TEXAS WATER DEVELOPMENT BOARD

REPORT 76

# WATER DELIVERY STUDY

# PECOS RIVER, TEXAS, QUANTITY AND QUALITY, 1967

By

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# PECOS RIVER, TEXAS

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## INTRODUCTION

### Purpose and Scope

This water-delivery study was made April 17-19, 1967, by the U.S. Geological Survey under a cooperative agreement with the Texas Water Development Board.

The purpose of this study was to determine changes in quantity and quality of a uniform flow of water from Red Bluff Reservoir in a 188.4-mile reach of the Pecos River between the dam and Girvin, Texas (Figure 1).

Water is released from Red Bluff Reservoir during the spring and summer months for irrigation of land on both sides of the Pecos River in an area extending from mile 43.3, the first diversion at Reeves County W.I.D. (Water Improvement District) No. 2 dam, to mile 111.5, the last diversion at Ward County W.I.D. No. 2 dam. Some 28,000 acres of land can be irrigated from the river (Ogilbee and others, 1961, p. 128); however, the number of acres irrigated varies from year to year depending on the quantity and quality of water in Red Bluff Reservoir.

Between Red Bluff Reservoir and Girvin, the Pecos River is a meandering stream with a channel about 60 feet wide. The low banks have not been overtopped since the floods of September and October 1941, and are generally covered with salt cedar and other brush vegetation. The river channel is characterized by long pools formed by gravel bars, rock outcrops, and low diversion dams. Photographs of the river at several sites in the study area during the investigation are shown in Figures 2 through 5.

### Previous Investigations

The first low-flow investigation to study gains and losses in the Pecos River was made in May 1918. The 203-mile reach began at the New Mexico-Texas state line and ended near Girvin. The results of this study are published in Water-Supply Paper 478 (Grover and others, 1922, p. 103).

A water-delivery study was made February 15 to March 31, 1964, and a low-flow study was made May 10-12, 1965, between Red Bluff Reservoir and Girvin. The results of those two studies are given in Texas Water Development Board Report 22 (Grozier and others, 1966).

Figure 2.--View Upstream Toward Pecos River Gaging Station near Orla (Mile 14.3)

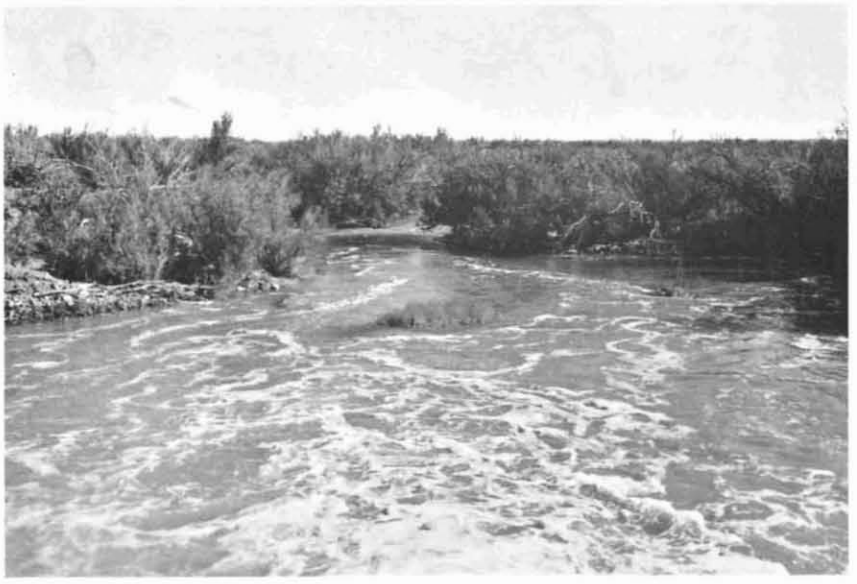

Figure 3.--View Downstream from Grandfalls-Big Valley Diversion Dam (Mile 93.6)

Figure 4.--Pecos River at Ward Co. W.I.D. No. 2
Diversion Dam (Mile 111.7)

Figure 5.--View Downstream at Former Pecos River
Gaging Station near Buenavista (Mile 158.2)

During the water-delivery study of February to March 1964, the rate of release from Red Bluff Reservoir, including seepage through the dam, was 129 cfs (cubic feet per second). The chloride concentration of the water released from the reservoir was 2,950 ppm (parts per million). In the 174.1 river miles between the gaging stations near Orla and Girvin, 57 percent of the water was lost to ground-water aquifers, evaporated, or transpired.

