DUKE POWER COMPANY

Jocassee Development
Report on the August 25, 1979
Earthquake and its effect on the
Jocassee Structures

1.0 INTRODUCTION

On August 25, 1979 a local magnitude 3.6 earthquake was recorded in the vicinity of Jocassee Development of the Keowee-Toxaway Project. The purpose of this report is to present information on the seismic event and to discuss the effect of the event on the Jocassee Dam and appurtenant structures.

For additional details on the Jocassee Development and a discussion of previous seismic activity refer to "Duke Power Company, Jocassee Development, Jocassee Dam, Seismic Investigation, October 1975 - May 31, 1977, Summary Report" submitted to the Nuclear Regulatory Commission (NRC) on July 19, 1977 and to the Federal Energy Regulatory Commission (FERC) on August 2, 1977. Also refer to "A Report on the Seismic Activity at Lake Jocassee between October 1975 and December 31, 1978" prepared by Dr. Pradeep Talwani of the University of South Carolina submitted to the NRC on February 15, 1979 and to the FERC on March 7, 1979.

Presently Duke has an agreement with the University of South Carolina (USC) to monitor seismicity using three semi-permanent stations Duke has previously installed in the Jocassee area. USC maintains the three field stations and Duke maintains the recording equipment located in the Jocassee Powerhouse. Duke provides the seismograph charts to USC and USC reports unusual activity to Duke and provides Duke with research reports.

2.0 AUGUST 25, 1979 EARTHQUAKE

At 9:31 p.m., on August 25, 1979, a local magnitude 3.6 earthquake was recorded in the Jocassee area. The earthquake was located about 2 miles southwest of the Jocassee Dam and was followed by a series of much smaller aftershocks.

Available particulars for these events are given below:

Date	Time	Mag. (local)	Location Lat/Long	Depth (km)
8/25/79	9:31 pm	3.6	34° 56.84' N/82° 56.69'W	2 to 3
8/25/79	9:45 pm	< 0	34° 56.56' N/82° 56.38'W	2.4
8/26/79	5:48 pm	< 0	34° 56.25' N/82° 56.21'W	4.05
8/27/79	1:07 am	2.0	34° 55.95' N/82° 56.15'W	1.74

From August 27, 1979 to September 4, 1979, 16 events had been recorded with a maximum magnitude of about 0.50.

The magnitude 3.6 event on August 25 was recorded by the three semi-permanent seismograph stations in the Jocassee area. After the event, USC deployed a series of 4 portable stations in the Jocassee area to monitor aftershocks.

The event did not trigger the strong motion instrument, located in the Oconee Nuclear Station which is set to be triggered by .01g acceleration. The Oconee Station is approximately 12 miles from Jocassee.

3.0 EFFECTS OF EARTHQUAKE ON JOCASSEE STRUCTURES

3.1 GENERAL

Immediately following the August 25, 1979 earthquake, the Jocassee Dam and appurtenant structures were inspected by plant personnel to detect any detrimental effects caused by the event. No significant changes were observed in the instrumentation or the structures themselves. On August 31, 1979, the plant structures were again inspected by plant personnel, engineers from Duke's Design Engineering Department and Professor George F. Sowers and Mr. C. E. Sams of Law Engineering Testing Company.

3.2 POWERHOUSE

Some minor cracking was observed for the first time in the Jocassee Powerhouse. In the Powerhouse Control Room, hairline cracks were observed in the glazed tile north wall. In the Cable Room, cracks were observed in the concrete block partition wall. These cracks formed a zig-zag pattern in the mortar joints of the non-structural walls and extended to several blocks on each wall. They have no significantly adverse effect on the powerhouse structure.

Four hairline cracks were also observed, for the first time, across the pipe gallery floor near the west end of the powerhouse. They may have been caused by the event, but could have existed prior to the event. These cracks are not considered to present any safety problems.

3.3 SEEPAGE

As reported in previous referenced reports, seepage through both abutments is collected and monitored. Some minor increases in the seepage readings were observed after the seismic event of August 25, but such variations are within the normal changes caused by rainfall and reservoir fluctuations. Almost three and one half inches of rainfall were recorded in the Jocassee area for the period August 22 through August 26, 1979. The Jocassee Reservoir level was increased from Elevation 1106.7 at midnight on August 24 to Elevation 1109.0 at midnight on August 26.

A Parshall Flume is used to measure cummulative seepage on the west abutment. A recording chart is used to monitor the flow instantaneously. Attached as Figure A is a copy of the chart for the day of August 25, 1979 showing an almost indiscernable increase in the seepage following the seismic event.

3.4 SURFACE MONUMENTS

There are thirteen monuments on the crest of the Jocassee Dam, nine monuments on the downstream side of the crest and four monuments on the upstream side. The monuments are monitored twice yearly for horizontal deflection and vertical settlement.

Readings of the monuments had been made on August 23, 1979 and were taken again, following the event, on August 27, 1979. The maximum vertical settlement recorded was .06 ft. However, the closure error for the vertical measurement was .08 ft. which is considered excessive. A resurvey on September 5, 1979 showed a maximum vertical settlement of .01 ft. with the closure error of .03 ft.,which is within the usual accuracy. The movement due to the earthquake, if any, is very small, when compared to the total settlement recorded to date.

Graphs showing settlement versus time are attached as Figures B-1 for 1973-77 and B-2 for 1978-79. The graphs were plotted using data taken on August 23, 1979 and September 5, 1979.

The readings showed a maximum horizontal deflection of .03 ft. which is very small when compared to the readings to date. Graphs showing horizontal deflection versus time are attached as Figures C-1(a) through C-9(a) for 1973-77 and C-1(b) through C-9(b) for 1978-79. Measurements taken on August 23, 1979 and August 27, 1979 were incorporated in the above plots.

3.5 SLOPE INDICATORS

As discussed in the referenced reports,a longitudinal crack had been noted along the upstream edge of the Jocassee Dam crest in 1973. Two slope indicator tubes were installed at station 14+46 and 14+92 to monitor movement of the crack. The tubes were installed just upstream of the crack and extended through the rock and filter material and into the core.

Prior to the August 25, 1979 earthquake, the slope indicator tubes had shown a maximum deflection in the upstream direction of about 6.5 inches, recorded on July 12, 1979. This deflection was measured at the 10 ft. depth of the tube which is about four feet into the embankment slope.

Readings taken on August 27 and September 4, 1979 show the movement of the tubes at 10 ft. depth to be about 1 inch in the downstream direction, relative to the July 12, 1979 reading,indicating that the shell material moved downstream and closed the crack to some degree.

There appeared to be no significant changes in the lower portion of tube extending into the core material.

Figure D-1(a) and (b) and D-2(a) and (b) are plots of Slope Indicator Tube #1 and #2 respectively and show deflection versus time for selected depths

below the top of the slope indicator tube. Readings of July 12, August 27 and September 4, 1979 were plotted.

The report of Law Engineering Testing Company, the independent consultant attached as Appendix 1 concludes that there were no significant changes as a result of the August 25, 1979 event which could affect the safety of structures.

4.0 CONCLUSION

Based on a thorough inspection of the structures and an evaluation of the dam instrumentation, no detrimental effect of the August 25, 1979 earthquake has been noted on the Jocassee Dam and the appurtenant structures.

