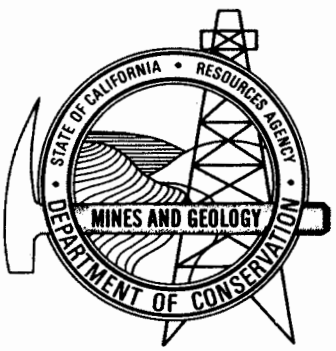
CSMIP STRONG-MOTION RECORDS FROM THE BISHOP, CALIFORNIA EARTHQUAKE OF 23 NOVEMBER 1984

CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

OFFICE OF STRONG MOTION STUDIES
REPORT OSMS 84-12

1984



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CSMIP STRONG-MOTION RECORDS FROM THE BISHOP, CALIFORNIA EARTHQUAKE OF 23 NOVEMBER 1984

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17 December 1984

California Strong Motion Instrumentation Program

Preliminary Data

(Subject to Revision)

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CONTENTS

CSMIP STRONG-MOTION RECORDS FROM THE BISHOP, CALIFORNIA EARTHQUAKE OF 23 NOVEMBER 1984

Introduction

The earthquake which occurred 20 km northwest of Bishop, California on 23 November 1984 continued the series of moderate magnitude earthquakes which have occurred in the area during the last decade. Many of the earthquakes in this series have generated significant strong motion records. The 23 November 1984 event occurred to the southeast of the May 1980 Mammoth Lakes sequence of four ML > 6 earthquakes. The accelerations from the 1984 earthquake are all significantly less than were recorded in 1980, although one station in this earthquake was located almost directly over the earthquake origin.

Earthquake Parameters

The determination of accurate earthquake locations is quite difficult in the Mammoth Lakes - Bishop area because of the complex geology and the limited distribution of seismic stations. The best estimate so far obtained by the U.S. Geological Survey (Cockerham, personal communication) is:

Epicenter: 37.46 N, 118.59 W

Depth: 13 km, approximate.

Origin time: 18:08:20 GMT (10:08 PST)

The local magnitude (ML) is estimated by U.C. Berkeley (Uhrhammer, personal communication) to be 5.9. No surface rupture was observed in the epicentral area; little significant damage was reported, though the earthquake was felt as far away as Bakersfield and

Sacramento.

The epicentral solution for this earthquake is complicated by the occurrence of a small earthquake about 4 seconds prior to the mainshock. It appears that the present best estimate for the epicenter given above actually corresponds to the small foreshock. Cramer (personal communication) has estimated from close-in data that the mainshock hypocenter is about 3 km southeast of the foreshock, is slightly deeper, and has an origin time of approximately 18:08:25. Close study of the accelerograms and trigger times appears to support that interpretation. The impact on the analysis of the recorded strong motion data would be to significantly increase the epicentral distance of the close-in Paradise Lodge station. There would be relatively little impact on the epicentral distances to the other stations, or on hypocentral distances to any of the stations.

Accelerograms

Strong-motion records were obtained from 12 stations of the California Strong-Motion Instrumentation Program (CSMIP) during the 23 November 1984 earthquake. These stations are shown on the station map in Figure 1, and are listed in Table 1 and Table 2. The highest acceleration, near 0.25 g, was recorded at the Paradise Lodge station, within 3 km of the preliminary epicenter listed above. The Paradise Lodge record has unusual high frequency energy; this is also present in records obtained at this station during previous earthquakes.

In addition to the accelerograms recorded during the 23 November mainshock, records were obtained during several of the aftershocks that occurred during following week. The aftershock which occurred

at approximately 19:12 GMT (about an hour after the mainshock) generated the most records; however even for this event the records were significantly smaller than the mainshock records. The Paradise Lodge station is an exception however. More than 20 records with amplitudes over 5% g and with good trigger times were obtained in the week following the mainshock.

Accelerograms were also obtained at many of the CSMIP stations in Table 1 during previous earthquakes. A total of 12 records were recovered during the two ML > 5 events of 6 January 1983 and are described in McJunkin et al. (1983). The 8 records recovered from the 5.8 ML event of 30 September 1981 are described in McJunkin and Kaliakin (1981). Many accelerograms were obtained during the the May 1980 sequence of four ML > 6 events and are described in Turpen (1980). The 5 records obtained during the 5.7 ML event of 4 October 1978 are described in McJunkin (1978). Discussions of the Mammoth Lakes area geology, seismicity and crustal movement are included in a special report published after the 1980 earthquakes (Sherburne, 1980).

Instrumentation Notes

Radio (WWVB) time code was recorded satisfactorily at all stations having receivers except the Long Valley Dam station, so absolute trigger times are available for many of the records. Also, note that at Long Valley Dam the centrally-recorded sensors (channels 1 - 13) failed to be recorded correctly; this was the only instrument malfunction among the 12 stations.

The Vermillion Dam station, on Lake Edison in the Sierra Nevada mountains, is inaccessible from fall until spring. Thus, it will not

be known until late spring what acceleration was recorded, if the instrument triggered. It seems likely that the system did trigger however.

The sensor configuration at the roof of the Mammoth Lakes High School Gymnasium has been slightly changed since the 1983 earthquake, as will be noted in comparing this report with the earlier reports noted above. Two sensors were repositioned to reduce noise levels; however the records should still be directly comparable with those obtained earlier. Also, note that this is the first record obtained from the gymnasium since the free-field instrument was installed to provide a record of the freefield ground motion for comparison with the motion at the base. A time code generator (internal clock) was used at the gym and it operated satisfactorily (a similar clock at the Chalfant station was not yet operating correctly).

Acknowledgements

The California Strong Motion Instrumentation Program extends its appreciation to the individuals and organizations which have permitted the installation of seismic strong-motion equipment on their property. C. Rojahn and J. Ragsdale planned sensor configurations for the buildings considered in this report; J. Ragsdale also reviewed sections of this report.

The records shown in this report were recovered at CSMIP stations instrumented by V. DaViega, A. Guyer, C. Hallstrom, M. Huston, H. LaGesse, R. Meneely, M. Seaton and W. Williams. These stations have been serviced and maintained by S. Rider, who also performed the post-earthquake recovery of accelerograms. The accelerograms were photographically developed by J. Farros. P. Knight assisted in report preparation and assembly. R. Boylan verified instrument orientations and also assisted in record recovery and report preparation. The joint efforts of all those involved made possible the timely publication of these data.

REFERENCES

McJunkin, R.D., 1978, Compilation of strong-motion records recovered from the Bishop, California, earthquake of 4 October 1978: Calif. Div. Mines and Geology, Office of Strong Motion Studies Report OSMS 78-7.1, 28 pp.

McJunkin, R.D. and N.A. Kaliakin, 1981, Strong-motion records recovered from the Mammoth Lakes, California, earthquake of 30 September 1981: Calif. Div. Mines and Geol. Report OSMS 81-10.1, 22 pp.

McJunkin, R.D., A.F. Shakal and N.A. Kaliakin, 1983, Strong-motion records recovered from the Mammoth Lakes, California, earthquakes of 6 January 1983: Calif. Div. Mines and Geol. Report OSMS 83-1.1, 30 pp.

Sherburne, R.W., (Ed.), 1980, Mammoth Lakes, California earthquakes of May, 1980: Calif. Div. Mines and Geol. Special Report SR-150, 141 pp.

Turpen, C.D., 1980, Strong-motion records from the Mammoth Lakes earthquakes of May 1980: Calif. Div. Mines and Geol. Report PR-27, 42 pp.

