UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DIVERSIONS FROM RED RIVER TO LAKE DALLAS, TEXAS; AND RELATED CHANNEL LOSSES

February and March 1954

by

Pat H. Holland

Prepared in cooperation with the Texas
State Board of Water Engineers

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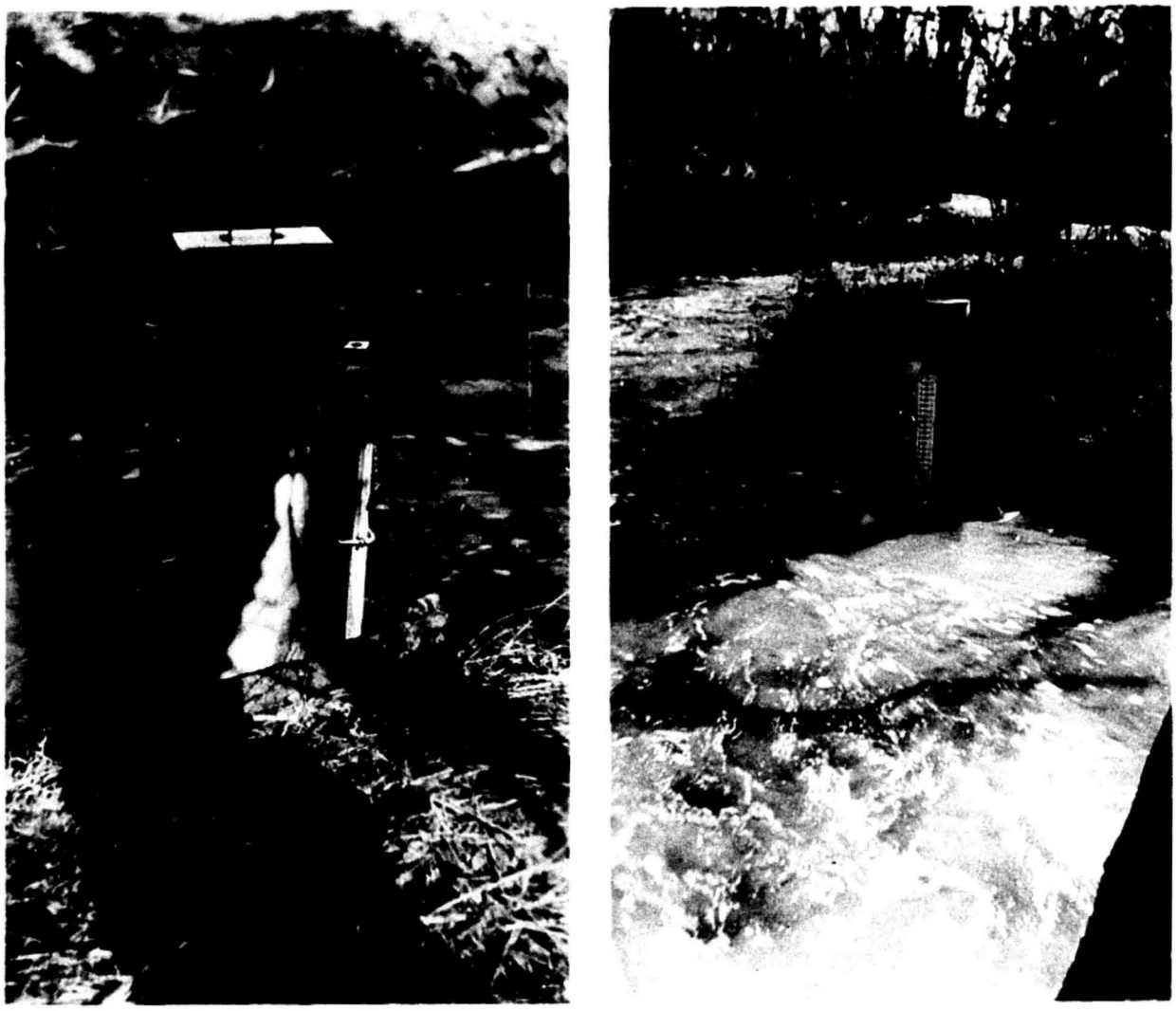

Temporary Recording Gage
Pecan Creek 3.5 miles north of Gainesville, Tex.

