ATLAS HA-590

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, TALLAHALA CREEK AT WALDRUP, MISSISSIPPI

By B. E. Colson, C. O. Ming, and George J. Arcement

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

HYDROLOGIC INVESTIGATIONS ATLAS
Published by the U.S. Geological Survey, 1978
W

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, TALLAHALA CREEK AT WALDRUP, 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 the first 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 Department of Transportation Federal Highway Administration, 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 flood flow 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 at Tallahala Creek at Waldrup, Miss., one of 22 sites plotted on figure 1:

ALABAMA
- Buckhorn Creek near Shiloh
- Pea Creek near Louisville
- Poley Creek near Sanford
- Yellow River near Sanford
- Whitewater Creek near Tarantum

LOUISIANA
- Alexander Creek near St. Francisville
- Beaver Creek near Kentwood
- Comite River near Olive Branch
- Cypress Creek near Downsville
- Flagon Bayou near Libuse
- Little Bayou de Loutre near Truxno
- Tenmile Creek near Elizabeth

MISSISSIPPI
- Bogue Chitto near Johnston Station
- Bogue Chitto near Summit
- Coldwater River near Red Banks
- Lobutcha Creek at Zama
- Okatoma Creek east of Magee
- Okatoma Creek near Magee
- Tallahala Creek at Waldrup
- Thompson Creek near Clara
- West Fork Amite River near Liberty
- Yockanookany River near Thomastown

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 represented 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 (looking 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 (1976), 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 TALLAHALA CREEK AT WALDRUP, MISSISSIPPI

Data for Tallahala Creek at Waldrup, Miss. obtained in an 8-kilometer reach crossed about midway by State Highway 528, are presented on nine sheets (fig. 2). Sheet 1 contains tables showing cross-section data (table 1) and discharge data (tables 2, 3, and 4). An aerial view of the reach through the bridge is shown in figure 3. Relative magnitudes of the floods are shown on the frequency curve (fig. 4).

The locations of representative ground elevations are shown on sheets 2A and 2B. These are 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 2B as they existed at the time of the floods. The cross section surveyed at the downstream side of the bridge is tabulated. The cross section shown for velocity distribution was obtained by sounding from the upstream side of the bridge during the discharge measurement.

Data for three floods on Tallahala Creek are presented. The first flood occurred April 14, 1969. Ten valley cross sections were surveyed after this flood (sheets 3A and 3B). A second flood occurred on February 21, 1971 (sheets 4A and 4B). The third flood occurred April 13, 1974 (sheets 5A and 5B). After the third flood, two additional cross sections were surveyed to better define the geometry of the approach to the bridge. The stability of the stage-discharge relation indicates that no significant changes have occurred in the flood plain downstream from the bridge. Valley cross sections as surveyed are considered valid for all floods.

Manning's roughness coefficient values and the 1974 flood boundaries are shown on sheets 2A to 5B.

FLOOD OF APRIL 14, 1969

Peak water-surface elevations, measured cross section, and velocities for the flood of April 14, 1969, are shown on sheets 3A and 3B. The flood crested at an elevation of 95.088 meters at the reference point located on the downstream guardrail 52 meters from the right abutment. The peak discharge was 354 cubic meters per second, from a stage-discharge relation developed for the site. A discharge of 277 cubic meters per second was measured on the recession at an elevation of 94.878 meters at the reference point (table 2). The recurrence interval of the peak discharge is 15 years (Colson and Hudson, 1976, fig. 4).

FLOOD OF FEBRUARY 21, 1971

Peak water-surface elevations for the flood of February 21, 1971, are shown on sheets 4A and 4B. The flood crested at an elevation of 94.649 meters at the reference point located on the downstream guardrail. The peak discharge was 215 cubic meters per second. A discharge of 202 cubic meters per second (table 3) was measured at an elevation of 94.634 meters, 0.015 meters below the crest elevation. The measured cross section and velocity distribution are shown on sheet 4B. The recurrence interval of the peak discharge is 4 years (Colson and Hudson, 1976, fig. 4).

FLOOD OF APRIL 13, 1974

Peak water-surface elevations for the flood of April 13, 1974, are shown on sheets 5A and 5B. The average crest elevation at the downstream bridge abutments was 95.166 meters. The peak discharge was 507 cubic meters per second from the stage-discharge relation. The recurrence interval of the 1974 peak discharge is 43 years (Colson and Hudson, 1976, fig. 4).

