# SUITABILITY OF THE PROPOSED NAVAJO RESERVOIR FOR WATER SUPPLY

DECEMBER, 1970

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
REGION VI
DALLAS, TEXAS

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# INTRODUCTION

The Oklahoma Water Resources Board requested in May 1963, that the U. S. Public Health Service, under its pollution control studies of the Arkansas and Red River, investigate the possibility of the proposed Navajo Reservoir being polluted from natural sources of salt water. Of prime concern was determining the suitability of the proposed reservoir for municipal and industrial water supply, if the major sources of salt water could be controlled.

Through a series of reorganizations in the Federal water pollution control program, responsibility for this study was transferred eventually to the Water Quality Office of the Environmental Protection Agency (EPA). During the preparation of this report the Navajo Reservoir project was made inactive and is not expected to be reactivated in the foreseeable future.

## Purpose of Investigation

North Fork Red River and Elm Fork of North Fork are the two principal streams within the drainage area of the proposed Navajo Reservoir. Their flow is sustained in part by salt springs and salt water seepage that significantly affect the quality of both streams. The purpose of the report is to present the findings of a water quality investigation of the principal sources of natural brines in the Elm Fork and North Fork basins and to estimate the water quality of the proposed Navajo Reservoir if the major sources of salt water on these tributary streams could be controlled.

## Area of Investigation

The proposed site of the Navajo Reservoir is located in southwestern Oklahoma on the lower reach of the North Fork Red River. Covering parts of Kiowa County and Jackson County, the reservoir would impound waters of the North Fork and its major tributary, Elm Fork. In addition, the reservoir would receive waters from minor streams, such as Elk Creek, from surface runoff and groundwater seepage

from adjacent land and from direct preciptation. The proposed reservoir site and the basins of the North Fork and Elm Fork are shown in Figure 1.

The area of investigation extends along the North Fork from Lake Altus to Sampling Station 490 and along Elm Fork from near Bull Creek to its confluence with the North Fork. Particular emphasis was placed on Elm Fork in Area VI, so designated by the Corps of Engineers in the course of their investigation of natural salt pollution in the Arkansas-Red River basins.

## Sources of Data

The basic data presented as part of this study were obtained from reports and records of the U. S. Public Health Service, the U. S. Geological Survey and from field investigations by the Federal Water Pollution Control Administration (FWPCA), a predecessor agency of the EPA. Consisting of water analyses and streamflow measurements. these data, in part, span a period ranging from July 1960 Through September 1967.

The U. S. Public Health Service initiated an intensive saline water investigation in the Arkansas-Red River basins in 1960. A network of water quality monitoring station was established of which three station were located in the North Fork and Elm Fork basins. Streamflow

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measurements were required as part of this U. S. Public Health Service investigation and wherever possible, the water quality monitoring stations were located at existing U. S. Geological Survey streamflow gaging stations.

The FWPCA, in continuing the original U. S. Public Health Service investigation, conducted a reconnaissance field survey to determine where additional water quality monitoring stations should be located in the study area. On the basis of this field survey two stations (Stations 4 and 5) were established on Elm Fork. Temporary continuous streamflow gaging stations were installed at these stations and operated, under contract, by the U. S. Geological Survey.

# FINDINGS AND CONCLUSIONS

Findings on the sources of chloride and sulfate brines in the watershed of the Navajo Reservoir, and conclusions regarding the estimated quality of the reservoir and its suitability as a source of water supply are presented in the paragraphs that follow.

## Sources of Natural Brines

1. Chloride brines in the drainage area above the Navajo Reservoir occur predominently in Area VI. An average chloride loading of 322 tons per day is discharged from Area VI. This loading constitutes 72 percent of the average total daily chloride loading of the North Fork near the proposed reservoir site (Sampling Station 490).
2. Sulfate brines are distributed generally throughout the drainage area above the Navajo Reservoir. An average sulfate loading of 12 tons per day is discharged from Area VI. This loading constitutes 4 percent of the average total daily sulfate loading of the North Fork near the proposed reservoir site (Sampling Station 490).

3. The flow-weighted average chloride and sulfate concentrations of the North Fork Red River at Sampling Station 490 were 655 mg/l and 455 mg/l, respectively, for the seven year period of field investigations.

4. Calculations indicate the evaporation from the reservoir will cause large increases in the mineral concentration of the impounded water.

## Estimated Quality of the Proposed Navajo Reservoir

1a. The cumulative average chloride concentration of the Navajo Reservoir, without control of brine discharges from Area VI, is estimated at 1,270 mg/l.

1b. With 80 percent control of brine discharges from Area VI, the cumulative average chloride concentration of the reservoir is estimated at 540 mg/l.

1c. With 100 percent control of brine discharges from Area VI, the cumulative average chloride concentration of the reservoir is estimated at 355 mg/l.

2a. The cumulative average sulfate concentration of the Navajo Reservoir, without control of brine discharges from Area VI, is estimated at 760 mg/l.

2b. With 80 percent control of brine discharges from Area VI, the cumulative average sulfate concentration of the reservoir is estimated at 735 mg/l.

2c. With 100 percent control of brine discharges from Area VI, the cumulative average sulfate concentration of the reservoir is estimated at 730 mg/l.

## Suitability of the Navajo Reservoir as a Source of Water Supply

### Municipal Supply

The estimated chloride concentrations of the reservoir with 80 percent control of Area VI, preclude its use for municipal water supply.

The estimated sulfate concentrations of the reservoir, with 80 percent control of Area VI, preclude its use for municipal water supply.

Industrial Supply

The estimated cumulative average chloride concentrations of the Navajo Reservoir, with 80 percent control of Area VI, are within the quality limits for process water used in the petroleum industry, for boiler makeup water and for those industries where brackish water can be used as cooling water in once-through systems and in the makeup recycle. The estimated chloride concentrations exceed the maximum for process water in the pulp and paper industry. For process water used in primary metals industry and for fresh cooling water in the once-through system and in the makeup water, the reservoir is of marginal quality. However, the cumulative averages do not reflect the large fluctuations in quality that frequently exceed the maximum limits of these water uses. Although periods of satisfactory reservoir quality do occur, these periods are temporary. The reliability of the reservoir quality is low. Standard deviations, based upon the yearly average concentrations for the three sets of 50-year projected reservoir use, are 135 mg/l for chloride and 185 mg/l for sulfate under 80 percent control of Area VI. As a source of industrial supply, the Navajo Reservoir is definitely unsuitable for a number of industries, is inherently inadequate for those having maximum limits of chloride concentrations that are near the cumulative average in the reservoir, and is suitable only for boiler makeup water and for brackish cooling water.

The estimated cumulative average sulfate concentrations of the Navajo Reservoir, without control, or with 80 percent control of Area VI, are within the maximum limits for boiler makeup water and for those industries where brackish water can be used for cooling in once-through systems and in the makeup recycle, and in process water in some chemical industries. The estimated sulfate concentrations exceed the maximums for fresh cooling water and for process water in the petroleum industry.

Agricultural Supply - Livestock Watering

Without control of Area VI the estimated chloride concentrations in the reservoir are generally less than the maximum recommended for livestock watering.

With 80 percent control of the estimated chloride discharges from Area VI the reservoir quality is suitable for livestock watering.

Under conditions of no control to 100 percent control of Area VI, estimated sulfate concentrations in the reservoir are generally less than the maximum recommended for livestock watering.

Agricultural Supply - Irrigation

Without control of Area VI the reservoir would have a very high sodium hazard and an extremely high salinity hazard making it unsuitable as a source of irrigation water.

With 80 percent control of Area VI the reservoir would have a medium sodium hazard and a very high salinity hazard making it unsuitable as a source of irrigation water.

# GEOLOGY

The natural quality of surface and groundwater is largely determined by geologic factors. Such factors include the types of rock underlying the region, the mineral composition of these rocks, their vertical and lateral sequence and extent, the size and distribution of their interconnected void spaces, regional and local structures, and the topographic relief developed upon the land surface.

The occurrence, distribution and chemical composition of the natural brines in the North Fork and Elm Fork basins are also largely determined by local and regional geologic factors. Principal among these are the sequence of rock layering (stratigraphy), the attitude of these rocks (structure) and the distribution of salt, gypsum, and anhydrite beds within and beyond the area of investigation.

## Stratigraphy and Structure

The study area is underlain by rocks that range in age from Precambrian to Quaternary and includes such

diverse rock types as granite, shale, siltstone, sandstone, dolomite, gypsum, anhydrite, sodium-chloride salt, gravel, sand, silt and clay. Regarding the occurrence of salt springs and salt water seepage within the basins, it is the sedimentary sequence of interbedded layers of Permian shale, siltstone, sandstone, dolomite, salt, gypsum and anhydrite that is the ultimate source of the natural brines that pollute Elm Fork and North Fork. Although the Quaternary alluvium is thought to contain mostly brackish or saline water, the water quality is determined predominantly by the inflow of saline river water and seepage from the bedrock upon which the alluvium is deposited.

The stratigraphic sequence of the Permian rocks in and near the North Fork and Elm Fork basins varies in a relatively moderate degree from one location to another and with depth below land surface. However, despite the differences, the rocks are similar in general appearance and lithology over a large area of western Oklahoma and north central Texas. Where these rocks crop out they consist of red and gray gypsiferous shale, siltstone, and fine-grained sandstone containing thick beds of gypsum ($CaSO_4.2H_2O$) and anhydrite ($CaSO_4$). Most Permian rock units contain deposits of rock salt (NaCl).

In Table 1 is a general description of the individual Permian rock units underlying southwestern Oklahoma. Based on a compilation by the U. S. Public Health Service, these units are listed in descending order and each unit crops out at one location or another within the North Fork and Elm Fork basins. Where each unit forms the land surface, the overlying Permian rock units are consequently absent.

Major structural features affecting the Permian rocks in and near the North Fork and Elm Fork drainage basins are the Anadarko depositional basin and the Wichita Mountains uplift. The Anadarko basin trends northwestward through west central and northern Oklahoma and is deepest adjacent to the Wichita Mountains uplift in the North Fork basin. The Permian rock units slope toward the axis of this structural depression. The occurrence of salt springs and saline groundwater may be affected more by topography and the mineral composition of the rocks than the structural features.

## Salt Deposits

Permian rock salt in the North Fork and Elm Fork basins occurs as massive layers, thin lenticular beds and disseminated particles. The massive layers commonly range in

Table 1

DESCRIPTION OF PERMIAN ROCK OUTCROPS IN SOUTHWESTERN OKLAHOMA

| Rock Unit | General Lithology, Salt Occurrence and Approximate Thickness |
|---|---|
| Quartermaster Formation | Upper 190 feet is composed chiefly of reddish-brown, fine-grained and medium-grained sandstone and some coarse-grained sandstone and discontinuous beds of siltstone. Lower 160 feet consists of brownish-red shale and thin beds of siltstone. Not known to contain salt in this area. 350 feet thick in Beckham County. |
| Cloud Chief Formation | Red, fine-grained, gypsiferous sandstone, thin interbedded, silty shale and thin beds of gypsum, anhydrite, and dolomite near the top and bottom. Not known to contain salt in this area. 430 feet thick in Beckham County. |
| Whitehorse Group | Predominately pink and red, shaley, silty, fine-grained sandstone and siltstone and a few irregular thin beds of gypsum and dolomite. Not known to contain salt in this area. 390 feet thick in Beckham County. |
| Blaine Gypsum | Massive, white beds of gypsum interbedded with red and gray gypsiferous shale. Dolomite beds underlie the gypsum beds locally. In some localities gypsum makes up 70 percent of the total thickness. Salt springs issue from the formation in southwest Beckham and southern Jackson Counties. 140 feet thick in Beckham County. |
| Dog Creek Shale | Predominately red, brown, and green, silty, blocky shale and thin dolomite. Locally shale is dolomitic and sandy. Contains small amount of salt in parts of southwestern Oklahoma. 80 feet thick in Beckham County. |

Table 1 (Cont'd)

| Rock Unit | General Lithology, Salt Occurrence, and Approximate Thickness |
|---|---|
| Flowerpot Shale | Red, brown, and maroon, silty, blocky, gypsiferous shale characterized by intersecting veins of satin spar and selenite crystals. Salt occurs within 30 feet of the surface locally in northern Harmon County. Salt springs issue from the formation in several localities in southwestern Oklahoma. 160 feet thick in Beckham County. Partially underlain by Duncan Sandstone. |
| Hennessey Shale | Yellowish-gray, buff, and red, blocky shale, and a few thin, fine-grained, calcareous sandstones. Not known to contain salt in this area. 850 feet thick in central-western Oklahoma. |
| Wichita Formation | Equivalent to the Garber Sandstone and Wellington Formation. Generally red-brown shale, siltstone, sandstone, impure limestone, and anhydrite. Contains stringers of salt locally. |

Source: Oklahoma Geological Survey, U. S. Geological Survey, University of Oklahoma, Oklahoma Planning and Resources Board, Geological Congress, XXI Session.

thickness from 100 to 200 feet, but generally occur at depths of more than 500 feet below land surface. These layers are not extensive and form salt zones consisting of isolated or interfingering layers that occur more abundantly than other rock types within the zone. Thin, lenticular beds occur uncommonly at depths less than 500 feet below land surface. Disseminated particles of rock salt are thought to occur throughout much of the Permian rock sequence, except near land surface where leaching has largely removed the rock salt.

## Gypsum and Anhydrite

Gypsum and anhydrite occur throughtout much of the upper part of the Permian rock sequence of the North Fork and Elm Fork basins. Of the eight Permian rock units that crop out in the area of investigation, the Blaine Gypsum and the Flowerpot Shale comprise the largest and most extensive beds of gypsum and anhydrite in the basin.

The Blaine Gypsum consists mainly of white, massive gypsum beds interbedded with red gypsiferous shale. Locally the gypsum beds are underlain by thin dolomite. The solvent action of water has developed numerous solution

cavities such as sinkholes and caves. Where the Blaine Gypsum is not exposed to direct weathering and erosion but is covered by overlying rock, the Blaine Gypsum consists principally of dense anhydrite of low permeability.

The Flowerpot Shale consists principally of red and gray gypsiferous shale containing rock salt in the subsurface. This unit characteristically has numerous thin intersecting veins of selenite (clear transparent gypsum). The overall permeability of the Flowerpot Shale varies markedly within short distances.

# HYDROLOGY

## Precipitation

The ultimate source of water for impoundment in the proposed Navajo Reservoir is precipitation. Occurring principally as rain and snow, the average annual precipitation in the North Fork and Elm Fork basins is approximately 25 inches of which 24 inches are rain and 1 inch is snow (in water equivalency). Rainwater and snowmelt are dispersed by surface runoff, percolation into soil and rock, evaporation and transpiration.

## Surface Runoff

The dispersal of rainfall and melt water as surface runoff results in rock particles being carried in solution or suspension into ditches, creeks, rivers, ponds, lakes, impoundments and other natural or manmade water bodies. These substances affect the quality of the receiving waters. Prolonged leaching of soil and bedrock has resulted in the removal of rock salt from the upper part of the exposed bedrock. As a result, shallow groundwater in the upland areas of the basins is potable. Leaching of gypsum and

anhydrite beds in the outcrop areas of the Blaine Gypsum, in particular, has developed innumerable solution openings including sinkholes, and enlarged fracture openings permitting the storage and movement of groundwater. Thus, the solvent effect of rainwater acting upon the exposed rock has increased groundwater recharge of the units affected.

## Groundwater Movement

The direction of groundwater movement in the zone of saturation is in response to the influence of gravity. During the process of groundwater replenishment, rainfall, snowmelt and influent seepage from surface water bodies percolate into soil and rock. Movement of groundwater is from areas of recharge to areas of discharge. Water level contour maps indicate the configuration of the water table of unconfined groundwater or the pressure surface of an artesian system. Theoretically groundwater moves at right angles to the contour lines from higher to lower elevations.

Rates of groundwater movement depend on the permeability of the rock units containing the water and the gradient of

the water table or artesian pressure surface. Where rocks are more permeable, the movement of water is comparatively free, although the rate of movement is very slow in comparison to the flow of streams.

The void spaces in soil and rock ultimately control the underground movement of water. In the Permian units that contribute water to the streams of the North Fork basin, the voids in the Blaine Gypsum, for example, consist of solution channels, sinkholes and small cave-like openings. The permeability is comparatively high in this rock unit. In the Flowerpot Shale the voids of the shale rock itself are extremely small and water moves very slowly through this part of the formation. However, the Flowerpot Shale contains fractures and numerous veins of selenite, which when leached from the formation permit the collection and movement of relatively small quantities of water throughout the formation.

Springs occur commonly in the middle reaches of Elm Fork in northwestern Harmon County, Oklahoma. These springs are formed where groundwater issues naturally from the Flowerpot Shale and either flows in narrow rivulets across the land surface and down the streams or flows unseen into the channel alluvial sediments and contributes to the flow

of the streams by seepage. Where subsurface discharge of springs are under sufficiently high hydrostatic pressure, the spring water may rise locally to the surface through the alluvial sediments and flow visibly across the valley floor to the stream channels.

Seepage occurs where groundwater oozes naturally from rock and issues either at the land surface or directly into surface water bodies such as streams, ditches, ponds, lakes and impoundments. Whereas springs flow forth from discrete openings more or less observable, seepage often occurs from a myriad of extremely minute openings wetting larger areas of rock surface and often forming no discernible flow channel leading from the seepage area. Subsurface seepage of groundwater through the bedrock voids directly in the channel alluvium and through the alluvium into the stream channels is the unseen, but no less important way to which groundwater is discharged in the North Fork and Elm Fork basins.

## Evaporation

Rainwater, snowmelt and surface waters are dispersed in part by evaporation. The North Fork and Elm Fork basins of southwestern Oklahoma lie within an area where

evaporation is relatively high. For example, based on U.S. Weather Bureau studies covering the period 1946-1955, the mean annual lake evaporation was approximately 65 inches in the study area. This compares to 20 inches in extreme northern Maine to 80 inches in the Big Bend area of Texas.

The combination of high evaporation rates and strongly mineralized surface waters result in extensive accumulations of salts incrusted on stream banks, on the scattered boulders and pebbles in the channels and in and around springs and seeps. A commercial salt works in the study area uses evaporation pits for the accumulation of sodium-chloride salt which is hauled away and sold.

Evaporation from the surface of the impounded waters causes increase in mineral concentration with passage of time. This principle was considered in estimating the water quality of the proposed Navajo Reservoir.

Water dispersal through the transpiration of the natural plant coverage is not thought to be significant because southwestern Oklahoma is an area of relatively sparse natural vegetal coverage.

## Streamflow

In the North Fork and Elm Fork basins streamflow is subject to considerable variation and is sustained largely by groundwater seepage. At the U. S. Geological Survey gaging station (Station 490) on the North Fork Red River near Headrick, Oklahoma, the flow record extends from April 1905 to March 1908 and from October 1937 to the present. As of September 1968, this record included extremes ranging from no flow at times in most years to 30,700 cfs on October 5, 1955 (gage height 11.50 feet). The maximum stage known was 16.1 feet sometime prior to 1927, from information by State Highway Department. Average annual discharge for 33 years of record (through water year 1968) is 315 cfs or 228,100 acre-feet per year. However, there is considerable variation in the average annual discharge.

During the reconnaissance field survey flow measurements were made at the time of stream sampling. As shown in Table 2, the principal flow during controlled discharge from Lake Altus is on Elm Fork. At the time of measurement the flow on Elm Fork was 490.5 cfs at a location one-half mile above the confluence with North Fork. The North Fork had a flow of 0.9 cfs at a location 200 yards above the confluence with Elm Fork.

SELECTED STREAMFLOW AND WATER-QUALITY DATA

| Location | Streamflow[1] (cfs) | Specific Conductance (micromhos/cm) | Chloride Concentration (mg/l) | Chloride/Specific Conductance Ratio | Chloride Loading (T/D) |
|---|---|---|---|---|---|
| Elm Fork at Sampling Station 754 | 12.1 | 7,880 | 2,300 | 0.29 | 75.2 |
| Salton Canyon | 0.3 | 223,000 | 191,000 | .86 | 154.4 |
| Robinson Canyon | 0.5 | 151,000 | 87,500 | .58 | 118.2 |
| Kiser Canyon | 0.2 | 227,000 | 195,000 | .86 | 105.4 |
| Fish Creek | 0.03E[2] | 20,500 | 7,600 | .37 | 1.0 |
| Elm Fork, Sec. 17, T.6N., R. 25W. | 15.4 | 26,000 | 10,900 | .42 | 453.7 |
| "A" Creek[3] | 0.1 | 146,900 | 125,000 | .85 | 33.8 |
| "B" Creek | 0.1E | 38,900 | 19,500 | .50 | 5.3 |
| Deer Creek | 0.3 | 3,590 | 340 | .10 | 0.3 |
| "C" Creek | 0.2 | 4,210 | 500 | .12 | 0.3 |
| Haystack Creek | 0.5 | 4,320 | 780 | .18 | 1.0 |
| Elm Fork, ½ mile above confluence with North Fork | 16.3 | 27,000 | 11,000 | .41 | 490.5 |
| North Fork, 200 yards above confluence with Elm Fork | 0.5 | 3,350 | 670 | .20 | 0.9 |
| "D" Creek | 0.4 | 2,030 | 290 | .14 | 0.3 |
| North Fork at Highway 283, 1½ miles below confluence with Elm Fork | 18.0 | 25,500 | 10,200 | .40 | 496.2 |
| Elk Creek | 8.5 | 1,450 | 145 | .10 | 3.3 |
| North Fork at Highway 62 | 40.5 | 13,000 | 4,550 | .35 | 498.0 |

1/ All data in this table from Reconnaissance Survey, March 1965.
2/ E - Estimated.
3/ "A," "B," "C" and "D" are unnamed tributaries shown in Figure 1.

# NATURAL BRINES

Natural brines in the Elm Fork and North Fork basins are highly mineralized groundwaters containing strong concentrations of chloride and sulfate salts. The salts are leached from rock salt deposits and from beds of gypsum and anhydrite. These brines, discharging to the streams as spring water and as seepage, together with salt water runoff and incidental effects of commercial salt recovery operations all combine to effect stream quality. From a water use standpoint, chloride, sulfate and sodium are critical constituents of water because their excessive concentration may preclude the use of the water for municipal, industrial or agricultural purposes.

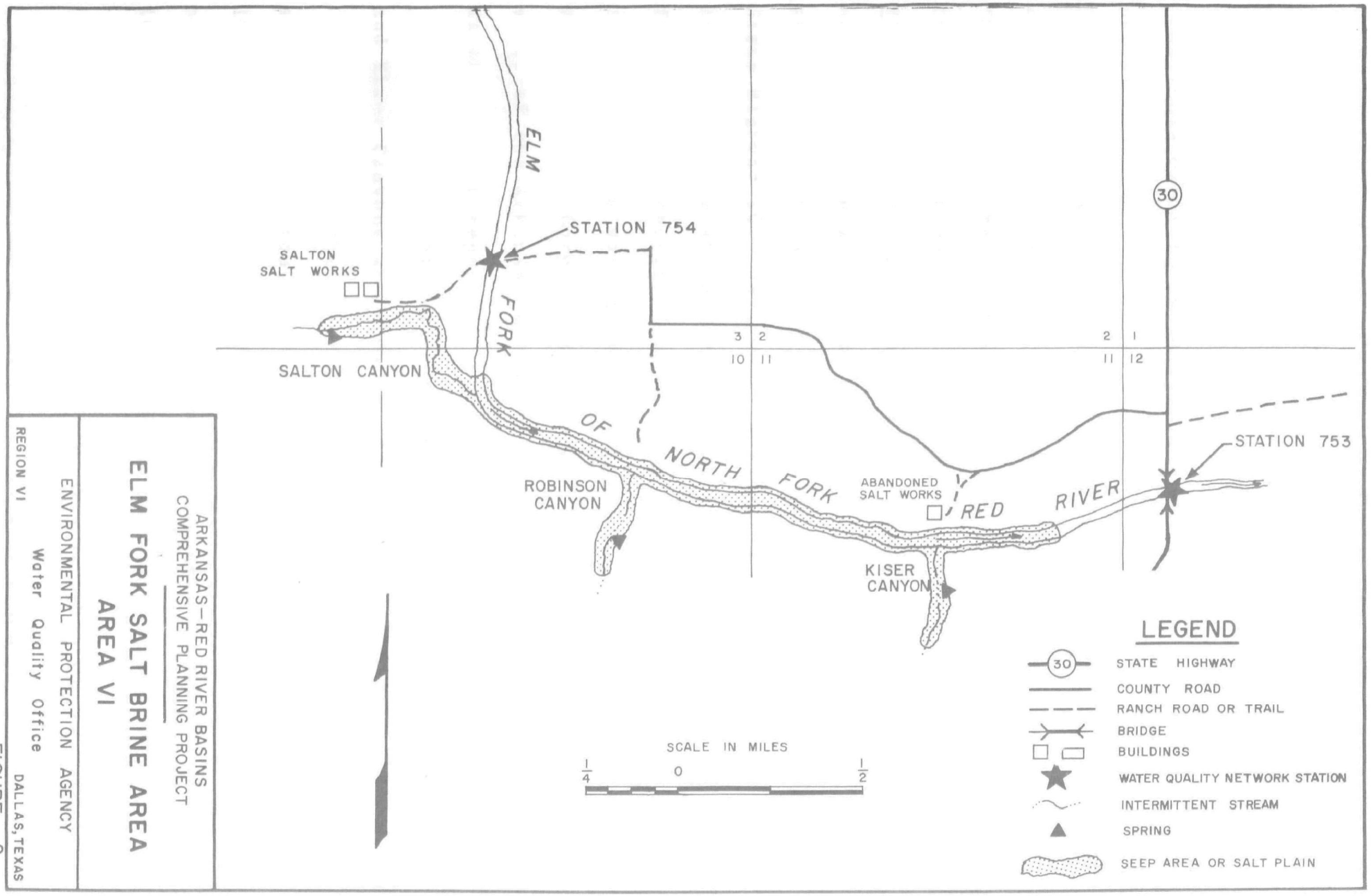
The natural discharge of salt water occurs predominantly from springs and by seepage. Overland runoff, during and following rainfall may dilute the concentration of salts in the streams. However, following periods of evaporation and natural accumulation of salt incrustations, rainfall may result in flushing these salts into the streams to cause temporary high salt loadings.

In the discussion that follows, the water quality data are based on water samples collected in March 1965. The

description of spring sites is obtained from the U. S. Geological Survey report entitled: Geology and Ground-Water Features of Salt Springs, Seeps and Plains in the Arkansas and Red River Basins of Western Oklahoma and Adjacent Parts of Kansas and Texas. A location map of Area VI showing prominent springs and seepage areas in Salton, Robinson and Kiser Canyons and along Elm Fork are shown in Figure 2. Water quality and streamflow data obtained from the Reconnaissance Survey of March 1965 are indicated in Table 2.

## Elm Fork Basin

Eight tributaries of Elm Fork that have salt springs were sampled in March 1965. These streams yield the most highly mineralized chloride waters draining to the proposed Navajo Reservoir. Chloride concentrations range from a maximum of 195,000 mg/l in Kiser Canyon to a minimum of 340 mg/l in Deer Creek. Although sulfate concentrations were not determined, the chloride/specific conductance ratios strongly suggest that water containing chloride as the principal anion is discharged from four streams. Generally downstream from these tributaries the remaining tributaries




ARKANSAS–RED RIVER BASINS
COMPREHENSIVE PLANNING PROJECT

# ELM FORK SALT BRINE AREA
## AREA VI

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
Water Quality Office
DALLAS, TEXAS

FIGURE 2

contribute water in which sulfate is probably the principal anion.

The largest salt springs and seepage areas in the Elm Fork basin are in Salton, Robinson and Kiser Canyons. These canyons are located on the right bank of Elm Fork in northwestern Harmon County, Oklahoma, and are shown in Figure 2. Covering a distance of about two miles, this spring and seepage area extends from three miles east of the Texas-Oklahoma State line to one mile west of Oklahoma State Highway 30. Salt water springs flow from the Flowerpot Shale at the base of the canyon walls and from the sand-covered canyon floor. As previously indicated, this spring and seepage area is designated Area VI in the Corps of Engineers' water quality control study of the Arkansas-Red River basins and is so designated in the present report.

Photographs of salt springs in Area VI and of Salton and Kiser Canyons are shown in Figures 3, 4 and 5.

In Area VI the chloride concentrations in water sampled from Salton, Robinson and Kiser Canyons were 191,000, 87,500 and 195,000 mg/l, respectively. With one exception, these concentrations range from 4.5 to 10.0 times larger than encountered at the 13 other stations

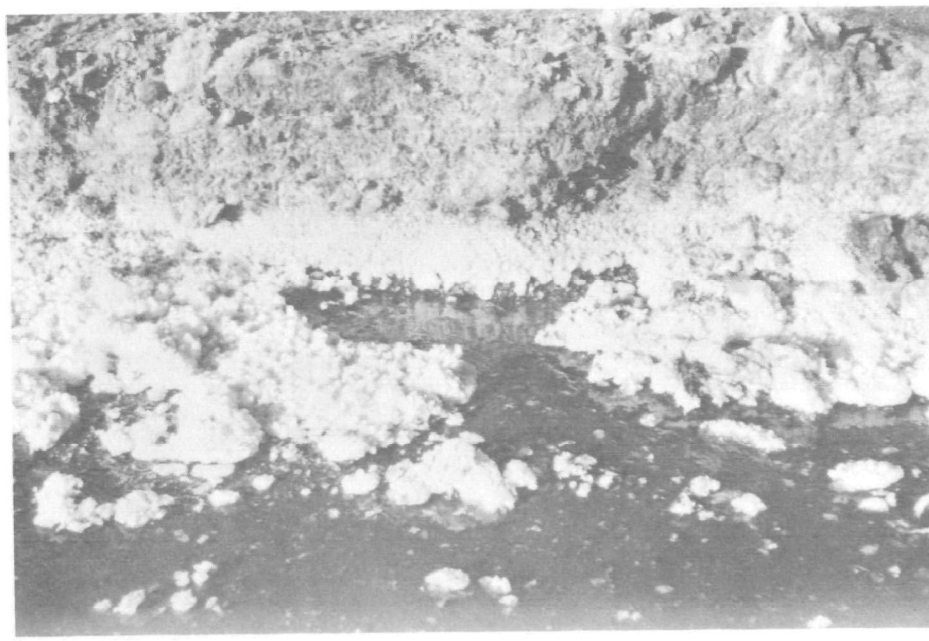


Figure 3.-Salt-water springs in Area VI, Elm Fork basin. Top, spring in Salton Canyon issuing at river's edge; bottom, spring in Kiser Canyon issuing through narrow outlet channel. Photographs by O. H. Linguist.

Figure 4.-Views along Elm Fork. Top, Elm Fork flowing towards foreground as it passes Kiser Canyon on the left; bottom Salton Salt Works evaporation pits in Salton Canyon. Elm Fork in distant background. Photographs by O. H. Linguist.

Figure 5.-Kiser Canyon looking downstream toward Elm Fork. Photograph by O.H. Linguist.

at which water was sampled in the North Fork basin. Total chloride loading from these three canyons was 378 T/D (tons per day).

Specific conductance readings on the water samples from Salton, Robinson and Kiser Canyons were 223,000, 151,000 and 227,000 micromhos per centimeter at 25°C., respectively. When comparing the ratio of chloride concentration of each water sample to the corresponding specific conductance of the sample, the respective figures are 0.86, 0.58 and 0.86. These high ratios indicate that chloride is the principal anion in the natural brine.

Fish Creek, which flows into Elm Fork about one mile downstream from Station 753, has a small spring about three miles from the confluence. At the time of sampling in March 1965, the chloride concentration was 7,600 mg/l. Total chloride loading was 1.0 T/D. The chloride/specific conductance ratio is 0.37 indicating that chloride was probably not the principal anion. Data from other sources, but not presented in this report, would indicate that sulfate is probably the principal anion in this water and occurs in a concentration exceeding 7,600 mg/l.

An unnamed tributary of Elm Fork, located six miles east and two miles north of Carl, Oklahoma, has highly

saline water. This stream (designated "A" in Figure 1) had a chloride concentration of 125,000 mg/l and a specific conductance of 146,900 micromhos when sampled in March 1965. The chloride/specific conductance ratio was 0.85 indicating that chloride is the principal anion in the water. Total chloride loading was 33.8 T/D.

An unnamed tributary (designated "B" in Figure 1)is located five miles north and four and one-half miles west of Reed, Oklahoma. This tributary has salt springs about one mile above its confluence with Elm Fork. The chloride concentration of sampled water was 10,900 mg/l. Total chloride loading was 5.3 T/D. Specific conductance was 38,900 micromhos. The chloride/specific conductance ratio is 0.50. Chloride may be the principal anion in this water.

Deer Creek enters along the left bank of Elm Fork at a point about five and one-half miles north of Reed, Oklahoma. The chloride concentration of sampled water was 340 mg/l. Total chloride loading was 0.3 T/D. Specific conductance was 3,590 micromhos. The chloride/specific conductance ratio is about 0.10 indicating that chloride is probably a minor anion constituent of the water. Sulfate may be the principal anion and probably occurs in a concentration exceeding 340 mg/l.

Another unnamed tributary (designated "C" in Figure 1) is located two and one-half miles north and two and one-half miles west of Reed, Oklahoma. There are salt springs about one mile above the confluence with Elm Fork. The chloride concentration and specific conductance of sampled water were 500 mg/l and 4,210 micromhos, respectively. The chloride/specific conductance ratio is 0.12 indicating that chloride is probably a minor anion constituent of the water. Sulfate may be the principal anion and probably occurs in a concentration exceeding 500 mg/l. Total chloride loading was 0.3 T/D.

Haystack Creek, in an area about 20 miles above its confluence with Elm Fork, has a number of salt springs of small volume. During periods of low flow, very little salt water discharges to the stream. However, evaporation causes salt deposits to be formed in the upper reaches of the creek, and during periods of high flow the salt is flushed into the creek. At the time of sampling in March 1965, the chloride concentration and specific conductance were 780 mg/l and 4,320 micromhos, respectively. The chloride/specific conductance ratio was 0.18, indicating that chloride is not the principal anion in the water. Sulfate may occur in concentrations exceeding 780 mg/l. Total chloride loading was 1.0 T/D.

Salt works in the Elm Fork basin are not thought to be significant sources of salt water pollution. Originally depending on the diversion of the flow of salt water springs to the evaporation pits, present operations rely on shallow dug wells and on drilled wells. The pumping of these wells reportedly affects the flow of local springs, indicating the hydrologic continuity between the source of well brines and those issuing naturally from springs.

During the 7-year period of record, the average total daily chloride and sulfate loadings issuing from Area VI were 322 tons and 12 tons, respectively.

## North Fork Basin

Two tributaries of North Fork were sampled in March 1965. These streams have the lowest chloride concentrations and are the least mineralized among those listed in Table 2. Chloride concentrations did not exceed 290 mg/l. Although sulfate was not determined, the general knowledge of the composition of waters in this region and the chloride/specific conductance ratio of the samples strongly suggest that sulfate is the principal anion in these two streams.

One tributary (designated "D" in Figure 1) is located four miles west and four and one-half miles north of Warren, Oklahoma. The chloride concentration and specific conductance of sampled water was 290 mg/l and 2,030 micromhos, respectively. Total chloride loading was about 0.3 T/D. The chloride/specific conductance ratio was 0.14, suggesting that sulfate may be the principal anion at a concentration exceeding 290 mg/l.

Elk Creek, entering North Fork from the left bank, is located four miles east and three and one-half miles north of Warren, Oklahoma. The chloride concentration and specific conductance of sampled water was 145 mg/l and 1,450 micromhos. Total chloride loading was 3.3 T/D. The chloride/specific conductance ratio is 0.10. Sulfate is assumed to be the principal anion at a concentration exceeding 145 mg/l.

During the 7-year period of record, the average total daily chloride and sulfate loadings at Sampling Station 490 were 448 tons and 314 tons, respectively. Brine discharges from Area VI accounted for approximately 72 percent of the chloride loading and 4 percent of the sulfate loading at Station 490.

# STREAM QUALITY

Stream quality data used in the present study were collected at five water quality monitoring stations for various periods between July 1960 through September 1967. The start of data collection in 1960 was part of an intensive two-year investigation by the U. S. Public Health Service to locate and define natural and man-made sources of salt pollution and to determine the impact of these sources on the quality of the receiving streams. At that time two stream quality monitoring stations (Stations 754 and 753) were established on Elm Fork and one (Station 490) on North Fork. Streamflow surveillance was required and the three water quality monitoring stations were located, where possible, at existing stream gaging stations. Upon initiation of the present study in 1963, the Monitoring and Surveillance Program was continued and expanded to include two additional stations (Stations 4 and 5), which were added as a result of the Reconnaissance Survey of March 1965. The FWQA, upon receiving this project from the Public Health Service, continued the stream sampling and stream gaging programs until the end of the field studies in September 1967.

Table 3 indicates the periods when each sampling station was operative during the Monitoring and Surveillance Program. The location of these five stations are discussed in Appendix A. The important aspects of the Monitoring and Surveillance Program and the Reconnaissance Survey are discussed in Appendix B and C, respectively. The daily flow and continuous recorded quality data (specific conductance) for the period October 1960 to September 1967 is tabulated in Appendix D. Monthly summary of continuous recorded flow and quality data (specific conductance, chlorides and sulfates) are presented in Appendix E.

## Elm Fork of North Fork Red River

Elm Fork is the principal source of salt water in the drainage area of the proposed Navajo Reservoir. Originating at the confluence of North Elm Creek and South Elm Creek in extreme southwestern Beckham County, Oklahoma, it flows 59 miles in an easterly direction through southwestern Oklahoma before entering the North Fork Red River. The confluence is two miles below Lake Altus and 32 miles upstream from the Navajo Reservoir damsite. The headwater streams extend into southern Wheeler County and southeastern Collingsworth County, Texas.

Table 3

DURATION OF MONITORING AND SURVEILLANCE PROGRAM

| Sampling Station | Monitoring and Surveillance | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 |
| 754 | *1/ | * | * | | | | | |
| 753 | *2/ | * | * | * | * | * | * | * |
| 4 | | | | | | *3/ | * | * |
| 5 | | | | | | *3/ | * | * |
| 490 | *4/ | * | * | * | * | * | * | * |

1/ Water quality monitoring and stream gaging started in July 1960, and discontinued in September 1962.

2/ Water quality monitoring started in July 1960, and discontinued in September 1967. Stream gaging in operation from October 1959, to present.

3/ Water quality monitoring and stream gaging started in April 1965, and discontinued in September 1967.

4/ Water quality monitoring started in July 1960, and discontinued in September 1967. Stream gaging in operation from April 1905, to March 1908, and from October 1937, to present.

Chloride Concentrations

Data on the natural concentrations of chloride in Elm Fork are presented in a series of cumulative frequency diagrams in Figure 6 and a cumulative frequency data in Table 4. The flow-weighted average chloride concentrations and annual mean chloride loads for the period 1961-1967 are listed in Table 5.

The cumulative frequency diagrams show the percent of time that certain chloride concentrations occurred at Sampling Stations 754, 753, 4 and 5. Also indicated are the extent to which extreme concentrations depart from the range of most frequent occurrence and, by comparing, how this differs from one sampling station to another. Moreover, each diagram consists of two curves, one reflecting natural conditions and the other reflecting hypothetical conditions based on the following assumptions.

1. Prevention of all brines in Area VI from draining into Elm Fork.
2. Salt mining operations in the study area remain unaltered in terms of location, salt recovery techniques, production rate or any other activity that may affect the salinization of Elm Fork.

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CUMULATIVE FREQUENCY DATA ON CHLORIDE CONCENTRATIONS

| Percentage of Time Equaled or Exceeded | Chloride Concentrations (mg/l)[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Without Control of Area VI | | | | | With 100 Percent Control of Area VI | | | |
| | Sampling Station | | | | | Sampling Station | | | |
| | 754[2] | 753 | 4 | 5 | 490 | 753 | 4 | 5 | 490 |
| 2.0 | 2,180 | 34,670 | 24,490 | 9,500 | 5,480 | 8,860 | 8,400 | 4,300 | 1,740 |
| 4.0 | 2,150 | 26,610 | 14,450 | 9,200 | 5,040 | 6,800 | 5,950 | 4,200 | 1,600 |
| 7.0 | 2,000 | 19,070 | 12,142 | 9,150 | 4,650 | 5,070 | 5,570 | 4,100 | 1,460 |
| 12.0 | 1,770 | 14,500 | 11,700 | 8,970 | 4,120 | 3,750 | 5,340 | 4,050 | 1,300 |
| 20.0 | 1,540 | 10,410 | 10,200 | 8,400 | 3,160 | 2,650 | 4,290 | 3,800 | 980 |
| 30.0 | 1,270 | 8,670 | 9,210 | 7,850 | 2,380 | 2,215 | 3,980 | 3,550 | 740 |
| 40.0 | 1,100 | 7,780 | 8,120 | 6,400 | 1,930 | 1,990 | 3,690 | 2,900 | 610 |
| 50.0 | 880 | 6,580 | 7,610 | 5,190 | 1,320 | 1,670 | 3,160 | 2,350 | 420 |
| 60.0 | 825 | 5,470 | 6,480 | 3,800 | 1,020 | 1,400 | 2,700 | 1,720 | 320 |
| 70.0 | 770 | 4,150 | 3,000 | 1,790 | 850 | 990 | 1,880 | 810 | 270 |
| 80.0 | 440 | 2,700 | 2,240 | 1,470 | 780 | 690 | 920 | 670 | 250 |
| 90.0 | 310 | 1,410 | 1,280 | 720 | 320 | 360 | 525 | 325 | 100 |
| 97.5 | 290 | 870 | 445 | 120 | 245 | 220 | 180 | 54 | 80 |

1/ Based on monthly mean concentrations.
2/ Conditions are the same at Station 754 with or without control of Area VI.

Table 5

MEAN ANNUAL STREAMFLOWS, CHLORIDE CONCENTRATIONS AND CHLORIDE LOADINGS, 1961-1967

| Location | Water Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 |
| Station 754[1/] | | | | | | | |
| Flow (cfs) | 51 | 57 | 25 | 26 | 45 | 42 | 46 |
| Chloride Conc. (mg/l) | 669 | 520 | 1,060 | 1,130 | 1,110 | 1,448 | 1,200 |
| Chloride Loading (T/D) | 92 | 80 | 72 | 79 | 136 | 164 | 149 |
| Station 753 | | | | | | | |
| Flow | 51 | 57 | 25 | 26 | 45 | 42 | 46 |
| Chloride Conc. | 2,590 | 2,050 | 4,130 | 4,480 | 4,353 | 5,700 | 4,720 |
| Chloride Loading | 358 | 315 | 281 | 310 | 533 | 645 | 584 |
| Station 4[2/] | | | | | | | |
| Flow | 76 | 85 | 31 | 33 | 102 | 59 | 61 |
| Chloride Conc. | 3,120 | 2,710 | 5,380 | 4,500 | 1,898 | 3,200 | 3,220 |
| Chloride Loading | 640 | 623 | 450 | 400 | 553 | 510 | 533 |
| Station 5[2/] | | | | | | | |
| Flow | 145 | 157 | 58 | 55 | 197 | 92 | 81 |
| Chloride Conc. | 1,460 | 1,390 | 2,790 | 2,880 | 911 | 1,730 | 2,180 |
| Chloride Loading | 670 | 690 | 510 | 500 | 484 | 427 | 478 |
| Station 490 | | | | | | | |
| Flow | 589 | 427 | 140 | 69 | 241 | 203 | 113 |
| Chloride Conc. | 466 | 499 | 846 | 1,190 | 485 | 1,020 | 1,350 |
| Chloride Loading | 741 | 570 | 319 | 221 | 315 | 558 | 411 |

1/ Data for 1963 - 1967 are estimated.
2/ Data for 1961 - 1964 are estimated.

3. General climatic conditions affecting the study area remain unchanged.
4. No man-made structures alter the natural flow of the stream except in Area VI.
5. No additional man-made pollution of Elm Fork.

Table 4 lists cumulative frequency data on chloride concentrations for conditions as they existed during the study and for hypothetical controlled conditions in which the quality of Elm Fork is assumed unaffected by natural brines from Area VI.

Table 5 lists the mean annual streamflow, chloride concentrations and chloride loading of Elm Fork for the period 1961-1967.

Of the four sampling stations established on Elm Fork, the highest chloride concentrations occur at Station 753, located immediately downstream from Area VI. At Station 753 chloride concentrations equal or exceed 1,410 mg/l 90 percent of the time and 6,580 mg/l 50 percent of the time. At Station 754, which is immediately upstream from Area VI, chloride concentrations equal or exceed 310 and 880 mg/l 90 and 50 percent of the time, respectively. Station 5 is farthest downstream on Elm Fork (36.2 miles below Station 753). The chloride concentrations at this station equal or exceed 720 mg/l and 5,190 mg/l 90 and 50 percent of the time, respectively. Of the four stations established on Elm Fork, water quality data collected at Station 754 and

753 define the impact that the natural brines from Area VI have on Elm Fork. Station 5 is closest to the proposed Navajo Reservoir and water quality data collected at this location represents the net effect of all upstream factors contributing to the chloride content of Elm Fork. For these reasons the water quality at this station is particularly important in estimating the water quality of the proposed impoundment.

The flow-weighted average chloride concentration and annual mean chloride load, as indicated in Table 5, range respectively from a maximum of 5,700 mg/l and 645 T/D at Sampling Station 753 to a minimum of 520 mg/l and 72 T/D at Sampling Station 754 for seven years of record. At Sampling Station 5 the annual mean chloride concentration and chloride load range, respectively, from a maximum of 2,180 mg/l and 484 T/D to a minimum of 911 mg/l and 427 T/D for three years of records.