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During the period Feb. 10 to Mar. 3, 1954, the City of Dallas pumped 1,363 acre-feet of water from its Red River plant into Pecan Creek (a tributary of Elm Fork Trinity River) 3.5 miles above Gainesville; 1,272 acre-feet of this diversion reached the head of Lake Dallas. Discharge records were obtained at four points along the channels. This water was transported down the channels of Pecan Creek and Elm Fork Trinity River to Lake Dallas, a distance of about 31 miles. Total flow of pumped water for three of the locations is given in the following table:

TOTAL ACRE-FEET FEB. 11 TO MAR. 3, 1954

	Pecan Creek 3.5 mi. north of Gainesville	Elm Fork Trinity R. 6 mi. south of Gainesville	Elm Fork Trinity R. at Highway 10 northeast of Denton	Loss in Acre-feet	Loss %
Channel Mile from Pumping Plant	3.0	12.6	33.9		
6 Pumps Operating 72 hours	685	683	645	40	5.8
4 Pumps Operating 72 hours	454	421	421	33	7.3
2 Pumps Operating 72 hours	224	220	206	18	8.0
Total Pumpage	1,363	1,324	1,272	91	6.7

As a drought emergency measure the City of Dallas in 1953 constructed a pumping plant on Red River directly north of Gainesville for the purpose of diverting Red River water over the Red-Trinity River divide and into Lake Dallas to supplement its municipal supply. Six electric pumps deliver water from Red River through a concrete pipe line and a cut channel a distance of about 3 miles to the head of Pecan Creek - a tributary of Elm Fork Trinity River. During the investigation from February 10 to March 3 each of the pumps delivered an average of 19 cfs at the lower end of the cut channel just upstream from the uppermost gaging station.

In August 1953 the City of Dallas requested that the Geological Survey and its cooperating agency the Texas Board of Water Engineers make an investigation of channel losses during a test run. Due to mechanical difficulties at the pumping plant, the test was delayed until February 1954. On February 10 three temporary recording gages were installed in the reach in addition to the regular gaging station on Elm Fork Trinity River near Sanger. The locations of the gages are shown in figure 1. The lower gage was installed at State Highway 10, northeast of Denton, which is the farthest downstream accessible point above backwater from Lake Dallas.

Prior to the investigation K. F. Hoefle, Superintendent of Dallas Water Department, and Pat H. Holland, Geological Survey engineer-in-charge of field investigations, agreed upon the following method of pump operation:

1. The interval of flow method be used to determine losses, with interval of 72 hours pumping and 72 hours shutdown or recession time between runs.

2. Three rates of flow be investigated - flow from 6, 4, and 2 pumps.

3. 6 pumps be started at noon February 11.

The pumps were started and operated as scheduled with only two interruptions when a single pump was stopped for a short time. The chart records

from the continuous recorders were complete and a full range of discharge measurements was obtained. The investigation was completed on March 3 but the recording gages were operated until March 18 and pumping continued after that time.

Prior to the investigation some pump tests had been made. One of these, of 4 days duration, had ended about noon of February 8. A residue of this water was present at all three of the Elm Fork stations when recorders were installed on February 10. Elm Fork Trinity River was flowing 5.0 cfs just above the mouth of Pecan Creek on February 12 and 4.0 cfs on February 19. Pecan Creek was dry above Gainesville and had only slight flow at its mouth. On February 11 all tributaries within the reach were inspected and all flow measured. A total of 2.9 cfs was measured in Isle du Bois, Spring, and Scott Creeks.

Hourly discharges were computed and figure 2 shows actual discharge hydrograph for the three stations and figure 3 shows discharge hydrograph with normal or base flow eliminated. Figure 4 is a time of travel curve between the upper and lower gages.

After careful analysis it was decided that the data obtained at Elm Fork Trinity River near Sanger was not sufficiently accurate to include in this report. The stage-discharge relation for medium and low stages is controlled by a clay and mud bar a short distance downstream from the gage. The highway bridge at this site is too weak to carry heavy equipment and therefore bulldozers and other equipment must be forded. The gage control, being the shallowest point near the bridge, is used as a ford for this equipment and often dirt is pushed into the channel before the vehicles are crossed thereby changing the stage-discharge relation. During the investigation the control at the Sanger station was disturbed to such an extent

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Figure 4
TIME OF TRAVEL CURVE

LAKE DALLAS
Diversions from Red River to Lake Dallas

Feb. 10 to Mar. 3, 1954

Plotted DLM Checked PHH

Discharge, in c.f.s., at Pecan Creek 3.5 miles north of Gainesville, Tex.

0
20
40
60
80
100
120

24 30 36 42 48 54

Time of travel, in hours, from Pecan Creek to Elm Fork Trinity at Highway 10

that the low and medium records could not be computed to good accuracy.