During the low-flow study of May 10-12, 1965, the flow in the Pecos River downstream from Red Bluff Reservoir was 2.58 cfs, which was seepage from the reservoir and leakage through the gates. The chloride concentration was 5,970 ppm. The flow in the river decreased to 0.39 cfs and the chloride concentration increased to 7,710 ppm at the Pecos River gaging station near Orla (mile 14.3). The river was dry between Reeves County W.I.D. No. 2 dam (mile 43.3) and the former Pecos River gaging station at Pecos (mile 71.8). At mile 86.3, the river had a flow of 3.18 cfs and a chloride concentration of 7,020 ppm. At Pecos County W.I.D. No. 2 dam (mile 105.8), the river was dry. Below this site, the river began to flow again, and at the Pecos River gaging station near Girvin (mile 188.4) the flow was 11.5 cfs. In this same reach, the chloride concentration decreased from 16,300 ppm to 8,290 ppm.

## GENERAL GEOLOGY

The study area is a part of the Pecos Plains and Toyah Basin. Alluvium of Cenozoic age is at the surface in most of the study area and unconformably overlies rocks ranging from the Rustler Formation of the Ochoa Series of Late Permian age to rocks of the Gulf Series of Late Cretaceous age. Rocks ranging in age from Permian to Recent crop out in small areas on both sides of the Pecos River. The alluvium consists of unconsolidated to partially consolidated sand, silt, gravel, boulders, clay, gypsum, and caliche. The alluvium is the principal aquifer in Reeves and northern Pecos Counties and is heavily pumped for irrigation in the vicinity of Pecos and Coyanosa.

## HYDROLOGY

The weather, flow, and other environmental factors were favorable for determining gains or losses of water released during this investigation. There was no rain during the study period, which was preceded by a long period of no flood runoff. Since the flood in August 1966, water has been released from Red Bluff Reservoir, so the river channel was well saturated and water losses from the channel should have reached a constant rate. Discharge losses therefore can be attributed to seepage and evapotranspiration. Salt cedars were in full leaf and there was a heavy growth of moss in many reaches of the river. A steady release of 547 cfs was begun on April 6, 1967 and was preceded by a release of 366 cfs which began March 18.

Water-delivery losses or gains between sites were determined by differences in measured discharges, taking into account the amounts of water diverted into irrigation canals. The water released from Red Bluff Reservoir during the study was released at a constant rate, as indicated by the continuous record at the Pecos River gaging station near Orla (mile 14.3). Inflow from tributaries during the study was minor and the stage at the gaging station Pecos River near Girvin (mile 188.4) did not change appreciably.

Water discharge was measured at 25 sites and samples for chemical analysis were collected at 29 sites in the study reach during April 17-19, 1967.

The study reach has been subdivided where significant changes in water discharge and chemical quality occurred. These are the same subdivisions used in Texas Water Development Board Report 22 (Grozier and others, 1966).

Results of discharge measurements and chloride concentrations are given in Table 1 and Figure 6, and chemical analyses of samples from 14 of these sites are given in Table 2. These data show changes in chemical quality and gains and losses of flow throughout the reach during the study.

## Reach from Red Bluff Reservoir (Mile 0) to Pecos (Mile 71.8)

The first measurement of water released from Red Bluff Reservoir was made just above the mouth of Salt (Screwbean) Draw (site 2A). This was the first practicable site for a discharge measurement downstream from the dam. Discharge (Table 1) included seepage from the reservoir at sites 1 and 1A. A discharge measurement at the gaging station on the Pecos River near Orla was attempted, but thick, stringy moss made this measurement of questionable accuracy, so it was not used in the study.

The loss in the 40.5-mile reach between sites 2A and 6 was 2.44 cfs per mile, compared with a loss of 0.44 cfs per mile during the study made February 15 to March 31, 1964.

The net loss in the 9.4-mile reach between sites 6 and 8 was 23.5 cfs, with no appreciable change in water quality. This is a loss of 2.50 cfs per mile compared with a 0.85 cfs per mile loss in the 1964 water-delivery study.

The net loss in the 8.2-mile reach between sites 8 and 10 was 34.2 cfs, or 4.17 cfs per mile, which was the greatest loss per mile measured between Red Bluff Reservoir and Girvin. Between sites 8 and 11, the 1964 study showed a loss of 1.3 cfs per mile.

