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UNITED STATES
DEPARMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FLOODS ON WHITE ROCK CREEK ABOVE WHITE ROCK LAKE AT DALLAS, TEXAS

Prepared in cooperation
with the City of Dallas

OPEN FILE No. 66

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ABOVE WHITE ROCK LAKE AT DALLAS, TEXAS

by

C. R. Gilbert

Prepared in cooperation with the
City of Dallas
by the Surface Water Branch
U. S. Geological Survey
Trigg Twichell, District Engineer

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Flood of July 27, 1962, inundating Northwest Highway (Loop 12). (Photo by Dallas Times Herald)

FLOODS ON WHITE ROCK CREEK

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INTRODUCTION

The White Rock Creek watershed within the city limits of Dallas, Texas, presents problems not unique in the rapid residential and industrial development encountered by many cities throughout the United States. The advantages of full development of the existing area within a city before expanding city boundaries, are related to both economics and civic pride. The expansion of city boundaries usually results in higher per capital costs for the operation of city governments.

Certainly no responsible city official would oppose reasonable development of watersheds and flood plains and thus sacrifice an increase in tax revenue. Within the words "reasonable development" lies the problem faced by these officials. They are aware that the natural function of a stream channel and its associated flood plain is to carry away excess water in time of flood. They are also aware that failure to recognize this has often led to haphazard development on flood plains with a consequent increase in flood damages. In the absence of factual data defining the risk involved in occupying flood plains, stringent corrective and preventative measures must be taken to regulate man's activities on flood plains to a point beyond normal precaution.

Flood-flow characteristics in the reach of White Rock Creek that lies between the northern city boundary of Dallas and Northwest Highway (Loop 12) at the upper end of White Rock Lake, are presented in this report. Hydrologic data shown include history and magnitude of floods, flood profiles, outlines of areas inundated by three floods, and estimates of mean velocities of flow at selected points.

Approximate areas inundated by floods of April 1942 and July 1962 along White Rock Creek and by the flood of October 1962 along Cottonwood Creek, Floyd Branch, and Jackson Branch, are delineated on maps. Greater floods have undoubtedly occurred in the past but no attempt is made to show their probable overflow limits because

basic data on such floods could not be obtained. Depths of inundation can be estimated from the information shown. Elevations shown are in feet above mean sea level, datum of 1929.

The data and computations supporting the results given herein are in the files of the Geological Survey in Austin, Texas.

Cooperation and Acknowledgment

The preparation of this report was financed through a cooperative agreement between the city of Dallas and the Geological Survey. Messrs. R. C. Hartung and F. H. Ruggles, Hydraulic Engineers, Geological Survey, assisted in the field investigations and related computations. Mr. H. H. Stirman, Director of Public Works of the city of Dallas and his staff provided useful historical flood data. Several long-time residents of the study area (Messrs. Emory Breedlove, Claude Bell, W. H. Stultz, Lindsey Green, E. B. Stewart, John Deuback, and others) contributed much information concerning past floods.

PHYSIOGRAPHY

The headwaters of White Rock Creek, a tributary of the Trinity River, are about 2 miles southeast of Frisco in Collin County and about $10\frac{1}{2}$ miles north of the Dallas city boundary. Headwater elevations are about 780 feet. The stream flows southward some 30 miles into White Rock Lake which has a conservation pool elevation of 458 feet. General features of the watershed in the study area are shown on plate 1 (in pocket).

From the northern city boundary of Dallas (mile 27.6) to the Texas and New Orleans Railroad Co. bridge (mile 18.7) the streambed has a nearly uniform slope of about 10 feet per mile. In the 5-mile reach between the railroad bridge and White Rock Lake, the slope decreases from about 5 feet per mile to about 2 feet per mile. Local valley relief is about 150 feet.

