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U. S. Department of Commerce
Sinclair Weeks, *Secretary*

Coast and Geodetic Survey
Robert F. A. Studds, *Director*

Special Publication No. 314

PLANE COORDINATE PROJECTION TABLES
VERMONT

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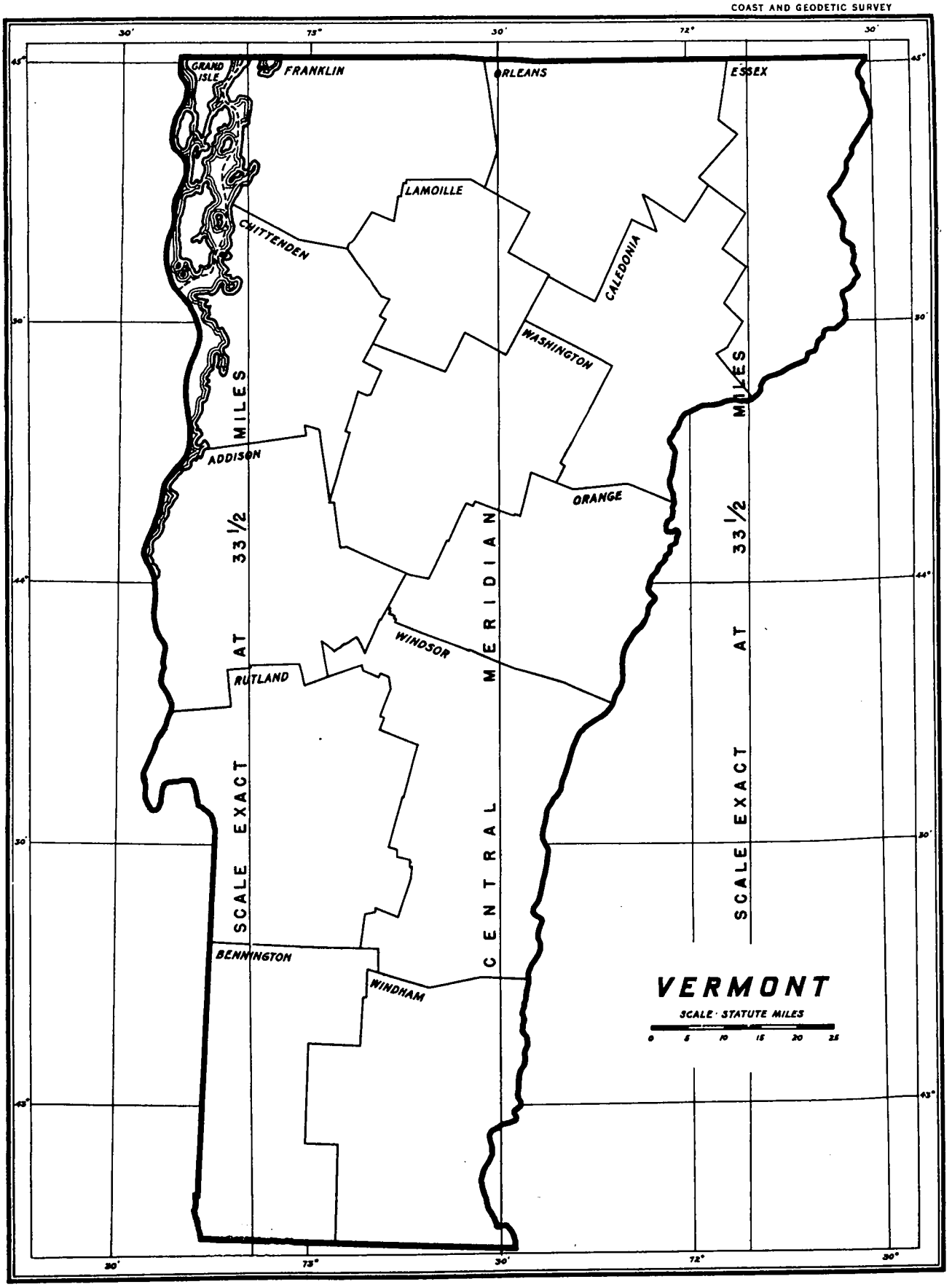
COAST AND GEODETIC SURVEY



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Foreword

The plane coordinate system used in this State is based on the transverse Mercator projection using a reduced scale for the central meridian of the zone. The tables in this publication are to be used for the conversion of geographic positions to plane coordinates or plane coordinates to geographic positions. The constants of the projection are listed with the tables.

The methods of computation have been designed for machine calculation. All of the functions that are required are given in this publication.

The formulas and sample computations which follow show the general methods for computing either type of coordinates.

