UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Principal Facts for Gravity Stations in Maryland, Northern Virginia, Southern Pennsylvania and the District of Columbia

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INTRODUCTION

This report presents the principal facts for gravity stations collected by the U.S. Geological Survey (USGS) between 1971 and 1982 in Maryland, northern Virginia, southern Pennsylvania, and the District of Columbia. The data were collected for several different projects with different objectives but in general were designed to fill in coverage between previous surveys (Bromery, 1968; Allingham, 1970; Johnson, 1973; Sabet, 1977; Daniels and Heironimus, 1980) and other surveys contained within the Department of Defense gravity file. The work in Maryland was done in cooperation with the Maryland Geological Survey.

DATA COLLECTION

A total of 5907 gravity observations were made using LaCoste and Romberg gravity meters G-2, G-4, G-8, G-64, and G-159. Thirteen secondary bases, referenced to bases IGB 11687A and IGB 11687C in Washington, DC, (International Gravity Standardization Net of 1971, Morelli and others, 1974, p.45) served as local reference bases and were used to correct for drift of the gravity meter. One base had been previously established (BLAIR, Appendix A), and twelve were established during this work (Appendix A). The meter was read on one of these bases at the beginning and end of each working day except in a few cases when the base readings were separated by more than 12 hours. The error of the drift correction probably increases with the interval between base readings. Station locations are shown in figure 1.

ELEVATION CONTROL

Station elevations were obtained from four types of reference elevations, most of which are derived from USGS 1:24,000 scale topographic maps as listed below. The elevation accuracy of types 3 and 4 is dependent largely on the contour interval of these maps. Within the area surveyed, the contour interval is 10 feet for Virginia maps and 20 feet for Maryland and Pennsylvania maps.

1. Benchmarks and "useful elevations" established by the National Geodetic Survey, USGS, and other agencies (elevation uncertainty $\pm$0.5 feet)
2. mean level of tidal waters (elevation uncertainty dependent on accuracy in gaging mean level of the tides, and is estimated as about $\pm$2 feet)
3. "spot" elevations at road intersections, lake elevations (uncertainty $\pm$one-third the contour interval, or $\pm$3 feet and $\pm$6 feet)
4. elevations interpolated between contours (uncertainty $\pm$one-half the contour interval, or $\pm$5 feet and $\pm$10 feet).

The majority of stations were based on category 3. Some of the bench marks used as reference elevations are more recent than the published topographic maps. These were plotted on the maps by means of descriptions provided by the agencies which installed the marks. Some of the bench marks were not actually observed but precise descriptions of their locations permitted reasonably accurate recovery of the original locations. Using a Bouguer reduction density of 2.67 gm/cm^3, the Bouguer anomaly uncertainty is 0.06 milligals per foot of elevation uncertainty.

DATA REDUCTION

Geographic coordinates of each station were obtained by scaling latitude and longitude from the marked station location on 1:24,000-scale topographic maps. The coordinates of a few stations were obtained by measuring the x and y coordinates with reference to the corners of each 7.5 minute topographic map using a digitizing tablet under computer control. Latitude and longitude were determined by interpolation after fitting a surface to the corner points.

Observed gravity measurements were corrected for earth-tide and linear meter-drift. Bouguer gravity anomaly values were computed using the 1967 gravity formula (International Association of Geodesy, 1971) with a reduction density of 2.67 g/cm^3 . Terrain corrections were

made by computer (Plouff, 1977) for the region extending radially from the station to 166.7 km utilizing digital terrain data. The computed terrain corrections use mean-elevation data in the form of a terrain grid at intervals of 15 seconds in latitude and longitude for corrections from 0 to 5 km, a 1-minute terrain grid for corrections from 5 to 21 km, and a 3-minute terrain grid for corrections from 21 to 166.7 km. A correction for the Earth's curvature is also applied. Reduction procedures are described in greater detail by Cordell and others (1982).

DATA LISTING

Stations were numbered sequentially within each 1° x 1° block of latitude and longitude and assigned a station identification letter coded from A through H for each block as described in Table 1. Data are contained in eight ASCII files named A.DAT through H.DAT on a 5.25 inch high density (1.2 MB) diskette written using an IBM-AT personal computer. Two additional files, TITLE.DAT which is the title page of this report, and HEADER.DAT which gives the headings for the data fields, are also included on the diskette. A sample data listing is given in Appendix B.

