

NOAA Technical Memorandum NOS NGS 37



VERTICAL MOVEMENT IN THE LOS MEDANOS AND
NASH DRAW AREAS, NEW MEXICO, AS INDICATED
BY 1977 AND 1981 LEVELING SURVEYS

Rockville, Md.
October 1982

**U.S. DEPARTMENT OF
COMMERCE**

National Oceanic and
Atmospheric Administration

National Ocean
Survey

NOAA Technical Publications

National Ocean Survey/National Geodetic Survey subseries

The National Geodetic Survey (NGS) of the National Ocean Survey (NOS), NOAA, establishes and maintains the basic national horizontal and vertical networks of geodetic control and provides governmentwide leadership in the improvement of geodetic surveying methods and instrumentation, coordinates operations to assure network development, and provides specifications and criteria for survey operations by Federal, State, and other agencies.

NGS engages in research and development for the improvement of knowledge of the figure of the Earth and its gravity field, and has the responsibility to procure geodetic data from all sources, process these data, and make them generally available to users through a central data base.

NOAA geodetic publications and relevant geodetic publications of the former U.S. Coast and Geodetic Survey are sold in paper form by the National Geodetic Information Center. To obtain a price list or to place an order contact:

National Geodetic Information Center
OA/C18x2
National Ocean Survey, NOAA
Rockville, MD 20852

(301) 443-8316

Publications can also be purchased over the counter at the National Geodetic Information Center, 11400 Rockville Pike, Room 14, Rockville, Md. (Do not send correspondence to this address.)

An excellent reference source for all Government publications is the National Depository Library Program, a network of about 1,300 designated libraries. Requests for borrowing Depository Library material may be made through your local library. A free listing of libraries in this system is available from the Library Division, U.S. Government Printing Office, 5236 Eisenhower Ave., Alexandria, VA 22304 (703-557-9013).

NOAA Technical Memorandum NOS NGS 37

VERTICAL MOVEMENT IN THE LOS MEDANOS AND
NASH DRAW AREAS, NEW MEXICO, AS INDICATED
BY 1977 AND 1981 LEVELING SURVEYS

Emery I. Balazs

National Geodetic Survey
Rockville, Md.
October 1982

For sale by the National Geodetic Information Center,
Rockville, MD 20852 Price \$2.45

UNITED STATES
DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and
Atmospheric Administration
John V. Byrne, Administrator

National Ocean
Survey
Herbert R. Lippold, Jr., Director



CONTENTS

Abstract	1
Introduction	1
The 1977 survey	1
The 1981 survey	4
Adjustment	4
Comparison	5
Conclusion	11
Acknowledgments	11
References	12
Appendix. Adjusted heights of the 1981 survey	13

VERTICAL MOVEMENT IN THE LOS MEDANOS AND NASH DRAW AREAS, NEW MEXICO,
AS INDICATED BY 1977 AND 1981 LEVELING SURVEYS

Emery I. Balazs
National Geodetic Survey
National Ocean Survey, NOAA
Rockville, Md. 20852

ABSTRACT. Free-adjusted heights of two survey epochs were compared for the Los Medanos and Nash Draw areas. The changes in heights of common bench marks were tabulated and plotted. The apparent movement for the area documented in this report is relative to bench mark 1 BOR, set in a bridge in Carlsbad, N. Mex. A total of 122 of the 147 common bench marks indicates consistent subsidence averaging approximately 18 mm between 1977 and 1981 (4.6 mm/yr). At two bench marks, located over potash mines in the area, the subsidence is much larger.

INTRODUCTION

In the fall of 1977, the National Geodetic Survey (NGS) completed a first-order, class I leveling survey in the vicinity of Carlsbad, N. Mex. The survey was requested by Sandia National Laboratories, Albuquerque, N. Mex., to establish a vertical reference network for evaluating elevation changes in the area of the Waste Isolation Pilot Plant (WIPP). WIPP is located in the Los Medanos area, about 45 km east of Carlsbad. (See fig. 1.) Plans were made in 1977 to relevel this network frequently to monitor vertical ground movement due to geological and mining activities in the area. Knowledge of the Earth's movement is one of the factors used to evaluate the suitability of the area for disposal of radioactive waste material. Because the time interval between the two surveys was very short, the resulting vertical movement velocities should be extrapolated cautiously and in conjunction with available geological information.

Releveling of the 1977 network was begun by NGS in August 1981. As a result of reduced funding, only 192 km of the 314-kilometer network were relevelled. This report compares and evaluates the results of the 1977 and 1981 surveys.

THE 1977 SURVEY

The 1977 survey was accomplished in two parts. Part one was the releveling of a 202-kilometer segment of an existing first-order line of the National Geodetic Vertical Network from Carlsbad to 70 km north of Sierra Blanca, Tex. The purpose of the releveling of the first-order line was to determine movement at Carlsbad relative to bench marks in the Diablo Plateau in Texas. Comparison of height differences determined in 1977 and in 1957-58 indicated a gradual increase in relative subsidence along the line from bench mark L 181, set in the mountains about 102 km east of El Paso, Tex., on Highway 62, to the Carlsbad area. Average regional subsidence in the Carlsbad area, as determined from these two precise leveling surveys between 1957 and 1977, was 104 mm (5 mm/yr), relative to bench mark L 181. (See fig. 2.)

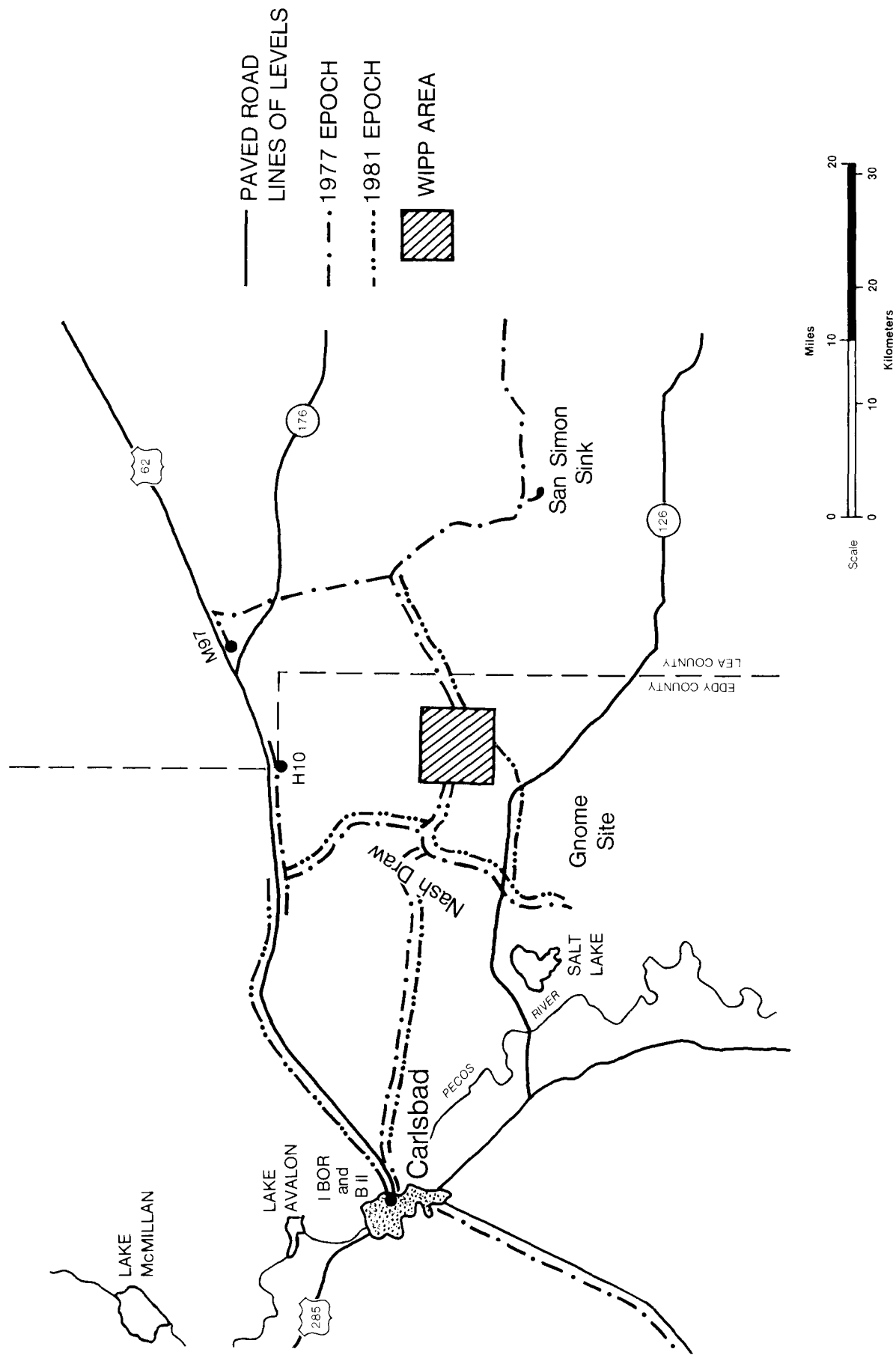


Figure 1.--Map of the area monitored for subsidence.

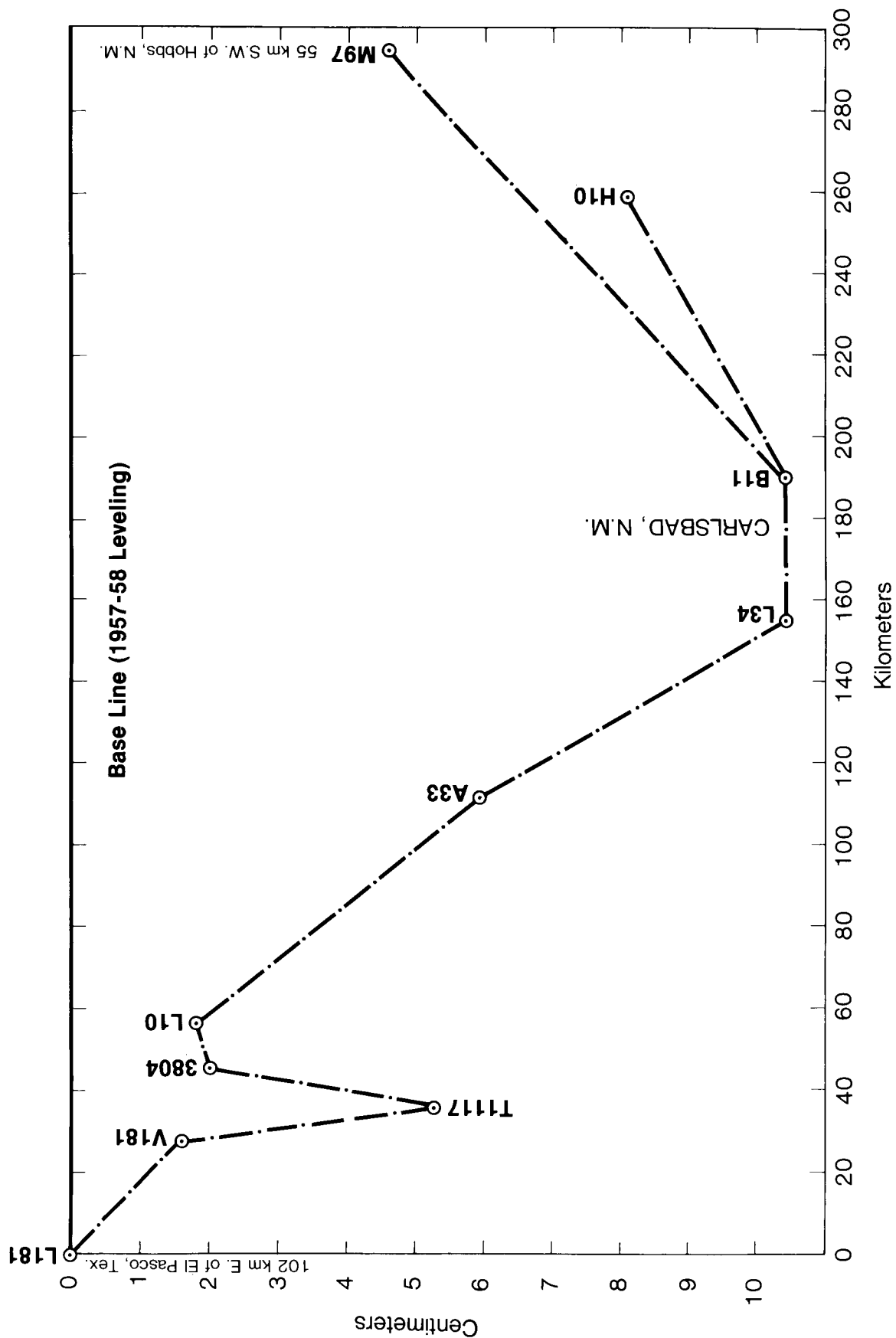


Figure 2.--Average regional subsidence in the Carlsbad, N. Mex. area.

The extent of releveled accomplished in part one of the 1977 project was not sufficient to establish vertical movement in an absolute sense. Therefore, it is also possible that the mountains in west Texas are uplifting and the Carlsbad area is stable, or any combination of the two extremes.

Part two of the 1977 survey was the establishment of a local vertical network from Carlsbad to the San Simon area. The network consisted of four lines, forming several small loops, connected to existing first- and second-order lines of the vertical control network. Due to ground movement in the area, the new leveling indicated that significant changes had occurred at the junctions with older lines, as shown in figure 2, at bench marks H 10 and M 97. Adjusted elevations for bench marks in part two resulted from a minimum-constraint (free) adjustment, with the existing elevation of bench mark 1 BOR, set in a bridge in Carlsbad, used as the starting elevation (datum point).

THE 1981 SURVEY

Releveling of the local network, which was established in 1977, began on August 31, 1981. The survey was performed to first-order, class I specifications (Federal Geodetic Control Committee 1974, 1980), using the double-simultaneous method (Whalen and Balazs 1976). Evaluation was based on loop misclosures for single-run lines forming loops, and on forward-backward differences for double-run spur lines (Whalen 1978). As a result of budgetary constraints, the survey was terminated on September 30, 1981, after the most important part of the network had been releveled. During the project, 147 bench marks were recovered and 15 new bench marks were established. Eleven of the new bench marks are high quality, class A marks, of which four are set in rock outcrops, and seven are stainless steel rods protected by sleeves, driven 4 to 12 m into the ground.