During the water-delivery study period April 17-19, 1967, there was a net loss of flow of 156.7 cfs in the 61.0-mile reach between Red Bluff Reservoir and Ward County Irrigation District No. 1 canal (site 9). This is a loss of 29 percent of the measured discharge (547 cfs) at mile 2.9 downstream from the reservoir. In the water-delivery study made February 15 to March 31, 1964, there was a loss of 40 percent of the initial discharge (129 cfs) between Red Bluff Reservoir and the gaging station at Pecos, with no diversions except seepage through canal headgates. The low-flow study made in May 1918 also showed this to be a losing reach.

During the study, a break in a lateral in Ward County Irrigation District No. 1 permitted an unknown quantity of water to be returned to the river between sites 10 and 11. Therefore, no computation of gains or losses in this 10.8-mile reach could be made. Prior to heavy pumping from irrigation wells in Reeves County in the early 1950's, ground water was discharged into the Pecos River through seeps and springs. In 1918, this was a gaining reach. Now, however, the water table slopes away from the river.

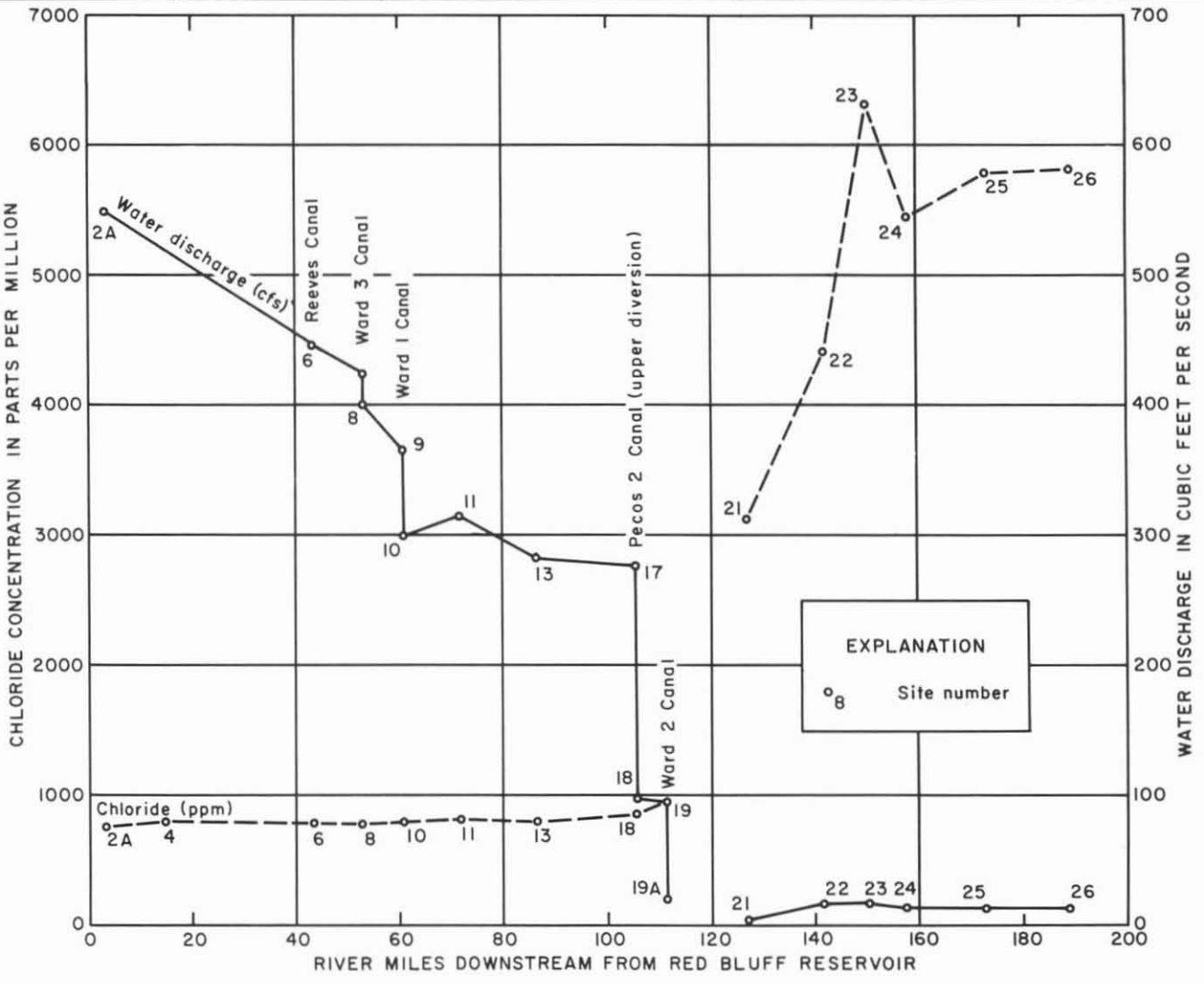


Figure 6

Chloride Concentration and Water Discharge, Pecos River, April 17-19, 1967

U. S. Geological Survey in cooperation with the Texas Water Development Board

## Reach from Pecos (Mile 71.8) to State Highway 18 near Grandfalls (Mile 127.4)

In a reach of the Pecos River from the former gaging station at mile 71.8 to Pecos River at the mouth of Toyah Creek (site 13), the discharge loss was 31 cfs, with no appreciable change in the chloride concentration. There was no known diversion or inflow in this reach. The loss in the 14.6-mile reach was 2.12 cfs per mile.

An abandoned oil well (site 14), known locally as "The River Well," was discharging 0.11 cfs of saline water that had a chloride concentration of 6,730 ppm. This is about the same discharge and chloride concentration that occurred during the 1964 water-delivery study. Flow from "The River Well" follows a small draw about 1,000 feet to the river and most of the flow probably enters the river through the alluvium.

The next measurement on the Pecos River was made at site 18 downstream from Pecos County W.I.D. No. 2 (upper diversion) dam. The net loss for the 19.4-mile reach between site 13 and site 18 was 6.0 cfs, or 0.31 cfs per mile, with no appreciable change in the chloride concentration.

In the 5.9-mile reach from site 18 to site 19A, there was a net loss of 3.0 cfs or 0.51 cfs per mile. In the reach from the former gaging station at Pecos (site 11) to site 19A, there was a net loss of 40.0 cfs, or 1.00 cfs per mile.