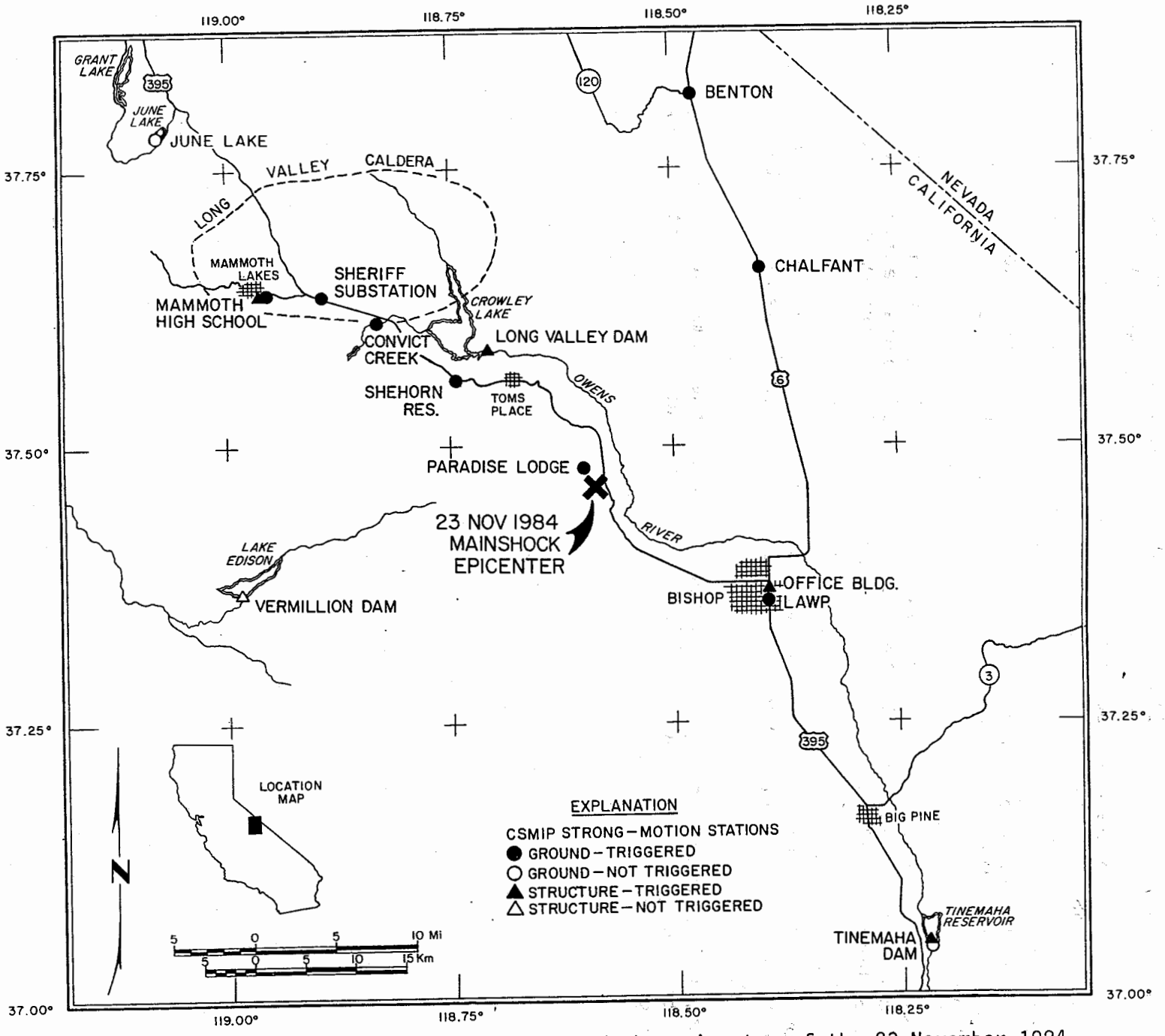


Figure 1. CSMIP strong-motion stations, and the epicenter of the 23 November 1984 earthquake. Stations are listed in Tables 1 and 2.

TABLE 1

CSMIP Strong Motion Stations - Bishop Earthquake of 23 Nov 1984

Station Name	N.Lat.	W.Long.	Sta. No.	Site Geology	Record Page*
Benton	37.818	118.475	54100	Alluvium	16
Bishop - Paradise Lodge	37.481	118.602	54424	Thin alluvium over tuff	13
Bishop - LAWP	37.360	118.396	54171	Alluvium	14
Bishop - 873 N. Main Office Building	37.370	118.396	54388	Alluvium	21
Chalfant - Zack Ranch	37.662	118.398	54428	Alluvium	15
Convict Creek UC Aquatic Res. Lab.	37.614	118.831	54099	Alluvium over glacial deposits	14
Crowley Lake Shehorn Residence	37.561	118.743	54T03	Alluvium over glacial deposits	13
June Lake	37.783	119.075	55429	Granitic rock	NT
Long Valley Dam	37.588	118.705	54214	Layered, blocky rhyolite	17
Mammoth Lakes High School Freefield	37.641	118.963	54482	Glacial deposits	16,28
Mammoth Lakes High School Gymnasium	37.641	118.963	54301	Glacial deposits	25
Mammoth Lakes Sheriff Substation	36.638	118.892	54T04	Thin alluvium over basalt	15
Tinemaha - Freefield	37.054	118.229	54101	Basalt	NT
Tinemaha Dam	37.052	118.219	54361	Basalt	29
Vermillion Dam	37.370	118.987	54362	Glacial deposits	

* Footnote: NT - Instrument not triggered, though operational.

TABLE 2 - Strong Motion Data

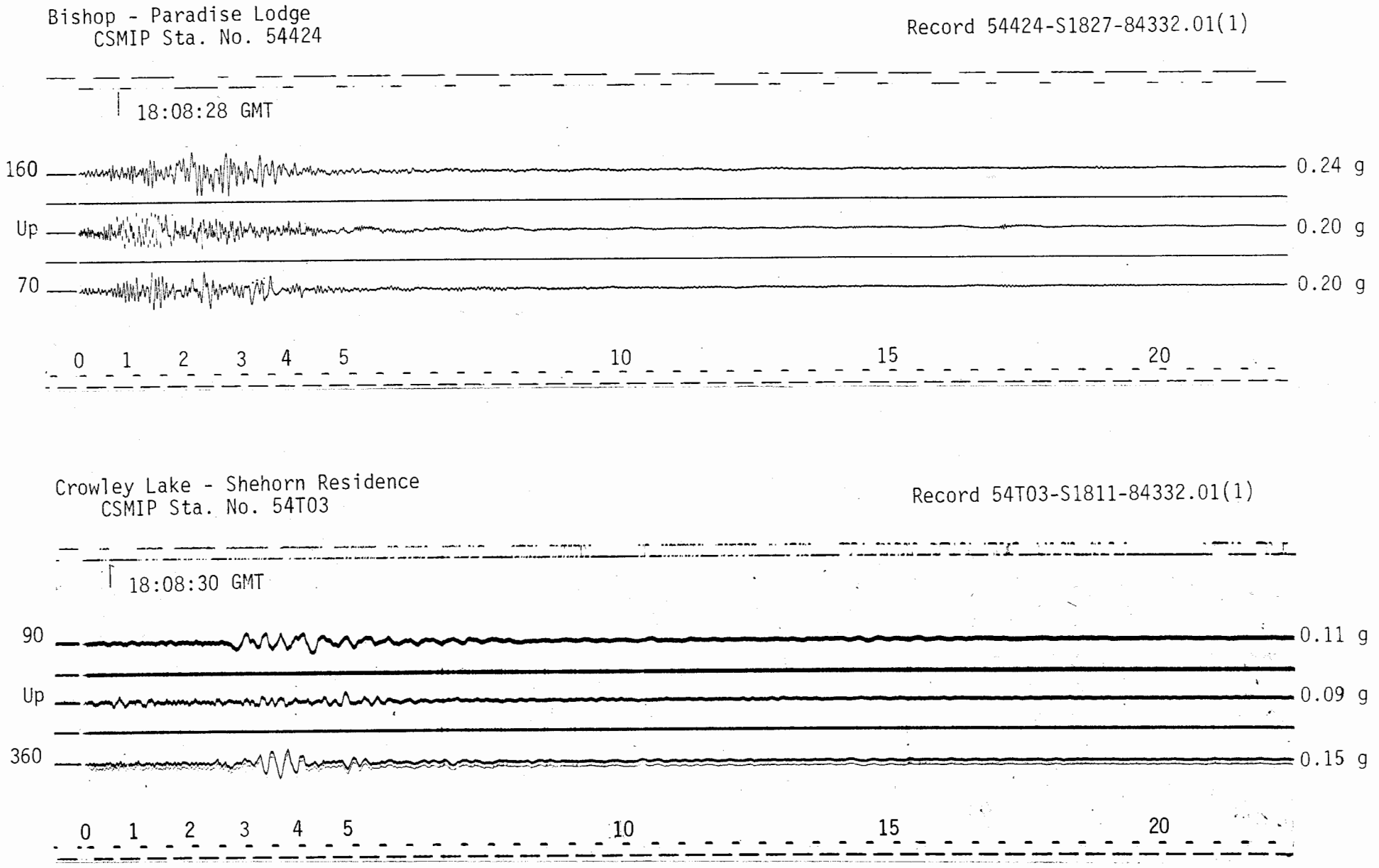
Station No.	Station Name	Structure Type, Size	Epicenter Dist.*	Trigger Time#	Max. Acceleration Comp.	Grnd. (g)	Struct. (g)	Pg.
54424	Bishop Paradise Lodge	1-story bldg.	3 [13]	08:27.2	160 Up 70	0.24 0.20 0.20		13
54214	Long Valley Dam	Earth Dam (19 sensors)	18 [22]	Radio inoperative	90 Up 360	0.08 0.06 0.08	0.06 0.05 0.08	17
54T03	Crowley Lake Shehorn Residence	1-story bldg.	18 [22]	08:29.5	90 Up 360	0.11 0.09 0.15		13
54388	Bishop 873 N. Main St. Office Bldg.	2-story office bldg. (13 sensors)	20 [23]	No radio	270 Up 360	0.04 0.03 0.07	0.08 -- 0.13	21
54171	Bishop LAWP	1-story bldg.	20 [24]	No radio	270 Up 180	0.04 0.04 0.06		14
54099	Convict Creek UC Aquatic Research Lab.	1-story bldg.	27 [30]	08:31.4	90 Up 360	0.06 0.04 0.06		14
54428	Chalfant Zack Ranch Microwave Site	1-story bldg.	28 [30]	Clock inoperative	360 Up 270	0.10 0.05 0.09		15
54T04	Mammoth Lakes Sheriff Substa.	1-story bldg.	33 [36]	No radio	180 Up 90	0.04 0.02 0.02		15

TABLE 2 - Strong Motion Data (Cont.)

