UNITED STATES DEPARTMENT OF AGRICULTURE

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Contribution from Office of Experiment Stations
A. C. TRUE, Director

Washington, D. C. PROFESSIONAL PAPER April 12, 1915

A REPORT ON THE METHODS AND COST OF RECLAIMING THE OVERFLOWED LANDS ALONG THE BIG BLACK RIVER, MISSISSIPPI

By

LEWIS A. JONES, Drainage Engineer
Assisted by W. J. SCHLICK, Drainage Engineer, and
C. E. RAMSER, Assistant Drainage Engineer

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CONTENTS.

INTRODUCTION.

With the cutting of the most valuable timber from the swamp and overflowed areas of the South, it becomes evident that future returns from these lands must be sought in agriculture. The first step toward rendering such areas available for cultivation is drainage. The conditions along the Big Black River in Mississippi are fairly representative of conditions that exist in greater or less degree on many southern streams.

In November, 1912, the attention of Drainage Investigations, Office of Experiment Stations, United States Department of Agriculture, was called to the conditions along the Big Black River and assistance in devising a plan of reclamation was requested. A preliminary examination of the district was made February 14 to 22, 1913. An agreement was entered into under which Drainage Investigations undertook to make a survey of the area and to prepare plans for its reclamation, the district agreeing to contribute to the expense of

Note.—This report is intended for engineers, landowners, and others interested in drainage enterprises in regions where the conditions are similar to those here described; it is suitable for distribution in the Gulf Coast States.

the work. Field work was begun April 20 and finished August 15, 1913.

The following report describes briefly the conditions found, discusses the drainage problems encountered, and presents the plan of drainage considered most practicable. It is believed that this information will be decidedly helpful to engineers, drainage district officials, residents, and owners of property in many localities where overflowed lands are to be reclaimed.

GENERAL DESCRIPTION OF THE DISTRICT.

LOCATION AND AREA.

The lands examined comprise that section of the valley of the Big Black River beginning near its source in Webster County, in the central part of the State of Mississippi, and extending in a southwesterly direction to the Alabama & Vicksburg Railway bridge, 14 miles east of Vicksburg, a total distance in a direct line of about 150 miles (see fig. 1). The bridge referred to is about 30 miles above the junction of the Big Black River with the Mississippi, and marks the head of navigation on the former stream. The total area of the flooded land above Cox Ferry, the lower end of the proposed improvements, is 133,460 acres.

TOPOGRAPHY.

THE WATERSHED.

The watershed of the Big Black River consists of bottom land from one-half mile to 2½ miles wide, bordered by rough, rolling land and steep hills which extend back a few miles from the bottoms. The surface of the rest of the watershed is rolling and in places quite rough. In general the topography of the land is such that the run-off is large and reaches the main streams in a short time. It is estimated that 75 per cent of the upland has been cleared and was at one time in cultivation, but a large part of it is now eroded and has been allowed to grow up to pine and brush thickets. The areas draining into the river at various points are shown in figure 2.

The bottom lands are comparatively level, being broken only by sloughs, old "ox bows," and bayous, formerly portions of the river channel. In general the banks of the river are from 1 to 3 feet higher than the land at the foot of the hills. From Mathiston to Goodman the bottoms average from 1 to 1½ miles wide, and from Goodman to Cox Ferry, near the Yazoo County line, the average width is from 2 to 2½ miles. At Cox Ferry the bottoms begin to narrow rapidly, and from a point 2 miles below the Ferry to the Alabama & Vicksburg Railway bridge average but from one-fourth to one-half mile in width. The valley has a fall of 3 feet per mile at the upper end of the district; this gradually decreases to 1½ feet per mile at the lower end.

Not more than 15 per cent of the bottom land is cleared; the remainder is either in virgin timber or is cut-over land covered with a dense growth of cane, brush, and briars. The cleared land lies along the edge of the bottoms or is in small tracts or ridges that are from 1 to 3 feet above the general elevation of the adjoining bottoms.

STREAMS.

In the upper part of the area covered by the survey the Big Black River has a channel varying from 30 to 75 feet in top width, from 20 to 50 feet in bottom width, and from 5 to 15 feet in depth below the general elevation of the ground; in the lower part the channel varies from 150 to 250 feet in top width, 75 to 100 feet in bottom width, and is from 15 to 25 feet deep. Throughout its entire length the channel is very crooked and is filled with drift and brush. The length of the river channel through the portion of the valley covered by this report is 1.7 times that of a line drawn down the general course of the valley. The banks are well defined and are covered with a dense growth of cane and briars. The bottom of the river is a silty loam or clay. At one point near Hoffman and at one or two points in the vicinity of Edwards there are traces of rock, but the formations are local and occur where they will not affect the proposed work.

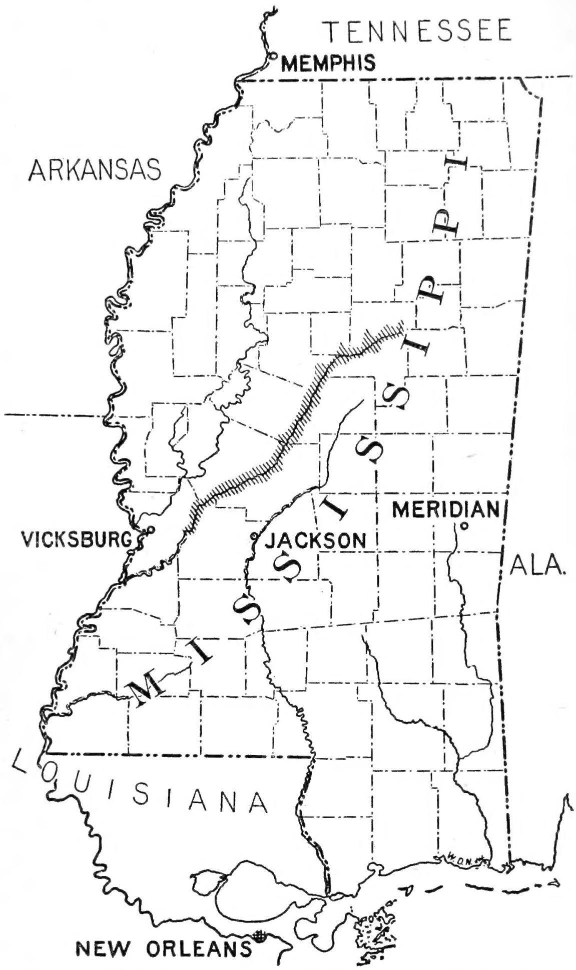

FIG. 1.—Map of Mississippi, showing location of Big Black River project.

Numerous creeks and ravines drain into the river; these vary in size from streams with watersheds of 150 square miles to those draining but one or two square miles. Figure 2 (in pocket at end of bulletin) shows the location and extent of each of these tributaries. Their channels, though smaller, are similar to that of the river.

CLIMATE.

The climate is typical of that of the Gulf States. Frequently during the summer the temperature reaches 95° F. and maintains that height for a considerable length of time. The winters are usually mild, and it is very seldom that the temperature falls to zero. The records of the United States Weather Bureau at the Yazoo City station show a maximum temperature of 107° and a minimum of —2°, with a mean annual temperature of 65°.

The mean annual precipitation during the past 12 years was 48.1 inches. The rainfall is well distributed throughout the year, the least occurring during the cotton-picking season of September, October, and November. A more extensive discussion of rainfall will be found in the section of this report dealing with run-off (p. 7).

AGRICULTURAL CONDITIONS.

Throughout the Big Black bottoms the soil is very uniform in character, being composed of a silty loam underlain by clay. The type is called "meadow" by the United States Bureau of Soils and is described by the bureau as follows: [1]

> The surface few inches of the material composing the meadow consists of a brown or drab silt loam. This is underlain by a drab, gray, or bluish silt or silty clay. In local areas and especially near streams there is considerable sand present in both soil and subsoil. * * * The type is still in process of formation, each successive flood bringing with it material that is left as a thin deposit over the bottoms. The soil is very rich, and if cleared, ditched, and diked would be capable of producing large yields. At present it is of value only for its timber and the pasture it affords.

The soil of the uplands is largely a brown or light brown loam, underlain by a brown clay. It is considered fertile, but is very easily eroded.

The bottoms, which are at present unsuitable for tillage, were originally covered with a heavy growth of timber consisting of water oak, black and sweet gum, sycamore, beech, and some cypress. The greater part of the valuable timber has been cut, and a second growth, together with a heavy stand of cane, brush, and briars, now covers the bottoms. With regard to lands bordering streams in Mississippi, it is generally recognized that heavy growths of timber indicate lasting productiveness of the soil, and that rank growths of underbrush, cane, and vines, such as occur in these bottoms, are seldom found on poor land.

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[1] U. S. Dept. of Agr., Bureau of Soils, Soil Survey of Holmes County, Miss., 1909.

As in most of the Southern States, cotton is the principal agricultural product, its acreage exceeding that of all other crops combined. Next to cotton, corn is the most important crop, although the production scarcely meets the local demand. Oats, cowpeas, and sugar cane are all grown to a limited extent, but are gradually increasing in acreage. In the vicinity of Durant the trucking industry has been developed to some extent, considerable quantities of strawberries, cabbage, peas, beans, etc., being profitably grown. The planters are becoming interested in live stock and small quantities of lespedeza and alfalfa are being planted. The injurious effect of the boll weevil on cotton has led more toward diversified cropping during the last five years.

TRANSPORTATION FACILITIES.

Several railway lines traverse various portions of the district. At each of the larger towns bordering the district and at one or two other points public highways are maintained across the bottoms. In all cases where any attempt is made to promote traffic during the winter months the cost of maintenance is very great, and even then many of the roads are impassable during the winter and spring seasons. Drainage improvements will, to a large extent, remedy these conditions.

PRESENT DRAINAGE CONDITIONS.

Under present conditions a heavy rainstorm, lasting from two to three days and extending over the entire watershed of the Big Black River, will cause a severe flood, covering from 75 to 100 per cent of the bottom lands to a depth of from 3 to 8 feet. Unusually heavy local rains, although extending over only a small part of the watershed, will often cause floods over the adjoining bottoms below the area affected by the storm. Floods occur most frequently during the winter and spring seasons, the water often covering the lowlands for a month at a time. From May to November overflows are less frequent, although several ruinous summer and fall floods have occurred. Thus there is great risk in planting crops on the lower land, and it is not entirely safe to plant on the more elevated portions of the bottom. So often have losses been sustained that it is now difficult to find anyone who will finance the working of the land.

Throughout the district the bottom lands of the streams tributary to the river are overflowed at all seasons of the year to a depth of from 1 to 3 feet. In the smaller creeks, from 1 mile to 8 or 10 miles in length, the overflow usually starts a short time after a heavy rain begins, and continues from four to five hours after the rain ceases. On account of their more extensive watersheds the lowlands along the larger tributaries, such as Bywy, Apookta, and Doaks Creeks, are flooded from one to two days after each severe storm that lasts a day or more.

Below the Alabama & Vicksburg Railway bridge the river has been declared navigable and the landowners are urging the United States War Department to improve the condition of the channel. There are a great many drifts in this section of the river, and the carrying capacity of the stream undoubtedly would be increased if its conditions were improved.

No extensive attempts at drainage have been made in the district investigated. One or two property owners have constructed small ditches to drain their fields after the floods have receded, and others have protected small fields by the construction of levees.

THE SURVEY.

In making the survey, base levels were first run along the railroads bordering the valley. Bench marks were established at intervals of 1 mile or less on railroad mileposts or other convenient objects.

The flood lines or edges of the overflowed land were located by compass and stadia. Lines of levels were run across the bottoms at intervals of approximately 1 mile, and all of the streams and larger sloughs were meandered. Levels were carried on all of these meander lines and bench marks established at intervals of approximately 1 mile. Cross sections of the streams and sloughs were taken at frequent intervals to determine the sizes and capacities of the channels.

Soil borings 15 feet deep were taken at intervals of one-half mile on the cross lines in order to ascertain the character of the soil to be encountered in excavation.

Department bench marks were set near a number of the towns, their locations being shown on the map (fig. 10), and their elevations and locations being given in Appendix I of this report. These bench marks consist of iron pipes, 3½ feet long and 3 inches in diameter, set in the ground to a depth of 3 feet. The top of each pipe is covered with a bronze cap on which is stamped "Office Experiment Stations, U. S. Dept. Agr. Drainage" and the elevation of the top of the bench mark to the nearest foot. All bench marks set were of a permanent nature. Those placed on trees were made by cutting a notch in the root and driving in a spike, the elevation being taken on the head of the spike. A few bench marks were established on bridge piers and tops of culverts. All of these, other than the department bench marks, are inscribed "U. S. B. M.," followed by the initial of the instrument man and a serial number. Their numbers and location are shown on the map and their elevations may be had by application to Drainage Investigations. All elevations refer to Gulf datum as established by the United States Geological Survey.

Very little time was spent in locating land lines, and as the original corners and lines have practically become obliterated it was necessary to tie the survey to known objects, such as railroad mileposts, roads, etc. The land lines shown on the map were obtained by adjusting the original field data secured by the General Land Office to fit the location of corners as determined by the drainage survey. The main watershed boundary was obtained from data given on the township plats prepared by the General Land Office. All data gathered during the survey were plotted before the field was abandoned, and are shown on the map (fig. 10). None of the proposed improvements was located on the ground.

THE DRAINAGE PROBLEM.

To obtain relief from present flood conditions along the Big Black River an adequate outlet must be provided for the water that flows from the hills on to the bottom lands after each heavy rain. The tortuous river channel, choked with drift and brush, is wholly insufficient as an outlet, and the heavy growth of underbrush and cane makes it impossible for the water to flow over the bottoms with any degree of rapidity. The problem is to open a waterway of sufficient capacity to carry the water off as rapidly as it reaches the bottoms. This must consist either of (1) a system of ditches and channel improvements to carry the water below the ground surface, (2) a system of levees and a floodway to carry the floodwater above the surface of the ground without damage to adjoining land, or (3) a combination of (1) and (2). The remaining pages of this report are devoted to a treatment of the various features entering into the design and construction of an efficient drainage system for these overflowed lands. Hydraulic problems are discussed, the feasibility of a number of drainage plans examined, and detailed cost estimates for the recommended plan given.

RUN-OFF.

Run-off is that part of rainfall which flows over or through the ground to drainage channels. The success of drainage improvements depends upon their ability to care for the run-off, hence it follows that the determination of the rate of run-off is of the utmost importance in the design of such improvements. This rate is ordinarily expressed in the number of cubic feet per second removed from each square mile, or in depth of water, considered as distributed uniformly over the watershed, removed in 24 hours. In this report the rate of run-off is usually expressed in the number of second-feet per square mile of drainage area.

FACTORS AFFECTING RUN-OFF.

Since all run-off is due to precipitation, it is obvious that the latter is the most important element in the study of run-off. Other factors that have more or less effect upon the rate of run-off are the size, shape, and topography of the watershed, character of soil and vegetation, rate of evaporation, and the water storage capacity of the streams, sloughs, and bottoms.

DETERMINATION OF RATE OF RUN-OFF.

By the establishment of a sufficient number of measuring stations over the watershed, the amount of rain falling during any period of time may be determined with comparative accuracy. However, the rate of run-off is influenced not only by the total amount of rain falling, but also by the duration, intensity, frequency, and distribution of storms, it being the composite effect of the rainfall occurring during the overflow together with that of other recent storms. Thus it may be seen that the determination of the maximum rate of run-off becomes a complex problem.

The most reliable method of ascertaining the maximum rate of run-off for any district consists in making accurate measurements of the amount of water flowing from the district during its highest flood. Since in most cases it is impossible to obtain this information for the stream under consideration, recourse must be had to other methods. Fairly reliable data may be obtained by investigating some stream in the same locality with the one in question whose channel and watershed are of similar size, shape, and slope, where the soil and vegetation are similar, where rainfall records are available, and run-off measurements have been made.

No run-off measurements for the Big Black River watershed have been made, but such measurements have been taken on the Pearl River watershed which adjoins that of the Big Black on the east, and which is quite similar in size, shape, topography, character of soil, and vegetation. The rainfall data collected at the Weather Bureau stations near the divide between these rivers are applicable to both watersheds. It was therefore decided to investigate the run-off of the Pearl River and to apply the results obtained to the Big Black watershed. As the size, shape, and topography of the watersheds, character of soil, and vegetation are quite similar, it was assumed that the effect of these factors would be the same on both watersheds.

RUN-OFF FROM PEARL RIVER WATERSHED.

A gauging station was established by the United States Geological Survey on the Pearl River at the county highway bridge near Jackson, Miss., June 24, 1901. From that date until the present time continuous daily gauge readings have been recorded and numerous discharge measurements have been made for river stages ranging from that of minimum flow to within a few feet of the maximum recorded by the gauge. From these data a discharge curve was constructed, and by extending this the corresponding discharges for higher gauge heights were estimated. The maximum discharge obtained in this manner is the probable maximum discharge that will occur under existing drainage conditions. If drainage improvements were made, a greater rate of run-off would result, since the water falling would immediately be removed from the surface of the ground instead of being allowed to accumulate over the bottoms as storage. In order to ascertain this increased rate of run-off it is necessary to make a careful study of

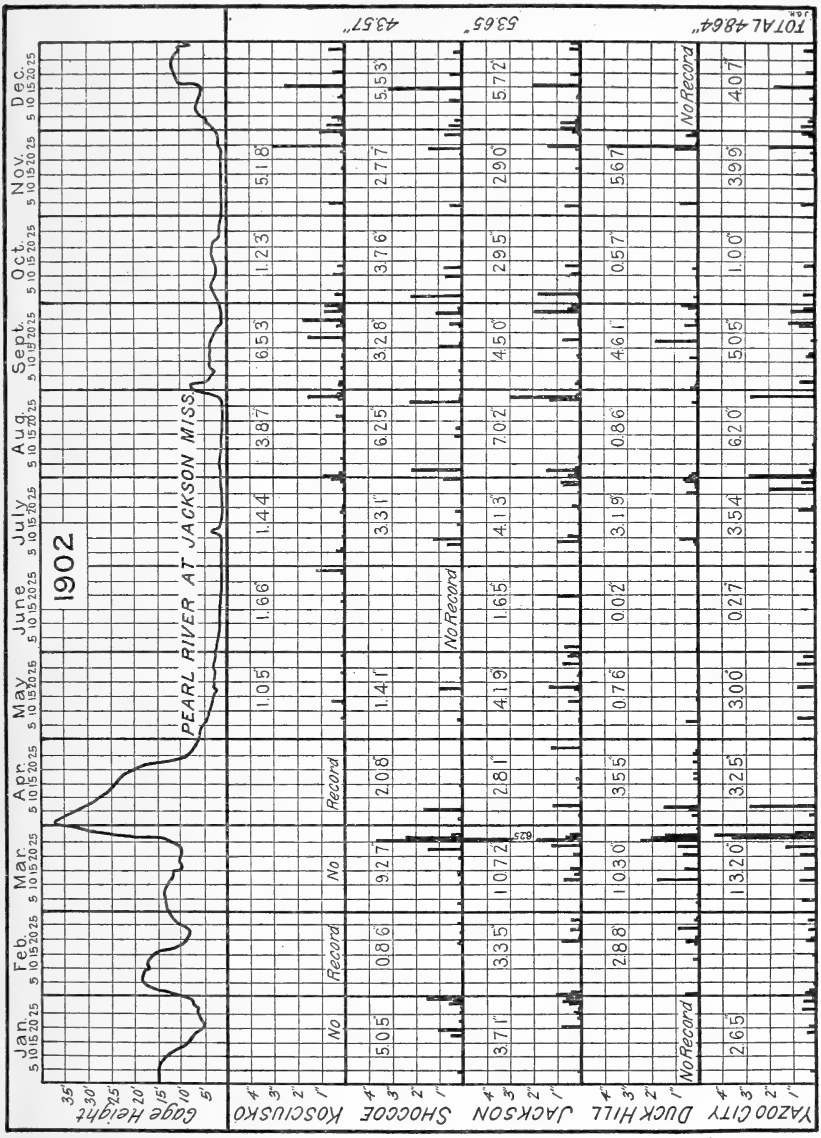

FIG. 3a.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1902.

rainfall and run-off conditions on the Pearl River for the maximum storms and flood conditions recorded.