Attachments

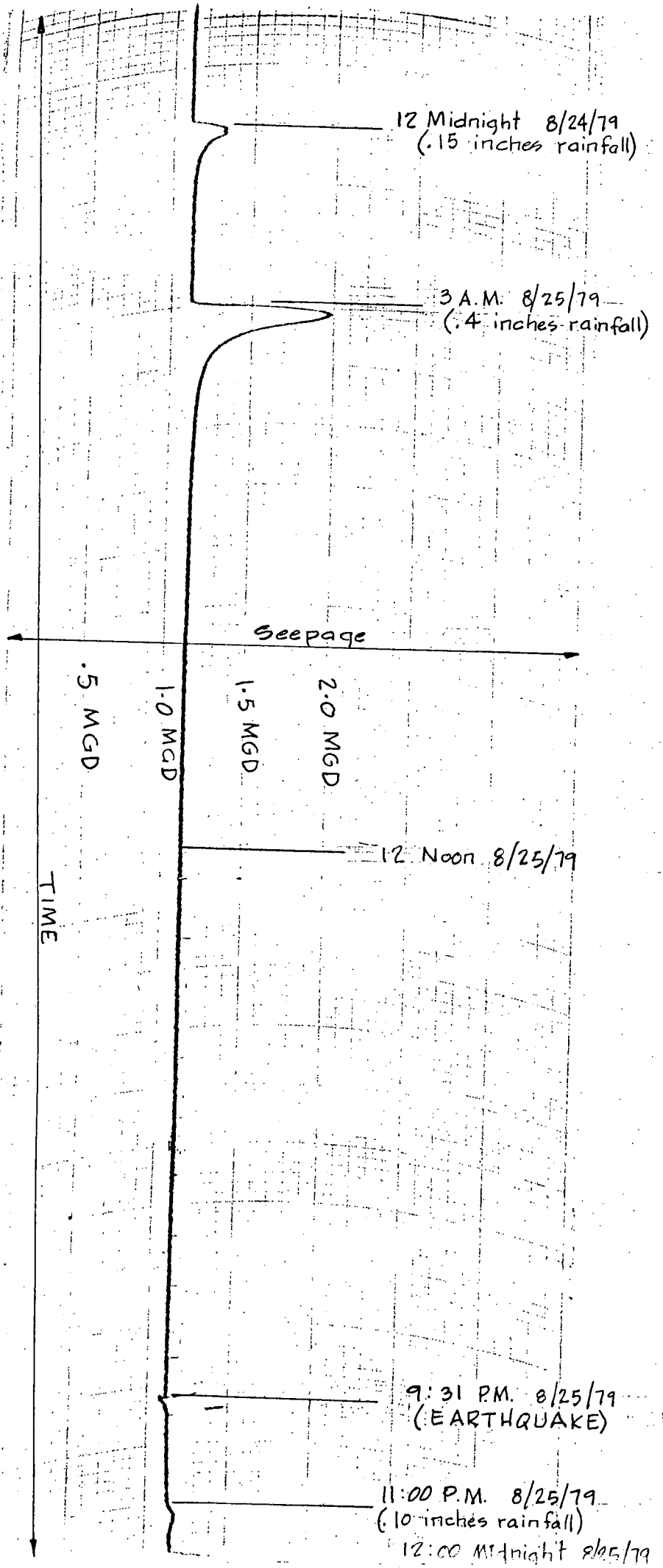
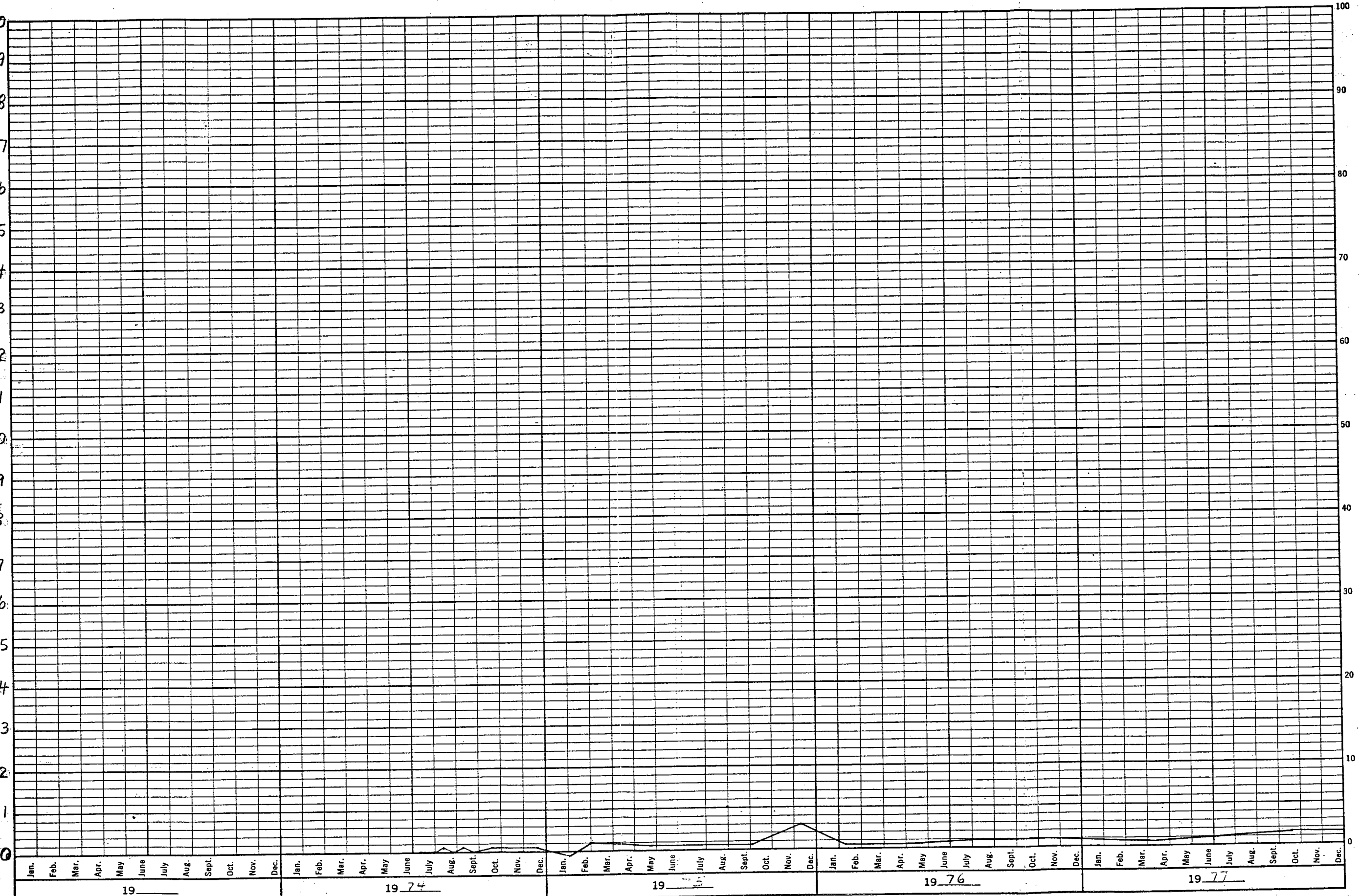


FIGURE A

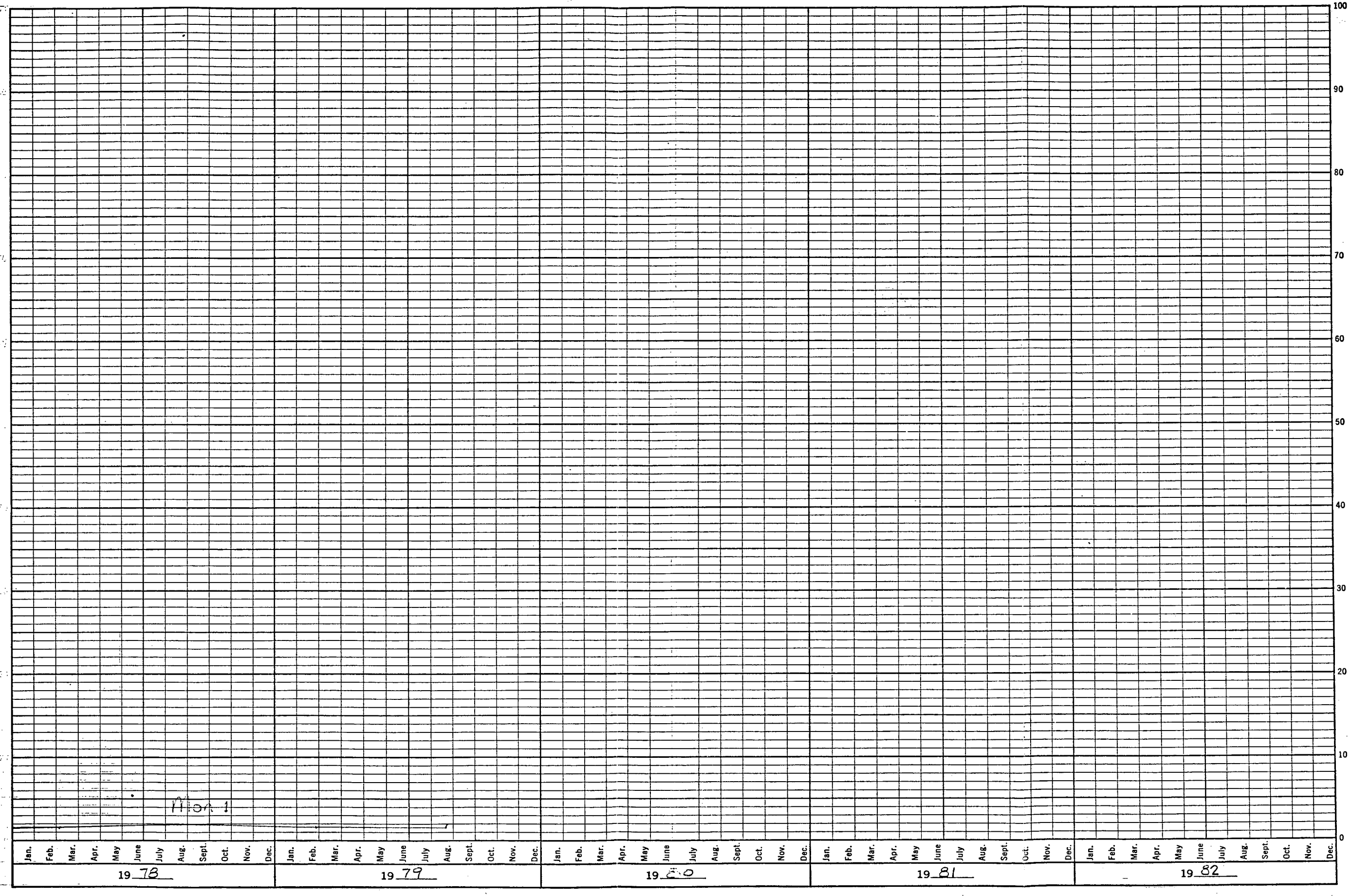
West Abutment Seepage
Parshall Flume Tape
For 8/25/79