Station No.	Station Name	Structure Type, Size	Epicenter Dist.*	Trigger Time#	Comp.	Max. Acceleration Grnd. (g)	Max. Acceleration Struct. (g)	Pg.
54362	Vermillion Dam	Earth dam (12 sensors)	37 [39]	-----		-- -- --	-- -- --	
54301	Mammoth Lakes Mammoth High School Gym	1-story gymnasium	39 [41]	08:33.1	253 Up 343	0.03 0.03 0.04	0.09 -- 0.17	25
54482	Mammoth Lakes Mammoth High School Freefield	Instr. Shltr. (T Hut)	39 [41]	08:33.1	253 Up 163	0.03 0.03 0.05		16, 28
54100	Benton	1-story bldg.	41 [43]	08:33.6	360 Up 270	0.03 0.03 0.03		16
54361	Tinemaha Dam	Earth dam (9 sensors)	55 [57]	08:44.8	212 Up 302	0.01 0.01 0.01	0.03 0.02 0.03	29

Footnotes: * - Distance given (in km) relative to the presently estimated epicentral location (USGS, Cockerham) of 37.46N, 118.59W (see text). Bracketed number is hypocentral distance, for a 13km source depth.

- Accelerograph trigger time, when present, in minutes and seconds after 18:00 GMT on 23 Nov. 1984.


Bishop - Paradise Lodge
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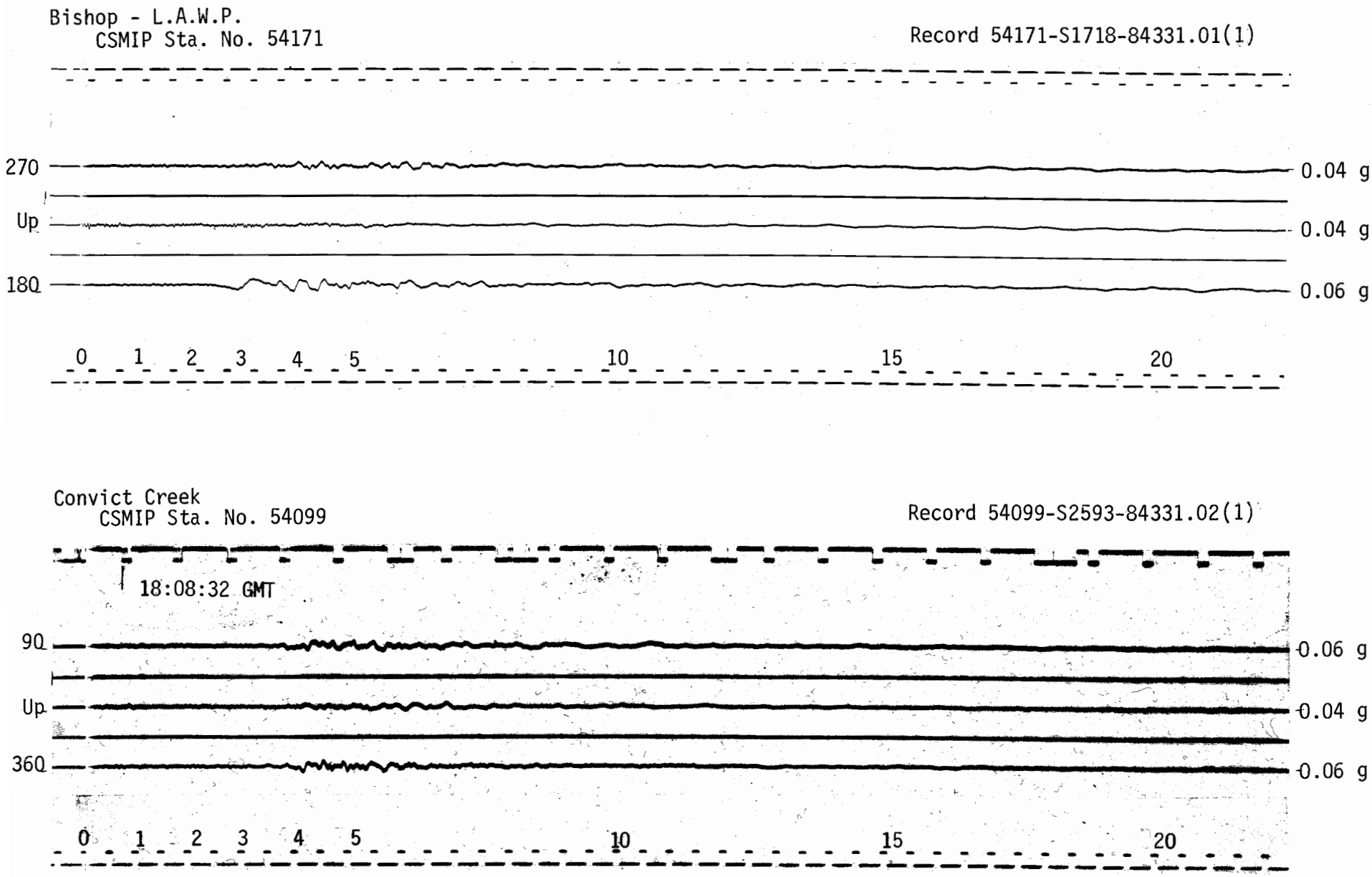
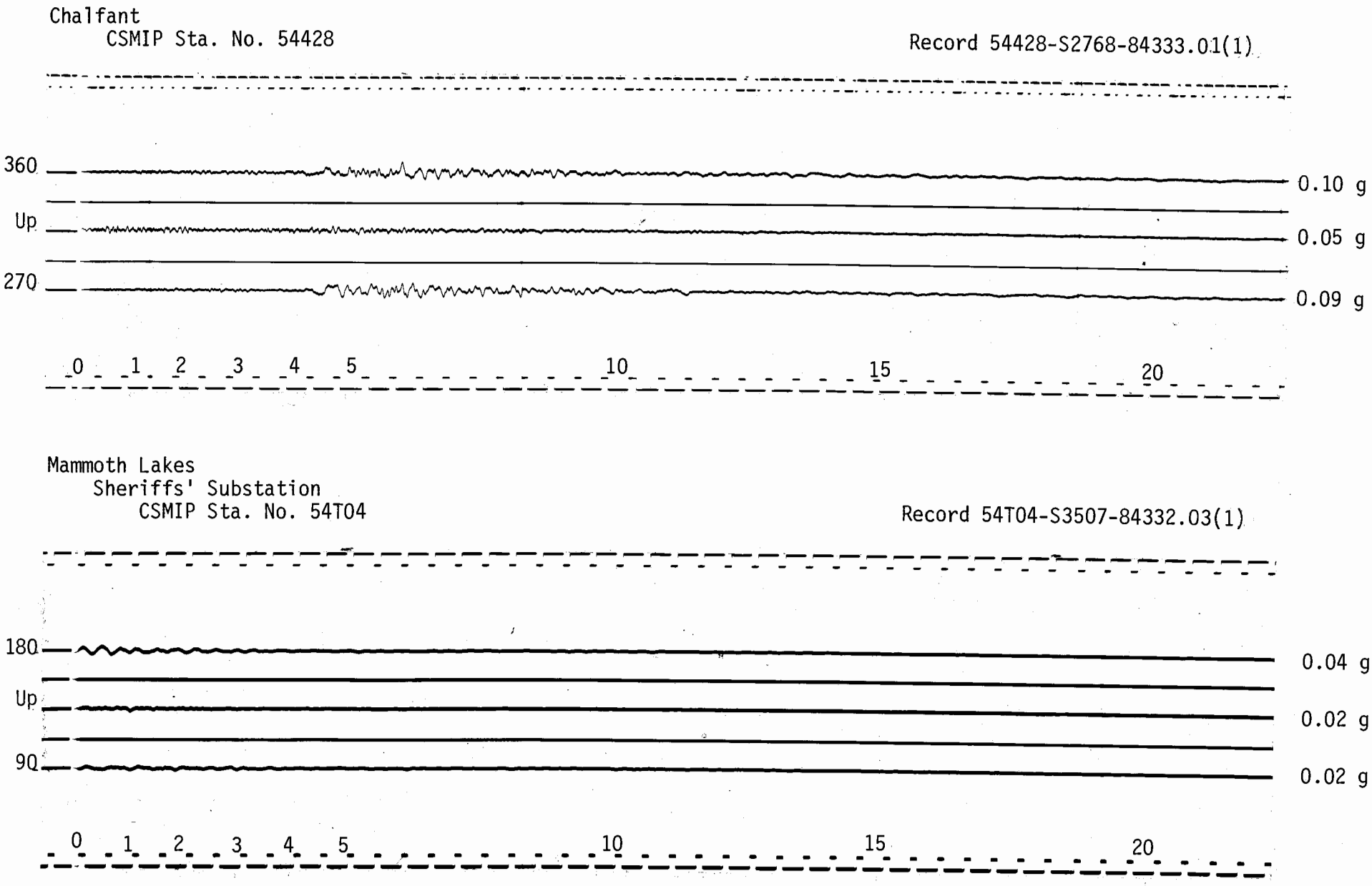
Record 54424-S1827-84332.01(1)
18:08:28 GMT
160
0.24 g
Up
0.20 g
70
0.20 g
0 1 2 3 4 5 10 15 20
Crowley Lake - Shehorn Residence
CSMIP Sta. No. 54T03
Record 54T03-S1811-84332.01(1)
18:08:30 GMT
90
0.11 g
Up
0.09 g
360
0.15 g
0 1 2 3 4 5 10 15 20