Control of Area VI, which is the hypothetical condition of pollution abatement previously discussed, would result in a large reduction in chloride concentrations. At Sampling Station 753 and 5, the controlled chloride concentrations that would occur are 525 and 100 mg/l or more 90 percent of the time, which indicate decreases of 885 and 220 mg/l or more 90 percent of the time from the natural chloride concentrations at these respective stations. The controlled chloride concentrations at Stations 753 and 5

are 1,670 and 420 mg/l or more 50 percent of the time. The corresponding decreases from the natural chloride concentrations are 4,910 and 2,840 mg/l or more 50 percent of the time.

## Sulfate Concentrations

Data on the natural concentrations of sulfate in Elm Fork are presented in a series of cumulative frequency diagrams in Figure 7 and as cumulative frequency data in Table 6. The annual mean sulfate concentrations and sulfate loads for the period 1961-1967 are listed in Table 7.

Under the previous discussions of chloride concentrations in Elm Fork, reference was made to cumulative frequency diagrams. Statements regarding the significance of these diagrams and of the cumulative frequency curves apply also to the present discussion of sulfate.

Of the four sampling stations established on Elm Fork, the highest sulfate concentrations occur at Station 753 and equal or exceed 1,240 mg/l 90 percent of the time and 1,630 mg/l 50 percent of the time. At Station 754, sulfate concentrations equal or exceed 1,050 and 1,370 mg/l 90 and 50 percent of the time, respectively. Sulfate concentrations at Station 5 equal or exceed 1,070 and 1,680 mg/l 90 and 50 percent of the time, respectively.

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Table 6

CUMULATIVE FREQUENCY DATA ON SULFATE CONCENTRATIONS

| Percentage of Time Equaled or Exceeded | Sulfate Concentrations (mg/l)[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Without Control of Area VI | | | | | With 100 Percent Control of Area VI | | | |
| | Sampling Station | | | | | Sampling Station | | | |
| | 754[2] | 753 | 4 | 5 | 490 | 753 | 4 | 5 | 490 |
| 2.0 | 1,730 | 2,490 | 2,590 | 1,970 | 1,510 | 2,305 | 2,480 | 1,915 | 1,460 |
| 4.0 | 1,720 | 2,180 | 2,580 | 1,830 | 1,370 | 2,020 | 2,470 | 1,790 | 1,320 |
| 7.0 | 1,700 | 2,090 | 2,420 | 1,760 | 1,220 | 1,930 | 2,300 | 1,700 | 1,170 |
| 12.0 | 1,640 | 1,970 | 2,130 | 1,740 | 1,150 | 1,830 | 2,040 | 1,690 | 1,120 |
| 20.0 | 1,580 | 1,870 | 1,910 | 1,725 | 1,070 | 1,730 | 1,820 | 1,670 | 1,030 |
| 30.0 | 1,520 | 1,740 | 1,810 | 1,710 | 1,000 | 1,615 | 1,730 | 1,660 | 970 |
| 40.0 | 1,450 | 1,670 | 1,780 | 1,700 | 910 | 1,545 | 1,700 | 1,650 | 910 |
| 50.0 | 1,370 | 1,630 | 1,750 | 1,680 | 830 | 1,510 | 1,680 | 1,630 | 810 |
| 60.0 | 1,350 | 1,590 | 1,690 | 1,670 | 655 | 1,470 | 1,620 | 1,620 | 630 |
| 70.0 | 1,330 | 1,515 | 1,480 | 1,540 | 530 | 1,400 | 1,420 | 1,500 | 510 |
| 80.0 | 1,150 | 1,420 | 1,340 | 1,180 | 475 | 1,315 | 1,280 | 1,150 | 460 |
| 90.0 | 1,050 | 1,240 | 1,220 | 1,070 | 330 | 1,140 | 1,170 | 1,040 | 320 |
| 97.5 | 1,040 | 1,080 | 1,030 | 1,050 | 200 | 1,000 | 990 | 1,020 | 190 |

1/ Based on monthly mean concentrations.
2/ Conditions are the same at Station 754 with or without control of Area VI.

Table 7

MEAN ANNUAL STREAMFLOWS, SULFATE
CONCENTRATIONS AND SULFATE LOADINGS, 1961 - 1967

| Location | Water Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 |
| Station 754[1/] | | | | | | | |
| Flow (cfs) | 51 | 57 | 25 | 26 | 45 | 42 | 46 |
| Sulfate Conc. (mg/l) | 1,282 | 1,203 | 1,410 | 1,400 | 1,460 | 1,470 | 1,260 |
| Sulfate Loading (T/D) | 177 | 185 | 96 | 98 | 179 | 166 | 156 |
| Station 753 | | | | | | | |
| Flow | 51 | 57 | 25 | 26 | 45 | 42 | 46 |
| Sulfate Conc. | 1,380 | 1,310 | 1,530 | 1,530 | 1,582 | 1,580 | 1,370 |
| Sulfate Loading | 190 | 201 | 104 | 106 | 194 | 179 | 169 |
| Station 4[2/] | | | | | | | |
| Flow | 76 | 85 | 31 | 33 | 102 | 59 | 61 |
| Sulfate Conc. | 1,416 | 1,360 | 1,735 | 1,570 | 1,489 | 1,458 | 1,330 |
| Sulfate Loading | 290 | 312 | 145 | 140 | 433 | 232 | 220 |
| Station 5[2/] | | | | | | | |
| Flow | 145 | 157 | 58 | 55 | 197 | 92 | 81 |
| Sulfate Conc. | 1,400 | 1,390 | 1,420 | 1,410 | 1,130 | 1,681 | 1,240 |
| Sulfate Loading | 640 | 690 | 260 | 245 | 601 | 415 | 272 |
| Station 490 | | | | | | | |
| Flow | 589 | 427 | 140 | 69 | 241 | 203 | 113 |
| Sulfate Conc. | 300 | 317 | 656 | 596 | 506 | 682 | 972 |
| Sulfate Loading | 477 | 362 | 247 | 111 | 329 | 373 | 296 |

1/ Data for 1963 - 1967 are estimated.
2/ Data for 1961 - 1964 are estimated.

The flow-weighted average sulfate concentrations and mean annual sulfate loads, as indicated in Table 7, range from the maximums of 1,681 mg.1 and 601 T/D at Station 5 to the minimums of 1,130 mg/1 and 96 T/D at Stations 5 and 754, respectively. At Station 5 the mean annual sulfate concentration and load range from the maximums of 1,681 mg/1 and 601 T/D to the minimums of 1,130 mg/1 and 272 T/D for the three years of record.

Control of Area VI would result in a small reduction in sulfate concentrations. At Sampling Stations 753 and 5, the controlled sulfate concentrations that would occur are 1,140 and 1,040 mg/1 or more 90 percent of the time, respectively, which amount to decreases of 100 and 30 mg/1 or more 90 percent of the time from the natural sulfate concentrations at these respective stations. The controlled sulfate concentrations at Stations 753 and 5 are 1,510 and 1,630 mg/1 or more 50 percent of the time. The corresponding decreases from the natural chloride concentrations are 120 and 50 mg/1 or more 50 percent of the time.

## North Fork Red River

North Fork is the primary source of water for impoundment in the proposed Navajo Reservoir. Originating in Gray County, near Pampa, Texas, it flows easterly and southerly through the Texas panhandle country and southwestern Oklahoma before entering the Red River. Elm Fork enters North Fork at a point 70.9 miles upstream from where North Fork joins the Red River.

### Chloride Concentrations

Data on the natural concentrations of chloride at Sampling Station 490 on the North Fork are included as a cumulative frequency diagram in Figure 6 and as cumulative frequency data in Table 4. The flow-weighted average chloride concentrations and annual mean chloride loads for the period 1961-1967 are listed in Table 5.

Sampling Station 490 is located 10.4 miles downstream from the damsite of the proposed Navajo Reservoir. Of the five stations established as part of the Monitoring and Surveillance Program, the water quality at Sampling Station 490 is thought to represent most closely the quality of the North Fork as it would flow into the proposed reservoir.

Elm Fork enters North Fork 32 miles upstream from the damsite and 9 miles upstream from where the blended waters of the two streams would enter the reservoir.

At Sampling Station 490 the chloride concentrations that occur are 320 mg/l or more 90 percent of the time. The chloride concentrations are 1,320 mg/l or more 50 percent of the time.

The flow-weighted average chloride concentration and annual mean chloride load, as indicated in Table 5, range, respectively, from a maximum of 1,350 mg/l and 741 T/D to a minimum of 466 mg/l and 221 T/D for the seven years of record.

Control of Area VI would result in a large reduction of chloride concentrations at Sampling Station 490. Concentrations that occur are 100 and 420 mg/l or more 90 percent and 50 percent of the time, respectively, which indicates decreases of 220 and 900 mg/l or more from the corresponding natural chloride concentrations.

## Sulfate Concentrations

Data on the natural concentrations of sulfate at Sampling Station 490 on North Fork are included as a cumulative frequency diagram in Figure 7 and as cumulative

frequency data in Table 6. The annual mean sulfate concentrations and sulfate loads for the period 1961-1967 are listed in Table 7.

At Sampling Station 490 the sulfate concentrations that occur are 330 mg/1 or more 90 percent of the time. The sulfate concentration is 830 mg/1 or more 50 percent of the time.

The flow-weighted average sulfate concentration and annual mean sulfate load, as indicated in Table 7, range, respectively, from a maximum of 972 mg/1 and 477 T/D to a minimum of 300 mg/1 and 111 T/D for the seven years of record.

Control of Area VI would result in small reduction of sulfate concentrations at Sampling Station 490. Concentrations that occur 90 percent and 50 percent of the time are 320 and 810 mg/1 or more, respectively, which indicate decreases of 10 and 20 mg/1 or more from the corresponding natural sulfate concentrations.

# NAVAJO RESERVOIR

The critical consideration regarding the proposed Navajo Reservoir is the suitability of the impounded water for municipal, industrial and agricultural supply. Plans for the reservoir have remained tentative and the project did not reach the state of final engineering design when it was inactivated. Details on the design characteristics of the reservoir are, therefore, also tentative.

The damsite traverses the North Fork Red River approximately two miles east and five miles north of the village of Headrick in Sec. 33, T.3 N., R. 18 W., at a point 43.4 miles upstream from where the North Fork flows into the Red River. Dam freeboard is 1,436 feet above mean sea level (ft.-m.s.l.) with a maximum water surface elevation of 1,430 ft.-m.s.l. Corresponding maximum water surface area and total reservoir capacity are 20,526 acres and 546,972 acre-feet, respectively. Elevations of proposed conservation pools are 1,400, 1,410, and 1,418 ft.-m.s.l. Corresponding water surface area and conservation storage at 1,400 ft.-m.s.l. is 7,823 acres and 144,648 acre-feet, respectively. Streambed elevation at the damsite is 1,346 ft.-m.s.l. At full

capacity, the reservoir will inundate the valley of the North Fork to a point approximately 23 river miles upstream from the dam. The valley of Elk Creek will be inundated approximately 5 river miles upstream from where it joins the North Fork in Sec. 12, T.4N., R.19E.

## Water Uses and Water Quality Criteria

The water impounded by the proposed Navajo Reservoir is intended to serve as a source of municipal and industrial water supply. The FWQA, in evaluating the suitability of this water for these two uses extended this evaluation to include agricultural water use for livestock watering and irrigation.

In the present study, water quality conditions relating to the Navajo Reservoir are discussed in terms of concentrations of chloride and sulfate and in terms of specific conductance. To evaluate the water suitability for irrigation, the sodium-adsorption ratio was calculated. Criteria presented in Table 8 are selected from Water Quality Criteria, a report of the National Technical Advisory Committee to the Secretary of the Interior, and from Water Quality Criteria, a report by the California Water Quality Control Board.

Table 8

SELECTED WATER QUALITY CRITERIA FOR MUNICIPAL, INDUSTRIAL, AND AGRICULTURAL WATER USES

| Water Use | Water Quality Criteria | | |
|---|---|---|---|
| | Chloride (mg/l) | Sulfate (mg/l) | Specific Conductance (micromhos/cm) |
| Municipal | 250[1/] | 250[1/] | --[2/] |
| Industrial | 200-22,000[3/] | 570-2,700[3/] | --[2/] |
| Agricultural | | | |
| Livestock Watering | 1,500[4/] | 1,000[4/] | --[2/] |
| Irrigation | --[2/] | --[2/] | 1,000-12,800[5/] |

1/ Applies to raw surface water after treatment that may include coagulation, sedimentation, filtration and disinfection.

2/ Not a water quality parameter for the water use indicated. Excess concentrations of another parameter will ordinarily deter water use first.

3/ Applies to raw surface water to be used for diverse industrial purpose that include boiler makeup, cooling, and process water for textile, lumber, pulp and paper, chemical, petroleum, primary metals, food and kindred products, and leather industry.

4/ Suggested or assumed maximum level of concentration.

5/ Criteria applicable to large variety of crops that collectively span a wide range in salt tolerance.

Water quality criteria form the basis for evaluating water suitability for the designated uses. These criteria are founded on empirical data and precautionary judgment arrived at to protect public health, safeguard industrial processes and equipment and promote agricultural productivity.

The listed criteria are presented in relation to municipal, industrial and agricultural water supplies. Agricultural water use is divided into two categories: stock watering and irrigation.

## Water Quality of the Navajo Reservoir

The water quality of the Navajo Reservoir is determined by a number of factors. Principal among these are the quantity and quality of water in storage in the reservoir at the outset of reservoir operations; the quantity and quality of inflow under alternative levels of quality control of Area VI; the quantity of evaporation loss from the reservoir; and the controlled reservoir withdrawals for the proposed water uses.

The quantity of water in the reservoir at the outset was assumed to be 144,648 acre-feet, the capacity of the

reservoir corresponding to the 1,400-foot conservation pool elevation. The quality of water was based on the flow-weighted mean chloride and sulfate concentrations (655 and 455 mg/l, respectively) at Sampling Station 490.

To estimate the chloride and sulfate concentrations at Station 490, under alternative conditions of water-quality control of Area VI, the average salt loadings from Area VI were determined for the 7-year period of record. The chloride and sulfate loadings from Area VI constituted 72 percent of the chloride loading and 4 percent of the sulfate loading at Station 490. Under the assumed levels of zero percent, 80 percent and 100 percent control of salt loadings from Area VI, the resulting conditions at Station 490 were calculated by correspondingly reducing the loading from Area VI at that station.

The weighted average chloride and sulfate concentrations of the North Fork at Station 490 under no control, 80 percent control and 100 percent control of brine discharges from Area VI are presented in Table 9.

Inflow characteristics were the mean monthly streamflow and water quality of the North Fork at Sampling Station 490 for the seven year period of record spanning water years 1961-1967. This station is located 42 river

Table 9

WATER QUALITY OF NORTH FORK RED RIVER
AT SAMPLING STATION 490

| Control of Area VI of Elm Fork | Flow-Weighted Average Chloride and Sulfate Concentrations at Sampling Station 490 (mg/l)[1/] |
|---|---|
| Chloride Concentrations: | |
| No control of Area VI | 655 |
| 80 percent control | 275 |
| 100 percent control | 185 |
| Sulfate Concentrations: | |
| No control of Area VI | 455 |
| 80 percent control | 445 |
| 100 percent control | 440 |

1/ All concentrations rounded to nearest five milligrams per liter.

miles downstream from where Elm Fork joins North Fork and 10 river miles below the proposed dam. Water quality at this location should closely represent the complete blend of waters flowing into the reservoir from North Fork.

Evaporation losses are based on mean monthly reservoir evaporation rates obtained from the Texas Water Development Board for Quadrangle C-8, which includes the area of the proposed Navajo Reservoir in southwestern Oklahoma. The increasing mineralization of the impounded water due to evaporation was calculated into the estimations of reservoir quality for an extrapolated period covering 50 years of hypothetical reservoir operation. The controlled yields from the reservoir were 6,666 acre-feet per month.

In estimating the water quality of the Navajo Reservoir, the cumulative average chloride and sulfate concentrations were determined by reservoir routing analysis and calculated for 5, 10, 20, 30, 40 and 50 years of reservoir operation. The chloride and sulfate reservoir routing analysis establishes a hydrologic system in which those factors that determine reservoir quality are brought together in mathematical formula used to calculate mean monthly chloride and sulfate concentrations.

Starting with a given quantity and quality of water in the proposed reservoir, the inflow from North Fork is assumed to be completely mixed with the water in the reservoir. The combined volume of the impounded waters is then subject to evaporation at the appropriate monthly rate. The increased mineralization due to evaporation is assumed to be uniformly dispersed throughout the impoundment, giving the quality of the reservoir for the particular month involved. A new initial reservoir capacity is calculated for the end of month conditions. This is determined by taking the reservoir capacity for the previous month, adding inflow, and subtracting the evaporation loss and controlled reservoir yield.

To obtain information on the changing quality of the reservoir over the years, caused in part by increasing mineralization due to evaporation, water quality estimates were extrapolated over a 50 year period by uniform random recycling, on a year by year basis, of the monthly mean streamflows, chloride and sulfate concentrations and evaporation rates for the seven years of field records. Three sets of recycled data, each covering a random 50 year sequence, were computed and averaged to obtain yearly mean chloride and sulfate

concentrations. Table 10 presents the estimated cumulative mean chloride and sulfate concentrations in the Navajo Reservoir for 50 years of operation without control and with 80 percent control and 100 percent control of Area VI. The concentrations are rounded to the closest 5 milligrams per liter.

As part of the calculations in estimating the chloride and sulfate concentrations, reservoir routing analyses were made assuming the reservoir was initially filled to three alternative conservation pool levels (1,400, 1,410 and 1,418 ft.-m.s.l.) with water having mean chloride and sulfate concentrations of 653 and 457 mg/l, respectively. In each of these three reservoir routings, the initital differences in the quantities of water in storage (144,648 acre-feet at the 1,400 foot level, 238,577 acre-feet at 1,410 foot, and 339,473 acre-feet at the 1,418 foot level) caused a difference of less than 5 mg/l in chloride and sulfate concentrations after the first year of reservoir operation.

The projected quality estimates are based on existing conditions at the time of the field investigations. Future upstream developments may affect these estimates.

Table 10



ESTIMATED WATER QUALITY OF THE NAVAJO RESERVOIR
DURING
50 YEARS OF OPERATION

| Control of Area VI of Elm Fork | Cumulative Average Chloride and Sulfate Concentrations (mg/l) Versus Years of Reservoir Operation | | | | | |
|---|---|---|---|---|---|---|
| | Years of Reservoir Operation | | | | | |
| | 5 | 10 | 20 | 30 | 40 | 50 |
| Chloride Concentrations | | | | | | |
| No control of Area VI | 1,015 | 1,070 | 1,145 | 1,270 | 1,140 | 1,265 |
| 80 percent control | 430 | 455 | 485 | 540 | 485 | 540 |
| 100 percent control | 285 | 300 | 320 | 355 | 320 | 355 |
| Sulfate Concentrations | | | | | | |
| No control of Area VI | 655 | 705 | 745 | 740 | 770 | 760 |
| 80 percnet control | 645 | 685 | 720 | 715 | 745 | 735 |
| 100 percent control | 640 | 680 | 715 | 710 | 740 | 730 |

Chloride Concentrations

As indicated in Table 9, the estimated mean chloride concentration of the North Fork is 655 mg/l at Sampling Station 490. Assuming 80 and 100 percent control of the concentration of salt brines issuing from Area VI on Elm Fork, the flow-weighted average chloride concentrations would be reduced to 275 and 185 mg/l, respectively.

The estimated cumulative average chloride concentration of the Navajo Reservoir over 50 years of hypothetical reservoir operations, under assumed alternative conditions of no control and of 80 and 100 percent control of the concentrations of Area VI, range from 285 to 1,270 mg/l, as indicated in Table 10.

Without quality control of Area VI the estimated cumulative average chloride concentrations in the Navajo Reservoir range from 1,015 mg/l to 1,270 mg/l over the 50 years of reservoir operation. The maximum monthly average to occur in the reservoir during this same period was 2,410 mg/l.

With 80 percent control of Area VI, the cumulative average chloride concentrations range from 430 mg/l to 540 mg/l over the 50 year period.

Assuming 100 percent control of Area VI, the estimated cumulative averages range from 285 mg/l to 355 mg/l over the 50 years of operation.

Sulfate Concentrations

As indicated in Table 9, the estimated mean sulfate concentration of the North Fork is 455 mg/l at Sampling Station 490. Assuming 80 and 100 percent effective control of the concentration of salt brines issuing from Area VI on Elm Fork, the flow-weighted average sulfate concentrations at Station 490 would be reduced to 445 and 440 mg/l, respectively.

The estimated cumulative average sulfate concentration of the Navajo Reservoir after 5 to 50 years of reservoir operation, under assumed alternative conditions of no control and of 80 and 100 percent control of Area VI, range in accumulative averages from 640 to 760 mg/l.

Without quality control of Area VI, the estimated cumulative average sulfate concentrations in the Navajo Reservoir range from 655 mg/l to 760 mg/l over the 50 years of hypothetical reservoir operation. The maximum monthly average to occur during this same period was 1,395 mg/l.

With 80 percent control of Area VI, the cumulative average sulfate concentrations range from 645 mg/l to 735 mg/l over the 50 year period.

Assuming 100 percent control of Area VI, the estimated accumulative averages range from 640 mg/l to 730 mg/l over the 50 years of operation.

# Water Suitability

## Municipal Supply

Evaluating the suitability of water for municipal supply is complicated by the fact that raw surface water supplies are commonly treated for quality improvement before distribution to the water customers. Generally undesirable water supplies such as ocean water or grossly polluted fresh water can, at a price, be converted to potable and palatable water. However, when considering only the more common treatment practices, such as coagulation, sedimentation, filtration and disinfection, the chloride and sulfate concentrations of the raw supply are unaffected by such treatment. The present evaluation of water suitability assumes only the four common types of pre-treatment referred to above; and that the chloride and sulfate concentrations of the raw reservoir water would prevail undiminished in the water delivered from the reservoir to the user.

Quality criteria established for public drinking water specifies permissible maximums of 250 mg/l for both chloride and sulfate concentrations. Thus the cumulative average concentrations of chloride and sulfate, under the several conditions of quality control of Area VI, exceed the permissible maximums by 105 to

1,020 mg/l for chloride and by 480 to 510 mg/l for sulfate. Thus, the quality of the Navajo Reservoir is unsuitable for public water supply.

Industrial Supply

Industrial water quality requirements are almost as varied and numerous as there are types of industrial products. For this reason no criteria relating to the chloride or sulfate concentrations of raw surface water supplies can apply to a large number of industrial water uses. Moreover, pre-treatment techniques permit utilizing water of grossly substandard quality to produce water of acceptable quality at the point of use. The present appraisal of water suitability is based on quality characteristics of surface waters that have been used as sources of industrial water supply.

The maximum concentrations of chloride in waters that have been used as sources of industrial supply range from 200 mg/l in process water of the pulp and paper industry to 22,000 mg/l in brackish cooling water in once-through systems and in the makeup cycle.

Chloride concentrations in the Navajo Reservoir are estimated to range from a cumulative average of 1,015 to 1,270 mg/l over the 50 years of hypothetical reservoir

operation, assuming no control of Area VI. Compared with the maximums established by industry, this range of concentration is within the quality limits for process water used in the petroleum industry (1,600 mg/l maximum), for boiler makeup water (19,000 mg/l), and for those industries where brackish water is used as cooling water in once-through systems and in the makeup recyle (22,000 mg/l). The estimated chloride concentrations exceed the maximums for process water in the pulp and paper industry (200 mg/l 1/), chemical industry (500 mg/l), and prime metals industry (500 mg/l), and for fresh cooling water in a once-through system (600 mg/l) and in the makeup recycle (500 mg/l).

With 80 percent control of Area VI, the estimated chloride concentrations range from a cumulative average of 430 to 540 mg/l over the 50 years of reservoir operation. These concentrations are within the quality limits of the same industries discussed above under conditions of no control of Area VI. The estimated chloride concentrations exceed the maximum for process water in the pulp and paper industry (200 mg/l 1/). For process water used in primary metals industries, and for fresh cooling water in the

1/ May be 1,000 mg/l or less for mechanical pulping operations.

once-through system and in the makeup recycle, the reservoir is of marginal quality with respect to accumulative average chloride concentrations with 80 percent control of Area VI. However, the cumulative averages do not reflect the large fluctuations in quality that frequently exceed the criteria for these water uses. Although periods of satisfactory reservoir quality do occur, these periods are temporary. The reliability of the reservoir quality is low. Standard deviations, based upon the yearly average concentrations for the three sets of 50-year projected reservoir use, are 135 mg/l for chloride and 185 mg/l for sulfate under 80 percent control of Area VI. As a source of industrial supply, the Navajo Reservoir is definitely unsuitable for a number of industries, inherently inadequate for those having maximums that are near the accumulative average chloride concentrations of the reservoir, and suitable only for boiler makeup water and for brackish cooling water.

The maximum concentrations of sulfate in waters that have been used as sources of industrial supply range from 570 in process water of the petroleum industry to 2,700 mg/l in brackish[1/] cooling water in once-through systems are in the makeup recycle.

Sulfate concentrations in the Navajo Reservoir are estimated to range from a cumulative average of 655 to 760 mg/l over the 50 years of reservoir operation, assuming no control of Area VI. Compared with the maximums

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1/ Water of more than 1,000 mg/l dissolved solids.

established within industry, this range of concentration is within the quality limits for boiler makeup water (1,400 mg/l maximum), and for those industries where brackish water is used for cooling in once-through systems and in the makeup recycle (2,700 mg/l), and in process water in the chemical industry (850 mg/l). The estimated sulfate concentrations exceed the maximums for fresh cooling water (680 mg/l) and for process water in the petroleum industry (570 mg/l).

With 80 percent control of Area VI, the estimated sulfate concentrations range from a cumulative average of 645 to 735 mg/l over the 50 years of reservoir operation. Quality control of Area VI, the prime source of sodium-chloride brine, reduces insignificantly the estimated sulfate concentrations in the reservoir. The suitability of the reservoir for industrial water supply with 80 percent control of Area VI is, therefore, the same as the suitability without control of Area VI.

## Agricultural Supply

Livestock watering.- Water suitability for livestock depends upon such factors as the species of animals drinking the water, their sex, physiology, natural adaptability to changing water quality conditions, and upon the water

content of their feed. Quality requirements have not been well established, probably because livestock generally have relatively high tolerance for saline water, and most water sources used to date have caused few problems. Such problems are not necessarily the consumption of lethal concentrations, but may arise from consuming water sufficiently saline to cause, for example, reduction in animal weight in beef cattle and reduced milk production from dairy cattle.

Chloride concentrations exceeding 4,000 mg/l reportedly have caused injury to livestock, whereas concentrations of 1,500 are assumed safe for cattle, swine, sheep and chickens.

Sulfate concentrations of approximately 2,100 mg/l have caused progressive weakening and death in cattle, whereas concentrations of no more than 1,000 mg/l are considered safe.

Chloride concentrations in the reservoir, under conditions of no control of Area VI, are generally less than the maximum recommended for livestock watering (1,500 mg/l). The cumulative average chloride concentrations in the reservoir range from 1,015 mg/l to 1,270 mg/l over the 50 years of operation.

With 80 percent control of Area VI, the water quality in the reservoir is suitable for livestock watering. The

cumulative average chloride concentrations range from 430 to 540 mg/l over the 50 years of reservoir operation.

Sulfate concentrations in the reservoir, under conditions of no control of Area VI, are generally less than the maximum recommended for livestock (1,000 mg/l). The cumulative average sulfate concentrations in the reservoir range from 645 to 735 mg/l for the 50 year period.

Irrigation.- Water suitability for irrigation is dependent upon the type of crops to be irrigated, the characteristics of the soil in which the crops are grown, and the climatic conditions to which they are exposed. The complex interaction of the many factors that relate to soil (such as mineral and organic composition, texture and structure), to plants (salt tolerance at various stages of plant growth) and to climate (sunshine, rainfall, temperature, wind and humidity) will ultimately determine whether water of a particular quality will be suitable for irrigation. A final evaluation of the suitability of water for irrigation must, therefore, consider the interaction of soil, plants, and climate.

It is beyond the scope of this study to consider these factors as they apply to the study area in southwestern Oklahoma. However, a general classification of

the water in the Navajo Reservoir is possible based on the Salinity Hazard Chart which correlates sodium-adsorption ratio (SAR) with the specific conductance.

Water containing sodium as the predominant cation can adversely affect soil structure and produce poor conditions of tilth. Potassium has similar affects, but generally occurs in very small concentrations and is often included in figures stated for sodium concentration.

The natural brines of Area VI contain high concentrations of sodium as exemplified by an analysis of spring water in Kiser Canyon in which sodium (and potassium) totals 120,000 mg/l.

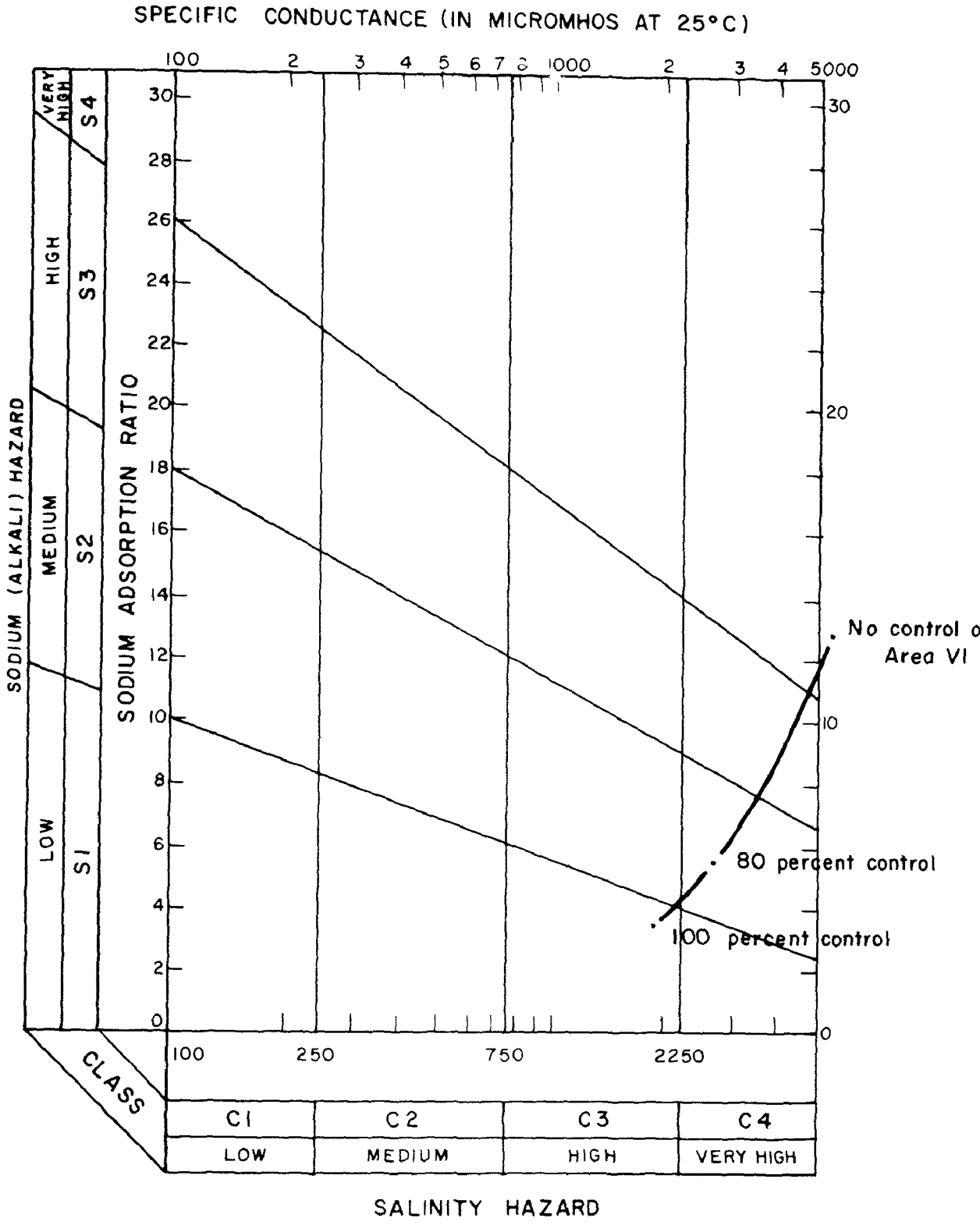
SAR values were computed from sodium and calcium (plus magnesium) concentrations that are equivalent, respectively, to the estimated chloride and sulfate concentrations of the Navajo Reservoir. Table 11 lists the computed SAR values and the corresponding specific conductance figures for 5, 20 and 50 years of reservoir operation. Figure 8 is a diagram for the classification of irrigation waters. The significance of the S1 through S4 and C1 through C4 coding is discussed in Appendix F.

Table 11

FIFTY YEAR PROJECTION OF
SODIUM-ADSORPTION-RATIOS FOR THE
NAVAJO RESERVOIR

| Control of Area VI on Elm Fork | Sodium-Adsorption Ratios and Specific Conductance Years of Reservoir Operation | | | | | |
|---|---|---|---|---|---|---|
| | 5 | | 20 | | 50 | |
| | SAR 1/ | S.C. 2/ | SAR | S.C. | SAR | S.C. |
| No control of Area VI | 11.0 | 4,510 | 11.6 | 4,930 | 12.7 | 5,140 |
| 80 percent control | 4.7 | 2,400 | 5.0 | 2,710 | 5.5 | 2,750 |
| 100 percent control | 3.1 | 1,690 | 3.3 | 1,790 | 3.6 | 1,980 |

1/ SAR Sodium-adsorption ratio.
2/ S.C. Specific conductance (in micromhos/cm).




**Classification of Irrigation Water from the proposed Navajo Reservoir**

(Diagram from USDA, Agricultural Handbook No. 60)

FIGURE 8

Without control of Area VI the reservoir has a very high sodium hazard (S4) and an extremely high salinity hazard (C4) making it unsuitable as a source of irrigation water.

With 80 percent control of Area VI the reservoir has a medium sodium hazard (S2) and a very high salinity hazard (S4) making it unsuitable as a source of irrigation water except under very special conditions.

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# Appendix A

## DESCRIPTION OF SAMPLING STATIONS

| Station No. | Location |
|---|---|
| 754 | Elm Fork at Salton Crossing, Oklahoma. Latitude 35°02', Long. 99°56' NE 1/4 SW 1/4, Section 3, T. 6 N., R. 26 W., approximately 2 1/2 miles above State Highway 30 at Salton Crossing, Harmon County, Oklahoma at about river mile 57 of the Elm Fork. (USGS Gaging Station No. 3034.00 located approximately 2 1/2 miles downstream from quality station). |
| 753 | Elm Fork near Carl, Oklahoma. Latitude 35 00'40", Long. 99°54'10", in SW 1/4 NW 1/4, Section 12, T. 6 N., R. 26 W., at bridge on State Highway 30, 4 miles NE of Carl, Harmon County, Oklahoma. River mile 54.0 of Elm Fork and drainage area of 416 square miles. |
| 4 | Elm Fork near Reed, Oklahoma. Latitude 34°58', Long. 99°42', on west line of Section 25, T. 6 N., R. 24 W., or downstream side of county bridge on FAS road, 1 mile upstream from Deer Creek, 4.2 miles north of Reed, and at about river miles 38 of the Elm Fork with a drainage area of 579 square miles. |
| 5 | Elm Fork - Mangum, Oklahoma. Latitude 34°56', Long. 99°30', on east line Section 10, T. 5 N., R. 22 W., at bridge on U. S. Highway 283, 3 miles north of Mangum, 5 miles downstream from Haystock Creek, and at river mile 17.8 of Elm Fork with a drainage area of 838 square miles. |
| 490 | North Fork of Red River near Headrick, Oklahoma. Latitude 34°28', Long. 99° 06', in center of N 1/2 Section 21, T. 2 N., R. 18 W., near left bank of downstream side of pier of bridge on U. S. |

Highway 62, 2 1/2 miles east of Headrick, 12.9 miles upstream from Otter Creek, and at river mile 33.0 of North Fork with a drainage area of 4244 square miles, of which 399 square miles is probably noncontributing.

# Appendix B

## MONITORING AND SURVEILLANCE PROGRAM

The stream quality monitoring and surveillance program consisted of continuous specific conductance recording with continuous flow measurement. Weekly samples were collected and analyzed for correlation of specific conductance with chloride and sulfate concentrations.

Stream monitoring included five stations, which are shown in Figure 1. Using information obtained from the Monitoring and Surveillance Program, cumulative frequency curves (Figures 4 and 6) were derived by procedures set forth in Statistical Methods in Hydrology, by Leo R. Beard, January 1962.

Data computations were made by the Statistical Services Section, Sanitary Engineering Center, FWQA, at Cincinnati, Ohio, and by personnel of the Arkansas-Red River project.

Chemical analyses were made according to procedures set forth in Standard Methods for Examination of Water and Wastewater, 12th Edition, 1965, except sulfate determinations in FWQA laboratories where a modified turbidimetric procedure was used to improve analytical accuracy.

# Appendix C

## RECONNAISSANCE SURVEY

A field survey was made in March 1965, on the Elm Fork and its tributaries from Station 754 to its confluence with the North Fork and on the North Fork and its tributaries from Lake Altus to Station 490.

The purpose of the survey was to determine the location of additional stations for the Monitoring and Surveillance Program. Each tributary was investigated near their confluence with Elm Fork or North Fork. At each flowing tributary the flow was measured and a water sample was taken.

Daily records of Stations 753 and 490 were examined for a period of thirty days preceding and seven days following the survey period. The average chloride concentration was 10,600 mg/l with insignificant flow variations. The flow from Area VI is negligible and has no bearing on total flow at Station 490.

# Appendix D

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 754

**Location** : Elm Fork at Salton Crossing, Oklahoma

**Water Year** : 1961

**Basin** : Red River

**Tributary to:** North Fork of the Red River

**Remarks** : Records poor. Stratification nil.

**Equations Used to Compute Constituents**

**Chlorides:** Log Cl = 1.5831 Log Sp.C. -2.9227

**Sulfates :** Log $SO_4$ = 0.3986 Log Sp.C. +1.6605

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 16 | 6088 | 73 | 4311 | 44 | 5500 | 47 | 4531 | 37 | 5500 | 30 | 5350 | 72 | 4423 | 43 | 5788 | 21 | 8177 | 14 | 11295 | 12 | 8597 | 9 | 12743 |
| 2 | 16 | 5941 | 70 | 4500 | 44 | 5500 | 43 | 4740 | 33 | 5500 | 30 | 5438 | 68 | 4626 | 43 | 5970 | 35 | 7759 | 14 | 7930 | 11 | 9018 | 9 | 15789 |
| 3 | 16 | 6017 | 69 | 4550 | 44 | 5500 | 40 | 4849 | 32 | 5500 | 30 | 5413 | 63 | 4612 | 44 | 6000 | 706 | 2481 | 14 | 7345 | 11 | 9010 | 9 | 14970 |
| 4 | 16 | 6288 | 70 | 4600 | 44 | 5500 | 39 | 5029 | 33 | 5500 | 29 | 5381 | 60 | 4845 | 47 | 5825 | 107 | 2625 | 14 | 10643 | 11 | 8623 | 11 | 10296 |
| 5 | 16 | 6064 | 72 | 4650 | 44 | 5500 | 41 | 4830 | 29 | 5500 | 29 | 5388 | 60 | 4913 | 49 | 5047 | 95 | 2909 | 13 | 8296 | 10 | 8370 | 11 | 8417 |
| 6 | 16 | 6467 | 70 | 4700 | 44 | 5430 | 41 | 4875 | 37 | 5800 | 29 | 5369 | 58 | 4881 | 41 | 5077 | 111 | 3139 | 12 | 15555 | 10 | 9378 | 11 | 8392 |
| 7 | 15 | 6638 | 69 | 4750 | 44 | 5500 | 41 | 4750 | 38 | 5600 | 29 | 5594 | 58 | 4813 | 36 | 6386 | 119 | 2799 | 12 | 17141 | 10 | 9235 | 11 | 9232 |
| 8 | 14 | 7063 | 72 | 4685 | 44 | 5688 | 40 | 4737 | 35 | 5500 | 29 | 5450 | 62 | 4775 | 34 | 9058 | 106 | 2946 | 12 | 3770 | 10 | 9493 | 12 | 7868 |
| 9 | 14 | 6825 | 72 | 4500 | 47 | 5801 | 39 | 4894 | 33 | 5500 | 29 | 5488 | 62 | 4400 | 32 | 8571 | 74 | 3508 | 13 | 3081 | 9 | 10130 | 12 | 8111 |
| 10 | 14 | 6841 | 70 | 4500 | 54 | 5339 | 41 | 4812 | 36 | 4500 | 29 | 5625 | 57 | 4604 | 29 | 6227 | 57 | 4031 | 14 | 5112 | 9 | 10719 | 11 | 8626 |
| 11 | 447 | 1650 | 70 | 4500 | 63 | 4218 | 41 | 5004 | 34 | 4700 | 30 | 5613 | 54 | 4940 | 28 | 6231 | 47 | 4495 | 13 | 6876 | 9 | 10619 | 11 | 8475 |
| 12 | 1210 | 1700 | 70 | 4500 | 59 | 3978 | 41 | 5025 | 33 | 5000 | 30 | 5494 | 52 | 5127 | 28 | 6336 | 40 | 6543 | 13 | 8907 | 10 | 9266 | 11 | 9044 |
| 13 | 144 | 2600 | 70 | 4500 | 54 | 4379 | 41 | 5038 | 29 | 5206 | 29 | 5487 | 51 | 6106 | 27 | 6743 | 35 | 7451 | 12 | 4703 | 16 | 5068 | 11 | 8510 |
| 14 | 85 | 3200 | 70 | 4500 | 53 | 4669 | 40 | 4944 | 28 | 5390 | 28 | 5671 | 51 | 5431 | 27 | 7293 | 33 | 6921 | 12 | 6612 | 12 | 7005 | 11 | 7695 |
| 15 | 106 | 4200 | 70 | 4599 | 54 | 4675 | 40 | 4988 | 28 | 5388 | 28 | 5672 | 51 | 4944 | 27 | 8215 | 32 | 6750 | 11 | 5480 | 12 | 7483 | 12 | 7344 |
| 16 | 105 | 3650 | 68 | 4775 | 52 | 4800 | 37 | 5000 | 30 | 5249 | 32 | 6242 | 49 | 5106 | 28 | 7243 | 32 | 6625 | 11 | 5762 | 12 | 7603 | 12 | 7679 |
| 17 | 468 | 3600 | 66 | 4625 | 51 | 4525 | 37 | 5022 | 29 | 5200 | 72 | 5078 | 49 | 5250 | 28 | 6834 | 32 | 6307 | 11 | 3628 | 11 | 8273 | 11 | 8013 |
| 18 | 1700 | 1800 | 64 | 4600 | 49 | 4500 | 35 | 5149 | 30 | 4988 | 88 | 3221 | 49 | 5283 | 29 | 6574 | 29 | 6201 | 9 | 8928 | 11 | 8759 | 11 | 8059 |
| 19 | 347 | 2500 | 62 | 4600 | 48 | 4400 | 34 | 5237 | 29 | 5100 | 71 | 3691 | 49 | 5337 | 36 | 5324 | 27 | 6328 | 9 | 7954 | 11 | 8609 | 12 | 8430 |
| 20 | 149 | 2900 | 58 | 4699 | 48 | 4579 | 34 | 5370 | 32 | 5298 | 73 | 3512 | 48 | 5400 | 33 | 4026 | 25 | 6300 | 8 | 8360 | 12 | 6842 | 13 | 8592 |
| 21 | 112 | 3400 | 56 | 4800 | 45 | 4924 | 34 | 5376 | 41 | 5132 | 68 | 4209 | 46 | 5447 | 28 | 4800 | 23 | 6400 | 58 | 4629 | 12 | 6216 | 11 | 7539 |
| 22 | 109 | 3412 | 54 | 4885 | 48 | 4550 | 37 | 5215 | 42 | 4540 | 62 | 4587 | 46 | 5494 | 25 | 6000 | 21 | 6450 | 291 | 2500 | 12 | 8386 | 11 | 8376 |
| 23 | 105 | 3690 | 52 | 4912 | 47 | 4649 | 38 | 4970 | 37 | 4733 | 58 | 4681 | 46 | 5501 | 23 | 7000 | 19 | 6500 | 42 | 3000 | 11 | 8791 | 11 | 9587 |
| 24 | 92 | 6348 | 51 | 4913 | 46 | 4700 | 38 | 4985 | 35 | 5163 | 57 | 4831 | 44 | 5580 | 23 | 7167 | 19 | 6550 | 21 | 4600 | 11 | 9205 | 10 | 13343 |
| 25 | 106 | 3547 | 51 | 4862 | 43 | 4700 | 31 | 6218 | 32 | 5075 | 58 | 4884 | 41 | 5822 | 26 | 7240 | 19 | 6600 | 18 | 7416 | 11 | 8542 | 10 | 9999 |
| 26 | 88 | 3512 | 49 | 4913 | 41 | 4725 | 32 | 5760 | 33 | 5037 | 56 | 4816 | 41 | 5937 | 25 | 5922 | 19 | 6650 | 16 | 7204 | 10 | 8918 | 11 | 8475 |
| 27 | 88 | 3775 | 50 | 4988 | 41 | 4800 | 32 | 5000 | 32 | 5163 | 53 | 4800 | 43 | 5862 | 24 | 5940 | 17 | 6700 | 16 | 7455 | 10 | 9694 | 11 | 7959 |
| 28 | 88 | 3850 | 48 | 5000 | 41 | 4887 | 33 | 4770 | 30 | 5286 | 54 | 5133 | 43 | 5819 | 24 | 6031 | 17 | 7021 | 13 | 6764 | 10 | 9532 | 11 | 7456 |
| 29 | 87 | 3919 | 45 | 5228 | 41 | 4825 | 30 | 4386 | -- | -- | 56 | 5331 | 43 | 5813 | 24 | 5938 | 16 | 7431 | 12 | 7164 | 10 | 10175 | 12 | 7119 |
| 30 | 80 | 4000 | 46 | 5500 | 42 | 4902 | 34 | 4489 | -- | -- | 65 | 4680 | 43 | 5881 | 23 | 6912 | 15 | 10477 | 12 | 7819 | 10 | 10538 | 12 | 8647 |
| 31 | 75 | 4100 | -- | -- | 48 | 4843 | 41 | 4747 | -- | -- | 73 | 4528 | -- | -- | 22 | 8006 | -- | -- | 12 | 7991 | 9 | 11054 | -- | -- |
| Mean | 192 | 2581 | 62 | 4697 | 47 | 4891 | 38 | 4975 | 33 | 5208 | 46 | 4818 | 52 | 5166 | 31 | 6347 | 65 | 3863 | 24 | 4988 | 11 | 8670 | 11 | 9018 |