KE 5 YEARS BY MONTHS 47 3653 MADE IN U.S.A.
X 100 DIVISIONS
KEUFFEL & ESSER CO.

Monument # 1 at Station 3+00 (Jocassee Dam)

FIGURE C-1(a)



JOCASSEE DAM MONUMENT #1 at STATION 3+00

FIGURE C-1(b)

Horizontal Deflection (Feet)

2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0

100 90 80 70 60 50 40 30 20 10 0

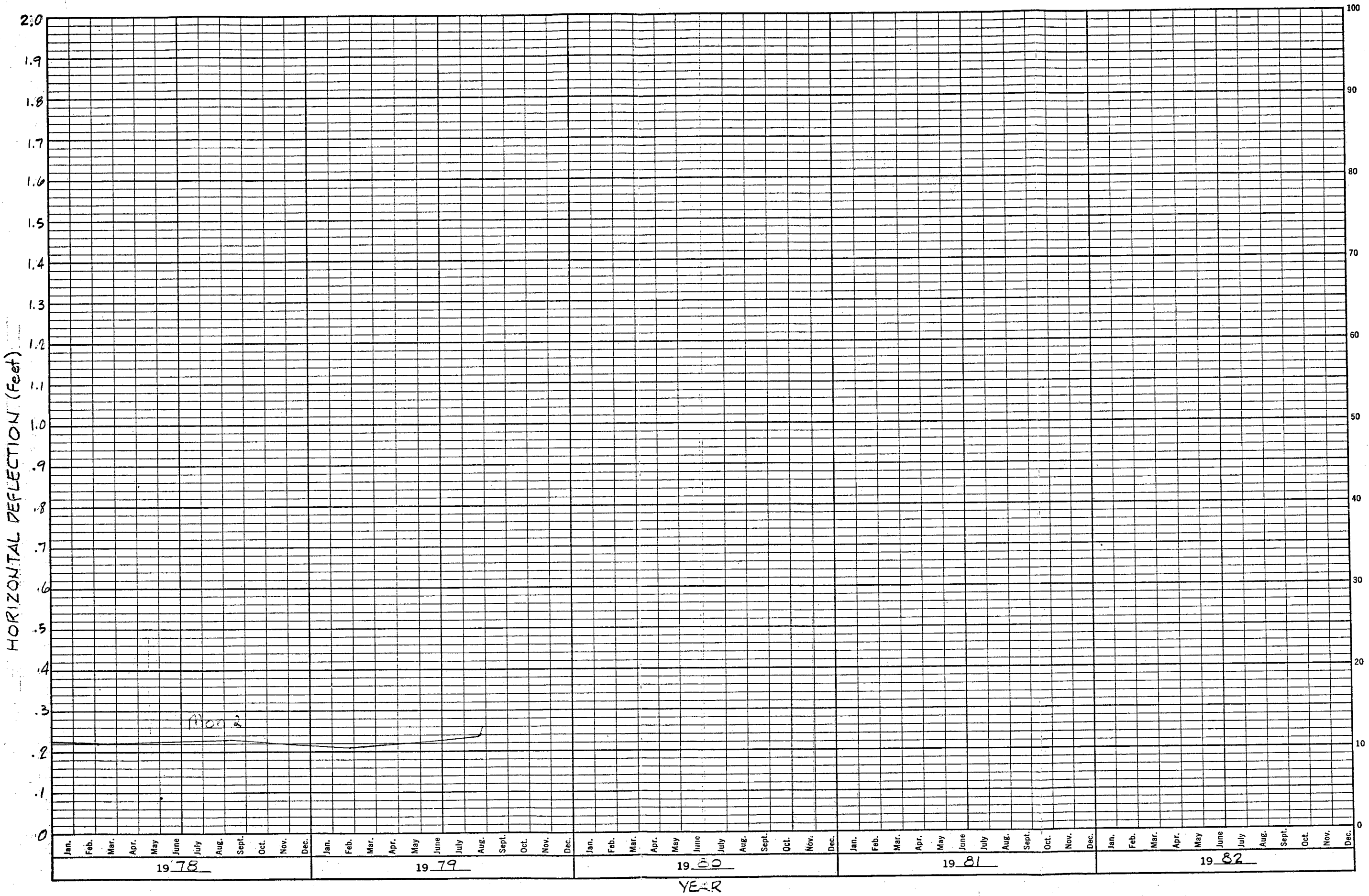
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19____ 19 74 19 75 19 76 19 77

YEAR

Monument # 2 at Station 5+00 (Jocassee Dam)

FIGURE C-2(a)



JOCASSEE DAM MONUMENT #2 at STATION 5+00

FIGURE C-2(b)

Horizontal Deflection (Feet)

2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0

100
90
80
70
60
50
40
30
20
10
0

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 ____ | 19 74 | 19 75 | 19 76 | 19 77

Mon. # 3

Mon. # 3A

YEAR

Monument #'s 3 & 3A at Sta. 7+00 (Jocassee Dam)

FIGURE C-3(a).

HORIZONTAL DEFLECTION (Feet)

2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0

100
90
80
70
60
50
40
30
20
10
0

MON. 3

MON. 3A

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 78 | 19 79 | 19 80 | 19 81 | 19 82

YEAR

JOCASSEE DAM - MONUMENT #'s 3 & 3A at STATION 7+00

FIGURE C-3(b)

Horizontal Deflection (Feet)

2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0

100 90 80 70 60 50 40 30 20 10 0

Mon. # 4

Mon. # 4A

Disturbed by Motor Grader

New Mon. Set

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 ____ | 19 74 | 19 75 | 19 76 | 19 77

YEAR

Monument #'s 4 & 4A at Sta. 9+00 (Jocassee Dam)

FIGURE C-4(a)

HORIZONTAL DEFLECTION (Feet)

