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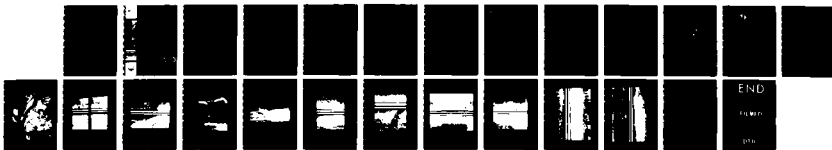
SIDE-SCAN SONAR SURVEY OF BAILEY'S DAM RED RIVER  
ALEXANDRIA LOUISIANA(U) COASTAL ENGINEERING RESEARCH  
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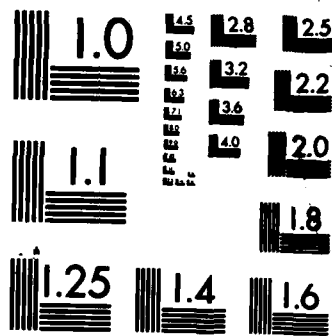
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MISCELLANEOUS PAPER CERC-85-9

SURVEY

# SIDE-SCAN SONAR OF BAILEY'S DAM, RED RIVER, ALEXANDRIA, LOUISIANA

by

Joan Pope

Coastal Engineering Research Center

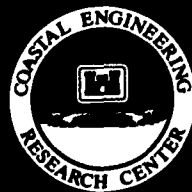
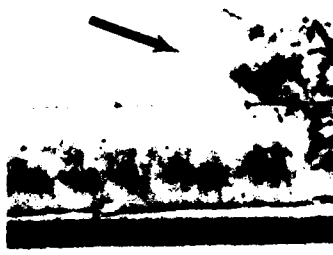
DEPARTMENT OF THE ARMY

Waterways Experiment Station, Corps of Engineers  
PO Box 631, Vicksburg, Mississippi 39180-0631



US Army Corps  
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AD-A160 182



September 1985

Final Report

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Prepared for

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A side-scan sonar survey was conducted of the Upper and Lower Bailey's Dams, which are submerged structures located in the Red River at Alexandria, Louisiana. These structures were built of timber, trees, and stone fill during the US Civil War and have historical significance. Example sonographs were obtained for the previously documented Lower Bailey's Dam to illustrate various dam features. A reconnaissance survey was performed of the area suspected to contain Upper Bailey's Dam. Several good (Continued)		

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20. ABSTRACT (Continued).

Sonograph images were obtained from this area and used to identify the probable position and condition of the upper dam. A number of example sonographs are included in this report along with a general discussion on the use and limitations of side-scan sonar for similar applications.

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PREFACE

This report was prepared by the US Army Engineer Waterways Experiment Station (WES) Coastal Engineering Research Center (CERC) for the US Army Engineer District, Vicksburg, to support their studies of the Red River Waterway, Pool 2, Bailey's Dam (reference DA 2544, No. 4333, 30 November 1984). The purpose of this work was to determine the condition and location of Upper Bailey's Dam in order that any project impacts to this cultural resource could be assessed. Ms. Joan Pope, Research Physical Scientist, Coastal Structures and Evaluation Branch, Engineering Development Division, conducted the survey and wrote the report under the general supervision of Mr. Thomas W. Richardson, Chief, Coastal Structures and Evaluation Branch. Messrs. John A. Loboda of CERC's Prototype Measurement and Analysis Branch and Thomas C. C. Birchett, Vicksburg District, assisted in conducting the survey. Dr. William L. Wood was Chief, Engineering Development Division, and Dr. Robert W. Whalin was Chief, CERC.

Commander and Director of WES during the preparation of this report was COL Robert C. Lee, CE; Technical Director was Mr. F. R. Brown. At the time of publication, Mr. Charles C. Calhoun was Acting Chief of CERC, COL Allen F. Grum, USA, was Director of WES, and Dr. Robert W. Whalin was Technical Director.



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UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

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DEPARTMENT OF THE ARMY  
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS  
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REPLY TO  
ATTENTION OF

WESCD-S

6 February 1985

MEMORANDUM FOR RECORD

SUBJECT: Side-Scan Sonar Survey of Bailey's Dam, Red River,  
Alexandria, Louisiana

1. On 20 December 1984 the Coastal Engineering Research Center (CERC) performed a side-scan sonar (SSS) survey of Upper and Lower Bailey's Dam, Red River, at Alexandria, Louisiana (Figure 1). The survey was conducted using a Klein Associates side-scan sonar system and a 21 foot MonArk survey vessel. The two dams were emergency structures built by Union forces during the Red River Campaign of the US Civil War. They were constructed of locally available timber and stone in an attempt to temporarily raise the local water level at Alexandria and allow a stranded fleet of Union vessels to escape the advancing forces of the Confederacy. Lower Bailey's Dam is intact and was well documented by Coastal Environments, Inc.\* in a November 1984 report prepared for the Vicksburg District. The condition and exact location of Upper Bailey's Dam was unknown. Bailey's Dam is on the National Register of Historic Places and the potential impact of the proposed Corps' Red River Waterway Project on these structures must be assessed for the Historical American Engineering Record (HAER). The intent of this SSS survey was to: (a) locate the upper dam and (b) determine its general condition as input for the HAER.