Plane coordinates from geographic positions

$$x = x' + 500{,}000$$

$$x' = H \cdot \Delta\lambda'' \pm a\,b$$

$$y = y_o + V \left(\frac{\Delta\lambda''}{100}\right)^2 \pm c$$

Grid azimuth = geodetic azimuth $- \Delta\alpha -$ second term

$$\Delta\alpha'' = \Delta\lambda'' \sin \phi + g$$

where

y_o, H, V, and a are based on the latitude of the geographic position,

and

b, c, and g are based on $\Delta\lambda''$.

$$\Delta\lambda'' = \text{Central Meridian} - \lambda$$

and

$\Delta\alpha''$ is the convergence of the meridian at the station with respect to the Central Meridian.

The second term for the reduction of geodetic to grid azimuths may be neglected for most work. However, for lines five miles or more in length if the same degree of accuracy is desired as is obtained by geographic computations, this term should be evaluated and used.

$$\text{Second term} = \frac{(y_2 - y_1)\ (2x_1' + x_2')}{(6\rho_o^2\ \sin 1'')_g}$$

<u>Geographic positions from plane coordinates</u>

$$P\ (x'/10{,}000)^2 + d = V\ (\Delta\lambda''/100)^2 + c$$

$$y_o = y - P\ (x'/10{,}000)^2 - d$$

Obtain the latitude from the table of y_o.

Use latitude to obtain H from the table.

$$x' = x - 500{,}000$$

$$\text{approximate } \Delta\lambda'' = x' \div H.$$

Determine <u>a</u> from latitude and <u>b</u> from approximate $\Delta\lambda$

then

$$\Delta\lambda'' = (x' \mp a\ b\ ) \div H$$

$$\Delta\alpha'' = Mx' - e$$

M is based on the y and e on the x and y of the plane coordinates.

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Form No. 744b

PLANE COORDINATES ON TRANSVERSE MERCATOR PROJECTION

(Condensed form for calculating-machine computation)

State Vermont Zone — Central meridian 72° 30′ 00.″000

Station	Stowell, 1878-85	Irish, 1943			
ϕ	43° 09′ 58.″526	44° 22′ 22.″810			
λ	72 29 31.418	73 12 06.978			
$\Delta\lambda$ = Central mer. − λ	+0° 00′ 28.″582	−0° 42′ 06.″978			
$\Delta\lambda''$	+28.″582	−2,526.″978			
$\left(\frac{\Delta\lambda''}{100}\right)^2$	0.082	638.562			
H	74.110 975	72.635 503			
V	1.229 237	1.231 546			
a / b	−0.726 / +0.017	−0.263 / +1.098			
$x' = H \cdot \Delta\lambda \pm ab$	+2,118.23	−183,548.03			
$V\left(\frac{\Delta\lambda''}{100}\right)^2 \pm c$	0.10	786.31			
Tabular y	242,816.52	682,686.37			
x	502,118.23	316,451.97			
y	242,816.62	683,472.68			
$\Delta\alpha''$	+19.″55	−1,767.″23			
$\Delta\alpha$	+0° 00′ 19.″6	−0° 29′ 27.″2			
Geod. Az. to Az. Mk.	108 24 58.5	280 15 39.4			
Grid Az. to Az. Mk.	108 24 39	280 45 07			

$x = x' + 500{,}000$

$y = \text{Tab. } y + V\left(\frac{\Delta\lambda''}{100}\right)^2 \pm c$

$\Delta\alpha'' = \Delta\lambda'' \sin\phi + g$

Grid Az. = Geod. Az. − $\Delta\alpha$

H and V = Tab. H and Tab. V.

When ab is $\frac{-}{+}$, $\frac{\text{decrease}}{\text{increase}}$ $H \cdot \Delta\lambda$ numerically.

g increases $\Delta\lambda'' \cdot \sin\phi$ numerically.

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Form No. 748a

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GEODETIC POSITIONS FROM TRANSVERSE MERCATOR COORDINATES

(CALCULATING MACHINE COMPUTATION)

STATE – ZONE Vermont

Station Stowell, 1878 - 85

X	502,118.23		Y	242,816.62
C	– 500,000.00		$P(\frac{X'}{10,000})^2 + d$	– 0.10
X'	+ 2,118.23		Y_o	242,816.52
P	2.23754		Approx. $\Delta\lambda = X' \div H$	+29"
d	0.00		$\Delta\lambda = (X' \mp ab) \div H$	+28".582
H	74.110 975		$\Delta\lambda$	+ 0° 00' 28".582
a | b	-0.726	+0.017	Central Meridian	72 30 00.000
ϕ	43° 09' 58".526		λ = C.M. – $\Delta\lambda$	72° 29' 31".418

Station Irish, 1943

X	316,451.97		Y	683,472.68
C	– 500,000.00		$P(\frac{X'}{10,000})^2 + d$	– 786.30
X'	- 183,548.03		Y_o	682,686.38
P	2.33389		Approx. $\Delta\lambda = X' \div H$	-2,527"
d	+0.02		$\Delta\lambda = (X' \mp ab) \div H$	-2,526".978
H	72.635 503		$\Delta\lambda$	- 0° 42' 06".978
a | b	-0.263	+1.098	Central Meridian	72 30 00.000
ϕ	44° 22' 22".810		λ = C.M. – $\Delta\lambda$	73° 12' 06".978

