DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, OKATOMA CREEK NEAR MAGEE, MISSISSIPPI

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Prepared in cooperation with the
DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
and the
MISSISSIPPI STATE HIGHWAY DEPARTMENT

HYDROLOGIC INVESTIGATIONS ATLAS
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FLOOD-FLOW DATA OKATOMA CREEK NEAR MAGEE, MISSISSIPPI

INTRODUCTION

New techniques for predicting water-surface profiles, needed in the design of economical, structurally sound, and environmentally compatible stream crossings, are under investigation. The investigation has accelerated with the advent of digital computers capable of analyzing large quantities of data. Among the techniques is the development of two-dimensional (2-D) digital models. Field data are essential for development and evaluation of these techniques for predicting water-surface profiles. This atlas is one of a series that will provide a wide range of field data.

Since 1969 the U.S. Geological Survey has been collecting backwater data where wide, densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This work was done in cooperation with the Federal Highway Administration Department of Transportation, the Alabama State Highway Department, the Louisiana Department of Transportation and Development, and the Mississippi State Highway Department. The objective of this cooperative project is to present the data in a format conducive to the development of improved models for predicting hydraulic responses of flow at highway crossings of streams in complex hydrologic and geographic settings.

Data were collected at the following 22 sites (fig. 1) for 35 floods; that is, 11 sites had 1 flood each; 9 sites, 2 floods each; and 2 sites, 3 floods each. Analysis of the data (Schneider and others, 1976) showed that backwater and discharge at these sites computed by methods presently in use, would be inaccurate. The floodflow data are unique in the range and detail in which information was collected and provide a base for evaluating digital models relating to open-channel flow. This atlas shows flood data obtained on Okatoma Creek near Magee, Miss., one of 22 sites plotted in figure 1:

HYDROLOGIC INVESTIGATIONS ATLAS NUMBER

ALABAMA
- Buckhorn Creek near Shiloh HA-607*
- Pea Creek near Louisville 608*
- Poley Creek near Sanford 609*
- Yellow River near Sanford 610*
- Whitewater Creek near Tarentum 611*

LOUISIANA
- Alexander Creek near St. Francisville HA-600*
- Beaver Creek near Kentwood 601*
- Comite River near Olive Branch 602
- Cypress Creek near Downsville 603*
- Flagon Bayou near Libuse 604*
- Little Bayou de Loutre near Truxno 605*
- Tenmile Creek near Elizabeth 606*

MISSISSIPPI
- Bogue Chitto near Johnston Station HA-591*
- Bogue Chitto near Summit 592*
- Coldwater River near Red Banks 593*
- Lobutcha Creek at Zama 594*
- Okatoma Creek east of Magee 595
- Okatoma Creek near Magee 596
- Tallahala Creek at Waldrup 590
- Thompson Creek near Clara 597*
- West Fork Amite River near Liberty 598*
- Yockanookany River near Thomastown 599*

* In press

DESCRIPTION OF DATA
TYPE OF DATA

Data collected at all study sites consist of (1) depths, velocities, and discharges measured through the bridge openings, and (2) peak water-surface elevations along the highway embankment and along cross sections. A minimum of eight valley cross sections were surveyed at approximately one valley-width intervals in the vicinity of the bridge at each site. Locations of the cross sections were alined perpendicularly to the assumed direction of flow. Cross sections were extended to intersect the edge of the valley at equal water-surface elevations. Surveying procedures described in the U.S. Geological Survey Techniques of Water-Resources Investigations series (Matthai, 1967; Benson and Dalrymple, 1967) were followed.

HIGH-WATER MARKS

Water-surface elevations were determined from high-water marks identified along the cross sections and the edges of the valley after each flood. During peak discharge measurements, water-surface elevations were marked with standard surveying stakes along the upstream and downstream sides of the highway embankment. For some floods additional high-water marks were identified in the valley adjacent to the bridge to define in detail the water surface in the approach and exit reaches.

BRIDGE GEOMETRY

Detailed bridge geometry was obtained at each site. The bridge cross section was surveyed at the most contracted section. Piers, spur dikes, wingwalls, abutment slopes, and other pertinent geometry were measured.