Table 1

STATION LETTER CODE	NUMBER OF STATIONS	LATITUDE RANGE	LONGITUDE RANGE	USGS 1° x 2° QUADRANGLE
A	84	39° - 40°	79° - 80°	Cumberland
B	137	39° - 40°	78° - 79°	Cumberland
C	1296	39° - 40°	77° - 78°	Baltimore
D	1221	39° - 40°	76° - 77°	Baltimore
E	424	39° - 40°	75° - 76°	Wilmington
F	145	38° - 39°	75° - 76°	Salisbury
G	1622	38° - 39°	76° - 77°	Washington
H	978	38° - 39°	77° - 78°	Washington

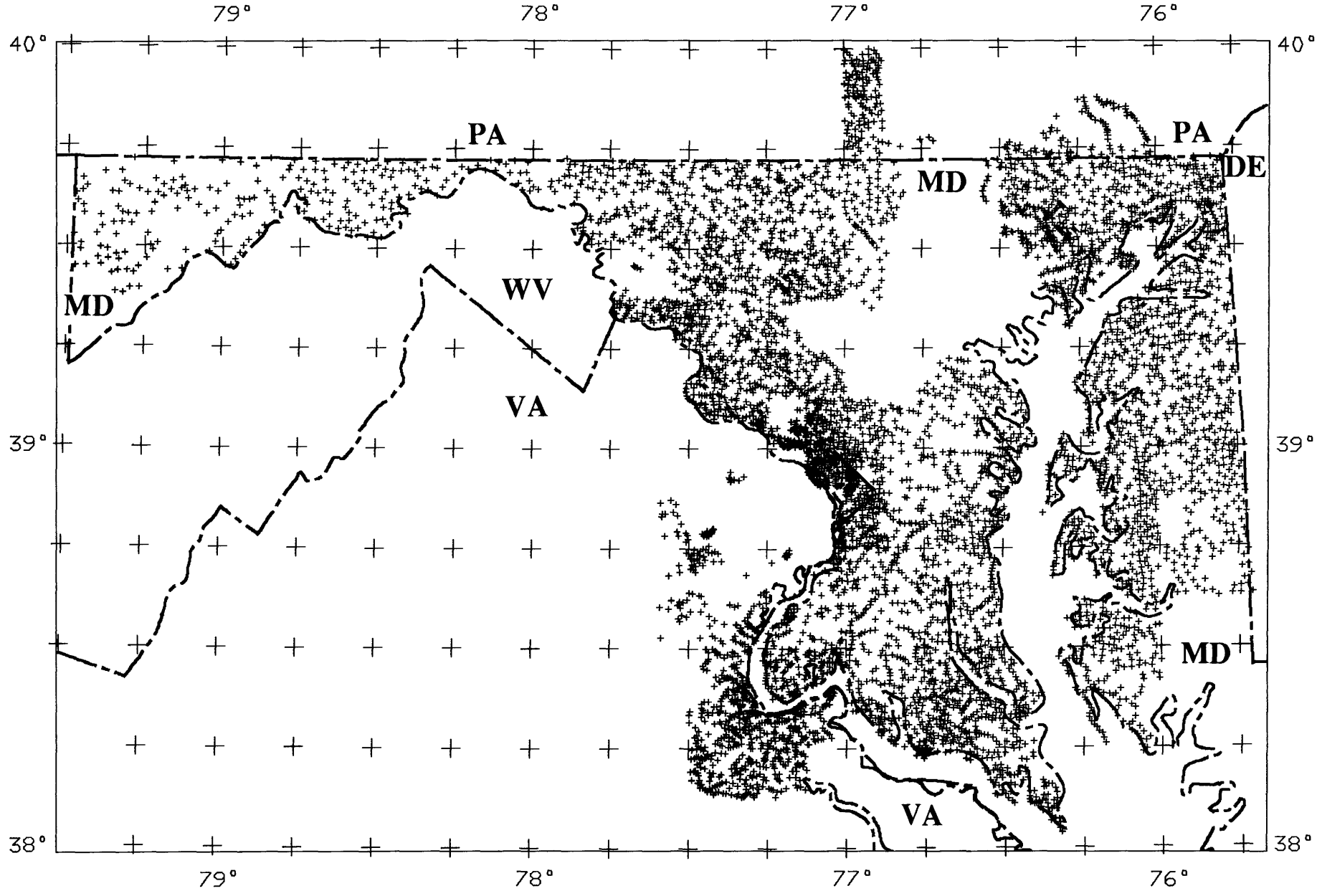

Figure 1 Map showing location of gravity stations.

