A CLASSIFICATION OF THE WING AND CLOSING DAMS ON THE UPPER MISSISSIPPI RIVER BORDERING IOWA

A report to the Fish and Wildlife Management Work Group of GREAT II
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ABSTRACT

Studies were initiated to inventory and classify the training structures along the Iowa bank of the Upper Mississippi River Pools 9 through 19. A total of 595 wing and closing dams were inventoried. Physical data collected from each dam site included water depth and river bottom contour, current velocities, and substrate samples. Data indicated that 217 (36 percent) of the dams within the study area had been completely eroded, covered with bottom sediments, or were physically removed by the Corps of Engineers. The remaining dams were sorted into twelve definable groups based on their physical characteristics, hydraulic regime and effect of the structure on the surrounding area.

STUDY OBJECTIVE

Classify and aggregate wing dams and closing structures on the basis of physical characteristics, hydraulic regimen and effect of the structure on the surrounding area.

INTRODUCTION

The Upper Mississippi River as originally defined by the Upper Mississippi River Conservation Committee (UMRCC) flows 926 miles from Hastings, Minnesota southward to Cauthersville, Missouri (Rasmussen, 1979). This section of the Great River consists of over 432,000 surface acres and provides a variety of commercial and recreational uses. Approximately one-third of the river (312 miles) flows along Iowa's eastern border and consists of over 191,000 surface acres (Rasmussen, 1979). An estimated 46,000 Iowa sport fishermen expend 1.2 million man-days harvesting nearly 33 fish per acre (Anonymous, 1976). Commercial fishermen on the upper river number about 2,000 each year and harvest approximately 11 million pounds of fish annually, valued at 1.2 million dollars (Anonymous, 1978).

Historically, since 1820, the Mississippi River has been "improved" for one purpose: "to keep the river open for a highway of commerce" (Rasmussen, 1979). During the mid 1800's, this work consisted mainly of clearing and snagging debris from the channel. In 1878, Congress authorized a four and one-half foot channel and the U.S. Army Corps of Engineers (COE) began to systematically construct rock and brush wing dams, closing dams, and bankline revetments (Tweet, 1975). Due to the success of experimental wing dams at Pig Eye Island (River Mile 834) and other locations, several thousand feet of wing and closing dams were built on the Upper Mississippi River by 1879 (Tweet, 1975). The wing dam proved to be an easy and permanent solution for maintaining the navigation channel. Congress authorized the Corps of Engineers in 1907 to build a six foot channel. This was accomplished by building more wing dams, dredging, and constructing additional locks. The Rock Island District alone estimated that the six foot channel would need an additional 2,000 wing dams, each 100 to 300 feet long (Tweet, 1975). By 1930, when the six foot channel was 82 percent completed, Congress authorized a nine foot channel. The wing and closing dams were not adequate to maintain the new nine foot depth. Consequently, the U.S. Army COE constructed the existing series of 29 concrete locks and dams. Since the completion of the locks and dams in 1933, many of the training structures have been removed or repaired (Appendix I). The present navigation channel is maintained by manipulating water flows through the locks and dams and by hydraulic dredging the problem areas.

STUDY BACKGROUND

The earliest wing dams on the Mississippi River were probably built by lumbermen and raftsmen during the mid 1800's (Tweet, 1975). They were crude brush dams held in place by wooden stakes and were used to wash out sand bars, thereby deepening the navigation channel. However, they seldom lasted more than a few years before deteriorating.

Major Warren (COE) was directed in 1866 to determine the most feasible means of maintaining a four and one-half foot channel (Tweet, 1975). Most rivermen believed that closing side chutes and narrowing the natural channel was the best means of improving navigation. Major Warren requested that two experimental dams be built. A closing dam was built at Prescott Island (River Mile 811) and a wing dam was built near the foot of Lake Pepin (River Mile 763.5). Both dams proved successful.

C.W. Durham (COE) built experimental wing dams at Pig Eye Island and eight other locations in 1873 (Tweet, 1975). The dams were constructed by driving two tiers of poles along the wing dam length nine feet apart. The space was then filled with willow brush weighted down with sacks of sand. These dams were very successful.

A total of 336.4 miles of wing and closing dams had been constructed by 1907 by engineers and contractors on the Upper Mississippi River (Tweet, 1975). Willow mats weighted down by rocks were used in the construction of most wing and closing dams until 1911 (Figure 1). By then the willow supply ran out and lumber mats were substituted. Approximately 73 miles of wing and closing dams were constructed within the study area prior to 1932 (Appendix I).

The construction of the locks and dams in the 1980's significantly altered the Upper Mississippi riverine environment. The locks and dams created a series of river lakes from the existing free flowing river. At first the impoundment of the river expanded water surface area and vastly increased aquatic productivity

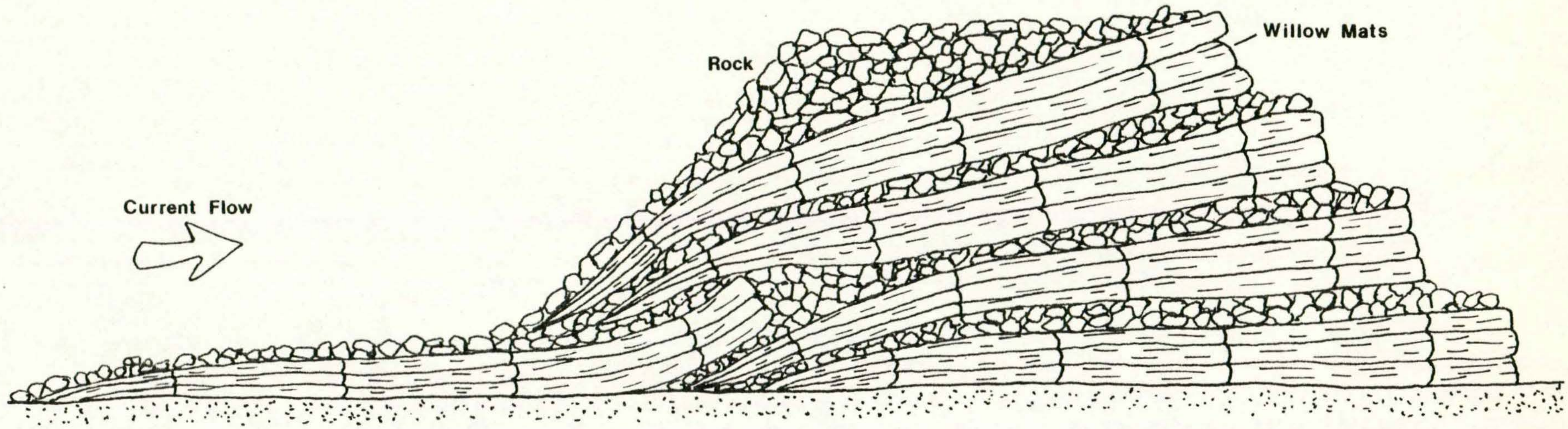

Figure 1. Cross section of a rock and brush wing dam on the Upper Mississippi River.

(Tweet, 1975). The increased water depth did provide a much improved navigational system. However, it was soon apparent that the series of locks and dams created a river that was less dynamic than the unregulated system. The construction of the locks and dams started an accelerated, man-induced aging process. The backwater areas that once were flushed and scoured by a changing main channel are now subject to siltation and fill at alarming rates (Ackerman, 1977; Claflin, 1977). Dredge spoil produced from the main channel maintenance activities has filled important fish spawning and nursery areas (Fish and Wildlife Management Work Group Draft Appendix, GREAT I). This habitat manipulation and degradation has resulted in a need to assess the importance of riverine habitats to fish populations. Wing and closing dams are among those habitats which have undergone a variety of changes. Wing dams are thought to be some of the best and most heavily used fish habitats along the main channel border (Robinson, 1970; Gengerke, 1978), however, little quantitative or qualitative work has been completed that assesses the importance of wing dams as fisheries habitats. To accomplish this goal, three factors need to be determined:

1. Location, physical characteristics, and classification of the wing and closing dams.
2. Sampling of wing and closing dams to determine fish usage of the areas.
3. The relationship between these parameters.

Once these factors have been determined, recommendations for the modification and reconstruction of training structures could be made that would meet both the hydraulic needs for the dam and also be beneficial to the river's fisheries. This project addresses the location, physical characteristics, and classification of the wing and closing dams.

METHODS AND PROCEDURES

The study area includes portions of the Upper Mississippi River Pools 9 through 19 that form Iowa's eastern border (Figure 2). The Fish Management Section of the Iowa Conservation Commission (ICC) inventoried the wing and closing dams on the Iowa side in Pools 9, 10, 12, 13, 14, 17, 18, and 19. Funding was provided by the Fish and Wildlife Management Work Group (FWMWG) of the Great River Environmental Action Team (GREAT II). The Fish Research Section of the ICC inventoried

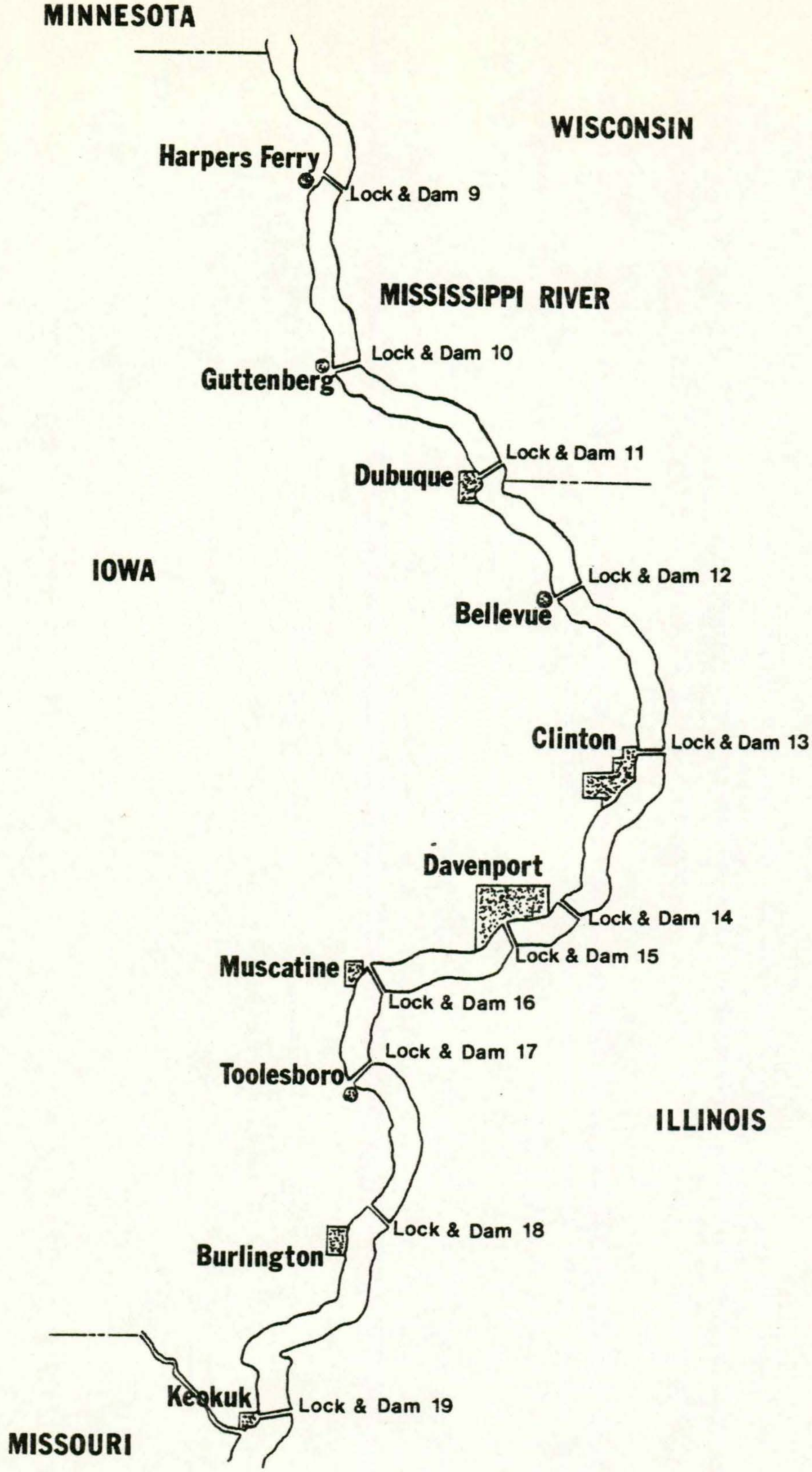

Figure 2. Iowa wing dam classification study area, Upper Mississippi River Pools 9 through 19, 1979.

Iowa's wing and closing dams in Pools 11, 15, and 16 under separate funding from the National Marine Fishery Service. Field data were collected between August 27, 1979 and November 5, 1979. Data from both studies were combined for analysis.

A preliminary wing and closing dam inventory was conducted using U.S. Army Corps of Engineer (COE) records from the Rock Island and St. Paul Districts. The COE records indicated that 558 wing and closing dams had been built along the Iowa border and were numbered in the order of construction date. The COE numbering system was modified for this study and the dams were renumbered in numerical order. The first upstream dam in each pool was designated dam number one (example: the first dam in pool 9 was numbered 9-1). Dams which had been divided by sedimentation or dredge spoil islands were renumbered and inventoried as separate dam types (straight or closing). A total of 35 dams were subdivided which added 37 dams to the COE number. Subdivided dams are noted with an asterisk in the Appendix. Construction data were tabulated for the 595 wing and closing dams bordering Iowa (Appendix I). Other information tabulated included river mile, construction date, rework date, rework type, length, elevation and depth at operating pool. The type of dam (straight, L-shape, or closing) and location in the river sinuosity (inside bend, outside bend, or straight section) were also noted.

Field data were collected for each training structure. Dams which could not be located with a reasonable effort were considered eroded or covered with bottom sediments. After locating each dam a twelve foot orange pole was placed at the shore end. A Raytheon model DE 719B recording fathometer was used to locate the distal end of the training structure and a Rangematic 1000 was used to determine the dam length. A floating line was used to measure 100 feet above and 100 feet below the dam and a series of poly jugs with anchors were used to outline each sample area.

Water depths and river bottom contours were recorded using the recording fathometer. A minimum of six transects were recorded for each dam (Figure 3). Three transects (1, 2, 3) were run upstream perpendicular to the dam and three transects (A, B, C) were run parallel to the dam from the distal end to the Iowa bank (Figure 3). Effort was made to maintain a constant boat speed while mapping.