The drainage area of White Rock Creek at the northern Dallas city limit is 26.6 square miles and at Northwest Highway (Loop 12), 83.0 square miles. There is considerable variation in the width of the valley. The main channel is 50 to 100 feet wide, approximately trapezoidal in cross section, and ranges from 10 to 22 feet in depth. The channel bottom is cut to limestone bedrock in the reach upstream from Greenville Avenue and is mostly compacted alluvial material downstream from this point. The steep banks consist of limestone in many reaches and well-compacted alluvial material in others. Trees and underbrush line the channel for most of its length.

Except for streets and an occasional residence or business establishment, the flood plain within the study area is presently unoccupied. There are 15 vehicular bridges across the main channel within the study area. There are several small "low-water" dams but their effects on the flood capacity of the channel are negligible.

Major tributaries between the northern city boundary of Dallas and White Rock Lake are Spanky Branch, Floyd Branch, Cottonwood Creek, and Jackson Branch.

DATA AVAILABLE

Collection of streamflow records was begun in the White Rock Creek basin in August 1961, and since that time floods of sufficient magnitude to be of considerable value in this study occurred July 27 and October 8, 1962. The continued collection of these records is important to test some of the necessary syntheses related to the major flood of April 19-20, 1942, and to define changes in hydrology due to progressive urbanization of the area. Streamflow records on streams in adjacent areas with characteristics comparable to those on White Rock Creek are short but provide useful data.

Long-time residents of the White Rock Creek area provided many flood-height references and much useful information concerning past floods.

Engineers of the Geological Survey made surveys of the White Rock Creek channel and flood plain at 14 of the 15 vehicular bridges and at 6 intermediate sites in the 14-mile reach of the study area. Values of channel roughness coefficients "n" were selected, and cross-sections were defined to elevations higher than those of the highest known floods.

FLOOD HISTORY

Upper White Rock Creek

White Rock Creek has been subjected to very intense rainfall in the past, and extensive inundation of the flood plain has occurred. The greatest flood since at least 1886 was that of April 19-20, 1942, according to Mr. Emory Breedlove, local resident since 1886. Information obtained from other long-time residents of the area substantiates this fact. Although official U. S. Weather Bureau rainfall stations adjacent to the watershed did not receive extraordinary amounts for the April 1942 storm (Love Field, 3.44 inches; Carrollton, 7.73 inches; and Fort Worth, 5.19 inches), there were unofficial reports of as much as 12 inches of rainfall in the upper

part of the watershed. Two days of general thunderstorm activity in the area prior to the occurrence of the 1942 storm, contributed to a higher-than-ordinary rate of flood runoff.

Although one person was drowned in the April 1942 flood at the Forest Lane crossing, newspaper accounts of the flood were minimized because of the events of World War II. The Dallas Times Herald on April 20, 1942, stated in part: "The water in the White Rock Creek area was reported by old-time residents as the highest in over 50 years." Concern over the war news was probably responsible in part for the lack of many personal recollections of the magnitude of this outstanding flood event. Flood-height information obtained from some residents and landowners in the area could not be verified. However, sufficient peak-stage data were obtained in the reach upstream from Greenville Avenue to define the approximate area inundated by the 1942 flood.

The flood of June 14, 1949 was probably the second highest since at least 1922, although some residents contend that the 1949 flood was higher than the 1942 flood. However, reliable information indicates the 1942 flood to be higher by more than 3 feet at the upper end of the reach and more than 1 foot in White Rock Lake at the lower end. The storm that caused the flood of June 14, 1949, was centered over the east side of the study area where the city of Richardson reported $11\frac{1}{2}$ inches of rainfall in a 12-hour period.

On July 27, 1962 the area upstream from Greenville Avenue received an average rainfall of 6.2 inches after almost 2 inches of rain had fallen the previous day. This precipitation caused flooding along White Rock Creek comparable to that experienced in June 1949. Downstream from Forest Lane, due to tributary inflow, flooding was probably greater in 1949.