ADJUSTMENT

After the observations of both epochs were verified and corrections were applied for known systematic errors, the data were stored on computer files. A new least-squares adjustment program, SCAN-II, developed by Mr. Johan J. Kok, Delft University of Technology, the Netherlands, was utilized to decrease the manual effort necessary to analyze the data in deformation studies. SCAN-II performs several statistical tests, evaluates the reliability of observations, and "flags" observations that are not within specified tolerances. Therefore, determination of the adjustability of data by other methods, usually by manual computation of loop misclosures and/or comparison of new versus old surveys, was not necessary. Three minimum-constraint adjustments were made. Bench marks common to both survey epochs were identified by the program and assigned the same unique identifier in both epochs. Bench mark 1 BOR was again selected as the fixed (datum) point for these adjustments.

The first adjustment was a readjustment of the 1977 data. Slightly different observational standard errors were applied in SCAN-II than in the original 1977 adjustment, which changed the readjusted elevations slightly. The largest difference was about 3 mm.

The second adjustment was performed to adjust the 1981 observations. All observations were accepted by the statistical tests built into SCAN-II. These adjusted heights were computed to provide information for the deformation study;

i.e., the difference between the 1977 and 1981 adjusted elevations provides the apparent movement of the bench marks tabulated in table 1. The results of the adjustment of the 1981 observations are listed in the appendix. The standard deviations (σ) of the adjusted heights were computed by SCAN-II as a function of the a priori standard deviation and the geometry of the network (Kok et al. 1980).

Observations from part two of the 1977 survey and from the 1981 survey were combined in the third adjustment. The third adjustment was performed to test if the changes in bench mark heights reflect actual movement or whether they can be accounted for by the uncertainty of the observations. Only the "quality" of observations was tested against statistical standards; other possible effects, such as movement of bench marks, were not modeled. Therefore, if some of the observations are flagged (rejected) in the combined adjustment, which had already been accepted in either one of the first two adjustments, the reason for the flagging is probably movement of the bench mark during the time between the two surveys. Observational data for 46 of the 147 common bench marks were flagged by the program, marking those points where movement was most significant. The statistical test for significant movement could have been more effective if a mathematical model for movement had been available, and if the bench marks which showed obvious movement were removed from the third adjustment.

COMPARISION

The adjusted heights and the differences between the 1977 and 1981 heights of common bench marks of the two surveys have been tabulated and plotted. (See table 1.) Figure 3 shows the bench mark locations with a unique number listed in table 1 under the heading "serial no." Figure 4 shows the bench mark locations with the movement in millimeters, which are listed in table 1 under the heading "H2-H1".

The height differences (H_2-H_1) of 10 bench marks near Carlsbad, where H_1 is the height of the bench marks in 1977 and H_2 in 1981, indicate small, relative uplift of approximately 1 mm/yr. Since all bench marks in the area are subsiding relative to bench mark L 181, as shown in figure 2, the apparent uplift should be interpreted as additional subsidence; i.e., all bench marks subsided an additional 9 mm relative to bench mark R 345, which showed 9 mm (maximum) apparent uplift. The remaining common bench marks indicate a slightly larger subsidence. The average subsidence, computed from 122 height differences, is 18.3 mm with a standard deviation of 6.9 mm. The first 22 points east of Carlsbad and three other points, L 350, USP 60 USGS, and B 348 (where the differences are significantly larger), were not included in the computation of average subsidence.

The large changes at the three bench marks can be explained as follows: A 1.027-meter subsidence at bench mark L 350 and a 0.254-meter subsidence at neighboring bench mark USP 60 USGS could result from localized subsidence over underground potash mines. The -0.183-meter change at bench mark B 348 is most likely due to movement of the well casing on which the bench mark was established. The survey team reported in 1981 that the well casing was loose.

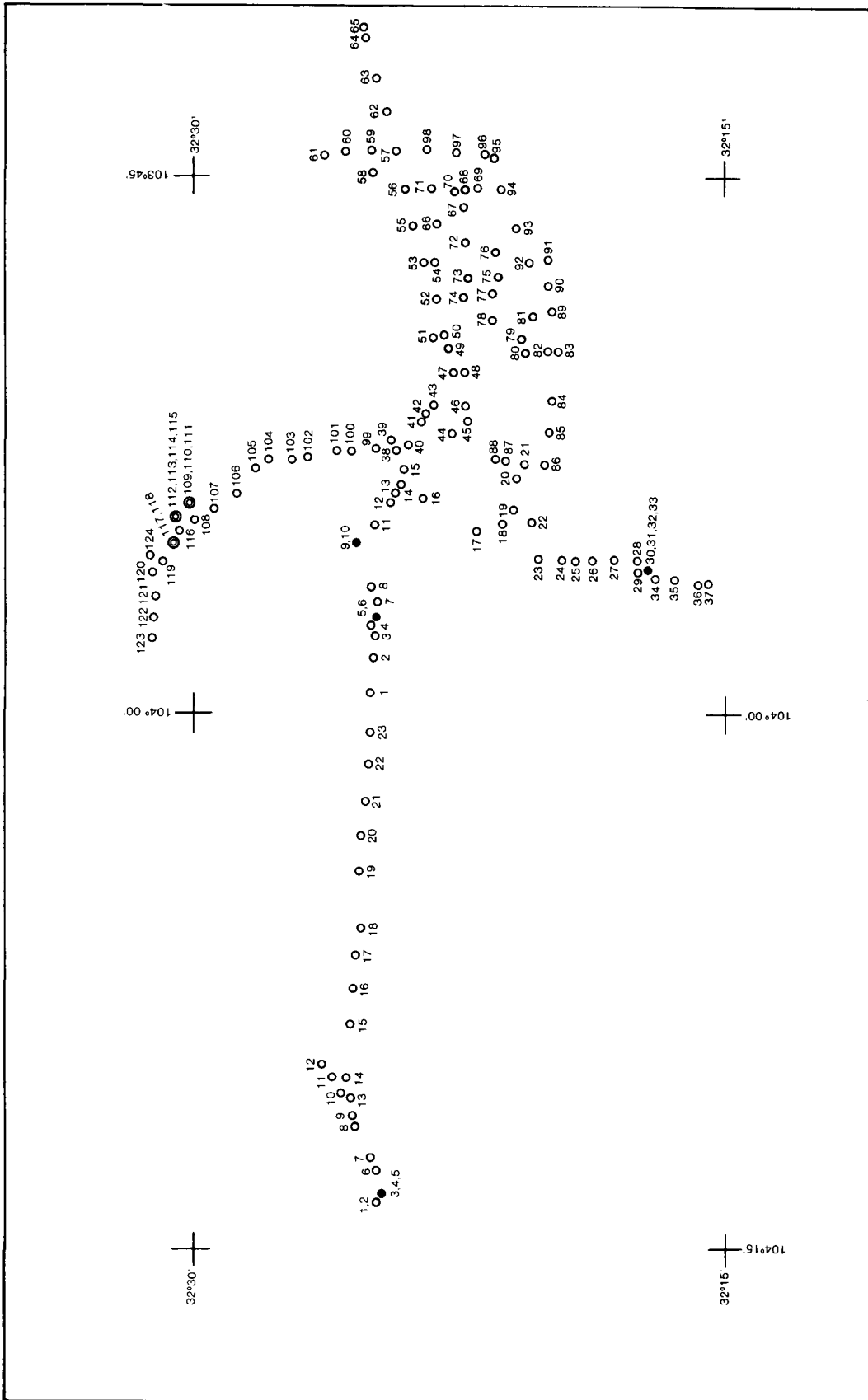


Figure 3.---Bench mark locations with unique numbers.

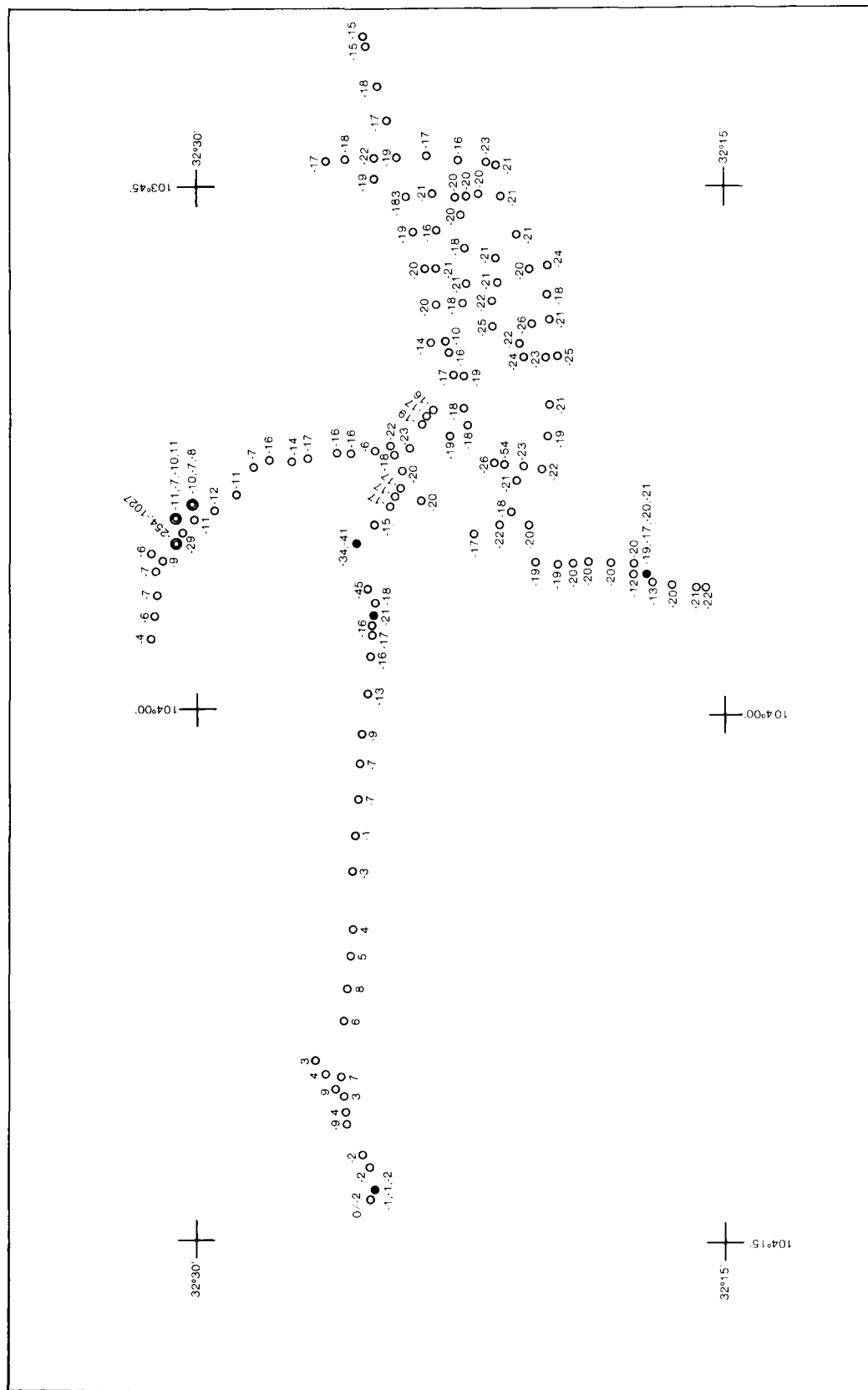


Figure 4.--Bench mark locations with movement in millimeters.

Table 1.--Heights and height differences of common bench marks in
quad N 32104 W, WIPP project in the San Simon area, New Mex.

SERIAL NO.	BENCH MARK DESIGNATION	H1(1977)	H2(1981)	H2-H1	SIGMA	LATITUDE			LONGITUDE		
		(m)	(m)	(m)	(mm)	°	'	"	°	'	"
1	1 BOR	946.617	946.617	0.0	0.0	32	25	3N	104	13	28W
2	GAGE USGS	944.217	944.215	-0.002	0.2	32	25	3N	104	13	28W
3	B 11	948.095	948.094	-0.001	0.6	32	25	8N	104	13	30W
4	Z 344	947.716	947.715	-0.001	1.1	32	25	14N	104	13	40W
5	N 345	946.404	946.402	-0.002	0.6	32	25	4N	104	13	25W
6	P 345	968.274	968.273	-0.002	1.5	32	25	14N	104	12	48W
7	U 256 RESET 1960	968.121	968.120	-0.002	2.0	32	25	25N	104	12	26W
8	M 96	954.515	954.506	-0.009	2.6	32	25	50N	104	11	34W
9	Q 345	961.435	961.439	0.004	2.8	32	25	56N	104	11	12W
10	R 345	965.034	965.043	0.009	3.0	32	26	10N	104	10	38W
11	S 345	974.180	974.185	0.004	3.2	32	26	27N	104	10	8W
12	N 96	963.565	963.568	0.003	3.5	32	26	44N	104	9	46W
13	T 345	958.845	958.848	0.003	3.0	32	25	60N	104	10	46W
14	U 345	962.462	962.469	0.007	3.3	32	26	4N	104	10	12W
15	W 345	944.488	944.495	0.006	4.0	32	25	52N	104	8	39W
16	X 345	955.688	955.696	0.008	4.4	32	25	46N	104	7	40W
17	Y 345	967.002	967.007	0.005	4.7	32	25	41N	104	6	44W
18	Z 345	958.721	958.725	0.004	4.9	32	25	32N	104	6	0W
19	B 346	961.753	961.750	-0.003	5.3	32	25	32N	104	4	22W
20	C 346	965.959	965.958	-0.001	5.6	32	25	26N	104	3	22W
21	D 346	980.808	980.801	-0.007	5.8	32	25	20N	104	2	24W
22	E 346	995.596	995.589	-0.007	6.0	32	25	16N	104	1	22W
23	F 346	1,015.947	1,015.938	-0.009	6.2	32	25	12N	104	0	30W

TOTAL NUMBER OF STATIONS IN THIS QUAD = 23

(continued)

