

CONSULTANT SERVICES

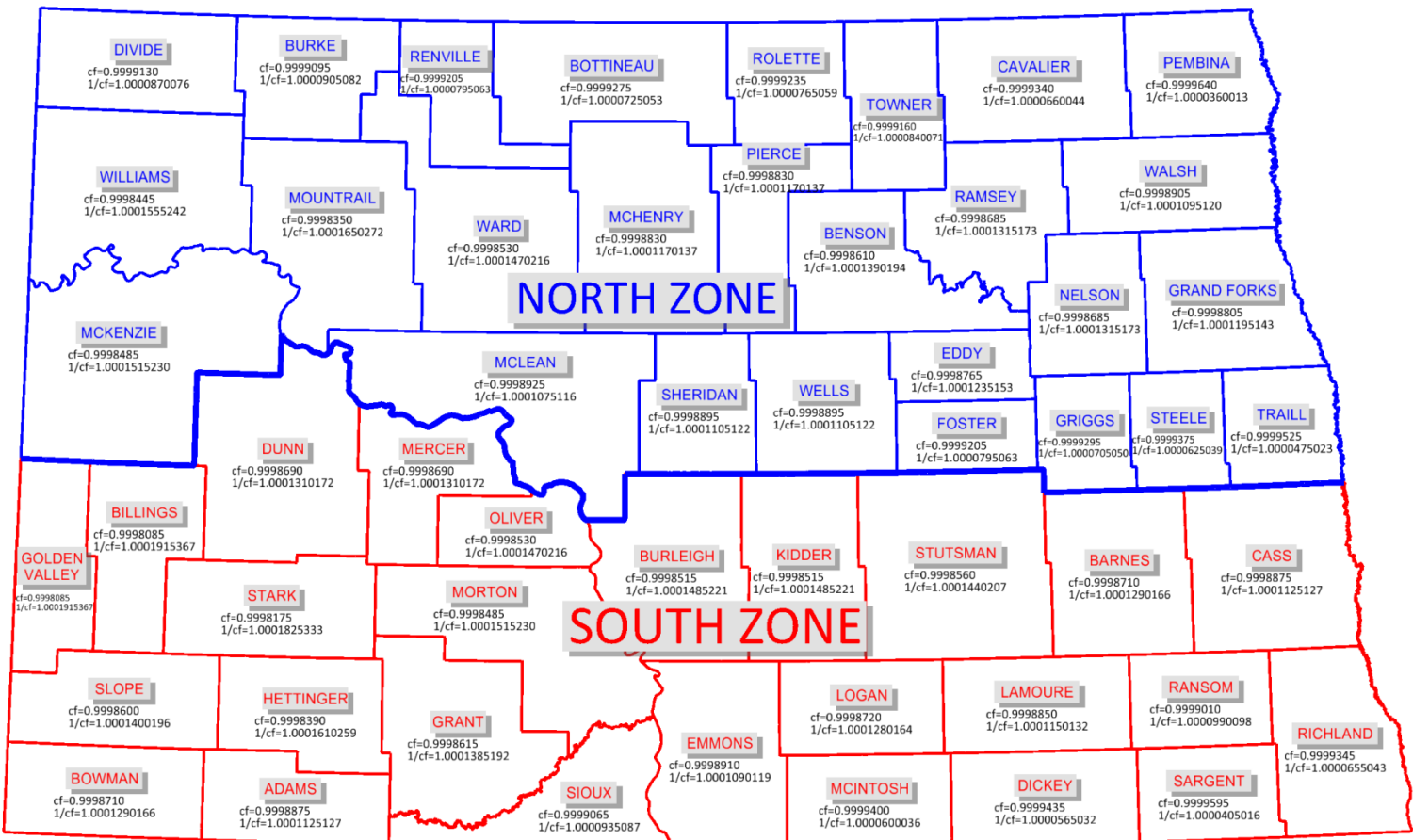
Third Edition

Date: March 2001

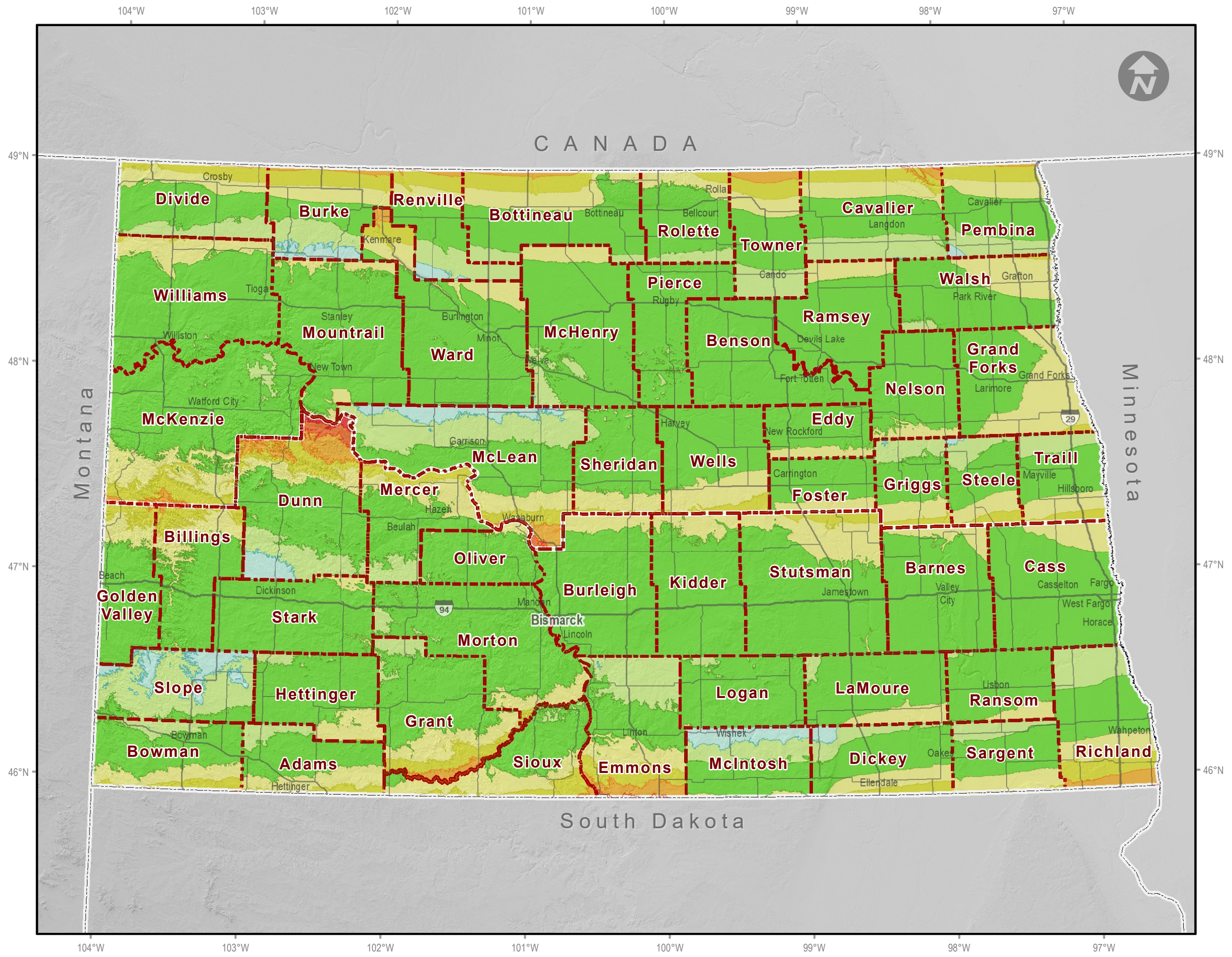
Revised: 1/13/2016

19-11.2 DOT County Coordinate Conversion Factors Map

ND LAMBERT STATE PLANE COORDINATE SYSTEM 82
DOT COUNTY COORDINATE CONVERSION FACTORS



State Plane Coordinate (or grid distance) = Ground Coordinate (or distance) times cf
Ground Coordinate (or distance) = State Plane Coordinate (or grid distance) times 1/cf

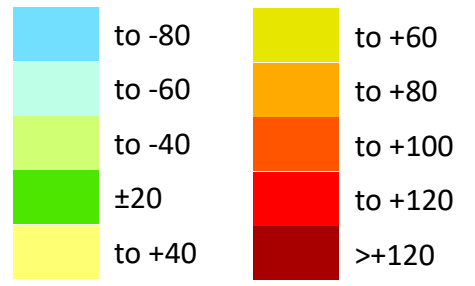


North Dakota Counties

Topographic surface linear distortion

State Plane Coordinate System 1983
using NDDOT county coordinate
conversion factors (3 arc-sec resolution)

Linear Distortion at the Topographic Surface in parts per million (ppm)

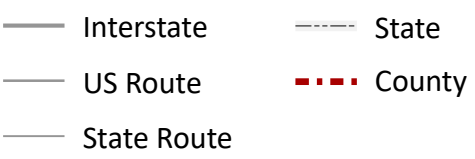


Distortion Values for All Zones in parts per million (ppm)

Min: -63 Range: 194
Max: +131 Mean: +5.7

Area of the state that is within:

± 10ppm: 38%	± 25ppm: 75%
± 20ppm: 66%	± 30ppm: 82%



QC Review Statistics: North Dakota State Plane Coordinate System 1983 - Linear Distortion at the Topographic Surface

Comparative statistics for linear distortion at survey monument locations stored in NGS datasheets and the North Dakota SPCS 83 with NDDOT county coordinate conversion factors

Summary Statistics	Min	Max	Std Dev	Median	Mean
Distortion Difference (ppm)	-0.6	0.9	0.2	0.1	0.1
Ellipsoid Height Difference (m)	-5.4	3.6	1.4	-0.6	-0.9