The measured loss in water discharge between the mouth of Salt (Screwbean) Draw and the Pecos River downstream from Ward County W.I.D. No. 2 diversion dam was 196.7 cfs. This is a loss in discharge of 36 percent between these sites.

All of the water being released from Red Bluff Reservoir was intended to be diverted into the irrigation canals and no water was to be allowed to flow past the Ward County W.I.D. No. 2 diversion dam. However, some water was flowing over the dam at the time of the investigation (20.6 cfs), but this water had not reached the bridge on State Highway 18 near Grandfalls (site 21), as indicated by the specific conductance of the samples. Therefore, no comparison of gains or losses in this reach of the river can be made.

## Reach from State Highway 18 near Grandfalls (Mile 127.4) to Girvin (Mile 188.4)

Between site 21 and site 22, there was a gain of 12.2 cfs, or 0.87 cfs per mile in the 14-mile reach. The chloride concentration of the inflow water was computed by the salt-dilution method, in which the discharge times the chloride concentration at the beginning of the reach (4.79 cfs x 3,140 ppm), plus the increase in discharge times the chloride concentration of the increase in discharge (12.2 cfs x C), is equal to the discharge times chloride concentration at the end of the reach (17.0 cfs x 4,420 ppm). Thus, the chloride concentration of the inflow between site 21 and site 22 was 4,920 ppm.

There was an apparent loss of 0.1 cfs between sites 22 and 23, but the chloride concentration increased in this reach from 4,420 to 6,340 ppm, which indicates an inflow of more saline water. The gain between sites 22 and 23

was equal to the losses, but the chloride concentration of the inflow was much greater than the initial chloride concentration of the water in the river.

The flow and chloride concentration of the Pecos River was almost uniform from mile 158.2 to mile 188.4. In the 30.2-mile reach, the gains equaled the seepage and evapotranspiration losses and the chloride concentration of the water increased from 5,450 ppm to 5,820 ppm.

Ground-water studies by Armstrong and McMillion (1961) in 1958 showed that the ground-water gradient between State Highway 18 near Grandfalls (mile 127.4) and Girvin (mile 188.4) was toward the river. Along part of the reach, the ground-water table intersects the river and water from the aquifer is discharged into the stream. The two water-delivery studies and the low-flow studies show that the amount of water added to the river from this source ranges from about 11 cfs to 24 cfs, as measured at Girvin. An unknown amount of the ground-water inflow is undoubtedly consumed by evapotranspiration.