Table 1.--Continued, Quad N 32103 W

SERIAL NO.	BENCH MARK DESIGNATION	H1(1977) (M)	H2(1981) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "			LONGITUDE ° ' "		
1	G 346	1039.589	1039.576	-0.013	6.4	32	25	5N	103	59	30W
2	H 346	1024.931	1024.915	-0.016	6.6	32	25	0N	103	58	30W
3	J 346	1015.943	1015.926	-0.017	6.7	32	24	57N	103	57	54W
4	K 346	1014.673	1014.657	-0.016	6.7	32	24	56N	103	57	38W
5	L 346	985.351	985.329	-0.021	6.8	32	24	52N	103	57	27W
6	MC 361 USGS	986.174	986.153	-0.021	6.8	32	24	52N	103	57	27W
7	221 IMCC USGS	977.550	977.533	-0.018	6.9	32	24	49N	103	56	58W
8	UNION 8 USGS	991.145	991.100	-0.045	7.0	32	25	1N	103	56	32W
9	N 346	984.262	984.228	-0.034	7.3	32	25	22N	103	55	16W
10	LOMMASSON 2 USGS	986.059	986.019	-0.041	7.3	32	25	22N	103	55	16W
11	P 346	956.757	956.742	-0.015	7.4	32	24	49N	103	54	46W
12	Q 346	958.044	958.027	-0.017	7.6	32	24	22N	103	54	12W
13	328 USGS	958.575	958.558	-0.017	7.6	32	24	12N	103	53	54W
14	338 USGS	952.425	952.408	-0.017	7.6	32	24	5N	103	53	40W
15	T 346	954.496	954.476	-0.020	7.7	32	23	60N	103	53	11W
16	N 347	947.579	947.559	-0.020	7.9	32	23	27N	103	54	0W
17	Q 347	922.303	922.285	-0.017	8.2	32	21	58N	103	54	58W
18	R 347	916.119	916.097	-0.022	8.4	32	21	14N	103	54	44W
19	U 348	927.448	927.429	-0.018	8.4	32	20	54N	103	54	20W
20	T 348	942.785	942.764	-0.021	8.6	32	20	47N	103	53	25W
21	S 348	951.329	951.306	-0.023	8.6	32	20	36N	103	52	60W
22	181 IMCC	913.618	913.597	-0.020	8.6	32	20	23N	103	54	40W
23	T 347	914.817	914.798	-0.019	8.8	32	20	14N	103	55	44W
24	S 1 S 6 S 12 S 7 USGLO	917.505	917.486	-0.019	8.9	32	19	36N	103	55	46W
25	U 347	912.438	912.418	-0.020	9.0	32	19	12N	103	55	46W
26	S 12 S 7 S 13 S 18 USGLO	914.680	914.659	-0.020	9.1	32	18	44N	103	55	46W
27	V 347	922.412	922.393	-0.020	9.3	32	18	6N	103	55	44W
28	W 347	920.378	920.359	-0.020	9.4	32	17	26N	103	55	44W
29	X 347	924.365	924.353	-0.012	9.5	32	17	23N	103	55	60W
30	F 350	944.214	944.194	-0.019	9.5	32	17	8N	103	56	2W
31	G 350	958.743	958.726	-0.017	9.5	32	17	8N	103	55	58W
32	H 350	960.527	960.506	-0.020	9.5	32	17	4N	103	55	58W
33	J 350	952.209	952.189	-0.021	9.5	32	16	60N	103	55	60W
34	22 USGS	934.701	934.687	-0.013	9.6	32	16	54N	103	56	14W
35	N 348	933.926	933.906	-0.020	9.7	32	16	18N	103	56	18W
36	18 USGS	926.540	926.519	-0.021	9.8	32	15	40N	103	56	24W
37	P 348	945.283	945.261	-0.022	9.9	32	15	22N	103	56	22W
38	U 346	955.795	955.777	-0.018	7.9	32	24	13N	103	52	38W
39	V 346	956.086	956.065	-0.022	7.8	32	24	18N	103	52	25W
40	W 346	960.199	960.165	-0.023	7.9	32	23	48N	103	52	29W
41	X 346	989.470	989.452	-0.019	8.0	32	23	26N	103	51	51W
42	Y 346	1007.239	1007.222	-0.017	8.1	32	23	18N	103	51	36W
43	Z 346	1016.105	1016.089	-0.016	8.1	32	23	7N	103	51	24W
44	D 347	1002.049	1002.030	-0.019	8.3	32	22	36N	103	52	9W
45	E 347	1004.028	1004.010	-0.018	8.4	32	22	8N	103	51	52W
46	F 347	1008.899	1008.870	-0.019	9.4	32	22	14N	103	51	22W
47	G 347	1028.891	1028.875	-0.017	8.6	32	22	28N	103	50	26W
48	H 347	1023.825	1023.806	-0.019	8.6	32	22	14N	103	50	26W
49	104 USGS	1032.761	1032.745	-0.016	8.6	32	22	38N	103	49	48W
50	J 347	1031.807	1031.797	-0.010	8.7	32	22	46N	103	49	30W
51	K 347	1029.616	1028.602	-0.014	8.7	32	23	6N	103	49	32W

(continued)

Table 1.--Continued, Quad N 32103 W

SERIAL NO.	BENCH MARK DESIGNATION	H1(1977) (M)	H2(1981) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
52	M 347	1036.548	1036.528	-0.020	8.7	32 22 58N	103 48 28W
53	Y 347	1053.211	1053.191	-0.020	8.8	32 23 16N	103 47 26W
54	Z 347	1058.280	1058.259	-0.021	8.8	32 23 2N	103 47 26W
55	A 348	1054.771	1054.752	-0.019	8.8	32 23 33N	103 46 24W
56	B 348	1069.837	1069.655	-0.183	9.0	32 23 48N	103 45 24W
57	C 348	1089.172	1089.153	-0.019	9.0	32 24 4N	103 44 22W
58	D 348	1078.607	1078.587	-0.019	9.2	32 24 42N	103 44 22W
59	E 348	1076.809	1076.788	-0.022	9.3	32 24 42N	103 44 58W
60	F 348	1081.777	1081.759	-0.018	9.3	32 25 28N	103 44 24W
61	G 348	1079.860	1079.843	-0.017	9.4	32 26 3N	103 44 30W
62	H 348	1109.737	1109.720	-0.017	9.2	32 24 20N	103 43 20W
63	M 348	1130.994	1130.976	-0.018	9.4	32 24 34N	103 42 20W
64	Q 348	1135.025	1135.010	-0.015	9.6	32 24 52N	103 41 12W
65	C 355	1150.720	1150.705	-0.015	9.6	32 24 54N	103 40 60W
66	L 349	1064.592	1064.576	-0.016	8.9	32 22 57N	103 46 24W
67	P 349	1071.614	1071.594	-0.020	9.1	32 22 12N	103 45 54W
68	Q 349	1079.001	1078.981	-0.020	9.2	32 22 10N	103 45 24W
69	R 349	1070.022	1070.002	-0.020	9.3	32 21 44N	103 45 21W
70	S 349	1082.294	1082.275	-0.020	9.2	32 22 24N	103 45 26W
71	U 349	1068.260	1068.240	-0.021	9.3	32 23 2N	103 45 22W
72	M 349	1061.042	1061.023	-0.018	9.0	32 22 8N	103 46 50W
73	K 349	1037.649	1037.629	-0.021	9.0	32 22 6N	103 47 50W
74	N 349	1031.553	1031.536	-0.018	9.1	32 22 12N	103 48 26W
75	J 349	1033.466	1033.445	-0.021	9.0	32 21 12N	103 47 48W
76	U 355	1049.337	1049.317	-0.021	9.1	32 21 16N	103 47 6W
77	H 349	1019.996	1019.974	-0.022	9.0	32 21 21N	103 48 18W
78	374 USGS	1018.808	1018.783	-0.025	9.0	32 21 20N	103 49 2W
79	F 349	1008.650	1008.628	-0.022	8.9	32 20 34N	103 49 31W
80	E 349	1005.843	1005.819	-0.024	8.9	32 20 29N	103 49 54W
81	C 349	1010.301	1010.275	-0.026	9.1	32 20 15N	103 48 56W
82	A 349	1001.746	1001.724	-0.023	8.9	32 19 51N	103 49 52W
83	Z 348	999.699	999.674	-0.025	8.9	32 19 32N	103 49 50W
84	X 348	978.719	978.698	-0.021	8.8	32 19 46N	103 51 14W
85	W 348	959.486	959.467	-0.019	8.7	32 19 50N	103 52 6W
86	R 348	941.445	941.422	-0.022	8.7	32 19 59N	103 53 4W
87	218 USGS	959.407	959.353	-0.054	8.7	32 21 9N	103 52 55W
88	V 348	964.551	964.526	-0.026	8.8	32 21 16N	103 52 56W
89	V 349	1010.030	1010.009	-0.021	9.0	32 19 42N	103 48 50W
90	Y 349	1011.733	1011.715	-0.018	9.0	32 19 44N	103 48 8W
91	W 349	1016.662	1016.638	-0.024	9.2	32 19 46N	103 47 20W
92	X 349	1018.099	1018.079	-0.020	9.1	32 20 20N	103 47 24W
93	Z 349	1040.309	1040.288	-0.021	9.2	32 20 40N	103 46 28W
94	A 350	1047.915	1047.894	-0.021	9.2	32 21 4N	103 45 22W
95	B 350	1065.741	1065.720	-0.021	9.2	32 21 30N	103 44 26W
96	E 350	1059.930	1059.907	-0.023	9.2	32 21 18N	103 44 30W
97	D 350	1089.218	1089.202	-0.016	9.2	32 22 18N	103 44 24W
98	C 350	1083.146	1083.129	-0.017	9.1	32 23 10N	103 44 18W
99	K 351	956.904	956.898	-0.006	7.8	32 24 44N	103 52 36W
100	L 351	967.062	967.046	-0.016	7.9	32 25 27N	103 52 40W
101	M 351	964.920	964.904	-0.016	8.0	32 25 50N	103 52 40W
102	N 351	955.058	955.041	-0.017	8.1	32 26 41N	103 52 50W

(continued)

Table 1.--Continued, Quad N 32103 W

SERIAL NO.	BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
103	J 351	955.768	955.754	-0.014	8.2	32 27 8N	103 52 55W
104	H 351	961.174	961.158	-0.016	8.2	32 27 44N	103 52 56W
105	G 351	965.019	965.011	-0.007	8.3	32 28 12N	103 53 8W
106	F 351	982.011	982.000	-0.011	8.4	32 28 42N	103 53 52W
107	M 350	986.678	986.666	-0.012	8.5	32 29 19N	103 54 20W
108	F 97	1001.335	1001.324	-0.011	8.5	32 29 58N	103 54 40W
109	B 351	1027.416	1027.406	-0.010	8.6	32 30 6N	103 54 8W
110	A 351	1043.236	1043.230	-0.007	8.6	32 30 4N	103 54 6W
111	Z 350	1019.428	1019.420	-0.008	8.6	32 30 10N	103 54 15W
112	Y 350	1047.232	1047.221	-0.011	8.6	32 30 36N	103 54 34W
113	X 350	1049.063	1049.056	-0.007	8.6	32 30 32N	103 54 36W
114	W 350	1037.370	1037.359	-0.010	8.7	32 30 30N	103 54 37W
115	U 350	1022.458	1022.447	-0.011	8.7	32 30 26N	103 54 38W
116	H 7 USGS	1014.831	1014.802	-0.029	8.7	32 30 26N	103 54 58W
117	USP 60 USGS	1024.619	1024.365	-0.254	8.7	32 30 31N	103 55 12W
118	L 350	1030.313	1029.286	-1.027	8.7	32 30 35N	103 55 14W
119	PD KERN 1 USGS	1034.007	1033.998	-0.009	8.8	32 30 54N	103 55 46W
120	K 350	1037.743	1037.736	-0.007	8.8	32 31 10N	103 56 4W
121	N 350	1029.635	1029.628	-0.007	8.8	32 31 8N	103 56 44W
122	P 352	1037.325	1037.318	-0.006	8.8	32 31 12N	103 57 20W
123	D 97	1034.450	1034.447	-0.004	8.9	32 31 18N	103 58 0W
124	C 351	1045.223	1045.217	-0.006	9.8	32 31 14N	103 55 34W

CONCLUSION

The first 22 bench marks located in Carlsbad and east of the city indicate little movement. The 122 remaining bench marks indicate a small but consistent subsidence of approximately 4.6 mm/yr for the area. Large elevation differences at bench marks L 350 and USP 60 USGS may be the result of localized subsidence over potash mines in the area, while the large change in elevation of bench mark B 348 is probably due to an unstable monument.

ACKNOWLEDGMENTS

I thank Mr. Johan J. Kok for helpful comments and for modifying SCAN-II to accept NGS data, Ms. Janice M. Bengston for programing aid, and Mr. Gary M. Young for helpful criticism of the draft report. The high-quality observations by NGS Field Party G-35, under the direction of Mr. Robert Kokesh, are also acknowledged.

This project was funded by the Sandia National Laboratories under contract document no. 68-1766, dated April 21, 1981.

REFERENCES

- Federal Geodetic Control Committee, 1974: Classification, Standards, of Accuracy, and General Specifications of Geodetic Control Surveys, 12 pp.
- Federal Geodetic Control Committee, 1975, rev. 1980: Specifications to Support Classifications, Standards of Accuracy, and General Specifications of Geodetic Control Surveys. Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., 46 pp. (set).
- Kok, J. J., Ehrnsperger W., and Rietveld H., 1980: The 1979 adjustment of the united European levelling network (UELN) and its analysis of precision and reliability. Proceedings of the Second International Symposium on Problems Related to the Redefinition of North American Vertical Geodetic Networks, May 26-30, 1980, Canadian Institute of Surveying, Ottawa, 455-483.
- Whalen, C. T., 1978: Control leveling. NOAA Technical Report NOS 73 NGS 8, National Geodetic Information Center, NOS/NOAA, Rockville, Md., 21 pp.
- Whalen, C. T. and Balazs, E. I., 1976: Test results of first-order class III leveling. NOAA Technical Report NOS 68 NGS 4, National Geodetic Information Center, NOS/NOAA, Rockville, Md., 30 pp.

