

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Gravity Survey Data for the International Falls and Roseau
CUSMAP projects, Minnesota, USA and Ontario, Canada

by

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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Introduction

This report presents the principal facts of gravity data collected by the USGS, Branch of Geophysics, for the International Falls and Roseau CUSMAP (Conterminous United States Mineral Appraisal Program) projects. The collection of gravity data was done in cooperation with the Minnesota Geological Survey and the Minnesota Department of Natural Resources-Division of Minerals. These new gravity stations were used to supplement the Minnesota Geological Survey, the Department of Defense, and the Geological Survey of Canada data bases for the production of the International Falls and Roseau complete Bouguer gravity anomaly maps.

The majority of the bedrock in the International Falls and Roseau quadrangles (figure 1) is buried by glacial overburden, therefore geologic interpretations are dependent upon sparse outcrops, exploration drilling, and geophysical surveys. The purpose of the gravity data collection was to obtain new coverage to aid in the geologic interpretations for the CUSMAP projects. The new stations were positioned to fill in large voids in regional coverage or along profiles to better define faults, contacts, and intrusive bodies.

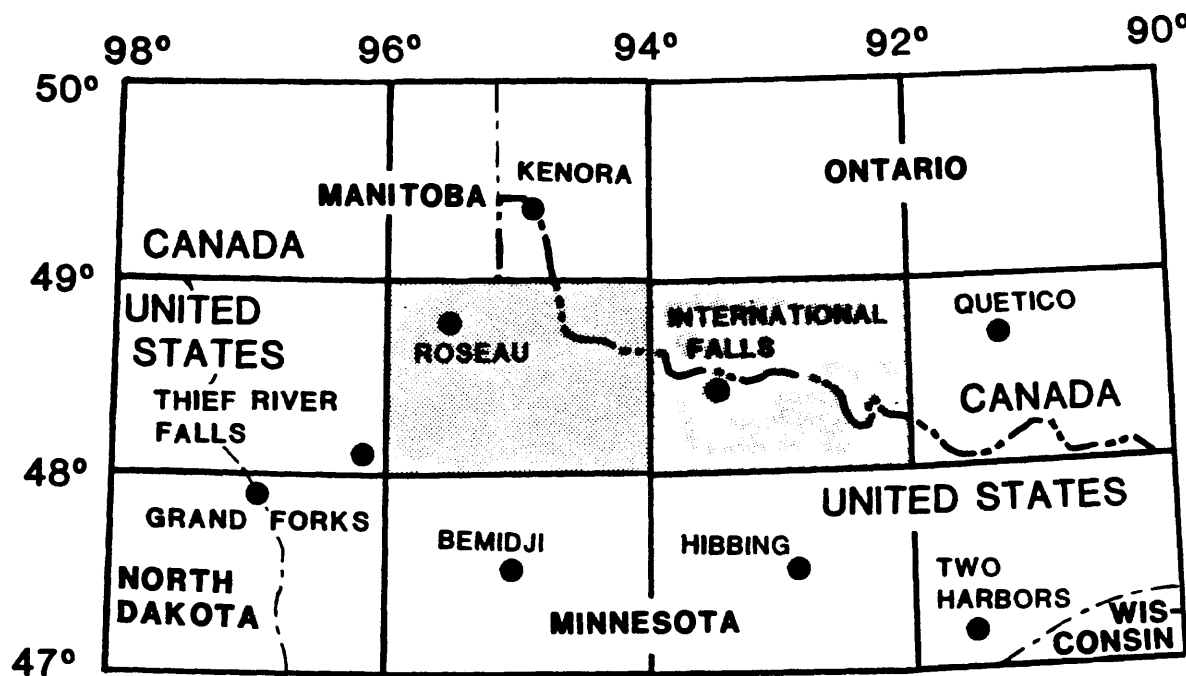
Data Collection

During the 1986 field season three gravity collection expeditions, spring, summer, and fall, were made to the International Falls and Roseau CUSMAP area. The spring expedition was planned to collect regional data in the large swamps while they were still frozen. Detailed gravity profiles, with station spacings ranging from 25 to 400 meters, were conducted along roads and logging trails during the summer expedition. During the fall expedition both regional and profile data were collected. Figure 2 shows the location of gravity stations and profiles within the International Falls and Roseau quadrangles.

617 gravity stations were collected in an area bound by latitude $47^{\circ} 47' 57''$ to $48^{\circ} 56' 56''$ N and longitude $92^{\circ} 42' 42''$ to $95^{\circ} 25' 05''$ W. Stations IF-39 through IF-50, IF-105, and secondary base station Cook, are located in the Hibbing $1^{\circ} \times 2^{\circ}$ quadrangle (figure 1). These data were collected in cooperation with the Minnesota Department of Natural Resources-Minerals Division during the fall expedition, and were processed along with the CUSMAP gravity data.

The most difficult part of the field operations was site access due to the large swamps which occupied the primary areas requiring regional gravity coverage. Navigation was also a problem, due to the dense vegetation which limited visibility and identification of landmarks. Snowmobiles and ATV's (all terrain vehicles) were used for site access in the swamplands, four wheel drive trucks were used along highways and secondary roads.

Each gravity station position and elevation was obtained from USGS 1:24,000-scale orthophotomaps and topographic maps, which have 5-ft contour intervals. When possible, stations were located at major landmarks such as road, trail and canal intersections, or other readily identifiable cultural features. When no landmarks were available, station locations were determined from field calibrated odometer readings. Maximum position uncertainty of gravity stations is thought to be less than 500 feet, which at latitude 48° N



LOCATION DIAGRAM

Figure 1. Location diagram showing the International Falls and Roseau quadrangles.

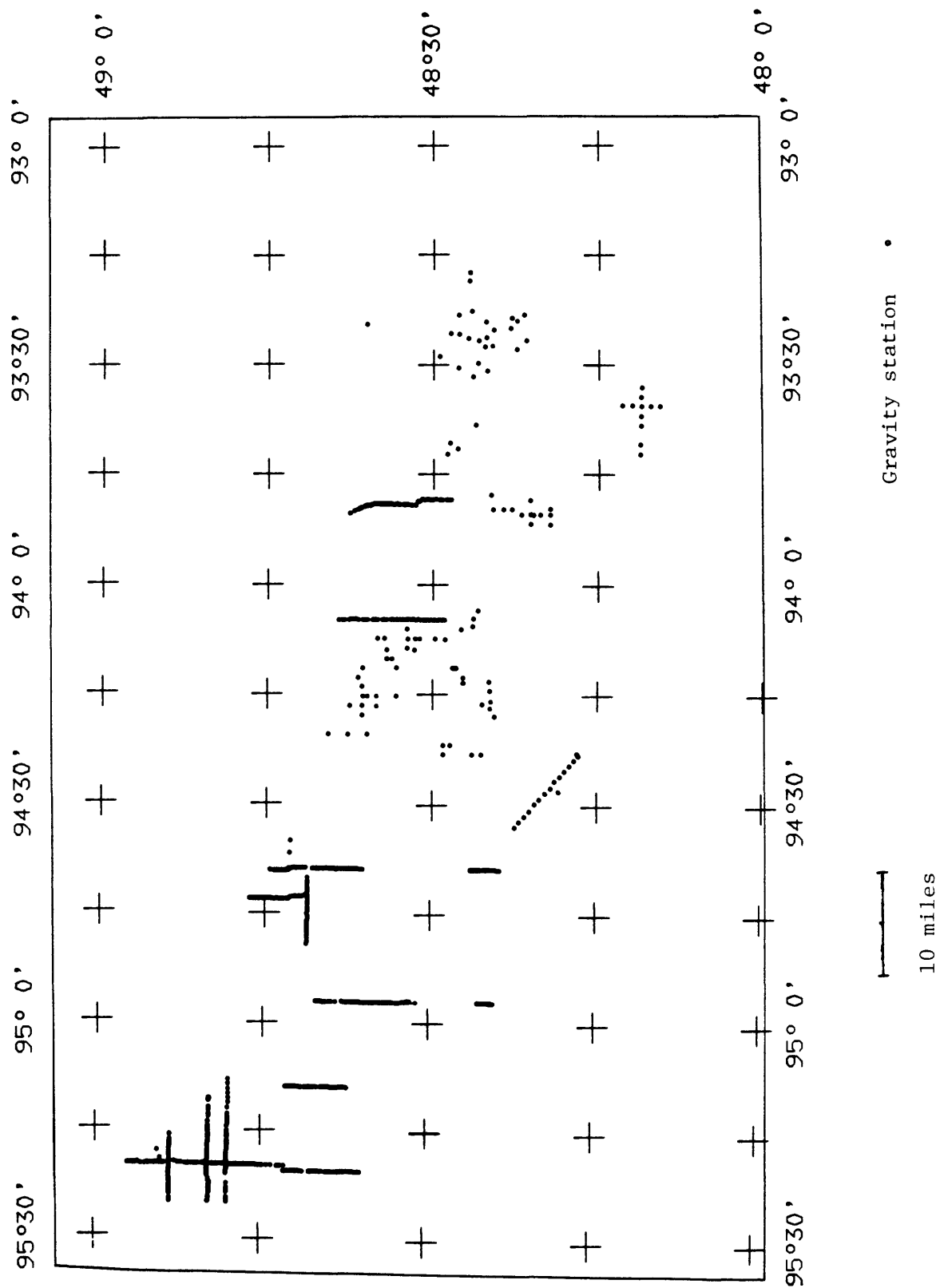


Figure 2. Location map showing the location of gravity stations within the International Falls and Roseau quadrangles.

translates into about 0.1 mGals error of latitude correction. Elevation uncertainty of gravity stations located at benchmarks is assumed to be 0.5 ft (0.15 m). For station elevations read off the 5-ft contour interval maps, the uncertainty is assumed to be one-third the contour interval or 1.7 ft. Using a reduction density of 2.67 g/cm^3 , this elevation uncertainty translates to a maximum uncertainty in the Bouguer anomaly value of approximately 0.06 mGals/foot.

Gravity measurements were made using LaCoste-Romberg gravity meter G-551, which has an accuracy of .01 mGals (gravity units in milligals). The gravity measurements were referenced to U.S. Department of Defense (DOD) bases at Warroad, Spooner, and International Falls; all located in Minnesota. These primary bases are part of the 1971 International Gravity Standardization Net (Morelli, 1974). Secondary base stations, tied to the primary bases, were established at the motels used by the field crews. Gravity field work was started and closed daily by making repeat observations at primary and/or secondary base stations to measure linear meter drift. Both primary and secondary base station descriptions are found in Appendix A.

Data Reduction

Programs running on the USGS Branch of Geophysics (Denver, CO) Digital Corp. VAX computers were used to process the gravity data. The latitude and longitude of each gravity station was obtained by digitizing the station location off the 1:24000 field maps. The program Greduc (Webring, unpublished) was used to obtain observed-gravity values corrected for linear-meter drift and earth tides. The observed gravity values, which are relative to the International Gravity Standardization Net, 1971, (Morelli, 1974), were processed by the authors using the 1967 gravity formula (International Association of Geodesy, 1967) and a reduction density of 2.67 g/cm^3 . Mathematical equations and assumptions used in the USGS data reduction programs are given by Cordell and others (1982).

Terrain corrections, to a radial distance of 166.7 km around each station, and complete Bouguer anomaly values were calculated using a computer program by Godson (unpublished, 1978) which uses a modification of the method of Plouff (1977) in conjunction with U.S. Department of Defense digital terrain data. These computed terrain corrections use mean-elevation data digitized on a 15-second grid for corrections from 0 to 5 km, 1-minute terrain data for corrections from 5 to 21 km, and 3-minute terrain data for corrections from 21 to 166.7 km.

The principal facts of the gravity data including: station identification, location, and elevation; the observed and theoretical gravity values; corrections for terrain effects, Bouguer slab, and Earth curvature; and the free air and complete Bouguer anomalies are given in Appendix B.

Acknowledgements

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References

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- Plouff, Donald, 1977, Preliminary documentation for a FORTRAN program to compute gravity terrain corrections based on topography digitized on a geographic grid: U.S. Geological Survey Open-File Report 77-535, 43 p.
- Webring M.W., Greduc: U.S. Geological Survey unpublished computer program description (available from the author at MS 964, Box 25046, Denver, CO. 80225).

Appendix A: Base Station Descriptions

Secondary Gravity Base Station Description

Note: These secondary base stations were established primarily to measure linear meter drift. Therefore, the latitude, longitude, and elevation are only approximate. The principal facts for these stations are **NOT ABSOLUTE**.

Station Designation: **WALLEYE**

Latitude: 48 42.75 N

Longitude: 94 36.70 W

Elevation: 1070 (feet above sea level)

Adopted Gravity Value: 980 858.41 IGSN 1971

Estimated accuracy: 0.1 mGals

First established: 3-8-1986 by Robert P. Kucks, USGS, Branch of Geophysics

Location Description: At the Walleye Inn, Highway 11 west, Baudette, Minnesota. Left (east) of the door, on the concrete slab directly outside the NE exit of the Walleye Inn.

Station Designation: **REEDS LANDING**

Latitude: 48 54.53 N

Longitude: 95 18.09 W

Elevation: 1063 (feet above sea level)

Adopted Gravity Value: 980 896.41 IGSN 1971

Estimated accuracy: 0.1 mGals

First established: 7-26-1986 by Robert J. Horton, USGS, Branch of Geophysics

Location Description: At the Reeds Landing Motel and Resort, in Warroad, Minnesota. Base station is located outside of room #4, on the concrete sidewalk, next to the wall, one foot right of the power outlet.

Station Designation: **THRIFTY**

Latitude: 48 36.05 N

Longitude: 93 24.45 W

Elevation: 1170 (feet above sea level)

Adopted Gravity Value: 980 944.20 IGSN 1971

Estimated accuracy: 0.1 mGals

First established: 10-23-1986 by Robert J. Horton, USGS, Branch of Geophysics

Location Description: At the Thrifty Scott, now the Days Inn Motel, in International Falls, Minnesota. Base station is located on the concrete slab, left (west) of the door, outside the rear exit on the SE end of the building.

Station Designation: **COOK**

Latitude: 47 47.96 N

Longitude: 992 42.70 W

Elevation: 1330 (feet above sea level)

Adopted Gravity Value: 980 742.10 IGSN 1971

Estimated accuracy: 0.5 mGals

First established: 10-29-1986 by Robert J. Horton, USGS, Branch of Geophysics

Location Description: At the Vermillion River Motel on U.S. Highway 53, in Cook, Minnesota. Base station is located on a narrow concrete slab, outside on the SW end of motel buildings under the street light in the parking area.

