

***EL DORADO LAKE  
WALNUT RIVER, KANSAS***

***WATER CONTROL MANUAL  
APPENDIX U  
TO  
WATER CONTROL MASTER MANUAL  
ARKANSAS RIVER BASIN***

***MAY 2001***

***DEPARTMENT OF THE ARMY  
TULSA DISTRICT, CORPS OF ENGINEERS***



**EL DORADO LAKE**

**NOTICE TO USERS OF THIS MANUAL**

Regulations specify that this Water Control Manual be used in loose-leaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that new information can be inserted to keep the manual current. All elevations referred to in this manual, unless noted otherwise, are in feet, NGVD (National Geodetic Vertical Datum).

**EMERGENCY REGULATION ASSISTANCE PROCEDURES**

In the event that unusual conditions arise during duty hours and at various hours during weekends and holidays, contact can be made by telephone to the Water Control Section, Tulsa District Office (918/669-7097). If the above office cannot be contacted, assistance can be obtained by contacting, in the order listed, one of the persons shown below. Section VII of this manual contains detailed instructions for emergency regulations. All project personnel associated with the regulation of the project must be thoroughly familiar with the procedure outlined in this section. A separate copy of this section has been provided to the project manager and must be displayed on the bulletin board at all times.

**EMERGENCY  
PERSONNEL ROSTER  
(May 2001)**

<b><u>TITLE AND NAME</u></b>	<b><u>RESIDENCE TELEPHONE</u></b>
Coordinator (b) (6)	(b) (6)
Backup Coordinator (b) (6)	(b) (6)
Backup Coordinator (b) (6)	(b) (6)
Chief, Water Control Section (b) (6)	(b) (6)
Chief, Hydrology-Hydraulics Branch (b) (6)	(b) (6)
Natural Disaster Specialist	(b) (6)
Readiness Branch (b) (6)	(b) (6)
Radio Call Signs	WUI 3 (Water Control Section) WUI 3919 (Emergency Management)

PERTINENT DATA  
EL DORADO LAKE

LOCATION: Walnut River at river mile 114.7, approximately 2 miles northeast of El Dorado, Kansas.

DRAINAGE AREA: 234 square miles above the dam. One inch of runoff equals 12,480 acre feet.

DAM: Type: Rolled earth embankment.  
Length: 20,850 feet (including main embankment, right and left abutment dikes, and spillway).  
Top of Dam: 1370.5 feet, NGVD.  
Max. Height: 99.0 feet above streambed.  
Top Width: 32 feet.

SPILLWAY: Location: Left abutment.  
Type: High level, Uncontrolled.  
Crest Elevation: 1353.0 feet, NGVD.  
Length: 350 feet.

CONDUIT: Type: Cut and cover oblong concrete conduit.  
Dimensions: 11.5 feet wide and 15.75 feet high.  
Invert elevation: 1279.0.  
Control: Two service and two emergency 5.5 feet wide and 15.75 feet high hydraulically operated wheel gates.

WATER SUPPLY: Size: 36-inch diameter  
Location: 36-inch water passage between wet wells, then beneath the flood control conduit.  
Control: Two 36-inch by 36-inch slide gates.  
Invert: 1274.0 feet NGVD (Lowest useable elevation 1290.5).

LOW FLOW: Size: 2 feet wide and 3 feet high  
Location: 4 feet by 6 feet water passage between the dual wet wells, then through the splitter pier to the flood control conduit.  
Control: 2 feet by 3.5 feet slide gate.  
Invert: 1302.0 feet NGVD.

LAND ACQUISITION:

Type	Guide Contour Elevation (feet NGVD)	Area (acres)
Fee Simple	1353.0	33,499
Easement	Varies	733

ELEVATIONS, AREAS, AND STORAGES:

Feature	Elevation (feet NGVD)	Lake Area <sup>(1)</sup> (acres)	Lake Capacity	
			Accumulative <sup>(1)</sup> (Acre-feet)	Incremental (Acre-feet)
Top of Dam	1370.5	-	-	-
Maximum Pool	1363.4	17,300	465,466	164362
Spillway Crest	1353.0	12,890	301,104	64840
Top of Flood Control Pool	1347.5	10,740	236,264	79214
Top of Conservation Pool	1339.0	7,997	157,050	154089
Top of Inactive Pool	1296.0	420	2,961	2961
Streambed at Dam	1271.5	0	0	0

(1) Based on 1989 sedimentation survey.  
Total drainage area is 234 square miles.

EL DORADO LAKE  
ARKANSAS RIVER, OKLAHOMA

WATER CONTROL MANUAL  
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B	HEC-1 Forecast Model for El Dorado Lake
C	Standing Instructions to Project Manager
D	Alternate Forecasting Method

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WALNUT RIVER, KANSAS

WATER CONTROL MANUAL

APPENDIX U

TO

WATER CONTROL MASTER MANUAL  
ARKANSAS RIVER BASIN

I - INTRODUCTION

1-01. Authorization. This manual is submitted in accordance with ER 1110-2-240 and prepared in accordance with EM 1110-2-3600, ER 1110-2-8156, and ETL 1110-2-241. The name El Dorado Reservoir was changed to El Dorado Lake by ER 1120-2-111, dated February 11, 1971, and TDR 1120-2-1, dated March 2, 1971.

1-02. Purpose and Scope. The purpose of this manual is to document the plan of water control; to present detailed information to higher authority; and to give guidance to personnel who will become concerned with, or responsible for, regulation of the reservoir during the life of the project. This manual also updates the El Dorado Lake, Appendix U, to the Arkansas River Basin Regulation Master Manual and supersedes regulations in the Water Control Manual for El Dorado Lake dated December 1981.

1-03. Related Manuals and Reports. This Manual is Appendix U to the Arkansas River Basin Water Control Master Manual. Other manuals important to the regulation of Marion Reservoir are:

- |                                |                |
|--------------------------------|----------------|
| Appendix A - Great Salt Plains | (October 1999) |
| Appendix B - Heyburn           | (October 1984) |

Appendix D - Hulah	(March 1999)
Appendix E - Part I - Pensacola	(August 1992)
Appendix E - Part II - Markham Ferry	(July 1992)
Appendix E - Part III - Fort Gibson	(July 1992)
Appendix G - Tenkiller	(July 1976)
Appendix J - Wister	(March 1974)
Appendix L - Oologah	(April 1997)
Appendix M - Keystone	(November 1989)
Appendix N - Eufaula	(January 1994)
Appendix R - Cheney	(February 1997)
Appendix T - Kaw	(February 1995)
Appendix W - Copan	(February 1983)
Appendix DCP-7 - Drought Contingency Plan	(June 1991)

for El Dorado Lake

Locations of existing and authorized projects in the Tulsa District are shown on Plate 1-1.

Reports important to the regulation of El Dorado Lake are:

Operation and Maintenance Manual Volume II (June 1984)  
Flood Emergency Plan

1-04. Project Owner. El Dorado Lake is owned by the U.S. Government.

1-05. Operating Agency. The Corps of Engineers is the operating agency for El Dorado Lake. The Project Manager, El Dorado Lake, operating through the El Dorado Project Office and the Operations Division, Tulsa District, has the responsibility for project operations. The project will be manned 24 hours a day when the pool level is above elevation 1,345.0. Below elevation 1,345.0,

the project will be manned during normal work hours each day. When the project is in a flood control regulation, operations personnel will closely monitor the project and the downstream river reaches.

The project is furnished a list of the Water Control Section personnel to contact when necessary. The Project Manager will furnish the Water Control Section a list of home telephone numbers of project personnel who can be contacted, if necessary, to make gate changes. The Project Manager resides as close to the project as is considered prudent to carry out his official duties.

1-06. Regulating Agencies. The Corps of Engineers is the regulatory agency for El Dorado Lake. This responsibility is with the Water Control Section, Hydrology-Hydraulics Branch, Tulsa District. Presently, there are no other agencies involved in the functional responsibilities of El Dorado Lake.

## II - DESCRIPTION OF PROJECT

2-01. Location. El Dorado Lake is located at mile 114.7 on the Walnut River, approximately 2 miles northeast of El Dorado in Butler County, Kansas. Project location is shown on plate 2-1.

2-02. Purpose. El Dorado Lake is a multi-purpose project for flood control, fish and wildlife, water quality, water supply, and recreation. This project will be operated in conjunction with local flood protection projects at El Dorado and Winfield, Kansas, for flood protection on the Walnut River, and in conjunction with Cheney Lake on the Ninnescah River and Kaw Lake on the Arkansas River.

2-03. Physical Components.

a. Embankment. The embankment is a rolled random and impervious earthfill structure about 20,850 feet long, including the spillway, and consists of three sections: main embankment section, right abutment dike section, and left abutment dike section. The main embankment is about 10,100 feet long and has a maximum height above the streambed of 99 feet. The top of dam is at 1370.5 with crest width of 32 feet to provide for two 12-foot-wide traffic lanes plus 4-foot shoulders. This portion of embankment contains an impervious earthcore, and the upstream slope has 12-inch riprap on 6-inch bedding material from crest to elevation 1355.0 and 24-inch riprap on 9-inch bedding from elevation 1355.0 to 1324.0. The downstream slope is grass covered. The right abutment dike is about 3,450 feet long and the left abutment dike is about 7,300 feet long including the spillway. The crest of the right abutment dike and the portion of left abutment dike from main embankment to spillway, about 3,200 feet, is 32 feet wide. Within these lengths, the portion of the dikes upstream of dam axis is impervious material and the downstream portion is random fill. Both upstream and downstream slopes

are grassed. The portion of left abutment dike from spillway to left end has a crest width of 10 feet. This section of dike is constructed of random fill, and has the crest and upstream and downstream slopes grassed. A general plan, the embankment, and the spillway are shown on Plate 2-2.

b. Spillway. The 350-foot-wide high level emergency spillway is uncontrolled and is excavated through the left abutment about 2 miles east of the river channel. The crest is at elevation 1353.0 and is protected by a 15-foot-wide concrete sill. The approach channel has a slope of one-half percent. The exit channel has a slope of one and one-half percent and discharges into Bird Creek, a tributary of the Walnut River. The spillway plan is shown on plate 2-2.

c. Outlet Works. The outlet works consists of a 15.75-foot by 11.5-foot oblong reinforced concrete conduit located in the main embankment to the left of the existing river. Plate 2-3 shows the elevations of inverts at inlet and outlet as being 1279.0 and 1275.0, respectively. The conduit discharges into a concrete stilling basin connected to the river channel by a riprap-lined channel approximately 1,000 feet long. The intake structure is provided with hydraulically operated service and emergency wheel gates installed in tandem in two 5.5-foot-wide by 15.75-foot-high passageways. The intake structure contains dual wet wells with three 3x4-foot slide gates operated in each wet well with invert elevations at 1290.5, 1309.0, and 1327.0 (NGVD). The outflow from the wet well for low flow release is through a 2x3-foot gated conduit in the splitter pier.

d. Water Supply. The water supply facilities consist of a 36-inch pipe with its intake from the wet well. The water supply pipe has a slide gate operated at an invert elevation of 1274.0 (NGVD). Due to the wet well intakes the lowest usable elevation is 1290.5. The water supply pipe is placed under the conduit through the embankment (as shown on Plate 2-4) and ties into the

city water supply line downstream.

e. Stilling Basin. The stilling basin is 33.0 feet wide with a 74.0-foot-long apron, which slopes from elevation 1265.5 at its intersection with the parabolic drop to elevation 1265.0 at the end sill. Baffle blocks are staggered in two rows to provide maximum interference to high velocity jets. The end sill is 5.5 feet high with a sloping upstream face. Details of the stilling basin are shown on plate 2-4.

f. Sedimentation and Degradation Ranges. Twenty-nine (29) sediment ranges are established in and above the lake area, their ends marked with permanent monuments. Distance between ranges will vary from 2,400 to 7,800 feet and the length from 900 to 13,000 feet. Locations of the sediment ranges are shown on plate 2-5. Six degradation ranges are established below El Dorado Dam to provide information on the downstream channel condition. Locations of the degradation ranges are shown on plate 2-6.

2-04. Related Control Facilities. There are no related control facilities.

2-05. Real Estate Acquisition. The acquisition guideline in the flat pool area is at spillway crest, elevation 1353.0, which is 5.5 feet above the top of flood control pool. The guideline in the upper reaches of the lake is either elevation 1353.0 or the elevation from the envelope curve of backwater effects of the 50-year flood, whichever is higher. Plate 2-7 shows the 50-year flood backwater. Reservoir land was generally purchased in fee to a blocked perimeter that encompasses the acquisition guide contour with a minimum distance of 300 feet measured horizontally from full conservation pool elevation 1339.0. Fee simple title has been acquired to land needed for construction of the dam and for operation and maintenance purposes in the damsite and public-use areas. Flowage easements were obtained in some extreme upper reaches. There are 33,499 acres in fee simple title and 733 acres in

easement.

2-06. Public Facilities. The four public areas developed are: (1) Walnut River Park, (2) Boulder Bluff, (3) Shady Creek Park, and (4) Bluestem Point. A fifth area, Lost Lake Park, was originally kept for future development and was later absorbed into the wildlife management area. Facilities provided at the four developed areas include bituminous surfaced roads and parking areas, concrete boat ramps, camping and picnicking units, sanitation facilities, and potable water. A public overlook is located on the left abutment, affording an excellent view of the complete dam and lake. All facilities are operated and maintained by the Kansas Department of Wildlife and Parks. Plate 2-8 shows the locations of the parks.

### III - HISTORY OF PROJECT

3-01. Authorization. El Dorado Lake was authorized for construction by the Flood Control Act of 1965, Public Law 89-298, 89<sup>th</sup> Congress.

3-02. Planning and Design. House Document No. 232, 89<sup>th</sup> Congress, 1<sup>st</sup> Session, recommended the construction of El Dorado Lake as a multipurpose project, including flood control, fish and wildlife, water quality, water supply, and recreation. The structure was changed to a limited-service spillway with flood control conduit during planning and design phases. This design provides more flood protection and less frequency of large releases. This is desirable since the city of El Dorado is located immediately downstream. A series of design memorandums have been prepared which cover site selection, hydrology, structural features, site clearing, relocations, and real estate.

3-03. Construction. A resumé of construction activities for El Dorado Lake is presented in Table 3-1.

TABLE 3-1

#### RESUMÉ OF CONSTRUCTION ACTIVITIES

Activity	Date
Construction began	October, 1973
Date of diversion	October, 1979
Final storage began	June 29, 1981
Conservation pool filled	February 26, 1985

3-04. Related Projects. El Dorado Lake is an integral unit of the multiple-purpose plan of the Walnut River and Upper Arkansas flood control system.

Projects of the Arkansas system above Keystone Lake are Cheney, Kaw, and Great Salt Plains Lakes (all in operation). The Walnut River system is operated for flood control, water supply, and other beneficial uses from El Dorado, Kansas to Keystone Dam.

3-05. Modification to Regulation. The flood control and conservation regulations as contained in this manual supersede those contained in the Water Control Manual for El Dorado Lake, approved December 1981, however, regulations remain essentially unchanged.

3-06. Principle Regulation Problems. El Dorado Lake will be operated for optimal flood reductions on the Walnut River from the dam to the mouth of the Walnut River and in conjunction with Cheney, Kaw, and Great Salt Plains Lakes to the upper limits of Keystone Lake. El Dorado will also be operated for optimal flood control benefits as part of the Arkansas River System. Flood releases will be made in accordance with predicted runoff from the uncontrolled area downstream and predicted volume of inflow into the pool, adjusting releases in accordance with predicted allowable release for downstream control points. Releases from each lake (except Great Salt Plains, which is uncontrolled) will be determined by the capability to evacuate stored flood waters at channel capacity and by the percent of flood control storage filled at each lake, including Kaw and Keystone.

At full flood control pool, most park facilities are closed and electrical power to some facilities is cut-off.

Release rates of 4,200 cfs or less can be made from El Dorado Lake without causing significant damage downstream of the dam.

TABLE 4-3  
 MAJOR STORMS  
 JANUARY 1922 THROUGH DECEMBER 1998  
 EL DORADO LAKE

Inclusive Date	Average Rainfall (inches)
3-9 April 1922	4.47
9-13 July 1922	3.78
6-11 June 1923	6.01
3-5 September 1926	4.15
1-4 October 1926	4.78
12-18 April 1927	4.58
12-21 June 1927	6.18
14-17 November 1928	9.50
18-24 June 1929	3.98
7-11 July 1929	3.95
5-11 September 1930	4.58
10-15 June 1931	5.04
10-23 September 1931	4.75
10-17 November 1931	4.59
18-21 June 1932	3.76
8-22 May 1935	7.96
17-21 October 1935	4.02
6-9 October 1936	4.40
14-19 July 1937	4.76
18-23 May 1938	4.89
15-16 August 1938	4.45
19-26 November 1940	3.97
28-30 September 1941	3.96
15-25 June 1942	5.32
2-8 September 1942	6.59
16-19 May 1943	3.70
14-22 March 1944	4.92

TABLE 4-3, Cont'd  
MAJOR STORMS  
JANUARY 1922 THROUGH DECEMBER 1998  
EL DORADO LAKE

Inclusive Date	Average Rainfall (inches)
22-23 April 1944	3.59
8-11 July 1944	3.50
20-26 August 1944	3.86
2-5 December 1944	4.02
10-16 April 1945	4.65
21-30 September 1945	9.01
8-16 April 1947	4.54
20-28 June 1948	5.14
14-22 July 1948	5.94
28 July - 2 August 1950	3.55
20-25 June 1951	4.22
28-30 June 1951	6.65
9-14 July 1951	3.83
3-13 September 1951	4.29
5-17 May 1957	4.90
19-25 June 1958	3.52
15-17 September 1958	3.70
12-18 July 1959	5.22
15-17 August 1959	3.63
30 September - 5 October 1959	6.22
30 April - 6 May 1961	4.20
20-23 July 1961	7.26
15-19 November 1964	4.39
4-6 June 1965	5.97
17-21 September 1965	3.71
2-7 September 1967	3.67
15-17 June 1968	3.54
24-30 July 1968	6.92

TABLE 4-3, Cont'd  
MAJOR STORMS  
JANUARY 1922 THROUGH DECEMBER 1998  
EL DORADO LAKE

Inclusive Date	Average Rainfall (inches)
22-25 May 1969	3.53
22-27 June 1969	4.20
14-17 September 1969	3.67
4-11 March 1973	5.34
25-30 September 1973	6.98
11-12 October 1973	4.58
2-4 July 1976	5.22
19-23 May 1977	3.73
17-27 June 1977	7.26
8-10 June 1979	7.50
12-18 October 1981	4.31
12-17 May 1982	3.78
27 September - 4 October 1986	4.37
12-14 August 1987	3.85
1-5 June 1989	3.70
19-26 August 1989	4.78
1-13 May 1993	5.29
23-28 December 1994	3.58
8-11 June 1995	5.83
19 October 1996	5.92
31 October - 4 November 1998	8.44

TABLE 4-4a  
FLOODS FOR PERIOD OF RECORD  
ARKANSAS CITY GAGE<sup>3)</sup>  
 (Arkansas River)  
 Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
24 May 1903	19.2	17,300
14 July 1922	22.10	28,600
10 June 1923	28.43	103,000
2 May 1924	21.50	22,400
4 October 1926	23.94	45,300
18 June 1928	19.46	19,900
24 June 1929	19.60	20,200
3 September 1933	18.81	16,800
31 May 1935	21.14	28,300
21 May 1938	19.50	19,600
29 June 1939	18.19	14,800
11 June 1941	18.90	17,200
22 June 1942	24.83	45,800
24 April 1944	28.21	73,500
17 April 1945	26.3	-
1 October 1945	24.9	-
15 April 1946	21.4	-
15 April 1947	23.07	36,000
25 July 1948	22.61	35,000
21 June 1949	19.71	20,800
2 August 1950	22.74	36,200
19 May 1951	26.47	66,000

<sup>3</sup> Gage record - Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4a, Cont'd  
FLOODS FOR PERIOD OF RECORD

ARKANSAS CITY GAGE<sup>(4)</sup>

(Arkansas River)

Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
1 July 1951	28.8	-
15 July 1951	28.18	-
4 October 1955	19.35	21,500
18 May 1957	25.55	73,100
29 June 1957	22.20	41,800
3 October 1959	21.01	39,100
25 August 1960	18.38	23,900
28 August 1960	18.10	22,500
7 May 1961	27.0	-
2 November 1961	18.97	-
3 June 1962	18.50	26,100
18 November 1964	24.6	-
7 June 1965	25.08	-
18 October 1968	19.28	32,300
28 April 1969	18.10	25,700
19 April 1970	19.90	31,500
12 March 1973	21.59	41,500
27 March 1973	19.39	29,000
2 April 1973	22.84	49,900

<sup>4</sup> Gage record -- Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4a, Cont'd  
FLOODS FOR PERIOD OF RECORD  
ARKANSAS CITY GAGE<sup>(5)</sup>  
 (Arkansas River)  
 Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
13 October 1973	23.72	56,800
22 April 1974	21.39	40,300
19 June 1975	19.85	32,800
6 July 1976	24.16	-
25 June 1977	20.86	-
3 September 1977	19.57	30,800
11 June 1979	24.34	48,400
2 November 1979	22.48	47,400
2 April 1983	18.15	23,800
25 March 1984	20.71	37,300
9 April 1984	18.20	23,800
12 October 1985	26.10	85,200
4 October 1986	20.31	34,900
19 March 1987	18.54	23,100
25 March 1987	20.52	35,500
28 May 1987	20.33	35,000
7 July 1987	18.82	26,800
6 September 1989	20.83	38,000
4 May 1993	19.68	27,000

<sup>5</sup> Gage record -- Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4a, Cont'd  
FLOODS FOR PERIOD OF RECORD

ARKANSAS CITY GAGE<sup>(6)</sup>

(Walnut River)

Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
11 May 1993	27.62	78,600
16 July 1993	24.02	49,300
20 July 1993	21.49	36,700
29 May 1995	21.97	39,000
11 June 1995	24.15	50,000
16 August 1995	18.18	22,700
3 November 1998	28.89	97,600

<sup>6</sup> Gage record -- Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4b  
FLOODS FOR PERIOD OF RECORD

TOWANDA GAGE <sup>(7)</sup>

(Whitewater River)

Flood Stage 22.00 Feet

Date	Stage (feet)	Discharge (cfs)
1923	27.6	(FLOODMARK)
April 1944	28.6	(FLOODMARK)
13 July 1963	24.03	12,600
16 November 1964	24.08	13,400
5 June 1965	28.02	40,200
10 June 1965	23.61	11,400
19 September 1965	23.16	9,640
22 September 1965	24.40	15,000
30 June 1967	22.49	7,580
26 July 1968	24.50	12,100
17 October 1968	25.20	15,600
27 April 1969	25.43	17,000
22 May 1969	24.69	13,000
24 June 1969	24.03	10,100
2 April 1970	22.20	6,980
19 April 1970	22.55	7,360
2 February 1973	23.16	8,090
11 March 1973	24.17	9,590
12 October 1973	24.86	11,800
21 April 1974	23.82	8,980

<sup>7</sup> Gage record – Towanda, Whitewater River, 1923 to 30 September 1998.

TABLE 4-4b, Cont'd  
FLOODS FOR PERIOD OF RECORD  
TOWANDA GAGE <sup>(8)</sup>  
 (Whitewater River)  
 Flood Stage 22.00 Feet

Date	Stage (feet)	Discharge (1) (cfs)
9 June 1975	23.19	7,820
4 July 1976	24.47	15,000
23 June 1977	22.90	8,800
19 May 1978	24.37	14,500
8 June 1979	29.73	58,400
5 April 1983	22.53	8,670
10 October 1985	28.21	41,600
7 July 1986	23.25	10,500
4 October 1986	22.76	9,180
1 March 1987	23.39	11,000
18 March 1987	22.18	7,950
2 April 1988	22.38	9,820
20 November 1992	22.93	8,950
9 May 1993	25.22	16,800
15 July 1993	22.93	8,950
19 July 1993	23.47	9,700
14 March 1996	22.61	8,520
24 May 1996	24.37	12,700
27 May 1996	25.93	21,200
15 August 1996	24.56	13,500
4 November 1998	31.05	93,100

<sup>8</sup> Gage record - Towanda, Whitewater River, 1923 to 30 September 1998.

TABLE 4-4c  
FLOODS FOR PERIOD OF RECORD  
WINFIELD GAGE <sup>(9)</sup>  
(Walnut River)  
Flood Stage 30.00 Feet

Date	Stage (feet)	Discharge (cfs)
4 May 1898	33.10	40,000
8 July 1904	35.20	48,000
22 May 1915	31.70	35,000
11 April 1922	32.20	28,900
10 June 1923	38.70	76,000
4 October 1926	34.20	38,700
19 June 1928	33.10	32,900
18 November 1928	41.00	94,400
20 May 1943	33.53	37,600
23 April 1944	38.30	105,000
17 April 1945	35.93	60,600
1 October 1945	34.70	46,400
14 April 1947	30.86	28,700
2 August 1950	33.48	31,600
1 July 1951	37.80	83,000
19 May 1957	30.37	30,100
4 October 1959	31.59	30,500
6 May 1961	35.36	57,600
17 November 1964	33.90	46,700
6 June 1965	35.97	61,800
19 April 1970	31.84	34,800
11 March 1973	30.78	31,800
12 October 1973	33.80	46,000

<sup>9</sup> Gage record – Winfield, Walnut River, 4 May 1904 to 30 September 1998.

Date	Stage (feet)	Discharge (cfs)
5 July 1976	34.51	45,100

TABLE 4-4c, Cont'd  
FLOODS FOR PERIOD OF RECORD  
WINFIELD GAGE <sup>(10)</sup>  
(Walnut River)  
Flood Stage 30.00 Feet

Date	Stage (feet)	Discharge (cfs)
24 June 1977	32.01	35,600
10 June 1979	35.24	56,500
3 October 1986	32.83	39,100
11 May 1993	33.40	44,500
10 June 1995	37.30	85,800
2 November 1998	37.85	97,000

<sup>10</sup> Gage record - Winfield, Walnut River, 4 May 1904 to 30 September 1998.

#### IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Walnut River flows southwest through the northern two-thirds of Butler County, then southward through Cowley County to its confluence with the Arkansas River at river mile 696. The Walnut River Basin drains 1955 square miles in southeastern Kansas, of which 234 square miles are above the El Dorado damsite. The watershed above the damsite is approximately rectangular in shape. Its maximum length and width are 20 miles and 15 miles, respectively. The watershed streambed elevation is 1271.0 and ranges upward to an elevation 1500 (NGVD). Vegetation on the rolling upland consists mainly of native grasses, widely scattered patches of sumac, buckbrush, and other shrubs. Tributaries above the damsite are Cole, Durechen, Satchel, and Bemis Creeks with Bemis Creek being the largest.

4-02. Topography. El Dorado Lake is in the Osage Plains section of the Central Lowlands physiologic province. The streams are generally well entrenched into the flood plains, and the valleys are wide and flat with steep sides. Limestone outcrops form scarps and benches along the valley walls.

4-03. Geology & Soils. The geology of the site is made of Barneston limestone formation and consists of the Fort Riley limestone and the Florence limestone members in descending order. The bedrock of the flood plain is Florence limestone and the Fort Riley limestone is the bedrock of the abutments. The Barneston formation dips to the northwest at 20 feet per mile, and the formation is thickest on the right side of the river. The right abutment is approximately 100 feet thick, and the left abutment is approximately 70 feet thick. Below the Barneston formation, core holes penetrated Blue Springs shale, Kinney limestone, and Wymore shale members of the Matfield formation. The overburden is predominantly moderately plastic clay. Most of these fountain soils, especially in abutment areas, have liquid limits ranging from 40 to 60. Depth of clays in the flood plain is fairly uniform, averaging

approximately 20 feet, but clays in the abutments average only 5 feet in thickness. A layer of coarse-grained soil underlies the clays across the entire width of the flood plain. This layer averages 3 feet in thickness and is predominately clayey sand or clayey gravel, which are relatively impervious.

4-04. Sediment. A relatively large amount of sedimentation occurs at El Dorado Lake because of the large amount of agriculture in the drainage basin and absence of any upstream lakes. The measurement of sediment deposited in the lake is accomplished by soundings along established range lines. The cross-sections of these ranges have been determined and their ends marked by permanent monuments with known vertical and horizontal positions. Sediment resurveys done by contract and are scheduled by the Tulsa District. The original sediment survey for El Dorado Lake was completed in 1981. Sediment data has been updated by one detailed resurvey, completed in May 1989. The rate of deposition for that resurvey, 297 acre-feet/year, is a somewhat faster rate than was originally estimated. El Dorado has six (6) degradation ranges extending to approximately river mile 91.2. Sedimentation ranges for El Dorado Lake are shown on plate 2-5, and degradation ranges are shown on Plate 2-6. There are presently no regulating procedures for sediment.

4-05. Climate. The climate in the region of El Dorado damsite is characterized by moderate winters and comparatively long summers with relatively high temperatures. Summer rains generally occur as thunderstorms with very intense rainfall of short duration and limited coverage. The winter rains are generally of low intensity, but cover a large area and are of considerably longer duration. The Gulf of Mexico is the source of much of the precipitation that falls on the basin.

Climatic characteristics for the basin are described in the following subsections:

a. Temperature.

Mean annual	56.6	degrees F
Maximum recorded (Winfield, KS August 12, 1936)	118	degrees F
Minimum recorded (El Dorado, KS February 13, 1905)	-28	degrees F

b. Rainfall. - Basin Average Totals Based on Period of Record (1954 - 1991, 1993 - 1998)

Average annual	29.3	inches
Maximum annual (1973)	42.0	inches
Minimum annual (1966)	12.2	inches
Percent occurring during growing season (April through September)	69.4	percent

The average monthly and annual rainfall and runoff data are shown in Table 4-1.

c. Snowfall. - Topeka Gage for Period of Record (1954 - 1991, 1993 - 1998)

Mean Annual	15.7	inches
Maximum Monthly (January 1987)	19.7	inches
Minimum Monthly (several occasions)	0.00	inches

TABLE 4-1

## AVERAGE MONTHLY AND ANNUAL RAINFALL AND RUNOFF DATA

## WALNUT RIVER BASIN ABOVE EL DORADO DAM

Month	Average <sup>(1)</sup> rainfall (inches)	Percent average annual rainfall	Average runoff <sup>(2)(3)</sup> El Dorado Dam Site		Percent of average annual runoff
			(acre-feet)	(inches)	
January	0.84	2.67	2,710	0.22	3.34
February	1.01	3.21	3,630	0.29	4.48
March	1.97	6.27	7,820	0.63	9.65
April	2.79	8.88	11,140	0.89	13.74
May	4.24	13.49	12,760	1.02	15.74
June	4.79	15.24	14,080	1.13	17.37
July	3.65	11.61	7,470	0.60	9.22
August	3.23	10.28	3,750	0.30	4.63
September	3.52	11.20	4,440	0.36	5.48
October	2.55	8.11	5,460	0.44	6.74
November	1.71	5.44	4,680	0.38	5.77
December	1.13	3.60	3,120	0.24	3.84
Total	31.43	100.00	81,060	6.50	100.00

(1) Period of Record 1930 through 1998.

(2) Period of Record 1922 through 1998.

(3) Drainage area above El Dorado Dam = 234 square miles

d. Evaporation. The estimated monthly pan evaporation at El Dorado Lake is shown in Table 4-2.

TABLE 4-2

ESTIMATED MONTHLY PAN EVAPORATION

Month	Normal <sup>(1)(2)</sup> Evaporation (inches)
January	1.43
February	1.62
March	3.30
April	5.01
May	7.14
June	7.76
July	9.34
August	8.28
September	6.47
October	4.48
November	2.54
December	1.70
Annual	59.07

(1) National Weather Service Class "A" pan.

(2) Period of Record 1980-1998.

e. Wind. The prevailing wind is from a southerly direction, with the greatest wind movements occurring in the spring months. A study of available wind velocity data indicated that for 1-minute and 1-hour durations, the highest wind velocities that can be expected are 70 and 50 miles per hour, respectively.

4-06. Storms & Floods. Most of the flood-producing storms over the watershed above El Dorado Dam have been from 2 to 4 days duration and have occurred in the spring and fall months. Longer storms have generally been made up of two or three periods of intense precipitation, with moderate precipitation on the intervening days saturating the watershed and resulting in a high percentage of

runoff from subsequent periods of heavy precipitation. The winter months produce little precipitation. Maximum rainfall occurs in May and June, with a noticeable decrease in the average rainfall in November, December, January, and February. The maximum storm over the watershed above El Dorado Dam during the 68 year Period of Record was 9.5 inches from 14 to 17 November, 1928. Storms with an average precipitation of 3.5 inches or more over the area above El Dorado are shown in Table 4-3 on pages T4-1 through T4-3. Over the Period of Record, about 69.4 percent of the rainfall occurred during the months April through September. The averages were computed from published precipitation records of rainfall recorded for the basin. These records do not necessarily record the center of intense storms. Antecedent precipitation, season of the year, and many other factors influence storm runoff so that floods have frequently followed periods of relatively small amounts of recorded rainfall. Conversely, some storms of greater amounts of recorded rainfall have caused only minor flooding. Major floods at the Arkansas City, Towanda, and Winfield, Kansas gages are shown in Tables 4-4a, 4-4b, and 4-4c located on pages T4-4 through T4-11.

4-07. Runoff Characteristics. The Walnut River basin above El Dorado Lake produces moderately high runoff. During design studies, the rainfall needed to satisfy initial losses before significant runoff begins was one inch initial loss and 0.5 of an inch infiltration. The time of concentration for major floods above the El Dorado damsite is approximately 9 hours. Stream gages pertinent to flood control operations for El Dorado Lake are El Dorado, Augusta, and Winfield, Kansas. Pertinent data for Arkansas City, Towanda, and Winfield gages are shown in Table 4-5, as these gages contain the most length of stream gage record in the region. Estimated monthly and annual flows past El Dorado Dam are shown in Table 4-6 on pages T4-12 through T4-14. The inflow volume frequency by months is shown in Table 4-7. The flow duration curve is shown on Plate 4-1.

TABLE 4-5

PERTINENT DATA FOR STREAM GAGING STATIONS

Station	River	Miles above mouth	Period of record	Gage zero	Flood stage (feet)	Bankfull capacity (cfs)
Arkansas City, KS	Arkansas	701.4	1921 to Present	1050.04	17.0	19,000
Towanda, KS	Whitewater	17.5	1959 to Present	1231.47	22.0	7,800
Winfield, KS	Walnut	24.8	1921 to Present	1082.86	30.0	29,500

TABLE 4-5 (continued)

PERTINENT DATA FOR STREAM GAGING STATIONS

Station	Maximum flood of record			2nd largest flood of record			3rd largest flood of record		
	Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge (cfs)
Ark. City, KS	3 Nov 1998	28.89	97,700	24 Apr 1944	28.21	73,500	11 May 1993	27.62	78,600
Towanda, KS	2 Nov 1998	30.50	80,600	8 June 1979	29.73	58,400	10 Oct 1986	28.21	41,600
Winfield, KS	18 Nov 1929	41.00	94,400	10 June 1923	38.70	76,000	23 Apr 1944	38.30	105,000

TABLE 4-7

INFLOW VOLUME FREQUENCY

(January 1922 - December 1998)

Month	MONTHLY INFLOW VOLUME IN ACRE-FEET				
	Frequency of Occurrence in Years				
	2	5	10	20	50
January	1,060	3,690	7,150	12,400	23,200
February	1,230	4,530	9,020	16,000	30,800
March	2,740	12,300	27,000	52,200	110,000
April	4,280	17,000	35,300	64,900	130,000
May	4,000	16,000	34,500	58,500	113,000
June	6,270	22,300	43,500	76,000	144,000
July	2,410	10,100	21,500	40,300	82,600
August	1,240	4,820	9,870	17,900	35,500
September	1,320	5,360	11,200	20,800	41,900
October	1,500	5,390	12,400	25,000	55,500
November	1,410	5,380	12,000	24,100	49,800
December	1,180	4,330	8,590	15,200	29,200

4-08. Water Quality. Water quality surveys have been conducted for El Dorado Lake. Water quality data were collected from three sites in the lake between May and October, 1998. The lake showed some thermal stratification during the summer, but did not develop a strong anoxic bottom layer of water. Periods of strong winds kept the lake well mixed. On some occasions, dissolved oxygen concentrations of less than 3 mg/l were recorded in the bottom 2-3 meters, primarily at the dam site. Both pH and alkalinity values indicated that the lake was well buffered and should not be subject to drastic changes in pH. The lake water was classified as moderately hard. Conductivity and total dissolved solids readings indicated the lake was fairly high in ionized salts. Using total phosphorus concentrations as an indicator, the lake was classified as eutrophic. Water clarity, as determined by turbidity and transparency

measurements, was limited. The Kansas Department of Health and Environment classified the lake as impacted by high turbidity. Concentrations of Iron and Manganese did not exceed EPA criteria for a raw drinking water source. Overall, the water in the lake is acceptable for municipal and industrial uses.

4-09. Channel and Floodway Characteristics. The regulating channel capacity for the Walnut River below El Dorado Dam is 4,200 cfs. Rating curves for Augusta and Winfield, Kansas are shown on Plates 4-2 and 4-3, respectively. Rating curves used by the Water Control Section are adjusted for changing conditions and are maintained in current status. Crest travel times in the vicinity of concern are given on Plate 4-4. Travel time varies with the magnitude of the flood, therefore this plate should be used as a guide only.

4-10. Upstream Structures. El Dorado Lake is the farthest upstream structure on the Walnut River.

4-11. Downstream Structures. El Dorado is the only structure on the Walnut River. Structures below El Dorado Lake include Great Salt Plains Lake on the Salt Fork of the Arkansas River and Kaw Lake on the Arkansas River. El Dorado Lake is operated in conjunction with Cheney Lake on the Ninnescah River, a tributary of the Arkansas River. El Dorado Lake is operated as a system with these projects in the multi-purpose plan for flood control, hydropower, navigation, and allied water uses on the Arkansas River and its tributaries.

4-12. Economic Data.

a. Population. The historical and projected populations of the principal cities and counties in the Walnut River Basin in Kansas are shown in Table 4-8. Although varying proportions of the counties listed lie within the watershed boundary, the entire population of each county is included.

Table 4-8

Population of Cities and Counties

5-01. County and City	1990	2000	2020	2040
Butler County	50,737	60,946	81,211	101,476
Augusta	7,876	9,047	11,150	13,253
Douglass	1,722	1,829	2,047	2,266
El Dorado	11,504	12,998	15,571	18,143
Cowley County	36,915	37,061	37,344	37,626
Arkansas City	12,762	12,078	10,946	9,814
Winfield	11,931	12,285	13,080	13,875
Counties Total	87,652	98,007	118,355	139,102

Source: Kansas Water Office, Population Estimates and Projections, rev 9/21/98

b. Agriculture. Most of the floodplain contains excellent farmland and is under cultivation. Although cropping patterns change from year to year, the general distribution of crops was updated by conversation with Kansas State agricultural extension agents for Butler and Cowley counties. Principal crops are wheat, alfalfa, grain sorghum, corn, soybeans, and cotton. Crop yield data are from a 1998 county profile whose source is the National Agricultural Statistics Service, U.S. Department of Agriculture. Crop values are based on 1999 Current Normalized Prices (CNP) found in Economics Guidance Memorandum 00-1, dated 2 March 2000. Prices are reflective of normalized prices through year 1999. The annual value of crops is shown in Table 4-9.

Table 4-9

**Annual Value of Crops  
(2000 Current Normalized Prices)**

Crops	Unit	El Dorado Dam to Whitewater River	Whitewater River to Little Walnut River	Little Walnut River to Rock Creek	Rock Creek to Arkansas River	Total All Reaches
Wheat	Acres	1,868	957	1,791	4,266	8,882
	Value	\$299,670	\$153,541	\$266,793	\$635,584	\$1,355,589
Alfalfa	Acres	849	435	814	1,939	4,037
	Value	\$233,916	\$119,851	\$281,944	\$671,677	\$1,307,388
Grain Sorghum	Acres	2,123	1,088	2,035	4,848	10,093
	Value	\$547,669	\$280,608	\$473,443	\$1,127,887	\$2,429,606
Corn	Acres	255	131	244	582	1,211
	Value	\$59,579	\$ 21,298	\$39,853	\$94,943	\$215,674
Soybeans	Acres	2,123	1,088	2,035	4,848	10,093
	Value	\$258,499	\$132,447	\$234,798	\$559,362	\$1,185,106
Cotton	Acres	425	218	407	970	2,019
	Value	\$105,785	\$54,201	\$101,424	\$241,624	\$503,035
Pasture	Acres	0	0	0	0	0
	Value	\$ -	\$ -	\$ -	\$ -	\$ -
Woods, pasture	Acres	849	435	814	1,939	4,037
Wasteland	Value	\$43,560	\$22,319	\$41,764	\$99,496	\$207,139
Total	Acres	8,490	4,350	8,140	19,392	40,372
	Value	\$1,548,679	\$784,264	\$1,440,020	\$3,430,574	\$7,203,537

Source: Kansas Agricultural Statistics, National Agricultural Statistics Service, U.S. Department of Agriculture, Statistics Division, Kansas Department of Agriculture.

c. Employment and Industry. In Butler County, non-farm employment comprises over 90% of total employment (24,221 in 1997). Over 60% of employment is in services, government, and retail trade. Manufacturing comprises less than 10% of total employment, with about 58 manufacturing establishments in 1997. About 28 mining (petroleum-related) establishments exist today, down from 45 establishments in 1980. Petroleum production and some refining still occur in the county. In 1997, there were 13 establishments with 100-499 employees, with no establishments with more than 500 employees. Farming and ranching remain important, although a State correctional facility and light industry represent growing segments of the economy, especially near the Wichita metropolitan area. In Cowley County in

1997, non-farm employment was 19,036 out of a total employment of 20,140. Of total employment, manufacturing employment was 4,262, followed by services, government, and retail trade. Cowley County had 15 establishments with 100-499 employees in 1997, and 4 with 500 or more employees. The number of mining establishments dropped from 26 to 20 between 1980 and 1997, while manufacturing increased from 45 to 49 establishments for that time period. Major employers in Arkansas City are a General Electric engine maintenance facility with 987 employees and a meat processing facility with 230 employees. There are about 17 major manufacturing employers in Winfield, including Coca Cola Bottling, Galaxy Tool, and Morton Buildings among others. Major employers in Winfield are in education and services.

d. Flood Damages and Flood Damages Prevented. The estimated average annual flood damages along the Walnut River from El Dorado Dam to the backwater limits of the Arkansas River, with and without the El Dorado project, are presented in Table 4-10. These damages and benefits are based on studies made during preparation of the El Dorado Dam and Reservoir Design Memorandum No. 3, dated February 1969, and updated to current price levels. Although no new floodplain economic inventory has been conducted, estimated losses to crops are based on recent data on prices, yields, and crop mix. Structural losses are updated from Memorandum No. 3. Levee improvements at Winfield and Arkansas City are under construction, and evaluations for levee improvements at Augusta are to be conducted in year 2000. Flood damages prevented by the El Dorado Dam project, cumulative through fiscal year 1999, total \$101,176,000. Two major floods, one in November 1998 and the other in April 1999, prevented an estimated \$41,000,000 and \$7,800,000 in downstream flood damages (based on El Dorado holdouts), respectively. Structural loss and area curves from El Dorado Dam to the Arkansas River are included in Plates 4-5 through 4-8.

Table 4-10

Average Annual Flood Damages  
(FY 2000 price levels)

Reach and Item El Dorado Dam to backwater Limits of Arkansas River	Average Annual Damages Existing Condition Residual Damages		Flood Damages Prevented Benefits \$
	Without project \$	With project \$	
Crops	577,715	437,308	140,407
Structures	4,126,917	3,323,098	803,819
Total	4,704,632	3,760,406	944,226

## V - DATA COLLECTION AND COMMUNICATION NETWORKS

### 5-01. Hydrometeorological Stations.

a. Facilities. The Water Control Section, Hydrology-Hydraulics Branch, Tulsa District Office; the National Weather Service (NWS); and the U.S. Geological Survey (USGS) cooperate to collect data and maintain a reliable communication network. All pertinent reporting observation stations for the Walnut River basin are shown on Plate 5-1.

Since El Dorado is the furthest upstream structure on the Walnut River, precipitation stations are the only means of predicting inflow. The precipitation stations important to El Dorado are Augusta, Beaumont, Cassoday, Cedar Point, El Dorado Lake, El Dorado, Florence, Matfield Green, Thrall, and Towanda, Kansas. Precipitation data obtained from observer gages in the area is also considered. Stream flow gages important to the regulation of El Dorado Lake are El Dorado, Augusta, and Winfield, Kansas on the Walnut River.

At El Dorado, a tipping bucket rain gage is located near the Project office.

Pool elevation bubbler readings are provided by a gage inside the control tower for the outlet works. Readings are stored in a digital data logger. A wire weight gage, also located inside the control tower, can be operated to measure pool elevation. An upstream staff gage is located approximately 20 feet left of the control tower and ranges in elevation from 1296.0 to 1332.0. Tailwater readings are provided by a staff gage located downstream of the dam. Readings from the downstream staff gage are primary indicators of outflow from the lake.