## WATER QUALITY AND USE

### General

A drought has prevailed in the Pecos Valley from Orla to Girvin since 1960. The major inflow to Red Bluff Reservoir during this period was floodwater that originated near Carlsbad, New Mexico, during a storm in August 1966. As a result of this flood, the total volume of water in the reservoir increased from 43,000 acre-feet to 276,000 acre-feet. The low flow into Red Bluff Reservoir has a high concentration of dissolved solids, mostly sodium chloride. The water in the reservoir before the flood was of this type. However, this water was diluted by the flood inflow, which was a calcium-sulfate type suitable for irrigation of free-draining soils.

### Domestic

Drinking water used on common carriers in interstate traffic cannot exceed the limits of concentration of dissolved constituents listed in the standards of the U.S. Public Health Service (1962). These standards are usually accepted as the basis for determining the suitability of waters for municipal and domestic use. The recommended limits for chloride and sulfate concentration are 250 ppm, and the dissolved solids should not exceed 500 ppm.

Water in Red Bluff Reservoir at the time of the investigation greatly exceeded these limits and was unsatisfactory for domestic use. The concentration of chloride, sulfate, and dissolved solids in the water of Red Bluff Reservoir near the dam on April 17-19, 1967, were as follows:

| | |
|---|---|
| Chloride | 760 ppm |
| Sulfate | 676 ppm |
| Dissolved solids | 2,300 ppm |

Water with more than 180 ppm hardness (or calcium carbonate) is very hard. The hardness of Red Bluff water was 834 ppm on April 17, 1967.

The concentration of dissolved solids of the base flow of the Pecos River near Girvin on April 18, 1967, was 14,600 ppm, about 6.3 times the concentration of water in Red Bluff Reservoir. Of course, none of the water in the Pecos River near Girvin came from Red Bluff Reservoir.

### Industrial

Saline waters, similar to those in Red Bluff Reservoir at the time of this investigation, are highly corrosive and, when these waters are heated or evaporated, scale forms in pipes and other containers. Because of these characteristics, the water was unsatisfactory for most industrial uses.

### Irrigation

The U.S. Salinity Laboratory Staff (1954, p. 69) lists the total concentration of soluble salts and the relative proportion of sodium to the other cations as the two most important characteristics in determining water quality for irrigation. Based on criteria of the Salinity Laboratory Staff, the water in Red Bluff Reservoir in April 1967 would be classified as having a moderate sodium hazard and salinity hazard. The water stored in Red Bluff Reservoir during low flows has very high sodium and salinity hazards. The floodwater of August 1966 diluted the water previously stored in the reservoir, and during the study all the water in the reservoir was suitable for irrigation.

## SUMMARY

Water was released from Red Bluff Reservoir at a uniform rate from April 6 to 18. The water released, including the seepage, from the reservoir amounted to 547 cfs, as measured at mile 2.9 downstream from the dam. The chloride concentration of the water at this site was 760 ppm. In the 188.4 miles of river studied, 346 cfs was diverted or leaked into canals. No other known diversions were made from the river. Surface inflow below the first river measurement (mile 2.9) was 0.74 cfs of saline water from Salt (Screwbean) Draw (mile 2.9) and 0.11 cfs from the Sulphur Well (mile 93.0).

The diversions were constant except where the diversion was reduced to leakage through the headgates at Reeves County W.I.D. No. 2 canal during the investigation. The distance and lag time to the downstream station below this diversion was considered great enough that negligible effects, if any, occurred downstream.

Water lost in subreaches between Red Bluff Reservoir (mile 0) and Ward County Irrigation District No. 1 canal (mile 61.0) varied from 2.44 cfs per mile to 4.17 cfs per mile. During the studies in February and March 1964 and May 1965, the highest water loss in any of the same subreaches was 1.27 cfs per mile.

The loss in the subreaches between Pecos River at Pecos (mile 71.8) to Pecos River at the bridge on State Highway 18 near Grandfalls (mile 127.4) varied from 0.31 to 2.12 cfs per mile. In the previous studies of 1964 and 1965, the subreach from Pecos River at Pecos (mile 71.8) to Pecos River at the mouth of Toyah Creek (mile 86.4) was a gaining reach, but the gain was not significant.

