



**US Army Corps  
of Engineers  
Omaha District**

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**Annual Report - 1992  
Tributary Reservoir Regulation Activities  
(August 1991 - July 1992)**

**Prepared by:  
Water Control Section  
Hydrologic Engineering Branch  
Engineering Division  
Omaha, Nebraska**

**DECEMBER 1992**

# Report Documentation Page

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MISSOURI RIVER DIVISION  
OMAHA DISTRICT  
SUMMARY OF 1991-1992  
RESERVOIR REGULATION ACTIVITIES

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**This report is the Omaha District's portion of the Missouri River Division's 1991-1992  
Annual Report on Reservoir Regulation Activities**

**MISSOURI RIVER DIVISION  
OMAHA DISTRICT  
SUMMARY OF 1991-1992**

**I. PURPOSE AND SCOPE.** This annual report summarizes significant tributary reservoir regulation activities and tributary flooding within the geographic boundaries of the Omaha District. The period covered by this report is 1 August 1991 through 31 July 1992 and is referred to as the report period.

**II. REFERENCES.**

- a. ER 1110-2-1400, 24 April 1970.
- b. ER 1110-2-240, 8 October 1982.
- c. Missouri River Division Letter, 1 October 1970, subject: Reservoir Regulation Reports.

**III. RESERVOIRS IN THE OMAHA DISTRICT.** The Omaha District, Corps of Engineers, civil works boundaries include 414,900 square miles that comprise the Missouri River watershed above Rulo, Nebraska.

a. **Reservoirs with Flood Control Storage.** There are 35 tributary reservoirs with allocated flood control storage covered in this report. The dams are listed below. Included are 24 Corps of Engineers dams and 11 Bureau of Reclamation dams. The locations of these 35 tributary reservoirs are shown in Appendix 1 and pertinent data are presented in Appendix 2. Appendix 3 summarizes chronologically the closure date for each of these tributary reservoirs and the six mainstem dams.

**CORPS OF ENGINEERS DAMS**

|   |  |
|---|--|
| 1. Bear Creek Dam, CO                       | 13. Papillion No. 20, NE (Wehrspann)     |
| 2. Bowman-Haley Dam, ND                     | 14. Pipestem Dam, ND                     |
| 3. Bull Hook Dam, MT                        | 15. Salt Creek No. 2, NE (Olive Creek)   |
| 4. Cedar Canyon Dam, SD                     | 16. Salt Creek No. 4, NE (Blue Stem)     |
| 5. Chatfield Dam, CO                        | 17. Salt Creek No. 8, NE (Wagon Train)   |
| 6. Cherry Creek Dam, CO                     | 18. Salt Creek No. 9, NE (Stagecoach)    |
| 7. Coldbrook Dam, SD                        | 19. Salt Creek No. 10, NE (Yankee Hill)  |
| 8. Cottonwood Springs Dam, SD               | 20. Salt Creek No. 12, NE (Conestoga)    |
| 9. Kelly Road Dam, CO                       | 21. Salt Creek No. 13, NE (Twin)         |
| 10. Papillion No. 11, NE (Glenn Cunningham) | 22. Salt Creek No. 14, NE (Pawnee)       |
| 11. Papillion No. 16, NE (Standing Bear)    | 23. Salt Creek No. 17, NE (Holmes Park)  |
| 12. Papillion No. 18, NE (Zorinski)         | 24. Salt Creek No. 18, NE (Branched Oak) |

## BUREAU OF RECLAMATION DAMS

|                         |                        |
|-------------------------|------------------------|
| 1. Boysen Dam, WY       | 7. Keyhole Dam, WY     |
| 2. Canyon Ferry Dam, MT | 8. Pactola Dam, SD     |
| 3. Clark Canyon Dam, MT | 9. Shadehill Dam, SD   |
| 4. Glendo Dam, WY       | 10. Tiber Dam, MT      |
| 5. Heart Butte Dam, ND  | 11. Yellowtail Dam, MT |

**b. Reservoirs Without Flood Control Storage.** There are two Corps of Engineers tributary lakes without allocated flood control storage included in this report. Both are subimpoundments of the Missouri River Main Stem Projects and were formed by the construction of relocations for transportation facilities and utilities. Lake Audubon, a subimpoundment of Lake Sakakawea, is located just northeast of Riverdale, North Dakota. Lake Audubon and Snake Creek Pumping Plant were to be major facilities of the Bureau of Reclamation's proposed Garrison Diversion Unit (GDU) Project. The GDU is presently being re-evaluated. While the project has not been deauthorized, it appears the scope of work will be scaled back. Lake Pocasse, a subimpoundment of Lake Oahe, is located near Pollock, South Dakota. The Bureau of Reclamation planned to use this lake as a regulating reservoir for the proposed Pollock-Herried Irrigation Unit. The development of this unit, however, has not materialized. Both lakes are used for fish and wildlife and recreational purposes. Their locations are shown on Appendix 1 and pertinent data are presented in Appendix 2.

#### IV. TRIBUTARY RUNOFF.

Tributary flows during the report period were below normal in most of the basin. Table 1 presents calculated percentages of normal runoff at pertinent locations within the basin. The Long Term Palmer Reports for Drought Severity from years 1988 through 1992 are shown on Figures 1 and 2. Table 2 lists peak discharges at selected gaging stations including many reservoir release control points used by the Omaha District.

Areas of extremely low runoff (less than 50% of normal) occurred in North Dakota, western South Dakota, eastern Nebraska, central Montana and central Colorado. Corresponding river basins are: the James (ND), Grand (ND), Knife (ND), Salt (NE), Upper Missouri (MT) and South Platte (CO).

Areas of 50% to 70% of normal runoff were in central Montana, central Wyoming, southwestern South Dakota and eastern Nebraska. River basins in these regions include the Marias (MT), Wind (WY), North Platte (WY), Cold Brook (SD), Papillion (NE) and Salt (NE).

River basins that experienced 71% to 100% of normal runoff were the Bighorn River basin in north central Wyoming, the Rapid Creek basin in western South Dakota, the Upper Missouri River basin in central Montana, the Salt Creek basin and the Papillion Creek basin in eastern Nebraska and the Bear Creek basin in central Colorado.

**TABLE 1**

**Percentage of Normal Runoff  
for  
Report Period (August 1, 1991 to July 31, 1992)**

| <u>PROJECT</u>               | <u>INFLOW<br/>ACRE-FEET</u> | <u>AVERAGE<br/>INFLOW<br/>ACRE-FEET</u> | <u>% OF AVERAGE</u> |
|------------------------------|-----------------------------|---|---------------------|
| <b>CORPS OF ENGINEERS</b>    |                             |   |                     |
| BOWMAN HALEY DAM             | 7,441                       | 21,039                                  | 35                  |
| BEAR CREEK DAM               | 31,434                      | 42,404                                  | 74                  |
| CHATFIELD DAM                | 81,724                      | 187,060                                 | 44                  |
| CHERRY CREEK DAM             | 9,235                       | 7,921                                   | 116                 |
| COLD BROOK DAM               | 352                         | 575                                     | 61                  |
| PAPIO DAM 11                 | 5,831                       | 8,104                                   | 72                  |
| PAPIO DAM 16                 | 379                         | 1,158                                   | 61                  |
| PAPIO DAM 18                 | 1,815 *                     | -----                                   | --                  |
| PAPIO DAM 20                 | 655                         | 1,398                                   | 50                  |
| PIPESTEM DAM                 | 7,747                       | 24,867                                  | 31                  |
| SALT CREEK DAM 2             | 477                         | 2,177                                   | 22                  |
| SALT CREEK DAM 4             | 2,509                       | 3,950                                   | 64                  |
| SALT CREEK DAM 8             | 3,728                       | 4,164                                   | 90                  |
| SALT CREEK DAM 9             | 1,975                       | 2,688                                   | 73                  |
| SALT CREEK DAM 10            | 1,906                       | 4,832                                   | 39                  |
| SALT CREEK DAM 12            | 843                         | 6,233                                   | 14                  |
| SALT CREEK DAM 13            | 1,241                       | 4,106                                   | 29                  |
| SALT CREEK DAM 14            | 3,309                       | 8,313                                   | 40                  |
| SALT CREEK DAM 17            | 2,245                       | 2,371                                   | 95                  |
| SALT CREEK DAM 18            | <u>10,526</u>               | <u>29,842</u>                           | <u>35</u>           |
| <b>TOTAL:</b>                | <b>173,527 **</b>           | <b>363,202</b>                          | <b>48</b>           |
| <b>BUREAU OF RECLAMATION</b> |                             |   |                     |
| BOYSEN DAM                   | 672,350                     | 1,072,598                               | 63                  |
| CANYON FERRY DAM             | 3,152,900                   | 4,144,360                               | 76                  |
| CLARK CANYON DAM             | 140,270                     | 304,339                                 | 46                  |
| GLENDO DAM                   | 810,081                     | 1,262,582                               | 64                  |
| HEART BUTTE DAM              | 12,451                      | 94,965                                  | 13                  |
| JAMESTOWN DAM                | 1,836                       | 29,390                                  | 6                   |
| KEYHOLE DAM                  | 7,155                       | 33,222                                  | 22                  |
| PACTOLA DAM                  | 23,670                      | 33,474                                  | 71                  |
| SHADEHILL DAM                | 20,129                      | 74,136                                  | 27                  |
| TIBER DAM                    | 350,170                     | 680,652                                 | 51                  |
| YELLOWTAIL DAM               | <u>2,061,010</u>            | <u>2,647,645</u>                        | <u>78</u>           |
| <b>TOTAL:</b>                | <b>7,252,022</b>            | <b>10,377,363</b>                       | <b>70</b>           |

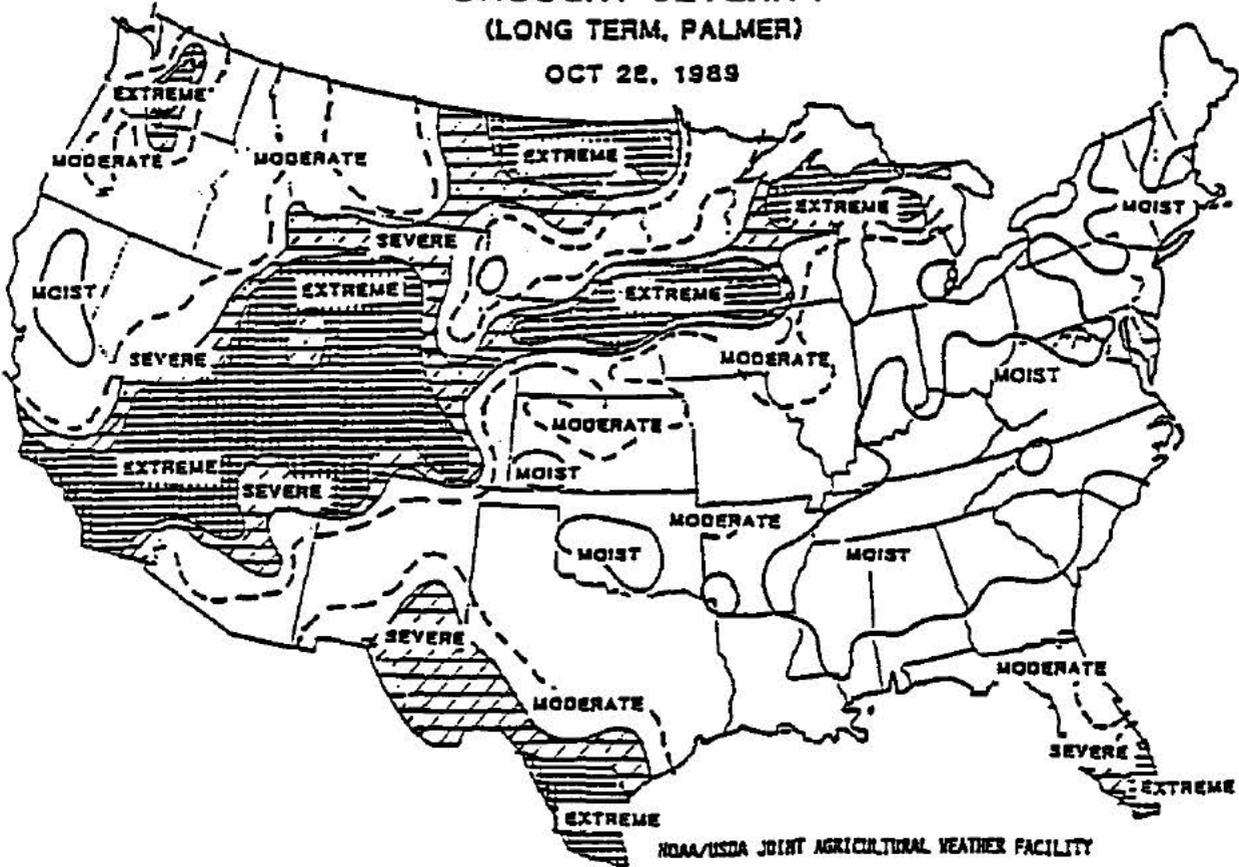
\* Dam closed 7 Dec 89 - no averages computed

\*\* Does not include Papio Dam 18

# DROUGHT SEVERITY

(LONG TERM, PALMER)

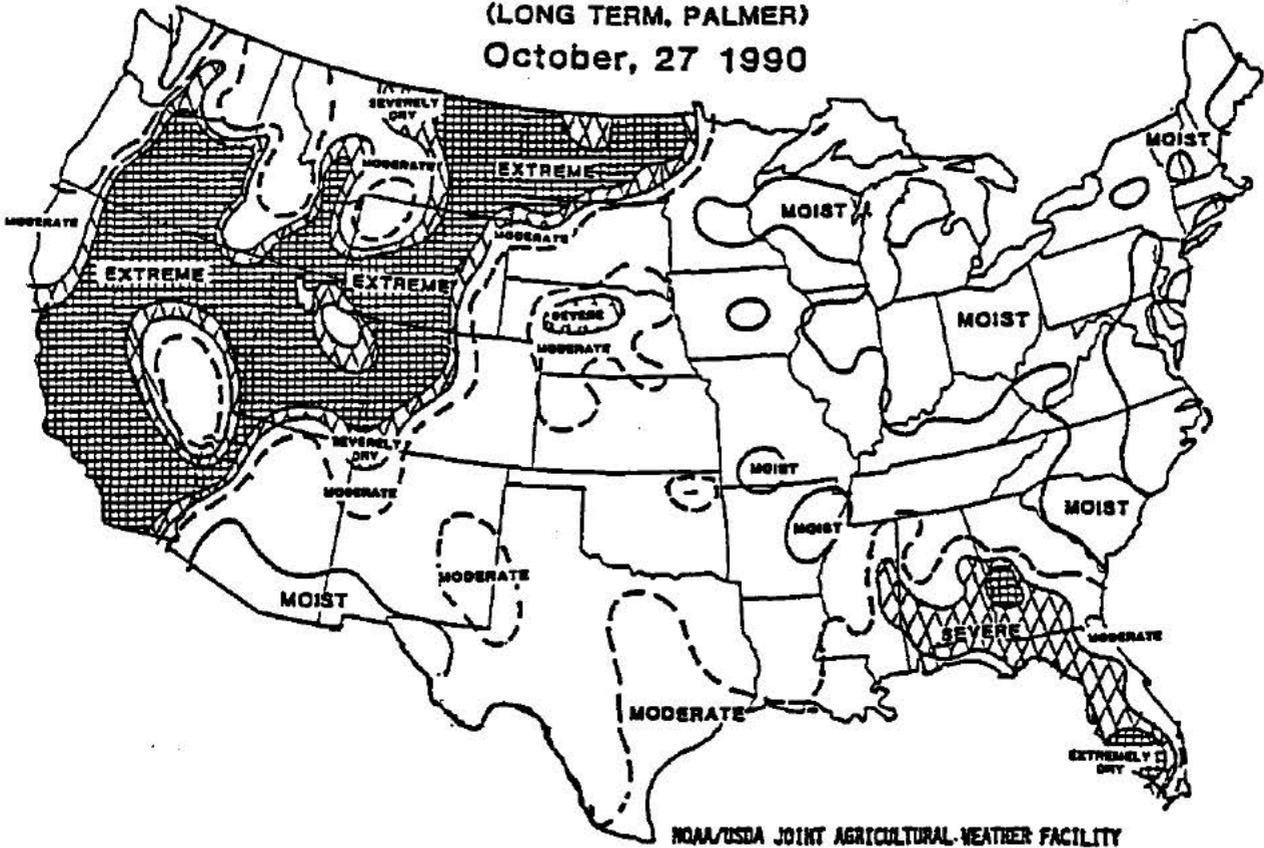
OCT 22, 1989



# DROUGHT SEVERITY

(LONG TERM, PALMER)

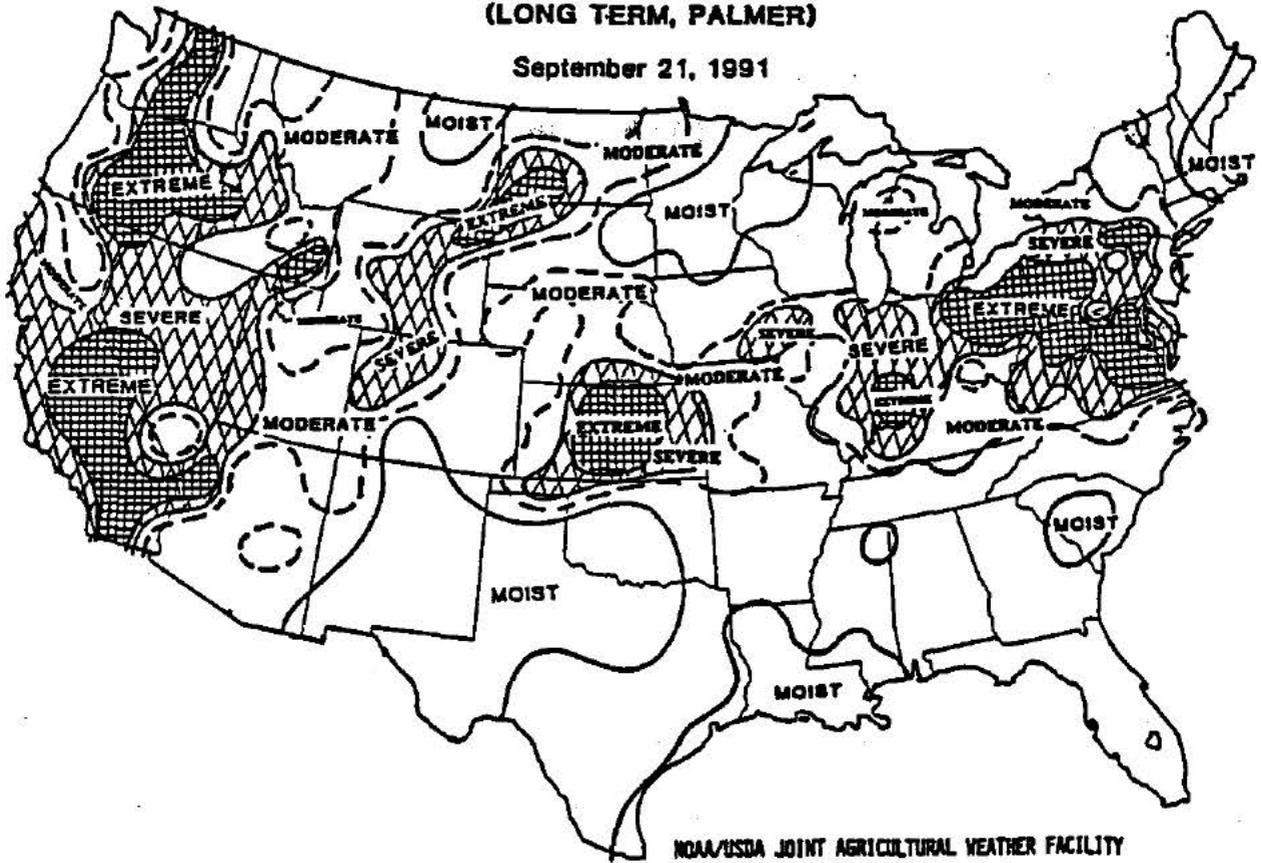
October, 27 1990



# DROUGHT SEVERITY

(LONG TERM, PALMER)

September 21, 1991



# DROUGHT SEVERITY

(LONG TERM, PALMER)

October 3, 1992

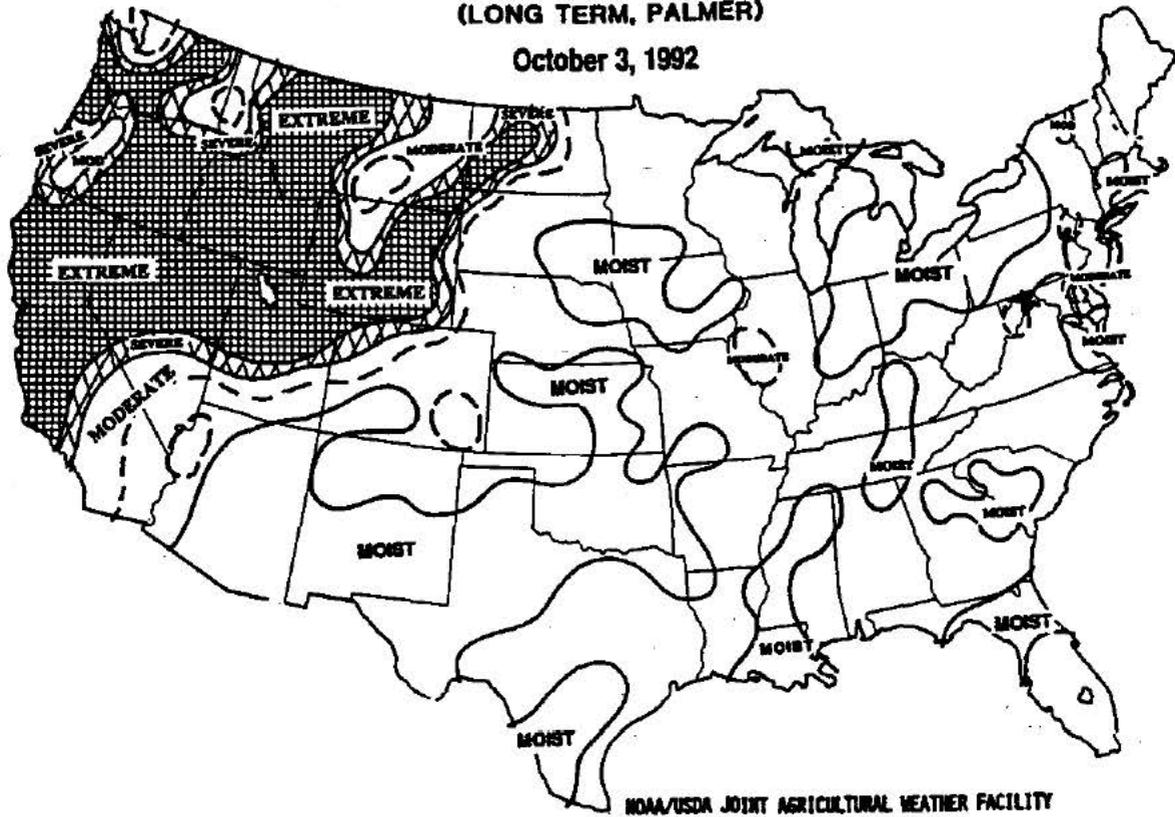


TABLE 2

## PERTINENT 1992 WY PROVISIONAL PEAK DISCHARGES (C.F.S.)

| STREAM              | STATION                   | DRAINAGE<br>AREA<br>(SQ. MILES) | PERIOD<br>OF RECORD<br>(YEARS) | FLOOD<br>STAGE<br>(FEET) | Maximum 1992 |                 |                    | Maximum<br>Known Flood |                 |                    |
|---------------------|---------------------------|---------------------------------|--------------------------------|--------------------------|--------------|-----------------|--------------------|------------------------|-----------------|--------------------|
|                     |                           |                                 |                                |                          | DATE         | STAGE<br>(FEET) | DISCHARGE<br>(CFS) | DATE                   | STAGE<br>(FEET) | DISCHARGE<br>(CFS) |
| Red Rock River      | Blw. Lima Res., MT        | 570                             | 69                             | 1.1                      | MAY 25 1992  | 3.67            | 686                | 15 MAY 1933            | 6.40            | 2,500              |
| Milk River          | At Havre, MT.             | 5,785                           | 66                             | 10.0                     | MAY 08 1992  | 6.01            | 1,650              | 12 APR 1899            | 19.30           | 20,000 A           |
| Milk River          | Nr. Saco, MT.             | 17,670                          | 15                             | 20.0                     | AUG 17 1991  | 3.91            | 464                | 03 APR 1978            | 24.20           | 12,400 C           |
| Milk River          | At Nashua, MT.            | 22,332                          | 53                             | 20.0                     | JUN 18 1992  | 3.30            | 523                | 18 APR 1952            | 31.38           | 45,300             |
| Missouri River      | Nr. Wolf Point, MT.       | 82,290                          | 64                             | 10.9                     | APR 19 1992  | 3.10            | 9,250              | 25 MAR 1939            | 14.40           | 66,800 D           |
| Wind River          | Riverton, WY.             | 2,309                           | 84                             | 8.0                      | JUN 28 1992  | 6.62            | 2,870              | 15 JUN 1935            | 10.15           | 13,300 E           |
| Little Wind River   | Nr. Riverton, WY.         | 1,904                           | 51                             | 10.0                     | JUL 02 1992  | 5.16            | 1,820              | 17 JUN 1963            | 10.85           | 14,700             |
| Wind River          | Blw. Boysen Res., WY.     | 7,701                           | 41                             | N/A                      | SEP 21 1991  | 5.39            | 1,710              | 07 JUL 1967            | 13.35           | 13,500             |
| Big Horn River      | At Kane, WY.              | 15,765                          | 63                             | 8.0                      | JUN 16 1992  | 5.70            | 9,060              | 16 JUN 1935            | 11.10           | 25,200             |
| Yellowstone River   | At Miles City, MT.        | 48,253                          | 65                             | 13.0                     | JUN 19 1992  | 9.51            | 39,400             | 22 MAY 1978            | 16.50           | 102,000            |
| Missouri River      | At Bismarck, N.D.         | 186,400                         | 65                             | 16.0                     | FEB 02 1992  | 11.05           | 24,200             | 06 APR 1952            | 27.90           | 500,000 B,F,G      |
| N. Fork Grand River | At Haley, N.D.            | 509                             | 57                             | 17.0                     | JUN 13 1992  | 6.67            | 90                 | 07 APR 1952            | 17.03           | 14,100 H           |
| Fall River          | At Hot Springs, S.D.      | 137                             | 55                             | 13.0                     | JUN 26 1992  | 3.65            | 179                | 04 SEP 1938            | 18.40           | 13,100 A           |
| Rapid Creek         | At Rapid City, S.D.       | 410                             | 56                             | 7.0                      | JUL 03 1992  | 5.02            | 263                | 09 JUN 1972            | 19.66           | 50,000             |
| Belle Fourche River | At. WY.-S.D. State Line   | 3,280                           | 46                             | 14.0                     | SEP 09 1991  | 4.47            | 143                | 18 JUN 1962            | 15.59           | 4,400              |
| Pipestem Creek      | Nr. Pingree, N.D.         | 700                             | 19                             | 10.0                     | MAR 09 1992  | 6.61            | 178                | 20 APR 1979            | 11.60           | 2,520 B,I          |
| James River         | Nr. Grace City, N.D.      | 1,060                           | 24                             | 12.0                     | MAR 07 1992  | 6.99            | 350                | 13 MAY 1969            | 12.00           | 3,100 B            |
| James River         | At Jamestown, N.D.        | 2,820                           | 58                             | 12.0                     | MAR 17 1992  | 4.41            | 130                | 13 MAY 1950            | 15.82           | 6,390 A,B          |
| James River         | At LaMoure, N.D.          | 4,390                           | 43                             | 14.0                     | MAR 21 1992  | 6.78            | 166                | 14 APR 1969            | 16.17           | 6,800              |
| James River         | At Columbia, S.D.         | 5,857                           | 47                             | 11.0                     | JUL 04 1992  | 5.63            | 30                 | 24,25 MAY 1950         | 16.89           | 5,420 J            |
| James River         | At Ashton, S.D.           | 9,742                           | 47                             | 13.0                     | JUL 01 1992  | 7.24            | 360                | 24 APR 1969            | 20.63           | 5,680 K            |
| James River         | Nr. Scotland, S.D.        | 20,653                          | 64                             | 13.0                     | JUL 13 1992  | 6.74            | 760                | 23 JUN 1984            | 20.45           | 29,400             |
| Vermillion River    | Nr. Vermillion, S.D.      | 2,302                           | 9                              | 21.0                     | JUL 13 1992  | 10.25           | 551                | 23 JUN 1984            | 31.77           | 21,400             |
| Big Sioux River     | At Akron, IA.             | 8,424                           | 64                             | 16.0                     | JUL 06 1992  | 18.00           | 8,780              | 09 APR 1969            | 22.99           | 80,800             |
| Missouri River      | At Sioux City, IA.        | 314,600                         | 95                             | 36.0                     | JUL 12 1992  | 19.90           | 36,500             | 14 APR 1952            | 24.28           | 441,000 A          |
| Little Sioux River  | Nr. Turin, IA.            | 3,526                           | 34                             | 20.0                     | JUL 14 1992  | 17.64           | 10,500             | 21 JUN 1983            | 26.54           | 31,200 L           |
| Big Papio Creek     | Fort Crook, NE.           | 384                             | 44                             | 29.0                     | AUG 07 1992  | 26.20           | 6,130              | 21 MAY 1982            | 30.68           | 12,700 A,M         |
| Missouri River      | At Omaha, NE.             | 322,800                         | 64                             | 29.0                     | JUL 15 1992  | 21.21           | 50,800             | 18 APR 1952            | 40.20           | 396,000            |
| North Platte River  | Nr. Sinclair, WY.         | 4,175                           | 53                             | 4.9                      | MAY 28 1992  | 5.17            | 3,800              | 11 JUN 1986            | 11.30           | 16,200             |
| North Platte River  | Blw. Whalen Diversion, WY | 16,425                          | 83                             | 4.5                      | JUL 01 1992  | 4.22            | 2,190              | 26 JUN 1955            | 9.85            | 22,000             |
| Laramie River       | Nr. Ft. Laramie, WY.      | 4,564                           | 77                             | 6.5                      | JUL 01 1992  | 3.36            | 332                | 10 MAY 1973            | 9.40            | 6,260              |
| North Platte River  | At Wy.-Neb. State Line    | 22,218                          | 63                             | 4.5                      | AUG 03 1992  | 3.26            | 1,360              | 02 JUN 1929            | 7.04            | 17,900             |
| North Platte River  | At Bridgeport, NE.        | 25,300                          | 87                             | 8.0                      | SEP 24 1991  | 7.69            | 1,660              | 26 JUN 1899            | 5.39            | 24,900 A           |
| North Platte River  | At Lewellen, NE.          | 28,600                          | 53                             | 7.0                      | SEP 25 1991  | 5.44            | 1,510              | 04 JUN 1971            | NR              | 13,500             |
| North Platte River  | At North Platte, NE.      | 30,900                          | 97                             | 7.0                      | JUL 12 1992  | 4.02            | 1,190              | 11 JUN 1909            | NR              | 29,600             |
| South Platte River  | At Waterton, CO.          | 2,621                           | 64                             | 6.0                      | JUN 04 1992  | 1.59            | 361                | 23 APR 1942            | 5.68            | 5,700              |
| Bear Creek          | At Morrison, CO.          | 164                             | 75                             | 7.5                      | JUN 27 1992  | 4.82            | 123                | 24 JUL 1896            | NR              | 8,600              |
| South Platte River  | At Denver, CO.            | 3,861                           | 99                             | 9.0                      | MAR 04 1992  | 6.52            | 3,405              | 17 JUN 1965            | 18.66           | 40,300             |
| Clear Creek         | At Derby, CO.             | 575                             | 76                             | 8.0                      | JUL 26 1992  | 2.38            | 369                | 24 JUL 1965            | 8.97            | 5,070              |
| South Platte River  | At Henderson, CO.         | 4,713                           | 66                             | 11.0                     | MAR 04 1992  | 7.42            | 6,240              | 06 MAY 1973            | 11.67           | 33,000 N           |
| South Platte River  | Nr. Kersey, CO.           | 9,598                           | 90                             | 10.0                     | AUG 04 1992  | 6.61            | 4,420              | 08 MAY 1973            | 11.73           | 31,500             |
| South Platte River  | At Julesburg, CO.         | 23,193                          | 90                             | 10.0                     | MAR 22 1992  | 5.36            | 1,950              | 20 JUN 1965            | 10.44           | 37,600 O           |
| South Platte River  | At North Platte, NE.      | 24,300                          | 78                             | 12.0                     | MAR 20 1992  | 2.98            | 983                | 03 JUN 1935            | 14.02           | 37,100             |
| Platte River        | At Brady, NE.             | 56,200                          | 55                             | 5.0                      | JUL 01 1992  | 2.69            | 989                | 29 JUN 1983            | NR              | 23,500             |
| Platte River        | Nr. Grand Island, NE.     | 58,800                          | 59                             | 4.0                      | JUL 25 1992  | 2.72            | 2,680              | 06 JUN 1935            | 5.99            | 30,000 P           |
| Elkhorn River       | At Waterloo, NE.          | 6,900                           | 73                             | 17.0                     | JUN 17 1992  | 11.53           | 18,900             | 12 JUN 1944            | 16.60           | 100,000 A          |

TABLE 2 (Continued)

PERTINENT 1992 WY PROVISIONAL PEAK DISCHARGES (C.F.S.) (Continued)

| STREAM            | STATION               | DRAINAGE<br>AREA<br>(SQ. MILES) | PERIOD<br>OF RECORD<br>(YEARS) | FLOOD<br>STAGE<br>(FEET) | Maximum 1991 |                 |                    | Maximum<br>Known Flood |                 |                    |
|-------------------|-----------------------|---------------------------------|--------------------------------|--------------------------|--------------|-----------------|--------------------|------------------------|-----------------|--------------------|
|                   |                       |                                 |                                |                          | DATE         | STAGE<br>(FEET) | DISCHARGE<br>(CFS) | DATE                   | STAGE<br>(FEET) | DISCHARGE<br>(CFS) |
| Salt Creek        | At Lincoln, NE.       | 684                             | 43                             | 20.5                     | JUN 13 1992  | 9.84            | 2,890              | 02 JUN 1951            | 26.15           | 28,200             |
| Salt Creek        | At Greenwood, NE.     | 1,051                           | 41                             | 20.0                     | JUN 13 1992  | 11.67           | 8,900              | 13 JUN 1984            | 26.50           | 46,800             |
| Platte River      | At Louisville, NE.    | 85,800                          | 37                             | 9.0                      | JUN 17 1992  | 7.11            | 32,500             | 14 JUN 1984            | 11.34           | 144,000 Q          |
| Missouri River    | At Nebraska City, NE. | 410,000                         | 63                             | 18.0                     | JUN 18 1992  | 13.78           | 55,000             | 18,19 APR 1952         | 27.66           | 414,000            |
| West Nishnabotna  | At Randolph, IA.      | 1,326                           | 44                             | 19.0                     | JUL 30 1992  | 12.97           | 3,830              | 26 MAY 1987            | 24.50           | 40,800 R           |
| East Nishnabotna  | At Red Oak, IA.       | 894                             | 64                             | 18.0                     | JUL 30 1992  | 14.47           | 6,930              | 13 SEP 1972            | 27.43           | 38,000 S           |
| Nishnabotna River | Above Hamburg, IA.    | 2,806                           | 66                             | 16.0                     | JUL 31 1992  | 20.81           | 11,100             | 24 JUN 1947            | 26.03           | 55,500 T           |
| Missouri River    | At Rulo, NE.          | 414,900                         | 43                             | 17.0                     | JUL 30 1992  | 20.53           | 87,000             | 22 APR 1952            | 25.60           | 358,000            |

- A) Site and datum then in use.  
 B) 1992 Water year peak was ice affected  
 C) Maximum gage height = 26.70 feet on March 4, 1986 due to ice effect  
 D) Maximum gage height for the water year occurred on December 17 - ice affected  
 E) Maximum gage height = 10.80 feet on December 30, 1983  
 F) Maximum discharge prior to Garrison Dam (1953)  
 G) Since Garrison Dam: Max discharge = 68,900 c.f.s.; July 13, 1975; 14.24 feet  
 H) Maximum gage height = 17.10 on April 15, 1950  
 I) Maximum of record ice affected  
 J) Maximum gage height = 17.11 feet on March 24, 1987  
 K) Maximum gage height = 21.17 feet on April 13, 1969 (backwater from Snake Creek)  
 L) Maximum gage height = 27.44 feet on February 19, 1971 - backwater from ice  
 M) Estimated stage at top of levee is approximately 40 feet  
 N) Maximum gage height = 12.93 feet on June 17, 1965  
 O) Discharge is combined flow for channels 1,2,3 and 4. Maximum gage height occurred in channel 1 & 2.  
 P) Maximum gage height = 6.16 on March 27, 1960 - backwater from ice  
 Q) Maximum gage height = 12.45 on March 30, 1960  
 R) Maximum gage height = 24.8 feet on March 5, 1949 due to backwater from ice  
 S) Maximum gage height = 28.23 feet on June 13, 1947  
 T) Maximum gage height = 28.27 on September 10, 1989

The only region that experienced more than 100% of normal runoff was the Cherry Creek basin in central Colorado.

## **V. RESERVOIR ACCOMPLISHMENTS.**

### **a. Flood Damages Prevented.**

Flood damages prevented by Corps of Engineers and Bureau of Reclamation projects in FY92 and cumulative totals of flood damage prevented for each of the projects are summarized in Table 3.

**b. Recreation Usage.** Visitation hours for each project for FY91 and FY92 are tabulated in Table 4.

**VI. RESERVOIR OPERATION.** Actual operations for the past year and proposed operations through calendar year 1992 are discussed briefly in the following subsections. Individual project operation summaries are contained in Appendix 4. A tabulation of the number of cases that the exclusive flood control zones in the 35 Omaha District tributary reservoirs have been filled to 25, 50, 75 and 100 percent is shown on Table 5. Most of the near capacity pools occurred at the Section 7 Bureau of Reclamation projects.

### **a. Previous Years Operation ( August 1, 1991 through July 31, 1992.)**

**(1) Corps of Engineers Lakes.** All Corps' tributary projects within the Omaha District were regulated in accordance with normal procedures during the period covered by this report. Bear Creek, Chatfield, Cherry Creek, Papio #11, Papio #18, Pipestem, Salt Creek #4, #8, #9, #10, #14, #17 and #18 stored water in the flood storage zone or above their normal level at some time during the reporting period. A new low pool of record was established at Bowman Haley Dam.

**(a) Bear Creek Reservoir, Colorado.** During the report period, the district renewed the two temporary one year municipal and industrial water supply storage contracts for a total of 74 acre feet under Section 6 of the Flood Control Act of 1944 (Public Law 534, 78th Congress), pending development of a long-term contract under the Water Supply Act of 1958, as amended. A revised Memorandum of Understanding (MOU) between the Corps of Engineers and the State of Colorado was signed on June 20, 1988, superseding the previous MOU dated May 11, 1977. Under the revised MOU, the State Engineer or his representative will determine the storage and releases necessary to satisfy downstream water rights requirements when the pool level is below elevation 5559.0 ft. MSL. This target elevation encroaches one foot into the flood storage zone and was selected to allow flexibility in targeting authorized pool levels. During the reporting period, no requests were received to change to continuous gated regulation to store water per the contract.

