INTERAGENCY ADVISORY COMMITTEE ON WATER DATA

NOTES ON SEDIMENTATION ACTIVITIES CALENDAR YEAR 1988

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
Water Resources Division
Office of Water Data Coordination
417 National Center
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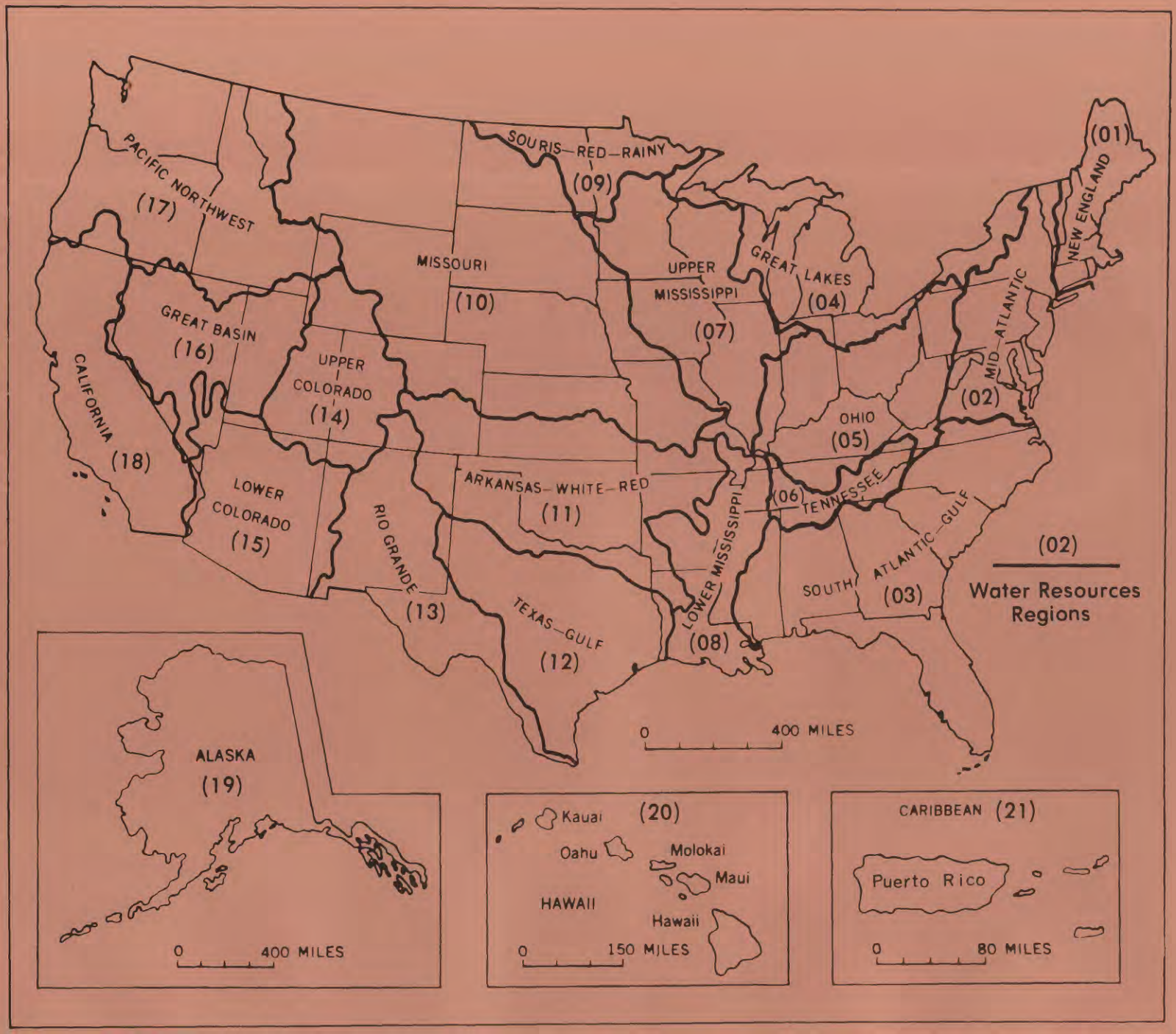

Water Resources Regions of the United States

NOTES ON SEDIMENTATION ACTIVITIES CALENDAR YEAR 1988

the
Subcommittee on Sedimentation
of the
INTERAGENCY ADVISORY COMMITTEE ON WATER DATA

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
Water Resources Division
Office of Water Data Coordination
417 National Center
Reston, Virginia 22092

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PREFACE

This report is a digest of information furnished by Federal agencies conducting sedimentation investigations. The decision to publish the report was made in 1946, from a proposal by the Chairman of the Federal Interagency River Basin Committee, Subcommittee on Ground Water. The subcommittee approved the proposal and agreed to issue this report as a means of effecting better coordination of the work of various Federal agencies in the field of sedimentation. The report was issued on a quarterly basis in 1946 and 1947, from 1948 to 1953 reports were issued every 6 months, and from 1954 to the present, the report has been issued annually.

Descriptions of work in progress or planned are included in the report, as well as important findings, new methods, new publications, information relating to laboratory and research activities, and other pertinent information. The material is organized by major drainage regions in the conterminous United States, Alaska, Hawaii, and the Caribbean.

Until 1979, each issue of this publication contained a list of stations where sediment data are collected giving the station location, drainage area, and other related information. Because the station list did not change significantly from year to year, it was eventually deleted from the publication. Also, because most users of the station list were only interested in the stations in a certain geographic area, it was felt that their needs could be served more efficiently by acquiring the necessary information through the National Water Data Exchange (NAWDEX). Therefore, locations and addresses of NAWDEX assistance centers are included in this report.

Information for this report was contributed by the representatives of participating Federal agencies. Suggestions for improving the report are welcome.

CONTENTS

	Page
Preface	iii
Sedimentation Subcommittee Agency Representation	vii
Locations of NAWDEX Assistance Centers	x
Annual Report	xxv
New England Region	
Geological Survey	1
Soil Conservation Service	3
Mid-Atlantic Region	
Corps of Engineers	4
Geological Survey	5
Soil Conservation Service	8
South Atlantic-Gulf Region	
Corps of Engineers	9
Geological Survey	14
Soil Conservation Service	19
Great Lakes Region	
Corps of Engineers	21
Geological Survey	27
Ohio Region	
Corps of Engineers	30
Geological Survey	34
Soil Conservation Service	38
Tennessee Region	
Geological Survey	39
Soil Conservation Service	40
Upper Mississippi Region	
Corps of Engineers	41
Geological Survey	42
Soil Conservation Service	47
Lower Mississippi Region	
Corps of Engineers	48
Geological Survey	52
Soil Conservation Service	56
Souris-Red-Rainy Region	
Corps of Engineers	57
Geological Survey	58
Soil Conservation Service	59
Missouri Region	
Bureau of Reclamation	60
Corps of Engineers	61
Geological Survey	68
Soil Conservation Service	76
Arkansas-White-Red-Region	
Corps of Engineers	78
Geological Survey	80
Soil Conservation Service	85

Texas-Gulf Region
Corps of Engineers 86
Geological Survey 87
Rio Grande Region
Bureau of Reclamation 89
Corps of Engineers 90
Geological Survey 91
Soil Conservation Service 93
Upper Colorado Region
Bureau of Reclamation 94
Geological Survey 95
Soil Conservation Service 99
Lower Colorado Region
Bureau of Reclamation 100
Geological Survey 101
Soil Conservation Service 104
Great Basin
Geological Survey 105
Soil Conservation Service 107
Pacific Northwest Region
Bureau of Reclamation 108
Corps of Engineers. 109
Geological Survey 112
Soil Conservation Service 118
California Region
Corps of Engineers 119
Geological Survey 124
Soil Conservation Service 127
Alaska Region
Geological Survey 128
Hawaii Region
Geological Survey 130
Caribbean Region
Corps of Engineers 131
Geological Survey 132
Soil Conservation Service 134
Laboratory and other Research Activities
Corps of Engineers 135
Environmental Protection Agency 146
Federal Highway Administration 155
Federal Interagency Sedimentation Project 159
Geological Survey 161

ILLUSTRATIONS:
Water Resources Regions of the United States . . . . . Inside Front Cover

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OFFICE CONTACT: Stanley A. Druse

NAME: Wyoming Water Research Center
ADDRESS: Wyoming University, P.O. Box 3067, University Station
Laramie, WY 82071
TELEPHONE:
Commercial: (307) 766-2143 FTS: 328-1110
OFFICE CONTACT: Barry Lawrence

SERVICE CHARGES

Charges for NAWDEX services are assessed at the option of the organization providing the requested data or data service. Search assistance services are provided free by NAWDEX to the greatest extent possible. Charges are assessed, however, for those requests requiring computer services, extensive personnel time, duplicating services, or service costs accrued by NAWDEX from other sources in the course of providing services. In all cases, charges assessed by NAWDEX Assistance Centers will not exceed the direct costs incurred in responding to the data request. Estimates of cost are provided by NAWDEX upon request and in all cases where costs are anticipated to be substantial.

ADDITIONAL INFORMATION

For additional information concerning the NAWDEX program or its services, contact:

Program Office
National Water Data Exchange (NAWDEX)
U.S. Geological Survey
421 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

Telephone: 703/860-6031
FTS 928-6031

1988 Annual Report

SUBCOMMITTEE ON SEDIMENTATION

Interagency Advisory Committee on Water Data

The Subcommittee on Sedimentation is a Federal interagency advisory group comprised of seventeen members representing nine agencies of the government. It deals with policy matters related to the coordination, collection and dissemination of sedimentation data and associated technology. The Technical Committee on Sedimentation is a separate body comprised of eleven members representing seven agencies. It reports to the Sedimentation Subcommittee and focuses its effort on the evaluation and improvement of existing technology and the development of new technology for sedimentation applications. It is also concerned with technology transfer and project support.

The Subcommittee was chaired during FY88 by Robert T. Joyce of the Tennessee Valley Authority with Co-Chairman G. Douglas Glysson of the U.S. Geological Survey. The Technical Committee was chaired by Robert I. Strand of the Bureau of Reclamation.

During FY88 the Subcommittee met six times: once in joint session with the Technical Committee (in San Francisco) and five times in Washington, D.C. The Technical Committee met twice: in San Francisco and in Minneapolis.

The principle activities of the groups during the past year included:

Fifth Federal Interagency Sedimentation Conference

The Planning Committee, formed last year and chaired by G. Douglas Glysson, U.S. Geological Survey, completed its work and was disbanded. It recommended that the Fifth Conference be held April 22-25, 1991, at the Riviera Hotel, Las Vegas, Nevada. The Subcommittee approved its recommendation.

A General Committee, chaired by Robert T. Joyce of the Tennessee Valley Authority, was formed to oversee the further planning, organization and administration of the Conference. A Technical Committee, chaired by Dr. Shou-shan Fan of the Federal Energy Regulatory Commission and Don Clarke of the Soil Conservation Service, will oversee matters related to the Conference program, and an Operations Committee, chaired by G. Douglas Glysson, will manage other matters related to the Conference's administration.

Detailed delegations of responsibility to the committees were made, membership rosters were completed and a 4-year calendar for the Conference was developed.

Unlike previous Conferences, this one will be open to presentations from outside the Federal government (limited to 40 percent of the total presentations) and exhibits will be solicited from commercial companies. There will also be separate technical short courses offered in conjunction with the Conference. It is expected that these additions will enhance potential interest in the meeting by state and local govenments, universities and agencies of foreign governments.

Ad Hoc Work Group on Sedimentation Models

This group, formed last year and chaired by Dr. Shou-shan Fan of the Federal Energy Regulatory Commission, continued its work in considering computer models used by Federal agencies to estimate sediment production and transport.

Its first symposium was held in San Francisco in October 1987, and a second is planned for Denver in October 1988. Presentations from these symposia, along with others made directly to the Subcommittee on Sedimentation at its regular meetings, will be published in a Proceedings in mid-1989. The work group made its first progress report to the Sedimentation Subcommittee December 31, 1987.

Technical Committee on Sedimentation

The Technical Committee provides oversight to the Federal Interagency Sedimentation Project, a project located at St. Anthony Falls Hydraulic Laboratory in Minneapolis and staffed principally by the U.S. Geological Survey and the U.S. Army Corps of Engineers. The Project has been concerned during the past year with studies of samplers; comparative tests of D-77 and P-6 samplers; the development of a pinch-valve for point-integrating samplers; development of specifications for particle-size analyzers; the evaluation of bed-load sampler nozzle configurations; consideration of a SALT controller; and, continuation of its support to field projects in member agencies. The Project issued two draft publications: "Recommended Method for Evaluating Fluvial-Sediment Particle-Size Analyzers and Specifications for Fluvial-Sediment Particle-Size Analyzers."

Notes on Sedimentation Activities

Information gathering was completed and it is anticipated that the Notes will be published late in 1988.

Handbook on Recommended Methods for Water Data Acquisition

Work continued on providing a draft revision to Chapter 3 of the Handbook.

Liaison with Canada

Dr. Terry J. Day, Environment Canada, Ottawa, was invited to sit on the Subcommittee as our liaison with Canadian government agencies interested in sedimentation activities. He accepted and his representative attended their first meeting in October, 1987.

Additional Subcommittee Members

Invitations were extended to the National Park Service and the U.S. Fish & Wildlife Service to join the Subcommittee as full members. It is expected that both agencies will accept the invitation and appoint representatives soon.

Anticipated Activities

Work will continue on the Fifth Federal Interagency Sedimentation Conference. The first Call for Papers will be issued in June 1989.

The Ad Hoc Work Group on Sedimentation Models will hold its second symposium in October 1989, hear further presentations in February 1989 and publish its Proceedings by mid-1989.

As the result of a presentation by Dr. Roy Trent of the Federal Highway Administration, the Subcommittee will pursue a workshop on scour in the vicinity of bridge piers. This will likely occur in 1989.

The Subcommittee will continue funding support for the activities of the Federal Interagency Sedimentation Project at St. Anthony Falls Hydraulic Laboratory. It will provide oversight and guidance through the Technical Committee. The Subcommittee will meet about six times during FY89 on a bimonthly basis. The Technical Committee will meet twice.

G. Douglas Glysson will serve as chairman of the Sedimentation Subcommittee during FY89.

NEW ENGLAND REGION

GEOLOGICAL SURVEY

St. John Subregion

1. Suspended-sediment data are being collected bimonthly at St. John River near Van Buren, ME, as a part of the National Stream Quality Accounting Network (NASQAN).

Penobscot Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Penobscot River at Eddington, ME, as a part of NASQAN.

Kennebec Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Kennebec River near North Sidney, ME, as a part of NASQAN.

Androscoggin Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Androscoggin River at Brunswick, ME, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Wild River at Gilead, ME, as a part of the National Hydrologic Benchmark Network.

Maine Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at St. Croix River at Milltown, ME.

Saco Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Saco River at Cornish, ME, and on a bimonthly basis at Presumpscot River near West Falmouth, ME, as a part of NASQAN.

Merrimack Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Merrimack River above Lowell, MA, as a part of NASQAN.

Connecticut Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Connecticut River at North Walpole, NH, and at Connecticut River at Thompsonville, CT, as a part of NASQAN.

2. Suspended-sediment data are being collected on approximately a daily basis at Stony Brook near Suffield, CT, Salmon River near East Hampton, CT, and Coginchaug River at Rockfall, CT, to determine daily sediment loads. The data collection is being done in cooperation with the State of Connecticut Department of Environmental Protection.

Massachusetts-Rhode Island Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Charles River at Dover, MA, at Blackstone River at Millville, MA, and at Pawcatuck River at Westerly, RI, as a part of NASQAN.

Connecticut Coastal Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Housatonic River at Stevenson, CT, and quarterly at Shetucket River at South Windham, CT, and at Quinebaug River at Jewett City, CT, as a part of NASQAN.

St. Francois Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Black River at Coventry, VT, as part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
150 Causeway Street, Suite 1309
Boston, MA 02114

NEW ENGLAND REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determination of sediment yields were made in the following watersheds:

a. Public Law 566

Major Drainage	Watershed	Stream	County	State
St. Johns	Prestile	Prestile	Arrostock	ME
Thames	Yantic	Yantic River	New London	CT

2. Reservoir Sedimentation Surveys

Reservoir	County	State
Mt. Zircon	Oxford	ME
Lake Washington	Providence	RI

3. Special Studies

Field data collections began for an evaluation of management alternatives for sediment and nutrient loading in vegetated filter strips. This evaluation is being conducted by the University of Rhode Island Agricultural Experiment Station under a working agreement with SCS.

MID ATLANTIC REGION

CORPS OF ENGINEERS

North Atlantic Division

Baltimore District

Sediment Survey - A survey of sedimentation ranges within Jennings Randolph(formerly Bloomington) Reservoir was performed in the fall of 1987. Jennings Randolph Reservoir is located on the North Branch Potomac River, eight miles upstream of Bloomington, Maryland. At full normal pool, the reservoir covers 952 acres, and its initial volume was 94,700 acre-feet. The task consisted of surveying six existing monumental cross sections, and initial surveying and monumentation of four additional cross sections. The hydrographic portion of the survey was accomplished with a fathometer.

This survey proved inconclusive, as it was not possible to match the previously surveyed cross sections with the resurveyed cross sections. The Baltimore District has not been successful in attempts at several reservoirs to determine sediment accumulation from range-type sedimentation surveys.

New York District

The District conducted sediment tests at the following locations.

Project name	Grain Size	Bulk Sediment	Elutriate	Bioassay	Bioaccumulation
Namaroneck Harbor, NY	X	X	X	X	X
East Chester Creek, NY	X	X	X	-	-
Glen Cove Creek, NY	X	X	X	X	X
Hudson River Channel, NY - Mile 4 to 5 Reach	X	X	X	X	X
New York Harbor, NY - Red Hook Flats Anchorage	X	X	X	X	X
Newark Bay, Hackensack and Passaic Rivers, NJ - Passaic River	X	X	X	X	X

MID-ATLANTIC REGION

GEOLOGICAL SURVEY

Richelieu Subregion

1. Suspended-sediment data are being collected on a periodic basis at Richelieu River (Lake Champlain) at Rouses Point, NY, as a part of the National Stream Quality Accounting Network (NASQAN).

Upper Hudson Subregion

1. Suspended-sediment data are being collected on a daily basis at Hudson River at Stillwater, NY, and Hudson River at Waterford, NY, in cooperation with the New York State Department of Environmental Conservation. Suspended-sediment data are being collected on a periodic basis at Hudson River at Rogers Island at Fort Edward, NY, and Hudson River at Schuylerville, NY.

2. Suspended-sediment data are being collected on a quarterly basis at Hudson River at Green Island, NY, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Esopus Creek at Shandaken, NY, as a part of the National Hydrologic Benchmark Network.

Lower Hudson-Long Island Subregion

1. Suspended-sediment data are being collected on a bimonthly basis and once during each of five storm events at Passaic River at Little Falls, NJ, and quarterly at Raritan River at Queens Bridge at South Bound Brook, NJ, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Nissequoque River near Smithtown, NY, and Carmans River at Yaphank, NY, as part of NASQAN.

Delaware Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Passaic River at Little Falls, NJ, and Toms River near Toms River, NJ, Maurice River at Norma, NJ, and West Branch Wading River at Maxwell, NJ, and on a quarterly basis at Delaware River at Trenton, NJ, and Raritan River at Queens Bridge at Bound Brook, NJ, as a part of NASQAN.

2. Suspended-sediment data are being collected on a monthly basis at McDonalds Branch in Lebonon State Forest, NJ, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data were collected once during each of five high-water events during 1987 at Passaic River at Little Falls, NJ.

4. Bottom material data (carbon, metals, organochlorine pesticides) are being collected at 32 sites in New Jersey on a yearly schedule.

Susquehanna Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Raystown Branch Juniata River at Saxton and Susquehanna River at Harrisburg,

and on a quarterly basis at Susquehanna River at Danville, West Branch Susquehanna River at Lewisburg, and Young Womans Creek near Renovo, as a part of the NASQAN and Hydrologic Benchmark programs.

2. Daily suspended-sediment data are being collected at Juniata River at Newport, PA, as a Federal sediment index station.

3. Suspended-sediment data are being collected on a bimonthly basis at Susquehanna River at Conowingo, MD, as a part of NASQAN and on a daily basis, beginning July 1984, as part of the Chesapeake Bay River-Input Monitoring project.

Upper Chesapeake Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Choptank River near Greensboro, MD, as part of NASQAN, and on a daily basis as part of the Chesapeake Bay River-Input Monitoring project.

2. Suspended-sediment data are being collected on a bimonthly basis at Patuxent River near Bowie, MD, as a part of NASQAN and on a daily basis, beginning October 1984, as part of the Chesapeake Bay River-Input Monitoring project.

Potomac Subregion

1. Suspended-sediment data are being collected on a daily basis at Monocacy River at Reichs Ford Bridge near Frederick, MD, as part of the Federal CBR program.

2. Suspended-sediment data are being collected on a daily basis at Potomac River at Point of Rocks, MD, as a part of the Federal CBR program.

3. Suspended-sediment data are being collected on a bimonthly basis at Potomac River at Shepherdstown, WV, Potomac River at Chain Bridge, Washington, D.C., and Shenandoah River at Millville, WV, as a part of NASQAN.

