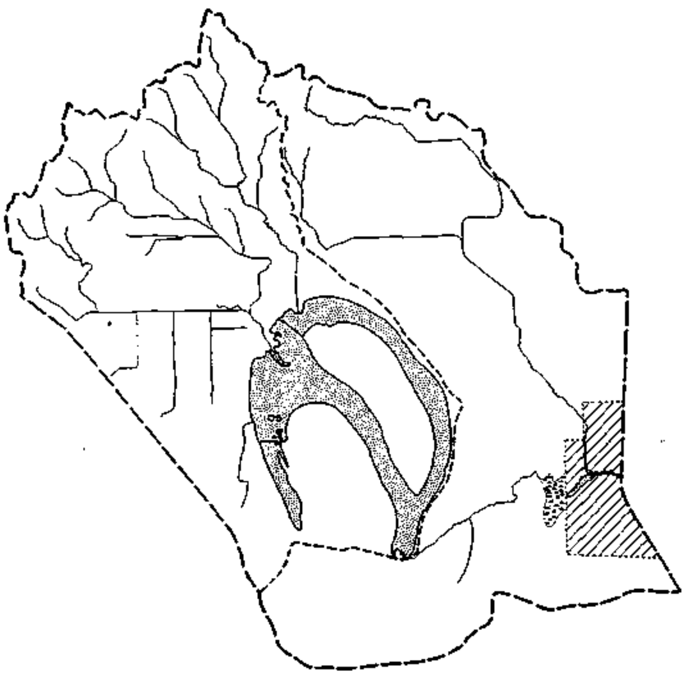
Illinois State Water Survey Division

SURFACE WATER SECTION

SWS Contract Report 491

HYDROLOGIC ANALYSIS OF THE POOR FARM AREA, ALEXANDER COUNTY, ILLINOIS

by Ming T. Lee



Prepared for the
Illinois Department of Conservation

Champaign, Illinois
May 1990

ENR Illinois Department of Energy and Natural Resources

HYDROLOGIC ANALYSIS OF THE POOR FARM AREA, ALEXANDER COUNTY, ILLINOIS

by

Ming T. Lee, P.E., Ph.D.
Hydrologist
Illinois State Water Survey
2204 Griffith Drive
Champaign, Illinois 61820-7495

Prepared for the Illinois Department of Conservation

May 1990

CONTENTS

HYDROLOGIC ANALYSIS OF THE POOR FARM AREA, ALEXANDER COUNTY, ILLINOIS

by Ming T. Lee

INTRODUCTION

The Illinois Department of Conservation is undertaking a study to determine the feasibility of developing a waterfowl area within the so-called 'Poor Farm" area in the Lake Creek watershed in Alexander County (figure 1). This area is located near the intersection of Road Run and Lake Creek, as shown in figure 2. An adequate site for the waterfowl area has to have sufficient shallow water impounded during the waterfowl migration season. The Department of Conservation asked the Illinois State Water Survey to conduct a hydrologic analysis to assess the water quantity available during the period of October through January, which is the migration season for geese.

Objectives

This project had three main purposes:

1) To analyze the streamflow data from October through January at stations adjacent to the Poor Farm area.
2) To estimate streamflow and the amount of water that the Lake Creek watershed can supply to the Poor Farm area under various dry-year conditions.
3) To estimate the water yield of the potential reservoir in the Poor Farm area during dry years.

Acknowledgments

This report was prepared under a research contract with the Illinois Department of Conservation. Robert Roads of the Technical Service Division, Illinois Department of Conservation, is the project coordinator.

The project was conducted under the guidance of Richard G. Semonin, (Chief), Michael L. Terstriep (Head, Surface Water Section), and Nani G. Bhowmik (Assistant Head, Surface Water Section), Illinois State Water Survey. Krishan P. Singh assisted in the low-streamflow analysis. Shery Zimmerman conducted most of the numerical computation. Kathleen Brown typed and formatted the final draft of the report, and Gail Taylor edited the report. John Brother and Linda Riggin prepared the maps; the

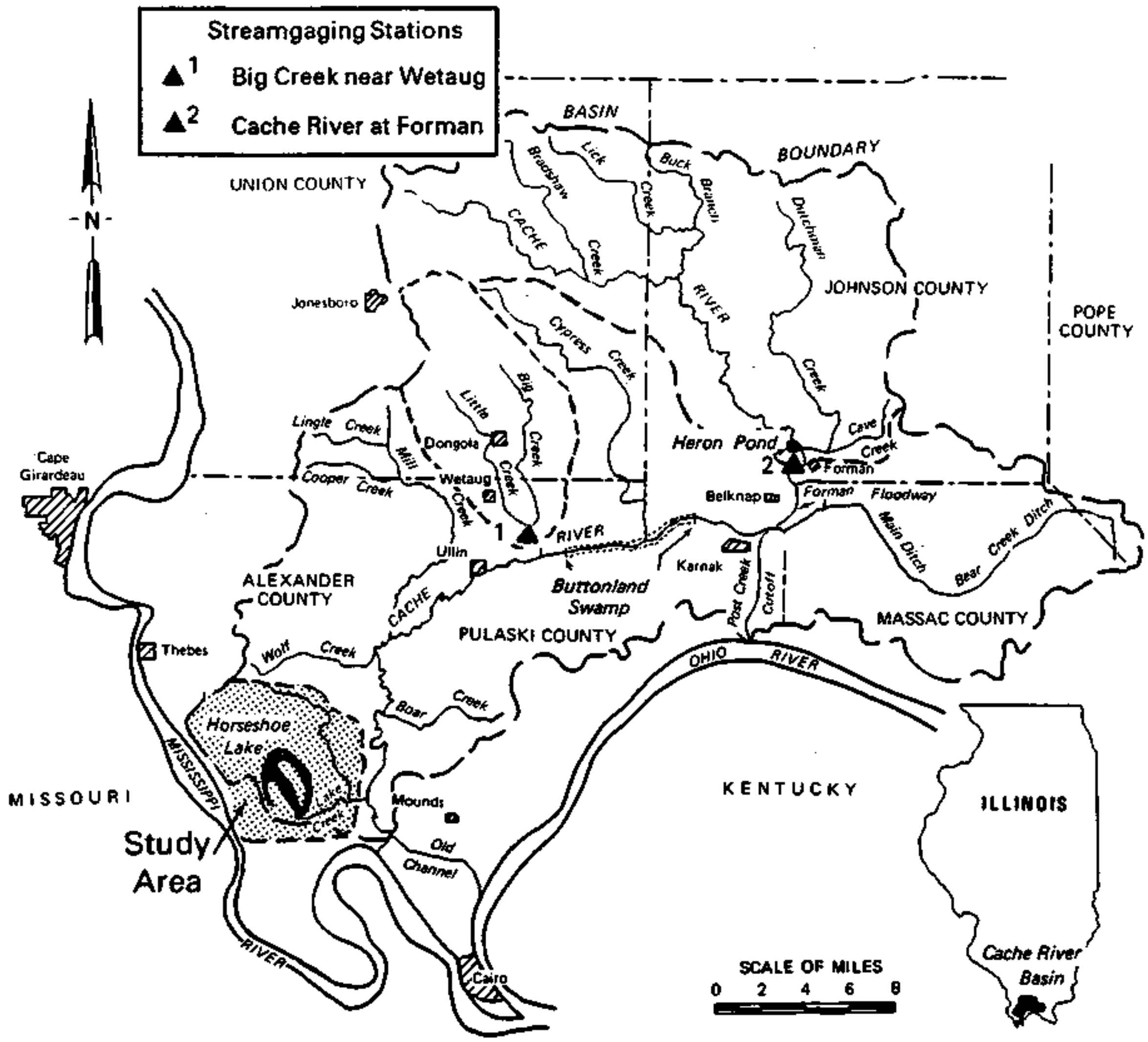


Figure 1. Locations of the Lake Creek watershed study area, adjacent watersheds, and streamgaging stations for those watersheds

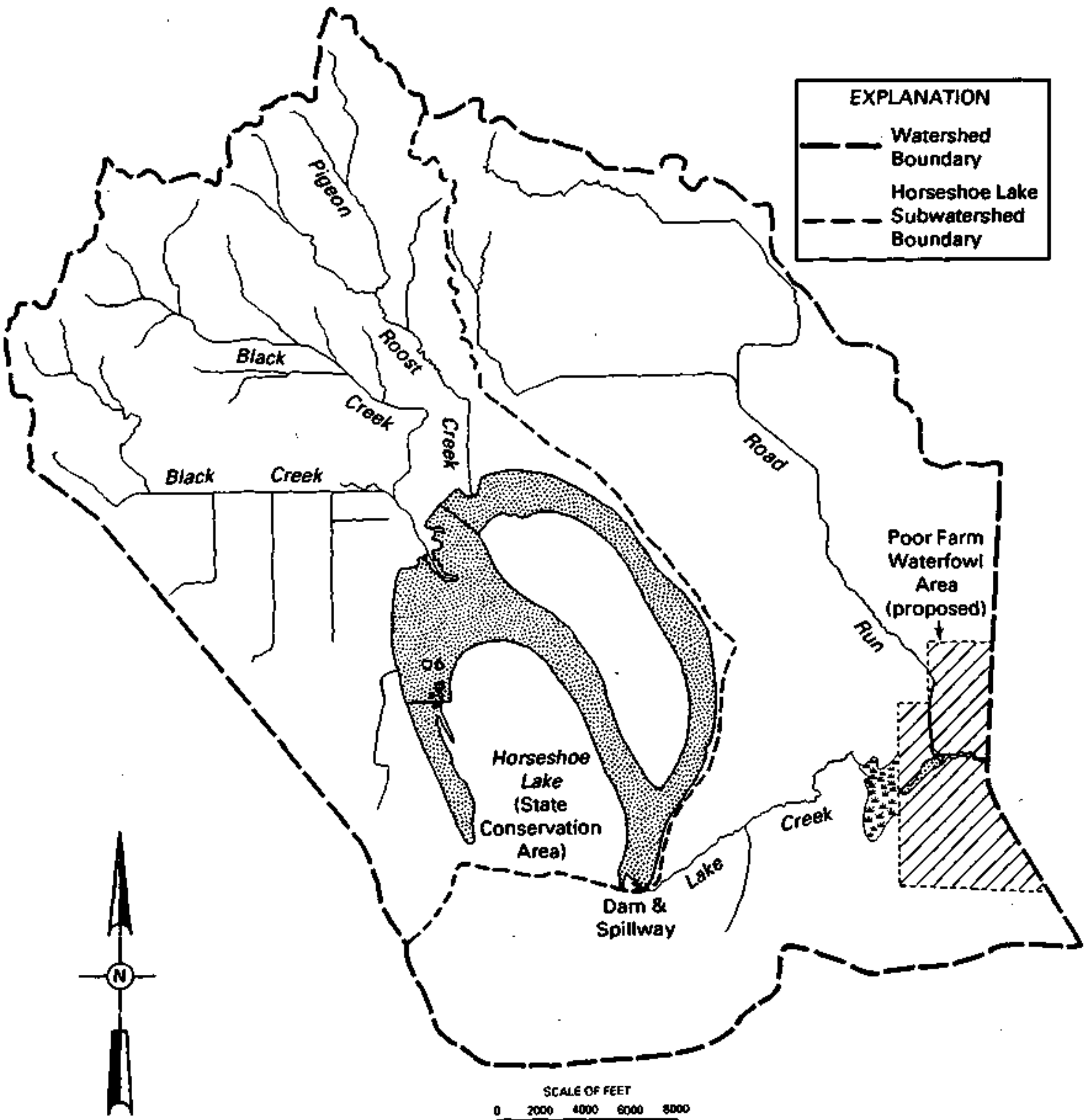


Figure 2. Lake Creek watershed, showing the Horseshoe Lake subwatershed and the Poor Farm area (proposed as a waterfowl area)

graphs were plotted on the computer by Shery Zimmerman and prepared for publication by John Brother.