APPENDIX.--ADJUSTED HEIGHTS OF THE 1981 SURVEY

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31 - SEPTEMBER 30, 1981

HGZ L 24674
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
I BOR	CW0139	946.61200	0.0	32.4172N	104.2239W
GAGE USGS	CW0137	944.20915	0.10	32.4172N	104.2239W
B 11	CW0136	948.08822	0.43	32.4189N	104.2250W
Z 344	CW0594	947.70938	0.75	32.4206N	104.2278W
N 345	CW0595	946.39688	0.41	32.4178N	104.2233W
P 345	CW0596	968.26722	1.08	32.4200N	104.2133W
U 256 RESET 1960	CW0141	968.11435	1.40	32.4239N	104.2067W
M 96	CW0142	954.50027	1.84	32.4294N	104.1928W
Q 345	CW0597	961.43333	2.00	32.4328N	104.1850W
R 345	CW0598	965.03743	2.09	32.4361N	104.1772W
S 345	CW0599	974.17914	2.20	32.4408N	104.1689W
N 96	CW0253	963.56282	2.40	32.4456N	104.1628W
T 345	CW0600	958.84297	2.12	32.4333N	104.1794W
U 345	CW0601	962.46312	2.33	32.4344N	104.1700W
W 345	CW0603	944.48932	2.82	32.4311N	104.1428W
X 345	CW0604	955.69033	3.05	32.4300N	104.1267W
Y 345	CW0605	967.00176	3.24	32.4283N	104.1111W
Z 345	CW0606	958.71972	3.38	32.4256N	104.1000W
B 346	CW0608	961.74468	3.68	32.4256N	104.0711W
C 346	CW0609	965.95249	3.83	32.4239N	104.0544W
D 346	CW0610	980.79570	3.95	32.4217N	104.0389W
E 346	CW0611	995.58393	4.08	32.4211N	104.0217W
F 346	CW0612	1015.93260	4.18	32.4206N	104.0078W
G 346	CV0483	1039.57079	4.30	32.4183N	103.9911W
H 346	CV0484	1024.90968	4.39	32.4167N	103.9750W
J 346	CV0485	1015.92056	4.43	32.4161N	103.9650W
K 346	CV0486	1014.65189	4.45	32.4156N	103.9606W
L 346	CV0487	985.32391	4.48	32.4144N	103.9572W
MC 361 USGS	CV0488	986.14717	4.48	32.4144N	103.9572W
221 IMCC USGS	CV0489	977.52717	4.53	32.4136N	103.9494W
UNION 8 USGS	CV0490	991.09460	4.61	32.4172N	103.9417W
N 346	CV0492	984.22243	4.70	32.4228N	103.9211W
LOMMASSON 2 USGS	CV0493	986.01317	4.70	32.4228N	103.9211W
P 346	CV0494	956.73671	4.76	32.4150N	103.9133W
Q 346	CV0495	958.02173	4.80	32.4061N	103.9039W
328 USGS	CV0496	958.55269	4.82	32.4039N	103.8983W
338 USGS	CV0497	952.40273	4.82	32.4017N	103.8950W
T 346	CV0498	954.47066	4.84	32.4000N	103.8867W
N 347	CV0553	947.55387	5.00	32.3911N	103.8994W
Q 347	CV0555	922.27967	5.25	32.3667N	103.9161W
R 347	CV0556	916.09172	5.36	32.3536N	103.9117W
U 348	CV0557	927.42402	5.42	32.3489N	103.9044W

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31 - SEPTEMBER 30, 1981

HGZ L 24674
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
T 348	CV0574	942.75880	5.50	32.3464N	103.8903W
S 348	CV0575	951.30019	5.54	32.3433N	103.8833W
181 IMCC	CV0558	913.59184	5.52	32.3394N	103.9111W
T 347	CV0559	914.79284	5.69	32.3372N	103.9289W
S 1 S 6 S 12 S 7 USGLO	CV0560	917.48041	5.79	32.3267N	103.9289W
U 347	CV0561	912.41297	5.88	32.3189N	103.9283W
S 12 S 7 S 13 S 18 USGLO	CV0562	914.65367	5.95	32.3117N	103.9289W
V 347	CV0563	922.38727	6.05	32.3011N	103.9283W
W 347	CV0564	920.35312	6.15	32.2906N	103.9283W
X 347	CV0565	924.34778	6.20	32.2889N	103.9336W
F 350	CV0566	944.18866	6.23	32.2856N	103.9328W
G 350	CV0567	958.72025	6.24	32.2850N	103.9322W
H 350	CV0568	960.50105	6.24	32.2839N	103.9322W
J 350	CV0569	952.18318	6.26	32.2828N	103.9325W
22 USGS	CV0570	934.68206	6.30	32.2811N	103.9378W
N 348	CV0571	933.90063	6.39	32.2706N	103.9389W
18 USGS	CV0572	926.51357	6.48	32.2611N	103.9394W
P 348	CV0573	945.25514	6.54	32.2556N	103.9394W
U 346	CV0499	955.77121	4.85	32.4036N	103.8789W
V 346	CV0500	956.05944	4.86	32.4050N	103.8733W
W 346	CV0501	960.15990	4.94	32.3967N	103.8750W
X 346	CV0502	989.44637	5.07	32.3906N	103.8633W
Y 346	CV0503	1007.21611	5.10	32.3883N	103.8600W
Z 346	CV0504	1016.08351	5.14	32.3856N	103.8561W
D 347	CV0505	1002.02472	5.26	32.3772N	103.8689W
E 347	CV0506	1004.00441	5.33	32.3694N	103.8639W
F 347	CV0507	1008.86437	5.38	32.3711N	103.8561W
G 347	CV0508	1028.86925	5.52	32.3750N	103.8406W
H 347	CV0509	1023.80054	5.55	32.3706N	103.8406W
104 USGS	CV0510	1032.73976	5.57	32.3778N	103.8300W
J 347	CV0511	1031.79140	5.59	32.3800N	103.8250W
K 347	CV0512	1028.59652	5.64	32.3850N	103.8250W
M 347	CV0513	1036.52249	5.64	32.3833N	103.8078W
Y 347	CV0514	1053.18542	5.69	32.3878N	103.7906W
Z 347	CV0515	1058.25380	5.72	32.3844N	103.7906W
A 348	CV0516	1054.74649	5.71	32.3922N	103.7733W
B 348	CV0517	1069.64932	5.80	32.3967N	103.7567W
C 348	CV0518	1089.14763	5.87	32.4006N	103.7389W
D 348	CV0519	1078.58201	5.96	32.4117N	103.7389W
E 348	CV0520	1076.78234	6.04	32.4111N	103.7494W
F 348	CV0521	1081.75374	6.08	32.4244N	103.7400W
G 348	CV0522	1079.83774	6.17	32.4339N	103.7411W

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31 - SEPTEMBER 30, 1981

HCZ L 24674
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
H 348	CV0523	1109.71444	6.02	32.4050N	103.7214W
M 348	CV0524	1130.97091	6.15	32.4100N	103.7050W
Q 348	CV0525	1135.00454	6.28	32.4150N	103.6867W
C 355	CV0526	1150.69911	6.31	32.4150N	103.6833W
L 349	CV0593	1064.57035	5.75	32.3828N	103.7736W
P 349	CV0594	1071.58904	5.89	32.3700N	103.7656W
Q 349	CV0595	1078.97569	5.95	32.3683N	103.7572W
R 349	CV0596	1069.99626	6.03	32.3614N	103.7550W
S 349	CV0597	1082.26950	5.99	32.3733N	103.7572W
U 349	CV0599	1068.23439	6.08	32.3850N	103.7569W
M 349	CV0600	1061.01808	5.80	32.3689N	103.7806W
K 349	CV0601	1037.62332	5.84	32.3683N	103.7972W
N 349	CV0602	1031.53021	5.92	32.3700N	103.8072W
J 349	CV0603	1033.43958	5.85	32.3533N	103.7967W
U 355	CV0604	1049.31145	5.95	32.3544N	103.7850W
H 349	CV0605	1019.96822	5.85	32.3544N	103.8053W
374 USGS	CV0606	1018.77714	5.84	32.3556N	103.8172W
F 349	CV0607	1008.62297	5.80	32.3417N	103.8250W
E 349	CV0608	1005.81356	5.78	32.3411N	103.8317W
C 349	CV0609	1010.26949	5.94	32.3361N	103.8161W
A 349	CV0582	1001.71841	5.73	32.3308N	103.8306W
Z 348	CV0581	999.66842	5.73	32.3256N	103.8300W
X 348	CV0580	978.69237	5.69	32.3297N	103.8533W
W 348	CV0579	959.46116	5.65	32.3303N	103.8694W
R 348	CV0578	941.41708	5.59	32.3331N	103.8847W
218 USGS	CV0576	959.34745	5.64	32.3528N	103.8822W
V 348	CV0577	964.52016	5.66	32.3550N	103.8822W
V 349	CV0583	1010.00397	5.82	32.3283N	103.8136W
Y 349	CV0584	1011.71010	5.87	32.3289N	103.8019W
W 349	CV0585	1016.63224	5.98	32.3294N	103.7889W
X 349	CV0586	1018.07381	5.92	32.3394N	103.7900W
Z 349	CV0587	1040.28262	5.96	32.3447N	103.7736W
A 350	CV0588	1047.88893	5.98	32.3517N	103.7561W
B 350	CV0589	1065.71467	5.98	32.3578N	103.7406W
E 350	CV0590	1059.90162	6.02	32.3550N	103.7417W
D 350	CV0591	1089.19635	5.96	32.3717N	103.7400W
C 350	CV0592	1083.12340	5.92	32.3861N	103.7389W
K 351	CV0552	956.89260	4.87	32.4128N	103.8767W
L 351	CV0551	967.04010	4.89	32.4242N	103.8778W
M 351	CV0550	964.89840	4.89	32.4306N	103.8778W
N 351	CV0549	955.03572	4.91	32.4444N	103.8806W
J 351	CV0548	955.74895	4.91	32.4522N	103.8817W

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31 - SEPTEMBER 30, 1981

HGZ L 24674
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
H 351	CV0547	961.15309	4.91	32.4622N	103.8817W
G 351	CV0546	965.00599	4.91	32.4697N	103.8853W
F 351	CV0545	981.99430	4.90	32.4789N	103.8972W
M 350	CV0544	986.66060	4.89	32.4889N	103.9056W
F 97	CV0453	1001.31814	4.88	32.4997N	103.9106W
B 351	CV0543	1027.40063	4.86	32.5025N	103.9017W
A 351	CV0542	1043.22438	4.86	32.5011N	103.9017W
Z 350	CV0541	1019.41417	4.85	32.5028N	103.9042W
Y 350	CV0540	1047.21538	4.84	32.5089N	103.9086W
X 350	CV0539	1049.05079	4.84	32.5086N	103.9089W
W 350	CV0538	1037.35405	4.83	32.5078N	103.9094W
U 350	CV0537	1022.44118	4.83	32.5069N	103.9100W
H 7 USGS	CV0536	1014.79641	4.82	32.5072N	103.9164W
USP 60 USGS	CV0535	1024.35967	4.81	32.5083N	103.9200W
L 350	CV0534	1029.28023	4.80	32.5097N	103.9222W
PD KERN 1 USGS	CV0533	1033.99273	4.78	32.5150N	103.9300W
K 350	CV0531	1037.73087	4.72	32.5194N	103.9344W
N 350	CV0530	1029.62263	4.68	32.5186N	103.9456W
P 352	CV0529	1037.31295	4.65	32.5200N	103.9561W
D 97	CV0451	1034.44118	4.61	32.5217N	103.9667W
C 351	CV0532	1045.21148	4.74	32.5206N	103.9250W
A 417	CW0602	948.39642	2.58	32.4333N	104.1561W
B 417	CW0607	959.56016	3.52	32.4261N	104.0872W
C 417	CV0491	992.60537	4.64	32.4222N	103.9383W
Q 417	CW0613	951.90528	2.74	32.4544N	104.1506W
Y 95 RESET 1960	CW0255	957.74893	2.97	32.4633N	104.1394W
P 417	CW0614	970.44148	3.22	32.4739N	104.1244W
Z 95 RESET 1960	CW0257	973.58466	3.42	32.4833N	104.1117W
N 417	CW0615	981.61094	3.58	32.4922N	104.0994W
M 417	CW0616	987.30807	3.73	32.5006N	104.0883W
L 417	CW0617	997.48904	3.86	32.5083N	104.0767W
K 417	CW0618	1006.45871	3.99	32.5167N	104.0628W
J 417	CW0619	1011.29919	4.12	32.5239N	104.0478W
M 1 NMGS	CW0122	1008.66722	4.25	32.5339N	104.0339W
H 417	CW0620	1011.08517	4.37	32.5300N	104.0172W
C 97 RESET 1960	CW0124	1017.09980	4.46	32.5275N	104.0006W
G 417	CV0527	1024.31381	4.53	32.5250N	103.9861W
F 417	CV0528	1034.54852	4.57	32.5233N	103.9761W
D 417	CV0598	1080.83789	6.05	32.3742N	103.7500W
E 417	CV0554	927.75991	5.13	32.3800N	103.9106W

ADDENDUM

to

NOAA Technical Memorandum NOS NGS-37

"Vertical Movement in the Los Medanos and Nash
Draw Areas, New Mexico, as Indicated by
1977 and 1981 Leveling Surveys"

Releveling of the vertical reference network described in this Technical Memorandum in the Los Medanos area, New Mex., was completed May 1982. The data of the 1982 survey were combined with 1981 data and the adjustment and comparison were repeated. Using the 1982 data, two additional loops of the network were closed. These additional redundancies in the adjustment caused small changes in adjusted elevations; therefore, some of the differences, (H2-H1) listed in table 1, also changed by a small amount. An updated table 1 and a new list of adjusted elevations, which supersedes the appendix, are part of the addendum.

The amount of apparent movement of bench marks leveled in 1982 is included in the updated table 1, but the bench mark locations are not plotted. Instead, the apparent movement indicated by the 1982 leveling is shown by profiles of the 1982 leveling lines, which also are part of the addendum.

In 1982 Sandia National Laboratories requested that NGS perform a special investigation in conjunction with the releveling project. They needed information on possible vertical surface movement associated with the amount of water in the brine reservoir. In May 1982 NGS established and leveled 15 high-quality bench marks over and around the underground reservoir, when the water level in the reservoir was high. In January 1983, when most of the water had been pumped from the reservoir, NGS releveled these 15 bench marks and connected them to bench marks outside the affected area. The apparent movement of these bench marks relative to bench mark G419, located a few kilometers north of the reservoir, is shown on the third profile of the addendum.