Bishop - L.A.W.P.
CSMIP Sta. No. 54171
Record 54171-S1718-84331.01(1)
270
0.04 g
Up
0.04 g
180
0.06 g
0 1 2 3 4 5 10 15 20
Convict Creek
CSMIP Sta. No. 54099
Record 54099-S2593-84331.02(1)
18:08:32 GMT
90
0.06 g
Up
0.04 g
360
0.06 g
0 1 2 3 4 5 10 15 20

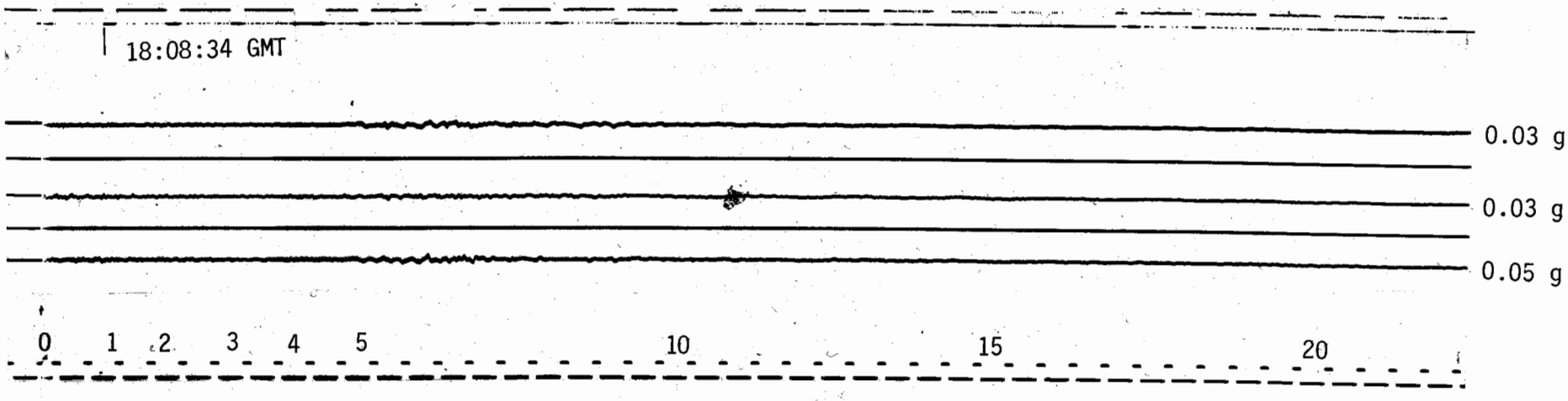

Chalfant
CSMIP Sta. No. 54428
Record 54428-S2768-84333.01(1)
360
Up
270
0.10 g
0.05 g
0.09 g
0 1 2 3 4 5 10 15 20
Mammoth Lakes
Sheriffs' Substation
CSMIP Sta. No. 54T04
Record 54T04-S3507-84332.03(1)
180
Up
90
0.04 g
0.02 g
0.02 g
0 1 2 3 4 5 10 15 20

Mammoth Lakes

Mammoth Lakes High School Free Field

CSMIP Sta. No. 54482

Record 54482-S2455-84331.04(1)



Benton

CSMIP Sta. No. 54100

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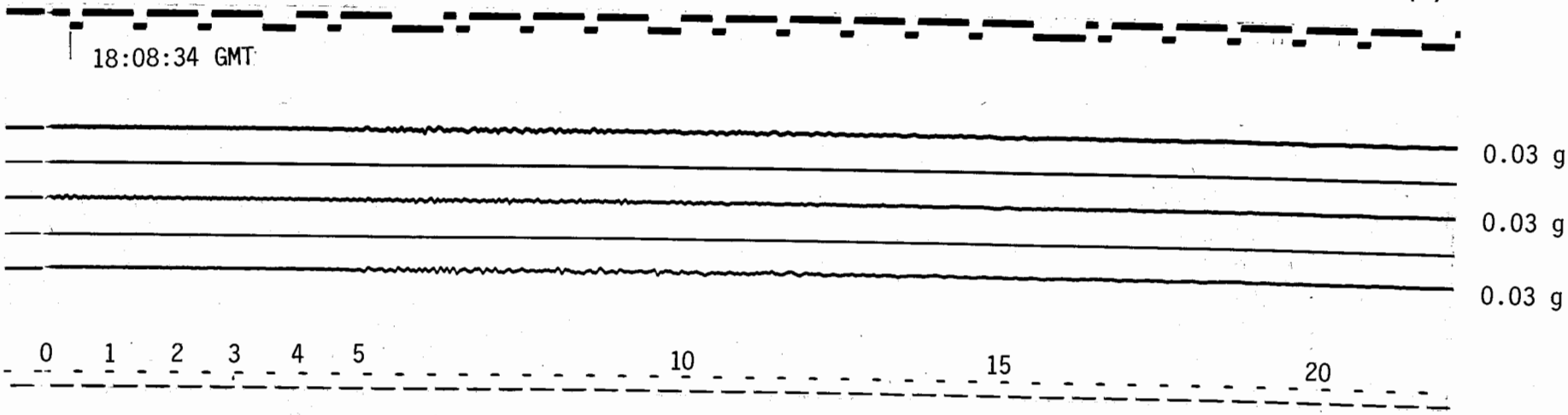
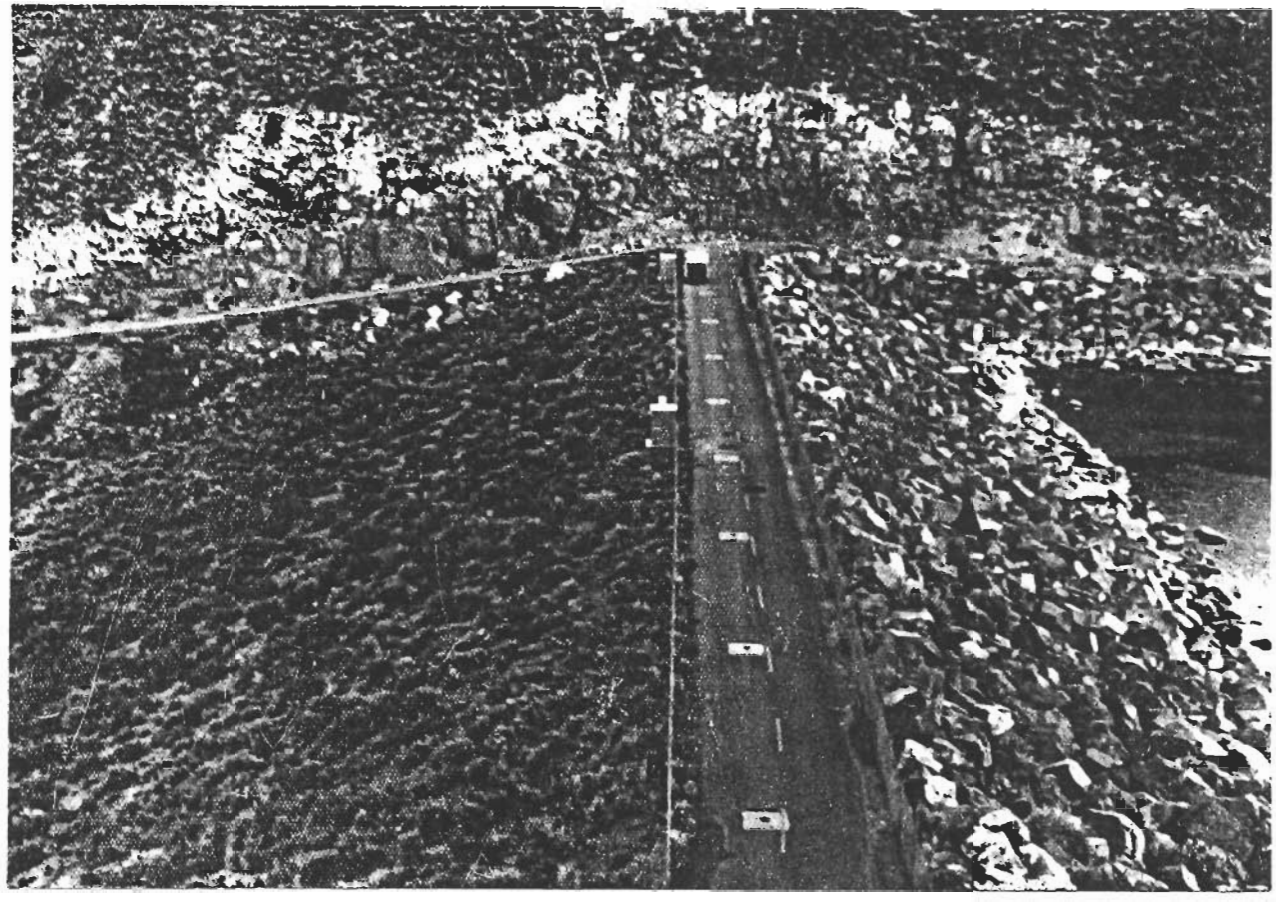