## Appendix D (Cont'd)

### DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 754

**Location** : Elm Fork at Salton Crossing, Oklahoma

**Water Year** : 1962

**Basin** : Red River

**Tributary to:** North Fork of the Red River

**Remarks** : Records poor. Stratification nil.

**Equations Used to Compute Constituents**

Chlorides: Log Cl = 1.5831 Log Sp.C. -2.9227

Sulfates : Log $SO_4$ = 0.3986 Log Sp.C. +1.6605

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 12 | 7769 | 40 | 6327 | 18 | 6740 | 15 | 5506 | 14 | 6000 | 13 | 7000 | 14 | 7250 | 60 | 6879 | 32 | 10199 | 16 | 9400 | 2468 | 1632 | 6 | 17006 |
| 2 | 12 | 7413 | 60 | 4500 | 18 | 6900 | 15 | 5453 | 14 | 6075 | 16 | 6800 | 14 | 7200 | 50 | 7147 | 29 | 8216 | 14 | 9600 | 130 | 2173 | 7 | 15866 |
| 3 | 12 | 7518 | 28 | 5500 | 18 | 6995 | 15 | 5316 | 14 | 6175 | 19 | 7500 | 15 | 7150 | 42 | 7103 | 27 | 7500 | 14 | 10300 | 64 | 3186 | 8 | 12863 |
| 4 | 12 | 7756 | 21 | 6313 | 18 | 6950 | 16 | 3912 | 14 | 6625 | 18 | 5800 | 16 | 7107 | 37 | 7082 | 13 | 7576 | 13 | 11200 | 52 | 4032 | 8 | 10156 |
| 5 | 12 | 8031 | 17 | 6242 | 20 | 6887 | 21 | 5581 | 14 | 6600 | 17 | 8000 | 18 | 7151 | 34 | 7106 | 53 | 7816 | 14 | 12002 | 37 | 4663 | 8 | 10499 |
| 6 | 12 | 9500 | 17 | 5979 | 20 | 7778 | 28 | 6362 | 14 | 6451 | 17 | 6550 | 21 | 7213 | 27 | 8532 | 25 | 6200 | 17 | 11663 | 29 | 5143 | 8 | 10162 |
| 7 | 12 | 11191 | 16 | 6336 | 19 | 6812 | 25 | 3672 | 15 | 6601 | 18 | 6475 | 20 | 7299 | 26 | 8534 | 14 | 6586 | 11 | 12316 | 24 | 5960 | 8 | 9428 |
| 8 | 12 | 9179 | 16 | 6691 | 20 | 7074 | 18 | 4696 | 15 | 6800 | 18 | 6375 | 18 | 7400 | 25 | 8378 | 16 | 6724 | 10 | 14500 | 22 | 6471 | 39 | 4780 |
| 9 | 17 | 8808 | 16 | 6633 | 21 | 6082 | 17 | 8581 | 15 | 6800 | 18 | 6324 | 18 | 7500 | 21 | 8598 | 127 | 5655 | 10 | 22000 | 20 | 6971 | 38 | 3600 |
| 10 | 15 | 8044 | 16 | 6812 | 20 | 6407 | 17 | 10445 | 15 | 6600 | 16 | 6722 | 18 | 7588 | 20 | 8774 | 73 | 4147 | 10 | 12500 | 18 | 7643 | 15 | 5617 |
| 11 | 12 | 8376 | 16 | 7013 | 19 | 10655 | 17 | 9311 | 15 | 6350 | 14 | 6800 | 18 | 7578 | 18 | 8800 | 23 | 5525 | 10 | 11412 | 16 | 8264 | 11 | 7109 |
| 12 | 12 | 8183 | 16 | 6559 | 15 | 7500 | 16 | 8410 | 16 | 6350 | 14 | 6800 | 17 | 7500 | 16 | 8800 | 14 | 6523 | 11 | 11613 | 15 | 10719 | 9 | 8333 |
| 13 | 13 | 8700 | 16 | 6486 | 13 | 5400 | 18 | 6888 | 16 | 6468 | 14 | 6800 | 16 | 7500 | 14 | 8800 | 10 | 7190 | 9 | 11270 | 16 | 10352 | 9 | 9250 |
| 14 | 12 | 8500 | 18 | 7789 | 12 | 5300 | 23 | 5262 | 16 | 6500 | 14 | 6800 | 15 | 7500 | 12 | 8800 | 8 | 7722 | 7 | 13983 | 16 | 9031 | 8 | 9939 |
| 15 | 12 | 7500 | 25 | 7783 | 11 | 5600 | 20 | 5447 | 16 | 6600 | 14 | 6800 | 14 | 7500 | 12 | 8970 | 2642 | 2268 | 6 | 15399 | 14 | 10343 | 14 | 6784 |
| 16 | 12 | 7800 | 25 | 7100 | 13 | 5700 | 19 | 6070 | 16 | 6800 | 14 | 6800 | 14 | 7500 | 15 | 9802 | 174 | 2492 | 6 | 16154 | 55 | 3099 | 73 | 3408 |
| 17 | 12 | 8000 | 24 | 7000 | 17 | 5700 | 19 | 5725 | 16 | 6975 | 14 | 6825 | 14 | 7500 | 36 | 8444 | 82 | 3737 | 6 | 16233 | 19 | 3470 | 611 | 2383 |
| 18 | 12 | 8000 | 21 | 7000 | 17 | 5700 | 17 | 4958 | 16 | 6900 | 14 | 7000 | 14 | 7500 | 34 | 6982 | 57 | 4939 | 6 | 16868 | 11 | 5568 | 67 | 2763 |
| 19 | 12 | 7500 | 21 | 7000 | 17 | 5751 | 18 | 6640 | 16 | 6700 | 14 | 7200 | 14 | 7500 | 18 | 7024 | 55 | 5114 | 6 | 17745 | 9 | 7600 | 44 | 4350 |
| 20 | 12 | 7000 | 21 | 7000 | 16 | 5802 | 23 | 6907 | 17 | 6549 | 14 | 7350 | 13 | 7500 | 14 | 7021 | 44 | 5608 | 6 | 17651 | 8 | 9800 | 1610 | 1889 |
| 21 | 12 | 7000 | 21 | 7000 | 15 | 6529 | 20 | 6667 | 17 | 7500 | 14 | 7300 | 13 | 7500 | 13 | 7099 | 34 | 5659 | 7 | 14908 | 8 | 11500 | 150 | 1968 |
| 22 | 12 | 7200 | 21 | 6975 | 15 | 7700 | 17 | 6019 | 16 | 8700 | 14 | 7250 | 13 | 7500 | 14 | 8551 | 28 | 5719 | 10 | 10343 | 7 | 12023 | 68 | 2767 |
| 23 | 12 | 8200 | 20 | 7050 | 15 | 7120 | 17 | 5962 | 17 | 8200 | 14 | 7300 | 13 | 7550 | 10 | 8675 | 24 | 6683 | 40 | 5263 | 7 | 12907 | 54 | 3333 |
| 24 | 12 | 7600 | 19 | 6651 | 15 | 5682 | 19 | 5221 | 16 | 7500 | 15 | 7400 | 13 | 7634 | 10 | 8459 | 22 | 7694 | 612 | 2127 | 7 | 14125 | 42 | 3809 |
| 25 | 12 | 7500 | 19 | 6400 | 15 | 5289 | 21 | 4505 | 17 | 7100 | 15 | 7400 | 14 | 7390 | 11 | 8013 | 21 | 7725 | 230 | 2203 | 7 | 14450 | 60 | 3718 |
| 26 | 12 | 7413 | 19 | 6400 | 15 | 5098 | 25 | 3910 | 17 | 9500 | 14 | 7400 | 579 | 3893 | 9 | 7859 | 20 | 8806 | 54 | 4425 | 7 | 14500 | 47 | 3387 |
| 27 | 12 | 7373 | 19 | 6412 | 15 | 5483 | 19 | 4251 | 14 | 12000 | 14 | 7449 | 4471 | 2055 | 9 | 8867 | 19 | 9407 | 38 | 5716 | 7 | 14500 | 38 | 3971 |
| 28 | 13 | 6876 | 18 | 6554 | 15 | 10839 | 17 | 4872 | 12 | 12000 | 13 | 7850 | 223 | 1900 | 9 | 3702 | 19 | 9551 | 33 | 6800 | 6 | 15448 | 35 | 4422 |
| 29 | 13 | 7832 | 18 | 6600 | 15 | 7769 | 15 | 5061 | -- | -- | 14 | 8582 | 114 | 4800 | 8 | 8502 | 18 | 9200 | 32 | 7300 | 6 | 16060 | 31 | 4800 |
| 30 | 14 | 6313 | 19 | 6615 | 15 | 6155 | 14 | 5763 | -- | -- | 14 | 8050 | 79 | 6200 | 8 | 8624 | 17 | 9211 | 27 | 7400 | 6 | 16770 | 29 | 5000 |
| 31 | 15 | 7688 | -- | -- | 15 | 4865 | 14 | 6000 | -- | -- | 14 | 7388 | -- | -- | 7 | 9354 | -- | -- | 20 | 6700 | 6 | 17500 | -- | -- |
| Avg | 13 | 7930 | 21 | 6490 | 16 | 6657 | 19 | 5862 | 15 | 7248 | 15 | 7074 | 195 | 2694 | 21 | 7887 | 125 | 3277 | 42 | 4634 | 101 | 2519 | 105 | 2657 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 753

**Location** : Elm Fork near Carl, Oklahoma

**Water Year** : 1961

**Basin** : Red River

**Tributary to:** North Fork of the Red River

**Remarks** : Records fair. Stratification nil.

**Equations Used to Compute Constituents**

Chlorides: Log Cl = 1.2762 Log Sp.C. -1.6867

Sulfates : Log $SO_4$ = 0.2809 Log Sp.C. +2.0156

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 16 | 24838 | 74 | 10113 | 44 | 12726 | 47 | 11897 | 37 | 11801 | 30 | 12563 | 72 | 8926 | 43 | 13513 | 21 | 17463 | 14 | 17751 | 12 | 22730 | 9 | 48092 |
| 2 | 16 | 25969 | 70 | 9638 | 44 | 13056 | 43 | 14949 | 33 | 8965 | 30 | 13822 | 68 | 10100 | 43 | 18317 | 35 | 12610 | 14 | 18013 | 11 | 24392 | 9 | 51703 |
| 3 | 16 | 27125 | 69 | 9725 | 44 | 13500 | 40 | 13487 | 33 | 8875 | 30 | 14207 | 63 | 10199 | 44 | 10942 | 706 | 4612 | 14 | 18727 | 11 | 24208 | 9 | 48821 |
| 4 | 16 | 31010 | 70 | 9784 | 44 | 13500 | 39 | 13260 | 34 | 10892 | 29 | 13766 | 60 | 11101 | 47 | 15069 | 107 | 2500 | 14 | 18867 | 11 | 27136 | 11 | 56890 |
| 5 | 16 | 33000 | 72 | 9562 | 44 | 13500 | 41 | 12601 | 29 | 19298 | 29 | 14225 | 60 | 12213 | 49 | 12783 | 95 | 9500 | 13 | 19149 | 10 | 29512 | 11 | 35617 |
| 6 | 16 | 32003 | 70 | 10199 | 44 | 13380 | 41 | 12693 | 37 | 20125 | 29 | 14544 | 58 | 11551 | 41 | 12428 | 111 | 4200 | 12 | 22988 | 10 | 31650 | 11 | 36925 |
| 7 | 15 | 31006 | 69 | 10100 | 44 | 13008 | 41 | 12226 | 38 | 13503 | 29 | 14940 | 58 | 11200 | 36 | 13894 | 119 | 1870 | 12 | 22321 | 10 | 29316 | 11 | 43088 |
| 8 | 14 | 30003 | 72 | 10338 | 44 | 17000 | 40 | 11800 | 35 | 9728 | 29 | 14065 | 62 | 11419 | 34 | 11218 | 106 | 5076 | 12 | 20529 | 10 | 29360 | 12 | 32492 |
| 9 | 14 | 29000 | 72 | 9700 | 47 | 17000 | 39 | 12616 | 33 | 18000 | 29 | 14463 | 62 | 9495 | 32 | 12205 | 74 | 8793 | 13 | 24475 | 9 | 35272 | 12 | 29235 |
| 10 | 14 | 28000 | 70 | 10023 | 54 | 20000 | 41 | 13400 | 36 | 17500 | 29 | 14227 | 57 | 10483 | 29 | 15039 | 57 | 11554 | 14 | 15701 | 9 | 33959 | 11 | 34328 |
| 11 | 447 | 7000 | 70 | 10750 | 63 | 10000 | 41 | 13575 | 34 | 17000 | 30 | 13414 | 54 | 10515 | 28 | 15849 | 47 | 12368 | 13 | 16391 | 9 | 37248 | 11 | 33325 |
| 12 | 1210 | 2800 | 70 | 11000 | 59 | 9000 | 41 | 13525 | 33 | 16500 | 30 | 13553 | 52 | 8651 | 28 | 16000 | 40 | 12158 | 13 | 22246 | 10 | 35527 | 11 | 40050 |
| 13 | 144 | 1900 | 70 | 10775 | 54 | 10500 | 41 | 13575 | 29 | 16000 | 29 | 12884 | 51 | 9057 | 27 | 16500 | 35 | 12402 | 12 | 18860 | 16 | 14453 | 11 | 37975 |
| 14 | 85 | 1454 | 70 | 11225 | 53 | 11000 | 40 | 13550 | 28 | 15000 | 28 | 15225 | 51 | 10756 | 27 | 17000 | 33 | 12800 | 12 | 21742 | 12 | 24462 | 11 | 30359 |
| 15 | 106 | 1579 | 70 | 11944 | 54 | 11601 | 40 | 13403 | 28 | 14280 | 28 | 15913 | 51 | 11702 | 27 | 17500 | 32 | 13000 | 11 | 23580 | 12 | 23044 | 12 | 31412 |
| 16 | 105 | 1562 | 68 | 10421 | 52 | 11323 | 37 | 13526 | 30 | 14151 | 32 | 15749 | 49 | 9460 | 28 | 18000 | 32 | 13200 | 11 | 19259 | 12 | 22954 | 12 | 32528 |
| 17 | 468 | 1991 | 66 | 9999 | 51 | 11049 | 37 | 11776 | 29 | 12688 | 72 | 8618 | 49 | 10538 | 28 | 18150 | 32 | 13500 | 11 | 16430 | 11 | 25056 | 11 | 33978 |
| 18 | 1700 | 2407 | 64 | 10250 | 49 | 11280 | 35 | 10671 | 30 | 12922 | 88 | 1851 | 49 | 13037 | 29 | 16394 | 29 | 14000 | 9 | 21776 | 11 | 29388 | 11 | 32581 |
| 19 | 347 | 3483 | 62 | 10574 | 48 | 11420 | 34 | 9918 | 29 | 13150 | 71 | 2494 | 49 | 14349 | 36 | 14545 | 27 | 14500 | 9 | 26116 | 11 | 30524 | 11 | 35228 |
| 20 | 149 | 4600 | 58 | 10774 | 48 | 11546 | 34 | 13627 | 32 | 13496 | 73 | 4200 | 48 | 20000 | 33 | 12481 | 25 | 15000 | 8 | 26558 | 12 | 28663 | 13 | 31525 |
| 21 | 112 | 5000 | 56 | 11398 | 45 | 12108 | 34 | 14264 | 41 | 12787 | 68 | 5000 | 46 | 17000 | 28 | 15294 | 23 | 15929 | 58 | 9510 | 12 | 20213 | 11 | 24326 |
| 22 | 109 | 5200 | 54 | 11817 | 48 | 11811 | 37 | 16629 | 42 | 11078 | 62 | 7938 | 46 | 16000 | 25 | 16589 | 21 | 18394 | 291 | 4047 | 12 | 27191 | 11 | 32413 |
| 23 | 105 | 5600 | 52 | 11100 | 47 | 12349 | 38 | 13152 | 37 | 12142 | 58 | 7149 | 46 | 14000 | 23 | 17325 | 19 | 16768 | 42 | 5219 | 11 | 30706 | 11 | 38102 |
| 24 | 92 | 5600 | 51 | 11315 | 46 | 12415 | 38 | 13502 | 35 | 12847 | 57 | 7267 | 44 | 13000 | 23 | 16298 | 19 | 16467 | 21 | 10646 | 11 | 32681 | 10 | 35277 |
| 25 | 106 | 5700 | 51 | 11900 | 43 | 12689 | 31 | 33138 | 32 | 12055 | 58 | 7303 | 41 | 12500 | 26 | 18983 | 19 | 16671 | 18 | 15895 | 11 | 28811 | 10 | 33709 |
| 26 | 88 | 6786 | 49 | 11900 | 41 | 10662 | 32 | 29696 | 33 | 12023 | 56 | 7556 | 41 | 13194 | 25 | 15342 | 19 | 14723 | 16 | 16779 | 10 | 31215 | 11 | 29628 |
| 27 | 88 | 7388 | 50 | 11900 | 41 | 10850 | 32 | 37058 | 32 | 12251 | 53 | 8214 | 43 | 13019 | 24 | 14138 | 17 | 15101 | 16 | 19969 | 10 | 33888 | 11 | 34388 |
| 28 | 88 | 7575 | 48 | 12000 | 41 | 12025 | 33 | 14927 | 30 | 12917 | 54 | 9752 | 43 | 12721 | 24 | 14200 | 17 | 15051 | 13 | 21960 | 10 | 33367 | 11 | 32758 |
| 29 | 87 | 8572 | 45 | 12120 | 41 | 12669 | 30 | 16070 | -- | -- | 56 | 12100 | 43 | 12775 | 24 | 14660 | 16 | 16976 | 12 | 20821 | 10 | 37257 | 12 | 26338 |
| 30 | 80 | 9114 | 46 | 12876 | 42 | 13396 | 34 | 16242 | -- | -- | 65 | 11347 | 43 | 13244 | 23 | 16130 | 15 | 17784 | 12 | 22500 | 10 | 40076 | 12 | 36007 |
| 31 | 75 | 9497 | -- | -- | 48 | 13149 | 41 | 14516 | -- | -- | 73 | 9321 | -- | -- | 22 | 17307 | -- | -- | 12 | 22940 | 9 | 43727 | -- | -- |
| Mean | 192 | 4229 | 63 | 10732 | 47 | 12508 | 38 | 15224 | 33 | 13596 | 46 | 9427 | 52 | 11870 | 31 | 15036 | 65 | 7789 | 24 | 11994 | 11 | 28999 | 11 | 35642 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 753

Location : Elm Fork near Carl, Oklahoma

Water Year : 1962

Basin : Red River

Tributary to: North Fork of the Red River

Remarks : Records fair.

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.2762 Log Sp.C. -1.6867

Sulfates : Log $SO_4$ = 0.2809 Log Sp.C. +2.0156

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 12 | 32654 | 40 | 11146 | 18 | 20166 | 15 | 15167 | 14 | 20263 | 13 | 24452 | 14 | 19750 | 60 | 12860 | 32 | 29721 | 16 | 19385 | 2468 | 2351 | 6 | 36000 |
| 2 | 12 | 28778 | 60 | 7460 | 18 | 20125 | 15 | 19718 | 14 | 20058 | 16 | 17405 | 14 | 20560 | 50 | 13826 | 29 | 21088 | 14 | 19864 | 130 | 3504 | 7 | 39500 |
| 3 | 12 | 27164 | 28 | 10974 | 18 | 21025 | 15 | 17400 | 14 | 18213 | 19 | 19083 | 15 | 20214 | 42 | 14710 | 27 | 19658 | 14 | 22037 | 64 | 6246 | 8 | 38000 |
| 4 | 12 | 27985 | 21 | 15649 | 18 | 20562 | 16 | 20500 | 14 | 18275 | 18 | 25989 | 16 | 20614 | 37 | 14640 | 13 | 20378 | 13 | 24471 | 52 | 9002 | 8 | 36000 |
| 5 | 12 | 28150 | 17 | 16440 | 20 | 20802 | 21 | 20000 | 14 | 13575 | 17 | 21655 | 18 | 27069 | 34 | 14060 | 53 | 16418 | 14 | 30469 | 37 | 10913 | 8 | 35000 |
| 6 | 12 | 30081 | 17 | 18308 | 20 | 21078 | 28 | 22000 | 14 | 20367 | 17 | 20089 | 21 | 22922 | 27 | 15204 | 25 | 15904 | 17 | 28534 | 29 | 10441 | 8 | 34000 |
| 7 | 12 | 27194 | 16 | 21393 | 19 | 18216 | 25 | 16000 | 15 | 21196 | 18 | 21390 | 20 | 20198 | 26 | 17180 | 14 | 18757 | 11 | 24036 | 24 | 11904 | 8 | 33000 |
| 8 | 12 | 29048 | 16 | 23163 | 20 | 19873 | 18 | 16500 | 15 | 17375 | 18 | 20609 | 18 | 17147 | 25 | 17865 | 16 | 24076 | 10 | 27130 | 22 | 13116 | 39 | 18087 |
| 9 | 17 | 26211 | 16 | 23385 | 21 | 19170 | 17 | 33000 | 15 | 17000 | 18 | 17298 | 18 | 19529 | 21 | 18619 | 127 | 11562 | 9 | 28605 | 20 | 14395 | 38 | 8110 |
| 10 | 15 | 24315 | 16 | 21997 | 20 | 16278 | 17 | 40000 | 15 | 19214 | 16 | 19550 | 18 | 21231 | 20 | 18520 | 73 | 7386 | 9 | 29628 | 18 | 16348 | 15 | 15679 |
| 11 | 12 | 28893 | 16 | 21594 | 19 | 22398 | 17 | 40000 | 15 | 18332 | 14 | 20432 | 18 | 20734 | 18 | 19111 | 23 | 16661 | 10 | 30746 | 16 | 18206 | 11 | 18950 |
| 12 | 12 | 26489 | 16 | 21321 | 15 | 30000 | 16 | 39000 | 16 | 19375 | 14 | 19271 | 17 | 22222 | 16 | 17089 | 14 | 19192 | 11 | 28998 | 15 | 20909 | 10 | 22000 |
| 13 | 13 | 26912 | 16 | 19454 | 13 | 28000 | 18 | 23000 | 16 | 18349 | 14 | 21500 | 16 | 18626 | 14 | 18924 | 10 | 19585 | 9 | 22536 | 16 | 25197 | 9 | 24000 |
| 14 | 12 | 22996 | 18 | 25760 | 12 | 17000 | 23 | 16000 | 16 | 18250 | 14 | 20500 | 15 | 19187 | 12 | 20986 | 8 | 20203 | 7 | 34371 | 16 | 21301 | 8 | 25000 |
| 15 | 12 | 24190 | 25 | 19373 | 11 | 15000 | 20 | 15000 | 16 | 19963 | 14 | 20000 | 14 | 20979 | 12 | 21643 | 2642 | 5100 | 6 | 37452 | 14 | 22120 | 14 | 30000 |
| 16 | 12 | 23548 | 25 | 14777 | 13 | 17000 | 19 | 13908 | 16 | 18000 | 14 | 24000 | 14 | 22713 | 15 | 21365 | 174 | 5420 | 6 | 40309 | 55 | 9793 | 73 | 15000 |
| 17 | 12 | 26728 | 24 | 18469 | 17 | 19500 | 19 | 17092 | 16 | 20250 | 14 | 24500 | 14 | 24208 | 36 | 25068 | 82 | 6660 | 6 | 39764 | 19 | 5653 | 611 | 6000 |
| 18 | 12 | 27435 | 21 | 21379 | 17 | 18500 | 17 | 17619 | 16 | 20625 | 14 | 33000 | 14 | 21755 | 34 | 16433 | 37 | 8403 | 6 | 39663 | 11 | 13061 | 67 | 7300 |
| 19 | 12 | 28650 | 21 | 22144 | 17 | 17000 | 18 | 27513 | 16 | 21876 | 14 | 28000 | 14 | 22523 | 18 | 17049 | 55 | 9477 | 6 | 40488 | 9 | 19387 | 44 | 8730 |
| 20 | 12 | 32487 | 21 | 21750 | 16 | 19854 | 23 | 28416 | 17 | 28000 | 14 | 30000 | 13 | 23818 | 14 | 17537 | 44 | 11081 | 6 | 46000 | 8 | 26264 | 1610 | 2980 |
| 21 | 12 | 21131 | 21 | 22641 | 15 | 19697 | 20 | 23389 | 17 | 32000 | 14 | 27169 | 13 | 24438 | 13 | 17996 | 34 | 12035 | 7 | 39388 | 8 | 28530 | 150 | 2830 |
| 22 | 12 | 21334 | 21 | 22351 | 15 | 16994 | 17 | 21056 | 16 | 24000 | 14 | 20456 | 13 | 25125 | 14 | 19396 | 28 | 12923 | 10 | 24093 | 7 | 26596 | 68 | 4860 |
| 23 | 12 | 22375 | 20 | 20404 | 15 | 16267 | 17 | 19812 | 17 | 20000 | 14 | 20052 | 13 | 24250 | 10 | 20252 | 24 | 14512 | 40 | 15351 | 7 | 25018 | 54 | 6115 |
| 24 | 12 | 23587 | 19 | 20766 | 15 | 18829 | 19 | 15308 | 16 | 19000 | 15 | 25461 | 13 | 26144 | 10 | 22076 | 22 | 15344 | 612 | 4000 | 7 | 29180 | 42 | 7669 |
| 25 | 12 | 23188 | 19 | 18600 | 15 | 19913 | 21 | 10699 | 17 | 20000 | 15 | 29569 | 14 | 24074 | 11 | 25182 | 21 | 15714 | 230 | 2700 | 7 | 31065 | 60 | 8691 |
| 26 | 12 | 21629 | 19 | 19425 | 15 | 18952 | 25 | 9341 | 17 | 16500 | 14 | 26038 | 579 | 6129 | 9 | 23[illegible]4 | 20 | 17383 | 54 | 9000 | 7 | 25948 | 47 | 8200 |
| 27 | 12 | 21712 | 19 | 20556 | 15 | 19687 | 19 | 10121 | 14 | 25000 | 14 | 27002 | 4471 | 2249 | 9 | 23546 | 19 | 18215 | 38 | 17000 | 7 | 27830 | 38 | 9000 |
| 28 | 13 | 15309 | 18 | 21615 | 15 | 19745 | 17 | 12909 | 12 | 26116 | 13 | 22446 | 223 | 4572 | 9 | 25526 | 19 | 17000 | 33 | 20352 | 6 | 30000 | 35 | 11000 |
| 29 | 13 | 17768 | 18 | 18724 | 15 | 22339 | 15 | 14324 | -- | -- | 14 | 23988 | 114 | 6931 | 8 | 21104 | 18 | 17407 | 32 | 20583 | 6 | 32000 | 31 | 13000 |
| 30 | 14 | 24876 | 19 | 19769 | 15 | 20821 | 14 | 17468 | -- | -- | 14 | 23563 | 79 | 10111 | 8 | 21142 | 17 | 19792 | 27 | 18694 | 6 | 33000 | 29 | 13000 |
| 31 | 15 | 23455 | -- | -- | 15 | 13867 | 14 | 19750 | -- | -- | 14 | 20846 | -- | -- | 7 | 24195 | -- | -- | 20 | 17189 | 6 | 35000 | -- | -- |
| Mean | 13 | 25311 | 21 | 18136 | 16 | 19670 | 19 | 20134 | 15 | 20433 | 15 | 22918 | 195 | 4215 | 21 | 17619 | 125 | [illegible]72 | 42 | 10026 | 101 | 4478 | 105 | 5911 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 753
**Location:** Elm Fork of North Fork Red River near Carl, Oklahoma
**Water Year:** 1963

**Basin:** Red River
**Tributary to:** Red River
**Remarks:**

Equations Used to Compute Constituents:
Chlorides: Log Cl = 1.26407 Log Sp.C. - 1.61783
Sulfates: Log $SO_4$ = 0.21096 Log Sp.C. + 2.31115

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho |
| 1 | 26 | 12800 | 22 | 19500 | 25 | 18000 | 24 | 12000 | 22 | 14500 | 21 | 20000 | 22 | 22000 | 12 | 30000 | 452 | 2120 | 1.4 | 26000 | 0.7 | 105000 | 35 | 12000 |
| 2 | 26 | 12800 | 22 | 19200 | 34 | 17500 | 23 | 12800 | 22 | 14500 | 22 | 18000 | 21 | 17200 | 13 | 29000 | 192 | 3930 | 1.1 | 30000 | .2 | 115000 | 20 | 26000 |
| 3 | 25 | 14000 | 22 | 18000 | 41 | 12300 | 24 | 13000 | 20 | 14500 | 20 | 16000 | 18 | 18500 | 13 | 28500 | 527 | 2200 | 1.1 | 33000 | .1 | 120000 | 11 | 38000 |
| 4 | 24 | 13500 | 22 | 18500 | 30 | 15000 | 26 | 17000 | 22 | 13000 | 21 | 19000 | 17 | 21000 | 12 | 28500 | 82 | 3470 | .9 | 35000 | .1 | 115000 | 8.2 | 35000 |
| 5 | 29 | 17200 | 22 | 17800 | 25 | 15800 | 25 | 16200 | 25 | 14000 | 20 | 18200 | 21 | 26000 | 14 | 34000 | 267 | 3100 | .5 | 42000 | .3 | 100000 | 7.4 | 40000 |
| 6 | 33 | 16000 | 22 | 20000 | 24 | 17200 | 23 | 17500 | 25 | 15200 | 19 | 17500 | 23 | 18000 | 14 | 26000 | 56 | 4500 | .5 | 40000 | .5 | 125000 | 6.7 | 41000 |
| 7 | 25 | 15000 | 22 | 17800 | 24 | 16800 | 23 | 17800 | 23 | 16000 | 20 | 16800 | 22 | 18500 | 14 | 26000 | 28 | 8200 | .5 | 42000 | .7 | 163000 | 3.1 | 54000 |
| 8 | 23 | 15500 | 22 | 17000 | 24 | 16200 | 22 | 17300 | 22 | 14300 | 19 | 16200 | 19 | 20500 | 12 | 31000 | 140 | 3650 | .7 | 46000 | 2.3 | 135000 | 2.3 | 57000 |
| 9 | 22 | 15800 | 22 | 18000 | 23 | 14000 | 22 | 18000 | 22 | 14800 | 18 | 16000 | 18 | 20500 | 11 | 32000 | 76 | 6000 | .5 | 43000 | 2.3 | 115000 | 2.3 | 57000 |
| 10 | 23 | 15500 | 22 | 20500 | 23 | 13800 | 22 | 17000 | 29 | 19000 | 22 | 20500 | 16 | 21500 | 9.7 | 35000 | 37 | 17000 | .4 | 52000 | 5.3 | 92000 | 2.7 | 60000 |
| 11 | 22 | 14300 | 23 | 18000 | 25 | 18000 | 15 | 45000 | 25 | 20000 | 22 | 18200 | 16 | 23000 | 8.7 | 38000 | 26 | 31000 | .4 | 54000 | 2.3 | 94000 | 3.6 | 58000 |
| 12 | 20 | 16000 | 22 | 16300 | 23 | 16800 | 12 | 45000 | 23 | 18000 | 19 | 18000 | 16 | 22500 | 8.7 | 40000 | 132 | 10600 | 15 | 38000 | 1.7 | 100000 | 5.3 | 35000 |
| 13 | 20 | 18500 | 22 | 17000 | 23 | 16200 | 12 | 36000 | 23 | 18000 | 18 | 19000 | 14 | 23000 | 8.7 | 34500 | 70 | 13500 | 7.4 | 39000 | 11 | 82000 | 6.7 | 30000 |
| 14 | 18 | 17200 | 22 | 18500 | 25 | 17000 | 14 | 33000 | 24 | 16500 | 18 | 19000 | 14 | 23000 | 7.9 | 39000 | 50 | 14000 | 6.7 | 35000 | 5.3 | 60000 | 6.7 | 38000 |
| 15 | 19 | 17500 | 23 | 17500 | 25 | 17500 | 14 | 24000 | 22 | 17500 | 18 | 18000 | 14 | 22000 | 7.9 | 42000 | 36 | 15000 | 6.7 | 27000 | 4.1 | 48000 | 15 | 25300 |
| 16 | 18 | 18000 | 24 | 18500 | 23 | 16500 | 15 | 20500 | 28 | 20000 | 17 | 20000 | 13 | 21000 | 8.7 | 40000 | 30 | 17000 | 4.7 | 32000 | 2.0 | 75000 | 463 | 4350 |
| 17 | 21 | 20000 | 29 | 18500 | 22 | 15000 | 15 | 16000 | 29 | 16300 | 17 | 19000 | 14 | 25000 | 8.7 | 28000 | 24 | 18000 | 3.1 | 52000 | 1.1 | 55000 | 48 | 13000 |
| 18 | 24 | 17500 | 33 | 15200 | 22 | 15200 | 16 | 13000 | 26 | 16000 | 16 | 21000 | 14 | 28000 | 7.1 | 37000 | 20 | 19000 | 3.1 | 61000 | 2.7 | 45000 | 30 | 15000 |
| 19 | 36 | 16900 | 30 | 15800 | 22 | 17800 | 14 | 20000 | 25 | 14000 | 18 | 18000 | 13 | 22000 | 7.1 | 37000 | 19 | 19000 | 2.7 | 60000 | 4.1 | 43000 | 16 | 18000 |
| 20 | 112 | 10100 | 28 | 17500 | 22 | 17800 | 15 | 22000 | 22 | 16000 | 17 | 18000 | 12 | 23000 | 7.1 | 38000 | 14 | 17000 | 2.7 | 63000 | 6.0 | 32000 | 12 | 18500 |
| 21 | 34 | 13500 | 28 | 18500 | 22 | 18500 | 16 | 16500 | 21 | 16500 | 18 | 19000 | 12 | 24500 | 7.9 | 37000 | 11 | 19000 | 2.0 | 58000 | 2.7 | 50000 | 10 | 21000 |
| 22 | 24 | 17000 | 26 | 16500 | 22 | 19800 | 16 | 15000 | 20 | 19500 | 18 | 18000 | 11 | 28000 | 8.3 | 34000 | 12 | 20000 | 1.1 | 62000 | 1.4 | 66000 | 9 | 21000 |
| 23 | 22 | 17000 | 25 | 14500 | 21 | 21000 | 15 | 15500 | 22 | 16500 | 17 | 20000 | 11 | 28000 | 8.7 | 32000 | 11 | 23000 | .4 | 70000 | .7 | 86000 | 8 | 25000 |
| 24 | 20 | 16500 | 24 | 18000 | 19 | 21500 | 16 | 15500 | 22 | 17000 | 17 | 21000 | 17 | 31300 | 9.7 | 33000 | 7.4 | 18000 | .4 | 75000 | 2.3 | 104000 | 8 | 36000 |
| 25 | 19 | 17000 | 24 | 14300 | 19 | 22500 | 17 | 16500 | 22 | 18200 | 17 | 19000 | 15 | 20500 | 9.7 | 30000 | 5.3 | 19000 | .4 | 77000 | 8.4 | 51500 | 7.4 | 35000 |
| 26 | 19 | 18000 | 72 | 10800 | 17 | 22800 | 18 | 17500 | 22 | 18500 | 16 | 19000 | 14 | 25000 | 8.7 | 32000 | 5.3 | 19500 | .2 | 86000 | 8.5 | 21300 | 7 | 32000 |
| 27 | 21 | 17000 | 62 | 9000 | 18 | 20000 | 16 | 19000 | 21 | 19000 | 16 | 18000 | 14 | 27000 | 7.9 | 33000 | 4.1 | 27000 | .4 | 88000 | 12 | 25000 | 6.7 | 34000 |
| 28 | 24 | 18000 | 34 | 14800 | 31 | 13300 | 18 | 17500 | 21 | 19000 | 16 | 20000 | 14 | 25000 | 6.8 | 37000 | 3.1 | 26000 | .9 | 90000 | 4.1 | 48000 | 6.7 | 34000 |
| 29 | 22 | 17500 | 28 | 16300 | 26 | 15000 | 20 | 15200 | -- | -- | 17 | 19700 | 13 | 24000 | 11 | 32000 | 1.7 | 27000 | 2.3 | 92000 | 3.1 | 55000 | 6.7 | 36000 |
| 30 | 22 | 16000 | 25 | 16700 | 24 | 15200 | 18 | 16500 | -- | -- | 18 | 19500 | 12 | 26000 | 592 | 2750 | 1.4 | 22000 | 3.1 | 93000 | 4.7 | 46000 | 6.7 | 38000 |
| 31 | 21 | 19200 | -- | -- | 24 | 14800 | 22 | 17000 | -- | -- | 18 | 20000 | -- | -- | 388 | 110 | -- | -- | 2.3 | 93000 | 7.4 | 35000 | -- | -- |
| Mean | 26 | 15400 | 28 | 16100 | 24 | 16800 | 18 | 18800 | 23 | 16700 | 18 | 18700 | 16 | 22800 | 40.8 | 350 | 78.0 | 5850 | 2.4 | 47900 | 3.5 | 57100 | 26.0 | 12700 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 753
Location: Elm Fork of North Fork Red River Near Carl, Oklahoma
Water Year: 1964

Basin: Red River
Tributary to: Red River
Remarks:

Equations Used to Compute Constituents:
Chlorides: LOG Cl=1.27192 LOG SC-1.64507
Sulfates: LOG $SO_4$=0.32935 LOG SC + 01.81378

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho |
| 1 | 6.7 | 35000 | 11 | 35000 | 14 | 26000 | 15 | 21000 | 19 | 20000 | 15 | 23500 | 12 | 24200 | 8.2 | 31000 | 19 | 22000 | 10 | 32500 | 1.7 | 127000 | 0.1 | 210000 |
| 2 | 6.7 | 35000 | 9.8 | 29000 | 14 | 25500 | 14 | 22500 | 17 | 22300 | 15 | 23500 | 11 | 25300 | 6.7 | 30500 | 17 | 22000 | 8 | 36500 | 0.7 | 150000 | 0.1 | 210000 |
| 3 | 6.7 | 36000 | 9.8 | 32000 | 14 | 26000 | 13 | 19500 | 21 | 27200 | 15 | 23300 | 12 | 26200 | 6.0 | 30000 | 13 | 25000 | 7 | 37000 | 0.3 | 160000 | 0.1 | 215000 |
| 4 | 6.7 | 35000 | 11 | 30500 | 15 | 26000 | 13 | 21500 | 53 | 17300 | 15 | 23000 | 12 | 25900 | 5.3 | 31000 | 13 | 30500 | 6 | 42200 | 0.3 | 185000 | 0.1 | 215000 |
| 5 | 5.3 | 35000 | 11 | 30000 | 15 | 27500 | 13 | 22500 | 53 | 13100 | 15 | 21700 | 12 | 23800 | 5.3 | 41000 | 12 | 26500 | 4.4 | 44000 | 0.2 | 190000 | 0.3 | 215000 |
| 6 | 5.3 | 34000 | 11 | 29500 | 15 | 27000 | 13 | 20000 | 37 | 14500 | 14 | 21600 | 12 | 23500 | 465 | 5600 | 11 | 29500 | 3.8 | 49000 | 0.2 | 185000 | 0.4 | 215000 |
| 7 | 6.0 | 34000 | 11 | 31000 | 15 | 32000 | 13 | 22000 | 26 | 19800 | 13 | 23800 | 11 | 23500 | 51 | 6950 | 7.4 | 35500 | 3.6 | 54000 | 0.1 | 190000 | 0.2 | 215000 |
| 8 | 6.0 | 35000 | 11 | 36000 | 15 | 40000 | 13 | 20500 | 23 | 17000 | 14 | 25500 | 11 | 32500 | 19 | 6200 | 6.0 | 36000 | 3.6 | 54000 | 0.2 | 190000 | 0.4 | 215000 |
| 9 | 6.0 | 36000 | 11 | 30000 | 15 | 40000 | 8 | 28000 | 23 | 18200 | 14 | 24500 | 11 | 24000 | 14 | 5310 | 5.3 | 36500 | 3.6 | 61000 | 0.4 | 195000 | 0.4 | 215000 |
| 10 | 6.0 | 31000 | 11 | 24000 | 15 | 41000 | 9 | 28500 | 21 | 19500 | 14 | 22100 | 11 | 25000 | 697 | 4070 | 4.7 | 38000 | 3.6 | 68000 | 0.3 | 190000 | 0.3 | 215000 |
| 11 | 6.0 | 34000 | 11 | 27000 | 13 | 37000 | 8 | 23200 | 19 | 20500 | 14 | 21300 | 11 | 30000 | 265 | 2720 | 14 | 30700 | 3.4 | 71000 | 0.1 | 190000 | 0.3 | 215000 |
| 12 | 6.7 | 35000 | 9.0 | 28000 | 11 | 40000 | 7 | 42000 | 19 | 23500 | 14 | 23000 | 9.8 | 31000 | 43 | 5320 | 41 | 10800 | 3.0 | 73000 | 0.1 | 190000 | 0.4 | 210000 |
| 13 | 6.7 | 36000 | 9.0 | 38500 | 9 | 27000 | 6 | 35000 | 19 | 21500 | 14 | 24300 | 9.8 | 25500 | 28 | 8230 | 1500 | 3820 | 2.4 | 75000 | 0.1 | 190000 | 0.7 | 210000 |
| 14 | 7.4 | 40000 | 9.0 | 29000 | 6 | 17000 | 11 | 34000 | 20 | 21800 | 13 | 23000 | 12 | 25500 | 21 | 7000 | 1550 | 3050 | 2.0 | 76000 | 1.1 | 200000 | 0.5 | 210000 |
| 15 | 8.2 | 42000 | 9.8 | 28500 | 7 | 19000 | 10 | 29000 | 21 | 24000 | 13 | 26000 | 11 | 27500 | 19 | 10800 | 367 | 5200 | 2.0 | 76000 | 20 | 128000 | 49 | 72000 |
| 16 | 9.0 | 40000 | 9.8 | 29700 | 8 | 27000 | 12 | 27000 | 21 | 21000 | 13 | 25000 | 11 | 32500 | 17 | 11500 | 178 | 8550 | 2.2 | 83000 | 11 | 96000 | 154 | 18500 |
| 17 | 9.0 | 37000 | 9.8 | 29000 | 8.5 | 23000 | 14 | 22000 | 20 | 22800 | 13 | 23500 | 11 | 36000 | 14 | 18000 | 137 | 10700 | 2.3 | 88000 | 7.4 | 97000 | 17 | 32000 |
| 18 | 9.0 | 37000 | 11 | 27500 | 9 | 23000 | 17 | 19000 | 19 | 22800 | 13 | 28300 | 9.8 | 44800 | 13 | 18800 | 100 | 11500 | 1.7 | 88000 | 5.3 | 110000 | 8.2 | 53000 |
| 19 | 9.0 | 34500 | 23 | 30000 | 9.5 | 24000 | 19 | 12000 | 17 | 22500 | 20 | 25000 | 11 | 76000 | 11 | 19500 | 50 | 12500 | 1.1 | 95000 | 3.6 | 120000 | 3.1 | 71000 |
| 20 | 16 | 45500 | 20 | 20200 | 10 | 18500 | 21 | 17000 | 16 | 22800 | 17 | 18200 | 9.0 | 40000 | 9.8 | 18000 | 28 | 16000 | 0.9 | 103000 | 2.0 | 135000 | 20 | 43000 |
| 21 | 11 | 33000 | 20 | 26500 | 9 | 37000 | 20 | 18500 | 16 | 24200 | 16 | 20400 | 8.2 | 25000 | 9.0 | 24000 | 20 | 18700 | 0.7 | 105000 | 1.7 | 150000 | 4.1 | 68000 |
| 22 | 11 | 31500 | 19 | 26000 | 8 | 54000 | 16 | 18200 | 15 | 24000 | 14 | 22400 | 8.2 | 34000 | 9.0 | 24000 | 18 | 21000 | 0.7 | 125000 | 1.4 | 160000 | 4.1 | 75000 |
| 23 | 11 | 34000 | 14 | 26500 | 10 | 27500 | 15 | 19000 | 16 | 21000 | 14 | 23200 | 8.2 | 31500 | 8.2 | 25000 | 17 | 23000 | 0.7 | 130000 | 0.5 | 160000 | 3.6 | 74000 |
| 24 | 11 | 30500 | 14 | 28000 | 14 | 17000 | 14 | 19000 | 15 | 20500 | 14 | 24000 | 8.2 | 31500 | 8.2 | 28500 | 16 | 25000 | 0.5 | 122000 | 0.3 | 180000 | 3.6 | 72000 |
| 25 | 9.8 | 30000 | 14 | 28500 | 17 | 14000 | 13 | 23000 | 15 | 21800 | 12 | 26300 | 8.2 | 29000 | 7.4 | 27000 | 14 | 26000 | 0.3 | 130000 | 0.2 | 200000 | 6.0 | 70000 |
| 26 | 9.8 | 30500 | 14 | 27000 | 20 | 16000 | 16 | 21500 | 14 | 22300 | 12 | 25500 | 6.7 | 32000 | 6.7 | 27000 | 13 | 25200 | 0.2 | 150000 | 0.2 | 200000 | 5.3 | 68000 |
| 27 | 9.8 | 32000 | 14 | 27500 | 15 | 22000 | 16 | 20000 | 15 | 21300 | 12 | 26300 | 7.4 | 31500 | 26 | 40700 | 12 | 27200 | 2.0 | 170000 | 0.1 | 200000 | 7.4 | 76000 |
| 28 | 9.8 | 32000 | 14 | 27500 | 13 | 23000 | 15 | 20500 | 15 | 21000 | 12 | 26200 | 7.4 | 32000 | 35 | 23600 | 11 | 28500 | 0.4 | 180000 | 0.1 | 205000 | 4.7 | 80000 |
| 29 | 9.8 | 33000 | 13 | 28000 | 14 | 23000 | 15 | 21000 | 15 | 21800 | 12 | 26200 | 7.4 | 31800 | 26 | 28400 | 11 | 30800 | 0.5 | 180000 | 0.1 | 205000 | 4.7 | 76000 |
| 30 | 9.8 | 32500 | 13 | 27500 | 16 | 21500 | 19 | 26000 | -- | -- | 11 | 25300 | 8.2 | 32000 | 33 | 18000 | 11 | 32200 | 1.7 | 142000 | 0.2 | 210000 | 4.7 | 68000 |
| 31 | 9.8 | 32000 | -- | -- | 15 | 20000 | 21 | 23000 | -- | -- | 12 | 24300 | -- | -- | 23 | 18000 | -- | -- | 3.6 | 85000 | 0.1 | 210000 | -- | -- |
| Mean | 8.4 | 34900 | 13 | 28200 | 12 | 26900 | 14 | 22000 | 21 | 20100 | 14 | 23700 | 10 | 30500 | 62 | 7400 | 141 | 5930 | 2.8 | 63700 | 1.9 | 123000 | 10 | 42300 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 753