TABLE 3

FLOOD DAMAGES PREVENTED FY 1992  
 CORPS OF ENGINEERS, OMAHA DISTRICT PROJECTS  
 LOCAL AND MAIN STEM REDUCTIONS (\$000)

OCTOBER 1992

SOURCE: WORK SHEETS

| Omaha District Projects     | Reach Location | Cumulative Thru FY 91 | APRIL | MAY | JUNE    | JULY    | AUGUST   | SEPTEMBER | Total FY 1992 | Cumulative Thru FY 92 |
|-----------------------------|----------------|-----------------------|-------|-----|---------|---------|----------|-----------|---------------|-----------------------|
| Missouri River Reservoirs   | MRO            | 1,035,076.4           | 0.0   | 0.0 | 0.0     | 8,106.0 | 0.0      | 0.0       | 8,106.0       | 1,043,182.4           |
| Other Reservoirs            |                |                       |       |     |         |         |          |           |               |                       |
| Aurora                      | CO             | 2,172.0               |       |     |         | 5,241.2 |          |           | 5,241.2       | 7,413.2               |
| Bear Creek Dam              | CO             | 450.0                 |       |     |         |         | 2,107.5  |           | 2,107.5       | 2,557.5               |
| Bowman-Haley                | ND/SD          | 1,838.0               |       |     | 4,545.8 |         |          |           | 4,545.8       | 6,383.8               |
| Chatfield                   | CO             | 1,945.0               |       |     |         |         | 8,772.5  |           | 8,772.5       | 10,717.5              |
| Cottonwood Springs          | SD             | 0.0                   |       |     |         |         |          |           | 0.0           | 0.0                   |
| Cherry Creek Dam            | CO             | 163,267.0             |       |     |         |         | 252.8    |           | 252.8         | 163,519.8             |
| Coldbrook Dam               | SD             | 0.0                   |       |     |         |         |          |           | 0.0           | 0.0                   |
| Papillion Creek             | NE             | 3,010.8               |       |     |         |         |          |           | 0.0           | 3,010.8               |
| Pipestem                    | ND             | 13,683.6              |       |     |         |         |          |           | 0.0           | 13,683.6              |
| Salt Creek Dams             | NE             | 45,811.6              |       |     |         |         |          |           | 0.0           | 45,811.6              |
| Subtotal:                   |                | 232,178.0             | 0.0   | 0.0 | 4,545.8 | 5,241.2 | 11,132.8 | 0.0       | 20,919.8      | 253,097.8             |
| Missouri River Levee System |                |                       |       |     |         |         |          |           |               |                       |
| L-601                       | IA             | 68,184.9              | 0.0   | 0.0 | 0.0     | 485.4   | 0.0      | 0.0       | 485.4         | 68,670.3              |
| L-594                       | IA             | 48,495.9              | 0.0   | 0.0 | 0.0     | 343.3   | 0.0      | 0.0       | 343.3         | 48,839.2              |
| L-575                       | IA/MO          | 66,885.1              | 0.0   | 0.0 | 0.0     | 1,372.5 | 0.0      | 0.0       | 1,372.5       | 68,257.6              |
| L-561/L-550                 | MO             | 54,991.4              | 0.0   | 0.0 | 0.0     | 1,172.7 | 0.0      | 0.0       | 1,172.7       | 56,164.1              |
| L-536                       | MO             | 15,175.7              | 0.0   | 0.0 | 0.0     | 321.0   | 0.0      | 0.0       | 321.0         | 15,496.7              |
| R-613                       | NE             | 14,816.3              | 0.0   | 0.0 | 0.0     | 106.6   | 0.0      | 0.0       | 106.6         | 14,922.9              |
| R-573                       | NE             | 2,807.0               | 0.0   | 0.0 | 0.0     | 59.0    | 0.0      | 0.0       | 59.0          | 2,866.0               |
| R-562                       | NE             | 8,515.3               | 0.0   | 0.0 | 0.0     | 183.4   | 0.0      | 0.0       | 183.4         | 8,698.7               |
| R-548                       | NE             | 6,069.4               | 0.0   | 0.0 | 0.0     | 127.8   | 0.0      | 0.0       | 127.8         | 6,197.2               |
| R-520                       | NE             | 1,789.8               | 0.0   | 0.0 | 0.0     | 39.3    | 0.0      | 0.0       | 39.3          | 1,829.1               |
| Subtotal:                   |                | 287,730.8             | 0.0   | 0.0 | 0.0     | 4,211.1 | 0.0      | 0.0       | 4,211.1       | 291,941.9             |
| Local Protection Projects   |                |                       |       |     |         |         |          |           |               |                       |
| Belle Fourche               | SD             | 380.0                 |       |     |         |         |          |           | 0.0           | 380.0                 |
| Big Sioux River             | IA             | 0.0                   |       |     |         |         |          |           | 0.0           | 0.0                   |
| Blackbird Creek             | NE             | 269.0                 |       |     |         |         |          |           | 0.0           | 269.0                 |
| Broken Bow                  | NE             | 108.0                 |       |     |         |         |          |           | 0.0           | 108.0                 |
| Clarkson                    | NE             | 670.9                 |       |     |         |         |          |           | 0.0           | 670.9                 |
| Columbus                    | NE             | 1,709.0               |       |     |         |         |          |           | 0.0           | 1,709.0               |
| Council Bluffs              | IA             | 397,993.0             | 0.0   | 0.0 | 0.0     | 0.0     | 0.0      | 0.0       | 0.0           | 397,993.0 *           |
| Emerson                     | IA             | 0.0                   |       |     |         |         |          |           | 0.0           | 0.0                   |
| Floyd River                 | IA             | 27,441.0              |       |     |         |         |          |           | 0.0           | 27,441.0              |
| Forsyth                     | MT             | 1,849.1               |       |     |         |         |          |           | 0.0           | 1,849.1               |
| Gering                      | NE             | 520.0                 |       |     |         |         |          |           | 0.0           | 520.0                 |
| Glasgow                     | MT             | 1,326.0               |       |     |         |         |          |           | 0.0           | 1,326.0               |
| Great Falls                 | MT             | 0.0                   |       |     |         |         |          |           | 0.0           | 0.0                   |
| Greybull                    | WY             | 4,345.0               |       |     |         |         |          |           | 0.0           | 4,345.0               |
| Hamburg                     | IA             | 71,289.5              |       |     |         |         |          |           | 0.0           | 71,289.5              |
| Havre                       | MT             | 20,664.0              |       |     |         | 3,366.7 |          |           | 3,366.7       | 24,030.7              |
| Hawarden                    | IA             | 552.0                 |       |     |         |         |          |           | 0.0           | 552.0                 |

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TABLE 3

TABLE 3 (Cont)  
 FLOOD DAMAGES PREVENTED FY 1992  
 CORPS OF ENGINEERS, OMAHA DISTRICT PROJECTS  
 LOCAL AND MAIN STEM REDUCTIONS (\$000)

| Omaha District Projects | Reach Location | Cumulative Thru FY 91 | APRIL | MAY | JUNE    | JULY     | AUGUST   | SEPTEMBER | Total FY 1992 | Cumulative Thru FY 92 |
|-------------------------|----------------|-----------------------|-------|-----|---------|----------|----------|-----------|---------------|-----------------------|
| Herreld                 | SD             | 33.0                  |       |     |         |          |          |           | 0.0           | 33.0                  |
| Hooper                  | NE             | 541.0                 |       |     |         |          |          |           | 0.0           | 541.0                 |
| Hot Springs             | SD             | 0.0                   |       |     |         |          |          |           | 0.0           | 0.0                   |
| Ida Grove               | IA             | 339.0                 |       |     |         |          |          |           | 0.0           | 339.0                 |
| Kenslers Bend           | SD/NE          | 33,584.0              |       |     |         |          |          | 914.0     | 914.0         | 34,498.0 **           |
| Little Papillion        | NE             | 4,475.7               |       |     |         |          |          |           | 0.0           | 4,475.7               |
| Little Sioux River      | IA             | 155,448.0             |       |     |         | 1,391.6  |          |           | 1,391.6       | 156,839.6             |
| Madison                 | NE             | 123.2                 |       |     |         |          |          |           | 0.0           | 123.2                 |
| Mandan                  | ND             | 20,323.0              |       |     |         |          |          |           | 0.0           | 20,323.0              |
| Harmarth                | ND             | 1,449.0               |       |     |         |          |          |           | 0.0           | 1,449.0               |
| Meadow Grove            | NE             | 49.0                  |       |     |         |          |          |           | 0.0           | 49.0                  |
| Norfolk                 | NE             | 6,985.0               |       |     |         |          |          |           | 0.0           | 6,985.0               |
| Omaha                   | NE             | 370,276.3             | 0.0   | 0.0 | 0.0     | 0.0      | 0.0      | 0.0       | 0.0           | 370,276.3             |
| Pebble Ck. @ Scribner   | NE             | 7,859.1               |       |     | 1,706.7 |          |          |           | 1,706.7       | 9,565.8               |
| Pierce                  | NE             | 496.0                 |       |     |         |          |          |           | 0.0           | 496.0                 |
| Platte R. @ Schuyler    | NE             | 665.0                 |       |     |         |          |          |           | 0.0           | 665.0                 |
| Red Dale Gulch          | SD             | 250.0                 |       |     |         |          |          |           | 0.0           | 250.0                 |
| Red Oak                 | IA             | 6,979.6               |       |     |         |          |          |           | 0.0           | 6,979.6               |
| Saco                    | MT             | 987.8                 |       |     |         |          |          |           | 0.0           | 987.8                 |
| Schuyler, Lost Ck.      | NE             | 394.0                 |       |     |         |          |          |           | 0.0           | 394.0                 |
| Scranton                | ND             | 0.0                   |       |     |         |          |          |           | 0.0           | 0.0                   |
| Sheridan                | WY             | 741.0                 |       |     |         |          |          |           | 0.0           | 741.0                 |
| Shields R. Clyde Park   | MT             | 156.0                 |       |     |         |          |          |           | 0.0           | 156.0                 |
| Sioux Falls             | SD             | 16,839.8              |       |     | 46.7    |          |          |           | 46.7          | 16,886.5              |
| Vaughn                  | MT             | 485.0                 |       |     |         |          |          |           | 0.0           | 485.0                 |
| Waterloo                | NE             | 470.0                 |       |     |         |          |          |           | 0.0           | 470.0                 |
| West Glendive,          | MT             | 387.0                 |       |     |         |          |          |           | 0.0           | 387.0                 |
| West Point              | NE             | 2,719.4               |       |     |         |          |          |           | 0.0           | 2,719.4               |
| Subtotal:               |                | 1,162,172.4           | 0.0   | 0.0 | 1,753.4 | 4,758.3  | 0.0      | 914.0     | 7,425.7       | 1,169,598.1           |
| Other Projects          |                |                       |       |     |         |          |          |           |               |                       |
| McCook Lake             | SD             | 0.0                   |       | 0.0 | 0.0     | 0.0      | 0.0      | 0.0       | 0.0           | 0.0 ***               |
| Total Corps Projects:   | MRO            | 2,717,157.6           | 0.0   | 0.0 | 6,299.2 | 22,316.6 | 11,132.8 | 914.0     | 40,662.6      | 2,757,820.2           |

\* Includes Missouri River Levees L-627 and L-624.

\*\* Based on estimates of annual benefits. Project serves other than flood control purposes.

\*\*\* \$400,000 recreational benefits cumulative at the rate of \$11,000 annually.

OCTOBER 1992

TABLE 3 (Cont)  
 FLOOD DAMAGES PREVENTED FY 1992  
 BUREAU OF RECLAMATION, OMAHA DISTRICT PROJECTS  
 LOCAL AND MAIN STEM REDUCTIONS (\$000)

| River Basin        | Omaha District Projects | Reach Location | Cumulative Thru FY 91 | APRIL | MAY | JUNE  | JULY    | AUGUST | SEPTEMBER | Total FY 1992 | Cumulative Thru FY 92 |
|--------------------|-------------------------|----------------|-----------------------|-------|-----|-------|---------|--------|-----------|---------------|-----------------------|
| Big Horn River     | Boysen                  | WY             | 32,602.5              | 0.0   | 0.0 | 0.0   | 348.2   | 0.0    | 0.0       | 348.2         | 32,950.7              |
|                    | Buffalo Bill            | WY             | 3,204.5               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 3,204.5               |
|                    | Bull Lake               | WY             | 1,993.9               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 1,993.9               |
|                    | Yellowtail              | MT             | 42,715.2              | 0.0   | 0.0 | 0.0   | 856.2   | 0.0    | 0.0       | 856.2         | 43,571.4              |
|                    | Subtotal:               |                | 80,516.1              | 0.0   | 0.0 | 0.0   | 1,204.4 | 0.0    | 0.0       | 1,204.4       | 81,720.5              |
| Cheyenne River     | Angostura               | SD             | 20.4                  | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 20.4                  |
|                    | Keyhole                 | WY/SD          | 2,026.8               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 2,026.8               |
|                    | Pactola                 | SD             | 1,310.5               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 1,310.5               |
|                    | Subtotal:               |                | 3,357.7               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 3,357.7               |
| Grand River        | Shadehill               | SD             | 7,742.3               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 7,742.3               |
| Heart River        | Heart Butte             | ND             | 11,824.1              | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 11,824.1              |
| James River        | Jamestown               | ND             | 18,244.4              | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 18,244.4              |
| Marias River       | Tiber                   | MT             | 40,230.8              | 0.0   | 0.0 | 0.0   | 69.4    | 0.0    | 0.0       | 69.4          | 40,300.2              |
| Milk River         | Fresno                  | MT             | 5,321.3               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 5,321.3               |
| Missouri River     | Canyon Ferry            | MT             | 75,449.1              | 0.0   | 0.0 | 0.0   | 190.3   | 0.0    | 0.0       | 190.3         | 75,639.4              |
| North Platte River | Pathfinder              | WY             | 4,792.2               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 4,792.2               |
|                    | Alcova                  | WY             | 209.7                 | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 209.7                 |
|                    | Seminole                | WY             | 10,032.6              | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 10,032.6              |
|                    | Guernsey                | WY             | 439.0                 | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 439.0                 |
|                    | Glendo                  | WY/NE          | 33,639.9              | 0.0   | 0.0 | 439.5 | 0.0     | 0.0    | 0.0       | 439.5         | 34,079.4              |
|                    | Subtotal:               |                | 49,113.4              | 0.0   | 0.0 | 439.5 | 0.0     | 0.0    | 0.0       | 439.5         | 49,552.9              |
| Sun River          | Gibson                  | MT             | 2,912.0               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 2,912.0               |
| Threeforks Basin   | Clark Canyon            | MT             | 6,982.1               | 0.0   | 0.0 | 0.0   | 0.0     | 0.0    | 0.0       | 0.0           | 6,982.1               |
|                    | Total Bureau Projects:  |                | 301,693.3             | 0.0   | 0.0 | 439.5 | 1,464.1 | 0.0    | 0.0       | 1,903.6       | 303,596.9             |

TABLE 4

RECREATION VISITATION IN HOURS

|                       | <u>FY91</u>             | <u>FY92</u>       | <u>Percent<br/>Change</u> |
|-----------------------|-------------------------|-------------------|---------------------------|
| Bowman Haley          | 140,508                 | 65,400            | -53%                      |
| Cottonwood Springs    | 126,076                 | 188,900           | 50%                       |
| Cold Brook            | 404,810                 | 474,200           | 17%                       |
| Pipestem              | 300,780                 | 317,200           | 5%                        |
| Papillion Creek #11   | 1,889,447               | 1,662,800         | -12%                      |
| Papillion Creek #16   | 576,437                 | 628,300           | 9%                        |
| Papillion Creek #18   | Not open for Recreation |                   |                           |
| Papillion Creek #20   | 1,182,110               | 1,073,100         | - 9%                      |
| Papillion Creek Total | 3,647,994               | 3,364,200         | - 8%                      |
| Chatfield             | 4,207,100               | 4,267,100         | 1%                        |
| Cherry Creek          | 6,910,800               | 6,682,400         | - 3%                      |
| Bear Creek            | 407,400                 | 432,900           | 6%                        |
| Salt Creek #2         | 104,969                 | 81,600            | -22%                      |
| Salt Creek #4         | 126,594                 | 106,500           | -16%                      |
| Salt Creek #8         | 178,987                 | 106,300           | -41%                      |
| Salt Creek #9         | 43,964                  | 50,100            | 14%                       |
| Salt Creek #10        | 137,533                 | 103,700           | -25%                      |
| Salt Creek #12        | 235,019                 | 219,600           | - 6%                      |
| Salt Creek #13        | 80,882                  | 75,800            | - 6%                      |
| Salt Creek #14        | 2,327,735               | 2,034,200         | -13%                      |
| Salt Creek #17        | 4,499,183               | 3,880,100         | -14%                      |
| Salt Creek #18        | 6,004,931               | 5,184,400         | -14%                      |
| Salt Creek Total      | 13,739,797              | 11,842,300        | -14%                      |
| <b>TOTAL</b>          | <b>29,656,865</b>       | <b>27,886,600</b> | <b>- 6%</b>               |

**TABLE 5**

**UTILIZATION OF EXCLUSIVE FLOOD STORAGE ZONE  
OMAHA DISTRICT TRIBUTARY PROJECT**

**Percent of Flood Control Storage**

| <u>Year</u>  | <u>of Tributary<br/>Projects</u> | <u>Total<br/>25% or<br/>More</u> | <u>50% or<br/>More</u> | <u>75% or<br/>More</u> | <u>100% or<br/>More</u> |
|--------------|----------------------------------|----------------------------------|------------------------|------------------------|-------------------------|
| 1967         | 26                               | 3                                | 2                      | 2                      | 0                       |
| 1968         | 27                               | 0                                | 0                      | 0                      | 0                       |
| 1969         | 27                               | 1                                | 0                      | 0                      | 0                       |
| 1970         | 28                               | 2                                | 2                      | 0                      | 0                       |
| 1971         | 28                               | 2                                | 1                      | 0                      | 0                       |
| 1972         | 28                               | 1                                | 0                      | 0                      | 0                       |
| 1973         | 28                               | 6                                | 2                      | 1                      | 0                       |
| 1974         | 31                               | 1                                | 1                      | 0                      | 0                       |
| 1975         | 32                               | 6                                | 2                      | 1                      | 1                       |
| 1976         | 32                               | 2                                | 1                      | 0                      | 0                       |
| 1977         | 32                               | 0                                | 0                      | 0                      | 0                       |
| 1978         | 33                               | 5                                | 1                      | 0                      | 0                       |
| 1979         | 33                               | 1                                | 0                      | 0                      | 0                       |
| 1980         | 33                               | 2                                | 1                      | 0                      | 0                       |
| 1981         | 33                               | 2                                | 1                      | 1                      | 0                       |
| 1982         | 33                               | 2                                | 1                      | 0                      | 0                       |
| 1983         | 34                               | 5                                | 1                      | 1                      | 0                       |
| 1984         | 35                               | 7                                | 2                      | 1                      | 1                       |
| 1985         | 35                               | 0                                | 0                      | 0                      | 0                       |
| 1986         | 35                               | 5                                | 0                      | 0                      | 0                       |
| 1987         | 35                               | 3                                | 0                      | 0                      | 0                       |
| 1988         | 35                               | 0                                | 0                      | 0                      | 0                       |
| 1989         | 35                               | 0                                | 0                      | 0                      | 0                       |
| 1990         | 35                               | 0                                | 0                      | 0                      | 0                       |
| 1991         | 35                               | 2                                | 1                      | 0                      | 0                       |
| 1992         | 35                               | 0                                | 0                      | 0                      | 0                       |
| <b>TOTAL</b> |                                  | <b>58</b>                        | <b>19</b>              | <b>7</b>               | <b>2</b>                |

**100% or More Events: 1975 - Canyon Ferry Reservoir/1984 - Clark Canyon Reservoir**

In January 1992, the Denver Regional Council of Governments (DRCOG) requested the Corps of Engineers' participation in a demonstration project at Bear Creek Reservoir using hypolimnetic withdrawals throughout the year. The water quality in the reservoir and downstream of the reservoir would be monitored to assess the effectiveness of this management practice on water quality. The Corps of Engineers would make variable releases through the year depending on the inflow. The following table shows the approximate release targets as requested by DRCOG:

| STREAMFLOW  | RELEASE   |
|-------------|-----------|
| > 20 cfs    | 10 cfs    |
| 15 - 20 cfs | 7 - 9 cfs |
| 10 - 15 cfs | 5 - 6 cfs |
| < 10 cfs    | 0 cfs     |

Release changes were made weekly as needed throughout the year and will continue through December 1992.

(b) **Chatfield Reservoir, Colorado.** During the reporting period, a total of 6 release orders were made while the pool was in the flood control zone. The releases ranged from 400 cfs to 100 cfs and were required only to release inflows to maintain the target pool elevation of 5432.0. These releases occurred between March 5, 1992 and April 21, 1992. Before and after these dates, releases were made by the State Engineer. Gated releases made by the State Engineer varied from a maximum of 550 cfs on August 6, 1991, to 0 cfs on September 11-15, 26-30, and October 1-31. A total of 19,105 AF was delivered via the canals during the reporting period compared with 14,940 AF during the last reporting period. The pool was in the flood control storage zone only slightly from March 1-10, March 25 - April 1, and April 7-21. The maximum pool elevation during this period was 5432.48 on April 19, 1992. All other release orders during the reporting period were made by the State Engineer or his representative.

(c) **Cherry Creek Reservoir, Colorado.** On April 1, 1988, the State of Colorado, through the State Engineer, implemented strict administration of water rights within the Cherry Creek Basin. When a senior river call is in effect, Cherry Creek Reservoir is required to pass inflow through the project. Releases from the project were coordinated by the Water Control Section to comply with downstream river calls as determined by the Colorado State Engineers Office. A total of 14 release orders were made during the report period. The releases were made to meet downstream water needs and for a sediment flushing exercise. Releases varied from 50 cfs to 2 for water control and water

rights and up to 240 cfs during the flushing exercise. Gate changes were made between August 1, 1991 and July 31, 1992. The sediment flushing releases were made May 19 & 20, 1992 to remove sediments inside of the intake and conduit. This exercise will be completed annually.

(d) **Bowman-Haley, North Dakota.** A new record low pool was established. No releases were made from the project.

(e) **Pipestem, North Dakota.** Pipestem pool was drawn down two feet in May to allow maintenance on the gates. Concurrently with the drawdown, the USBR diverted the water released from Pipestem into their Oaks Test Irrigation Area. This drawdown and diversion were criticized by the U.S. Fish and Wildlife Service (FWS) as possibly harmful to their Sand Lake National Wildlife Refuge. A number of meetings were held in Bismarck, ND between the Corps, USBR, and FWS to discuss the drawdown and to review the operation of Pipestem and Jamestown Reservoirs as it affects FWS's refuges. Water Control Section has initiated an update of the design hydrology of Pipestem and the development of a real-time water control model for Pipestem and Jamestown Reservoirs. It is hoped that through this process, impacts to refuges can be lessened during flood events.

(f) **Papillion Creek Basin, Nebraska.** Due to drought conditions, no low level releases were accomplished this year. No other gated releases were made during the report period.

(g) **Salt Creek Basin, Nebraska.** No special operations were requested or necessary at the Salt Creek projects during the report period.

Releases were required from Salt Creek #18 to meet downstream senior water rights on August 4 through September 11, 1991 and July 1 through July 7, 1992.

(2) **Bureau of Reclamation Dams.** Reservoir operations at the eleven Bureau of Reclamation projects in the Omaha District were carried out in accordance with normal regulation procedures during the period covered by this report.

The only Section 7 project that stored water in the flood control zone was Yellowtail Dam. These were relatively minor encroachments that occurred in September 1991 and July 1992.

#### **b. Proposed Operations.**

(1) **Corps of Engineers.** With the exception of Bear Creek, Cheery Creek, Chatfield and Pipestem, all Corps of Engineers tributary dams have ungated service outlets and no gate operations are normally required except for occasional opening of the low level outlets for various purposes. Releases to meet downstream water rights can be expected at Bowman Haley,

Cold Brook, Chatfield, Cherry Creek, and Salt Creek #18. Evacuation of stored flood water in these projects is scheduled as soon as practicable after each flood event.

(a) **North Dakota.** Flood releases from Pipestem Dam will be coordinated with those from the Bureau's Jamestown Dam. The low level gate at Pipestem will be opened when water is flowing over the drop inlet to assist in the improvement of lake water quality. At Bowman-Haley Reservoir, the water quality improvement program calls for releases from the low-level drawdown tube during periods of pronounced lake stratification that typically occur in late winter and again in late summer around July 15. If the local sponsor concurs and winter downstream conditions permit, water will be evacuated from the lower elevations each year starting in early February.

(b) **South Dakota.** Cold Brook reservoir inflows up to 1.1 cfs will be released to the Larive Lake Resort when requested to meet their water right.

(c) **Colorado.** At Chatfield Reservoir, the pool level is expected to fluctuate between elevations 5423 and 5432 ft. MSL at all times except during prolonged periods of drought or excessive run-off. Each year, from May 1 to August 31, the pool level is not expected to fall below elevation 5426.85 ft MSL (20,000 AF) for recreational purposes. Storage of water above elevation 5426.85 to elevation 5432.0 ft. MSL will depend on the availability of free water and/or excessive run-off and/or the desire of the City of Denver to store water. During the Colorado irrigation season, inflows to Cherry Creek Reservoir will be calculated by the Water Control Section and the State Engineer on a daily basis and releases will be balanced on a weekly basis to comply with State water rights. Releases will be made at Cherry Creek Reservoir in May or June to flush sediment from around the gates in the intake structure. Flushes will not be scheduled during the December through March period. The flushing schedule utilizes approximately 150 to 250 AF of water. At Bear Creek Reservoir, the low level gate will be opened when practical during the June through August period when the lake typically stratifies to assist in the improvement of lake water quality if requested.

(d) **Nebraska.** At Salt Creek Dam #18, releases of inflow up to a total of 11.57 cfs may be made. Releases up to 3 cfs without proving inflow will be made when required to satisfy downstream water rights. Low level releases will be made when practicable from the Papio projects to allow water to be discharged from lower elevations in an attempt to improve lake water quality.

(2) **Bureau of Reclamation.** As in the past, the Bureau will continue to operate their reservoirs to meet flood control commitments and to coordinate operations with other interests to achieve optimum use of water resources. Generally, all reservoirs will be operated as close to the top of their conservations pools as possible. Pertinent special operating plans are described as follows: Boysen, Canyon Ferry, Clark Canyon, Tiber and Yellowtail Reservoirs require evacuation and refill of joint-use storage for flood control based on mountain run-off inflow forecasts.

**(a) Canyon Ferry.** The Canyon Ferry Reservoir Operating Plan requires that releases are adjusted as soon as the storage has peaked, usually in June or July, so the pool will be drawn to near elevation 3780 ft. MSL by the following March 1. In addition, the Montana Power Company will try to limit releases from Hebgen Reservoir to maintain Canyon Ferry pool below elevation 3794 ft. MSL after December 1. Storage below elevation 3794 ft. MSL prior to winter freeze up is desired to prevent ice jam problems at the upper end of the lake. Beginning near the first of January, releases will be set based on the most probable spring inflow forecast to allow the reservoir to fill to elevation 3797 ft. MSL near the end of June.

**(b) Tiber.** In accordance with the Water Control Agreement, the joint-use zone at Tiber Reservoir will be vacated to elevation 2976 ft. MSL by March 1. March-June releases are based on forecasted inflows with the objective of filling Lake Elwell to elevation 2993 ft. MSL by the end of June. However, if necessary, March-June releases may be based on filling the reservoir to as high as elevation 3008 ft. MSL by the end of June to provide replacement storage and assist the Corps in the operation of the main stem reservoir system.

**(c) Yellowtail.** Yellowtail Reservoir will be regulated to be no higher than elevation 3630 ft. MSL by November 30 to reduce chances of headwater ice problems. The drawdown will continue through the winter months so that the pool elevation will be no higher than 3605 ft. MSL before the beginning of spring run-off based on a normal run-off forecast. March through July releases will be based on forecasted inflows with the objective of filling Yellowtail Reservoir to elevation 3640 ft. MSL by the end of July.

**(d) Others.** Replacement storage up to a combined total of 1,075,500 acre-feet can be made available in Clark Canyon, Tiber, and Canyon Ferry Reservoirs on a forecast basis. Fresno Reservoir in Montana is lowered each year and regulated to provide flood control in accordance with a June 4, 1957 Letter of Understanding. In addition to the reservoirs covered in this report, other Bureau reservoirs, without allocated flood control storage space, will provide flood control in their normal operation of storing seasonal run-off. Some of these projects are Gibson Dam in Montana and Bull Lake, Pathfinder, Seminoe, and Buffalo Bill Dams in Wyoming.

**VII. MAJOR REGULATION PROBLEMS.** Regulation problems experienced during the period of this report are discussed briefly in the following paragraphs.

**a. Water Quality.** Water quality problems including algal blooms and low dissolved oxygen exist at certain tributary reservoirs. The principal water quality issues and problems at each of the projects during 1992 are covered in a separate report prepared by the Water Quality Unit.

**b. Downstream Channel Capacity.** Inadequate or reduced channel capacity is a problem below many of the tributary reservoirs. Encroachment by natural plant growth due to low flows, by flood deposits left in place, and by human construction and agriculture practices are common. In some cases, downstream channel capacity is significantly less than flood control releases. For example, the channel downstream of Cold Brook Dam is undefinable due to residential construction. The channel capacity of the South Platte River below the Tri-Lakes projects hinders or prevents releases in accordance with the three-reservoir (Chatfield, Bear Creek, and Cherry Creek) plan of regulation to evacuate flood storage. Compounding this situation is the fact that the reservoir design routings for Chatfield, Bear Creek and Cherry Creek Reservoirs were made independently of each other and that the individual routings neglected 1) the effect of the releases from the other two dams in the three-reservoir system, 2) the effect of the incremental runoff below the dams, and 3) the actual channel capacity below the three dams.

This year's experience with releasing water at the USBR projects has provided valuable information on the downstream channel capacities at these projects. At Boysen Reservoir, the capacity of the downstream channel is limited to around 11,000 cfs by a bridge crossing at Thermopolis. The design discharge is 15,000 cfs. At Yellowtail, the maximum nondamaging release appears to be around 12,000 cfs. The design discharge is 20,000 cfs. A release of 15,000 cfs at Canyon Ferry was made without causing damage. The design discharge is 15,000 cfs.

**c. Releases for Purposes other than Authorized Project Functions.** No releases were made for purposes other than authorized project functions.

**d. Potential Hazardous Conditions.** A potential problem exists if water is released over the project spillways where the land downstream of the project has been developed into urban areas. A hazard-to-life condition exists if a significant flow of water is discharged over the spillways at these projects.

**VIII. WATER CONTROL MANUALS.** Attempts to obtain funding for revision and/or preparation of Water Control Manuals through the O&M budgeting process have continued to be unsuccessful. The District is allocating limited funds from other functions to work on high priority manuals. Final approval on the completed Papillion Creek Water Control Manual is still forthcoming from the Missouri River Division. The Lake Audubon and Westerly Creek Manuals are expected to be completed in Fiscal Year 1993.

Attempts to obtain funding for the Tri-Lakes (Chatfield, Cherry Creek, and Bear Creek) Master Manual has also been unsuccessful. However, a limited amount of funding will be made available in Fiscal Year 1993 to allow development of a detailed scope and cost estimate for inclusion in future budgeting.

## **IX. DATA COLLECTION PROGRAM AND PROCEDURES.**

**a. Collection of Water Control Data.** Data from hydrologic gages for water control management is obtained from various sources including contract observers, project offices, National Weather Service, Geological Survey, Bureau of Reclamation and Satellite Data Collection Platforms (DCPs). The National Weather Service provides current weather conditions, 3-day forecasts and precipitation and snowfall reports along with current river levels, river level forecasts, and flood forecasts. Since March 1986, this service, called "Datacol", has been retrieved from a NWS computer in Kansas City.

At the end of FY91, the section purchased an Alden weather system including a new computer monitor and services which will allow capture and storage of numerous radar images automatically. This system replaced the Kavouras system which was purchased in 1983.

This system couples with software developed for the Rock Island District which converts radar images to initial precipitation information which then is used in other hydrologic models for real-time and forecasting applications. Radar images from nineteen (19) sites in eight states surrounding the Missouri River basin are available with this system. In addition, the National Weather Service automatically sends satellite images via a direct telephone line to the system.

Since early 1992, the Omaha District, Water Control Section has been developing an HECDSS database for storing river and reservoir data. Data is input into the database from two sources. SHEFDSS is used to read data from the District's Direct Readout Ground Station. A program developed by district programmers reads data retrieved from NOAA's NESDIS computer at Wallops Island, Virginia. The combined data set is then screened using HEC's recently released DATCHK and DATVUE programs.

**b. Automated Remote Sensors.** State-of-the-art, remote site, satellite data transmissions are utilized for water control management. Satellite collection equipment being used by the District was purchased from Sutron Corporation. The equipment was and is installed and maintained by Section personnel and/or by contract. Currently, there are 21 data collection platforms (DCPs) in Montana, 4 in Wyoming, 21 in Colorado, 12 in North Dakota, 18 in South Dakota, 41 in Nebraska and 16 in Iowa for a total of 133 sites. In FY 1993, DCPs will be installed at five of the Missouri River mainstem dams to automate collection of weather data.

**TABLE 6  
WORK PRIORITIES**

**FINAL RESERVOIR REGULATION MANUALS**

| PRIORITY | PROJECT        | REMARKS  |
|----------|----------------|--|
| 1        | Tri-Lakes      | Manual to be scoped in FY93 for FY95 budget cycle. |
| 2        | Papio          | Waiting final comments from MRD.                   |
| 3        | Chatfield      | Technical Report scheduled completion in FY93.     |
| 4        | Westerly Creek | Scheduled completion in FY93.                      |
| 5        | Lake Audubon   | Scheduled completion in FY93.                      |
| 6        | Canyon Ferry   | Scheduled start in FY93.                           |
| 7        | Glendo         |  |
| 8        | Bear Creek     |  |

**UPDATE WATER CONTROL MANUALS**

|   |           |   |
|---|-----------|---|
| 1 | Pactola   | To reflect raise in dam and widening of spillway                            |
| 2 | Coldbrook | To reflect changed outlet pipe and line from stilling basin to Larvie Lake. |
| 3 | Shadehill | To reflect changed outlet works.  |

**INSTRUCTION TO DAM TENDERS**

|   |             |                          |
|---|-------------|--------------------------|
| 1 | Heart Butte | To reflect raise in dam. |
|---|-------------|--------------------------|

**VOLUME FORECAST**

|   |              |
|---|--------------|
| 1 | Glendo       |
| 2 | Tiber        |
| 3 | Boysen       |
| 4 | Canyon Ferry |

The DCPs in the District transmit real-time river and reservoir levels, precipitation, evaporation, piezometer levels, wind, water and air temperature data. The hourly data collected by these remote sensors is transmitted to two ground receiving sites located in Omaha, Nebraska (Corps of Engineers) and Boise, Idaho (Bureau of Reclamation). This information is currently transmitted via GOES-west and GOES-central satellites located at 135 degrees west longitude and 98-108 degrees west longitude, respectively.

A majority of the stream gaging stations in the district use mercury manometers. Mercury exposure and its ensuing life-threatening side effects have prompted the United States Geological Survey (USGS) and the Corps to find a suitable and safe replacement. The Water Control Section and the Iowa USGS have worked together during the past year setting up two experimental stations to test a multitude of possible mercury manometer replacements. The two stations selected were Missouri River at Nebraska City and Big Papillion Creek at 125th and Fort Street, Omaha. The sites were selected due to the near proximity and also because the gage houses are large enough to hold the additional equipment. During the spring of 1992 a Paroscientific (PS2) pressure sensor made by the Hydrologic Instrumentation Facility (HIF), a Watergage I and a Watergage II both manufactured by Fluid Data Systems and a Waterlog (H-300) pressure transducer from Design Analysis Associates were installed at both sites. The stations are being closely monitored for one full year. The data will be examined and compared with that of the mercury manometer to determine the best replacement.

Vandalism continues to be a problem at the gaging stations. The most frequently experienced destruction or theft occurs to the solar panels and antennas. During a span of two weeks, the solar panel and antenna at Zorinsky Lake, Papio Site 18 were vandalized three times. An eight-foot high chain link fence was constructed around the gage house during the summer.

**c. Cooperative Hydrologic Programs.** Funding for the Omaha District's stream gaging activities is furnished through two programs. The Cooperative Stream Gaging (FC-33) program provides support to seven Geological Survey Districts. The districts are Colorado, Iowa, Montana, Nebraska, North Dakota, South Dakota and Wyoming. Collection and publication of data such as stage, discharge, sediment, water quality and ground water records are the primary functions of this program. The cooperative program also provides funding for DCP and telemark maintenance. The National Weather Service Reporting Network (FC-50) program provides financial support for the collection of data from 40 gaging stations within six river district offices. Formerly operated by the Corps of Engineers, these stations are required for reservoir regulation. The stations are in addition to the regular National Weather Service reporting stations.

**d. Water Quality.** The Omaha District Water Quality Unit conducts sampling and analysis of physical, chemical and biological parameters on reservoirs in the Omaha District. Projects are normally sampled six times per year by in-house personnel, area personnel or under contract. Occasional surveys and special investigations on all projects are conducted as necessary to identify or resolve specific water quality problems.

In-house personnel sample the Papillion Creek and Salt Creek reservoirs. Bowman-Haley, Coldbrook Chatfield, Bear Creek, Cherry Creek, Lake Audubon, Lake Pocasse, Lake Yankton Pipestem and the Missouri River main stem reservoirs are sampled by area personnel or under contract. Periodic sampling at Cottonwood Springs reservoir has ceased since this project currently impounds very little water.

Inflows and releases are sampled by area or in-house personnel at all tributary projects. Inflows and releases of main stem projects are sampled by area personnel or under contract by the USGS.

Continual remote monitoring and data storage of dissolved oxygen, temperature, conductivity and pH are conducted downstream of Gavins Point, Garrison and Fort Peck Projects. Continual remote monitoring of dissolved oxygen and temperature and periodic monitoring of conductivity and pH is conducted at Big Bend, Fort Randall and Oahe Projects. The monitoring is conducted by Area personnel.

e. **Sediment.** All suspended sediment samples collected in the Omaha District are obtained by the Geological Survey under the Cooperative Stream Gaging Agreement. Complete sedimentation surveys of small reservoir projects are made at approximately 10 year intervals. These include aggradation surveys to update water volume storage and sediment accumulation values, monitor headwater disposition and lake shoreline erosion; and degradation surveys to monitor downstream channel changes.

## **X. FLOODING.**

The following are excerpts from the National Weather Service's Monthly Report of River and Flood Conditions.

### **a. Nebraska.**

(1) **May.** The only significant storm of the month fell on the night of the 15th-16th. Some 2-3 inches falling in the North Fork Elkhorn River in the northeast filled the levels at Pierce to Hadar to bankfull and slightly higher levels. The area between Grand Island and Ravenna had localized lowland flooding as 2 to as much as 6 inches fell from the same storm.

(2) **June.** The only flood producing storm fell on the night of June 15-16 when 2-4 inches fell in the northeast section. A narrow band of 5-6 inches extended from Howells to Beemer where flood waters caused minor damage to the town of Howells in the main business district. Heavy rains filled the Pebble Creek basin briefly out of banks onto lowlands and some county roads.

**(3) July.** The statewide average monthly rainfall based on 163 Coop Weather Stations was 6.45 inches or 4.07 inches wetter than the 2.38 inch normal. The record of 6.77 inches was set in July 1958. This July was the wettest month in 10 years when May 1982 averaged 6.48 inches.

Looking at the monthly rainfall by climatic sections, the southeast caught 11 inches, the east central 7 to 8 inches, the northeast, central and south central 5 to 6 inches, and the north central, southwest and panhandle 3 to 4 inches. Departures from normal amounts ranged from plus 8 inches in the southeast to plus 1 inch in the far west.

A large storm fell on the evening through early morning hours of the 24th and 25th in southeast Nebraska. Intense and widespread rains of 4 to 7 inches fell in the evening hours from Nebraska City to Syracuse to Roca to Crete bringing flash flooding to many towns and villages affecting mainly basements, streets and some city parks. The rural areas suffered serious cropland flooding, county road and culvert washouts. These rains fell in the upper reaches of Little Nemaha, Salt, Big Nemaha, and Big Blue river basins.

The very next afternoon, additional 1 to 3 inches fell in the far southeast bringing the Little Nemaha River at Auburn to its highest levels in 13 years. The local state highway flooded, as well as considerable croplands along the bottomlands. Falls City came 5 to 6 feet out of banks flooding its lowlands to its mouth and briefly closing a state highway.

#### FLOOD ABOVE FLOOD STAGE PEAK

| River & Station                   | Stage | From | To   | Stage | Date                 |
|-----------------------------------|-------|------|------|-------|----------------------|
| Missouri River at Rulo, NE        | 17    | 7/29 | 7/30 | 20.5  | 7/30                 |
| Salt Creek at Roca, NE            | 19    | 7/25 | 7/25 | 21.76 | 7/25<br>(11,000 cfs) |
| Little Nemaha River at Auburn, NE | 22    | 7/25 | 7/26 | 24.6  | 7/25<br>(42,000 cfs) |
|                                   |       | 7/30 | 7/30 | 22.8  | 7/30                 |

b. Iowa.

(1) **March.** The first major precipitation event occurred March 5th-6th, with .50 to 1.50 inches falling over much of the state. The runoff from this rain event, combined with the previous increased flows, pushed several rivers, mainly in northern Iowa, out of their banks. Only minor flooding occurred, however, and by the middle of the month most rivers were back within bank.

**FLOOD ABOVE FLOOD STAGE PEAK**

| River & Station                      | Stage | From | To   | Stage | Date |
|--------------------------------------|-------|------|------|-------|------|
| Little Sioux River<br>at Spencer, IA | 10    | 3/7  | 3/7  | 10.1  | 3/7  |
|                                      |       | 3/9  | 3/11 | 10.3  | 3/10 |
| at Linn Grove, IA                    | 12    | 3/9  | 3/14 | 12/72 | 3/11 |

(2) **April.** The first significant precipitation of the month fell on April 15-16, when portions of the northwest and the southeast half of the state received more than half an inch. Local 1 to 1.5 inch amounts were observed, and Mount Ayer in extreme southern Iowa measured 2.42 inches. This helped saturate the soil for the next major rain event.

On the 18th and 19th, widespread rains of .75 to 1.75 inches fell over the state, pushing most rivers and streams to near bankfull, and causing minor flooding in a few locations. Another .50 inch to an inch fell over many sections during the next 48 hours, resulting in minor flooding scattered over many sections of the state. The weather turned drier during the last week of April, and most rivers had either fallen below flood stage or were falling.

**FLOOD ABOVE FLOOD STAGE PEAK**

| River & Station                      | Stage | From | To   | Stage | Date |
|--------------------------------------|-------|------|------|-------|------|
| Little Sioux River<br>at Spencer, IA | 10    | 4/20 | 4/26 | 11.9  | 4/22 |
| at Linn Grove, IA                    | 12    | 4/21 | 4/29 | 15.54 | 4/23 |
| at Cherokee, IA                      | 17    | 4/24 | 4/24 | 17/6  | 4/25 |

(3) May. Between 1 and 2 inches was reported over the Little Sioux and Boyer River basins May 16-17. This resulted in brief crests slightly above flood stage on portions of the Little Sioux River.

**FLOOD ABOVE FLOOD STAGE PEAK**

| River & Station                   | Stage | From | To   | Stage | Date |
|-----------------------------------|-------|------|------|-------|------|
| Little Sioux River at Spencer, IA | 10    | 5/18 | 5/18 | 10.2  | 5/18 |

(4) July. July was a cool month, averaging 5.5 degrees below normal at 68.8 degrees. This was second coolest July in 120 years.

On the 10th, 2-3 inches fell over the headwaters of the Floyd River. Widespread 1 to 2 inch amounts were received over central and eastern portions on the 24th and 25th.

Due to the dry antecedent conditions, only minor river flooding was observed at scattered locations around the state.

**FLOOD ABOVE FLOOD STAGE PEAK**

| River & Station                   | Stage | From | To   | Stage | Date |
|-----------------------------------|-------|------|------|-------|------|
| Little Sioux River at Spencer, IA | 10    | 7/11 | 7/20 | 11.3  | 7/14 |
|                                   |       | 7/26 | 7/29 | 10.8  | 7/27 |
| at Linn Grove, IA                 | 12    | 7/15 | 7/18 | 12.09 | 7/15 |
| at Cherokee, IA                   | 17    | 7/13 | 7/13 | 17.4  | 7/13 |
| Nishnabotna River at Hamburg, IA  | 16    | 7/13 | 7/13 | 18.94 | 7/13 |

**c. South Dakota.**

(1) March. Flooding on the Big Sioux River occurred the first several days of March. Most of the damage caused by flooding was to agriculture. Since the flooding occurred well before planting, the damage was slight.

(2) **June.** A localized flash flood occurred in the northwest corner the 13th. Six to possibly 10 inches of rain fell near Ludlow, causing Crooked Creek to washout culverts and fences. For a more detailed description of this event, see the project write-up for Bowman-Haley Reservoir.

A few spots in the northeast and east central also experienced flooding. A precipitation observer at Clear Lake recorded 2.60 inches the 15th, 4.55 inches the 16th and 4.38 inches the 17th. Hidewood Creek had extensive flooding due to this rain. This flooding covered most of the rural road crossing over the Big Sioux River in the areas of Dempster, Estelline and Bruce. As the crest of the Big Sioux moved downstream, it was mostly in-bank by the time it reached Sioux Falls.

**FLOOD ABOVE FLOOD STAGE PEAK**

| River & Station                     | Stage | From | To   | Stage | Date |
|-------------------------------------|-------|------|------|-------|------|
| Big Sioux River<br>at Brookings, SD | 9     | 6/20 | 6/27 | 12.4  | 6/20 |
| at Dell Rapids, SD                  | 12    | 6/24 | 6/25 | 12.3  | 6/24 |

(3) **July.** On the evening of July 1st, heavy rains fell in the southeast Sioux Falls to Brandon to Garretson area with several 5-inch plus reports. The lower portion of the Split Rock Creek flooded and the Big Sioux River, which was still high the mid June runoff event, flooded from Split Rock Creek downstream to Akron.

**FLOOD ABOVE FLOOD STAGE PEAK**

| River & Station                    | Stage | From | To  | Stage | Date |
|------------------------------------|-------|------|-----|-------|------|
| Big Sioux River<br>at Hawarden, IA | 15    | 7/4  | 7/5 | 17.4  | 7/4  |
| at Akron, IA                       | 16    | 7/5  | 7/6 | 18.0  | 7/6  |

d. **North Dakota.** No flooding in the Omaha District boundaries was observed during the reporting year.

e. **Montana.**

**June.** Moderate to heavy precipitation fell along most of the Yellowstone River basin the third and fourth week of June. With the soil being dry and most of the major rivers well below normal, heavy rains came out of the Crazy Mountains and destroyed a levee on the Shields River in Park County on June 17th. The resulting flood washed out two county roads, dirt around several bridge abutments, a culvert and flooded several acres of pasture land.

f. **Wyoming.** No flooding in the Omaha District boundaries was observed during the reporting year.

g. **Colorado.**

(1) **August.** Urban and Small Stream Flood Advisories were required for Denver and the surrounding area on August 2nd, when a major rain event produced between one and two inches of rain in an hour period. Many cars were stranded by high waters in streets and underpasses and small hail compounded the problem by clogging drains. No serious stream and river flooding was reported.

The heavy rain potential increased on August 3rd and Flash Flood watches were issued for much of the eastern foothills area. Locally heavy rains were reported over much of the watch area. Street and highway flooding was fairly widespread, but no river or stream flooding was reported.

Another event on August 4th produced street flooding in a small area of southeast Denver and prompted the issuance of an Urban and Small Stream Flood Advisory for that area. The next major event was on the sixth when Urban and Small Stream Flood Advisories were posted for parts of Park County where a small stream flood closed a highway for a short time. On the same day, minor street flooding was reported in Denver, Jefferson, Weld and Boulder Counties.

The last significant heavy rain event was on August 19th, when a flash flood warning was required for Clear Creek County to the west of Denver. Heavy rain caused Clear Creek and several small tributaries to come out of their banks. Numerous mudslides were recorded in the vicinity.

(2) **May.** On May 26th a flash flood watch was issued for the northwest plateau and the northern mountains of Colorado due to locally heavy rains. Nearly one and a half inches of rain fell in two to three hours in some locations. Water over roads was reported, but no significant damage occurred.

On May 27th, a Small Stream Flood Advisory was issued for Plateau Creek at Cameo, northeast of Grand Junction, where the stream rose slightly above flood stage for

a few hours. Again, water came over the road in one or two places but no damage was reported.

**(3) June.** The first significant precipitation event of the month was on June 8th. A cold front meeting moist unstable air produced widespread rain and hail along the front range. An Urban and Small Stream Advisory was followed by a flash flood warning for portions of the Denver Metropolitan Area. Boulder Creek and St. Vrain Creek were reported out of their banks near I-25. Rains of two to three inches in a one hour period in the warning area forced the closure of I-25 for two hours in both directions.

Another rain event on June 20th prompted the issuance of an Urban and Small Stream Advisory for southern Boulder and central Jefferson Counties. No serious flooding occurred.

A Small Stream Advisory was required for portions of Douglas County on June 23rd as Doppler Radar indicated two inches or more of rain in a two hour period near the headwaters of Plum Creek. No serious flooding was reported.