NGS Control Mark (from NGS Datasheets)		County	NDDOT County CF	Values from NGS Datasheets			Values from Rasters		QC Review Statistics	
PID	Name			SPCS Combined Factor (CF)	NGS Mark Distortion Computed with NDDOT CF (ppm)	Ellipsoid Height (m)	Distortion Raster (ppm)	Ellipsoid Height Raster (m)	Distortion difference (ppm) (NGS - Raster)	Ellipsoid height difference (m) (NGS - Raster)
QT0218	P 101=CGS	ADAMS	0.9998875	0.99991948	31.984	789.468	32.2	788.6	0.2	-0.8
RS0476	FAA HEI A	ADAMS	0.9998875	0.99991064	23.143	806.334	23.2	806.4	0.1	0.0
RQ0771	VALLPORT	BARNES	0.9998710	0.99987527	4.271	398.230	4.3	398.3	0.0	0.0
RQ0524	S 497	BARNES	0.9998710	0.99987115	0.150	417.777	0.1	418.1	-0.1	0.3
SM0663	TTS 41 Y	BENSON	0.9998610	0.99987532	14.322	428.138	14.5	427.3	0.2	-0.8
DJ8563	MAAH DAAH HEY CENTENNIAL	BILLINGS	0.9998085	0.99980909	0.590	811.698	1.3	807.4	0.7	-4.3
DF4864	NORWEGIAN ET	BILLINGS	0.9998085	0.99980365	-4.851	845.903	-4.3	842.4	0.5	-3.5
RS0231	U 13	BILLINGS	0.9998085	0.99982748	18.984	699.328	19.5	696.2	0.5	-3.1
DE5680	DICKINSON CBL 1400	BILLINGS	0.9998085	0.99980982	1.320	809.212	1.7	806.6	0.4	-2.7
RS0325	J 494	BILLINGS	0.9998085	0.99980989	1.390	807.447	1.6	806.2	0.2	-1.3
RS0324	H 494	BILLINGS	0.9998085	0.99980799	-0.510	819.735	-0.4	819.0	0.1	-0.7
RS0338	C 493	BILLINGS	0.9998085	0.99982405	15.553	717.845	15.0	721.4	-0.6	3.6
RS0472	FAA D04 A	BOWMAN	0.9998710	0.99986063	-10.371	885.826	-10.3	886.2	0.0	0.3
TG1932	BOUNDARY MON 646 CD US	BURKE	0.9999095	0.99997753	68.036	548.776	68.4	545.6	0.3	-3.2
TG1929	BOUNDARY MON 621 CD US	BURKE	0.9999095	0.99997556	66.066	561.971	66.4	559.0	0.4	-3.0
TG0981	E 332	BURKE	0.9999095	0.99987524	-34.263	727.554	-34.0	725.1	0.3	-2.4
DH4429	FPI 1	BURLEIGH	0.9998515	0.99985902	7.521	492.284	8.1	488.4	0.6	-3.9
AA2866	DAKOTA	BURLEIGH	0.9998515	0.99985244	0.940	532.357	1.4	529.5	0.5	-2.9
AC7093	BIS AP STA B	BURLEIGH	0.9998515	0.99986107	9.571	480.513	9.7	479.4	0.2	-1.1
RR0276	BAP	BURLEIGH	0.9998515	0.99986079	9.291	481.560	9.5	480.5	0.2	-1.1
SN0108	U 126	BURLEIGH	0.9998515	0.99985242	0.920	633.189	0.9	632.8	0.0	-0.4
AC7092	BIS AP STA A	BURLEIGH	0.9998515	0.99986077	9.271	481.574	9.3	481.4	0.0	-0.1
AH5338	BIS C	BURLEIGH	0.9998515	0.99986129	9.791	480.496	9.8	480.4	0.0	-0.1
AC7090	BIS ARP	BURLEIGH	0.9998515	0.99986106	9.561	480.257	9.5	480.4	0.0	0.2
RP1146	H 506	CASS	0.9998875	0.99989774	10.241	249.492	10.7	246.4	0.5	-3.1
DF7623	FARGO 0009	CASS	0.9998875	0.99989710	9.601	248.833	10.0	246.4	0.4	-2.4
RP0697	G 499	CASS	0.9998875	0.99989705	9.551	249.300	9.8	247.8	0.2	-1.5
RP1150	M 506	CASS	0.9998875	0.99990029	12.791	253.328	12.9	252.6	0.1	-0.8
RP1147	J 506	CASS	0.9998875	0.99989818	10.681	250.747	10.7	250.5	0.0	-0.3
DF7625	FARGO 0015	CASS	0.9998875	0.99989886	11.361	245.590	11.4	245.5	0.0	-0.1
RP1148	K 506	CASS	0.9998875	0.99989892	11.421	250.595	11.4	250.5	0.0	-0.1
RP1151	N 506	CASS	0.9998875	0.99990087	13.372	252.875	13.4	252.8	0.0	-0.1
AE1795	SN8 A	CASS	0.9998875	0.99989569	8.191	256.606	8.2	256.8	0.0	0.2
RP0665	D 499	CASS	0.9998875	0.99989167	4.170	283.457	4.1	283.9	-0.1	0.4
TE0150	W 406	CAVALIER	0.9999340	0.99994414	10.141	472.068	10.0	472.1	-0.1	0.0
RQ0079	G 26	DICKEY	0.9999435	0.99996357	20.071	370.752	20.3	370.1	0.2	-0.6
TG1928	BOUNDARY MON 591 CD US	DIVIDE	0.9999130	0.99995395	40.954	700.333	41.0	699.2	0.1	-1.1
TG2076	FAA D50 A	DIVIDE	0.9999130	0.99995387	40.874	573.644	40.8	573.1	0.0	-0.5
SO0374	G 82	DUNN	0.9998690	0.99987570	6.701	645.217	6.7	644.8	0.0	-0.4
RR0055	M 9	EMMONS	0.9998910	0.99992799	36.994	527.058	37.1	526.8	0.1	-0.2
SO0699	U 94	GOLDEN VALLEY	0.9998085	0.99982235	13.853	800.531	14.0	799.3	0.2	-1.3

QC Review Statistics: North Dakota State Plane Coordinate System 1983 - Linear Distortion at the Topographic Surface

Comparative statistics for linear distortion at survey monument locations stored in NGS datasheets and the North Dakota SPCS 83 with NDDOT county coordinate conversion factors

Summary Statistics	Min	Max	Std Dev	Median	Mean
Distortion Difference (ppm)	-0.6	0.9	0.2	0.1	0.1
Ellipsoid Height Difference (m)	-5.4	3.6	1.4	-0.6	-0.9

NGS Control Mark (from NGS Datasheets)		County	NDDOT County CF	Values from NGS Datasheets			Values from Rasters		QC Review Statistics	
PID	Name			SPCS Combined Factor (CF)	NGS Mark Distortion Computed with NDDOT CF (ppm)	Ellipsoid Height (m)	Distortion Raster (ppm)	Ellipsoid Height Raster (m)	Distortion difference (ppm) (NGS - Raster)	Ellipsoid height difference (m) (NGS - Raster)
DM7011	SULLY	GOLDEN VALLEY	0.9998085	0.99980861	0.110	812.712	0.0	813.5	-0.1	0.8
AJ2501	GF 4	GRAND FORKS	0.9998805	0.99990412	23.623	229.217	24.0	227.2	0.3	-2.0
AJ2499	GF 2	GRAND FORKS	0.9998805	0.99990347	22.973	228.755	23.2	227.2	0.3	-1.6
AJ2500	GF 3	GRAND FORKS	0.9998805	0.99990424	23.743	226.395	23.9	225.2	0.2	-1.2
AJ2502	GF 5	GRAND FORKS	0.9998805	0.99990456	24.063	227.303	24.3	226.2	0.2	-1.1
SL0382	S 266	GRAND FORKS	0.9998805	0.99990317	22.673	230.637	22.9	229.6	0.2	-1.0
AJ2503	GF 6	GRAND FORKS	0.9998805	0.99990478	24.283	226.939	24.4	226.2	0.1	-0.8
AJ2506	GF 9	GRAND FORKS	0.9998805	0.99990702	26.523	227.924	26.7	227.2	0.1	-0.7
AC7108	GFK AP STA C	GRAND FORKS	0.9998805	0.99990303	22.533	229.926	22.7	229.2	0.1	-0.7
AC7109	GFK AP STA A2	GRAND FORKS	0.9998805	0.99990235	21.853	228.949	21.9	228.5	0.1	-0.4
SL1165	D 477	GRAND FORKS	0.9998805	0.99988847	7.971	320.569	8.1	320.1	0.1	-0.4
AC7112	GFK E	GRAND FORKS	0.9998805	0.99990269	22.193	228.598	22.3	228.2	0.1	-0.4
AJ2505	GF 8	GRAND FORKS	0.9998805	0.99990681	26.313	227.547	26.4	227.2	0.1	-0.4
SL0377	G 261	GRAND FORKS	0.9998805	0.99990411	23.613	229.119	23.6	229.2	0.0	0.1
AJ2498	GF 1	GRAND FORKS	0.9998805	0.99990299	22.493	225.783	22.5	226.1	0.0	0.4
AJ2504	GF 7	GRAND FORKS	0.9998805	0.99990583	25.333	228.358	25.2	229.2	-0.1	0.8
RR0753	H 502	GRANT	0.9998615	0.99988006	18.563	680.925	18.6	681.2	0.0	0.3
RS0081	F 99	HETTINGER	0.9998390	0.99984675	7.751	732.483	7.9	731.9	0.2	-0.6
RQ0487	E 486	KIDDER	0.9998515	0.99985558	4.081	514.061	4.2	513.5	0.1	-0.6
RQ0161	R 43	LAMOURE	0.9998850	0.99988828	3.280	575.673	3.6	574.2	0.3	-1.4
TF2081	RISING	MCHENRY	0.9998830	0.99987358	-9.421	449.297	-9.0	446.4	0.4	-2.9
DJ8561	DENBIGH CENTENNIAL	MCHENRY	0.9998830	0.99987330	-9.701	442.520	-9.6	441.5	0.1	-1.0
TG1256	TOBACCO RM 1	MCKENZIE	0.9998485	0.99983675	-11.752	633.194	-11.1	628.8	0.7	-4.4
DH4420	BIRNT HILLS DISCOVERY II	MCKENZIE	0.9998485	0.99983913	-9.371	618.303	-9.3	617.9	0.1	-0.4
DJ5120	NEW TOWN DISCOVERY II	MCKENZIE	0.9998485	0.99984917	0.670	563.683	0.7	563.7	0.0	0.0
DM7010	SATHER	MCKENZIE	0.9998485	0.99985612	7.621	671.600	7.7	671.7	0.0	0.1
SO0587	B 94	MCKENZIE	0.9998485	0.99988333	34.835	693.722	34.6	695.4	-0.2	1.7
SN0909	ASH	MCLEAN	0.9998925	0.99989579	3.290	587.418	3.9	583.8	0.6	-3.6
SO0222	DAISY	MCLEAN	0.9998925	0.99986265	-29.853	653.794	-29.4	650.9	0.5	-2.9
SN0845	CONTROL	MCLEAN	0.9998925	0.99992958	37.084	559.657	37.3	558.7	0.2	-1.0
SN1438	J 468	MCLEAN	0.9998925	0.99989251	0.010	557.977	0.0	558.3	0.0	0.3
SN0952	C 401	MERCER	0.9998690	0.99990900	40.005	567.533	40.5	563.6	0.5	-3.9
AJ5463	LINK	MERCER	0.9998690	0.99987903	10.031	651.483	10.5	648.0	0.5	-3.5
DH4422	COTEAU DISCOVERY II	MERCER	0.9998690	0.99989970	30.704	591.947	30.9	589.9	0.2	-2.0
DJ8551	NACRC 03	MERCER	0.9998690	0.99988486	15.862	504.723	16.1	502.9	0.2	-1.8
SN1707	HAZEN	MERCER	0.9998690	0.99988643	17.432	524.799	17.6	523.2	0.2	-1.6
DH4426	HAZEN DISCOVERY II	MERCER	0.9998690	0.99988705	18.052	516.117	18.2	514.9	0.1	-1.2
DJ8549	NACRC 01	MERCER	0.9998690	0.99988392	14.922	540.773	14.8	540.9	-0.1	0.1
DJ8558	NACRC 10	MERCER	0.9998690	0.99987045	1.450	601.274	1.4	601.4	-0.1	0.2
DJ8550	NACRC 02	MERCER	0.9998690	0.99988846	19.463	511.905	19.3	512.6	-0.2	0.7
RR0193	C 130	MORTON	0.9998485	0.99988908	40.586	497.752	40.8	496.7	0.2	-1.0