The stream gage at El Dorado, Kansas is the automated, fully maintained outflow gage.

b. Reporting. The reporting procedure for precipitation and stream

gaging stations is on a cooperative basis with the NWS. The reporting criteria for the pertinent precipitation and stream gaging stations are shown in Table 5-1. Hydrometeorological data collected by project personnel at Marion Reservoir will be submitted to the Water Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone (918) 669-7097 or VHF-FM radio, call signal WUI-3). Detailed instructions on reporting criteria are presented in Section I-2 of Exhibit C, Standing Instructions to Project Manager.

TABLE 5-1  
REPORTING CRITERIA FOR PERTINENT STATIONS

Station	Report to	Times of report
<b>Rainfall stations</b>		
Airport stations	National Weather Service	6-hour rainfall as of 6 a.m., 12 noon, 6 p.m., and 12 midnight.
Corps of Engineers dams	Corps of Engineers	Reporting criteria identical to that listed in subparagraph 5-07d.
All other stations	National Weather Service	Initial report at 7:00 a.m. Report at 1:00 p.m. When 0.50 inches of precipitation has occurred since 7:00 a.m. Report at 7:00 p.m. when 0.50 inches of precipitation has occurred since 1:00 p.m.
<b>Stream gage stations</b>		
<b>Walnut River</b>		
El Dorado, Kansas	Data Collection Platform	As needed.
Augusta, Kansas	Data Collection Platform	As needed.
Winfield, Kansas	Data Collection Platform	As needed.
<b>Radar Stations</b>	National Weather Service	Hourly.

c. Maintenance. Maintenance and repair of the weather stations instrumentation are responsibilities of the NWS. Maintenance and repair of stream gages are responsibilities of the administering agency. Both the Corps

of Engineers and the USGS have stream gaging equipment in the Walnut River Basin. The Hydrology/Hydraulics Engineering Section, Hydrology-Hydraulics Branch, Tulsa District, is charged with the responsibility for the equipment owned by the Corps of Engineers.

d. Automation. The reporting of data from pool elevation and stream gaging stations has been automated through the use of Data Collection Platform's (DCP's) which record data hourly and transmit the data every four hours or when the threshold value is exceeded. The data is transmitted via GOES satellite to a downlink and computer facility owned and operated by the National Oceanic and Atmospheric Administration (NOAA) near Washington, D.C. The data is transferred to the Tulsa District Water Control Data System Computer by using the DOMSAT downlink located at the Tulsa District Office or by using telephone modems. When received, the river stage is converted to flow and lake elevation is converted to storage. All the data is then stored in a data base in the Corps' Water Control Data System computer for access when needed. DCP's also report rain data in the same way. In addition to DCP data, observer rainfall data is collected and stored in the computer for use in forecasting. Observers phone the NWS offices in this region and the NWS then encodes the data into a Standard Hydrologic Exchange Format (SHEF). This data is then transferred to the Water Control Data System Computer using telephone modems and a dedicated phone line to the Tulsa National Weather Service River Forecast Center. Once the data is received, it is decoded and handled in a manner similar to the DCP data. Informative display of all data is possible through the use of several versatile computer programs developed for use on the Water Control Data System.

5-02. Water Quality Stations. Three (3) baseline water quality monitoring stations exist at El Dorado Lake. Water quality samples from the reservoir are taken by Tulsa District office personnel at random times when needed. Chemical and physical analysis are the types of water quality analyses performed at El

Dorado Lake. The last water quality analysis was performed in 1998. This data is reported directly to the Tulsa District office.

5-03. Sedimentation Stations.

a. Facilities. The twenty-nine (29) sedimentation ranges above El Dorado Lake and six (6) degradation ranges below El Dorado Dam are used for sedimentation measurements. These ranges are surveyed periodically for the purpose of computing sediment deposition, and new lake area and capacity data. The most recent sedimentation survey was completed in 1989.

b. Reporting. As necessary.

c. Maintenance. Sedimentation and degradation ranges will be maintained by the Corps of Engineers.

5-04. Recording Hydrologic Data. Hydrologic information is recorded as it is received by the Water Control Section, as described in the following subsections.

a. Stages and discharges. Stages received from streamgaging stations and the corresponding discharges are maintained in the Water Control Data System computer.

b. Precipitation. Precipitation data received from the NWS and DCP stations are maintained in the Water Control Data System computer. Data received from the project is combined with NWS observer precipitation data and stored in the data base with the stage/discharge data. This data can then be accessed by computer programs for plotting distribution, determining basin rainfall, and forecasting runoff (see Chapter VI).

c. Water Quality Data. The Environmental Analysis and Compliance Branch and Operations Division, Tulsa District takes water quality samples in the lake at random times as needed.

d. Radar and Satellite Reports. Current computer-enhanced satellite images, weather charts, and national radar summaries are accessed when needed and received into the Water Control Data System computer from a private vendor. Also, a computer-enhanced image of the real-time radar scope image depicting cloud coverage and relative intensity is available from the National Weather Service and is routinely received from Oklahoma City. Computer images of rainfall data (NEXRAD) are also available and are compared with ground data. NWS locations in and near the Tulsa District with this capability, in addition to Oklahoma City, are Kansas City and Monett, Missouri; Garden City and Wichita, Kansas; and Amarillo, Texas. Hard copies of any of this data are available by use of color printers located in the Water Control Section.

5-05. Communication Network. Wire facilities at El Dorado Lake are local and long distance telephone service. Radio communication is by VHF-FM fixed station (call signal WUI-304) capable of reaching local mobile stations, the Tulsa District, and other stations on the north loop of the District via repeater relay. Maintenance of the telephone lines is the responsibility of the company that leases the lines to the Government. To alert the public of pending gate changes, a warning horn is located at the project.

5-06. Communication with Project.

a. Regulating Office. Instructions for the storage and release of water from the lake will be communicated by the Water Control Section to the responsible project operative personnel at El Dorado Lake. This communication will normally be made by long distance telephone, but on occasion could be made

by VHF-FM radio. The project reporting instructions, described in paragraph 5-07 and Exhibit C of this Manual, will be communicated directly to the Water Control Section. Should communication between the project and the District Office be disrupted, the Project Manager will, on his own initiative, direct regulation of the lake in accordance with the emergency rules of regulation as required in Section VII and Exhibit C of this Manual. The Organization Chart for Flood Control Regulation of El Dorado Lake is shown on Plate 5-2.

b. Between Project Office and Others. Communication between project personnel and other Federal, State, and local agencies will be sufficient to effect the coordination described in Section IX of this Manual.

5-07. Project Reporting Instructions. Daily lake data from El Dorado will be submitted to the Water Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7097 or VHF-FM radio, call signal WUI-3). The Water Control Section office is manned from 7:00 a.m. to 4:30 p.m. daily and various hours on weekends and holidays. Data for non-working days shall be read from the data logger and submitted the following workday. Data will be submitted in accordance with the form shown on Plate 5-3. Should unusual conditions arise during non-working hours, one of the persons listed on page i should be contacted. The following data should be included in the daily report.

a. As of 8 a.m. Number of gates open; amount of gate opening; outflow stage at 8 a.m.; precipitation and pan evaporation in inches for the preceding 24 hours (7 a.m. to 7 a.m.); and wind velocity and direction (at 8 a.m.).

b. Each Gate Operation. Date and time of gate operation, number of gates open and amount of gate opening before and after gate operation, and pool elevation. Confirmation of gate changes shall be made immediately after completion of the change. Complaints about pool elevations or releases, operating machinery failure, and out-of-service times for maintenance shall be

reported to the Water Control Section as they occur.

c. During Flood Periods. In addition to subparagraphs a and b above, additional reports may be required by the Water Control Section.

d. Rainfall Reports. Rainfall reports shall be made as follows:

- (1) At 8 a.m. all precipitation that has occurred during the preceding 24 hours, 7 a.m. to 7 a.m. (covered by routine report on working days).
- (2) At 1 p.m. when 0.50 inch or more of precipitation has occurred since 7 a.m., or if it has continued to rain since reporting at 8 a.m.
- (3) At 7 p.m. when 0.50 inch or more of precipitation has occurred since the 8 a.m. report and no 1 p.m. report was made, or if it has continued to rain since reporting at 1 p.m.
- (4) Report at once the occurrence of 2.00 inches or more of precipitation that occurs during a period of 6 hours or less. During non-working hours, the report should be made to one of the persons listed on page i.
- (5) After office hours, rainfall reports should be made as indicated in sub-section (4) above; however, if no contact with Water Control Section personnel can be made, rainfall reports should be made to the National Weather Service, Tulsa, Oklahoma, telephone is 1-800-722-2778.

5-08. Warnings. It is the responsibility of the Project Manager and project personnel authorized to make gate changes to maintain a list in current status of residents and/or property which might be endangered or inconvenienced by large and/or prolonged releases. If damaging releases are expected to occur, notification will be made by telephone, or oral warning by Corps employees. Notification will be made in accordance with the Tulsa District supplements to ER 500-1-1. This would include media such as radio, television, telephone, citizens band radio, use of law enforcement and civil defense agencies and their communication system, National Guard and reserve units, supplemented by oral warning by Corps employees. Studies have been made to determine the possible downstream flood conditions that could exist in the event of a maximum spillway release or failure of the dam at maximum pool. Approximate water surface profiles and flooded area maps giving the results of these studies are kept in the El Dorado Lake Operation and Maintenance Manual, Volume II, Contingency Plan for Emergencies. In every case, when a gate change is made a horn is blown to give warning to people immediately downstream of El Dorado Dam.

5-09. Frequency of Gate Changes. During flood periods, gate changes may be directed by the Water Control Section at any time. When floodwaters have significantly risen into the flood control pool, gate changes can be expected two or three times daily. When the pool level is at or above the top of flood control pool, gate changes may occur every hour. Only under the most unusual circumstances will changes be ordered more frequently than once every hour. Frequency of gate changes during low flow operation will generally be less than once a day.

## VI - HYDROLOGIC FORECASTS

6-01. General. Hydrologic forecasts are necessary in predicting stream flow above and below El Dorado Lake to determine if and when releases should be made.

a. Role of Corps of Engineers. Hydrologic forecasts are made by the Forecasting Section, Tulsa District, for use in the regulation of lakes for flood control and other authorized purposes and for the benefit of Corps of Engineers' constructed projects and flood-mitigating activities. As distinguished from the NWS which furnishes weather and flood forecasts to the public, the District furnishes current information on lake levels, discharges, and any other available information on observed conditions. The Water Control Section (lake information recording), telephone number (918) 669-7521, is listed in the Tulsa, Oklahoma telephone directory to provide the public a means of receiving current lake information such as pool levels and discharges. General news releases are made by the Public Affairs Office, which is kept fully informed of the hydrologic situation as appropriate. Further discussion of the role of the Corps of Engineers in hydrologic forecasts is presented in Section V of the Water Control Master Manual for the Arkansas River Basin.

b. Role of Other Agencies. The NWS in Norman, Oklahoma is the official agency that makes flood forecast information available to the public. This information is disseminated from the Weather Wire Circuit (by commercial vendors) to subscribing government agencies and the various news media. The Water Control Section receives information via AFOS. The NWS issues routine scheduled reports containing the following forecasts:

- (1) Weather forecasts (daily, severe weather, and 5-day

extended).

- (2) National weather summaries and additional details for the five south-central states.
- (3) Quantitative precipitation forecasts are made daily for first six-hour, second six-hour, day one 24-hour, and day two 24-hour rainfall totals.
- (4) Three-day river stage forecasts, when required.
- (5) Rainfall required to produce bankfull stages (weekly).
- (6) Urgent priority messages such as severe weather warnings, watches, forecasts and statements and instructions from Civil Defense during emergency conditions are transmitted immediately, regardless of scheduled traffic. Unscheduled traffic, including the following, is sent whenever the circuit is idle.
  - (a) Damage reports.
  - (b) Road information and winter weather conditions.
  - (c) River and flood warning bulletins, forecasts and statements.
  - (d) Thirty-day forecast.
- (7) Percent chance of precipitation (twice daily).

6-02. Flood Condition Forecasts.

a. Requirements. Flood condition forecasts are necessary whenever substantial rainfall has occurred on the basin above or below El Dorado Lake. The flood forecasting reaches used for El Dorado Lake are shown on Plate 6-1. To use this model the following data is required:

1. Rainfall for stations listed in Table 5-1.
2. El Dorado project pool elevation for time of forecast.
3. Flood hydrographs for gages listed in table 4-5.

b. Methods. The Forecasting Section makes individual lake inflow forecasts and forecasts of flow for the uncontrolled areas below the dams. These forecasts are made using using computer program 723-X6-L2010 (HEC-1).

(1) Forecasting River Stages. The official forecasts of the NWS are used in predicting river stages. Forecasts are also made by the Forecasting Section by applying the peak flows determined by the procedures described below to stage discharge curves. Forecasts for the stream gages listed in Table 4-5 and other basin gages are pertinent to the regulation of El Dorado Lake.

(2) Forecasting Flows. The following sub-paragraphs describe the methods used to forecast flows into El Dorado Lake.

(a) Runoff Estimate. Precipitation data is received from the NWS and the DCP's by the water control computer. The average precipitation over the project basin is computed by a computer program called RAIN. The RAIN program takes the DCP data and plots isohyetal maps of

24-hour rainfall. It then computes the basin average total rainfall using a triangular mesh analysis. The program is able to break the rainfall down into sub-basin totals for input into the HEC-1 forecasting model, from which reservoir inflow volume estimates are made and pool elevations are predicted.

(b) Computer Model. A HEC-1 inflow model has been developed for El Dorado Lake. The complete HEC-1 inflow model is shown in Exhibit B. Exhibit B also contains an output file for one inch of runoff over the watershed.

(c) Inflow Computations. Computation of the forecasted inflow and pool elevations is accomplished by using the HEC-1 computer model. Input requirements are runoffs, or rainfall, and loss rate; initial base flow, if any; starting pool elevation; and controlled releases. The model is run interactively on the Water Control Data System computer located in the Hydrology-Hydraulics Branch of the Tulsa District Office and on the water control computer in the Southwestern Division Office in Dallas. The model is also available on a magnetic tape that can be loaded on any other computer. These are used as backups if the primary computer is down. DSS files are backed up on magnetic disk periodically. The predicted inflow hydrograph is verified and adjusted as necessary by comparing it to the actual developing hydrograph. The developing hydrograph is computed from known pool elevations and controlled releases. A

sample inflow computation is shown on Plate 6-2.

(d) Flood Control Releases. Estimated hydrographs at control points downstream from the dam are made by procedures described in Section V of the Arkansas River Basin Water Control Master Manual and paragraph 6-02 of this Manual. These hydrographs are adjusted to conform with the latest hydrologic information available. Trial releases from El Dorado Lake are routed and combined with the adjusted hydrographs for determinations of the desired hydrographs at the downstream control points.

c. Alternate Method. An alternate method of forecasting, for back-up purposes, is presented in Exhibit D, Alternate Forecasting Method. This involves use of hand methods and unit hydrographs.

#### 6-03. Conservation Purpose Forecasts.

a. Requirements. Conservation forecasts may be required to predict pool levels during fish spawning season, special recreation events, and water supply. Forecasts may also be required for water quality.

b. Methods. Forecasts for conservation purposes during non-flood periods would rely largely on statistical interpretation of historical data. The flow duration curve, Plate 4-1, and the peak inflow probability curve (natural river conditions), Plate 8-6, would be considered in conjunction with NWS forecasts in making conservation forecasts during non-flood periods.

#### 6-04. Long-range Forecasts.

a. Requirements. The regulatory decision involved in evacuating stored floodwater, sustaining yield during low flow periods, and maintaining constant, or slowly changing pool levels for conservation purposes is dependent on accurate estimates of the water volume that will pass through the reservoir.

b. Methods. Reliable methods for long-range runoff forecasts are not presently available. The NWS publishes an "Average Monthly Weather Outlook" semi-monthly that may be used as an estimate of the trend of the weather but should not be given too much weight for one forecast, especially for a specific point. The NWS forecasts described in paragraph 6-01b are more useful in a shorter range.

6-05. Drought Forecast

a. Requirements. Drought forecasts may be required to predict length and severity of a dry condition, for planning and for estimating limits of conservation storage.

b. Methods. Tracking droughts blends science and art. No single definition of drought works for all circumstances, so people rely on drought indices to detect and measure droughts. The drought monitor is a synthesis of multiple indices, outlooks, and news accounts that represent a consensus of federal and academic scientists. The product will be refined over time as ways are found to make it better reflect the needs of decision-makers and others that use the information. A one-week forecast is published on the Internet by the Climate Prediction Center, based on temperature and precipitation from the mid-range forecasts.

c. Reference Documents. The Tulsa District contacts the National

Weather Service website and the Climate Prediction Center website for drought information as needed. The District has also published a Drought Contingency Plan for El Dorado Lake, dated June 1991, which addresses drought concerns relating to the water control management needs of the project. This document is located in the H&H Branch files in the Tulsa District.

## VII - WATER CONTROL PLAN

7-01. General Objectives. The primary purpose of El Dorado Lake is flood control. El Dorado, operated in conjunction with Cheney Lake, Kaw Lake, and Great Salt Plains Lake, is used to control flooding in the upper portion of the Arkansas River Basin. This lake system is a part of the multi-purpose plan for flood control, generation of hydro-electric power, navigation, and allied water uses on the Arkansas River and tributaries in Kansas, Arkansas, and Oklahoma. Flood releases from El Dorado will be made in accordance with predicted runoff from the uncontrolled area downstream of the dam, allowable stage for the lake, and the proportion of available storage remaining in the various lakes in the Arkansas River System.

7-02. Constraints. Since El Dorado is operated as part of a two-reservoir system (with Cheney above Kaw), and because of its role in the overall operation of lakes and reservoirs in the Arkansas River Basin, releases from the lake have to be coordinated with expected runoff, available flood storage, and releases made at other lakes in the system. The non-damaging channel capacity below El Dorado Dam is 4,200 cfs. The original channel capacity was considered to be 4,500 cfs, but was later updated by actual experience.

### 7-03. Overall Plan For Water Control.

a. General. El Dorado is regulated as a unit in a multi-purpose system for the benefit of water resources in the Arkansas River Basin. Development of these resources is discussed in the Arkansas River Basin Water Control Master Manual, while the specific purposes of each of the various projects are detailed in the appropriate water control manual.

b. System Regulation. El Dorado will be operated for optimal flood reductions on the Walnut River from El Dorado Dam to its confluence with the Arkansas River and in conjunction with Cheney, Kaw, and Great Salt Plains Lakes

to the upper limits of Keystone Lake. El Dorado Lake will also be operated for optimal flood control benefits as part of the Arkansas River System. Flood releases will be made in accordance with predicted runoff from the uncontrolled area downstream and predicted volume of inflow into the pool, adjusting releases in accordance with predicted allowable release for downstream control points. Releases from each lake (except Great Salt Plains, which is uncontrolled) will be determined by the capability to evacuate stored flood waters at channel capacity. While flood waters are being accumulated in the system, each lake shall be regulated to retain equivalent flood control capabilities, as much as possible. Priority for releases, as shown on curves "B" and "C", Plate 7-54 of the Arkansas River Basin Water Control Master Manual, is given to the lakes with the least amount of flood storage available and considering predicted inflow into the lake and conditions downstream. Section 7 of the Arkansas River Basin Water Control Master Manual provides detailed information on the Arkansas River System operation.

7-04. Standing Instructions to Project Manager. During flood periods, the lake will be regulated in accordance with normal regulations for flood control operations as directed in sub-paragraph 7-05a and Exhibit C of this Manual. Instructions for storage and discharge of flood waters will be issued by the Water Control Section. In the event communication with the Tulsa District Office is disrupted, lake regulation will become the responsibility of the Project Manager and will be accomplished in accordance with sub-paragraph 7-05b and Exhibit C of this Manual. In addition, the Project Manager will immediately make every effort to re-establish communications with the Tulsa District Office. The Project Manager will make daily observations of the weather station and pool level data and report those observations as directed in paragraph 5-07 and repeated in Exhibit C. Should an emergency situation occur in which communication is not lost, such as inoperable gates, a drowning accident, excessive trash in gates, a broken buoy line, or power outage, the Water Control Section shall be notified immediately.

7-05. Flood control.

a. Normal Regulation for Flood Control Operations. El Dorado Lake will be operated for optimal flood reductions on the Walnut River from El Dorado Dam to its confluence with the Arkansas River and in conjunction with Cheney Lake from that point to the upper limits of Kaw Lake. Releases will also be coordinated with the flood control operation of Kaw, Great Salt Plains, and Keystone Lakes, to provide optimal flood control benefits in the Walnut and Arkansas River Basins.

TABLE 7-1

NORMAL FLOOD CONTROL REGULATION SCHEDULE

EL DORADO LAKE, WALNUT RIVER, KANSAS

Pool Stage	Pool Conditions	Regulation
Below 1339.0	-	Releases will be made to maintain 1339.0 but will not be less than the downstream requirements defined in paragraph 7-07. The requirements explained in paragraph 7-07 and the regulations required in paragraph 7-08 will be met to the extent practicable.
1339.0 - 1347.5	Rising	Make releases according to the following schedule, except that releases, when combined with unregulated flows downstream, shall not exceed an 18-foot stage at the dam (4,200 cfs), an 18-foot stage at El Dorado gage (14,800 cfs), a 23-foot stage at Augusta gage (10,500 cfs), or a 30-foot stage at Winfield gage (29,500 cfs).

RELEASE SCHEDULE

<u>Pool Stages</u>	<u>Maximum Allowable Release Rates (cfs)</u>
1339.0 - 1339.5	500
1339.5 - 1340.0	1,000
1340.0 - 1341.0	2,000
1341.0 - 1342.0	3,000
1342.0 - 1347.5	4,200

TABLE 7-1, CONT'D

NORMAL FLOOD CONTROL REGULATION SCHEDULE

EL DORADO LAKE, WALNUT RIVER, KANSAS

1347.5 - 1353.0	Rising	If the forecasted pool level will crest at or below elevation 1348.5, a maximum release of 4,200 cfs will be made. If the forecasted pool level will crest above elevation 1348.5, the flood control conduit gates will be opened in increments of 1,000 cfs each hour until both gates are fully opened or until the pool begins falling.
Above 1353.0	Rising or Falling	Continue maximum release possible.
1353.0 - 1347.5	Falling	Continue maximum release attained during rising pool until pool level recedes to elevation 1347.5.
1347.5 - 1339.0	Falling	Make releases according to the following schedule, except that the release, when combined with unregulated flows downstream, shall not exceed those stages listed under the above rising pool conditions.

RELEASE SCHEDULE

<u>Pool Stages</u>	<u>Maximum Allowable Release Rates (cfs)</u>
1347.5-1342.0	4,200
1342.0-1341.0	3,000 + Inflow*
1341.0-1339.7	2,000 + Inflow*
1339.7-1339.1	1,000 + Inflow*
1339.1-1339.0	Transition

\*Forecasted inflow over a 2 to 5-day period.

NOTE: Do not exceed 4,200 cfs.

b. Emergency Flood Control Regulations. Should communication with the Tulsa District Office be disrupted, the Project Manager will, on his own initiative, direct operation of the reservoir in accordance with the following rules of operation until communication is restored. In addition, the Project

Manager will immediately make every effort to re-establish communication with the Tulsa District Office and, if necessary, send information to the Tulsa District Office by automobile or any means available. The conduit gates shall be operated at a uniform opening (see Table 7-2).

TABLE 7-2

EMERGENCY FLOOD CONTROL REGULATION SCHEDULEEL DORADO LAKE, WALNUT RIVER, KANSAS

Pool Stage	Pool Conditions	Regulation
1339.0 - 1345.5	Rising	<p>a. Should the Project Manager have knowledge that no significant rainfall has occurred downstream from the project, the current release will be continued.</p> <p>b. Should the Project Manager have knowledge or suspect that significant rainfall has occurred downstream from the project, the current release will be reduced to the low flow requirement in Table 7-3. The reduction will be made at a rate not to exceed 700 cfs per 2-hour period.</p>
1345.5 - 1347.5	Rising	<p>a. The releases shall be increased according to the schedule provided below.</p> <p>b. If the outflow being made at the time emergency regulations become effective is greater than the outflow indicated by the schedule, continue this outflow until the schedule indicates an increase is required.</p>
Above 1347.5	Rising	If the conduit gates have not been fully opened when the lake water surface reaches elevation 1347.5, releases shall be increased 1,000 cfs each quarter (1/4) hour until both gates are fully open and shall remain fully open until the pool level recedes to elevation 1347.5.
Above 1347.5	Falling	Continue maximum release until the pool level recedes to elevation 1347.5.
1347.5 - 1339.5	Falling	Maintain release in effect at the time communication was lost or maintain release which was initiated under rising pool conditions. If the release is greater than 4,200 cfs begin a gradual reduction of the release rate to 4,200 cfs (not to exceed 700 cfs per 2-hour period) making sure not to reduce the release below inflow. (See Plate 6-2 for inflow computation example).
1339.5 - 1339.0	Falling	Begin a gradual reduction of the release rate (not to exceed 500 cfs per 2-hours) to keep the pool at the conservation level (1339.0).

EMERGENCY RELEASE SCHEDULE

<u>Pool Stages</u>	<u>Change Release to</u>
1345.5	500 cfs
1346.0	1000 cfs
1346.5	2000 cfs
1347.0	3000 cfs
1347.5	4200 cfs

NOTE: Do not exceed 4,200 cfs.

7-06. Recreation. Recreation is included as an authorized project purpose, however, no storage or releases are specifically provided for recreational purposes. Requests for special releases will be considered as the situation warrants. All recreation area access roads are constructed above the top of flood control pool, elevation 1347.5. Some campsite facilities could be inundated above elevation 1342.0. Locations of public facilities are listed in paragraph 2-06 of this manual and shown on Plate 2-8.

7-07. Water Quality. Low flow releases will be regulated to provide discharge for fish and wildlife benefit and downstream pollution control to the extent possible. Releases for water quality control will be made in accordance with monthly flow requirements as shown in Table 7-3 or as modified by field evaluation. To satisfy the water quality demand an average of 5.2 mgd (8 cfs) of the total dependable yield will be used until it is needed for water supply.

The low flow sluice has a capacity of 246 cfs at the top of conservation pool, elevation 1339.0, and an inlet invert at elevation 1302.0. Additional releases will be made as necessary to alleviate or respond to emergency conditions such as fish kills and flow augmentation for pollution abatement or aesthetics.

TABLE 7-3  
MONTHLY AND ANNUAL LOW FLOW RELEASES  
FOR EL DORADO LAKE

Month	Low Flow Releases (cfs)
January	5
February	5
March	5
April	7
May	8
June	12
July	13
August	13
September	11
October	7
November	5
December	5
Annual	8

7-08. Fish and Wildlife. Fish and wildlife is included as an authorized project purpose. However, no storage or releases are specifically provided for fish and wildlife purposes. Releases made for water quality control, discussed in Section 7-07, will be sufficient to maintain and enhance downstream fisheries until the entire storage is needed for municipal and industrial water supply. Releases are occasionally made on an "as-needed" basis to relieve oxygen deficiency of fish trapped in stilling basins. Management of fish and wildlife resources will be under the direction of the Kansas Department of Wildlife and Parks. A minimum monthly and annual low flow release schedule is presented in Table 7-3.

7-09. Water Supply.

a. General. Currently El Dorado Lake contains 157,050 acre-feet of conservation storage. This storage includes 142,800 acre-feet for water supply. The U.S. Government currently has a Water Marketing Contract of 8 mgd with the City of El Dorado. Future water supply includes the remaining yield of 14.2 mgd. Plate 7-1 shows an example of water supply storage accounting.

b. Water Rights. Water rights for the Walnut River are issued by the Kansas Department of Agriculture, Division of Water Resources. Water rights holders above the confluence of the Walnut and Arkansas Rivers on the Walnut River are presented in Table 7-4 on pages T7-1 through T7-2. Releases from inflow to satisfy downstream water rights will be made at the request of the Kansas Water Office. The Kansas Water Office will inform the Water Control Section as to amount and time distribution of the required release.

7-10. Hydro-electric Power. Operation of El Dorado Lake does not include hydro-electric power generation.

7-11. Navigation. El Dorado Lake will be regulated for flood control in conjunction with the other lakes in the Arkansas River Basin, to help provide a tapered recession of flows along the Arkansas River navigation channel. The coordinated regulation of the lakes is discussed in Chapter 7 of the Arkansas River Basin Water Control Master Manual.

7-12. Drought Contingency Plans. A drought contingency plan for El Dorado Lake was approved in June, 1991. This plan identifies water uses and needs within the basin and outlines steps that can be taken to alleviate the problems encountered during a drought.

7-13. Flood Emergency Action Plans. A flood emergency action plan is outlined in the Operation and Maintenance Manual, Volume II, for El Dorado Lake. The

purpose of the manual is to specify procedures to protect the public from possible property damage or loss of life as a result of uncontrolled releases of water due to failure or severe damage to the dam appurtenant works.

7-14. Deviation from Normal Regulation. The District Commander is occasionally requested to deviate from normal regulation of the reservoirs. Prior approval is obtained from the Southwestern Division (SWD) Office for the subsequent action, except as noted in sub-paragraph 7-14a below. Deviation requests usually fall into the following categories:

a. Emergencies. Emergency deviations require immediate action with no time in which to seek approval from SWD. These emergencies include drowning, accidents, failure of operating facilities, and pollution. The Southwestern Division Office is informed as soon as possible and a written confirmation describing the deviation and conditions will be furnished as soon as possible.

b. Unplanned Minor Deviations. These are unplanned instances that create a temporary need for minor deviations from the normal regulation of the reservoir, although they are not considered emergencies. Construction accounts for the major portion of these incidents and includes utility stream crossings, bridge work, and major construction contracts. Also, deviations are sometimes necessary for maintenance and inspection. Requests for changing release rates are generally from a few hours to a few days. Each request is analyzed on its own merits. Consideration is given to upstream watershed conditions, potential flood threat, conditions of lakes, and possible alternative measures. In an effort to maintain good public relations, the requests are usually granted, provided there are no adverse effects on the overall operation of the project for optimum benefits to the authorized and useful purposes. Approval for deviations will normally be obtained from SWD by memorandum. In some cases, subject to SWD approval, e-mail, telephone, or fax may be used to expedite the granting of requests.

c. Planned Deviations. Other instances include anticipated or planned deviation. Each condition will be analyzed on its merits. Sufficient data on flood potential, reservoir and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes will be presented by letter, telephone, E-mail or facsimile to SWD along with Tulsa District recommendations for review or approval.

7-15. Rate of Release Changes. Gradual increases and decreases in releases from the lake shall be made when possible in order to minimize detrimental effects to the reservoir area and downstream channel. Every reasonable precaution will be made to eliminate, if possible, bank sloughing, undercutting, excessive erosion, and danger to human and animal life. Situations may arise which will not allow an orderly increase and/or decrease in releases. Examples of these situations are large flood releases as described in paragraph 7-05, and drownings which occur downstream of the dam. Conduit releases are normally increased and decreased in increments no greater than 700 cfs. This change is normally made no more frequently than every 2 hours for a rising pool, and every 3 hours for a falling pool.

7-16. Operational Curves. The evaporation curve, tailwater rating curve, spillway rating curve, conduit rating curve, partial gate-opening conduit discharge rating curves, and low flow sluice rating curve are shown on Plates 7-2 through 7-8. Rating curves used by the Water Control Section are adjusted for changing conditions and are maintained in current status. Table 7-5 located on pages T7-3 through T7-8 shows elevation vs. area and capacity data for El Dorado Lake.

## VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The effects of emergency flood control regulation schedules on the spillway design flood and standard project flood (one-half spillway design flood) and one example of normal and emergency regulations on floods of record for El Dorado Lake are presented in this Manual. The examples were selected to show the effects of flood control regulation schedules on a variety of possible flood conditions.

8-02. Flood Control.

a. Probable Maximum Flood. The probable maximum flood based on the latest criteria is not considered to be a valid design flood for this project.

b. Spillway Design Flood. The spillway design flood developed during original project design was the maximum flood used for evaluation of the effects of emergency operations. The spillway design flood is the probable maximum flood based on earlier (Hydromet 33) criteria. The spillway design flood has a duration of 96 hours and a peak inflow of 257,000 and total volume of 296,300 acre-feet (23.74 inches over the drainage area). The flood was routed through El Dorado Lake on full and empty flood control pools using the emergency regulations outlined in Table 7-2. The full pool regulation resulted in a maximum pool elevation of 1363.4 and a maximum discharge of 40,600 cfs. The empty pool regulation resulted in a maximum pool of 1360.41 feet and a peak discharge of 24,700 cfs. The operational hydrographs resulting from full and empty flood control pool routings by emergency regulations are shown on Plate 8-1.

c. Standard Project Flood. The standard project flood was considered to be one-half of the spillway design flood. The resulting flood has a total

volume of 148,150 acre-feet with a peak inflow of 128,500 cfs. The flood was routed through El Dorado Lake on full and empty flood control pools using emergency regulations as outlined in Table 7-2. The full and empty pool regulation resulted in a peak discharges of 12,100 cfs and 7,300 cfs at the peak pool elevations of 1356.3 and 1351.96, respectively. The operational hydrographs resulting from full and empty flood control pool routings by emergency regulations are shown on Plate 8-2.

d. Flood of October - November 1998. This flood caused the most significant pool stages since the construction of El Dorado Lake. This resulted from a cumulative rainfall of 8.44 inches. The inflow hydrograph from this flood was routed through El Dorado on an empty flood control pool using normal and emergency regulations as outlined in Tables 7-1 and 7-2, respectively. The operational hydrographs resulting from routing this flood through El Dorado Lake using normal and emergency regulations are shown on Plate 8-3.

8-03. Recreation. El Dorado Lake is located in an area of rolling farmland including prairies, woodlands and marshes. A total of 3,460 acres of land above top of conservation pool, elevation 1339.0, have been designated for recreational purposes. Four public use areas have been developed around the lake. Some picnic areas are being inundated at elevation 1342.0, some camping sites at 1343.0, and some loop roads at elevation 1346.0. All major access roads are above top of flood control pool, elevation 1347.5. Minimum elevation for the top of boat ramps is 1342.4. Bottom of boat ramps is elevation 1320.0 (or four feet below 10-year drawdown frequency). Lower limit of clearing is elevation 1319.0. Below this elevation, activities on the lake would be significantly reduced.

8-04. Water Quality. Conservation storage includes 33,450 acre-feet for water

quality control. Low flow releases are made in accordance with the established schedule as discussed in the next paragraph.

8-05. Fish and Wildlife. Fish and wildlife is not included as an authorized project purpose, therefore, no storage or releases are specifically provided for fish and wildlife purposes. However, low flow releases are made according to the established schedule (Table 7-3) to relieve oxygen deficiency of fish downstream of the dam. Minor and planned deviations to the regulatory plan will be reviewed on a case-by-case basis as necessary to coordinate fish and wildlife resources which are under the direction of the Kansas Department of Wildlife and Parks.

Waterfowl habitat has increased and the lake provides hunting opportunities for several species. There have been some losses of squirrel and deer habitat. However, because of the vast acreage of these habitat types in the general area, the minor loss does not have a significant effect on the hunting of these species in the area. El Dorado Lake provides a greater diversification of fish and wildlife habitat and specific losses are partially offset by wildlife management of the lake perimeter lands.

8-06. Water Supply. Conservation storage includes 142,900 acre-feet of water supply. The water supply storage of El Dorado Lake has been sold to the city of El Dorado, Kansas.

8-07. Hydro-electric Power. Operation of El Dorado Lake does not include hydro-electric generation.

8-08. Navigation. El Dorado Lake does not contain any storage for navigation operations. At the discretion of the water control section, releases may be

structured to support the system as discussed in paragraphs 3-06 and 7-03b.

8-09. Drought Contingency Plans. The Drought Contingency Plan has carefully addressed the problems encountered during a drought. It provides a basis for implementing actions necessary for conservation of water supply and has been structured according to the severity of the drought. This will enable the Water Control Section to more effectively coordinate with the public and District elements during such emergencies.

8-10. Flood Emergency Action Plans. Preparation of these reports has focused attention upon the need for effective coordination during floods. Coordination strategy has been established between the Water Control Section and other District elements that deal with media and local government. This has proven to yield positive results during the more recent flood events.

8-11. Frequencies.

a. Pool Elevation Duration and Probability. Pool level hydrographs for a synthetic period of record, preceding the construction of El Dorado Dam, extending from January 1940 through December 1995 have been analyzed for exceedance probabilities. Pool elevation probabilities are shown on Plate 8-4. The pool elevation duration curve is shown on Plate 8-5.

b. Peak Inflow Probability. The inflow probability curve was derived from SUPER run A98X01 for the years (1940-1995). The peak inflow probability curve is shown on Plate 8-6.

8-12. Other Studies.

a. Improvements in Forecasting. Studies are in progress to improve the forecasting techniques presented in Section VI of this Manual. Computer programs have been developed to forecast inflows into the lake, the resulting pool elevations and the effects of releases at the downstream gages. Use of these programs has greatly shortened the reaction time in preparing regulation schedules.

b. Channel and Floodway Improvement. There are currently no channelization projects in progress between El Dorado Lake and Kaw Lake. Ground and aerial reconnaissance are made as required to determine if revised channel capacities and maximum discharge limits are warranted.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organizations.

a. Corps of Engineers. El Dorado Lake is owned by the U.S. Government. The Tulsa District of the Corps of Engineers is the operating agency for El Dorado Lake. The Project Manager, El Dorado Lake, operating through the Area Manager at Marion Lake Office and Operations Division, Tulsa District, has the responsibility for project operations dealing with lands and recreation. Project reporting instructions are presented in Section V, and project operating instructions are presented in Section VII of this Manual.

(1) Responsibilities and Duties During Normal Operations. The Water Control Section, Hydrology and Hydraulics Branch, Tulsa District Office, is charged with the following responsibilities and duties under general supervision of the Engineering and Construction Division.

- (a) Regulation of lakes and dissemination of data.
- (b) Investigations and refinement of regulation procedures.
  - 1. Analysis of past floods.
  - 2. Reconnaissance to determine channel capacities.
  - 3. Improvement of forecasting techniques.
  - 4. Planning and coordination of the hydrometeorologic reporting network with the National Weather Service and the U.S. Geological

Survey.

(c) Train personnel in flood control duties.

1. Periodic visits to projects by personnel of the section to familiarize themselves with regulation facilities, become acquainted with the operating personnel, and provide the background for improving facilities and methods.
2. Instruction of Hydrology and Hydraulics Branch personnel in flood control procedures to supplement the Water Control Section during flood emergencies, when necessary.

(d) Prepare reports on lake regulations.

1. Recurring reports.
2. Water control manuals.
3. Postflood reports.

(2) Responsibilities and Duties During Flood Emergencies. During flood emergencies, the Water Control Section is responsible for the following:

- (a) Evaluation of current hydrologic, hydraulic, and meteorologic data.
- (b) Presentation of storm and flood analysis to the

District Engineer and other interested District personnel.

- (c) When necessary, furnishing of personnel to assist project operating personnel in flood regulations.
- (d) Regulation of lakes in accordance with flood control regulation schedules.
- (e) Furnish information to higher authority.
  - 1. Initial reports to Southwestern Division and Office of the Chief of Engineers by telephone.
  - 2. Supply the Emergency Operations Center with information in support of situation reports.
- (f) Furnish information to the Reservoir Information Control Center.

The duties of the project operating personnel under flood conditions are set forth in Section VII of this Manual. The details of the overall procedures of the Tulsa District under emergency conditions are set forth in Tulsa District Supplement A, Natural Disaster Activities, to ER 500-1-1.

(3) Assignment of Personnel. During nonflood periods, instructions for the routine regulation of the lake are accomplished by personnel of the Water Control Section. However, during flood periods, assistance of other personnel may be required to maintain effective regulation of the lake.

Plate 5-2 shows the organization of the Water Control Section. The area and magnitude of the flood will determine the number of people engaged in each particular activity.

- (4) Provision for 24-hour Alert. The National Weather Service and project personnel are provided with a list of names, addresses, and telephone numbers of key personnel of the Engineering and Construction Division with instructions to provide warning if unusual conditions occur. Responsible personnel are on duty at the Tulsa District Office 24 hours a day whenever basin and/or project conditions warrant and during flood emergencies. Responsible personnel will be on duty or on call at the project at all times.
  
- (5) Role of Project Manager. The Project Manager will regulate the lake according to instructions issued by personnel of the Water Control Section. The instructions follow the "Normal Regulations for Flood Control," included in Section VII and paragraph II-1 of Exhibit C. If the Project Manager loses communication with the District Office, he will immediately make every effort to re-establish communication with the District Office while initiating emergency regulations for flood control, which is also included in Section VII and paragraph II-2 of Exhibit C in this Manual.

b. Other Federal Agencies. The National Weather Service (NWS) and the U.S. Geological Survey cooperate together with the Water Control Section, Hydrology and Hydraulics Branch, Tulsa District Office, to accumulate rainfall and streamflow data. The Environmental Protection Agency, together with the State of Kansas, establishes the standards for quality of releases.

c. State and County Agencies. Management of the fish and wildlife resources of El Dorado Lake is the responsibility of the Kansas Department of Wildlife and Parks.

d. Private Organizations. Presently, there are no private organizations that have regulatory responsibilities at El Dorado Lake.

9-02. Interagency Coordination. Cooperative arrangements with other Federal agencies, state agencies, and local interests are discussed in Section X of the Water Control Master Manual, Arkansas River Basin, Tulsa and Little Rock Districts, dated July 1980. Excerpts of interest to the regulation of El Dorado Lake are presented below.

a. Local Press and Corps Bulletins. The Corps of Engineers and the NWS cooperate in forecasting river stages and streamflows. The Corps will provide the local press with NWS river stage and flood forecasts, which may be supplemented with observed river stages, observed and forecasted lake conditions and other information on observed conditions, and technical advice to enable local interests to obtain optimum flood protection and to perform rescue and relief functions.

b. National Weather Service. The Tulsa District Office and the Tulsa River Forecast Center, NWS, exchange hydrometeorologic data and reports in order to prevent duplication of effort in obtaining and disseminating data. The NWS is the responsible agency for issuing public forecasts of stream stages. This exchange of data is discussed in greater detail in Section VI of this Manual.

c. U.S. Geological Survey. The Corps of Engineers and the U.S. Geological Survey (USGS) cooperate in a program for the construction, maintenance, and operation of streamgaging stations throughout the Tulsa

District. During floods, the Corps of Engineers and the USGS coordinate field activities to obtain the desired stream discharge measurements.

d. Power Marketing Agency. Operation of El Dorado Lake does not include hydro-electric power generation.

e. Other Federal, State, or Local Agencies. The Tulsa District Office exchanges information with state government officials, the Kansas and Oklahoma Departments of Transportation, Kansas and Oklahoma Highway Patrols, and others during flood emergencies. The Tulsa District also coordinates with state agencies concerning fish and wildlife throughout normal operation.

9-03. Interagency Agreements. Presently, there are no interagency agreements.

9-04. Commissions, River Authority, Compacts and Committees. Arkansas River Basin compacts have been established between the states of Arkansas and Oklahoma, and Kansas and Oklahoma. The major purposes of these compacts are:

a. To promote interstate comity between Arkansas and Oklahoma, and Kansas and Oklahoma.

b. To provide for an equitable apportionment of the waters of the Arkansas River between Arkansas and Oklahoma, and Kansas and Oklahoma, and to promote the orderly development thereof.

c. To provide an agency for administering the water apportionment agreed to in the compacts.

d. To encourage the maintenance of an active pollution abatement program in each of the three states and to seek the further reduction of both natural and manmade pollution in the waters of the Arkansas River Basin.

e. To facilitate cooperation of the water administration agencies of Arkansas and Oklahoma, and Kansas and Oklahoma in the total development and management of the water resources of the Arkansas River Basin.

9-05. Non-Federal Hydropower. Operation of El Dorado Lake does not include hydro-electric power generation.

9-06. Reports.

a. Daily Reports. This report is prepared in accordance with TDR 1130-2-12 by the Water Control Section daily, except Saturday, Sunday, and holidays to cover a period of 24 hours. The report provides data for use by personnel whose work requires knowledge pertaining to the regulation of reservoirs, field investigations, stream gaging, construction of flood control projects affected by releases from lakes, answering public inquiries, and preparing public releases. The report includes a summary of hydrologic conditions as of 8 a.m. of that day and lake data for the previous and present days. The report is completed and dispatched from the Hydrology-Hydraulics Branch daily.

b. Monthly Lake Reports. The Water Control Section, in accordance with paragraph 6-04 of EM 1110-2-3600 and paragraph 12(d) of ER 1110-2-240, prepares the monthly lake regulation tabulation. These reports are a record of reservoir regulation for all flood control, navigation, or multiple-purpose storage lakes that are under supervision of, or of direct interest to, the District Office. Supplemental information on the regulation of the lakes, such as explanation of deviations from approved schedules, is added as a note on the tabulation or as an attachment. These tabulations are promptly prepared each month and maintained in such form as to be readily available for transmittal to the Chief of Engineers or others upon request.

c. Flood Situation Reports. The Water Control Section submits daily situation reports during floods in accordance with ER 500-1-1 AND OM 500-1-6. The report contains various types of information relative to the floods. Pertinent data specifically required for lakes are as follows: name of lake, lake stage, predicted maximum stage and anticipated date, rates of inflow and outflow in cfs, percent of flood control storage used to date and predicted maximum stage, and any special information particularly pertinent to the flood situation.

d. Post Flood Reports. A Post Flood Report is prepared in accordance with ER 500-1-1 and OM 500-1-6, as soon as practicable after a flood causing major damage. The report describes flood emergency operation by the Corps of Engineers and others. Included in summary form are: available hydrologic information, damage estimate, and other engineering data considered to be essential for flood control and flood plain studies or in the review of possible claims against the United States. The report is prepared by the District Office Emergency Management personnel, using information compiled and prepared by the Water Control Section. The report should be completed within approximately 90 days after most emergency activities are complete, including a statement of final costs.

e. Annual Report. This report is prepared by the Water Control Section. The report contains a summation of the general conditions of the river basins and the individual projects in the District for the preceding fiscal year. Included is information on flood and low flow regulation, rainfall, maximum and minimum lake levels and river stages experienced, flood reductions, navigation and power production. The report also presents the activities and accomplishments of the Water Control Section for inclusion in the Division's Annual Report.

f. Summary of Reports. Table 9-1 is a summary of the reports required in the regulation of lakes and reservoirs in the Tulsa District.