In the early morning on October 8, 1962, a very intense storm of short duration occurred in the upper White Rock Creek basin. Rainfall averaging 4.5 inches fell on the watershed in about 3 hours. Flooding was more severe than in July 1962 in the reach downstream from Forest Lane.

Other floods of note occurred in the upper White Rock Creek watershed in April 1922, May 1946, and August 1947. Frequent flooding on this steep-sloped stream is probable.

Cottonwood Creek and Floyd Branch

The greatest flood which has occurred since at least 1892 on Cottonwood Creek and its major tributary Floyd Branch is that of June 14, 1949. The flood of April 19-20, 1942, on both streams was from one-half to one foot lower than in 1949.

The storm of October 8, 1962 was centered over the Cottonwood Creek watershed. Precipitation in this tributary watershed ranged from about 4 inches in the upper part to more than 7 inches at the lower end. Flood heights at Forest Lane were comparable to those of June 14, 1949 on Cottonwood Creek and April 19-20, 1942 on Floyd Branch.

Cottonwood Creek, which flows into White Rock Creek immediately upstream from the Texas and New Orleans Railroad Co. bridge, comprises about one-fifth of the drainage area of White Rock Creek upstream from this point.

MAGNITUDE AND FREQUENCY OF FLOODS

Sufficient data have not been obtained in the Dallas area to completely define a flood-frequency relation for drainage areas as small as the upper White Rock Creek basin (83 square miles). Investigations to define flood-frequency relations in the White Rock Creek basin are now in progress.

As applied to flood events, recurrence interval is the average interval of time within which a given flood height will be equaled or exceeded once. Frequencies of floods may also be stated in terms of their probabilities (reciprocals of their recurrence intervals). For example, a flood with a 25-year recurrence interval would have a 4-percent chance of being equaled or exceeded in any one year. It should not be inferred that the "100-year" flood will occur once and only once during a 100-year period. It may occur in any year or even in successive years. The 100-year flood has one chance in one hundred of being equaled or exceeded in any given year.

The flood of April 19-20, 1942, is the greatest flood in at least 77 years. Although more than 20 years have elapsed since the 1942 flood (which conceivably could have a recurrence interval of as much as 100 years) on White Rock Creek, an equal or greater flood could occur at any time.

Preliminary studies indicate that floods of the magnitude of those of July 27 and October 8, 1962, may be expected to occur on an average of once in 15 to 20 years. The occurrence of these floods within a span of about 2½ months emphasizes the fact that

recurrence intervals are average figures--the average number of years that will elapse between occurrences of floods that will equal or exceed a certain flood height. Wide deviations from the average are commonplace in nature.

Where threat to human life is not a factor it is not usually economically feasible to build a structure to withstand the largest known or expected flood. Most bridges in the White Rock Creek basin are designed for a discharge capacity less than that experienced in April 1942. For economical design it is essential that bridge construction costs be balanced against flood damages or liabilities arising from failure or interruption of services.

INUNDATION BY WHITE ROCK CREEK

Absolute accuracy is not attainable in involved open-channel hydraulic computations such as those which form the basis for the results presented in this report for the flood of April 19-20, 1942. The flood profiles and area inundated, even in those reaches with apparently reliable flood heights are subject to some variation from the results given herein.

Method of Computation and Assumptions

Methods used in computing the backwater effect of channel and constriction geometry and roughness, and flows over embankments are those outlined in U. S. Geological Survey Circulars 284, 376, and 397. The standard-step method of computing backwater curves was used to define profiles.

The following assumptions were made as a basis for the computations:

1. With regard to the April 19-20, 1942 flood: Where sufficient data are not available to accurately define the major changes, the geometry and roughness of the valley and the various constrictions in those reaches not defined by flood-heights are now essentially the same as in 1942. It was further assumed that bridges and culverts were not clogged with debris to any great extent during the 1942 flood.

2. Other assumptions which affect the computations have been made at specific sites or in specific reaches within the study area. Justifications for such assumptions are contained in the file of computations for the report in Austin, Texas.