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Comparative statistics for linear distortion at survey monument locations stored in NGS datasheets and the North Dakota SPCS 83 with NDDOT county coordinate conversion factors

Summary Statistics	Min	Max	Std Dev	Median	Mean
Distortion Difference (ppm)	-0.6	0.9	0.2	0.1	0.1
Ellipsoid Height Difference (m)	-5.4	3.6	1.4	-0.6	-0.9

NGS Control Mark (from NGS Datasheets)		County	NDDOT County CF	Values from NGS Datasheets			Values from Rasters		QC Review Statistics	
PID	Name			SPCS Combined Factor (CF)	NGS Mark Distortion Computed with NDDOT CF (ppm)	Ellipsoid Height (m)	Distortion Raster (ppm)	Ellipsoid Height Raster (m)	Distortion difference (ppm) (NGS - Raster)	Ellipsoid height difference (m) (NGS - Raster)
RR0725	D 501	MORTON	0.9998485	0.99983241	-16.092	663.468	-16.1	663.4	0.0	-0.1
DH4425	FORT LINCOLN DISCOVERY II	MORTON	0.9998485	0.99985945	10.952	492.084	10.9	492.7	-0.1	0.6
RR0986	FAA Y19 A	MORTON	0.9998485	0.99984727	-1.230	569.244	-1.3	569.9	-0.1	0.6
SO0053	VAN HOOK	MOUNTRAIL	0.9998350	0.99984873	13.732	572.585	14.0	570.8	0.3	-1.7
TG1638	C 465	MOUNTRAIL	0.9998350	0.99983880	3.801	664.591	3.9	663.7	0.1	-0.9
TG0499	STANLEY NORTH BASE	MOUNTRAIL	0.9998350	0.99983164	-3.361	681.662	-3.4	681.8	0.0	0.2
DJ8554	NACRC 06	OLIVER	0.9998530	0.99984813	-4.871	640.099	-4.3	636.1	0.6	-4.0
DJ8553	NACRC 05	OLIVER	0.9998530	0.99985251	-0.490	604.739	0.0	601.4	0.5	-3.3
DJ8552	NACRC 04	OLIVER	0.9998530	0.99985448	1.480	630.736	1.6	629.4	0.2	-1.3
DJ8556	NACRC 08	OLIVER	0.9998530	0.99984889	-4.111	654.277	-4.0	653.1	0.1	-1.2
DJ8555	NACRC 07	OLIVER	0.9998530	0.99985083	-2.170	637.304	-2.2	637.0	0.0	-0.3
TF1846	J 474	PIERCE	0.9998830	0.99988139	-1.610	444.153	-1.6	444.2	0.0	0.0
DK2812	CGN 2	RAMSEY	0.9998685	0.99986992	1.420	421.534	2.1	417.6	0.6	-4.0
DQ7744	DVL G	RAMSEY	0.9998685	0.99987023	1.730	419.817	1.8	419.2	0.1	-0.6
TE0705	P 255	RAMSEY	0.9998685	0.99987022	1.720	420.531	1.8	420.1	0.1	-0.4
DK2811	CGN 1	RAMSEY	0.9998685	0.99986940	0.900	424.572	1.0	424.2	0.1	-0.3
TE1214	W 255	RAMSEY	0.9998685	0.99987118	2.680	421.883	2.7	421.6	0.0	-0.3
DQ7743	DVL F	RAMSEY	0.9998685	0.99987090	2.400	414.969	2.4	414.8	0.0	-0.2
DQ9303	RTI 2	RAMSEY	0.9998685	0.99986945	0.950	424.170	0.9	424.2	0.0	0.1
AE1792	DVL E	RAMSEY	0.9998685	0.99987093	2.430	414.988	2.4	415.2	0.0	0.2
DQ9304	RTI 3	RAMSEY	0.9998685	0.99986949	0.990	423.978	0.9	424.2	0.0	0.3
DQ9302	RTI 1	RAMSEY	0.9998685	0.99986952	1.020	423.795	0.9	424.3	-0.1	0.5
TE1574	K 478	RAMSEY	0.9998685	0.99986912	0.620	426.169	0.3	427.9	-0.3	1.8
DM7009	NC TRAIL	RANSOM	0.9999010	0.99991737	16.372	301.291	16.6	300.1	0.2	-1.2
TF2252	MOHALL APT	RENVILLE	0.9999205	0.99993110	10.601	481.146	10.7	480.0	0.1	-1.1
TF2123	CLAY	RENVILLE	0.9999205	0.99991351	-6.991	483.248	-6.9	482.4	0.1	-0.9
TF1427	L 283	RENVILLE	0.9999205	0.99992977	9.271	486.846	9.3	486.4	0.0	-0.5
RP0260	U 375	RICHLAND	0.9999345	0.99992933	-5.170	263.953	-5.0	263.3	0.2	-0.7
RP1173	F 505	RICHLAND	0.9999345	0.99993825	3.750	263.935	3.8	263.7	0.1	-0.2
AE1794	GWR A	SARGENT	0.9999595	0.99993772	-21.781	356.052	-21.6	355.4	0.2	-0.6
RR0811	CANNON BALL RESET	SIoux	0.9999065	0.99987902	-27.483	545.569	-26.6	540.3	0.9	-5.3
DH4424	FORT YATES DISCOVERY II	SIoux	0.9999065	0.99994543	38.934	474.540	39.1	474.2	0.2	-0.4
RS0238	D 98	SLOPE	0.9998600	0.99981431	-45.696	831.433	-45.6	830.9	0.1	-0.5
DF4863	3N	SLOPE	0.9998600	0.99984134	-18.663	801.065	-18.7	801.5	0.0	0.5
RS0183	Z 19	SLOPE	0.9998600	0.99982395	-36.055	845.409	-36.2	846.3	-0.1	0.9
DJ8562	FOREST CENTENNIAL	SLOPE	0.9998600	0.99983083	-29.174	730.885	-29.5	733.2	-0.3	2.3
AC7101	DIK B	STARK	0.9998175	0.99981491	-2.590	773.743	-2.3	772.0	0.3	-1.7
AE1791	DIK C	STARK	0.9998175	0.99981489	-2.610	773.146	-2.4	771.8	0.2	-1.4
RS0303	N 492	STARK	0.9998175	0.99982185	4.351	729.364	4.5	728.4	0.1	-0.9
AH4991	NORTH	STARK	0.9998175	0.99981527	-2.230	770.554	-2.1	769.8	0.1	-0.7
AC7099	DIK A	STARK	0.9998175	0.99981547	-2.030	769.434	-1.9	768.8	0.1	-0.6