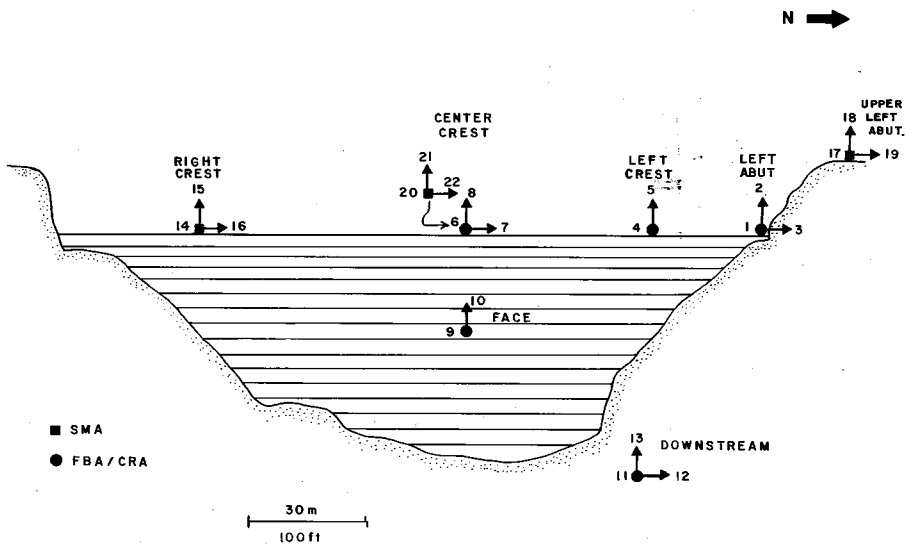
Lake Crowley - Long Valley Dam



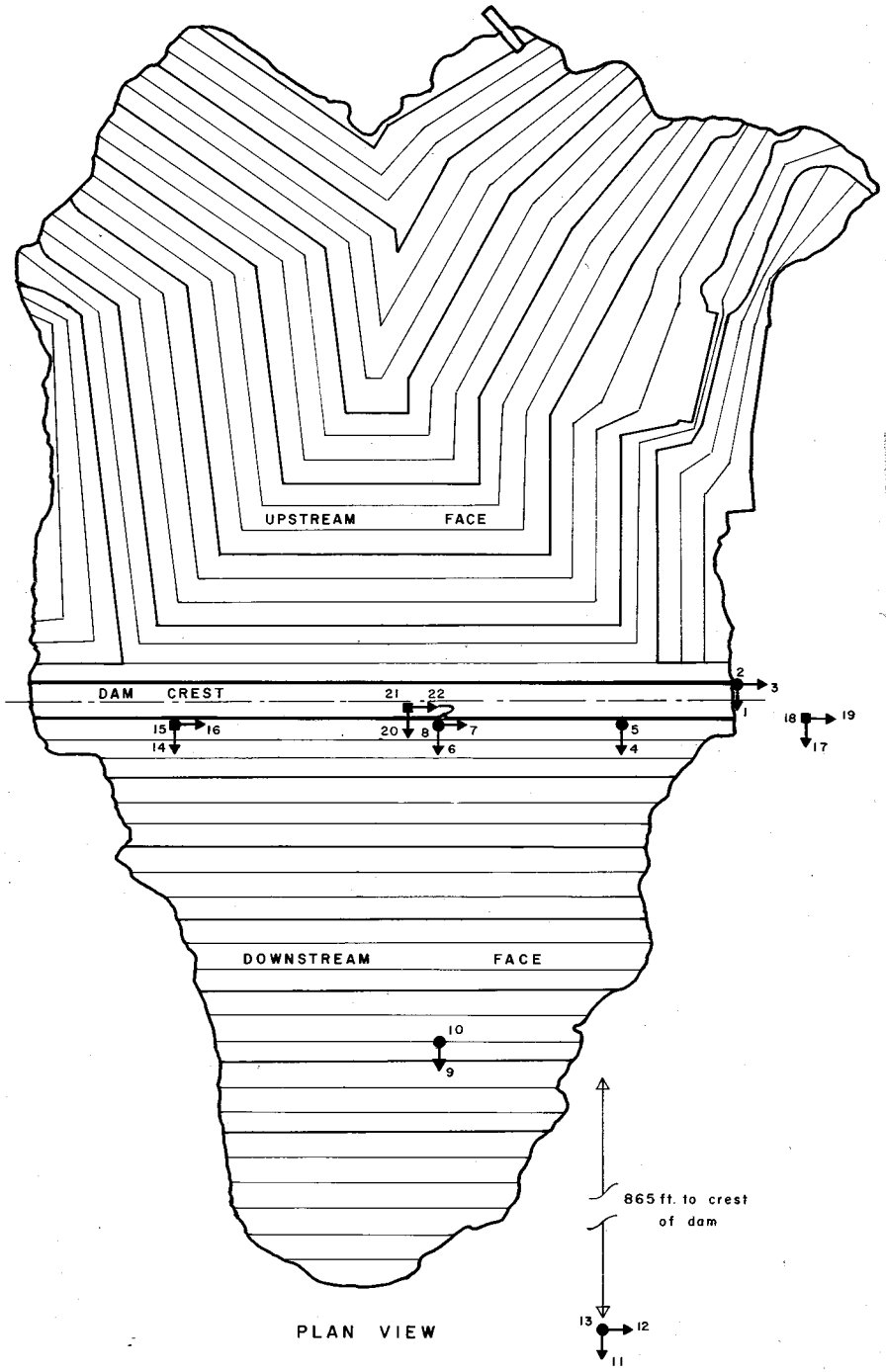
Location: Southeast end of Lake Crowley on Owens River, Mono County, California
Crest Length: 600 ft.
Height of Dam: 125 ft.
Depth of water (max): 111 ft.
Elevation crest of dam: 6791 ft.
Designed 1941, constructed 1942.

Construction: Earthfill dam, compacted earth core, with rip rap on upstream face. Founded on layered, blocky rhyolite deposited in flows 2 - 15 ft thick.