Current velocities were measured and recorded for each wing or closing dam using a Gurley model 622-E cable suspended current meter. The boat was anchored and allowed to stabilize. One minute readings were made 100 feet above (A), on (B), and 100 feet below the dam (C) (Figure 4). Current velocities were measured

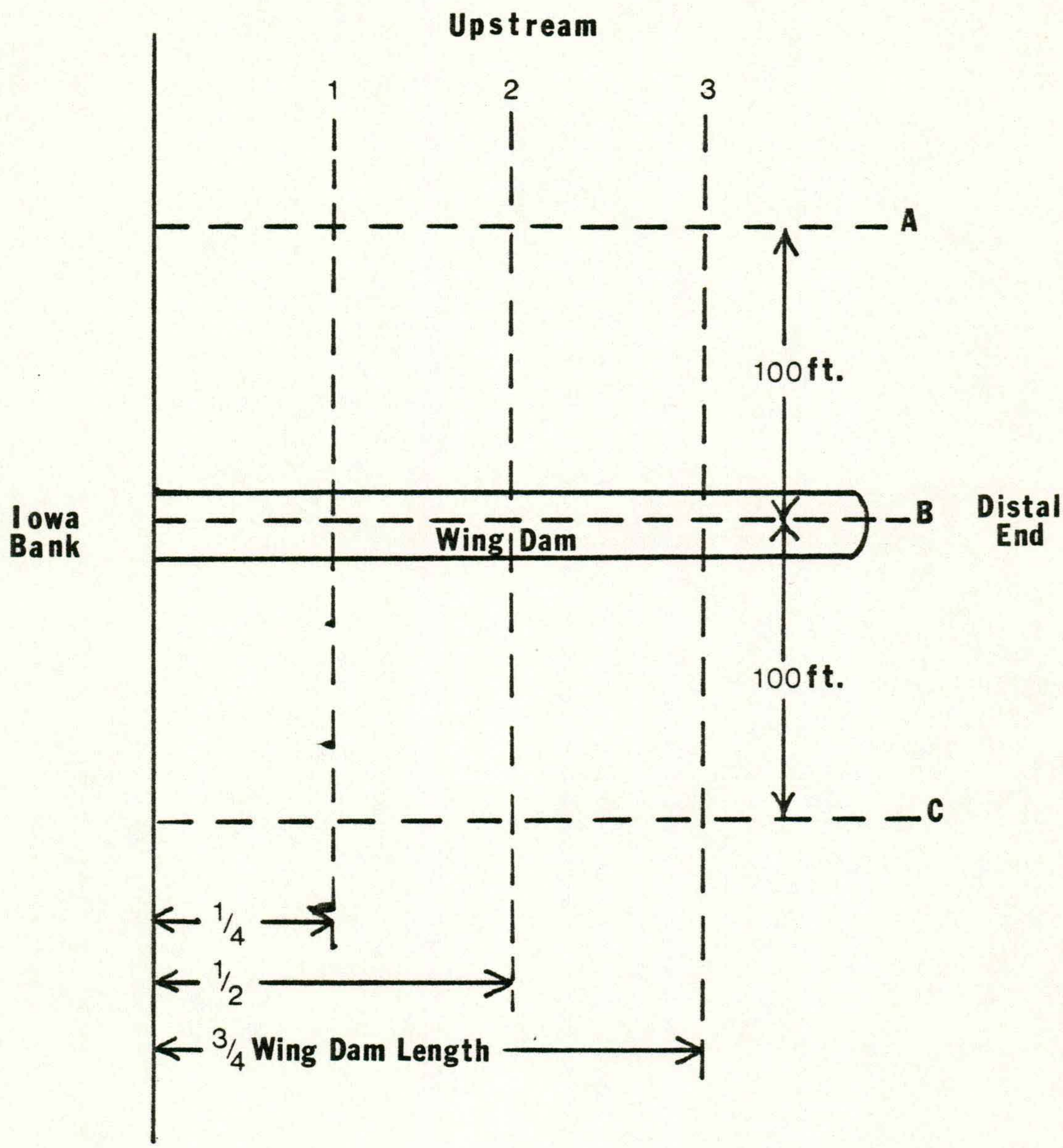

Figure 3. Transect locations for recording bottom contours of the Upper Mississippi River wing dam bordering Iowa, 1979.

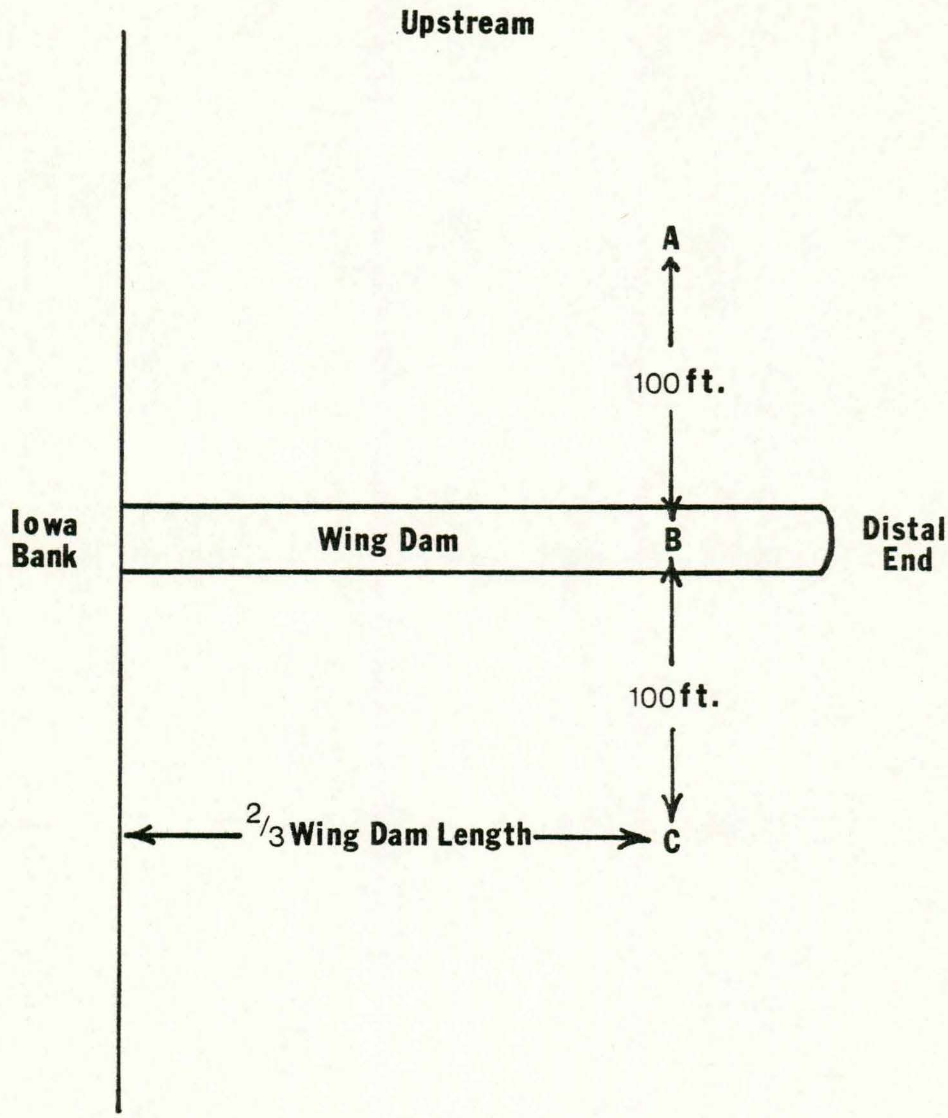

Figure 4. Sample locations for measuring current velocities on the Upper Mississippi River wing dams bordering Iowa, 1979.

2/3 the dam length from shore and 6/10 the water depth.

A standard nine inch Ponar dredge was used to collect bottom samples. A total of four samples (A, B, C, D) were collected for each dam (Figure 5). Sample locations were 100 feet upstream and 100 feet downstream at 1/3 and 2/3 the dam length. A visual percent particle size estimate was recorded for each grab (<0.62 mm-silt, 0.62 to 2 mm-sand, 2 to 250 mm-gravel, >250 mm-boulders).

Aquatic vegetation, if present, was identified as emergent or submergent and relative abundance was noted as sparse, moderate, or heavy.

After the field investigations were complete, the wing and closing dams were drawn to scale on topographic GREAT II (Great River Environmental Action Team) base maps and numbered.

RESULTS

A total of 595 wing and closing dams were inventoried on the Upper Mississippi River bordering Iowa (Table 1). Data showed that 194 (33 percent) of the structures within the study area had been completely eroded or covered with bottom sediments. An additional 23 dams (4 percent) had been physically removed by the Corps of Engineers. This equals a 36 percent loss of dams due to sedimentation or erosion and removal (Table 1).

The greatest number of wing and closing dams were constructed in Pool 11 (Table 1). The highest percent loss from sedimentation or erosion and removal was 80 percent in Pool 15 (Table 1). The lowest percent loss was 15 percent in Pool 17 (Table 1).

Corps records indicate that approximately 386,714 linear feet of wing and closing dams were constructed along the Iowa shore (Table 2). Field measurements indicate approximately 218,953 feet of the training structures remain in 1979 resulting in a net loss of 167,761 feet (43 percent) (Table 2). The greatest net loss by pool was 47,708 feet in Pool 18 (Table 2).

The mean water depth on the dams corrected to operating pool level for all pools combined was 5.5 feet (Table 3). The greatest mean depth was 8.8 feet in Pool 19 and lowest was 4.0 feet in Pool 14 (Table 3). All training structures within the study area were submergent at operating pool levels. The greatest average maximum depth within 100 feet above the structures was 15.2 feet on Pool

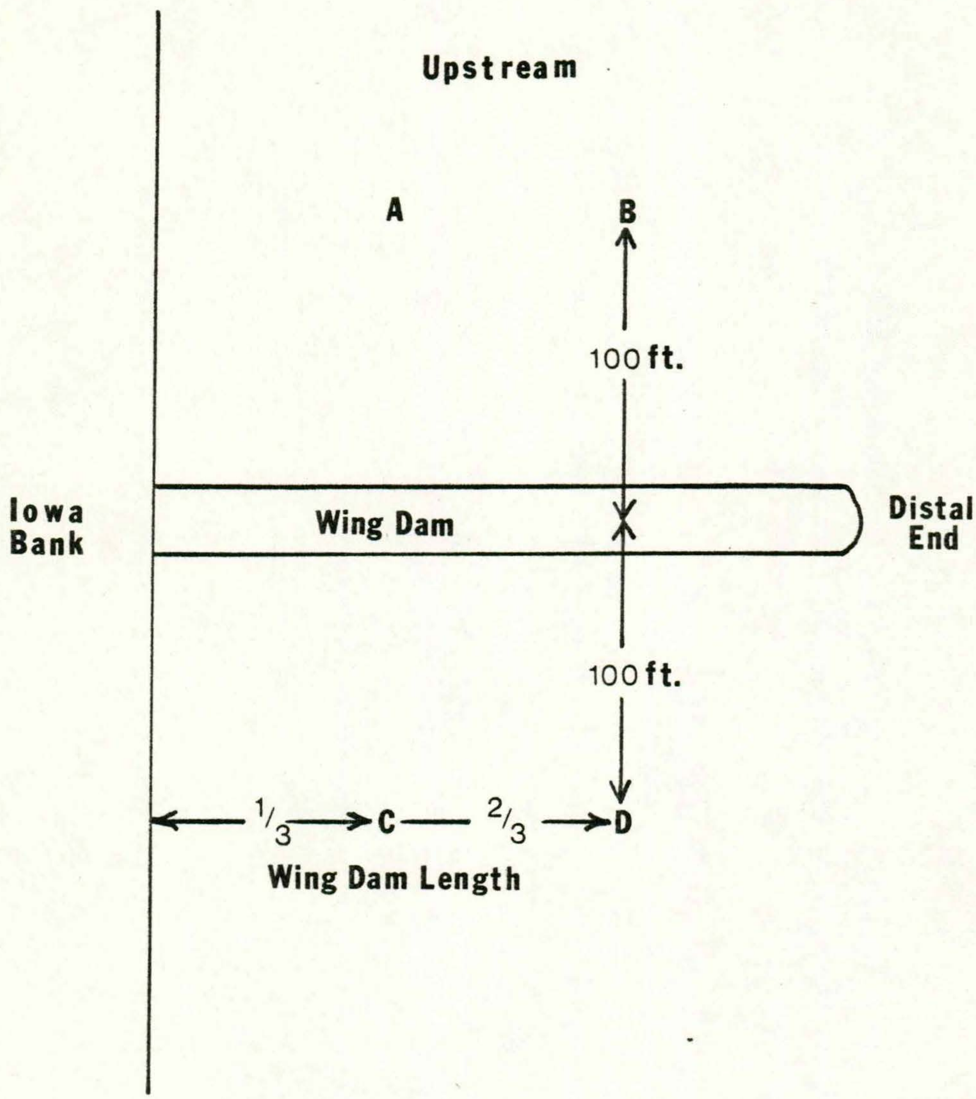

Figure 5. Sample locations for collecting substrate material from the Upper Mississippi River wing dams bordering Iowa, 1979.

Table 1. The total number of training structures completely eroded, covered with bottom sediments or physically removed as compared with the number of structures constructed in each pool of the Upper Mississippi River bordering Iowa, 1979.

Pool	Number of Training Structures Constructed	Covered or eroded		Removed		Total	
		Number	Percent	Number	Percent	Removed Number	Eroded or Covered Percent
9	29	11	38	1	3	12	41
10	67	31	46	0	0	31	46
11	92	21	23	0	0	21	23
12	50	16	32	3	6	19	40
13	72	28	39	0	0	28	39
14	48	12	25	3	6	15	31
15	15	0	0	12	80	12	80
16	63	11	17	3	5	14	22
17	33	5	15	0	0	5	15
18	87	32	37	0	0	32	37
19	39	27	69	1	3	28	72
Total	595	194	33	23	4	217	36

Table 2. Comparison of total length of wing and closing dams constructed with the total length present in 1979 by pool on the Upper Mississippi River bordering Iowa.

Pool	Total Wing Dam Lengths in Feet		Loss of Structure Length	
	Constructed	Present in 1979	Feet	Percent
9	12,867	5,721	7,146	56
10	38,590	20,095	18,495	48
11	50,610	30,315	20,295	40
12	29,296	18,130	11,166	38
13	44,184	32,340	11,844	27
14	33,480	24,663	8,817	26
15	5,855	3,150	2,705	46
16	38,007	29,023	8,984	24
17	24,520	16,622	7,898	32
18	75,272	27,564	47,708	63
19	34,033	11,330	22,703	67
Total	386,714	218,953	167,761	43

Table 3. Average water depth on the training structures at flat pool and the average maximum depths within 100 feet above and below the training structures by pool on the Upper Mississippi River bordering Iowa, 1979.

Pool	Average depth on structure at flat pool	Average maximum depth above structure	Average maximum depth below structure
9	4.9	12.3	15.6
10	4.8	14.6	17.0
11	4.5	14.0	17.4
12	5.8	11.7	13.9
13	5.7	14.9	19.1
14	4.0	12.9	15.0
15	5.3	9.1	9.5
16	5.7	12.9	12.5
17	5.6	12.8	14.7
18	5.9	14.5	18.3
19	8.8	15.2	16.8
Overall Average	5.5	13.2	15.4

19 (Table 3). The greatest average maximum depth within 100 feet below the structures was 19.1 feet in Pool 13 (Table 3).

Sand was the dominant bottom type in all pools comprising 78.6 percent of the total substrate material collected (Table 4). The highest percent composition of sand by pool was 100 percent in Pool 15 (Table 4). Silt was the second most abundant substrate material at 14.4 percent (Table 4). The greatest percent of silt was 32.7 in Pool 14 (Table 4). Gravel was the third most abundant substrate material at 4.3 percent and boulder was the least abundant at 2.7 percent (Table 4). Gravel was most abundant in Pool 16 with 13.4 percent, with boulder most abundant in Pool 18 with 9.3 percent (Table 4).