Station

X			Y	
C	–		$P(\frac{X'}{10,000})^2 + d$	–
X'			Y_o	
P			Approx. $\Delta\lambda = X' \div H$	"
d			$\Delta\lambda = (X' \mp ab) \div H$	"
H			$\Delta\lambda$	° ' "
a | b			Central Meridian	
ϕ	° ' "		λ = C.M. – $\Delta\lambda$	° ' "

Station

X			Y	
C	–		$P(\frac{X'}{10,000})^2 + d$	–
X'			Y_o	
P			Approx. $\Delta\lambda = X' \div H$	"
d			$\Delta\lambda = (X' \mp ab) \div H$	"
H			$\Delta\lambda$	° ' "
a | b			Central Meridian	
ϕ	° ' "		λ = C.M. – $\Delta\lambda$	° "

When a b is $\frac{+, \text{ decrease}}{-, \text{ increase}}$ X' numerically

Constants for Vermont

Central Meridian	72° 30' 00".000
log R	-155.1
Scale reduction (Central Meridian)	1 : 28,000
$\log\left(\frac{1}{6\rho_0^2}\right)_g$	4.580 6308 -20
$\log\left(\frac{1}{6\rho_0^2 \sin 1''}\right)_g$	9.895 0559 -20
$\left(\frac{1}{6\rho_0^2 \sin 1''}\right)_g$	0.7853×10^{-10}

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TRANSVERSE MERCATOR PROJECTION
VERMONT

Lat.	y_o feet	Δy_o per second	H	ΔH per second	V	ΔV per second	a
42 30	0.00	101.230 00	74.911 473	331.68	1.227 022	1.07	1.000
42 31	6 073.80	101.230 17	74.891 572	331.80	1.227 086	1.05	-.993
42 32	12 147.61	101.230 50	74.871 664	331.88	1.227 149	1.05	-.986
42 33	18 221.44	101.230 67	74.851 751	332.02	1.227 212	1.03	-.979
42 34	24 295.28	101.231 17	74.831 830	332.10	1.227 274	1.03	-.972
42 35	30 369.15	101.231 33	74.811 904	332.22	1.227 336	1.02	-.965
42 36	36 443.03	101.231 67	74.791 971	332.32	1.227 397	1.02	-.958
42 37	42 516.93	101.232 00	74.772 032	332.43	1.227 458	1.02	-.951
42 38	48 590.85	101.232 33	74.752 086	332.53	1.227 519	1.00	-.944
42 39	54 664.79	101.232 67	74.732 134	332.63	1.227 579	1.00	-.937
42 40	60 738.75	101.233 00	74.712 176	332.75	1.227 639	.98	-.930
42 41	66 812.73	101.233 00	74.692 211	332.85	1.227 698	.98	-.923
42 42	72 886.71	101.233 50	74.672 240	332.95	1.227 757	.98	-.916
42 43	78 960.72	101.233 83	74.652 263	333.07	1.227 816	.97	-.909
42 44	85 034.75	101.234 00	74.632 279	333.17	1.227 874	.97	-.902
42 45	91 108.79	101.234 50	74.612 289	333.27	1.227 932	.95	-.896
42 46	97 182.86	101.234 67	74.592 293	333.38	1.227 989	.95	-.889
42 47	103 256.94	101.235 00	74.572 290	333.48	1.228 046	.93	-.882
42 48	109 331.04	101.235 17	74.552 281	333.58	1.228 102	.93	-.875
42 49	115 405.15	101.235 67	74.532 266	333.70	1.228 158	.93	-.868
42 50	121 479.29	101.235 83	74.512 244	333.80	1.228 214	.92	-.861
42 51	127 553.44	101.236 17	74.492 216	333.92	1.228 269	.92	-.854
42 52	133 627.61	101.236 50	74.472 181	334.02	1.228 324	.90	-.847
42 53	139 701.80	101.236 83	74.452 140	334.12	1.228 378	.90	-.841
42 54	145 776.01	101.237 00	74.432 093	334.23	1.228 432	.90	-.834
42 55	151 850.23	101.237 33	74.412 039	334.33	1.228 486	.88	-.827
42 56	157 924.47	101.237 67	74.391 979	334.43	1.228 539	.88	-.820
42 57	163 998.73	101.238 00	74.371 913	334.53	1.228 592	.87	-.813
42 58	170 073.01	101.238 33	74.351 841	334.65	1.228 644	.87	-.807
42 59	176 147.31	101.238 50	74.331 762	334.75	1.228 696	.85	-.800
43 00	182 221.62		74.311 677		1.228 747		-.793

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TRANSVERSE MERCATOR PROJECTION
VERMONT