Table 1.--Heights and height differences of common bench marks
in quads N 32103 W and N 32104 W,
WIPP project in the San Simon area, New Mexico

BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
I BOR	946.612	946.612	0.0	0.0	32 25 3N	104 13 28W
GAGE USGS	944.211	944.209	-0.002	0.2	32 25 3N	104 13 28W
B 11	948.089	948.088	-0.001	0.6	32 25 8N	104 13 30W
Z 344	947.711	947.709	-0.001	1.1	32 25 14N	104 13 40W
N 345	946.399	946.397	-0.002	0.6	32 25 4N	104 13 25W
P 345	968.269	968.267	-0.002	1.5	32 25 14N	104 12 48W
U 256 RESET 1960	968.116	968.114	-0.002	2.0	32 25 25N	104 12 26W
M 96	954.509	954.500	-0.009	2.6	32 25 50N	104 11 34W
Q 345	961.430	961.433	0.004	2.8	32 25 56N	104 11 12W
R 345	965.029	965.037	0.009	3.0	32 26 10N	104 10 38W
S 345	974.175	974.179	0.004	3.2	32 26 27N	104 10 8W
N 96	963.559	963.563	0.003	3.5	32 26 44N	104 9 46W
T 345	958.840	958.843	0.003	3.0	32 25 60N	104 10 46W
U 345	962.456	962.463	0.007	3.3	32 26 4N	104 10 12W
W 345	944.483	944.490	0.007	4.0	32 25 52N	104 8 39W
X 345	955.683	955.691	0.008	4.4	32 25 46N	104 7 40W
Y 345	966.997	967.002	0.006	4.7	32 25 41N	104 6 44W
Z 345	958.716	958.720	0.005	4.9	32 25 32N	104 6 0W
B 346	961.747	961.746	-0.002	5.3	32 25 32N	104 4 22W
C 346	965.954	965.953	-0.000	5.6	32 25 26N	104 3 22W
D 346	980.803	980.797	-0.006	5.8	32 25 20N	104 2 24W
E 346	995.591	995.585	-0.005	6.0	32 25 16N	104 1 22W
F 346	1015.942	1015.934	-0.008	6.2	32 25 12N	104 0 30W
G 346	1039.584	1039.572	-0.011	6.4	32 25 5N	103 59 30W
H 346	1024.925	1024.911	-0.014	6.6	32 25 0N	103 58 30W
J 346	1015.937	1015.922	-0.015	6.7	32 24 57N	103 57 54W
K 346	1014.668	1014.654	-0.014	6.7	32 24 56N	103 57 38W
L 346	985.345	985.326	-0.020	6.8	32 24 52N	103 57 27W
MC 361 USGS	986.168	986.149	-0.019	6.8	32 24 52N	103 57 27W
221 IMCC USGS	977.545	977.529	-0.016	6.9	32 24 49N	103 56 58W
UNION 8 USGS	991.139	991.097	-0.043	7.0	32 25 1N	103 56 32W
N 346	984.256	984.225	-0.032	7.2	32 25 22N	103 55 16W
LOMMASSON 2 USGS	986.054	986.015	-0.039	7.2	32 25 22N	103 55 16W
P 346	956.752	956.739	-0.013	7.4	32 24 49N	103 54 46W
Q 346	958.038	958.024	-0.014	7.5	32 24 22N	103 54 12W
328 USGS	958.570	958.555	-0.014	7.6	32 24 12N	103 53 54W
338 USGS	952.420	952.405	-0.015	7.6	32 24 5N	103 53 40W
T 346	954.491	954.473	-0.017	7.7	32 23 60N	103 53 11W
N 347	947.574	947.556	-0.017	7.8	32 23 27N	103 53 60W
Q 347	922.297	922.282	-0.015	8.2	32 21 58N	103 54 58W
R 347	916.113	916.094	-0.019	8.3	32 21 14N	103 54 44W

(continued)

Table 1.--Continued

BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
U 348	927.442	927.427	-0.016	8.4	32 20 54N	103 54 20W
T 348	942.779	942.761	-0.018	8.5	32 20 47N	103 53 25W
S 348	951.323	951.303	-0.021	8.5	32 20 36N	103 52 60W
181 IMCC	913.612	913.594	-0.018	8.5	32 20 23N	103 54 40W
T 347	914.811	914.795	-0.016	8.7	32 20 14N	103 55 44W
S1 S6 S12 S7	917.500	917.483	-0.017	8.8	32 19 36N	103 55 46W
U 347	912.433	912.416	-0.017	9.0	32 19 12N	103 55 46W
S12 S7 S13 S18	914.674	914.656	-0.018	9.1	32 18 44N	103 55 46W
V 347	922.407	922.390	-0.017	9.2	32 18 6N	103 55 44W
W 347	920.373	920.356	-0.017	9.3	32 17 26N	103 55 44W
X 347	924.360	924.350	-0.009	9.4	32 17 23N	103 55 60W
F 350	944.208	944.191	-0.017	9.4	32 17 8N	103 56 2W
G 350	958.737	958.723	-0.014	9.4	32 17 8N	103 55 58W
H 350	960.522	960.504	-0.018	9.4	32 17 4N	103 55 58W
J 350	952.204	952.186	-0.018	9.5	32 16 60N	103 55 60W
22 USGS	934.696	934.685	-0.011	9.5	32 16 54N	103 56 14W
N 348	933.921	933.903	-0.018	9.6	32 16 18N	103 56 18W
18 USGS	926.534	926.516	-0.018	9.8	32 15 40N	103 56 24W
P 348	945.277	945.258	-0.020	9.8	32 15 22N	103 56 22W
U 346	955.789	955.774	-0.015	7.7	32 24 13N	103 52 38W
V 346	956.081	956.062	-0.019	7.7	32 24 18N	103 52 25W
W 346	960.182	960.163	-0.020	7.8	32 23 48N	103 52 29W
X 346	989.465	989.449	-0.016	8.0	32 23 26N	103 51 51W
Y 346	1007.233	1007.219	-0.014	8.0	32 23 18N	103 51 36W
Z 346	1016.100	1016.086	-0.014	8.1	32 23 7N	103 51 24W
D 347	1002.043	1002.028	-0.016	8.2	32 22 36N	103 52 9W
E 347	1004.023	1004.007	-0.016	8.3	32 22 8N	103 51 52W
F 347	1008.882	1008.867	-0.015	8.3	32 22 14N	103 51 22W
G 347	1028.886	1028.872	-0.013	8.5	32 22 28N	103 50 26W
H 347	1023.820	1023.804	-0.016	8.5	32 22 14N	103 50 26W
104 USGS	1032.756	1032.743	-0.013	8.5	32 22 38N	103 49 48W
J 347	1031.802	1031.795	-0.007	8.5	32 22 46N	103 49 30W
K 347	1028.610	1028.600	-0.010	8.6	32 23 6N	103 49 32W
M 347	1036.542	1036.526	-0.016	8.6	32 22 58N	103 48 28W
Y 347	1053.205	1053.189	-0.016	8.6	32 23 16N	103 47 26W
Z 347	1058.275	1058.258	-0.017	8.7	32 23 2N	103 47 26W
A 348	1054.765	1054.750	-0.016	8.7	32 23 33N	103 46 24W
B 348	1069.832	1069.653	-0.179	8.8	32 23 48N	103 45 24W
C 348	1089.167	1089.151	-0.016	8.9	32 24 4N	103 44 22W
D 348	1078.601	1078.585	-0.016	9.0	32 24 42N	103 44 22W
E 348	1076.804	1076.786	-0.018	9.1	32 24 42N	103 44 58W
F 348	1081.772	1081.757	-0.014	9.1	32 25 28N	103 44 24W
G 348	1079.854	1079.841	-0.013	9.3	32 26 3N	103 44 30W

(continued)

Table 1.--Continued

BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
H 348	1109.732	1109.718	-0.014	9.0	32 24 20N	103 43 20W
M 348	1130.989	1130.975	-0.014	9.2	32 24 34N	103 42 20W
Q 348	1135.019	1135.008	-0.011	9.3	32 24 52N	103 41 12W
C 355	1150.715	1150.703	-0.012	9.3	32 24 54N	103 40 60W
B 355	1155.945	1155.934	-0.012	9.4	32 25 4N	103 40 12W
D 355	1152.960	1152.946	-0.014	9.5	32 25 14N	103 39 36W
E 355	1118.973	1118.960	-0.013	9.6	32 25 34N	103 38 36W
G 355	1120.163	1120.153	-0.010	9.8	32 25 50N	103 37 40W
TT 9 USGS	1126.834	1126.840	0.006	9.8	32 25 57N	103 37 8W
H 355	1147.453	1147.443	-0.010	10.0	32 26 10N	103 36 12W
J 355	1127.183	1127.177	-0.006	10.1	32 26 28N	103 35 10W
K 355	1116.914	1116.903	-0.011	10.2	32 26 40N	103 34 18W
L 355	1132.799	1132.787	-0.012	10.2	32 26 52N	103 33 30W
TT 8 USGS	1140.269	1140.257	-0.012	10.3	32 27 1N	103 33 6W
Z 354	1127.231	1127.218	-0.013	10.4	32 27 14N	103 32 8W
X 354	1143.336	1143.321	-0.015	10.5	32 27 28N	103 31 14W
TT 7 USGS	1140.996	1140.986	-0.010	10.5	32 27 36N	103 31 6W
W 354	1143.416	1143.402	-0.015	10.6	32 27 36N	103 30 32W
Y 354	1142.187	1142.175	-0.012	10.5	32 28 6N	103 31 12W
F 355	1145.563	1145.557	-0.007	10.6	32 28 51N	103 31 28W
BERRY RM 2	1161.684	1161.679	-0.005	10.7	32 29 42N	103 31 48W
BERRY RM 1	1161.665	1161.660	-0.005	10.7	32 29 42N	103 31 48W
BERRY	1162.379	1162.373	-0.006	10.7	32 29 42N	103 31 48W
A 355	1148.096	1148.091	-0.005	10.8	32 30 24N	103 32 6W
Z 352	1155.675	1155.670	-0.005	10.8	32 30 34N	103 32 12W
Y 352	1155.435	1155.432	-0.003	10.9	32 31 18N	103 32 20W
X 352	1151.326	1151.323	-0.003	10.9	32 31 26N	103 32 28W
W 352	1135.316	1135.316	-0.000	11.0	32 32 4N	103 32 56W
V 352	1128.317	1128.314	-0.003	11.1	32 32 36N	103 33 36W
U 352	1118.462	1118.464	0.002	11.1	32 33 10N	103 34 18W
T 352	1110.107	1110.109	0.001	11.2	32 33 46N	103 35 6W
S 352	1105.737	1105.744	0.007	11.3	32 34 26N	103 35 24W
R 352	1101.430	1101.435	0.005	11.3	32 35 19N	103 35 22W
Q 352	1103.550	1103.556	0.006	11.4	32 36 10N	103 35 20W
M 355	1099.768	1099.774	0.006	11.5	32 35 52N	103 36 16W
N 355	1097.913	1097.917	0.004	11.5	32 35 48N	103 36 24W
P 355	1098.466	1098.469	0.004	11.5	32 36 26N	103 36 52W
Q 355	1096.759	1096.762	0.004	11.6	32 36 55N	103 37 16W
R 355	1097.225	1097.233	0.008	11.6	32 37 20N	103 37 28W
H 58 USGS	1101.998	1102.001	0.003	11.7	32 37 40N	103 37 0W
S 355	1095.212	1095.214	0.001	11.6	32 37 5N	103 37 56W
M 97	1093.067	1093.066	-0.000	11.6	32 36 48N	103 38 27W
T 355	1088.872	1088.878	0.007	11.7	32 36 34N	103 39 4W

(continued)

Table 1.--Continued

BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
H 59 USGS	1088.220	1088.225	0.005	11.7	32 36 24N	103 40 4W
L 349	1064.586	1064.574	-0.013	8.7	32 22 57N	103 46 24W
P 349	1071.609	1071.592	-0.017	8.9	32 22 12N	103 45 54W
Q 349	1078.996	1078.979	-0.017	9.0	32 22 10N	103 45 24W
R 349	1070.017	1070.000	-0.017	9.1	32 21 44N	103 45 21W
S 349	1082.289	1082.273	-0.016	9.1	32 22 24N	103 45 26W
U 349	1068.255	1068.238	-0.017	9.2	32 23 2N	103 45 22W
M 349	1061.036	1061.021	-0.015	8.8	32 22 8N	103 46 50W
K 349	1037.644	1037.626	-0.018	8.8	32 22 6N	103 47 50W
N 349	1031.548	1031.533	-0.015	8.9	32 22 12N	103 48 26W
J 349	1033.460	1033.442	-0.019	8.8	32 21 12N	103 47 48W
U 355	1049.332	1049.314	-0.018	8.9	32 21 16N	103 47 6W
H 349	1019.990	1019.971	-0.020	8.8	32 21 21N	103 48 18W
374 USGS	1018.802	1018.780	-0.022	8.8	32 21 20N	103 49 2W
F 349	1008.645	1008.626	-0.019	8.8	32 20 34N	103 49 31W
E 349	1005.837	1005.816	-0.021	8.8	32 20 29N	103 49 54W
C 349	1010.296	1010.272	-0.024	8.9	32 20 15N	103 48 56W
A 349	1001.741	1001.721	-0.020	8.7	32 19 51N	103 49 52W
Z 348	999.693	999.671	-0.022	8.7	32 19 32N	103 49 50W
X 348	978.713	978.695	-0.018	8.7	32 19 46N	103 51 14W
W 348	959.480	959.464	-0.016	8.6	32 19 50N	103 52 6W
R 348	941.439	941.420	-0.019	8.6	32 19 59N	103 53 4W
218 USGS	959.402	959.350	-0.052	8.6	32 21 9N	103 52 55W
V 348	964.546	964.523	-0.023	8.7	32 21 16N	103 52 56W
V 349	1010.025	1010.007	-0.018	8.8	32 19 42N	103 48 50W
Y 349	1011.728	1011.713	-0.015	8.9	32 19 44N	103 48 8W
W 349	1016.657	1016.635	-0.022	9.0	32 19 46N	103 47 20W
X 349	1018.094	1018.077	-0.017	9.0	32 20 20N	103 47 24W
Z 349	1040.303	1040.286	-0.018	9.0	32 20 40N	103 46 28W
A 350	1047.910	1047.892	-0.018	9.0	32 21 4N	103 45 22W
B 350	1065.736	1065.718	-0.018	9.0	32 21 30N	103 44 26W
E 350	1059.925	1059.905	-0.020	9.1	32 21 18N	103 44 30W
D 350	1089.213	1089.200	-0.013	9.0	32 22 18N	103 44 24W
C 350	1083.141	1083.127	-0.014	8.9	32 23 10N	103 44 18W
K 351	956.899	956.895	-0.004	7.8	32 24 44N	103 52 36W
L 351	967.056	967.043	-0.013	7.9	32 25 27N	103 52 40W
M 351	964.915	964.901	-0.014	7.9	32 25 50N	103 52 40W
N 351	955.053	955.038	-0.015	8.1	32 26 41N	103 52 50W
J 351	955.763	955.752	-0.011	8.1	32 27 8N	103 52 55W
H 351	961.169	961.156	-0.013	8.2	32 27 44N	103 52 56W
G 351	965.013	965.009	-0.005	8.3	32 28 12N	103 53 8W
F 351	982.005	981.997	-0.009	8.4	32 28 42N	103 53 52W
M 350	986.672	986.663	-0.009	8.4	32 29 19N	103 54 20W

(continued)