**Location :** Elm Fork of North Fork Red River near Carl, Oklahoma

**Water Year :** 1965

**Basin :** Red River

**Tributary to:** Red River

**Remarks :** *discharge measurement made on this day

**Equations Used to Compute Constituents**

Chlorides: Log Cl = 1.22916 Log Sp.C. -1.43934

Sulfates : Log $SO_4$ = .23475 Log Sp.C. +2.22941

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 5.3 | 69500 | 8.2 | 41500 | 19 | 30100 | 14 | 29600 | 13 | 30800 | 16 | 37000 | 14 | 29100 | 7.4 | 36100 | 2.7 | 79100 | 24 | 18200 | 2.7 | 61300 | 5.3 | 99100 |
| 2 | 5.3 | 65000 | 8.2 | 43500 | 20 | 28400 | 14 | 27800 | 11 | 37900 | 14 | 33200 | 15 | 29100 | 8.2 | 34400 | 291 | 24300 | 21 | 17100 | 2.3 | 75100 | 3.6 | 101000 |
| 3 | 6.0 | 63000 | 8.2 | 40900 | 20 | 29200 | 11 | 24500 | 12 | 27900 | 17 | 26700 | 15 | 28200 | 7.4 | 37400 | 466 | *8740 | 19 | 20300 | 2.3 | 69300 | 3.6 | 109000 |
| 4 | 4.7 | 68500 | 9.0 | 46000 | 9.0 | 43700 | 11 | 25400 | 13 | 22800 | 16 | 27800 | 13 | 30800 | 6.7 | 41500 | 3660 | 2000 | 16 | 19300 | 1.7 | 71000 | 2.7 | 119000 |
| 5 | 4.7 | 77500 | 16 | 43000 | 15 | 29400 | 12 | 28800 | 14 | 24500 | 16 | 24200 | 14 | 30700 | 6.0 | 41900 | 1930 | 2530 | 15 | 19300 | 1.1 | 79900 | 32 | 110000 |
| 6 | 4.7 | 86300 | *15 | 45300 | 16 | 26800 | 12 | 30200 | 13 | 28800 | 15 | 24000 | 13 | 28500 | 5.3 | 46400 | 100 | 5300 | 13 | 20500 | 1.1 | 98900 | 644 | 18800 |
| 7 | 4.7 | 87400 | 13 | 33100 | 12 | 27100 | 9.8 | 24900 | 13 | 25800 | 13 | 26200 | 16 | 31700 | 4.1 | 53800 | 60 | 7930 | 11 | 21600 | 2.3 | 100000 | 69 | 13300 |
| 8 | 5.3 | 77300 | 9.8 | 34800 | 11 | 28700 | 12 | 25600 | *13 | 28200 | 13 | 26200 | 16 | 31000 | 3.6 | 46700 | 50 | 10400 | 9.8 | 26900 | 1.7 | 93300 | 33 | 27200 |
| 9 | 5.3 | 85600 | 9.0 | 35300 | 13 | 25200 | 13 | 30400 | 17 | 32000 | *13 | 26300 | 26 | 29600 | 3.1 | 46000 | *46 | 12900 | 9.0 | 27600 | 3.8 | 77400 | 23 | 36700 |
| 10 | 5.3 | 91000 | 9.0 | 37800 | 28 | 25000 | 15 | 30700 | 16 | 26300 | 13 | 27100 | 50 | 11500 | 8.2 | 58500 | 39 | 14000 | 8.2 | 29300 | 3.1 | 74000 | 19 | 41100 |
| 11 | 6.0 | 89500 | 8.2 | 39800 | *26 | 18600 | 15 | 25900 | 15 | 27000 | 14 | 30800 | 14 | 24000 | 7.4 | 40900 | 41 | 16800 | 6.7 | 28000 | *2.3 | 87000 | 16 | 48300 |
| 12 | 6.7 | 73400 | 7.4 | 36800 | 16 | 22600 | *15 | 24400 | 12 | 34800 | 19 | 29400 | 11 | 24000 | 6.7 | 31000 | 35 | 14900 | 6.0 | 29500 | 2.7 | 108000 | 15 | 50800 |
| 13 | 6.0 | 60300 | 7.4 | 37000 | 13 | 25000 | 14 | 23500 | 14 | 23600 | 20 | 23400 | 9.8 | 31000 | 9.0 | 39600 | 505 | 13200 | 6.0 | 33100 | 2.3 | 117000 | 14 | 54500 |
| 14 | 6.0 | 56500 | 8.2 | 37900 | 11 | 28700 | 13 | 22400 | 13 | 27600 | 17 | 22300 | *682 | 16700 | 9.8 | 36900 | 94 | 5160 | 6.0 | 36600 | 2.3 | 126000 | 12 | 66500 |
| 15 | 6.0 | 56100 | 124 | 2620 | 11 | 27600 | 13 | 26200 | 13 | 24800 | 16 | 23000 | * 62 | 13700 | 8.2 | 33300 | 639 | 3890 | *6.0 | 41600 | 5.3 | 116000 | 11 | 73600 |
| 16 | 5.3 | 56300 | 229 | 7610 | 14 | 25400 | 13 | 26400 | 12 | 31200 | 15 | 28400 | 14 | 15800 | 7.4 | 38200 | *224 | 4120 | 6.0 | 40700 | 8.2 | 60800 | 9.0 | 71500 |
| 17 | 5.3 | 59300 | 291 | 4300 | 11 | 42400 | 12 | 30100 | 15 | 24800 | 16 | 25100 | 11 | 17500 | 6.0 | 45400 | 63 | 6980 | 5.3 | 42900 | 6.0 | 65900 | 9.8 | 70000 |
| 18 | 4.1 | 53100 | 88 | 9720 | 12 | 44700 | 13 | 26000 | 14 | 24900 | 14 | 28300 | 9.8 | 18800 | 5.3 | 47700 | 41 | 8680 | 4.7 | 42800 | 4.7 | 74400 | 19 | 59000 |
| 19 | 3.6 | 58900 | 33 | 14300 | 15 | 32700 | 13 | 27600 | 14 | 24400 | 14 | 28400 | 9.0 | 22000 | 11 | 46800 | 29 | 10000 | 3.1 | 45900 | 5.3 | 79200 | 209 | 12200 |
| 20 | 4.1 | 66600 | 20 | 19400 | 20 | 25200 | 13 | 26600 | 13 | 26300 | 13 | 27800 | 8.2 | 27000 | *8.2 | 54500 | 21 | 11000 | 2.7 | 53700 | 5.3 | 74300 | 556 | 9730 |
| 21 | 4.7 | 64100 | 15 | 21000 | *23 | 18500 | 13 | 27100 | 13 | 26300 | 15 | 25700 | 8.2 | 31100 | 5.3 | 60700 | 17 | 12700 | 2.3 | 59800 | 3.6 | 87000 | 620 | 3450 |
| 22 | 4.7 | 60600 | 14 | 21700 | 15 | 24400 | 13 | 28400 | 12 | 33400 | 15 | 28400 | 7.4 | 33800 | 4.7 | 69000 | 15 | 15200 | 1.7 | 64600 | 3.1 | 88400 | 54 | 7760 |
| 23 | 4.7 | 58100 | 15 | 22200 | 12 | 27100 | 13 | 27600 | *8.2 | 38700 | *14 | 27100 | 6.0 | 36800 | 4.7 | 73000 | 16 | 12800 | 1.4 | 70000 | 3.1 | 86300 | 29 | 18700 |
| 24 | 9.0 | 60900 | 16 | 26100 | 11 | 26700 | 12 | 30600 | 9.0 | 68100 | 14 | 29000 | 6.7 | 39900 | 5.3 | 72900 | 11 | 17000 | 1.4 | 76300 | 55 | 24400 | *21 | 23000 |
| 25 | 92 | 22100 | *16 | 28500 | 9.8 | 26800 | *12 | 28400 | 13 | 42300 | 14 | 30100 | 6.7 | 39100 | 4.1 | 72100 | 215 | 11100 | 1.4 | 80800 | 9.0 | 34500 | 20 | 24000 |
| 26 | 46 | 18200 | 17 | 27000 | 9.0 | 26800 | 12 | 26600 | 16 | 21600 | 14 | 29600 | 12 | 28600 | 33 | 29700 | 254 | 4060 | 1.4 | 92800 | 3.1 | 73300 | 19 | 25000 |
| 27 | 19 | 35500 | 19 | 29200 | 9.0 | 24500 | 11 | 26100 | 14 | 25400 | 15 | 27500 | *11 | 29700 | 12 | 24000 | 77 | 6910 | 1.4 | 86600 | 2.0 | 94000 | 17 | 26400 |
| 28 | 13 | 60400 | 20 | 28400 | 9.0 | 27400 | 12 | 30400 | 13 | 29000 | 14 | 28300 | 11 | 30100 | 7.4 | 51700 | 48 | 12700 | 23 | 40100 | 109 | 90000 | 15 | 29500 |
| 29 | 12 | 73200 | 20 | 26800 | 9.0 | 27900 | 12 | 33000 | -- | -- | 15 | 27000 | 9.0 | 31300 | 5.3 | 70300 | 37 | 17100 | 9.0 | 38000 | 23 | 84500 | 15 | 29700 |
| 30 | 9.8 | 45000 | 19 | 28800 | 9.0 | 27000 | 13 | 27300 | -- | -- | 14 | 28200 | 8.2 | 35000 | 4.7 | 7440 | 29 | 18900 | 4.1 | 39900 | *6.0 | 83000 | 15 | 30300 |
| 31 | 8.2 | 43600 | -- | -- | 11 | 27400 | 13 | 30000 | -- | -- | 14 | 28600 | -- | -- | 3.6 | 7740 | -- | -- | 3.1 | 48600 | 6.0 | 91200 | -- | -- |
| Mean | 10.6 | 45000 | 36.4 | 13700 | 14.2 | 27300 | 12.7 | 27500 | 13.2 | 29200 | 14.9 | 27500 | 37.0 | 19700 | 7.39 | 44600 | 302 | 5070 | 8.02 | 29900 | 9.3 | 73200 | 84.4 | 16300 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 753

Location : Elm Fork of North Fork of Red River near Carl, Oklahoma

Water Year : 1966

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.13376 Log Sp. C. - 1.00727

Sulfates : $SO_4$ = 0.0126 Sp.C. +1384

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 13 | 28200 | 24 | 20800 | 26 | 18600 | 24 | 22000 | 4.5 | 25700 | 23 | 22400 | 16 | 27000 | 17 | 28800 | 8.2 | 49100 | 4.1 | 68400 | 2.0 | 84100 | 521 | 5460 |
| 2 | 13 | 29000 | 23 | 21700 | 26 | 21300 | 24 | 20800 | 4.0 | 22600 | 21 | 19600 | 16 | 26400 | 16 | 26500 | 9.8 | 45800 | 3.6 | 77500 | 1.6 | 101700 | 84 | 13900 |
| 3 | 13 | 30100 | 23 | 20000 | 20 | 20800 | 24 | 18300 | 3.5 | 19800 | 20 | 21300 | 15 | 26200 | 14 | 25500 | 8.2 | 50900 | 2.7 | 78500 | 1.4 | 127900 | 146 | 15700 |
| 4 | 14 | 31300 | 23 | 21600 | 19 | 23300 | 24 | 18300 | 3.0 | 18300 | 20 | 21500 | 15 | 28300 | 13 | 29100 | 6.0 | 67400 | 2.0 | 86000 | 1.7 | 137000 | 421 | 6210 |
| 5 | 17 | 32400 | 23 | 20700 | 17 | 23200 | 24 | 21400 | 6.7 | 15200 | 20 | 23000 | 15 | 24700 | 13 | 25700 | 4.0 | 75000 | 2.0 | 96000 | 0.9 | 147500 | 76 | 10900 |
| 6 | 16 | 29200 | 23 | 20200 | 19 | 22500 | 24 | 19000 | 28 | 14000 | 19 | 21600 | 15 | 22400 | 13 | 25300 | 3.0 | 88750 | 1.7 | 110600 | 0.7 | 157500 | 41 | 16600 |
| 7 | 14 | 30700 | 23 | 21100 | 19 | 21800 | 24 | 18800 | 28 | 17100 | 20 | 22100 | 15 | 22800 | 13 | 27500 | 2.3 | 97100 | 1.4 | 125500 | 4.1 | 145000 | 35 | 15200 |
| 8 | 12 | 34200 | 23 | 21800 | 19 | 21500 | 23 | 21100 | 29 | 17800 | 20 | 19500 | 15 | 24900 | 13 | 30400 | 2.3 | 104000 | 1.4 | 132500 | 2.0 | 117600 | 33 | 17400 |
| 9 | 11 | 35400 | 23 | 22600 | 20 | 23800 | 23 | 22000 | 26 | 19900 | 20 | 20700 | 15 | 28300 | 13 | 29200 | 2.0 | 111250 | 1.4 | 155000 | 8.3 | 54600 | 26 | 19500 |
| 10 | 9.8 | 34800 | 23 | 21900 | 21 | 24000 | 23 | 22900 | 21 | 21600 | 20 | 19900 | 15 | 27800 | 13 | 30900 | 2.0 | 116750 | 1.4 | 164000 | 12 | 29100 | 24 | 20000 |
| 11 | 9.0 | 34000 | 23 | 21600 | 21 | 22400 | 23 | 23800 | 21 | 21500 | 20 | 21300 | 15 | 27500 | 13 | 33500 | 2.3 | 122750 | 11 | 50400 | 6.0 | 54400 | 24 | 20100 |
| 12 | 9.0 | 36800 | 21 | 22100 | 17 | 22500 | 23 | 23000 | 20 | 20600 | 20 | 23500 | 15 | 25800 | 13 | 27500 | 2.3 | 121000 | 3.1 | 45900 | 2.0 | 69800 | 23 | 21100 |
| 13 | 9.0 | 37500 | 21 | 23400 | 17 | 22900 | 21 | 22900 | 20 | 21250 | 20 | 25500 | 17 | 24800 | 13 | 30800 | 2.3 | 114500 | 1.1 | 79800 | 5.6 | 46600 | 23 | 23200 |
| 14 | 9.8 | 35800 | 26 | 22600 | 17 | 22700 | 21 | 23800 | 20 | 25100 | 20 | 22600 | 16 | 26900 | 13 | 28500 | 2.3 | 118000 | 0.7 | 119500 | 12 | 23300 | 21 | 26100 |
| 15 | 9.8 | 34800 | 26 | 21000 | 16 | 22000 | 21 | 22800 | 21 | 24200 | 21 | 20700 | 16 | 28900 | 12 | 32500 | 2.3 | 122700 | 0.5 | 132500 | 7.4 | 52600 | 89 | 26400 |
| 16 | 12 | 32300 | 24 | 21000 | 17 | 21800 | 23 | 21600 | 20 | 20200 | 21 | 23000 | 16 | 31000 | 12 | 32400 | 2.7 | 109700 | 0.4 | 144500 | 7.4 | 84800 | 118 | 14400 |
| 17 | 804 | 26600 | 23 | 20600 | 17 | 21300 | 20 | 28600 | 20 | 18400 | 21 | 25500 | 16 | 29300 | 11 | 39100 | 6.7 | 100600 | 0.3 | 160500 | 4.1 | 76600 | 695 | 8690 |
| 18 | 2060 | 2840 | 21 | 22100 | 19 | 21400 | 18 | 24800 | 19 | 19100 | 20 | 26500 | 16 | 28500 | 11 | 35800 | 9.0 | 52600 | 0.3 | 165500 | 91 | 74000 | 327 | 4440 |
| 19 | 174 | 5220 | 21 | 23000 | 19 | 21200 | 25 | 23000 | 21 | 20100 | 20 | 26800 | 17 | 25000 | 11 | 39100 | 8.2 | 40500 | 0.3 | 176300 | 693 | 5180 | 23 | 11400 |
| 20 | 85 | 8260 | 23 | 24100 | 19 | 21400 | 33 | 15400 | 21 | 20800 | 20 | 25800 | 17 | 22200 | 11 | 42800 | 5.3 | 48500 | 0.2 | 183700 | 93 | 12300 | 17 | 16200 |
| 21 | 55 | 12000 | 24 | 25100 | 19 | 19500 | 24 | 29000 | 23 | 23300 | 20 | 24800 | 17 | 25900 | 11 | 38100 | 10 | 53400 | 0.2 | 177500 | 95 | 13900 | 16 | 17800 |
| 22 | 48 | 13100 | 24 | 23300 | 19 | 18200 | 21 | 41600 | 23 | 21600 | 20 | 26400 | 33 | 37200 | 9.8 | 40000 | 27 | 30700 | 0.3 | 145000 | 108 | 15700 | 15 | 18300 |
| 23 | 43 | 13700 | 24 | 20400 | 24 | 21500 | 18 | 25000 | 20 | 18500 | 19 | 25200 | 41 | 19500 | 9.0 | 43000 | 9.0 | 42600 | 4.7 | 104000 | 722 | 5000 | 14 | 21700 |
| 24 | 39 | 15900 | 23 | 20100 | 31 | 21500 | 15 | 21600 | 20 | 17200 | 19 | 27700 | 31 | 17900 | 7.4 | 48800 | 5.3 | 55800 | 734 | 20100 | 295 | 3900 | 12 | 23100 |
| 25 | 37 | 17800 | 23 | 20500 | 24 | 19000 | 23 | 20100 | 20 | 18800 | 19 | 26000 | 23 | 26700 | 7.4 | 53400 | 3.1 | 68400 | 153 | 3610 | 77 | 11400 | 12 | 20500 |
| 26 | 33 | 18000 | 21 | 20600 | 20 | 20100 | 20 | 22300 | 20 | 20700 | 19 | 24800 | 20 | 23900 | 7.4 | 47100 | 2.7 | 87200 | 33 | 31400 | 53 | 17600 | 11 | 24300 |
| 27 | 31 | 18500 | 20 | 20000 | 19 | 20200 | 18 | 22400 | 29 | 23700 | 19 | 24800 | 17 | 17000 | 8.2 | 45200 | 47 | 50400 | 14 | 34900 | 33 | 21100 | 300 | 14500 |
| 28 | 29 | 19000 | 20 | 20000 | 19 | 21200 | 14 | 25400 | 28 | 22000 | 19 | 23300 | 15 | 21900 | 8.2 | 4420 | 24 | 23900 | 9.0 | 46600 | 21 | 22000 | 100 | 3215 |
| 29 | 28 | 19100 | 21 | 18900 | 19 | 21300 | 10 | 26000 | -- | -- | 19 | 23000 | 14 | 29700 | 9.8 | 382( | 11 | 36400 | 6.0 | 64300 | 15 | 22000 | 40 | 11800 |
| 30 | 26 | 17700 | 23 | 16600 | 19 | 21700 | 5.0 | 21700 | -- | -- | 17 | 26000 | 14 | 27900 | 11 | 30900 | 6.7 | 50600 | 4.0 | 67200 | 13 | 23300 | 39 | 14900 |
| 31 | 24 | 19800 | -- | -- | 23 | 21800 | 5.0 | 23700 | -- | -- | 16 | 27000 | -- | -- | 9.0 | 4660 | -- | -- | 2.7 | 76400 | 685 | 19200 | -- | -- |
| [illegible] | 120 | 11200 | 22.8 | 21300 | 20 | 21400 | 20.6 | 22700 | 19.3 | 20200 | 19.7 | 23500 | 17.9 | 25700 | 11.5 | 33900 | 7.9 | 53800 | 32.3 | 22000 | 99.1 | 13300 | 111 | 10200 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 753

Location : Elm Fork North Fork Red River near Carl, Oklahoma

Water Year : 1967

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.12491 Log Sp.C. -1.00846

Sulfates : Log $SO_4$ = 0.28983 Log Sp.C. +1.92989

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 30 | 18300 | 15 | 24800 | 20 | 25100 | 19 | 29300 | 20 | 27900 | 17 | 29600 | 14 | 32500 | 12 | 25100 | 31 | 9330 | 14 | 22600 | 9.0 | 35800 | 6.8 | 67800 |
| 2 | 26 | 19100 | 16 | 25300 | 20 | 25000 | 21 | 26700 | 20 | 27000 | 16 | 29200 | 15 | 30600 | 11 | 27000 | 26 | 12200 | 11 | 25000 | 7.8 | 29800 | 7.3 | 60000 |
| 3 | 26 | 18800 | 18 | 25800 | 19 | 24500 | 15 | 27200 | 20 | 22900 | 17 | 26000 | 14 | 24600 | 9.0 | 30000 | 24 | 18000 | 162 | 32100 | 7.7 | 33300 | 12 | 53600 |
| 4 | 24 | 20400 | 19 | 26400 | 20 | 23800 | 17 | 23800 | 19 | 25600 | 17 | 28100 | 12 | 30400 | 9.8 | 30300 | 20 | 21600 | 2030 | 2450 | 17 | 40200 | 500 | 8000 |
| 5 | 25 | 21800 | 19 | 27900 | 20 | 21100 | 19 | 21200 | 19 | 27300 | 16 | 28800 | 12 | 26600 | 572 | 35800 | 18 | 25100 | 163 | 11500 | 29 | 23500 | 112 | 8100 |
| 6 | 24 | 19900 | 19 | 28000 | 20 | 24500 | 22 | 21000 | 15 | 29000 | 17 | 30200 | 11 | 28700 | 682 | 4490 | 16 | 28300 | 63 | 15000 | 17 | 23800 | 77 | 15200 |
| 7 | 24 | 24200 | 19 | 26400 | 20 | 25200 | 15 | 26500 | 17 | 24700 | 16 | 24600 | 10 | 31300 | 67 | 3880 | 16 | 28500 | 42 | 14300 | 9.5 | 24300 | 73 | 12500 |
| 8 | 21 | 24500 | 18 | 25400 | 17 | 23500 | 13 | 35100 | 19 | 20400 | 12 | 31500 | 11 | 32700 | 43 | 8490 | 14 | 28500 | 30 | 14000 | 6.0 | 31500 | 39 | 13100 |
| 9 | 20 | 23500 | 17 | 25800 | 19 | 19000 | 12 | 38100 | 19 | 22300 | 15 | 21100 | 12 | 34500 | 41 | 13100 | 9.9 | 38500 | 22 | 15000 | 5.0 | 35100 | 30 | 17600 |
| 10 | 19 | 22300 | 18 | 26200 | 16 | 22800 | 20 | 22400 | 19 | 24900 | 17 | 19500 | 12 | 33400 | 31 | 13300 | 7.4 | 40000 | 17 | 18000 | 4.2 | 45800 | 22 | 27400 |
| 11 | 20 | 22100 | 19 | 25900 | 18 | 23800 | 21 | 18900 | 20 | 21000 | 16 | 25400 | 25 | 36500 | 28 | 13500 | 6.4 | 52400 | 12 | 19300 | 3.8 | 45600 | 17 | 32300 |
| 12 | 20 | 24600 | 19 | 24800 | 20 | 17300 | 26 | 16300 | 19 | 21900 | 14 | 27800 | 1630 | 6350 | 25 | 16100 | 5.4 | 51400 | 9.2 | 19300 | 3.5 | 46700 | 12 | 35600 |
| 13 | 19 | 22600 | 18 | 24900 | 17 | 21100 | 22 | 19300 | 18 | 21100 | 12 | 26500 | 598 | 3410 | 25 | 19000 | 5.0 | 44100 | 7.0 | 24500 | 2.9 | 54400 | 10 | 34900 |
| 14 | 18 | 22900 | 18 | 25800 | 19 | 17800 | 21 | 23800 | 17 | 26600 | 12 | 26000 | 111 | 5060 | 24 | 20000 | 4.5 | 48500 | 5.0 | 28300 | 2.6 | 62300 | 20 | 48100 |
| 15 | 16 | 22400 | 18 | 25700 | 20 | 20300 | 20 | 24200 | 17 | 25600 | 11 | 27200 | 67 | 9540 | 20 | 18600 | 4.7 | 51500 | 4.2 | 29800 | 1.9 | 62900 | 15 | 36800 |
| 16 | 17 | 23300 | 18 | 25300 | 17 | 23800 | 20 | 25500 | 16 | 24000 | 11 | 29900 | 57 | 13200 | 17 | 20100 | 3.9 | 48500 | 3.6 | 31500 | 4.3 | 56200 | 12 | 44800 |
| 17 | 28 | 31300 | 18 | 22600 | 16 | 25400 | 19 | 24000 | 17 | 22700 | 11 | 28600 | 50 | 15600 | 15 | 23700 | 2.8 | 48500 | 3.5 | 32500 | 7.2 | 39200 | 12 | 36400 |
| 18 | 31 | 22400 | 18 | 20700 | 17 | 25000 | 16 | 32600 | 17 | 28000 | 10 | 30100 | 45 | 17800 | 12 | 25400 | 3.9 | 50000 | 4.0 | 33700 | 5.5 | 41900 | 11 | 35600 |
| 19 | 27 | 21400 | 18 | 22000 | 17 | 22900 | 16 | 32200 | 18 | 26000 | 18 | 40200 | 41 | 19000 | 12 | 26800 | 5.1 | 49000 | 567 | 12800 | 4.7 | 46100 | 10 | 31500 |
| 20 | 22 | 25000 | 18 | 22300 | 16 | 23200 | 22 | 22800 | 17 | 26500 | 48 | 29000 | 41 | 17600 | 13 | 30000 | 2.9 | 51300 | 194 | 5600 | 3.5 | 54300 | 1470 | 13100 |
| 21 | 21 | 22500 | 18 | 23800 | 15 | 24400 | 23 | 19800 | 16 | 23000 | 28 | 17200 | 35 | 18300 | 12 | 29100 | 2.1 | 59100 | 77 | 9300 | 24 | 42400 | 669 | 2750 |
| 22 | 18 | 23700 | 19 | 23300 | 15 | 23800 | 20 | 21900 | 17 | 22200 | 18 | 22300 | 30 | 19200 | 11 | 24300 | 2.0 | 75000 | 39 | 12300 | 9.9 | 32300 | 114 | 4900 |
| 23 | 16 | 20800 | 18 | 22100 | 9 | 43200 | 19 | 25500 | 17 | 21300 | 16 | 27100 | 26 | 21500 | 10 | 27800 | 1.6 | 86000 | 31 | 16400 | 5.1 | 34700 | 56 | 8400 |
| 24 | 17 | 23100 | 18 | 21200 | 10 | 46000 | 19 | 25900 | 15 | 23300 | 14 | 29700 | 24 | 24000 | 9.9 | 29600 | 2.0 | 80500 | 25 | 19400 | 4.1 | 47300 | 40 | 10300 |
| 25 | 17 | 26100 | 19 | 22700 | 12 | 32400 | 19 | 25500 | 16 | 19500 | 17 | 24800 | 22 | 24400 | 8.2 | 34100 | 647 | 16000 | 21 | 21800 | 3.9 | 64300 | 34 | 13800 |
| 26 | 16 | 26000 | 20 | 26100 | 12 | 31200 | 18 | 26300 | 18 | 21900 | 16 | 28300 | 20 | 22100 | 7.3 | 37200 | 118 | 6280 | 20 | 22700 | 3.1 | 70500 | 28 | 12500 |
| 27 | 16 | 23100 | 18 | 23100 | 20 | 21100 | 17 | 28600 | 18 | 23600 | 14 | 28000 | 18 | 40000 | 7.6 | 40200 | 32 | 12300 | 19 | 23400 | 2.6 | 71000 | 25 | 10700 |
| 28 | 16 | 21800 | 18 | 21900 | 7.8 | 41900 | 18 | 33000 | 17 | 27700 | 14 | 27200 | 18 | 84600 | 8.5 | 39300 | 26 | 17400 | 16 | 25100 | 2.0 | 69000 | 23 | 14500 |
| 29 | 15 | 25400 | 19 | 25500 | 12 | 31700 | 18 | 26300 | -- | -- | 12 | 30000 | 17 | 69600 | 18 | 32800 | 24 | 22700 | 16 | 29500 | 3.2 | 68000 | 25 | 14200 |
| 30 | 15 | 28100 | 20 | 25200 | 14 | 27100 | 19 | 26900 | -- | -- | 14 | 32900 | 15 | 24800 | 170 | 12600 | 19 | 20700 | 12 | 36000 | 3.9 | 66600 | 24 | 14400 |
| 31 | 17 | 30000 | -- | -- | 16 | 29400 | 19 | 25600 | -- | -- | 12 | 33400 | -- | -- | 56 | 7780 | -- | -- | 9.2 | 36000 | 5.2 | 66800 | -- | -- |
| | 20.6 | 23100 | 18.2 | 24600 | 16.4 | 24800 | 18.8 | 25100 | 17.7 | 24200 | 16.1 | 27500 | 100.4 | 9690 | 64.1 | 17900 | 36.7 | 17800 | 117.7 | 8220 | 7.1 | 39400 | 116.8 | 11200 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 4

Location : Elm Fork of North Fork of Red River near Reed, Okla.

Water Year : 1965

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.29117 Log Sp. C. - 1.74855

Sulfates : Log $SO_4$ = 0.35335 Log Sp. C. + 1.79713

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | | | | | | | | | | | | | | | 6.7 | 35100 | 3.2 | 37000 | 28 | 16700 | 2.9 | 42000 | 5.3 | 37500 |
| 2 | | | | | | | | | | | | | | | 6.2 | 36000 | 103 | 37800 | 23 | 17900 | 2.5 | 44300 | 3.6 | 40300 |
| 3 | | | | | | | | | | | | | | | 6.2 | 38000 | 119 | 2660 | 19 | 19900 | 2 | 46300 | 2.2 | 44500 |
| 4 | | | | | | | | | | | | | | | 6.2 | 40100 | 4920 | 3090 | 16 | 21000 | 1.6 | 47400 | 2 | 49900 |
| 5 | | | | | | | | | | | | | | | 6.2 | 40500 | 1890 | 2640 | 17 | 22000 | 1.3 | 49400 | 6 | 41000 |
| 6 | | | | | | | | | | | | | | | 208 | 33500 | 335 | 3270 | 16 | 22900 | 1.4 | 40600 | 800 | 6370 |
| 7 | | | | | | | | | | | | | | | 227 | 2990 | 151 | 6060 | 14 | 23200 | 2.5 | 20700 | 100 | 15000 |
| 8 | | | | | | | | | | | | | | | 41 | 4330 | 94 | 8240 | 13 | 23100 | 6 | 37600 | 60 | 16000 |
| 9 | | | | | | | | | | | | | | | 22 | 6730 | 56 | 10500 | 11 | 24100 | 5 | 45500 | 35 | 21900 |
| 10 | | | | | | | | | | | | | | | 33 | 7360 | 42 | 12100 | 10 | 26300 | 3 | 47100 | 25 | 27500 |
| 11 | | | | | | | | | | | | | | | 30 | 20700 | 41 | 14000 | 8.7 | 28300 | 2.5 | 47200 | 20 | 32800 |
| 12 | | | | | | | | | | | | | | | 19 | 31200 | 41 | 14700 | 7.7 | 30000 | 1.8 | 49400 | 18 | 38300 |
| 13 | | | | | | | | | | | | | | | 17 | 37600 | 276 | 13500 | 6.7 | 30800 | 1.3 | 52100 | 17 | 40500 |
| 14 | | | | | | | | | | | | | | | 23 | 26500 | 271 | 3780 | 6.7 | 32100 | 1.6 | 52500 | 16 | 44000 |
| 15 | | | | | | | | | | | | | | | 14 | 30900 | 285 | 4730 | 7.7 | 32800 | 2.2 | 48000 | 15 | 45200 |
| 16 | | | | | | | | | | | | | | | 12 | 37000 | 555 | 5000 | 6.7 | 33200 | 2.2 | 48200 | 14 | 45600 |
| 17 | | | | | | | | | | | | | | | 11 | 39000 | 128 | 4920 | 6.7 | 34700 | 3.5 | 49100 | 12 | 47800 |
| 18 | | | | | | | | | | | | | | | 9.7 | 39500 | 81 | 6810 | 5.8 | 35100 | 4.5 | 53300 | 20 | 35900 |
| 19 | | | | | | | | | | | | | | | 9 | 37700 | 58 | 9720 | 4.0 | 36900 | 4 | 58600 | 200 | 9800 |
| 20 | | | | | | | | | | | | | | | 82 | 40500 | 54 | 11100 | 2.9 | 40000 | 7 | 60000 | 700 | 4340 |
| 21 | | | | | | | | | | | | | 11 | 26600 | 6.2 | 44000 | 34 | 12800 | 2.5 | 40700 | 5 | 60000 | 1360 | 3790 |
| 22 | | | | | | | | | | | | | 10 | 28000 | 5.8 | 44100 | 30 | 14300 | 2.2 | 40600 | 4 | 60000 | 134 | 4220 |
| 23 | | | | | | | | | | | | | 9 | 29400 | 4.8 | 40600 | 184 | 7270 | 1.8 | 41400 | 3 | 60000 | 60 | 8520 |
| 24 | | | | | | | | | | | | | 8 | 29700 | 5.8 | 41600 | 128 | 6650 | 1.6 | 42200 | 2.5 | 59400 | 34 | 14000 |
| 25 | | | | | | | | | | | | | 7 | 27700 | 4.4 | 45000 | 961 | 19000 | 1.3 | 42100 | 5 | 25400 | 31 | 16900 |
| 26 | | | | | | | | | | | | | 12 | 29900 | 4.0 | 47800 | 401 | 6180 | 1.3 | 43900 | 10 | 31800 | 28 | 19600 |
| 27 | | | | | | | | | | | | | 10 | 32600 | 17 | 44800 | 105 | 6600 | 1.6 | 42900 | 4 | 40300 | 24 | 23000 |
| 28 | | | | | | | | | | | | | 10 | 36600 | 13 | 24600 | 56 | 7830 | 25 | 26100 | 3 | 44900 | 20 | 25200 |
| 29 | | | | | | | | | | | | | 9.2 | 37700 | 8.2 | 27500 | 45 | 11400 | 14 | 35600 | 10 | 18700 | 17 | 27900 |
| 30 | | | | | | | | | | | | | 8.2 | 35000 | 4.8 | 31400 | 36 | 14300 | 6.2 | 38500 | 25 | 22500 | 14 | 30400 |
| 31 | | | | | | | | | | | | | -- | -- | 3.6 | 3280 | -- | -- | 4.0 | 40300 | 7.2 | 32500 | --- | -- |
| Mean | | | | | | | | | | | | | -- | -- | 25.6 | 21600 | 383 | 5810 | 9.42 | 26100 | 4.44 | 39300 | 126 | 7880 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 4 **Basin :** Red River

**Location :** Elm Fork of North Fork of Red River near Reed, Oklahoma **Tributary to:** Red River

**Remarks :**

**Water Year :** 1966

**Equations Used to Compute Constituents**

Chlorides: Log Cl = 1.28233 Log Sp. C. - 1.68305

Sulfates : $SO_4$ = 0.0281 Sp.C. +1146

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 13 | 31000 | 33 | 18400 | 23 | 22000 | 27 | 22200 | 22 | 27800 | 22 | 22900 | 20 | 26500 | 18 | 25500 | 5.4 | 43500 | 3.4 | 34000 | 4.0 | 34000 | 920 | 4535 |
| 2 | 14 | 32000 | 31 | 19100 | 25 | 21300 | 26 | 22000 | 24 | 25500 | 21 | 23900 | 19 | 26500 | 19 | 27800 | 7.0 | 37000 | 2.5 | 37800 | 2.0 | 45000 | 100 | 7250 |
| 3 | 15 | 32100 | 31 | 20300 | 25 | 20200 | 24 | 22000 | 26 | 23400 | 19 | 23800 | 18 | 26600 | 17 | 28300 | 6.2 | 37500 | 1.9 | 39900 | 1.3 | 43300 | 71 | 9590 |
| 4 | 17 | 31800 | 31 | 21000 | 24 | 21600 | 22 | 22000 | 28 | 21700 | 16 | 23300 | 18 | 28300 | 15 | 29000 | 3.8 | 41800 | 1.5 | 42000 | 1.0 | 45600 | 846 | 4060 |
| 5 | 23 | 31000 | 31 | 20200 | 23 | 21000 | 22 | 21500 | 34 | 19400 | 16 | 22800 | 17 | 29700 | 14 | 29000 | 3.2 | 43300 | 1.3 | 44900 | .9 | 46700 | 110 | 4850 |
| 6 | 21 | 31000 | 31 | 20700 | 24 | 22300 | 23 | 20000 | 36 | 18000 | 15 | 23600 | 16 | 28900 | 13 | 29000 | 2.5 | 44000 | .8 | 50300 | 1.3 | 49100 | 50 | 8090 |
| 7 | 20 | 32300 | 31 | 21000 | 24 | 23700 | 23 | 21100 | 35 | 16100 | 15 | 24000 | 15 | 29000 | 13 | 29000 | 2.2 | 45600 | .8 | 51800 | 1.6 | 45000 | 30 | 13110 |
| 8 | 16 | 32600 | 31 | 20900 | 23 | 23600 | 22 | 21800 | 67 | 10600 | 16 | 24600 | 15 | 27700 | 12 | 29000 | 1.9 | 47500 | .7 | 53400 | 1.0 | 48300 | 26 | 16500 |
| 9 | 14 | 33300 | 32 | 21000 | 25 | 23400 | 21 | 20700 | 43 | 13000 | 18 | 23400 | 15 | 26800 | 11 | 29800 | 1.7 | 50000 | .7 | 54800 | 2.2 | 49800 | 22 | 18500 |
| 10 | 13 | 33800 | 31 | 21300 | 27 | 22500 | 20 | 21300 | 31 | 19600 | 18 | 23500 | 14 | 27300 | 12 | 30800 | 1.5 | 50000 | 1.1 | 50800 | 21 | 46100 | 20 | 21300 |
| 11 | 11 | 35200 | 30 | 21800 | 27 | 23100 | 20 | 22300 | 27 | 20000 | 21 | 23500 | 14 | 28600 | 12 | 30800 | 1.5 | 47300 | .8 | 54200 | 18 | 25500 | 18 | 21000 |
| 12 | 9.7 | 36600 | 29 | 22000 | 26 | 23300 | 20 | 23200 | 26 | 20300 | 149 | 8770 | 14 | 29600 | 11 | 32600 | 1.3 | 46500 | 1.0 | 56000 | 6.4 | 29100 | 16 | 21500 |
| 13 | 9.7 | 36600 | 27 | 22000 | 24 | 23900 | 20 | 23500 | 25 | 20000 | 23 | 18400 | 14 | 29800 | 11 | 34500 | 1.3 | 45800 | 3.2 | 56300 | 4.4 | 32800 | 16 | 23500 |
| 14 | 11 | 36800 | 26 | 22300 | 24 | 22400 | 20 | 24100 | 24 | 19800 | 20 | 22000 | 13 | 29900 | 10 | 33100 | 1.2 | 47000 | 1.8 | 57800 | 11 | 42000 | 14 | 24600 |
| 15 | 13 | 36800 | 26 | 22700 | 23 | 21900 | 20 | 24100 | 24 | 19500 | 19 | 23700 | 13 | 29000 | 9.9 | 31500 | 1.3 | 47000 | 1.3 | 57300 | 9.4 | 32900 | 58 | 19900 |
| 16 | 13 | 37600 | 23 | 22300 | 24 | 22100 | 20 | 24000 | 24 | 20600 | 19 | 24500 | 12 | 28500 | 9.9 | 32600 | 1.2 | 47500 | .9 | 58000 | 2.5 | 34125 | 62 | 14700 |
| 17 | 413 | 30400 | 22 | 21700 | 24 | 22700 | 20 | 24400 | 24 | 22400 | 19 | 24500 | 11 | 29100 | 8.8 | 33100 | 1.4 | 47000 | .7 | 58800 | .5 | 39500 | 273 | 17300 |
| 18 | 6240 | 2300 | 22 | 21600 | 26 | 23300 | 19 | 24400 | 22 | 21600 | 18 | 24500 | 12 | 29700 | 8.1 | 34600 | 2.7 | 48300 | .6 | 56000 | 6.4 | 35900 | 886 | 6190 |
| 19 | 493 | 3190 | 22 | 21900 | 26 | 22300 | 18 | 22200 | 23 | 20500 | 16 | 24500 | 12 | 31200 | 7.4 | 35100 | 4.7 | 50100 | .5 | 60500 | 402 | 13980 | 128 | 6040 |
| 20 | 188 | 4930 | 24 | 21500 | 25 | 22200 | 15 | 24500 | 24 | 20000 | 16 | 24800 | 12 | 32400 | 7.0 | 35300 | 6.0 | 53900 | 2.6 | 56250 | 112 | 5590 | 64 | 9280 |
| 21 | 127 | 6410 | 26 | 22100 | 25 | 22900 | 18 | 22700 | 26 | 20000 | 16 | 24600 | 12 | 31800 | 6.7 | 35800 | 5.2 | 57800 | 2.1 | 54000 | 50 | 8025 | 46 | 12900 |
| 22 | 101 | 7360 | 27 | 22900 | 25 | 23000 | 21 | 19800 | 26 | 20800 | 15 | 26500 | 22 | 25500 | 6.5 | 36600 | 5.3 | 56200 | 1.7 | 55750 | 70 | 11910 | 37 | 15700 |
| 23 | 78 | 9690 | 27 | 22900 | 33 | 23700 | 25 | 20000 | 22 | 22300 | 14 | 27000 | 38 | 24700 | 5.7 | 38200 | 13 | 55800 | 1.8 | 53250 | 337 | 6865 | 30 | 16900 |
| 24 | 63 | 11500 | 26 | 23100 | 42 | 23900 | 30 | 23900 | 21 | 23100 | 14 | 26900 | 32 | 30000 | 4.9 | 39200 | 6.7 | 49000 | 159 | 35000 | 742 | 2820 | 28 | 19500 |
| 25 | 51 | 13000 | 26 | 23000 | 33 | 23800 | 32 | 25900 | 22 | 21100 | 15 | 26800 | 26 | 22000 | 4.7 | 39400 | 4.7 | 46100 | 363 | 4050 | 105 | 5880 | 26 | 20600 |
| 26 | 44 | 14800 | 25 | 23000 | 29 | 23100 | 28 | 23000 | 22 | 20300 | 15 | 26700 | 25 | 22500 | 4.7 | 39200 | 3.4 | 46500 | 72 | 8425 | 49 | 11000 | 24 | 21900 |
| 27 | 40 | 15700 | 22 | 23000 | 27 | 22200 | 20 | 16700 | 27 | 20100 | 19 | 26500 | 21 | 24500 | 4.7 | 39100 | 3.0 | 47600 | 33 | 15270 | 37 | 17800 | 423 | 12900 |
| 28 | 38 | 16400 | 22 | 22900 | 26 | 21900 | 19 | 18800 | 27 | 20700 | 108 | 13800 | 19 | 27000 | 4.7 | 39800 | 11 | 51800 | 16 | 25000 | 32 | 19500 | 530 | 2910 |
| 29 | 36 | 17000 | 22 | 23000 | 26 | 21700 | 18 | 24300 | -- | -- | 28 | 18200 | 17 | 24400 | 4.9 | 40800 | 10 | 36100 | 11 | 33000 | 30 | 23300 | 125 | 7420 |
| 30 | 35 | 17000 | 22 | 22500 | 26 | 22000 | 18 | 26000 | -- | -- | 23 | 23500 | 18 | 24000 | 6.2 | 42500 | 5.4 | 32000 | 8.2 | 30000 | 27 | 25000 | 26 | 8000 |
| 31 | 35 | 18600 | -- | -- | 27 | 22100 | 20 | 27900 | -- | -- | 20 | 25500 | -- | -- | 7.0 | 43800 | -- | -- | 6.2 | 31100 | 731 | 19780 | -- | -- |
| Mean | 265 | 5430 | 27.0 | 21600 | 26.2 | 22600 | 21.6 | 22600 | 27.9 | 19400 | 25.3 | 19600 | 17.5 | 27200 | 9.7 | 32200 | 4.2 | 46800 | 22.6 | 15700 | 90.9 | 11950 | 168 | 7584 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 4