The 1964 measured cross section and velocity distribution are shown on sheet 5B as representative of the velocity distribution for the 1974 flood data. The flood measurement of April 6, 1964, was at an elevation of 95.436 meters, 0.27 meters higher than the 1974 flood peak at the downstream bridge abutments. This measured discharge was 591 cubic meters per second of which 57 cubic meters per second flowed over the highway embankment (table 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 Tallahala Creek at Waldrup, Miss. Water depths, velocities, and discharges through bridge openings on Tallahala Creek at Waldrup, Miss. for floods of April 14, 1969, February 21, 1971, and April 13, 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. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A1, 30 p.

Bradley, J. N., 1970, Hydraulics of bridge waterways: Federal Highway Admin., Hydraulic Design Ser. No. 1, 111 p.

Colson, B. E., and Hudson, J. W., 1976, Flood frequency of Mississippi streams: Mississippi State Highway Dept., 34 p.

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, 1976, Guidelines for determining flood flow frequency: Washington, D. C., U.S. Water Resources Council Bull. 17, 26 p.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

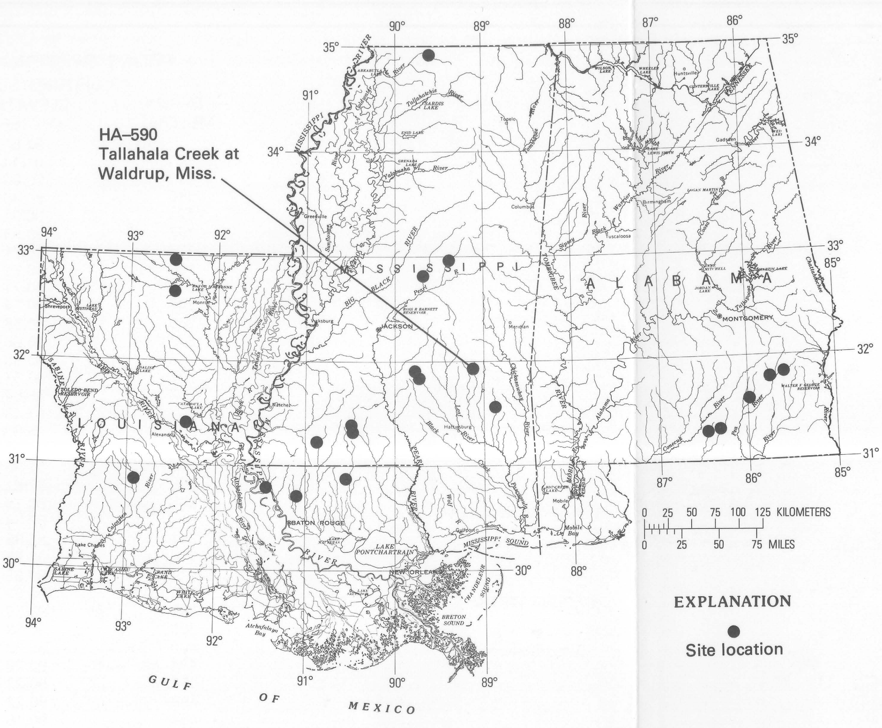

FIGURE 1.—INDEX MAP OF STUDY SITES IN THE BRIDGE BACKWATER INVESTIGATION PROJECT, ALABAMA, LOUISIANA, AND MISSISSIPPI.