2. Although the lower dam is accessible during very low water, both structures were completely submerged at the time of this survey and navigation of the Red River was not impeded by the presence of these structures. Figure 2 is a stylized drawing of the original Civil War project. A large portion of the lower dam was constructed of layers of cut timber fashioned into a "Tree Dam" which extended across approximately half the channel from the north bank, a deep channel or "chute" across a third of the channel, and a few standard timber cribs along the south bank (Figure 3). Originally the upper dam consisted of a line of timber cribs built halfway across the channel from the south bank, a chute, and an arrowhead arrangement of a Tree Dam and a "Bracket Dam" built out from the north bank (Figure 2). Figures 1 and 4 may be used to illustrate the approximate location of these structures relative to modern features.

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\* Coastal Environments, Inc. 1984. "Archaeological Investigation and Preparation of Historic American Engineering Record Documentation for Lower Bailey's Dam (16 RA 90), Rapides Parish, Louisiana," draft report prepared for the Vicksburg District under contract No. PD-84-125.

SUBJECT: Side-Scan Sonar Survey of Bailey's Dam, Red River,  
Alexandria, Louisiana

3. Side-scan sonar emits a high frequency acoustical pulse which is reflected from the bottom or submerged features to produce an image. A pair of transducers is mounted in a "towfish" which is connected to an onboard recorder. The resultant SSS record or sonograph is a sound-produced image of the bottom on both sides of the towfish. Figure 5 is a comparison of two separate sonographs which were obtained during two different runs from an area downstream (south) of Lower Bailey's Dam. Across the center of both sonographs are the two dark bands which mark the towfish location. The horizontal scale lines are 15 m apart. Darker areas represent regions that are more sound reflective because they (a) have more relief (i.e., are positive features) or (b) are composed of a more sound-reflective substance (i.e., rock, concrete, or steel). The arrows point to the submerged portion of a modern crib which supports a sewer pipe outfall. Just below the crib is a target which appears to be a submerged log or tree. This figure illustrates the repeatability and resolution which is a significant advantage of a 500-kHz SSS system.

4. The SSS survey utilized both the higher range (100 m), lower resolution, 100-kHz system and a lower range (50 m), higher resolution, 500-kHz system. The 100-kHz system allowed surveying of the whole channel at one time, including general features and lineations of the channel bottom. The 500-kHz system allowed definition of the dam features. The lower sound-reflectivity properties of wood relative to the bedrock bottom which dominates the channel at the dam sites created a significant technical problem in attempting to get a good quality sonograph. SSS produces the best record definition when the target is significantly more sound reflective than the surrounding bottom material. During this survey the record from the Bailey's Dam sites was dominated by sound returns from the bedrock outcrops. Therefore, it was necessary to (a) manually tune the SSS for the objects of interest, (b) attempt many runs from different angles and using different boat speeds, (c) piece together one picture from numerous fragments of records, and (d) base the record interpretation on the presence of cross-channel lineations, regularly patterned areas, and areas where the bottom return was masked. Examples of the features observed and the interpretations made are illustrated in Figures 5-14.

5. Prior to searching for Upper Bailey's Dam, several SSS runs were made of Lower Bailey's Dam. This was done to verify that SSS could be used to document the presence of Bailey's Dam and to produce some reference sonographs for each of the various dam features. Portions of both the Tree Dam (Figures 6 and 7) and the cribs (Figures 8 and 9) are documented.

6. A series of runs was conducted from the Highways 71, 165, 167 Bridge under the Missouri-Pacific railroad bridge, to the new boat launching ramp just downstream of Bayou Rigoleta. As a result of this survey reasonable location for Upper Bailey's Dam has been identified. The survey continued to identify a cross-channel lineation or masking and even the suggestion of crib-like features in the midchannel area at a location approximately midway between the first and second reference poles downstream of the railroad bridge, labeled "C" and "D" in Figure 4 and the example sonographs (Figures 10-13).

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SUBJECT: Side-Scan Sonar Survey of Bailey's Dam, Red River,  
Alexandria, Louisiana

Although the survey produced a record of the Tree Dam at the lower dam, no evidence of a similar feature along the north bank side of the channel was evident for the upper dam. The sonographs from this area were clear and natural tree debris could be identified (Figure 14). Therefore, it appears that the Tree Dam and Bracket Dam are no longer intact for the upper dam. A portion of the timber crib section does appear to be intact in the midchannel area and may extend toward the south bank, where a sand shoal appears to be covering the remains.