**Location** : Elm Fork North Fork Red River near Reed, Oklahoma

**Water Year** : 1967

**Basin** : Red River

**Tributary to:** Red River

**Remarks** :

**Equations Used to Compute Constituents**

**Chlorides:** Log Cl = 1.24628 Log Sp.C. -1.52955

**Sulfates :** Log $SO_4$ = 0.34493 Log Sp.C. +1.72892

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (umho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 42 | 9800 | 17 | 27600 | 20 | 26100 | 18 | 28000 | 16 | 25800 | 14 | 28000 | 15 | 32500 | 11 | 26400 | 70 | 8960 | 30 | 21700 | 9.7 | 24400 | 8.7 | 33900 |
| 2 | 31 | 13000 | 16 | 28000 | 20 | 27300 | 21 | 26500 | 16 | 26100 | 13 | 30000 | 15 | 33000 | 9.2 | 27200 | 48 | 12800 | 26 | 24100 | 9.7 | 26200 | 3.6 | 30000 |
| 3 | 28 | 16000 | 17 | 28000 | 20 | 26800 | 13 | 26400 | 16 | 26600 | 13 | 31800 | 15 | 33000 | 8.7 | 26900 | 34 | 15800 | 43 | 25500 | 9.2 | 27700 | 3.2 | 28000 |
| 4 | 24 | 18000 | 18 | 28000 | 20 | 26800 | 15 | 24500 | 16 | 26900 | 13 | 31500 | 14 | 31700 | 9.2 | 27300 | 28 | 19100 | 3770 | 2950 | 13 | 26700 | 310 | 15100 |
| 5 | 23 | 19300 | 18 | 27300 | 20 | 26200 | 18 | 22200 | 16 | 26000 | 13 | 30300 | 13 | 30200 | 314 | 25700 | 24 | 21300 | 423 | 3700 | 16 | 27800 | 187 | 5250 |
| 6 | 22 | 21400 | 19 | 26300 | 20 | 25300 | 18 | 22500 | 16 | 28100 | 13 | 30000 | 13 | 31300 | 1840 | 3690 | 22 | 23300 | 155 | 5300 | 21 | 31700 | 74 | 8670 |
| 7 | 21 | 21500 | 19 | 26000 | 20 | 25300 | 18 | 21800 | 14 | 29200 | 13 | 29900 | 12 | 31000 | 219 | 3540 | 20 | 24800 | 88 | 7100 | 14 | 28300 | 60 | 15300 |
| 8 | 21 | 21900 | 18 | 25800 | 19 | 27600 | 17 | 24600 | 15 | 29300 | 11 | 31100 | 11 | 30800 | 81 | 5850 | 15 | 27000 | 48 | 8100 | 11 | 27400 | 43 | 11500 |
| 9 | 20 | 22800 | 18 | 25200 | 19 | 27900 | 19 | 25900 | 16 | 26500 | 14 | 28200 | 12 | 31900 | 61 | 9180 | 12 | 29400 | 29 | 10200 | 9.7 | 29800 | 27 | 15500 |
| 10 | 19 | 23300 | 19 | 25000 | 16 | 27500 | 19 | 28200 | 16 | 24500 | 16 | 28700 | 12 | 32900 | 50 | 10600 | 9.0 | 30000 | 21 | 13000 | 8.7 | 33600 | 19 | 20100 |
| 11 | 19 | 23500 | 19 | 25500 | 16 | 27000 | 19 | 29000 | 17 | 25200 | 16 | 25700 | 12 | 32700 | 41 | 12200 | 6.2 | 31000 | 15 | 14000 | 8.2 | 34000 | 14 | 22700 |
| 12 | 18 | 23600 | 20 | 24900 | 19 | 27100 | 21 | 20400 | 16 | 25100 | 16 | 24900 | 1890 | 8480 | 36 | 13400 | 5.1 | 31800 | 11 | 16500 | 7.0 | 34000 | 9.7 | 25500 |
| 13 | 18 | 23700 | 20 | 24200 | 18 | 24700 | 20 | 20100 | 16 | 25100 | 16 | 27600 | 1680 | 4340 | 32 | 14900 | 4.8 | 32300 | 8.7 | 18700 | 5.2 | 34100 | 7.7 | 28600 |
| 14 | 16 | 25100 | 20 | 24600 | 18 | 22300 | 19 | 20400 | 16 | 24600 | 16 | 29300 | 263 | 3640 | 30 | 16100 | 4.4 | 33400 | 6.7 | 20500 | 4.6 | 35000 | 14 | 26900 |
| 15 | 16 | 25200 | 20 | 25600 | 18 | 22200 | 18 | 23000 | 14 | 26600 | 14 | 30500 | 128 | 5730 | 27 | 17800 | 4.0 | 35100 | 4.8 | 21300 | 3.9 | 36300 | 15 | 27000 |
| 16 | 16 | 25200 | 20 | 26100 | 20 | 22300 | 18 | 25000 | 14 | 29500 | 14 | 30400 | 92 | 9300 | 22 | 18100 | 3.6 | 36300 | 4.4 | 22100 | 3.2 | 34500 | 10 | 32500 |
| 17 | 23 | 25000 | 20 | 26500 | 19 | 23800 | 18 | 25800 | 14 | 28000 | 14 | 30800 | 72 | 9880 | 20 | 19700 | 21 | 34500 | 4.8 | 23100 | 6.7 | 33500 | 8.2 | 33900 |
| 18 | 27 | 25700 | 20 | 24800 | 19 | 26000 | 15 | 27500 | 14 | 27500 | 14 | 31400 | 61 | 13100 | 17 | 20200 | 7.2 | 32900 | 4.8 | 24000 | 9.7 | 34000 | 6.7 | 34200 |
| 19 | 25 | 26200 | 20 | 24400 | 19 | 26300 | 12 | 27700 | 15 | 28100 | 17 | 28700 | 54 | 14600 | 16 | 21700 | 4.8 | 30300 | 816 | 10700 | 9.6 | 35900 | 6.2 | 35100 |
| 20 | 21 | 26000 | 20 | 25000 | 20 | 26500 | 14 | 28900 | 14 | 29400 | 26 | 27200 | 50 | 16500 | 17 | 22300 | 4.0 | 33200 | 306 | 3880 | 5.3 | 38100 | 811 | 18400 |
| 21 | 20 | 26000 | 20 | 25000 | 20 | 26000 | 20 | 24000 | 14 | 29100 | 34 | 24100 | 46 | 18700 | 19 | 22600 | 3.2 | 37800 | 110 | 5040 | 19 | 27200 | 1110 | 3200 |
| 22 | 20 | 26000 | 20 | 25800 | 20 | 26000 | 19 | 24600 | 14 | 30000 | 24 | 17900 | 34 | 18300 | 16 | 24600 | 2.9 | 40300 | 70 | 6900 | 18 | 31600 | 238 | 3630 |
| 23 | 19 | 25500 | 20 | 25500 | 16 | 28100 | 19 | 23300 | 14 | 29000 | 19 | 21800 | 29 | 19800 | 14 | 26900 | 2.5 | 40300 | 46 | 9150 | 13 | 37900 | 74 | 5400 |
| 24 | 19 | 24300 | 20 | 25000 | 14 | 27700 | 18 | 25300 | 13 | 28000 | 18 | 25700 | 23 | 20200 | 11 | 27100 | 1.6 | 42400 | 33 | 11900 | 8.2 | 33600 | 55 | 8750 |
| 25 | 19 | 24100 | 21 | 24000 | 13 | 30000 | 16 | 28500 | 13 | 27300 | 18 | 27900 | 20 | 20800 | 8.2 | 27000 | 566 | 17500 | 25 | 14800 | 5.3 | 35000 | 45 | 10500 |
| 26 | 20 | 24400 | 21 | 23800 | 12 | 33700 | 16 | 28500 | 14 | 26000 | 19 | 28500 | 18 | 22900 | 6.7 | 28000 | 289 | 3630 | 20 | 17300 | 3.6 | 35300 | 34 | 12100 |
| 27 | 20 | 25400 | 20 | 25400 | 16 | 30600 | 16 | 29500 | 15 | 26000 | 17 | 26700 | 16 | 23100 | 6.2 | 29000 | 74 | 6790 | 17 | 19100 | 3.2 | 35800 | 64 | 10300 |
| 28 | 19 | 25800 | 20 | 26700 | 20 | 30400 | 16 | 28200 | 15 | 26200 | 16 | 29800 | 15 | 23800 | 6.7 | 28800 | 48 | 11700 | 16 | 20400 | 2.9 | 36000 | 31 | 11300 |
| 29 | 19 | 24100 | 19 | 25700 | 14 | 27800 | 16 | 29000 | -- | -- | 15 | 30000 | 15 | 24600 | 55 | 22900 | 38 | 14700 | 15 | 21400 | 1.8 | 37700 | 28 | 16200 |
| 30 | 19 | 23400 | 19 | 25300 | 10 | 29100 | 16 | 28500 | -- | -- | 15 | 30000 | 14 | 25500 | 59 | 11500 | 34 | 19300 | 13 | 22100 | 1.3 | 38600 | 25 | 17400 |
| 31 | 19 | 25200 | -- | -- | 14 | 31000 | 16 | 26000 | -- | -- | 15 | 30300 | -- | -- | 201 | 7660 | -- | -- | 10 | 23300 | 25 | 29200 | -- | -- |
| | 21.4 | 22200 | 19.3 | 25600 | 17.7 | 26700 | 17.4 | 25400 | 15 | 27100 | 16.3 | 27800 | 155.5 | 8230 | 105.3 | 86[illegible] | 46.9 | 14700 | 199.7 | 5260 | 9.2 | 31100 | 111.4 | 10400 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 5

**Location** : Elm Fork of North Fork of Red River near Mangum, Okla.

**Water Year** : 1965

**Basin** : Red River

**Tributary to:** Red River

**Remarks** :

**Equations Used to Compute Constituents**

**Chlorides:** Log Cl = 1.23993 Log Sp.C. -1.52385

**Sulfates :** Log $SO_4$ = 0.29992 Log Sp.C. +1.96980

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | | | | | | | | | | | | | | | 8.9 | 30700 | 4.1 | 17600 | 43 | 11600 | 3.6 | 25800 | 7.0 | 23900 |
| 2 | | | | | | | | | | | | | | | 8.4 | 30300 | 175 | 15400 | 34 | 12300 | 2.8 | 27700 | 4.8 | 25800 |
| 3 | | | | | | | | | | | | | | | 7.5 | 28500 | 261 | 5460 | 30 | 15000 | 2.2 | 28400 | 3.6 | 27000 |
| 4 | | | | | | | | | | | | | | | 7.0 | 29500 | 5090 | 2180 | 26 | 15900 | 1.8 | 28000 | 2.6 | 28200 |
| 5 | | | | | | | | | | | | | | | 7.0 | 31100 | 2320 | 2490 | 26 | 16600 | 1.4 | 28000 | 163 | 22900 |
| 6 | | | | | | | | | | | | | | | 7.9 | 30900 | 519 | 3400 | 53 | 11400 | 2.7 | 27600 | 1530 | 3070 |
| 7 | | | | | | | | | | | | | | | 878 | 7160 | 193 | 5060 | 26 | 12500 | 14 | 20500 | 480 | 4400 |
| 8 | | | | | | | | | | | | | | | 137 | 4710 | 154 | 5910 | 19 | 16700 | 11 | 20700 | 114 | 6200 |
| 9 | | | | | | | | | | | | | | | 36 | 9000 | 80 | 7860 | 17 | 17800 | 6.2 | 21800 | 60 | 10000 |
| 10 | | | | | | | | | | | | | | | 28 | 13400 | 73 | 9020 | 14 | 18500 | 4.5 | 22700 | 41 | 14600 |
| 11 | | | | | | | | | | | | | | | 41 | 17800 | 61 | 10700 | 12 | 19600 | 3.3 | 23500 | 33 | 16400 |
| 12 | | | | | | | | | | | | | | | 25 | 13800 | 54 | 12500 | 9.8 | 20800 | 2.0 | 24400 | 28 | 18200 |
| 13 | | | | | | | | | | | | | | | 20 | 18000 | 251 | 71100 | 8.9 | 21300 | 1.8 | 24800 | 23 | 20100 |
| 14 | | | | | | | | | | | | | | | 43 | 21000 | 915 | 2640 | 8.4 | 22000 | 1.8 | 25600 | 20 | 21500 |
| 15 | | | | | | | | | | | | | 492 | 4060 | 22 | 22300 | 521 | 2450 | 7.9 | 22000 | 2.6 | 25100 | 18 | 22500 |
| 16 | | | | | | | | | | | | | 100 | 5060 | 16 | 23500 | 868 | 3280 | 7.0 | 22300 | 2.6 | 24200 | 17 | 23900 |
| 17 | | | | | | | | | | | | | 49 | 7720 | 14 | 25100 | 244 | 3040 | 6 | 23000 | 2.0 | 24300 | 16 | 24900 |
| 18 | | | | | | | | | | | | | 32 | 10200 | 12 | 26300 | 115 | 4890 | 5 | 23300 | 3.1 | 25400 | 19 | 20300 |
| 19 | | | | | | | | | | | | | 24 | 14200 | 9.8 | 27500 | 80 | 7130 | 4 | 23900 | 2.6 | 25900 | 3480 | 4720 |
| 20 | | | | | | | | | | | | | 20 | 17800 | 8.4 | 28100 | 60 | 9260 | 3.9 | 24600 | 5.0 | 25200 | 2910 | 1530 |
| 21 | | | | | | | | | | | | | 17 | 20100 | 8.4 | 28800 | 40 | 11100 | 3.6 | 25000 | 7.0 | 22600 | 4270 | 1620 |
| 22 | | | | | | | | | | | | | 15 | 21400 | 8.4 | 29700 | 35 | 12100 | 3.3 | 24800 | 4.8 | 14300 | 821 | 2110 |
| 23 | | | | | | | | | | | | | 13 | 22700 | 7.5 | 29900 | 225 | 10600 | 2.6 | 24700 | 3.9 | 16900 | 196 | 4190 |
| 24 | | | | | | | | | | | | | 12 | 23800 | 7.0 | 30100 | 246 | 4420 | 2.4 | 24900 | 2.6 | 21900 | 94 | 6740 |
| 25 | | | | | | | | | | | | | 12 | 24000 | 5.8 | 31000 | 1580 | 2830 | 2.4 | 24500 | 1.7 | 24500 | 50 | 9060 |
| 26 | | | | | | | | | | | | | 26 | 19000 | 6.2 | 30900 | 1240 | 2850 | 2.2 | 23900 | 11 | 34500 | 30 | 11000 |
| 27 | | | | | | | | | | | | | 16 | 16300 | 5.1 | 30800 | 297 | 4870 | 2.0 | 24900 | 5.5 | 37000 | 20 | 12700 |
| 28 | | | | | | | | | | | | | 13 | 25500 | 15 | 36100 | 115 | 5850 | 3.6 | 25900 | 3.6 | 32500 | 18 | 14900 |
| 29 | | | | | | | | | | | | | 12 | 27800 | 10 | 38800 | 80 | 7690 | 13 | 27600 | 4.2 | 30200 | 16 | 16000 |
| 30 | | | | | | | | | | | | | 10 | 29300 | 7.0 | 30100 | 52 | 9150 | 8.3 | 26900 | 37 | 32000 | 22 | 17100 |
| 31 | | | | | | | | | | | | | -- | -- | 5.1 | 22000 | -- | -- | 4.8 | 25500 | 12 | 21800 | -- | -- |
| Mean | | | | | | | | | | | | | 550 | -- | 45.9 | 1130 | 532 | 3360 | 13.2 | 16800 | 5.49 | 26300 | 484 | 3400 |

## Appendix D (Cont'd)

### DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 5

Location : Elm Fork of North Fork Red River near Mangum, Oklahoma

Water Year : 1966

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.38632 Log Sp. C. - 2.12817

Sulfates : $SO_4$ = 0.00382 Sp.C. +1653

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 22 | 18300 | 58 | 14500 | 33 | 18800 | 32 | 19000 | 28 | 21750 | 37 | 16400 | 24 | 17250 | 24 | 22750 | 11 | 27700 | 7.9 | 37800 | 5.8 | 22450 | 1600 | 4360 |
| 2 | 22 | 19230 | 55 | 15100 | 34 | 18700 | 32 | 19000 | 30 | 21600 | 33 | 16900 | 23 | 19250 | 23 | 22000 | 10 | 28000 | 5.5 | 38650 | 4.8 | 23700 | 294 | 3480 |
| 3 | 22 | 20000 | 49 | 15800 | 35 | 18300 | 30 | 19500 | 30 | 20600 | 31 | 18600 | 21 | 19400 | 23 | 22000 | 9.8 | 28900 | 3.9 | 36600 | 4.1 | 25000 | 106 | 5430 |
| 4 | 24 | 20200 | 48 | 15850 | 34 | 18500 | 28 | 20000 | 32 | 20000 | 27 | 20000 | 20 | 19800 | 21 | 22700 | 8.9 | 30100 | 3.6 | 35250 | 3.6 | 25000 | 573 | 5570 |
| 5 | 29 | 20750 | 47 | 16300 | 33 | 17800 | 28 | 20000 | 40 | 19800 | 24 | 19750 | 20 | 20400 | 20 | 23000 | 7 | 30500 | 2.4 | 34250 | 3.3 | 25750 | 332 | 4130 |
| 6 | 30 | 21100 | 46 | 17200 | 32 | 17600 | 28 | 20000 | 44 | 18600 | 24 | 19700 | 20 | 21000 | 18 | 23100 | 5.8 | 30000 | 2.0 | 33300 | 3.6 | 26000 | 121 | 4760 |
| 7 | 28 | 21530 | 46 | 17000 | 32 | 17950 | 27 | 19600 | 46 | 17500 | 24 | 19700 | 20 | 21000 | 17 | 23400 | 4.8 | 30000 | 1.4 | 33000 | 8.9 | 24000 | 68 | 8100 |
| 8 | 24 | 22300 | 46 | 17000 | 32 | 18000 | 27 | 19100 | 44 | 16700 | 24 | 19550 | 21 | 21400 | 15 | 24000 | 4.5 | 30000 | 1.2 | 33000 | 15 | 21000 | 50 | 10850 |
| 9 | 22 | 23100 | 46 | 17250 | 32 | 18000 | 27 | 19000 | 200 | 7800 | 27 | 19300 | 20 | 22500 | 15 | 24000 | 3.9 | 29500 | .9 | 33100 | 6.2 | 14850 | 34 | 13600 |
| 10 | 20 | 23000 | 43 | 17000 | 33 | 18000 | 27 | 19000 | 65 | 4540 | 28 | 19600 | 20 | 22950 | 14 | 23800 | 3.6 | 28900 | .9 | 32400 | 4.8 | 9330 | 28 | 14800 |
| 11 | 19 | 23000 | 43 | 17000 | 35 | 18600 | 27 | 18900 | 46 | 8850 | 28 | 19450 | 20 | 22750 | 14 | 23500 | 3.3 | 28400 | .9 | 31900 | 220 | 7520 | 26 | 16200 |
| 12 | 15 | 23800 | 43 | 17200 | 36 | 18400 | 27 | 18200 | 42 | 14100 | 344 | 8100 | 20 | 22000 | 13 | 23850 | 2.8 | 28000 | .5 | 31400 | 150 | 6900 | 24 | 17900 |
| 13 | 15 | 24000 | 37 | 17600 | 35 | 18100 | 26 | 18300 | 38 | 16200 | 126 | 2560 | 20 | 22000 | 13 | 24200 | 3.1 | 28000 | .3 | 31000 | 28 | 11700 | 24 | 18900 |
| 14 | 14 | 24100 | 37 | 17900 | 33 | 18700 | 26 | 18850 | 36 | 17000 | 51 | 7530 | 18 | 22300 | 13 | 24250 | 2.8 | 28000 | .2 | 30200 | 26 | 12100 | 24 | 19200 |
| 15 | 14 | 24200 | 37 | 17900 | 33 | 19100 | 26 | 19600 | 34 | 17250 | 38 | 12150 | 18 | 22900 | 13 | 24400 | 2.8 | 28000 | .9 | 30000 | 19 | 13250 | 30 | 18800 |
| 16 | 14 | 25550 | 37 | 17900 | 33 | 19800 | 26 | 19600 | 34 | 16500 | 33 | 14850 | 17 | 23300 | 12 | 24800 | 3.3 | 26750 | 3.1 | 29150 | 17 | 26300 | 117 | 13700 |
| 17 | 29 | 24400 | 36 | 17500 | 34 | 20000 | 26 | 19600 | 32 | 16550 | 29 | 17500 | 16 | 24000 | 12 | 25400 | 3.6 | 26000 | 1.4 | 27900 | 12 | 32300 | 94 | 10100 |
| 18 | 9320 | 2525 | 36 | 17500 | 35 | 19600 | 25 | 19200 | 32 | 16750 | 28 | 18500 | 16 | 23800 | 12 | 25800 | 15 | 22400 | .7 | 29150 | 9.8 | 31800 | 1240 | 4800 |
| 19 | 3480 | 1740 | 35 | 17400 | 35 | 20200 | 27 | 14950 | 31 | 17850 | 27 | 19500 | 16 | 23300 | 10 | 25900 | 13 | 15600 | .3 | 29900 | 219 | 21200 | 306 | 3200 |
| 20 | 430 | 3600 | 36 | 17350 | 36 | 20800 | 32 | 13700 | 31 | 18100 | 26 | 20000 | 16 | 23800 | 10 | 25600 | 6.6 | 15700 | .2 | 30000 | 318 | 4860 | 124 | 4800 |
| 21 | 258 | 5800 | 36 | 17400 | 36 | 21000 | 28 | 15350 | 36 | 15500 | 25 | 20000 | 16 | 24000 | 10 | 25650 | 6.6 | 19650 | .2 | 28800 | 76 | 5960 | 80 | 7950 |
| 22 | 191 | 7440 | 36 | 17200 | 36 | 20900 | 26 | 18600 | 35 | 17100 | 24 | 19750 | 25 | 23900 | 9.8 | 25700 | 14 | 23400 | .1 | 27200 | 64 | 7760 | 56 | 10700 |
| 23 | 156 | 8500 | 36 | 17500 | 40 | 19950 | 22 | 19600 | 35 | 17500 | 24 | 20200 | 54 | 23100 | 9.4 | 25800 | 9.8 | 17000 | 6.0 | 27950 | 212 | 8500 | 44 | 12750 |
| 24 | 126 | 10200 | 36 | 17900 | 75 | 16950 | 30 | 18900 | 33 | 17900 | 24 | 20950 | 53 | 23000 | 8.4 | 26100 | 10 | 21350 | 18 | 18000 | 1400 | 3000 | 36 | 14950 |
| 25 | 110 | 10950 | 36 | 18000 | 59 | 14950 | 40 | 18350 | 33 | 18500 | 24 | 21250 | 42 | 24400 | 8.4 | 26300 | 9.4 | 30000 | 379 | 11300 | 329 | 3100 | 30 | 15450 |
| 26 | 98 | 12000 | 34 | 18250 | 40 | 18100 | 26 | 19150 | 33 | 19500 | 24 | 22000 | 34 | 22700 | 7.9 | 26150 | 6.6 | 32500 | 135 | 6950 | 119 | 5300 | 27 | 16900 |
| 27 | 86 | 12450 | 32 | 19100 | 34 | 18550 | 30 | 22000 | 36 | 18100 | 25 | 21900 | 30 | 20250 | 7.9 | 26100 | 4.5 | 32500 | 51 | 9780 | 65 | 8800 | 128 | 15200 |
| 28 | 78 | 12950 | 31 | 19000 | 32 | 20300 | 28 | 20900 | 42 | 16900 | 85 | 19450 | 26 | 21500 | 7.9 | 26250 | 2.8 | 32500 | 25 | 13200 | 44 | 11000 | 1260 | 3170 |
| 29 | 70 | 14000 | 31 | 19000 | 31 | 19400 | 26 | 19900 | -- | -- | 52 | 6930 | 25 | 22750 | 7.5 | 26000 | 4.8 | 32600 | 17 | 15800 | 37 | 15000 | 247 | 3275 |
| 30 | 68 | 14100 | 31 | 19000 | 31 | 19100 | 24 | 19900 | -- | -- | 32 | 10450 | 24 | 23000 | 7.0 | 26000 | 12 | 34750 | 13 | 18750 | 27 | 16950 | 106 | 5275 |
| 31 | 62 | 14500 | -- | -- | 32 | 19100 | 26 | 20750 | -- | -- | 28 | 13150 | -- | -- | 7.5 | 27200 | -- | -- | 10 | 19200 | 42 | 17500 | -- | -- |
| | 481 | 3490 | 40 | 17200 | 36.2 | 18700 | 27.7 | 18900 | 42.8 | 15100 | 44.4 | 13500 | 23.8 | 22200 | 13.0 | 24200 | 6.9 | 26200 | 22.3 | 12400 | 113 | 6760 | 241 | 5350 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 5

Location : Elm Fork North Fork Red River near Mangum, Oklahoma

Water Year : 1967

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.25625 Log Sp.C. -1.57209

Sulfates : Log $SO_4$ = 0.28303 Log Sp.C. +1.98577

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (umho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 72 | 8290 | 17 | 23000 | 18 | 23700 | 17 | 24300 | 18 | 26000 | 16 | 24800 | 15 | 24900 | 14 | 21200 | 99 | 7890 | 33 | 15300 | 16 | 16900 | 33 | 16900 |
| 2 | 52 | 11000 | 17 | 23300 | 18 | 23700 | 21 | 25400 | 18 | 26000 | 14 | 25700 | 13 | 26100 | 13 | 22000 | 118 | 5780 | 28 | 17500 | 14 | 17200 | 13 | 21700 |
| 3 | 43 | 12900 | 17 | 23800 | 18 | 23900 | 20 | 24500 | 17 | 24400 | 14 | 26100 | 13 | 28000 | 12 | 22900 | 57 | 8430 | 25 | 18100 | 13 | 17800 | 7.5 | 19850 |
| 4 | 38 | 14700 | 17 | 24300 | 19 | 24200 | 18 | 22300 | 17 | 24500 | 14 | 27100 | 13 | 29000 | 13 | 23500 | 38 | 12400 | 4400 | 3470 | 15 | 17800 | 65 | 19700 |
| 5 | 34 | 15300 | 17 | 24400 | 20 | 24000 | 21 | 21400 | 17 | 25000 | 14 | 28000 | 12 | 29000 | 20 | 19600 | 28 | 15000 | 1300 | 2530 | 23 | 17900 | 372 | 7200 |
| 6 | 31 | 16200 | 18 | 24300 | 22 | 24000 | 23 | 22000 | 15 | 25000 | 13 | 28000 | 12 | 28500 | 2520 | 5100 | 22 | 17200 | 258 | 3390 | 31 | 15200 | 137 | 5120 |
| 7 | 30 | 17200 | 20 | 24000 | 21 | 24000 | 21 | 21600 | 16 | 24300 | 13 | 27700 | 12 | 27700 | 450 | 3010 | 18 | 18800 | 144 | 5530 | 25 | 19600 | 75 | 7700 |
| 8 | 29 | 19000 | 20 | 23100 | 20 | 23900 | 14 | 20300 | 15 | 24100 | 12 | 26900 | 12 | 28000 | 143 | 4140 | 14 | 19500 | 98 | 6780 | 18 | 21900 | 73 | 13500 |
| 9 | 28 | 19100 | 20 | 23600 | 20 | 23100 | 15 | 21400 | 16 | 25300 | 13 | 26200 | 12 | 27800 | 86 | 6040 | 12 | 20400 | 66 | 7910 | 14 | 24000 | 43 | 13500 |
| 10 | 26 | 19900 | 20 | 23500 | 18 | 23600 | 18 | 20600 | 15 | 26100 | 13 | 27100 | 12 | 27000 | 62 | 8560 | 9.2 | 21800 | 46 | 8900 | 12 | 24000 | 30 | 13350 |
| 11 | 24 | 20700 | 20 | 23700 | 18 | 23700 | 21 | 22000 | 15 | 24900 | 15 | 27700 | 12 | 27800 | 48 | 10500 | 7.2 | 22300 | 30 | 10500 | 10 | 23800 | 21 | 15300 |
| 12 | 23 | 21000 | 20 | 23800 | 18 | 23400 | 25 | 24300 | 16 | 23600 | 14 | 26800 | 2110 | 9780 | 40 | 11500 | 6.3 | 22700 | 20 | 11600 | 9.8 | 23700 | 15 | 17600 |
| 13 | 22 | 21000 | 20 | 23900 | 20 | 22700 | 26 | 24100 | 16 | 23600 | 14 | 25900 | 2980 | 2070 | 35 | 12500 | 5.8 | 23500 | 15 | 13000 | 9.4 | 23600 | 13 | 19800 |
| 14 | 20 | 21500 | 20 | 24000 | 20 | 22800 | 26 | 21700 | 15 | 24400 | 13 | 25500 | 694 | 2780 | 32 | 13400 | 5.5 | 22800 | 11 | 13700 | 8.4 | 23100 | 82 | 9890 |
| 15 | 19 | 22000 | 20 | 23300 | 20 | 22500 | 24 | 20200 | 13 | 24000 | 13 | 26100 | 198 | 3950 | 29 | 14000 | 5.1 | 23300 | 8.0 | 14500 | 7.9 | 22400 | 22 | 13000 |
| 16 | 19 | 22000 | 20 | 23000 | 21 | 22500 | 23 | 21200 | 13 | 24000 | 12 | 26900 | 128 | 6410 | 27 | 14700 | 4.5 | 23500 | 6.2 | 15400 | 7.0 | 21700 | 15 | 16200 |
| 17 | 24 | 21100 | 19 | 23200 | 22 | 22500 | 20 | 23600 | 13 | 24000 | 13 | 27300 | 100 | 7250 | 24 | 15800 | 5.1 | 23300 | 5.4 | 15600 | 6.6 | 21700 | 12 | 19900 |
| 18 | 32 | 20300 | 19 | 24300 | 23 | 22500 | 17 | 23800 | 13 | 24800 | 13 | 27300 | 92 | 10600 | 20 | 16200 | 17 | 22400 | 6.0 | 16100 | 18 | 14900 | 9.8 | 21000 |
| 19 | 35 | 20000 | 19 | 25000 | 22 | 23000 | 15 | 23500 | 13 | 24900 | 16 | 26400 | 70 | 12900 | 18 | 17000 | 8.0 | 25900 | 1220 | 7450 | 11 | 17100 | 7.9 | 22600 |
| 20 | 32 | 21000 | 19 | 23700 | 24 | 23600 | 18 | 23800 | 13 | 24600 | 26 | 22600 | 55 | 12100 | 20 | 17800 | 4.5 | 25600 | 1070 | 3580 | 9.4 | 19500 | 43 | 25000 |
| 21 | 28 | 22600 | 19 | 23000 | 24 | 24000 | 22 | 24200 | 14 | 25000 | 31 | 22700 | 45 | 11100 | 22 | 18000 | 3.8 | 25400 | 248 | 4400 | 8.9 | 19300 | 1530 | 4380 |
| 22 | 24 | 17700 | 18 | 23000 | 23 | 23900 | 23 | 25500 | 14 | 25900 | 37 | 30100 | 34 | 13400 | 19 | 18500 | 3.5 | 25900 | 160 | 5580 | 15 | 23500 | 544 | 2680 |
| 23 | 20 | 14500 | 19 | 23800 | 18 | 24000 | 22 | 23300 | 13 | 26800 | 24 | 18500 | 28 | 17300 | 17 | 19600 | 3.4 | 25300 | 96 | 6900 | 17 | 26700 | 157 | 2940 |
| 24 | 18 | 15500 | 19 | 24000 | 15 | 24000 | 22 | 23800 | 14 | 27000 | 18 | 21600 | 25 | 17500 | 15 | 19800 | 3.9 | 25500 | 63 | 8500 | 13 | 28000 | 88 | 4930 |
| 25 | 19 | 18300 | 20 | 24000 | 13 | 24000 | 20 | 24200 | 14 | 26900 | 17 | 22400 | 22 | 17500 | 14 | 20900 | 119 | 21700 | 41 | 10000 | 11 | 28000 | 59 | 6650 |
| 26 | 19 | 21500 | 20 | 24000 | 20 | 24000 | 19 | 25200 | 14 | 25800 | 15 | 23500 | 23 | 18800 | 13 | 21600 | 648 | 6150 | 33 | 11500 | 7.8 | 28000 | 58 | 9380 |
| 27 | 19 | 22000 | 20 | 24000 | 24 | 24500 | 20 | 25900 | 15 | 25500 | 18 | 25200 | 21 | 19000 | 14 | 21900 | 148 | 3930 | 28 | 11800 | 6.0 | 28000 | 101 | 9940 |
| 28 | 18 | 22500 | 18 | 24000 | 18 | 25200 | 18 | 26000 | 15 | 24500 | 15 | 23300 | 20 | 19000 | 15 | 21000 | 73 | 6950 | 26 | 12900 | 5.1 | 28000 | 86 | 8620 |
| 29 | 18 | 23200 | 17 | 24000 | 15 | 26000 | 18 | 26100 | -- | -- | 13 | 24300 | 19 | 19200 | 17 | 19200 | 47 | 9880 | 24 | 13800 | 4.8 | 27800 | 41 | 8280 |
| 30 | 18 | 23400 | 17 | 24000 | 13 | 25900 | 19 | 26000 | -- | -- | 12 | 26000 | 17 | 20600 | 109 | 14100 | 36 | 12700 | 22 | 14400 | 4.1 | 25700 | 32 | 12000 |
| 31 | 17 | 23000 | -- | -- | 15 | 24200 | 19 | 26000 | -- | -- | 14 | 25000 | -- | -- | 131 | 14600 | -- | -- | 18 | 16200 | 12 | 24900 | -- | -- |
| | 27.4 | 17700 | 18.9 | 23800 | 19.4 | 23700 | 20.2 | 23500 | 14.9 | 25000 | 16.1 | 25400 | 227.3 | 6100 | 129.4 | 6920 | 52.3 | 9450 | 308 | 4500 | 12.4 | 21200 | 126.2 | 6480 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 490

Location : North Fork of Red River near Headrick, Oklahoma

Water Year : 1961

Basin : Red River

Tributary to: Red River

Remarks : Records poor. Stratification nil.

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.2890 Log Sp.C. -1.7093

Sulfates : $SO_4$ = 0.1206 Sp.C.

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 32 | 6127 | 670 | 3450 | 165 | 6628 | 396 | 3851 | 209 | 7089 | 287 | 3486 | 299 | 4361 | 150 | 7030 | 52 | 7500 | 134 | 4776 | 76 | 5026 | 44 | 6331 |
| 2 | 26 | 7026 | 357 | 4300 | 159 | 6643 | 389 | 3871 | 272 | 7085 | 184 | 3822 | 395 | 3967 | 220 | 3243 | 53 | 7462 | 113 | 5237 | 69 | 6109 | 42 | 6636 |
| 3 | 23 | 7500 | 276 | 4535 | 155 | 6688 | 397 | 3950 | 294 | 5830 | 149 | 5040 | 431 | 3906 | 192 | 5745 | 72 | 6622 | 175 | 4527 | 64 | 6895 | 55 | 5759 |
| 4 | 22 | 8218 | 258 | 4883 | 159 | 6600 | 398 | 4050 | 360 | 4587 | 138 | 5958 | 529 | 3417 | 179 | 5220 | 1145 | 1947 | 196 | 2962 | 61 | 6900 | 121 | 3515 |
| 5 | 19 | 9388 | 239 | 4944 | 167 | 6689 | 394 | 4249 | 389 | 3640 | 115 | 6274 | 493 | 3076 | 136 | 3915 | 6326 | 1588 | 100 | 4088 | 60 | 6626 | 295 | 3351 |
| 6 | 19 | 9676 | 242 | 4900 | 181 | 6737 | 424 | 4163 | 371 | 3432 | 111 | 6528 | 476 | 3000 | 108 | 4503 | 5028 | 1013 | 85 | 4803 | 71 | 6454 | 168 | 1875 |
| 7 | 16 | 10177 | 225 | 4879 | 210 | 6368 | 506 | 3541 | 372 | 3625 | 112 | 6751 | 351 | 2508 | 190 | 5268 | 4076 | 1246 | 80 | 5431 | 71 | 6400 | 106 | 2832 |
| 8 | 15 | 10452 | 199 | 4841 | 219 | 5700 | 474 | 3400 | 360 | 3759 | 103 | 7198 | 273 | 2597 | 222 | 3413 | 5808 | 1390 | 74 | 5478 | 87 | 6442 | 109 | 2480 |
| 9 | 15 | 10309 | 441 | 4663 | 213 | 5209 | 406 | 3583 | 358 | 3006 | 111 | 7477 | 326 | 3268 | 172 | 3197 | 11035 | 1532 | 84 | 5500 | 64 | 6953 | 70 | 4200 |
| 10 | 14 | 10608 | 450 | 4253 | 238 | 5187 | 275 | 3800 | 359 | 3142 | 105 | 7242 | 383 | 2752 | 164 | 4523 | 4135 | 1410 | 110 | 5269 | 59 | 6664 | 293 | 6000 |
| 11 | 12 | 7569 | 438 | 4251 | 256 | 4917 | 221 | 4440 | 367 | 4294 | 101 | 6900 | 439 | 4110 | 102 | 4848 | 2858 | 1762 | 106 | 5476 | 59 | 6006 | 153 | 3600 |
| 12 | 1465 | 2469 | 352 | 4323 | 283 | 4872 | 210 | 5200 | 395 | 4174 | 102 | 6851 | 323 | 2900 | 87 | 5464 | 2638 | 1937 | 129 | 6591 | 58 | 5143 | 119 | 3500 |
| 13 | 6196 | 1542 | 176 | 4759 | 376 | 4900 | 212 | 5050 | 538 | 3767 | 102 | 7149 | 265 | 4200 | 80 | 6531 | 2613 | 2056 | 240 | 5743 | 52 | 5427 | 225 | 3150 |
| 14 | 3213 | 945 | 166 | 6063 | 560 | 4184 | 223 | 4900 | 611 | 3188 | 106 | 7238 | 241 | 4600 | 72 | 6644 | 2830 | 2027 | 724 | 2270 | 56 | 5763 | 157 | 3850 |
| 15 | 1191 | 992 | 163 | 6780 | 689 | 3925 | 279 | 4540 | 557 | 2863 | 106 | 7516 | 224 | 4800 | 67 | 7319 | 2816 | 1968 | 227 | 3619 | 67 | 6437 | 113 | 4700 |
| 16 | 606 | 1526 | 171 | 6980 | 1062 | 2345 | 435 | 4200 | 361 | 2775 | 106 | 7354 | 220 | 4800 | 65 | 7789 | 2453 | 1964 | 127 | 3235 | 105 | 8440 | 98 | 5300 |
| 17 | 355 | 1847 | 278 | 5811 | 1164 | 2460 | 419 | 4100 | 324 | 3358 | 160 | 6634 | 190 | 5000 | 65 | 9346 | 1659 | 1963 | 98 | 3940 | 100 | 9638 | 83 | 6200 |
| 18 | 8956 | 997 | 286 | 4963 | 837 | 2820 | 404 | 3850 | 275 | 2566 | 508 | 4110 | 129 | 5100 | 119 | 8158 | 858 | 2291 | 81 | 4350 | 90 | 6728 | 74 | 7620 |
| 19 | 19025 | 1085 | 289 | 4972 | 790 | 2885 | 397 | 3850 | 262 | 2169 | 1106 | 2564 | 116 | 6500 | 374 | 2760 | 784 | 2572 | 67 | 5318 | 114 | 4127 | 69 | 7750 |
| 20 | 7426 | 1084 | 281 | 4906 | 699 | 2967 | 411 | 3831 | 285 | 3525 | 1039 | 3599 | 109 | 6540 | 820 | 2941 | 586 | 2745 | 58 | 5500 | 536 | 2165 | 68 | 7576 |
| 21 | 3044 | 1600 | 279 | 4991 | 451 | 3335 | 352 | 3691 | 302 | 3715 | 1140 | 2453 | 104 | 6812 | 815 | 2227 | 549 | 3150 | 80 | 5335 | 945 | 800 | 66 | 7290 |
| 22 | 2588 | 1962 | 275 | 5000 | 425 | 3713 | 266 | 4091 | 320 | 4115 | 975 | 2450 | 100 | 7099 | 266 | 2720 | 451 | 3184 | 680 | 2906 | 264 | 1079 | 62 | 7452 |
| 23 | 2380 | 2094 | 274 | 5169 | 396 | 3725 | 263 | 4859 | 357 | 4115 | 752 | 2848 | 97 | 7138 | 197 | 3672 | 294 | 3236 | 1216 | 1909 | 133 | 2453 | 59 | 7374 |
| 24 | 2200 | 2183 | 274 | 5166 | 385 | 3750 | 259 | 5008 | 375 | 4170 | 569 | 3112 | 94 | 7324 | 178 | 4234 | 276 | 3913 | 543 | 2591 | 97 | 3482 | 639 | 2556 |
| 25 | 1588 | 2162 | 272 | 5203 | 374 | 3918 | 250 | 5375 | 455 | 4214 | 446 | 3550 | 88 | 6751 | 137 | 4373 | 290 | 3839 | 417 | 4630 | 81 | 4137 | 2792 | 1312 |
| 26 | 3313 | 2130 | 258 | 5278 | 363 | 3987 | 240 | 5307 | 516 | 3354 | 278 | 4150 | 84 | 7164 | 94 | 3948 | 259 | 3671 | 209 | 5047 | 69 | 4570 | 663 | 1400 |
| 27 | 2919 | 2100 | 249 | 5102 | 365 | 4050 | 230 | 6312 | 491 | 3000 | 251 | 4725 | 84 | 7792 | 80 | 4851 | 351 | 3481 | 139 | 4270 | 61 | 5122 | 266 | 1600 |
| 28 | 1840 | 2250 | 164 | 5084 | 358 | 4118 | 223 | 5910 | 415 | 3000 | 233 | 5000 | 82 | 7327 | 74 | 5669 | 275 | 3303 | 126 | 4434 | 56 | 5632 | 164 | 2050 |
| 29 | 1164 | 2800 | 156 | 6417 | 366 | 4137 | 230 | 5250 | -- | -- | 243 | 4900 | 80 | 7596 | 70 | 6186 | 176 | 3634 | 110 | 4967 | 53 | 6199 | 153 | 2600 |
| 30 | 1049 | 3100 | 165 | 6991 | 373 | 3991 | 252 | 5870 | -- | -- | 269 | 4605 | 87 | 8155 | 66 | 6069 | 146 | 3694 | 104 | 5227 | 50 | 6686 | 137 | 3000 |
| 31 | 997 | 3250 | -- | -- | 406 | 4000 | 227 | 6213 | -- | -- | 274 | 4428 | -- | -- | 61 | 722 | -- | -- | 86 | 5220 | 48 | 6592 | -- | -- |
| | 2314 | 1515 | 277 | 4898 | 414 | 3861 | 325 | 4217 | 377 | 3731 | 332 | 3874 | 237 | 4183 | 181 | 4078 | 2030 | 1733 | 217 | 3604 | 122 | 3739 | 249 | 2661 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 490

Location : North Fork of Red River near Headrick, Oklahoma

Water Year : 1962

Basin : Red River

Tributary to: Red River

Remarks : Records poor. Stratification nil.

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.2890 Log Sp.C. -1.7093

Sulfates : $SO_4$ = 0.1206 Sp.C.