2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0

100 90 80 70 60 50 40 30 20 10 0

Mon. 4

Mon. 4A

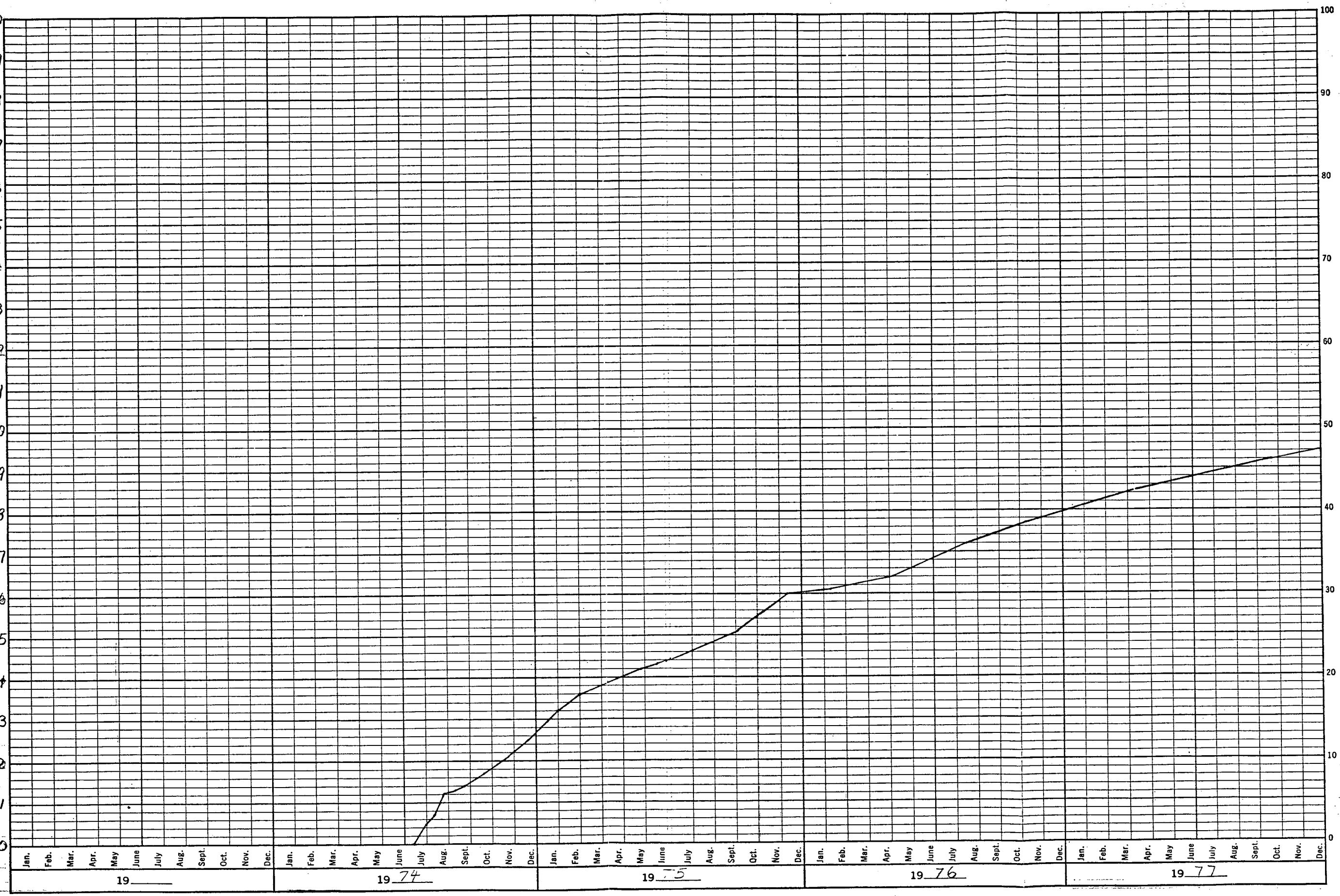
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 78 | 19 79 | 19 80 | 19 81 | 19 82

YEAR

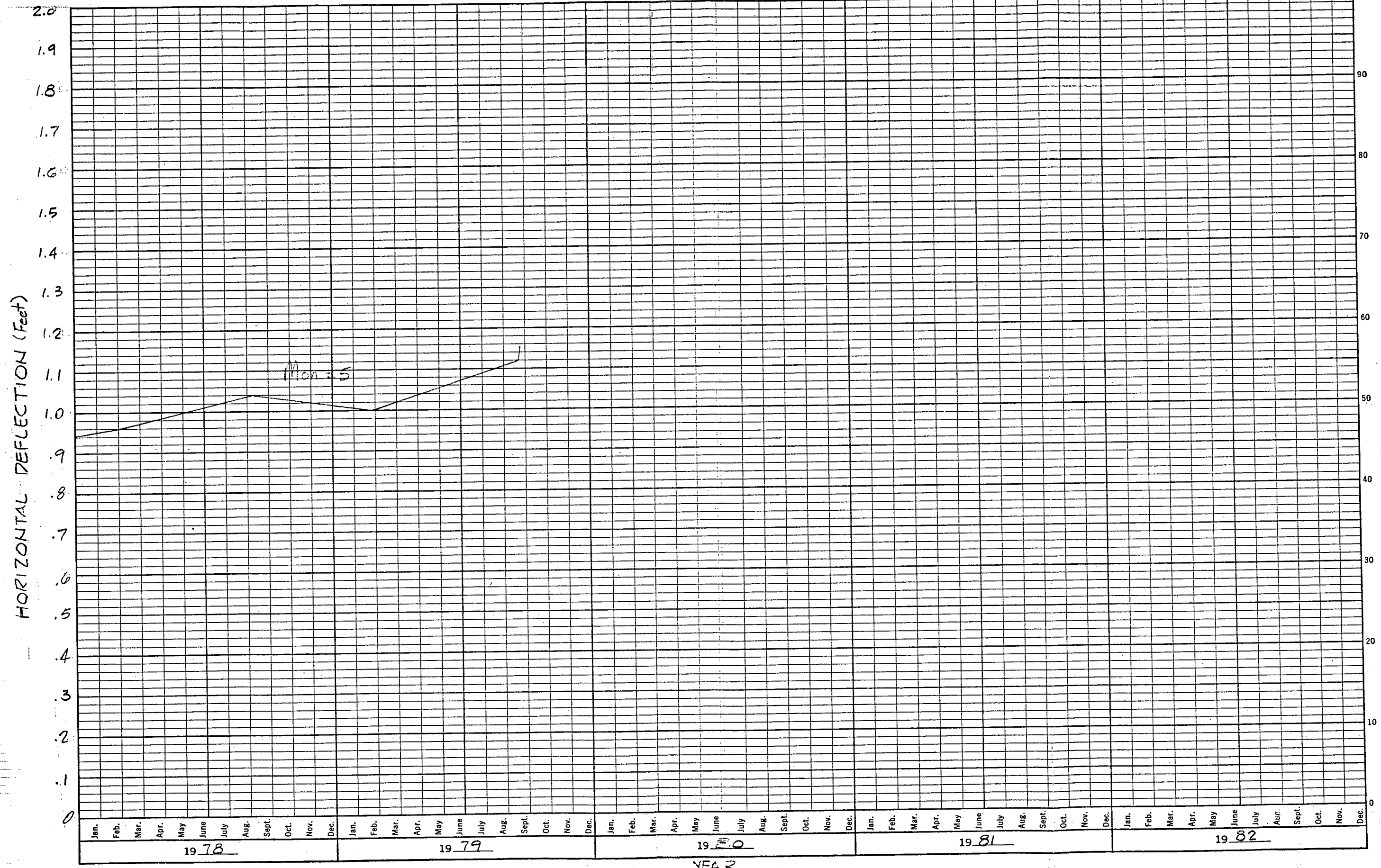
JOCASSEE DAM MONUMENT #'s 4 & 4A at STATION 9+00

FIGURE C-4(b)