Minor shifting of the stage-discharge relation occurred at the gage below Gainesville and therefore this record although good is not considered as accurate as that at Pecan Creek and Elm Fork Trinity northeast of Denton.

Base data is considered excellent and except for some minor uncertainties in determining the normal flow at the two Elm Fork stations, the results as a whole are considered excellent. There was no normal or base flow at the Pecan Creek station. Accuracy of the interval of flow method depends on an accurate definition of the interval as it progresses downstream. This can be done by sandwiching the foreign water between two troughs that return to the normal flow. Considerable time would be required to allow the troughs or the flow recession to return to absolute base flow. The 72 hour pumping interval proved sufficient to produce desired volumes of flow but the 72 hour shutdown or recession time was not long enough for recession flows to return to normal. Probably twice the allotted recession time would have been enough but 72 hours was the maximum that could be allowed due to the imminence of weather changes. Rainfall of consequence would end this type of study and past history indicates that some rains are almost certain during February in this section of northeast Texas. However, the inaccuracies due to uncertain normal flow are of small consequence owing to the small percentages involved.

The small percentage of loss encountered in delivery of Red River water can be attributed largely to the low seasonal evaporation and transpiration losses and the relatively impervious nature of the stream-bed material. The geologic formations across which the streams flow are of the Washita group of the Cretaceous age consisting generally of clays and marls with a few thin beds of limestone and sandy clay, all of which are relatively impervious.[1]

The weather was ideal for this type of investigation because no rain fell in the vicinity and the sun was shining much of the time. Evaporation losses, however, might have been higher than the seasonal average because brisk winds blew from the north, south and west with accompanying dust clouds at times from the west and northwest. Conditions were ideal for high evaporation and transpiration for this season of the year and the losses experienced should be near the maximum for a winter season.

Field work and partial computation of data in this report was performed under the direction of R. L. Allen, Area Engineer, Fort Worth Area office.

1/ References to geology and ground water have been reviewed in the Ground Water Branch, Austin, Tex.

