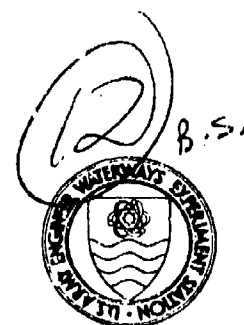


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TECHNICAL REPORT H-77-9

LITERATURE SURVEY AND PRELIMINARY EVALUATION OF STREAMBANK PROTECTION METHODS

by

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May 1977

Final Report

Approved For Public Release: Distribution Unlimited



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Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under Work Unit 02, Authorized by Section 32,
Water Resources Development Act, 1974

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Report H-77-9 ✓	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) LITERATURE SURVEY AND PRELIMINARY EVALUATION OF STREAMBANK PROTECTION METHODS.	5. TYPE OF REPORT & PERIOD COVERED Final report. 15 Jul 74	
6. AUTHOR(s) Malcolm R. Keown Noel R. Oswalt Edward B. Perry	7. PERFORMING ORG. NAME 15 Oct 76	
8. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Hydraulics Laboratory, Mobility and Environmental Systems Laboratory, Soils and Pavements Laboratory P. O. Box 631, Vicksburg, Miss. 39180	9. CONTRACT OR GRANT NUMBER(s)	
10. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers, U. S. Army Washington, D. C. 20315	11. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Work Unit 02	
12. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 265p.	13. REPORT DATE May 1977	
	14. NUMBER OF PAGES 262	
	15. SECURITY CLASS. (of this report) Unclassified	
	16. DECLASSIFICATION/DOWNGRADING SCHEDULE	
17. DISTRIBUTION STATEMENT (of this Report) Authorized for public release; distribution unlimited.		
18. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) (14) WFS-TR-H-77-1		
19. SUPPLEMENTARY NOTES		
20. KEY WORDS (Continue on reverse side if necessary and identify by block number) Bank erosion Bank protection This document contains the results of a literature survey and two preliminary studies.		
21. ABSTRACT (Continue on reverse side if necessary and identify by block number) A preliminary study of streambank erosion control was conducted with the major emphasis on an extensive literature survey of known streambank protection methods. In conjunction with the survey, preliminary investigations were conducted to identify the mechanisms that contribute to streambank erosion and to evaluate the effectiveness of the most widely used streambank protection methods. The results of the literature survey and the two preliminary investigations are presented herein.		

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20. ABSTRACT (Continued) *Y App 1473A) Appendices include: (1)*

The text of the Streambank Erosion Control Evaluation and Demonstration Act of 1974 is presented in Appendix A. *(3)* A list of commercial concerns that market streambank protection products is provided in Appendix B. Appendix C contains a glossary of streambank protection terminology. *(4)* A detailed bibliography resulting from the literature survey is provided in Appendix D, and a listing of selected bibliographies related to streambank protection are provided in Appendix E.

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PREFACE

The study reported herein was performed from July 1974 to 15 October 1976 by the U. S. Army Engineer Waterways Experiment Station (WES) for the Office, Chief of Engineers, under Work Unit 02, "Literature Survey and Evaluation of Bank Protection Methods," authorized by Section 32 of the Water Resources Development Act of 1974, Public Law 93-251. Section 32 may be cited as the "Streambank Erosion Control Evaluation and Demonstration Act of 1974."

This study was a multilaboratory effort. It was planned by Mr. N. R. Oswalt, Chief, Spillways and Channels Branch, under the general supervision of Messrs. J. L. Grace, Chief, Structures Division, and H. B. Simmons, Chief, Hydraulics Laboratory. The streambank erosion study and the identification of new methods for streambank protection were the responsibility of Dr. E. B. Perry of the Soil Mechanics Division (SMD) Research Group under the direct supervision of Mr. C. L. McAnear, Chief, SMD, and the general supervision of Mr. J. P. Sale, Chief, Soils and Pavements Laboratory. The literature search and preliminary investigation of the effectiveness of various streambank protection methods were performed by Messrs. M. P. Keown and E. A. Dardeau, Jr., of the Environmental Simulation Branch (ESB) under direct supervision of Mr. J. K. Stoll, Chief, ESB, and under the general supervision of Messrs. B. O. Benn, Chief, Environmental Systems Division, and W. G. Shockley, Chief, Mobility and Environmental Systems Laboratory (MESL). Acknowledgment is made to Mr. J. G. Kennedy, Data Handling Branch, MESL, who contributed significantly to this effort. This report was prepared by Messrs. Keown, Oswalt, Perry, and Dardeau.

COL G. H. Hilt, CE, and COL J. L. Cannon, CE, were the Directors of WES during the study and preparation of the report. Mr. F. R. Brown was Technical Director.

CONTENTS

	<u>Page</u>
PREFACE	2
CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) AND METRIC (SI) TO U. S. CUSTOMARY UNITS OF MEASUREMENT	5
PART I: INTRODUCTION	6
PART II: LITERATURE SURVEY	7
PART III: PRELIMINARY INVESTIGATION OF STREAMBANK EROSION	12
Types of Streambank Erosion	12
Mechanics of Streambank Erosion	12
Physical Characteristics of Stable Channels	17
Methods of Studying Streambank Stability	26
Soil Mechanics Aspects of Streambank Stability	31
PART IV: PRELIMINARY ASSESSMENT OF STREAMBANK PROTECTION METHODS	37
Stone Riprap	37
Concrete Pavement	42
Articulated Concrete Mattresses	43
Transverse Dikes	47
Fences	50
Asphalt Mix	52
Kellner Jack Field	57
Vegetation	59
Gabions	62
Erosion-Control Matting	63
Bulkheads	65
Other Methods for Streambank Protection	68
PART V: NEW METHODS OF STREAMBANK PROTECTION	83
PART VI: CONCLUSIONS AND RECOMMENDATIONS	85
Conclusions	85
Recommendations	86
REFERENCES	88
TABLES 1-5	
APPENDIX A: SECTION 32 OF THE WATER RESOURCES DEVELOPMENT ACT OF 1975, PUBLIC LAW 93-251 (STREAMBANK EROSION CONTROL EVALUATION AND DEMONSTRATION ACT OF 1974)	A1
APPENDIX B: LISTING OF COMMERCIAL CONCERNS THAT MARKET STREAMBANK PROTECTION PRODUCTS	B1

CONTENTS

	<u>Page</u>
APPENDIX C: GLOSSARY OF STREAMBANK PROTECTION TERMINOLOGY . .	C1
APPENDIX D: LITERATURE SURVEY OF STREAMBANK PROTECTION	D1
Single-Component Revetment	D2
Mattresses, Matting, and Pavements	D44
Bulkheads	D87
Soil Stabilization Techniques	D95
River Training Structures	D117
APPENDIX E: SELECTED BIBLIOGRAPHIES ON STREAMBANK PROTECTION	E1

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) AND
METRIC (SI) TO U. S. CUSTOMARY UNITS OF MEASUREMENT

Units of measurement used in this report can be converted as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
<u>U. S. Customary to Metric (SI)</u>		
inches	2.54	centimetres
feet	0.3048	metres
miles (U. S. statute)	1.609344	kilometres
square feet	0.09290304	square metres
square yards	0.8361274	square metres
acres	4046.856	square metres
cubic yards	0.7645549	cubic metres
cubic feet per second	0.02831685	cubic metres per second
feet per second	0.3048	metres per second
tons (short)	907.1847	kilograms
pounds (force) per square foot	47.88026	pascals
degrees (angular)	0.01745329	radians
Fahrenheit degrees	0.555	Celsius degrees or Kelvins*
<u>Metric (SI) to U. S. Customary</u>		
millimetres	0.03937007	inches
metres	3.280839	feet
centimetres per second	0.3937007	inches per second
metres per second	3.280839	feet per second
tons (metric) per cubic metre	0.8427	tons (short) per cubic yard

* To obtain Celsius (C) readings from Fahrenheit (F) readings, use the following formula: $C = 0.555(F - 32)$. To obtain Kelvin (K) readings, use: $K = 0.55(F + 459.67)$.

LITERATURE SURVEY AND PRELIMINARY EVALUATION
OF STREAMBANK PROTECTION METHODS

PART I: INTRODUCTION

1. In a letter dated 14 June 1974, subject, "Streambank Erosion Control Evaluation and Demonstration Act of 1974," the Office, Chief of Engineers (OCE), directed the U. S. Army Engineer Waterways Experiment Station (WES) to conduct a preliminary study of streambank erosion control. The major emphasis of the study was to be an extensive literature survey of known streambank protection methods. In conjunction with the survey, preliminary investigations were to be conducted to identify the mechanisms that contribute to streambank erosion and to evaluate the effectiveness of the most widely used streambank protection methods. The results of the literature survey and the two preliminary investigations are contained in this report.

2. Personnel of three technical laboratories at the WES (Hydraulics, Soils and Pavements, and Mobility and Environmental Systems) initiated this work on 15 July 1974. An interim evaluation report on streambank protection was submitted to OCE on 24 September 1974. A table summarizing the causes of erosion and typical bank protection methods as a function of maximum flow rate was included in that report and is included herein for general information (Table 1). After the interim report was submitted, work continued until the literature search was completed on 15 October 1976.

PART II: LITERATURE SURVEY

3. A comprehensive search for literature sources relevant to streambank protection methods was initiated by the WES in August 1974 in response to the requirements of the Streambank Erosion Control Evaluation and Demonstration Act of 1974 (Appendix A). A list of appropriate key words was compiled and used to search the libraries of the following agencies for relevant literature sources:

- a. Technical Information Center, WES, Vicksburg, MS.
- b. Hydraulic Engineering Information Analysis Center, WES, Vicksburg, MS.
- c. Mississippi River Commission, Vicksburg, MS.
- d. U. S. Army Engineer District, Kansas City, MO.
- e. Office, Chief of Engineers, Washington, D. C.
- f. U. S. Geological Survey, Reston, VA.
- g. The Engineer School, Fort Belvoir, VA.
- h. Coastal Engineering Research Center, Fort Belvoir, VA.
- i. Water Resources Institute, Washington, D. C.
- j. Department of Transportation, Washington, D. C.
- k. Library of Congress, Washington, D. C.
- l. American Forestry Association, Washington, D. C.
- m. Environmental Law Institute, Washington, D. C.
- n. National Geographic Society, Washington, D. C.
- o. Transportation Research Board, Washington, D. C.

4. In addition to the agencies listed in paragraph 3, the following selected government agencies, universities, commercial concerns, and research organizations were contacted to locate relevant literature that had not had widespread circulation, as well as to inquire about the effectiveness and costs of currently used streambank protection methods:

- a. U. S. Army Engineer Divisions, Lower Mississippi Valley, Vicksburg, MS, and Ohio River, Cincinnati, OH.
- b. U. S. Army Engineer Districts, Rock Island, IL; Vicksburg, MS; Kansas City, MO; San Francisco and Sacramento, CA; Baltimore, MD; Pittsburgh, PA; Louisville, KY; and Nashville, TN.

- c. U. S. Department of Agriculture, Agricultural Research Service, Oxford, MS; Forest Service, Washington, D. C.; and Region 5, San Francisco, CA.
- d. U. S. Department of Transportation, Federal Highway Administration, Washington, D. C., and Sevierville, TN.
- e. U. S. Department of the Interior, National Park Service, Denver, CO; and Bureau of Reclamation, Denver, CO.
- f. Louisiana Highway Department, Baton Rouge, LA.
- g. Texas Highway Department, Austin, TX.
- h. University of California, Water Resources Center, Berkeley, CA.
- i. Colorado State University, Engineering Research Center, Fort Collins, CO.
- j. University of Iowa, Institute of Hydraulic Research, Iowa City, IA
- k. Central Hydraulics Laboratory of France, Maisons-Alfort, France
- l. Advance Construction Specialties Company, Memphis, TN.
- m. Air Logistics Corp., Pasadena, CA.
- n. American Excelsior Co., Sheboygan, WI.
- o. ARMO Steel Corporation, Washington, D. C.
- p. Bekaert Gabions, Reno, NV.
- q. Boiardi Products Corp., New York, NY.
- r. Bomanite Corp., Palo Alto, CA.
- s. Bowie Industries, Bowie, TX.
- t. Carthage Mills, Inc., Cincinnati, OH.
- u. Celanese Fibers Marketing Co., New York, NY.
- v. Conwed Corp., Minneapolis, MN.
- w. Construction Techniques, Inc., Cleveland, OH.
- x. DuPont, Wilmington, DE.
- y. Edward E. Gillen Co., Milwaukee, WI.
- z. ERCO Systems, Inc., New Orleans, LA.
- aa. Erosion Control, Inc., West Palm Beach, FL.
- bb. Finn Equipment Co., Cincinnati, OH.
- cc. GAF Corp., New York, NY.
- dd. Grass Growers, Inc., Plainfield, NJ.

- ee. Grass Pavers, Ltd., Royal Oak, MI.
- ff. Griffon Company, Inc., Houston, TX.
- gg. Gulf States Paper Corp., Tuscaloosa, AL.
- hh. Hold-That-River, Inc., Houston, TX.
- ii. Hudson Pulp and Paper Corp., Palatka, FL.
- jj. Kaiser Aluminum, Oakland, CA.
- kk. Koch Brothers, Inc., Kansas City, KS.
- ll. Louisiana Industries, Bossier City, LA.
- mm. Ludlow Textiles, Dalton, GA.
- nn. Maccaferri Gabions, Inc., Williamsport, MD.
- oo. Menardi-Southern, Houston, TX.
- pp. Monsanto Textiles Co., St. Louis, MO.
- qq. Owens-Corning Fiberglass Corp., Toledo, OH.
- rr. Phillips Petroleum Co., Bartlesville, OK.
- ss. Reinco, Plainfield, NJ.
- tt. Spidel Foundations Harbor and Marine Corp., Benton Harbor, MI.
- uu. Superior Fiber Mulch, Hunt Valley, MD.
- vv. United States Textures Sales Corp., Baton Rouge, LA.
- ww. VSL Corp., Los Gatos, CA.
- xx. Asphalt Institute, College Park, MD.
- yy. Bituminous Coal Research, Inc., Monroeville, PA.
- zz. Portland Cement Association, Skokie, IL.

A tabulation of the commercial organizations that market streambank protection products (with their respective addresses and products) is provided in Appendix B. Also in Appendix B are the addresses of the research organizations that direct part of their efforts toward the study of streambank protection.

5. Literature sources were also located by interrogating available computer data banks. Computer bibliographies relevant to streambank protection were obtained from the following information systems (system names in parentheses):

- a. North Carolina State University, Water Resources Research Institute, Raleigh, NC (SWRSIC)

- b. Smithsonian Institution, Smithsonian Scientific Information Exchange, Washington, D. C. (SSIE)
- c. U. S. Department of Agriculture, Washington, D. C. (CRIS)
- d. U. S. Department of Agriculture, National Agricultural Library, Beltsville, MD. (CAIN)
- e. U. S. Department of Commerce, National Technical Information Service, Springfield, VA. (NTISearch)
- f. U. S. Department of Defense, Defense Supply Agency, Defense Documentation Center, Alexandria, VA. (DOD On-Line Retrieval System)
- g. U. S. Government Legislative Branch, Library of Congress, Washington, D. C. (SCORPIO)
- h. University of Arizona, School of Renewable Natural Resources, Tucson, AZ. (WAMIS)
- i. University of Wisconsin, Water Resources Information Center, Madison, WI. (WRSIC)

6. For the purposes of the literature search, streambank protection methods were broken down into five groups:

- a. Group A - Placement of single-component revetment
- b. Group B - Placement of mattresses, matting, and pavement
- c. Group C - Construction of bulkheads
- d. Group D - Stabilization of soil
- e. Group E - Construction of river training structures

Group A includes single components, such as blocks, riprap, sacks, etc., that are used to cover a streambank and are generally not connected with each other or stabilized by wire, grout, cable, or other devices.

Group B includes materials, such as articulated concrete mattresses and pavements, that are unitized and reinforced to increase stability and longevity and are used primarily for protecting large bank surfaces on major river systems. The materials in Groups A and B require support from the bank to remain in place, but bulkheads (Group C) support themselves (sometimes also supporting the bank) and generally serve to physically separate the soil-water interface. Several materials or methods are commonly used to improve the resistivity of soil to stream erosion; these are included in Group D. The methods in Group E do not protect the streambank directly, but deflect stream currents away from

erodible banks. Thirty-eight materials, structures, and techniques (loosely termed "methods" herein) for protecting streambanks were identified during this study. These were categorized into one of the five groups discussed above and are presented in Table 2. Appendix C is a glossary of terms, including those in Table 2.

7. As potentially useful literature sources were located, each was examined for content and, if accepted, placed in an alphabetical listing under one or more of the streambank protection categories listed in Table 2. The resulting bibliography is presented as Appendix D. Also, a selected listing of bibliographies related to streambank protection was assembled and is presented in Appendix E.

PART III: PRELIMINARY INVESTIGATION OF STREAMBANK EROSION

Types of Streambank Erosion

8. There are several types of streambank erosion* that are described by the American Society of Civil Engineers Task Committee on Channel Stabilization Works and others.¹⁻⁷ These types are:

- a. Attack at the toe of the underwater slope, leading to bank failure and erosion. The greatest period of bank failure normally occurs in a falling river at the medium stage or lower.⁸
- b. Erosion of soil along the bank caused by current action.
- c. Sloughing of saturated cohesive banks, i.e. banks incapable of free drainage, due to rapid drawdown.
- d. Flow slides (liquefaction) in saturated silty and sandy soil.
- e. Erosion of the soil by seepage out of the bank at relatively low channel velocities.⁹⁻¹¹
- f. Erosion of upper bank, river bottom, or both, due to wave action caused by wind or passing boats.¹²⁻¹⁵

Mechanics of Streambank Erosion

9. The mechanics of streambank erosion are related to the geometry and hydraulic characteristics of the stream.¹⁶ Figure 1 shows that the highest water velocities and deepest parts of the channel are at the points of bend where the thalweg lies closest to the concave bank.¹⁷ During periods of extreme floods, the highest water velocities lie closest to the convex bank, as shown in Figure 2.¹⁷ Figure 3 shows that the maximum water velocity occurs just below the water surface.¹⁷ The effect of vegetation on the variation of velocity with depth below the water surface is shown in Figure 4.^{18,19} A manual for establishing protective stands of perennial vegetation on soils of low productivity has been published by the U. S. Environmental Protection Agency.²⁰

* Natural or man-induced bank recession, channel deepening, or both.

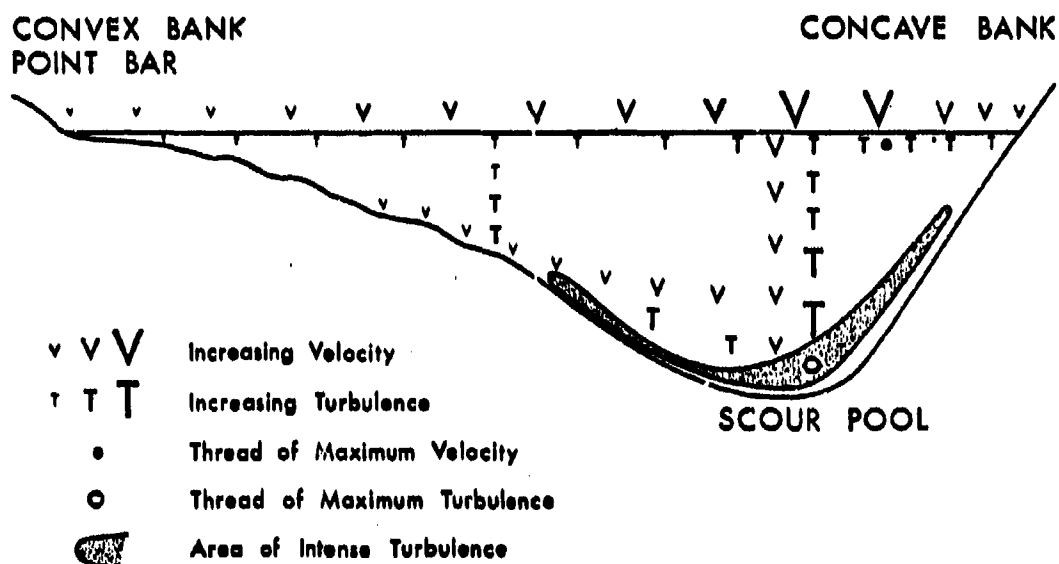


Figure 1. Velocity and turbulence in a river bend (Reference 17)

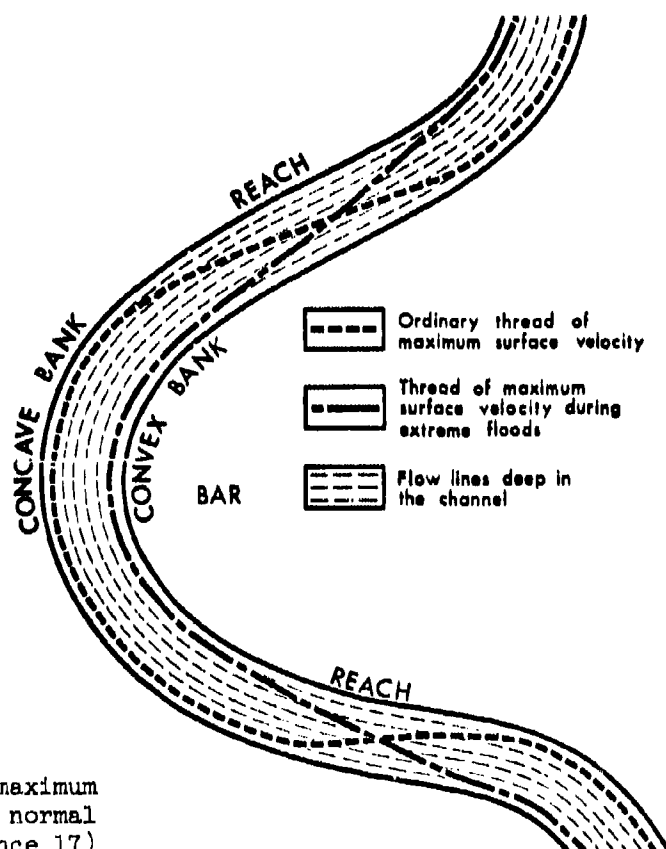


Figure 2. Location of maximum surface velocity during normal and flood flows (Reference 17)

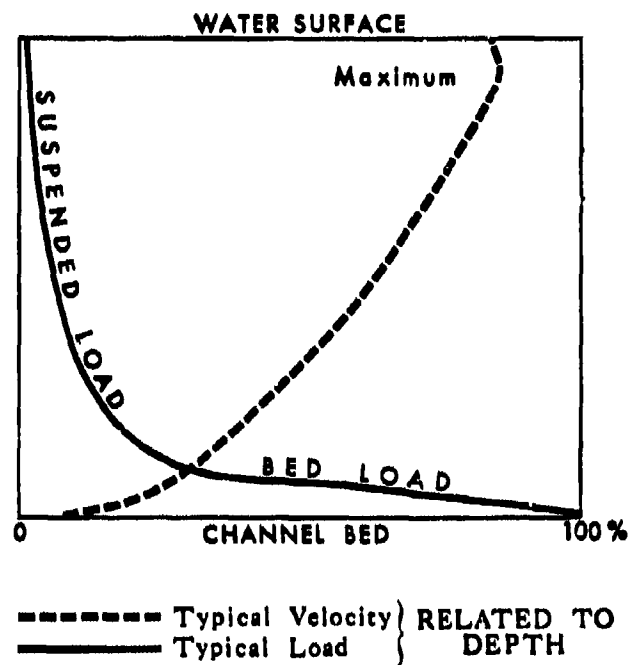


Figure 3. Variation of velocity and sediment load with depth below water surface (Reference 17)

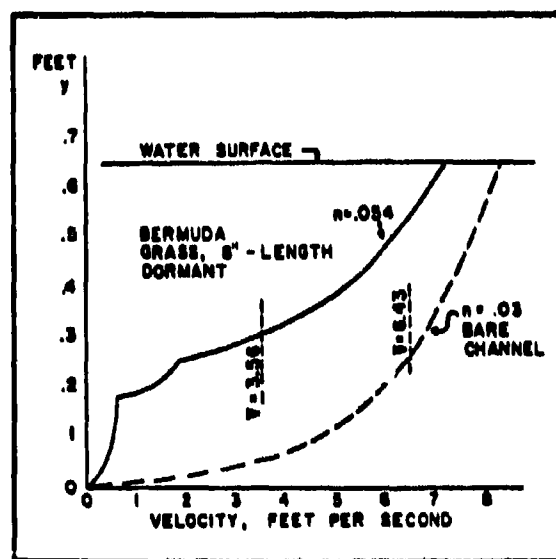


Figure 4. Influence of vegetation on variation of velocity with depth below water surface (adapted from Reference 19)

Fisk²¹ described bank recession as follows (Figure 5):

Scouring in the thalweg destroys the equilibrium between the saturated substratum sand and the mass of river water. If the bank consists of sandy material, sloughing occurs immediately. If the bank consists of clay, sloughing may occur only after considerable scour has taken place.

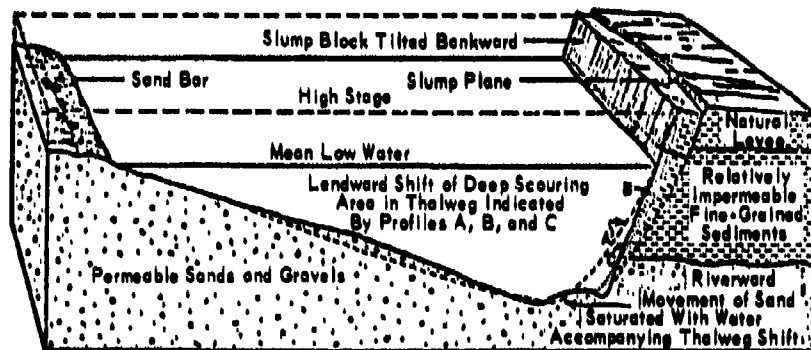


Figure 5. Bank recession through slumping
(Reference 21)

10. Until the use of revetments in modern times, clay plugs (channel fill deposits of highly plastic clays formed by filling of oxbow lakes produced by cutoffs of meander loops) were the major restrictive influence on river activity and have been instrumental in determining the history of the Mississippi River.²² According to Kesel et al.,²³ bank stability is decreased by rapid fluctuations of the river level, mainly at high-water periods; these high-water periods or rapid fluctuations cause increased pore-water pressure and thus increase the weight and decrease the effective shear strength of the bank material. It has been estimated that the lower bank protection represents about 75 percent of the area to be protected and about 90 percent of the total cost of protection.²⁴

11. Krinitzsky and others²⁵⁻²⁷ have postulated the influences of the geology of riverbank soils on the mechanics of streambank erosion along the lower Mississippi River. Data for the studies were taken from revetted sites for which periodic hydrographic surveys and soil property data obtained in connection with foundation investigations were available. The revetments are believed to cause the thalweg to deepen to a

greater extent than it would if the banks were not revetted. However, since there are few bends along the lower Mississippi River that are not revetted, the processes evaluated were considered applicable to present conditions.

12. Figure 6 shows the alluvial fill in the vicinity of a

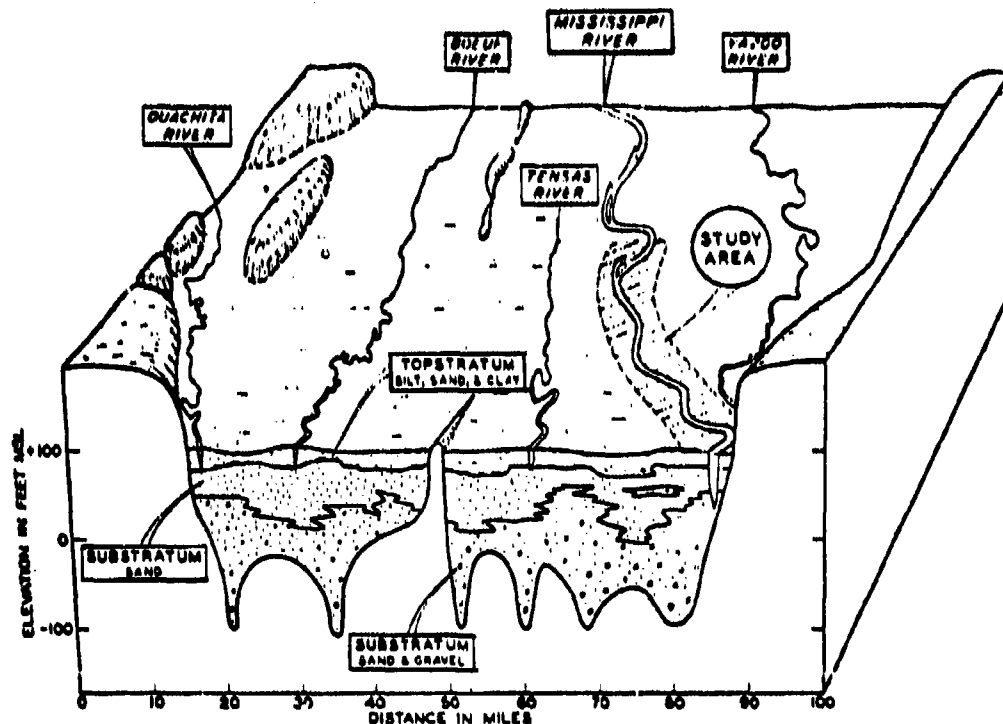


Figure 6. Alluvial fill in vicinity of a study area (Reference 25)

study area. Erosion of soil in the scour pool was found to steepen the riverbank slope near its toe, which precipitated a limited shear or flow failure. Such failure might be limited to subaqueous failure, or it might trigger other failures in the bank, resulting in an upper bank failure. A direct relation was found between the magnitude of seasonal scour in the thalweg pool and the sizes of the subaqueous bank failures. The type of soil in the bank had an important modifying influence on subaqueous bank failure, and shear failure in the upper bank occurred when the shearing stresses in the bank material

exceeded the available shear strength of the soil.

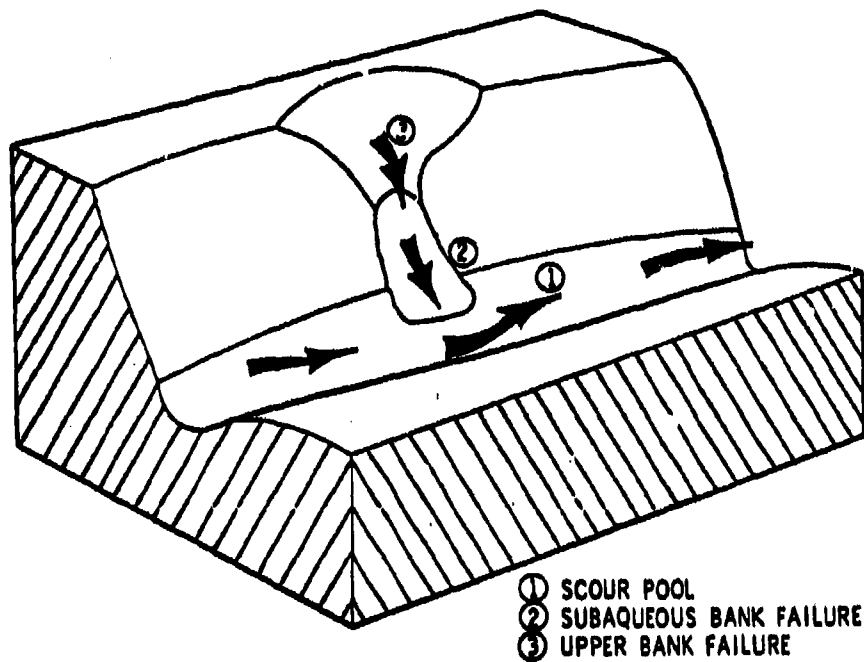
13. Flow failures were initiated in layers of saturated, low-relative-density sands in the substratum portion of the riverbank. These sand layers liquefy when strain or vibration produces excess pore pressures that reduce the effective stress and, consequently, the shear strength to zero. Flow failures are recognized by the bowl-shaped indentations that occur in the bank or by the comparatively narrow neck through which the sediment is discharged. During flood periods, flow slides frequently occur on the convex bank near the point at which the thread of maximum surface velocity impinges upon the riverbank (Figure 2). Empirical criteria have been developed at the WES to assess the susceptibility of riverbanks to flow failure.^{25,28}

14. Figure 7a shows the general process of bank erosion in the alluvial valley of the lower Mississippi River.²⁵ Bank failures in the deltaic clays (Figure 7b) were found to result from the deepening of the thalweg pool and the accompanying oversteepening of the underwater slopes of the river bendways, thereby leading to a shear bank failure, which usually involved the full height of the bank.^{26,27} The influence of geology of riverbank soils on the mechanics of bank failure in the alluvial valley of the lower Mississippi River is shown in Figure 8.²⁵

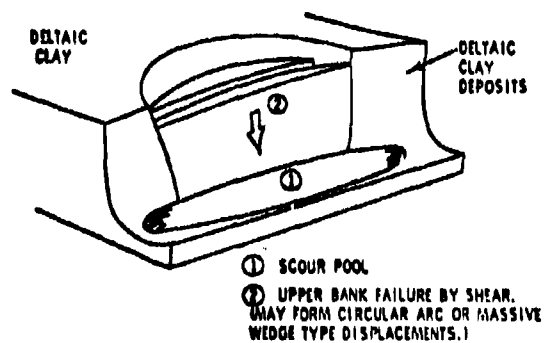
Physical Characteristics of Stable Channels

15. Seepage investigations in the Mississippi and Arkansas River Valleys have resulted in a correlation between field permeability and grain size, as shown in Figure 9.²⁹ The bottom velocities for initiation of bed-load movement as a function of grain size are shown in Figure 10.³⁰

16. Field observations and laboratory studies have shown that the depths of cross sections increase with the resistances of riverbanks to erosion.^{4,31} The failure to recognize the need for a large width-depth ratio in sands has been recognized as a mistake, since channel widths increase until stability is achieved.³² Schumm³³⁻³⁵ conducted an



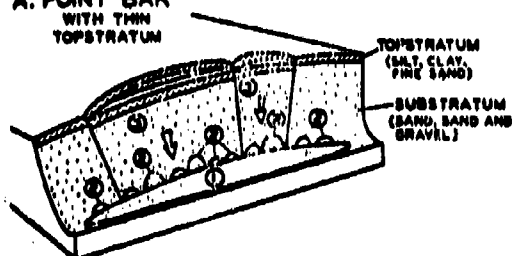
a. Alluvial valley



b. Deltaic clays

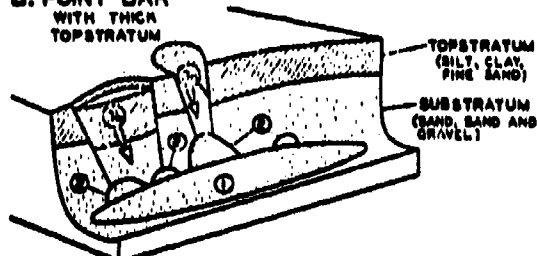
Figure 7. General process of bank erosion in the lower Mississippi River (References 25 and 27)

**A. POINT BAR
WITH THIN
TOPSTRATUM**



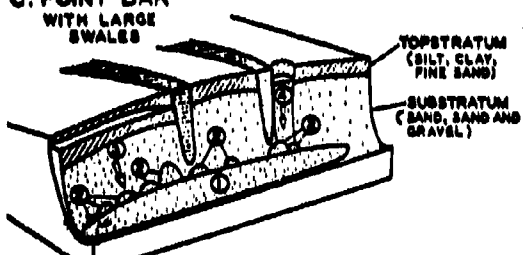
- ① SCOUR POOL.
- ② NUMEROUS, SMALL SUBAQUEOUS FAILURES BY FLOW OR SHEAR.
- ③ BLOWING AND THIN UPPER BANK FAILURES BY SHEAR.

**B. POINT BAR
WITH THICK
TOPSTRATUM**



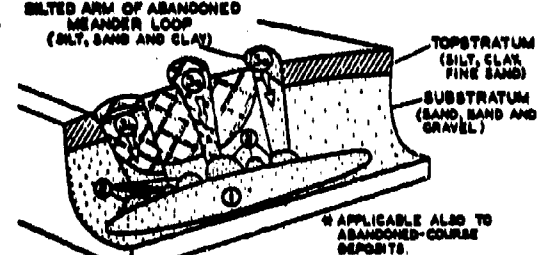
- ① SCOUR POOL.
- ② SMALL TO LARGE SUBAQUEOUS FAILURES BY FLOW OR SHEAR.
- ③ UPPER BANK FAILURE BY FLOW (3a) OR SHEAR (3b).

**C. POINT BAR
WITH LARGE
SWALES**



- ① SCOUR POOL.
- ② SMALL SUBAQUEOUS FAILURES BY FLOW OR SHEAR.
- ③ THIN UPPER BANK FAILURE TERMINATED BY SWALE.
- ④ UPPER BANK FAILURE BY FLOW OR SHEAR LOCALIZED ADJACENT TO A SWALE.

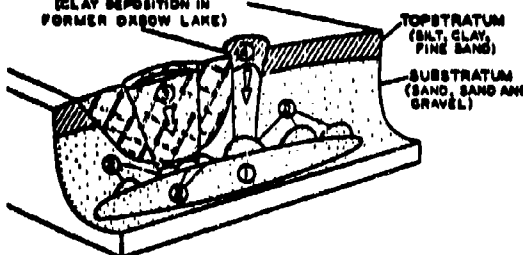
**D. CHANNEL FILL *
SILTED ARM OF ABANDONED
MEANDER LOOP
(SILT, SAND AND CLAY)**



* APPLICABLE ALSO TO ABANDONED-COURSE DEPOSITS.

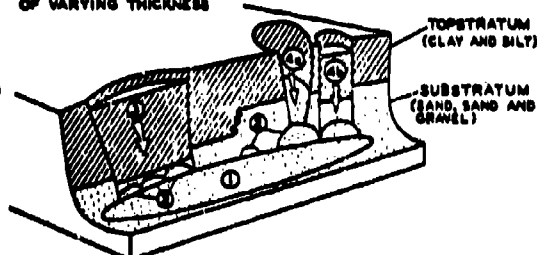
- ① SCOUR POOL.
- ② SUBAQUEOUS FAILURES BY FLOW OR SHEAR.
- ③ UPPER BANK FAILURE BY FLOW (3a) OR SHEAR (3b).

**E. CHANNEL FILL
CLAY PLUG
(CLAY DEPOSITION IN
FORMER Oxbow LAKE)**



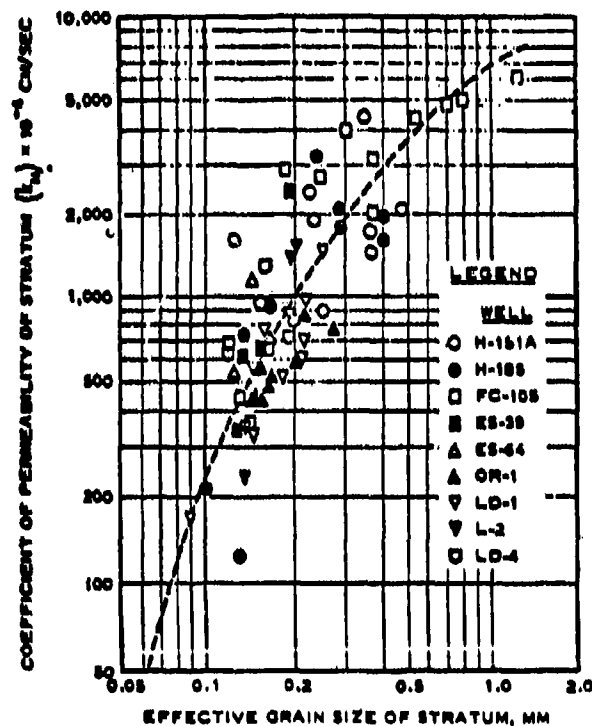
- ① SCOUR POOL.
- ② SUBAQUEOUS BANK FAILURE BY FLOW OR SHEAR.
- ③ UPPER BANK FAILURE BY SHEAR IN CLAY PLUG.
- ④ UPPER BANK FAILURE BY FLOW OR SHEAR, PERIPHERAL TO THE CLAY PLUG.

**F. BACKSWAMP
CLAY AND SILTY CLAY
OF VARYING THICKNESS**



- ① SCOUR POOL.
- ② SUBAQUEOUS BANK FAILURE BY FLOW OR SHEAR.
- ③ UPPER BANK FAILURE BY SHEAR.
- ④ UPPER BANK FAILURE BY FLOW (4a) OR SHEAR (4b).

Figure 8. Influence of geology of riverbank soils on the mechanics of bank failure in the alluvial valley of the lower Mississippi River (Reference 25)



NOTES: k_H BASED ON FIELD PUMPING TESTS.
 D_{10} IS THE SIZE IN MM OF THE MAXIMUM
 PARTICLES IN THE MINUS 10 PERCENT
 FRACTION (FRACTION FINER THAN
 90 PERCENT OF THE SAMPLE BY WEIGHT).

Figure 9. Field permeability versus grain size in the Mississippi and Arkansas River Valleys (Reference 29)

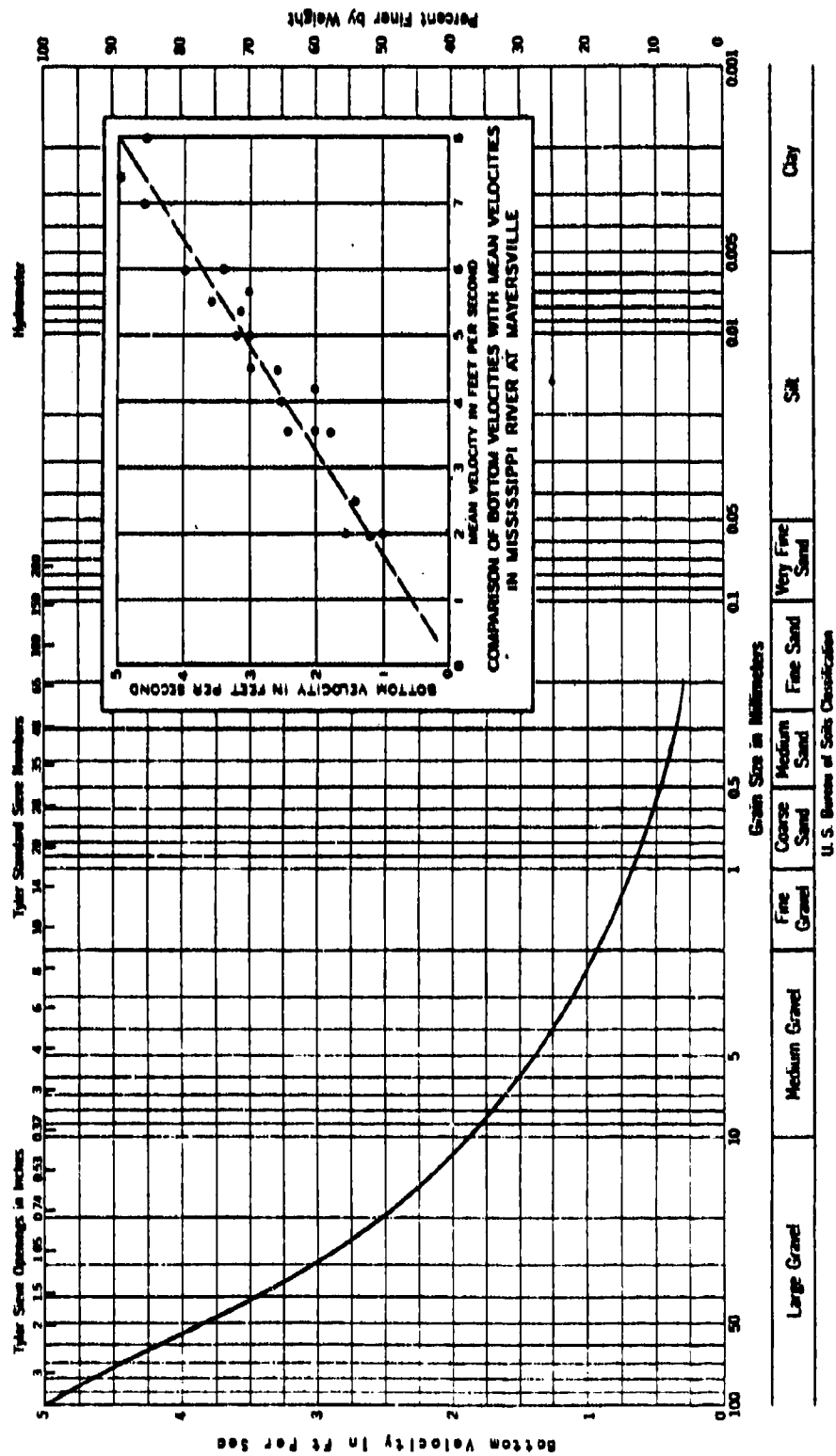


Figure 10. Bottom velocities for initiation of bed-load movement versus grain size (Reference 30)

investigation of ephemeral streams (i.e. streams in which flow is directly related to storm runoff and is not continuous for periods greater than 24 hr) that transported only small (less than 20 percent) quantities of coarse gravel. In this investigation Schumm developed a relation (Figure 11) for width-depth ratio versus percent silt-clay (material smaller than 0.074 mm*) in the banks and channel as a criterion for

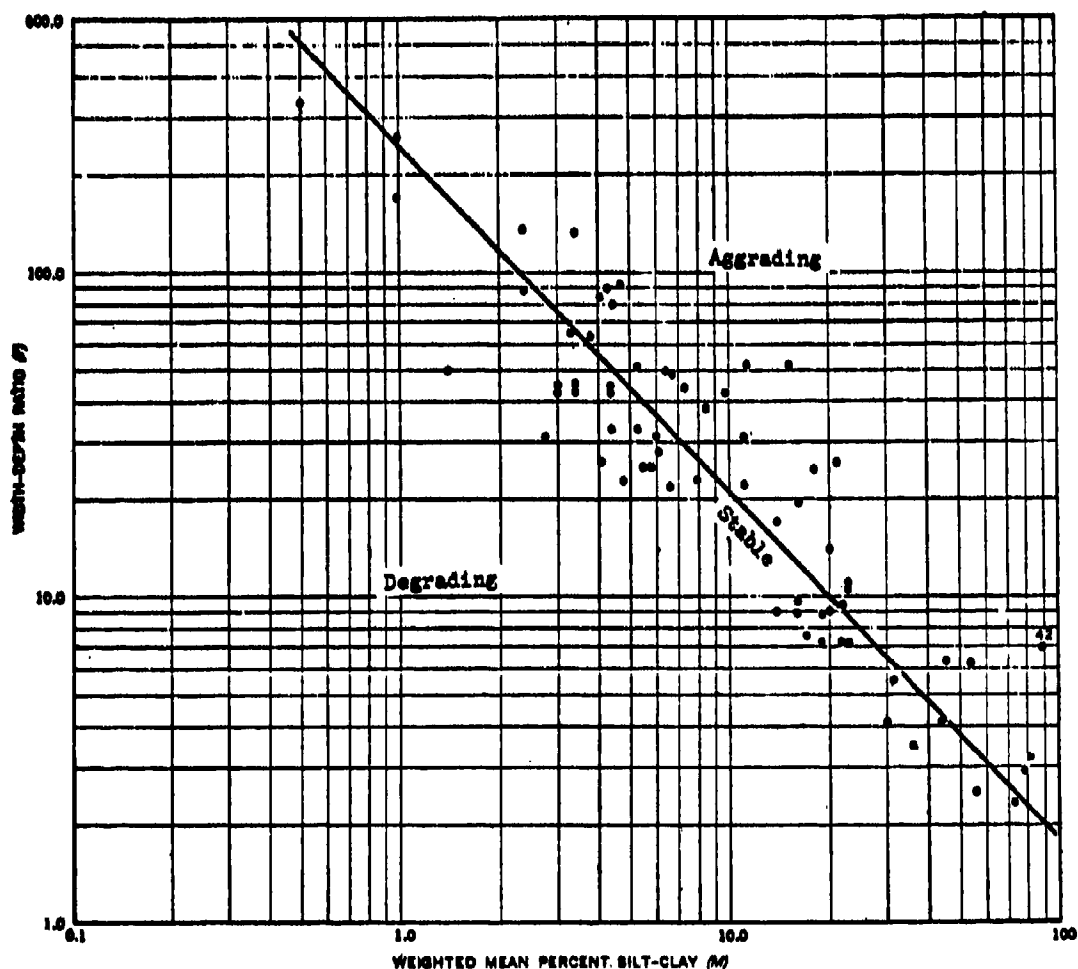


Figure 11. Width-depth ratio versus percent silt-clay in banks and channels as a stability criterion for ephemeral streams (Reference 33)

* A table of factors for converting metric (SI) units of measurement to U. S. customary units and U. S. customary to metric (SI) is presented on page 5.

degrading or aggrading.³³ Stream gradient shows an inverse relation to percent silt-clay in banks and channels (Figure 12).³⁴ He classified

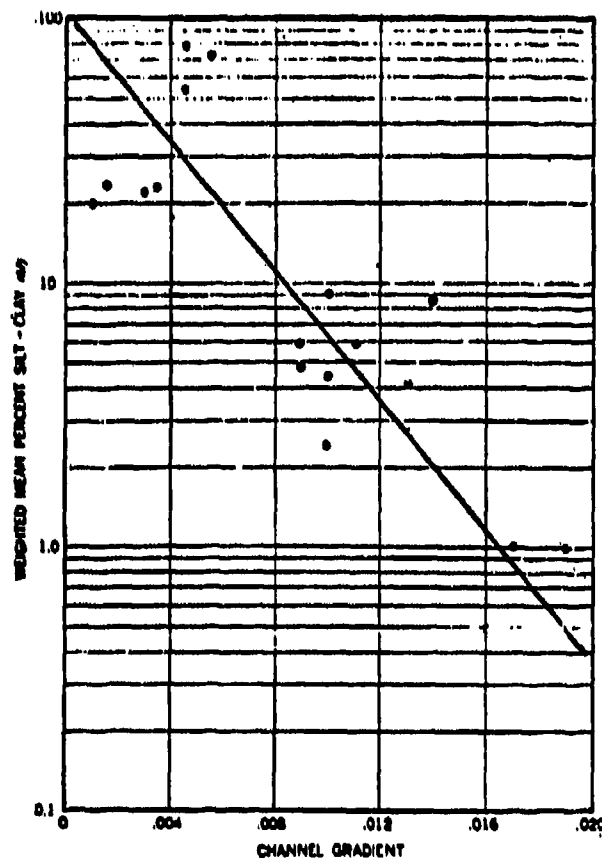


Figure 12. Relation between percent silt-clay in banks and channels and channel gradient for stable ephemeral streams (Reference 34)

alluvial river channels transporting less than 20 percent coarse gravel as stable, eroding, or depositing based on channel stability and the predominant mode of sediment transport as shown in Table 3.³⁵

17. If a large amount of fine sediment is present in the flow, it may deposit on the banks and in the channel and thereby decrease the erodibility of the material. Conversely, fine sediment may increase both the viscosity and specific weight of the fluid and the tractive force (force per unit area exerted by the flow of the river past the

banks and channel), thus enhancing the instability of the channel.³⁶

18. Brice³⁷ developed a relation between bank erodibility as a function of sinuosity index (ratio of channel length to length of meander-belt axis) and channel width for the Calamus River in Nebraska (Figure 13). Differences in bank erodibility were mainly determined by vegetal growth along the banks.

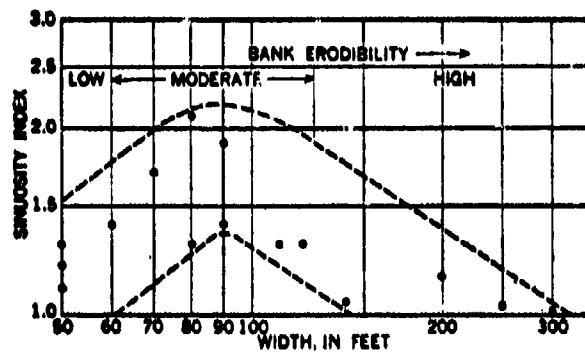


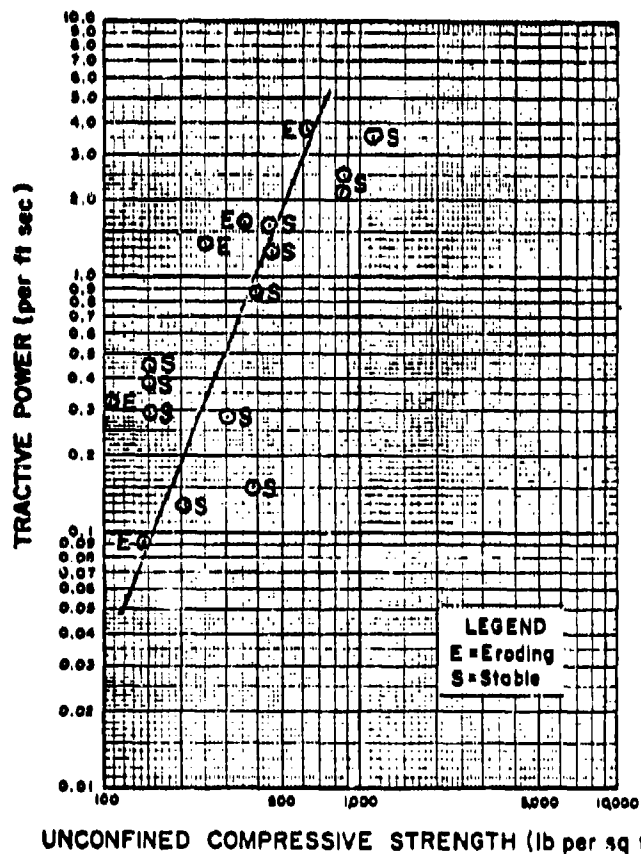
Figure 13. Bank erodibility as a function of sinuosity index and channel width for the Calamus River, Nebraska (Reference 37)

19. Wall³⁸ conducted a study to determine the influence of soil gradation on channel stability in the Savannah River. In studies of both trouble-free and troublesome areas, no correlation was found between channel stability and soil gradation.

20. Goss³⁹ conducted a study of nine unstable and six stable reaches of the Washita River in Oklahoma to determine the relation between physical and mineralogical properties and streambank erodibility. The clay mineralogy and bulk density were very similar for all samples. The sand grains from the stable areas were less rounded than those from the unstable areas and were usually coated with clay or organic matter. The sand grains from the unstable areas were relatively clean. DeCoursey and Hunt^{40,41} conducted a study of stable test reaches from 75 streams in and adjacent to Oklahoma. The bank and bed material properties were related to the channel characteristics through a statistical analysis and using regime and tractive force theories of channel design.

21. Flaxman⁴² conducted an investigation along 12 channels in six

western states to determine channel stability in cohesive soils. Field measurements were made in channels relatively free of vegetation to determine the tractive power, which is the product of the channel slope, hydraulic radius, specific weight of water, and average velocity. The observed distinction between eroding and stable channels was recognized as being a subjective determination, with only qualitative results possible. Undisturbed samples of nearly saturated cohesive soils were taken from the test channels to determine unconfined compressive strengths. Figure 14 shows the relation developed between channel stability as a function of tractive power and unconfined compressive strength.⁴²



Methods of Studying Streambank Stability

22. Historically, methods used to study channel stabilization problems have been as follows:^{29,43-45}

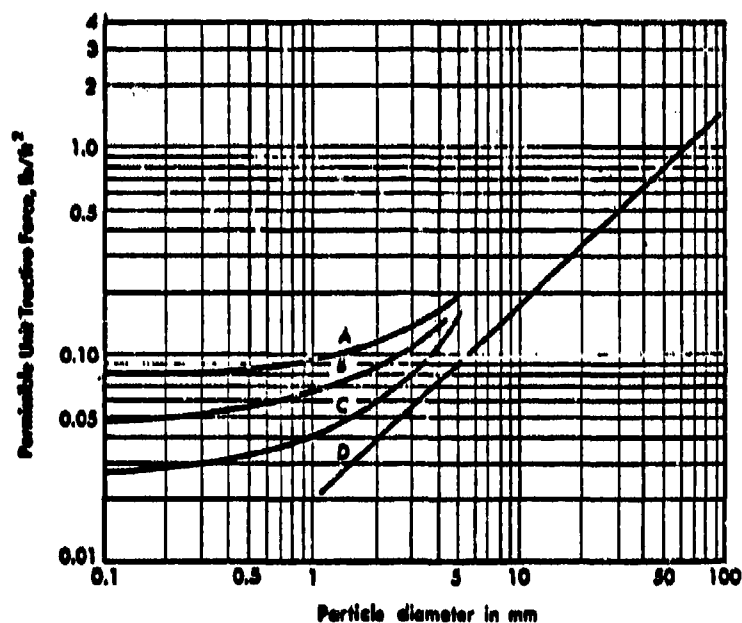
- a. Using movable-bed hydraulic models.
- b. Constructing regulating works in the river in increments, using the river itself as a model.

Although movable-bed models with erodible banks have been used to reproduce sections of banks where active caving is present in the prototype stream, the use of erodible banks is usually not considered practical because of the variations in the erodibility, shear strength characteristics, and groundwater conditions of the materials forming the banks of the natural stream. Also, reproducing the conditions in the model is difficult even if sufficient prototype data are available.^{1,29,31,46} Using the river itself as a model can be useful if the increments constructed earlier are used to determine the reconstruction required to correct shortcomings in the earlier structures and to guide in designing subsequent improved structures. However, the trial-and-error field construction method often entails great expense, long delay, and limited success.²⁹

23. Fukuoka and Yamamura⁴⁷ conducted full-scale model tests on instrumented embankments on the Yodo River in Japan. The test embankments were not subjected to river flow, but rather to artificial rainfall and static water level rise until shear failure occurred.

24. Based on observations of canal performances, allowable mean velocities have been estimated for canals in various soil types. Table 4 presents values of nonscour velocities as a function of soil density and canal depth for both noncohesive and cohesive soils.⁴⁸

25. Research conducted by the Bureau of Reclamation⁴⁹ has resulted in correlations between tractive force and soil properties. Figure 15 shows the permissible tractive force versus particle diameter for cohesionless soils.⁴⁹ The relation between permissible tractive force and void ratio for cohesive soils is shown in Figure 16. A study⁴⁹ of undisturbed soil samples from test reaches of canals revealed the



CURVE A, FOR AVERAGE PARTICLE SIZE, WITH HIGH CONTENT OF FINE SEDIMENT IN THE WATER, FOR FINE BED MATERIAL; CURVE B, FOR AVERAGE PARTICLE SIZE, WITH LOW CONTENT OF FINE SEDIMENT IN THE WATER, FOR FINE BED MATERIAL; CURVE C, FOR AVERAGE PARTICLE SIZE, WITH CLEAR WATER, FINE BED MATERIAL; CURVE D, FOR SIZE OF PARTICLE SUCH THAT 25 PERCENT OF PARTICLES ARE LARGER, WITH COARSE BED MATERIAL.

Figure 15. Permissible unit tractive force versus particle diameter for channel beds in cohesionless soils (Reference 49)

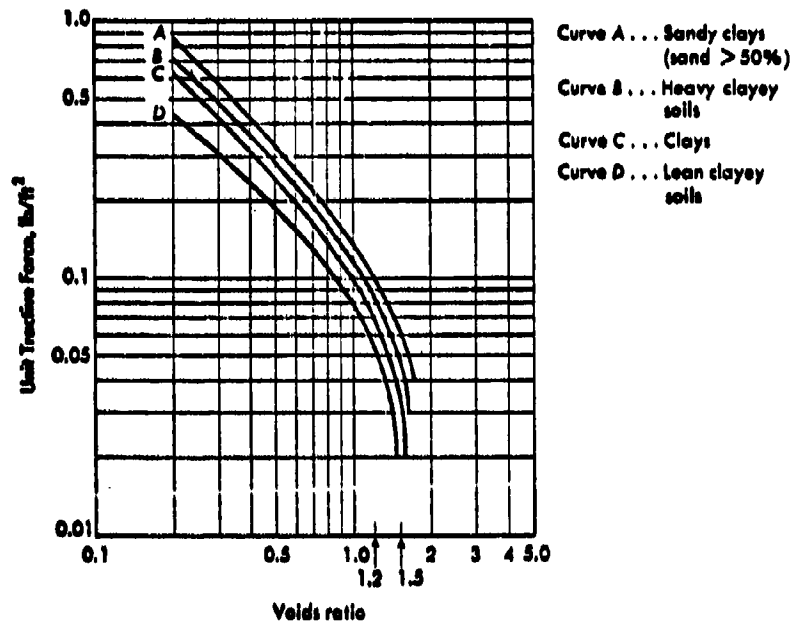


Figure 16. Permissible unit tractive force versus void ratio for channel beds in cohesive soils (Reference 49)

relation between critical tractive force (i.e. tractive force at the instant erosion noticeably began) obtained from laboratory tests and the plasticity characteristics of the samples (Figure 17). Figure 18 shows the relation between plasticity and erosion characteristics of cohesive soils.⁴⁹ The use of the tractive force principle in cohesive soils has been limited by the lack of knowledge concerning the influence of various parameters on erodibility.⁵⁰⁻⁵²

26. Schroeder^{53,54} classified 121 natural and artificial channels in Nebraska and Iowa according to stability and percent density of vegetative cover. Tractive forces for each test reach were computed using the mean annual peak discharge. Figures 19 and 20 show the curves obtained for limiting bed and bank tractive forces, respectively, versus plasticity index and mean grain size for the ephemeral streams studied.