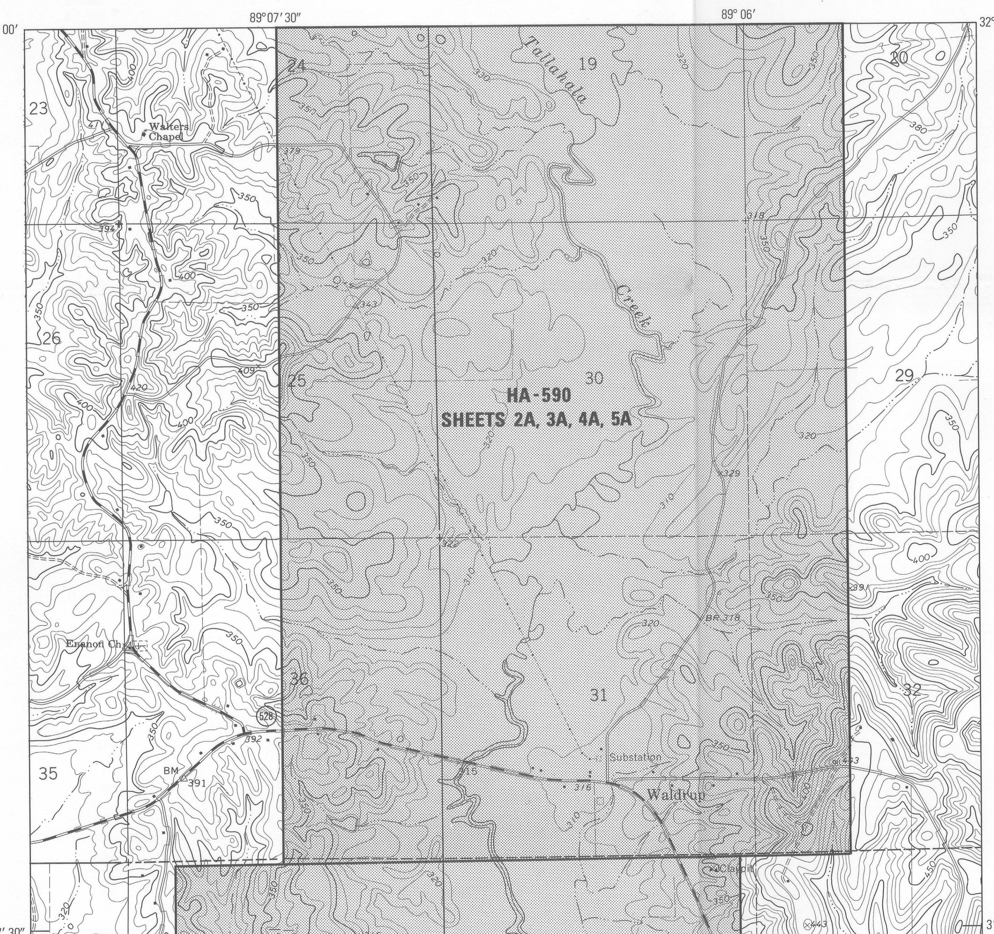

FIGURE 2.—INDEX MAP OF STUDY REACH, TALLAHALA CREEK AT WALDRUP, MISSISSIPPI.

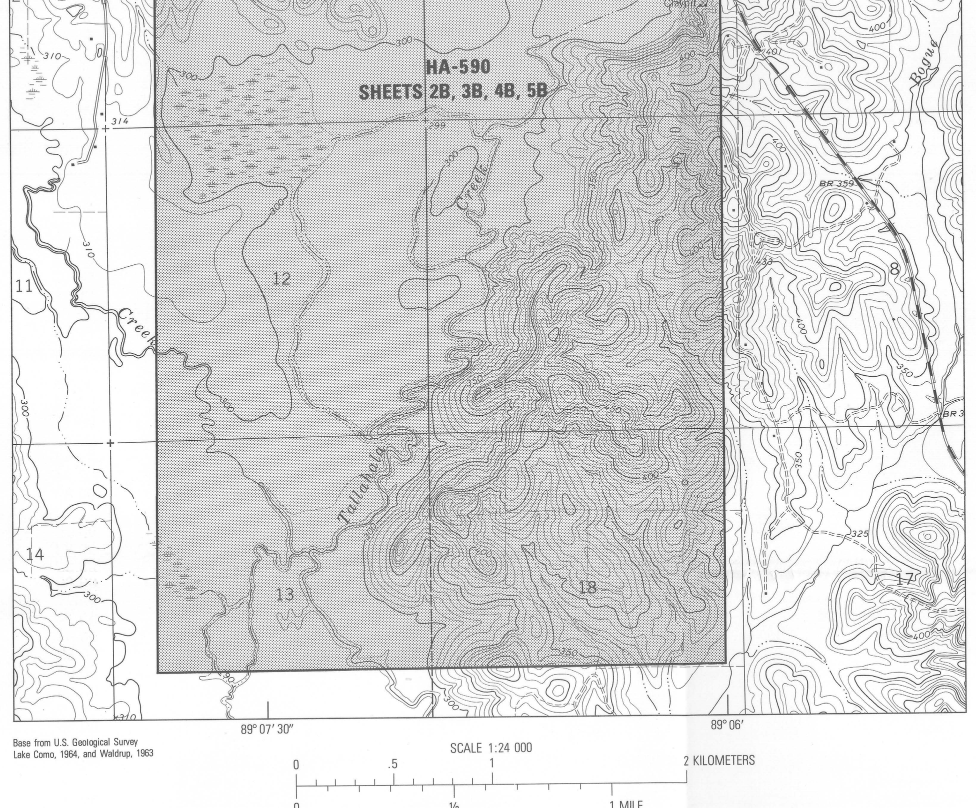

FIGURE 3.—AERIAL VIEW LOOKING DOWNSTREAM AT BRIDGE ON STATE HIGHWAY 528 AT WALDRUP, MISSISSIPPI, MARCH 22, 1978.

