TENNESSEE DEPARTMENT

OF

TRANSPORTATION

TENNESSEE GEODETIC REFERENCE NETWORK

** * * TGRN * * **

REFERENCE MANUAL

Second Edition

Issued by the Design Division

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NETWORK DESCRIPTION

The Tennessee Geodetic Reference Network (TGRN) consists of sixty (60) highly accurate, three-dimensional marks spaced evenly across the state. Most locations in the state fall within 25 kilometers (15 miles) from a network station, a suitable reference distance for surveys performed by single or dual frequency Global Positioning System (GPS) receivers.

The network has been surveyed to Order B geodetic accuracy standards as specified in the "Proposed Geometric Geodetic Survey Standards and Specifications for Geodetic Surveys Using GPS Relative Positioning Techniques," (Hothem 1986). It is tied to the North American Datum of 1983 (NAD/83) by connections to three (3) stations of the National Geodetic Survey (NGS) Eastern United States Strain Network. Internal accuracies of the network stations exceed 1:1,000,000. Coordinates are described as NAD 83 (1995).

Azimuth points are located at twelve (12) of the TGRN stations and others may be added in the future. However, the TRGN is intended as a reference for GPS surveys, which require no azimuth marks, and their installation is of low priority. Existing azimuth marks and any future points will be fully described in this document.

Monuments at TGRN stations are brass caps in exposed bedrock outcroppings or driven steel rods encased in PVC pipe with access covers. Most stations have a fiberglass or conventional metal witness post nearby.

The T.D.O.T. is responsible for maintenance of the TRGN and any pertinent information concerning potential or existing problems at monument sites will be appreciated. Any destruction of the monument or witness post, new or proposed development in the immediate area, changes in visibility around the mark, etc., should be reported to the T.D.O.T. Survey Coordinator, Design Division, 1300 James K. Polk Bldg., Nashville, Tennessee 37243-0348, 615-532-3135. Users should also be careful to insure that access covers are tightly closed upon completion of a survey.

USE OF THIS MANUAL

This document is designed to provide the user with information necessary for locating and using the stations of the Tennessee Geodetic Reference Network (TGRN) as reference points for GPS surveys.

In addition to summary sheets listing station coordinates, etc., each of the sixty (60) network stations are described by three sheets as follows:

Description: Contains all pertinent written information relative to the mark, including coordinates, elevation, location, to reach, etc.

Visibility Diagram: A standard visibility diagram illustrating, in most cases, any obstructions extending above 10^0. Obstructions below 10^0 may not be shown, however if clear visibility extends below 10^0, it will be so noted.

Quad Sheet: The station is indicated on a portion of a USGS quadrangle map, scale 1:24,000.

The map is placed such that north is toward the top of the page. Stations with azimuth marks have an additional description sheet and visibility diagram for the azimuth marks.

Any error or inaccuracies in the descriptions, visibility diagrams or quad sheets should be reported to the T.D.O.T. Survey Coordinator as shown on the previous page.

EXPLANATION OF DATA

It should be noted that state plane coordinates and ellipsoid values are given in meters. The T.D.O.T. converts meters to U.S. Survey Feet for design computations. The conversion is accomplished by multiplying meters by 39.37/12, which is 3.28083333333 to 12 significant figures.

Elevations are given in feet and meters, referenced to the NAVD 1988 and are considered accurate to the nearest listed decimal. Elevations of the network stations were determined using conventional spirit leveling, performed to second order closure standards. Elevations for the replacement stations were computed using the WGS 84 Reference Ellipsoid and the Geoid 96 model, as noted throughout this document. Elevations for azimuth marks were determined from computations using the WGS 84 Reference Ellipsoid and the Geoid 96 Model.

Azimuth marks were surveyed as part of a GPS project separate from the TGRN survey previously described. The requirement for azimuth mark accuracy was First Order (1:100,000).

USE OF THE NETWORK

As previously stated, the TGRN is designed primarily as a reference system for GPS surveys. It was developed and is owned by T.D.O.T. However, it is also part of the NGRS and available for public use.

The T.D.O.T. reserves the right of access to TGRN stations at any time required to meet work schedules. To avoid potential conflicts, other users should contact T.D.O.T. offices, as noted below, before stations are occupied. Station occupation by other than T.D.O.T. crews will generally be on a first come first served basis. However, special consideration will be given to certain uses, e.g., crustal motion surveys, research projects, etc.