Lower Chesapeake Subregion

1. Suspended-sediment data are being collected on a daily basis on Rappahanock River at Remington, VA, as a Federal sediment index station.

2. Suspended-sediment data are being collected bimonthly at Rappahannock River near Fredericksburg, VA, Mattaponi River near Beulahville, VA, Pamunkey River near Hanover, VA, Appomattox River at Matoaca, VA, and James River at Cartersville, VA, as part of NASQAN.

3. Suspended-sediment data are being collected quarterly at Holiday Creek near Andersonville, VA, as part of the National Hydrologic Benchmark Network.

4. Suspended-solids data are being collected daily at Rappahanock River near Fredricksburg and James River at Cartersville, VA, in cooperation with the Virginia Water Control Board.

Special Studies

1. A study of agricultural best management practices in the carbonate region of southeastern Pennsylvania was started in the Conestoga River basin in Lancaster County, PA, during 1982. Suspended-sediment, nutrient, and

pesticide data were collected during 1988 from the Little Conestoga Creek near Morgantown and near Churchtown, from a 25-acre corn and alfalfa field and from a 50-acre corn field that were selected for conservation treatment with best management practices. Automatic samplers are used at each of the sites.

2. Sediment data are being collected with automatic samplers from three streams in the lower Susquehanna River basin as part of a study of nutrient discharges. Samples are also obtained from an additional four streams during storms.

3. Suspended-sediment data are being collected with automatic samplers from two 200-acre agricultural basins in the noncarbonate region of southeastern Pennsylvania. The study is designed to evaluate the effects of best management practices on sediment and nutrient discharge.

4. Suspended-sediment data are being collected with automatic samplers from seven agricultural fields ranging in size from 1.5 to 14 acres. Data are collected at five stream gages using both automatic and manual samplers. These data are being collected throughout the Patuxent River basin, MD, to provide loading factors and calibration/verification data for the Hydrological Simulation Program-Fortran (HSPF) model of the watershed.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
208 Carroll Building
8600 LaSalle Road
Towson, MD 21204

District Chief, WRD
U.S. Geological Survey
P.O. Box 1669
Albany, NY 12201

District Chief, WRD
U.S. Geological Survey
810 Bears Tavern Road
Suite 206
West Trenton, NJ 08628

District Chief, WRD
U.S. Geological Survey
603 Morris Street
Charleston, WV 25301

District Chief, WRD
U.S. Geological Survey
P.O. Box 1107
Harrisburg, PA 17108

Chief, Virginia Office, WRD
U.S. Geological Survey
3600 West Broad Street, Room 606
Richmond, VA 23230

MID ATLANTIC REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following watersheds:

a. Public Law 566

Major Drainage	River	County	State
Lake Champlain - Richelieu	Lower Lomoille River	Chittenden & Lamoille	VT
Potomac	Linganore Ck.	Frederick	MD
Susquehanna River	Wisconisco Ck.	Dauphin & Skuykill	PA
Susquehanna River	Fishing Ck.	Columbia	PA
NY Barge Canal	Virgin Ck.	Madison	NY

2. Reservoir Sedimentation Surveys

Reservoir	County	State
Clove Lake	Sussex	NJ
Choconut - 2B	Broome	NY
Marsh Creek (PA-602)	Tioga	PA

3. Special Studies

VERMONT

LaPlatte River Watershed Water Quality Comprehensive Monitoring and Evaluation (CM&E) continuing.
St. Albans Bay Watershed Water Quality Comprehensive Monitoring and Evaluation (CM&E) continuing.

Special Projects to monitor the effects of conservation practices on stream water quality. Conducted by Univ. of VT in cooperation with U.S.D.A.

SOUTH ATLANTIC-GULF REGION

CORPS OF ENGINEERS

South Atlantic Division

Charleston District

Coastal Shoreline Monitoring. Monitoring of coastal shoreline changes for the jetty systems at Little River and Murrells Inlets, South Carolina, continued through 1988. The third five-year monitoring period for Murrells Inlet, South Carolina, which was begun in October 1987, continued throughout 1988. Maintenance dredging at Murrells Inlet and placement of the dredged material along the beach front at North Litchfield Beach, Huntington Beach State Park, and south Garden City was completed in May 1988. The second five-year monitoring plan for Little River Inlet was continued during 1988. Anticipated date for the report covering the initial monitoring phase is FY 1989. The monitoring of the projects is being performed to determine the effect that a weir jetty system has on littoral transport processes and adjacent shorelines. Data being gathered for monitoring these projects include:

a. Aerial photography
b. Beach profiles upcoast and downcoast of the jetties
c. Observed LEO wave data
d. Hydrographic surveys of the inlet area
e. Structural performance
f. Beach sand sampling (Murrells Inlet only)

The data, which is gathered on a regular basis, is forwarded to the Coastal Engineering Research Center at US Army Engineers Waterways Experiment Station in Vicksburg, Mississippi, for analysis and report preparation.

Cooper River Rediversion Project. The post-construction monitoring of the entrance, intake and tailrace canals was begun following completion of the Cooper River Rediversion Project in 1985. The monitoring consists of 114 cross sections across the canals plus seven cross sections across the Santee River in addition to a photographic history of bank erosion. The monitoring is to be done annually for the first three years, then again in the fifth year of operation, and thereafter at five-year intervals unless conditions warrant otherwise. The third annual survey was taken during 1988. The next survey is scheduled to be done in 1990. Following initial start-up of the powerhouse in 1985, a scour hole developed immediately off the end of the stilling basin. Emergency measures were taken to repair the scour hole by dewatering a portion of the tailrace canal, filling the scour hole with soil to elevation -5 NGVD, and then placing a five-foot layer of riprap across the channel bottom. Upon completion of this repair, another scour hole formed downstream of the initial hole. Plans and specifications were prepared during 1988 to armor the bottom of the scour hole with riprap. Construction began in December 1988 with completion scheduled for early 1989.

Bank-to-bank cross sections are also being taken at 1,000-foot intervals in the Charleston Harbor (Cooper River) from Fort Sumter to Snow Point. These sections are being used to monitor sediment movement in the harbor as a result of the reduced fresh water releases into the river from Lake Moultrie. These

cross sections will reveal any sloughing of navigation channel banks and will aid in determining effects on sediment deposits outside of these channels. These cross sections are to be taken annually for a five-year period. The fourth set of cross sections was taken during 1988.

Mobile District

Sedimentation Surveys. The sedimentation range networks in Aberdeen and Bay Springs Lakes were resurveyed during the year. These lakes are located on the Tennessee-Tombigbee Waterway. Additionally, the ranges in William "Bill" Dannelly Reservoir and R. E. "Bob" Woodruff Lake on the Alabama River were resurveyed. The data was collected by standard land survey procedures combined with hydrographic surveys by fathometer and soundings. The data is computerized and will be retrieved for use in various hydrologic and sedimentation studies.

Sediment load Measurements. The daily suspended sediment sampling station at Amory, Mississippi was continued throughout the year. However, the station at Columbus, Aberdeen and Fulton have been changed from daily to periodic sampling sites.

The ongoing program of collecting suspended samples also includes periodic sampling at 36 stations. Twenty-eight of these are operated by U.S. Geological Survey at the following locations:

Alabama	Alabama River at Montgomery, AL
	Alabama River at Claiborne, AL
	Black Warrior River near Northport, AL
	Chickasaw Bogue Creek at Linden, AL
	Tombigbee River at Pickensville, AL
	Tombigbee River at Cochrane, AL
	Tombigbee River at Gainesville, AL
	Tombigbee River at Jackson, AL
Florida	Apalachicola River at Chattahoochee, FL
	Apalachicola River at Sumatra, FL
Georgia	Chattahoochee River at Whiteburg, GA
	Chattahoochee River at West Point, GA
	Etowah River near Kingston, GA
	Flint River at Newton, GA
	Oostanaula River at Resaca, GA
Mississippi	Buttahatchee River near Aberdeen, MS
	Luxapallila Creek at Columbus, MS
	Mantachie Creek at Dorsey, MS
	Noxubee River at Macon, MS
	Tombigbee River at Marietta, MS
	Tombigbee River at Fulton, MS
	Tombigbee River at Bigbee, MS
	Tombigbee River at Amory, MS
	Tombigbee River at Aberdeen, MS
	Tombigbee River at Columbus, MS

Mississippi	Town Creek near Nettleton, MS
	Twenty-Mile Creek at Guntown, MS
	Twenty-Mile Creek at Mantachie, MS

Bed material samples were collected at numerous study and gaging stations within the Mobile District. Grain size analyses were utilized in bed load computations for the various streams.

Equipment used to obtain suspended sediment or bed material samples was the DH-48, DH-59, D-74, P-61, BMH-53, BM-54, and BMH-60.

Other Investigations.

1. Tennessee-Tombigbee Waterway Bendway Management Study. Periodic reports on the effects of sedimentological processes on cut-off bendways have been published by the Waterways Experiment Station. Management recommendations in the reports have been implemented to minimize the effects of sediment deposition in bendways downstream of Aberdeen Lock and Dam. During the year, eighteen supplemental sedimentation ranges were added to the existing network of ranges in Aberdeen Lake in order to further define the deposition rate.

2. Apalachicola, Chattahoochee, and Flint Rivers. Measurement of river flow and suspended sediment load is a continuing effort to comply with the "Apalachicola, Chattahoochee and Flint Rivers Navigation Maintenance Plan." Measurements were obtained periodically during the year at the seven locations prescribed by the plan.

Savannah District

Dredging Survey. District performed examination and before and after dredging surveys in Savannah and Brunswick Harbors and in the Atlantic Intercoastal Waterway (AIWW) between Hilton Head, S.C. and Fernandina Beach, Florida. Annual surveys for Savannah and Brunswick Harbors were also published in 1988. Annual surveys are bank-to-bank hydrographic survey lines at 500 foot intervals. Following is a summary of the number of project controlling depth surveys made during 1988:

Project	No. of Surveys	
Savannah Harbor	9	
Brunswick Harbor	12	
Atlantic Intracoastal Waterway	4	
Savannah River below Augusta (SRBA)	2	
Kings Bay Naval Submarine Base	1	(Naval Project)

The controlling depth surveys summarize the minimum depths in each channel quarter of a specified reach in Savannah and Brunswick Harbors. Controlling depth surveys of the AIWW and SRBA summarize minimum depths in specified reaches along the channel centerline. Three condition surveys of Kings Bay were published. Condition surveys are full channel width hydrographic survey lines run at 500 and 250 foot intervals.

Wilmington District

Inlet Sedimentation

1. Masonboro Inlet.

a. Purpose. To determine the rate and extent of shoaling between the jetties and in the sound areas behind the inlet and to determine sound bypassing requirements.

b. Type of Survey. Hydrographic.

c. Elements Measured. Depths in the inlet and beach profiles.

d. Survey Scope. Complete hydrographic surveys are made of the inlet between the jetties and Banks Channel, Shinn Creek, and Masonboro Channel. In addition, surveys are made of the adjacent beaches, Wrightsville Beach and Masonboro Island, to determine impacts of the jetties on the stability of the shorelines and regulate sand bypassing requirements.

e. Surveys of the inlet are made at 6-month intervals whereas beach surveys are made annually.

f. Based on the results of the surveys, sand bypassing from Masonboro Inlet was accomplished between April and July 1986 with 900,000 cubic yards being pumped northward to Wrightsville Beach and 1,128,000 cubic yards placed on Masonboro Island to the south. No dredging has been accomplished in the inlet since that time. Surveys of the sediment trap in the inlet and in Banks Channel show an accumulation of 562,000 cubic yards of material since the completion of the 1986 sand bypassing operation.

2. Carolina Beach Inlet.

a. Purpose. To monitor the rate of shoaling in a deposition basin constructed in the inlet. The deposition basin is to be used as a source of future beach nourishment material for the Town of Carolina Beach.

b. Type of Survey. Hydrographic.

c. Elements Measured. Depths in the deposition basin and beach profiles.

d. Survey Scope. Hydrographic surveys are made of the deposition basin and the inlet ocean bar and interior channels. Beach profile surveys are made on Masonboro Island and Carolina Beach. The survey data is used to determine nourishment requirements for Carolina Beach and assess the ability of the deposition basin to trap sufficient quantities of material to satisfy the nourishment requirements.

e. Surveys of the deposition basin and beach profiles are made annually.

f. The deposition basin was dredged in the spring of 1985 with approximately 765,000 cubic yards of material being pumped southward to the

north end of Carolina Beach. A survey of the deposition basin made in the summer of 1984 indicated that over 555,000 cubic yards of sand had accumulated in the trap. Renourishment of the Carolina Beach project using an expanded deposition basin began on 16 March 1988 and was completed on 27 April 1988. A total of 950,000 CY was removed from the trap and placed on the northern 6,000 feet of Carolina Beach.

3. Oregon Inlet.

a. Purpose. To measure shoaling rates in a dredge maintained navigation channel across the inlet's ocean bar and monitor the response of the adjacent beaches, Bodie Island to the North and Pea Island to the south.

b. Type of Survey. Hydrographic.

c. Elements Measured. Depths in the inlet bar channel and beach profiles.

d. Survey Scope. Hydrographic surveys are made approximately every two weeks in the bar channel, extending from the Bonner Bridge seaward to the 25-foot depth contour. Beach profiles are made along 3 miles of beach both north and south of the inlet every two months.

e. The beach profile surveys were begun in 1983. Due to the relatively short period of record, no conclusions have been reached as to the impact of dredging on the stability of the beaches. However, rapid erosion of the north end of Pea Island has been occurring over the last 2 years with the erosion threatening the Bonner Bridge, U.S. Coast Guard Station, and N.C. Highway 12 on Pea Island. The bar channel surveys indicate rapid channel shoaling particularly following coastal storms.

Reservoir Sedimentation. B. Everett Jordan Project. The first sedimentation resurvey of B. Everett Jordan Lake began in November 1987. Due to surveying problems, this project has been delayed. When completed, this survey will incorporate both land and hydrographic survey data and will determine the extent of sediment deposition in Jordan Lake since impoundment on 4 February 1982. The survey is expected to be finished by late 1989.

SOUTH ATLANTIC-GULF REGION

GEOLOGICAL SURVEY

Chowan-Roanoke Subregion

1. Suspended-sediment data are collected bimonthly at Dan River at Paces, VA, and quarterly at Nottoway River near Sebrell, VA, Meherrin River at Emporia, VA, and Blackwater River near Franklin, VA, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are collected quarterly at Roanoke River at Roanoke Rapids, NC, as part of NASQAN.

Neuse-Pamlico Subregion

1. Suspended-sediment data are collected bimonthly at Neuse River at Kinston, Tar River at Tarboro, and Contentnea Creek at Hookerton, NC, as a part of NASQAN.

Cape Fear Subregion

1. Suspended-sediment data are collected quarterly on the Cape Fear River at Lock 1 near Kelly, NC, as part of the NASQAN program.

2. Suspended-sediment data are being collected on a monthly basis and during floods at five sites in the Grove Creek basin, near Kenansville, NC, to define effects of channel modifications, in cooperation with the North Carolina Department of Human Resources.

Pee Dee Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Scape Ore Swamp near Bishopville, SC, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Lynches River at Effingham, SC, Black River at Kingstree, SC, Rocky River near Norwood, NC, and at Pee Dee River at Pee Dee, SC, as a part of NASQAN.

3. Suspended-sediment data are being collected daily and more frequently during flood events at the Yadkin River at Yadkin College, NC, as part of the Federal Collection of Basic Records (CBR) program.

Santee-Edisto Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Lakes Marion-Moultrie Diversion Canal near Pineville, SC, and at Edisto River near Givhans, SC, and quarterly at Coosawhatchie River near Hampton, SC, as a part of NASQAN.

2. Suspended-sediment data are being collected on a monthly basis at Crawl Creek near Pineville, SC, Santee River below St. Stephens, SC. This is being done in cooperation with the COE.

Ogeechee-Savannah Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Upper Three Runs near New Ellenton, SC, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a quarterly basis at Savannah River near Clyo, GA, and bimonthly at Ogeechee River near Eden, GA, as a part of NASQAN.

Altamaha-St. Marys Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Falling Creek near Juliette, GA, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Altamaha River near Everett City, GA, and quarterly at Satilla River at Atkinson, GA, as a part of NASQAN.

St. Johns Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at four sites in Florida as a part of NASQAN.

Southern Florida Subregion

1. Suspended-sediment data are being collected on a bimonthly or quarterly basis at six sites in Florida as a part of NASQAN.

Peace-Tampa Bay Subregion

1. Suspended-sediment data are being collected on a quarterly basis at two sites in Florida as a part of NASQAN.

Suwannee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at two sites in Florida as a part of NASQAN.

Ochlockonee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at one sites in Florida as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis at one site in Florida as a part of the National Hydrologic Benchmark Network.

Apalachicola Subregion

1. Suspended-sediment data are being collected on a quarterly basis at two sites in Florida as a part of NASQAN. Suspended-sediment data are being collected periodically at four sites in the Apalachicola River basin in cooperation with the COE.

2. Suspended-sediment data are being collected on a bimonthly basis at Flint River at Newton, GA, and Chattahoochee River near Columbia, AL, as part of NASQAN.

Choctawhatchee-Escambia Subregion

1. Suspended-sediment data are being collected on a quarterly basis at four sites in Florida as a part of NASQAN.

Alabama Subregion

1. Suspended-sediment data are being collected 10 times per year and quarterly at Alabama River near Montgomery, AL, in cooperation with the COE, as a part of NASQAN, respectively, and bimonthly at Alabama River at Claiborne, AL, as a part of NASQAN.

Mobile-Tombigbee Subregion

1. Suspended-sediment data are being collected 10 times per year at Tombigbee River at Gainesville, AL, and at Black Warrior River at Northport, AL, in cooperation with the COE, monthly at Tombigbee River at Gainesville, bimonthly at Black Warrior River below Warrior Dam near Eutaw, AL, and quarterly at Tombigbee River at Coffeeville lock and dam, AL, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Blackwater River near Bradley and Sipsey Fork near Grayson, AL, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a periodic basis in cooperation with the COE at the following sites:

Tombigbee River near Marrietta, MS
Twentymile Creek near Guntown, MS
Twentymile Creek near Mantachie, MS
Tombigbee River near Fulton, MS
Mantachie Creek below Dorsey, MS
Tombigbee River at Bigbee, MS
Tombigbee River near Amory, MS
Tombigbee River at Aberdeen, MS
Buttahatchie River near Aberdeen, MS
Tombigbee River near Columbus, MS
Luxapallila Creek near Columbus, MS
Town Creek at Nettleton, MS
Noxubee River at Macon, MS

Additional data are being collected on two storm events per year at the following sites:

Tombigbee River near Fulton, MS
Mantachie Creek below Dorsey, MS
Tombigbee River at Aberdeen, MS
Town Creek at Nettleton, MS
Noxubee River at Macon, MS

Pascagoula Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Pascagoula River near Benndale, MS, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Cypress Creek near Janice, MS, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a quarterly basis at Escatawpa River near Agricola, MS, as part of NASQAN.

Pearl Subregion

1. Suspended-sediment data are being collected on a daily basis at Pearl River near Bogulusa, LA, as a part of the Federal CBR program.

2. Suspended-sediment data are being collected on a bimonthly basis at Pogue Chitto River near Bush, LA, as a part of NASQAN.

Special Studies

1. Suspended-sediment and bed-material data are being collected periodically and during two storm events per year at five sites in order to gage sediment deposition in certain Georgia reservoirs as part of a cooperative program with the COE.

2. Suspended-sediment data are collected at 5-minute intervals during storm runoff from two 6-acre farm tracts used to evaluate land-management practices in northern Guilford County, NC. Sediment data are also collected at a 660-acre multiuse site and a 44-acre forested site in conjunction with the program, conducted in cooperation with the Guilford County Soil and Water Conservation District.

3. Suspended-sediment data were collected monthly and more frequently during high flows at 10 forested basins across North Carolina. Sizes of basins range from 0.6 to 7.5 square miles. Conducted in cooperation with the North Carolina Department of Natural Resources and Community Development, the data will help define background levels of sediment in the State's streams. Data collection for this study was completed June 1988.

4. Suspended-sediment data are collected monthly at 20 sites as part of the surface-water quality assessment for the Triangle J COG Region located in the central Piedmont of North Carolina. The data are collected in cooperation with the Triangle Area Water-Supply Monitoring Project Steering Committee.

5. Suspended-sediment data are collected bimonthly and more frequently during runoff conditions at six sites in the Treyburn Project, a large-scale development in the upper Neuse River basin in cooperation with the city of Durham. This data is needed to assess impacts of various land-use development on surface-water quality.

6. The effect on downstream receiving waters of water-control structures located on artificial drainage canals in eastern North Carolina is largely unknown. To address this question in part, water-quality samples are being collected from three canals that drain agricultural land in Beaufort County and three similar canals in Hyde County.

Samples are collected biweekly; samples are also automatically collected during high-flow events at approximately hourly intervals. The samples are analyzed for nutrient concentrations as well as for sediment concentrations. This work is being done cooperatively with NRCD, with additional assistance from the Beaufort and Hyde County Soil and Water Conservation Districts.

7. In the summer of 1989, a bathymetric study to determine the extent of sediment deposition in Lake Michie, a water supply for the city of Durham, will be done. Lake Michie is located in northern Durham County, NC, and was built in 1926 and has been surveyed three times in the past (1926, 1935, 1970).