DESCRIPTION OF THE STUDY AREA

Surface Hydrologic System

The Poor Farm area is located at the outlet of Lake Creek in Alexander County, Illinois, as shown in figure 2. Lake Creek drains to the Cache River about one-half mile from the intersection of Routes 3 and 127. A portion of upper Lake Creek was impounded as Horseshoe Lake, which has been developed as a State Conservation Area. Pigeon Roost Creek and Black Creek, two main tributaries of Lake Creek, drain to Horseshoe Lake (figure 2). Road Run, an eastern tributary, joins Lake Creek at the northern property boundary of the Poor Farm area, as shown in figure 2. The total drainage area of the Lake Creek watershed is 45.8 square miles.

The Poor Farm area is part of the large wetland areas of the Cache River bottomland. The Mississippi River is only about one mile south of the Poor Farm area, and Mississippi River floods inundate the area almost annually.

Rainfall

The average annual precipitation in Alexander County is 44 inches (Neely et al., 1987). For the wettest year expected on the average of once in five years, the annual precipitation is 52 inches, and for the driest year expected once every five years, the annual precipitation is 36 inches. The average annual snowfall is about 9 inches.

Runoff

The average annual runoff in the Poor Farm area is 15 inches. A detailed water budget was developed for the Horseshoe Lake watershed (Lee et al., 1986). The average annual runoff for 1984-1985 in the Horseshoe Lake watershed was measured as 22 inches.

There is no long-term streamgaging station in the Lake Creek watershed. The closest streamgaging stations are at Big Creek near Wetaug and the Cache River at Forman.

The area of the county lying between the Mississippi and Ohio River levees is below the 100-year flood elevation of the rivers. The levees are considered adequate to protect against the 100-year flood on either river, but if a greater flood were to occur or if the levees failed, the lowlands of the county could be severely flooded.

Land Use

According to the inventory of the United States Geological Survey (USGS, 1983), the land uses in the Lake Creek watershed and the Poor Farm area were as follows:

Table 1. Land uses in the Lake Creek Watershed and the Poor Farm Area

	Lake Creek watershed		*Poor Farm area*	
Land use	*(ac)*	*(pct)*	*(ac)*	*(pct)*
Urban	135	0.46	0	0.0
Agricultural	18,511	63.0	907	87.7
Rangeland	0	0.0	0	0.0
Forest	6,228	21.2	73	7.1
Water	1,396	4.8	44	4.3
Wetland	3,107	10.6	9	0.9
Barren	0	0.0	0	0.0
TOTAL	29,375	100.0	1,034	100.0

Agriculture in the Lake Creek watershed constitutes 63 percent of the land use. Forest lands, which are primarily located in the bluff areas, occupy about 21 percent. Water bodies cover 1,396 acres or 4.8 percent. Wetlands cover about 10.6 percent of the total watershed.

In the present Poor Farm area, 87.7 percent of the lands are in agriculture, 7.1 percent in forest, 4.3 percent in water, and 0.9 percent in wetlands.

Soils

The soils in the Lake Creek watershed are predominantly silty loams that have been developed in the bottomland alluvium and upland loess deposits. Three main soil associations cover the watershed area: Alvin-Roby-Ruark soils, Ginat-Weinback-Sciotoville soils, and Karnak-Darwin soils (USDA, 1968). Descriptions of these three soil associations are given in table 2.

Table 2. Soil Association Descriptions

Soil association	*Description*
Alvin-Roby-Ruark	Deep, fine-textured or moderately fine-textured subsoil; a coarse- to fine-textured substratum; level to sloping stream terraces
Ginat-Weinback-Sciotoville	Deep, fine-textured or moderately textured substratum; level to sloping stream terraces
Karnak-Darwin	Light colored and moderately dark colored, fine-textured, very poorly drained, slightly to medium acid bottomland soil

Topography

Most areas in the Lake Creek watershed are located in the Mississippi and Cache River bottomlands. The land surface ranges from being level to having very mild slopes. The upland areas of the Pigeon Roost Creek, Black Creek, and Road Run watersheds are located in the bluff areas. Thus these parts of the watersheds have steep slopes and are subject to severe erosion.

DATA SOURCES

Streamflow Data

There is no long-term streamflow gaging station in the Lake Creek watershed. Thus data from gaging stations in adjacent watersheds were used for this project. The stations on the Cache River at Forman and Big Creek near Wetaug were selected as representative hydrologic stations. Both are close to the study area, and long-term data are available for them.

The station on the Cache River at Forman is located in Johnson County, on the downstream side of the highway bridge about 1.2 miles southwest of Forman. The drainage area at Forman is 244 square miles, and the long-term average annual runoff is 16.5 inches. The 6-month, 10-year low flow at this site is 0.3 inches, and the 12-month, 10-year low flow is 5 inches. Streamflow data are available from 1924 through 1987.

The Big Creek watershed is located in Pulaski County, 2.0 miles southeast of Wetaug. The total drainage area is 32.2 square miles, and the average annual runoff is 15.8 inches. The 6-month, 10-year low flow at the gaging station is 0.6 inches, and the 12-month, 10-year low flow is 5 inches. Streamflow data are available from 1941 through 1987.

Land Use Data

Since hydrologic data for stations in adjacent watersheds were used, it is necessary to compare the watershed characteristics of the study area and those of the watersheds where the representative streamgaging stations are located. One of the main watershed characteristics is land use and **land** cover. The U.S. Geological Survey land use and land cover data (USGS, 1983), which are available in the Illinois Geographic Information System (GIS), were used. Both level 1 and level 2 land use classifications were used.

Lake Evaporation Data

The net lake evaporation is defined as the total gross evaporation over a specific duration less the total concurrent precipitation for that period. As described in Water Survey Bulletin 67 (Terstriep et al., 1982), two data sets are required: total monthly precipitation and gross monthly lake evaporation. The former is readily available from the National Weather Bureau. The data for gross lake evaporation are not directly available. Evaporation pan data are available for several locations, but only for about seven months of each year. Thus a method of indirect estimation is needed. In the Lamoreux method (Lamoreux, 1962), mean daily air temperatures, mean daily dewpoint temperatures, mean daily wind movement, and mean daily solar radiation are considered as the input data. The result is the mean monthly evaporation series. The data were analyzed to obtain lake evaporation rates for various durations and recurrence intervals.

Infiltration Data

The soil association data in the Illinois Geographic Information System were used to define the infiltration loss. As described by the USDA (1968), the major soil associations in the Poor Farm area are the Alvin-Roby-Ruark, Ginat-Weinback-Sciotoville, and Karnak-Darwin. The Alvin soils are moderately permeable. The Ginat soils are slowly permeable and have a high water table during wet periods. The Karnak soils are very slowly permeable, and the water table is near the surface during much of the year.

Because of the clayey layer in the soil profiles and because of the high water tables, the infiltration rate is relatively low.

Aerial Photographs

USDA aerial photographs dated September 25, 1965 (the only available photographs) were obtained from the University of Illinois geographic library. These photographs were used for verifying land use and land cover conditions in the Poor Farm area.

USGS Topographic Maps

The 7.5-minute topographic maps of the Lake Creek watershed were obtained from the Illinois State Geological Survey. The maps were used to determine the watershed boundaries and drainage pattern.

Optical Disk System (CD-ROM)

An optical disk system that contains all data for daily streamflow, hourly rainfall, and water quality in Illinois is available in the Water Survey's Surface Water Section. The system, which was developed by U.S. West Knowledge Engineering, Inc. (1987), is the main source of hydrologic data for this project.

DATA ANALYSIS

After the available data were reviewed, the following tasks were conducted to assess the availability of surface water resources in the Poor Farm area.

Defining the Watershed Boundary

The Poor Farm area receives streamflow from Lake Creek and Road Run. The drainage boundary of the Lake Creek watershed was defined and is shown in figure 2.

The total drainage area of the Lake Creek watershed is 45.8 square miles. A portion of the watershed (23.8 square miles) was impounded as Horseshoe Lake.

Streamflow Data Analysis

Because no streamflow data are available for the Lake Creek watershed, streamflow records for the adjacent watersheds at the Cache River and Big Creek streamgaging stations were used.

The daily streamflow data for the Cache River at Forman and Big Creek near Wetaug for October through January were retrieved from the optical disk system (CD-ROM). The daily streamflows were converted into LOTUS format (LOTUS, 1987).

The record length for the Cache River is 64 years (1924 through 1987), and that of Big Creek is 47 years (1941 through 1987). To make consistent comparisons, the daily streamflow data for Big Creek were extended by using the method described in Water Survey Bulletin 67 (Terstriep et al., 1982).

After all the data were prepared, a LOTUS macro was developed to compute the consecutive 30, 45, 60, 75, and 90 days of average low flows at these two streamgaging stations in each hydrologic year. A second macro was developed to rank the annual low flows. The Mean Recurrence Interval (MRI) is computed as follows:

$$MRI = (N+1)/m$$

where

MRI = mean recurrence interval in years

N = number of years of available data

m = rank when the low-flow events are arranged in order of magnitude, with number 1 being the lowest

A description of the LOTUS macros is given in Appendix 1. The 30-, 45-, 60-, 75-, and 90-day low flows for each hydrologic year are included in Appendix 2. The results for 30- to 90-day low flows are plotted in figures 3 through 7.

Comparing the Watershed Characteristics of Lake Creek, the Cache River, and Big Creek

Before the data can be used for the analysis of the Poor Farm area, the characteristics of the watershed of the Poor Farm area (the Lake Creek watershed), as well as those of the Cache River and Big Creek watersheds, are needed. These characteristics are listed in table 3.

The Lake Creek watershed has a smaller percentage of land in cropland and a larger percentage in water and wetlands than the other areas. The aerial photographs of the Poor Farm area seem to verify these differences. The general trend indicates that all three watersheds are dominated by agricultural land. Because of the larger percentage of wetlands in the Lake Creek watershed, the low flows in the watershed are predicted to be higher.