There was no significant difference in percent composition of substrate particle size by wing and closing dam type, however, there were significant differences in substrate particle size due to location of the dam in the river's sinuosity (Table 5). Sand was the dominant substrate material collected from the dams regardless of river location (77.4 percent). However, the percent composition of the larger particles increased on the straight and outside bends of the river (Table 5).

Current velocities were taken on different days over a three month period. There were many changes in the river stage and water discharge rates during this period. It was not possible, from the data collected, to compare current velocities among dams within the pools and among pools. The highest average current velocities for all pools were recorded on the dams at 1.66 feet per second (FPS) (Table 6). The recorded average current velocities 100 feet above and 100 feet below the dams were 0.99 FPS and 1.00 FPS, respectively (Table 6).

There was no significant difference in the average water depth on the dams due to location. The average water depth on the dams varied from 5.6 feet in straight sections to 4.9 feet on inside bends (Table 7). However, there was a significant difference in the average maximum depth in the dam study area due to dam location (Table 8). The average maximum depth for all pools was greatest at 19.7 feet along dams located on outside bends (Table 8).

Aquatic vegetation was not observed at any of the sampling sites during the study period. This was probably due to the late fall field data collection dates, the relatively high current velocities measured along the dams, and the constant shifting of the river substrate materials.

Table 4. Mean percent composition of substrate particle size by pool on the Upper Mississippi River bordering Iowa, 1979.

Pool	Substrate Particle Size in Percent			
	Silt	Sand	Gravel	Boulder
9	8.4	91.6	0	0
10	5.6	92.9	1.2	0.1
11	11.1	86.5	2.5	0
12	18.7	77.5	2.4	1.0
13	17.0	75.4	7.0	0.6
14	32.7	63.1	3.0	1.2
15	0	100.0	0	0
16	10.5	75.0	13.4	1.6
17	14.7	69.9	7.1	8.4
18	21.9	64.6	3.9	9.3
19	17.5	68.0	6.5	7.8
Mean Total	14.4	78.6	4.3	2.7

Table 5. Mean percent composition of substrate particle size by training structure type and location on the Upper Mississippi River bordering Iowa, 1979.

Structure Type	Percent Substrate Composition			
	Silt	Sand	Gravel	Boulder
S (straight)	15.1	77.3	5.0	2.7
L (L-shape)	16.2	71.4	6.2	6.2
C (closing)	16.5	78.0	2.9	2.1
Total	15.9	75.6	4.7	3.7
Location				
I (inside bend)	9.3	87.4	2.7	0.6
O (outside bend)	17.6	68.9	9.8	3.6
S (straight)	16.1	75.8	4.9	3.3
Total	14.3	77.4	5.8	2.5

Table 6. Mean current velocities recorded on, 100 feet above, and 100 feet below the dams by pool along the Upper Mississippi River bordering Iowa, 1979.

Pool	Current Velocity (FPS)		
	On the dam	100 feet above	100 feet below
9	1.22	0.75	0.68
10	1.16	0.72	0.68
11	1.24	0.79	0.68
12	2.11	1.42	1.35
13	1.85	1.10	0.95
14	1.11	0.73	0.63
15	3.18	1.36	1.78
16	2.27	1.43	1.42
17	1.12	0.81	1.10
18	1.90	0.98	0.97
19	1.07	0.81	0.73
Overall Average	1.66	0.99	1.00

Table 7. Average water depths on the dams by location for each pool on the Upper Mississippi River bordering Iowa, 1979.

Pool	Average Depth in Feet		
	Inside Bend	Outside Bend	Straight Section
9	4.4	-	5.3
10	4.3	5.1	4.9
11	3.8	4.3	3.6
12	4.7*	3.6*	5.7
13	5.7	5.4	5.7
14	-	3.5	4.5
15	-	-	6.0
16	5.3	5.6	6.3
17	3.8*	6.1*	6.1
18	6.0	6.5	7.2
19	8.8*	8.9*	10.5
Overall Average	4.9	5.3	5.6

*Small sample size

Table 8. Average maximum water depth within the wing dam study areas by location for each pool on the Upper Mississippi River bordering Iowa, 1979.

Pool	Average Maximum Water Depth In Wing Dam Study Area In Feet		
	Inside Bend	Outside Bend	Straight Section
9	14.5	-	15.5
10	13.7	17.8	18.4
11	15.7	23.2	20.1
12	18.7*	8.8*	15.7
13	18.4	25.7	18.4
14	-	19.2	16.9
15	-	-	13.9*
16	12.6	15.0	13.9
17	9.7	11.1	13.8
18	14.4	19.3	18.0
19	13.8*	17.3*	19.5
Overall Average	15.2	19.7	15.6

*Small sample size

Rationale for the Selection of Classification Criteria

A computer program was initially used to compare data collected. It was expected that the analysis would provide classification of the dams due to natural breaks within the system. The method used for clustering was an unweighted pair method. The program arranged the set of objects whose pairwise similarity coefficients were given into mutually exclusive homogenous subgroups and displayed the results in the form of a dendrograph. However, it became apparent that by using this analysis, the dams would not drop out into identifiable groups. The cluster analysis provided insight into the relationship among dams, but the selection criteria remained undetermined.

Consequently, in developing the classification system an attempt was made to select and limit the physical criteria to those characteristics deemed most important and over which man could exert some control. The wing and closing dams were grouped by the following criteria:

1. Depth of water on the dam adjusted to operating pool:
   - 0 to 5 feet
   - >5 feet
2. Location of training structure in relation to the river's channel:
   - I - inside bend
   - O - outside bend
   - S - straight section
3. Substrate particle size:
   - SS - sand and/or silt
   - SS+GB - sand and/or silt plus gravel and/or boulder

These criteria provided a means of classifying the dams into twelve definable groups (Figure 6). A total of 373 wing and closing dams were sorted into the twelve groups (Table 9). A total of five wing dams were not surveyed. Wing dams 11-9 and 14-18 were emergent due to the river stage being below operating pool level. Wing dam 11-42 was located in a barge fleeting area and was inaccessible for survey work. Wing dam 12-2 was temporarily removed for bridge construction and wing dam 14-16 had a flood wall constructed over a portion of the structure.

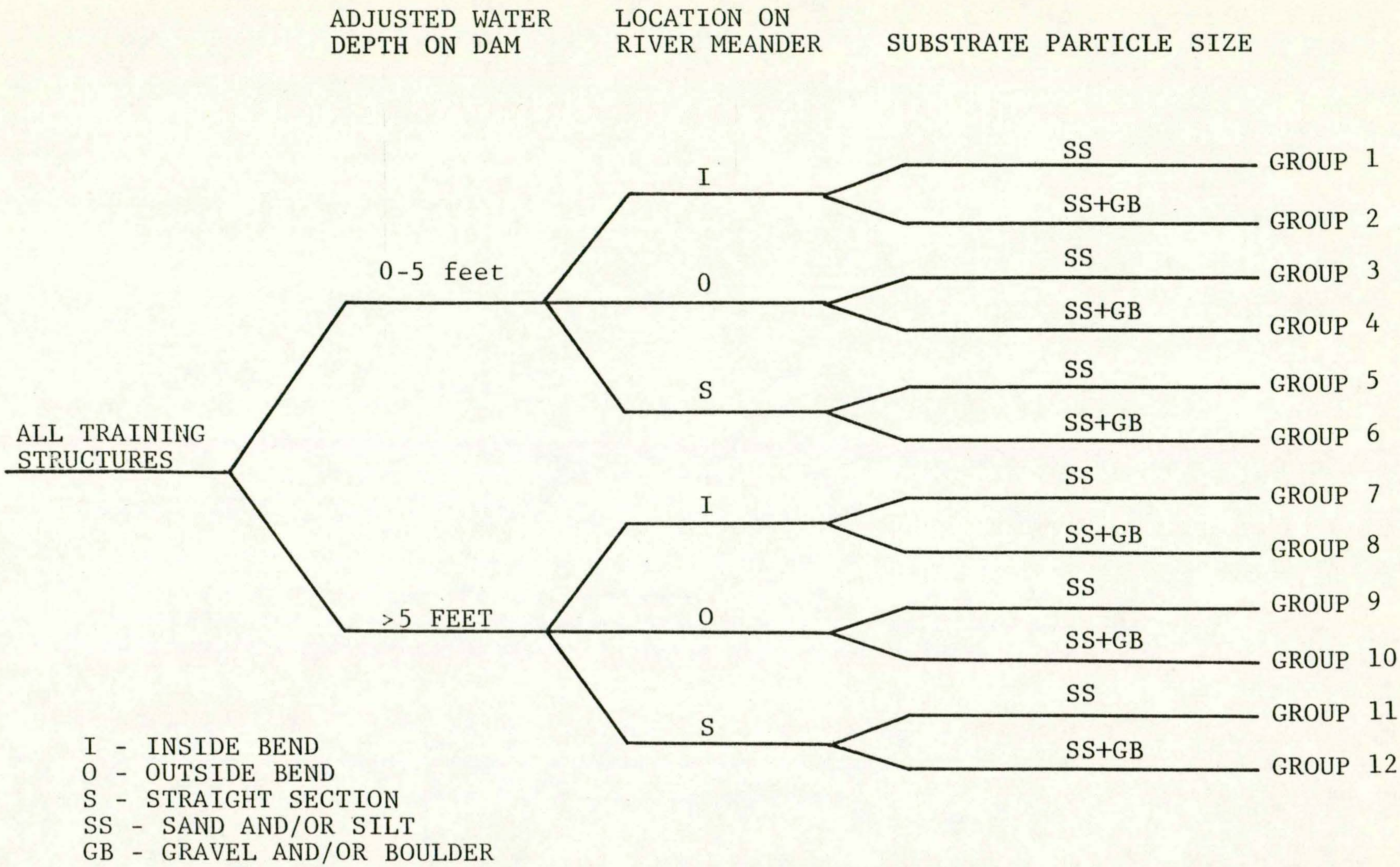

Figure 6. Schematic diagram of the physical classification criteria used to group the training structures on the Upper Mississippi River bordering Iowa, 1979.

Table 9. Classification of the wing and closing dams by selected physical parameters on the Upper Mississippi River bordering Iowa, 1979.

Group Number							
1	2	3	4	5		6	7
9- 5	10-46	10- 2	11-12	9-15	12-35	10- 1	9- 8
9- 6	10-61	10- 4	11-36	9-20	13-17	10-15	9- 9
9- 7	16- 8	10-20	12- 7	10-22	14- 2	10-16	9-22
9-16	16- 9	11-13	13- 1	10-23	14- 7	11-69	10-17
9-17	16-19	11-22	13-22	10-25	14-19	11-91	10-18
9-19	17-14	11-24	13-51	10-31	14-20	12- 1	10-27
10-10	17-26	11-52	14-29	10-36	14-22	12- 8	11-61
10-26	18-44	11-55	14-40	10-37	14-24	12-27	11-63
10-41		13-23	16-17	10-48	14-26	13- 4	11-81
10-42		13-24	16-38	10-62	14-28	14- 6	11-82
10-43		13-25	19- 2	11- 3	14-32	14-10	12-15
10-45		13-39		11- 4	14-33	14-42	12-41
11- 6		14-31		11- 5	14-47	16-18	13- 7
11- 7		14-37		11-17	14-48	16-24	13- 8
11- 8		14-38		11-18	15- 1	16-25	13- 9
11-10		14-39		11-19	15- 2	17-15	13-52
11-11		16- 1		11-20	16-26	17-19	16- 6
11-49		16- 2		11-21	16-27	17-20	16-11
11-64				11-25	16-58	17-22	16-22
12-16				11-32	17- 1	17-23	16-53
13-46				11-33	17-11	17-33	16-54
13-53				11-34	17-21	18-15	17-12
13-54				11-35	17-24	18-22	18-71
13-55				11-41	18-24	18-34	19-32
14-23				11-48	18-28	18-35	
16- 7				11-59	18-29	18-46	
16-10				11-66	18-30	18-47	
16-23				11-74	18-33	18-48	
18-12				11-75	18-54	18-53	
18-19				12- 4	18-58	18-55	
18-36				12- 5			
				12-23			
				12-25			
				12-34			
Number 31	8	18	11		64	30	24

Table 9 (continued)

	Group Number							
	8	9	10	11			12	
	13- 6	10- 3	10-59	9- 3	12- 6	16-37	10-35	17-16
	13-11	10-19	13-13	9- 4	12-21	16-42	10-40	17-17
	13-45	10-21	13-13	9-10	12-22	16-43	10-60	17-18
	13-47	10-47	13-37	9-11	12-26	16-44	11-16	17-29
	16- 5	11- 1	13-38	9-13	12-31	16-45	11-39	17-32
	16-51	11- 2	13-56	9-21	12-32	16-49	11-40	18- 1
	16-52	11-14	13-57	10-13	12-33	16-50	12- 9	18- 6
	17- 6	11-45	13-58	10-28	12-36	16-61	12-44	18-16
	17- 7	11-46	14-12	10-63	12-37	17-28	12-45	18-17
	17-13	11-51	16- 3	11-47	12-38	17-31	13- 2	18-18
	18- 9	11-54	16- 4	11-50	12-39	18- 2	13- 3	18-20
	18-10	13-49	16-16	11-53	12-40	18- 4	13-16	18-21
	18-11	13-50	16-39	11-56	12-43	18- 5	13-26	18-25
	18-38	16-41	16-40	11-57	12-47	18-23	13-27	18-41
	18-45	16-59	18- 8	11-58	13- 5	18-59	13-28	18-43
	18-66		18-70	11-60	13-12	18-62	13-34	18-60
	18-72		19- 6	11-65	13-14	19-23	14-15	18-61
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				11-68	13-20		14-43	18-64
				11-70	13-21		16-12	18-67
				11-71	13-29		16-14	18-77
				11-72	13-71		16-21	18-79
				11-73	14-34		16-32	18-84
				11-76	14-35		16-34	18-85
				11-77	14-36		16-35	19- 4
				11-78	14-44		17- 2	19- 8
				11-79	14-45		17- 3	19-11
				11-80	15-13		17- 4	19-29
				11-90	16-28		17- 5	19-30
					16-29		17-10	
					16-31			
					16-33			
Total	18	15	17	---	---	78	---	59

RECOMMENDATIONS

This classification system was developed to provide a systematic sorting of the physical parameters for the wing and closing dams located along the Iowa border. This system is one of many methods which could be utilized. The considerable amount of data collected for this study could be used for the development of an expanded or refined classification system. The cluster analysis approach should be continued, but programmed to select different physical criteria in an attempt to better define the relationships among physical parameters. This classification system is, however, the first step in the process to better understand these structures and their roles as fish habitats.

Continued Wing Dam Investigations

It is recommended that the Fish Research Section of the ICC continue the wing dam investigations. The proposed study would use the data collected and the classification system developed from the present study. The proposed study objectives and methods are included in Appendix II.

ACKNOWLEDGEMENTS

I would like to acknowledge many people who gave valuable assistance throughout this study. Gary Ackerman, Bob DeCook, Al Van Vooren, Dennis Wiess, John Pitlo, Mark Anderson, Dean Beck, and Gaylen Reetz were instrumental in collecting field data. Mark Anderson, Dean Beck, and Gaylen Reetz assisted in tabulating the data, and John Pitlo contributed to the data analysis.