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 108 | 3650 | 483 | 3968 | 106 | 6677 | 165 | 7412 | 99 | 7548 | 47 | 8048 | 40 | 8925 | 370 | 3638 | 293 | 2207 | 122 | 4250 | 107 | 5227 | 18 | 8099 |
| 2 | 129 | 4300 | 2820 | 885 | 107 | 6813 | 168 | 7665 | 90 | 7477 | 52 | 7456 | 40 | 9000 | 255 | 4323 | 1467 | 1797 | 100 | 4440 | 2466 | 3768 | 19 | 7494 |
| 3 | 128 | 4100 | 5660 | 932 | 112 | 7066 | 178 | 7669 | 86 | 7124 | 55 | 8403 | 39 | 8925 | 195 | 5019 | 1808 | 1000 | 83 | 5216 | 2424 | 1857 | 21 | 7165 |
| 4 | 127 | 4954 | 2681 | 890 | 121 | 6838 | 164 | 7425 | 84 | 7231 | 52 | 8685 | 40 | 8900 | 158 | 5565 | 662 | 2215 | 72 | 5792 | 819 | 1558 | 23 | 7499 |
| 5 | 110 | 6291 | 691 | 1119 | 132 | 6467 | 167 | 7622 | 82 | 7330 | 51 | 8238 | 43 | 8931 | 121 | 6169 | 386 | 3205 | 63 | 5302 | 384 | 1897 | 31 | 7221 |
| 6 | 93 | 6647 | 385 | 1592 | 138 | 6948 | 171 | 6863 | 79 | 7537 | 51 | 8704 | 48 | 8700 | 110 | 6833 | 339 | 2541 | 56 | 5594 | 243 | 2705 | 41 | 7388 |
| 7 | 85 | 6524 | 247 | 2158 | 135 | 6820 | 238 | 6385 | 79 | 8043 | 51 | 8721 | 53 | 8876 | 103 | 7632 | 2834 | 1218 | 48 | 5676 | 175 | 3480 | 50 | 6792 |
| 8 | 84 | 6017 | 157 | 2805 | 141 | 6485 | 194 | 6916 | 75 | 6995 | 51 | 9075 | 54 | 9077 | 97 | 8183 | 2485 | 1611 | 45 | 5907 | 131 | 4184 | 42 | 5959 |
| 9 | 131 | 4908 | 118 | 3421 | 139 | 6750 | 81 | 7204 | 65 | 7673 | 51 | 8963 | 56 | 10357 | 88 | 8651 | 2459 | 1676 | 50 | 6392 | 100 | 4610 | 35 | 6369 |
| 10 | 1790 | 1193 | 102 | 3893 | 134 | 6758 | 51 | 7739 | 62 | 8024 | 51 | 8667 | 59 | 10125 | 77 | 8564 | 10335 | 1476 | 50 | 6405 | 92 | 5581 | 201 | 4634 |
| 11 | 3073 | 420 | 90 | 4319 | 120 | 6819 | 51 | 8232 | 62 | 8030 | 50 | 8374 | 58 | 10464 | 71 | 8352 | 7038 | 1078 | 42 | 7048 | 83 | 5812 | 202 | 1851 |
| 12 | 718 | 393 | 80 | 4600 | 105 | 7400 | 88 | 7509 | 59 | 8398 | 50 | 8623 | 109 | 7872 | 65 | 8997 | 5063 | 1461 | 40 | 6992 | 74 | 5860 | 83 | 3029 |
| 13 | 289 | 782 | 73 | 4900 | 123 | 7800 | 116 | 6499 | 58 | 8375 | 50 | 8988 | 99 | 5638 | 57 | 9375 | 3875 | 1663 | 36 | 7416 | 65 | 5747 | 62 | 6425 |
| 14 | 146 | 1641 | 73 | 5251 | 160 | 5500 | 115 | 5987 | 58 | 8272 | 50 | 8563 | 80 | 6170 | 55 | 9651 | 4625 | 1340 | 50 | 7051 | 61 | 6879 | 44 | 9447 |
| 15 | 111 | 2453 | 108 | 5267 | 171 | 6254 | 112 | 6443 | 59 | 8250 | 50 | 9075 | 71 | 7643 | 51 | 9974 | 3750 | 1830 | 115 | 6857 | 56 | 7198 | 43 | 10207 |
| 16 | 90 | 3573 | 157 | 5408 | 162 | 6517 | 119 | 6515 | 59 | 8175 | 50 | 9022 | 66 | 8545 | 50 | 10117 | 4000 | 1837 | 79 | 10184 | 48 | 6946 | 38 | 8963 |
| 17 | 73 | 4887 | 421 | 4724 | 164 | 7017 | 135 | 6209 | 59 | 8175 | 48 | 9016 | 64 | 8187 | 48 | 10000 | 4250 | 1605 | 64 | 8606 | 43 | 6735 | 227 | 4409 |
| 18 | 61 | 5399 | 344 | 5298 | 171 | 7203 | 156 | 6357 | 61 | 8095 | 47 | 8817 | 62 | 8596 | 44 | 9825 | 2940 | 1884 | 133 | 5858 | 38 | 7050 | 2356 | 1254 |
| 19 | 58 | 5566 | 196 | 4033 | 181 | 7443 | 96 | 6999 | 59 | 7551 | 48 | 9072 | 61 | 7843 | 43 | 9496 | 2265 | 1931 | 127 | 3006 | 34 | 7648 | 2125 | 3504 |
| 20 | 54 | 5749 | 149 | 4338 | 182 | 7921 | 70 | 8180 | 59 | 7525 | 55 | 8515 | 59 | 8906 | 45 | 8490 | 2835 | 1811 | 87 | 4926 | 40 | 8019 | 619 | 2279 |
| 21 | 55 | 5966 | 125 | 5169 | 180 | 7619 | 62 | 8618 | 59 | 8256 | 51 | 8865 | 56 | 8969 | 60 | 7893 | 2889 | 1975 | 79 | 6445 | 42 | 8684 | 3886 | 2222 |
| 22 | 51 | 5911 | 110 | 5432 | 168 | 7249 | 68 | 8417 | 58 | 8500 | 50 | 8953 | 51 | 8576 | 48 | 9822 | 2679 | 2089 | 54 | 6078 | 35 | 9147 | 2816 | 1361 |
| 23 | 45 | 5775 | 104 | 5648 | 162 | 7300 | 89 | 8171 | 58 | 8500 | 50 | 8643 | 50 | 9118 | 40 | 11557 | 1928 | 2184 | 51 | 6266 | 30 | 10251 | 943 | 1245 |
| 24 | 45 | 5967 | 109 | 6003 | 169 | 7112 | 113 | 7357 | 56 | 8500 | 47 | 8675 | 61 | 8599 | 200 | 7824 | 1080 | 2327 | 59 | 5521 | 27 | 9601 | 439 | 1862 |
| 25 | 45 | 6188 | 95 | 5849 | 170 | 6629 | 138 | 6545 | 56 | 8500 | 45 | 8400 | 70 | 8423 | 195 | 5 25 | 755 | 2390 | 289 | 3909 | 25 | 9399 | 340 | 2326 |
| 26 | 47 | 6636 | 82 | 6289 | 167 | 7071 | 158 | 6677 | 58 | 8625 | 44 | 8623 | 65 | 8049 | 75 | 667 | 520 | 2552 | 2091 | 3628 | 23 | 8399 | 245 | 2886 |
| 27 | 44 | 7076 | 82 | 6482 | 164 | 7275 | 135 | 7683 | 55 | 9021 | 43 | 8827 | 811 | 6382 | 381 | 5959 | 284 | 2499 | 1075 | 2991 | 23 | 8061 | 182 | 3299 |
| 28 | 48 | 6986 | 78 | 6500 | 166 | 7357 | 121 | 8625 | 49 | 8339 | 42 | 9232 | 3930 | 3395 | 2001 | 175 | 248 | 2791 | 392 | 1786 | 21 | 8607 | 150 | 3797 |
| 29 | 40 | 6707 | 92 | 6595 | 175 | 7362 | 120 | 8976 | -- | -- | 40 | 8976 | 1403 | 2530 | 799 | 214 | 189 | 3421 | 218 | 1873 | 20 | 9052 | 122 | 4667 |
| 30 | 47 | 6586 | 101 | 6334 | 171 | 7046 | 115 | 8431 | -- | -- | 40 | 9350 | 679 | 3463 | 669 | 1016 | 151 | 4055 | 146 | 3246 | 19 | 8527 | 97 | 5073 |
| 31 | 96 | 5701 | -- | -- | 167 | 7356 | 106 | 8203 | -- | -- | 40 | 8763 | -- | -- | 259 | 154 | -- | -- | 114 | 4192 | 18 | 8340 | -- | -- |
| | 259 | 1835 | 534 | 1826 | 150 | 7012 | 125 | 7279 | 66 | 7931 | 49 | 8710 | 279 | 4474 | 220 | 3938 | 2482 | 1653 | 194 | 3986 | 250 | 3252 | 517 | 2329 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 490
Location: North Fork of Red River near Headrick, Oklahoma
Water Year: 1963

Basin: Red River
Tributary to: Red River
Remarks:

Equations Used to Compute Constituents:
Chlorides: Log Cl = 1.24811 Log Sp.C. - 1.53141
Sulfates: $SO_4$ = 0.08942 Sp.C. + 322

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho | cfs | μmho |
| 1 | 78 | 6200 | 112 | 5300 | 115 | 7700 | 75 | 8500 | 96 | 7700 | 178 | 5400 | 257 | 3000 | 36 | 11000 | 2140 | 1900 | 20 | 6700 | 0.1 | 8500 | 17 | 3850 |
| 2 | 68 | 5700 | 89 | 6300 | 109 | 6500 | 80 | 8600 | 112 | 7800 | 182 | 5300 | 114 | 2500 | 34 | 11000 | 3000 | 1900 | 18 | 7000 | 0 | -- | 9.6 | 4800 |
| 3 | 66 | 5650 | 78 | 6700 | 104 | 6100 | 80 | 8800 | 99 | 8300 | 182 | 5200 | 72 | 4000 | 33 | 10500 | 2120 | 1200 | 16 | 7200 | 0 | -- | 5.9 | 6100 |
| 4 | 59 | 5500 | 74 | 7200 | 106 | 6200 | 82 | 9000 | 82 | 8700 | 164 | 5100 | 62 | 7800 | 31 | 10000 | 662 | 1300 | 15 | 7200 | 0 | -- | 3.8 | 7000 |
| 5 | 76 | 5200 | 70 | 7400 | 115 | 6200 | 80 | 8600 | 86 | 9300 | 165 | 5200 | 64 | 8600 | 468 | 1950 | 737 | 2800 | 14 | 7100 | 0 | -- | 3.6 | 8000 |
| 6 | 82 | 4900 | 70 | 7800 | 127 | 7400 | 75 | 8200 | 82 | 9300 | 445 | 4200 | 72 | 9500 | 214 | 3200 | 541 | 2800 | 12 | 7000 | 0 | -- | 3.1 | 8500 |
| 7 | 80 | 5500 | 62 | 8100 | 104 | 7200 | 74 | 8300 | 72 | 9000 | 319 | 3100 | 68 | 9100 | 62 | 5200 | 2880 | 1210 | 12 | 7000 | 0 | -- | 0 | -- |
| 8 | 114 | 5100 | 59 | 8100 | 84 | 7300 | 80 | 8400 | 68 | 8400 | 194 | 3600 | 59 | 9500 | 39 | 7000 | 1930 | 1650 | 13 | 7000 | 0 | -- | 0 | -- |
| 9 | 140 | 6700 | 59 | 8200 | 74 | 7700 | 78 | 8500 | 68 | 8100 | 186 | 4500 | 58 | 9900 | 33 | 9000 | 726 | 1850 | 13 | 7000 | 0 | -- | 0 | -- |
| 10 | 99 | 7100 | 59 | 8400 | 74 | 7800 | 72 | 8100 | 78 | 7400 | 190 | 4250 | 58 | 9500 | 27 | 9500 | 1360 | 1500 | 17 | 7000 | 0 | -- | 0 | -- |
| 11 | 82 | 6200 | 59 | 8600 | 68 | 7900 | 68 | 8100 | 86 | 6900 | 210 | 4250 | 54 | 10200 | 26 | 9700 | 1130 | 1400 | 14 | 7000 | 0 | -- | 0 | -- |
| 12 | 72 | 6050 | 56 | 8800 | 64 | 8000 | 60 | 8900 | 109 | 6500 | 202 | 4550 | 51 | 10100 | 23 | 10000 | 600 | 1950 | 10 | 7000 | 0 | -- | 0 | -- |
| 13 | 66 | 6300 | 54 | 9000 | 68 | 8000 | 50 | 9400 | 145 | 5500 | 186 | 5150 | 50 | 10000 | 21 | 10500 | 364 | 2600 | 13 | 7100 | 0 | -- | 0 | -- |
| 14 | 62 | 6700 | 56 | 9000 | 68 | 7800 | 40 | 9700 | 236 | 4400 | 198 | 4900 | 48 | 10000 | 20 | 10500 | 389 | 2800 | 16 | 7200 | 0 | -- | 50 | 5000 |
| 15 | 56 | 7100 | 53 | 9000 | 62 | 7800 | 38 | 8300 | 236 | 3400 | 214 | 4500 | 45 | 9900 | 18 | 10700 | 363 | 3200 | 127 | 2400 | 0 | -- | 24 | 4000 |
| 16 | 51 | 7600 | 51 | 9000 | 61 | 8400 | 34 | 7500 | 250 | 3150 | 198 | 4350 | 42 | 9900 | 16 | 10600 | 266 | 4300 | 50 | 1500 | 1.8 | 9000 | 95 | 2600 |
| 17 | 50 | 8300 | 58 | 9000 | 61 | 8400 | 30 | 7000 | 277 | 3350 | 190 | 4350 | 40 | 9800 | 15 | 10000 | 152 | 2850 | 43 | 4600 | 17 | 6800 | 312 | 2690 |
| 18 | 58 | 8100 | 66 | 9000 | 62 | 8600 | 26 | 7000 | 282 | 3500 | 194 | 4550 | 38 | 9800 | 14 | 10000 | 115 | 3000 | 35 | 10200 | 23 | 5000 | 656 | 3630 |
| 19 | 62 | 8000 | 72 | 9050 | 62 | 8600 | 20 | 8000 | 286 | 4000 | 178 | 4450 | 33 | 9900 | 14 | 10000 | 92 | 3500 | 20 | 6800 | 27 | 6900 | 265 | 6580 |
| 20 | 74 | 6700 | 72 | 9050 | 62 | 8600 | 15 | 8300 | 326 | 4100 | 107 | 4700 | 32 | 10000 | 22 | 10000 | 84 | 4500 | 14 | 6500 | 20 | 7000 | 104 | 5200 |
| 21 | 609 | 2560 | 76 | 8900 | 62 | 8500 | 14 | 8000 | 415 | 3350 | 80 | 5100 | 31 | 10000 | 21 | 10000 | 78 | 5400 | 11 | 6700 | 15 | 7000 | 59 | 5200 |
| 22 | 518 | 1600 | 76 | 8900 | 61 | 8400 | 13 | 6500 | 328 | 3400 | 70 | 6700 | 30 | 10200 | 20 | 10300 | 70 | 5300 | 8.6 | 7300 | 10 | 7000 | 42 | 5400 |
| 23 | 324 | 6300 | 70 | 8900 | 61 | 8300 | 12 | 7500 | 220 | 3950 | 62 | 7400 | 28 | 10300 | 19 | 10600 | 54 | 5200 | 7.2 | 7700 | 0 | -- | 32 | 5700 |
| 24 | 148 | 5000 | 64 | 8800 | 64 | 8200 | 12 | 8200 | 182 | 4900 | 58 | 7800 | 28 | 10400 | 18 | 10300 | 237 | 3000 | 7 | 8100 | 0 | -- | 24 | 6300 |
| 25 | 99 | 5200 | 64 | 8800 | 70 | 8100 | 13 | 8700 | 170 | 5500 | 53 | 7900 | 29 | 10500 | 17 | 9600 | 194 | 1100 | 6 | 8400 | 0 | -- | 21 | 7100 |
| 26 | 80 | 5350 | 70 | 8800 | 68 | 8100 | 14 | 8700 | 174 | 5400 | 50 | 8100 | 37 | 10500 | 16 | 9200 | 48 | 2400 | 5 | 8800 | 0 | -- | 19 | 7500 |
| 27 | 62 | 5450 | 76 | 8700 | 64 | 8000 | 14 | 8500 | 174 | 5300 | 50 | 8100 | 48 | 10600 | 15 | 9200 | 30 | 4900 | 4 | 9000 | 0 | -- | 16 | 7600 |
| 28 | 445 | 2580 | 84 | 8700 | 70 | 8000 | 14 | 8300 | 170 | 5400 | 54 | 8800 | 45 | 10800 | 16 | 9200 | 26 | 5800 | 3 | 9000 | 0 | -- | 12 | 8000 |
| 29 | 869 | 930 | 133 | 8000 | 70 | 8000 | 20 | 8000 | -- | -- | 50 | 8000 | 45 | 10800 | 15 | 9000 | 23 | 6200 | 2 | 8900 | 0 | -- | 9 | 8400 |
| 30 | 239 | 1740 | 175 | 6500 | 68 | 8100 | 30 | 8100 | -- | -- | 72 | 7000 | 40 | 11000 | 134 | 8000 | 21 | 6500 | 1 | 8800 | 6.2 | 3200 | 6 | 8800 |
| 31 | 146 | 3600 | -- | -- | 74 | 8200 | 50 | 8000 | -- | -- | 102 | 6000 | -- | -- | 4270 | 108 | -- | -- | .5 | 8700 | 17 | 4800 | -- | -- |
| Mean | 162 | 3740 | 74 | 8070 | 77 | 7660 | 44 | 8400 | 175 | 4920 | 154 | 4880 | 56 | 8040 | 185 | 232 | 681 | 1860 | 17.7 | 5530 | 4.4 | 6190 | 59.6 | 4380 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 490
Location: North Fork Red River Near Headrick, Oklahoma
Water Year: 1964

Basin: Red River
Tributary to: Red River
Remarks:

Equations Used to Compute Constituents:
Chlorides: Log Cl = 1.19320 Log SC -1.29717
Sulfates: Log $SO_4$ = 0.80788 Log SC -0.18556

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (umho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 5 | 9000 | 12 | 8300 | 20 | 10200 | 20 | 15200 | 21 | 13000 | 31 | 12800 | 22 | 13000 | 7.7 | 13200 | 500 | 2800 | 35 | 9200 | 0 | -- | 0.1 | 6400 |
| 2 | 4 | 9200 | 10 | 8500 | 18 | 10800 | 20 | 15800 | 20 | 13000 | 31 | 12900 | 21 | 13200 | 8.4 | 12200 | 184 | 2140 | 29 | 9000 | 0 | -- | 0.1 | 5700 |
| 3 | 3 | 9400 | 9.4 | 8500 | 18 | 12000 | 18 | 15200 | 23 | 12500 | 29 | 12900 | 19 | 13800 | 11 | 12000 | 103 | 2940 | 22 | 8500 | 0 | -- | 0.1 | 5400 |
| 4 | 3.5 | 9200 | 8.4 | 8500 | 18 | 12600 | 18 | 14200 | 185 | 7200 | 29 | 12500 | 20 | 15000 | 8.4 | 12700 | 66 | 4130 | 19 | 8200 | 0 | -- | 0.1 | 5000 |
| 5 | 2 | 9000 | 8.0 | 8500 | 18 | 13500 | 17 | 14000 | 1270 | 1360 | 29 | 12800 | 22 | 15000 | 7.1 | 12200 | 52 | 6200 | 15 | 8200 | 0 | -- | 0.1 | 5000 |
| 6 | 1.5 | 9000 | 7.7 | 8500 | 18 | 13600 | 17 | 14200 | 1190 | 1840 | 27 | 12800 | 18 | 15000 | 9.4 | 11500 | 50 | 8500 | 10 | 8400 | 0 | -- | 0 | -- |
| 7 | 1 | 9000 | 7.4 | 8500 | 17 | 13600 | 16 | 14200 | 646 | 1650 | 27 | 11800 | 16 | 15000 | 9.4 | 11500 | 40 | 11500 | 7 | 8700 | 0 | -- | 0 | -- |
| 8 | 0.7 | 9000 | 7.1 | 8500 | 16 | 13500 | 14 | 15000 | 265 | 5120 | 29 | 11800 | 14 | 15000 | 8.7 | 11000 | 35 | 10000 | 5 | 9700 | 0 | -- | 0 | -- |
| 9 | 0.5 | 9000 | 7.1 | 8500 | 16 | 13200 | 12 | 15700 | 142 | 4630 | 29 | 11200 | 13 | 15000 | 75 | 15500 | 29 | 11500 | 3.4 | 10700 | 0 | -- | 0 | -- |
| 10 | 0.4 | 9000 | 6.8 | 8400 | 18 | 13300 | 10 | 15700 | 104 | 5600 | 28 | 11700 | 12 | 14800 | 209 | 7080 | 24 | 13800 | 2.8 | 10500 | 0 | -- | 0 | -- |
| 11 | 0.3 | 9000 | 6.5 | 8500 | 18 | 13500 | 7 | 15500 | 85 | 6500 | 26 | 13000 | 11 | 15000 | 415 | 3000 | 26 | 11700 | 2.0 | 10800 | 0 | -- | 0 | -- |
| 12 | 0.2 | 9000 | 6.2 | 8500 | 17 | 13800 | 6 | 15200 | 71 | 7500 | 26 | 13300 | 10 | 16000 | 726 | 3250 | 25 | 9500 | 1.4 | 11000 | 0 | -- | 0 | -- |
| 13 | 0.1 | 8800 | 7.4 | 9000 | 14 | 14000 | 5 | 16000 | 64 | 8300 | 25 | 13800 | 10 | 16500 | 930 | 3870 | 27 | 8700 | 0.9 | 11000 | 0 | -- | 0 | -- |
| 14 | 0 | -- | 7.4 | 10000 | 9 | 14100 | 5.5 | 16000 | 57 | 8800 | 25 | 12800 | 10 | 17500 | 245 | 3050 | 89 | 8890 | 0.6 | 10800 | 0 | -- | 0 | -- |
| 15 | 0 | -- | 7.4 | 10700 | 11 | 14000 | 5.5 | 16000 | 55 | 9500 | 25 | 12800 | 10 | 17500 | 129 | 3300 | 3220 | 4270 | 0.4 | 10000 | 0.3 | 2900 | 0.2 | 9000 |
| 16 | 0 | -- | 7.1 | 10700 | 12 | 13200 | 6 | 15200 | 53 | 10000 | 24 | 12500 | 9.8 | 17000 | 91 | 4260 | 1950 | 2280 | 0.2 | 9600 | 0.1 | 3200 | 0.2 | 9300 |
| 17 | 0 | -- | 6.0 | 10700 | 10 | 13000 | 7 | 13500 | 50 | 10000 | 24 | 12800 | 9.4 | 16000 | 68 | 5300 | 707 | 2250 | 0.2 | 9600 | 0 | -- | 0.2 | 8700 |
| 18 | 0 | -- | 6.0 | 10800 | 7 | 13200 | 8 | 12000 | 48 | 10500 | 27 | 13000 | 9.8 | 15500 | 52 | 6300 | 789 | 1300 | 0.1 | 9000 | 47 | 3300 | 212 | 6700 |
| 19 | 0 | -- | 20 | 8330 | 6.5 | 13800 | 9 | 12000 | 47 | 11000 | 39 | 12000 | 10 | 15000 | 41 | 6300 | 220 | 1750 | 0.1 | 8700 | 25 | 8650 | 167 | 9300 |
| 20 | 0 | -- | 31 | 8800 | 6 | 13900 | 10 | 12200 | 45 | 11800 | 34 | 11800 | 18 | 16500 | 35 | 6700 | 109 | 3290 | 0 | -- | 34 | 7020 | 83 | 8600 |
| 21 | 0 | -- | 41 | 11000 | 5.5 | 14000 | 14 | 12500 | 44 | 12000 | 33 | 14000 | 20 | 15500 | 29 | 9200 | 88 | 4350 | 0 | -- | 20 | 3500 | 109 | 8600 |
| 22 | 0 | -- | 57 | 10500 | 5 | 14000 | 18 | 13400 | 44 | 11800 | 32 | 14500 | 14 | 10500 | 24 | 9500 | 164 | 5180 | 0 | -- | 7.6 | 3800 | 268 | 3310 |
| 23 | 3.1 | 8500 | 65 | 13500 | 5.5 | 14000 | 17 | 15000 | 41 | 11000 | 31 | 15200 | 12 | 11000 | 20 | 9200 | 219 | 4420 | 0 | -- | 2.7 | 5500 | 133 | 1930 |
| 24 | 305 | 2210 | 51 | 11500 | 7 | 14100 | 17 | 15800 | 40 | 11000 | 31 | 14800 | 12 | 12000 | 18 | 10200 | 109 | 2670 | 0 | -- | 0.8 | 6200 | 72 | 2440 |
| 25 | 1470 | 635 | 56 | 8300 | 10 | 14000 | 16 | 16500 | 35 | 11000 | 28 | 14000 | 12 | 12500 | 15 | 10800 | 89 | 3100 | 0 | -- | 0.3 | 6800 | 48 | 3080 |
| 26 | 164 | 890 | 44 | 12500 | 19 | 13500 | 16 | 16000 | 33 | 11000 | 26 | 13800 | 12 | 13000 | 13 | 11000 | 75 | 4300 | 0 | -- | 0.6 | 7200 | 38 | 3750 |
| 27 | 59 | 1570 | 34 | 14000 | 19 | 14000 | 14 | 15200 | 31 | 12200 | 26 | 13000 | 10 | 14000 | 11 | 11000 | 65 | 5500 | 0 | -- | 0.6 | 5900 | 307 | 1960 |
| 28 | 35 | 3030 | 27 | 11000 | 18 | 13800 | 14 | 15000 | 32 | 12000 | 24 | 12800 | 9.0 | 15000 | 11 | 11000 | 55 | 6200 | 0 | -- | 0.2 | 6300 | 244 | 1210 |
| 29 | 22 | 6700 | 24 | 9300 | 21 | 13500 | 14 | 15000 | 31 | 12200 | 23 | 13000 | 8.4 | 15200 | 21 | 9560 | 51 | 6700 | 0 | -- | 0.2 | 6600 | 76 | 1210 |
| 30 | 18 | 8000 | 21 | 9500 | 21 | 13500 | 18 | 13400 | -- | -- | 22 | 12500 | 8.4 | 14500 | 163 | 5180 | 40 | 7600 | 0 | -- | 0.2 | 6800 | 50 | 2550 |
| 31 | 13 | 8500 | -- | -- | 21 | 14500 | 21 | 13000 | -- | -- | 22 | 12200 | -- | -- | 867 | 2130 | -- | -- | 0 | -- | 0.1 | 6800 | -- | -- |
| Mean | 68 | 1220 | 20 | 10500 | 14 | 13300 | 13 | 14600 | 165 | 3940 | 28 | 13000 | 13 | 14600 | 138 | 4140 | 307 | 3490 | 5.0 | 8900 | 4.5 | 5330 | 60 | 4070 |

# Appendix D (Cont'd)

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 490

Location : North Fork of Red River near Headrick, Oklahoma

Water Year : 1965

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: LOG CL = 1.34488 LOG SP.C. - 1.89235

Sulfates : LOG $SO_4$ = 0.49847 LOG SP.C. + 1.00762

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 41 | 3790 | 15 | 12300 | 42 | 8370 | 35 | 13000 | 22 | 12000 | 24 | 12100 | 21 | 12800 | 29 | 10700 | 30 | 8010 | 123 | 2750 | 4.3 | 11000 | .3 | 9880 |
| 2 | 30 | 6130 | 12 | 12500 | 42 | 9320 | 33 | 12900 | 20 | 12600 | 22 | 13100 | 23 | 12400 | 27 | 10400 | 28 | 9570 | 92 | 3450 | 4.3 | 11400 | .2 | 10000 |
| 3 | 23 | 7530 | 22 | 10700 | 41 | 9350 | 31 | 13000 | 26 | 12200 | 24 | 13200 | 43 | 11400 | 25 | 9630 | 237 | 7000 | 76 | 4380 | 4.8 | 11800 | .3 | 10000 |
| 4 | 17 | 8090 | 46 | 5090 | 34 | 8210 | 32 | 13000 | 27 | 12200 | 22 | 13400 | 34 | 12400 | 24 | 8730 | 579 | 2160 | 64 | 5100 | 3.9 | 11300 | .3 | 10000 |
| 5 | 12 | 8280 | 57 | 8470 | 32 | 9170 | 32 | 12700 | 28 | 13100 | 21 | 13500 | 34 | 12900 | 23 | 8830 | 4400 | 2880 | 51 | 6550 | 2.8 | 9740 | .2 | 10000 |
| 6 | 9.4 | 8000 | 471 | 5460 | 35 | 9650 | 34 | 12300 | 27 | 12100 | 21 | 13300 | 32 | 13000 | 23 | 9170 | 3510 | 2390 | 51 | 8010 | 2.7 | 10500 | .2 | 11200 |
| 7 | 7.4 | 7820 | 478 | 1580 | 37 | 10600 | 34 | 11900 | 27 | 12300 | 20 | 13200 | 30 | 13600 | 22 | 9640 | 1570 | 2120 | 48 | 8300 | 3.9 | 11600 | 392 | 9010 |
| 8 | 5.5 | 7890 | 237 | 3610 | 36 | 11400 | 33 | 11700 | 26 | 12000 | 19 | 14200 | 34 | 13800 | 697 | 7370 | 500 | 2230 | 51 | 8500 | 4.1 | 11400 | 837 | 4970 |
| 9 | 4.3 | 8000 | 125 | 3990 | 35 | 11100 | 32 | 11500 | 34 | 11800 | 20 | 14100 | 39 | 11600 | 822 | 1960 | 254 | 2670 | 51 | 9130 | 3.2 | 11400 | 241 | 5310 |
| 10 | 3.5 | 8150 | 74 | 5880 | 42 | 10800 | 32 | 11300 | 35 | 11800 | 19 | 13500 | 56 | 12300 | 248 | 2220 | 178 | 3350 | 45 | 9730 | 5.0 | 11300 | 98 | 4350 |
| 11 | 2.8 | 8240 | 50 | 5080 | 42 | 11000 | 34 | 11800 | 35 | 12200 | 21 | 13000 | 36 | 12000 | 119 | 2680 | 138 | 4210 | 37 | 9750 | 3.4 | 12200 | 53 | 4660 |
| 12 | 3.0 | 7570 | 35 | 5560 | 40 | 11900 | 38 | 12100 | 33 | 12800 | 27 | 12300 | 29 | 12000 | 88 | 3760 | 111 | 5080 | 32 | 9530 | 2.4 | 10800 | 34 | 5380 |
| 13 | 3.0 | 7380 | 29 | 6630 | 41 | 12100 | 33 | 10900 | 32 | 12700 | 29 | 12500 | 55 | 9330 | 74 | 4450 | 406 | 3630 | 29 | 9670 | 5.9 | 12100 | 25 | 6310 |
| 14 | 2.1 | 8450 | 24 | 8020 | 45 | 12500 | 33 | 11200 | 31 | 12200 | 32 | 13100 | 72 | 7800 | 83 | 5460 | 971 | 2450 | 26 | 9980 | 13 | 12600 | 19 | 5450 |
| 15 | 1.5 | 8760 | 21 | 8840 | 50 | 13100 | 32 | 11400 | 31 | 12100 | 32 | 13500 | 66 | 12600 | 101 | 6720 | 1440 | 2120 | 29 | 10200 | 18 | 6340 | 14 | 4080 |
| 16 | 1.3 | 9000 | 39 | 8400 | 46 | 13000 | 31 | 11400 | 29 | 11700 | 34 | 13800 | 615 | 9340 | 72 | 6480 | 940 | 2260 | 23 | 11200 | 16 | 6220 | 12 | 3610 |
| 17 | .8 | 8960 | 207 | 3780 | 20 | 13000 | 32 | 11500 | 28 | 13000 | 39 | 12800 | 371 | 3420 | 62 | 7630 | 1160 | 1750 | 21 | 11600 | 9.8 | 6380 | 9.0 | 3600 |
| 18 | .5 | 9000 | 1070 | 4770 | 16 | 13000 | 32 | 11700 | 28 | 13000 | 37 | 12100 | 158 | 3170 | 52 | 9880 | 595 | 2650 | 19 | 11500 | 7.1 | 7480 | 8.7 | 3770 |
| 19 | .2 | 9220 | 1200 | 1980 | 32 | 12700 | 33 | 12500 | 27 | 13400 | 33 | 12200 | 99 | 3880 | 113 | 7750 | 162 | 2600 | 16 | 11400 | 4.8 | 8480 | 1850 | 2370 |
| 20 | .2 | 9490 | 612 | 2030 | 36 | 11100 | 31 | 13000 | 27 | 13500 | 32 | 12500 | 76 | 4880 | 101 | 4070 | 92 | 3000 | 14 | 12000 | 4.1 | 9300 | 14000 | 769 |
| 21 | .2 | 9530 | 284 | 1810 | 46 | 11000 | 32 | 12900 | 26 | 12900 | 29 | 12600 | 58 | 6100 | 84 | 4660 | 64 | 3850 | 13 | 11900 | 3.0 | 10100 | 14200 | 573 |
| 22 | .2 | 9430 | 155 | 2360 | 46 | 11600 | 33 | 12700 | 26 | 12800 | 29 | 12300 | 46 | 7390 | 50 | 5710 | 57 | 4730 | 12 | 11600 | 2.4 | 10800 | 12000 | 803 |
| 23 | .2 | 9340 | 117 | 3260 | 42 | 12000 | 32 | 12400 | 20 | 12000 | 26 | 12900 | 39 | 8330 | 40 | 7100 | 53 | 5280 | 10 | 11200 | 2.1 | 10700 | 3850 | 795 |
| 24 | .2 | 9010 | 90 | 4480 | 41 | 12500 | 31 | 12400 | 10 | 12100 | 23 | 13000 | 35 | 8980 | 37 | 8020 | 47 | 5730 | 9.4 | 11100 | 1.5 | 10100 | 884 | 1600 |
| 25 | .2 | 10000 | 71 | 5550 | 41 | 13000 | 30 | 12200 | 14 | 13500 | 23 | 13300 | 35 | 9550 | 36 | 9080 | 189 | 5840 | 11 | 10600 | 1.1 | 9880 | 487 | 2790 |
| 26 | .2 | 9940 | 60 | 6330 | 39 | 13000 | 29 | 12300 | 30 | 12300 | 22 | 13000 | 33 | 9910 | 41 | 8850 | 705 | 2910 | 16 | 8480 | 1.0 | 9450 | 354 | 3850 |
| 27 | .1 | 9520 | 57 | 7240 | 37 | 13000 | 29 | 12900 | 26 | 11200 | 22 | 13000 | 32 | 10100 | 40 | 8370 | 1520 | 1730 | 11 | 11400 | .9 | 9400 | 280 | 4950 |
| 28 | 3.4 | 9990 | 50 | 7500 | 38 | 13000 | 28 | 12300 | 27 | 13700 | 22 | 13000 | 33 | 10200 | 64 | 7120 | 716 | 1670 | 10 | 11100 | 1.2 | 9880 | 234 | 5680 |
| 29 | 37 | 17300 | 47 | 8000 | 38 | 13000 | 26 | 12000 | -- | -- | 21 | 13200 | 36 | 10200 | 69 | 4630 | 248 | 2180 | 8.7 | 10900 | 1.3 | 9680 | 200 | 6330 |
| 30 | 27 | 15100 | 42 | 7420 | 35 | 13100 | 26 | 12000 | -- | -- | 21 | 13100 | 33 | 11100 | 40 | 5930 | 168 | 2250 | 6.2 | 11000 | .6 | 9080 | 168 | 6550 |
| 31 | 19 | 12400 | -- | -- | 34 | 13000 | 26 | 12000 | -- | -- | 21 | 12900 | -- | -- | 32 | 7200 | -- | -- | 5.2 | 11000 | .3 | 8710 | -- | -- |
| Mean | 8.26 | 9540 | 193 | 3650 | 38.1 | 11600 | 31.6 | 12200 | 26.9 | 12500 | 25.4 | 13000 | 76.8 | 8110 | 108 | 5230 | 702 | 2550 | 32.6 | 7500 | 4.48 | 9380 | 1675 | 1100 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

**FWPCA Station No.:** 490

**Location** : North Fork of Red River near Headrick, Oklahoma

**Water Year** : 1966

**Basin** : Red River

**Tributary to:** Red River

**Remarks** :

**Equations Used to Compute Constituents**

Chlorides: Log Cl = 1.18015 Log Sp. C. - 1.25483

Sulfates : $SO_4$ = 0.0559 Sp.C. +454

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 149 | 6700 | 192 | 7780 | 100 | 10500 | 99 | 7880 | 60 | 9120 | 98 | 8530 | 55 | 11300 | 75 | 10800 | 19 | 12000 | 4.3 | 11600 | 2.9 | 10000 | 72 | 6000 |
| 2 | 140 | 6700 | 188 | 8000 | 106 | 10450 | 96 | 8330 | 80 | 9380 | 103 | 8900 | 55 | 8810 | 72 | 11000 | 19 | 12000 | 2.9 | 11900 | 0 | -- | 950 | 4160 |
| 3 | 131 | 6950 | 190 | 7900 | 103 | 10300 | 92 | 8500 | 100 | 9830 | 100 | 8850 | 55 | 7150 | 92 | 10200 | 19 | 12000 | 1.4 | 11900 | 0 | -- | 677 | 2000 |
| 4 | 122 | 8080 | 180 | 7600 | 100 | 10200 | 92 | 8500 | 100 | 9800 | 92 | 9000 | 55 | 7180 | 100 | 7890 | 16 | 12000 | .9 | 12000 | 0 | -- | 258 | 2740 |
| 5 | 122 | 9380 | 174 | 7630 | 98 | 10100 | 98 | 8930 | 147 | 9680 | 86 | 9000 | 55 | 7500 | 63 | 9200 | 13 | 12000 | .6 | 12000 | 0 | -- | 210 | 2980 |
| 6 | 122 | 9500 | 170 | 7700 | 96 | 10000 | 91 | 8730 | 138 | 9730 | 80 | 9000 | 55 | 7730 | 57 | 10600 | 9.4 | 12750 | .3 | 12200 | 0 | -- | 570 | 2110 |
| 7 | 120 | 9500 | 168 | 7700 | 96 | 10000 | 89 | 8930 | 137 | 10000 | 80 | 9380 | 50 | 7800 | 52 | 12000 | 8.4 | 13000 | 0 | -- | .4 | 7800 | 278 | 2260 |
| 8 | 113 | 9500 | 160 | 8230 | 94 | 10000 | 87 | 9080 | 153 | 9830 | 84 | 9380 | 50 | 8380 | 46 | 11700 | 7.4 | 13000 | 0 | -- | 0 | -- | 151 | 2830 |
| 9 | 110 | 9500 | 155 | 8500 | 94 | 10000 | 89 | 9080 | 687 | 5480 | 79 | 8630 | 50 | 9330 | 38 | 11000 | 8.4 | 13000 | 0 | -- | 0 | -- | 99 | 3090 |
| 10 | 100 | 9500 | 151 | 8500 | 96 | 10000 | 91 | 9380 | 521 | 2080 | 80 | 8760 | 50 | 10300 | 36 | 11000 | 8.4 | 13000 | 0 | -- | 0 | -- | 75 | 3460 |
| 11 | 90 | 9880 | 156 | 8500 | 98 | 10000 | 89 | 8960 | 282 | 7390 | 80 | 8990 | 50 | 10200 | 44 | 11000 | 5.8 | 13000 | 2.9 | 11500 | 0 | -- | 49 | 4200 |
| 12 | 80 | 10000 | 153 | 8550 | 92 | 10000 | 89 | 9100 | 204 | 6160 | 84 | 9000 | 50 | 10200 | 36 | 11000 | 5.0 | 13000 | 1.9 | 12000 | 0 | -- | 33 | 5300 |
| 13 | 84 | 10000 | 144 | 9050 | 91 | 10000 | 89 | 9180 | 158 | 3880 | 561 | 4800 | 46 | 10400 | 36 | 11000 | 5.0 | 13000 | 0 | -- | 137 | 9080 | 31 | 7130 |
| 14 | 92 | 10450 | 142 | 9500 | 91 | 10000 | 84 | 8960 | 129 | 4350 | 584 | 5040 | 46 | 10600 | 33 | 11200 | 5.8 | 13000 | 0 | -- | 225 | 1590 | 25 | 9330 |
| 15 | 80 | 9930 | 147 | 9500 | 87 | 10000 | 84 | 8800 | 120 | 5180 | 258 | 2160 | 46 | 10800 | 31 | 11200 | 3.6 | 13000 | 0 | -- | 64 | 2590 | 48 | 7620 |
| 16 | 74 | 9000 | 137 | 9500 | 87 | 10000 | 80 | 8800 | 122 | 6030 | 159 | 2540 | 33 | 11000 | 33 | 11500 | 4.3 | 12700 | 0 | -- | 18 | 2830 | 46 | 5860 |
| 17 | 70 | 9200 | 128 | 9500 | 86 | 10000 | 77 | 9280 | 106 | 6680 | 123 | 3410 | 36 | 11000 | 33 | 11800 | 18 | 12100 | 0 | -- | 9.4 | 3190 | 74 | 4880 |
| 18 | 6760 | 2400 | 126 | 9500 | 89 | 10000 | 77 | 9130 | 100 | 7700 | 93 | 4210 | 29 | 11200 | 29 | 11800 | 5.8 | 12000 | 0 | -- | 3.6 | 3860 | 353 | 4950 |
| 19 | 17700 | 1250 | 129 | 9500 | 87 | 10000 | 91 | 8850 | 100 | 7900 | 87 | 4980 | 25 | 11700 | 29 | 11800 | 3.6 | 12000 | 0 | -- | 1.4 | 5260 | 808 | 5000 |
| 20 | 7680 | 790 | 128 | 9500 | 86 | 9920 | 92 | 8500 | 91 | 7830 | 93 | 5800 | 21 | 12000 | 29 | 11850 | 5.8 | 12000 | 0 | -- | 0 | -- | 828 | 2390 |
| 21 | 1670 | 1340 | 124 | 9500 | 89 | 9680 | 96 | 8600 | 87 | 8380 | 87 | 6580 | 19 | 12000 | 31 | 12000 | 5.8 | 11600 | 0 | -- | 93 | 10500 | 306 | 2050 |
| 22 | 705 | 2860 | 120 | 9650 | 91 | 9530 | 195 | 9000 | 91 | 8500 | 75 | 7330 | 33 | 11300 | 29 | 12400 | 8.4 | 11500 | 0 | -- | 194 | 8480 | 176 | 2530 |
| 23 | 438 | 4150 | 120 | 9500 | 108 | 9300 | 80 | 9130 | 96 | 8500 | 69 | 7880 | 57 | 10400 | 25 | 12250 | 8.4 | 11000 | 0 | -- | 143 | 3930 | 126 | 3390 |
| 24 | 332 | 4980 | 119 | 9500 | 1100 | 2560 | 60 | 8890 | 99 | 8480 | 66 | 8050 | 75 | 11750 | 21 | 12000 | 5.8 | 10800 | 0 | -- | 238 | 2830 | 105 | 4790 |
| 25 | 317 | 5600 | 117 | 9500 | 336 | 4510 | 80 | 8780 | 94 | 8650 | 65 | 8330 | 109 | 11750 | 21 | 12000 | 3.6 | 10700 | 0 | -- | 1430 | 2080 | 90 | 6640 |
| 26 | 282 | 5980 | 115 | 9500 | 252 | 4780 | 50 | 9380 | 92 | 9130 | 65 | 8580 | 132 | 10400 | 23 | 12000 | 6.3 | 9810 | 0 | -- | 902 | 1180 | 78 | 8290 |
| 27 | 258 | 6280 | 110 | 9680 | 165 | 4850 | 100 | 9480 | 94 | 8950 | 65 | 8950 | 117 | 10100 | 23 | 12000 | 48 | 6800 | 58 | 11500 | 335 | 1110 | 75 | 8080 |
| 28 | 238 | 6500 | 104 | 9950 | 146 | 6830 | 100 | 9550 | 98 | 8600 | 65 | 9000 | 93 | 9000 | 21 | 12000 | 15 | 9150 | 65 | 8300 | 188 | 2460 | 66 | 8250 |
| 29 | 222 | 6580 | 100 | 10380 | 111 | 7400 | 100 | 10100 | -- | -- | 60 | 8980 | 84 | 9080 | 19 | 12000 | 11 | 10800 | 23 | 9750 | 135 | 4190 | 647 | 5820 |
| 30 | 210 | 6900 | 99 | 10500 | 106 | 7330 | 50 | 10200 | -- | -- | 60 | 8800 | 84 | 9580 | 19 | 12000 | 7.4 | 11600 | 7.4 | 10000 | 102 | 5150 | 730 | 1430 |
| 31 | 202 | 7380 | -- | -- | 98 | 7400 | 50 | 10300 | -- | -- | 60 | 11600 | -- | -- | 18 | 12000 | -- | -- | 4.3 | 10000 | 81 | 5930 | -- | -- |
| | 1252 | 2040 | 142 | 8840 | 144 | 6990 | 88.3 | 9000 | 153 | 6790 | 121 | 6400 | 57.2 | 9880 | 39.2 | 10950 | 10.3 | 11100 | 5.58 | 9990 | 139 | 2840 | 268 | 3570 |

## DAILY FLOW AND CONTINUOUS RECORDED QUALITY DATA

FWPCA Station No.: 490

Location : North Fork Red River near Headrick, Oklahoma

Water Year : 1967

Basin : Red River

Tributary to: Red River

Remarks :