MANNING'S ROUGHNESS COEFFICIENT

Schneider and others (1976) used composite Manning's roughness coefficient values (n) where frequent changes in roughness occurred. In their study, composite values of (n) were verified by matching step backwater computations of the water surface with actual water-surface profiles for measured discharges. The range of (n) values used in this report is based on values used by Schneider and others (1976). Roughness varies from open fields to dense forests.

Roughness values or ranges of roughness values in different parts of the flood plain are shown on the maps. The values shown are based on water depth. The high value is value where depth is less than 0.6 meter and the low value applies where water depth is greater than 1.0 meter. A linear relation of roughness to water depth is assumed for water depths between 0.6 and 1.0 meter.

PRESENTATION OF DATA

The data are presented on topographic maps enlarged from standard 1:24,000 (or 1:62,500) scale Geological Survey topographic maps which comply with National Map Accuracy Standards. Accuracy limitations of the base maps are retained in the enlargements. Although positions may be scaled closely on the enlargements, they are not defined with greater accuracy than positions on the base maps.

Ground elevations are placed adjacent to solid squares. Elevations of floodmarks are indicated by numerical values adjacent to solid triangles. Floodmark elevations for separate floods are shown on separate sheets. Bridge geometry and road-embankment dimensions are shown with brief notations of pier spacing and configuration.

In addition to the data points shown on the maps, discharge measurements of selected floods, plots of cross sections, and velocity-distribution diagrams are shown. Cross-section elevations are tabulated to define stream channels and flood-plain features in greater detail. Each cross section is referred to a zero station established at the extreme left edge (facing downstream) of the valley.

DATUM

All elevations presented in this report are referred to National Geodetic Vertical Datum of 1929 (NGVD).

FLOOD FREQUENCY

Flood-frequency relations are presented graphically. Techniques for deriving flood-frequency relations are those described by the U.S. Water Resources Council (1977), and by Colson and Hudson (1976).

INTERNATIONAL SYSTEM OF UNITS (SI)

The International System of Units (SI) is used throughout this report. All data were measured in the U.S. customary units and converted to SI units. Ground elevations which were originally determined to the nearest tenth of a foot are rounded to the nearest 0.01 meter. Water-surface elevations which were surveyed to hundredths of a foot are rounded to millimeters. The same criteria apply to all other dimensions, except contour elevations which are shown to the nearest tenth of a meter.

The following factors may be used to convert SI units to the U.S. customary units:

MULTIPLY SI UNITS	*BY*	*TO OBTAIN U.S. CUSTOMARY UNITS*
	LENGTH	
Meter (m)	3.281	Feet (ft)
	AREA	
Square meter (m^2)	10.76	Square feet (ft^2)
	VOLUME	
Cubic meter (m^3)	35.31	Cubic feet (ft^3)
	VELOCITY	
Meter per second (m/s)	3.281	Feet per second (ft/s)
	FLOW RATE	
Cubic meter per second (m^3/s)	35.31	Cubic feet per second (ft^3/s)

DATA FOR OKATOMA CREEK NEAR MAGEE, MISSISSIPPI

Data for Okatoma Creek near Magee, Miss. obtained in a 3-kilometer reach crossed about midway by State Highway 28, are presented on three sheets (fig. 2). Sheet 1 contains tables showing cross-section data (table 1) and discharge data (table 2). An aerial view across the channel upstream from the bridge is shown in figure 3. Relative magnitude of the flood is shown on the frequency curve (fig. 4).

The locations of representative ground elevations are shown on sheet 2. These points of significant changes in cross-section elevations or alinement of the axis. Plots of the cross sections are graphic presentations of the tabular data.

Bridge geometry and road embankments are shown on sheet 2 as they existed at the time of the floods. The cross section surveyed at the downstream side of the bridge is tabulated on sheet 1. The cross section shown for velocity distribution was obtained by sounding from the upstream side of the bridge during the discharge measurement.

Data for the flood of April 12, 1974 on Okatoma Creek are presented. Nine valley-cross sections were surveyed after this flood (sheet 2).

Manning's roughness coefficient values and the 1974 flood boundaries are shown on sheets 2 and 3.