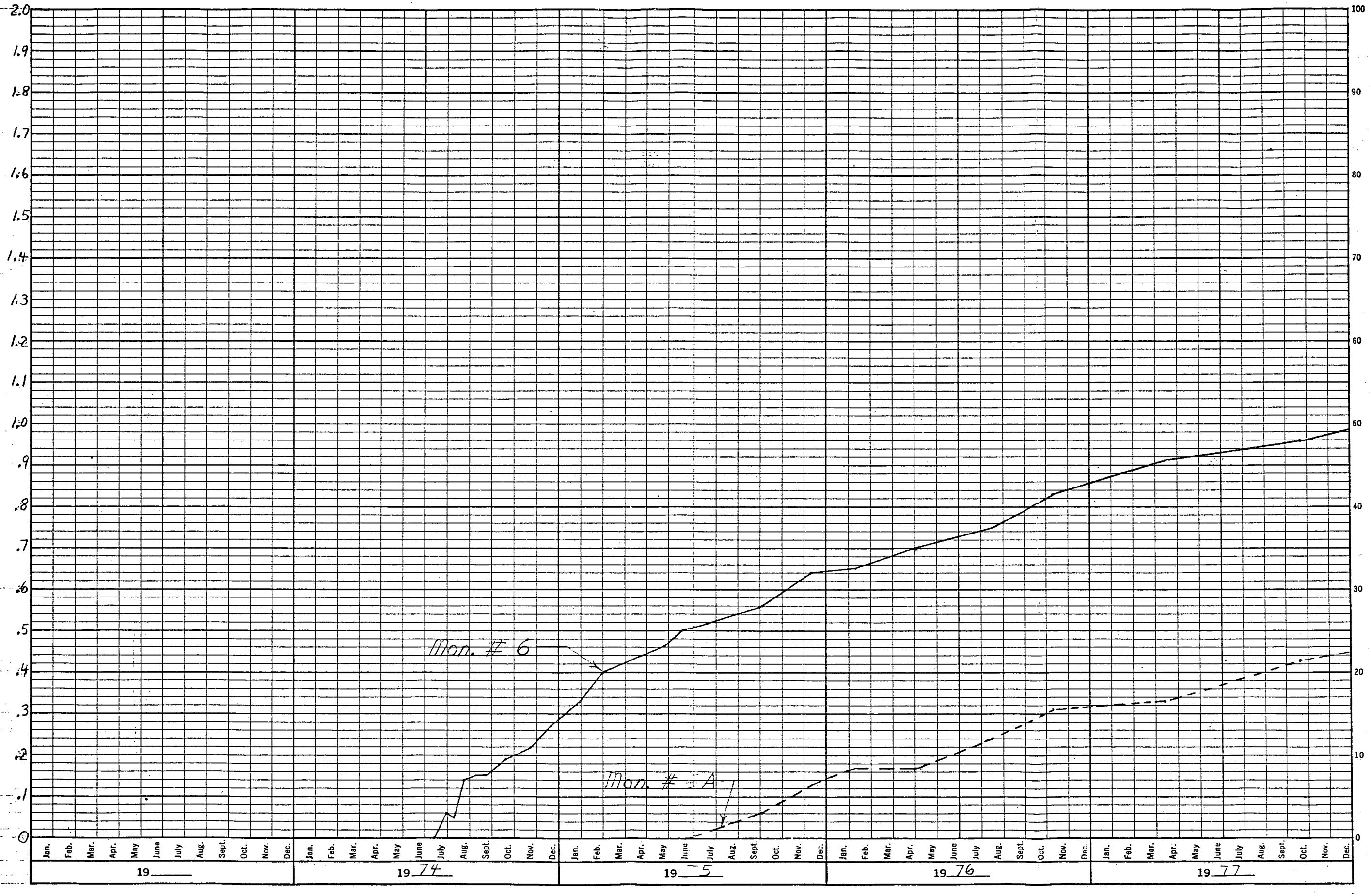
Monument # 5 at Station 11+00 (Jocassee Dam)

FIGURE C-5(a)



JOCASSEE DAM MONUMENT #5 at STATION 11+00

FIGURE C-5(b)



Monument #'s 6 & 6A at Sta. 13+00 (Jocassee Dam)

FIGURE C. 6(a)

HORIZONTAL DEFLECTION (Feet)

2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0

100 90 80 70 60 50 40 30 20 10 0

Nov. 6

Nov. 6A

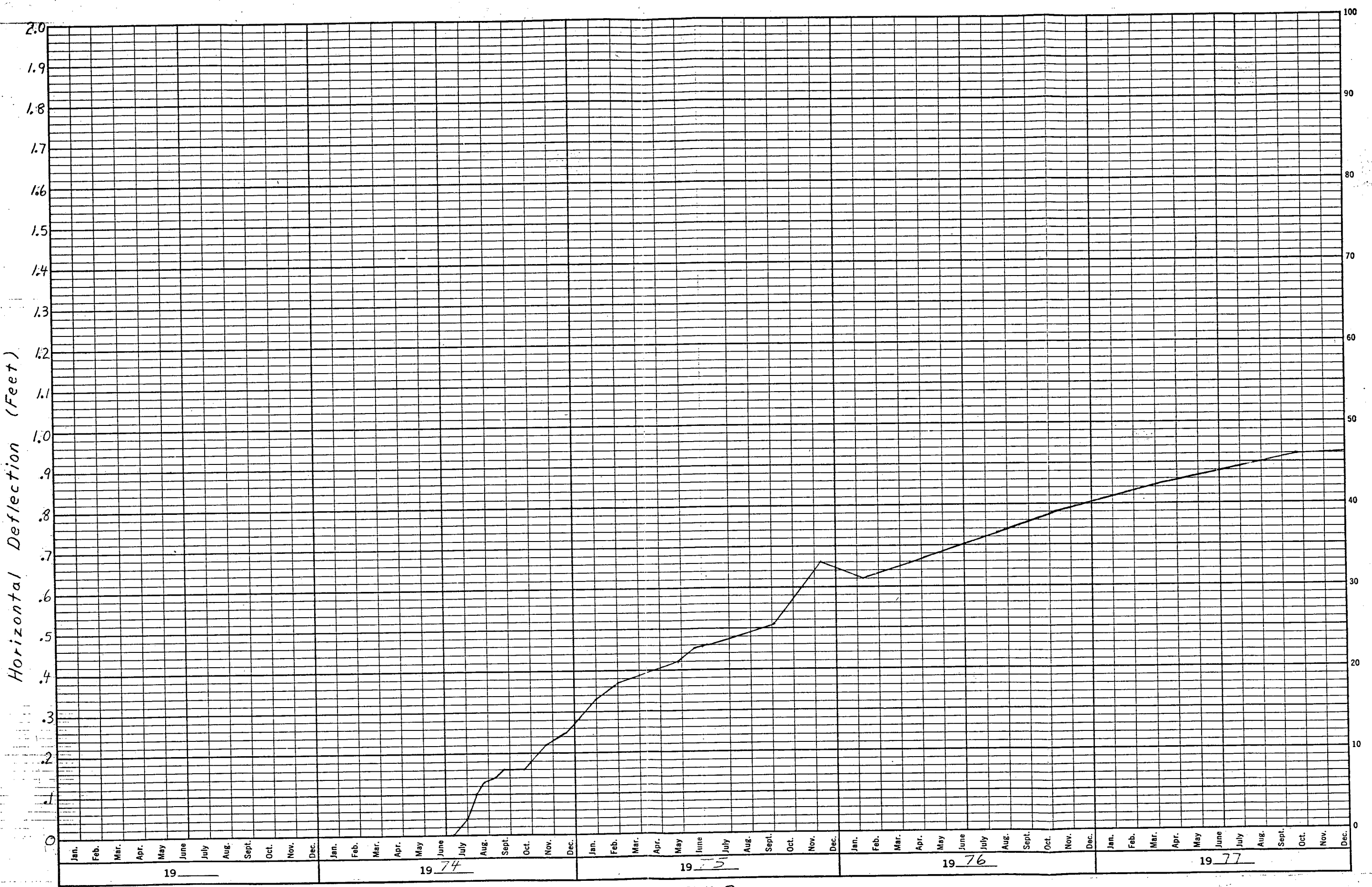
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 78 | 19 79 | 19 80 | 19 81 | 19 82

YEAR

JOCASSEE DAM - MONUMENT #'s G & GA at STATION 13+00

FIGURE C-6(b)



Monument # 7 at Station 15+00 (Jocassee Dam)

FIGURE C-7(a)

HORIZONTAL DEFLECTION (Feet)

2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0

Mon 7

100
90
80
70
60
50
40
30
20
10
0

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 78 | 19 79 | 19 80 | 19 81 | 19 82

YEAR

JOCASSEE DAM MONUMENT #7 at STATION 15+00

FIGURE C-7

Horizontal Deflection (Feet)