TABLE 9-1  
SUMMARY OF REPORTS

Name of Report	When Required	Form Number	Regulation Requiring Reporting
Daily Report	Daily, except Saturday, Sunday, and holidays	SWT Form 56 & 57	TDR 1130-2-12
Monthly Lake Report	Monthly	----	EC 1110-2-240 EC 1110-2-3600
Flood Situation Report	During floods	----	OM 500-1-6 ER 500-1-1
Post Flood Report	Following a flood causing major damage	----	OM 500-1-6 ER 500-1-1
Annual Report	Annually	----	OM 500-1-6 ER 1110-2-240

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**TABLES**

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TABLE 4-3  
MAJOR STORMS  
JANUARY 1922 THROUGH DECEMBER 1998  
EL DORADO LAKE

Inclusive Date	Average Rainfall (inches)
3-9 April 1922	4.47
9-13 July 1922	3.78
6-11 June 1923	6.01
3-5 September 1926	4.15
1-4 October 1926	4.78
12-18 April 1927	4.58
12-21 June 1927	6.18
14-17 November 1928	9.50
18-24 June 1929	3.98
7-11 July 1929	3.95
5-11 September 1930	4.58
10-15 June 1931	5.04
10-23 September 1931	4.75
10-17 November 1931	4.59
18-21 June 1932	3.76
8-22 May 1935	7.96
17-21 October 1935	4.02
6-9 October 1936	4.40
14-19 July 1937	4.76
18-23 May 1938	4.89
15-16 August 1938	4.45
19-26 November 1940	3.97
28-30 September 1941	3.96
15-25 June 1942	5.32
2-8 September 1942	6.59
16-19 May 1943	3.70
14-22 March 1944	4.92

TABLE 4-3, Cont'd  
 MAJOR STORMS  
 JANUARY 1922 THROUGH DECEMBER 1998  
 EL DORADO LAKE

Inclusive Date	Average Rainfall (inches)
22-23 April 1944	3.59
8-11 July 1944	3.50
20-26 August 1944	3.86
2-5 December 1944	4.02
10-16 April 1945	4.65
21-30 September 1945	9.01
8-16 April 1947	4.54
20-28 June 1948	5.14
14-22 July 1948	5.94
28 July - 2 August 1950	3.55
20-25 June 1951	4.22
28-30 June 1951	6.65
9-14 July 1951	3.83
3-13 September 1951	4.29
5-17 May 1957	4.90
19-25 June 1958	3.52
15-17 September 1958	3.70
12-18 July 1959	5.22
15-17 August 1959	3.63
30 September - 5 October 1959	6.22
30 April - 6 May 1961	4.20
20-23 July 1961	7.26
15-19 November 1964	4.39
4-6 June 1965	5.97
17-21 September 1965	3.71
2-7 September 1967	3.67
15-17 June 1968	3.54
24-30 July 1968	6.92

TABLE 4-3, Cont'd  
MAJOR STORMS  
JANUARY 1922 THROUGH DECEMBER 1998  
EL DORADO LAKE

Inclusive Date	Average Rainfall (inches)
22-25 May 1969	3.53
22-27 June 1969	4.20
14-17 September 1969	3.67
4-11 March 1973	5.34
25-30 September 1973	6.98
11-12 October 1973	4.58
2-4 July 1976	5.22
19-23 May 1977	3.73
17-27 June 1977	7.26
8-10 June 1979	7.50
12-18 October 1981	4.31
12-17 May 1982	3.78
27 September – 4 October 1986	4.37
12-14 August 1987	3.85
1-5 June 1989	3.70
19-26 August 1989	4.78
1-13 May 1993	5.29
23-28 December 1994	3.58
8-11 June 1995	5.83
19 October 1996	5.92
31 October – 4 November 1998	8.44

TABLE 4-4a  
FLOODS FOR PERIOD OF RECORD  
ARKANSAS CITY GAGE<sup>(3)</sup>  
 (Arkansas River)  
 Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
24 May 1903	19.2	17,300
14 July 1922	22.10	28,600
10 June 1923	28.43	103,000
2 May 1924	21.50	22,400
4 October 1926	23.94	45,300
18 June 1928	19.46	19,900
24 June 1929	19.60	20,200
3 September 1933	18.81	16,800
31 May 1935	21.14	28,300
21 May 1938	19.50	19,600
29 June 1939	18.19	14,800
11 June 1941	18.90	17,200
22 June 1942	24.83	45,800
24 April 1944	28.21	73,500
17 April 1945	26.3	-
1 October 1945	24.9	-
15 April 1946	21.4	-
15 April 1947	23.07	36,000
25 July 1948	22.61	35,000
21 June 1949	19.71	20,800
2 August 1950	22.74	36,200
19 May 1951	26.47	66,000

<sup>3</sup> Gage record - Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4a, Cont'd  
FLOODS FOR PERIOD OF RECORD  
ARKANSAS CITY GAGE<sup>(4)</sup>  
 (Arkansas River)  
 Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
1 July 1951	28.8	-
15 July 1951	28.18	-
4 October 1955	19.35	21,500
18 May 1957	25.55	73,100
29 June 1957	22.20	41,800
3 October 1959	21.01	39,100
25 August 1960	18.38	23,900
28 August 1960	18.10	22,500
7 May 1961	27.0	-
2 November 1961	18.97	-
3 June 1962	18.50	26,100
18 November 1964	24.6	-
7 June 1965	25.08	-
18 October 1968	19.28	32,300
28 April 1969	18.10	25,700
19 April 1970	19.90	31,500
12 March 1973	21.59	41,500
27 March 1973	19.39	29,000
2 April 1973	22.84	49,900

<sup>4</sup> Gage record -- Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4a, Cont'd  
FLOODS FOR PERIOD OF RECORD  
ARKANSAS CITY GAGE<sup>(5)</sup>  
 (Arkansas River)  
 Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
13 October 1973	23.72	56,800
22 April 1974	21.39	40,300
19 June 1975	19.85	32,800
6 July 1976	24.16	-
25 June 1977	20.86	-
3 September 1977	19.57	30,800
11 June 1979	24.34	48,400
2 November 1979	22.48	47,400
2 April 1983	18.15	23,800
25 March 1984	20.71	37,300
9 April 1984	18.20	23,800
12 October 1985	26.10	85,200
4 October 1986	20.31	34,900
19 March 1987	18.54	23,100
25 March 1987	20.52	35,500
28 May 1987	20.33	35,000
7 July 1987	18.82	26,800
6 September 1989	20.83	38,000
4 May 1993	19.68	27,000

<sup>5</sup> Gage record -- Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4a, Cont'd  
FLOODS FOR PERIOD OF RECORD  
ARKANSAS CITY GAGE<sup>6)</sup>  
(Walnut River)  
Flood Stage 18.0 Feet

Date	Stage (feet)	Discharge (1) (cfs)
11 May 1993	27.62	78,600
16 July 1993	24.02	49,300
20 July 1993	21.49	36,700
29 May 1995	21.97	39,000
11 June 1995	24.15	50,000
16 August 1995	18.18	22,700
3 November 1998	28.89	97,600

<sup>6</sup> Gage record -- Arkansas City, Arkansas River, 25 May 1903 to 30 September 1998.

TABLE 4-4b  
FLOODS FOR PERIOD OF RECORD  
TOWANDA GAGE <sup>(7)</sup>  
 (Whitewater River)  
 Flood Stage 22.00 Feet

Date	Stage (feet)	Discharge (cfs)
1923	27.6	(FLOODMARK)
April 1944	28.6	(FLOODMARK)
13 July 1963	24.03	12,600
16 November 1964	24.08	13,400
5 June 1965	28.02	40,200
10 June 1965	23.61	11,400
19 September 1965	23.16	9,640
22 September 1965	24.40	15,000
30 June 1967	22.49	7,580
26 July 1968	24.50	12,100
17 October 1968	25.20	15,600
27 April 1969	25.43	17,000
22 May 1969	24.69	13,000
24 June 1969	24.03	10,100
2 April 1970	22.20	6,980
19 April 1970	22.55	7,360
2 February 1973	23.16	8,090
11 March 1973	24.17	9,590
12 October 1973	24.86	11,800
21 April 1974	23.82	8,980

<sup>7</sup> Gage record – Towanda, Whitewater River, 1923 to 30 September 1998.

TABLE 4-4b, Cont'd  
FLOODS FOR PERIOD OF RECORD  
TOWANDA GAGE <sup>(8)</sup>  
 (Whitewater River)  
 Flood Stage 22.00 Feet

Date	Stage (feet)	Discharge (1) (cfs)
9 June 1975	23.19	7,820
4 July 1976	24.47	15,000
23 June 1977	22.90	8,800
19 May 1978	24.37	14,500
8 June 1979	29.73	58,400
5 April 1983	22.53	8,670
10 October 1985	28.21	41,600
7 July 1986	23.25	10,500
4 October 1986	22.76	9,180
1 March 1987	23.39	11,000
18 March 1987	22.18	7,950
2 April 1988	22.38	9,820
20 November 1992	22.93	8,950
9 May 1993	25.22	16,800
15 July 1993	22.93	8,950
19 July 1993	23.47	9,700
14 March 1996	22.61	8,520
24 May 1996	24.37	12,700
27 May 1996	25.93	21,200
15 August 1996	24.56	13,500
4 November 1998	31.05	93,100

<sup>8</sup> Gage record - Towanda, Whitewater River, 1923 to 30 September 1998.

TABLE 4-4c  
FLOODS FOR PERIOD OF RECORD  
WINFIELD GAGE <sup>(9)</sup>  
(Walnut River)  
Flood Stage 30.00 Feet

Date	Stage (feet)	Discharge (cfs)
4 May 1898	33.10	40,000
8 July 1904	35.20	48,000
22 May 1915	31.70	35,000
11 April 1922	32.20	28,900
10 June 1923	38.70	76,000
4 October 1926	34.20	38,700
19 June 1928	33.10	32,900
18 November 1928	41.00	94,400
20 May 1943	33.53	37,600
23 April 1944	38.30	105,000
17 April 1945	35.93	60,600
1 October 1945	34.70	46,400
14 April 1947	30.86	28,700
2 August 1950	33.48	31,600
1 July 1951	37.80	83,000
19 May 1957	30.37	30,100
4 October 1959	31.59	30,500
6 May 1961	35.36	57,600
17 November 1964	33.90	46,700
6 June 1965	35.97	61,800
19 April 1970	31.84	34,800
11 March 1973	30.78	31,800
12 October 1973	33.80	46,000
5 July 1976	34.51	45,100

<sup>9</sup> Gage record – Winfield, Walnut River, 4 May 1904 to 30 September 1998.

TABLE 4-4c, Cont'd  
FLOODS FOR PERIOD OF RECORD

WINFIELD GAGE <sup>(10)</sup>

(Walnut River)

Flood Stage 30.00 Feet

Date	Stage (feet)	Discharge (cfs)
24 June 1977	32.01	35,600
10 June 1979	35.24	56,500
3 October 1986	32.83	39,100
11 May 1993	33.40	44,500
10 June 1995	37.30	85,800
2 November 1998	37.85	97,000

<sup>10</sup> Gage record - Winfield, Walnut River, 4 May 1904 to 30 September 1998.

TABLE 4-6  
MONTHLY AND ANNUAL FLOWS IN ACRE-FEET AT EL DORADO DAMSITE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1921	-	-	-	-	-	-	-	-	-	120	70	130	-
1922	120	140	3600	21100	17400	1800	13900	670	600	230	5100	760	65420
1923	590	440	1200	1500	10800	52400	7400	910	930	4100	3000	1500	84770
1924	1100	1500	7000	11900	5000	2000	1800	4300	510	910	440	460	36920
1925	2000	750	500	2000	1900	1200	200	100	620	360	1000	220	10850
1926	550	330	390	1700	1000	790	180	860	22900	32000	5400	2800	68900
1927	2500	2000	11800	60100	7000	18100	1900	33100	5600	5700	2300	1700	151800
1928	1500	1900	5900	5500	3300	44300	7700	2100	590	780	63200	9800	146570
1929	14400	2500	4300	14600	16300	10300	19200	4600	550	430	710	420	88310
1930	430	1100	690	670	11200	2100	310	200	7400	560	5600	1200	31460
1931	560	580	1000	2900	2400	18300	1000	450	1900	240	11000	3200	43530
1932	2400	2400	2000	1400	1200	14200	9100	1000	350	210	180	370	34810
1933	220	170	280	230	1500	150	440	6600	1300	260	100	140	11390
1934	120	110	170	2500	2900	1700	80	20	1500	1600	5000	1200	16900
1935	770	570	510	880	43500	18700	1500	520	230	6500	6200	1500	81380
1936	950	360	440	300	1100	140	30	0	440	9300	380	680	14120
1937	4600	4000	3200	5400	10500	5600	13500	1900	2400	290	340	430	52160
1938	280	360	1900	2800	34200	14000	1200	3300	970	220	370	310	59910
1939	290	280	420	910	460	6200	490	4600	80	50	60	110	13950
1940	160	160	270	8700	8600	1400	370	320	1000	120	1600	1200	23900
1941	5200	2900	1500	5400	3100	22200	5200	6500	26800	12900	11900	4200	107800
1942	1800	5100	3100	17300	6300	15900	7700	3600	31600	12800	2700	16000	123900
1943	6500	4700	2200	1600	35000	18000	4700	720	380	550	360	680	75390
1944	600	440	27500	62300	19700	5400	8100	2500	1200	4000	1300	28200	161240
1945	1800	1800	15200	51500	6400	3300	7000	1500	37600	8300	1800	1600	137800
1946	5400	2200	4600	3000	2100	1100	370	470	590	670	1400	370	22270
1947	360	330	11400	41000	15600	6700	1500	470	110	100	120	440	78130
1948	190	560	3600	850	340	21400	35100	3000	710	370	1100	600	67820
1949	21900	24600	11200	15500	12200	5700	9400	1300	3800	2800	770	920	110090

TABLE 4-6, CONT'D  
MONTHLY AND ANNUAL FLOWS IN ACRE-FEET AT EL DORADO DAMSITE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1950	1300	820	750	890	1100	6600	30100	30900	5500	1500	790	820	81070
1951	850	2500	2400	4700	44700	98300	49200	8500	18200	4200	6400	3000	242950
1952	2400	1600	9000	10800	8400	1400	1000	610	140	120	260	430	36160
1953	300	200	6000	3500	25100	1200	430	250	60	120	240	260	37660
1954	190	190	170	250	520	270	70	0	0	110	60	50	1880
1955	90	230	80	70	1900	2200	80	20	310	3900	70	90	9040
1956	80	120	90	130	40	2200	380	70	2	0	6	30	3148
1957	30	50	70	5300	33500	26600	6000	520	3200	830	3200	1500	80800
1958	1400	2000	29700	7800	2700	3600	12600	1400	9100	1000	1400	1000	73700
1959	890	930	1500	3100	17500	1700	26900	7700	1200	40600	2700	5000	109720
1960	5200	5500	23700	9100	17800	5500	6800	13000	2900	11900	2300	2700	106400
1961	1200	3000	9900	11200	44900	6300	33800	7900	24300	23200	28100	6100	199900
1962	14000	16700	7000	2800	2200	7500	7700	780	13700	3200	1600	1300	78480
1963	1900	1100	4100	980	2500	2500	6700	650	750	380	360	350	22270
1964	330	290	320	5500	4600	10700	240	1000	1100	1200	26100	6800	58180
1965	2100	2600	6000	23900	5000	82000	8000	8200	37200	2400	1400	1900	180700
1966	1200	2700	1400	1100	1800	760	220	380	120	100	140	180	10100
1967	220	170	160	370	150	36800	6000	5200	3600	9300	1000	1400	64370
1968	1200	900	1100	3500	6400	12200	26100	4500	1900	22600	14100	10700	105200
1969	3800	5600	15100	44500	53000	50200	5500	1500	7900	3400	2200	4500	197200
1970	1800	1200	2900	42700	4100	23400	1200	430	570	13800	830	890	93820
1971	7500	6000	5000	1900	6600	10600	2200	460	240	1800	5100	8700	56100
1972	1400	1200	730	5800	15400	410	2200	370	1100	30	1500	2600	32740
1973	11000	19200	70400	10600	6800	5700	920	630	16800	30100	2400	11000	185550
1974	8300	2700	10500	16400	30100	15300	980	2600	3500	920	8700	4300	104300
1975	3500	10500	8100	6600	19000	56200	2300	1100	940	500	780	900	110420
1976	710	670	700	13000	3300	2700	24500	400	230	230	280	310	47030
1977	290	370	460	610	10100	31800	1700	8000	6600	1400	4000	1200	66530
1978	860	7600	7800	3500	20800	3900	480	270	510	0	0	0	45720

TABLE 4-6, CONT'D  
MONTHLY AND ANNUAL FLOWS IN ACRE-FEET AT EL DORADO DAMSITE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1979	553	2166	14142	4879	8362	39213	6948	1045	536	369	3154	2890	84258
1980	4366	6040	18446	17792	5472	2737	1968	1168	0	184	0	184	58358
1981	61	56	61	60	1722	1726	984	246	119	615	6605	2152	14406
1982	9346	10441	6702	1428	46362	27491	5657	0	595	184	119	1045	109371
1983	861	1611	8485	36119	3689	11603	1045	430	655	738	417	246	65899
1984	1168	978	43226	40403	14142	12496	246	184	179	3320	2856	10576	129775
1985	4366	24270	4980	7498	23365	23861	3443	5349	3868	53002	19041	4304	177348
1986	1045	3221	3197	7379	15679	4344	16048	3505	6724	43041	1190	10207	115581
1987	6702	19271	31174	11782	8547	5236	3320	11437	1607	553	1190	9285	110104
1988	4243	230	13958	33382	5226	893	5472	0	179	246	476	184	64489
1989	553	555	1537	238	3320	7855	676	26009	19934	676	0	184	61539
1990	2705	4665	26317	7081	9961	21362	738	4427	774	861	1964	246	81100
1991	123	0	307	9580	19061	2499	2337	1045	1131	799	2856	3628	43367
1992	1230	518	9531	3570	2890	52959	18139	6764	1904	1537	34631	21521	155193
1993	12175	21715	13712	9461	77474	11365	20414	799	3749	246	1309	369	172788
1994	61	611	1168	29931	15741	3570	3013	1353	0	0	2559	307	58314
1995	369	0	24103	7617	60627	91458	5411	22013	774	123	0	184	212678
1996	0	496	982	992	4383	1002	0	3114	2598	228	16483	1924	32202
1997	506	19329	3769	21025	14579	25438	3699	2430	1200	4463	2975	18545	117958
1998	4136	3273	26866	18446	7418	2321	6883	506	6298	26281	79091	10929	192448
1999	4731	6347	5355	70562	23286	40502	6440	7716	9759	-	-	-	-
MEAN	2700	3650	7808	11838	13363	15533	6879	3750	4832	5420	5467	3308	84549
MAXIMUM	21900	24600	70400	70562	53000	98300	49200	33100	37600	53002	79091	28200	242950
MINIMUM	30	0	61	60	40	140	0	0	0	0	0	0	1880

TABLE 7 - 4  
WATER RIGHT HOLDERS - WALNUT RIVER  
COWLEY COUNTY

SECTION	TOWNSHIP	RANGE	TYPE OF RIGHT*	AUTHORIZED QUANTITY	AUTHORIZED RATE	TYPE OF USE**	
	11	33 S	4 E	A	61 AF	620 GPM	IRR
SE 1/4	20	34 S	4 E	A	92 AF	1200 GPM	IRR
SW 1/4	29	32 S	4 E	A	163 AF	500 GPM	IRR
SE 1/4	30	34 S	4 E	A	235.997 AF	3500 GPM	MUN
NE 1/4	29	30 S	4 E	A	60 AF	1060 GPM	IRR
SW 1/4	18	31 S	4 E	A	210 AF	880 GPM	IRR
SW 1/4	20	30 S	4 E	A	40 AF	800 GPM	IRR
NW 1/4	20	30 S	4 E	A	16 AF	800 GPM	IRR
SE 1/4	19	30 S	4 E	A	160 AF	1600 GPM	IRR
SE 1/4	19	30 S	4 E	A	160 AF	1600 GPM	IRR
SE 1/4	31	30 S	4 E	A	68 AF	610 GPM	IRR
NW 1/4	23	33 S	4 E	A	144 AF	900 GPM	IRR
SE 1/4	30	33 S	5 E	A	99 AF	500 GPM	IRR
NE 1/4	31	33 S	5 E	A	99 AF	500 GPM	IRR
SE 1/4	30	33 S	5 E	A	7 AF	500 GPM	IRR
SE 1/4	7	30 S	4 E	A	180 AF	1200 GPM	IRR
SE 1/4	30	33 S	5 E	A	100.5 AF	750 GPM	IRR
NE 1/4	31	33 S	5 E	A	100.5 AF	750 GPM	IRR
NE 1/4	17	34 S	4 E	T	59.015 AF	500 GPM	IND
NW 1/4	6	31 S	4 E	A	300 AF	1200 GPM	IRR
NW 1/4	6	31 S	4 E	A	300 AF	1200 GPM	IRR
	6	31 S	4 E	A	318 AF	1800 GPM	IRR

TABLE 7 - 4, Cont'd  
 WATER RIGHT HOLDERS - WALNUT RIVER  
 BUTLER COUNTY

SECTION	TOWNSHIP	RANGE	TYPE OF RIGHT*	AUTHORIZED QUANTITY	AUTHORIZED RATE	TYPE OF USE**
SE 1/4 32	28 S	4 E	A	217 AF	1000 GPM	IRR
SE 1/4 32	28 S	4 E	A	176 AF	910 GPM	IRR
SE 1/4 8	28 S	4 E	A	0.15 AF	20 GPM	DOM
NE 1/4 25	25 S	5 E	A	5685 AF	5589 GPM	MUN
SE 1/4 31	29 S	4 E	A	503 AF	1890 GPM	IRR
NE 1/4 34	27 S	4 E	A	2.5 AF	450 GPM	IRR
SE 1/4 26	28 S	3 E	A	36.827 AF	0 GPM	REC
SE 1/4 30	29 S	4 E	A	172.5 AF	800 GPM	IRR
SE 1/4 31	29 S	4 E	A	224 AF	1000 GPM	IRR
NE 1/4 25	25 S	5 E	V	2456 AF	3400 GPM	MUN
SE 1/4 27	27 S	4 E	V	2224.943 AF	2000 GPM	IND
SW 1/4 11	26 S	5 E	V	3989.554 AF	10250 GPM	IND
NE 1/4 34	27 S	4 E	P	2.455 AF	400 GPM	

\* A = Appropriated, V = Vested, P = Term Permit, T = Temporary Permit

\*\* IRR = Irrigation, MUN = Municipal, IND = Industrial, DOM = Domestic, REC = Recreation

Table 7-5  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

AREA IN 1000'S OF ACRES

ELEV	0	1	2	3	4	5	6	7	8	9
1270	.000	.000	.000	.000	.000	.000	.000	.000	.000	.007
1280	.011	.017	.021	.024	.029	.033	.036	.038	.040	.043
1290	.079	.162	.221	.283	.336	.374	.451	.510	.570	.739
1300	.843	.945	1.042	1.218	1.422	1.573	1.666	1.700	1.909	2.105
1310	2.237	2.370	2.496	2.601	2.665	2.857	2.966	3.185	3.318	3.452
1320	3.625	3.820	4.052	4.280	4.467	4.728	5.004	5.350	5.633	5.866
1330	6.157	6.527	6.794	6.972	7.099	7.306	7.525	7.818	8.113	8.400
1340	8.761	9.144	9.472	9.794	10.112	10.512	11.099	11.742	12.214	12.369
1350	12.433	14.050	14.126	14.184	14.259	14.309	16.179	16.270	16.411	16.476
1360	16.525	.000	.000	.000	.000	.000	.000	.000	.000	.000

CAPACITY IN 1000'S OF ACRE-FEET

ELEV	0	1	2	3	4	5	6	7	8	9
1270	.000	.000	.000	.000	.000	.000	.000	.000	.000	.004
1280	.013	.027	.046	.068	.095	.126	.160	.197	.236	.278
1290	.339	.459	.651	.903	1.212	1.567	1.980	2.460	3.000	3.655
1300	4.446	5.340	6.333	7.463	8.783	10.281	11.900	13.583	15.388	17.395
1310	19.566	21.869	24.302	26.851	29.484	32.245	35.156	38.232	41.483	44.868
1320	48.407	52.129	56.065	60.231	64.605	69.202	74.068	79.245	84.737	90.486
1330	96.498	102.840	109.500	116.383	123.419	130.621	138.037	145.708	153.674	161.930
1340	170.511	179.463	188.771	198.404	208.357	218.669	229.475	240.895	252.873	265.165
1350	277.566	290.807	304.895	319.050	333.272	347.556	362.800	379.024	395.365	411.808
1360	428.309	.000	.000	.000	.000	.000	.000	.000	.000	.000

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1270.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1271.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1272.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1273.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1274.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1275.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1276.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1277.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1278.0	.000	.000	.000	.000	.001	.001	.001	.002	.002	.003
1279.0	.004	.004	.005	.006	.007	.008	.009	.009	.010	.012
1280.0	.013	.014	.015	.016	.017	.019	.020	.022	.023	.025
1281.0	.027	.028	.030	.032	.034	.036	.038	.039	.041	.044
1282.0	.046	.048	.050	.052	.054	.056	.059	.061	.063	.066
1283.0	.068	.071	.073	.076	.078	.081	.083	.086	.089	.092
1284.0	.095	.098	.100	.103	.107	.110	.113	.116	.119	.122
1285.0	.126	.129	.132	.136	.139	.142	.146	.149	.153	.157
1286.0	.160	.164	.167	.171	.175	.178	.182	.186	.190	.193
1287.0	.197	.201	.205	.209	.212	.216	.220	.224	.228	.232
1288.0	.236	.240	.244	.248	.252	.256	.261	.265	.269	.273
1289.0	.278	.282	.287	.292	.298	.304	.310	.317	.324	.331
1290.0	.339	.347	.356	.366	.377	.388	.401	.414	.428	.443
1291.0	.459	.476	.493	.510	.529	.547	.567	.587	.608	.629
1292.0	.651	.673	.696	.720	.744	.769	.794	.820	.847	.875
1293.0	.903	.931	.960	.990	1.020	1.051	1.082	1.114	1.146	1.179
1294.0	1.212	1.246	1.280	1.315	1.350	1.385	1.421	1.457	1.493	1.530
1295.0	1.567	1.605	1.643	1.683	1.723	1.764	1.805	1.848	1.891	1.935
1296.0	1.980	2.025	2.071	2.118	2.165	2.212	2.261	2.310	2.359	2.409
1297.0	2.460	2.511	2.563	2.616	2.669	2.723	2.777	2.832	2.887	2.943
1298.0	3.000	3.058	3.117	3.179	3.242	3.306	3.373	3.441	3.510	3.582
1299.0	3.655	3.729	3.804	3.881	3.959	4.037	4.117	4.197	4.279	4.362

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1300.0	4.446	4.530	4.616	4.703	4.791	4.880	4.970	5.061	5.153	5.246
1301.0	5.340	5.435	5.531	5.627	5.725	5.824	5.924	6.025	6.127	6.229
1302.0	6.333	6.438	6.545	6.654	6.764	6.876	6.990	7.106	7.223	7.342
1303.0	7.463	7.586	7.711	7.838	7.967	8.098	8.231	8.366	8.503	8.642
1304.0	8.783	8.926	9.071	9.216	9.364	9.513	9.663	9.815	9.969	10.124
1305.0	10.281	10.438	10.597	10.757	10.917	11.079	11.241	11.404	11.569	11.734
1306.0	11.900	12.067	12.234	12.401	12.569	12.737	12.906	13.075	13.244	13.413
1307.0	13.583	13.754	13.927	14.103	14.280	14.459	14.641	14.824	15.010	15.198
1308.0	15.388	15.579	15.773	15.969	16.167	16.367	16.568	16.772	16.978	17.185
1309.0	17.395	17.606	17.818	18.032	18.247	18.464	18.681	18.900	19.121	19.343
1310.0	19.566	19.790	20.016	20.243	20.471	20.701	20.932	21.164	21.398	21.633
1311.0	21.869	22.107	22.346	22.586	22.827	23.070	23.314	23.559	23.805	24.051
1312.0	24.302	24.552	24.803	25.056	25.309	25.563	25.819	26.075	26.333	26.591
1313.0	26.851	27.111	27.372	27.634	27.896	28.159	28.423	28.687	28.952	29.217
1314.0	29.484	29.751	30.020	30.292	30.565	30.840	31.117	31.396	31.677	31.960
1315.0	32.245	32.531	32.818	33.107	33.396	33.687	33.978	34.271	34.565	34.860
1316.0	35.156	35.454	35.754	36.056	36.360	36.666	36.975	37.286	37.599	37.914
1317.0	38.232	38.551	38.871	39.193	39.516	39.841	40.167	40.494	40.822	41.152
1318.0	41.483	41.816	42.149	42.485	42.821	43.159	43.498	43.839	44.180	44.524
1319.0	44.868	45.214	45.562	45.911	46.263	46.616	46.970	47.327	47.685	48.045
1320.0	48.407	48.770	49.135	49.503	49.872	50.243	50.617	50.992	51.369	51.748
1321.0	52.129	52.512	52.898	53.286	53.676	54.068	54.463	54.860	55.259	55.661
1322.0	56.065	56.471	56.880	57.291	57.704	58.120	58.537	58.957	59.380	59.804
1323.0	60.231	60.660	61.091	61.524	61.958	62.394	62.833	63.273	63.715	64.159
1324.0	64.605	65.053	65.503	65.956	66.412	66.871	67.332	67.795	68.262	68.731
1325.0	69.202	69.676	70.153	70.633	71.115	71.601	72.089	72.579	73.073	73.569
1326.0	74.068	74.570	75.076	75.585	76.097	76.613	77.133	77.656	78.182	78.712
1327.0	79.245	79.782	80.321	80.863	81.408	81.955	82.506	83.059	83.616	84.175
1328.0	84.737	85.301	85.868	86.437	87.008	87.582	88.158	88.737	89.318	89.901
1329.0	90.486	91.074	91.665	92.259	92.856	93.455	94.058	94.664	95.272	95.883

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1330.0	96.498	97.115	97.736	98.361	98.990	99.622	100.258	100.898	101.542	102.189
1331.0	102.840	103.494	104.150	104.810	105.472	106.136	106.804	107.474	108.147	108.822
1332.0	109.500	110.180	110.862	111.546	112.232	112.919	113.609	114.300	114.992	115.687
1333.0	116.383	117.081	117.780	118.480	119.182	119.885	120.589	121.295	122.001	122.709
1334.0	123.419	124.130	124.843	125.558	126.275	126.994	127.715	128.439	129.164	129.892
1335.0	130.621	131.353	132.087	132.823	133.561	134.301	135.044	135.789	136.536	137.285
1336.0	138.037	138.791	139.547	140.307	141.070	141.836	142.604	143.376	144.150	144.928
1337.0	145.708	146.491	147.278	148.067	148.859	149.654	150.452	151.253	152.057	152.864
1338.0	153.674	154.486	155.302	156.120	156.942	157.766	158.593	159.423	160.256	161.092
1339.0	161.930	162.772	163.617	164.466	165.319	166.175	167.035	167.899	168.766	169.636
1340.0	170.511	171.389	172.270	173.156	174.046	174.939	175.836	176.737	177.642	178.551
1341.0	179.463	180.379	181.298	182.221	183.147	184.076	185.009	185.944	186.883	187.826
1342.0	188.771	189.720	190.672	191.627	192.586	193.547	194.512	195.480	196.452	197.426
1343.0	198.404	199.385	200.369	201.357	202.347	203.341	204.338	205.338	206.341	207.347
1344.0	208.357	209.370	210.388	211.409	212.434	213.463	214.496	215.534	216.575	217.620
1345.0	218.669	219.723	220.783	221.849	222.921	223.998	225.082	226.171	227.267	228.368
1346.0	229.475	230.588	231.707	232.833	233.966	235.104	236.250	237.401	238.560	239.724
1347.0	240.895	242.072	243.253	244.439	245.630	246.825	248.025	249.230	250.440	251.654
1348.0	252.873	254.095	255.319	256.544	257.771	258.999	260.229	261.461	262.694	263.928
1349.0	265.165	266.402	267.640	268.878	270.117	271.357	272.598	273.839	275.080	276.323
1350.0	277.566	278.817	280.085	281.368	282.668	283.984	285.316	286.665	288.029	289.410
1351.0	290.807	292.212	293.619	295.026	296.433	297.842	299.251	300.661	302.071	303.483
1352.0	304.895	306.308	307.721	309.135	310.550	311.965	313.381	314.798	316.214	317.632
1353.0	319.050	320.469	321.888	323.309	324.730	326.151	327.574	328.997	330.421	331.846
1354.0	333.272	334.698	336.124	337.552	338.979	340.407	341.836	343.265	344.695	346.125
1355.0	347.556	348.996	350.455	351.932	353.429	354.944	356.478	358.030	359.601	361.191
1356.0	362.800	364.418	366.037	367.657	369.278	370.900	372.523	374.147	375.772	377.398
1357.0	379.024	380.652	382.281	383.911	385.543	387.177	388.811	390.448	392.085	393.724
1358.0	395.365	397.006	398.648	400.291	401.934	403.578	405.223	406.868	408.514	410.161
1359.0	411.808	413.456	415.104	416.753	418.402	420.052	421.703	423.353	425.005	426.656

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1270.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1271.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1272.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1273.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1274.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1275.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1276.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1277.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1278.0	.000	.000	.000	.000	.001	.001	.001	.002	.002	.003
1279.0	.004	.004	.005	.006	.007	.008	.009	.009	.010	.012
	.007	.007	.008	.008	.009	.009	.009	.010	.010	.011
1280.0	.013	.014	.015	.016	.017	.019	.020	.022	.023	.025
	.011	.012	.012	.013	.014	.014	.015	.015	.016	.016
1281.0	.027	.028	.030	.032	.034	.036	.038	.039	.041	.044
	.017	.018	.018	.018	.019	.019	.020	.020	.020	.021
1282.0	.046	.048	.050	.052	.054	.056	.059	.061	.063	.066
	.021	.021	.022	.022	.022	.023	.023	.023	.024	.024
1283.0	.068	.071	.073	.076	.078	.081	.083	.086	.089	.092
	.024	.025	.025	.026	.026	.027	.027	.028	.028	.029
1284.0	.095	.098	.100	.103	.107	.110	.113	.116	.119	.122
	.029	.030	.030	.030	.031	.031	.032	.032	.032	.033
1285.0	.126	.129	.132	.136	.139	.142	.146	.149	.153	.157
	.033	.033	.034	.034	.034	.035	.035	.035	.036	.036
1286.0	.160	.164	.167	.171	.175	.178	.182	.186	.190	.193
	.036	.036	.036	.037	.037	.037	.037	.038	.038	.038
1287.0	.197	.201	.205	.209	.212	.216	.220	.224	.228	.232
	.038	.038	.038	.039	.039	.039	.039	.040	.040	.040
1288.0	.236	.240	.244	.248	.252	.256	.261	.265	.269	.273
	.040	.040	.041	.041	.041	.042	.042	.042	.043	.043
1289.0	.278	.282	.287	.292	.298	.304	.310	.317	.324	.331
	.043	.047	.050	.054	.058	.061	.065	.068	.072	.076

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1290.0	.339	.347	.356	.366	.377	.388	.401	.414	.428	.443
	.079	.087	.096	.104	.112	.121	.129	.137	.146	.154
1291.0	.459	.476	.493	.510	.529	.547	.567	.587	.608	.629
	.162	.168	.174	.180	.186	.192	.198	.203	.209	.215
1292.0	.651	.673	.696	.720	.744	.769	.794	.820	.847	.875
	.221	.227	.234	.240	.246	.252	.258	.264	.271	.277
1293.0	.903	.931	.960	.990	1.020	1.051	1.082	1.114	1.146	1.179
	.283	.288	.294	.299	.304	.310	.315	.320	.326	.331
1294.0	1.212	1.246	1.280	1.315	1.350	1.385	1.421	1.457	1.493	1.530
	.336	.340	.344	.347	.351	.355	.359	.363	.366	.370
1295.0	1.567	1.605	1.643	1.683	1.723	1.764	1.805	1.848	1.891	1.935
	.374	.382	.389	.397	.405	.413	.420	.428	.436	.443
1296.0	1.980	2.025	2.071	2.118	2.165	2.212	2.261	2.310	2.359	2.409
	.451	.457	.463	.469	.475	.481	.486	.492	.498	.504
1297.0	2.460	2.511	2.563	2.616	2.669	2.723	2.777	2.832	2.887	2.943
	.510	.516	.522	.528	.534	.540	.546	.552	.558	.564
1298.0	3.000	3.058	3.117	3.179	3.242	3.306	3.373	3.441	3.510	3.582
	.570	.587	.604	.621	.638	.655	.672	.688	.705	.722
1299.0	3.655	3.729	3.804	3.881	3.959	4.037	4.117	4.197	4.279	4.362
	.739	.749	.760	.770	.781	.791	.802	.812	.822	.833
1300.0	4.446	4.530	4.616	4.703	4.791	4.880	4.970	5.061	5.153	5.246
	.843	.853	.863	.874	.884	.894	.904	.914	.925	.935
1301.0	5.340	5.435	5.531	5.627	5.725	5.824	5.924	6.025	6.127	6.229
	.945	.955	.965	.974	.984	.994	1.003	1.013	1.023	1.032
1302.0	6.333	6.438	6.545	6.654	6.764	6.876	6.990	7.106	7.223	7.342
	1.042	1.060	1.077	1.095	1.112	1.130	1.148	1.165	1.183	1.201
1303.0	7.463	7.586	7.711	7.838	7.967	8.098	8.231	8.366	8.503	8.642
	1.218	1.238	1.259	1.279	1.300	1.320	1.340	1.361	1.381	1.402
1304.0	8.783	8.926	9.071	9.216	9.364	9.513	9.663	9.815	9.969	10.124
	1.422	1.437	1.452	1.467	1.482	1.498	1.513	1.528	1.543	1.558
1305.0	10.281	10.438	10.597	10.757	10.917	11.079	11.241	11.404	11.569	11.734
	1.573	1.582	1.592	1.601	1.610	1.620	1.629	1.638	1.648	1.657
1306.0	11.900	12.067	12.234	12.401	12.569	12.737	12.906	13.075	13.244	13.413
	1.666	1.669	1.673	1.676	1.680	1.683	1.686	1.690	1.693	1.697
1307.0	13.583	13.754	13.927	14.103	14.280	14.459	14.641	14.824	15.010	15.198
	1.700	1.721	1.742	1.763	1.784	1.805	1.826	1.846	1.867	1.888
1308.0	15.388	15.579	15.773	15.969	16.167	16.367	16.568	16.772	16.978	17.185
	1.909	1.929	1.948	1.968	1.987	2.007	2.027	2.046	2.066	2.086
1309.0	17.395	17.606	17.818	18.032	18.247	18.464	18.681	18.900	19.121	19.343
	2.105	2.118	2.132	2.145	2.158	2.171	2.184	2.197	2.211	2.224

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1310.0	19.566	19.790	20.016	20.243	20.471	20.701	20.932	21.164	21.398	21.633
	2.237	2.250	2.264	2.277	2.290	2.304	2.317	2.330	2.343	2.357
1311.0	21.869	22.107	22.346	22.586	22.827	23.070	23.314	23.559	23.805	24.053
	2.370	2.383	2.395	2.408	2.421	2.433	2.446	2.458	2.471	2.484
1312.0	24.302	24.552	24.803	25.056	25.309	25.563	25.819	26.075	26.333	26.591
	2.496	2.507	2.517	2.528	2.538	2.549	2.559	2.570	2.580	2.591
1313.0	26.851	27.111	27.372	27.634	27.896	28.159	28.423	28.687	28.952	29.217
	2.601	2.608	2.614	2.620	2.627	2.633	2.639	2.646	2.652	2.659
1314.0	29.484	29.751	30.020	30.292	30.565	30.840	31.117	31.396	31.677	31.960
	2.665	2.684	2.704	2.723	2.742	2.761	2.780	2.799	2.819	2.838
1315.0	32.245	32.531	32.818	33.107	33.396	33.687	33.978	34.271	34.565	34.860
	2.857	2.868	2.879	2.890	2.901	2.912	2.922	2.933	2.944	2.955
1316.0	35.156	35.454	35.754	36.056	36.360	36.666	36.975	37.286	37.599	37.914
	2.966	2.988	3.010	3.032	3.054	3.076	3.098	3.119	3.141	3.163
1317.0	38.232	38.551	38.871	39.193	39.516	39.841	40.167	40.494	40.822	41.152
	3.185	3.198	3.212	3.225	3.238	3.252	3.265	3.278	3.292	3.305
1318.0	41.483	41.816	42.149	42.485	42.821	43.159	43.498	43.839	44.180	44.524
	3.318	3.332	3.345	3.358	3.372	3.385	3.398	3.412	3.425	3.439
1319.0	44.868	45.214	45.562	45.911	46.263	46.616	46.970	47.327	47.685	48.045
	3.452	3.469	3.487	3.504	3.521	3.539	3.556	3.573	3.591	3.608
1320.0	48.407	48.770	49.135	49.503	49.872	50.243	50.617	50.992	51.369	51.748
	3.625	3.645	3.664	3.684	3.703	3.723	3.742	3.762	3.781	3.801
1321.0	52.129	52.512	52.898	53.286	53.676	54.068	54.463	54.860	55.259	55.661
	3.820	3.843	3.866	3.890	3.913	3.936	3.959	3.983	4.006	4.029
1322.0	56.065	56.471	56.880	57.291	57.704	58.120	58.537	58.957	59.380	59.804
	4.052	4.075	4.098	4.121	4.143	4.166	4.189	4.212	4.234	4.257
1323.0	60.231	60.660	61.091	61.524	61.958	62.394	62.833	63.273	63.715	64.159
	4.280	4.299	4.318	4.336	4.355	4.374	4.392	4.411	4.430	4.448
1324.0	64.605	65.053	65.503	65.956	66.412	66.871	67.332	67.795	68.262	68.731
	4.467	4.493	4.519	4.545	4.571	4.598	4.624	4.650	4.676	4.702
1325.0	69.202	69.676	70.153	70.633	71.115	71.601	72.089	72.579	73.073	73.569
	4.728	4.756	4.783	4.811	4.839	4.866	4.894	4.921	4.949	4.977
1326.0	74.068	74.570	75.076	75.585	76.097	76.613	77.133	77.656	78.182	78.712
	5.004	5.039	5.073	5.108	5.142	5.177	5.212	5.246	5.281	5.316
1327.0	79.245	79.782	80.321	80.863	81.408	81.955	82.506	83.059	83.616	84.175
	5.350	5.378	5.407	5.435	5.463	5.492	5.520	5.548	5.576	5.605
1328.0	84.737	85.301	85.868	86.437	87.008	87.582	88.158	88.737	89.318	89.901
	5.633	5.656	5.680	5.703	5.726	5.750	5.773	5.796	5.819	5.843
1329.0	90.486	91.074	91.665	92.259	92.856	93.455	94.058	94.664	95.272	95.883
	5.866	5.895	5.924	5.953	5.983	6.012	6.041	6.070	6.099	6.128

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1330.0	96.498	97.115	97.736	98.361	98.990	99.622	100.258	100.898	101.542	102.189
	6.157	6.194	6.231	6.268	6.305	6.342	6.379	6.416	6.453	6.490
1331.0	102.840	103.494	104.150	104.810	105.472	106.136	106.804	107.474	108.147	108.822
	6.527	6.554	6.581	6.607	6.634	6.661	6.687	6.714	6.741	6.767
1332.0	109.500	110.180	110.862	111.546	112.232	112.919	113.609	114.300	114.992	115.687
	6.794	6.812	6.830	6.847	6.865	6.883	6.901	6.919	6.937	6.954
1333.0	116.383	117.081	117.780	118.480	119.182	119.885	120.589	121.295	122.001	122.709
	6.972	6.985	6.997	7.010	7.023	7.036	7.048	7.061	7.074	7.086
1334.0	123.419	124.130	124.843	125.558	126.275	126.994	127.715	128.439	129.164	129.892
	7.099	7.120	7.141	7.161	7.182	7.203	7.223	7.244	7.265	7.285
1335.0	130.621	131.353	132.087	132.823	133.561	134.301	135.044	135.789	136.536	137.285
	7.306	7.328	7.350	7.372	7.394	7.416	7.438	7.459	7.481	7.503
1336.0	138.037	138.791	139.547	140.307	141.070	141.836	142.604	143.376	144.150	144.928
	7.525	7.554	7.584	7.613	7.642	7.672	7.701	7.730	7.760	7.789
1337.0	145.708	146.491	147.278	148.067	148.859	149.654	150.452	151.253	152.057	152.864
	7.818	7.848	7.877	7.907	7.936	7.966	7.995	8.025	8.054	8.084
1338.0	153.674	154.486	155.302	156.120	156.942	157.766	158.593	159.423	160.256	161.092
	8.113	8.142	8.170	8.199	8.228	8.257	8.285	8.314	8.343	8.371
1339.0	161.930	162.772	163.617	164.466	165.319	166.175	167.035	167.899	168.766	169.636
	8.400	8.436	8.472	8.508	8.545	8.581	8.617	8.653	8.689	8.725
1340.0	170.511	171.389	172.270	173.156	174.046	174.939	175.836	176.737	177.642	178.551
	8.761	8.799	8.838	8.876	8.914	8.953	8.991	9.029	9.068	9.106
1341.0	179.463	180.379	181.298	182.221	183.147	184.076	185.009	185.944	186.883	187.826
	9.144	9.177	9.210	9.243	9.275	9.308	9.341	9.374	9.406	9.439
1342.0	188.771	189.720	190.672	191.627	192.586	193.547	194.512	195.480	196.452	197.426
	9.472	9.504	9.536	9.569	9.601	9.633	9.665	9.698	9.730	9.762
1343.0	198.404	199.385	200.369	201.357	202.347	203.341	204.338	205.338	206.341	207.347
	9.794	9.826	9.858	9.889	9.921	9.953	9.985	10.017	10.049	10.080
1344.0	208.357	209.370	210.388	211.409	212.434	213.463	214.496	215.534	216.575	217.620
	10.112	10.152	10.192	10.232	10.272	10.312	10.352	10.392	10.432	10.472
1345.0	218.669	219.723	220.783	221.849	222.921	223.998	225.082	226.171	227.267	228.368
	10.512	10.571	10.630	10.688	10.747	10.806	10.864	10.923	10.982	11.040
1346.0	229.475	230.588	231.707	232.833	233.966	235.104	236.250	237.401	238.560	239.724
	11.099	11.163	11.228	11.292	11.356	11.421	11.485	11.549	11.613	11.678
1347.0	240.895	242.072	243.253	244.439	245.630	246.825	248.025	249.230	250.440	251.654
	11.742	11.789	11.837	11.884	11.931	11.978	12.025	12.073	12.120	12.167
1348.0	252.873	254.095	255.319	256.544	257.771	258.999	260.229	261.461	262.694	263.928
	12.214	12.230	12.245	12.261	12.276	12.292	12.307	12.323	12.338	12.354
1349.0	265.165	266.402	267.640	268.878	270.117	271.357	272.598	273.839	275.080	276.323
	12.369	12.375	12.382	12.388	12.395	12.401	12.408	12.414	12.420	12.427

Table 7-5, Cont'd  
ELEVATION VERSUS AREA AND CAPACITY DATA

EL DORADO LAKE, KANSAS  
 20 OCTOBER 1993  
 BASED ON 1 MAY 1989 RESURVEY

POOL ELEV [FT. NGVD]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1350.0	277.566	278.817	280.085	281.368	282.668	283.984	285.316	286.665	288.029	289.410
	12.433	12.595	12.757	12.918	13.080	13.242	13.403	13.565	13.727	13.888
1351.0	290.807	292.212	293.619	295.026	296.433	297.842	299.251	300.661	302.071	303.483
	14.050	14.058	14.065	14.073	14.080	14.088	14.096	14.103	14.111	14.118
1352.0	304.895	306.308	307.721	309.135	310.550	311.965	313.381	314.798	316.214	317.632
	14.126	14.132	14.138	14.144	14.149	14.155	14.161	14.167	14.172	14.178
1353.0	319.050	320.469	321.888	323.309	324.730	326.151	327.574	328.997	330.421	331.846
	14.184	14.192	14.199	14.207	14.214	14.222	14.229	14.237	14.244	14.252
1354.0	333.272	334.698	336.124	337.552	338.979	340.407	341.836	343.265	344.695	346.125
	14.259	14.264	14.269	14.274	14.279	14.284	14.289	14.294	14.299	14.304
1355.0	347.556	348.996	350.455	351.932	353.429	354.944	356.478	358.030	359.601	361.191
	14.309	14.496	14.683	14.870	15.057	15.244	15.431	15.618	15.805	15.992
1356.0	362.800	364.418	366.037	367.657	369.278	370.900	372.523	374.147	375.772	377.398
	16.179	16.188	16.197	16.206	16.215	16.225	16.234	16.243	16.252	16.261
1357.0	379.024	380.652	382.281	383.911	385.543	387.177	388.811	390.448	392.085	393.724
	16.270	16.284	16.298	16.312	16.326	16.341	16.355	16.369	16.383	16.397
1358.0	395.365	397.006	398.648	400.291	401.934	403.578	405.223	406.868	408.514	410.161
	16.411	16.418	16.424	16.431	16.437	16.444	16.450	16.457	16.463	16.470
1359.0	411.808	413.456	415.104	416.753	418.402	420.052	421.703	423.353	425.005	426.656
	16.476	16.481	16.486	16.491	16.496	16.501	16.506	16.510	16.515	16.520

***EXHIBITS***

***EXHIBIT A***

***SUPPLEMENTARY PERTINENT DATA***

***EL DORADO LAKE***

**EXHIBIT A**

**SUPPLEMENTARY PERTINENT DATA**

**EL DORADO LAKE**

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TABLE INDEX

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A-1	Elevation, Areas, and Storage for El Dorado Lake	A-2
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I. - GENERAL INFORMATION

<u>ITEM</u>	<u>DESCRIPTION</u>
Other names for project	None.
Location	Butler County, Kansas, Walnut River Basin, Walnut River, river mile 114.7.
Type of project	Dam and lake.
Objectives of regulations	Multi-purpose - Flood control, water supply, water quality control, recreation, and sport fishing and hunting.
Project owner	U.S. Government.
Operating agency	U.S. Corps of Engineers. The normal working hours of operation for weekdays are 7:00 a.m. to 4:30 p.m.; working hours for weekends, holidays and nights vary. Working hours for flood emergency conditions are 24 hours.
Regulating agency	U.S. Army Corps of Engineers.
Water supply contracts	Administered by the Tulsa District Office.
Water rights	Administered by the Kansas Water Office.
Project cost	\$92,413,000.
Closure date	June 29, 1981.