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RS0292	C 492	STARK	0.9998175	0.99982312	5.621	721.403	5.7	720.8	0.1	-0.6
RS0267	J 491	STARK	0.9998175	0.99982753	10.032	692.885	9.8	694.3	-0.2	1.4
DJ8564	MEDORA CENTENNIAL	STARK	0.9998175	0.99982126	3.761	733.223	3.5	734.7	-0.2	1.5
SL0895	G 304	STEELE	0.9999375	0.99993022	-7.280	342.625	-7.0	341.6	0.2	-1.0
AA2872	ARROWWOOD	STUTSMAN	0.9998560	0.99989789	41.896	421.580	42.0	420.3	0.1	-1.3
AE1793	JMS C	STUTSMAN	0.9998560	0.99986978	13.782	429.982	13.7	430.5	-0.1	0.5
TE2110	BOUNDARY MON 729 CD US	TOWNER	0.9999160	0.99998579	69.796	496.991	70.3	493.1	0.5	-3.9
DL6768	HIGDEM	WALSH	0.9998905	0.99990311	12.611	220.631	12.8	219.2	0.2	-1.4
DL6769	WOSICK	WALSH	0.9998905	0.99990319	12.691	220.380	12.8	219.4	0.1	-0.9
TD0340	E 116	WALSH	0.9998905	0.99990329	12.791	219.875	12.7	220.1	0.0	0.2
TF2210	ZION	WARD	0.9998530	0.99983622	-16.782	636.704	-16.4	634.4	0.4	-2.3
DL6344	MAFB 124	WARD	0.9998530	0.99987657	23.573	477.095	23.8	475.5	0.2	-1.6
DL6343	MAFB 125	WARD	0.9998530	0.99987729	24.294	488.001	24.5	486.6	0.2	-1.4
TF2199	YELLOW	WARD	0.9998530	0.99985624	3.240	564.890	3.4	563.6	0.2	-1.3
DH4419	ACKERMAN 1	WARD	0.9998530	0.99986199	8.991	505.122	9.2	503.9	0.2	-1.3
DH9585	MINOT AFB MON 99	WARD	0.9998530	0.99987742	24.424	475.509	24.6	474.4	0.1	-1.1
TF0939	TRANSPORT AZ MK	WARD	0.9998530	0.99986269	9.691	500.289	9.8	499.2	0.1	-1.1
TF0938	MOT AP STA B	WARD	0.9998530	0.99986272	9.721	499.354	9.8	498.7	0.1	-0.6
AC7117	MOT AP STA A2	WARD	0.9998530	0.99986353	10.532	489.749	10.5	490.1	-0.1	0.3
SM1222	FAA ND17 A	WELLS	0.9998895	0.99987571	-13.792	466.576	-13.8	466.7	0.0	0.1
DH4421	NORTH DAKOTA POPULATION CENTER	WELLS	0.9998895	0.99989179	2.290	468.166	2.3	468.3	0.0	0.1
DJ5118	CONFLUENCE DISCOVERY II	WILLIAMS	0.9998445	0.99984964	5.141	559.645	6.0	554.3	0.9	-5.4
AE1789	ISN A	WILLIAMS	0.9998445	0.99984803	3.531	569.061	3.6	568.5	0.1	-0.6

NGS Data Sheet source: datasheet95, version 8.12.5.3, data date: 3/10/2019 (<https://www.ngs.noaa.gov/datasheets/>)

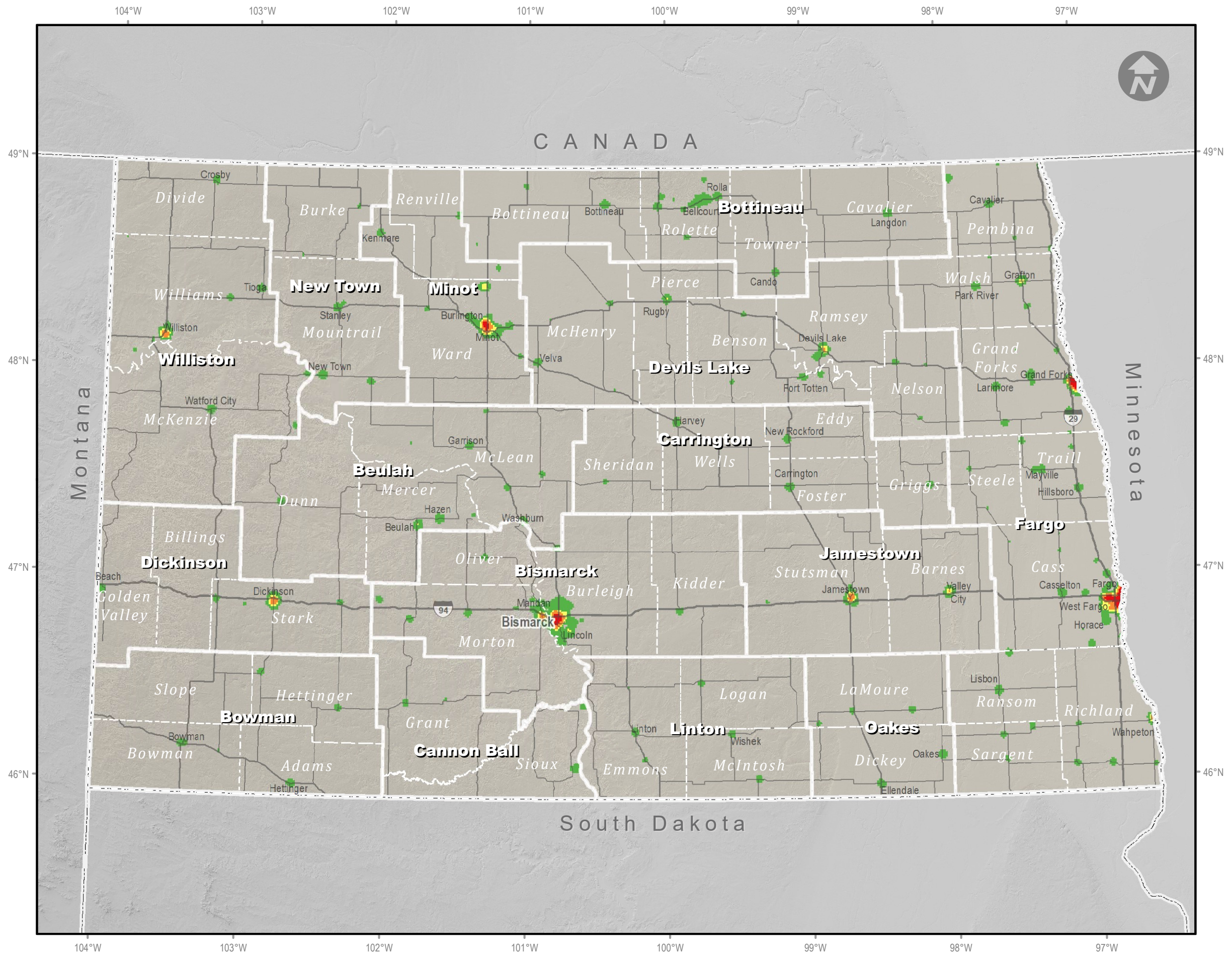
Distortion* Values by County

State Plane Coordinate System 1983 using NDDOT county coordinate conversion factors

County	Raster File	Distortion in parts per million (ppm)			
		Minimum	Maximum	Mean	Range
Adams	Mod_ND_S_Adams_ppm03s.img	-41	52	8.9	93
Barnes	Mod_ND_S_Barnes_ppm03s.img	-6	37	8.7	43
Benson	Mod_ND_N_Benson_ppm03s.img	-9	21	7.8	30
Billings	Mod_ND_S_Billings_ppm03s.img	-27	68	18.8	95
Bottineau	Mod_ND_N_Bottineau_ppm03s.img	-36	72	14.7	108
Bowman	Mod_ND_S_Bowman_ppm03s.img	-41	62	6.9	103
Burke	Mod_ND_N_Burke_ppm03s.img	-57	72	7.3	128
Burleigh	Mod_ND_S_Burleigh_ppm03s.img	-14	37	6.2	51
Cass	Mod_ND_S_Cass_ppm03s.img	-5	37	10.6	41
Cavalier	Mod_ND_N_Cavalier_ppm03s.img	-41	88	6.2	129
Dickey	Mod_ND_S_Dickey_ppm03s.img	-54	57	3.6	110
Divide	Mod_ND_N_Divide_ppm03s.img	-42	65	6.3	108
Dunn	Mod_ND_S_Dunn_ppm03s.img	-56	131	11	187
Eddy	Mod_ND_N_Eddy_ppm03s.img	-6	30	11.6	36
Emmons	Mod_ND_S_Emmons_ppm03s.img	-45	91	10	136
Foster	Mod_ND_N_Foster_ppm03s.img	-19	37	6.2	56
GoldenValley	Mod_ND_S_GoldenValley_ppm03s.img	-33	67	10.9	101
GrandForks	Mod_ND_N_GrandForks_ppm03s.img	-11	47	18.2	58
Grant	Mod_ND_S_Grant_ppm03s.img	-36	83	10.4	119
Griggs	Mod_ND_N_Griggs_ppm03s.img	-44	57	2.8	101
Hettinger	Mod_ND_S_Hettinger_ppm03s.img	-33	44	4.3	77
Kidder	Mod_ND_S_Kidder_ppm03s.img	-18	37	8.7	55
LaMoure	Mod_ND_S_LaMoure_ppm03s.img	-35	39	4.1	74
Logan	Mod_ND_S_Logan_ppm03s.img	-27	24	-4.9	52
McHenry	Mod_ND_N_McHenry_ppm03s.img	-42	34	-6.3	76
McIntosh	Mod_ND_S_McIntosh_ppm03s.img	-62	29	-18.1	90
McKenzie	Mod_ND_N_McKenzie_ppm03s.img	-36	77	8.4	112
McLean	Mod_ND_N_McLean_ppm03s.img	-52	98	-8	150
Mercer	Mod_ND_S_Mercer_ppm03s.img	-43	65	12	109
Morton	Mod_ND_S_Morton_ppm03s.img	-31	53	0.1	85
Mountrail	Mod_ND_N_Mountrail_ppm03s.img	-17	47	8.3	64
Nelson	Mod_ND_N_Nelson_ppm03s.img	-4	34	7.2	38
Oliver	Mod_ND_S_Oliver_ppm03s.img	-25	39	1.3	65
Pembina	Mod_ND_N_Pembina_ppm03s.img	-54	68	7.2	122
Pierce	Mod_ND_N_Pierce_ppm03s.img	-30	18	-7.9	47
Ramsey	Mod_ND_N_Ramsey_ppm03s.img	-4	31	8.6	35
Ransom	Mod_ND_S_Ransom_ppm03s.img	-25	34	4.8	59
Renville	Mod_ND_N_Renville_ppm03s.img	-56	70	1.9	126
Richland	Mod_ND_S_Richland_ppm03s.img	-39	81	11.4	120
Rolette	Mod_ND_N_Rolette_ppm03s.img	-32	61	4.7	94
Sargent	Mod_ND_S_Sargent_ppm03s.img	-40	45	2.2	85

