0.06
99	Computed	278457.31	2335760.25
	GPS Observed	278457.19	2335760.25
	Difference	-0.12	0.00
100	Computed	278457.45	2335790.94
	GPS Observed	278457.29	2335790.96
	Difference	-0.16	0.02
101	Computed	278590.07	2343761.07
	GPS Observed	278590.11	2343761.06
	Difference	0.04	-0.01
102	Computed	279187.34	2356875.45
	GPS Observed	279187.33	2356875.46
	Difference	-0.01	0.01
103	Computed	279572.05	2380612.53
	GPS Observed	279572.00	2380612.59
	Difference	-0.05	0.06
104	Computed	279593.79	2385912.66
	GPS Observed	279593.61	2385912.51
	Difference	-0.18	-0.15
105	Computed	279705.10	2396443.92
	GPS Observed	279705.12	2396443.88
	Difference	0.03	-0.04
106	Computed	279705.35	2396465.70
	GPS Observed	279705.36	2396465.71
	Difference	0.01	0.01

Corner Number		Northing	Easting
107	Computed	279860.09	2409698.96
	GPS Observed	279860.12	2409698.95
	Difference	0.03	-0.01
108	Computed	279860.15	2409706.40
	GPS Observed	279860.15	2409706.40
	Difference	0.00	0.00
109	Computed	279882.01	2412348.92
	GPS Observed	279882.15	2412348.98
	Difference	0.14	0.06
110	Computed	279959.21	2420286.88
	GPS Observed	279959.30	2420286.89
	Difference	0.09	0.02
111	Computed	279959.23	2420288.96
	GPS Observed	279959.25	2420288.93
	Difference	0.02	-0.02
112	Computed	277326.20	2417729.07
	GPS Observed	277326.18	2417729.10
	Difference	-0.02	0.03
113	Computed	276982.91	2391299.02
	GPS Observed	276983.01	2391299.02
	Difference	0.10	0.00
114	Computed	276587.54	2354379.55
	GPS Observed	276587.60	2354379.51
	Difference	0.07	-0.04
115	Computed	272326.53	2306970.71
	GPS Observed	272326.49	2306970.76
	Difference	-0.04	0.05
116	Computed	272402.08	2309611.86
	GPS Observed	272402.07	2309611.96
	Difference	-0.01	0.10
117	Computed	272640.45	2317511.71
	GPS Observed	272640.36	2317511.81
	Difference	-0.09	0.10
118	Computed	272895.37	2322762.52
	GPS Observed	272895.21	2322762.54
	Difference	-0.16	0.02

Table 5 (continued)

Corner Number		Northing	Easting
119	Computed	273375.78	2338750.40
	GPS Observed	273375.74	2338750.39
	Difference	-0.04	-0.01
120	Computed	273685.98	2346643.77
	GPS Observed	273685.95	2346643.81
	Difference	-0.03	0.04
121	Computed	274113.00	2362319.00
	GPS Observed	274112.99	2362319.03
	Difference	-0.01	0.03
122	Computed	274270.90	2380911.67
	GPS Observed	274270.83	2380911.74
	Difference	-0.07	0.07
123	Computed	274365.73	2386152.02
	GPS Observed	274365.69	2386152.00
	Difference	-0.04	-0.02
124	Computed	274528.96	2401999.58
	GPS Observed	274528.91	2401999.53
	Difference	-0.05	-0.05
125	Computed	274659.96	2407285.65
	GPS Observed	274659.86	2407285.58
	Difference	-0.10	-0.06
126	Computed	274702.88	2420471.70
	GPS Observed	274702.83	2420471.89
	Difference	-0.05	0.19
127	Computed	272017.43	2410025.57
	GPS Observed	272017.42	2410025.56
	Difference	-0.01	-0.01
128	Computed	271895.68	2402098.87
	GPS Observed	271895.61	2402098.88
	Difference	-0.07	0.01
129	Computed	271872.42	2399425.52
	GPS Observed	271872.48	2399425.74
	Difference	0.06	0.22
130	Computed	271849.44	2396768.41
	GPS Observed	271849.43	2396768.43
	Difference	-0.01	0.02

Corner Number		Northing	Easting
131	Computed	271473.53	2362388.67
	GPS Observed	271473.56	2362388.68
	Difference	0.03	0.01
132	Computed	270977.41	2344109.67
	GPS Observed	270977.35	2344109.64
	Difference	-0.06	-0.02
133	Computed	270380.62	2325518.94
	GPS Observed	270380.66	2325519.03
	Difference	0.04	0.09
134	Computed	267041.24	2307178.16
	GPS Observed	267041.05	2307177.99
	Difference	-0.18	-0.17
135	Computed	267111.77	2309810.75
	GPS Observed	267111.61	2309810.61
	Difference	-0.16	-0.14
136	Computed	267923.26	2330992.75
	GPS Observed	267923.32	2330992.74
	Difference	0.06	-0.01
137	Computed	267984.28	2333636.63
	GPS Observed	267984.29	2333636.66
	Difference	0.01	0.03
138	Computed	268459.78	2349480.77
	GPS Observed	268459.77	2349480.86
	Difference	-0.01	0.09
139	Computed	268638.89	2354781.25
	GPS Observed	268638.97	2354781.26
	Difference	0.08	0.01
140	Computed	268903.32	2365106.23
	GPS Observed	268903.20	2365106.28
	Difference	-0.12	0.05
141	Computed	268936.22	2367787.24
	GPS Observed	268936.10	2367787.28
	Difference	-0.12	0.04
142	Computed	268954.63	2370471.27
	GPS Observed	268954.47	2370471.38
	Difference	-0.16	0.11

Table 5 (continued)

Corner Number		Northing	Easting
143	Computed	269099.40	2386313.18
	GPS Observed	269099.39	2386313.19
	Difference	-0.01	0.01
144	Computed	269161.51	2394244.61
	GPS Observed	269161.50	2394244.67
	Difference	-0.01	0.06
145	Computed	269220.29	2396872.17
	GPS Observed	269220.27	2396872.17
	Difference	-0.02	0.00
146	Computed	269261.46	2402199.96
	GPS Observed	269261.49	2402200.03
	Difference	0.03	0.07
147	Computed	266628.73	2402292.73
	GPS Observed	266628.73	2402292.72
	Difference	0.00	-0.01
148	Computed	266468.73	2391714.64
	GPS Observed	266468.78	2391714.53
	Difference	0.05	-0.11
149	Computed	266463.15	2386427.34
	GPS Observed	266463.11	2386427.31
	Difference	-0.04	-0.03
150	Computed	266103.40	2360141.05
	GPS Observed	266103.41	2360141.06
	Difference	0.01	0.01
151	Computed	265815.90	2349572.76
	GPS Observed	265815.90	2349572.73
	Difference	0.00	-0.03
152	Computed	265575.59	2341680.23
	GPS Observed	265575.63	2341680.20
	Difference	0.04	-0.03
153	Computed	265463.29	2339035.64
	GPS Observed	265463.33	2339035.62
	Difference	0.04	-0.02
154	Computed	265399.43	2336385.55
	GPS Observed	265399.53	2336385.47
	Difference	0.10	-0.08

Corner Number		Northing	Easting
155	Computed	265098.52	2325729.47
	GPS Observed	265098.59	2325729.54
	Difference	0.07	0.07
156	Computed	264985.64	2323083.58
	GPS Observed	264985.64	2323083.68
	Difference	0.00	0.10
157	Computed	264306.21	2301970.40
	GPS Observed	264306.23	2301970.39
	Difference	0.02	-0.01
158	Computed	261905.54	2312592.04
	GPS Observed	261905.50	2312591.95
	Difference	-0.04	-0.08
159	Computed	263466.99	2360255.12
	GPS Observed	263467.00	2360255.01
	Difference	0.01	-0.11
160	Computed	263826.43	2386541.24
	GPS Observed	263826.43	2386541.22
	Difference	0.00	-0.02
161	Computed	263842.38	2391826.74
	GPS Observed	263842.38	2391826.69
	Difference	0.00	-0.05
162	Computed	261368.46	2402486.57
	GPS Observed	261368.41	2402486.46
	Difference	-0.05	-0.11
163	Computed	261323.34	2397184.69
	GPS Observed	261323.39	2397184.64
	Difference	0.05	-0.05
164	Computed	261154.49	2383968.87
	GPS Observed	261154.52	2383968.88
	Difference	0.03	0.01
165	Computed	261121.76	2381310.90
	GPS Observed	261121.80	2381310.82
	Difference	0.04	-0.08
166	Computed	261093.18	2378686.42
	GPS Observed	261093.13	2378686.40
	Difference	-0.05	-0.02

Table 5 (continued)

Corner Number		Northing	Easting
167	Computed	261064.72	2376055.64
	GPS Observed	261064.65	2376055.70
	Difference	-0.07	0.06
168	Computed	261053.17	2373415.35
	GPS Observed	261053.12	2373415.39
	Difference	-0.05	0.04
169	Computed	261041.41	2370776.60
	GPS Observed	261041.35	2370776.59
	Difference	-0.06	-0.01
170	Computed	260967.02	2365429.38
	GPS Observed	260966.98	2365429.34
	Difference	-0.04	-0.04
171	Computed	260890.66	2362774.17
	GPS Observed	260890.70	2362774.13
	Difference	0.04	-0.04
172	Computed	260821.31	2360358.62
	GPS Observed	260821.32	2360358.58
	Difference	0.01	-0.04
173	Computed	260699.37	2355031.30
	GPS Observed	260699.41	2355031.20
	Difference	0.04	-0.10
174	Computed	259941.64	2328566.09
	GPS Observed	259941.67	2328566.14
	Difference	0.04	0.05
175	Computed	259264.25	2312702.96
	GPS Observed	259264.20	2312702.93
	Difference	-0.04	-0.03
176	Computed	257415.73	2333952.39
	GPS Observed	257415.67	2333952.41
	Difference	-0.06	0.02
177	Computed	257874.72	2349842.36
	GPS Observed	257874.79	2349842.27
	Difference	0.07	-0.09
178	Computed	258048.32	2355125.83
	GPS Observed	258048.44	2355125.77
	Difference	0.12	-0.06

Corner Number		Northing	Easting
179	Computed	258735.41	2402587.86
	GPS Observed	258735.35	2402587.73
	Difference	-0.06	-0.13
180	Computed	258755.90	2405219.15
	GPS Observed	258755.96	2405219.27
	Difference	0.06	0.12
181	Computed	258800.33	2410506.16
	GPS Observed	258800.48	2410506.25
	Difference	0.15	0.09
182	Computed	258820.45	2413176.79
	GPS Observed	258820.57	2413176.76
	Difference	0.12	-0.03
183	Computed	258838.12	2415805.80
	GPS Observed	258838.23	2415805.84
	Difference	0.11	0.04
184	Computed	255941.65	2392157.91
	GPS Observed	255941.66	2392157.92
	Difference	0.02	0.01
185	Computed	255914.71	2386854.66
	GPS Observed	255914.73	2386854.70
	Difference	0.02	0.04
186	Computed	255771.33	2373629.40
	GPS Observed	255771.28	2373629.36
	Difference	-0.05	-0.04
187	Computed	255545.85	2360555.25
	GPS Observed	255545.84	2360555.14
	Difference	-0.01	-0.11
188	Computed	255007.99	2342024.37
	GPS Observed	255008.01	2342024.43
	Difference	0.02	0.06
189	Computed	254910.10	2339380.85
	GPS Observed	254910.04	2339380.88
	Difference	-0.06	0.03
190	Computed	254674.38	2328772.49
	GPS Observed	254674.36	2328772.52
	Difference	-0.02	0.03

Table 5 (continued)

Corner Number		Northing	Easting
191	Computed	253976.77	2312964.31
	GPS Observed	253976.72	2312964.25
	Difference	-0.05	-0.06
192	Computed	253902.77	2310325.92
	GPS Observed	253902.83	2310325.91
	Difference	0.06	-0.01
193	Computed	253746.55	2302430.51
	GPS Observed	253746.51	2302430.47
	Difference	-0.04	-0.04
194	Computed	251260.59	2310471.63
	GPS Observed	251260.54	2310471.68
	Difference	-0.05	0.05
195	Computed	251434.38	2315739.48
	GPS Observed	251434.36	2315739.42
	Difference	-0.02	-0.06
196	Computed	251538.41	2318363.93
	GPS Observed	251538.26	2318363.91
	Difference	-0.15	-0.01
197	Computed	251778.45	2323599.89
	GPS Observed	251778.32	2323599.92
	Difference	-0.13	0.03
198	Computed	251910.23	2326244.83
	GPS Observed	251910.09	2326244.89
	Difference	-0.14	0.06
199	Computed	252044.81	2328883.13
	GPS Observed	252044.73	2328883.15
	Difference	-0.08	0.02
200	Computed	252835.00	2357979.92
	GPS Observed	252835.10	2357979.87
	Difference	0.10	-0.05
201	Computed	253129.99	2373738.61
	GPS Observed	253129.97	2373738.73
	Difference	-0.02	0.12
202	Computed	253308.07	2392265.98
	GPS Observed	253308.03	2392266.09
	Difference	-0.04	0.11

Corner Number		Northing	Easting
203	Computed	250647.26	2392379.60
	GPS Observed	250647.27	2392379.72
	Difference	0.01	0.12
204	Computed	250639.16	2387084.60
	GPS Observed	250639.14	2387084.64
	Difference	-0.02	0.04
205	Computed	250267.45	2360717.35
	GPS Observed	250267.54	2360717.23
	Difference	0.09	-0.12
206	Computed	249716.49	2342218.91
	GPS Observed	249716.48	2342218.84
	Difference	-0.01	-0.07
207	Computed	248901.62	2318492.78
	GPS Observed	248901.54	2318492.77
	Difference	-0.08	-0.01
208	Computed	245772.82	2300090.82
	GPS Observed	245772.89	2300090.87
	Difference	0.07	0.05
209	Computed	245773.31	2300115.55
	GPS Observed	245773.29	2300115.53
	Difference	-0.02	-0.02
210	Computed	246068.82	2313358.62
	GPS Observed	246068.74	2313358.59
	Difference	-0.08	-0.03
211	Computed	246384.49	2321264.32
	GPS Observed	246384.64	2321264.26
	Difference	0.15	-0.06
212	Computed	246384.96	2321274.84
	GPS Observed	246385.04	2321274.84
	Difference	0.08	0.00
213	Computed	247157.34	2344927.03
	GPS Observed	247157.36	2344927.04
	Difference	0.02	0.01
214	Computed	247370.30	2352854.70
	GPS Observed	247370.20	2352854.59
	Difference	-0.10	-0.11

Table 5 (continued)