Description of Constrictions

The valley of White Rock Creek and its constrictions within the study area as they existed in 1956 are shown on the topographic map which forms the base for plates 1-2. There has been some construction in the area since that date. No attempt was made to add new features to the map. The effect of the new construction was considered in the computations, however.

Tabulated in table 1 are the pertinent data for all except one of the vehicular bridges on the main channel in the study area. The excepted bridge is on Abrams Road, which is approximately one-half river mile upstream from the Skillman Street crossing. The Abrams Road bridge was not surveyed because field inspection indicated that it offers little or no constriction to flood flow.

Although the bridges at Alpha Road, Forest Lane, and Valley View Lane were replaced after the 1942 flood, reliable information indicates the geometry of the present bridges and the elevation of bridge approaches to be almost identical to those existing in 1942. The three railway bridges, and the bridges at Loop 12, Fair Oaks Avenue, Greenville Avenue, and Keller Springs Road, are essentially the same now as they were in 1942 as regards geometry and approach elevations. A small relief bridge was constructed adjacent to the main channel bridge at the Texas and New Orleans Railroad Co. site subsequent to the 1942 flood. This relief bridge (net waterway area of 707 square feet) is assumed to represent the same hydraulic efficiency as the "washouts" that took place around abutments in 1942. The upstream service road (Coit Road) at Central Expressway site was the main channel bridge at this crossing in 1942 and caused little if any constriction at that time. The bridges and fills at Skillman Street and Central Expressway did not exist at the time of the 1942 flood. New bridges with much higher approach fills were constructed at Belt Line Road and Preston Road subsequent to the 1942 flood. Flood heights in the vicinity of these bridges check the water surface profile of the 1942 flood defined by indirect methods.

With the possible exception of the bridges at Loop 12, major backwater conditions probably were not experienced at any of the automobile bridges spanning White Rock Creek during the 1942 flood because most of the flood flow went around bridges and over the low approach fills.

Table 1.--Geometry of vehicular bridges over upper White Rock Creek

Location	River mile in study reach 1/ (miles)	Elevation of lowest point of superstructure (feet)	Net area of opening(s) at most constricted plane (square feet)	Depth of opening(s) superstructure to ground	
				Maximum (feet)	Average (feet)
Loop 12	13.5	463.1	2/ 2,212	10.7	5.7
M. K. & T. RR.	14.3	465.7	2/ 3,844	15.7	7.0
Skillman St.	14.9	476.5	5,748	24.0	11.5
Fair Oaks Ave.	16.4	473.8	3/ 903	15.4	8.0
Greenville Ave.	17.7	4/ 490.2	954	21.4	15.4
T. & N.O. RR.	18.7	494.5	5/ 4,235	29.8	12.0
Central Expressway	19.1	512.8	8,697	34.2	15.2
Forest Ln.	19.6	506.0	1,430	22.1	15.1
Valley View Ln.	21.3	520.0	1,331	19.8	11.9
Alpha Rd.	22.0	530.0	1,945	23.8	17.3
Preston Rd.	23.6	594.4	2,794	27.9	15.2
Belt Line Rd.	24.5	558.5	3,047	30.4	13.7
St.Louis-S.W. Ry.	25.5	569.0	2,677	31.4	22.2
Keller Springs Rd.	26.1	565.7	1,449	21.0	13.2

Note.--Recording streamflow gage located at Greenville Ave. and Keller Springs Rd., crest-stage gages at all other sites except St. Louis-S.W. Ry.

1/ Distance measured along low-water channel upstream from mouth.
2/ 3 bridges.
3/ 1 bridge, 2 culverts.
4/ Elevation is for crown of arch.
5/ 2 bridges, 1 culvert.