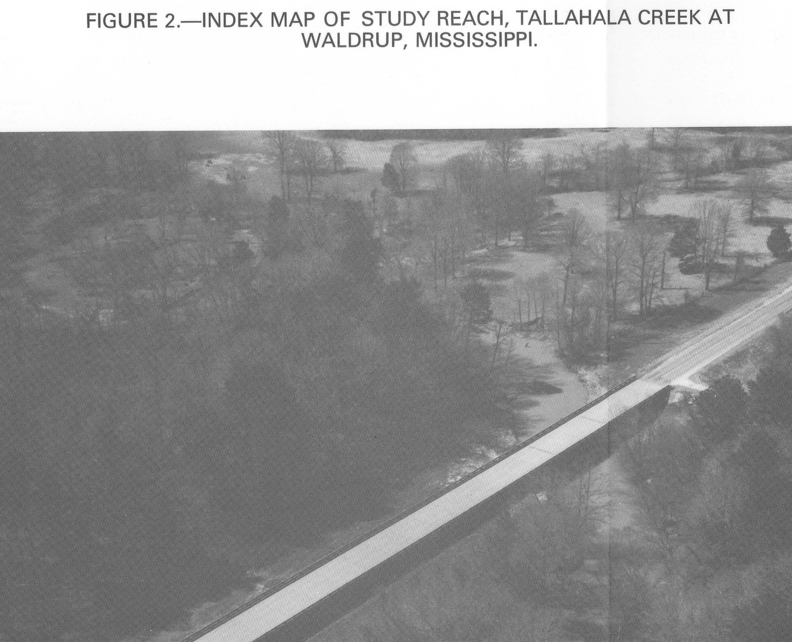

FIGURE 4.—FREQUENCY OF FLOODS, TALLAHALA CREEK AT WALDRUP, MISSISSIPPI

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

TABLE 1.—VALLEY CROSS-SECTION DATA FOR TALLAHALA CREEK AT WALDRUP, MISSISSIPPI.

CROSS SECTION 1

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	92.51
41	91.14
110	90.04
115	90.40
124	90.62
145	90.53
183	90.71
190	90.71
215	90.71
245	90.74
269	90.68
277	90.68
289	90.59
292	90.37
297	88.64
298	87.48
300	86.87
302	86.87
304	87.36
305	87.81
308	88.15
311	88.64
311	89.95
314	90.53
316	90.65
329	90.62
348	90.56
386	90.53
409	90.22
434	90.22
456	90.22
469	90.22
484	90.16
496	90.13
507	90.13
522	89.92
528	90.16
539	90.10
547	90.10
559	90.10
573	90.13
592	90.04
609	89.95
630	89.85
638	89.82
642	89.85
654	89.85
656	89.89
666	89.92
671	89.89
677	89.85
703	89.73
711	89.79
717	89.64
724	89.82
737	89.76
757	89.58
769	89.37
786	89.40
803	89.34
811	89.09
811	88.82
819	88.82
828	88.82
828	89.12
832	89.58
837	90.56
839	90.62
841	91.10
842	91.32
849	91.44
858	91.01
863	90.83
870	90.95
876	91.17
878	91.50
884	91.74

CROSS SECTION 2

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	92.69
55	92.20
61	91.32
70	91.26
72	88.94
74	88.36
77	88.24
79	88.48
81	88.97
82	89.43
85	90.89
88	90.68
94	91.38
110	91.29
120	90.92
137	91.10
153	91.32
169	90.59
175	90.95
186	91.41
193	90.59
207	90.62
215	91.17
228	91.01
258	90.95
285	91.35
302	91.01
323	90.95
348	91.10
368	91.14
392	90.95
404	90.95
421	91.04
437	90.98
458	90.95
476	90.95
503	90.92
523	90.86
531	90.77
539	90.43
554	90.43
557	90.74
563	90.89
574	90.92
591	90.95
601	90.83
625	90.83
650	90.80
674	90.77
690	90.74
718	90.62
737	90.59
750	90.56
769	90.56
785	90.50
803	90.56
821	90.62
835	90.50
849	90.43
869	90.46
891	90.53
908	90.59
920	90.53
943	90.53
963	90.53
995	90.56
1006	90.53
1020	90.40
1037	90.34
1052	90.13
1082	89.40
1092	88.64
1097	88.91
1118	90.13
1123	90.43
1128	89.95
1140	90.22
1151	90.74
1159	91.50
1189	91.53
1198	91.93
1209	92.60