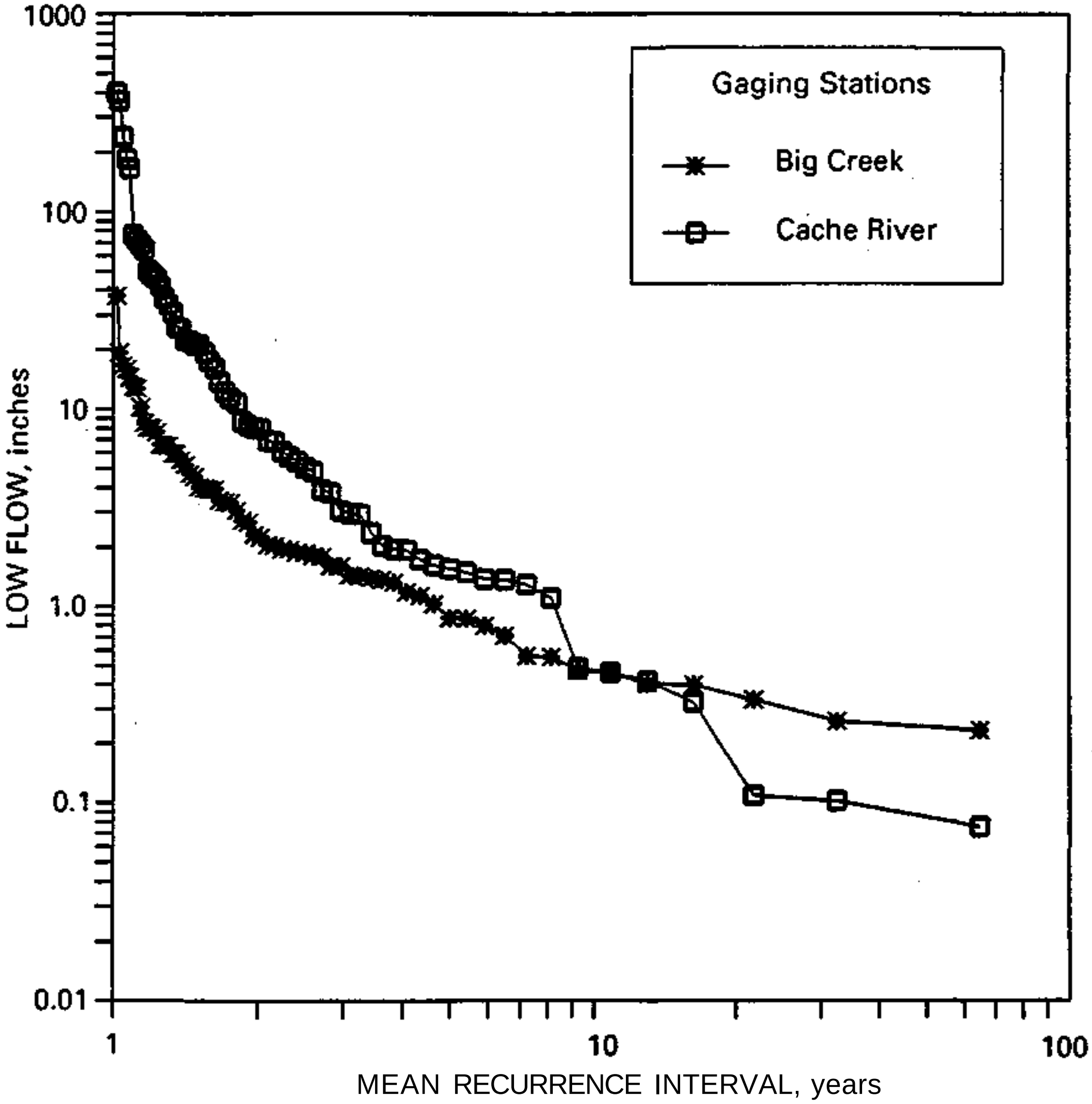


Figure 3. 30-day low flows versus recurrence intervals
for Big Creek and the Cache River

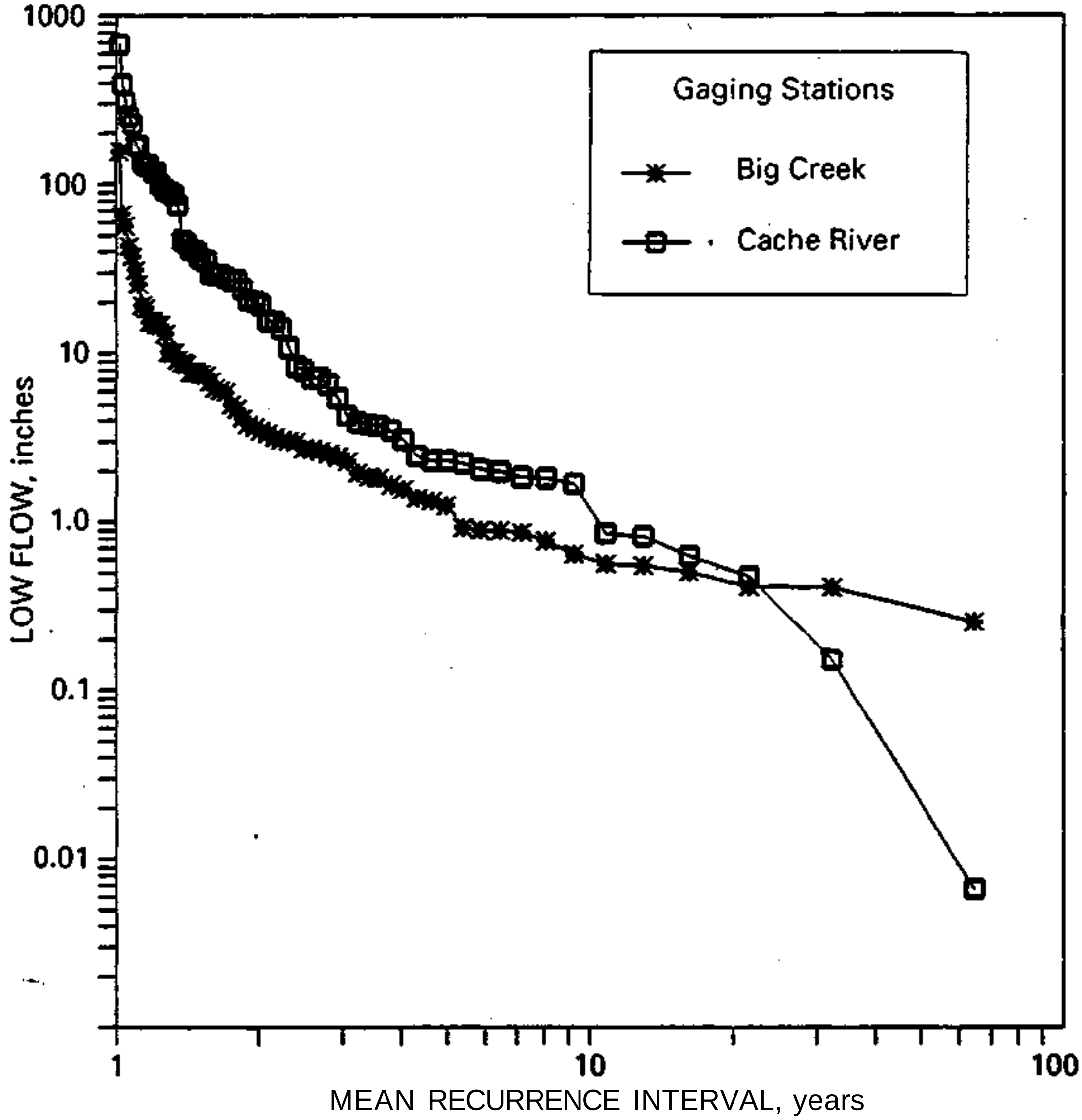


Figure 4. 45-day low flows versus recurrence intervals
for Big Creek and the Cache River

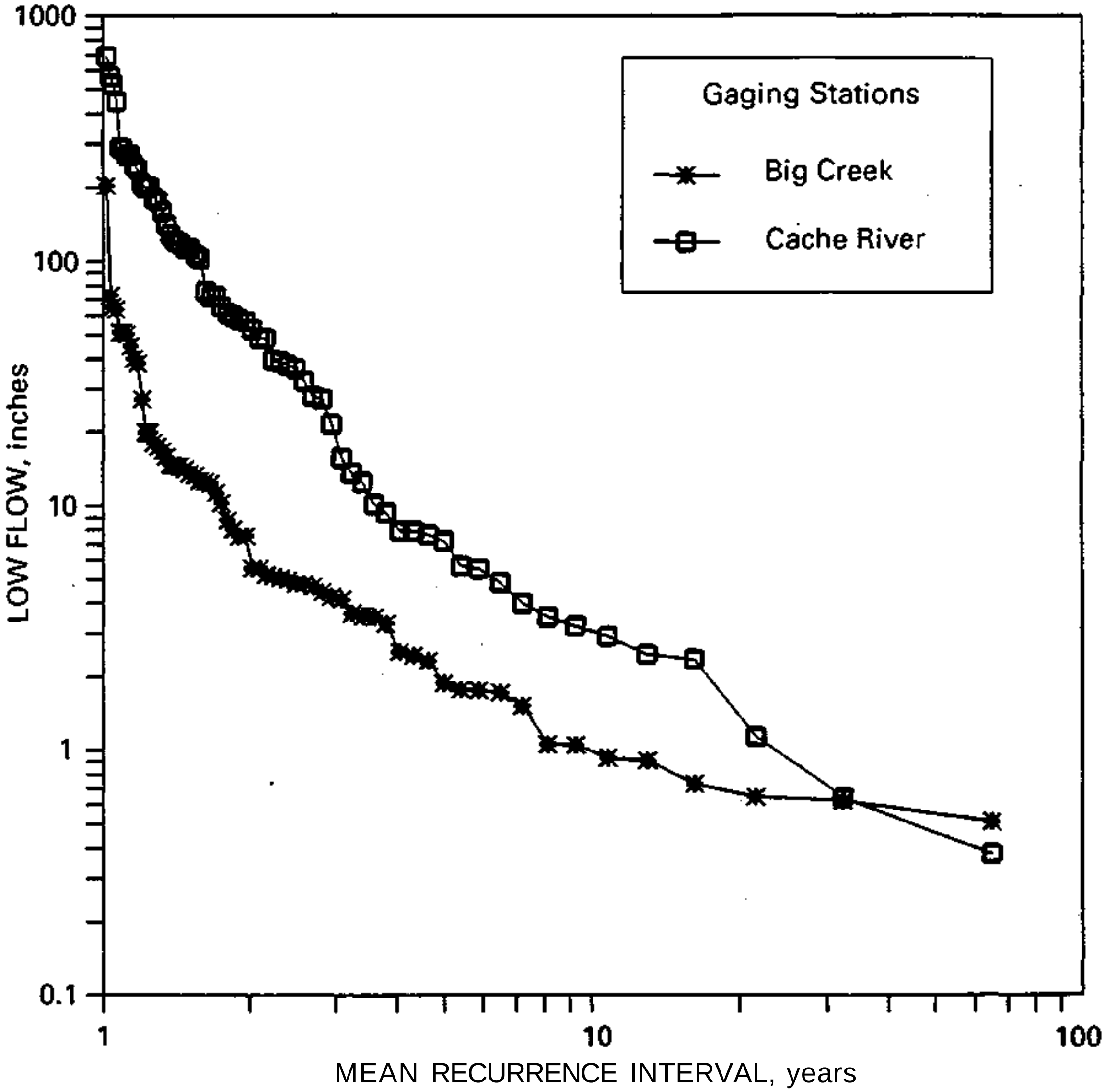


Figure 5. 60-day low flows versus recurrence intervals
for Big Creek and the Cache River