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APPENDIX A: GRAVITY REFERENCE BASES USED IN SURVEY

Summary:

Base Name	Latitude Deg	Min	Longitude Deg	Min	Elev (ft)	Adopted Grav(mgal) (IGSN71)
Primary Bases						
IGB11687A*	38	53.60	77	02.00	1	980104.29
IGB11687C*	38	53.60	77	02.00	11	980103.63
HERNDON CA	38	59.71	77	18.82	223	980094.60
Secondary and Tertiary bases						
BLAIR	38	59.55	77	02.01	300	980086.88
BRUNS	39	01.68	77	03.02	425	980081.11
NC-17	38	56.81	77	22.08	405	980084.04
LAPLAT	38	31.92	76	58.06	136	980029.18
ABERDN	39	29.85	76	10.63	62	980121.22
CAYOTS	39	29.19	75	50.92	82	980115.97
EASTON	38	45.81	76	03.90	35	980036.02
FREDBG	38	18.07	77	27.57	60	980014.06
PATRIC	39	24.83	77	25.64	301	980091.29
ELKTON	39	36.05	75	48.27	81	980143.61
BOUNDS	39	30.03	76	10.21	61	980122.99
QUAL	39	36.98	77	41.46	542	980039.34
BRAD	39	38.21	78	50.72	1080	980016.37

* Morelli and others (1974, p.45)

Description of secondary gravity bases:

Base name: BLAIR
Parent base: IGB11687A
USGS 7.5' quadrangle: Washington West, MD, DC, VA

The base is located at the rear of a commercial office building at 8300 Colesville Road, Silver Spring, Maryland, at the intersection with East-West Highway, over a red spot on the sidewalk opposite a flagpole near the southeast corner of the building and at the southwest corner of the parking area for a Giant Foods supermarket. The gravity tie to IGB11687A was made in 1969 using 4 LaCoste-Romberg gravity meters (unpublished report, H.W. Oliver, 1970).

Base name: BRUNS
Parent bases: IGB11687C, BLAIR
USGS 7.5' quadrangle: Kensington, MD

Description: At a private residence at 10503 Brunswick Ave., Silver Spring, Maryland, 1.1 miles north along Georgia Avenue from the intersection with Interstate 495, 0.3 miles west on Plyers Mill Road, and south on Brunswick Avenue about 0.1 mile. The base is in the center of the first concrete step up from the concrete walk leading to the front of the house.

Base name: NC-17
Parent bases: IGB11687C, HERNDON CA
USGS 7.5' quadrangle: Vienna, VA

Description: At the National Center of the U.S. Geological Survey, 0.6 mile northwest of Reston Parkway, at 12201 Sunrise Valley Drive, Reston, Virginia, over USGS bench mark NC17 located at the southwest end of a service road passing under the building, on the concrete foundation and walkway southeast of and parallel to the roadway, about 18" above the level of the road. Ties to both parent bases agree to within 0.01 mgal. Herndon CA is tied directly to Herndon AA, one of a series of bases established using an absolute gravity instrument built by the Joint Institute for Laboratory Astrophysics (Peter and others, 1989).

Base name: LAPLAT
Parent base: IGB11687C, BLAIR
USGS 7.5' quadrangle:

Description: Along Maryland Route 6, 0.5 mile east of LaPlata, Maryland, over bench mark T49 reset 1949, set in the south side of a bridge over Clark Run.

Description of tertiary gravity bases:

Base name: ABERDN
Parent base: BLAIR
USGS 7.5' quadrangle: Perryman, MD

Description: On the northwest side of US Route 40 about 1.2 miles southwest of the center of Aberdeen, Maryland, at the Tuckahoe Manor Motel, on the concrete walk, in front of window of room 21, the last room on the northeast end of the building.

Base name: CAYOTS
Parent base: BRUN
USGS 7.5' quadrangle: Cecilton, MD

Description: At Cayots, Maryland, 3.4 miles southwest of Chesapeake City, Maryland, at the northwest corner of the intersection of Maryland Routes 213 and 310, over bench mark Cayots 1964.

Base name: EASTON
Parent base: BRUN
USGS 7.5' quadrangle: Easton, MD

Description: At Easton, Maryland, 0.75 miles south of the center of town along Maryland Route 565, on the east side of the highway on the grounds of a school, over a bench mark labeled "Mag Sta".

Base name: FREDBG
Parent base: NC17
USGS 7.5' quadrangle: Fredericksburg, VA

Description: In Fredericksburg, Virginia at the US Post Office on the northeast side of Princess Anne Street, over bench mark labeled "C 1 1926", set in granite at the north end of the portico facing the street, between the north pillar and building wall (from the description by Johnson and Ziegler, 1972).

Base name: PATRIC
Parent base: NC17
USGS 7.5' quadrangle: Frederick, MD

Description: In Frederick, Maryland, on US Route 40 (West Patrick Street), 0.45 miles east of the overpass of US Route 15, on the north side of the highway, over bench mark Z 80, set in the headwall of a culvert under West Patrick Street.

Base name: ELKTON
Parent base: NC17
USGS 7.5' quadrangle: Elkton, MD, DE

Description: On US Route 40 east of Elkton, Maryland, 1.1 miles west of the Maryland-Delaware state line, near the intersection with Maryland Route 7, on the south side of the highway, over bench mark B118 which is set in the concrete of a catch basin, about 100 feet west of the intersection.