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
520 19th Avenue
Tuscaloosa, AL 35401

District Chief, WRD
U.S. Geological Survey
6481 Peachtree Industrial Blvd.
Suite B
Doraville, GA 30360

District Chief, WRD
U.S. Geological Survey
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

District Chief, WRD
U.S. Geological Survey
1835 Assembly Street, Suite 677A
Columbia, SC 29201

District Chief, WRD
U.S. Geological Survey
227 N. Bronough Street, Suite 3015
Tallahassee, FL 32301

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

District Chief, WRD
U.S. Geological Survey
P.O. Box 2857
Room 436, Century Postal Station
300 Fayetteville Street Mall
Raleigh, NC 27602

Chief, Virginia Office, WRD
U.S. Geological Survey
3600 West Broad Street, Room 606
Richmond, VA 23230

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yeilds, or sediment damages were made for the following activities.

a. Public Law 566

Major Drainage	Watershed	Stream	County	State
Choctawhatchee-Escambia	Pates	Tribs to the Choctawhatchee	Houston Geneva	AL
Tombigbee	Factory Creek	Factory Creek	Sumter	AL
Tombigbee	Memphis-Noxubee	Tribs to Tombigbee River	Sumter Pickens	AL
Apalachicola	Little Kolomoki Factory Creeks (continuation)	Tribs to the Chattahoochee River	Early	GA
	North Lanier (continuation)	Chestatee & Chattahoochee Rivers	White Hall Lumpkin	GA
	Chickasawhat-chee Creek (continuation)	Flint River	Terrell	GA
	Turkey Creek (continuation)	Turkey Creek	Dooly Houston	GA
Ogeechee	Upper Fifteen Mile (continuation)	Upper Fifteen Mile	Emanuel	GA
	Upper Lotts Creek (continuation)	Lotts Creek	Bullock	GA
	Ogeechee Area (continuation)	Ogeechee R. Tributaries	Screven	GA
Withlacoochee	Piscola Creek (continuation)	Piscola Creek	Thomas Brooks	GA
Roanoke	Big & Double Creek	Big Creek Double Creek	Stokes Surry	NC NC
Neuse	Black Creek	Black Stream	Johnston Wake	NC NC

Sante-Cooper	Sandy Run	Sandy Run	Cleveland Rutherford	NC NC
Pee Dee River Basin	Black Creek	Black Creek	Chesterfield Darlington	SC SC
Ashley-Combahee-Edisto River Basin	South Edisto	South Fork Edisto River	Bamberg Barnwell	SC SC
Santee River Basin	Stoney Fork South Fork	Stoney Fork & South Fork - Tributaries to Fishing Creek	Chester York	SC SC
Pee Dee River	Scape Ore	Scape Ore Swamp-Tributary to Black River	Kershaw Lee	SC SC
Roanoke-Bannister	Sandy Creek	Sandy Creek	Pittsylvania Halifax	VA

2. Special Resource Studies

Gulf of Mexico Program (Gulf Initiative) -
Preliminary studies to identify sediment source areas with resulting downstream deposition effects. Study involves states of Alabama, Florida, Mississippi, Louisiana and Texas.

GREAT LAKES REGION

CORPS OF ENGINEERS

North Central Division

Buffalo District

Claim for Buffalo River Dredging performed in 1986. The 1986 contract dredging for the upper 14,400 feet of the Federal navigation channel was performed between the end of July and the middle of August. The remaining lower reach was not completed until the end of October. When the "after dredging" soundings of the upper 14,400 feet were conducted after October 31, the contractor claimed that additional sediment had accumulated. The purpose of this analysis was to determine if the actual daily flows on the Buffalo River from August 11 through October 31, 1986 were capable of depositing 32,600 cubic yards of sediment in the upper navigation channel. In addition, to substantiate or refute this claim, a sediment transport simulation was performed using the computer model HEC-6, "Scour and Deposition in Rivers and Reservoirs,"

The input data used for this analysis included (1) cross sections of the 1986 "after dredging soundings;" (2) the sediment rating curve and sediment gradations developed for the 1986 Buffalo River Sedimentation Study; (3) Manning's "n" value; (4) expansion and contraction coefficients; and (5) actual total daily flows from the United States Geological Survey gaging stations at Buffalo Creek, Cayuga Creek, and Cazenovia Creek. The representative lake level of 571.5 LGLD for the period of interest was also considered.

An analysis was performed to determine if August 11, 1986 through October 31, 1986 was above the average for sediment transport, accumulation, and recorded flows. This was done by substituting the daily flows for August 1984, October 1985, and September 1986 into the HEC-6 sediment simulation. It was determined that these flows represented "average" conditions.

Results of the analysis using the actual flow for the period of interest indicate that approximately 15,000-32,000 cubic yards of sediment could have accumulated in the reach of question. For an "average period," approximately 2,300-4,900 cubic yards of sediment could have accumulated in that same upper reach of the Federal navigation channel.

Ashtabula River Sedimentation Study. A preliminary sedimentation study was performed on the lower portion of the Ashtabula River. The study area extended from the upstream limit of the Federal navigation channel to the mouth of the river. This lower portion is characterized by relatively straight channel reaches approximately 200 feet in width, with two much wider and shallower turning basins. Dredging has been performed from the outer harbor up through the first turning basin periodically since around the turn of the century. From this turning basin upstream to the limit of the navigation channel, dredging has not been performed since 1964 because much of the sediment has been classified heavily polluted or toxic.

The purpose of the study was to determine the dredging intervals, maintenance

dredging quantities and shoaling rates for four possible alternatives.

Sediment transport simulations were conducted using the HEC-6 computer programs, "Scour and Deposition in Rivers and Reservoirs". The input data that were used included existing cross sections developed from the 1988 soundings, sediment data obtained by the USGS, a flow duration curve from the USGS, Manning's "n", and expansion and contraction coefficients. Available soundings from 1969, 1970, 1971, 1972, 1973, 1974 and 1988 were also used to plot changes in channel bottom elevation. These data were used to perform a preliminary calibration of the HEC-6 model. The flow duration curve was used to typify the flow variation over a year. This was repeated, using a 27-year (1960 through 1987) average lake level, for study periods of 25 years and 50 years.

Bottom elevation/station curves were plotted for each of the four alternatives for the total 25 or 50 years of simulation. From these curves, the average dredging interval was determined. In addition, the dredged quantities that would be required for maintenance were calculated from these curves. Elevation/time curves were also plotted for representative sections for each option. Shoaling rates were calculated by taking the derivative of these curves. The shoaling rates were used in the economic analysis of the boating value benefits.

Environmental Analyses of Harbor Sediments for O & M Program.

1. Sediment Testing. Sediment samples were obtained from the various locations within the District as listed below. Sediment sampling consisting of bulk chemical, elutriate and bioassay testing was completed at Ashtabula, Lorain, Toledo, and Wilson Harbors.

Project	No. of Stations	Type of Test
Ashtabula Harbor, Ohio	15	Particle Size Analysis, Bulk Chemistry (Inorganic & Organic), Sediment Bioassay, Elutriate Testing
Lorain Harbor, Ohio	24	Sediment Bioassay, Particle Size Analysis, Hydrometer Test, Bulk Chemistry (Organic & Inorganic), Elutriate Testing
Toledo Harbor, Ohio Federal Navigation Channel	28	Bulk Chemical Analysis (Organic and Inorganic), Sediment Bioassay, Elutriate, Particle Size Analysis, Hydrometer Testing
Wilson Harbor, New York	7	Particle Size Analysis, Sediment Bioassay, Bulk Chemical Analysis (Organic & Inorganic), Elutriate Testing

2. Sediment and Water Testing. The purpose of the testing was to evaluate the sediments for open-lake or confined disposal following maintenance dredging of the Federal Navigation channels. In addition, special water quality and sediment testing projects are summarized below.

Project	Type of Test
Maumee Bay Bottom Characterization Study	Sub-bottom Profiling; In-situ Camera Imagery for Benthic Organisms Depositional and Erosional Areas; Sediment Type
Times Beach, Buffalo, New York	Fish and Bird Chemical Analysis for PGB, PAH, Metals Contamination; Fish Sampling for Population Size, Species, Composition
Presque Isle, Pennsylvania	Sediment Testing included Bulk Analysis, Particle Size, and Fecal Goliform
Black Rock Lock, Buffalo, New York	Sediment Testing for Metals, Wet Chemical Analysis, Volatile and Semi-Volatile Organics, Water was Sampled for Metals, Volatile Organics, Semi-Volatile Organics, and Suspended Solids
Touissant River, Ohio	Bulk Inorganic, Elutriate

3. Discussion of the Project.

a. Ashtabula Harbor. Sediment and bioassay testing showed that open-lake disposal of harbor sediments is acceptable.

b. Lorain Harbor, Ohio. Testing at proposed bend cutoffs at Lorain Harbor has provided a body of data indicating that the material is suitable for open-lake disposal. Navigation channel sediments must be put into the Combined Disposal Facility (CDF).

c. Toledo Harbor, Ohio. Sediment and bioassay testing showed that open-lake disposal of sediments dredged from lake mile 2 lakeward is acceptable. Sediments dredged from lake mile 2 upstream must be put in CDF.

d. Wilson Harbor. Sediment and bioassay testing showed that open-lake disposal is acceptable.

e. Maumee Bay Bottom Characterization Study is currently underway using sediment profile imagery and computer image analysis. This study is expected to indicate benthic conditions, erosion and deposition areas, and sediment particle distribution. The data will identify areas best suited for dredge disposal.

f. Times Beach, Buffalo, New York. The U.S. Fish and Wildlife Service conducted detailed fish inventories and sampling at the Times Beach CDF in the spring and fall. They will prepare an analysis of species age and

size distributions as well as examinations for surface lesions. A number of fish, vegetation (algae, pondweed), birds, ducks, and crawfish were sampled for chemical analyses of metals, PCB's, and PAH's.

g. Presque Isle, Pennsylvania. Bulk inorganics and fecal coliform testing was done on sand used for beach nourishment. It was determined that the sand being placed was not responsible for the high coliform counts recorded in the waters off the recreational bathing beaches.

h. Black Rock Lock Increased Flow Study. In conjunction with an International Joint Commission Reference on reduction of Lake Erie Levels, a study of potential increases in contaminant transport, which could result due to increases in flows through the Black Rock Lock, was completed.

i. Touissant River, Ohio. Testing was done, and approval to use the material for beach nourishment was obtained from the State of Ohio and U.S. Environmental Protection Agency.

Chicago District

Indiana Harbor, Indiana - The District funded a Sediment Survey of Indiana Harbor Canal, Indiana Harbor, and adjacent Lake Michigan by the Metropolitan Sanitary District of Greater Chicago in 1987. The report of this survey was completed in August 1988. The report includes chemical analyses of sediments from 3 canal locations, 2 harbor locations and 25 locations in Lake Michigan. Grab samples were composited and analyzed for PCBs, total solids, total volatile solids, total organic carbon, fats, oils and arsenic, chromium, iron, lead, manganese, nickel and zinc. Some samples were set aside for toxicity analyses. The report is available in District files.

The District also funded a study by Indiana University Northwest Environmental Research Laboratory in relation to maintenance dredging of Indiana Harbor. Sediment core samples were taken from one Calumet River Branch, two Lake George Branch and three mainstream canal locations. Three core samples were also taken from the Anchorage and Maneuver Basin. Large sediment composite grab samples were taken from one Calumet River Branch, one main stream, and one Anchorage and Maneuver Basin location. Each grab sample consisted of a 55 gallon drum filled with sediment representative from channel bottom to project depth. A report of this study including chemical and solidification analyses of these sediments will be completed in 1989. The report will be available in District files.

Detroit District

Sediment Sampling Activities. Environmental Analysis. In 1988, sediment samples were obtained as part of a routine, periodic sediment testing program at the following locations for environmental analysis:

Bay Pork, MI
Black River, MI
Duluth-Superior, MN & WI
Grand Haven, MI
Oconto, WI
Rouge River, MI
Saginaw River, MI
Saxon, WI

Green Bay, WI
Kewaunee, WI
Little Lake, MI
Manistique, MI
Sheboygan, WI
St. Joseph, MI
Sturgeon Bay, WI
Whitefish Point, MI

Sediments were analyzed for metals, PCBs, pesticides, nutrients, and physical parameters. Water samples were also collected concurrently to determine ambient water quality conditions.

Sediment samples were also collected at the following potential underwater disposal sites: Black River (U.P.), Charlevoix, Ludington, and Bay Port harbors in Michigan. These samples were collected by divers during a visual inspection of bottom conditions and were analyzed for grain size and benthic organisms.

Sedimentation Surveys. Operations and Maintenance Surveys. In 1988, hydrographic surveys were completed at Great Lakes harbors, channels and rivers (see listing below). Condition survey were made at 84 locations to record the bathymetry of navigable waters. The results of the surveys are compiled and disseminated to the public in "Notes to Mariners" bulletins if there were significant changes affecting navigation. Twenty-one "Prior" and twenty-one "After" surveys were made is support of O&M maintenance dredging operations. "Prior" surveys were conducted to determine the shoaling conditions before scheduled dredging. "After" surveys confirm that the required dredging depth was achieved.

Holland, MI
Keweenaw, MI
Menominee, MI & WI
Saginaw River, MI
Grand River, MI
Grand Haven, MI
Sebewaing, MI
Detour, MI
St. Clair River, MI
Sheboygan, MI
Monroe, MI
Kewaunee, WI
Big Suamico, WI
Saugatuck, MI
Bolles, MI
Point Lockout, MI
Charlevoix, MI
Muskegon, MI
Green Bay, MI
Duluth-Superior, MN-WI
Lexington, MI
Lake St. Clair, MI
Presque Isle, MI
Knife River, MN
Algoma, WI
Manitowoc, WI
St. Marys River, MI
Detroit River, MI
Kenosha, WI
Manistee, MI
Pentwater, MI
Arcadia, MI
Ludington, MI
Leland, MI
Portage Lake, MI
Marquette, MI
Frankfort, MI
Saxon, WI
Cornucopia, WI
South Haven, MI
Little Lake, MI
Port Wing, WI
Lac La Belle, MI
Grand Traverse, MI
New Buffalo, MI
Alpena, MI
Ontonagon, MI
Bay Port, MI
Cheboygan, MI
St. Joseph, MI
Menasha, WI
Black River, MI
Pine River, MI
Belle River, MI
White Lake, MI
Clinton River, MI
Grays Reef, MI
Kawkawlin River, MI
Manistique, MI
Port Sanilac, MI
Two Rivers, WI

Special Studies.

1. Hopper Dredge Studies. This study was conducted during August and September, 1987 and continued in 1988. Two locations were chosen, one in a sandy area, and one in a silty area, on the Saginaw River. Three stations on board the dredge were monitored: hopper inflow, hopper contents, and hopper

overflow. Additionally, plume monitoring was conducted in the river to compare background conditions on the impact of dredging with and without overflow. Results of this study were completed in April 1988. A draft report of the analysis entitled "Evaluation of Hopper Loading and Overflow for Saginaw River, Michigan" by N. R. Palermo and R. E. Randall was released by the Waterways Experiment Station in October, 1988.

2. Field Verification of PCB Mass Balance Model. As part of an inter-agency Confined Disposal Facility (CDF) Workgroup, a model was developed to estimate the loss of dissolved PCB by pond water seeping through permeable dikes. Field and laboratory testing was conducted to verify these procedures and determine the response characteristics of pond water dissolved PCB concentration to disposal operations. Samples were collected at the CDF during August and September 1987. Laboratory analysis was completed in FY 88. The Environmental Protection Agency and the U.S. Fish and Wildlife Service conducted bio-uptake studies using caged animals in August and September 1987, and in August and September 1988. The organisms were placed inside and outside the CDF walls and will be tested for uptake of PCBs and other pollutants. Reports of these projects will be completed in 1989.

3. Sediment Bioassessment Study. The Detroit District is working with the St. Paul District and the State of Wisconsin to develop and evaluate a bioassessment protocol to be used for the regulatory testing of dredged material. Sediment was collected in 1988 and will be used to evaluate several techniques. Testing will include acute lethality testing, chronic toxicity testing, and bioaccumulation exposures.

GREAT LAKES REGION

GEOLOGICAL SURVEY

Western Lake Superior Subregion

1. Suspended-sediment data are being collected on a periodic and storm-event basis at Bad River near Odanah, WI, on a quarterly basis at Baptism River near Beaver Bay, MN, and on a bimonthly basis at St. Louis River at Scanlon, MN, as a part of the National Stream Quality Accounting Network (NASQAN).

Southern Lake Superior-Lake Superior Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Washington Creek at Windigo (Isle Royale), MI, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a quarterly basis at Ontonagon River near Rockland, MI, and at Tahquamenon River near Tahquamenon Paradise, MI, as a part of NASQAN.

Northwestern Lake Michigan Subregion

1. Suspended-sediment data are being collected on an intermittent basis at Popple River near Fence, WI, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Fox River at Wrightstown, WI, and Escanaba River at Cornell, MI, and on a quarterly basis at Ford River near Hyde, MI, as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic and storm-event basis at White Creek at Forest Glen Beach, Silver Creek and Green Lake Inlet near Green Lake, WI, in cooperation with the Green Lake Sanitary District.

4. Suspended-sediment data are being collected on a periodic and storm-event basis at the Fox River at Appleton, WI, and intermittently at the Fox River outlets from Lake Winnebago at Neenah, WI, and at Menasha, WI. These data are being collected in cooperation with the Wisconsin Department of Natural Resources.

5. Suspended-sediment data are being collected on a daily basis at the following sites, as part of a study to determine PCB loading to Green Bay. This study is being conducted in cooperation with the Wisconsin Department of Natural Resources and the U.S. Environmental Protection Agency.

Fox River at Green Bay, WI
Fox River at Depere, WI
Oconto River at Oconto, WI
Pestigo River at Oconto, WI
Menominee River at Marinette, WI
Escanaba River at Escanaba, WI

Southwestern Lake Michigan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Milwaukee River at Milwaukee, WI, and at Manitowac River at Manitowac, WI, as a part of NASQAN.

Southeastern Lake Michigan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Grand River at Eastmanville, MI, St. Joseph River at Niles, MI, and Kalamazoo River near Fennville, MI, as a part of NASQAN.

Northeastern Lake Michigan-Lake Michigan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Manistee River at Manistee, MI, and on a quarterly basis at Muskegon River near Bridgeton, MI, as a part of NASQAN.

Northwestern Lake Huron Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Thunder Bay River at Alpena, MI, and Au Sable River near Au Sable, MI, as a part of NASQAN.

Southwestern Lake Huron-Lake Huron Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Pigeon River near Caseville, MI, Rifle River near Sterling, MI, and bimonthly at Tittabawassee River near Midland, MI, as a part of NASQAN.

St. Clair-Detroit River Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Clinton River at Mount Clemens, MI, as a part of NASQAN.

Western Lake Erie Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Maumee River at Waterville, OH, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at Sandusky River near Fremont, OH, Maumee River at Waterville, OH, Honey Creek at Melmore, OH, and Huron River at Milam, OH, in cooperation with the Ohio Department of Natural Resources.

3. Suspended-sediment data are being collected on a quarterly basis at River Raisin near Monroe, MI, as a part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Vermilion River near Fitchville, OH, in cooperation with the Ohio Environmental Protection Agency.

Southern Lake Erie Subregion

1. Suspended-sediment data are being collected on a daily basis at Cuyahoga River at Independence, OH, and at Grand River at Painesville, OH, in cooperation with the Ohio Department of Natural Resources.

Eastern Lake Erie-Lake Erie Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Cattaraugas Creek at Gowanda, NY, and Niagara River (Lake Ontario) at Fort Niagara, NY, as a part of NASQAN.

Southwestern Lake Ontario Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Genesee River at Charlotte Docks at Rochester, NY, as a part of NASQAN.

Southeastern Lake Ontario Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Oswego River at Lock 7 at Oswego, NY, and on a bimonthly basis at Sandy Creek at Adams, NY, as a part of NASQAN.

Northeastern Lake Ontario-Lake Ontario-St. Lawrence Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Black River at Watertown, NY, and on a quarterly basis at Raquette River at Raymondville, NY, St. Regis River at Brasher Center, NY, and St. Lawrence River at Cornwall, Ontario, near Massena, NY, as a part of NASQAN.

2. Suspended-sediment data (quantity and quality) are being collected in the Irondequoit basin, Monroe County, NY, to determine the effects of the instream impoundment on streamflow and water quality in a small residential headwater basin.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Champaign County Bank Plaza
102 East Main St., 4th Floor
Urbana, IL 61801

District Chief, WRD
U.S. Geological Survey
6520 Mercantile Way, Suite 5
Lansing, MI 48911

District Chief, WRD
U.S. Geological Survey
702 Post Office Building
St. Paul, MN 55101

District Chief, WRD
U.S. Geological Survey
P.O. Box 1669
Albany, NY 12201

District Chief, WRD
U.S. Geological Survey
975 West Third Avenue
Columbus, OH 43212

District Chief, WRD
U. S. Geological Survey
6417 Normandy Lane
Madison, WI 53719

District Chief, WRD
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46254

OHIO REGION

CORPS OF ENGINEERS

OHIO RIVER DIVISION

Huntington District

Sedimentation Surveys.