CROSS SECTION 3

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	93.30
5	92.48
10	91.74
30	91.65
42	91.81
48	91.59
60	92.05
75	92.02
97	92.02
109	92.08
122	92.14
132	92.11
143	92.11
146	92.14
148	91.71
152	89.92
154	89.64
155	89.37
156	89.21
158	88.73
159	88.57
161	88.39
162	89.09
163	89.28
164	89.64
166	89.89
170	91.59
176	92.35
190	91.74
203	91.96
212	91.93
220	91.78
226	91.38
233	91.07
241	91.38
243	91.99
246	92.20
254	92.26
270	92.38
292	92.38
310	92.29
328	92.08
345	91.96
356	92.17
370	92.23
383	92.20
411	92.17
427	92.11
439	92.05
456	91.78
468	92.02
476	91.90
492	91.84

CROSS SECTION 3 (Cont.)

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
508	91.81
528	91.90
547	91.78
567	91.68
584	91.23
609	91.38
631	91.68
646	91.62
650	91.35
653	91.01
656	90.68
659	90.68
663	89.76
667	90.07
670	90.68
676	91.47
682	91.99
688	92.60
694	92.81
718	92.75
734	92.63
745	92.72
765	93.15
778	93.33
790	93.42
811	93.51
819	93.33
829	93.12
835	93.24
846	93.94
846	93.91
858	94.91

CROSS SECTION 4

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	95.95
31	94.58
84	93.60
115	93.21
174	92.84
212	92.60
214	92.23
220	92.57
233	92.63
290	92.57
294	92.05
297	91.41
298	91.99
304	92.72
308	92.14
310	91.90
321	92.99
410	93.27
478	93.12
481	93.21
520	92.81
530	92.45
533	92.26
536	91.65
538	90.83
539	90.68
540	91.59
543	92.54
547	92.42
548	92.45
559	93.12
585	93.18
602	92.87
621	92.29
629	91.41
632	90.50
633	90.16
634	89.98
635	89.82
635	89.64
636	89.37
637	89.25
638	89.06
638	89.00
639	89.12
639	89.58
640	89.76
641	89.95
641	90.16
642	90.50
644	92.72
647	92.72
658	92.96
665	93.09
672	93.30
681	93.15
692	93.09
694	93.21
696	92.96
697	92.66
699	92.69
700	93.15
713	93.06
725	92.99
731	92.96
737	92.60
748	93.33
755	93.66
761	94.18
769	94.64
775	94.82
784	94.85
794	94.76
807	94.46
818	94.31
825	94.21
831	94.27
839	94.24
853	94.21
861	93.79
865	93.57
870	93.24
879	92.84
882	92.51
885	92.72
896	93.06
902	93.27
914	93.91
954	97.02
965	98.76

CROSS SECTION 5

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	94.76
9	94.67
16	93.63
21	93.36
68	94.34
99	93.48
115	93.79
129	93.70
147	93.88
159	93.88
169	93.70
194	93.33
202	93.15
205	92.87
208	92.17
217	91.35
220	91.90
223	93.24
226	93.45
233	93.36
243	93.33
253	93.24
266	93.12
299	93.12
312	93.15
325	93.30
328	92.63
329	90.53
331	90.31
333	90.13
333	90.10
334	90.01
335	89.70
336	89.70
336	89.40
337	89.15
337	89.18
338	89.12
339	89.25
339	89.64
340	89.89
343	90.59
346	91.41
347	92.23
350	92.96
364	92.60
379	93.12
396	93.51
400	93.39
402	92.72
404	93.18
420	93.54
430	93.27
442	92.87
446	92.84
450	92.38
457	92.08
463	92.42
472	92.87
479	92.38
485	92.08
498	92.69
502	93.02
514	92.72
527	92.60
538	92.51
544	92.81
547	93.06
559	92.99
570	93.30
576	92.99
587	92.48
591	92.17
602	92.51
605	92.78
611	93.48
618	94.67
619	95.74

BRIDGE SECTION

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	95.65
2	94.18
4	93.76
7	92.57
9	92.23
10	91.93
12	91.90
15	91.53
18	91.50
21	91.38

BRIDGE SECTION (Cont.)