The rainfall records of the United States Weather Bureau for stations on the Pearl River watershed show that the two greatest protracted and general rains occurring since 1898 were in March, 1902, and May, 1909. The maximum river stage recorded at Jackson since 1901 occurred on April 1, 1902, being 37.2 feet; the next highest reading recorded was 35.3 feet on May 30, 1909. Flood stage as fixed by the Weather Bureau is 20 feet on the gauge.

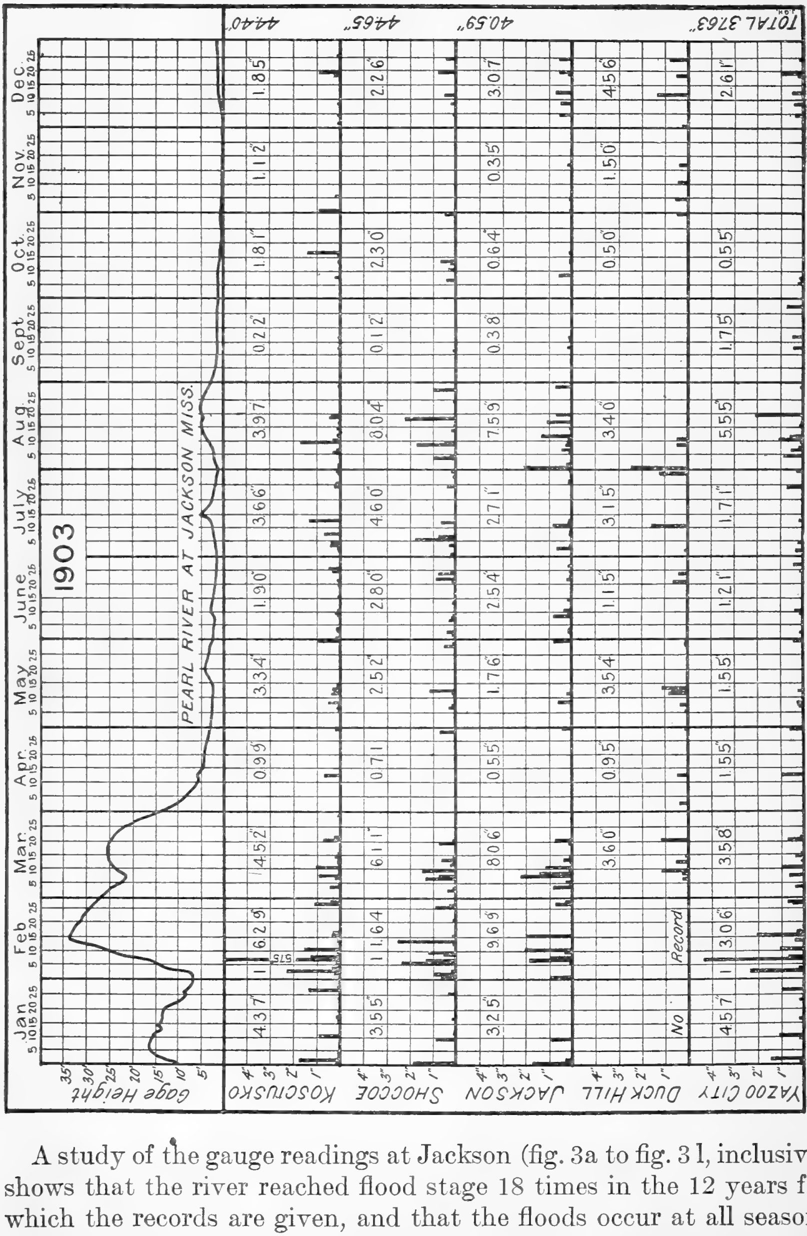

FIG. 3b.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1903.

A study of the gauge readings at Jackson (fig. 3a to fig. 3 l, inclusive) shows that the river reached flood stage 18 times in the 12 years for which the records are given, and that the floods occur at all seasons of the year, the summer and fall floods reaching practically the same heights as the winter floods. By studying the rainfall data plotted below the hydrograph, and by referring to the watershed map (fig. 2), a clear idea can be obtained of the intensity and extent of the rainfall causing the floods, features that are of great importance in determin-

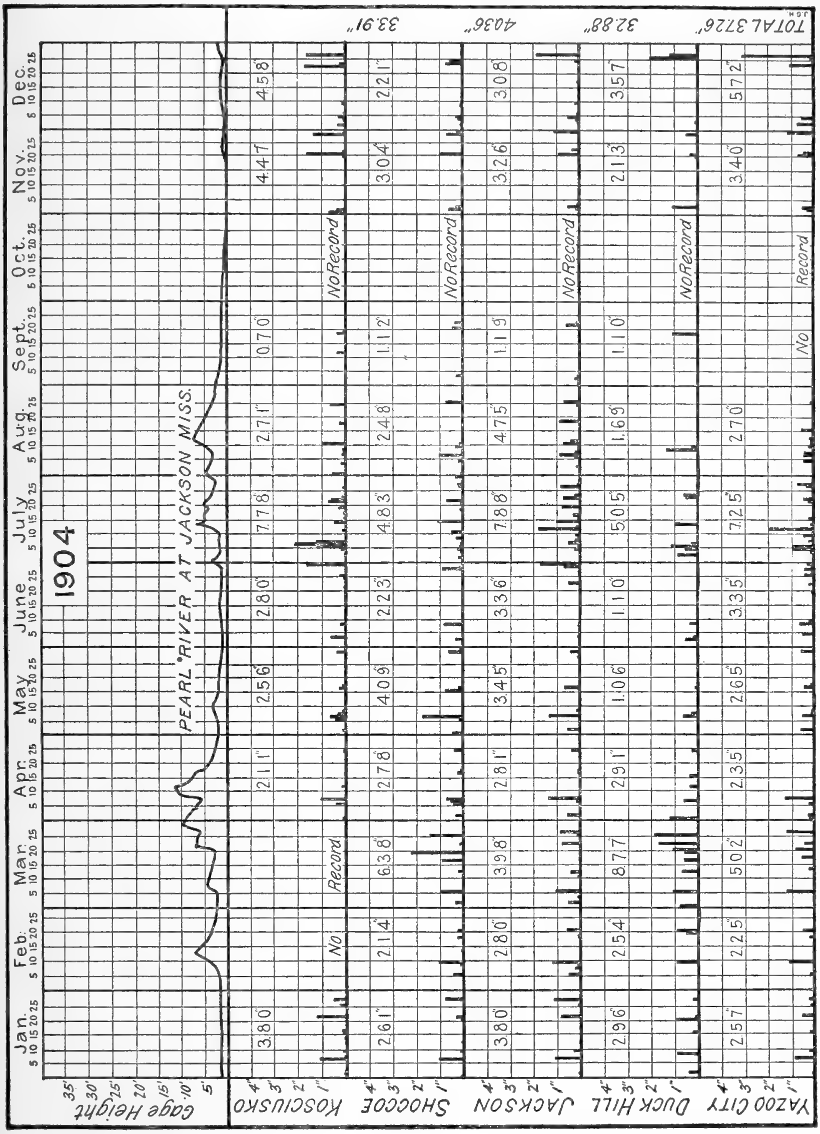

FIG. 3c.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1904.

ing the maximum rate of run-off. A method of determining the probable maximum rate of run-off by the use of the hydrograph of the Pearl River at Jackson was suggested by C. E. Ramser, assistant drainage engineer, and is given below.

The hydrograph shown in figure 4, A, is that for the Pearl River at Jackson, Miss., covering a period from May 18 to July 17, 1909; it indicates all fluctuations in rate of run-off during that period. The

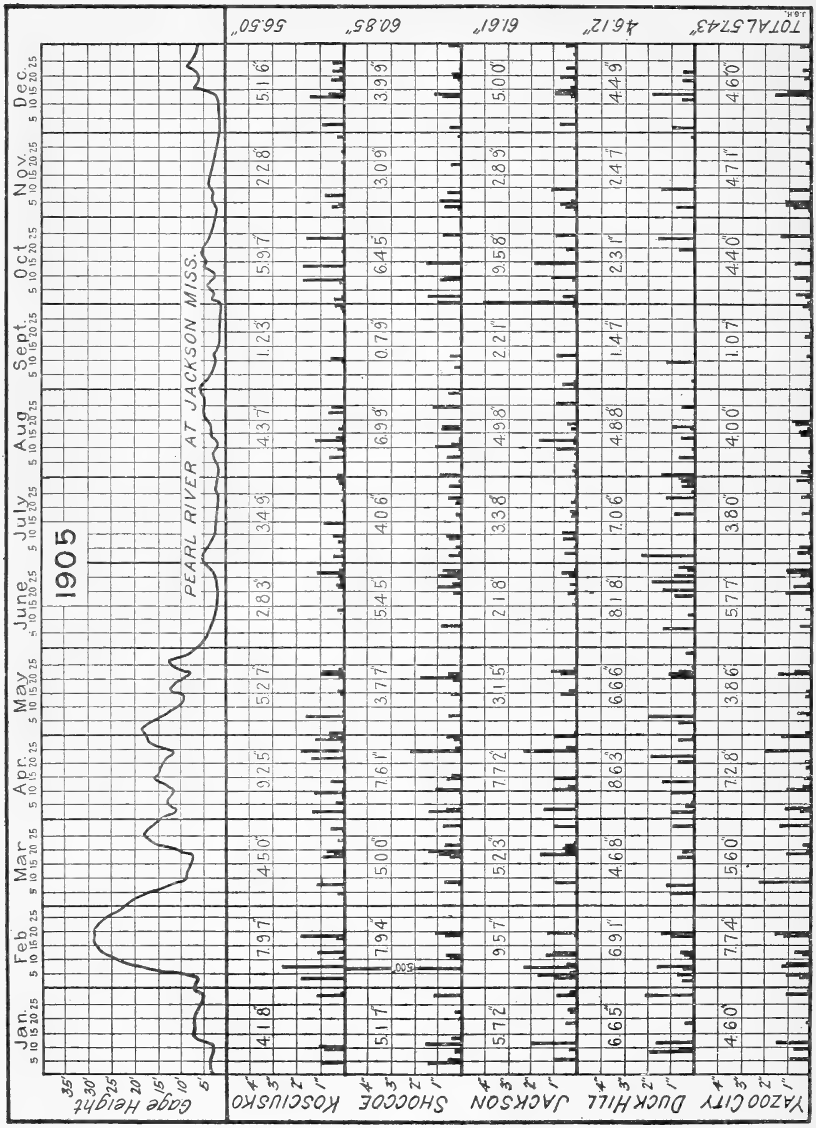

FIG. 3d.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1905.

initial rise occurring on May 18 was due to the rain of May 15, and the final rain affecting the run-off for the period considered occurred on July 9. The upper curve of the diagram represents the actual rate of run-off for the period; the lower curve indicates what the rate of run-off would have been for the same period had there been no rain after May 20. This lower curve was obtained by platting a portion of the continuous hydrograph of the Pearl River for a period of

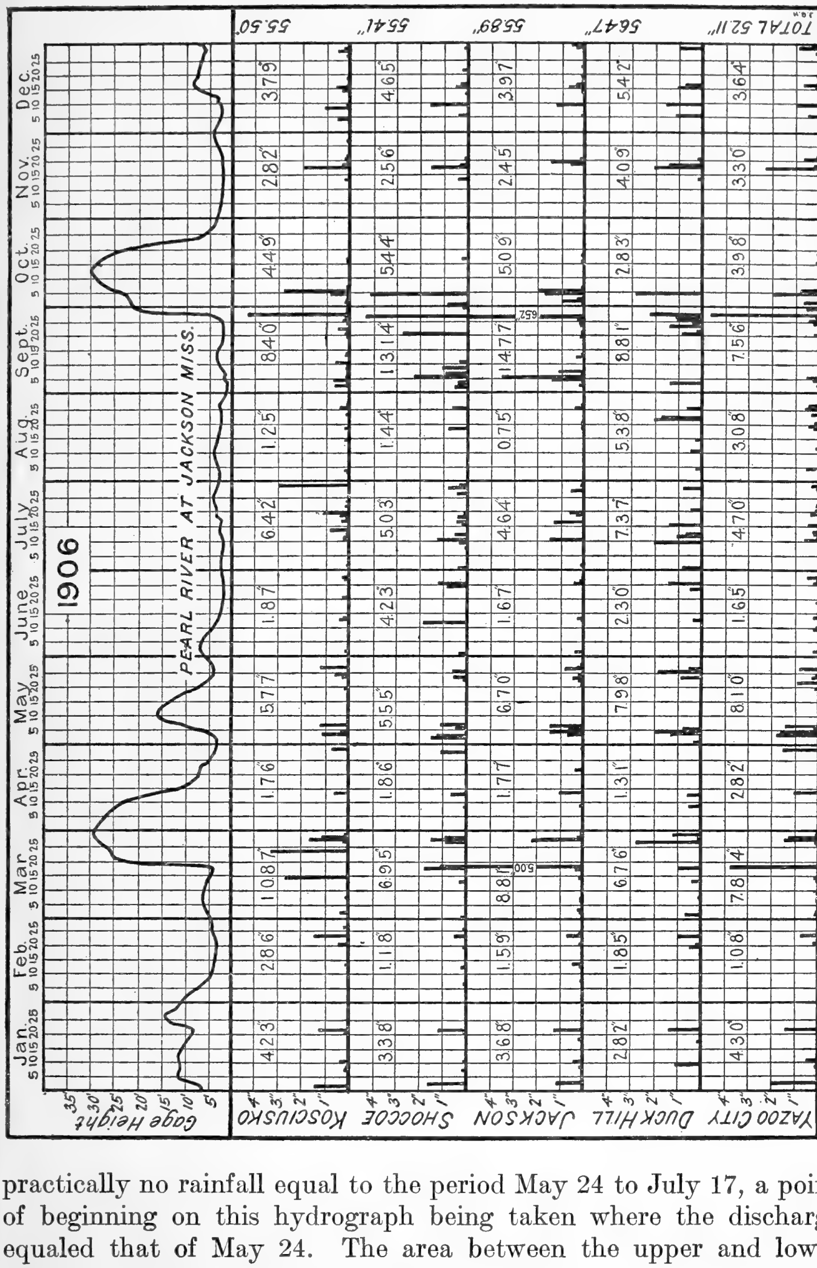

FIG. 3e.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1906.

practically no rainfall equal to the period May 24 to July 17, a point of beginning on this hydrograph being taken where the discharge equaled that of May 24. The area between the upper and lower curves represents the total amount of run-off due to the period of rainfall considered. This area equals 23.35 square units. One square unit being equal to 4 days (reduced to seconds) multiplied by 8,000 cubic feet per second, or 2,764,800,000 cubic feet, then 23.35 square

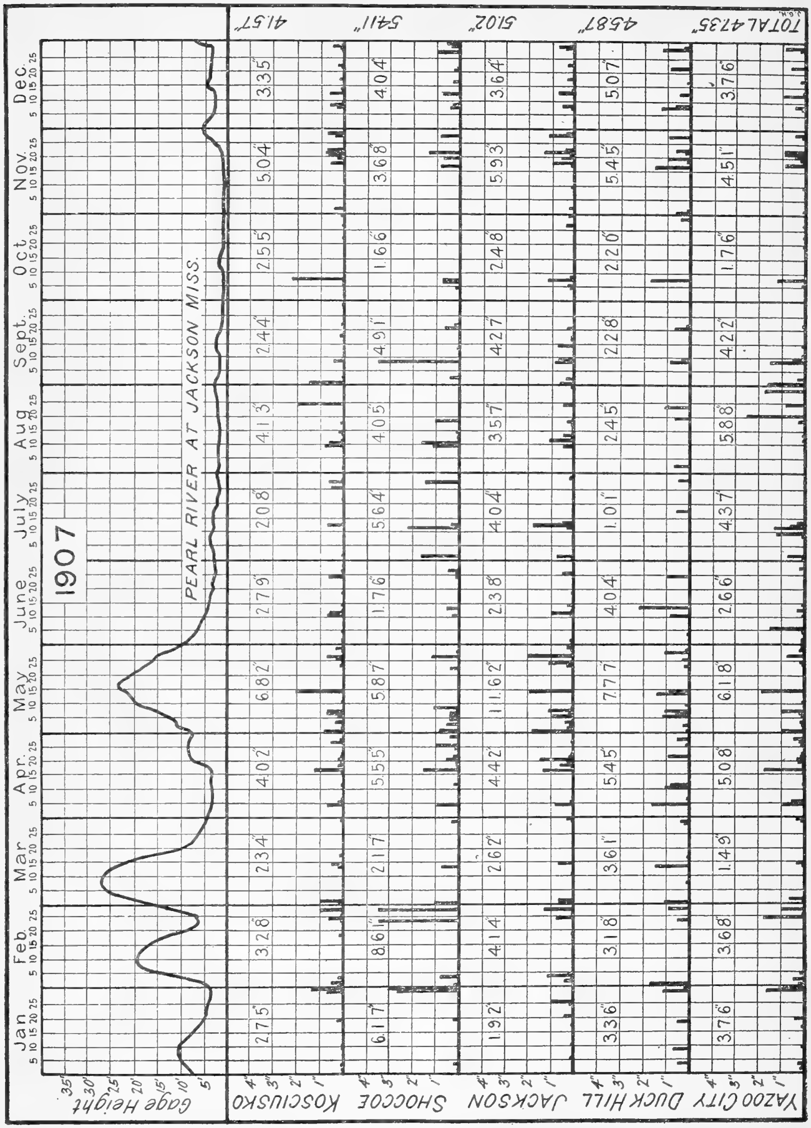

FIG. 3f.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1907.

units represent a total of 64,500,000,000 cubic feet of run-off for the period from the watershed area of 3,120 square miles, which is equivalent to a total run-off of 8.9 inches in depth.

The average rainfall on the watershed for this period, as recorded at the Weather Bureau stations at Louisville, Kosciusko, and Jackson, was 16 inches. To this rainfall is attributed the 8.9 inches of run-off computed above. The run-off was therefore equivalent to 55.6 per cent of the rainfall.

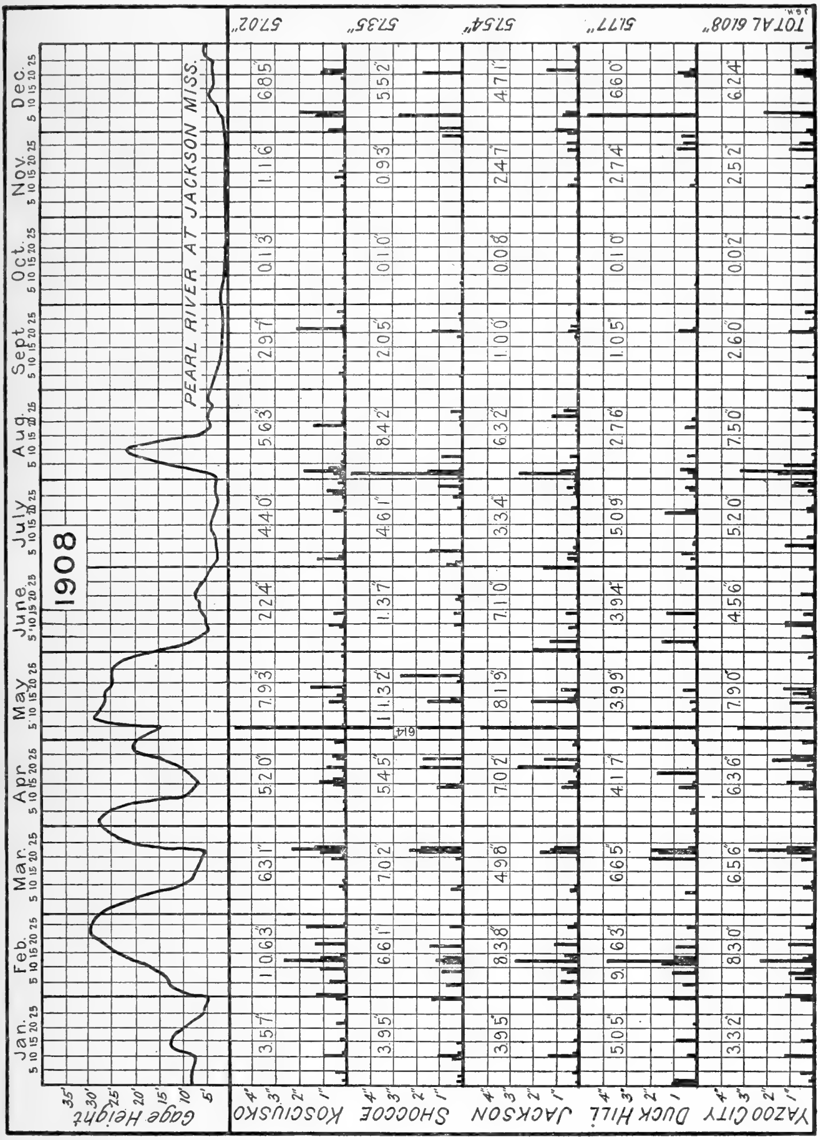

FIG. 3g.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1908.