7. SSS has become famous as a tool for finding lost objects and discovering ancient shipwrecks. This study carries that technology even further by illustrating the value of SSS for finding and defining the condition of other types of cultural resources. CERC has been actively developing the capability to remotely inspect coastal structures, but these features are usually rock or concrete targets on a less sound-reflective surface (i.e., sand or silt). The SSS survey of Bailey's Dams has proved the viability of inspecting low reflectivity targets and the ability to conduct shallow water surveys in a riverine environment. Each of these conditions may reduce record quality, but valuable information can still be obtained.

JOAN POPE  
Research Physical Scientist  
Coastal Engineering Research Center

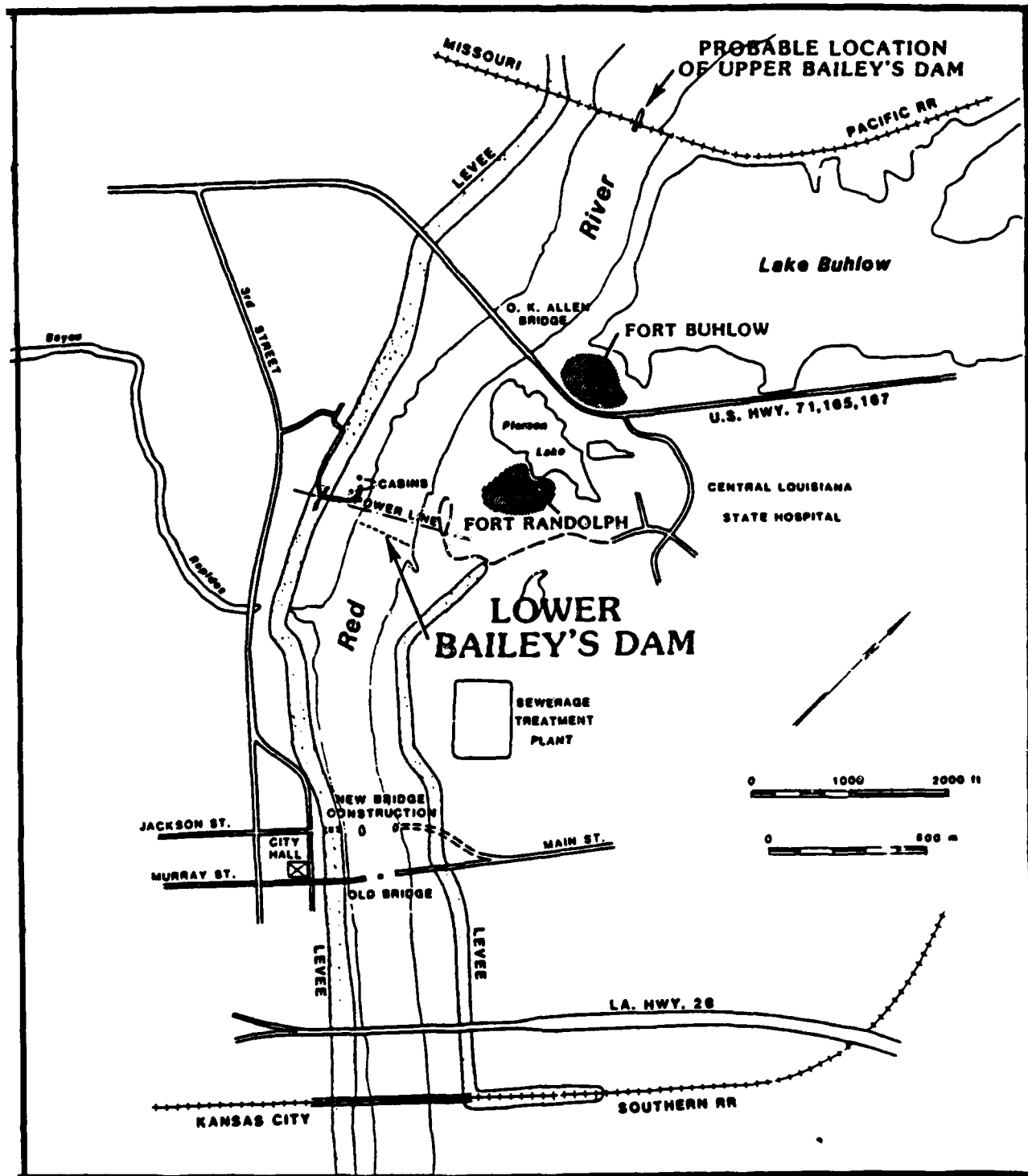


Figure 1. General map of Alexandria, Louisiana, showing the location of Bailey's Dams (Coastal Environments, Inc. 1984)