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
26	90.92
28	90.37
30	90.31
32	90.43
34	90.28
36	90.56
38	90.56
40	90.83
44	91.56
47	91.93
50	92.29
56	92.93
59	92.93
62	93.06
71	93.06
77	93.12
90	93.15
96	93.02
99	92.93
105	92.90
120	92.81
126	92.69
132	92.51
135	92.51
138	92.60
141	93.18
144	93.82
150	93.97
152	95.65

CROSS SECTION 6

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	95.22
40	95.86
70	96.26
79	96.26
79	94.85
99	94.85
137	93.82
152	93.79
186	93.88
211	93.79
215	93.76
218	93.76
223	93.66
250	93.91
269	93.79
273	93.76
275	91.10
278	90.50
281	89.85
284	90.10
285	90.10
287	91.07
289	93.24
302	93.42
319	93.42
323	92.99
334	92.93
340	93.27
375	92.96
387	92.81
415	93.48
445	93.42
455	93.42
470	92.87
490	93.45
518	93.27
549	93.57
563	93.91
574	94.09
593	94.98
602	95.52
611	96.13

CROSS SECTION 7

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	96.32
11	95.46
21	94.55
33	93.73
38	93.70
52	93.21
53	93.21
54	92.32
57	92.35
58	93.12
94	93.09
135	93.18
155	93.24
194	93.27
234	93.27
257	93.36
295	93.39
335	93.45
348	93.45
389	93.54
425	93.66
444	93.79
468	93.39
494	93.48
505	93.73
512	93.85
520	92.69
523	90.53
529	89.98
533	93.48
543	93.88
565	93.85
580	93.76
596	93.57
618	93.45
638	93.60
657	93.51
661	92.35
673	93.27
692	93.51
698	93.33
703	93.51
714	93.54
738	93.54
746	93.21
747	92.84
751	93.27
766	93.39
770	93.18
774	92.57
775	93.06
781	93.76
789	94.49
796	95.13
802	96.32

CROSS SECTION 8

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	97.60
14	96.19
39	94.61
43	94.67
67	94.43
87	94.55
94	93.85
100	94.64
170	94.43
189	95.68
190	94.15
208	94.31
226	94.15
239	94.21
241	94.06
247	94.27
262	94.27
273	94.34
281	93.97
284	94.31
293	94.18
301	94.18
308	94.24
319	94.18
332	94.18
347	94.00
353	94.43
357	94.18
383	94.18
415	94.12
430	94.06
442	94.21
452	93.82
460	94.12
470	94.27
474	94.00
476	93.24
479	93.70
483	92.75
486	92.17
493	89.98
499	91.68
500	94.06
507	94.09
518	94.24
526	94.09
530	93.94
562	94.15
575	93.91
584	94.06
590	94.21
595	93.88
597	93.51
600	93.06
606	92.60
611	92.87
614	93.51
617	94.52
621	94.58
630	94.40
643	94.37
657	94.18
667	94.37
684	94.40
684	94.24
691	94.43
703	94.18
707	93.54
714	94.37
723	94.06
734	93.82
740	94.27
753	94.27
767	94.24
771	94.12
796	94.24
816	94.12
827	94.27
832	94.09
840	94.24
847	94.61
853	95.16
858	95.68
862	96.19

CROSS SECTION 9

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	99.06
32	100.13
44	101.01
87	101.28
118	100.22
134	99.12
143	98.24
156	97.26
171	96.19
194	95.34
206	94.98
227	94.73
239	95.52
242	94.21
247	94.64
256	94.95
274	95.40
280	95.25
286	94.82
288	94.31
292	93.91
293	94.09
294	94.64
297	95.25
304	95.62
315	95.62
342	95.62
363	95.62
392	95.22
408	95.46
425	95.52
436	95.37
440	94.91
442	93.88
442	92.66
443	92.05
445	91.93
446	92.05
450	92.35
452	92.51
454	92.96
455	94.43
458	95.13
461	95.65
465	95.55
484	95.43
504	95.40
529	95.34
553	95.34
569	95.16
595	95.01
611	95.04
620	94.85
630	94.85
639	94.95
650	94.64
657	94.24
666	94.46
675	94.76
685	95.13
690	94.15
693	94.31
696	94.18
699	94.58
703	94.88
708	95.04
712	95.22
718	95.34
721	96.01
725	97.20
730	97.99