In the reach of the Pecos River between State Highway 18 near Grandfalls and the gaging station near Girvin, there was a net gain of 8.2 cfs. A gain of 12.2 cfs from mile 127.4 (site 21) to mile 141.4 (site 22) and a loss of 3.6 cfs from mile 150.2 (site 23) to mile 158.2 (site 24) were the only significant changes in the reach. In the other subreaches between State Highway 18 and Girvin, the flow was stable, or water losses were equal to inflow.

The quality of water from Red Bluff Reservoir during the study period, April 17-19, 1967, was satisfactory for irrigation of soils with good drainage and unsatisfactory for domestic and most industrial purposes.

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Table 1.--Summary of water discharge measurements and chloride concentrations, Pecos River water-delivery study, April 1967

| Site No. | Date (1967) | Stream | Location | River mile[1] | Water temp. (°F) | Discharge in cfs | | | Chloride (ppm) | Specific conductance (micromhos at 25°C) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main stream | Tributary | Diversion | | | |
| -- | April 17 | Red Bluff Reservoir | Lat 31°54'08", long 103°54'43", on lake above outlet | 0 | 62 | -- | -- | -- | -- | 3,550 | |
| -- | 17 | do | Lat 31°54'08", long 103°54'43", at outlet | 0 | 62 | -- | -- | -- | 760 | 3,590 | |
| 1 | 17 | Bank seepage | Lat 31°54'05", long 103°54'30", about 250 feet downstream from Red Bluff Reservoir. Left bank. | .05 | 58 | -- | 3.72 | -- | 980 | 5,150 | Seepage along left river bank, which is composed of alluvium. |
| 1A | 17 | Bank seepage | Lat 31°53'53", long 103°54'26", about 1,000 feet downstream from Red Bluff Dam. Right bank. | .3 | 62 | -- | .33 | -- | 1,780 | 8,080 | Seepage along right river bank, which is composed of alluvium. |
| 2A | 17 | Pecos River | Lat 31°52'36", long 103°52'59", just upstream from mouth of Salt (Screwbean) Draw. | 2.9 | 64 | 547 | -- | -- | 760 | 3,620 | Heavy growth of saltcedars along both banks and in channel. River bed is gravel. |
| 3 | 17 | Salt (Screw-bean) Draw | Lat 31°52'33", long 103°53'04", about 2,000 feet upstream from mouth. | 2.9 | 69 | -- | .74 | -- | 5,800 | 20,100 | Channel has bed of sand and gravel, with heavy growth of saltcedars along each bank. |
| 4 | 17 | Pecos River | Lat 31°48'14", long 103°48'26", at stream-gaging station, Pecos River near Orla. | 14.3 | 70 | -- | -- | -- | 800 | 3,710 | Channel has bed of gravel, with heavy growth of saltcedars along each bank. Sandstone outcrops at gaging station. |
| 5 | 18 | Reeves Co. WID No. 2 Canal | Lat 31°37'57", long 103°34'30", 175 feet downstream from head-gates. | 43.3 | 63 | -- | -- | 0.76 | 800 | 3,730 | Channel is composed of gravel and silt and has heavy growth of salt-cedars along each bank. |
| 6 | 18 | Pecos River | Lat 31°37'57", long 103°34'22", 800 feet downstream from Reeves Co. WID No. 2 channel dam. | 43.4 | 63 | 448 | -- | -- | 790 | 3,720 | Channel is composed of gravel and silt and has grass and saltcedars along each bank. |
| 7 | 18 | Ward Co. WID No. 3 Canal | Lat 31°36'03", long 103°30'14", at head-gates of canal. | 52.6 | 64 | -- | -- | 22.5 | 780 | 3,700 | Canal has been cleaned. Silty bottom. Very little saltcedars in canal. |

[1] Downstream from Red Bluff Dam.

Table 1.--Summary of water discharge measurements and chloride concentrations, Pecos River water-delivery study, April 1967--Continued