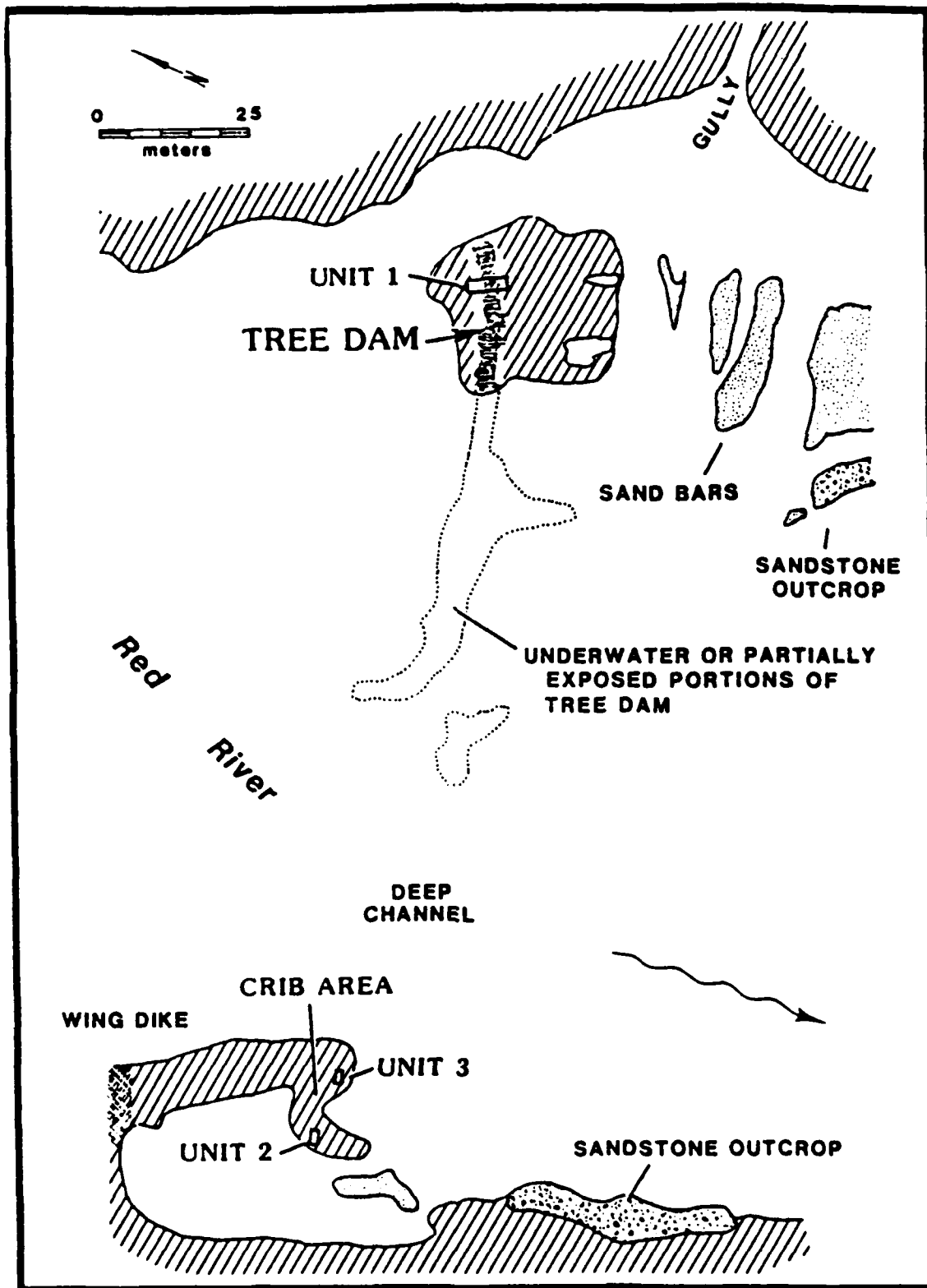


Figure 3. Plan of present condition of Lower Bailey's Dam  
 (Coastal Environments, Inc. 1984)