27. Schumm's relation³³ of width-depth ratio versus percent silt-clay in banks and channels as a stability criterion for ephemeral streams is given in Figure 11. Flaxman's relation⁴² for channel

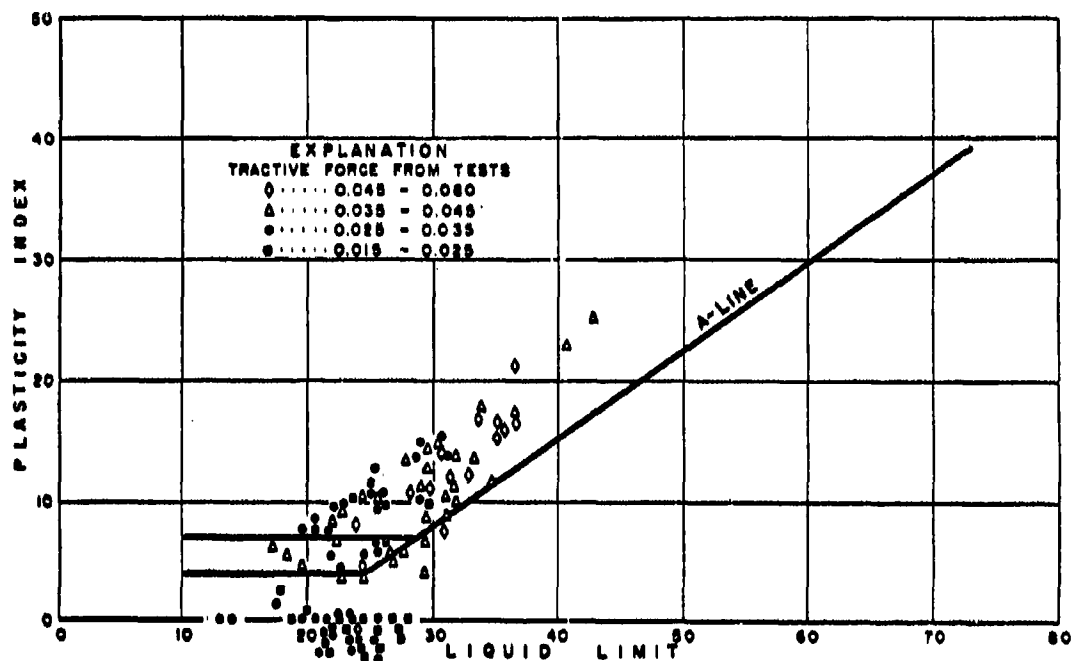


Figure 17. Critical tractive force obtained from laboratory tests and plasticity characteristics of samples (Reference 49)

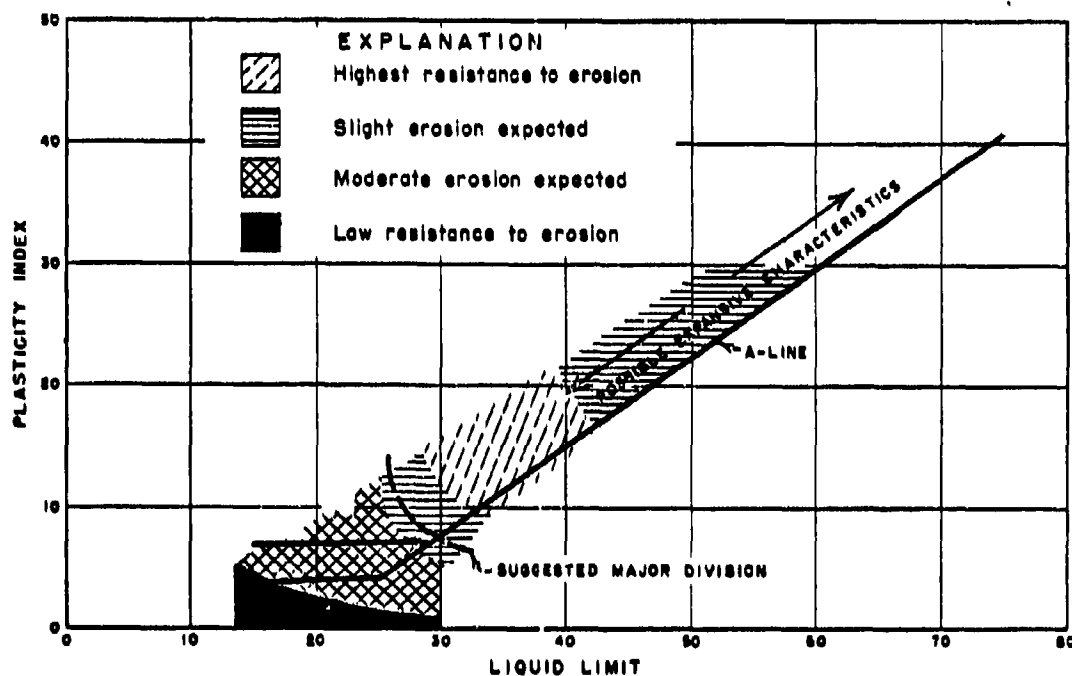


Figure 18. Relationship between plasticity and erosion characteristics (Reference 49)

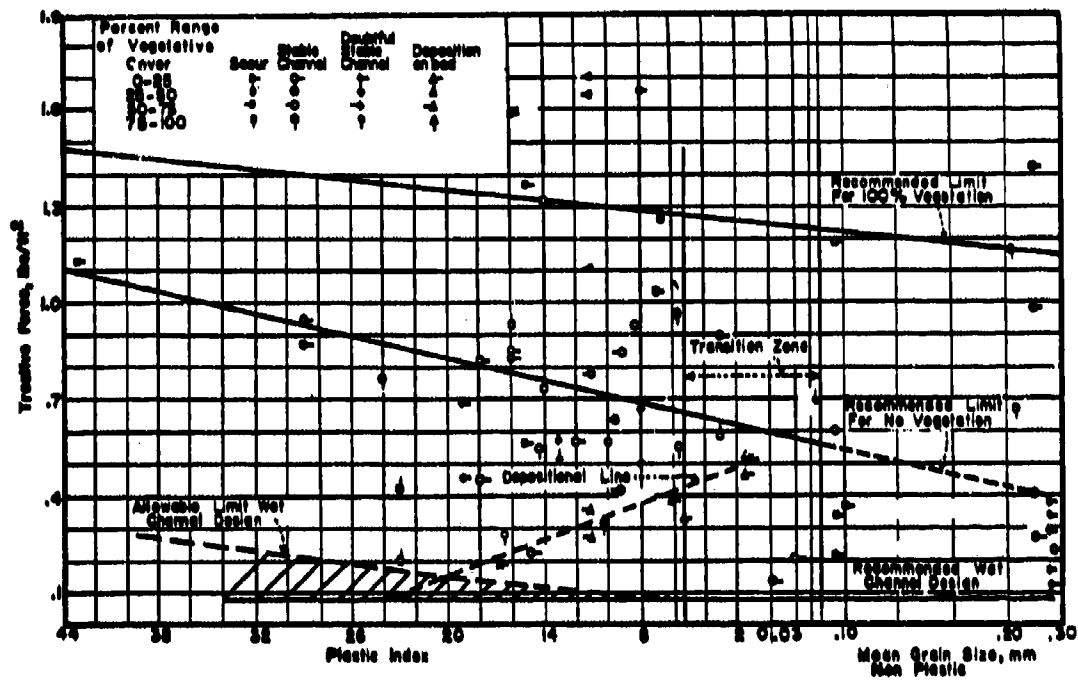


Figure 19. Limiting channel bed tractive force for ephemeral streams (References 53 and 54)

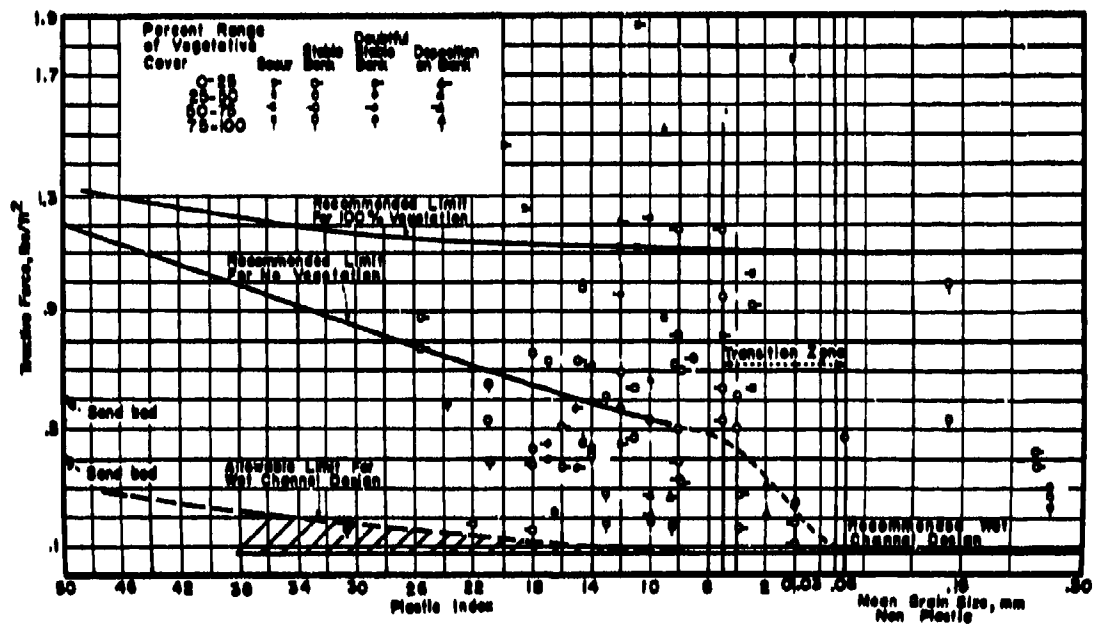


Figure 20. Limiting channel bank tractive force for ephemeral streams (References 53 and 54)

stability as a function of tractive power and unconfined compressive strength is given in Figure 14.

28. Strand⁵⁵ used field observations of and data collected from four noneroding test sections of a tributary of the Middle Loup River in central Nebraska to evaluate four criteria used in the design of stable channels in cohesive soils. According to Schumm's relation³³ for width-depth ratio versus percent silt-clay in banks and channel, the test sections are of the type tending to aggrade as shown in Figure 21.⁵⁵ Figures 22 and 23 (Reference 55) show that the test sections studied plot within Schroeder's⁵⁴ recommended limit for 100 percent vegetative cover. The banks on the test sections were generally well covered with vegetation. Strand⁵⁵ noted that other channel studies have disproved portions of the curves shown in Figures 22 and 23. Figure 24 (Reference 55), using Flaxman's relation⁴² for tractive power versus unconfined compressive strength, shows that the test sections would be stable for the mean annual flood peak discharge.

Soil Mechanics Aspects of Streambank Stability

29. Although the general types of alluvial deposits are limited in number, there are so many variations in the conditions of deposition and subsequent erosion within the individual types that it is questionable whether two localities could be found in which any appreciable amounts of sediments are exactly similar in character.^{22,56} The variation in depositional environment, coupled with the long reaches usually involved in streambank stability, makes it impractical to conduct detailed soil and groundwater investigations that would otherwise be justified for the foundation design of structures such as locks or dams. Therefore, to determine which areas require more detailed investigations because of unfavorable soil and groundwater conditions, it is imperative to utilize any existing geologic and soils data on the soils in the area of interest and to supplement this information with limited subsurface exploration and laboratory testing.²⁹

30. The erosive characteristics of cohesionless soils, which are

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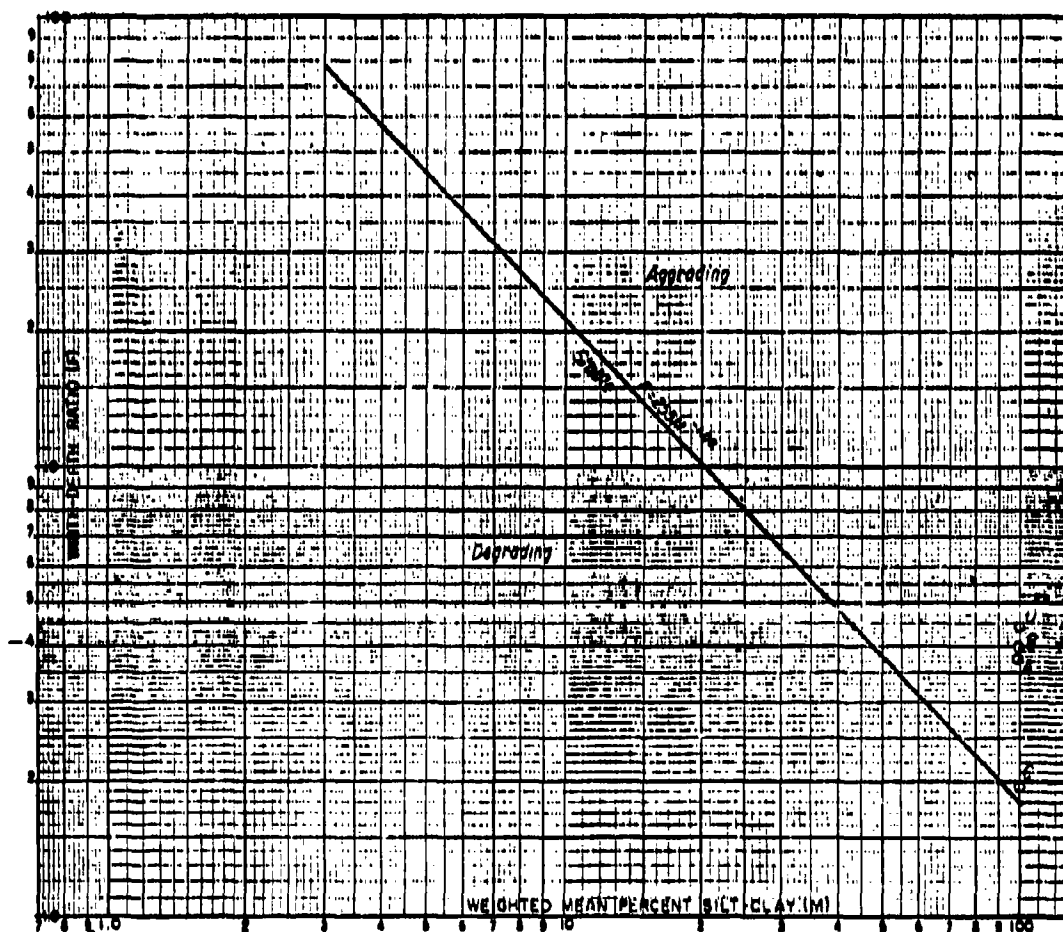


Figure 21. Evaluation of channel stability of Middle Loup River, Nebraska, using Schumm's relation³³ for width-depth ratio versus percent silt-clay (Reference 55)

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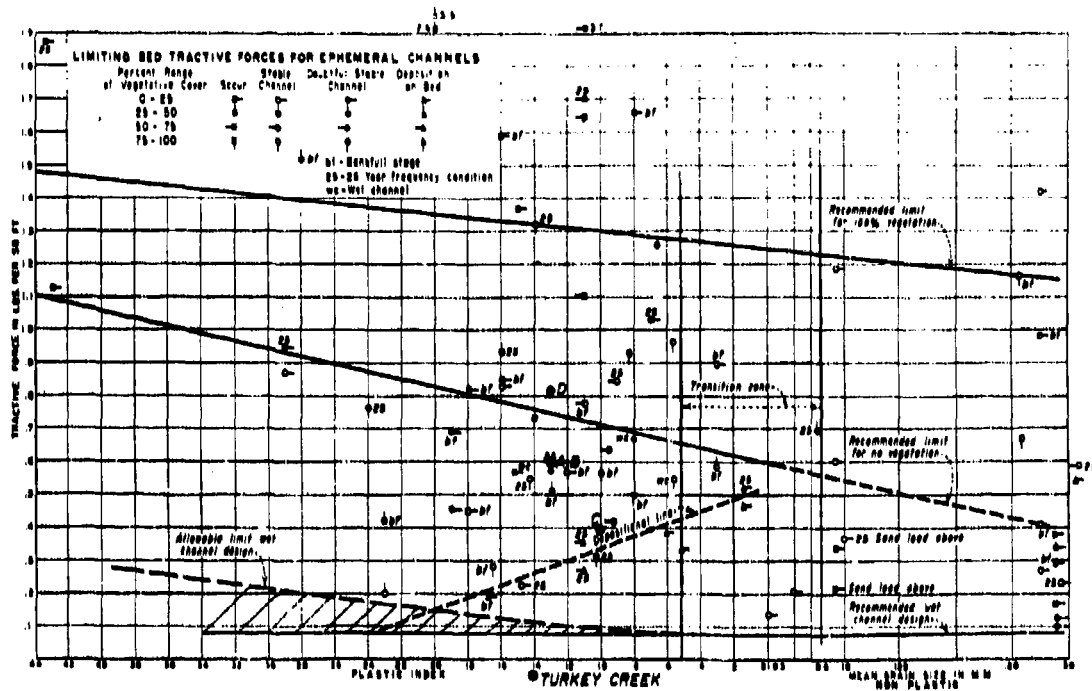


Figure 22. Evaluation of channel bed stability of Middle Loup River, Nebraska, using Schroeder's relation⁵⁴ for bed tractive force versus plasticity index (Reference 55)

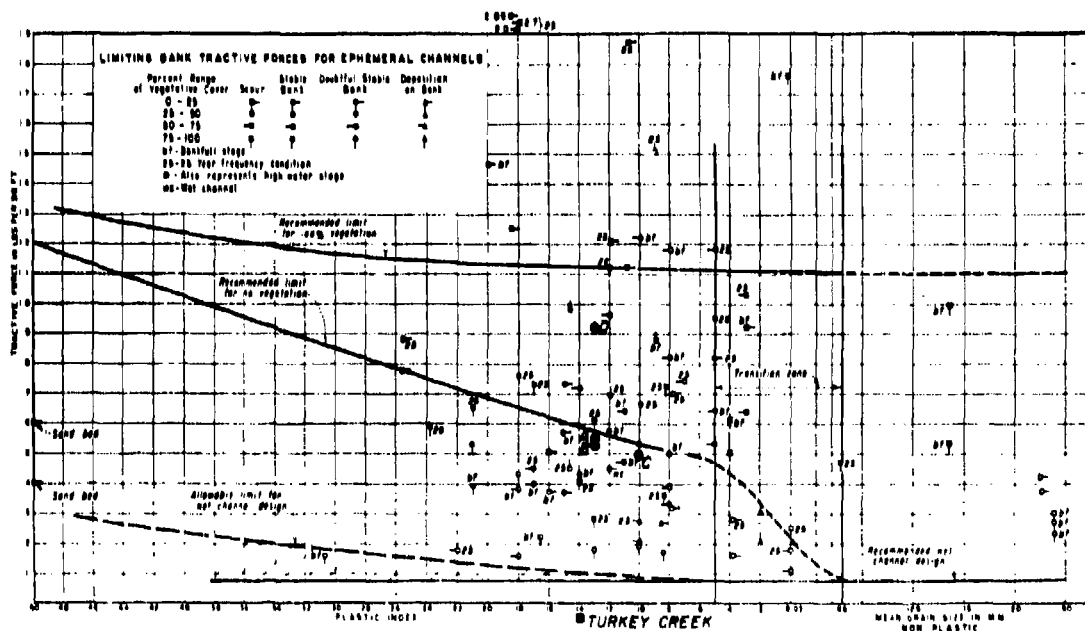


Figure 23. Evaluation of channel bank stability of Middle Loup River, Nebraska, using Schroeder's relation⁵⁴ for bank tractive force versus plasticity index (Reference 55)

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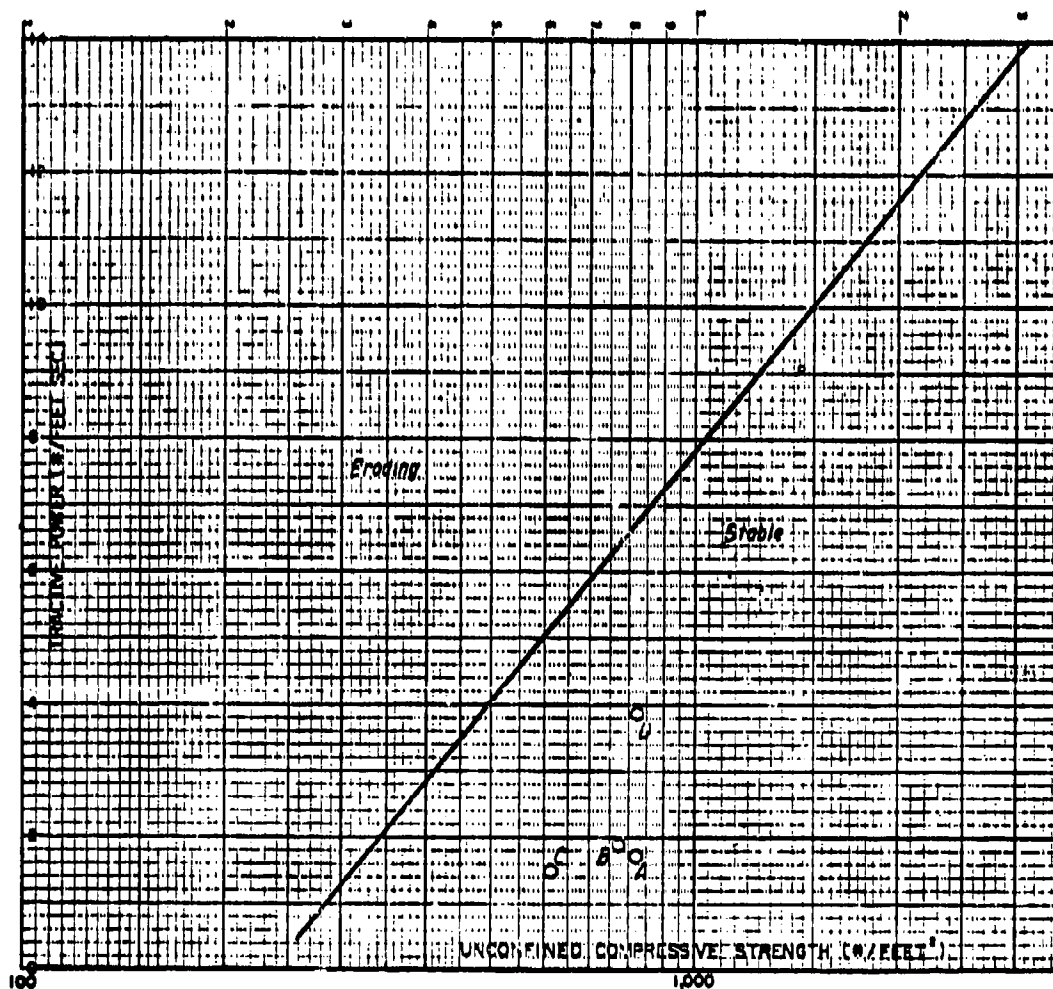


Figure 24. Evaluation of channel stability of Middle Loup River, Nebraska, using Flaxman's relation⁴² for tractive power versus unconfined compressive strength (Reference 55)

controlled by gravitational forces, and the basic parameters affecting the erosion of cohesionless soils (particle size, grain shape, gradation, moisture content, and relative density) are fairly well understood.⁵⁷ However, the development of a quantitative procedure for streambank stability analysis has been stymied, in part, by a lack of understanding of the erosive characteristics of cohesive soils, which are controlled by physical and electrical surface phenomena.^{52,53,55-61} However, an understanding of the erosive process in cohesive soils has advanced considerably during the past decade.⁵¹ The basic parameters affecting the erosion of cohesive soils are soil pore-water concentration (type and amount of cations), composition of soil (percentages of sand, silt, and clay), type and amount of clay mineral, moisture content, dry unit weight, soil pH, eroding fluid composition (type and amount of cations), eroding fluid pH, and temperature of eroding fluid. Both the flume erosion test^{53,62-67} and the rotating cylinder apparatus^{51,53,58-62} have been used to determine the rate of erosion versus applied shear stress for cohesive soils. Flume erosion tests have recently been conducted to determine the critical shear stress on remolded samples of bed material in connection with a study to determine whether armoring was required when groins were placed in the Rhine River.⁶⁸

31. Figure 25 shows a quantitative procedure for streambank stability analysis. Such a procedure could be utilized to determine bank recession with time for a selected stream. This information could then be used in planning and designing streambank protection for the stream.^{69,70}

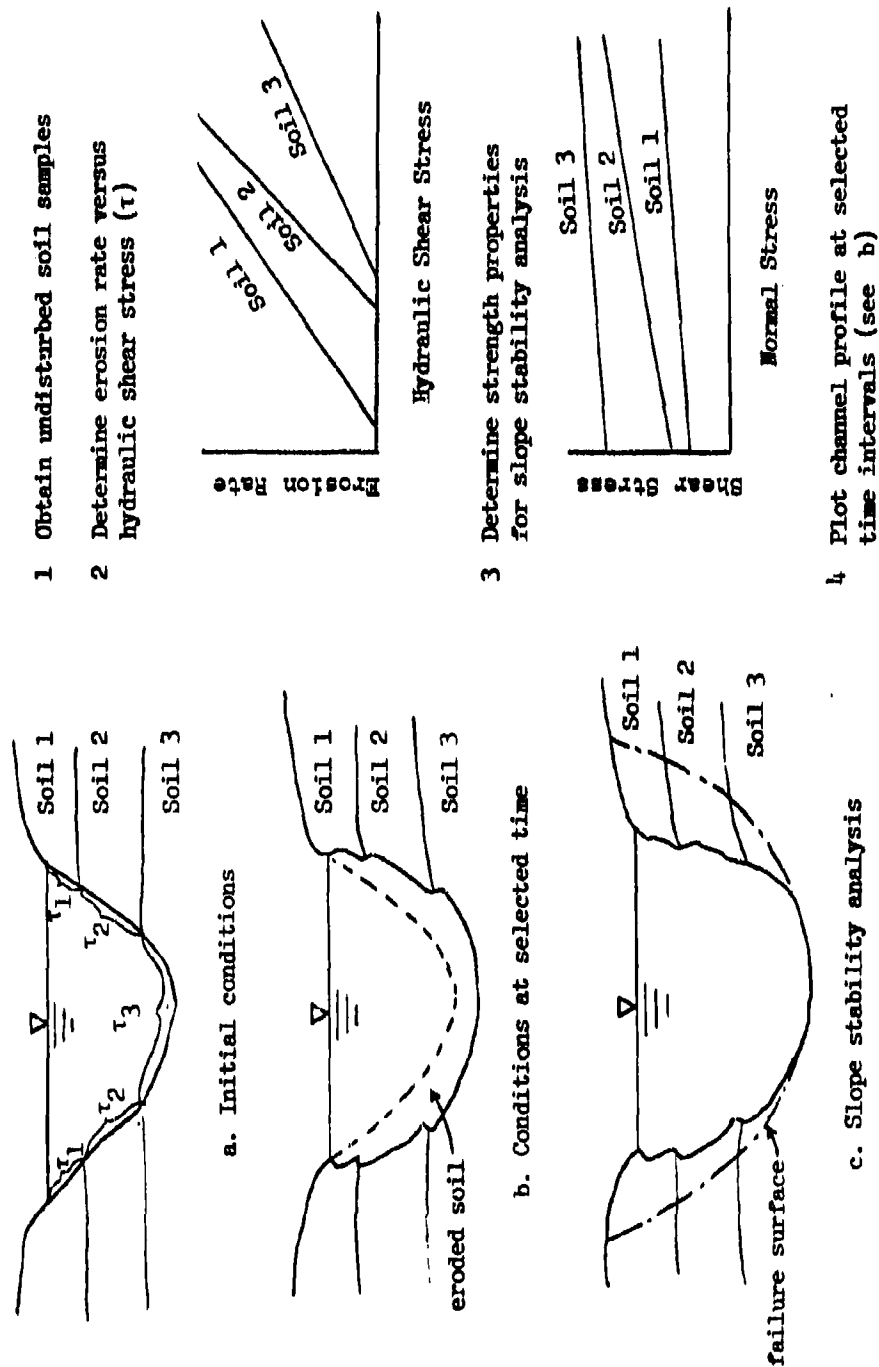


Figure 25. Procedure for streambank stability analysis

PART IV: PRELIMINARY ASSESSMENT OF STREAMBANK PROTECTION METHODS

32. Effective protection of streambanks along the navigable waterways of the United States is an integral part of the Corps of Engineers responsibility to maintain navigation channels, protect property, and improve water quality. A variety of experiments have been conducted to determine the most effective and economical bank protection "methods" (paragraph 6) for various areas; however, no specific guidelines have resulted that can be used to assist the engineer in developing design specifications for a particular bank protection problem. What has developed is the use of a group of methods that has found subjective favor in the engineering community. The most widely used of these are:

- a. Stone riprap.
- b. Concrete pavement.
- c. Articulated concrete mattresses.
- d. Transverse dikes.
- e. Fences.
- f. Asphalt mix.
- g. Jacks.
- h. Vegetation.
- i. Gabions.
- j. Erosion-control matting.
- k. Bulkheads.

The use and effectiveness of each of these are discussed in the following paragraphs using information derived from the references listed in Appendix D. In addition, several other methods are discussed that are not used on a widespread basis.

Stone Riprap

33. Riprap consists of rock courses placed along the bank to be protected (Figure 26). Prior to placement, the bank is usually graded if the slope is irregular. A bed of gravel or porous filter material is



Figure 26. Riprap placement

then placed over the graded bank to allow seepage but prevent erosion of the bank material. Where stones of sufficient size are available, riprap is usually the first choice among the bank protection methods considered because of the following general advantages:

- a. A riprap blanket is flexible and is neither impaired nor weakened by slight movement of the bank resulting from settlement or other minor adjustments.
- b. Local damage or loss is easily repaired by the placement of more rock.
- c. Construction is not complicated and no special equipment or construction practices are necessary.
- d. Appearance is natural, hence acceptable in recreational areas.
- e. If riprap is exposed to fresh water, vegetation will often grow through the rocks adding structural value to the bank material and restoring natural roughness.
- f. Riprap is recoverable and may be stockpiled for future use.

34. The effectiveness of a riprap blanket is evaluated in terms of the stability of the blanket under the influence of excessive hydraulic flow conditions, the ability of the bedding material to prevent the erosion of the natural bank material through the riprap, and resistance to undercutting and raveling at the ends of the blanket. Meeting the design objectives necessary to guarantee effective bank protection requires (a) determination of the shape, size, and weight of the stones in the riprap blanket that will be stable under excessive hydraulic flow conditions; (b) well-graded bedding material or filter cloth that will prevent erosion of the bank material through the blanket; (c) optimum blanket and bed thickness; and (d) proper termination of the riprap blanket.

35. Several empirical relations have been developed, using Airy's law, to determine the minimum stone size and weight that will be stable for the maximum hydraulic flow that will occur along the bank to be protected.⁷¹ When the size and weight are determined, the values are usually interpreted as a median value, i.e., 50 percent of the stones used in the blanket must have diameters greater than the computed median

diameter, and no more than 50 percent of the stone can weigh less than the computed median weight. No analytical method has been developed to determine the optimum stone shape; the selection of the stone shape is usually a compromise between subjective experience and what is available. Elongated stones are generally rejected in favor of "block-type" stones because they fit together better. Sharp edges are preferred over rounded edges for increased stability. In general, no stones should be used with length-to-width ratios greater than 3 and no more than 25 percent of the stones should have a length-to-width ratio greater than 2.5.

36. Both quarry-run and graded stone are used for riprap placement. Large stones are usually eliminated by the contractor; these stones should be removed from the blanket or broken up because accelerated water flow around a large stone can cause scour as well as removal of small stones adjacent to the large one. Poor gradation may also encourage riprap blanket failure because oversize stones may preclude mutual mechanical support among individual stones. If the gradation of riprap is such that movement of the underlying natural material through the blanket is likely, a filter bed of sand, crushed rock, gravel, or synthetic cloth (Figure 27) must be placed under the stone blanket. An ideal riprap blanket design would provide a gradual reduction in stone size until the stone of the blanket blends with the natural bed material; however, this is seldom economically justified. The stability of the riprap blanket is sometimes improved by grouting the stones; however, this technique reduces the permeability of the bank, which may lead to revetment failure due to hydrostatic pressure under the blanket.

37. The thickness of a riprap blanket should be at least 1 to 1.5 times the maximum diameter of the largest stones used in the blanket or twice the average diameter of the stones used. The recommended maximum bank slope for dumped stone is 1V on 2H. The maximum slope can be increased to 1V on 1.5H for hand-emplaced stone.

38. Riprap has been used effectively in channel stabilization and realignment efforts using the "trench-fill" technique (Figure 28). This approach requires that the bank be graded to conform to the desired channel configuration. A trench is excavated at the base of the graded



Figure 27. Installation of filter cloth prior to placement of riprap (photo courtesy of the Erosion Control Division, Carthage Mills, Inc.)

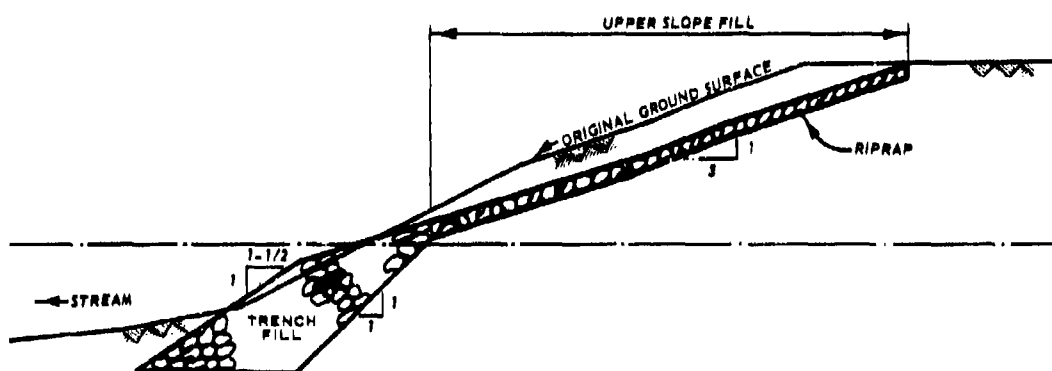


Figure 28. Trench-fill revetment

bank and filled with riprap as shown in Figure 28. Additional riprap is placed on the graded bank above the trench. As the erosive action of the stream acts on the bank between the stream and the trench, the bank fails, and eventually the trench becomes the revetment.

39. In-place cost of a stone riprap blanket (Table 5*), including bank preparation, bedding material, and transportation of stone, can vary greatly depending on the location and availability of suitable rock. The current estimate for average in-place cost (1976) ranges from \$3.50/yd³ in an area where stone is readily available to \$30.00/yd³ in a metropolitan area where stone must be hauled over long distances.

40. The majority of theoretical design work related to streambank protection works has been directed toward riprap. A review of available literature indicates that the riprap studies have yet to be consolidated into a straightforward design procedure that a field engineer can confidently use; however, Engineer Manuals⁷¹⁻⁷³ can provide limited design guidance. Also, experience can be gained in on-site work and physical model studies.

Concrete Pavement

41. Concrete pavement is generally an expensive bank protection method because forms must be constructed and concrete mix design, batching, and curing must be rigidly controlled. However, use of concrete pavement provides a high degree of reliability over a long life with a minimum of maintenance (Figure 29). The only major problem results from scour under the slabs due to inadequate subsurface drainage; deterioration of the concrete slab itself is rarely significant. Pavement is used along banks, bridge abutments, and main-line levees in heavily populated or industrialized areas where a large safety factor is required. In-place cost (1976) for concrete pavement, including bank preparation and construction of forms, ranges from \$90 to \$125 per 100 ft² (Table 5).

* Table 5 summarizes 1976 costs for all methods discussed in this part. Cost figures in this report were supplied by Corps of Engineers Divisions and Districts.



Figure 29. Concrete pavement bank protection

Articulated Concrete Mattresses

42. The development of articulated concrete mattresses (Figure 30) began in 1914 chiefly as a result of the threatened exhaustion of convenient willow growths from which timber and brush mattresses had previously been constructed. Since termination of experiments with bituminous mattresses in 1945 (paragraph 60), concrete mattresses have been used almost exclusively for subaqueous revetment on the lower Mississippi River. An articulated concrete mattress, because of its weight and flexibility, is an effective performer on parts of the bank that are subject to excessive hydraulic flow conditions. Because of the specialized construction equipment required, use of this method cannot be economically justified for small streams except those close to the Mississippi River where the mattresses can be delivered to the construction site by truck or barge.

43. The basic unit of the mattress is a slab of concrete 3 ft 10-1/4 in. long by 14 in. wide by 3 in. thick. These slabs are cast on and tied together by corrosion-resistant reinforcement wire to form rectangular units 4 ft wide by 25 ft long when allowance is made for the

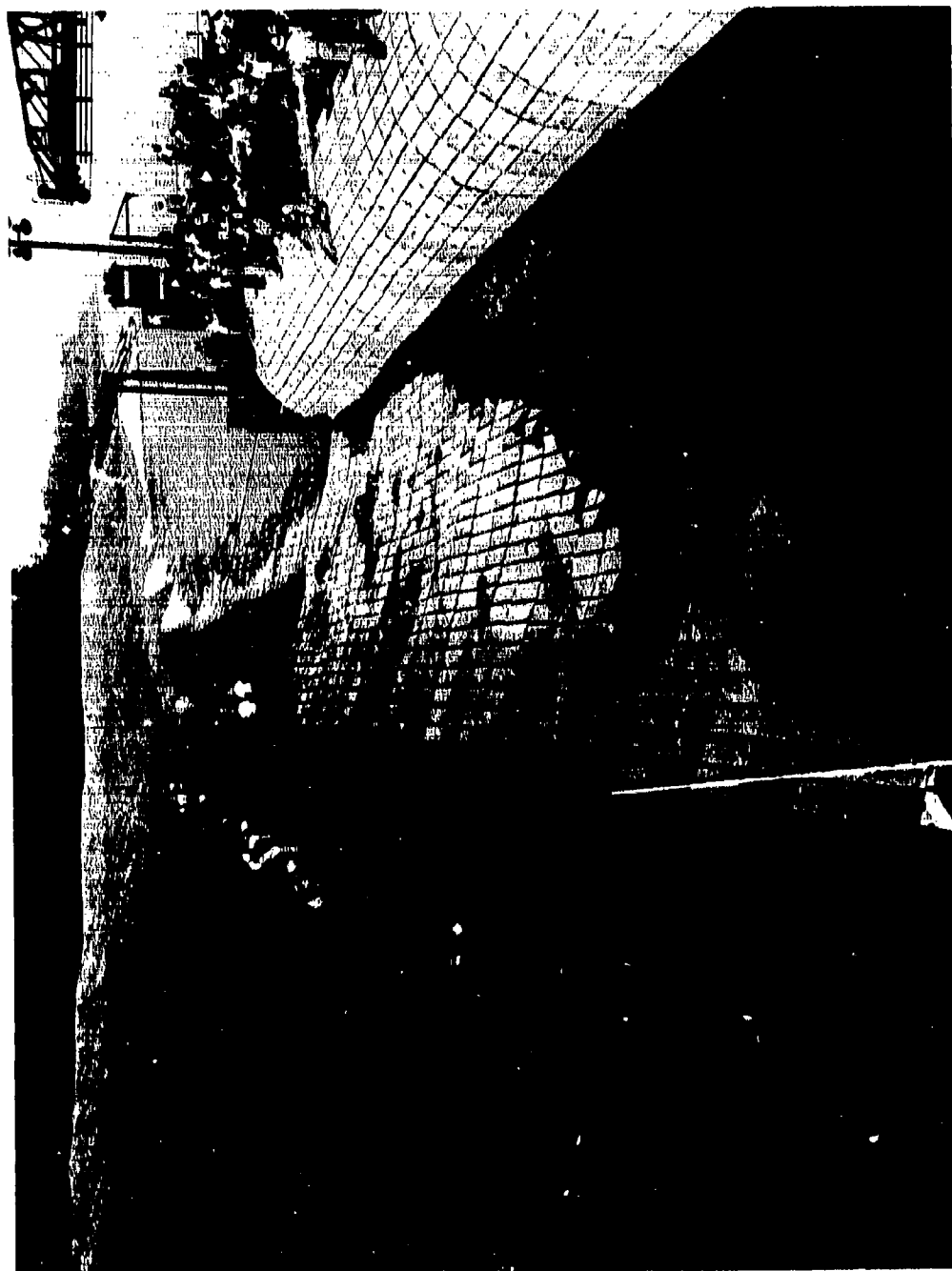


Figure 30. Articulated concrete mattress being sunk from launching barge

1-in. space between the slabs and for the space between adjacent rectangles. These units are commonly called "squares." Because a mattress is made up of squares connected by articulated joints, it possesses a measure of flexibility in all directions. Thus a mattress has the capability of adjusting itself to irregularities in the bank and to scour pockets that may develop. The principal disadvantage of the concrete mattress is the possibility of bank material eroding and escaping through the interstices of the articulated joints.

44. Articulated concrete mattresses with the ends and sides of the slabs notched in a "V" shape (designated a V-type mattress) were developed to reduce the size of the interstices. This design reduced the openings from about 10 percent of the total mattress surface area to 1 percent. Subsequent surveys conducted over a period of several years indicate that the V-type mattresses sank very little because of bank materials washing through the interstices.

45. After the submerged bank has been shaped in preparation for placement of a mattress, the squares are assembled on a launching barge that is anchored over the underwater bank. A mattress up to 140 ft wide, measured parallel to the bank, is assembled by placing the squares side by side on the launching barge and connecting them with corrosion-resistant wire and clamps (Figure 30). When the squares have been assembled into a 25- by 140-ft unit, the configuration is termed a "launch." After the launch has been assembled and connected to successive launches, the completed mattress is moved off the barge and sunk in place on the underwater bank by securing the mattress to the bank and moving the barge toward midstream.

46. Shaping of subaqueous banks and mat sinking operations are not commenced until the river stage has fallen to 15 ft above mean low water. Normally, if a sustained rise above 15 ft is in prospect, these operations are suspended. The restriction of river stage on operations limits revetment placement to the low-water season usually between mid-July and mid-December. In emergencies, mattresses have been placed when the stage was as high as 25 ft above mean low-water stage, river currents and debris conditions permitting. The upper limit of concrete

subaqueous revetment is normally 6 ft above mean low water. The mattresses are laid into the river to a point 50 ft past the thalweg unless a lesser distance is specified. As of 1976 there were two mattress-sinking plants in operation on the lower Mississippi River, each designed to place a mattress 140 ft wide. Both of these units are capable of placing 10,000 squares per day. At this rate, approximately 20 bank miles of mattresses can be laid by each unit during a normal working period of five months, i.e. the low-water season. Average in-place cost (1976) of the articulated concrete mattress, including bank preparation, is \$84 per square (100 ft²) (Table 5).

47. Prior to 1940, squares were cast entirely on a floating plant. However, as the volume of work increased, it became apparent that this immobilized too many barges during the concrete curing period. To speed up the casting operations, land casting fields have been placed at convenient locations along the riverbanks. At this time (1976) there are seven land casting fields between Cairo and New Orleans having storage capacities ranging from 40,000 to 380,000 squares, which makes it possible to cast and store these units in the quantity necessary for normal demand (Figure 31). The production rate for the floating casting



Figure 31. Concrete squares stored at casting field

plant of 1931 was approximately 60 squares/hr. Steady improvement in field casting production efficiency has resulted in an increase from 100 squares/hr in 1948 to a maximum of 200 in 1970.

Transverse Dikes

48. Transverse dikes are considered to be an indirect method of bank protection, because eroding river currents are deflected away from the bank or reduced in velocity, as opposed to a direct method in which the bank is physically isolated from the eroding currents.

49. Transverse dikes are of two principal types, permeable and impermeable. The permeable type is effective in slowing the current over a portion of the channel area thereby causing deposition of sediment. The accumulation of sediment and the retardation of flow produced by a dike system cause the main channel section to carry a larger proportion of the water than it did in the absence of the dike system thereby increasing the current velocity and the sediment transport capacity. As a result, greater depth is maintained in the main channel. A permeable dike is most effective on a stream where the velocity is sufficient to carry a substantial load of coarse sediment that will settle as a result of a moderate reduction in current velocity. Impermeable dikes do not require sediment deposition to redirect the hydraulic flow. An impermeable dike simply reduces the width of the river, and the river, as it is contracted to a narrower channel, attempts to regain the cross-sectional area required to pass the same discharge as was passed before the dike field was put into place. When the bank opposite the dike field has become stable, the main flow begins to scour out the bed of the river, which produces an improved navigation channel. After the river has deepened enough to regain its normal cross-sectional area, the bottom scouring stops.

50. Timber piles are the basic components of most permeable dikes (Figure 32). Timber-pile dikes of various designs have been constructed using face boards with horizontal bracing, as well as single piles and clumps (three piles strapped together) in single or multiple rows. The



Figure 32. Timber-pile dike

design selected depends on the depth of the stream and the severity of the hydraulic flow conditions that must be sustained by the pile dike once it is in place. The spacing of the piles or clumps can be varied from one location to another in accordance with the quantity and character of the sediment transported. For example, very fine sand entrained by the water requires greater reduction in flow velocity to settle out than does coarser material, and as a result, closer spacing of the piles or clumps is needed. The permeability of pile dikes can be further reduced by suspending screens to encourage more complete and effective deposition. This technique is especially useful where the sediment movement is not great and the sediment contains fines that would otherwise not deposit.

51. Transverse stone dikes are now the most widely used impermeable dikes (Figure 33). They are usually constructed from quarry-run stone with specified limitations on the maximum size of stone and amount of fines. These dikes are built with crowns of various widths up to 10 ft or more, depending on the severity of the expected attack, the



Figure 33. Transverse stone dike

method of construction, and the requirements for maintenance. The principal mechanical advantage in using stone is that a dike can be constructed so that the void volume is minimized and little or no water passes through. Thus, when used for channel contraction or bank protection purposes, impermeable dikes do not require the deposition of sediment in the dike field to as great an extent as do the permeable dikes. Nevertheless, sediment between the dikes is necessary to make the contraction or protection continuous along the dike field and to reduce the scalloping of the banks between the dikes that may be caused by eddies and overtopping flow.

52. In general, transverse dikes extend into the stream past the point where the highest velocities occur. This function is to move the thalweg from its position along an eroding bank to an alignment controlled by the location of the structures.

53. When the principal purpose of transverse stone or pile dikes is bank protection, they are sited uniformly along caving banks based on the following considerations. The spacing between any two dikes has

generally been related to the average of their lengths multiplied by a spacing-length ratio. The spacing-length ratio is derived from the experience of the designer. The final selection of spacing and length may be an economic one, but for bank protection purposes, the length of the dikes should be just sufficient to move the eroding current away from the bank. Of course, there is a limitation on length since it must not be such that the dike will unduly restrict the navigation channel or increase the current velocity to an unacceptable value.

54. The average construction cost of pile board dikes is \$40 to \$55/lin ft (1976). Untreated pile clumps (three 60-ft piles to a clump) range in cost from \$1500 to \$2300 each (1976). Transverse stone dikes range in cost from \$40 to \$65/lin ft (1976) (Table 5).

Fences

55. Wire fences are used to solve a variety of bank protection problems on low-gradient streams with discharges less than 500,000 cfs. Fences can be positioned parallel to the bank (Figure 34) as well as



Figure 34. Wooden fence constructed parallel to bank



Figure 35. Wire fences constructed transverse to streamflow

transverse to the streamflow (Figure 35). Two fences parallel to the bank are sometimes constructed 3 to 10 ft apart. Brush, hay, or rock is stacked between the fences, providing an extra measure of protection against the erosive action of the water currents. If the fences are constructed parallel to the bank and the bank is steep enough, a second fence is not required for holding the brush backfill. Fences constructed parallel to the bank generally serve as an erosion stopgap measure to allow sufficient time for the establishment of vegetation or to prevent sloughing of the bank. Fences constructed across part of the stream section promote sediment deposition. A transverse fence can be positioned to deflect debris downstream or to trap it. By constructing the fence so that it is oriented downstream at an oblique angle to the current flow, debris will be deflected into the main channel. This technique is useful if the stream has a heavy debris load and the designer desires to keep the banks clear. Conversely, the fence can be constructed so that it is oriented upstream at an oblique angle to the current flow. Debris is then trapped behind the fence. This construction method is effective for clearing the main channel of debris and serves to encourage sediment deposition.

56. Many types of local materials can be used for fence construction. The fence posts can be of treated or untreated wood, used rails,

pipe steel beams, or concrete. Additional supporting members for the posts can be constructed of the same materials. The fencing material is generally wood or wire. If wire is used, the required tensile strength depends on the design loading by the water and debris. Field fencing and welded-wire fencing are effective for heavy and medium loading and chicken wire, for light loading.

57. Fencing is not considered to be one of the most effective means of bank protection, but it is commonly used because no special techniques are required for construction and there is a wide availability of materials suitable for assembly of the fences. Installed cost of the fencing is \$25 to \$50/lin ft (1976) if all material must be purchased new (Table 5); the cost is substantially reduced by the use of secondhand or free materials that are commonly available in rural areas.

Asphalt Mix

58. Asphalt mix has been used in several ways to provide bank protection--as blocks, reinforced mattresses, or uncompacted on an upper bank.

59. Asphalt blocks were used in 1918 and again in 1951 as a substitute for ballasting stone and riprap on the lower Mississippi River below Natchez, Mississippi. Quality stone for riprap is not widely available in this region and must be transported from several hundred miles away, but river sand and petroleum products (essential ingredients of asphalt blocks) are available. The casting and dumping of asphalt blocks proved to be uneconomical for use as ballast or riprap in 1918 and in 1951 as compared with using imported stone. Since 1951, only minor placement and evaluation have been done to investigate the effectiveness of asphalt blocks for constructing bank protection works. Further investigation based on current market values may be warranted.

60. Another type of asphaltic bank protection was used on the lower Mississippi River from 1934 to 1945. Compacted, cable-reinforced mattresses (commonly called bituminous mattresses) were laid on the

shaped riverbank below the low-water line. Most protection of this type was below Baton Rouge, Louisiana, where the bituminous mattresses were placed over timber or old willow mattresses as reinforcement against bank failure (Figure 36). The reinforced, compacted bituminous



Figure 36. Bituminous mattress placed over timber mattress

mattresses were designed to have many of the necessary features of an effective subaqueous mattress. They were continuous, impermeable, fairly flexible, and resistant to abrasion; unfortunately, many failures occurred. The impermeability of a bituminous mattress rendered sinking impossible in currents greater than 5 fps. Even though holes were drilled in the mattress, it acted much like a flag in the breeze. Eventually, the mattress would tear or fold over downstream. Although specifications called for a flexibility superior to that required for highway pavements, the mattresses could not withstand the constant flapping, bending, and folding that occurred at many locations. Low-water inspections indicated that the mattresses did not conform very well to changes in the channel geometry. This resulted in sections



Figure 37. Failure of bituminous mattress

breaking away leaving only exposed cable (Figure 37). Other problems resulted from failure of the works at exposed ends and at the connection between the mattresses and the upper bank works. Serious problems also occurred when the impermeable mattresses restricted the natural bank drainage. The increased pressure differential eventually caused failures at weak points in the mattresses ("blow holes"). The mechanically sophisticated plant required to lay the mattresses and the high frequency of failures made the cost of this protection method exceed that of articulated concrete mattresses (paragraphs 42-47). Efforts to place bituminous mattresses were terminated in 1945.

61. The use of uncompacted bulk asphalt mix dumped from trucks (Figure 38) or spreaders (Figure 39) on upper banks has proved to be successful. Bulk asphalt mixes have been in common use since 1945.

62. The mix used for upper bank revetments generally consists of river bar sand and 6 percent, by weight, of 85-100 penetration asphalt. The sand is obtained from the nearest or most accessible bar in the

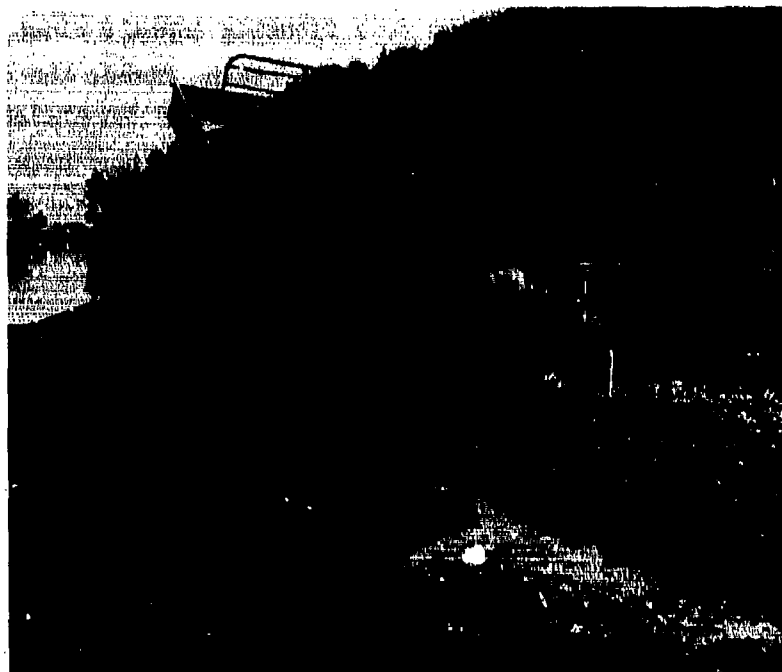


Figure 38. Bulk asphalt dumped from truck
onto upper bank (photo courtesy of Royal
Dutch Shell)

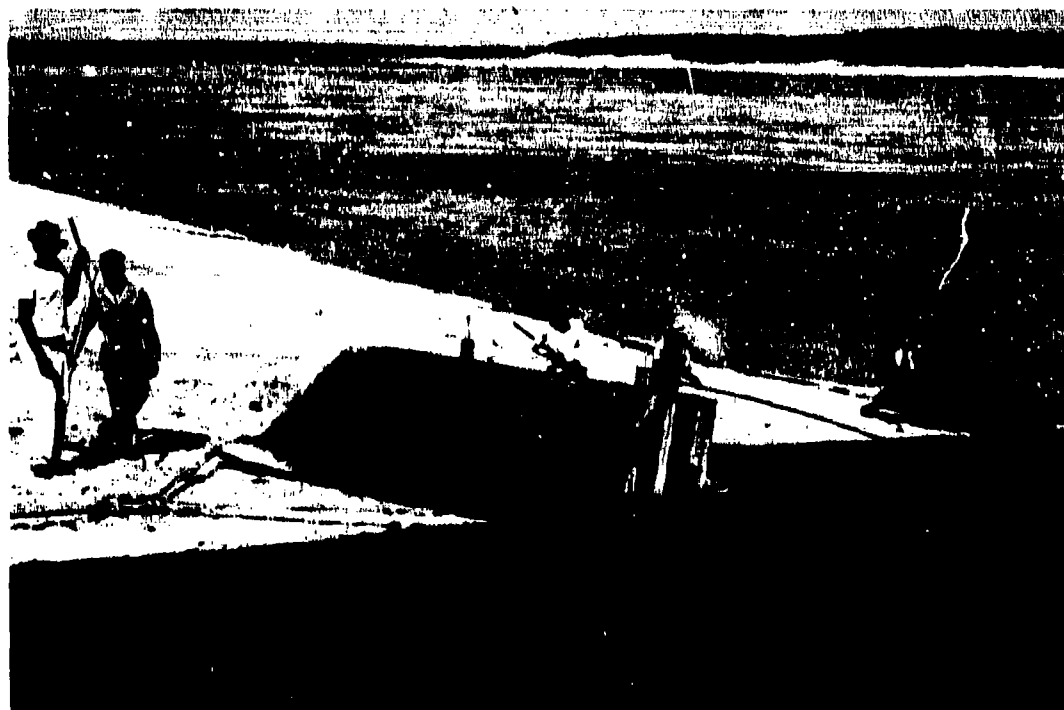


Figure 39. Spreader placing asphalt mix on upper bank

river and is transported by barge to a floating asphalt plant where it is dried and mixed with the asphalt. After being mixed, the material is picked up from the discharge bin with a clam bucket and placed in a dump truck or pull-type spreader box on the lower edge of the bank to be paved. A tractor at the top of the bank pulls the spreader slowly up the bank with a winch. In this manner, a nominal 5-in.-thick layer of sand-asphalt is placed on the previously graded bank and left in an uncompacted condition. (The banks are usually graded to a 1V on 3H slope.) This technique has been satisfactory where floodwater velocities have not exceeded 7 fps. Above this velocity, excessive abrasion or total failure of large sections of revetment have occurred. Failure also may occur because of uplift from hydrostatic pressure after a rapid drawdown. Although permeability of the asphalt increases with age, the pores of the pavement rapidly become clogged with silt, which increases the possibility of failure due to buildup of hydrostatic pressure. A subsurface drainage system can eliminate this problem in some cases.

63. Annual surveys have shown that the wearing rate of asphalt paving on upper banks is 1/16 to 1/8 in. per year as a result of abrasion. A very thin surface layer of the asphalt weathers until it loses its adhesive qualities. This can be observed on most asphalt revetments, as the mix takes on a light brown appearance and loses its cohesiveness in the thin layer. In this condition, the thin layer is easily removed by rain, wind, and water currents, and then the weathering process is repeated. If it is assumed that the yearly rate of surface wear is a maximum of about 1/8 in., at the end of 25 years the bank slope will be covered with a 2-in.-thick pavement, which is considered to be serviceable in some situations. This may be a reasonably good minimum estimate for the design life of asphalt pavements on upper bank revetments based on natural deterioration and wear. It should also be noted that the asphalt binder deteriorates with age and the pavement becomes more brittle. Hence, the pavement becomes more subject to massive mechanical failures due to floodwater velocities, impact by debris, hydrostatic pressure, or penetration by vegetation.

64. In-place average cost (1976) for asphalt used for upper bank paving is \$60 to \$80/yd³ including the costs for bank preparation (Table 5).

65. Between 1946 and 1949 trial installations of subaqueous protection composed of mass asphalt mix at temperatures of 225-275°F were placed along the banks of the lower Mississippi River. Loads of 330 tons of hot mix containing 25 percent asphalt were dumped in bulk by hopper barges covering a slope surface of 600 yd² extending out 300 ft from the toe of the bank. The experiments demonstrated that a sand-asphalt mixture can be dropped in a large mass through a considerable depth of water and develop a satisfactory mat. This method, although successful, has been largely neglected except for patchwork, because the major emphasis has been placed on development of articulated concrete mattresses.

Kellner Jack Field

66. The term "jacks" includes a variety of wooden, metal, and concrete configurations. The most common consists of three linear members that are bolted or welded at their midpoint such that each member is perpendicular to the other two (similar to the shape of a toy jack). The members are laced together with cable. The jacks are then assembled in a linear array and connected at intervals of 15-30 ft with cables. Arrays that are parallel to streamflow are called diversion lines; those that make an angle with the flow are termed retard lines. The retard lines are attached to the bank with deadmen and extended into the channel where the free end is anchored to a diversion line. The resulting system is called a Kellner jack field (Figure 40).

67. Use of a Kellner field is considered to be an indirect bank protection method because the protection works are not in direct contact with the bank. The field is also considered to be a river "training aid," since the thalweg is moved away from the bank by the field. This displacement tends to scour out the main channel and improve navigation.

68. A Kellner field is permeable and extremely flexible and

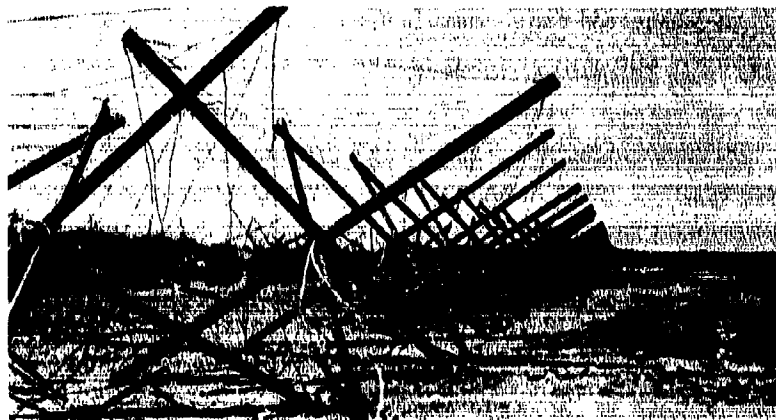


Figure 40. Kellner jack field

readily conforms to channel geometry. The placement of Kellner fields has found wide application in the southwestern and midwestern United States where the wide, shallow, silt-laden streams are subject to severe scour during high-velocity flows. The flow velocity may be reduced from a peak of 5 fps to 0.50 to 0.25 fps by an effective Kellner field. The jacks and connecting cable slow the current and cause deposition of the suspended sediments, which in turn build up eroded banks. This system also encourages the collection of debris, which improves the effective density of the works and removes dangerous obstacles from the navigation channel. Vegetation, which not only provides additional bank protection, but also reduces the channel area exposed to evaporation, usually becomes rapidly established in the built-up areas behind the retard lines. This promotes water conservation, an important consideration in arid and semiarid regions.

69. The Kellner field was developed in the 1920's as an economical alternative to pile dikes. Since then, this system has been used for a variety of long-term and emergency protection measures. The jacks can be constructed from used angle iron or rails and can be assembled by inexperienced crews in a relatively short time. The Santa Fe Railroad initially used the system on a large scale in Kansas, Oklahoma, Texas, and New Mexico. Some of the fields have been in place over 25 years. The only maintenance has been the replacing of sections of arrays that

were damaged by debris. Some corrosion has been noted on the jack members, but the useful life of a field should be in excess of 50 years. Successful use of Kellner fields also has been reported by the Albuquerque, Sacramento, and San Francisco Districts of the U. S. Army Corps of Engineers and by the Texas, Oklahoma, and Kansas highway departments.