Rains of over two inches in a short period of time prompted the issuance of an Urban and Small Stream Flood Advisory on the 24th for portions of Larimer County. Three feet of water was reported at some street intersections in Fort Collins although no gaged streams were reported out of their banks.

**(4) July.** An Urban and Small Stream Flood Advisory was issued for the eastern Denver Metro Area on July 15th when as much as three inches of rain fell in a short time in the advisory area. Many roads were flooded. There were numerous reports of clogged drains and flooding of low lying areas as well as overbank flows on some small streams in the advisory area. No serious flooding was reported.

Another Urban and Small Stream Flood Advisory was issued for the southern portion of the Denver Metro Area on July 20th. Heavy thunderstorms caused considerable street flooding and drainage problems but no serious damage.

Small Stream Flood Advisories were required for eastern Arapahoe and southern Washington Counties on July 23rd. Up to four inches of rain in two to three hours caused minor flooding of small streams as well as numerous reports of water over roads and other flooding of low lying areas.

**XI. WATER CONTROL INITIATIVES.** During the report period, studies by the Water Control Section and others included the following:

**Missouri River Division Water Control Data System Master Plan.** The Omaha District has acquired a Unix based workstation within the Water Control Section. The workstation will be used for daily data acquisition and operational functions within the section. The Hydrology Branch network has converted to an ethernet networking system

which has been connected to the district's ethernet backbone. This will allow the section to communicate through the backbone system with the Reservoir Control Center and many other offices both within and outside the Corps.

Several years ago, Waterways Experiment Station (WES) developed software for the Rock Island District and others to be used in conjunction with the Alden weather radar system. The software reads the Alden radar files and computes rainfall amounts over an area. This information can then be read into other software such as runoff models. This year, as part of the Oahe Dam Safety exercise, Water Control and WES modified the software by inputting Bad River basin (South Dakota) information. The hourly precipitation values generated by the software were written to DSS and then input into a HEC-1F inflow forecasting model that was developed for the Bad River basin. Hydrograph(s) from the HEC-1F model were then input into hydraulic models such as HEC-2 and UNET.

Water Control Section is in the process of installing a 2.4 meter antenna on the roof of the Zorinski Federal Building. This dish will be used as part of a Domsat Receive Only Terminal (DROT) for GOES Data Collection System (DCS). Messages will be received and processed by two "data capture" terminals, loaded with SCO Unix operating system and DCS Automated Processing System software. Programs have been written that will transfer this data into the DSS database residing on the CDC 4330 workstation. The section has also developed download routines which write downloaded Vax data to HEC-DSS database format. This database will then be used in conjunction with the Unix based programs developed at HEC on the workstation.

**XII. FERC Applications.** During the period of this report, 9 applications for preliminary permits, licenses or exemption from licensing were made to the Federal Energy Regulatory commission by various entities for studies in connection with new or existing hydropower facilities within the Omaha District. These applications were reviewed and comments were prepared by the Omaha District on the impacts of the proposed plant.

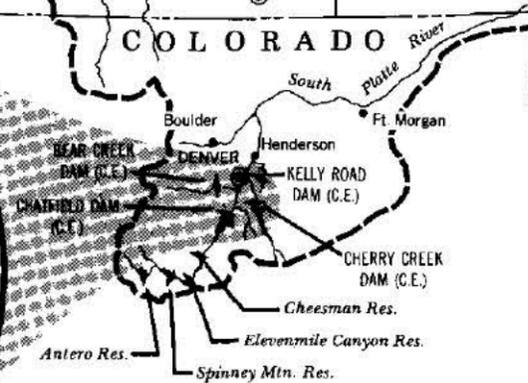
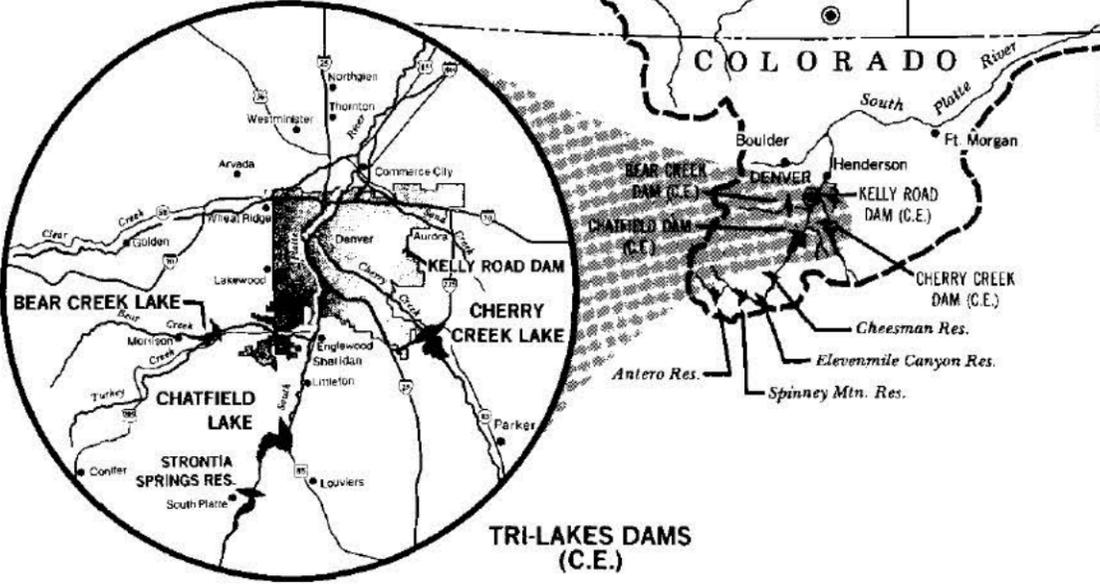
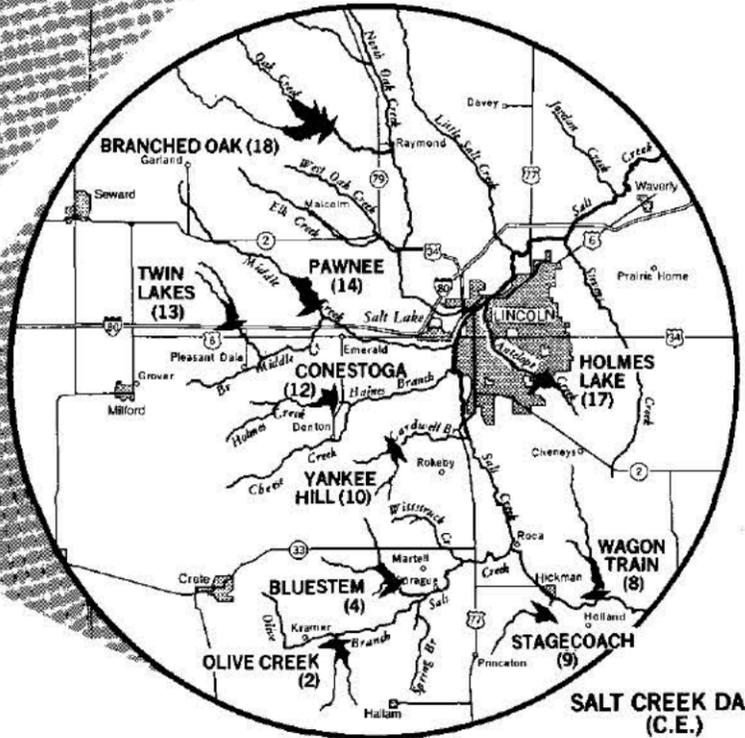
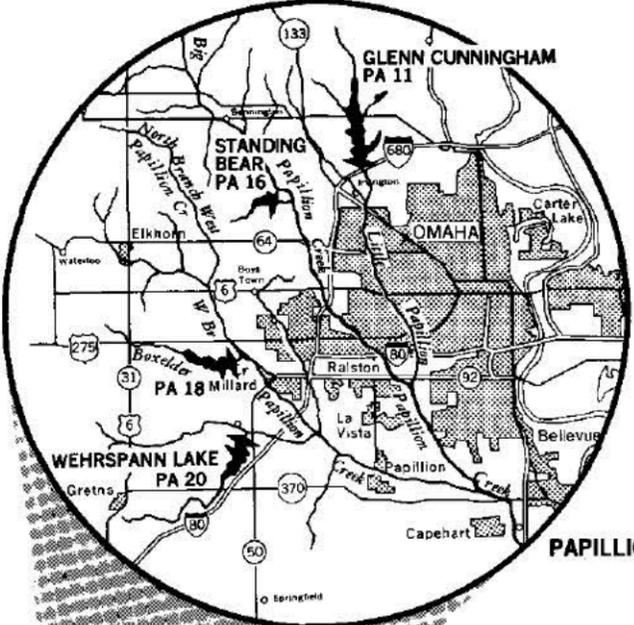
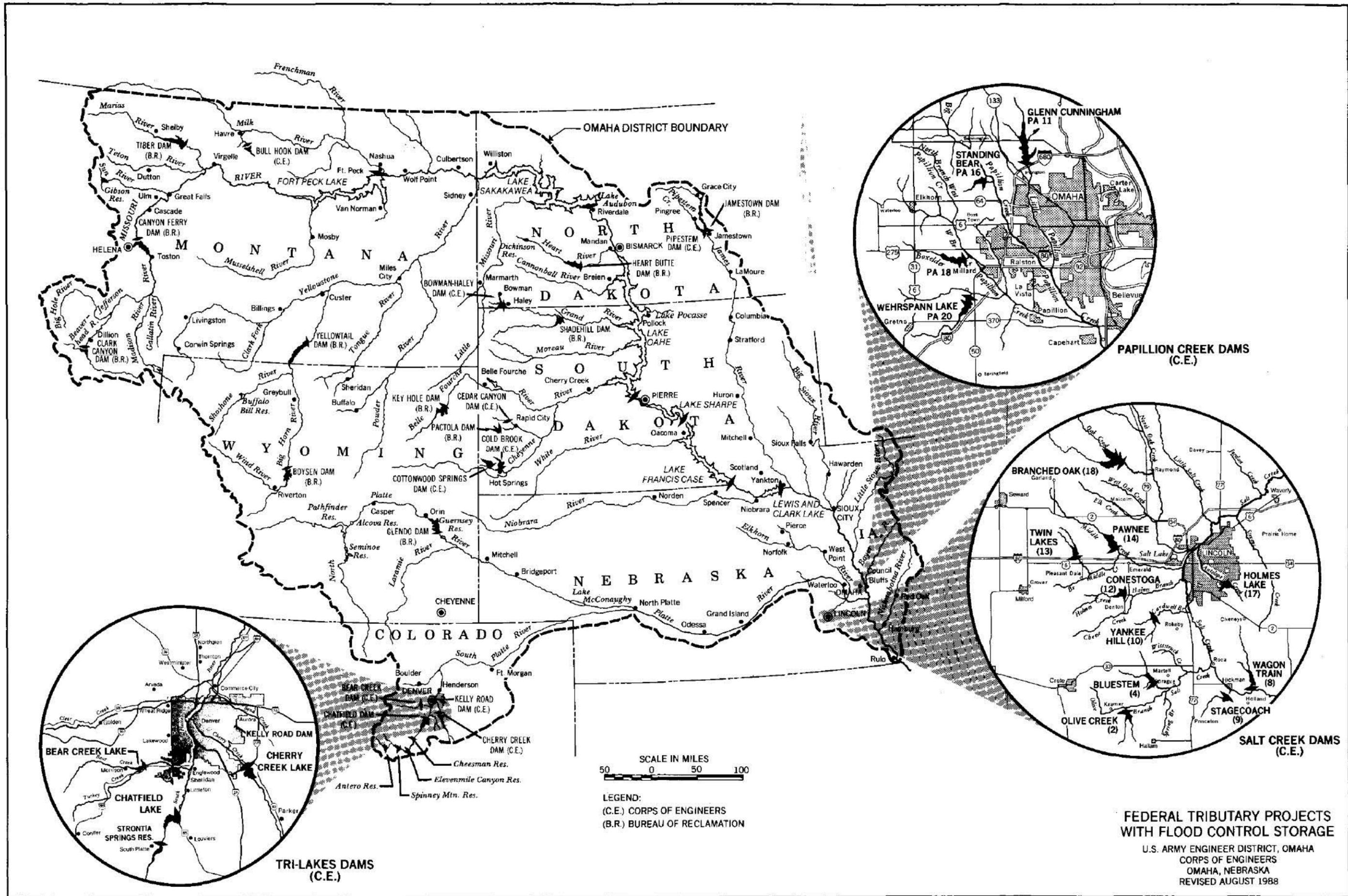
**XIII. TRAINING AND METHODS.** During the period of this report, employees in the Section attended the courses listed below:

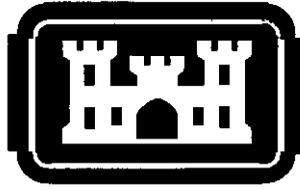
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|-------------------------------|-----------|------------------|
| 1. Hydrologic Data Management | Davis, CA | 40 hours May 92  |
| 2. UNIX Usage & Shell Prog    | Omaha, NE | 40 hours Feb 92  |
| 3. CPR/First Aid Training     | Omaha, NE | 8 hours Apr 92   |
| 4. Real Time Water Control    | Davis, CA | 80 hours Dec 91  |
| 5. Mo Riv Nav Exc             | Omaha, NE | 8 hours Jun 92   |
| 6. Long Term Training         | Omaha, NE | 2080 hours 91-92 |

On-the-Job instruction and training of new employees and existing staff members continues as duties and new techniques require.

**XIV. PERSONNEL.** The personnel strength of the Water Control Section currently consists of three Hydraulic Engineers, four Hydraulic Engineering Technicians, one Secretary, and one Hydraulic Engineering Technician (part-time college student); a total of 9 personnel.

**MAP  
OF  
FLOOD CONTROL  
DAMS**





**PROJECT DATA SHEETS - TRIBUTARY**

**(5 SHEETS)**

**CORPS OF ENGINEERS DAMS**

**SALT CREEK BASIN DAMS - C.E.**

**PAPILLION CREEK BASIN DAMS - C.E.**

**BUREAU OF RECLAMATION DAMS**

**SUBIMPOUNDMENT DAMS (TWO) - C.E.**

**SUMMARY OF ENGINEERING DATA — FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL  
MISSOURI RIVER TRIBUTARIES — U.S. ENGINEER DISTRICT — OMAHA  
CORPS OF ENGINEERS**

| ITEM NO | SUBJECT                                 | BEAR CREEK   | BOWMAN HALEY  | BULL HOOK --<br>SCOTT DOULEE                                   | CEDAR CANYON                   | CHATFIELD  | CHERRY CREEK   | GOLD BROOK   | DUTTONWOOD SPRINGS   | KELLY ROAD   | PIPERSTEM   |   |
|---------|---|--|---|--|--------------------------------|--|--|--|--|--|---|---|
| 1       | <b>GENERAL</b>                          |  |   |  |                                |  |  |  |  |  |   |   |
| 2       | Location of dam                         | 3 mi. S.W. of Denver, Colo.                                    | 8 mi. W. of Haley, R.D.   | 1 mi. S. of Hawk, Mont.  | 3.5 mi. W. of Rapid City, S.D. | 1 mi. S. of Denver, Colo.  | 10 mi. S.E. of Denver, Colo.                             | 1 mi. E. of Hot Springs, S.D.  | 4.5 mi. W. of Hot Springs, S.D.                            | Lovely J.F.B., Denver, Colo.                                       | 3 mi. N.W. Jamestown, N.D.  |   |
| 3       | River and river mile                    | Bear Creek R. Fr. Grand  | R. Fr. Grand  | Bull Hook Cr. Scott Coulee                                     | Madison Cr. Scott Coulee       | South Platte River   | Cherry Creek   | Cold Brook   | Chickadee Springs Creek                                    | Hoarsy Creek   | Hoarsy Creek  |   |
| 4       | Drainage area (sq. mi.)                 | 236  | 448   | 54   | 2.4                            | 3,818  | 386  | 70.5   | 76   | 19.84  | 154   |   |
| 5       | Reservoir length (mi.)                  | 0.5 at 5556  | 2.5 at 2755   | Normally dry   | Normally dry                   | 2.0 at 5430  | 1.5 at 5550  | 1.2 at 3648.5  | 0.8 at 3675  | Normally dry   | 1.5 at 1442.4   |   |
| 6       | Location of Dam                         | At Cheyenne Dam  | Cannon Dam  | Fl. Rock Dam   | —                              | On site  | At Cheyenne Dam  | On site  | At Cold Brook Dam  | Rocky Mt. Area   | On site   |   |
| 7       | Travel time to Missouri River           | 3 weeks  | 1 day to Cheyenne Dam   | —  | —                              | 7 weeks  | —  | —  | —  | —  | 3 weeks   |   |
| 8       | Max. discharge of record                | 4,808 cfs  | 14,100 cfs  | 440 cfs  | 110,000 cfs                    | 58,000 cfs   | 110,000 cfs  | 8400 cfs   | 8400 cfs   | —  | 4,000 cfs   |   |
| 9       | Project cost (\$)                       | \$41,708,000   | \$4,372,200   | \$1,837,300  | \$122,500                      | August 1945  | \$1,671,136,000  | June 1965  | June 1963  | Sept. 1938   | \$2,863,000   | \$2,377,500   |
| 10      | <b>DAM AND EMBANKMENT</b>               |  |   |  |                                |  |  |  |  |  |   |   |
| 11      | Top of dam — R. MSL                     | 5688.5   | 2794.0  | 2613.3 (B.H.)  | 2613.3 (S.C.)                  | 3654.0   | 3647.0   | 3675.0   | 3651.0   | 5372.8   | 5363.0 Head Elev.   | 587.5   |
| 12      | Length of dam — R.                      | 5,300 — main 2,100 — South                                     | 5730  | 1900 (B.H.)  | 1900 (S.C.)                    | 1220   | 1,308  | 425  | 1390   | 4700   | 4200  | 1507.5  |
| 13      | Height of dam — R.                      | 178.5 — main 85 — South  | 29  | 7318 (H.)  | 5318 (C.)                      | 47   | 147  | 141  | 127  | 32   | 107.5   | 1400  |
| 14      | Stream bed — R. MSL                     | 5,519  | 2715  | 2548 (B.H.)  | 2500 (S.C.)                    | 3512   | 3340   | 3504   | 3545   | 3632   | 3540  | 1400  |
| 15      | Abutment formation                      | Clay, shale, silts, sandstone                                  | Lutite, sandy clay, silty sand  | Calcareous, loess clay   | Miscellaneous limestone        | Sandy sandstone — Denver Form.   | Sandstone, clay, silt                                    | Sandstone, shale, limestone  | Miscellaneous limestone                                    | Overburden — sandy clay  | Sandy overburden — P. Shale   | 1400  |
| 16      | Type of fill                            | Rolling earth  | Rolling earth   | Rolling earth  | Rolling earth                  | Rolling earth  | Rolling earth  | Rolling earth  | Rolling earth  | Rolling earth  | Rolling earth   | 1400  |
| 17      | Fill quantity in cu. yds.               | 11,246,000 — main 770,000 — South                              | 1,750,000   | 1,309,000  | 150,000                        | 14,850,000   | 14,850,000   | 950,000  | 950,000  | 200,000  | 1,800,000   | 1,800,000   |
| 18      | Date of closure                         | Jul. 1977  | Aug. 1966   | Oct. 1955  | —                              | —  | —  | —  | —  | —  | —   | —   |
| 19      | Date of habitation (base F.C.)          | May 1978   | Mar. 1969   | —  | —                              | —  | —  | —  | —  | —  | —   | —   |
| 20      | <b>SPILLWAY</b>                         |  |   |  |                                |  |  |  |  |  |   |   |
| 21      | Discharge capacity — cfs                | 153,500 cfs at 5684.5  | 82,870 cfs at 2780  | 75,390 cfs at 2605   | 2943.0 (B.H.)                  | 7548.0 (S.C.)  | 1400 cfs at 3599.8                                       | 186,800 cfs at 3621.8  | 80,800 cfs at 3667.0                                       | 38,800 cfs at 3650.5   | 3500 cfs R.H. 5306.8  | 64,200 cfs at 1507.8  |
| 22      | Cost per cu. yd.                        | 5.67   | 2.77  | 3.545  | 3.545                          | 3.545  | 3.545  | 3.545  | 3.545  | 3.545  | 3.545   | 3.545   |
| 23      | Width — ft.                             | 800  | 850   | 800  | 800                            | 800  | 800  | 800  | 800  | 800  | 800   | 800   |
| 24      | Gate, number, size, type                | Ungated earth channel  | Ungated earth notch (2)   | Ungated earth channel  | Ungated rock channel           | Ungated converging chute   | Ungated earth channel                                    | Ungated sharp crested weir   | Ungated broad weir   | Ungated broad weir   | Ungated earth channel   | Ungated earth channel   |
| 25      | <b>RESERVOIR ELEV. AND AREA</b>         |  |   |  |                                |  |  |  |  |  |   |   |
| 26      | Maximum pool                            | 5688.5   | 2794.0  | 2613.3   | 2613.3                         | 3654.0   | 3647.0   | 3675.0   | 3651.0   | 5372.8   | 5363.0  | 587.5   |
| 27      | Top of flood control pool               | 5635.5   | 2777.0  | 2515.4   | 2515.4                         | 3545.0   | 3545.0   | 3545.0   | 3545.0   | 5306.8   | 5306.8  | 580.0   |
| 28      | Top of multipurpose pool                | 5558.0   | 2754.0  | 2478.0   | 2478.0                         | 3432.0   | 3432.0   | 3432.0   | 3432.0   | 5244.0   | 5244.0  | 575.0   |
| 29      | Top of inactive pool                    | 5528.0   | 2740.0  | 2465.0   | 2465.0                         | 3328.0   | 3328.0   | 3328.0   | 3328.0   | 5140.0   | 5140.0  | 565.0   |
| 30      | <b>STORAGE ZONES (Elev. - Capacity)</b> |  |   |  |                                |  |  |  |  |  |   |   |
| 31      | Surcharge                               | 5635.5-5684.5  | 2777.0-2794.0   | 2515.4-2605.0  | 2515.4-2605.0                  | 3545.0-3654.0  | 3545.0-3647.0  | 3545.0-3675.0  | 3545.0-3651.0  | 5306.8-5372.8  | 5306.8-5363.0   | 580.0-587.5   |
| 32      | Flood control                           | 3558.0-5635.5  | 2754.0-2777.0   | 2478.0-2515.4  | 2478.0-2515.4                  | 3432.0-3545.0  | 3432.0-3545.0  | 3432.0-3545.0  | 3432.0-3545.0  | 5244.0-5306.8  | 5244.0-5306.8   | 575.0-580.0   |
| 33      | Multipurpose                            | 5528.0-5558.0  | 2740.0-2754.0   | 2465.0-2478.0  | 2465.0-2478.0                  | 3328.0-3432.0  | 3328.0-3432.0  | 3328.0-3432.0  | 3328.0-3432.0  | 5140.0-5244.0  | 5140.0-5244.0   | 565.0-575.0   |
| 34      | Inactive                                | 5518.0-5528.0  | 2735.0-2740.0   | 2455.0-2465.0  | 2455.0-2465.0                  | 3288.0-3328.0  | 3288.0-3328.0  | 3288.0-3328.0  | 3288.0-3328.0  | 5080.0-5140.0  | 5080.0-5140.0   | 560.0-565.0   |
| 35      | Draw (top of flood control pool)        | 5518.0   | 2735.0  | 2455.0   | 2455.0                         | 3288.0   | 3288.0   | 3288.0   | 3288.0   | 5080.0   | 5080.0  | 560.0   |
| 36      | <b>OUTLET WORKS</b>                     |  |   |  |                                |  |  |  |  |  |   |   |
| 37      | Number and size — conduits              | 1 — 7 ft. circular — upstream<br>1 — 7x10.5 ft. — downstream   | 1 — 10 ft. circular conduit   | 1 — 30 in. RCP w. Bull Hook<br>1 — 30 in. RCP — Scott Coulee   | 1 — 24 in. C.M.P.              | 1 — 11x18 ft. oval conduit   | 2 — 8x12 ft. oval conduit<br>1 — 12 ft. circular conduit | 1 — 6 ft. RCP conduit<br>1 — 8 in. siphon pipe   | 1 — 48 in. concrete  | 1 — 5.5 ft. circular conduit<br>1 — 30 in. CMP                     | 1 — 8 ft. circular conduit  | 1 — 8 ft. circular conduit  |
| 38      | Conduit length — ft.                    | 1800 ft.   | 341 ft.   | 282 ft. — Bull Hook<br>206 ft. — Scott Coulee                  | 230 ft.                        | —  | 679.5 ft.  | 907 ft.  | 1200 ft.   | —  | 975 ft.   | 975 ft.   |
| 39      | Number — size — type gates              | 2 — 30 in. hydraulic slide<br>2 — 1x1 ft. slide — gate on gate | 2 — 30 in. valves — at 2740.0<br>1 — 30 in. interior gate valve<br>1 — 30 in. interior gate valve | 2 — 24 in. valves, Bull Hook<br>1 — 24 in. valve, Scott Coulee | Ungated inlet — at 3526        | 1 — 8x13.5 ft. hydraulic slide<br>2 — 2x7 ft. slide — gate on gate<br>1 — 72 in. butterfly | 5 — 8x8 ft. — hydraulic slide<br>2 — 16 in. bypass gates | Ungated drop inlet — at 3645<br>2 — 12 in. gate valves — at 3548<br>1 — 4 in. valve<br>250 cfs at 3600.0<br>1540 cfs at 3651.4 | Ungated drop inlet — at 3675<br>1 — 2x3 ft. gate — at 3666 | Ungated drop inlet — at 5324.4<br>1 — 36 in. valve 1.3x3 ft. slide | Ungated drop inlet — at 1442.4<br>2 — 4x7 ft. hydraulic slide<br>1 — 36 in. valve 1.3x3 ft. slide | Ungated drop inlet — at 1442.4<br>2 — 4x7 ft. hydraulic slide<br>1 — 36 in. valve 1.3x3 ft. slide |
| 40      | Discharge capacity                      | 2,160 cfs at 5687  | 2,160 cfs at 2780   | 123 cfs at 2583 — Bull Hook<br>183 cfs at 2583 — Scott Coulee  | 49 cfs at 3545                 | 6400 cfs at 3600.0   | 8100 cfs at 3660.0                                       | 1540 cfs at 3651.4   | 580 cfs at 3636.0  | 578 cfs at 5367.0  | 2,300 cfs at 1495.5   | 2,300 cfs at 1495.5   |
| 41      | <b>POWER INSTALLATION</b>               | none   | none  | none   | none                           | none   | none   | none   | none   | none   | none  |   |

MRO FORM 1501

- (1) Costs are as of 9-30-80  
 (2) Bowman Haley Spillway equipped with Face Pier (Clear Elevation 2780 ft. R. MSL.)  
 (3) Use to updated hydrological improvements Assessment by Cherry Creek Reservoir with the maximum pool the spillway would be developed

November 1980

**SUMMARY OF ENGINEERING DATA -- FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL  
MISSOURI RIVER TRIBUTARIES -- U.S. ENGINEER DISTRICT -- OMAHA  
SALT CREEK BASIN -- NEBRASKA**

| ITEM NO.                             | SUBJECT  | DAM NO. 2<br>(Olive Creek Lake)                      | DAM NO. 4<br>(Blue Stem Lake)                        | DAM NO. 8<br>(Wagon Train Lake)                      | DAM NO. 9<br>(Stegmoch Lake)                         | DAM NO. 10<br>(Yankton Hill Lake)                    | DAM NO. 12<br>(Corwith Lake)                         | DAM NO. 13<br>(Twin Lake)                            | DAM NO. 14<br>(Pawnee Lake)                          | DAM NO. 17<br>(Hornes Park Lake)                     | DAM NO. 18<br>(Branched Oak Lake)      |
|--------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
| <b>GENERAL</b>                       |  |  |  |  |  |  |  |  |  |  |  |
| 1                                    | Location of dam  | 1.5 mi. E. of Kramer                                 | 2.5 mi. W. of Sprague                                | 1.5 mi. N. of Holland                                | 1 mi. S. of Hickman                                  | 3.5 mi. E. of Denton                                 | 1.5 mi. N. of Denton                                 | 2 mi. N.W. of Pleasantdale                           | 2 mi. W. of Emerald                                  | 5 E. edge of Lincoln                                 | 4 mi. W. of Raymond                    |
| 2                                    | River and outfalls                                       | S. Trib. of Olive Cr.                                | N. Trib. of Olive Cr.                                | N. Trib. of Hickman Cr.                              | S. Trib. of Hickman Cr.                              | Carroll Cr.  | Holmes Cr.   | Middle Cr.   | M. Middle Cr.  | Arroyo Cr.   | San Cr.                                |
| 3                                    | Drainage area in square miles                            | 8.2  | 18.8   | 15.6   | 9.7  | 9.4  | 15.1   | 11.9   | 25.9   | 5.4  | 88.7                                   |
| 4                                    | Reservoir length in miles                                | 1.2  | 1.6  | 1.8  | 1.4  | 9.7  | 1.4  | 1.5  | none   | 0.7  | 3.7                                    |
| 5                                    | Location of Damometer                                    | none   | none                                   |
| 6                                    | Travel time to Lincoln, NE                               | 23 hrs.  | 15 hrs.  | 8 hrs.   | 6 hrs.   | 3 hrs.   | 3 hrs.   | 7 hrs.   | 7 hrs.   | 3 hrs.   | 6 hrs.                                 |
| 7                                    | Max. discharge of record                                 | —  | —  | —  | —  | —  | —  | —  | —  | —  | —                                      |
| 8                                    | Project cost   | (1)  | (1)  | (1)  | (1)  | (1)  | (1)  | (1)  | (1)  | (1)  | (1)                                    |
| <b>DAM AND EMBANKMENT</b>            |  |  |  |  |  |  |  |  |  |  |  |
| 9                                    | Top of dam -- H. MSL.                                    | 1356.0   | 1354.0   | 1312.0   | 1294.0   | 1270.0   | 1290.0   | 1304.0   | 1271.0   | 1273.0   | 1325.0                                 |
| 10                                   | Length of dam -- ft.                                     | 3029.0   | 2796.0   | 1659.0   | 2759.0   | 3166.0   | 3000.0   | 2075.0   | 5000.0   | 7700.0   | 5200.0                                 |
| 11                                   | Height of dam -- ft.                                     | 45.0   | 57.0   | 48.0   | 57.0   | 52.0   | 63.0   | 65.0   | 56.0   | 55.0   | 70.0                                   |
| 12                                   | Stream bed -- H. MSL.                                    | 1314.0   | 1277.0   | 1250.0   | 1246.0   | 1218.0   | 1197.0   | 1266.0   | 1266.0   | 1218.0   | 1250.0                                 |
| 13                                   | Abutment formation                                       | Clay -- sand -- pit                                  | Clay -- sand   | Clay   | Clay -- sand   | Clay -- sand   | Clay -- sand   | Clay -- sand -- pit                                  | Clay -- sand   | Clay -- sand   | Clay -- sand -- pit                    |
| 14                                   | Type of fill   | rolled earth   | rolled earth                           |
| 15                                   | Fill quantity in cu. yds.                                | 319,000  | 471,000  | 379,000  | 514,000  | 572,000  | 650,000  | 610,000  | 819,000  | 900,000  | 246,000                                |
| 16                                   | Date of closure  | 20 Sep. 1963   | 15 Sep. 1962   | 24 Sep. 1962   | 27 Aug. 1963   | 5 Oct. 1965  | 24 Sep. 1963   | 26 Sep. 1965   | 16 Jun. 1964   | 17 Sep. 1962   | 21 Aug. 1967                           |
| 17                                   | Date of initial fill                                     | 30 Jun. 1965   | 8 Jul. 1963  | 24 Jun. 1963   | 25 Mar. 1963   | 10 Jun. 1967   | May 1965   | 16 Mar. 1966   | 21 Jun. 1967   | 2 Jun. 1965  | 18 Jun. 1973                           |
| <b>SPILLWAY</b>                      |  |  |  |  |  |  |  |  |  |  |  |
| 18                                   | Discharge capacity -- cfs                                | 15875 at H. 1257.1                                   | 22925 at H. 1331.7                                   | 23219 at H. 1299.8                                   | 17585 at H. 1291.6                                   | 12100 at H. 1267.8                                   | 27220 at H. 1256.2                                   | 25200 at H. 1261.8                                   | 18675 at H. 1260.1                                   | 800 at H. 1299.7                                     | 7675 at H. 1317.5                      |
| 19                                   | Length of spillway -- ft.                                | 1350.0   | 1377.5   | 1289.0   | 1289.0   | 1282.0   | 1252.0   | 1263.0   | 1263.0   | 1268.0   | 1311.0                                 |
| 20                                   | Width -- ft.   | 340.0  | 340.0  | 430.0  | 430.0  | 400.0  | 790.0  | 400.0  | 700.0  | 400.0  | 200.0                                  |
| 21                                   | Spillway material, type                                  | Ungrouted earth channel                              | Ungrouted earth channel                |
| <b>RESERVOIR ELEV. AND AREA</b>      |  |  |  |  |  |  |  |  |  |  |  |
| 22                                   | Maximum pool   | 1357.1   | 1351.7   | 1308.8   | 1291.6   | 1267.8   | 1256.2   | 1301.8   | 1268.1   | 1269.7   | 1317.3                                 |
| 23                                   | Top of flood control pool                                | 1350.0   | 1322.5   | 1309.0   | 1286.0   | 1262.0   | 1252.0   | 1263.0   | 1263.0   | 1268.0   | 1311.0                                 |
| 24                                   | Top of first spill pool                                  | none   | none                                   |
| 25                                   | Top of conservation pool                                 | 1335.0   | 1307.4   | 1287.8   | 1271.1   | 1244.9   | 1232.9   | 1241.0   | 1244.3   | 1242.4   | 1294.8                                 |
| 26                                   | Top of settlement pool                                   | 1335.0   | 1306.1   | 1284.6   | 1271.1   | 1241.9   | 1232.9   | 1237.4   | 1244.3   | 1240.0   | 1275.7                                 |
| <b>STORAGE ZONES (Inv. Capacity)</b> |  |  |  |  |  |  |  |  |  |  |  |
| 27                                   | Surcharge zone   | 1350.0-1357.1  | 2910AF   | 1307.5-1321.7  | 7215AF   | 1280.0-1287.8  | 5940AF   | 1255.0-1261.8  | 3790AF   | 1262.5-1269.7  | 1526AF                                 |
| 28                                   | Excess flow control zone                                 | 1335.0-1350.0  | 3980AF   | 1307.4-1292.5  | 7115AF   | 1287.8-1302.0  | 8780AF   | 1244.9-1252.0  | 5250AF   | 1242.4-1268.0  | 5885AF                                 |
| 29                                   | Joint use zone   | none   | none                                   |
| 30                                   | Conservation zone  | none   | 1306.1-1307.4  | 386AF  | 1284.6-1287.8  | 830AF  | 1241.9-1244.9  | 983AF  | 1244.3   | 1242.4   | 273AF                                  |
| 31                                   | Settlement pool zone                                     | 1314.0-1335.0  | 1490AF   | 1277.0-1306.1  | 2295AF   | 1260.0-1264.6  | 1860AF   | 1196.0-1237.4  | 2020AF   | 1219.0-1240.0  | 623AF                                  |
| 32                                   | Gross Storage (Inv. of surcharge)                        | 5470 AF  | 8790AF   | 9760AF   | 9260AF   | 8940AF   | 7983AF   | 10660AF  | 28110AF  | 8790AF   | 9760AF                                 |
| <b>ORIFICE WORKS</b>                 |  |  |  |  |  |  |  |  |  |  |  |
| 33                                   | Number and size -- conduits                              | 1 -- CMP -- 48" Dia. with 30" RCP lining             | 1 -- CMP -- 60" Dia. with 42" RCP lining             | 1 -- CMP -- 60" Dia. with 42" RCP lining             | 1 -- CMP -- 60" Dia. with 30" RCP lining             | 1 -- CMP -- 48" Dia. with 30" RCP lining             | 1 -- CMP -- 60" Dia. with 42" RCP lining             | 1 -- CMP -- 60" Dia. with 42" RCP lining             | 1 -- CMP -- 60" Dia. with 42" RCP lining             | 1 -- CMP -- 60" Dia. with 42" RCP lining             | 1 -- CMP -- concrete lined -- 72" Dia. |
| 34                                   | Conduit length -- ft.                                    | 290  | 215  | 290  | 290  | 290  | 290  | 290  | 290  | 290  | 290                                    |
| 35                                   | Controlled outlet (type -- size -- type -- invert elev.) | 1 -- 36" x 36" LRI gate -- 1330.0                    | 1 -- 36" x 36" LRI gate -- 1303.0                    | 1 -- 36" x 36" LRI gate -- 1283.5                    | 1 -- 36" x 36" LRI gate -- 1261.0                    | 1 -- 36" x 36" LRI gate -- 1237.0                    | 1 -- 36" x 36" LRI gate -- 1270.0                    | 1 -- 42" x 54" LRI gate -- 1335.0                    | 1 -- 42" x 54" LRI gate -- 1236.0                    | 1 -- 36" x 36" LRI gate -- 1270.0                    | 1 -- 48" x 72" LRI gate -- 1276.3      |
| 36                                   | Ungrouted outlets (type -- size -- elev.)                | 2 -- 24" x 24" -- 1340.0<br>2 -- 12" x 30" -- 1335.0 | 2 -- 30" x 30" -- 1213.5<br>2 -- 12" x 54" -- 1307.4 | 2 -- 30" x 30" -- 1292.6<br>2 -- 12" x 34" -- 1267.6 | 2 -- 24" x 24" -- 1277.1<br>2 -- 12" x 30" -- 1274.1 | 2 -- 18" x 24" -- 1259.0<br>2 -- 12" x 30" -- 1244.9 | 2 -- 18" x 24" -- 1242.3<br>2 -- 12" x 34" -- 1232.9 | 2 -- 24" x 24" -- 1341.0<br>2 -- 12" x 30" -- 1242.5 | 2 -- 24" x 24" -- 1341.0<br>2 -- 12" x 30" -- 1242.5 | 2 -- 24" x 24" -- 1249.8<br>2 -- 12" x 30" -- 1242.5 | 2 -- 42" x 44" -- 1263.95<br>200       |
| 37                                   | Check cover -- cts (at base of EFC zone)                 | 80   | 75   | 75   | 80   | 75   | 80   | 145  | 210  | 80   | 200                                    |
| <b>POWER INSTALLATION</b>            |  |  |  |  |  |  |  |  |  |  |  |
| 38                                   | No. and size of turbines                                 | none   | none                                   |
| 39                                   | No. and rating of generators                             | none   | none                                   |
| 40                                   | Plant capacity   | none   | none                                   |
| 41                                   | Power Plant dist. (m.p.m.) (at base of EFC zone)         | none   | none                                   |

(1) Total project financial cost including all dams -- \$12,875,000 (Costs are as of 9-30-60)

October 1969

**SUMMARY OF ENGINEERING DATA — FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL  
MISSOURI RIVER TRIBUTARIES — U.S. ENGINEER DISTRICT — OMAHA  
PAPILLION CREEK BASIN — NEBRASKA**

| ITEM NO.                             | SUBJECT  | DAM NO. 11<br>(Glenn Cunningham Lake) | DAM NO. 16<br>(Standing Bear Lake) | DAM NO. 18<br>(Zorinsky Lake) | DAM NO. 20<br>(Waparush Lake) |                  |          |                        |         |  |
|--------------------------------------|--|---------------------------------------|------------------------------------|-------------------------------|-------------------------------|------------------|----------|------------------------|---------|--|
| <b>GENERAL</b>                       |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
| 1                                    | Location of dam  | 2514 State Street                     | 12th and Fort Street               | 10th and "F" Street           | 15th and Dixie Road           |                  |          |                        |         |  |
| 2                                    | River and channel  | Keight Creek —                        | Tributary Big Pine —               | Smelter Creek —               | Tiv. South Branch Papio —     |                  |          |                        |         |  |
| 3                                    | Drainage area (sq. mi.)  | 17.8                                  | 6                                  | 16.4                          | 13.1                          |                  |          |                        |         |  |
| 4                                    | Reservoir length in miles  | 2.5                                   | 1.0                                | 1.5                           | 1.3                           |                  |          |                        |         |  |
| 5                                    | Location of Damabator  | None                                  | None                               | None                          | None                          |                  |          |                        |         |  |
| 6                                    | Travel time in Missouri River                                    | 5-10 Hours                            | 5-10 Hours                         | 5-10 Hours                    | 5-10 Hours                    |                  |          |                        |         |  |
| 7                                    | Max. discharge of reservoir                                      | —                                     | —                                  | —                             | —                             |                  |          |                        |         |  |
| 8                                    | Project cost (\$)  | \$11,800,000                          | \$4,300,000                        | \$20,656,000                  | \$14,824,800                  |                  |          |                        |         |  |
| <b>DAM AND EMBANKMENT</b>            |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
| 9                                    | Top of dam — ft. MSL   | 1152                                  | 1130.0                             | 1143.5                        | 1121                          |                  |          |                        |         |  |
| 10                                   | Length of dam — ft.  | 1940                                  | 1400                               | 1600                          | 1610                          |                  |          |                        |         |  |
| 11                                   | Height of dam — ft.  | 87                                    | 70                                 | 84                            | 56                            |                  |          |                        |         |  |
| 12                                   | Stream bed — ft. MSL   | 1085                                  | 1050                               | 1070.5                        | 1009                          |                  |          |                        |         |  |
| 13                                   | Abutment foundation  | Loam clay loess                       | Loam clay loess                    | Loam clay loess               | Loam clay loess               |                  |          |                        |         |  |
| 14                                   | Type of fill   | Roller earth                          | Roller earth                       | Roller earth                  | Roller earth                  |                  |          |                        |         |  |
| 15                                   | Fill quantity in cu. yds.  | 658,000                               | 481,000                            | 1,263,000                     | 267,450                       |                  |          |                        |         |  |
| 16                                   | Date of closure  | 5 Aug 1974                            | 3 Oct 1977                         | 15 July 1964                  | 21 Sep 1967                   |                  |          |                        |         |  |
| 17                                   | Date of initial fill   | 7 Sep 1977                            | 24 Oct 1977                        | —                             | 26 May 1967                   |                  |          |                        |         |  |
| <b>SPILLWAY</b>                      |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
|                                      | Discharge capacity — cfs (max. pool)                             | 18,700                                | 9,500                              | 30,600                        | 12,000                        |                  |          |                        |         |  |
|                                      | crest elev. — ft. MSL  | 1142                                  | 1121                               | 1125.2                        | 1120                          |                  |          |                        |         |  |
|                                      | width — ft.  | 700                                   | 700                                | 400                           | 600                           |                  |          |                        |         |  |
|                                      | Gates, number, size, type  | Ungrated earth channel                | Ungrated earth channel             | Ungrated earth channel        | Ungrated earth channel        |                  |          |                        |         |  |
| <b>RESERVOIR ELEV. AND AREA</b>      |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
| 22                                   | Maximum pool   | 1147                                  | 1120a                              | 1130.2                        | 1120.5                        | 805a             |          |                        |         |  |
| 23                                   | Top of flood control pool  | 1142                                  | 1121                               | 1120.2                        | 1113.1                        | 485a             |          |                        |         |  |
| 24                                   | Top of maintenance pool  | 1131                                  | 1104                               | 1110.0                        | 1095.83                       | 238a             |          |                        |         |  |
|                                      |  |                                       |                                    |                               | (See (2) footnote)            |                  |          |                        |         |  |
| <b>STORAGE DATA (Elev. Capacity)</b> |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
| 25                                   | Surcharge  | 1145-1147                             | 5,405AF                            | 1121-1127                     | 2,910AF                       | 1120.2-1130.2    | 7,225AF  | 1113.1-1125.8          | 8,128AF |  |
| 26                                   | Flood control  | 1121-1142                             | 13,899AF                           | 1104-1121                     | 3,720AF                       | 1110.0-1130.2    | 7,565AF  | 1095.83-1113.1         | 6,118AF |  |
| 27                                   | Maintenance  | 1085-1121                             | 3,262AF                            | 1080-1104                     | 1,508AF                       | 1060.5-1110.0    | 3,475AF  | 1080-1095.83           | 2,882AF |  |
| 28                                   | Gross storage (incl. of surcharge)                               |                                       | 17,167AF                           |                               | 5,228AF                       |                  | 11,050AF |                        | 9,010AF |  |
| <b>OUTLET WORKS</b>                  |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
| 29                                   | Number and size — conduits                                       | 1 — RCP — 54" diameter                | 1 — RCP — 30" diameter             | 1 — RCP — 48" diameter        | 1 — RCP — 48" diameter        |                  |          |                        |         |  |
| 30                                   | Conduit length — ft.   | 600                                   | 738                                | 787                           | 624                           |                  |          |                        |         |  |
| 31                                   | Discharge capacity at conduit — CFS (at top of F.C. Pool)        | 570                                   | 180                                | 490                           | 490                           |                  |          |                        |         |  |
| 32                                   | Gated outlets (No. — size — invert elev. of intake in ft. MSL)   | 1 — 30" x 30"                         | 1100                               | 1 — 24" x 36"                 | 1080.0                        | 1 — 24" x 30"    | 1080.0   | 1 — 30" x 30" diameter | 1027.0  |  |
|                                      |  |                                       |                                    |                               |                               | 1 — 8" diameter  | 1034.25  | 1 — 8" diameter        | 1080.0  |  |
| 33                                   | Discharge capacity of gated outlets — CFS (at base of F.C. Pool) | 90                                    | 80                                 | 180                           | 140                           |                  |          |                        |         |  |
| 34                                   | Ungrated outlets (No. — size — invert elev. — ft. MSL)           | 2 — 2 0' x 4 0'                       | 1121                               | 2 — 1 0' x 2 5'               | 1104.0                        | 2 — 1 5' x 3 5'  | 1110.0   | 2 — 1 25' x 3 5'       | 1095.83 |  |
|                                      |  | 2 — 2 5' x 9 0'                       | 1127.5                             | 2 — 2 0' x 6 0'               | 1108.0                        | 2 — 3 15' x 6 0' | 1117.0   | 2 — 3 07' x 6 0'       | 1103.4  |  |
| <b>POWER INSTALLATION</b>            |  |                                       |                                    |                               |                               |                  |          |                        |         |  |
| 35                                   | None   | None                                  | None                               | None                          | None                          |                  |          |                        |         |  |

MRO, FORM 1580  
1-60

(1) Cost as of 5-2-80  
(2) Based on a survey of July 1967 the elevation of the overflow top was changed from 1095.0 ft. MSL to 1095.83 ft. MSL.