T.D.O.T. Contacts – Special Projects

All Regions:	Survey Coordinator Design Division 1300 James K. Polk Bldg. Nashville, TN 37234-0348	Phone - (615) 532-3135 Fax - (615) 532-2799

T.D.O.T. Contacts – Usual Survey Projects

Region 1:	GPS Crew Supervisor Regional Survey Office Supervisor Survey Office 7345 Region Lane Knoxville, TN 37914	Phone - (423) 594-9406 Phone - (423) 594-9387
Region 2:	GPS Crew Supervisor Regional Survey Office Supervisor Survey Office P.O. Box 22368 Chattanooga, TN 37422	Phone - (423) 510-1146 Phone - (423) 510-1240
Region 3:	GPS Crew Supervisor Regional Survey Office Supervisor Survey Office 6601 Centennial Boulevard Nashville, TN 37243-0360	Phone - (615) 350-4255 Phone - (615) 350-4252
Region 4:	GPS Crew Supervisor Regional Survey Office Supervisor Survey Office 300 Benchmark Place Jackson, TN 38302	Phone - (423) 935-0138 Phone - (423) 935-0137

It is recommended that GPS survey projects utilizing the TGRN as a reference begin at a station of the TGRN and end at another station of the TGRN. Network points are relatively closely spaced across the state making this procedure easily possible. Projects should not be tied to conventional stations of the NGRS. Such factors as local distortion, extreme differences in accuracy etc. may result in closures worse that the published accuracy of the NGRS stations. The NGRS will, at some point, publish a re-adjustment of the NGRS in Tennessee relative to the TGRN. This adjustment should significantly improve the quality of ties between TGRN and NGRS points. However, for best results, GPS surveys should be adjusted to TGRN stations exclusively.

Some network stations are located at city/county airports and require permission for entry to the property. The station description includes directions for obtaining entry. If, however, those procedures fail, contact should be made with the local police or county sheriff's office. Contact with the airport office during working hours when nighttime observations are required is also strongly recommended. The fields are often locked and local police usually do not have keys.

There are a number of factors which influence the relationship between geoid height, ellipsoid height and orthometric elevation. Consequently, a precise geoid elevation is not always derived from differencing the elevation and ellipsoid height listed in this document. However, T.D.O.T. has in most cases found this procedure to be satisfactory for engineering work.