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IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-21	33-18	611.0	C	1900	1933	RP	200	602.5	-0.5	10/9	345	-1.74	S	4	0	100	0	0	6.1	6.9	.65	1.10	.25
11-22	33-17	610.8	S	1900	1933	RP	735	602.0	-1.0	10/8	270	-2.74	O	7	0	100	0	0	7.3	11.9	1.00	1.40	.50
11-23	33-16	610.8	C	1900	1915	RP	445	600.5	-2.5	E/C													
11-24	33-23	610.6	S	1903	1976	RP	690	603.0	0.0	10/8	339	-1.40	O	4	0	100	0	0	14.5	16.5	.70	1.60	.60
11-25	33-22*	610.4	S	1903	1976	RP	250	600.6	-2.4	10/8	315	-2.87	S	7	0	100	0	0	17.5	34.9	1.20	2.00	1.00
11-26	33-22	610.4	C	1903	1976	RP	250	600.6	-2.4	E/C													
11-27	33-21	610.2	S	1903	1933	RP	635	601.0	-2.0	E/C													
11-28	33-29	610.0	S	1906	1933	RP	620	602.3	-0.7	E/C													
11-29	33-30	609.9	C	1906	1928	RP	761	601.8	-1.2	E/C													
11-30	33-20	609.8	S	1900	1933	RP	632	600.6	-2.4	E/C													
11-31	33-7	609.6	C	1898	1933	RP	880	601.3	-1.7	E/C													
11-32	33-41	609.5	S	1915	1933	RP	124	601.6	-1.4	10/8	174	-1.67	S	7	0	100	0	0	8.1	18.9	.60	.90	.60
11-33	33-40	609.4	S	1915	1933	RP	300	604.7	+1.7	10/8	130	-2.00	S	7	0	100	0	0	7.4	17.6	.50	.60	.40
11-34	33-8	609.2	C	1898	1933	RP	1022	600.5	-2.5	10/8	1350	-2.27	S	7	0	100	0	0	8.1	10.6	.60	.50	.50
11-35	33-11	609.1	S	1898	1933	RP	800	599.6	-3.4	10/8	900	-2.80	S	7	0	100	0	0	9.4	17.4	.50	1.10	.20
11-36	33-12	608.9	S	1900	1933	RP	507	600.5	-2.5	10/5	630	-3.49	O	1	0	98	2	0	7.1	7.1	1.00	1.20	.80
11-37	33-34	608.1	L	1911	1925	RP	1115	598.3	-4.7	E/C													
11-38	33-35	607.8	S	1911	--	--	--	600.2	-2.8	E/C													
11-39	33-38	607.2	S	1914	1927	Ex 100'	130	599.9	-3.1	10/5	165	-14.62	S	3	25	45	30	0	19.1	19.1	1.00	1.10	1.20
11-40	33-54	607.0	S	1927	--	--	270	599.8	-3.2	10/5	275	-12.26	S	7	0	65	35	0	23.1	25.0	1.10	1.30	.70
11-41	33-55	606.9	S	1927	1928	Ex 350'	450	599.2	-3.8	10/5	315	-2.12	S	7	0	100	0	0	23.8	30.4	.60	.70	.50
11-42	33-36	606.7	S	1914	1925 1926 1934	> Ex 345 RP	983	601.2	-1.8	Barge Fleeting Area - Unable to Map													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-43	33-60	606.6	S	1928	--	--	603	599.2	-3.8	Barge Fleeting Area - WD E/C													
11-44	33-59	606.3	S	1928	--	--	417	599.0	-4.0	Barge Fleeting Area - WD E/C													
11-45	33-48	605.2	S	1915	1925	RP	473	597.6	-5.4	10/5	570	-6.06	O	7	0	100	0	0	19.7	22.1	1.30	2.20	.80
11-46	33-6	604.8	C	1898	1929	RP	730	597.8	-5.2	10/4	690	-5.78	O	4	0	100	0	0	22.0	32.9	.90	2.80	1.80
11-47	33-49	604.7	S	1915	1925	RP	327	597.3	-5.7	10/4	309	-10.15	S	7	0	100	0	0	14.8	16.8	1.60	2.70	1.20
11-48	33-50	604.5	S	1915	1976	RP 285	394	598.9	-4.1	10/4	186	-3.65	S	1	0	100	0	0	14.6	13.8	.90	2.00	.60
11-49	33-51	604.3	S	1915	1976	RP **165**	400	598.2	-4.8	10/4	210	-4.35	I	6	0	100	0	0	8.2	9.0	.90	1.10	1.00
11-50	33-52	604.0	S	1923	1927	RP	800	597.3	-5.7	10/4	840	-5.95	S	6	0	100	0	0	14.8	14.8	.50	1.60	.80
11-51	34-25	603.2	S	1926	1929	RP	229	596.0	-7.0	10/4	245	-7.17	O	3	25	75	0	0	21.5	23.5	.90	1.00	.70
11-52	34-26	603.1	L	1926	--	--	621	597.6	-5.4	10/2	296	-4.24	O	6	12	88	0	0	10.3	11.2	.65	1.00	.80
11-53	34-24*	602.9	C	1926	--	--	600	597.0	-6.0	10/2	510	-5.28	S	6	0	100	0	0	11.4	33.8	.90	1.20	1.00
11-54	34-24	602.9	S	1926	--	--	400	597.0	-6.0	10/2	525	-7.04	O	3	0	100	0	0	15.0	13.0	1.30	1.90	1.20
11-55	34-11*	602.8	C	1908	1926	RP	200	597.4	-5.6	10/2	225	-4.51	O	6	0	100	0	0	11.0	19.2	1.00	1.10	1.10
11-56	34-11	602.8	S	1908	1976	RP 210	495	597.4	-5.6	10/2	540	-6.48	S	6	0	100	0	0	15.9	15.6	1.30	2.00	1.10
11-57	34-27*	602.4	C	1927	--	--	500	596.8	-6.2	10/2	570	-6.01	S	6	0	100	0	0	10.4	11.8	.70	1.10	.50
11-58	34-27	602.4	S	1927	1976	RP 230	254	596.8	-6.2	10/2	234	-10.68	S	4	0	100	0	0	23.7	33.6	1.50	1.60	.70
11-59	34-1	602.2	C	1887	1927	RP	627	599.8	-3.5	10/2	675	-4.61	S	6	0	100	0	0	14.1	42.8	.80	1.20	.70
11-60	34-28*	602.1	C	1927	--	--	750	596.9	-6.1	10/1	750	-5.04	S	2	0	100	0	0	9.0	7.3	.75	.75	.75
11-61	34-28	602.1	S	1927	1976	RP 190	200	596.9	-6.1	10/1	180	-5.87	I	3	12	88	0	0	14.2	14.6	.90	1.20	1.00
11-62	34-29	601.9	S	1927	1929	Ex 275	360	596.8	-6.2	E/C													
11-63	34-30	601.9	C	1927	1928	Ex 270	270	597.8	-5.2	10/1	285	-5.27	I	6	37	63	0	0	17.0	34.0	.60	1.30	.60
11-64	34-40	601.6	S	1928	--	--	455	599.5	-3.5	10/1	285	-3.67	I	7	50	50	0	0	6.8	6.4	.60	.80	.60
11-65	34-13	600.7	S	1914	1976	RP	663	596.0	-7.0	10/1	600	-5.14	S	2	12	88	0	0	22.2	22.7	.40	1.00	.65

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-66	34-14	600.6	S	1914	1976	RP	400	596.7	-6.3	10/1	375	-3.90	S	2	0	100	0	0	18.5	18.0	.65	.80	.70
11-67	34-19	596.1	S	1915	1928	RP	445	596.5	-6.5	9/28	420	-6.82	S	3	15	85	0	0	15.1	15.7	.70	.80	.60
11-68	34-18	595.9	S	1915	1928	RP	540	598.3	-4.7	9/28	330	-5.18	S	7	27	73	0	0	16.0	20.0	.75	.90	.60
11-69	35-43	595.4	S	1928	--	--	226	599.1	-3.9	9/28	255	-4.48	S	4	7	86	7	0	15.4	20.8	.90	1.10	.70
11-70	35-10	595.2	S	1900	1928	EX 75	415	595.7	-7.3	9/28	390	-6.85	S	4	40	60	0	0	20.1	22.4	.80	.90	.70
11-71	35-11	595.1	S	1900	1928	EX 200	678	597.4	-5.6	9/28	540	-6.28	S	4	42	58	0	0	17.4	21.9	.60	.80	.90
11-72	35-16	594.9	S	1900	1928	EX 125	685	596.8	-6.2	9/28	570	-6.12	S	6	40	60	0	0	12.4	11.4	.70	1.00	.70
11-73	35-12	594.7	S	1900	1928	RP	600	596.5	-6.5	9/28	225	-6.32	S	4	55	45	0	0	12.9	14.7	.70	.90	.40
11-74	35-13	594.5	S	1900	1928	EX 90	751	596.5	-6.5	9/28	675	-4.95	S	1	32	68	0	0	15.6	16.6	.50	.80	.60
11-57	35-14	594.3	S	1900	1928	RP	842	596.6	-6.4	9/27	750	-4.67	S	1	19	81	0	0	15.1	15.0	.65	.85	.75
11-76	35-35	594.1	S	1926	1927	EX 550	735	593.2	-9.8	9/27	600	-5.63	S	1	45	55	0	0	14.2	15.2	.65	.80	.60
11-77	35-36	593.9	S	1927	--	--	613	594.2	-8.8	9/27	255	-9.23	S	6	26	74	0	0	13.0	13.6	.95	1.05	.80
11-78	35-30	593.7	S	1915	1925	RP	455	594.3	-8.7	9/27	450	-8.10	S	6	32	68	0	0	15.1	16.9	.85	1.10	.75
11-79	35-38	591.3	S	1928	--	--	383	596.5	-6.5	9/27	360	-8.03	S	7	0	100	0	0	19.9	33.1	.70	1.20	.50
11-80	35-39	591.2	S	1928	--	--	613	594.6	-8.4	9/27	645	-8.57	S	4	0	100	0	0	21.0	22.0	.70	1.25	.50
11-81	35-26	591.0	S	1911	1928	EX 260	850	592.8	-10.2	9/27	900	-9.53	I	7	0	100	0	0	18.0	14.8	.70	.95	.60
11-81	35-21	590.8	S	1911	1928	EX 100	1025	594.2	-8.8	9/26	1050	-8.22	I	1	0	100	0	0	13.8	11.1	1.00	1.20	.90
11-83	35-22	590.5	S	1911	1929	RP	1145	594.6	-8.4	E/C													
11-84	35-23	590.2	S	1911	1929	RP	1166	595.0	-8.0	E/C													
11-85	35-24	590.0	S	1911	1929	RP	775	594.4	-8.6	E/C													
11-86	36-22	584.8	S	1915	--	--	1276	592.3	-10.7	E/C													
11-87	36-23	584.6	S	1915	--	--	1020	589.4	-13.6	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-88	36-24	584.4	S	1915	--	--	660	590.1	-12.9	E/C													
11-89	36-2	584.3	S	1893	1918	RP	530	589.9	-13.1	E/C													
11-90	36-1	583.9	S	1893	1936	RM 45	980	587.0	-16.0	9/26	750	-13.82	S	3	57	43	0	0	24.3	46.3	1.00	1.40	.50
11-91	36-25	583.6	S	1915	1936 1938> 1976	RM 330 RS 125	400	603.0	0.0	9/26	510	-1.31	S	4	69	6	25	0	32.1	35.2	1.00	.80	.50
11-92	36-26	583.4	C	1915	1936 1938	RM 320	380	588.4	-14.6	E/C													
12-1	36-11	581.6	S	1912	1929	RF	562	589.3	- 2.7	10/15	360	- 2.56	S	1	0	95	5	0	12.2	13.3	.84	1.94	.84
12-2	36-12	581.3	S	1912	1929	RP	860	589.8	- 2.2	Bridge Construction- Unable to Map													
12-3	36-18	580.9	S	1914	1915	RP	920	590.0	- 2.0	E/C													
12-4	36-13	580.5	S	1912	--	--	924	588.4	- 3.6	10/15	840	- 3.02	S	6	58	42	0	0	15.7	18.6	.70	.81	.77
12-5	36-14	580.3	S	1912	1928	RP	730	590.3	- 1.7	10/15	975	- 1.46	S	3	61	39	0	0	10.1	25.4	.29	.36	.33
12-6	36-15	580.1	S	1912	1928	RP	660	588.4	- 3.6	10/24	540	- 5.92	S	3	100	0	0	0	16.6	13.0	.26	.84	.62
12-7	37-UN	577.1	S	--	--	--	--	--	--	10/24	180	- 3.59	0	3	0	85	0	15	8.6	8.8	1.56	2.37	1.45
12-8	87-44	575.0	S	1928	--	--	355	--	--	10/24	300	- 4.92	S	4	1	54	20	25	13.8	14.2	1.80	2.70	1.31
12-9	37-34	574.9	S	1926	1928	RP	464	586.8	- 5.2	10/24	1050	- 5.52	S	1	1	78	21	0	9.0	9.8	1.52	2.41	1.72
12-10	37-23	574.5	L	1913	--	--	869	587.2	- 4.8	E/C													
12-11	37-24	574.3	L	1912	--	--	1625	587.5	- 4.5	E/C													
12-12	37-25	574.1	S	1912	--	--	543	586.7	- 5.3	E/C													
12-13	37-UN	573.3	C	1893	--	--	388	587.9	- 4.1	E/C													
12-14	37-2	--	C	--	--	--	--	--	--	E/C													
12-15	37-18	573.3	S	1911	1929	RF	378	586.9	- 5.1	10/25	--	- 5.14	I	6	0	100	0	0	12.9	26.8	1.48	2.09	1.24
12-16	37-17	573.0	S	1911	1929	RP	473	587.4	- 4.6	10/25	480	- 4.24	I	2	0	100	0	0	10.6	8.2	1.31	2.12	1.27
12-17	37-33	572.8	S	1913	--	--	634	588.2	- 3.8	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
12-18	37-14	572.3	C	1911	--	--	798	587.2	- 4.8	E/C													
12-19	37-15	572.1	S	1911	--	--	650	586.5	- 5.5	E/C													
12-20	37-16	571.9	S	1911	1928	RP	350	588.6	- 3.4	E/C													
12-21	38-6	568.9	S	1902	1922	RP	480	585.5	- 6.5	10/29	690	-6.27	S	7	1	99	0	0	10.4	9.4	1.94	3.30	2.05
12-22	38-5	568.7	S	1902	1928	RP	702	587.2	- 4.8	10/29	750	-6.00	S	3	0	100	0	0	9.4	8.6	1.91	3.85	2.05
12-23	38-13	568.5	S	1912	1928	RP	796	588.1	- 3.9	10/29	900	-3.54	S	6	58	42	0	0	6.6	23.3	1.72	2.63	1.56
12-24	38-10	568.3	S	1902	1912 1913 1928	> Ex 290 RP	854	587.0	- 5.0	E/C													
12-25	38-16	568.1	S	1918	1928	RP	610	587.4	- 4.6	10/29	--	-2.60	S	5	0	100	0	0	6.6	7.4	1.60	1.91	1.56
12-26	38-17	567.3	S	1913	1929	Ex 250	350	584.7	- 7.3	10/29	300	-6.60	S	2	22	78	0	0	7.9	8.5	1.87	2.82	1.45
12-27	38-15	567.1	L	--	1940	RM 496	367	584.4	- 7.6	10/29	300	-4.70	S	3	15	56	24	5	9.1	10.8	1.38	2.41	1.84
12-28	38-14	566.8	C	1914	1940	RM	--	586.1	- 5.9	RM													
12-29	38-20	565.8	S	1913	1940	RM	--	585.7	- 6.3	RM													
12-30	38-18	565.5	S	1913	1940	RM	--	586.4	- 5.6	RM													
12-31	38-21	564.3	S	1922	--	--	500	583.6	- 8.4	10/30	525	-7.65	S	3	10	90	0	0	20.8	25.6	1.64	3.12	1.17
12-32	38-4	564.1	S	1902	1926	RM 160	799	584.3	- 7.7	11/2	750	-7.84	S	7	0	100	0	0	16.8	20.3	1.38	2.30	1.41
12-33	38-3	563.9	S	1902	1922	RP	960	584.3	- 7.7	11/2	975	-7.01	S	6	0	100	0	0	15.6	16.0	1.72	2.37	1.60
12-34	38-22	563.7	S	1929	--	--	778	586.3	- 5.7	11/2	750	-4.57	S	7	32	68	0	0	13.8	12.1	1.48	3.04	1.13
12-35	38-23	563.5	S	1929	--	--	772	585.8	- 6.2	11/2	750	-4.71	S	1	0	100	0	0	9.9	9.1	1.38	2.23	1.17
12-36	38-24	563.3	S	1929	--	--	545	584.9	- 7.1	11/2	525	-5.61	S	4	10	90	0	0	11.4	11.8	1.31	1.48	.70
12-37	39-36	562.4	S	1922	--	--	305	581.5	-10.5	11/2	300	-5.21	S	3	5	95	0	0	19.8	23.8	1.20	2.12	1.27
12-38	39-37	562.2	L	1922	--	--	984	582.6	- 9.4	11/2	1000	-8.67	S	4	27	73	0	0	14.8	14.6	1.60	2.09	1.52
12-39	39-38	562.1	S	1922	--	--	413	584.4	- 7.6	11/2	400	-6.64	S	7	7	93	0	0	11.4	11.6	1.48	2.19	1.72
12-40	39-47	561.8	C	1927	--	--	550	582.8	- 9.2	11/2	500	-7.17	S	6	5	95	0	0	16.2	19.8	1.64	1.87	1.80