October 1980

**SUMMARY OF ENGINEERING DATA — FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL  
MISSOURI RIVER TRIBUTARIES — U.S. ENGINEER DISTRICT — OMAHA  
BUREAU OF RECLAMATION DAMS**

| ITEM NO. | SUBJECT   | BOYSEN                             | CANYON FERRY                                   | CLARK CANYON                | GLENDO                       | HEART BUTTE                  | JAMESTOWN                   | KEYHOLE                        | FACTOLA                       | SHADEHILL                   | TIBER                                | YELLOWTAIL  |
|----------|---|------------------------------------|--|-----------------------------|------------------------------|------------------------------|-----------------------------|--------------------------------|-------------------------------|-----------------------------|--------------------------------------|---|
| 1        | <b>GENERAL</b>                                    |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 2        | Location of dam                                   | 20 mi. S. of Thermopylae, Wyo.     | 17 mi. E.E. of Helena, Mont.                   | 19 mi. S.W. of Dixon, Mont. | 4.5 mi. S.E. of Glendo, Wyo. | 15 mi. S. of Glen Urie, W.D. | 1 mi. N. of Jamestown, N.D. | 12 mi. N.E. of Moorcroft, Wyo. | 15 mi. W. of Rapid City, S.D. | 1 mi. W. of Shadehill, S.D. | 15 mi. S.W. of Chester, Mont.        | 45 mi. S.W. of Hardin, Mont.                          |
| 3        | River and mileage                                 | Blad R. M. 295                     | Missouri R. M. 2253                            | Beaverhead R. M. 290        | North Platte R. M. 290       | Heart R. M. 100 S            | James R. M. 500             | Boyle Fourth R. M. 295         | Rapid Cr. R. M. 110           | Grand R. M. 80              | Marble R. M. 73                      | Big Horn R. M. 73                                     |
| 4        | Drainage area in square miles                     | 7110                               | 15900  | 2376                        | 14330                        | 1710                         | 1300                        | 1950                           | 319                           | 2190                        | 4950                                 | 19,828  |
| 5        | Reservoir length in miles                         | 17.5 at el. 4725                   | 25 mi W. 3000                                  | 5 mi W. 3590.4              | 15 mi W. 4635                | On site                      | 40 mi W. 1454               | 10 mi W. 4111.4                | 6.5 mi W. 4821.5              | 18 mi W. 2302               | 25 mi W. 3912.5                      | 71 mi W. 3657   |
| 6        | Location of dam                                   | On site                            | On site  | Dixon, Mont.                | On site                      | On site                      | On site                     | On site                        | On site                       | On site                     | On site                              | On site   |
| 7        | Travel time to Missouri River                     | 4.5 days to Ft. Rock               | 2.5 days to Three Forks                        | 3700 CFS Jun. 1908          | 39,000 CFS Jun. 1908         | 30,500 CFS May 1979          | 2,800 CFS Apr. 1969         | 12,000 CFS Apr. 1952           | 2200 CFS May 1952             | 58,000 CFS Apr. 1950        | 40,000 CFS Jun. 1948                 | 37,400 CFS Jun. 1935                                  |
| 8        | Max. discharge at record                          | 29,800 cfs Jul. 1923               | 47000 cfs Jun. 1908                            | 3700 CFS Jun. 1908          | 39,000 CFS Jun. 1908         | 30,500 CFS May 1979          | 2,800 CFS Apr. 1969         | 12,000 CFS Apr. 1952           | 2200 CFS May 1952             | 58,000 CFS Apr. 1950        | 40,000 CFS Jun. 1948                 | 37,400 CFS Jun. 1935                                  |
| 9        | Project cost (\$)                                 | \$33,498,000                       | \$42,546,000                                   | \$11,108,000                | \$11,108,000                 | \$3,578,000                  | \$3,717,000                 | \$4,722,000                    | \$7,861,000                   | \$7,268,000                 | \$44,909,000 (1983)                  | \$95,900,000  |
| 10       | <b>DAM AND EMBANKMENT</b>                         |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 11       | Top of dam — ft. MSL                              | 4758.0                             | 3890.5   | 5578.0                      | 4875.0                       | 2124.0                       | 1471.0                      | 4134.0                         | 4855.0 (23)                   | 2318.0                      | 3076.0                               | 3683.0  |
| 12       | Length of dam — ft.                               | 1143                               | 1000   | 7950                        | 2098                         | 1850                         | 1418                        | 2420                           | 5280                          | 12,840                      | 4300                                 | 1450  |
| 13       | Height of dam — ft.                               | 150                                | 228  | 147.5                       | 147                          | 124                          | 85                          | 118                            | 248                           | 192                         | 301                                  | 524   |
| 14       | Stream bed — ft. MSL                              | 4608                               | 3625.5   | 5448.5                      | 4708                         | 2000                         | 1386                        | 4018                           | 4422                          | 2156                        | 2825.5                               | 3180  |
| 15       | Abutment formation                                | Sandstone — shale — brecciated     | Shale — slate                                  | Sand — brecciated tuff      | Sandstone — shale            | Sandstone                    | Fluvial shale               | Sandstone and shale            | Shale and schist              | Sand, silt and clay         | Shale and sandstone                  | Limestone   |
| 16       | Type of fill                                      | Roller earth                       | Concrete gravity                               | Roller earth                | Roller earth                 | Roller earth                 | Roller earth                | Roller earth and rock          | Roller earth and rock         | Roller earth                | Concrete gravity                     | Concrete gravity                                      |
| 17       | Fill quantity in cu. yds.                         | 1,527,000                          | 407,100  | 1,884,000                   | 2,878,000                    | 1,140,000                    | 983,000                     | 1,329,000                      | 4,532,000                     | 3,391,000                   | 12,046,000                           | 1,548,000   |
| 18       | Date of closure                                   | Oct. 1951                          | Mar. 1963                                      | Jun. 1968                   | Aug. 1948                    | Apr. 1950                    | Apr. 1965                   | May 1952                       | Aug. 1958                     | Jun. 1950                   | Oct. 1960                            | Dec. 1966   |
| 19       | Date of initial fill (top of concrete pool)       | Jun. 1952                          | Jul. 1955                                      | Jun. 1965                   | May 1950                     | Apr. 1950                    | Apr. 1965                   | May 1978                       | Jun. 1953                     | Apr. 1952                   | Aug. 1954                            | Jun. 1967   |
| 20       | <b>SPELLWAY</b>                                   |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 21       | Discharge capacity — cfs (Max. pool)              | 20,000 at el. 4725                 | 150,000  | 9530                        | 10,300                       | 5830                         | 2930                        | 11800                          | 255,000                       | 8700                        | 127,000 cfs                          | 97000   |
| 22       | Gate elev. — ft. MSL                              | 4789.0                             | 3786.9   | 5580.4                      | 4853.0                       | 2064.5                       | 1454                        | 4029.3                         | 4821.5                        | 2371.9                      | 2307.0                               | 2993.0  |
| 23       | Width — ft.                                       | 60 (total)                         | 204 (total)                                    | 100                         | 45                           | 27                           | 8.5                         | 425                            | 18.25                         | 1500                        | 58                                   | 58 (total)  |
| 24       | State, number, size, type                         | 2 (30x25 ft) radial                | 88 (total) 4 (1512x5 ft) radial                | 222 (grates)                | Ungrated chute               | Ungrated gate hole           | Ungrated gate hole          | Ungrated gate hole             | Ungrated gate hole            | Ungrated gate hole          | Ungrated gate hole                   | Ungrated gate hole                                    |
| 25       | <b>RESERVOIR ELEV. AND AREA</b>                   |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 26       | Maximum pool                                      | 4752.0                             | 38,860a  | 5571.0                      | 6900a                        | 4680.0                       | 2118.2                      | 10,950a                        | 4861.7                        | 1,380a                      | 2312.0                               | 3680.0  |
| 27       | Top of flood control pool                         | 4732.2                             | 22,170a  | 5500.4                      | 5900a                        | 4653.0                       | 17,900a                     | 8,540a                         | 4621.5                        | 1,250a                      | 2302.0                               | 3657.0  |
| 28       | Top of joint use pool                             | 4729.9                             | 19,560a  | 5498.1                      | 5180a                        | 4651.0                       | 17,900a                     | 8,540a                         | 4621.5                        | 1,250a                      | 2302.0                               | 3657.0  |
| 29       | Top of conservation pool                          | 4717.0                             | 16,880a  | 5375.0                      | 4485a                        | 4635.0                       | 12,370a                     | 2064.5                         | 4480.2                        | 800a                        | 2271.9                               | 3614.0  |
| 30       | Top of inactive pool                              | 4685.0                             | 9,390a   | 5178.0                      | 4478.0                       | 4618.0                       | 2030.0                      | 180a                           | 4051.0                        | 100a                        | 2250.8                               | 3547.0  |
| 31       | <b>STORAGE ZONES (Flow Capacity)</b>              |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 32       | Storage zone                                      | 4732.2-4752.0                      | 529,700AF                                      | none                        | 5680.4-5671.0                | 73,830AF                     | 4653.0-4688.0               | 339,300AF                      | 2064.5-2118.2                 | 208,400AF                   | 1454.0-1464.4                        | 158,800AF   |
| 33       | Exclusion flood control zone                      | 4729.9-4732.2                      | 128,400AF                                      | 3787.0-3800.0               | 99,460AF                     | 5248.1-5560.0                | 78,200AF                    | 4675.0-4693.0                  | 271,800AF                     | 2064.5-2064.5               | 147,800AF                            | 1452.7-1454.0   |
| 34       | Joint use zone                                    | 4717.0-4729.9                      | 146,100AF                                      | 3770.0-3797.0               | 795,135AF                    | 5535.1-5546.1                | 50,440AF                    | none                           | none                          | none                        | none                                 | none  |
| 35       | Conservation zone                                 | 4685.0-4717.0                      | 403,800AF                                      | 3728.0-3778.0               | 711,460AF                    | 5478.0-5535.7                | 126,120AF                   | 4570.0-4635.0                  | 454,300AF                     | 2030.0-2064.5               | 69,000AF                             | 1400.0-1429.8   |
| 36       | Inactive zone                                     | 4685.0-4685.0                      | 752,100AF                                      | 3635.0-3728.0               | 445,455AF                    | 5446.0-5478.0                | 1,510AF                     | 4508.0-4570.0                  | 53,200AF                      | 2000.0-2030.0               | 9,800AF                              | 1386.0-1400.0   |
| 37       | Ground Storage (Ext. of storage)                  | 952,400AF                          | 7,051,520AF                                    | 257,180AF                   | 799,460AF                    | 799,460AF                    | 223,800AF                   | 223,800AF                      | 334,200AF                     | 99,920AF                    | 99,920AF                             | 99,920AF  |
| 38       | <b>OUTLET WORKS</b>                               |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 39       | Number and size — complete                        | 1 — 88 in. I.D.<br>1 — 52 in. I.D. | 4 — 84 in. I.D.<br>1 — 13 ft. I.D. pump intake | 1 — 8 ft. I.D.              | 1 — 21 ft. I.D.              | 1 — 83 in. I.D.              | 1 — 8.5 ft. x 13.5 ft.      | 1 — 8 ft.                      | 1 — 7 ft. I.D.                | 1 — 7 ft. I.D.              | 1 — 7 ft. I.D.                       | 1 — 8 ft.   |
| 40       | Canal length — ft.                                | 300                                | 64 in. — 115                                   | 741                         | 2500                         | 503                          | 443.75                      | 740                            | 355                           | 255                         | 227 — 1110 ft. — 1090                | 2 — 84 in.<br>1 — 8.5 ft.                             |
| 41       | No. — size — type gate                            | 3 — 48 in. Jnt. valves             | 4 — 77 in. Slide valves                        | 2 — 36x5 ft. Slide          | 3 — 7.75x7.75 ft. Slide      | 1 — 4x5 ft. Slide            | 2 — 6x8 ft. Slide           | 2 — 5x5 ft. Slide              | 2 — 37.5x2.75 ft. Slide       | 1 — 6x8 ft. Slide           | 1 — 5x5 ft. Slide, 1 — 18" butterfly | 3 — 36x48 gate<br>84 in. — 2500 each<br>9.5 ft. — 402 |
| 42       | March, capacity, — cfs (At base of EPC zone)      | 64 in. — 648<br>57 in. — 670       | 1 — 12 ft. dia. 800<br>3 — 12.5 ft. dia. 9.870 | 2200                        | 11,300                       | 880                          | 2175 at el. 1429.8          | 1720                           | 1070                          | 500 at el. 2200             | 1425 at el. 2293                     | 1425 at el. 2293                                      |
| 43       | <b>POWER INSTALLATION</b>                         |                                    |  |                             |                              |                              |                             |                                |                               |                             |                                      |   |
| 44       | No. and size of turbines                          | 2 — 10,500 HP                      | 3 — 23,500 HP                                  | none                        | 2 — 16,750 HP                | none                         | none                        | none                           | none                          | none                        | none                                 | 4 — 87,500 HP   |
| 45       | No. and rating of generators                      | 2 — 7500 KW                        | 3 — 18,867 KW                                  | none                        | 2 — 12,000 KW                | none                         | none                        | none                           | none                          | none                        | none                                 | 4 — 82,500 KW   |
| 46       | Plant capacity                                    | 15,000 KW                          | 50,000 KW                                      | none                        | 24,000 KW                    | none                         | none                        | none                           | none                          | none                        | none                                 | 250,000 KW  |
| 47       | Power plant stock, capacity (At base of EPC zone) | 2300 cfs                           | 3700 cfs                                       | none                        | 3300 cfs                     | none                         | none                        | none                           | none                          | none                        | none                                 | 7800 cfs  |

(1) These costs to complete the dam and reservoir, the associated recreation and fish and wildlife facilities and the power plant were applicable. Costs do not include bridge facilities except those located at the Dam. Costs are at el. 8-30-79.

(2) Pictorial Dam was raised 15 feet in 1967.

(2) TIBER AUXILIARY OUTLET  
No. and size of complete  
Canal length — ft.  
No. — size — type gate  
Discharge capacity — cfs

1 — 10.75 ft. I.D.  
1535  
1 — 7.75x7.75 ft. Slide  
2 — 7.0x2.0 ft. Slide  
4250 at el. 3020.2

(3) Pictorial Dam was raised 15 feet in 1967.

PERTINENT DATA

SPRING CREEK DAM  
(LAKE POCASSE)

Location - On Spring Creek arm of Lake Oahe, at Pollock, South Dakota

Purpose - It is a road relocation route for the area inundated by Lake Oahe. Control structures are provided to regulate Lake Pocasse for fish and wildlife, and recreation.

Drainage Area - 660 sq. mi. (224 sq. mi. of which is non-contributing).

Dam and Embankment

Type of Fill - Rolled Earth  
Top of Dam Elev. - 1625 ft. MSL  
Length of Dam - 3,200 ft.  
Height of Dam - 40 ft. maximum  
Streambed - 1585 ft. MSL  
Date of Closure - 1961  
Date of Initial Fill - Between 1961 and 1964

Spillway - Nine 6 x 8 ft. uncontrolled box culverts with a crest elevation of 1617 ft. MSL.

Reservoir Elevations, Area and Capacity

|                            | Ft. MSL | Acres | Acre-Feet |
|----------------------------|---------|-------|-----------|
| Top of Embankment          | 1625    | 2,500 | 26,000    |
| Spillway Crest             | 1617    | 1,520 | 11,000    |
| Top of Mid-level Outlet    | 1614    | 1,130 | 7,000     |
| Invert of Mid-level Outlet | 1609    | 500   | 3,440     |
| Invert of Low-level Outlet | 1602    | 60    | 1,000     |
| Streambed                  | 1585    | 0     | 0         |

Outlet Works - One 5 ft. CMP conduit with a 5 x 5 ft. sluice gate, invert elev. 1602 and a 5 x 12 ft. overflow roller gate, invert elev. 1609.

PERTINENT DATA

SNAKE CREEK DAM  
(LAKE AUDUBON)

Location - On Snake Creek arm of Lake Sakakawea, approximately 12 miles northeast of Garrison Dam, North Dakota.

Purpose - The dam and reservoir are a relocation route for transportation facilities and utilities which were inundated by Lake Sakakawea, a regulating reservoir for the Bureau's Garrison Diversion Unit, and provide for fish and wildlife, and recreation.

Drainage Area - 250 sq. mi. (110 sq. mi. of which is non-contributing).

Dam and Embankment

Type of Fill - Rolled Earth  
Top of Dam Elev. - 1865 ft. MSL  
Length of Dam - 12,900 ft.  
Height of Dam - 85 ft. maximum  
Streambed - 1780 ft. MSL  
Date of Closure - 1952  
Date of Initial Fill - Sept. 1975

Spillway - None (An original designated ungated spillway of 3 - 60" culverts with a crest of elevation of 1850 was filled in and closed in 1972 when the embankment was widened to provide for a four lane highway. It was located 180 ft. north of regulating conduit).

Reservoir Elevations, Area and Capacity

|                               | Ft. MSL | Acres  | Acre-Feet |
|-------------------------------|---------|--------|-----------|
| Maximum Normal Operating Pool | 1850    | 20,620 | 396,000   |
| Minimum Normal Operating Pool | 1847    | 18,780 | 336,870   |
| Top of Inactive Pool          | 1810    | 1,450  | 13,180    |
| Streambed                     | 1780    | 0      | 0         |

Outlet Works - A 7 x 10 ft. reinforced concrete conduit, invert elev. 1810, regulated by a 7 x 10 ft. sluice gate. An external crane is required to operate the gate. Located about 3,000 ft. south of north end of main embankment. Discharge capacity 2,300 c.f.s. under 15 ft. head differential. Two 7 x 10 ft. bulkheads one on each side of sluice gate. Stilling basin on Garrison side.

**TOTAL NUMBER**

**OF**

**FLOOD CONTROL**  
**RESERVOIRS**

**IN OMAHA DISTRICT**

TOTAL NUMBER OF FLOOD CONTROL RESERVOIRS IN THE OMAHA DISTRICT  
MONITORED AND/OR REGULATED AND REPORTED BY THE RESERVOIR REGULATION SECTION

| AS OF<br>1 JAN | MAIN<br>STEM   | TRIBUTARY                       |                               | TOTAL* |
|----------------|----------------|---------------------------------|-------------------------------|--------|
|                |                | C.E.                            | U.S.B.R.                      |        |
| 1937           | 0              | 0                               | 0                             | 0      |
| 1938           | 1 (Ft. Peck)   | 0                               | 0                             | 1      |
| 1939-48        | 1              | 0                               | 0                             | 1      |
| 1949           | 1              | 1 (Cherry Creek)                | 0                             | 2      |
| 1950           | 1              | 1                               | 1 (Heart Butte)               | 3      |
| 1951           | 1              | 1                               | 3 (Shadehill, Tiber)          | 5      |
| 1952           | 1              | 1                               | 4 (Boysen)                    | 6      |
| 1953           | 2 (Ft Randall) | 2 (Cold Brook)                  | 5 (Keyhole)                   | 9      |
| 1954           | 3 (Garrison)   | 3 (Kelly Road)                  | 6 (Jamestown)                 | 12     |
| 1955           | 3              | 3                               | 6                             | 12     |
| 1956           | 4 (Gavins Pt)  | 4 (Bull Hook-Scott Coulee)      | 6                             | 14     |
| 1957           | 4              | 4                               | 8 (Glendo, Pactola)           | 16     |
| 1958           | 4              | 4                               | 8                             | 16     |
| 1959           | 5 (Oahe)       | 4                               | 8                             | 17     |
| 1960           | 5              | 5 (Cedar Canyon)                | 8                             | 18     |
| 1961           | 5              | 5                               | 8                             | 18     |
| 1962           | 5              | 5                               | 8                             | 18     |
| 1963           | 5              | 8 (Salt Creek)                  | 8                             | 21     |
| 1964           | 6 (Big Bend)   | 11 (Salt Creek)                 | 8                             | 25     |
| 1965           | 6              | 12 (Salt Creek)                 | 9 (Clark Canyon)              | 27     |
| 1966           | 6              | 14 (Salt Creek)                 | 9                             | 29     |
| 1967           | 6              | 15 (Bowman-Haley)               | 11 (Yellowtail, Canyon Ferry) | 32     |
| 1968           | 6              | 16 (Salt Creek)                 | 11                            | 33     |
| 1969           | 6              | 16                              | 11                            | 33     |
| 1970           | 6              | 17 (Cottonwood Springs)         | 11                            | 34     |
| 1971-73        | 6              | 17                              | 11                            | 34     |
| 1974           | 6              | 20 (Pipestem, Chatfield, Papio) | 11                            | 37     |
| 1975           | 6              | 21 (Papio)                      | 11                            | 38     |
| 1976           | 6              | 21                              | 11                            | 38     |
| 1977           | 6              | 21                              | 11                            | 38     |
| 1978           | 6              | 22 (Bear Creek)                 | 11                            | 39     |
| 1979-82        | 6              | 22                              | 11                            | 39     |
| 1983           | 6              | 23 (Papio)                      | 11                            | 40     |
| 1984           | 6              | 24 (Papio)                      | 11                            | 41     |
| 1985-92        | 6              | 24                              | 11                            | 41     |

\*Two Subimpoundments (Lake Pocasse and Snake Creek) are not included.

**REGULATION SHEETS**

**FOR**

**PAST YEARS**

# CORPS OF ENGINEERS PROJECTS

1. BEAR CREEK DAM
2. BOWMAN-HALEY DAM
3. BULL HOOK DAM
4. CEDAR CANYON DAM
5. CHATFIELD DAM
6. CHERRY CREEK DAM
7. COLDBROOK DAM
8. COTTONWOOD SPRINGS DAM
9. KELLY ROAD DAM
10. WESTERLY CREEK
11. PAPILLION DAM NO. 11
12. PAPILLION DAM NO. 16
13. PAPILLION DAM NO. 18
14. PAPILLION DAM NO. 20
15. PIPESTEM DAM
16. SALT CREEK DAM NO. 2
17. SALT CREEK DAM NO. 4
18. SALT CREEK DAM NO. 8
19. SALT CREEK DAM NO. 9
20. SALT CREEK DAM NO. 10
21. SALT CREEK DAM NO. 12
22. SALT CREEK DAM NO. 13
23. SALT CREEK DAM NO. 14
24. SALT CREEK DAM NO. 17
25. SALT CREEK DAM NO. 18
26. SNAKE CREEK DAM
27. SPRING CREEK DAM

**BEAR CREEK DAM AND LAKE  
BEAR CREEK, SOUTH PLATTE RIVER BASIN, COLORADO  
1991-1992 REGULATION**

The Omaha District entered into two temporary one year storage contracts for municipal and industrial water supply under Section 6 of the Flood Control Act of 1944 (Public Law 34, 78th Congress), pending development of a long-term contract under the Water Supply Act of 1958 as amended (43 U.S.C. 390 b-f). The first contract dated September 17, 1987 was for 25 acre feet with the Indian Hills Water District. This contract was renewed in April 1991. The cost of storage per acre-foot in each of these contracts is approximately \$2700.00.

In response to the contracts for temporary water storage, a revised Memorandum of Understanding (MOU) between the Corps of Engineers and the State of Colorado was signed on June 20, 1988. This memorandum supersedes the previous MOU dated May 11, 1977. Under normal conditions the Bear Creek Dam outlet works is set to automatically pass streamflow up to 500 cfs when pool elevations are above the drop inlet-outlet weir crest of 5558 feet MSL. When conditions warrant, higher releases are made by opening two slide service gates in the dome type gated control structure buried under the embankment. Under the revised MOU, the State Engineer or his representative will determine the storage and releases necessary to satisfy downstream water right requirements when the pool level is below elevation 5559 ft. MSL. Elevation 5559 is one foot into the flood storage zone and was selected to allow flexibility in targeting authorized pool levels. Bear Creek Reservoir was not made operational during the reporting period as has been done in the past.

The State of Colorado, Department of Natural Resources, Division of Game, Fish and Parks, in a letter dated October 1, 1970, agreed to provide water for the initial filling and replenishment of evaporation losses from the recreation pool, by purchase or other means, consistent with Federal and State laws to assure effective operation of the project for recreation.

In January 1992, the Denver Regional Council of Governments (DRCOG) requested Corps of Engineers participation in a demonstration project at Bear Creek Reservoir using hypolimnetic withdrawals throughout the year. The water quality in the reservoir and downstream of the reservoir would be monitored to assess the effectiveness of this management practice on water quality. The Corps of Engineers would make variable releases throughout the year depending on the inflow. The table on the following page shows the approximate release targets as requested by DRCOG.

| <u>STREAM FLOW</u> | <u>RELEASE</u> |
|--------------------|----------------|
| > 20 cfs           | 10 cfs         |
| 15 - 20 cfs        | 7 - 9 cfs      |
| 10 - 15 cfs        | 5 - 6 cfs      |
| < 10 cfs           | 0 cfs          |

Release changes were made weekly as needed throughout the year and will continue through December 1992.

Runoff during the reporting period was 79 percent of normal. Snowmelt runoff occurred during February and March with inflows reported at 79 percent of the historic average. A total of 188 AF or .7 percent of the 28,757 AF flood storage zone was utilized at the maximum pool elevation of 5559.70 on August 1. No flood control was achieved during this period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b>  |
|---------|--------------------------|----------------------------|
| Highest | 910 cfs May 01 80        | 800 cfs May 5-12 80        |
| 2nd     | 690 cfs Jun 10 79        | 800 cfs Jun 12 79          |
| 3rd     | 625 cfs May 23 83        | 605 cfs Jun 29 - Jul 02 83 |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 5581.0 Jun 23 83 |
| 2nd     | 5576.3 May 19 80 |
| 3rd     | 5567.9 Jun 10 79 |

**Minimums of Record (since initial fill):**

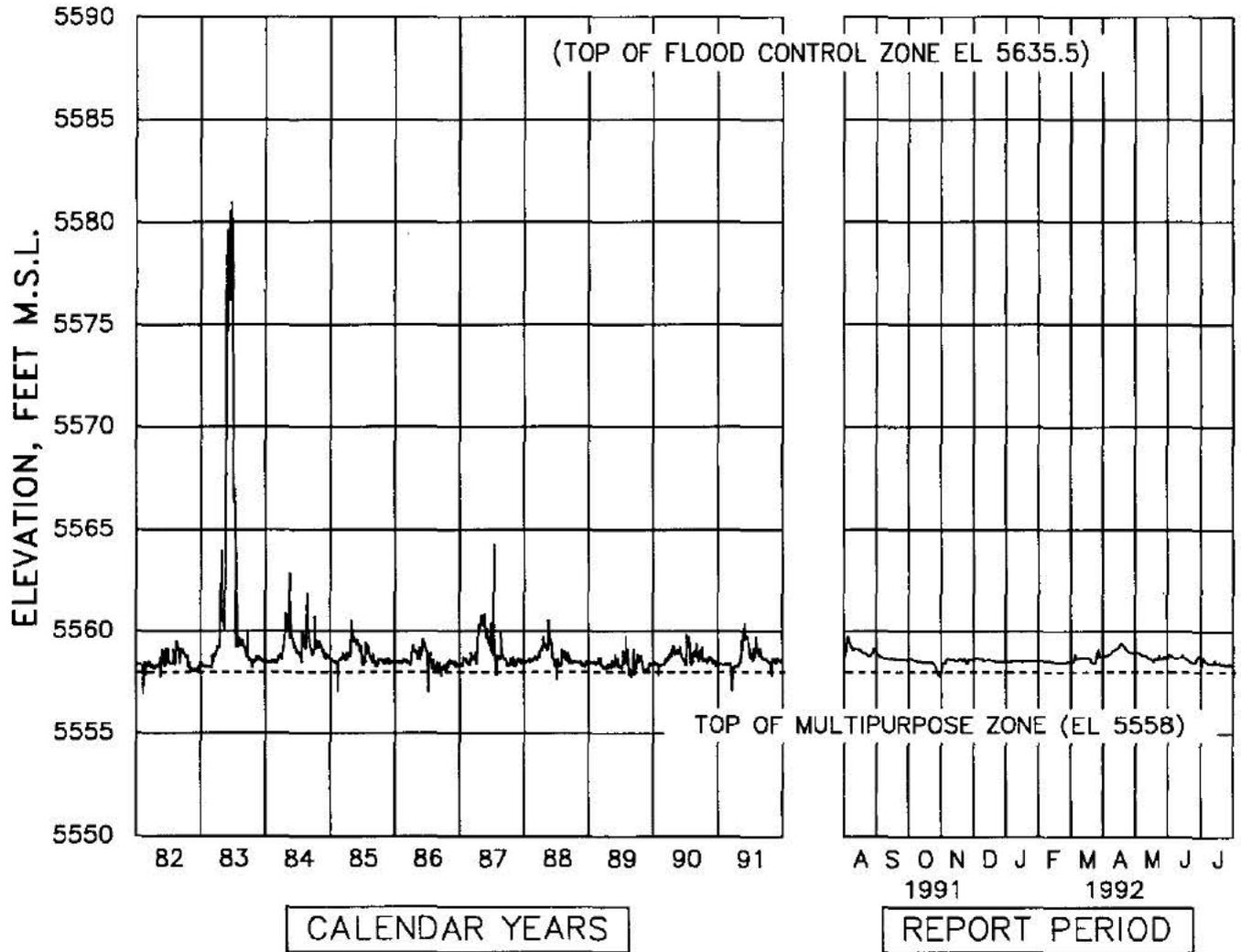
|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 5556.98 Feb 09 82 |
| 2nd    | 5557.08 Jul 09 86 |

**Report Period:** (August 1, 1991 through July 31, 1992)

|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>31,404, 79% of normal       | <b>Total Outflow (AF)</b><br>31,153, 79% of normal         |
| <b>Peak Daily Inflow (CFS)</b><br>170, Aug 04           | <b>Peak Daily Outflow (CFS)</b><br>167, Aug 04             |
| <b>Peak Pool Elevation (Ft. MSL)</b><br>5559.70, Aug 01 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>5557.80, Oct 29 |

# BEAR CREEK DAM AND LAKE BEAR CREEK, SOUTH PLATTE RIVER BASIN, COLORADO 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**BOWMAN HALEY DAM AND LAKE  
GRAND RIVER BASIN, NORTH DAKOTA  
1991-1992 REGULATION**

Five consecutive years of drought produced a new record minimum pool of 2747.57 on June 12, 1992. This is the lowest pool since the date of initial fill in 1969.

On June 13, 1992 an intense storm in and near Crooked Creek basin in South Dakota produced up to 10.5 inches of rain and golf- ball sized hail. Runoff from this event resulted in the 2nd highest mean daily inflow on record of 2,135 cfs on June 14. The peak calculated mean hourly inflow was estimated to be approximately 7,000 cfs. The peak instantaneous inflow as determined by the USGS was 12,900 cfs. Crooked Creek discharge was estimated at 12,700 cfs while the North Fork Grand River discharge contributed 200 cfs. Peak discharge of Crooked Creek at U.S. Highway 85, near Ludlow, South Dakota was 12,400 cfs. The complete results of a cooperative study performed by the USGS to determine the areal extent of rainfall that occurred on June 13, 1992, in Harding County, South Dakota and to determine the peak discharge of Crooked Creek caused by the rainfall are located in the Bowman-Haley project file in Water Control Section.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 5,310 cfs Mar 27 78      | 2,390 cfs Mar 28 78       |
| 2nd     | 2,135 cfs Jun 14 92      | 1,124 cfs Mar 14 72       |
| 3rd     | 1,770 cfs Mar 11 72      | 930 cfs Mar 30 71         |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 2762.66 Mar 28 78 |
| 2nd     | 2758.50 Mar 13 72 |
| 3rd     | 2758.08 Mar 30 71 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 2747.57 Jun 12 92 |
| 2nd    | 2749.17 Jul 31 91 |
| 3rd    | 2749.93 Nov 16 81 |

Report Period: (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
7441, 37% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
2135, Jun 14

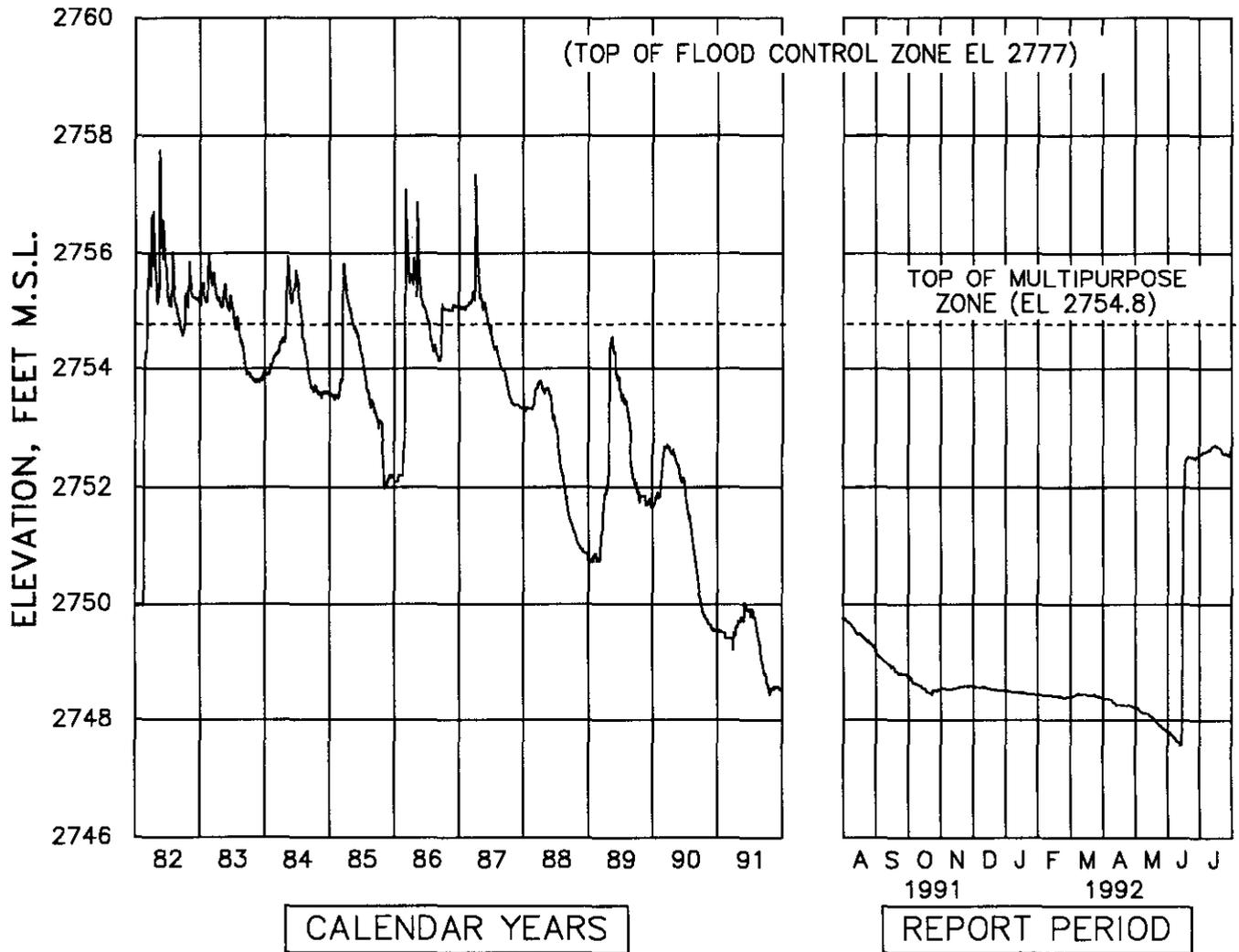
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
2752.71, Jul 13

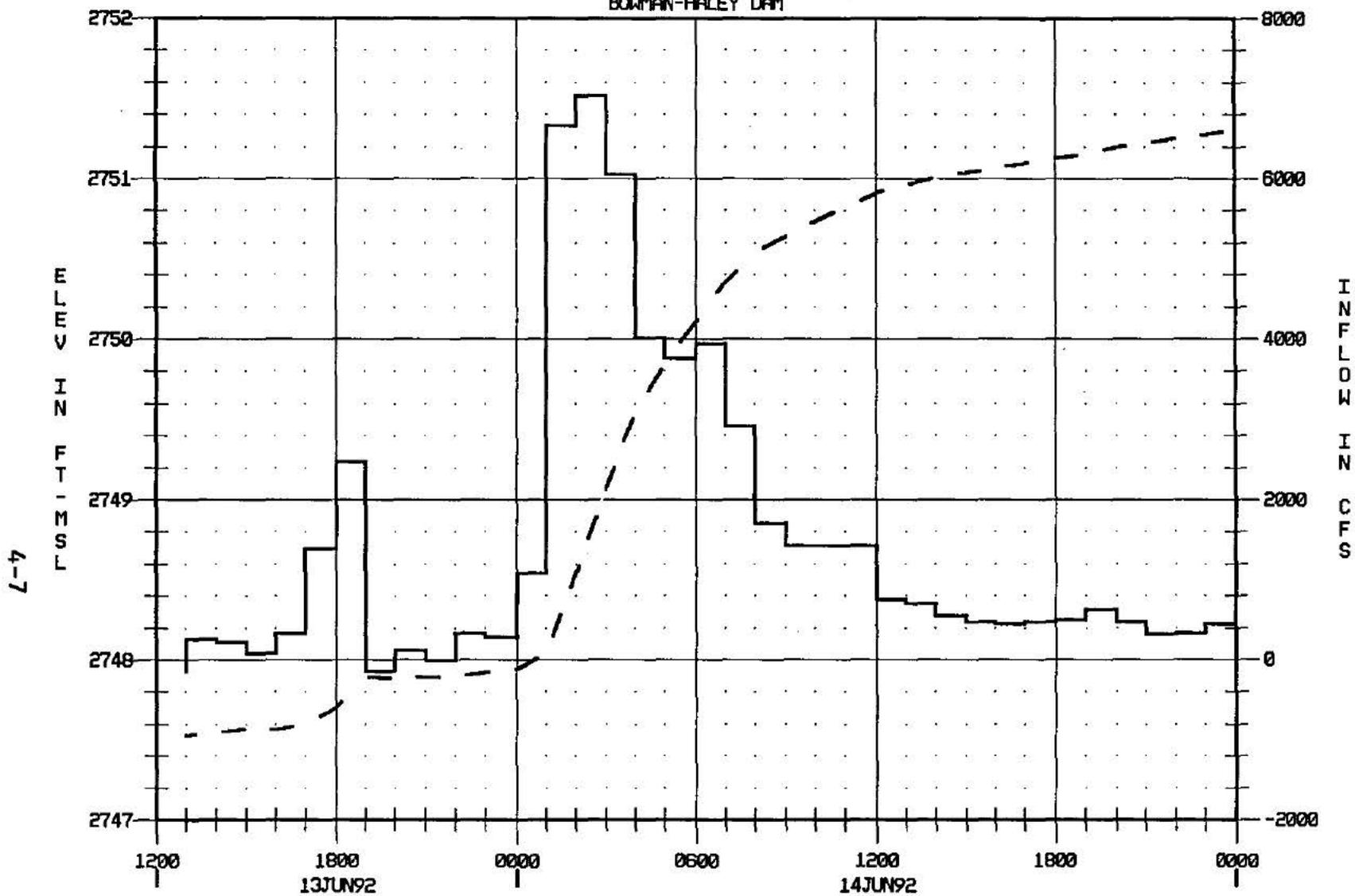
**Minimum Pool Elevation (Ft. MSL)**  
2747.57, Jun 12

# BOWMAN-HALEY DAM AND LAKE GRAND RIVER BASIN, NORTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



BOWMAN-HALEY DAM



4-7

--- BOWMAN-HALEY POOL ELEVATION  
— CALCULATED MEAN HOURLY INFLOW (NO DISCHARGE)

**BULL HOOK-SCOTT COULEE DAMS  
MILK RIVER BASIN, MONTANA  
1991-1992 REGULATION**

Bull Hook and Scott Coulee Dams are both part of the Bull Hook Unit providing flood control for the city of Havre, Montana. Bull Hook and Scott Coulee dams are both located south of Havre on Bull Hook and Scott Coulee Creeks, respectively.

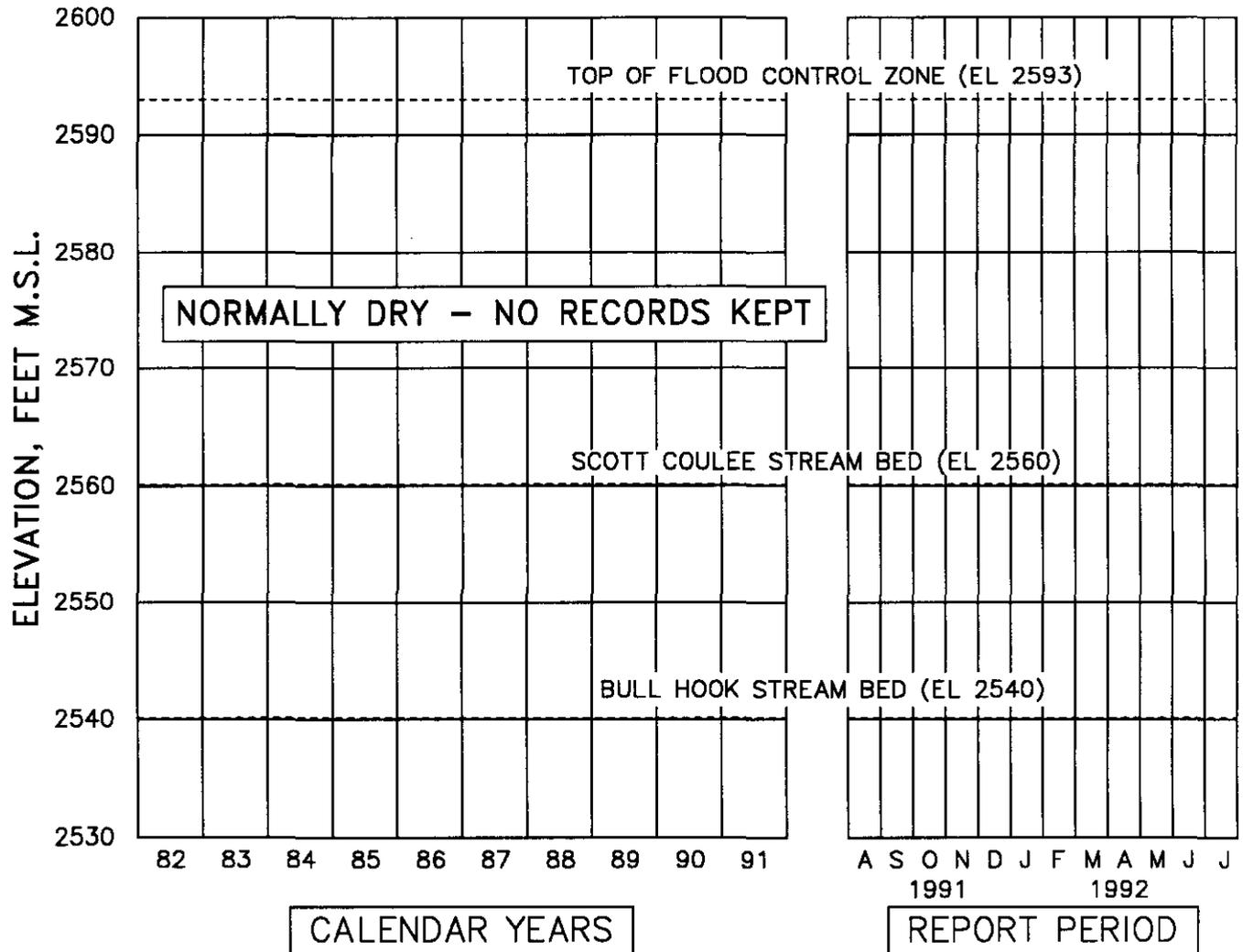
Under normal circumstances, the conduit valves of both dams will be kept partially open to evacuate accumulated storage as expeditiously as possible to allow the dams to function as flood protection facilities if excess runoff occurs upstream. Valve openings are to be maintained that will allow only the minimal damages to occur in the City of Havre.