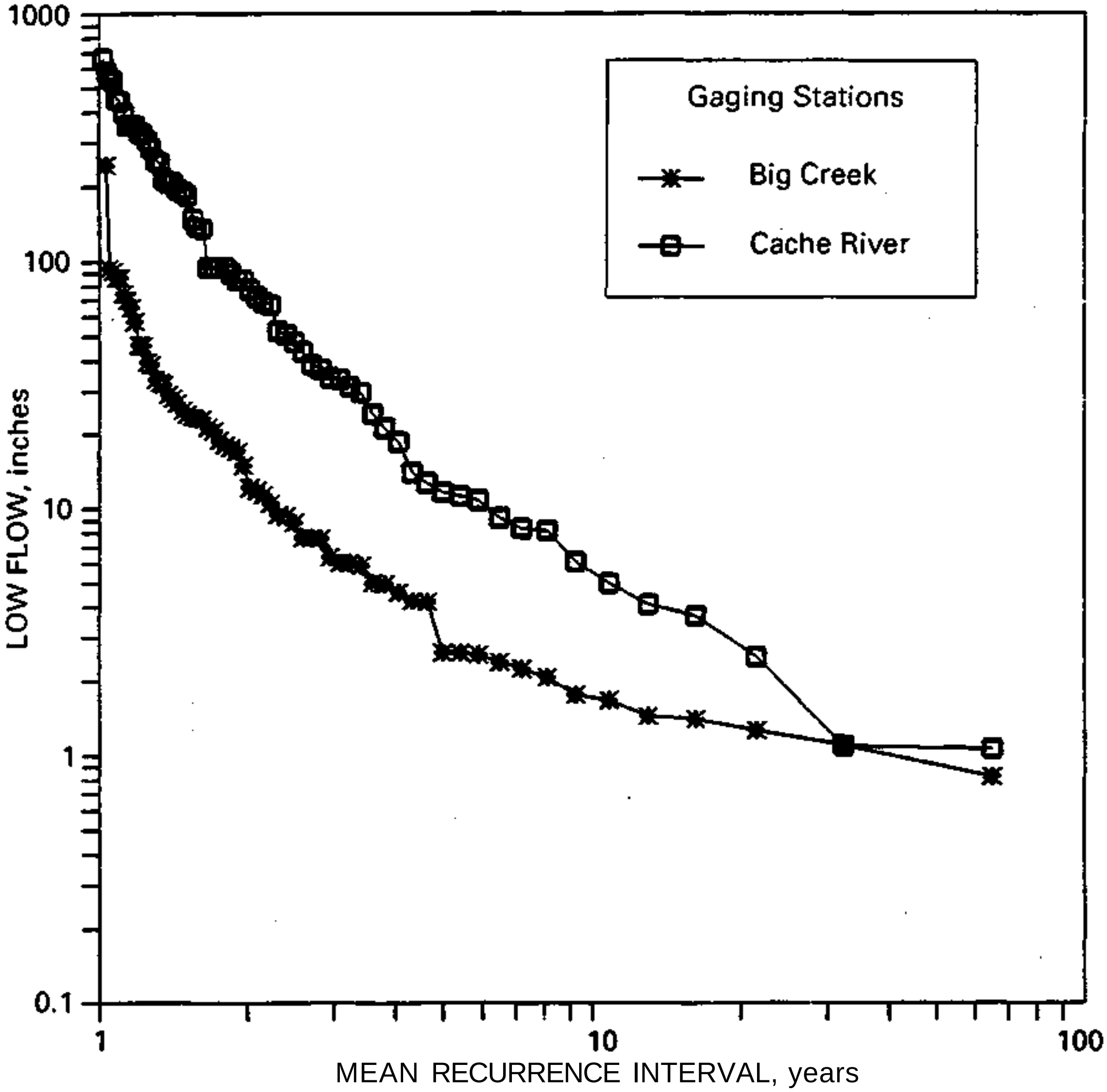


Figure 6. 75-day low flows versus recurrence intervals
for Big Creek and the Cache River

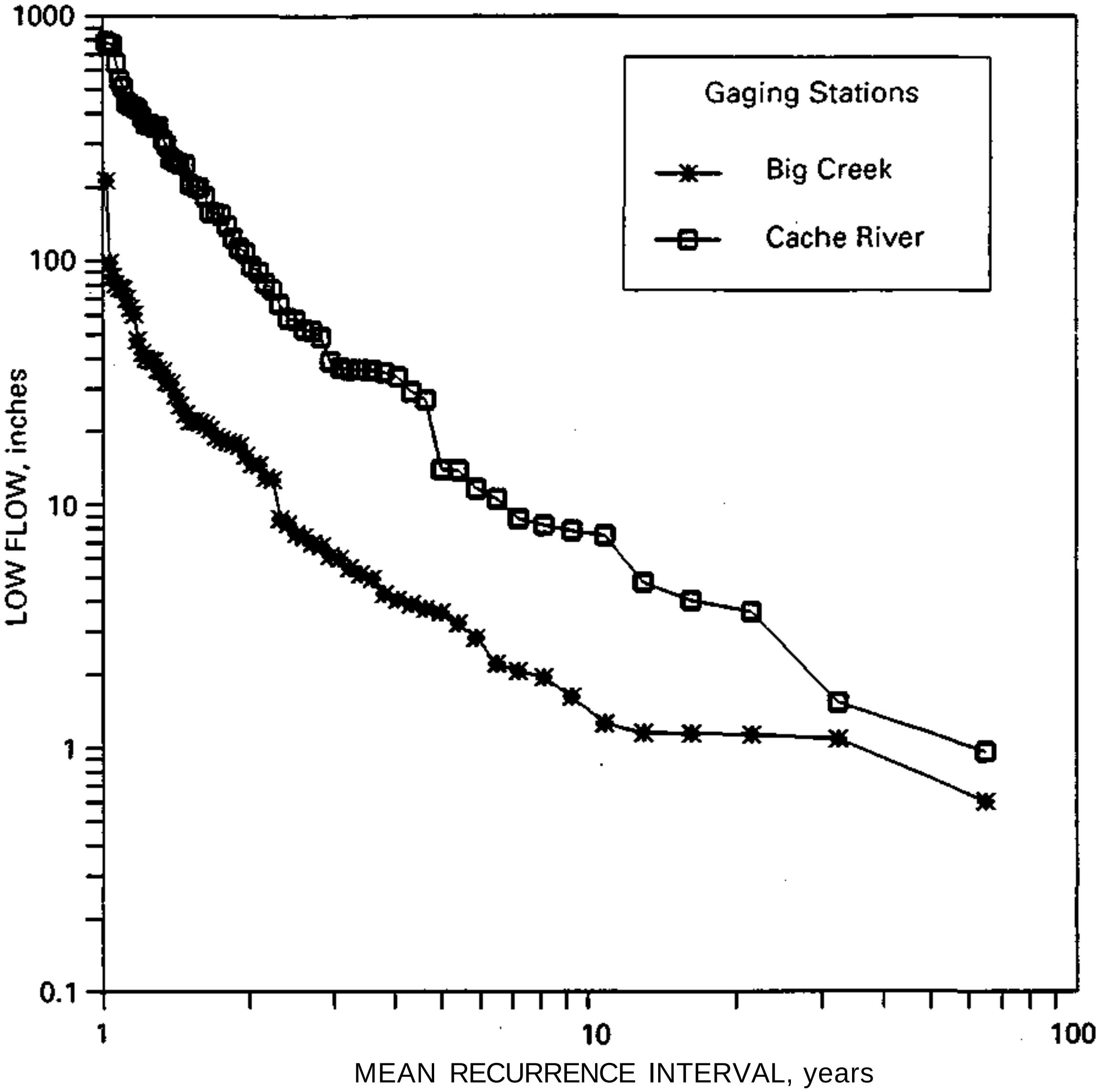


Figure 7. 90-day low flows versus recurrence intervals
for Big Creek and the Cache River

Table 3. Land Uses in Lake Creek, Cache River, and Big Creek Watersheds

Land use	*Lake Creek (ac)*	*Lake Creek (%)*	*Big Creek (ac)*	*Big Creek (%)*	*Cache River (ac)*	*Cache River (%)*
Urban	135	0.46	988	4.7	1,649	1.2
Agricultural	18,511	63.0	17,097	82.1	97,776	70.6
Rangeland	0	0.0	0	0	0	0.0
Forest	6,228	21.2	2,733	13.1	34,467	24.9
Water	1,396	4.8	20	0	152	0.1
Wetland	3,107	10.6	0	0	2,762	2.0
Barren	0	0	2	0	1,197	0.86
TOTAL	29,375	100	20,821	100	138,576	100

Determining the Runoff Volume of the Poor Farm Area

To determine the inflows in the Poor Farm area, a linear interpretation from the Cache River and Big Creek data was made on the basis of drainage areas. Runoff volumes were tabulated in acre-feet in terms of the mean recurrence intervals and durations. For example, the expected lowest inflows during 30-, 45-, 60-, 75-, and 90-day durations on the average of once every ten years are 27.4, 52.5, 127.3, 254.4, and 390.9 acre-feet (table 4).

Table 4. Estimated Runoff Volume in the Poor Farm Area

Mean recurrence interval (years)	*Runoff (ac-ft) for given duration: 30 days*	*45 days*	*60 days*	*75 days*	*90 days*
30	14.8	34.9	74.7	164.7	199.9
15	22.6	45.8	101.3	200.8	269.7
10	27.4	52.5	127.3	254.4	390.9
5	54.4	118.5	270.1	488.8	776.5
2	154.4	414.1	1,069.8	2,530.2	3,671.7

Determining the Amount of Lake Evaporation

No lake evaporation records are available for the Lake Creek watershed. The closest location that has evaporation data is Carbondale, which is about 50 miles north of Lake Creek.

The maximum net lake evaporation at Carbondale is listed in table 5. The values are taken from Water Survey Bulletin 67 (Terstriep et al., 1982).