In a similar manner the hydrograph of the Pearl River was platted for March, April, and May, 1902, and is shown in figure 4, B. The rainfall records for this period show an average total precipitation of 13.1 inches at Jackson and Louisville, no records being available for Kosciusko. The total run-off to this rainfall, as obtained from the hydrograph, was 53,353,000,000 cubic feet, which is equivalent to 7.35 inches in depth over the entire watershed. These figures indicate that the run-off during the spring flood of 1902 amounted to 56.1 per cent of the rainfall.

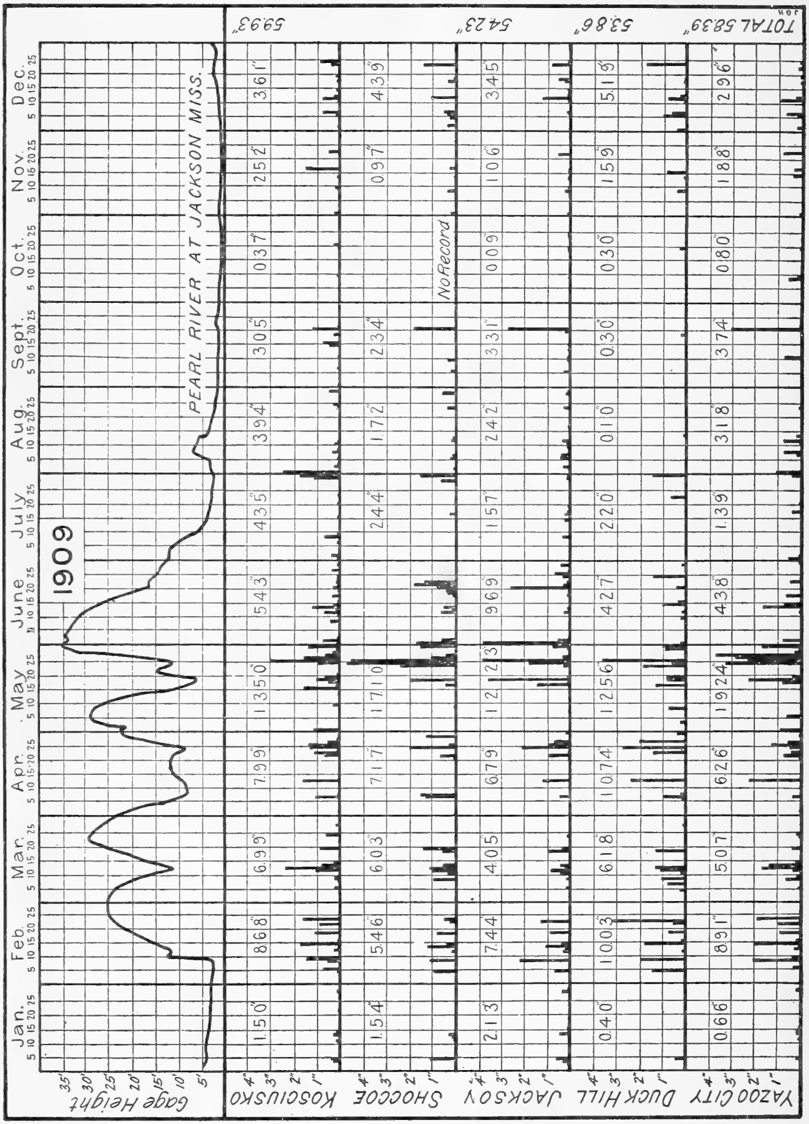

FIG. 3h.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1909.

The method employed for obtaining the probable maximum rate of run-off involves the determination of the following:

(1) The approximate time required for the maximum flood-producing storm to raise the river from a low stage to a maximum stage at the gauging station, when no storage exists.

(2) The approximate time required for the river to fall from a maximum to a low stage when no storage exists.

(3) The probable shape of the hydrograph as determined from a consideration of (1) and (2).

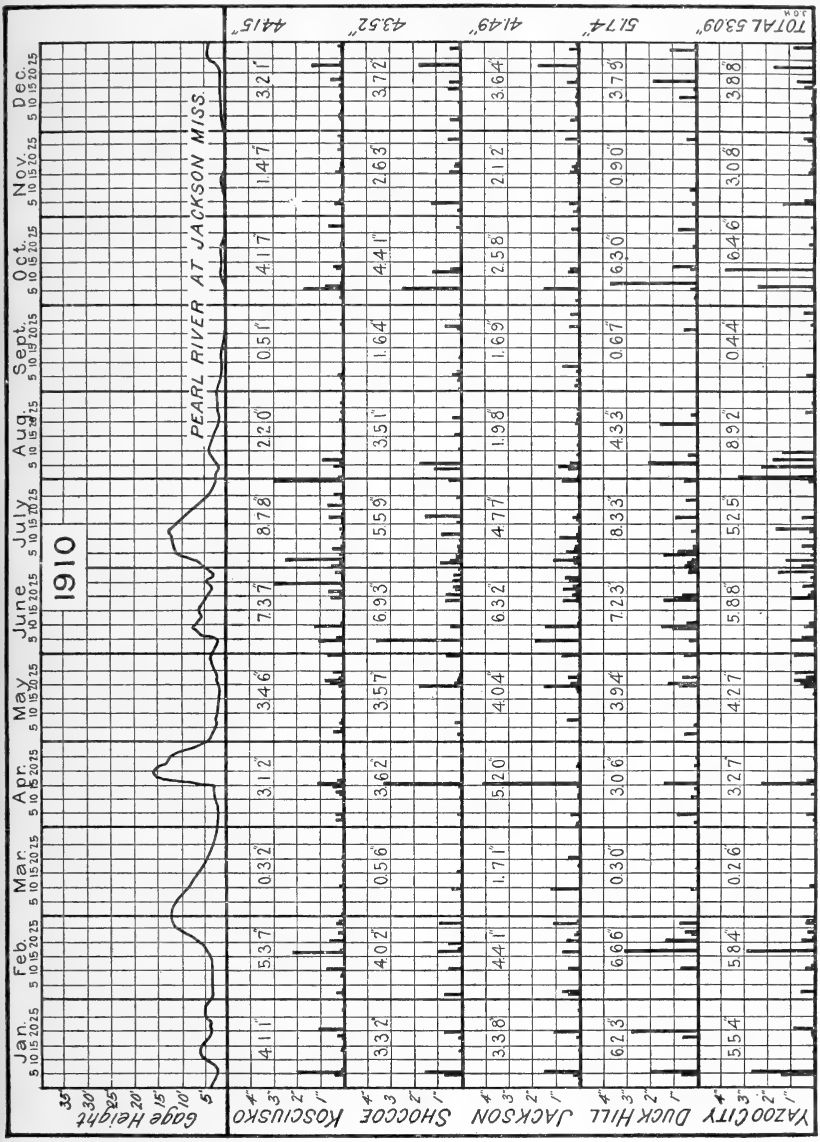

FIG. 3i.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1910.

(4) The total run-off for the entire flood period.

(5) The probable run-off due to rains occurring after the maximum stage is reached.

(6) The amount of run-off which would produce the maximum stage as determined by deducting (5) from (4).

(7) The probable maximum rate of run-off as determined from a hydrograph constructed according to (3) and (6).

The time required for the Pearl River to rise is shown by the line *a b* in figure 4, A and B, and was about six days in each case. It

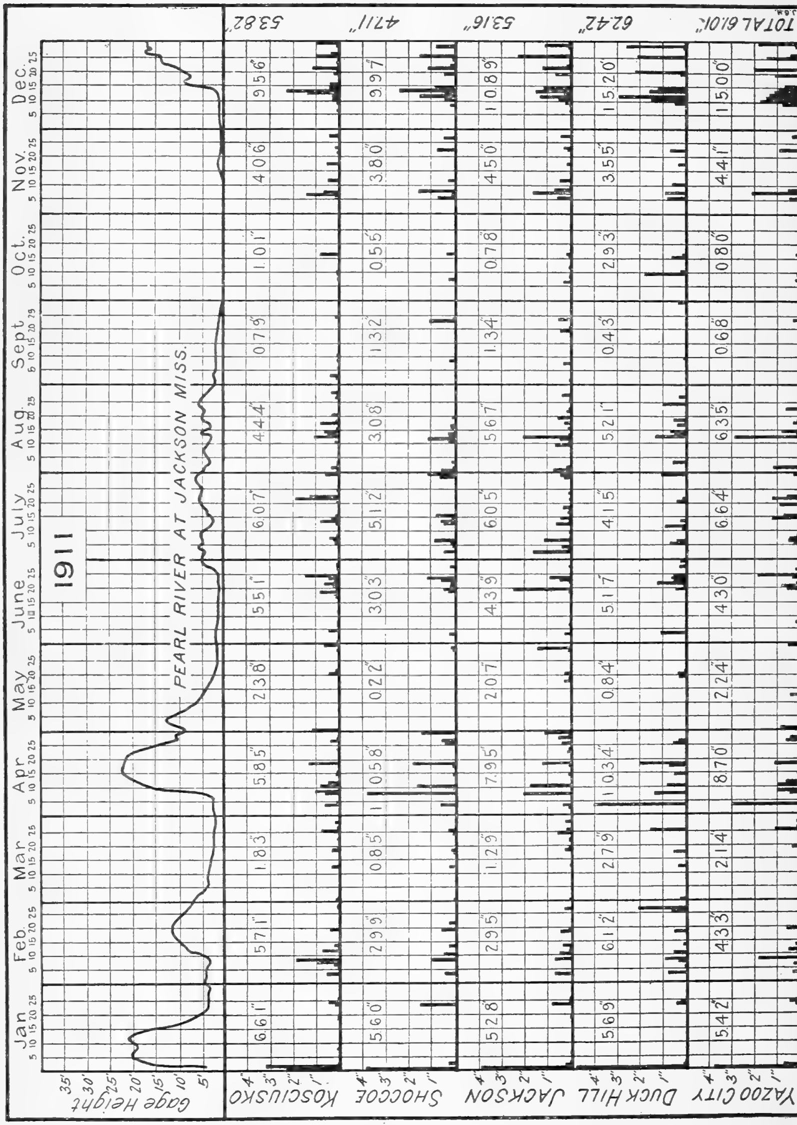

FIG. 3j.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1911.

would be impossible to predict precisely the effect of improved drainage conditions upon this interval of time, but owing to the increased velocity of flow in the channel a less time would be expected, and in the computations this time will be taken as five days.

A study of the hydrographs of numerous streams tends to show that when practically no storage exists and when no rains occur just before, at, or after the maximum river stage, the time required for a stream to rise is approximately equal to the time consumed in falling. Owing

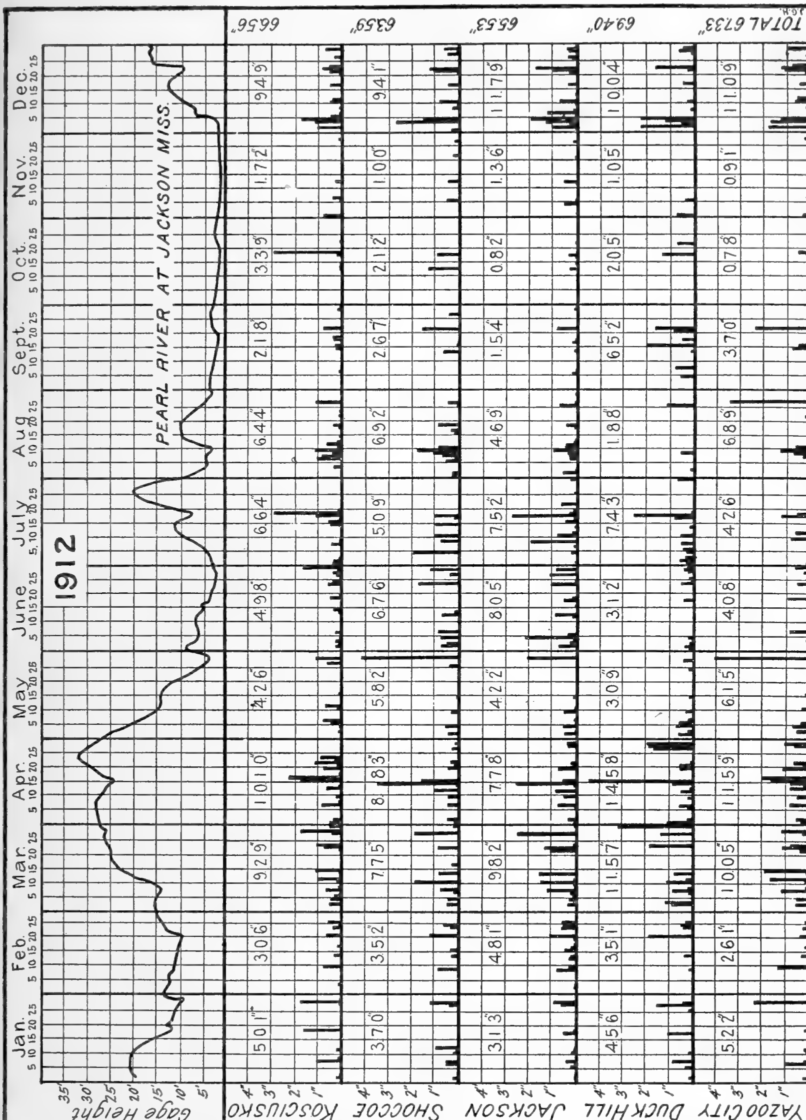

FIG. 3k.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1912.

to the lack of definite knowledge as to the storage and rainfall conditions on most streams, it is difficult to obtain accurate information on this point, but it is believed that the table following shows in a general way the truth of this statement.

Time of rising and falling of streams under minimum storage conditions as indicated by hydrographs resulting from practically continuous rains before but unaffected by rainfall after maximum stage was reached.

Name of river.	Observation station.	Date of maximum stage.	Time rising.	Time falling.	Maximum stage.	Flood stage.
			Days.	*Days.*	*Feet.*	*Feet.*
Tombigee	Columbus, Miss	Apr. 20, 1893	6	6	17.5	33
Do	do	Feb. 29, 1908	3½	4	10	33
Do	do	Mar. 28, 1908	7	6½	21	33
Do	do	July 13, 1910	5½	5½	19	33
Do	do	Apr. 24, 1911	5	5	26	33
Do	Aberdeen, Miss	Dec. 9, 1912	5½	6½	25.5	33
Do	do	Apr. 11, 1911	5	5	32	33
Do	Cochrane, Ala	Apr. 27, 1911	4½	5	31.5	41
Do	Fulton, Miss	Apr. 19, 1910	3	3	10	17
Do	Demopolis, Ala	Nov. 30, 1899	7	7	16.5	35
Do	do	Feb. 9, 1907	8	10	45	35
Do	do	Dec. 27, 1908	3½	4	25	35
Do	do	June 27, 1909	5	5½	42	35
Do	do	July 22, 1912	3	3	17.5	35
West Pearl	Pearl River, La	May 28, 1910	6	6	12.8	12
Savannah	Augusta, Ga	July 15, 1905	5	5	20.7	32
Flint	Montezuma, Ga	Feb. 15, 1905	5½	5½	20.7	20
Pea	Pera, Ala	Feb. 16, 1905	8	9	29.4	
Total			96	101½		

The above table indicates that the time of falling is slightly greater than that consumed in rising, as may be seen by comparing the total number of days in each case. However, in the method under discussion, if the time of falling be taken equal to that of rising the result will tend toward a run-off rate that is too large rather than too small, and there will thus be introduced a factor of safety which is especially desirable in planning levee systems. Therefore, in the following computations the assumption is made that the time of falling after the maximum rate of run-off is reached will be the same as the time of rising, and that a uniform rate of rising and falling is maintained, the latter assumption also being on the side of safety.

If a hydrograph of the Pearl River for the storm period of 1902 be constructed, showing the river to perform in accordance with the foregoing conditions, it would consist of a triangle whose base represents 10 days, as shown by the line *a u* in figure 4, B. The lower portion of the hydrograph would probably conform quite closely to the curve *u n* whose rate of falling is slightly greater than that indicated by curves representing this stage of subsidence during other periods. Thus the hydrograph *afunr* would represent the performance of the stream from March 26 to May 12 under improved drainage conditions, and assuming that no rainfall occurred which affected its decline.

The total run-off for the storm period of 1902 is represented by the area *maoqs* as shown on the actual hydrograph of the Pearl River. An inspection of this hydrograph shows the decline of the river to have been materially affected by rainfall after April 1, which inference is substantiated by reference to the rainfall records. Since this rainfall would not affect the maximum stage of the assumed hydrograph *afunr*, its run-off should be deducted from that of the entire period. The run-off due to this rainfall can be approximately

FIG. 31.—Hydrograph of Pearl River and daily precipitation in vicinity of Big Black River, 1913.

ascertained by applying the percentage of rainfall flowing off, as heretofore computed, to the total amount of rainfall occurring between March 30 and May 10. The average total rainfall at Jackson and Louisville from April 5 to May 10 was 3.9 inches. The portion of the rainfall flowing off was, as previously calculated, 56 per cent for this storm period. Fifty-six per cent of 3.9 inches is 2.18 inches, or 15,950,000,000 cubic feet. The run-off which produced the maximum rate is equal to the total run-off, represented by the area *maoqs*, minus the above computed amount and should be equivalent to the area *mafunrs* under the hydrograph as constructed for improved conditions.

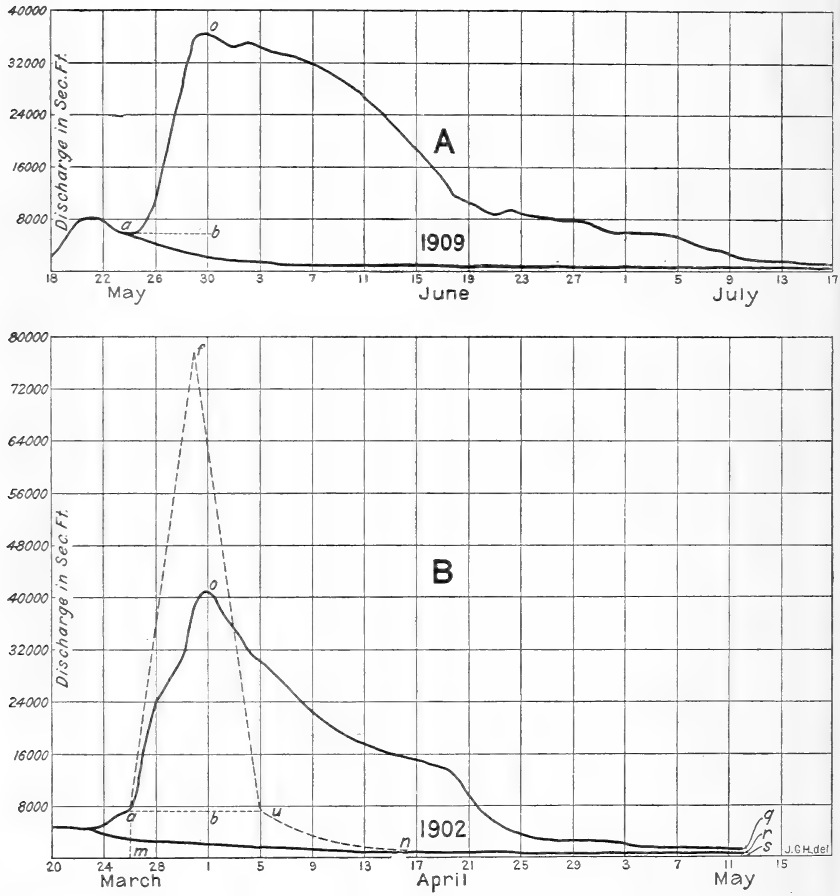

FIG. 4.—Discharge hydrograph of Pearl River at Jackson, Miss.