FLOOD OF APRIL 12, 1974

Peak water-surface elevations, measured cross section, and velocities for the flood of April 12, 1974, are shown on sheet 3. The flood crested at an elevation of 111.350 meters at the reference point located on the downstream guardrail of the bridge. A peak discharge of 456 m^3/s was measured on the recession at an elevation of 111.270 meters at the reference point (table 2). The recurrence interval of the peak discharge is greater than 100 years (Colson and Hudson, 1976, fig. 4).

SUMMARY

Floodflow data that will provide a base for evaluating digital models relating to open-channel flow were obtained at 22 sites on streams in Alabama, Louisiana, and Mississippi. Thirty-five floods were measured. Analysis of the data indicated that backwater and discharges computed by standard indirect methods currently in use would be inaccurate where densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This atlas presents flood information at the site on Okatoma Creek near Magee, Miss. Water depths, velocities, and discharges through bridge openings on Okatoma Creek near Magee, Miss. for flood of April 12, 1974, were measured, together with peak water-surface elevations along embankments and along cross sections. Manning's roughness coefficient values in different parts of the flood plain are shown on maps, and flood-frequency relations are shown on graphs.

ADDITIONAL INFORMATION

Other information pertaining to floods in Alabama, Louisiana, and Mississippi may be obtained at the offices of the U.S. Geological Survey listed below:

U.S. Geological Survey
Room 202, Oil and Gas Board Building (P.O. Box V)
University, Alabama 35486

U.S. Geological Survey
6554 Florida Boulevard (P.O. Box 66492)
Baton Rouge, Louisiana 70896

U.S. Geological Survey
430 Bounds Street
Jackson, Mississippi 39206

SELECTED REFERENCES

Barnes, H. H., Jr., 1967, Roughness characteristics of natural channels: U.S. Geol. Survey Water Supply Paper 1849, 213 p.

Benson, M. A., and Dalrymple, T., 1967, General field and office procedures for indirect discharge measurements: U.S. Geological Survey Techniques Water-Resources Inv., book 3, chap. A1, 30 p.

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Hains, C. F., 1973, Floods in Alabama, magnitude and frequency: Alabama Highway Dept., 37 p.

Hedman, E. R., 1964, Effects of spur dikes on flow through constrictions: Am. Soc. Civil Engineers Proc., Jour. Hydraulics Div., v. 91, no. HY4, July 1965, p. 155–165.

Matthai, H. F., 1967, Measurement of peak discharge at width contractions by indirect methods: U.S. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A4, 44 p.

Neely, B. L., Jr., 1976, Floods in Louisiana, magnitude and frequency, 3d ed.: Louisiana Dept. Highways, 340 p.

Schneider, V. R., Board, J. W., Colson, B. E., Lee, F. N., and Druffel, L., 1976, Computation of backwater and discharge at width constrictions of heavily vegetated flood plains: U.S. Geol. Survey Water-Resources Inv. 76–129, 64 p.

U.S. Water Resources Council, 1977, Guidelines for determining flood flow frequency: Washington, D.C., U.S. Water Resources Council Bull. 17A, 163 p.