Corner Number		Northing	Easting
215	Computed	247370.72	2352870.39
	GPS Observed	247370.72	2352870.38
	Difference	0.01	-0.01
216	Computed	247730.21	2366008.62
	GPS Observed	247730.00	2366008.53
	Difference	-0.20	-0.09
217	Computed	247730.52	2366024.55
	GPS Observed	247730.32	2366024.51
	Difference	-0.20	-0.04
218	Computed	247884.20	2376620.81
	GPS Observed	247884.28	2376620.82
	Difference	0.08	0.01
219	Computed	247884.56	2379276.40
	GPS Observed	247884.51	2379276.40
	Difference	-0.05	0.00
220	Computed	247884.56	2379279.37
	GPS Observed	247884.55	2379279.40
	Difference	-0.01	0.03
221	Computed	247967.90	2384570.47
	GPS Observed	247967.91	2384570.45
	Difference	0.01	-0.02
222	Computed	247999.84	2387209.73
	GPS Observed	247999.79	2387209.75
	Difference	-0.05	0.02
223	Computed	248045.85	2395043.60
	GPS Observed	248045.83	2395043.66
	Difference	-0.02	0.06
224	Computed	248046.18	2395062.34
	GPS Observed	248046.13	2395062.39
	Difference	-0.05	0.06
225	Computed	248173.08	2402983.57
	GPS Observed	248173.05	2402983.41
	Difference	-0.03	-0.16
226	Computed	248173.34	2403003.92
	GPS Observed	248173.28	2403003.91
	Difference	-0.06	-0.01

Corner Number		Northing	Easting
227	Computed	248206.37	2405646.81
	GPS Observed	248206.37	2405646.84
	Difference	0.00	0.03
228	Computed	248249.65	2410914.56
	GPS Observed	248249.54	2410914.51
	Difference	-0.11	-0.05
229	Computed	245449.57	2405708.85
	GPS Observed	245449.44	2405708.81
	Difference	-0.13	-0.04
230	Computed	245389.33	2400443.14
	GPS Observed	245389.30	2400443.20
	Difference	-0.03	0.06
231	Computed	244403.11	2342357.52
	GPS Observed	244403.24	2342357.52
	Difference	0.13	0.00
232	Computed	244294.06	2337039.47
	GPS Observed	244294.28	2337039.43
	Difference	0.22	-0.04
233	Computed	243851.54	2323909.73
	GPS Observed	243851.58	2323909.74
	Difference	0.04	0.01
234	Computed	240353.51	2300120.17
	GPS Observed	240353.59	2300120.14
	Difference	0.08	-0.03
235	Computed	240372.18	2302729.98
	GPS Observed	240372.21	2302729.86
	Difference	0.03	-0.12
236	Computed	241922.58	2347681.81
	GPS Observed	241922.54	2347681.69
	Difference	-0.04	-0.12
237	Computed	242163.60	2355558.98
	GPS Observed	242163.70	2355559.07
	Difference	0.10	0.09
238	Computed	242429.79	2366064.51
	GPS Observed	242429.88	2366064.36
	Difference	0.09	-0.15

Table 5 (continued)

Corner Number		Northing	Easting
239	Computed	242829.84	2408396.56
	GPS Observed	242829.72	2408396.50
	Difference	-0.12	-0.06
240	Computed	239952.14	2387424.12
	GPS Observed	239952.08	2387424.21
	Difference	-0.06	0.09
241	Computed	239953.15	2384784.83
	GPS Observed	239953.13	2384784.83
	Difference	-0.02	0.00
242	Computed	239954.07	2382139.19
	GPS Observed	239953.97	2382139.16
	Difference	-0.10	-0.03
243	Computed	239671.59	2360951.79
	GPS Observed	239671.76	2360951.82
	Difference	0.17	0.03
244	Computed	239445.62	2353003.45
	GPS Observed	239445.61	2353003.47
	Difference	-0.01	0.02
245	Computed	239381.41	2350370.89
	GPS Observed	239381.25	2350370.88
	Difference	-0.16	-0.01
246	Computed	239117.62	2342491.04
	GPS Observed	239117.67	2342491.00
	Difference	0.05	-0.04
247	Computed	238845.67	2329233.66
	GPS Observed	238845.53	2329233.59
	Difference	-0.14	-0.07
248	Computed	238099.16	2310759.19
	GPS Observed	238099.11	2310759.00
	Difference	-0.05	-0.19
249	Computed	235216.65	2305538.92
	GPS Observed	235216.67	2305538.96
	Difference	0.02	0.04
250	Computed	235873.95	2321411.84
	GPS Observed	235873.98	2321411.75
	Difference	0.03	-0.09

Corner Number		Northing	Easting
251	Computed	236292.03	2331848.76
	GPS Observed	236292.06	2331848.91
	Difference	0.04	0.15
252	Computed	236408.33	2339939.61
	GPS Observed	236408.40	2339939.53
	Difference	0.07	-0.08
253	Computed	237033.33	2361016.62
	GPS Observed	237033.54	2361016.67
	Difference	0.21	0.05
254	Computed	237368.56	2392777.72
	GPS Observed	237368.51	2392777.67
	Difference	-0.05	-0.04
255	Computed	237434.50	2397984.15
	GPS Observed	237434.34	2397983.95
	Difference	-0.16	-0.19
256	Computed	234823.09	2403287.06
	GPS Observed	234823.11	2403287.05
	Difference	0.02	-0.01
257	Computed	234660.91	2387545.40
	GPS Observed	234660.69	2387545.35
	Difference	-0.22	-0.05
258	Computed	234625.61	2376968.19
	GPS Observed	234625.52	2376968.09
	Difference	-0.09	-0.10
259	Computed	234500.86	2366273.39
	GPS Observed	234500.74	2366273.27
	Difference	-0.12	-0.12
260	Computed	234394.60	2361086.30
	GPS Observed	234394.76	2361086.29
	Difference	0.16	-0.01
261	Computed	233649.21	2331937.79
	GPS Observed	233649.38	2331937.94
	Difference	0.17	0.15
262	Computed	233563.88	2329344.96
	GPS Observed	233563.97	2329345.16
	Difference	0.09	0.20

Table 5 (continued)

Corner Number		Northing	Easting
263	Computed	232919.66	2313531.92
	GPS Observed	232919.60	2313531.94
	Difference	-0.06	0.02
264	Computed	232690.93	2308243.38
	GPS Observed	232690.89	2308243.29
	Difference	-0.04	-0.09
265	Computed	231678.40	2298776.27
	GPS Observed	231678.57	2298776.07
	Difference	0.17	-0.20
266	Computed	230807.70	2326790.85
	GPS Observed	230807.63	2326790.95
	Difference	-0.07	0.10
267	Computed	231183.07	2342681.83
	GPS Observed	231183.09	2342681.82
	Difference	0.02	-0.01
268	Computed	231576.90	2355843.99
	GPS Observed	231576.89	2355843.91
	Difference	-0.01	-0.07
269	Computed	231756.17	2361164.79
	GPS Observed	231756.27	2361164.77
	Difference	0.10	-0.02
270	Computed	232017.39	2384961.46
	GPS Observed	232017.57	2384961.38
	Difference	0.18	-0.08
271	Computed	232109.26	2392838.29
	GPS Observed	232109.26	2392838.25
	Difference	0.00	-0.04
272	Computed	232199.08	2403321.43
	GPS Observed	232198.96	2403321.47
	Difference	-0.12	0.04
273	Computed	232347.38	2413852.41
	GPS Observed	232347.37	2413852.32
	Difference	-0.01	-0.09
274	Computed	229744.56	2419195.91
	GPS Observed	229744.54	2419195.93
	Difference	-0.02	0.03

Corner Number		Northing	Easting
275	Computed	229479.36	2395447.78
	GPS Observed	229479.38	2395447.73
	Difference	0.02	-0.05
276	Computed	229325.84	2371739.88
	GPS Observed	229325.72	2371739.79
	Difference	-0.12	-0.09
277	Computed	229118.24	2361243.81
	GPS Observed	229118.27	2361243.82
	Difference	0.03	0.01
278	Computed	228959.45	2355909.41
	GPS Observed	228959.49	2355909.45
	Difference	0.04	0.04
279	Computed	228050.05	2324233.79
	GPS Observed	228050.08	2324233.76
	Difference	0.03	-0.03
280	Computed	227195.84	2303069.13
	GPS Observed	227195.87	2303069.15
	Difference	0.03	0.02
281	Computed	225099.29	2316324.74
	GPS Observed	225099.18	2316324.90
	Difference	-0.11	0.16
282	Computed	225930.07	2342749.99
	GPS Observed	225929.90	2342750.05
	Difference	-0.17	0.06
283	Computed	226151.00	2348417.71
	GPS Observed	226151.07	2348417.67
	Difference	0.07	-0.04
284	Computed	226873.43	2398123.79
	GPS Observed	226873.33	2398123.90
	Difference	-0.10	0.11
285	Computed	226895.53	2400742.44
	GPS Observed	226895.51	2400742.64
	Difference	-0.02	0.20
286	Computed	227086.36	2416583.65
	GPS Observed	227086.14	2416583.62
	Difference	-0.22	-0.03

Table 5 (continued)

Corner Number		Northing	Easting
287	Computed	224340.12	2408681.70
	GPS Observed	224339.97	2408681.84
	Difference	-0.15	0.14
288	Computed	224176.15	2390302.03
	GPS Observed	224176.00	2390301.96
	Difference	-0.15	-0.07
289	Computed	224433.18	2374440.82
	GPS Observed	224433.20	2374440.85
	Difference	0.03	0.03
290	Computed	223833.58	2361348.14
	GPS Observed	223833.60	2361348.24
	Difference	0.02	0.10
291	Computed	223738.11	2356031.96
	GPS Observed	223738.00	2356032.03
	Difference	-0.11	0.07
292	Computed	223215.00	2340160.22
	GPS Observed	223214.97	2340160.24
	Difference	-0.03	0.02
293	Computed	222456.16	2316402.86
	GPS Observed	222456.23	2316403.03
	Difference	0.07	0.17
294	Computed	222235.16	2311112.57
	GPS Observed	222235.05	2311112.65
	Difference	-0.11	0.08
295	Computed	221910.04	2303211.72
	GPS Observed	221910.05	2303211.71
	Difference	0.01	-0.01
296	Computed	221857.10	2300587.99
	GPS Observed	221857.02	2300588.01
	Difference	-0.08	0.02
297	Computed	219811.01	2316475.23
	GPS Observed	219810.84	2316475.33
	Difference	-0.17	0.10
298	Computed	220122.87	2324385.08
	GPS Observed	220122.95	2324385.05
	Difference	0.08	-0.03

Corner Number		Northing	Easting
299	Computed	220432.00	2332239.40
	GPS Observed	220431.80	2332239.30
	Difference	-0.20	-0.10
300	Computed	221096.72	2374493.97
	GPS Observed	221096.83	2374493.96
	Difference	0.11	-0.01
301	Computed	221466.33	2377141.63
	GPS Observed	221466.48	2377141.60
	Difference	0.15	-0.03
302	Computed	221803.90	2416691.48
	GPS Observed	221803.79	2416691.56
	Difference	-0.11	0.08
303	Computed	221852.46	2419331.19
	GPS Observed	221852.26	2419331.28
	Difference	-0.20	0.09
304	Computed	219075.59	2411459.48
	GPS Observed	219075.44	2411459.42
	Difference	-0.15	-0.06
305	Computed	218782.48	2374540.25
	GPS Observed	218782.56	2374540.24
	Difference	0.08	-0.01
306	Computed	218449.20	2356129.85
	GPS Observed	218449.08	2356130.04
	Difference	-0.12	0.19
307	Computed	216954.18	2311229.45
	GPS Observed	216954.04	2311229.61
	Difference	-0.14	0.16
308	Computed	214086.36	2305961.43
	GPS Observed	214086.30	2305961.50
	Difference	-0.06	0.07
309	Computed	214531.35	2316556.27
	GPS Observed	214531.37	2316556.24
	Difference	0.02	-0.03
310	Computed	214735.89	2321841.34
	GPS Observed	214735.83	2321841.31
	Difference	-0.06	-0.03

Table 5 (continued)

Corner Number		Northing	Easting
311	Computed	214736.23	2321849.71
	GPS Observed	214736.13	2321849.69
	Difference	-0.10	-0.02
312	Computed	215217.32	2335030.17
	GPS Observed	215217.33	2335030.22
	Difference	0.01	0.05
313	Computed	215647.05	2350871.36
	GPS Observed	215646.92	2350871.37
	Difference	-0.13	0.01
314	Computed	216005.74	2366653.56
	GPS Observed	216005.86	2366653.53
	Difference	0.12	-0.03
315	Computed	216006.04	2366673.47
	GPS Observed	216006.14	2366673.45
	Difference	0.10	-0.02
316	Computed	216239.58	2385501.56
	GPS Observed	216239.69	2385501.36
	Difference	0.11	-0.20
317	Computed	216335.78	2403581.87
	GPS Observed	216335.99	2403581.84
	Difference	0.21	-0.03
318	Computed	216335.94	2403595.29
	GPS Observed	216336.01	2403595.31
	Difference	0.07	0.02
319	Computed	216528.62	2416795.47
	GPS Observed	216528.51	2416795.36
	Difference	-0.10	-0.11
320	Computed	213876.47	2416919.89
	GPS Observed	213876.42	2416919.79
	Difference	-0.05	-0.10
321	Computed	213768.31	2411648.30
	GPS Observed	213768.30	2411648.22
	Difference	-0.01	-0.07
322	Computed	213650.76	2403687.03
	GPS Observed	213650.79	2403686.98
	Difference	0.03	-0.05

Corner Number		Northing	Easting
323	Computed	213537.86	2395796.30
	GPS Observed	213537.83	2395796.38
	Difference	-0.03	0.08
324	Computed	212794.33	2374676.65
	GPS Observed	212794.38	2374676.64
	Difference	0.05	-0.01
325	Computed	212725.49	2353545.42
	GPS Observed	212725.41	2353545.45
	Difference	-0.08	0.03
326	Computed	212595.18	2345623.08
	GPS Observed	212595.16	2345623.14
	Difference	-0.02	0.06
327	Computed	212474.86	2340319.53
	GPS Observed	212474.90	2340319.53
	Difference	0.04	0.00
328	Computed	212509.28	2332432.84
	GPS Observed	212509.10	2332432.79
	Difference	-0.17	-0.04
329	Computed	212134.44	2324529.36
	GPS Observed	212134.37	2324529.40
	Difference	-0.07	0.04
330	Computed	208794.73	2311319.72
	GPS Observed	208794.79	2311319.68
	Difference	0.07	-0.04
331	Computed	209112.65	2316608.51
	GPS Observed	209112.70	2316608.42
	Difference	0.05	-0.09
332	Computed	210138.38	2356236.23
	GPS Observed	210138.25	2356236.20
	Difference	-0.13	-0.03
333	Computed	207327.10	2348360.50
	GPS Observed	207327.00	2348360.63
	Difference	-0.10	0.13
334	Computed	207245.17	2343101.39
	GPS Observed	207245.08	2343101.54
	Difference	-0.09	0.16

Table 5 (continued)

Corner Number		Northing	Easting
335	Computed	206457.25	2316635.84
	GPS Observed	206457.32	2316635.81
	Difference	0.07	-0.03
336	Computed	205856.91	2306094.43
	GPS Observed	205856.95	2306094.43
	Difference	0.05	0.00
337	Computed	203675.55	2314027.48
	GPS Observed	203675.51	2314027.50
	Difference	-0.04	0.02
338	Computed	205124.91	2372134.58
	GPS Observed	205124.80	2372134.49
	Difference	-0.11	-0.09
339	Computed	205384.21	2382756.25
	GPS Observed	205384.30	2382756.14
	Difference	0.09	-0.11
340	Computed	205717.77	2406681.08
	GPS Observed	205717.86	2406680.95
	Difference	0.09	-0.13
341	Computed	206023.19	2419795.92
	GPS Observed	206023.20	2419796.04
	Difference	0.01	0.12
342	Computed	203374.86	2419878.95
	GPS Observed	203374.93	2419879.10
	Difference	0.07	0.15
343	Computed	203218.90	2414628.35
	GPS Observed	203218.93	2414628.33
	Difference	0.03	-0.02
344	Computed	203029.10	2401455.68
	GPS Observed	203029.12	2401455.59
	Difference	0.02	-0.09
345	Computed	202741.39	2382797.80
	GPS Observed	202741.47	2382797.72
	Difference	0.08	-0.07
346	Computed	202482.01	2372211.13
	GPS Observed	202481.93	2372211.12
	Difference	-0.08	-0.01