It can be seen from the figure that the area *maunrs* is common to each of the two distinct hydrographs for actual and improved conditions. Therefore the run-off to be provided for by the triangle *afu* must equal the run-off in the area *aoqrnu*, minus the above amount to be deducted for rainfall occurring subsequent to April 5. The area *aoqrnu* equals 16.76 square units, or 46,350,000,000 cubic feet, which diminished by 15,950,000,000 equals 30,400,000,000 cubic feet of run-off to be provided for by the area included in the triangle *afu*. Since the base of this triangle was shown to represent 10 days (864,000 seconds), and its area must equal 30,400,000,000 cubic feet of run-off, the altitude must be equal to

$$\frac{2\times 30,400,000,000}{864,000}=70{,}400 \text{ second feet.}$$

The maximum ordinate of the area *maunrs* is 7,200 second-feet. The maximum rate of run-off is measured by the ordinate from the apex of the triangle to the horizontal axis of the figure and is equal to the sum of 70,400 and 7,200 or 77,600 second-feet, which is equivalent to 24.8 second-feet per square mile of watershed area. In view of the fact that the upper portion of a discharge hydrograph is generally rounded off and therefore does not conform to the apex of a triangle, the 0.8 second-feet is dropped. Thus 24 second-feet per square mile is the probable maximum rate of run-off to be expected from a drainage area of 3,120 square miles on the Pearl River under improved conditions.

RUN-OFF FROM SMALL AREAS.

In determining the probable maximum rate of run-off for areas on the Big Black River that are smaller than the one just considered, it was necessary to rely entirely upon the rainfall records, since no satisfactory run-off data are available for comparison. This involves consideration of the following three essential factors: (1) The time required for water to flow from the most remote part of the watershed to the lower end or point of discharge; (2) the maximum rate of rainfall of a duration equal to this time; and (3) the percentage of rainfall flowing off.

The rainfall records of Kosciusko and Duck Hill, Miss., are applicable to the upper end of the Big Black watershed, comprising an area of 1,200 square miles. This area is about 85 miles long and has an average width of 14 miles. The profile of the Big Black River Valley (fig. 11) shows the average slope of this section to be approximately 1.6 feet per mile. If it be assumed that a floodway with an average depth of flow of 6 feet is to be constructed for 75 of the 85 miles, the velocity of flow computed by the Chezy formula, with n equal to 0.040, would be 2.2 feet per second, or $1\frac{1}{2}$ miles per hour for maximum flow. Since the depth of water in the floodway will increase from a low to a high stage, the velocity will be less during the earlier part of the storm, and it would therefore be reasonable to reduce the above-computed velocity, say, to $1\frac{1}{4}$ miles per hour. Then the time required to flow the 75 miles would be 2 days and 12 hours. The water from the outer edge of the watershed must flow from the hills to the bottoms. Considering the tortuous path the water must follow, a rough estimate of the distance would be 20 miles, and assuming a velocity of 1¼ miles per hour, the time required for the water to flow this distance would be about 16 hours. Hence the total time required for the water to flow from the upper edge of the watershed to the lower end of the area under consideration would be 3 days and 4 hours. According to factor (2) a rain of 3 days' duration will produce a maximum rate of flow from the total area.

In the consideration of drainage areas of about 100 square miles the probable maximum rate of run-off from Apookta Creek was investigated in conjunction with the rainfall records at Kosciusko, this rain-gauge station being in the neighborhood of Apookta Creek. The drainage area for this creek is 102.5 square miles and is approximately 10 miles long and 10 miles wide. Employing the same method as in the foregoing case, the time element was obtained by estimating the distance at 30 miles and the velocity at 1¼ miles per hour, which gives 24 hours as the time required for the water to traverse the watershed.

As previously explained, the run-off from the Pearl River watershed for the two maximum storms was 55.6 and 56.1 per cent. Actual gaugings of the flow in Twenty-Mile Creek, near Baldwyn, Miss., were made by C. E. Ramser, who determined the run-off from the drainage area of 80 square miles to have been 1.17 inches from a storm of 1.88 inches in April, 1913. In that instance the run-off was 62.3 per cent. These data justify to a certain extent the assumption here made that approximately 60 per cent of the total rainfall will run off. Then, assuming as before that for any flood the rising and falling stages will be of equal duration and at a uniform rate, it can be shown that the maximum daily rate of run-off will be 60 per cent of the average daily rainfall for the maximum storm of duration equal to the period of rising flood.

The rainfall records (fig. 3 a to 3 l) show the greatest three-day rain since 1903 on the 1,200 square miles at the upper end of the Big Black River watershed to have occurred in May, 1909 (fig. 3h), the average total precipitation for the two stations having been 5.85 inches, or 1.95 inches per 24 hours. If 60 per cent of the rainfall be assumed to flow off, then the probable maximum rate of run-off would be 60 per cent of 1.95 inches, or 1.17 inches per 24 hours, which is equivalent to 31.5 second-feet per square mile for the area of 1,200 square miles. The maximum rainfall of one days' duration for Apookta Creek, as taken from the records at Kosciusko (fig. 3b), was 5.8 inches, this rain having occurred February 6, 1903. Assuming 60 per cent of the rainfall to flow off, the probable maximum run-off for 24 hours will be 3.48 inches, which is equivalent to 93.7 second-feet per square mile.

APPLICATION OF RUN-OFF RESULTS.

The following is a summary of the results obtained for the three drainage areas discussed:

Drainage area.	Probable run-off.
Square miles.	*Second-feet per square mile.*
3,120	24.0
1,200	31.5
100	93.7

In order to utilize these results as a basis for determining run-off from other areas, it is necessary to incorporate them into a formula which will give the probable run-off from any desired drainage area. A formula of the Murphy type seems best adapted to the use of the above data.

The Murphy formula is

$$Q=\frac{46790}{M+320}+15$$

in which Q equals the discharge in second-feet from each square mile, and M the watershed area in square miles. Adopting a general formula of the above form, viz.,

$$Q=\frac{X}{M+Y}+Z$$

the values of X, Y, and Z were derived by substituting for Q and M the following values obtained for the Big Black watershed:

Where $M=100$, $Q=95$
Where $M=1200$, $Q=32$
Where $M=3000$, $Q=24$

Substituting the above values, and solving, the following formula was obtained:

$$Q=\frac{18700}{M+144}+18$$

For convenience in the use of this equation its curve has been platted (fig. 5). It is believed that this curve represents the maximum rate of run-off that may be expected under improved conditions, and the design of all levee improvements has been based upon it, although no rate of run-off greater than 90 second-feet per square mile has been used.

If a levee system be insufficient to care for the flood conditions, great damage may be done to the land presumed to be protected and to the levees themselves; great care should therefore be taken to provide for maximum run-off conditions. On the other hand, if a ditch be designed to care for only the ordinary floods, it prevents a large number of overflows and aids materially in reducing the maximum floods. The cost of ditches designed on this basis will be much less than that necessary to care for the maximum conditions, while the land will be greatly benefited by the decrease in the number, durations, and heights of the floods.

Investigations by C. E. Ramser, in Lee County, Miss., where conditions are quite similar to those existing in the Big Black watershed, seem to show that a ditch that has a capacity sufficient to care for a run-off of 55 second-feet per square mile for an area of 25 square miles, and a capacity of 25 second-feet per square mile for an area of 100 miles, is sufficient to handle a large number of the floods such as formerly had occurred, and to reduce greatly the heights and durations of the maximum floods. Believing that a design fulfilling these conditions is economical in this case, the following formula of the Murphy type has been developed by the use of the above values.

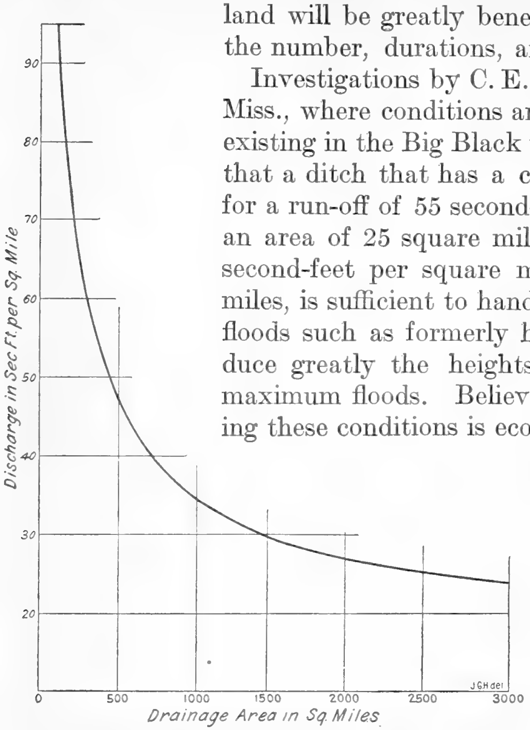

FIG. 5.—Discharge curve used in design of levees, Big Black River, Miss.

$$Q = \frac{1000}{M} + 15$$

The curve for this equation has been platted by substituting various values for M and solving for Q; this curve (fig. 6) has been used in computing the sizes of all ditches, except that no ditch had been designed for a greater run-off than 70 second-feet per square mile.

DRAINAGE PLANS CONSIDERED.

Before the final plan, as hereafter discussed, was decided upon, other possible methods of reclamation were carefully investigated and compared. These are very briefly discussed below.

IMPROVING PRESENT CHANNEL.

The plan of clearing the present river channel and making cut-offs was first investigated. It was found that the channel, even if it were straightened throughout and cleared of all drifts and brush, would not have sufficient capacity to care for the run-off as indicated by the curve for ditches (fig. 6), and that such improvements would not reduce the flood height sufficiently to prevent the summer and fall overflows, which are very injurious to the crops.

RELIEF DITCH.

A relief ditch was then laid out in such a manner that two separate channels could be maintained the entire length of the bottom below Bywy Creek. Owing to construction limitations the maximum section of this ditch was designed with a bottom width of 100 feet and a depth of flow of 13 feet. With this ditch and with the river channel cleared, the run-off, as computed by the ditch formula, could be cared for above the mouth of Poplar Creek; but from this point downstream it is believed that the relief obtained would not justify the expenditure. The estimated cost of this plan, including the construction of the ditch and the clearing of the old channel, amounted to $27 per acre of land benefited.

LEVEE AND FLOODWAY PLAN.

Preliminary computations were then made on a system of protection consisting of levees and floodways. The necessary widths of river floodway and heights of levees were determined. Interior drainage was provided for by ditches with outlets through floodgates to the river channel. The results obtained show that while the cost of the complete system will be high, considering present land values and economic conditions in the district, yet portions of the valley can be reclaimed at a reasonable cost even at the present time, and the remainder can be reclaimed at a later date as conditions justify. Plans and estimates were therefore made along the lines just described; these are discussed in some detail in the following pages.

PROPOSED PLAN.

The general plan as proposed for the drainage of the Big Black River bottoms consists of:

(1) The construction of a main ditch and of the necessary laterals at the upper end of the valley.

(2) The construction of levees.

(3) The clearing of a floodway through the bottoms, including the present river channel.

(4) Provision for interior drainage by the construction of ditches and the clearing of present channels.

The proximity of the river channel to the bluffs or higher land at frequent intervals and the entrance of tributaries into the bottoms divide the overflowed land into natural drainage units. From the Mathiston-Walthall Road to Cox Ferry 36 drainage districts have been planned. These districts, as well as the drainage improvements recommended, are clearly shown on the accompanying maps and profiles (figs. 10–12, in pocket at end of bulletin).[1]

[1] For index map to figure 10, see figure 2.

METHODS OF COMPUTATION.

In computing the sizes of ditches and levees and the capacities of the floodways, the Chezy formula, $v=c\sqrt{rs}$, was used. In this formula c is a coefficient depending upon channel conditions and determined by Kutter's formula, in which the coefficient of roughness, n, was taken at 0.030 for ditches, 0.035 for cleared channels, and 0.040 for floodways.

To provide a margin of safety, ditches were given a depth of 1 foot greater than that computed as necessary to handle the discharge. The tops of the levees were taken at 3 feet above the high-water line as computed.

In determining the capacity of the floodway it was necessary to consider its cross section in two parts, owing to the fact that in many of the bends of the channel the water will flow in a direction opposite to that in the floodway. Such a condition is shown at *a* in figure 7. The friction existing between the two bodies of water flowing in opposite directions is without doubt less than that between the water and the ground surface in the floodway; hence it should be safe to compute the discharge of the floodway as though the channel did not exist, adding thereto the discharge of the channel to obtain the total capacity of the floodway. The capacity of the section *efgh* (fig. 8) was computed by using the slope of the river channel, and taking n equal to 0.035; whereas in determining the capacity of the section *abcd* the slope used was that of the valley, and n was taken as 0.040. By adding the two results the total capacity of the floodway was obtained.

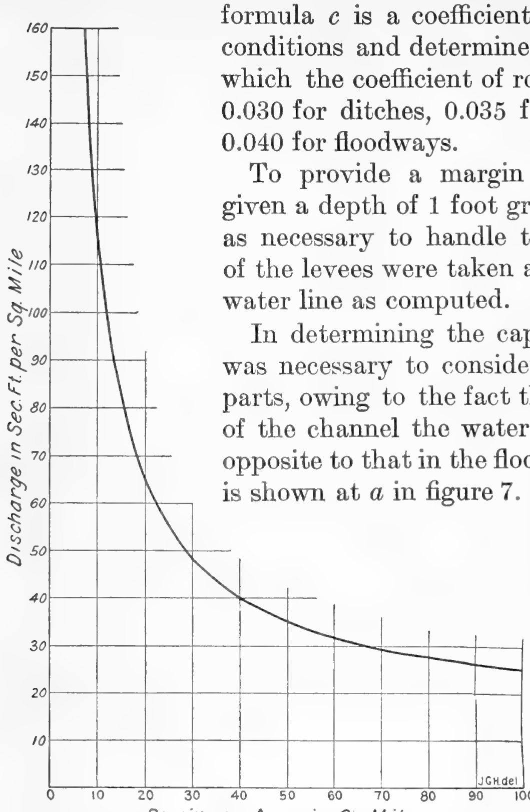

FIG. 6.—Discharge curve used in design of ditches, Big Black River, Miss.

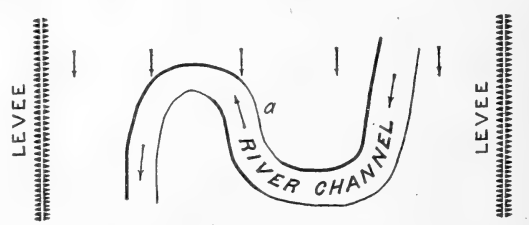

FIG. 7.—Sketch showing directions of flow in floodway, Big Black River, Miss.

In computing the capacities of the creek floodways, where the ditches parallel the levees, the discharge of the section represented by *bcfghk* (fig. 9) was computed by taking the line *fghk* as the wetted perimeter for the area, and *n* equal to 0.030. The discharges of the areas *abkl* and *cdef* were then computed, taking *n* equal to 0.040; the sum of these three results gave the total capacity of the floodway.

CONSTRUCTION.

No attempt is made here to provide full specifications for the proposed work. It is intended under this caption merely to point to

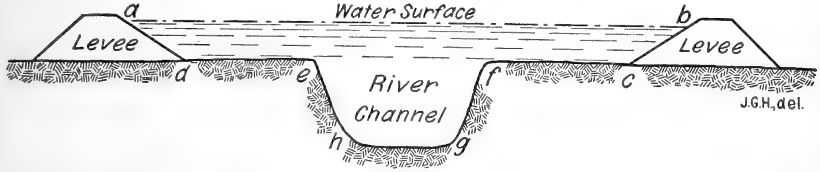

FIG. 8.—Sketch illustrating method of computing capacity of river floodway, Big Black River, Miss.

some of the more important details that have governed the design of the improvements and to emphasize those features of location and construction which are vital to the success of the system.

DITCHES.

The minimum ditch planned has a bottom width of 6 feet, side slopes of 1 to 1, and a depth of flow of 6 feet; such a ditch can be constructed economically with the same type of machine that builds the

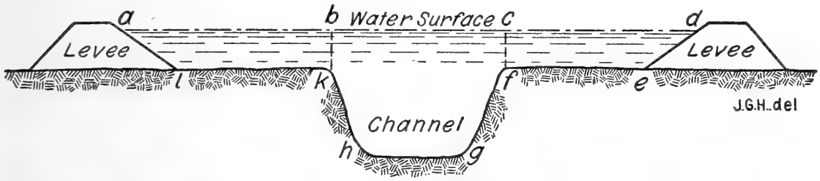

FIG. 9.—Sketch illustrating method of computing capacities of creek floodways, Big Black River, Miss.

levees. Ditch No. 4, in district No. 1, can be constructed economically by a floating dredge because its size is sufficient to justify installing such a machine. The width of the berm is independent of the width of the ditch, but varies with the depth of excavation. For cuts of 10 feet or less a berm of 10 feet is planned; for cuts greater than 10 feet a berm of 12 feet is recommended.

In existing channels, where clearing is the only improvement needed, all timber and underbrush should be cut, all débris removed, and all stumps cut level with the ground. The widths of right-of-way for ditches were computed by taking $3\frac{1}{2}$ times the width of the top, plus the width of both berms.

LEVEES.

The ground should be carefully inspected to secure the best location. The locations as shown on the map may be varied from whenever by so doing advantage can be taken of higher or firmer ground. In no case should a levee be located less than 200 feet from the bank of the river, and care should be taken to protect the levees against washing or undermining at the sharp bends of the stream. Changes in direction should be made by easy curves rather than by sharp angles.

The base should be cleared of all vegetation and stumps, and the large roots removed. For levees more than 10 feet high a muck ditch about 3 feet deep and 6 feet wide should be dug along the center line of the embankment. This ditch may be filled as is any other portion of the levee. The surface of the ground on which the levee is to be built should be broken with a plow, so that a bond will be formed which will prevent seepage from following the surface between the old and the new material.

The soil of which the levees are to be built is a heavy river silt or clay and will form a strong and fairly impervious embankment. The durations of the extreme high-water stages will be short, so that the levees will not ordinarily be saturated for more than a few feet from the ground surface. The estimates for the levees have therefore been based on a top width of 4 feet, side slopes of 2½ to 1 on water side and 1½ to 1 on land side for river floodway levees, and 3 to 1 on water side and 2 to 1 on land side for the creek floodway levees. This difference in slopes is recommended because of the fact that the creek floodway levees will be subjected to a current of greater velocity than will those of the river floodway.

The levees should be built of clean earth that is free from vegetable matter taken from the side of the levee next to the waterway. The pits from which the earth is taken should have side slopes at least as flat as 1 to 1; and if practicable should not be more than 6 feet deep. Along the river levees a berm or strip of land at least 10 feet wide, from which no earth has been taken, should be left between the pit and the toe of the levee. For the creek floodway levees the berm should be 50 feet wide and the borrow pit of the shape specified. The widths of right of way for levees were computed by adding to the width of base and berm, the width of borrow pit, based upon a depth of 6 feet and side slopes 1 to 1.