CROSS SECTION 10

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	98.66
10	98.15
18	97.81
26	97.41
43	96.93
51	96.65
62	96.59
79	96.47
101	96.23
114	95.95
126	96.26
130	96.47
147	96.53
161	96.44
176	96.38
182	96.07
184	96.16
199	96.35
223	96.35
240	96.35
254	96.29
282	96.44
302	96.23
326	96.53
340	96.47
352	96.44
365	95.19
387	95.55
404	94.49
409	94.18
411	94.03
413	94.40
416	95.80
429	96.35
447	96.50
462	96.35
473	96.32
506	96.44
538	96.65
545	96.44
552	95.22
559	95.04
563	95.19
571	96.10
579	96.26
593	96.26
609	96.47
610	93.18
624	96.68
628	96.13
630	94.12
639	92.93
642	93.54
643	94.12
645	96.16
645	96.53
649	96.50
664	95.98
665	96.29
673	95.65
681	95.34
689	95.71
693	95.77
697	96.59
702	97.60
707	98.27
723	99.15

TABLE 2.—DISCHARGE MEASUREMENT OF APRIL 14, 1969, OF TALLAHALA CREEK AT WALDRUP, MISS. (WATER SURFACE ELEVATION=94.878 METERS). TOTAL DISCHARGE=277 CUBIC METERS PER SECOND.

STATION (METERS)	DEPTH (METERS)	ANGLE (DEGREES)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
1.2	0.0	0	0.0	0.0
3.0	0.98	0	0.6	0.272
9.1	1.98	14	0.2	1.643
			0.8	1.430
15.2	2.44	11	0.2	1.893
			0.8	1.228
21.3	2.13	0	0.2	1.228
			0.8	0.811
27.4	2.07	0	0.2	0.652
			0.8	0.503
36.6	1.95	0	0.2	0.338
			0.8	0.323
45.7	1.95	0	0.2	0.524
			0.8	0.381
54.9	1.83	0	0.2	0.173
			0.8	0.090
64.0	1.74	0	0.2	0.637
			0.8	0.503
73.2	1.71	0	0.2	0.722
			0.8	0.360
82.3	1.83	0	0.2	0.214
			0.8	0.123
88.4	1.83	0	0.2	0.338
			0.8	0.173
94.5	1.83	0	0.2	0.448
			0.8	0.491
100.6	2.44	19	0.2	1.643
			0.8	1.228
106.7	3.23	19	0.2	1.317
			0.8	1.228
109.7	4.27	23	0.2	0.924
			0.8	0.884
112.8	4.08	23	0.2	1.228
			0.8	0.969
115.8	4.57	23	0.2	1.149
			0.8	0.637
118.9	4.33	16	0.2	1.079
			0.8	0.829
121.9	4.51	11	0.2	0.930
			0.8	0.994
125.0	4.11	0	0.2	0.799
			0.8	0.969
128.0	4.11	0	0.2	1.100
			0.8	0.668
134.1	3.20	0	0.2	0.994
			0.8	0.503
140.2	2.93	0	0.2	1.402
			0.8	1.180
146.3	1.68	0	0.2	0.637
			0.8	0.594
150.6	0.0	0	0.0	0.0

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

TABLE 3.—DISCHARGE MEASUREMENT OF FEBRUARY 21, 1971, OF TALLAHALA CREEK AT WALDRUP, MISS. (WATER-SURFACE ELEVATION=94.634 METERS). TOTAL DISCHARGE=202 CUBIC METERS PER SECOND.

