

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Principal facts for a gravity survey of the Ennis,
Montana Geothermal Area

by

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On November 4, 1978, thirty-three gravity stations were established about one mile north of Ennis, Montana, in the Ennis geothermal area, southwestern Montana (fig. 1).

Elevations for the stations were determined by transit level (R. Leonard, U.S. Geological Survey, written commun., 1978) and by benchmark or spot elevations shown on the U.S. Geological Survey topographic map of Ennis at a scale of 1:62,500.

The gravity readings were made with a LaCoste-Romberg¹ gravimeter (number g-235) having a scale factor of about one milligal per division.

A base station was occupied at the beginning and end of the day of metering (fig. 1). The observed gravity was referenced to the U.S. Department of Defense base station (ACIC 0475-0) in Helena, Montana (fig. 2), having a value based on the International Gravity Standardization Net, 1971 (Defense Mapping Agency Aerospace Center, 1974).

The Geodetic Reference System 1967 formula (International Association of Geodesy, 1967) was used to compute theoretical gravity.

The two Bouguer anomalies were computed by use of the following U.S.G.S. computer programs:

- 1.) U.S.G.S. Gravity Reduction System (R. H. Godson, D. Dansereau, and R. Sweeney, unpub. data, 1978)
- 2.) Program Bouguer (R. H. Godson, U.S.G.S. unpub. data, 1978)

¹Use of brand names in this report is for descriptive purposes only, and in no way constitutes endorsement by the U.S. Geological Survey.

Terrain, tidal, and drift corrections were made with the above two programs. All corrections were made from each station to a distance of 167 kilometers. Densities of 2.67 g/cm^3 and 2.50 g/cm^3 were used in computing the Bouguer anomaly.

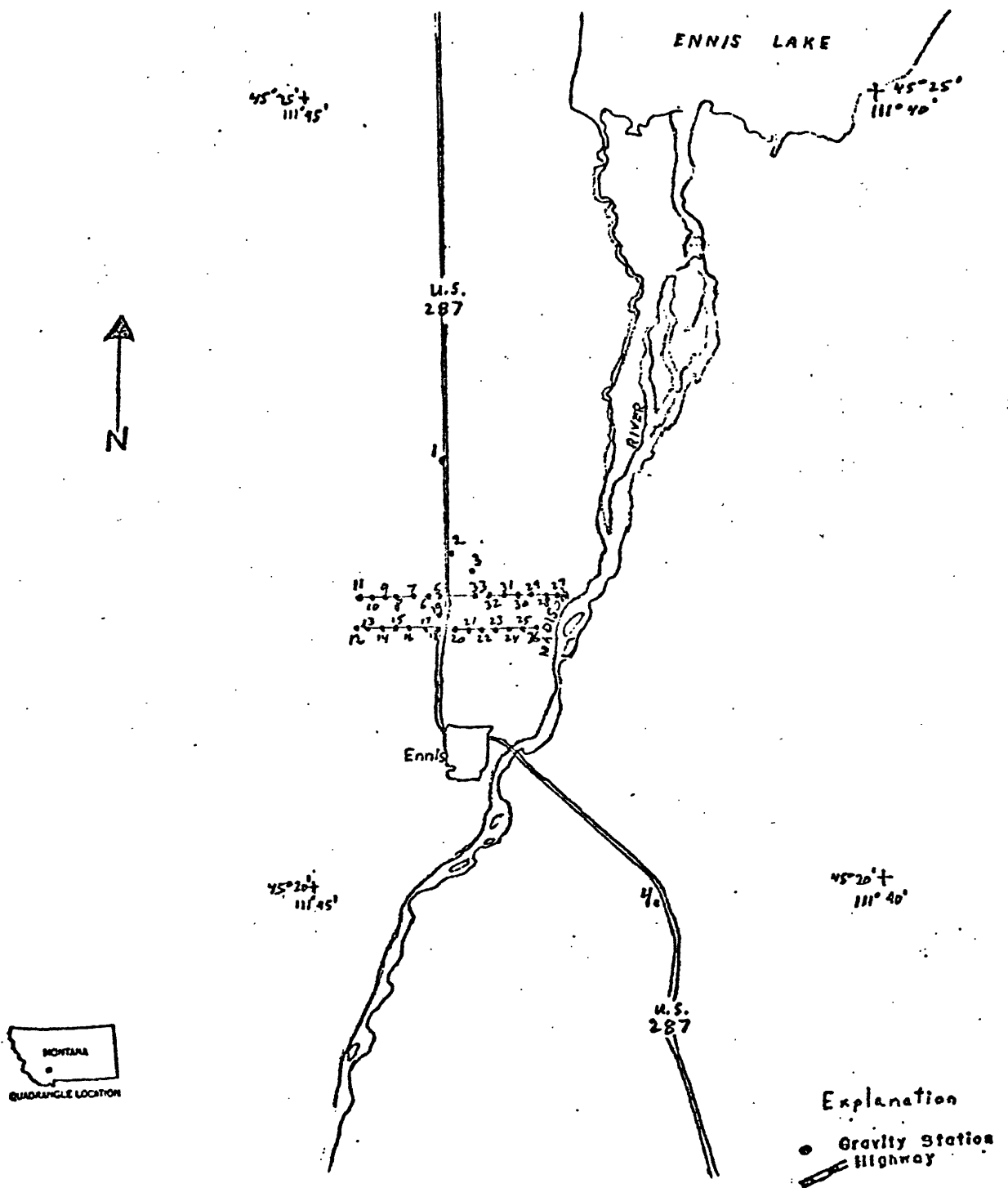
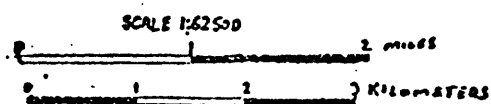