1. Beech Fork Lake, Twelvepole Creek, West Virginia. A report on the 1987 sedimentation resurvey of 13 sediment ranges in the seasonal pool area and three sediment ranges downstream of the dam was submitted to and approved by the Ohio River Division in 1988. The 1987 sedimentation resurvey of Beech Fork Lake indicated that the rate of sedimentation for the 9.73 year period between the date storage began and the mean date of the resurvey was 0.27 acre-foot per year per square mile of contributing drainage area.

2. North Fork of Pound Lake, North Fork of Pound River, Virginia. A letter report on the 1987 sedimentation investigation of reconnaissance scope was submitted to and approved by the Ohio River Division in 1988. Fathometer profiles, without horizontal control, were obtained along 15 sediment ranges within the seasonal pool area. The 1987 sedimentation reconnaissance indicated that the rate of sedimentation may have increased. It was recommended that the next sedimentation resurvey be a detailed resurvey of selected sediment ranges in the seasonal pool area.

Sediment Load Measurements.

1. Fishtrap Lake, Levisa Fork, Kentucky. Suspended sediment data were collected from the Levisa Fork at Big Rock, Virginia, gaging station and at gaging stations on five tributary streams in the Fishtrap Lake Drainage Basin during 1988.

2. Dewey Lake, Johns Creek, Kentucky. Suspended sediment data were collected from the Johns Creek at Meta, Kentucky, monitoring station and at a gaging station on a tributary stream in the Dewey Lake Drainage Basin during 1988.

3. R. D. Bailey lake, Guyandot River, West Virginia. Suspended sediment data were collected from the Clear Fork and the Baileysville monitoring stations in 1988.

4. Yatesville Lake, Blaine Creek, Kentucky. Suspended sediment data were collected from the Blaine Creek at Blaine, Kentucky monitoring station throughout 1988.

Louisville District

Sedimentation Surveys.

1. Cagles Mill Lake, Mill Creek Indiana. Resurveyed in 1988 and preliminary sediment volume calculations are complete. The report is

scheduled to be completed by spring 1989.

2. Carr Fork Lake, Carr Fork Creek, Kentucky. The Litt Carr sediment structure was resurveyed in June 1988. Total accumulation and rate of accumulation were determined and provided to the Civil Design Branch of this district. Plans are being made to modify the outlet to provide additional sediment storage.

3. Carr Fork Lake, Defeated Creek, Kentucky. The Defeated Creek sediment structure was resurveyed in June 1988. Total accumulation and rate of accumulation has been determined; however, no plans are being made to modify or dredge the structure at this time.

Nashville District

Sedimentation Surveys.

1. Center Hill Lake, Caney Fork River, Tennessee. A revised report based on Ohio River Division comments will be forwarded in April 1989.

2. Dale Hollow Lake, Obey River, Tennessee. A partial resurvey of the sedimentation range network was conducted in June 1987. The survey analysis of February 1988 showed minor changes in cross-section areas. The report of the full scale resurvey of July 1980 gave a calculated deposition rate less than the rate estimated during project design. A check survey will be scheduled for 1992.

3. J. Percy Priest Lake, Stone River, Tennessee. Full resurvey of the sedimentation range network in July 1988 showed a deposition rate of 0.48 acre-feet per square mile per year from September 1987 to July 1988. The rate determined at project design was 0.40 af/sm/yr. A report will be forwarded to the Ohio River Division for review and approval in FY 89.

4. Laurel River Lake, Laurel River, Kentucky. Twenty-six sedimentation ranges were resurveyed in September 1985, including two ranges SR25B and SR26B, located in the Corbin, Kentucky water supply reservoir. The 26 ranges were established in October 1978. In July 1988, nine ranges that showed heavy deposition in the September resurvey were resurveyed to verify this deposition. The July 1988 resurvey verified the September 1985 survey. Sediment deposition volumes were calculated for the time period October 1978 to September 1985. The deposition determined was 2,171 acre-feet which results in a rate of 314 acre-feet/year or 1.09 acre-feet/year/square mile. This deposition rate would result in depletion of the original inactive pool in 798 years. A resurvey is recommended for the year 1990.

5. Martins Fork Lake, Martins Fork of Clover Fork River, Kentucky. The sedimentation study for Martins Fork was completed by the Waterways Experiment Stations in September 1988. The study was designed to predict lake storage loss up to 50 years into the future under various assumptions of future conditions. Results of the alternatives revealed that for the assumed future conditions tested, the dam should provide most of the intended degree of flood control. The loss of flood control storage after 50 years varied from a low of 1.65 percent to a high of 13.9 percent. The report also concluded that if

long-term degradation of water is not of paramount concern, the reservoir could be counted on to provide significant flood control benefits under any future alternative analyzed. Also, the frequency of the sedimentation range resurveys could be reduced to three- to five-year intervals. It also concluded the continuous sediment sampling gage on Martins Fork could be discontinued, if no further studies were planned for the basin. The Nashville District Operations Readiness Division has been briefed by degradation problem, primarily to allow that division to define the sedimentation effect on recreation.

6. Old Hickory Reservoir, Cumberland River, Tennessee. The preliminary report of the September 1985, range network resurvey shows total deposition from June 1954, date of original survey to September 1985 was five percent of original storage volume. Some tributary range plots showed sequential and significant deposition from June 1954 through resurveys of June 1965, September 1980, and September 1985. Recreational use of the reservoir along these tributaries is being affected. However, based on preliminary analysis, total reservoir volume decrease to date is not significant. A sedimentation report will be forwarded to the Ohio River Division after a verification of data and plots on tributaries showing significant deposition is made.

7. Wolf Creek Reservoir, Cumberland River, Kentucky. In 1950, a sedimentation range network was established in the Wolf Creek Reservoir. Resurveys and additional ranges were made in 1963, 1979 and 1983. The first full resurvey of the network was completed in October 1986. Computations of deposition along the Cumberland River in the reservoir were made using ranges common to the 1963 and 1986 resurveys. These computations reflect that the original inactive pool has been decreased by 23,400 acre-feet of 1.3 percent since the dam's impoundment. The report will be submitted to the Ohio Division in 1989.

Pittsburgh District

Sedimentation Surveys.

1. Conemaugh River Lake, Conemaugh River, Pennsylvania. A detailed sedimentation report for the 1982 Conemaugh River Lake survey was submitted in FY 1985. Review comments by the Ohio River Division and Chief of Engineers' Office have been received. Resolution of comments is waiting for the district's anticipated sediment removal activities to based on a study by the Waterways Experiment Station.

2. Tionesta Lake, Tionesta Creek, Pennsylvania. A selected range sedimentation report at Tionesta Lake was completed in FY 1988. The report was approved by the Ohio River Division in FY 1988.

3. Allegheny Reservoir, Allegheny River, Pennsylvania. A selected range sedimentation survey was initiated at Allegheny Reservoir (Kinzua Dam) in FY 1986 and completed in FY 1987. A sedimentation report will be submitted in FY 1989.

4. East Branch Clarion River Lake, East Branch Clarion River, Pennsylvania. A selected range sedimentation survey at East Branch Clarion

River Lake was completed in FY 1987. A sedimentation report will be submitted in FY 1989.

5. Mosquito Creek Lake, Mosquito Creek, Ohio. A selected range sedimentation survey at Mosquito Creek Lake was completed in FY 1987. A sedimentation report will be submitted in FY 1990.

6. Woodcock Creek Lake, Woodcock Creek, Pennsylvania. A selected range sedimentation survey at Woodcock Creek Lake was completed in FY 1988. A sedimentation report will be submitted in FY 1990.

7. Union City Reservoir, French Creek, Pennsylvania. A selected range sedimentation survey at Union City Reservoir was completed in FY 1988. A sedimentation report will be submitted in FY 1990.

Other Investigations. Results of the district reservoir sedimentation studies indicate all projects except Conemaugh River Lake do not have excessive sediment deposition. The Conemaugh River Lake sedimentation study is currently being reviewed by the Waterways Experiment Station.

OHIO REGION

GEOLOGICAL SURVEY

Upper Ohio Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Allegheny River at New Kensington, PA, Monangahela River at Braddock, PA, Beaver River at Beaver Falls, PA, Ohio River at Benwood, near Wheeling, WV, and at Little Kanawha River at Palestine, WV, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a daily basis at East Branch Shade River near Tuppers Plains, OH, West Branch Shade River near Harrisonville, OH, and West Branch Shade River near Burlingham, OH, in cooperation with Ohio Department of Natural Resources.

3. Suspended-sediment data are being collected on a daily basis at Wheeling Creek near Blaine, OH, in cooperation with the Ohio Department of Natural Resources.

Muskingum Subregion

1. Suspended-sediment data are being collected on a daily basis at Muskingum River at McConnelsville, OH, in cooperation with the Ohio Department of Natural Resources.

Hocking Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Hocking River below Athens, OH, as a part of NASQAN.

Kanawha Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Kanawha River at Winfield, WV, as a part of NASQAN.

2. Suspended-sediment data were collected on an event basis at Soak Creek at Sophia, WV, in cooperation with the U.S. Soil Conservation Service (discontinued September 1988).

3. Suspended-sediment data are being collected on a bimonthly basis as part of NASQAN on the New River at Glen Lyn, VA.

Scioto Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Scioto River at Higby, OH, as a part of NASQAN.

Big Sandy-Guyandotte Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Guyandotte River at Branchland, WV, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Big Sandy River at Louisa, KY, as part of NASQAN.

3. Suspended-sediment data were collected on a daily basis, and more frequently during storm events, at Levisa Fork near Grundy, VA, in cooperation with the U.S. Army Corps of Engineers (COE), Huntington District (discontinued September 1986).

Great Miami Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Whitewater River near Alpine, IN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Great Miami River at New Baltimore, OH, as a part of NASQAN.

Middle Ohio Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Upper Twin Creek at McGaw, OH, and at South Hogan Creek near Dillsboro, IN, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a daily basis at Little Miami River at Milford, OH, in cooperation with the Ohio Department of Natural Resources.

Kentucky-Licking Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Licking River at Butler, KY, and on a bimonthly basis at Kentucky River at Lock 2 at Lockport, KY, as a part of NASQAN.

Green Subregion

1. Suspended-sediment data are being collected on a daily basis at Green River at Munfordville, KY, as a part of the Federal Sediment Index Network, and on a bimonthly basis as part of NASQAN.

Wabash Subregion

1. Suspended-sediment data are being collected on a monthly basis at White River near Centerton, IN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Little Wabash River at Main Street at Carmi, IL, and Embarras River at Sainte Marie, IL, as a part of NASQAN.

Cumberland Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at South Fork Cumberland River near Stearns, KY, and Cumberland River at Carthage, TN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily and storm-event basis in cooperation with the COE, Nashville District, at the following stations:

Clover Fork at Harlan, KY
Bennett Fork at Middlesboro, KY
Stony Fork at Middlesboro, KY
Yellow Creek near Middlesboro, KY

Cumberland River at Barbourville, KY
Cumberland River near Pineville, KY
Cumberland River at Cumberland Falls, KY
Cumberland River at Williamsburg, KY
Martins Fork above Smith, KY (discontinued September 1988)
South Fork Cumberland River near Stearns, KY

Lower Ohio Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Rolling Fork near Lebanon Junction, KY, and on a bimonthly basis at Ohio River at Lock and Dam 53 near Grand Chain, IL, Whitewater River near Alpines, IN, and Salt River at Shepherdsville, KY, as part of NASQAN.

2. Suspended-sediment data are being collected quarterly at South Hogan Creek near Dillsboro, IN, as part of the National Hydrologic Benchmark Network.

Special Studies

1. Suspended-sediment data were collected with an automatic sampler from a tributary site in the Big Sandy Creek basin in Fayette County, PA, during 1987. The data were collected as part of a study to evaluate the effects of surface mining on the Big Sandy Creek basin of southwestern Pennsylvania.

2. Suspended-sediment data were collected with automatic samplers at one site in the Indian Creek basin in Westmoreland and Fayette Counties, PA. The data were collected as part of a study to evaluate the impacts of surface mining on Indian Creek.

3. A study of course material movement and channel adjustment in the South Fork Cumberland River basin, TN, is being conducted in cooperation with the Tennessee Division of Surface Mining and Reclamation.

4. Sedimentation has affected the storage capacity, recreational use, and aesthetic qualities of Versailles Lake, Whitewater Lake, and Long Lake. The State Park Department of the Indiana Department of Natural Resources needs information about the thickness of sediment, volume of sediment, rate of sedimentation, and sources of sediment to properly manage these lakes. Depth and width data were collected in Versailles Lake, Whitewater Lake, and Long Lake in 1987-88. Historical depth and width data were obtained for the lakes. The 1987-88 and historical depth and width data were used to construct cross-section profiles for the lakes. Land-use and channel morphology data were collected in the basins of the lakes.

5. A study of suspended-sediment transport at 7 daily-record stations and 70 partial-record stations in Indiana during 1952-84 was done in cooperation with the Indiana Department of Natural Resources. Results are reported in: Crawford, C. G., and Mansue, L. J., 1988, Suspended-sediment characteristics of Indiana streams, 1952-84: U.S. Geological Survey Open-File Report 87-527, 79 p.

6. The streamflow and sediment components of the watershed model "Hydrological Simulation Program - Fortran" were evaluated using 2 years and 9 months of data from a 2.7-square-mile agricultural watershed. Results are reported in: Arihood, L. D., in press, Evaluation of a watershed model to simulate sediment transport in a small agricultural watershed in Indiana: U.S. Geological Survey Water-Resources Investigations Report 88-4222.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Busey County Bank Plaza
102 East Main Street, 4th Floor
Urbana, IL 61801

District Chief, WRD
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46278

District Chief, WRD
U. S. Geological Survey
208 Carroll Building
8600 La Salle Road
Towson, MD 21204

District Chief, WRD
U.S. Geological Survey
P.O. Box 1107
Harrisburg, PA 17108

District Chief, WRD
U.S. Geological Survey
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

Chief, Virginia Office, WRD
U.S. Geological Survey
3600 West Broad Street, Room 606
Richmond, VA 23230

District Chief, WRD
U.S. Geological Survey
2301 Bradley Avenue
Louisville, KY 40217

District Chief, WRD
U.S. Geological Survey
975 West Third Avenue
Columbus, OH 43212

District Chief, WRD
U.S. Geological Survey
603 Morris Street
Charleston, WV 25301

OHIO REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made for work plans in the following watersheds:

a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Wabash River	Bonpas Cr.	Bonpas Cr.	Edwards Wabash Richland Lawrence	IL
Ohio River	Wheeling Creek	Wheeling Creek	Marshall Ohio	WV

2. Reservoir Sedimentation Surveys

Reservior sedimentation surveys were made in the following reservoirs:

Reservior	County	State
Lake Santee	Decatur	IN
Ambridge (Aliquippa)	Beaver	PA
Lake Vega	Madison	KY

3. Speical Studies

Reconnaissance surveys of 50 lakes was undertaken in Ohio in 1988. The lakes varied in size from 20 acres to 5,000 acres, and were randomly distributed througout all the major land resource areas in the state. Undisturbed sediment samples were taken for physical analyses (density, grain size, moisture) and chemical analyses (20 parameters). Water samples were taken at each lake for total phosphorous determination. Secchi disc measurements were also made in each lake. A report will be published in January, 1990.

A watershed erosion study and sediment yield field analysis will be done in support of the reservoir sedimentation survey of Lake Santee, Decatur County, IN.

Land voiding and erosion rate estimates were complete for ephemeral gully erosion on selected areas in 25 counties of west-central Indiana. Ephemeral gully erosion was estimated through the use of the "Ephemeral Gully Erosion Model," developed by Watson, Laflen, Franti, ARS, and further developed by SCS for field use.

TENNESSEE REGION

GEOLOGICAL SURVEY

Upper Tennessee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at French Broad River at Marshall, NC, and bimonthly at Clinch River at Melton Hill Dam, TN, and Holston River near Knoxville, TN, as part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are collected on a bimonthly basis at Little River above Townsend, TN, and quarterly at Cataloochee Creek near Cataloochee, NC, as a part of the National Hydrologic Benchmark program.

Middle Tennessee-Hiwassee Subregion

1. Suspended-sediment data are being collected in the Tennessee River basin in Georgia at 3 sites on a monthly basis and at 13 sites on a semiannual basis as part of the Office of Surface Mining Coal Hydrology program.

Lower Tennessee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tennessee River at Pickwick Landing Dam, TN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Buffalo River near Flat Woods, TN, as part of the National Hydrologic Benchmark Network.

Special Studies

1. Suspended-sediment data were collected at 15-minute intervals for three sites located in Asheville, NC. This data will be used to characterize urban stormwater quality in the mountaineous Asheville area.

2. Suspended-sediment data are being collected four times per year at three sites along Carters Creek, Maury County, TN, as part of a monitoring program designed to assess effects of large-scale construction activities.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
6481 Peachtree Industrial Boulevard
Suite B
Doraville, GA 30360

District Chief, WRD
U.S. Geological Survey
P.O. Box 2857
Room 436, Century Postal Station
300 Fayetteville Street Mall
Raleigh, NC 27602

District Chief, WRD
U.S. Geological Survey
2301 Bradley Avenue
Louisville, KY 40202

District Chief, WRD
U.S. Geological Survey
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

District Chief, WRD
U.S. Geological Survey
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

TENNESSEE REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following watersheds:

a. Public Law 566

Major Drainage	Watershed	Stream	County	State
S. Fork Holston	Three Creek	Unnamed Tributaties	Washington	VA

UPPER MISSISSIPPI REGION

CORPS OF ENGINEERS

North Central Division

Chicago District

Chicago River-North Branch, Illinois. The District contracted the Department of Energy Argonne National Laboratory to sample sediment by coring at a total of 21 stations in the Chicago River North Branch, North Branch Canal and North Branch turning basin. The sediment was composited vertically and horizontally from 3 closely located borings per station. The composites were analyzed for PCBs. A priority pollutant scan was also conducted on selected samples. The contract report will be completed in 1989. The report provides data needed to assess the degree of contamination of the sediments. The report will be available in District files.

Rock Island District

Suspended Sediment Sampling. Suspended load sampling is being conducted at 22 stations, 3 located on the Mississippi River and 19 on its tributaries, including 2 on tributaries to the Illinois River. Nineteen long-term stations are operated and maintained directly by the District. Four stations which began in conjunction with the GREAT II program are now being operated and maintained under a cooperative program with the U.S. Geological Survey.

Sedimentation Surveys. Sedimentation survey reports for Red Rock, Coralville and Saylorville Reservoirs were completed in 1986 and 1987. Field surveys at Coralville Reservoir were completed in The Fall of 1988. A new report will be published in 1989.

St. Paul District

Both suspended and bedload measurements were conducted daily at six stations by the U.S. Geological Survey under the sponsorship of the District and published in their Water Resources Data. These stations are at Anoka, MN on Mississippi River; near Big Stone City, MN on Whetstone River; near Odessa, MN on Yellow Bank River; at Mankato, MN on Minnesota River; at Winona, MN on Mississippi River and at McGregor, IA on Mississippi River.

UPPER MISSISSIPPI REGION

GEOLOGICAL SURVEY

Mississippi Headwaters Subregion

1. Suspended-sediment data are being collected on a daily basis during open water at Mississippi River near Anoka, MN, in cooperation with the U.S. Army Corps of Engineers (COE).

2. Suspended-sediment data are being collected on a bimonthly basis at Mississippi River near Royalton, MN, and on a quarterly basis at Mississippi River at Nininger, MN, as a part of the National Stream Quality Accounting Network (NASQAN).

Minnesota Subregion

1. Suspended-sediment data are being collected on a daily basis during open water at Minnesota River at Mankato, MN, and on a daily basis March through August at Whetstone River near Big Stone City, SD, and at Yellow Bank River near Odessa, MN, in cooperation with the COE.

2. Suspended-sediment data are being collected on a quarterly basis at Minnesota River near Jordon, MN, as a part of NASQAN.

Chippewa Subregion

1. Suspended-sediment data are being collected on a periodic and storm-event basis to determine daily loads at Duncan Creek near Tildon, WI, in cooperation with the Wisconsin Department of Natural Resources.

2. Suspended-sediment data are being collected on a quarterly basis at Chippewa River near Durand, WI, as a part of NASQAN.

Upper Mississippi-Black-Whitewater Subregion

1. Suspended-sediment data are being collected during high-flow events and on a bimonthly basis at North Fork Whitewater River near Elba, MN, in cooperation with the U.S. Fish and Wildlife Service as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected during high-flow events at Middle Fork Whitewater River near St. Charles, MN, in cooperation with the U.S. Fish and Wildlife Service.

3. Suspended-sediment data are being collected periodically at Mississippi River at Winona, MN, in cooperation with the COE.

4. Suspended-sediment data are being collected on a bimonthly basis at Durand and Black River at Galesville, WI, as a part of NASQAN.

Upper Mississippi-Maquoketa-Plum Subregion

1. Suspended-sediment data are being collected on a daily basis at Mississippi River at McGregor, IA, in cooperation with the COE, St. Paul District.

2. Suspended-sediment data are being collected on a periodic and storm-event basis to determine monthly suspended-sediment loads for the COE at the Grant River at Burton, WI.

Wisconsin Subregion

1. Suspended-sediment and bed-material data are being collected on a bimonthly basis at Ten Mile Creek near Necoosa and Wisconsin River at Muscoda, WI, as part of NASQAN.