Corner Number		Northing	Easting
347	Computed	202336.01	2364283.58
	GPS Observed	202335.88	2364283.66
	Difference	-0.13	0.08
348	Computed	202277.74	2359129.98
	GPS Observed	202277.67	2359129.94
	Difference	-0.07	-0.04
349	Computed	202241.11	2356481.69
	GPS Observed	202241.01	2356481.69
	Difference	-0.10	0.00
350	Computed	202061.90	2351143.67
	GPS Observed	202061.88	2351143.60
	Difference	-0.02	-0.06
351	Computed	202053.97	2348506.63
	GPS Observed	202054.13	2348506.54
	Difference	0.16	-0.09
352	Computed	201953.71	2335364.21
	GPS Observed	201953.71	2335364.14
	Difference	0.00	-0.06
353	Computed	201666.85	2327332.70
	GPS Observed	201666.79	2327332.71
	Difference	-0.05	0.01
354	Computed	201288.27	2319365.90
	GPS Observed	201288.36	2319365.84
	Difference	0.09	-0.06
355	Computed	199583.64	2356552.87
	GPS Observed	199583.53	2356552.83
	Difference	-0.11	-0.04
356	Computed	200181.40	2393497.42
	GPS Observed	200181.49	2393497.29
	Difference	0.09	-0.13
357	Computed	200723.78	2419961.94
	GPS Observed	200723.69	2419962.09
	Difference	-0.09	0.15
358	Computed	198084.85	2420046.92
	GPS Observed	198085.02	2420046.74
	Difference	0.17	-0.18

Table 5 (continued)

Corner Number		Northing	Easting
359	Computed	197939.81	2414777.90
	GPS Observed	197939.92	2414777.89
	Difference	0.11	-0.01
360	Computed	197717.28	2401605.36
	GPS Observed	197717.23	2401605.26
	Difference	-0.05	-0.10
361	Computed	197455.26	2382930.56
	GPS Observed	197455.37	2382930.42
	Difference	0.11	-0.14
362	Computed	197039.21	2361891.81
	GPS Observed	197039.10	2361891.67
	Difference	-0.11	-0.14
363	Computed	196739.03	2340739.22
	GPS Observed	196738.97	2340739.26
	Difference	-0.06	0.04
364	Computed	196503.35	2330071.50
	GPS Observed	196503.33	2330071.51
	Difference	-0.02	0.01
365	Computed	195855.27	2316822.92
	GPS Observed	195855.28	2316822.93
	Difference	0.01	0.01
366	Computed	195724.01	2314176.08
	GPS Observed	195724.03	2314176.07
	Difference	0.02	-0.01
367	Computed	195263.72	2306202.82
	GPS Observed	195263.71	2306202.79
	Difference	-0.01	-0.03
368	Computed	193199.47	2316873.90
	GPS Observed	193199.46	2316873.88
	Difference	-0.01	-0.02
369	Computed	194003.92	2335526.53
	GPS Observed	194003.96	2335526.53
	Difference	0.04	0.00
370	Computed	194163.29	2346048.86
	GPS Observed	194163.20	2346048.76
	Difference	-0.09	-0.10

Corner Number		Northing	Easting
371	Computed	194313.44	2356661.28
	GPS Observed	194313.32	2356661.12
	Difference	-0.12	-0.16
372	Computed	194536.78	2372431.55
	GPS Observed	194536.75	2372431.58
	Difference	-0.03	0.03
373	Computed	195066.76	2401688.84
	GPS Observed	195066.75	2401688.74
	Difference	-0.01	-0.09
374	Computed	195131.81	2406971.11
	GPS Observed	195131.81	2406971.03
	Difference	0.00	-0.08
375	Computed	195163.94	2409587.79
	GPS Observed	195163.98	2409587.78
	Difference	0.04	-0.01
376	Computed	195443.53	2420132.14
	GPS Observed	195443.74	2420132.17
	Difference	0.21	0.03
377	Computed	192843.43	2422857.62
	GPS Observed	192843.55	2422857.56
	Difference	0.12	-0.06
378	Computed	192773.81	2420213.08
	GPS Observed	192773.77	2420213.00
	Difference	-0.04	-0.08
379	Computed	192713.59	2417582.97
	GPS Observed	192713.61	2417582.96
	Difference	0.02	-0.01
380	Computed	192522.99	2409664.34
	GPS Observed	192523.10	2409664.36
	Difference	0.11	0.02
381	Computed	191891.01	2372502.50
	GPS Observed	191890.92	2372502.48
	Difference	-0.09	-0.02
382	Computed	191454.82	2340847.84
	GPS Observed	191454.86	2340847.97
	Difference	0.04	0.13

Table 5 (continued)

Corner Number		Northing	Easting
383	Computed	190551.43	2316913.47
	GPS Observed	190551.38	2316913.53
	Difference	-0.05	0.06
384	Computed	189969.61	2306274.03
	GPS Observed	189969.61	2306274.04
	Difference	0.00	0.02
385	Computed	187622.49	2311620.83
	GPS Observed	187622.54	2311620.88
	Difference	0.05	0.05
386	Computed	188027.21	2319597.32
	GPS Observed	188027.18	2319597.39
	Difference	-0.03	0.07
387	Computed	188886.56	2351504.52
	GPS Observed	188886.61	2351504.49
	Difference	0.05	-0.03
388	Computed	189011.85	2356758.61
	GPS Observed	189011.93	2356758.60
	Difference	0.08	-0.01
389	Computed	189115.28	2362051.19
	GPS Observed	189115.35	2362051.21
	Difference	0.07	0.02
390	Computed	189129.74	2364626.87
	GPS Observed	189129.69	2364626.77
	Difference	-0.05	-0.10
391	Computed	189545.86	2391113.33
	GPS Observed	189545.87	2391113.26
	Difference	0.01	-0.07
392	Computed	189668.12	2396508.53
	GPS Observed	189668.10	2396508.36
	Difference	-0.02	-0.17
393	Computed	189891.64	2409754.20
	GPS Observed	189891.69	2409754.15
	Difference	0.05	-0.05
394	Computed	190131.61	2420293.05
	GPS Observed	190131.55	2420293.06
	Difference	-0.06	0.02

Corner Number		Northing	Easting
395	Computed	190192.38	2422924.64
	GPS Observed	190192.45	2422924.65
	Difference	0.07	0.01
396	Computed	187538.13	2423000.91
	GPS Observed	187538.15	2423000.95
	Difference	0.02	0.04
397	Computed	187471.17	2420355.37
	GPS Observed	187471.07	2420355.38
	Difference	-0.10	0.01
398	Computed	187433.97	2417724.37
	GPS Observed	187433.95	2417724.35
	Difference	-0.02	-0.02
399	Computed	187027.63	2396536.94
	GPS Observed	187027.58	2396536.77
	Difference	-0.05	-0.17
400	Computed	186782.37	2380599.17
	GPS Observed	186782.38	2380599.24
	Difference	0.01	0.07
401	Computed	186618.10	2372656.16
	GPS Observed	186618.09	2372656.19
	Difference	-0.01	0.03
402	Computed	186151.25	2340921.19
	GPS Observed	186151.17	2340921.20
	Difference	-0.08	0.01
403	Computed	185767.71	2327618.94
	GPS Observed	185767.65	2327618.99
	Difference	-0.06	0.05
404	Computed	183463.08	2338280.69
	GPS Observed	183462.99	2338280.67
	Difference	-0.09	-0.02
405	Computed	183725.88	2354198.25
	GPS Observed	183725.84	2354198.05
	Difference	-0.04	-0.20
406	Computed	184167.92	2383339.33
	GPS Observed	184167.92	2383339.27
	Difference	0.01	-0.06

Table 5 (continued)

Corner Number		Northing	Easting
501	Computed	307074.83	2312393.88
	GPS Observed	307074.67	2312393.98
	Difference	-0.16	0.10
502	Computed	307147.88	2315018.94
	GPS Observed	307147.83	2315018.97
	Difference	-0.05	0.03
503	Computed	305116.71	2312410.42
	GPS Observed	305116.61	2312410.48
	Difference	-0.10	0.06
504	Computed	304398.97	2311047.59
	GPS Observed	304398.89	2311047.56
	Difference	-0.08	-0.03
505	Computed	304454.18	2313112.87
	GPS Observed	304454.07	2313112.94
	Difference	-0.11	0.07
506	Computed	304510.85	2315025.00
	GPS Observed	304510.71	2315024.99
	Difference	-0.14	-0.01
507	Computed	301961.16	2320140.03
	GPS Observed	301960.99	2320140.11
	Difference	-0.17	0.08
508	Computed	301860.42	2315009.51
	GPS Observed	301860.25	2315009.57
	Difference	-0.17	0.05
509	Computed	302030.44	2312414.95
	GPS Observed	302030.46	2312414.97
	Difference	0.02	0.02
510	Computed	301791.21	2312414.83
	GPS Observed	301791.13	2312414.91
	Difference	-0.08	0.08
511	Computed	299222.69	2314993.63
	GPS Observed	299222.57	2314993.77
	Difference	-0.12	0.14
512	Computed	299323.79	2320130.67
	GPS Observed	299323.69	2320130.86
	Difference	-0.10	0.19

Corner Number		Northing	Easting
513	Computed	299341.23	2322663.99
	GPS Observed	299341.05	2322664.12
	Difference	-0.18	0.12
514	Computed	297561.49	2354213.57
	GPS Observed	297561.59	2354213.41
	Difference	0.10	-0.16
515	Computed	297371.85	2351556.97
	GPS Observed	297371.95	2351556.85
	Difference	0.10	-0.12
516	Computed	297194.92	2348902.46
	GPS Observed	297194.94	2348902.47
	Difference	0.02	0.01
517	Computed	297159.26	2346246.66
	GPS Observed	297159.32	2346246.67
	Difference	0.06	0.01
518	Computed	296898.99	2330573.21
	GPS Observed	296899.02	2330573.06
	Difference	0.03	-0.14
519	Computed	296829.82	2327950.39
	GPS Observed	296829.95	2327950.33
	Difference	0.13	-0.06
520	Computed	296753.77	2325299.24
	GPS Observed	296753.75	2325299.12
	Difference	-0.02	-0.12
521	Computed	294192.30	2327954.88
	GPS Observed	294192.40	2327954.76
	Difference	0.09	-0.12
522	Computed	294255.50	2330528.19
	GPS Observed	294255.49	2330528.15
	Difference	-0.02	-0.04
523	Computed	294312.21	2333179.27
	GPS Observed	294312.13	2333179.30
	Difference	-0.09	0.04
524	Computed	294342.53	2335789.59
	GPS Observed	294342.43	2335789.52
	Difference	-0.10	-0.07

Table 5 (continued)

Corner Number		Northing	Easting
525	Computed	294377.29	2338394.94
	GPS Observed	294377.30	2338395.00
	Difference	0.01	0.06
526	Computed	294417.38	2340967.26
	GPS Observed	294417.32	2340967.30
	Difference	-0.06	0.04
527	Computed	294485.70	2343528.94
	GPS Observed	294485.74	2343528.97
	Difference	0.04	0.03
528	Computed	294507.22	2346205.69
	GPS Observed	294507.20	2346205.70
	Difference	-0.02	0.01
529	Computed	294730.32	2351545.33
	GPS Observed	294730.43	2351545.23
	Difference	0.11	-0.10
530	Computed	295384.78	2372667.87
	GPS Observed	295384.81	2372667.85
	Difference	0.03	-0.02
531	Computed	295398.65	2375312.12
	GPS Observed	295398.47	2375312.15
	Difference	-0.18	0.03
532	Computed	295380.00	2380583.99
	GPS Observed	295379.92	2380583.91
	Difference	-0.08	-0.07
533	Computed	295413.25	2383236.83
	GPS Observed	295413.20	2383236.71
	Difference	-0.05	-0.12
534	Computed	295429.06	2384596.63
	GPS Observed	295429.04	2384596.56
	Difference	-0.03	-0.08
535	Computed	295759.51	2385897.34
	GPS Observed	295759.42	2385897.24
	Difference	-0.09	-0.11
536	Computed	295443.12	2386036.49
	GPS Observed	295442.98	2386036.35
	Difference	-0.14	-0.14

Corner Number		Northing	Easting
537	Computed	293111.68	2414907.79
	GPS Observed	293111.74	2414907.70
	Difference	0.07	-0.08
538	Computed	292791.89	2388547.95
	GPS Observed	292791.82	2388547.75
	Difference	-0.07	-0.20
539	Computed	292777.79	2383247.75
	GPS Observed	292777.62	2383247.62
	Difference	-0.18	-0.13
540	Computed	292748.98	2377948.91
	GPS Observed	292749.05	2377948.92
	Difference	0.07	0.01
541	Computed	292273.01	2354197.57
	GPS Observed	292273.07	2354197.44
	Difference	0.06	-0.13
542	Computed	292091.54	2351548.57
	GPS Observed	292091.71	2351548.50
	Difference	0.17	-0.07
543	Computed	291907.55	2348857.84
	GPS Observed	291907.67	2348857.70
	Difference	0.11	-0.15
544	Computed	291876.63	2346251.76
	GPS Observed	291876.63	2346251.64
	Difference	0.00	-0.12
545	Computed	291846.06	2343602.46
	GPS Observed	291846.02	2343602.57
	Difference	-0.04	0.11
546	Computed	291778.02	2341012.15
	GPS Observed	291777.96	2341012.20
	Difference	-0.05	0.05
547	Computed	291702.92	2335797.06
	GPS Observed	291702.90	2335797.08
	Difference	-0.02	0.02
548	Computed	290116.08	2375306.41
	GPS Observed	290116.04	2375306.43
	Difference	-0.05	0.02

Table 5 (continued)

Corner Number		Northing	Easting
549	Computed	290110.59	2377943.48
	GPS Observed	290110.54	2377943.51
	Difference	-0.05	0.02
550	Computed	290104.54	2380598.41
	GPS Observed	290104.48	2380598.35
	Difference	-0.07	-0.06
551	Computed	290132.57	2383256.55
	GPS Observed	290132.56	2383256.43
	Difference	-0.01	-0.11
552	Computed	290160.70	2385914.66
	GPS Observed	290160.64	2385914.54
	Difference	-0.05	-0.13
553	Computed	290165.93	2388553.86
	GPS Observed	290165.97	2388553.72
	Difference	0.04	-0.14
554	Computed	290150.17	2391195.35
	GPS Observed	290150.18	2391195.23
	Difference	0.01	-0.11
555	Computed	290460.61	2412257.45
	GPS Observed	290460.53	2412257.31
	Difference	-0.07	-0.14
556	Computed	258686.90	2397283.05
	GPS Observed	258686.93	2397282.93
	Difference	0.03	-0.12
557	Computed	258630.40	2394642.95
	GPS Observed	258630.40	2394642.81
	Difference	0.00	-0.13
558	Computed	258549.58	2386752.36
	GPS Observed	258549.63	2386752.22
	Difference	0.05	-0.13
559	Computed	258526.96	2384087.71
	GPS Observed	258527.07	2384087.60
	Difference	0.11	-0.11
560	Computed	258484.38	2381420.79
	GPS Observed	258484.32	2381420.77
	Difference	-0.06	-0.02