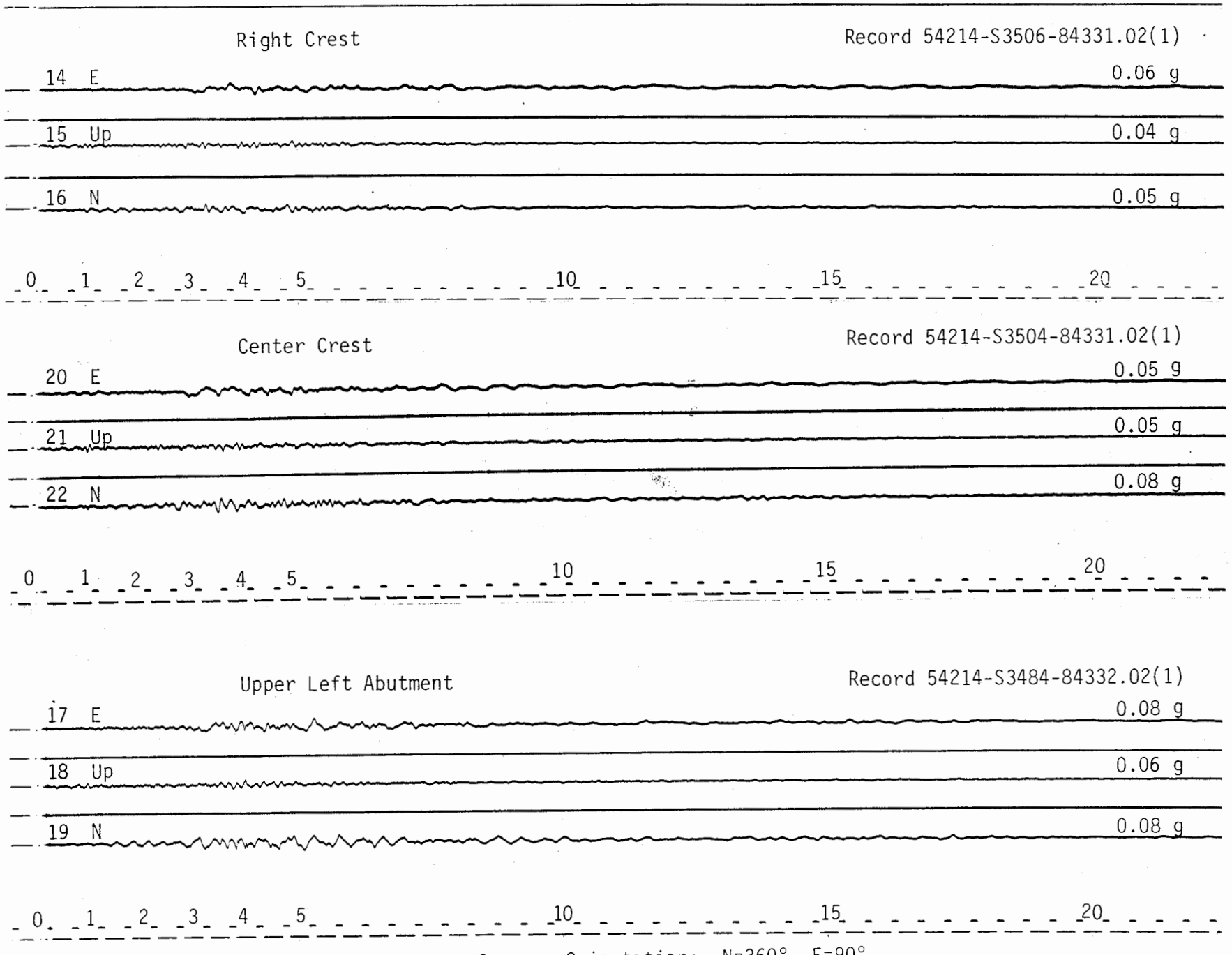
LONG VALLEY DAM



ELEVATION VIEW



PLAN VIEW



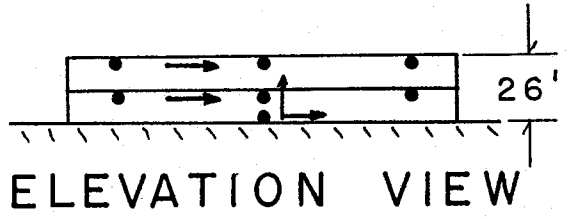
Structure Reference Orientation: N=360°, E=90°

Bishop - 873 Nth. Main Office Building

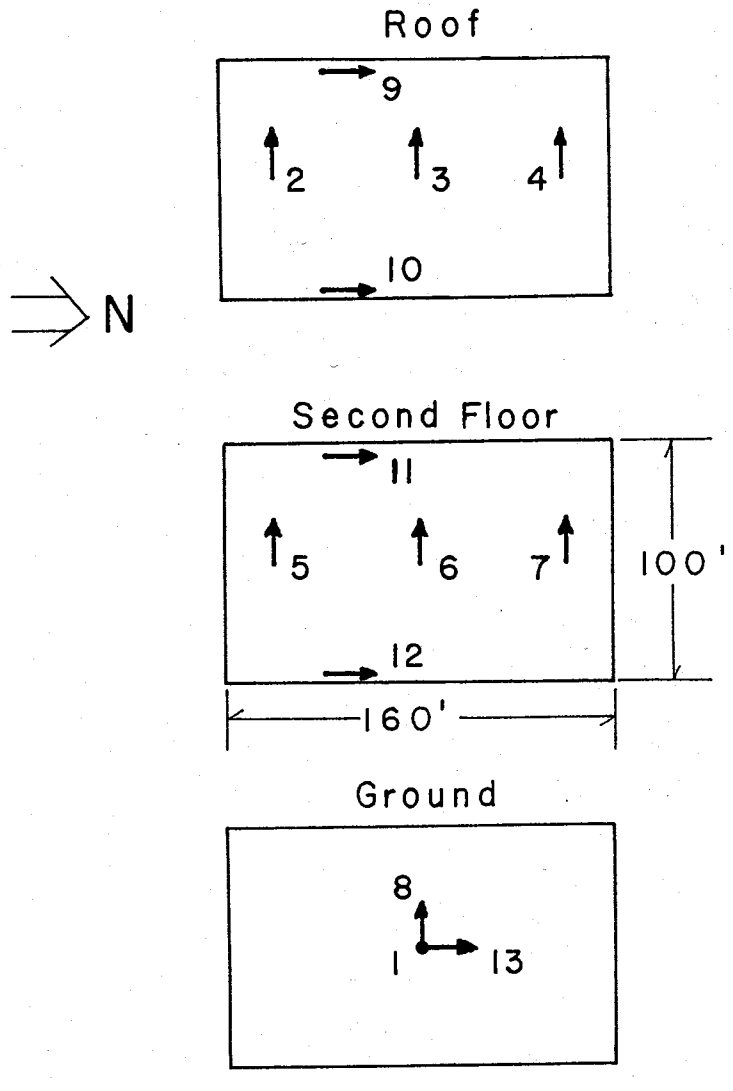
Location: 873 N. Main Street
Bishop, California
No. Stories above
/below ground: 2 / 0
Base Dimensions: 100' x 160'
Designed: 1976, constructed 1976.

Vertical Load Carrying System:
Steel columns, steel trusses, light gauge steel joists.
Lateral Force Resisting System:
Moment resistant frame of steel columns and trusses in transverse direction, steel rod X bracing in exterior walls in longitudinal direction.
Foundation Type: Reinforced-concrete spread footings.

BISHOP - 873 N. MAIN OFFICE BLDG.