Upper Mississippi-Iowa-Skunk-Wapsipinicon Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Cedar River at Cedar Falls, IA, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at the following in cooperation with the Iowa Geological Survey:

Iowa River at Marshalltown, IA
South Skunk River at Colfax, IA
Skunk River at Augusta, IA

3. Suspended-sediment data are also being collected on a bimonthly basis at Skunk River at Augusta, IA, as part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Iowa River at Wapello, IA, in cooperation with COE, Rock Island District. Suspended-sediment data are also being collected on a bimonthly basis as part of NASQAN.

Rock Subregion

1. Suspended-sediment data are being collected on a periodic and storm-event basis at:

Jackson Creek at County Hwy H near Elkhorn, WI
Jackson Creek tributary near Elkhorn, WI
Delavan Lake tributary at South Shore Drive at Delavan Lake, WI

These data are being collected in cooperation with the Delavan Lake Sanitary District.

2. Suspended-sediment data are being collected on a storm-event basis in cooperation with Dane County, WI, at:

Pheasant Branch Creek at Middleton, WI, at U.S. Highway 12
Spring Harbor Storm Sewer at Madison, WI

3. Suspended-sediment data are being collected on a quarterly basis at Rock River near Joslin, IL, as part of NASQAN.

Des Moines Subregion

1. Suspended-sediment data are being collected on a daily basis at Des Moines River near Saylorville, IA, in cooperation with the COE, Rock Island District.

2. Suspended-sediment data are being collected on a bimonthly basis at Raccoon River at Van Meter, IA, as a part of NASQAN.

3. Suspended-sediment data are being collected on a daily basis at Des Moines River at St. Francisville, MO, in cooperation with the COE, Rock Island District, and bimonthly as part of NASQAN.

Upper Mississippi-Salt-Subregion

1. Suspended-sediment data are being collected on a daily basis and particle-size data collected on a intermittent basis in cooperation with the COE at the following stations:

North Fork Salt River near Hunnewell, MO
Middle Fork Salt River at Paris, MO
Salt River near New London, MO

2. Suspended-sediment data are being collected on a daily basis at Mississippi River below Alton, IL, in cooperation with the COE, St. Louis District, and on a bimonthly basis at Alton, IL, as part of NASQAN.

3. Suspended-sediment data are being collected eight times a year at Cuiver River near Troy, MO, as part of NASQAN and in cooperation with the Missouri Department of Natural Resources.

Upper Illinois Subregion

1. Suspended-sediment data were collected monthly and more frequently during high flows as part of NAWQA at the following stations:

Illinois River at Marseilles, IL
Kankakee River at Momence, IL
Iroquois River at Chebanse, IL
Des Plaines River at Riverside, IL
Du Page River at Shorewood, IL
Fox River at Algonquin, IL
Fox River at Dayton, IL
Chicago Sanitary and Ship Canal at Romeoville, IL

2. Suspended-sediment data are being collected on a monthly basis at Illinois River at Marseilles, IL, as a part of NASQAN and NAWQA.

Lower Illinois Subregion

1. Suspended-sediment data were being collected every other day, and more frequently during high flows, at Illinois River at Valley City, IL, in cooperation with the COE, St. Louis District. Additional samples are collected on a bimonthly basis at Sangamon River near Oakford, IL, and Spoon River at Seville, IL, as part of the NASQAN program.

Upper Mississippi-Kaskaskia-Meramec Subregion

1. Suspended-sediment data are being collected every other day, and more often during high flows, in cooperation with the COE, St. Louis District at the following sites:

Kaskaskia River at Cooks Mills, IL
Kaskaskia River at Venedy Station, IL
Big Muddy River at Murphysboro, IL

Suspended-sediment samples are also collected on a bimonthly basis at Big Muddy River at Murphysboro, IL, as part of the NASQAN program.

2. Suspended-sediment data are being collected on a daily basis at Mississippi River at St. Louis, MO, in cooperation with the COE, St. Louis District.

3. Suspended-sediment data are being collected on a daily basis at Mississippi River at Thebes, IL, in cooperation with the COE, St. Louis District. Suspended-sediment data also are being collected on a monthly basis in cooperation with the Missouri Department of Natural Resources.

4. Suspended-sediment data are being collected on a daily basis at Mississippi River at Chester, IL, in cooperation with the COE, St. Louis District.

5. Suspended-sediment data are being collected on a bimonthly basis at Meramac River near Eureka, MO, as part of NASQAN.

Special Studies

1. Suspended-sediment data were collected monthly at Mississippi River at Bemidji, Mississippi River near Bemidji, and Schoolcraft River near Bemidji, MN, in cooperation with the Minnesota Department of Natural Resources. The data was collected through June 1988 as part of a water-quality study being conducted by local groups.

2. Suspended-sediment data were collected every other day, and more frequently during high flows at Big Creek near Bryant, IL, in cooperation with the Metropolitan Sanitary District of Greater Chicago (discontinued December 1986). The sediment data collected were used to monitor changes in sediment transport during the reclamation of a strip-mined area by irrigating with digested sludge from sewage treatment facilities.

Laboratory Activities

The Geological Survey laboratory in Iowa City, IA, analyzed suspended-sediment samples collected by the COE at:

Bay Creek at Nebo, IL
Turkey River at Garbor, IL
Crow Creek at Beltendort, IA
Green River at Geneseo, IL
Wapsipinicon River at DeWitt, IA
Iowa River at Marengo, IA
Iowa River at Coralville Dam, IA
Mississippi River at Burlington, IA
Mississippi River at Keokuk, IA
Des Moines River near Stratford, IA
Raccoon River at Van Meter, IA
North River near Norwalk, IA
Middle River near Indianola, IA
South River near Ackworth, IA
Des Moines River near Tracy, IA
Des Moines River at Keosauqua, IA
Mississippi River at East Dubuque, IL

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Busey County Bank Plaza
102 East Main Street, 4th floor
Urbana, IL 61801

District Chief, WRD
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46254

District Chief, WRD
U.S. Geological Survey
P.O. Box 1230
Iowa City, IA 52244

District Chief, WRD
U.S. Geological Survey
702 Post Office Building
St. Paul, MN 55101

District Chief, WRD
U.S. Geological Survey
1400 Independence Road
Mail Stop 200
Rolla, MO 65401

District Chief, WRD
U.S. Geological Survey
6417 Normandy Lane
Madison, WI 53719

UPPER MISSISSIPPI REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made for work plans in the following watersheds:

Public Law-566

Major Drainage	Watershed	Stream	County	State
Des Moines River	Indian Cr.	Indian Cr.	Van Buren	IA
Mackinaw River	Evergreen Lake	Six Mile Cr.	McLean	IL
Fox River	Somonauk Cr.	Somonauk Cr.	DeKalb	IL
Big Muddy River	Craborachard Cr.	Craborachard Cr.	Williamson	IL

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Diamond Lake	Poweshiek	IA
Evergreen Lake	McLean	IL
Shoal Creek #5	Montgomery	IL

3. Special Studies

A lake shore erosion and sediment deposition study was made for Evergreen Lake in McLean County, Illinois.

An engineering guide, "Minnesota Technical Release NO.8, Sediment Basins", was distributed.

LOWER MISSISSIPPI REGION

CORPS OF ENGINEERS

Lower Mississippi Valley Division

Memphis District

Sediment sampling continued at the 15 stations previously established in the St. Francis Basin and the station previously established near Colt, Arkansas, in the L'Anguille River Basin. Suspended sediment samplers DH76TM, DH78, D74ALTM and bed sampler BMH60 were used. Records of discharge, observed suspended and bed sediment grain size distribution, observed suspended sediment concentrations, computed suspended sediment load and temperature are maintained.

New Orleans District

Sediment Load Measurements

1. Suspended sediment and bed material sampling were continued at the following 12 ranges: Mississippi River at Coochie, LA, semimonthly; Mississippi River at Tarbert Landing, MS, semimonthly; Old River Outflow Channel near Knox Landing, LA, semimonthly; Atchafalaya River at Simmesport, LA, semimonthly; Old River Auxiliary Structure Outflow Channel, semimonthly; Wax Lake Outlet at Calumet, LA, monthly; Lower Atchafalaya River at Morgan City, LA, monthly; Red River above Old River Outflow Channel, semimonthly; Atchafalaya Basin, Bayou Chene below Bayou Crook Chene, weekly; Atchafalaya Basin, Lake Long below Bayou La Rompe, weekly; Atchafalaya Basin, Little Tensas below Blind Tensas Cut, weekly; Atchafalaya Basin, East Access Channel above Chicot Pass, weekly. Bed material sampling was continued on the Mississippi River at Mile 312 on a monthly basis.

2. Suspended sediment samples were taken with a U.S. P-46, or U.S. P-61 sampler. Bed material samples were taken with a BM-54 sampler or drag bucket-type sampler.

Office Investigations. For the district, WES is completing an investigation of the Atchafalaya Bay, incorporating both physical and mathematical model to study the bay hydrodynamics and the effects the Atchafalaya River will have in the future. Two sediment models are being used to forecast long-term evolution of the delta, HAD-1 and STUDH. HAD-1 is a pseudo two-dimensional sediment computations program using steady state hydraulics. STUDH is a sediment transport program using unsteady two-dimensional flows in the horizontal plane.

A computer Data Base System is being used to analyze, store, retrieve sediment data and to store hydrographic data for the period of record in the district.

The district has a contract with Louisiana State University to study the subaerial growth rates of the Atchafalaya Bay Deltas. The task involves the use of remotely sensed data to update the growth rates of the deltas.

In April and May 1988, the district collected a series of biweekly sediment samples at three stations in the Atchafalaya Basin. The samples were collected to evaluate the diversion of sediment from the Atchafalaya River main channel into the Old Atchafalaya River. Suspended sediment and bed material were taken in the Atchafalaya River above Whiskey Bay Pilot Channel, the Old Atchafalaya River at Range 5, and Whiskey Bay Pilot Channel below the Old Atchafalaya River. This sampling was undertaken in conjunction with the Atchafalaya Basin Cross Basin Channel Realignment project. Continued biweekly sampling is being proposed at the Old Atchafalaya River at Range 5 location as part of the realignment project monitoring program.

During the month of August 1988, the district collected bed material samples at 14 locations on Bayou Teche and the Vermillion River. These samples were taken in conjunction with the Teche-Vermillion project with the intent of evaluating shoaling in these channels.

The Old river auxiliary Structure Outflow Channel and the Mississippi River at Mile 312 were established as permanent sediment ranges during 1988.

The district is investigating methods of diverting suspended and bed sediments from the Lower Mississippi River and its passes to create marsh environment. The investigation is in conjunction with Mississippi River Delta and Coastal Louisiana Land Loss/Marsh Creation Studies. To assist in the investigation, WES has developed a mathematical sediment model of the Lower Mississippi River and Southwest pass to determine the effects of sediment diversion on dredging in the mainstem channel and passes.

A qualitative sediment study was undertaken, by the district, as part of the Amite River and Tributaries Feasibility Study to assess the impacts of proposed project alternatives on river morphology and sediment transport.

The district contracted with a private consultant to analyze historical bed material data for the Mississippi River. The intent of the analysis is to identify any changes in the bed material gradation of the Mississippi River within the boundaries of the district over time.

St. Louis District

The data collected with the first resurvey of the sedimentation ranges at Mark Twain Lake is being reduced as time, money, and manpower permits. Data discrepancies have been found and are being analyzed. This data analysis will continue.

The Report of Sedimentation for the 1984 resurvey at Lake Shelbyville, the 1982 and 1984 resurveys at Carlyle Lake, and the 1985 resurvey at Rend Lake are complete.

Vicksburg District

Sedimentation Surveys. Channel surveys, including cross sections and profiles, were obtained on many streams within the District during the year. These data, which are to be used in various hydrologic and hydraulic studies,

were collected by surveying existing and new permanent ranges, temporary ranges, and fathometer spot surveys.

Sediment Load Measurements.

1. Both bed sample and suspended sample measurements are being made weekly at three locations on the Mississippi River. These locations are Natchez, MS; Vicksburg, MS; and Arkansas City, AR. Bed materials are gathered using a BM-54 bed material sampler, and suspended material samples are collected using a P-61 suspended materials sampler.

2. An ongoing program in which the suspended sample, bed material sample, temperature, discharge, and stage data are collected and computerized for many stations within the District has been continued. Sedimentation data were collected at approximately 40 stations during 1988. Bed samples were collected using either BM-54, BMH-60, or drag bucket bed material samplers, while suspended samples were collected using either D-48, D-57, D-61, or D-74 suspended material samplers or by dip sampling.

3. A comprehensive data collection program was continued for Goodwin Creek. This data collection program was continued by the Agricultural Research Service at no cost to the District.

Office Investigations.

1. Red River Waterway.

a. A sediment study was continued to determine the impact of the influx of sediment from bank caving above Shreveport, LA, on the Red River Waterway system. The study includes comparison of bankline movement and channel cross sections over time to quantify bank caving throughout the Shreveport, LA, to Index, AR, reach. Also, a determination of the expected reduction in sediment influx due to construction of bank stabilization measures is included.

b. During 1988, work on the TABS-2 numerical models for Locks and Dams Nos. 4 and 5 continued. The purpose of these numerical models is to aid in the design of the structures and adjacent channels by identifying probable sediment transport characteristics for alternative features.

c. During 1988, the Red River sediment sampling program was expanded in order to obtain sufficient sediment data to insure the effective design of project features. Previously, suspended sediment samples were taken at random time intervals at Fulton, AR, Shreveport, and Alexandria, LA. The program expansion includes weekly suspended sediment sampling and discharge measurements at Fulton, Shreveport, and Alexandria. Also, suspended sediment samples and discharge measurements are taken biweekly at Spring Bank, AR, and Grand Ecore, LA.

2. Demonstration Erosion Control Project. Several sediment studies and a comprehensive data collection program are underway as part of the DEC. The DEC is a joint effort between the District and the Soil Conservation Service to reduce flooding, erosion, and sedimentation problems in 15 watersheds in the Yazoo River Basin. These consist of the followings:

a. Detailed geomorphic and sediment transport studies were continued in 1988 for Batupan Bogue, Hotophia Creek, Hickahala Creek, Abiaca Creek, Long Creek, and Black Creek watersheds as part of the development of technical work plans for these watersheds.

b. Automatic suspended-sediment sample stations have been installed in all six DEC watersheds. Stations on Batupan Bogue, Otoucalofa Creek, Hickahala Creek, Senatobia Creek, and Hotophia Creek have been operational for approximately 3 years. Stations on Fannegusha Creek, Long Creek, and Harland Creek went into operation in early 1987. These are being maintained and operated by U.S. Geological Survey for the District.

c. A comprehensive data collection program was continued for Goodwin Creek. The study by WES to develop procedures for the determination of total sediment load was completed.

3. Shoccoe Dam GDM. A sediment investigation to determine the amount of deposition which can be expected to occur if the proposed Shoccoe Dam Project is constructed was discontinued in 1988. All engineering studies associated with Shoccoe Dam have been discontinued due to local opposition.

4. Seven sediment index ranges for Sardis Lake were resurveyed in 1988. An analysis to determine if a resurvey of all the sediment ranges is needed will be completed in 1989.

Southwestern Division

Little Rock District

Sediment sampling continued at Dam No. 2, L&D No. 3, L&D No. 4, L&D No. 5 and David D. Terry L&D on the Arkansas River. Samples were taken intermittently with USD-49 and concentration in terms of the percent of weight were obtained.

LOWER MISSISSIPPI REGION

GEOLOGICAL SURVEY

Lower Mississippi-Hatchie Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Mississippi River at Memphis, TN, Obion River at Obion, TN, and at Hatchie River at Bolivar, TN, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected once every other week at eight stations in the Obion-Forked Deer River basin as a part of a study on the adjustment of fluvial systems following dredging and straightening (discontinued September 1988).

Lower Mississippi-St. Francis Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at St. Francis River at Parkin, AR, and at St. Francis Bay at Riverfront, AR, as a part of NASQAN.

Lower Mississippi-Yazoo Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Yazoo River at Redwood, MS, and on a quarterly basis at Mississippi River near Arkansas City, AR, as a part of NASQAN.

2. Suspended-sediment data are being collected by a automatic PS-69 sampler at North Fork Tillatoba Creek near Teasdale, MS, in cooperation with the U.S. Soil Conservation Service.

3. Suspended-sediment data are being collected by an automatic PS-69 pumping sampler at the following sites in cooperation with the Interagency Demonstration Erosion Control Task Force:

Hotopha Creek near Batesville, MS
Otoucalofa Creek near Water Valley, MS
Hickahala Creek near Senatobia, MS
Senatobia Creek at Senatobia, MS
Batupan Bogue at Grenada, MS
Peters (Long) Creek near Pope, MS
Fannegusha Creek near Howard, MS
Harland Creek near Howard, MS

Lower Red-Ouachita Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Ouachita River at Columbia, LA, at Red River near Simmesport, LA, and on a quarterly basis at Ouachita River at Camden, AR, as a part of NASQAN. Sediment data are being collected on a quarterly basis at Big Creek at Pollock, LA, as a part of the National Hydrologic Benchmark Network.

Boeuf-Tensas Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tensas River at Tendal, LA, and bimonthly at Boeuf River at Fort Necessity, LA, as a part of NASQAN.

Lower Mississippi-Big Black Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Big Black River at Bovina, MS, and quarterly at Homochitto Creek at Rosetta, MS, and Mississippi River at Vicksburg, MS, as part of NASQAN.

Lower Mississippi-Lake Maurepas Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Amite River at 4-H Camp near Denham Springs, LA, Tangipahoa River at Robert, LA, Lower Grand River at Bayou Sorrel, LA, and at Tchefuncta River near Covington, LA, as a part of NASQAN.

Louisiana Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bayou Teche at Keystone Lock and Dam below St. Martinville, LA, Mermentau River at Mermentau, LA, and at Calcasieu River near Kinder, LA, and monthly at Atchafalaya River near Melville, LA, as a part of NASQAN and in cooperation with the U.S. Army Corps of Engineers (COE).

2. Suspended-sediment data are being collected on a bimonthly basis at the following sites as a part of NASQAN.

Mississippi River at Belle Chasse, LA
Mississippi River near St. Francisville, LA

3. Suspended-sediment and bed-material data are collected at the following sites on a monthly basis in cooperation with the COE:

Lower Atchafalaya River at Morgan City, LA
Wax Lake Outlet at Calumet, LA

4. Suspended-sediment and bed-material data are collected weekly by the COE in the Atchafalaya Basin at Bayou Chene above Bayou Crook Chene, East Access Channel above Lake Chicot, Lake Long below Bayou LaRompe, and Little Tensas Cut.

Special Studies

1. Suspended-sediment data are being collected at 15 stations on the St. Francis River and selected tributaries for the COE. Seven sites are collected on a monthly basis, one of which is also sampled daily. The remaining eight sites are collected on a monthly basis from November through June. Monitoring is expected to continue from year to year as the need exists.

2. In cooperation with the U.S. Soil Conservation Service, an intensive study of channel adjustment and sediment transport is being conducted on the Cane Creek basin in the Hatchie River basin. Two stations on Cane Creek have been equipped with PS-69 samplers (discontinued 1988).

3. In cooperation with the Tennessee Department of Transportation, a study to model the effects of man-induced channel adjustments in the fluvial channels of western Tennessee is being conducted. Bed-material samplers are collected twice annually at low flow. Bank material is sampled for particle-size distribution, Atterberg limits, density, moisture content, and dispersion. In situ shear strength tests are carried out with a borehole shear tester for the

purpose of modeling bank stability and rates of channel widening (study completed).

Simon, Andrew, and Hupp, C. R., 1987, Geomorphic and vegetative recovery processes along modified Tennessee streams: An interdisciplinary approach to disturbed fluvial systems: in Forest Hydrology and Watershed Management, International Association of Hydrologic Sciences, Pub. No. 167, p. 251-262.

Simon, Andrew, and Robbins, C. H., 1987, Man-induced gradient adjustment of the South Fork Forked Deer River, West Tennessee: Environmental Geology and Water Sciences, v. 9, no. 2, p. 109-118.

Simon, Andrew, 1989, Shear-strength determination and stream-bank instability in less-derived alluvium, West Tennessee, USA: in Applied Quaternary Research, F. J. de Mulder and B. P. Hageman (eds.), A. A. Balkema, Rotterdam, p. 129-146.

Simon, Andrew, 1989, A model of channel response in disturbed alluvial channels: Earth Surface Processes and Landforms, v. 14, no. 1, p. 11-26.

Simon, Andrew, 1989, Graduation processes and channel evolution in modified West Tennessee streams: Process, response, and form: U.S. Geological Survey Professional Paper 1470, 93 p. (in press).

4. In cooperation with the Tennessee Department of Transportation, a study on the effects of bridge structures on wetland sedimentation is being conducted. Bed-material samples are collected twice annually at low flow to determine dominant particle sizes. Samples of overbank deposits are collected along transects and artificial substrates serve to monitor recent deposition rates. Historical deposition is determined through exhumation of buried root collars and through dendro-chronology. Sixty single-stage sediment samplers are being used to document sediment transport across flood plains. The effects of bridge structures are analyzed through step-backwater and sediment-transport computations.