Table 1.--Continued

BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
F 97	1001.329	1001.321	-0.008	8.5	32 29 58N	103 54 40W
B 351	1027.410	1027.403	-0.007	8.5	32 30 6N	103 54 8W
A 351	1043.231	1043.227	-0.004	8.6	32 30 4N	103 54 6W
Z 350	1019.422	1019.417	-0.006	8.6	32 30 10N	103 54 15W
Y 350	1047.227	1047.218	-0.009	8.6	32 30 36N	103 54 34W
X 350	1049.058	1049.053	-0.004	8.6	32 30 32N	103 54 36W
W 350	1037.364	1037.357	-0.008	8.6	32 30 30N	103 54 37W
U 350	1022.452	1022.444	-0.008	8.6	32 30 26N	103 54 38W
H 7 USGS	1014.825	1014.792	-0.033	8.6	32 30 26N	103 54 58W
USP 60 USGS	1024.613	1024.334	-0.279	8.7	32 30 31N	103 55 12W
L 350	1030.307	1029.242	-1.065	8.7	32 30 35N	103 55 14W
PD KERN 1 USGS	1034.002	1033.992	-0.010	8.7	32 30 54N	103 55 46W
K 350	1037.738	1037.729	-0.009	8.7	32 31 10N	103 56 4W
N 350	1029.629	1029.621	-0.009	8.8	32 31 8N	103 56 44W
P 352	1037.319	1037.311	-0.008	8.8	32 31 12N	103 57 20W
D 97	1034.445	1034.439	-0.006	8.9	32 31 18N	103 58 0W
C 351	1045.218	1045.210	-0.008	8.8	32 31 14N	103 55 34W
D 351	1076.396	1076.383	-0.013	9.0	32 31 20N	103 54 36W
E 351	1089.520	1089.507	-0.013	9.1	32 31 24N	103 53 38W
P 351	1089.178	1089.163	-0.015	9.3	32 31 30N	103 52 34W
Q 351	1088.100	1088.086	-0.014	9.3	32 31 32N	103 52 12W
R 351	1085.722	1085.704	-0.018	9.5	32 31 38N	103 51 14W
S 351	1093.464	1093.444	-0.020	9.6	32 31 39N	103 50 12W
T 351	1092.238	1092.219	-0.020	9.7	32 31 42N	103 49 14W
U 351	1082.537	1082.477	-0.060	9.8	32 31 44N	103 48 40W
V 351	1084.187	1084.073	-0.113	9.9	32 31 44N	103 48 6W
W 351	1078.723	1078.689	-0.035	10.0	32 31 24N	103 48 36W
H 97	1078.442	1078.410	-0.033	10.0	32 31 25N	103 48 40W
X 351	1059.074	1059.049	-0.025	10.1	32 31 4N	103 49 4W
H 10 USGS	1055.933	1055.904	-0.029	10.2	32 30 46N	103 49 32W
Y 351	1085.449	1085.356	-0.093	10.1	32 31 6N	103 47 40W
Z 351	1096.519	1096.455	-0.064	10.2	32 30 35N	103 47 26W
K 352	1098.550	1098.481	-0.070	10.2	32 30 28N	103 47 26W
L 352	1094.291	1094.238	-0.053	10.2	32 30 16N	103 46 60W
J 352	1097.757	1097.714	-0.043	10.3	32 30 12N	103 46 50W
M 352	1087.816	1087.758	-0.059	10.3	32 30 16N	103 47 20W
FC 89 USGS	1069.273	1069.252	-0.021	10.4	32 29 59N	103 48 0W
N 352	1075.191	1075.153	-0.037	10.4	32 29 46N	103 48 0W
NFU 30 USGS	1071.261	1071.217	-0.044	10.5	32 29 34N	103 47 58W
NFU 37 USGS	1062.417	1062.369	-0.048	10.5	32 29 32N	103 48 30W
A 352	1072.328	1072.301	-0.027	10.0	32 31 58N	103 47 24W
B 352	1071.461	1071.434	-0.027	10.1	32 32 8N	103 46 56W
C 352	1077.586	1077.564	-0.022	10.2	32 32 24N	103 46 16W

(continued)

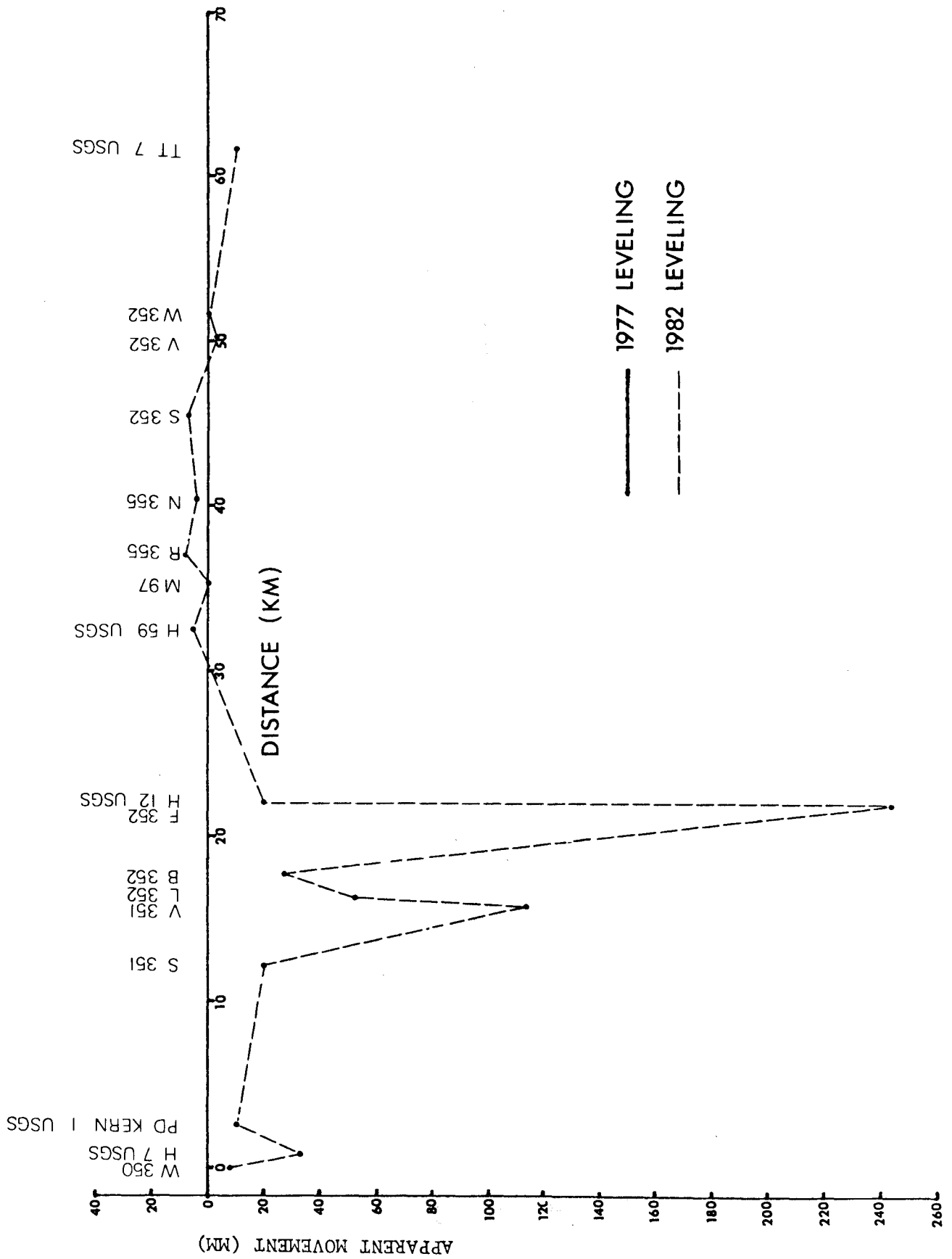
Table 1.--Continued

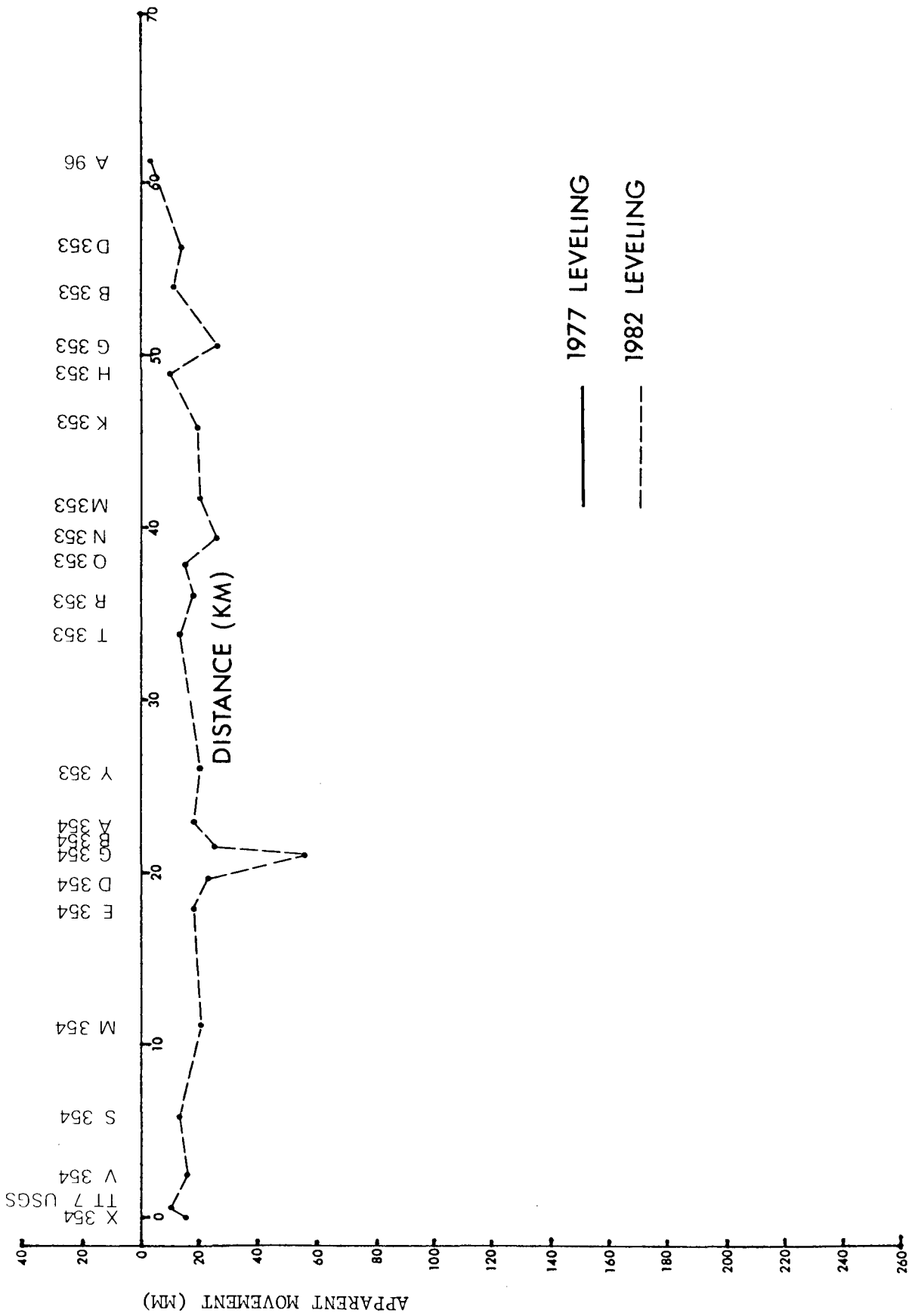
BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
D 352	1080.052	1080.032	-0.020	10.3	32 32 42N	103 45 15W
E 352	1080.070	1080.048	-0.022	10.4	32 32 52N	103 44 42W
G 352	1081.813	1081.780	-0.032	10.4	32 32 30N	103 44 42W
F 352	1084.527	1084.283	-0.244	10.5	32 32 12N	103 44 42W
H 352	1089.154	1089.134	-0.020	10.6	32 32 12N	103 43 42W
36 NMGS	1078.387	1078.367	-0.021	10.4	32 33 4N	103 44 59W
H 12 USGS	1078.079	1078.058	-0.020	10.4	32 33 2N	103 44 58W
A 96	1017.638	1017.636	-0.003	15.2	32 20 27N	103 9 49W
E 353	1013.880	1013.872	-0.008	15.1	32 21 12N	103 9 19W
P 98	1016.333	1016.321	-0.012	15.0	32 22 2N	103 8 60W
D 353	1019.850	1019.836	-0.014	14.9	32 22 49N	103 8 36W
C 353	1019.828	1019.821	-0.008	14.8	32 23 25N	103 8 20W
N 98	1023.666	1023.648	-0.017	14.8	32 23 40N	103 8 18W
B 353	1025.312	1025.300	-0.011	14.7	32 23 53N	103 8 23W
A 353	1032.178	1032.163	-0.015	14.7	32 23 54N	103 8 38W
F 353	1037.825	1037.811	-0.014	14.6	32 23 56N	103 9 32W
G 353	1035.242	1035.217	-0.026	14.5	32 23 56N	103 10 33W
H 353	1039.500	1039.491	-0.009	14.4	32 23 55N	103 11 30W
J 353	1048.573	1048.558	-0.016	14.3	32 23 57N	103 12 36W
K 353	1069.630	1069.612	-0.019	14.2	32 23 56N	103 13 37W
P 353	1077.090	1077.071	-0.019	14.1	32 23 56N	103 14 31W
L 353	1080.165	1080.145	-0.020	14.0	32 23 56N	103 15 31W
M 353	1081.678	1081.658	-0.020	13.9	32 23 54N	103 16 2W
5 RDS USGS	1090.525	1090.505	-0.019	13.8	32 23 56N	103 16 48W
N 353	1093.008	1092.982	-0.026	13.7	32 23 58N	103 17 41W
Q 353	1089.836	1089.821	-0.015	13.6	32 23 54N	103 18 38W
R 353	1089.350	1089.332	-0.018	13.5	32 22 58N	103 18 42W
T 353	1076.852	1076.840	-0.013	13.3	32 21 44N	103 18 43W
U 353	1075.426	1075.409	-0.017	13.2	32 20 51N	103 18 42W
V 353	1066.863	1066.847	-0.016	13.1	32 20 23N	103 19 20W
W 353	1082.325	1082.308	-0.017	12.9	32 20 27N	103 20 23W
X 353	1076.277	1076.259	-0.018	12.8	32 20 24N	103 21 26W
Y 353	1080.722	1080.702	-0.020	12.7	32 20 7N	103 22 22W
Z 353	1059.193	1059.175	-0.018	12.5	32 19 34N	103 23 7W
A 354	1024.949	1024.931	-0.018	12.4	32 19 32N	103 23 56W
B 354	1023.873	1023.848	-0.025	12.3	32 19 32N	103 24 58W
F 354	1021.241	1021.215	-0.026	12.4	32 18 44N	103 25 22W
G 354	1003.598	1003.542	-0.056	12.5	32 18 28N	103 24 58W
H 354	997.739	997.704	-0.035	12.6	32 18 16N	103 24 36W
C 354	1024.614	1024.589	-0.025	12.2	32 19 32N	103 25 33W
D 354	1025.650	1025.627	-0.023	12.2	32 19 34N	103 26 10W
E 354	1031.901	1031.883	-0.018	12.0	32 20 24N	103 26 14W
J 354	1038.394	1038.372	-0.021	11.9	32 21 20N	103 26 16W