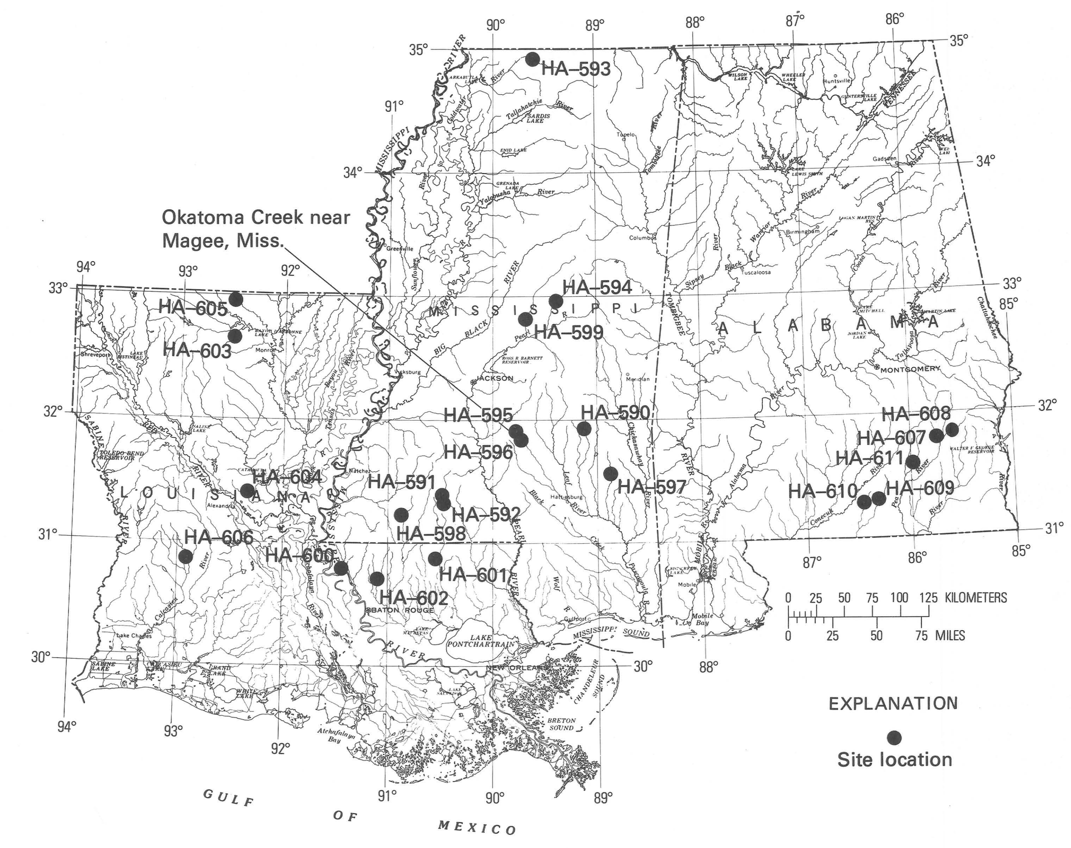

FIGURE 1.—INDEX MAP OF STUDY SITES IN THE BRIDGE BACKWATER INVESTIGATION PROJECT, ALABAMA, LOUISIANA, AND MISSISSIPPI.