5. In cooperation with the Tennessee Department of Health and Environment, Division of Construction Grants and Loans, a study of runoff from agricultural production areas to tributaries to Reelfoot Lake is being conducted. Daily suspended-sediment concentration data are being collected at one site in the North Reelfoot Creek basin, and storm-event sampling is being conducted at one site each in the South Reelfoot Creek basin and the Running Slough basin.

Laboratory Activities

The Geological Survey sediment laboratory located in Baton Rouge, LA, analyzed suspended-sediment and bed-material samples collected by the COE at the following locations:

Old River Outflow near Knox Landing
Red River above Old River Outflow
Mississippi River at Coochie
Mississippi River at Tarbert Landing
Atchafalaya River at Simmesport
Bayou Chene above Bayou Crook Chene
East Access Channel above Lake Chicot
Lake Long below Bayou LaRompe
Little Tensas below Blind Tensas Cut

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Office Building
Room 2301
700 West Capitol Avenue
Little Rock, AR 72201

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

District Chief, WRD
U.S. Geological Survey
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

District Chief, WRD
U.S. Geological Survey
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

LOWER MISSISSIPPI REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damage and determinations of sediment yields were made for work plans in the following watersheds:

Public Law 566

Major Drainage	Watershed	Stream	County	State
Lower Mississippi	Yocona-Spybuck	Yocona Creek	St. Francis and Lee	AR

SOURIS-RED-RAINY REGION

CORPS OF ENGINEERS

North Central Division

St. Paul District

Sediment loads were measured by the U.S. Geological Survey at two river stations (near Kindred, ND on Sheyenne River and at Walhalla, ND on Pembina River) under the District sponsorship.

SOURIS-RED-RAINY REGION

GEOLOGICAL SURVEY

Souris Subregion

1. Suspended-sediment data are being collected on a periodic basis at Souris River near Westhope, ND, as part of the National Stream Quality Accounting Network (NASQAN).

2. Daily observer sediment concentrations are collected as part of the U.S. Fish and Wildlife Service Refuge Monitoring Program at the following gaging stations:

Souris River near Bantry, ND
Willow Creek near Willow City, ND
Stone Creek near Kramer, ND
Deep River below Cut Bank Creek near Upham, ND
Boundary Creek near Landa, ND
Souris River near Westhope, ND

The samples at the above sites are collected during a 2-month period coinciding with the spring snowmelt.

Red Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Sheyenne River at Kindred, ND, and Red River at the north at Halstad, MN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis at Beaver Creek near Finley, ND, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a bimonthly basis at the Red River of the North at Emerson, Manitoba, Canada, as part of NASQAN. The Water Survey of Canada provides daily sediment concentrations information at this site.

4. Suspended-sediment data are being collected on a bimonthly basis at the Red Lake River at Crookston, MN, and quarterly at Roseau River below State Ditch 51 near Caribou, MN, as a part of NASQAN.

Rainy Subregion

1. Suspended-sediment data were collected on a quarterly basis at Kawishiwi River near Ely, MN, as part of the National Hydrologic Benchmark Network, and on a bimonthly basis at Rainy River at Manitou Rapids, MN, as part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
702 Post Office Building
St. Paul, MN 55101

District Chief, WRD
U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58501

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made for work plans in the following watersheds:

a. River Basin Investigations

Major Basin	Basin Reported	State
Des Lacs--Souiris	Des Lacs--Souiris	ND, MN

MISSOURI

BUREAU OF RECLAMATION

Dunlap Diversion Dam - The Dunlap Diversion Dam is located 8 miles dowrstream of Box Butte Dam on the Niobrara River. Releases are made from Box Butte for subsequent diversion at Dunlap. Sediment deposition has been a mainterance problem in the head end of the canal. A suspended sediment and bed material sample were collected from the river in July. Based upon computed total sediment loads, a settling basin was sized to trap the sediment load prior to diversion. A basin 400 feet long, 50 feet wide and 5 feet below streambed would be required to trap and store the annual sediment load. If a dredge were placed in the basin, dimensions of 300 feet long, 50 feet wide, and 2 feet below grade would be required to trap 84 percent of the maximum daily sand load.

Platte River Channel Studies - An extensive study of Platte River sediment transport and morphologic changes was completed. Sand transport of the Platte River from North Platte to Grand Island, Nebraska was computed for several different time periods. For the period 1926-1939, the Platte River carried a sand load of 2.1 million tons per year of which 60 percent came from the North Platte system. Presently, (1953-1985) the river transports an average annual sand load of 603,000 tons per year, all of which is contributed by the South Platte drainage.

The Platte River at Overton and the Platte River at Grand Island were analyzed for sand transport rates for the period 1958-1986. The computed loads were 698,000 tons per year and 706,000 tons per year, respectively. This indicates that the sediment transport is in equilibrium for this reach of river. Aerial photo interpretation confirms that channel change is no longer occurring in this reach.

A trial case of mathematical modeling of river channel changes for two short reaches of river over 2 to 3 year periods was also completed. It was concluded that mathematical modeling could be applied for longer periods to predict channel changes.

MISSOURI BASIN REGION

CORPS OF ENGINEERS

Missouri River Division

Kansas City District

Sediment Load Measurements. The measurements of suspended sediments were continued at five stations through the water year. The Missouri District of the U.S. Geological Survey collects monthly points and bed samples on the main stem of the Missouri River at St. Joseph, Kansas City, and Herman, Missouri for navigation monitoring purpose. Types of records maintained are: temperatures; sand, silt, and clay percentages; suspended sand gradations; gradation of bed samples; sand and total concentrations; suspended and sand loads. The remaining two stations are located on the Smokey Hill River. One station (types of records maintained are: temperatures; total concentrations; and suspended sediment loads) is located below Kanopolis Lake to measure outflowing materials, and the other (types of records maintained are: temperatures; sand, silt, and clay percentages; gradation of bed materials; total concentration; and suspended loads) is an inflow station to Kanopolis Lake. In July, as part of the cooperative plan with the U.S.G.S., the Missouri District also began performing gradation analysis for the sediment samples collected at the three Missouri River stations.

Lake Reservoir Sediment Activities.

1. Harlan County Lake.

a. The third resurvey of Harlan County Lake was started during this reporting period. Since the last resurvey in 1972, a considerable amount of vegetation clearing was required along the range lines; many monuments has to be re-established, due to bank erosion; and some monuments had to be relocated from private property to federal land because of disposal action of the Real Estate Division. This additional range maintenance exceeded the time frame and funds established, which resulted in only a partial resurvey. Three Republican River main stem ranges located in the flood pool and two multi-purpose pool ranges located on Prairie Dog Creek remain to be surveyed. No degradation ranges were resurveyed. This remaining survey work, along with core sampling, will be accomplished during fiscal year 1989.

b. The underwater data was acquired via off-shore, range-azimuth hydrographic instrumentation, and conventional topographic surveying methods were used for land extensions. During the time of the survey, the average pool elevation was near 1937.8 NGVD, 8.2 feet below the multi-purpose pool elevation of 1,946.0 NGVD. Therefore, a considerable surface area in the headwaters and around the bank perimeter was exposed. Several of the range lines located in the exposed areas remained saturated and were quick. These conditions required some alternative measures to be used in obtaining the cross sections' bed elevations. Comparison of the 1988 multi-purpose pool cross sections with those sections collected in 1951 indicated an average annual bankline retreat of 2.5 feet per year along an apparent beaching slope of 1V on 37.5H.

Special Studies.

1. Missouri River. The Kansas City District, along with an Iowa U.S.G.S. observer, collected bed material samples on the Missouri River at five mile intervals from Ponca, Nebraska, to the confluence with the Mississippi River. No funding was established for sample analysis by either the Omaha or Kansas City Districts. Kansas City District personnel were to be utilized in performing an MA analysis for the samples collected within its jurisdictional waters at the District's soil laboratory. However, the Geotechnical Branch would not grant permission to use the facility until clearance from the laboratory's director was received. This decision remains outstanding.

2. Missouri and Mississippi Rivers Confluence Data. Because of low navigation flows this past season, considerable shoaling was experienced at the confluence and at other locations in the Missouri River. A special emphasis was made to acquire specific flow data and channel geometry at the confluence. Velocity distributions, bed samples, and hydrographic soundings were obtained both on the Missouri and Mississippi Rivers. Soundings were collected on the Missouri River from the mouth to mile 1.6 and on the Mississippi River from approximately below the old lock and dam structure Number 26 to just above the entrance to the Chain of Rocks lock and dam. Point velocities were collected at approximately 100 feet intervals across the channel at miles 1.4 and 0.8 on the Missouri River and at miles 195 and 195.7 on the Mississippi River. Velocity measurements were collected utilizing a geomagnetic compass and vane meter to obtain magnitude and direction. However, the compass failed and the remaining velocity measurements were collected with a Price Current Meter. Horizontal distance from the bank to the boat being used for the data collection was controlled by utilizing an electronic distance meter. After the Missouri River bed material sampling program was completed, additional bed materials were obtained on the Missouri River and Mississippi River at the sections where velocity measurements were to be collected. Additional samples were also collected on a point shoal that continued to redevelop after being dredged several times.

3. Harry S. Truman (HST). The monitoring program below the Harry S. Truman project, in the head waters of the Lake of the Ozarks (LOZ), is being continued. The program includes monitoring the effect of hydro-power generation on downstream degradation, deposition, bank line changes, suspended solids, recreational velocities, cove entrances, coves, boat docks, and/or any other related physical phenomena. The reach being monitored below the project extends some 40 miles into the Osage River arm of the LOZ. Erosion sites were located downstream along the bank lines at locations considered to be most vulnerable to attack, for reference data and at sites specifically requested by the project manager or by local land owners. Presently, these sites are surveyed on a quarterly schedule with each site being extended to the channel thalweg annually. Intensive thalweg-timed, depth integrated sediment samples and point velocity distributions have been collected at several downlake sites for each increase in the incremental step up of power generation or for differing combinations of physical conditions concerning HST's releases and LOZ's tailwaters. A five-unit generator, with a high LOZ pool elevation, was analyzed this past reporting period. Annual reports, based on the District's observations and data collections, have been prepared and published annually since the monitoring program began in 1982.

OMAHA DISTRICT

Special Studies.

1. Perry Creek Flood Control Channel Improvement. Analysis was completed of a low flow channel configuration for the proposed Perry Creek (Sioux City, Iowa) flood control channel. The suggested design was based upon observation of the existing channel, coupled with stable channel design theory. An evaluation of the sediment depletion/dredge-frequency rate of a planned recreation pond in the low flow channel was also included.

2. Williston Levee Adequacy Study. A review of available hydrologic data in the vicinity of the Williston, North Dakota protective works revealed that four feet of freeboard remained at the time of the 1978 hydrographic survey. This remaining freeboard compares with the design which called for three feet of freeboard. Concern exists, however, that aggradation effects since 1978 may have reduced the freeboard below the design requirements. A detailed evaluation of hydrologic conditions, including future aggradation conditions, will begin in FY90.

3. Excess Land Study in Response to JTAC. Analysis of lake shoreline erosion, including projections of the ultimate limits of recession, was undertaken along 700+ miles of Lake Oahe and Lake Sakakawea shoreline in North and South Dakota. The lands, adjacent to the Standing Rock and Fort Berthold Indian reservations, were analyzed in support of a Real Estate Division boundary-adequacy/land-exchange study, done under request of the Joint Tribal Advisory Council (JTAC) and the Secretary of Civil Works for the Army.

4. Carter lake, Iowa Groundwater Flooding Study. A study was conducted under the Section 205 (Small Flood Control Projects) program to determine the relationship between Carter Lake levels and the surrounding water table. Local interests contended that regulating lake levels will control groundwater fluctuations in the surrounding residential area, reducing basement flooding and sewerline damage. The results of the study show that a relationship does exist between the two, albeit a time-lagged relationship, and that regulating the lake level could control the water table immediately surrounding the lake. However, no evidence exists confirming the local's suspicion that sewerline damages are caused by fluctuating lake levels. It was suggested in the study that water table levels be controlled by pumping the groundwater, not by regulating the lake.

5. Yellowstone River Phase I Boundary Adequacy Study. An A-E contractor prepared a report documenting data and trends pertinent to geomorphic changes on the Yellowstone and Missouri Rivers in the vicinity of their confluence. This study was undertaken as a result of recent complaints and legal claims against the government, which have shed doubt on the accuracy of the original property acquisition boundaries in the headwaters and tributaries of the District's main stem reservoirs. Trends recorded in this document will be analyzed to establish the necessity of a government boundary needs (Phase II) study.

6. Lower James River Degradation Study. A study was undertaken to identify and describe the extent of degradation and streambank erosion on the lower 13 miles of the James River in South Dakota, and to determine to what

extent these conditions are related to Missouri River channel changes and Gavins Point Dam operation. Through analysis of channel geometry changes and channel capacity, flow, and velocity relationships, it was concluded that the greatest degree of change on the James is likely attributable to the presence of Gavins Point Dam.

7. Wakpala, South Dakota Sedimentation and Flooding Analysis. An assessment was made of existing and future delta conditions on Oak Creek, a tributary arm of Lake Oahe, near the Indian village of Wakpala, South Dakota. The purpose of this assessment, done in support of a Section 205 initial appraisal study, was to determine the backwater influence of the lake on the annual flooding problem at the village.

8. Lake Oahe Recreation Site Analysis. Nine sites along the Standing Rock Indian Reservation at Lake Oahe in South Dakota were evaluated for possible future recreation site development. This study was done in support of a recreation development program between the Omaha District and the Standing Rock Tribe. Factors considered in the evaluation were bank erosion, littoral processes, and delta encroachment.

9. Holmes Lake Shoreline Investigation. The ultimate shoreline erosion limits were determined around the entire perimeter of Holmes Lake in Lincoln, Nebraska. Existing erosion along this lake has exposed electrical underground wiring as well as tree root system. The analysis included protection alternatives.

10. Niobrara, Nebraska Ferry Crossing Analysis. The location of a proposed ferry crossing of the upper reaches of Lewis and Clark Lake was reviewed, as part of that lake's master plan, in terms of potential aggradation problems. This ferry service is being considered by agencies of the state of South Dakota to reduce travel times between cities in Nebraska and South Dakota. In general, the review determined that the route chosen was reasonable, even though some shoaling problems could be expected under certain flow conditions.

11. Plum Creek Arm Reconnaissance Study. A report was completed documenting the results of the 1988 reconnaissance survey of the Plum Creek Arm of Chatfield Lake to resolve project concerns regarding extensive sediment buildup. Analysis of the data reveals extensive aggradation in the channel upstream of the existing government boundary, resulting in reduced flow capacity at the Titan Road bridge.

12. Glen Cunningham Lake Sedimentation Study. This report documented the change in storage capacity of Glen Cunningham Lake (near Omaha, Nebraska) over the 11 year period between 1976 and 1987. Sediment depletion and related impacts at this lake are extremely important, and often publicized, due to the lake's proximity to a major metropolitan area and its heavy public use. This document also contained discussions of sediment distribution and surface area loss, as well as cross-section, thalweg profile, and area-capacity curve plots. It has been published as an MRD Sediment Memoranda.

13. Area Capacity Update - Cherry Creek Lake. Area-capacity analysis was completed for the 1988 survey of Cherry Creek Lake located in Denver, Colorado. The results of this analysis were used in the hydrologic

improvement study of the lake, as well as in the day to day reservoir regulation operations. Sediment depletion volumes were computed below the maximum pool elevation of 5,636 feet m.s.l. The measured long term sediment depletion rate at this lake is 158 acre-ft/yr. This rate has declined steadily between survey periods since initial fill in 1957 (384 till 1965, 245 till 1974), likely reflecting the occurrence (or lack of occurrence) of large runoff events. The high rates of deposition experienced between 1957 and 1965(384 acre-ft/year), and 1965 and 1974(122 acre-ft/year) correspond to major floods in the area in 1965 and 1974.

14. Fort Peck Lake Sedimentation Study. This study documented basic observations and trends of geomorphic data at Fort Peck Reservoir over the past 50 years. It was completed per EM 1110-2-4000 and has been submitted to Missouri River Division for consideration as an MRD Sediment Memoranda.

Sediment Load Measurements. The Omaha District operated five suspended sediment sampling stations during the year. One is a Missouri River station and four are major tributary stations. The U.S. Geological Survey operates the stations under a cooperative stream gaging program and includes computation and publication of sediment load records. In addition, they collect suspended sediment samples, bed materials, and flow velocity data in the Missouri River at Nebraska City, Nebraska; Omaha, Nebraska; and Sioux City, Iowa. Data collected include point integrated samples, flow velocity, and bed samples at five vertical locations in the cross section. Samples are obtained from a boat at each station at about six week intervals during the open water season. This data will be used to document the bed material load being transported by the Missouri River.

Aggradation/Degradation Reach Groundwater Measurements. As a result of complaints and legal claims against the government, stemming from aggradation or degradation effects on groundwater levels adjacent to privately owned lands, several observation wells have been placed along the Missouri River in the major aggradation and degradation reaches. These wells are being used to monitor the degree of impact over time. All records are obtained either by the U.S.G.S. or by contract observers.

1. Niobrara River. Four observation wells were read weekly to monitor groundwater changes associated with lake headwater aggradation effects in Lewis and Clark Lake and the effects of delta growth at the mouth of the Niobrara River.

2. Fort Randall Project. Four wells were read weekly upstream of the Niobrara township on the Missouri River. Data from these wells are used to monitor the ground water impacts of aggradation in the Missouri River.

3. Pierre, South Dakota. Nine observation wells were installed in 1983 in response to local complaints of high ground water levels. Two additional wells were installed in December 1985 as part of the Pierre-Fort Pierre Ice Affected Flooding Study. Data from these wells are used to predict the groundwater levels associated with aggradation. Readings are taken bi-weekly.

4. Garrison Project. Four wells (down from 19 prior to November 1987) are located immediately downstream of Garrison Dam. They were read monthly and will be used to assess relationships between river stages and groundwater

levels.

5. Buford-Trenton Irrigation District. Fourteen wells were read monthly, quarterly, or bi-weekly to monitor the effect of Missouri River stage increases on local groundwater levels.

6. Yellowstone Confluence. Seventeen wells are located in the vicinity of the confluence of the Missouri and Yellowstone Rivers. These wells were installed in 1987 and will be used to monitor the effect of Missouri River and Yellowstone River stage increases on local groundwater levels. They were read on a monthly or bi-weekly basis during 1988.

7. Fort Peck Project. Four wells were read monthly immediately downstream of Fort Peck Dam. Data from these wells were used for the Fort Peck Additional Hydropower Study, and will be used in the future to assess relationships between river stages and groundwater levels. Eighteen wells were removed from this location in November 1987.

Reservoir Sediment Activities.

1. Garrison Project. Seventy-eight ranges on Lake Sakakawea and its major tributaries were surveyed under A-E contract. This work included locating sediment range monuments, replacing destroyed monuments, and repainting location markers. The data collected is to be combined with 1987 survey data to update reservoir area and capacity volumes for use in the day-to-day operation of Garrison Dam. It will also be used for shoreline erosion analysis and for determining aggradation trends in the lake and headwater tributary areas. An additional work item, completed for the Corps by the U.S. Geological Survey, included the collection of discharge and suspended sediment data for use in a multi-objective study. Objectives included identifying areas of deposition or resuspension during steady flow conditions, determining sources of suspended sediment loads, and identifying areas (if any) experiencing net annual deposition.

2. Oahe Project. An inspection trip was made to Lake Oahe to examine archeological sites which are candidates for either bank stabilization or mitigation by excavation. Two previously protected sites were also visited. Personnel from Omaha District, Missouri River Division, and the South Dakota State Historic Preservation Office attended the inspection.

3. Ft. Randall Project. A water surface profile of the degradation reach was measured during a steady state discharge of 37,000 cfs. This data will be used to identify changes in water surface slopes, changes in channel flow capacity, probable locations of bed armoring, and rating curve trends at recording gages in the reach.

4. Gavins Point Project. Bed samples were collected in the first ten miles below the dam. Grain size analysis of these samples will be utilized to indicate the extent of bed armoring and to calibrate past samples to account for collection inadequacies. In addition, water surface profiles were run for discharges of 32,000 and 37,000 cfs in the degradation reach. These will be used to identify changes in water surface slopes and channel flow capacity, to indicate probable locations of bed armoring, and to update rating curve trends at recording gages in the reach.

5. Salt Creek Project. An A-E contractor completed a hydrographic resurvey of Conestoga Lake. This data will be used to update reservoir area and capacity records. In addition, range monuments were located and replaced or restored as necessary.

6. Cherry Creek Project. A complete inhouse hydrographic resurvey was made of Cherry Creek Lake. All range monuments were located and replaced or restored as necessary. This data has been used to update reservoir area and capacity records for use in the daily operation of the dam.

7. Chatfield Project. Eight sediment ranges on the Plum Creek Arm of Chatfield Lake were surveyed to determine the extent of aggradation occurring in that arm, especially in the vicinity of the Titan Road Bridge.

8. Cold Brook Project. A reconnaissance hydrographic survey was made of Cold Brook Lake. This survey involved controlled soundings of the underwater portion of index ranges. The data will be used to determine potential problem areas and the scheduling of future complete resurveys.