Lat.	y_o feet	Δy_o per second	H	ΔH per second	V	ΔV per second	a
43 00	182 221.62	101.238 83	74.311 677	334.85	1.228 747	.85	-.793
43 01	188 295.95	101.239 17	74.291 586	334.97	1.228 798	.83	-.786
43 02	194 370.30	101.239 50	74.271 488	335.07	1.228 848	.85	-.780
43 03	200 444.67	101.239 83	74.251 384	335.17	1.228 899	.82	-.773
43 04	206 519.06	101.240 00	74.231 274	335.27	1.228 948	.83	-.766
43 05	212 593.46	101.240 33	74.211 158	335.38	1.228 998	.82	-.760
43 06	218 667.88	101.240 67	74.191 035	335.48	1.229 047	.80	-.753
43 07	224 742.32	101.241 00	74.170 906	335.60	1.229 095	.80	-.746
43 08	230 816.78	101.241 33	74.150 770	335.70	1.229 143	.80	-.739
43 09	236 891.26	101.241 50	74.130 628	335.80	1.229 191	.78	-.733
43 10	242 965.75	101.241 83	74.110 480	335.92	1.229 238	.78	-.726
43 11	249 040.26	101.242 17	74.090 325	336.02	1.229 285	.77	-.719
43 12	255 114.79	101.242 50	74.070 164	336.12	1.229 331	.78	-.713
43 13	261 189.34	101.242 83	74.049 997	336.23	1.229 378	.75	-.706
43 14	267 263.91	101.243 00	74.029 823	336.33	1.229 423	.75	-.700
43 15	273 338.49	101.243 33	74.009 643	336.43	1.229 468	.75	-.693
43 16	279 413.09	101.243 67	73.989 457	336.53	1.229 513	.75	-.686
43 17	285 487.71	101.244 00	73.969 265	336.65	1.229 558	.72	-.680
43 18	291 562.35	101.244 33	73.949 066	336.75	1.229 601	.73	-.673
43 19	297 637.01	101.244 50	73.928 861	336.85	1.229 645	.72	-.667
43 20	303 711.68	101.244 83	73.908 650	336.95	1.229 688	.72	-.660
43 21	309 786.37	101.245 17	73.888 433	337.07	1.229 731	.70	-.653
43 22	315 861.08	101.245 50	73.868 209	337.17	1.229 773	.70	-.647
43 23	321 935.81	101.245 67	73.847 979	337.27	1.229 815	.68	-.640
43 24	328 010.55	101.246 00	73.827 743	337.38	1.229 856	.68	-.634
43 25	334 085.31	101.246 50	73.807 500	337.48	1.229 897	.67	-.627
43 26	340 160.10	101.246 67	73.787 251	337.58	1.229 937	.67	-.620
43 27	346 234.90	101.246 83	73.766 996	337.68	1.229 977	.67	-.614
43 28	352 309.71	101.247 33	73.746 735	337.80	1.230 017	.65	-.607
43 29	358 384.55	101.247 50	73.726 467	337.90	1.230 056	.65	-.601
43 30	364 459.40	101.247 83	73.706 193	338.00	1.230 095	.63	-.594
43 31	370 534.27	101.248 17	73.685 913	338.12	1.230 133	.63	-.588
43 32	376 609.16	101.248 50	73.665 626	338.22	1.230 171	.63	-.581
43 33	382 684.07	101.248 83	73.645 333	338.32	1.230 209	.62	-.575
43 34	388 759.00	101.249 00	73.625 034	338.43	1.230 246	.62	-.568
43 35	394 833.94	101.249 33	73.604 728	338.52	1.230 283	.60	-.562
43 36	400 908.90	101.249 67	73.584 417	338.63	1.230 319	.60	-.555
43 37	406 983.88	101.249 83	73.564 099	338.75	1.230 355	.58	-.549
43 38	413 058.87	101.250 33	73.543 774	338.83	1.230 390	.58	-.542
43 39	419 133.89	101.250 50	73.523 444	338.95	1.230 425	.58	-.536
43 40	425 208.92	101.250 83	73.503 107	339.05	1.230 460	.57	-.529
43 41	431 283.97	101.251 17	73.482 764	339.17	1.230 494	.57	-.523
43 42	437 359.04	101.251 50	73.462 414	339.25	1.230 528	.57	-.516
43 43	443 434.13	101.251 67	73.442 059	339.37	1.230 562	.55	-.510
43 44	449 509.23	101.252 00	73.421 697	339.47	1.230 595	.53	-.503
43 45	455 584.35	101.252 33	73.401 329	339.58	1.230 627	.53	-.497
43 46	461 659.49	101.252 67	73.380 954	339.67	1.230 659	.53	-.491
43 47	467 734.65	101.253 00	73.360 574	339.78	1.230 691	.53	-.484
43 48	473 809.83	101.253 33	73.340 187	339.88	1.230 723	.50	-.478
43 49	479 885.03	101.253 50	73.319 794	339.98	1.230 753	.52	-.471
43 50	485 960.24	101.253 83	73.299 395	340.08	1.230 784	.50	-.465
43 51	492 035.47	101.254 17	73.278 990	340.20	1.230 814	.50	-.459
43 52	498 110.72	101.254 33	73.258 578	340.30	1.230 844	.48	-.452
43 53	504 185.98	101.254 83	73.238 160	340.40	1.230 873	.48	-.446
43 54	510 261.27	101.255 00	73.217 736	340.50	1.230 902	.47	-.440
43 55	516 336.57	101.255 33	73.197 306	340.62	1.230 930	.47	-.434
43 56	522 411.89	101.255 67	73.176 869	340.70	1.230 958	.47	-.427
43 57	528 487.23	101.256 00	73.156 427	340.82	1.230 986	.45	-.421
43 58	534 562.59	101.256 17	73.135 978	340.93	1.231 013	.45	-.415
43 59	540 637.96	101.256 67	73.115 522	341.02	1.231 040	.43	-.408
44 00	546 713.36		73.095 061		1.231 066		-.402