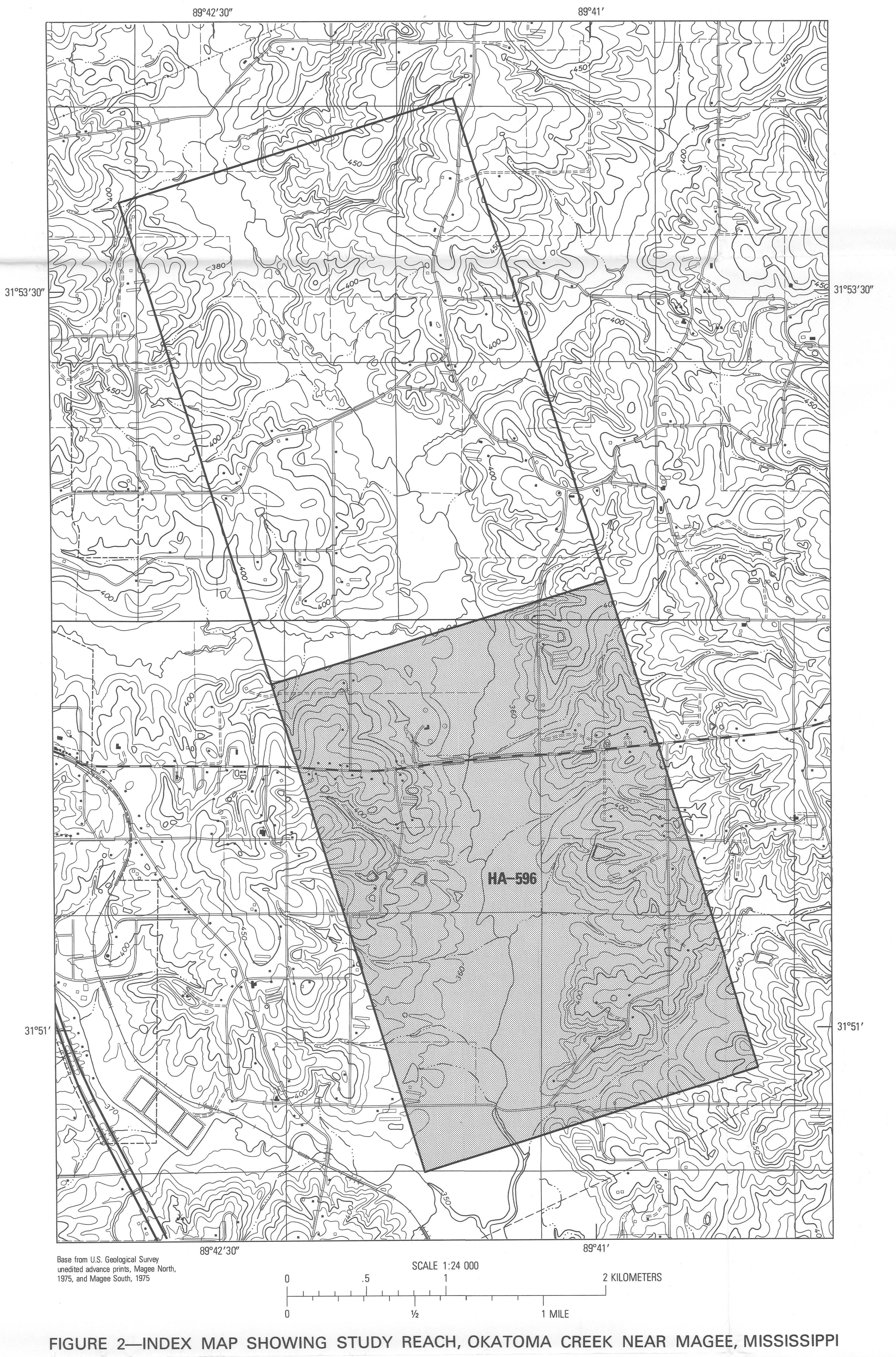

FIGURE 2—INDEX MAP SHOWING STUDY REACH, OKATOMA CREEK NEAR MAGEE, MISSISSIPPI

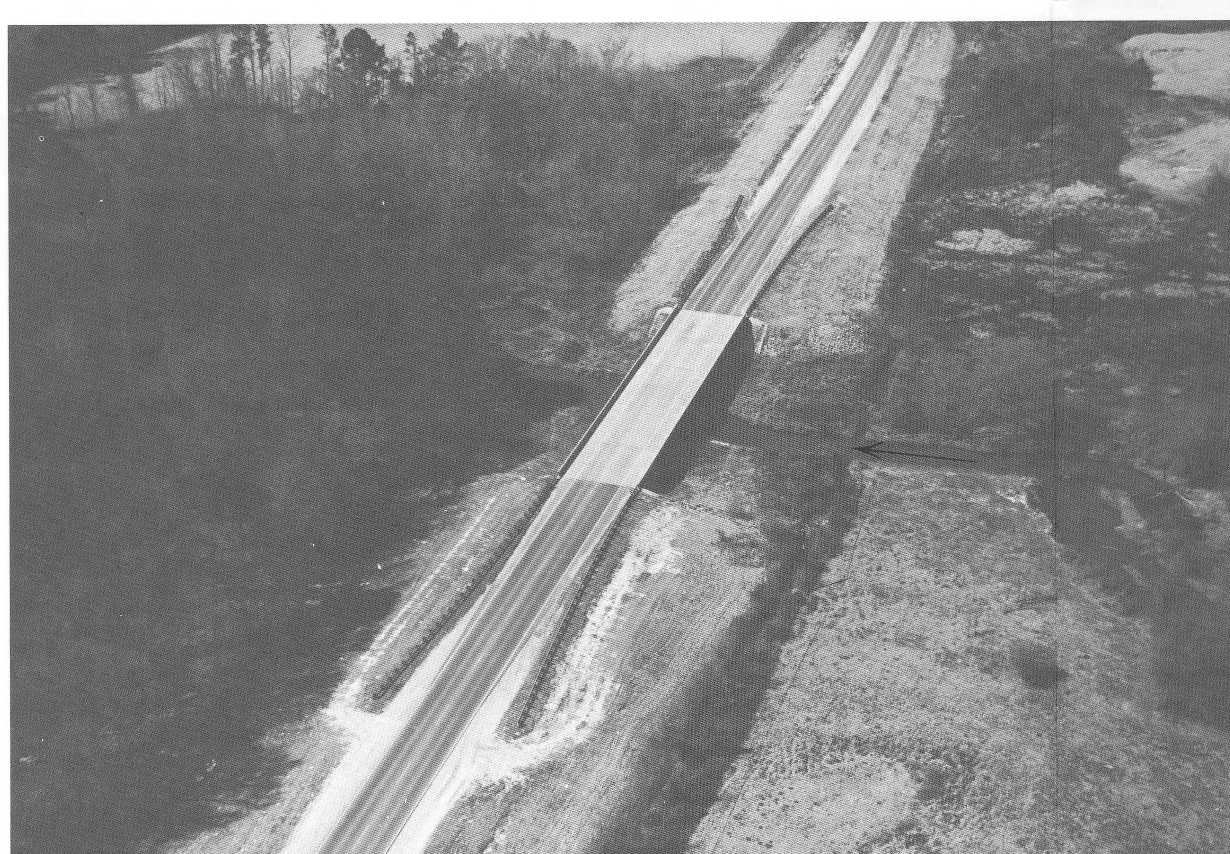

FIGURE 3—AERIAL VIEW LOOKING ACROSS CHANNEL UPSTREAM FROM BRIDGE ON STATE HIGHWAY 28 NEAR MAGEE, MISSISSIPPI

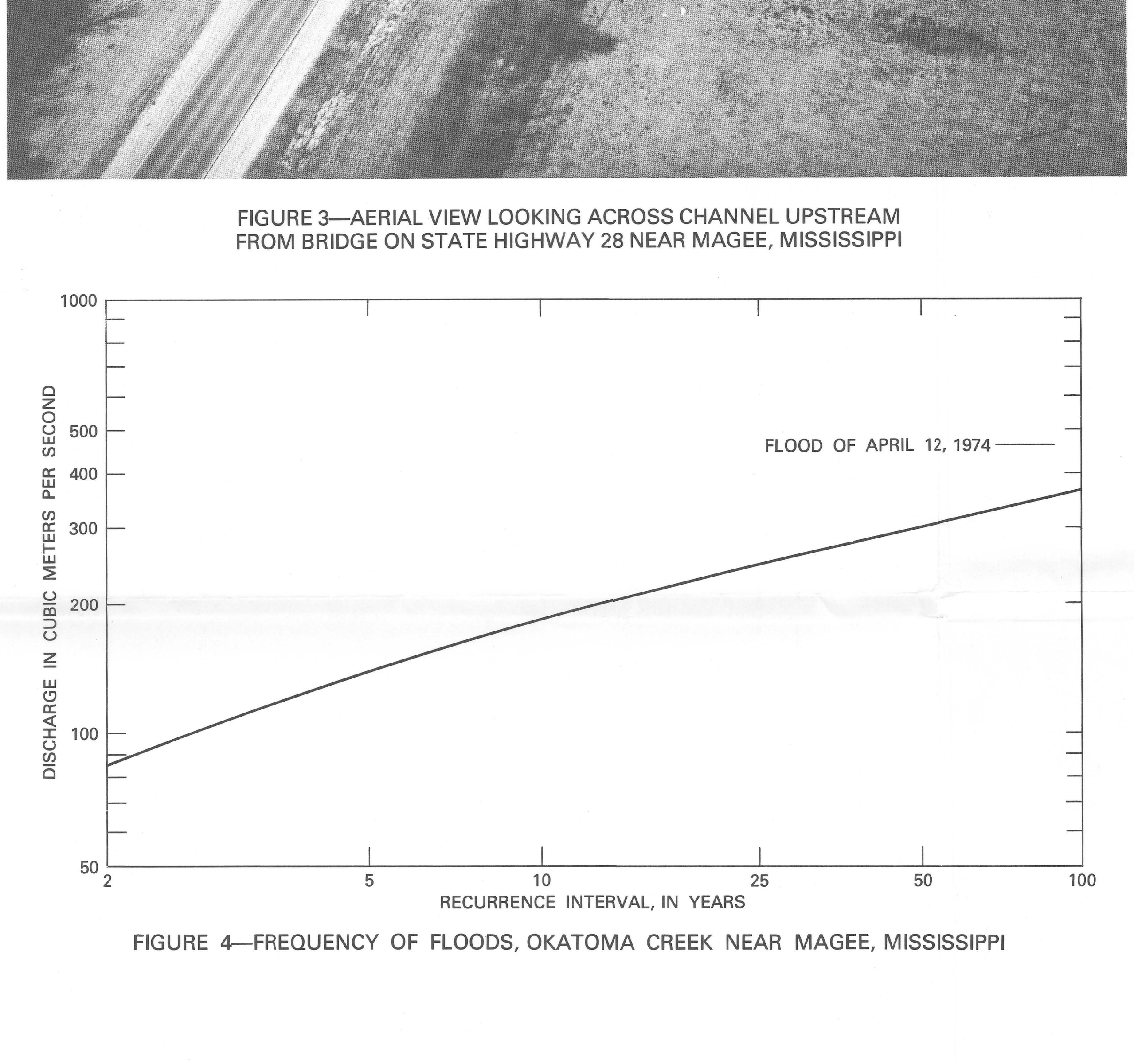

FIGURE 4—FREQUENCY OF FLOODS, OKATOMA CREEK NEAR MAGEE, MISSISSIPPI

TABLE 1—VALLEY CROSS SECTION DATA FOR OKATOMA CREEK NEAR MAGEE, MISSISSIPPI. ZERO STATION IS AT THE LEFT EDGE OF THE VALLEY (FACING DOWNSTREAM).

CROSS SECTION 1

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	108.75
35	107.41
62	107.29
94	106.98
117	106.83
143	106.53
147	106.25
158	106.41
205	106.83
217	104.88
217	105.58
219	106.71
237	106.77
243	105.95
250	106.50
262	106.92
279	106.89
300	106.83