At times of high flows on the Milk River, it may be necessary to shut off releases in both dams to prevent flooding behind the Milk River levees.

On July 23, 1992 an intensive storm passed over the Scott Coulee drainage basin and Havre, Montana. The storm lasted about 30 minutes and produced rain and golf ball sized hail. Street flooding occurred in Havre. With the gate closed, Scott Coulee Dam backed up water to an estimated depth of 10 feet. After flood waters had receded in Havre, the gate was opened in Scott Coulee and the impoundment drained. It took approximately two weeks to drain. Inflows were estimated as high as 340 cfs.

# BULL HOOK – SCOTT COULEE DAMS MILK RIVER BASIN, MONTANA 1991–1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.

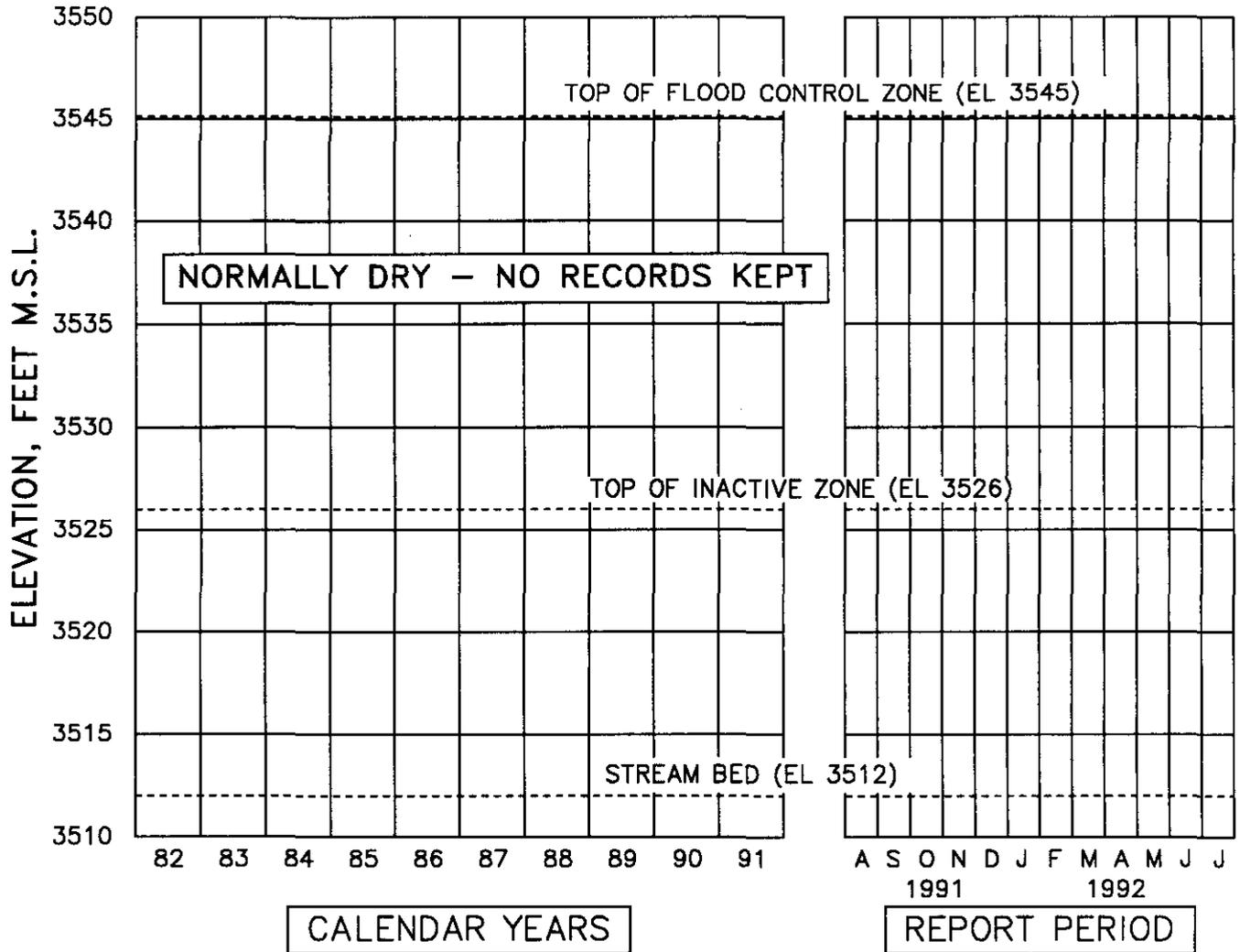


**CEDAR CANYON DAM (RED DALE GULCH)  
RAPID CREEK BASIN, SOUTH DAKOTA  
1991-1992 REGULATION**

Cedar Canyon Dam is located on the western outskirts of Rapid City, South Dakota. The dam is designed as a detention structure with no permanent storage, however, a small pool may sometimes exist in the dead storage below the invert of the outlet pipe. The dam collects runoff from approximately 261 acres. The outlet and spillway are uncontrolled. No water accumulated during the report period. Inflow was negligible and outflow was zero for the period. No flood control was achieved.

**CEDAR CANYON DAM (RED DALE GULCH)  
RAPID CREEK BASIN, SOUTH DAKOTA  
1991-1992 REGULATION**

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**CHATFIELD DAM AND LAKE  
SOUTH PLATTE RIVER BASIN, COLORADO  
1991-1992 REGULATION**

Before the dam became operational, the Corps (CEMRO-ED-HC) requested that the Colorado State Engineers Office, acting through the District 8 Water Commissioner, assume responsibility for determining releases from the multipurpose pool in an effort to keep the Corps free of water rights conflicts. This relationship was put into a formal document dated March 30, 1973 when the multipurpose pool was increased from elevation 5430 to 5432 ft. MSL and contained water storage commitments by the State. By contract, the State is committed to keeping the pool above elevation 5423 for recreation and fish and wildlife purposes. Since 1979, the City of Denver through the State of Colorado has been permitted to regulate storage in the conservation pool in return for the City's commitment to provide sufficient water in the pool for recreation. The City is committed to keeping 20,000 AF (Elevation 5426.94 ft. MSL) of water in the pool from May 1 through August 31, and permitted to use 10,000 AF of storage space in the reservoir between elevations 5423.8 and 5432.0 ft. MSL. The original top of multipurpose pool level was at elevation 5426 ft. MSL.

The pool entered the flood control zone on March 5 and remained at or above elevation 5432 through April 21, 1992. The total inflow for the reporting period was 81,724 AF (45% of normal).

Flood storage space utilized was 694 AF of 206,945 AF or .3 percent of the flood storage space at the maximum pool elevation of 5432.48 on April 19. No flood control was achieved during this period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 3,370 cfs May 30 83      | 3,034 cfs May 15 84       |
| 2nd     | 3,155 cfs May 09 80      | 3,027 cfs May 27 87       |
| 3rd     | 3,030 cfs May 15 84      | 2,858 cfs Jul 08 83       |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 5447.58 May 26 80 |
| 2nd     | 5447.08 Jun 30 83 |
| 3rd     | 5445.97 Jun 16 83 |

**Minimums of Record (since initial fill):**

|               | <b>Pool-Date</b>  |
|---------------|-------------------|
| <b>Lowest</b> | 5424.33 Nov 21 90 |
| <b>2nd</b>    | 5424.46 Nov 17 85 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
81724, 45% of normal

**Total Outflow (AF)**  
80254, 46% of normal

**Peak Daily Inflow (CFS)**  
535, Aug 06

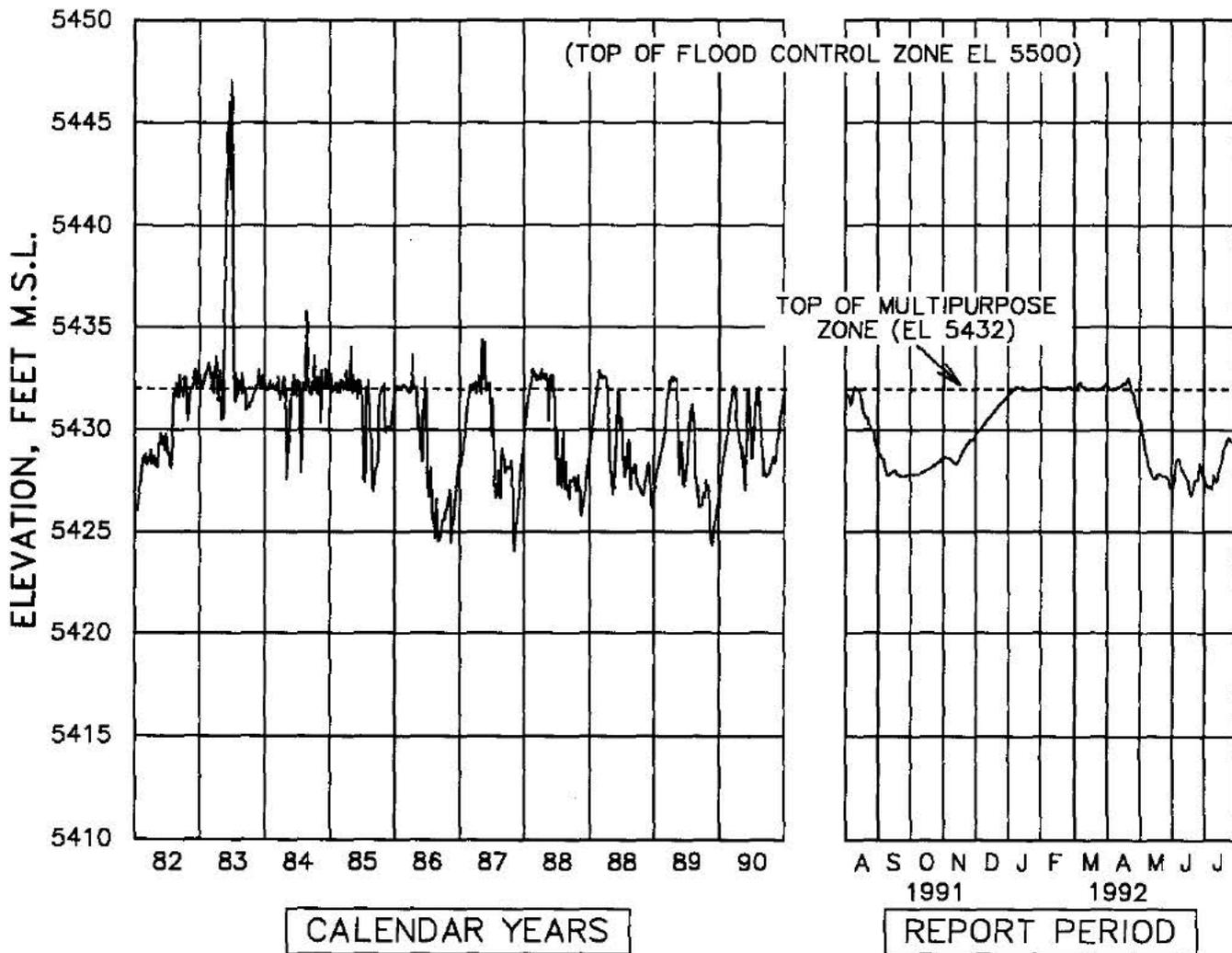
**Peak Daily Outflow (CFS)**  
582, Aug 05

**Peak Pool Elevation (Ft. MSL)**  
5432.48, Apr 19

**Minimum Pool Elevation (Ft. MSL)**  
5426.79, Jun 17

# CHATFIELD DAM AND LAKE SOUTH PLATTE RIVER BASIN, COLORADO 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**CHERRY CREEK DAM AND LAKE  
CHERRY CREEK, SOUTH PLATTE RIVER BASIN, COLORADO  
1991-1992 REGULATION**

Corps of Engineers dams located above populated areas are designed to store and/or pass a Probable Maximum Flood (PMF) without overtopping the embankment. The PMF is estimated using probable maximum precipitation estimates developed by the National Weather Service. The most recent precipitation estimates for this area, published in Hydrometeorological Report No. 55 (HMR 55) in March 1984, were applied to the Cherry Creek Lake project. It was found that the reservoir could safely pass no more than 63 percent of the PMF under existing development with adequate freeboard.

The probability of overtopping of the Cherry Creek embankment is very remote. However, the consequences of failure would be catastrophic.

The PMF was selected as the base safety condition or design goal for the alternatives to be developed in accordance with IWR Report 86-R-7. Downstream from Cherry Creek Dam, the peak discharge for the PMF and floods less than the PMF would increase greatly with dam failure when compared to the nonfailure condition. The population within the potential Cherry Creek flood area downstream from the dam is estimated to be as high as 138,000. Potential flood damages are nearly \$3 billion for the with dam failure condition.

A number of alternatives are being considered to enable the project to safely pass the PMF. The alternatives included widening of the existing spillway, adding a new spillway at one of three locations in the embankment, constructing an additional reservoir (Castlewood) about 30 miles upstream from Cherry Creek Lake, hardening the dam face, raising the dam crest, and no action. The alternatives are being considered individually and in combination with each other.

The Reconnaissance Report "Hydrologic Improvement Assessment, Cherry Creek Lake, Colorado", September 1990 has been reviewed by Missouri River Division and is currently under review at Headquarters, USACE. The Feasibility Study process was started in October 1992.

Releases from the project are made to evacuate flood control zone storage and to meet downstream calls. The pool has been allowed to rise up to elevation 5552.0, two feet above the normal multipurpose pool elevation, in order to store water for later use in downstream calls and to help make up for evaporation losses. Water was also stored in Chatfield for the same purposes. The State had been notified that this operation would be allowed on a temporary basis only until an investigation and an environmental assessment were completed.

On July 25, 1988, the Omaha District received a request from the Colorado Department of Natural Resources to raise the conservation pool level at Cherry Creek Reservoir to elevation 5552.0 ft. MSL. This change would allow the Department of Natural Resources to fully use the storage right that they hold and would provide some operational flexibility to store early spring runoff and deliver it at a later date. The Corps has denied this request due to the hydrologic deficiencies of the project.

On June 4, 1992 the Colorado Water and Conservation Board at the request of the Colorado Division of Parks and Outdoor Recreation requested to store 752 AF of water (approximately .5 feet) in the flood control zone at Chatfield Reservoir. The water would be captured during the spring when free water was available and released to satisfy calls on Cherry Creek. The Corps of Engineers' response to the Colorado Water conservation Board outlines the steps that must be done in order to pursue this request. The process could take several years.

Inflows to Cherry Creek Reservoir for the reporting period were 119% of average (9235 AF). Inflows peaked in June with 3287 AF entering the reservoir.

The flushing operation to remove sediment from the intake structure was accomplished on May 19-20. Releases consisted of 240 cfs for 15 minutes from each gate. Sediment within the intake structure around the gates was successfully removed during the exercise.

Urban Drainage and Flood Control District continued their work to improve the Cherry Creek channel downstream of the dam during the report period. Several drop structures and channel stabilization projects were added in this reach.

A total of 1,283 AF or about 1.6 percent of the 79,960 AF exclusive flood storage zone was utilized at the maximum pool elevation of 5551.48 on March 31. No downstream flooding was prevented by this project.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b>                        |
|---------|--------------------------|--|
| Highest | 6,150 cfs Jun 16 65      | 560 cfs Aug 07-08 65                             |
| 2nd     | 3,195 cfs May 06 73      | 375 cfs Jun 08 75                                |
| 3rd     | 1,440 cfs Jul 24 83      | 330 cfs Apr 23 - May 01 83<br>May 28 - Jun 02 83 |
|         | <b>Pool-Date</b>         |  |
| Highest | 5565.82 Jun 03 73        |  |
| 2nd     | 5562.52 Aug 01 65        |  |
| 3rd     | 5557.89 Jul 25 83        |  |

**Maximum Hourly Inflow:** 56,000 cfs 7-8 p.m., June 16, 1965

**Minimums of Record (since initial fill):**

|               | <b>Pool-Date</b>       |
|---------------|------------------------|
| <b>Lowest</b> | 5543.51 Jan 29 65      |
| <b>2nd</b>    | 5545.90 Nov 23 - 24 78 |

**Report Period:** (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
9235, 119% of normal

**Total Outflow (AF)**  
6062, 120% of normal

**Peak Daily Inflow (CFS)**  
167, Mar 28

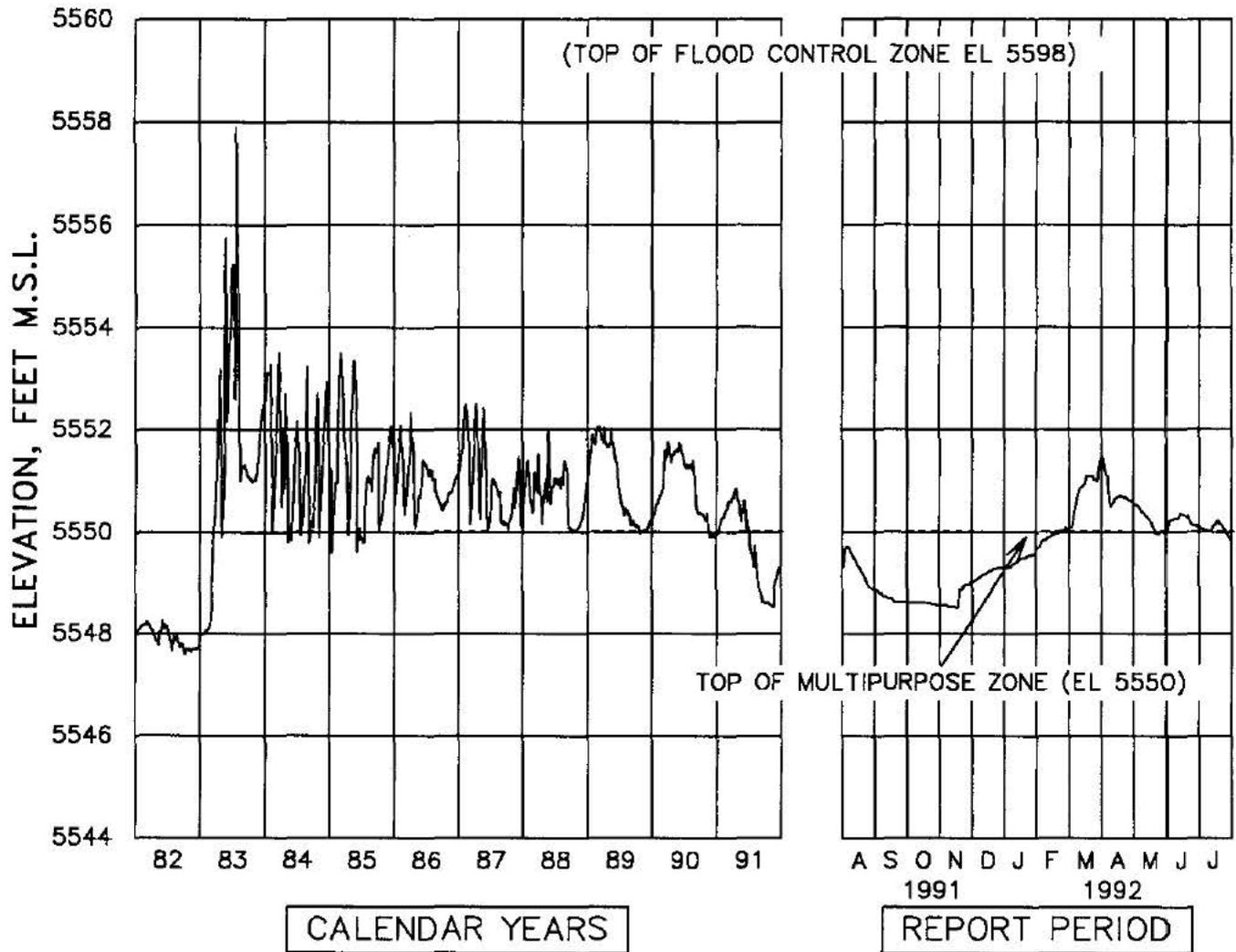
**Peak Daily Outflow (CFS)**  
100, Apr 1-8

**Peak Pool Elevation (Ft. MSL)**  
5551.48, Mar 31

**Minimum Pool Elevation (Ft. MSL)**  
5548.52, Nov 13

# CHERRY CREEK DAM AND LAKE CHERRY CREEK, SOUTH PLATTE RIVER BASIN, COLORADO 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**COLD BROOK DAM AND LAKE  
FALL RIVER BASIN, SOUTH DAKOTA  
1991-1992 REGULATION**

Releases from Cold Brook Reservoir are regulated to comply with State water law. Larive Lake Resort, located below the dam, holds a senior water right entitling it to the Cold Brook Reservoir inflow up to 1.1 cfs.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 74 cfs Jul 14 62         | 2.4 cfs Mar 23 87         |
| 2nd     | 65 cfs Jul 08 61         | 2.0 cfs May 16-20 72      |
| 3rd     | 40 cfs May 19 82         | 1.9 cfs Oct 01 72         |
|         |                          | Jan 07 73                 |
|         |                          | Jun 09-11 75              |
|         |                          | May 02-07 76              |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 3585.38 Aug 17 82 |
| 2nd     | 3585.26 Jul 22 82 |
| 3rd     | 3585.25 Jan 12 85 |
|         | Feb 22-24 85      |
|         | Mar 23/May 03 87  |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>        |
|--------|-------------------------|
| Lowest | 3576.6 Oct 22 77        |
| 2nd    | 3576.8 Sep 14-Oct 02 81 |
|        | Sep 21-22 77            |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
352, 63% of normal

**Total Outflow (AF)**  
263, 56% of normal

**Peak Daily Inflow (CFS)**  
2.2, May 31

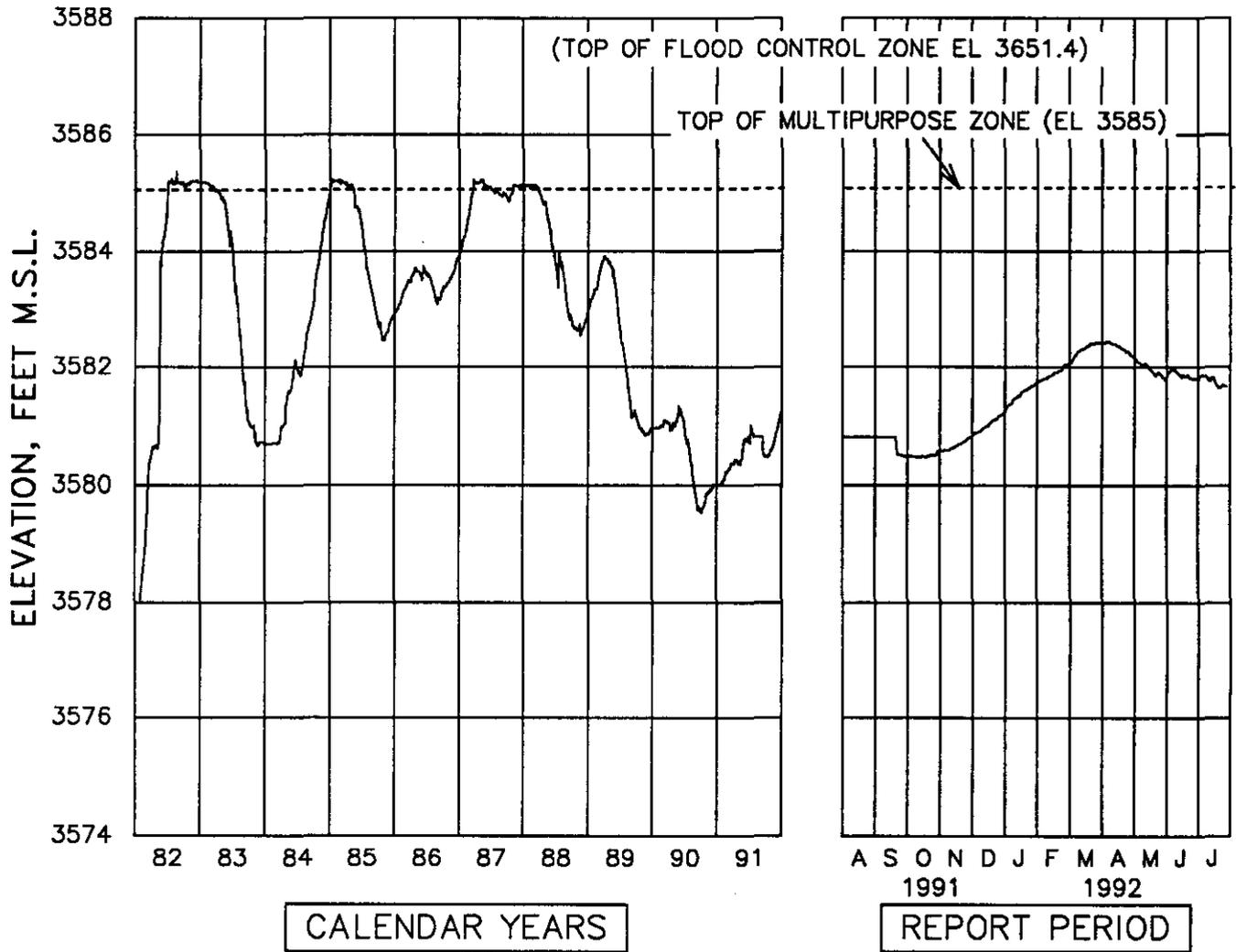
**Peak Daily Outflow (CFS)**  
.5, Apr 08

**Peak Pool Elevation (Ft. MSL)**  
3582.45, Apr 04

**Minimum Pool Elevation (Ft. MSL)**  
3580.47, Oct 17

# COLD BROOK DAM AND LAKE FALL RIVER BASIN, SOUTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**COTTONWOOD SPRINGS DAM AND LAKE  
FALL RIVER BASIN, SOUTH DAKOTA  
1991-1992 REGULATION**

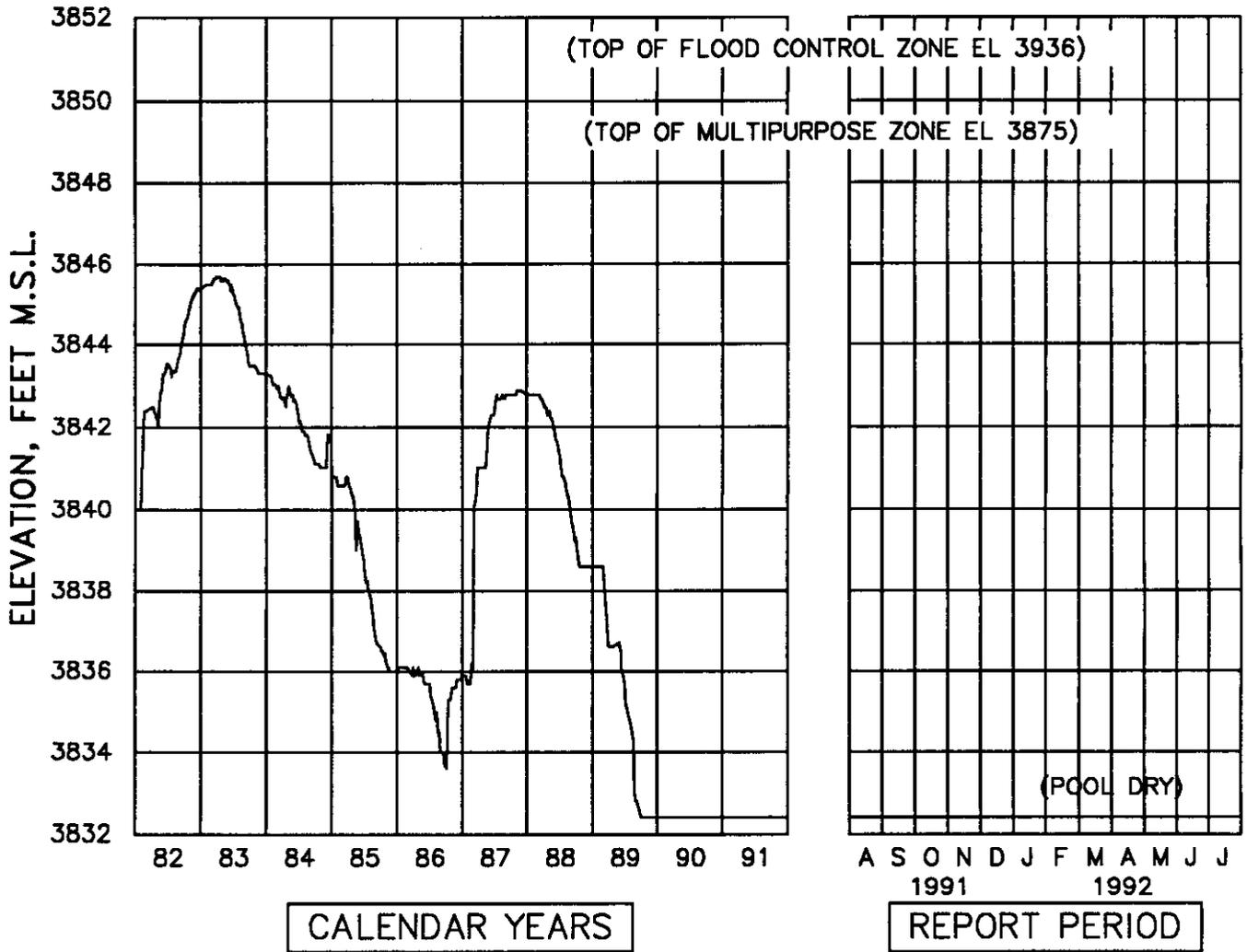
Cottonwood Springs Creek damsite is located on Cottonwood Springs Creek approximately 1/2 mile above its confluence with Hot Brook, a tributary of Fall River. The site is located 4.5 miles west of Hot Springs, Fall River County, South Dakota. The purpose for the project is to provide flood protection for Hot Springs, South Dakota and along the Fall River. No water accumulated during the report period. Inflow was negligible and outflow was zero for the period. No flood control was achieved.

**Maximums of Record:**

|                | <b>Pool Date</b>  | <b>Daily<br/>Inflow-Date</b> | <b>Daily<br/>Outflow-Date</b> |
|----------------|-------------------|------------------------------|-------------------------------|
| <b>Highest</b> | 3847.9 Jun 09 79  | -                            | -                             |
| <b>2nd</b>     | 3845.7 Mar-Apr 83 | -                            | -                             |

# COTTONWOOD SPRINGS DAM AND LAKE FALL RIVER BASIN, SOUTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.

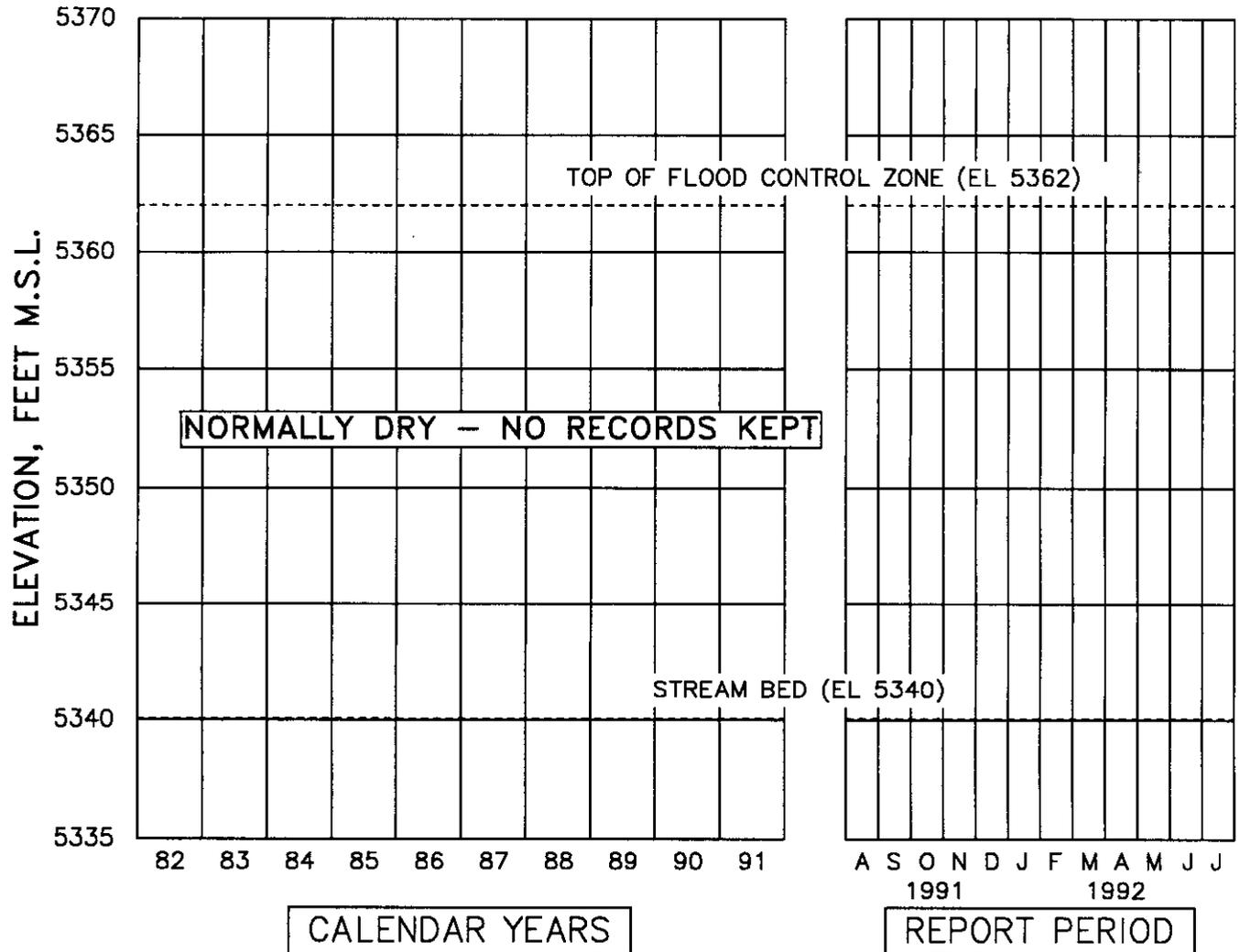


**KELLY ROAD DAM  
SAND CREEK BASIN, COLORADO  
1991-1992 REGULATION**

Kelly Road Detention Dam is located on Westerly Creek, a tributary of Sand Creek and the South Platte River and provides flood control for the City of Aurora. It is located entirely within the boundaries of Lowry Air Force Base. The project's sole purpose is flood control and was not designed to permanently store water. Water is automatically impounded by the project and released through a ground level 24-inch CMP conduit or high overflow inlet. A gate on the 24-inch conduit is kept in the open position. The intended closure of the gate is to contain oil or other spills within the air base. The City of Aurora is responsible for obtaining pool gage readings during flood periods and general observation of project operation.

# KELLY ROAD DAM SAND CREEK BASIN, COLORADO 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**WESTERLY CREEK DAM  
SAND CREEK BASIN, COLORADO  
1991-1992 REGULATION**

The Westerly Creek Dam is located approximately 0.8 miles upstream from the Kelly Road Dam on the southern edge of Lowry Air Force Base. Construction of Westerly Creek Dam was completed in July 1991. Both the dam and the detention area are located within the confines of the Lowry Air Force Base and were constructed for the purpose of flood control. The reservoir is generally dry and no permanent storage is provided. The reservoir is discharged by an orifice - controlled outlet structure and overflow spillway. The capacity of the outlet works is 98 cfs at a pool capacity elevation of 5,431.4 feet MSL. Discharge from the outlet works is governed by the capacity of the existing 48-inch RCP storm sewer running into the Kelly Road pool. The sluice gate is intended to remain open unless overtopping of the Kelly Road Dam is imminent or the downstream storm sewer capacity is exceeded due to inflows from the downstream drainage area. At this time the gate would be closed until downstream conditions permit releases from the Westerly Creek pool.

**GLENN CUNNINGHAM DAM AND LAKE  
PAPILLION CREEK BASIN - NO. 11, NEBRASKA  
1991-1992 REGULATION**

Heavy rainfall kept the pool level in the flood control zone in August, but declined below that level around the end of August. The pool level stayed below the flood control zone until November for a brief period, re-entered it in January and stayed until the end of the reporting period. Inflow in July was 183 percent of average due to heavy rainfall and runoff. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 345 cfs Jun 15 80        | 152 cfs Jun 18 84         |
| 2nd     | 344 cfs Mar 02 79        | 116 cfs Jun 16 80         |
| 3rd     | 301 cfs Jun 16 84        | 87 cfs Mar 04 79          |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1124.4 Jun 17 84 |
| 2nd     | 1123.7 Jun 15 80 |
| 3rd     | 1123.2 Mar 03 79 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1119.5 Nov 15 89 |
| 2nd    | 1120.2 Oct 30 90 |

**Report Period:** (August 1, 1991 through July 31, 1992)

|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>4287, 73% of normal | <b>Total Outflow (AF)</b><br>5831, 78% of normal |
|---|--|

|  |   |
|--|---|
| <b>Peak Daily Inflow (CFS)</b><br>81, Jul 12 | <b>Peak Daily Outflow (CFS)</b><br>26, Apr 25 |
|--|---|

|   |   |
|---|---|
| <b>Peak Pool Elevation (Ft. MSL)</b><br>1121.74, Apr 25, Jul 13 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>1120.33, Dec 6 |
|---|---|

Report Period: (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
4287, 73% of normal

**Total Outflow (AF)**  
5831, 78% of normal

**Peak Daily Inflow (CFS)**  
81, Jul 12

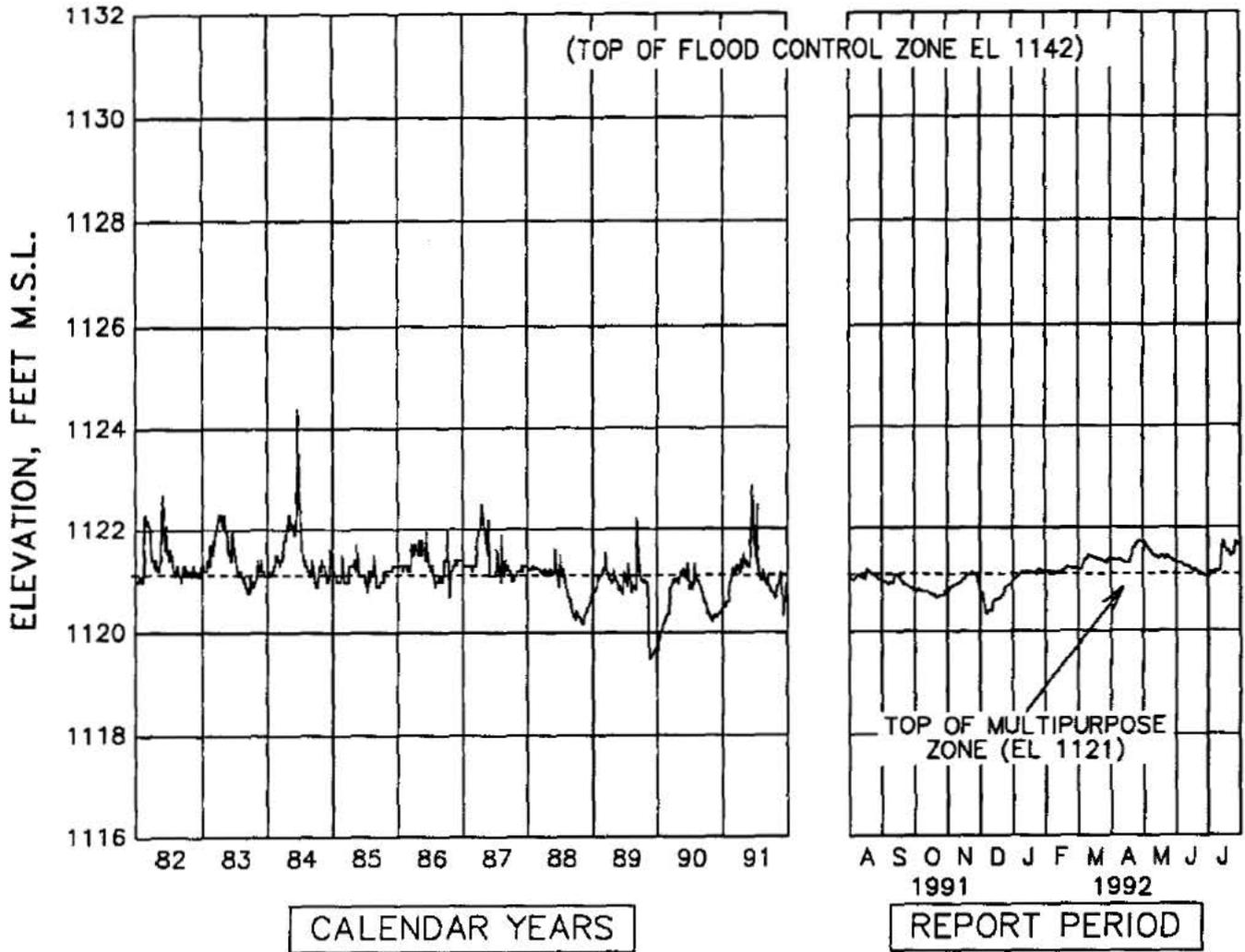
**Peak Daily Outflow (CFS)**  
26, Apr 25

**Peak Pool Elevation (Ft. MSL)**  
1121.74, Apr 25, Jul 13

**Minimum Pool Elevation (Ft. MSL)**  
1120.33, Dec 6

GLENN CUNNINGHAM DAM AND LAKE  
 PAPILLION CREEK BASIN - NO. 11, NEBRASKA  
 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**STANDING BEAR DAM AND LAKE  
PAPILLION CREEK BASIN - NO. 16, NEBRASKA  
1991-1992 REGULATION**

The pool level during the reporting period never exceeded above the flood control zone due to a lack of precipitation and runoff during the report period. The pool level fluctuated significantly in July due to heavy precipitation. Inflow during July was 268 percent of average. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 266 cfs Jun 14 84        | 65 cfs Jun 16-17 84       |
| 2nd     | 235 cfs Aug 09 87        | 57 cfs Aug 09 87          |
| 3rd     | 203 cfs Jun 14 91        | 52 cfs May 22 82          |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1107.8 Jan 16 84 |
| 2nd     | 1107.1 Aug 08 87 |
| 3rd     | 1106.8 May 21 82 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1095.9 Feb 28 91 |
| 2nd    | 1097.6 May 22 90 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
397, 36% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
31, Jul 12