Equations Used to Compute Constituents

Chlorides: Log Cl = 1.35188 Log Sp.C. -1.96250

Sulfates : Log $SO_4$ = 0.22076 Log Sp.C. +2.15611

Discharge (cfs) and Specific Conductance, Micromhos/$cm^2$ (μmho)

| Day | October | | November | | December | | January | | February | | March | | April | | May | | June | | July | | August | | September | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho | cfs | umho |
| 1 | 284 | 1070 | 23 | 15000 | 19 | 16100 | 22 | 17000 | 35 | 12300 | 23 | 17000 | 15 | 17400 | 26 | 9850 | 89 | 12000 | 13 | 4730 | 33 | 8530 | 0.6 | 11000 |
| 2 | 174 | 2140 | 23 | 15000 | 18 | 16300 | 19 | 17500 | 32 | 11700 | 22 | 17800 | 16 | 17000 | 21 | 10400 | 341 | 11000 | 1.9 | 6590 | 32 | 8500 | 0 | -- |
| 3 | 132 | 5240 | 23 | 15000 | 18 | 16600 | 17 | 18000 | 29 | 14500 | 18 | 18000 | 17 | 17000 | 15 | 11200 | 454 | 5220 | 12 | 7180 | 27 | 8480 | 0.2 | 11600 |
| 4 | 102 | 6950 | 23 | 15000 | 19 | 16800 | 17 | 18000 | 28 | 14900 | 19 | 18400 | 16 | 17000 | 14 | 11200 | 357 | 3860 | 56 | 5550 | 27 | 8530 | 1.7 | 11700 |
| 5 | 87 | 7100 | 23 | 15100 | 21 | 16900 | 19 | 18000 | 30 | 14900 | 21 | 19000 | 12 | 17000 | 27 | 10600 | 207 | 5030 | 2960 | 3810 | 27 | 9030 | 9.8 | 11900 |
| 6 | 84 | 7580 | 26 | 15200 | 21 | 17000 | 18 | 17700 | 29 | 15500 | 20 | 19000 | 9.4 | 17000 | 76 | 7930 | 128 | 5200 | 1640 | 2440 | 26 | 10000 | 55 | 13000 |
| 7 | 72 | 8500 | 26 | 15500 | 21 | 17000 | 53 | 16000 | 27 | 15600 | 21 | 19000 | 9.7 | 17000 | 1120 | 6280 | 86 | 6130 | 690 | 2640 | 22 | 11500 | 391 | 12500 |
| 8 | 66 | 9880 | 26 | 15800 | 19 | 17000 | 25 | 6960 | 29 | 15000 | 12 | 19000 | 8.9 | 17000 | 1090 | 2860 | 57 | 7530 | 420 | 3050 | 19 | 11700 | 215 | 6830 |
| 9 | 63 | 10900 | 25 | 15800 | 24 | 17000 | 22 | 9760 | 29 | 15200 | 16 | 19000 | 12 | 17000 | 432 | 2790 | 39 | 8650 | 295 | 3850 | 22 | 11900 | 133 | 6300 |
| 10 | 52 | 11000 | 26 | 15800 | 26 | 17000 | 30 | 13800 | 28 | 15100 | 23 | 18300 | 14 | 17300 | 199 | 3000 | 34 | 9950 | 219 | 4840 | 22 | 12000 | 102 | 7880 |
| 11 | 49 | 11000 | 26 | 15100 | 29 | 17000 | 29 | 15000 | 25 | 15100 | 19 | 18000 | 12 | 16600 | 144 | 3600 | 27 | 10500 | 167 | 5340 | 17 | 12000 | 69 | 8680 |
| 12 | 46 | 11000 | 26 | 14900 | 28 | 17000 | 23 | 15000 | 25 | 15100 | 17 | 18000 | 14 | 15400 | 116 | 4530 | 22 | 10500 | 132 | 5930 | 14 | 12400 | 35 | 9730 |
| 13 | 44 | 11000 | 26 | 15000 | 25 | 17000 | 21 | 15000 | 26 | 16100 | 17 | 18000 | 2760 | 8430 | 91 | 5280 | 17 | 10400 | 106 | 6380 | 13 | 12700 | 16 | 11100 |
| 14 | 36 | 12800 | 26 | 15200 | 23 | 17000 | 21 | 15000 | 24 | 16500 | 15 | 17500 | 3970 | 2310 | 82 | 6080 | 13 | 10300 | 86 | 6700 | 11 | 13800 | 24 | 11100 |
| 15 | 31 | 13000 | 26 | 15100 | 21 | 17000 | 24 | 15000 | 23 | 16500 | 14 | 16300 | 1740 | 2010 | 63 | 7510 | 10 | 10100 | 73 | 7000 | 9.8 | 13400 | 35 | 11000 |
| 16 | 29 | 13000 | 26 | 15000 | 22 | 17000 | 23 | 15300 | 22 | 16500 | 13 | 16600 | 912 | 2230 | 47 | 7850 | 6.4 | 10900 | 57 | 7530 | 8.0 | 13100 | 212 | 8090 |
| 17 | 33 | 13000 | 26 | 15000 | 21 | 17000 | 24 | 14300 | 22 | 16700 | 10 | 16300 | 522 | 2840 | 37 | 8100 | 8.4 | 11400 | 55 | 8650 | 7.9 | 12900 | 128 | 3830 |
| 18 | 44 | 13000 | 26 | 15100 | 21 | 17000 | 16 | 14100 | 24 | 17000 | 0 | -- | 300 | 3390 | 27 | 8550 | 37 | 7320 | 55 | 8480 | 7.8 | 12700 | 67 | 3700 |
| 19 | 41 | 13000 | 26 | 15600 | 21 | 16600 | 13 | 13900 | 24 | 17000 | 0.3 | 15500 | 252 | 4080 | 17 | 9080 | 24 | 9600 | 63 | 7750 | 8.2 | 12400 | 34 | 5580 |
| 20 | 35 | 13000 | 26 | 16000 | 19 | 16400 | 21 | 12900 | 22 | 17000 | 5.6 | 16500 | 213 | 4800 | 16 | 9780 | 21 | 12200 | 389 | 7970 | 13 | 13000 | 19 | 9030 |
| 21 | 33 | 13000 | 26 | 16000 | 20 | 16100 | 22 | 12200 | 22 | 17000 | 9.6 | 17600 | 182 | 5380 | 16 | 10400 | 6.4 | 12100 | 1640 | 3750 | 5.3 | 14200 | 11 | 10100 |
| 22 | 33 | 13500 | 26 | 16000 | 20 | 15700 | 24 | 11800 | 21 | 17000 | 16 | 16600 | 154 | 5780 | 15 | 11000 | 1.9 | 12200 | 643 | 3580 | 6.0 | 14100 | 708 | 9560 |
| 23 | 29 | 14000 | 26 | 16000 | 17 | 15000 | 23 | 14100 | 22 | 17000 | 24 | 15900 | 126 | 6680 | 13 | 11000 | 0.3 | 11800 | 334 | 3050 | 4.4 | 13900 | 947 | 2910 |
| 24 | 29 | 14100 | 26 | 16000 | 14 | 15300 | 26 | 14700 | 23 | 17000 | 27 | 15100 | 96 | 8150 | 8.5 | 11000 | 0 | -- | 210 | 3780 | 2.6 | 13400 | 437 | 2230 |
| 25 | 26 | 14100 | 26 | 16000 | 12 | 15000 | 26 | 14700 | 22 | 17000 | 30 | 15900 | 90 | 8300 | 4.6 | 11300 | 0 | -- | 139 | 4480 | 2.5 | 13300 | 202 | 2700 |
| 26 | 26 | 14000 | 26 | 16000 | 11 | 15000 | 25 | 14500 | 21 | 17300 | 27 | 16700 | 69 | 8200 | 2.7 | 11900 | 6.1 | 9740 | 94 | 5280 | 15 | 13000 | 118 | 3460 |
| 27 | 25 | 14000 | 25 | 16000 | 13 | 15000 | 24 | 14600 | 22 | 17000 | 24 | 19400 | 57 | 8330 | 1.7 | 12000 | 602 | 8350 | 68 | 5930 | 26 | 12200 | 270 | 3190 |
| 28 | 23 | 14200 | 21 | 16000 | 15 | 15900 | 25 | 14500 | 23 | 16800 | 7.5 | 19300 | 47 | 8780 | 1.1 | 12100 | 434 | 4950 | 56 | 6480 | 9.5 | 11700 | 235 | 2630 |
| 29 | 23 | 14500 | 21 | 16000 | 15 | 15900 | 23 | 14300 | -- | -- | 5.1 | 18700 | 46 | 9180 | 3.4 | 12500 | 172 | 3580 | 62 | 6750 | 3.0 | 11000 | 384 | 2160 |
| 30 | 23 | 14500 | 21 | 16000 | 12 | 15900 | 24 | 14000 | -- | -- | 6.9 | 18600 | 35 | 9400 | 6 | 12600 | 58 | 3750 | 53 | 7500 | 0.9 | 11500 | 198 | 3580 |
| 31 | 23 | 14800 | -- | -- | 22 | 16300 | 31 | 13700 | -- | -- | 13 | 17600 | -- | -- | 29 | 12000 | -- | -- | 38 | 8130 | 0.9 | 9780 | -- | -- |
| [illegible] | 58 | 8190 | 24.9 | 15500 | 19.6 | 16500 | 23.5 | 14500 | 25.3 | 15700 | 16.5 | 17600 | 390.9 | 4400 | 140.7 | 510 | 116.4 | 6730 | 349.3 | 3950 | 14.3 | 11030 | 174.4 | 5540 |

# Appendix E

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

The tabulation presented in Appendix E summarizes the streamflow and specific conductance data of Appendix D, and lists the monthly chloride and sulfate concentrations and loads at Stations 754, 753, 4, 5 and 490.

Correlations between conductance and concentration of chlorides and sulfates were determined for each station from analyses of weekly grab samples collected during the study. These individual correlations were used to compute constituent concentrations. The correlation equations are shown for each tabulation. Flow measurements were then used to translate concentration in mg/l to load in tons per day.

Also presented as part of this tabulation is a summary of stream flow data consisting of mean annual flow and the range of annual flows in cubic feet per second.

All tabulations indicate zero when the measurement was zero and a dash when no data was obtained.

All flow data included in this compilation were furnished by the District Office of the Surface Water Branch of the U. S. Geological Survey in Oklahoma. The maximum and minimum of the daily means are shown for

each month and for the entire year. Complete flow measurements are shown in this part including periods when no specific conductance was measured.

Specific conductance was flow-weighted to obtain monthly means. The concentration of each constituent was computed from the specific conductance, using correlation equations derived from laboratory analyses of weekly samples. The tabulation shows the highest and lowest of the daily means of specific conductance recorded and concentration computed during each month and the water year. A zero daily mean concentration (and load) representing a zero daily flow was not considered in selection of the monthly and annual minimum daily means. Zero daily flows are shown, however.

When continuous specific conductance measurements were not obtained for a significant portion of time, an engineering review was made of the nonmeasured periods and reasonable quality estimates assigned to all or a portion of the missing record. Flow rates, flow patterns, continuous recorded qualities before and after the no record period, similarity of flows and patterns to measured periods, and results of grab samples were used to select reasonable estimates of quality for periods up to several weeks.

# Appendix E (cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 754 Remarks:

Stream and Location: Elm Fork of North Fork of Red River at Salton Crossing, Oklahoma
Lat. 35°02', long. 99°56', NE¼ SW¼, Sec.3, T.6 N., R.26W., approximately
2½ miles above State Hwy 30 at Salton Crossing, Harmon County, Okla.
(USGS Gaging Station No. 3034.00 located approximately 2½ miles downstream from quality station.)

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | STREAM FLOW Cubic Feet/Second Extremes Max. Day | STREAM FLOW Cubic Feet/Second Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C Wt. Mean | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C Extremes Max. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | CHLORIDES (Cl) Milligrams/Liter Extremes Max. Day | CHLORIDES (Cl) Milligrams/Liter Extremes Min. Day | CHLORIDES (Cl) Tons/Day Wt. Mean | CHLORIDES (Cl) Tons/Day Extremes Max. Day | CHLORIDES (Cl) Tons/Day Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | SULFATES ($SO_4$) Milligrams/Liter Extremes Max. Day | SULFATES ($SO_4$) Milligrams/Liter Extremes Min. Day | SULFATES ($SO_4$) Tons/Day Wt. Mean | SULFATES ($SO_4$) Tons/Day Extremes Max. Day | SULFATES ($SO_4$) Tons/Day Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct. | | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | | |
| | Apr. | | | | | | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | | | | | | |
| | June | | | | | | | | | | | | | | | | | | | | |
| 1960 | July | 22.8 | 50 | 544 | 10 | 5990 | 18000 | 2320 | 1350 | 6730 | 253 | 106 | 213 | 19 | 1460 | 2280 | 1010 | 115 | 367 | 55 |
| | Aug. | 31.0 | 32 | 442 | 10 | 8700 | 24800 | 2360 | 2610 | 11700 | 273 | 226 | 1420 | 61 | 1710 | 2590 | 1020 | 148 | 1690 | 55 |
| | Sept. | 19.8 | 27 | 189 | 11 | 8900 | 15500 | 5580 | 2260 | 5120 | 1020 | 82 | 169 | 45 | 1720 | 2150 | 1430 | 62 | 90 | 47 |
| SUMMARY | | 74.0 | 36 | 544 | 10 | 7910 | 24800 | 2320 | 2130 | 11700 | 253 | 150 | 1420 | 19 | 1630 | 2590 | 1010 | 114 | 1690 | 47 |
| 1960 | Oct. | 31.0 | 192 | 1700 | 14 | 2580 | 7060 | 1650 | 301 | 1480 | 148 | 155 | 779 | 49 | 1050 | 1570 | 877 | 541 | 4160 | 58 |
| | Nov. | 30.0 | 62 | 73 | 45 | 4700 | 5500 | 4310 | 776 | 996 | 678 | 128 | 149 | 111 | 1330 | 1430 | 1290 | 220 | 252 | 168 |
| | Dec. | 31.0 | 47 | 63 | 41 | 4890 | 5800 | 3980 | 825 | 1080 | 597 | 105 | 139 | 87 | 1350 | 1460 | 1250 | 173 | 216 | 149 |
| 1961 | Jan. | 31.0 | 38 | 47 | 30 | 4980 | 6220 | 4390 | 851 | 1210 | 697 | 87 | 102 | 57 | 1360 | 1490 | 1300 | 139 | 168 | 106 |
| | Feb. | 28.0 | 33 | 42 | 28 | 5210 | 5800 | 4500 | 914 | 1080 | 726 | 82 | 107 | 68 | 1390 | 1460 | 1310 | 124 | 151 | 103 |
| | Mar. | 31.0 | 46 | 88 | 28 | 4820 | 6240 | 3220 | 808 | 1220 | 427 | 101 | 169 | 75 | 1340 | 1490 | 1150 | 167 | 273 | 109 |
| | Apr. | 30.0 | 52 | 72 | 41 | 5170 | 6110 | 4400 | 903 | 1190 | 700 | 126 | 166 | 115 | 1380 | 1480 | 1300 | 193 | 251 | 162 |
| | May | 31.0 | 31 | 49 | 22 | 6350 | 9060 | 4030 | 1250 | 2200 | 608 | 104 | 202 | 53 | 1500 | 1730 | 1250 | 124 | 183 | 95 |
| | June | 30.0 | 65 | 706 | 15 | 3860 | 10500 | 2480 | 570 | 2780 | 283 | 100 | 539 | 64 | 1230 | 1840 | 1030 | 215 | 1960 | 72 |
| | July | 31.0 | 24 | 291 | 8 | 4990 | 17100 | 2500 | 854 | 6000 | 286 | 56 | 224 | 14 | 1360 | 2230 | 1040 | 89 | 812 | 35 |
| | Aug. | 31.0 | 11 | 16 | 9 | 8670 | 11100 | 5070 | 2050 | 3030 | 876 | 60 | 76 | 39 | 1700 | 1880 | 1370 | 49 | 57 | 45 |
| | Sept. | 30.0 | 11 | 13 | 9 | 9020 | 15800 | 7120 | 2180 | 5300 | 1500 | 65 | 12. | 48 | 1730 | 2160 | 1570 | 51 | 58 | 47 |
| SUMMARY | | 365.0 | 51 | 1700 | 8 | 4280 | 17100 | 1650 | 669 | 6000 | 148 | 92 | [illegible] | 14 | 1280 | 2230 | 877 | 177 | 4160 | 35 |

MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River basin: Red FWPCA Station Number: 754 Remarks:

Stream and Location: Elm Fork of North Fork of Red River at Salton Crossing, Oklahoma
Lat. 35°02', long. 99°56', NE¼ SW¼, Sec.3, T.6 N., R.26W., approximately
2½ miles above State Hwy 30 at Salton Crossing, Harmon County, Okla.
(USGS Gaging Station No. 3034.00 located approximately 2½ miles downstream from quality station.)

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | STREAM FLOW Extremes Max. Day | STREAM FLOW Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter[2] @ 25° C Wt. Mean | SPECIFIC CONDUCTANCE Extremes Max. Day | SPECIFIC CONDUCTANCE Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | CHLORIDES (Cl) Milligrams/Liter Extremes Max. Day | CHLORIDES (Cl) Milligrams/Liter Extremes Min. Day | CHLORIDES (Cl) Tons/Day Wt. Mean | CHLORIDES (Cl) Tons/Day Extremes Max. Day | CHLORIDES (Cl) Tons/Day Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | SULFATES ($SO_4$) Milligrams/Liter Extremes Max. Day | SULFATES ($SO_4$) Milligrams/Liter Extremes Min. Day | SULFATES ($SO_4$) Tons/Day Wt. Mean | SULFATES ($SO_4$) Tons/Day Extremes Max. Day | SULFATES ($SO_4$) Tons/Day Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | Oct. | 31.0 | 13 | 17 | 12 | 7930 | 11200 | 6310 | 1780 | 3070 | 1250 | 60 | 99 | 47 | 1640 | 1880 | 1500 | 55 | 79 | 52 |
| | Nov. | 30.0 | 21 | 60 | 16 | 6490 | 7790 | 4500 | 1270 | 1730 | 726 | 73 | 132 | 52 | 1510 | 1640 | 1310 | 87 | 211 | 66 |
| | Dec. | 31.0 | 16 | 21 | 11 | 6660 | 10800 | 4870 | 1350 | 2900 | 823 | 59 | 147 | 29 | 1530 | 1860 | 1350 | 67 | 96 | 39 |
| 1962 | Jan. | 31.0 | 19 | 28 | 14 | 5860 | 10450 | 3670 | 1100 | 2760 | 526 | 55 | 127 | 25 | 1450 | 1830 | 1220 | 73 | 114 | 55 |
| | Feb. | 28.0 | 15 | 17 | 12 | 7250 | 12000 | 6000 | 1540 | 3430 | 1140 | 64 | 132 | 43 | 1580 | 1930 | 1470 | 66 | 83 | 55 |
| | Mar. | 31.0 | 15 | 19 | 13 | 7070 | 8580 | 5800 | 1490 | 2020 | 1080 | 60 | 85 | 53 | 1570 | 1690 | 1460 | 63 | 83 | 58 |
| | Apr. | 30.0 | 195 | 4470 | 13 | 2690 | 7630 | 1900 | 322 | 1670 | 185 | 169 | 2530 | 57 | 1070 | 1620 | 930 | 560 | 11580 | 56 |
| | May | 31.0 | 21 | 60 | 7 | 7890 | 9800 | 6880 | 1760 | 2490 | 1420 | 98 | 231 | 41 | 1640 | 1780 | 1560 | 91 | 252 | 32 |
| | June | 30.0 | 125 | 2640 | 8 | 3280 | 10200 | 2270 | 439 | 2650 | 247 | 147 | 1740 | 38 | 1150 | 1810 | 1000 | 387 | 7090 | 36 |
| | July | 31.0 | 42 | 612 | 6 | 4630 | 22000 | 2130 | 760 | 8950 | 222 | 86 | 366 | 69 | 1320 | 2460 | 970 | 150 | 1600 | 34 |
| | Aug. | 31.0 | 101 | 2470 | 6 | 2520 | 17500 | 1630 | 290 | 6230 | 146 | 79 | 969 | 25 | 1040 | 2250 | 875 | 281 | 5830 | 36 |
| | Sept. | 30.0 | 105 | 1610 | 6 | 2660 | 17000 | 1890 | 315 | 5950 | 185 | 89 | 804 | 40 | 1060 | 2220 | 925 | 300 | 4010 | 37 |
| SUMMARY | | 365.0 | 57 | 4470 | 6 | 3640 | 22000 | 1630 | 520 | 8950 | 146 | 80 | 2530 | 25 | 1200 | 2460 | 875 | 185 | 11580 | 32 |
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| | Apr. | | | | | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | | | | | |
| | June | | | | | | | | | | | | | | | | | | | |
| | July | | | | | | | | | | | | | | | | | | | |
| | Aug. | | | | | | | | | | | | | | | | | | | |
| | Sept. | | | | | | | | | | | | | | | | | | | |
| SUMMARY | | | | | | | | | | | | | | | | | | | | |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 753 Remarks:

Stream and Location: Elm Fork of North Fork of Red River near Carl, Oklahoma, Lat. 35°00'35", long. 99°54'20", NW¼, Sec. 12, T.6 N., R.26 W., at bridge on State Hwy 30, 4 mi. NE of Carl, Harmon County, Oklahoma.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day |
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| | Apr. | | | | | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | | | | | |
| | June | | | | | | | | | | | | | | | | | | | |
| 1960 | July | 20 | 50 | 544 | 10 | 13200 | 50200 | 5530 | 4100 | 20800 | 1240 | 673 | 3180 | 256 | 1500 | 2180 | 1170 | 246 | 1910 | 57 |
| | Aug. | 25.7 | 32 | 442 | 10 | 38600 | 70000 | 22500 | 14900 | 31300 | 7360 | 1360 | 15000 | 326 | 2020 | 2390 | 1740 | 184 | 2340 | 56 |
| | Sept. | 27.2 | 27 | 189 | 11 | 20400 | 43200 | 6530 | 6900 | 16900 | 1550 | 513 | 4530 | 238 | 1690 | 2080 | 1230 | 126 | 904 | 54 |
| SUMMARY | | 73.0 | 36 | 544 | 10 | 22900 | 70000 | 5530 | 8140 | 31300 | 1240 | 855 | 15000 | 238 | 1750 | 2390 | 1170 | 184 | 2340 | 69 |
| 1960 | Oct. | 31.0 | 192 | 1700 | 14 | 4230 | 33000 | 1450 | 873 | 12020 | 217 | 451 | 2000 | 50 | 1080 | 1930 | 797 | 559 | 4240 | 182 |
| | Nov. | 30.0 | 63 | 74 | 45 | 10730 | 12880 | 9560 | 2860 | 3620 | 2470 | 483 | 619 | 403 | 1410 | 1480 | 1360 | 237 | 276 | 177 |
| | Dec. | 31.0 | 47 | 63 | 41 | 12510 | 20000 | 9000 | 3490 | 6340 | 2290 | 445 | 925 | 315 | 1470 | 1670 | 1340 | 187 | 244 | 157 |
| 1961 | Jan. | 31.0 | 38 | 47 | 30 | 15220 | 39700 | 9920 | 4480 | 15210 | 2590 | 455 | 1300 | 238 | 1550 | 2030 | 1380 | 158 | 174 | 127 |
| | Feb. | 28.0 | 33 | 42 | 28 | 13600 | 20130 | 8880 | 3880 | 6390 | 2250 | 346 | 633 | 196 | 1500 | 1680 | 1330 | 134 | 166 | 116 |
| | Mar. | 31.0 | 46 | 88 | 28 | 9430 | 15910 | 1850 | 2430 | 4740 | 304 | 302 | 536 | 72 | 1360 | 1570 | 858 | 169 | 266 | 116 |
| | Apr. | 30.0 | 52 | 72 | 41 | 11870 | 20000 | 8650 | 3260 | 6340 | 2180 | 456 | 820 | 306 | 1450 | 1670 | 1320 | 202 | 259 | 162 |
| | May | 31.0 | 31 | 49 | 22 | 15040 | 18980 | 10940 | 4410 | 5940 | 2940 | 366 | 660 | 264 | 1550 | 1650 | 1420 | 128 | 195 | 96 |
| | June | 30.0 | 65 | 706 | 15 | 7790 | 18390 | 1870 | 1900 | 5700 | 308 | 333 | 1860 | 99 | 1280 | 1640 | 860 | 225 | 2120 | 66 |
| | July | 31.0 | 24 | 291 | 8 | 11990 | 26560 | 4050 | 3300 | 9110 | 826 | 216 | 649 | 133 | 1450 | 1810 | 1070 | 95 | 839 | 41 |
| | Aug. | 31.0 | 11 | 16 | 9 | 29000 | 43730 | 14450 | 10190 | 17220 | 4190 | 297 | 4[illegible] | 176 | 1860 | 2090 | 1530 | 54 | 64 | 47 |
| | Sept. | 30.0 | 11 | 13 | 9 | 35640 | 56890 | 24330 | 13260 | 24080 | 8140 | 393 | 7[illegible] | 240 | 1970 | 2250 | 1770 | 58 | 67 | 50 |
| SUMMARY | | 365.0 | 51 | 1700 | 8 | 9920 | 56890 | 1450 | 2590 | 24080 | 217 | 358 | 20[illegible] | 50 | 1380 | 2250 | 797 | 190 | 4240 | 41 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 753 Remarks:

Stream and Location: Elm Fork of North Fork of Red River near Carl, Oklahoma, Lat. 35°00'35", long. 99°54'20", NW¼, Sec. 12, T.6 N., R.26 W., at bridge on State Hwy 30, 4 mi. NE of Carl, Harmon County, Oklahoma.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | STREAM FLOW Extremes Max. Day | STREAM FLOW Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter[2] @ 25° C Wt. Mean | SPECIFIC CONDUCTANCE Extremes Max. Day | SPECIFIC CONDUCTANCE Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | CHLORIDES (Cl) Milligrams/Liter Extremes Max. Day | CHLORIDES (Cl) Milligrams/Liter Extremes Min. Day | CHLORIDES (Cl) Tons/Day Wt. Mean | CHLORIDES (Cl) Tons/Day Extremes Max. Day | CHLORIDES (Cl) Tons/Day Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | SULFATES ($SO_4$) Milligrams/Liter Extremes Max. Day | SULFATES ($SO_4$) Milligrams/Liter Extremes Min. Day | SULFATES ($SO_4$) Tons/Day Wt. Mean | SULFATES ($SO_4$) Tons/Day Extremes Max. Day | SULFATES ($SO_4$) Tons/Day Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | Oct. | 31.0 | 13 | 17 | 12 | 25310 | 32650 | 15310 | 8570 | 11830 | 4510 | 289 | 416 | 157 | 1790 | 1920 | 1550 | 60 | 84 | 55 |
| | Nov. | 30.0 | 21 | 60 | 16 | 18140 | 25760 | 7460 | 5600 | 8760 | 1800 | 323 | 430 | 222 | 1630 | 1800 | 1270 | 94 | 205 | 74 |
| | Dec. | 31.0 | 16 | 21 | 11 | 19670 | 30000 | 13870 | 6210 | 10640 | 3860 | 274 | 419 | 125 | 1670 | 1880 | 1500 | 74 | 93 | 44 |
| 1962 | Jan. | 31.0 | 19 | 28 | 14 | 20130 | 40000 | 9340 | 6400 | 15360 | 2400 | 320 | 705 | 138 | 1680 | 2030 | 1350 | 84 | 130 | 62 |
| | Feb. | 28.0 | 15 | 17 | 12 | 20430 | 32000 | 13580 | 6520 | 11560 | 3870 | 270 | 527 | 146 | 1680 | 1910 | 1500 | 70 | 87 | 57 |
| | Mar. | 31.0 | 15 | 19 | 13 | 22920 | 33000 | 17300 | 7550 | 12030 | 5270 | 305 | 435 | 228 | 1740 | 1930 | 1610 | 70 | 89 | 59 |
| | Apr. | 30.0 | 195 | 4470 | 13 | 4220 | 27070 | 2250 | 870 | 9330 | 392 | 457 | 4710 | 236 | 1080 | 1820 | 910 | 568 | 10940 | 62 |
| | May | 31.0 | 21 | 60 | 7 | 17620 | 25540 | 12860 | 5400 | 8670 | 3610 | 300 | 825 | 137 | 1620 | 1790 | 1480 | 90 | 241 | 32 |
| | June | 30.0 | 125 | 2640 | 8 | 7270 | 29720 | 5100 | 1740 | 10510 | 1110 | 586 | 7910 | 141 | 1260 | 1870 | 1140 | 423 | 8140 | 37 |
| | July | 31.0 | 42 | 612 | 6 | 10030 | 46000 | 2700 | 2630 | 18370 | 493 | 297 | 1340 | 177 | 1380 | 2120 | 960 | 156 | 1760 | 67 |
| | Aug. | 31.0 | 101 | 2470 | 6 | 4480 | 35000 | 2350 | 939 | 12960 | 413 | 254 | 2750 | 66 | 1100 | 1960 | 920 | 298 | 6120 | 30 |
| | Sept. | 30.0 | 105 | 1610 | 6 | 5910 | 39500 | 2830 | 1340 | 15120 | 523 | 379 | 2430 | 180 | 1190 | 2030 | 967 | 337 | 4260 | 33 |
| SUMMARY | | 365.0 | 57 | 4470 | 6 | 8250 | 46000 | 2250 | 2050 | 18370 | 392 | 315 | 7910 | 66 | 1310 | 2120 | 910 | 201 | 10940 | 30 |
| 1962 | Oct. | 31.0 | 26 | 112 | 18 | 15400 | 20000 | 10100 | 4730 | 6590 | 2780 | 334 | 836 | 258 | 1570 | 1650 | 1430 | 110 | 431 | 77 |
| | Nov. | 30.0 | 28 | 72 | 22 | 16100 | 20500 | 9000 | 5030 | 6800 | 2400 | 371 | 585 | 301 | 1580 | 1660 | 1400 | 117 | 281 | 94 |
| | Dec. | 31.0 | 24 | 41 | 17 | 16800 | 22800 | 12?00 | 5270 | 7780 | 3570 | 342 | 508 | 255 | 1590 | 1700 | 1490 | 103 | 164 | 78 |
| 1963 | Jan. | 31.0 | 18 | 26 | 12 | 18800 | 45000 | 12000 | 6100 | 18400 | 3460 | 302 | 468 | 193 | 1630 | 1960 | 1480 | 81 | 112 | 60 |
| | Feb. | 28.0 | 23 | 29 | 20 | 16700 | 20000 | 13000 | 5240 | 6590 | 3820 | 328 | 495 | 227 | 1590 | 1650 | 1510 | 100 | 127 | 83 |
| | Mar. | 31.0 | 18 | 22 | 16 | 18700 | 21000 | 16000 | 6040 | 7010 | 4970 | 299 | 402 | 240 | 1630 | 1670 | 1580 | 81 | 98 | 70 |
| | Apr. | 30.0 | 16 | 23 | 11 | 22800 | 31300 | 17200 | 7780 | 11600 | 5450 | 328 | 530 | 253 | 1700 | 1820 | 1600 | 72 | 100 | 52 |
| | May | 31.0 | 41 | 592 | 6.8 | 9850 | 42000 | 2750 | 2690 | 16800 | 537 | 296 | 930 | 235 | 1420 | 1930 | 1090 | 157 | 1730 | 34 |
| | June | 30.0 | 78 | 527 | 1.4 | 5850 | 31000 | 2120 | 1390 | 11500 | 386 | 293 | 573 | 28 | 1280 | 1810 | 1030 | 268 | 1470 | 6.3 |
| | July | 31.0 | 24 | 15 | 0.2 | 47900 | 93000 | 26000 | 19850 | 46000 | 9180 | 127 | 597 | 21 | 1990 | 2290 | 1750 | 13 | 76 | 1.2 |
| | Aug. | 31.0 | 35 | 12 | 0.1 | 57100 | 16300 | 21300 | 24840 | 5090 | 7140 | 233 | 1760 | 16 | 2060 | 1580 | 1670 | 19 | 66 | 0.6 |
| | Sept. | 30.0 | 26 | 463 | 2.3 | 12700 | 60000 | 4350 | 3730 | 26400 | 958 | 262 | 1[illegible] | 153 | 1500 | 2080 | 1200 | 106 | 1490 | 13 |
| SUMMARY | | 365.0 | 25 | 592 | 0.1 | 13800 | 93000 | 2120 | 4130 | 46000 | 386 | 281 | [illegible]0 | 16 | 1530 | 2290 | 1030 | 104 | 1730 | 0.6 |

# Appendix E (Cont'd)

MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: **Red** FWPCA Station Number: 753 Remarks:

Stream and Location: **Elm Fork of North Fork of Red River near Carl, Oklahoma Lat. 35°00'35", long. 99°54'20", NW¼, Sec. 12, T.6 N., R.26 W., at bridge on State Hwy 30, 4 mi. NE of Carl, Harmon County, Oklahoma.**

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE[1] Micromhos/Centimeter[2] @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day |
| 1963 | Oct. | 31.0 | 8.4 | 16 | 5.3 | 34900 | 45500 | 30000 | 13600 | 19000 | 11200 | 308 | 817 | 187 | 2040 | 2230 | 1940 | 46 | 96 | 29 |
| | Nov. | 30.0 | 13 | 23 | 9 | 28200 | 38500 | 20200 | 10400 | 15400 | 6780 | 353 | 692 | 248 | 1900 | 2110 | 1710 | 64 | 120 | 46 |
| | Dec. | 31.0 | 12 | 20 | 6 | 26900 | 54000 | 14000 | 9750 | 23700 | 4250 | 330 | 671 | 88 | 1870 | 2360 | 1510 | 63 | 87 | 26 |
| 1964 | Jan. | 31.0 | 14 | 21 | 6 | 22000 | 42000 | 12000 | 7550 | 17200 | 3490 | 282 | 451 | 174 | 1750 | 2170 | 1440 | 65 | 100 | 33 |
| | Feb. | 29.0 | 21 | 53 | 14 | 20100 | 27200 | 13100 | 6730 | 9890 | 3910 | 388 | 792 | 278 | 1700 | 1880 | 1480 | 98 | 231 | 66 |
| | Mar. | 31.0 | 14 | 20 | 11 | 23700 | 28300 | 18200 | 8300 | 10400 | 5940 | 310 | 477 | 266 | 1800 | 1910 | 1650 | 67 | 98 | 54 |
| | Apr. | 30.0 | 10 | 12 | 6.7 | 30500 | 76000 | 23500 | 11400 | 36600 | 8210 | 306 | 1080 | 196 | 1940 | 2640 | 1790 | 52 | 78 | 36 |
| | May | 31.0 | 62 | 697 | 5.3 | 7490 | 41000 | 2720 | 1920 | 16700 | 529 | 319 | 1660 | 47 | 1230 | 2150 | 881 | 204 | 1880 | 28 |
| | June | 30.0 | 141 | 1550 | 4.7 | 5930 | 38000 | 3050 | 1430 | 15100 | 612 | 541 | 3280 | 191 | 1140 | 2100 | 915 | 432 | 3970 | 27 |
| | July | 31.0 | 2.8 | 10 | 0.2 | 63700 | 180000 | 32500 | 29200 | 109000 | 12400 | 218 | 333 | 47 | 2490 | 3500 | 1990 | 19 | 54 | 1.8 |
| | Aug. | 31.0 | 1.9 | 20 | 0.1 | 123000 | 210000 | 96000 | 67400 | 133000 | 49200 | 352 | 3800 | 31 | 3090 | 3690 | 2850 | 16 | 168 | 1.0 |
| | Sept. | 30.0 | 10 | 154 | 0.1 | 42300 | 215000 | 18500 | 17300 | 137000 | 6060 | 472 | 2510 | 36 | 2180 | 3720 | 1660 | 60 | 685 | 1.0 |
| SUMMARY | | 366.0 | 26 | 1550 | 0.1 | 14600 | 215000 | 2720 | 4480 | 137000 | 529 | 310 | 3800 | 31 | 1530 | 3720 | 881 | 106 | 3970 | 1.0 |
| 1964 | Oct. | 31.0 | 10.6 | 92 | 3.6 | 45000 | 91000 | 18200 | 19100 | 45300 | 6270 | 545 | 1960 | 256 | 2100 | 2480 | 1700 | 60 | 439 | 22 |
| | Nov. | 30.0 | 36.4 | 291 | 7.4 | 13700 | 46000 | 2620 | 4420 | 19600 | 579 | 434 | 1320 | 193 | 1590 | 2110 | 1080 | 156 | 945 | 40 |
| | Dec. | 31.0 | 14.2 | 28 | 9 | 27300 | 44700 | 18500 | 10300 | 18900 | 6390 | 395 | 696 | 219 | 1870 | 2090 | 1700 | 71 | 137 | 44 |
| 1965 | Jan. | 31.0 | 12.7 | 15 | 9.8 | 27500 | 33000 | 22400 | 10400 | 13000 | 8090 | 356 | 479 | 243 | 1870 | 1950 | 1780 | 64 | 77 | 48 |
| | Feb. | 28.0 | 13.2 | 17 | 8.2 | 29200 | 68100 | 21600 | 11200 | 31700 | 7730 | 399 | 766 | 288 | 1900 | 2310 | 1770 | 67 | 88 | 45 |
| | Mar. | 31.0 | 14.9 | 20 | 13 | 27200 | 37000 | 22300 | 10300 | 15000 | 8040 | 412 | 643 | 357 | 1860 | 2000 | 1780 | 75 | 97 | 65 |
| | Apr. | 30.0 | 37 | 682 | 6 | 19700 | 39900 | 11500 | 6910 | 16400 | 3560 | 689 | 10300 | 177 | 1730 | 2040 | 1520 | 173 | 3050 | 32 |
| | May | 31.0 | 7.4 | 33 | 3.1 | 44600 | 77400 | 24000 | 18900 | 37100 | 8800 | 376 | 1010 | 163 | 2090 | 2380 | 1810 | 42 | 169 | 18 |
| | June | 30.0 | 302 | 3660 | 2.7 | 5070 | 79100 | 2000 | 1300 | 38100 | 415 | 1060 | 6980 | 170 | 1260 | 2400 | 1010 | 1024 | 9930 | 17 |
| | July | 31.0 | 8.0 | 24 | 1.4 | 29900 | 92800 | 17100 | 11500 | 46400 | 5800 | 249 | 1020 | 123 | 1910 | 2490 | 1670 | 41 | 126 | 8.8 |
| | Aug. | 31.0 | 9.3 | 109 | 1.1 | 73200 | 126000 | 24400 | 34700 | 67600 | 8980 | 873 | 13100 | 114 | 2350 | 2670 | 1820 | 59 | 723 | 7.1 |
| | Sept. | 30.0 | 84.4 | 644 | 2.7 | 6300 | 119000 | 3450 | 5470 | 63000 | 8110 | 1250 | 11300 | 320 | 1650 | 2640 | 1150 | 376 | 2960 | 19 |
| SUMMARY | | 365.0 | 45.4 | 3660 | 1.1 | 13500 | 126000 | 2000 | 4350 | 67600 | 415 | 533 | 13100 | 114 | 1582 | 2670 | 1010 | 194 | 9930 | 7.1 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: **Red** FWPCA Station Number: **753** Remarks:

Stream and Location: **Elm Fork of North Fork of Red River near Carl, Oklahoma Lat. 35°00'35", long. 99°54'20", NW¼, Sec. 12, T.6 N., R.26 W., at bridge on State Hwy 30, 4 mi. NE of Carl, Harmon County, Oklahoma.**

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | Extremes Max. Day | Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C Wt. Mean | Extremes Max. Day | Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | Extremes Max. Day | Extremes Min. Day | Tons/Day Wt. Mean | Extremes Max. Day | Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | Extremes Max. Day | Extremes Min. Day | Tons/Day Wt. Mean | Extremes Max. Day | Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | Oct. | 31.0 | 120 | 2060 | 9 | 11200 | 37500 | 2840 | 3830 | 15100 | 809 | 1240 | 22100 | 326 | 1530 | 1860 | 1420 | 493 | 7880 | 44 |
| | Nov. | 30.0 | 22.8 | 26 | 20 | 21300 | 25100 | 16600 | 7950 | 9570 | 5990 | 489 | 616 | 370 | 1650 | 1700 | 1590 | 102 | 117 | 88 |
| | Dec. | 31.0 | 20 | 31 | 17 | 21400 | 24000 | 18200 | 7990 | 9100 | 6650 | 431 | 668 | 339 | 1650 | 1690 | 1610 | 89 | 138 | 72 |
| 1966 | Jan. | 31.0 | 20.6 | 33 | 5 | 22700 | 28600 | 15400 | 8540 | 11100 | 5500 | 474 | 956 | 109 | 1670 | 1740 | 1580 | 93 | 140 | 22 |
| | Feb. | 28.0 | 19.3 | 29 | 3 | 20200 | 25700 | 14000 | 7480 | 9830 | 4940 | 389 | 698 | 54 | 1640 | 1710 | 1560 | 85 | 131 | 13 |
| | Mar. | 31.0 | 19.7 | 23 | 16 | 23500 | 27700 | 19500 | 8880 | 10700 | 7190 | 472 | 549 | 386 | 1680 | 1730 | 1630 | 89 | 103 | 74 |
| | Apr. | 30.0 | 17.9 | 41 | 14 | 25700 | 37200 | 17000 | 9830 | 15000 | 6150 | 474 | 1334 | 280 | 1710 | 1850 | 1600 | 82 | 180 | 65 |
| | May | 31.0 | 11.5 | 17 | 7.4 | 33900 | 53400 | 25500 | 13500 | 22500 | 9740 | 418 | 510 | 343 | 1810 | 2060 | 1710 | 56 | 80 | 39 |
| | June | 30.0 | 7.9 | 47 | 2 | 53800 | 122750 | 23900 | 22700 | 57300 | 9050 | 483 | 2660 | 278 | 2060 | 2930 | 1690 | 44 | 256 | 15 |
| | July | 31.0 | 32.3 | 734 | 0.2 | 22000 | 183700 | 3610 | 8240 | 91400 | 1060 | 717 | 14700 | 47 | 1660 | 3700 | 1430 | 145 | 3240 | 2.0 |
| | Aug. | 31.0 | 99.1 | 722 | 0.7 | 13300 | 157500 | 3900 | 4660 | 76800 | 1160 | 1240 | 13000 | 144 | 1550 | 3370 | 1430 | 415 | 3000 | 6.4 |
| | Sept. | 30.0 | 111 | 695 | 11 | 10200 | 26400 | 3215 | 3450 | 10100 | 931 | 1030 | 5400 | 245 | 1510 | 1720 | 1430 | 453 | 2797 | 50 |
| SUMMARY | | 365.0 | 42 | 2060 | 0.2 | 15900 | 183700 | 2840 | 5700 | 91400 | 809 | 645 | 22100 | 47 | 1580 | 3700 | 1420 | 179 | 7880 | 2.0 |
| 1966 | Oct. | 31.0 | 20.6 | 31 | 15 | 23100 | 31300 | 18300 | 7950 | 11200 | 6120 | 441 | 840 | 303 | 1570 | 1710 | 1460 | 87 | 129 | 65 |
| | Nov. | 30.0 | 18.2 | 20 | 15 | 24600 | 28000 | 20700 | 8530 | 9870 | 7030 | 418 | 503 | 347 | 1590 | 1660 | 1520 | 78 | 87 | 64 |
| | Dec. | 31.0 | 16.4 | 20 | 7.8 | 24800 | 46000 | 17300 | 8610 | 17300 | 5740 | 381 | 470 | 308 | 1600 | 1910 | 1440 | 71 | 86 | 39 |
| 1967 | Jan. | 31.0 | 18.8 | 26 | 12 | 25100 | 38100 | 16300 | 8730 | 14000 | 5370 | 442 | 573 | 357 | 1600 | 1810 | 1420 | 81 | 99 | 58 |
| | Feb. | 28.0 | 17.7 | 20 | 15 | 24200 | 29000 | 19500 | 8370 | 10300 | 6570 | 400 | 528 | 282 | 1590 | 1670 | 1490 | 76 | 89 | 64 |
| | Mar. | 31.0 | 16.1 | 48 | 10 | 27500 | 33400 | 17200 | 9670 | 12000 | 5700 | 420 | 1320 | 283 | 1650 | 1740 | 1440 | 72 | 216 | 45 |
| | Apr. | 30.0 | 100.4 | 1630 | 10 | 9690 | 84600 | 3410 | 2990 | 34200 | 924 | 809 | 8140 | 300 | 1220 | 2280 | 899 | 329 | 4710 | 46 |
| | May | 31.0 | 64.1 | 682 | 7.3 | 17900 | 40200 | 3880 | 5960 | 14800 | 1070 | 1030 | 20000 | 249 | 1450 | 1840 | 933 | 251 | 2730 | 35 |
| | June | 30.0 | 36.7 | 647 | 1.6 | 17800 | 86000 | 6280 | 5930 | 34900 | 1840 | 586 | 9130 | 129 | 1450 | 2290 | 1070 | 144 | 2450 | 9.8 |
| | July | 31.0 | 117.7 | 2030 | 3.5 | 8220 | 36000 | 2450 | 2490 | 13100 | 637 | 789 | 6230 | 110 | 1160 | 1780 | 817 | 368 | 4460 | 16 |
| | Aug. | 31.0 | 7.1 | 29 | 1.9 | 39400 | 71000 | 23500 | 14500 | 28100 | 8100 | 277 | 1010 | 125 | 1830 | 2170 | 1570 | 35 | 123 | 10.7 |
| | Sept. | 30.0 | 116.8 | 1470 | 6.8 | 11200 | 67800 | 2750 | 3520 | 26700 | 725 | 1110 | 16600 | 302 | 1270 | 2140 | 850 | 400 | 5240 | 39 |
| SUMMARY | | 365.0 | 45.9 | 2030 | 1.6 | 14500 | 86000 | 2450 | 4720 | 34900 | 637 | 584 | 20100 | 110 | 1370 | 2290 | 817 | 169 | 5240 | 9.8 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: **Red** FWPCA Station Number: 4 Remarks:

Stream and Location: **Elm Fork of North Fork Red River near Reed, Oklahoma Lat. 34°58', long 99°42', on west line of Sec. 25, T.6 N., R.24 W., on downstream side of pier of county road bridge, 1 mi. upstream from Deer Creek, 4.2 mi. north of Reed, and at about mile 38.**