fig. 1 GRAVITY STATION LOCATION MAP,
ENNIS GEOTHERMAL AREA,
ENNIS, MONTANA



PRINCIPAL FACTS FOR GRAVITY STATIONS

Explanation of the headings of the accompanying table of principal facts:

STATION IDENTIFICATION	Gravity station number.
LATITUDE	North latitude in degrees, minutes and hundredths of minutes.
LONGITUDE	West longitude in degrees, minutes and hundredths of minutes.
ELE	Elevation in feet (to convert to meters, multiply by 0.3048).
ST	State identification (Montana).
OBSERVED	Observed gravity in milligals.
THEORETICAL	Theoretical gravity in milligals.
TERRAIN	Terrain correction in milligals.
BOUGUER	Bouguer correction in milligals.
CURV	Curvature correction in milligals.
FREE AIR	Free-air anomaly in milligals.
COMPLETE-BOUGUER	Bouguer anomaly in milligals, based on densities of 2.67 and 2.50.

Table 1 BOUGUER GRAVITY DATA for the Ennis, Montana Geothermal Area

Ennis Gravity Stations
Gathered by M. Senterfit 1978
Meter ID: 9-235 Date: 03/23/79

STATION IDENTIFICATION proj sta-id	LATITUDE deg min	LONGITUDE deg min	ELEVATION ELE ST (in ft)	GRAVITY		CORRECTIONS		ANOMALIES	
				OBSERVED	THEORETICAL	TERRAIN BOUGUER CURV	SPECIAL	FREE AIR	COMPLETE-BOUGUER
North : helena	46 36.50	-111 59.50	3872.0 mt	980363.26	980764.56	0.54	-132.06	-1.24	-170.03
North :	45 23.20	-111 43.89	4895.0 mt	980173.90	980654.05	1.50	-166.95	-1.40	-186.81
North :	45 22.10	-111 43.84	4924.0 mt	980173.80	980652.38	1.38	-167.94	-1.40	-183.64
North :	45 22.00	-111 43.67	4924.0 mt	980172.98	980652.23	1.36	-167.94	-1.40	-184.32
North :	45 19.90	-111 41.91	4981.0 mt	980150.52	980649.07	1.40	-169.89	-1.41	-200.17
North :	45 21.85	-111 43.87	4926.0 mt	980173.11	980652.01	1.39	-168.01	-1.40	-183.82
North :	45 21.85	-111 44.00	4928.0 mt	980174.61	980652.01	1.42	-168.08	-1.40	-182.17
North :	45 21.85	-111 44.13	4927.0 mt	980176.28	980652.01	1.45	-168.05	-1.40	-180.53
North :	45 21.85	-111 44.27	4928.0 mt	980177.36	980652.01	1.52	-168.08	-1.40	-179.32
North :	45 21.85	-111 44.40	4928.0 mt	980178.07	980652.01	1.55	-168.08	-1.40	-178.58
North :	45 21.85	-111 44.54	4926.0 mt	980178.47	980652.01	1.65	-168.01	-1.40	-178.20
North :	45 21.85	-111 44.68	4931.0 mt	980178.27	980652.01	1.78	-168.18	-1.40	-177.46