Flood Profiles

The profile of the thalweg (a line following the lowest part of the valley) and profiles of the water surface along the main channel of White Rock Creek for the floods of April 19-20, 1942, and July 27 and October 8, 1962, are shown in figure 1 (p. 15). River miles above the mouth of White Rock Creek, used for the profiles in figure 1 are also marked along the creek on the flood map (plates 1 and 2). Distances were scaled from Geological Survey topographic maps. Elevations of flood heights were determined from surveys made in the spring of 1962 and immediately after the floods of July 27 and October 8, 1962. The profile for the 1942 flood is shown for the water surface at the time of the flood and also as it would probably be today with the present bridges and approach fills. The profiles shown for the floods of July 27 and October 8, 1962, are constructed from floodmark elevations determined in the field. The effects of the heavy runoff from the flood of October 8, 1962 on Cottonwood Creek, which enters White Rock Creek immediately upstream from the Texas and New Orleans Railroad Co. bridge, is evident (fig. 1).

The discharges used in the routing computations for the 1942 flood varied from 27,000 cfs at the northern Dallas city boundary to 60,000 cfs at Loop 12. A discharge of 29,000 cfs was estimated for the flood of October 8, 1962 at the Texas and New Orleans Railroad Co. bridge (drainage area, 64.1 square miles). A discharge of 17,100 cfs was measured for the flood of October 8, 1962 for the 8.50 square mile drainage area of Cottonwood Creek upstream from Forest Lane.

The routed backwater profile probably would not be a straight line between routing sections as it is shown on figure 1, but would be slightly concave. The error involved in assuming a straight line is small compared to approximations inherent in other assumptions. Minor variations in the profiles are expected between sections due to changing geometry and roughness in the channel and flood plain and due to abrupt bends.

Areas and Depths of Inundation

The estimated boundaries of areas inundated by the floods of April 19-20, 1942 and July 27, 1962, along the main channel are shown on plates 1 and 2, respectively. Also shown on plate 2 are the areas inundated by the flood of October 8, 1962 on Cottonwood Creek, Floyd Branch, and Jackson Branch, and along the White Rock Creek channel downstream from Forest Lane. Downstream from Forest Lane the flood of July 27, 1962, inundated very nearly the same area as that covered by the flood of October 8, 1962. Due to the

limitations of accuracy imposed by a 10-foot contour-interval topographic map, some small areas shown as being flooded on plates 1 and 2 probably did not or will not be flooded at elevations given. It is just as probable that some borderline areas not shown inundated, were or will be inundated at the elevations shown on profiles.

The inundated area shown on plate 1 is the area that would be inundated with the present bridge structures in place. The area actually inundated by the 1942 flood upstream from Belt Line Road, Central Expressway, Preston Road, and Skillman Street, was somewhat less than that shown. The areas shown inundated on plate 2 are defined by highwater marks left by the floods of July 27 and October 8, 1962.

Depths of inundation can be estimated by subtracting the ground elevation from the water-surface elevation in figure 1. Approximate ground elevations can be estimated from information indicated by contours shown on plates 1 and 2, although more accurate elevations can be obtained by leveling to nearby bench marks.

Velocity of Flow

The velocity of the flood flow in both the main channel and on the overflow plain of White Rock Creek will vary widely. Point velocities in the center of the main channel upstream from Greenville Avenue approached 15 fps (feet per second) during the 1942 flood. Generally the velocities of flow over the flood plain will be less than those in the main channel, but they will attain erosive magnitudes at some points. The mean velocity of the flow over the flood plain near Alpha Road and Valley View Lane was of the order of 6 fps for the 1942 flood. Upstream from bridges at the railroad crossings and Loop 12, the constrictions shown to have created considerable backwater, the mean velocity in the flood plain was about 2 fps during the 1942 flood.

During the flood of 1942 an automobile was stranded some distance from the left (east) end of the Forest Lane bridge (the flood plain elevation at this point is about 2 feet lower than that of the road fill) and the occupant attempted to "ride out" the flood atop the car. The velocity was sufficient to wash the person downstream although only a slight drop in water surface across the road fill was evident. The velocity at this point was probably in excess of 5 fps.