(continued)

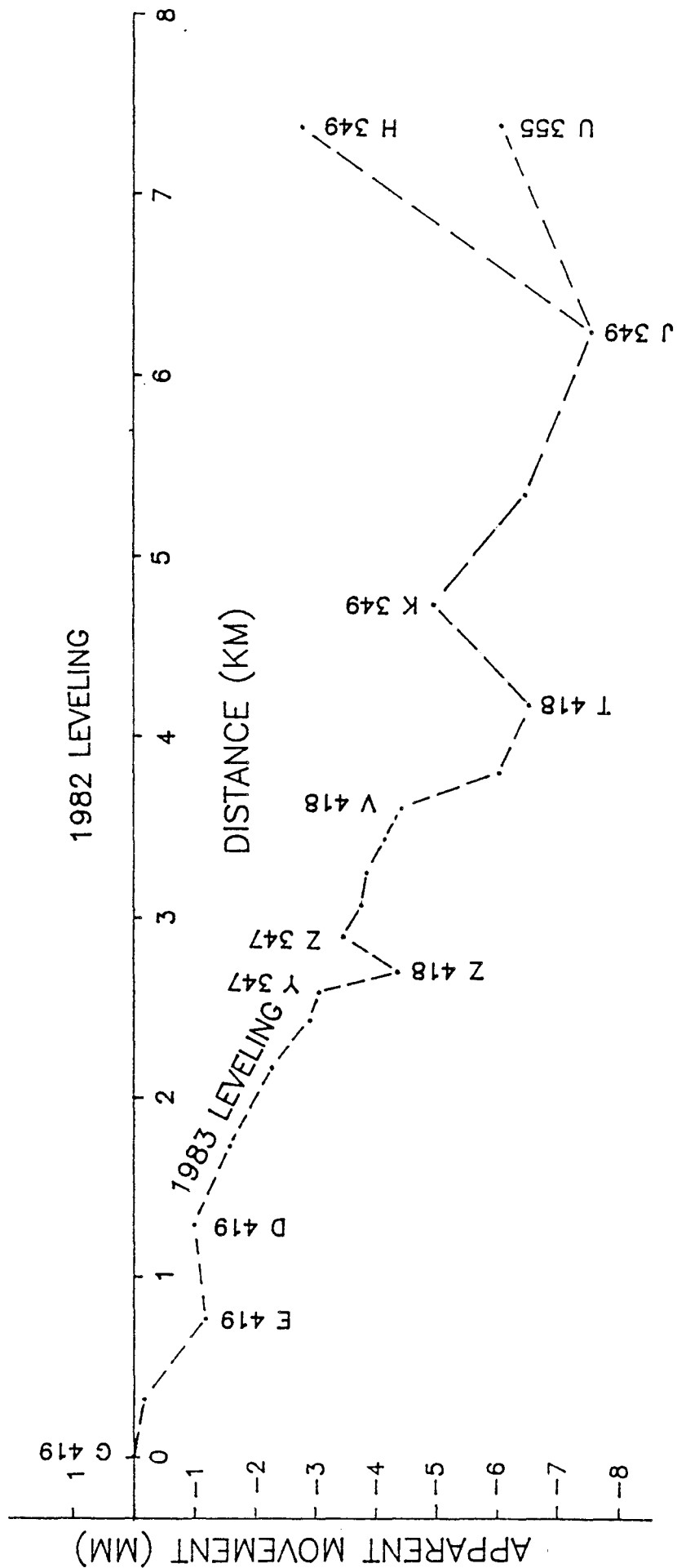
Table 1.--Continued

BENCH MARK DESIGNATION	H1 (1977) (M)	H2 (1981-82) (M)	H2-H1 (M)	SIGMA (MM)	LATITUDE ° ' "	LONGITUDE ° ' "
K 354	1053.341	1053.322	-0.019	11.8	32 22 11N	103 26 13W
L 354	1051.089	1051.071	-0.018	11.7	32 22 48N	103 26 25W
M 354	1058.975	1058.956	-0.018	11.6	32 23 12N	103 26 18W
N 354	1071.109	1071.088	-0.021	11.4	32 23 55N	103 26 54W
P 354	1089.272	1089.256	-0.016	11.3	32 24 34N	103 27 23W
Q 354	1106.332	1106.315	-0.017	11.2	32 25 18N	103 27 58W
R 354	1125.481	1125.466	-0.015	11.1	32 25 42N	103 28 15W
S 354	1112.426	1112.413	-0.013	11.0	32 26 18N	103 28 40W
T 354	1130.466	1130.453	-0.014	10.9	32 26 40N	103 28 58W
U 354	1133.288	1133.274	-0.013	10.8	32 27 14N	103 29 28W
V 354	1141.584	1141.569	-0.016	10.7	32 27 44N	103 29 54W





55 KM EAST OF CARLSBAD VIA SAN SIMON SINK TO 13 KM SOUTH OF EUNICE, NEW MEXICO



11-A

PROFILE 3
50 KM EAST OF CARLSBAD VIA WIPP SITE TO 5 KM SOUTH OF WIPP, NM.