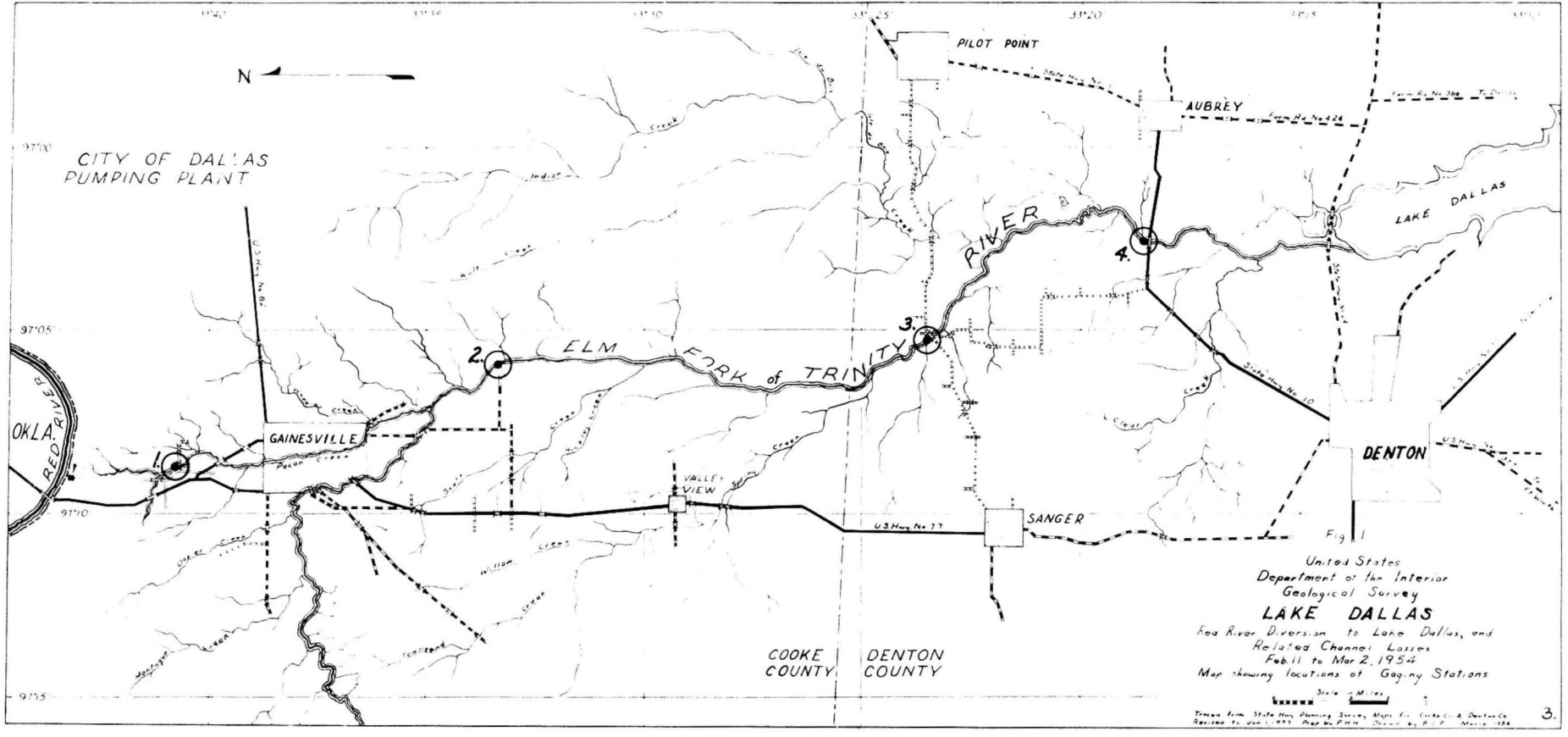

Fig 1

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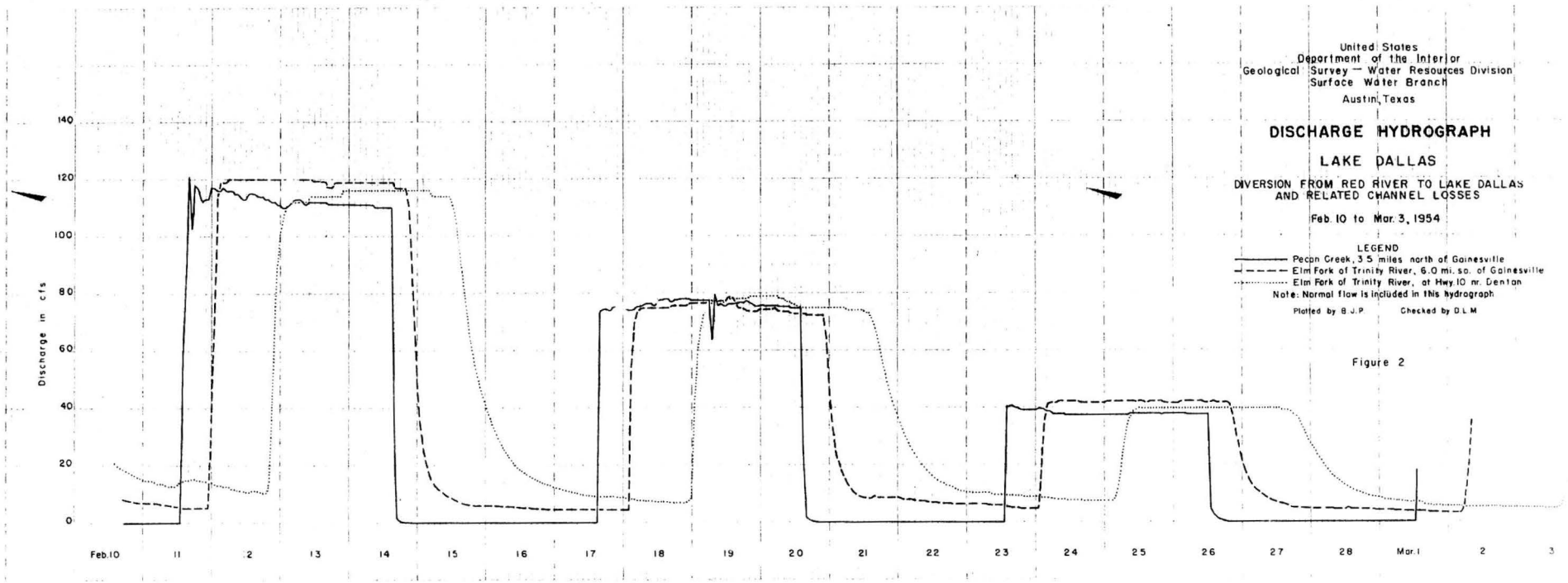
LAKE DALLAS

Red River Diversion to Lake Dallas, and
Related Channel Losses
Feb. 11 to Mar. 2, 1954
Map showing locations of Gaging Stations

Scale of Miles

Traced from State Hwy Planning Survey Maps for Cooke Co. & Denton Co.
Revised to Jan. 1953. Prep. by P.H.H. Drawn by H.E.F. March 1954.