GRAVITY BASE STATION

LATITUDE		48° 36.1'N (1)		STATION DESIGNATION	
LONGITUDE		93° 24.5'W (1)		INTERNATIONAL FALLS	
ELEVATION		342.60 METERS (1)		COUNTRY/STATE	
				USA/Minnesota	
REFERENCE CODE NUMBERS				ADOPTED GRAVITY VALUE	
ACIC 4129-1				g = 980 845.02 mgals	
				IGSN 1971 = 980 831.37	
				ESTIMATED ACCURACY	
				DATE	
				MONTH/YEAR	
				1/71	
				± 0.1 mgals	

DESCRIPTION AND/OR SKETCH

At International Falls, Koochecking County, at the county courthouse on Fourth Street, in the center of a cement column at the west side of the main entrance. A standard USC & GS disk, stamped "Q 10 1931" and set vertically. Gravity station is located on concrete below disk. (1)

REFERENCE SOURCE

(1) 03409

GRAVITY BASE STATION

LATITUDE		48° 54.0'N (1)		STATION DESIGNATION	
LONGITUDE		95° 19.2'W (1)		WARROAD	
ELEVATION		325.10 METERS (1)		COUNTRY/STATE	
				USA/Minnesota	
REFERENCE CODE NUMBERS				ADOPTED GRAVITY VALUE	
ACIC 4139-1				g = 980 905.18 mgals	
				IGSN 1971= 980 891.53	
				ESTIMATED ACCURACY	
				DATE	
				MONTH/YEAR	
				1/71	
				± 0.1 mgals	

DESCRIPTION AND/OR SKETCH

At Warroad, Roseau County, on State Highway 11, 0.1 mile south of the south end of the bridge over Warroad River, in the lawn of the parsonage of St Mary's Church, 37 feet east of the centerline of the highway, and 2 feet south of the walk leading to the parsonage. A standard USC & GS disk stamped "R 209 1935" and set in the top of a concrete post. Gravity station is located on ground on west side of BM. (1)

REFERENCE SOURCE

(1) 03409

GRAVITY BASE STATION

LATITUDE		48° 42.7'N	(1)	STATION DESIGNATION	
LONGITUDE		94° 35.1'W	(1)	SPOONER	
ELEVATION		331.07	METERS (1)	COUNTRY/STATE	
				USA/Minnesota	
REFERENCE CODE NUMBERS				ADOPTED GRAVITY VALUE	
ACIC 4683-1				g = 980 874.77 mgals	
				IGSN 1971 = 980 861.12	
				ESTIMATED ACCURACY	DATE
				± 0.1 mgals	MONTH/YEAR
					1/71

DESCRIPTION AND/OR SKETCH

At Spooner, Lake of the Woods County, on State Highway 11, about 100 yards northwest of the former public school, 30 feet west of the centerline of a dirt road leading south, at the northeast corner of a private yard, 48 feet northeast of the northeast corner of the house, 37 feet south of the centerline of the highway, 2 feet south of the south sidewalk, and 1 foot west of a white wooden witness post. A standard USC & GS disk, stamped "A 44 1934" and set in the top of a concrete post. Gravity station is located on ground on west side of BM. (1)

REFERENCE SOURCE

(1) 03409

Appendix B: Principal Facts of Gravity Data

Explanation of headings

IDENTIFICATION

Proj	Project name.
Sta-id	Gravity station identification number.

LOCATION

Latitude	North latitude in degrees, decimal minutes.
Longitude	West longitude in degrees, decimal minutes.
Ele	Station elevation in feet.
St	State where station is located.

GRAVITY

Observed	Observed gravity in milligals.
Theoretical	Theoretical gravity in milligals.

CORRECTIONS

Terrain	Terrain correction, 167 km radius, in milligals.
Bouguer	Bouguer slab correction in milligals.
Curv	Curvature correction in milligals.
Special	Not used.

ANOMALIES

Free air	Free air anomaly in milligals.
Complete-Bouguer	Complete Bouguer anomaly in milligals for designated density.

International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver CO
 2g-551 elev=90.01 srt=10 Date: 9-JUN-1988 16:23:45.12

STATION IDENTIFICATION proj sta-id	L O C A T I O N LATITUDE LONGITUDE deg min deg min	ELE (in ft)	SF OBSERVED	G R A V I T Y THEORETICAL	C O R R E C T I O N S FERRAIN BOUGUER CURV (d1=2.67)	A N O M A L I E S FREE COMPLETE-BOUGUER SPEC AIR d1=2.67 d2=2.50 FIELDS
IIFR-1	48 39.38	-94 20.53	1100.00	mn 980848.83	980949.18	-0.03 -37.52 -0.45
IIFR-2	48 37.64	-94 20.53	1105.00	mn 980845.45	980946.58	-0.03 -37.69 -0.45
IIFR-3	48 35.93	-94 20.53	1100.00	mn 980840.91	980944.02	-0.03 -37.52 -0.45
IIFR-4	48 37.48	-94 16.65	1113.00	mn 980842.44	980946.34	-0.03 -37.96 -0.46
IIFR-5	48 36.34	-94 16.64	1129.00	mn 980846.73	980944.63	-0.02 -38.51 -0.46
IIFR-6	48 35.06	-94 16.64	1125.00	mn 980851.18	980942.71	-0.03 -38.37 -0.46
IIFR-7	48 36.39	-94 17.95	1119.00	mn 980844.52	980944.70	-0.03 -38.17 -0.46
IIFR-8	48 36.42	-94 14.04	1133.00	mn 980848.37	980944.75	-0.02 -38.64 -0.46
IIFR-9	48 36.34	-94 15.36	1132.00	mn 980846.54	980944.63	-0.01 -38.61 -0.46
IIFR-10	48 35.91	-94 15.35	1143.00	mn 980848.36	980943.98	-0.01 -38.98 -0.47
IIFR-11	48 35.05	-94 15.34	1132.00	mn 980853.66	980942.70	-0.01 -38.61 -0.46
IIFR-12	48 33.32	-94 15.32	1132.00	mn 980852.98	980940.10	-0.02 -38.61 -0.46
IIFR-13	48 36.77	-94 12.73	1126.00	mn 980850.37	980945.27	-0.03 -38.40 -0.46
IIFR-14	48 36.35	-94 11.42	1132.00	mn 980852.34	980944.64	-0.03 -38.61 -0.46
IIFR-15	48 34.17	-94 10.11	1144.00	mn 980856.54	980941.38	-0.02 -39.02 -0.47
IIFR-16	48 33.70	-94 10.10	1160.00	mn 980857.62	980940.67	0.01 -39.56 -0.47
IIFR-17	48 33.30	-94 11.40	1162.00	mn 980857.66	980940.08	0.03 -39.63 -0.47
IIFR-18	48 34.19	-94 8.87	1149.00	mn 980857.16	980941.41	-0.02 -39.19 -0.47
IIFR-19	48 35.04	-94 7.36	1151.00	mn 980855.32	980942.68	-0.02 -39.26 -0.47
IIFR-20	48 34.41	-94 7.36	1139.00	mn 980858.50	980941.73	-0.03 -38.85 -0.47
IIFR-21	48 29.82	-94 7.36	1147.00	mn 980834.02	980934.86	-0.03 -39.12 -0.47
IIFR-22	48 31.18	-94 7.35	1148.00	mn 980837.91	980936.90	-0.02 -39.15 -0.47
IIFR-23	48 28.95	-94 7.39	1146.00	mn 980832.85	980933.56	-0.03 -39.09 -0.47
IIFR-24	48 26.42	-94 5.58	1149.00	mn 980828.30	980929.77	-0.03 -39.19 -0.47
IIFR-25	48 26.36	-94 4.58	1160.00	mn 980827.73	980929.68	-0.02 -39.56 -0.47
IIFR-26	48 25.92	-94 3.50	1165.00	mn 980826.58	980929.02	-0.02 -39.73 -0.48
IIFR-27	48 27.45	-94 6.08	1140.00	mn 980830.02	980931.31	-0.03 -38.88 -0.47
IIFR-28	48 32.34	-94 6.09	1144.00	mn 980848.10	980938.64	-0.01 -39.02 -0.47
IIFR-29	48 32.28	-94 7.38	1151.00	mn 980849.63	980938.55	0.00 -39.26 -0.47
IIFR-30	48 32.31	-94 8.69	1153.00	mn 980852.37	980938.59	0.01 -39.33 -0.47
IIFR-31	48 31.57	-94 7.40	1148.00	mn 980843.37	980937.48	-0.01 -39.15 -0.47
IIFR-32	48 31.64	-94 8.94	1153.00	mn 980848.29	980937.59	0.00 -39.33 -0.47
IIFR-33	48 28.99	-94 23.12	1150.00	mn 980856.29	980933.62	-0.02 -39.22 -0.47
IIFR-34	48 28.99	-94 21.84	1146.00	mn 980858.08	980933.62	-0.01 -39.09 -0.47
IIFR-35	48 28.33	-94 21.82	1158.00	mn 980855.63	980932.63	-0.01 -39.50 -0.47
IIFR-36	48 26.38	-94 23.10	1180.00	mn 980839.25	980929.71	0.02 -40.25 -0.48
IIFR-37	48 25.53	-94 23.09	1189.00	mn 980836.18	980928.44	0.02 -40.55 -0.48
IIFR-38	48 22.48	-94 32.90	1193.00	mn 980820.81	980923.87	0.04 -40.69 -0.49
IIFR-39	48 22.04	-94 32.22	1193.00	mn 980820.82	980923.20	0.05 -40.69 -0.49
IIFR-40	48 21.59	-94 31.48	1196.00	mn 980820.42	980922.53	0.04 -40.79 -0.49

BOUGUER GRAVITY DATA

International Falls-Roseau CUSMAP Gravity Data
USGS Branch of Geophysics, Denver CO
29-551

Date: 9-JUN-1988 16:23:49.92

elevmz guz=01 stitime a-f g-x

STATION IDENTIFICATION proj sta-id	L O C A T I O N S		G R A V I T Y		C O R R E C T I O N S		A N O M A L I E S					
	LATITUDE deg min	LONGITUDE deg min	ELE (in ft)	ST OBSERVED THEORETICAL	TERRAIN BOUGUER CURV (dl=2.67)	SPECIAL	FREE AIR	COMPLETE-BOUGUER SPEC dl=2.67 d2=2.50 FIELDS				
:IFR-41	48 21.09	-94 30.69	1198.00	mn 980820.36	980921.78	0.01	-40.86	-0.49	0.00	11.23	-30.11	-27.48
:IFR-42	48 20.62	-94 29.80	1200.00	mn 980819.45	980921.08	0.01	-40.93	-0.49	0.00	11.21	-30.20	-27.56
:IFR-43	48 20.24	-94 29.15	1203.00	mn 980817.67	980920.51	0.01	-41.03	-0.49	0.00	10.28	-31.23	-28.58
:IFR-44	48 19.74	-94 28.32	1204.00	mn 980817.32	980919.76	0.01	-41.06	-0.49	0.00	10.77	-30.77	-28.12
:IFR-45	48 18.50	-94 28.05	1206.00	mn 980814.12	980917.90	0.00	-41.13	-0.49	0.00	9.62	-32.00	-29.35
:IFR-46	48 19.20	-94 27.55	1206.00	mn 980816.09	980918.95	0.01	-41.13	-0.49	0.00	10.55	-31.06	-28.42
:IFR-47	48 18.84	-94 26.67	1205.00	mn 980814.52	980918.41	0.00	-41.10	-0.49	0.00	9.42	-32.17	-29.52
:IFR-48	48 18.38	-94 26.02	1205.00	mn 980813.25	980917.72	0.00	-41.10	-0.49	0.00	8.84	-32.75	-30.10
:IFR-49	48 17.95	-94 25.29	1206.00	mn 980812.78	980917.07	0.00	-41.13	-0.49	0.00	9.11	-32.51	-29.86
:IFR-50	48 17.52	-94 24.56	1208.00	mn 980812.43	980916.43	0.00	-41.20	-0.49	0.00	9.59	-32.10	-29.45
:IFR-51	48 17.09	-94 23.83	1209.00	mn 980810.96	980915.78	0.00	-41.24	-0.49	0.00	8.86	-32.86	-30.21
:IFR-52	48 16.71	-94 23.19	1211.00	mn 980810.12	980915.21	0.00	-41.30	-0.49	0.00	8.78	-33.02	-30.36
:IFR-53	48 16.80	-94 22.91	1209.00	mn 980810.13	980915.35	0.00	-41.24	-0.49	0.00	8.46	-33.26	-30.61
:IFR-54	48 24.75	-94 15.91	1179.00	mn 980825.70	980927.27	0.01	-40.21	-0.48	0.00	9.30	-31.38	-28.79
:IFR-55	48 24.38	-94 17.90	1184.00	mn 980826.82	980926.71	0.02	-40.38	-0.48	0.00	11.44	-29.40	-26.80
:IFR-56	48 24.76	-94 16.86	1180.00	mn 980826.71	980927.28	0.01	-40.25	-0.48	0.00	10.39	-30.33	-27.74
:IFR-57	48 25.47	-94 16.36	1175.00	mn 980829.10	980928.34	0.00	-40.08	-0.48	0.00	11.24	-29.31	-26.73
:IFR-58	48 24.83	-94 14.48	1174.00	mn 980825.10	980927.38	0.00	-40.04	-0.48	0.00	8.11	-32.41	-29.83
:IFR-59	48 24.88	-94 13.21	1169.00	mn 980825.42	980927.46	0.00	-39.87	-0.48	0.00	7.88	-32.47	-29.90
:IFR-60	48 27.24	-94 12.67	1149.00	mn 980832.69	980931.00	-0.02	-39.19	-0.47	0.00	9.73	-29.95	-27.42
:IFR-61	48 27.24	-94 13.34	1154.00	mn 980833.27	980931.00	-0.02	-39.36	-0.47	0.00	10.78	-29.07	-26.53
freedsldg	48 56.35	-95 18.09	1063.00	mn 980896.41	980971.58	-0.01	-36.26	-0.44	0.00	24.78	-11.92	-9.58
:101	48 53.19	-95 25.09	1093.00	mn 980865.88	980969.84	0.00	-37.28	-0.45	0.00	-1.19	-38.91	-36.51
:102	48 53.19	-95 24.66	1092.00	mn 980867.49	980969.84	0.00	-37.24	-0.45	0.00	0.33	-37.36	-34.96
:103	48 53.19	-95 24.11	1091.00	mn 980869.50	980969.84	0.00	-37.21	-0.45	0.00	2.24	-35.42	-33.02
:104	48 53.19	-95 23.78	1091.00	mn 980870.15	980969.84	0.00	-37.21	-0.45	0.00	2.89	-34.77	-32.37
:105	48 53.20	-95 23.41	1094.00	mn 980870.99	980969.86	0.00	-37.31	-0.45	0.00	4.00	-33.76	-31.36
:106	48 53.21	-95 23.14	1098.00	mn 980871.31	980969.88	0.01	-37.45	-0.45	0.00	4.68	-33.21	-30.80
:107	48 53.21	-95 22.78	1087.00	mn 980873.38	980969.88	0.00	-37.07	-0.45	0.00	5.72	-31.80	-29.41
:108	48 53.21	-95 22.46	1085.00	mn 980875.78	980969.88	0.00	-37.01	-0.45	0.00	7.93	-29.52	-27.14
:109	48 53.21	-95 22.07	1082.00	mn 980877.33	980969.88	0.01	-36.90	-0.44	0.00	9.19	-28.14	-25.77
:110	48 53.21	-95 21.79	1079.00	mn 980878.52	980969.88	0.02	-36.80	-0.44	0.00	10.11	-27.12	-24.75
:111	48 53.21	-95 21.40	1075.00	mn 980879.91	980969.88	0.01	-36.67	-0.44	0.00	11.11	-25.98	-23.62
:112	48 53.22	-95 21.14	1079.00	mn 980882.01	980969.89	0.02	-36.80	-0.44	0.00	13.58	-23.65	-21.28
:113	48 53.22	-95 20.78	1077.00	mn 980884.48	980969.89	0.02	-36.73	-0.44	0.00	15.86	-21.30	-18.93
:114	48 53.21	-95 20.51	1077.00	mn 980886.17	980969.88	0.02	-36.73	-0.44	0.00	17.57	-19.59	-17.22
:115	48 53.21	-95 20.18	1075.00	mn 980887.20	980969.88	0.01	-36.67	-0.44	0.00	18.41	-18.69	-16.32
:116	48 53.23	-95 19.85	1075.00	mn 980888.38	980969.91	0.01	-36.67	-0.44	0.00	19.56	-17.54	-15.18
:117	48 53.22	-95 19.59	1070.00	mn 980890.00	980969.89	0.00	-36.49	-0.44	0.00	20.72	-16.21	-13.86
:118	48 53.22	-95 19.24	1076.00	mn 980890.48	980969.89	0.02	-36.70	-0.44	0.00	21.76	-15.36	-13.00