II. - RESERVOIR INFORMATION

TABLE A-1

ELEVATION, AREAS, AND STORAGES FOR EL DORADO LAKE

Feature	Elevation (feet, NGVD)	Area (acres)	Storage	
			(acre- feet)	(inches) <sup>(1)</sup>
Top of Dam	1370.5	-	-	-
Maximum Pool	1363.4	17,300	465,466	37.30
Spillway Crest	1353.0	12,890	301,104	24.13
Top of Flood Control Pool	1347.5	10,740	236,264	18.93
Top of Conservation Pool	1339.0	7,997	157,050	12.58
Top of Inactive Pool	1296.0	420	2,961	0.24
Flood Control Storage	1339.0-1347.5	-	79,214	6.35
Conservation Storage	1296.0-1339.0	-	154,089	12.35
Streambed at Dam	1271.5	-	-	-

(1) From a total drainage area of 234 square miles.

(2) Storage yield of 22.2 mgd for water supply including joint use of 5.2 mgd for interim water quality control.

TABLE A-2

MAJOR FLOODS PAST EL DORADO DAMSITE

Date	Peak Inflow (cfs)	Volume (acre-feet)	Runoff (inches)
22 - 24 April 1944	17,500	27,700	2.22
8 - 10 June 1979	41,200	52,400	4.20
27 September - October 1986	8,075	35,740	2.86
19 - 26 August 1989	8,410	22,840	1.83
1 - 13 May 1993	16,300	72,800	5.83
31 October - 4 November 1998	32,000	81,530	6.53

II. - RESERVOIR INFORMATION, cont'd

<u>ITEM</u>	<u>DESCRIPTION</u>
Real estate taking line for fee title	The acquisition guideline for El Dorado Lake is elevation 1353.0, or the envelope curve of backwater effects of the 50-year flood, whichever is higher. Fee purchase limits encompass the acquisition guideline with a minimum distance of 300 feet horizontally from the top of conservation pool, elevation 1339.0. There are 33,499 acres in fee.
Real estate taking line for easement	Flowage easements were required in some extreme upper reaches of the lake. There are 733 acres in easement.
Range of clearing	The upper limit of clearing is elevation 1339.0 and the lower limit is elevation 1319.0. The extent of clearing was confined to the main portion of the lake in the vicinity of the dam.

II. - RESERVOIR INFORMATION, cont'd

Pool elevation corresponding to discharge capability of maximum non-damaging flow rate downstream	Non-damaging channel capacity below El Dorado Dam is estimated at 4,200 cfs. This flowrate can be discharged when the pool level is at elevation 1308.0 and above.
Reservoir length at top of conservation pool	7.6 miles.
Shoreline length at top of conservation pool	98 miles
Safety aspects possibly requiring warning	All recreation access roads are constructed above elevation 1347.5. Some campsite facilities could be inundated above elevation 1342.0. At full flood control pool, most park areas are closed and power to some facilities is cut-off.
Emergency drawdown	The minimum time to empty from top of conservation pool (elevation 1339.0) to top of inactive pool (elevation 1296.0) is approximately 16 days.

### III. - HYDROLOGY

<u>ITEM</u>	<u>DESCRIPTION</u>
Drainage area	234 square miles.
Probable maximum flood	Not applicable.
Spillway design flood	
Maximum water surface elevation	1363.4 feet, NGVD.
Peak inflow (into full pool)	257,000 cfs.
Total storm runoff (into full pool)	23.74 inches.
Volume (into full pool)	296,300 acre-feet.
Maximum outflow	40,600 cfs.
Flood duration	96 hours.
Standard project flood	
Maximum water surface elevation	1356.3 feet, NGVD.
Peak inflow (into full pool)	128,500 cfs.
Total storm runoff	11.87 inches.
Volume (into full pool)	148,150 acre-feet.
Maximum outflow	12,100 cfs.
Flood duration	96 hours.
Climate	Moderate.
One-inch runoff	12,480 acre-feet.
Storm types	Primarily thunderstorms.

III. - HYDROLOGY cont'd

Flood seasons	Primary flood period March through June with a secondary flood period of September through October; however, floods have occurred in every month of the year.
Low flow season	August, November through February; however, low flow can occur at any time of the year.
Minimum instantaneous flow	0 cfs on several occasions.
Minimum daily flow	0 cfs on several occasions.
Minimum monthly flow	0 acre-feet on several occasions.
Minimum annual flow and date	1,880 acre-feet in 1954.
Average annual flow	84,549 acre-feet.
Maximum annual flow and date	242,950 acre-feet in 1951.
Maximum monthly flow and date	98,300 acre-feet in June, 1951.
Maximum daily flow	21,450 cfs November 1, 1998.
Maximum instantaneous flow	41,200 cfs on June 9, 1979.

III. - HYDROLOGY cont'd

Name and location of key streamflow stations	El Dorado, Kansas, Walnut River (river mile 109.6); Augusta, Kansas, Walnut River (river mile 87.5); Winfield, Kansas, Walnut River (river mile 24.8).
Type of hydrometeorologic data recorded at damsite	Pool elevations, tailwater stage, rainfall, pan evaporation, wind speed and direction, lake water condition, weather conditions.
Number of precipitation stations used in hydrologic forecasting of El Dorado Reservoir	Ten (10).
Number of sediment ranges	Twenty-nine (29).
Number of degradation ranges	Six (6).

IV. - EMBANKMENT

Location	Walnut River, river mile 114.7.
Purpose	Flood control, water supply, water quality control, recreation, and fish and wildlife.
Type	Earthfill.
Type of fill	Random and impervious.
Slope protection	Riprap upstream, seeded to grass downstream.
Height	99 feet above streambed.
Length	20,850 feet (including spillway).
Top elevation	1370.5 feet, NGVD.
Design flood	Spillway Design Flood developed in original project design.
Used for roadway	A 24-foot wide roadway is provided along the crest.
Elevation of streambed	1271.5 feet, NGVD.

V. - RIGHT ABUTMENT DIKE

Location	Right abutment.
Purpose	Forms right section of embankment.
Type	Earthfill.
Type of fill	Random and impervious.
Height	20 feet.
Length	3,450 feet.
Top Elevation	1370.5 feet, NGVD.
Crest width	32 feet.
Used for roadway	Yes.

VI. - LEFT ABUTMENT DIKE

Location	Left Abutment.
Purpose	Forms left section of embankment.
Type	Earthfill.
Type of fill	Random and impervious.
Height	20 feet.
Length	7,300 feet.
Top Elevation	1370.5 feet, NGVD.
Crest Width	32 feet.
Used for roadway	Yes.

VII. - SPILLWAY

Location	Left Abutment
Type	Uncontrolled broad-crested weir
Crest elevation	1353.0 feet, NGVD
Net overflow length	350 feet
Maximum Discharge Capacity (Maximum pool elevation)	30,600 cfs at elev. 1363.4 feet, NGVD
Type of energy dissipator	None
Frequency of pool attaining crest elevation	In excess of 100 years

VIII. - OUTLET FACILITIES

a - CONDUIT

<u>ITEM</u>	<u>DESCRIPTION</u>
Purpose	Flood Control
Type of outlet	Concrete oblong conduit
Size of outlet	11.5-foot-wide by 15.75-foot-high
Type of service gate	Hydraulically operated wheel gates
Number and size of gates	Two 5.5-foot-wide by 15.75-foot-high
Entrance invert elevation	1279.0 feet, NGVD.
Exit invert elevation	1275.0 feet, NGVD.
Discharge at pertinent elevation	Top of flood control pool (1347.5) 7,200 cfs  Top of conservation pool (1339.0) 6,500 cfs  Bottom of conservation pool (1296) 1,800 cfs
Minimum time required to open/close service gates	16 minutes. The service gates will raise or lower independently at the rate of 1 foot per minute.
Type emergency closure and time required	Hydraulically operated wheel gate which requires 16 minutes to close.



VIII. - OUTLET FACILITIES cont'd

c - WATER SUPPLY

Purpose	Water Supply
Type outlet	Circular
Size of outlet	36-inch pipe

IX. - CONTROL POINTS

<u>ITEM</u>	<u>DESCRIPTION</u>
Gage	El Dorado, Kansas.
Location	River mile 109.6. On right bank, at downstream side of bridge on U.S. Highway 54 on east edge of El Dorado, at mouth of West Branch.
Purpose of gage	Provide stage and precipitation data and serve as a control point for flood releases from El Dorado Lake.
Channel and flood plain description	The channel is bedrock with scattered large cobble and silt. Channel is straight downstream from the control. Right bank has a narrow overflow confined by the railroad embankment.
Drainage area	350 sq. mi.
Target flow rate	14,850 cfs.
Time of crest travel	2 hours.
Monitoring provisions	Data Collection Platform.
Zero of gage	1258.457 feet, NGVD.
Channel usage	Water supply, fishing, and navigation control.

IX. - CONTROL POINTS cont'd

<u>ITEM</u>	<u>DESCRIPTION</u>
Gage	Augusta, Kansas.
Location	River mile 87.5. On right at south edge of Augusta, 1.6 mi. upstream from the Whitewater River.
Purpose of gage	Provide stage and precipitation data and serve as a control point for flood releases from El Dorado Lake.
Channel and flood plain description	Low-flow channel is rock outcroppings and silt, with heavily vegetated banks. Channel and possible backwater from the Whitewater will control at high flows.
Drainage area	452 sq. mi.
Target flow rate	10,500 cfs.
Time of crest travel	12 hours.
Monitoring provisions	Data Collection Platform.
Zero of gage	1,194.802 feet, NGVD.
Channel usage	Water supply, fishing, and navigation control.

IX. - CONTROL POINTS cont'd

<u>ITEM</u>	<u>DESCRIPTION</u>
Gage	Winfield, Kansas.
Location	River mile 24.8. At upstream side of bridge on U.S. Highway 77 1.0 mile south of Winfield, 1.0 mile upstream from Black Crook Creek.
Purpose of gage	Provide stage and precipitation data and serve as a control point for flood releases from El Dorado Lake.
Channel and flood plain description	The channel is well defined and fairly straight in the vicinity of the gage.
Drainage area	1,880 sq. mi.
Target flow rate	29,500 cfs.
Time of crest travel	24-48 hours.
Monitoring provisions	Data Collection Platform.
Zero of gage	1,082.86 feet, NGVD.
Channel usage	Water supply, fishing, and navigation control.

***EXHIBIT B***

***HEC-1 FORECASTING MODEL***

***EL DORADO LAKE***

EXHIBIT B

HEC-1 INFLOW MODEL AND SAMPLE OUTPUT

EL DORADO LAKE

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1.	HEC-1 Inflow Model	B-1
2.	HEC-1 Sample Output	B-3

```

ID      EL DORADO FORECAST                COOK,AUG81
ID      "UI" FOR LAKE SURFACE AREA DERIVED FROM "FORM 1787" dtd 17 AUG 1990
ID
IT      60                                288
*FREE
IO      5
VS UPPER  UPPER  UPPER  LOCAL  LOCAL  LOCAL  LAKE  LAKE  LAKE
VV 3.11  5.11  2.11  3.11  5.11  2.11  3.11  5.11  2.11
VS INFL  RELE  NETIN  ELDR  ELDR  CONSPL
VV 2.11  2.11  2.11  7.11  2.11  2.11
* *****
KK UPPER  UPPER BASIN
BA 205
* B      BASE FLOW FOR ENTIRE MODEL
BF 0      -.10  1.03
* L      LOSSES FOR ENTIRE MODEL
LU 0.0    0.00
PB 0
ZR=PI    B=TOTAL  C=PRECIP-INC  F=ADJUST
UI 2150   19486   28992   25974   19120   12916   8398   5376   3432
2196
UI 1416   922     606     402     270     184     126    88     60
46
UI 34     18     10     8     6     4     4     0
* *****
KK LOCAL  LOCAL AREA
BA 15.9
PB 0
ZR=PI    B=TOTAL  C=PRECIP-INC  F=ADJUST
UI 4198  3092    806     184     44     12     4     2
* *****
KK LAKE  LAKE SURFACE AREA WITH NORMAL POOL AT ELEV 1339.0
KM      ADJUST "BA" HERE AND FOR "KK LOCAL" WITH DIFFERENT STARTING ELEV
KM      ALSO ADJUST "UI" HERE WITH DIFFERENT STARTING ELEV
KM      ELEV-AREA-UI TABLE AVAILABLE IN FILE FOLDER
BA 13.1
BF 0      -0.1  1.10
LU 0      0
PB 0
ZR=PI    B=TOTAL  C=PRECIP-INC  F=ADJUST
UI 8470
* *****
KK INFL  LAKE INFLOW
HC 3
ZW      B=ELDR  C=FLOW-RES IN  F=CALC
* *****
KK RELE  OUTFLOWS FROM ELDRADO
BA 1
ZR=-QI   B=ELDR  C=FLOW-RES OUT  F=EST
* *****
KK NETIN  COMBINE INFLOW AND OUTFLOW TO GET NET INFLOW
HC 2
* *****
KK ELDR  INFLOWS ROUTED THRU LAKE
* :PLOT-MACRO: ELDR
KM      SEASONAL TOP CONSV POOL VARIES FROM ELEV 1338 TO 1340

```

KM TOP F.C. POOL ELEV = 1347.5  
 KM UNCONTROLLED SPILLWAY CRES ELEV = 1353  
 KM MAX POOL ELEV = 1363.4  
 \* E ELDORADO LAKE STARTING ELEVATION  
 RS 1 ELEV 1339.00  
 SV127172 156994 165132 173566 182309 191370 200756 220503 236253  
 252733  
 SV264223 301408 307778 314148 330200 346300 378500 410700 442800  
 465400  
 SE 1335 1339 1340 1341 1342 1343 1344 1346 1347.5  
 1349  
 SE 1350 1353 1353.5 1354 1355 1356 1358 1360 1362  
 1363.4  
 SQ 0 0 0 0 0 0 0 0 0  
 0  
 SQ 0 0 200 600 1800 3600 8800 15600 24800  
 30600  
 SE 1335 1339 1340 1341 1342 1343 1344 1346 1347.5  
 1349  
 SE 1350 1353 1353.5 1354 1355 1356 1358 1360 1362  
 1363.4  
 ZW B=ELDR C=ELEV F=CALC  
 \* \*\*\*\*\*  
 KK CONDU CONDUIT OUTFLOWS FROM ELDRADO  
 BA 1  
 ZR=QI B=ELDR C=FLOW-RES OUT F=EST  
 \* \*\*\*\*\*  
 KK CONSPL CONDUIT + SPILLWAY  
 HC 2  
 ZW B=ELDR C=FLOW-RES OUT F=TOTAL  
 \* \*\*\*\*\*  
 ZZ

RUNOFF SUMMARY  
 FLOW IN CUBIC FEET PER SECOND  
 TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
+									
+	HYDROGRAPH AT								
	UPPER	28992.	3.00	18627.	6697.	2893.	205.00		
+	HYDROGRAPH AT								
	LOCAL	4198.	1.00	1518.	607.	284.	15.90		
+	HYDROGRAPH AT								
	LAKE	8470.	1.00	1947.	692.	246.	13.10		
+	3 COMBINED AT								
	INFL	30561.	3.00	21192.	7964.	3423.	234.00		
+	HYDROGRAPH AT								
	RELE	0.	0.00	0.	0.	0.	1.00		
+	2 COMBINED AT								
	NETIN	30561.	3.00	21192.	7964.	3423.	235.00		
+	ROUTED TO								
	ELDR	0.	0.00	0.	0.	0.	235.00	1341.60	277.00
+	HYDROGRAPH AT								
	CONDU	0.	0.00	0.	0.	0.	1.00		
+	2 COMBINED AT								
	CONSPL	0.	0.00	0.	0.	0.	236.00		

TABLE 1

STATION		UPPER	UPPER	UPPER	LOCAL	LOCAL	LOCAL	LAKE	LAKE	LAKE
		RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW
PER	DAY MON HRMN									
1	1 JUL 0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1 JUL 0100	1.00	1.00	2150.00	1.00	1.00	4198.00	1.00	1.00	8470.00
3	1 JUL 0200	0.00	0.00	19486.00	0.00	0.00	3092.00	0.00	0.00	838.97
4	1 JUL 0300	0.00	0.00	28992.00	0.00	0.00	806.00	0.00	0.00	762.70
5	1 JUL 0400	0.00	0.00	25974.00	0.00	0.00	415.12	0.00	0.00	693.36
6	1 JUL 0500	0.00	0.00	19120.00	0.00	0.00	403.03	0.00	0.00	630.33
7	1 JUL 0600	0.00	0.00	12916.00	0.00	0.00	391.29	0.00	0.00	573.02
8	1 JUL 0700	0.00	0.00	8398.00	0.00	0.00	379.90	0.00	0.00	520.93
9	1 JUL 0800	0.00	0.00	5376.00	0.00	0.00	368.83	0.00	0.00	473.57
10	1 JUL 0900	0.00	0.00	3432.00	0.00	0.00	358.09	0.00	0.00	430.52
11	1 JUL 1000	0.00	0.00	2850.85	0.00	0.00	347.66	0.00	0.00	391.38
12	1 JUL 1100	0.00	0.00	2767.82	0.00	0.00	337.53	0.00	0.00	355.80
13	1 JUL 1200	0.00	0.00	2687.20	0.00	0.00	327.70	0.00	0.00	323.46
14	1 JUL 1300	0.00	0.00	2608.93	0.00	0.00	318.16	0.00	0.00	294.05
15	1 JUL 1400	0.00	0.00	2532.95	0.00	0.00	308.89	0.00	0.00	267.32
16	1 JUL 1500	0.00	0.00	2459.17	0.00	0.00	299.89	0.00	0.00	243.02
17	1 JUL 1600	0.00	0.00	2387.54	0.00	0.00	291.16	0.00	0.00	220.93
18	1 JUL 1700	0.00	0.00	2318.00	0.00	0.00	282.68	0.00	0.00	200.84
19	1 JUL 1800	0.00	0.00	2250.49	0.00	0.00	274.44	0.00	0.00	182.58
20	1 JUL 1900	0.00	0.00	2184.94	0.00	0.00	266.45	0.00	0.00	165.98
21	1 JUL 2000	0.00	0.00	2121.30	0.00	0.00	258.69	0.00	0.00	150.90
22	1 JUL 2100	0.00	0.00	2059.52	0.00	0.00	251.16	0.00	0.00	137.18
23	1 JUL 2200	0.00	0.00	1999.53	0.00	0.00	243.84	0.00	0.00	124.71
24	1 JUL 2300	0.00	0.00	1941.29	0.00	0.00	236.74	0.00	0.00	113.37
25	2 JUL 0000	0.00	0.00	1884.75	0.00	0.00	229.84	0.00	0.00	103.06
26	2 JUL 0100	0.00	0.00	1829.85	0.00	0.00	223.15	0.00	0.00	93.69
27	2 JUL 0200	0.00	0.00	1776.56	0.00	0.00	216.65	0.00	0.00	85.18
28	2 JUL 0300	0.00	0.00	1724.81	0.00	0.00	210.34	0.00	0.00	77.43
29	2 JUL 0400	0.00	0.00	1674.58	0.00	0.00	204.21	0.00	0.00	70.39
30	2 JUL 0500	0.00	0.00	1625.80	0.00	0.00	198.26	0.00	0.00	63.99
31	2 JUL 0600	0.00	0.00	1578.45	0.00	0.00	192.49	0.00	0.00	58.18
32	2 JUL 0700	0.00	0.00	1532.48	0.00	0.00	186.88	0.00	0.00	52.89
33	2 JUL 0800	0.00	0.00	1487.84	0.00	0.00	181.44	0.00	0.00	48.08
34	2 JUL 0900	0.00	0.00	1444.50	0.00	0.00	176.16	0.00	0.00	43.71
35	2 JUL 1000	0.00	0.00	1402.43	0.00	0.00	171.03	0.00	0.00	39.74
36	2 JUL 1100	0.00	0.00	1361.58	0.00	0.00	166.04	0.00	0.00	36.12
37	2 JUL 1200	0.00	0.00	1321.93	0.00	0.00	161.21	0.00	0.00	32.84
38	2 JUL 1300	0.00	0.00	1283.42	0.00	0.00	156.51	0.00	0.00	29.85
39	2 JUL 1400	0.00	0.00	1246.04	0.00	0.00	151.95	0.00	0.00	27.14
40	2 JUL 1500	0.00	0.00	1209.75	0.00	0.00	147.53	0.00	0.00	24.67
41	2 JUL 1600	0.00	0.00	1174.52	0.00	0.00	143.23	0.00	0.00	22.43
42	2 JUL 1700	0.00	0.00	1140.31	0.00	0.00	139.06	0.00	0.00	20.39
43	2 JUL 1800	0.00	0.00	1107.09	0.00	0.00	135.01	0.00	0.00	18.54
44	2 JUL 1900	0.00	0.00	1074.85	0.00	0.00	131.08	0.00	0.00	16.85
45	2 JUL 2000	0.00	0.00	1043.54	0.00	0.00	127.26	0.00	0.00	15.32
46	2 JUL 2100	0.00	0.00	1013.15	0.00	0.00	123.55	0.00	0.00	13.93
47	2 JUL 2200	0.00	0.00	983.64	0.00	0.00	119.95	0.00	0.00	12.66
48	2 JUL 2300	0.00	0.00	954.99	0.00	0.00	116.46	0.00	0.00	11.51
49	3 JUL 0000	0.00	0.00	927.17	0.00	0.00	113.07	0.00	0.00	10.46
50	3 JUL 0100	0.00	0.00	900.17	0.00	0.00	109.77	0.00	0.00	9.51

TABLE 1		STATION		UPPER	UPPER	UPPER	LOCAL	LOCAL	LOCAL	LAKE	LAKE	LAKE
(CONT.)				RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW
PER	DAY	MON	HRMN									
51	3	JUL	0200	0.00	0.00	873.95	0.00	0.00	106.58	0.00	0.00	8.65
52	3	JUL	0300	0.00	0.00	848.50	0.00	0.00	103.47	0.00	0.00	7.86
53	3	JUL	0400	0.00	0.00	823.78	0.00	0.00	100.46	0.00	0.00	7.15
54	3	JUL	0500	0.00	0.00	799.79	0.00	0.00	97.53	0.00	0.00	6.50
55	3	JUL	0600	0.00	0.00	776.49	0.00	0.00	94.69	0.00	0.00	5.91
56	3	JUL	0700	0.00	0.00	753.88	0.00	0.00	91.93	0.00	0.00	5.37
57	3	JUL	0800	0.00	0.00	731.92	0.00	0.00	89.26	0.00	0.00	4.88
58	3	JUL	0900	0.00	0.00	710.60	0.00	0.00	86.66	0.00	0.00	4.44
59	3	JUL	1000	0.00	0.00	689.90	0.00	0.00	84.13	0.00	0.00	4.03
60	3	JUL	1100	0.00	0.00	669.81	0.00	0.00	81.68	0.00	0.00	3.67
61	3	JUL	1200	0.00	0.00	650.30	0.00	0.00	79.30	0.00	0.00	3.33
62	3	JUL	1300	0.00	0.00	631.36	0.00	0.00	76.99	0.00	0.00	3.03
63	3	JUL	1400	0.00	0.00	612.97	0.00	0.00	74.75	0.00	0.00	2.76
64	3	JUL	1500	0.00	0.00	595.12	0.00	0.00	72.57	0.00	0.00	2.50
65	3	JUL	1600	0.00	0.00	577.78	0.00	0.00	70.46	0.00	0.00	2.28
66	3	JUL	1700	0.00	0.00	560.96	0.00	0.00	68.41	0.00	0.00	2.07
67	3	JUL	1800	0.00	0.00	544.62	0.00	0.00	66.42	0.00	0.00	1.88
68	3	JUL	1900	0.00	0.00	528.75	0.00	0.00	64.48	0.00	0.00	1.71
69	3	JUL	2000	0.00	0.00	513.35	0.00	0.00	62.60	0.00	0.00	1.56
70	3	JUL	2100	0.00	0.00	498.40	0.00	0.00	60.78	0.00	0.00	1.41
71	3	JUL	2200	0.00	0.00	483.89	0.00	0.00	59.01	0.00	0.00	1.29
72	3	JUL	2300	0.00	0.00	469.79	0.00	0.00	57.29	0.00	0.00	1.17
73	4	JUL	0000	0.00	0.00	456.11	0.00	0.00	55.62	0.00	0.00	1.06
74	4	JUL	0100	0.00	0.00	442.82	0.00	0.00	54.00	0.00	0.00	0.97
75	4	JUL	0200	0.00	0.00	429.93	0.00	0.00	52.43	0.00	0.00	0.88
76	4	JUL	0300	0.00	0.00	417.40	0.00	0.00	50.90	0.00	0.00	0.80
77	4	JUL	0400	0.00	0.00	405.25	0.00	0.00	49.42	0.00	0.00	0.73
78	4	JUL	0500	0.00	0.00	393.44	0.00	0.00	47.98	0.00	0.00	0.66
79	4	JUL	0600	0.00	0.00	381.98	0.00	0.00	46.58	0.00	0.00	0.60
80	4	JUL	0700	0.00	0.00	370.86	0.00	0.00	45.23	0.00	0.00	0.55
81	4	JUL	0800	0.00	0.00	360.06	0.00	0.00	43.91	0.00	0.00	0.50
82	4	JUL	0900	0.00	0.00	349.57	0.00	0.00	42.63	0.00	0.00	0.45
83	4	JUL	1000	0.00	0.00	339.39	0.00	0.00	41.39	0.00	0.00	0.41
84	4	JUL	1100	0.00	0.00	329.50	0.00	0.00	40.18	0.00	0.00	0.37
85	4	JUL	1200	0.00	0.00	319.91	0.00	0.00	39.01	0.00	0.00	0.34
86	4	JUL	1300	0.00	0.00	310.59	0.00	0.00	37.88	0.00	0.00	0.31
87	4	JUL	1400	0.00	0.00	301.54	0.00	0.00	36.77	0.00	0.00	0.28
88	4	JUL	1500	0.00	0.00	292.76	0.00	0.00	35.70	0.00	0.00	0.25
89	4	JUL	1600	0.00	0.00	284.23	0.00	0.00	34.66	0.00	0.00	0.23
90	4	JUL	1700	0.00	0.00	275.95	0.00	0.00	33.65	0.00	0.00	0.21
91	4	JUL	1800	0.00	0.00	267.92	0.00	0.00	32.67	0.00	0.00	0.19
92	4	JUL	1900	0.00	0.00	260.11	0.00	0.00	31.72	0.00	0.00	0.17
93	4	JUL	2000	0.00	0.00	252.54	0.00	0.00	30.80	0.00	0.00	0.16
94	4	JUL	2100	0.00	0.00	245.18	0.00	0.00	29.90	0.00	0.00	0.14
95	4	JUL	2200	0.00	0.00	238.04	0.00	0.00	29.03	0.00	0.00	0.13
96	4	JUL	2300	0.00	0.00	231.11	0.00	0.00	28.18	0.00	0.00	0.12
97	5	JUL	0000	0.00	0.00	224.38	0.00	0.00	27.36	0.00	0.00	0.11
98	5	JUL	0100	0.00	0.00	217.84	0.00	0.00	26.57	0.00	0.00	0.10
99	5	JUL	0200	0.00	0.00	211.50	0.00	0.00	25.79	0.00	0.00	0.09
100	5	JUL	0300	0.00	0.00	205.34	0.00	0.00	25.04	0.00	0.00	0.08

TABLE 1 (CONT.)				UPPER RAIN	UPPER EXCESS	UPPER FLOW	LOCAL RAIN	LOCAL EXCESS	LOCAL FLOW	LAKE RAIN	LAKE EXCESS	LAKE FLOW
PER	DAY	MON	HRMN									
101	5	JUL	0400	0.00	0.00	199.35	0.00	0.00	24.31	0.00	0.00	0.07
102	5	JUL	0500	0.00	0.00	193.55	0.00	0.00	23.60	0.00	0.00	0.07
103	5	JUL	0600	0.00	0.00	187.91	0.00	0.00	22.92	0.00	0.00	0.06
104	5	JUL	0700	0.00	0.00	182.44	0.00	0.00	22.25	0.00	0.00	0.06
105	5	JUL	0800	0.00	0.00	177.12	0.00	0.00	21.60	0.00	0.00	0.05
106	5	JUL	0900	0.00	0.00	171.97	0.00	0.00	20.97	0.00	0.00	0.05
107	5	JUL	1000	0.00	0.00	166.96	0.00	0.00	20.36	0.00	0.00	0.04
108	5	JUL	1100	0.00	0.00	162.09	0.00	0.00	19.77	0.00	0.00	0.04
109	5	JUL	1200	0.00	0.00	157.37	0.00	0.00	19.19	0.00	0.00	0.03
110	5	JUL	1300	0.00	0.00	152.79	0.00	0.00	18.63	0.00	0.00	0.03
111	5	JUL	1400	0.00	0.00	148.34	0.00	0.00	18.09	0.00	0.00	0.03
112	5	JUL	1500	0.00	0.00	144.02	0.00	0.00	17.56	0.00	0.00	0.03
113	5	JUL	1600	0.00	0.00	139.82	0.00	0.00	17.05	0.00	0.00	0.02
114	5	JUL	1700	0.00	0.00	135.75	0.00	0.00	16.55	0.00	0.00	0.02
115	5	JUL	1800	0.00	0.00	131.80	0.00	0.00	16.07	0.00	0.00	0.02
116	5	JUL	1900	0.00	0.00	127.96	0.00	0.00	15.60	0.00	0.00	0.02
117	5	JUL	2000	0.00	0.00	124.23	0.00	0.00	15.15	0.00	0.00	0.02
118	5	JUL	2100	0.00	0.00	120.61	0.00	0.00	14.71	0.00	0.00	0.01
119	5	JUL	2200	0.00	0.00	117.10	0.00	0.00	14.28	0.00	0.00	0.01
120	5	JUL	2300	0.00	0.00	113.69	0.00	0.00	13.86	0.00	0.00	0.01
121	6	JUL	0000	0.00	0.00	110.38	0.00	0.00	13.46	0.00	0.00	0.01
122	6	JUL	0100	0.00	0.00	107.16	0.00	0.00	13.07	0.00	0.00	0.01
123	6	JUL	0200	0.00	0.00	104.04	0.00	0.00	12.69	0.00	0.00	0.01
124	6	JUL	0300	0.00	0.00	101.01	0.00	0.00	12.32	0.00	0.00	0.01
125	6	JUL	0400	0.00	0.00	98.07	0.00	0.00	11.96	0.00	0.00	0.01
126	6	JUL	0500	0.00	0.00	95.21	0.00	0.00	11.61	0.00	0.00	0.01
127	6	JUL	0600	0.00	0.00	92.44	0.00	0.00	11.27	0.00	0.00	0.01
128	6	JUL	0700	0.00	0.00	89.75	0.00	0.00	10.94	0.00	0.00	0.01
129	6	JUL	0800	0.00	0.00	87.13	0.00	0.00	10.63	0.00	0.00	0.01
130	6	JUL	0900	0.00	0.00	84.60	0.00	0.00	10.32	0.00	0.00	0.00
131	6	JUL	1000	0.00	0.00	82.13	0.00	0.00	10.02	0.00	0.00	0.00
132	6	JUL	1100	0.00	0.00	79.74	0.00	0.00	9.72	0.00	0.00	0.00
133	6	JUL	1200	0.00	0.00	77.42	0.00	0.00	9.44	0.00	0.00	0.00
134	6	JUL	1300	0.00	0.00	75.16	0.00	0.00	9.17	0.00	0.00	0.00
135	6	JUL	1400	0.00	0.00	72.97	0.00	0.00	8.90	0.00	0.00	0.00
136	6	JUL	1500	0.00	0.00	70.85	0.00	0.00	8.64	0.00	0.00	0.00
137	6	JUL	1600	0.00	0.00	68.78	0.00	0.00	8.39	0.00	0.00	0.00
138	6	JUL	1700	0.00	0.00	66.78	0.00	0.00	8.14	0.00	0.00	0.00
139	6	JUL	1800	0.00	0.00	64.84	0.00	0.00	7.91	0.00	0.00	0.00
140	6	JUL	1900	0.00	0.00	62.95	0.00	0.00	7.68	0.00	0.00	0.00
141	6	JUL	2000	0.00	0.00	61.11	0.00	0.00	7.45	0.00	0.00	0.00
142	6	JUL	2100	0.00	0.00	59.33	0.00	0.00	7.24	0.00	0.00	0.00
143	6	JUL	2200	0.00	0.00	57.61	0.00	0.00	7.02	0.00	0.00	0.00
144	6	JUL	2300	0.00	0.00	55.93	0.00	0.00	6.82	0.00	0.00	0.00
145	7	JUL	0000	0.00	0.00	54.30	0.00	0.00	6.62	0.00	0.00	0.00
146	7	JUL	0100	0.00	0.00	52.72	0.00	0.00	6.43	0.00	0.00	0.00
147	7	JUL	0200	0.00	0.00	51.18	0.00	0.00	6.24	0.00	0.00	0.00
148	7	JUL	0300	0.00	0.00	49.69	0.00	0.00	6.06	0.00	0.00	0.00
149	7	JUL	0400	0.00	0.00	48.24	0.00	0.00	5.88	0.00	0.00	0.00
150	7	JUL	0500	0.00	0.00	46.84	0.00	0.00	5.71	0.00	0.00	0.00

TABLE 1		STATION		UPPER	UPPER	UPPER	LOCAL	LOCAL	LOCAL	LAKE	LAKE	LAKE
(CONT.)				RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW
PER	DAY	MON	HRMN									
151	7	JUL	0600	0.00	0.00	45.47	0.00	0.00	5.55	0.00	0.00	0.00
152	7	JUL	0700	0.00	0.00	44.15	0.00	0.00	5.38	0.00	0.00	0.00
153	7	JUL	0800	0.00	0.00	42.86	0.00	0.00	5.23	0.00	0.00	0.00
154	7	JUL	0900	0.00	0.00	41.62	0.00	0.00	5.07	0.00	0.00	0.00
155	7	JUL	1000	0.00	0.00	40.40	0.00	0.00	4.93	0.00	0.00	0.00
156	7	JUL	1100	0.00	0.00	39.23	0.00	0.00	4.78	0.00	0.00	0.00
157	7	JUL	1200	0.00	0.00	38.08	0.00	0.00	4.64	0.00	0.00	0.00
158	7	JUL	1300	0.00	0.00	36.97	0.00	0.00	4.51	0.00	0.00	0.00
159	7	JUL	1400	0.00	0.00	35.90	0.00	0.00	4.38	0.00	0.00	0.00
160	7	JUL	1500	0.00	0.00	34.85	0.00	0.00	4.25	0.00	0.00	0.00
161	7	JUL	1600	0.00	0.00	33.84	0.00	0.00	4.13	0.00	0.00	0.00
162	7	JUL	1700	0.00	0.00	32.85	0.00	0.00	4.01	0.00	0.00	0.00
163	7	JUL	1800	0.00	0.00	31.89	0.00	0.00	3.89	0.00	0.00	0.00
164	7	JUL	1900	0.00	0.00	30.97	0.00	0.00	3.78	0.00	0.00	0.00
165	7	JUL	2000	0.00	0.00	30.06	0.00	0.00	3.67	0.00	0.00	0.00
166	7	JUL	2100	0.00	0.00	29.19	0.00	0.00	3.56	0.00	0.00	0.00
167	7	JUL	2200	0.00	0.00	28.34	0.00	0.00	3.46	0.00	0.00	0.00
168	7	JUL	2300	0.00	0.00	27.51	0.00	0.00	3.36	0.00	0.00	0.00
169	8	JUL	0000	0.00	0.00	26.71	0.00	0.00	3.26	0.00	0.00	0.00
170	8	JUL	0100	0.00	0.00	25.93	0.00	0.00	3.16	0.00	0.00	0.00
171	8	JUL	0200	0.00	0.00	25.18	0.00	0.00	3.07	0.00	0.00	0.00
172	8	JUL	0300	0.00	0.00	24.44	0.00	0.00	2.98	0.00	0.00	0.00
173	8	JUL	0400	0.00	0.00	23.73	0.00	0.00	2.89	0.00	0.00	0.00
174	8	JUL	0500	0.00	0.00	23.04	0.00	0.00	2.81	0.00	0.00	0.00
175	8	JUL	0600	0.00	0.00	22.37	0.00	0.00	2.73	0.00	0.00	0.00
176	8	JUL	0700	0.00	0.00	21.72	0.00	0.00	2.65	0.00	0.00	0.00
177	8	JUL	0800	0.00	0.00	21.09	0.00	0.00	2.57	0.00	0.00	0.00
178	8	JUL	0900	0.00	0.00	20.47	0.00	0.00	2.50	0.00	0.00	0.00
179	8	JUL	1000	0.00	0.00	19.88	0.00	0.00	2.42	0.00	0.00	0.00
180	8	JUL	1100	0.00	0.00	19.30	0.00	0.00	2.35	0.00	0.00	0.00
181	8	JUL	1200	0.00	0.00	18.73	0.00	0.00	2.28	0.00	0.00	0.00
182	8	JUL	1300	0.00	0.00	18.19	0.00	0.00	2.22	0.00	0.00	0.00
183	8	JUL	1400	0.00	0.00	17.66	0.00	0.00	2.15	0.00	0.00	0.00
184	8	JUL	1500	0.00	0.00	17.15	0.00	0.00	2.09	0.00	0.00	0.00
185	8	JUL	1600	0.00	0.00	16.65	0.00	0.00	2.03	0.00	0.00	0.00
186	8	JUL	1700	0.00	0.00	16.16	0.00	0.00	1.97	0.00	0.00	0.00
187	8	JUL	1800	0.00	0.00	15.69	0.00	0.00	1.91	0.00	0.00	0.00
188	8	JUL	1900	0.00	0.00	15.23	0.00	0.00	1.86	0.00	0.00	0.00
189	8	JUL	2000	0.00	0.00	14.79	0.00	0.00	1.80	0.00	0.00	0.00
190	8	JUL	2100	0.00	0.00	14.36	0.00	0.00	1.75	0.00	0.00	0.00
191	8	JUL	2200	0.00	0.00	13.94	0.00	0.00	1.70	0.00	0.00	0.00
192	8	JUL	2300	0.00	0.00	13.53	0.00	0.00	1.65	0.00	0.00	0.00
193	9	JUL	0000	0.00	0.00	13.14	0.00	0.00	1.60	0.00	0.00	0.00
194	9	JUL	0100	0.00	0.00	12.76	0.00	0.00	1.56	0.00	0.00	0.00
195	9	JUL	0200	0.00	0.00	12.39	0.00	0.00	1.51	0.00	0.00	0.00
196	9	JUL	0300	0.00	0.00	12.03	0.00	0.00	1.47	0.00	0.00	0.00
197	9	JUL	0400	0.00	0.00	11.67	0.00	0.00	1.42	0.00	0.00	0.00
198	9	JUL	0500	0.00	0.00	11.33	0.00	0.00	1.38	0.00	0.00	0.00
199	9	JUL	0600	0.00	0.00	11.00	0.00	0.00	1.34	0.00	0.00	0.00
200	9	JUL	0700	0.00	0.00	10.68	0.00	0.00	1.30	0.00	0.00	0.00

TABLE 1  
(CONT.)