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH DEPTH	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
12-41	39-15	560.5	C	1901	1926	RP	608	581.5	-10.5	10/31	600	- 8.97	I	5	0	100	0	0	9.6	7.6	1.52	2.12	1.31
12-42	39-35	560.9	S	1914	--	--	800	583.7	- 8.3	E/C													
12-43	39-14	559.7	C	1901	1926	NT 60	658	582.7	- 9.3	11/5	600	-10.33	S	6	7	93	0	0	15.1	16.7	1.02	1.41	1.45
12-44	39-16	559.4	S	1901	1925	RP	1590	--	--	9/28	2190	- 9.08	S	4	24	73	3	0	17.1	28.9	.72	.88	.75
12-45	39-20	558.9	S	1913	--	--	520	582.0	-10.0	11/5	500	- 8.50	S	1	21	78	1	0	16.5	16.1	1.09	1.72	.99
12-46	39-22	558.8	S	1913	--	--	--	583.0	- 9.0	E/C													
12-47	39-23	558.8	S	1913	--	--	500	582.7	- 9.3	11/5	100	- 9.10	S	7	12	88	0	0	16.4	13.9	1.17	1.56	1.20
12-48	39-24	558.7	S	1913	--	--	469	581.5	-10.5	RM													
12-49	39-26	558.4	S	1913	--	--	748	581.3	-10.7	E/C													
12-50	39-28	558.3	S	1913	--	--	455	581.6	-10.4	E/C													
13-1	39-5	556.0	S	1897	1914	RP	364	582.1	- 0.9	8/27	300	- 4.23	O	4	0	0	75	25	9.7	10.5	1.48	2.01	1.31
13-2	39-7	555.8	S	1897	1914	RP	469	580.7	- 2.3	8/30	525	- 5.81	S	3	70	28	2	0	11.7	16.8	.99	1.68	.81
13-3	39-4	555.6	S	1897	1934	RP	846	581.4	- 1.6	8/28	900	- 5.04	S	4	21	78	1	0	18.0	19.1	.73	2.67	1.02
13-4	39-3	555.4	S	1897	1914	RP	1270	582.6	- 0.4	8/28	1050	- 4.70	S	7	0	99	1	0	9.3	8.9	.91	1.68	1.27
13-5	39-31	555.1	S	1914	1934	RP	560	582.6	- 0.4	8/30	600	- 5.75	S	7	14	86	0	0	14.6	12.8	1.02	2.30	1.27
13-6	39-17	554.9	S	1901	1925 1934	Ex 150 RP	430	582.5	- 0.5	8/28	390	- 5.94	I	7	0	50	50	0	11.6	10.9	1.52	2.86	1.27
13-7	39-17	554.9	C	1901	1934	RP	832	582.5	- 0.5	8/30	750	- 5.58	I	3	0	100	0	0	12.9	14.9	1.06	2.16	.81
13-8	39-18*	554.6	S	1901	1925 1934	Ex 250 RP	600	582.1	- 0.9	8/30	675	- 5.85	I	7	0	100	0	0	11.5	10.1	.73	1.98	1.06
13-9	39-18	554.6	C	1901	1934	RP	713	582.1	- 0.9	8/31	750	- 5.88	I	4	0	100	0	0	12.7	12.6	1.09	1.94	.99
13-10	39-19*	554.4	S	1901	1915 1934	Ex 850	975	581.4	- 1.6	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
13-11	39-19	554.4	C	1901	1934	RP	229	581.4	-1.6	8/31	975	-6.04	I	1	20	70	10	0	10.1	11.0	1.17	1.60	1.17
13-12	40-3	552.6	S	1916	1932	RP	840	581.6	-1.4	8/31	840	-6.21	S	6	0	100	0	0	19.2	18.5	1.60	1.48	1.24
13-13	40-4	552.5	S	1916	1934	RP	807	582.0	-1.0	9/7	1320	-5.57	0	6	0	99	1	0	13.1	23.3	1.24	1.41	1.09
13-14	40-17	552.3	S	1928	1934	RP	939	581.6	-1.4	9/7	1380	-5.31	S	3	0	100	0	0	10.0	9.1	.95	1.60	1.20
13-15	40-18	552.1	C	1928	--	--	750	581.9	-1.1	E/C													
13-16	40-18	552.1	C	1928	--	--	315	581.9	-1.1	9/7	315	-6.21	--	1	0	90	10	0	10.3	9.6	1.24	1.87	1.34
13-17	40-20*	552.0	S	1929	--	--	1113	580.4	-2.6	9/20	285	-2.28	S	3	2	98	0	0	10.8	15.2	1.41	2.34	.94
13-18	40-20	552.0	C	1929	--	--	350	580.4	-2.6	E/C													
13-19	40-5*	551.8	S	1916	1928	RP	500	580.9	-2.1	9/7	351	-6.91	S	3	0	100	0	0	8.8	22.2	.95	1.17	.62
13-20	40-5	551.8	C	1916	1928	RP	703	580.9	-2.1	9/7	705	-6.07	S	6	0	100	0	0	10.0	28.6	.66	1.27	.99
13-21	40-6	551.6	S	1916	1976	RP	736	581.6	-1.4	9/7	1020	-5.37	S	3	0	100	0	0	12.8	26.2	.44	1.17	.66
13-22	40-7	550.7	L	1916	1941	RM 200	736	581.6	-1.4	9/10	1425	-2.98	0	6	0	45	55	0	16.3	36.1	1.17	3.08	.40
13-23	40-21	550.4	S	1929	1976	RP	951	581.7	-1.3	9/10	1200	-4.12	0	6	0	100	0	0	11.4	30.1	.66	1.72	.47
13-24	40-22	550.3	S	1929	1976	RP	1083	581.9	-1.1	9/10	1200	-3.12	0	6	0	100	0	0	10.1	31.2	.70	2.19	.77
13-25	40-23	550.1	S	1929	1976	RP	935	581.8	-1.2	9/10	840	-3.48	0	3	12	88	0	0	9.6	19.6	.91	2.01	.84
13-26	40-13	546.3	S	1924	1978	RP	452	577.9	-5.1	9/10	360	-7.05	S	4	0	99	1	0	18.7	30.1	1.64	3.19	1.41
13-27	40-14	546.2	S	1924	1978	RP	563	577.8	-5.2	9/10	450	-7.05	S	3	2	97	1	0	17.4	19.0	.55	1.94	.99
13-28	40-15	546.0	S	1924	1978	RP	478	579.6	-3.4	9/12	285	-6.24	S	3	1	95	4	0	17.6	23.0	.81	1.98	.70
13-29	40-16	545.9	S	1924	1978	RP	598	579.5	-3.5	9/12	264	-5.91	S	7	0	100	0	0	14.2	10.1	.77	1.56	.84
13-30	40-9	545.1	S	1917	1923	Ex 200	720	578.0	-5.0	E/C													
13-31	40-10	545.0	S	1917	1922	Ex 430	768	578.1	-4.9	E/C													
13-32	40-11	544.8	S	1922	--	--	715	578.0	-5.0	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
13-33	40-12	544.7	S	1923	--	--	485	578.2	-4.8	E/C													
13-34	41-16	543.4	C	1923	1926	RP	630	576.9	-6.1	9/11	900	-7.28	S	6	0	94	6	0	12.1	23.8	2.01	2.01	1.52
13-35	41-2	541.4	S	1887	1892	RP	600	573.8	-9.2	E/C													
13-36	41-1	541.4	C	1887	--	--	336	576.3	-6.7	E/C													
13-37	41-6	540.9	S	1892	1931	RP	360	577.1	-5.9	9/13	360	-7.16	0	2	39	60	1	0	26.7	37.7	.77	1.98	.09
13-38	41-7	540.8	S	1892	1931	RP	717	577.7	-5.3	9/25	975	-6.06	0	3	38	61	1	0	23.9	10.1	.66	2.01	1.24
13-39	41-4	540.7	C	1892	1931	RP	852	578.1	-4.9	9/25	1020	-4.39	0	5	99	1	0	0	9.8	9.9	1.06	1.34	.81
13-40	41-5	540.4	C	1892	--	--	200	576.9	-6.1	E/C													
13-41	41-11	539.5	S	1894	--	--	380	576.9	-6.1	E/C													
13-42	41-10	539.2	S	1894	--	--	955	575.6	-7.4	E/C													
13-43	41-9	538.9	C	1894	--	--	--	--	--	E/C													
13-44	41-2	538.7	C	1894	--	--	--	--	--	E/C													
13-45	42-4	537.1	S	1905	1978	RP	1230	575.0	-8.0	9/25	1800	-6.08	I	2	0	96	4	0	14.7	16.2	1.34	2.34	1.31
13-46	42-5	536.9	S	1906	1928	RP	825	581.0	-2.0	9/25	1020	-4.28	I	6	0	100	0	0	13.3	31.8	1.20	2.34	1.41
13-47	42-40	536.8	S	1927	1928	Ex 225	550	581.5	-1.5	9/25	600	-6.67	I	4	45	55	0	0	30.5	24.1	1.41	1.64	1.02
13-48	42-6	536.3	C	1906	--	--	300	574.5	-8.5	E/C													
13-49	42-43	533.4	S	1928	1929	RP	602	573.7	-9.3	9/25	675	-5.11	0	3	39	61	0	0	14.9	29.0	.62	1.06	.59
13-50	42-17	533.3	L	1917	1929	RP	765	576.0	-7.0	9/25	1200	-6.37	0	7	49	51	0	0	14.1	11.1	.81	.81	.59
13-51	42-15	533.1	C	1917	1962	RS, RP	1045	573.9	-9.1	9/25	1125	-2.37	0	4	11	69	20	0	10.8	36.2	.81	2.74	.47
13-52	42-44	532.8	S	1929	--	--	294	574.8	-8.6	9/25	300	-8.04	I	7	2	98	0	0	23.8	26.8	1.06	2.23	.66
13-53	42-45	532.6	S	1929	--	--	577	577.1	-5-9	9/27	630	-4.88	I	5	20	80	0	0	8.8	7.3	.95	1.24	.91
13-54	42-46	532.4	S	1929	--	--	694	577.4	-5.6	9/25	1050	-4.98	I	4	60	40	0	0	20.9	11.7	1.31	1.98	1.13
13-55	42-47	532.3	S	1929	--	--	532	577.2	-5.8	9/27	450	-4.12	I	5	41	59	0	0	7.6	7.8	1.02	1.24	.91

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
13-56	42-36	530.7	S	1925	--	--	139	577.2	-5.8	9/27	90	-12.05	0	4	9	60	40	0	26.2	27.8	1.38	1.24	.73
13-57	42-37	530.6	S	1925	--	--	505	575.5	-7.5	9/27	225	-7.05	0	4	25	53	22	0	14.5	25.5	1.06	1.31	.55
13-58	42-34	530.3	S	1924	1926	RP	885	575.6	-7.4	9/27	510	-6.05	0	7	0	99	1	0	15.1	14.6	1.20	1.64	.88
13-59	42-35	530.1	S	1924	1926	RP	1050	575.0	-8.0	E/C													
13-60	42-28	529.1	C	1924	1929	RP	341	573.5	-9.5	E/C													
13-61	42-27	528.9	C	1924	1926	RP	235	572.5	-10.5	E/C													
13-62	43-17	524.6	C	1904	--	--	277	569.9	-13.1	E/C													
13-63	43-22*	524.1	S	1904	--	--	--	--	--	E/C													
13-64	43-22	524.1	C		--	--	--	--	--	E/C													
13-65	43-21	524.0	S	1904	1924	Ex 195	653	572.8	-10.2	E/C													
13-66	43-27	523.8	S	1924	--	--	775	571.4	-11.6	E/C													
13-67	43-28	523.6	S	1924	--	--	821	572.3	-10.7	E/C													
13-68	43-29	523.4	S	1924	--	--	679	574.1	-8.9	E/C													
13-69	43-30	523.2	S	1924	--	--	693	573.3	-9.7	E/C													
13-70	43-31	523.1	S	1924	--	--	632	574.2	-8.6	E/C													
13-71	43-32	522.8	S	1924	--	--	630	573.3	-9.7	9/27	255	--	--	--	100	0	0	0	--	--	.26	.32	.26
13-72										E/C													
14-1	43-49	522.5	S	1928	1935	RM 275	600	574.5	+2.5	RM													
14-2	43-1	522.3	S	1894	1924	RP	382	570.8	-1.2	10/1	288	-1.34	S	2	5	95	0	0	9.5	5.4	.30	.44	.12
14-3	43-2	522.3	C	1894	1924	RP	300	571.4	-0.6	E/C													
14-4	43-2	522.3	C	1894	1924	RP	300	571.4	-0.6	E/C													
14-5	43-40	522.4	S	1924	--	RM	591	571.4	-0.6	RM													
14-6	43-3	522.2	S	1894	1924	Ex 175	600	568.8	-3.2	10/1	705	-4.54	S	3	0	90	10	0	19.5	23.9	.88	.66	.55