Corner Number		Northing	Easting
561	Computed	258446.83	2378797.53
	GPS Observed	258446.85	2378797.41
	Difference	0.03	-0.12
562	Computed	258428.63	2376166.07
	GPS Observed	258428.46	2376166.04
	Difference	-0.17	-0.03
563	Computed	258390.65	2370874.60
	GPS Observed	258390.61	2370874.52
	Difference	-0.04	-0.08
564	Computed	255753.10	2370980.97
	GPS Observed	255753.07	2370980.90
	Difference	-0.03	-0.07
565	Computed	255789.29	2376279.66
	GPS Observed	255789.34	2376279.53
	Difference	0.05	-0.13
566	Computed	255808.68	2378917.25
	GPS Observed	255808.64	2378917.20
	Difference	-0.04	-0.05
567	Computed	255881.40	2384198.08
	GPS Observed	255881.33	2384198.06
	Difference	-0.07	-0.03
568	Computed	255928.19	2389505.94
	GPS Observed	255928.14	2389505.98
	Difference	-0.05	0.05
569	Computed	255994.67	2394743.38
	GPS Observed	255994.64	2394743.24
	Difference	-0.03	-0.14
570	Computed	256049.33	2397388.39
	GPS Observed	256049.23	2397388.22
	Difference	-0.10	-0.17
571	Computed	253355.82	2394851.22
	GPS Observed	253355.87	2394851.18
	Difference	0.05	-0.04
572	Computed	253293.57	2389611.61
	GPS Observed	253293.54	2389611.59
	Difference	-0.03	-0.02

Table 5 (continued)

Corner Number		Northing	Easting
573	Computed	253280.16	2386957.09
	GPS Observed	253280.20	2386957.04
	Difference	0.04	-0.04
574	Computed	253249.97	2384305.08
	GPS Observed	253249.93	2384304.94
	Difference	-0.13	
575	Computed	253206.56	2381657.70
	GPS Observed	253206.49	2381657.55
	Difference	-0.07	-0.14
576	Computed	253176.11	2379027.67
	GPS Observed	253176.10	2379027.64
	Difference	-0.01	-0.03
577	Computed	253150.41	2376394.64
	GPS Observed	253150.41	2376394.53
	Difference	0.00	-0.11
578	Computed	253109.38	2371084.21
	GPS Observed	253109.30	2371084.20
	Difference	-0.07	-0.02
579	Computed	253073.58	2368428.82
	GPS Observed	253073.49	2368428.74
	Difference	-0.10	-0.08
580	Computed	253015.23	2365777.56
	GPS Observed	253015.11	2365777.38
	Difference	-0.12	-0.18
581	Computed	252959.35	2363125.15
	GPS Observed	252959.28	2363125.00
	Difference	-0.07	-0.15
582	Computed	243149.74	2305403.39
	GPS Observed	243149.81	2305403.38
	Difference	0.07	0.00
583	Computed	243281.62	2308037.97
	GPS Observed	243281.64	2308037.95
	Difference	0.01	-0.02
584	Computed	240863.60	2313321.67
	GPS Observed	240863.59	2313321.57
	Difference	-0.01	-0.10

Corner Number		Northing	Easting
585	Computed	240900.47	2310676.75
	GPS Observed	240900.46	2310676.69
	Difference	-0.01	-0.06
586	Computed	240738.62	2310510.33
	GPS Observed	240738.61	2310510.25
	Difference	-0.02	-0.09
587	Computed	240628.08	2308030.27
	GPS Observed	240628.08	2308030.24
	Difference	0.00	-0.02
588	Computed	237979.52	2308113.14
	GPS Observed	237979.64	2308113.22
	Difference	0.12	0.08
589	Computed	238218.71	2313405.83
	GPS Observed	238218.82	2313405.77
	Difference	0.11	-0.06
590	Computed	238331.17	2316046.50
	GPS Observed	238331.28	2316046.29
	Difference	0.12	-0.21
591	Computed	238442.56	2318687.47
	GPS Observed	238442.55	2318687.27
	Difference	-0.01	-0.20
592	Computed	238499.65	2321334.02
	GPS Observed	238499.59	2321333.86
	Difference	-0.06	-0.15
593	Computed	236201.75	2329280.77
	GPS Observed	236201.63	2329280.68
	Difference	-0.12	-0.10
594	Computed	236084.91	2326670.04
	GPS Observed	236084.83	2326669.89
	Difference	-0.08	-0.15
595	Computed	235967.60	2324058.88
	GPS Observed	235967.78	2324058.96
	Difference	0.19	0.08
596	Computed	235803.79	2318768.98
	GPS Observed	235803.82	2318768.77
	Difference	0.03	-0.21

Table 5 (continued)

Corner Number		Northing	Easting
597	Computed	235576.33	2313481.38
	GPS Observed	235576.27	2313481.40
	Difference	-0.06	0.01
598	Computed	235458.91	2310842.38
	GPS Observed	235459.11	2310842.19
	Difference	0.20	-0.19
599	Computed	235337.09	2308194.97
	GPS Observed	235337.13	2308194.84
	Difference	0.04	-0.12
600	Computed	233157.20	2318815.70
	GPS Observed	233157.24	2318815.55
	Difference	0.05	-0.15
601	Computed	233243.12	2321468.06
	GPS Observed	233243.23	2321468.01
	Difference	0.11	-0.05
602	Computed	229938.15	2305651.05
	GPS Observed	229938.19	2305650.88
	Difference	0.03	-0.17
603	Computed	227398.92	2308356.96
	GPS Observed	227398.84	2308356.84
	Difference	-0.08	-0.12
604	Computed	227514.70	2310999.10
	GPS Observed	227514.76	2310999.04
	Difference	0.06	-0.07
605	Computed	224984.47	2313680.42
	GPS Observed	224984.43	2313680.30
	Difference	-0.04	-0.12
606	Computed	224881.29	2311046.26
	GPS Observed	224881.18	2311046.11
	Difference	-0.11	-0.15
607	Computed	222346.82	2313749.18
	GPS Observed	222346.74	2313749.33
	Difference	-0.08	0.15
608	Computed	219922.90	2319130.51
	GPS Observed	219922.91	2319130.52
	Difference	0.01	0.01

Corner Number		Northing	Easting
609	Computed	219698.92	2313819.98
	GPS Observed	219698.79	2313820.14
	Difference	-0.12	0.16
610	Computed	217169.11	2316529.91
	GPS Observed	217169.08	2316529.90
	Difference	-0.03	-0.01
611	Computed	217482.19	2324436.11
	GPS Observed	217482.22	2324436.01
	Difference	0.03	-0.09
612	Computed	214941.49	2327132.31
	GPS Observed	214941.43	2327132.25
	Difference	-0.06	-0.06
613	Computed	214841.61	2324487.03
	GPS Observed	214841.57	2324486.89
	Difference	-0.04	-0.14
614	Computed	214630.83	2319212.25
	GPS Observed	214630.78	2319212.17
	Difference	-0.04	-0.08
615	Computed	209484.17	2324577.99
	GPS Observed	209484.07	2324577.92
	Difference	-0.11	-0.08
616	Computed	209761.62	2329886.16
	GPS Observed	209761.46	2329885.99
	Difference	-0.17	-0.17
617	Computed	209846.61	2332503.42
	GPS Observed	209846.47	2332503.23
	Difference	-0.15	-0.19
618	Computed	207191.65	2340447.20
	GPS Observed	207191.58	2340447.33
	Difference	-0.07	0.13
619	Computed	207239.24	2337846.24
	GPS Observed	207239.26	2337846.19
	Difference	0.03	-0.05
620	Computed	204582.54	2337910.73
	GPS Observed	204582.56	2337910.61
	Difference	0.02	-0.12

Table 5 (continued)

Corner Number		Northing	Easting
621	Computed	204546.31	2340526.53
	GPS Observed	204546.34	2340526.52
	Difference	0.03	-0.01
622	Computed	202806.73	2390760.07
	GPS Observed	202806.69	2390759.95
	Difference	-0.04	-0.12
623	Computed	202780.48	2388094.92
	GPS Observed	202780.68	2388094.71
	Difference	0.20	-0.21
624	Computed	202764.90	2385444.66
	GPS Observed	202764.89	2385444.47
	Difference	0.00	-0.19
625	Computed	202017.58	2345858.16
	GPS Observed	202017.60	2345858.09
	Difference	0.03	-0.07
626	Computed	201995.16	2343268.44
	GPS Observed	201995.18	2343268.34
	Difference	0.02	-0.10
627	Computed	201972.31	2340615.25
	GPS Observed	201972.27	2340615.10
	Difference	-0.04	-0.15
628	Computed	201962.98	2337982.07
	GPS Observed	201962.91	2337981.95
	Difference	-0.07	-0.12
629	Computed	199370.52	2340677.78
	GPS Observed	199370.49	2340677.71
	Difference	-0.03	-0.07
630	Computed	199376.76	2343369.85
	GPS Observed	199376.81	2343369.77
	Difference	0.05	-0.08
631	Computed	199374.16	2345913.72
	GPS Observed	199374.06	2345913.63
	Difference	-0.09	-0.09
632	Computed	199412.78	2348567.93
	GPS Observed	199412.81	2348567.73
	Difference	0.03	-0.19

Corner Number		Northing	Easting
633	Computed	197476.23	2388217.60
	GPS Observed	197476.26	2388217.56
	Difference	0.03	-0.04
634	Computed	196793.53	2348634.11
	GPS Observed	196793.41	2348633.96
	Difference	-0.12	-0.15
635	Computed	196755.07	2343399.16
	GPS Observed	196755.10	2343399.15
	Difference	0.03	-0.01
636	Computed	194148.21	2343432.75
	GPS Observed	194148.22	2343432.88
	Difference	0.01	0.13
637	Computed	194160.79	2348701.51
	GPS Observed	194160.65	2348701.51
	Difference	-0.14	0.00
638	Computed	194818.81	2388296.00
	GPS Observed	194818.78	2388295.97
	Difference	-0.02	-0.02
639	Computed	192186.30	2391047.29
	GPS Observed	192186.36	2391047.24
	Difference	0.06	-0.05
640	Computed	192163.68	2388362.13
	GPS Observed	192163.75	2388362.01
	Difference	0.08	-0.12
641	Computed	192162.29	2385720.19
	GPS Observed	192162.32	2385720.13
	Difference	0.03	-0.06
642	Computed	191458.06	2346129.88
	GPS Observed	191458.08	2346129.84
	Difference	0.02	-0.05
643	Computed	188770.32	2343544.71
	GPS Observed	188770.23	2343544.66
	Difference	-0.09	-0.05
644	Computed	188763.10	2346193.08
	GPS Observed	188763.17	2346193.08
	Difference	0.08	0.01

Table 5 (continued)

Corner Number		Northing	Easting
645	Computed	188822.93	2348816.58
	GPS Observed	188822.98	2348816.46
	Difference	0.05	-0.12
646	Computed	189508.06	2388439.69
	GPS Observed	189508.07	2388439.69
	Difference	0.01	0.00
647	Computed	186862.19	2388545.24
	GPS Observed	186862.25	2388545.24
	Difference	0.06	0.00

Corner Number		Northing	Easting
648	Computed	186186.12	2346231.27
	GPS Observed	186186.13	2346231.21
	Difference	0.01	-0.06
649	Computed	184212.88	2385986.62
	GPS Observed	184212.81	2385986.66
	Difference	-0.07	0.03
650	Computed	184239.67	2388619.88
	GPS Observed	184239.78	2388620.02
	Difference	0.11	0.14

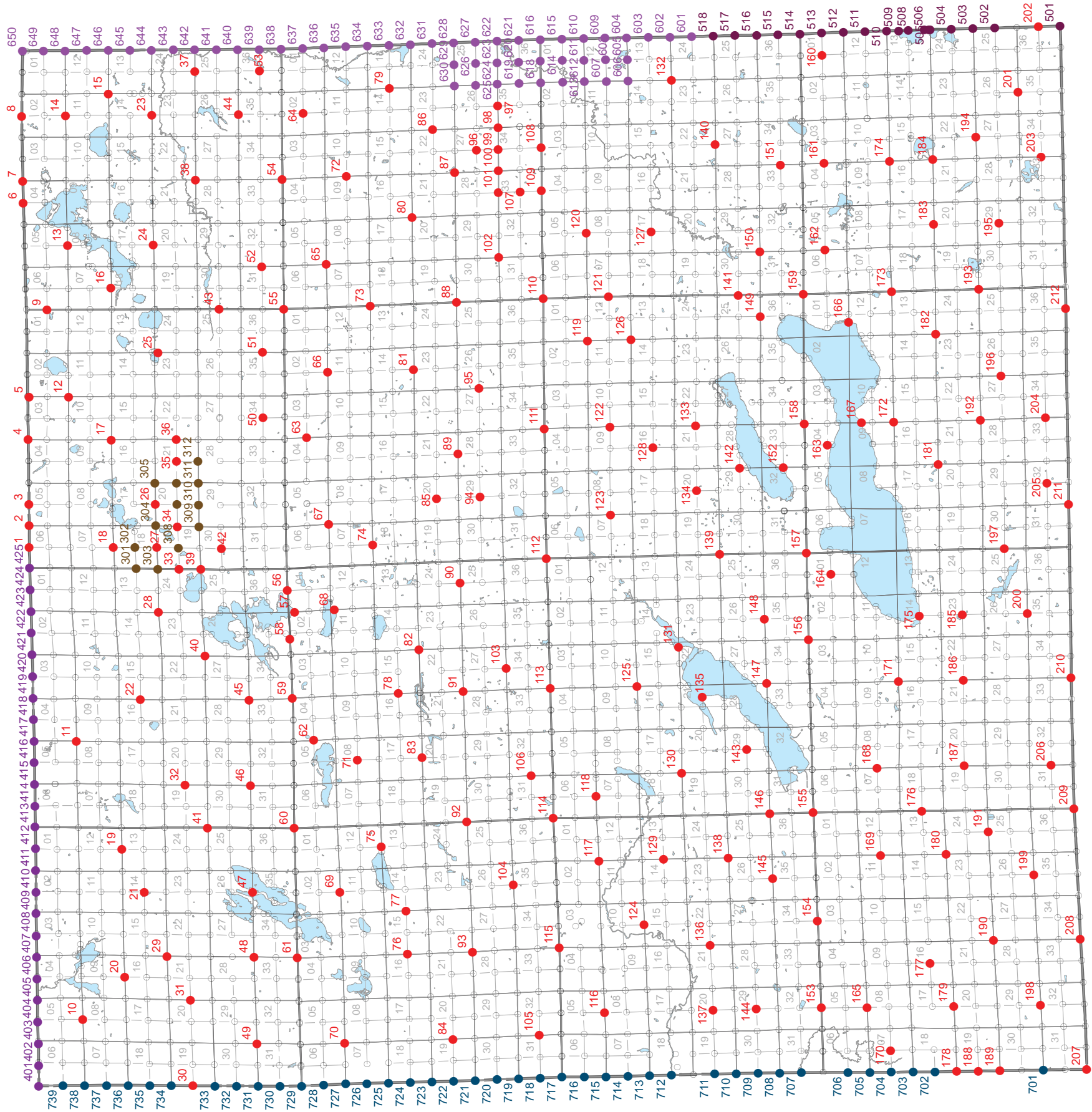
CORNER IDENTIFICATION NUMBER LOCATION GIVEN ON FIGURE 3

	Northing	Easting
Sum of Squared Differences.....	4.07	4.21
Average.....	-0.01	-0.02
Minimum Difference	-0.22	-0.21
Maximum Difference	0.22	0.22
RMSE.....	0.09	0.09
RMSE _{min} / RMSE _{max}	1.00	
NSSDA 95% RMSE Accuracy _r	0.21	
Note: RMSE _{min} / RMSE _{max} is between 0.6 and 1.0, Accuracy _r = 2.4477 * 0.5 *(RMSE _{Northing} + RMSE _{Easting})		

Source: SEWRPC.