In the study reach, main channel velocities averaged from 8 to 14 fps during the 1942 flood and about 9 fps during the flood of

October 8, 1962. About 80 percent of the flow at the Texas and New Orleans Railroad Co. bridge on October 8, 1962, was in the main channel where point velocities probably exceeded 12 fps.

It should be emphasized that some point velocities will exceed mean velocities substantially. It is not possible to predict, with a high degree of accuracy, what the velocity will be during a given flood at any given point in the channel.

Effects of Alterations

Channel and Flood Plain

Alterations to the flood plain and main channel may modify the results presented in this report. For example, if debris plugs bridge openings or there are other changes in the hydraulic efficiency of the main channel or flood plain (additional growth or construction on flood plain, growth along main channel, and construction of diversion dams), areas of inundation, flood depths, and velocities in parts of the overflow section will all tend to be greater than under present conditions. Conversely, these factors will be reduced if the hydraulic efficiency of the main channel and flood plain is improved by removal of trees and underbrush along the main channel, enlargement of bridge openings, or paving of main channel banks.

Watershed Drainage Area

The urbanization and development of a watershed usually results in modification of the following two hydrologic factors which govern the magnitude of flood peaks: Imperviousness of the watershed and lag time between rainfall excess and the flood peak. Suburban development in a watershed such as White Rock Creek tends to increase the overall imperviousness of a drainage basin and thus increase the percentage of runoff from a given amount of rainfall. Primary in any suburban development is the construction of storm sewers and the improvement of principal stream channels, both of which may affect the lag time of the drainage systems.

Very little data are available to accurately define changes in the magnitude and frequency of floods in the upper White Rock Creek area that result from progressive suburban development. Carter[1/] has evaluated changes in the mean annual flood (recurrence interval, 2.33 years) for streams in the vicinity of Washington, D. C. Carter's analysis indicates that suburban development may increase the magnitude of peak discharge of the mean annual flood, a maximum of about

1/ Carter, R. W., 1960, Magnitude and frequency of floods in suburban areas: U. S. Geological Survey, Professional Paper 424-B.

80 percent on streams in the Washington, D. C. area. Wiitala[2/] has made a similar analysis for two streams in the vicinity of Detroit, Michigan. His analysis indicates that the mean annual peak discharge on a stream draining a suburban area is about twice that for an undeveloped watershed nearby.

Extrapolated data from the two analyses above do not necessarily apply to the upper White Rock Creek area. Increased urbanization in the White Rock Creek basin may increase some flood peaks and possibly the frequency of inundation of the flood plain, but the effects of urbanization remain to be defined through a continuing program of hydrologic investigation.

INUNDATION ON TRIBUTARY STREAMS

The following four tributaries in the upper White Rock Creek basin are subject to substantial overflows: Spanky Branch, Floyd Branch, Cottonwood Creek, and Jackson Branch. Their flood plains are relatively narrow except in the lower reaches where the highest stages are usually caused by backwater from White Rock Creek.

Little factual data concerning historical floods on the tributaries were obtained in the numerous interviews with local residents but available information indicates no serious property damage or loss of life. Flood-frequency relations for drainage areas as small as those of the tributaries to White Rock Creek have not been derived in the Dallas area. Streamflow data to be obtained in the future are intended to provide a basis for defining flood-frequency relations on small drainage areas.

The areas inundated along reaches of Cottonwood Creek, Floyd Branch, and Jackson Branch during the flood of October 8, 1962, are shown on plate 2. The areas are very nearly the same as those inundated during the flood of June 1949. Depth of inundation during the flood of July 27, 1962, was about 1 foot less than during the flood of October 8, 1962.

SUMMARY

The hydrologic and hydraulic factors contained in this report are summarized as follows:

2/ Wiitala, S. W., 1961, Some aspects of the effect of urban and suburban development upon runoff: U. S. Geological Survey, Open File Report.