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BOUGUER GRAVITY DATA

International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver CO
 29-551

Date: 9-JUN-1988 16:23:55.48

STATION IDENTIFICATION proj sta-id	L O C A T I O N LATITUDE deg min	L O C A T I O N LONGITUDE deg min	E L E min (in ft)	S I OBSERVED	G R A V I T Y THEORETICAL	T E R R A I N BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	F R E E AIR	A N O M A L I E S	
									COMPLETE-BOUGUER d1=2.67	SPEC FIELDS
1119	48 53.21	-95 18.86	1075.00	mn	980892.44	980969.88	0.00	-36.67	-0.44	0.00
1120	48 53.22	-95 18.54	1078.00	mn	980892.78	980969.89	0.01	-36.77	-0.44	0.00
1121	48 53.22	-95 18.22	1077.00	mn	980892.31	980969.89	0.01	-36.73	-0.44	0.00
1122	48 53.21	-95 17.87	1077.00	mn	980891.34	980969.88	0.00	-36.73	-0.44	0.00
1123	48 53.21	-95 17.55	1076.00	mn	980889.60	980969.88	0.00	-36.70	-0.44	0.00
1124	48 53.21	-95 17.21	1073.00	mn	980887.55	980969.88	0.00	-36.60	-0.44	0.00
1125	48 53.21	-95 16.91	1070.00	mn	980884.84	980969.88	0.00	-36.49	-0.44	0.00
1126	48 53.21	-95 16.58	1068.00	mn	980881.97	980969.88	0.00	-36.43	-0.44	0.00
1127	48 53.20	-95 15.88	1064.00	mn	980877.79	980969.86	-0.01	-36.29	-0.44	0.00
1128	48 49.64	-95 25.08	1098.00	mn	980859.95	980964.53	0.01	-37.45	-0.45	0.00
1129	48 49.64	-95 24.62	1100.00	mn	980860.81	980964.53	0.01	-37.52	-0.45	0.00
1130	48 49.64	-95 24.28	1100.00	mn	980861.15	980964.53	0.01	-37.52	-0.45	0.00
1131	48 49.59	-95 23.76	1100.00	mn	980862.43	980964.46	0.01	-37.52	-0.45	0.00
1132	48 49.57	-95 23.42	1100.00	mn	980863.04	980964.43	0.01	-37.52	-0.45	0.00
1133	48 49.57	-95 23.06	1100.00	mn	980863.91	980964.43	0.01	-37.52	-0.45	0.00
1134	48 49.57	-95 22.77	1100.00	mn	980865.27	980964.43	0.01	-37.52	-0.45	0.00
1135	48 49.55	-95 22.49	1102.00	mn	980866.53	980964.40	0.01	-37.59	-0.45	0.00
1136	48 49.63	-95 22.09	1098.00	mn	980868.67	980964.52	0.00	-37.45	-0.45	0.00
1137	48 49.67	-95 21.78	1098.00	mn	980871.96	980964.58	0.01	-37.45	-0.45	0.00
1138	48 49.71	-95 21.44	1098.00	mn	980874.33	980964.64	0.01	-37.45	-0.45	0.00
1139	48 49.74	-95 21.12	1102.00	mn	980876.34	980964.68	0.01	-37.59	-0.45	0.00
1140	48 49.74	-95 20.79	1103.00	mn	980878.23	980964.68	0.01	-37.62	-0.45	0.00
1141	48 49.73	-95 20.48	1105.00	mn	980879.87	980964.67	0.01	-37.69	-0.45	0.00
1142	48 49.74	-95 20.21	1106.00	mn	980880.83	980964.68	0.01	-37.72	-0.45	0.00
1143	48 49.74	-95 19.81	1108.00	mn	980882.32	980964.68	0.01	-37.79	-0.45	0.00
1144	48 49.75	-95 19.49	1106.00	mn	980882.05	980964.70	0.01	-37.72	-0.45	0.00
1145	48 49.74	-95 19.15	1112.00	mn	980878.55	980964.68	0.01	-37.93	-0.46	0.00
1146	48 49.74	-95 18.83	1115.00	mn	980875.49	980964.68	0.01	-38.03	-0.46	0.00
1147	48 49.75	-95 18.50	1117.00	mn	980873.30	980964.70	0.01	-38.10	-0.46	0.00
1148	48 49.73	-95 18.17	1110.00	mn	980871.71	980964.67	0.01	-37.86	-0.45	0.00
1149	48 49.74	-95 17.85	1112.00	mn	980869.76	980964.68	0.01	-37.93	-0.46	0.00
1150	48 49.73	-95 17.51	1116.00	mn	980868.27	980964.67	0.01	-38.06	-0.46	0.00
1151	48 49.73	-95 17.17	1120.00	mn	980867.63	980964.67	0.01	-38.20	-0.46	0.00
1152	48 49.73	-95 16.85	1122.00	mn	980865.39	980964.67	0.01	-38.27	-0.46	0.00
1153	48 49.73	-95 16.51	1126.00	mn	980864.59	980964.67	0.01	-38.40	-0.46	0.00
1154	48 49.72	-95 16.16	1127.00	mn	980864.62	980964.66	0.01	-38.44	-0.46	0.00
1155	48 49.72	-95 15.87	1130.00	mn	980864.68	980964.66	0.01	-38.54	-0.46	0.00
1156	48 49.72	-95 15.54	1128.00	mn	980865.26	980964.66	0.01	-38.47	-0.46	0.00
1157	48 49.73	-95 15.22	1131.00	mn	980864.77	980964.67	0.01	-38.58	-0.46	0.00
1158	48 49.73	-95 14.87	1135.00	mn	980864.83	980964.67	0.03	-38.71	-0.46	0.00

International Falls-Roseau CUSMAP Gravity Data
USGS Branch of Geophysics, Denver, CO
29-551

elev=f guz=01 srctime a-f g-x Date: 9-JUN-1988 16:24:08.81

STATION IDENTIFICATION proj sta-id	L O C A T I O N S		G R A V I T Y		T E R R A I N		C O R R E C T I O N S		F R E E		A N O M A L I E S	
	LATITUDE deg min	LONGITUDE deg min	ELE (in ft)	ST OBSERVED	THEORETICAL	TERRAIN	BOUGUER	CURV (d1=2.67)	SPECIAL	AIR	COMPLETE-BOUGUER d1=2.67 d2=2.50	SPEC FIELDS
:159	48 49.74	-95 14.55	1132.00	mn 980864.57	980964.68		0.01	-38.61 -0.46	0.00	6.33	-32.73 -30.24	
:160	48 49.74	-95 13.90	1136.00	mn 980863.45	980964.68		0.02	-38.76 -0.46	0.00	5.59	-33.60 -31.10	
:161	48 49.73	-95 13.25	1131.00	mn 980862.20	980964.67		0.01	-38.58 -0.46	0.00	3.88	-35.15 -32.66	
:162	48 49.73	-95 12.89	1125.00	mn 980861.47	980964.67		0.01	-38.37 -0.46	0.00	2.58	-36.24 -33.77	
:163	48 49.72	-95 12.34	1124.00	mn 980860.51	980964.66		0.01	-38.34 -0.46	0.00	1.54	-37.25 -34.78	
:164	48 49.72	-95 11.99	1123.00	mn 980859.83	980964.66		0.01	-38.30 -0.46	0.00	0.77	-37.98 -35.52	
:165	48 49.71	-95 10.68	1127.00	mn 980859.15	980964.64		0.01	-38.44 -0.46	0.00	0.48	-38.41 -35.93	
:166	48 49.72	-95 11.00	1130.00	mn 980858.86	980964.66		0.01	-38.54 -0.46	0.00	0.46	-38.54 -36.05	
:167	48 49.72	-95 10.68	1128.00	mn 980858.20	980964.66		0.01	-38.47 -0.46	0.00	-0.39	-39.31 -36.83	
:168	48 48.00	-95 13.25	1160.00	mn 980862.51	980962.08		0.02	-39.56 -0.47	0.00	9.50	-30.51 -27.97	
:169	48 48.00	-95 12.80	1164.00	mn 980861.24	980962.08		0.03	-39.70 -0.47	0.00	8.61	-31.53 -28.98	
:170	48 47.99	-95 11.97	1166.00	mn 980859.09	980962.06		0.03	-39.77 -0.48	0.00	6.67	-33.55 -30.98	
:171	48 47.99	-95 11.28	1164.00	mn 980857.65	980962.06		0.03	-39.70 -0.47	0.00	5.04	-35.11 -32.55	
:172	48 47.98	-95 10.01	1178.00	mn 980854.88	980962.05		0.04	-40.18 -0.48	0.00	3.60	-37.02 -34.43	
:173	48 47.98	-95 9.36	1185.00	mn 980853.10	980962.05		0.06	-40.42 -0.48	0.00	2.48	-38.36 -35.76	
:174	48 47.98	-95 8.69	1189.00	mn 980851.65	980962.05		0.07	-40.55 -0.48	0.00	1.40	-39.57 -36.96	
:175	48 47.99	-95 8.03	1187.00	mn 980851.55	980962.06		0.05	-40.49 -0.48	0.00	1.10	-39.82 -37.22	
:176	48 47.98	-95 10.67	1173.00	mn 980856.56	980962.05		0.04	-40.01 -0.48	0.00	4.81	-35.63 -33.06	
:177	48 48.00	-95 13.57	1155.00	mn 980862.85	980962.08		0.02	-39.39 -0.47	0.00	9.38	-30.47 -27.93	
:178	48 48.00	-95 13.90	1156.00	mn 980863.26	980962.08		0.02	-39.43 -0.47	0.00	9.88	-30.00 -27.46	
:179	48 48.00	-95 14.23	1152.00	mn 980863.42	980962.08		0.02	-39.29 -0.47	0.00	9.67	-30.08 -27.55	
:180	48 48.01	-95 14.57	1152.00	mn 980863.46	980962.09		0.02	-39.29 -0.47	0.00	9.69	-30.05 -27.52	
:181	48 48.00	-95 15.21	1145.00	mn 980863.47	980962.08		0.02	-39.05 -0.47	0.00	9.05	-30.45 -27.93	
:182	48 48.00	-95 15.44	1141.00	mn 980864.02	980962.08		0.02	-38.92 -0.47	0.00	9.23	-30.13 -27.62	
:183	48 48.00	-95 15.87	1141.00	mn 980864.43	980962.08		0.02	-38.92 -0.47	0.00	9.64	-29.72 -27.22	
:184	48 48.00	-95 16.19	1142.00	mn 980864.71	980962.08		0.02	-38.95 -0.47	0.00	10.01	-29.38 -26.87	
:185	48 48.00	-95 16.52	1142.00	mn 980864.36	980962.08		0.02	-38.95 -0.47	0.00	9.66	-29.73 -27.23	
:186	48 48.00	-95 16.83	1139.00	mn 980864.45	980962.08		0.02	-38.85 -0.47	0.00	9.47	-29.82 -27.32	
:187	48 48.00	-95 17.17	1136.00	mn 980865.40	980962.08		0.02	-38.75 -0.46	0.00	10.14	-29.05 -26.56	
:188	48 48.00	-95 17.51	1136.00	mn 980866.03	980962.08		0.02	-38.76 -0.46	0.00	10.77	-28.42 -25.92	
:189	48 48.00	-95 17.82	1136.00	mn 980866.77	980962.08		0.02	-38.75 -0.46	0.00	11.51	-27.68 -25.18	
:190	48 48.00	-95 18.17	1131.00	mn 980867.92	980962.08		0.01	-38.58 -0.46	0.00	12.19	-26.84 -24.35	
:191	48 48.01	-95 18.48	1133.00	mn 980869.33	980962.09		0.02	-38.64 -0.46	0.00	13.77	-25.32 -22.83	
:192	48 48.00	-95 18.82	1131.00	mn 980870.57	980962.08		0.02	-38.58 -0.46	0.00	14.84	-24.18 -21.69	
:193	48 48.00	-95 19.14	1130.00	mn 980872.16	980962.08		0.01	-38.54 -0.46	0.00	16.33	-22.66 -20.18	
:194	48 48.00	-95 19.48	1127.00	mn 980874.25	980962.08		0.01	-38.44 -0.46	0.00	18.14	-20.75 -18.27	
:195	48 48.01	-95 19.82	1129.00	mn 980876.98	980962.09		0.01	-38.51 -0.46	0.00	21.04	-17.92 -15.44	
:196	48 48.01	-95 20.16	1126.00	mn 980877.74	980962.09		0.01	-38.40 -0.46	0.00	21.53	-17.33 -14.86	
:197	48 48.01	-95 20.48	1123.00	mn 980877.95	980962.09		0.01	-38.30 -0.46	0.00	21.45	-17.30 -14.83	
:198	48 48.01	-95 20.80	1121.00	mn 980876.87	980962.09		0.01	-38.23 -0.46	0.00	20.18	-18.50 -16.04	

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BOUGUER GRAVITY DATA

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International Falls-Roseau CUSMAP Gravity Data
USGS Branch of Geophysics, Denver CO
29-551