STATION (METERS)	DEPTH (METERS)	ANGLE (DEGREES)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
1.8	0.0	0	0.0	0.0
6.1	1.28	8	0.6	0.802
9.1	1.68	11	0.2	1.667
			0.8	1.244
12.2	1.98	14	0.2	1.588
			0.8	1.305
15.2	2.19	11	0.2	1.189
			0.8	1.335
21.3	1.92	8	0.2	0.552
			0.8	0.509
27.4	1.83	0	0.2	0.341
			0.8	0.256
33.5	1.77	8	0.2	0.223
			0.8	0.149
39.6	1.68	8	0.2	0.497
			0.8	0.509
45.7	1.71	8	0.2	0.137
			0.8	0.113
51.8	1.62	8	0.2	0.509
			0.8	0.405
57.9	1.52	0	0.6	0.378
64.0	1.49	180	0.6	0.119
70.1	1.58	0	0.2	0.341
			0.8	0.226
76.2	1.58	11	0.2	0.649
			0.8	0.369
82.3	1.55	0	0.2	0.171
			0.8	0.140
88.4	1.55	19	0.2	0.387
			0.8	0.311
94.5	1.52	25	0.6	0.250
100.6	2.07	32	0.2	0.658
			0.8	1.052
106.7	2.83	32	0.2	1.551
			0.8	0.765
109.7	3.35	32	0.2	1.189
			0.8	1.311
112.8	3.93	36	0.2	1.216
			0.8	1.216
115.8	4.02	28	0.2	1.244
			0.8	1.052
118.9	4.27	25	0.2	0.914
			0.8	1.030
121.9	4.21	23	0.2	0.820
			0.8	0.732
125.0	4.24	23	0.2	0.856
			0.8	0.732
128.0	4.42	36	0.2	0.576
			0.8	0.472
132.6	3.02	23	0.2	0.588
			0.8	0.433
137.2	3.02	16	0.2	0.689
			0.8	0.689
140.2	2.77	14	0.2	0.856
			0.8	0.689
144.8	2.23	0	0.2	1.817
			0.8	1.305
148.4	0.98	0	0.6	0.576
150.9	0.0	0	0.0	0.0

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

TABLE 4.—DISCHARGE MEASUREMENT OF APRIL 6, 1964, OF TALLAHALA CREEK AT WALDRUP, MISS. (WATER-SURFACE ELEVATION=95.613 METERS). FLOW THROUGH BRIDGE=534 CUBIC METERS PER SECOND, FLOW LEFT OF BRIDGE=57 CUBIC METERS PER SECOND, AND TOTAL DISCHARGE=591 CUBIC METERS PER SECOND.

FLOW THROUGH BRIDGE

STATION (METERS)	DEPTH (METERS)	ANGLE (DEGREES)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
0.0	0.0	0	0.0	0.0
3.0	1.52	180	0.2	0.436
			0.8	0.512
9.1	2.29	0	0.2	0.567
			0.8	1.170
15.2	3.35	25	0.2	2.396
			0.8	2.234
21.3	3.05	25	0.2	2.054
			0.8	1.798
27.4	2.90	23	0.2	1.798
			0.8	1.679
33.5	2.87	11	0.2	0.786
			0.8	0.631
39.6	2.80	0	0.2	0.963
			0.8	1.100
45.7	2.74	0	0.2	0.314
			0.8	0.408
51.8	2.68	0	0.2	0.805
			0.8	0.591
57.9	2.59	0	0.2	1.125
			0.8	0.768
64.0	2.59	0	0.2	1.527
			0.8	1.125
76.2	2.68	0	0.2	1.079
			0.8	0.546
82.3	2.74	0	0.2	1.146
			0.8	0.604
88.4	2.90	8	0.2	0.988
			0.8	0.591
94.5	3.05	11	0.2	1.600
			0.8	1.600
100.6	3.66	0	0.2	1.170
			0.8	1.402
106.7	4.27	0	0.2	0.988
			0.8	1.170
112.8	4.88	0	0.2	0.988
			0.8	0.786
118.9	4.91	0	0.2	0.920
			0.8	0.942
125.0	4.63	0	0.2	1.314
			0.8	0.942
131.1	4.27	0	0.2	1.225
			0.8	1.198
137.2	3.96	0	0.2	2.015
			0.8	2.015
143.3	3.20	25	0.2	1.344
			0.8	2.015
150.6	0.94	180	0.6	0.619
152.1	0.0	0	0.0	0.0

FLOW LEFT OF BRIDGE

STATION (METERS)	DEPTH (METERS)	ANGLE (DEGREES)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
−487.7	0.0	0	0.0	0.0
−408.4	0.24	0	0.6	0.119
−373.4	0.29	0	0.6	0.640
−344.4	0.27	0	0.6	0.732
−304.8	0.27	53	0.6	0.814
−262.1	0.24	66	0.6	0.762
−216.4	0.32	66	0.6	0.762
−188.4	0.40	8	0.6	0.701
−160.0	0.29	18	0.6	0.911
−121.9	0.32	53	0.6	1.021
−83.8	0.18	45	0.6	0.890
−42.7	0.09	53	0.0	0.716
−11.0	0.09	36	0.0	0.521
−1.8	0.0	0	0.0	0.0

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

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1978—W78275

For sale by Branch of Distribution, U.S. Geological Survey 1200 South Eads Street, Arlington, VA 22202 and Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225