North :	45 21.66	-111 44.70	4950.0 mt	980175.19	980651.72	1.69	-168.83	-1.40	-179.72
North :	45 21.66	-111 44.56	4934.0 mt	980176.85	980651.72	1.63	-168.28	-1.40	-179.07
North :	45 21.66	-111 44.42	4934.0 mt	980177.55	980651.72	1.55	-168.28	-1.40	-178.46
North :	45 21.66	-111 44.29	4933.0 mt	980176.75	980651.72	1.51	-168.25	-1.40	-179.35
North :	45 21.66	-111 44.15	4935.0 mt	980175.40	980651.72	1.44	-168.32	-1.40	-180.65
North :	45 21.66	-111 44.02	4935.0 mt	980174.55	980651.72	1.40	-168.32	-1.40	-181.55
North :	45 21.66	-111 43.89	4935.0 mt	980173.31	980651.72	1.37	-168.32	-1.40	-182.81
North :	45 21.74	-111 43.89	4932.0 mt	980173.47	980651.84	1.38	-168.22	-1.40	-182.94
North :	45 21.85	-111 43.87	4926.0 mt	980173.15	980652.01	1.39	-168.01	-1.40	-183.78
North :	45 21.64	-111 43.80	4911.0 mt	980172.20	980651.70	1.45	-167.50	-1.40	-185.24
North :	45 21.64	-111 43.67	4911.0 mt	980170.99	980651.70	1.43	-167.50	-1.40	-186.48
North :	45 21.64	-111 43.54	4910.0 mt	980169.95	980651.70	1.40	-167.47	-1.40	-187.60
North :	45 21.64	-111 43.40	4908.0 mt	980169.29	980651.70	1.39	-167.40	-1.40	-188.40
North :	45 21.64	-111 43.27	4906.0 mt	980168.65	980651.70	1.39	-167.33	-1.40	-189.16
North :	45 21.64	-111 43.13	4907.0 mt	980168.05	980651.70	1.38	-167.36	-1.40	-189.71
North :	45 21.64	-111 43.00	4907.0 mt	980167.62	980651.70	1.38	-167.36	-1.40	-190.14
North :	45 21.85	-111 42.82	4896.0 mt	980168.37	980652.01	1.42	-166.99	-1.40	-190.32
North :	45 21.85	-111 42.95	4899.0 mt	980168.99	980652.01	1.39	-167.09	-1.40	-189.55
North :	45 21.85	-111 43.08	4900.0 mt	980169.88	980652.01	1.39	-167.12	-1.40	-188.60
North :	45 21.85	-111 43.21	4903.0 mt	980171.07	980652.01	1.40	-167.23	-1.40	-187.22
North :	45 21.85	-111 43.35	4901.0 mt	980172.09	980652.01	1.41	-167.16	-1.40	-186.31
North :	45 21.85	-111 43.48	4902.0 mt	980172.92	980652.01	1.42	-167.19	-1.40	-185.41
North :	45 21.85	-111 43.62	4900.0 mt	980173.40	980652.01	1.45	-167.12	-1.40	-185.02
North :	45 22.00	-111 43.67	4924.0 mt	980173.06	980652.23	1.36	-167.94	-1.40	-184.24
North : helena	46 36.50	-111 59.50	3872.0 mt	980363.26	980764.56	0.54	-132.06	-1.24	-170.03