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STATION IDENTIFICATION proj sta-id	L O C A T I O N S		E L E		G R A V I T Y		T E R R A I N		C O R R E C T I O N S		F R E E		A N O M A L I E S	
	LATITUDE deg min	LONGITUDE deg min	deg min	(in ft)	ST OBSERVED	THEORETICAL	FERRAIN	BOUGUER CURV (d1=2.67)	SPECIAL	AIR	COMPLETE-BOUGUER	SPEC		
											d1=2.67	d2=2.50	FIELDS	
:199	48 48.01	-95 21.12	1121.00	mn	980876.69	980962.09	0.01	-38.23	-0.46	0.00	20.00	-18.68	-16.22	
:200	48 47.99	-95 22.44	1118.00	mn	980869.36	980962.06	0.01	-38.13	-0.46	0.00	12.42	-26.16	-23.70	
:201	48 47.98	-95 23.74	1118.00	mn	980862.68	980962.05	0.01	-38.13	-0.46	0.00	5.76	-32.82	-30.37	
:202	48 47.98	-95 23.50	1110.00	mn	980863.56	980962.05	0.01	-37.86	-0.45	0.00	5.89	-32.42	-29.98	
:203	48 47.98	-95 23.08	1110.00	mn	980866.27	980962.05	0.01	-37.86	-0.45	0.00	8.60	-29.70	-27.27	
:204	48 47.97	-95 24.40	1110.00	mn	980860.59	980962.03	0.01	-37.86	-0.45	0.00	2.94	-35.37	-32.93	
:205	48 47.97	-95 24.79	1115.00	mn	980859.33	980962.03	0.01	-38.03	-0.46	0.00	2.14	-36.34	-33.89	
:206	48 47.97	-95 25.05	1113.00	mn	980859.18	980962.03	0.01	-37.96	-0.46	0.00	1.80	-36.60	-34.16	
Warroad	48 54.04	-95 19.19	1068.00	mn	980891.53	980971.12	0.00	-36.43	-0.44	0.00	20.84	-16.03	-13.68	
:207	48 55.82	-95 19.89	1068.00	mn	980889.25	980973.77	0.00	-36.43	-0.44	0.00	15.90	-20.97	-18.62	
:208	48 55.41	-95 19.88	1069.00	mn	980889.84	980973.16	0.00	-36.46	-0.44	0.00	17.20	-19.70	-17.35	
:209	48 55.20	-95 19.88	1070.00	mn	980890.41	980972.85	0.00	-36.49	-0.44	0.00	18.17	-18.77	-16.42	
:210	48 54.97	-95 19.88	1073.00	mn	980890.66	980972.51	0.01	-36.60	-0.44	0.00	19.04	-17.99	-15.63	
:211	48 54.69	-95 19.87	1073.00	mn	980890.60	980972.09	0.00	-36.60	-0.44	0.00	19.41	-17.63	-15.27	
:212	48 54.47	-95 19.85	1073.00	mn	980890.79	980971.76	0.00	-36.60	-0.44	0.00	19.93	-17.11	-14.75	
:213	48 54.13	-95 19.86	1069.00	mn	980890.93	980971.25	0.00	-36.46	-0.44	0.00	20.20	-16.70	-14.35	
:214	48 53.88	-95 19.83	1065.00	mn	980890.90	980970.88	-0.01	-36.32	-0.44	0.00	20.17	-16.61	-14.27	
:215	48 53.70	-95 19.85	1070.00	mn	980890.27	980970.61	0.00	-36.49	-0.44	0.00	20.28	-16.66	-14.31	
:216	48 52.11	-95 19.81	1080.00	mn	980886.05	980968.23	0.00	-36.84	-0.44	0.00	19.37	-17.91	-15.53	
:217	48 51.71	-95 19.82	1084.00	mn	980884.64	980967.63	0.00	-36.97	-0.45	0.00	18.94	-18.48	-16.10	
:218	48 51.48	-95 19.80	1088.00	mn	980884.32	980967.29	0.00	-37.11	-0.45	0.00	19.34	-18.22	-15.83	
:219	48 51.25	-95 19.81	1089.00	mn	980883.69	980966.95	0.00	-37.14	-0.45	0.00	19.14	-18.45	-16.06	
:220	48 51.06	-95 19.79	1092.00	mn	980883.57	980966.66	0.00	-37.24	-0.45	0.00	19.59	-18.10	-15.70	
:221	48 50.82	-95 19.79	1093.00	mn	980883.06	980966.30	0.01	-37.28	-0.45	0.00	19.54	-18.18	-15.78	
:222	48 50.61	-95 19.77	1092.00	mn	980883.53	980965.98	0.01	-37.24	-0.45	0.00	20.23	-17.46	-15.06	
:223	48 50.18	-95 19.81	1100.00	mn	980882.14	980965.34	0.01	-37.52	-0.45	0.00	20.23	-17.73	-15.31	
:224	48 49.96	-95 19.81	1100.00	mn	980882.49	980965.02	0.00	-37.52	-0.45	0.00	20.91	-17.06	-14.64	
:225	48 49.54	-95 19.81	1107.00	mn	980881.19	980964.38	0.01	-37.76	-0.45	0.00	20.90	-17.30	-14.87	
:226	48 49.31	-95 19.82	1116.00	mn	980879.65	980964.04	0.01	-38.06	-0.46	0.00	20.55	-17.96	-15.51	
:227	48 49.10	-95 19.80	1126.00	mn	980877.44	980963.73	0.01	-38.40	-0.46	0.00	19.59	-19.27	-16.79	
:228	48 48.89	-95 19.80	1125.00	mn	980878.53	980963.41	0.01	-38.37	-0.46	0.00	20.90	-17.92	-15.45	
:229	48 48.67	-95 19.80	1125.00	mn	980879.02	980963.09	0.01	-38.37	-0.46	0.00	21.72	-17.10	-14.63	
:230	48 48.44	-95 19.80	1130.00	mn	980878.94	980962.74	0.02	-38.54	-0.46	0.00	22.45	-16.53	-14.05	
:231	48 48.21	-95 19.82	1130.00	mn	980877.76	980962.39	0.02	-38.54	-0.46	0.00	21.62	-17.36	-14.88	
:232	48 47.78	-95 19.82	1128.00	mn	980875.17	980961.75	0.01	-38.47	-0.46	0.00	19.49	-19.44	-16.96	
:233	48 47.56	-95 19.82	1134.00	mn	980872.78	980961.42	0.03	-38.68	-0.46	0.00	17.99	-21.12	-18.63	
:234	48 47.30	-95 19.80	1135.00	mn	980870.86	980961.03	0.02	-38.71	-0.46	0.00	16.55	-22.60	-20.11	
:235	48 47.12	-95 19.80	1139.00	mn	980870.36	980960.77	0.02	-38.85	-0.47	0.00	16.69	-22.60	-20.10	
:236	48 46.91	-95 19.82	1135.00	mn	980870.39	980960.45	0.02	-38.71	-0.46	0.00	16.67	-22.49	-19.99	
:237	48 46.68	-95 19.80	1141.00	mn	980870.58	980960.10	0.02	-38.92	-0.47	0.00	17.76	-21.60	-19.09	

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International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver, CO
 2g-551

Date: 9-JUN-1988 16:24:21.79

g-x g-y g-z

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE LONGITUDE deg min deg min	ELE (in ft)	ST (in ft)	G R A V I T Y OBSERVED THEORETICAL	TERRAIN BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	A N O M A L I E S FREE COMPLETE-BOUGUER SPEC d1=2.67 d2=2.50 FIELDS
:238	48 46.45 -95 19.82	1140.00 mn	980868.77	980959.76	0.02	-38.88 -0.47	0.00 16.21 -23.12 -20.61
:239	48 46.24 -95 19.83	1144.00 mn	980867.37	980959.45	0.02	-39.02 -0.47	0.00 15.49 -23.97 -21.46
:240	48 46.02 -95 19.82	1145.00 mn	980865.50	980959.12	0.02	-39.05 -0.47	0.00 14.05 -25.45 -22.94
:241	48 45.81 -95 19.82	1150.00 mn	980863.92	980958.80	0.02	-39.22 -0.47	0.00 13.25 -26.42 -23.90
:242	48 45.58 -95 19.81	1150.00 mn	980862.54	980958.46	0.02	-39.22 -0.47	0.00 12.21 -27.46 -24.93
:243	48 45.38 -95 19.79	1153.00 mn	980861.29	980958.16	0.02	-39.33 -0.47	0.00 11.55 -28.23 -25.69
:244	48 45.18 -95 19.81	1160.00 mn	980859.82	980957.86	0.03	-39.56 -0.47	0.00 11.04 -28.97 -26.43
:245	48 44.96 -95 19.83	1163.00 mn	980857.71	980957.53	0.03	-39.67 -0.47	0.00 9.54 -30.58 -28.02
:246	48 44.78 -95 19.83	1166.00 mn	980856.98	980957.27	0.04	-39.77 -0.48	0.00 9.35 -30.86 -28.30
:247	48 44.34 -95 19.86	1194.00 mn	980852.98	980956.60	0.07	-40.72 -0.49	0.00 8.65 -32.49 -29.87
:248	48 43.97 -95 19.83	1205.00 mn	980850.07	980956.05	0.07	-41.10 -0.49	0.00 7.33 -34.19 -31.55
:249	48 43.40 -95 19.83	1215.00 mn	980848.10	980955.20	0.07	-41.44 -0.49	0.00 7.15 -34.71 -32.05
:250	48 43.15 -95 19.84	1205.00 mn	980848.81	980954.82	0.05	-41.10 -0.49	0.00 7.30 -34.24 -31.60
:251	48 42.78 -95 19.83	1210.00 mn	980848.39	980954.27	0.05	-41.27 -0.49	0.00 7.90 -33.81 -31.16
:252	48 52.35 -95 19.82	1079.00 mn	980886.67	980968.59	0.00	-36.80 -0.44	0.00 19.54 -17.70 -15.33
:253	48 56.95 -95 19.87	1063.00 mn	980885.82	980975.47	-0.01	-36.26 -0.44	0.00 10.31 -26.40 -24.06
:254	48 56.50 -95 19.87	1064.00 mn	980886.59	980974.80	-0.01	-36.29 -0.44	0.00 11.84 -24.89 -22.55
:255	48 56.69 -95 19.87	1062.00 mn	980886.85	980975.08	-0.01	-36.22 -0.44	0.00 11.63 -25.04 -22.70
:256	48 56.27 -95 19.88	1063.00 mn	980888.06	980974.45	-0.01	-36.26 -0.44	0.00 13.56 -23.14 -20.80
:257	48 56.06 -95 19.77	1065.00 mn	980888.77	980974.13	0.00	-36.32 -0.44	0.00 14.78 -21.98 -19.64
:258	48 52.75 -95 19.63	1075.00 mn	980888.51	980969.19	0.01	-36.67 -0.44	0.00 20.40 -16.69 -14.33
:spooner	48 42.70 -94 36.10	1086.00 mn	980861.12	980954.15	-0.03	-37.04 -0.45	0.00 9.09 -28.43 -26.04
:521	48 27.97 -94 11.33	1144.00 mn	980833.00	980932.09	-0.03	-39.02 -0.47	0.00 8.48 -31.04 -28.52
:522	48 27.98 -94 11.32	1142.00 mn	980833.12	980932.11	-0.03	-38.95 -0.47	0.00 8.39 -31.06 -28.55
:523	48 27.99 -94 11.33	1140.00 mn	980833.28	980932.12	-0.03	-38.88 -0.47	0.00 8.36 -31.02 -28.51
:524	48 28.01 -94 11.34	1141.00 mn	980834.26	980932.15	-0.03	-38.92 -0.47	0.00 9.40 -30.01 -27.51
:525	48 28.02 -94 11.35	1142.00 mn	980833.15	980932.16	-0.03	-38.95 -0.47	0.00 8.37 -31.08 -28.57
:526	48 28.03 -94 11.35	1143.00 mn	980833.00	980932.18	-0.03	-38.98 -0.47	0.00 8.30 -31.18 -28.67
:527	48 28.05 -94 11.35	1143.00 mn	980833.04	980932.21	-0.03	-38.98 -0.47	0.00 8.30 -31.18 -28.66
:528	48 28.06 -94 11.35	1143.00 mn	980833.07	980932.23	-0.03	-38.98 -0.47	0.00 8.32 -31.16 -28.65
:529	48 28.08 -94 11.35	1144.00 mn	980833.03	980932.26	-0.03	-39.02 -0.47	0.00 8.34 -31.17 -28.66
:530	48 28.09 -94 11.35	1142.00 mn	980832.99	980932.27	-0.03	-38.95 -0.47	0.00 8.10 -31.35 -28.83
:531	48 28.10 -94 11.35	1142.00 mn	980833.05	980932.29	-0.03	-38.95 -0.47	0.00 8.14 -31.31 -28.80
:532	48 28.12 -94 11.35	1141.00 mn	980833.20	980932.31	-0.03	-38.92 -0.47	0.00 8.18 -31.23 -28.72
:533	48 28.13 -94 11.35	1141.00 mn	980833.20	980932.33	-0.03	-38.92 -0.47	0.00 8.16 -31.25 -28.74
:534	48 28.14 -94 11.35	1141.00 mn	980833.24	980932.34	-0.03	-38.92 -0.47	0.00 8.19 -31.23 -28.72
:535	48 28.16 -94 11.35	1141.00 mn	980833.27	980932.38	-0.03	-38.92 -0.47	0.00 8.19 -31.23 -28.72
:536	48 28.17 -94 11.35	1141.00 mn	980833.17	980932.39	-0.03	-38.92 -0.47	0.00 8.07 -31.34 -28.83
:537	48 28.18 -94 11.35	1141.00 mn	980833.35	980932.41	-0.03	-38.92 -0.47	0.00 8.23 -31.18 -28.67
:538	48 28.20 -94 11.35	1141.00 mn	980833.39	980932.44	-0.03	-38.92 -0.47	0.00 8.24 -31.17 -28.66

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International Falls-Roseau CUSMAP Gravity Data
USGS Branch of Geophysics, Denver CO
2g-551 elev=ft gu=0.01 srt=time a-f g-x Date: 9-JUN-1988 16:24:26.91