70. Average initial cost of the field is a function of the availability of used materials. The cost (1976) varies from \$16/ to \$47/lin ft, which includes the costs of the jacks, the cable to connect them, deadmen on the bank, and labor (Table 5).

71. Although Kellner fields are not aesthetically harmonious with a floodplain landscape, they have proven to be effective when used in locations where timber and riprap are not economically available, but scrap materials are. Jacks are not recommended for use in areas with a corrosive atmosphere, where extremely high velocity flows are experienced, or where the banks to be protected are higher than the jacks.

Vegetation

72. The principal functions of vegetation for streambank protection are to keep fast-moving water and transported coarse materials away from the surface of a streambank slope and to improve the structural integrity of the bank. Vegetation is generally divided into two broad categories: grasses and woody plants. The grasses require much less time than the woody plants to become established on banks, but offer less protection during periods of high-velocity flow (Figure 41). Experiments¹⁹ have demonstrated that the ability of grass to reduce stream velocity (and hence retard erosion) is directly related to the length, width, and density of the blade, the areal density of the grass, and the depth of the root system. A well-established stand of selected grass can reduce the stream velocity as much as 90 percent at the boundary layer between the water and the soil.

73. The major factor affecting the selection of a particular species of grass to be planted is the length of time required for the grass stand to become established on the slope. The selection of a



Figure 41. Grass used for bank protection

grass species is also based on soil and air temperature, total rainfall and distribution of rainfall, type of soil available for planting, the slope of the bank, and the ability of the soil to store water for plant growth during dry periods. Some species having physical attributes that provide optimum resistance to erosion often must be excluded from use in regions where the growing season is short or where the banks are subjected to prolonged periods of submergence.²⁰

74. The topsoil of the bank to be protected is generally stripped because it provides a fertile bed that enhances weed growth, which tends to choke out the grass. The soil that is exposed is usually rolled and then scarified prior to planting. The grass can be planted by sodding, sprigging, or more commonly by the mechanical broadcasting of mulches consisting of seed, fertilizer, and other organic mixtures (Figure 42).

75. Woody plants generally have a greater initial cost than grass and require a longer time to become established, but they provide more effective long-term protection. For sections of a streambank where scour is a problem, woody plants established at the toe of the



Figure 42. Mechanical broadcaster spreading mulch on stream top bank (photo courtesy of Bowie Industries)

slope and grass above the toe have proven to be good protection. Trees raised in nurseries are preferred over local plants because they are usually healthier, bushier, and have better developed root systems at maturity.

76. Above the mean high-water line of bank slopes and in back-water areas, the major soil erosive action results from the mechanical disintegration of soil masses by alternate wetting and drying (periods of precipitation and sunshine) and wind. Grasses have proven to be excellent deterrents to soil erosion under these conditions. Of all the bank protection methods, vegetation is the only self-renewable method and in many cases the most economical and aesthetically pleasing.

77. The cost (1976) of planting grass ranges from \$500 to \$650 per acre, including soil preparation and fertilizer (Table 5). If woody vegetation is planted with the grass, the average cost is approximately three times that of grass alone.

Gabions

78. Prefabricated gabion cages have been marketed in Europe for many years; however, gabions for the construction of bank protection works in the United States have been used widely only in the past 15 years. The basic element of the gabion works is the cage or "basket." The cage is a rectangular wire-mesh structure divided by diaphragms into cells (Figure 43). The mesh is generally galvanized steel wire, which

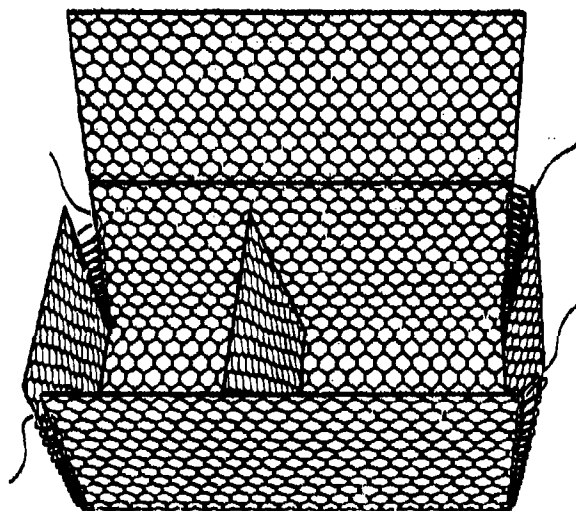


Figure 43. Gabion cage (photo courtesy of Maccaferri Gabions, Inc.)

is coated if the gabions are to be used in a corrosive atmosphere.

79. Prior to placement of the cages, a support apron is laid on the bank that will extend at least 6 ft past the toe of the gabion works (Figure 44). The apron, also constructed of gabion cages, has a minimum height 1.5 to 2 times the depth of the scour predicted at the toe of the bank. Each cage is placed and securely wired to the apron or its neighbors and then filled with stone. Ideally, the stone should be slightly larger than the wire mesh and should be of maximum available density. It should also be able to physically withstand abrasion and be nonfriable and resistant to weathering and freeze-thaw actions. To avoid bulging at the sides of the cage, tie wires are often connected between opposite

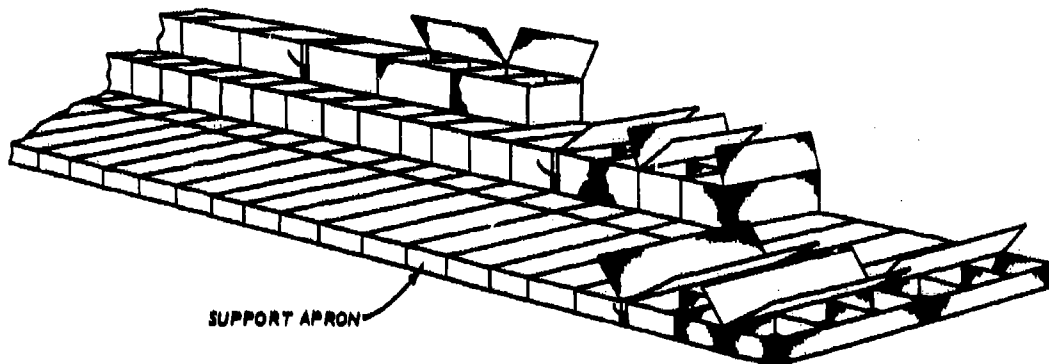


Figure 44. Typical arrangement of gabions used to protect a streambank (photo courtesy of Maccaferri Gabions, Inc.)

walls inside the cells prior to filling with stone.

80. Gabion works are somewhat flexible and are therefore able to accommodate minor changes in bank geometry. The voids between the stones allow bank drainage, which aids in the elimination of failures due to excessive hydrostatic pressure. Filter cloths are sometimes used behind gabions to prevent excessive soil losses.

81. Current in-place costs (1976) for gabion works (Figure 45) are \$40/ to \$47/yd³ (Table 5). The costs can be reduced somewhat for very large projects near economical sources of stone.

Erosion-Control Matting

82. A variety of erosion-control mats are available on the commercial market. Many of these mats are produced from by-products of other manufacturing processes. This type of bank protection is generally installed by hand (Figure 46) and secured to the bank with stakes or staples. For some applications, the matting, stakes, and staples are biodegradable.

83. The matting is structured in the form of a web, which allows vegetation to grow through the mat. In many design applications, this is considered to be a short-term bank protection measure that allows natural vegetation to reestablish itself on an eroding bank or allows

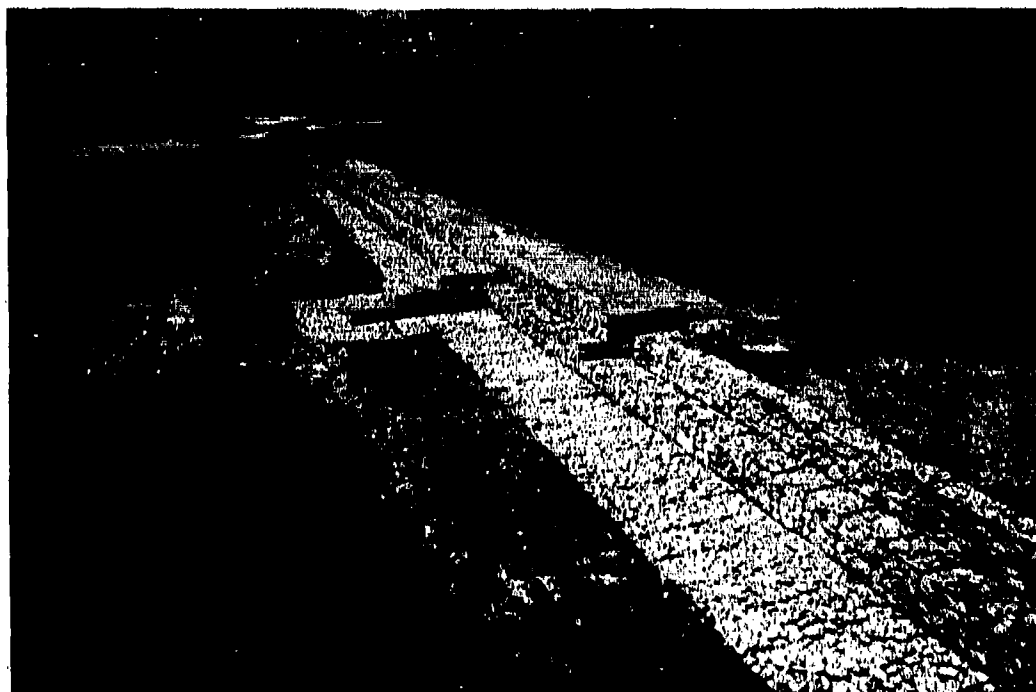


Figure 45. In-place gabion works (photo courtesy of Maccaferri Gabions, Inc.)

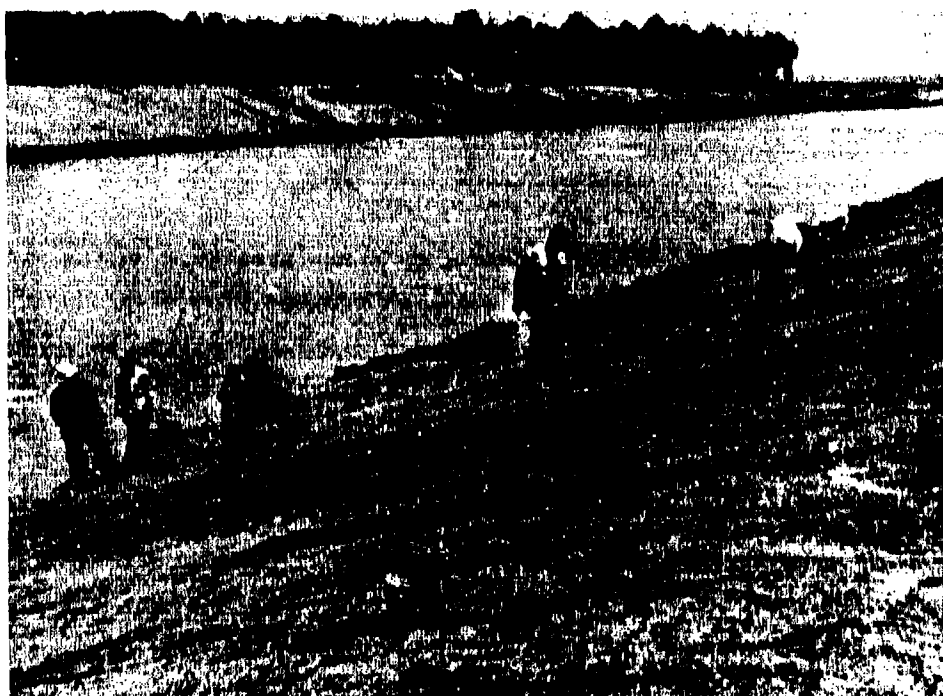


Figure 46. Erosion-control matting being placed by hand

new vegetation adequate time to become established. Some of the currently available mats decompose and add organic matter to the topsoil. Nonorganic webbing has caused some problems during later grass cuttings because of its tendency to become tangled with mower blades.

84. Installed costs (1976) for matting ranges from \$0.50/ to \$0.65/yd² (Table 5).

Bulkheads

85. Bulkheads are used to protect streambanks when the bank slope is unstable, to expedite the flow of traffic across the water-land interface, or when additional waterfront area is required, i.e. filling behind the bulkhead. A timber bulkhead (Figure 47) generally costs less initially than a comparable concrete bulkhead, but its design life is shorter because of deterioration and destruction caused by repetitive cycles of wetting and drying and attack by organisms. A concrete bulkhead (Figure 48) can provide long service if failures due to cracking or pressure from the fill behind it can be avoided.^{6,74} Concrete bulkheads generally require minimal maintenance; whereas timber requires regular application of wood preservative to minimize deterioration.⁷⁵⁻⁷⁷ Hence, costs (initial plus long term) are in many cases nearly the same.

86. Prefabricated asbestos fiber (Figure 49) and metal (Figure 50) bulkheads are available from commercial sources. Each sheet of commercial bulkhead is worked into the soil with a compressed air jet or is driven into the ground with a mechanical aid. The sheets are then joined together and capped. The use of sheet bulkheads eliminates the necessity for driving deep piles or, in some cases, constructing concrete forms; concrete caps are used on some projects.

87. Installed costs (1976) for bulkheads range widely from \$14/ to \$105/lin ft (Table 5), depending on availability of materials. Costs of concrete, timber, aluminum, and fiber bulkheads are generally competitive, at an average of \$50/lin ft when materials are readily available.

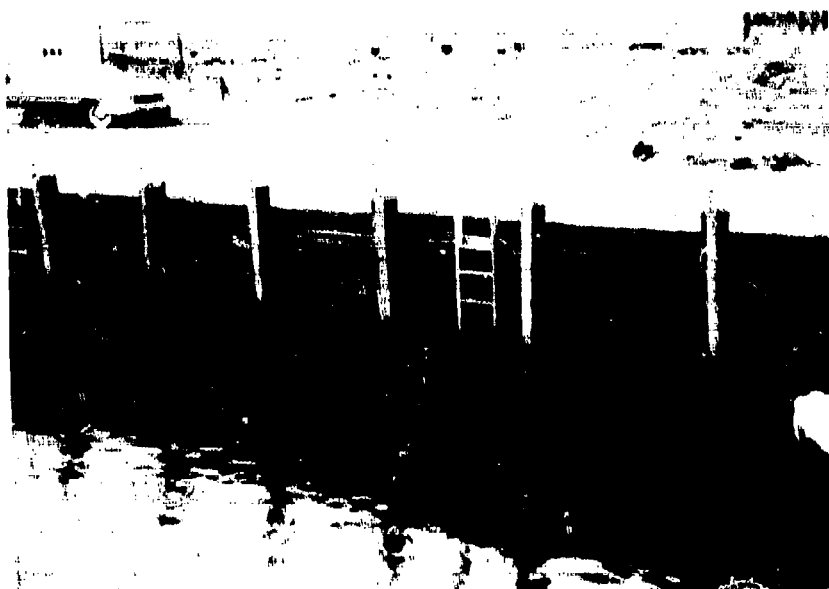


Figure 47. Timber bulkhead



Figure 48. Concrete bulkhead (photo courtesy of the Portland Cement Association)

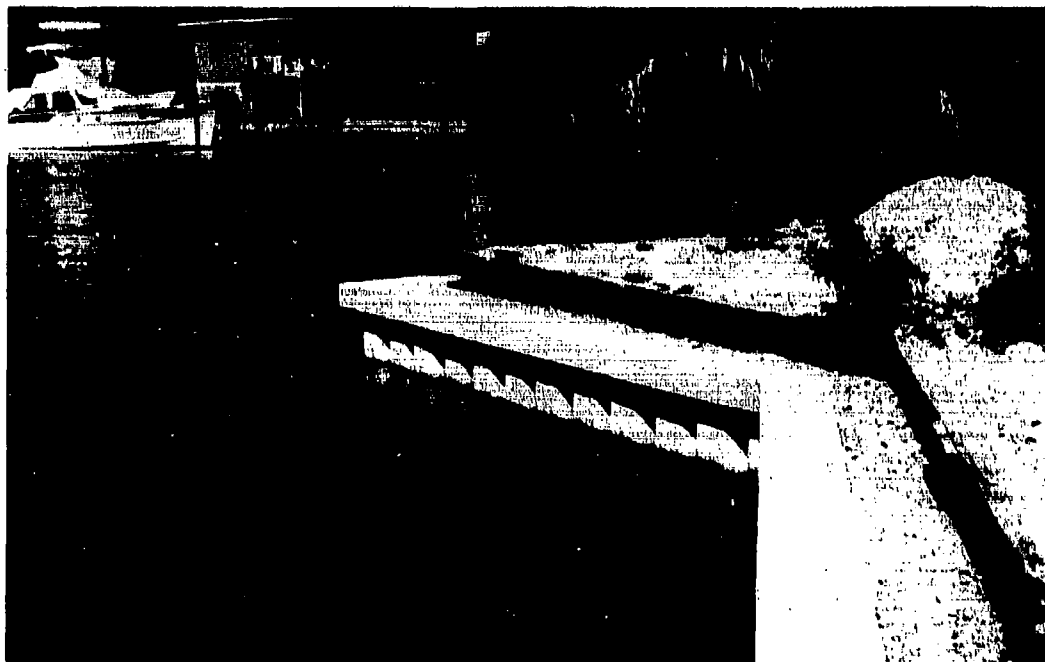


Figure 49. Asbestos fiber bulkhead (photo courtesy of GAF Corporation)

Figure 50. Aluminum bulkhead (photo courtesy of Kaiser Aluminum)



Other Methods for Streambank Protection

Limited-use methods

88. Additional methods for streambank protection have found application in the United States; however, these methods are not used as widely as those discussed in paragraphs 33-87 because of the lack of locally available materials or manufacturing processes. These limited-use methods are briefly discussed below. No costs are provided because the cost data that are available are generally applicable only to local areas.

89. Automobile bodies. Automobile bodies are used by farmers and other landowners as an emergency or low-budget bank protection method. The bodies are generally placed along the bank in random fashion (Figure 51) and laced with wire cable that is secured to deadmen



Figure 51. Automobile bodies on a streambank

or trees. Although the use of automobile bodies is assumed to be a preventive measure, bank erosion is sometimes actually increased by the bodies because their random placement and shapes may direct the flow

towards the bank instead of away from it. Automobile bodies have been used mostly along small streams in areas where riprap is not economically available, where heavy ice flows are not a problem, and where the waters do not cause excessive rust. Large-scale use of automobile bodies as bank protection devices would improve the landscape aesthetically by eliminating some of the junkyards scattered along the nation's highways but would make the banks of streams unsightly and inaccessible.

90. Cellular blocks. Precast cellular blocks are available from several commercial sources (Appendix B). These blocks are cast with cells to allow vegetation to grow through the blocks thus permitting the vegetation root structure to enhance the structural integrity of the bank (Figure 52). Filter cloths are used under the blocks where

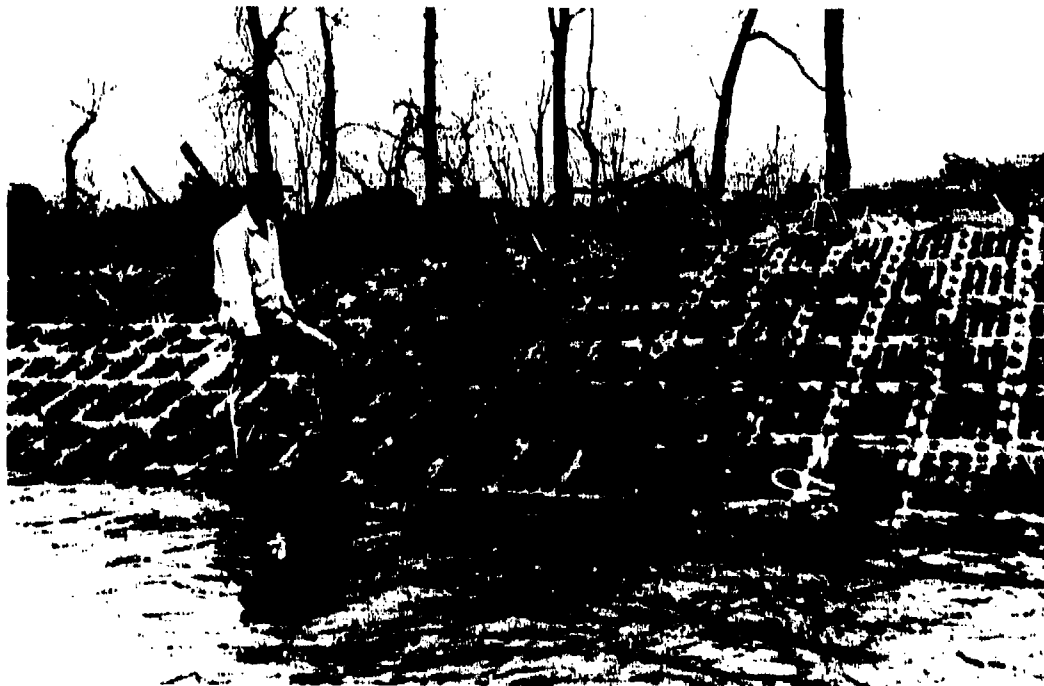


Figure 52. Cellular blocks (photo courtesy of D. A. Parsons, Agricultural Research Service, U. S. Department of Agriculture)

soil erosion is a problem. Although specialized equipment is available to install large sections of cellular blocks, hand placement is frequently used when mechanized apparatus is not available or access to the

bank is not adequate. After the cellular blocks have been placed, the resulting revetment has sufficient flexibility to conform to minor changes in bank geometry. In areas of the United States where riprap is not readily available, cellular blocks can provide a viable substitute.

91. Ceramic materials. Ceramic riprap and ceramic mattresses have had very limited application as bank protection. The only known ceramic riprap revetment in the United States, which is now underwater, was placed on the Ohio River by the Corps of Engineers above the present location of Markland Dam. The majority of information available on the use of ceramics for bank protection can be found in Reference 24.

92. Concrete blocks. Precast concrete blocks as well as recycled block (sidewalks, roadways, etc.) have application in areas where suitable stone is not available for riprap revetment or where a source of salvaged blocks is readily available. Costs for a revetment of precast blocks (Figure 53) generally are higher than for a comparable revetment of riprap because of the casting process and individual placement of the blocks. More salvaged blocks could be used in future bank protection works as more highway reconstruction projects are implemented (Figure 54).

93. Rock-and-wire mattresses. This type of bank protection consists of riprap encased in wire (Figure 55). With the use of the wire, the depth of the revetment can be less than for a comparable riprap blanket, and the wire retards loss of individual stones. Although less stone is needed, the cost is more than that of a riprap blanket because of the labor required to fabricate the wire casing.

94. Rubble. Widespread urban renewal projects and other redevelopment efforts have made large quantities of rubble available. Although somewhat unsightly (Figure 56), rubble can provide excellent bank protection for projects where minimal funds are available, such as those frequently planned by private landowners.

95. Sack revetment. Sacks made of burlap and filled with soil, soil-cement, sand, or sand-cement mixtures have long been used for erosion protection around hydraulic structures and for emergency work along levees and streambanks during floods. The burlap bags eventually

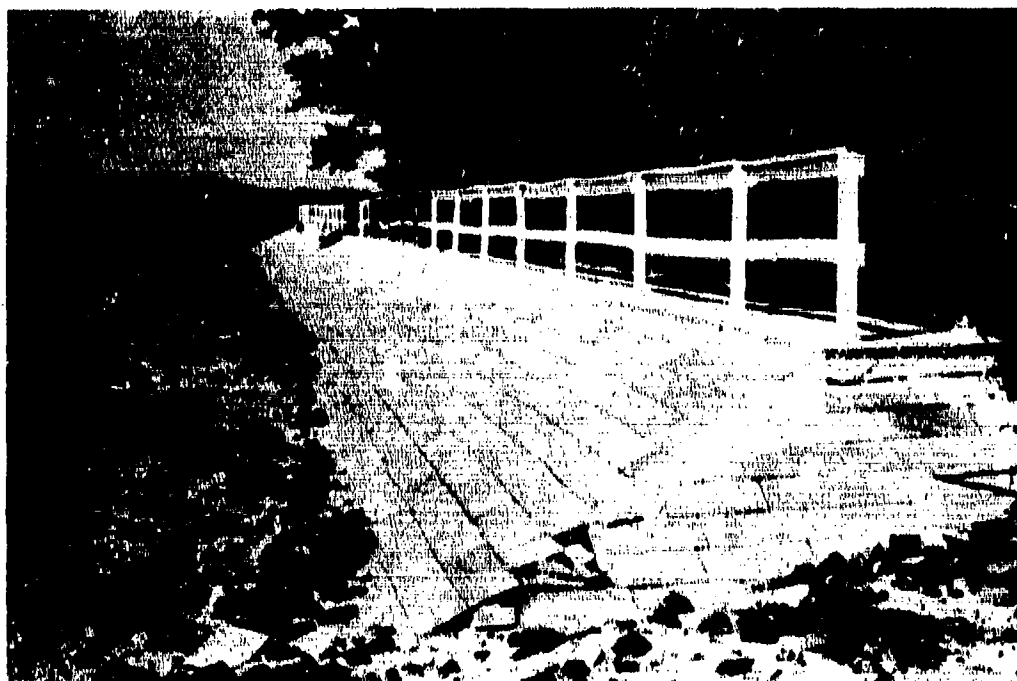


Figure 53. Precast concrete blocks (photo courtesy of Portland Cement Association)



Figure 54. Concrete blocks salvaged from highway reconstruction project



Figure 55. Rock-and-wire mattress



Figure 56. Rubble used for bank protection

rot; therefore, only bags filled with soil-cement or sand-cement mixtures provide long-term benefits. On-site mixing of cement and sand obtained from the streambed and placed on the bank in biodegradable sacks now being marketed can provide an effective alternative (Figure 57) to the



Figure 57. Sack revetment using biodegradable material for the sacks

use of riprap in areas where suitable stone is not available.

96. Soil cement. Soil-cement pavement and blocks have found wide application in the protection of upper banks and, to a lesser extent, in lower banks. Soil-cement pavement (Figure 58) containing 8 to 15 percent portland cement has the advantages of ease of placement, low cost, and availability of materials; however, lack of flexibility and low permeability precludes its use for applications where changes in bank geometry must be accommodated by the revetment, when traffic must be sustained, or when the bank must be drained to maintain stability. Soil-cement blocks have been used in Asia for many years as a substitute for riprap; however, blocks have been used at only a few sites in the United States. Adequate engineering data to determine their effectiveness are not yet available.



Figure 58. Soil-cement mixture used to pave bank (photo courtesy of Portland Cement Association)

97. Synthetic mattresses, matting, and tubing. Several manufacturers are marketing synthetic casings (Appendix B) that are filled in place or on the bank to be protected with locally available sand (Figure 59) or other materials. Many of these products have been used as foreshore protection (especially in Europe) and are now being used as



Figure 59. Synthetic casing used to protect a stream-bank at bridgehead (photo courtesy of Construction Techniques, Inc.)

direct bank protection in areas where sand is available.

98. Temperature control. Limited experiments have been conducted to determine the feasibility of using freezing and fusion processes to stabilize in situ soils on streambanks. In polar climates, steel probes have been used to prevent thawing of frozen banks during summer months (Figure 60). Installation and operation of freeze probes are expensive; hence, the only known installations are in polar locations where stone is not available and property or structures must be protected.

99. Soils can be stabilized to increase their strength and resistance to erosion by heat fusion. Because of increasing costs for fuels, this process may have limited potential; however, experiments have been reported for this method.²⁴

100. Tetrapods. Tetrapods have been used effectively for many years as foreshore protection to dissipate energy resulting from continuous wave action. Some use is now being made of tetrapods as components of bank protection revetment (Figure 61). The geometric configuration and mass of tetrapods affords excellent stability under the action of hydraulic forces; however, a casting facility is needed for fabrication and heavy equipment for placement; therefore, tetrapods have not been widely used on streambanks.

101. Used-tire matting. Mattresses constructed of used automobile tires have been successfully employed as streambank protection by the U. S. Army Engineer District, Sacramento; U. S. Bureau of Indian Affairs, Oklahoma; Washington State Highway Department; West Virginia Department of Natural Resources, and U. S. Forest Service, Mississippi. The used tires are generally put in place as a mat (Figure 62). They are laid over the surface to be protected and lashed together with wire or nonbiodegradable rope to form a mat structure. The mat is held in place on the slope by deadmen anchors to prevent it from sliding down the bank or floating. Holes are sometimes drilled in the sidewalls of the tires to allow trapped air to escape and prevent mat flotation. After vegetation becomes established and sediment builds up, mat stability becomes less of a problem.

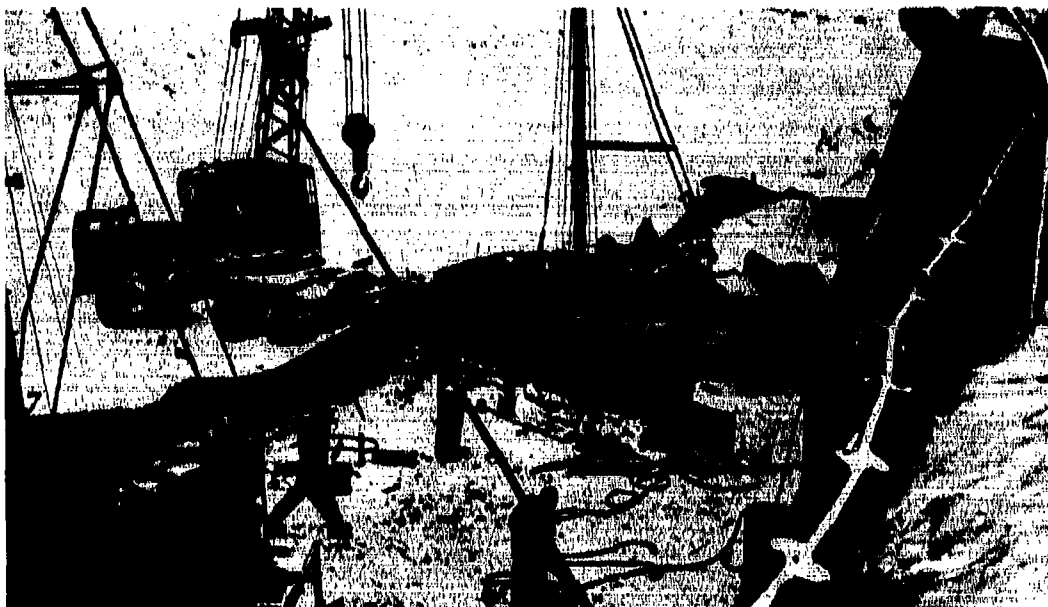


Figure 60. Freeze probe being inserted into streambank
(photo courtesy of Western Construction)



Figure 61. Tetrapods (photo courtesy of California
Department of Transportation)



Figure 62. Automobile tires on a streambank

Obsolete methods

102. Several methods for streambank protection that were employed earlier are now no longer widely used because of increased labor costs, lack of materials, or the development of more effective streambank protection techniques. These methods which are generally regarded as being obsolete include fascine mattresses, timber and brush, log and cable, cribs, and tetrahedrons.

103. Fascine mattresses. A fascine mattress consists of bundles of untreated tree stems roped together and placed on the bank to be protected (Figure 63). This technique was used on the lower Mississippi River during the early part of this century when there was an abundant supply of willow trees along the banks as a source of timber.

104. Timber-and-brush mattresses. Timber-and-brush mattresses were used extensively for upper and lower bank protection in the latter portion of the nineteenth and early part of the twentieth centuries. Timber and brush were woven by hand into a mattress that was launched from a barge (Figure 64). After the mattress was secured to the bank, stone ballast was placed on the mattress to sink the mattress onto the

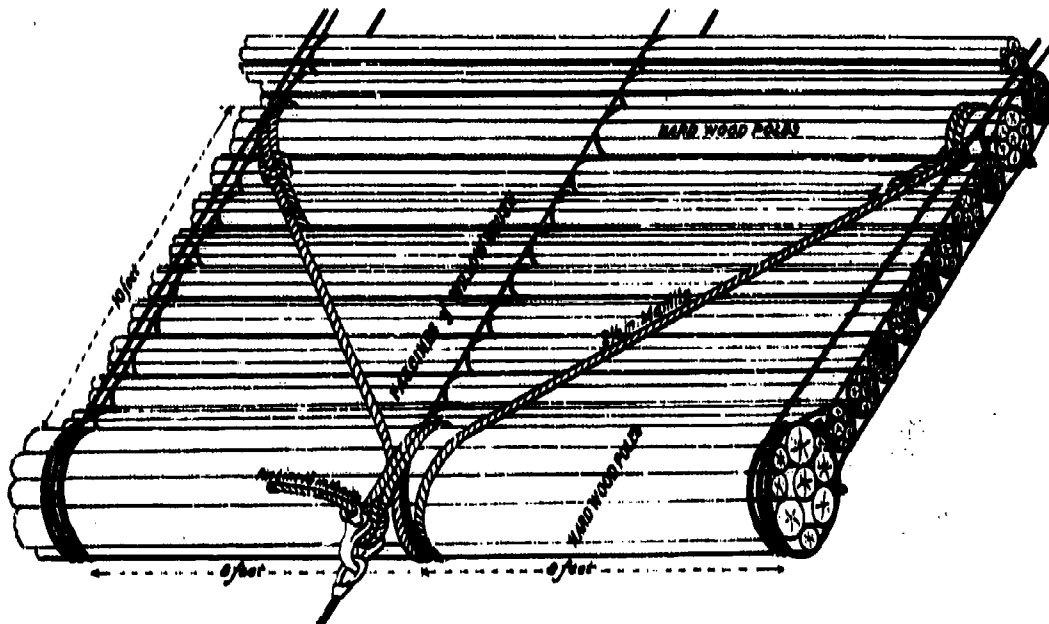


Figure 63. Fascine mattress



Figure 64. Assembly of timber-and-brush mattress on launch barge

portion of the bank below the waterline and to improve the upper bank stability under hydraulic loading (Figure 65). Fascine mattresses as

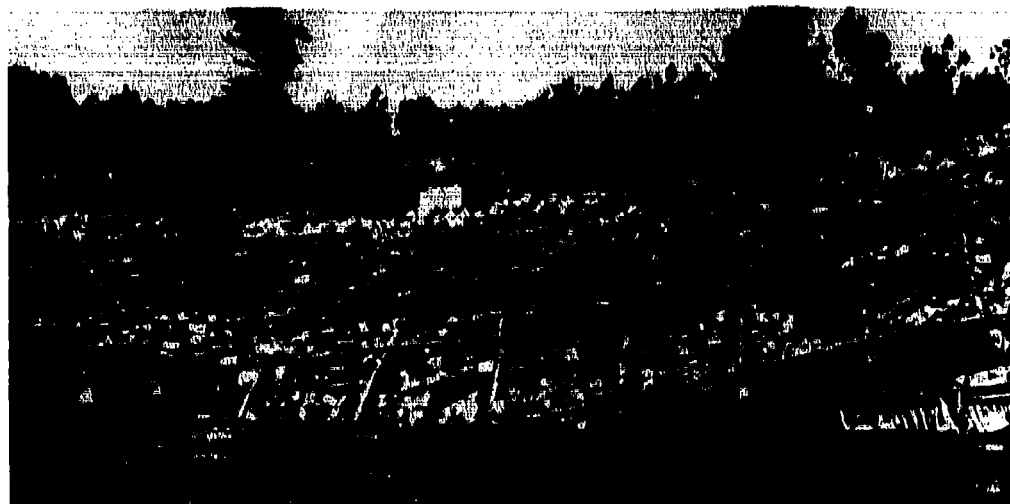


Figure 65. Timber-and-brush mattress with stone ballast

well as timber and brush mattresses have limited design lives as upper bank protection due to timber rot. The alternate wetting and drying of the timber by rain and stage change tend to cause the effectiveness of the mattress to rapidly decrease as the timber rots. Because of the limited design life of the mattresses as upper bank protection, the depletion of sources of timber near the Mississippi River, and the inordinate amount of hand labor involved, use of these mattresses was abandoned by the Corps of Engineers in favor of bituminous and articulated concrete mattresses (bituminous mattresses have not been used since 1945, paragraph 60).

105. Log and cable, and cribs. Streambanks have also been protected directly with timber cabled to deadmen (Figure 66) and earth- or stone-filled cribs made of timber (Figure 67) that direct erosive currents away from the streambank. These methods have been used primarily on small streams and are now being used on a very limited basis in the western United States.

106. Tetrahedrons. Tetrahedrons (Figure 68) are used to construct permeable dike fields that are arranged in a manner similar to a

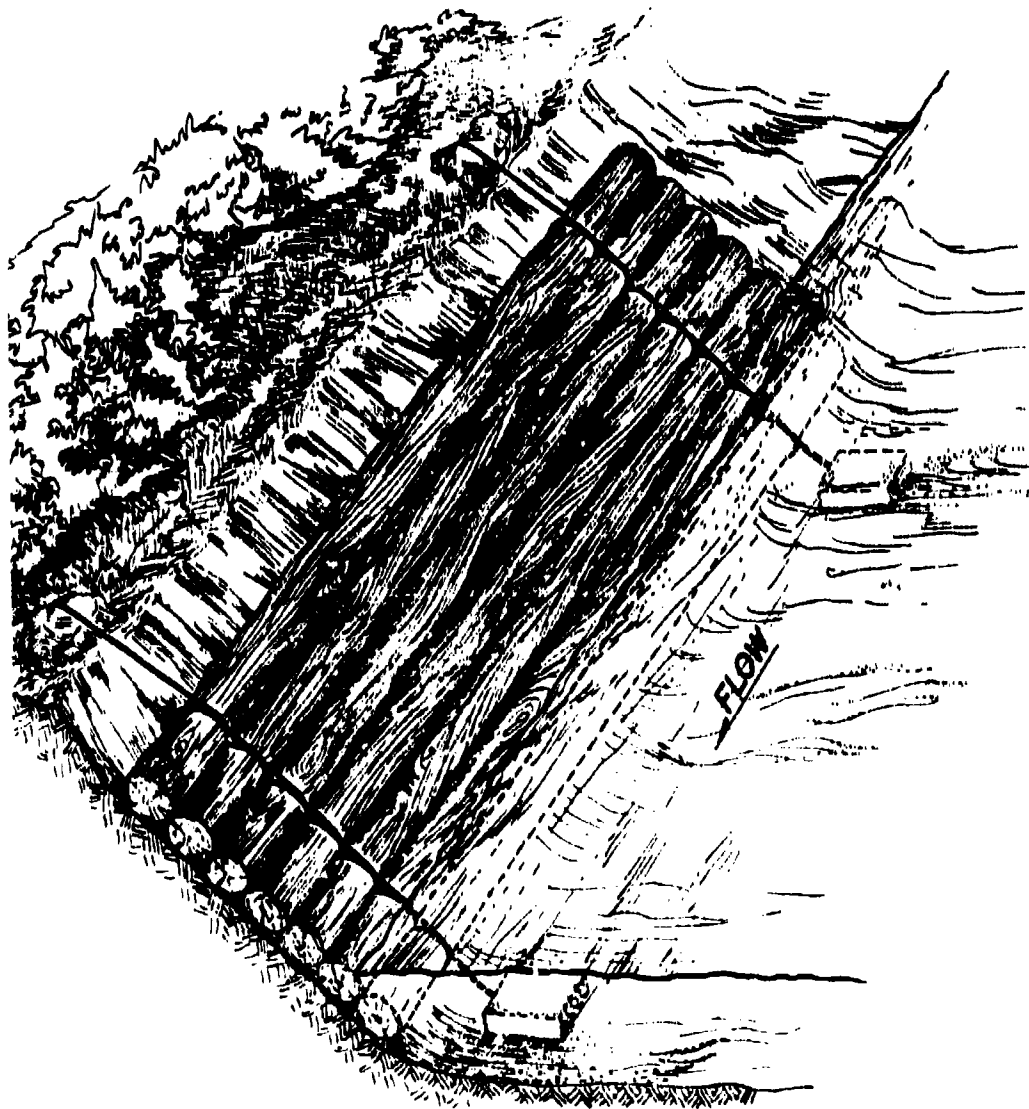


Figure 66. Log-and-cable revetment

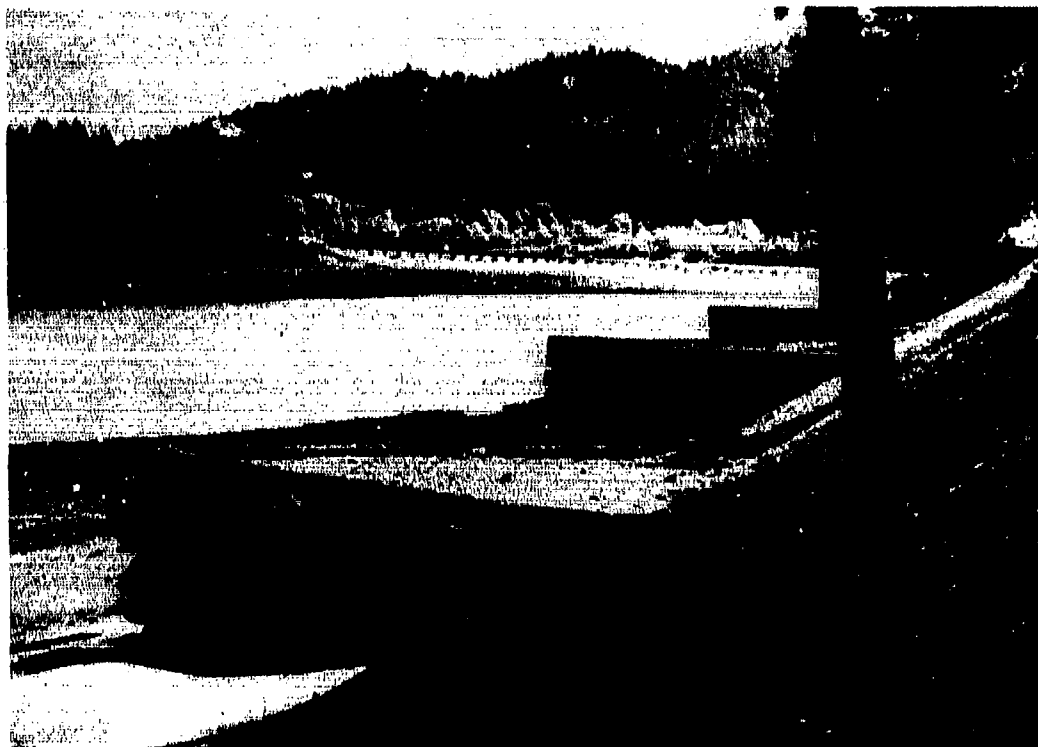


Figure 67. Cribs (photo courtesy of California Department of Transportation)



Figure 68. Tetrahedrons (photo courtesy of California Department of Transportation)

Kellner jack field (paragraphs 66-71). Six sections of rail or beam are required to fabricate a tetrahedron but only three for a comparable jack; hence, tetrahedrons have not been used as much as Kellner jacks even though the tetrahedrons are more stable under hydraulic loading.

PART V: NEW METHODS OF STREAMBANK PROTECTION

107. One of the major objectives of the Streambank Erosion Control Evaluation and Demonstration Act of 1974 (Appendix A) is the development of new methods for effective and economical bank protection. Many innovative methods are currently being discussed and field-evaluated on a limited basis.⁷⁸⁻⁸⁷ The following methods are among the most promising for upper bank protection:

- a. Used-tire mattress of interconnected tubes positioned perpendicular to the stream (modular units composed of tires stacked on edge, filled with sand and gravel, and interconnected with a steel cable through concrete-filled tires placed on either end of the sand- and gravel-filled tires to complete the modular unit).
- b. Membrane encapsulated soil systems (continuous bank paving and soil-filled bag revetment).
- c. Chemical stabilization (portland cement, lime, or asphalt) to form monolithic stabilization, stabilized soil blocks, stabilized soil trenches parallel to the stream, chemically grouted soil piles, and continuous armor coating.
- d. Rigid or collapsible honeycomb material backfilled with soil.
- e. Reinforced earth systems employing membranes and fabrics.
- f. Local waste products (without treatment, with minor processing, chemically treated, or membrane encapsulated).
- g. Military surplus products such as lightweight pierced landing mat, antisubmarine net, and floating bridges.

108. The following methods should be considered for improved lower bank protection:

- a. Used-tire gabion-like bulkhead (modular units with tires stacked vertically, filled with sand and gravel, and interconnected with a steel cable through concrete-filled tires placed on either end of the sand- and gravel-filled tires to complete the modular unit).
- b. Used-tire mattresses (paragraphs 101 and 107a).
- c. Reinforced earth systems employing membranes and fabrics (paragraph 107e).

- d. Stabilization of large masses of soil to form an "artificial clay plug" of controlled dimensions.
- e. Root piles (soil stabilization technique consisting of an array of slender piles driven into the streambank; Appendix B).

PART VI: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

109. This report, including the references on erosion and the selected bibliography on streambank protection methods presented in Appendix D, should provide sufficient information to establish the current state of the art on both streambank erosion and the commonly used streambank protection methods.

110. The various types of streambank erosion have been well documented. Existing methods of studying streambank stability include movable-bed hydraulic models and empirical relations based on physical characteristics of stable channels only.

111. The erosion of soils is a function of many parameters, some of which have been identified only recently. There is no available general solution relating all of these parameters to the relative resistivity of soils to erosion. Within the present state of the art, a quantitative procedure for evaluation of streambank stability would require determination of the erosion rate versus hydraulic shear stress from laboratory tests on undisturbed soil samples.

112. The state of the art of streambank protection has not advanced significantly since 1950⁸⁸ (except for a few patented techniques that have been used on a very limited basis); therefore, the selected bibliography in Appendix D should remain current with only minor revisions as new work is documented.

113. Streambank erosion and hydraulic conditions vary so widely from one location to another that it has been considered good engineering practice to solve each bank protection problem independently. Under similar erosive and hydraulic conditions (whether natural or man-made), no method has universal applicability because of logistic and economic constraints such as the availability and cost of materials, transportation, construction equipment, and manpower. An urgent need exists to develop general design guidelines for all effective streambank protection methods, including approaches that consider the entire stream basin

rather than protection of local reaches only.

114. Preliminary assessment of the effectiveness of the most commonly used streambank protection methods is presented in this report; however, further research and testing are required for complete evaluation. Initial examination of some of the less common methods for protecting streambanks indicates that worthwhile assessments will be difficult. Conversations with persons knowledgeable on the subject of streambank protection and examination of the available literature confirmed that much of the experimental bank protection design, especially that of private citizens and nongovernmental agencies, is not documented.

115. Streambank protection, in its present form, is, at best, "subjective engineering." Of all the methods surveyed, only one, stone riprap, has been studied in detail. The results from this research have not been collated for transfer to the practicing engineer in the form of general design criteria. Engineer manuals (References 71-73) can provide limited design guidance.

116. The program authorized by the Streambank Erosion Control Evaluation and Demonstration Act of 1974 will greatly assist in the needed research on streambank erosion and demonstration of effective protection methods.

Recommendations

117. On the basis of the information presented in this report, it is recommended that:

- a. A procedure be developed for evaluating streambank stability based on laboratory measurements of erosion rates and strength properties of undisturbed soils, considering both normal water levels and rapid drawdown.
- b. Research be conducted to define the causes and mechanisms of streambank erosion in terms of fluvial geology and to develop techniques for monitoring sedimentological conditions in stream channels.
- c. Both laboratory and field hydraulic research be conducted to develop and evaluate new methods and techniques for general application in protecting streambanks against erosion.

- d. Practical design criteria be developed for determining the optimum riprap requirements on streambanks for straight and curved reaches because of its extensive and varied usage.
- e. General limits of stream attack in channel bends be determined to minimize the length of streambank protection.
- f. More effective and economical methods of streambank protection be validated by prototype field demonstration projects throughout the United States as directed by the Section 32 Program (Appendix A).
- g. Those streambanks be identified that are too erosive or costly to protect.
- h. Those streambanks be identified that require regulated floodplain use to prevent domestic or industrial bank-line development. Floodplain regulation could permit low investment activities (tree farms, wildlife reserves, or recreational areas) and enhancement of the local environment.
- i. Those streambanks be identified that merit no protection due to their slow rate of erosion.

REFERENCES

1. American Society of Civil Engineers Task Committee on Channel Stabilization Works, "Channel Stabilization on Alluvial Rivers," presented at the ASCE Transportation Engineering Conference, Cincinnati, Ohio, Feb 1964.
2. Barnes, R. C., Jr., "Streambank Erosion," Soil Conservation, Vol 33, No. 6, Jan 1963, pp 126-128.
3. Dury, G. H., Rivers and River Terraces, Praeger, New York, 1970.
4. Elliott, D. O., "The Improvement of the Lower Mississippi River for Flood Control and Navigation" (3 vols), May 1932, Mississippi River Commission, CE, Vicksburg, Miss.
5. Moore, N. R., "Improvement of the Lower Mississippi River and Tributaries 1931-1972," 1972, Mississippi River Commission, CE, Vicksburg, Miss.
6. State of California, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.
7. Tiffany, J. B., "Review of Research on Channel Stabilization of the Mississippi River, 1931-1962," Committee on Channel Stabilization, Technical Report No. 2, Sep 1963, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
8. Jackson, T. H., "Bank Protection on Mississippi and Missouri Rivers," Jun 1935, U. S. Army Engineer Division, South Pacific, San Francisco, Calif.
9. Burgi, P. H. and Karaki, S., "Seepage Effect on Channel Bank Stability," Journal, Irrigation and Drainage Division, American Society of Civil Engineers, Vol 97, No. IRL, Mar 1971, pp 59-72.
10. Harrison, S. S. and Clayton, L., "Effects of Ground-Water Seepage on Fluvial Processes," Geological Society of America Bulletin, Vol 81, Apr 1970, pp 1217-1226.
11. Palmer, H. D., "Shoreline Erosion in Upper Chesapeake Bay: The Role of Groundwater," Shore and Beach, Vol 41, No. 2, Oct 1973, p 1822.
12. Bumm, H. et al., "Nouveaux Matériaux et Réalisations Nouvelles pour la Défense des Rives et la Protection du Fond des Canaux, des Rivières et des Ports; Prix de Revient et Avantages Respectifs" ("New Materials and New Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports; Their Cost and Respective Advantages"), Translation No. 73-4, Mar 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by J. C. Van Tienhoven.

13. Fuquay, G. A., "Bank Erosion on Low-Velocity Streams," Proceedings, Eighth Congress of the International Commission on Irrigation and Drainage, New Delhi, 1972.
14. Limerinos, J. T. and Smith, W., "Evaluation of the Causes of Levee Erosion in the Sacramento-San Joaquin Delta, California," Geological Survey Water-Resources Investigations 28-74, Jan 1975, U. S. Department of the Interior, Washington, D. C.
15. Palombo, D. A., "Development of Information on Bank Erosion Along Navigation Streams, Ohio River," report to U. S. Army Engineer District, Louisville, under Contract 76-M-525, Apr 1976, Moody and Associates, Inc., Meadville, Pa.
16. Leopold, L. B. and Davis, K. S., Water, Time-Life Books, New York, 1966; edited by the editors of Life.
17. Russell, R. J., "River and Delta Morphology," Coastal Studies Series No. 20, 1967, Louisiana State University Press, Baton Rouge, La.
18. Carson, M. A. and Kirby, M. J., Hillslope Form and Process, Cambridge University Press, Cambridge, England, 1972.
19. Parsons, D. A., "Vegetative Control of Streambank Erosion," Proceedings, Federal Inter-Agency Sedimentation Conference, Jackson, Miss., 1963, pp 130-136.
20. U. S. Environmental Protection Agency, "Methods of Quickly Vegetating Soils of Low Productivity, Construction Activities," EPA-440/9-75-006, Jul 1975, Office of Water Planning and Standards, Washington, D. C.
21. Fisk, H. N., "Mississippi River Valley Geology Relation to River Regime," American Society of Civil Engineers Transactions, Vol 117, 1952, pp 667-689.
22. Mabrey, P. R. et al., "Geological Investigation of Mississippi River Activity, Memphis, Tennessee, to Mouth of Arkansas River," Technical Memorandum No. 3-288, Jun 1949, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
23. Kesel, R. H. et al., "Lateral Erosion and Overbank Deposition on the Mississippi River in Louisiana Caused by 1973 Flooding," Geology, Vol 2, No. 9, Sep 1974, pp 461-464.
24. U. S. Army Engineer Waterways Experiment Station, CE, "Feasibility Study of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.
25. Krinitzsky, E. L., "Geological Influences on Bank Erosion Along Meanders of the Lower Mississippi River," Potamology Investigations Report 12-15, Sep 1965, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

26. Stanley, D. J., Krinitzsky, E. L., and Compton, J. R., "Mississippi River Bank Failure, Fort Jackson, Louisiana," Geological Society of America Bulletin, Vol 77, No. 8, Aug 1966, pp 859-866.
27. Turnbull, W. J., Krinitzsky, E. L., and Weaver, F. J., "Bank Erosion in Soils of the Lower Mississippi Valley," Journal, Soil Mechanics and Foundation Engineering Division, American Society of Civil Engineers, Vol 92, No. SMI, Jan 1966, pp 121-136.
28. Torrey, V. H., III, and Gann, A. R., "Verification of Empirical Method for Determining Riverbank Stability, 1970 and 1971 Data," Potamology Investigations Report 12-22, Apr 1976, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
29. Fenwick, G. B., ed., "State of Knowledge of Channel Stabilization in Major Alluvial Rivers," Committee on Channel Stabilization, Technical Report No. 7, Oct 1969, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
30. Kolb, C. R., "Review of Petrographic Studies of Bed Material, Mississippi River and Its Tributaries, and Offshore Areas of Deposition," Technical Report No. 3-436, Jun 1956, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
31. Friedkin, J. F., "A Laboratory Study of the Meandering of Alluvial Rivers," May 1945, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
32. Simons, D. B., "Theory and Design of Stable Channels in Alluvial Materials," Doctoral Dissertation, May 1957, Colorado State University, Fort Collins, Colo.
33. Schumm, S. A., "A Tentative Classification of Alluvial River Channels," Geological Survey Circular 477, 1963, U. S. Department of the Interior, Washington, D. C.
34. _____, "Effect of Sediment Characteristics on Erosion and Deposition in Ephemeral Stream Channels," Geological Survey Professional Paper 352-C, 1961, U. S. Department of the Interior, Washington, D. C.
35. _____, "The Shape of Alluvial Channels in Relation to Sediment Type," Geological Survey Professional Paper 352-B, U. S. Department of the Interior, Washington, D. C.
36. Simons, D. B., Richardson, E. V., and Haushild, W. L., "Some Effects of Fine Sediments on Flow Phenomena," Geological Survey Water-Supply Paper 1498-G, 1963, U. S. Department of the Interior, Washington, D. C.
37. Brice, J. C., "Channel Patterns and Terraces of the Loup Rivers in Nebraska," Geological Survey Professional Paper 422-D, 1964, U. S. Department of the Interior, Washington, D. C.
38. Wall, W. J., "Influence of Soil Types on Stabilization of the Savannah River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, No. WW3, Aug 1965, pp 7-23.

39. Goss, D. W., "Relationship of Physical and Mineralogical Properties and Streambank Stability," Water Resources Bulletin, Vol 9, No. 1, Feb 1973, pp 140-144.
40. DeCoursey, D. G. and Hunt, C. G., "Bank and Bed Materials Consideration in Alluvial Channel Design," paper presented at American Society of Civil Engineers Hydraulics Division Conference, Knoxville, Tenn., Jul 1975.
41. _____, "Characteristics of Stable Natural Channels and Their Relationship to Channel Design," Proceedings, Third Federal Inter-Agency Sedimentation Conference, Denver, Colo., Mar 1976.
42. Flaxman, E. M., "Channel Stability in Undisturbed Cohesive Soils," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 89, No. HY2, Mar 1963, pp 87-96.
43. State of New York, Department of Transportation, Bureau of Soil Mechanics, "Bank and Channel Protective Lining Design Procedure," Soils Design Procedure SDP-2, Albany, N. Y. Aug 1971.
44. Richardson, E. V., "Highways in the River, Environment, Hydraulic and Environmental Design Considerations," Training and Design Manual, May 1975, U. S. Department of Transportation, Federal Highway Administration, Washington, D. C.
45. Simons, D. B. et al., "The River Environment," CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1976, Civil Engineering Department, Colorado State University, Fort Collins, Colo.
46. Committee on Channel Stabilization, "Symposium on Channel Stabilization Problems," Technical Report No. 1, Vol 1, Sep 1963, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
47. Fukuoka, M. and Yamamura, K., "Full-Scale Model Tests of Slope Failure of River Embankments," Proceedings, Sixth International Conference on Soil Mechanics and Foundation Engineering, Montreal, Vol II, 1965, pp 467-471.
48. Mamak, W., River Regulation, Arkady, Warszaw, Poland, 1964 (translated by Israel Program for Scientific Translations).
49. Gibbs, H. J., "A Study of Erosion and Tractive Force Characteristics in Relation to Soil Mechanics Properties, Earth Research Program," Soil Engineering Report No. EM-643, Feb 1962, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.
50. Doubt, P. D., "Design of Stable Channels in Erodible Materials," Proceedings, Federal Inter-Agency Sedimentation Conference, Jackson, Miss., 1963, pp 373-376.
51. Perry, E. B., "Piping in Earth Dams of Dispersive Clay; Literature Review and Design of Laboratory Tests," Technical Report No. S-75-15, Nov 1975, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

52. Raudkivi, A. J., Loose Boundary Hydraulics, 2nd ed., Pergamon Press, Oxford, England, 1976.
53. American Society of Civil Engineers Task Committee on Erosion of Cohesive Materials, "Erosion of Cohesive Sediments," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 94, No. HY4, Jul 1968, pp 1017-1049.
54. Schroeder, K. B., "Channel Deterioration Study of Natural and Artificial Drainageways in Republican, Loup, and Little Sioux River Areas - Nebraska and Iowa," Interim Report, Sep 1953, U. S. Department of the Interior, Bureau of Reclamation, Hydrology Branch, Denver, Colo.
55. Strand, R. I., "Turkey Creek Channel Stability Studies, Farwell Unit Middle Loup Division, Pick-Sloan Missouri Basin Program," REC-ERC-71-9, Jan 1971, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.
56. Kukal, Z., Geology of Recent Sediments, Academic Press, New York, 1971.
57. Buller, A. T. and McManus, J., "Channel Stability in Relation to Buried Unconsolidated Sediments," Proceedings, International Symposium on River Mechanics, Bangkok, Vol 1, Jan 1973, pp 723-734.
58. Highway Research Board, "Soil Erosion: Causes and Mechanisms Prevention and Control," Special Report 135, 1973, Washington, D. C.
59. Partheniades, E. and Passwell, R. E., "Erosion of Cohesive Soil and Channel Stabilization," Report No. 19, Oct 1968, Department of Civil Engineering, State University of New York, Buffalo, N. Y.
60. Shen, H. W., ed. and publisher, Environmental Impact on Rivers, Fort Collins, Colo., 1973.
61. _____, River Mechanics (2 vols), Fort Collins, Colo., 1971.
62. Kandish, A. and Arulanandan, K., "Hydraulic Erosion of Cohesive Soils," Soil Properties, Transportation Research Board Record 497, 1974, Washington, D. C., pp 60-68.
63. Straub, L. G., "Report on Erosion Resistance Tests of Clay Specimens from San Jacinto River Dam Site, Houston, Texas," Jan 1946, University of Minnesota, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.
64. U. S. Army Engineer Waterways Experiment Station, CE, "Development of Operating Technique for and Verification of Channel-Meander Model," Potamology Investigations Report No. 16-1, Sep 1953, Vicksburg, Miss.
65. Wolman, M. G. and Brush, L. M., Jr., "Factors Controlling the Size and Shape of Stream Channels in Coarse Noncohesive Sands," Geological Survey Professional Paper 282-G, 1961, U. S. Department of the Interior, Washington, D. C.

66. Kruchinina, A. A., "Results of the Study of the Scouring Process in Cohesive Soils," Transaction, Vedenker All-Union Scientific Research Institute of Hydraulic Engineering, Vol 88, 1969, pp 70-77; translated by Israel Program for Scientific Translations, Jerusalem, 1971.
67. Einsele, G. et al., "Mass Physical Properties, Sliding and Erodibility of Experimentally Deposited and Differently Consolidated Clayey Muds," Sedimentology, Vol 21, No. 3, Aug 1974, pp 339-372.
68. Dorer, H. and Gehrig, W., "Determination of Critical Shear Stress in a Natural River," Proceedings, Sixteenth Congress of the International Association for Hydraulic Research, Sao Paulo, Brazil, Vol 2, 1975, pp 90-96.
69. Ilk, F. K., "Methods and Criteria for Bank Protection on the Lower Colorado River," Proceedings, Federal Inter-Agency Sedimentation Conference, Jackson, Miss., 1963, pp 366-372.
70. Thomson, S., "Riverbank Stability Study at the University of Alberta, Edmonton," Canadian Geotechnical Journal, Vol 7, 1970, pp 157-172.
71. Headquarters, Department of the Army, Office, Chief of Engineers, "Hydraulic Design of Flood Control Channels," EM 1110-2-1601, 1970, Government Printing Office, Washington, D. C.
72. _____, Engineering Technical Letter, ETL 1110-2-120, 14 May 1971, Government Printing Office, Washington, D. C.
73. U. S. Army Engineer Waterways Experiment Station, Hydraulic Design Criteria, HDC 712-1, constant revision, Vicksburg, Miss.
74. Portland Cement Association, "Concrete Shore Protection," 1955, Chicago. Ill.
75. Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, Washington, D. C.
76. University of Michigan, Lake Hydraulics Laboratory, "Low Cost Shore Protection for the Great Lakes," Oct 1952 (reprinted 1975), Ann Arbor, Mich.
77. U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual" (3 vols), 1973, Government Printing Office, Washington, D. C.
78. Schoklitsch, A., Hydraulic Structures, American Society of Mechanical Engineers, Vol II, 1937, pp 1053-1120; translated by S. Shulits.
79. U. S. Army Engineer District, Portland, "Report on Experiment Slope Protection for River Banks and Levees," Dec 1946, Portland, Oreg.