STATION				UPPER	UPPER	UPPER	LOCAL	LOCAL	LOCAL	LAKE	LAKE	LAKE
				RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW
PER	DAY	MON	HRMN									
201	9	JUL	0800	0.00	0.00	10.37	0.00	0.00	1.26	0.00	0.00	0.00
202	9	JUL	0900	0.00	0.00	10.07	0.00	0.00	1.23	0.00	0.00	0.00
203	9	JUL	1000	0.00	0.00	9.78	0.00	0.00	1.19	0.00	0.00	0.00
204	9	JUL	1100	0.00	0.00	9.49	0.00	0.00	1.16	0.00	0.00	0.00
205	9	JUL	1200	0.00	0.00	9.22	0.00	0.00	1.12	0.00	0.00	0.00
206	9	JUL	1300	0.00	0.00	8.95	0.00	0.00	1.09	0.00	0.00	0.00
207	9	JUL	1400	0.00	0.00	8.69	0.00	0.00	1.06	0.00	0.00	0.00
208	9	JUL	1500	0.00	0.00	8.43	0.00	0.00	1.03	0.00	0.00	0.00
209	9	JUL	1600	0.00	0.00	8.19	0.00	0.00	1.00	0.00	0.00	0.00
210	9	JUL	1700	0.00	0.00	7.95	0.00	0.00	0.97	0.00	0.00	0.00
211	9	JUL	1800	0.00	0.00	7.72	0.00	0.00	0.94	0.00	0.00	0.00
212	9	JUL	1900	0.00	0.00	7.49	0.00	0.00	0.91	0.00	0.00	0.00
213	9	JUL	2000	0.00	0.00	7.28	0.00	0.00	0.89	0.00	0.00	0.00
214	9	JUL	2100	0.00	0.00	7.06	0.00	0.00	0.86	0.00	0.00	0.00
215	9	JUL	2200	0.00	0.00	6.86	0.00	0.00	0.84	0.00	0.00	0.00
216	9	JUL	2300	0.00	0.00	6.66	0.00	0.00	0.81	0.00	0.00	0.00
217	10	JUL	0000	0.00	0.00	6.46	0.00	0.00	0.79	0.00	0.00	0.00
218	10	JUL	0100	0.00	0.00	6.28	0.00	0.00	0.77	0.00	0.00	0.00
219	10	JUL	0200	0.00	0.00	6.09	0.00	0.00	0.74	0.00	0.00	0.00
220	10	JUL	0300	0.00	0.00	5.92	0.00	0.00	0.72	0.00	0.00	0.00
221	10	JUL	0400	0.00	0.00	5.74	0.00	0.00	0.70	0.00	0.00	0.00
222	10	JUL	0500	0.00	0.00	5.58	0.00	0.00	0.68	0.00	0.00	0.00
223	10	JUL	0600	0.00	0.00	5.41	0.00	0.00	0.66	0.00	0.00	0.00
224	10	JUL	0700	0.00	0.00	5.26	0.00	0.00	0.64	0.00	0.00	0.00
225	10	JUL	0800	0.00	0.00	5.10	0.00	0.00	0.62	0.00	0.00	0.00
226	10	JUL	0900	0.00	0.00	4.95	0.00	0.00	0.60	0.00	0.00	0.00
227	10	JUL	1000	0.00	0.00	4.81	0.00	0.00	0.59	0.00	0.00	0.00
228	10	JUL	1100	0.00	0.00	4.67	0.00	0.00	0.57	0.00	0.00	0.00
229	10	JUL	1200	0.00	0.00	4.53	0.00	0.00	0.55	0.00	0.00	0.00
230	10	JUL	1300	0.00	0.00	4.40	0.00	0.00	0.54	0.00	0.00	0.00
231	10	JUL	1400	0.00	0.00	4.27	0.00	0.00	0.52	0.00	0.00	0.00
232	10	JUL	1500	0.00	0.00	4.15	0.00	0.00	0.51	0.00	0.00	0.00
233	10	JUL	1600	0.00	0.00	4.03	0.00	0.00	0.49	0.00	0.00	0.00
234	10	JUL	1700	0.00	0.00	3.91	0.00	0.00	0.48	0.00	0.00	0.00
235	10	JUL	1800	0.00	0.00	3.80	0.00	0.00	0.46	0.00	0.00	0.00
236	10	JUL	1900	0.00	0.00	3.69	0.00	0.00	0.45	0.00	0.00	0.00
237	10	JUL	2000	0.00	0.00	3.58	0.00	0.00	0.44	0.00	0.00	0.00
238	10	JUL	2100	0.00	0.00	3.47	0.00	0.00	0.42	0.00	0.00	0.00
239	10	JUL	2200	0.00	0.00	3.37	0.00	0.00	0.41	0.00	0.00	0.00
240	10	JUL	2300	0.00	0.00	3.28	0.00	0.00	0.40	0.00	0.00	0.00
241	11	JUL	0000	0.00	0.00	3.18	0.00	0.00	0.39	0.00	0.00	0.00
242	11	JUL	0100	0.00	0.00	3.09	0.00	0.00	0.38	0.00	0.00	0.00
243	11	JUL	0200	0.00	0.00	3.00	0.00	0.00	0.37	0.00	0.00	0.00
244	11	JUL	0300	0.00	0.00	2.91	0.00	0.00	0.35	0.00	0.00	0.00
245	11	JUL	0400	0.00	0.00	2.83	0.00	0.00	0.34	0.00	0.00	0.00
246	11	JUL	0500	0.00	0.00	2.74	0.00	0.00	0.33	0.00	0.00	0.00
247	11	JUL	0600	0.00	0.00	2.66	0.00	0.00	0.32	0.00	0.00	0.00
248	11	JUL	0700	0.00	0.00	2.59	0.00	0.00	0.32	0.00	0.00	0.00
249	11	JUL	0800	0.00	0.00	2.51	0.00	0.00	0.31	0.00	0.00	0.00
250	11	JUL	0900	0.00	0.00	2.44	0.00	0.00	0.30	0.00	0.00	0.00

TABLE 1		STATION		UPPER	UPPER	UPPER	LOCAL	LOCAL	LOCAL	LAKE	LAKE	LAKE
(CONT.)				RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW	RAIN	EXCESS	FLOW
PER	DAY	MON	HRMN									
251	11	JUL	1000	0.00	0.00	2.37	0.00	0.00	0.29	0.00	0.00	0.00
252	11	JUL	1100	0.00	0.00	2.30	0.00	0.00	0.28	0.00	0.00	0.00
253	11	JUL	1200	0.00	0.00	2.23	0.00	0.00	0.27	0.00	0.00	0.00
254	11	JUL	1300	0.00	0.00	2.17	0.00	0.00	0.26	0.00	0.00	0.00
255	11	JUL	1400	0.00	0.00	2.10	0.00	0.00	0.26	0.00	0.00	0.00
256	11	JUL	1500	0.00	0.00	2.04	0.00	0.00	0.25	0.00	0.00	0.00
257	11	JUL	1600	0.00	0.00	1.98	0.00	0.00	0.24	0.00	0.00	0.00
258	11	JUL	1700	0.00	0.00	1.92	0.00	0.00	0.23	0.00	0.00	0.00
259	11	JUL	1800	0.00	0.00	1.87	0.00	0.00	0.23	0.00	0.00	0.00
260	11	JUL	1900	0.00	0.00	1.81	0.00	0.00	0.22	0.00	0.00	0.00
261	11	JUL	2000	0.00	0.00	1.76	0.00	0.00	0.21	0.00	0.00	0.00
262	11	JUL	2100	0.00	0.00	1.71	0.00	0.00	0.21	0.00	0.00	0.00
263	11	JUL	2200	0.00	0.00	1.66	0.00	0.00	0.20	0.00	0.00	0.00
264	11	JUL	2300	0.00	0.00	1.61	0.00	0.00	0.20	0.00	0.00	0.00
265	12	JUL	0000	0.00	0.00	1.56	0.00	0.00	0.19	0.00	0.00	0.00
266	12	JUL	0100	0.00	0.00	1.52	0.00	0.00	0.19	0.00	0.00	0.00
267	12	JUL	0200	0.00	0.00	1.47	0.00	0.00	0.18	0.00	0.00	0.00
268	12	JUL	0300	0.00	0.00	1.43	0.00	0.00	0.17	0.00	0.00	0.00
269	12	JUL	0400	0.00	0.00	1.39	0.00	0.00	0.17	0.00	0.00	0.00
270	12	JUL	0500	0.00	0.00	1.35	0.00	0.00	0.16	0.00	0.00	0.00
271	12	JUL	0600	0.00	0.00	1.31	0.00	0.00	0.16	0.00	0.00	0.00
272	12	JUL	0700	0.00	0.00	1.27	0.00	0.00	0.16	0.00	0.00	0.00
273	12	JUL	0800	0.00	0.00	1.23	0.00	0.00	0.15	0.00	0.00	0.00
274	12	JUL	0900	0.00	0.00	1.20	0.00	0.00	0.15	0.00	0.00	0.00
275	12	JUL	1000	0.00	0.00	1.16	0.00	0.00	0.14	0.00	0.00	0.00
276	12	JUL	1100	0.00	0.00	1.13	0.00	0.00	0.14	0.00	0.00	0.00
277	12	JUL	1200	0.00	0.00	1.10	0.00	0.00	0.13	0.00	0.00	0.00
278	12	JUL	1300	0.00	0.00	1.07	0.00	0.00	0.13	0.00	0.00	0.00
279	12	JUL	1400	0.00	0.00	1.03	0.00	0.00	0.13	0.00	0.00	0.00
280	12	JUL	1500	0.00	0.00	1.00	0.00	0.00	0.12	0.00	0.00	0.00
281	12	JUL	1600	0.00	0.00	0.97	0.00	0.00	0.12	0.00	0.00	0.00
282	12	JUL	1700	0.00	0.00	0.95	0.00	0.00	0.12	0.00	0.00	0.00
283	12	JUL	1800	0.00	0.00	0.92	0.00	0.00	0.11	0.00	0.00	0.00
284	12	JUL	1900	0.00	0.00	0.89	0.00	0.00	0.11	0.00	0.00	0.00
285	12	JUL	2000	0.00	0.00	0.87	0.00	0.00	0.11	0.00	0.00	0.00
286	12	JUL	2100	0.00	0.00	0.84	0.00	0.00	0.10	0.00	0.00	0.00
287	12	JUL	2200	0.00	0.00	0.82	0.00	0.00	0.10	0.00	0.00	0.00
288	12	JUL	2300	0.00	0.00	0.79	0.00	0.00	0.10	0.00	0.00	0.00
			MAX	1.00	1.00	28992.00	1.00	1.00	4198.00	1.00	1.00	8470.00
			MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			AVE	0.00	0.00	776.73	0.00	0.00	77.59	0.00	0.00	61.45

1TABLE 2		STATION	INFL FLOW	RELE FLOW	NETIN FLOW	ELDR STAGE	ELDR FLOW	CONSPL FLOW	
PER	DAY	MON	HRMN						
1	1	JUL	0000	0.00	0.00	0.00	1339.00	0.00	0.00
2	1	JUL	0100	14818.00	0.00	14818.00	1339.08	0.00	0.00
3	1	JUL	0200	23416.96	0.00	23416.96	1339.27	0.00	0.00
4	1	JUL	0300	30560.70	0.00	30560.70	1339.54	0.00	0.00
5	1	JUL	0400	27082.48	0.00	27082.48	1339.84	0.00	0.00
6	1	JUL	0500	20153.36	0.00	20153.36	1340.07	0.00	0.00
7	1	JUL	0600	13880.32	0.00	13880.32	1340.24	0.00	0.00
8	1	JUL	0700	9298.83	0.00	9298.83	1340.35	0.00	0.00
9	1	JUL	0800	6218.40	0.00	6218.40	1340.43	0.00	0.00
10	1	JUL	0900	4220.61	0.00	4220.61	1340.48	0.00	0.00
11	1	JUL	1000	3589.89	0.00	3589.89	1340.52	0.00	0.00
12	1	JUL	1100	3461.15	0.00	3461.15	1340.55	0.00	0.00
13	1	JUL	1200	3338.36	0.00	3338.36	1340.59	0.00	0.00
14	1	JUL	1300	3221.14	0.00	3221.14	1340.62	0.00	0.00
15	1	JUL	1400	3109.16	0.00	3109.16	1340.65	0.00	0.00
16	1	JUL	1500	3002.08	0.00	3002.08	1340.68	0.00	0.00
17	1	JUL	1600	2899.63	0.00	2899.63	1340.71	0.00	0.00
18	1	JUL	1700	2801.52	0.00	2801.52	1340.74	0.00	0.00
19	1	JUL	1800	2707.52	0.00	2707.52	1340.76	0.00	0.00
20	1	JUL	1900	2617.38	0.00	2617.38	1340.79	0.00	0.00
21	1	JUL	2000	2530.89	0.00	2530.89	1340.82	0.00	0.00
22	1	JUL	2100	2447.85	0.00	2447.85	1340.84	0.00	0.00
23	1	JUL	2200	2368.08	0.00	2368.08	1340.86	0.00	0.00
24	1	JUL	2300	2291.40	0.00	2291.40	1340.89	0.00	0.00
25	2	JUL	0000	2217.66	0.00	2217.66	1340.91	0.00	0.00
26	2	JUL	0100	2146.70	0.00	2146.70	1340.93	0.00	0.00
27	2	JUL	0200	2078.38	0.00	2078.38	1340.95	0.00	0.00
28	2	JUL	0300	2012.59	0.00	2012.59	1340.97	0.00	0.00
29	2	JUL	0400	1949.18	0.00	1949.18	1340.99	0.00	0.00
30	2	JUL	0500	1888.06	0.00	1888.06	1341.01	0.00	0.00
31	2	JUL	0600	1829.12	0.00	1829.12	1341.03	0.00	0.00
32	2	JUL	0700	1772.25	0.00	1772.25	1341.04	0.00	0.00
33	2	JUL	0800	1717.36	0.00	1717.36	1341.06	0.00	0.00
34	2	JUL	0900	1664.37	0.00	1664.37	1341.08	0.00	0.00
35	2	JUL	1000	1613.19	0.00	1613.19	1341.09	0.00	0.00
36	2	JUL	1100	1563.75	0.00	1563.75	1341.11	0.00	0.00
37	2	JUL	1200	1515.97	0.00	1515.97	1341.12	0.00	0.00
38	2	JUL	1300	1469.79	0.00	1469.79	1341.13	0.00	0.00
39	2	JUL	1400	1425.14	0.00	1425.14	1341.15	0.00	0.00
40	2	JUL	1500	1381.95	0.00	1381.95	1341.16	0.00	0.00
41	2	JUL	1600	1340.18	0.00	1340.18	1341.17	0.00	0.00
42	2	JUL	1700	1299.76	0.00	1299.76	1341.19	0.00	0.00
43	2	JUL	1800	1260.64	0.00	1260.64	1341.20	0.00	0.00
44	2	JUL	1900	1222.78	0.00	1222.78	1341.21	0.00	0.00
45	2	JUL	2000	1186.12	0.00	1186.12	1341.22	0.00	0.00
46	2	JUL	2100	1150.63	0.00	1150.63	1341.23	0.00	0.00
47	2	JUL	2200	1116.25	0.00	1116.25	1341.24	0.00	0.00
48	2	JUL	2300	1082.96	0.00	1082.96	1341.25	0.00	0.00
49	3	JUL	0000	1050.70	0.00	1050.70	1341.26	0.00	0.00
50	3	JUL	0100	1019.46	0.00	1019.46	1341.27	0.00	0.00

TABLE 2 (CONT.)		STATION	INFL FLOW	RELE FLOW	NETIN FLOW	ELDR STAGE	ELDR FLOW	CONSPL FLOW
PER	DAY	MON	HRMN					
51	3	JUL	0200	989.17	0.00	989.17	1341.28	0.00
52	3	JUL	0300	959.83	0.00	959.83	1341.29	0.00
53	3	JUL	0400	931.39	0.00	931.39	1341.30	0.00
54	3	JUL	0500	903.82	0.00	903.82	1341.31	0.00
55	3	JUL	0600	877.09	0.00	877.09	1341.32	0.00
56	3	JUL	0700	851.18	0.00	851.18	1341.33	0.00
57	3	JUL	0800	826.06	0.00	826.06	1341.33	0.00
58	3	JUL	0900	801.70	0.00	801.70	1341.34	0.00
59	3	JUL	1000	778.07	0.00	778.07	1341.35	0.00
60	3	JUL	1100	755.16	0.00	755.16	1341.36	0.00
61	3	JUL	1200	732.94	0.00	732.94	1341.36	0.00
62	3	JUL	1300	711.39	0.00	711.39	1341.37	0.00
63	3	JUL	1400	690.48	0.00	690.48	1341.38	0.00
64	3	JUL	1500	670.20	0.00	670.20	1341.38	0.00
65	3	JUL	1600	650.52	0.00	650.52	1341.39	0.00
66	3	JUL	1700	631.43	0.00	631.43	1341.40	0.00
67	3	JUL	1800	612.91	0.00	612.91	1341.40	0.00
68	3	JUL	1900	594.95	0.00	594.95	1341.41	0.00
69	3	JUL	2000	577.51	0.00	577.51	1341.41	0.00
70	3	JUL	2100	560.60	0.00	560.60	1341.42	0.00
71	3	JUL	2200	544.18	0.00	544.18	1341.42	0.00
72	3	JUL	2300	528.25	0.00	528.25	1341.43	0.00
73	4	JUL	0000	512.79	0.00	512.79	1341.43	0.00
74	4	JUL	0100	497.79	0.00	497.79	1341.44	0.00
75	4	JUL	0200	483.23	0.00	483.23	1341.44	0.00
76	4	JUL	0300	469.10	0.00	469.10	1341.45	0.00
77	4	JUL	0400	455.39	0.00	455.39	1341.45	0.00
78	4	JUL	0500	442.08	0.00	442.08	1341.46	0.00
79	4	JUL	0600	429.17	0.00	429.17	1341.46	0.00
80	4	JUL	0700	416.63	0.00	416.63	1341.46	0.00
81	4	JUL	0800	404.46	0.00	404.46	1341.47	0.00
82	4	JUL	0900	392.65	0.00	392.65	1341.47	0.00
83	4	JUL	1000	381.19	0.00	381.19	1341.48	0.00
84	4	JUL	1100	370.06	0.00	370.06	1341.48	0.00
85	4	JUL	1200	359.26	0.00	359.26	1341.48	0.00
86	4	JUL	1300	348.77	0.00	348.77	1341.49	0.00
87	4	JUL	1400	338.59	0.00	338.59	1341.49	0.00
88	4	JUL	1500	328.71	0.00	328.71	1341.49	0.00
89	4	JUL	1600	319.12	0.00	319.12	1341.50	0.00
90	4	JUL	1700	309.82	0.00	309.82	1341.50	0.00
91	4	JUL	1800	300.78	0.00	300.78	1341.50	0.00
92	4	JUL	1900	292.01	0.00	292.01	1341.50	0.00
93	4	JUL	2000	283.49	0.00	283.49	1341.51	0.00
94	4	JUL	2100	275.22	0.00	275.22	1341.51	0.00
95	4	JUL	2200	267.20	0.00	267.20	1341.51	0.00
96	4	JUL	2300	259.41	0.00	259.41	1341.51	0.00
97	5	JUL	0000	251.85	0.00	251.85	1341.52	0.00
98	5	JUL	0100	244.50	0.00	244.50	1341.52	0.00
99	5	JUL	0200	237.38	0.00	237.38	1341.52	0.00
100	5	JUL	0300	230.46	0.00	230.46	1341.52	0.00

TABLE 2		STATION		INFL	RELE	NETIN	ELDR	ELDR	CONSPL
(CONT.)				FLOW	FLOW	FLOW	STAGE	FLOW	FLOW
PER	DAY	MON	HRMN						
101	5	JUL	0400	223.74	0.00	223.74	1341.53	0.00	0.00
102	5	JUL	0500	217.22	0.00	217.22	1341.53	0.00	0.00
103	5	JUL	0600	210.89	0.00	210.89	1341.53	0.00	0.00
104	5	JUL	0700	204.74	0.00	204.74	1341.53	0.00	0.00
105	5	JUL	0800	198.77	0.00	198.77	1341.53	0.00	0.00
106	5	JUL	0900	192.98	0.00	192.98	1341.54	0.00	0.00
107	5	JUL	1000	187.36	0.00	187.36	1341.54	0.00	0.00
108	5	JUL	1100	181.90	0.00	181.90	1341.54	0.00	0.00
109	5	JUL	1200	176.60	0.00	176.60	1341.54	0.00	0.00
110	5	JUL	1300	171.45	0.00	171.45	1341.54	0.00	0.00
111	5	JUL	1400	166.46	0.00	166.46	1341.54	0.00	0.00
112	5	JUL	1500	161.61	0.00	161.61	1341.55	0.00	0.00
113	5	JUL	1600	156.90	0.00	156.90	1341.55	0.00	0.00
114	5	JUL	1700	152.33	0.00	152.33	1341.55	0.00	0.00
115	5	JUL	1800	147.89	0.00	147.89	1341.55	0.00	0.00
116	5	JUL	1900	143.58	0.00	143.58	1341.55	0.00	0.00
117	5	JUL	2000	139.40	0.00	139.40	1341.55	0.00	0.00
118	5	JUL	2100	135.34	0.00	135.34	1341.55	0.00	0.00
119	5	JUL	2200	131.39	0.00	131.39	1341.56	0.00	0.00
120	5	JUL	2300	127.57	0.00	127.57	1341.56	0.00	0.00
121	6	JUL	0000	123.85	0.00	123.85	1341.56	0.00	0.00
122	6	JUL	0100	120.24	0.00	120.24	1341.56	0.00	0.00
123	6	JUL	0200	116.74	0.00	116.74	1341.56	0.00	0.00
124	6	JUL	0300	113.34	0.00	113.34	1341.56	0.00	0.00
125	6	JUL	0400	110.04	0.00	110.04	1341.56	0.00	0.00
126	6	JUL	0500	106.83	0.00	106.83	1341.56	0.00	0.00
127	6	JUL	0600	103.72	0.00	103.72	1341.56	0.00	0.00
128	6	JUL	0700	100.70	0.00	100.70	1341.57	0.00	0.00
129	6	JUL	0800	97.76	0.00	97.76	1341.57	0.00	0.00
130	6	JUL	0900	94.92	0.00	94.92	1341.57	0.00	0.00
131	6	JUL	1000	92.15	0.00	92.15	1341.57	0.00	0.00
132	6	JUL	1100	89.47	0.00	89.47	1341.57	0.00	0.00
133	6	JUL	1200	86.86	0.00	86.86	1341.57	0.00	0.00
134	6	JUL	1300	84.33	0.00	84.33	1341.57	0.00	0.00
135	6	JUL	1400	81.87	0.00	81.87	1341.57	0.00	0.00
136	6	JUL	1500	79.49	0.00	79.49	1341.57	0.00	0.00
137	6	JUL	1600	77.17	0.00	77.17	1341.57	0.00	0.00
138	6	JUL	1700	74.93	0.00	74.93	1341.57	0.00	0.00
139	6	JUL	1800	72.74	0.00	72.74	1341.57	0.00	0.00
140	6	JUL	1900	70.63	0.00	70.63	1341.58	0.00	0.00
141	6	JUL	2000	68.57	0.00	68.57	1341.58	0.00	0.00
142	6	JUL	2100	66.57	0.00	66.57	1341.58	0.00	0.00
143	6	JUL	2200	64.63	0.00	64.63	1341.58	0.00	0.00
144	6	JUL	2300	62.75	0.00	62.75	1341.58	0.00	0.00
145	7	JUL	0000	60.92	0.00	60.92	1341.58	0.00	0.00
146	7	JUL	0100	59.15	0.00	59.15	1341.58	0.00	0.00
147	7	JUL	0200	57.42	0.00	57.42	1341.58	0.00	0.00
148	7	JUL	0300	55.75	0.00	55.75	1341.58	0.00	0.00
149	7	JUL	0400	54.13	0.00	54.13	1341.58	0.00	0.00
150	7	JUL	0500	52.55	0.00	52.55	1341.58	0.00	0.00

TABLE 2		STATION		INFL	RELE	NETIN	ELDR	ELDR	CONSPL
(CONT.)				FLOW	FLOW	FLOW	STAGE	FLOW	FLOW
PER	DAY	MON	HRMN						
151	7	JUL	0600	51.02	0.00	51.02	1341.58	0.00	0.00
152	7	JUL	0700	49.53	0.00	49.53	1341.58	0.00	0.00
153	7	JUL	0800	48.09	0.00	48.09	1341.58	0.00	0.00
154	7	JUL	0900	46.69	0.00	46.69	1341.58	0.00	0.00
155	7	JUL	1000	45.33	0.00	45.33	1341.58	0.00	0.00
156	7	JUL	1100	44.01	0.00	44.01	1341.58	0.00	0.00
157	7	JUL	1200	42.73	0.00	42.73	1341.58	0.00	0.00
158	7	JUL	1300	41.48	0.00	41.48	1341.58	0.00	0.00
159	7	JUL	1400	40.28	0.00	40.28	1341.58	0.00	0.00
160	7	JUL	1500	39.10	0.00	39.10	1341.59	0.00	0.00
161	7	JUL	1600	37.96	0.00	37.96	1341.59	0.00	0.00
162	7	JUL	1700	36.86	0.00	36.86	1341.59	0.00	0.00
163	7	JUL	1800	35.78	0.00	35.78	1341.59	0.00	0.00
164	7	JUL	1900	34.74	0.00	34.74	1341.59	0.00	0.00
165	7	JUL	2000	33.73	0.00	33.73	1341.59	0.00	0.00
166	7	JUL	2100	32.75	0.00	32.75	1341.59	0.00	0.00
167	7	JUL	2200	31.79	0.00	31.79	1341.59	0.00	0.00
168	7	JUL	2300	30.87	0.00	30.87	1341.59	0.00	0.00
169	8	JUL	0000	29.97	0.00	29.97	1341.59	0.00	0.00
170	8	JUL	0100	29.10	0.00	29.10	1341.59	0.00	0.00
171	8	JUL	0200	28.25	0.00	28.25	1341.59	0.00	0.00
172	8	JUL	0300	27.43	0.00	27.43	1341.59	0.00	0.00
173	8	JUL	0400	26.63	0.00	26.63	1341.59	0.00	0.00
174	8	JUL	0500	25.85	0.00	25.85	1341.59	0.00	0.00
175	8	JUL	0600	25.10	0.00	25.10	1341.59	0.00	0.00
176	8	JUL	0700	24.37	0.00	24.37	1341.59	0.00	0.00
177	8	JUL	0800	23.66	0.00	23.66	1341.59	0.00	0.00
178	8	JUL	0900	22.97	0.00	22.97	1341.59	0.00	0.00
179	8	JUL	1000	22.30	0.00	22.30	1341.59	0.00	0.00
180	8	JUL	1100	21.65	0.00	21.65	1341.59	0.00	0.00
181	8	JUL	1200	21.02	0.00	21.02	1341.59	0.00	0.00
182	8	JUL	1300	20.41	0.00	20.41	1341.59	0.00	0.00
183	8	JUL	1400	19.81	0.00	19.81	1341.59	0.00	0.00
184	8	JUL	1500	19.24	0.00	19.24	1341.59	0.00	0.00
185	8	JUL	1600	18.68	0.00	18.68	1341.59	0.00	0.00
186	8	JUL	1700	18.13	0.00	18.13	1341.59	0.00	0.00
187	8	JUL	1800	17.60	0.00	17.60	1341.59	0.00	0.00
188	8	JUL	1900	17.09	0.00	17.09	1341.59	0.00	0.00
189	8	JUL	2000	16.59	0.00	16.59	1341.59	0.00	0.00
190	8	JUL	2100	16.11	0.00	16.11	1341.59	0.00	0.00
191	8	JUL	2200	15.64	0.00	15.64	1341.59	0.00	0.00
192	8	JUL	2300	15.18	0.00	15.18	1341.59	0.00	0.00
193	9	JUL	0000	14.74	0.00	14.74	1341.59	0.00	0.00
194	9	JUL	0100	14.31	0.00	14.31	1341.59	0.00	0.00
195	9	JUL	0200	13.90	0.00	13.90	1341.59	0.00	0.00
196	9	JUL	0300	13.49	0.00	13.49	1341.59	0.00	0.00
197	9	JUL	0400	13.10	0.00	13.10	1341.59	0.00	0.00
198	9	JUL	0500	12.72	0.00	12.72	1341.59	0.00	0.00
199	9	JUL	0600	12.35	0.00	12.35	1341.59	0.00	0.00
200	9	JUL	0700	11.99	0.00	11.99	1341.59	0.00	0.00

TABLE 2		STATION		INFL	RELE	NETIN	ELDR	ELDR	CONSPL
(CONT.)				FLOW	FLOW	FLOW	STAGE	FLOW	FLOW
PER	DAY	MON	HRMN						
201	9	JUL	0800	11.64	0.00	11.64	1341.59	0.00	0.00
202	9	JUL	0900	11.30	0.00	11.30	1341.59	0.00	0.00
203	9	JUL	1000	10.97	0.00	10.97	1341.59	0.00	0.00
204	9	JUL	1100	10.65	0.00	10.65	1341.59	0.00	0.00
205	9	JUL	1200	10.34	0.00	10.34	1341.59	0.00	0.00
206	9	JUL	1300	10.04	0.00	10.04	1341.59	0.00	0.00
207	9	JUL	1400	9.75	0.00	9.75	1341.59	0.00	0.00
208	9	JUL	1500	9.46	0.00	9.46	1341.59	0.00	0.00
209	9	JUL	1600	9.19	0.00	9.19	1341.59	0.00	0.00
210	9	JUL	1700	8.92	0.00	8.92	1341.59	0.00	0.00
211	9	JUL	1800	8.66	0.00	8.66	1341.60	0.00	0.00
212	9	JUL	1900	8.41	0.00	8.41	1341.60	0.00	0.00
213	9	JUL	2000	8.16	0.00	8.16	1341.60	0.00	0.00
214	9	JUL	2100	7.92	0.00	7.92	1341.60	0.00	0.00
215	9	JUL	2200	7.69	0.00	7.69	1341.60	0.00	0.00
216	9	JUL	2300	7.47	0.00	7.47	1341.60	0.00	0.00
217	10	JUL	0000	7.25	0.00	7.25	1341.60	0.00	0.00
218	10	JUL	0100	7.04	0.00	7.04	1341.60	0.00	0.00
219	10	JUL	0200	6.84	0.00	6.84	1341.60	0.00	0.00
220	10	JUL	0300	6.64	0.00	6.64	1341.60	0.00	0.00
221	10	JUL	0400	6.44	0.00	6.44	1341.60	0.00	0.00
222	10	JUL	0500	6.26	0.00	6.26	1341.60	0.00	0.00
223	10	JUL	0600	6.07	0.00	6.07	1341.60	0.00	0.00
224	10	JUL	0700	5.90	0.00	5.90	1341.60	0.00	0.00
225	10	JUL	0800	5.73	0.00	5.73	1341.60	0.00	0.00
226	10	JUL	0900	5.56	0.00	5.56	1341.60	0.00	0.00
227	10	JUL	1000	5.40	0.00	5.40	1341.60	0.00	0.00
228	10	JUL	1100	5.24	0.00	5.24	1341.60	0.00	0.00
229	10	JUL	1200	5.09	0.00	5.09	1341.60	0.00	0.00
230	10	JUL	1300	4.94	0.00	4.94	1341.60	0.00	0.00
231	10	JUL	1400	4.79	0.00	4.79	1341.60	0.00	0.00
232	10	JUL	1500	4.66	0.00	4.66	1341.60	0.00	0.00
233	10	JUL	1600	4.52	0.00	4.52	1341.60	0.00	0.00
234	10	JUL	1700	4.39	0.00	4.39	1341.60	0.00	0.00
235	10	JUL	1800	4.26	0.00	4.26	1341.60	0.00	0.00
236	10	JUL	1900	4.14	0.00	4.14	1341.60	0.00	0.00
237	10	JUL	2000	4.02	0.00	4.02	1341.60	0.00	0.00
238	10	JUL	2100	3.90	0.00	3.90	1341.60	0.00	0.00
239	10	JUL	2200	3.78	0.00	3.78	1341.60	0.00	0.00
240	10	JUL	2300	3.67	0.00	3.67	1341.60	0.00	0.00
241	11	JUL	0000	3.57	0.00	3.57	1341.60	0.00	0.00
242	11	JUL	0100	3.46	0.00	3.46	1341.60	0.00	0.00
243	11	JUL	0200	3.36	0.00	3.36	1341.60	0.00	0.00
244	11	JUL	0300	3.26	0.00	3.26	1341.60	0.00	0.00
245	11	JUL	0400	3.17	0.00	3.17	1341.60	0.00	0.00
246	11	JUL	0500	3.08	0.00	3.08	1341.60	0.00	0.00
247	11	JUL	0600	2.99	0.00	2.99	1341.60	0.00	0.00
248	11	JUL	0700	2.90	0.00	2.90	1341.60	0.00	0.00
249	11	JUL	0800	2.82	0.00	2.82	1341.60	0.00	0.00
250	11	JUL	0900	2.73	0.00	2.73	1341.60	0.00	0.00

TABLE 2		STATION		INFL	RELE	NETIN	ELDR	ELDR	CONSPL
(CONT.)				FLOW	FLOW	FLOW	STAGE	FLOW	FLOW
PER	DAY	MON	HRMN						
251	11	JUL	1000	2.65	0.00	2.65	1341.60	0.00	0.00
252	11	JUL	1100	2.58	0.00	2.58	1341.60	0.00	0.00
253	11	JUL	1200	2.50	0.00	2.50	1341.60	0.00	0.00
254	11	JUL	1300	2.43	0.00	2.43	1341.60	0.00	0.00
255	11	JUL	1400	2.36	0.00	2.36	1341.60	0.00	0.00
256	11	JUL	1500	2.29	0.00	2.29	1341.60	0.00	0.00
257	11	JUL	1600	2.22	0.00	2.22	1341.60	0.00	0.00
258	11	JUL	1700	2.16	0.00	2.16	1341.60	0.00	0.00
259	11	JUL	1800	2.10	0.00	2.10	1341.60	0.00	0.00
260	11	JUL	1900	2.03	0.00	2.03	1341.60	0.00	0.00
261	11	JUL	2000	1.98	0.00	1.98	1341.60	0.00	0.00
262	11	JUL	2100	1.92	0.00	1.92	1341.60	0.00	0.00
263	11	JUL	2200	1.86	0.00	1.86	1341.60	0.00	0.00
264	11	JUL	2300	1.81	0.00	1.81	1341.60	0.00	0.00
265	12	JUL	0000	1.76	0.00	1.76	1341.60	0.00	0.00
266	12	JUL	0100	1.70	0.00	1.70	1341.60	0.00	0.00
267	12	JUL	0200	1.65	0.00	1.65	1341.60	0.00	0.00
268	12	JUL	0300	1.61	0.00	1.61	1341.60	0.00	0.00
269	12	JUL	0400	1.56	0.00	1.56	1341.60	0.00	0.00
270	12	JUL	0500	1.51	0.00	1.51	1341.60	0.00	0.00
271	12	JUL	0600	1.47	0.00	1.47	1341.60	0.00	0.00
272	12	JUL	0700	1.43	0.00	1.43	1341.60	0.00	0.00
273	12	JUL	0800	1.39	0.00	1.39	1341.60	0.00	0.00
274	12	JUL	0900	1.35	0.00	1.35	1341.60	0.00	0.00
275	12	JUL	1000	1.31	0.00	1.31	1341.60	0.00	0.00
276	12	JUL	1100	1.27	0.00	1.27	1341.60	0.00	0.00
277	12	JUL	1200	1.23	0.00	1.23	1341.60	0.00	0.00
278	12	JUL	1300	1.20	0.00	1.20	1341.60	0.00	0.00
279	12	JUL	1400	1.16	0.00	1.16	1341.60	0.00	0.00
280	12	JUL	1500	1.13	0.00	1.13	1341.60	0.00	0.00
281	12	JUL	1600	1.09	0.00	1.09	1341.60	0.00	0.00
282	12	JUL	1700	1.06	0.00	1.06	1341.60	0.00	0.00
283	12	JUL	1800	1.03	0.00	1.03	1341.60	0.00	0.00
284	12	JUL	1900	1.00	0.00	1.00	1341.60	0.00	0.00
285	12	JUL	2000	0.97	0.00	0.97	1341.60	0.00	0.00
286	12	JUL	2100	0.94	0.00	0.94	1341.60	0.00	0.00
287	12	JUL	2200	0.92	0.00	0.92	1341.60	0.00	0.00
288	12	JUL	2300	0.89	0.00	0.89	1341.60	0.00	0.00
			MAX	30560.70	0.00	30560.70	1341.60	0.00	0.00
			MIN	0.00	0.00	0.00	1339.00	0.00	0.00
			AVE	915.77	0.00	915.77	1341.41	0.00	0.00

***EXHIBIT C***

***STANDING INSTRUCTIONS TO PROJECT MANAGER***

***EL DORADO LAKE***

EXHIBIT C

STANDING INSTRUCTIONS TO PROJECT MANAGER  
EL DORADO LAKE

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**EXHIBIT C**  
**STANDING INSTRUCTIONS TO PROJECT MANAGER**  
**EL DORADO LAKE**

I - GENERAL

1. Operation. The lake will be regulated in accordance with the normal regulations for flood control as directed in Section VII of this Manual or Paragraph II-2 of this Exhibit. Instructions for storage and discharge of floodwater will be issued by the Water Control Section. In the event communications with the Tulsa District Office are disrupted, the lake will be regulated in accordance with the schedule of emergency regulations for flood control (see Section VII of this Manual or paragraph II-3 of this Exhibit). In addition, the Project Manager will immediately make every effort to re-establish communications with the Tulsa District Office.

2. Data Reporting Instructions. Daily reservoir data from El Dorado Lake will be submitted to the Water Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7097 or VHF-FM radio, call signal WUI-3). The Water Control Section office is manned from 7:00 a.m. to 4:30 p.m. daily and various hours on weekends and holidays. Data for non-working days shall be read from the data logger and submitted the following workday. Data will be submitted in accordance with the form shown on Plate 5-3. Should unusual conditions arise during non-working hours, one of the persons listed on page i should be contacted. The following data should be included in the daily report:

a. As of 8 a.m. Number of gates open; amount of gate opening; outflow stage at 8 a.m.; precipitation and pan evaporation in inches for the preceding 24 hours (7 a.m. to 7 a.m.); and wind velocity and direction (at 8 a.m.).

b. Each Gate Operation. Date and time of gate operation; number of gates open and amount of gate opening before and after gate operation; and pool elevation. Confirmation of gate changes shall be made immediately after completion of the change. Complaints about pool elevations or releases, operating machinery failure, and out-of-service times for maintenance shall be reported to the Water Control Section as they occur.

c. During Flood Periods. In addition to subparagraphs a and b above, additional reports may be required by the Water Control Section.

d. Rainfall Reports. Rainfall reports shall be made as follows:

(1) At 8 a.m. all precipitation that has occurred during the preceding 24 hours, 7 a.m. to 7 a.m. (covered by routine report on working days).

(2) At 1 p.m. when 0.50 inch or more of precipitation has occurred since 7 a.m., or if it has continued to rain since reporting at 8 a.m.

(3) At 7 p.m. when 0.50 inch or more of precipitation has occurred since the 8 a.m. report and no 1 p.m. report was made, or if it has continued to rain since reporting at 1 p.m.

(4) Report at once the occurrence of 2.00 inches or more of precipitation that occurs during a period of 6 hours or less. During non-working hours, the report should be made to one of the persons listed on page i.

(5) After office hours, rainfall reports should be made as indicated in sub-section (4) above; however, if no contact with Water Control Section personnel can be made, rainfall reports should be made to the National

Weather Service, Tulsa, Oklahoma, telephone number 1-800-722-2778.

3. Reporting Unusual Events. Events or conditions not normally encountered in the routine operation of the dam and lake which might endanger the dam or necessitate temporary or permanent revision of the operating procedures such as settlement, movement, or cracking of the earth embankment or abutments; unusual change in seepage rates, or development of new seepage areas; mechanical malfunction or failure; structural settlement, movement, cracking, or vibration; landslides, rockslides, or indications of an impending movement; or an occurrence indicating any degree of jeopardy to the safety of the dam, or to the safety of the public shall be reported promptly to the Water Control Section, Hydrology and Hydraulics Branch.

4. Warnings. It is the responsibility of the Project Manager and project personnel authorized to make gate changes to maintain a list in current status of residents and/or property which might be endangered or inconvenienced by large and/or prolonged releases. If damaging releases are expected to occur, notification will be made by telephone, or oral warning by Corps employees. Notification will be made in accordance with the Tulsa District supplements to ER 500-1-1. This would include media such as radio, television, telephone, citizens band radio, use of law enforcement and civil defense agencies and their communication system, National Guard and reserve units, supplemented by oral warning by Corps employees. Studies have been made to determine the possible downstream flood conditions that could exist in the event of a maximum spillway release or failure of the dam at maximum pool. Approximate water surface profiles and flooded area maps giving the results of these studies are kept in the El Dorado Lake Operation and Maintenance Manual, Volume II, Contingency Plan for Emergencies. In every case, when a gate change is made a horn is blown to give warning to people immediately downstream of El Dorado Dam.

5. Frequency of Gate Changes. During flood periods, gate changes may be directed by the Water Control Section at any time. When the floodwaters have significantly risen into the flood control pool, gate changes can be expected two or three times daily. When the pool level is at or above the top of the flood control pool, gate changes may occur every hour. Only under the most unusual circumstances will changes be ordered more frequently than once every hour. Frequency of gate changes during low flow operation will generally be less than once a day.

## II - REGULATION PROCEDURES

1. Regulating River Stages and Discharges. The regulation schedules provide that the channel capacity of 4,200 cfs is not to be exceeded insofar as practicable. Floodwaters will be released as rapidly as practicable with consideration given to minimizing flooding of low-water crossing and low-lying farmland. Factors considered in the determination of releases are: maximum inflow into the reservoir during a rise, general climatic conditions, season of the year with respect to the probability of floods, status of crops in low-lying farmlands, and maximum non-damaging stages or discharges.

2. Normal Regulation for Flood Control Operations. El Dorado Lake will be operated for optimal flood reductions on the Walnut River from El Dorado Dam to its confluence with the Arkansas River and in conjunction with Cheney Lake from that point to the upper limits of Kaw Lake. Releases will also be coordinated with the flood control operation of Kaw, Great Salt Plains, and Keystone Lakes, to provide optimal flood control benefits in the Walnut and Arkansas River Basins.

3. Emergency Flood Control Regulations. Should communication with the Tulsa District Office be disrupted, the Project Manager will, on his own initiative, direct operation of the reservoir in accordance with the following rules of operation until communication is restored. In addition, the Project Manager will immediately make every effort to re-establish communication with the Tulsa District Office and, if necessary, send information to the Tulsa District Office by automobile or any means available. The conduit gates shall be operated at a uniform opening (see Table C-1).

4. During Emergency Events. The Project Manager may temporarily deviate from the current release rates in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid serious hazards to life. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Water Control Section and shall include justification for the action. Continuation of the deviation will require the express approval of the Water Control Section.

TABLE C-1

EMERGENCY FLOOD CONTROL REGULATION SCHEDULEEL DORADO LAKE, WALNUT RIVER, KANSAS

Pool Stage	Pool Conditions	Regulation
1339.0 - 1345.5	Rising	<p>a. Should the Project Manager have knowledge that no significant rainfall has occurred downstream from the project, the current release will be continued.</p> <p>b. Should the Project Manager have knowledge or suspect that significant rainfall has occurred downstream from the project, the current release will be reduced to the low flow requirement in Table 7-3. The reduction will be made at a rate not to exceed 700 cfs per 2-hour period.</p>
1345.5 - 1347.5	Rising	<p>a. The release shall be increased according to the schedule provided.</p> <p>b. If the outflow being made at the time emergency regulations become effective is greater than the outflow indicated by the schedule, continue this outflow until the schedule indicates an increase is required.</p>
Above 1347.5	Rising	If the conduit gates have not been fully opened when the lake water surface reaches elevation 1347.5, releases shall be increased 1,000 cfs each quarter (1/4) hour until both gates are fully open and shall remain fully open until the pool level recedes to elevation 1347.5.
Above 1347.5	Falling	Continue maximum release until the pool level recedes to elevation 1347.5.
1347.5 - 1339.5	Falling	Maintain release in effect at the time communication was lost or maintain release which was initiated under rising pool conditions. If the release is greater than 4,200 cfs begin a gradual reduction of the release rate to 4,200 cfs (not to exceed 700 cfs per 2-hour period) making sure not to reduce the release below inflow. (See Plate 6-2 for inflow computation example).
1339.5 - 1339.0	Falling	Begin a gradual reduction of the release rate (not to exceed 500 cfs per 2-hours) to keep the pool at the conservation level (1339.0).

EMERGENCY RELEASE SCHEDULE

<u>Pool Stages</u>	<u>Change Release to</u>
1345.5	500 cfs
1346.0	1000 cfs
1346.5	2000 cfs
1347.0	3000 cfs
1347.5	4200 cfs

NOTE: Do not exceed 4,200 cfs.

***EXHIBIT D***

***ALTERNATE FORECASTING METHOD***

***EL DORADO LAKE***

**EXHIBIT D**

**ALTERNATE FORECASTING METHOD**

**EL DORADO LAKE**

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(2) Forecasting flows. Inflow and flow at the key control points are estimated by the following procedures.