Figure 4. 21 Mar 84 aerial photograph

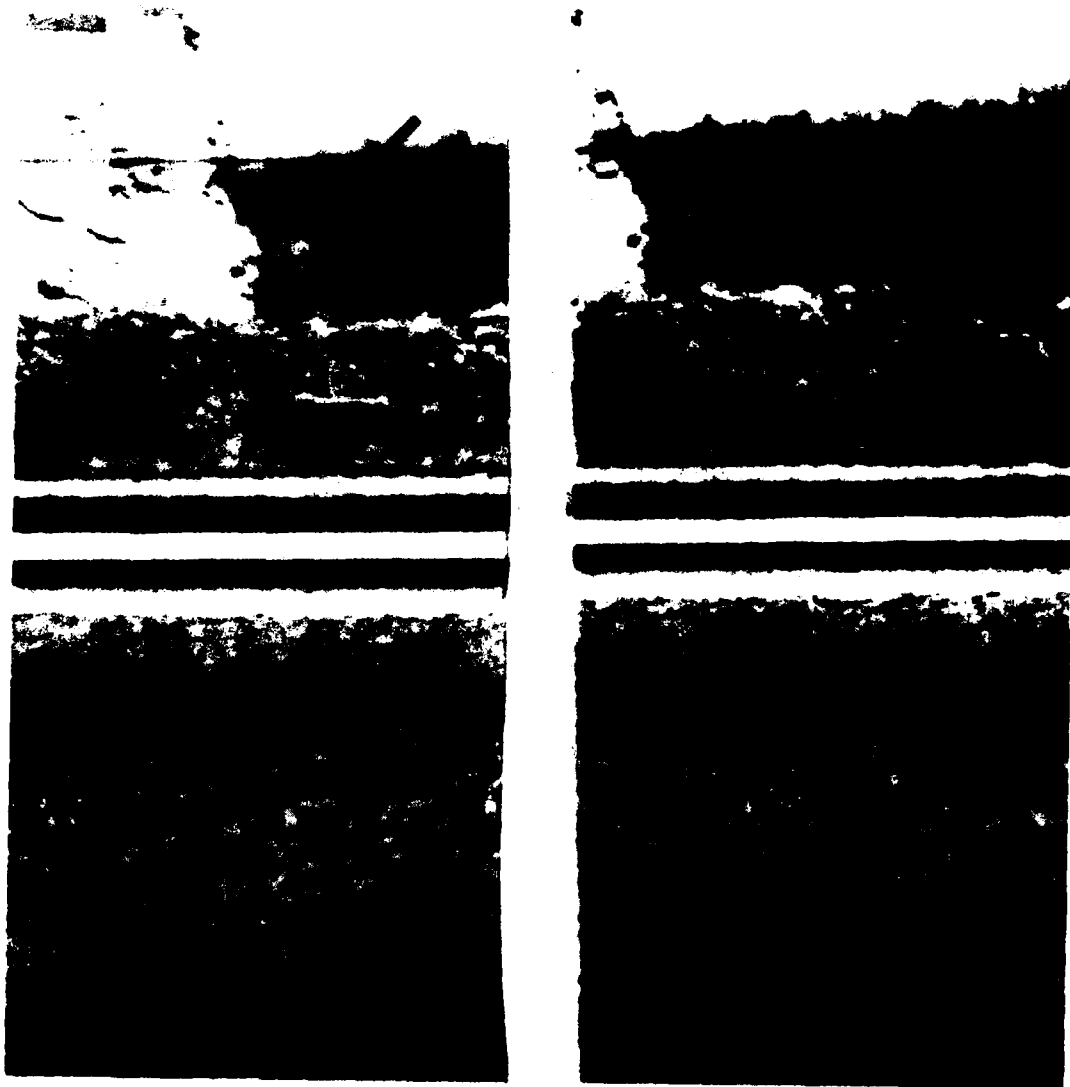


Figure 5. Comparison of two sonographs of the same target. The arrow is pointing to a crib which is supporting a sewer outfall. The east bank of the Red River is toward the top, the channel thalweg toward the bottom. A log is just below the crib (500 kHz)





Figure 6. The 500-kHz sonograph of Lower Bailey's Dam, Tree Dam. This is a portion which was underwater during the survey illustrated in Figure 3