| Site No. | Date (1967) | Stream | Location | River mile[1] | Water temp. (°F) | Discharge in cfs | | | Chloride (ppm) | Specific conductance (micromhos at 25°C) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main stream | Tributary | Diversion | | | |
| 8 | April 18 | Pecos River | Lat 31°35'58", long 103°30'16", 1,000 feet downstream from Ward Co. WID No. 3 dam. | 52.8 | 64 | 402 | -- | -- | 780 | 3,700 | Channel has bed of gravel, with saltcedars along each bank. |
| 9 | 17 | Ward Co. Irr. Dist. No. 1 Canal. | Lat 31°31'26", long 103°29'44", at headgates of canal. | 61.0 | 63 | -- | -- | 67.8 | 800 | 3,750 | There is a sandstone outcrop at channel dam. |
| 10 | 17 | Pecos River | Lat 31°31'27", long 103°29'44", 600 feet downstream from Ward Co. Irr. Dist. No. 1 canal dam. | 61.0 | 65 | 300 | -- | -- | 800 | 3,770 | Channel is sandstone. |
| 11 | 17 | do | Lat 31°26'11", long 103°28'00", at former stream-gaging station, Pecos River at Pecos. | 71.8 | 68 | 315 | -- | -- | 830 | 3,850 | Channel has bed of sand and gravel. Steep banks have heavy growth of saltcedars. |
| 12 | 18 | Toyah Creek | Lat 31°24'36", long 103°19'30", at mouth. | 86.3 | -- | -- | -- | 0 | -- | -- | Streambed is sandy loam. Some saltcedars in channel near the river. |
| 13 | 18 | Pecos River | Lat 31°24'46", long 103°19'30", 0.1 mile downstream from Toyah Creek. | 86.4 | 66 | 284 | -- | -- | 820 | 3,830 | Channel is sandy loam, with saltcedars along each bank and in the water. |
| 14 | 18 | Sulphur Well (known locally as The River Well). | Lat 31°25'40", long 103°15'24", at abandoned oil well about 1,000 feet from river. | 93.0 | 76 | -- | 0.11 | -- | 6,730 | 22,500 | Flow follows a small draw leading to river. |
| 15 | 18 | Grandfalls-Big Valley Canal | Lat 31°25'21", long 103°15'21", at headgates of canal. | 93.2 | 75 | -- | -- | .20 | 840 | 3,880 | Channel has bed of sandy loam, with saltcedars along each bank. |
| 17 | 19 | Pecos Co. WID No. 2 Canal (upper diversion) | Lat 31°21'51", long 103°06'06", at headgates of canal. | 105.6 | 67 | -- | -- | 178 | 860 | 3,950 | Channel has bed of sandy clay. Banks of canal have been cleaned by bulldozer. |
| 18 | 19 | Pecos River | Lat 31°21'54", long 103°06'00", 800 feet downstream from Pecos Co. WID No. 2 (upper diversion) dam. | 105.8 | 67 | 99.9 | -- | -- | 860 | 3,960 | Channel has bed of sand and gravel, with grass and saltcedars on both low banks. High banks of sandy loam are covered with saltcedars. |
| 19 | 18 | Ward Co. WID No. 2 Canal | Lat 31°22'10", long 103°00'20", at gage. | 111.5 | 65 | -- | -- | 76.3 | 940 | 4,260 | Channel is covered with saltcedars. |

[1] Downstream from Red Bluff Dam.

Table 1.--Summary of water discharge measurements and chloride concentrations, Pecos River water-delivery study, April 1967--Continued

| Site No. | Date (1967) | Stream | Location | River mile[1] | Water temp. (°F) | Discharge in cfs | | | Chloride (ppm) | Specific conductance (micromhos at 25°C) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main stream | Tributary | Diversion | | | |
| 19A | April 18 | Pecos River | Lat 31°22'48", long 103°02'08", 300 feet downstream from Ward Co. WID No. 2 diversion dam. | 111.7 | 65 | 20.6 | -- | -- | 980 | 4,390 | Channel is gravel and sandy loam, with weeds and saltcedars. Banks are sandy loam with dense growth of saltcedars. |
| 21 | 18 | do | Lat 31°18'20", long 102°52'30", at bridge on State Highway 18 near Grandfalls. | 127.4 | 72 | 4.79 | -- | -- | 3,140 | 11,600 | Right bank is steep,with a few saltcedars. Left bank is low with saltcedars. Two oil wells located in river, one upstream and one downstream from highway bridge. |
| 22 | 18 | do | Lat 31°17'10", long 102°44'30", about 1/2 mile downstream from former stream-gaging station, Pecos River below Grandfalls. | 141.4 | 68 | 17.0 | -- | -- | 4,420 | 16,400 | Channel has bed of sandy loam, silt, and gravel. Banks are covered with saltcedars. |
| 23 | 18 | do | Lat 31°18'50", long 102°39'20", 300 feet upstream from Farm Road 1053 bridge near Imperial. | 150.2 | 69 | 16.9 | -- | -- | 6,340 | 21,500 | Channel bed is sandy loam. Banks are low with very few trees. Saltcedars are dense on the flood plain. |
| 24 | 18 | do | Lat 31°16'00", long 102°35'50", at site of former stream-gaging station, Pecos River near Buenavista. | 158.2 | 70 | 13.3 | -- | -- | 5,450 | 19,100 | Channel has bed of sand and gravel, and has steep banks. Saltcedars cover each bank. |
| 25 | 18 | do | Lat 31°12'20", long 102°27'35", at Horsehead Crossing near Girvin. | 173.2 | 75 | 13.0 | -- | --- | 5,790 | 20,400 | Channel is sandy loam with light growth of saltcedars along each bank. |
| 26 | 18 | do | Lat 31°06'40", long 102°25'00", in flume at stream-gaging station Pecos River near Girvin (regular gage). | 188.4 | 71 | 13.0 | -- | -- | 5,820 | 20,800 | Channel has bed of sandy loam, with saltcedars along each bank. Concrete control on rock outcrop 60 feet below gage. |