STATION IDENTIFICATION prof sta-id	L O C A T I O N S LATITUDE deg min	ELE m (in ft)	G R A V I T Y ST OBSERVED THEORETICAL	TERRAIN BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	A N O M A L I E S FREE AIR d1=2.67 d2=2.50 FIELDS
1539	48 28.21	-94 11.35	1141.00 mn 980833.46	980932.45	-0.03 -38.92 -0.47	0.00 8.30 -31.12 -28.61
1540	48 28.22	-94 11.35	1141.00 mn 980833.52	980932.47	-0.03 -38.92 -0.47	0.00 8.34 -31.07 -28.56
1541	48 27.94	-94 11.35	1141.00 mn 980833.18	980932.05	-0.03 -38.92 -0.47	0.00 8.42 -30.99 -28.48
1542	48 27.93	-94 11.35	1141.00 mn 980833.11	980932.03	-0.03 -38.92 -0.47	0.00 8.37 -31.05 -28.54
1543	48 27.91	-94 11.35	1140.00 mn 980833.03	980932.00	-0.03 -38.88 -0.47	0.00 8.23 -31.15 -28.65
1544	48 27.90	-94 11.35	1140.00 mn 980832.96	980931.98	-0.03 -38.88 -0.47	0.00 8.17 -31.21 -28.70
1545	48 27.89	-94 11.35	1141.00 mn 980832.86	980931.97	-0.03 -38.92 -0.47	0.00 8.18 -31.23 -28.72
1546	48 27.87	-94 11.35	1141.00 mn 980832.82	980931.94	-0.03 -38.92 -0.47	0.00 8.17 -31.24 -28.73
1520	48 27.95	-94 11.34	1142.00 mn 980833.18	980932.06	-0.03 -38.95 -0.47	0.00 8.50 -30.95 -28.44
1259	48 28.96	-94 4.77	1135.00 mn 980831.30	980933.57	-0.03 -38.71 -0.46	0.00 4.45 -34.75 -32.26
1260	48 29.13	-94 4.77	1140.00 mn 980831.02	980933.83	-0.03 -38.88 -0.47	0.00 4.39 -34.99 -32.48
1261	48 29.37	-94 4.77	1140.00 mn 980830.78	980934.19	-0.03 -38.88 -0.47	0.00 3.79 -35.59 -33.08
1262	48 29.60	-94 4.77	1140.00 mn 980831.41	980934.53	-0.03 -38.88 -0.47	0.00 4.07 -35.31 -32.80
1263	48 29.83	-94 4.77	1141.00 mn 980832.21	980934.88	-0.03 -38.92 -0.47	0.00 4.62 -34.79 -32.28
1264	48 30.03	-94 4.76	1140.00 mn 980832.68	980935.18	-0.03 -38.88 -0.47	0.00 4.69 -34.68 -32.18
1265	48 30.25	-94 4.76	1140.00 mn 980833.16	980935.51	-0.03 -38.88 -0.47	0.00 5.05 -34.33 -31.82
1266	48 30.46	-94 4.75	1140.00 mn 980833.76	980935.82	-0.03 -38.88 -0.47	0.00 5.13 -34.25 -31.74
1267	48 30.68	-94 4.75	1139.00 mn 980834.54	980936.15	-0.03 -38.85 -0.47	0.00 5.49 -33.85 -31.35
1268	48 30.90	-94 4.75	1139.00 mn 980834.93	980936.48	-0.03 -38.85 -0.47	0.00 5.55 -33.79 -31.29
1269	48 31.12	-94 4.76	1139.00 mn 980835.48	980936.81	-0.03 -38.85 -0.47	0.00 5.76 -33.58 -31.07
1270	48 31.33	-94 4.75	1138.00 mn 980836.53	980937.13	-0.03 -38.81 -0.47	0.00 6.41 -32.90 -30.39
1271	48 31.56	-94 4.76	1139.00 mn 980837.18	980937.47	-0.03 -38.85 -0.47	0.00 6.81 -32.53 -30.03
1272	48 31.79	-94 4.76	1139.00 mn 980838.32	980937.81	-0.03 -38.85 -0.47	0.00 7.61 -31.74 -29.23
1273	48 32.00	-94 4.76	1139.00 mn 980839.79	980938.13	-0.03 -38.85 -0.47	0.00 8.76 -30.58 -28.07
1274	48 32.22	-94 4.76	1138.00 mn 980841.30	980938.46	-0.03 -38.81 -0.47	0.00 9.84 -29.47 -26.96
1275	48 32.43	-94 4.75	1138.00 mn 980842.79	980938.77	-0.03 -38.81 -0.47	0.00 11.02 -28.29 -25.78
1276	48 32.75	-94 4.76	1138.00 mn 980846.00	980939.25	-0.03 -38.81 -0.47	0.00 13.76 -25.55 -23.05
1277	48 32.96	-94 4.75	1137.00 mn 980847.99	980939.56	-0.03 -38.78 -0.46	0.00 15.34 -23.93 -21.43
1278	48 33.29	-94 4.76	1135.00 mn 980848.86	980940.06	-0.03 -38.71 -0.46	0.00 15.52 -23.68 -21.19
1279	48 33.57	-94 4.75	1135.00 mn 980850.03	980940.48	-0.03 -38.71 -0.46	0.00 16.28 -22.93 -20.43
1280	48 33.81	-94 4.75	1130.00 mn 980851.80	980940.84	-0.02 -38.54 -0.46	0.00 17.22 -21.81 -19.32
1281	48 34.21	-94 4.75	1126.00 mn 980852.93	980941.44	-0.02 -38.40 -0.46	0.00 17.37 -21.52 -19.04
1282	48 34.39	-94 4.76	1124.00 mn 980854.23	980941.71	-0.02 -38.34 -0.46	0.00 18.21 -20.61 -18.14
1283	48 34.60	-94 4.75	1133.00 mn 980854.54	980942.02	-0.02 -38.64 -0.46	0.00 19.05 -20.08 -17.58
1284	48 35.05	-94 4.76	1144.00 mn 980854.54	980942.70	-0.02 -39.02 -0.47	0.00 19.41 -20.09 -17.58
1285	48 35.29	-94 4.76	1151.00 mn 980854.52	980943.05	-0.02 -39.26 -0.47	0.00 19.70 -20.05 -17.52
1286	48 35.49	-94 4.75	1158.00 mn 980854.32	980943.35	-0.02 -39.50 -0.47	0.00 19.86 -20.13 -17.59
1287	48 35.92	-94 4.75	1158.00 mn 980853.35	980944.00	0.00 -39.50 -0.47	0.00 18.24 -21.73 -19.19
1288	48 36.11	-94 4.77	1158.00 mn 980851.93	980944.28	0.02 -39.50 -0.47	0.00 16.54 -23.41 -20.87
1289	48 36.35	-94 4.76	1158.00 mn 980850.75	980944.64	0.02 -39.50 -0.47	0.00 15.00 -24.95 -22.41

BOUGUER GRAVITY DATA

International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver, CO
 20-551

Date: 9-JUN-1988 16:24:31.82

elevsf gus.01 srtatme a-f g-x

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE deg min	ELE (in ft)	G R A V I T Y ST OBSERVED THEORETICAL	C O R R E C T I O N S TERRAIN BOUGUER CURV (d1=2.67)	FREE AIR	A M O N A L I E S COMPLETE-BOUGUER d1=2.67 d2=2.50 FIELDS				
:290	48 36.78	-94 4.77	1160.00 mn 980848.64	980945.29	0.04	-39.56 -0.47	0.00	12.43	-27.57	-25.02
:291	48 36.96	-94 4.76	1160.00 mn 980847.91	980945.55	0.04	-39.56 -0.47	0.00	11.43	-28.58	-26.03
:292	48 37.21	-94 4.76	1160.00 mn 980846.87	980945.93	0.04	-39.56 -0.47	0.00	10.01	-29.99	-27.44
:293	48 37.43	-94 4.76	1140.00 mn 980847.30	980946.26	-0.01	-38.88 -0.47	0.00	8.23	-31.12	-28.62
:294	48 37.62	-94 4.87	1164.00 mn 980845.96	980946.55	0.04	-39.70 -0.47	0.00	8.86	-31.27	-28.72
:295	48 37.99	-94 4.80	1143.00 mn 980848.06	980947.10	-0.01	-38.98 -0.47	0.00	8.44	-31.02	-28.51
:296	48 38.21	-94 4.81	1124.00 mn 980848.50	980947.43	-0.03	-38.34 -0.46	0.00	6.76	-32.07	-29.59
:297	48 38.58	-94 4.81	1085.00 mn 980852.74	980947.98	-0.02	-37.01 -0.45	0.00	6.78	-30.69	-28.31
valley	48 42.75	-94 36.70	1070.00 mn 980858.41	980954.23	-0.03	-36.49 -0.44	0.00	4.79	-32.17	-29.82
:298	48 42.86	-94 38.12	1088.00 mn 980857.48	980954.39	-0.03	-37.11 -0.45	0.00	5.39	-32.19	-29.80
:299	48 43.08	-94 39.12	1088.00 mn 980856.92	980954.72	-0.03	-37.11 -0.45	0.00	4.51	-33.08	-30.68
:300	48 43.30	-94 39.10	1084.00 mn 980856.94	980955.05	-0.03	-36.97 -0.45	0.00	3.82	-33.63	-31.24
:301	48 43.52	-94 39.12	1083.00 mn 980857.53	980955.38	-0.03	-36.94 -0.44	0.00	3.99	-33.42	-31.04
:302	48 43.73	-94 39.12	1082.00 mn 980857.43	980955.69	-0.03	-36.90 -0.44	0.00	3.48	-33.90	-31.52
:303	48 43.95	-94 39.12	1082.00 mn 980857.76	980956.02	-0.03	-36.90 -0.44	0.00	3.47	-33.90	-31.52
:304	48 44.17	-94 39.14	1082.00 mn 980857.81	980956.35	-0.02	-36.90 -0.44	0.00	3.20	-34.17	-31.79
:305	48 44.51	-94 39.10	1080.00 mn 980858.39	980956.86	-0.02	-36.84 -0.44	0.00	3.08	-34.22	-31.84
:306	48 45.46	-94 43.07	1080.00 mn 980859.86	980958.28	-0.03	-36.84 -0.44	0.00	3.13	-34.18	-31.80
:307	48 45.71	-94 43.09	1080.00 mn 980860.00	980958.66	-0.03	-36.84 -0.44	0.00	2.90	-34.41	-32.04
:308	48 45.90	-94 43.08	1077.00 mn 980859.65	980958.94	-0.03	-36.73 -0.44	0.00	1.98	-35.22	-32.86
:309	48 46.11	-94 43.09	1077.00 mn 980859.49	980959.25	-0.03	-36.73 -0.44	0.00	1.51	-35.69	-33.32
:310	48 46.33	-94 43.09	1080.00 mn 980860.43	980959.58	-0.03	-36.84 -0.44	0.00	2.40	-34.91	-32.53
:311	48 45.24	-94 43.08	1076.00 mn 980859.54	980957.95	-0.03	-36.70 -0.44	0.00	2.76	-34.41	-32.04
:312	48 45.00	-94 43.07	1076.00 mn 980859.38	980957.59	-0.03	-36.70 -0.44	0.00	2.97	-34.21	-31.84
:313	48 44.80	-94 43.07	1080.00 mn 980858.61	980957.29	-0.03	-36.84 -0.44	0.00	2.87	-34.44	-32.06
:314	48 44.58	-94 43.06	1085.00 mn 980857.85	980956.96	-0.03	-37.01 -0.45	0.00	2.91	-34.57	-32.18
:315	48 44.37	-94 43.06	1086.00 mn 980858.18	980956.65	-0.03	-37.04 -0.45	0.00	3.65	-33.87	-31.48
:316	48 44.14	-94 43.07	1088.00 mn 980858.00	980956.30	-0.03	-37.11 -0.45	0.00	4.00	-33.59	-31.19
:317	48 43.93	-94 43.05	1090.00 mn 980857.81	980955.99	-0.03	-37.18 -0.45	0.00	4.31	-33.34	-30.94
:318	48 43.71	-94 43.05	1092.00 mn 980858.32	980955.66	-0.02	-37.24 -0.45	0.00	5.34	-32.38	-29.97
:319	48 43.50	-94 43.05	1092.00 mn 980857.64	980955.34	-0.02	-37.24 -0.45	0.00	4.98	-32.74	-30.33
:320	48 43.29	-94 43.06	1093.00 mn 980857.73	980955.03	-0.02	-37.28 -0.45	0.00	5.47	-32.28	-29.87
:321	48 43.04	-94 43.06	1095.00 mn 980857.75	980954.66	-0.02	-37.35 -0.45	0.00	6.06	-31.76	-29.35
:322	48 42.84	-94 43.06	1099.00 mn 980858.06	980954.36	-0.02	-37.48 -0.45	0.00	7.04	-30.91	-28.50
:323	48 42.68	-94 42.84	1100.00 mn 980858.75	980954.12	-0.01	-37.52 -0.45	0.00	8.07	-29.91	-27.49
:324	48 42.39	-94 42.74	1094.00 mn 980859.41	980953.69	-0.02	-37.31 -0.45	0.00	8.59	-29.19	-26.79
:325	48 42.19	-94 42.74	1117.00 mn 980858.22	980953.38	0.00	-38.10 -0.46	0.00	9.87	-28.69	-26.23
:326	48 41.98	-94 42.76	1120.00 mn 980858.46	980953.07	-0.01	-38.20 -0.46	0.00	10.70	-27.96	-25.50
:327	48 41.76	-94 42.73	1120.00 mn 980858.97	980952.74	-0.01	-38.20 -0.46	0.00	11.54	-27.13	-24.67
:328	48 41.56	-94 42.73	1113.00 mn 980859.97	980952.45	-0.02	-37.96 -0.46	0.00	12.18	-26.26	-23.81

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BOUGUER GRAVITY DATA

International Falls-Roseau CUSHAP Gravity Data
USGS Branch of Geophysics, Denver CO
20-551 elev= f gu= 01 srt= tme a= f q= x Date: 9-JUN-1988 16:24:37.80

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE deg min	LONGITUDE deg min	ELE (in ft)	SF OBSERVED	G R A V I T Y THEORETICAL	TERRAIN BOUGUER CURV (dl=2.67)	C U R V E C T I O N S SPECIAL	A N O M A L I E S FREE COMPLETE-BOUGUER SPEC AIR dl=2.67 d2=2.50 FIELDS
1329	48 41.33	-94 42.50	1120.00	mn 980860.47	980952.10	-0.02	-38.20 -0.46	0.00 13.68 -25.00 -22.54
1330	48 41.11	-94 42.45	1125.00	mn 980861.29	980951.77	-0.01	-38.37 -0.46	0.00 15.31 -23.53 -21.06
1331	48 41.11	-94 49.27	1166.00	mn 980843.74	980951.77	0.02	-39.77 -0.48	0.00 1.62 -38.61 -36.05
1332	48 41.11	-94 48.87	1160.00	mn 980845.27	980951.77	0.01	-39.56 -0.47	0.00 2.58 -37.45 -34.90
1333	48 41.11	-94 48.46	1155.00	mn 980846.09	980951.77	0.00	-39.39 -0.47	0.00 2.93 -36.93 -34.39
1334	48 41.11	-94 48.06	1154.00	mn 980847.30	980951.77	0.00	-39.36 -0.47	0.00 4.04 -35.79 -33.25
1335	48 41.11	-94 47.72	1149.00	mn 980848.57	980951.77	0.00	-39.19 -0.47	0.00 4.84 -34.81 -32.29
1336	48 41.10	-94 47.34	1140.00	mn 980850.85	980951.76	0.00	-38.88 -0.47	0.00 6.29 -33.06 -30.56
1337	48 41.10	-94 47.06	1140.00	mn 980851.69	980951.76	0.00	-38.88 -0.47	0.00 7.12 -32.22 -29.72
1338	48 41.10	-94 46.67	1140.00	mn 980853.37	980951.76	0.00	-38.88 -0.47	0.00 8.80 -30.54 -28.04
1339	48 41.10	-94 46.40	1139.00	mn 980853.79	980951.76	-0.01	-38.85 -0.47	0.00 9.13 -30.19 -27.69
1340	48 41.11	-94 46.12	1139.00	mn 980854.74	980951.77	-0.01	-38.85 -0.47	0.00 10.08 -29.25 -26.74
1341	48 41.09	-94 45.76	1145.00	mn 980855.19	980951.74	0.00	-39.05 -0.47	0.00 11.11 -28.41 -25.89
1342	48 41.09	-94 45.44	1149.00	mn 980854.87	980951.74	0.00	-39.19 -0.47	0.00 11.17 -28.49 -25.97
1343	48 41.11	-94 45.10	1152.00	mn 980855.46	980951.77	0.01	-39.29 -0.47	0.00 12.02 -27.73 -25.20
1344	48 41.09	-94 44.77	1154.00	mn 980855.36	980951.74	0.02	-39.36 -0.47	0.00 12.13 -27.68 -25.15
1345	48 41.09	-94 44.42	1146.00	mn 980855.83	980951.74	0.01	-39.09 -0.47	0.00 11.84 -27.70 -25.18
1346	48 41.10	-94 44.10	1138.00	mn 980857.62	980951.76	0.00	-38.81 -0.47	0.00 12.87 -26.41 -23.91
1347	48 41.10	-94 43.76	1133.00	mn 980859.02	980951.76	0.00	-38.64 -0.46	0.00 13.80 -25.31 -22.82
1348	48 41.11	-94 43.42	1129.00	mn 980859.48	980951.77	-0.01	-38.51 -0.46	0.00 13.87 -25.11 -22.63
1349	48 41.10	-94 43.11	1125.00	mn 980860.51	980951.76	-0.01	-38.37 -0.46	0.00 14.53 -24.31 -21.83
1350	48 41.12	-94 42.78	1126.00	mn 980861.00	980951.78	-0.01	-38.40 -0.46	0.00 15.10 -23.78 -21.30
1351	48 41.12	-94 42.12	1126.00	mn 980861.65	980951.78	0.01	-38.40 -0.46	0.00 15.74 -23.13 -20.66
1352	48 41.11	-94 41.79	1125.00	mn 980860.49	980951.77	-0.01	-38.37 -0.46	0.00 14.51 -24.33 -21.86
1353	48 41.11	-94 41.45	1121.00	mn 980861.11	980951.77	-0.02	-38.23 -0.46	0.00 14.75 -23.96 -21.50
1354	48 41.15	-94 41.18	1120.00	mn 980861.77	980951.83	-0.02	-38.20 -0.46	0.00 15.26 -23.42 -20.96
1355	48 41.15	-94 40.79	1118.00	mn 980861.33	980951.83	-0.02	-38.13 -0.46	0.00 14.63 -23.98 -21.53
1356	48 41.15	-94 40.56	1115.00	mn 980861.06	980951.83	-0.02	-38.03 -0.46	0.00 14.08 -24.43 -21.98
1357	48 41.16	-94 40.14	1116.00	mn 980861.14	980951.84	-0.02	-38.06 -0.46	0.00 14.23 -24.31 -21.85
1358	48 42.06	-94 38.91	1080.00	mn 980857.54	980954.39	-0.03	-36.84 -0.44	0.00 4.70 -32.61 -30.23
1359	48 42.67	-94 38.93	1090.00	mn 980858.18	980954.10	-0.03	-37.18 -0.45	0.00 6.57 -31.08 -28.69
1360	48 42.46	-94 38.81	1090.00	mn 980859.00	980953.79	-0.03	-37.18 -0.45	0.00 7.70 -29.95 -27.55
1361	48 42.28	-94 38.80	1093.00	mn 980859.67	980953.52	-0.03	-37.28 -0.45	0.00 8.92 -28.83 -26.43
1362	48 42.02	-94 38.80	1097.00	mn 980861.22	980953.13	-0.02	-37.42 -0.45	0.00 11.24 -26.65 -24.24
1363	48 41.80	-94 38.80	1097.00	mn 980861.21	980952.80	-0.01	-37.42 -0.45	0.00 11.56 -26.32 -23.91
1364	48 41.59	-94 38.79	1100.00	mn 980860.79	980952.48	-0.01	-37.52 -0.45	0.00 11.74 -26.24 -23.82
1365	48 41.28	-94 38.80	1110.00	mn 980861.05	980952.02	-0.02	-37.86 -0.45	0.00 13.40 -24.94 -22.50
1366	48 40.68	-94 38.81	1116.00	mn 980862.44	980951.13	-0.02	-38.06 -0.46	0.00 16.25 -22.29 -19.84
1367	48 40.41	-94 38.82	1115.00	mn 980865.40	980950.72	-0.02	-38.03 -0.46	0.00 19.52 -18.98 -16.53
1368	48 40.29	-94 38.82	1115.00	mn 980865.05	980950.54	-0.02	-38.03 -0.46	0.00 19.35 -19.15 -16.70