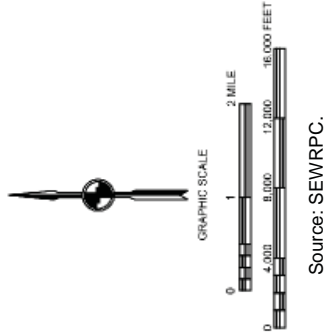
FIGURE 1

MAP OF WALWORTH COUNTY SHOWING US PUBLIC LAND SURVEY CORNERS OCCUPIED FOR GPS OBSERVATIONS TO DETERMINE NAD83 (2011) COORDINATES AS BASIS FOR DATUM CONVERSION COMPUTATIONS



LEGEND

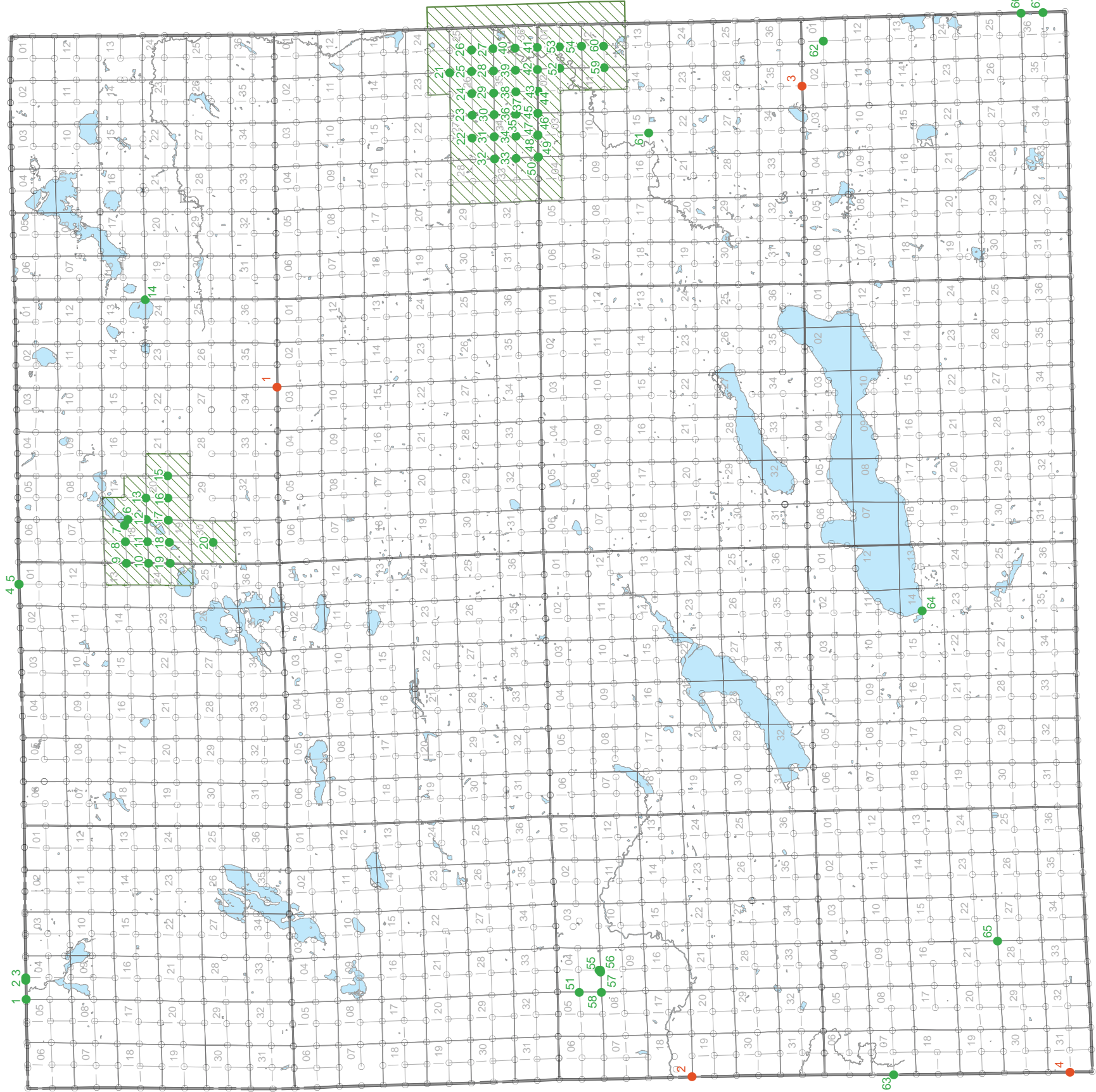
- Monumented USPLSS
Corners Recovered and Occupied for GPS
Observations to be Used as Basis for Datum Conversion Computations (212 Corners)
- Monimented USPLSS
Corners Either Recovered and Occupied for GPS
Observations or with Adjusted NAD83 (2011) Position Provided by the Jefferson County Surveyor (25 Corners)
- Monimented USPLSS
Corners Either Recovered and Occupied for GPS
Observations or with Adjusted NAD83 (2011) Position Determined in the Kenosha County Network Adjustment (18 Corners)
- Monimented USPLSS
Corners Either Recovered and Occupied for GPS
Observations or with Adjusted NAD83 (2011) Position Provided by the Rock County Surveyor (39 Corners)
- Monimented USPLSS
Corners Either Recovered and Occupied for GPS
Observations or with Adjusted NAD83 (2011) Position Determined in the Racine County Network Adjustment (50 Corners)



Source: SEWRPC.

MAP OF WALWORTH COUNTY SHOWING US PUBLIC LAND AND SURVEY CORNERS THE INITIALLY COMPUTED COORDINATES OF WHICH DID NOT MEET SURVEY CONTROL NETWORK ACCURACY STANDARDS

FIGURE 2



LEGEND

- Monumented Corner Not Meeting Network Accuracy Standards and Readjusted (67 Corners)
- USPLSS Corners Incorrectly Monumented (4 Corners)
- Problem Areas

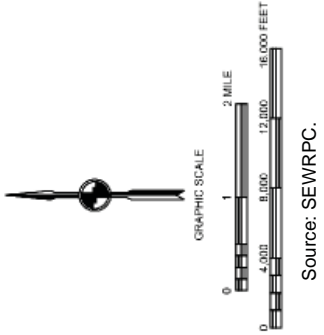
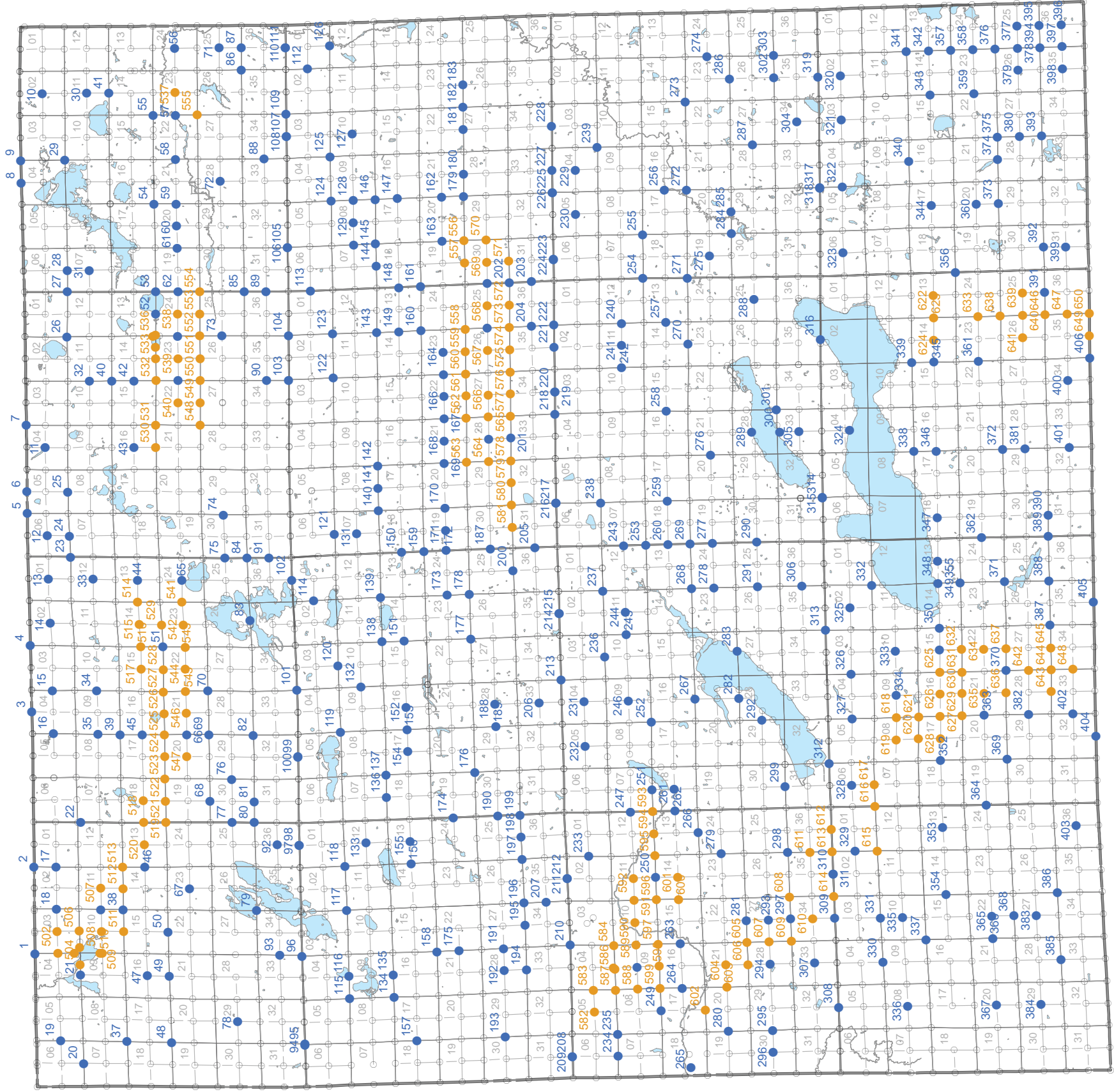


FIGURE 3

MAP OF WALWORTH COUNTY SHOWING US PUBLIC LAND AND SURVEY CORNERS OCCUPIED FOR GPS OBSERVATIONS TO VERIFY COMPUTED COORDINATE POSITIONS



LEGEND

- Monumented USPLSS Corners Recovered and Occupied for GPS Observations Providing Independent Check on the Accuracy of Computed NAD83 (2011) Coordinates
- WISDOT Provided Monumented USPLSS Corners Recovered and Occupied for Additional Observations Providing a Secondary Check on the Accuracy of Computed NAD83 (2011)

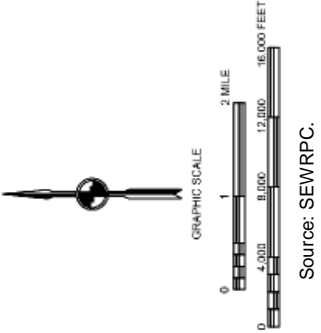


Figure 4

SAMPLE DOSSIER

RECORD OF U.S. PUBLIC LAND SURVEY CONTROL STATION	
U.S. PUBLIC LAND SURVEY CORNER $\frac{11}{14} \frac{12}{13}$	T <u>02</u> N, R <u>17</u> E, <u>WALWORTH</u> COUNTY, WISCONSIN
HORIZONTAL: NORTH AMERICAN DATUM OF 1927 VERTICAL: NATIONAL GEODETIC VERTICAL DATUM OF 1929 HOR. CONTROL: <u>AYRES ASSOCIATES</u> <u>2000</u> VERT. CONTROL: <u>AYRES ASSOCIATES</u> <u>2001</u> NORTHING: <u>237,298.25</u> USFT EASTING: <u>2,419,025.83</u> USFT ELEVATION: <u>972.618</u> FT HOR. ACCURACY: <u>3rd ORDER, CLASS I</u> VERT. ACCURACY: <u>2nd ORDER, CLASS II</u>	HORIZONTAL: NORTH AMERICAN DATUM OF 1983/2011 VERTICAL: NORTH AMERICAN VERTICAL DATUM OF 1988 (12) HOR. CONTROL: <u>SEWRPC</u> <u>2018</u> VERT. CONTROL: _____ NORTHING: <u>237,307.29</u> USFT EASTING: <u>2,387,488.96</u> USFT ELEVATION: _____ FT HOR. ACCURACY: <u>3rd ORDER, CLASS I (OBSERVED)</u> VERT. ACCURACY: _____
RBM ELEV. IN SKETCH BELOW TIED TO NGVD29 DATUM. CONVERSION FROM NGVD29 _____ FT DERIVES NAVD88 HEIGHT	
LOCATION SKETCH:	

SURVEYOR'S AFFIDAVIT:

 STATE OF WISCONSIN) SS
WALWORTH COUNTY)

As Walworth County Surveyor, I hereby certify that I set a cut limestone monument with Walworth County brass cap to mark this corner; replacing a five-inch-diameter by 30-inch-long concrete monument with iron pipe as set to mark this corner in 1972 by Thomas P.A. Jensen, S-1084; replacing a subsurface iron rod and still deeper remnants of an old wood stake in a nest of stones then marking this corner; that I referenced the same as shown hereon; and that this record is correct and complete to the best of my knowledge and belief.