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE Micromhos/Centimeter[2] @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day |
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| 1965 | Apr. | 10.0 | 9.4 | 12 | 7 | 31300 | 37700 | 26600 | 11390 | 14500 | 9220 | 289 | 375 | 183 | 2431 | 2600 | 2290 | 62 | 77 | 43 |
| | May | 31.0 | 26 | 227 | 3.6 | 21600 | 47800 | 2990 | 7046 | 19700 | 548 | 486 | 696 | 11.7 | 2132 | 2820 | 1060 | 147 | 1400 | 24 |
| | June | 30.0 | 383 | 4920 | 3.2 | 5810 | 37800 | 2640 | 1293 | 14500 | 467 | 1334 | 7590 | 122 | 1340 | 2600 | 1010 | 1383 | 14200 | 22 |
| | July | 31.0 | 9.4 | 28 | 1.3 | 26100 | 43900 | 16700 | 8997 | 17600 | 5060 | 228 | 382 | 59 | 2279 | 2740 | 1950 | 58 | 147 | 9.5 |
| | Aug. | 31.0 | 4.4 | 25 | 1.3 | 39300 | 60000 | 18700 | 15260 | 26400 | 5850 | 183 | 501 | 60 | 2634 | 3060 | 2040 | 32 | 146 | 10 |
| | Sept. | 30.0 | 126 | 1360 | 2 | 7880 | 49900 | 3790 | 1917 | 20800 | 745 | 651 | 3150 | 106 | 1493 | 2870 | 1150 | 507 | 4220 | 15 |
| SUMMARY | | 163.0 | 102 | 4920 | 1.3 | 7820 | 60000 | 2640 | 1898 | 26400 | 467 | 553 | 7590 | 11.7 | 1489 | 3060 | 1010 | 433 | 14200 | 9.5 |
| 1965 | Oct. | 31.0 | 265 | 6240 | 9.7 | 5430 | 37600 | 2300 | 1280 | 15300 | 424 | 914 | 7130 | 387 | 1299 | 2203 | 1210 | 928 | 20400 | 57 |
| | Nov. | 30.0 | 27 | 33 | 22 | 21600 | 23100 | 18400 | 7500 | 8180 | 6110 | 546 | 624 | 448 | 1753 | 1795 | 1660 | 128 | 150 | 106 |
| | Dec. | 31.0 | 26 | 42 | 23 | 22600 | 23900 | 20200 | 7950 | 8540 | 6880 | 561 | 967 | 464 | 1781 | 1816 | 1710 | 126 | 206 | 108 |
| 1966 | Jan. | 31.0 | 22 | 32 | 15 | 22600 | 27900 | 16700 | 7950 | 10400 | 5390 | 463 | 817 | 291 | 1781 | 1930 | 1610 | 104 | 161 | 74 |
| | Feb. | 28.0 | 28 | 67 | 21 | 19400 | 27800 | 10600 | 6540 | 10400 | 3000 | 492 | 617 | 411 | 1691 | 1927 | 1440 | 127 | 260 | 102 |
| | Mar. | 31.0 | 25 | 149 | 14 | 19600 | 27000 | 8770 | 6620 | 9990 | 2360 | 451 | 1230 | 340 | 1697 | 1905 | 1390 | 116 | 559 | 72 |
| | Apr. | 30.0 | 18 | 38 | 11 | 27200 | 32400 | 22000 | 10100 | 12600 | 7680 | 476 | 983 | 326 | 1910 | 2056 | 1760 | 90 | 188 | 58 |
| | May | 31.0 | 9.7 | 19 | 4.7 | 32200 | 43800 | 25500 | 12500 | 18600 | 7900 | 327 | 533 | 204 | 2050 | 2377 | 1860 | 54 | 99 | 28 |
| | June | 30.0 | 4.2 | 13 | 1.2 | 46800 | 57800 | 32000 | 20200 | 26500 | 12400 | 229 | 887 | 66 | 2461 | 2770 | 2040 | 28 | 95 | 8.0 |
| | July | 31.0 | 23 | 363 | 0.5 | 15700 | 60500 | 4050 | 4980 | 28100 | 877 | 303 | 5960 | 38 | 1587 | 2846 | 1260 | 97 | 1230 | 3.8 |
| | Aug. | 31.0 | 91 | 742 | 0.5 | 11950 | 49800 | 2820 | 3510 | 21900 | 551 | 860 | 13200 | 22 | 1482 | 2545 | 1230 | 363 | 3350 | 3.0 |
| | Sept. | 30.0 | 168 | 920 | 14 | 7584 | 24600 | 2910 | 1960 | 8860 | 574 | 888 | 3610 | 322 | 1359 | 1837 | 1230 | 615 | 3150 | 69 |
| SUMMARY | | 365.0 | 59 | 6240 | 0.5 | 11100 | 60500 | 2300 | 3200 | 28100 | 424 | 510 | 13700 | 22 | 1458 | 2846 | 1210 | 232 | 20400 | 3.0 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 4 Remarks:

Stream and Location: Elm Fork of North Fork Red River near Reed, Oklahoma
Lat. 34°58', long 99°42', on west line of Sec. 25, T.6 N., R.24 W.,
on downstream side of pier of county road bridge, 1 mi. upstream
from Deer Creek, 4.2 mi. north of Reed, and at about mile 38.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE Micromhos/Centimeter$^2$ @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Extremes | | | Extremes | | | Extremes | | | Extremes | | | | Extremes | | | Extremes | |
| | | | Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day |
| 1966 | Oct. | 31.0 | 21 | 42 | 16 | 22200 | 26200 | 9800 | 7710 | 9480 | 2780 | 445 | 639 | 315 | 1690 | 1790 | 1280 | 97.5 | 145 | 76 |
| | Nov. | 30.0 | 19 | 21 | 16 | 25600 | 28000 | 23800 | 9210 | 10300 | 8410 | 479 | 523 | 444 | 1780 | 1830 | 1730 | 92.4 | 98 | 79 |
| | Dec. | 31.0 | 18 | 20 | 10 | 26700 | 33700 | 22200 | 9710 | 13000 | 7710 | 463 | 538 | 291 | 1800 | 1950 | 1690 | 86 | 98 | 50 |
| 1967 | Jan. | 31.0 | 17 | 21 | 12 | 25400 | 29500 | 20100 | 9120 | 11000 | 6820 | 428 | 545 | 330 | 1770 | 1870 | 1630 | 83.1 | 102 | 59 |
| | Feb. | 28.0 | 15 | 17 | 13 | 27100 | 30000 | 24500 | 9890 | 11200 | 8720 | 400 | 436 | 350 | 1810 | 1880 | 1750 | 73.2 | 81 | 64 |
| | Mar. | 31.0 | 16 | 34 | 11 | 27800 | 31800 | 17900 | 10200 | 12100 | 5900 | 449 | 783 | 347 | 1830 | 1910 | 1570 | 80.3 | 159 | 56 |
| | Apr. | 30.0 | 156 | 1890 | 11 | 8230 | 33000 | 3640 | 2240 | 12600 | 810 | 939 | 11900 | 344 | 1200 | 1940 | 906 | 503 | 6160 | 56 |
| | May | 31.0 | 105 | 1840 | 6.2 | 8660 | 29000 | 3540 | 2390 | 10800 | 783 | 677 | 7840 | 180 | 1220 | 1850 | 898 | 347 | 4520 | 31 |
| | June | 30.0 | 47 | 566 | 1.6 | 14700 | 42400 | 3630 | 4610 | 17300 | 807 | 583 | 8740 | 75 | 1470 | 2110 | 905 | 185 | 2380 | 9.1 |
| | July | 31.0 | 200 | 3770 | 4.4 | 5260 | 25500 | 2950 | 1280 | 9170 | 624 | 690 | 6840 | 91 | 1030 | 1770 | 843 | 554 | 19900 | 20 |
| | Aug. | 31.0 | 9.2 | 25 | 1.3 | 31100 | 38600 | 24400 | 11700 | 15400 | 8680 | 291 | 735 | 54 | 1900 | 2050 | 1750 | 47.1 | 125 | 7.2 |
| | Sept. | 30.0 | 111 | 1110 | 3.2 | 10400 | 35100 | 3200 | 3000 | 13700 | 690 | 900 | 13300 | 89 | 1300 | 1980 | 867 | 391 | 26000 | 16 |
| SUMMARY | | 365.0 | 61 | 3770 | 1.3 | 11000 | 42400 | 2950 | 3220 | 17300 | 624 | 533 | 13000 | 75 | 1330 | 2110 | 843 | 220 | 26000 | 7.2 |
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| | Apr. | | | | | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | | | | | |
| | June | | | | | | | | | | | | | | | | | | | |
| | July | | | | | | | | | | | | | | | | | | | |
| | Aug. | | | | | | | | | | | | | | | | | | | |
| | Sept. | | | | | | | | | | | | | | | | | | | |
| SUMMARY | | | | | | | | | | | | | | | | | | | | |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: **Red** FWPCA Station Number: 5 Remarks:

Stream and Location: **Elm Fork of North Fork Red River near Mangum, Oklahoma Lat. 34°56', long 99°30', on east line Sec. 10, T.5 N., R.22 W., at bridge on U. S. Highway 283, 3 miles north of Mangum, 5 miles downstream from Haystack Creek, and at mile 17.8.**

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE Micromhos/Centimeter[2] @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day |
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| 1965 | Apr. | 16.0 | 54 | 492 | 10 | 8280 | 29300 | 4060 | 2160 | 10350 | 892 | 314 | 1180 | 167 | 1400 | 2040 | 1130 | 203 | 1500 | 35 |
| | May | 31.0 | 46 | 878 | 5.1 | 11300 | 38800 | 4710 | 3175 | 14700 | 1070 | 393 | 4260 | 97 | 1530 | 2220 | 1180 | 189 | 3170 | 26 |
| | June | 30.0 | 532 | 5090 | 4.1 | 3360 | 71100 | 2180 | 706 | 31100 | 413 | 1012 | 21000 | 60 | 1070 | 2660 | 936 | 1534 | 12800 | 19 |
| | July | 31.0 | 13 | 53 | 2 | 16800 | 27600 | 11400 | 5190 | 9610 | 3210 | 185 | 459 | 16 | 1730 | 2000 | 1540 | 62 | 220 | 10 |
| | Aug. | 31.0 | 5.5 | 37 | 1.4 | 26300 | 37000 | 14300 | 9050 | 13800 | 4250 | 134 | 1150 | 37 | 1970 | 2190 | 1640 | 29 | 208 | 8 |
| | Sept. | 30.0 | 484 | 4270 | 2.6 | 3400 | 28200 | 1530 | 716 | 9670 | 2660 | 935 | 10100 | 69 | 1070 | 2020 | 841 | 1396 | 11100 | 14 |
| SUMMARY | | 169.0 | 197 | 5090 | 1.4 | 4130 | 71100 | 1530 | 911 | 31100 | 413 | 484 | 21000 | 16 | 1130 | 2660 | 841 | 601 | 12800 | 8 |
| 1965 | Oct. | 31.0 | 481 | 9320 | 14 | 3490 | 25550 | 1740 | 607 | 9580 | 231 | 787 | 9750 | 334 | 1666 | 1750 | 1660 | 2160 | 41800 | 66 |
| | Nov. | 30.0 | 40 | 58 | 31 | 17200 | 19100 | 14500 | 5540 | 6400 | 4370 | 597 | 683 | 531 | 1719 | 1730 | 1710 | 185 | 267 | 144 |
| | Dec. | 31.0 | 36 | 75 | 31 | 18700 | 21000 | 14950 | 6220 | 7300 | 4560 | 607 | 1100 | 536 | 1724 | 1730 | 1710 | 168 | 348 | 145 |
| 1966 | Jan. | 31.0 | 28 | 40 | 22 | 18900 | 22000 | 13700 | 6310 | 7790 | 4040 | 471 | 653 | 332 | 1725 | 1740 | 1710 | 129 | 185 | 103 |
| | Feb. | 28.0 | 43 | 200 | 28 | 15100 | 21750 | 4540 | 4620 | 7670 | 8740 | 533 | 1480 | 2.4 | 1711 | 1740 | 1670 | 197 | 906 | 131 |
| | Mar. | 31.0 | 44 | 344 | 24 | 13500 | 22000 | 2560 | 3960 | 7790 | 395 | 474 | 1810 | 134 | 1705 | 1740 | 1660 | 204 | 1560 | 112 |
| | Apr. | 30.0 | 24 | 54 | 16 | 22200 | 24400 | 17250 | 7890 | 8990 | 5560 | 536 | 1210 | 364 | 1738 | 1750 | 1720 | 111 | 253 | 75 |
| | May | 31.0 | 13 | 24 | 7 | 24200 | 27200 | 22000 | 8890 | 10500 | 7790 | 312 | 529 | 185 | 1745 | 1760 | 1740 | 61 | 113 | 33 |
| | June | 30.0 | 6.9 | 15 | 2.8 | 26200 | 34750 | 15600 | 9920 | 14700 | 4840 | 184 | 475 | 82 | 1753 | 1790 | 1710 | 33 | 70 | 13 |
| | July | 31.0 | 22 | 379 | 0.1 | 12400 | 38650 | 6950 | 3520 | 17000 | 1580 | 212 | 3170 | 2.8 | 1700 | 1800 | 1680 | 102 | 1730 | 0.5 |
| | Aug. | 31.0 | 113 | 1400 | 3.3 | 6760 | 32300 | 3000 | 1520 | 13300 | 4920 | 463 | 1860 | 86 | 1679 | 1780 | 1660 | 511 | 6280 | 16 |
| | Sept. | 30.0 | 241 | 1600 | 24 | 5350 | 19200 | 3170 | 1100 | 6450 | 531 | 715 | 3570 | 379 | 1673 | 1730 | 1670 | 1087 | 7200 | 111 |
| SUMMARY | | 365.0 | 92 | 9320 | 0.1 | 7440 | 38650 | 1740 | 1730 | 17000 | 231 | 427 | 9750 | 2.8 | 1681 | 1800 | 1660 | 415 | 41700 | 0.5 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red  FWPCA Station Number: 5  Remarks:

Stream and Location: Elm Fork of North Fork Red River near Mangum, Oklahoma
Lat. 34°56', long 99°30', on east line Sec. 10, T.5 N., R.22 W.,
at bridge on U. S. Highway 283, 3 miles north of Mangum, 5 miles
downstream from Haystack Creek, and at mile 17.8.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day | Wt. Mean | Extremes Max. Day | Extremes Min. Day |
| 1966 | Oct. | 31.0 | 27 | 72 | 17 | 17700 | 23400 | 8290 | 5810 | 8260 | 2240 | 429 | 449 | 370 | 1540 | 1670 | 1240 | 114 | 241 | 76 |
| | Nov. | 30.0 | 19 | 20 | 17 | 23800 | 25000 | 23000 | 8430 | 8970 | 8080 | 430 | 459 | 370 | 1680 | 1700 | 1660 | 86 | 87 | 76 |
| | Dec. | 31.0 | 19 | 24 | 13 | 23700 | 26000 | 22500 | 8400 | 9420 | 7860 | 439 | 566 | 299 | 1680 | 1720 | 1650 | 88 | 109 | 59 |
| 1967 | Jan. | 31.0 | 20 | 26 | 14 | 23500 | 26100 | 20200 | 8190 | 9470 | 6860 | 446 | 601 | 261 | 1670 | 1720 | 1600 | 91 | 118 | 60 |
| | Feb. | 28.0 | 15 | 18 | 13 | 25000 | 27000 | 23600 | 8970 | 9880 | 8340 | 360 | 457 | 299 | 1700 | 1740 | 1670 | 68 | 83 | 59 |
| | Mar. | 31.0 | 16 | 37 | 12 | 25400 | 30100 | 18500 | 9150 | 11300 | 6150 | 397 | 1130 | 303 | 1710 | 1790 | 1560 | 74 | 179 | 56 |
| | Apr. | 30.0 | 227 | 2980 | 12 | 6100 | 29000 | 2070 | 1520 | 10800 | 392 | 931 | 15700 | 320 | 1140 | 1770 | 840 | 698 | 7390 | 56 |
| | May | 31.0 | 129 | 2520 | 12 | 6920 | 23500 | 3010 | 1790 | 8300 | 6280 | 624 | 8290 | 260 | 1180 | 1670 | 934 | 412 | 7340 | 54 |
| | June | 30.0 | 52 | 648 | 3.4 | 9450 | 25900 | 3930 | 2640 | 9380 | 878 | 372 | 2690 | 83 | 1290 | 1720 | 1010 | 181 | 1990 | 16 |
| | July | 31.0 | 308 | 4400 | 5.4 | 4500 | 18100 | 2530 | 1040 | 5980 | 505 | 863 | 8910 | 72 | 1050 | 1550 | 889 | 871 | 11500 | 22 |
| | Aug. | 31.0 | 12 | 31 | 4.1 | 21200 | 28000 | 14900 | 7290 | 10300 | 4680 | 244 | 445 | 103 | 1620 | 1760 | 1470 | 54 | 124 | 19 |
| | Sept. | 30.0 | 126 | 1530 | 7.5 | 6480 | 25000 | 2680 | 1650 | 8970 | 543 | 561 | 4170 | 136 | 1160 | 1700 | 904 | 395 | 4290 | 32 |
| SUMMARY | | 365.0 | 81 | 4400 | 3.4 | 8100 | 30100 | 2070 | 2180 | 11300 | 392 | 478 | 15700 | 72 | 1240 | 1790 | 840 | 272 | 11500 | 16 |
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| | Apr. | | | | | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | | | | | |
| | June | | | | | | | | | | | | | | | | | | | |
| | July | | | | | | | | | | | | | | | | | | | |
| | Aug. | | | | | | | | | | | | | | | | | | | |
| | Sept. | | | | | | | | | | | | | | | | | | | |
| SUMMARY | | | | | | | | | | | | | | | | | | | | |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 490 Remarks:

Stream and Location: North Fork of Red River near Headrick, Oklahoma
Lat. 34°38', long. 99°06' in center of N½, Sec. 21, T.2 N., R.18 W at bridge on U. S. Hwy 62, 2½ mi. east of Headrick, Jackson County, Oklahoma, and at river mile 33 above mouth.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | STREAM FLOW Extremes Max. Day | STREAM FLOW Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter[2] @ 25° C Wt. Mean | SPECIFIC CONDUCTANCE Extremes Max. Day | SPECIFIC CONDUCTANCE Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | CHLORIDES (Cl) Milligrams/Liter Extremes Max. Day | CHLORIDES (Cl) Milligrams/Liter Extremes Min. Day | CHLORIDES (Cl) Tons/Day Wt. Mean | CHLORIDES (Cl) Tons/Day Extremes Max. Day | CHLORIDES (Cl) Tons/Day Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | SULFATES ($SO_4$) Milligrams/Liter Extremes Max. Day | SULFATES ($SO_4$) Milligrams/Liter Extremes Min. Day | SULFATES ($SO_4$) Tons/Day Wt. Mean | SULFATES ($SO_4$) Tons/Day Extremes Max. Day | SULFATES ($SO_4$) Tons/Day Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct. | | | | | | | | | | | | | | | | | | | |
| | Nov. | | | | | | | | | | | | | | | | | | | |
| | Dec. | | | | | | | | | | | | | | | | | | | |
| | Jan. | | | | | | | | | | | | | | | | | | | |
| | Feb. | | | | | | | | | | | | | | | | | | | |
| | Mar. | | | | | | | | | | | | | | | | | | | |
| | Apr. | | | | | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | | | | | |
| | June | | | | | | | | | | | | | | | | | | | |
| 1960 | July | 24.0 | 502 | 5380 | 22 | 2160 | 10100 | 1570 | 411 | 2820 | 258 | 662 | 3810 | 147 | 261 | 1220 | 190 | 421 | 2800 | 72 |
| | Aug. | 30.4 | 79 | 647 | 12 | 5250 | 7390 | 2710 | 1240 | 1900 | 521 | 260 | 2610 | 45 | 635 | 894 | 328 | 133 | 1280 | 22 |
| | Sept. | 2.5 | 45 | 219 | 12 | 6090 | 6520 | 5820 | 1480 | 1610 | 1390 | 220 | 333 | 156 | 737 | 789 | 704 | 110 | 163 | 79 |
| SUMMARY | | 57.4 | 209 | 5380 | 12 | 2620 | 10100 | 1570 | 535 | 2820 | 258 | 428 | 3810 | 45 | 316 | 1220 | 190 | 253 | 2800 | 22 |
| 1960 | Oct. | 31.0 | 2310 | 19000 | 12 | 1520 | 10600 | 945 | 246 | 3020 | 134 | 1530 | 8220 | 64 | 183 | 1280 | 114 | 1140 | 6730 | 30 |
| | Nov. | 30.0 | 277 | 670 | 156 | 4900 | 6990 | 3450 | 1120 | 1760 | 710 | 832 | 1280 | 510 | 591 | 843 | 416 | 441 | 752 | 271 |
| | Dec. | 31.0 | 414 | 1160 | 155 | 3860 | 6740 | 2350 | 820 | 1680 | 432 | 916 | 1560 | 692 | 467 | 813 | 284 | 520 | 934 | 338 |
| 1961 | Jan. | 31.0 | 325 | 506 | 210 | 4220 | 6310 | 3400 | 919 | 1550 | 696 | 804 | 1070 | 583 | 509 | 761 | 411 | 445 | 594 | 319 |
| | Feb. | 28.0 | 377 | 611 | 209 | 3730 | 7090 | 2170 | 785 | 1800 | 390 | 797 | 1320 | 279 | 450 | 855 | 262 | 458 | 660 | 185 |
| | Mar. | 31.0 | 332 | 1140 | 101 | 3870 | 7520 | 2450 | 824 | 1940 | 457 | 736 | 2100 | 400 | 466 | 907 | 295 | 418 | 1220 | 227 |
| | Apr. | 30.0 | 237 | 529 | 80 | 4180 | 8160 | 2510 | 910 | 2150 | 472 | 581 | 1060 | 364 | 504 | 984 | 303 | 322 | 589 | 193 |
| | May | 31.0 | 181 | 820 | 61 | 4080 | 9350 | 2230 | 880 | 2560 | 404 | 430 | 1290 | 215 | 493 | 1130 | 270 | 241 | 786 | 122 |
| | June | 30.0 | 2030 | 11000 | 52 | 1730 | 7500 | 1010 | 292 | 1930 | 146 | 1600 | 7420 | 272 | 210 | 905 | 123 | 1140 | 5510 | 128 |
| | July | 31.0 | 217 | 1220 | 58 | 3600 | 6590 | 1910 | 751 | 1630 | 331 | 439 | 1160 | 204 | 436 | 795 | 231 | 255 | 757 | 105 |
| | Aug. | 31.0 | 122 | 945 | 48 | 3740 | 9640 | 800 | 787 | 2670 | 108 | 258 | [illegible]7 | 115 | 452 | 1160 | 97 | 148 | 378 | 92 |
| | Sept. | 30.0 | 249 | 2790 | 42 | 2660 | 7750 | 1310 | 508 | 2010 | 204 | 341 | [illegible]50 | 137 | 321 | 935 | 158 | 215 | 1190 | 88 |
| SUMMARY | | 365.0 | 589 | 19000 | 12 | 2490 | 10600 | 800 | 466 | 3020 | 108 | 741 | 8[illegible]20 | 64 | 300 | 1280 | 97 | 477 | 6730 | 30 |

MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 490 Remarks:

Stream and Location: North Fork of Red River near Headrick, Oklahoma
Lat. 34°38', long. 99°06' in center of N½, Sec. 21, T.2 N., R. 18 W at bridge on U. S. Hwy 62, 2½ mi. east of Headrick, Jackson County, Oklahoma, and at river mile 33 above mouth.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second | | | SPECIFIC CONDUCTANCE Micromhos/Centimeter[2] @ 25° C | | | CHLORIDES (Cl) Milligrams/Liter | | | CHLORIDES (Cl) Tons/Day | | | SULFATES ($SO_4$) Milligrams/Liter | | | SULFATES ($SO_4$) Tons/Day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Extremes | | | Extremes | | | Extremes | | | Extremes | | | | Extremes | | | Extremes | |
| | | | Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day | Wt. Mean | Max. Day | Min. Day |
| 1961 | Oct. | 31.0 | 259 | 3070 | 40 | 1840 | 7080 | 393 | 314 | 1790 | 43 | 219 | 870 | 82 | 221 | 854 | 48 | 154 | 696 | 74 |
| | Nov. | 30.0 | 534 | 5660 | 73 | 1830 | 6600 | 885 | 312 | 1640 | 124 | 449 | 2000 | 220 | 220 | 796 | 107 | 317 | 1720 | 116 |
| | Dec. | 31.0 | 150 | 182 | 105 | 7010 | 7920 | 5500 | 1770 | 2070 | 1290 | 717 | 1020 | 473 | 847 | 955 | 663 | 343 | 470 | 230 |
| 1962 | Jan. | 31.0 | 125 | 238 | 51 | 7280 | 8980 | 5990 | 1860 | 2430 | 1440 | 624 | 1010 | 278 | 878 | 1080 | 722 | 295 | 495 | 129 |
| | Feb. | 28.0 | 66 | 99 | 49 | 7930 | 9020 | 7000 | 2080 | 2450 | 1770 | 368 | 517 | 291 | 956 | 1090 | 844 | 170 | 243 | 132 |
| | Mar. | 31.0 | 49 | 55 | 40 | 8710 | 9350 | 7460 | 2340 | 2590 | 1920 | 306 | 339 | 254 | 1050 | 1130 | 900 | 138 | 153 | 114 |
| | Apr. | 30.0 | 279 | 3930 | 39 | 4470 | 10500 | 2530 | 992 | 2980 | 477 | 746 | 7440 | 251 | 541 | 1270 | 306 | 407 | 4350 | 112 |
| | May | 31.0 | 220 | 2000 | 40 | 3940 | 11600 | 1020 | 841 | 3390 | 147 | 499 | 1600 | 177 | 476 | 1400 | 123 | 283 | 1140 | 125 |
| | June | 30.0 | 2480 | 10300 | 151 | 1650 | 4060 | 1000 | 275 | 874 | 144 | 1840 | 6650 | 315 | 200 | 490 | 121 | 1330 | 4970 | 200 |
| | July | 31.0 | 194 | 2090 | 36 | 3990 | 10200 | 1790 | 855 | 2870 | 304 | 448 | 4260 | 170 | 482 | 1230 | 216 | 253 | 2470 | 86 |
| | Aug. | 31.0 | 250 | 2470 | 18 | 3250 | 10300 | 1560 | 657 | 2910 | 255 | 443 | 5290 | 108 | 392 | 1240 | 189 | 266 | 3030 | 49 |
| | Sept. | 30.0 | 517 | 3890 | 18 | 2330 | 10200 | 1250 | 428 | 2870 | 193 | 596 | 4230 | 99 | 282 | 1230 | 151 | 392 | 2820 | 47 |
| SUMMARY | | 365.0 | 427 | 10300 | 18 | 2630 | 11600 | 393 | 499 | 3390 | 43 | 570 | 7440 | 82 | 317 | 1400 | 48 | 362 | 4970 | 47 |
| 1962 | Oct. | 31.0 | 162 | 869 | 50 | 3740 | 8300 | 930 | 847 | 2290 | 149 | 370 | 1420 | 210 | 656 | 1060 | 405 | 287 | 949 | 137 |
| | Nov. | 30.0 | 74 | 175 | 51 | 8070 | 9050 | 5300 | 2212 | 2550 | 1310 | 441 | 796 | 348 | 1040 | 1130 | 796 | 208 | 425 | 154 |
| | Dec. | 31.0 | 77 | 127 | 61 | 7660 | 8600 | 6100 | 2070 | 2400 | 1560 | 429 | 680 | 354 | 1010 | 1090 | 867 | 208 | 336 | 170 |
| 1963 | Jan. | 31.0 | 44 | 82 | 12 | 8400 | 9700 | 6500 | 2330 | 2780 | 1690 | 275 | 560 | 59 | 1070 | 1190 | 903 | 127 | 249 | 32 |
| | Feb. | 28.0 | 175 | 415 | 68 | 4920 | 9300 | 3150 | 1190 | 2640 | 684 | 564 | 835 | 407 | 762 | 1150 | 604 | 360 | 695 | 191 |
| | Mar. | 31.0 | 154 | 445 | 50 | 4880 | 8800 | 3100 | 1180 | 2460 | 670 | 491 | 1170 | 269 | 758 | 1110 | 599 | 315 | 837 | 140 |
| | Apr. | 30.0 | 56 | 257 | 28 | 8040 | 11000 | 2500 | 2200 | 3260 | 512 | 332 | 526 | 157 | 1040 | 1310 | 546 | 157 | 409 | 94 |
| | May | 31.0 | 185 | 4270 | 14 | 2320 | 11000 | 1080 | 467 | 3260 | 180 | 233 | 2070 | 102 | 530 | 1310 | 419 | 264 | 4820 | 46 |
| | June | 30.0 | 681 | 3000 | 21 | 1860 | 6500 | 1100 | 354 | 1690 | 184 | 650 | 2940 | 63 | 488 | 903 | 420 | 896 | 3980 | 51 |
| | July | 31.0 | 18 | 127 | 0.5 | 5530 | 10200 | 1500 | 1380 | 2960 | 271 | 66 | 280 | 3.3 | 817 | 1230 | 456 | 39 | 183 | 1.5 |
| | Aug. | 31.0 | 4.4 | 27 | 0 | 6190 | 9000 | 0 | 1590 | 2540 | -- | 19 | 133 | 0 | 876 | 1130 | -- | 10 | 68 | 0 |
| | Sept. | 30.0 | 60 | 656 | 0 | 4380 | 8800 | 0 | 1030 | 2460 | -- | 166 | 1440 | 0 | 714 | 1110 | -- | 114 | 1140 | 0 |
| SUMMARY | | 365.0 | 140 | 4270 | 0 | 3740 | 11000 | 0 | 846 | 3260 | -- | 319 | 2940 | 0 | 656 | 1310 | -- | 247 | 4820 | 0 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: **Red** FWPCA Station Number: **490** Remarks:

Stream and Location: **North Fork of Red River near Headrick, Oklahoma Lat. 34°38', long. 99°06' in center of N½, Sec. 21, T.2 N., R. 18 W at bridge on U. S. Hwy 62, 2½ mi. east of Headrick, Jackson County, Oklahoma, and at river mile 33 above mouth.**

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | STREAM FLOW Extremes Max. Day | STREAM FLOW Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C Wt. Mean | SPECIFIC CONDUCTANCE Extremes Max. Day | SPECIFIC CONDUCTANCE Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | CHLORIDES (Cl) Milligrams/Liter Extremes Max. Day | CHLORIDES (Cl) Milligrams/Liter Extremes Min. Day | CHLORIDES (Cl) Tons/Day Wt. Mean | CHLORIDES (Cl) Tons/Day Extremes Max. Day | CHLORIDES (Cl) Tons/Day Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | SULFATES ($SO_4$) Milligrams/Liter Extremes Max. Day | SULFATES ($SO_4$) Milligrams/Liter Extremes Min. Day | SULFATES ($SO_4$) Tons/Day Wt. Mean | SULFATES ($SO_4$) Tons/Day Extremes Max. Day | SULFATES ($SO_4$) Tons/Day Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1963 | Oct. | 31.0 | 68 | 1470 | 0 | 1220 | 9400 | 0 | 243 | 2780 | -- | 45 | 441 | 0 | 203 | 1060 | -- | 37 | 474 | 0 |
| | Nov. | 30.0 | 20 | 65 | 6 | 10500 | 14000 | 8300 | 3170 | 4480 | 2390 | 174 | 746 | 41 | 1160 | 1460 | 956 | 63 | 247 | 16 |
| | Dec. | 31.0 | 14 | 21 | 5 | 13300 | 14500 | 10200 | 4200 | 4660 | 3060 | 160 | 263 | 60 | 1400 | 1500 | 1130 | 53 | 85 | 20 |
| 1964 | Jan. | 31.0 | 13 | 21 | 5 | 14600 | 16500 | 12000 | 4700 | 5430 | 3720 | 167 | 277 | 70 | 1510 | 1670 | 1290 | 54 | 86 | 22 |
| | Feb. | 29.0 | 165 | 1270 | 20 | 3940 | 13000 | 1360 | 984 | 4090 | 277 | 437 | 1270 | 220 | 524 | 1370 | 222 | 232 | 906 | 74 |
| | Mar. | 31.0 | 28 | 39 | 22 | 13000 | 15200 | 11200 | 4090 | 4930 | 3420 | 307 | 410 | 224 | 1370 | 1560 | 1220 | 103 | 135 | 77 |
| | Apr. | 30.0 | 13 | 22 | 8.4 | 14600 | 17500 | 10500 | 4700 | 5830 | 3170 | 170 | 286 | 105 | 1510 | 1750 | 1160 | 55 | 91 | 34 |
| | May | 31.0 | 138 | 930 | 7.1 | 4140 | 15500 | 2130 | 1040 | 5040 | 472 | 387 | 2410 | 72 | 545 | 1580 | 319 | 203 | 1290 | 25 |
| | June | 30.0 | 307 | 3220 | 24 | 3490 | 13800 | 1300 | 852 | 4390 | 262 | 704 | 9370 | 189 | 475 | 1440 | 214 | 393 | 4840 | 72 |
| | July | 31.0 | 5 | 35 | 0 | 8900 | 11000 | 0 | 2600 | 3350 | -- | 35 | 254 | 0 | 1010 | 1200 | -- | 14 | 98 | 0 |
| | Aug. | 31.0 | 4.5 | 47 | 0 | 5330 | 8650 | 0 | 1410 | 2520 | -- | 17 | 179 | 0 | 669 | 989 | -- | 8 | 76 | 0 |
| | Sept. | 30.0 | 60 | 307 | 0 | 4070 | 9300 | 0 | 1020 | 2740 | -- | 166 | 1060 | 0 | 538 | 1050 | -- | 87 | 458 | 0 |
| SUMMARY | | 366.0 | 69 | 3220 | 0 | 4620 | 17500 | 0 | 1190 | 5830 | -- | 221 | 9370 | 0 | 596 | 1750 | -- | 111 | 4840 | 0 |
| 1964 | Oct. | 31.0 | 8.3 | 41 | 0.1 | 9540 | 17300 | 3790 | 2880 | 6420 | 833 | 64 | 637 | 0.8 | 980 | 1320 | 619 | 22 | 131 | 0.3 |
| | Nov. | 30.0 | 193 | 1200 | 12 | 3650 | 12500 | 1580 | 786 | 4150 | 257 | 409 | 3260 | 134 | 605 | 1120 | 400 | 315 | 2000 | 36 |
| | Dec. | 31.0 | 38 | 50 | 16 | 11600 | 13100 | 9210 | 3750 | 4420 | 2360 | 385 | 593 | 188 | 1080 | 1150 | 910 | 111 | 154 | 49 |
| 1965 | Jan. | 31.0 | 32 | 38 | 26 | 12200 | 13000 | 10900 | 4010 | 4370 | 3450 | 342 | 411 | 274 | 1110 | 1140 | 1050 | 95 | 113 | 77 |
| | Feb. | 28.0 | 27 | 35 | 10 | 12500 | 13700 | 11200 | 4145 | 4690 | 3580 | 301 | 360 | 107 | 1122 | 1170 | 1060 | 81 | 102 | 30 |
| | Mar. | 31.0 | 25 | 39 | 19 | 13000 | 14200 | 12100 | 4370 | 4920 | 3970 | 299 | 448 | 239 | 1144 | 1200 | 1100 | 78 | 119 | 61 |
| | Apr. | 30.0 | 77 | 615 | 21 | 8110 | 13800 | 3170 | 2320 | 4740 | 655 | 480 | 4630 | 241 | 904 | 1180 | 566 | 187 | 1600 | 64 |
| | May | 31.0 | 108 | 822 | 22 | 5200 | 10700 | 1960 | 1274 | 3360 | 343 | 371 | 3810 | 163 | 724 | 1040 | 445 | 211 | 1610 | 58 |
| | June | 30.0 | 702 | 4400 | 28 | 2550 | 9570 | 1670 | 489 | 2890 | 277 | 925 | 6810 | 184 | 508 | 982 | 411 | 961 | 6380 | 72 |
| | July | 31.0 | 33 | 123 | 5.2 | 7500 | 12000 | 2750 | 2085 | 3920 | 541 | 183 | 374 | 49 | 869 | 1100 | 527 | 76 | 174 | 15 |
| | Aug. | 31.0 | 4.5 | 18 | 0.3 | 9380 | 12600 | 6220 | 2817 | 4190 | 1620 | 34 | 146 | 2.1 | 972 | 1130 | 792 | 12 | 39 | 0.8 |
| | Sept. | 30.0 | 1675 | 14200 | 0.2 | 1100 | 11200 | 573 | 158 | 3580 | 66 | 713 | 3670 | 1.6 | 334 | 1060 | 241 | 1508 | 10500 | 0.5 |
| SUMMARY | | 365.0 | 241 | 14200 | 0.1 | 2535 | 17300 | 573 | 485 | 6420 | 66 | 315 | 6800 | 0.8 | 506 | 1320 | 241 | 329 | 10500 | 0.3 |

# Appendix E (Cont'd)

## MONTHLY SUMMARY OF CONTINUOUS RECORDED FLOW AND QUALITY DATA

River Basin: Red FWPCA Station Number: 490 Remarks:

Stream and Location: North Fork of Red River near Headrick, Oklahoma
Lat. 34°38', long. 99°06' in center of N½, Sec. 21, T.2 N., R.18 W at bridge on U. S. Hwy 62, 2½ mi. east of Headrick, Jackson County, Oklahoma, and at river mile 33 above mouth.

| Year | Month | Number of Days of Specific Conductance Record | STREAM FLOW Cubic Feet/Second Mean | STREAM FLOW Extremes Max. Day | STREAM FLOW Extremes Min. Day | SPECIFIC CONDUCTANCE Micromhos/Centimeter² @ 25° C Wt. Mean | SPECIFIC CONDUCTANCE Extremes Max. Day | SPECIFIC CONDUCTANCE Extremes Min. Day | CHLORIDES (Cl) Milligrams/Liter Wt. Mean | CHLORIDES (Cl) Milligrams/Liter Extremes Max. Day | CHLORIDES (Cl) Milligrams/Liter Extremes Min. Day | CHLORIDES (Cl) Tons/Day Wt. Mean | CHLORIDES (Cl) Tons/Day Extremes Max. Day | CHLORIDES (Cl) Tons/Day Extremes Min. Day | SULFATES ($SO_4$) Milligrams/Liter Wt. Mean | SULFATES ($SO_4$) Milligrams/Liter Extremes Max. Day | SULFATES ($SO_4$) Milligrams/Liter Extremes Min. Day | SULFATES ($SO_4$) Tons/Day Wt. Mean | SULFATES ($SO_4$) Tons/Day Extremes Max. Day | SULFATES ($SO_4$) Tons/Day Extremes Min. Day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | Oct. | 31.0 | 1252 | 17700 | 70 | 2040 | 10450 | 790 | 448 | 3080 | 146 | 1510 | 12000 | 498 | 568 | 1040 | 498 | 1917 | 25000 | 183 |
| | Nov. | 30.0 | 142 | 192 | 99 | 8840 | 10500 | 7700 | 2530 | 3100 | 2150 | 968 | 1130 | 811 | 948 | 1040 | 884 | 363 | 460 | 278 |
| | Dec. | 31.0 | 144 | 1100 | 86 | 6990 | 10500 | 2560 | 1920 | 3100 | 585 | 745 | 1730 | 670 | 845 | 1040 | 597 | 328 | 1770 | 234 |
| 1966 | Jan. | 31.0 | 88 | 195 | 50 | 9000 | 10300 | 7880 | 2580 | 3030 | 2210 | 614 | 1350 | 365 | 957 | 1030 | 894 | 228 | 503 | 132 |
| | Feb. | 28.0 | 153 | 687 | 60 | 6790 | 10000 | 2080 | 1850 | 2920 | 458 | 763 | 2650 | 379 | 834 | 1010 | 570 | 344 | 1410 | 155 |
| | Mar. | 31.0 | 121 | 584 | 60 | 6400 | 11600 | 2160 | 1730 | 3480 | 479 | 564 | 2440 | 248 | 812 | 1100 | 575 | 265 | 1160 | 153 |
| | Apr. | 30.0 | 57 | 132 | 19 | 9880 | 12000 | 7150 | 2880 | 3620 | 1970 | 444 | 1090 | 185 | 1006 | 1130 | 854 | 155 | 368 | 58 |
| | May | 31.0 | 39 | 100 | 18 | 10950 | 12400 | 7890 | 3250 | 3770 | 2210 | 343 | 739 | 176 | 1066 | 1150 | 895 | 113 | 253 | 55 |
| | June | 30.0 | 10 | 48 | 3.6 | 11100 | 13000 | 6800 | 3310 | 3980 | 1850 | 92 | 239 | 31 | 1074 | 1180 | 834 | 30 | 107 | 10 |
| | July | 31.0 | 5.6 | 65 | 0 | 9990 | 12200 | -- | 2920 | 3700 | -- | 44 | 537 | 0 | 1012 | 1140 | -- | 15 | 172 | 0 |
| | Aug. | 31.0 | 139 | 1430 | 0 | 2840 | 10500 | -- | 662 | 3100 | -- | 248 | 1760 | 0 | 613 | 1040 | -- | 230 | 2200 | 0 |
| | Sept. | 30.0 | 268 | 950 | 25 | 3570 | 9330 | 1430 | 867 | 2690 | 294 | 626 | 2810 | 123 | 654 | 976 | 534 | 472 | 1760 | 66 |
| SUMMARY | | 365.0 | 203 | 17700 | 0 | 4080 | 13000 | -- | 1020 | 3980 | -- | 558 | 12000 | 0 | 682 | 1180 | -- | 373 | 25000 | 0 |
| 1966 | Oct. | 31.0 | 58 | 284 | 23 | 8190 | 14800 | 1070 | 2130 | 4730 | 136 | 333 | 412 | 104 | 1050 | 1190 | 668 | 164 | 510 | 73 |
| | Nov. | 30.0 | 25 | 26 | 21 | 15500 | 16000 | 1?900 | 5040 | 5260 | 4780 | 338 | 367 | 297 | 1210 | 1210 | 1200 | 81 | 85 | 68 |
| | Dec. | 31.0 | 20 | 29 | 11 | 16500 | 17000 | 15000 | 5480 | 5710 | 4820 | 290 | 444 | 142 | 1220 | 1230 | 1200 | 65 | 96 | 35 |
| 1967 | Jan. | 31.0 | 24 | 53 | 13 | 14500 | 18000 | 6960 | 4600 | 6170 | 1710 | 292 | 751 | 115 | 1190 | 1250 | 1010 | 75 | 135 | 41 |
| | Feb. | 28.0 | 25 | 35 | 21 | 15700 | 17300 | 12300 | 5130 | 5850 | 3690 | 350 | 385 | 322 | 1210 | 1240 | 1150 | 82 | 108 | 69 |
| | Mar. | 31.0 | 17 | 30 | 0 | 17600 | 19400 | -- | 5980 | 6830 | -- | 266 | 440 | 0 | 1240 | 1270 | -- | 55 | 98 | 0 |
| | Apr. | 30.0 | 391 | 3970 | 8.9 | 4400 | 17400 | 2010 | 918 | 5890 | 318 | 968 | 16400 | 136 | 913 | 1240 | 768 | 962 | 8450 | 29 |
| | May | 31.0 | 141 | 1120 | 1.1 | 5100 | 12600 | 2790 | 1120 | 3810 | 496 | 425 | 4470 | 11 | 943 | 1150 | 826 | 358 | 2970 | 3.4 |
| | June | 30.0 | 116 | 602 | 0 | 6730 | 12200 | -- | 1630 | 3650 | -- | 512 | 3530 | 0 | 1000 | 1140 | -- | 315 | 1700 | 0 |
| | July | 31.0 | 349 | 2960 | 1.9 | 3950 | 8650 | 2440 | 794 | 2290 | 414 | 747 | 6010 | 8.1 | 891 | 1060 | 802 | 839 | 7030 | 5.1 |
| | Aug. | 31.0 | 14 | 33 | 0.9 | 11030 | 14200 | 8480 | 3180 | 4480 | 2230 | 123 | 255 | 6.5 | 1120 | 1180 | 1055 | 43 | 94 | 2.6 |
| | Sept. | 30.0 | 174 | 947 | 0 | 5540 | 13000 | -- | 1250 | 177 | -- | 589 | 4?90 | 0 | 961 | 698 | -- | 452 | 2120 | 0 |
| SUMMARY | | 365.0 | 113 | 3970 | 0 | 5850 | 19400 | -- | 1350 | 6830 | -- | 411 | 16 00 | 0 | 972 | 1270 | -- | 296 | 8450 | 0 |

# Appendix F

## SODIUM-ADSORPTION RATIOS

The sodium adsorption ratios or SAR's were determined for both existing and controlled conditions of Area VI using the procedure set forth in "Diagnosis and Improvement of Saline and Alkali Soils" by U. S. Salinity Laboratory Staff, U. S. Department of Agriculture on page 72. The SAR's for existing conditions were calculated using correlations between chloride concentrations and specific conductance; controlled conditions were determined using a correlation between total dissolved solids and specific conductance as determined in the "Arkansas-Red River Basin Water Quality Conservation" - Appendix Volume III - Water Quality Data by the U. S. Public Health Service, page 178. The SAR's were determined by using the estimated cumulative mean chloride and sulfate concentrations to determine the various concentrations of calcium, magnesium, and sodium. Using cations concentration in the formula

$$SAR=Na\sqrt{Ca^{++}+Mg^{++})/2}$$

where $Na^{+}$, $Ca^{++}$, and $Mg^{++}$ represent the concentration in milliequivalents per liter of the respective ions.

Conductivity

Low-salinity water (C1) can be used for irrigation with most crops on most soils with little likelihood

that soil salinity will develop. Some leaching is required, but this occurs under normal irrigation practices except in soils of extremely low permeability.

Medium-salinity water (C2) can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

High-salinity water (C3) cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

Very high salinity water (C4) is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching, and very salt-tolerant crops should be selected.

Sodium

The classification of irrigation waters with respect of SAR is based primarily on the effect of exchangeable sodium on the physical condition of the soil. Sodium-sensitive plants may, however, suffer injury as a result of sodium accumulation in plant tissues when

exchangeable sodium values are lower than those effective in causing deterioration of the physical condition of soil.

Low-sodium water (S1) can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium. However, sodium-sensitive crops such as stone-fruit trees and avocados may accumulate injurious concentrations of sodium.

Medium-sodium water (S2) will present an appreciable sodium hazard in fine-textured soils having high cation-exchange-capacity, especially under low-leaching conditions, unless gypsum is present in the soil. This water may be used on coarse-textured or organic soils with good permeability.

High-sodium water (S3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management - good drainage, high leaching, and organic matter additions. Gypsiferous soils may not develop harmful levels of exchangeable sodium from such waters. Chemical amendments may be required for replacement of exchangeable sodium, except that amendments may not be feasible with waters of very high salinity.

Very high sodium water (S4) is generally unsatisfactory for irrigation purposes except at low and perhaps

medium salinity, where the solution of calcium from the soil or use of gypsum or other amendments make the use of these waters feasible.

Sometimes the irrigation water may dissolve sufficient calcium from calcareous soils to decrease the sodium hazard appreciably, and this should be taken into account in the use of C1-S3 and C1-S4 waters. For calcareous soils with high pH values or for non-calcareous soils, the sodium status of waters in classes C1-S3, C1-S4, and C2-S4 may be improved by the addition of gypsum to the water. Similarly it may be beneficial to add gypsum to the soil periodically when C2-S3 and C3-S2 waters are used.