80. Fairley, J. G. et al., "Use of Plastic Filter Cloth in Revetment Construction," Potamology Investigations Report 21-4, Jun 1970, U. S. Army Engineer District, Memphis, Tenn.
81. Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course for River Systems Planning and Environmental Aspects, University of Nebraska, Lincoln, Nebr., 1972.
82. Becker, B. C. and Mills, T. C., "Guidelines for Erosion and Sediment Control Planning and Implementation," EPA-R2-72-015, Aug 1972, U. S. Environmental Protection Agency, Washington, D. C.
83. Sale, J. P., Parker, F., and Barker, W. R., "Membrane Encapsulated Soil Layers," Journal, Soil Mechanics and Foundations Division, American Society of Civil Engineers, Vol 99, No. SM12, Dec 1973, pp 1077-1089.
84. Stein, D. E. and Pavoni, J. L., "Preliminary Bank Revetment Procedure Review," Oct 1974, University of Louisville, Louisville, Ky.
85. Brater, E. F., Armstrong, J. M., and McGill, M., "Michigan's Demonstration Erosion Control Program," Evaluation Report, Nov 1974, Michigan Department of Natural Resources, Lansing, Mich.
86. Webster, S. L. and Andress, A., "Investigation of Fabrics and Bituminous Surfaces for Use in MESL Construction," Miscellaneous Paper No. S-76-14, Aug 1976, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
87. Al-Hussaini, M. M. and Perry, E. B., "Effect of Horizontal Reinforcement on Stability of Earth Masses," Technical Report S-76-11, Sep 1976, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.
88. Keown, M. P., Dardeau, E. A., Jr., and Kennedy, J. G., "Inventory of Sediment Sample Collection Stations in the Mississippi River Basin," Technical Report M-77-1, Mar 1977, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Table 1
Causes of Erosion and Bank Protection Methods Used for Selected Stream Classifications

Maximum Flow Rate, cfs	General Stream Classification and Examples	Causes Of Erosion*	Typical Bank Protection Methods Used
>1,000,000	Major alluvial (Mississippi)	1,3,4,5,6	1. Articulated concrete mattress 2. Stone riprap 3. Vegetation (upper bank & levees) 4. Monolithic concrete paving (levees) 5. Asphalt paving (upper bank) 6. Erosion-control matting (upper bank) 7. Bulkhead
>500,000 to 1,000,000	Secondary alluvial (Missouri, Tennessee, Arkansas, Rio Grande)	1,3,5,6	1. Stone riprap or transverse dikes 2. Wooden piles or fences 3. Vegetation (upper banks & levees) 4. Jacks 5. Gabions 6. Erosion control matting (upper banks) 7. Bulkhead

(Continued)

- * 1. Rainfall erosion of upper banks.
 2. Overland flow (or runoff).
 3. Current attack at toe of slope leading to shear in upper bank.
 4. Flow slides (liquefaction).
 5. Erosion of lower banks and channel by current action.
 6. Erosion of banks and channel by wave action due to wind or passing boats.
 7. Erosion of banks by seepage water at relatively low channel velocities.

Table 1 (Concluded)

Maximum Flow Rate, cfs	General Stream Classification and Examples	Causes of Erosion	Typical Bank Protection Methods Used
>100,000 to 500,000	High-gradient tributary (Republican, Delaware, Allegheny, Black Warrior)	2, 3, 5, 7	1. Stone riprap or transverse dikes 2. Wooden piles or fences 3. Vegetation (upper banks) 4. Gabions 5. Erosion-control matting (upper banks)
>100,000 to 500,000	Low-gradient tributary (Red, Snake, Sacramento, Apalachicola, Illinois)	2, 3, 5, 7	1. Stone riprap or transverse dikes 2. Wooden piles or fences 3. Jacks 4. Vegetation 5. Wire fences 6. Gabions 7. Erosion-control matting
<100,000	High-gradient tributary (Yellowstone, Mueches, French Broad, Kennebec)	2, 3, 5, 7	1. Stone riprap or transverse dikes 2. Wooden piles or fences 3. Vegetation (upper banks) 4. Gabions 5. Erosion-control matting (upper banks)
<100,000	Low-gradient tributary (Ouachita, Oconee, Rock, Minnesota)	2, 3, 5, 7	1. Stone riprap or transverse dikes 2. Wooden piles or fences 3. Jacks 4. Vegetation 5. Wire fences 6. Gabions 7. Erosion-control matting

Table 2

Streambank Protection Materials, Structures, or MethodsSingle-Component Revetment

Asphalt blocks
 Automobile bodies
 Cellular blocks
 Ceramic riprap
 Concrete blocks
 Rubble
 Sack revetment
 Stone riprap
 Tetrapods
 Trench-fill revetment

Mattresses, Matting, and
Pavement Revetment

Articulated concrete mattresses
 Asphalt pavement
 Bituminous mattresses
 Ceramic mattresses
 Concrete pavement
 Erosion-control matting
 Fascine mattresses
 Gabions
 Log and cable
 Rock-and-wire mattresses
 Synthetic mattresses, matting,
 and tubing

Mattresses, Matting, and
Pavement Revetment (Continued)

Timber-and-brush mattresses
 Used-tire matting

Bulkheads

Concrete or stone
 Fiber
 Metal
 Timber

Soil Stabilization

Asphalt (bulk)
 Grout
 Organic mixtures and mulches
 Soil cement
 Temperature control
 Vegetation

River Training Structures

Cribs
 Dikes (sill, groin, spur,
 jetty)
 Fences
 Kellner jack field
 Tetrahedron field

Table 3

Classification of Alluvial River Channels for Rivers Transporting Less Than 20 Percent Coarse Gravel (Reference 35)

Mode of Sediment Transport	Channel Sediment (m), %	Proportion of Total Sediment Load		Channel Stability		
		Suspended Load, %	Bedload %	Stable (Graded Stream)	Depositing (Excess Load)	Eroding (Deficiency of Load)
Suspended load	30-100	85-100	0-15	Stable suspended-load channel. Width-depth ratio less than 7; sinuosity greater than 2.1; gradient relatively gentle	Depositing suspended load channel. Major deposition on banks causes narrowing of channel; streambed deposition minor	Eroding suspended-load channel. Streambed erosion predominant; channel widening minor
Mixed load	8-30	65-85	15-35	Stable mixed-load channel. Width-depth ratio greater than 7 less than 25; sinuosity less than 2.1 greater than 1.5; gradient moderate	Depositing mixed-load channel. Initial major deposition on banks followed by streambed deposition	Eroding mixed-load channel. Initial streambed erosion followed by channel widening
Bedload	0-8	30-65	35-70	Stable bedload channel. Width-depth ratio greater than 25; sinuosity less than 1.5; gradient relatively steep	Depositing bedload channel. Streambed deposition and island formation	Eroding bedload channel. Little streambed erosion; channel widening predominant

Table 4
Monscours Velocities for Soils (Reference 48)

Kind of Soil	Values of Monscours Velocities for Noncohesive Soils, m/sec				
	Grain Dimensions		Mean Depth of River		
	mm		0.4 m	1.0 m	2.0 m and More
Silt with fine sand, vegetable soil	0.005-0.05		0.15-0.20	0.20-0.30	0.25-0.40
Fine sand with admixture of medium grains	0.05-0.25		0.20-0.35	0.30-0.45	0.40-0.55
Fine sand with loam; sand of medium grain size with admixture of coarser grains	0.25-1.00		0.35-0.50	0.45-0.60	0.55-0.70
Coarse sand with admixture of gravel; sand of medium grain size with loam	1.00-2.50		0.50-0.65	0.60-0.75	0.70-0.80
Fine gravel with admixture of medium grains	2.50-5.00		0.65-0.80	0.75-0.85	0.80-1.00
Coarse gravel with sand and fine gravel	5.00-10.0		0.80-0.90	0.85-1.05	1.00-1.15
Small pebbles with sand and gravel	10.0-15.0		0.90-1.10	1.05-1.20	1.15-1.35
Medium-size pebbles with sand and gravel	15.0-25.0		1.10-1.25	1.20-1.45	1.35-1.65
Coarse pebbles with admixture of gravel	25.0-40.0		1.25-1.50	1.45-1.85	1.65-2.10
Small pavers with pebbles and gravel	40.0-75.0		1.50-2.00	1.85-2.40	2.10-2.75
Small-size cobblestone	75.0-100		2.00-2.45	2.40-2.80	2.75-3.20
Medium-size cobblestone	100-150		2.45-3.00	2.80-3.35	3.20-3.75
Coarse cobblestone	150-200		3.00-3.50	3.35-3.80	3.75-4.30
Boulders	200		3.50-3.85	3.80-4.75	4.30-5.35

Values of Monscours Velocities for Cohesive Soils, m/sec

Kind of Soil	Mean Depth of River, m											
	Poorly Compact Soils				Medium Compact Soils				Very Compact Soils			
	Volumetric Weight				Volumetric Weight				Volumetric Weight			
	Up to 1.2 tons/m ³				1.20-1.66 tons/m ³				1.66-2.04 tons/m ³			
	0.4	1.0	2.0	3.0	0.4	1.0	2.0	3.0	0.4	1.0	2.0	3.0
Sandy loams (heavy)	0.35	0.40	0.45	0.50	0.70	0.85	0.95	1.10	1.00	1.20	1.40	1.50
Sandy loams (light)	0.35	0.40	0.45	0.50	0.65	0.80	0.90	1.00	0.95	1.20	1.40	1.50
Loess soils in the conditions of finished settlement	—	—	—	—	0.60	0.70	0.80	0.85	0.80	1.00	1.20	1.30
Loamy sands	According to tabulation above depending upon the sand fractions											

According to tabulation above depending upon the sand fractions

Note: Volumetric weights refer to the dry soil.

Table 5
1976 In-Place Cost* Summary for the Streambank Protection
Methods Discussed in Paragraphs 33-87

<u>Streambank Protection Method</u>	<u>Cost/Unit, \$</u>	<u>Unit</u>
Stone riprap	3.50-30.00	yd ³
Concrete pavement	90-125	100 ft ²
Articulated concrete mattresses	84	100 ft ²
Transverse dikes:		
Pile board	40-55	lin ft
Untreated clumps	1500-2300	clump (three 60-ft piles)
Stone	40-65	lin ft
Fences	25-50**	lin ft
Asphalt mix (upper bank)	60-80	yd ³
Kellner jack field	16-47†	lin ft
Vegetation (grass)	1.15-1.49 (500-650)	100 ft ² (acre)
Gabions	40-47	yd ³
Erosion-control matting	5.56-7.22 (0.50-0.65)	100 ft ² (yd ²)
Bulkheads	14-105	lin ft

* Cost figures supplied by Corps of Engineers Divisions and Districts.

** Range applies to new materials.

† Range applies to used and new materials.

APPENDIX A: SECTION 32 OF THE WATER RESOURCES DEVELOPMENT ACT
OF 1975, PUBLIC LAW 93-251 (STREAMBANK EROSION CONTROL
EVALUATION AND DEMONSTRATION ACT OF 1974)

Section 32:

- a. This section may be cited as the "Streambank Erosion Control Evaluation and Demonstration Act of 1974."
- b. The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to establish and conduct for a period of five fiscal years a national streambank erosion prevention and control demonstration program. The program shall consist of:
 - (1) An evaluation of the extent of streambank erosion on navigable rivers and their tributaries;
 - (2) Development of new methods and techniques for bank protection, research on soil stability, and identification of the causes of erosion;
 - (3) A report to the Congress on the results of such studies and the recommendations of the Secretary of the Army on means for the prevention and correction of streambank erosion; and
 - (4) Demonstration project including bank protection works.
- c. Demonstration projects authorized by this section shall be undertaken on streams selected to reflect a variety of geographical and environmental conditions, including streams with naturally occurring erosion problems and streams with erosion caused or increased by man-made structures or activities. At a minimum, demonstration projects shall be conducted at multiple sites on:
 - (1) The Ohio River;
 - (2) That reach of the Missouri River between Fort Randall, South Dakota, and Sioux City, Iowa;
 - (3) That reach of the Missouri River in North Dakota at or below the Garrison Dam, including areas on the right bank at river miles 1345; 1310; 1311; 1316.5; 1334.5; 1341; 1343.5; 1379.5; and on the left bank at river miles 1316.5; 1320.5; 1323; 1326.5; 1335.7; 1338.5; 1345.2; 1357.5; 1360; 1366.5; 1368; and 1374;
 - (4) The delta and hill areas of the Yazoo River Basin generally in accordance with the recommendations of Chief of Engineers in his report dated 23 September 1972;
 - (5) The delta of the Eel River, California;
 - (6) The lower Yellowstone River from Intake, Montana, to the mouth of such river.

- d. Prior to construction of any projects under this section, non-Federal interests shall agree that they will provide without cost to the United States lands, easement, and rights-of-way necessary for construction and subsequent operation of the projects; hold and save the United States free from damages due to construction, operation, and maintenance of the projects; and operate and maintain the projects upon completion.
- e. There is authorized to be appropriated not to exceed \$50,000,000 to carry out this action.
- f. The Secretary of the Army shall make an interim report to Congress on work undertaken pursuant to this section by September 30, 1978, and shall make a final report to the Congress no later than December 31, 1981.

**APPENDIX B: LISTING OF COMMERCIAL CONCERNS THAT MARKET
STREAMBANK PROTECTION PRODUCTS**

1. A listing of commercial organizations that market streambank protection products is provided below.

<u>Company</u>	<u>Address</u>	<u>Product(s)</u>
Advance Construction Specialties Company	P. O. Box 17212 Memphis, Tenn. 38117	Filter cloths
Air Logistics Corporation	3600 East Foothill Blvd. Pasadena, Calif. 91109	Mo-Mat
ALCOA Marine Corporation	8235 Pen Randal Place Upper Marlboro, Md. 20870	Aluminum marine retaining walls (sheet piling)
American Excelsior Company	P. O. Box 249 Sheboygan, Wis. 53081	Curlex Blanket TM, Holdgro TM Fabric
ARMCO Steel Corporation	419 Chanin Bldg. 815 Connecticut Ave., NW Washington, D. C. 20006	Bulkheads
Bekaert Gabions	4930 Energy Way Reno, Nev. 89502	Gabions
Boiard Products Corporation	211 E. 43rd St. New York, N. Y. 10017	Grasstone
Bomanite Corporation	81 Encina Ave., Palo Alto, Calif. 94301	Grasscrete
Bowie Industries	P. O. Box 931 Bowie, Tex. 76230	Hydro-Mulcher
Carthage Mills, Inc.	124 W. 66th St. Cincinnati, Ohio 45216	Plastic filter cloth
Celanese Fibers Marketing Company	1211 Avenue of the Americas New York, N. Y. 10036	Mirafi 140 fabric filter cloth
Conwed Corporation	760 29th Avenue, SE Minneapolis, Minn. 55414	Conwed erosion-control net and Hydro-Mulch
Construction Techniques, Inc.	11900 Shaker Blvd. Cleveland, Ohio 44120	Fabriform
DuPont	1007 Market St. Wilmington, Del. 19898	TYPAR filter cloth

(Continued)

<u>Company</u>	<u>Address</u>	<u>Product(s)</u>
Dowling Bag Company	P. O. Box 1768 Valdosta, Ga. 31601	Jute mesh
Edward E. Gillen, Company	228 W. Becher St. Milwaukee, Wis. 53207	Longard tubing and filter cloth
ERCO Systems, Inc.	P. O. Box 4133 New Orleans, La. 70178	Gobi (cellular) blocks
Erosion Control, Inc.	205 Datura St. West Palm Beach, Fla. 33401	Dura-Bags, fencing, artificial sea- weed filter cloth
Finn Equipment Company	P. O. Box 68 "Station O" Cincinnati, Ohio 45208	Equipment for broadcasting Hydro-Mulch
Firestone Coated Fabrics Co.	P. O. Box 887 Magnolia, Ark. 71753	Rubber-coated fabric tanks, Fabritank
Firewater Company	1 First St. Los Altos, Calif. 94022	Crust-500 (acetate emulsion)
GAF Corporation	140 W. 51st St. New York, N. Y. 10020	Corrugated canal bulkheading
Grass Growers, Inc.	P. O. Box 584 Plainfield, N. J. 07601	Terra Tack mulch binder
Grass Pavers, Ltd.	3807 Crooks Road Royal Oak, Mich. 48073	Monoslabs (cellular)
Griffon Company, Inc.	P. O. Box 33248 Houston, Tex. 77033	Griff net
Gulf States Paper Corporation	P. O. Box 3199 Tuscaloosa, Ala. 35401	Erosion-control fabrics
Hold-That-River, Inc.	P. O. Box 45335 Houston, Tex. 77045	Timber fencing
Hudson Pulp and Paper Corporation	P. O. Box 919 Palatka, Fla. 32077	Paper riprapi, bulkhead bags prefilled
Johns-Manville	Ken-Caryl-Ranch P. O. Box 5108 Denver, Colo.	Tile-Guard filter fabric
Kaiser Aluminum	300 Lakeside Dr. Oakland, Calif. 94643	Shore-All sheet piling

(Continued)

Company	Address	Product(s)
Kennross-Naue Canada, Ltd.	320 Alameda Drive Palm Springs, Fla. 33461	Filter cloth, cellular blocks, sand trap mats
Koch Brothers, Inc.	35 Osage Avenue Kansas City, Kans. 66105	Zenith filter
Louisiana Industries	P. O. Box 5396 Bossier City, La.	Monoslabs (cellular)
Ludlow Textiles	300 West Emory St. Dalton, Ga. 30720	Jute mats
Maccaferri Gabions, Inc.	RR#2, Box 43A Williamsport, Md. 21795	Gabions
Menardi-Southern	P. O. Box 12454 Houston, Tex. 21795	Monofilter (J. P. Stevens)
Monsanto Textiles Company	800 N. Lindbergh Blvd. St. Louis, Mo. 63166	BIDIM engineering fabric
Owens-Corning Fiberglas Corporation	Fiberglas Tower Toledo, Ohio 43659	Bituminous treated glass fibers
Ozite Corporation	1755 Butterfield Rd. Libertyville, Ill. 60048	HD-10 filter fabric
Phillips Petroleum Company	15D 2 Phillips Blvd. Bartlesville, Okla. 74004	Petroset rubberiz- ing emulsions
Reinco	P. O. Box 584 Plainfield, N. J. 07061	Equipment for broadcasting Hydro-Mulch; Terra Tack
Spidel Foundations Harbor and Marine Corporation	1055 North Shore Dr. Benton Harbor, Mich. 49022	Z-Wall piling
Superior Fiber Mulch	Suite 501 Executive Plaza II Hunt Valley, Md. 21031	Mulch
Soil Seal Corporation	600 S. Harvard Blvd. Los Angeles, Calif. 90005	Soil cement,

(Continued)

<u>Company</u>	<u>Address</u>	<u>Product(s)</u>
United States Textures Sales Corporation	4229 Jeffrey Drive Baton Rouge, La. 70816	Nicolon
VSL Corporation	236 N. Santa Cruz Ave. Los Gatos, Calif. 95030	VSL Hydro-Lining
Warren-Fondedile	675 Massachusetts Ave. Central Plaza Cambridge, Mass. 02139	Root piles

2. A limited number of research organizations direct part of their efforts toward the study of streambank protection. These organizations are listed below.

<u>Organization</u>	<u>Address</u>
Asphalt Institute	Asphalt Institute Bldg. College Park, Md. 20740
Bituminous Coal Research, Inc.	350 Hochbers Rd. Monroeville, Pa. 15146
Portland Cement Association	Old Orchard Rd. Skokie, Ill. 60076

APPENDIX C: GLOSSARY OF STREAMBANK PROTECTION TERMINOLOGY

Armor. Artificial surfacing placed on the banks of a stream to resist erosion or scour.

Articulated concrete mattress. Rigid concrete slabs usually hinged together with corrosion-resistant wire fasteners; primarily for lower bank protection.

Asphalt block. Precast or broken pieces of asphalt that can be hand-placed or dumped on a streambank or filter for protection against erosion.

Asphalt (bulk). Mass uncompacted asphalt usually dumped from a truck (upper bank protection) or a barge (lower bank protection) that is designed to stabilize the bank against erosion.

Bank protection. Placement of revetment or other armor to stabilize a streambank against erosion or use of a river training structure designed to deflect the hydraulic erosive forces away from a streambank.

Bituminous mattress. An impermeable rock-, mesh-, or metal-reinforced mattress of asphaltic or other bituminous material placed on a streambank to prevent erosion.

Bulkhead. A vertical or nearly vertical structure supporting a natural or artificial embankment.

Cellular block. Regularly cavitated concrete block placed directly on a streambank or filter to prevent erosion. The cavities permit the growth of either volunteer or planted vegetation.

Ceramic mattress. Ceramic slabs hinged together with corrosion-resistant fasteners placed on a streambank to prevent erosion.

Ceramic riprap. An armor of whole or broken ceramic blocks or slabs placed on a streambank or filter to prevent erosion.

Concrete block. Precast whole or broken concrete material placed on a streambank or filter to prevent erosion.

Crib. An open-frame structure filled with earth or stone ballast designed to absorb energy and to deflect hydraulic currents away from a streambank.

Cut bank. The concave wall of a meandering stream that is maintained as a steep or overhanging cliff by the impinging streamflow against its base.

Dike (sill, groin, spur, jetty). A river training aid constructed of earth, wood, or stone, designed to deflect erosive currents away from a bank and to control movement of bed material.

Erosion-control matting. Fibrous matting (e.g. jute, paper, fiber-glass, etc.) placed or sprayed on a streambank for the purpose of preventing erosion or providing temporary stabilization until vegetation is established.

Fascine. A bundle of brush, sticks, or timber used to make a foundation mat or to make a revetment to protect a streambank against erosion.

Fence. A river training structure normally consisting of mesh attached to a series of posts often in double rows; the interstitial space between the rows may be filled with rock, brush, or other locally available materials.

Filter. Layer of sand, evenly graded rock, or cloth, placed between the bank armor and soil for one or more of three purposes: to prevent the soil from coming through the armor by extrusion or erosion, to prevent the armor from sinking into the soil, and to permit natural seepage from the streambank to occur and thus prevent buildup of excessive hydrostatic pressure.

Freeze probe. A steel cylindrical bar used as a soil stabilization technique in polar climates to maintain bank stability and retard erosion by freezing the soil during warm months.

Gabion. A wooden, wire mesh, or cloth basket or cage filled with earth, stone, or other locally available material placed as a component of a bank protection structure.

Grout. A fluid mixture of cement and water or of cement, sand, and water used to fill joints and voids.

Jack (Jackstraw, Kellner jack). A component of a river training structure consisting of wire or cable strung on three mutually perpendicular metal, wooden, or concrete struts.

Log and cable. Trees or timber anchored to a streambank by a series of cables to serve as protection against erosion.

Lower bank. That portion of a streambank having an elevation less than the mean water level of the stream.

Mattress. A broad flat cage or network of concrete, wood, stone, or other locally available materials used to protect a streambank against erosion.

Organic mixtures and mulches. Any of a number of organic agents (e.g. petrochemicals or vegetative matter) used to stabilize a streambank against erosion by affording permanent protection or temporary protection and nutrients for the establishment of vegetation. These agents, which may be in the form of liquids, emulsions, or slurries, are normally applied by means of mechanical broadcasters.

Pavement. Streambank surface covering, usually impermeable, designed to serve as armor against erosion. Common pavements used on streambanks are concrete and compacted asphalt.

Pile. An elongated member, usually made of timber, concrete, or steel, that serves as a structural component of a river training structure.

Point bar. The convex side of a loop of a meandering stream where active deposition of bed load and suspended sediment load occurs.

Revetment. Armor of erosion-resistant material designed to protect a streambank.

River training structure. Any configuration constructed in a stream or placed on, adjacent to, or in the vicinity of a streambank, which is intended to deflect currents, induce sediment deposition, induce scour, or in some other way alter the velocity regimen of the stream.

Rock-and-wire mattress. A flat or cylindrical wire cage filled with stones or other suitable material placed on a streambank as armor against erosion.

Rubble. Rough, irregular fragments of random size placed on a streambank to retard erosion. The fragments may consist of broken concrete slabs, masonry, or other suitable refuse.

Sack revetment. A revetment consisting of sacks (e.g. burlap, paper, or nylon) filled with concrete, sand, stones, or other available material placed on a streambank to serve as protection against erosion.

Soil cement. A mixture of soil and portland cement at a prescribed moisture content that is compacted to provide stability for a soil surface and to prevent its erosion.

Soil fusion. A process to stabilize a streambank by heating the soil.

Stone riprap. Natural cobbles, boulders, or broken stones dumped or placed on a streambank or filter as armor against erosion.

Synthetic mattress, matting, casing, and tubing. A grout- or sand-filled, manufactured, semiflexible casing placed on a streambank to prevent erosion.

Tetrahedron. Component to river training works made of six steel or concrete struts fabricated in the shape of a pyramid.

Tetrapod. Bank protection component of precast concrete consisting of four legs joined at a central block, each leg making an angle of 109.5 deg with the other three.

Timber-and-brush mattress. A mattress made of brush, poles, logs, or lumber interwoven or otherwise lashed together. The resulting configuration is then placed on the bank of a stream and weighted with natural or artificial stone ballast.

Toe. That portion of a stream cross section where the lower bank terminates and the channel bottom or the opposite lower bank begins.

Trench-fill revetment. Stone, concrete, or ceramic material placed in a trench dug behind and parallel to an eroding streambank. When the erosive action of the stream reaches the trench, the material placed in the trench retards further erosion.

Upper bank. That portion of a streambank having an elevation greater than the mean water level of the stream.

Vegetation. Woody or nonwoody plants used to stabilize a streambank and retard erosion.

APPENDIX D: LITERATURE SURVEY OF STREAMBANK PROTECTION

1. An index is provided below as an aid for locating references on individual protection methods.

<u>Method</u>	<u>Page</u>	<u>Method</u>	<u>Page</u>
<u>Single-Component Revetment</u>		<u>Mattresses, Matting, and Pavement Revetment (Cont'd)</u>	
Asphalt blocks	D2	Timber-and-brush mattresses	D78
Automobile bodies	D2	Used-tire matting	D85
Cellular blocks	D4		
Ceramic riprap	D6	<u>Bulkheads</u>	
Concrete blocks	D6	Concrete or stone	D87
Rubble	D10	Fiber	D90
Sack revetment	D11	Metal	D91
Stone riprap	D13	Timber	D92
Tetrapods	D41		
Trench-fill revetment	D41	<u>Soil Stabilization</u>	
<u>Mattresses, Matting, and Pavement Revetment</u>		Asphalt (bulk)	D95
Articulated concrete mattresses	D44	Grout	D95
Asphalt pavement	D52	Organic mixtures and mulches	D97
Bituminous mattresses	D57	Soil cement	D100
Ceramic mattresses	D59	Thermal control	D102
Concrete pavement	D60	Vegetation	D102
Erosion-control matting	D63	<u>River Training Structures</u>	
Fascine mattresses	D65	Cribs	D117
Gabions	D67	Dikes (sill, groin, spur, jetty)	D119
Log and cable	D72	Fences	D142
Rock-and-wire mattresses	D73	Kellner jack field	D145
Synthetic mattresses, matting, and tubing	D76	Tetrahedron field	D150

Single-Component Revetment

Asphalt blocks

Anonymous, "U. S. Engineers Work on Underwater Bank Project," Construction, Vol 19, No. 11, Nov 1952, p 38.

Avakian, L. S., "Ashbury's Successful Asphalt Jetties," Asphalt Jetties Save the World's Shorelines, Information Series No. 149, pp 4-5, Jan 1969, The Asphalt Institute, College Park, Md.

_____, "Battering Storms Leave Asphalt Jetty Unharmed," Asphalt, Vol 17, No. 4, Oct 1965, p 13.

Blanquet, P. A., "Memoire sur les Protections des Berges en Amerique et en Hollande" ("Memorandum on Bank Protection in America and in Holland"), Translation No. 53-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch for Mississippi River Commission, CE, Vicksburg, Miss.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

D'Angremond, K. et al., "Use of Asphalt in Breakwater Construction," Proceedings of the 12th Coastal Engineering Conference, Washington, Vol 3, Chapter 98, 1970, pp 1601-1627.

Huber, R. L., "Contract on Works and Bank Stabilization," Bank Stabilization Manual; Draft 1948, Prepared by Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

U. S. Army Engineer District, New Orleans, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, New Orleans, La.

Visser, W. and Claessen, A. I. M., "Asphalt Rules the Dutch Waves," Customer Publication 171/75, 1975, Shell International Petroleum Co., Ltd., Amsterdam.

Automobile bodies

Anonymous, "Car Wrecks Used to Stabilize River Bank," World Road News (Switzerland), Vol 1, No. 9, Sep 1966, p 21.

Baltimore Sun, "Old Cars as Breakwater Add Woes to Seaside Town," 12 Apr 1966, Baltimore, Md.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Cheatham, G. C., "Bank Protection--Erosion Controls," unpublished and undated handout prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Davis, E. I. and Lipscomb, E. B., "Stabilizing the Lower Mississippi River," Civil Engineering (New York), Vol 35, No. 11, Nov 1965, pp 61-69.

Gallegly, H. L., "Corralled with Car Bodies," Texas Highways, Vol 9, No. 1, Jan 1962, pp 12-15.

Keeley, J. W., "Bank Protection and River Control in Oklahoma," 1971, U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, Oklahoma Division, Oklahoma City, Okla.

Moore, N. A., "Improvement of the Lower Mississippi River and Tributaries 1931-1972," 1972, Mississippi River Commission, CE, Vicksburg, Miss.

New York Times, "Fire Islands Resisting Ocean," 24 Jul 1958, New York, N. Y.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Ore.

U. S. Army Engineer District, Fort Peck, CE, "Report on Measures for Bank Protection on the Yellowstone River and Tributaries," Civil Works Investigation No. 509-e, Jun 1954, Fort Peck, Mont.

U. S. Army Engineer District, Kansas City, CE, "Bank Erosion," unpublished and undated handout prepared for landowners, Kansas City, Mo.

_____, "Car Bodies Stabilization," (unpublished), Kansas City, Mo.

U. S. Army Engineer District, Vicksburg, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, Vicksburg, Miss.

U. S. Department of Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Projects, McCook, Nebr.

Cellular blocks

Agerschou, H. A., "Synthetic Material Filters in Coastal Protection," Proceedings of the American Society of Civil Engineers, Vol 87, No. WW1, 1961, pp 111-123.

Amber, G. H., "Report on Installation of Monoslab 'Ready Revetments' at Cayuga Creek, State of New York," May 1976, Grass Pavers Limited, Royal Oak, Mich.

Ann Arbor News, "At the Bottom of the Situation," 23 Sep 1974, Ann Arbor, Mich.

Anonymous, "Brush Mattress and Mud-Cell Revetment Protects Missouri Pacific Railroad," Engineering News-Record, Vol 92, No. 24, 12 Jun 1924, p 1025-25.

Boiardi Products Corporation, "A New Concept in Modular Paving that Integrates Beauty with Function--Lockstone," 1975, New York.

_____, "Grasstone, Earth Pavers for the Regreening of America," undated, New York.

_____, "Specification, Grass Stone Units No. 550," 1 Jan 1975, New York.

Buffalo Evening News, "Low-Cost Creek Tamer," 10 Apr 1976, Buffalo, N. Y.

Cox, A. L., "Paving Block Study, Final Report," Research Report No. 58, Oct 1971, State of Louisiana, Department of Highways, Baton Rouge, La.

Crews, J. E., "Bank Stabilization in Susquehanna River Basin," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 96, No. WW1, Feb 1970, pp 87-95.

De Ment, L. E., "Two New Methods of Erosion Protection for Louisiana," 1976; Prepared for presentation at the 15th International Coastal Engineering Conference, Honolulu, Hawaii, U. S. Army Engineer District, New Orleans, CE.

ERCO Systems, Inc, "Soil Stabilization and Erosion Control Systems," undated, New Orleans, La.

Grass Pavers Limited, "Interlocking Type Monoslab Revetment Grid for 'Sea Defense' System Schraudenbach," undated, Royal Oak, Mich.

_____, "Introducing Monoslabs, Turf and Soil Concrete Grids," 1974, Royal Oak, Mich.

Grass Pavers Limited, "Typical Cross-Sections of Interlocking Monoslab (Concrete Revetment Grids) Installation Used for 'Sea Defense'," undated, Royal Oak, Mich.

Louisiana, State of, Department of Highways, "Spur Dike at Bridge Ends," 14 Sep 1971, Baton Rouge, La.

_____, "Standard Plans, Flexible Revetment," 19 Nov 1973, Baton Rouge, La.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

McCartney, B. L. and Ahrens, J. P., "Stability of Gobi Block Revetment," Technical Memorandum No. 55, Oct 1975, U. S. Army Coastal Engineering Research Center, CE, Fort Belvoir, Va.

Naue-Fosertechnik, "Terrafix, Terradrän," Espelkamp-Fiestel, West Germany.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, A Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Parsons, D. A., "Cellular Concrete Block Revetment," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 9, Paper 4311, No. WW2, May 1965, pp 27-37.

_____, "Effects of Flood Flow on Channel Boundaries," Transactions, American Society of Civil Engineers, Vol 126, Paper No. 3115, Part 1, 1961, pp 350-361.

Parsons, D. A. and Apmann, R. P., "Cellular Concrete Block Revetment," Civil Engineering (New York), Vol 35, No. 2, Feb 1965, p 66.

U. S. Army Engineer Waterways Experiment Station, CE, "The Flume Investigation of Prototype Revetment," Miscellaneous Paper No. 2-35, Sep 1952, Vicksburg, Miss.

U. S. Department of Interior, National Park Service, "Natchez Trace Parkway, Plans for Proposed Project 3C4, Grading, Base, Surfacing, and Structures, U. S. 45 to Mississippi Highway 363, Lee County, Mississippi," May 1976, Tupelo, Miss.; Plans prepared by U. S. Department of Transportation, Federal Highway Administration, Region 15, Arlington, Va.

U. S. Department of Interior, National Park Service, U. S. Department of Transportation, Federal Highway Administration, Region 15, "Project 3C4, Natchez Trace Parkway, Proposal and Contract," 13 May 1976, Tupelo, Miss., and Sevierville, Tenn., U. S. Government Printing Office, Washington, D. C.

Ceramic riprap

Anonymous, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

Buzzell, D. A., "Current Slope Protection Practice," Jan 1946; Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Washington, D. C.

Favoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Ray, K. B., "The Section and Armour of a Guide Bank for the Training and Control of the Great Alluvial Rivers," Technical Paper No. 309, 1941, The Railway Board, Calcutta.

Tilton, G. A., Jr., "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

U. S. Army Engineer Division, Ohio River, CE, "Laboratory First Interim Report on Ceramic Riprap Investigation," Aug 1949, Cincinnati, Ohio.

U. S. Army Engineer Waterways Experiment Station, CE, "Feasibility Study of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.

Concrete blocks

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

American Association of State Highway Officials, Task Force on Hydraulics; "Guidelines for Erosion and Sediment Control in Highway Construction," Highway Drainage Guidelines, Washington, D. C., Vol 3, 1973.

American Society of Civil Engineers, "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 74, No. 6, Jun 1948, pp 845-866.

Anonymous, "Broken Concrete Slab Riprap in Waterway," Western Construction News, Vol 18, No. 7, Jul 1943, p 316.

_____, "Concrete Riprap Used to Protect Embankment," Concrete Highways and Public Improvements, Vol 35, No. 1, Winter 1953-1959, pp 11-12.

Anonymous, "Concrete Slabs Are Laid for Bridge Abutment," Contractors and Engineers, Vol 53, No. 2, Feb 1956, pp 138-140.

Blanquet, P. A., "Memoire sur les Protections des Bordes en Amerique et en Hollande" ("Memorandum on Bank Protection in America and in Holland"), Translation No. 53-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch for the Mississippi River Commission, CE, Vicksburg, Miss.

Blenkharn, A., "Paper," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965.

Bumm, H. et al., "Nouveaux Matériaux et Réalisations Nouvelles pour la Défense des Rives et la Protection du Fond des Canaux, des Rivières et des Ports; Prix de Revient et Avantages Respectifs" ("New Materials and New Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports; Their Cost and Respective Advantages"), Translation No. 73-4, Mar 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by J. C. Van Tienhoven.

Buzzell, D. A., "Current Slope Protection Practice," Jan 1946; Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Washington, D. C.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Davis, E. I. and Lipscomb, E. B., "Stabilizing the Lower Mississippi River," Civil Engineering (New York), Vol 35, No. 11, Nov 1965, pp 64-69.

Denny, E. R., "The Battle to Beat Shore Erosion," Baltimore Sun, 13 Oct 1968, Baltimore, Md.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Elliot, D. O., Improvement of the Lower Mississippi River for Flood Control and Navigation, Vol II, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss., May 1932.

Hall, J. V. and Jachowski, R. A., "Concrete Block Revetment near Benedict, Maryland," Miscellaneous Paper 1-64, Jan 1964, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C.

Haselwood, F. W., "Acres of Concrete Riprap and Cribbs Placed to Protect Trinity River Banks," California Highways and Public Works, Vol 19, No. 3, Mar 1941.

Haas, R. H., "Development of Concrete Revetments on the Lower Mississippi," Concrete, Apr and May 1947, pp 1-10 (reprint).

Headquarters, Department of the Army, Office of the Chief of Engineers, Bank Protection, Mississippi River; Plant Methods and Materials in Use on Works Under Direction of Mississippi River Commission, Washington, D. C., 1922.

Hertzberg, R., "Foreshore Protection, Lower Mississippi River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, No. WW2, Part 1, May 1965, pp 1-16.

Hill, C. S., "Mississippi River Flood Control, III--Revetment Construction Plant and Methods," Engineering News-Record, Vol 102, 31 Jan 1929, pp 182-185.

Huber, R. L., "Contract on Works and Bank Stabilization," Bank Stabilization Manual, Draft, 1948; Prepared by Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

Louisiana, State of, Department of Highways, "Spur Dike at Bridge Ends," 14 Sep 1971, Baton Rouge, La.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

Ockerson, J. A., "Flood Control of the Mississippi River," Flood Problems, a Symposium, Transactions, American Society of Civil Engineers, Vol 85, Paper No. 1505, 1922.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Posey, C. J., "Means of Preventing Loss of Reservoir Capacity Through Sedimentation," Proceedings, 14th Congress of International Association for Hydraulic Research, Vol 50, 1972, pp 29-30.

Salberg, F. J., "Protection Against River Erosion," Civil Engineering (London), Vol 36, No. 418, Apr 1941, p 448.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965.

Schoklitsch, A., Hydraulic Structures, Vol 1, American Society of Mechanical Engineers, New York, 1937.

Shuto, N., "Hydraulic Resistance of Artificial Concrete Blocks," Proceedings, 12th Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 97, 1970, pp 1587-1599.

Silberberger, L. F., "Streambank Stabilization," Agricultural Engineering, Vol 40, No. 4, Apr 1959, pp 214-217.

Skladnev, M. F. and Shrenkov, I. A., "Concrete Blocks for Slope Protection," Hydrotechnical Construction, No. 2, Feb 1971, pp 162-185.

Tanner, W. F., "Can We Save Our Beaches?" Atlanta Journal and Constitution Magazine, 6 Dec 1964, pp 10-12 and 14.

Tenaud, R., "Paper," Les Defenses de Berge "Economiques" sur les Canaux et Rivières Navigables ("Economic" Protection of the Banks of Navigable Canals and Rivers), Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Lands for Ocean- and Inland-Navigation (Subject 6), XXIInd International Navigation Congress (PIANC), Paris, 1969.

Thomas, B. F. and Watt, D. A., The Improvement of Rivers: A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams, 2d ed., Part I, Wiley, New York, 1931.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual" (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

U. S. Army Engineer District, Omaha, CE, "Report on Channel Protection Against High Velocity Flow," Jun 1953, Omaha, Nebr.

U. S. Army Engineer District, Vicksburg, CE, "Bank Protection and Dike Data Sheets," 30 Jun 1949, Vicksburg, Miss.

_____, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, Vicksburg, Miss.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, A Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Army Engineer Waterways Experiment Station, CE, "Investigations of Certain Proposed Methods of Bank and Embankment Protection," Waterways Experiment Station Paper No. 12, Jul 1933, Vicksburg, Miss.

_____, "Preliminary Flume Tests of Mississippi River Revetment," Potamology Investigations Report No. 2-4, Second Interim Report, Nov 1951, Vicksburg, Miss.

U. S. Department of Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo.; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Project, McCook, Nebr.

U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, "Use of Riprap for Bank Protection," Hydraulic Engineering Circular 11, Jun 1967, Washington, D. C.

Weller, H. E., "Bank Protection of Varanasi Ghats and Other Locations on Ganga River," Aug 1969, Mississippi River Commission, CE, Vicksburg, Miss.

Rubble

Anonymous, "Stabilization of River Bank at Cod Beck," The Surveyor, Vol 116, No. 3410, 31 Aug 1957, pp 914-915.

Cunningham, B., Coast Erosion and Protection, Charles Griffen and Co., Ltd., London, 1934.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Font, J. B., "Damage Functions for a Rubble Mound Breakwater Under the Effect of Swells," Proceedings of the 12th Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 96, 1970, pp 1567-1585.

House of Representatives, "Shoreline Protection," House Document No. 91-22, 91st Congress, 1st Session, 20 Nov 1969, Washington, D. C.; Hearing before the Subcommittee on Rivers and Harbors of the Committee on Public Works.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Tanner, W. F., "Can We Save Our Beaches?" Atlanta Journal and Constitution Magazine, 6 Dec 1964, pp 10-12 and 14.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual" (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

Sack revetment

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Anonymous, "Concrete Riprap Bridge Approaches," Western Construction News, Vol 22, No. 4, 4 Apr 1947, p 81.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Improvised Riprap Checks Erosion of Peace River Bridge Foundation," Construction Equipment, Vol 6, No. 2, Aug 1952, pp 30-31.

_____, "Novel River Bank Protection Saves Highway Bridge and Fill," Construction Methods, Vol 15, No. 10, Oct 1933, pp 34-37.

_____, "Sacked Concrete Riprap Protects California Streambanks," Concrete Highways and Public Improvements, Vol 21, No. 2, Apr-Mar 1940, pp 6-7.

Anonymous, "Sack of Concrete for Bank Protection," Contractors and Engineers Monthly, Vol 44, No. 8, Aug 1947.

_____, "Soil-Cement Revetment Moves," Engineering News-Record, Vol 123, No. 15, 12 Oct 39, p 53.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Cheatham, G. C., "Bank Protection--Erosion Controls," unpublished and undated handouts prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Child, C. F., "Concrete Riprap Bank Protection," California Highways and Public Works, Vol 18, No. 1, Jun 1940, p 20.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Construction Techniques, Inc., "Creek, Bank and Bridge Abutment Repair," Fabriform Report FF-63, undated, Cleveland, Ohio.

Erosion Control, Inc., "Erosion Control," undated, West Palm Beach, Fla.

Finch, H. A., "Earth-Cement Mixtures in Sacks Used for River Bank Revetment," Engineering News-Record, Vol 12, No. 19, 11 May 1939, p 67.

Hudson Pulp and Paper Corporation, "Hudson's Reinforced Paper Riprap Bulkheading Bags Prefilled," undated, New York, N. Y.

Intrusion-Prepakt, Inc., "Experimental Beach Rehabilitation," Fabriform Report FF-37, undated, Cleveland, Ohio.

_____, "Fabricast Bags, Buttress Oceanfront Homesites," Fabriform Report FF-53, undated, Cleveland, Ohio.

_____, "Fabricast Cribbing Stabilizes Rock Cut," Fabriform Report FF-57, undated, Cleveland, Ohio.

_____, "Fabricast Molded Blocks," 1975, Cleveland, Ohio.

_____, "Fabriform Molded Riprap," Fabriform Report FF-49, undated, Cleveland, Ohio.

_____, "Spotlight on the World of Prepakt"; Published quarterly since 1973, Cleveland, Ohio.

Louisiana, State of, Department of Highways, "Spur Dike at Bridge Ends," 14 Sep 1971, Baton Rouge, La.

_____, "Standard Plans, Flexible Revetment," 19 Nov 1973, Baton Rouge, La.

McCauly, M. L. and Mearns, R. W., "Evaluation of a Shoreline Erosion Control Project," Research Project, 1974, State of California, Division of Highways, Sacramento, Calif.; Performed for U. S. Department of Transportation, Federal Highway Administration.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Pickels, G. W., "Flood Protection by Channel Improvement," Drainage and Flood Control, Chapter 11, McGraw-Hill, New York, 1941, pp 321-354.

Portland Cement Association, "Airport Drainage," 1966, Chicago, Ill.

U. S. Army Engineer District, New Orleans, CE, "Design Data, Morameal Test Revetment," undated, New Orleans, La.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Army Engineer School, CE, "Flood Control, Flood Fighting," E206-13(1-52) ML, 1951, Fort Belvoir, Va.

U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, "Use of Riprap for Bank Protection," Hydraulic Engineering Circular 11, Jun 1967, Washington, D. C.

Virginia Institute of Marine Science, "Is Shoreline Erosion Your Problem?" Marine Resource Information Bulletin, May-Jun 1976, pp 1 and 4.

Ziribel, R., "Sand-Filled Tubes for Shore Protection," The Military Engineer, Vol 66, No. 431, May-Jun 1974, pp 170-171.

Stone riprap

Ables, J. H., Jr., and Pickering, G. A., "Flood Control Project on Lytle and Warm Creeks and Santa Ana River, California; Hydraulic Model Investigation," Technical Report M-75-7, Apr 1975, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Agerschou, H. A., "Synthetic Material Filters in Coastal Protection," Proceedings, American Society of Civil Engineers, Vol 87, No. WW1, 1961, pp 111-123.

Ahrens, J. P., "Large Wave Tank Tests of Riprap Stability, CERC-TM-51, May 1975, U. S. Army Coastal Engineering Research Center, CE, Fort Belvoir, Va.

_____, "The Influence of Breaker Type on Riprap Stability," Proceedings, Twelfth Coastal Engineering Conference, September 13-18, 1970, Washington, D. C., American Society of Civil Engineers, Vol 3, 1970, pp 1557-1566.

Albertson, M. L. and Smith, G. L., "Principles of Energy Dissipation on Erosion-Control Structures," 1957, Colorado Agricultural and Mechanical College, Civil Engineering Department, Fort Collins, Colo.; Prepared as Paper No. 15 for presentation for Joint ARS-SCS Irrigation-Drainage Conference, Colorado Springs, Colo., 14-15 Jan 1957.

American Association of State Highway Officials, Task Force on Hydraulics, "Guidelines for Erosion and Sediment Control in Highway Construction," Highway Drainage Guidelines, Washington, D. C., Vol 31, 1973.

American Society of Civil Engineers, "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 74, No. 6, Jun 1948, pp 845-866.

American Society of Civil Engineers, Task Committee for Preparation of Manual on Sedimentation, "Chapter V--Sediment Control Methods; Introduction and Watershed Area," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 95, No. HY2, Proceedings Paper 6438, Mar 1969, pp 649-675.

Anderson, A. G., Paintal, A. S., and Davenport, J. T., "Tentative Design Procedures for Riprap-Lined Channels," Research Results Digest (National Cooperative Highway Research Program), Digest 1, Dec 1968, pp 1-5.

Anderson, A. G. et al, "Tentative Design Procedure for Riprap-Lined Channels," National Cooperative Highway Research Program Report 108, 1970, University of Minnesota, Minneapolis, Minn.

Anonymous, "Arkansas River Being Confined at Chronic Trouble Tract," Construction News, Vol 27, No. 42, 19 Oct 1960, p 58.

Anonymous, "Cold Weather Aids Bank Protection Work," Contractors and Engineers, Vol 61, No. 10, Oct 1964, p 76.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "First Floodflow Experiments of Vicksburg Hydraulic Laboratory," Engineering News-Record, Vol 106, No. 24, 11 Jun 1931, p 970.

_____, "Gravel Revetment Placed by Scrapers," Contractors and Engineers Monthly, Vol 32, No. 6, Jun 1936, pp 22-23.

_____, "How County Controls Erosion on Slim Rights-of-Way," Rural and Urban Roads, Vol 10, No. 5, May 1972, pp 24-26.

_____, "How They Place Riprap on the Big Muddy," Construction Methods and Equipment, Vol 33, No. 12, Dec 1951, p 50.

_____, "How to Wrap Up a Riprap Job," Construction Methods and Equipment, Vol 42, No. 6, Jun 1960, pp 135-136.

_____, "Levees, Revetment Retard Bank Scour," Contractors and Engineers Monthly, Vol 45, No. 8, Aug 1948, pp 52-56.

_____, "New Mexico Used Creosoted Piles and Woven Wire for Bank Protection," Wood Preserving News, Vol 17, No. 6, Jun 1939, pp 70-71.

_____, "New Plans for the Mississippi," Engineering News-Record, Vol 111, No. 6, 10 Aug 1933, pp 166-169.

_____, "Paved Banks Line Channels for Los Angeles River Floods," Construction Methods and Equipment, Vol 21, No. 7, Jul 1939, p 72.

_____, "Pile Dikes and Riprap Control Bank Erosion," Contractors and Engineers, Vol 52, No. 1, Jan 1955, pp 16-17.

_____, "Riprap Hand Placed Under Water," Engineering News-Record, Vol 170, No. 7, Feb 1943, p 71.

_____, "Riprap on the Rincon," Southwest Builder and Contractor, Vol 125, No. 14, 8 Apr 1955, pp 10-13.

_____, "Riprap Stone Production Requires Careful Sizing," Rock Products, Vol 51, No. 11, Nov 1948, pp 80-81.

_____, "Riprap Stones Lifted With Sullivan Bolts," Roads and Streets, Vol 105, No. 5, May 1962, p 81.

Anonymous, "Riprap Used in Treatment of Erosion," Carolina Highways, Vol 2, No. 8, Sep 1950, p 18.

_____, "Rock Paved Slope Channel Improvement," Southwest Builder and Contractor, Vol 99, No. 23, 5 Jun 1942, pp 16-19.

_____, "Rocks Solve Stabilization Problem and Add Beauty," Better Roads, Vol 37, No. 3, Mar 1967, p 32.

_____, "Skilled Crane Operator Is Key to Experimental Riprapping," Roads and Streets, Vol 115, No. 11, Nov 1972, p 40.

_____, "Slope Protection for Earth Dams," Research Project, 1973, U. S. Army Coastal Engineer Research Center, Washington, D. C.

_____, "Small Size Riprap is Best," Western Construction, Vol 29, No. 7, Jul 1954, p 69.

_____, "Snake River Bank Stabilization," Journal, Waterways and Harbors Division, Proceedings, American Society of Civil Engineers, Vol 92, No. WW1, Feb 1966, p 1.

_____, "Stone Revetment and Flood Wall," Contractors and Engineers Monthly, Vol 38, No. 7, Jul 1941, pp 1 and 22-23.

_____, "Taking the Threat Out of a River," Railway Age, Vol 93, No. 9, Aug 1932, pp 282-284 and 289.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

Bajpai, A. N., "Design of Rubble Mound Breakwaters," Dock and Port Authority, Vol 27, May 1964, pp 377-383.

Barnes, R. C., Jr., "Erosion Control Structures," River Mechanics II, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Barsdale, R. W., "Bank Protection on Central Valley Streams," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 86, No. WW4, Nov 1960, pp 1-16.

Bartleman, B., "Ohio River Chewing Away at Smithland," Sun Democrat, 1 Apr 1973, Paducah, Ky.

Bass, G., "Cement-Stabilized Riprap," Texas Highways, Vol 4, No. 12, Oct 1957, pp 6-7.

Bettle, A. F. and Dyer, C. E., "Revetment--Stabilization of the Channel of the Rio Grande from Caballo Dam to Fort Quitman, New Mexico-Texas," Symposium on Channel Stabilization Problems, Vol 3, Technical Report No. 1, Chapter 2, Jun 1965.

Bhomik, N. G., "Development of Criteria for Shore Protection Against Wind-Generated Waves for Lakes and Ponds in Illinois," Research Project, 1975, U. S. Department of Interior, Office of Water Research and Technology, Washington, D. C.; Performed by University of Illinois, State Water Survey Division, Urbana, Ill.

Blaess, A. F. et al., "Methods of Protecting River Banks Against Erosion," Bulletin of the American Railway Engineering Association, Vol 30, No. 311, Nov 1928, pp 260-270.

_____, "Report on Methods for Providing Against River Bank Erosion," Bulletin of American Railway Engineering Association, Vol 31, No. 324, Feb 1930, p 1333.

Blaisdell, F. W., "Model Test of Box Inlet Drop Spillway and Stilling Basin Proposed for Tillatoba Creek, Tallahatchie County, Mississippi," 1973, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.

_____, "Scour and Protection Against Scour at Conservation Structures," Research Project, 1974, U. S. Department of Agriculture, Agricultural Research Service, North Central Region, Minneapolis, Minn.

Blaisdell, F. W. and Anderson, C. L., "Scour and Protection Against Scour at Conservation Structures," Research Project, 1976, U. S. Department of Agriculture, Agricultural Research Service, Minneapolis, Minn.

Blaisdell, F. W., Anderson, C. L., and Yalamanchili, K., "Cantilever Outlet Scour Holes and Plunge Pools," Research Project, 1976, U. S. Department of Agriculture, Agricultural Research Service, Minneapolis, Minn.; Performed by University of Minnesota, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.

Blanquet, P. A., "Memoire sur les Protections des Berges en Amerique et en Hollande" ("Memorandum on Bank Protection in America and in Holland"), Translation No. 53-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch for Mississippi River Commission, CE, Vicksburg, Miss.

Bohan, J. P., "Erosion and Riprap Requirements at Culvert and Storm-Drain Outlets," Research Report H-70-2, Jan 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Brandis, W. F., "Letter to Dean David Hamilton, School of Agriculture, Tennessee State University, Nashville, Tenn.," unpublished, 12 Jun 1973, U. S. Army Engineer District, Nashville, CE, Nashville, Tenn.

Brogdon, N. J. and Grace, J. L., "Stability of Riprap and Discharge Characteristics, Overflow Embankments, Arkansas River, Arkansas; Hydraulic Model Investigation," Technical Report 2-650, Jun 1964, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Brown, B. J., "Boundary Effects of Graded Roughness Elements in Two-Dimensional Flow in Open Channels," Miscellaneous Paper H-70-6, May 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Brown, C. H., "Smithland, Kentucky, Bank Protection," Memorandum for Hydraulic Branch Files (unpublished), 20 Feb 1973, U. S. Army Engineer District, Nashville, CE, Nashville, Tenn.

Buchanan, G. C., "The Rangoon River Training Works," Institute of Civil Engineers, Vol 202, 1915-1916, pp 143-242.

Buffalo Evening News, "Low-Cost Creek Tamer," 10 Apr 1976, Buffalo, N. Y.

Bumm, H. et al., "Nouveaux Matériaux et Réalisations Nouvelles pour la Défense des Rives et la Protection du Fond des Canaux, des Rivières et des Ports; Prix de Revient et Avantages Respectifs" ("New Materials and New Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports; Their Costs and Respective Advantages"), Translation No. 73-4, Mar 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by J. C. Van Tienhoven.

Burgi, P. H. and Fujimoto, S., "Hydraulic Model Studies of Crystal Dam Spillway and Outlet Works, Colorado River Storage Project," U. S. Department of Interior, Bureau of Reclamation, Engineering and Research Center, Denver, Colo.

Bursali, S., "Economic Revetments for Protecting the Banks of Meric and Ergene Rivers Flood Canals Against Wave Erosion," Proceedings of the International Association for Hydraulic Research Symposium on River Mechanics, Asian Institute of Technology, Bangkok, Thailand, Vol I, Sediment Transportation, 1973, pp 203-212.

Bush, J. L., "Channel Stabilization on the Arkansas River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 88, No. WW2, Part I, 1962, pp 51-67.

Buzzell, D. A., "Current Slope Protection Practice," Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Jan 1946, Washington, D. C.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Campbell, F. B., "Hydraulic Design of Rock Riprap," Miscellaneous Paper No. 2-777, Feb 1966, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Canadian Center for Inland Waters, Environment Canada, "Shore Erosion--Cause and Cure," 1974, Ottawa.

Carey, W. C., "Comprehensive River Stabilization," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 92, No. WW1, Feb 1966, pp 59-86.

_____, "Construction Problems in Comprehensive River Stabilization," undated, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

Carthage Mills, "Eliminate Water-Caused Soil Erosion; Specify Poly-Filter X, Filter X, Poly-Filter GB," undated, Cincinnati, Ohio.

_____, "Filter Handbook," undated, Cincinnati, Ohio.

Causey, W. R., "Bank Stabilization, Red River Below Denison Dam," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter IV, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Cheatham, G. C., "Bank Protection--Erosion Controls," unpublished and undated handout prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Crews, James E., "Bank Stabilization in Susquehanna River Basin," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 96, No. WW1, Feb 1970, pp 87-95.

Crosby, L. G., "Design of an Interisland Barge Harbor for the Island of Tau, American Samoa; Hydraulic Model Investigation," Technical Report H-74-16, Dec 1974, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Curry, R. L., "Investigation of Concrete Aggregate and Riprap Stone for the Rend Lake Reservoir, St. Louis District," Miscellaneous Paper No. 6-589, Jul 1963, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Darwin, A. G., "Protective Works for Lewiston Hydroelectric Development," Western Construction News, Vol 4, No. 4, 25 Feb 1929, pp 107-108.

Davis, F. J. et al., "Riprap Slope Protection for Earth Dams, a Review of Practices and Procedures," 1973, Bureau of Reclamation, Engineering Research Center, Denver, Colo.

_____, "Wichita Project, Kansas, Cheney Dam, Design Considerations for Dam Embankment," Apr 1962, U. S. Department of Interior, Bureau of Reclamation, Denver, Colo.

Day, M. E., "Protection of Erodible Channels and Surface with Gravel or Riprap" (unpublished and undated), U. S. Department of Interior, Canal Branch, Denver, Colo.

Dee, W. H., "Laboratory Tests of Concrete Aggregate and Riprap Materials, Palo Verde Diversion Dam, Palo Verde Irrigation District," Concrete Laboratory Report No. C-766, 1954, U. S. Department of Interior, Bureau of Reclamation, Denver, Colo.

Degenhardt, E. A., Channel Stabilizations of the Middle Mississippi River (Unpublished Thesis), Colorado State University, Fort Collins, Colo., Aug 1973.

Des Champs, J., "Rock Blanket Stops River Erosion," Engineering and Contract Record, Vol 76, No. 5, May 1963, pp 63-65.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Edminster, F. C., Atkinson, W. S., and McIntire, A. C., "Streambank Erosion Control on the Winoski River, Vermont," U. S. Department of Agriculture Circular 837, 1949, Washington, D. C.

E. I. du Pont de Nemours and Co., Inc., "Construction of Subgrade Drains Using Typar Spunbonded Polypropylene as a Filter Fabric," Preliminary Information Memo No. 361, 17 May 1976, Wilmington, Del.

E. I. du Pont de Nemours and Co., Inc., "Typar Case History--J. D. Barter Construction Co., Harrisburg, Illinois," Goreville Project--Interstate Highway 24, May 1976, Wilmington, Del.

Elliot, S. F. and May, R. R., "Bank Protection for New River Channel," Engineering News-Record, Vol 125, No. 25, 19 Dec 1940, pp 61-63.

Ellis, W., "Laboratory Tests on One Sample of Gravel Protection for Bank Protection--Osborne Canal--Webster Unit--Missouri River Basin Project," Earth Laboratory Report EM-506, 1957, U. S. Department of Interior, Bureau of Reclamation, Denver, Colo.

Emmons, W. F. and Meyer, A. A., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 75, No. 1, Jan 1949, pp 155-158.

Esmiol, E. E., "Rock as Upstream Slope Protection for Earth Dams," Report DD-3, Mar 1966 (Revised May 1967), Bureau of Reclamation, Denver, Colo.

Executive Committee--General Secretary, Permanent International Association of Navigation Congresses, "XVIIth International Navigation Conference Proceedings," Lisbon, 1949.

Fairley, J. G. et al., "Use of Plastic Filter Cloth in Revetment Construction, Potamology Research Project 11," Potamology Investigations Report 21-4, Jun 1970; Sponsored by Mississippi River Commission, CE, conducted by U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Feagin, L. B., "Program of the Mississippi River Commission," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter V, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Ferrese, H. and Pemberton, E. L., "Condition of Channelization and Levee System, Region 3--Colorado River Front Work and Levee System," Review of Maintenance, Report of Examination, Apr 1972, U. S. Department of Interior, Bureau of Reclamation, Engineering and Research Center, Office of Design and Construction, Denver, Colo.