TRANSVERSE MERCATOR PROJECTION
VERMONT

Lat.	y_o feet	Δy_o per second	H	ΔH per second	V	ΔV per second	a
44 00	546 713.36	101.256 83	73.095 061	341.13	1.231 066	.43	-.402
44 01	552 788.77	101.257 00	73.074 593	341.23	1.231 092	.43	-.396
44 02	558 864.19	101.257 50	73.054 119	341.33	1.231 118	.42	-.390
44 03	564 939.64	101.257 83	73.033 639	341.45	1.231 143	.42	-.383
44 04	571 015.11	101.258 00	73.013 152	341.55	1.231 168	.40	-.377
44 05	577 090.59	101.258 33	72.992 659	341.65	1.231 192	.40	-.371
44 06	583 166.09	101.258 67	72.972 160	341.75	1.231 216	.38	-.365
44 07	589 241.61	101.258 83	72.951 655	341.85	1.231 239	.38	-.359
44 08	595 317.14	101.259 33	72.931 144	341.95	1.231 262	.38	-.352
44 09	601 392.70	101.259 50	72.910 627	342.07	1.231 285	.37	-.346
44 10	607 468.27	101.259 83	72.890 103	342.17	1.231 307	.37	-.340
44 11	613 543.86	101.260 17	72.869 573	342.27	1.231 329	.35	-.334
44 12	619 619.47	101.260 50	72.849 037	342.37	1.231 350	.35	-.328
44 13	625 695.10	101.260 67	72.828 495	342.47	1.231 371	.33	-.321
44 14	631 770.74	101.261 00	72.807 947	342.58	1.231 391	.33	-.315
44 15	637 846.40	101.261 33	72.787 392	342.68	1.231 411	.33	-.309
44 16	643 922.08	101.261 67	72.766 831	342.78	1.231 431	.32	-.303
44 17	649 997.78	101.262 00	72.746 264	342.88	1.231 450	.32	-.297
44 18	656 073.50	101.262 33	72.725 691	342.98	1.231 469	.30	-.290
44 19	662 149.24	101.262 50	72.705 112	343.10	1.231 487	.30	-.284
44 20	668 224.99	101.262 83	72.684 526	343.20	1.231 505	.30	-.278
44 21	674 300.76	101.263 17	72.663 934	343.30	1.231 523	.28	-.272
44 22	680 376.55	101.263 33	72.643 336	343.40	1.231 540	.27	-.266
44 23	686 452.35	101.263 67	72.622 732	343.52	1.231 556	.28	-.259
44 24	692 528.17	101.264 17	72.602 121	343.60	1.231 573	.27	-.253
44 25	698 604.02	101.264 33	72.581 505	343.72	1.231 589	.25	-.247
44 26	704 679.88	101.264 67	72.560 882	343.82	1.231 604	.25	-.241
44 27	710 755.76	101.265 00	72.540 253	343.92	1.231 619	.25	-.235
44 28	716 831.66	101.265 17	72.519 618	344.03	1.231 634	.23	-.228
44 29	722 907.57	101.265 50	72.498 976	344.12	1.231 648	.23	-.222
44 30	728 983.50	101.265 83	72.478 329	344.23	1.231 662	.22	-.216
44 31	735 059.45	101.266 17	72.457 675	344.32	1.231 675	.23	-.210
44 32	741 135.42	101.266 50	72.437 016	344.43	1.231 689	.20	-.204
44 33	747 211.41	101.266 67	72.416 350	344.53	1.231 701	.20	-.197
44 34	753 287.41	101.267 17	72.395 678	344.63	1.231 713	.20	-.191
44 35	759 363.44	101.267 33	72.375 000	344.75	1.231 725	.20	-.185
44 36	765 439.48	101.267 50	72.354 315	344.83	1.231 737	.18	-.179
44 37	771 515.53	101.268 00	72.333 625	344.95	1.231 748	.17	-.173
44 38	777 591.61	101.268 33	72.312 928	345.05	1.231 758	.17	-.166
44 39	783 667.71	101.268 50	72.292 225	345.15	1.231 768	.17	-.160
44 40	789 743.82	101.268 83	72.271 516	345.25	1.231 778	.15	-.154
44 41	795 819.95	101.269 17	72.250 801	345.37	1.231 787	.15	-.148
44 42	801 896.10	101.269 33	72.230 079	345.45	1.231 796	.15	-.142
44 43	807 972.26	101.269 83	72.209 352	345.57	1.231 805	.13	-.135
44 44	814 048.45	101.270 00	72.188 618	345.67	1.231 813	.12	-.129
44 45	820 124.65	101.270 33	72.167 878	345.77	1.231 820	.12	-.123
44 46	826 200.87	101.270 67	72.147 132	345.87	1.231 827	.12	-.117
44 47	832 277.11	101.271 00	72.126 380	345.97	1.231 834	.12	-.111
44 48	838 353.37	101.271 17	72.105 622	346.08	1.231 841	.08	-.104
44 49	844 429.64	101.271 50	72.084 857	346.17	1.231 846	.10	-.098
44 50	850 505.93	101.271 83	72.064 087	346.28	1.231 852	.08	-.092
44 51	856 582.24	101.272 17	72.043 310	346.37	1.231 857	.08	-.086
44 52	862 658.57	101.272 50	72.022 528	346.48	1.231 862	.07	-.080
44 53	868 734.92	101.272 67	72.001 739	346.58	1.231 866	.07	-.073
44 54	874 811.28	101.273 00	71.980 944	346.68	1.231 870	.05	-.067
44 55	880 887.66	101.273 33	71.960 143	346.80	1.231 873	.05	-.061
44 56	886 964.06	101.273 67	71.939 335	346.88	1.231 876	.05	-.055
44 57	893 040.48	101.274 00	71.918 522	347.00	1.231 879	.03	-.049
44 58	899 116.92	101.274 33	71.897 702	347.08	1.231 881	.03	-.042
44 59	905 193.38	101.274 50	71.876 877	347.20	1.231 883	.02	-.036
45 00	911 269.85		71.856 045		1.231 884		-.030