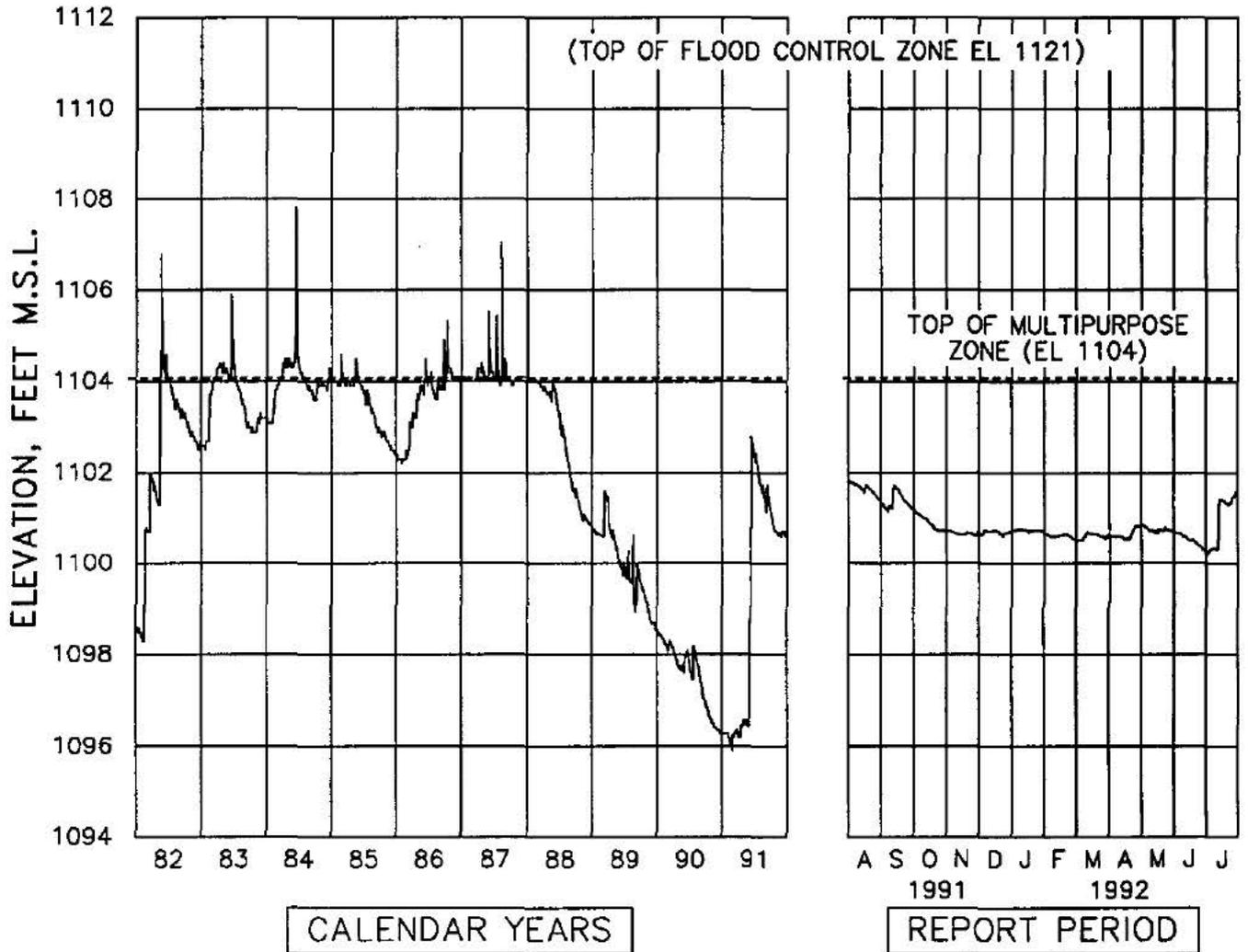
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
1101.82, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
1100.25, Jun 30

**STANDING BEAR DAM AND LAKE  
PAPILLION CREEK BASIN – NO. 16, NEBRASKA  
1991–1992 REGULALTION**

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**ZORINSKI DAM AND LAKE  
PAPILLION CREEK BASIN - NO. 18, NEBRASKA  
1991-1992 REGULATION**

The pool level during the reporting period rose in the flood control zone for the first time since closure of the low level gate in December 7, 1989. This rise was due to heavy precipitation and runoff during the months of April and July. Inflows to the project during April and July were 200 percent and 176 percent of average respectively. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 181 cfs Jul 12 92        | 32 cfs Jul 13 92          |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 1111.31 Jul 12 92 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1109.81 Jun 30 92 |
| 2nd    | 1108.53 Nov 09 91 |

**Report Period: (August 1, 1991 through July 31, 1992)**

|                          |                           |
|--------------------------|---------------------------|
| <b>Total Inflow (AF)</b> | <b>Total Outflow (AF)</b> |
| 1815, 96% of normal      | 589, 200% of normal       |

|                                |                                 |
|--------------------------------|---------------------------------|
| <b>Peak Daily Inflow (CFS)</b> | <b>Peak Daily Outflow (CFS)</b> |
| 181, Jul 12                    | 32, Jul 13                      |

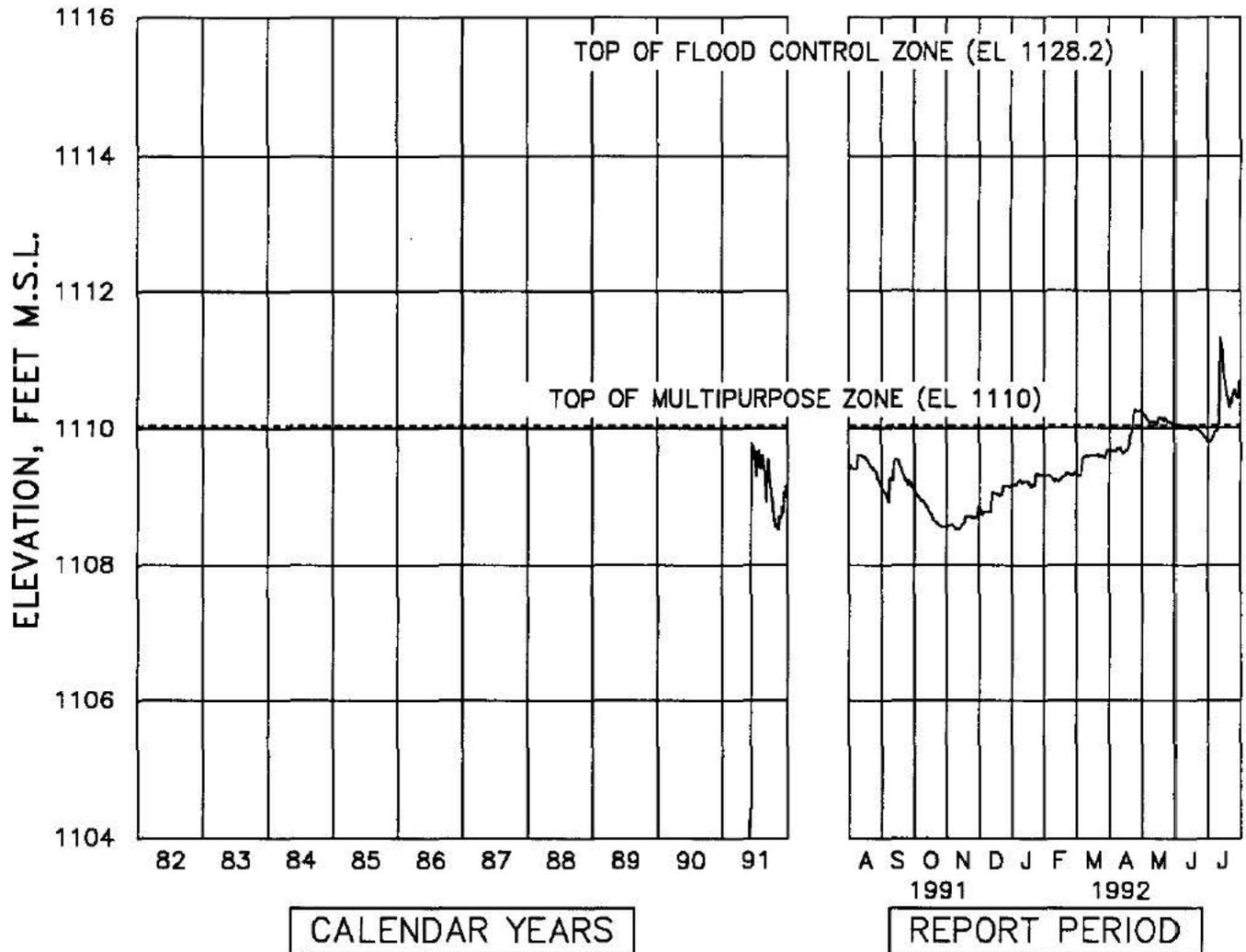
|                                      |   |
|--------------------------------------|---|
| <b>Peak Pool Elevation (Ft. MSL)</b> | <b>Minimum Pool Elevation (Ft. MSL)</b> |
| 1111.31, Jul 12                      | 1108.53 Nov 09                          |

# ZORINSKI DAM AND LAKE

## PAPILLION CREEK BASIN – NO. 18, NEBRASKA

### 1991–1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**WEHRSPAN DAM AND LAKE  
PAPILLION CREEK BASIN - NO. 20, NEBRASKA  
1991-1992 REGULATION**

The pool level at the beginning the reporting period declined until November when it started to level off. A slight rise occurred in the pool level in April and July due to rainfall and minor runoff. Precipitation of 3.20 inches in April and 7.53 inches during July had inflows of 160 percent and 211 percent of average respectively. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 515 cfs Aug 25 87        | 77 cfs Aug 26 87          |
| 2nd     | 341 cfs Jun 14 91        |                           |
| 3rd     | 285 cfs Oct 11 86        | 28 cfs Jun 09 87          |
|         | May 26 87                | 22 cfs Sep 01 87          |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 1099.5 Aug 25 87  |
| 2nd     | 1097.14 Jun 14 91 |
| 3rd     | 1096.7 May 27 87  |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1085.4 May 02 90 |
| 2nd    | 1085.9 Feb 02 91 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
655, 55% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
68, Jul 12

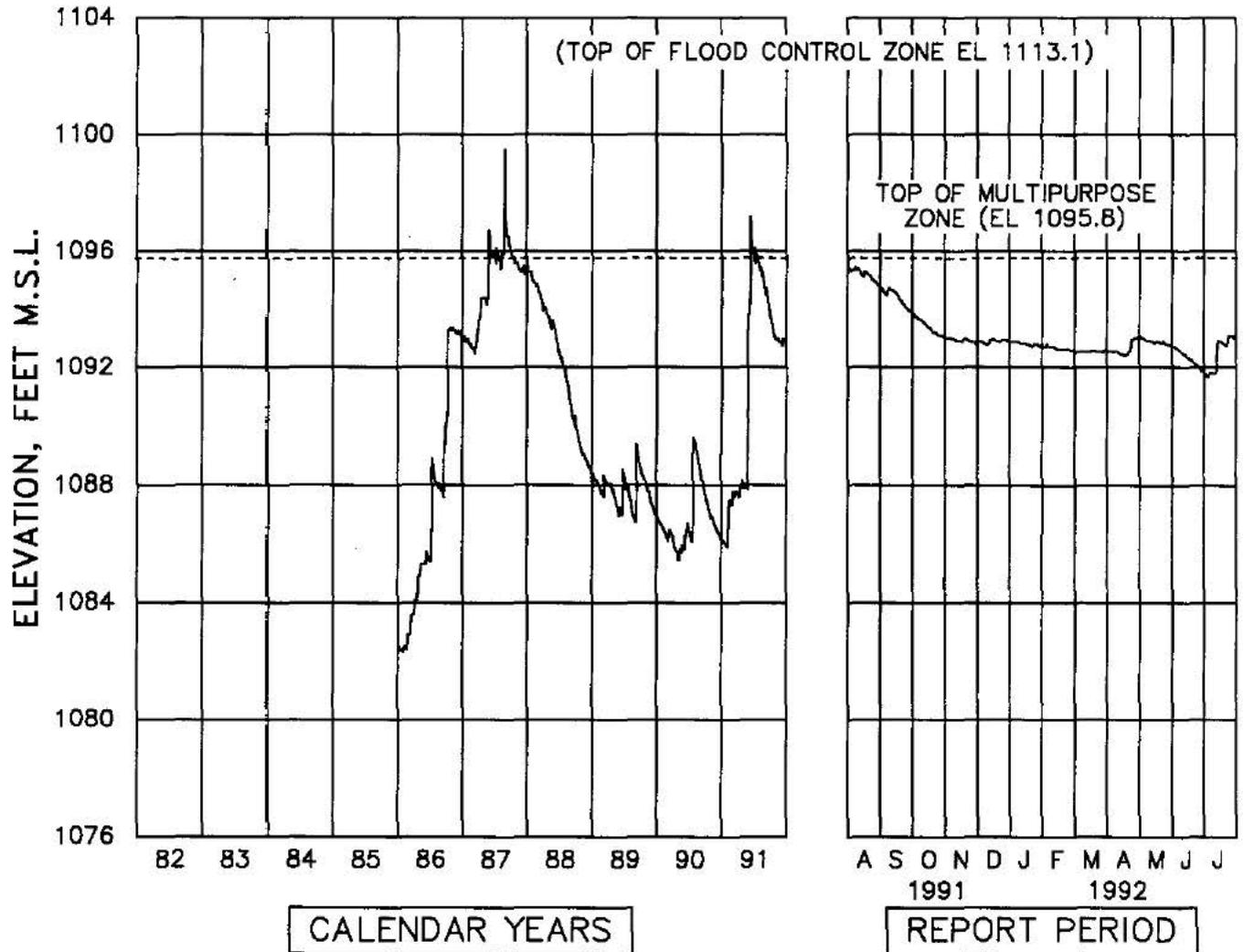
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
1095.47, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
1091.78, Jun 30

# WEHRSPANN DAM AND LAKE PAPILLION CREEK BASIN – 20, NEBRASKA 1991–1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**PIPESTEM DAM AND LAKE  
PIPESTEM CREEK, JAMES RIVER BASIN, NORTH DAKOTA  
1991-1992 REGULATION**

Releases out of Pipestem began March 6, 1992 when the pool elevation rose above the multipurpose pool (1442.40 feet above MSL). Discharges continued until May 28, 1992 when the pool elevation fell to 1440.50 feet above MSL. No other discharges were made during the reporting period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b>  |
|---------|--------------------------|--|
| Highest | 3,380 cfs Apr 20 75      | 310 cfs Oct 22-26, 31<br>Nov 01, 75                                      |
| 2nd     | 3,000 cfs Apr 18 79      | 250 cfs April 10-12 76   |
| 3rd     | 1,945 cfs Mar 05 83      | 200 cfs Apr 26-29 79<br>Aug 30-Nov 12 79<br>Apr 06-09 84<br>Apr 07-15 88 |
|         | <b>Pool-Date</b>         |  |
| Highest | 1468.35 May 10 79        |  |
| 2nd     | 1466.28 Apr 15 87        |  |
| 3rd     | 1466.06 Jul 17 75        |  |

**Minimums of Record (since initial fill):**

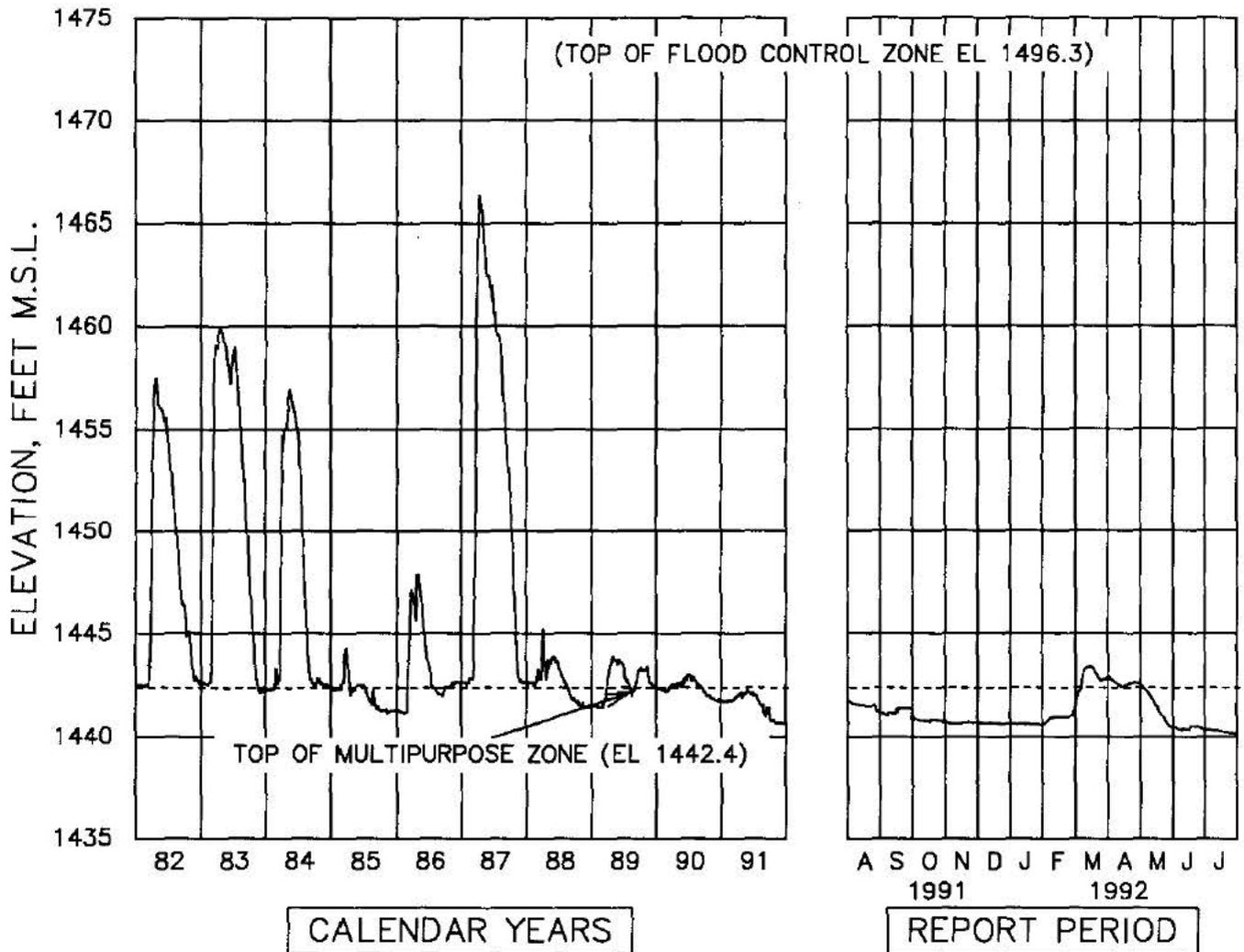
|        | <b>Pool-Date</b>     |
|--------|----------------------|
| Lowest | 1439.97 Jan 01 77    |
| 2nd    | 1440.11 Jul 31 92    |
| 3rd    | 1440.50 Feb 09-10 75 |

**Report Period:** (August 1, 1991 through July 31, 1992)

|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>7747, 31% of normal         | <b>Total Outflow (AF)</b><br>5882                          |
| <b>Peak Daily Inflow (CFS)</b><br>190, Mar 06           | <b>Peak Daily Outflow (CFS)</b><br>117, Mar 17             |
| <b>Peak Pool Elevation (Ft. MSL)</b><br>1443.43, Mar 13 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>1440.11, Jul 31 |

PIPESTEM DAM AND LAKE  
 PIPESTEM CREEK, JAMES RIVER BASIN, NORTH DAKOTA  
 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**OLIVE CREEK DAM AND LAKE  
SALT CREEK BASIN - NO. 2, NEBRASKA  
1991-1992 REGULATION**

Below normal precipitation and runoff kept the pool level under the flood storage zone throughout the reporting period. The pool level started the reporting period declining until November when small rises occurred through July and a sharp rise was caused due to heavy rainfall at the end of July. Precipitation of 8.42 inches at the damsite for the month of July produced inflows of 225 percent of average. New minimums of record were established during the report period. No flood control was achieved during the report period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 764 cfs Jun 12 84        | 176 cfs Oct 12 73         |
| 2nd     | 749 cfs Oct 10 73        | 171 cfs Jun 13 84         |
| 3rd     | 730 cfs Oct 11 86        | 145 cfs Oct 12 87         |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1342.6 Oct 11 73 |
| 2nd     | 1342.6 Jun 12 84 |
| 3rd     | 1341.3 Oct 11 86 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1326.63 Oct 28 91 |
| 2nd    | 1326.31 Jul 04 92 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
477, 24% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
123, Jul 25

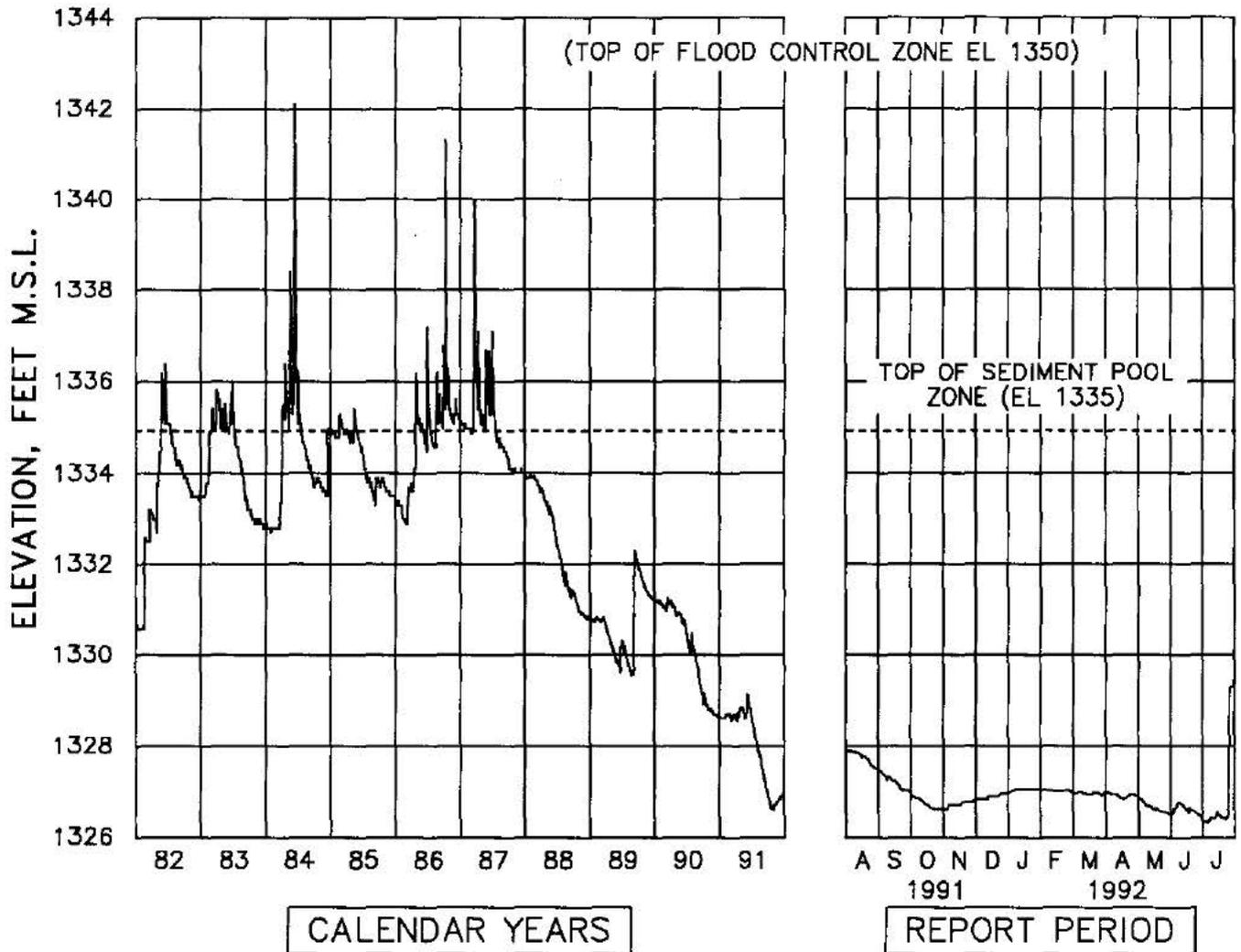
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
1329.68, Jul 30

**Minimum Pool Elevation (Ft. MSL)**  
1326.31, Jul 04

# OLIVE CREEK DAM AND LAKE SALT CREEK BASIN - NO. 2, NEBRASKA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**BLUESTEM DAM AND LAKE  
SALT CREEK BASIN - NO. 4, NEBRASKA  
1991-1992 REGULATION**

The pool level started the reporting period declining. In October minor rises caused the pool level to fluctuate moderately until June and July when heavy rainfall during those months caused the pool level to reach and enter the flood control zone in July. Precipitation of 3.68 inches in June and 10.59 inches during July caused inflows of 25 percent and 768 percent of average respectively. A new lowest of record was set during the reporting period. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 1,477 cfs Oct 10 73      | 342 cfs Oct 12 73         |
| 2nd     | 911 cfs Oct 11 86        | 198 cfs Jun 13 84         |
| 3rd     | 908 cfs Jun 13 84        | 139 cfs Oct 12 86         |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1316.5 Oct 11 73 |
| 2nd     | 1314.5 Jun 13 84 |
| 3rd     | 1312.5 Oct 11 86 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1299.46 May 31 92 |
| 2nd    | 1299.77 Nov 13 91 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
2509, 65% of normal

**Total Outflow (AF)**  
81, 3% of normal

**Peak Daily Inflow (CFS)**  
414, Jul 24

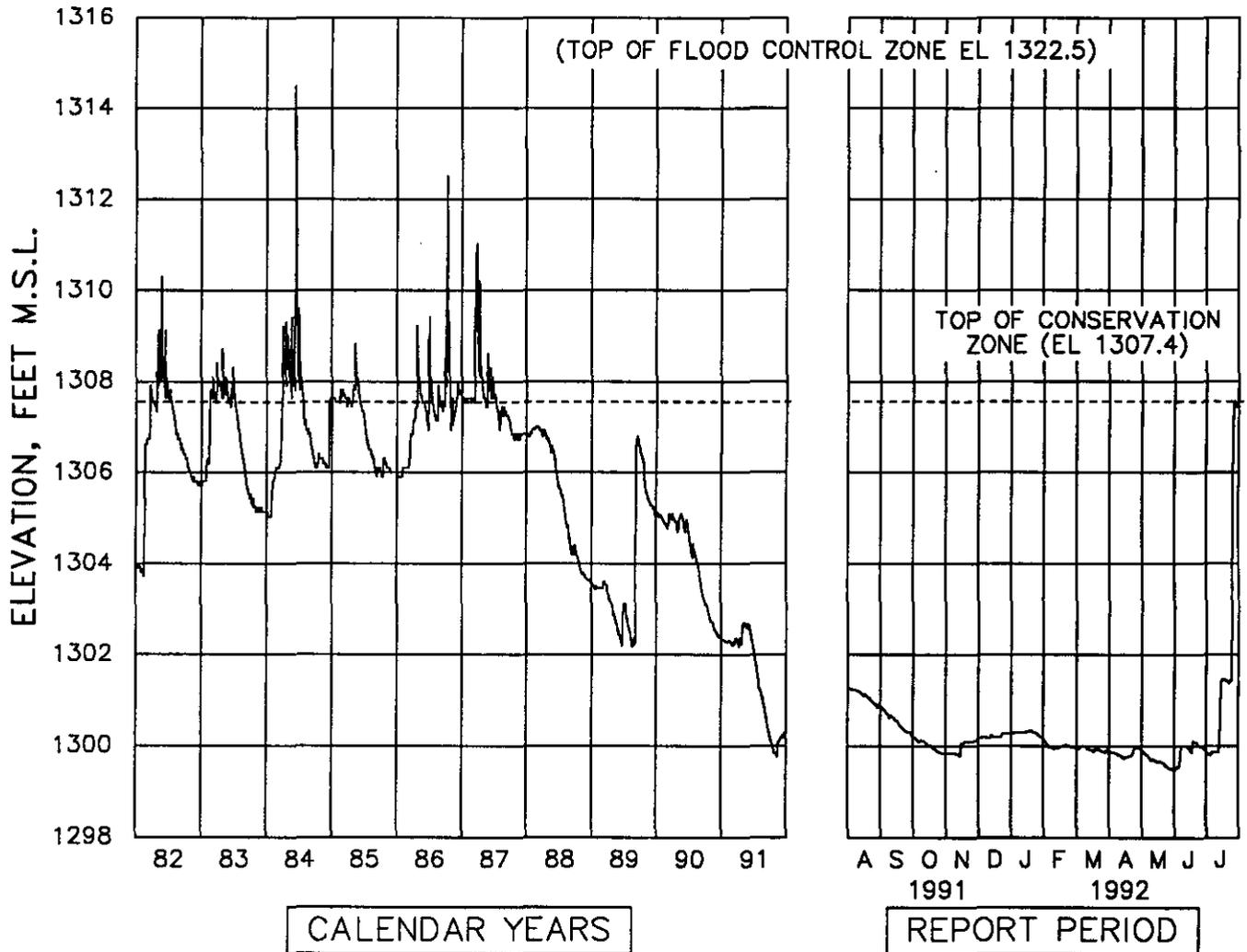
**Peak Daily Outflow (CFS)**  
23, Jul 31

**Peak Pool Elevation (Ft. MSL)**  
1308.21, Jul 30

**Minimum Pool Elevation (Ft. MSL)**  
1299.46, May 31

# BLUESTEM DAM AND LAKE SALT CREEK BASIN - NO. 4, NEBRASKA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**WAGON TRAIN DAM AND LAKE  
SALT CREEK BASIN - NO. 8, NEBRASKA  
1991-1992 REGULATION**

The pool level started to decline in August and continue until November when minor rises occurred due to precipitation and runoff. Heavy rainfall of 12.38 inches in July caused the pool level to enter the flood control zone during the end of July. Precipitation produced inflows of 784 percent of average in July. A new lowest pool of record was established during the reporting period. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 1,199 cfs Oct 10 73      | 329 cfs Oct 12 73         |
| 2nd     | 1,027 cfs Oct 11 86      | 175 cfs Oct 12 86         |
| 3rd     | 874 cfs Sep 08 89        | 170 cfs Jun 14 84         |

|         | <b>Pool-Date</b>              |
|---------|-------------------------------|
| Highest | 1295.4 Oct 11 73              |
| 2nd     | 1293.2 Jun 13 84<br>Oct 11 86 |
| 3rd     | 1292.8 Sep 09 89              |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1281.72 Nov 01 91 |
| 2nd    | 1282.2 Nov 28 75  |

**Report Period: (August 1, 1991 through July 31, 1992)**

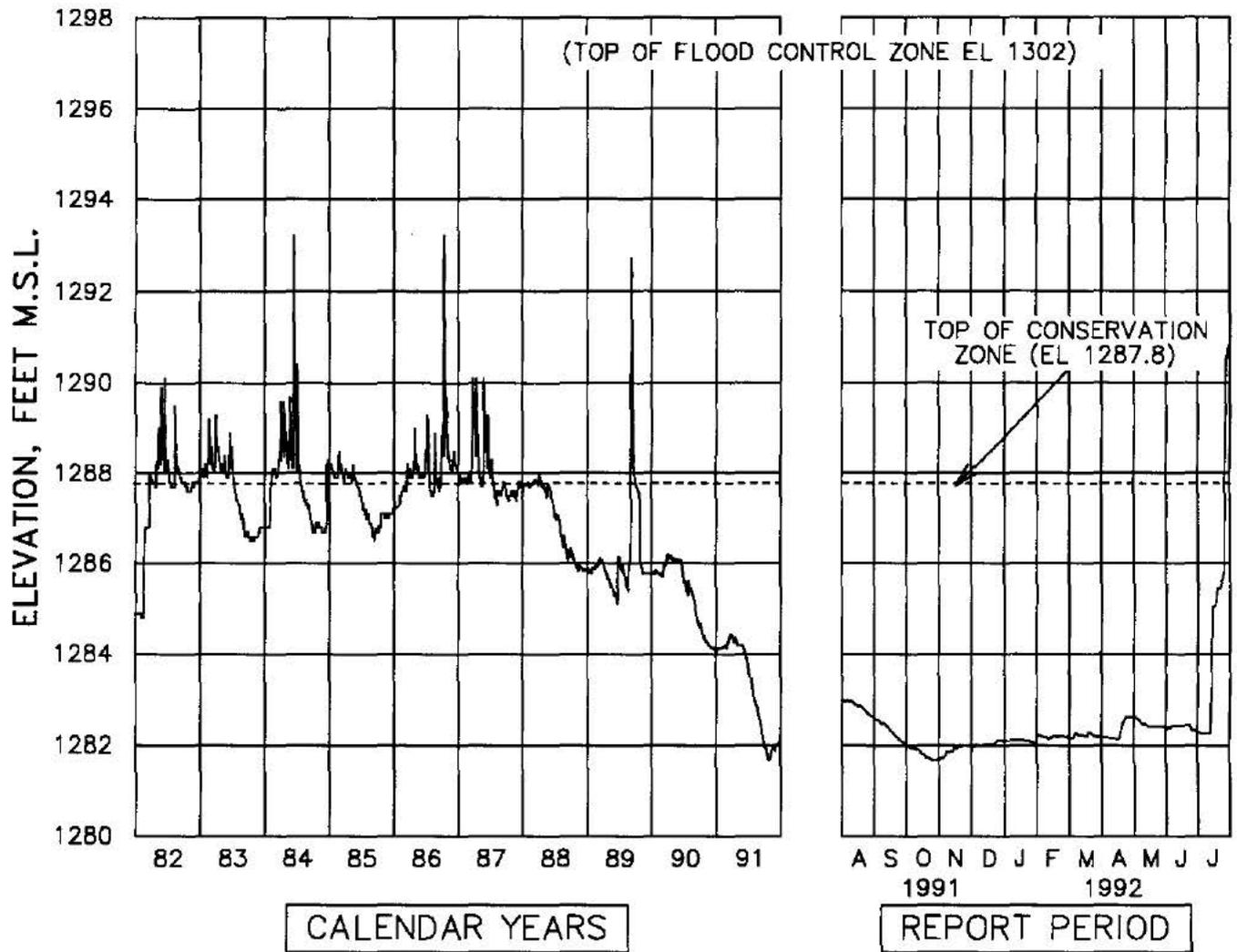
|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>3728, 91% of normal | <b>Total Outflow (AF)</b><br>1077, 36% of normal |
|---|--|

|   |  |
|---|--|
| <b>Peak Daily Inflow (CFS)</b><br>795, Jul 26 | <b>Peak Daily Outflow (CFS)</b><br>102, Jul 29 |
|---|--|

|   |  |
|---|--|
| <b>Peak Pool Elevation (Ft. MSL)</b><br>1290.80, Jul 28 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>1281.72, Nov 01 |
|---|--|

# WAGON TRAIN DAM AND LAKE SALT CREEK BASIN – NO. 8, NEBRASKA 1991–1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**STAGECOACH DAM AND LAKE  
SALT CREEK BASIN - NO. 9, NEBRASKA  
1991-1992 REGULATION**

Due to gage malfunction during January through April, the pool level was estimated for the majority of those months. The pool level began the reporting period declining until November when it slowly began to climb its way into the flood control zone due to some runoff and precipitation. Heavy rainfall in July put the pool level in the flood control zone near the end of the month. Inflows to the project during July were 612 percent of average. A new lowest of record was set during the reporting period. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 958 cfs Oct 10 73        | 190 cfs Oct 12 73         |
| 2nd     | 829 cfs Oct 11 86        | 116 cfs Oct 12 86         |
| 3rd     | 482 cfs Jun 12 84        | 109 cfs Jun 14 84         |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1279.0 Oct 11 73 |
| 2nd     | 1277.4 Oct 11 86 |
| 3rd     | 1277.1 Jun 13 84 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1259.60 Oct 31 91 |
| 2nd    | 1260.5 Aug 09 76  |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
1975, 76% of normal

**Total Outflow (AF)**  
69, 4% of normal

**Peak Daily Inflow (CFS)**  
258, Jul 26

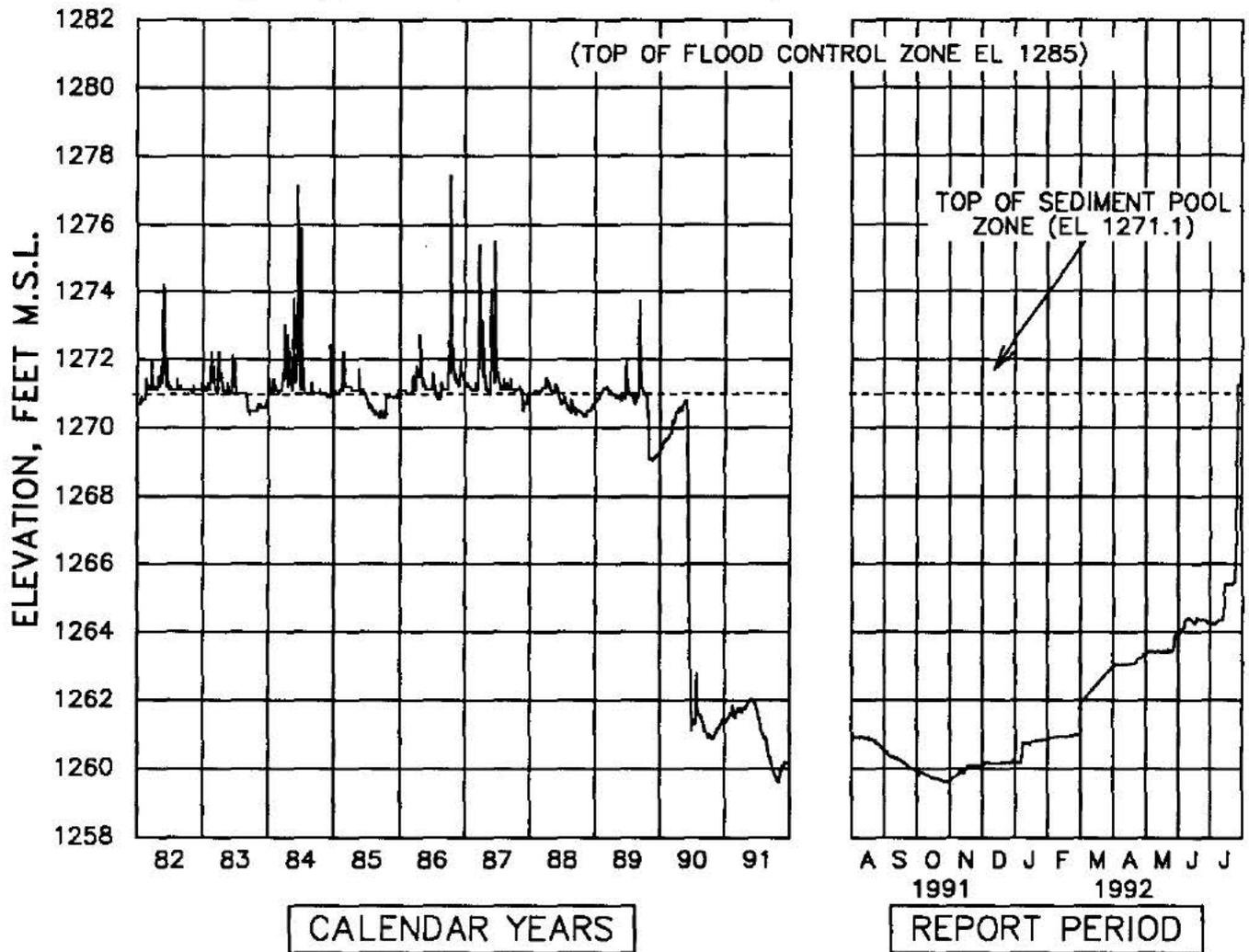
**Peak Daily Outflow (CFS)**  
14, Jul 31

**Peak Pool Elevation (Ft. MSL)**  
1271.87, Jul 30

**Minimum Pool Elevation (Ft. MSL)**  
1259.60, Oct 31

# STAGECOACH DAM AND LAKE SALT CREEK BASIN - NO. 9, NEBRASKA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**YANKEE HILL DAM AND LAKE  
SALT CREEK BASIN - NO. 10, NEBRASKA  
1991-1992 REGULATION**

The pool level began the reporting period declining until November when slight rises occurred due to rainfall and runoff. The pool level dropped again in February and continued through May. Minor rises resumed in June. Due to heavy rainfall in July, the pool level entered the flood control zone toward the end of the month. Inflows to the project during July were 494 percent of average. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 690 cfs Oct 10 73        | 145 cfs Oct 12 73         |
| 2nd     | 575 cfs Sep 08 89        | 114 cfs Jun 14 84         |
| 3rd     | 538 cfs Oct 11 86        | 100 cfs Mar 25 87         |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1252.3 Oct 11 73 |
| 2nd     | 1250.7 Jun 13 84 |
| 3rd     | 1250.0 Mar 25 87 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1238.9 Aug 08 77 |
| 2nd    | 1239.1 Sep 19 81 |

**Report Period:** (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
1906, 41% of normal

**Total Outflow (AF)**  
385, 10% of normal

**Peak Daily Inflow (CFS)**  
307, Jul 24

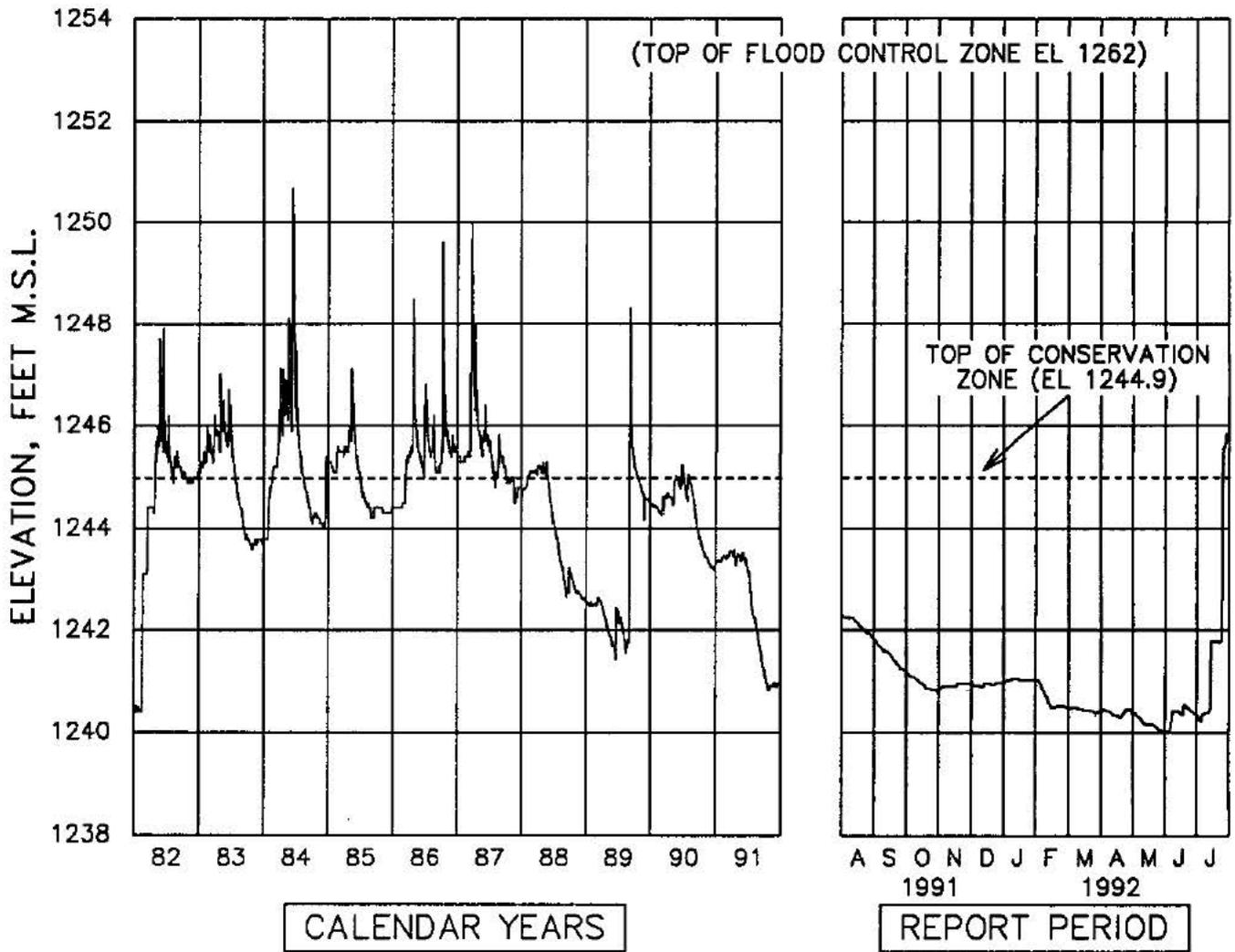
**Peak Daily Outflow (CFS)**  
63, Jul 31

**Peak Pool Elevation (Ft. MSL)**  
1247.38, Jul 30

**Minimum Pool Elevation (Ft. MSL)**  
1240.00, May 30, 31

# YANKEE HILL DAM AND LAKE SALT CREEK BASIN - NO. 10, NEBRASKA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**CONESTOGA DAM AND LAKE  
SALT CREEK BASIN - NO. 12, NEBRASKA  
1991-1992 REGULATION**