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	% SD	% GR	% BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	ON	DOWN
14-7	43-38	522.1	C	1924	1928	Ex 50	702	571.1	-0.9	10/1	201	-1.21	S	7	90	10	0	0	8.1	3.6	.18	.22	.08
14-8	43-39	521.9	S	1924	1928	Ex 375	625	574.6	+2.6	E/C													
14-9	43-25	--	S	1907	--	--	509	572.2	+0.2	Removed in bridge construction													
14-10	44-23	520.0	S	1927	--	--	1117	574.6	+2.6	10/4	1410	-4.42	S	4	25	55	20	0	33.4	28.1	1.38	1.38	.55
14-11	44-19	519.9	C	1924	--	--	158	568.8	-3.2	E/C													
14-12	44-24*	519.8	S	1927	--	--	200	573.8	+1.8	10/4	450	-5.39	O	4	19	77	4	0	30.9	23.2	.55	.84	.66
14-13	44-24	519.8	C	1927	--	--	200	573.8	+1.8	E/C													
14-14	44-29	519.6	L	1928	--	--	895	572.0	0.0	E/C													
14-15	44-28	519.4	S	1928	--	--	440	572.8	+0.8	10/4	300	-5.19	S	3	23	56	21	0	13.2	15.5	.88	1.27	.73
14-16	44-18	519.3	C	1924	1952	RS	426	569.1	-2.9	Unable To Map - Flood Wall Built On Top													
14-17	44-9	519.0	S	1900	--	--	220	567.7	-4.3	E/C													
14-18	44-17	517.5	L	1924	1961	EX	1300	569.2	-2.8	10/4	EM	S	--	--	--	--	--	--	--	--	--	--	--
14-19	44-20	513.8	S	1925	--	--	760	568.4	-3.6	10/5	1320	-3.76	S	4	50	50	0	0	8.3	12.6	.70	1.64	1.09
14-20	44-21	513.6	S	1925	--	--	575	570.1	-1.9	10/5	780	-4.30	S	4	25	75	0	0	10.0	11.1	1.09	1.31	.95
14-21	44-22	513.5	S	1925	--	--	430	569.1	-2.9	10/5	720	-6.66	S	4	23	65	12	0	16.1	13.7	1.31	1.56	.91
14-22	45-2	511.3	S	1898	1925	RP	1359	568.4	-3.6	10/5	720	-5.00	S	2	0	100	0	0	10.8	10.3	1.20	1.87	1.06
14-23	45-3	511.1	C	1899	--	--	580	568.4	-3.6	10/5	252	-3.55	I	4	40	60	0	0	7.8	8.8	.81	1.13	.73
14-24	45-4	511.1	S	1899	1925	RP	857	568.4	-3.6	10/8	1020	-3.08	S	3	2	98	0	0	12.1	13.9	.81	1.06	.36
14-25	45-36	510.5	S	1925	--	--	825	568.6	-3.4	E/C													
14-26	45-10*	510.3	S	1910	1925	RP	300	568.7	-3.3	10/8	222	-2.18	S	3	69	31	0	0	12.3	12.1	.59	.99	.44
14-27	45-10	510.3	C	1910	1925	RP	600	568.7	-3.3	E/C													
14-28	45-11	510.1	S	1910	1925	Ex 285	1215	569.6	-2.4	10/8	1350	-4.28	S	6	12	88	0	0	13.1	22.6	.81	1.34	.84
14-29	45-15*	510.0	S	1919	1925	Ex 625	500	568.7	-3.3	10/8	480	-3.05	O	3	50	49	1	0	15.2	15.1	.70	1.31	.91
14-30	45-15	510.0	C	1919	1925	RP	500	568.7	-3.3	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
14-31	45-37	509.8	S	1925	--	--	1230	568.8	-3.2	10/9	1800	-4.17	0	3	37	63	0	0	16.2	18.3	1.06	1.60	1.80
14-32	45-16*	509.6	C	1919	1925	Ex 980	1000	567.8	-4.2	10/9	1600	-4.00	S	5	0	100	0	0	7.6	9.0	.88	1.09	.95
14-33	45-16	509.6	T	1919	1925	Ex 980	1000	567.8	-4.2	10/9	1350	-4.03	S	4	0	100	0	0	16.5	20.0	.99	1.38	.84
14-34	45-12	509.3	S	1910	--	--	550	566.6	-5.4	10/8	375	-5.75	S	6	11	89	0	0	16.2	20.4	.66	1.24	.84
14-35	45-13	509.2	C	1910	--	--	735	573.8	+1.8	10/9	1650	-6.43	S	4	0	100	0	0	16.2	14.2	.66	1.09	.81
14-36	45-23	507.6	C	1923	--	--	568	567.0	-5.0	10/9	675	-5.20	S	3	0	100	0	0	11.9	23.9	.66	.99	.30
14-37	45-27	506.2	S	1924	--	--	483	568.8	-3.2	10/9	510	-2.67	0	3	95	5	0	0	8.6	19.5	.77	1.02	.30
14-38	45-26	506.0	S	1924	--	--	841	568.9	-3.1	10/9	1050	-3.47	0	6	55	45	0	0	14.6	23.5	.66	1.38	.66
14-39	45-25	505.9	S	1924	--	--	1656	569.5	-2.5	10/9	375	-1.97	0	7	70	30	0	0	5.9	7.8	.62	1.24	.47
14-40	45-17	505.4	C	1921	--	--	700	569.2	-2.8	10/9	1425	-3.33	0	4	22	77	1	0	15.2	20.2	.81	2.09	.88
14-41	45-18	504.6	C	1922	--	--	335	566.7	-5.3	E/C													
14-42	46-12	501.3	S	1927	--	--	335	567.7	-4.3	10/10	365	-3.98	S	4	45	6	19	30	8.5	8.5	.51	.73	.47
14-43	46-13	501.2	S	1927	--	--	451	567.0	-5.0	10/10	870	-5.15	S	4	52	36	6	6	17.3	21.5	.99	.77	.33
14-44	46-14	501.0	S	1927	--	--	900	566.2	-5.8	10/10	1200	-5.81	S	1	39	61	0	0	10.5	11.1	.84	.91	.40
14-45	46-10	500.8	S	1927	--	--	1090	565.4	-6.6	10/10	--	-6.15	S	3	85	15	0	0	9.2	15.5	.84	.91	.70
14-46	46-1	500.4	S	1924	--	--	970	567.7	-4.3	E/C													
14-47	46-2	500.1	L	1924	1925 1927	Ex 1210	1890	566.0	-6.0	10/10	--	-4.61	S	3	26	73	0	0	10.0	12.4	.70	1.09	.62
14-48	46-3	499.8	S	1924	1925	RP	680	565.8	-6.2	10/10	1200	-3.95	S	3	45	55	0	0	13.7	37.0	.62	1.20	.40
15-1	47-3	491.0	S	1891	1895	RS Ex 100 PD	1550	--	--	9/12	1500	-3.30	S	7	0	100	0	0	9.1	7.0	1.00	3.85	2.25
15-2	47-6½	489.9	S	1891	1899	WD	850	--	--	9/12	900	-3.56	S	1	0	100	0	0	9.2	10.0	1.50	2.80	1.10

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
15-3	47-9	488.1	S	1890	1936	RM	535	--	--	RM													
15-4	47-9½	487.9	S	1895	1936	RM	1250	--	--	RM													
15-5	47-10	487.8	S	1892	1936	RM 500	105	--	--	RM													
15-6	47-37	487.7	S	1912	1936	RM	--	--	--	RM													
15-7	47-18	487.6	S	1896	1936	RM	830	--	--	RM													
15-8	47-36	487.5	S	1912	1936	RM	--	--	--	RM													
15-9	47-35	487.5	S	--	1936	RM	--	--	--	RM													
15-10	47-34	487.1	S	1912	1936	RM	--	--	--	RM													
15-11	47-33	486.9	S	1912	1936	RM 290	--	--	--	RM													
15-12	47-32	486.7	S	1894	1936	RM 722	--	--	--	RM													
15-13	47-16	486.5	S	1895	1936	RM 915	735	--	--	9/12	750	-11.13	S	1	0	100	0	0	9.0	13.9	1.95	2.20	1.50
15-14	47-31	486.4	S	1895	1936	RM 839	--	--	--	RM													
15-15	47-30	486.2	S	1912	1936	RM 1025	--	--	--	RM													
16-1	48-33	481.2	S	1929	--	--	990	544.7	-0.3	9/13	1350	-4.69	O	2	0	100	0	0	12.3	10.6	2.20	2.70	2.20
16-2	48-35	481.0	S	1929	--	--	1426	546.3	+1.3	9/13	1350	-2.92	O	7	0	100	0	0	10.6	12.7	2.00	4.40	1.80
16-3	48-34	480.7	S	1929	--	--	760	543.7	-1.3	9/13	660	-6.15	O	6	0	63	37	0	13.5	14.9	1.50	3.80	2.40
16-4	48-36	480.4	S	1929	--	--	690	544.0	-1.0	9/13	660	-7.25	O	3	0	51	49	0	13.6	18.8	2.30	4.10	2.00
16-5	48-37	480.2	S	1929	--	--	515	542.0	-3.0	9/14	570	-6.92	I	3	0	81	19	0	19.2	20.8	1.60	3.60	1.70
16-6	48-38	479.9	S	1929	--	--	720	542.5	-2.5	9/14	675	-6.49	I	2	0	100	0	0	14.0	12.7	1.80	2.80	1.90
16-7	48-4	479.6	S	1896	1939	RM 290	790	541.5	-0.5	9/14	750	-4.29	I	4	0	100	0	0	12.0	11.4	1.50	1.90	1.20
16-8	48-2	479.4	S	1896	1936 1939 1967	RM 790	400	546.2	+1.2	9/14	570	-2.89	I	3	0	93	7	0	9.9	9.1	.90	3.40	1.00

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
16-9	48-3	479.2	S	1896	1936 1939 1967	RM 865	217	546.4	+1.4	9/14	675	-2.52	I	3	0	88	12	0	11.0	9.9	1.30	3.50	1.30
16-10	48-5	470.0	S	1896	1936 1939 1967	RM 720	463	546.2	+1.2	9/17	870	-1.45	I	7	37	63	0	0	9.8	8.3	1.40	2.90	.80
16-11	48-6	478.7	S	1896	1939 1967	RM 390	500	541.9	-3.1	9/17	630	-5.29	I	3	17	83	0	0	8.1	8.3	1.20	1.70	1.30
16-12	48-7	478.6	L	1896	1967	RM 170	460	541.4	-3.6	9/17	1295	-5.15	S	7	2	79	19	0	11.9	10.3	1.60	1.75	1.55
16-13	48-8	478.6	S	1896	--	--	1500	543.0	-2.0	E/C													
16-14	48-12	478.1	S	1897	1926	RP	480	542.5	-2.5	9/17	600	-5.32	S	4	0	45	30	25	12.6	11.0	2.00	3.25	1.75
16-15	48-13	477.3	C	1901	1931	RP	1545	548.2	+3.2	E/C													
16-16	48-17	477.2	S	1901	1967	RM 170	170	543.4	-1.6	9/18	375	-9.59	O	3	0	27	73	0	15.5	14.1	1.70	2.80	2.20
16-17	48-23	477.0	S	1901	1967	RM 200	190	542.5	-2.5	9/18	156	-2.36	O	1	0	0	50	50	10.3	10.5	2.60	3.00	2.20
16-18	48-24	476.8	S	1901	1967	RM 210	80	542.6	-2.4	9/18	80	-3.53	S	7	0	4	94	2	7.9	5.9	1.80	2.20	1.60
16-19	48-20	476.3	S	1901	--	--	760	543.2	-1.8	9/18	600	-3.06	I	6	98	1	0	0	8.0	3.3	.50	.50	.50
16-20	48-21	476.1	S	1901	1968	RM 530	530	541.4	-3.6	RM - Commercial Loading Area													
16-21	48-22	475.9	S	1901	--	--	320	542.6	-2.4	9/18	435	-13.19	S	1	0	80	20	0	15.6	15.1	2.20	2.40	2.20
16-22	49-10	474.5	S	1907	1912	RP	120	542.2	-2.8	9/18	300	-5.16	I	7	45	55	0	0	12.6	10.1	1.40	2.30	1.50
16-23	49-15	474.3	S	1907	1912	RP	430	542.6	-2.4	9/18	600	-4.16	I	4	25	75	0	0	11.7	9.0	1.70	2.50	1.80
16-24	49-17	474.1	S	1907	1912	RP	570	542.4	-2.6	9/19	540	-3.18	S	3	12	88	1	0	8.5	9.8	1.20	2.40	1.00
16-25	49-19	473.9	S	1908	1912	RP	630	543.1	-1.9	9/19	420	-2.54	S	7	0	56	44	0	7.2	14.3	1.50	2.70	1.80
16-26	49-24	473.6	S	1912	--	--	310	541.7	-3.3	9/19	210	-4.98	S	3	50	50	0	0	14.8	14.7	.50	1.10	.40
16-27	49-25	473.5	S	1912	--	--	330	542.8	-2.2	9/19	291	-4.24	S	7	34	66	0	0	13.5	12.2	.60	1.50	.80
16-28	49-29	472.8	S	1912	--	--	550	540.6	-4.4	9/19	525	-6.71	S	6	37	63	0	0	13.5	14.0	1.50	2.80	1.60