TRANSVERSE MERCATOR PROJECTION
VERMONT

Lat.	y_o feet	Δy_o per second	H	ΔH per second	V	ΔV per second	a
45 00	911 269.85	101.274 83	71.856 045	347.30	1.231 884	.02	-.030
45 01	917 346.34	101.275 17	71.835 207	347.40	1.231 885	+ .02	-.024
45 02	923 422.85	101.275 50	71.814 363	347.50	1.231 886	.00	-.018
45 03	929 499.38	101.275 67	71.793 513	347.62	1.231 886	- .02	-.011
45 04	935 575.92	101.276 00	71.772 656	347.70	1.231 885	.00	-.005
45 05	941 652.48	101.276 33	71.751 794	347.80	1.231 885	- .02	+.001
45 06	947 729.06	101.276 67	71.730 926	347.92	1.231 884	- .03	.007
45 07	953 805.66	101.277 00	71.710 051	348.00	1.231 882	- .03	.013
45 08	959 882.28	101.277 17	71.689 171	348.12	1.231 880	- .03	.020
45 09	965 958.91	101.277 67	71.668 284	348.22	1.231 878	- .05	.026
45 10	972 035.57	101.277 83	71.647 391	348.32	1.231 875	- .05	.032
45 11	978 112.24	101.278 17	71.626 492	348.42	1.231 872	- .07	.038
45 12	984 188.93	101.278 33	71.605 587	348.52	1.231 868	- .07	.044
45 13	990 265.63	101.278 67	71.584 676	348.62	1.231 864	- .07	.051
45 14	996 342.35	101.279 17	71.563 759	348.72	1.231 860	- .08	.057
45 15	1 002 419.10	101.279 33	71.542 836	348.83	1.231 855	- .10	.063
45 16	1 008 495.86	101.279 67	71.521 906	348.92	1.231 849	- .08	.069
45 17	1 014 572.64	101.280 00	71.500 971	349.03	1.231 844	- .10	.075
45 18	1 020 649.44	101.280 33	71.480 029	349.12	1.231 838	- .12	.082
45 19	1 026 726.26	101.280 33	71.459 082	349.23	1.231 831	- .12	.088
45 20	1 032 803.08		71.438 128		1.231 824		.094