Table 5. Maximum Net Lake Evaporation
for Selected Durations and Recurrence Intervals

Mean recurrence interval (years)	*Evaporation (in.) for given duration*				
	30 days	*45 days*	*60 days*	*75 days*	*90 days*
30	5.90	7.92	9.94	11.99	14.03
15	5.60	7.59	9.58	11.32	13.05
10	5.35	7.29	9.23	10.67	12.10
5	4.77	6.55	8.33	9.04	9.75

Assuming that the existing water bodies and wetlands in the Poor Farm area can be developed as shallow impoundments, the surface area will be about 53 acres (44 acres of water bodies and 9 acres of wetlands). The net water yield consists of streamflows minus the maximum net lake evaporation.

Table 6 shows the water available in acre-feet As indicated in this table, the impoundments could be dry during 30- and 15-year droughts.

Table 6. Net Water Yield of the Lake Creek Watershed

Mean recurrence interval (years)	*Yield (ac-ft) for given duration*				
	30 days	*45 days*	*60 days*	*75 days*	*90 days*
30	Dry	Dry	30.8	111.8	138.0
15	Dry	12.3	59.0	150.9	212.1
10	3.8	20.3	86.5	207.3	337.5
5	33.3	89.6	233.3	448.9	733.4

Assessing Infiltration Losses

Because of the low permeabilities of the soils in the Poor Farm area, the clayey layers in the soil profile, the short impoundment durations, and the high ground-water level in the region, the infiltration loss will be insignificant compared to the losses to streamflows and evaporation.

Estimating the Sedimentation Rate

The sedimentation rate was estimated on the basis of the Upper Mississippi River Basin Commission (UMRBC) method (Terstriep et al., 1982) and results from a field lake sediment survey of Horseshoe Lake (Bogner et al., 1985). The UMRBC method gives quite high results. The Horseshoe Lake sediment survey provides an estimate of the lake sedimentation rate as about 0.47 inches per year. For the assumed water impoundment area of 53 acres, the potential lake sedimentation rate will be 2.08 acre-feet per year.

The other consideration regarding the lake sedimentation rate is the lake trap efficiency (TE) in the Poor Farm area. The trap efficiency in the Poor Farm region will be lower than that of Horseshoe Lake because the Poor Farm area has shallower water and a lower capacity-inflow ratio. Therefore it may be concluded that the sedimentation rate will not be a significant factor in considering the Poor Farm region as a waterfowl conservation area.

DISCUSSION

The availability of the Poor Farm area as a waterfowl conservation area was analyzed on the basis of data from streamgaging stations in adjacent watersheds, because there are no streamgaging stations in the studied watershed. The results indicated that for 30-day durations, the watershed can have from 14.8 to 154.4 acre-feet of runoff volume under various drought recurrence intervals ranging from 2 through 30 years. Runoff volumes for 45-, 60-, 75-, and 90-day durations were also computed. In general, more water becomes available with longer durations. It is worthwhile to note here that the analysis concentrates on the extreme dry-year condition when a possible water shortage will occur. For average (normal) and wet years, there will be sufficient water for the region. In fact, the Poor Farm area is included in the 100-year flood zone. The high-water stages of the Mississippi and Cache Rivers could inundate the region almost annually.

Along with the available water quantity, the potential water losses through evaporation, infiltration, and lake sedimentation were estimated. The net lake evaporation was found to be a major loss during 30- to 60-day periods under a drought with a 15-year recurrence interval. Infiltration and sedimentation losses were found to be less dominant factors for maintaining the water volumes in the region.

The accuracy of the low-streamflow assessment was affected by numerous factors. First, the Horseshoe Lake watershed covers about 52 percent of the Poor Farm drainage area. The streamflows at the Poor Farm area may be reduced when the lake level is below the spillway crest. Second, the maximum net lake evaporation occurs mostly in the hot summer months. For the months of October through January, the net lake evaporation should be below that of the hot summer months. Third, the data for low flows during extreme droughts are less reliable than those for more frequent low flows. Fourth, the wetlands and water bodies in the Poor Farm area could store water in the surface and subsurface systems during wet seasons and release the water during dry seasons. Detailed data are needed for a quantitative assessment of the wetland effects on stream flows.

CONCLUSIONS

The following conclusions can be drawn from the hydrologic analyses of the available data.

1. Under 30-year drought conditions, the Poor Farm region can receive 14.8, 34.9, 74.7, 164.7, and 199.9 acre-feet of runoff for 30-, 45-, 60-, 75-, and 90-day durations, respectively.

For less severe droughts such as those with 15-, 10-, 5-, and 2-year recurrence intervals, the water quantities were also computed. In general, more water becomes available with longer durations.

2. Considering the water losses resulting from lake evaporation, water shortages may occur during 30- and 15-year drought conditions. Under drought conditions expected once every 10 years or less, the Poor Farm area has enough water to overcome the losses resulting from lake evaporation.

3. Losses to infiltration and sedimentation were considered to be less significant factors in the Poor Farm hydrologic analysis.

4. About 52 percent of the Lake Creek watershed was impounded as the Horseshoe Lake State Conservation Area. Because Horseshoe Lake has more storage capacity, its water can be released to the Poor Farm area during drought conditions if there is sufficient water in Horseshoe Lake. This option should be considered during the planning stage.

REFERENCES

Bogner, W.C., W.P. Fitzpatrick, and D.S. Blakley. 1985. *Sedimentation Rates in Horseshoe Lake, Alexander County, Illinois.* Illinois State Water Survey Contract Report 364.

Lamoreux, W.M. 1962. *Modern Evaporation Formula Adapted to Computer Use.* Monthly Weather Review, January.

Lee, M.T., N.G. Bhowmik, P.B. Makowski, D.S. Blakley, R.K. Raman, W.B. Bogner, and W.P. Fitzpatrick. 1986. *Sediment Management for Horseshoe Lake and Its Watershed, Alexander County, Illinois.* Illinois State Water Survey Contract Report 396.

LOTUS, Inc. 1987. *Lotus 123 Software.* Cambridge, MA.

Neely, RD., and C.G. Heister, compilers. 1987. *The Natural Resources of Illinois: Introduction and Guide.* Illinois Natural History Survey Special Report 6,224 p.

Terstriep, M.L., M. Demissie, D.C. Noel, and H.V. Knapp. 1982. *Hydrologic Design of Impounding Reservoirs in Illinois.* Illinois State Water Survey Bulletin 67.

United States Department of Agriculture (USDA). 1968. *Soil Survey of Pulaski and Alexander Counties, Illinois.* Soil Conservation Service, USDA, Washington, DC.

United States Geological Survey. 1983. *LUDA Level 2 Database.* USGS.

U.S. West Knowledge Engineering, Inc. 1987. *Hydrodata User's Manual.* Denver, CO.

Upper Mississippi River Basin Commission. 1970. *Upper Mississippi River Comprehensive Basin Study, Appendix G, Fluvial Sediment.* Upper Mississippi River Basin Coordinating Committee.

Appendix 1. Description of the LOTUS Macros for Performing the Frequency Analyses

Sort Macro

Objective: Date each flow record entry. Sort from highest to lowest flow. Divide into nine files based on sorting.

Method: Use seven macros - \A, Month, Dates, Move, \Z, \f, \C - that in turn invoke one another.

\A: Using LOTUS 123 functions (@ROWS, @COLS), establish size of data set. Number of columns is equal to the number of years, and number of rows is equal to the number of days in the set. Creates counter for loop to be used later. Invokes macros MONTH and DATES.

MONTH: Labels 366 rows with the appropriate months beginning with October and running through until September. Names this as range MONTHS.

DATES: Creates range DATE containing dates for whole year. Invokes macro MOVE.

MOVE: Moves flow record columns one at a time, ending with one long combined column. Moves from one column to next by deleting moved column. As each column is moved, flow record is appropriately dated as to month, day and year with the help of ranges MONTHS and DATE. Macros MOVE and \Z make up a loop that runs equal to the number of columns of data.

\Z: Invokes MOVE based on the number of columns established in \A, until all columns are combined into one long column. When this is accomplished, macro \F is invoked.

\F: Sorts data in file by descending flow. Ranks all data and creates percent ranking {l-rank/(total number of data entries + 1)}. Sets up file for dates with no corresponding flow (e.g. Feb. 29,1937). Invokes macro \C.

\C: Creates ten files of approximately equal size by dividing total number of rows by ten. Based on percent ranking.

Interpolation Macro

Objective: To extend flow record of gage station A by using longer flow record of similar gage station B.

Method: Eliminate entire flow record, and days duplicated in both gage station records from gage station B. Combine and sort the two records together (based on percent-ranking). Macro INTERPOLATION is invoked on every record left from gage station B. Use straight line interpolation based on slope formula:

$$\frac{(Y_1-Y_2)}{(X_1-X_2)} = \frac{(Y_1-Y_3)}{(X_1-X_3)}$$

where $X_1>X_2>X_3$

$Y_1>Y_2$

X_1,X_2,Y_1,Y_2 = data from gaging station A

X_3 = data from gaging station B

Y_3 = data to be computed for gaging station B

Minimum Flow Macro

Objective: To determine minimum flow for given number of days (e.g., 30, 45) in a set of data over an extended number of years.

Method: Use Hydrodata form of flow years. Each year's data set is divided into groups of X days, where X represents the minimum flow series (e.g., 30-, 45-, 60-, or 90-day minimum flow). The groups are of consecutive days, e.g., Group 1: Oct 1-Oct 30, Group 2: Oct 2-Oct 31, etc. Each sum is normalized by dividing by the size of the group. The minimum sum in each set is copied to a new range set aside for minimum flows. This range will have one value per year. Process is applied to each year's data set and repeated for the different flow series.