BOUGUER GRAVITY DATA

International Falls-Roseau CUSHAP Gravity Data
USGS Branch of Geophysics, Denver: CD
29-551 elev= f gus=01 srtstme a-f g-x Date: 9-JUN-1988 16:24:43.48

STATION IDENTIFICATION proj sta-ld	L O C A T I O N S LATITUDE deg min	LONGITUDE deg min	ELE (in ft)	ST OBSERVED	G R A V I T Y THEORETICAL	TERRAIN BOUGUER CURV (di=2.67)	C O R K E C T I O N S SPECIAL	FREE AIR	A M O M A L I E S COMPLETE-BOUGUER SPEC d1=2.67 d2=2.50 FIELDS
1369	48 40.06	-94 38.83	1113.00	mn 980864.04	980950.20	-0.02	-37.96 -0.46	0.00	18.50 -19.94 -17.49
1370	48 39.80	-94 38.83	1108.00	mn 980863.25	980949.80	-0.02	-37.79 -0.45	0.00	17.63 -20.63 -18.20
1371	48 39.63	-94 38.83	1115.00	mn 980861.85	980949.55	-0.02	-38.03 -0.46	0.00	17.14 -21.37 -18.91
1372	48 39.42	-94 38.83	1117.00	mn 980861.31	980949.24	-0.02	-38.10 -0.46	0.00	17.10 -21.47 -19.02
1373	48 39.19	-94 38.84	1117.00	mn 980860.61	980948.90	-0.02	-38.10 -0.46	0.00	16.74 -21.83 -19.38
1374	48 38.98	-94 38.84	1120.00	mn 980860.14	980948.58	-0.02	-38.20 -0.46	0.00	16.88 -21.80 -19.34
1375	48 38.77	-94 38.84	1120.00	mn 980859.06	980948.27	-0.02	-38.20 -0.46	0.00	16.11 -22.57 -20.11
1376	48 38.55	-94 38.85	1125.00	mn 980858.07	980947.94	-0.02	-38.37 -0.46	0.00	15.92 -22.93 -20.46
1377	48 38.32	-94 38.86	1125.00	mn 980857.52	980947.59	-0.02	-38.37 -0.46	0.00	15.71 -23.14 -20.66
1378	48 38.12	-94 38.86	1127.00	mn 980856.36	980947.30	-0.02	-38.44 -0.46	0.00	15.03 -23.89 -21.41
1379	48 37.88	-94 38.86	1125.00	mn 980854.30	980946.93	-0.02	-38.37 -0.46	0.00	13.15 -25.70 -23.23
1380	48 37.66	-94 38.85	1126.00	mn 980852.33	980946.60	-0.02	-38.40 -0.46	0.00	11.60 -27.28 -24.81
1381	48 37.46	-94 38.87	1115.00	mn 980852.38	980946.30	-0.02	-38.03 -0.46	0.00	10.92 -27.58 -25.13
1382	48 37.26	-94 38.86	1124.00	mn 980850.81	980946.01	-0.02	-38.34 -0.46	0.00	10.49 -28.32 -25.85
1383	48 37.02	-94 38.87	1125.00	mn 980848.14	980945.65	-0.02	-38.37 -0.46	0.00	8.28 -30.57 -28.10
1384	48 36.81	-94 38.87	1129.00	mn 980845.86	980945.33	-0.02	-38.51 -0.46	0.00	6.69 -32.30 -29.82
1385	48 36.61	-94 38.86	1129.00	mn 980843.66	980945.03	-0.02	-38.51 -0.46	0.00	4.78 -34.20 -31.72
1386	48 36.39	-94 38.88	1132.00	mn 980841.96	980944.70	-0.01	-38.61 -0.46	0.00	3.70 -35.38 -32.89
1387	48 36.17	-94 38.88	1133.00	mn 980840.44	980944.38	0.00	-38.64 -0.46	0.00	2.60 -36.51 -34.02
1388	48 23.75	-94 38.78	1175.00	mn 980822.99	980925.77	0.02	-40.08 -0.48	0.00	7.71 -32.82 -30.24
1389	48 23.97	-94 38.79	1175.00	mn 980823.01	980926.09	0.02	-40.08 -0.48	0.00	7.40 -33.14 -30.55
1390	48 24.19	-94 38.78	1176.00	mn 980822.77	980926.43	0.02	-40.11 -0.48	0.00	6.92 -33.65 -31.06
1391	48 24.41	-94 38.78	1175.00	mn 980822.83	980926.76	0.02	-40.08 -0.48	0.00	6.56 -33.98 -31.40
1392	48 24.63	-94 38.78	1170.00	mn 980823.01	980927.09	0.00	-39.91 -0.48	0.00	5.94 -34.45 -31.87
1393	48 24.83	-94 38.78	1164.00	mn 980822.73	980927.38	0.00	-39.70 -0.47	0.00	4.79 -35.38 -32.82
1394	48 25.06	-94 38.79	1169.00	mn 980822.36	980927.73	0.00	-39.87 -0.48	0.00	4.55 -35.79 -33.22
1395	48 25.15	-94 38.80	1169.00	mn 980822.62	980927.87	0.00	-39.87 -0.48	0.00	4.67 -35.68 -33.11
1396	48 25.29	-94 38.79	1169.00	mn 980822.74	980928.08	0.00	-39.87 -0.48	0.00	4.59 -35.76 -33.19
1397	48 25.51	-94 38.80	1164.00	mn 980823.39	980928.41	-0.01	-39.70 -0.47	0.00	4.44 -35.75 -33.19
1398	48 25.73	-94 38.80	1165.00	mn 980823.75	980928.73	0.00	-39.73 -0.48	0.00	4.56 -36.65 -33.09
1399	48 25.93	-94 38.79	1166.00	mn 980824.24	980929.03	0.00	-39.77 -0.48	0.00	4.85 -35.39 -32.83
1400	48 26.16	-94 38.78	1163.00	mn 980825.08	980929.38	0.00	-39.67 -0.47	0.00	5.06 -35.08 -32.53
1401	48 26.37	-94 38.78	1160.00	mn 980825.29	980929.70	-0.01	-39.56 -0.47	0.00	4.67 -35.38 -32.83
1402	48 25.47	-94 57.01	1197.00	mn 980829.74	980928.34	0.01	-40.83 -0.49	0.00	13.95 -27.35 -24.72
1403	48 25.41	-94 57.01	1197.00	mn 980829.10	980928.26	0.01	-40.83 -0.49	0.00	13.40 -27.91 -25.28
1404	48 25.36	-94 57.01	1197.00	mn 980828.77	980928.18	0.01	-40.83 -0.49	0.00	13.15 -28.16 -25.53
1405	48 25.30	-94 57.03	1197.00	mn 980828.18	980928.09	0.02	-40.83 -0.49	0.00	12.64 -28.65 -26.02
1406	48 25.25	-94 57.02	1197.00	mn 980827.81	980928.02	0.02	-40.83 -0.49	0.00	12.35 -28.94 -26.31
1407	48 25.19	-94 57.02	1196.00	mn 980827.88	980927.92	0.02	-40.79 -0.49	0.00	12.42 -28.84 -26.21
1408	48 25.14	-94 57.02	1196.00	mn 980827.54	980927.85	0.01	-40.79 -0.49	0.00	12.15 -29.12 -26.49

International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver CO
 20-551 elevsf gus.01 srtzme a-f g-x Date: 9-JUN-1988 16:24:49.02

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE LONGITUDE deg min deg min	ELE (in ft)	SI OBSERVED	G R A V I T Y THEORETICAL	TERRAIN BOUGUER CURV (dl=2.67)	C O R R E C T I O N S SPECIAL	A N O M A L I E S FREE COMPLETE-BOUGUER SPEC AIR dl=2.67 d2=2.50 FIELDS
1409	48 25.09 -94 57.02	1196.00 mn	980827.26	980927.77	0.01 -40.79 -0.49	0.00	11.94 -29.32 -26.70
1410	48 25.03 -94 57.03	1196.00 mn	980826.95	980927.69	0.01 -40.79 -0.49	0.00	11.73 -29.54 -26.92
1411	48 24.98 -94 57.01	1197.00 mn	980826.82	980927.61	0.01 -40.83 -0.49	0.00	11.76 -29.54 -26.91
1412	48 24.93 -94 57.01	1197.00 mn	980826.73	980927.54	0.01 -40.83 -0.49	0.00	11.74 -29.56 -26.93
1413	48 24.87 -94 57.02	1198.00 mn	980826.45	980927.45	0.01 -40.86 -0.49	0.00	11.66 -29.68 -27.05
1414	48 24.82 -94 57.01	1200.00 mn	980826.24	980927.37	0.01 -40.93 -0.49	0.00	11.71 -29.70 -27.06
1415	48 24.76 -94 57.01	1201.00 mn	980825.80	980927.28	0.02 -40.96 -0.49	0.00	11.45 -29.99 -27.35
1416	48 24.71 -94 57.02	1199.00 mn	980825.48	980927.20	0.01 -40.89 -0.49	0.00	11.02 -30.36 -27.72
1417	48 24.66 -94 57.02	1198.00 mn	980824.95	980927.13	0.01 -40.86 -0.49	0.00	10.47 -30.87 -28.24
1418	48 24.60 -94 57.02	1197.00 mn	980824.63	980927.04	0.01 -40.83 -0.49	0.00	10.15 -31.16 -28.53
1419	48 24.56 -94 57.02	1195.00 mn	980824.73	980926.98	0.01 -40.76 -0.49	0.00	10.11 -31.13 -28.50
1420	48 24.50 -94 57.03	1195.00 mn	980824.75	980926.89	0.01 -40.76 -0.49	0.00	10.23 -31.01 -28.38
1421	48 24.43 -94 57.00	1195.00 mn	980824.77	980926.79	0.01 -40.76 -0.49	0.00	10.35 -30.88 -28.26
1422	48 24.40 -94 57.03	1194.00 mn	980824.61	980926.74	0.02 -40.72 -0.49	0.00	10.14 -31.05 -28.43
1423	48 24.33 -94 57.00	1194.00 mn	980824.41	980926.63	0.02 -40.72 -0.49	0.00	10.05 -31.14 -28.52
1424	48 24.28 -94 57.02	1194.00 mn	980824.24	980926.56	0.02 -40.72 -0.49	0.00	9.95 -31.24 -28.62
1425	48 24.23 -94 57.03	1193.00 mn	980823.96	980926.48	0.02 -40.69 -0.49	0.00	9.65 -31.50 -28.88
1426	48 24.17 -94 57.03	1193.00 mn	980823.96	980926.40	0.02 -40.69 -0.49	0.00	9.74 -31.41 -28.79
1427	48 24.13 -94 57.02	1192.00 mn	980823.97	980926.34	0.02 -40.66 -0.49	0.00	9.72 -31.40 -28.79
1428	48 25.52 -94 57.02	1197.00 mn	980831.76	980928.42	0.01 -40.83 -0.49	0.00	15.89 -25.41 -22.78
1429	48 32.16 -94 57.06	1255.00 mn	980851.07	980938.37	0.05 -42.80 -0.51	0.00	30.71 -12.55 -9.80
1430	48 31.71 -94 57.07	1241.00 mn	980856.81	980937.70	0.05 -42.33 -0.50	0.00	35.81 -6.97 -4.25
1431	48 31.13 -94 57.08	1216.00 mn	980859.18	980936.83	0.04 -41.47 -0.49	0.00	36.69 -5.24 -2.57
1432	48 31.96 -94 57.06	1249.00 mn	980852.56	980938.07	0.05 -42.60 -0.51	0.00	31.93 -11.12 -8.38
1433	48 32.39 -94 57.09	1255.00 mn	980851.65	980938.71	0.05 -42.80 -0.51	0.00	30.94 -12.32 -9.56
1434	48 32.72 -94 57.14	1269.00 mn	980847.33	980939.20	0.07 -43.28 -0.51	0.00	27.45 -16.28 -13.49
1435	48 32.95 -94 57.15	1275.00 mn	980845.30	980939.55	0.07 -43.49 -0.52	0.00	25.63 -18.30 -15.51
1436	48 33.24 -94 57.15	1270.00 mn	980843.25	980939.98	0.07 -43.32 -0.51	0.00	22.68 -21.08 -18.29
1437	48 33.43 -94 57.15	1275.00 mn	980842.40	980940.27	0.08 -43.49 -0.52	0.00	22.01 -21.91 -19.11
1438	48 33.67 -94 57.15	1276.00 mn	980842.66	980940.63	0.08 -43.52 -0.52	0.00	22.00 -21.95 -19.15
1439	48 33.89 -94 57.16	1277.00 mn	980842.23	980940.96	0.08 -43.55 -0.52	0.00	21.34 -22.65 -19.85
1440	48 34.12 -94 57.16	1279.00 mn	980841.64	980941.30	0.08 -43.62 -0.52	0.00	20.60 -23.46 -20.66
1441	48 34.34 -94 57.16	1280.00 mn	980841.61	980941.63	0.08 -43.66 -0.52	0.00	20.33 -23.76 -20.95
1442	48 34.58 -94 57.16	1280.00 mn	980842.16	980941.99	0.08 -43.66 -0.52	0.00	20.52 -23.57 -20.77
1443	48 34.81 -94 57.15	1281.00 mn	980843.72	980942.34	0.09 -43.69 -0.52	0.00	21.83 -22.28 -19.48
1444	48 34.99 -94 57.16	1280.00 mn	980844.34	980942.61	0.08 -43.66 -0.52	0.00	22.09 -22.00 -19.20
1445	48 35.21 -94 57.17	1277.00 mn	980844.50	980942.94	0.08 -43.55 -0.52	0.00	21.64 -22.35 -19.55
1446	48 35.43 -94 57.16	1277.00 mn	980843.74	980943.27	0.08 -43.55 -0.52	0.00	20.55 -23.44 -20.64
1447	48 35.59 -94 57.16	1288.00 mn	980843.50	980943.51	0.10 -43.93 -0.52	0.00	21.10 -23.25 -20.42
1448	48 35.86 -94 57.16	1267.00 mn	980844.29	980943.91	0.07 -43.21 -0.51	0.00	19.52 -24.14 -21.36