340	106.80
397	107.05
401	106.53
424	106.53
435	106.07
442	105.74
445	106.04
453	106.25
470	106.25
487	106.16
515	107.53
531	108.78

CROSS SECTION 2

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	109.51
1	109.21
3	108.57
64	107.93
102	107.59
134	107.29
166	107.14
181	107.26
185	107.20
242	107.20
242	105.37
251	105.16
253	107.11
304	106.50
314	107.35
357	107.08
384	106.92
417	107.05
425	108.45
434	109.12
440	110.43

CROSS SECTION 3

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	110.86
37	109.21
62	108.84
91	108.42
115	107.99
156	107.78
188	107.59
223	107.90
252	107.50
290	107.26
294	107.90
301	107.81
387	107.59
396	107.59
417	107.81
448	108.30
453	106.07
455	106.77
456	107.69
471	107.81
476	107.93
482	107.38
489	107.78
519	107.90
548	107.69
571	107.90
585	109.03
604	110.15

CROSS SECTION 4

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.01
12	110.19
49	108.60
100	108.45
192	108.14
219	107.78
224	108.45
261	108.17
301	108.45
307	108.42
313	108.36
368	108.51
372	108.54
381	108.57
386	108.60
445	108.51
446	107.47
452	107.41
453	108.33
456	108.48
513	108.51
535	108.48
540	109.58
588	111.62

CROSS SECTION 5

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	111.19
3	110.86
15	109.58
52	108.81
85	108.69
155	108.51
162	108.51
166	108.48
190	108.66
205	108.57
278	108.51
280	108.57
322	108.81
331	108.75
342	108.69
349	108.60
369	108.66
397	109.03
401	107.99
412	105.25
415	107.99
416	108.97
450	108.97
473	109.24
493	110.12
509	110.92
514	112.11

CROSS SECTION 6

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	111.83
27	110.19

CROSS SECTION 6 (Cont.)