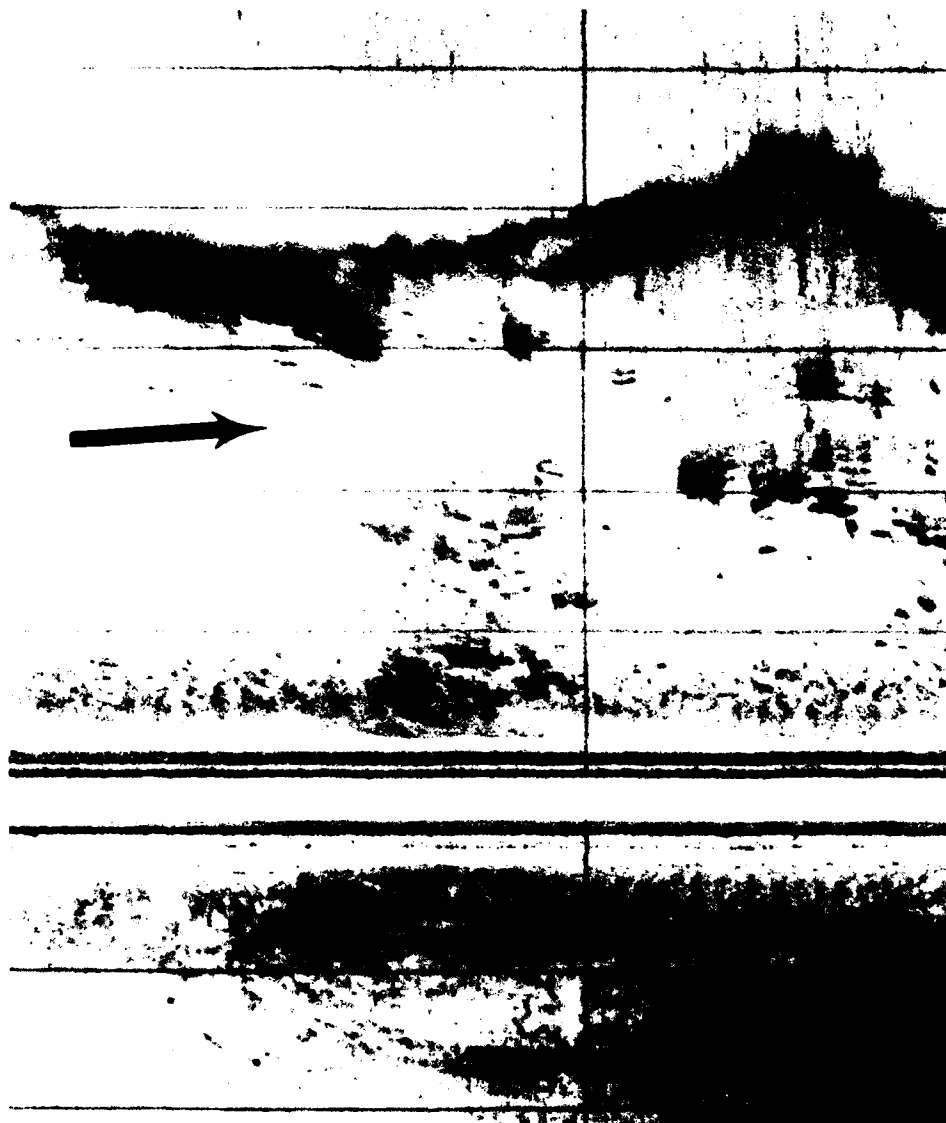


Figure 7. The 100-kHz sonograph of Lower Bailey's Dam, Tree Dam, and east bank. Arrow points to a chute between the tree dam and the bank. Compare with Figure 6



Figure 8. Portion of a crib on the west bank  
side of Lower Bailey's Dam



Figure 9. Crib section of Lower Bailey's Dam. This target is closer to the chute or channel center than that shown in Figure 8

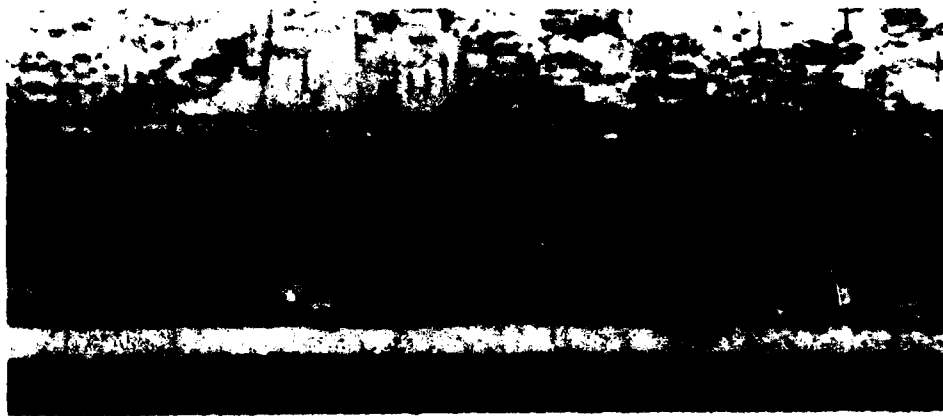


Figure 10. Well-defined image of a crib at Upper Bailey's Dam. Railroad bridge is toward the left. Short vertical dashes on image are due to interference from the boat's fathometer