1. The greatest flood since at least 1886 in the reach of White Rock Creek upstream from White Rock Lake, occurred April 19-20, 1942. The flood was the result of intense rainfall over the watershed (unofficially reported as about 12 inches at the headwaters) after two days of intermittent thunderstorms. The peak discharge is estimated as 27,000 cfs at the upper end of the study area (northern Dallas boundary) where the drainage area is 26.6 square miles. At the lower end of the reach at Northwest Highway (Loop 12) where the drainage area is 83.0 square miles, the discharge is estimated as 60,000 cfs.

An outstanding flood, comparable to that of 1942 in the lower reaches of the study area but about 3 feet lower than the 1942 flood in the upper reaches, occurred June 14, 1949. The 1949 flood resulted from intense rainfall over the east side of the watershed. The storm was centered over Richardson near the headwaters of Cottonwood Creek and Floyd Branch. Richardson received an unofficial rainfall total of $11\frac{1}{2}$ inches during a 12-hour period.

Floods of July 27 and October 8, 1962 were comparable in magnitude to that of June 1949, downstream from Forest Lane. Rainfall in the study area averaged more than 6 inches for the storm of July 27, 1962. The storm of October 8, 1962 was centered over the Cottonwood Creek and Floyd Branch watersheds where more than 7 inches of rainfall were recorded at one point. The average rainfall in the study area was in excess of 4 inches. A discharge of 29,000 cfs was estimated for the peak of the flood of October 8, 1962 on White Rock Creek at the Texas and New Orleans Railroad Co. bridge where the drainage area is 64.1 square miles. The peak discharge of the October 8, 1962 flood on Cottonwood Creek at Forest Lane, where the drainage area is 8.50 square miles, was 17,100 cfs.

Other floods of note occurring in the study area were those of April 1922, May 1946, and August 1947.

2. Sufficient streamflow data have not been obtained to statistically define recurrence intervals for the floods discussed in this report. Studies to derive a flood-frequency relation in the White Rock Creek basin are now underway. The flood of April 19-20, 1942 is the greatest flood in at least 77 years but its recurrence interval may be much greater. A flood equal in magnitude to those of July 27 and October 8, 1962, might recur on an average of once in 15 to 20 years.

3. Water-surface profiles for the floods of April 1942, July 27, and October 8, 1962, together with the profile of the thalweg are shown in figure 1.

4. Estimated boundaries of inundation along the main channel of White Rock Creek during the 1942 flood and the flood of July 27, 1962 are shown on plates 1 and 2, respectively. Also shown on plate 2 are areas inundated by the flood of October 8, 1962, in downstream reaches of Cottonwood Creek, Floyd Branch, and Jackson Branch.

Estimates of the depth of inundation along White Rock Creek can be made from information in figure 1 and plates 1 and 2.

5. Velocities of flood flow in both the main channel and the overflow plain of White Rock Creek will vary widely. Point velocities in the main channel probably approached 15 fps during the 1942 flood and were in excess of 12 fps during the flood of October 8, 1962. Velocities over the overflow plain averaged from 2 fps to 6 fps for the 1942 flood.

6. Changes in the flood plain and main channel may modify the results presented in this report. Reduction in the hydraulic efficiency of the main channel and flood plain by construction activities or by additional vegetal growth will tend to increase flood heights, area inundated, and some point velocities. These factors will be reduced if the hydraulic efficiency of the main channel and flood plain are improved.

7. Changes in the general imperviousness of the watershed by suburban development and changes in the lag time of rainfall excess and runoff may affect the magnitude and frequency of floods. A continuing program of hydrologic investigations is needed to define the changes.

8. Additional data are needed to define the magnitude and frequency of floods on tributaries to White Rock Creek in the study area.