The material can be most economically handled by a dry-land excavator of some type that will take the material from the pit and place it in the levee at one operation. When the required amount of material is in place, the top and sides of the embankment should be smoothed to an even surface and the whole planted in any grass adapted to the soil and climate.

FLOODWAYS.

In floodways all trees and underbrush should be cut and removed and all drift disposed of; stumps should be cut level with the ground. The heights of the levees have been computed upon a basis which requires that everything that will seriously impede the flow of water shall be removed from the floodway, the latter including the river channel itself; the widths to be cleared are given in Appendix II.

It is recommended that a separate organization be formed to clear the entire river floodway, since, to be effective, this must be cleared through the length of the levee improvements. It is not believed that the clearing can be advantageously handled by the separate levee districts, working independently. To clear this floodway, the entire valley between the lower end of district No. 1 and Cox Ferry should be organized into one drainage district. The cost of the work should be assessed, according to the benefits to result, to all of the land that at present is subject to overflow, excepting that within the floodway itself. The floodway should be cleared to a point 2 miles below Cox Ferry in order to prevent the increase of flood height at the Ferry that otherwise would result from the more rapid discharge of the upper river.

SEDIMENTATION AREAS.

The smaller streams and ravines which enter the valley from the surrounding hills usually carry a large amount of sediment and drift, which being deposited is continually filling up the lands where the streams enter the bottoms. For this reason many of these smaller streams have not established channels for themselves, but have filled up and spread over the bottom. If ditches are constructed to connect these small streams with the main drainage channels, the same process of sedimentation will continue and the ditches will soon become filled.

To overcome this difficulty in the ditches that are to be constructed, it will be necessary to provide sedimentation areas, each bounded by a levee on the lower or downstream side that will serve to impound the water and decrease its velocity, thus causing the suspended matter to be deposited. In this manner the excess sediment and drift can be confined to a limited area and damage to ditches prevented. When an area has become filled to such a height that storage is no longer possible, a new levee can be constructed a little farther upstream or downstream; thus a new sedimentation area is formed, leaving the old one, filled with fertile soil, available for cultivation.

These areas are of the utmost importance in the reclamation of a river valley of the character of that of the Big Black, and as they make it possible for the farmer to retain the most fertile soil on his farm, they should be constructed by him regardless of whether the larger drainage work is carried out or not. As these sedimentation areas will in most cases be outside the district boundaries, no estimates of cost have been made for them.

The sediment carried by these tributaries originates for the most part in the erosion of the surrounding hills. Too much stress can not be laid on the importance of controlling this action by proper terracing of slopes. It should be realized that it is the most fertile particles of soil that are thus carried away, not only to the detriment of the land, but to the great damage of the drainage channels in which the sediment is deposited.

COST OF IMPROVEMENTS.

In the estimates for the construction of ditches and levees the cost of clearing right of way is provided for in the price per cubic yard for excavation.

It is believed that the ditches can be excavated at an average cost of 9 cents per cubic yard. Levees with berms of from 10 to 15 feet are estimated at 13 cents per cubic yard, and those with berms of 50 feet at 18 cents per cubic yard; in both cases the earth is assumed to be measured in excavation. The increased unit cost of the levee work over that for the ditches is due to the greater cost of depositing all of the earth on one side of the ditch or borrow pit, and to the cost of leveling and smoothing the bank. Where a 50-foot berm is specified a longer boom will be required than is necessary on the remainder of the work. This requirement, together with the greater distance which the earth must be moved, increases the fuel consumption as well as the time of construction.

In estimating the cost of floodgates, rough designs are made for three gates with capacities of 175, 525, and 1,400 second-feet, respectively, and the cost of each was determined on the basis of 1 per cent reinforced concrete construction, costing $25 per cubic yard in place. The cost of all other gates were estimated by determining their required capacities, and interpolating between the three computed costs.

The cost of right of way for levees and ditches was estimated at $10 per acre, no allowance being made for right of way for ditches which follow the present channels. The expense of clearing all brush, logs, and stumps from present channels was estimated at $750 per mile.

It is not expected that it will be necessary for the organization to purchase the land to be cleared for the river floodway. Therefore this item is not included in the estimate. The cost of clearing the floodway is estimated at $20 per acre, with an additional $1 per acre for incidental expenses. The timber cut should remain the property of the landowner.

An addition of 10 per cent on the estimated cost of the improvements is made to cover legal, engineering, and other incidental expenses. A detailed estimate of cost is given in the table on page 33.

Estimate of cost, by districts.

District No.	Assessable area.	Excavation.						Channel clearing.		Right of way.				Flood-gates.		Total of preceding costs.	Legal, engineering, and contingent expenses, at 10 per cent.	Total cost.[1]	Cost per acre.[1]	Remarks.
		Ditches.			Levees.															
		No.	At 9 cents.	Cost.	At 13 cents.	At 18 cents.	Cost.	Length.	Cost at $750 per mile.	For ditches.	For levees.	Total.	Cost at $10 per acre.	No.	Cost.					
	Acres.		*Cu. yds.*		*Cu. yds.*	*Cu. yds.*		*Miles.*		*Acres.*	*Acres.*	*Acres.*								
1	14,223	4	2,223,930	$200,154						662		662	$6,620			$206,774	$20,677	$227,451	$15.99	
2	1,726	1	177,520	15,977	21,320	23,470	$6,996			33	57	90	900	1	$800	24,673	2,467	27,140	15.72	
3	2,643	4	86,140	7,753	241,950	71,900	44,396			55	122	177	1,770	3	2,400	56,319	5,632	61,951	23.43	
4	2,901				217,600		28,288	8.9	$6,675		64	64	640	1	1,000	36,603	3,660	40,263	13.88	Jack Slough to be cleared.
5	1,421	1	11,460	1,031	224,800		29,224	2.1	1,575	7	63	70	700	3	2,500	35,030	3,503	38,533	27.12	Icky Slough to be cleared.
6	1,540	1	41,790	3,761	193,410		25,143			28	56	84	840	1	750	30,494	3,049	33,543	21.78	
7	1,778	2	35,600	3,204	169,980	116,500	43,067			22	126	148	1,480	2	1,500	49,251	4,925	54,176	30.47	
8	1,718				208,500		27,105	3.5	2,625		59	59	590	1	900	31,220	3,122	34,342	20.00	Gary Slough to be cleared.
9	1,589	1	61,500	5,535	45,650	166,700	35,941			34	60	94	940	1	750	43,166	4,317	47,483	29.88	
10	1,853	2	55,520	4,997	195,870		25,463			32	54	86	860	2	2,300	33,620	3,362	36,982	19.96	
11	1,525	1	82,550	7,430	187,850		24,421			43	53	96	960	1	1,300	34,111	3,411	37,522	24.60	
12	1,997	3	78,240	7,042	268,820	39,380	42,035			45	86	131	1,310	3	3,300	53,687	5,369	59,056	29.57	
13	1,098	1	19,200	1,728	126,360	37,520	23,180			12	47	59	590	2	1,650	27,148	2,715	29,863	27.20	
14	1,998	2	96,070	8,646	253,740		32,986			54	68	122	1,220	1	1,200	44,052	4,405	48,457	24.25	
15	1,015	1	34,350	3,092	156,960		20,405			21	41	62	620	1	900	25,017	2,502	27,519	27.11	
16	1,519	1	63,470	5,712	200,440		26,057			34	52	86	860	1	750	33,379	3,338	36,717	24.17	
17	6,169	3	186,500	16,785	557,440		72,467	5.3	3,975	74	145	219	2,190	3	6,400	101,817	10,182	111,999	18.16	Jack Lake to be cleared.
18	1,418	1	198,350	17,852	262,390		34,111			73	68	141	1,410	1	3,500	56,873	5,687	62,560	44.12	
19	3,244	1	155,300	13,977	372,550	18,440	51,751			69	102	171	1,710	2	2,750	70,188	7,019	77,207	23.80	
20	6,013	2	262,640	23,638	480,000		62,400	.6	450	105	133	238	2,380	2	4,200	93,068	9,307	102,375	17.03	Slough into Blue Lake to be cleared.
21	1,860	1	94,850	8,537	246,800	45,000	40,184			46	93	139	1,390	1	1,200	51,311	5,131	56,442	30.35	
22	2,521	1	21,570	1,941	308,900		40,157	3.9	2,925	13	79	92	920	3	2,500	48,443	4,844	53,287	21.14	Stevens, Brushy, and Tate Sloughs to be cleared.
23	5,671	3	261,310	23,518	412,260	56,280	63,724			112	138	250	2,500	2	5,500	95,242	9,524	104,766	18.47	
24	1,254	1	83,320	7,499	208,750		27,138			41	52	93	930	1	2,000	37,567	3,757	41,324	32.95	
25	2,523	2	154,680	13,901	234,300	89,500	46,569			64	97	161	1,610	1	3,500	65,580	6,558	72,138	28.59	
26	1,132	1	27,310	2,458	152,540	52,200	29,226	.3	225	16	57	73	730	1	900	33,539	3,354	36,893	32.59	Panther Creek to be cleared below outlet of ditch A.

[1] Costs given do not include cost of clearing main floodway. This is estimated to cost $494,970 (viz, 23,570 acres at $21 per acre). This cost is assessed to the total area overflowed below district No. 1, less that of the floodway itself (viz, 118,570 acres less 23,570 acres=95,000 acres), making the cost per acre benefited, $5.21.

Estimate of cost, by districts—Continued.

District No.	Assessable area.	Excavation.						Channel clearing.		Right of way.				Floodgates.		Total of preceding costs.	Legal, engineering, and contingent expenses, at 10 per cent.	Total cost.	Cost per acre.	Remarks.
		Ditches.			Levees.															
		No.	At 9 cents.	Cost.	At 13 cents.	At 18 cents.	Cost.	Length.	Cost at $750 per mile.	For ditches.	For levees.	Total.	Cost at $10 per acre.	No.	Cost.					
	Acres.		*Cu. yds.*		*Cu. yds.*	*Cu. yds.*		*Miles.*		*Acres.*	*Acres.*	*Acres.*								
27	6,211	4	245,830	$22,125	$450,080	$116,000	$79,390	2.3	$1,725	98	153	251	$2,510	3	$6,700	$112,450	$11,245	$123,695	$19.92	Sandy Run and outlet sloughs for ditches B and C to be cleared.
28	1,035	1	50,300	4,527	185,190	57,690	34,459	....	......	26	54	80	800	1	1,200	40,986	4,099	45,085	43.56	
29	1,502	1	48,220	4,340	329,300	....	42,809	....	......	28	77	105	1,050	1	900	49,099	4,910	54,009	35.96	
30	1,254	1	13,150	1,184	174,200	90,800	38,990	....	......	8	75	83	830	2	1,900	42,904	4,290	47,194	37.63	
31	6,541	3	174,550	15,710	740,760	35,970	102,773	2.8	2,100	84	188	272	2,720	6	11,750	135,053	13,505	148,558	22.71	Indian and Big Ditch Creeks to be cleared.
32	874	...	....	....	224,000	....	29,120	1.6	1,200	......	51	51	510	1	1,000	31,830	3,183	35,013	40.06	Slough to be cleared.
33	1,927	1	97,860	8,807	279,640	....	36,353	....	......	39	65	104	1,040	1	1,500	47,700	4,770	52,470	27.23	
34	2,444	2	94,550	8,510	439,250	....	57,103	....	......	51	101	152	1,520	1	1,200	68,333	6,833	75,166	30.76	
35	1,238	1	45,660	4,109	253,890	....	32,997	....	......	25	60	85	850	1	1,000	38,956	3,896	42,852	34.61	
36	713	...	....	....	210,700	....	27,391	....	......	......	46	46	460	1	900	28,751	2,875	31,626	44.36	
	96,088	55	5,283,290	475,480	9,236,190	1,017,350	1,383,819	31.3	23,475	2,054	2,842	4,896	48,960	59	82,500	2,014,234	201,423	2,215,657	23.06	

MAINTENANCE.

The most successful operation of any drainage system requires that it be maintained in the highest possible degree of efficiency. Where levees are involved, neglect may result not only in their destruction, but in great damage to crops, stock, and other property, and even in loss of human life. Each levee district should maintain an organization for systematic inspection and repairs. The levees should be periodically inspected in order that minor defects may be discovered and repaired.

To facilitate examination the levees should, where practicable, be kept in grass. Under no circumstances should their slopes be permitted to become covered with rank growths of vegetation that might obscure their weaknesses and the operations of burrowing animals.

Ordinarily, if minor defects be attended to promptly, levees will not require a heavy expense for maintenance. Floodgates should be examined after each heavy rain and great care taken to see that they are always in perfect condition and are unobstructed by débris or vegetation.

The maintenance of ditches consists largely in keeping them clear of vegetation and débris, so that the full, unobstructed channel will always be available. No bridges, fences, fish traps, or other structures should be permitted to interfere with the free flow of water.

The efficiency of the floodway will depend upon the degree to which they are kept clear of vegetation. This is especially true of the river floodway where the fall is slight. Periodical clearing will be necessary to prevent this waterway from reverting to its present obstructed condition.

SUMMARY.

The lowlands along the Big Black River, Miss., represent a condition that each year becomes more prominent in the South. Formerly, heavy growths of valuable timber afforded a revenue from the swamp and overflowed land; with the cutting of this timber, however, the land becomes valueless unless drained and put under cultivation.

Under present conditions from 75 to 100 per cent of the Big Black River bottoms are overflowed to a depth of from 3 to 8 feet by each heavy rainstorm that lasts from 2 to 3 days and covers the entire watershed. The problem is to restrict the area flooded and to reduce the durations of the overflows by promoting a quick passage of the flood water through the valley.

The plan for ultimate reclamation involves the excavation of a main ditch and laterals in the upper portion of the valley, and the construction of a leveed floodway throughout the remaining portion. Provision for tributary streams and for interior drainage is also made. To carry out this work, 36 drainage districts are planned, having a total area of 96,088 acres. The estimated cost of this

work, exclusive of that of clearing the main floodway varies in the different drainage districts from $15.72 to $44.36 per acre, the average cost per acre for the entire 36 districts being $23.06. It is recommended that the clearing of the main floodway be done by a separate organization comprising all of the overflowed land below district No. 1, exclusive of that of the floodway itself. On this basis the cost of clearing would be $5.21 per acre benefited.

Especial attention is called to the necessity of providing sedimentation areas at the lower extremities of the several tributaries of the river, and of taking immediate steps to arrest the hillside erosion now taking place within the watershed.

It is doubtful if conditions in the valley at this time justify the expenditure necessary for the complete reclamation as outlined, although at least one of the districts (No. 1) should be carried out at once. A feature that contributes greatly to the high cost per acre for the levee districts is the narrowness of the bottoms as compared with the large amount of water that must be provided for. It has seemed advisable, however, to prepare plans for the reclamation of the entire part of the valley under consideration, as the increasing demand for agricultural land will doubtless make the ultimate reclamation of these lands desirable.

In weighing the advantages of drainage as against the cost, the landowners should not lose sight of those benefits which may be termed secondary as distinct from those to which a direct money value can be assigned. First among benefits of this class should be placed the improved health conditions that follow improvements of this nature. Experience has also shown that the betterment of roads, made possible by drainage, results not only in greatly decreased cost of their maintenance, but also in the cheaper transportation of produce and in generally improved educational and social conditions in the community.

APPENDIX I.

BENCH MARKS.

Each bench mark listed below consists of an iron pipe 3½ feet long and 3 inches in diameter, set in the ground to a depth of 3 feet. The top of pipe is covered with a bronze cap on which is stamped "Office Experiment Stations, U. S. Dept. Agr. Drainage" with elevation of top of bench mark to the nearest foot. Elevations refer to Gulf datum. A much greater number of bench marks were made by driving nails in notches cut in roots of trees, and in other ways. The locations and elevations of any of these may be learned by inquiry addressed to the Chief of Drainage Investigations, United States Department of Agriculture, Washington, D. C.

List of department bench marks.

Elevation.	Location.
Feet.	
353.47	At Stewart, 100 feet north of center line of Southern Railway depot in public square.
311.55	At Kilmichael, west side Doris road, ½ mile south of railroad crossing at bend in road, 10 feet north of 8-inch oak in northeast corner of pigpen.
345.33	At Vaiden, about 1,000 feet south of Illinois Central Railroad station and 100 feet south of railroad section house on west edge of railroad right of way, 10 feet north of cattle guard.
290.77	At West, 250 feet east of Illinois Central Railroad depot, in northwest corner of G. Millon's yard.
248.79	At Durant, 1,700 feet east of center line of Illinois Central Railroad, at foot of bluff on south side of public highway running east from Park Hotel.
234.60	At Goodman, 100 feet south of Illinois Central Railroad station, near west wall of brick store owned by Tate & Co.
231.30	At Pickens, 150 feet east of Illinois Central Railroad station, in northwest corner of hotel yard, 75 feet south of public highway crossing river bottom.
212.00	At Vaughan, 150 feet northwest of Illinois Central Railroad station, in northeast corner of J. L. Blakeman's yard.
204.47	At Hay, 150 feet northeast of Illinois Central Railroad station, in front of store owned by the Powell estate, of Yazoo City.
178.56	At Forlorn, 50 feet west of center line Yazoo & Mississippi Valley Railroad and 40 feet north of railroad water tank.
157.31	At Cox Ferry, 12 feet north and 6 feet west of northeast corner of Cox's house, in front yard between two west posts of bell tower.

APPENDIX II.

FLOODWAY DATA.

Computation of capacity of river floodway.