Fletcher, B. P. and Grace, J. L., Jr., "Practical Guidance for Design of Lined Channel Expansions at Culvert Outlets; Hydraulic Model Investigation," Technical Report H-74-9, Oct 1974, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Fletcher, B. P. and Grace, J. L., Jr., "Practical Guidance for Estimating and Controlling Erosion at Culvert Outlets," Mississippi Water Research Institute Publication, 1972, pp 137-173.

Fletcher, B. P. and Grace, J. L., Jr., "Practical Guidance for Estimating and Controlling Erosion at Culvert Outlets," Miscellaneous Paper H-72-5, May 1972, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Spillway for Rend Lake Reservoir, Big Muddy River, Illinois; Hydraulic Model Investigation," Technical Report H-69-7, May 1969, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Foreman, B. C., "Reconnaissance Investigation of Bank Erosion at Smithland," Memorandum for Chief, Engineering Division (unpublished), 12 Jul 1972, U. S. Army Engineer District, Nashville, CE, Nashville, Tenn.

Freeland, S. J., "River Training of the Lower Colorado River" (unpublished and undated), U. S. Department of Interior, Bureau of Reclamation, Lower Colorado Region, Boulder City, Nev.

Gamble, J. and Mearns, R., "Investigation of Rock Slope Protection Material," Material and Research Department, Research Report No. M and R 632561, Apr 1967, State of California, Department of Public Works, Division of Highways, Sacramento, Calif.; Prepared in cooperation with the U. S. Department of Commerce, Bureau of Public Roads.

Givens, F. B., Jr., "Shoreline Erosion Control on Virginia's Rivers and Bays," Shore and Beach, Vol 44, No. 1, Apr 1976, pp 25-30.

Gorrie, R. M., Soil and Water Conservation with Punjab, Simea, New Delhi, India, 1946.

Grace, J. L., Jr., "Spillway for Typical Low-Head Navigation Dam, Arkansas River, Arkansas; Hydraulic Model Investigation," Technical Report 2-655, Sep 1964, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Grace, J. L., Jr., and Melsheimer, E. S., "Spillway for West Point Dam, Chattahoochee River, Alabama and Georgia; Hydraulic Model Investigation," Technical Report 2-815, Mar 1968, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Grace, J. L., Jr., Calhoun, C. C., and Brown, D. N., "Drainage and Erosion Control Facilities, Field Performance Investigation," Miscellaneous Paper H-73-6, Jun 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Granberg, W. J., "Columbia River Gets Coat of Armor," Excavating Engineer, Vol 45, No. 4, Apr 1951, p 21.

Grimm, C. I. and Leopold, N., "Hydraulic Data Pertaining to the Design of Rock Revetment," 10 May 1939, U. S. Army Engineer District, Portland, CE, Portland, Oreg.

Haas, R. H., "Stabilization Problems, Lower Mississippi River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Chapter I, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Haas, R. H. and Graham, J., "Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6)," XXIInd International Navigation Congress (PIANC), 1969, Paris.

Hansen, E. A., "Stabilizing Eroding Streambanks in Sand Drift Areas of the Lake States," Research Paper NC-21, 1968, U. S. Department of Agriculture, Forest Service, Washington, D. C.

Hansen, E. A. et al., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings of the American Society of Civil Engineers, Vol 74, No. 8, Oct 1948, pp 1395-1411.

Haydon, G. C., "The Missouri River and Its Improvements," 1931, U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Headquarters, Department of the Army, Office of the Chief of Engineers, "Additional Guidance for Riprap Channel Protection," Engineering Technical Letter No. 1110-2-120, 14 May 1971, Washington, D. C.

_____, "Criteria for Graded Stone Riprap Channel Protection," Draft Report, 20 Apr 1966, Washington, D. C.

_____, "Engineering and Design Criteria for Riprap Channel Protection," Engineering Technical Letter No. 1110-2-60, 13 Jun 1969, Washington, D. C.

_____, "Hydraulic Design of Flood Control Channels," EM 1110-2-1601, 1 Jul 1970, Washington, D. C.

_____, "Slope Protection," Civil Works Engineer Bulletin No. 52-15, 2 Jun 1952 (also designated EM 1110-2-3901), Washington, D. C.

Heath, W. F., "River Bank Protection Works," 1963, International Boundary and Water Commission, U. S. Section, Harlingen, Tex.

Hedar, P. A., "Filters as Protection Against Erosion," Reprints and Preliminary Reports No. 6, 1964, Swedish Geotechnical Institute, Stockholm, pp 13-20.

Henley, J. E., "Channel Stabilization Work in the Vicksburg District," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 4, Chapter I, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Herr, L. A., "The Control of Erosion and Sediment in Highway Construction," Proceedings, National Conference on Sediment Control, Washington, D. C., 1969, pp 41-47.

Hertzberg, R., "Foreshore Protection, Lower Mississippi River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, No. WW2, Part I, May 1965, pp 1-16.

Hickson, R. E., "Columbia River Stabilization and Improvement for Navigation," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Chapter IV, Jun 1965, Committee on Channel Stabilization, CE, Vicksburg, Miss.

House of Representatives, "Shoreline Protection," House Document No. 91-92, 91st Congress, 1st Session, 20 Nov 1969, Washington, D. C.; Hearing before the Subcommittee on Rivers and Harbors of the Committee on Public Works.

Huber, R. L., "Channel Stabilization of the Missouri River," Jun 1952; Presented to the American Society of Civil Engineers, Denver, Colo.

_____, "Contract on Works and Bank Stabilization," Bank Stabilization Manual, Draft, 1948, Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

Hudson, R. Y. and Jackson, R. A., "Design of Riprap Cover Layers for Railroad Relocation Fills, Ice Harbor and John Day Lock and Dam Projects; Hydraulic Model Investigations," Miscellaneous Paper No. 2-465, Jan 1962, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Hulman, L. G., Erosion and Riprapped Embankments by Oblique Waves, Master's Thesis, University of Iowa, Iowa City, Iowa, 1967.

Hurst, C. K. and Brebner, A., "Shore Erosion and Protection, St. Lawrence River, Canada," Proceedings, 22nd International Navigation Congress, Paris, Section 1, Subject 6, pp 45-56.

Ilk, F. K., "Methods and Criteria for Bank Protection on the Lower Colorado River," Proceedings, Federal Interagency Sedimentation Conference, Agricultural Research Service, Paper No. 42, 1963, pp 366-372.

Intrusion-Prepakt, Inc., "Fabriform Lines Old Canal," Fabriform Report FF-56, undated, Cleveland, Ohio.

Intrusion-Prepakt, Inc., "Fabriform Molded Riprap," Fabriform Report FF-49, undated, Cleveland, Ohio.

Intrusion-Prepakt, Inc., "Fabriform Stabilizes Trouble Areas on Flood-prone Creek," Fabriform Report FF-58, undated, Cleveland, Ohio.

_____, "Spotlight on the World of Prepakt"; Published quarterly since 1973, Cleveland, Ohio.

Issacs, W. E., "Channel Stabilization on the Arkansas River, Little Rock District," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 2, Chapter VIII, May 1964, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Jachowski, R. A., "Shore Erosion Study, U. S. Naval Radio Station, Lola, North Carolina," May 1968, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C.

Jachowski, R. A. and Watts, G. M., "Development of Functional Structural Design Criteria," Research Project, 1976, U. S. Army Coastal Engineering Research Center, Fort Belvoir, Va.

Jackson, J. L., "Geologic Studies at Arbuckle Dam, Murray County, Oklahoma," Bulletin of the Association of Engineering Geologists, Vol 5, No. 2, Fall 1968, pp 79-99.

Jackson, R. A., "Investigation of In-Shore Harbor, Site X; Designs of Riprap Cover Layers," Technical Report No. 2-740, Report 2, Sep 1966, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

James, G. S., "Erosion Prevention on Eastern Region Wildlands," Proceedings of the 22nd Annual Meeting of the Soil Conservation Society of America, Des Moines, Iowa, 1967, pp 141-145.

Jewell, H. H., "Rock Riprap Replaces Porous Concrete Slope Protection," Formes de la Construcccion (Spain), Vol 2, No. 13, Aug-Sep 1949, pp 531-532.

Johnson, P. L., "Hydraulic Model Studies of Plunge Basins for Jet Flow," Jun 1974, U. S. Department of Interior, Bureau of Reclamation, Engineering and Research Center, Denver, Colo.

Jones, L. B., "Snake River Bank Stabilization," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 92, No. WW1, Feb 1966, pp 1-16.

Karabatsos, G. J., "Channel Stabilization in the Gering Valley, Nebraska," May 1962; Presented at American Society of Civil Engineers Conference, Omaha, Nebr.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Kaufman, R. I., "Bank Caving Investigations, Huntington Point Revetment, Mississippi," Potamology Investigations Report No. 13-1, Jun 1952, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Keeley, J. W., Bank Protection and River Control in Oklahoma, Federal Highway Administration, Bureau of Public Roads, Oklahoma Division, Oklahoma City, Okla., 1971.

Komar, P. D. and Campbell, C. R., "Erosion of Siletz Spit, Oregon," Shore and Beach, Apr 1976, pp 9-15.

Lee, T., "Design of Filter System for Rubble-Mound Structures," Proceedings, 13th Conference on Coastal Engineering, Vancouver, B. C., Canada, Vol 3, Chapter 109, 1972, pp 1917-1933.

Lejcher, T. R., "A Method for Determining Riprap Specifications," Field Notes, Vol 5, No. 5-6, May-Jun 1973, p 1.

Lewis, G. L., Riprap Protection of Bridge Footings, Ph. D. Dissertation, Colorado State University, Fort Collins, Colo., Mar 1972.

Lima, J. O. and Morgan, W. B., Protection of Earth Embankments by Riprap of Uniform Size, Thesis, State University of Iowa, Iowa City, Iowa, Aug 1951.

Lindner, C. P., "Bank Stabilization and Contraction Problems in the South Atlantic Division," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 2, Sep 1963, pp 12-20, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Linnton Hydraulic Laboratory, Bank Protection Studies, Portland, Oreg., 1 Jun 1938.

Louisiana, State of, Department of Highways, "Spur Dike at Bridge Ends," 14 Sep 1971, Baton Rouge, La.

_____, "Standard Plans, Flexible Revetment," 12 Nov 1973, Baton Rouge, La.

Madden, E. B., "Stabilization Plan for the Arkansas River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 3, pp 21-46, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Manamperi, H. S., Tests of Graded Riprap for Protection of Erodible Material, Masters Thesis, State University of Iowa, Iowa City, Iowa, 1952.

Manning, J., "River Control Structure," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 2, Chapter II, May 1964, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Manning, J. W., "Proposed Plan for Bank Erosion Control and Bank Stabilization on the Kansas River, Mile 28.5 to Mile 20.8," Memorandum for File, 23 March 1956 (unpublished), U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Maryland, State of, Department of Transportation, State Highway Administration, Bureau of Highway Design, "Sedimentation and Erosion Control Guide," 1 Jul 1970 (rev. 13 Feb 1973), Baltimore, Md.

Mather, K. and Mather, B., "Evaluation of Stone for Protection Work," Miscellaneous Paper No. 6-480, Mar 1962, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Matthes, G. H., "Report on Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

McCool, A. A., Jr., A Study of Bank Stabilization on the Lower Mississippi River, Unpublished Thesis, Louisiana State University, Baton Rouge, La., Aug 1951, pp 89-92.

McEwan, J. S., "Bank and Level Stabilization, Lower Colorado River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 87, No. WW4, Nov 1961, pp 17-25.

McKenzie, G. K., "Recent Developments in the Field of Low Cost Slope Protection for Levees and River Banks in the Portland, Oregon, District," Proceedings, 2d International Conference on Soil Mechanics and Foundation Engineering, Rotterdam, Vol 7, 21-30 Jun 1948, pp 112-116.

Meese, R. H., "How to Protect Highways from Flood Damage with Riprap, Cribbs, Masonry, Fascines, and Bank Stabilization," Pacific Builder and Engineer, Vol 58, No. 12, Dec 1952, pp 64-65.

Melsheimer, E. S., "Spillway for Oakley Dam, Sangamon, Illinois; Hydraulic Model Investigation," Technical Report H-70-13, Nov 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Middleton, L. M., "Manual for Soil Erosion and Sediment Control," Mar 1976, U. S. Department of Transportation, Federal Highway Administration, Region 15, Sevierville, Tenn.

Mississippi River Flood Control Association, The Flood of 1927, Memphis, Tenn., 1928.

Moore, N. A., "Improvement of the Lower Mississippi River and Tributaries 1931-1972," Mississippi River Commission, Vicksburg, Miss., 1972.

Murphy, T. E., "Control of Scour at Hydraulic Structures," Miscellaneous Paper No. H-71-5, Mar 1971, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Control Structure, Little Sioux River, Iowa; Hydraulic Model Investigation," Technical Report 2-762, Feb 1967, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Property Structure for Gering Valley Project, Scottsbluff County, Nebraska; Hydraulic Model Investigation," Technical Report 2-760, Feb 1967, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Murphy, T. L. and Grace, J. L., Jr., "Riprap Requirements for Overflow Embankments," Highway Research Board Record, No. 30, 1963, pp 47-55.

_____, "Riprap Requirements for Overflow Embankments," Miscellaneous Paper 2-552, Jan 1963, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Myers, H. B., "Red River Bank Stabilization" (unpublished and undated), Mississippi River Commission, CE, Vicksburg, Miss.

National Cooperative Highway Research Board, "Field Evaluation of Tentative Design Procedure for Riprap-Lined Channels," Research Results Digest No. 67, 1975, National Academy of Sciences, Washington, D. C.

Naue-Fosertechnik, "Terrafix, Terradrän," undated, Espelkamp-Fiestel, West Germany.

Nebraska, University of, Department of Civil Engineering, River Engineering Laboratory, "Laboratory Investigation of Performance of Riprap Toe Structures with Channel Degradation," May 1968, Mead, Nebr.

Nece, R. E., "Effectiveness of Bridge Pier Riprap Practice in Washington State," Jan 1974, Washington University, Department of Civil Engineering, Seattle, Wash.

Nicholson, J. H. and Snyder, J. E., "Manual for Soil Erosion Control in the Tennessee Valley," 1939, Tennessee Valley Authority, Knoxville, Tenn.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

O'Laughlin, E. M. et al., "Scale Effects in Hydraulic Model Tests of Rock-Protected Structures," IIHR Report No. 124, Feb 1970, Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City, Iowa.

Oliver, P. A. and Freeland, S. J., "Stabilization of the Lower Colorado River," River Control Office In-house Report, Aug 1966, U. S. Department of Interior, Bureau of Reclamation, Boulder City, Nev.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Oswalt, N. R., "Riprap Protection for Subimpoundment Dams, Rend Lake Reservoir, Illinois; Hydraulic Model Investigation," Miscellaneous Paper H-68-1, Jan 1968, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Spillway for Aliceville Lock and Dam, Tombigbee River, Alabama; Hydraulic Model Investigation," Technical Report H-74-10, Oct 1974, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Oswalt, N. R. and Pickering, G. A., "Spillway for Columbus Lock and Dam, Tombigbee River, Alabama; Hydraulic Model Investigation," Technical Report H-74-13, Nov 1974, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Oswalt, N. R., George, J. F., and Pickering, G. A., "Fourmile Run Local Flood-Control Project, Alexandria and Arlington County, Virginia; Hydraulic Model Investigation," Technical Report H-73-19, Dec 1975, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Painter, W. T., "Problems of Great Lakes Shore Erosion," Water for the Human Environment, Proceedings, First World Congress on Water Resources, Technical Sessions, Chicago, Vol 3, 1973, pp 40-60.

Palmer, R. Q. and Walker, J. R., "Honolulu Reef Runway Dike," Proceedings, Twelfth Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, 1970, pp 1557-1566.

Parsons, D. A., "Effects of Flood Flow on Channel Boundaries," Transactions, American Society of Civil Engineers, Vol 126, Paper No. 3115, Part I, 1961, pp 350-361.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Petersen, M. S., "Hydraulic Aspects of Arkansas River Stabilization," Bulletin of the Permanent International Association of Navigation Congresses, Vol III, No. 13, 1964, pp 3-39.

Pickering, G. A., "Drop Structure for Walnut-Creek Project, Walnut Creek, California; Hydraulic Model Investigation," Technical Report 2-730, Jun 1966, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Spillway for Alum Creek Dam, Alum Creek, Ohio; Hydraulic Model Investigation," Technical Report H-70-4, Apr 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Spillway for Belleville Locks and Dam, Ohio River, Ohio and West Virginia; Hydraulic Model Investigation," Technical Report 2-687, Aug 1965, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Spillway for Kaysinger Bluff Dam, Osage River, Missouri; Hydraulic Model Investigation," Technical Report 2-809, Jan 1968, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Pickering, G. A. and Murphy, T. E., "Ansonia-Derby Local Protection Project, Manugatuch and Housatonic River, Connecticut; Hydraulic Model Investigation," Technical Report H-69-4, Apr 1969, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Plakida, M. E., "The Effect of Wave Slope on the Determination of Block Weight in Riprap Exposed to Wave Action," Hydrotechnical Construction (in Russian), No. 1, Jan 1969, pp 58-63.

Portland Cement Association, "Concrete Shore Protection," 1937, Chicago, Ill.

Posey, C. J., "Erosion Prevention Experiments," Proceedings, 13th Congress of International Association of Hydraulic Research, Kyoto, Japan, Vol 2, 1969, pp 211-219.

_____, "Means of Preventing Loss of Reservoir Capacity Through Sedimentation," Proceedings, 14th Congress of International Association for Hydraulic Research, Vol 5, "Hydraulic Research and Its Impact on the Environment," 1972, pp 29-30.

Posey, C. J., "Tests of Scour Protection for Bridge Piers," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 100, No. HY12, Proceedings Paper 11017, Dec 1974, pp 1773-1783.

Powell, B., "Riprap Rescue; U. S. Plans to Save River-Threatened Street at Smithland," The Courier-Journal, Louisville, Ky., 31 Mar 1973.

Ramette, M., "Protection de Talus au Moyen d'Encrochements (Rock-fill Protection of River and Canal Banks)," Bulletin du Centre de Recherches et d'Essais de Chatou, No. 3, 1963, pp 7-16.

_____, "Riprap Protection of River and Canal Banks (Protection de Talus au Moyen d'Encrochements)," Translation 63-7, Dec 1963, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Ray, K. B., "The Section and Armour of a Guide Bank for the Training and Control of the Great Alluvial Rivers," Technical Paper No. 309, 1941, The Railway Board, Calcutta.

Richards, A. L., "Placing Rock in Mississippi River Shore Protection," Professional Memoirs, No. 39, 1916, pp 392-398.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

_____, "Lower Yellowstone Riverbank Stabilization Program," Review Board Report, Aug 1974, U. S. Department of Interior, Bureau of Reclamation, Upper Missouri Region, Billings, Mont.

Roberts, J., "Proper End Treatment Boosts Culvert Effectiveness," Rural and Urban Roads, Vol 6, No. 4, Apr 1968, pp 62-64.

Roumph, R. F., Performance of Riprap Toe Structures with Channel Degradation, Masters Thesis, University of Nebraska, Department of Civil Engineering, Lincoln, Nebr., Aug 1970.

Sain, K. and Rao, K. L., "Report on the Recent River Valley Projects in China," Mar 1955, Government of India, Central Water and Power Commission, New Delhi, India.

Saville, T., Jr., "Rock Movement in Large-Scale Tests of Riprap Stability Under Wave Action," Aug 1967, U. S. Army Coastal Engineering Research Center, Washington, D. C.; Reprinted from Tenth Engineering Coastal Engineering Conference in Tokyo, Chapter 56, held Sep 1966.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and New Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Schilling, M. G., "Culvert Outlet Protection Design: Computer Program Documentation," Report No. FHWA-RD-74-501, Jan 1974, State of Wyoming, Department of Highways, Cheyenne, Wyo., Prepared for U. S. Department of Transportation, Federal Highway Administration.

Schoklitsch, A., Hydraulic Structures, Vol 2, American Society of Mechanical Engineers, New York, 1937.

Schuster, J., "Study of Height and Frequency of Waves Acting on Tailrace Slopes and Riverbanks During 1949 Flood Season, Grand Coulee Dam, Columbia Basin Project," Hydraulic Laboratory Report No. 336, 28 Nov 1952, U. S. Department of Interior, Bureau of Reclamation, Denver, Colo.

Searcy, J. K., "Use of Riprap for Bank Protection," Hydraulic Engineering Circular No. 11, 1967, U. S. Department of Transportation, Bureau of Public Roads, Washington, D. C.

Sikka, D. R., "Highlights of Flood Protection Works Done on River Narmoda at Hoshongabad in Madhya Pradesh State--India," Proceedings, International Association for Hydraulic Research, Symposium on River Mechanics, Asian Institute of Technology, Bangkok, Thailand, Vol II, "Flood Investigation," 9-12 Jan 1973, pp 329-339.

Silberberger, L. F., "Streambank Stabilization," Agricultural Engineering, Vol 40, No. 4, Apr 1959, pp 214-217.

Simons, D. B. and Lewis, G. L., "Flood Protection at Bridge Crossings," Publication No. CER 71-72 DBS-GLL 10, 1971, Colorado State University, Engineering Research Center, Fort Collins, Colo.

Simons, D. B., Stevens, M. A., and Watts, F. J., "Flood Protection at Culvert Outlets," Publication No. CER 69-70 DBS-MAS-FJWF, Colorado State University, Engineering Research Center, Fort Collins, Colo; Prepared for Wyoming State Highway Department, Planning and Research Division, Cheyenne, Wyo., in cooperation with the U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Smith, K., "Riprap Placed from Barge," Constructioneer, 10 Feb 1964, p 26.

Spindler, W. H., "Erosion Prevention, an Essential of Highway Design," The Highway Magazine, Vol 19, No. 12, Dec 1928, pp 319-321.

Spring, F. J. E., "River Training and Control on the Guide Bank Systems," Technical Paper No. 153, 1903; Reprinted 1935 for the Railway Board at the East Indian Railway Press, Calcutta.

Stanton, C. R. and McCarlie, R. A., "Streambank Stabilization in Manitoba," Journal, Soil and Water Conservation, Vol 17, No. 4, Aug 1962, pp 169-171.

Stevens, D. B., et al., "Flood Protection at Culvert Outlets," 1970, Wyoming State Highway Department, Planning and Research Division, Cheyenne, Wyo.

Stevens, M. A., Scour on Riprap at Culvert Outlets, Ph. D. Dissertation, Colorado State University, Fort Collins, Colo., Jan 1969.

Stevens, M. A., Simons, D. B., and Watts, F. J., "Riprapped Basins for Culvert Outfalls," Highway Research Record, No. 373, 1971, pp 24-38.

Striffler, W. D., "Streambank Stabilization in Michigan--A Survey," Station Paper No. 84, Aug 1960, U. S. Department of Agriculture, Forest Service, Lake States Forest Experiment Station; and Michigan Department of Conservation, East Lansing, Mich., and Lansing, Mich.

Switzerland, Service Federal des Routes et des Dignes, "Stabilisation Végétale des Cours d'Eau (Stabilization of Watercourses with Vegetation)," 1973, Office, Federal des Imprimeries et du Material, Berne, Switzerland.

Tabor, P., "Early Streambank Stabilization," Soil Conservation, Vol 26, No. 2, Sep 1960, p 46.

Tanner, W. F., "Can We Save Our Beaches?" Atlanta Journal and Constitution Magazine, 6 Dec 1964, pp 10-12 and 14.

Taube, C. M., "Stabilization of an Eroded River Bank," Journal, Soil and Water Conservation, Vol 22, No. 6, Nov-Dec 1967, pp 249-250.

Tenaud, R., "Paper," Les Defenses de Berge "Economiques" sur les Canaux et Rivières Navigables ("Economic" Protection of the Banks of Navigable Canals and Rivers), Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers, and Canals for Ocean- and Inland-Navigation (Subject 6), XXIIInd International Navigation Congress (PIANC), Paris, 1969.

Thomas, B. F. and Watt, D. A., The Improvement of Rivers: A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams, 2d ed., Part I, Wiley, New York, 1913.

Thomsen, A. L., Wohlt, P. E., and Harrison, A. S., "Riprap Stability on Earth Embankments Tested in Large- and Small-Scale Wave Tanks," Technical Memorandum No. 37, Jun 1972, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C., and U. S. Army Engineer Division, Missouri River, Omaha, Nebr.

Thornber, C. H., "Bank Stabilization, Willamette and Columbia Rivers," Symposium on Channel Stabilization Problems, Vol 3, Technical Report No. 1, Chapter 5, Jun 1965.

Thornber, C. H. and Bubenik, M. C., "Channel Stabilization of the Willamette River" (unpublished and undated).

Thorson, D. and Shirole, A. M., "Design Criteria for Controlled Scour and Energy Dissipation at Culvert Outlets Using Rock and Sill," 1969, South Dakota School of Mines and Technology, Rapid City, S. Dak.

Tiefenbrun, A. J., "Bank Stabilization of Mississippi River Between the Ohio and Missouri Rivers," Proceedings, Federal Interagency Sedimentation Conference, Agricultural Research Service, Miscellaneous Publication No. 970, Paper No. 45, 1963, pp 387-399.

Tilton, G. A., Jr., "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

_____, "New Combination Bank Protection Constructed on Eel River near Dyerville," California Highways and Public Works, Vol 21, No. 1, Jun 1943, p 48.

Tufnell, C. F., "Economical River Training in India," Institute of Civil Engineering, Vol 72, 1882-1883, pp 1 et seq.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

Uppal, H. L., "A Study of Flood Control and River Training Measures on the Beas River with the Help of Models," Proceedings, Technical Conference on Flood Control in Asia and the Far East, United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Flood Control Series No. 3, Paper No. 8, 1952, pp 109-121.

U. S. Army Beach Erosion Board, CE, "Shore Protection Planning and Design," Technical Report No. 4, 1954, U. S. Government Printing Office, Washington, D. C.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Corps of Engineers, Committee on Channel Stabilization, Technical Report 11, Mar 1974, Vicksburg, Miss.

U. S. Army Engineer District, Baltimore, CE, "Channel Protection Against High Velocity Flow," Nov 1949, Baltimore, Md.

_____, "Northeast Flood Study, Susquehanna River Basin, Flood Control and Mine Subsidence in Wyoming Valley, Pennsylvania," Draft, Environmental Impact Statement, Mar 1972, Baltimore, Md.

U. S. Army Engineer District, Buffalo, CE, "Big Creek and Metro Zoo Flood and Aesthetic Improvement, Cleveland, Ohio," Draft, Environmental Impact Statement, Jun 1972, Buffalo, N. Y.

U. S. Army Engineer District, Cincinnati, CE, "Investigation of Slope Protection--Cincinnati District," Sep 1946, Cincinnati, Ohio.

U. S. Army Engineer District, Fort Peck, CE, "Report on Measures for Bank Protection on the Yellowstone River and Tributaries," Civil Works Investigation No. 509-e, Jun 1954, Fort Peck, Mont.

U. S. Army Engineer District, Kansas City, CE, "A Base Line Study of the Missouri: Rulo, Nebraska, to Mouth near St. Louis, Missouri," Contract Report, 31 Aug 1974, Kansas City, Mo.; Prepared by University of Missouri, Rolla, Mo., et al.

_____, "Bank Erosion," unpublished and undated handout prepared for landowners, Kansas City, Mo.

_____, "Invitation for Bids (Construction Contract) No. DAC W41-76-B-0050: Channel Stabilization, Missouri River to Mouth--Rulo to Upper Miami Bends (mile 498.4 to mile 262.6)," Mar 29, 1976, Kansas City, Mo.

_____, "Report on Evaluation of Freeboard and Slope Protection," May 1964, Kansas City, Mo.

_____, "Republican River Basin-Harlan County Dam and Reservoir--Riprap Appraisal," Sep 1964, Kansas City, Mo.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

_____, "Report on Stone Work; San Gabriel River Improvement, Santa Fe Dam to Whittier Narrows Dam Contract No. 60-156," Sep 1960, Los Angeles, Calif.

U. S. Army Engineer District, Memphis, CE, "Revetment and Dike Data Sheets," 30 Jun 1964, Memphis, Tenn.

U. S. Army Engineer District, Nashville, "Bank Erosion" (handwritten draft), 8 April 1974, Nashville, Tenn.

_____, "Bank Stabilization, Livingston Point, Paducah, Kentucky," (unpublished report), 4 Jun 1965, Nashville, Tenn.

U. S. Army Engineer District, New Orleans, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, New Orleans, La.

_____, "Interim Report on Navigation and Bank Stabilization," Mar 1966, New Orleans, La.

U. S. Army Engineer District, Omaha, CE, "Fort Randall Dam--Lake Franciscos (Missouri River), St. Joseph's Indian School (S.A.) Riprap Failure Report," Apr 1965, Omaha, Nebr.

_____, "Great Falls Flood Control Project, Sun River, Montana," Final Environmental Impact Statement, 19 Aug 1971, Omaha, Nebr.

_____, "Report on Channel Protection Against High Velocity Flow," Jun 1953, Omaha, Nebr.

_____, "Special Flood Hazard Information Report: Bear Creek, Denver Metropolitan Area," Dec 1972, Omaha, Nebr.

U. S. Army Engineer District, Portland, CE, "Design Memorandum, Willamette River Basin, Oregon," 1964, Portland, Oreg.

_____, "Engineers Test Effect of High Water on Riprap," Engineering News-Record, Vol 147, No. 13, 27 Sep 1951, p 86.

_____, "Lower Columbia River Protection Project, Oregon and Washington," Final Environmental Impact Statement, Aug 1972, Portland, Oreg.

_____, "Report on Channel Protection Against High Velocity Flow," 1 Jul 1951, Portland, Oreg.

_____, "Report on Experimental Slope Protection for River Banks and Levees," 9 Dec 1946, Portland, Oreg.

_____, "Report on High Velocity Revetment Tests," Civil Works Investigation 485, 1 Jan 1952, Portland, Oreg.

U. S. Army Engineer District, Rock Island, CE, "How to Engineer a Solution to Long-Term Erosion Problems," undated, Rock Island, Ill.

U. S. Army Engineer District, Sacramento, CE, "Cobble Bank Protection Placed in 1954-1955," 28 Sep 1956, Sacramento, Calif.

U. S. Army Engineer District, Sacramento, CE, "Levee and Channel Slope Protection Criteria," Apr 1960, Sacramento, Calif.

_____, "Report on Channel Protection Against High Velocity Flows, Sacramento River, California," 1948, Sacramento, Calif.

_____, "Sacramento River Bank Protection Project, California," Final Environmental Impact Statement, Nov 1972, Sacramento, Calif.

_____, "Stockton Ship Channel Bank Protection, San Francisco Bay to Stockton, California," Final Environmental Impact Statement, Oct 1971, Sacramento, Calif.

U. S. Army Engineer District, San Francisco, CE, "Lower Klamath River Flood Control Project," Draft, Environmental Impact Statement, Jun 1971, San Francisco, Calif.

_____, "Russian River Basin (Channel Improvement and Bank Stabilization), Sonoma and Merced Counties, California," 1972, San Francisco, Calif.

U. S. Army Engineer District, Seattle, CE, "Green River, Washington, Riprap Sections for Study of Channel Protection Against High Velocity Flows," Civil Works Investigation No. 470, Jun 1950, Seattle, Wash.

_____, "Green River, Washington, Riprap Sections for Study of Channel Protection Against High Velocity Flows," Civil Works Investigation No. 270, Interim Report on Testing, Nov 1951, Seattle, Wash.

_____, "Protection Against High Velocity Flow," Civil Works Investigation SM-3, 1949, Seattle, Wash.

U. S. Army Engineer District, St. Louis, CE, "Dively Drainage and Levee District (District 23)," Final Environmental Impact Statement, 1972, St. Louis, Mo.

U. S. Army Engineer District, Tulsa, CE, "Canton Dam: Analysis of Design for Repairs to Riprap," 14 Jun 1957, Tulsa, Okla.

_____, "Specifications and Drawings for Repair of Embankment Protection Stone, Arkansas River Watershed, Canton Dam, North Canadian River, Oklahoma," Dec 1961, Tulsa, Okla.

_____, "Specifications and Drawings for Repairs and Protection of Embankment Stone, Arkansas River Watershed, Hulak Dam, Caney River, Oklahoma," Feb 1961, Tulsa, Okla.

U. S. Army Engineer District, Vicksburg, CE, "Bank Protection and Dike Data Sheets," 30 Jun 1949, Vicksburg, Miss.

U. S. Army Engineer District, Vicksburg, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, Vicksburg, Miss.

U. S. Army Engineer Division, New England, CE, "Channel Protection Against High Velocity Flows," Civil Works Investigation No. 452-G," 1950, Waltham, Mass.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Army Engineer Division, North Pacific, CE, "High Velocity Channel, South Fork Coeur D'Alene River at Wallace, Idaho," Report No. TR-139-1, Nov 1969, Bonneville, Oreg.

U. S. Army Engineer Division, Pacific Ocean, CE, "Flood Control Project, Namo River, Territory of Guam," Nov 1972, Draft, Environmental Impact Statement, Honolulu, Hawaii.

U. S. Army Engineer Division, South Pacific, CE, "Bank Protection on Mississippi and Missouri Rivers," 1 Jun 1935, San Francisco, Calif.

U. S. Army Engineer Waterways Experiment Station, CE, "Feasibility of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.

_____, "Old River Low-Sill Control Structure, Studies of Riprap Placement Plans; Hydraulic Model Investigation," Technical Report No. 2-447, Jul 1957, Vicksburg, Miss.

U. S. Department of Agriculture, Forest Service, "Forest Service Standard Specifications for Construction of Roads and Bridges," 1972, U. S. Government Printing Office, Washington, D. C.

_____, "Uniform Specifications for Timber Purchaser Road Construction," Jul 1974, U. S. Government Printing Office, Washington, D. C.

_____, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Forest Service, California Region, "A Guide to Erosion Reduction on National Forest Timber Sale Areas," 1954, San Francisco, Calif.

U. S. Department of Agriculture, Forest Service, Region Five, "Sims Bridge (31N210000) Shasta-Trinity National Forest, Riprap, Camber, General Notes," 1976, San Francisco, Calif.

U. S. Department of Agriculture, Soil Conservation Service, "Winters Creek Watershed, Nebraska," Final Environmental Impact Statement, Mar 1972, Washington, D. C.

U. S. Department of Interior, Bureau of Reclamation, "Bank Protection, Dike and Channel Improvement, Red Bluff Diversion Dam," Specifications No. DC-6075, 1964, Denver, Colo.

_____, "Milburn Diversion Dam Dike Protection," Specifications No. DC-6670, 1968, Denver, Colo.

_____, "Report on Channel Stabilization of Azotea and Willow Creeks," Sep 1966, Denver, Colo.

_____, "Riprap Testing Research--Comparison of an Ultrasonic Cavitation Test with Petrographic and Physical Tests to Evaluate Rock Durability," Chemical Engineering Branch Report No. ChE-23, 8 Jan 1965, Denver, Colo.

U. S. Department of Interior, Bureau of Reclamation, Lower Colorado Region, "Report of Task Force, Review of River Management Program, Colorado River Front Work and Levee System," Jul 1971, Boulder City, Nev.

U. S. Department of Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Projects, McCook, Nebr.

U. S. Department of Interior, Federal Water Quality Administration, "Urban Soil Erosion and Sediment Control," Water Pollution Control Research Series 1503DTLO5/70, May 1970, U. S. Government Printing Office, Washington, D. C.; Prepared by National Association of Counties Research Foundation, Washington, D. C.

U. S. Department of Interior, National Park Service, "Natchez Trace Parkway, Plans for Proposed Project 3C4, Grading, Base, Surfacing, and Structures, U. S. 45 to Mississippi Highway 363, Lee County, Mississippi," May 1976, Tupelo, Miss.; Plans prepared by U. S. Department of Transportation, Federal Highway Administration, Region 15, Arlington, Va.

U. S. Department of Interior, National Park Service, and U. S. Department of Transportation, Federal Highway Administration, Region 15, "Project 3C4, Natchez Trace Parkway, Proposal and Contract," 13 May 1976, Tupelo, Miss., and Sevierville, Tenn., U. S. Government Printing Office, Washington, D. C.

U. S. Department of Transportation, Federal Highway Administration, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," Publication FP-74, 1974, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, "Use of Riprap for Bank Protection," Hydraulic Engineering Circular 11, Jun 1967, Washington, D. C.

U. S. Environmental Protection Agency, "Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activities," EPA 430/9-73-007, Oct 1973, U. S. Government Printing Office, Washington, D. C.; Prepared by Hittman Associates, Inc., Columbia, Md.

U. S. Environmental Protection Agency, Office of Water Programs, "Control of Erosion and Sediment Deposition from Construction of Highways and Land Development," Sep 1971, U. S. Government Printing Office, Washington, D. C.

U. S. Filter Corporation, Menardi-Southern Division, "Protect Supporting Soils, Specify Monofilter," undated, Houston, Tex.

Van Ornum, J. L., The Regulation of Rivers, McGraw-Hill, New York, 1914.

Volkhart, P., Tschoop, J., and Bisaz, E., "The Effect of Sills on River Beds," Proceedings, International Association for Hydraulic Research Symposium on River Mechanics, Asian Institute of Technology, Bangkok, Thailand, Vol I, "Sediment Transportation," 1973, pp 167-178.

Wall, W. J., "Planning, Construction, and Maintenance of the Stabilization Works on the Savannah River," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter VIII, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Weller, H. E., "Bank Erosion Problems on the Brahmaputra River," Sep 1966, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Bank Protection of Varanasi Ghats and Other Locations on Ganges River," Aug 1969, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Brahmaputra River Bank Protection in India," Irrigation and Power, Vol 27, No. 2, Apr 1970, pp 177-189.

West, T. R. and Salzman, U., "Rock Quality Determination for Large-Sized Stone Used in Engineering Construction," Research Project, 1975, Purdue University, School of Science, Lafayette, Ind.

White, J. H. et al., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 75, No. 3, Part I, Mar 1949, pp 406-410.

Winkley, B. R., "Practical Aspects of River Regulation and Control," River Mechanics I, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Yakovlev, N. N., "Some Aspects of Design and Construction of Earth and Rockfill Dams in India," Water Resources, Sep 1968, pp 1-16.

Tetrapods

Anonymous, "Protection Against Erosion by the Sea," Concrete and Constructional Engineering (London), Apr 1956, pp 355-356.

_____, "Tetrapods Used in Marine Construction," World Dredging and Marine Construction, Vol 3, No. 2, Jul-Aug 1967, pp 30-31.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Danel, P. and Greslou, L., "The Tetrapod," Proceedings, Eighth Conference on Coastal Engineering, Mexico City Council on Wave Research, The Engineering Foundation, Part 3, Chapter 27, 1963, pp 469-481.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Font, J. B., "Damage Functions for a Rubble Mound Breakwater Under the Effect of Swells," Proceedings, 12th Coastal Engineering Conference, Washington, Vol 3, Chapter 96, 1970, pp 561-585.

Portland Cement Association, "Concrete Structures for Flood Control, Soil and Water Conservation," 1937, Chicago, Ill.

Shuto, N., "Hydraulic Resistance of Artificial Concrete Blocks," Proceedings, 12th Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 97, 1970, pp 1587-1599.

Trench-fill revetment

Carey, W. C., "Construction Problems in Comprehensive River Stabilization," undated, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Haas, R. H. and Graham, J., "Paper," Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6), XXIIInd International Navigation Congress, (PIANC), Paris, 1969.

Hakundy, R. W., "System and Method for Preventing Erosion," Official Gazette, Vol 893, No. 1, 7 Dec 1971, p 53.

Houck, L. H., "Channel Stabilization Cleans Muddy Missouri," Excavating Engineer, Vol 53, No. 4, Apr 1959, pp 35-37 and 40-41.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Kryuchkov, N. I. and Mlynskiy, V. V., "A Method of Protecting Banks of The Amu-Darya River" (in Russian), Gridro tekhnika i Melioratsiya, No. 1, Jan 1971, pp 44-47.

Lipscomb, E. B. and Otto, W. C., "Paper," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Madden, E. B., "Stabilization Plan for the Arkansas River, Symposium on Channel Stabilization Problems," Technical Report No. 1, Vol 1, Chapter 3, Sep 1963, pp 21-46. Committee on Channel Stabilization, CE, U. S. Army, Vicksburg, Miss.

Manning, J. W., "Proposal Plan for Bank Erosion Control and Bank Stabilization on the Kansas River, Mile 28.5 to Mile 20.8," Memorandum for File, 23 March 1956, (unpublished), U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Sibert, K. V., "Kansas River Bank Stabilization Plan of Improvement Leecompton-Lawrence, Kansas," Memorandum for Files (unpublished), Nov 22, 1954, U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

U. S. Army Engineer District, Kansas City, CE, "Channel Stabilization Structure," File No. SP-P-0474, Sheets 1-10, Apr 1974, Kansas City, Mo.

_____, "Invitation for Bids (Construction Contrast) No. DACW41-76-B-0050: Channel Stabilization Missouri River to Mouth--Rulo to Upper Miami Bends (mile 498.4 to mile 262.6)," March 29, 1976, Kansas City, Mo.

U. S. Army Engineer District, Mobile, CE, "Channel Stabilization Studies on the Apalachicola River," 1965, Mobile, Ala.

U. S. Army Engineer District, New Orleans, CE, "Design Data, Morameal Test Revetments, New Orleans, La.," undated.

U. S. Army Engineer District, Omaha, CE, "Missouri River Garrison Dam to Lake Oahe Reservoir," Final Environmental Impact Statement, Nov 1973, Omaha, Nebr.

Mattresses, Matting, and Pavement Revetment

Articulated concrete mattresses

American Society of Civil Engineers, "Channel Stabilization of Alluvial River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, Feb 1965, pp 7-37.

Anonymous, "Acres of Concrete Mat," Construction Methods, Mar 1949, pp 42-45.

_____, "Arkansas River Being Confined at Chronic Trouble Tract," Construction News, Vol 27, No. 42, 19 Oct 1960, p 58.

_____, "Articulated Block Revetment Replaces Upper Bank Slabs," Engineering News-Record, Vol 114, No. 22, 30 May 1935, pp 773-774.

_____, "Bank Stabilization," Modern Concrete, Vol 21, No. 10, Feb 1958, p 38.

_____, "Concrete Mattress for Old Man River," Construction News Monthly, Vol 22, No. 8, 10 Aug 1955, p 16.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Flexible Concrete Mattresses for River Bank Protection," Engineering (London), Vol 169, No. 4289, 9 Apr 1948, pp 337-339 and 348.

_____, "Giant Mat Puller Effective in Checking River's Erosion," Construction World, Vol 16, No. 8, Jun 1961, p 19.

_____, "Heavy Erosion Mats Dragged to New Position," World Construction, Vol 14, No. 6, Jun 1961, p 31.

_____, "Huge Mats Tame Unruly River," Construction Methods and Equipment, Vol 44, No. 4, Apr 1962, p 167.

_____, "Nobody Sleeps on This Mattress," New Orleans Port Record, Vol 24, No. 4, Jan 1966, pp 6-7.

_____, "Ole Miss Dons Her Armor," Excavating Engineer, Vol 46, No. 10, Oct 1952, pp 12-20.

_____, "Paving Mississippi Banks with Concrete," Civil Engineering (New York), Vol 5, No. 8, Aug 1935, p 511.

_____, "Protecting Riverbank Against Erosion," Waterways Journal, Vol 74, No. 45, 4 Feb 1961, p 114.

Anonymous, "Revetment and Bank Protection on the Mississippi River," Public Works, Vol 60, No. 2, Feb 1929, pp 49-54.

_____, "Revetting a River Bank at High Water," Engineering News-Record, Vol 133, No. 12, Sep 21, 1944, pp 92-95.

_____, "River Banks Stabilized by Revetments and Dikes," Civil Engineering (London), Vol 20, No. 2, Feb 1950, pp 44-45.

_____, "Slab Revetment Equipment," Engineering News-Record, Vol 108, No. 15, 14 Apr 1932, p 554.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

Baker, R. C., "Casting Articulated Concrete Mattress," Mar 1960, Presented at National Meeting, American Society of Civil Engineers, New Orleans, La.

Blanquet, P. A., "Memoire sur les Protections des Berges en Amerique et en Hollande" ("Memorandum on Bank Protection in America and in Holland"), Translation No. 63-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch for the Mississippi River Commission, CE, Vicksburg, Miss.

Brownlee, H. L., Jr., "Completion Report--Experimental Articulated Concrete Revetment on Red River," Unpublished Memorandum, 8 Aug 1961, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Carey, W. C., "Comprehensive River Stabilization," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 92, No. WW1, Feb 1966, pp 59-86.

_____, "Construction Problems in Comprehensive River Stabilization," undated, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

_____, "The Mechanisms by Which Alluvial Streams Turn or Change Direction," 20 Jun 1962, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

Causey, W. R., "Bank Stabilization, Red River Below Denison Dam," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter IV, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Davis, E. I. and Lipscomb, E. B., "Stabilizing the Lower Mississippi River," Civil Engineering (New York), Vol 35, No. 116, Nov 1965, pp 64-69.

Davis, G. B., "Inspection of Revetments (Upper Bank Paving) Between Vicksburg and Memphis on 17 and 18 Apr 1946," Unpublished Memorandum, 22 Apr 1940, Mississippi River Commission, CE, Vicksburg, Miss.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Elliot, D. O., Improvement of the Lower Mississippi River for Flood Control and Navigation, Vol II, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss., May 1932.

Fairley, J. G., et al., "Use of Plastic Filter Cloth in Revetment Construction, Potamology Research Project II," Potamology Investigations Report 21-4, Jun 1970, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Sponsored by the Mississippi River Commission, CE, and Conducted by U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Feagin, L. B., "Program of the Mississippi River Commission," Symposium on Channel Stabilization Problems, Report No. 1, Vol. 4, Chapter V, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Franco, J. J., "Effects of River Stages on Bank Stabilization--Analyses of Field Data Potamology Research Project 1," Potamology Investigations Report 20-1, Dec 1965, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Gilland, M. W., "Articulated-Concrete Revetment Construction on the Mississippi River," Engineering News-Record, Vol 105, 25 Dec 1930, pp 996-1003.

_____, "Making and Placing Concrete Revetment Mat," Journal of the American Concrete Institute, Vol 1, No. 8, Jun 1930, pp 799-830.

Goodrum, J., "Stabilizing the Mississippi Banks with Articulated Concrete Mattresses," World Construction, Vol 8, No. 3, Mar-Jun 1955, p 40.

Haas, R. H., "Development of Concrete Revetments on the Lower Mississippi," Concrete, April and May 1947, pp 1-10 (reprint).

Haas, R. H., "Stabilization of Lower Mississippi River" (unpublished and undated), Mississippi River Commission, CE, Vicksburg, Miss.

Haas, R. H. and Graham, "Paper," Inland Navigation (Sect. 1). Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6). XXIIInd International Navigation Congress (PIANC), Paris, 1969.

Haas, R. H. and Weller, H. E., "Bank Stabilization by Revetments and Dikes," Proceedings, American Society of Civil Engineers, Vol 78, Separate No. 148, Sep 1952.

Haydon, G. C., "The Missouri River and Its Improvements," 1931, U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Headquarters, Department of the Army, Office of the Chief of Engineers, Bank Protection, Mississippi River; Plant Methods and Materials in Use on Works Under Direction of Mississippi River Commission, Washington, D. C., 1922.

Henley, J. E., "Channel Stabilization Work in the Vicksburg District," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 4, Chapter I, Feb 1966, pp I-1 - I-26, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Huber, R. L., "Contraction Works and Bank Stabilization," Bank Stabilization Manual, Draft, 1948, Committee on Regulation and Stabilization of River by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Kaufman, R. I., "Bank Caving Investigations, Huntington Point Revetment, Mississippi," Potamology Investigations Report No. 13-1, Jun 1952, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Kearney, F. and Prendergast, J., "Study of Articulated Concrete Revetment Mattress: Test and Analysis--Results of FY 1974 Program," TR-M-94, Jan 1976, U. S. Army Construction Engineering Research Laboratory, CE, Champaign, Ill.

Knappen, T. T. and Brown, V. J., "Concrete Revetment on the Mississippi River," Engineering and Contracting, Vol 69, No. 2, Feb 1930, pp 57-62.

Larkin, T. B., "Controlling Floods Along the Mississippi," Civil Engineering (New York), Vol 13, No. 10, Oct 1933, pp 560-564.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, pp VIII-1 - VIII-37, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Lipscomb, E. B. and Otto, W. C., "Paper," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Louckes, F. I., "Revetments, Economics, and Conditions Affecting," Mar 1936, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Markham, E. M., "Results of Experiments Looking to the Development of a Form of Subaqueous Concrete Revetment for the Protection of River Banks Against Scour or Erosion," Professional Memoirs, No. 42, 1916, No. 42, pp 721-733.

Matthes, G. H., "Report in Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

McCool, A. A., Jr., A Study of Bank Stabilization on the Lower Mississippi River, Unpublished Thesis, Louisiana State University, Baton Rouge, La., pp 89-92, Aug 1951.

Mississippi River Flood Control Association, The Flood of 1927, Memphis, Tenn., 1928.

Moore, N. R., Improvement of the Lower Mississippi River and Tributaries 1931-1972, Mississippi River Commission, CE, Vicksburg, Miss., 1972.

Ockerson, J. A., "Flood Control of the Mississippi River," Flood Problems; a Symposium, Transactions, American Society of Civil Engineers, Vol 85, Paper No. 1505, 1922.

Okazaki, B., "Behavior of Flexible Reinforced-Concrete Mattresses as Bank Protection in Deep Rivers," Engineering News-Record, Vol 97, No. 7, 12 Aug 1926, pp 248-250.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Pickels, G. W., "Flood Protection by Channel Improvement," Drainage and Flood Control, Chapter 11, McGraw-Hill, New York, 1941, pp 321-354.

Pickett, A. B., "Corps of Engineers Introduces New Type of Revetment on Lower Mississippi," Vol 53, No. 12, Dec 1945, p 14.

_____, "New Method of Revetting Old Man River," Engineering News-Record, Vol 135, 20 Sep 1945, pp 390-394.

Pittman, H. V., De La Sayette, E. R., and Lelivasky, S., "Discussion of Bank Stabilization by Revetments and Dikes," Discussion of Proceedings--Separates, American Society of Civil Engineers, Vol 79, Separate No. 368, No. 148, Dec 1953, pp 368-1 - 368-10.

Portland Cement Association, "Concrete Structures for Flood Control, Soil and Water Conservation," 1937, Chicago, Ill.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965.

Senour, C., "Stabilization of Banks of Streams of the Lower Alluvial Valley of the Mississippi River," Proceedings, Federal Interagency Sedimentation Conference, Denver, Colo., 6-8 May 1947, pp 185-199.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Somervell, B., "Slab-Revetment Equipment, Mississippi River," Engineering News-Record, Vol 108, 14 Apr 1932, pp 554-557.

Steen, J. B., "Faster Lower Cost Bank Stabilization," Diesel Power, May 1955, pp 35-37.

Stewart, J. L., "Protection of Roads and Bridges Against Stream Erosion," Roads and Streets, Vol 70, No. 5, May 1930, pp 171-172.

Straub, L. G. and Olson, R. M., "Mississippi River Revetment Studies," Project Report No. 21, Jun 1951, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

Straub, L. G. and Olson, R. M., "Mississippi River Revetment Studies; Tests on a Double Layer of Articulated Mattress," Project Report No. 28, Supplement 1 to Project Report 21, May 1952, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

Turnbull, W. J., Krinitzsky, E. L., and Weaver, F. J., "Bank Erosion in Soils of the Lower Mississippi Valley," Journal, Soil Mechanics and Foundations Division, American Society of Civil Engineers, Vol 92, No. SM1, Paper 4632, Jan 1966, pp 121-136.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Engineer District, Memphis, CE, "Revetment and Dike Data Sheets," 30 Jun 1964, Memphis, Tenn.

U. S. Army Engineer District, New Orleans, CE, "Channel Improvement Data Report," 1965, New Orleans, La.

_____, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, New Orleans, La.

_____, "Investigation to Determine the Extent of Coverage of Subaqueous Slope in Revetment Placement," Oct 1947, New Orleans, La.

U. S. Army Engineer District, St. Louis, CE, "Improvement of Middle Mississippi River," May 1939, St. Louis, Mo.

U. S. Army Engineer District, Vicksburg, CE, "Bank Protection and Dike Data Sheets," 30 Jun 1949, Vicksburg, Miss.

_____, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, Vicksburg, Miss.

U. S. Army Engineer Division, South Pacific, CE, "Bank Protection on Mississippi and Missouri Rivers," Jun 1935, San Francisco, Calif.

U. S. Army Engineer School, "Open River Regulation; Training Structures," E.202-4(2-59) MD, 1959, Fort Belvoir, Va.

U. S. Army Engineer Waterways Experiment Station, CE, "Feasibility of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.

_____, "Flume Investigation of Prototype Revetment," Miscellaneous Paper No. 2-35, Sep 1952, Vicksburg, Miss.

U. S. Army Engineer Waterways Experiment Station, CE, "Preliminary Flume Tests of Mississippi River Revetment," Potamology Investigations Report No. 2-4, Second Interim Report, Nov 1951, Vicksburg, Miss.

Van Ornum, J. L., The Regulation of Rivers, McGraw-Hill, New York, 1914.

Van Reenan, E. D., "Acoustic Study of Mississippi River Revetments," Report No. B-2370, 21 May 1962, Edgerton, Germeshausen, and Grier, Boston; Prepared under contract for U. S. Army Engineer District, New Orleans, CE.

Vinzant, G. W., "Revetments in the Vicksburg District," The Military Engineer, Vol 22, No. 125, Sep-Oct 1930, pp 448-453.

Vogel, H. D., "Protection of Beds and Banks of Inland Waterways, Deep Water Channels and Drainage Canals," 1 Nov 1940; Prepared for the VII International Navigation Congress, American Section, Permanent International Association of Navigation Congresses, Berlin, Germany.

Waddill, G. D., "History of Kempe Bend Revetment," Unpublished Memorandum, 26 Mar 1947, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Report and Maps on Asphalt Subaqueous Revetment," 12 Oct 1943, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Types of Mattresses Used for Bank Protection in the New Orleans District and Their Effectiveness," Unpublished Memorandum, 19 Jun 1947, Mississippi River Commission, CE, Vicksburg, Miss.

Weller, H. E., "Bank Protection of Varanasi Ghats and Other Locations on Ganges River," Aug 1969, Mississippi River Commission, CE, Vicksburg, Miss.

White, J. H. et al., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundation Division," Proceedings, Society of Civil Engineers, Vol 75, No. 3, Part I, Mar 1949, pp 406-410.

Winkley, B. R., "Practical Aspects of River Regulation and Control," River Mechanics I, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Woods, C., "Concrete Revetments Are Powerful Weapons in War Against the Mississippi," Compressed Air Magazine, Vol 64, No. 7, Jul 1959, p 20.

Asphalt pavement

American Society of Civil Engineers, "Channel Stabilization of Alluvial Rivers," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, Feb 1965, pp 7-37.

_____, "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 74, No. 6, Jun 1948, pp 845-866.

Anonymous, "Asphalt Paving Extended on Willamette River Levees," Western Construction News, Vol 12, No. 9, Sep 1937, pp 364-366.

_____, "Asphalt Used to Protect Revetments in Experiment to Control Bank Erosion," Western Construction News, Vol 12, No. 2, Feb 1937, pp 52-54.

_____, "Use of Asphalt Revetments Extended After Flood Test," Western Construction News, Vol 13, No. 12, Dec 1938, pp 430-431.

Asphalt Institute, "The Asphalt for Conservation and Control of Water," Information Series No. 131, Sep 1964, College Park, Md.

Barsdale, R. W., "Bank Protection on Central Valley Streams," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 86, No. WW4, Nov 1960, pp 1-16.

Bessen, F. S., Jr., "Asphalt Revetments Tested by Floods of Two Seasons," Western Construction News, Vol 14, No. 4, Apr 1939, pp 128-130.

Bessen, F. S., Jr., and Conner, J. S., Jr., "A Report on Experimental Use of Asphalt in Bank Revetment," 1939, U. S. Army Engineer District, Portland, CE, Portland, Oreg.

Blanquet, P. A., "Memoire sur les Protection des Berges en Amerique et en Hollande" ("Memorandum on Bank Protection in America and In Holland"), Translation No. 53-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch for the Mississippi River Commission, CE, Vicksburg, Miss.

Bumm, H. et al., "Nouveaux materiaux et Realisations Nouvelles pour la Defense des Rives et la Protection du Fond des Canaux, des Rivieres et des Ports, Prix de Revient et Avantages Respectifs" ("New Materials and New Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports, Their Cost and Respective Advantages"), (Translation No. 73-4, Mar 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by J. C. Van Tienhoven.

Buzzell, D. A., "Current Slope Protection Practice," Jan 1946, Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Washington, D. C.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Christison, W. E., "Asphaltic Paving Used on Flood Control Revetments," Western Construction News, Vol 12, No. 6, Jun 1937, pp 224-225.

_____, "Use of Asphalt Revetments Extended After Flood Test," Western Construction News, Vol 13, No. 12, Dec 1938, pp 430-431.

Cybanski, J. N., "Cationic Waterborne Soil Sealant," Symposium for New Uses of Asphalt, American Chemical Society, 156th Annual Meeting, Atlantic City, N. J., 1968.

Dobbie, C. H. and Kennerell, E. J. R., "Use of Bitumen in Hydraulic Works," Journal of the Institution of Civil Engineering, Paper No. 5736, 1949-1950.

Edge, D. E., "Asphalt in Erosion Control and Hydraulics (unpublished and undated), The Asphalt Institute, College Park, Md.

Ellsperman, L. M. and Hickey, M. E., "The Uses of Asphalt in Hydraulic Construction by the Bureau of Reclamation, 1946-1959," 5-6 Nov 1959; Presented at Third Annual Kansas Asphalt Paving Conference, University of Kansas, Lawrence, Kans.

Feagin, L. B., "Program of the Mississippi River Commission," Symposium on Channel Stabilization Problems, Report No. 1, Chapter V, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Geier, F. H. and Morrison, W. R., "Buried Asphalt Membrane Canal Lining," Research Report No. 12, 1968, Bureau of Reclamation, Denver, Colo.

Haas, R. H., "Stabilization Problems, Lower Mississippi River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 1, Sep 1963, pp 1-11, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Haas, R. H. and Graham, J., "Paper," Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6) XXIIInd International Navigation Congress (PIANC), Paris, 1969.

Haas, R. H. and Weller, H. E., "Bank Stabilization by Revetments and Dikes," Proceedings, American Society of Civil Engineers, Vol 78, Separate No. 48, Sep 1952.

Henley, J. E., "Channel Stabilization Work in the Vicksburg District," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 4, Chapter I, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Hertzberg, R., "Wave-Wash Control on Mississippi River Levees," American Society of Civil Engineers Transactions, Vol 119, 1954, pp 628-638.

Hettema, T., Kerhoven, R. E., and Roelofs, F., "Paper," Inland Navigation (Sect. 1), New Methods and Materials for Protecting the Banks and Bottoms of Canals, Rivers, and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Joseph, A. H., "Life Expectancy of Sand Asphalt Mixes for Upper-Bank Revetments," Miscellaneous Paper No. 4-385, Mar 1960, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Kaufman, R. J., "Bank Caving Investigations, Huntington Point Revetment, Mississippi," Potamology Investigations Report No. 13-1, Jun 1952, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Lipscomb, E. B. and Otto, W. C., "Paper," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Matthes, G. H., "Report on Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

McCool, A. A., Jr., A Study of Bank Stabilization on the Lower Mississippi River, Unpublished Thesis, Louisiana State University, Baton Rouge, La., pp 89-92, Aug 1951.

McCrone, R. M. and Weggel, H., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Design," Proceedings, American Society of Civil Engineers, Vol 74, No. 10, Dec 1948, pp 1653-1655.

McKenzie, G. K., "Recent Developments in the Field of Low Cost Slope Protection for Levees and River Banks in the Portland, Oregon, District," Proceedings, 2d International Conference on Soil Mechanics and Foundation Engineering, Rotterdam, Vol 7, 21-30 Jun 1948, pp 112-116.

Meredith, E. C., "Investigation of Bituminous Cold Mixes for the Protection of Upper River Banks," Technical Memorandum No. 3-362, Apr 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Moore, N. A., Improvement of the Lower Mississippi River and Tributaries 1931-1972, Mississippi River Commission, CE, Vicksburg, Miss., 1972.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Pickett, A. B., "Uncompacted Mass Asphalt Paving for River Banks and Levees," Civil Engineering (New York), Vol 16, No. 10, Oct 1946, pp 451-453.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Cost and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

Tenaud, R., "Paper," Les Defense de Berge "Economiques" sur les Canaux et Rivières Navigables ("Economic" Protection of the Banks of Navigable Canals and Rivers), Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean and Inland Navigation (Subject 6), XXIInd International Navigation Congress (PIANC), Paris, 1969.

Thornber, C. H. and Bubenik, M. B., "Channel Stabilization of the Willamette River" (unpublished and undated), Mississippi River Commission, CE, Vicksburg, Miss.