MISSOURI REGION

GEOLOGICAL SURVEY

Saskatchewan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at St. Mary's River at Montana, USA-Alberta, Canada, border, as a part of the National Stream Quality Accounting Network (NASQAN).

Missouri-Marias Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Missouri River at Toston, MT, and bimonthly at Sun River near Vaughn, MT, as a part of NASQAN.

Missouri-Musselshell Subregion

1. Suspended-sediment data are being collected on a daily basis at Missouri River near Landusky, MT, and at Musselshell River at Mosby, MT, in cooperation with the U.S. Army Corps of Engineers (COE).

2. Suspended-sediment data are being collected on a bimonthly basis at Musselshell River at Harlowton and at Musselshell, MT, as part of the Federal Collection of Basic Records (CBR) program.

Milk Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Milk River at Nashua, MT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Little Peoples Creek near Hays, MT, Big Sandy Creek at Reservation Boundary near Rocky Boy, MT, and Lodge Pole Creek at Lodge Pole, MT, and bimonthly at Big Sandy Creek near Havre, MT, in cooperation with the Bureau of Indian Affairs.

3. Suspended-sediment data are being collected on a quarterly basis at Rock Creek below Horse Creek near the international boundary, as a part of the National Hydrologic Benchmark Network.

Missouri-Poplar Subregion

1. Suspended-sediment data are being collected on a monthly basis in cooperation with Montana Department of Natural Resources at the following sites to define water-quality characteristics of the Poplar River basin:

Poplar River at international boundary
East Poplar River at international boundary
East Fork Poplar River near Scobey, MT

2. Suspended-sediment data are being collected on a bimonthly basis at Poplar River near Poplar, MT, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Beaver Creek at international boundary as part of the Water Ways Treaty Program.

Upper Yellowstone Subregion

1. Suspended-sediment data are being collected on a daily basis beginning in September in cooperation with the National Park Service at the Yellowstone River at Corwin Springs, MT, and at the Lamar River near Tower Falls Ranger Station, Yellowstone National Park.

2. Suspended-sediment data are being collected on a bimonthly basis at Yellowstone River near Livingston, MT, and quarterly at Yellowstone River at Billings, MT, as part of NASQAN.

Big Horn Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Bighorn River at Bighorn, MT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a 6-week and storm-event basis at Bighorn River at Kane, WY, as a part of the Missouri River basin program.

3. Suspended-sediment data are being collected on a daily basis during storm events for the nonwinter season at East Fork Nowater Creek near Colter, WY, in cooperation with the Wyoming State Engineer.

4. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Wind River at Riverton, WY, as part of NASQAN.

Powder-Tongue Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tongue River at Miles City, MT, and a bimonthly basis at Powder River at Locate, MT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis March through September at Powder River at Moorhead, MT, and at Powder River at Broadus, MT, as part of the National Research Program.

3. Suspended-sediment data are being collected on a daily basis during storm events for the nonwinter season at Dead Horse Creek near Buffalo, WY, in cooperation with the Wyoming State Engineer.

4. Suspended-sediment data are being collected on a monthly basis at Tongue River at Tongue River Dam and quarterly at Hanging Woman Creek near Birney, MT, and Otter Creek at Ashland, MT in cooperation with the U.S. Bureau of Land Management.

Lower Yellowstone Subregion

1. Suspended-sediment data are being collected on a daily basis at Yellowstone River near Sidney, MT, in cooperation with the COE.

2. Suspended-sediment data are being collected on a quarterly basis at Armells Creek near Forsyth, MT, and Rosebud Creek at mouth near Rosebud, MT, in cooperation with the U.S. Bureau of Land Management.

Missouri-Little Missouri Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Bear Den Creek near Mandaree, ND, as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a periodic basis at Little Missouri River near Watford City, ND, as part of NASQAN.

Missouri-Oahe Subregion

1. Suspended-sediment data are being collected on a periodic basis at Knife River at Hazen, ND, at Heart River near Mandan, ND, and at Cannonball River at Breien, ND, as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis on Brush Creek near Beulah, ND, and Buffalo Creek tributary near Gascayne, ND, as part of a State monitoring program for coal development.

3. Suspended-sediment data are being collected on a periodic basis at Grand River at Little Eagle, SD, and Moreau River near Whitehorse, SD, as a part of NASQAN.

4. The U.S. Geological Survey in cooperation with the COE, Omaha District, has begun a study to describe the characteristics of suspended-sediment movement and changes in concentration in the reach of the Missouri River between Garrison Dam and the headwaters of Oahe Reservoir. Suspended-sediment data are being collected at 20 sites on the Missouri River during a range of steady-state discharges.

Missouri-Cheyenne Subregion

1. Suspended-sediment data are being collected on a periodic basis at Belle Fourche River near Elm Springs, SD, and at Cheyenne River at Cherry Creek, SD, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis during storm events during the nonwinter season at Little Thunder Creek near Hampshire, WY, and Black Thunder Creek near Hampshire, WY, in cooperation with the Wyoming State Engineer.

3. Suspended-sediment data are being collected on a 6-week and storm-event basis in cooperation with the city of Gillette, WY, at Stonepile Creek at Gillette, WY.

4. Suspended-sediment data are being collected on a storm-event basis at miscellaneous sites.

5. Suspended-sediment data are being collected on a quarterly basis at Castle Creek above Deerfield Dam, near Hill City, SD, as a part of the National Hydrologic Benchmark Network.

Missouri-White Subregion

1. Suspended-sediment data are being collected on a daily basis at the South Fork, Bad River near Cottonwood, SD, and Bad River near Fort Pierre, SD, in cooperation with the State of South Dakota and the COE.

2. Suspended-sediment data are being collected on a monthly basis at Little White River near Vetal, SD, and Little White River above Rosebud, SD, in cooperation with the U.S. Bureau of Reclamation (USBR).

Missouri-Andes Creek Subregion

1. Suspended-sediment data are being collected on a monthly basis at Andes Creek near Armour, SD, Lake Andes Tributary No. 1 near Lake Andes, SD, Lake Andes Tributary No. 2 near Lake Andes, SD, and Lake Andes Tributary No. 3 near Armour, SD, in cooperation with the USBR and as part of the Missouri River basin program.

Missouri-Choteau Creek Subregion

1. Suspended-sediment data are being collected on a monthly basis at Choteau Creek near Wagner, SD, and Choteau Creek near Dante, SD, in cooperation with the USBR.

Niobrara Subregion

1. Suspended-sediment data are being collected on approximately a bimonthly basis at Niobrara River at Mariaville, NE, in cooperation with the USBR.

2. Suspended-sediment data are being collected on approximately a bimonthly basis at Niobrara River near Verdel, NE, as a part of NASQAN.

Missouri-James Subregion

1. Suspended-sediment data are being collected on a periodic basis at James River at LaMoure, ND, James River at Pingree, ND, and James River near Ludden, ND, as part of the Missouri River program.

2. Suspended-sediment data are being collected on a periodic basis at James River near Manfred, ND, James River near Grace City, ND, Lake Juanita tributary near Grace City, ND, James River above Arrowhead Lake near Kensal, ND, Kelly Creek near Bordulac, ND, James River at Jamestown, ND, James River at Oakes, ND, and James River near Hecla, SD, as part of the Garrison Diversion Refuge Monitoring Program.

3. Suspended-sediment data are being collected on a monthly basis at James River near Columbia, SD, and at James River near Scotland, SD, as a part of NASQAN, and the Missouri River basin program.

4. Suspended-sediment data are being collected on a periodic basis at James River at Columbia, SD, James River at Ashton, SD, James River at Huron, SD, and James River near Scotland, SD, in cooperation with the USBR.

Missouri-Big Sioux Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Big Sioux River at Akron, IA, as a part of NASQAN.

North Platte Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at North Platte River near Lisco, NE, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Encampment River above Hog Park Creek near Encampment, WY, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a 6-week and storm-event basis at Deer Creek in canyon near Glenrock, WY.

4. Suspended-sediment data are being collected on a bimonthly and storm-event basis at North Platte River above Seminoe Reservoir, near Sinclair, WY, as part of NASQAN.

5. Suspended-sediment data are being collected on a bimonthly basis at North Platte River above Seminoe Reservoir, near Sinclair, WY, Medicine Bow River above Seminoe Reservoir, near Hanna, WY, and North Platte River above Pathfinder Reservoir, WY, in cooperation with the USBR.

South Platte Subregion

1. Suspended-sediment data are being collected on a quarterly basis at South Platte River at Julesburg, CO, and bimonthly at South Platte at Henderson, CO, as a part of NASQAN.

2. Suspended-sediment data are being collected monthly at North Fork Cache La Poudre River at Livermore, CO.

Platte Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Platte River at Louisville, NE, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Platte River near Duncan, NE, as part of NASQAN.

Loup Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Cedar River near Fullerton, NE, as part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Dismal River near Thedford, NE, as part of the National Hydrologic Benchmark Network.

Elkhorn Subregion

1. Suspended-sediment data are being collected at Elkhorn River at Waterloo, NE, on a bimonthly basis as a part of NASQAN.

Missouri-Little Sioux Subregion

1. Suspended-sediment data which includes bed material, suspended-sediment samples, and velocities at several points in a vertical are being collected at the following stations in cooperation with the COE, Omaha District:

Missouri River at Sioux City, IA
Missouri River at Omaha, NE
Missouri River at Nebraska City, NE

Missouri-Nishnabotna Subregion

1. Suspended-sediment data are being collected on a daily basis at Nodaway River at Clarinda, IA, in cooperation with the Iowa Geological Survey.

2. Suspended-sediment data are being collected on a quarterly basis at Nishnabotna River above Hamburg, IA, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Platte River at Sharps Station, MO, as a part of NASQAN.

4. Suspended-sediment data are being collected on a monthly basis at Missouri River at St. Joseph, MO, in cooperation with the Missouri Department of Natural Resources.

Republican Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Beaver Creek at Cedar Bluffs, KS, South Fork Sappa Creek near Brewster, KS, Prairie Dog Creek above Keith Sebelius Lake, KS, and White Rock Creek near Burr Oak, KS, in cooperation with the Kansas Water Office (discontinued June 1988).

2. Suspended-sediment data are being collected on a bimonthly basis at Republican River near Clay Center, KS, as part of NASQAN.

Smoky Hill Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Smoky Hill River at Enterprise, KS, Big Creek near Hays, KS, Saline River near Russell, KS, North Fork Solomon River at Glade, KS, and South Fork Solomon River above Webster Reservoir, KS, in cooperation with the Kansas Water Office.

2. Suspended-sediment data are being collected on a bimonthly basis at South Fork Solomon River at Osborne, KS, as part of NASQAN (beginning October 1, 1986).

Kansas Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Big Blue River at Barneston, NE, as part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at West Fork Big Blue River near Dorchester, NE, as part of the Federal CBR program.

3. Suspended-sediment data are being collected on a monthly basis and on a storm-event basis as part of the Lower Kansas River basin NAWQA study at the following sites:

West Fork Big Blue River near Dorchester, NE
Big Blue River at Barneston, NE
Little Blue River at Hollenberg, KS
Kansas River at Fort Riley, KS
Kings Creek near Manhattan, KS
Black Vermillion River near Frankfurt, KS
Big Blue River near Manhattan, KS
Kansas River at DeSoto, KS
Wakarusa River near Lawrence, KS

Mill Creek near Paxico, KS
Kansas River at Topeka, KS
Delaware River near Muscoteh, KS
Delaware River below Perry Dam, KS

4. Suspended-sediment data are being collected on a 6-week basis at Little Blue River near Barnes, KS, in cooperation with the Kansas Water Office.

5. Suspended-sediment data are being collected on a quarterly basis at Kings Creek near Manhattan, KS, as part of the National Hydrologic Benchmark Network.

Chariton-Grand Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Elk Creek near Decatur City, IA, as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a monthly basis at Grand River near Summer, MO, as a part of NASQAN, and in cooperation with the Missouri Department of Natural Resources.

Gasconade-Osage Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Dragoon Creek near Burlingame, KS, and Pottawatomie Creek near Garnett, KS, in cooperation with the Kansas Water Office.

2. Suspended-sediment data are being collected on a monthly basis at Osage River below St. Thomas, MO, and at Osage River above Schell City, MO, as a part of NASQAN.

3. Suspended-sediment data are being collected on a monthly basis at Gasconade River near Jerome, MO, as a part of NASQAN, and in cooperation with the Missouri Department of Natural Resources.

Lower Missouri Subregion

1. Suspended-sediment data are being collected on a monthly basis at Missouri River at Hermann, MO, as a part of NASQAN, and in cooperation with the Missouri Department of Natural Resources.

Special Studies

1. PS-69 pumping sediment samplers are operating at Lower Hay Creek Tributary near Wilbaux, MT, discontinued September 30, 1981, and at West Branch Antelope Creek Tributary No. 4 near Zap, ND, as part of EMERIA studies. Sediment data are collected at these and several other sites in the study basins.

2. A study to determine relations between sediment production and peak discharge for a storm-runoff event continued in Wyoming. Three stations were equipped with Manning samplers and were operated during the year for the study.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

District Chief, WRD
U.S. Geological Survey
4821 Quail Crest Place
Lawrence, KS 66049

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 428
301 South Park Ave., Drawer 10076
Helena, MT 59626

District Chief, WRD
U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58501

District Chief, WRD
U.S. Geological Survey
2617 East Licolnway
Cheyenne, WY 82003

District Chief, WRD
U.S. Geological Survey
P.O. Box 1230
Iowa City, IA 52244

District Chief, WRD
U.S. Geological Survey
1400 Independence Road
Mail Stop 200
Rolla, MO 65401

District Chief, WRD
U.S. Geological Survey
Room 406, Federal Building
100 Centennial Mall, North
Lincoln, NE 68508

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 317
200 4th Street, S.W.
Huron, SD 57350

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made for work plans in the following watersheds:

a. Public Law-566

Major Drainage	Waterhed	Stream	County	State
Missouri River	Boyer	Mill Cr.	Crawford	IA
Missouri River	Boyer	Mill Cr.	Harrison	IA
Missouri River	Boyer	Picayun Cr.	Harrison	IA
Missouri River	Nishnabotna	Troublesome Cr.	Audubon	IA
Missouri River	Nishnabotna	Turkey Cr.	Cass	IA
Missouri River	Nodaway R.	Mill Cr.	Page	IA
Missouri River	Thompson R.	Little River	Decatur	IA
Missouri River	Pony Creek	Pony Creek	Nemaha	KS
			Brown	KS
			Richardson	NE
Missouri River	Frene Creek	Frene Cr.	Gasconade	MO
Missouri River	W. Fk. Grand	W. Fork	Andrew	MO
			Gentry	MO
			Nodaway	MO
			Worth	MO
Missouri River	E. Fk. Grand	E. Fork	Harrison	MO
			Worth	MO
			Ringgold	MO
			Union	MO
Missouri River	Perche-Hinkson	Perche Cr.	Boone	MO
			Howard	MO
			Randolph	MO
Big Blue River	Soap Creek	Soap Creek	Gage	NE
Arkansas River	Hickory Cr.	Hickory Cr.	Newton	MO

b. Public Law-534

Major Drainage	Watershed	Stream	County	State
Little Sioux R.	Maple R.	Dutch Hollow	Woodbury	IA
Little Sioux R.	Maple R.	Little Whiskey	Woodbury	IA

c. River Basin Investigations

Major Basin	Basin Reported	State
Platte R. and Niobrara River	Sandhills Cooperative Study	NE
Statewide	Nebraska Watershed Evaluation Cooperative River Basin Study	NE

d. Flood Plain Management Studies

Project Name	County	State
Lower Wood River	Buffalo, Hall, Merrick	NE

e. Resource Conservation and Development

Project Name	County	State
Keya Paha Streambank Critical Area Treatment	Keya Paha	NE
Clearwater Creek Critical Area Treatment	Holt	NE

2. Reservoir Sedimentation Surveys.

The following reservoir sedimentation surveys were made during Public Law-566 planning for the North Fork of Crazy Woman Creek Watershed:

Reservoir	County	State
Basch	Johnson	WY
Kingsbury-Todd No.1	Johnson	WY
Muffie	Johnson	WY
Tass	Johnson	WY

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sediment Load Measurements. Suspended sediment measurements were made at two stations (Arkansas River below John Martin Reservoir and Purgatoire River below Trinidad Lake near Trinidad) in the region.

Other Investigations. Trinidad and John Martin Dams continued to be operated to control sediment in the Arkansas River Basin.

Little Rock District

Sedimentation Surveys. Sediment ranges were surveyed in Beaver, Nimrod, Dardanelle, and Ozark Reservoirs. The survey equipment was not available to survey the other scheduled reservoirs because it was in use on the navigation system due to the low stages on the Mississippi River.

Sediment Load Measurements. 51 Sediment measurements were obtained on Arkansas River, Mulberry, Spadra Creek, Little Piney Creek, Piney Creek, Petit Jean, Fourche La Fave, White River, Taylor Bay, James River, Bryant Creek, North Fork, Current River, Black River, Piney Fork, Strawberry River, Little River. The concentration in percent of weight records were maintained.

Tulsa District

Sedimentation Surveys. A reconnaissance sedimentation survey was performed on Elk City Lake, Kansas, and the data processed for submittal to Southwestern Division in February 1989. A contract was awarded to perform a detailed resurvey on Keystone Lake, Oklahoma, with the survey to be completed in the spring of 1989. A predredge survey was performed on Pennington Creek, a tributary to Lake Texoma and a post dredge survey will probably be performed after the construction of a sediment control structure. The installation and testing of the hydrographic survey system delivered in December 1988 has ben completed. Ongoing upgrading and modifying is being performed by the manufacturer with no costs incurred by the government.

Sediment Load Measurements. The suspended sediment sampling program consists of 45 stations. Presently there are 37 operational stations in the Arkansas River Basin and 8 operational stations in the Red River Basin. Samplers DH-48 and DH-49 were used.

Arkansas River Basin	Arkansas Riv	at Arkansas City, KS
		Haskell, OK
		Kaw Dam
		Ralston, OK
		Tulsa, OK
	Beaver Riv	Guymon,OK

	Birch Cr	Barnsdall, OK
	Big Hill Cr	Cherryvale, KS
	Bird Cr	Sperry, OK
	Black Bear Cr	Pavonee, OK
	Canadian Riv	Calvin, OK
	Caney Riv	Ramona, OK
	Cimarron Riv	Perdins, OK
	Cottonwood Riv	Marion, KS
		Plymouth, KS
	Deep fork Riv	Arcadia, OK
		Beggs, OK
		Warwick, OK
	Elk Riv	Elk Falls, KS
	Grand (Neosho) Riv	Americus, KS
		Commerce, OK
		Council Grove, KS
	Hominy Cr	Skiatook, OK
	Illinois Riv	Tahlequah, OK
	Little Ark Riv	Valley Center, KS
	Little Caney Riv	Copan, OK
	N. Canadian Riv	Oklahoma City, KS
	N. Canadian (beaver) Riv	Optima Dam
		Selling, OK
	Otter Cr	Climax, KS
	Salt fork, Ark Riv	Aloa, OK
		Jet, OK
	Sand Cr	Okesa, OK
	Verdigris Riv	Claremore, OK
		Lenapah, OK
	Walnut Riv	Winfield, KS
	Whitewater Riv	Towanda, KS
Red River Basin	Beaver Cr at	Waurika, OK
	Glover Cr	Glover, OK
	Kiamichi Riv	Antlers, OK
		Big Cedar, OK
	North Fork, Wichita Riv	Truscott, TX
	Red Riv	Dekalb, TX
		Quanah, TX

Other Investigations. Requests for sediment data involving local flood control projects within the District were made during 1988. Two contracts were awarded during 1988 to process the Reservoir Sediment Data Summaries (ENG Form 1787) for Hugo and Kaw Lakes, Oklahoma. Hugo Lake was completed in early summer and forwarded to Division and Kaw Lake will be completed in the spring of 1989.

ARKANSAS-WHITE-RED REGION

GEOLOGICAL SURVEY

Upper White Subregion

1. Suspended-sediment data are being collected bimonthly at White River at Calico Rock, AR, as part of the State Coop Program.

2. Suspended-sediment data are being collected on a bimonthly basis at North Sylamore Creek near Fifty Six, AR, as part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a bimonthly basis at White River at Newport, AR, as a part of the National Stream Quality Accounting Network (NASQAN).

Upper Arkansas Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Arkansas River at Portland, CO, as part of NASQAN. In addition, suspended sediment and sediment chemistry data are being collected depending on stage for the period May through September at this station.

2. Suspended-sediment data are being collected on a bimonthly basis at Halfmoon Creek near Malta, CO, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a daily basis at the following stations, in cooperation with the U.S. Army, Fort Carson, CO:

Purgatoire River near Thatcher, CO
Taylor Arroyo below Rock Crossing near Thatcher, CO
Chacauco Creek at mouth near Timpas, CO
Bent Canyon Creek at mouth near Timpas, CO
Purgatoire River at Rock Crossing near Timpas, CO
Big Arroyo near Thatcher, CO

4. Suspended-sediment data are being collected on a daily basis, approximately 6 months of the year, at Badger Creek upper station near Howard, CO, and Badger Creek lower station near Howard, CO, in cooperation with the U.S. Bureau of Land Management.