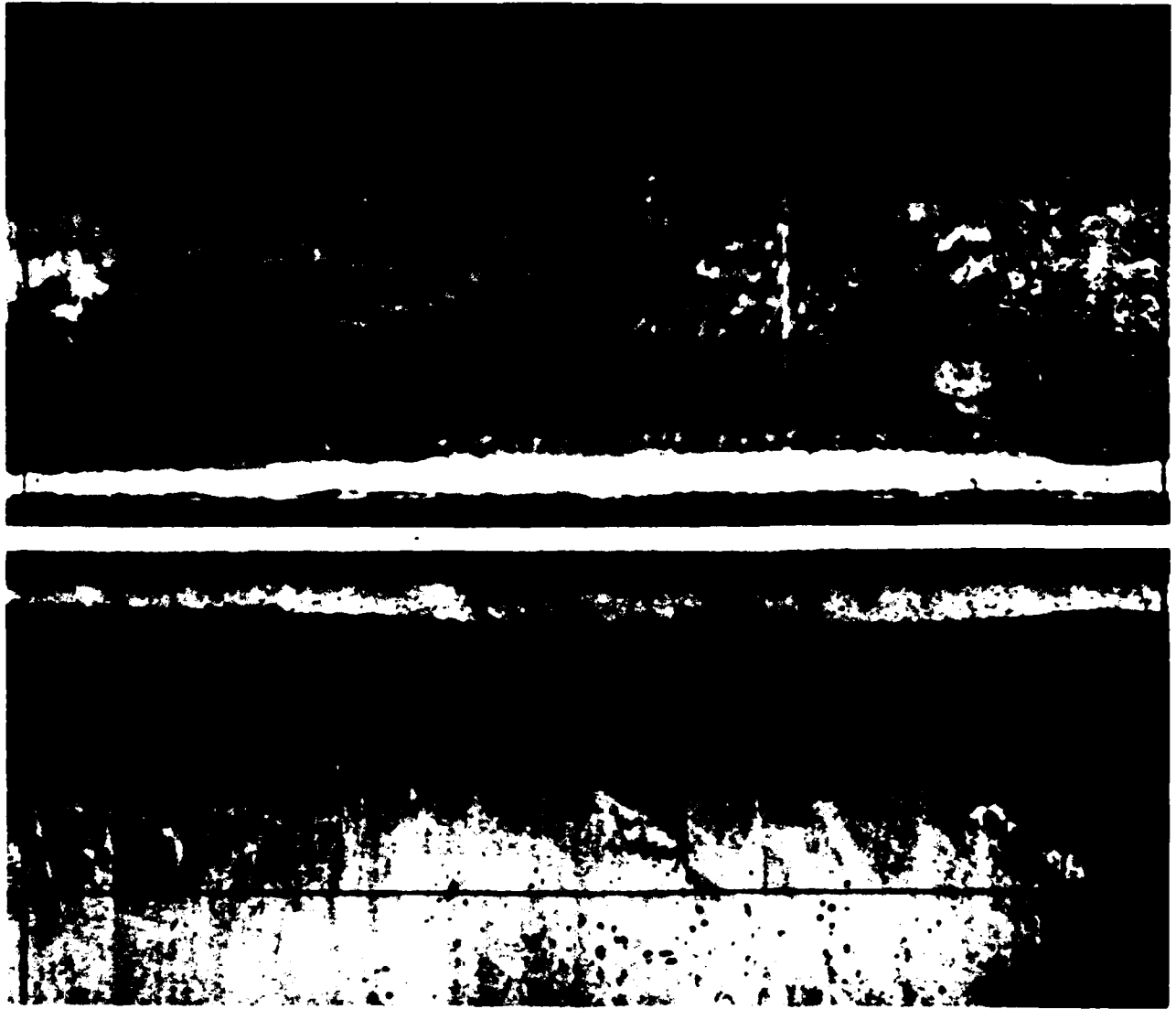


Figure 11. Upper Bailey's Dam crib section. Boat near west bank heading downstream