Station.		Drainage area.	Required capacity.	Distance, center to center of levees.	Floodway, exclusive of river channel.					River channel.			Capacity.	Total capacity.	Remarks.
From—	To—				Area of cross section.	Slope.	Depth of flow.	Velocity.	Capacity.	Area of cross section.	Slope.	Velocity.			
		Sq. mi.	*Sec.-ft.*	*Feet.*	*Sq. ft.*	*Ft. per mi.*	*Feet.*	*Ft. per sec.*	*Sec.-ft.*	*Sq. ft.*	*Ft. per mi.*	*Ft. per sec.*	*Sec.-ft.*	*Sec.-ft.*	
[1] 60	257	165	12,900	1,150	5,580	2.11	5.0	2.24	12,500	400	1.65	2.49	995	13,495	Station 257, end of ditch No. 4
257	342	282	17,500	1,500	7,340	1.85	5.2	2.17	15,950	465	1.19	2.20	1,025	16,975	Station 342, mouth of Calabretta Creek.
342	381	346	19,360	1,500	8,075	1.85	5.5	2.26	18,250	465	1.19	2.20	1,025	19,275	Station 381, mouth of McCurtens Creek.
381	444	387	20,900	1,500	8,210	2.11	5.6	2.44	20,030	645	1.19	3.01	1,940	21,970	
444	841	404	21,200	1,500	8,210	2.11	5.6	2.44	20,030	645	1.19	3.01	1,940	21,970	
841	892	485	22,940	1,500	8,210	2.11	5.6	2.44	20,030				[2] 2,590	22,620	
892	992	485	22,940	1,570	8,620	1.95	5.75	2.32	20,000	1,040	1.06	2.89	3,000	23,000	Station 992, mouth of Mulberry Creek.
992	1109	536	24,390	1,500	8,650	1.95	6.05	2.43	21,050				[2] 3,300	24,350	Station 1109, mouth of Poplar Creek.
1109	1309	627	26,950	1,500	9,020	2.11	6.2	2.58	23,300	1,395	1.06	2.96	4,130	27,430	Station 1309, mouth of Lewis Creek.
1309	1494	685	27,750	1,600	9,750	2.11	6.25	2.66	25,900	1,525	1.06	3.02	4,610	30,510	Station 1494, mouth of Dry Creek.
1494	1586	701	28,040	1,600	9,750	1.69	6.25	2.38	23,100	1,525	1.06	3.02	4,610	27,710	
1586	1636	701	28,040	1,800	11,000	1.43	6.4	2.18	24,050	1,525	1.06	3.02	4,610	28,660	Station 1636, mouth of Hays Creek.
1636	1853	795	30,200	1,700	10,800	1.69	6.5	2.42	26,200				[2] 3,750	29,950	Station 1853, mouth of Peachhollow Creek.
1853	1906	842	31,150	1,800	11,450	1.69	6.5	2.42	27,680	1,270	1.06	2.89	3,660	31,340	
1906	1956	842	31,150	1,900	12,100	1.43	6.6	2.23	27,100	1,270	1.06	2.89	3,660	30,760	Station 1956, mouth of Zilpha Creek.
1956	2226	950	33,250	1,800	11,870	1.69	6.75	2.51	29,900	1,270	1.06	2.89	3,660	33,560	Station 2226, mouth of Martin Creek.
2226	2348	987	34,000	1,800	11,870	1.69	6.75	2.51	29,900	1,540	.92	3.16	4,870	34,770	Station 2348, mouth of Jordan Creek.
2348	2491	1,010	34,600	1,800	11,870	[3] 1.69	6.75	2.51	29,900	1,540	.92	3.16	4,870	34,770	Station 2491, mouth of Apookta Creek.
2491	2654	1,117	36,860	1,800	12,345	1.90	7.0	2.71	33,500	1,540	.92	3.16	4,870	38,370	Station 2654, mouth of Indian Creek.
2654	2816	1,127	37,200	1,800	12,345	1.90	7.0	2.71	33,500	1,525	1.06	3.34	5,090	38,590	
2816	2955	1,145	37,600	1,800	12,345	1.90	7.0	2.71	33,500	1,770	1.06	3.38	5,950	39,450	Station 2955, mouth of Long Creek.
2955	3184	1,225	39,300	1,800	12,345	1.90	7.0	2.71	33,500	2,120	1.06	3.35	7,100	40,600	Station 3184, mouth of Box Creek.
3184	3290	1,274	39,900	1,800	12,345	1.90	7.0	2.71	33,500				[2] 6,500	40,000	
3290	3331	1,274	39,900	2,000	13,745	1.58	7.1	2.5	34,400				[2] 6,500	40,900	Station 3331, mouth of Seneatcha Creek.
3331	3768	1,387	42,100	1,800	12,780	1.90	7.25	2.78	35,600				[2] 7,000	42,600	Station 3768, mouth of Bear Creek.
3768	4017	1,450	43,250	1,800	12,780	1.95	7.25	2.82	36,100	2,135	1.06	3.46	7,390	43,490	Station 4017, mouth of Cypress Creek.
4017	4159	1,592	45,800	1,900	13,510	1.95	7.25	2.82	38,200				[2] 7,500	45,700	
4159	4209	1,592	45,800	2,100	14,975	1.69	7.4	2.63	39,400				7,500	46,900	Station 4209, mouth of Doaks Creek.
4209	4472	1,804	49,800	2,000	14,730	1.95	7.5	2.89	42,600				[2] 7,000	49,600	
4472	4572	1,804	49,800	2,200	16,220	1.69	7.8	2.71	44,000				7,000	51,000	Station 4572, mouth of Bear Creek.
4572	4601	1,971	52,800	2,000	15,690	1.95	8.0	3.02	47,400	1,815	.92	3.22	5,850	53,250	
4601	4651	2,023	53,900	2,200	17,290	1.69	8.1	2.81	48,700	1,765	.92	3.16	5,575	54,275	Station 4651, mouth of Panther Creek.
4651	4800	2,023	53,900	2,100	16,995	1.69	8.6	2.88	49,000	1,765	.92	3.16	5,575	54,575	Station 4750, mouth of Deer Creek.

4800	5541	2,267	58,100	2,000	17,625	1.48	9.0	2.88	50,800	2,145	.92	3.2	6,875	57,675	
5541	5591	2,267	58,100	2,200	19,425	1.21	9.1	2.60	50,500	2,145	.92	3.2	6,875	57,375	Station 5591, mouth of Bogue Chitto.
5591	5700	2,400	60,700	2,000	18,110	1.48	9.25	2.95	53,500	....	....	....	[2] 7,000	60,500	
5700	5835	2,470	62,000	2,000	19,000	1.32	9.5	2.88	54,700	2,380	.92	3.45	8,200	62,900	Station 5835, mouth of Bogue Felia.
5835	5962	2,470	62,000	2,000	19,000	1.32	9.85	2.88	54,700	2,380	....	3.45	8,200	62,900	Station 5962, mouth of Cox Ferry.

[1] Floodway starts at Station 60 of profile down general course of valley (fig. 11).
[2] Interpolated with reference to channel cross section.
[3] Slope of ground surface, Station 2348 to Station 2491, is 1.90. Water surface is calculated at grade of 1.69, thus gaining 0.25 foot in depth.

Computation of capacity of creek floodways.

District number.	Name.	Drainage area.	Required capacity.	Distance, center to center of levees.	Slope.	Floodway, exclusive of ditch section.				Ditch section.					Total capacity.
						Area of cross section.	Depth of flow.	Velocity.	Capacity.	Bottom width.	Depth of flow.	Area of cross section.	Velocity.	Capacity.	
		Sq. mi.	*Sec.-ft.*	*Feet.*	*Ft. per mi.*	*Sq. ft.*	*Feet.*	*Ft. per sec.*	*Sec.-feet.*	*Feet.*	*Feet.*	*Sq. ft.*	*Ft. per sec.*	*Sec.-ft.*	*Sec.-ft.*
3	McCurtens Creek, upper end	42	3,770	440	2.56	1,266	3.5	1.88	2,380	10	10	190	3.72	2 at 700	3,780
	McCurtens Creek, lower end	....	....	300	....	....	5.6	....	....	[1]	....	....	....	....	....
7	Poplar Creek, upper end	82	3,370	630	2.11	2,390	4.5	2.04	4,860	18	11.5	3[illegible]	3.94	2 at 1,260	7,380
	Poplar Creek, lower end	....	....	310	....	....	5.9	....	....	[1]	....	....	....	....	....
23–25	Lambs Creek, upper end	19	1,710	190	2.11	477	3.0	1.52	730	40	8	375	3.71	2 at 1,390	3,510
	Lambs Creek, lower end	....	....	300	....	....	....	....	....	[1]	....	....	....	....	....
26–28	Panther Creek, upper end	50	4,400	275	1.58	1,064	8.0	2.74	2,920	80	16	1,470	5.20	7,650	10,570
	Panther Creek, lower end	....	....	300	....	....	8.25	....	....	[1]	....	....	....	....	....
25–27	Picket Creek, upper end	24	2,120	225	1.58	520	4.0	1.66	860	50	9.5	550	3.65	2,010	2,870
	Picket Creek, lower end	....	....	300	....	....	8.0	....	....	[1]	....	....	....	....	....
27–30	Cypress Creek, upper end	32	2,890	210	2.11	704	4.0	1.92	1,350	50	9.5	640	4.66	2,980	4,430
	Cypress Creek, lower end	....	....	300	....	....	9.0	....	....	[1]	....	....	....	....	....
30–31	Walachi Bogue, upper end	32	2,860	260	3.17	745	5.0	2.68	2,000	50	12.0	720	5.96	4,290	6,290
	Walachi Bogue, lower end	....	....	300	....	....	9.0	....	....	[1]	....	....	....	....	....

[1] Ditch to be of sufficient size to build levees.

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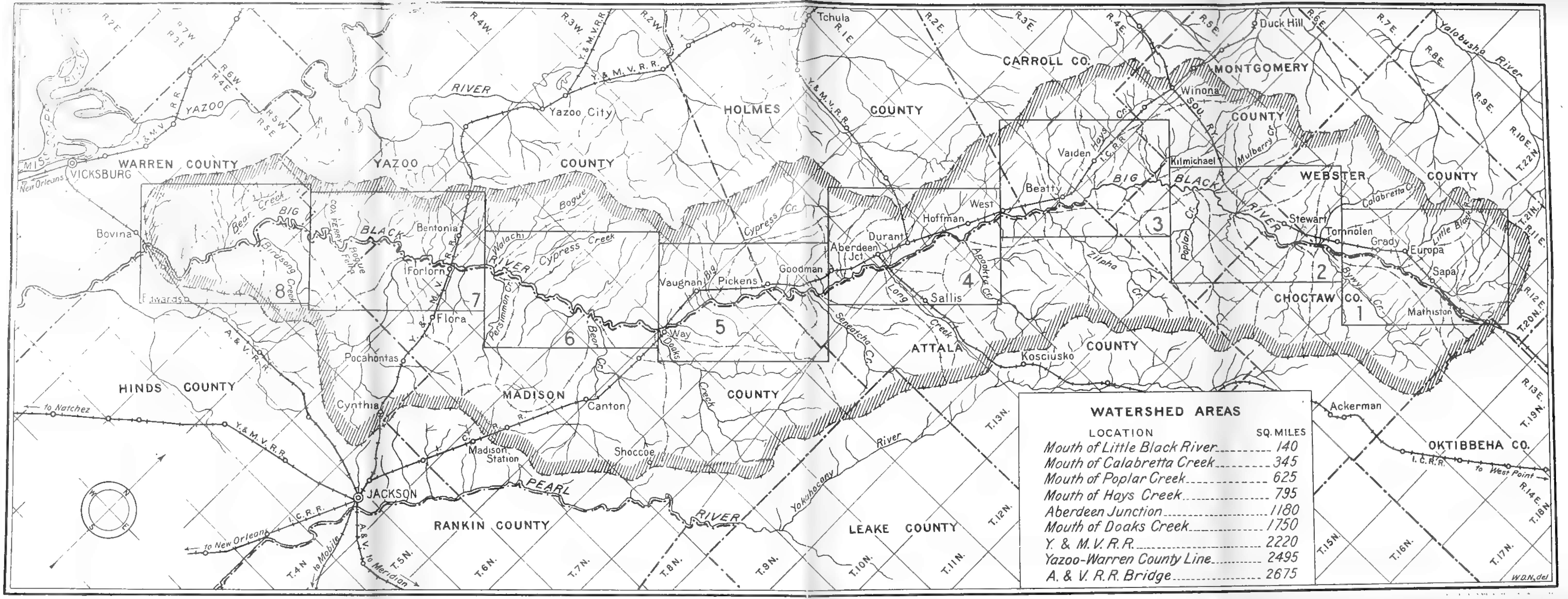

FIG. 2.—Watershed map of Big Black River, Mississippi, and index of map, figure 1.

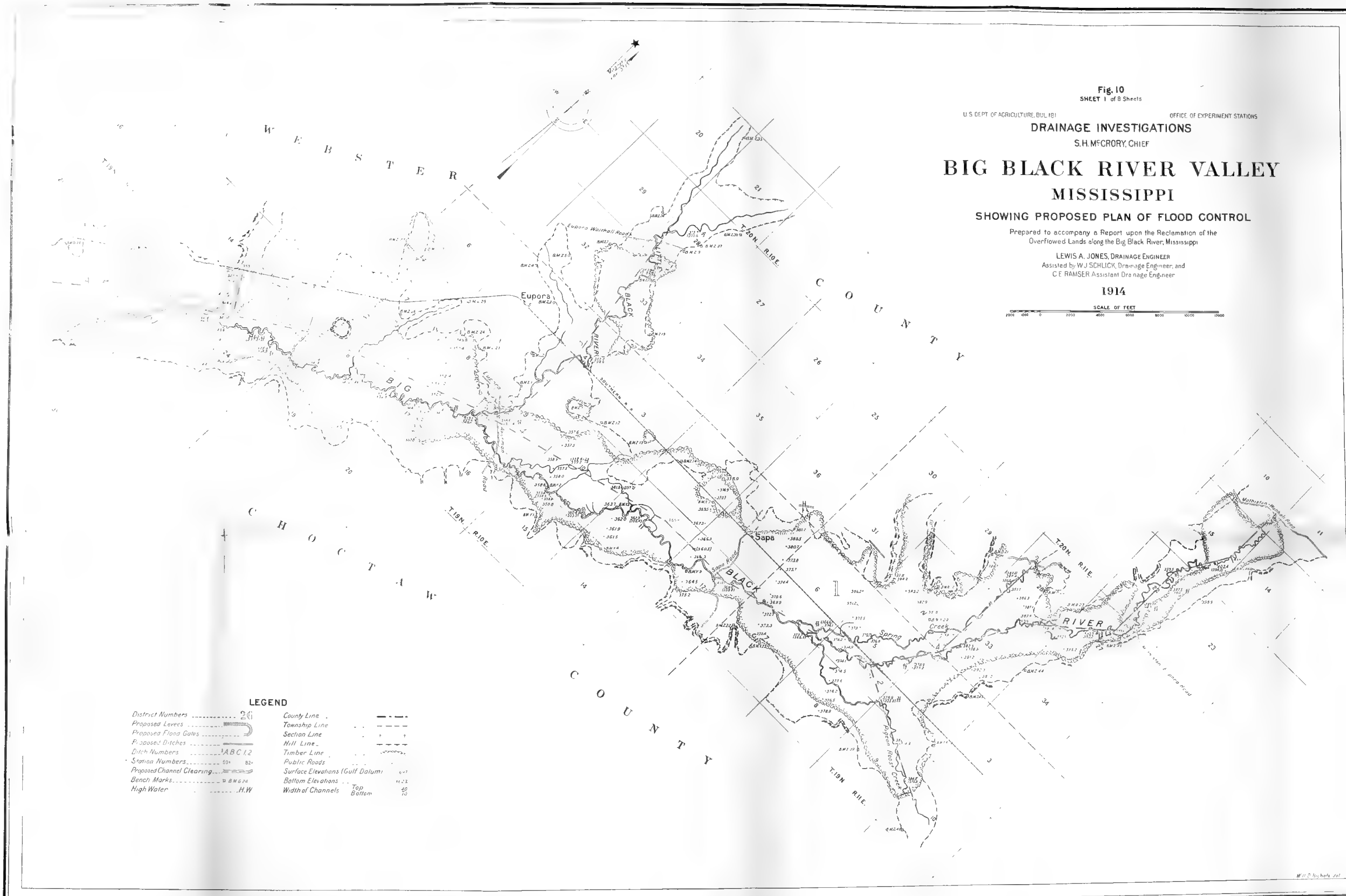
Fig. 10
SHEET 1 of 8 Sheets
U.S. DEPT. OF AGRICULTURE, BUL. 181
OFFICE OF EXPERIMENT STATIONS
DRAINAGE INVESTIGATIONS
S. H. McCRORY, CHIEF
BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL
Prepared to accompany a Report upon the Reclamation of the Overflowed Lands along the Big Black River, Mississippi
LEWIS A. JONES, DRAINAGE ENGINEER
Assisted by W. J. SCHLICK, Drainage Engineer, and
C. E. RAMSER Assistant Drainage Engineer
1914
SCALE OF FEET
WEBSTER
COUNTY
CHOCTAW
COUNTY
Eupora
Sapa
BIG BLACK RIVER
LITTLE BLACK RIVER
Spring Creek
Pigeon Roost Creek
Eupora Walthall Road
Sapa Road
T. 20 N. R. 10 E.
T. 19 N. R. 10 E.
T. 20 N. R. 11 E.
T. 19 N. R. 11 E.
LEGEND
District Numbers 26
Proposed Levees
Proposed Flood Gates
Proposed Ditches
Ditch Numbers A B C 1, 2
Station Numbers
Proposed Channel Clearing
Bench Marks B.M.G.24
High Water H.W.
County Line
Township Line
Section Line
Hill Line
Timber Line
Public Roads
Surface Elevations (Gulf Datum)
Bottom Elevations
Width of Channels Top Bottom

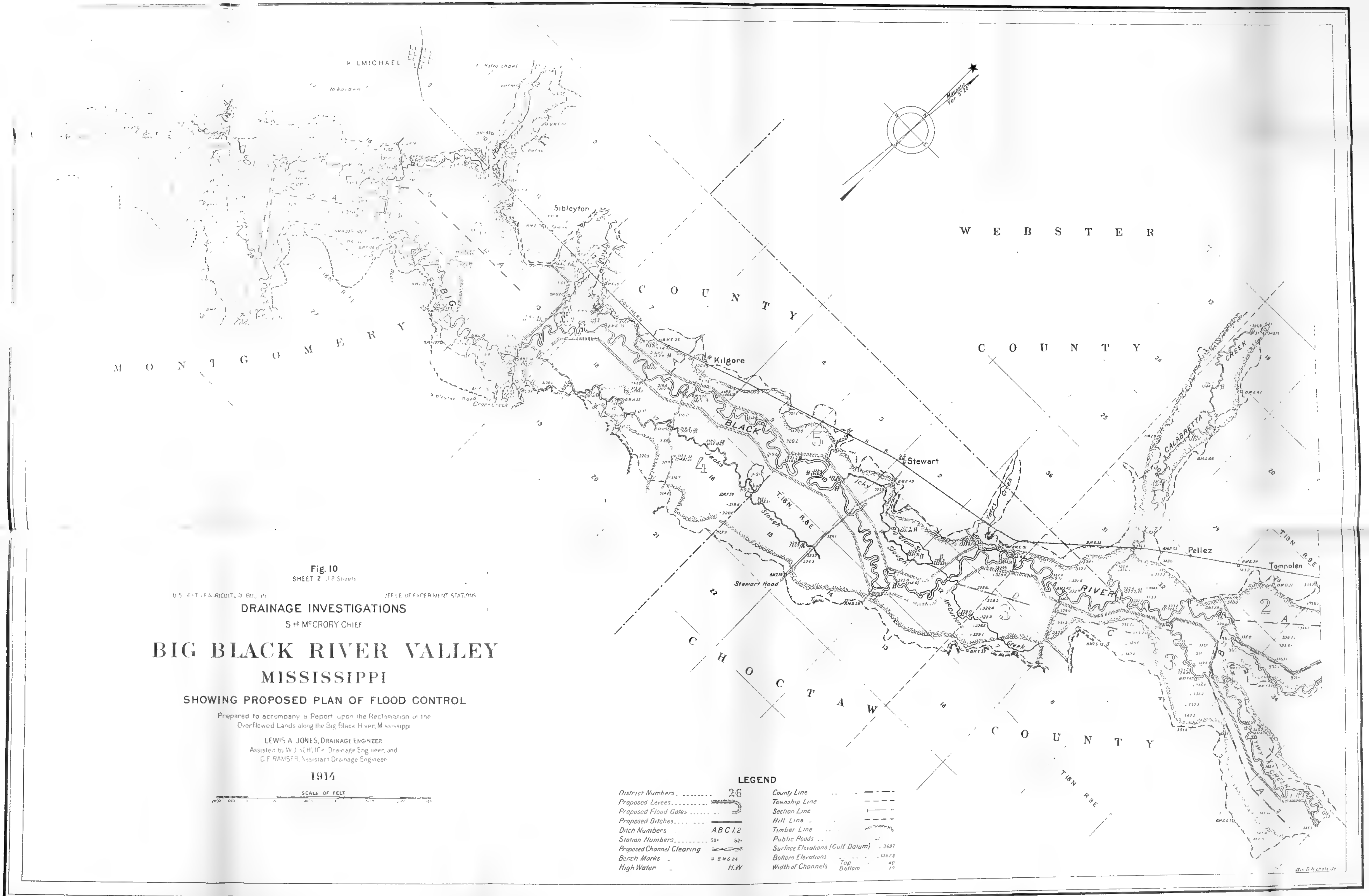
Fig. 10
SHEET 2 of 8 Sheets
DRAINAGE INVESTIGATIONS
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1914
SCALE OF FEET
LEGEND
District Numbers 26
Proposed Levees
Proposed Flood Gates
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Ditch Numbers A B C 1.2
Station Numbers 50+ 82+
Proposed Channel Clearing
Bench Marks B.M.G.24
High Water H.W
County Line
Township Line
Section Line
Hill Line
Timber Line
Public Roads
Surface Elevations (Gulf Datum) 3697
Bottom Elevations
Width of Channels Top 40 Bottom
MONTGOMERY
WEBSTER COUNTY
COUNTY
CHOCTAW COUNTY
Sibleyton
Kilgore
Stewart
Pellez
Tomnolen
BIG BLACK RIVER
Calabretta Creek
Stewart Road
Sibleyton Road
T.18N. R.8E.
T.19N. R.9E.
T.18N. R.9E.