Precipitation and runoff during the reporting period was below normal. The pool level remained below flood control zone throughout the period. The pool level began the reporting period declining. Minor rises occurred during the report period but none so observant as the month of July due to precipitation of 7.87 inches. Inflows to the project during July were 137 percent of average. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 907 cfs Mar 24 87        | 185 cfs Mar 25 87         |
| 2nd     | 661 cfs Jun 27 83        | 152 cfs Jun 16 82         |
| 3rd     | 620 cfs Jun 15 82        | 51 cfs Oct 12 73          |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1241.1 Mar 24 87 |
| 2nd     | 1239.6 Oct 11 73 |
| 3rd     | 1238.3 Jun 15 82 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1228.4 Aug 28 77  |
| 2nd    | 1229.12 Jun 30 92 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
845, 14% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
169, Jul 30

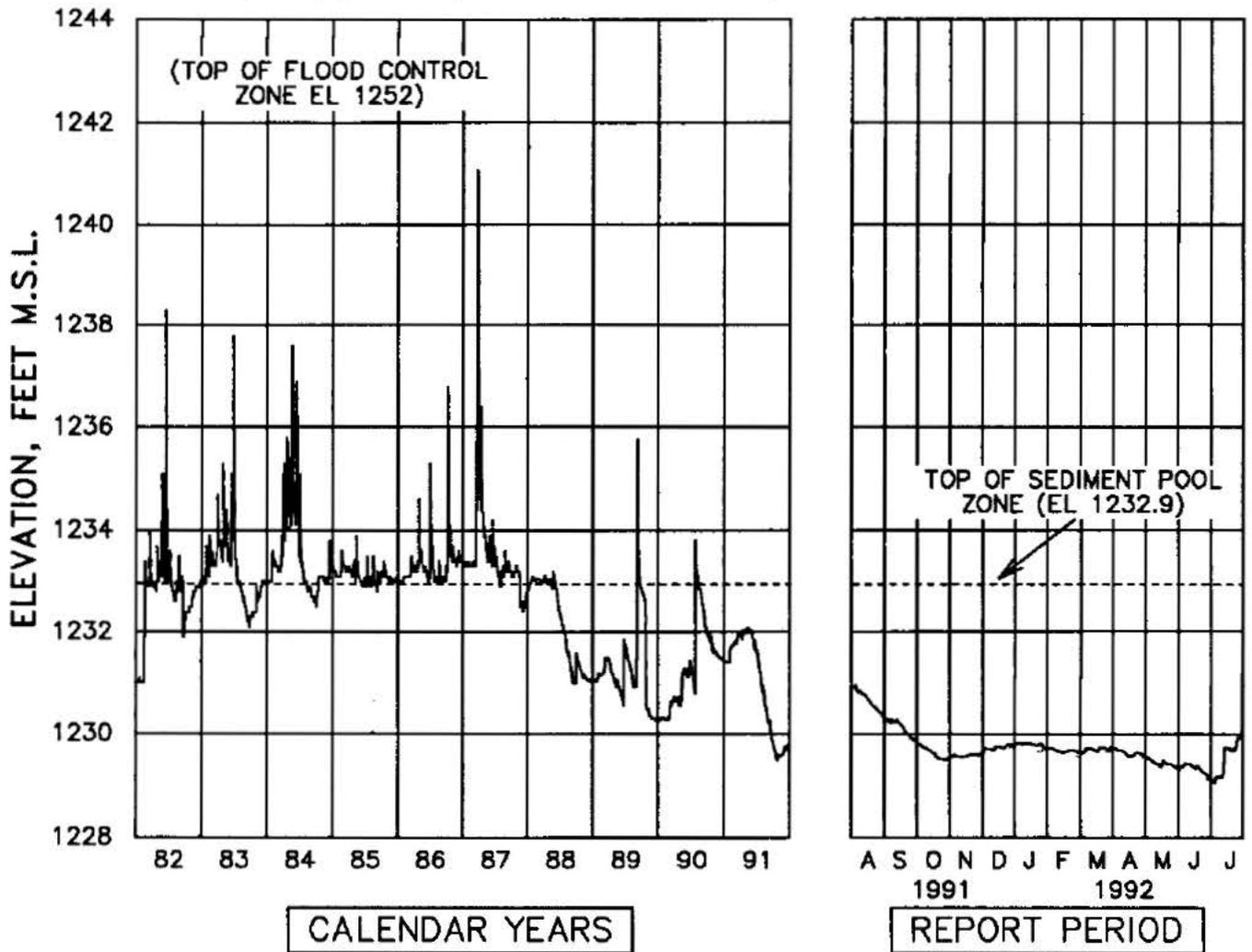
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
1231.66, Jul 31

**Minimum Pool Elevation (Ft. MSL)**  
1229.12, Jun 30

# CONESTOGA DAM AND LAKE SALT CREEK BASIN – NO. 12, NEBRASKA 1991–1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**TWIN LAKES DAM AND LAKE  
SALT CREEK BASIN - NO. 13, NEBRASKA  
1991-1992 REGULATION**

Because of below normal precipitation and runoff during the reporting period, the pool level remained under the flood control zone. The pool level reached a new lowest of record during the period. It started the reporting period declining and slight rises occurred in the pool level during the months of November through June. In June and July heavy rainfall of 4.22 inches and 6.75 inches at the damsite caused high rises in the pool level. Inflows during June and July were 48 percent and 253 percent of average respectively. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 539 cfs Mar 23 87        | 168 cfs Jun 30 83         |
| 2nd     | 507 cfs Jun 28 83        | 167 cfs Mar 24 87         |
| 3rd     | 476 cfs Jun 12 84        | 162 cfs May 20 84         |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1346.9 Jun 29 83 |
| 2nd     | 1346.0 Mar 23 87 |
| 3rd     | 1344.6 May 19 84 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1332.13 Oct 31 91 |
| 2nd    | 1332.2 Aug 18 89  |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
1211, 32% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
148, Jul 30

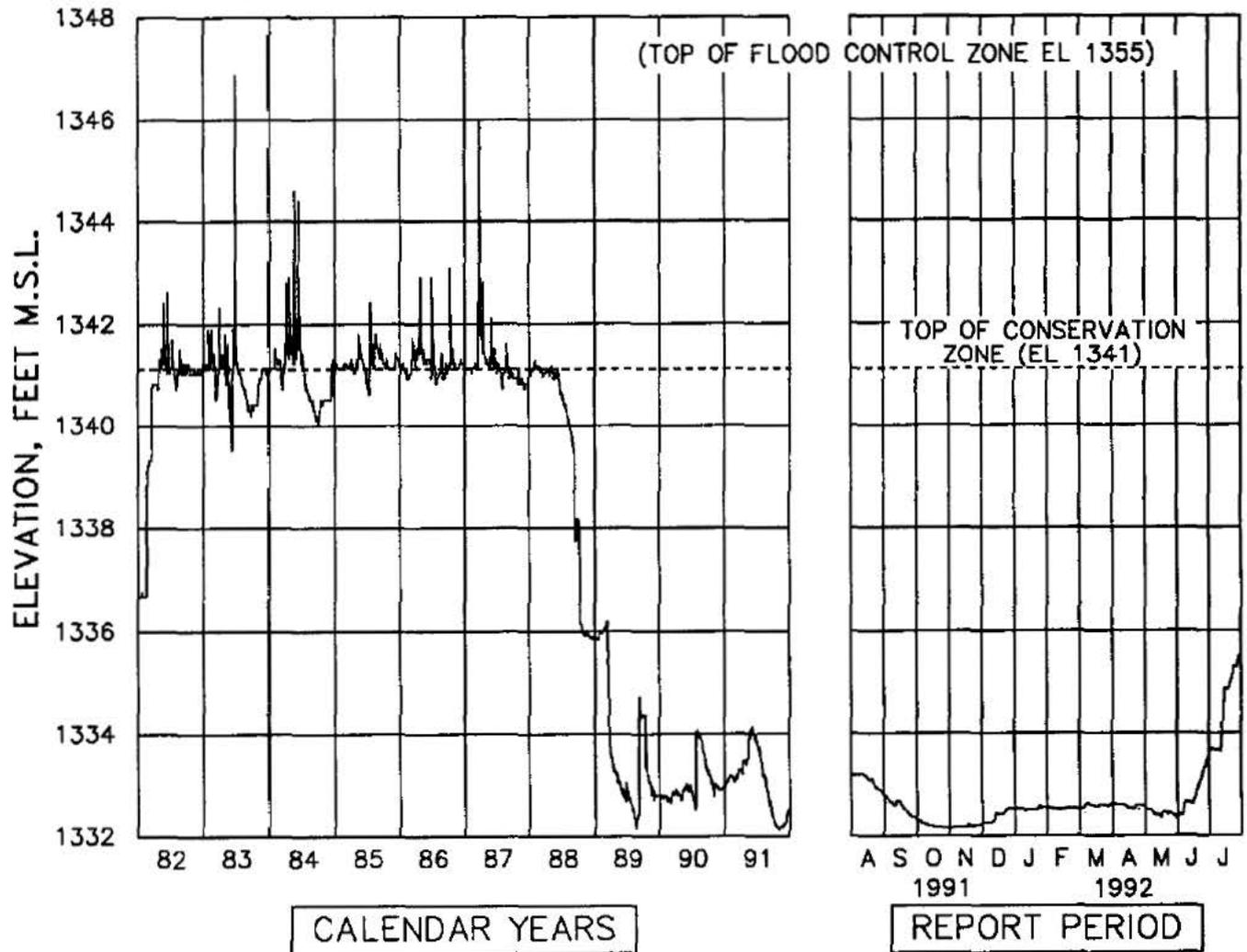
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
1337.20, Jul 31

**Minimum Pool Elevation (Ft. MSL)**  
1332.13, Oct 31

# TWIN LAKES DAM AND LAKE SALT CREEK BASIN - NO. 13, NEBRASKA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**PAWNEE DAM AND LAKE  
SALT CREEK BASIN - NO. 14, NEBRASKA  
1991-1992 REGULATION**

The pool level remained below the flood control zone throughout the reporting period due to a lack of precipitation and runoff. The pool level began the reporting period declining, but in November started to rise and continue through the rest of the period. Heavy rainfall in July (5.08 inches) had inflows of 180 percent of average. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 1,381 cfs Mar 24 87      | 419 cfs Mar 25, 26 87     |
| 2nd     | 1,074 cfs Jul 19 85      | 311 cfs Jun 13 84         |
| 3rd     | 901 cfs Jul 01 86        | 294 cfs Jul 01 86         |

|         | <b>Pool-Date</b>         |
|---------|--------------------------|
| Highest | 1248.4 Mar 24, 25, 27 87 |
| 2nd     | 1247.1 Jun 12 84         |
| 3rd     | 1246.8 Jul 01 86         |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1240.2 Oct 14 79 |
| 2nd    | 1241.2 Jan 01 77 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
3309, 42% of normal

**Total Outflow (AF)**  
36, 1% of normal

**Peak Daily Inflow (CFS)**  
248, Jul 30

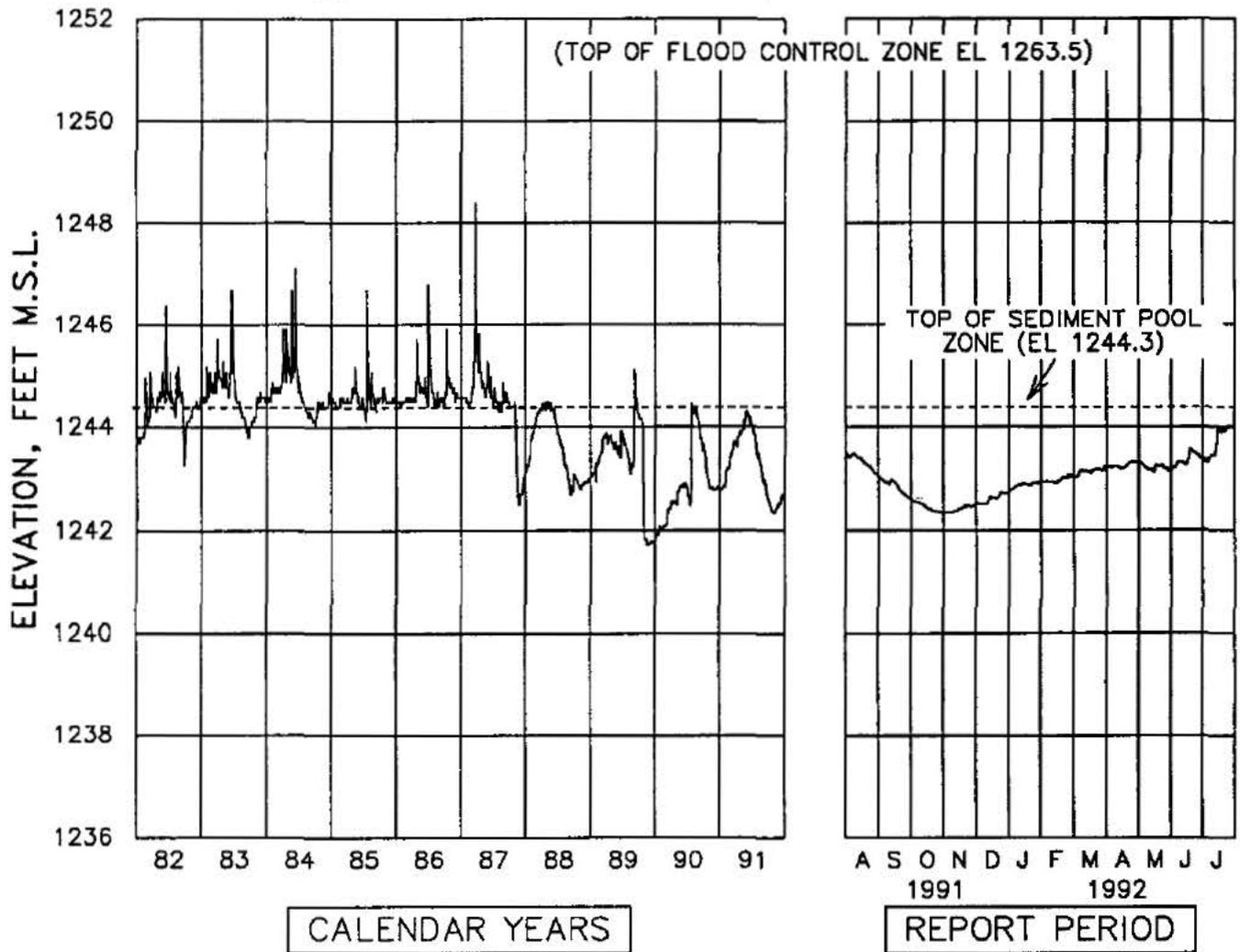
**Peak Daily Outflow (CFS)**  
12, Jul 31

**Peak Pool Elevation (Ft. MSL)**  
1244.61, Jul 30

**Minimum Pool Elevation (Ft. MSL)**  
1242.34, Oct 28

PAWNEE DAM AND LAKE  
SALT CREEK BASIN - NO. 14, NEBRASKA  
1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**ANTELOPE CREEK DAM AND HOLMES PARK LAKE  
SALT CREEK BASIN - NO. 17, NEBRASKA  
1991-1992 REGULATION**

The pool level started to decline during the beginning of the reporting period. At the end of November, the pool level began to climb and continued throughout the period. Due to runoff and precipitation in March, the pool level entered the flood control zone for a brief period and receded below the level until the end of April. The pool level re-entered the flood control zone, fluctuating above and below the level, until the beginning of July and stayed until the end of the reporting period. Heavy rainfall in April through July produced inflows to the project of 43 percent, 73 percent, 153 percent and 508 percent of average respectively. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 567 cfs Sep 08 89        | 187 cfs Jun 29 83         |
| 2nd     | 401 cfs Jun 27 83        | 140 cfs Sep 09 89         |
| 3rd     | 381 cfs Jun 27 83        | 134 cfs May 25 84         |

|         | <b>Pool-Date</b> |
|---------|------------------|
| Highest | 1249.1 Sep 08 89 |
| 2nd     | 1248.1 Jun 27 83 |
| 3rd     | 1247.9 Oct 11 86 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1232.9 Aug 03 77 |
| 2nd    | 1236.8 Feb 26 76 |

**Report Period: (August 1, 1991 through July 31, 1992)**

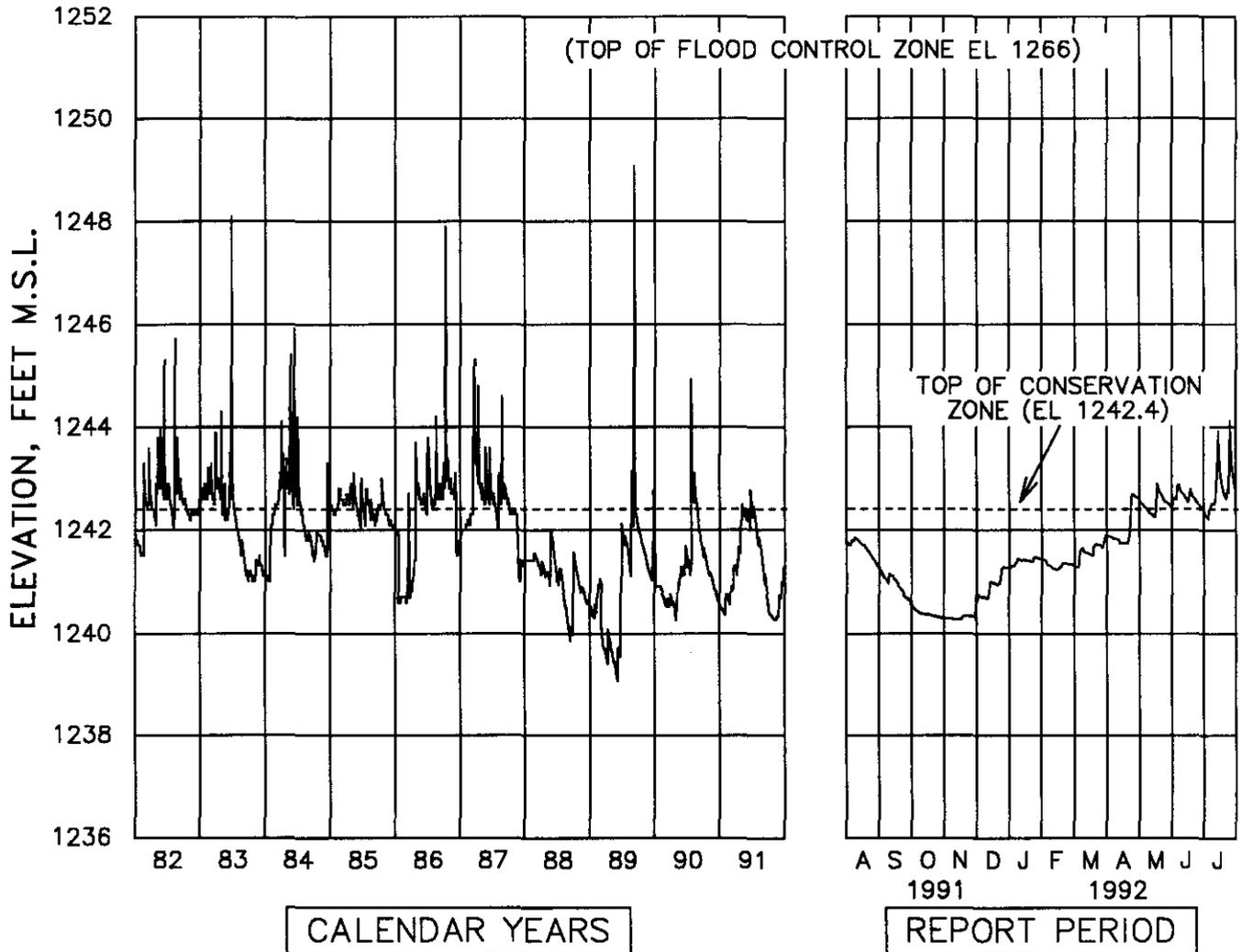
|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>2245, 98% of normal | <b>Total Outflow (AF)</b><br>1652, 96% of normal |
|---|--|

|   |   |
|---|---|
| <b>Peak Daily Inflow (CFS)</b><br>133, Jul 24 | <b>Peak Daily Outflow (CFS)</b><br>61, Jul 25 |
|---|---|

|   |  |
|---|--|
| <b>Peak Pool Elevation (Ft. MSL)</b><br>1244.11, Jul 24 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>1240.28, Nov 08 |
|---|--|

# ANTELOPE CREEK DAM AND HOLMES PARK LAKE SALT CREEK BASIN – NO. 17, NEBRASKA 1991–1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**BRANCHED OAK DAM AND LAKE  
SALT CREEK BASIN - NO. 18, NEBRASKA  
1991-1992 REGULATION**

Precipitation in August during the reporting period kept the pool level in the flood control zone for a brief moment and receded below the level in the middle of August. In November, runoff and precipitation made the pool level rise and fluctuate up until July when heavy rainfall of 7.72 inches at the damsite caused the pool level to re-enter the flood control zone and stay throughout the period. Inflow to the project during July was 99 percent of average. Gated releases were made in August, September and July. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 3,700 cfs Aug 25 87      | 730 cfs Aug 26 87         |
| 2nd     | 2,435 cfs Mar 23 87      | 670 cfs Jun 19 83         |
| 3rd     | 1,780 cfs Jun 18 83      | 667 cfs Mar 24 87         |

|         | <b>Pool-Date</b>              |
|---------|-------------------------------|
| Highest | 1287.9 Aug 26 87              |
| 2nd     | 1287.7 Jun 18 83<br>Mar 23 87 |
| 3rd     | 1287.2 Jun 13 84              |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b> |
|--------|------------------|
| Lowest | 1280.9 Jan 01 77 |
| 2nd    | 1281.5 Nov 25 89 |

**Report Period: (August 1, 1991 through July 31, 1992)**

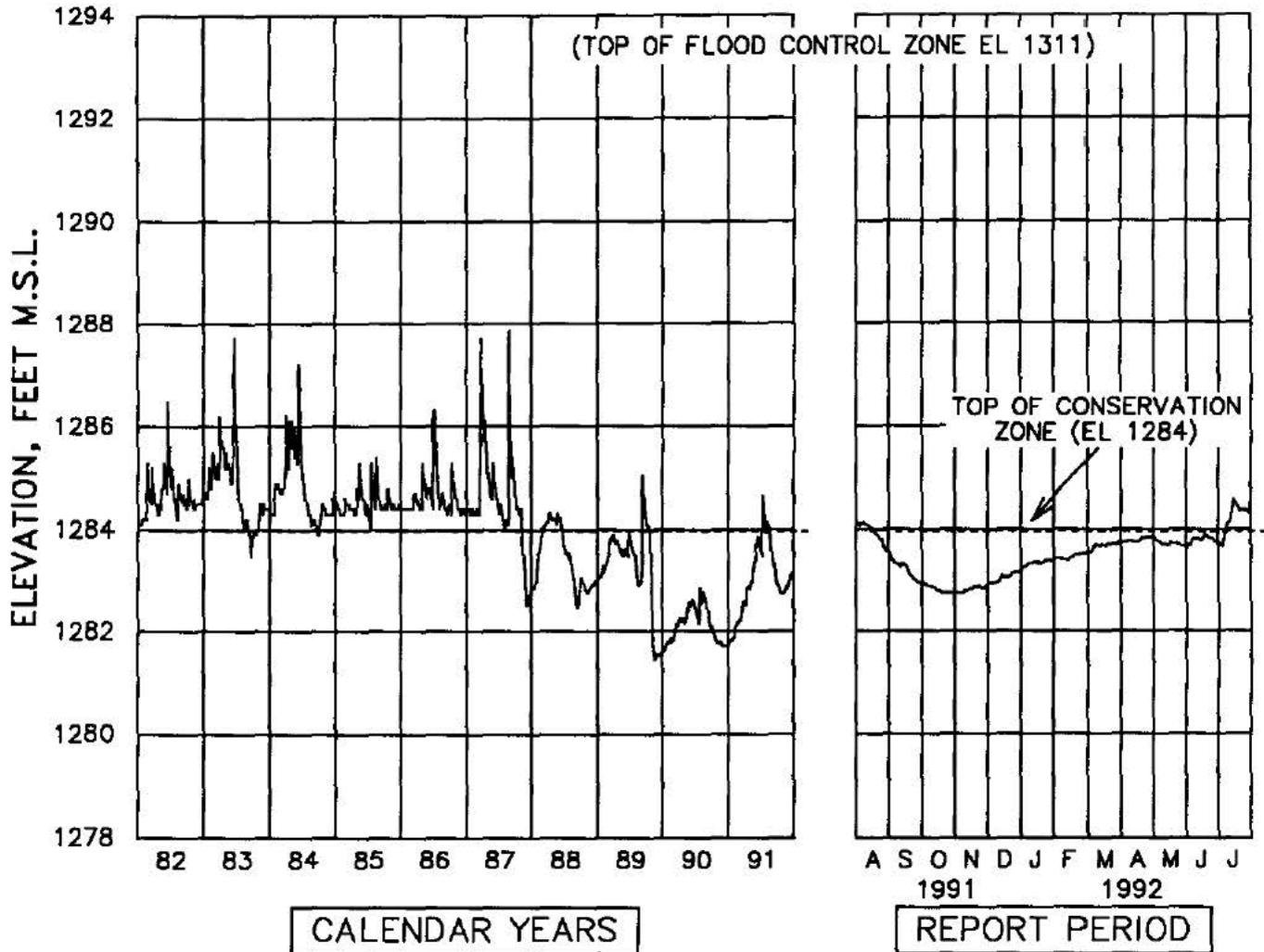
|  |  |
|--|--|
| <b>Total Inflow (AF)</b><br>10526, 38% of normal | <b>Total Outflow (AF)</b><br>2371, 11% of normal |
|--|--|

|   |   |
|---|---|
| <b>Peak Daily Inflow (CFS)</b><br>575, Jul 30 | <b>Peak Daily Outflow (CFS)</b><br>87, Jul 31 |
|---|---|

|   |  |
|---|--|
| <b>Peak Pool Elevation (Ft. MSL)</b><br>1284.88, Jul 31 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>1282.73, Nov 03 |
|---|--|

# BRANCHED OAK DAM AND LAKE SALT CREEK BASIN - NO. 18, NEBRASKA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



SNAKE CREEK DAM AND LAKE AUDUBON  
 LAKE SAKAKAWEA SUBIMPOUNDMENT  
 MISSOURI RIVER BASIN, NORTH DAKOTA  
 1991-1992 REGULATION

Lake Audubon, a subimpoundment of Garrison Reservoir, is located 8 miles northeast of Riverdale, North Dakota. The embankment, known as "Snake Creek", has a crest elevation of 1865 ft. MSL. The original planned operating level of 1850 ft. MSL, Lake Audubon would cover 20,600 acres and contains 396,000 AF of water.

The embankment was constructed with the primary purpose of relocating U.S. Highway 83 and the Soo Line Railroad across the Snake Creek Arm of the Garrison Diversion. In addition, during the planning stage it was decided to create a gated subimpoundment for the dual purpose of fish and wildlife enhancement, and the future diversion of water for anticipated irrigation. The pool level has been kept below elevation 1850 because (1) all land surrounding the lake has not been acquired to maintain the 1850 level and (2) that level (head) is not needed to supply water to the revised lower irrigation acreage. Garrison pool levels are limited to less than 15 feet above the Audubon pool for dam safety consideration. Most of the time, however, the Lake Audubon level is higher than the Garrison pool. If the latter condition exists, the Snake Creek pumping plant, operated by the Bureau, is used to transfer water from Garrison Reservoir to Lake Audubon. Gravity flow discharge to or from Lake Audubon is conveyed by a gated conduit 7 feet wide by 10 feet high with invert elevation at 1810 ft. MSL. This gated conduit is normally closed.

Lake Audubon was operated in accordance with the 1987 Letter of Understanding between the Corps, the Bureau of Reclamation, Fish and Wildlife Service, and the North Dakota Game and Fish Department. On October 11, the gate was opened and the pool was lowered from 1846.8 to 1843.7 in response to a request from the USBR. Beginning on April 6, and continuing intermittently through the spring and summer months, water was pumped into Lake Audubon from Lake Sakakawea. The pool was maintained as close to the target pool of 1847.2 as possible.

**Maximums of Record:**

**Minimums of Record:**

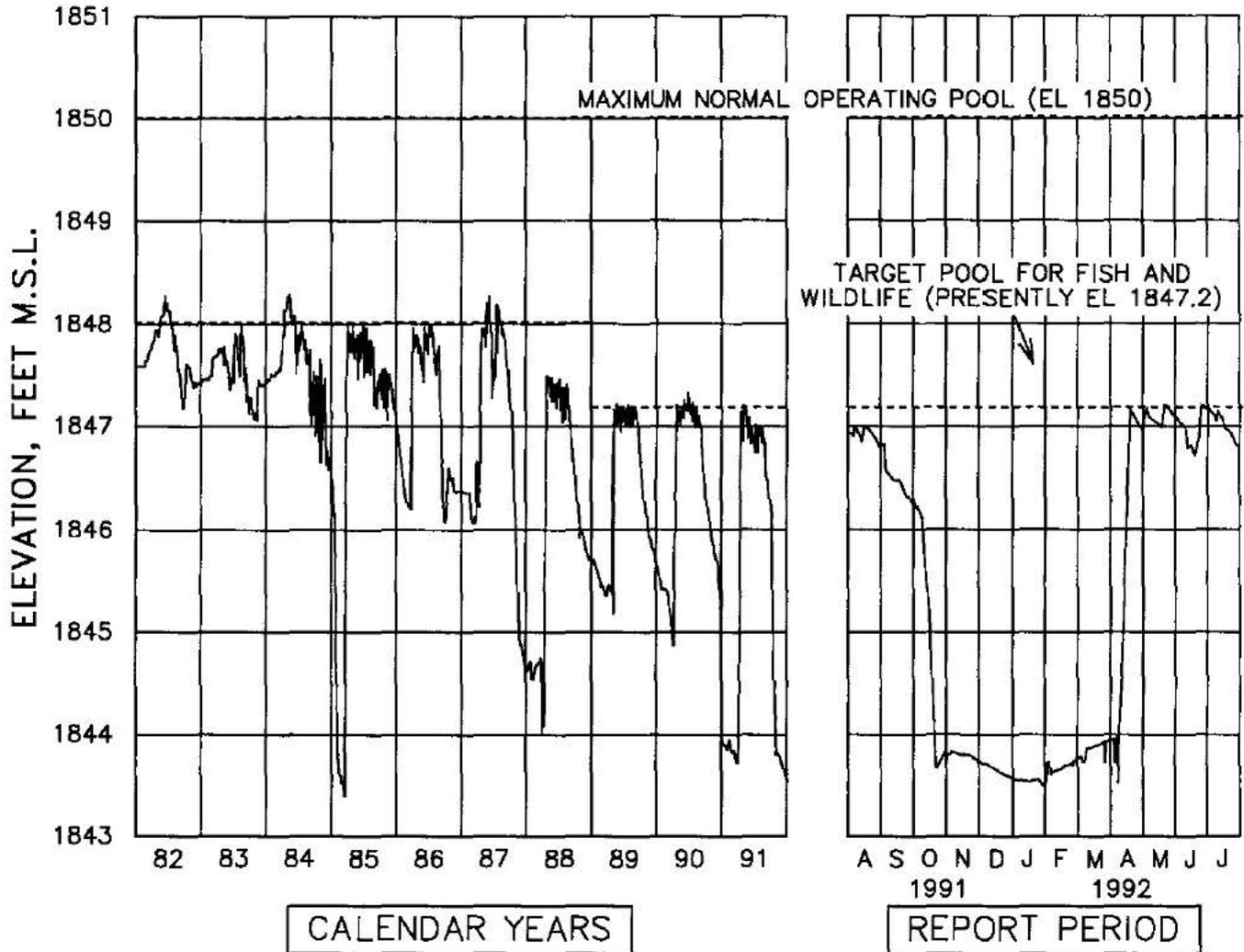
|         | <b>Pool Date</b>  |        | <b>Pool Date</b>  |
|---------|-------------------|--------|-------------------|
| Highest | 1848.61 Apr 26 76 | Lowest | 1843.39 Mar 13 85 |
| 2nd     | 1848.57 May 21 79 | 2nd    | 1843.50 Jan 27 92 |
| 3rd     | 1844.02 Mar 29 88 |        |                   |

Report Period: (August 1, 1991 through July 31, 1992)

|                                      |   |
|--------------------------------------|---|
| <b>Peak Pool Elevation (Ft. MSL)</b> | <b>Minimum Pool Elevation (Ft. MSL)</b> |
| 1847.20, May 20                      | 1843.50, Jan 27                         |

**SNAKE CREEK DAM AND LAKE AUDUBON  
LAKE SAKAKAWEA SUBIMPOUNDMENT  
MISSOURI RIVER BASIN, NORTH DAKOTA  
1991-1992 REGULATION**

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**BOYSEN DAM AND LAKE  
BIGHORN RIVER BASIN, WYOMING  
1991-1992 REGULATION**

Boysen Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone as per the Field Working Agreement dated May 5, 1967. When this occurs release determination is the responsibility of the Corps of Engineers (District Engineer).

The pool level did not enter the flood control zone during the report period and no releases were required for flood control.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 19,253 cfs Jun 23 67     | 14,204 cfs Jul 07 67      |
| 2nd     | 17,975 cfs Jun 17 63     | 10,688 cfs Jun 16 91      |
| 3rd     | 16,516 cfs Jun 15 91     | 8,518 cfs Jun 24 63       |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 4730.83 Jul 06 67 |
| 2nd     | 4729.85 Jul 05 57 |
| 3rd     | 4729.18 Jun 16 91 |

**Minimums of Record (since initial fill):**

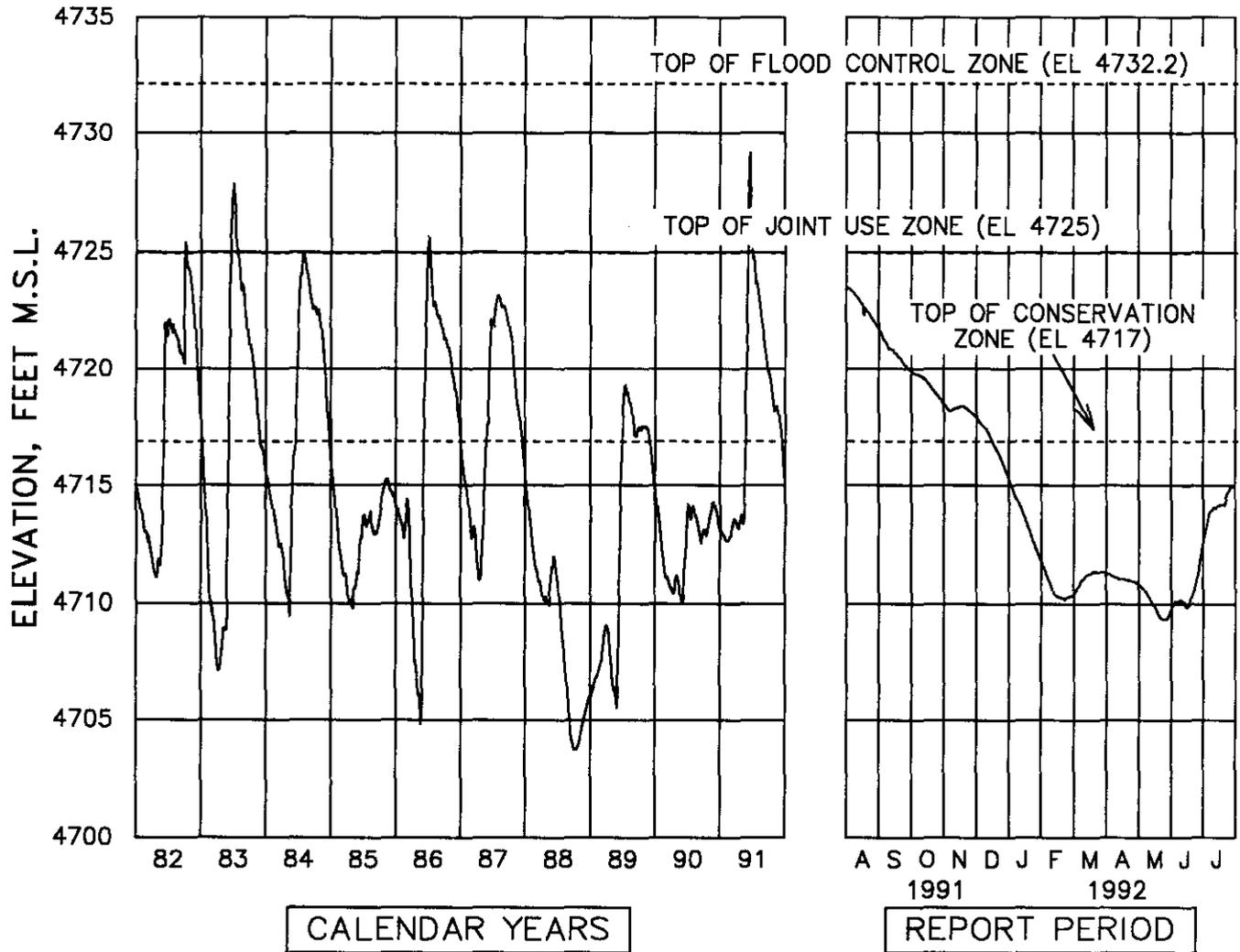
|        | <b>Pool-Date</b>     |
|--------|----------------------|
| Lowest | 4684.18 Mar 18-19 56 |
| 2nd    | 4686.42 Sep 21 60    |

**Report Period:** (August 1, 1991 through July 31, 1992)

|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>672,350, 65% of normal      | <b>Total Outflow (AF)</b><br>825,100, 80% of normal        |
| <b>Peak Daily Inflow (CFS)</b><br>4,016, Jun 27         | <b>Peak Daily Outflow (CFS)</b><br>1,607, Sep 17           |
| <b>Peak Pool Elevation (Ft. MSL)</b><br>4723.48, Aug 01 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>4709.35, May 25 |

# BOYSEN DAM AND LAKE BIGHORN RIVER BASIN, WYOMING 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**CANYON FERRY DAM AND RESERVOIR  
MISSOURI RIVER BASIN, MONTANA  
1991-1992 REGULATION**

Canyon Ferry Reservoir is regulated by the Bureau (Regional Director) except when the pool level rises into the exclusive flood control zone or that portion of the joint use (conservation-flood control) zone required for flood control, as per the Field Working Agreement dated May 23, 1977. When this occurs, release determination is the responsibility of the Corps (District Engineer).

Inflow was insufficient to fill the joint-use zone. No flood control releases were made.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 29,050 cfs May 24 81     | 25,720 cfs Jun 13 81      |
| 2nd     | 27,570 cfs Jun 19 74     | 24,370 cfs Jun 19 64      |
| 3rd     | 27,110 cfs May 30 56     | 24,030 cfs May 31 56      |

|         | <b>Pool-Date</b>    |
|---------|---------------------|
| Highest | 3800.00 55, 56, 62  |
| 2nd     | 3799.93 Jul 7-12 75 |
| 3rd     | 3799.66 Jun 4-5 62  |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 3764.70 Apr 11 67 |
| 2nd    | 3772.75 Mar 25 62 |

**Report Period:** (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
3,152,900, 79% of normal

**Total Outflow (AF)**  
2,669,510, 67% of normal

**Peak Daily Inflow (CFS)**  
8,311, Jun 19

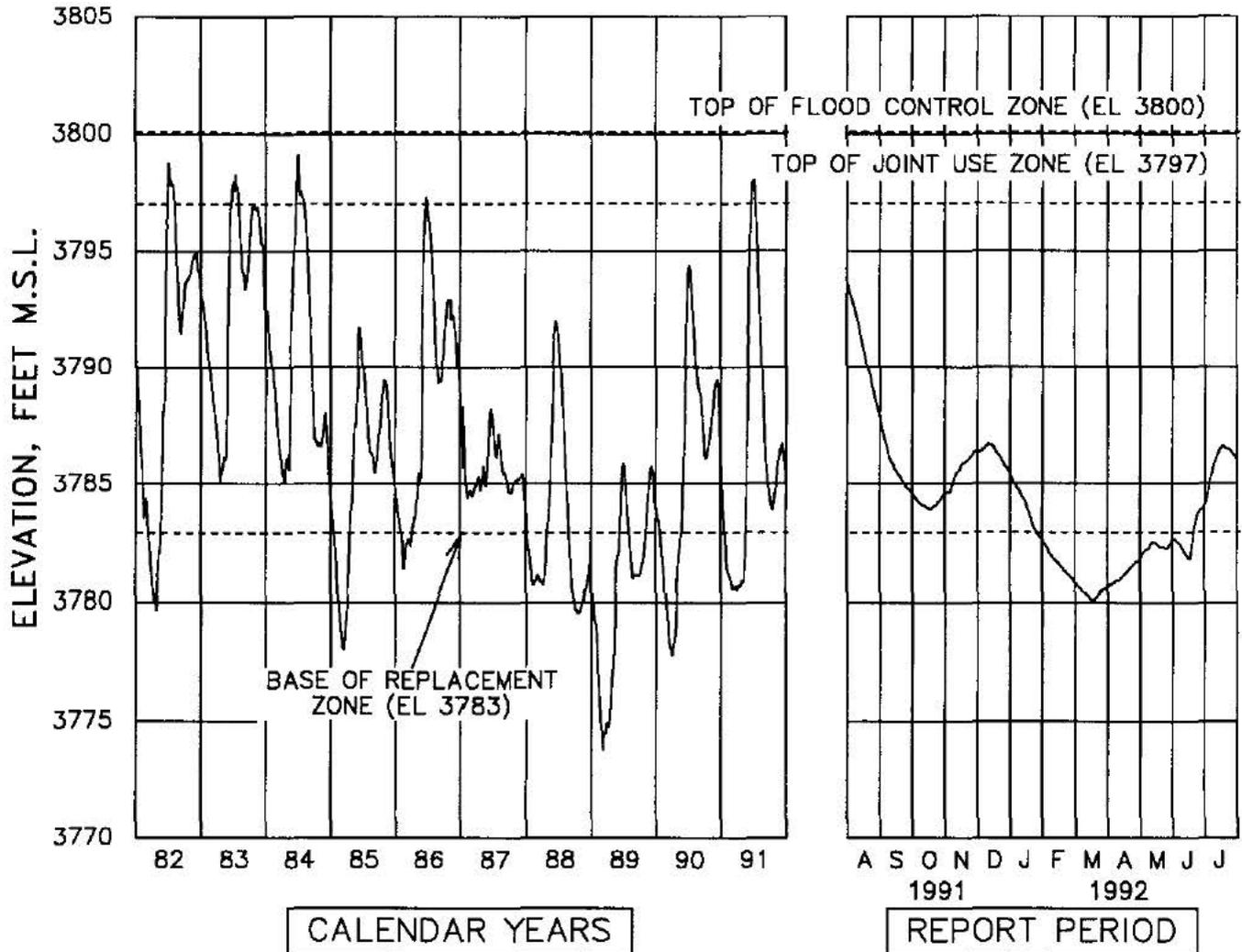
**Peak Daily Outflow (CFS)**  
4,583, Jan 29

**Peak Pool Elevation (Ft. MSL)**  
3793.55, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
3780.08, Mar 15

# CANYON FERRY DAM AND RESERVOIR MISSOURI RIVER BASIN, MONTANA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**CLARK CANYON DAM AND RESERVOIR  
BEAVERHEAD RIVER BASIN, MONTANA  
1991-1992 REGULATION**

Clark Canyon Reservoir (Hap Hawkins Lake) is regulated by the Bureau (Regional Director) except when the pool level rises into the exclusive flood control zone or that portion of the joint use (conservation-flood control) zone required for flood control, as per the Field Working Agreement dated November 19, 1971. When this occurs, release determination is the responsibility of the Corps (District Engineer).