TENNESSEE GEODETIC REFERENCE NETWORK LISTING

1983 (1995) DATUM

STATION NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	NORTHING (Y) (meters)	EASTING (X) (meters)	ZONE	CONVERGENCE D	M	S	SCALE FACTOR	ELLIPSOID ELEVATION (meters)	NAVD88 ELEV. (meters)
GPS 1	36 22 6.43923	82 10 46.87679	232489.480	942754.124	TN	+ 2	14	11.6	0.99999180	442.787	475.044
GPS 2	36 24 5.68835	82 36 45.67357	234732.431	903795.239	TN	+ 1	58	59.0	0.99999736	501.520	532.898
GPS 3	36 27 23.98466	82 53 12.35190	240025.304	879028.538	TN	+ 1	49	21.4	1.00000734	349.671	381.081
GPS 4	36 21 0.80437	83 23 36.35206	226891.329	833944.070	TN	+ 1	31	33.6	0.99998889	560.426	591.542
GPS 5	36 21 19.01611	83 50 37.77662	226468.911	793515.132	TN	+ 1	15	44.3	0.99998969	347.467	378.005
GPS 6	36 24 50.17099	84 16 51.61977	232199.681	754168.868	TN	+ 1	0	22.9	0.99999952	532.285	561.711
GPS 7	36 21 32.15041	84 49 55.88927	225367.296	704811.214	TN	+ 0	41	1.3	0.99999027	456.818	485.650
GPS 8	36 26 26.05199	85 14 39.27422	234062.789	667760.442	TN	+ 0	26	32.8	1.00000433	283.553	314.137
GPS 9	36 23 12.08772	85 38 11.58508	227882.940	632608.894	TN	+ 0	12	46.0	0.99999482	134.525	164.757
GPS 10	36 25 20.90063	86 10 56.62007	231808.158	583642.796	TN	- 0	6	24.4	1.00000103	124.633	154.109
GPS 11	36 25 3.03384	86 43 2.18380	231477.921	535671.167	TN	- 0	25	11.7	1.00000015	220.749	250.351
GPS 12	36 26 56.15662	87 5 55.14863	235281.953	501507.416	TN	- 0	38	35.5	1.00000588	182.866	212.305
GPS 13	36 26 12.08662	87 28 39.59121	234370.897	467511.300	TN	- 0	51	54.3	1.00000361	104.652	134.104
GPS 14	36 27 55.87137	87 59 17.61954	238379.917	421804.201	TN	- 1	9	50.4	1.00000903	115.117	144.058
GPS 15	36 20 29.80229	88 22 43.77071	225415.400	386468.876	TN	- 1	23	33.6	0.99998755	144.686	173.017
GPS 16	36 18 40.14105	88 46 14.11174	222961.771	351216.147	TN	- 1	37	19.2	0.99998299	95.615	123.814
GPS 17	36 17 0.92962	89 12 15.25245	221094.024	312189.551	TN	- 1	52	33.2	0.99997910	66.419	94.670
GPS 18	36 11 36.69841	82 48 47.61259	211054.539	886567.843	TN	+ 1	51	56.4	0.99996802	457.171	488.499
GPS 19	35 58 12.57726	83 15 33.63286	185065.499	847156.481	TN	+ 1	36	16.2	0.99995121	368.487	399.303
GPS 20	35 59 46.63703	83 42 37.72458	186918.108	806412.669	TN	+ 1	20	25.4	0.99995239	277.894	308.663
GPS 21	35 58 32.57520	84 10 42.59261	183749.668	764266.219	TN	+ 1	3	59.0	0.99995145	272.178	302.843
GPS 22	35 58 13.97076	84 29 53.89903	182686.679	735436.740	TN	+ 0	52	44.9	0.99995123	218.050	248.072

TENNESSEE GEODETIC REFERENCE NETWORK LISTING

1983 (1995) DATUM

STATION NAME	LATITUDE (NORTH)			LONGITUDE (WEST)			NORTHING (Y) (meters)	EASTING (X) (meters)	ZONE	CONVERGENCE			SCALE FACTOR	ELLIPSOID ELEVATION (meters)	NAVD88 ELEV. (meters)
										D	M	S			
GPS 23	35	59	59.73334	85	2	40.17756	185327.762	686146.592	TN	+ 0	33	33.8	0.99995258	504.701	533.472
GPS 24	36	0	18.93229	85	30	12.08369	185612.552	644773.926	TN	+ 0	17	26.7	0.99995285	285.308	314.526
GPS 25	36	0	13.92199	85	58	26.32378	185344.838	602345.939	TN	+ 0	0	54.8	0.99995278	156.497	185.733
GPS 26	36	0	42.03374	86	21	50.65409	186271.990	567180.505	TN	- 0	12	47.3	0.99995319	149.407	178.261
GPS 27	35	57	56.80756	86	48	18.24648	181417.276	527385.086	TN	- 0	28	16.7	0.99995103	195.362	224.232
GPS 28	36	1	9.46654	87	15	23.50236	187783.506	486742.735	TN	- 0	44	8.2	0.99995361	184.562	213.258
GPS 29	36	6	50.74940	87	44	30.11690	198970.353	443203.003	TN	- 1	1	10.8	0.99996031	200.418	229.182
GPS 30	36	0	43.56473	88	7	22.15355	188333.446	408651.887	TN	- 1	14	34.0	0.99995321	110.918	139.319
GPS 31	35	56	20.27975	88	34	22.61540	181195.087	367873.166	TN	- 1	30	22.7	0.99995007	131.773	160.107
GPS 32	35	55	40.36036	88	59	52.36166	181056.413	329510.244	TN	- 1	45	18.3	0.99994974	69.378	97.590
GPS 33	35	59	54.49354	89	24	13.70245	190081.966	293170.794	TN	- 1	59	33.8	0.99995250	71.660	99.801
GPS34-V2-9	35	44	25.59370	83	59	19.92189	157986.358	781901.535	TN	+ 1	10	38.6	0.99994973	283.883	314.211
GPS 35	35	32	36.90156	84	22	59.97885	135487.098	746588.083	TN	+ 0	56	47.3	0.99996118	287.116	317.376
GPS 36	35	37	25.02507	84	46	28.67730	143850.763	710998.362	TN	+ 0	43	2.6	0.99995511	198.857	229.139
GPS 37	35	34	56.79049	85	13	4.09281	138870.791	670891.887	TN	+ 0	27	28.5	0.99995799	222.754	251.899
GPS 38	35	36	22.02445	85	42	19.11789	141254.477	626700.578	TN	+ 0	10	21.1	0.99995627	242.582	272.043
GPS 39	35	37	25.18832	86	8	31.33914	143170.237	587133.284	TN	- 0	4	59.4	0.99995511	329.255	354.782
GPS 40	35	36	39.00001	86	34	50.78192	141893.566	547381.950	TN	- 0	20	24.0	0.99995595	184.959	213.024
GPS 41	35	36	50.00367	87	4	45.27711	142615.670	502225.601	TN	- 0	37	54.6	0.99995574	168.868	196.620
GPS 42	35	34	35.65475	87	25	47.83248	138882.974	470394.430	TN	- 0	50	13.7	0.99995844	158.686	186.739
GPS 43	35	37	0.11024	87	50	10.44976	143948.562	433657.882	TN	- 1	4	30.0	0.99995556	141.384	169.531
GPS 44	35	39	16.41539	88	22	50.45988	149210.603	384447.938	TN	- 1	23	37.5	0.99995328	128.622	156.752