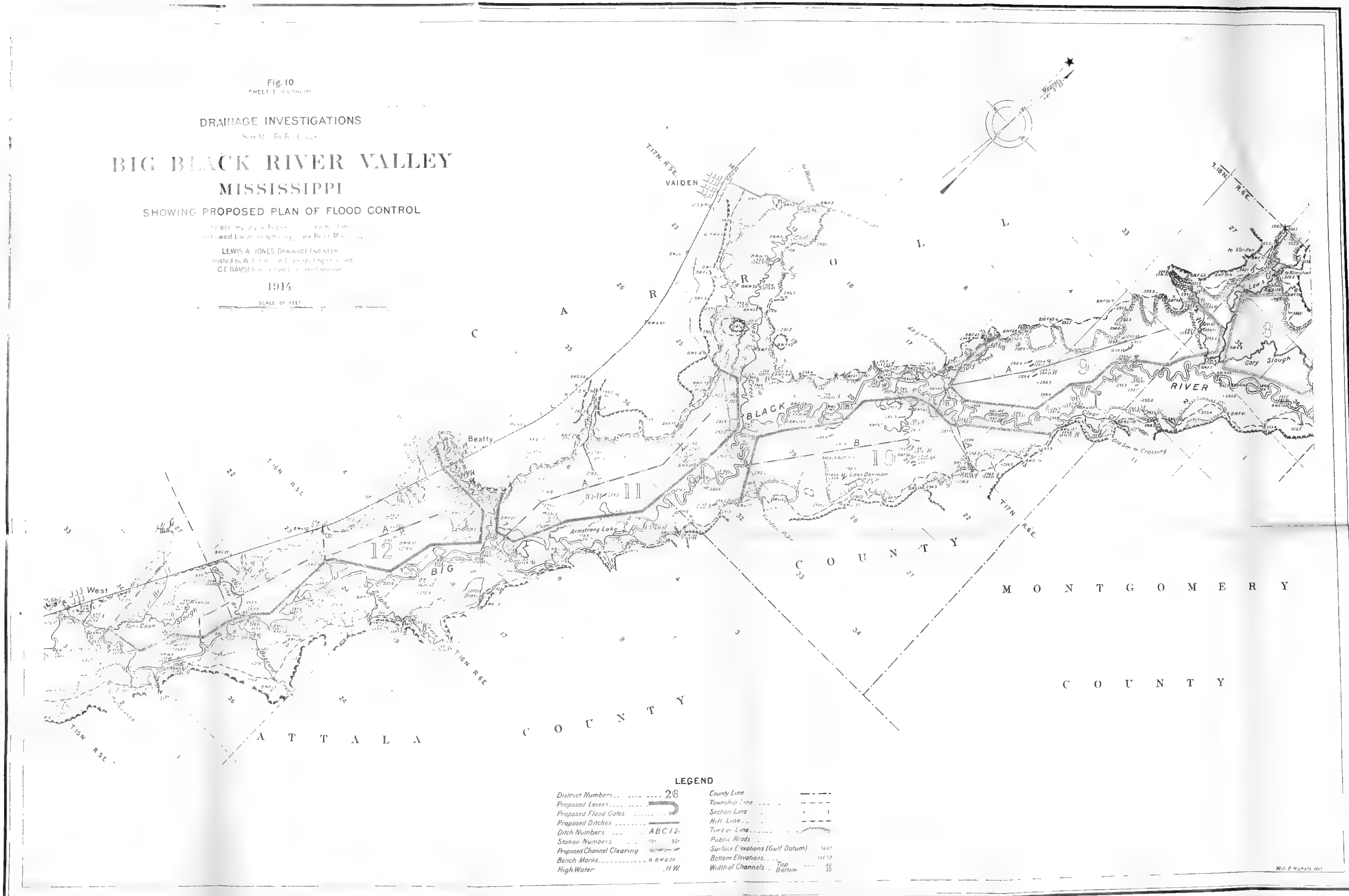

Fig. 10
DRAINAGE INVESTIGATIONS
BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL
LEWIS A. JONES DRAINAGE ENGINEER
C.E. RAMSER
1914
SCALE OF FEET
VAIDEN
Beatty
West
to Winona
to Vaiden
to Kilmichael
Kayes Crossing
Dry Creek
Gary Slough
Clear Cr.
Old Smith Crossing
Lake Denman
Armstrong Lake
Vaiden Pike
Tar-Coon
Slough
Zilpha
BLACK
RIVER
BIG
12
11
10
9
8
T.17N. R.5E.
T.16N. R.5E.
T.16N. R.6E.
T.17N. R.6E.
T.18N. R.6E.
T.15N. R.5E.
CARROLL
COUNTY
MONTGOMERY
COUNTY
ATTALA
COUNTY
LEGEND
District Numbers 26
Proposed Levees
Proposed Flood Gates
Proposed Ditches
Ditch Numbers A B C 1 2
Station Numbers
Proposed Channel Clearing
Bench Marks B.M.624
High Water H.W.
County Line
Township Line
Section Line
Hill Line
Timber Line
Public Roads
Surface Elevations (Gulf Datum)
Bottom Elevations
Width of Channels Top Bottom 40/10

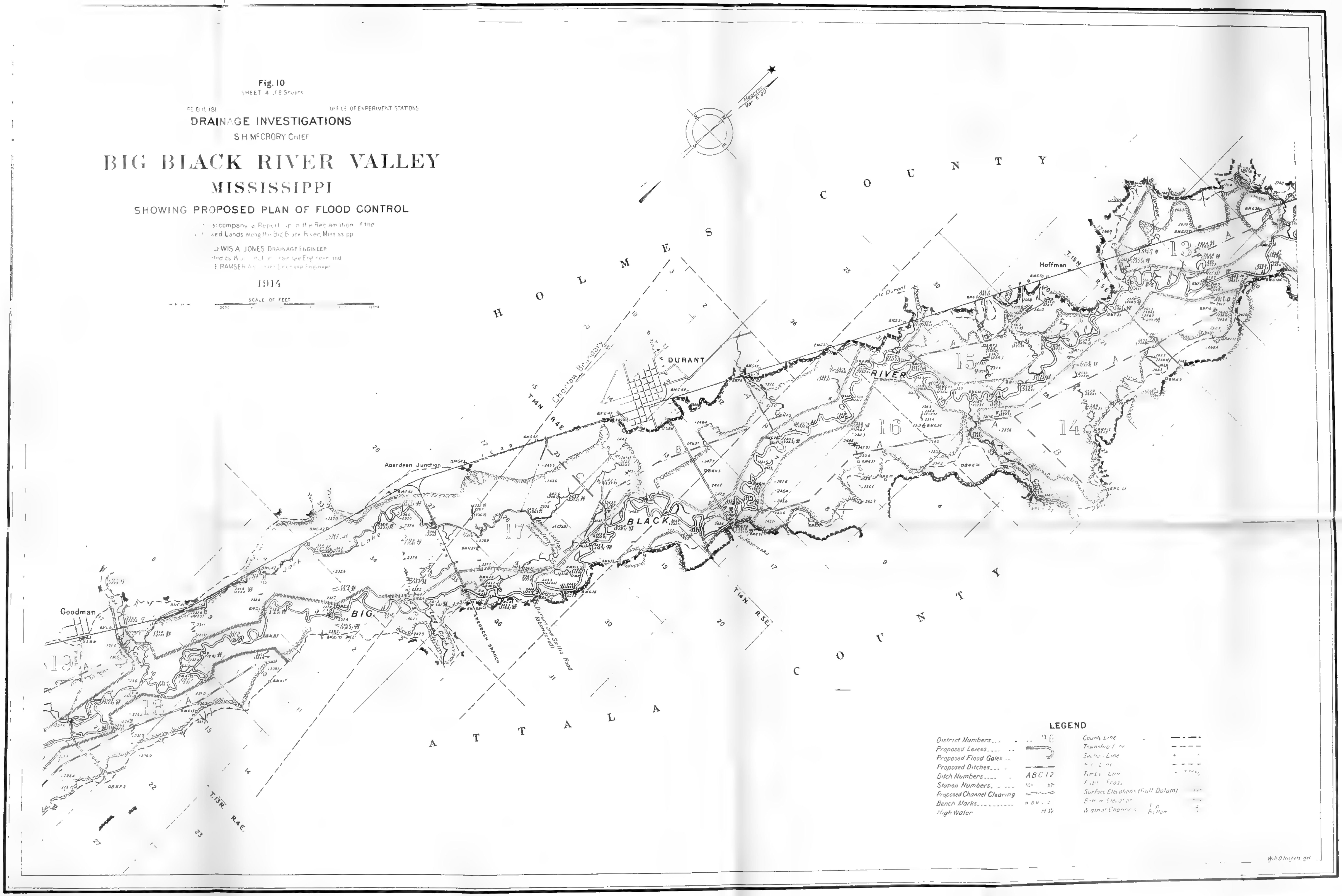

Fig. 10
DRAINAGE INVESTIGATIONS
S H McCRORY CHIEF
OFFICE OF EXPERIMENT STATIONS
BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL
LEWIS A. JONES DRAINAGE ENGINEER
1914
SCALE OF FEET
HOLMES COUNTY
ATTALA COUNTY
DURANT
Goodman
Hoffman
Aberdeen Junction
BIG BLACK RIVER
Jack Lake
Choctaw Boundary
ABERDEEN BRANCH
Durant and Sallis Road
to Durant
to Kosciusko
T.14N. R.4E.
T.14N. R.5E.
T.13N. R.4E.
T.15N. R.5E.
Magnetic Var 6°00'
LEGEND
District Numbers
Proposed Levees
Proposed Flood Gates
Proposed Ditches
Ditch Numbers
Station Numbers
Proposed Channel Clearing
Bench Marks
High Water
County Line
Township Line
Section Line
Surface Elevations (Gulf Datum)

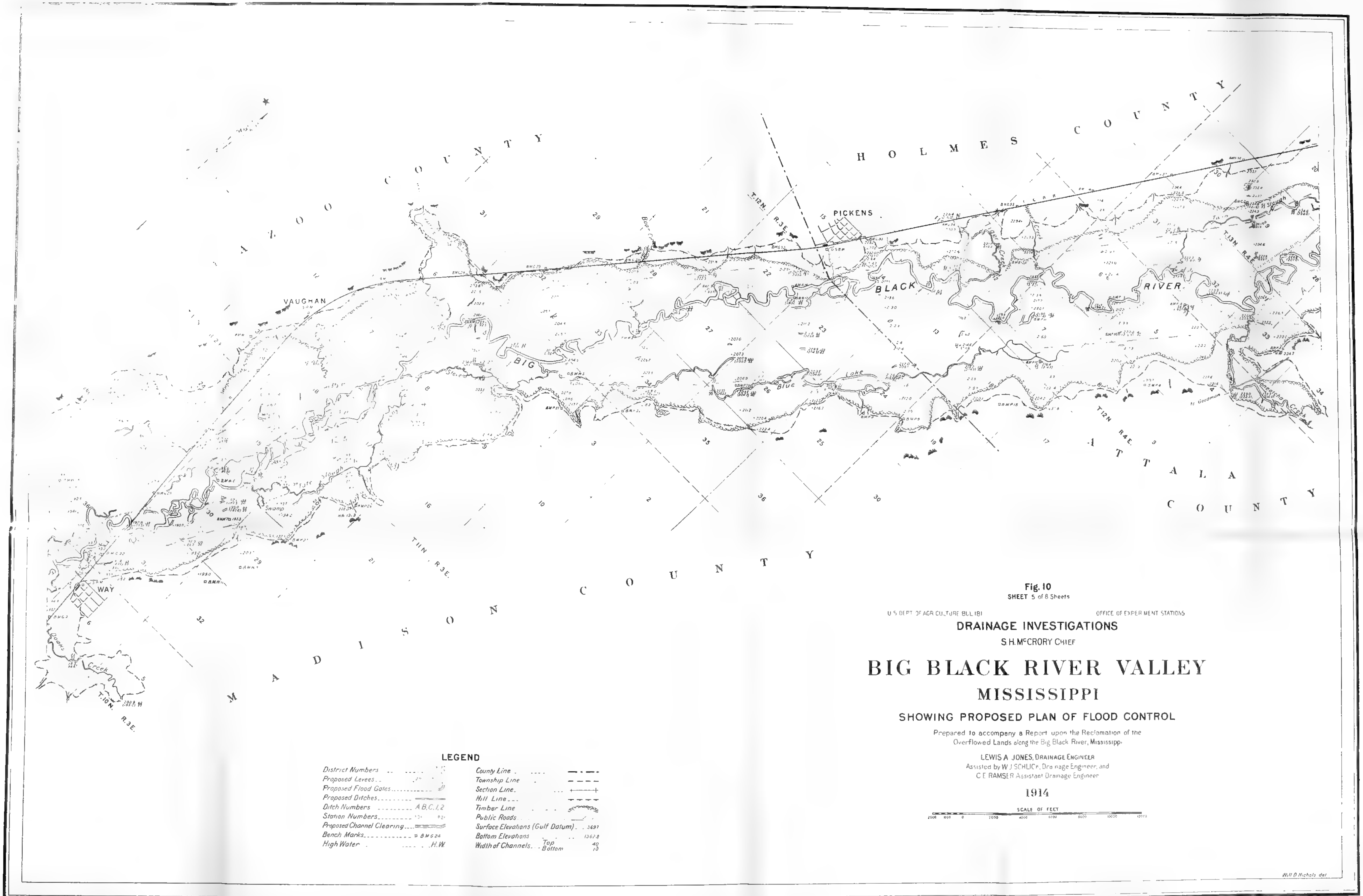

Fig. 10
SHEET 5 of 8 Sheets

U.S. DEPT. OF AGRICULTURE BUL. 181 OFFICE OF EXPERIMENT STATIONS

DRAINAGE INVESTIGATIONS
S. H. McCRORY CHIEF

BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL

Prepared to accompany a Report upon the Reclamation of the Overflowed Lands along the Big Black River, Mississippi

LEWIS A. JONES, DRAINAGE ENGINEER
Assisted by W. J. SCHLICK, Drainage Engineer, and
C. E. RAMSER Assistant Drainage Engineer

1914

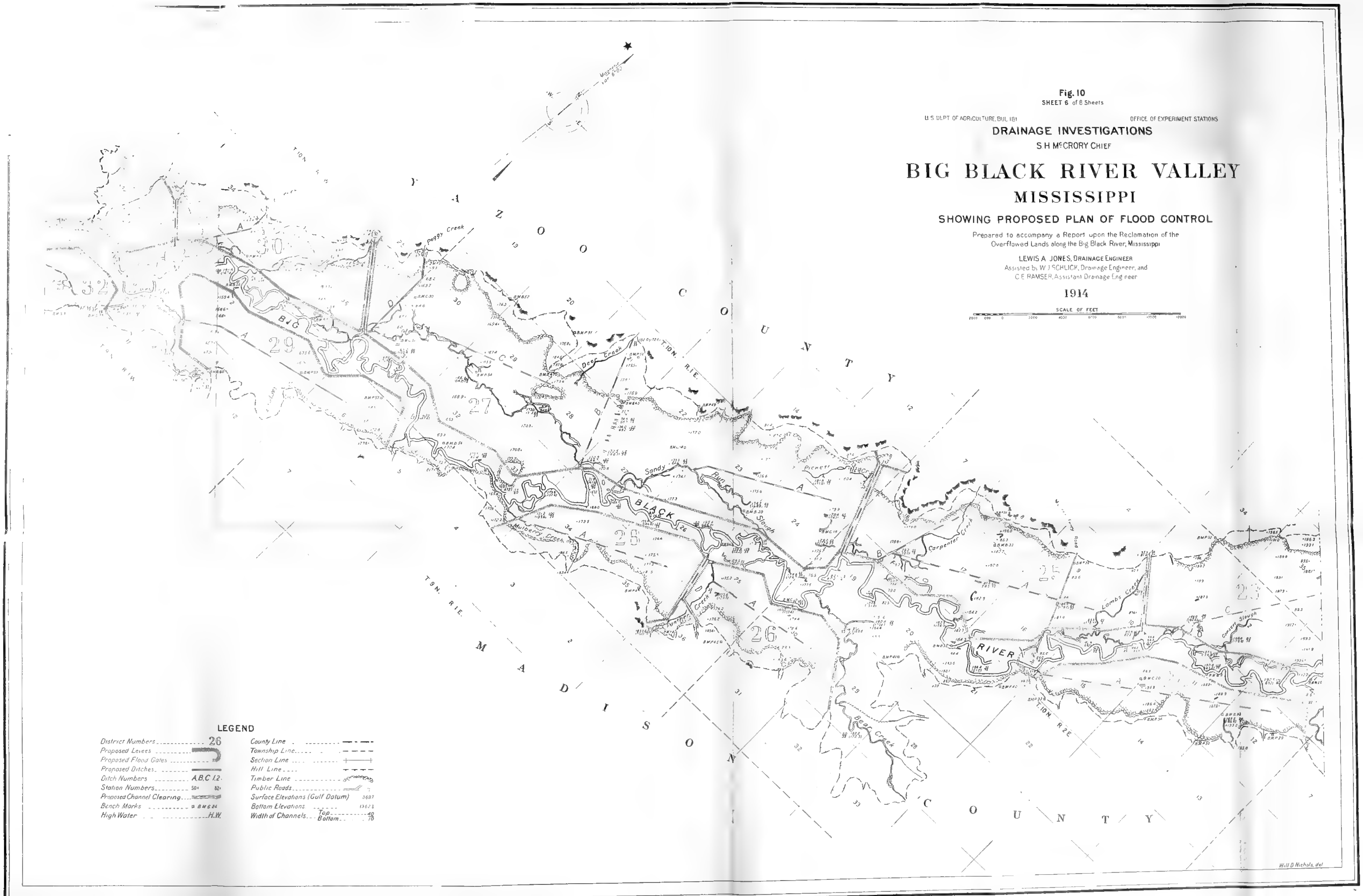

Fig. 10
SHEET 6 of 8 Sheets
U.S. DEPT OF AGRICULTURE, BUL 181
OFFICE OF EXPERIMENT STATIONS
DRAINAGE INVESTIGATIONS
S.H. McCRORY CHIEF
BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL
Prepared to accompany a Report upon the Reclamation of the Overflowed Lands along the Big Black River, Mississippi
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Assisted by W. J. SCHLICK, Drainage Engineer, and
C. E. RAMSER, Assistant Drainage Engineer
1914
SCALE OF FEET
YAZOO COUNTY
MADISON COUNTY
BIG BLACK RIVER
Peggy Creek
Deer Creek
Sandy Run
Mulberry Creek
Picnett Cr.
Carpenter Creek
Lambs Creek
Bear Creek
LEGEND
District Numbers 26
Proposed Levees
Proposed Flood Gates
Proposed Ditches
Ditch Numbers A,B,C 1.2
Station Numbers 50+ 82+
Proposed Channel Clearing
Bench Marks B.M.6.24
High Water H.W.
County Line
Township Line
Section Line
Hill Line
Timber Line
Public Roads
Surface Elevations (Gulf Datum)
Bottom Elevations
Width of Channels Top 40 Bottom 10
Will D. Nichols, del.