International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver, CO
 29-551 elevm gus.01 srtstme a-f g-x Date: 9-JUN-1988 16:24:54.56

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE LONGITUDE deg min deg min	ELE (in ft)	ST OBSERVED	G R A V I T Y THEORETICAL	TERRAIN BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	FREE AIR	A N O M A L I E S COMPLETE-BOUGUER d1=2.67 d2=2.50 FIELDS
1449	48 36.08 -94 57.16	1257.00	mn 980844.11	980944.24	0.05	-42.67 -0.51	18.06	-25.27 -22.51
1450	48 36.31 -94 50.15	1254.00	mn 980842.87	980944.59	0.05	-42.77 -0.51	16.19	-27.03 -24.28
1451	48 36.54 -94 57.14	1252.00	mn 980842.20	980944.93	0.05	-42.70 -0.51	15.00	-28.16 -25.41
1452	48 36.74 -94 50.15	1248.00	mn 980840.80	980945.23	0.05	-42.57 -0.51	12.92	-30.10 -27.36
1453	48 36.94 -94 57.14	1246.00	mn 980840.01	980945.52	0.04	-42.50 -0.51	11.64	-31.32 -28.58
1454	48 37.17 -94 57.13	1242.00	mn 980838.40	980945.87	0.04	-42.36 -0.50	9.32	-33.51 -30.78
1455	48 37.39 -94 57.13	1241.00	mn 980837.54	980946.20	0.04	-42.33 -0.50	8.03	-34.76 -32.04
1456	48 37.62 -94 50.12	1241.00	mn 980837.39	980946.55	0.04	-42.33 -0.50	7.53	-35.26 -32.53
1457	48 37.89 -94 57.12	1236.00	mn 980836.39	980946.95	0.04	-42.16 -0.50	5.67	-36.95 -34.24
1458	48 38.40 -94 50.11	1233.00	mn 980835.93	980947.71	0.04	-42.05 -0.50	4.16	-38.36 -35.65
1459	48 38.83 -94 57.08	1226.00	mn 980835.33	980948.36	0.04	-41.82 -0.50	2.25	-40.02 -37.33
1460	48 39.05 -94 50.10	1220.00	mn 980835.55	980948.69	0.03	-41.61 -0.50	1.58	-40.50 -37.82
1461	48 39.34 -94 57.09	1214.00	mn 980835.66	980949.12	0.03	-41.41 -0.49	0.69	-41.18 -38.51
1462	48 39.55 -94 50.09	1209.00	mn 980836.11	980949.44	0.03	-41.24 -0.49	0.35	-41.34 -38.69
1463	48 39.80 -94 57.08	1206.00	mn 980836.48	980949.80	0.03	-41.13 -0.49	0.07	-41.52 -38.87
1464	48 40.04 -94 57.07	1203.00	mn 980836.95	980950.16	0.03	-41.03 -0.49	-0.09	-41.58 -38.94
1465	48 40.20 -94 57.06	1202.00	mn 980837.21	980950.41	0.03	-41.00 -0.49	-0.17	-41.63 -38.99
1469	48 32.16 -94 57.06	1255.00	mn 980851.03	980938.37	0.05	-42.80 -0.51	30.67	-12.59 -9.84
1470	48 37.22 -95 8.89	1273.00	mn 980857.32	980945.95	0.08	-43.42 -0.51	31.07	-12.78 -9.99
1471	48 37.40 -95 8.89	1265.00	mn 980857.96	980946.22	0.07	-43.15 -0.51	30.69	-12.90 -10.12
1467	48 37.61 -95 8.86	1256.00	mn 980859.34	980946.53	0.06	-42.84 -0.51	30.91	-12.37 -9.62
1468	48 37.80 -95 8.85	1252.00	mn 980859.66	980946.81	0.05	-42.70 -0.51	30.57	-12.59 -9.84
1470	48 38.03 -95 8.83	1248.00	mn 980859.70	980947.16	0.05	-42.57 -0.51	29.90	-13.13 -10.39
1471	48 38.24 -95 8.84	1245.00	mn 980859.31	980947.47	0.05	-42.46 -0.50	28.91	-14.01 -11.28
1472	48 38.48 -95 8.85	1243.00	mn 980858.75	980947.84	0.05	-42.40 -0.50	27.79	-15.06 -12.33
1473	48 38.67 -95 8.85	1242.00	mn 980857.95	980948.12	0.05	-42.36 -0.50	26.62	-16.19 -13.47
1474	48 38.90 -95 8.85	1241.00	mn 980857.40	980948.46	0.05	-42.33 -0.50	25.63	-17.15 -14.43
1475	48 39.14 -95 8.85	1239.00	mn 980855.68	980948.82	0.06	-42.26 -0.50	23.36	-19.34 -16.62
1476	48 39.34 -95 8.85	1237.00	mn 980852.71	980949.12	0.06	-42.19 -0.50	19.91	-22.72 -20.01
1477	48 39.57 -95 8.86	1236.00	mn 980851.99	980949.46	0.06	-42.16 -0.50	18.75	-23.85 -21.13
1478	48 40.00 -95 8.86	1233.00	mn 980849.51	980950.11	0.05	-42.05 -0.50	15.34	-27.17 -24.46
1479	48 40.23 -95 8.87	1233.00	mn 980848.35	980950.45	0.06	-42.05 -0.50	13.84	-28.66 -25.95
1480	48 40.45 -95 8.87	1232.00	mn 980847.99	980950.78	0.06	-42.02 -0.50	13.05	-29.40 -26.70
1481	48 40.68 -95 8.87	1225.00	mn 980847.81	980951.13	0.04	-41.78 -0.50	11.87	-30.37 -27.68
1482	48 40.85 -95 8.87	1225.00	mn 980847.59	980951.38	0.04	-41.78 -0.50	11.40	-30.84 -28.15
1483	48 41.08 -95 8.86	1226.00	mn 980846.78	980951.73	0.04	-41.82 -0.50	10.33	-31.94 -29.25
1484	48 41.39 -95 8.86	1222.00	mn 980846.86	980952.19	0.04	-41.68 -0.50	9.58	-32.56 -29.88
1485	48 41.95 -95 8.87	1219.00	mn 980847.04	980953.02	0.04	-41.58 -0.50	8.64	-33.39 -30.72
1486	48 42.21 -95 8.87	1218.00	mn 980847.29	980953.41	0.04	-41.54 -0.49	8.40	-33.59 -30.92
1487	48 42.39 -95 8.86	1218.00	mn 980847.39	980953.69	0.04	-41.54 -0.49	8.23	-33.77 -31.09

BOUGUER GRAVITY DATA

International Falls-Roseau CUSMAP Gravity Data
 USGS Branch of Geophysics, Denver CO
 20-551

elev= g=0.1 srttime a-f g-x Date: 9-JUN-1988 16:25:01.23

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE LONGITUDE deg min deg min	ELE (in ft)	SF	G R A V I T Y OBSERVED THEORETICAL	TERRAIN BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	FREE AIR	A N O M A L I E S COMPLETE-BOUGUER d1=2.67 d2=2.50 FIELDS				
:488	48 42.58	-95 8.85	1218.00	mn 980847.67	980953.97	0.04	-41.54	-0.49	0.00	8.23	-33.77	-31.09
:489	48 42.78	-95 8.86	1217.00	mn 980847.79	980954.27	0.04	-41.51	-0.49	0.00	7.96	-34.01	-31.33
:490	48 41.72	-95 8.86	1219.00	mn 980846.86	980952.68	0.04	-41.58	-0.50	0.00	8.80	-33.23	-30.55
:466	48 37.22	-95 8.89	1273.00	mn 980857.39	980945.95	0.08	-43.42	-0.51	0.00	31.14	-12.71	-9.92
:491	48 35.88	-95 20.58	1227.00	mn 980841.88	980943.94	0.05	-41.85	-0.50	0.00	13.32	-28.98	-26.28
:492	48 36.07	-95 20.55	1222.00	mn 980842.29	980944.23	0.05	-41.68	-0.50	0.00	12.97	-29.16	-26.48
:493	48 36.32	-95 20.54	1223.00	mn 980842.55	980944.60	0.05	-41.71	-0.50	0.00	12.94	-29.22	-26.53
:494	48 36.54	-95 20.54	1222.00	mn 980842.42	980944.93	0.05	-41.68	-0.50	0.00	12.40	-29.73	-27.05
:495	48 36.75	-95 20.52	1226.00	mn 980842.24	980945.24	0.05	-41.82	-0.50	0.00	12.28	-29.98	-27.29
:496	48 36.98	-95 20.54	1225.00	mn 980842.23	980945.59	0.05	-41.78	-0.50	0.00	11.83	-30.40	-27.71
:497	48 37.22	-95 20.54	1226.00	mn 980842.10	980945.95	0.05	-41.82	-0.50	0.00	11.44	-30.83	-28.14
:498	48 37.45	-95 20.56	1233.00	mn 980841.79	980946.29	0.05	-42.05	-0.50	0.00	11.44	-31.07	-28.36
:499	48 37.60	-95 20.57	1235.00	mn 980841.77	980946.52	0.07	-42.12	-0.50	0.00	11.38	-31.17	-28.46
:500	48 37.88	-95 20.57	1236.00	mn 980841.54	980946.93	0.07	-42.16	-0.50	0.00	10.83	-31.76	-29.05
:501	48 38.17	-95 20.57	1235.00	mn 980841.38	980947.37	0.07	-42.12	-0.50	0.00	10.14	-32.41	-29.70
:502	48 38.49	-95 20.57	1236.00	mn 980841.29	980947.84	0.07	-42.16	-0.50	0.00	9.67	-32.92	-30.21
:503	48 38.70	-95 20.57	1236.00	mn 980841.10	980948.16	0.07	-42.16	-0.50	0.00	9.16	-33.43	-30.72
:504	48 38.92	-95 20.56	1236.00	mn 980840.78	980948.49	0.07	-42.16	-0.50	0.00	8.51	-34.08	-31.37
:505	48 39.35	-95 20.56	1231.00	mn 980841.21	980949.13	0.05	-41.99	-0.50	0.00	7.83	-34.61	-31.91
:506	48 39.61	-95 20.57	1230.00	mn 980841.52	980949.52	0.05	-41.95	-0.50	0.00	7.66	-34.74	-32.05
:507	48 39.81	-95 20.56	1229.00	mn 980841.67	980949.82	0.05	-41.92	-0.50	0.00	7.41	-34.95	-32.26
:508	48 39.98	-95 20.55	1228.00	mn 980842.55	980950.08	0.05	-41.88	-0.50	0.00	7.94	-34.40	-31.70
:509	48 40.22	-95 20.57	1226.00	mn 980843.44	980950.44	0.05	-41.82	-0.50	0.00	8.28	-33.98	-31.29
:510	48 40.43	-95 20.56	1226.00	mn 980843.95	980950.75	0.05	-41.82	-0.50	0.00	8.48	-33.78	-31.09
:511	48 41.08	-95 20.55	1214.00	mn 980846.04	980951.73	0.05	-41.44	-0.49	0.00	8.46	-33.39	-30.72
:512	48 41.32	-95 20.55	1212.00	mn 980846.00	980952.09	0.04	-41.34	-0.49	0.00	7.88	-33.91	-31.25
:513	48 41.53	-95 20.55	1212.00	mn 980846.54	980952.40	0.04	-41.34	-0.49	0.00	8.10	-33.69	-31.03
:514	48 41.73	-95 20.54	1212.00	mn 980846.50	980952.70	0.05	-41.34	-0.49	0.00	7.77	-34.01	-31.35
:515	48 41.96	-95 20.55	1213.00	mn 980846.30	980953.04	0.05	-41.37	-0.49	0.00	7.32	-34.50	-31.84
:516	48 42.16	-95 20.54	1214.00	mn 980846.81	980953.34	0.05	-41.41	-0.49	0.00	7.62	-34.23	-31.56
:517	48 42.36	-95 20.57	1222.00	mn 980846.05	980953.64	0.05	-41.68	-0.50	0.00	7.31	-34.82	-32.13
:518	48 42.49	-95 20.57	1226.00	mn 980846.41	980953.84	0.05	-41.82	-0.50	0.00	7.85	-34.41	-31.72
:519	48 42.75	-95 20.56	1210.00	mn 980847.90	980954.23	0.05	-41.27	-0.49	0.00	7.45	-34.26	-31.61
:IF2	48 23.68	-93 49.73	1144.00	mn 980819.30	980925.66	-0.03	-39.02	-0.47	0.00	1.20	-38.31	-35.80
:IF3	48 22.91	-93 49.73	1148.00	mn 980818.83	980924.51	-0.03	-39.15	-0.47	0.00	2.27	-37.39	-34.86
:IF4	48 22.03	-93 50.42	1156.00	mn 980817.59	980923.19	-0.03	-39.43	-0.47	0.00	3.11	-36.82	-34.28
:IF5	48 21.16	-93 50.44	1167.00	mn 980816.59	980921.88	-0.02	-39.80	-0.48	0.00	4.44	-35.85	-33.29
:IF6	48 21.15	-93 51.75	1169.00	mn 980817.00	980921.87	-0.01	-39.87	-0.48	0.00	5.05	-35.30	-32.73
:IF7	48 20.89	-93 50.44	1168.00	mn 980816.41	980921.48	-0.01	-39.84	-0.48	0.00	4.75	-35.57	-33.01
:IF8	48 20.29	-93 50.45	1174.00	mn 980816.60	980920.58	-0.01	-40.04	-0.48	0.00	6.42	-34.12	-31.53