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
16-29	49-28	472.6	S	1912	--	--	1080	541.3	-3.7	9/19	1095	-5.84	S	6	0	100	0	0	13.1	12.6	1.50	3.20	1.40
16-30	49-30	472.0	S	1912	--	--	550	537.5	-7.5	E/C													
16-31	49-42	470.8	S	1913	--	--	375	539.7	-5.3	9/19	309	-5.21	S	1	5	95	0	0	9.9	9.6	1.10	1.50	1.00
16-32	49-41	470.6	S	1913	--	--	330	540.3	-4.7	9/20	465	-7.21	S	1	0	75	25	0	14.8	14.8	1.90	2.70	1.60
16-33	49-40	470.4	S	1913	1938	RM 250	80	537.6	-7.4	9/20	360	-7.62	S	1	0	100	0	0	15.8	15.1	1.20	2.20	1.30
16-34	49-37	470.2	S	1913	1938	RM 200	265	539.2	-5.8	9/20	510	-7.18	S	1	0	88	12	0	16.5	16.8	1.00	1.50	.80
16-35	49-36	470.1	S	1913	--	--	400	539.0	-6.0	9/20	450	-7.85	S	6	0	88	12	0	15.8	13.6	1.00	2.10	1.20
16-36	50-34	467.0	S	1914	1928	RP	470	539.5	-5.5	E/C													
16-37	50-35	466.8	S	1914	1928	RP	578	547.2	+2.2	9/20	480	-8.22	S	7	0	100	0	0	16.5	15.8	1.50	2.20	1.60
16-38	50-31	466.6	S	1914	--	--	605	539.2	-6.0	9/20	285	-2.48	O	3	0	75	25	0	13.8	17.5	1.10	1.50	.60
16-39	50-30	466.4	S	1914	--	--	580	542.4	-2.6	9/21	240	-6.09	O	7	12	68	20	0	15.0	16.3	1.50	1.20	1.20
16-40	50-29	466.2	S	1914	--	--	650	537.6	-7.4	9/21	690	-5.55	O	2	25	60	15	0	15.3	14.4	1.40	2.30	1.30
16-41	50-16	466.0	S	1910	--	--	840	538.6	-6.4	9/21	870	-6.95	O	1	12	88	0	0	15.6	13.3	1.20	2.30	1.70
16-42	50-17	465.8	S	1910	--	--	990	538.5	-6.5	9/24	975	-6.28	S	1	37	63	0	0	14.2	13.7	1.30	2.50	1.50
16-43	50-33	465.6	S	1914	--	--	410	536.3	-8.7	9/24	291	-9.11	S	6	0	100	0	0	15.1	13.5	.80	2.40	1.60
16-44	50-18	465.4	S	1911	--	--	740	538.2	-6.8	9/24	900	-5.15	S	4	55	45	0	0	16.5	15.8	1.50	2.10	1.20
16-45	50-19	465.2	S	1911	--	--	540	538.1	-6.9	9/24	675	-6.65	S	7	12	88	0	0	13.3	12.2	1.20	1.80	1.40
16-46	50-22	464.9	S	1912	--	--	810	537.5	-7.5	E/C													
16-47	50-23	464.7	S	1912	--	--	540	537.3	-7.7	E/C													
16-48	50-41	464.5	S	1915	--	--	835	538.2	-6.8	E/C													
16-49	50-42	464.2	S	1915	--	--	1100	537.1	-7.9	9/24	570	-6.25	S	1	0	100	0	0	8.8	8.5	1.20	1.30	1.20
16-50	50-45	464.0	S	1915	--	--	800	539.2	-5.8	9/24	456	-5.91	S	2	0	100	0	0	12.0	10.9	1.20	1.40	1.30
16-51	50-3	463.0	S	1895	--	--	560	535.3	-9.7	9/25	585	-7.68	I	7	0	90	10	0	16.4	13.3	1.20	1.50	1.00
16-52	50-4	462.8	L	1895	1939	RM 210	750	537.0	-8.0	9/25	720	-7.04	I	4	0	96	4	0	12.1	12.0	1.75	2.25	1.25

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
16-53	51-12	462.1	S	1897	--	--	1780	536.3	-8.7	9/25	1650	-8.31	I	6	0	100	0	0	17.1	14.5	1.10	1.40	1.15
16-54	51-19	461.5	S	1913	--	--	650	535.0	-10.0	9/25	465	-8.41	I	2	0	100	0	0	12.6	10.9	1.70	1.80	1.60
16-55	51-23	460.9	S	1914	--	--	580	537.1	-7.9	E/C													
16-56	51-28	460.7	S	1924	--	--	920	534.9	-10.1	E/C													
16-57	51-22	460.5	S	1914	1924	RP	610	537.6	-7.4	E/C													
16-58	51-32	460.3	S	1927	--	--	325	545.5	+0.5	9/25	180	-1.81	S	4	58	42	0	0	11.9	8.1	.75	1.35	.30
16-59	51-13	458.1	S	1897	1928	RP	325	539.4	-5.6	9/25	195	-8.11	O	2	0	100	0	0	12.6	16.1	1.10	1.25	1.10
16-60	51-14	458.0	S	1897	1928	RP	133	536.8	-8.2	E/C													
16-61	51-24	457.6	S	1924	--	--	435	533.2	-11.8	9/25	420	-11.31	S	4	0	100	0	0	22.6	25.0	.85	2.00	1.00
16-62	51-25	457.4	S	1924	1935	RM	500	--	--	RM													
16-63	51-27	457.2	S	1924	1935	RM	425	--	--	RM													
17-1	51-7	456.4	S	1896	--	--	1110	532.8	-3.2	8/27	840	-4.49	S	6	0	100	0	0	8.6	9.4	.88	.91	.77
17-2	51-8	456.3	S	1896	--	--	1000	531.2	-4.8	8/28	975	-11.23	S	2	0	50	5	45	13.5	12.3	1.06	.97	.77
17-3	51-9	456.1	S	1896	--	--	750	532.5	-3.5	8/28	705	-7.07	S	1	0	53	5	42	12.1	12.3	.58	1.38	.99
17-4	52-5	448.0	L	1916	--	--	1070	531.4	-4.6	8/29	825	-6.42	S	2	0	91	9	0	11.5	11.8	1.05	1.68	.86
17-5	52-6	447.8	C	1917	--	--	792	533.2	-2.8	8/29	390	-6.42	S	3	0	75	25	0	13.6	11.7	1.38	2.97	1.10
17-6	52-6	447.8	C	1917	--	--	1190	533.2	-2.8	8/29	435	-5.52	I	1	0	83	17	0	9.1	9.3	1.10	2.23	1.11
17-7	52-7*	447.3	C	1916	--	--	600	532.7	-3.3	8/29	375	-5.72	I	1	0	78	22	0	7.6	8.4	1.07	1.44	1.05
17-8	52-7	447.3	C	1916	--	--	270	532.7	-3.3	E/C													
17-9	52-8	447.5	S	1918	--	--	1560	530.7	-5.3	E/C													
17-10	52-9*	447.0	S	1925	--	--	250	531.1	-4.9	8/30	285	-5.37	S	2	4	95	1	0	12.4	9.2	.88	1.53	.39
17-11	52-9	447.0	C	1925	--	--	500	531.0	-5.0	8/30	420	-3.47	S	5	25	75	0	0	11.4	20.7	2.27	2.38	2.27
17-12	53-26	446.7	S	1925	--	--	620	--	--	8/30	330	-6.77	I	1	7	93	0	0	9.5	9.9	2.38	2.50	2.00

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
17-13	53-24	446.4	S	1925	--	--	490	--	--	8/30	315	-8.00	I	1	0	89	11	0	13.2	12.7	.52	.99	.57
17-14	53-33	446.1	S	1925	1935	RT	1120	--	--	8/31	1350	-4.51	I	1	40	59	1	0	7.7	6.7	.68	1.72	.93
17-15	53-25	445.9	S	1925	--	--	525	--	--	8/30	381	-3.88	S	1	0	98	2	0	6.5	7.7	.49	1.01	.56
17-16	53-5	444.8	S	1899	1934	RP	555	533.1	-2.9	9/18	675	-7.23	S	3	0	50	12	38	20.2	19.8	.99	1.99	.43
17-17	53-6	444.6	S	1899	1934	RP	850	533.3	-2.7	9/18	765	-5.06	S	3	1	50	11	38	13.7	15.2	.56	1.72	.58
17-18	53-7	444.4	S	1899	1924 1934	Ex 200 RP	855	533.0	-3.0	9/18	1080	-6.50	S	2	1	91	8	0	19.5	18.0	.57	1.38	.43
17-19	53-21	444.1	S	1924	1935	RT,RE	850	--	--	9/27	900	-3.96	S	6	18	81	1	0	9.7	15.3	.85	1.87	.73
17-20	53-22	443.8	S	1924	1935	RT,RE	945	--	--	9/27	1025	-3.83	S	3	2	94	4	0	8.2	9.7	.81	1.72	.81
17-21	53-16	443.6	S	1917	1934	RP	1080	--	--	9/18	435	-4.76	S	6	0	100	0	0	10.2	15.5	.61	.99	.57
17-22	53-43	443.2	C	1928	--	--	700	--	--	9/18	750	-2.06	S	6	63	20	17	0	15.5	20.6	.48	1.01	.95
17-23	53-45	443.0	S	1928	--	--	710	--	--	9/18	750	-2.06	S	3	41	35	20	4	13.0	19.8	.31	1.50	.63
17-24	53-44	442.8	S	1928	--	--	409	--	--	8/31	360	-2.99	S	6	77	23	0	0	5.9	14.9	.24	.27	.40
17-25	53-33	439.8	S	1926	--	--	255	--	--	E/C													
17-26	53-38	439.5	S	1926	--	--	840	--	--	9/7	510	-3.86	I	1	19	69	12	0	6.5	6.6	.60	1.07	.59
17-27	53-8	439.2	S	1901	--	--	920	528.6	-7.4	E/C													
17-28	53-40	439.2	S	1926	1928	RP	881	--	--	9/7	435	-9.42	S	4	10	90	0	0	19.2	21.5	.97	1.35	.82
17-29	53-39	439.0	S	1926	--	--	878	--	--	10/8	222	-13.97	S	3	10	15	8	67	21.7	24.7	1.16	1.41	1.10
17-30	53-18	438.0	C	1917	1927	RP	100	--	--	E/C													
17-31	53-19	437.8	S	1917	1927	RP	450	--	--	9/7	135	-5.56	S	1	60	40	0	0	9.2	10.0	.69	.86	.57
17-32	53-20	437.6	S	1917	1927	Ex 325	720	--	--	9/7	705	-6.92	S	2	0	99	1	0	9.0	9.0	.53	.91	.54
17-33	54-4	437.4	S	1917	1927	RP	675	--	--	9/7	249	-4.66	S	2	35	60	5	0	7.7	8.7	.57	1.10	.50
18-1	54-32	437.0	S	1927	1935	RM 141	459	--	--	9/10	360	-15.8	S	3	0	53	47	0	26.6	28.8	1.13	1.68	1.07

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-2	54-34	436.7	S	1927	--	--	460	--	--	9/10	555	-5.47	S	3	25	75	0	0	16.4	26.2	.77	2.53	.99
18-3	54-10	436.0	S	1924	--	--	400	--	--	E/C													
18-4	54-5	435.8	S	1917	--	--	720	--	--	9/10	285	-11.40	S	3	69	31	0	0	21.6	25.8	1.72	1.72	1.92
18-5	54-6	435.6	S	1918	--	--	500	--	--	9/10	375	-8.03	S	3	37	63	0	0	16.5	17.9	.64	1.79	.59
18-6	54-3	435.3	C	1916	--	--	580	--	--	9/10	540	-7.30	S	3	75	5	19	1	15.3	27.8	.89	1.14	1.06
18-7	54-17	434.2	C	1927	1947	Rm 500	1300	--	--	E/C													
18-8	54-16	433.8	S	1927	1978	RP	500	--	--	9/11	900	-7.48	O	3	0	50	12	38	22.0	28.1	1.47	3.39	.98
18-9	54-15	433.5	S	1927	--	--	1400	--	--	9/11	1500	-10.61	I	1	0	96	4	0	19.0	19.4	1.01	1.87	1.32
18-10	54-18	433.0	S	1927	--	--	1155	--	--	9/11	825	-6.38	I	7	0	99	1	0	13.0	13.4	1.05	2.78	1.13
18-11	54-29	432.6	S	1927	--	--	1050	--	--	9/11	660	-10.28	I	3	0	97	3	0	19.4	20.1	.82	2.33	1.44
18-12	54-27*	432.1	S	1927	--	--	400	--	--	9/11	204	-3.05	I	5	0	100	0	0	7.3	7.4	.64	.86	1.03
18-13	54-27	432.1	C	1927	--	--	380	--	--	E/C													
18-14	54-27	432.1	C	1927	--	--	400	--	--	E/C													
18-15	54-26	431.8	S	1927	--	--	798	--	--	9/11	192	-4.18	S	4	23	25	2	50	15.1	19.1	1.44	1.95	.61
18-16	54-25	431.5	S	1927	1932	RM 65	495	--	--	9/11	285	-5.55	S	4	0	84	8	8	14.2	13.9	1.35	1.79	1.56
18-17	54-24	431.3	S	1927	1932	RM 215	829	--	--	9/11	120	-6.68	S	4	25	25	0	50	16.8	19.1	1.13	2.18	1.05
18-18	54-23*	431.1	S	1927	1932	Rm 335	500	--	--	9/11	150	-5.05	S	7	6	69	0	25	18.3	18.6	.91	2.78	.41
18-19	54-23	431.1	C	1927	--	--	800	--	--	9/11	120	-2.55	I	3	100	0	0	0	8.5	11.9	2.5	2.94	1.72
18-20	54-21	430.8	S	1927	1932	RM 150	1735	--	--	9/14	465	-5.92	S	4	0	50	1	49	23.9	23.5	.79	3.18	1.16
18-21	54-20	430.5	S	1927	--	--	1930	--	--	9/14	420	-11.95	S	3	0	0	12	88	17.6	23.0	1.21	2.28	.93
18-22	54-35	430.1	C	1928	--	--	1800	--	--	9/14	40	EP	S	4	50	0	0	50	18.0	20.5	1.51	2.08	1.75
18-23	54-38*	429.8	S	1928	--	--	450	--	--	9/14	360	-12.25	S	6	0	100	0	0	22.1	23.9	1.28	2.08	2.03
18-24	54-38	429.8	C	1928	--	--	500	--	--	9/14	330	-3.39	S	6	39	61	0	0	18.5	23.1	1.12	1.82	1.59
18-25	54-36	429.4	S	1928	--	--	1430	--	--	9/14	540	-7.09	S	6	29	70	1	0	16.9	22.5	1.13	1.72	.56