Base name: BOUNDS
Parent base: NC17
USGS 7.5' quadrangle: Aberdeen, MD

Description: Along US Route 40 about 0.75 miles southwest of the center of Aberdeen, Maryland, near the intersection Maryland Route 7, on the northwest side of Route 40, over bench mark S31, which is northeast of a small stream and southwest of the Bounds Furniture store. This base was chosen to replace base ABERDN because it is more accessible.

Base name: QUAL
Parent base: NC17
USGS 7.5' quadrangle: Funkstown, MD

Description: Along US Route 40 southeast of Hagerstown, Maryland, at the Quality Inn, about 0.5 mile north of the intersection with Interstate 70, on the walkway directly in front of room 4.

Base name: BRAD
Parent base: NC17
USGS 7.5' quadrangle: Cumberland, MD

Description: In LaVale, Maryland, along US Route 40 on the south side of the highway, at the restaurant of the Braddock Motor Inn, at the northwest corner of the parking lot, on the pavement about 40 feet northeast of the Pioneer Monument, and 20 feet east of a power pole.

APPENDIX B: EXPLANATION OF PRINCIPAL FACTS

Explanation of headings:

STATION ID	Gravity station identification number
LOCATION:	
LATITUDE	North latitude in degrees, decimal minutes
LONGITUDE	West longitude in degrees, decimal minutes
ELEV	Station elevation in feet
OBSERVED GRAVITY	Observed gravity in milligals
CORRECTIONS:	
TERRAIN	Terrain correction from 0 to 166.7 km radius, in milligals
CURV	Curvature correction in milligals
ANOMALIES	
FREE AIR	Free-air anomaly in milligals
COMPLETE BOUGUER	Complete Bouguer anomaly in milligals for density 2.67 gm/cm^3

Sample list of principal facts showing field headings. The data are on a diskette.

STATION	LOCATIONS			OBSERVED	CORRECTIONS		ANOMALIES	
ID	LATITUDE deg min	LONGITUDE deg min	ELEV (in ft)	GRAVITY (mgals)	TERRAIN (dens=2.67)	CURV	FREE AIR	COMPLETE BOUGUER
A1	39 29.31	79 2.59	940.4	980008.64	2.93	-0.39	-26.40	-55.94
A2	39 30.73	79 1.45	1154.0	979997.82	2.97	-0.47	-19.24	-56.10
A3	39 31.84	79 1.05	1252.0	979994.11	2.78	-0.51	-15.37	-55.80
A4	39 32.41	79 0.38	1318.5	979990.87	2.78	-0.53	-13.20	-55.92
A5	39 42.90	79 0.41	2528.0	979941.15	0.81	-0.92	35.28	-51.05
A6	39 38.24	79 1.04	2522.0	979932.28	1.39	-0.92	32.74	-52.80
A7	39 38.78	79 2.63	2588.5	979930.15	0.97	-0.94	36.07	-52.18
A8	39 35.75	79 1.41	2630.0	979920.73	1.56	-0.95	35.04	-54.05
A9	39 34.93	79 3.25	2668.0	979916.83	1.90	-0.96	35.93	-54.12
A10	39 36.14	79 4.73	1782.0	979972.29	2.38	-0.69	6.28	-52.81
A11	39 37.21	79 6.80	2224.0	979948.69	1.71	-0.83	22.66	-52.31
A12	39 38.50	79 5.59	2585.0	979931.01	0.90	-0.93	37.01	-51.19
A13	39 38.30	79 7.03	2480.0	979937.05	0.99	-0.90	33.48	-51.02
A14	39 39.05	79 7.41	2718.0	979924.29	0.99	-0.97	41.99	-50.70
A15	39 38.75	79 8.14	2657.0	979927.72	0.98	-0.95	40.13	-50.47
A16	39 37.84	79 8.97	2758.0	979920.23	1.15	-0.98	43.48	-50.42
A17	39 38.50	79 10.18	2279.0	979950.33	1.20	-0.85	27.56	-49.81
A18	39 39.84	79 9.82	2539.0	979937.33	0.96	-0.92	37.03	-49.53
A19	39 40.34	79 8.04	2557.0	979936.69	0.86	-0.93	37.34	-49.94
A20	39 42.74	79 9.64	2485.0	979946.79	1.03	-0.91	37.12	-47.52
A21	39 39.30	79 11.63	2539.0	979937.44	0.93	-0.92	37.93	-48.66
A22	39 40.02	79 13.05	2603.0	979935.87	1.08	-0.94	41.32	-47.32
A23	39 37.95	79 14.69	2703.0	979927.03	0.86	-0.97	44.94	-47.35
A24	39 37.96	79 12.70	2650.0	979929.07	0.92	-0.95	41.99	-48.43
A25	39 36.48	79 13.23	2628.0	979927.86	0.82	-0.95	40.90	-48.86