Distortion* Values by County					
State Plane Coordinate System 1983 using NDDOT county coordinate conversion factors					
County	Raster File	Distortion in parts per million (ppm)			
		Minimum	Maxium	Mean	Range
Sheridan	Mod_ND_N_Sheridan_ppm03s.img	-32	49	3.4	80
Sioux	Mod_ND_S_Sioux_ppm03s.img	-28	76	17.9	103
Slope	Mod_ND_S_Slope_ppm03s.img	-63	-3	-32.4	61
Stark	Mod_ND_S_Stark_ppm03s.img	-21	31	4.1	51
Steele	Mod_ND_N_Steele_ppm03s.img	-45	56	3.6	101
Stutsman	Mod_ND_S_Stutsman_ppm03s.img	-16	52	12.9	68
Towner	Mod_ND_N_Towner_ppm03s.img	-39	79	9.1	118
Traill	Mod_ND_N_Traill_ppm03s.img	-39	56	4.8	94
Walsh	Mod_ND_N_Walsh_ppm03s.img	-23	45	9.5	68
Ward	Mod_ND_N_Ward_ppm03s.img	-22	80	4.4	102
Wells	Mod_ND_N_Wells_ppm03s.img	-23	54	10.1	77
Williams	Mod_ND_N_Williams_ppm03s.img	-24	47	4	71
All Counties	Mod_ND_Mosaic_AllCounties_ppm03s.img	-63	131	5.7	194

**Linear distortion is derived at the topographic surface.*



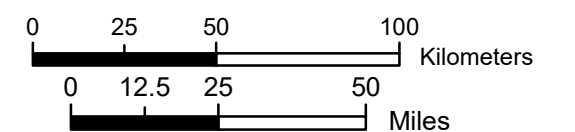
North Dakota Population Density

**- 8/1/2019 DRAFT -
FOR REVIEW PURPOSES**

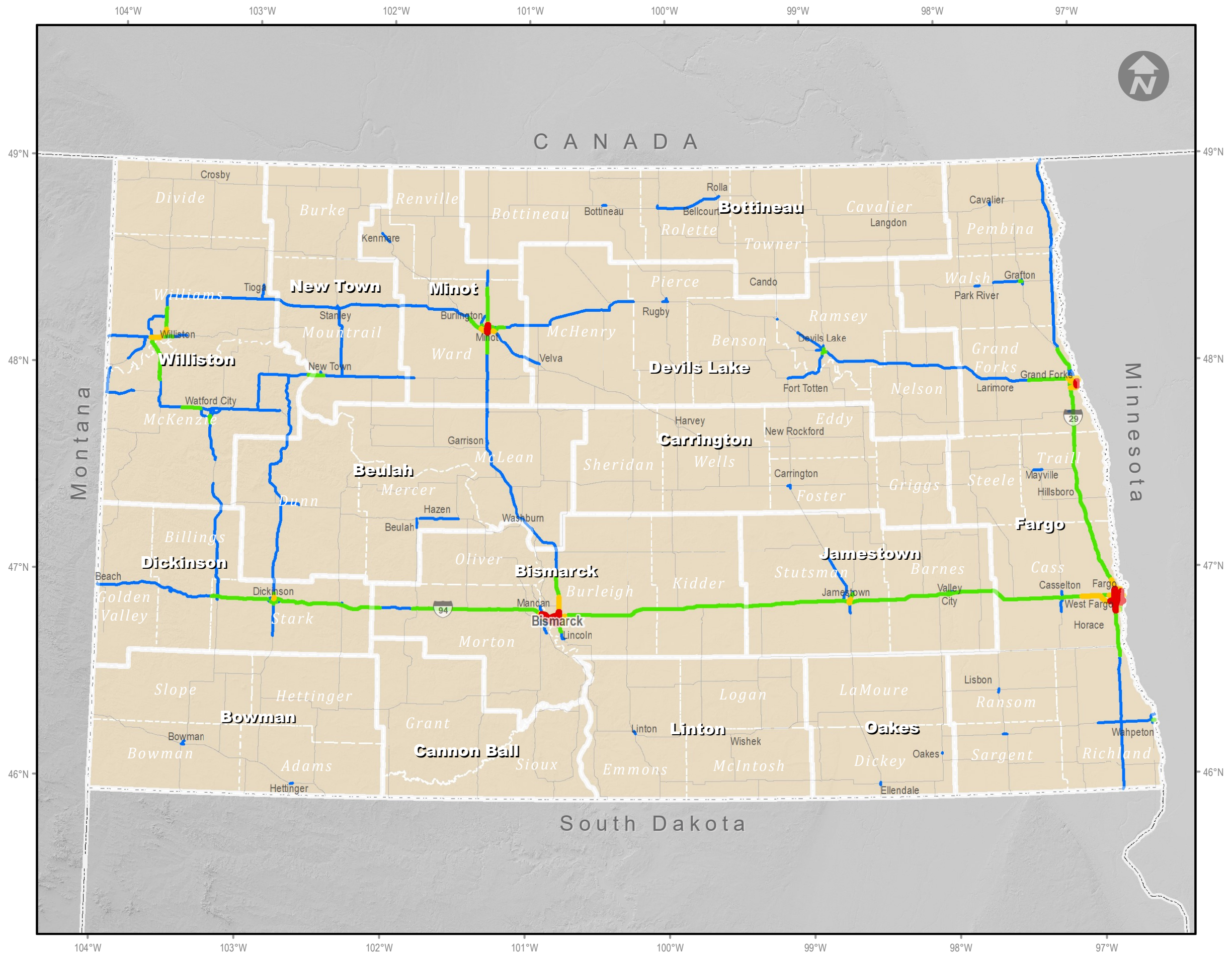
- County
- LDP Zone
- State

- Persons per km²**
- Less than 25
 - 25 to 249
 - 250 to 499
 - 500 to 999
 - 1,000 or more

Source: U.S. Census Bureau, 2010 Decennial Census
Kernel density raster created from population by
census block



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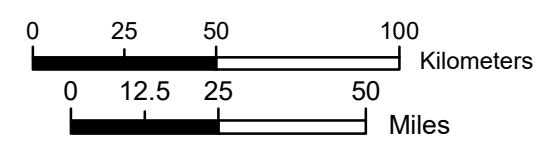
North Dakota 2017 Annual Average Daily Traffic (AADT)

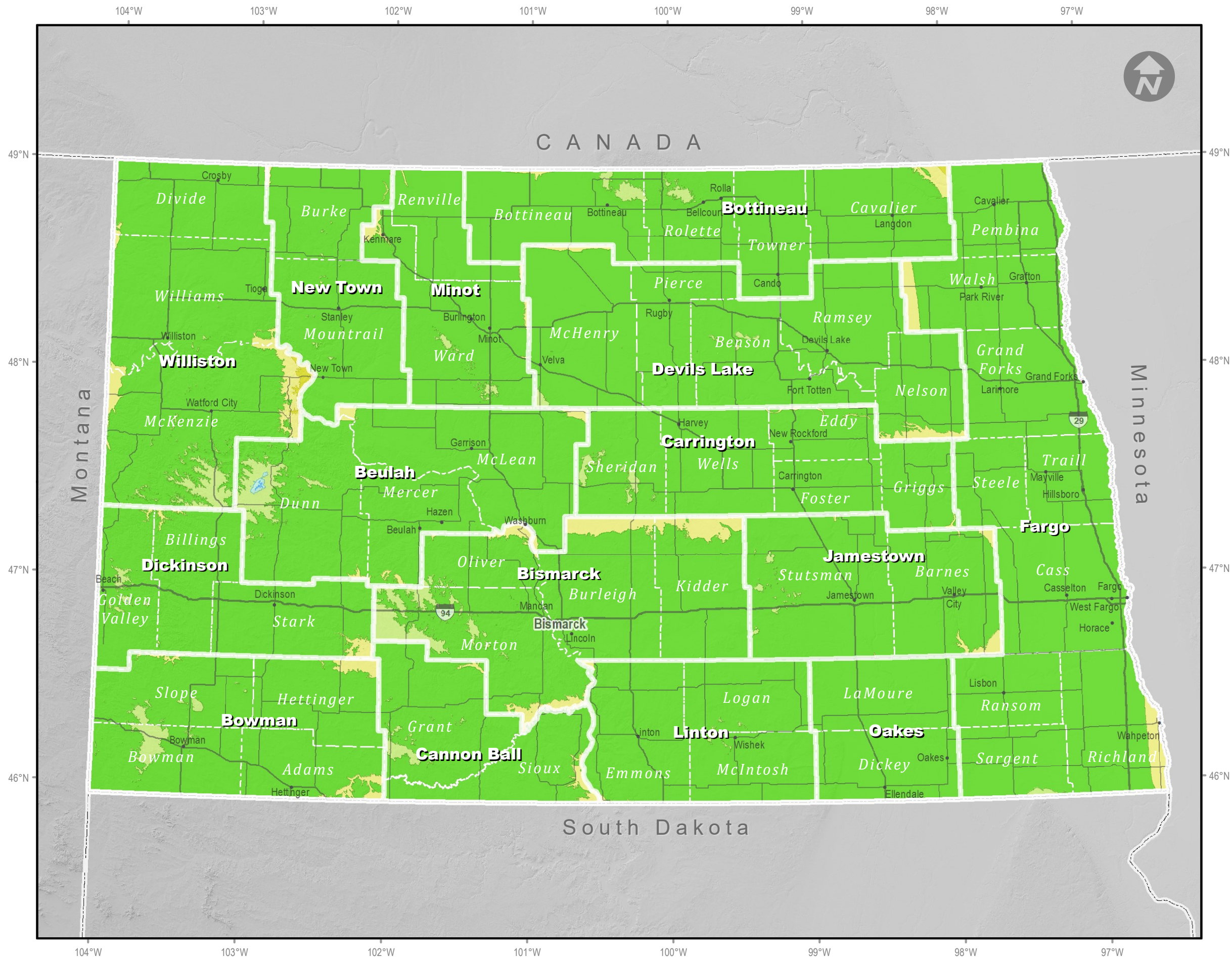
**- 8/1/2019 DRAFT -
FOR REVIEW PURPOSES**