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-26	54-39*	429.1	S	1928	--	--	350	--	--	E/C													
18-27	54-39	429.1	C	1928	--	--	850	--	--	E/C													
18-28	54-37	428.8	S	1928	--	--	1110	--	--	9/20	420	-2.82	S	2	0	100	0	0	6.2	6.5	.90	1.79	1.25
18-29	54-1	428.9	C	1904	1954	RS	1130	--	--	9/14	900	-3.95	S	6	12	88	0	0	18.7	41.0	.85	5.56	1.21
18-30	55-19	428.6	S	1916	1919	EX	580	526.4	-1.6	9/20	150	-2.05	S	1	0	100	0	0	6.3	6.9	.73	1.47	.18
18-31	55-20	428.4	S	1918	--	--	1100	524.3	-3.7	E/C													
18-32	55-10	428.2	S	1904	1919	Ex 370	1225	524.8	-3.2	E/C													
18-33	55-12	428.0	S	1905	1919	Ex 200	1105	525.1	-2.9	9/19	1050	-4.60	S	2	1	99	0	0	10.3	9.0	1.10	1.56	1.35
18-34	55-22	427.7	S	1923	--	--	940	524.8	-3.2	9/19	750	-4.83	S	4	25	74	1	0	11.2	10.3	.99	2.08	1.19
18-35	55-24	427.4	S	1923	--	--	1020	526.1	-1.9	9/19	930	-5.00	S	2	0	90	10	0	10.1	8.4	1.07	2.53	1.05
18-36	55-23	427.2	S	1923	--	--	1000	524.8	-3.2	9/19	420	-5.00	I	5	0	100	0	0	9.9	9.6	1.25	2.08	1.13
18-37	55-21	426.9	C	1923	--	--	290	524.3	-3.7	E/C													
18-38	55-25	426.9	S	1923	--	--	685	524.0	-4.0	9/20	360	-5.38	I	1	0	75	25	0	10.4	8.8	1.72	1.72	1.60
18-39	55-27	426.6	S	1925	--	--	670	523.6	-4.4	E/C													
18-40	55-26	426.3	L	1925	--	--	1545	523.1	-4.9	E/C													
18-41	55-28*	426.0	S	1925	--	--	1240	522.2	-5.8	9/20	315	-5.82	S	3	50	49	1	0	13.6	14.4	.33	.80	.53
18-42	55-28	426.0	C	1925	--	--	620	522.2	-5.8	E/C													
18-43	55-29	425.7	S	1925	--	--	580	523.7	-4.3	9/25	450	-6.35	S	6	0	37	38	25	16.7	23.4	.54	1.23	.18
18-44	55-18	425.2	C	1889	1953	RS,RP	555	519.8	-8.2	9/25	480	-2.71	I	4	0	99	1	0	14.1	35.9	1.07	4.05	1.29
18-45	55-30	424.7	S	1925	--	--	800	523.3	-4.7	9/21	495	-6.30	I	7	48	50	2	0	12.0	15.8	.49	.52	.43
18-46	55-33	424.4	S	1928	--	--	615	527.9	-0.1	9/21	540	-4.66	S	2	0	75	25	0	14.2	13.4	.95	1.72	1.23
18-47	55-35*	424.1	S	1928	--	--	900	524.4	-3.6	9/21	435	-3.53	S	3	30	63	7	0	11.0	13.3	.93	1.53	1.05
18-48	55-35	424.1	C	1928	--	--	350	524.4	-3.6	9/25	135	--	S	5	21	70	9	0	4.0	3.3	.17	.91	.20
18-49	55-5	423.8	S	1899	1928	RP	1420	523.2	-4.8	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-50	55-4	423.7	C	1899	--	--	445	522.3	-5.7	E/C													
18-51	55-32	423.4	S	1928	--	--	1260	522.4	-5.6	E/C													
18-52	55-34	423.1	S	1928	--	--	1320	523.3	-4.7	E/C													
18-53	55-8	422.7	S	1903	1929	Ex 750	1490	527.8	-0.2	9/25	375	-1.55	S	3	17	82	1	0	9.6	11.9	.55	.79	.32
18-54	55-9	422.5	S	1903	1979	Ex 440	1475	528.7	+0.7	9/21	1650	-1.60	S	7	21	89	0	0	9.3	12.9	.43	.79	.16
18-55	56-3	421.9	C	1895	1963	RP	900	519.8	-8.2	9/25	840	--	S	6	14	60	1	25	11.1	37.2	.46	2.43	--
18-56	56-8	421.9	S	1905	1924	EX	910	523.3	-4.7	E/C													
18-57	56-9	421.8	S	1905	1924	EX	860	523.1	-4.9	E/C													
18-58	56-7	421.5	C	1903	1963	RP	400	522.3	-5.7	9/25	395	--	S	3	35	65	0	0	6.5	23.2	--	--	--
18-59	56-19	421.5	S	1926	--	--	450	521.4	-6.6	10/1	675	-7.63	S	7	1	99	0	0	15.8	15.6	1.13	1.28	.95
18-60	56-20	421.3	S	1926	--	--	450	519.1	-8.9	10/1	570	-8.49	S	2	20	77	3	0	17.8	17.5	.79	1.42	.75
18-61	56-21	421.1	S	1926	--	--	450	524.1	-3.9	9/25	390	-12.05	S	1	12	62	1	25	19.7	18.9	.93	1.40	1.01
18-62	56-22	420.9	S	1926	--	--	600	522.9	-5.1	9/25	540	-9.51	S	6	40	60	0	0	16.4	21.2	1.01	1.36	1.17
18-63	56-23	420.9	S	1926	--	--	600	522.2	-5.8	10/1	585	-7.83	S	3	5	93	2	0	14.9	21.6	1.04	1.53	1.05
18-64	56-24	420.4	L	1926	--	--	950	521.3	-6.7	10/1	960	-7.06	S	6	15	75	10	0	12.5	13.5	1.01	1.60	.94
18-65	56-2	420.3	L	1895	--	--	1400	523.7	-4.3	E/C													
18-66	56-10	419.5	L	1918	--	--	1717	520.1	-7.9	9/13	330	-9.78	I	4	16	59	0	25	21.3	25.4	.54	.83	.49
18-67	56-12	419.4	S	1918	--	--	600	520.0	-8.0	9/13	345	-8.62	S	7	30	67	3	0	17.9	21.4	.69	1.44	.65
18-68	56-13	419.2	S	1918	--	--	320	519.0	-9.0	E/C													
18-69	56-11	419.1	S	1918	--	--	100	521.2	-6.8	E/C													
18-70	56-18	418.9	S	1924	--	--	700	519.4	-8.6	9/13	195	-9.12	O	4	34	40	1	25	14.4	29.0	.65	1.15	.70
18-71	56-25	417.4	S	1927	--	--	425	521.5	-6.5	9/13	168	-6.82	I	3	50	50	0	0	17.0	20.6	.48	1.10	.22
18-72	56-4	417.2	S	1897	1927	RP	1180	519.9	-8.1	9/13	1185	-7.12	I	7	24	70	6	0	15.0	16.0	1.16	1.68	1.03
18-73	56-5	417.0	S	1897	1927	EX	1480	520.5	-7.5	E/C													

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18-74	56-6	416.7	S	1897	1927	EX	1960	521.4	-6.6	E/C													
18-75	57-3	416.3	S	1900	--	--	1140	521.0	-7.0	E/C													
18-76	57-11	415.9	L	1927	--	--	1425	520.1	-7.9	E/C													
18-77	57-2	415.8	S	1897	1931	RP	1400	521.0	-7.0	10/4	795	-7.14	S	7	24	75	1	0	17.2	21.1	.49	1.32	.72
18-78	57-1	415.8	S	1897	1927	EX 200	870	520.6	-7.4	E/C													
18-79	57-12	415.7	S	1927	--	--	550	517.7	-10.3	10/4	225	-5.36	S	7	27	71	2	0	10.2	9.5	1.07	1.19	.93
18-80	57-15	415.3	S	1927	--	--	700	520.0	-8.0	E/C													
18-81	57-14	415.0	S	1927	--	--	835	521.8	-6.2	E/C													
18-82	57-17	414.2	S	1927	--	--	980	518.5	-9.5	E/C													
18-83	57-18	414.0	S	1927	--	--	504	522.9	-5.1	E/C													
18-84	57-19	413.4	S	1927	--	--	425	522.2	-5.8	9/13	285	-7.32	S	2	64	35	1	0	12.7	16.8	.85	1.79	1.41
18-85	57-8	413.2	S	1915	1929	RP	820	518.8	-9.2	9/13	--	-9.28	S	4	40	35	25	0	14.5	25.3	.68	1.13	.73
18-86	57-9	413.0	S	1915	1938	RM 150	810	522.0	-6.0	E/C													
18-87	57-10	412.8	S	1915	1929	EX 225	720	515.5	-12.5	E/C													
19-1	57-4	410.4	C	1905	--	--	370	513.7	-4.5	E/C													
19-2	58-23	408.8	C	1948	--	--	1800	--	--	9/26	2100	EP	0	6	0	75	0	25	15.3	27.8	.23	--	.16
19-3	58-15	408.4	C	1897	--	--	486	--	--	E/C													
19-4	58-21	407.5	C	1905	--	--	450	--	--	9/26	435	-5.98	S	7	0	96	4	0	7.8	10.9	.28	.30	.28
19-5	58-1	407.0	C	1877	1897	RP	--	--	--	E/C													
19-6	58-4	406.9	C	1889	1900	RP	830	--	--	9/26	900	-7.44	0	6	17	82	1	0	17.9	17.8	.28	.22	.29
19-7	58-12	406.8	S	1891	1900	RP	945	--	--	9/26	975	-5.08	E	3	23	60	17	0	9.9	9.6	1.03	1.10	1.05
19-8	58-9	406.3	S	1891	1900	RP	810	--	--	9/26	465	-6.28	S	1	0	99	1	0	10.8	11.0	1.13	2.23	.86
19-9	58-16	405.5	S	1897	1935	RM	2080	--	--	RM													

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19-10	58-3	405.2	C	1881	--	--	460	--	--	E/C													
19-11	58-19	404.9	S	1903	1908	RF	3020	513.0	-5.2	9/26	2400	-6.48	S	4	0	62	33	5	18.4	26.4	1.11	1.46	.82
19-12	58-20	404.6	S	1903	1935	RM	450	--	--	E/C													
19-13	59-15	397.3	S	1899	--	--	800	--	--	10/9	270	-8.91	O	7	6	87	7	0	15.8	17.3	1.38	1.68	1.17
19-14	59-5	396.1	S	1895	--	--	764	--	--	E/C													
19-15	59-6	395.5	S	1895	--	--	900	--	--	E/C													
19-16	59-7	395.3	S	1895	--	--	800	--	--	E/C													
19-17	59-8	395.1	S	1895	--	--	1225	--	--	E/C													
19-18	60-10*	394.3	S	1895	1903	EX	400	--	--	E/C													
19-19	60-10	394.3	C	1895	1903	RP	200	--	--	E/C													
19-20	60-10	394.3	C	1895	1903	RP	200	--	--	E/C													
19-21	60-4	392.5	C	1892	1898	RP	660	--	--	E/C													
19-22	60-9	392.4	C	1893	1898	RP	258	--	--	E/C													
19-23	60-6	392.1	S	1893	--	--	940	--	--	10/9	750	-12.05	S	3	34	66	0	0	18.6	17.0	.82	1.10	.80
19-24	60-5	391.7	S	1893	--	--	1050	--	--	E/C													
19-25	60-7	391.4	S	1893	1898	RP	1300	--	--	E/C													
19-26	60-1	391.5	C	1878	--	--	--	--	--	E/C													
19-27	60-2	391.4	C	1878	--	--	--	--	--	E/C													
19-28	60-3	391.5	C	1878	--	--	--	--	--	E/C													
19-29	60-11	389.4	L	1889	1898	EX 800	1200	--	--	10/10	--	-13.46	S	3	33	30	1	35	21.1	22.2	--	--	--
19-30	60-12	389.0	S	1889	1899	RS 4 EX 100	1610	--	--	10/10	1040	-13.96	S	3	15	79	1	5	19.1	17.9	.72	.97	.69
19-31	60-25	388.7	S	1899	--	--	970	--	--	E/C													
19-32	60-13	388.5	S	1889	1892	RS 4	2240	--	--	10/10	1995	-12.56	I	1	75	25	0	0	17.6	17.4	.72	.85	.79

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
19-33	60-14	388.1	S	1889	1895	EX 500	2740	--	--	E/C													
19-34	60-20	387.4	S	1895	--	--	800	--	--	E/C													
19-35	60-29*	387.3	C	1909	--	--	230	--	--	E/C													
19-36	60-29	387.3	C	1909	--	--	230	--	--	E/C													
19-37	60-17	387.2	S	1889	1895	EX 150	1550	--	--	E/C													
19-38	60-16	387.0	C	1889	1907	RP	565	--	--	E/C													
19-39	60-18	386.6	S	1889	--	--	700	--	--	E/C													

*Subdivided dams

APPENDIX II

The Fish Research Section of the ICC (Bellevue Station) will conduct a four-year post study which will use the data acquired and wing dam classification system developed from this study. The project will be initiated during the spring of 1980. The study objectives and methods are:

TITLE: Wing Dam Investigations

OBJECTIVE(S): 1) Determine wing dam characteristics which are important to fish populations. 2) Develop a strategic plan to recommend construction and modification of wing dams which is compatible with the integrity of the fishery.

To accomplish these objectives the study will be comprised of at least four jobs.

JOB 1.

Title: Determine use of wing dams by adult fish

Objective: To determine the seasonal and diurnal use of wing dams by adult fish by determining species composition and relative abundance.

Procedures:

1. A minimum of 19% of the classified wing dams will be selected and samples for habitation by adult fish through a stratified selection design.

2. Fish sampling methods will include trammel and experimental gill nets, trap nets, and electrofishing equipment.

3. All fish collected will be identified by species, counted, measured, and its condition noted (especially during the spring reproduction season). If large numbers of a species are captured at a single station, length will be recorded from a randomly selected subsample.

4. Information collected will include relative abundance, catch-per-unit-effort, species abundance and composition, and length frequency.

5. Environmental parameters to be collected on each wing dam sampled include water temperature, turbidity as determined by Secchi disc, and water velocity measured at .6 of the depth upstream, downstream, and on the dam.

6. Determine those wing dam characteristics most conducive to adult fish use and identify seasonal and diurnal use patterns by appropriate statistical analyses.

Job 2.

Title: Use of wing dams for reproduction and by juvenile fish

Objective: Determine use of wing dams as spawning sites by adult fish species and habitation by juvenile fish for nursing activities.

Procedures:

1. Collection of gravid females and ripe males with gillnets, trammel nets, trap nets, and electrofishing equipment during the spawning season (April-July) will be used to estimate the importance of wing dams for reproduction.

2. Juvenile fish populations will be sampled with standardized meter net tows and larval fish traps at the designated wing dams for adult fish sampling.

3. Expected sampling regime, depending upon the distribution of the classification data and the ability to use the designated sampling methods during the time of year when current velocities, debris, and siltation are at their highest levels.

Number of wing dams to be sampled = 24

1 sampling period in April-May for ripe adults and juvenile fish

24 samples X 2 sampling regimes (adults and juveniles) = 48 samples

Sampling will be repeated for May-June, and June-July for a total of 144 samples per year.

4. All juvenile fish captured by meter net tows and fish traps will be identified and relative abundance determined by proportion.

5. Environmental parameters to be collected during each sample period include water temperature, turbidity as determined by Secchi disc, and water velocity measured at .6 of the depth upstream, downstream, and on the wing dam.

6. Determine those wing dam characteristics most conducive to fish reproduction and larval fish use by appropriate statistical analyses.

JOB 3.

Title: Adult fish use of wing dams as determined by radiotelemetry

Objective: Determine the importance of Mississippi River wing dam habitat to commercial food fish species.

Procedure:

1. Common commercial food fish, as determined by Job 1, will be tagged with radio transmitters to determine the extent of wing dam use and the wing dam types selected for occupancy.

2. Approximately 35 to 40 radio transmitters will be evenly distributed among 2 or 3 fish species. Transmitter attachment will be either internally or externally, depending upon the transmitter type, fish species, and field conditions.

3. Transmitters with the following minimum specifications will be used: 1) 6 month life expectancy 2) weight within 2% of the fish body weight 3) minimum signal reception distance of .5 mile. In the event that transmitters cannot be obtained that meet the above specifications, life expectancy will be sacrificed to obtain specifications 2 and 3.

4. Fish will be tagged in the spring and contacted throughout summer and fall. In the event that contact with the fish are lost, an attempt will be made to use an airplane to relocate the fish. If transmittered fish are captured and the tag returned, every effort will be made to place the transmitter on a different fish.

5. Tracking will consist of searching for tagged fish 7 days each month during May-Sept., totaling 35 days. Providing time and manpower permits, some night tracking is also contemplated.

6. Data analyses will consist of the percent of time spent in wing dam habitats compared to other habitats. Also, the type of wing dam use will be noted.

<u>JOB 4.</u>

Title: Document fishermen usage and catch on wing dams

Objective: Determine the extent commercial fishermen use wing dams.

Procedure:

1. Document fishermen usage by direct observation and personal contact.

2. Determine species sought, species harvested, catch-per-effort, and amount of time spent fishing wing dam habitats.

3. Associate the physical characteristics of wing dams with commerical fishing and fish occupation.

RESULTS AND BENEFITS EXPECTED:

This study will provide valuable information relative to the importance of wing dam habitats to fish and commercial fishing on the Upper Mississippi River. In addition, it will aid in designing and planning new hydrological navigation structures and the modification and repair of deteriorating structures.