Appendix 2. Annual 30-, 45-, 60-, 75-, and 90-Day Low Flows

30-day minimum flow

Big Creek				*Cache River*			
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1924	Oct. 1	Oct. 30	12.780	1924	Oct. 5	Nov. 3	165.500
1925	Oct. 16	Nov. 14	1.949	1925	Oct. 24	Nov. 22	8.013
1926	Dec. 18	Jan. 16	6.609	1926	Dec. 29	Jan. 27	63.630
1927	Oct. 16	Nov. 14	3.076	1927	Jan. 2	Jan. 31	19.380
1928	Dec. 22	Jan. 20	16.030	1928	Oct. 20	Nov. 18	239.600
1929	Oct. 1	Oct. 30	5.509	1929	Oct. 20	Nov. 18	72.240
1930	Oct. 3	Nov. 1	1.791	1930	Oct. 21	Nov. 19	6.843
1931	Oct. 26	Nov. 24	1.393	1931	Nov. 25	Dec. 24	5.059
1932	Oct. 1	Oct. 30	0.263	1932	Nov. 25	Dec. 24	0.459
1933	Oct. 2	Oct. 31	12.980	1933	Nov. 23	Dec. 22	185.700
1934	Nov. 17	Dec. 16	1.599	1934	Nov. 8	Dec. 7	5.449
1935	Oct. 3	Nov. 1	4.046	1935	Oct. 11	Nov. 9	30.590
1936	Oct. 1	Oct. 30	2.256	1936	Oct. 11	Nov. 9	13.900
1937	Oct. 3	Nov. 1	1.939	1937	Oct. 26	Nov. 24	12.260
1938	Nov. 17	Dec. 16	2.329	1938	Oct. 17	Nov. 15	11.400
1939	Oct. 20	Nov. 18	0.559	1939	Dec. 13	Jan. 11	1.953
1940	Nov. 19	Dec. 18	0.870	1940	Nov. 9	Dec. 8	2.043
1941	Oct. 1	Oct. 30	0.399	1941	Jan. 2	Jan. 31	0.076
1942	Nov. 14	Dec. 13	3.983	1942	Nov. 13	Dec. 12	17.620
1943	Oct. 1	Oct. 30	1.889	1943	Nov. 13	Dec. 12	1.293
1944	Oct. 7	Nov. 5	1.326	1944	Nov.13	Dec. 12	1.546
1945	Oct. 8	Nov. 6	0.463	1945	Oct. 20	Nov. 18	0.103
1946	Oct. 10	Nov. 8	6.559	1946	Jan. 1	Jan. 30	36.530
1947	Oct. 1	Oct. 30	3.956	1947	Jan. 1	Jan. 30	8.669
1948	Oct. 1	Oct. 30	3.936	1948	Jan. 1	Jan. 30	16.200
1949	Oct. 1	Oct. 30	1.863	1949	Dec. 30	Jan. 28	2.963
1950	Nov. 1	Nov. 30	5.939	1950	Oct. 8	Nov. 6	21.500
1951	Oct. 4	Nov. 2	10.290	1951	Nov. 19	Dec. 18	50.650
1952	Oct. 1	Oct. 30	7.613	1952	Nov. 29	Dec. 28	42.070
1953	Oct. 1	Oct. 30	1.359	1953	Dec. 11	Jan. 9	0.416
1954	Oct. 1	Oct. 30	0.403	1954	Dec. 20	Jan. 18	0.109
1955	Oct. 17	Nov. 15	1.133	1955	Dec. 26	Jan. 24	1.363
1956	Dec. 19	Jan. 17	0.469	1956	Nov. 5	Dec. 4	1.626
1957	Oct. 7	Nov. 5	0.863	1957	Nov. 5	Dec. 4	4.873
1958	Oct. 1	Oct. 30	14.490	1958	Nov. 5	Dec. 4	47.720
1959	Oct. 12	Nov. 10	1.809	1959	Oct. 28	Nov. 26	3.783
1960	Oct. 15	Nov.13	2.683	1960	Dec. 21	Jan. 19	45.660
1961	Oct. 6	Nov. 4	2.063	1961	Dec. 21	Jan. 19	1.099
1962	Oct. 1	Oct. 30	1.179	1962	Dec. 21	Jan. 19	0.326
1963	Nov. 20	Dec. 19	0.713	1963	Oct. 26	Nov. 24	1.486

30-day minimum flow (concluded)

Big Creek Year	Start	End	Flow	Cache River Year	Start	End	Flow
1964	Oct. 1	Oct. 30	0.236	1964	Nov. 1	Nov. 30	0.000
1965	Oct. 20	Nov. 18	0.336	1965	Dec. 23	Jan. 21	0.489
1966	Oct.22	Nov. 20	2.719	1966	Nov. 1	Nov. 30	6.153
1967	Oct. 3	Nov. 1	2.029	1967	Dec 21	Jan. 19	2.373
1968	Oct. 30	Nov. 28	7.999	1968	Dec. 8	Jan. 6	76.230
1969	Oct.3	Nov. 1	1.436	1969	Oct. 22	Nov. 20	3.915
1970	Oct.14	Nov. 12	4.683	1970	Nov. 18	Dec. 17	10.780
1971	Nov.21	Dec. 20	8.083	1971	Nov. 18	Dec 17	21.170
1972	Oct. 9	Nov. 7	0.805	1972	Nov. 8	Dec 7	1.938
1973	Oct.1	Oct. 30	1.424	1973	Nov. 8	Dec. 7	8.081
1974	Oct. 21	Nov. 19	1.599	1974	Oct. 27	Nov. 25	5.746
1975	Oct. 4	Nov. 2	4.537	1975	Dec. 22	Jan. 20	33.630
1976	Oct. 1	Oct. 30	3.459	1976	Dec. 22	Jan. 20	22.470
1977	Dec.31	Jan. 29	0.556	1977	Oct. 12	Nov. 10	1.373
1978	Oct. 4	Nov. 2	3.372	1978	Dec. 7	Jan. 5	22.100
1979	Dec.14	Jan. 12	37.520	1979	Oct. 18	Nov. 16	1.735
1980	Oct. 3	Nov. 1	5.934	1980	Dec. 19	Jan. 17	8.233
1981	Dec.31	Jan. 29	1.032	1981	Oct. 30	Nov. 28	3.076
1982	Nov.24	Dec. 23	5.228	1982	Oct. 30	Nov. 28	2.938
1983	Jan. 2	Jan. 31	16.660	1983	Nov. 14	Dec 13	6.926
1984	Dec.25	Jan. 23	8.561	1984	Nov. 14	Dec. 13	25.940
1985	Oct. 1	Oct. 30	19.480	1985	Nov. 14	Dec 13	367.100
1986	Jan. 2	Jan. 31	6.471	1986	Nov. 9	Dec. 8	68.030
1987	Oct. 8	Nov. 6	3.386	1987	Nov. 17	Dec. 16	25.600

45-day minimum flow

	Big Creek				*Cache River*		
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1924	Oct. 9	Nov. 22	14.800	1924	Oct. 9	Nov. 22	227.600
1925	Oct. 1	Nov. 14	2.293	1925	Oct. 1	Nov. 14	10.910
1926	Dec. 8	Jan. 21	10.020	1926	Dec. 8	Jan. 21	129.500
1927	Oct. 1	Nov. 14	3.384	1927	Oct. 1	Nov. 14	24.060
1928	Oct. 1	Nov. 14	37.160	1928	Dec. 18	Jan. 31	395.600
1929	Oct. 1	Nov. 14	6.794	1929	Oct. 1	Nov. 14	86.600
1930	Oct. 1	Nov. 14	8.638	1930	Oct. 1	Nov. 14	129.600
1931	Oct. 3	Nov. 16	1.566	1931	Oct. 23	Dec. 6	7.124
1932	Oct. 1	Nov. 14	0.417	1932	Oct. 3	Nov. 16	0.859
1933	Nov. 9	Dec. 23	19.230	1933	Nov. 9	Dec. 23	308.200
1934	Nov. 2	Dec. 16	2.722	1934	Nov. 9	Dec. 23	20.820
1935	Oct. 7	Nov. 20	7.504	1935	Oct. 7	Nov. 20	92.790
1936	Dec. 18	Jan. 31	4.155	1936	Dec. 18	Jan. 31	35.440
1937	Nov. 14	Dec. 28	3.004	1937	Nov. 14	Dec. 28	20.250
1938	Nov. 2	Dec. 16	2.718	1938	Nov. 2	Dec. 16	15.680
1939	Oct. 3	Nov. 16	0.551	1939	Oct. 4	Nov. 17	1.695
1940	Nov. 4	Dec. 18	0.931	1940	Nov. 4	Dec. 18	2.308
1941	Oct. 1	Nov. 14	1.395	1941	Oct. 1	Nov. 14	2.299
1942	Nov. 7	Dec. 21	5.877	1942	Nov. 8	Dec. 22	41.070
1943	Oct. 1	Nov. 14	3.086	1943	Oct. 1	Nov. 14	6.577
1944	Nov. 11	Dec. 25	1.817	1944	Nov. 14	Dec. 28	8.002
1945	Oct. 6	Nov. 19	0.648	1945	Oct. 10	Nov. 23	0.477
1946	Nov. 20	Jan. 3	15.530	1946	Nov. 22	Jan. 5	134.900
1947	Oct. 1	Nov. 14	6.044	1947	Oct. 1	Nov. 14	15.360
1948	Oct. 1	Nov. 14	4.957	1948	Oct. 1	Nov. 14	19.400
1949	Oct. 1	Nov. 14	15.370	1949	Oct. 1	Nov. 14	75.780
1950	Oct. 27	Dec. 10	6.191	1950	Oct. 27	Dec. 10	30.060
1951	Oct. 1	Nov. 14	25.560	1951	Oct. 1	Nov. 14	117.300
1952	Oct. 1	Nov. 14	31.300	1952	Oct. 1	Nov. 14	98.530
1953	Oct. 1	Nov. 14	1.959	1953	Oct. 1	Nov. 14	0.626
1954	Oct. 1	Nov. 14	0.411	1954	Oct. 11	Nov. 24	0.153
1955	Oct. 16	Nov. 29	1.337	1955	Oct. 21	Dec. 4	2.011
1956	Dec. 13	Jan. 26	0.566	1956	Dec. 15	Jan. 28	1.848
1957	Oct. 1	Nov. 14	0.771	1957	Oct. 2	Nov. 15	3.897
1958	Oct. 1	Nov. 14	65.970	1958	Oct. 1	Nov. 14	169.700
1959	Oct. 1	Nov. 14	2.546	1959	Oct. 1	Nov. 14	14.160
1960	Oct. 26	Dec. 9	3.484	1960	Oct. 26	Dec. 9	46.760
1961	Oct. 1	Nov. 14	2.642	1961	Oct. 1	Nov. 14	2.459
1962	Oct. 1	Nov. 14	3.033	1962	Oct. 1	Nov. 14	3.788
1963	Nov. 4	Dec. 18	0.899	1963	Oct. 9	Nov. 22	2.062
1964	Oct. 1	Nov. 14	0.257	1964	Oct. 7	Nov. 20	0.006
1965	Oct. 5	Nov. 18	0.504	1965	Oct. 9	Nov. 22	0.826

45-day minimum flow (concluded)