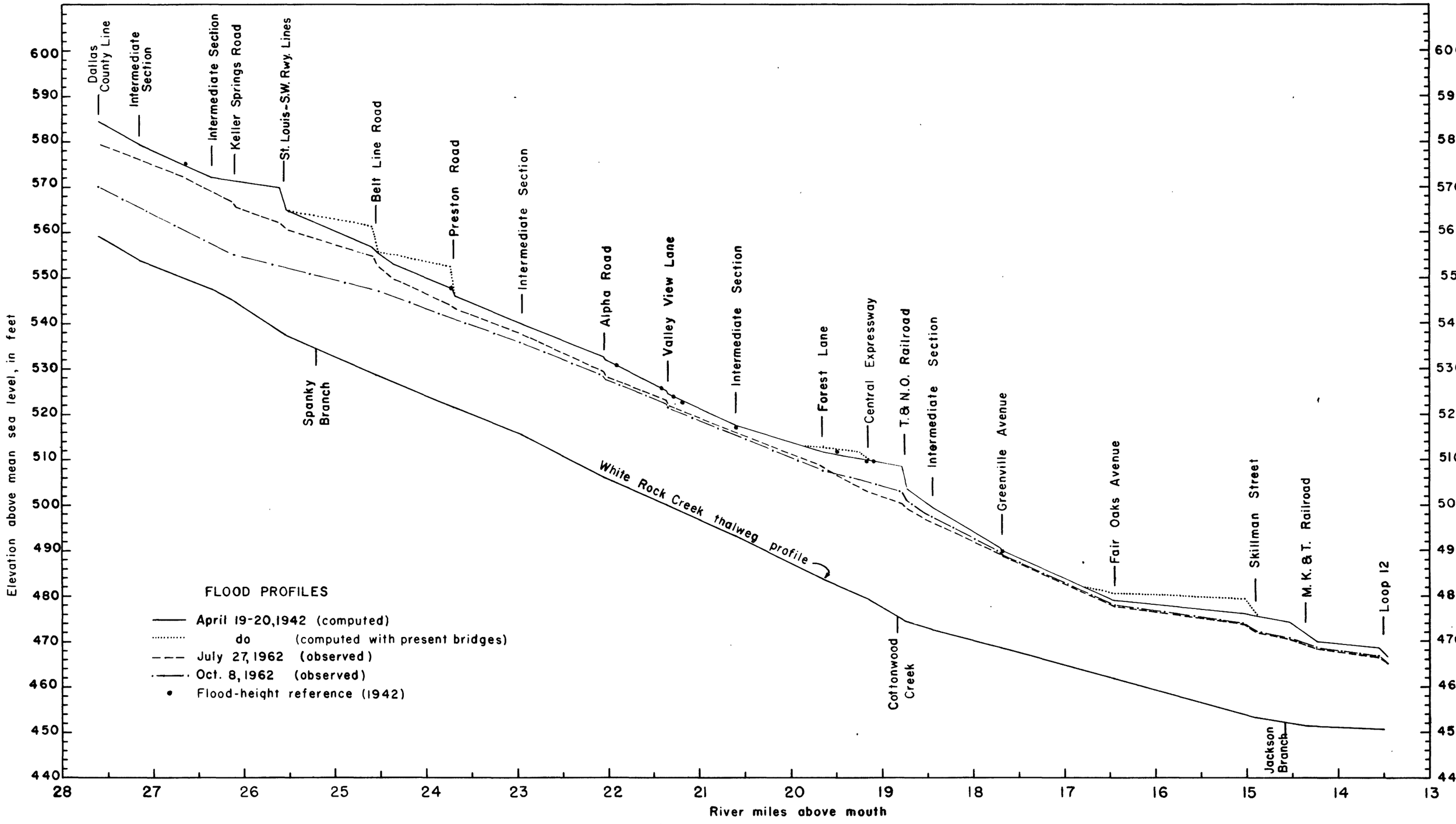

Figure 1.--Profiles of floods on upper White Rock Creek at Dallas, Texas