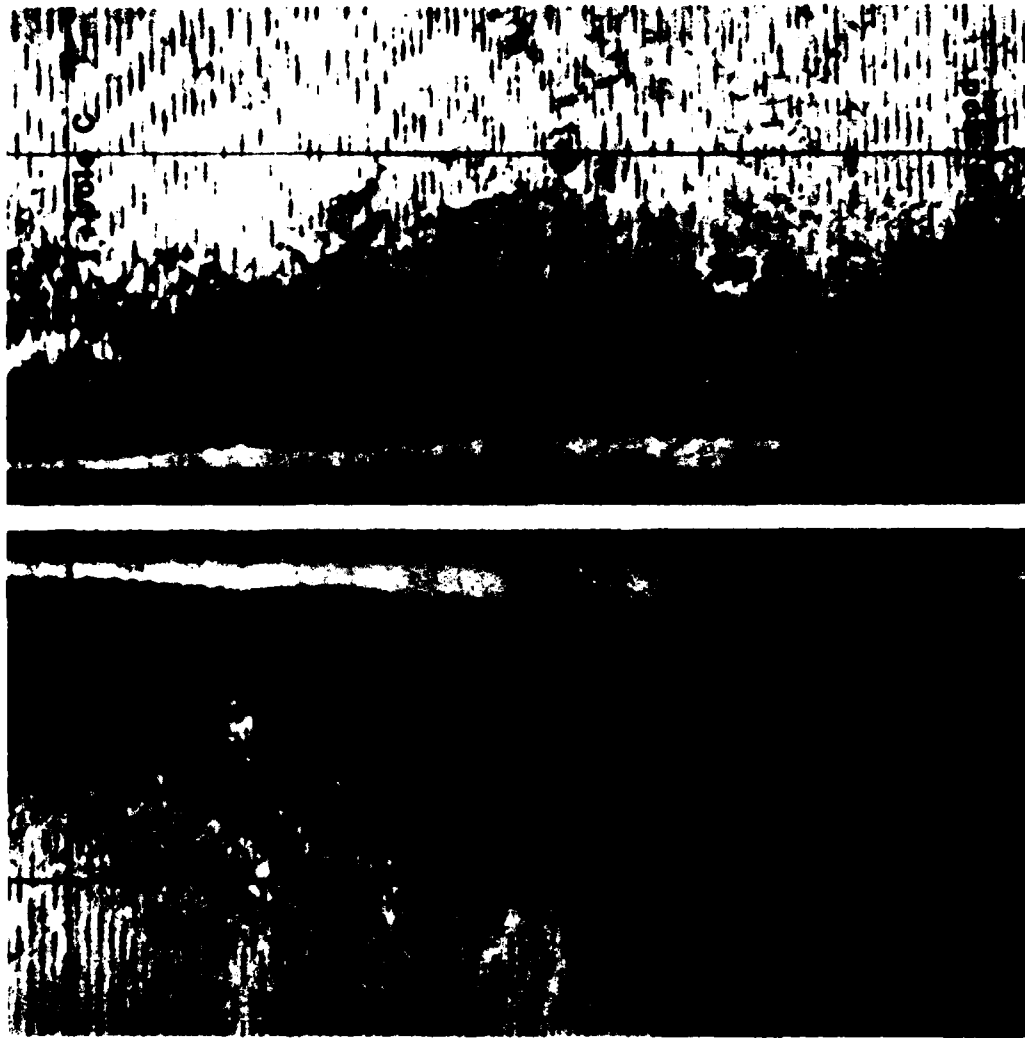


Figure 12. Upper Bailey's Dam crib section. Boat east of the center of channel heading downstream. Sonograph contains interference pattern from the boat's fathometer

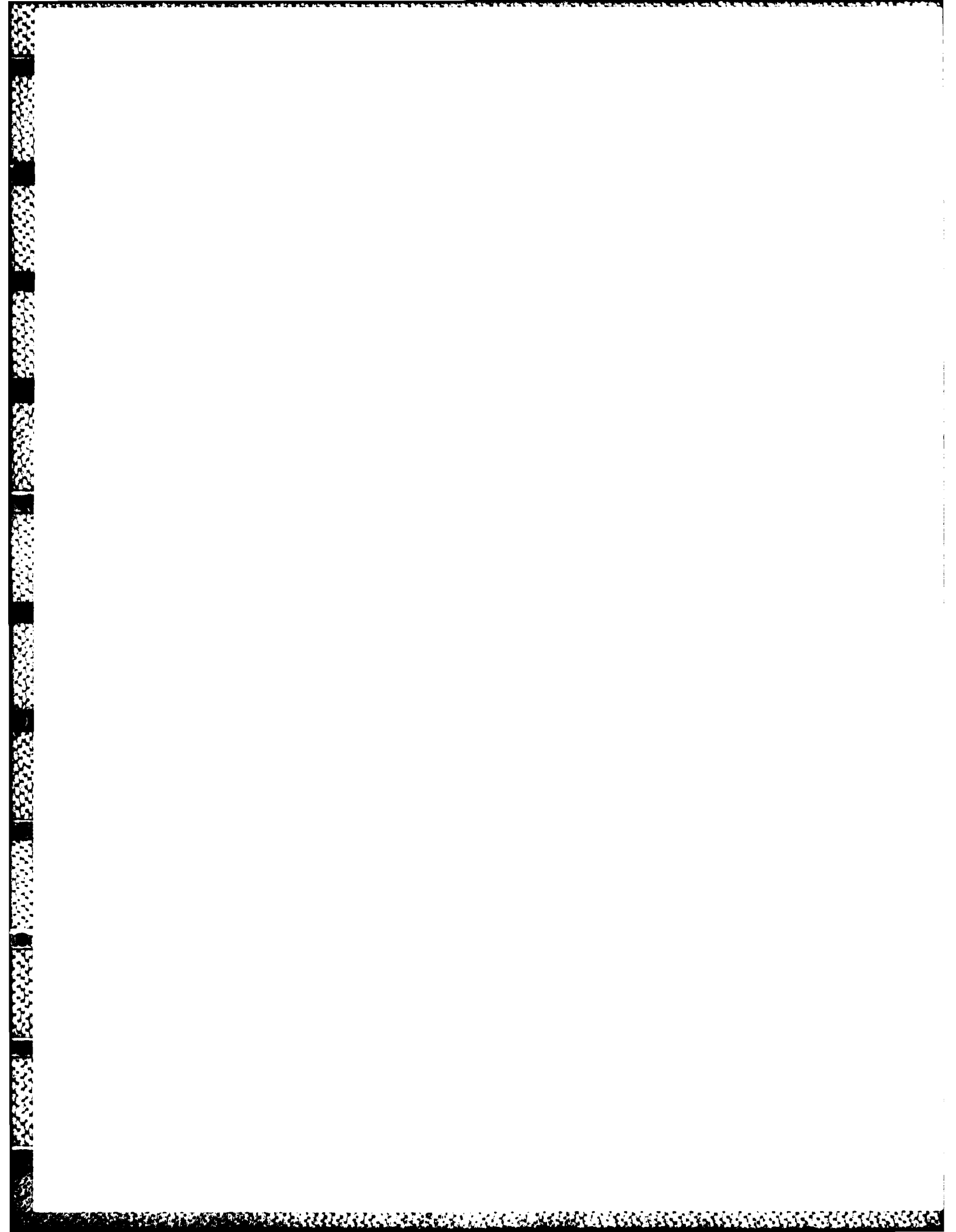


Figure 13. Upper Bailey's Dam crib section. Boat heading upstream close to east bank





Figure 14. Just downstream of Upper Bailey's Dam close to east bank. Arrow is pointing to a pile of tree and log debris which is close to the bank



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