2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0

100
90
80
70
60
50
40
30
20
10
0

Mon. # 8

Mon. # 8A

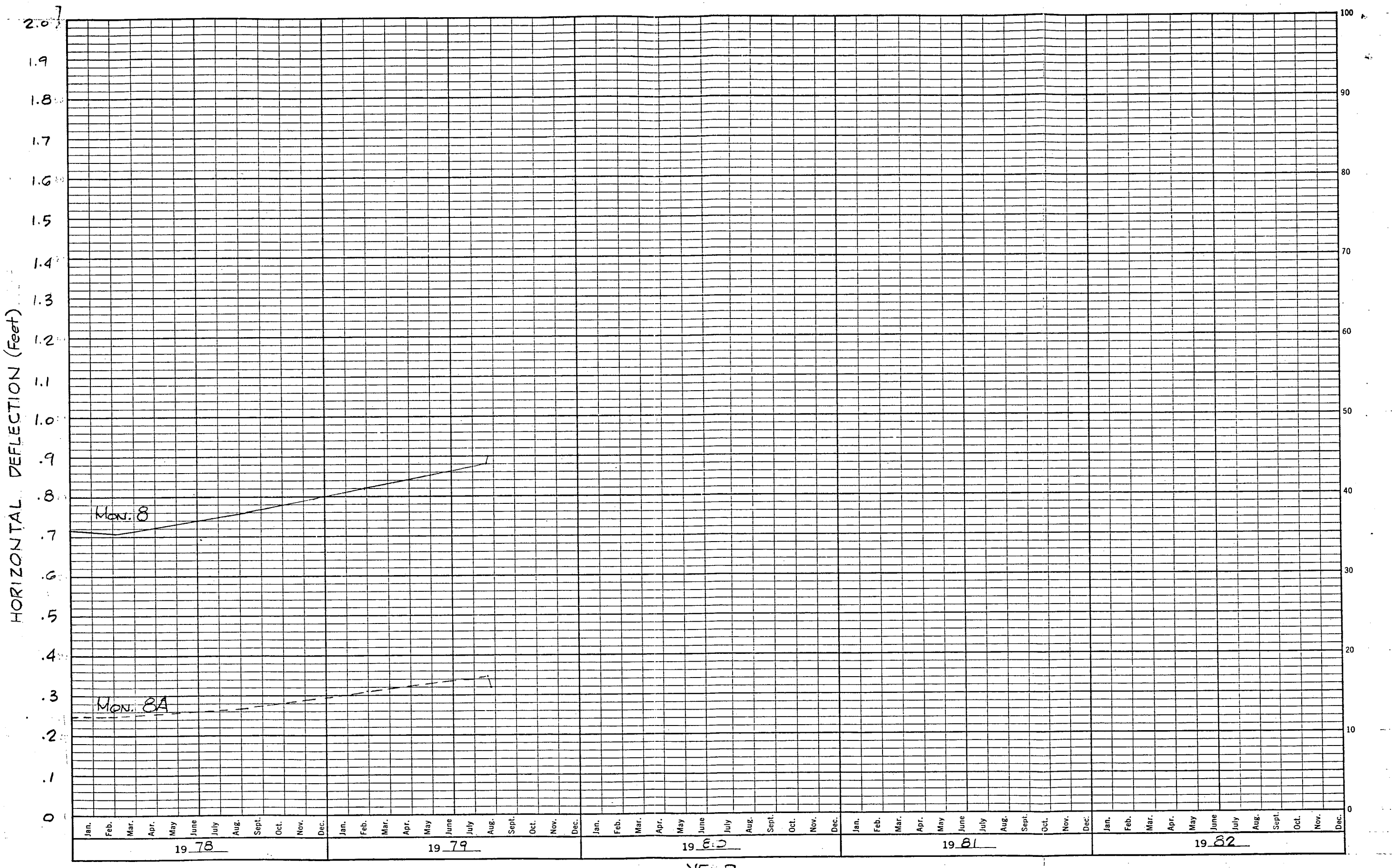
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 ____ | 19 74 | 19 75 | 19 76 | 19 77

YEAR

Monument #'s 8 & 8A at Station 17+00 (Jocassee Dam)

FIGURE C-8(a)



JOCASSEE DAM MONUMENT #'s 8 & 8A at STATION 17+00

FIGURE C-86

Horizontal Deflection (Feet)

2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0

100 90 80 70 60 50 40 30 20 10 0

Destroyed

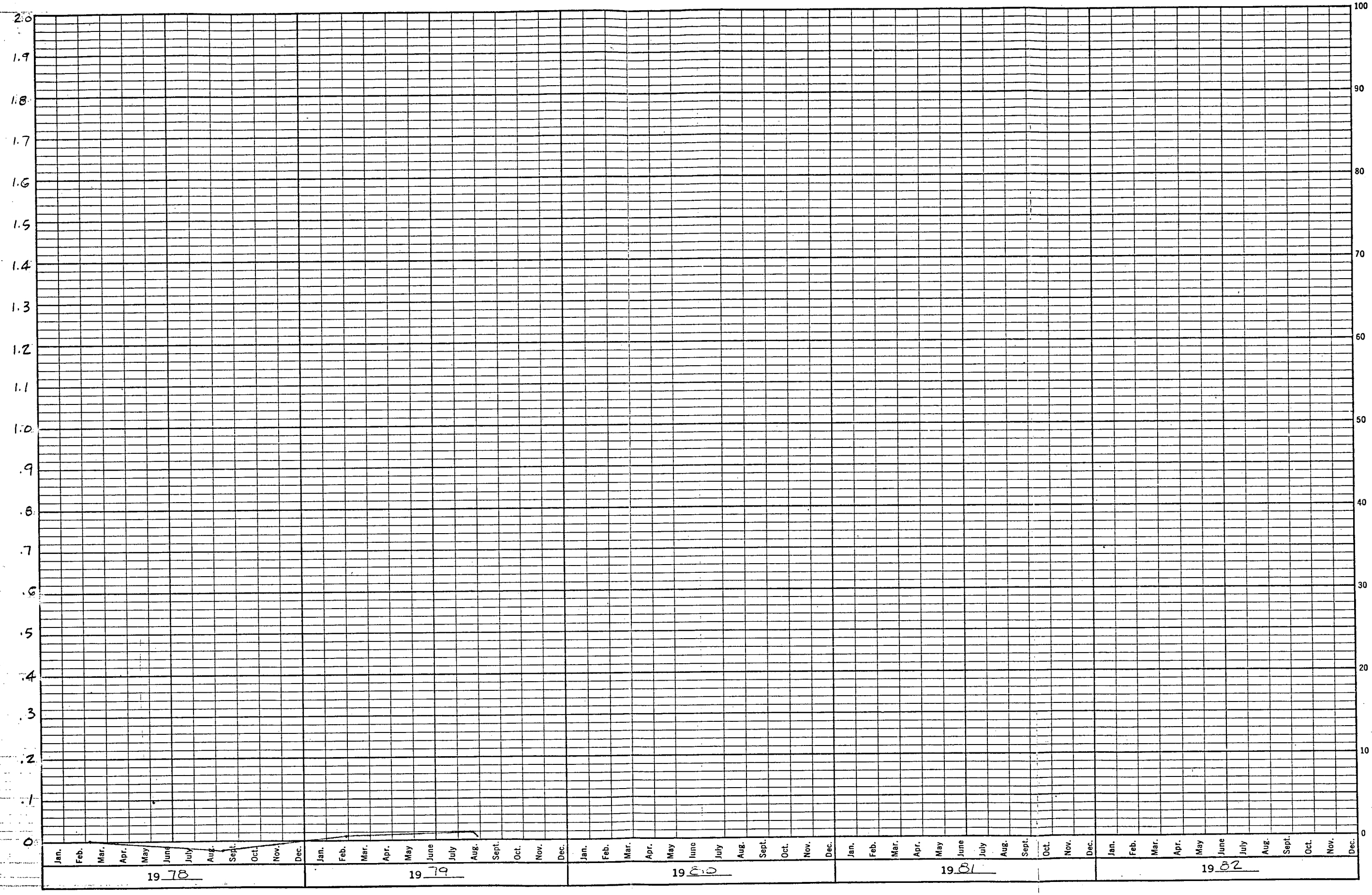
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 ____ | 19 74 | 19 75 | 19 76 | 19 77

YEAR

Monument # 9 at Station 19+00 (Jocassee Dam)

FIGURE C-9a



JOCASSEE DAM - MONUMENT # 9 at STATION 19+00

FIGURE-C-9(b)

DEFLECTION (inches)

7
6
5
4
3
2
1
0
-1
-2
-3

UPSTREAM

DOWNSTREAM

10 FT. DEPTH

14 FT. DEPTH

30 FT. DEPTH

20 FT. DEPTH

LAW ENGINEERING READINGS

DUKE READINGS

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 73 | 19 74 | 19 75 | 19 76 | 19 77

K&E 5 YEARS BY MONTHS X 100 DIVISIONS KEUFFEL & ESSER CO. 359-192L MADE IN U.S.A.

JOCASSEE DAM SLOPE INDICATOR #1 STATION 14+46

FIGURE D.1(a)

SHEET 1

DEFLECTION (inches)

8 100
7 90
6 80
5 70
4 60
3 50
2 40
1 30
0 20
-1 10
-2 0

10 FT. DEPTH

14 FT. DEPTH

30 FT. DEPTH

20 FT. DEPTH

100
90
80
70
60
50
40
30
20
10
0

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 78 | 19 79 | 19 80 | 19 81 | 19 82

— — — LAW ENGINEERING READINGS
——— DUKE READINGS

K+E 5 YEARS BY MONTHS 47 3653
X 100 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

JOCASSEE DAM SLOPE INDICATOR #1 STATION 14+46

FIGURE D-1(b)
SHEET 2

DEFLECTION (inches)

7
6
5
4
3
2
1
0
-1
-2
-3

UPSTREAM

DOWNSTREAM

10 FT. DEPTH

12 FT. DEPTH

30 FT. DEPTH

20 FT. DEPTH

LAW ENGINEERING READINGS

DUKE READINGS

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

1973 | 1974 | 1975 | 1976 | 1977

K+E 359-192L 5 YEARS BY MONTHS X 100 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.