(a) Runoff estimation. As explained in paragraph 5-04b, precipitation data are recorded on a map of the District and entered into the computer program named "UPDATE". The program accepts station rainfall, updates the station antecedent precipitation index (API) for each rainfall station and computes the API and average rainfall for drainage areas above each lake in the District. The program is normally updated once a week except in the event of significant rainfall, when it is brought up to the current date. The API is an empirical factor which indicates the effect of previous precipitation on runoff and is adjusted daily. Separate APIs are kept for each lake and area as shown on the sample printout on plate 6-2. By definition, the API decreases 10 percent daily and increases by the amount of average daily precipitation in inches. A procedure to allow the API to reach minus 4 was derived by the River Forecast Center of Tulsa, Oklahoma. This modified procedure takes into account the month of the year and extended periods of minimum precipitation. The minimum allowable runoff by this method is 10 percent of the precipitation. The APIs above 0.2 are

computed by definition. When the API is between 0.2 and minus (-) 4, the APIs are computed by daily adding a negative API constant. These negative API constants are shown in table 6-1. The API is applied to a rainfall-runoff relationship curve to obtain the surface runoff in inches for the area affected by the rain. An example of the use of this curve as applied to a storm above Arkansas City is shown on plate 6-3. The storm used as an example in the use of this curve had an API of 2.58 inches for the 24-hour period prior to the storm. The storm occurred in the 16th week of the year and had a rainfall duration of 8 hours and an average rainfall of 3.60 inches. These factors applied to the rainfall-runoff relationship curves indicate a surface runoff of 2.33 inches. Negative APIs are applied to the rainfall-runoff curve in one of the following ways: (1) when the sum of the API and the precipitation is a positive value, the API is set to zero and the positive value is used for the rainfall; or (2) when the sum of the API and the precipitation is a negative value, the runoff is set to the minimum allowable runoff, which is 10 percent of the precipitation. The runoff estimating procedure is also programmed for the time-sharing computer. The program is named "RUNOFF" and is maintained in the Reservoir Control Section. A sample of the printout is shown on plate 6-4. The Reservoir Control Section maintains current documentation and use explanation for all computer programs used in reservoir regulation.

TABLE 6-1  
NEGATIVE API CONSTANTS

Month	:	0.2	API	-2	:	-2	API	-3	:	-3	API	-4
January	:	-0.02	:	-0.02	:	-0.00			:			
February	:	-0.03	:	-0.02	:	-0.01			:			
March	:	-0.05	:	-0.03	:	-0.02			:			
April	:	-0.08	:	-0.04	:	-0.02			:			
May	:	-0.10	:	-0.05	:	-0.03			:			
June	:	-0.13	:	-0.07	:	-0.04			:			
July	:	-0.13	:	-0.07	:	-0.04			:			
August	:	-0.12	:	-0.06	:	-0.03			:			
September	:	-0.09	:	-0.05	:	-0.03			:			
October	:	-0.07	:	-0.04	:	-0.02			:			
November	:	-0.04	:	-0.02	:	-0.01			:			
December	:	-0.02	:	-0.01	:	-0.01			:			

(b) Unit hydrograph. After the estimate of runoff is made using the API method, the runoff value is applied to the unit hydrograph to predict the runoff hydrograph. The unit hydrograph for the area above El Dorado Lake and an example of its application is shown on plate 6-5. The unit hydrographs for the forecasting reaches (shown on plate 6-1) are on plates 6-5 thru 6-8. The use of unit hydrographs is explained in subparagraph (e), page 6-4.

(c) Inflow computations. After receipt of pool elevations, the inflow into the lakes is computed and the predicted hydrograph is compared, and adjusted as necessary, with the developing hydrograph. A sample inflow computation is shown on plate 6-9.

(d) Flood routing. Flood routing procedures used in manual forecasting inflows and releases are accomplished by the progressive average lag method. The computerized forecasts utilize Modified Puls routing techniques. A summary of manual forecasting procedures is presented in table 6-2. A simplified diagram showing crest travel time is presented on plate 4-9. This diagram should be used as a guide only, as the crest travel time depends on the magnitude of the flood.

(e) Forecast example. The method of using the unitgraphs is demonstrated (see plate 6-5) in the estimation of the inflow hydrograph from the area above El Dorado Lake. Adjusting the vertical position of the 1,000 c.f.s. base line of the template immediately gives any desired multiple of the unit hydrograph ordinate. In the example, the 1,000 c.f.s. base line is set on 2,330 c.f.s., thus multiplying all ordinates of the unit hydrograph by 2.33 (the runoff in inches derived by the example given in subparagraph 6-02b(2)(a)). The horizontal positioning of the template is achieved by placing the left edge of the template at the time the runoff begins. In the event a second storm occurs before the surface runoff from the preceding storm is completed, the hydrograph of the second storm is plotted as described above and the contemporaneous ordinates of both storms are added to give the composite runoff hydrograph. Pool elevations should be obtained periodically so that inflow computations can be made and the estimated inflow hydrograph adjusted, if necessary.

(f) Flood control releases. The estimated hydrograph at the Winfield gage is made by the procedures outlined in table 6-2. Estimated hydrographs at other control points downstream from the El Dorado Dam and above the Van Buren, Arkansas gage, are made by procedures described in the Water Control Manual, Kaw Lake (appendix T), Reservoir Regulation Manual, Keystone Lake (appendix M), and Navigation Reservoir Regulation Manuals (appendix S, Part II through VI), to the Water Control Master Manual, Arkansas River Basin. These hydrographs are adjusted to conform with the latest hydrologic information available. Trial releases from El Dorado Lake are routed and combined with the adjusted hydrographs for determinations of the desired hydrographs of the downstream control points.

TABLE 6-2

SUMMARY OF FORECASTING PROCEDURES

Station for which forecast is made	Procedures	Routing method (1)	Plate No.	Example Plate No.
Walnut River above El Dorado Dam	1. Apply unit hydrograph template for area above El Dorado Damsite.	-	6-5	6-5
El Dorado, KS	1. Apply unit hydrograph template for area below El Dorado Dam and above El Dorado, KS. 2. Route El Dorado Lake release to El Dorado, KS. (2) 3. Summation of ordinates (1) and (2).	-	6-6	6-5
Augusta, KS	1. Route El Dorado, KS flows to Augusta, KS. (3) 2. Apply unit hydrograph template for area below El Dorado, KS and above Augusta, KS. 3. Summation of ordinates (1) and (2).	-	6-7	6-5
Winfield, KS	1. Route Augusta, KS flows to Winfield, KS. (4) 2. Apply unit hydrograph template for area below Augusta, KS and above Winfield, KS. 3. Summation of ordinates (1) and (2).	-	6-8	6-5

(1) Reference the Kaw Lake Water Control Manual, paragraph 6-02, for forecasting procedures below the Winfield gage.

(2) Lag releases 3 hours.

(3) Progressive average lag.

- a. Length of inflow period - 6 hours.
- b. Number of inflow periods averaged - 3.
- c. Lag time (inflow periods) - 1.

(4) Progressive average lag.

- a. Length of inflow period - 6 hours.
- b. Number of inflow periods averaged - 3.
- c. Lag time (inflow periods) - 2.







TABLE 5-1

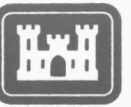
REPORTING PRECIPITATION STATIONS SERVING THE WALNUT RIVER  
(Above El Dorado Dam and Walnut River and Whitewater River  
above the Winfield Gage)

WALNUT RIVER above <u>EL DORADO DAM</u>		WALNUT RIVER above <u>EL DORADO</u> , Kansas, below El Dorado Dam	
DRAINAGE AREA: 234 sq. mi.		DRAINAGE AREA: 101 sq. mi.	
River mile: 100.2		River mile: 93.8	
Rainfall Station	Wt.(1)	Rainfall Station	Wt.(1)
El Dorado Dam	.27	El Dorado, Kansas	.32
Burns, Kansas	.07	Potwin, Kansas	.14
Wonsevu, Kansas	.02	Burns, Kansas	.24
Cassoday, Kansas	.44	El Dorado Dam, Kansas	.25
Rosalia, Kansas	.20	Rosalia, Kansas	.05
Total	1.00	Total	1.00
WALNUT and WHITEWATER RIVER above <u>AUGUSTA</u> , Kansas and below El Dorado, Kansas		WALNUT RIVER above <u>WINFIELD</u> , Kansas and below Augusta, Kansas	
DRAINAGE AREA: 100 sq. mi.		DRAINAGE AREA: 1,537 sq. mi.	
River mile: 77.3		River mile: 24.8	
Rainfall Station	Wt.(1)	Rainfall Station	Wt.(1)
Sedgewick, Kansas	.02	Winfield, Kansas	.06
Newton, Kansas	.07	Oxford, Kansas	.01
Elbing, Kansas	.18	Rock, Kansas	.17
Burns, Kansas	.09	Derby, Kansas	.05
Potwin, Kansas	.34	Wichita Airport	.01
El Dorado, Kansas	.14	Augusta, Kansas	.17
El Dorado Dam, Kansas	.02	El Dorado, Kansas	.01
Augusta, Kansas	.13	El Dorado Dam, Kansas	.02
Peabody, Kansas	.01	Rosalia, Kansas	.05
		Beaumont, Kansas	.14
		Atlanta, Kansas	.16
		Smileyberg, Kansas	.15
Total	1.00	Total	1.00

(1) Proportion of Total drainage area represented by Thiessen Polygon surrounding rainfall stations

LEGEND

-  USACE PROJECTS
  -  OPERATED FOR FLOOD CONTROL
  -  LOCAL PROTECTION PROJECTS
  -  MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
  -  LOCK
  -  TULSA AREA LEVEES
- CHERRY/RED FORK CREEKS  
 FLAT ROCK/VALLEY VIEW CREEKS  
 HAIKEY CREEK  
 JENKS  
 JOE CREEK  
 MINGO CREEK  
 TULSA/WEST TULSA

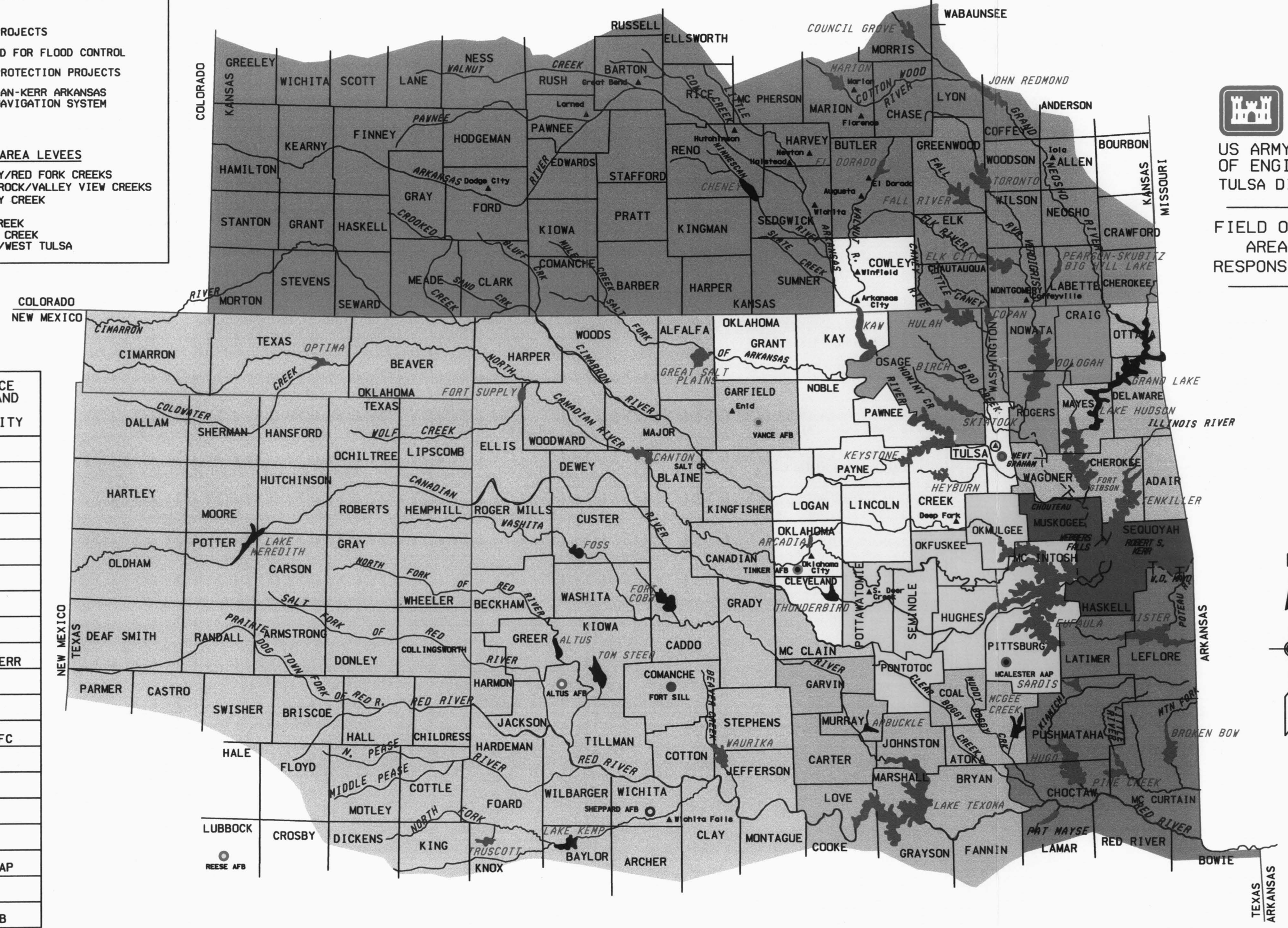


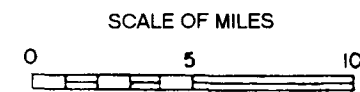
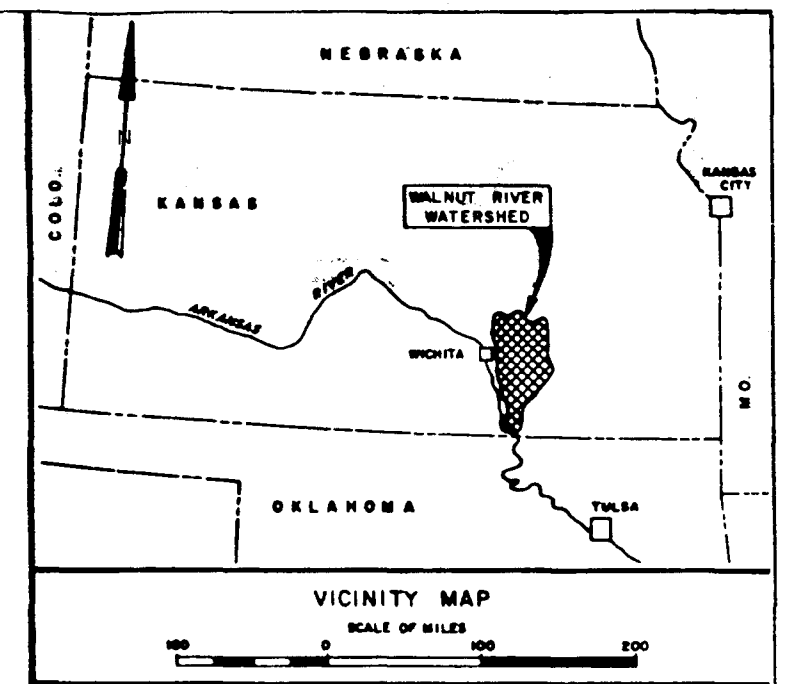
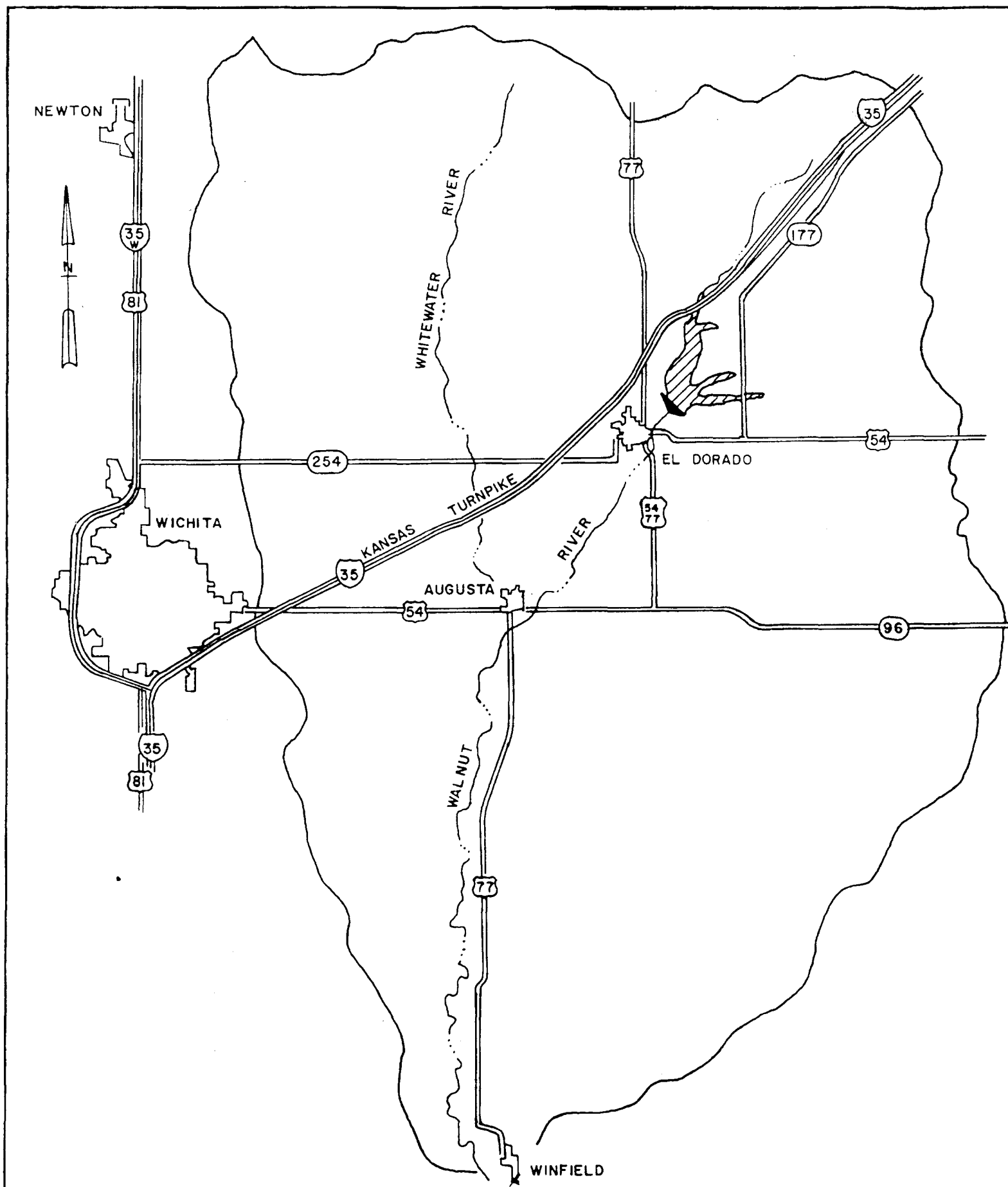
US ARMY CORPS OF ENGINEERS  
 TULSA DISTRICT

FIELD OFFICES' AREAS OF RESPONSIBILITY

FIELD OFFICE LOCATIONS AND AREAS OF RESPONSIBILITY

MARION
FALL RIVER
DOLOGAH
CANTON
KEYSTONE
FORT GIBSON
WAURIKA
EUFULA
ROBERT S. KERR
TEXOMA
HUGO
TULSA RES OFC
VANCE AFB
TINKER AFB
ALTUS AFB
FORT SILL
MCALESTER AAF
REESE AFB
SHEPPARD AFB





ARKANSAS RIVER WATERSHED WALNUT RIVER, KANSAS

EL DORADO LAKE

LOCATION AND VICINITY MAP

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

(b) (7)(F)

WALNUT RIVER WATERSHED WALNUT RIVER, KANSAS

EL DORADO LAKE  
EMBANKMENT AND SPILLWAY DETAILS

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

(b) (7)(F)

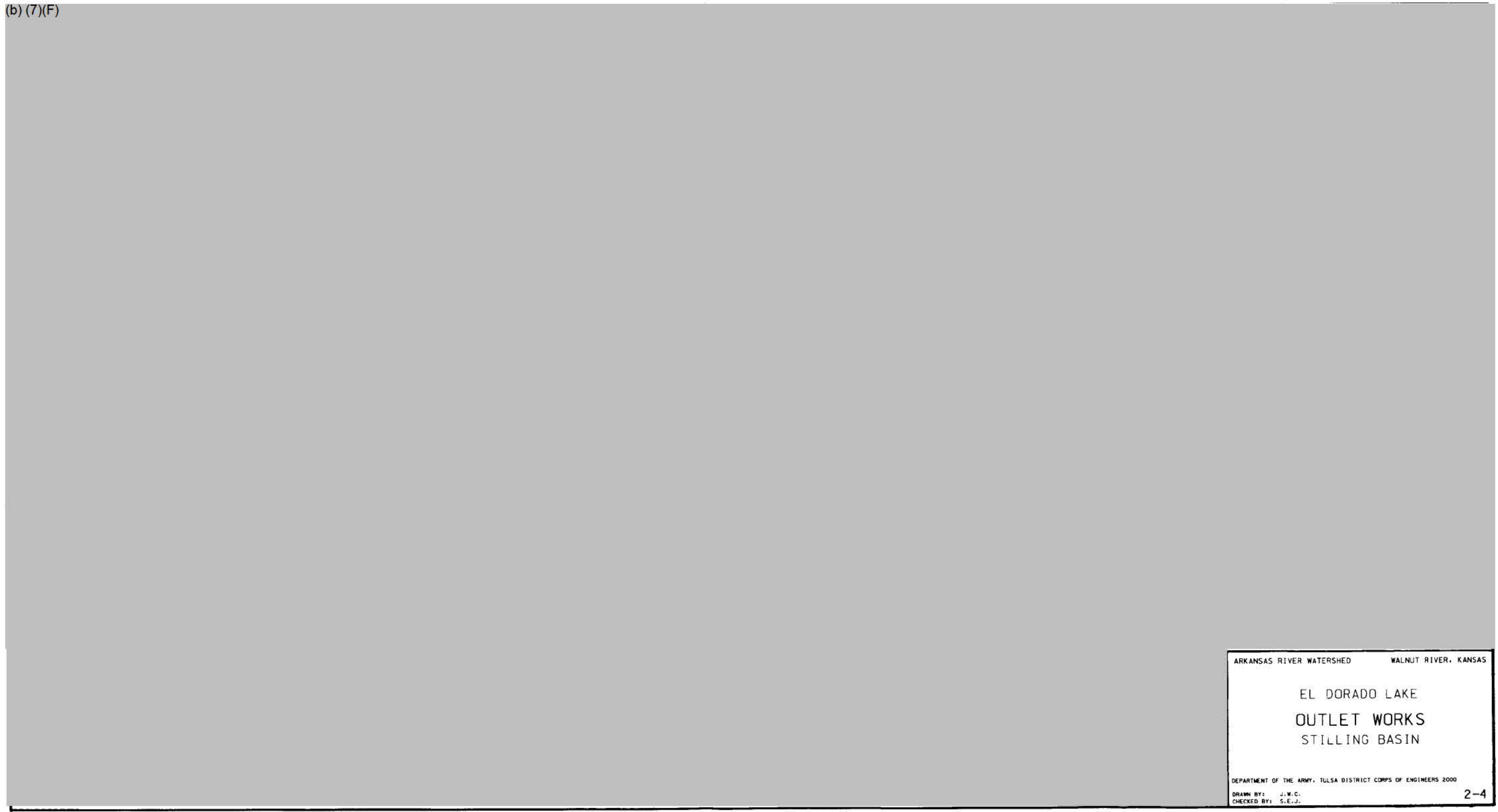
ARKANSAS RIVER WATERSHED WALNUT RIVER, KANSAS

EL DORADO LAKE  
OUTLET WORKS  
INTAKE STRUCTURE

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

(b) (7)(F)

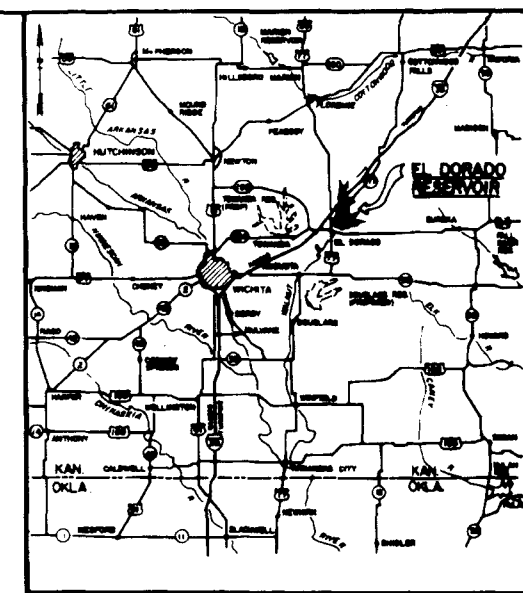
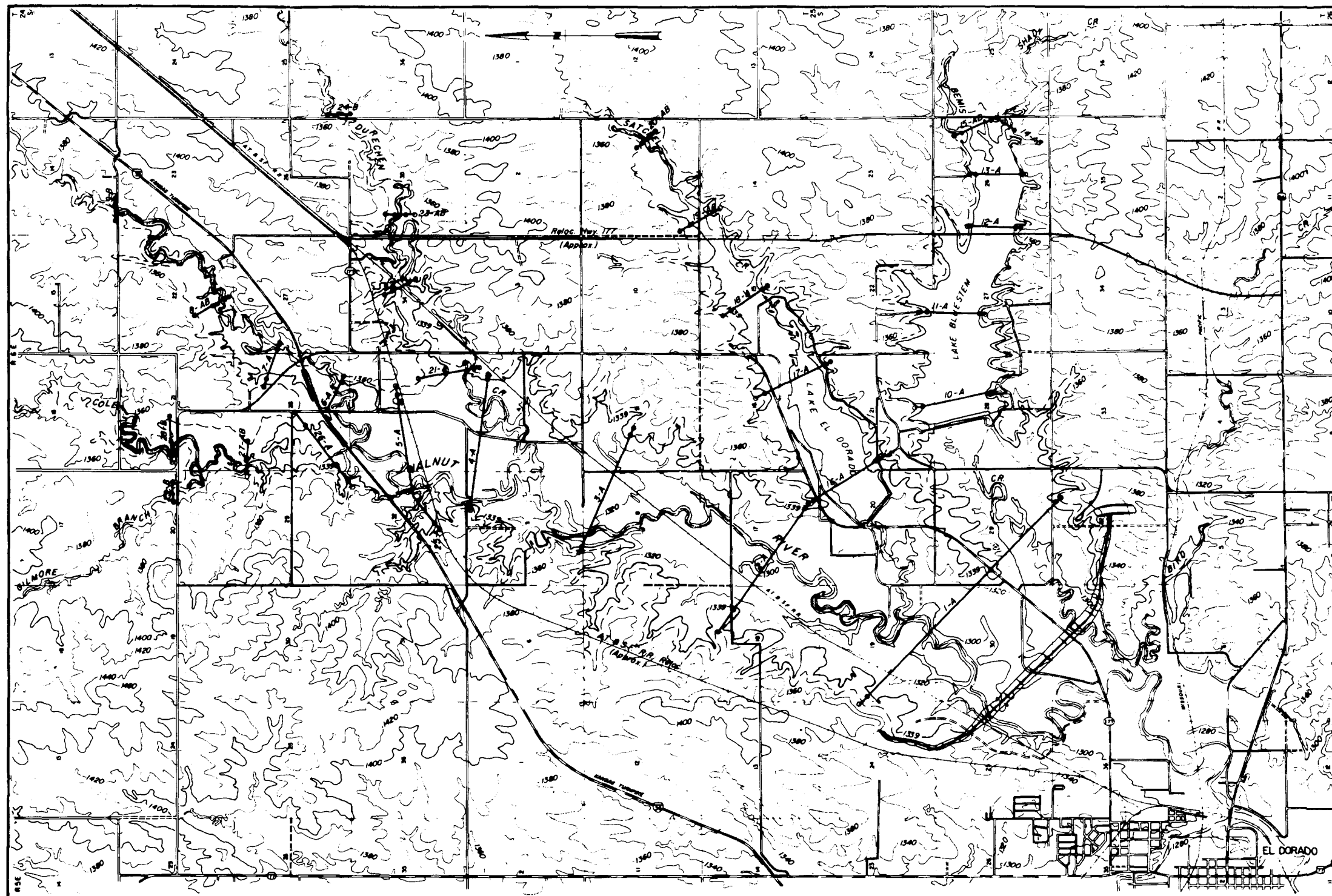


ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

EL DORADO LAKE  
OUTLET WORKS  
STILLING BASIN

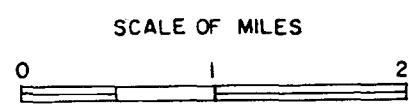
DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

2-4



VICINITY MAP  
SCALE OF MILES  
0 10 20

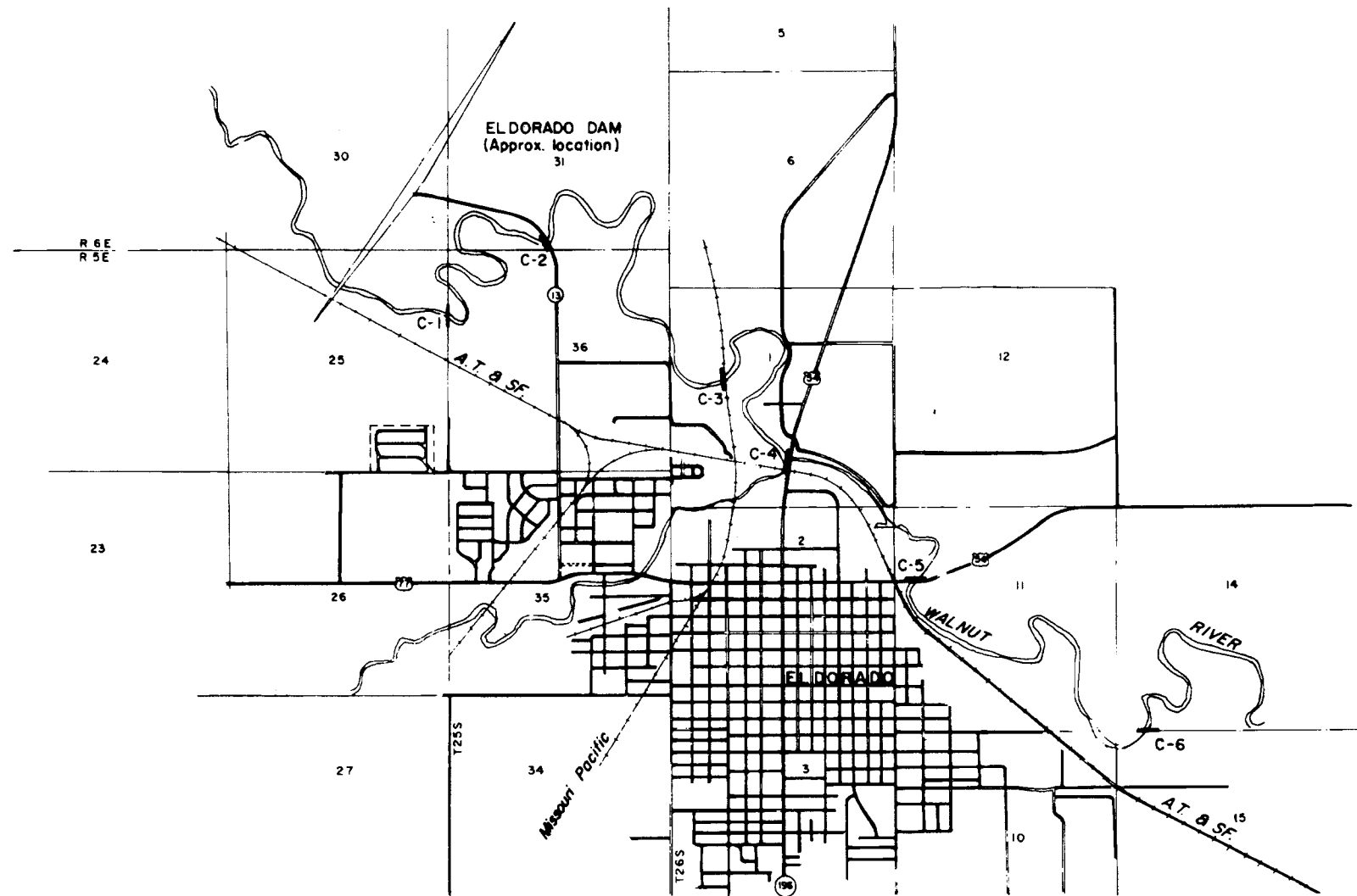
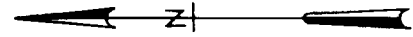
- LEGEND:
- TOP OF CONSERVATION POOL
  - - - TOP OF FLOOD CONTROL POOL
  - SEDIMENTATION RANGES
  - RELOCATED ROADS



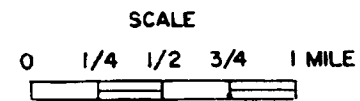
ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

EL DORADO LAKE  
SEDIMENTATION RANGES  
AND VICINITY MAPS

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.



LEGEND:  
C-6 Degradation ranges

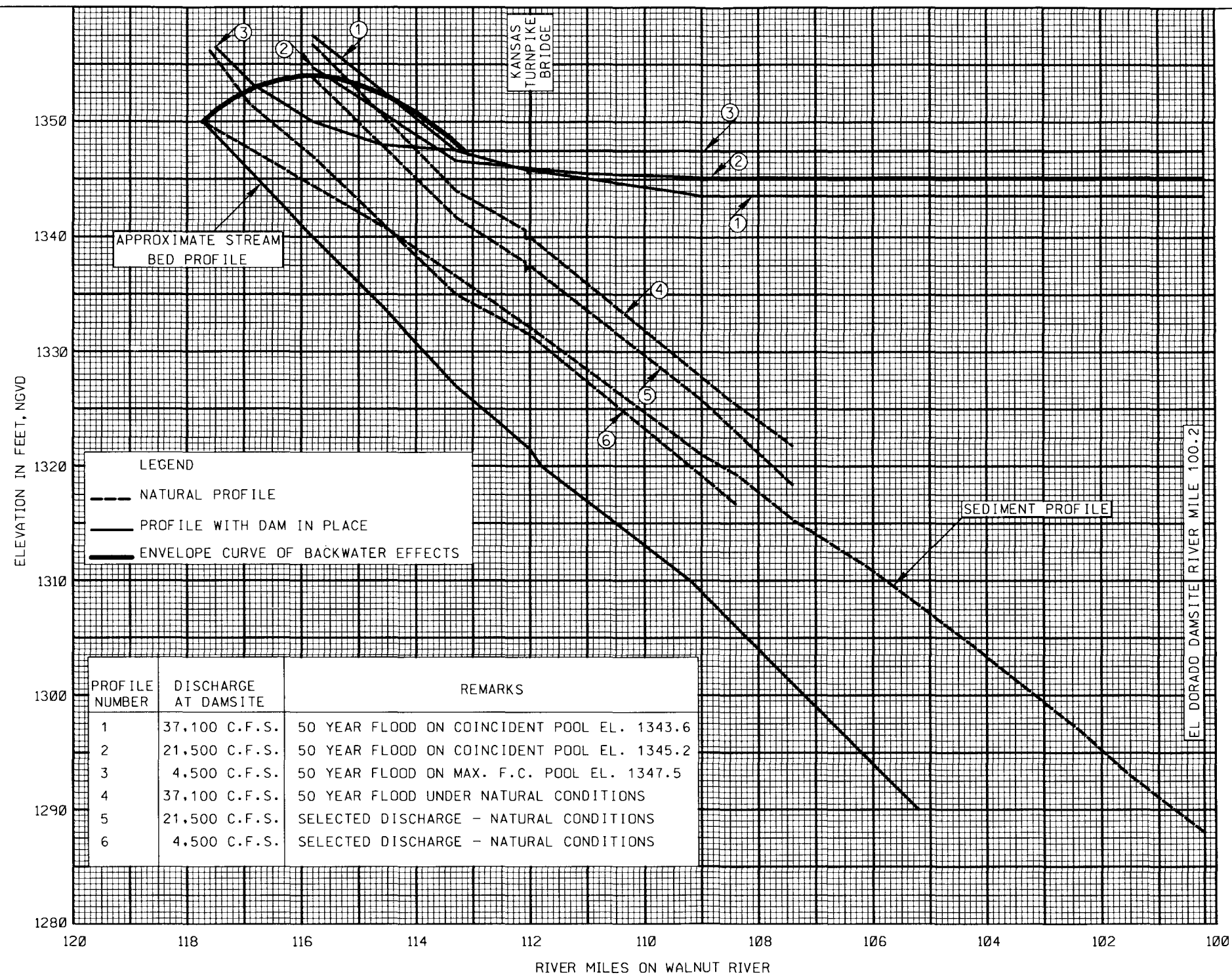


ARKANSAS RIVER WATERSHED WALNUT RIVER, KANSAS

# EL DORADO LAKE DEGRADATION RANGES

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.



LEGEND  
 - - - NATURAL PROFILE  
 — PROFILE WITH DAM IN PLACE  
 — ENVELOPE CURVE OF BACKWATER EFFECTS

PROFILE NUMBER	DISCHARGE AT DAMSITE	REMARKS
1	37,100 C.F.S.	50 YEAR FLOOD ON COINCIDENT POOL EL. 1343.6
2	21,500 C.F.S.	50 YEAR FLOOD ON COINCIDENT POOL EL. 1345.2
3	4,500 C.F.S.	50 YEAR FLOOD ON MAX. F.C. POOL EL. 1347.5
4	37,100 C.F.S.	50 YEAR FLOOD UNDER NATURAL CONDITIONS
5	21,500 C.F.S.	SELECTED DISCHARGE - NATURAL CONDITIONS
6	4,500 C.F.S.	SELECTED DISCHARGE - NATURAL CONDITIONS

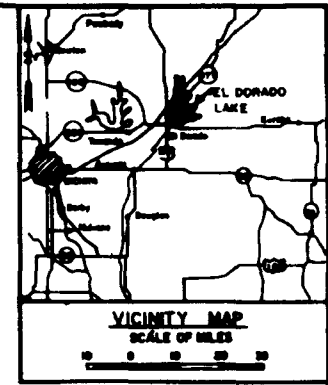
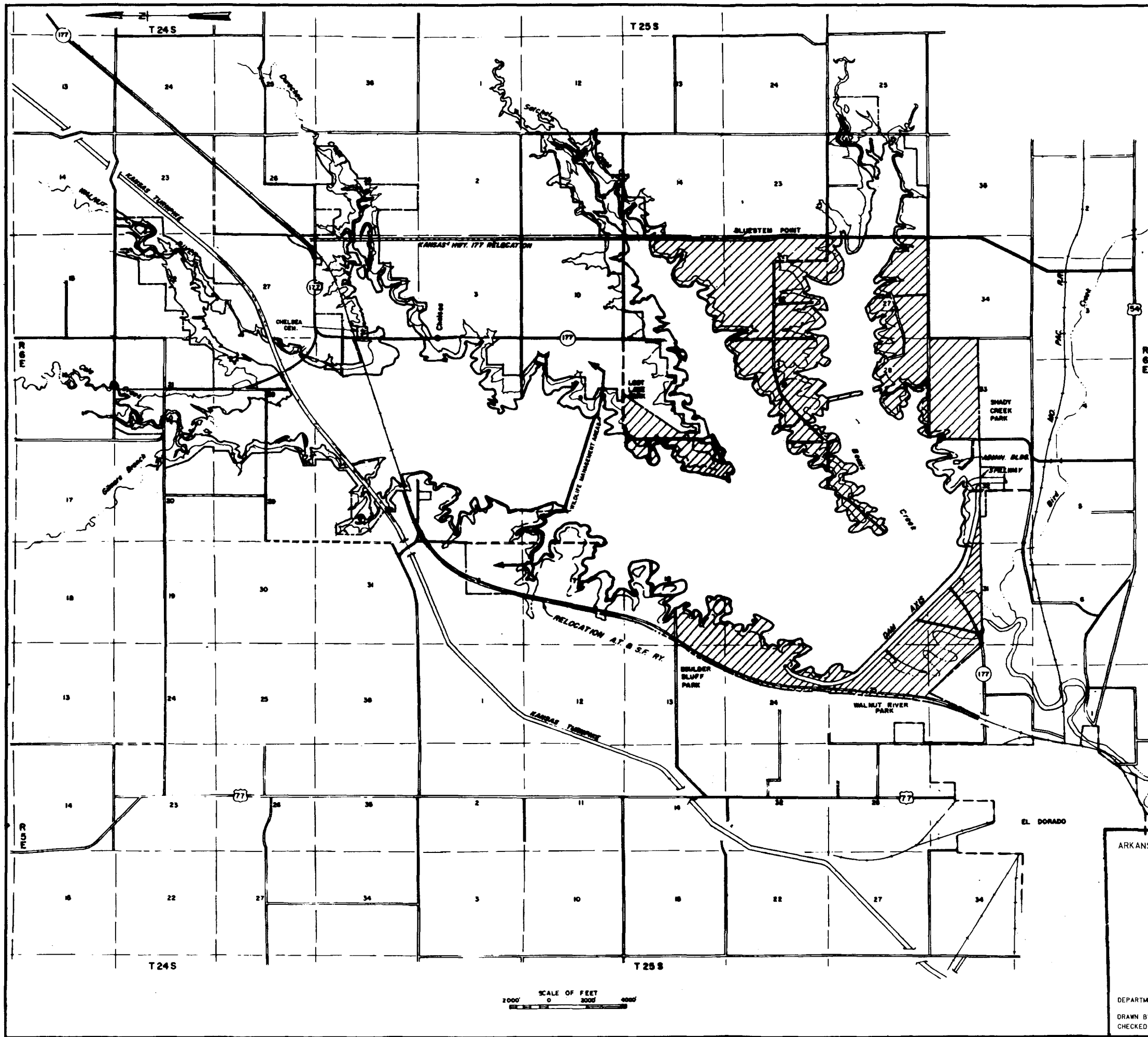
ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE

ENVELOPE CURVE OF  
BACKWATER EFFECTS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.

2-7



- LEGEND**
- APPROXIMATE PROJECT BOUNDARY
  - FLOOD CONTROL POOL ELEVATION 1347.5
  - CONSERVATION POOL ELEVATION 1339.0
  - STATE HIGHWAY
  - COUNTY ROADS
  - EXISTING RAILROAD
  - PROPOSED FENCE

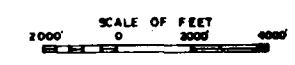
ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

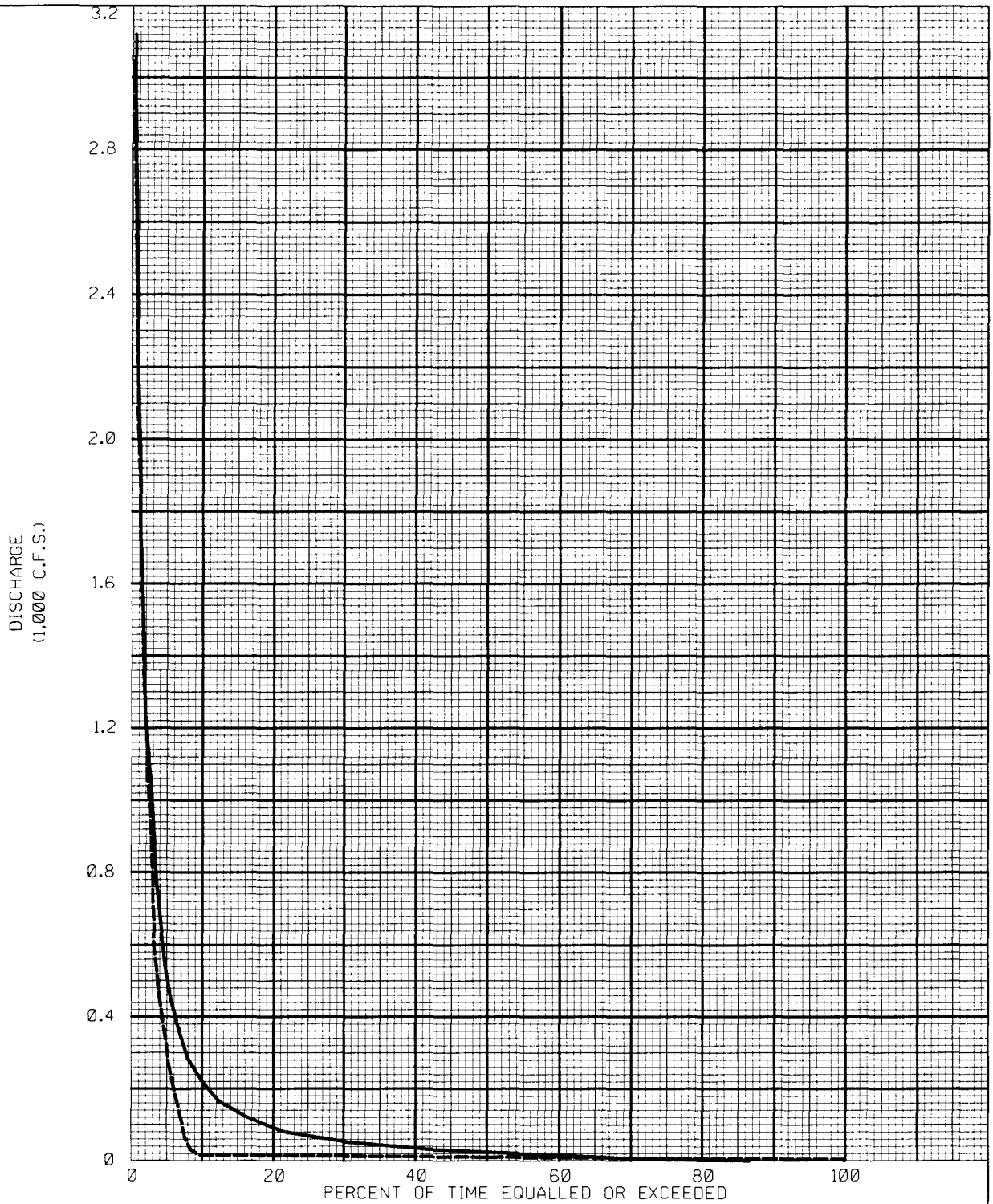
EL DORADO LAKE

PUBLIC USE SITES

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.