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
64	109.91
123	108.69
158	109.00
193	109.03
207	108.87
246	108.87
313	108.97
351	108.81
371	108.54
372	105.46
375	105.25
378	105.06
381	106.01
386	107.47
386	108.36
399	108.90
471	109.30
515	109.76
575	111.50
610	112.75

BRIDGE SECTION

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	111.98
0	111.80
3	110.61
6	109.55
9	108.94
12	108.66
15	108.78
18	108.75
21	108.69
24	108.63
27	108.60
30	108.54
31	108.60
34	105.55
37	105.28
40	104.91
43	105.52
46	107.26
46	108.26
49	108.45
52	108.42
55	108.26
58	108.78
61	109.61
64	111.01
67	111.80

CROSS SECTION 7

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.32
8	111.50
17	110.79
21	110.15
38	109.88
74	109.94
101	110.00
111	110.37
114	109.12
121	109.18
127	110.09
162	109.51
200	109.45
248	109.12
300	108.90
301	108.97
333	108.97
355	108.57
356	107.38
369	107.44
379	107.78
392	107.23
392	108.02
394	108.81
400	108.81
426	108.75
447	108.66
463	108.75
468	107.99
500	108.78
528	109.61
550	110.09
574	110.49
594	110.58
628	111.19
647	111.53
655	110.73
657	110.28
659	111.34
680	112.01
702	113.14

CROSS SECTION 8

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.59
33	111.89
100	109.48
140	109.00
173	108.97
179	108.66
208	109.00
243	108.87
270	109.15
272	108.42
317	108.36
360	108.81
363	108.81
368	107.26
377	107.93
378	108.08
379	109.27
411	108.97
432	108.84
465	109.06
480	109.61
490	110.31
505	111.10
521	112.14
541	112.96

CROSS SECTION 9

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.47
11	111.53
23	111.25
61	110.28
80	109.70
108	109.06
111	109.12
125	109.51
142	108.78
177	108.87
179	107.75
186	108.02
187	109.18
193	109.21
199	108.51
226	109.45
243	108.51
247	108.84
272	109.39
293	109.36
341	109.45
391	109.48
415	109.61
472	109.94
515	110.12
560	110.89
608	111.71
656	112.11
696	113.36

TABLE 2—DISCHARGE MEASUREMENT OF APRIL 12, 1974, ON OKATOMA CREEK NEAR MAGEE, MISSISSIPPI. (WATER SURFACE ELEVATION=111.270 METERS. TOTAL DISCHARGE=456 CUBIC METERS PER SECOND).

STATION (METERS)	DEPTH (METERS)	ANGLE (COEFFICIENT)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
3.0	0.0	0	0.0	0.0
6.1	1.40	0	0.6	0.573
9.1	1.89	16	0.2	1.512
			0.8	1.917
12.2	2.44	0	0.2	1.359
			0.8	1.661
13.7	2.44	0	0.2	2.490
			0.8	2.490
15.2	2.44	0	0.2	3.490
			0.8	3.237
16.8	2.47	0	0.2	3.752
			0.8	3.316
18.3	2.44	0	0.2	3.685
			0.8	3.085
19.8	2.44	0	0.2	3.551
			0.8	2.883
22.9	2.50	0	0.2	3.685
			0.8	3.316
25.9	2.44	0	0.2	1.661
			0.8	1.847
29.0	2.59	0	0.2	2.371
			0.8	3.158
32.0	3.35	0	0.2	2.655
			0.8	1.954
35.1	3.51	0	0.2	2.883
			0.8	2.167
36.6	5.49	0	0.2	2.883
			0.8	2.490
38.1	5.73	0	0.2	3.085
			0.8	2.947
39.6	6.40	0	0.2	2.947
			0.8	2.883
41.1	6.16	0	0.2	1.780
			0.8	2.121
42.7	5.67	0	0.2	1.661
			0.8	1.622
44.2	3.05	0	0.2	2.655
			0.8	2.554
47.2	2.80	0	0.2	3.014
			0.8	2.460
51.8	2.90	0	0.2	3.158
			0.8	3.014
56.4	2.56	0	0.2	3.014
			0.8	3.158
61.0	1.92	0	0.2	2.371
			0.8	1.993
64.6	0.0	0	0.0	0.0

[1]Observation depth is the ratio of the velocity observation depth to the total depth at the station.

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