DATE OF SURVEY: 24 MARCH 2000
Leland H. Kreblin
 REGISTERED LAND SURVEYOR

S - 1960

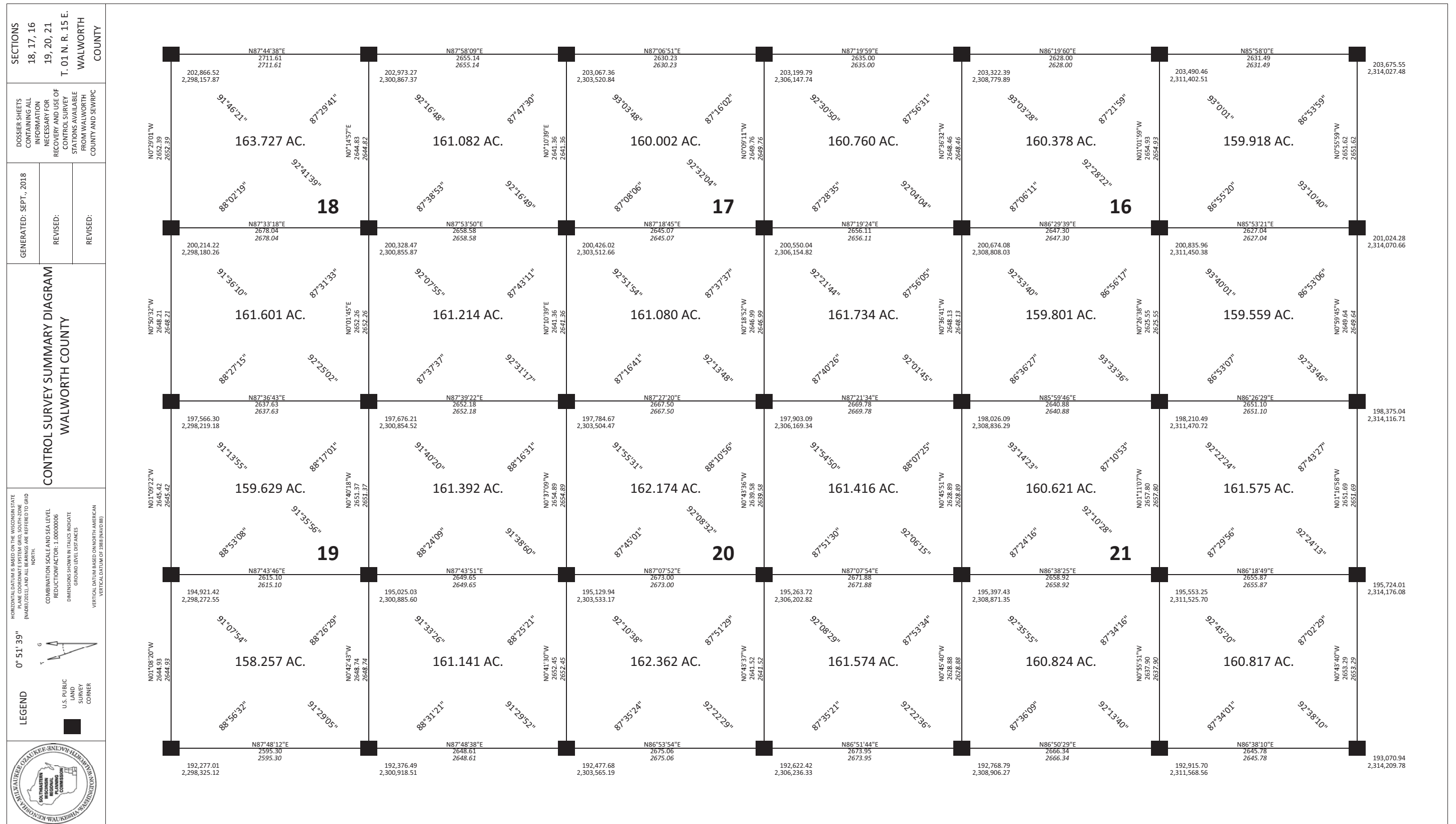
 FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION (SEWRPC)
 CERTIFICATION APPLIES ONLY TO THE LOCATION SKETCH AND SURVEYOR AFFIDAVIT

02170550

55 -

Source: SEWRPC.

SAMPLE CONTROL SURVEY SUMMARY DIAGRAM



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Appendix C

From

**SEWRPC ADDENDUM TO MEMORANDUM REPORT No. 206
“REVISED ESTIMATE OF THE COSTS OF CONVERTING THE LEGACY
DATUMS WITHIN THE REGION TO NATIONAL DATUMS”, AUGUST 2015**

INTRODUCTION

The seven-county Southeastern Wisconsin Region has an extensive and accurate network of both horizontal and vertical control survey stations. The integrated horizontal and vertical control survey stations are comprised of the 11,985 U.S. Public Land Survey System (USPLSS) corners within the Region and accessories thereto. The horizontal network is referenced to the North American Datum of 1927 (NAD 27), while the vertical network is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). The survey methods used to create the horizontal control network ranged from using theodolites and tellurometers to using Global Positioning System (GPS) instrumentation. The survey methods used to create the vertical control network ranged from using differential spirit leveling with invar rods read optically to using coded invar rods read automatically by the level instrument.

The introduction of newer technologies, especially the use of GPS instrumentation, has made the use of the legacy control survey network inconvenient when relating to newer datums created by the Federal government. The Commission continues to maintain the legacy control survey network in five of the seven counties comprising its Region and continues to monitor the use of the network within those counties. From time to time the Commission retains consultants to develop processes and/or mathematical formulas to assist surveyors, public works engineers, and other users in the use of the networks. However, some county land information system managers continue to request that the Commission investigate the means by which the legacy networks could be converted to newer datums and to estimate the attendant costs.

This appendix proposes new methods for converting the Commission legacy horizontal datum, from NAD 27 to the latest newer datum and adjustment—the North American Datum of 1983 with the National Adjustment of 2011, (NAD 83 (2011)), and for converting the legacy vertical datum from the NGVD 29 to the North American Vertical Datum of 1988 adjustment of 2012, (NAVD 88 (2012)), and to do so cost effectively.

METHODOLOGY FOR CONVERSION OF HORIZONTAL CONTROL

The Commission staff has developed a method for the conversion of its legacy horizontal control survey coordinate positions to the new horizontal datum while maintaining the relative positions of the legacy control survey stations, and maintaining the original accuracy standards of the network. The method utilizes the measurements made in the creation of the legacy horizontal control survey network within the Region and minimizes the number of field observations required to position the control survey stations on the new datum and

on the corresponding map projection. As already noted, the legacy network utilizes monumented corners of the USPLSS as control survey stations and, in effect, recreates the USPLSS within the Region tying that system to the National geodetic control system.

The datum conversion method developed by the Commission staff can be applied by subareas of the Region as small as six square miles in extent, although more practical subareas would consist of USPLSS townships, or of entire counties. When applied at the township level, the method requires field observations to obtain the coordinate positions of the township corners on the new datum together with such observations on a carefully selected number of control survey stations—approximately eight—consisting of section and quarter-section corners within the township. Four of the eight corners could be the four corners marking the exterior boundaries of a six-section SEWRPC Control Survey Summary Diagram (CSSD) used by the Commission to display the legacy control survey network. Having determined the coordinate positions on the new datum of approximately 12 USPLSS corners—the coordinates of the remaining 157 corners are computed using the lengths of the quarter-section lines and the interior angles of the quarter sections within the township as determined in the legacy survey. This computation consists of a least squares adjustment¹ of the network within the township.

Upon completion of the determination of the coordinate positions of all of the stations—USPLSS corners—within the area concerned, a small random sample of stations would be selected and the coordinate positions of these stations determined by additional field observations, thus providing a check on the accuracy of the completed conversion. If discrepancies exceeding the desired accuracy standards are found appropriate adjustments or further field measurements would have to be made.

The method developed by the Commission staff significantly reduces the cost entailed in datum conversion from such costs entailed in application of the conversion method proposed in SEWRPC Technical Report No. 206. Importantly, the method preserves the integrity of the legacy control survey network within the Region, maintaining the relative positions in the form of quarter-section-line lengths and bearings as determined in the creation of the legacy network, and does so within the accuracy standards of that network.

Field Observations

As noted, the conversion method requires the conduct of a limited number of field observations to determine the coordinate positions on the new datum of a carefully selected number of existing legacy stations. The necessary field observations would be made using state-of-the-art GPS instrumentation and procedures.

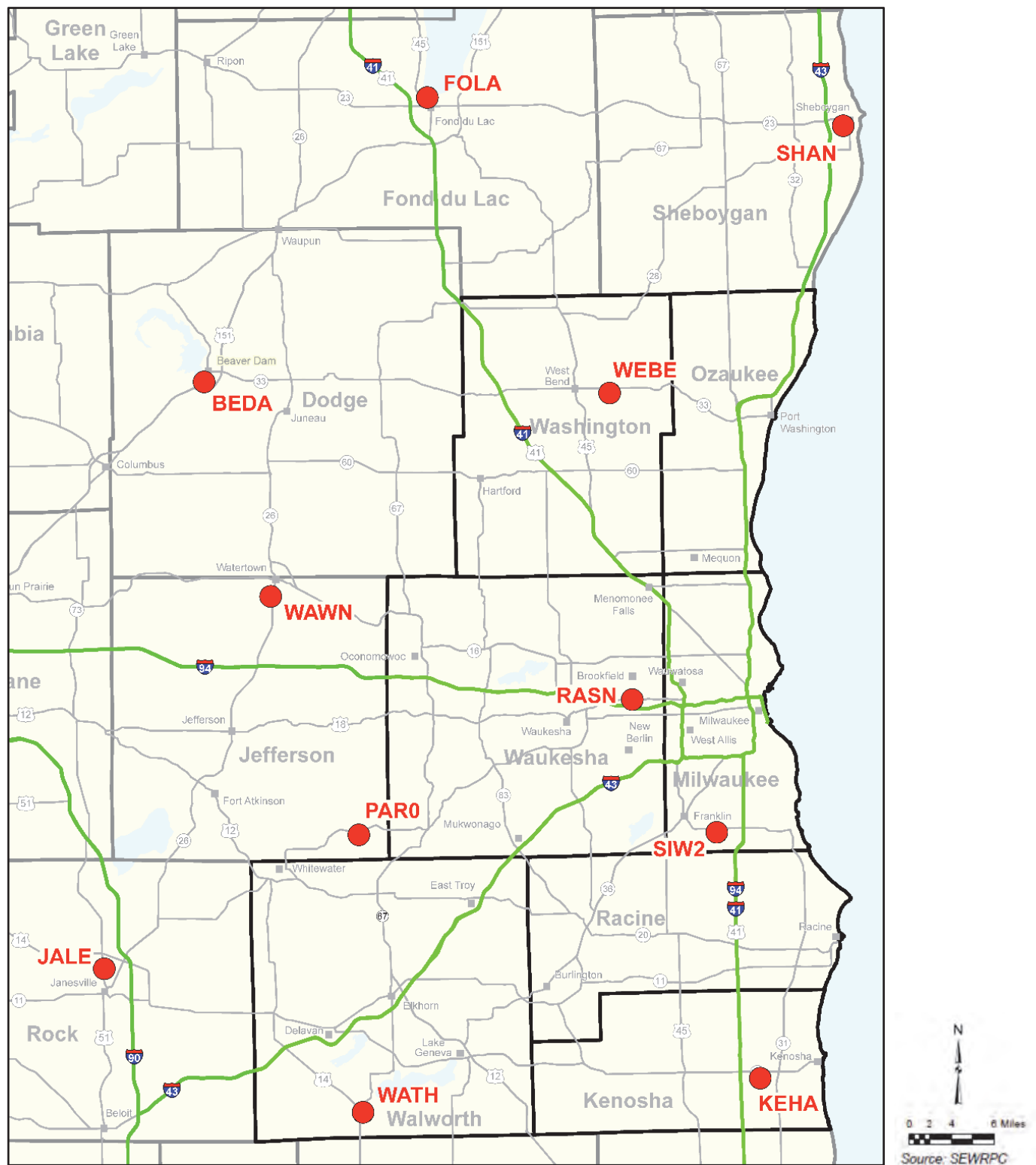
The Wisconsin Department of Transportation (WisDOT) completed a network of Continuous Operating Reference Stations (WISCORS) within the Region and the State in 2015. These stations within and adjacent to the Region are shown on Figure 1, and serve as the primary control network within the Region, replacing the old First- and Second-Order triangulation and base line stations. Satellite measurements permit the creation of a mathematical model that supports an online processing technology known as Virtual Reference Station (VRS) technology. This technology permits real-time positioning without the need for base stations and with minimal observation times while achieving centimeter-level accuracy. The VRS² technology is proposed to serve as the basis of the field measurements needed to determine horizontal positions in the new datum.

¹The term “least squares adjustment” refers to a mathematical procedure based on the theory of probability that derives the statistically most likely coordinate location of points defined by multiple measurements in a network. Moreover, a least squares adjustment defines a best-fit solution for weighed measurements finding a minimum for the sum of the squares of the measurement residuals. A measurement residual is the amount needed to correct a measurement for it to fit into the best-fit solution found by the least squares adjustment.

²For definition of VRS technology see Footnote 2, page 2, of Addendum.

Figure 1

WISCORS STATIONS IN AND ADJACENT TO THE SOUTHEASTERN WISCONSIN REGION



The following protocol would be followed in making the necessary field observations:

1. For each of the control survey stations—USPLSS corners—to be occupied, a copy of the SEWRPC “Record of U.S. Public Land Survey Control Station” (dossier sheet) shall be obtained.
2. The dossier sheet shall be used to recover the station, and a minimum of two of the tie distances from the station to witness marks shown on the dossier sheets shall be measured to ensure that the station has not been disturbed.
3. The following potential sources of error shall be considered and adjusted for in the measurement process: positional dilution of precision (PDOP), number of satellites visible, mask angle, potential multipath, and solar activity.
4. Each observation shall have a minimum duration of 5 seconds using a 1-second epoch rate.
5. At the end of the observation, the antenna of the instrument shall be set near the ground so a complete loss of satellite lock occurs. The antenna shall then be repositioned over the monument for an additional observation.
6. A minimum of three observations shall be made at each station occupied. The second and third direct observation shall also have at a minimum a duration of 5 seconds using a 1-second epoch rate.
7. Steps 5 and 6 shall be repeated as necessary to obtain the desired minimum of three observations.
8. The Root Mean Square Error (RMSE) of the three observations shall be calculated for each coordinate component (Northing, Easting, and Elevation) at each of the stations occupied using the following equation.

$$RMSE = \sqrt{\frac{\sum_{i=1}^N [Average_i - Check_i]^2}{N}}$$

Average_i = Average position of the Northing, Easting, or Elevation at the USPLSS Corner

Check_i = Northing, Easting, or Elevation value from the individual GPS observations at a USPLSS Corner

N = Number of observations at a USPLSS corner

9. The computed RMSE for the Northing, Easting, and Elevation components shall not exceed the following:
Northing 0.06 foot
Easting 0.06 foot
Elevation 0.09 foot
10. Additional observations shall be performed as required to meet the maximum allowable RMSE. Any combination of observations may be used to achieve the acceptable RMSE, provided all coordinate components (Northing, Easting, and Elevation) are used in the solution.

Computations

Two major computation phases are involved in the proposed horizontal datum conversion methodology. The first phase consists of the extraction of legacy system information. The second phase consists of a least squares adjustment converting the legacy positions to the new datum.

The use of legacy system information is considered the most significant feature of the proposed methodology. The use of this information will not only serve to reduce costs, but will assist in validating the control station positioning, and serve to identify any issues that might arise in the conversion process such as not achieving the desired accuracy standards in a part of the network.

TYPICAL SEWRPC CONTROL SURVEY SUMMARY DIAGRAM



Using the station – corner – identification system that is described in the next section (See Figure 3), Table 1 illustrates the format of the values to be extracted from CSSD to be used in the least squares adjustments.