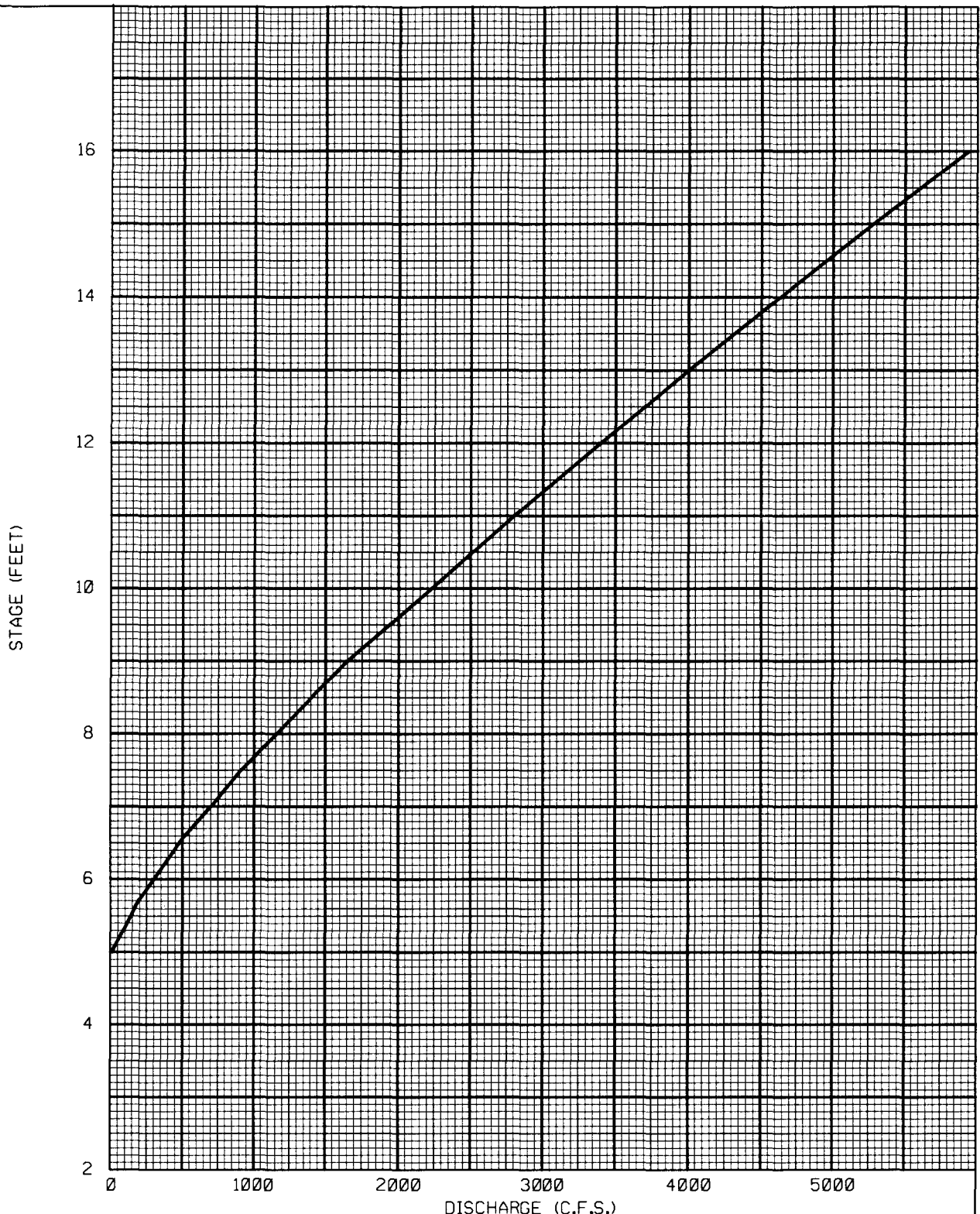
LEGEND:  
 ——— INFLOW  
 - - - - - OUTFLOW

NOTE:  
 1. APPROACHES ZERO AT 6,100 C.F.S.  
 2. BASED ON PERIOD OF RECORD  
 JAN. 1940 THRU DEC. 1995

ARKANSAS RIVER WATERSHED                      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
 FLOW DURATION CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



DATUM = 1221.91 FT.  
 RATING NO. 4, AUGUST 29, 1988

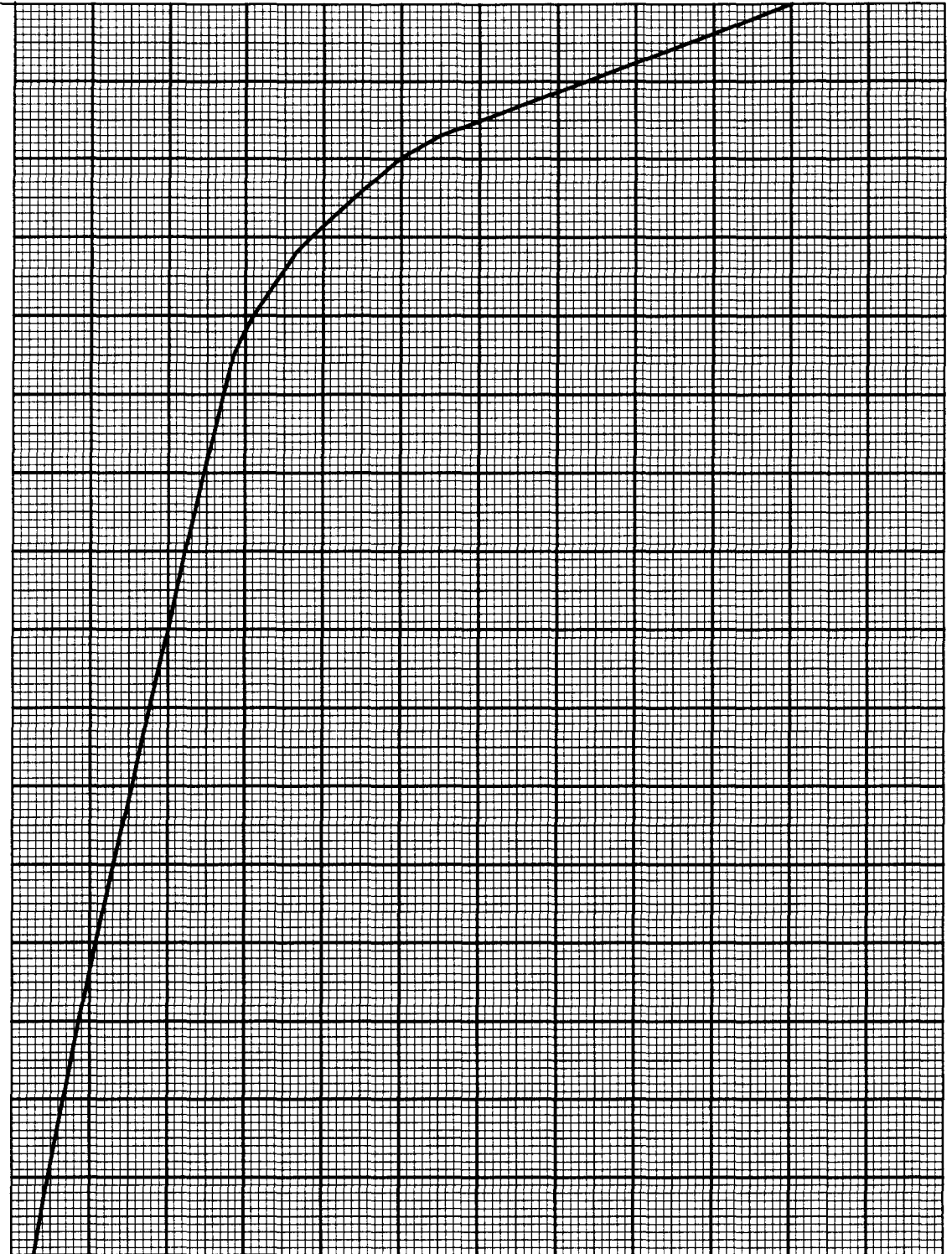
ARKANSAS RIVER WATERSHED                      WALNUT RIVER, KANSAS

### DISCHARGE RATING CURVE AUGUSTA, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.

STAGE (FEET)

34  
30  
26  
22  
18  
14  
10  
6  
2



60,000 80,000 100,000  
DISCHARGE (C.F.S.)

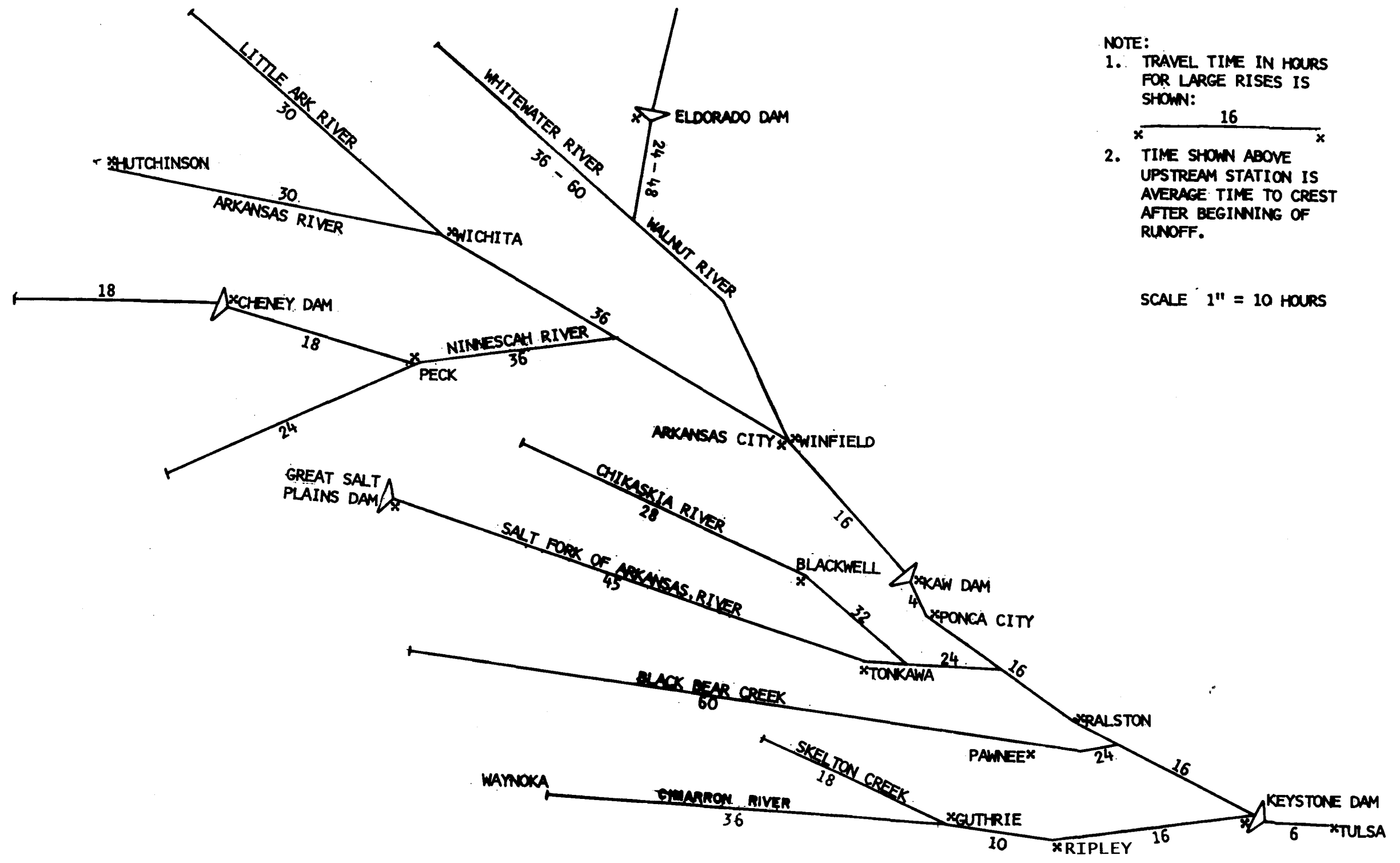
ARKANSAS RIVER WATERSHED

WALNUT RIVER, KANSAS

### DISCHARGE RATING CURVE WINFIELD, KANSAS

DATUM = 1082.86 FT.  
RATING NO. 37, MAY 5, 1998

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.



NOTE:  
 1. TRAVEL TIME IN HOURS FOR LARGE RISES IS SHOWN:  
 16  
 \*-----\*

2. TIME SHOWN ABOVE UPSTREAM STATION IS AVERAGE TIME TO CREST AFTER BEGINNING OF RUNOFF.

SCALE 1" = 10 HOURS

ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

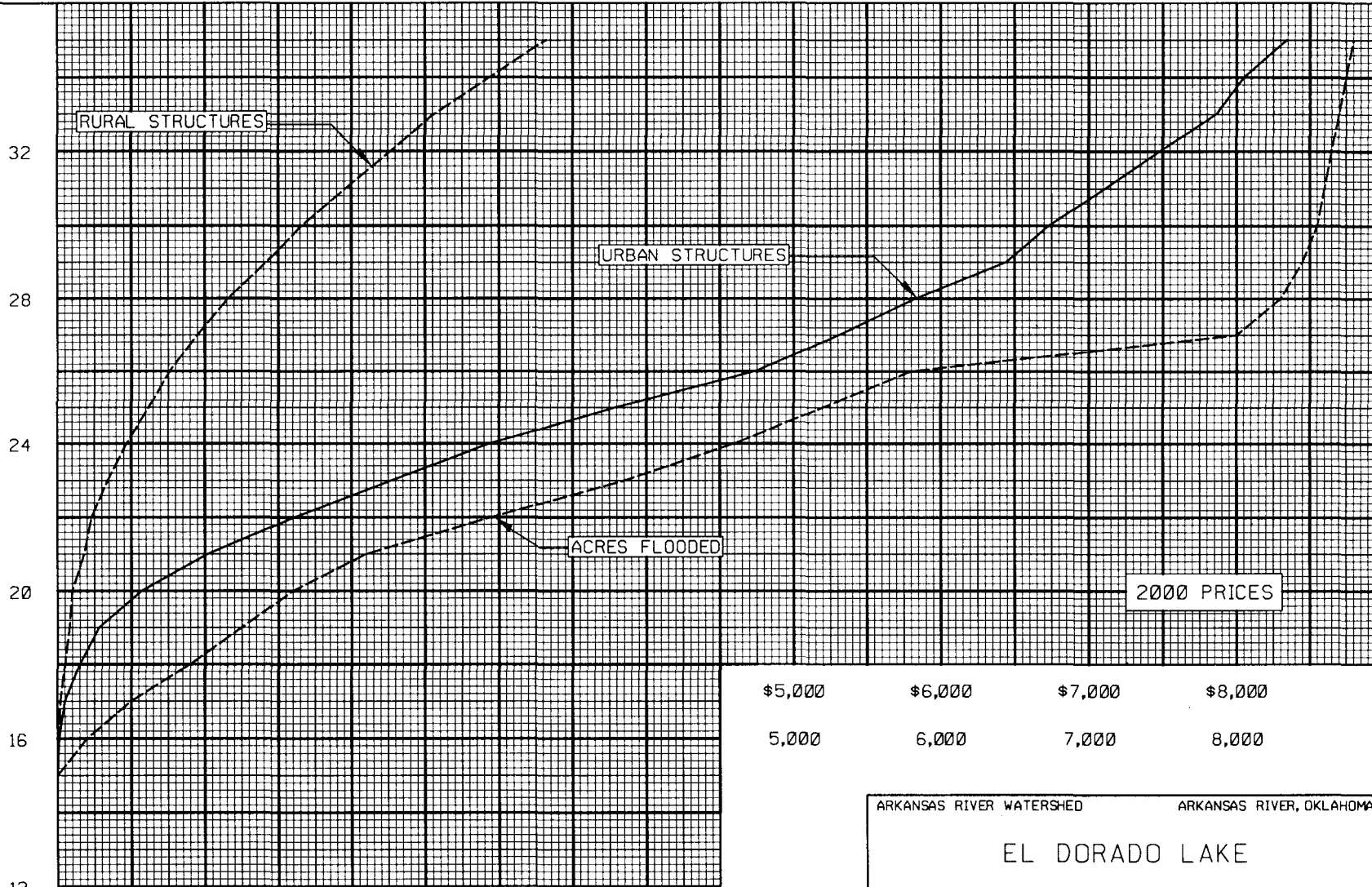
EL DORADO LAKE  
 TIME OF CREST TRAVEL

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.

4-4

SALLISAW GAGE (FEET)



STR. LOSSES (\$1,000)	0	\$1,000	\$2,000	\$3,000	\$4,000
ACRES FLOODED	0	1,000	2,000	3,000	4,000

\$5,000	\$6,000	\$7,000	\$8,000
5,000	6,000	7,000	8,000

ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
 STRUCTURAL LOSS  
 AND AREA CURVES  
 EL DORADO DAM  
 TO WHITEWATER RIVER

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.

AUGUSTA GAGE (FEET)

40  
36  
32  
28  
24  
20

RURAL STRUCTURES

ACRES FLOODED

URBAN STRUCTURES

2000 PRICES

\$10,000	\$12,000	\$14,000	\$16,000
5,000	6,000	7,000	8,000

STR. LOSSES (\$1,000)	0	\$2,000	\$4,000	\$6,000	\$8,000
ACRES FLOODED	0	1,000	2,000	3,000	4,000

ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
STRUCTURAL LOSS  
AND AREA CURVES  
WHITEWATER RIVER  
TO LITTLE WALNUT RIVER

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

WINFIELD GAGE (FEET)

40  
38  
36  
34  
32  
30

STRUCTURES

ACRES FLOODED

2000 PRICES

\$1,000	\$1,200	\$1,400	\$1,600
5,000	6,000	7,000	8,000

STR. LOSSES (\$1,000)	0	\$200	\$400	\$600	\$800
ACRES FLOODED	0	1,000	2,000	3,000	4,000

ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE

STRUCTURAL LOSS  
AND AREA CURVES

LITTLE WALNUT RIVER  
TO ROCK CREEK

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

WINFIELD GAGE (FEET)

50

46

42

38

34

30

RURAL STRUCTURES

URBAN STRUCTURES

ACRES FLOODED

2000 PRICES

\$20,000	\$24,000	\$28,000	\$32,000
20,000	24,000	28,000	32,000

STR. LOSSES (\$1,000)	0	\$4,000	\$8,000	\$12,000	\$16,000
ACRES FLOODED	0	4,000	8,000	12,000	16,000

ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
 STRUCTURAL LOSS  
 AND AREA CURVES  
 ROCK CREEK TO THE  
 ARKANSAS RIVER

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



38°00' +

37°30' +

37°00' +  
97°30'

○ FLORENCE

○ MATFIELD GREEN

○ THRALL

○ EUREKA

○ HOWARD

● GRENOLA

○ DEXTER

○ NEWTON

○ SEDGWICK

○ RIPLEY

○ WICHITA AP

● CASSODAY

○ DEBRAFF

○ DEBRAFF

○ ROSALIA

● BEAUMONT

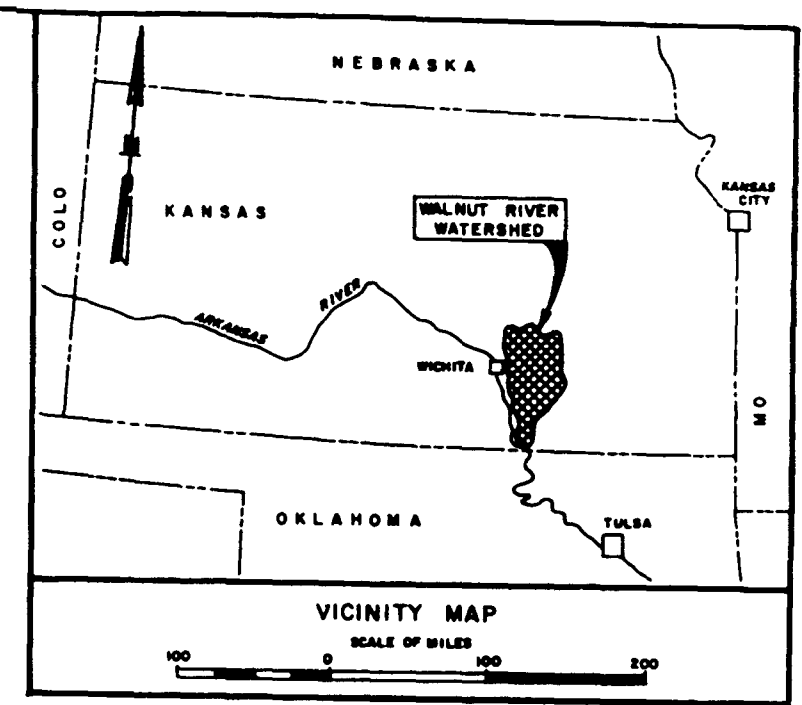
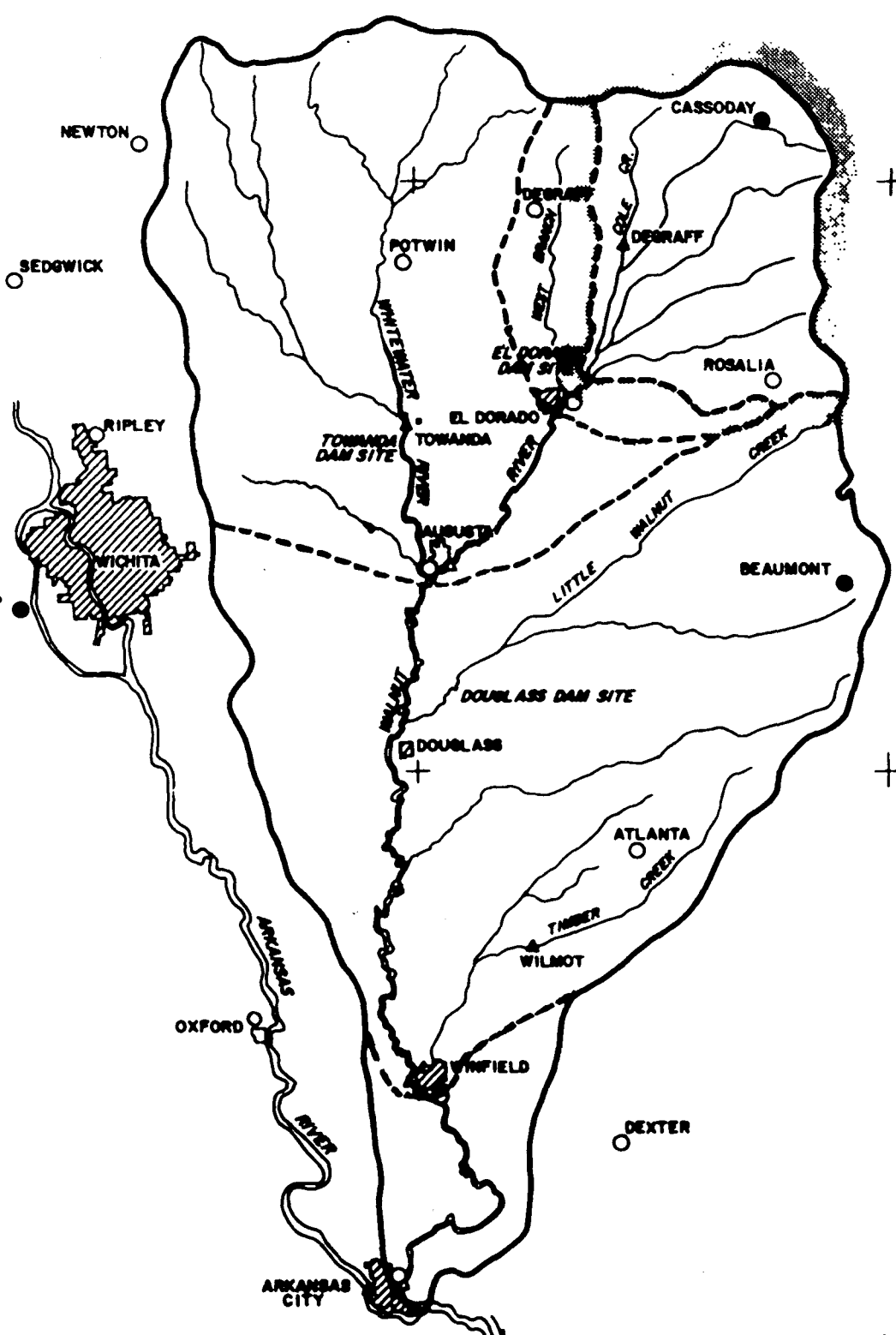
○ ATLANTA

○ WILMOT

○ OXFORD

○ WINFIELD

○ ARKANSAS CITY



**LEGEND**

**PRECIPITATION STATIONS**

- RECORDING
- NON RECORDING

**STREAM GAGING STATIONS**

- ▲ RECORDING
- △ NON RECORDING, STAGES ONLY

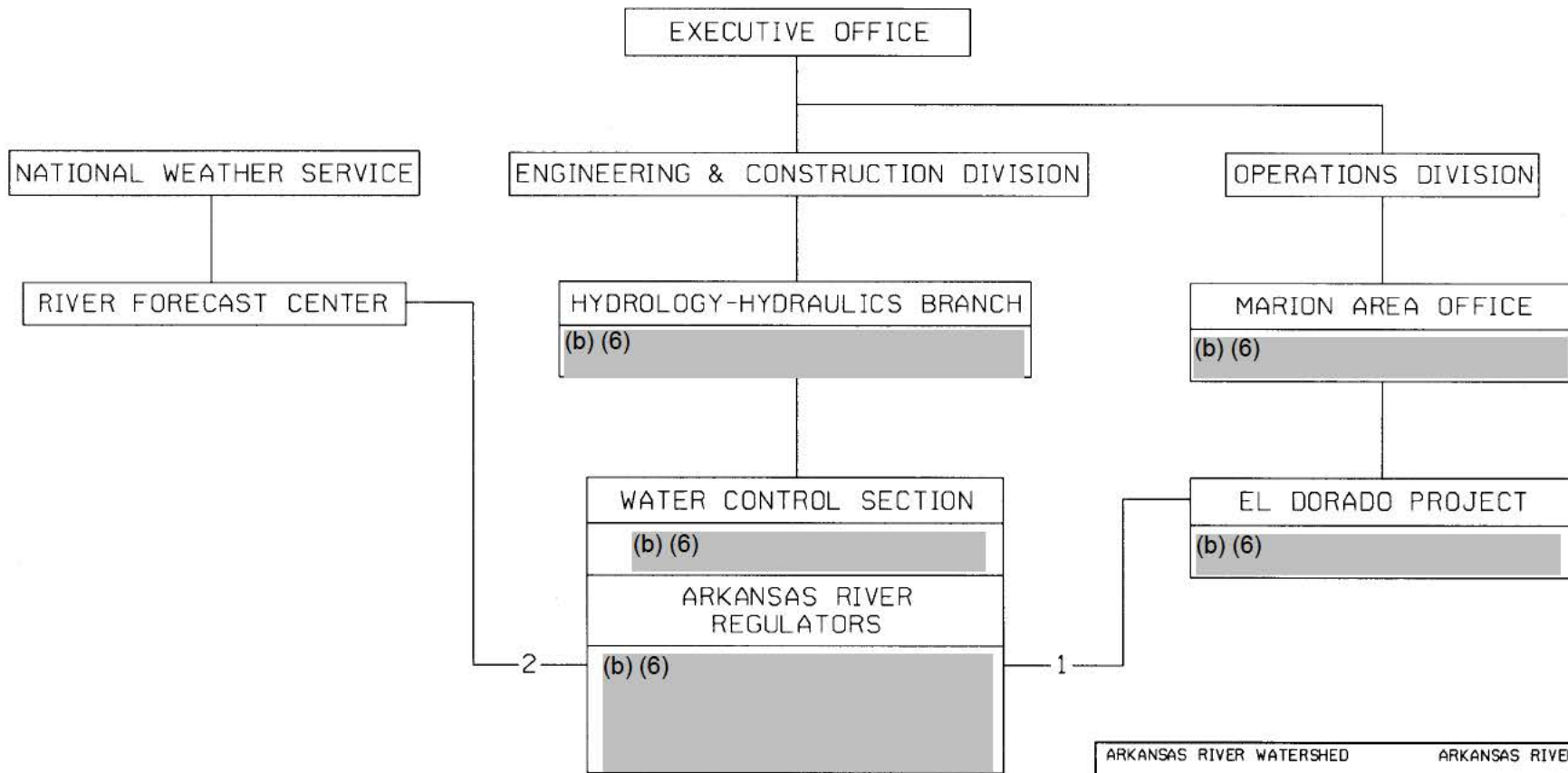
ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

EL DORADO LAKE  
 REPORTING RAINFALL  
 AND  
 STREAM GAGING STATIONS

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

ORGANIZATION OF FLOOD CONTROL REGULATION  
EL DORADO LAKE  
TULSA DISTRICT  
(March 2000)



1. DIRECT COMMUNICATIONS ARE MAINTAINED BETWEEN THE LAKES AND THE WATER CONTROL SECTION FOR TRANSMISSION OF LAKE DATA AND INSTRUCTIONS.
2. PRECIPITATION AND STREAM GAGE DATA ARE FURNISHED BY THE NATIONAL WEATHER SERVICE, RIVER FORECAST CENTER.

ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
ORGANIZATIONAL CHART  
OF FLOOD CONTROL REGULATION  
EL DORADO DAM

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

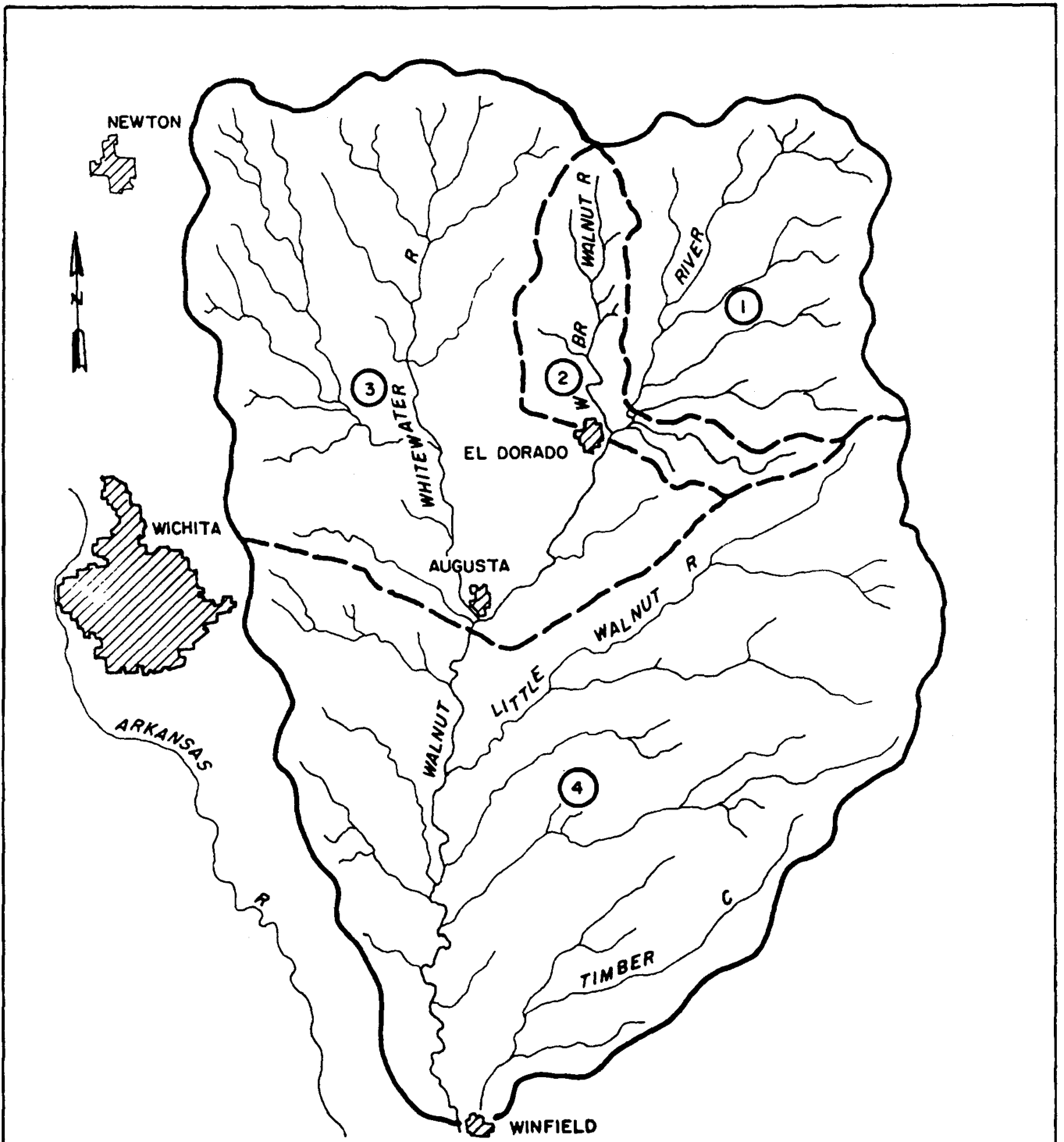
PROJECT

LAKE DATA

DATE MARCH XX

LINE #	ITEM	TIME	18																
1	POOL ELEVATION	12N	1339 46																
2	POOL ELEVATION	4PM	1339 47																
3	POOL ELEVATION	12M	1339 49																
4	POOL ELEVATION	8AM	1339 48																
5	TAILWATER ELEVATION	8AM	7 95																
6	24 HR AVG POWER DISCHARGE	12M																	
7	24 HR AVG TOTAL DISCHARGE	12M																	
8	NET POWER GENERATION	12M																	
9	GEN#1 HRS OF USE	12M																	
	GEN#2 HRS OF USE	12M																	
	GEN#3 HRS OF USE	12M																	
	GEN#4 HRS OF USE	12M																	
10	INSTANTANEOUS POWER DISCHARGE	8AM																	
11	INSTANTANEOUS TOTAL DISCHARGE	8AM	290																
12/13	LAKE WEATHER	8AM	Mr	Cl															
14	TOTAL PRECEDING 6 HOUR PRECIPITATION ENDING AT	1PM																	
		7PM																	
		1AM																	
		7AM																	
15	TOTAL 24 HOUR PRECIPITATION	7AM																	
16	COMMENTS ON PRECIP DIST		TRACE																
17	EVAPORATION 24 HOURS	8AM	048																
18/19	WIND DIRECTION AND VELOCITY	8AM	C	B-0		B-		B-		B-		B-		B-		B-		B-	
20	WATER SUPPLY																		
21	GATE SETTINGS NO, TYPE, AND OPENING	8AM	LF 0 5																
22	GATE CHANGES	DATE TIME	3/17/XX																
			1000																
23	POOL ELEVATION		1339 46																
24	FROM	GATE SETTING	LF 07																
25	TO	GATE SETTING	LF 5																
26	GATE CHANGES	DATE TIME																	
27	POOL ELEVATION																		
28	FROM	GATE SETTING																	
29	TO	GATE SETTING																	
30	GATE CHANGES	DATE TIME																	
31	POOL ELEVATION																		
32	FROM	GATE SETTING																	
33	TO	GATE SETTING																	

ARKANSAS RIVER WATERSHED                      WALNUT RIVER, KANSAS  
  
 EL DORADO LAKE  
  
 LAKE DATA  
  
 DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



**NOTES**

- ① AREA ABOVE EL DORADO DAMSITE
- ② AREA ABOVE EL DORADO GAGE AND BELOW EL DORADO DAMSITE
- ③ AREA ABOVE AUGUSTA GAGE AND BELOW EL DORADO GAGE
- ④ AREA ABOVE WINFIELD GAGE AND BELOW AUGUSTA GAGE

ARKANSAS RIVER WATERSHED	WALNUT RIVER KANSAS
EL DORADO LAKE	
FORECAST REACHES	
DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2000	
DRAWN BY: J.W.C.	
CHECKED BY: S.E.J.	



EL DORADO LAKE

WATER SUPPLY STORAGE ACCOUNTING

TOTAL CONSERVATION STORAGE 154,100 A.F.  
 CONTRACTED STORAGE USER #1 31,900 A.F.  
 CONTRACTED STORAGE USER #2 33,450 A.F.  
 CONTRACTED STORAGE USER #3 88,750 A.F.

Month	User	Beginning Storage A.F.	Inflow Share A.F.	Total Losses A.F.	Withdrawn A.F.	Ending Storage A.F.
Jan	Lake	154,100	90	331	972	152,887
	1	31,900	19	68	476	31,374
	2	33,450	20	72	496	32,902
	3	88,750	52	191	0	88,611
Feb	Lake	152,887	230	789	878	151,450
	1	31,374	48	161	430	30,831
	2	32,902	50	169	448	32,335
	3	88,611	132	459	0	88,284
Mar	Lake	151,450	80	1,235	972	149,323
	1	30,831	17	250	476	30,121
	2	32,335	17	262	496	31,594
	3	88,284	46	722	0	87,608
Apr	Lake	149,323	70	1,825	941	146,627
	1	30,121	14	366	461	29,308
	2	31,594	15	384	480	30,744
	3	87,608	40	1,074	0	86,575
May	Lake	146,627				

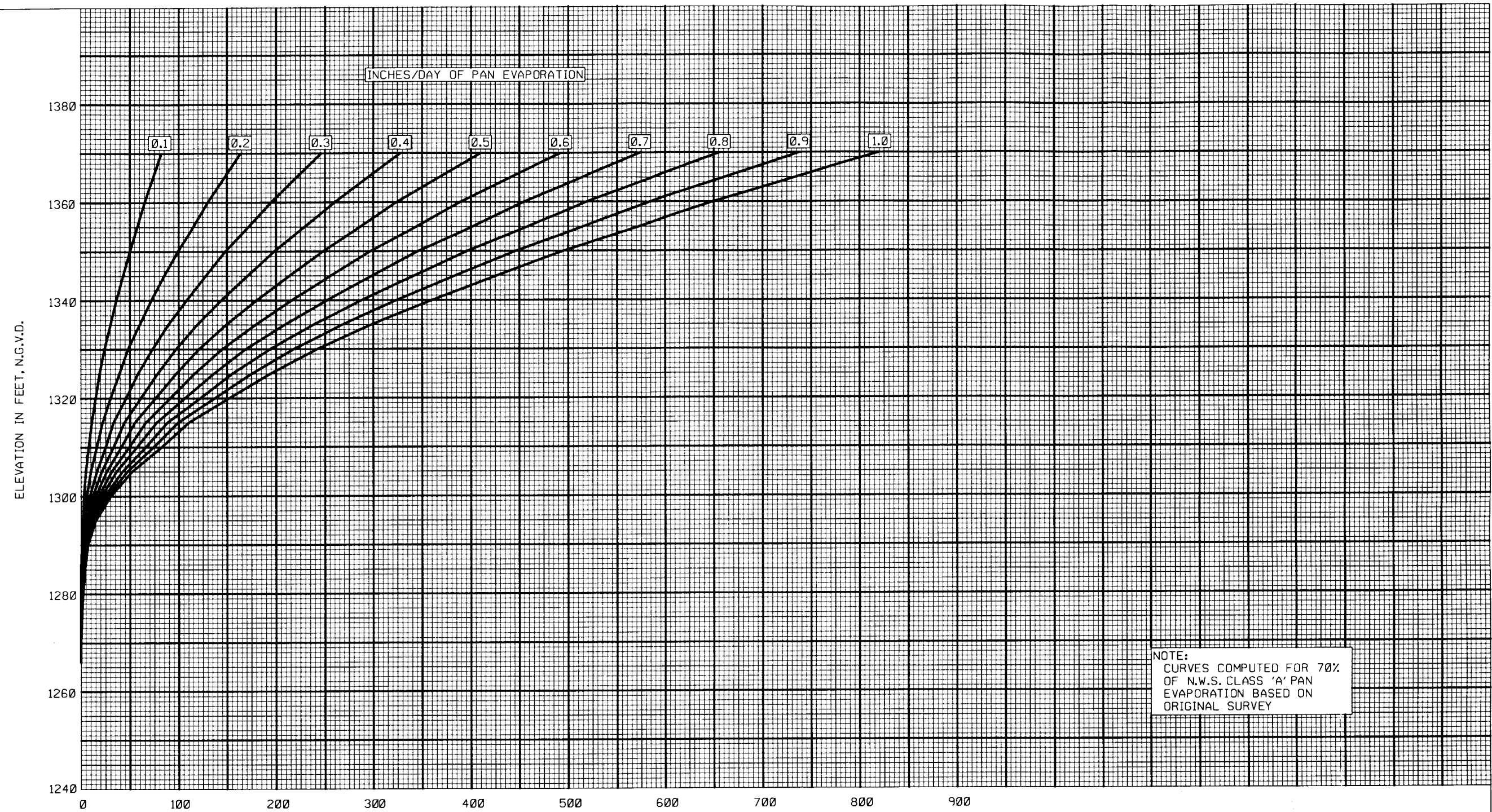
ARKANSAS RIVER WATERSHED

WALNUT RIVER, KANSAS

EL DORADO LAKE  
 WATER SUPPLY  
 STORAGE ACCOUNTING

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1900

DRAWN BY: J.V.C.  
 CHECKED BY: S.C.B.



NOTE:  
 CURVES COMPUTED FOR 70%  
 OF N.W.S. CLASS 'A' PAN  
 EVAPORATION BASED ON  
 ORIGINAL SURVEY

ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

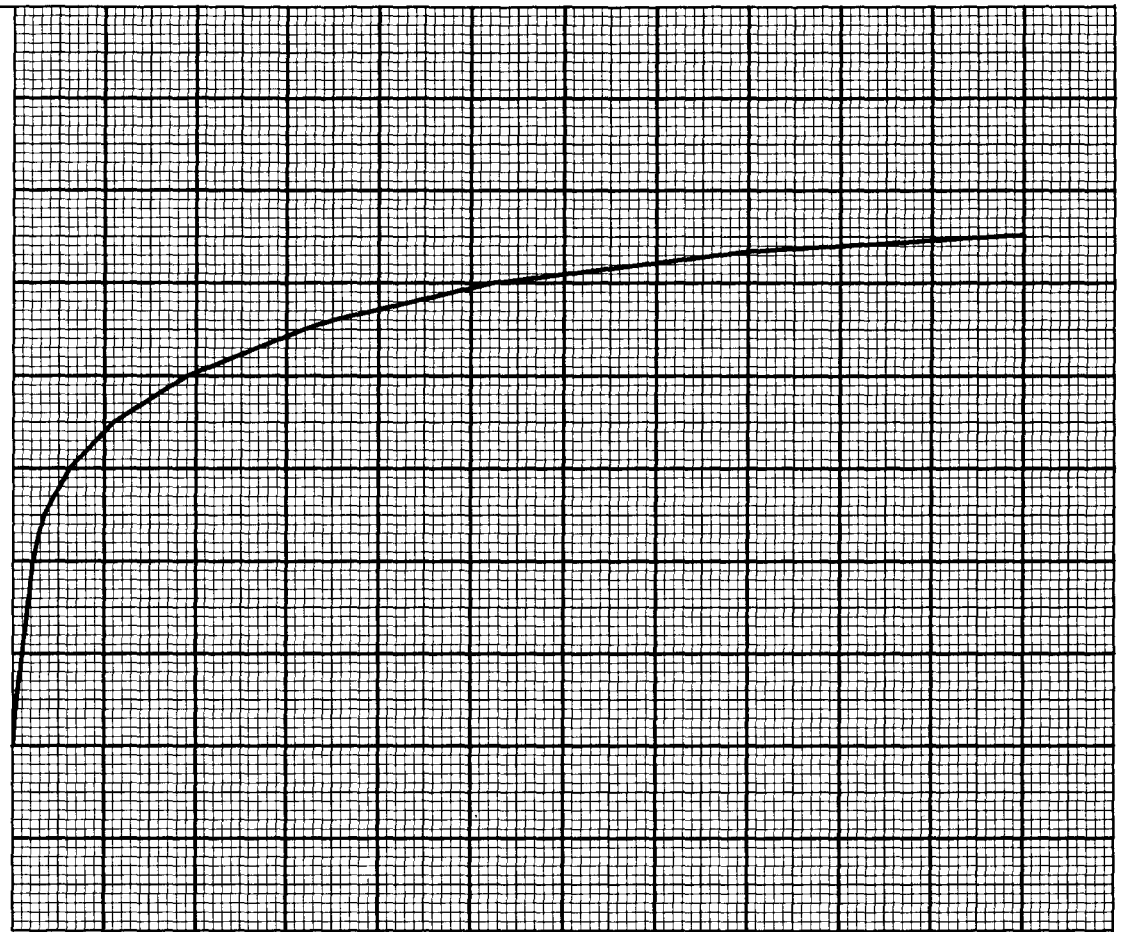
EL DORADO LAKE

EVAPORATION CURVES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.