[1] Downstream from Red Bluff Dam.

Table 2.--Summary of chemical analyses of water from selected sites, Pecos River watershed below Red Bluff Reservoir, April 17-19, 1967

[Analytical results in parts per million except as indicated]

| Site No. | Date | Discharge (cfs) | Silica ($SiO_2$) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Dissolved solids (Calculated) | | | Hardness as $CaCO_3$ | | Sodium adsorption ratio | Specific conductance (micromhos at 25°C) | pH | Density |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Parts per Million | Tons acre-foot | Tons per day | Calcium, Magnesium | Noncarbonate | | | | |
| 2A | April 17 | 547 | -- | -- | -- | -- | -- | -- | -- | 760 | -- | -- | -- | -- | -- | -- | 3,620 | -- | -- |
| 3 | 17 | .74 | 5.1 | 892 | 375 | 3,530 | 30 | 141 | 3,140 | 5,800 | 13,800 | -- | -- | 3,770 | 3,650 | -- | 20,100 | 7.3 | 1.009 |
| 4 | 17 | -- | -- | -- | -- | -- | -- | -- | -- | 800 | -- | -- | -- | -- | -- | -- | 3,710 | -- | -- |
| 8 | 18 | 402 | -- | -- | -- | -- | -- | -- | -- | 780 | -- | -- | -- | -- | -- | -- | 3,700 | -- | -- |
| 11 | 17 | 315 | -- | -- | -- | -- | -- | 128 | 724 | 830 | -- | -- | -- | 875 | 770 | -- | 3,850 | 7.3 | -- |
| 13 | 18 | 284 | -- | -- | -- | -- | -- | 129 | -- | 820 | -- | -- | -- | 880 | 774 | -- | 3,830 | 7.4 | -- |
| 18 | 19 | 99.9 | -- | -- | -- | -- | -- | -- | -- | 860 | -- | -- | -- | -- | -- | -- | 3,960 | -- | -- |
| 19A | 18 | 20.6 | -- | -- | -- | -- | -- | | 804 | 980 | -- | -- | -- | 950 | 836 | -- | 4,390 | 7.3 | -- |
| 21 | 18 | 4.79 | 2.6 | 424 | 194 | 1,930 | 30 | 114 | 1,580 | 3,140 | 7,360 | -- | -- | 1,860 | 1,760 | -- | 11,600 | 7.3 | -- |
| 22 | 18 | 17.0 | -- | -- | -- | -- | -- | 128 | 2,910 | 4,420 | -- | -- | -- | 3,220 | 3,120 | -- | 16,400 | 7.3 | -- |
| 23 | 18 | 16.9 | -- | -- | -- | -- | -- | 78 | 2,850 | 6,340 | -- | -- | -- | 3,430 | 3,370 | -- | 21,500 | 7.2 | -- |
| 24 | 18 | 13.3 | -- | -- | -- | -- | -- | 79 | 2,970 | 5,450 | -- | -- | -- | 3,550 | 3,490 | -- | 19,100 | 7.3 | -- |
| 25 | 18 | 13.0 | -- | -- | -- | -- | -- | -- | -- | 5,790 | -- | -- | -- | -- | -- | -- | 20,400 | -- | -- |
| 26 | 18 | 13.0 | 1.5 | 782 | 498 | 3,700 | 48 | 150 | 3,650 | 5,820 | 14,600 | -- | -- | 4,000 | 3,880 | -- | 20,800 | 7.1 | 1.010 |