Following the end of irrigation season in mid-September, releases to the East Bench Irrigation District were terminated. Wintertime releases were reduced to as low as 29 cfs in an attempt to conserve water. Inflow was barely sufficient to fill the conservation pool by the start of irrigation season in March. This was the first year since 1988 that the conservation pool has filled.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 3,416 cfs Jun 22 84      | 2,561 cfs Jun 25 84       |
| 2nd     | 2,800 cfs Jun 20 75      | 1,289 cfs Jul 31 75       |
| 3rd     | 2,208 cfs Mar 31 69      | 1,275 cfs Aug 12-24 75    |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 5564.70 Jun 25 84 |
| 2nd     | 5556.88 Jul 22 75 |
| 3rd     | 5554.54 Jun 25 76 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>     |
|--------|----------------------|
| Lowest | 5508.67 Aug 23-25 89 |
| 2nd    | 5511.87 Aug 23 90    |

**Report Period:** (August 1, 1991 through July 31, 1992)

|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>140,270, 49% of normal      | <b>Total Outflow (AF)</b><br>152,050, 53% of normal        |
| <b>Peak Daily Inflow (CFS)</b><br>1280, Mar 31          | <b>Peak Daily Outflow (CFS)</b><br>821, Jun 11             |
| <b>Peak Pool Elevation (Ft. MSL)</b><br>5537.69, Apr 27 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>5517.40, Sep 07 |

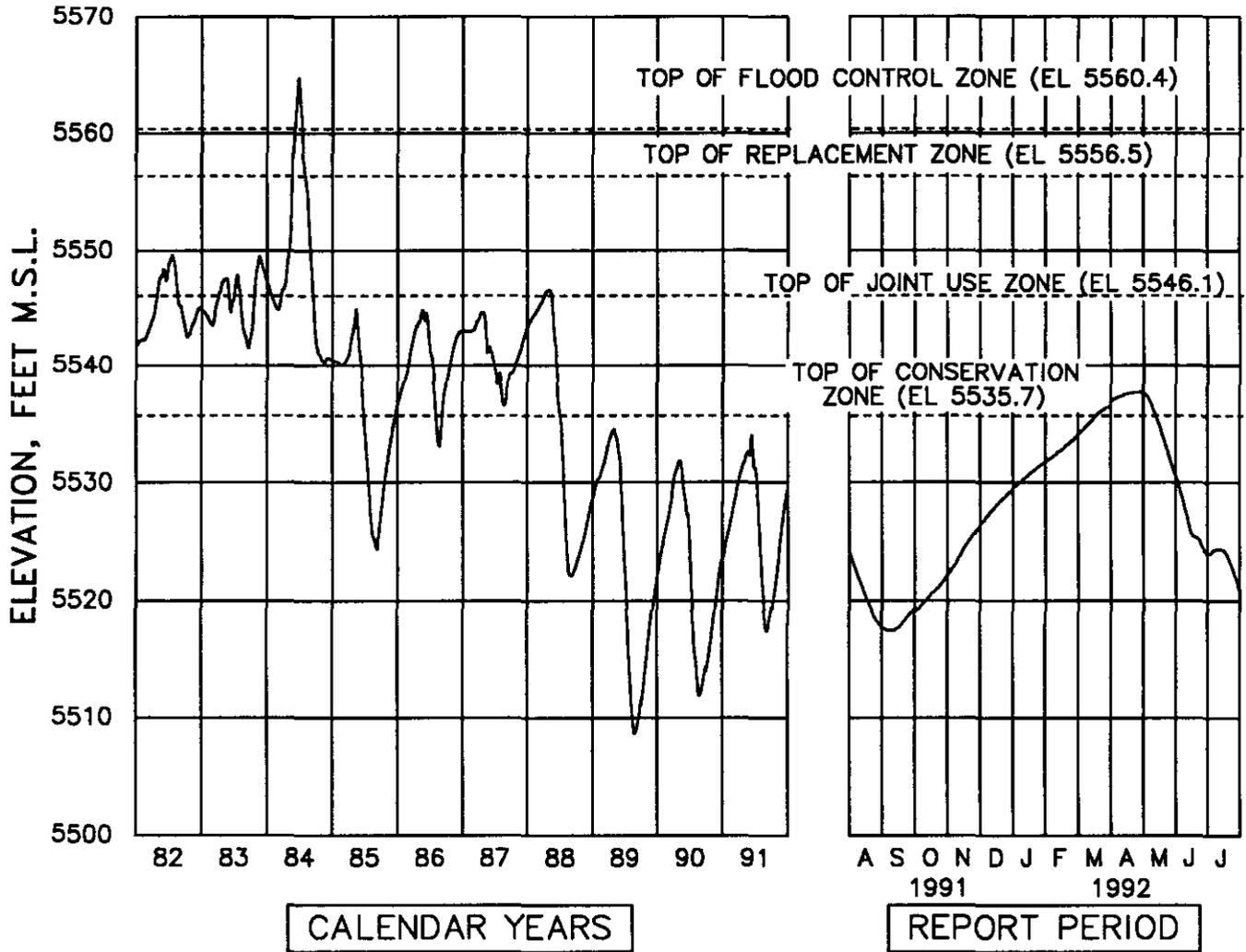
# **NON-CORPS PROJECTS**

**Regulated for flood control according to regulations in the Federal Register and supplemental agreements (between the Bureau of Reclamation and Corps of Engineers) in compliance with the 1944 Flood Control Act.**

- 1. BOYSEN DAM**
- 2. CANYON FERRY DAM**
- 3. CLARK CANYON DAM**
- 4. GLENDO DAM**
- 5. HEART BUTTE DAM**
- 6. JAMESTOWN DAM**
- 7. KEYHOLE DAM**
- 8. PACTOLA DAM**
- 9. SHADEHILL DAM**
- 10. TIBER DAM**
- 11. YELLOWTAIL DAM**

# CLARK CANYON DAM AND RESERVOIR BEAVERHEAD RIVER BASIN, MONTANA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**GLENDO DAM AND RESERVOIR  
NORTH PLATTE RIVER BASIN, WYOMING  
1991-1992 REGULATION**

Glendo Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone. When this occurs, release determination is the responsibility of the Corps (District Engineer) as per the Field Working Agreement dated May 12, 1977. The bureau imposed an elevation restriction of 4650 ft. MSL in December of 1983 due to increased dike seepage. The final inspection was conducted on October 17, 1989. On February 16, 1990, the Bureau of Reclamation's Regional Office in Billings, Montana, officially rescinded Glendo Reservoir's operating restriction. The top of flood control pool is again at elevation 4653.

Glendo began the report period at elevation 4611.47 ft. MSL (19.27 feet higher than the beginning of the last report period). For the report period, inflows were 66 percent of average.

Glendo Reservoir pool did not enter the exclusive flood control zone during the report period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 18,840 cfs May 15 65     | 10,292 cfs Jun 30 84      |
| 2nd     | 17,560 cfs Jun 13 70     | 10,266 cfs Jul 01 84      |
| 3rd     | 14,661 cfs May 21 73     | 10,060 cfs Aug 26 83      |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 4650.90 May 27 73 |
| 2nd     | 4650.27 Jun 14 83 |
| 3rd     | 4648.45 May 31 71 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 4548.10 Sep 28 66 |
| 2nd    | 4560.42 Sep 26 72 |

**Report Period: (August 1, 1991 through July 31, 1992)**

**Total Inflow (AF)**  
810,081, 66% of normal

**Total Outflow (AF)**  
780,116, 66% of normal

**Peak Daily Inflow (CFS)**  
3396, Jul 18

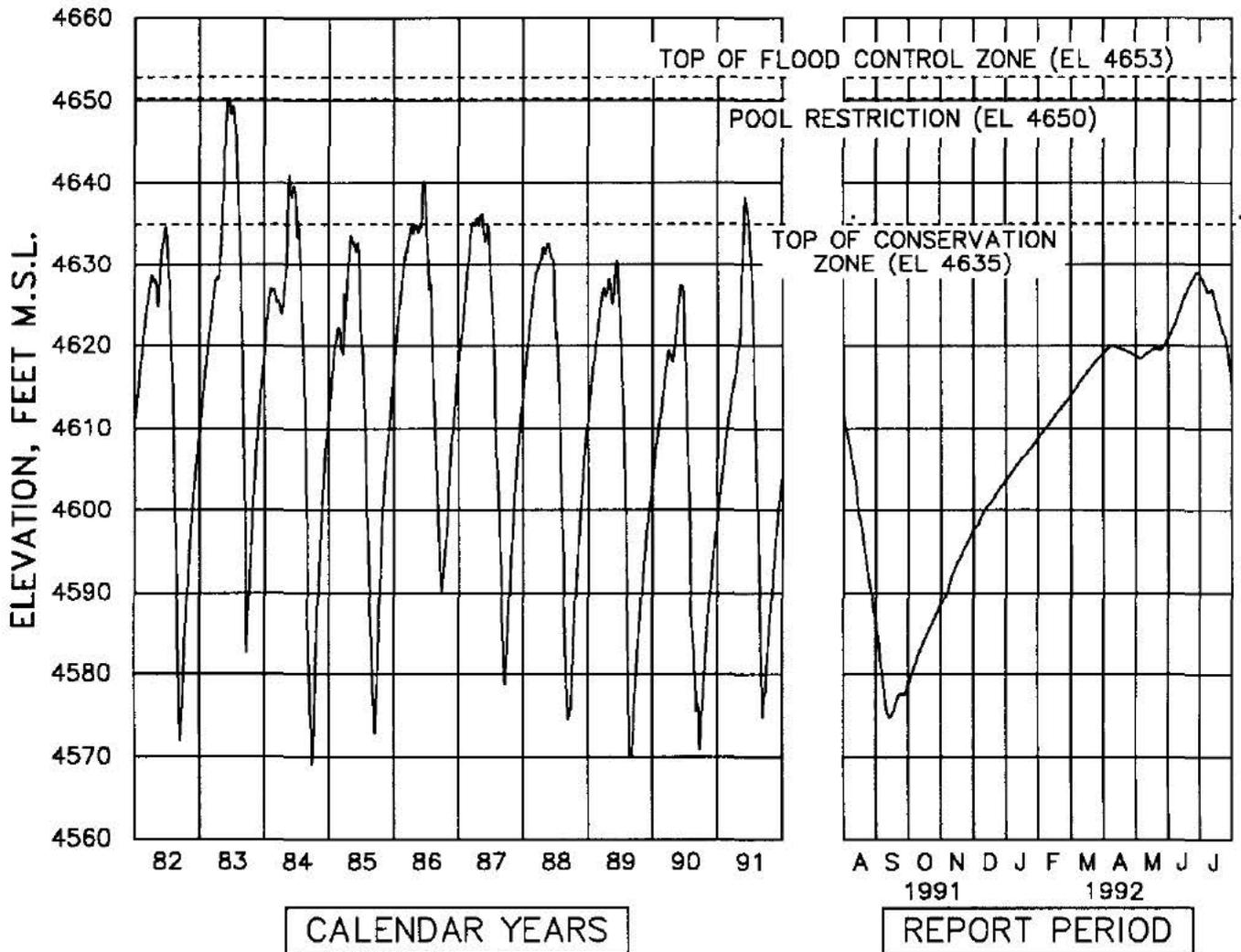
**Peak Daily Outflow (CFS)**  
7471, Jul 26

**Peak Pool Elevation (Ft. MSL)**  
4629.00, Jun 28

**Minimum Pool Elevation (Ft. MSL)**  
4574.78, Sep 13

# GLENDO DAM AND RESERVOIR NORTH PLATTE RIVER BASIN, WYOMING 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**HEART BUTTE DAM AND RESERVOIR (LAKE TSCHIDA)  
HEART RIVER BASIN, NORTH DAKOTA  
1991-1992 REGULATION**

Heart Butte Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone. When this occurs, release determination is the responsibility of the Corps (District Engineer) as per the Field Working Agreement dated Mar 15, 1951.

Due to extreme dry conditions throughout the Heart River Basin, record low pool elevations persisted.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 22,450 cfs May 09 70     | 4,050 cfs Apr 09 52       |
| 2nd     | 22,000 cfs Apr 17 50     | 3,931 cfs May 31 78       |
| 3rd     | 12,960 cfs Apr 06 52     | 3,864 cfs May 13 70       |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 2086.23 Apr 09 52 |
| 2nd     | 2083.77 Mar 31 78 |
| 3rd     | 2082.70 May 12 70 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 2049.00 Oct 28 91 |
| 2nd    | 2051.44 Nov 07 90 |
| 3rd    | 2052.80 Dec 31 61 |

**Report Period:** (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
12451, 13% of normal

**Total Outflow (AF)**  
7378, 8% of normal

**Peak Daily Inflow (CFS)**  
400, Jun 13

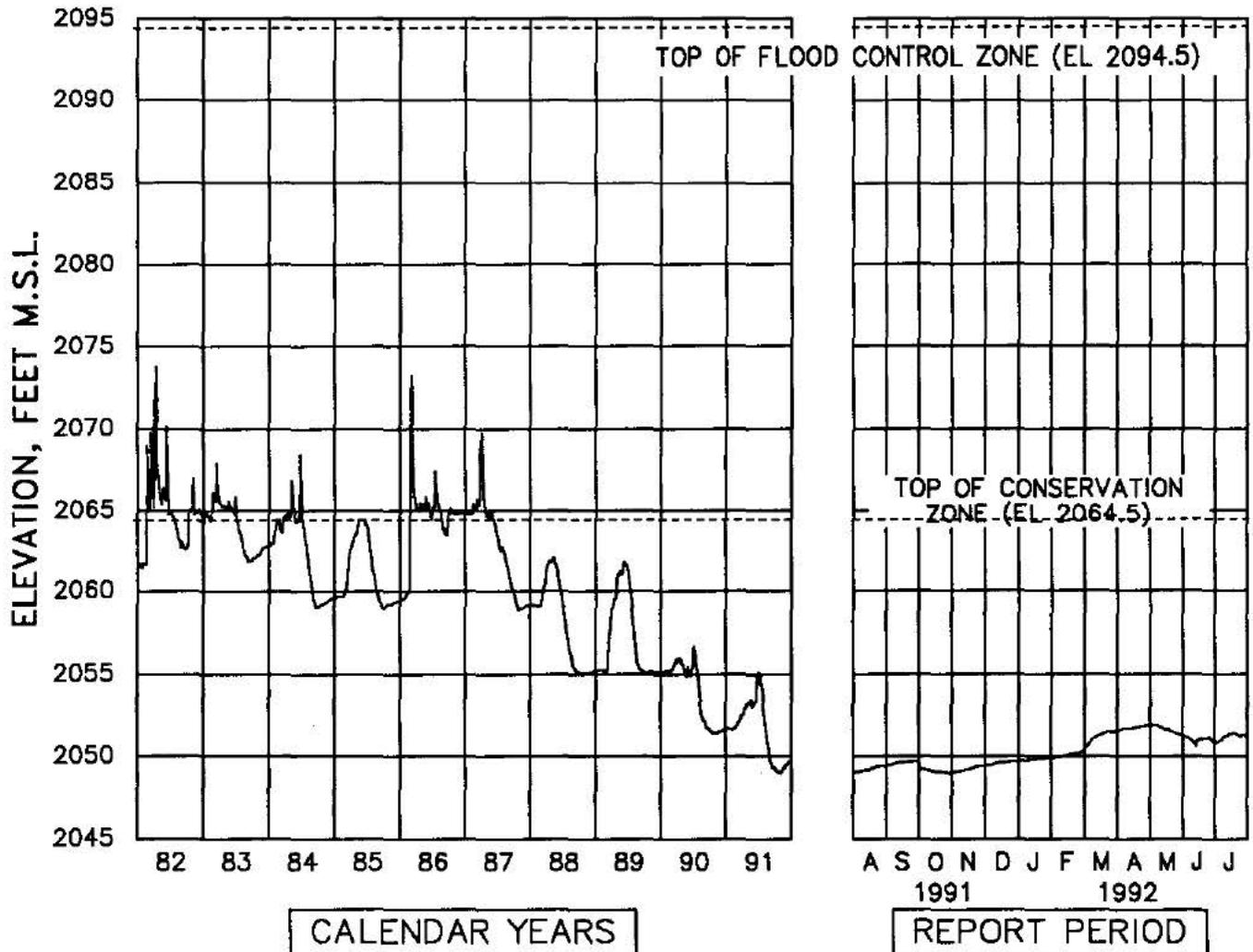
**Peak Daily Outflow (CFS)**  
97, Aug 01

**Peak Pool Elevation (Ft. MSL)**  
2051.95, May 01

**Minimum Pool Elevation (Ft. MSL)**  
2049.00, Oct 28

# HEART BUTTE DAM AND RESERVOIR (LAKE TSCHIDA) HEART RIVER BASIN, NORTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**JAMESTOWN DAM AND RESERVOIR  
JAMES RIVER BASIN, NORTH DAKOTA  
1991-1992 REGULATION**

Jamestown Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone or that portion of joint use conservation-flood control zone required for flood control, as per the Field Working Agreement dated July 15, 1975. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

Jamestown Reservoir pool elevation again steadily decreased over the reporting period. The minimum pool elevation and record low during the previous reporting period was the maximum pool elevation during the current reporting period (1423.50 feet above MSL). The new record low since initial fill was established July 27, 1992 at 1421.41 feet above MSL. The recorded precipitation for the reporting year was 13.49 inches. The average annual precipitation for Jamestown is 19 inches.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b>                    |
|---------|--------------------------|--|
| Highest | 7,220 cfs Apr 18 69      | 489 cfs Apr 16 83, 31                        |
| 2nd     | 3,300 cfs Apr 04 87      | 400 cfs Mar, Apr, May 66<br>May, Jun, Jul 69 |
| 3rd     | 2,900 cfs May 03 79      | 370 cfs Apr 15-19 87                         |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 1444.10 Apr 27 69 |
| 2nd     | 1442.04 Apr 16 87 |
| 3rd     | 1440.90 Apr 01 73 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 1421.41 Jul 31 92 |
| 2nd    | 1423.53 Jul 31 91 |
| 3rd    | 1425.58 Jul 31 90 |
| 4th    | 1427.25 Jul 31 89 |

Report Period: (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
1836, 6% of normal

**Total Outflow (AF)**  
0

**Peak Daily Inflow (CFS)**  
80, Feb 27

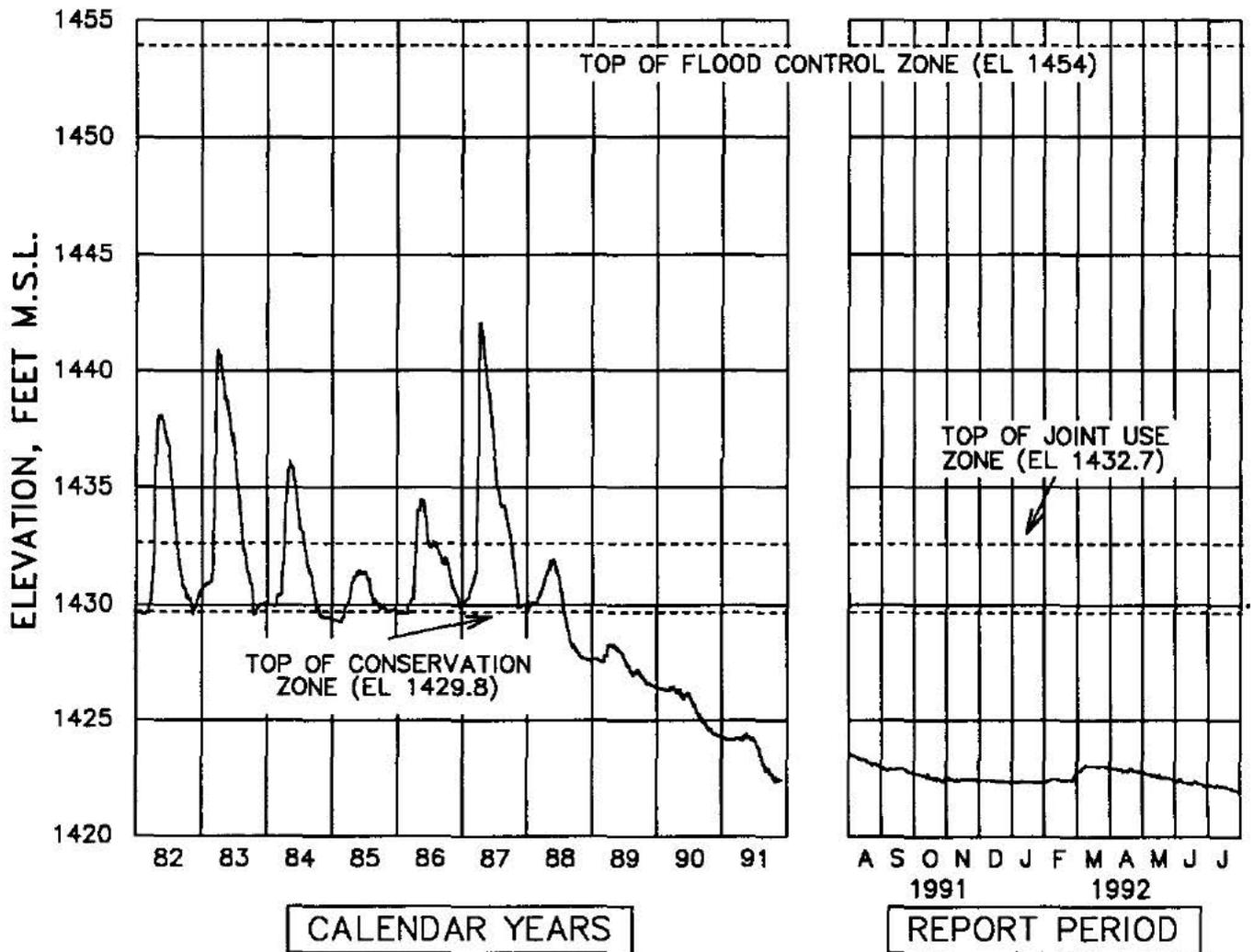
**Peak Daily Outflow (CFS)**  
0

**Peak Pool Elevation (Ft. MSL)**  
1423.50, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
1421.41, Jul 27

# JAMESTOWN DAM AND RESERVOIR JAMES RIVER BASIN, NORTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**KEYHOLE DAM AND RESERVOIR  
BELLE FOURCHE RIVER BASIN, WYOMING  
1991-1992 REGULATION**

Keyhole Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone as per the Field Working Agreement dated February 11, 1970. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

The pool elevation hit a record low of 4063.86 feet above MSL in July. This record low was approximately three feet lower than the previous low; a low that was set just one year earlier. Irrigation demands resulted in an pool elevation drop from 4073.91 feet on July 1 to 4066.93 feet on September 10.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 10,720 cfs May 19 78     | 1,347 cfs May 24 78       |
| 2nd     | 4,780 cfs Feb 29 72      | 820 cfs May 23-24 62      |
| 3rd     | 3,530 cfs Jun 18 62      | 801 cfs Mar 11-15 72      |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 4100.38 May 07 78 |
| 2nd     | 4098.78 Mar 07 72 |
| 3rd     | 4096.41 May 06 73 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>     |
|--------|----------------------|
| Lowest | 4063.86 Jul 22-23 92 |
| 2nd    | 4066.94 Dec 12-22 90 |
| 3rd    | 4070.73 Sep 18 89    |
| 4th    | 4074.08 Jul 31 89    |

Report Period: (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
7,155, 22% of normal

**Total Outflow (AF)**  
16,990

**Peak Daily Inflow (CFS)**  
449, Jul 07

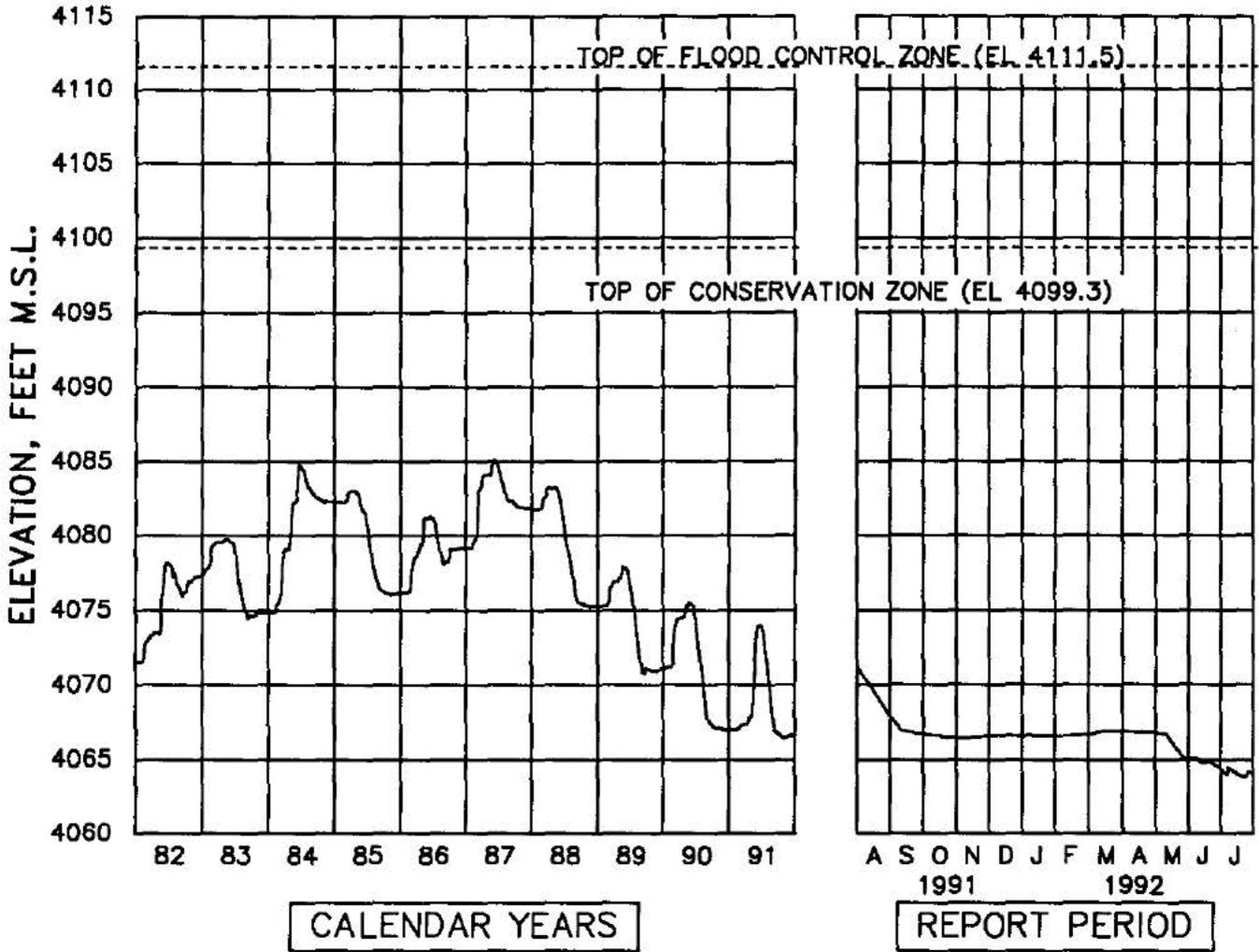
**Peak Daily Outflow (CFS)**  
134, Aug 01

**Peak Pool Elevation (Ft. MSL)**  
4071.13, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
4063.86, Jul 22-23

# KEYHOLE DAM AND RESERVOIR BELLE FOURCHE RIVER BASIN, WYOMING 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**PACTOLA DAM AND RESERVOIR  
RAPID CREEK BASIN, SOUTH DAKOTA  
1991-1992 REGULATION**

Pactola Reservoir is regulated by the Bureau (Regional Director) except when the pool level rises into the exclusive flood control zone. When this occurs, release determination is the responsibility of the Corps (District Engineer) as per the Field Working Agreement for this project dated August 27, 1969.

Precipitation and runoff during the reporting period was below normal. The pool level fluctuated a brief period during the months of March through May due to minor precipitation and runoff. Inflows to the project during the months of March, April and May were 145 percent, 51 percent and 45 percent of average respectively. In January a minimum release of 18 cfs was made in order to maintain downstream fisheries. Beginning in May storage was regulated in response to irrigation demands. No flood control was achieved during the period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 1,110 cfs May 16 65      | 500 cfs May 20 65         |
| 2nd     | 485 cfs May 11 78        | 350 cfs May 22 78         |
| 3rd     | 450 cfs Jun 07 91        | 255 cfs May 11 83         |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 4585.87 May 19 65 |
| 2nd     | 4585.44 May 21 78 |
| 3rd     | 4585.06 Jan 22 72 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 4531.53 Jan 24 91 |
| 2nd    | 4533.12 Feb 21 90 |

Report Period: (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
23300, 72% of normal

**Total Outflow (AF)**  
22930, 78% of normal

**Peak Daily Inflow (CFS)**  
85, May 10

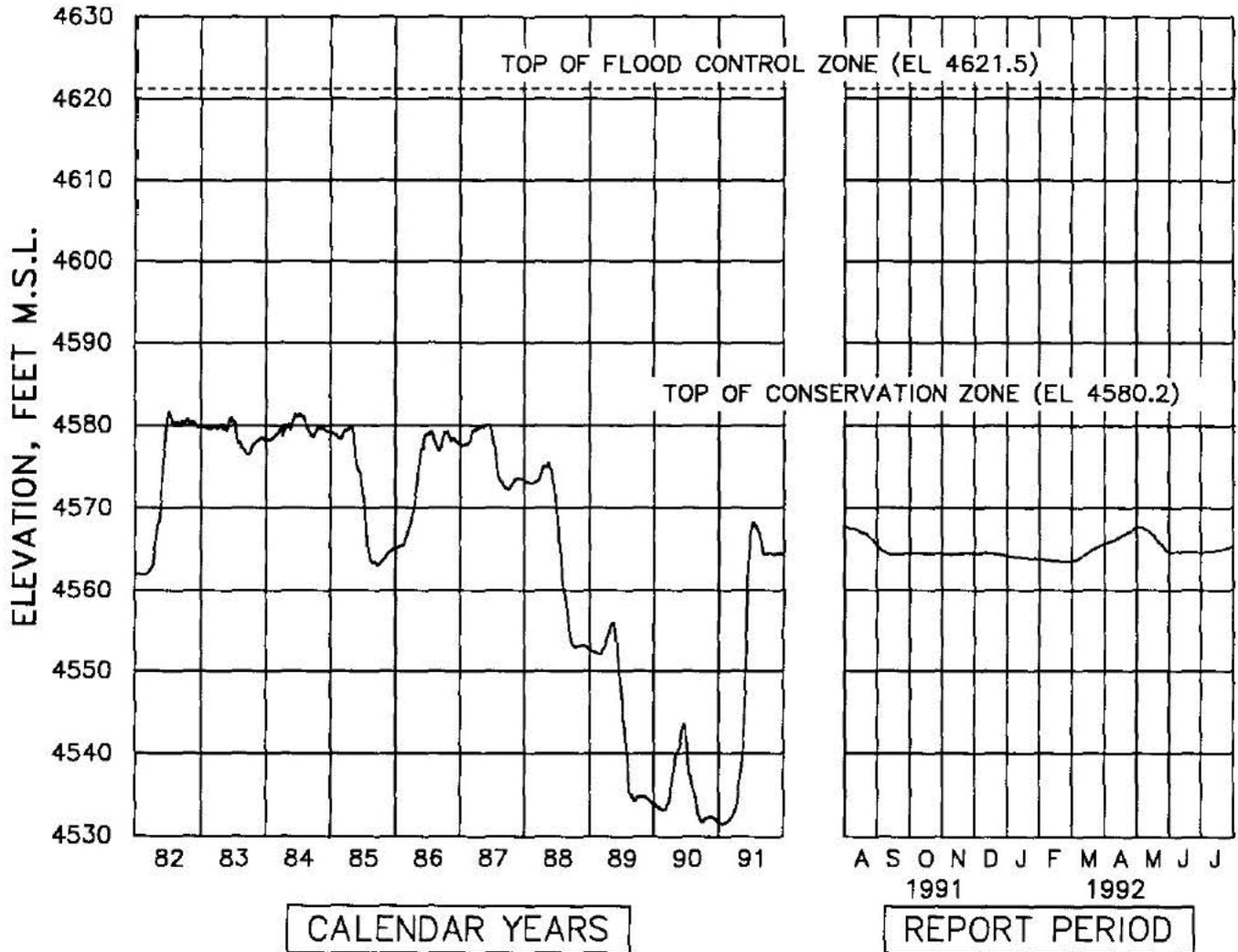
**Peak Daily Outflow (CFS)**  
114, May 20

**Peak Pool Elevation (Ft. MSL)**  
4567.77, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
4563.62, Feb 21

# PACTOLA DAM AND RESERVOIR RAPID CREEK BASIN, SOUTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**SHADEHILL DAM AND RESERVOIR  
GRAND RIVER BASIN, SOUTH DAKOTA  
1991-1992 REGULATION**

Shadehill Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone as per the Field Working Agreement dated May 15, 1972. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 32,152 cfs Apr 08 52     | 5,078 cfs Apr 10 52       |
| 2nd     | 9,900 cfs Mar 29 78      | 4,190 cfs Apr 01 78       |
| 3rd     | 6,730 cfs Mar 13 72      | 3,020 cfs Mar 16 72       |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 2297.90 Apr 10 52 |
| 2nd     | 2282.42 Apr 01 78 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 2258.62 Nov 17 81 |
| 2nd    | 2259.11 Feb 28 62 |

**Report Period:** (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**  
20,129, 27% of normal

**Total Outflow (AF)**  
14,204

**Peak Daily Inflow (CFS)**  
680, Jun 16

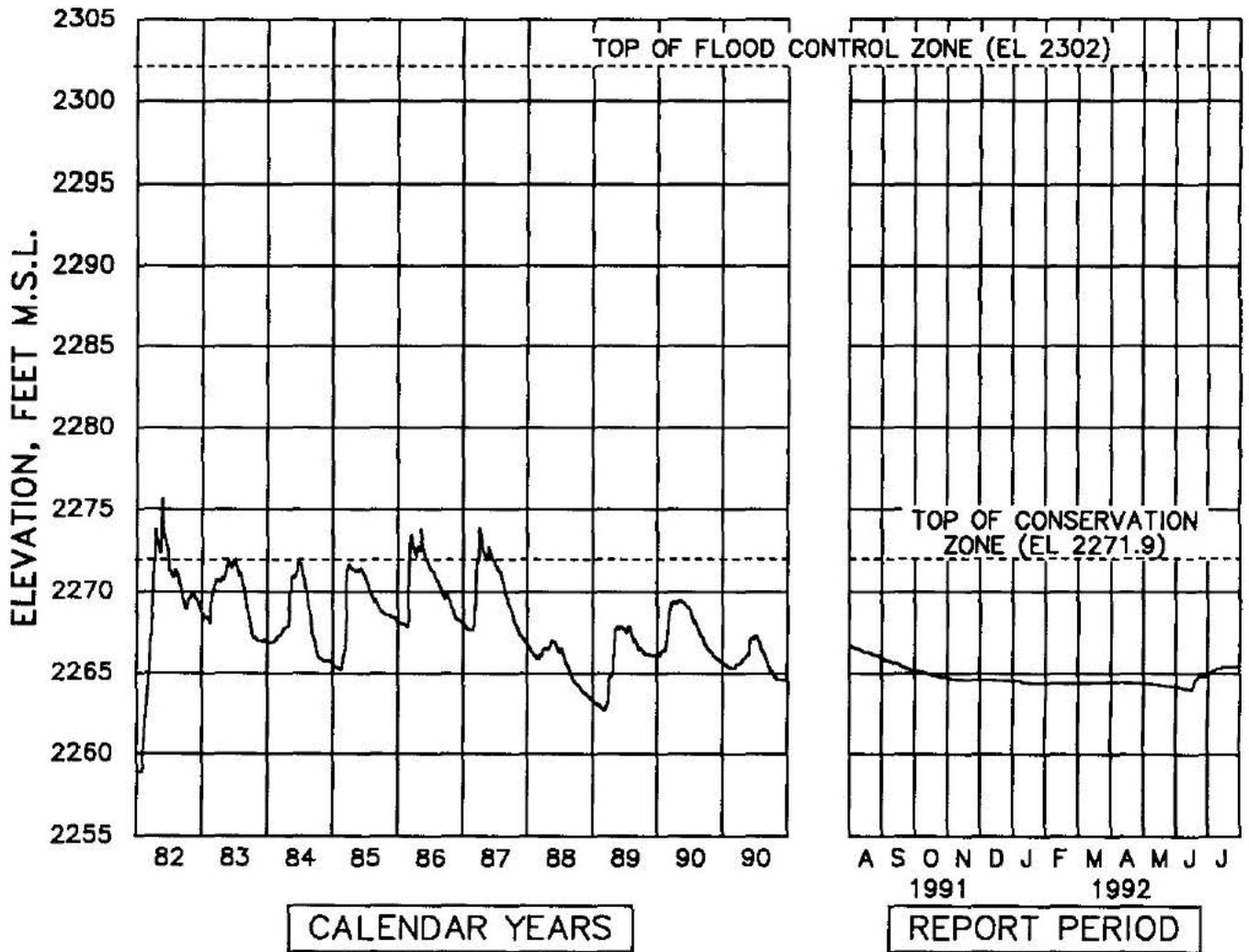
**Peak Daily Outflow (CFS)**  
27, Aug 02

**Peak Pool Elevation (Ft. MSL)**  
2265.92, Aug 01

**Minimum Pool Elevation (Ft. MSL)**  
2263.97, Jun 13

# SHADEHILL DAM AND RESERVOIR GRAND RIVER BASIN, SOUTH DAKOTA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**TIBER DAM AND RESERVOIR (LAKE ELWELL)  
 MARIAS RIVER BASIN, MONTANA  
 1991-1992 REGULATION**

The Reservoir is regulated by the Bureau except when the pool level rises into the flood control zone or that portion of the joint use (conservation-flood control) zone required for flood control as per the Water Control Agreement. When this occurs, release determination is the responsibility of the Corps (District Engineer). When replacement storage is required for the downstream Fort Peck Reservoir, releases from Tiber Dam will be adjusted beginning Mar 1, based on anticipated inflow, to fill the reservoir to elevation 3008.1 ft. MSL prior to mid July. Minimum releases to achieve this fill are 300 cfs.

No water was stored for the purpose of flood control during the report period.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b>        |
|---------|--------------------------|----------------------------------|
| Highest | 102,888 cfs Jun 10 64    | 10,300 cfs Jun 13-14 64          |
| 2nd     | 53,053 cfs Jun 21 75     | 5,777 cfs Jun 25 75<br>Jul 11 75 |
| 3rd     | 25,200 cfs Feb 26 86     | 5,308 cfs Jun 22-24 67           |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 3005.59 Jul 12 65 |
| 2nd     | 3001.91 Jun 13 64 |
| 3rd     | 2995.53 Jul 03 91 |

**Minimums of Record (since initial fill):**

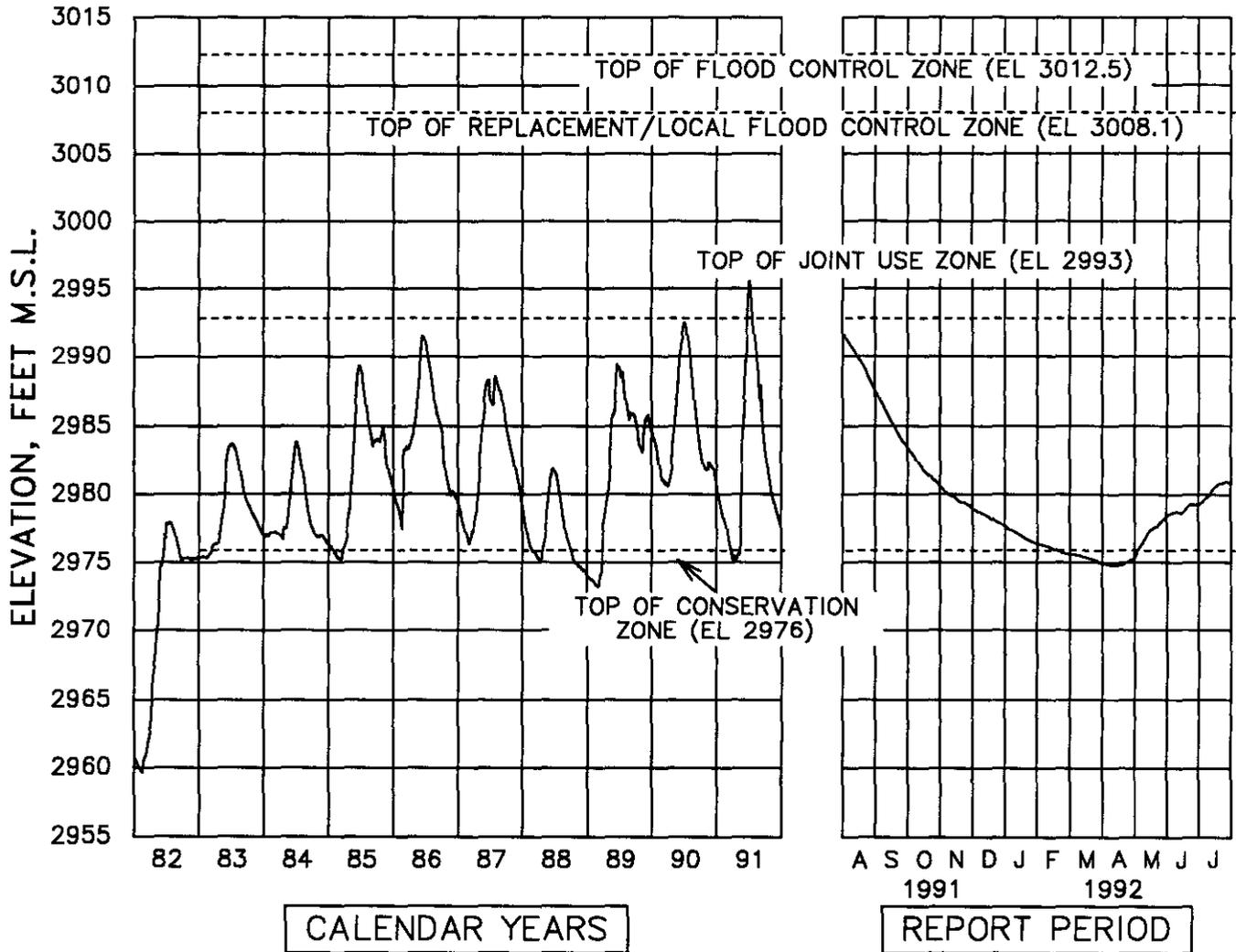
|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 2953.81 Mar 28 68 |
| 2nd    | 2955.31 Apr 27 67 |

**Report Period:** (August 1, 1991 through July 31, 1992)

|   |  |
|---|--|
| <b>Total Inflow (AF)</b><br>350,170, 52% of normal      | <b>Total Outflow (AF)</b><br>481,313, 78% of normal        |
| <b>Peak Daily Inflow (CFS)</b><br>1755, Jul 12          | <b>Peak Daily Outflow (CFS)</b><br>1573, Aug 24            |
| <b>Peak Pool Elevation (Ft. MSL)</b><br>2991.61, Aug 01 | <b>Minimum Pool Elevation (Ft. MSL)</b><br>2974.79, Apr 11 |

# TIBER DAM AND RESERVOIR (LAKE ELWELL) MARIAS RIVER BASIN, MONTANA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.



**YELLOWTAIL DAM AND LAKE (BIG HORN LAKE)  
BIG HORN RIVER BASIN, MONTANA  
1991-1992 REGULATION**

Yellowtail Reservoir is regulated by the Bureau of Reclamation (Regional Director) except when the pool level rises into the exclusive flood control zone (3640 ft. MSL) or that portion of the joint use zone required for flood control as per Field Working Agreement dated March 5, 1971. When this occurs, release determination is the responsibility of the Corps of Engineers (District Engineer).

Rainfall in early September resulted in a one foot encroachment into the flood control zone. Flood control releases of up to 4000 cfs evacuated this storage by the end of September.

As a result of spring runoff, the pool again entered the flood control zone in July. Peak flood control releases of 3400 cfs dropped the pool into the conservation zone by the first part of August.

**Maximums of Record:**

|         | <b>Daily Inflow-Date</b> | <b>Daily Outflow-Date</b> |
|---------|--------------------------|---------------------------|
| Highest | 29,775 cfs Jul 01 67     | 24,721 cfs Jul 08 67      |
| 2nd     | 19,005 cfs Jun 10 81     | 14,947 cfs Jul 03 70      |
| 3rd     | 18,607 cfs Jun 26 69     | 12,638 cfs Jun 12 91      |

|         | <b>Pool-Date</b>  |
|---------|-------------------|
| Highest | 3656.36 Jul 06 67 |
| 2nd     | 3648.55 Jul 13 78 |
| 3rd     | 3647.11 Jun 26 91 |

**Minimums of Record (since initial fill):**

|        | <b>Pool-Date</b>  |
|--------|-------------------|
| Lowest | 3583.30 Apr 14 89 |
| 2nd    | 3584.45 Mar 11 70 |

Report Period: (August 1, 1991 through July 31, 1992)

**Total Inflow (AF)**

2,061,000, 82% of normal

**Total Outflow (AF)**

2,014,320, 83% of normal

**Peak Daily Inflow (CFS)**

11,020, Jun 16

**Peak Daily Outflow (CFS)**

4,444, Oct 03

**Peak Pool Elevation (Ft. MSL)**

3641.92, Jul 27

**Minimum Pool Elevation (Ft. MSL)**

3612.51, May 06

# YELLOWTAIL DAM AND LAKE (BIG HORN LAKE) BIG HORN RIVER BASIN, MONTANA 1991-1992 REGULATION

A 10-year pool elevation hydrograph is shown below, with the current reporting period expanded for ease of reading.