3.



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Austin, Texas

DISCHARGE HYDROGRAPH

LAKE DALLAS

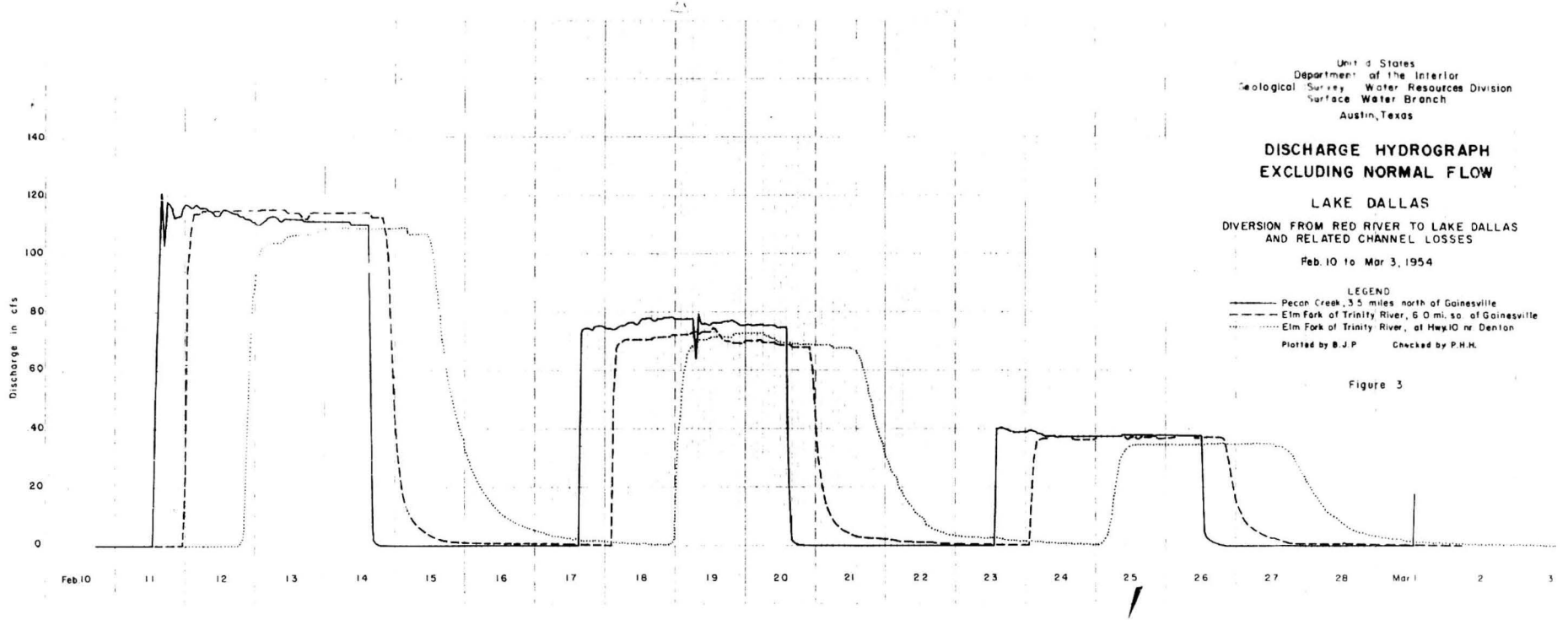
DIVERSION FROM RED RIVER TO LAKE DALLAS
AND RELATED CHANNEL LOSSES

Feb. 10 to Mar. 3, 1954

LEGEND
Pecan Creek, 3.5 miles north of Gainesville
Elm Fork of Trinity River, 6.0 mi. so. of Gainesville
Elm Fork of Trinity River, at Hwy. 10 nr. Denton
Note: Normal flow is included in this hydrograph

Plotted by B.J.P. Checked by D.L.M.

Figure 2



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DISCHARGE HYDROGRAPH EXCLUDING NORMAL FLOW

LAKE DALLAS

DIVERSION FROM RED RIVER TO LAKE DALLAS AND RELATED CHANNEL LOSSES

Feb. 10 to Mar 3, 1954

LEGEND
Pecan Creek, 3.5 miles north of Gainesville
Elm Fork of Trinity River, 6.0 mi. so. of Gainesville
Elm Fork of Trinity River, at Hwy 10 nr. Denton

Plotted by B.J.P Checked by P.H.H.

Figure 3