Big Creek				*Cache River*			
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1966	Oct. 14	Nov. 27	3.179	1966	Oct. 29	Dec. 12	7.188
1967	Oct. 12	Nov. 25	2.422	1967	Oct. 12	Nov. 25	3.499
1968	Oct. 1	Nov. 14	14.630	1968	Oct. 1	Nov. 14	119.000
1969	Oct. 1	Nov. 14	1.666	1969	Oct. 1	Nov. 14	5.472
1970	Oct. 1	Nov. 14	9.231	1970	Oct. 1	Nov. 14	26.910
1971	Nov. 1	Dec. 15	8.795	1971	Oct. 1	Nov. 14	29.110
1972	Oct. 12	Nov. 25	0.868	1972	Oct. 12	Nov. 25	2.230
1973	Oct. 1	Nov. 14	18.490	1973	Oct. 1	Nov. 14	252.900
1974	Oct. 7	Nov. 20	1.857	1974	Oct. 7	Nov. 20	8.431
1975	Oct. 2	Nov. 15	12.970	1975	Oct. 2	Nov. 15	171.600
1976	Oct. 1	Nov. 14	4.652	1976	Oct. 1	Nov. 14	40.640
1977	Dec. 18	Jan. 31	0.895	1977	Dec. 18	Jan. 31	3.093
1978	Oct. 4	Nov. 17	3.786	1978	Oct. 4	Nov. 17	26.980
1979	Dec. 11	Jan. 24	43.010	1979	Oct. 1	Nov. 14	1.827
1980	Oct. 3	Nov. 16	7.701	1980	Oct. 1	Nov. 14	29.350
1981	Dec. 18	Jan. 31	1.252	1981	Dec. 18	Jan. 31	4.233
1982	Dec. 5	Jan. 18	7.794	1982	Oct. 1	Nov. 14	3.743
1983	Oct. 15	Nov. 28	156.600	1983	Oct. 1	Nov. 14	44.630
1984	Oct. 9	Nov. 22	10.220	1984	Oct. 1	Nov. 14	36.850
1985	Oct. 1	Nov. 14	56.810	1985	Nov. 7	Dec. 21	682.000
1986	Dec. 18	Jan. 31	7.459	1986	Dec. 18	Jan. 31	91.080
1987	Oct. 10	Nov. 23	3.649	1987	Oct. 11	Nov. 24	28.020

60-day minimum flow

	Big Creek				Cache River		
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1924	Oct. 1	Nov. 29	14.800	1924	Oct. 1	Nov. 29	200.700
1925	Oct. 9	Dec. 7	2.451	1925	Oct. 9	Dec. 7	12.510
1926	Oct. 1	Nov. 29	51.260	1926	Nov. 23	Jan. 21	237.500
1927	Oct. 1	Nov. 29	4.976	1927	Oct. 1	Nov. 29	48.540
1928	Oct. 15	Dec. 13	44.850	1928	Oct. 15	Dec. 13	526.700
1929	Oct. 1	Nov. 29	8.717	1929	Oct. 1	Nov. 29	119.000
1930	Oct. 10	Dec. 8	7.553	1930	Oct. 10	Dec. 8	106.500
1931	Oct. 2	Nov. 30	1.775	1931	Oct. 2	Nov. 30	10.110
1932	Oct. 1	Nov. 29	2.518	1932	Oct. 1	Nov. 29	32.400
1933	Oct. 9	Dec. 7	18.070	1933	Oct. 9	Dec. 7	270.900
1934	Nov. 8	Jan. 6	3.314	1934	Nov. 8	Jan. 6	27.090
1935	Dec. 3	Jan. 31	39.860	1935	Dec. 3	Jan. 31	448.300
1936	Oct. 1	Nov. 29	5.043	1936	Dec. 3	Jan. 31	52.750
1937	Oct. 7	Dec. 5	3.509	1937	Oct. 7	Dec. 5	38.670
1938	Oct. 19	Dec. 17	5.155	1938	Oct. 19	Dec. 17	57.640
1939	Oct. 1	Nov. 29	0.906	1939	Oct. 1	Nov. 29	4.018
1940	Oct. 1	Nov. 29	1.058	1940	Nov. 4	Jan. 2	3.209
1941	Oct. 1	Nov. 29	1.890	1941	Oct. 1	Nov. 29	5.674
1942	Oct. 20	Dec. 18	17.500	1942	Oct. 23	Dec. 21	75.820
1943	Dec. 3	Jan. 31	14.600	1943	Dec. 3	Jan. 31	121.100
1944	Oct. 1	Nov. 29	1.759	1944	Oct. 2	Nov. 30	7.626
1945	Oct. 7	Dec. 5	0.733	1945	Oct. 8	Dec. 6	0.641
1946	Oct. 25	Dec. 23	19.840	1946	Oct. 25	Dec. 23	159.000
1947	Oct. 1	Nov. 29	14.660	1947	Oct. 1	Nov. 29	59.790
1948	Oct. 1	Nov. 29	5.229	1948	Oct. 1	Nov. 29	21.560
1949	Oct. 1	Nov. 29	27.160	1949	Oct. 1	Nov. 29	175.100
1950	Oct. 13	Dec. 11	15.940	1950	Oct. 13	Dec. 11	141.700
1951	Oct. 1	Nov. 29	38.190	1951	Oct. 1	Nov. 29	245.200
1952	Oct. 1	Nov. 29	63.550	1952	Oct. 1	Nov. 29	288.300
1953	Oct. 1	Nov. 29	4.258	1953	Oct. 1	Nov. 29	5.518
1954	Oct. 1	Nov. 29	0.511	1954	Oct. 1	Nov. 29	0.378
1955	Oct. 6	Dec. 4	2.309	1955	Oct. 6	Dec. 4	15.570
1956	Nov. 28	Jan. 26	0.646	1956	Nov. 30	Jan. 28	2.939
1957	Nov. 22	Jan. 20	4.789	1957	Oct. 1	Nov. 29	27.980
1958	Nov. 21	Jan. 19	72.770	1958	Oct. 1	Nov. 29	566.700
1959	Nov. 16	Jan. 14	7.568	1959	Oct. 1	Nov. 29	71.870
1960	Oct. 12	Dec. 10	4.134	1960	Oct. 10	Dec. 8	65.240
1961	Oct. 1	Nov. 29	5.568	1961	Oct. 1	Nov. 29	13.600
1962	Oct. 1	Nov. 29	16.770	1962	Oct. 1	Nov. 29	112.900
1963	Oct. 21	Dec. 19	1.053	1963	Oct. 21	Dec. 19	2.356
1964	Oct. 1	Nov. 29	0.626	1964	Oct. 1	Nov. 29	1.133
1965	Oct. 1	Nov. 29	3.539	1965	Oct. 1	Nov. 29	3.523

60-day minimum flow (concluded)

Big Creek				*Cache River*			
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1966	Oct. 13	Dec. 11	3.639	1966	Oct. 15	Dec. 13	9.334
1967	Oct. 3	Dec. 1	4.808	1967	Oct. 1	Nov. 29	7.128
1968	Oct. 1	Nov. 29	12.370	1968	Oct. 1	Nov. 29	102.500
1969	Oct. 1	Nov. 29	12.570	1969	Oct. 1	Nov. 29	36.150
1970	Oct. 1	Nov. 29	14.140	1970	Oct. 1	Nov. 29	61.580
1971	Oct. 17	Dec. 15	10.260	1971	Oct. 1	Nov. 29	39.580
1972	Oct. 4	Dec. 2	0.932	1972	Oct. 4	Dec. 2	2.474
1973	Oct. 1	Nov. 29	19.930	1973	Oct. 1	Nov. 29	291.000
1974	Oct. 1	Nov. 29	50.480	1974	Oct. 1	Nov. 29	270.300
1975	Oct. 2	Nov. 30	14.530	1975	Oct. 2	Nov. 30	200.000
1976	Oct.l	Nov. 29	4.439	1976	Oct.l	Nov. 29	37.530
1977	Dec. 3	Jan. 31	1.533	1977	Dec. 3	Jan. 31	7.853
1978	Oct. 1	Nov. 29	5.556	1978	Oct. 1	Nov. 29	56.900
1979	Dec. 2	Jan. 30	51.360	1979	Oct. 1	Nov. 29	71.600
1980	Oct. 1	Nov. 29	11.310	1980	Oct. 1	Nov. 29	112.700
1981	Dec. 3	Jan. 31	1.727	1981	Dec. 3	Jan. 31	7.903
1982	Nov. 24	Jan. 22	8.013	1982	Oct. 1	Nov. 29	4.832
1983	Oct. 22	Dec. 20	203.400	1983	Oct. 1	Nov. 29	128.300
1984	Oct. 2	Nov. 30	12.680	1984	Oct. 1	Nov. 29	181.000
1985	Oct. 1	Nov. 29	65.230	1985	Oct. 1	Nov. 29	685.100
1986	Dec. 3	Jan. 31	13.380	1986	Dec. 3	Jan. 31	206.100
1987	Oct. 1	Nov. 29	4.692	1987	Oct. 1	Nov. 29	48.410

75-day minimum flow

	Big Creek				*Cache River*		
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1924	Oct. 1	Dec. 14	38.450	1924	Oct. 1	Dec. 14	333.600
1925	Oct. 1	Dec. 14	4.994	1925	Oct. 1	Dec.14	36.740
1927	Oct. 6	Dec. 19	6.403	1926	Nov. 18	Jan. 31	327.600
1928	Oct. 1	Dec. 14	65.170	1927	Oct. 6	Dec.19	50.860
1929	Oct. 1	Dec. 14	18.240	1928	Oct. 1	Dec. 14	583.800
1930	Oct. 1	Dec. 14	8.802	1929	Oct. 1	Dec. 14	215.900
1931	Oct. 1	Dec. 14	2.615	1930	Oct. 1	Dec. 14	95.160
1932	Oct. 1	Dec. 14	4.269	1931	Oct. 28	Jan. 10	11.690
1933	Oct. 9	Dec. 22	23.490	1932	Oct. 1	Dec. 14	43.510
1934	Oct. 3	Dec. 16	4.231	1933	Oct. 9	Dec. 22	287.900
1935	Oct. 5	Dec. 18	86.400	1934	Nov. 12	Jan. 25	31.340
1936	Nov. 18	Jan. 31	6.078	1935	Oct. 5	Dec. 18	453.300
1937	Oct. 4	Dec. 17	4.591	1936	Nov. 18	Jan. 31	47.200
1938	Oct. 2	Dec. 15	5.926	1937	Oct. 4	Dec. 17	38.490
1939	Oct. 1	Dec. 14	1.409	1938	Oct. 2	Dec. 15	52.370
1940	Oct. 1	Dec. 14	1.273	1939	Oct. 1	Dec. 14	5.030
1941	Oct. 1	Dec. 14	2.256	1940	Oct. 31	Jan. 13	3.707
1942	Oct. 7	Dec. 20	19.00	1941	Oct. 1	Dec. 14	6.141
1943	Oct. 1	Dec. 14	27.00	1942	Oct. 8	Dec. 21	68.590
1944	Oct. 12	Dec. 25	2.401	1943	Oct. 1	Dec. 14	149.500
1945	Oct. 7	Dec. 20	1.108	1944	Oct. 1	Dec. 14	8.255
1946	Oct. 10	Dec. 23	21.560	1945	Oct. 8	Dec. 21	1.098
1947	Oct. 1	Dec. 14	23.700	1946	Oct. 11	Dec. 24	136.500
1948	Oct. 1	Dec. 14	6.096	1947	Oct. 1	Dec. 14	94.950
1949	Oct. 1	Dec. 14	32.200	1948	Oct. 1	Dec. 14	21.420
1950	Oct. 8	Dec. 21	39.570	1949	Oct. 1	Dec. 14	191.200
1951	Oct. 1	Dec. 14	57.410	1950	Oct. 1	Dec. 14	250.000
1952	Oct. 1	Dec. 14	94.200	1951	Oct. 1	Dec. 14	309.400
1953	Oct. 1	Dec. 14	7.611	1952	Oct. 1	Dec. 14	445.600
1954	Oct. 1	Dec. 14	1.778	1953	Oct. 1	Dec. 14	14.130
1955	Oct. 14	Dec. 27	12.250	1954	Oct. 1	Dec. 14	4.114
1956	Nov. 5	Jan. 18	1.448	1955	Oct. 14	Dec. 27	29.680
1957	Oct. 1	Dec. 14	9.331	1956	Nov. 12	Jan. 25	10.820
1958	Oct. 1	Dec. 14	91.760	1957	Oct. 1	Dec. 14	33.500
1959	Oct. 11	Dec. 24	11.380	1958	Oct. 1	Dec. 14	538.200
1960	Oct. 1	Dec. 14	10.600	1959	Oct. 14	Dec. 27	72.610
1961	Oct. 1	Dec. 14	24.370	1960	Oct. 1	Dec. 14	94.750
1962	Oct. 1	Dec. 14	29.170	1961	Oct. 1	Dec. 14	84.810
1963	Oct. 6	Dec. 19	1.674	1962	Oct. 1	Dec. 14	184.400
1964	Oct. 1	Dec. 14	0.826	1963	Oct. 8	Dec. 21	2.526
1965	Oct. 1	Dec. 14	9.539	1964	Oct. 1	Dec. 14	1.071
1966	Oct. 17	Dec. 30	5.019	1965	Oct. 1	Dec. 14	24.330
1967	Oct. 1	Dec. 14	23.310	1966	Oct. 17	Dec. 30	12.810