JOCASSEE DAM SLOPE INDICATOR #2 STATION 14+92

FIGURE D-2(a)

SHEET 1

DEFLECTION (inches)

8 7 6 5 4 3 2 1 0 -1 -2

100 90 80 70 60 50 40 30 20 10 0

10 FT. DEPTH

12 FT. DEPTH

30 FT. DEPTH

20 FT. DEPTH

LAW ENGINEERING READINGS

DUKE READINGS

Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

19 78 | 19 79 | 19 80 | 19 81 | 19 82

K&E 5 YEARS BY MONTHS X 100 DIVISIONS KEUFFEL & ESSER CO. 47 3653 MADE IN U.S.A.

JOCASSEE DAM SLOPE INDICATOR # 2 STATION 14+92

FIGURE D-2(b)
SHEET 2

APPENDIX 1

Law Engineering Testing Company
Report on Effect of Earthquake
of August 25, 1979 on Integrity of
Jocassee Dam

September 17, 1979

Mr. S. B. Hager, Chief Engineer
Civil-Environmental Division
Duke Power Company
422 South Church Street
Charlotte, North Carolina 28242

Subject: Effect of Earthquake of August 25, 1979 on Integrity of Jocassee Dam

Dear Mr. Hager:

At your request Professor George Sowers and Mr. Clay Sams, accompanied by engineers from the Duke Power Company, Charlotte, made an inspection of Jocassee Dam on Friday afternoon and evening of August 31. An earthquake of local magnitude 3.6 occurred Saturday evening, August 25, 1979. As with other earthquakes in the region where shocks are very infrequent, people were alarmed by the sound and motion associated with the event. Their accounts were magnified in person-to-person transmission to persons outside the area into alarming rumors that questioned the safety of the dam.

Three high magnification seismometers continue to monitor ground motion. These have been maintained by the University of South Carolina and are the subject of separate reports. According to Dr. Talwani, the epicenter was downstream and southwest of the dam about 2-3 km.

There were two objectives in our inspection: 1) to make an independent inspection of the dam including a review of the data already collected by Duke Power as a part of their regular monitoring program and, 2) to examine specific phenomena that had been objects of rumored public concern.

Rumored Damage

In addition to specious reports regarding abutment leaks, there were rumors regarding damage to a school and movement of a boat.

Dr. Talwani's team examined the school at Salem where cracks had been reported. They found that there were no cracks caused by the earthquake.

At the time of the earthquake, Mr. Clyde Pelfrey was fishing in a boat about 1/4 mile downstream and somewhat west of the dam. He was probably within a mile of the epicenter. He told us that he felt a sharp upward force or thump on the bottom of the boat. The sensation was like the boat bottom rising one inch. This sensation is consistent with the sensation of the bottom of one's foot being "slapped" when standing directly above a tunnel in which blasting occurs.

Unfortunately his account became distorted by person to person transmission. The story that reached us was that his boat rose 1 inch above the water surface.

Evaluation of Instrumentation

The on-going instrumentation and data gathering provide quantitative data on the continuing performance of the dam. The records through the years have shown slow settlement and deflection of the dam as well as continuous seepage from the abutments. All are influenced by reservoir fluctuation. The abutment seepage is also influenced by rainfall.

In the two week period commencing one week before the earthquake, the reservoir fluctuations were only a few feet. Rainfall, however, was heavy throughout the period; nearly 6 inches total with about half the first week and half the second.

In general the instrumentation has disclosed some small changes following the earthquake. Most of the changes that have been measured are small compared to the long-term changes--so small that they probably would not have been subject to special scrutiny except for the earthquake.

The observation wells have exhibited no changes except for W-4. The level in W-4 dropped about 5 feet following the earthquake and has remained at that lower level since. The well is on the right abutment downstream of the dam axis in the area in which the greatest abutment seepage occurs. A drop in piezometric level downstream of the axis is not an indication of impending trouble. We conclude that the piezometric data reveal nothing hazardous to the dam.

The weirs either indicate no flow change or a very slight increase following the earthquake. The chart recording for flow through the Parshall flume on the right abutment showed practically no increase in flow - less than the width of the recorder pentip, if any, which would correspond to less than 10 gpm out of a total between 700 and 800 gpm. The fluctuations are well within the range previously observed. There is nothing in the weir records to suggest any significant change in the abutment seepage patterns. According to Duke's technician who monitors these readings, there has been no show of silt in any of the weirs. We conclude that there has been no significant change in abutment seepage caused by the earthquake.

Surface Monuments

Observations of crest settlement and horizontal movement are made at regular intervals by theodolite and precise levels. Such readings had been made on August 23, 2 days before the earthquake. New measurements were ordered by Duke immediately after the event. They were made on August 27 and indicate small settlement of the crest, negligible on the right or west abutment and increasing toward the left abutment. The greatest indicated settlement was 0.7 inches adjacent to the left abutment in the same area the greatest crest settlement has occurred since the dam was constructed. There was also an indicated slight movement of the crest in a downstream direction, amounting to 0.36 inches near mid-length of the dam.

The closing error in the August 27 level traverse was 0.96 inches, greater than the usual 0.36 inches or less. A re-survey of elevation was made on September 5, and indicated settlement since August 23 of 0.12 inches at practically all points along the crest. The September 5 survey had a closing error within the usual range, and is thus believed to be more representative of actual settlement than the August 27 survey. Thus, this suggests the crest settlements were even less than indicated by the August 27 level traverse. In either case, both the settlement and the

deflection are very small compared to the continuing small dam movements. Interestingly enough, the area on the upstream face that previously exhibited surficial movement showed no abnormal movement. We conclude that the observed movements are only what should be expected and that they indicate no unusual behavior nor distress.

Examination

The dam had already been examined by Mr. Raleigh Martin, the technician who is responsible for the continuing weir and piezometer records. He noted no changes in areas of previous surface rock movement: the right abutment berm and the upstream surface near the left abutment. He did feel that there might have been a slight subsidence of the dumped rock on the right abutment bench near well W-4; however, he could point to no specific change.

We examined the right abutment, its rock-covered bench, the crest of the dam, the left abutment and made a traverse down the downstream face and along the berm at elevation 925 on the downstream face. We could find no evidence of any movement of rock or change in the rock fill surface on the west abutment bench, the crest, or the toe. Some rocks loosely piled on one-another at angles approaching the rock friction angle were not displaced. Surprisingly the surficial rock slides previously observed had not been re-activated. We did find 3 scattered rocks weighing 20 to 75 pounds on the downstream berm that had fresh impact spalls, suggesting that these had rolled downward 2 to 5 feet. Considering the millions of rocks loosely dumped on the dam surface at a slope approaching the angle of repose, it is surprising that more had not been dislodged. Although there were several large rocks on the berm, an examination disclosed intact moss and other evidence that these rocks had been in their present locations for a long time. Moreover, Mr. Martin specifically remembered seeing them previously.

Two inclinometers spaced 46 ft apart, extending 40-45 ft below the crest of the dam and located at the top of the upstream slope were installed in November, 1973, to evaluate the depth of movement causing longitudinal cracking along the upstream edge of the dam crest. These inclinometers have verified the Consulting Board's conclusion that the movements causing the crack were surficial in nature, and involved only the upstream shell material. (The Consulting Board concluded that the longitudinal tension crack was the result of unequal strains between the core and upstream shell produced by the normal deflection and settlement of the dam.) These inclinometers were read on July 12, 1979, and

again on August 27, 2 days after the earthquake. They indicated the upper 12 to 14 ft of upstream slope shell material in the vicinity of the inclinometers moved "downstream" by up to about an inch. We interpret this to simply be the shell material "settling" back into the tension crack. The inclinometers showed no appreciable change in readings in the casing length within the core. We conclude that the inclinometer readings are perfectly consistent with previous data concerning this longitudinal crack, and are of no consequence to the integrity of the dam.

We conclude that the embankment exhibits no change as a result of the earthquake and that the few surface rock movements that occurred are of no significance.

Reservoir

Mr. Martin examined the reservoir rim adjacent to the dam by boat. The rim appears unchanged. He did note a few loose rock in the rim of the old quarry that might have rolled or slid downward. It is our opinion that such loose rock movements are to be expected either from earth tremors or severe weather.