Tomkins, W. F., "Asphalt Mattress for Protecting River Banks," Construction Methods and Equipment, Vol 20, No. 4, Apr 1938, p 58.

_____, "Water Control and Erosion Prevention Using Asphalt," Jun 1939, The Asphalt Institute, Washington, D. C.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

U. S. Army Engineer District, New Orleans, "Channel Improvement Data Report, FY 1973," New Orleans, La.

U. S. Army Engineer District, Portland, CE, "A Report on Experimental Use of Asphalt in Bank Revetment on the Upper Willamette River," 1930, Portland, Oreg.

_____, "Report on Experimental Slope Protection for River Banks and Levees," 9 Dec 1946, Portland, Oreg.

U. S. Army Engineer District, Vicksburg, CE, "Bank Protection and Dike Data Sheets," 30 Jun 1949, Vicksburg, Miss.

U. S. Army Engineer Division, South Pacific, "Bank Protection on Mississippi and Missouri Rivers," 1 Jun 1935, San Francisco, Calif.

U. S. Army Engineer School, "Open River Regulation; Training Structures," E.202-4(2-59) ML, 1959, Fort Belvoir, Va.

U. S. Army Engineer Waterways Experiment Station, CE, "Bank Caving Investigations, Marville Revetment, Mississippi River," Technical Memorandum No. 3-318, Sep 1950, Vicksburg, Miss.

_____, "Feasibility of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.

_____, "Interim Report on Investigation of Sand-Asphalt Revetment," 1 Jul 1949, Vicksburg, Miss.

_____, "Preliminary Flume Tests of Mississippi River Revetment," Potamology Investigations Report No. 2-4, Second Interim Report, Nov 1951, Vicksburg, Miss.

U. S. Department of Transportation, Federal Highway Administration, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," Publication FP-74, 1974, U. S. Government Printing Office, Washington, D. C.

Van Asbeck, W. R., "Modern Design and Construction of Dams and Dikes Built with the Use of Asphalt," Aug 1968, Presented to the VIIth Conference on Coastal Engineering, The Hague, Netherlands.

_____, "River Banks and Dikes," Bitumen in Hydraulic Engineering, Shell International Petroleum, London, Vol 1, 1959, pp 74-98.

_____, "River Banks and Dikes," Bitumen in Hydraulic Engineering, Elsevier, London, Vol 2, 1964, pp 45-66.

Van Reenan, E. D., "Acoustic Study of Mississippi River Revetments," Report No. B-2370, 21 May 1962, Edgerton, Germeshausen, and Grier, Boston; Prepared under contract for U. S. Army Engineer District, New Orleans, CE.

Visser, W. and Claessen, A. I. M., "Asphalt Rules the Dutch Waves," Customer Publication 171/75, 1975, Shell International Petroleum Co., Ltd., Amsterdam.

Waddill, G. D., "Effectiveness of Asphalt Bank Protection," Unpublished Memorandum, 26 Jun 1947, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Effectiveness of Asphalt Bank Protection," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter VI, pp VI-1 - VI-5, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Bituminous mattresses

Agostini, R. and Papetti, A., "Rivestimenti Flessibili nei Canali e nei Corsi d'Acqua Canalizzati; Tabelle per il Dimensionamento dei Canali a Sezione Trapezia (Flexible Revetments for Canals and Canalized Watercourses; Tables for Dimensions of Channels and Their Cross Sections)," 1976, Officine Maccaferri S.p.A., Bologna, Italy.

Agostini, R. et al., "Maccaferri Gabions," 1971, Officine Maccaferri S.p.A., Bologna, Italy.

Anonymous, "Asphalt Mat Revetment," Engineering News-Record, Vol 112, 28 June 1934, pp 825-830.

_____, "Asphalt Mattress," Construction Methods, Vol 22, No. 4, Apr 1940, p 45.

_____, "Asphalt Mattress for Canal Bank Protection," Shell Bitumen Review, Vol 1, No. 1, Spring 1957, pp 7-9.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "New Plans for the Mississippi," Engineering News-Record, Vol 111, No. 6, 10 Aug 1933, pp 166-169.

_____, "Test River Bank Protection with Asphalt Mattress," Construction Methods, Vol 15, No. 9, Sep 1933, p 15.

Asphalt Institute, The, "Asphalt Mat Revetment on the Mississippi," Engineering News-Record, 28 Jun 1934.

Blanquet, P. A., "Memoire sur les Protections des Berges en Amerique et en Hollande" ("Memorandum on Bank Protection in America and in Holland"), Translation No. 53-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch, for the Mississippi River Commission, CE, Vicksburg, Miss.

Carey, W. C., "Asphalt Mixtures for Resisting the Attacks of Water in Motion," 8 Feb 1955, U. S. Army Engineer District, CE, New Orleans, La.

_____, "Comprehensive River Stabilization," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 92, No. WW1, Feb 1966, pp 59-86.

_____, "Construction Problems in Comprehensive River Stabilization," undated, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

_____, "The Development of the Asphalt Mattress," The Military Engineer, Vol 27, No. 156, Nov-Dec 1935, pp 430-436.

_____, "The Development of the Asphalt Mattress for River Bank Protection," Information Serial No. 25, 1 Jan 1936, The Asphalt Institute, Washington, D. C.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Davis, E. I. and Lipscomb, E. B., "Stabilizing the Lower Mississippi River," Civil Engineering, Vol 35, No. 11, Nov 1965, pp 61-69.

Huber, R. L., "Contract on Works and Bank Stabilization," Bank Stabilization Manual, Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss., Draft, 1948.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Oct 1969, Chapter VIII, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Maccaferri Gabions, Inc., "Gabion Weirs," 1970, Montreal, Toronto, and Vancouver, Canada.

_____, "Notes on Mastic Grouted Gabions and Revet Mattress," undated, Flushing, N. Y.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXIst International Navigation Congress (PIANC), Stockholm, 1965.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Engineer Division, South Pacific, CE, "Bank Protection on Mississippi and Missouri Rivers," 1 Jun 1935, San Francisco, Calif.

Van Asbeck, W. F., "River Banks and Dikes," Bitumen in Hydraulic Engineering, Vol 2, Elsevier, London, 1964, pp 45-66.

Visser, W. and Claessen, A. I. M., "Asphalt Rules the Dutch Waves," Customer Publication 171/75, 1975, Shell International Petroleum Co., Ltd., Amsterdam.

Vogel, H. D., "Paper," Protection of Beds and Banks of Inland Waterways, Deep Water Channels and Drainage Canals; Prepared for VII International Navigation Congress, American Section, Permanent International Association of Navigational Congress, 1 Nov 1940.

Waddill, G. C., "Effectiveness of Asphalt Bank Protection," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter VI, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

_____, "Effectiveness of Asphalt Bank Protection," Unpublished Memorandum, 26 Jun 1947, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Report and Maps on Asphalt Subaqueous Revetment, 12 Oct 1943, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Types of Mattresses Used for Bank Protection in the New Orleans District and Their Effectiveness," Unpublished Memorandum, 19 Jun 1947, Mississippi River Commission, CE, Vicksburg, Miss.

Winkley, B. R., "Practical Aspects of River Regulation and Control," River Mechanics I, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Ceramic mattresses

Buzzell, D. A., "Fused Ceramic Material for Riprap on Keystone Dam," Engineering News-Record, Vol 120, No. 22, 2 Jun 1938, p 787.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

U. S. Army Engineer Waterways Experiment Station, CE, "Feasibility of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.

Concrete pavement

American Society of Civil Engineers, "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 74, No. 6, Jun 1948, pp 845-866.

Blaess, A. F. et al., "Report on Methods for Providing Against River Bank Erosion," Bulletin of American Railway Engineering Association, Vol 31, No. 324, Feb 1930, p 1333.

Blanquet, P. A., "Memoire sur les Protections des Berges en Amerique et en Hollande" ("Memorandum on Bank Protection in America and in Holland"), Translation No. 53-3, Mar 1953, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; Translated by M. M. Welch for the Mississippi River Commission, CE, Vicksburg, Miss.

Buzzell, D. A., "Current Slope Protection Practice," Jan 1946; Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Washington, D. C.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Davis, G. B., "Inspection of Revetments (Upper Bank Paving) Between Vicksburg and Memphis on 17 and 18 Apr 1946," Unpublished Memorandum, 22 Apr 1966, Mississippi River Commission, CE, Vicksburg, Miss.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Elliot, D. O., Improvement of the Lower Mississippi River for Flood Control and Navigation, Vol II, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss., May 1932.

Haas, R. H., "Development of Concrete Revetments on the Lower Mississippi," Concrete, Apr and May 1947, pp 1-10 (reprint).

Haas, R. H. and Graham, J., "Paper," Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6), XXIInd International Navigation Congress, (PIANC), Paris, 1969.

Haas, R. H. and Weller, H. E., "Bank Stabilization by Revetments and Dikes," Proceedings, American Society of Civil Engineers, Vol 78, Separate No. 480, Sep 1952.

Haydon, G. C., "Concrete Paved Bank Revetment, Missouri River Improvement," Professional Memoirs, No. 50, 1918, pp 157-170.

Hertzberg, R., "Wave-Wash Control on Mississippi River Levees," American Society of Civil Engineers Transactions, Vol 119, 1954, pp 628-638.

Huber, R. L., "Contract on Works and Bank Stabilization," Bank Stabilization Manual, Draft, 1948, Prepared by Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

Knappen, T. T. and Brown V. J., "Concrete Revetment on the Mississippi River," Engineering and Contracting, Vol 69, No. 2, Feb 1930, pp 57-62.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Matthes, G. H., "Report on Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

McKenzie, G. K., "Recent Developments in the Field of Low Cost Slope Protection for Levees and River Banks in the Portland, Oregon District," Proceedings, 2d International Conference on Soil Mechanics and Foundation Engineering, Rotterdam, 21-30 Jun 1948, Vol 7, pp 112-116.

Meese, R. H., "How to Protect Highways from Flood Damage With Riprap, Crib Masonry, Fascines, and Bank Stabilization," Pacific Builder and Engineer, Vol 58, No. 12, Dec 1952, pp 64-65.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Nicholson, J. H. and Snyder, J. E., "Asphalt Riverbank Paving Taming the Mighty Mississippi," Asphalt Institute Quarterly, Vol 12, No. 1, Jan 1960, p 12.

_____, "Bank Revetment Developments on the Mississippi River," Part 1, "Asphalt Mat Revetment," Part 2, "Tetrahedron-Block Revetment," Engineering News-Record, Vol 112, No. 26, 28 Jun 1934, pp 825-830 and Vol 113, No. 1, 5 Jul 1934, pp 5-8.

_____, "Manual for Soil Erosion Control in the Tennessee Valley," 1939, Tennessee Valley Authority, Knoxville, Tenn.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Portland Cement Association, "Concrete Structures for Flood Control, Soil and Water Conservation," 1937, Chicago, Ill.

Schoklitsch, A., Hydraulic Structures, Vol 2, American Society of Mechanical Engineers, New York, 1937.

Shaver, H. M., Jr., "Banking the Potomac," Virginia Highway Bulletin, Vol 21, No. 7, Jun 1955, p 15.

Tenaud, R., "Paper," Les Defenses de Berge "Economiques" sur les Canaux et Rivières Navigables ("Economic" Protection of the Banks of Navigable Canals and Rivers), Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6), XXIInd International Navigation Congress (PIANC), Paris, 1969.

Tomlin, R. K., "Defense Against Old Man River," Construction Methods, Vol 12, No. 11, Nov 1930, p 58.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

U. S. Army Engineer District, Portland, CE, "Report on Experimental Slope Protection for River Banks and Levees," 9 Dec 1946, Portland, Oreg.

U. S. Army Engineer District, Vicksburg, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, Vicksburg, Miss.

U. S. Department of Transportation, Federal Highway Administration, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," Publication FP-74, 1974, U. S. Government Printing Office, Washington, D. C.

Washbourne, L. B., Mississippi River Improvement; Concrete Bank Revetment in the Memphis Engineer District, Thesis, University of California, Berkeley, Calif., May 1930.

White, J. K. et al., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundation Division," Proceedings, American Society of Civil Engineers, Vol 75, No. 3, Part I, Mar 1949, pp 406-410.

Erosion-control matting

Agerschou, H. A., "Synthetic Material Filters in Coastal Protection," Proceedings, American Society of Civil Engineers, Vol 7, No. WW1, 1961, pp 111-123.

American Excelsior Co. (AMXCO), "Curlex Blanket," undated, Arlington, Tex.

_____, "The Ultimate in Erosion Control," undated, Arlington, Tex.

Anonymous, "Bridge Department Uses New Type of Bank Protection," California Highways, Vol 2, No. 11, Nov 1925, p 8.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "The Use of Wire Netting in Revetment Work," Engineering, Vol 141, No. 3666, 17 Apr 1936, pp 428-429.

Brown, G. L., Jr., "Fiberglas for Erosion Control" (unpublished), Jul 1976, Atlanta, Ga.

Celanese Fibers Marketing Co., "Mirafi 140," 1975, New York, N. Y.
Conwed Corporation, "Conwed Economy Erosion Control Netting," undated, Minneapolis, Minn.

Firestone Coated Fabrics Co., "Presenting the Embankment-Supported Fabritank," 1970, Magnolia, Ark.

Gilbert, W. B. and Deal, E. E., "Temporary Ditch Liners for Erosion Control and Sod Establishment" (unpublished and undated), Turf Project, Crop Science Department, North Carolina State University, Raleigh, N. C.

Goss, R. L., Blanchard, R. M., and Mellon, W. R., "The Establishment of Vegetation on Nontopsoiled Highway Slopes in Washington," Final Report, Nov 1970, Washington State Highway Commission and Washington State University Agricultural Research Center, Olympia, Wash.

Gulf States Paper Corporation, "At Huge Dallas-Fort Worth Airport: How Honeysuckle Hills Replaced Texas Fields of Bluebonnets," undated, Tuscaloosa, Ala.

_____, "Hold Gro Recommended Installation Steps," undated, Tuscaloosa, Ala.

Herr, L. A., "The Control of Erosion and Sediment in Highway Construction," Proceedings of the National Conference on Sediment Control, Washington, D. C., 1969, pp 41-47.

Holeman, J. N. and Sauer, E. F., "Conservation in a New Town," Soil Conservation, Vol 35, No. 2, Sep 1969, pp 35-38.

Ludlow Corporation, "Control Erosion and Costs with Ludlow Soil Saver," undated, Needham Heights, Mass.

_____, "How to Use Ludlow Soil Saver," undated, Needham, Mass.

Naue-Fosertechnik, "Terrafix, Terradrän," undated, Espelkanp-Fiestel, West Germany.

Newcastle-upon-Tyne University, Landscape Development of Steep Slopes, Oriel Press, Newcastle upon Tyne, England, 1972.

Normann, J. M., "Design of Stable Channels with Flexible Linings," Hydraulic Engineering Circular No. 15, Oct 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Ore.

Owens-Corning Fiberglas Corp., "The Grounds Keeper, Fiberglas Erosion Control," Publication No. 1-EC-7183, Dec 1975, Toledo, Ohio.

_____, "The Grounds Keeper, Fiberglas Erosion Control," Publication No. 5-EC-7184, Dec 1975, Toledo, Ohio.

Reid, G., How to Hold Up a Bank, A. S. Barnes and Co., New York, 1969.

Richardson, E. V., "Optimization of Water Delivery Systems," Research Project, 1975, State of Colorado, Denver, Colo; Performed by Colorado State University, Agricultural Experiment Station, Fort Collins, Colo.

Switzerland, Service Federal des Routes et des Dignes, "Stabilisation Végétatale des Cours d'Eau (Stabilization of Watercourses with Vegetation)," 1973, Office, Federal des Imprimeries et du Material, Berne, Switzerland.

Tilton, G. A., Jr., "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

Toth, J., "U. S. Soil Conservation Service Test Site, Montville, New Jersey" (unpublished and undated), Morristown, N. J.

U. S. Army Engineer District, Sacramento, CE, "Bank Protection Test Sites, Cottonwood Creek, Tehama County," Report No. 1 (unpublished), 15 Oct 1971, Sacramento, Calif.

U. S. Environmental Protection Agency, "Guidelines for Erosion and Sediment Control Planning and Implementation," EPA-R2-72-015, Aug 1972, U. S. Government Printing Office, Washington, D. C.

_____, "Methods of Quickly Vegetating Soils of Low Productivity, Construction Activities," EPA 440/9-75-006, Jul 1975, U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, Office of Water Programs, "Control of Erosion and Sediment Deposition from Construction of Highways and Land Development," Sep 1971, U. S. Government Printing Office, Washington, D. C.

Fascine mattresses

American Railway Engineers Association, "Natural Waterways: Prevention of Erosion," American Railway Engineers Association Bulletin, Report on Assignment 3, Vol 56, No. 521, Feb 1955, pp 679-687.

Anonymous, "River Bank Protection with Fascine Boxes on the Texas and Pacific," Railway Engineer and Maintenance, Vol 46, No. 8, Aug 1950, pp 744-746.

Cheatham, G. C., "Bank Protection--Erosion Controls," Unpublished and undated handout prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Dawson, E. F., Notes on the Mississippi River, Thacker, Sprink and Co., Calcutta, 1900.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Elliot, D. O., Improvement of the Lower Mississippi River for Flood Control and Navigation, Vol II, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss., May 1932.

Headquarters, Department of the Army, Office of the Chief of Engineers, Bank Protection, Mississippi River; Plant Methods and Materials in Use on Works Under Direction of Mississippi River Commission, 1922, Washington, D. C.

Iszkowski, R., "Regulation of the Isar According to Wolf's Method," Wochenschrift des Osterreichischen Ingenieur--und Architekten-Vereines, 1888, p 74 et seq.

Matthes, G. H., "Report on Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

Meese, G. C., "How to Protect Highways from Flood Damage with Riprap, Cribs Masonry, Fascines, and Bank Stabilization," Pacific Builder and Engineer, Vol 58, No. 12, Dec 1952, pp 64-65.

Minikin, R. C. R., Practical River and Canal Engineering, Charles Griffin and Co., Ltd., London, 1920.

Mississippi River Flood Control Association, The Flood of 1927, Memphis, Tenn., 1928.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Pickels, G. W., "Flood Protection by Channel Improvement," Drainage and Flood Control, Chapter 11, McGraw-Hill, New York, 1941, pp 321-254.

Rossini, T., "Works for the Regulation of the Minor Bed of the River Po in View of Navigation by Vessels of 600 Tons," Permanent International Association of Navigation Congresses, Bulletin No. 40, Jul 1954, pp 175-207.

Schoklitsch, A., Hydraulic Structures, Vol 1, American Society of Mechanical Engineers, New York, 1937.

Sih, L.-T., "Embankments and Bank Protection of the Taiwan Rivers," Proceedings, Technical Conference on Flood Control in Asia and the Far East, United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Flood Control, Series No. 3, Paper No. 7, 1952, pp 87-108.

Switzerland, "Service Federal des Routes et des Dignes," Stabilisation Végétatale des Cours d'Eau (Stabilization of Watercourses with Vegetation)," 1973, Office, Federal des Imprimeries et du Material, Berne, Switzerland.

Thomas, B. F. and Watt, D. A., The Improvement of Rivers; A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams, 2d ed., Part I, Wiley, New York, 1913.

Thornber, C. H., "Bank Stabilization, Willamette and Columbia Rivers," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Jun 1965, Committee on Channel Stabilization, CE, Vicksburg, Miss.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

Waddill, G. D., "History of Kempe Bend Revetment," Unpublished Memorandum, 26 Mar 1947, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Types of Mattresses Used for Bank Protection in the New Orleans District and Their Effectiveness," Unpublished Memorandum, 19 Jun 1947, Mississippi River Commission, CE, Vicksburg, Miss.

Gabions

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Agostini, R. and Papetti, A., "Revestimenti Flessibili nei Canali e nei Corsi d'Acqua Canalizzati; Tabelle per il Dimensionamento dei Canali a Sezione Trapezia (Flexible Revetments for Canals and Canalized Watercourses; Tables for Dimensions of Channels and Their Cross Sections)," 1976, Officine Maccaferri S.p.A., Bologna, Italy.

Agostini, R. et al., "Maccaferri Gabions," 1971, Officine Maccaferri S.p.A., Bologna, Italy.

Anonymous, "City of Denver Builds Creosoted Pile Bank Protection," Wood Preserving News, Vol 13, No. 11, Nov 1935, pp 155-156.

_____, "Ecology Preserved with Gabion Embankment," California Builder and Engineer, Vol 82, No. 5, 12 Mar 1976, pp 18-19.

_____, "Gabion Bank Protection," Engineering News-Record, Vol 157, No. 8, 23 Aug 1956, p 61.

_____, "Gabions Control Erosion," The Military Engineer, Vol 68, No. 441, Jan-Feb 1976, pp 28-29.

_____, "Gabions Plug Side on Tennessee Highway," Roads and Streets, Vol 114, No. 9, Sep 1971, pp 62-63.

_____, "Gabion Wall Provides Key to Basin Construction," Constructioneer, 3 Nov 1969, pp 26-27.

_____, "Montgomery County Halts Washout," Constructioneer, 19 Feb 1968, p 31.

_____, "Safety Improvement on New York's I-81 Nears Completion," Constructioneer, 15 Nov 1971, pp 24-25.

_____, "Use of Gabions Grows for Erosion," Better Roads, Vol 46, No. 6, pp 23-24.

Bartles, H., "Gabion Weir at Dimbulah," Queensland Agricultural Journal, Vol 97, No. 12, Dec 1971, pp 627-632.

Canadian Center for Inland Waters, Environment Canada, "Shore Erosion--Cause and Cure," 1974, Ottawa.

Clay, C., "Control Works on the River Wear," Civil Engineering and Public Works Review, Vol 48, No. 561, Mar 1953, pp 255-258.

Crews, J. E., "Bank Stabilization in Susquehanna River Basin," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 96, No. WW1, Feb 1970, pp 87-95.

Crosby, L. G., "Design of an Interisland Barge Harbor for the Island of Tau, American Samoa, Hydraulic Model Investigation," Technical Report H-74-16, Dec 1974, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Fajin, O. F., "A Study of Methods of Stabilizing and Improving Ozark Streams," 1974, Research Project, State Department of Conservation, Jefferson City, Mo.; Performed for U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Federal Aid Division.

Headquarters, Department of the Army, Office of the Chief of Engineers, "Civil Works Construction Guide Specifications for Wire Mesh Gabions (Slope and Channel Protection)," CW 02541, Draft, 1976, Washington, D. C.

Holeman, J. N. and Saver, E. J., "Conservation in a New Town," Soil Conservation, Vol 35, No. 2, Sep 1969, pp 35-38.

James, G. S., "Erosion Prevention in Eastern Region Wildlands," Proceedings of the 22nd Annual Meeting of the Soil Conservation Society of America, Des Moines, Iowa, 1967, pp 141-145.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Lavagnino, S., "Gabions Guard River Banks Against 50,000 CFS Flow," Civil Engineering (New York), Vol 44, No. 5, May 1974, pp 88-89.

Maccaferri Gabions, Inc., "Construction of Marinas with Maccaferri Gabions," 1969, Flushing, N. Y.

_____, "Gabion Specifications," undated, Flushing, N. Y.

_____, "Gabion Weirs," 1970, Montreal, Toronto, and Vancouver, Canada.

_____, "Instructions for Assembly and Erections," undated, Flushing, N. Y.

_____, "Maccaferri Gabions," undated, New York, N. Y.

_____, "Notes on Mastic-Grouted Gabions and Revet Mattress," undated, Flushing, N. Y.

_____, "The Point, Annapolis, When Is a Wall Not a Wall at All," undated, Flushing, N. Y.

_____, "Trapezoidal Gabions," 1973, Flushing, N. Y.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

Officine Maccaferri, S.p.A., "Gabions for Flexible River Groynes," Technical Booklet No. 10, undated, Bologna, Italy.

_____, "The Use of Gabions in Flood Control," Technical Booklet No. 1, undated, Bologna, Italy.

_____, "The Use of Gabions in the Construction of Weirs," Technical Booklet No. 9, undated, Bologna, Italy.

Oswalt, N. R., George, J. F., and Pickering, G. A., "Fourmile Run Local Flood-Control Project, Alexandria and Arlington County, Virginia; Hydraulic Model Investigation," Technical Report H-75-19, Dec 1975, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Posay, C. J., "Erosion Prevention Experiments," Proceedings of the 13th Congress of International Association of Hydraulic Research, Kyoto, Japan, Vol 2, 1969, pp 211-219.

Precise Products, "American Gabions," undated, Browning, Mont.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Schuster, R. C., "Gabions in Highway Construction," TRB Special Report 148, 1974, National Academy of Sciences, Washington, D. C.

Shirdan, L. "Paper," Ocean Navigation (Sect. 1), Breakwaters with Vertical and Sloping Faces, Measurement of Waves, Study of Wave Forces, Methods of Calculation (Subject 1), XX1st International Navigation Congress (PIANC), Stockholm, 1965, pp 101-110.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Stewart, J. L., "Protection of Roads and Bridges Against Stream Erosion," Roads and Streets, Vol 70, No. 5, May 1930, pp 171-172.

Terra Aqua Conservation, "Bekaert Gabions," Jan 1976, Reno, Nev.

U. S. Army Engineer District, Rock Island, CE, "How to Engineer a Solution to Long-Term Erosion Problems," undated, Rock Island, Ill.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Department of Agriculture, Forest Service, "Forest Service Standard Specifications for Construction of Roads and Bridges," 1972, U. S. Government Printing Office, Washington, D. C.

_____, "Regional Standard Drawings," Jul 1975, San Francisco, Calif.

_____, "Salmon Creek Bridge (IN20821) Gabions," 26 Mar 1976, San Francisco, Calif.

_____, "Smokehouse Creek Bridge (IN20819) Gabions," 25 Mar 1976, San Francisco, Calif.

_____, "Uniform Specifications for Timber Purchaser Road Construction," Jul 1974, U. S. Government Printing Office, Washington, D. C.

_____, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Interior, Federal Water Quality Administration, "Urban Soil Erosion and Sediment Control," Water Pollution Control Research Series 1503DTL05/70, May 1970, U. S. Government Printing Office, Washington, D. C.; Prepared by National Association of Counties Research Foundation, Washington, D. C.

U. S. Department of Interior, National Park Service, "Plans for Proposed East Approach, Project 4(2), Channel Improvement, Canyonlands National Park Road System, Utah," 1971, Denver, Colo.; Prepared by U. S. Department of Transportation, Federal Highway Administration, Region 9, Denver, Colo.

_____, "Plans for Proposed Project 4(1), 5(1) Bituminous Stabilized Base, Length 15.997 Miles, East Approach and Needles Road, Canyonlands National Park Road System, Utah," 1969, Denver, Colo.; Prepared by U. S. Department of Transportation, Federal Highway Administration, Region 9, Denver, Colo.

U. S. Department of Transportation, Federal Highway Administration, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," Publication FP-74, 1974, U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, "Guidelines for Erosion and Sediment Control Planning and Implementation," EPA-R2-72-015, Aug 1972, U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, "Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activities," EPA 430/9-73-007, Oct 1973, U. S. Government Printing Office, Washington, D. C.; Prepared by Hitman Associates, Inc., Columbia, Md.

Weller, H. E., "Bank Protection of Varanasi Ghats and Other Locations on Ganga River," Aug 1969, Mississippi River Commission, CE, Vicksburg, Miss.

Log and cable

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Barnes, R. C., Jr., "Erosion Control Structures," River Mechanics II, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Felker, R. H., "Streambank Control," Soil Conservation, Vol 12, No. 5, Dec 1946, pp 114-117.

James, G. S., "Erosion Prevention in Eastern Region Wildlands," Proceedings, 22nd Annual Meeting of the Soil Conservation Society of America, Des Moines, Iowa, 1967, pp 141-145.

Knapp, F. H. and Libby, J. A., "Erosion of Stream Banks, Its Prevention and Correction," Regional Bulletin No. 78, Engineering Series No. 6, Forestry Series No. 14, 1 Apr 1942, U. S. Department of Agriculture, Soil Conservation Service, Albuquerque, N. Mex.

Lowry, G. L. and Hunt, L., "Study of Biological and Physical Factors Affecting Eroding Shoreline Areas and Their Initial Stabilization," Research Project, 1976, State of Texas, Austin, Tex.; Performed by Stephen F. Austin State University, School of Forestry, Nacogdoches, Tex.

Stewart, J. L., "Protection of Roads and Bridges Against Stream Erosion," Roads and Streets, Vol 70, No. 5, May 1930, pp 171-172.

U. S. Army Engineer District, Fort Peck, CE, "Report on Measures for Bank Protection on the Yellowstone River and Tributaries," Civil Works Investigation No. 509-e, Jun 1954, Fort Peck, Mont.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Soil Conservation Service, "Work Plan for Watershed Protection and Flood Prevention, Northeast Tributaries of the Leon River Watershed," Mar 1961, Fort Worth, Tex.

U. S. Department of Transportation, Federal Highway Administration, "Erosion and Sediment Control on Highway Construction Projects," Federal-Aid Highway Program Manual, Washington, D. C., Vol 6, Chapter 7, Section 3, Subsection 1, 25 Sep 1974.

Weller, H. E., "Brahmaputra River Bank Protection in India," Irrigation and Power, Vol 27, No. 2, Apr 1970, pp 177-189.

Wood Brothers Construction Co., "River Bank Protection," 1923, Lincoln, Nebr.

Rock-and-wire mattresses

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Agostini, R. and Papetti, A., "Rivestimenti Flessibili nei Canali e nei Corsi d'Acqua Canalizzati; Tabelle per il Dimensionamento dei Canali a Sezione Trapezia (Flexible Revetments for Canals and Canalized Watercourses; Tables for Dimensions of Channels and Their Cross Sections)," 1976, Officine Maccaferri S.p.A., Bologna, Italy.

Agostini, R. et al., "Maccaferri Gabions," 1971, Officine Maccaferri S.p.A., Bologna, Italy.

Anderson, F. P., "River Control by Wire Net-Work," Institute of Civil Engineering, Vol 173, 1908.

Anonymous, "Bank Protection of Pressure-Coated Timber Grillage and Stone," Wood Preserving News, Vol 10, No. 8, Aug 1932, pp 116-117.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Gabions Control Erosion," The Military Engineer, Vol 68, No. 441, Jan-Feb 1976, pp 28-29.

_____, "New Riprap Idea at Ice-Harbor Dam," Western Construction, Vol 32, No. 1, Jan 1957, p 114.

_____, "Reno Mattress Halts Erosion at North Woodmere Park," Constructioneer, 22 Feb 1971, pp 24-25.

_____, "Wire and Willow Mat Revetment on the Missouri River," Engineering News-Record, Vol 90, No. 6, 8 Feb 1923, p 258.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Gorrie, R. M., Soil and Water Conservation in the Punjab, Simla, New Delhi, India, 1946.

Grant, A. P. and Fenton, G. R., "Willows and Poplars for Conservation and River Works," Bulletin No. 6, 1948, Soil Conservation and Rivers Control Council, Wellington, N. Z.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Maccaferri Gabions, Inc., "Gabion Specifications," undated, Flushing, N. Y.

_____, "Gabion Weirs," 1970, Montreal, Toronto, and Vancouver, Canada.

_____, "Maccaferri Revet Mattress (Maccaferri Reno Mattress)," undated, New York, N. Y.

_____, "Notes on Mastic-Grouted Gabions and Revet Mattress," undated, Flushing, N. Y.

Nash, A. M., "Wire Mattress and Riprap," Roads and Streets, Vol 87, Dec 1944, pp 85-88.

Officine Maccaferri, S.p.A., "The Use of Gabions in the Construction of Weirs," Technical Booklet No. 9, undated, Bologna, Italy.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, A Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Posey, C. J., "Erosion Control: Stability of Rock Sausages," Report No. 19, 1973, University of Connecticut, Institute of Water Resources, Storrs, Conn.

Posey, C. J., "Erosion Prevention Experiments," Proceedings, 13th Congress of International Association of Hydraulic Research, Kyoto, Japan, Vol 2, 1969, pp 211-219.

_____, "Flood-Erosion Protection for Highway Fills," Bulletin No. 13, Dec 1960, Iowa Highway Research Board, Des Moines, Iowa.

Precise Products, "American Gabions," undated, Browning, Mont.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Sih, L.-T., "Embankments and Bank Protection of the Taiwan Rivers," Proceedings, Technical Conference on Flood Control in Asia and the Far East, United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Flood Control Series No. 3, Paper No. 7, 1952, pp 87-108.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Stewart, J. L., "Protection of Roads and Bridges Against Stream Erosion," Roads and Streets, Vol 70, No. 5, May 1930, pp 171-172.

Tilton, G. A., "Bank Protection by Fence Types, Tetrahedrons, and Jackstraws," California Highways and Public Works, Vol 17, No. 8, Aug 1939, pp 10-12.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

U. S. Department of Agriculture, Forest Service, "Forest Service Standard Specifications for Construction of Roads and Bridges," 1972, U. S. Government Printing Office, Washington, D. C.

_____, "Uniform Specifications for Timber Purchaser Road Construction," Jul 1974, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, "Use of Riprap for Bank Protection," Hydraulic Engineering Circular 11, Jun 1967, Washington, D. C.

U. S. Filter Corporation, Menardi-Southern Division, "Protect Supporting Soils, Specify Monofilter," undated, Houston, Tex.

Synthetic mattresses, matting, and tubing

Anonymous, "Grout-Filled Mattress System for River Banks," Civil Engineering and Public Works Review, Vol 64, No. 752, Mar 1969.

_____, "New Construction Method Protects River Banks," Construction, Vol 33, No. 8, 11 Apr 1966, p 66.

_____, "Submerged Motor Mats Control Waterway Erosion," Engineering News-Record, Vol 176, No. 24, Jun 16, 1966, p 170.

Construction Techniques, Inc., "Bank Stabilization and Bridge Abutment Protection," Fabriform Report FF-101, undated, Cleveland, Ohio.

_____, "Canal Stabilization," Fabriform Report FF-102, undated, Cleveland, Ohio.

_____, "Creek Bank and Bridge Abutment--Repair," Fabriform Report FF-63, undated, Cleveland, Ohio.

_____, "River Bank Protection," Fabriform Report FF-64, undated, Cleveland, Ohio.

_____, "Slope Erosion Protection for Bridge Abutment," Fabriform Report FF-100, undated, Cleveland, Ohio.

De Ment, L. E., "Two New Methods of Erosion Protection for Louisiana," 1976, U. S. Army Engineer District, New Orleans, CE; Prepared for presentation at the 15th International Coastal Engineering Conference, Honolulu, Hawaii.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Intrusion-Prepakt, Inc., "Bank Protection for Boat Basin," Fabriform Report FF-50, undated, Cleveland, Ohio.

_____, "Canal Lining," Fabriform Report FF-38, undated, Cleveland, Ohio.

_____, "Channel Lining," Fabriform Report FF-10, undated, Cleveland, Ohio.

_____, "Dodge Creek Bank Protection," Fabriform Report FF-48, undated, Cleveland, Ohio.

Intrusion-Prepakt, Inc., "Erosion Control (Chevron Oil Co.)," Fabriform Report FF-14, undated, Cleveland, Ohio.

_____, "Erosion Control (State of New York)," Fabriform Report FF-47, undated, Cleveland, Ohio.

_____, "Experimental Beach Rehabilitation," Fabriform Report FF-37, undated, Cleveland, Ohio.

_____, "Fabricast Molded Blocks," 1975, Cleveland, Ohio.

_____, "Fabriform Lines Old Canal," Fabriform Report FF-56, undated, Cleveland, Ohio.

_____, "Fabriform Mats Stabilize Channel for Cassadaga Creek," Fabriform Report FF-29 (rev.), undated, Cleveland, Ohio.

_____, "Fabriform Paves Steep Slope," Fabriform Report FF-54, undated, Cleveland, Ohio.

_____, "Fabriform Stabilizes Trouble Areas in Flood Prone Creeping," Fabriform Report FF-58, undated, Cleveland, Ohio.

_____, "Intracoastal Waterway--Bank Protection," Fabriform Report FF-59, undated, Cleveland, Ohio.

_____, "Lakefront Slope Protection--Seawall Overtopping," Fabriform Report FF-62, undated, Cleveland, Ohio.

_____, "Land Development and Drainage Control with Fabriform," Fabriform Report FF-60, undated, Cleveland, Ohio.

_____, "Power Plant Intake Canal-Bank Stabilization," Fabriform Report FF-61, undated, Cleveland, Ohio.

_____, "Spotlight on the World of Prepakt," Published quarterly since 1973, Cleveland, Ohio.

_____, "Stabilization of Creek Banks Beneath Interstate Bridge," Fabriform Report FF-63, undated, Cleveland, Ohio.

Jakobsen, P. R. and Nielsen, A. H., "Some Experiments with Sand-Filled Flexible Tubes," Proceedings, 12th Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 92, 1970, pp 1513-1521.

Monsanto Textiles Co., "Bidim Engineering Fabric for Soil Stabilization and Drainage," undated, St. Louis, Mo.

U. S. Environmental Protection Agency, "Guidelines for Erosion and Sediment Control Planning and Implementation," EPA-R2-72 015, Aug 1972, U. S. Government Printing Office, Washington, D. C.

Van Lookeren Campagne, J. P. A., "Applications of Nylon in Hydraulic Engineering; Experience Gained in Holland and South America," Dock and Harbour Authority, Vol 43, No. 508, Feb 1963, pp 318-320.

VSL Corporation, "Discharge Canal Four Corners Plant, New Mexico," Feb 1971, Los Gatos, Calif.

_____, "Guide Specifications," undated, Los Gatos, Calif.

_____, "VSL Hydro-Lining," undated, Los Gatos, Calif.

Timber-and-brush mattresses

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Anonymous, "Brush Mattress and Mud-Cell Revetment Protects Missouri Pacific Railroad," Engineering News-Record, Vol 92, No. 24, 12 Jun 1924, p 1024-1025.

_____, "Constructing Framed Mattress for Mississippi Revetment," Engineering News-Record, Vol 104, No. 18, 1 May 1930, pp 720-724.

_____, "Fabricating Fascine Mattress for Mississippi Revetment," Engineering News-Record, Vol 105, No. 1, 3 Jul 1930, pp 4-7.

_____, "Levees, Revetment Retard Bank Scour," Contractors and Engineers Monthly, Vol 45, No. 8, Aug 1948, pp 52-56.

_____, "Pile Dike Protects Caving River Bank," Contractors and Engineers Monthly, Vol 44, No. 8, Aug 1947, pp 52-55.

_____, "Specifications for the Construction of the Several Types of River Bank Protection in Common Use--1935," Bulletin of the American Engineering Railway Association, Vol 37, No. 379, Sep 1935, pp 92-95.

_____, "Willow Mats Economical for Bank Protection," Roads and Streets, Vol 91, No. 2, Feb 1948, pp 92-94.

_____, "Willow Mats Protect Eroding River Banks," Contractors and Engineers Monthly, Vol 42, No. 8, Aug 1945, p 41.

Barnes, R. C., Jr., "Erosion Control Structures," River Mechanics II, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Barsdale, R. W., "Bank Protection on Central Valley Streams," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 86, No. WW4, Nov 1960, pp 1-16.

Blaess, A. F. et al., "Methods of Protecting River Banks Against Erosion," Bulletin, American Railway Engineering Association, Vol 30, No. 311, Nov 1928, pp 260-270.

_____, "Report on Methods for Providing Against River Bank Erosion," Bulletin of American Railway Engineering Association, Vol 31, No. 324, Feb 1930, p 1333.

Buchanan, G. C., "The Rangoon River Training Works," Institute of Civil Engineers, Vol 202, 1915-1916, pp 143-242.

Carey, W. C., "Construction Problems in Comprehensive River Stabilization," undated, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

Causey, W. R., "Bank Stabilization Red River Below Denison Dam," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter IV, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Central Board of Irrigation and Power, "Manual on River Behavior, Control, and Training," Publication No. 60, 1956, New Delhi, India.

Childs, W. M., "Bank Stabilization Revetment Design," Unpublished Memorandum, 8 Jan 1945, Mississippi River Commission, Vicksburg, Miss.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Coppée, H. St. L., "Bank Revetment on the Lower Mississippi," Proceedings, American Society of Civil Engineers, No. 1, 1896, pp 36-117.

Cozzens, H. R., "Steel Rails for Bank Protection on Salinas River, California," Civil Engineering, New York, Vol 16, No. 3, Mar 1946, pp 113-115.

Crews, James E., "Bank Stabilization in Susquehanna River Basin," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 96, No. WW1, Feb 1970, pp 87-95.

Davis, E. I. and Lipscomb, E. B., "Stabilizing the Lower Mississippi River," Civil Engineering, Vol 35, No. 11, Nov 1963, pp 6-69.

Dawson, E. F., Notes on the Mississippi River, Thacker, Sprink and Co., Calcutta, 1900.

Degenhardt, E. A., Channel Stabilization of the Middle Mississippi River, Unpublished Thesis, Colorado State University, Fort Collins, Colo., Aug 1973.

Dempster, M. G., "River Bank Protection at Strat Ford, Victoria," Commonwealth Engineer, Vol 23, No. 7, Feb 1936, pp 213-216.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Dupré, D. D., Jr., "Willow Mats Economical for Bank Protection," Roads and Streets, Vol 91, No. 2, Feb 1948, pp 92-94.

Edminster, F. C., Atkinson, W. S., and McIntire, A. C., "Streambank Erosion Control on the Winooski River, Vermont," U. S. Department of Agriculture Circular 837-1949, Washington, D. C.

Edwards, S. and Iakish, R., "Use of Plank or Lumber Apron Mat for Shore Protection on the Upper Mississippi River Between the Wisconsin River and Le Clair, Iowa," Professional Memoirs, No. 39, 1916, pp 383-391.

Elliot, D. O., Improvement of the Lower Mississippi River for Flood Control and Navigation, Vol II, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss., May 1932.

Fox, S. W., "Technical Methods of River Improvement as Developed on the Lower Missouri River by the General Government, from 1876 to 1903," Transactions, American Society of Civil Engineers, Vol 54, 1905, pp 280-345.

Grant, A. P. and Fenton, G. R., "Willows and Poplars for Conservation and River Works," Bulletin No. 6, 1948, Soil Conservation and Rivers Control Council, Willington, N. Z.

Haas, R. H. and Graham, J., "Paper," Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6), XXIInd International Navigation Congress, (PIANC), Paris, 1969.

Haas, R. H. and Weller, H. E., "Bank Stabilization by Revetments and Dikes," Proceedings, American Society of Civil Engineers, Vol 78, Separate No. 48, Sep 1952.

Headquarters, Department of the Army, Office of the Chief of Engineers, Bank Protection, Mississippi River; Plant Methods and Materials in Use on Works Under Direction of Mississippi River Commission, Washington, D. C., 1922.

Hertzberg, Rudolf, "Wave-Wash Control on Mississippi River Levees," Transactions, American Society of Civil Engineers, Vol 119, 1954, pp 628-638.

House of Representatives, "A Communication from the Mississippi River Commission in Reference to the Works of Protection to the Banks of that River; Also to the Failure to Make Provision for the Expenses of the Commission," Letter from the Secretary of War, House Executive Document No. 66, 49th Congress, 2d Session, 7 Jan 1887, Government Printing Office, Washington, D. C.

Huber, R. L., "Channel Stabilization of the Missouri River," Jun 1952; presented to the American Society of Civil Engineers, Denver, Colo.

_____, "Contract on Works and Bank Stabilization," Bank Stabilization Manual, Draft, 1948, prepared by Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

Issacs, W. E., "Channel Stabilization on the Arkansas River, Little Rock District," Symposium on Channel Stabilization Problems, Technical Report 1, Vol 2, Chapter VIII, May 1964, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Knapp, F. H. and Libby, J. A., "Erosion of Stream Banks, Its Prevention and Correction," Regional Bulletin No. 78, Engineering Series No. 6, Forestry Series No. 14, 1 Apr 1942, U. S. Department of Agriculture, Soil Conservation Service, Albuquerque, N. Mex.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Louckes, F. I., "Revetments--Economics and Conditions Affecting," Mar 1936, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Madden, E. B., "Stabilization Plan for the Arkansas River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 3, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Matthes, G. H., "Report on Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

McCool, A. A., Jr., A Study of Bank Stabilization on the Lower Mississippi River, Unpublished Thesis, Louisiana State University, Baton Rouge, La., pp 89-92, Aug 1951.

Mississippi River Flood Control Association, The Flood of 1927, Memphis, Tenn., 1928.

Morehead, L. B., "Willow Mats Halt Streambank Erosion," Soil Conservation, Vol 5, No. 5, Nov 1939, pp 127 and 131.

Myers, H. B., "Red River Bank Stabilization" (unpublished and undated), Mississippi River Commission, CE, Vicksburg, Miss.

Nebraska, University of, Agricultural College Extension Service, "Soil Washing, the Cause and Methods of Prevention," Extension Circular No. 123, Jun 1924, Lincoln, Nebr.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

Ockerson, J. A., "Flood Control of the Mississippi River," Flood Problems; a Symposium, Transactions, American Society of Civil Engineers, Vol 85, Paper No. 1505, 1922.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, A Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Ore.

Parker, F. Y., "Basket-Weave Mattress Revetment on the Missouri River," Engineering News-Record, Vol 106, 5 Mar 1931, pp 395-397.

_____, "Less Used and Experimental Bank Structures," Engineering News-Record, 20 Aug 1931, pp 301-303.

_____, "Missouri River Abatis," The Military Engineer, Vol XXIII, No. 132, Nov-Dec 1931, pp 535-536.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Pickels, G. W., "Flood Protection by Channel Improvement," Drainage and Flood Control, Chapter 11, McGraw-Hill, New York, 1941, pp 321-354.

Pittman, H. V., De La Sayette, E. R., and Lelivasky, S., "Discussion of Bank Stabilization by Revetments and Dikes," Discussion of Proceedings--Separates, American Society of Civil Engineers, Vol 79, Separate No. 368, No. 148, Dec 1953, pp 368-1 - 368-10.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Thomas, B. F. and Watt, D. A., The Improvement of Rivers: A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams, 2d ed., Part I, Wiley, New York, 1913.

Tiefenbrun, A. J., "Bank Stabilization of Mississippi River Between the Ohio and Missouri Rivers," Proceedings, Federal Interagency Sedimentation Conference, Agricultural Research Service, Jackson, Miss., Miscellaneous Publication No. 970, Paper No. 45, 1963, pp 387-399.

Trudeau, A. G., "New Type Brush Revetment," Engineering News-Record, Vol 119, 4 Nov 1937, pp 759-761.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Engineer District, Kansas City, CE, "Improving and Stabilizing the Channel of the Missouri River," Jan 2, 1948 (5th rev.), Kansas City, Mo.

U. S. Army Engineer District, Memphis, CE, "Revetment and Dike Data Sheets," 30 Jun 1964, Memphis, Tenn.

U. S. Army Engineer District, New Orleans, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, New Orleans, La:

U. S. Army Engineer District, Sacramento, CE, "Report on Channel Protection Against High Velocity Flow," undated, Sacramento, Calif.

U. S. Army Engineer District, Vicksburg, CE, "Bank Protection and Dike Data Sheets," 30 Jun 1949, Vicksburg, Miss.

_____, "Channel Improvement Data Report, FY 1973," 30 June 1973, Vicksburg, Miss.

U. S. Army Engineer Division, South Pacific, "Bank Protection on Mississippi and Missouri Rivers," 1 Jun 1935, San Francisco, Calif.

U. S. Army Engineer School, CE, "Flood Control, Flood Fighting," E.206-13 (1-52) ML, 1951, Fort Belvoir, Va.

_____, "Open River Regulation; Training Structures," Report No. E.202-4(2-59) ML, 1959, Fort Belvoir, Va.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo.; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Projects, McCook, Nebr.

Van Ornum, J. L., The Regulation of Rivers, McGraw-Hill, New York, 1914.

Vinzant, G. W., "Revetments in the Vicksburg District," Military Engineer, Vol 22, No. 125, Sep-Oct 1930, pp 448-453.

Vogel, H. D., "Protection of Beds and Banks of Inland Waterways, Deep Water Channels and Drainage Canals," 1 Nov 1940; Prepared for the VII International Navigation Congress, American Section, Permanent International Association of Navigation Congresses, Berlin, Germany.

Waddill, G. D., "Bank Stabilization, Red River, Vicinity of Shreveport, La.," Unpublished Memorandum, 25 Aug 1944, U. S. Engineer Division, Lower Mississippi Valley, CE, Vicksburg, Miss.

_____, "History of Kempe Bend Revetment," Unpublished Memorandum, 26 Mar 1947, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Types of Mattresses Used for Bank Protection in the New Orleans District and Their Effectiveness," Unpublished Memorandum, 19 Jun 1947, Mississippi River Commission, CE, Vicksburg, Miss.

Wall, E. E., "River Control at the New St. Louis Water-Works, Engineering News-Record, Vol 96, No. 14, 8 Apr 1926, pp 570-572.

Wall, W. J., "Influence of Soil Types on Stabilization of the Savannah River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, No. WW3, Part 1, Aug 1965, pp 7-23.

_____, "Planning, Construction, and Maintenance of the Stabilization Works on the Savannah River," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter VIII, Feb 1965, Committee on Channel Stabilization, CE, Vicksburg, Miss.

_____, "Stabilization Works on the Savannah River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 88, No. WW1, Feb 1962, pp 101-116.

Weller, H. E., "Bank Erosion Problems on the Brahmaputra River," Sep 1966, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Bank Protection on the Mississippi River and Tributaries," Bulletin, Permanent International Association of Navigation Congresses, No. 37, 1952 (extract).

_____, "Brahmaputra River Bank Protection in India," Irrigation and Power, Vol 27, No. 2, Apr 1970, pp 177-189.

Winkley, B. R., "Practical Aspects of River Regulation and Control," River Mechanics I, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hseih Wen Shen, Fort Collins, Colo., 1971.

Used-tire matting

Anderson, E. J., "Old Tires Retread Worn Streambanks," Soil Conservation, Vol 34, No. 11, Jun 1969, pp 256-257.

Anonymous, "Rubber Riprap on the Riverbank," Automotive News, Vol 48, No. 4448, 30 July 1973, p 11.

_____, "Scrap Tires Build Banks," Kelly-Springfield Today, Dec 1975.

_____, "Tired of Riprap? Try...", Pacific Builder and Engineer, Vol 79, No. 14, 20 Jul 1973, pp 26-27.

Cheatham, G. C., "Bank Protection--Erosion Controls," Unpublished and undated handout prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Harrison, D., "Derelict Tires May Save Lake Front," Goodyear Triangle, 25 Oct 1971, p 5.

Keeley, J. W., "Bank Protection and River Control in Oklahoma," 1971, Federal Highway Administration, Bureau of Public Roads, Oklahoma Division, Oklahoma City, Okla.

Kowalski, T., ed., "1974 Floating Breakwater Conference Papers," Marine Technical Report Series No. 24, 1974, University of Rhode Island, Sea Grant, Ocean Engineering, Kingston, R. I.

Oertel, G. F. and Harding, J. L., "Effectiveness of Inexpensive Substrate Stabilizers and Energy Dissipators in an Area of High Tidal Range and Intense Boat Wave Erosion," Mar 1976, Skidway Institute of Oceanography, Savannah, Ga.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Reed, R. L., "Gulf Waters Eating Away a Louisiana Resort Beach," New York Times, New York, N. Y., 29 May 1971.

Rhodes, W. E., "Tires, Inexpensive Shoreline Erosion Control" (unpublished), 1963, Wittman, Md.

U. S. Army Engineer District, Kansas City, CE, "Bank Erosion," Unpublished and undated handout prepared for landowners, Kansas City, Mo.

U. S. Army Engineer District, Rock Island, CE, "How to Engineer a Solution to Long-Term Erosion Problems," undated, Rock Island, Ill.

U. S. Army Engineer District, Sacramento, CE, "Bank Protection Test Sites, Cottonwood Creek, Tehama County," Report No. 1, 15 Oct 1971, Sacramento, Calif., unpublished.

Bulkheads

Concrete or stone

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Agostini, R. et al., "Maccaferri Gabions," 1971, Officine Maccaferri S.p.A., Bologna, Italy.

Anonymous, "Cellular-Type Wall Built on Steel Piles," Contractors and Engineering Monthly, Apr 1948, p 20.

_____, "Concrete Flood Wall Is Built on Sheet Piles," Contractors and Engineers Monthly, Vol 44, No. 12, Dec 1947, p 54.

_____, "Concrete Flood Wall Protects," American City, Vol 48, No. 8, Aug 1933, p 42.

_____, "Gabions Control Erosion," The Military Engineer, Vol 68, No. 441, Jan-Feb 1976, pp 28-29.

_____, "How County Controls Erosion on Slim Rights-of-Way," Rural and Urban Roads, Vol 10, No. 5, May 1972, pp 24-26.

_____, "Stone Revetment and Flood Wall," Contractors and Engineers Monthly, Vol 38, No. 7, Jul 1941, pp 1, 22-23.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

Bartnett, E. J., "Man Battles Sea for Area's Shore," New York Times, New York, N. Y., 3 Sep 1956.

Blenkharn, A., "Paper," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXXIst International Navigation Congress (PIANC), Stockholm, 1965, pp 69-86.

Brater, E. F., Armstrong, J. M., and McGill, M., "Pere Marquette," Evaluation Report, Demonstration Erosion Control Program, University of Michigan, Coastal Zone Laboratory, Ann Arbor, Mich., Nov 1974.

Burgoyne, W. M., "Causes of Erosion and Various Methods of Shore Protection," The Canadian Engineer, Vol 66, No. 24, 12 Jun 1934, pp 7-11.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Canadian Center for Inland Waters, Environment Canada, "Shore Erosion-- Cause and Cure," 1974, Ottawa.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Cunningham, B., Coast Erosion and Protection, Charles Griffen and Co., Ltd., London, 1934.

Dempster, M. G., "River Bank Protection at Stratford, Victoria," Commonwealth Engineer, Vol 23, No. 7, Feb 1936, pp 213-216.

Denny, E. R., "The Battle to Beat Shore Erosion," Baltimore Sun, Baltimore, Md., 13 Oct 1968.

Devlin, J. C., "Sea Trims Jersey Fifth of Mile and Threatens Cape May Point," New York Times, New York, N. Y., 6 Sep 1959.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Duvivier, J., "Coast Protection: Some Recent Works on the East Coast, 1942-1952," Proceedings, Part I, Institution of Civil Engineers, Paper No. 5901, Jan 1953, pp 510-531.

_____, "The Selsey Coast Protection Scheme," Proceedings, Institution of Civil Engineers, Vol 20, Paper No. 6542, Dec 1961, pp 481-506.

Escoffier, F. F. and Dolive, W. L., "Shore Protection in Harrison County, Mississippi," Bulletin, Beach Erosion Board, Vol 8, No. 3, Jul 1954, pp 1-12.

Hood, H., "River Wall in Reinforced Concrete," Structural Engineer, Vol 1, No. 1, Jun 1933, pp 2-14.

Hudson Pulp and Paper Corporation, "Hudson's Reinforced Paper Rip Rap Bulkheading Bags Prefilled," undated, New York, N. Y.

Hurst, C. K. and Brebner, A., "Shore Erosion and Protection, St. Lawrence River, Canada," Proceedings, 22nd International Navigation Congress, Paris, Section 1, Subject 6, pp 45-56.

Jachowski, R. A., "Shore Erosion Study, U. S. Naval Radio Station, Lola, North Carolina," May 1968, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C.

Jachowski, R. A. and Watts, G. M., "Development of Functional Structural Design Criteria," Research Project, 1976, U. S. Army Coastal Engineering Research Center, Fort Belvoir, Va.

James, G. S., "Erosion Prevention on Eastern Region Wildlands," Proceedings, 22nd Annual Meeting of the Soil Conservation Society of America, Des Moines, Iowa, 1967, pp 141-145.

Maccaferri Gabions, Inc., "Construction of Marinas with Maccaferri Gabions," 1969, Flushing, N. Y.

_____, "Maccaferri Gabions," undated, New York, N. Y.

_____, "Structural Designing Data, Retaining Walls," 1974, Flushing, N. Y.

Mason, M. A., "Beach Erosion and Shore Protection," E207, 11(350) ML, 1948, U. S. Army Engineer School, CE, Fort Belvoir, Va.

Michigan, University of, Lake Hydraulics Laboratory, "Low Cost Shore Protection for the Great Lakes," Oct 1952 (reprinted 1975), Ann Arbor, Mich.

Minikin, R. C. R., Practical River and Canal Engineering, Charles Griffen and Co., Ltd, London, 1920.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

Organizing Committee, Tenth Conference on Coastal Engineering, "Outline of Coastal Engineering in Japan," 1966, Tokyo, Japan.

Pickering, G. A. and Murphy, T. E., "Ansonia-Derby Local Protection Project, Maugatuch and Housatonic River, Connecticut; Hydraulic Model Investigation, Technical Report H-69-4, Apr 1969, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Pittman, H. V., "Concrete Wall Replaces Levee at Helena, Ark.," Engineering News-Record, Vol 110, No. 24, 15 Jun 1933, p 780.

Portland Cement Association, "Concrete Shore Protection," 1937, Chicago, Ill.

_____, "Concrete Structures for Flood Control, Soil and Water Conservation," 1937, Chicago, Ill.

Russell, R. C. H., "Coast Erosion and Defense," Hydraulics Research Paper No. 3, 1960, Department of Scientific and Industrial Research, Hydraulics Research Station, Her Majesty's Stationery Office, London.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965, pp 1-22.

Speidel-Foundation and Marine, Inc, "Z-Wall," undated, Benton Harbor, Mich.

Tanner, W. F., "Can We Save Our Beaches?" Atlanta Journal and Constitution Magazine, 6 Dec 1964, pp 10-12 and 14.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Beach Erosion Board, CE, "Manual of Procedures in Beach Erosion Studies," Paper No. 2, 1 Dec 1938, Washington, D. C.

_____, "Shore Protection Planning and Design," Technical Report No. 4, 1954, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, A Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Forest Service, Region Five, "Regional Standard Drawings," Jul 1975, San Francisco, Calif.

U. S. Filter Corporation, Menardi-Southern Division, "Protect Supporting Soils, Specify Monofilter," undated, Houston, Tex.

Zijlstra, S., "Preserving the Canals of Old Holland," Pure Iron Era, Vol 3, No. 9, 1953, p 19.

Fiber

Air Logistics Corporation, "Mo-Mat, a New Ground Mobility and Construction System," Apr 1971, Pasadena, Calif.

_____, "Technical Manual for the Mo-Mat System," Sep 1975, Pasadena, Calif.

GAF Corporation, "GAF Corrugated Canal Bulkheading," undated, New York, N. Y.

Mineral Fiber Products Bureau, "Design Manual for Asbestos-Cement Canal Bulkheads," 1964, New York, N. Y.

Metal

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials on Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Anonymous, "Sheet Piles Driven Through Ice Stabilized Banks," Contractors and Engineers, Vol 57, No. 10, Oct 1972, pp 38-39.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Dempster, M. G., "River Bank Protection at Stratford, Victoria," Commonwealth Engineer, Vol 23, No. 7, Feb 1936, pp 213-216.

Hickey, R. E., "Sheet Piling for Shore Protection Structures," Shore and Beach, Vol 30, Oct 1962, pp 18-22.

Jachowski, R. A., "Shore Erosion Study, U. S. Naval Radio Station, Lola, North Carolina," May 1968, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C.

Kaiser Aluminum Chemical and Sales, Inc., "Kaiser Aluminum Shore All," 1 May 1976, Oakland, Calif.

_____, "Shore-All Marine Retaining Wall Systems," 1975, Oakland, Calif.

Mason, M. A., "Beach Erosion and Shore Protection," E207.11(350)ML, 1948, U. S. Army Engineer School, CE, Fort Belvoir, Va.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

Portland Cement Association, "Concrete Structures for Flood Control, Soil and Water Conservation," 1937, Chicago, Ill.

U. S. Army Corps of Engineers, Beach Erosion Board, CE, "Manual of Procedures in Beach Erosion Studies," Paper No. 2, 1 Dec 1938, Washington, D. C.

U. S. Department of the Interior, National Park Service, "Plans for Proposed East Approach, Project 4(2), Channel Improvement, Canyonlands National Park Road System, Utah," 1971, Denver, Colo.; Prepared by U. S. Department of Transportation, Federal Highway Administration, Region 9, Denver, Colo.

Timber

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Anonymous, "Bank Protection of Pressure-Coated Timber Grillage and Stone," Wood Preserving News, Vol 10, No. 8, Aug 1932, pp 116-117.

_____, "City of Denver Builds Creosoted Pile Bank Protection," Wood Preserving News, Vol 13, No. 11, Nov 1935, pp 155-156.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Two Types of Creosoted Timber Bank Protection at Colorado Bridge," Wood Preserving News, Vol 13, No. 1, Jan 1935, pp 8-9.

Anonymous, "Work from Water Side to Build River Wall," American Contractor, Vol 9, No. 39, pp 16-17.

Bromley, J. A., "Shore Erosion and Prevention in Tidewater, Maryland," Wood Preserving News, Vol 17, No. 5, May 1939, pp 51-53 and 61.

Burpee, C. M., "Timber Provides Low-Cost Protection," Shore and Beach, Vol 30, Apr 1962, pp 25-27.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Cunningham, B., Coast Erosion and Protection, Charles Griffen and Co., Ltd., London, 1934.

Davidson, W. C., "Bank Protection Along the Rio Bonito in New Mexico," Highway Magazine, Vol 18, No. 2, Feb 1927, pp 46-47.