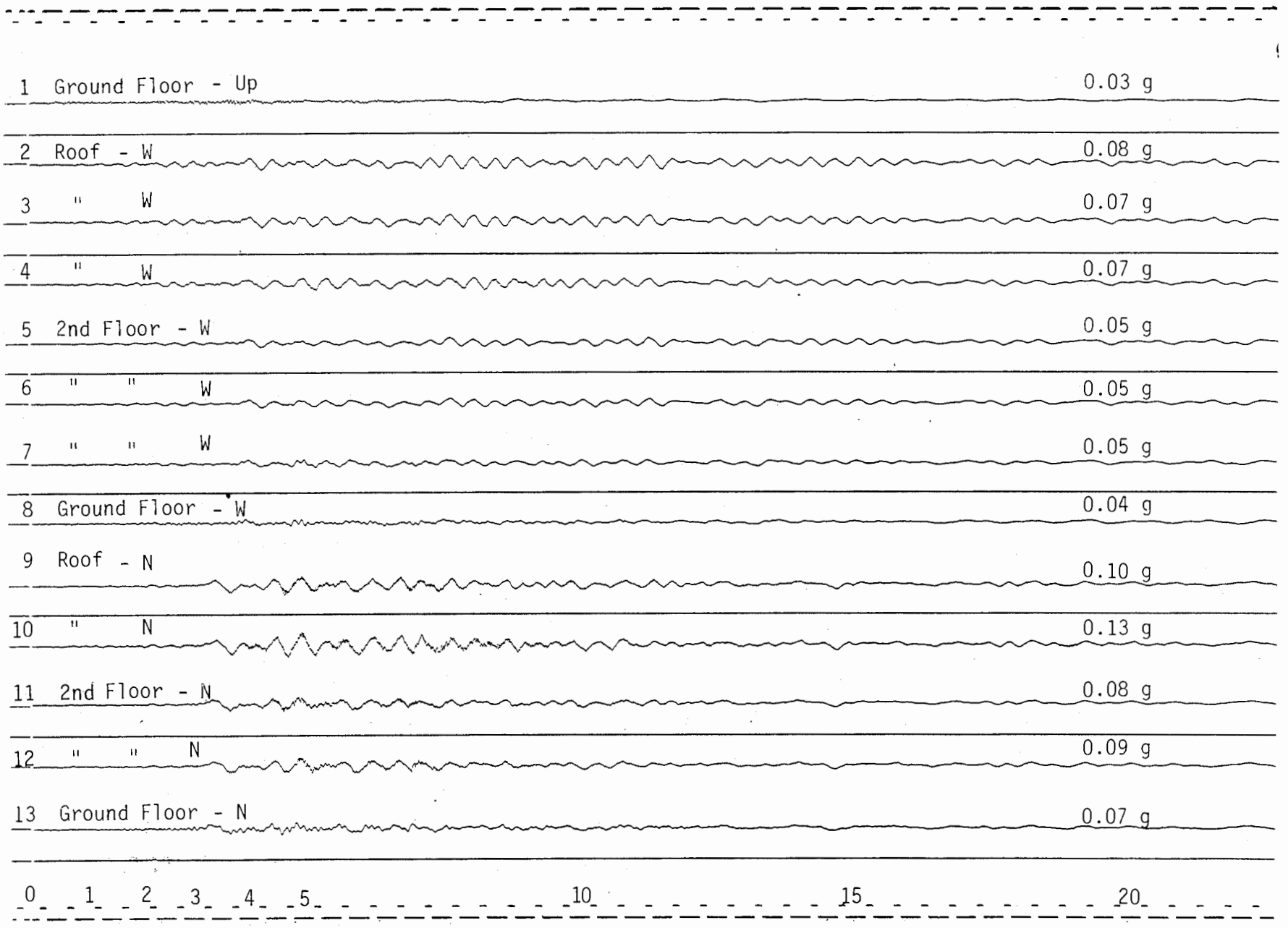
ELEVATION VIEW



PLAN VIEW

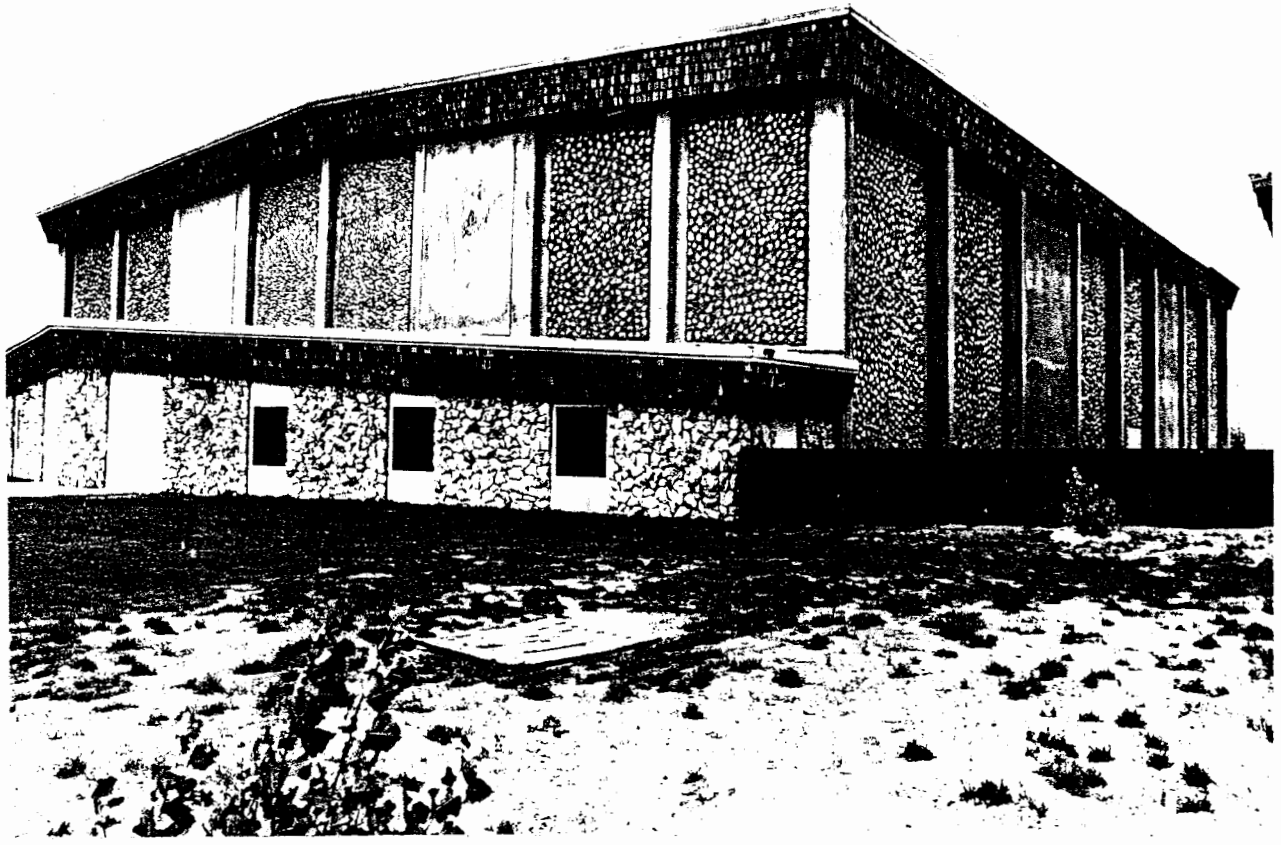
Bishop - 873 North Main St.
CSMIP Sta. No. 54388

Record 54388-C0183-84332.01(1)



Structure Reference Orientation: N=360°, W=270°

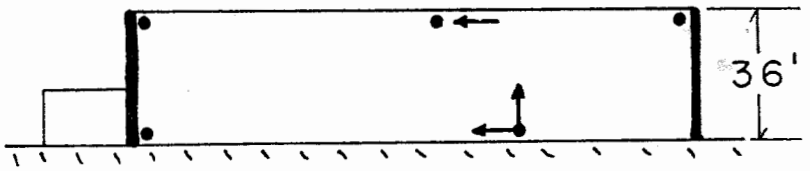
Mammoth Lakes - Mammoth High School Gymnasium



Location: Sierra Park Rd and Meridian Blvd, Mammoth Lakes, CA
No. Stories above /below ground: 1 / 0
Base Dimensions: 110' x 144', plus low-rise 24' entryway at West end.
Designed 1973, constructed 1974.

Vertical Load Carrying System:
2x6 joists 12" o.c. supported by steel trusses, on steel columns.
Lateral Force Resisting System:
Horizontal steel bracing in plane of lower chord of roof trusses; vertical steel bracing encased in reinforced cast-in-place concrete shear walls.
Foundation Type: Reinforced-concrete spread footings.

MAMMOTH LAKES
HIGH SCHOOL GYMNASIUM



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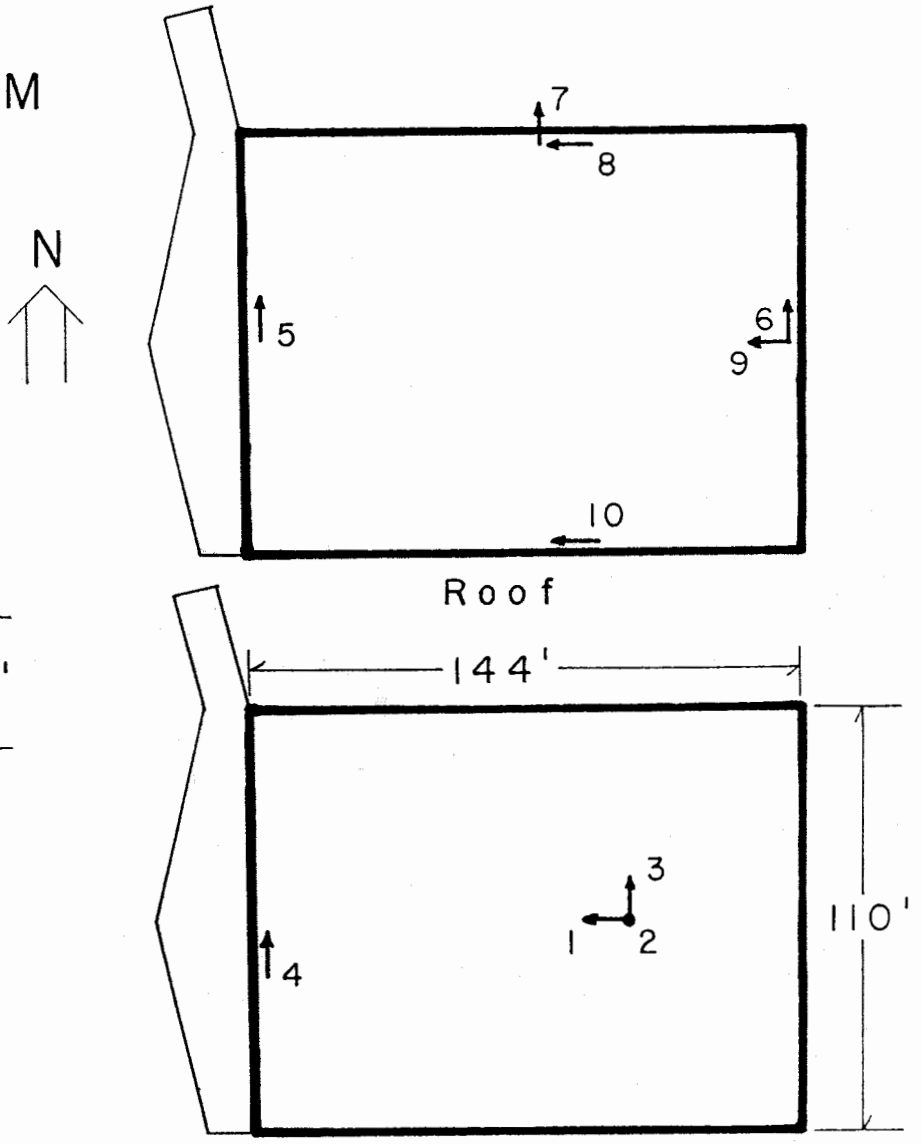