C-7

Table 1**FORMAT OF INPUT TO LEAST SQUARE ADJUSTMENT**

Code (A: Angle)	Backsight – At – Foresight	Angle (Degrees – Minutes – Seconds)
A	0418144-0418169-0418168	89-18-45
A	0418145-0418144-0418169	90-44-58
A	0418168-0418145-0418144	89-33-17
A	0418169-0418168-0418145	90-23-00
A	0418145-0418168-0318012	89-24-08
Code (D: Distance)	From - To	Grid Distance (US Survey Feet)
D	0418144-0418169	2634.97
D	0418144-0418145	2562.27
D	0418169-0418168	2576.23
D	0418145-0418168	2637.62
D	0418168-0318012	21.74

Source: SEWRPC.

The first step in the least squares computation is to constrain the legacy control positions. This provides verification of the accuracy of the legacy control survey network as documented by each CSSD and the completeness of the input of the spatial measurements. After acceptance of the CSSD spatial measurements, additional CSSDs can be added to the network until the defined adjustment area has been completed.

Once the individual areas have been completed in this manner, a final step prior to incorporating the new positional data is the application of an effective weighting strategy. This is critical given the use of legacy measurements integrating with the precise GPS field observed positioning. An effective strategy will allow displacement of the differences (measurement residuals) found between the measurement types, and account for the numerous possible measurement paths between unconstrained USPLSS corners. The algorithms in a least squares adjustment provide a rigorous means for this. Tolerance and weights could change once the network design is applied to the entire subarea concerned. However, a typical half mile length, the weight assigned for the grid distance would be 0.03 foot and interior angle at 30 arc seconds. USPLSS corner positions (new datum positions) that have been observed but not constrained in the network adjustment would be assigned weights of 0.1 foot (both Northing and Easting).

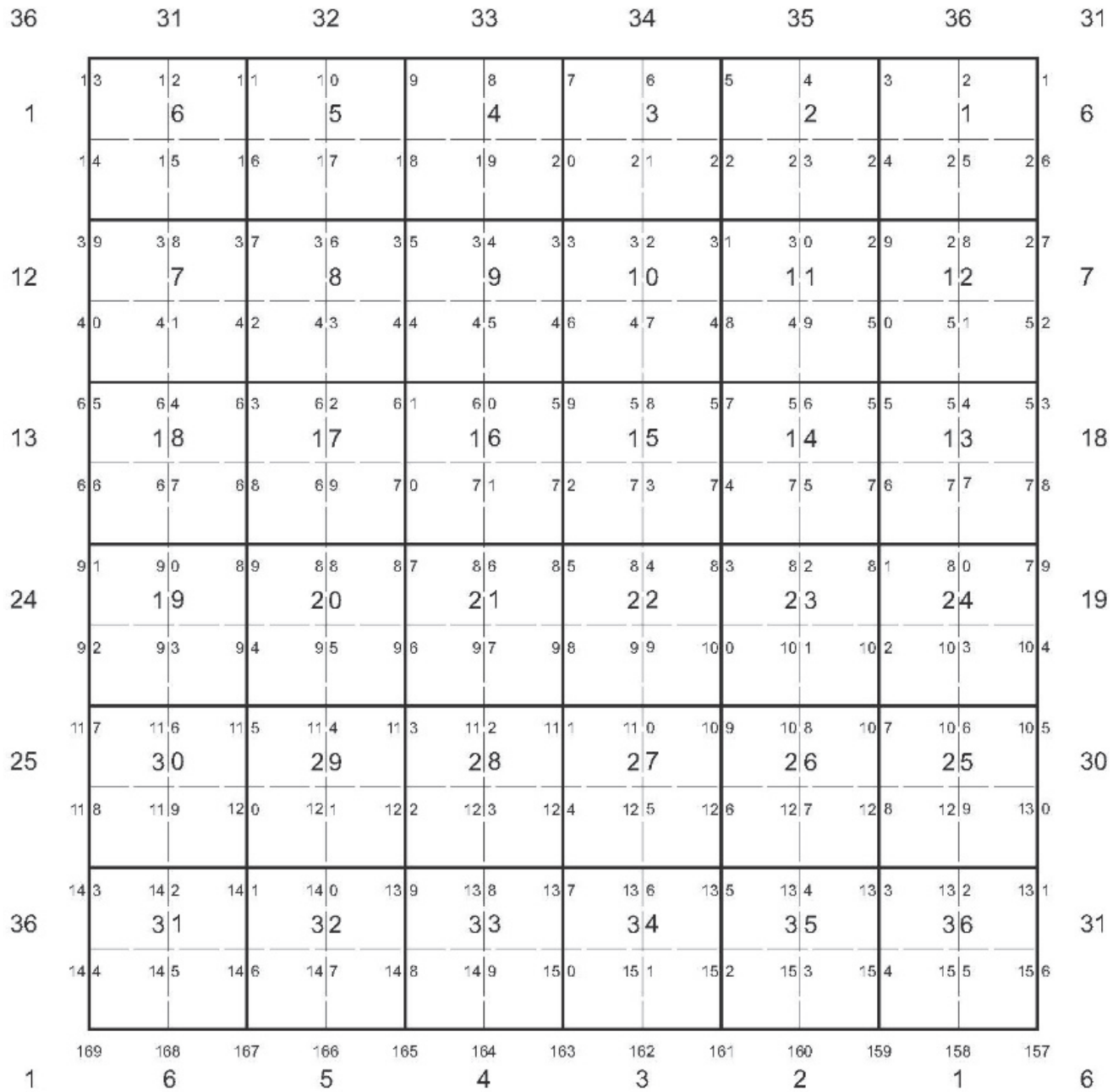
CONTROL SURVEY STATION NUMBERING

A control survey station numbering system will be required that provides a unique numeric identification for each control survey station in the network throughout the Region. This will allow stations to be used in multiple adjustments without conflict or duplication in the control networks. It is proposed to use the Commission's long-standing numbering system for this purpose. That system is illustrated in Figure 3.

Under the Commission system, the number identifying each station, while unique within each township, it is not unique for corners located along common range lines between two townships, or for common corners along township lines. The Commission system would be modified by adding a prefix to each corner number specifying the township and range. Corners along the eastern and southern boundaries of every township would be numbered

Figure 3

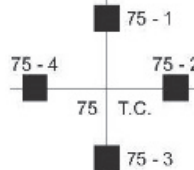
PROPOSED CONTROL SURVEY STATION – USPLSS CORNER – NUMBERING SYSTEM



T _____ N , R _____ E

MEANDER CORNER
NUMBERS

■ U.S.P.L.S. SECTION AND QUARTER
SECTION CORNERS WHICH
HAVE BEEN RELOCATED,
MONUMENTED, AND COORDINATED



NOTE: IF NUMBER IS RULED
OUT, SEE ABUTTING
TOWN FOR DOSSIER.
PREPARED BY: SEWRPC.

Source: SEWRPC.

according to the normal township numbering system. However, corners along the northern and western boundaries would be numbered using the numbers of the corners in the adjacent township. This provides a unique number for every corner and eliminates the possibility of corners having two numbers as would be the case if numbered by individual township. The northern boundaries of townships containing closing corners would be numbered as followed by the Commission system aside from the added town and range prefix.

DEMONSTRATION APPLICATION OF METHODOLOGY

A demonstration application of the horizontal datum conversion methodology developed by the Commission staff was carried out in July 2015. A typical 6-square-mile area consisting of Sections 28 through 33 in Township 4 North, Range 18 East, Town of East Troy, Walworth County, was selected for the demonstration.

The legacy data for the demonstration area are shown on Figure 4. The monuments marking four corners of the area, together with the monument marking the Southwest corner of Section 29 which is near the center of the area, were occupied and the coordinate positions of these corners on NAD 83 (2011) were determined by a GPS survey. The survey was conducted in accordance with the protocol set forth in this appendix. The newly determined coordinate positions for these five corners are shown on Figure 5.

The ground level lengths of the quarter-section lines within the area, together with the interior angles of the quarter sections, were extracted from the legacy data shown on the diagram comprising Figure 4. The ground level lengths of the quarter-section lines were reduced to grid lengths using the combination elevation and scale reduction factor for the State Plane Coordinate System based upon the new datum. A least square adjustment of the network was then used to compute the State Plane Coordinates³ of the remaining 30 stations—corners—within the area. The resulting values are shown on the diagram comprising Figure 5. The grid distances and bearings of the one-quarter section lines on the new datum were then determined by inverse computation from the new coordinate values. The grid distances were then converted to ground level distances using the combination factor for the new coordinate system. The areas of the quarter-sections were computed using the new ground level distances and bearings of the quarter-section lines. These results are also shown on the diagram comprising Figure 5.

Examination of the two diagrams comprising Figures 4 and 5 will show that the maximum change in the ground level length of the quarter-section lines between the legacy and new datums was 0.13 foot. The maximum change in the bearings of the quarter-section lines was 7 seconds of arc. The maximum change in the computed areas of the one-quarter sections was 0.011 acre.

Seven of the computed USPLSS corners were selected for an independent performance evaluation. These corners are identified on the diagram comprising the Figure 5. The monuments marking these corners were occupied and the coordinate position of these corners on the new datum determined by GPS survey. A comparison of the computed and the surveyed values is provided in Table 2. The maximum difference in the coordinate values of 0.23 foot falls well within the desired accuracy standard specified for the legacy network within the Region.

³The NAD 83 state plane coordinate values are defined in meters. For this appendix the metric values were converted to feet using the ratio of 39.37 inches per meter exact to 12 inches per U.S. Survey Foot, which approximates 1 meter equaling 3.280833333 U.S. Survey Feet.

Table 2

NAD83/2011 COMPUTED POSITIONS VERSUS GPS OBSERVED INDEPENDENT POSITIONS

USPLSS Corner	Computed		GPS Observed (July 23, 2015)			Delta (USFT)	
	Northing (USFT)	Easting (USFT)	Northing (USFT)	Easting (USFT)		Northing	Easting
0418123	287,734.64	2,404,333.97	287,734.73	2,404,333.98		0.09	0.01
0418150	282,482.37	2,407,019.81	282,482.60	2,407,019.82		0.23	0.01
0418167	279,705.08	2,396,443.96	279,705.12	2,396,443.88		-0.04	0.08
			GPS Observed (March 5, 2015)				
0418115	290,233.03	2,396,397.43	290,233.00	2,396,397.53		-0.03	0.10
0418116	290,194.98	2,393,758.74	290,194.87	2,393,758.84		-0.11	0.10
			GPS Observed (February 9, 2015)				
0417130	287,518.28	2,391,200.65	287,518.24	2,391,200.67		-0.04	0.02
0418131	284,893.05	2,391,206.35	284,893.08	2,391,206.29		0.03	-0.06
					Average:	0.03	0.01
					Maximum Difference:	0.23	0.10
					Minimum Difference:	-0.11	-0.08
					Standard Deviation:	0.11	0.07

Source: SEWRPC.

METHODOLOGY FOR CONVERSION OF VERTICAL CONTROL

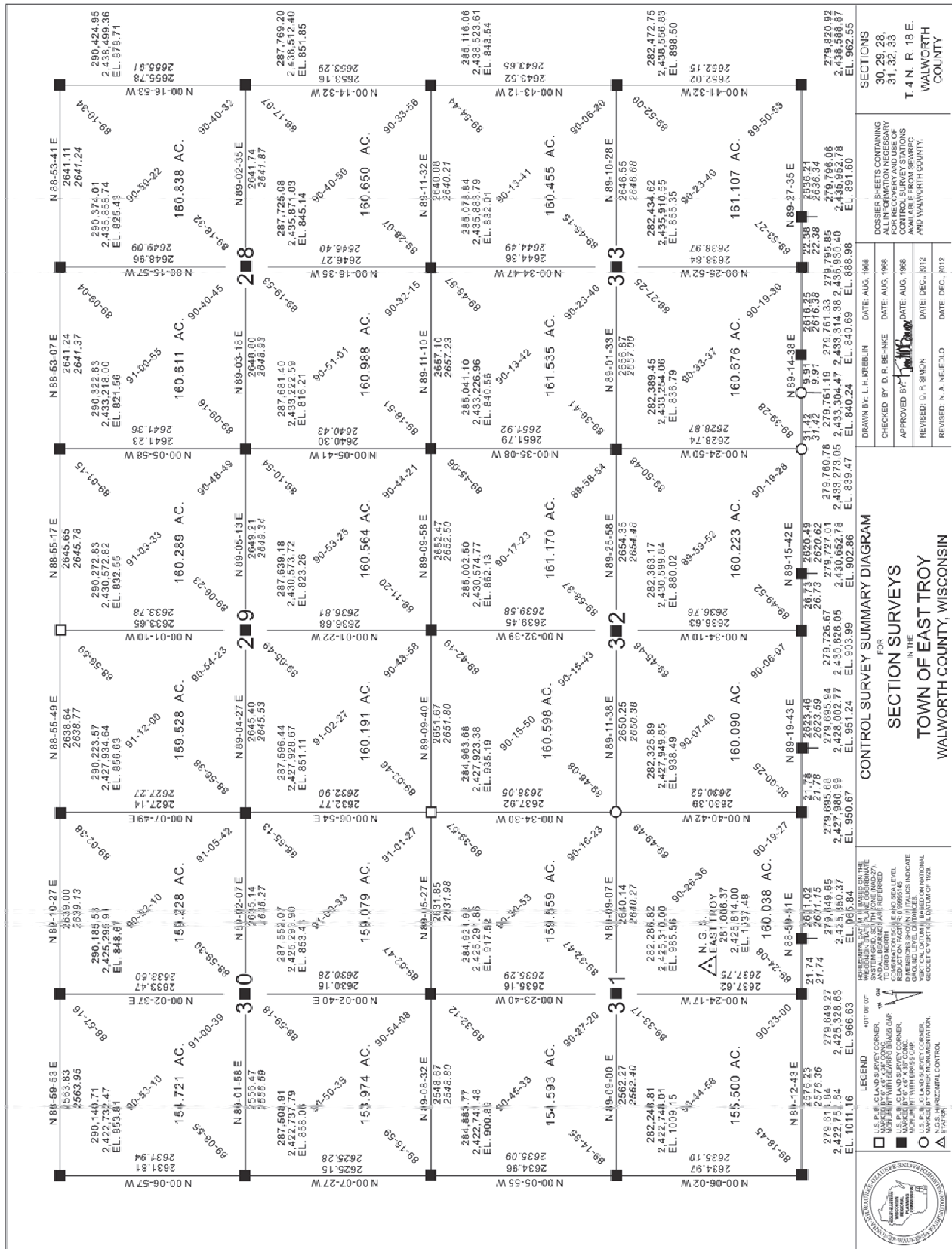
The foregoing text deals only with the datum conversion relating to horizontal positions. As noted in the addendum to which this appendix is attached, a similar problem exists relating to the vertical control survey network within the Region. The elevation data provided by the legacy vertical control survey network are based upon the NGVD 29. The National Geodetic Survey in 1977, began a new adjustment project that became the new vertical datum, the North American Vertical Datum of 1988 (NAVD 88). As is the case for horizontal positions, no precise mathematical relationship exists between the legacy and new datums. The Commission in 1995, published SEWRPC Technical Report No. 35, *Vertical Datum Differences in Southeastern Wisconsin*. That report provided a means for converting elevations from the legacy datum to the new datum and provided an iso-hypsometric map to facilitate the conversion of orthometric heights and elevations from one datum to the other. The iso-hypsometric map provided in SEWRPC Technical Report No. 35 was based on the interpolation of datum differences computed for points located on a 10,000-foot grid using VERTCON. The validity of VERTCON was checked by using the datum differences at the 435 NGS (former U.S. Coast and Geodetic Survey) bench marks within the Region as published by NGS.