- County
- LDP Zone
- State

- 2017 AADT**
- Less than 2,500
 - 2,500 to 7,499
 - 7,500 to 14,999
 - 15,000 to 24,999
 - More than 25,000

Source: Annual Average Daily Traffic (AADT) data from the 2017 Highway Performance Monitoring System (HPMS) submittal for North Dakota DOT to the Federal Highway Administration (FHWA)

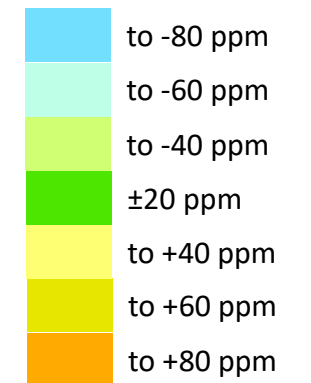




North Dakota Preliminary LDP Zones

**- 8/1/2019 DRAFT -
FOR REVIEW PURPOSES**

**Linear Distortion
at the Topographic Surface
in parts per million (ppm)**



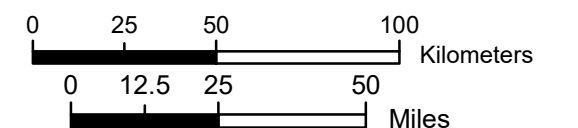
**Distortion Values for All Zones
in parts per million (ppm)**

Min: -65 Range: 127
Max: +62 Mean: -0.9

Area of the state that is within:

± 10ppm: 64% ± 25ppm: 98%
± 20ppm: 95% ± 30ppm: 99%

— Interstate - - - State
— US Route - - - County
— State Route - - - LDP Zone



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Option 1: Four Zones

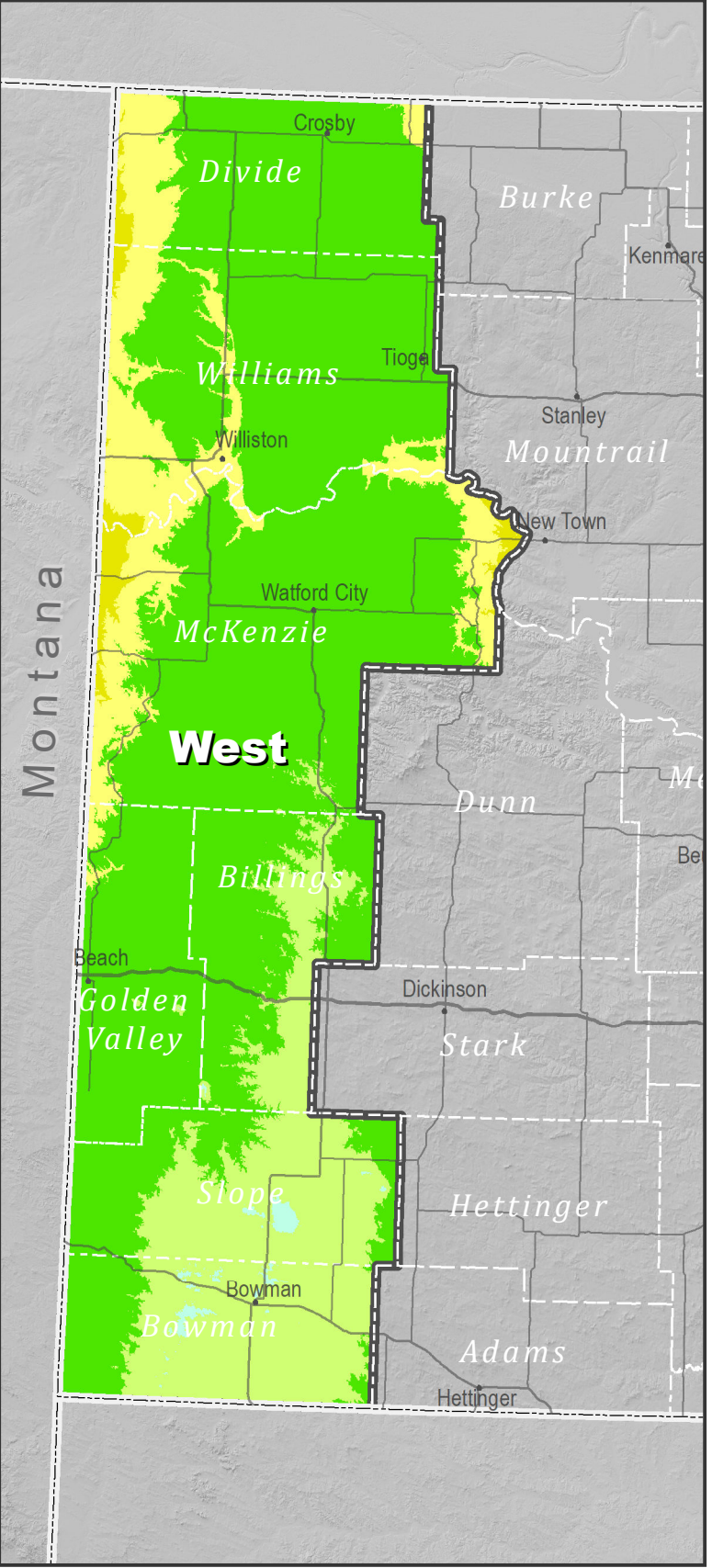
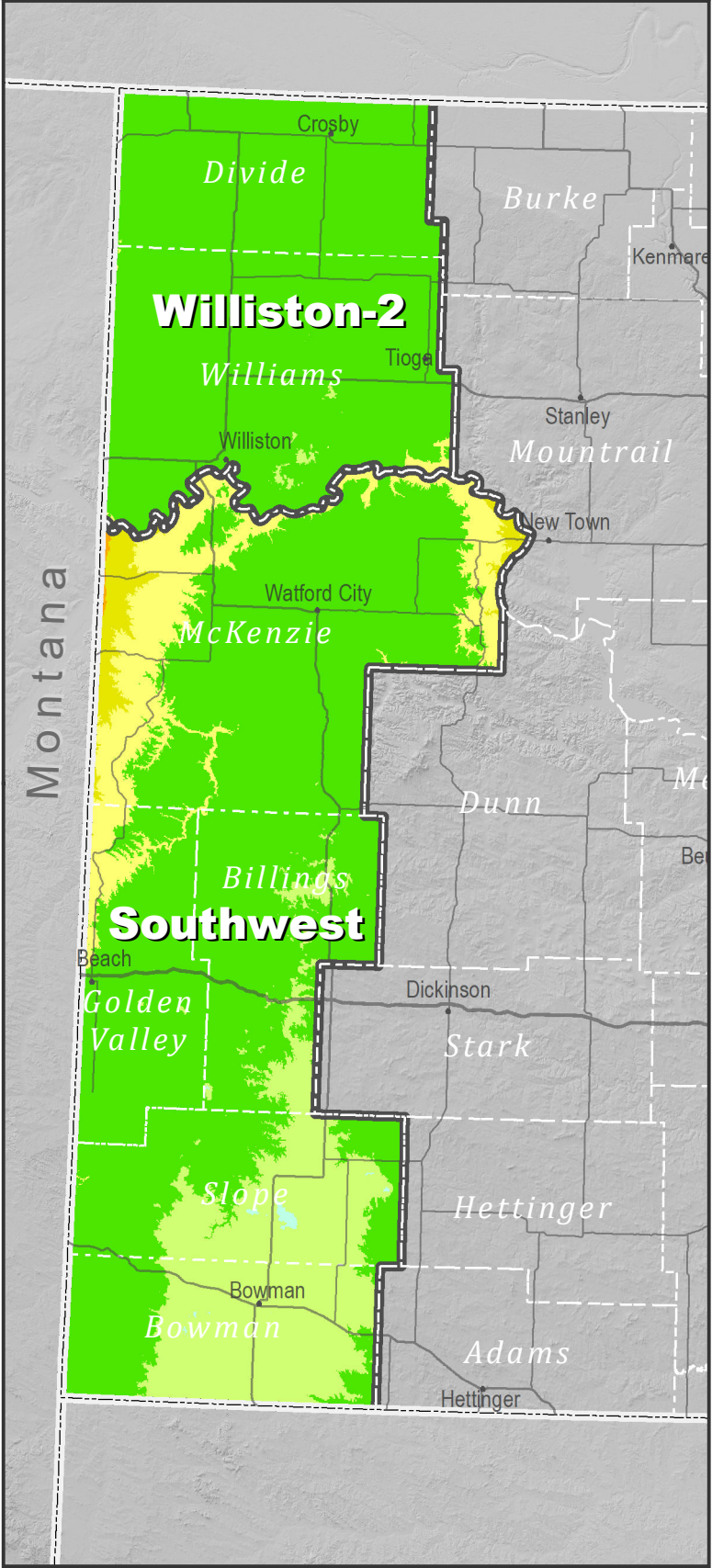
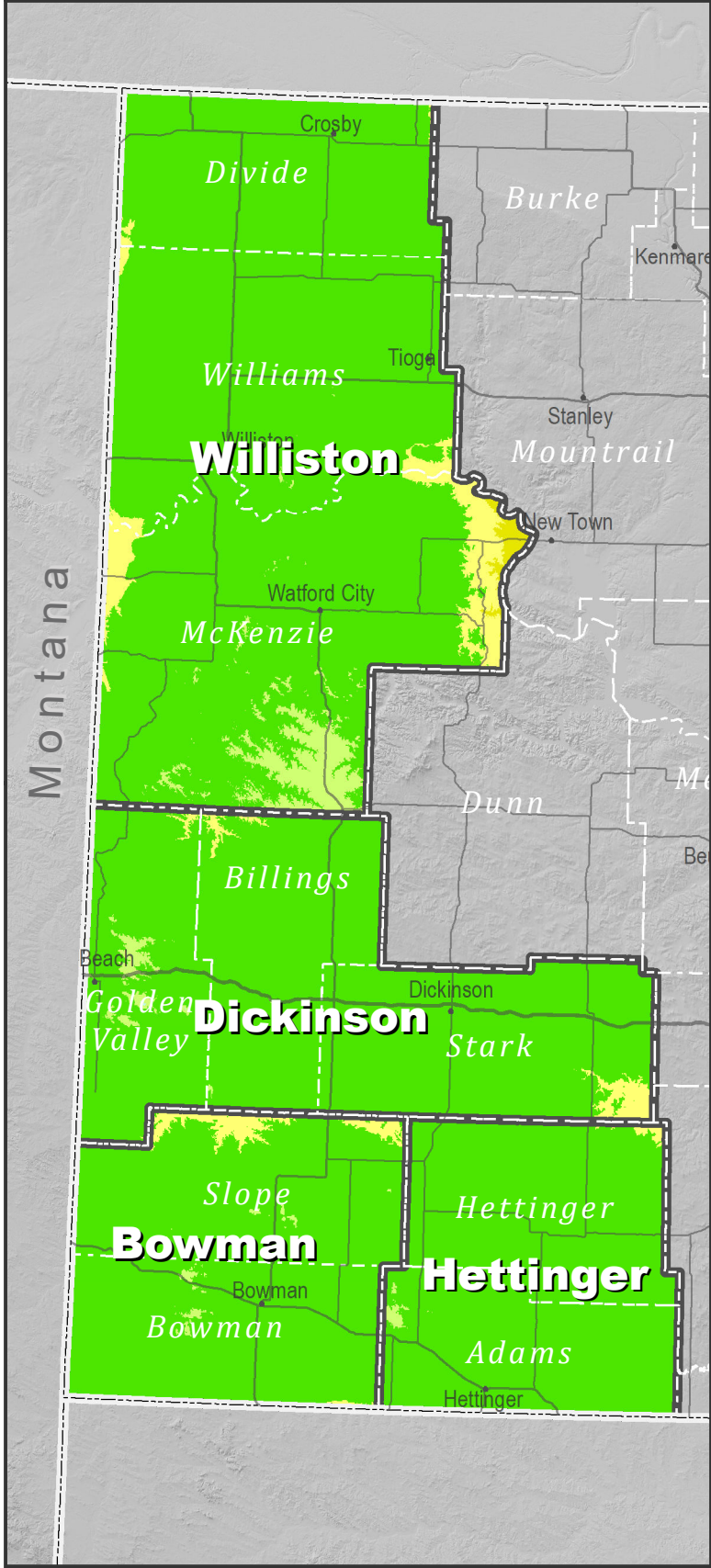
Distortion Values (ppm)		Area of the zone that is within:			
Min: -46	Range: 108	± 10ppm: 67%	± 25ppm: 97%		
Max: 62	Mean: -0.8	± 20ppm: 94%	± 30ppm: 99%		