PLAN VIEW

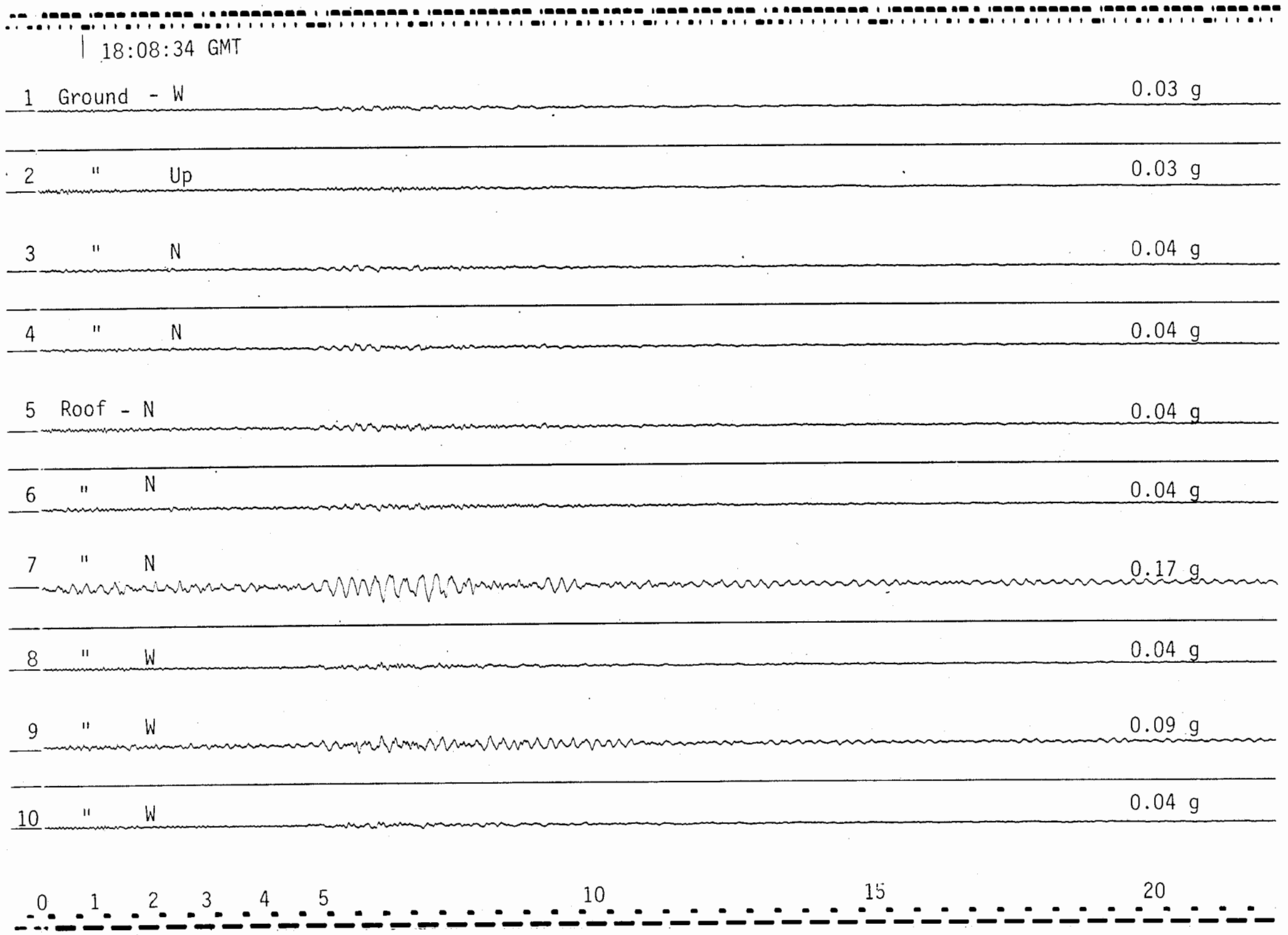
Mammoth Lakes

Mammoth High School Gymnasium

CSMIP Sta. No. 54301

Record 54301-C0135-84331.05(1)

18:08:34 GMT



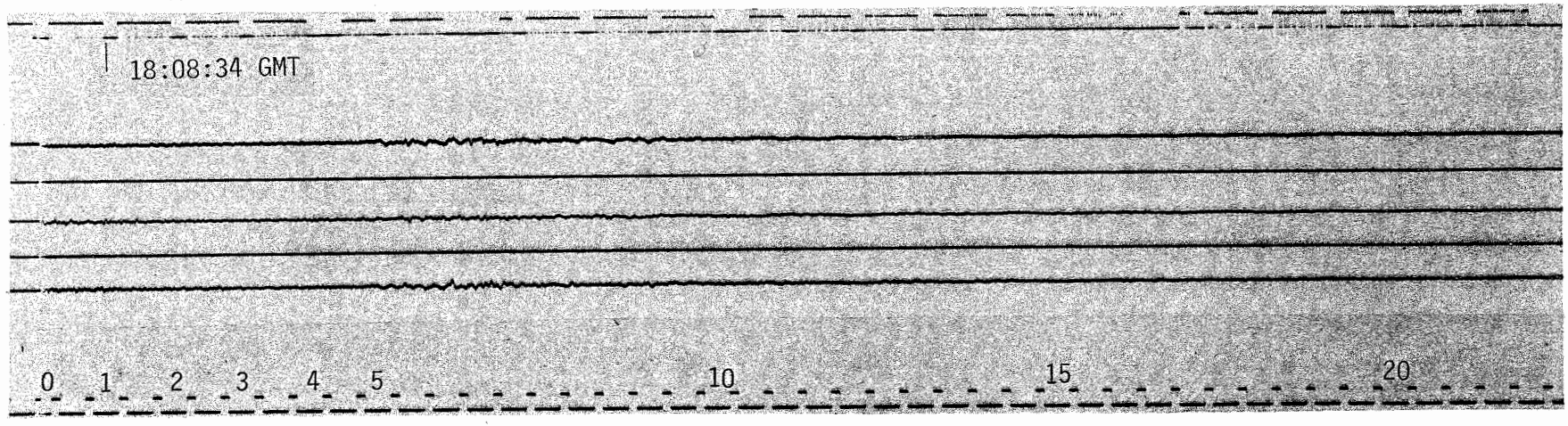
Structure Reference Orientation: N=343°, W=253°

Mammoth Lakes

Mammoth Lakes High School Free Field

CSMIP Sta. No. 54482

Record 54482-S2455-84331.04(1)



(This record also shown in Ground-Motion section, p. 16)

Tinemaha Dam

CSMIP Sta. No. 54361

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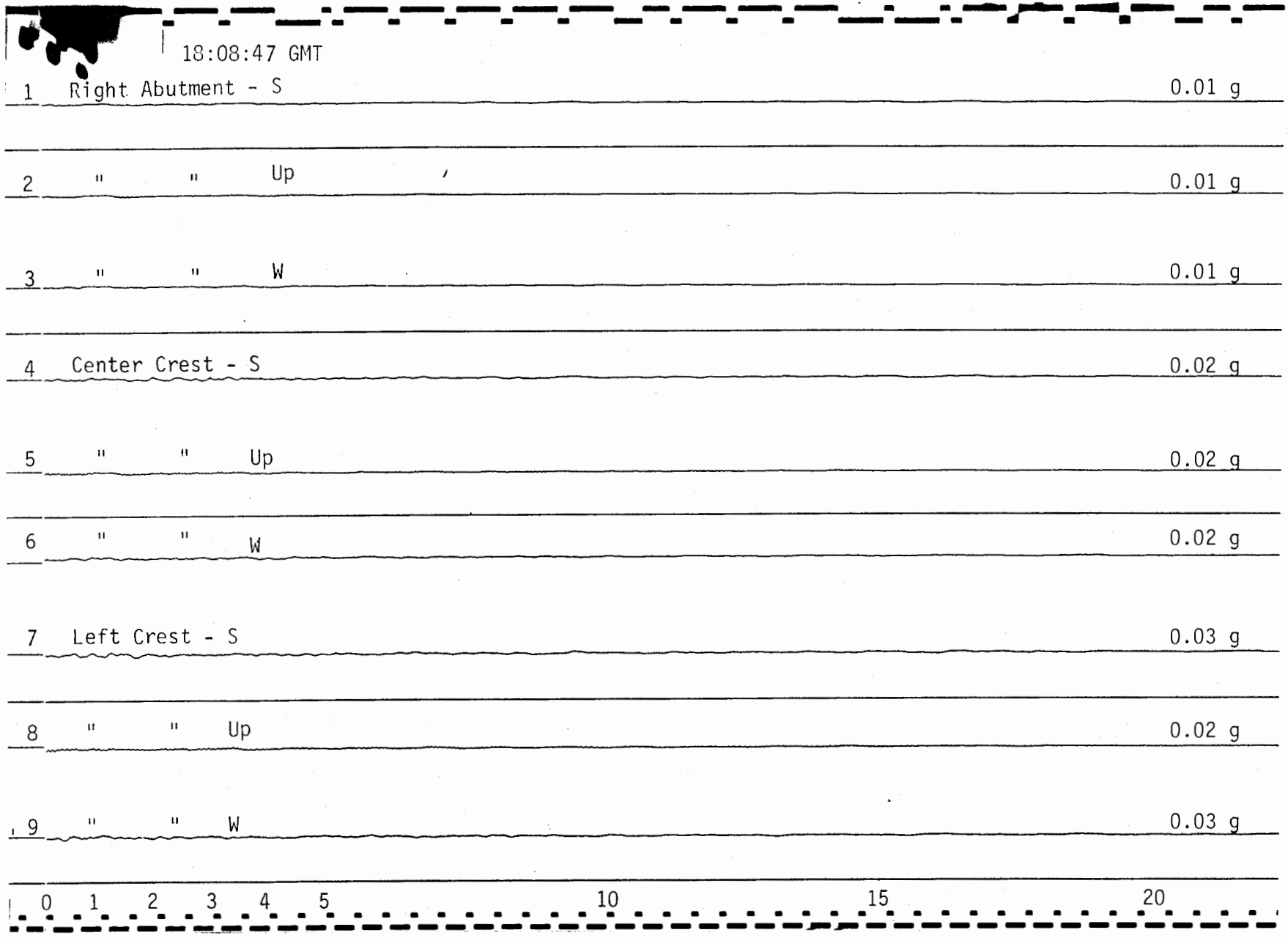

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