Since the completion of SEWRPC Technical Report No. 35, the Wisconsin Department of Transportation (WisDOT) in conjunction with NGS completed the Wisconsin Height Modernization Program (WI-HMP) within the Region. This program provided high-order orthometric height data on a carefully distributed network of substantial monumented bench marks. The locations of these bench marks are shown on Figure 6. The orthometric heights determined for these bench marks are referred to NAVD 88 (2012).

It is proposed to effect the conversion of elevations between the legacy and new datum by establishing accurate, measured legacy datum elevations on each of the 460 height modernization stations within the Region, thus, establishing an accurate, measured relationship between the two datums on each of the stations. The legacy datum elevations would be established by differential level surveys connecting the Commission legacy bench marks to the height modernization stations. Such transfer should involve no more than the survey of approximately one-half mile of high-order differential level lines for each transfer.

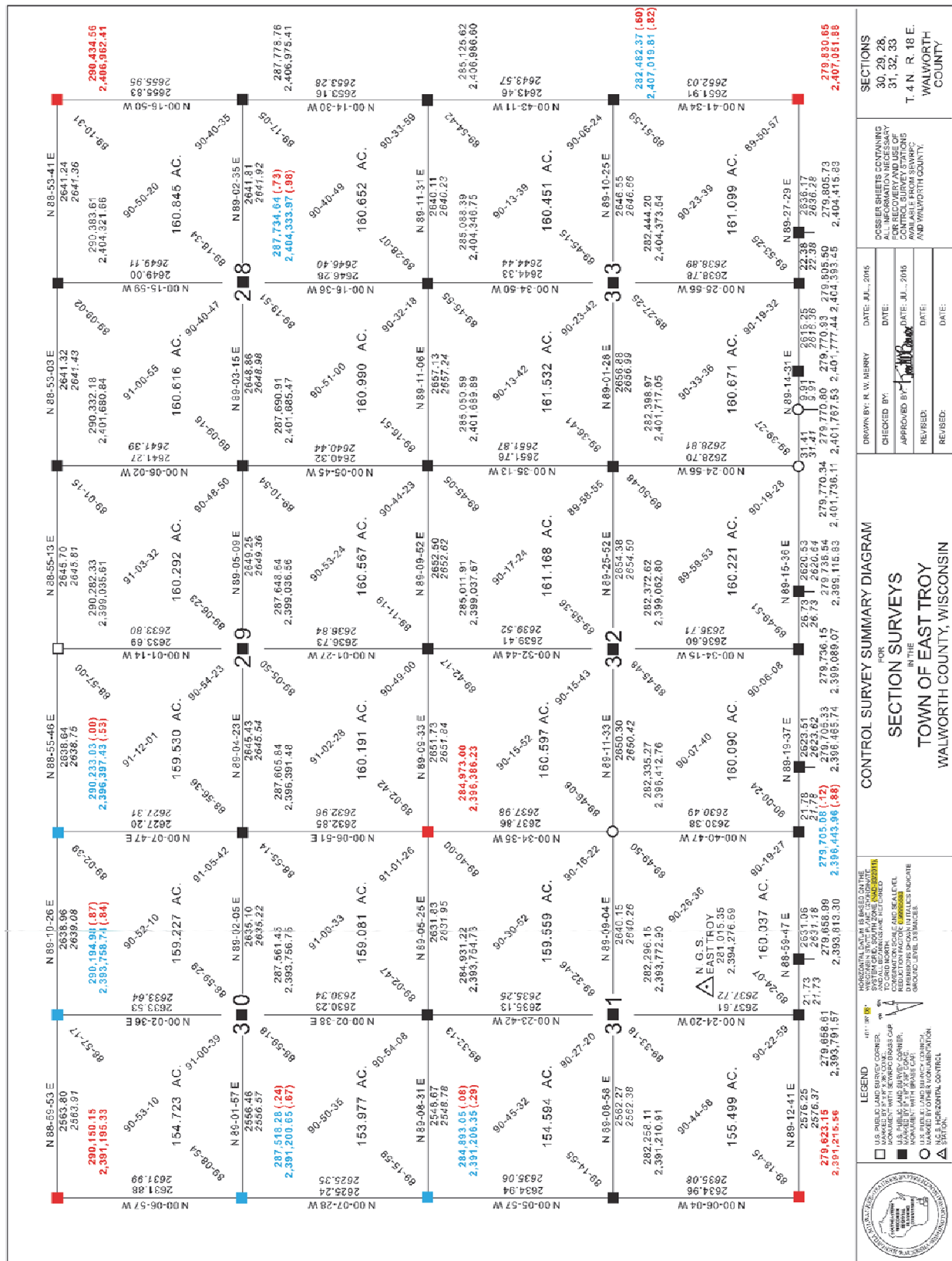
Using the accurate differences between the two datums as determined by actual differential level survey for each datum, a new iso-hypsometric map of the Region can be prepared. This map may be expected to be more accurate than the map provided in SEWRPC Technical Report No. 35. This map can then be used to transfer orthometric heights and elevations between the two datums to Second-Order, Class II accuracy standards.

SEWRPC CONTROL SURVEY SUMMARY DIAGRAM – NAD 27



Source: SEWRPC.

SEWRPC CONTROL SURVEY SUMMARY DIAGRAM – NAD 83 (2011)



Source: SEWRPC.

WISCONSIN HEIGHT MODERNIZATION BENCH MARKS WITHIN THE SOUTHEASTERN WISCONSIN REGION



REVISED “RECORD OF USPLSS CONTROL STATION” DOCUMENTS

The Commission has prepared and maintains a document known as “Record of U.S. Public Land Survey Control Station” for each of the more than 11,000 control survey stations – USPLSS corners within, and in a few cases, adjacent to the Region. These documents are commonly referred to as “dossier” sheets. As a control survey station is converted from the legacy to the new datums, a new dossier sheet will have to be provided. A revised format will be required for the dossier sheets and a proposed format is provided in Figure 7. The proposed format provides for the display of dual horizontal positions and vertical heights of the station.

Figure 7

REVISED “RECORD OF U.S. PUBLIC LAND SURVEY CONTROL STATION”

RECORD OF U. S. PUBLIC LAND SURVEY CONTROL STATION			
U. S. PUBLIC LAND SURVEY CORNER		30/29 31/32	T 4 N, R 18 E, WALWORTH COUNTY, WISCONSIN
HORIZONTAL CONTROL SURVEY BY: SEWRPC		YEAR: 2001	HORIZONTAL CONTROL SURVEY BY: SEWRPC
VERTICAL CONTROL SURVEY BY: OWEN AYRES / SEWRPC		YEAR: 2002/2012	VERTICAL CONTROL SURVEY BY: SEWRPC
HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1927		HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (2011)	
VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929		VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (2012)	
STATE PLANE COORDINATES OF:		STATE PLANE COORDINATES OF:	
NORTHING: 284,963.68 USFT		NORTHING: 284,973.00 USFT	
EASTING: 2,427,923.38 USFT		EASTING: 2,396,386.23 USFT	
ELEVATION: 935.187 FT		ELEVATION:	
HORIZONTAL ACCURACY: THIRD ORDER, CLASS I		HORIZONTAL ACCURACY: THIRD ORDER, CLASS I (GPS OBSERVED)	
VERTICAL ACCURACY: SECOND ORDER, CLASS II		VERTICAL ACCURACY: SECOND ORDER, CLASS II (INTERPOLATED)	

LOCATION SKETCH:

SURVEYOR'S AFFIDAVIT:

STATE OF WISCONSIN) SS
WALWORTH COUNTY)

As Walworth County Surveyor, I hereby certify that following water main construction, I set a concrete monument with SEWRPC brass cap to mark the location of this corner; replacing a concrete monument with Walworth County brass cap set to mark the location of this corner in September 1985 by Lloyd L. Jensen, S-211, former Walworth County Surveyor; replacing a cast iron plug with cross set in the then existing bituminous driveway pavement in October 1961 by George A. Swier, State Highway Commission of Wisconsin Project Engineer, following highway reconstruction; that I have referenced the same as shown hereon; and that this record is correct and complete to the best of my knowledge and belief.

DATE OF SURVEY: 23 JULY 2007

REGISTERED LAND SURVEYOR

S - 157

141

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

COSTS

The costs of the various major work elements involved in datum conversion were estimated separately for the horizontal and vertical components of the work entailed. The costs were developed by analyzing the major work elements of each of the two conversions.

For the horizontal datum conversion, six major work elements were considered:

1. The extraction of the data required from the legacy control survey network. These data include the location and monumentation of existing control survey stations—USPLSS corners; the lengths of the quarter-section lines; the interior angles of the quarter-sections; and attendant combination scale and sea level reduction factors.
2. The necessary field observations including the recovery of a set of carefully located and distributed legacy control survey stations and the conduct of the GPS observations on these stations as required to determine the coordinates of the stations concerned referred to NAD 83 (2011).
3. The determination of the coordinate positions of all of the other stations in the network concerned utilizing the data extracted from the legacy network.
4. Selection of an approximately 10 percent sample of the stations having computed coordinates for occupation and GPS survey to check the coordinate values of the selected stations.
5. Preparation of new “Record of U.S. Public Land Survey Control Station” document—dossier sheet—for each of the control survey stations concerned.
6. Preparation and publication of a project completion report.

For each of these major work elements, estimates were made of the direct and indirect labor costs, of the associated overhead costs, and an allowance for contingencies. These costs are set forth in Table 3. The costs of such items as mileage, equipment, and report preparation would need to be estimated on a job-by-job basis, assuming that the Commission performs the work entailed. Estimates were made of the cost of implementation of the horizontal datum conversion for the seven-county Region as a whole; and for implementation by subarea—namely by survey township. These costs are presented in Tables 3 through 5. In any consideration of these cost estimates, it should be recognized that precise estimates, of the costs of completion of the work by a specific county, or by specific subarea, are possible only on the basis of a more detailed study design for the conduct of the work by the area concerned. Consequently, the costs of the work elements set forth in the Tables 3 through 5 must be considered tentative and changes in the allocation of costs to work elements must be expected as the work proceeds. It should be noted that if the datum conversion is implemented by subarea, the cost of completing a larger area, such as a county or the Region, as a whole, will be somewhat higher.

The costs of the work would have to be borne by those individual county land information systems that desire the horizontal datum conversion to be completed. Work could be accomplished for the county as a whole or by subareas, particularly survey townships. The estimated cost by county is provided in Table 4 and by typical township in Table 5.

For the vertical datum conversion, four major work elements were considered:

1. The high-order differential level circuits required to determine accurate elevations referred to NGVD 29 for each of the 460 Height Modernization stations within the Region. The total length of the level lines was estimated at approximately 250 miles.
2. The computation of the surveyed vertical datum differences at each of the 460 height modernization stations.
3. Preparation of a new iso-hypsometric map of the Region by interpolation of the datum differences found at the 460 height modernization stations.
4. Preparation and publication of a project completion report.

Table 3**COST ESTIMATE – HORIZONTAL DATUM CONVERSION - SEVEN COUNTY REGION**

Description	Cost
Extraction of Legacy Measurements	\$49,600
Field Observations	
• Labor	179,520
Contingency for Additional Field Observations and Time for Inclusion into Least-Squares Adjustments	19,680
Determination of Coordinate Positioning using selected NAD83/2011 field observation and extracted legacy measurements	33,000
Preparation of new "Record of U.S. Public Land Survey Control Station" documents and Control Survey Summary Diagrams	118,400
Total	\$400,200 ^a

^aVehicle mileage and equipment costs must be estimated on a job-by-job basis; therefore, no line items are included for these costs in the table.

Source: SEWRPC.

Table 4**COST ESTIMATE – HORIZONTAL DATUM CONVERSION – INDIVIDUAL COUNTY**

Description	Cost						
	Kenosha County	Milwaukee County	Ozaukee County	Racine County	Walworth County	Washington County	Waukesha County
Extraction of Legacy Measurements	\$5,080	\$4,400	\$4,400	\$6,360	\$10,520	\$7,960	\$10,880
Field Observations							
• Labor	18,240	16,200	15,960	23,040	38,400	28,800	38,880
Contingency for Additional Field Observations and Time for Inclusion into Least-Squares Adjustments	1,920	1,500	1,800	2,520	3,840	3,240	4,860
Determination of Coordinate Positioning using selected NAD83/2011 field observation and extracted legacy measurements	3,520	2,640	3,520	4,400	7,040	4,400	7,480
Preparation of new "Record of U.S. Public Land Survey Control Station" documents and Control Survey Summary Diagrams	12,136	10,656	10,360	14,800	25,456	19,240	25,752
Individual County Total	\$40,896 ^a	\$35,396 ^a	\$36,040 ^a	\$51,120 ^a	\$85,256 ^a	\$63,640 ^a	\$87,852 ^a

^aVehicle mileage and equipment costs must be estimated on a job-by-job basis; therefore, no line items are included for these costs in the table.

Source: SEWRPC.

For each of these major work elements, estimates of the costs were made in the same manner as for the horizontal datum conversion work.

As a practical matter, the work entailed in vertical datum conversion should be completed for the Region as a whole. These costs are presented in Table 6. The costs of the work would have to be borne by the individual county land information systems. The costs could be distributed among the counties on the basis of any system agreed to by the seven-county land information systems. One such possible system would utilize the proportional area that each county comprises of the Region. The application of this system is illustrated in Table 7.

Table 5

COST ESTIMATE - HORIZONTAL DATUM CONVERSION - TYPICAL TOWNSHIP

Description	Cost
Extraction of Legacy Measurements	\$ 960
Field Observations	
• Labor	3,600
Contingency for Additional Field Observations and Time for Inclusion into Least-Squares Adjustments	720
Determination of Coordinate Positioning using selected NAD83/2011 field observation and extracted legacy measurements	880
Preparation of new "Record of U.S. Public Land Survey Control Station" documents and Control Survey Summary Diagrams	1,480
Total	\$7,640 ^a

^aVehicle mileage and equipment costs must be estimated on a job-by-job basis; therefore, no line items are included for these costs in the table.

Source: SEWRPC.

Table 6

COST ESTIMATE – VERTICAL DATUM CONVERSION - SEVEN COUNTY REGION

Description	Cost Breakdown
High Order Differential Level Circuits to Determine Accurate NGVD 29 Elevations on 460 Height Modernization Bench Marks within Region	\$177,408
Compilation and Computations Supporting the Vertical Differences of the Height Modernization Bench Marks	26,400
Preparation of new Iso-Hypsometric Map	8,800
Preparation and Publication of Project Completion Report	13,200
Preparation of new "Record of U.S. Public Land Survey Control Station" documents and Control Survey Summary Diagrams	76,960
Total	\$302,768

Source: SEWRPC.

Table 7

COST ESTIMATE - VERTICAL DATUM CONVERSION - INDIVIDUAL COUNTY

Description	Percent of Regional Area	Cost
Kenosha County	10.3	\$31,185
Milwaukee County.....	9.0	27,249
Ozaukee County	8.8	26,644
Racine County	12.7	38,452
Walworth County.....	21.4	64,792
Washington County.....	16.2	49,048
Waukesha County.....	21.6	65,398
Total	100.0	\$302,768

Source: SEWRPC.