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
I BOR	CW0139	946.61200	0.0	32.4172N	104.2239W
GAGE USGS	CW0137	944.20915	0.10	32.4172N	104.2239W
B 11	CW0136	948.08822	0.43	32.4189N	104.2250W
Z 344	CW0594	947.70938	0.75	32.4206N	104.2278W
N 345	CW0595	946.39688	0.41	32.4178N	104.2233W
P 345	CW0596	968.26722	1.08	32.4200N	104.2133W
U 256 RESET 1960	CW0141	968.11435	1.40	32.4239N	104.2067W
M 96	CW0142	954.50027	1.84	32.4294N	104.1928W
Q 345	CW0597	961.43333	2.00	32.4328N	104.1850W
R 345	CW0598	965.03740	2.09	32.4361N	104.1772W
S 345	CW0599	974.17907	2.20	32.4408N	104.1689W
N 96	CW0253	963.56268	2.40	32.4456N	104.1628W
T 345	CW0600	958.84301	2.12	32.4333N	104.1794W
U 345	CW0601	962.46323	2.33	32.4344N	104.1700W
W 345	CW0603	944.48964	2.82	32.4311N	104.1428W
X 345	CW0604	955.69077	3.04	32.4300N	104.1267W
Y 345	CW0605	967.00231	3.24	32.4283N	104.1111W
Z 345	CW0606	958.72035	3.37	32.4256N	104.1000W
B 346	CW0608	961.74553	3.67	32.4256N	104.0711W
C 346	CW0609	965.95346	3.81	32.4239N	104.0544W
D 346	CW0610	980.79678	3.93	32.4217N	104.0389W
E 346	CW0611	995.58514	4.06	32.4211N	104.0217W
F 346	CW0612	1015.93392	4.15	32.4206N	104.0078W
G 346	CV0483	1039.57224	4.27	32.4183N	103.9911W
H 346	CV0484	1024.91125	4.35	32.4167N	103.9750W
J 346	CV0485	1015.92220	4.40	32.4161N	103.9650W
K 346	CV0486	1014.65356	4.42	32.4156N	103.9606W
L 346	CV0487	985.32562	4.44	32.4144N	103.9572W
MC 361 USGS	CV0488	986.14889	4.44	32.4144N	103.9572W
221 IMCC USGS	CV0489	977.52895	4.48	32.4136N	103.9494W
UNION 8 USGS	CV0490	991.09654	4.57	32.4172N	103.9417W
N 346	CV0492	984.22455	4.64	32.4228N	103.9211W
LOMMASSON 2 USGS	CV0493	986.01529	4.65	32.4228N	103.9211W
P 346	CV0494	956.73896	4.69	32.4150N	103.9133W
Q 346	CV0495	958.02412	4.73	32.4061N	103.9039W
328 USGS	CV0496	958.55513	4.74	32.4039N	103.8983W
338 USGS	CV0497	952.40519	4.75	32.4017N	103.8950W
T 346	CV0498	954.47320	4.76	32.4000N	103.8867W
N 347	CV0553	947.55642	4.91	32.3911N	103.8994W
Q 347	CV0555	922.28226	5.14	32.3667N	103.9161W
R 347	CV0556	916.09433	5.24	32.3536N	103.9117W
U 348	CV0557	927.42664	5.29	32.3489N	103.9044W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
T 348	CV0574	942.76143	5.36	32.3464N	103.8903W
S 348	CV0575	951.30283	5.39	32.3433N	103.8833W
181 IMCC	CV0558	913.59446	5.39	32.3394N	103.9111W
T 347	CV0559	914.79546	5.56	32.3372N	103.9289W
S 1 S 6 S 12 S 7 USGLO	CV0560	917.48303	5.67	32.3267N	103.9289W
U 347	CV0561	912.41559	5.76	32.3189N	103.9283W
S 12 S 7 S 13 S 18 USGLO	CV0562	914.65629	5.83	32.3117N	103.9289W
V 347	CV0563	922.38989	5.93	32.3011N	103.9283W
W 347	CV0564	920.35574	6.03	32.2906N	103.9283W
X 347	CV0565	924.35040	6.09	32.2889N	103.9336W
F 350	CV0566	944.19128	6.12	32.2856N	103.9328W
G 350	CV0567	958.72287	6.12	32.2850N	103.9322W
H 350	CV0568	960.50367	6.13	32.2839N	103.9322W
J 350	CV0569	952.18580	6.15	32.2828N	103.9325W
22 USGS	CV0570	934.68468	6.19	32.2811N	103.9378W
N 348	CV0571	933.90324	6.28	32.2706N	103.9389W
18 USGS	CV0572	926.51619	6.37	32.2611N	103.9394W
P 348	CV0573	945.25776	6.44	32.2556N	103.9394W
U 346	CV0499	955.77378	4.77	32.4036N	103.8789W
V 346	CV0500	956.06202	4.78	32.4050N	103.8733W
W 346	CV0501	960.16253	4.86	32.3967N	103.8750W
X 346	CV0502	989.44909	4.98	32.3906N	103.8633W
Y 346	CV0503	1007.21886	5.00	32.3883N	103.8600W
Z 346	CV0504	1016.08627	5.03	32.3856N	103.8561W
D 347	CV0505	1002.02759	5.14	32.3772N	103.8689W
E 347	CV0506	1004.00734	5.20	32.3694N	103.8639W
F 347	CV0507	1008.86735	5.24	32.3711N	103.8561W
G 347	CV0508	1028.87238	5.34	32.3750N	103.8406W
H 347	CV0509	1023.80367	5.38	32.3706N	103.8406W
104 USGS	CV0510	1032.74296	5.37	32.3778N	103.8300W
J 347	CV0511	1031.79463	5.39	32.3800N	103.8250W
K 347	CV0512	1028.59975	5.44	32.3850N	103.8250W
M 347	CV0513	1036.52581	5.42	32.3833N	103.8078W
Y 347	CV0514	1053.18885	5.43	32.3878N	103.7906W
Z 347	CV0515	1058.25761	5.44	32.3844N	103.7906W
A 348	CV0516	1054.74985	5.46	32.3922N	103.7733W
B 348	CV0517	1069.65272	5.52	32.3967N	103.7567W
C 348	CV0518	1089.15107	5.56	32.4006N	103.7389W
D 348	CV0519	1078.58544	5.66	32.4117N	103.7389W
E 348	CV0520	1076.78577	5.74	32.4111N	103.7494W
F 348	CV0521	1081.75718	5.79	32.4244N	103.7400W
G 348	CV0522	1079.84118	5.88	32.4339N	103.7411W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
H 348	CV0523	1109.71800	5.66	32.4050N	103.7214W
M 348	CV0524	1130.97458	5.74	32.4100N	103.7050W
Q 348	CV0525	1135.00833	5.83	32.4150N	103.6867W
C 355	CV0526	1150.70273	5.84	32.4150N	103.6833W
B 355	CV0696	1155.93357	5.91	32.4183N	103.6706W
D 355	CV0697	1152.94593	5.95	32.4208N	103.6606W
E 355	CV0698	1118.96029	6.01	32.4256N	103.6450W
G 355	CV0699	1120.15334	6.08	32.4303N	103.6283W
TT 9 USGS	CV0700	1126.84045	6.11	32.4325N	103.6194W
H 355	CV0701	1147.44257	6.16	32.4367N	103.6028W
J 355	CV0702	1127.17725	6.21	32.4408N	103.5875W
K 355	CV0703	1116.90326	6.25	32.4447N	103.5719W
L 355	CV0704	1132.78671	6.28	32.4481N	103.5592W
TT 8 USGS	CV0705	1140.25698	6.30	32.4500N	103.5514W
Z 354	CV0706	1127.21801	6.33	32.4539N	103.5356W
X 354	CV0707	1143.32120	6.36	32.4575N	103.5222W
TT 7 USGS	CV0692	1140.98581	6.36	32.4597N	103.5178W
W 354	CV0691	1143.40192	6.43	32.4597N	103.5094W
Y 354	CV0708	1142.17494	6.38	32.4678N	103.5200W
F 355	CV0709	1145.55660	6.40	32.4808N	103.5253W
BERRY RM 2	CV0710	1161.67908	6.43	32.4947N	103.5306W
BERRY RM 1	CV0711	1161.65985	6.43	32.4947N	103.5306W
BERRY	CV0712	1162.37343	6.43	32.4947N	103.5306W
A 355	CV0713	1148.09068	6.45	32.5069N	103.5358W
Z 352	CV0714	1155.67002	6.45	32.5097N	103.5369W
Y 352	CV0715	1155.43181	6.46	32.5219N	103.5389W
X 352	CV0716	1151.32273	6.46	32.5239N	103.5411W
W 352	CV0717	1135.31613	6.47	32.5344N	103.5486W
V 352	CV0718	1128.31360	6.47	32.5436N	103.5600W
U 352	CV0719	1118.46438	6.47	32.5528N	103.5719W
T 352	CV0720	1110.10858	6.47	32.5631N	103.5850W
S 352	CV0721	1105.74357	6.46	32.5744N	103.5906W
R 352	CV0722	1101.43510	6.45	32.5889N	103.5894W
Q 352	CV0723	1103.55578	6.44	32.6031N	103.5883W
M 355	CV0724	1099.77401	6.42	32.5978N	103.6036W
N 355	CV0725	1097.91699	6.41	32.5964N	103.6067W
P 355	CV0726	1098.46918	6.39	32.6069N	103.6139W
Q 355	CV0727	1096.76250	6.37	32.6156N	103.6208W
R 355	CV0728	1097.23273	6.36	32.6219N	103.6250W
H 58 USGS	CV0468	1102.00099	6.44	32.6278N	103.6164W
S 355	CV0729	1095.21354	6.35	32.6183N	103.6314W
M 97	CV0467	1093.06646	6.32	32.6136N	103.6397W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
T 355	CV0730	1088.87841	6.30	32.6094N	103.6519W
H 59 USGS	CV0466	1088.22511	6.26	32.6067N	103.6681W
L 349	CV0593	1064.57361	5.50	32.3828N	103.7736W
P 349	CV0594	1071.59230	5.65	32.3700N	103.7656W
Q 349	CV0595	1078.97895	5.72	32.3683N	103.7572W
R 349	CV0596	1069.99952	5.79	32.3614N	103.7550W
S 349	CV0597	1082.27276	5.75	32.3733N	103.7572W
U 349	CV0599	1068.23765	5.85	32.3850N	103.7569W
M 349	CV0600	1061.02118	5.52	32.3689N	103.7806W
K 349	CV0601	1037.62626	5.48	32.3683N	103.7972W
N 349	CV0602	1031.53315	5.57	32.3700N	103.8072W
J 349	CV0603	1033.44160	5.50	32.3533N	103.7967W
U 355	CV0604	1049.31361	5.55	32.3544N	103.7850W
H 349	CV0605	1019.97076	5.51	32.3544N	103.8053W
374 USGS	CV0606	1018.77972	5.53	32.3556N	103.8172W
F 349	CV0607	1008.62563	5.52	32.3417N	103.8250W
E 349	CV0608	1005.81624	5.52	32.3411N	103.8317W
C 349	CV0609	1010.27217	5.68	32.3361N	103.8161W
A 349	CV0582	1001.72114	5.49	32.3308N	103.8306W
Z 348	CV0581	999.67114	5.49	32.3256N	103.8300W
X 348	CV0580	978.69506	5.48	32.3297N	103.8533W
W 348	CV0579	959.46384	5.46	32.3303N	103.8694W
R 348	CV0578	941.41974	5.43	32.3331N	103.8847W
218 USGS	CV0576	959.35009	5.49	32.3528N	103.8822W
V 348	CV0577	964.52280	5.51	32.3550N	103.8822W
V 349	CV0583	1010.00677	5.58	32.3283N	103.8136W
Y 349	CV0584	1011.71296	5.63	32.3289N	103.8019W
W 349	CV0585	1016.63510	5.75	32.3294N	103.7889W
X 349	CV0586	1018.07676	5.68	32.3394N	103.7900W
Z 349	CV0587	1040.28565	5.72	32.3447N	103.7736W
A 350	CV0588	1047.89204	5.73	32.3517N	103.7561W
B 350	CV0589	1065.71787	5.71	32.3578N	103.7406W
E 350	CV0590	1059.90482	5.76	32.3550N	103.7417W
D 350	CV0591	1089.19963	5.69	32.3717N	103.7400W
C 350	CV0592	1083.12675	5.64	32.3861N	103.7389W
K 351	CV0552	956.89518	4.80	32.4128N	103.8767W
L 351	CV0551	967.04270	4.83	32.4242N	103.8778W
M 351	CV0550	964.90100	4.84	32.4306N	103.8778W
N 351	CV0549	955.03833	4.86	32.4444N	103.8806W
J 351	CV0548	955.75157	4.87	32.4522N	103.8817W
H 351	CV0547	961.15572	4.87	32.4622N	103.8817W
G 351	CV0546	965.00862	4.87	32.4697N	103.8853W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
F 351	CV0545	981.99694	4.86	32.4789N	103.8972W
M 350	CV0544	986.66324	4.84	32.4889N	103.9056W
F 97	CV0453	1001.32080	4.82	32.4997N	103.9106W
B 351	CV0543	1027.40329	4.80	32.5025N	103.9017W
A 351	CV0542	1043.22704	4.80	32.5011N	103.9017W
Z 350	CV0541	1019.41683	4.79	32.5028N	103.9042W
Y 350	CV0540	1047.21804	4.77	32.5089N	103.9086W
X 350	CV0539	1049.05345	4.76	32.5086N	103.9089W
W 350	CV0538	1037.35672	4.76	32.5078N	103.9094W
U 350	CV0537	1022.44411	4.76	32.5069N	103.9100W
H 7 USGS	CV0536	1014.79191	4.74	32.5072N	103.9164W
USP 60 USGS	CV0535	1024.33433	4.72	32.5083N	103.9200W
L 350	CV0534	1029.24193	4.71	32.5097N	103.9222W
PD KERN 1 USGS	CV0533	1033.99225	4.68	32.5150N	103.9300W
K 350	CV0531	1037.72871	4.66	32.5194N	103.9344W
N 350	CV0530	1029.62055	4.63	32.5186N	103.9456W
P 352	CV0529	1037.31095	4.60	32.5200N	103.9561W
D 97	CV0451	1034.43925	4.56	32.5217N	103.9667W
C 351	CV0532	1045.21000	4.68	32.5206N	103.9250W
D 351	CV0616	1076.38267	4.83	32.5225N	103.9097W
E 351	CV0617	1089.50745	4.95	32.5236N	103.8939W
P 351	CV0618	1089.16274	5.09	32.5250N	103.8761W
Q 351	CV0619	1088.08584	5.13	32.5256N	103.8706W
R 351	CV0620	1085.70398	5.24	32.5272N	103.8539W
S 351	CV0621	1093.44379	5.35	32.5275N	103.8367W
T 351	CV0622	1092.21861	5.45	32.5289N	103.8206W
U 351	CV0623	1082.47701	5.51	32.5289N	103.8106W
V 351	CV0624	1084.07322	5.57	32.5294N	103.8019W
W 351	CV0625	1078.68856	5.66	32.5233N	103.8097W
H 97	CV0459	1078.40984	5.66	32.5236N	103.8108W
X 351	CV0626	1059.04942	5.75	32.5183N	103.8178W
H 10 USGS	CV0458	1055.90437	5.83	32.5128N	103.8258W
Y 351	CV0627	1085.35569	5.69	32.5189N	103.7944W
Z 351	CV0628	1096.45504	5.78	32.5100N	103.7906W
K 352	CV0629	1098.48073	5.81	32.5081N	103.7903W
L 352	CV0630	1094.23797	5.84	32.5047N	103.7836W
J 352	CV0631	1097.71427	5.87	32.5033N	103.7806W
M 352	CV0632	1087.75760	5.88	32.5044N	103.7886W
FC 89 USGS	CV0633	1069.25220	5.99	32.4997N	103.7989W
N 352	CV0634	1075.15318	6.04	32.4964N	103.8000W
NFU 30 USGS	CV0635	1071.21685	6.07	32.4928N	103.7986W
NFU 37 USGS	CV0636	1062.36862	6.13	32.4922N	103.8078W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
A 352	CV0637	1072.30097	5.64	32.5328N	103.7897W
B 352	CV0638	1071.43417	5.68	32.5361N	103.7819W
C 352	CV0639	1077.56415	5.74	32.5400N	103.7708W
D 352	CV0640	1080.03183	5.82	32.5464N	103.7539W
E 352	CV0641	1080.04796	5.87	32.5467N	103.7447W
G 352	CV0642	1081.78014	5.93	32.5428N	103.7450W
F 352	CV0643	1084.28334	5.98	32.5369N	103.7450W
H 352	CV0644	1089.13443	6.07	32.5372N	103.7278W
36 NMGS	CV0462	1078.36684	5.89	32.5514N	103.7492W
H 12 USGS	CV0645	1078.05837	5.89	32.5508N	103.7494W
A 96	CV0324	1017.63581	10.06	32.3408N	103.1636W
E 353	CV0646	1013.87224	9.98	32.3536N	103.1553W
P 98	CV0323	1016.32076	9.89	32.3672N	103.1500W
D 353	CV0647	1019.83576	9.81	32.3806N	103.1433W
C 353	CV0648	1019.82062	9.74	32.3903N	103.1389W
N 98	CV0322	1023.64846	9.72	32.3944N	103.1383W
B 353	CV0649	1025.30040	9.70	32.3978N	103.1394W
A 353	CV0650	1032.16319	9.68	32.3981N	103.1439W
F 353	CV0651	1037.81091	9.60	32.3989N	103.1589W
G 353	CV0652	1035.21650	9.52	32.3989N	103.1761W
H 353	CV0653	1039.49111	9.44	32.3986N	103.1911W
J 353	CV0654	1048.55755	9.35	32.3992N	103.2100W
K 353	CV0655	1069.61163	9.26	32.3986N	103.2272W
P 353	CV0656	1077.07116	9.19	32.3986N	103.2419W
L 353	CV0657	1080.14473	9.10	32.3992N	103.2589W
M 353	CV0658	1081.65814	9.05	32.3983N	103.2678W
5 RDS USGS	CV0659	1090.50549	8.98	32.3986N	103.2808W
N 353	CV0660	1092.98156	8.91	32.3989N	103.2953W
Q 353	CV0661	1089.82077	8.83	32.3983N	103.3100W
R 353	CV0662	1089.33240	8.72	32.3828N	103.3114W
T 353	CV0664	1076.83978	8.60	32.3628N	103.3119W
U 353	CV0665	1075.40871	8.50	32.3483N	103.3119W
V 353	CV0666	1066.84674	8.41	32.3406N	103.3225W
W 353	CV0667	1082.30753	8.31	32.3408N	103.3394W
X 353	CV0668	1076.25888	8.22	32.3406N	103.3561W
Y 353	CV0669	1080.70213	8.11	32.3358N	103.3725W
Z 353	CV0670	1059.17456	8.01	32.3264N	103.3856W
A 354	CV0671	1024.93079	7.93	32.3261N	103.3997W
B 354	CV0672	1023.84804	7.84	32.3261N	103.4150W
F 354	CV0673	1021.21527	7.94	32.3131N	103.4222W
G 354	CV0674	1003.54178	7.99	32.3089N	103.4161W
H 354	CV0675	997.70411	8.05	32.3042N	103.4097W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
C 354	CV0676	1024.58870	7.78	32.3261N	103.4250W
D 354	CV0677	1025.62728	7.71	32.3264N	103.4361W
E 354	CV0678	1031.88251	7.61	32.3406N	103.4367W
J 354	CV0679	1038.37241	7.50	32.3553N	103.4375W
K 354	CV0680	1053.32229	7.40	32.3686N	103.4372W
L 354	CV0681	1051.07119	7.32	32.3797N	103.4406W
M 354	CV0682	1058.95622	7.25	32.3875N	103.4381W
N 354	CV0683	1071.08776	7.15	32.3992N	103.4475W
P 354	CV0684	1089.25590	7.05	32.4097N	103.4558W
Q 354	CV0685	1106.31526	6.93	32.4222N	103.4667W
R 354	CV0686	1125.46636	6.87	32.4272N	103.4697W
S 354	CV0687	1112.41319	6.78	32.4369N	103.4769W
T 354	CV0688	1130.45266	6.71	32.4444N	103.4822W
U 354	CV0689	1133.27435	6.61	32.4533N	103.4903W
V 354	CV0690	1141.56863	6.51	32.4622N	103.4983W
A 417	CW0602	948.39663	2.58	32.4333N	104.1561W
B 417	CW0607	959.56089	3.51	32.4261N	104.0872W
C 417	CV0491	992.60735	4.59	32.4222N	103.9383W
Q 417	CW0613	951.90499	2.74	32.4544N	104.1506W
Y 95 RESET 1960	CW0255	957.74853	2.97	32.4633N	104.1394W
P 417	CW0614	970.44094	3.21	32.4739N	104.1244W
Z 95 RESET 1960	CW0257	973.58400	3.41	32.4833N	104.1117W
N 417	CW0615	981.61016	3.57	32.4922N	104.0994W
M 417	CW0616	987.30718	3.72	32.5006N	104.0883W
L 417	CW0617	997.48804	3.84	32.5083N	104.0767W
K 417	CW0618	1006.45759	3.98	32.5167N	104.0628W
J 417	CW0619	1011.29794	4.10	32.5239N	104.0478W
M 1 NMGS	CW0122	1008.66582	4.22	32.5339N	104.0339W
H 417	CW0620	1011.08362	4.34	32.5300N	104.0172W
C 97 RESET 1960	CW0124	1017.09812	4.42	32.5275N	104.0006W
G 417	CV0527	1024.31203	4.48	32.5250N	103.9861W
F 417	CV0528	1034.54666	4.53	32.5233N	103.9761W
E 417	CV0554	927.76248	5.03	32.3800N	103.9106W
D 417	CV0598	1080.84115	5.82	32.3742N	103.7500W
H 419	CV0736	1078.09893	5.97	32.5619N	103.7344W
J 419	CV0737	1072.68514	6.06	32.5764N	103.7153W
K 419	CV0738	1077.57393	6.13	32.5906N	103.7108W
L 97	CV0465	1082.55080	6.19	32.5983N	103.6931W
L 419	CV0739	1083.85315	6.23	32.6033N	103.6808W
S 418	CV0740	1036.86396	5.50	32.3628N	103.7906W
T 418	CV0741	1041.48979	5.48	32.3728N	103.7906W
U 418	CV0742	1044.36391	5.47	32.3761N	103.7900W

ADJUSTED HEIGHTS OF THE 1981-1982 SURVEYS.

RELEVELING OF SAN SIMON AREA, NEW MEXICO
AUGUST 31, 1981 - MAY 19, 1982

HGZ L 24674, L 24697
3 MM FIRST-ORDER/CLASS I

BENCH MARK DESIGNATION	ACRN	HEIGHT METERS	SIGMA MM	LAT. DEGR	LONG. DEGR
V 418	CV0743	1047.46928	5.46	32.3783N	103.7900W
W 418	CV0744	1051.36391	5.46	32.3806N	103.7900W
X 418	CV0745	1053.40223	5.45	32.3822N	103.7900W
Y 418	CV0746	1056.17949	5.45	32.3831N	103.7911W
Z 418	CV0747	1054.95700	5.44	32.3856N	103.7900W
A 419	CV0748	1053.01705	5.45	32.3894N	103.7900W
B 419	CV0749	1051.52559	5.47	32.3922N	103.7897W
C 419	CV0750	1047.80563	5.51	32.3956N	103.7894W
D 419	CV0751	1043.41815	5.55	32.3989N	103.7900W
E 419	CV0752	1042.49067	5.59	32.4044N	103.7900W
F 419	CV0753	1041.68179	5.63	32.4083N	103.7906W
G 419	CV0754	1041.69320	5.66	32.4122N	103.7900W
R 418	CV0755	1083.75995	8.68	32.3764N	103.3117W

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

National Geodetic Survey , OA/C18x2

Rockville, Maryland 20852

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-210
THIRD CLASS MAIL