Option 2: Two Zones

Distortion Values (ppm)		Area of the zone that is within:			
Min: -54	Range: 118	± 10ppm: 45%	± 25ppm: 86%		
Max: 64	Mean: -1.1	± 20ppm: 77%	± 30ppm: 93%		

Option 3: One Zone

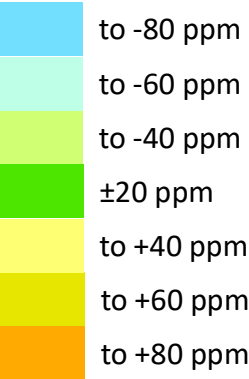
Distortion Values (ppm)		Area of the zone that is within:			
Min: -58	Range: 114	± 10ppm: 42%	± 25ppm: 79%		
Max: 56	Mean: 0.1	± 20ppm: 68%	± 30ppm: 87%		



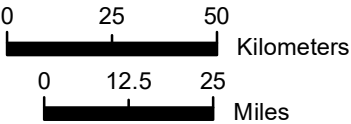
North Dakota
Preliminary LDP Zones

- 8/21/2019 DRAFT -
FOR REVIEW PURPOSES

Linear Distortion
at the Topographic Surface
in parts per million (ppm)

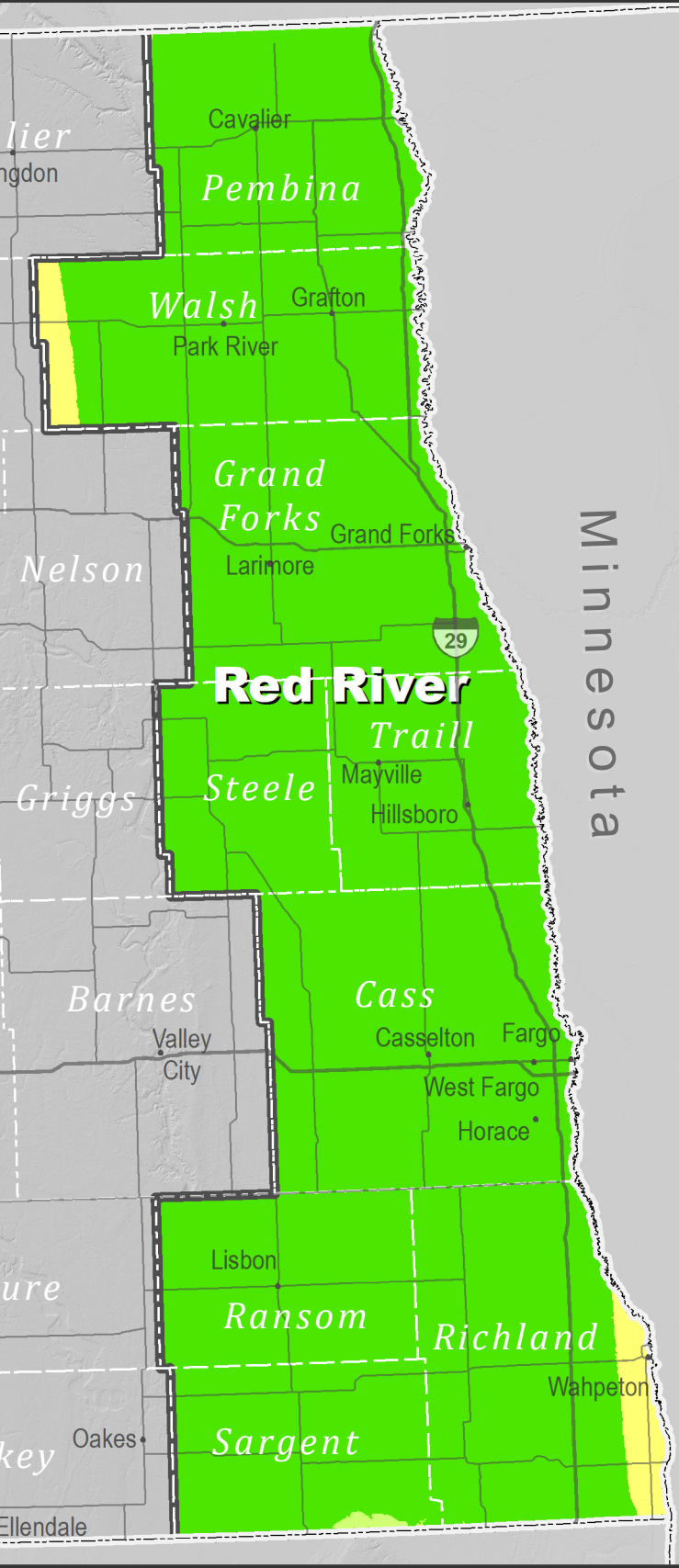


- Interstate
- US Route
- State Route
- State
- County
- LDP Zone



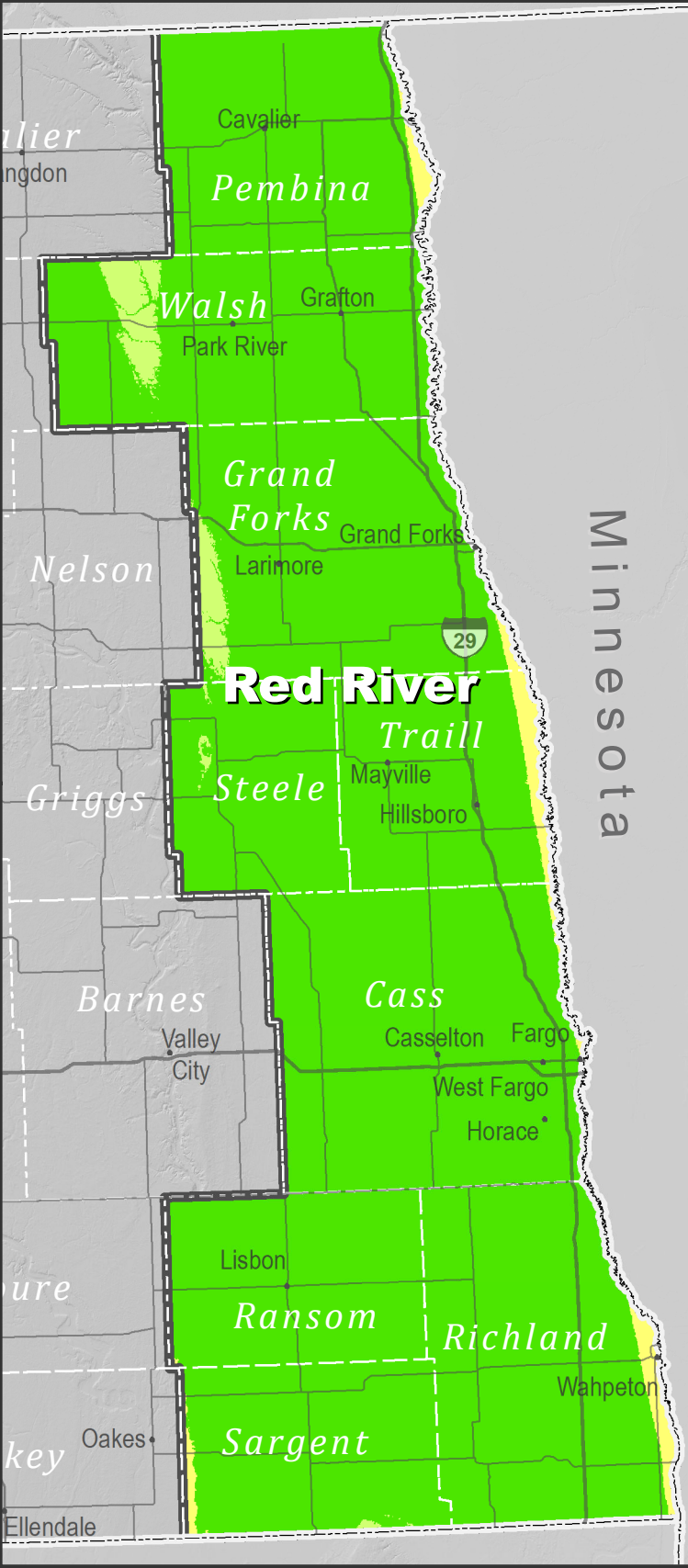
Option 1: Red River, Transverse Mercator

Distortion Values (ppm)		Area of the zone that is within:			
Min: -40	Range: 76	± 10ppm: 73%	± 25ppm: 99%		
Max: 35	Mean: -1.8	± 20ppm: 97%	± 30ppm: 100%		



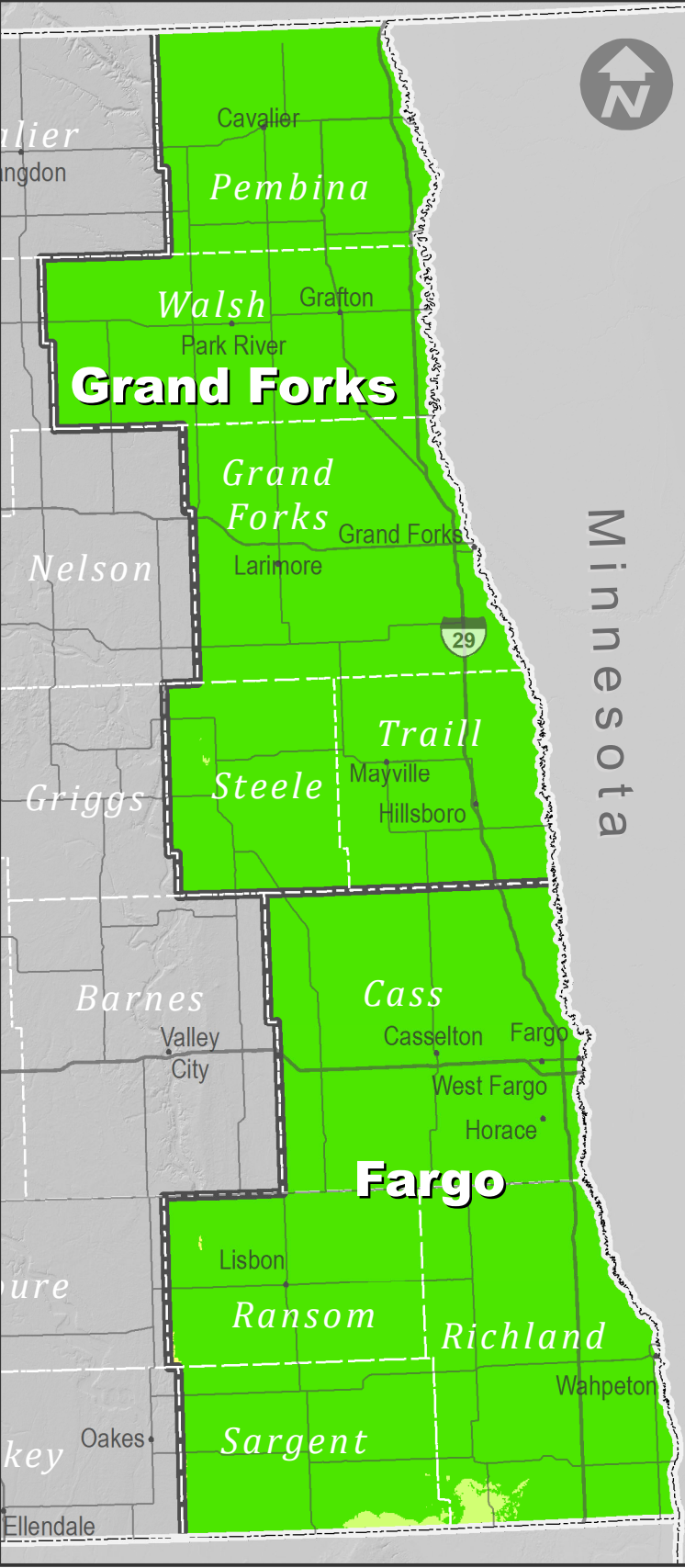
Option 2: Red River, Oblique Mercator

Distortion Values (ppm)		Area of the zone that is within:			
Min: -34	Range: 63	± 10ppm: 58%	± 25ppm: 100%		
Max: 29	Mean: -1.7	± 20ppm: 96%	± 30ppm: 100%		



Option 3: Grand Forks + Fargo, TM

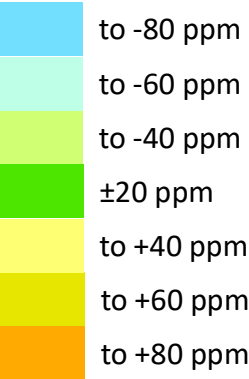
Distortion Values (ppm)		Area of the zone that is within:			
Min: -40	Range: 63	± 10ppm: 64%	± 25ppm: 100%		
Max: 23	Mean: -4.6	± 20ppm: 99%	± 30ppm: 100%		



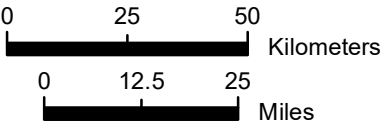
North Dakota
Preliminary LDP Zones