GRAVITY BASE STATION			
LATITUDE		STATION DESIGNATION	
46° 36.5' N (1)		HELENA	
LONGITUDE			
111° 59.5' W (1)		COUNTRY/STATE	
ELEVATION		USA/Montana	
1180.5 METERS (1)		ADOPTED GRAVITY VALUE	
REFERENCE CODE NUMBERS		g = 980 363.50 mgals	
ACIC 0475-0			
IGC 15661J			
WA 31		ESTIMATED ACCURACY	
		DATE	
		MONTH/YEAR	
		Aug/1968	
		± 0.1 mgals	

DESCRIPTION AND/OR SKETCH

Station is located at Helena, Mont., Municipal Airport, at the gate of the barrier, on the ramp side of the terminal building, opposite the terminal exit to planes, on the asphalt. (1)

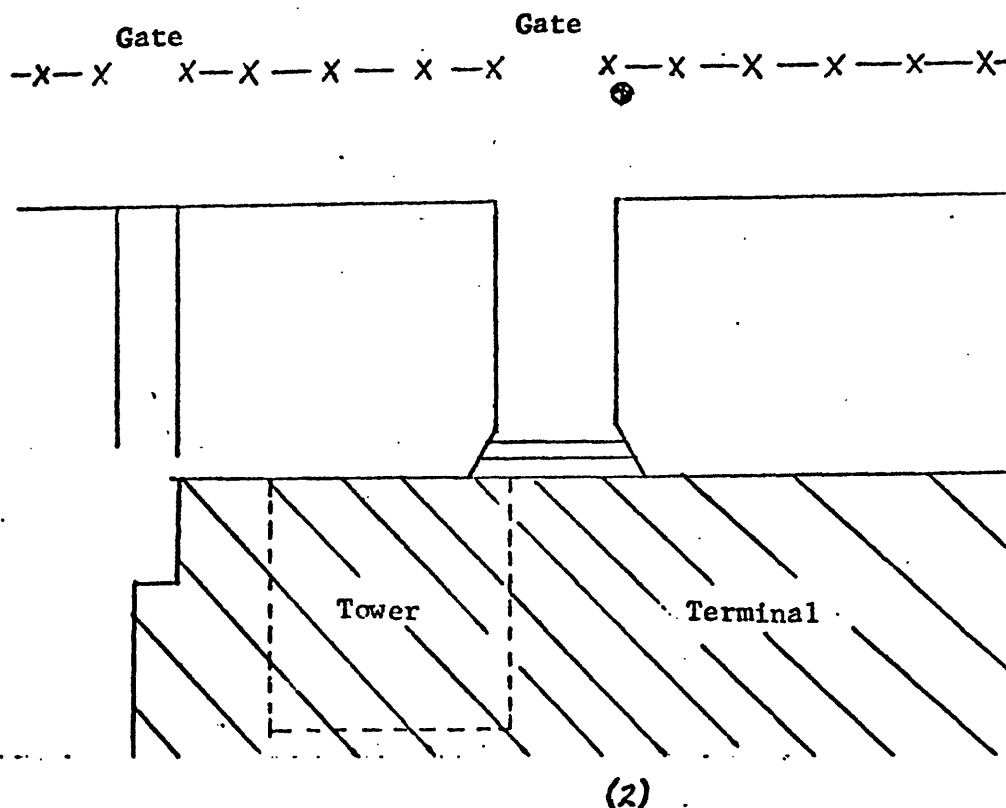


Figure 2.--Helena Municipal Airport base station statistics.

REFERENCE SOURCE

(1) 01355 (2) 05100

References

Defense Mapping Agency Aerospace Center, 1974, World Relative Gravity Reference Network, North America, Part 2, Defense Mapping Agency Aerospace Center Reference Publication 25, with supplement updating gravity values to the International Gravity Standardization Net 1971, 1635 p.

International Association of Geodesy, 1967, Geodetic Reference System, 1967: International Association of Geodesy Special Publication 3, 74 p.