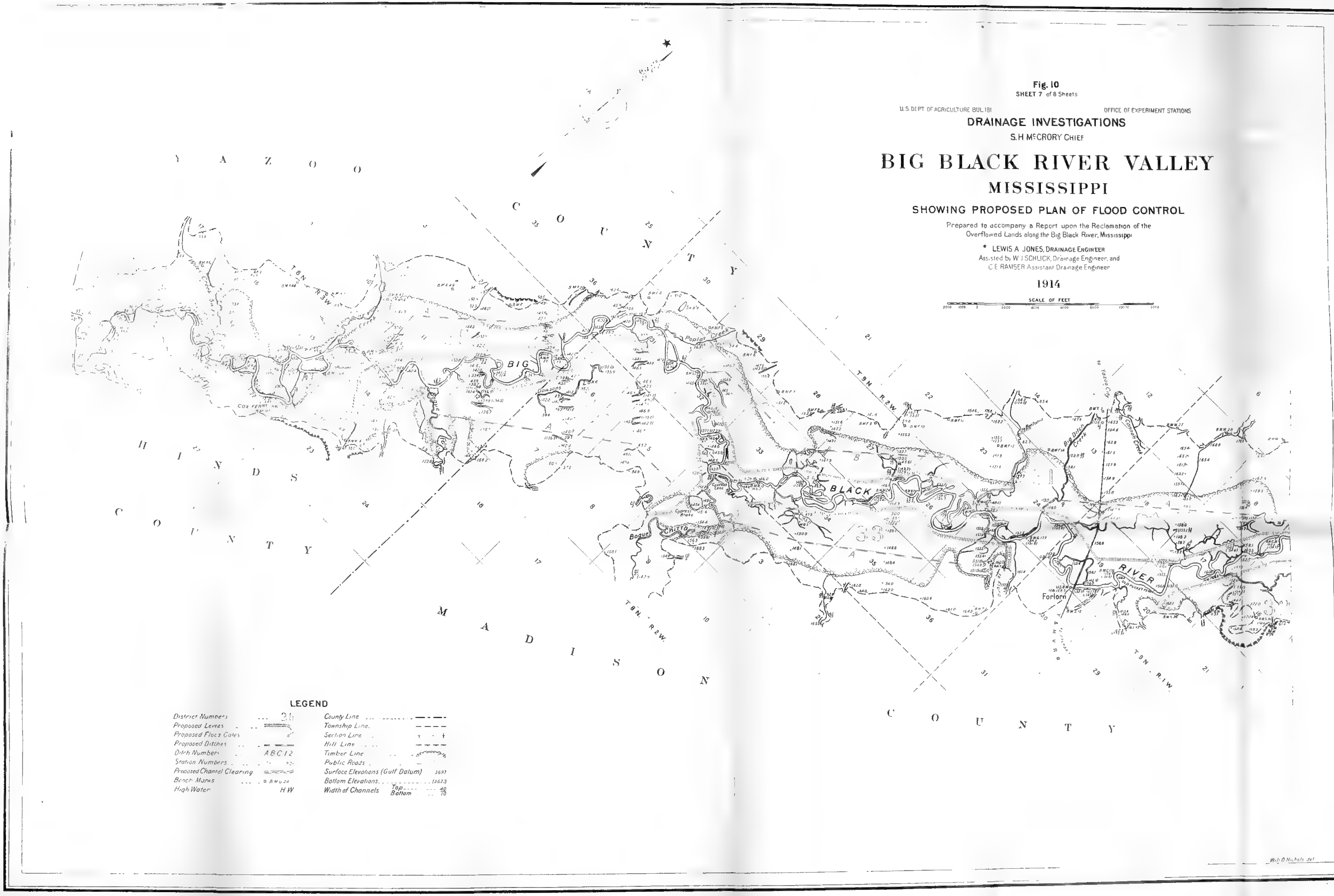

Fig. 10
SHEET 7 of 8 Sheets
U.S. DEPT OF AGRICULTURE BUL. 181
OFFICE OF EXPERIMENT STATIONS
DRAINAGE INVESTIGATIONS
S. H. McCRORY CHIEF
BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL
Prepared to accompany a Report upon the Reclamation of the Overflowed Lands along the Big Black River, Mississippi
LEWIS A. JONES, DRAINAGE ENGINEER
Assisted by W. J. SCHLICK, Drainage Engineer, and C. E. RAMSER Assistant Drainage Engineer
1914
SCALE OF FEET
YAZOO COUNTY
HINDS COUNTY
MADISON COUNTY
BIG BLACK RIVER
Bogue Chitto
Poplar Creek
Big Ditch Creek
Forlorn
T8N R3W
T9N R2W
T8N R2W
T9N R1W
LEGEND
District Numbers
Proposed Levees
Proposed Flood Gates
Proposed Ditches
Ditch Numbers ABC12
Station Numbers
Proposed Channel Clearing
Bench Marks
High Water HW
County Line
Township Line
Section Line
Hill Line
Timber Line
Public Roads
Surface Elevations (Gulf Datum)
Bottom Elevations
Width of Channels Top Bottom

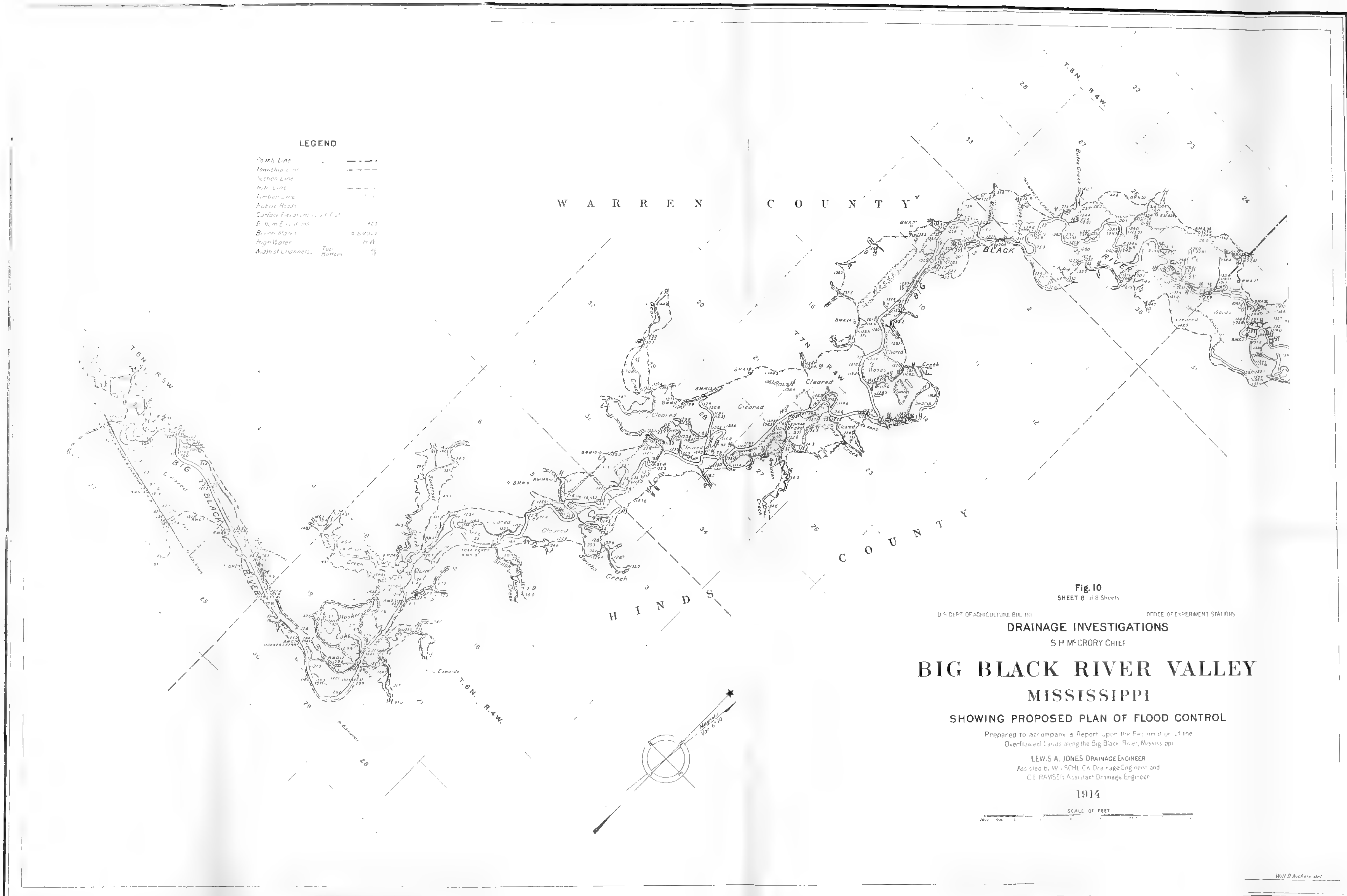

Fig. 10
SHEET 8 of 8 Sheets

U S DEPT OF AGRICULTURE BUL 181 — OFFICE OF EXPERIMENT STATIONS

DRAINAGE INVESTIGATIONS

S H McCRORY CHIEF

BIG BLACK RIVER VALLEY
MISSISSIPPI
SHOWING PROPOSED PLAN OF FLOOD CONTROL

Prepared to accompany a Report upon the Reclamation of the Overflowed Lands along the Big Black River, Mississippi

LEWIS A. JONES DRAINAGE ENGINEER
Assisted by W. . SCHL CK Drainage Engineer and
C E RAMSER Assistant Drainage Engineer

1914

SCALE OF FEET

Fig. 11

… OF AGRICULTURE BUL. 181 — OFFICE OF EXPERIMENT STATIONS

DRAINAGE INVESTIGATIONS

S. H. McCRORY CHIEF

BIG BLACK RIVER VALLEY

MISSISSIPPI

SHOWING PROPOSED PLAN OF FLOOD CONTROL

Prepared to accompany a Report upon the Reclamation of the Overflowed Lands along the Big Black River, Mississippi

LEWIS A. JONES, Drainage Engineer
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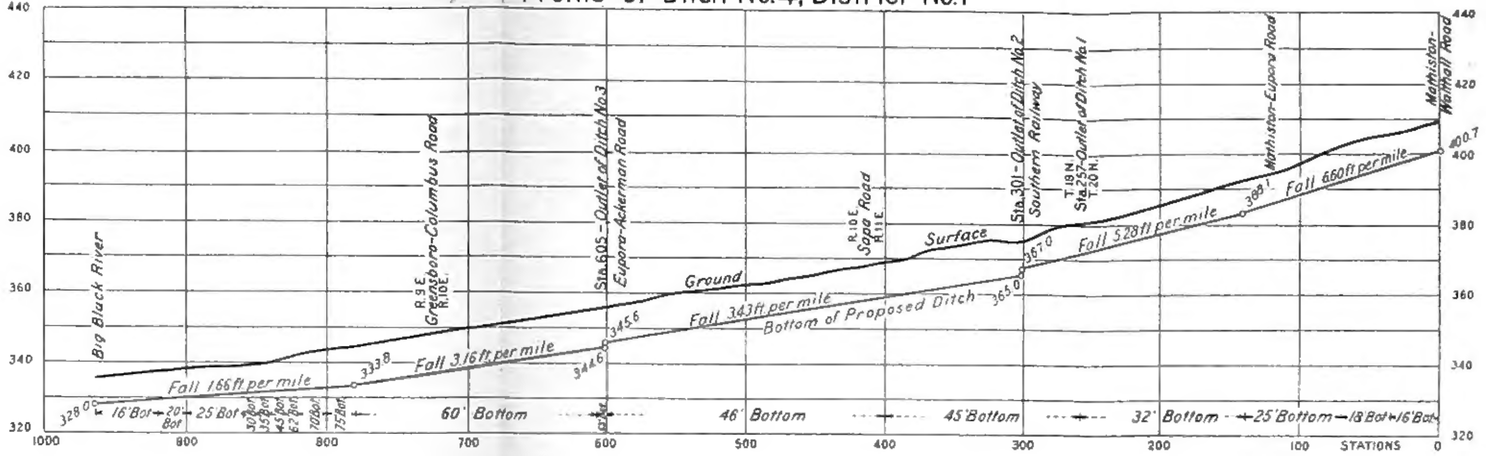
C. E. RAMSER, Assistant Drainage Engineer

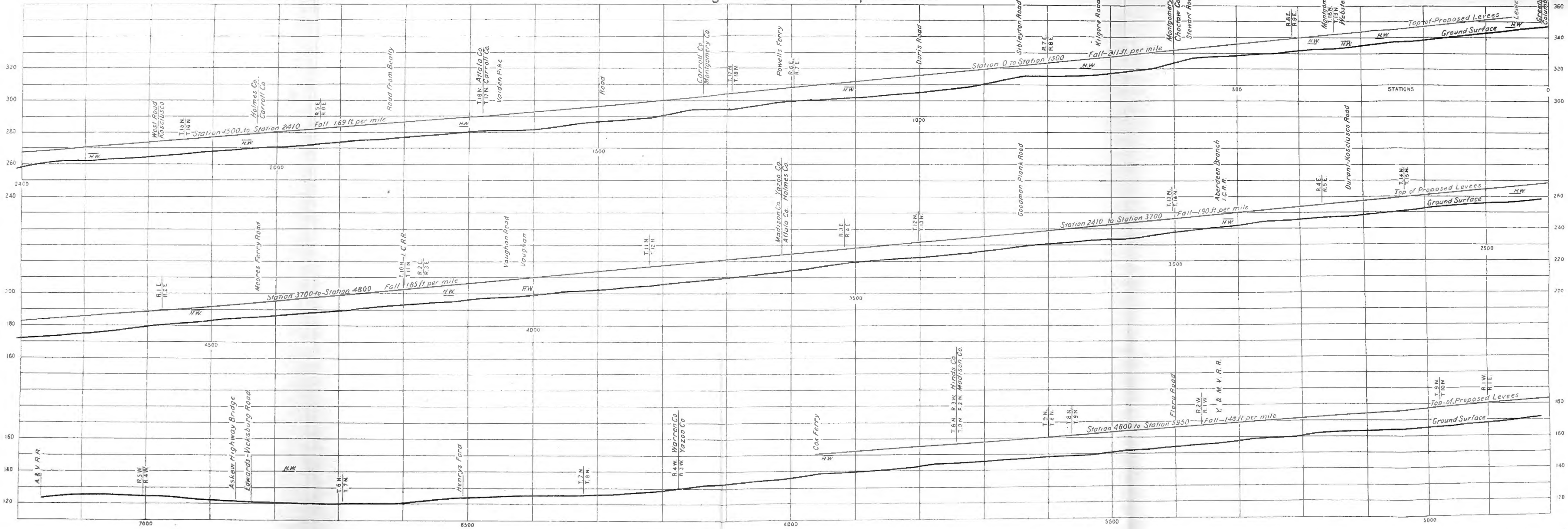
1914

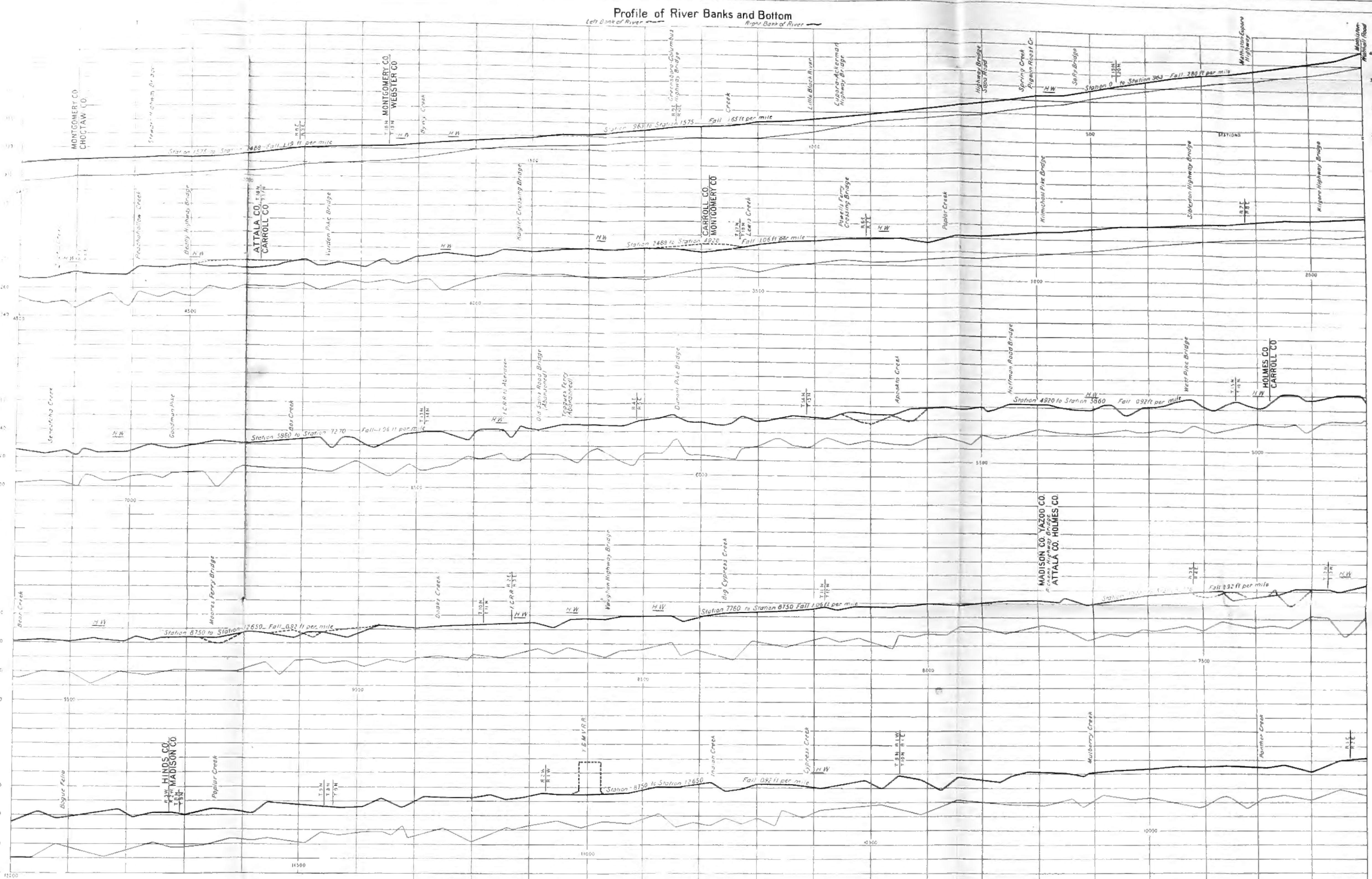
Elevations refer to Gulf Datum

Profile of Ditch No. 4, District No. 1



Profile along General Course of Proposed Levees





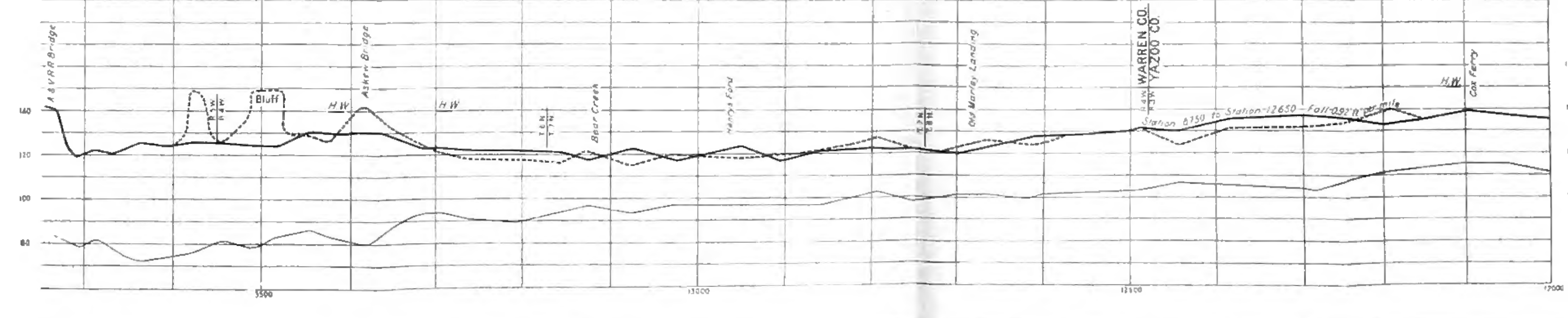


Fig. 12

U.S. DEPT OF AGRICULTURE BUL. 181 OFFICE OF EXPERIMENT STATIONS

DRAINAGE INVESTIGATIONS

S. H. McCRORY CHIEF

BIG BLACK RIVER VALLEY

MISSISSIPPI

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Elevations refer to Gulf Datum