ELEVATION IN FEET, N.G.V.D.

1310  
1300  
1290  
1280  
1270



DISCHARGE IN 1000 C.F.S.

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

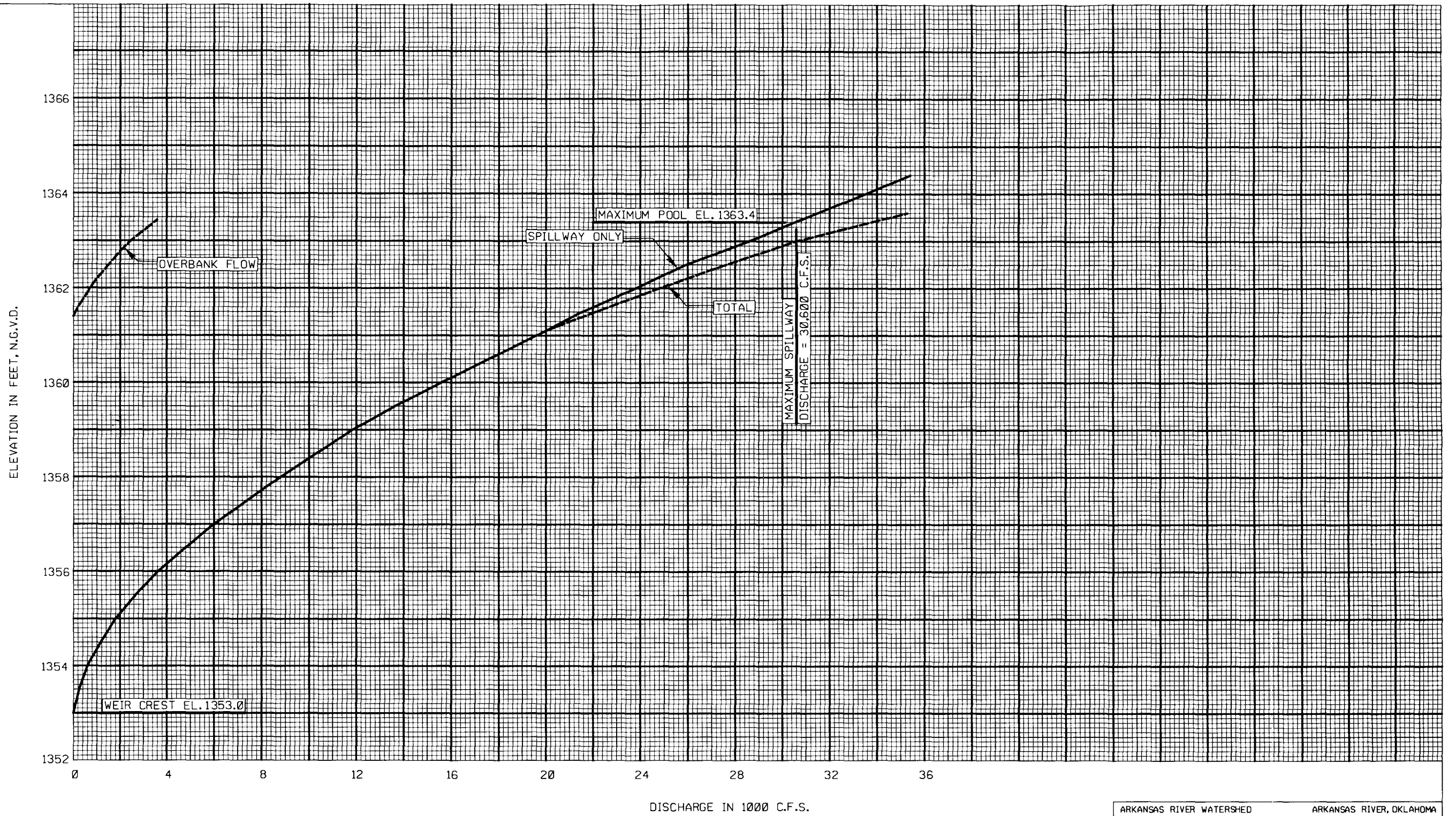
EL DORADO LAKE

TAILWATER RATING CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000

DRAWN BY: J.W.C.

CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

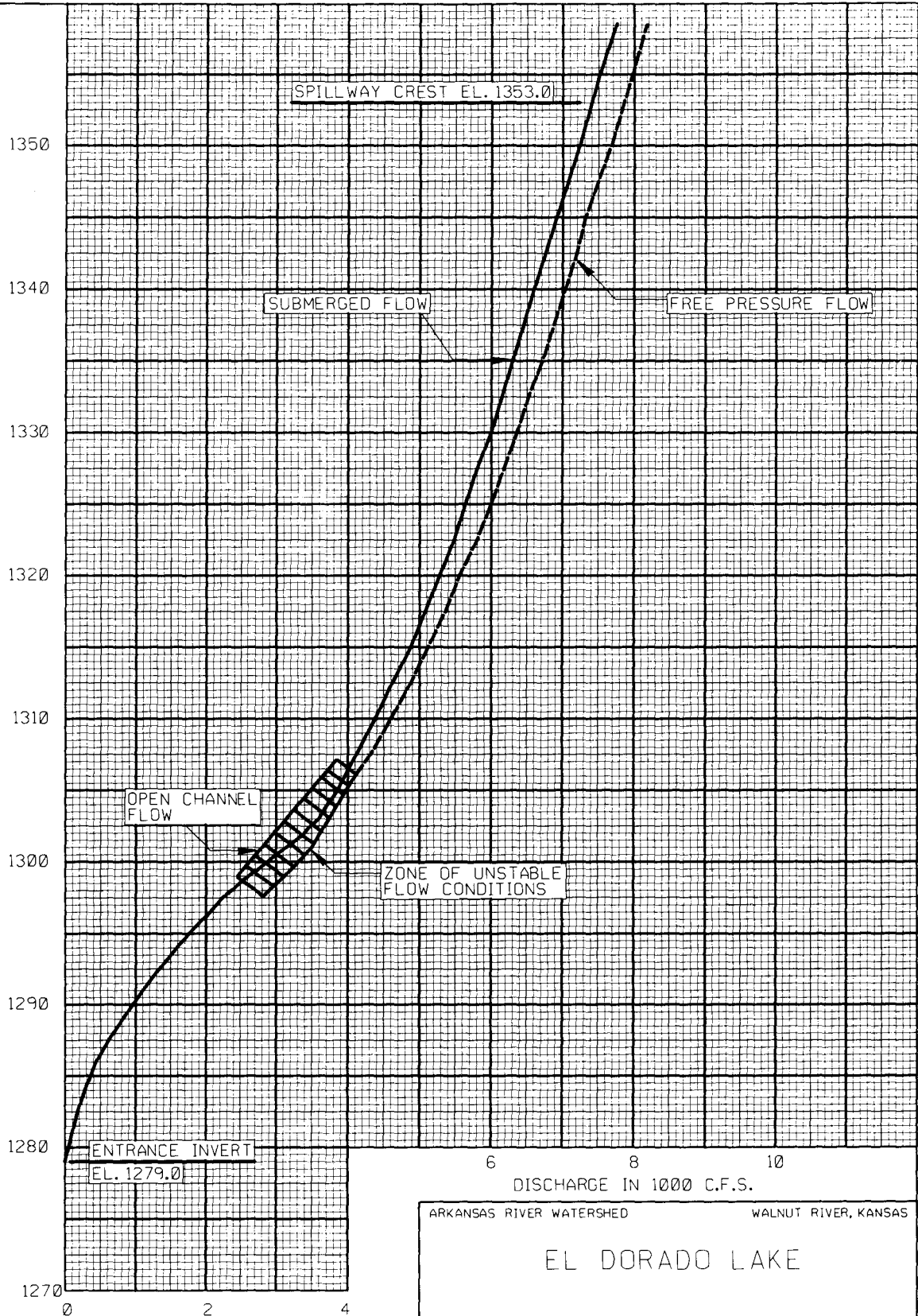
EL DORADO LAKE

SPILLWAY RATING CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.

7-4

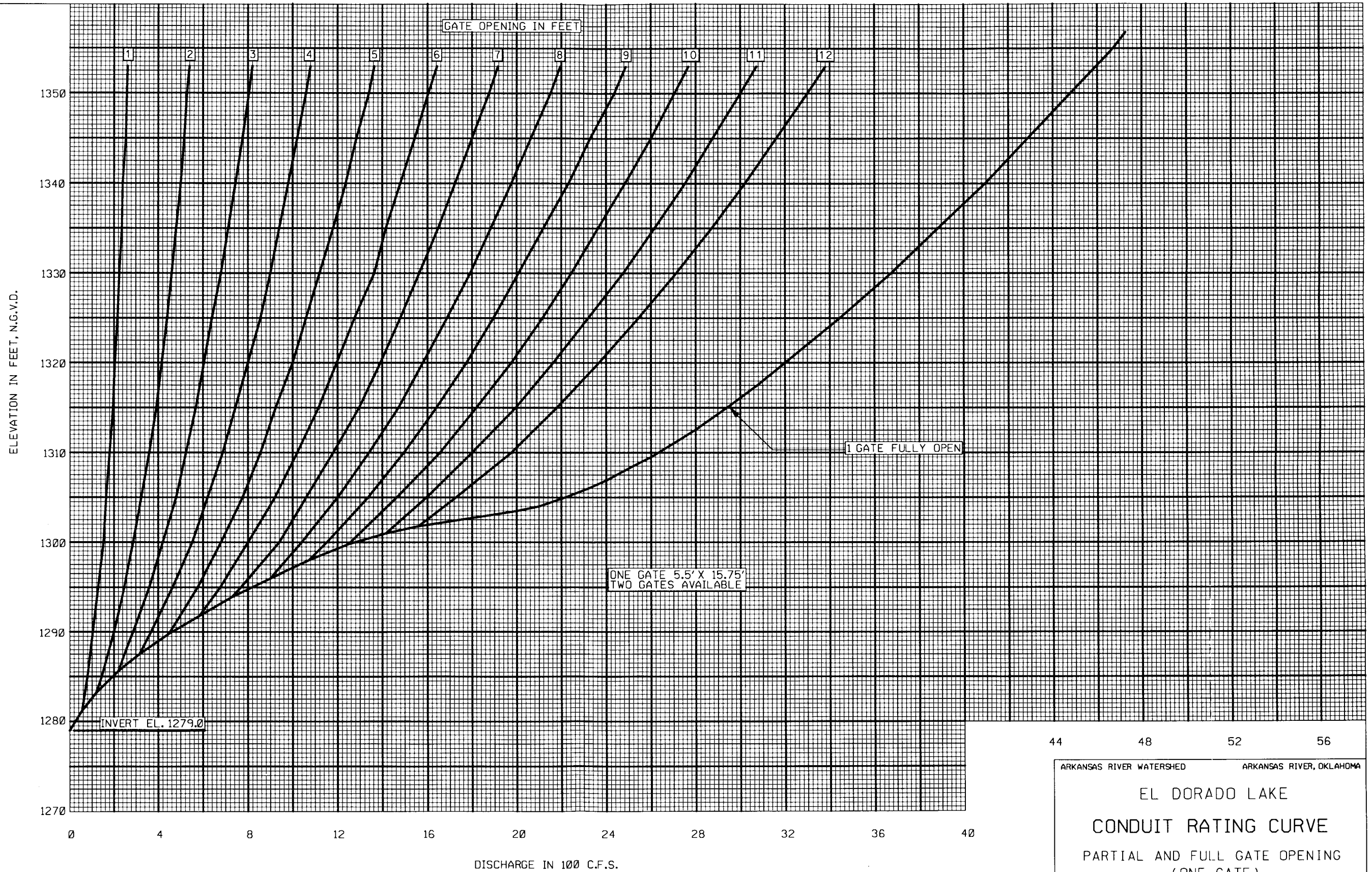
ELEVATION IN FEET, N.G.V.D.



ARKANSAS RIVER WATERSHED WALNUT RIVER, KANSAS

# EL DORADO LAKE CONDUIT RATING CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

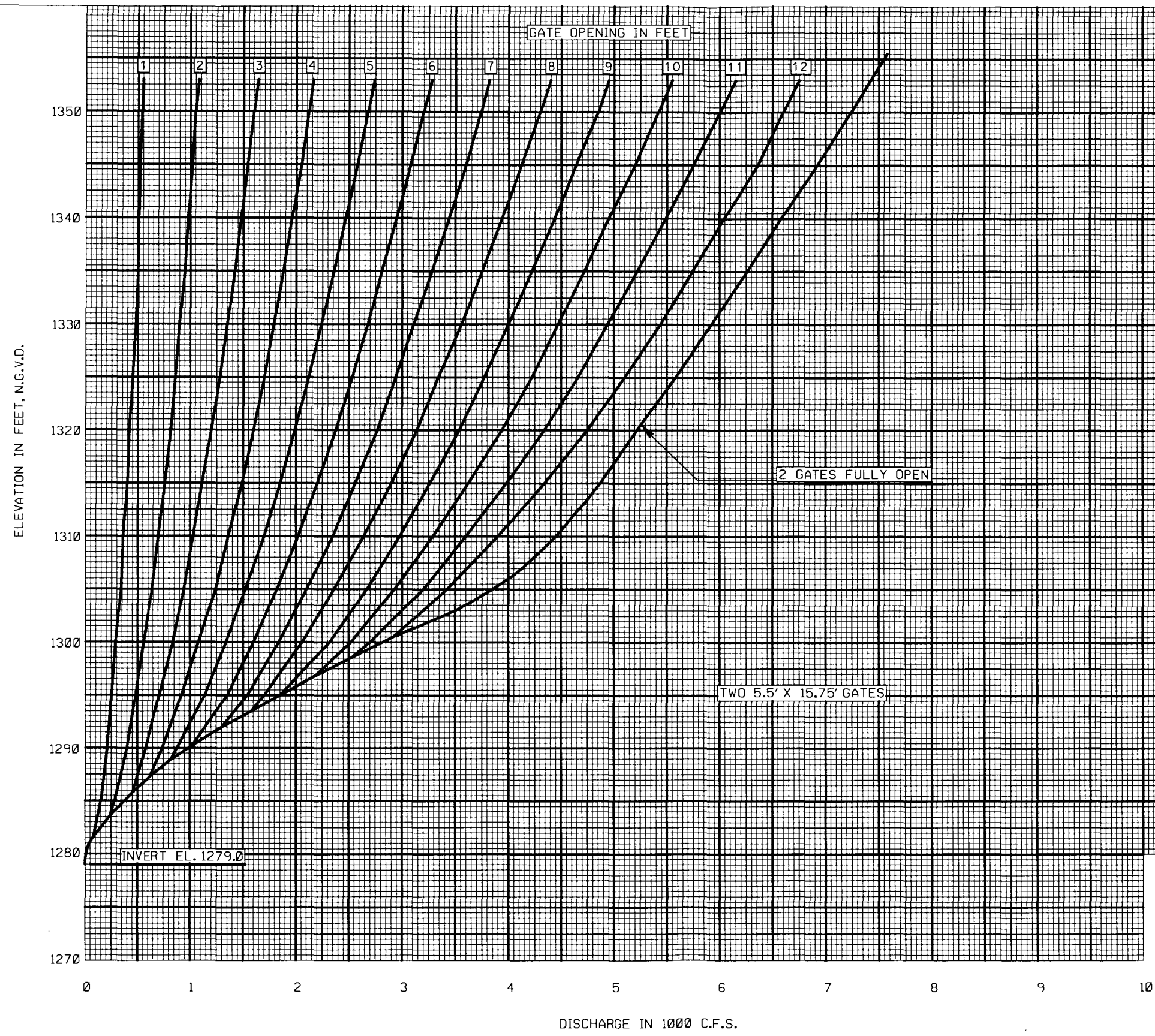


44 48 52 56

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
 CONDUIT RATING CURVE  
 PARTIAL AND FULL GATE OPENING  
 (ONE GATE)

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

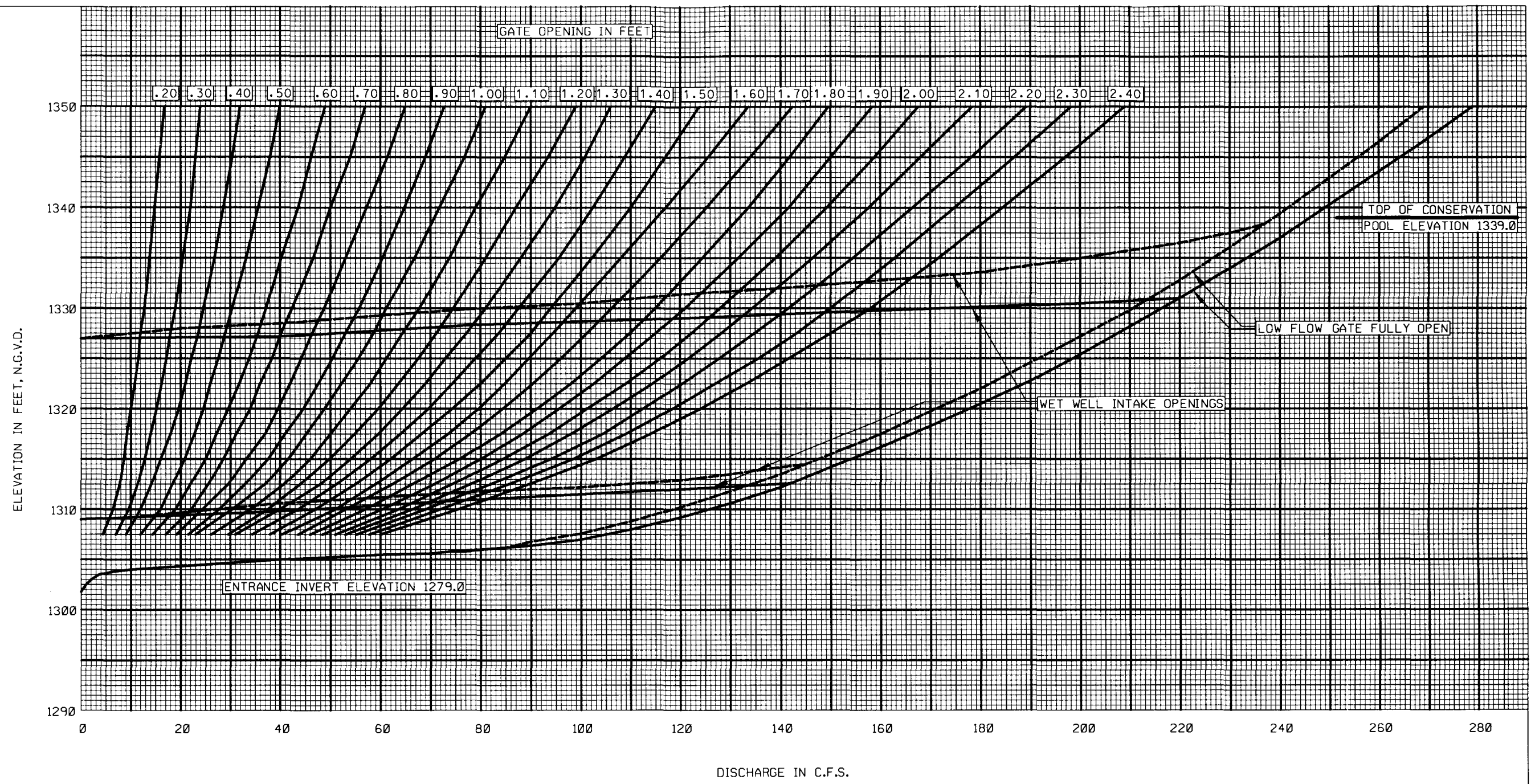
EL DORADO LAKE

CONDUIT RATING CURVE

PARTIAL AND FULL GATE OPENING  
(TWO GATES)

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

7-7

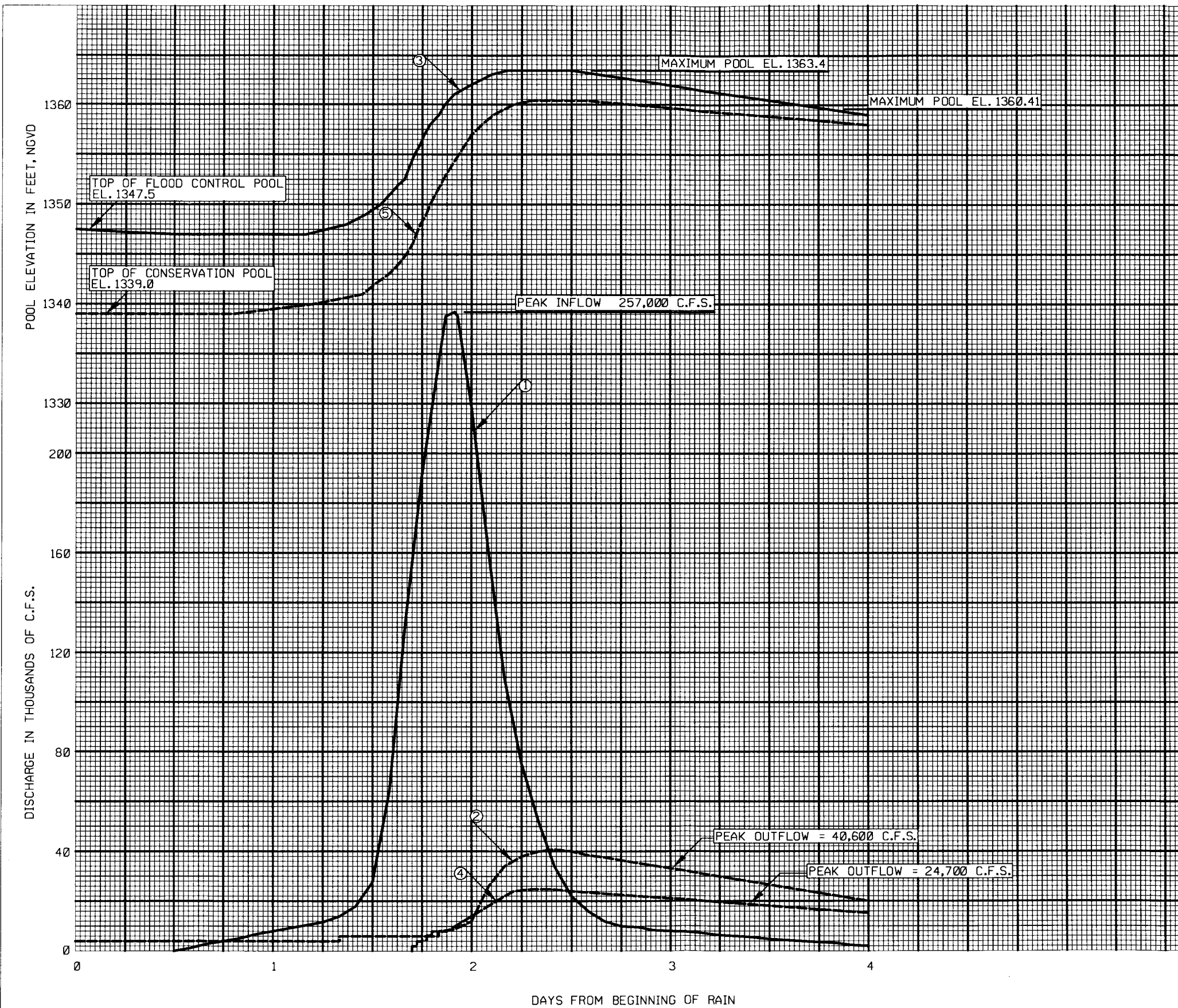


ARKANSAS RIVER WATERSHED      ARKANSAS RIVER, OKLAHOMA

EL DORADO LAKE  
DISCHARGE RATING CURVE  
2' X 3' LOW FLOW SLUICE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.

7-8



NOTE:

EMERGENCY OPERATION

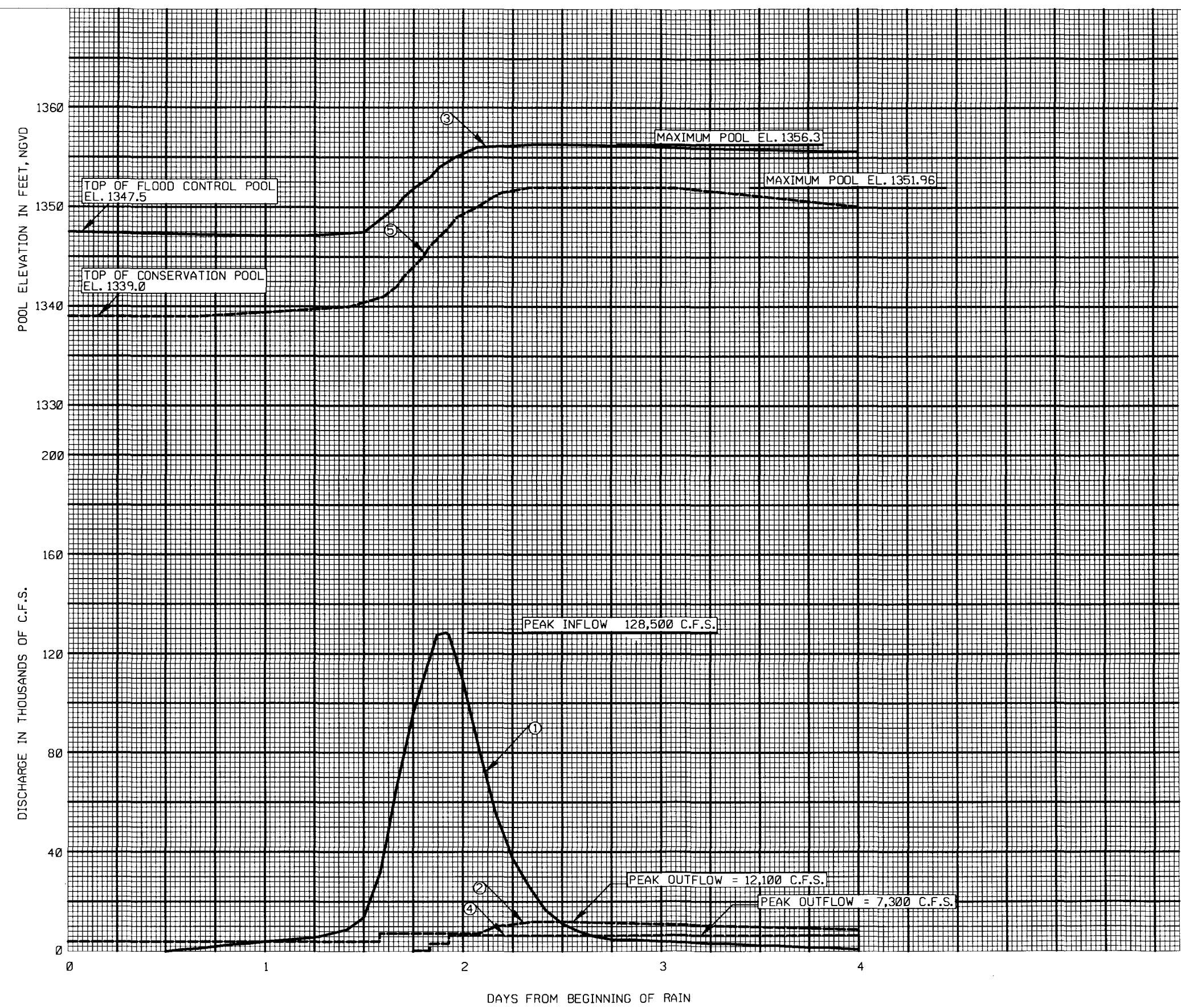
- 1 INFLOW HYDROGRAPH
- 2 OUTFLOW - FLOOD ON FULL POOL
- 3 POOL STAGE - FLOOD ON FULL POOL
- 4 OUTFLOW - FLOOD ON EMPTY POOL
- 5 POOL STAGE - FLOOD ON EMPTY POOL

ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

EL DORADO LAKE

SPILLWAY DESIGN FLOOD  
OPERATIONAL HYDROGRAPHS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.



NOTE:

EMERGENCY OPERATION

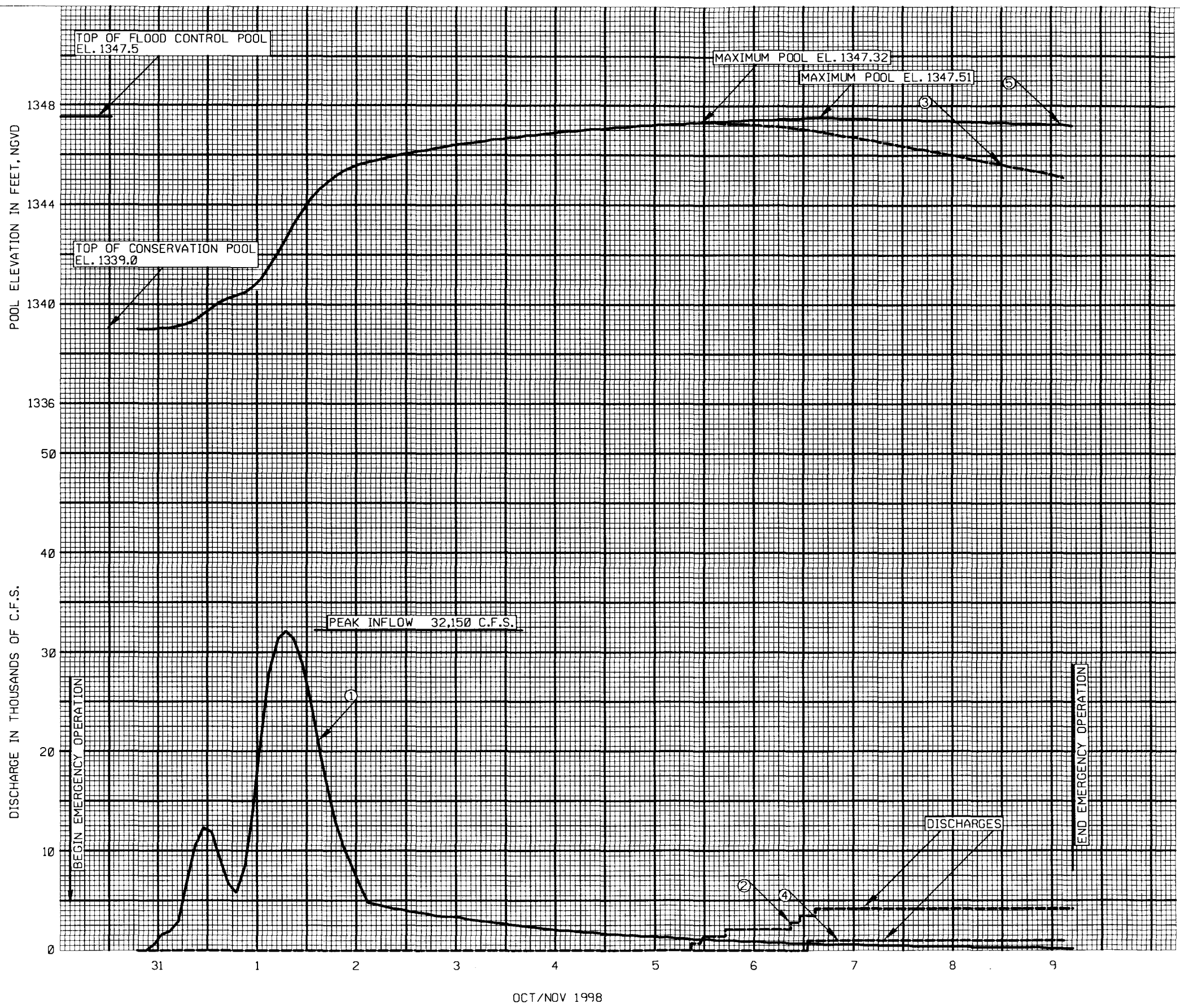
- 1 INFLOW HYDROGRAPH
- 2 OUTFLOW - FLOOD ON FULL POOL
- 3 POOL STAGE - FLOOD ON FULL POOL
- 4 OUTFLOW - FLOOD ON EMPTY POOL
- 5 POOL STAGE - FLOOD ON EMPTY POOL

ARKANSAS RIVER WATERSHED                      WALNUT RIVER, KANSAS

EL DORADO LAKE

1/2 SPILLWAY DESIGN FLOOD  
OPERATIONAL HYDROGRAPHS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



LEGEND

- ① INFLOW HYDROGRAPH
- ② OUTFLOW - NORMAL REGULATION
- ③ POOL STAGE - NORMAL REGULATION
- ④ OUTFLOW - EMERGENCY REGULATION
- ⑤ POOL STAGE - EMERGENCY REGULATION

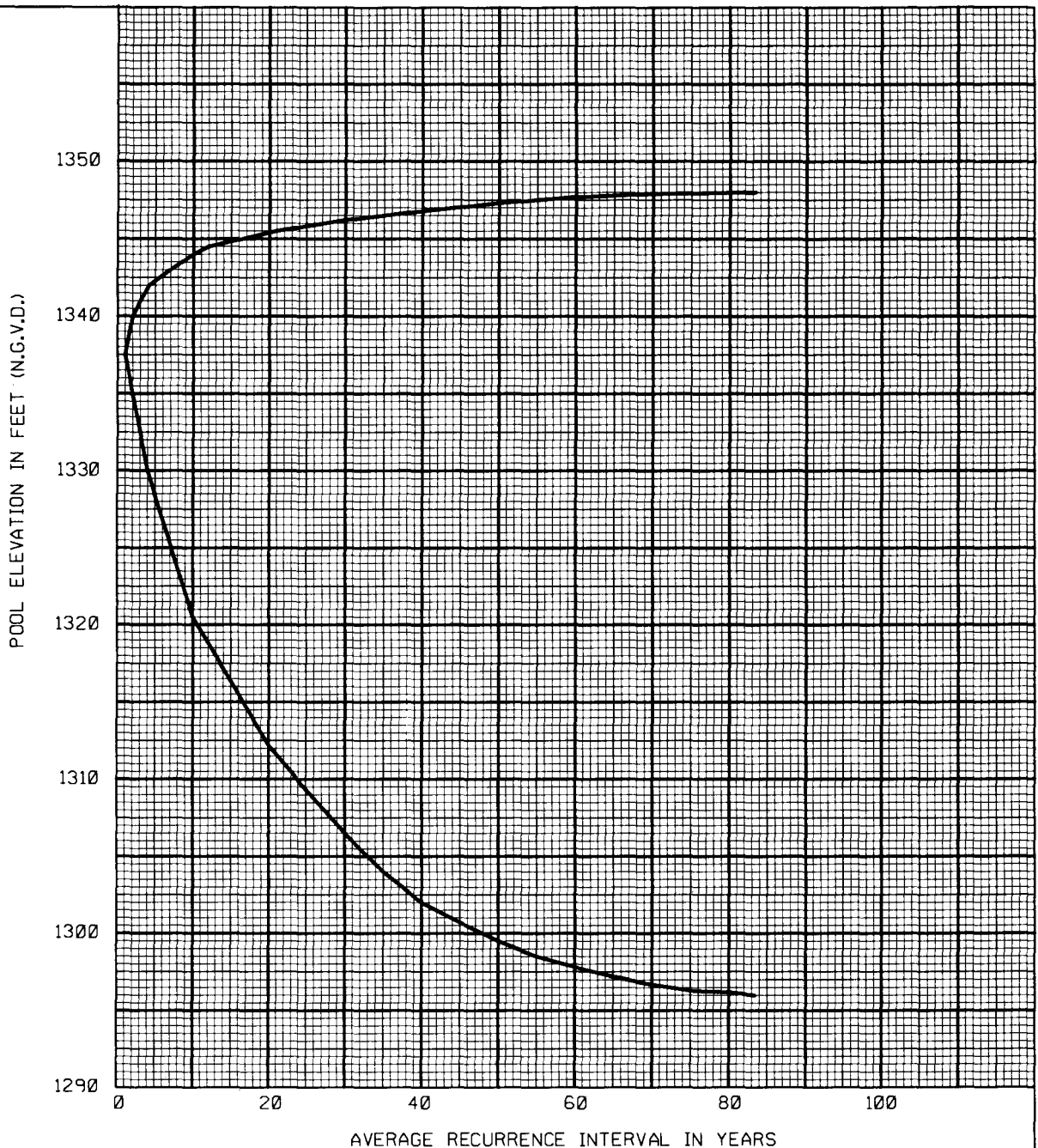
NOTES:

1. REGULATING CAPACITY BELOW THE DAM IS 4,200 C.F.S.

ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

EL DORADO LAKE  
 OPERATIONAL HYDROGRAPHS  
 FLOOD OF OCT/NOV 1998

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



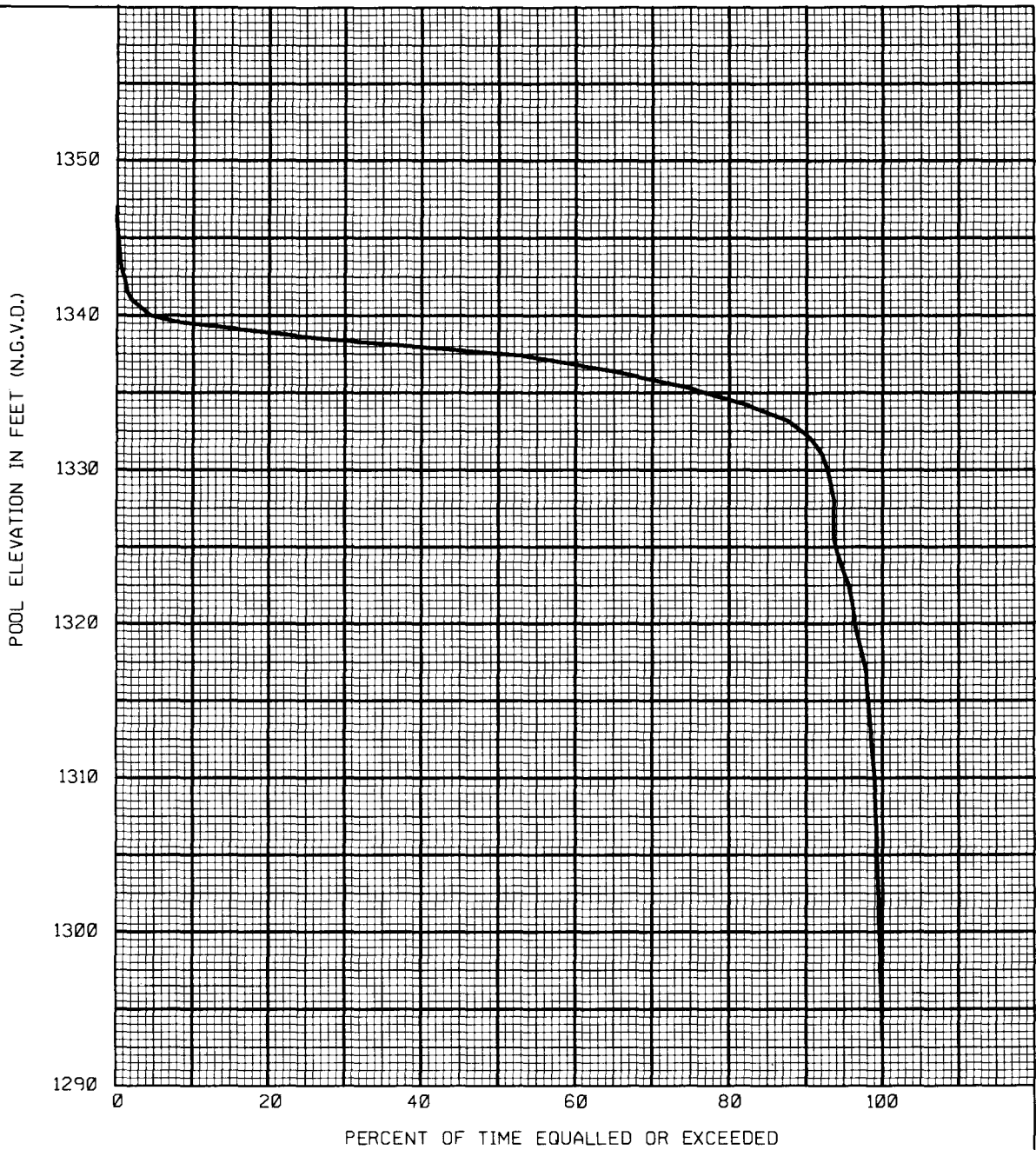
DAM OPERATED FROM 1940 - 1995

ARKANSAS RIVER WATERSHED WALNUT RIVER, KANSAS

EL DORADO LAKE

POOL ELEVATION  
PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



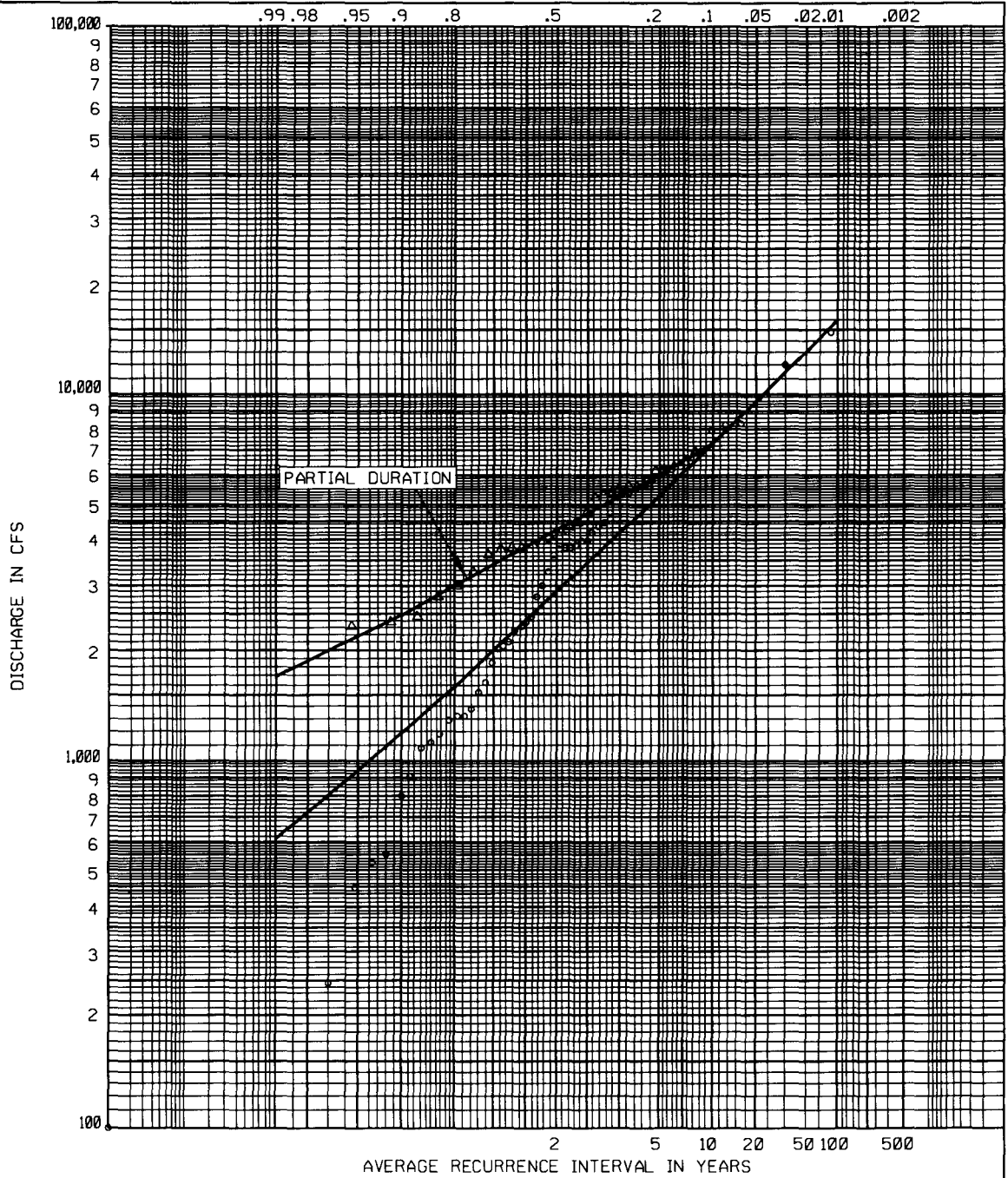
DAM OPERATED FROM 1940 - 1995

ARKANSAS RIVER WATERSHED      WALNUT RIVER, KANSAS

EL DORADO LAKE

POOL ELEVATION  
DURATION CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
 DRAWN BY: J.W.C.  
 CHECKED BY: S.E.J.



NOTES

1. BASED ON DAILY VALUES OF ANNUAL PEAK DISCHARGES FOR THE PERIOD OF RECORD 1940 THROUGH 1995 AT THE EL DORADO GAGE.
2. PEAK FLOWS FROM SUPER RUN A98X01.

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

PEAK INFLOW  
PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 2000  
DRAWN BY: J.W.C.  
CHECKED BY: S.E.J.