Dawson, E. F., Notes on the Mississippi River, Thacker, Sprink and Co., Calcutta, 1900.

Denny, E. R., "The Battle to Beat Shore Erosion," Baltimore Sun, 13 Oct 1968, Baltimore, Md.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Givens, F. B., Jr., "Shoreline Erosion Control on Virginia's Rivers and Bays," Shore and Beach, Vol 44, No. 1, Apr 1976, pp 25-30.

Hertzberg, R., "Foreshore Protection, Lower Mississippi River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, No. WW2, Part 1, May 1965, pp 1-6.

Jachowski, R. A., "Shore Erosion Study, U. S. Naval Radio Station, Lola, North Carolina," May 1968, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C.

Jachowski, R. A. and Watts, G. M., "Development of Functional Structural Design Criteria," Research Project, 1976, U. S. Army Coastal Engineering Research Center, Fort Belvoir, Va.

Mason, M. A., "Beach Erosion and Shore Protection," E207.11(350) ML, 1948, U. S. Army Engineer School, CE, Fort Belvoir, Va.

Michigan, University of, Lake Hydraulics Laboratory, "Low Cost Shore Protection for the Great Lakes," Oct 1952 (reprinted 1975), Ann Arbor, Mich.

Myers, H. B., "Red River Bank Stabilization," Unpublished and undated, Mississippi River Commission, CE, Vicksburg, Miss.

Naples University, Istituto di Costruzioni Navali, "Research on Collision-Resisting Structures," Oct 1966, Naples, Italy.

Naue-Fosertechnik, "Terrafix, Terradran," undated, Espelkamp-Fiestel, W. Germany.

Reid, G., How to Hold Up a Bank, A. S. Barnes and Co., New York, 1969.

Slaughter, T. H., "Shore Erosion in Tidewater, Maryland," Shore and Beach, Apr 1964, pp 15-20 and 24.

Stepanov, A. V., "Obschii Prodolyni-Izgib Karpusa Sudna s Parymi Lywkami (Shipbuilding and Marine Structures)," 20 May 1975, Naval Intelligence Support Center, Translation Division, Washington, D. C.

Stewart, J. L., "Protection of Roads and Bridges Against Stream Erosion," Roads and Streets, Vol 70, No. 5, May 1930, pp 171-172.

Stickney, A., "On Plan of Bank Protection for the Mississippi River," 5 Nov 1896; Presented at Mississippi River Commission, CE, Vicksburg, Miss.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Beach Erosion Board, CE, "Manual of Procedures in Beach Erosion Studies," Paper No. 2, 1 Dec 1938, Washington, D. C.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual" (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer District, Alaska, CE, "FY 66--Erosion Control Maintenance Study, Yukon River, Galena Airport, Alaska," 17 Dec 1965, Anchorage, Alaska.

U. S. Army Engineer District, Omaha, CE, "Report on Channel Protection Against High Velocity Flow," Jun 1953, Omaha, Nebr.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Army Engineer School, CE, "Flood Control, Flood Fighting," E206-13(1-52) ML, 1951, Fort Belvoir, Va.

U. S. Filter Corporation, Menardi-Southern Division, "Protect Supporting Soils, Specify Monofilter," undated, Houston, Tex.

Van Ornum, J. L., The Regulation of Rivers, McGraw-Hill, New York, 1914.

Soil Stabilization Techniques

Asphalt (bulk)

Anonymous, "Asphalt Plant-Mix Placed Under Water," Contractors and Engineering Monthly, Nov 1947, pp 1-4.

_____, "Rugged, Versatile Asphalt Has Many Uses in Water Control and Conservation," Asphalt Institute Quarterly, Vol 7, No. 2, Apr 1955, pp 12-13.

McCrone, R. M., "Underwater Placement of Hot Asphalt Mix," 26 Feb 1947; Presented at Vicksburg Engineers Club, Vicksburg, Miss.

Meredith, E. C., "Investigation of Mass Placement of Sand Asphalt for Underwater Protection of River Banks," Technical Memorandum No. 3-329, Aug 1951, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Moore, N. A., "Improvement of the Lower Mississippi River and Tributaries, 1931-1972," 1972, Mississippi River Commission, CE, Vicksburg, Miss.

Pickett, A. B., "Uncompacted Mass Asphalt for River Banks and Levees," Civil Engineering, Vol 16, No. 10, Oct 1946, p 451.

Tompkins, W. F., "Water Control and Erosion Prevention Using Asphalt," Construction Series No. 43, Jun 1939, Asphalt Institute, Washington, D. C.

Visser, W. and Claessen, A. I. M., "Asphalt Rules the Dutch Waves," Customer Publication 171/75, 1975, Shell International Petroleum Co., Ltd., Amsterdam.

Waddill, G. D., "Report and Maps on Asphalt Subaqueous Revetment," 12 Oct 1943, Mississippi River Commission, CE, Vicksburg, Miss.

Grout

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials on Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

American Society of Civil Engineers, "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings of the American Society of Civil Engineers, Vol 74, No. 6, Jun 1948, pp 845-866.

Anonymous, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Rolling Plant Grouts Paved Slopes," Construction Methods, Vol 22, No. 2, Feb 1940, p 35.

Asphalt Institute, "Asphalt Leads the Fight Against Beach Erosion," Nov 1955, College Park, Md.

Bass, G., "Cement-Stabilized Riprap," Texas Highways, Vol 4, No. 12, Oct 1957, pp 6-7.

Buzzell, D. A., "Current Slope Protection Practice," Jan 1946; Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Washington, D. C.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highways Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highways Practice, Sacramento, Calif., Nov 1970.

D'Angremond, K. et al., "Use of Asphalt in Breakwater Construction," Proceedings, 12th Coastal Engineering Conference, Washington, Vol 3, Chapter 98, 1970, pp 1601-1627.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Edge, D. E., "Asphalt in Erosion Control and Hydraulics (unpublished and undated), The Asphalt Institute, College Park, Md.

Elliot, S. F and May, R. R., "Bank Protection for New River Channel," Engineering News-Record, Vol 125, No. 25, 19 Dec 1940, pp 61-65.

Hetteema, T., Kerkhoven, R. E., and Roelofs, F., "Paper," Inland Navigation (Sect. 1), New Methods and Materials for Protecting the Banks and Bottoms of Canals, Rivers, and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965.

Morrison, W. R., "Petrochemicals for Erosion Control, Stabilization, Grouting, and Linings," Research Project, 1974, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.

Phillips Petroleum Co., "Petroset Rubberizing Emulsions," undated, Bartlesville, Okla.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XIst International Navigation Congress (PIANC), Stockholm, 1965.

Thornber, C. H. and Bubenik, M. C., "Channel Stabilization of the Willamette River" (unpublished and undated), Mississippi River Commission, CE, Vicksburg, Miss.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, "Use of Riprap for Bank Protection," Hydraulic Engineering Circular 11, Jun 1967, Washington, D. C.

Van Asbeck, W. F., "River Banks and Dikes," Bitumen in Hydraulic Engineering, Vol 2, Elsevier, London, 1964, pp 45-66.

Visser, W. and Claessen, A. I. M., "Asphalt Rules the Dutch Waves," Customer Publication 171/75, 1975, Shell International Petroleum Co., Ltd., Amsterdam.

Organic mixtures and mulches

Anonymous, "Preventing Erosion on Highway Fills with Straw," Public Works, Vol 63, No. 10, Oct 1932, p 34.

Asphalt Institute, "Asphalt Mulch Treatment," Manual Series No. 97, Feb 1960, 1st ed., College Park, Md.

Beard, J. B., "Investigations of Effective Vegetative Establishment Practices for Michigan Roadsides," 12 Feb 1971, Michigan State University, East Lansing, Mich.

Bethlahmy, N. and Kidd, W. J., Jr., "Controlling Soil Movement from Steep Road Fills," Research Note Int-45, U. S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah.

"Bowie Industries, Inc.," Bowie Hydro-Mulcher, undated, Bowie, Tex.

_____, "Procedure Outline for Hydro-Sprigging with the Use of Wood Cellulose Fiber Mulch and the Bowie Hydro-Mulcher" (unpublished and undated), Bowie, Tex.

Bowie Machine Works, Inc., "Facts About Hydro-Mulching, the New One-Step Method for Establishing Turf," undated, Bowie, Tex.

Chepil, W. S. et al., "Vegetative and Nonvegetative Materials to Control Wind and Water Erosion," Soil Science Society of America Proceedings, Vol 27, No. 1, Jan-Feb 1963, pp 86-89.

Conwed Corporation, "Conwed Hydro Mulch and Hydro Mulch 2000 Fiber," Minneapolis, Minn.

_____, "Hydraulic Mulching, the One-Step Approach to Turf Establishment," undated, Minneapolis, Minn.

Diseker, E. G., Richardson, E. C., and Hendrickson, B. H., "Roadbank Erosion and Its Control in the Piedmont Upland of Georgia," ARS 41-73, Aug 1963, U. S. Department of Agriculture, Agricultural Research Service, Washington, D. C.

Edge, D. E., "Asphalt in Erosion Control and Hydraulics" (unpublished and undated), The Asphalt Institute, College Park, Md.

Gilbert, W. B. and Deal, E. E., "Temporary Ditch Liners for Erosion Control and Sod Establishment" (unpublished and undated), Turf Project Crop Science Department, North Carolina State University, Raleigh, N. C.

Gorrie, T. M., Soil and Water Conservation in the Punjab, Simla, New Delhi, India, 1946.

Goss, R. L., Blanchard, R. M., and Mellon, W. R., "The Establishment of Vegetation on Nontopsoiled Highway Slopes in Washington, Final Report, Nov 1970, Washington State Highway Commission and Washington State University Agricultural Research Center, Olympia, Wash.

Grass Growers, "Terra Tack," undated, Plainfield, N. J.

Holeman, J. N. and Sauer, E. F., "Conservation in a New Town," Soil Conservation, Vol 35, No. 2, Sep 1969, pp 35-38.

Maryland, State of, Department of Transportation, State Highway Administration, Bureau of Highway Design, "Sedimentation and Erosion Control Guide," 1 Jul 1970 (rev. 13 Feb 1973), Baltimore, Md.

McCully, W. G. and Bowmer, W. J., "Erosion Control on Roadside in Texas," Research Report 67-8, Jul 1969, Texas Transportation Institute, Texas A&M University, College Station, Tex.

Merriam, J., "Erosion and Weathering Tests on Soil Modified with Asphalt Emulsion and with Portland Cement Lower Cost Canal Lining Program," Laboratory Report No. EM 647, 1962, U. S. Department of Interior, Bureau of Reclamation, Soils Engineering Branch, Denver, Colo.

Meyer, L. D., Johnson, C. B., and Foster, G. R., "Stone and Woodchip Mulches for Erosion Control," Journal of Soil and Water Conservation, Vol 27, No. 6, Nov-Dec 1972, pp 267-269.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Morrison, W. R., "Petrochemicals for Erosion Control Stabilization, Grouting, and Linings," Research Project, 1974, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.

Newcastle-Upon-Tyne University, Landscape Development of Steep Slopes, Oriel Press, Newcastle Upon Tyne, England, 1972.

New York Times, "Land Erosion Rx: Rubber-Oil Spray," 18 Aug 1968, New York, N. Y.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky; Prepared by University of Louisville, Louisville, Ky.

Phillips Petroleum Co., "Petroset Rubberizing Emulsions," undated, Bartlesville, Okla.

_____, "Petroset SB Emulsions for Soil Binding," undated, Bartlesville, Okla.

_____, "Petroset SB Soil Binder," undated, Bartlesville, Okla.

Smith, W. L., "Mulching Flood Prevention Structures," Soil Conservation, Vol 26, No. 2, Sep 1960, pp 38-39.

Toth, J., "U. S. Soil Conservation Service Test Site, Montville, New Jersey," (unpublished and undated), Morristown, N. J.

Turfiber, Inc., "Recommendations for Mixing and Applying Turfiber as a Fiber Mulch in Hydraulic Seeding for Erosion Control," Jun 1976, Hunt Valley, Md.

U. S. Department of Agriculture, Forest Service, California Region, "A Guide to Erosion Reduction on National Forest Timber Sale Areas," 1954, San Francisco, Calif.

U. S. Department of the Interior, Federal Water Quality Administration, "Urban Soil Erosion and Sediment Control," Water Pollution Control Research Series 1503DTLO5/70, May 1970, U. S. Government Printing Office, Washington, D. C.; Prepared by National Association of Counties Research Foundation, Washington, D. C.

U. S. Department of Transportation, Federal Highway Administration, "Erosion and Sediment Control on Highway Construction Projects," Federal-Aid Highway Program Manual, Washington, D. C., Vol 6, Chapter 7, Section 3, Subsection 1, 25 Sep 1974.

U. S. Environmental Protection Agency, "Guidelines for Erosion and Sediment Control Planning and Implementation," EPA-R2-72-015, Aug 1972, U. S. Government Printing Office, Washington, D. C.

_____, "Methods of Quickly Vegetating Soils of Low Productivity, Construction Activities," EPA 440/9-75-006, Jul 1975, U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, Office of Water Programs, "Control of Erosion and Sediment Deposition from Construction of Highways and Land Development," Sep 1971, U. S. Government Printing Office, Washington, D. C.

Soil cement

Anonymous, "Bureau to Test Substitute Materials for Riprap on Earth Fill Dams," Rocky Mountain Contractor, Vol 33, No. 4, Apr 1951, p 22.

_____, "Soil-Cement Revetment Moves," Engineering News-Record, Vol 123, No. 15, 12 Oct 1939, p 53.

Central Board of Irrigation and Power, "Soil Science and Soil Mechanics," Irrigation and Power Research in India, Research Pamphlet, Section E, 1958, pp 28-29.

Crews, J. E., "Bank Stabilization in Susquehanna River Basin," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 96, No. WW1, Feb 1970, pp 87-95.

Davis, F. J., Gray, E. W., and Jones, C. W., "Use of Soil Cement for Slope Protection," Onzième Congres des Grands Barrages, Commission Internationale des Grands Barrages, Madrid, 1973, pp 237-255.

Davis, F. J. et al., "Wichita Project, Kansas, Cheney Dam, Design Considerations for Dam Embankment," Apr 1962, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.

DeGroot, G., "Soil-Cement Slope Protection on Bureau of Reclamation Features," Report No. REC-ERC-71-20, May 1971, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.

Din, M. M., "River Training with the Employment of Soil Cement," Indian Concrete Journal, 15 Dec 1949, pp 312-313.

Finch, H. A., "Earth-Cement Mixture in Sacks Used for River-Bank Revetment," Engineering News-Record, Vol 122, No. 19, 11 May 1939, p 659.

Jones, C. W., "Effect of a Polymer on the Properties of Soil Cement," Report REC-OCE-70-18, May 1970, U. S. Department of the Interior, Bureau of Reclamation, Denver, Colo.

Pavoni, J. L. and Stein, D. E., "Environmental Impact of Riverbank Revetment," May 1975, U. S. Army Engineer District, Louisville, CE, Louisville, Ky.; Prepared by University of Louisville, Louisville, Ky.

Portland Cement Association, "Shotcrete Canal and Ditch Linings," Concrete Information, Skokie, Ill., 1960.

_____, "Soil Cement for Paving Slopes and Linings," Soil Cement Information, Skokie, Ill., 1974.

_____, Soil-Cement Mixtures, Laboratory Handbook, 3rd ed., Chicago, 1950.

_____, "Soil-Cement Slope Protection at Merritt Dam, Photographic Construction Report," 1964, Chicago, Ill.

_____, "Soil-Cement Slope Protection for Embankments: Construction," Concrete Information, Skokie, Ill., 1975.

_____, "Soil-Cement Slope Protection for Embankments: Planning and Design," Soil-Cement Information, Skokie, Ill., 1975.

Shen, C. K. and Akky, M. R., "Erodibility and Durability of Cement-Stabilized Loam Soil," Transportation Research Record, No. 501, 1974, National Academy of Sciences, Washington, D. C.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Engineer District, New Orleans, CE, "Design Data Morameal Test Revetment," undated, New Orleans, La.

U. S. Army Engineer Waterways Experiment Station, CE, "Feasibility of Improved Methods for Riverbank Stabilization," Contract Report 3-81, Nov 1964, Vicksburg, Miss.; Prepared by Harza Engineering Co., Chicago, Ill.

U. S. Department of the Interior, Bureau of Reclamation, "Bank Protection, Dike and Channel Improvement, Red Bluff Diversion Dam," Specifications No. DC-6075, 1964, Denver, Colo.

U. S. Department of the Interior, Bureau of Reclamation, "Ten-Year Test of Soil-Cement Slope Protection as a Substitute for Rock Riprap--Bonny Dam--Missouri River Basin Project, Colorado," Earth Laboratory Report No. EM-630, 6 Nov 1961, Denver, Colo.

Wilder, C. R., "Bank Stabilization in Susquehanna River Basin," Discussion, Journal, Waterways, Harbors, and Coastal Engineering Division, American Society of Civil Engineers, Vol 96, No. WW1, Nov 1970, pp 863-866.

Thermal control

Anonymous, "Cold Probes Stabilize Banks," Construction Methods and Equipment, Vol 46, No. 3, Mar 1964, p 106.

_____, "Cold Weather Aids Bank Protection Works," Contractors and Engineers, Vol 61, No. 10, Oct 1964, p 76.

_____, "Probes Hold Shifting River," Western Construction, Vol 39, No. 3, Mar 1964, p 132.

U. S. Army Corps of Engineers, Pacific Northwest Sections, "Alaskans Freeze a River Bank to Halt Floods; USN Plans Big Contract Year," Construction World, Vol 19, No. 2, Feb 1964, p 52.

Vegetation

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Allen, J., "Farm-City Project in Iowa Cuts Erosion and Flooding," Soil Conservation, Vol 41, No. 9, Apr 1976, pp 4-5.

Amber, G. H., "Report on Installation of Monoslab 'Ready Revetments' at Cayuga Creek, State of New York," May 1976, Grass Pavers Limited, Royal Oak, Mich.

American Association of State Highway Officials, Task Force on Hydraulics, "Guidelines for Erosion and Sediment Control in Highway Construction," Highway Drainage Guidelines, Vol 3, 1973, Washington, D. C.

American Society of Civil Engineers, "Review of Slope Protection Methods, Report on the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 74, No. 6, Jun 1948, pp 845-866.

American Society of Civil Engineers, Task Committee for Preparation of Manual on Sedimentation, "Chapter V-Sediment Control Methods; Introduction and Watershed Area," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 95, No. HY2, Proceedings Paper 6438, Mar 1969, pp 649-675.

Andersson, O. and Hakansson, A., "Underhall av Mindre Vattendrag; I Allman del om Vegetation, Erosion och Slantsabilitet (Maintenance of Small Rivers, I on Vegetation, Erosion, and Slope Stability (in Swedish)," Grundforbättring, Vol 24, Nos. 3 and 4, 1971, pp 113-130.

Anonymous, "Beach Nourishment Along California Coastline," Shore and Beach, Apr 1968, pp 37-42.

_____, "Bridge Department Uses New Type of Bank Protection," California Highways, Vol 2, No. 11, Nov 1925, p 8.

_____, "How County Controls Erosion on Slim Rights-of-Way," Rural and Urban Roads, Vol 10, No. 5, May 1972, pp 24-26.

_____, "Protecting Steep Banks by Planting Live Willow Poles," Engineering News-Record, Vol 94, No. 20, 14 May 1925, pp 8122-8123.

Atkins, M. D. and Coyle, J. J., "Grass Waterways in Soil Conservation," USDA Leaflet No. 477, 1960, U. S. Government Printing Office, Washington, D. C.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

Bailey, R. W. and Copeland, O. L., "Vegetation and Engineering Structures in Flood and Erosion Control," U. S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah.

Baker, D. M. and Eaton, E. C., "Flood and Erosion Control Problems and Their Solution (Discussion)," Proceedings, American Society of Civil Engineers, Vol 62, No. 5, May 1936, pp 740-746.

Barnes, R. C., "Erosion Control Structures," Highway Research Board Special Report 135, 1973, National Academy of Sciences, Washington, D. C.

Barnett, A. P., Diseker, E. G., and Richardson, E. C., "Evaluation of Mulching Methods for Erosion Control on Newly Prepared and Seeded Highway Backslopes," Journal of Agronomy, Vol 59, 1967, pp 83-88.

Beasley, R. P., Erosion and Sediment Pollution Control, Iowa State University Press, Ames, Iowa, 1972.

Bowie Industries, Inc., "Bowie Hydro-Mulcher" (undated), Bowie, Tex.

Bowie Industries, Inc., "Procedure Outline for Hydro-Sprigging with the Use of Wood Cellulose, Fiber Mulch and the Bowie Hydro-Mulcher" (unpublished and undated), Bowie, Tex.

Bowie Machine Works, Inc., "Facts About Hydro-Mulching, the New One-Step Method for Establishing Turf" (undated), Bowie, Tex.

Brown, G. L., Jr., "Fiberglas for Erosion Control" (unpublished), Jul 1976, Atlanta, Ga.

Brown, T. A., "A Plant for Shoreline Erosion Control" (unpublished and undated), U. S. Department of Agriculture, Soil Conservation Service, Jackson, Miss.

Bursali, S., "Economic Revetments for Protecting the Banks of Meric and Ergene Rivers Flood Canals Against Wave Erosion," Proceedings, International Association for Hydraulic Research Symposium on River Mechanics, Asian Institute of Technology, Bangkok, Thailand, Vol I, 1973, pp 203-212.

Buzzell, D. A., "Current Slope Protection Practice," Jan 1946; Presented to American Society of Civil Engineers, Soil Mechanics and Foundation Division, Committee on Earth Dams, Subcommittee on Slope Protection, Washington, D. C.

Cheatham, G. C., "Bank Protection-Erosion Controls," Unpublished and undated handout prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Chepil, W. S. et al., "Vegetative and Nonvegetative Materials to Control Wind and Water Erosion," Proceedings, Soil Science Society of America, Vol 27, No. 1, Jan-Feb 1963, pp 86-89.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Craig, R. M. and Williams, A. T., "Native Vegetation Along Manmade Channels in South Florida," Proceedings, Florida State Horticultural Society, Vol 88, 1975, pp 383-388.

Dale, T. and Ross, W. A., "Conserving Farm Lands," Vocational Division Bulletin No. 201, Agricultural Series No. 53, 1939, U. S. Department of the Interior, U. S. Government Printing Office, Washington, D. C.

Davis, A., "Highway Erosion Control Demonstration," The Dixie Contractor, Vol 11, No. 32, 16 Feb 1938, p 6.

Davis, J. H., Jr., "Stabilization of Beaches and Dunes by Vegetation in Florida," Report No. 7, Sep 1975, Florida Sea Grant Program, Gainesville, Fla.

Dean, K. C., Havens, R., and Valdez, E. C., "Utilization and Stabilization of Solid Wastes," Proceedings, 16th Ontario Industrial Waste Conference, Niagara Falls, Ontario, Canada, 1969, pp 18-42.

Denny, E. R., "The Battle to Beat Shore Erosion," Baltimore Sun, 13 Oct 1968, Baltimore, Md.

Diseker, E. G. and McGinnes, J. T., "Evaluation of Climatic, Slope, and Site Factors on Erosion from Unprotected Roadbanks," Transactions, American Society of Agricultural Engineers, Vol 10, No. 1, Jan 1967, pp 9-11 and 14.

Diseker, E. G. and Richardson, E. G., "Highway Erosion Research Studies," Oct 1961, U. S. Department of Agriculture, Agricultural Research Service, Cartersville, Ga.; Prepared for presentation at the Twentieth Annual Short Course on Roadside Development, Columbus, Ohio.

_____, "Roadside Sediment Production and Control," Transaction, American Society of Agricultural Engineers, Vol 4, No. 1, Jan 1961, pp 62-64 and 68.

Diseker, E. G. and Yoder, R. E., "Sheet Erosion Studies on Cecil Clay," Bulletin 245, Nov 1936, Alabama Polytechnic Institute, Agricultural Experiment Station, Auburn, Ala.

Diseker, E. G., Richardson, E. C., and Hendrickson, B. H., "Roadbank Erosion and Its Control in the Piedmont Upland of Georgia," ARS 41-73, Aug 1963, U. S. Department of Agriculture, Agricultural Research Service, Washington, D. C.

Dodd, J. D. and Webb, J. W., "Establishment of Vegetation for Shoreline Stabilization in Galveston Bay," Miscellaneous Paper 6-75, Apr 1975, U. S. Army Coastal Engineering Research Center, CE, Fort Belvoir, Va.

Doran, W. E., "The Effect of Vegetation on the Stabilization of Artificial Slopes," Discussion, and "The Use of Vegetation in Stabilizing Artificial Slopes," Discussion, Proceedings, Institution of Civil Engineers, Biology, and Civil Engineering, 1949, pp 125-129.

Dowd, M. J., "How the Imperial Irrigation District Meets Its Problem of Silt Deposition and Erosion," Engineering and Contracting, Vol 49, No. 12, Dec 1930, pp 436-438.

Eastgate, L., "Vegetated Stabilization of Grassed Waterways and Dams by Washes," Bulletin No. 6, 6 Jun 1969, Water Research Foundation of Australia, Canberra, Australia.

Edminster, F. C., "Streambank Plantings for Erosion Control in the Northeast," Leaflet No. 258, 1949, U. S. Department of Agriculture, Washington, D. C.

Edminster, F. C., Atkinson, W. S., and McIntire, A. C., "Streambank Erosion Control on the Winooski River, Vermont," U. S. Department of Agriculture Circular 837, 1949, Washington, D. C.

Elliott, C. G., Engineering for Land Drainage, Wiley, London, 1912.

Felker, R. H., "Streambank Control," Soil Conservation, Vol 12, No. 5, Dec 1946, pp 114-117.

Finn Equipment Company, "Erosion Control Equipment," undated, Cincinnati, Ohio.

Gorrie, R. M., Soil and Water Conservation in the Punjab, Simla, New Delhi, India, 1946.

Goss, R. L., Blanchard, R. M., and Mellon, W. R., "The Establishment of Vegetation on Nontopsoiled Highway Slopes in Washington," Final Report, Nov 1970, Washington State Highway Commission and Washington State University Agricultural Research Center, Olympia, Wash.

Gra e, J. L., Calhoun, C. C., and Brown, D. N., "Drainage and Erosion Control Facilities, Field Performance Investigation," Miscellaneous Paper H-73-6, Jun 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Graetz, K. R., "Sericea for Erosion Protection and Beauty Along Highways," Journal, Soil and Water Conservation, Vol 21, No. 3, May-Jun 1966, pp 92-94.

Grant, A. P. and Fenton, G. R., "Willow and Poplars for Conservation and River Works," Bulletin No. 6, 1948, Soil Conservation and Rivers Control Council, Wellington, N. Z.

Grass Growers, "Terra Tack," undated, Plainfield, N. J.

Gulf States Paper Corporation, "At Huge Dallas-Fort Worth Airport: How Honeysuckle Hills Replaced Texas Fields of Bluebonnets," undated, Tuscaloosa, Ala.

_____, "Hold Gro Recommended Installation Steps," undated, Tuscaloosa, Ala.

Hansen, E. A., "Stabilizing Eroding Streambanks in Sand Drift Areas of the Lake States," Research Paper NC-21, U. S. Department of Agriculture, North Central Forest Experiment Station, St. Paul, Minn.

Herr, L. A., "The Control of Erosion and Sediment in Highway Construction," Proceedings, National Conference on Sediment Control, Washington, D. C., 1969, pp 41-47.

Holeman, J. N. and Sauer, E. F., "Conservation in a New Town," Soil Conservation, Vol 35, No. 2, Sep 1969, pp 35-38.

Horton, J. S., "Trees and Shrubs for Erosion Control in Southern California Mountains," undated, State of California, Department of Forestry, Division of Natural Resources, Sacramento, Calif.

Hursh, C. R., "The Naturalization of Roadbanks," Technical Note No. 51, 1 Feb 1942, U. S. Department of Agriculture, Forest Service, Washington, D. C.

Ingebo, P. A., "Suppression of Channel-Side Chaparral Cover Increases Streamflow," Journal, Soil and Water Conservation, Vol 26, No. 2, Mar-Apr 1971, pp 79-81.

James, G. S., "Erosion Prevention on Eastern Region Wildlands," Proceedings, 22nd Annual Meeting of the Soil Conservation Society of America, Des Moines, Iowa, 1967, pp 141-145.

Jones, L. G. and Thompson, L. M., "Soil Erosion and Its Control," 1941, Agricultural and Mechanical College of Texas, Department of Agronomy, College Station, Tex.

Kay, B. L., "Tackifiers for Straw Mulch," Agronomy Progress Report No. 63, 15 Feb 1975, University of California Agricultural Experiment Station in cooperation with U. S. Department of Agriculture, Agricultural Extension Service, Davis, Calif.

_____, "Tackifiers for Straw Mulch," Agronomy Progress Report No. 76, Apr 1976, University of California Agricultural Experiment Station in cooperation with U. S. Department of Agriculture, Agricultural Extension Service, Davis, Calif.

Kentucky, University of, College of Agriculture, "Soil Erosion and Its Control," Circular No. 129, Mar 1928 (revised), Lexington, Ky.

Kittredge, J., "Vegetation for Erosion Control," Forest Influences, Dover, New York, Chapter 24, 1973, pp 311-354.

Knapp, F. H. and Libby, J. A., "Erosion of Stream Banks, Its Prevention and Correction," Regional Bulletin No. 78, Engineering Series No. 6, Forestry Series No. 14, 1 Apr 1942, U. S. Department of Agriculture, Soil Conservation Service, Albuquerque, N. Mex.

Kozmenko, A. S. and Brande, I. D., "Silvicultural Measures Against Soil Erosion," Manual of Afforestation and Soil Melioration, 2nd ed., Israel Program for Scientific Translations, Jerusalem, 1966, pp 81-136.

Lattanzi, A. R., Meyer, L. D., and Bumgardner, M. F., "Influences of Mulch Rate and Slope Steepness on Internal Erosion," Proceedings, Soil Science Society of America, Vol 38, No. 6, Nov-Dec 1974, pp 946-950.

Launchbaugh, J. L., "Seeding Western Wheatgrass with Increasing Rates of Perennial Ryegrass or Smooth Brome in Waterways," Journal, Range Management, Vol 17, No. 5, Sep-Oct 1964, pp 245-248.

Lester, H. H., "Streambank Erosion Control," Agricultural Engineering, Vol 27, No. 9, Sep 1946, pp 407-410.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Lowdermilk, W. C., "Erosion Control in Japan," 1934, U. S. Department of Agriculture, Soil Conservation Service, Washington, D. C.; Mimeographed copy reprinted from 1927 edition of Oriental Engineer; Originally published in Peking, China.

Lowry, G. L. and Hunt, L., "Study of Biological and Physical Factors Affecting Eroding Shoreline Areas and Their Initial Stabilization," Research Project, 1976, State of Texas, Austin, Tex.; Performed by Stephan F. Austin State University, School of Forestry, Nacogdoches, Tex.

Maryland, State of, Department of Transportation, State Highway Administration, Bureau of Highway Design, "Sedimentation and Erosion Control Guide," 1 Jul 1970 (rev. 13 Feb 1973), Baltimore, Md.

McCully, W. G. and Bowmer, W. J., "Erosion Control On Roadside in Texas," Research Report 67-8, Jul 1969, Texas Transportation Institute, Texas A&M University, College Station, Tex.

McDonald, A., "Erosion and Its Control in Oklahoma Territory," Miscellaneous Publication No. 301, Mar 1938, U. S. Department of Agriculture, U. S. Government Printing Office, Washington, D. C.

McWhorter, J. C., Carpenter, T. B., and Clark, R. W., "Erosion Control Criteria for Drainage Channels," Mar 1968, Agricultural Experiment Station, Mississippi State University, State College, Miss.

Meyer, L. D. and Mannering, J. V., "The Influence of Vegetation and Vegetative Mulches on Soil Erosion," Proceedings, Third International Seminar for Hydrology Professors, Purdue University, West Lafayette, Ind., National Science Foundation, 1971, pp 355-366.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Middleton, L. M., "Manual for Soil Erosion and Sediment Control," Mar 1976, U. S. Department of Transportation, Federal Highway Administration, Region 15, Sevierville, Tenn.

Mihola, L., "Příspěvek k Pudoochrannému a Vodohospodarskému Zalesnění v Pávodí Roznovské Běvy (A Contribution to the Soil-Protecting and Hydrologically Important Afforestation in the Catchment Area of the Roznovská Běva River)," (in Czechoslovakian), Lesnická Práce, Vol 51, No. 12, 1972, pp 539-545.

Miller, C. R. and Borland, W. M., "Stabilization of Five Mile and Muddy Creeks," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 89, No. HY 1, 1963, pp 67-98.

Miller, E. L. and Budy, J. D., "Survival of Grass and Tree Species at High Elevations in the Sierra Nevada," Research Project, 1974, University of Nevada, Agricultural Experiment Station, Reno, Nevada; Performed for the U. S. Department of Agriculture, Cooperative State Research Service, Nevada.

Mosier, J. G. and Gustafson, A. F., "Washing of Soils and Methods of Prevention," Bulletin No. 207, Apr 1918, University of Illinois, Agricultural Experiment Station, Urbana, Ill.

Musat, I., "Asigurarea Protecției Malurilor Lacurilor de Acumulare și Cursurilor de Apă Cu Ajutorul Vegetației Forestiere (Stabilizing the Banks of Lakes and Rivers by Means of Forest Plantings)," (in Romanian), Rev Padurilor, Vol 86, No. 1, Jan 1971, pp 19-22.

Nathan, K., "An Improved Procedure for Grassed Waterways," Transactions, American Society of Agricultural Engineers, Vol 15, No. 11, Jan-Feb 1972, pp 66-68.

National Cooperative Highway Research Board, "Erosion Control on Highway Construction," NCHRP SYA 18, 1973, National Academy of Sciences, Washington, D. C.

Nebraska, University of Agricultural College Extension Service, "Soil Washing, the Cause and Methods of Prevention," Extension Circular No. 123, Jun 1924, Lincoln, Nebr.

Newcastle-Upon-Tyne University, Landscape Development of Steep Slopes, Oriel Press, Newcastle Upon Tyne, England, 1972.

New York Times, "Christmas Trees Get Lease On Life as Dune Builders," 3 Jan 1962, New York, N. Y.

New York Times, "Fire Islanders Resisting Ocean," 24 Jul 1958, New York, N. Y.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, A Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oregon.

Palmer, V. J., "A Method for Designing Vegetated Waterways," Agricultural Engineering, Vol 26, No. 12, Dec 1945, pp 516-520.

Palys, Z. and Stanek, M., "Wplyw Erozji Wodnej w Zlewni Rzeki Szczawa na Zrozniciowanie gleb i Plonow Roslin Uprawnych (The Effect of Water Erosion on the Differentiation of Soils and Yields of Cultivated Plants in the Watershed of the Szczawa River" (in Polish), Zeszyty Probu Postepow Nauk Rohn, Vol 119, 1971, pp 123-134.

Parsons, D. A., "Vegetative Control of Streambank Erosion," Proceedings, Federal Interagency Sedimentation Conference, Agriculture Research Service, Jackson, Miss., Miscellaneous Publication No. 970, Paper No. 20, 1963, pp 130-136.

Pichamuthu, C. S., "Soil Erosion and Its Prevention," Bulletin No. 20, 1951, Mysore Geological Department, Government Press, Bangalore, India.

Porter, H. L. and Silberberger, L. F., "Streambank Stabilization," Journal, Soil and Water Conservation, Vol 15, 1960, pp 214-216.

Posey, C. J., "Erosion--Proofing Drainage Channels," Journal, Soil and Water Conservation, Vol 28, No. 2, Mar-Apr 1973, pp 93-95.

Ree, W. O., "Permissible Velocities in Vegetation-Lined Conservation Channels" (unpublished and undated), U. S. Department of Agriculture, Agricultural Research Service, Stillwater, Okla.

_____, "The Design of Vegetated Waterways," 22-27 Jun 1957; Presented at Public Lands and Public Works Meeting of the American Society of Agricultural Engineers, East Lansing, Mich.

Ree, W. O. and Palmer, V. J., "Flow of Water in Channels Protected by Vegetative Linings," Technical Bulletin No. 967, Feb 1949, U. S. Department of Agriculture, Soil Conservation Service, Stillwater, Okla.

Reid, G., How To Hold Up a Bank, A. S. Barnes and Co., New York, 1969.

Reinco, "Reinco Hydrograssers and Power Mulchers," undated; Plainfield, N. J.

Reinhardt, J., "How Erosion is Prevented Along Roads in Wisconsin Glacial Region," The Highway Magazine, Vol 19, No. 1, Jan 1928, pp 21-22.

Ross, P. H., "Erosion Control and Arizona's Failure," Arizona Highways, Vol 8, No. 12, pp 3-4 and 24-26.

Rowalt, E. M., "Soil Defense in the Piedmont," Farmers' Bulletin No. 1767, 1937, U. S. Department of Agriculture, U. S. Government Printing Office, Washington, D. C.

Rowe, P. B., "Influence of Wooded Chaparral on Water and Soil in Central California," undated, State of California, Department of Natural Resources, Sacramento, California.

Rowland, V. R., "Kinta River Deviation," Proceedings, Institution of Civil Engineers, Vol 24, Jan 1963, pp 29-46.

Rule, G. K. and Nethrstrom, "Soil Defense in the Pacific Southwest," Farmers Bulletin No. 1848, Jul 1940, U. S. Department of Agriculture, U. S. Government Printing Office, Washington, D. C.

Sain, K. and Rao, K. L., "Report on the Recent River Valley Projects in China," Mar 1955, Government of India, Central Water and Power Commission, New Delhi, India.

Sally, H. L., Lining of Earthen Irrigation Channels, Asia Publishing House, New York, 1965.

Scheifele, O. S., "Natural Process of Bank Protection," Canadian Engineer, Vol 62, No. 6, 9 Feb 1932, p 11.

_____, "Protection of River Banks and Levees," Canadian Engineer, Vol 54, No. 2, 10 Jan 1928, p 119.

Schick, M., "Stabilization of Spillways and Channel Surfaces by Vegetation," Research Project, 1974, E. W. Nickerson and Sons, London.

Schmidt, B. L., Taylor, G. S., and Miller, R. W., "Effect of Corn Steep Liquor for Erosion Control and Vegetative Establishment on Highway Back Slopes," Agronomy Journal, Vol 61, Mar-Apr 1969, pp 214-217.

Seibert, P., "Importance of Natural Vegetation for the Protection of the Banks of Streams, Rivers, and Canals," Nature and Environment Series No. 2, pp 35-67, 1968, Freshwater Council of Europe, Delft, The Netherlands.

Sharp, W. C. and Vaden, J., "10-Year Report on Sloping Techniques Used to Stabilize Eroding Tidal River Banks," Shore and Beach, Apr 1970, pp 31-35.

Shen, H. W., "Sedimentation and Contaminant Criteria for Watershed Planning and Management," Publication No. CER71-72 HWS48, Jun 1972, Colorado State University, Engineering Research Center, Fort Collins, Colo.

Siddoway, F. H. and Ford, R. H., "Seedbed Preparation and Seeding Methods to Establish Grassed Waterways," Journal, Soil and Water Conservation, Vol 26, No. 2, Mar-Apr 1971, pp 73-76.

Silberberger, L. F., "Streambank Stabilization," Agricultural Engineering, Vol 40, No. 4, Apr 1959, pp 214-217.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Snell, E. L., "Fiber Glass Protection to River Banks," Institution of Water Engineers Journal, Vol 22, No. 1, Feb 1968, p 72.

Spandler, W. H., "Erosion Prevention, An Essential of Highway Design," The Highway Magazine, Vol 19, No. 12, Dec 1928, p 319-321.

Stanton, C. R. and McCarlie, R. A., "Streambank Stabilization in Manitoba," Journal of Soil and Water Conservation, Vol 17, No. 4, Aug 1962, pp 169-171.

Steinberg, I. H., "Russian River Channel Works," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 86, No. WW4, Nov 1966, pp 17-32.

Striffler, W. D., "Streambank Stabilization in Michigan--A Survey," Station Paper No. 84, Aug 1960, U. S. Department of Agriculture Forest Service, Lake State Forest Experiment Station and Michigan Department of Conservation, East Lansing, Mich., and Lansing, Mich.

Switzerland, Service Federal des Routes et des Dignes, "Stabilisation Végétate des Cours d'Eau (Stabilization of Watercourses with Vegetation)," 1973, Office, Federal des Imprimeries et du Material, Berne, Switzerland.

Tabor, P., "Early Streambank Stabilization," Soil Conservation, Vol 26, No. 2, Sep 1960, p 46.

Taube, C. M., "Stabilization of an Eroded River Bank," Journal, Soil and Water Conservation, Vol 22, No. 6, Nov-Dec 1967, pp 249-250.

Thompson, W. R., Jr., and Palmertree, H. D., "Mulches Improve New Turf Stands," Weeds, Trees, and Turf, Vol 6, No. 12, Dec 1967, pp 48 and 50.

Thornber, C. H., "Bank Stabilization, Willamette and Columbia Rivers," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Chapter 5, Jun 1965.

U. S. Army Coastal Engineering Research Center, CE, "Establishment of Vegetation for Shoreline Stabilization in Galveston Bay," Miscellaneous Paper No. 6-75, Apr 1975, Fort Belvoir, Va.; Prepared by J. D. Dodd and J. W. Webb, Department of Range Science, Texas A&M University under Contract No. DACW 72-74-C-0002 with additional funding from Texas Agricultural Experiment Station.

_____, "Evaluation of Potential Use of Vegetation for Erosion Abatement Along the Great Lakes Shoreline," Report No. 9604-003-17, Jun 1975, U. S. Government Printing Office, Washington, D. C.; Prepared by Dames and Moore, Cincinnati, Ohio, under Contract No. DACW 72-74-C-0022.

_____, "Shore Protection Manual" (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer District, Cincinnati, CE, "Investigation of Slope Protection--Cincinnati District," Sep 1946, Cincinnati, Ohio.

U. S. Army Engineer District, Fort Peck, CE, "Report on Measure for Bank Protection on the Yellowstone River and Tributaries," Civil Works Investigation No. 509-e, Jun 1954, Fort Peck.

U. S. Army Engineer District, Kansas City, CE, "A Base Line Study of the Missouri: Rulo, Nebraska, to Mouth near St. Louis, Missouri," Contract Report, 31 Aug 1974, Kansas City, Mo.; Prepared by University of Missouri, Rolla, Mo., et al.

U. S. Army Engineer District, Kansas City, CE, "Bank Erosion," Unpublished and undated handout prepared for landowners, Kansas City, Mo.

U. S. Army Engineer District, Omaha, CE, "Mud Creek at Broken Bow, Nebraska, Final Environmental Impact Statement," Mar 1972, Omaha, Nebr.

U. S. Army Engineer District, Sacramento, CE, "Sacramento River Bank Protection, California," Final Environmental Impact Statement, Nov 1972, Sacramento, Calif.

U. S. Army Engineer District, Walla Walla, CE, "Long Hollow Creek Channel Clearing Nez Pierce, Idaho," Final Environmental Impact Statement, 1972, Walla Walla, Wash.

U. S. Army Engineer District, Wilmington, CE, "Transters Creek, Beaufort, Martin, and Pitt Counties, North Carolina Flood Control," Draft Environmental Impact Statement," 26 May 1971, Wilmington, N. C.

U. S. Army Engineer Division, New England, CE, "Bound Brook Flood Control, Scituate, Massachusetts," Final Environmental Impact Statement, May 1972, Waltham, Mass.

U. S. Department of Agriculture, "Cuyahogan River Watershed, Program for Runoff and Waterflow Retardation and Soil Erosion Prevention," 1953, Washington, D. C.

_____, "Flowering Ornamentals Can Control Roadside Erosion, USDA Reports," USDA 1662-1965, 26 May 1965, Washington, D. C.

_____, "Gullies, How to Control and Reclaim Them," Farmers Bulletin No. 1234, Feb 1932, Washington, D. C.

_____, "Making a Model to Show How Forests Prevent Erosion," USDA Leaflet No. 58, 1930, Washington, D. C.

U. S. Department of Agriculture, Agricultural Research Service, "Stream Channel Stability and Stabilization Practices," Research Project, 1974, Performed by U. S. Department of Agriculture, Sedimentation Laboratory, Oxford, Miss.

U. S. Department of Agriculture, Forest Service, "Uniform Specifications for Timber Purchaser Road Construction," Jul 1974, U. S. Government Printing Office, Washington, D. C.

_____, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Forest Service, California Region, "A Guide to Erosion Reduction on National Forest Timber Sale Areas," 1954, San Francisco, Calif.

U. S. Department of Agriculture, Soil Conservation Service, Grasses and Legumes for Soil Conservation in the Pacific Northwest and Great Basin States, Agricultural Handbook 339, 1968, U. S. Government Printing Office, Washington, D. C.

_____, "Oliver Bottoms Resource Conservation and Development Project, Sebastian County, Arkansas," Final Environmental Impact Statement, 10 Sep 1972, Washington, D. C.

_____, "Planting and Management Guide for Vegetative Wave Protection of Earth Dam Embankments," 1955, Washington, D. C.

_____, "Standards and Specifications for Vegetating Critical Areas," Technical Guide IV-G, 1972, Lansing, Mich.

U. S. Department of Agriculture, Soil Conservation Service, "Work Plan for Watershed Protection and Flood Prevention, Leona River Watershed," Jan 1973 (rev. Oct 1974), Fort Worth, Tex.

_____, "Work Plan for Watershed Protection and Flood Prevention, Northeast Tributaries of the Leon River Watershed," Mar 1961, Fort Worth, Tex.

U. S. Department of Agriculture, Soil Conservation Service, Wisconsin State Soil Conservation Committee, "A Tour Guide of the La Crosse, Wisconsin, Soil Conservation Station," 1957, Madison, Wis.

U. S. Department of the Interior, Bureau of Reclamation, "A Plan of Channel Erosion Control, Fivemile Creek, Riverton Project, Wyoming," Apr 1953, Denver, Colo.

_____, "A Study of Channel Erosion Control, Muddy Creek, Riverton Project, Wyoming," Jun 1954, Denver, Colo.

U. S. Department of the Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo.; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Project, McCook, Nebr.

U. S. Department of the Interior, Federal Water Quality Administration, "Urban Soil Erosion and Sediment Control," Water Pollution Control Research Series 1503DTLO5/70, May 1970, U. S. Government Printing Office, Washington, D. C., Prepared by National Association of Counties Research Foundation, Washington, D. C.

U. S. Department of the Interior, National Park Service, "Natchez Trace Parkway, Plans for Proposed Project 3C4, Grading, Base, Surfacing, and Structures, U. S. 45 to Mississippi Highway 363, Lee County, Mississippi," May 1976, Tupelo, Miss; Prepared by U. S. Department of Transportation Federal Highway Administration, Region 15, Arlington, Va.

U. S. Department of the Interior, National Park Service and U. S. Department of Transportation, Federal Highway Administration, Region 15, "Project 3C4, Natchez Trace Parkway, Proposal and Contract," 13 May 1976, Tupelo, Miss. and Sevierville, Tenn., U. S. Government Printing Office, Washington, D. C.

U. S. Department of the Interior, U. S. Soil Erosion Service, "Erosion Control Methods for the South Carolina Piedmont," 1935, Spartanburg, S. C.

U. S. Department of Transportation, Federal Highway Administration, "Erosion and Sediment Control on Highway Construction Projects," Federal-Aid Highway Program Manual, Washington, D. C., Vol 6, Chapter 7, Section 3, Subsection 1, 25 Sep 1974.

U. S. Department of Transportation, Federal Highway Administration, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," Publication FP-74, 1974, U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, "Guidelines for Erosion and Sediment Control Planning and Implementation," EPA-R2-72-015, Aug 1972, U. S. Government Printing Office, Washington, D. C.

_____, "Methods of Quickly Vegetating Soils of Low Productivity, Construction Activities," EPA 440/9-75-006, Jul 1975, U. S. Government Printing Office, Washington, D. C.

_____, "Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activities," EPA 430/9-73-007, Oct 1973, U. S. Government Printing Office, Washington, D. C.; Prepared by Hittman Associates, Inc., Columbia, Md.

U. S. Environmental Protection Agency, Office of Water Programs, "Control of Erosion and Sediment Deposition from Construction of Highways and Land Development," Sep 1971, U. S. Government Printing Office, Washington, D. C.

Valtyni, J., "Spevnovacie Ucinky Vrb Pri Vegetacych Upravach Tokov (Reinforcing Effects of Willows at Vegetative River Regulation)" (in Slovak), Lesn Cas, Vol 17, No. 2, 1971, pp 105-113.

Vaughn-Jacklin Corp., "Reclamation and Environmental Price List," undated, Chicago, Ill.

Waldron, H. H., "Debris Flow and Erosion Control Problems Caused by the Ash Eruptions of Irazu Volcano, Costa Rica," Bulletin 1241-I, 1967, U. S. Department of the Interior, Geological Survey, Washington, D. C.

Weir, W. W., "Soil Erosion in California: Its Prevention and Control," Bulletin 538, Aug 1932, University of California, Agricultural Experiment Station, Berkeley, Calif.

Whitaker, E. S., "New Deal in Slope Treatment Aims to Prevent Erosion and Beautify Roadsides," California Highways and Public Works, Vol 17, No. 7, Jul 1934, pp 6 and 10.

Wilson, J. A. and Landers, R. G., "Plant Species as Wildlife Cover and Erosion Control on 'Mudflats' in Iowa's Large Reservoir System," ISURRI-S1, 1973, Iowa State Water Resources Research Institute, Ames, Iowa.

Woodburn, R., "Erosion Control in Kentucky by C. C. C. Forces," Engineering News-Record, Vol 112, No. 4, 25 Jan 1934, pp 105-107.

Young, W. C., "Plants for Shoreline Erosion Control in Southern Areas of the United States," Geophysical Monograph Series, Vol 17, 1973, pp 798-803.

River Training Structures

Cribs

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Anonymous, "Taking the Threat Out of a River," Railway Age, Vol 93, No. 9, Aug 1932, pp 282-284 and 289.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Causey, W. R., "Bank Stabilization, Red River Below Denison Dam," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter IV, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Coppée, H. St. L., "Bank Revetment on the Lower Mississippi," Proceedings, American Society of Civil Engineers, No. 1, 1896, pp 36-117.

Dawson, E. F., Notes on the Mississippi River, Thacker, Sprink and Co., Calcutta, 1900.

Dunkley, C. L., "Suggestions for Temporary Erosion and Siltation Control Measures," Feb 1973, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

Haselwood, F. W., "Acres of Concrete Riprap and Cribs Placed to Protect Trinity River Banks," California Highways and Public Works, Vol 19, No. 3, Mar 1941, p 8.

Headquarters, Department of the Army, Office of the Chief of Engineers, Bank Protection, Mississippi River; Plant Methods and Materials in Use on Works Under Direction of Mississippi River Commission, Government Printing Office, Washington, D. C., 1922.

Hurst, C. K. and Brebner, A., "Shore Erosion and Protection, St. Lawrence River, Canada," Proceedings, 22nd International Navigation Congress, Paris, Section 1, Subject 6, pp 45-56.

Intrusion-Prepakt, Inc., "Fabricast Cribbing Stabilizes Rock Cut,"
Fabriform Report FF-57, undated, Cleveland, Ohio.

_____, "Spotlight on the World of Prepakt," published quarterly
since 1973, Cleveland, Ohio.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and
Environmental Design Consideration," Sep 1974, Colorado State Univer-
sity, Engineering Research Center, Fort Collins, Colo.; Prepared for
U. S. Department of Transportation, Federal Highway Administration and
National Highway Institute.

Leete, F. A., Regulation of Rivers Without Embankments, as Applied in
the Training Works of the Headquarters of the Rangom River, Burma,
Crosby Lockwood and Son, London, 1934.

Madden, E. B., "Stabilization Plan for the Arkansas River," Symposium
on Channel Stabilization Problems, Technical Report No. 1, Vol 1,
Chapter 3, pp 21-46, Sep 1963, Committee on Channel Stabilization, CE,
Vicksburg, Miss.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S.
Department of the Interior and National Science Foundation.

Michigan, University of, Lake Hydraulics Laboratory, "Low Cost Shore
Protection for the Great Lakes," Oct 1952 (reprinted 1975), Ann Arbor,
Mich.

Miller, C. R. and Borland, W. M., "Stabilization of Fivemile and Muddy
Creeks," Journal, Hydraulics Division, American Society of Civil Engi-
neers, Vol 89, No. HY 1, pp 67-98.

Nagai, S., "Researches on Seawalls," Proceedings, 12th Coastal Engi-
neering Conference, American Society of Civil Engineers, Washington,
Vol 3, Chapter 88, 1970, pp 1431-1450.

Newman, R. H., "A River Training Wall in New Zealand," The Structural
Engineer, Vol 11, No. 8, Aug 1933, pp 355-360.

O'Brien, J. T., "Studies of the Pervious Fence for Streambank
Revetment," Report No. A-70-1, Feb 1951, U. S. Department of Agricul-
ture, Soil Conservation Service, Washington, D. C.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic
and Environmental Design Considerations, Training and Design Manual,"
May 1975, U. S. Department of Transportation, Federal Highway Admini-
stration, U. S. Government Printing Office, Washington, D. C.

Schoklitsch, A., Hydraulic Structures, Vol 2, American Society of
Mechanical Engineers, New York, 1937.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

U. S. Army Engineer District, Kansas City, CE, "Improving and Stabilizing the Channel of the Missouri River," Jan 2, 1948 (fifth revision), Kansas City, Mo.

U. S. Army Engineer District, New Orleans, CE, "Interim Report on Navigation and Bank Stabilization," Mar 1966, New Orleans, La.

U. S. Army Engineer District, Omaha, CE, "Report on Channel Protection Against High Velocity Flow," Jun 1953, Omaha, Nebr.

U. S. Army Engineer Division, New England, CE, "Channel Protection Against High Velocity Flows," OWI 452-G, 1950, Waltham, Mass.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Department of Agriculture, Forest Service, "Uniform Specifications for Timber Purchaser Road Construction," Jul 1974, U. S. Government Printing Office, Washington, D. C.

_____, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Forest Service, Region Five, "Regional Standard Drawings," Jul 1975, San Francisco, Calif.

U. S. Department of Transportation, Federal Highway Administration, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," Publication FP-74, 1974, U. S. Government Printing Office, Washington, D. C.

Dikes (sill, groin, spur, jetty)

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Advance Construction Specialties Co., Inc., "Stop Erosion of Subgrade Materials in Water Control Structures, Retain Drainage Design," undated, Memphis, Tenn.

Agerschou, H. A., "Synthetic Material Filters in Coastal Protection," Proceedings, American Society of Civil Engineers, Vol 87, No WW1, 1961, pp 111-123.

Agostini, R. et al., "Maccaferri Gabions," 1971, Officine Maccaferri S.p.A., Bologna, Italy.

Ahmad, M., "Experiments on Design and Behavior of Spur Dikes," Proceedings, Minnesota International Hydraulics Convention, 1-4 Sep 1953, pp 145-159.

_____, "Spacing and Projection of Spurs for Bank Protection," Civil Engineering (London), Vol 46, No. 537, Mar 1951, pp 172-174; No. 538, Apr 1951, pp 256-258.

American Association of State Highway Officials, Task Force on Hydraulics, "Guidelines for Erosion and Sediment Control in Highway Construction," Highway Drainage Guidelines, Vol 3, Washington, D. C., 1973.

American Railway Engineers Association, "Natural Waterways: Prevention of Erosion," American Railway Engineers Association Bulletin, Report on Assignment 3, Vol 56, No. 521, Feb 1955, pp 679-687.

American Society of Civil Engineers, "Channel Stabilization of Alluvial River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, Feb 1965, pp 7-37.

Anonymous, "Arkansas River Being Confined at Chronic Trouble Tract," Construction News, Vol 27, No. 42, 19 Oct 1960, p 58.

_____, "Bank Protection," Louisiana Highways, Vol 4, No. 2, Feb 1950, pp 1 and 4.

_____, "Bridge Protected from Shifting Channel," Engineering News-Record, Vol 89, No. 21, 23 Nov 1922, pp 884-885.

_____, "Gabions Control Erosion," The Military Engineer, Vol 68, No. 441, Jan-Feb 1976, pp 28-29.

_____, "New Form of Bank Protection on Sacramento River," Engineering News-Record, Vol 97, No. 5, 29 Jul 1926, pp 190-191.

_____, "New Plans for the Mississippi," Engineering News-Record, Vol 111, No. 6, 10 Aug 1933, pp 166-169.

_____, "Permeable Pile Jetties Stop River Bank Erosion," Construction Methods, Vol 27, No. 9, Sep 1945, p 81.

_____, "Pile Dike Protects Caving River Bank," Contractors and Engineering Monthly, Vol 44, No. 8, Aug 1947, pp 52-55.

_____, "Pile Dikes and Riprap Control Bank Erosion," Contractors and Engineers, Vol 52, No. 1, Jan 1955, pp 16-17.

Anonymous, "Piling and Wire Fencing Protects Stream Banks near Bridges," Engineering News-Record, Vol 96, No. 10, 11 Mar 1926.

_____, "Protection Against Erosion by the Sea," Concrete and Constructional Engineering (London), Apr 1956, pp 355-356.

_____, "River Banks Stabilized by Revetments and Dikes," Civil Engineering (London), Vol 20, No. 2, Feb 1950, pp 44-45.

_____, "Specifications for the Construction of the Several Types of River Bank Protection in Common Use--1935," Bulletin, American Engineering Railway Association, Vol 37, No. 379.

_____, "Stabilizing Colorado River Banks," Wood Preserving News, Vol 22, No. 12, Dec 1944, pp 120-121 and 129.

_____, "Tetrapods Used in Marine Construction," World Dredging and Marine Construction, Vol 3, No. 2, Jul-Aug 1967, pp 30-31.

_____, "The Regulation of the River Rhine at St. Gallen," Die Eisenbahn, 24 May 1879.

_____, "Timber Deflectors Prevent Bank Scour," Engineering News-Record, Vol 127, No. 5, 31 Jul 1941, p 154.

_____, "Timber Groins for Beach Protection," Engineering and Contracting, Vol 49, No. 12, pp 433-435.

_____, "Training the Ganga at Kankhal," Bhagirath (Irrigation and Power Monthly), Vol 5, Apr 1959, pp 384-385.

_____, "Two Types of Creosoted Timber Bank Protection at Colorado Bridge," Wood Preserving News, Vol 13, No. 1, Jan 1935, pp 8-9.

Asphalt Institute, "Asphalt for Beach Protection," Dec 1950, Institute, New York, N. Y.

_____, "Asphalt Leads the Fight Against Beach Erosion," Nov 1955, College Park, Md.

Avakian, L. S., "Asbury Park's Successful Asphalt Jetties," Asphalt Jetties Save the World's Shoreline, The Asphalt Institute, College Park, Md., Information Series No. 149, Jan 1969, pp 4-5.

_____, "Battering Storms Leave Asphalt Jetty Unharmed," Asphalt, Vol 17, No. 4, Oct 1965, p 13.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

Bajpai, G. N., "Design of Rubble Mound Breakwaters, Dock and Port Authority, Vol 27, May 1964, pp 377-383.

Balsillie, J. H. and Berg, D. W., "State of Groin Design and Effectiveness," CERC Reprint 15-73, 1973, U. S. Army Coastal Engineering Research Center, Fort Belvoir, Va.

Baltimore Sun, "Old Cars as Breakwater Add Woes to Seaside Town," 12 Apr 1966, Baltimore, Md.

Bartnett, E. J., "Man Battles Sea for Area's Shore," New York Times, 3 Sep 1956, New York, N. Y.

Berg, D. W. and Watts, G. M., "Variations in Groin Design," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 93, No. WW2, Proceedings Paper 5241, pp 79-100.

Blackman, B., "Report on Jetties," 1938, U. S. Shore Protection Board, Washington, D. C.

Blaess, A. F. et al., "Methods of Protecting River Banks Against Erosion," Bulletin, American Railway Engineering Association, Vol 30, No. 311, Nov 1928, pp 260-270.

_____, "Report on Methods for Providing Against River Bank Erosion," Bulletin of the American Railway Engineering Association, Vol 31, No. 324, Feb 1930, p 1333.

Blumenthal, K. P., "The Construction of a Drift Sand Dyke on the Island Rottumerplatt," Proceedings, Ninth Coastal Engineering Conference, American Society of Civil Engineers, Chapter 23, 1965, pp 346-367.

Bodoky, L., "Condition of the Rivers and Navigable Communications in Hungary," Magyar Mernok-es Epitesz - Egylet Rozlonye, Vol XIII, 1936, p 35 et seq.

Boland, R. A., Jr., and Bobb, W. H., "Effects of Proposed Elizabeth River Dike on Tides, Currents, Salinities, and Shoaling; Hydraulic Model Investigation," Miscellaneous Paper H-69-13, Dec 1969, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Braithwaite and Company Engineers, Limited, "The Du-Plat-Taylor Adjustable Groynes," Catalogue No. S1032, 1933, Westminster, England.

Brogdon, N. J., Jr., "Grays Harbor Estuary, Washington," Technical Report H-72-2 (4 reports), Sep 1972, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Bromley, J. A., "Shore Erosion and Prevention in Tidewater, Maryland," Wood Preserving News, Vol 17, No. 5, May 1939, pp 51-53 and 61.