75-day minimum flow (concluded)

Big Creek				*Cache River*			
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1968	Oct. 1	Dec. 14	45.920	1967	Oct. 1	Dec. 14	94.470
1969	Oct. 1	Dec. 14	20.730	1968	Oct. 1	Dec. 14	255.800
1970	Oct. 13	Dec. 26	17.200	1969	Oct. 1	Dec. 14	90.120
1971	Oct. 1	Dec. 14	11.960	1970	Oct. 15	Dec. 28	84.840
1972	Oct. 1	Dec. 14	2.627	1971	Oct. 1	Dec. 14	34.170
1973	Oct. 1	Dec. 14	46.070	1972	Oct. 1	Dec. 14	18.750
1974	Oct. 1	Dec. 14	70.220	1973	Oct. 1	Dec. 14	395.000
1975	Oct. 2	Dec. 15	17.750	1974	Oct. 1	Dec. 14	353.300
1976	Oct. 1	Dec. 14	7.691	1975	Oct. 2	Dec. 15	195.600
1977	Nov. 6	Jan. 19	2.085	1976	Oct. 1	Dec. 14	67.040
1978	Oct. 1	Dec. 14	25.180	1977	Nov. 7	Jan. 20	9.179
1979	Nov. 14	Jan. 27	86.240	1978	Oct 1	Dec. 14	209.000
1980	Oct. 3	Dec. 16	15.030	1979	Oct. 1	Dec. 14	209.200
1981	Nov. 17	Jan. 30	2.565	1980	Oct. 1	Dec. 14	139.400
1982	Oct. 20	Jan. 2	28.100	1981	Nov. 8	Jan. 21	8.367
1983	Oct. 9	Dec. 22	243.300	1982	Oct. 1	Dec. 14	11.350
1984	Oct. 1	Dec. 14	32.550	1983	Oct. 1	Dec. 14	551.600
1985	Oct. 1	Dec. 14	74.440	1984	Oct. 1	Dec. 14	355.200
1986	Nov. 18	Jan. 31	33.480	1985	Oct 1	Dec. 14	662.600
1987	Oct. 9	Dec. 22	7.648	1986	Nov. 18	Jan. 31	353.000
				1987	Oct. 9	Dec. 22	77.690

90-day minimum flow

Big Creek Year	Start	End	Flow	Cache River Year	Start	End	Flow
1924	Oct. 1	Dec. 29	64.120	1924	Oct. 1	Dec. 29	547.500
1925	Oct. 1	Dec. 29	4.059	1925	Oct. 1	Dec. 29	35.790
1926	Oct. 23	Jan. 20	35.260	1926	Oct. 23	Jan. 20	418.200
1927	Oct. 1	Dec. 29	5.519	1927	Oct. 1	Dec. 29	57.340
1928	Oct. 21	Jan. 18	85.860	1928	Oct. 21	Jan. 18	643.600
1929	Oct. 1	Dec. 29	22.080	1929	Oct. 1	Dec. 29	313.800
1930	Oct. 1	Dec. 29	12.890	1930	Oct. 1	Dec. 29	197.700
1931	Oct. 26	Jan. 23	2.073	1931	Oct. 26	Jan. 23	10.560
1932	Oct. 1	Dec. 29	3.912	1932	Oct. 1	Dec. 29	48.620
1933	Oct. 1	Dec. 29	31.550	1933	Oct. 1	Dec. 29	384.900
1934	Oct. 4	Jan. 1	3.725	1934	Oct. 28	Jan. 25	35.000
1935	Oct. 2	Dec. 30	60.660	1935	Oct. 2	Dec. 30	426.300
1936	Oct. 1	Dec. 29	5.188	1936	Oct. 1	Dec. 29	58.160
1937	Oct. 1	Dec. 29	3.603	1937	Oct. 1	Dec. 29	35.840
1938	Oct. 23	Jan. 20	7.439	1938	Oct. 23	Jan. 20	90.420
1939	Oct. 1	Dec. 29	1.144	1939	Oct. 1	Dec. 29	4.799
1940	Oct. 1	Dec. 29	1.091	1940	Oct. 9	Jan. 6	4.021
1941	Oct. 1	Dec. 29	3.245	1941	Oct. 1	Dec. 29	13.900
1942	Oct. 3	Dec. 31	31.950	1942	Oct. 1	Dec. 29	138.800
1943	Oct. 1	Dec. 29	22.180	1943	Oct. 1	Dec. 29	157.200
1944	Oct. 1	Dec. 29	1.951	1944	Oct. 1	Dec. 29	8.207
1945	Oct. 1	Dec. 29	1.161	1945	Oct. 1	Dec. 29	1.546
1946	Oct. 7	Jan. 4	19.130	1946	Oct. 9	Jan. 6	157.700
1947	Oct. 1	Dec. 29	18.490	1947	Oct. 1	Dec. 29	107.900
1948	Oct. 1	Dec. 29	6.766	1948	Oct. 1	Dec. 29	36.530
1949	Oct. 1	Dec. 29	40.000	1949	Oct. 1	Dec. 29	262.200
1950	Oct. 1	Dec. 29	47.540	1950	Oct. 1	Dec. 29	365.100
1951	Oct. 1	Dec. 29	42.060	1951	Oct. 1	Dec. 29	296.900
1952	Oct. 1	Dec. 29	76.330	1952	Oct. 1	Dec. 29	513.200
1953	Oct. 1	Dec. 29	5.998	1953	Oct. 1	Dec. 29	13.880
1954	Oct. 1	Dec. 29	1.258	1954	Oct. 1	Dec. 29	3.652
1955	Oct. 1	Dec. 29	18.070	1955	Oct. 1	Dec. 29	52.490
1956	Oct. 30	Jan. 27	1.138	1956	Oct. 31	Jan. 28	11.610
1957	Oct. 1	Dec. 29	6.993	1957	Oct. 1	Dec. 29	33.560
1958	Oct. 1	Dec. 29	97.810	1958	Oct. 1	Dec. 29	766.200
1959	Oct. 1	Dec. 29	8.393	1959	Oct. 1	Dec. 29	66.230
1960	Oct. 15	Jan. 12	15.920	1960	Oct. 1	Dec. 29	200.100
1961	Oct. 1	Dec. 29	17.500	1961	Oct. 1	Dec. 29	95.030
1962	Oct. 1	Dec. 29	28.280	1962	Oct. 1	Dec. 29	255.500
1963	Oct. 4	Jan. 1	4.297	1963	Oct. 1	Dec. 29	7.465
1964	Oct. 1	Dec. 29	0.604	1964	Oct. 1	Dec. 29	0.965

90-day minimum flow (concluded)

Big Creek				*Cache River*			
Year	*Start*	*End*	*Flow*	*Year*	*Start*	*End*	*Flow*
1965	Oct. 1	Dec. 29	7.608	1965	Oct. 1	Dec. 29	29.190
1966	Oct. 3	Dec. 31	4.988	1966	Oct. 3	Dec. 31	38.720
1967	Oct. 1	Dec. 29	21.220	1967	Oct. 1	Dec. 29	123.800
1968	Oct. 21	Jan. 18	39.310	1968	Oct. 22	Jan. 19	355.400
1969	Oct. 1	Dec. 29	35.910	1969	Oct. 1	Dec. 29	154.600
1970	Oct. 1	Dec. 29	17.920	1970	Oct. 1	Dec. 29	81.350
1971	Oct. 1	Dec. 29	12.660	1971	Oct. 1	Dec. 29	51.740
1972	Oct. 1	Dec. 29	2.828	1972	Oct. 1	Dec. 29	26.940
1973	Oct. 1	Dec. 29	38.780	1973	Oct. 1	Dec. 29	442.400
1974	Oct. 1	Dec. 29	69.910	1974	Oct. 1	Dec. 29	433.100
1975	Oct. 1	Dec. 29	14.730	1975	Oct. 1	Dec. 29	205.500
1976	Oct. 1	Dec. 29	8.751	1976	Oct. 1	Dec. 29	112.500
1977	Nov. 3	Jan. 31	1.624	1977	Nov. 3	Jan. 31	8.718
1978	Oct. 14	Jan. 11	21.750	1978	Oct. 1	Dec. 29	250.900
1979	Nov. 1	Jan. 29	80.380	1979	Oct. 1	Dec. 29	246.500
1980	Oct. 1	Dec. 29	14.550	1980	Oct. 1	Dec. 29	183.300
1981	Nov. 3	Jan. 31	2.223	1981	Nov. 3	Jan. 31	7.789
1982	Oct. 24	Jan. 21	20.370	1982	Oct. 1	Dec. 29	35.600
1983	Oct. 22	Jan. 19	212.400	1983	Oct. 1	Dec. 29	788.800
1984	Oct. 27	Jan. 24	23.670	1984	Oct. 1	Dec. 29	355.000
1985	Oct. 1	Dec. 29	77.760	1985	Oct. 1	Dec. 29	765.400
1986	Nov. 3	Jan. 31	25.700	1986	Nov. 3	Jan. 31	359.000
1987	Oct. 9	Jan. 6	6.184	1987	Oct. 9	Jan. 6	76.570