TENNESSEE GEODETIC REFERENCE NETWORK LISTING

1983 (1995) DATUM

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GPS 45	35 34 11.15853	88 48 37.73490	140838.947	345272.828	TN	- 1	38	43.3	0.99995898	92.260	120.443
GPS 46	35 32 25.93758	89 14 21.79851	138799.476	306304.956	TN	- 1	53	47.3	0.99996145	88.510	116.327
GPS 47	35 35 23.72751	89 35 7.90381	145369.229	275136.637	TN	- 2	5	56.8	0.99995743	54.946	82.256
GPS 48	35 13 30.67645	84 34 54.50769	99887.197	729104.556	TN	+ 0	49	49.0	1.00000447	213.890	243.645
GPS 48R	35 14 46.82218	84 34 3.03065	102252.571	730371.836	TN	+ 0	50	19.1	1.00000065	195.306	**225.081
GPS 49	35 11 0.08451	85 3 41.11929	94720.735	685489.249	TN	+ 0	32	58.1	1.00001243	231.325	261.396
GPS 50	35 11 23.59597	85 29 5.80634	95158.817	646909.746	TN	+ 0	18	5.5	1.00001115	179.226	208.276
GPS 51*	35 12 18.47480	85 53 51.36649	96731.521	609324.431	TN	+ 0	3	35.1	1.00000822	563.281	591.969
GPS 52	35 14 28.42030	86 24 38.98606	100809.803	562606.579	TN	- 0	14	25.9	1.00000156	201.404	229.638
GPS 53	35 11 36.35019	86 52 12.66117	95780.765	520750.132	TN	- 0	30	34.0	1.00001046	207.692	235.364
GPS 54	35 14 4.78742	87 15 35.36870	100741.095	485325.066	TN	- 0	44	15.2	1.00000274	257.388	285.054
GPS 55	35 13 3.70427	87 43 10.78428	99496.050	443439.219	TN	- 1	0	24.3	1.00000586	301.681	329.384
GPS 56	35 13 53.40625	88 11 22.03225	101881.560	400709.327	TN	- 1	16	54.5	1.00000332	96.501	124.062
GPS 57	35 12 21.02953	88 29 58.23938	99711.687	372420.007	TN	- 1	27	47.9	1.00000809	156.577	184.197
GPS 58	35 12 44.84620	89 2 36.18469	101847.588	322937.768	TN	- 1	46	54.2	1.00000684	123.473	151.291
GPS 59	35 9 21.84872	89 26 47.90713	96812.678	286020.331	TN	- 2	1	4.1	1.00001790	96.964	124.595
GPS 60	35 8 46.44496	89 54 24.04763	97296.815	244089.427	TN	- 2	17	13.7	1.00001993	56.712	84.091

* GPS 51-RESET

** GPS derived elevation using the Geoid 96 Model and the WGS 1984 Reference Ellipsoid