TRANSVERSE MERCATOR PROJECTION

VERMONT

$\Delta\lambda''$	b	Δb	c	$\Delta\lambda''$	b	Δb	c
0	0.000	+0.060	0.000				
100	+0.060	+0.059	0.000	2600	+1.105	+0.006	-0.111
200	+0.119	+0.059	-0.001	2700	+1.111	+0.002	-0.116
300	+0.178	+0.059	-0.002	2800	+1.113	-0.003	-0.121
400	+0.237	+0.059	-0.003	2900	+1.110	-0.007	-0.125
500	+0.296	+0.057	-0.005	3000	+1.103	-0.012	-0.130
600	+0.353	+0.057	-0.007	3100	+1.091	-0.017	-0.133
700	+0.410	+0.055	-0.010	3200	+1.074	-0.021	-0.135
800	+0.465	+0.054	-0.014	3300	+1.053	-0.027	-0.136
900	+0.519	+0.053	-0.018	3400	+1.026	-0.032	-0.135
1000	+0.572	+0.051	-0.022	3500	+0.994	-0.038	-0.133
1100	+0.623	+0.050	-0.027	3600	+0.956	-0.043	-0.131
1200	+0.673	+0.047	-0.032	3700	+0.913	-0.049	-0.128
1300	+0.720	+0.046	-0.038	3800	+0.864	-0.055	-0.124
1400	+0.766	+0.044	-0.043	3900	+0.809	-0.061	-0.120
1500	+0.810	+0.041	-0.049	4000	+0.748	-0.070	-0.115
1600	+0.851	+0.039	-0.055	4100	+0.678	-0.076	-0.109
1700	+0.890	+0.037	-0.061	4200	+0.602	-0.082	-0.101
1800	+0.927	+0.033	-0.067	4300	+0.520	-0.090	-0.091
1900	+0.960	+0.031	-0.073	4400	+0.430	-0.096	-0.078
2000	+0.991	+0.027	-0.079	4500	+0.334	-0.106	-0.063
2100	+1.018	+0.025	-0.085	4600	+0.228	-0.111	-0.045
2200	+1.043	+0.021	-0.091	4700	+0.117	-0.117	-0.025
2300	+1.064	+0.017	-0.096	4800	0.000	-0.118	0.000
2400	+1.081	+0.014	-0.101	4900	-0.118	-0.122	+0.026
2500	+1.095	+0.010	-0.106	5000	-0.240		+0.053

$F = 7.00 \times 10^{-13}$

TRANSVERSE MERCATOR PROJECTION

TABLE FOR g

$$\Delta\alpha'' = \sin\phi\,(\Delta\lambda'') + g$$

Latitude	$\Delta\lambda''$						
	0"	1000"	2000"	3000"	4000"	5000"	6000"
24°	0".00	0".00	0".02	0".07	0".17	0".33	0".58
25	0	0	0.02	0.07	0.17	0.34	0.59
26°	0.00	0.00	0.02	0.08	0.18	0.35	0.60
27	0	0	0.02	0.08	0.18	0.35	0.61
28	0	0	0.02	0.08	0.18	0.36	0.62
29	0	0	0.02	0.08	0.19	0.37	0.63
30	0	0	0.02	0.08	0.19	0.37	0.64
31°	0.00	0.00	0.02	0.08	0.19	0.37	0.64
32	0	0	0.02	0.08	0.19	0.38	0.65
33	0	0	0.02	0.08	0.19	0.38	0.65
34	0	0	0.02	0.08	0.19	0.38	0.65
35	0	0	0.02	0.08	0.19	0.38	0.65
36°	0.00	0.00	0.02	0.08	0.19	0.38	0.65
37	0	0	0.02	0.08	0.19	0.38	0.65
38	0	0	0.02	0.08	0.19	0.38	0.65
39	0	0	0.02	0.08	0.19	0.37	0.64
40	0	0	0.02	0.08	0.19	0.37	0.64
41°	0.00	0.00	0.02	0.08	0.19	0.37	0.63
42	0	0	0.02	0.08	0.18	0.36	0.63
43	0	0	0.02	0.08	0.18	0.36	0.62
44	0	0	0.02	0.08	0.18	0.35	0.61
45	0	0	0.02	0.08	0.18	0.35	0.60
46°	0.00	0.00	0.02	0.07	0.17	0.34	0.59
47	0	0	0.02	0.07	0.17	0.33	0.58
48	0	0	0.02	0.07	0.17	0.33	0.56
49	0	0	0.02	0.07	0.16	0.32	0.55
50	0.00	0.00	0.02	0.07	0.16	0.31	0.54

$$g = \left[\frac{C\,(\sin 1'')\,\cos^3\phi}{2A^2} + F\right](\Delta\lambda'')^3$$

A, C and F are position factors.

Y CORRECTION FOR COMPUTATION OF GEOGRAPHIC POSITIONS FROM PLANE COORDINATES TRANSVERSE MERCATOR PROJECTION, VERMONT

$$P(x'/10{,}000)^2 + d = V(\Delta y/100)^2 + c$$

P taken out for y-coordinate
d taken out for x'

y	P	ΔP	x'	d
0	2.18601	2108	0	0.00
100,000	2.20709	2126	50,000	0.00
200,000	2.22835	2146	100,000	+ 0.01
300,000	2.24981	2164	150,000	+ 0.02
400,000	2.27145	2184	200,000	+ 0.02
500,000	2.29329	2204	250,000	+ 0.01
600,000	2.31533	2224	300,000	- 0.03
700,000	2.33757	2245	350,000	- 0.09
800,000	2.36002	2267		
900,000	2.38269	2288		
1,000,000	2.40557			