Bubenik, M. C., "Channel Stabilization, Columbia River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 6, pp 69-74, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Burgoyne, W. M., "Causes of Erosion and Various Methods of Shore Protection," The Canadian Engineer, Vol 66, No. 24, 12 Jun 1934, pp 7-11.

Bush, J. L., "Channel Stabilization on the Arkansas River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 88, No. WW2, Part I, 1962, pp 51-67.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Campbell, T. N., "Trout and Title X," Soil Conservation, Vol 41, No. 10, May 1976, pp 18-20.

Canadian Center for Inland Waters, Environment Canada, "Shore Erosion--Cause and Cure," 1974, Ottawa.

Carey, W. C., "Construction Problems in Comprehensive River Stabilization," undated, U. S. Army Engineer District, New Orleans, CE, New Orleans, La.

Causey, W. R., "Bank Stabilization, Red River Below Denison Dam," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter IV, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Chase, W. H., "Redwood Timber Deflectors Built as Bank Protection on Eel River," California Highways and Public Works, Vol 19, No. 5, May 1941, pp 2-4.

Chatterton, A. E. and Little, D. H., "Some Jetty Designs," Proceedings, The Institution of Civil Engineers, Vol 33, Paper 6725, Mar 1966, pp 403-418.

Cheatham, G. C., "Bank Protection-Erosion Controls," Unpublished and undated handout prepared for landowners, U. S. Army Engineer District, Tulsa, CE, Tulsa, Okla.

Childs, W. M., "Experimental Retards, Mile 90, Red River (Interim Report)," Office Memorandum, 16 Jun 1948, Mississippi River Commission, Vicksburg, Miss.

Christian, H. E., "Channel Stabilization and Bank Protection," Summer Short Course on River Systems, University of Nebraska, Lincoln, Nebr., 1972.

Claxton, P., "Stabilization Methods Used on the Indus Recommended for the Mississippi," Engineering News-Record, Vol 103, 17 Oct 1929.

Clay, C., "Control Works on the River Wear," Civil Engineering and Public Works Review, Vol 48, No. 56, Mar 1953, pp 255-258.

Cobb, W. C., "The Passes of the Mississippi River," Transactions, American Society of Civil Engineers, Vol CT, 1953, pp 1147-1162.

Collier, C. A., "Seawall and Revetment Effectiveness, Cost and Construction," Report No. 6, May 1975, Florida Sea Grant Program, Gainesville, Fla.

Colson, B. E. and Wilson, K. V., "Hydraulic Performance of Bridges, Efficiency of Earthen Spur Dikes in Mississippi," MSMD-RD-73-15-SD, Feb 1974, Mississippi State Highway Department, Jackson Research and Development Division, Jackson, Miss.

Coppée, H. St. L., "Bank Revetment on the Lower Mississippi," Proceedings, American Society of Civil Engineers, No. 1, 1896, pp 36-117.

Corthell, E. L., A History of the Jetties at the Mouth of the Mississippi River, Wiley, New York, 1880.

Cotton, K. E., "Timber in the Construction of Sea Defence and River Works," Civil Engineering and Public Works Review, Vol 51, No. 604, pp 1135-1137.

Crews, J. E., "Bank Stabilization in Susquehanna River Basin," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 96, No. WW1, Feb 1970, pp 87-95.

Cunningham, B., Coast Erosion and Protection, Charles Griffen and Co., Ltd., London, 1934.

Curd, W. C., "Bank Protection and Restoration, A Problem in Sedimentation," Transactions, American Society of Civil Engineers, Vol 84, Paper No. 146, 1921, pp 303-330.

D'Angremont, K. et al., "Use of Asphalt in Breakwater Construction," Proceedings, 12th Coastal Engineering Conference, Washington, Vol 3, Chapter 98, 1970, pp 1601-1627.

Davis, E. I. and Lipscomb, E. B., "Stabilizing the Lower Mississippi River," Civil Engineering, Vol 35, No. 11, Nov 1965, pp 64-69.

Dawson, E. F., Notes on the Mississippi River, Thacker, Sprink and Co., Calcutta, 1900.

Degenhardt, E. A., Channel Stabilization of the Middle Mississippi River (Unpublished Thesis), Colorado State University, Fort Collins, Colo., Aug 1973.

Denton, H., "Ocean Nibbling Two Feet a Year from Beaches at Ocean City," Washington Post, 14 Nov 1971, Washington, D. C.

Dobson, G. C., "The Evolution of Bank Protection Works in the United States, 1867-1932," 21 Oct 1932, U. S. Army Engineer District, Memphis, CE, Memphis, Tenn.

Dodge, R. O., "Design of Columbia River Pile Dikes," Journal, Waterways, Harbors, and Coastal Engineering Division, American Society of Civil Engineers, Vol 97, No. 2, May 1971, pp 323-348.

Drisko, J. B., "Improving the Oder River," Civil Engineering (London), Vol 3, Jun 1933, pp 314-318.

Duke, C. M., "Shoaling of the Lower Hudson River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 87, No. WW1, Paper 2730, Feb 1961, pp 29-45.

Dunham, J. W. and Finn, A. A., "Small-Craft Harbors, Design, Construction and Operation," Special Report No. 2, Dec 1974, U. S. Army Coastal Engineering Research Center, U. S. Government Printing Office, Washington, D. C.

Duvivier, J., "Coast Protection: Some Recent Works on the East Coast, 1942-1952," Proceedings, Part I, Institution of Civil Engineers, Paper No. 5901, Jan 1953, pp 510-531.

_____, "The Selsey Coast Protection Scheme," Proceedings, Institution of Civil Engineers, Vol 20, Paper No. 6542, Dec 1961, pp 481-506.

Elliot, D. O., Improvement of the Lower Mississippi River for Flood Control and Navigation, Vol II, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss., May 1932.

Emmons, W. F. and Meyer, A. A., "Review of Slope Protection Methods, Report of the Subcommittee on Slope Protection of the Committee on Earth Dams of the Soil Mechanics and Foundations Division," Proceedings, American Society of Civil Engineers, Vol 75, No. 1, Jan 1949, pp 155-158.

Executive Committee--General Secretary, "Permanent International Association of Navigation Congresses," Proceedings, XVIIth International Navigation Conference, Lisbon, 1949.

Fajin, O. F., "A Study of Methods of Stabilizing and Improving Ozark Streams," 1974, Research Project, State Department of Conservation, Jefferson City, Mo.; Performed for U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Federal Aid Division.

Feagin, L. B., "Program of the Mississippi River Commission," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter V, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Felker, R. H., "Streambank Control," Soil Conservation, Vol 12, No. 5, Dec 1946, pp 114-117.

Font, J. B., "Damage Functions for a Rubble Mound Breakwater Under the Effect of Swells," Proceedings, 12th Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 96, 1970, pp 1567-1585.

Fowler, J., "River Tees Improvements," Institute of Civil Engineering, Vol 90, 1887.

Fox, S. W., "Technical Methods of River Improvement as Developed on the Lower Missouri River by the General Government from 1876 to 1903," American Society of Civil Engineers Transactions, Vol 54, 1905, pp 280-345.

Franco, J. J., "Laboratory Research on Design of Dikes for River Regulation," Miscellaneous Paper 2-860, Nov 1966, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Research for River Regulation Dike Design," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 93, No. WW3, Aug 1967, pp 71-87.

Franco, J. J. and Glover, J. E., "Effects of Submerged Sills in the St. Clair River; Hydraulic Model Investigation," Technical Report H-72-4, Aug 1972, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Franco, J. J. and McKellar, C. D., Jr., "Channel Conditions, Devil's Island Reach, Mississippi River, Missouri and Illinois; Hydraulic Model Investigation," Technical Report H-73-1, Feb 1973, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Freeman, J. R., "Flood Problems in China," American Society of Civil Engineers Transactions, Vol 85, 1922, pp 1405-1460.

Gill, M. A., "Erosion of Sand Beds Around Spur Dikes," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 98, No. HY 9, Sep 1972, pp 1587-1602.

Givens, F. B., Jr., "Shoreline Erosion Control on Virginia's Rivers and Bays," Shore and Beach, Vol 44, No. 1, Apr 1976, pp 25-30.

Grant, A. P. and Fenton, G. R., "Willows and Poplars for Conservation and River Works," Bulletin No. 6, 1948, Soil Conservation and Rivers Control Council, Wellington, N. Z.

Grass Pavers, Ltd., "Introducing Monoslabs, Turf and Soil Concrete Grids," 1974, Royal Oak, Mich.

Gupta, S. N. et al., "Alluvial River Behavior--A Few Aspects of Its Simulation in a Model," Proceedings, 13th Congress of International Association of Hydraulic Research, Vol 1, Kyoto, Japan, 1969, pp 1 et seq.

Haas, R. H. and Graham, J., "Paper," Inland Navigation (Sect. 1), Principles Governing the Design and Construction of Economic Revetments for Protecting the Banks of Rivers and Canals for Ocean- and Inland-Navigation (Subject 6), XXIIInd International Navigation Congress (PIANC), Paris 1969.

Haas, R. H. and Weller, H. E., "Bank Stabilization by Revetments and Dikes," Proceedings, American Society of Civil Engineers, Vol 78, Separate No. 48, Sep 1952.

Harloe, B. M., "Channel Regulation by Dikes on the Middle Mississippi," Engineering News-Record, Vol 112, 10 May 1934, pp 606-610.

Hartke, W. O., "The Stone-Fill Dike in the Mississippi River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 4, Chapter II, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Haydon, G. C., "The Missouri River and Its Improvements," 1931, U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Headquarters, Department of the Army, Office of the Chief of Engineers, Bank Protection, Mississippi River, Plant Methods and Materials in Use on Works Under Direction of Mississippi River Commission, Washington, D. C., 1922.

Hearn, G., "Stabilization of Alluvial Rivers in India," Engineering News-Record, Vol 108, 17 Mar 1932, pp 393-395.

Henley, J. E., "Channel Stabilization Work in the Vicksburg District," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 4, Chapter I, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Hertzberg, R., "Foreshore Protection, Lower Mississippi River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, No. WW2, Part I, May 1965, pp 1-16.

_____, "Wave-Wash Control on Mississippi River Levees," Transactions, American Society of Civil Engineers, Vol 119, 1954, pp 628-638.

Hickson, R. E., "Columbia River Ship Channel Improvement and Maintenance," Paper 2883, Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 87, No. WW3, Aug 1961, pp 71-93.

Hickson, R. E., "Columbia River Stabilization and Improvement for Navigation," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Chapter 4, Jun 1965.

Hodge, L. P., "Tree Groins," Institute of Civil Engineering, Vol 184, pp 1910-1911.

House of Representatives, "Shoreline Protection," House Document No. 91-22, 91st Congress, 1st Session, 20 Nov 1969, Washington, D. C.; Hearing Before the Subcommittee on Rivers and Harbors of the Committee on Public Works.

Huber, R. L., "Channel Stabilization of the Missouri River," June 1952; Presented to American Society of Civil Engineers, Denver, Colo.

_____, "Contract on Works and Bank Stabilization," Bank Stabilization Manual, Draft, 1948, Prepared by Committee on Regulation and Stabilization of Rivers by Open Channel Works, American Society of Civil Engineers, Vicksburg, Miss.

Hsu, S.-T., "Use of Permeable Dikes for River Training of Yungting River," Proceedings, Technical Conference on Flood Control in Asia and the Far East, United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Flood Control Series No. 3, Paper No. 9, 1952, pp 122-125.

Hurst, C. K. and Brebner, A., "Shore Erosion and Protection, St. Lawrence River, Canada," Proceedings, 22nd International Navigation Congress, Paris, Section 1, Subject 6, pp 45-56.

Hyde, G. E. and Beeman, O., "Improvement of the Navigability of the Columbia River by Dredging and Construction Works," Proceedings, Federal Interagency Sedimentation Conference, U. S. Department of Agriculture, Agricultural Research Service, Jackson, Miss., Paper No. 53, pp 454-461.

India, Central Board of Irrigation and Power, "Manual on River Behavior, Control, and Training," Publication No. 60, 1956, New Delhi, India.

Inglis, C. C., "Training Works Constructed in the Rupnarayan River in Bengal--After Model Experiments--To Prevent Further Bank Erosion Endangering the Bengal-Nagpur Railway Line Linking Bombay with Calcutta and Madras," Journal, Institution of Civil Engineering, Session 1945-1946, Maritime Paper No. 3, 5 Feb 1946.

Intrusion-Prepakt, Inc., "Cooling Pond-Dike Protection," undated, Fabriform Report FF-65, Cleveland, Ohio.

_____, "Fabricast Molded Blocks," 1975, Cleveland, Ohio.

_____, "Spotlight on the World of Prepakt," Published quarterly since 1973, Cleveland, Ohio.

Issacs, W. E., "Channel Stabilization on the Arkansas River, Little Rock District," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 2, Chapter VIII, May 1964, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Iszkowski, R., "Regulation of the Isar According to Wolf's Method," Wochenschrift des Osterreichischen Ingenieur - und Architekten Vereines, 1888, p 74 et seq.

Jachowski, R. A., "Behavior of Sand-Asphalt Groins at Ocean City, Maryland," Miscellaneous Paper 2-59, May 1959, U. S. Army Corps of Engineers, Beach Erosion Control Board, Washington, D. C.

Jachowski, R. A. and Watts, G. M., "Development of Functional Structural Design Criteria," Research Project, 1976, U. S. Army Coastal Engineering Research Center, Fort Belvoir, Va.

Jakobsen, P. R. and Nielsen, A. H., "Some Experiments with Sand-Filled Flexible Tubes," Proceedings, 12th Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 92, 1970, pp 1513-1521.

Jentoft, L. H. et al., "Natural Waterways: Prevention of Erosion," Bulletin, American Railway Engineering Association, Vol 56, No. 521, Feb 1955, pp 679-687.

Jones, H. H., "Training Works on the Lower Granges Canal," Professional Papers on Civil Engineering, 2nd Series, Vol 6, 1922, pp 278-286.

Kapteyn, P. T., "Improvement of the Lower Weser," Tidjschrift van het Koninklijk Instituut van Ingenieurs, 1892-1893.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Keeley, J. W., "Bank Protection and River Control in Oklahoma," 1971, Federal Highway Administration, Bureau of Public Roads, Oklahoma Division, Oklahoma City, Okla.

Kidby, J. W., "Columbia and Lower Willamette Rivers, 40- by 600-Ft Project," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Chapter 3, Jun 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Kikkawa H. and Ashida, K., "Study of Groins--Preliminary Study of Flow in the Vicinity of Groins," Journal of Research, Public Works Institute, Japan, Vol 2, Research Paper 3, Mar 1957.

Krischan, C., "Experiments with Model Groins for River Engineering," Zeitschrift des oesterr eichischen Ingenieur und Architekten--Vereines, 1902, p 469.

Lee, T. T., "Design of Filter System for Rubble-Mound Structures," Proceedings, 13th Coastal Engineering Conference, Vancouver, B. C., Canada, Vol 3, Chapter 109, 1972, pp 1917-1933.

Lillivang, O. J., "Groins and Effects Minimizing Liabilities," Proceedings, Santa Barbara Specialty Conference, American Society of Civil Engineers, Santa Barbara, Calif., Chapter 31, 1966, pp 749-754.

Lindner, C. P., "Bank Stabilization and Contraction Problems in the South Atlantic Division," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 2, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

_____, "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Lipscomb, E. B. and Otto, W. C., "Paper," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965.

Louisiana, State of, Department of Highways, "Spur Dike at Bridge Ends," 14 Sep 1971, Baton Rouge, La.

Lowdermilk, W. C., "Erosion Control in Japan," 1934, U. S. Department of Agriculture, Soil Conservation Service, Washington, D. C.; Mimeographed copy reprinted from 1927 edition of Oriental Engineer originally published in Peking, China.

Lowe, J. H., "The Protective Works for Preventing the Threatened Outbreak of the South Rangitata River, New Zealand," Institute of Civil Engineering, Vol 64, 1880-1881, p 1 et seq.

Maccaferri Gabions, Inc., "Construction of Marinas with Maccaferri Gabions," 1969, Flushing, N. Y.

_____, "Maccaferri Gabions," undated, New York, N. Y.

Madden, E. B., "Stabilization Plan for the Arkansas River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 3, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Magnuson, N. C., "Planning and Design of a Low-Weir Section Jetty at Masonboro Inlet, North Carolina," Coastal Engineering Santa Barbara Specialty Conference, American Society of Civil Engineers, Santa Barbara, Calif., Chapter 31, 1966, pp 749-754.

Manak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Manning, J., "River Control Structures," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 2, Chapter II, May 1964, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Manning, J. W., "Proposed Plan for Bank Erosion Control and Bank Stabilization on the Kansas River, Mile 28.5 to Mile 20.8," Unpublished Memorandum for File, 23 March 1956, U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Mason, M. A., "Beach Erosion and Shore Protection," E 207.11(350)ML, 1948, U. S. Army Engineer School, CE, Fort Belvoir, Va.

McEwan, J. S., "Bank and Level Stabilization, Lower Colorado River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 87, No. WW4, Nov 1961, pp 17-25.

McLean, J. L., "Control of Rivers Without Embankments," Proceedings, Regional Technical Conference on Flood Control in Asia and the Far East, United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Flood Control Series No. 3, Paper No. 4, 1952, p 607.

Michigan, State of, Department of Highways, "Program for Soil Erosion and Sedimentation Control for Application for Designation as Authorized Public Agency According to Requirements of Act 347, P. A. of 1972," 1972, Lansing, Mich.

Michigan, University of, Lake Hydraulic Laboratory, "Low Cost Shore Protection for the Great Lakes," Oct 1952 (reprinted 1975), Ann Arbor, Mich.

Miller, C. R. and Borland, W. M., "Stabilization of Fivemile and Muddy Creeks," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 89, No. HY 1, 1963, pp 67-98.

Minikin, R. C. R., Practical River and Canal Engineering, Charles Griffin and Co., Ltd., London, 1920.

Mississippi River Flood Control Association, The Flood of 1927, Memphis, Tenn., 1928.

Moore, J. T., "A Case History of Santa Cruz Harbor, California," Report No. HEL-24-14, Jun 1972, University of California, Hydraulic Engineering Laboratory, Berkeley, Calif.

Moore, N. A., Improvement of the Lower Mississippi River and Tributaries 1931-1972, Mississippi River Commission, Vicksburg, Miss., 1972.

Morger, J., "Engineering Study of River Jetties, Tuxpan and Alvarado, Mexico," U. S. Naval Forces Southern Command, 18 Dec 1967; Prepared for the Secretary of the Navy, Mexico.

Myers, H. B., "Red River Bank Stabilization," unpublished and undated, Mississippi River Commission, CE, Vicksburg, Miss.

Naue-Fosertechnik, "Terrafix, Terradran," undated, Espelkamp-Fiestel, W. Germany.

Nevins, T. H. F., "Control of River Erosion by Permeable Timber Groynes," Commonwealth Engineer, Vol 21, No. 2, 1 Sep 1933, p 33.

New York Times, "Army Charts Jersey Erosion Plan," 9 Jun 1961, New York, N. Y.

_____, "Army Completes Fire Island Work," 6 Dec 1959, New York, N. Y.

_____, "Fire Island Holds Talks on Erosion," 23 Aug 1959, New York, N. Y.

_____, "Owners of Two L. I. Jetties Agree to Remove Them," 17 Jun 1971, New York, N. Y.

Nixon, M., "Flood Regulation and River Training," River Engineering and Water Conservation Works, R. B. Thorn, ed., Chapter 18, Butterworths, London, 1966, pp 239-271.

O'Brien, J. T., "Studies of the Pervious Fence for Streambank Revetment," Report No. A-70-1, Feb 1951, U. S. Department of Agriculture, Soil Conservation Service, Washington, D. C.

Odom, B. W., Jr., "River Regulation Works on the Apalachicola River," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter VII, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Officine Maccaferri, S.p.A., "Gabions for Flexible River Groynes," Technical Booklet No. 10, undated, Bologna, Italy.

_____, "The Use of Gabions in the Construction of Weirs," Technical Booklet No. 9, undated, Bologna, Italy.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, A Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oregon.

Organizing Committee, Tenth Conference on Coastal Engineering, "Outline of Coastal Engineering in Japan," 1966, Tokyo, Japan.

Palmer, R. Q. and Walker, J. R., "Honolulu Reef Runway Dike," Proceedings, Twelfth Coastal Engineering Conference, American Society of Civil Engineers, Washington, Vol 3, Chapter 99, 1970, pp 1557-1566.

Parker, F. Y., "Seven Pile Dikes Protect Missouri River Against Bank Erosion," Engineering News-Record, Vol 95, No. 13, 24 Sep 1925, pp 519-520.

Parker, T. C. and Kittredge, F. A., "Wire-Bound Rock Training Walls Solve Zion Park Flood Problem," Engineering News-Record, Vol 115, 14 Nov 1935, pp 684-686.

Petersen, M. S., "Hydraulic Aspects of Arkansas River Stabilization," Bulletin, Permanent International Association of Navigation Congresses, Vol III, No. 13, 1964, pp 3-39.

Pickels, G. W., "Flood Protection by Channel Improvement," Drainage and Flood Control, Chapter 11, McGraw-Hill, New York, 1941, pp 321-354.

Pickering, G. A. and Murphy, T. E., "Ansonia-Derby Local Protection Project, Maugatuck and Housatonic River, Connecticut; Hydraulic Model Investigation," Technical Report No. H-69-4, Apr 1969, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Pittman, H. V., De La Sayette, E. R., and Lelivasky, S., "Discussion of Bank Stabilization by Revetments and Dikes," Discussion of Proceedings--Separates, American Society of Civil Engineers, Vol 79, Separate No. 368, No. 148, Dec 1953, pp 368-1 - 368-10.

Portland Cement Association, "Concrete Shore Protection," 1937, Chicago, Ill.

Precise Products, "American Gabions," undated, Browning, Mont.

Reed, R. L., "Gulf Waters Eating Away a Louisiana Resort Beach," New York Times, 29 May 1971, New York, N. Y.

Reid, G., How to Hold Up A Bank, A. S. Barnes and Co., New York, 1969.

Rhodes, W. E., "Tires, Inexpensive Shoreline Erosion Control" (unpublished), 1963, Wittman, Md.

Richardson, E. V. and Simon, D. B., "Spurs and Guide Banks," 6 February 1974, Colorado State University, Fort Collins, Colo.; Prepared for Water and Environment Consultants, Inc., Fort Collins, Colo.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

_____, "Lower Yellowstone Riverbank Stabilization Program," Review Board Report, Aug 1974, U. S. Department of Interior, Bureau of Reclamation, Upper Missouri Region, Billings, Mont.

Rijkswaterstaat, The Hague, "The Realization and Function of the Northern Basin of the Delta Project," 1973, The Hague, Netherlands.

Ross, P. H., "Erosion Control and Arizona's Future," Arizona Highways, Vol 8, No. 12, pp 3-4 and 24-26.

Rossini, R., "Works for the Regulation of the Minor Bed of the River Po in View of Navigation by Vessels of 600 Tons," Bulletin, Permanent International Association of Navigation Congresses, No. 40, Jul 1954, pp 175-207.

Russell, R. C. H., "Coast Erosion and Defence," Hydraulics Research Paper No. 3, 1960, Department of Scientific and Industrial Research, Hydraulics Research Station, Her Majesty's Stationery Office, London.

Sain, K. and Pao, K. L., "Report on the Recent River Valley Projects in China," Mar 1955, Government of India, Central Water and Power Commission, New Delhi, India.

Scheen, J. W., "General Report," Inland Navigation (Sect. 1), New Materials and Methods for Protecting the Banks and Bottoms of Canals, Rivers, and Ports and Their Costs and Relative Advantages (Subject 4), XXist International Navigation Congress (PIANC), Stockholm, 1965.

Seoates, D., "Getting Rid of Gullies," Southern Ruralist, Vol 35, No. 18, 15 Dec 1928.

Senour, C., "Stabilization of Banks of Streams of the Lower Alluvial Valley of the Mississippi River," Proceedings, Federal Interagency Sedimentation Conference, Denver, Colo., Vol 8, May 1947, pp 185-189.

Sharp, W. C. and Vaden, J., "10-Year Report on Sloping Techniques Used to Stabilize Eroding Tidal River Banks," Shore and Beach, April 1970, pp 31-35.

Sibert, K. V., "Kansas River Bank Stabilization Plan of Improvement Lecompton-Lawrence, Kansas," Unpublished Memorandum for File, Nov 22, 1954, U. S. Army Engineer District, Kansas City, CE, Kansas City, Mo.

Sih, L.-T., "Embankments and Bank Protection of the Taiwan Rivers," Proceedings, Technical Conference on Flood Control in Asia and the Far East Flood Control Series No. 3, United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Paper No. 7, 1952, pp 87-108.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CHER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Spring, F. J. E., "River Training and Control on the Guide Bank System," Technical Paper No. 153, 1903; Reprinted 1935 for Railway Board at the East Indian Railway Press, Calcutta, India.

Stacy, W. A., "Bank Stabilization in Nebraska," Wood Preserving News, Vol 26, No. 2, Feb 1946, pp 18-20 and 25-26.

Stewart, J. L., "Protection of Roads and Bridges Against Stream Erosion," Roads and Streets, Vol 70, No. 5, May 1930, pp 171-172.

Stickney, A., "On Plan of Bank Protection for the Mississippi River," 5 Nov 1896; Presented at the Mississippi River Commission, CE, Vicksburg, Miss.

Taube, C. M., "Stabilization of an Eroded River Bank," Journal, Soil and Water Conservation, Vol 22, No. 6, Nov-Dec 1967, pp 249-250.

Tejasen, J. and Remillieux, M., "Chad Phya River Training Works," Proceedings, International Association for Hydraulic Research Symposium on River Mechanics, Asian Institute of Technology, Bangkok, Thailand, Vol 1, 1973, pp 241-250.

Terra Aqua Conservation, "Bekaert Gabions," Jan 1976, Reno, Nev.

Thomas, B. F. and Watt, D. A., The Improvement of Rivers: A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams, 2d ed., Part I, Wiley, New York, 1913.

Thompson, J. C., "Report to the Committee on Channel Stabilization, Middle Rio Grande Project," 13 Feb 1963, U. S. Department of the Interior, Bureau of Reclamation, Albuquerque, N. Mex.

Thronber, C. H., "Bank Stabilization, Willamette and Columbia Rivers," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Chapter 5, Jun 1965, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Thorson, D. and Shirole, A. M., "Design Criteria for Controlled Scour and Energy Dissipation at Culvert Outlets Using Rock and Sill," 1969, South Dakota School of Mines and Technology, Rapid City, S. Dak.

Tiefenbrun, A. J., "Bank Stabilization of Mississippi River Between the Ohio and Missouri River," Proceedings, Federal Interagency Sedimentation Conference, Agricultural Research Service, Jackson, Miss., Miscellaneous Paper No. 970, Paper No. 45, 1963, pp 387-397.

Tilton, G. A., Jr., "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

Tison, L. J., "The Action of Projecting Obstacles, Primarily Spur Dikes on Banks" (unpublished and undated), Mississippi River Commission, CE, Vicksburg, Miss.

Towl, R. N., "Missouri River Bank Protection at Omaha, Nebraska," Transactions, American Society of Civil Engineers, Vol 85, 1922, p 1482.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series No. 4, 1953, Bangkok, Thailand.

U. S. Army Beach Erosion Board, CE, "Manual of Procedures in Beach Erosion Studies," Paper No. 2, 1 Dec 1938, Washington, D. C.

_____, "Shore Protection Planning and Design," Technical Report No. 4, 1954, U. S. Government Printing Office, Washington, D. C.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual" (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer District, Alaska, CE, "FY 66--Erosion Control Maintenance Study, Yukon River, Galena Airport, Alaska," 17 Dec 1965, Anchorage, Alaska.

U. S. Army Engineer District, Fort Peck, CE, "Report on Measures for Bank Protection on the Yellowstone River and Tributaries," Civil Works Investigation No. 509-e, Jun 1954, Fort Peck, Mont.

U. S. Army Engineer District, Kansas City, CE, "A Base Line Study of the Missouri: Rulo, Nebraska, to Mouth near St. Louis, Missouri," Contract Report, 31 Aug 1974, Kansas City, Mo.; Prepared by University of Missouri, Rolla, Mo., et al.

_____, "Bank Erosion," Unpublished and undated handout prepared for landowners, Kansas City, Mo.

_____, "Channel Stabilization Structure," File No. SP-P-0474, Sheets 1-10, Apr 1974, Kansas City, Mo.

_____, "Improving and Stabilizing the Channel of the Missouri River," Jan 2, 1948 (fifth revision), Kansas City, Mo.

_____, "Invitation for Bids (Construction Contract) No. DACW 41-76-B-0050: Channel Stabilization Missouri River to Mouth--Rulo to Upper Miami Bends (Mile 498.4 to Mile 262.6)," March 29, 1976, Kansas City, Mo.

U. S. Army Engineer District, Memphis, CE, "Report on Experimental Groins for Bank Protection," 31 Mar 1931, Memphis, Tenn.

_____, "Revetment and Dike Data Sheets," 30 Jun 1964, Memphis, Tenn.

U. S. Army Engineer District, Mobile, CE, "Channel Stabilization Studies on the Apalachicola River," 1965, Mobile, Ala.

U. S. Army Engineer District, New Orleans, CE, "Bayou Lafourche, Louisiana; Design Memorandum No. 1, Belle Pass Jetty Rehabilitation," Dec 1960, New Orleans, La.

_____, "Calcasieu River and Pass, Louisiana; Design Memorandum No. 2, Jetty Rehabilitation," Jul 1961, New Orleans, La.

_____, "Channel Improvement Data Report," 1965, New Orleans, La.

_____, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, New Orleans, La.

U. S. Army Engineer District, New Orleans, CE, "Interim Report on Navigation and Bank Stabilization," Mar 1966, New Orleans, La.

U. S. Army Engineer District, Omaha, CE, "Missouri River Garrison Dam to Lake Oahe Reservoir," Final Environmental Impact Statement, Nov 1973, Omaha, Nebr.

U. S. Army Engineer District, Portland, CE, "Lower Columbia River Protection Project, Oregon and Washington," Final Environmental Impact Statement, Aug 1972, Portland, Oreg.

_____, "Report on Pile Dike Structures, CWI No. 509-d, Nooksack River, Washington," 1953, Portland, Oreg.

_____, "Reports on Technical Details of Methods and Designs Employed on River and Harbor Works," 14 Dec 1939, Portland, Oreg.

U. S. Army Engineer District, Rock Island, CE, "How to Engineer a Solution to Long-Term Erosion Problems," undated, Rock Island, Ill.

U. S. Army Engineer District, Seattle, CE, "Nooksack River, Washington, Report on Pile Dike Structures," Civil Works Investigation No. 509-d, Jun 1953, Seattle, Wash.

U. S. Army Engineer District, St. Louis, CE, "Geomorphology of the Middle Mississippi River," Contract Report Y-72-2, Jul 1974, St. Louis, Mo.; Prepared by Engineering Research Center, Colorado State University, Fort Collins, Colo., and monitored by Office of Environmental Studies, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Improvement of Middle Mississippi River," May 1939, St. Louis, Mo.

U. S. Army Engineer District, Vicksburg, CE, "Channel Improvement Data Report, FY 1973," 30 Jun 1973, Vicksburg, Miss.

U. S. Army Engineer Division, New England, CE, "Small Navigation Project, Andrews River, Harwich, Massachusetts," Draft Environmental Impact Statement, 19 Jun 1971, Waltham, Mass.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Army Engineer School, CE, "Flood Control, Flood Fighting," E206-13(1-52) ML, 1951, Fort Belvoir, Va.

_____, "Jetties and Breakwaters," Coastal and Harbor Engineering, Fort Belvoir, Va., Lesson No. 72, 19 Mar 1948.

U. S. Army Engineer School, CE, "Open River Regulation; Training Structures," E202-4(2-59) ML, 1959, Fort Belvoir, Va.

U. S. Army Engineer Waterways Experiment Station, CE, "Model Studies for Channel Stabilization, Mississippi," Paper 15, Jan 1934, Vicksburg, Miss.

U. S. Department of Agriculture, "Cuyahoga River Watershed, Program for Runoff and Water Flow Retardation and Soil Erosion Prevention," 1953, Washington, D. C.

U. S. Department of Agriculture, Forest Service, Region Five, "Salmon Creek Bridge (1N20821) Gabions," 26 Mar 1976, San Francisco, Calif.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Soil Conservation Service, "The Effect of a Watershed Project for Poplar River Watershed, Wisconsin," Draft Environmental Impact Statement, Jul 1972, Madison, Wis.

U. S. Department of the Interior, Bureau of Reclamation, "A Plan of Channel Erosion Control, Fivemile Creek, Reverton Project, Wyoming," Apr 1953, Denver, Colo.

_____, "Bank Protection, Dike and Channel Improvement, Red Bluff Diversion Dam," Specifications No. DC-6075, 1964, Denver, Colo.

_____, "Milburn Diversion Dam Dike Protection," Specifications No. DC-6670, 1968, Denver, Colo.

_____, "Senator Wash Dam Dikes and Pump Generating Plant, California, Technical Record of Design and Construction," Water Resources Technical Publication, Mar 1970, Denver, Colo.

U. S. Department of the Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo.; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Projects, McCook, Nebr.

U. S. Department of the Interior, Bureau of Reclamation, Upper Colorado Region, "Provo River Channel Revision, Deer Creek Division," Feb 1958, Salt Lake City, Utah.

U. S. Department of the Interior, Federal Water Quality Administration, "Urban Soil Erosion and Sediment Control," Water Pollution Control Research Series, 1503DTLO5/70, May 1970, U. S. Government Printing Office, Washington, D. C.; Prepared by National Association of Counties Research Foundation, Washington, D. C.

U. S. Department of the Interior, National Park Service, "Natchez Trace Parkway, Plans for Proposed Project 304, Grading, Base, Surfacing, and Structures, U. S. 45 to Mississippi Highway 363, Lee County, Mississippi," May 1976, Tupelo, Miss.; Prepared by U. S. Department of Transportation, Federal Highway Administration, Region 15, Arlington, Va.

U. S. Department of the Interior, National Park Service, and U. S. Department of Transportation, Federal Highway Administration, Region 15, "Project 304, Natchez Trace Parkway, Proposal and Contract," 13 May 1976, Tupelo, Miss, and Sevierville, Tenn., U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, "Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activities," EPA 430/9-73-007, Oct 1973, U. S. Government Printing Office, Washington, D. C.; Prepared by Hittman Associates, Inc., Columbia, Md.

Van Asbeck, W. F., "Modern Design and Construction of Dams and Dikes Built with the Use of Asphalt," Aug 1968; Presented to the VIIth Conference on Coastal Engineering, The Hague, Netherlands.

_____, "River Banks and Dikes," Bitumen in Hydraulic Engineering, Vol 2, Elsevier, London, 1964, pp 45-66.

Van Orman, C. R., "Preventing Bank Caving by Deflecting River Current," Engineering and Contracting, Vol 68, No. 3, Mar 1929, p 123.

Van Ornum, J. L., The Regulation of Rivers, McGraw-Hill, New York, 1914.

Virginia Institute of Marine Science, "Is Shoreline Erosion Your Problem?" Marine Resource Information Bulletin, May-June 1976, pp 1 and 4.

Visser, W. and Claessen, A. I. M., "Asphalt Rules the Dutch Waves," Customer Publication 171/75, 1975, Shell International Petroleum Co., Ltd., Amsterdam.

Volkhart, P., Tschoop, J., and Bisaz, E., "The Effect of Sills on River Bend," Proceedings, Asian Institute of Technology, International Association for Hydraulic Research Symposium on River Mechanics, Bangkok, Thailand, Vol I, 1973, pp 167-178.

Waddill, G. D., "Bank Protection, Submerged Spur Dikes," Unpublished Memorandum, 25 Mar 1947, Mississippi River Commission, CE, Vicksburg, Miss.

Wall, E. E., "River Control at the New St. Louis Water-Works," Engineering News-Record, Vol 96, No. 14, 8 April 1926, pp 570-572.

Wall, W. J., "Influence of Soil Types on Stabilization of the Savannah River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 9, No. WW3, Aug 1965, pp 7-23.

_____, "Planning, Construction, and Maintenance of the Stabilization Works on the Savannah River," Symposium on Channel Stabilization Problems, Report No. 1, Vol 4, Chapter VIII, Feb 1966, Committee on Channel Stabilization, CE, Vicksburg, Miss.

_____, "Stabilization Works on the Savannah River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 88, No. WW1, Feb 1962, pp 101-116.

Weir, W. W., "Soil Erosion in California: Its Prevention and Control," Bulletin 538, Aug 1932, University of California, Agricultural Experiment Station, Berkeley, Calif.

Weller, H. E., "Bank Erosion Problems on the Brahmaputra River," Sep 1966, Mississippi River Commission, CE, Vicksburg, Miss.

_____, "Bank Protection on the Mississippi River and Tributaries," Bulletin, Permanent International Association of Navigation Congresses, Extract No. 37, 1952, pp 1-19.

_____, "Brahmaputra River Bank Protection in India," Irrigation and Power, Vol 27, No. 2, Apr 1970, pp 177-189.

Winkley, B. R., "Practical Aspects of River Regulation and Control," River Mechanics I, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Woodburn, R., "Erosion Control in Kentucky by C. C. C. Forces," Engineering News-Record, Vol 112, No. 4, 25 Jan 1934, pp 105-107.

Works Committee for Regularization of the Rhine, "Tests and Study of a Rational Method of Constructing Groynes on the Upper Rhine," Bulletin, Permanent International Association of Navigation Congresses, No. 38, Jul 1953, pp 115-133.

Young, G. E., "Open River Regulation in Germany," The Military Engineer, Vol 25, Jan-Feb 1933, pp 156-160.

_____, "Regulation of German Rivers and Comparisons with American Practice," 10 Dec 1931, Miscellaneous File No. 211, U. S. Army Engineer Office, CE, Norfolk, Va.; Unpublished Memorandum to Chief of Engineers, Washington, D. C.

_____, "Technique of Open-River Regulation, American and German," The Military Engineer, Vol 25, May-June 1933, pp 199-204.

Zeribel, R., "Sand-Filled Tubes for Shore Protection," The Military Engineer, Vol 66, No. 431, May-Jun 1974, pp 170-171.

Fences

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Anonymous, "Brush, Wire Mesh and Old Rails Make River Retards," Engineering News-Record, Vol 97, No. 15, 7 Oct 1926, pp 576-577.

_____, "Creosoted Pile and Woven Wire Bank Protection in Los Angeles County," Wood Preserving News, Vol 24, No. 11, Nov 1946, pp 104 and 108.

_____, "Fence Types of Bank Protection," Southwest Builder and Contractor, Vol 98, No. 9, 7 Sep 1939, pp 10-12.

_____, "Hog Wire Stops Stream Erosion," Contractors and Engineers Monthly, Vol 33, No. 5, Nov 1936, pp 1 and 20.

_____, "New Mexico Used Creosoted Piles and Woven Wire for Bank Protection," Wood Preserving News, Vol 17, No. 6, Jun 1939, pp 70-71.

_____, "Permeable Dikes Built of Wire Fencing," Engineering News-Record, Vol 131, 4 Nov 1943, pp 674-675.

_____, "Piling and Wire Fencing Protects Stream Banks near Bridges," Engineering News-Record, Vol 96, No. 10, 11 Mar 1926, p 419.

Ayres, Q. C., Soil Erosion and Its Control, McGraw-Hill, New York and London, 1936.

Bradley, J. A., "Reed-Backed Fences for Channel Protection," Civil Engineering, New York, Vol 14, No. 9, Sep 1944, pp 387-388.

Brashears, H. A. and Frogge, R. R., "Stabilizing a River Channel for the Conveyance of Irrigation Water and Sediment Control," Proceedings, Ninth Congress of the International Commission on Irrigation and Drainage, Moscow, Question 30, Jul 1975, pp 30.433-30.447.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Celanese, Fibers Marketing Co., "Mirafi 140," 1975, New York, N. Y.

Erosion Control, Inc., "Erosion Controls," undated, West Palm Beach, Fla.

Heath, W. F., "River Bank Protection Works," 1963, International Boundary and Water Commission, U. S. Section, Harlingen, Tex.

Knapp, F. H. and Libby, J. A., "Erosion of Streambanks, Its Prevention and Correction," Regional Bulletin No. 78, Engineering Series No. 6, Forestry Series No. 14, 1 Apr 1942, U. S. Department of Agriculture, Soil Conservation Service, Albuquerque, N. Mex.

Leete, F. A., Regulation of Rivers Without Embankments. As Applied in the Training Works of the Headquarters of the Rangoon River, Burma. Crosby Lockwood and Son, London, 1934.

Manak, W., River Regulation. Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

McLean, J. L., "Control of Rivers Without Embankments," Proceedings, Regional Technical Conference on Flood Control in Asia and the Far East. United Nations Economic Commission for Asia and the Far East, Bangkok, Thailand, Flood Control Series No. 3, Paper No. 4, 1952, pp 60-71.

Middleton, L. M., "Manual for Soil Erosion and Sediment Control," Mar 1976, U. S. Department of Transportation, Federal Highway Administration, Region 15, Sevierville, Tenn.

Miller, C. R. and Borland, W. M., "Stabilization of Fivemile and Muddy Creeks," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 89, No. HY1, pp 67-98.

New York Times, "Fire Islanders Resisting Ocean," 24 Jul 1958, New York, N. Y.

Nicholson, J. H. and Snyder, J. E., "Manual for Soil Erosion Control in the Tennessee Valley," 1939, Tennessee Valley Authority, Knoxville, Tenn.

O'Brien, J. T., "Studies of the Pervious Fence for Streambank Revetment," Report No. A-70-1, Feb 1951, U. S. Department of Agriculture, Soil Conservation Service, Washington, D. C.; Prepared under Contract 3304.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Senour, C., "Stabilization of Banks of Streams of the Lower Alluvial Valley of the Mississippi River," Proceedings, Federal Interagency Sedimentation Conference, Denver, Colo., 6-8 May 1947, pp 185-189.

Simons, D. B. et al., "The River Environment--A Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Stacey, W. A., "A Lesson in Bank Protection," Wood Preserving News, Vol 35, No. 2, Feb 1957, p 16.

Steinberg, I. H., "Russian River Channel Works," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 86, No. WW4, Nov 1966, pp 17-32.

Tilton, G. A., Jr., "Bank Protection by Fence Types, Tetrahedrons, and Jackstraws," California Highways and Public Works, Vol 17, No. 8, Aug 1939, pp 10-12.

_____, "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series, No. 4, 1953, Bangkok, Thailand.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer District, Los Angeles, CE, "Channel Protection Against High Velocity Flow," Jul 1949, Los Angeles, Calif.

U. S. Army Engineer District, San Francisco, CE, "Report on Measures for Bank Protection, Project CWI 509-b, Salinas and Pajaro Rivers, California," Jun 1954, San Francisco, Calif.

_____, "Russian River Basin (Channel Improvement and Bank Stabilization), Sonoma and Mendocino Counties, California," 1972, San Francisco, Calif.

U. S. Army Engineer Division, North Central, CE, "Help Yourself, a Discussion of the Critical Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection," undated, Chicago, Ill.

U. S. Army Engineer School, "Open River Regulation; Training Structures," E202-4(2-59) ML, 1959, Fort Belvoir, Va.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No. 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

U. S. Department of Agriculture, Forest Service, Region Five, "Regional Standard Drawings," Jul 1975, San Francisco, Calif.

U. S. Department of the Interior, Bureau of Reclamation, Region 7, "Frenchman Creek Channelization Studies," Jul 1963, Denver, Colo; Prepared by Hydrology Branch and Office Engineering Branch, Kansas River Projects, McCook, Nebr.

U. S. Department of the Interior, National Park Service, "Natchez Trace Parkway, Plans for Proposed Project 304, Grading, Base, Surfacing, and Structures, U. S. 45 to Mississippi Highway 363, Lee County, Mississippi," May 1976, Tupelo, Miss.; Prepared by U. S. Department of Transportation, Federal Highway Administration, Region 15, Arlington, Va.

U. S. Department of the Interior, National Park Service, and U. S. Department of Transportation, Federal Highway Administration, Region 15, "Project 304, Natchez Trace Parkway, Proposal and Contract," 13 May 1976, Tupelo, Miss., and Sevierville, Tenn., U. S. Government Printing Office, Washington, D. C.

U. S. Environmental Protection Agency, Office of Water Programs, "Control of Erosion and Sediment Deposition from Construction of Highways and Land Development," Sep 1971, U. S. Government Printing Office, Washington, D. C.

Weller, H. E., "Brahmaputra River Bank Protection in India," Irrigation and Power, Vol 27, No. 2, Apr 1970, pp 177-189.

Woodson, R. C. and Martin, J. T., "The Rio Grande Comprehensive Plan in New Mexico and Its Effects on the River Regime Through the Middle Valley," Proceedings, Federal Interagency Sedimentation Conference, Agricultural Research Service, Jackson, Miss., Miscellaneous Publication No. 970, Paper No. 41, 1963, pp 357-365.

Kellner Jack field

American Society of Civil Engineers, "Channel Stabilization of Alluvial Rivers," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 91, Feb 1965, pp 7-37.

Anonymous, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Jack-Type Jetties Protect Levees," Engineering News-Record, Vol 152, No. 3, 21 Jan 1954, pp 42-43.

_____, "Stabilizing Colorado River Banks," Wood Preserving News, Vol 22, No. 12, Dec 1944, pp 120-121 and 129.

Anonymous, "Stream banks Saved from Flood Erosion," Contractors and Engineers Monthly, Vol 42, No. 11, Nov 1945, pp 1 and 24.

Barnes, R. C., Jr., "Erosion Control Structures," River Mechanics II, Institute on River Mechanics, Colorado State University, Jun 1970; Edited and published by Hsieh Wen Shen, Fort Collins, Colo., 1971.

Bettle, A. F. and Dyer, C. E., "Revetment Stabilization of the Channel of the Rio Grande from Caballo Dam to Fort Quitman, New Mexico-Texas," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 3, Chapter 2, Jun 1965.

Blaess, A. F. et al., "Report on Methods for Providing Against River Bank Erosion," Bulletin, American Railway Engineering Association, Vol 31, No. 324, Feb 1930, p 1333.

Brashears, H. A. and Frogge, R. R., "Stabilizing a River Channel for the Conveyance of Irrigation Water and Sediment Control," Proceedings, Ninth Congress of the International Commission on Irrigation and Drainage, Moscow, Question 30, Jul 1975, pp 30.433-30.447.

Byers, W. G., "Stabilization of Canadian River at Canadian, Texas," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 88, No. WW3, Aug 1962, pp 13-26.

California, State of, Department of Public Works, Division of Highway, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Carlson, E. J., "Hydraulic Studies to Develop Design Criteria for Use of Steel Jack and Jetty Fields for Channelization in Rivers," Aug 1959; Presented at Eighth Congress of International Association of Hydraulic Research, U. S. Bureau of Reclamation, Denver, Colo.

Carlson, E. J. and Dodge, R. A., Jr., "Control of Alluvial Rivers by Steel Jetties," 14-18 May 1960; Presented at First Water Resources Engineering Conference, American Society of Civil Engineers, Omaha, Nebr.

Carlson, E. J. and Enger, P. F., "Use of Steel Jetties for Bank Protection and Channelization in Rivers," 22-24 Aug 1956; Presented at meeting of Hydraulics Division, American Society of Civil Engineers, Madison, Wis.

Christian, H. E., "Channel Stabilization and Bank Protecting," Summer Short Course on River Systems, 1972, University of Nebraska, Lincoln, Nebr.

Cozzens, H. F., "Steel Rails for Bank Protection on Salinas River, California," Civil Engineering, New York, Vol 16, No. 3, Mar 1946, pp 113-115.

Frogge, R. R., "Stabilization of Frenchman River Using Steel Jacks," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 93, No. WW3, Aug 1967, pp 89-168.

House of Representatives, "Russian River, California," House Document No. 585, 81st Congress, 2d Session, 1950, Government Printing Office, Washington, D. C.

Hyvarinen, C. E., "Channel Stabilization Practices on the Middle Rio Grande River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 5, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Karaki, S. et al., "Highways in the River Environment, Hydraulic and Environmental Design Consideration," Sep 1974, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of Transportation, Federal Highway Administration and National Highway Institute.

Keeley, J. W., "Bank Protection and River Control in Oklahoma," 1971, Federal Highway Administration, Bureau of Public Roads, Oklahoma Division, Oklahoma City, Okla.

Lindner, C. P., "Channel Improvement and Stabilization Measures," State of Knowledge of Channel Stabilization in Major Alluvial Rivers, G. B. Fenwick, ed., Technical Report No. 7, Chapter VIII, Oct 1969, Committee on Channel Stabilization, CE, Vicksburg, Miss.

Madden, E. B., "Stabilization Plan for the Arkansas River," Symposium on Channel Stabilization Problems, Technical Report No. 1, Vol 1, Chapter 3, Sep 1963, Committee on Channel Stabilization, CE, Vicksburg, Miss.

McEwan, J. S., "Bank and Level Stabilization, Lower Colorado River," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 87, No. WW4, Nov 1961, pp 17-25.

Miller, C. R. and Borland, W. M., "Stabilization of Fivemile and Muddy Creeks," Journal, Hydraulics Division, American Society of Civil Engineers, Vol 89, No. HY 1, pp 67-98.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Richardson, E. V. et al., "Highways in the River Environment, Hydraulic and Environmental Design Considerations, Training and Design Manual," May 1975, U. S. Department of Transportation, Federal Highway Administration, U. S. Government Printing Office, Washington, D. C.

_____, "Lower Yellowstone Riverbank Stabilization Program," Review Board Report, Aug 1974, U. S. Department of the Interior, Bureau of Reclamation, Upper Missouri Region, Billings, Mont.

Schembera, R. E., "Development of Hydraulic and Sediment Transport Relationships and Their Use for Design of Middle Rio Grande Channelization" (unpublished and undated), U. S. Department of Interior, Bureau of Reclamation, Denver, Colo.

Simons, D. B. et al., "The River Environment--a Reference Document," Publication No. CER 75-76 DBS-PFL-YHC-SAS-14, Dec 1975, Colorado State University, Engineering Research Center, Fort Collins, Colo.; Prepared for U. S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minn.

Smith, L. B., "Erosion of Stream Bank," Proceedings, Kansas Engineering Society, Topeka, Kans., 1929 (reprint).

Stacey, W. A., "A Lesson in Bank Protection, How Kansas State Highway Department Built Up a River Bank with Four Permeable Jetties," Wood Preserving News, Feb 1957, p 16.

Stanton, C. R. and McCarlie, R. A., "Streambank Stabilization in Manitoba," Journal, Soil and Water Conservation, Vol 17, No. 4, Aug 1962, pp 169-171.

Steinberg, I. H., "Russian River Channel Works," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 86, No. WW4, Nov 1966, pp 17-22.

Thompson, J. C., "Report to the Committee on Channel Stabilization, Middle Rio Grande Project," 13 Feb 1963, U. S. Department of the Interior, Bureau of Reclamation, Albuquerque, N. Mex.

Tilton, G. A., Jr., "Bank Protection by Fence Types, Tetrahedrons, and Jackstraws," California Highways and Public Works, Vol 17, No. 8, Aug 1939, pp 10-12.

_____, "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

U. S. Army Engineer District, Albuquerque, CE, "Report on Measure for Bank Protection, Use of Kellner Jetties on Alluvial Streams," Jun 1953, Albuquerque, N. Mex.

U. S. Army Engineer District, Albuquerque, CE, "Report on Measures for Bank Protection--Use of Steel Jetties on Alluvial Streams," Civil Works Investigation No. 858, Aug 1962, Albuquerque, N. Mex.

U. S. Army Engineer District, Fort Peck, CE, "Report on Measures for Bank Protection on the Yellowstone River and Tributaries," Civil Works Investigation No. 509-e, Jun 1954, Fort Peck, Mont.

U. S. Army Engineer District, Sacramento, CE, "Levee and Channel Slope Protection Criteria," Apr 1960, Sacramento, Calif.

U. S. Army Engineer District, San Francisco, CE, "Report on Measures for Bank Protection, Project CWI 509-e, Salinas and Pajaro Rivers, California," Jun 1954, San Francisco, Calif.

_____, "Russian River Basin (Channel Improvement and Bank Stabilization), Sonoma and Mercedino Counties, California," 1972, San Francisco, Calif.

U. S. Army Engineer District, Tulsa, CE, "Report on Use of Kellner-Type Jetties on the Arkansas River in the Tulsa District," Nov 1959, Tulsa, Okla.

U. S. Department of the Interior, Bureau of Reclamation, "A Plan of Channel Erosion Control, Fivemile Creek, Riverton Project, Wyoming," Apr 1953, Denver, Colo.

_____, "A Study of Channel Erosion Control, Muddy Creek, Riverton Project, Wyoming," Jun 1954, Denver, Colo.

_____, "Frenchman Creek Channelization" (unpublished and undated), Kansas River Projects In-house Report, McCook, Nebr.

_____, "Kansas River Projects, Frenchman Creek Channelization Studies," undated, McCook, Nebr.

_____, "Sediment Studies for Channelization of the Rio Grande Between Cochiti and Mouth of Rio Puerco, Middle Rio Grande Project, New Mexico," Vol 1, Aug 1961, Albuquerque, N. Mex.

_____, Southwest Region, "Initial Stage Channel Rectification, Middle Rio Grande Project," Definite Plan Report, Amarillo, Tex., Vol 1A, Jun 1952.

Van Orman, C. R., "Theory and Practice in the Design of Permeable Jetties," Proceedings, Kansas Engineering Society, Topeka, Kans., 1931 (reprint).

Woodson, R. C., "Stabilization of the Middle Rio Grande in New Mexico," Journal, Waterways and Harbors Division, American Society of Civil Engineers, Vol 87, No. WW4, Nov 1961, pp 1-15.

Tetrahedron field

Acheson, A. R., River Control and Drainage in New Zealand, Ministry of Works, Wellington, N. Z., 1968.

Anonymous, "Bank Revetment Developments on the Mississippi River; Part I: Asphalt Mat Revetment," Engineering News-Record, Vol 112, No. 26, 28 June 1934, pp 825-830.

_____, "Bank Revetment Developments on the Mississippi River; Part II: Tetrahedron-Block Revetment," Engineering News-Record, Vol 113, No. 1, 5 Jul 1934, pp 5-8.

_____, "Concrete Skeleton Tetrahedrons Prevent Bank Erosion During Floods," Engineering News-Record, Vol 100, No. 19, 10 May 1928, pp 752-753.

_____, "Effective River Control by Concrete Tetrahedrons," Engineering News-Record, Vol 115, No. 14, 3 Oct 1935, pp 470-471.

_____, "Effects of Record Floods on Bank Protection and Revetment Studied," Southwest Builder and Contractor, Vol 94, No. 5, 4 Aug 1939, pp 10-13.

_____, "Preventing Flood Damage to Highways and Bridges," Better Roads, Vol 2, No. 10, Oct 1932, p 23.

_____, "The Six Legged Tetrahedron," California Highways and Public Works, Feb-Mar 1928, pp 3-4 and 15.

California, State of, Department of Public Works, Division of Highways, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1960.

_____, Bank and Shore Protection in California Highway Practice, Sacramento, Calif., Nov 1970.

Felker, R. H., "Streambank Control," Soil Conservation, Vol 12, No. 5, Dec 1946, pp 114-117.

Haas, R. H., "Development of Concrete Revetments on the Lower Mississippi," Concrete, April and May 1947, pp 1-10 (reprint).

Keeley, J. W., "Bank Protection and River Control in Oklahoma," 1971, Federal Highway Administration, Bureau of Public Roads, Oklahoma Division, Oklahoma City, Okla.

Knapp, F. H. and Libby, J. A., "Erosion of Stream Banks, Its Prevention and Correction," Regional Bulletin No. 78, Engineering Series No. 6, Forestry Series No. 14, 1 Apr 1942, U. S. Department of Agriculture, Soil Conservation Service, Albuquerque, N. Mex.

Mamak, W., River Regulation, Arkady, Warsaw, 1964; Published for U. S. Department of Interior and National Science Foundation.

Matthes, G. H., "Notes on Tetrahedral-Block Revetment," 27 May 1943, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

_____, "Report on Revetments," 8 Oct 1941, Mississippi River Commission, CE, Vicksburg, Miss.

Oregon, State of, Soil and Water Conservation Commission, "Streambank Erosion in Oregon, a Report to the Fifty-Seventh Legislative Assembly," 1973, Salem, Oreg.

Portland Cement Association, "Concrete Structures for Flood Control, Soil and Water Conservation," 1937, Chicago, Ill.

Tilton, G. A., Jr., Bank Protection by Fence Types, Tetrahedrons, and Jackstraws," California Highways and Public Works, Vol. 17, No. 8, Aug 1939.

_____, "Floods Provide Tests of Bank Protection," Pacific Road Builder and Engineering Review, Vol 51, No. 1, Jul 1939, pp 31-34.

United Nations Economic Commission for Asia and the Far East, "River Training and Bank Protection," Flood Control Series No. 4, 1953, Bangkok, Thailand.

U. S. Army Coastal Engineering Research Center, CE, "Shore Protection Manual" (in 3 vols), 1973, U. S. Government Printing Office, Washington, D. C.

U. S. Army Engineer District, Memphis, CE, "Revetment and Dike Data Sheets," 30 Jun 1964, Memphis, Tenn.

U. S. Army Engineer District, San Francisco, CE, "Report on Measures for Bank Protection, Project CWI 509-b, Salinas and Pajaro Rivers, California," Jun 1954, San Francisco, Calif.

U. S. Army Engineer School, "Open River Regulation; Training Structures," E202-4(2-59) ML, 1959, Fort Belvoir, Va.

U. S. Army Engineer Waterways Experiment Station, CE, "Experiments to Determine the Effectiveness of Concrete Tetrahedral Blocks as Revetment," Technical Memorandum No. 20-2, 28 Jan 1933, Vicksburg, Miss.

U. S. Department of Agriculture, Forest Service, "Watershed Structural Measures Handbook," Forest Service Handbook No 2509.12, Jul 1969, U. S. Government Printing Office, Washington, D. C.

APPENDIX E: SELECTED BIBLIOGRAPHIES ON STREAMBANK PROTECTION

Anderson, A. G., "Fluid Flow Diversion, A Summary and Bibliography of Literature," Project Report No. 1, Aug 1947, University of Minnesota, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.

Asphalt Institute, "Bibliography, Asphalt in Hydraulics Structures," compiled in 6-year intervals since 1964 (unpublished), College Park, Md.

Bituminous Coal Research, Inc., "Reclamation of Coal-Mined Land, A Bibliography with Abstracts," 21 Oct 1975, Monroeville, Pa.

Bolsillis, J. H. and Bruns, R. O., "Groins: An Annotated Bibliography," Miscellaneous Paper 1-72, Apr 1972, U. S. Army Coastal Engineering Research Center, CE, Washington, D. C.

Gaines, S. H., "Bibliography on Soil Erosion and Soil and Water Conservation," Miscellaneous Publication No. 312, Oct 1938, U. S. Department of Agriculture, Government Printing Office, Washington, D. C.

Graf, D. A., "Soil Erosion and Its Prevention: A Partial List of References," 1933, U. S. Bureau of Agricultural Engineering Library, Washington, D. C.

Habercom, G. E., "Erosion Control (A Bibliography with Abstracts)," NTS/PS-75/469, Jun 1975, National Technical Information Service, U. S. Department of Commerce, Springfield, Va.

Harrison, E. A., "Erosion Control Methodology: A Bibliography with Abstracts," NTS-WIN-73-080, Oct 1973, National Technical Information Service, Springfield, Va.

India, Central Board of Irrigation and Power, "Review and Bibliography on Development of Economic Alternatives to Stone for River Protection Works" (undated), New Delhi, India.

Pennsylvania, Commonwealth of, Department of Environmental Resources, "Mine Drainage Abstracts, A Bibliography," Published annually since 1964, Harrisburg, Pa.; prepared by Bituminous Coal Research, Inc., Monroeville, Pa.

U. S. Army Corps of Engineers Commission on Channel Stabilization, "Channel Stabilization Publications Available in Corps of Engineers Offices," Technical Report No. 4, Nov 1966, Vicksburg, Miss.

University of Arizona, School of Renewable Natural Resources, "Selected References on Soil Erosion," WAMIS Abstract No. 3, Jul 1976, Tucson, Ariz.

Wieland, L. H., "Soil Erosion Bibliography," 1933, U. S. Department of the Interior, Washington, D. C.

In accordance with HR 70-2-3, paragraph 6c(1)(b), dated 15 February 1973, a facsimile catalog card in Library of Congress format is reproduced below.

Keown, Malcolm Price

Literature survey and preliminary evaluation of stream-bank protection methods, by M. P. Keown, N. R. Oswalt, E. B. Perry, and E. A. Dardeau, Jr. Vicksburg, U. S. Army Engineer Waterways Experiment Station, 1977.

1 v. (various pagings) illus. 27 cm. (U. S. Waterways Experiment Station. Technical report H-77-9)

Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Work Unit 02, Authorized by Section 32, Water Resources Development Act, 1974.

Includes bibliography.

1. Bank erosion. 2. Bank protection. I. Dardeau, Elba A., joint author. II. Oswalt, Noel R., joint author. III. Perry, Edward Balk, joint author. IV. U. S. Army. Corps of Engineers. (Series: U. S. Waterways Experiment Station, Vicksburg, Miss. Technical report H-77-9)

TA7.W34 no.H-77-9