Power House

After the earthquake, the Duke Power operating staff made a thorough examination of the power house for any signs of distress. Cracks were noted in two areas: 1) in the control room walls and 2) in the floor of the level of the pipe gallery, particularly of the east end. Although these cracks had not been previously noted there had been no regular inspection for cracks and therefore it is not certain if they were quake-related.

We examined these cracks in detail, (including using a magnifying glass). The control room cracks are in thin walls that are not structural (load supporting). There are zig-zag cracks in mortar joints in glazed tile on the north side of the control room. This wall rests on the floor and is separated from the structural wall about 6 inches, but with spaced metal ties. The cracks are as wide as 1/16 inch. They could have been caused by long-term structural deflection; they could have been enlarged by vibration. They are not characteristics of structural damage caused by earthquake motion. There are also mortar joint cracks in a concrete block partition, generally less than 1/16 inch wide. These could be shrinkage but could have been aggravated by vibration. They are not characteristic of structural damage caused by earthquake motion.

Several cracks in the floor of the pipe gallery extend upstream from the turbine pit walls to the downstream face of the structure. They are uniformly about 1/32 inch wide, relatively straight, and appear to extend through the slab. Two exhibit water staining, showing that they have been present for some time, probably years. Although there are no stains in the others a close examination shows all of them to be identical. It is our opinion that these cracks have been present for an indeterminate period. Their orientation suggest that they are temperature or shrinkage cracks. They are not characteristic of structural distortion produced by earthquakes.

We recommend that gage points to set on all of these and that they be observed for the effects of temperature and reservoir loading.

Conclusion

We conclude that there is no evidence of any impairment of function or reduction of safety in Jocassee Dam as a result of the earthquake on August 25, 1979.

Very truly yours,

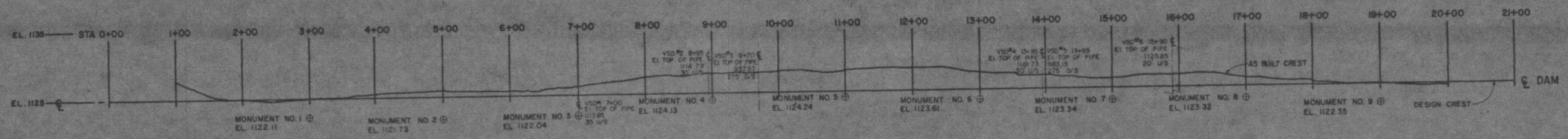
LAW ENGINEERING TESTING COMPANY

Clay E. Sams

Clay E. Sams, P. E.
Geotechnical Consultant
Registered, S. C. 3667

George F. Sowers, P. E.
Sr. Geotechnical Consultant
Registered, S. C. 6231

CES/GFS/tmc



STA. 3+00 MONUMENT NO. 1
STA. 5+00 NO. 2
STA. 7+00 NO. 3 NO. 3A
STA. 9+00 NO. 4 NO. 4A
STA. 11+00 NO. 5
STA. 13+00 NO. 6 NO. 6A
STA. 15+00 NO. 7
STA. 17+00 NO. 8 NO. 8A
STA. 19+00 NO. 9

SETTLEMENT IN FEET 0 2 4 6 8 1 12 14 16 18 2,0 2 4 6 8 1 12 14 16 18 2,0 2 4 6 8 1 12 14 16 18 2,0 2 4 6 8 1 12 14 16 18 2,0 2 4 6 8 1 12 14 16 18 2,0 2 4 6 8 1 12 14 16 8 2

1973: JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
1974: JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
1975: JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
1976: JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
1977: JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER

50-269/270/287
LTR 10-3-79
7910090237

NO.	REVISIONS	CHKD	APPR	DATE	INSPECTED CIVIL	ELEC	MECH.

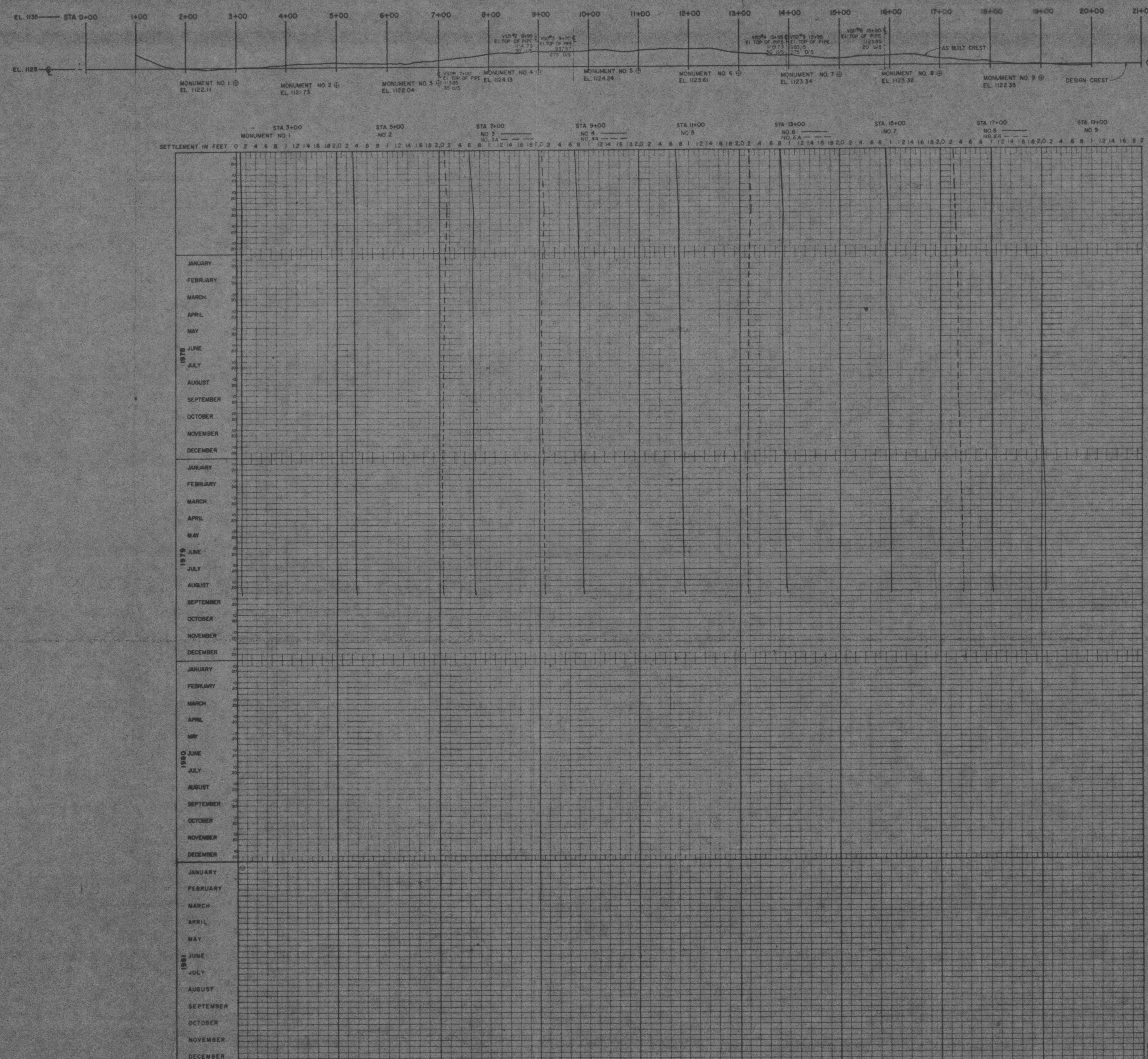
DUKE POWER COMPANY
JOCASSEE DAM

SURFACE SETTLEMENT MONUMENTS ALONG CREST

DESIGNED ____ DATE ____ DRFT ____ DATE ____
DRAWN P.C. L. PITM DATE 8-3-78 TRSD ____ DATE ____
CHECKED ____ DATE ____ APVD ____ DATE ____

DWG. NO. FIGURE B-1

Vertical Deflection



DUKE POWER COMPANY
JOCASSEE DAM

SURFACE SETTLEMENT MONUMENTS ALONG CREST

DESIGNER	DATE	INSP.	DATE
DRAWN	DATE	INSP.	DATE
CHECKED	DATE	APPR.	DATE

REVISIONS

DWG. NO. FIGURE B-2

Vertical Deflection

50-269/270/287
Ltr 10-3-79 7910090237