TRANSVERSE MERCATOR PROJECTION

Vermont

$$\Delta\alpha = Mx' - e$$

y	M	ΔM
0	0.009 0185	870
100,000	0.009 1055	877
200,000	0.009 1932	885
300,000	0.009 2817	893
400,000	0.009 3710	901
500,000	0.009 4611	910
600,000	0.009 5521	918
700,000	0.009 6439	926
800,000	0.009 7365	935
900,000	0.009 8300	944
1,000,000	0.009 9244	

e

y \ x'	100,000	200,000	300,000
0	0.0	0.1	0.3
500,000	0.0	0.1	0.3
1,000,000	0.0	0.1	0.4

Transverse Mercator Projection for Vermont

x' (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio	x' (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio
0	-155.1	0.9999643	175,000	- 3.2	0.9999993
5,000	-155.0	0.9999643	180,000	+ 5.6	1.0000013
10,000	-154.6	0.9999644	185,000	+ 14.7	1.0000034
15,000	-154.0	0.9999645	190,000	+ 24.0	1.0000055
20,000	-153.1	0.9999647	195,000	+ 33.5	1.0000077
25,000	-152.0	0.9999650	200,000	+ 43.3	1.0000100
30,000	-150.6	0.9999653	205,000	+ 53.3	1.0000123
35,000	-149.0	0.9999657	210,000	+ 63.6	1.0000146
40,000	-147.2	0.9999661	215,000	+ 74.2	1.0000171
45,000	-145.0	0.9999666	220,000	+ 85.0	1.0000196
50,000	-142.7	0.9999671	225,000	+ 96.0	1.0000221
55,000	-140.1	0.9999677	230,000	+107.3	1.0000247
60,000	-137.2	0.9999684	235,000	+118.8	1.0000274
65,000	-134.1	0.9999691	240,000	+130.6	1.0000301
70,000	-130.8	0.9999699	245,000	+142.6	1.0000328
75,000	-127.2	0.9999707	250,000	+154.9	1.0000357
80,000	-123.3	0.9999716	255,000	+167.4	1.0000385
85,000	-119.2	0.9999726	260,000	+180.2	1.0000415
90,000	-114.9	0.9999735	265,000	+193.2	1.0000445
95,000	-110.3	0.9999746	270,000	+206.5	1.0000475
100,000	-105.5	0.9999757	275,000	+220.0	1.0000507
105,000	-100.4	0.9999769	280,000	+233.8	1.0000538
110,000	- 95.1	0.9999781	285,000	+247.8	1.0000571
115,000	- 89.5	0.9999794	290,000	+262.0	1.0000603
120,000	- 83.7	0.9999807	295,000	+276.5	1.0000637
125,000	- 77.6	0.9999821	300,000	+291.3	1.0000671
130,000	- 71.3	0.9999836	305,000	+306.3	1.0000705
135,000	- 64.7	0.9999851	310,000	+321.6	1.0000741
140,000	- 57.9	0.9999867	315,000	+337.1	1.0000776
145,000	- 50.8	0.9999883	320,000	+352.8	1.0000812
150,000	- 43.5	0.9999900	325,000	+368.8	1.0000849
155,000	- 35.9	0.9999917	330,000	+385.1	1.0000887
160,000	- 28.1	0.9999935	335,000	+401.6	1.0000925
165,000	- 20.1	0.9999954	340,000	+418.4	1.0000963
170,000	- 11.8	0.9999973	345,000	+435.4	1.0001003
			350,000	+452.6	1.0001042

CORRECTIONS TO NATURAL SCALE RATIOS*
(in units of the 7th decimal place)

For Lambert Projection, Δφ' as argument				For Lambert or transverse Mercator Projection	
Δφ'	Corr'n (Plus)	Δφ'	Corr'n (Plus)	Δy or Δx	Corr'n (Plus)
1	0	31	34	10,000	0
2	0	32	36	20,000	0
3	0	33	38	30,000	1
4	1	34	40	40,000	2
5	1	35	43	50,000	2
6	1	36	45	60,000	3
7	2	37	48	70,000	5
8	2	38	51	80,000	6
9	3	39	53	90,000	8
10	4	40	56	100,000	10
11	4	41	59	110,000	11
12	5	42	62	120,000	14
13	6	43	65	130,000	16
14	7	44	68	140,000	19
15	8	45	71	150,000	21
16	9	46	74	160,000	24
17	10	47	77	170,000	27
18	11	48	81	180,000	31
19	13	49	84	190,000	34
20	14	50	88	200,000	38
21	15	51	91	210,000	42
22	17	52	95	220,000	46
23	19	53	98	230,000	50
24	20	54	102	240,000	55
25	22	55	106	250,000	59
26	24	56	110	260,000	64
27	26	57	114	270,000	69
28	27	58	118	280,000	74
29	29	59	122	290,000	80
30	32	60	126	300,000	86
				310,000	91
				320,000	97
				330,000	103
				340,000	110
				350,000	116

Δφ' is the difference in latitude in minutes of the ends of the line.

*Scale ratio interpolated for mean latitude or mean x' of the ends of a line and corrected by the above table is a true mean value accurate to within one in the seventh decimal place.

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