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BOUGUER GRAVITY DATA

International Falls-Roseau CUSMAP Gravity Data
USGS Branch of Geophysics, Denver CO
29-551

elev= g-u=0.1 srt= Date: 9-JUN-1988 16:25:06.12

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE LONGITUDE deg min deg min	ELE (in ft)	ST OBSERVED	G R A V I T Y THEORETICAL	TERRAIN BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	FREE AIR	A N O M A L I E S COMPLETE-BOUGUER d1=2.67 d2=2.50 FIELDS	SPEC
IF9	48 19.42 -93 50.45	1183.00	MN 980815.64	980919.27	-0.02	-40.35 -0.48	7.61	-33.25 -30.64	
IF10	48 19.42 -93 51.76	1189.00	MN 980816.51	980919.27	-0.01	-40.55 -0.48	9.04	-32.01 -29.40	
IF11	48 19.42 -93 49.67	1180.00	MN 980815.11	980919.27	-0.02	-40.25 -0.48	6.79	-33.96 -31.36	
IF12	48 21.19 -93 48.54	1157.00	MN 980816.29	980921.93	-0.03	-39.46 -0.47	3.15	-36.81 -34.27	
IF1	48 24.65 -93 49.71	1139.00	MN 980818.79	980927.12	-0.03	-38.85 -0.47	-1.23	-40.57 -38.07	
IF13	48 24.79 -93 47.77	1135.00	MN 980819.21	980927.33	-0.03	-38.71 -0.46	-1.39	-40.60 -38.10	
IF14	48 26.47 -93 31.62	1125.00	MN 980815.51	980929.84	-0.05	-38.37 -0.46	-8.55	-47.43 -44.96	
IF15	48 27.73 -93 30.42	1128.00	MN 980814.48	980931.73	-0.05	-38.47 -0.46	-11.19	-50.18 -47.69	
IF16	48 29.45 -93 28.82	1134.00	MN 980813.86	980934.30	-0.04	-38.68 -0.46	-13.81	-53.00 -50.50	
IF17	48 28.45 -93 25.71	1114.00	MN 980815.10	980932.81	-0.05	-38.00 -0.46	-12.96	-51.46 -49.01	
IF18	48 27.72 -93 25.74	1128.00	MN 980815.24	980931.72	-0.05	-38.47 -0.46	-10.41	-49.39 -46.91	
IF21	48 26.85 -93 26.40	1142.00	MN 980814.66	980930.41	-0.03	-38.95 -0.47	-8.38	-47.82 -45.31	
IF22	48 27.70 -93 23.15	1134.00	MN 980815.17	980931.69	-0.04	-38.68 -0.46	-9.89	-49.07 -46.57	
IF23	48 26.54 -93 22.63	1120.00	MN 980816.46	980929.95	-0.05	-38.20 -0.46	-8.17	-46.88 -44.41	
IF25	48 26.77 -93 18.56	1172.00	MN 980815.56	980930.29	0.04	-39.97 -0.48	-4.52	-44.53 -42.36	
IF24	48 26.68 -93 17.38	1174.00	MN 980814.09	980930.16	0.02	-40.04 -0.48	-5.67	-46.17 -43.59	
IF26	48 22.92 -93 23.54	1175.00	MN 980814.64	980924.52	-0.03	-40.08 -0.48	0.60	-39.98 -37.40	
IF27	48 22.45 -93 23.96	1178.00	MN 980814.81	980923.82	-0.03	-40.18 -0.48	1.76	-38.93 -36.34	
IF28	48 21.79 -93 23.18	1137.00	MN 980816.04	980922.83	-0.04	-38.78 -0.46	0.12	-39.16 -36.66	
IF29	48 23.01 -93 24.99	1172.00	MN 980815.90	980924.66	-0.03	-39.97 -0.48	1.45	-39.04 -36.46	
IF30	48 24.53 -93 25.23	1153.00	MN 980815.19	980926.94	0.00	-39.33 -0.47	-3.33	-43.13 -40.60	
IF31	48 25.24 -93 24.06	1135.00	MN 980816.62	980928.00	-0.04	-38.71 -0.46	-4.66	-43.87 -41.38	
IF32	48 25.21 -93 26.28	1164.00	MN 980815.70	980927.95	-0.01	-39.70 -0.47	-2.80	-42.98 -40.43	
IF33	48 25.14 -93 30.83	1131.00	MN 980816.58	980927.85	-0.04	-38.58 -0.46	-4.92	-44.00 -41.51	
IF34	48 25.97 -93 29.76	1144.00	MN 980815.22	980929.09	-0.04	-39.02 -0.47	-6.30	-45.83 -43.31	
IF35	48 28.81 -93 42.28	1112.00	MN 980820.02	980933.35	-0.05	-37.93 -0.46	-8.77	-47.20 -44.75	
IF36	48 27.80 -93 41.57	1122.00	MN 980817.66	980931.84	-0.04	-38.27 -0.46	-8.68	-47.45 -44.98	
IF37	48 28.55 -93 40.76	1120.00	MN 980819.00	980932.96	-0.05	-38.20 -0.46	-8.65	-47.36 -44.89	
IF38	48 26.22 -93 38.19	1118.00	MN 980818.45	980929.47	-0.05	-38.13 -0.46	-5.89	-44.53 -42.07	
IF105	47 49.30 -93 14.08	1385.00	MN 980759.47	980874.08	0.05	-47.24 -0.56	15.62	-32.12 -29.08	
IF39	47 56.84 -93 17.61	1350.00	MN 980768.55	980885.40	0.05	-46.04 -0.54	10.09	-36.45 -33.49	
IF40	47 57.10 -93 15.60	1303.00	MN 980767.69	980885.79	0.02	-44.44 -0.53	4.42	-40.53 -37.67	
IF41	47 57.05 -93 16.55	1332.00	MN 980771.28	980885.72	0.03	-45.43 -0.54	10.81	-35.13 -32.20	
IF42	47 57.09 -93 17.40	1342.00	MN 980770.37	980885.78	0.04	-45.77 -0.54	10.77	-35.50 -32.55	
IF43	47 57.46 -93 18.00	1348.00	MN 980770.27	980886.34	0.04	-45.98 -0.54	10.69	-35.79 -32.83	
IF44	47 57.98 -93 18.33	1327.00	MN 980772.05	980887.12	0.02	-45.26 -0.53	9.71	-36.07 -33.15	
IF45	47 58.43 -93 18.60	1310.00	MN 980772.02	980887.79	0.01	-44.68 -0.53	7.41	-37.78 -34.91	
IF39	47 56.84 -93 17.61	1350.00	MN 980768.55	980885.40	0.05	-46.04 -0.54	10.09	-36.45 -33.49	
IF46	47 53.88 -93 13.32	1300.00	MN 980769.29	980880.96	0.00	-44.34 -0.52	10.57	-34.30 -31.44	
IF47	47 53.88 -93 14.06	1309.00	MN 980768.66	980880.96	0.01	-44.65 -0.53	10.78	-34.38 -31.51	

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 2g-551 elevmft gnm.01 srtstme e-f g-x Date: 9-JUN-1988 16:25:13.77

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE LONGITUDE deg min deg min	ELE (in ft)	SF	G R A V I T Y OBSERVED THEORETICAL (di=2.67)	C O R R E C T I O N S TERRAIN BOUGUER CURV (di=2.67)	A M O M A L I E S FREE COMPLETE-BOUGUER SPEC AIR d1=2.67 d2=2.50 FIELDS
IF48	47 54.84	-93 14.38	1296.00	MN 980766.80	980882.40	0.00 -44.20 -0.52 0.00
IF49	47 55.41	-93 15.64	1322.00	MN 980772.57	980883.26	0.00 -45.09 -0.53 0.00
IF50	47 56.02	-93 15.57	1303.00	MN 980772.50	980884.17	0.01 -44.44 -0.53 0.00
COOK	47 47.96	-92 42.70	1330.00	MN 980742.10	980872.07	0.01 -45.36 -0.54 0.00
IF51	48 37.59	-93 50.36	1106.00	MN 980859.64	980946.50	-0.04 -37.72 -0.45 0.00
IF52	48 37.16	-93 50.06	1125.00	MN 980860.89	980945.86	-0.02 -38.37 -0.46 0.00
IF53	48 36.84	-93 49.84	1113.00	MN 980860.16	980945.38	-0.04 -37.96 -0.46 0.00
IF54	48 36.68	-93 49.74	1110.00	MN 980859.39	980945.13	-0.04 -37.86 -0.45 0.00
IF55	48 36.52	-93 49.58	1117.00	MN 980857.39	980944.90	-0.04 -38.10 -0.46 0.00
IF56	48 36.19	-93 49.36	1117.00	MN 980856.50	980944.41	-0.13 -38.10 -0.46 0.00
IF57	48 35.97	-93 49.32	1107.00	MN 980856.24	980944.07	-0.04 -37.76 -0.45 0.00
IF58	48 35.74	-93 49.28	1103.00	MN 980854.57	980943.73	-0.04 -37.62 -0.45 0.00
IF59	48 35.59	-93 49.19	1102.00	MN 980854.49	980943.51	-0.04 -37.59 -0.45 0.00
IF60	48 35.41	-93 49.07	1105.00	MN 980854.03	980943.23	-0.04 -37.69 -0.45 0.00
IF61	48 35.09	-93 49.04	1105.00	MN 980853.62	980942.76	-0.04 -37.69 -0.45 0.00
IF62	48 34.87	-93 49.06	1105.00	MN 980852.02	980942.43	-0.04 -37.69 -0.45 0.00
IF63	48 34.66	-93 49.05	1103.00	MN 980851.30	980942.11	-0.04 -37.62 -0.45 0.00
IF64	48 34.23	-93 49.06	1095.00	MN 980850.26	980941.47	-0.05 -37.35 -0.45 0.00
IF65	48 34.46	-93 49.07	1102.00	MN 980850.51	980941.81	-0.05 -37.59 -0.45 0.00
IF66	48 33.98	-93 49.09	1101.00	MN 980849.30	980941.09	-0.05 -37.55 -0.45 0.00
IF67	48 33.79	-93 49.08	1106.00	MN 980849.28	980940.81	-0.04 -37.72 -0.45 0.00
IF68	48 33.59	-93 49.11	1102.00	MN 980848.17	980940.51	-0.05 -37.59 -0.45 0.00
IF69	48 33.35	-93 49.09	1102.00	MN 980846.42	980940.15	-0.05 -37.59 -0.45 0.00
IF70	48 33.06	-93 49.11	1104.00	MN 980845.73	980939.72	-0.05 -37.65 -0.45 0.00
IF71	48 32.72	-93 49.11	1103.00	MN 980841.18	980939.20	-0.05 -37.62 -0.45 0.00
IF72	48 32.48	-93 49.11	1101.00	MN 980835.68	980938.84	-0.05 -37.55 -0.45 0.00
IF73	48 32.29	-93 49.11	1101.00	MN 980834.63	980938.56	-0.05 -37.55 -0.45 0.00
IF74	48 31.99	-93 49.21	1098.00	MN 980833.16	980938.11	-0.05 -37.45 -0.45 0.00
IF75	48 31.63	-93 49.18	1101.00	MN 980834.07	980937.57	-0.05 -37.55 -0.45 0.00
IF76	48 31.41	-93 48.74	1096.00	MN 980835.43	980937.24	-0.05 -37.38 -0.45 0.00
IF77	48 31.25	-93 48.71	1084.00	MN 980835.74	980937.01	-0.05 -36.97 -0.45 0.00
IF78	48 31.03	-93 48.43	1095.00	MN 980834.92	980936.67	-0.05 -37.35 -0.45 0.00
IF79	48 30.77	-93 48.44	1090.00	MN 980835.76	980936.29	-0.05 -37.18 -0.45 0.00
IF80	48 30.52	-93 48.42	1093.00	MN 980833.99	980935.91	-0.05 -37.28 -0.45 0.00
IF81	48 30.30	-93 48.43	1097.00	MN 980831.76	980935.58	-0.05 -37.42 -0.45 0.00
IF82	48 30.07	-93 48.43	1101.00	MN 980829.98	980935.23	-0.05 -37.55 -0.45 0.00
IF83	48 29.46	-93 48.43	1103.00	MN 980825.51	980934.32	-0.05 -37.62 -0.45 0.00
IF84	48 29.23	-93 48.43	1101.00	MN 980823.79	980933.98	-0.05 -37.55 -0.45 0.00
IF85	48 28.59	-93 48.42	1106.00	MN 980820.65	980933.02	-0.05 -37.72 -0.45 0.00
IF86	48 28.39	-93 48.49	1108.00	MN 980819.65	980932.72	-0.05 -37.79 -0.45 0.00

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elev= f g-x g-y g-z g-w g-v g-u g-t g-s g-r g-q g-p g-o g-n g-m g-l g-k g-j g-i g-h g-g g-f g-e g-d g-c g-b g-a g-z g-y g-x g-w g-v g-u g-t g-s g-r g-q g-p g-o g-n g-m g-l g-k g-j g-i g-h g-g g-f g-e g-d g-c g-b g-a

STATION IDENTIFICATION proj sta-id	L O C A T I O N S LATITUDE deg min	LONGITUDE deg min	ELE (in ft)	GRA V I T Y ST OBSERVED	TERRAIN BOUGUER CURV (d1=2.67)	C O R R E C T I O N S SPECIAL	FREE AIR	A N O M A L I E S COMPLETE-BOUGUER d1=2.67 d2=2.50 FIELDS	SPEC			
:IF87	48 28.80	-93 48.42	1103.00	MN 980821.68	980933.34	-0.05	-37.62	-0.45	0.00	-7.94	-46.06	-43.64
:IF88	48 29.76	-93 48.42	1102.00	MN 980827.97	980934.77	-0.05	-37.59	-0.45	0.00	-3.18	-41.27	-38.85
:IF89	48 24.68	-93 27.42	1172.00	MN 980814.66	980927.16	-0.02	-39.97	-0.48	0.00	-2.30	-42.78	-40.20
:IF90	48 25.35	-93 27.49	1161.00	MN 980815.74	980928.16	0.00	-39.60	-0.47	0.00	-3.25	-43.32	-40.77
:IF91	48 25.91	-93 26.69	1150.00	MN 980814.75	980929.01	-0.03	-39.22	-0.47	0.00	-6.12	-45.85	-43.32
:IF92	48 21.59	-93 26.61	1131.00	MN 980817.38	980922.53	-0.03	-38.58	-0.46	0.00	1.20	-37.87	-35.38
:IF93	48 22.46	-93 27.90	1136.00	MN 980817.82	980923.84	-0.03	-38.75	-0.46	0.00	0.80	-38.44	-35.94
:IF94	48 11.22	-93 42.10	1233.00	MN 980798.28	980906.98	0.00	-42.05	-0.50	0.00	7.24	-36.32	-32.61
:IF95	48 11.24	-93 40.83	1223.00	MN 980797.83	980907.01	-0.01	-41.71	-0.50	0.00	5.82	-36.40	-33.71
:IF96	48 11.20	-93 38.24	1226.00	MN 980797.61	980906.95	-0.01	-41.82	-0.50	0.00	5.94	-36.39	-33.69
:IF97	48 11.19	-93 36.93	1244.00	MN 980795.56	980906.94	0.01	-42.43	-0.50	0.00	5.60	-37.32	-34.59
:IF98	48 11.12	-93 35.54	1247.00	MN 980793.36	980906.83	0.00	-42.53	-0.51	0.00	3.79	-39.25	-36.51
:IF99	48 11.12	-93 34.33	1234.00	MN 980792.04	980906.83	-0.01	-42.09	-0.50	0.00	1.24	-41.35	-38.64
:IF100	48 11.10	-93 33.04	1230.00	MN 980792.18	980906.80	-0.01	-41.95	-0.50	0.00	1.04	-41.42	-38.72
:IF101	48 9.41	-93 35.54	1249.00	MN 980785.87	980904.27	-0.01	-42.60	-0.51	0.00	-0.95	-44.07	-41.33
:IF102	48 10.24	-93 35.54	1248.00	MN 980789.92	980905.51	-0.01	-42.57	-0.51	0.00	1.76	-41.32	-38.57
:IF103	48 11.98	-93 35.52	1223.00	MN 980798.78	980908.12	-0.01	-41.71	-0.50	0.00	5.66	-36.86	-33.87
:IF104	48 12.86	-93 35.51	1208.00	MN 980802.27	980909.44	-0.02	-41.20	-0.49	0.00	6.42	-35.29	-32.63
:IFALLS	48 36.10	-93 24.50	1124.00	MN 980831.37	980944.27	-0.05	-38.34	-0.46	0.00	-7.21	-46.06	-43.58
:THRIFTY	48 36.05	-93 24.45	1170.00	MN 980827.62	980944.20	0.02	-39.91	-0.48	0.00	-6.56	-46.93	-44.36