- 8/21/2019 DRAFT -
FOR REVIEW PURPOSES

Linear Distortion
at the Topographic Surface
in parts per million (ppm)



- Interstate
- US Route
- State Route
- State
- County
- LDP Zone



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Distortion Values by Preliminary Zone					
<i>(Zone names based on the most populous city in the zone)</i>					
Zone Name	Raster File	Distortion in parts per million (ppm)			
		Minimum	Maximum	Mean	Range
Beulah	Beulah1_LCC_k1000089_cp4727_09s.img	-65	39	0.8	104
Bismarck	Bismarck1_LCC_k1000081_cp4649_09s.img	-37	43	0.4	80
Bottineau	Bottineau1_LCC_k1000066_cp4836_09s.img	-30	49	-0.1	79
Bowman	Bowman1_LCC_k1000123_cp4617_09s.img	-37	39	0.4	75
Cannon Ball	CannonBall1_LCC_k1000093_cp4617_09s.img	-34	37	0.3	71
Carrington	Carrington1_LCC_k1000072_cp473130_09s.img	-31	28	1.1	58
Devils Lake	DevilsLake1_LCC_k1000056_cp4810_09s.img	-32	34	-6.0	66
Dickinson	Dickinson1_LCC_k1000112_cp4700_09s.img	-46	32	-1.0	77
Fargo	Fargo1_TM_k1000035_cp9718_09s.img	-40	35	-1.8	76
Jamestown	Jamestown1_LCC_k1000067_cp4657_09s.img	-25	31	1.9	56
Linton	Linton1_LCC_k1000081_cp4618_09s.img	-23	27	-3.1	50
Minot	Minot1_TM_k1000080_cp10127_09s.img	-24	29	0.4	52
New Town	NewTown1_LCC_k1000094_cp10227_09s.img	-23	23	-1.1	45
Oakes	Oakes1_TM_k1000061_cp9820_09s.img	-16	11	-0.1	27
Williston	Williston1_TM_k1000092_cp10327_09s.img	-34	62	-1.4	96
All Combined	allZones_Prelim1_Mosaic_ppm09s.img	-65	62	-0.9	127

Note: Linear distortion is derived at the topographic surface.