5. Suspended-sediment data are being collected on a periodic basis at the following stations, in cooperation with the city of Colorado Springs:

Fountain Creek near Colorado Springs, CO
Fountain Creek at Colorado Springs, CO
Fountain Creek at Secrity, CO

6. Study is being performed to determine what metals are being transported on the sediments and in solution in the Leadville, CO, area.

Middle Arkansas Subregion

1. Suspended-sediment data are being collected on a 6-week basis at the following sites in cooperation with the Kansas Water Office:

Rattlesnake Creek near Macksville, KS (discontinued June 30, 1988)
Cow Creek near Lyons, KS
Little Arkansas River at Alta Mills, KS (discontinued June 30, 1988)
North Fork Ninnescah River above Cheney Reservoir, KS
South Fork Ninnescah River near Pratt, KS (discontinued June 30, 1988)
South Fork Ninnescah River near Murdock, KS
Slate Creek at Wellington, KS (discontinued June 30, 1988)
Arkansas River at Arkansas City, KS (discontinued June 30, 1988)
Whitewater River at Towanda, KS (discontinued June 30, 1988)

2. Suspended-sediment data are being collected on a quarterly basis at Arkansas River near Coolidge, KS, as part of NASQAN.

3. Suspended-sediment data are being collected on a 6-week basis at Little Arkansas River at Valley Center and at Whitewater River at Tawanda, KS, in cooperation with the U.S. Army Corps of Engineers (COE).

Upper Cimarron Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Crooked Creek near Nye, KS, in cooperation with the Kansas Water Office (discontinued June 30, 1988).

2. Suspended-sediment data are being collected at Cimarron River near Kenton, OK, Cimarron River near Englewood, KS, and Cimarron River near Forgan, OK, in cooperation with the U.S. Bureau of Reclamation (USBR).

Lower Cimarron Subregion

1. Suspended-sediment data are being collected at Cimarron River near Buffalo, OK, as a part of NASQAN.

2. Suspended-sediment data are being collected at Cimarron River at Perkins, OK, in cooperation with the COE and as a part of NASQAN.

Arkansas-Keystone Subregion

1. Suspended-sediment data are being collected at Arkansas River near Ponca City, OK, Salt Fork Arkansas River Near Jet, OK, Salt Fork Arkansas River at Alva, OK, Black Bear Creek at Pawnee, OK, and Arkansas River near Haskell, OK, in cooperation with the COE.

2. Suspended-sediment data are being collected at Arkansas River at Ralston, OK, as a part of NASQAN, and in cooperation with the COE.

Neosho-Verdigris Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Lightning Creek near McCune, KS, and at Neosho River near Parsons, KS, in cooperation with the Kansas Water Office.

2. Suspended-sediment data are being collected on a 6-week or periodic basis at the following sites in cooperation with the COE:

Otter Creek at Climax, KS
Elk River at Elk Falls, KS
Big Hill Creek near Cherryvale, KS
Neosho River at Council Grove, KS

Neosho River near Americus, KS
Cottonwood River below Marion Lake, KS
Cottonwood River near Plymouth, KS

3. Suspended-sediment data are being collected at Neosho River below Fort Gibson Lake near Fort Gibson, OK, as a part of NASQAN.

4. Suspended-sediment data are being collected on a periodic basis at the following sites in cooperation with the COE:

Verdigris River near Lenapah, OK
Little Caney River near Copan Lake, OK
Sand Creek at Okesa, OK
Caney River near Ramona, OK
Verdigris River near Claremore, OK
Birch Creek below Birch Lake near Barnsdall, OK
Hominy Creek below Skiatook Lake near Skiatook, OK
Bird Creek near Sperry, OK

Upper Canadian Subregion

1. Suspended-sediment data are being collected at the following stations at this indicated frequency in cooperation with the New Mexico Interstate Stream Commission:

Cimarron River near Cimarron, NM (semiannual)
Ponil Creek near Cimarron, NM (bimonthly)
Rayado Creek near Cimarron, NM (bimonthly)
Mora River at La Cueva, NM (bimonthly)
Ute Reservoir near Logan, NM (annual)

2. Suspended-Sediment data are being collected on a bimonthly basis at the Canadian River near Sanchez, NM, in conjunction with the Water Quality Surveillance Program in cooperation with the New Mexico Interstate Stream Commission and as part of NASQAN.

Lower Canadian Subregion

1. Suspended-sediment data are being collected at Canadian River near Canadian, TX, as part of NASQAN.

2. Suspended-sediment data are being collected at Canadian Sandy Creek near Ada, OK, and Little River near Bowlegs, OK, in cooperation with the USBR.

3. Suspended-sediment are being collected at Canadian River at Calvin, OK, as a part of NASQAN and in cooperation with the COE.

North Canadian Subregion

1. Suspended-sediment data are being collected at North Canadian River at Woodward, OK, and at Beaver River at Beaver, OK, as a part of NASQAN.

2. Suspended-sediment data are being collected at North Canadian River near Wetumka, Ok, as a part of NASQAN.

3. Suspended-sediment data are being collected at the following sites in cooperation with the COE:

Beaver River near Guymon, OK
North Canadian River near Seiling, OK
Deep Fork near Arcadia, OK
Deep Fork near Warwick, OK

4. Suspended-sediment data are being collected at Deep Fork near Beggs, OK, for NASQAN and in cooperation with the COE.

5. Suspended-sediment data are being collected at North Canadian River near Harrah, OK, in cooperation with the Oklahoma Water Resources Board.

Lower White Subregion

1. Suspended-sediment data are being collected daily at Cache River at Patterson, AR, and at Cache River near Cotton Plant, AR, as part of a cooperative study with the Waterways Experiment Station of the COE.

2. Suspended-sediment data are being collected bimonthly at Bayou DeView at Morton, AR, as part of the State Coop Program.

Lower Arkansas Subregion

1. Suspended-sediment data are being collected at Arkansas River at Tulsa, OK, and on a bimonthly basis at Arkansas River at Dam 13 near Van Buren, AR, and at Arkansas River at David D. Terry Lock and Dam below Little Rock, AR, as a part of NASQAN.

2. Suspended-sediment data are being collected at Illinois River near Tahlequah, OK, in cooperation with the COE.

Red Headwaters Subregions

1. Suspended-sediment data are being collected periodically at North Fork Red River near Headrick, OK, at Salt Fork Red River near Elmer, OK, at Prairie Dog Town Red River near Wayside, TX, and at Prairie Dog Town Fork Red River near Childress, TX (discontinued September 1986), as a part of NASQAN.

Red-Washita Subregion

1. Suspended-sediment data are being collected periodically at Red River near Burkburnett, TX, at Red River at Denison Dam near Denison, TX (discontinued September 1986), and at Red River near Gainesville, TX (discontinued September 1986), as a part of NASQAN.

2. Suspended-sediment data are being collected at Washita River near Dickson, OK, in cooperation with the COE and as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic basis at the following sites in cooperation with the COE:

Red River near Quanah, TX
North Wichita River near Truscott, TX
Red River near DeKalb, TX
Beaver Creek near Waurika, OK

4. Suspended-sediment data are being collected at Blue Beaver Creek near Cache, OK, as part of the National Hydrologic Benchmark Network.

Red-Sulphur Subregion

1. Suspended-sediment data are being collected at Kiamichi River near Big Cedar, OK, as a part of the National Hydrologic Benchmark Network and in cooperation with the COE.

2. Suspended-sediment data are being collected bimonthly at Red River at Index, AR, as a part of NASQAN.

3. Suspended-sediment data are being collected on a bimonthly basis at Cossatot River near Vandervoort, AR, as part of the National Hydrologic Benchmark Network.

4. Suspended-sediment data are being collected on a quarterly basis at Twelve-mile Bayou near Dixie, LA, and Red River at Alexandria, LA, as a part of NASQAN.

5. Suspended-sediment data are being collected on a daily basis at Bayou Pierre near Lake End and on a monthly basis at Grand Bayou near Coushatta, LA, as a part of a lignite study for the Louisiana Office of Public Works.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Office Building
Room 2301
700 West Capitol Avenue
Little Rock, AR 72201

District Chief, WRD
U.S. Geological Survey
4821 Quail Crest Place
Lawrence, KS 66049

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
215 Dean A. McGee Avenue
Room 621
Oklahoma City, OK 73102

District Chief, WRD
U. S. Geological Survey
8011 Cameron Road
Austin, TX 78753

District Chief, WRD
U.S. Geological Survey
Building 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determination of sediment yields were made for the following activities.

a. Public Law 566

Major Drainage	Watershed	Stream	County	State
Arkansas	Choska Drainage	Porter	Waggoner	OK
Red River	Little Beaver	Little	Grady	OK
		Beaver	Stephens	
		Buckhorn	Cotton	
		Hell		
		Stage Stand		
		Rock		
		Morton		
Arkansas River	Brazil Creek	Brazil	Leflore	OK
		Wildhorse	Haskell	OK
		Owl	Latimer	OK
		Rock		
		Jefferson		
Cimarron River	Wild Horse Creek	Wild Horse	Payne	OK
N. Canadian River	Six Mile Creek	Six Mile	Candian	OK

b. River Basin Investigations

Major Basins	Study Area	State
Red River	Southwest Oklahoma	OK

2. Special Studies

Project Descriptions	Counties	State
a. Lugert-Altus Irrigation and Drainage Study	Southwest Oklahoma	OK
b. Ephemeral Gully Erosion Study Program for state-wide application in the field and area offices.	All	OK
c. Sediment Source Survey for Chandler Municipal Lake	Lincoln	OK
d. Sediment Source Survey for Elmore City Lake	Garvin	OK
e. Sediment Source Survey for Purcell City Lake	McClain	OK

TEXAS-GULF REGION

CORPS OF ENGINEERS

Southwestern Division

Fort Worth District

1. Report on Sedimentation, Stillhouse Hollow Lake, Lampasas River, Brazos River Basin, Texas, Resurvey of November 1987 was submitted to the Division office for approval.

2. Dr. Max Spindler, an associate professor at the University of Texas at Arlington, was hired as a summer employee by the District. Whose assignment in H&H Branch included developing an empirical formula and a computer program which will be used to distribute sediment in the District reservoirs.

Galveston District

A total of 265 inplace samples were obtained from navigation projects. These samples were analyzed to determine the quality of the sediment relative to chemical constituents which would be resuspended during dredging, disposal activities, and construction. The projects sampled and number of samples taken are as follows:

Navigation Project	Number of Samples
Matagorda Ship channel	27
Gulf Intracoastal Waterway	137
Brazos Island Harbor	7
Sabine-Neches Waterway	13
Houston Ship Channel	27
Freeport Harbor	10
Corpus Christi Ship Channel	13
Galveston Harbor	21
Cedar Bayou	10
Total	265

Surveyed cross-sections are established for the Horsepen and Langham diversion channel in Addicks Reservoir and for the Mason Creek diversion channel and Buffalo Bayou in Barker Reservoir. Staff gages were placed to monitor sediment deposition. A resurvey of these cross-sections will be made in FY 89 to determine the amount of sediment accumulation in the reservoirs.

TEXAS-GULF REGION

GEOLOGICAL SURVEY

Sabine Subregion

1. Suspended-sediment data are being collected at Sabine River near Ruliff, TX, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a daily basis at Bayou Grand Cane near Stanley, LA, Bayou Castor near Logansport, TX, and Bayou San Patricio near Benson, LA, as a part of a lignite study for the Louisiana Office of Public Works. Suspended-sediment data is also being collected at Bayou Grand Cane near Stanley, LA, and Bayou Castor near Logansport, TX, on an event basis with a PS-69.

3. Suspended-sediment data are being collected on a daily basis at Big Sandy Creek near Big Sandy, TX, in cooperation with the U.S. Bureau of Reclamation (USBR) beginning October 1, 1984 (discontinued September 1986).

Neches Subregion

1. Suspended-sediment data are being collected on a periodic basis at Neches River at Evadale, TX, as a part of NASQAN.

Trinity Subregion

1. Suspended-sediment data are being collected on a periodic basis at Mountain Creek near Cedar Hill, TX, Duck Creek near Garland, TX, and at Kings Creek near Kaufman, TX, as a part of the Federal Collection of Basic Records (CBR) program (discontinued September 30, 1982).

2. Suspended-sediment data are being collected on a periodic basis at Trinity River at Trinidad, TX, as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic basis at Trinity River at Romayor, TX, and at Chocolate Bayou near Alvin, TX (discontinued September 1986), as a part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Bedias Creek near Madisonville, TX, in cooperation with the USBR (discontinued September 1986).

Galveston Bay-San Jacinto Subregion

1. Suspended-sediment data are being collected on a periodic basis at West Fork San Jacinto River near Conroe, TX, and at Buffalo Bayou at West Belt Dr., Houston, TX (discontinued September 1986), as part of NASQAN.

2. Suspended-sediment data are being collected on a storm-event basis at Cypress Creek near Westfield, TX, in cooperation with the U.S. Army Corps of Engineers, Galveston, beginning October 1, 1986.

Middle Brazos Subregion

1. Suspended-sediment data are being collected on a periodic basis at Salt Fork Brazos River near Aspermont, TX, Double Mountain Fork Brazos River near

Aspermont, TX, Brazos River near Highbank, TX, and at Brazos River near South Bend, TX, as a part of NASQAN.

Lower Brazos Subregion

1. Suspended-sediment data are being collected on a daily and periodic basis at Brazos River at Richmond, TX, as part of the Federal CBR program and also as part of NASQAN (daily sampling discontinued September 1986).

2. Suspended-sediment data are being collected four times a year at South Fork Rocky Creek near Briggs, TX, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a periodic basis at Little River near Cameron, TX, as a part of NASQAN.

Upper Colorado Subregion

1. Suspended-sediment data were being collected on a periodic basis at Colorado River above Silver, TX, as a part of NASQAN.

Lower Colorado-San Bernard Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Colorado River at Austin, TX, Colorado River at Wharton, TX, Colorado River near San Saba, TX, and at San Bernard River near Boling, TX (discontinued September 1986), as a part of NASQAN. The collection of suspended-sediment data at Llano River at Llano, TX (discontinued September 1986) began April 1, 1979, as part of NASQAN.

2. Suspended-sediment data for total-load determination is being collected on a periodic basis at Colorado River above Columbus, TX, in cooperation with the Lower Colorado River Authority beginning October 1, 1982 (discontinued September 1986).

Central Texas Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Guadalupe River at Victoria, TX, San Antonio River at Goliad, TX, Lavaca River near Edna, TX, and at Mission River at Refugio, TX, as a part of NASQAN.

Nueces-Southwestern Texas Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Nueces River near Three Rivers, TX, as a part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
8011 Cameron Road
Austin, TX 78753

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

RIO GRANDE

BUREAU OF RECLAMATION

Velarde Community Ditches - Cross drainage studies were completed for the design of 7 crossing structures on the Alcalde Acequia. Hydraulics and scour depths were computed for 10-, 25-, 50-, and 100-year floods at each crossing structure. The following table summarizes the estimated scour depths:

Stream	100-year scour (feet)
Relief ditch	6
Sanchez Arroyo	8
Arroyo Cande	5
Arroyo de Pueblo	6
Arroyo del Palacio	6
Alcalde Arroyo	5
Arroyo de los Chavez	3

Elephant Butte Reservoir Resurvey - Elephant Butte Reservoir was resurveyed in February. This was the first survey since 1980. A total of 45,288 acre-feet of sediment had been deposited in the 8 years. This deposition rate of 5,612 acre-feet per year is significantly greater than the previous period and is indicative of recent high runoff years. The most recent sediment yield rate is 0.47 acre-feet per square mile per year. A survey report will be published in 1989.

RIO GRANDE REGION

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sedimentation Surveys

1. An aerial survey of the sediment ranges at Two Rivers Reservoir was conducted in March 1988. The purpose of the survey was to determine the changes in overall reservoir storage. The letter report describing and analyzing the reservoir sedimentation resurvey at Two Rivers Reservoir is scheduled for completion in calender year 1989.

2. The new elevation-area-capacity tables for Two Rivers Reservoir were adopted on 1 April 1989.

Sediment Load Measurements. Suspended sediment measurements were made at four stations in the Rio Grande Region. These stations are located on Rio Chama above Abiquiu Dam, below Abiquiu Dam; on Rio Grande below Cochiti Lake; on Jemez River below Jemez Canyon Dam. All samples are secured by the DH-48, DH-59 or DH-49 samplers according to flow conditions. Samples are not usually accrued on weekends and holidays.

Other Investigation. Abiquiu, Cochiti, Galisteo, and Jemez Canyon Dams continued to be operated to control sediment flow in the Rio Grande.

RIO GRANDE REGION

GEOLOGICAL SURVEY

Rio Grande Headwaters Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Rio Grande near Lobatos, CO, as a part of the National Stream Quality Accounting Network (NASQAN).

Rio Grande-Elephant Butte Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Rio Hondo near Valdez, NM, and at Rio Bueblo de Taos below Los Cordouas, NM, in cooperation with the New Mexico Interstate Streams Commission (NMISC).

2. Suspended-sediment data are being collected on a bimonthly basis at Rio Grande above San Juan Pueblo, NM, and at Rio Chama near Chamita, NM, in cooperation with the Bureau of Indian Affairs and Rio Chama near La Puente, NM, in cooperation with the NMISC.

3. Suspended-sediment data are being collected on a daily basis at Rio Grande at Otowi Bridge near San Ildefonso, NM, and at Rio Grande near Albuquerque, NM, as a part of the Federal Collection of Basic Records (CBR) program.

4. Suspended-sediment data are being collected on a daily basis at Rio Grande below Cochiti Dam, NM, in cooperation with the Bureau of Indian Affairs.

5. Suspended-sediment data are being collected on a daily basis at Arroyo Chico near Guadalupe, NM, at Rio Puerco above Arroyo Chico near Gaudalupe, NM, and at Rio Puerco near Bernardo, NM, in cooperation with the U.S. Bureau of Land Management (BLM), NMISC, and U.S. Army Corps of Engineers.

6. Suspended-sediment data are being collected on a bimonthly basis at Rio Grande at San Felipe, NM, Rio San Jose near Grants, NM, and at Rio Grande at Isleta, NM, in conjunction with the Water Quality Surveillance Program and financed cooperatively by NMISC.

7. Suspended-sediment data are being collected at Santa Fe River above Cochiti Dam, NM (quarterly), Cochiti Lake, NM (annually), and Jemez River near Jemez, NM (semiannually), in cooperation with the NMISC.

8. Suspended-sediment data are being collected on a daily basis at Rio Grande near Bernardo, NM, at Rio Grande at San Acacia, NM, and at Rio Grande at San Marcial, NM, in cooperation with NMISC.

9. Suspended-sediment data for total-load determinations are being collected on a quarterly basis at Rio Grande at Albuquerque, NM, at Rio Grande near Bernardo, NM, at Rio Grande at San Acacia, NM, and Rio Grande at San Marcial, NM, in cooperation with NMISC.

10. Suspended-sediment data are being collected on a quarterly and storm-event basis at Rio Mora near Terrero, NM, as a part of the National Hydrologic Benchmark Network.

11. Suspended-sediment data are being collected on a bimonthly basis at Pecos River above Santa Rosa Lake, NM, and Pecos River near Acme, NM, in cooperation with NMISC.

12. Suspended-sediment data are being collected on a daily basis at Pecos River near Artesia, NM, as part of the Federal CBR program.

13. Suspended-sediment data were collected on a bimonthly basis at Pecos River near Puerto de Luna, NM, in conjunction with the Water Quality Surveillance Program and in cooperation with NMISC.

14. Suspended-sediment data are being collected on a bimonthly basis at Pecos River at Red Bluff, NM, at Rio Grande at El Paso, TX, and at Rio Grande at Fort Quitman, TX, as a part of NASQAN.

Rio Grande-Amistad Subregion

1. Suspended-sediment data are being collected on a periodic basis at Rio Grande at Foster Ranch, near Langtry, TX, and at Devils River at Pafford Crossing, near Comstock, TX, as a part of NASQAN and was changed to a Hydrologic Benchmark Station on October 1, 1986.

Rio Grande Closed Basins Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Rio Tularosa near Bent, NM, as a part of NASQAN.

Lower Pecos Subregion

1. Suspended-sediment data are being collected on a periodic basis at Pecos River near Langtry, TX, as a part of NASQAN.

Lower Rio Grande Subregion

1. Suspended-sediment data are being collected on a periodic basis at Rio Grande River near Brownsville, TX, and at Arroyo Colorado at Harlingen, TX (started October 1, 1986), as part of NASQAN.

2. Suspended-sediment data are being collected on a weekly or more frequent basis at North Floodway near Sebastion, TX, and at Arroyo Colorado Floodway at El Fuste Siphon, south of Mercedes, TX, as part of the Federal CBR program (discontinued September 30, 1983).

Special Studies

A water-quality monitoring plan for the Rio Grande and Red River in Taos County, NM, was initiated in October 1978 by the BLM. The study objectives are to monitor long-term changes in water quality (chemical and sediment) at 12 selected sampling sites. BLM personnel collect monthly samples and the Geological Survey analyzes the samples and publishes the data.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
8011 Cameron Road
Austin, TX 78753

SOIL CONSERVATION SERVICE

1. Reservoir Sedimentation Surveys
   a. Reservoir sedimentation surveys were made on the following reservoirs:

Reservoir	County (s)	State
Sebastian Martin-Black Mesa Site #2	Rio Arriba	New Mexico

   b. A partial survey has been completed on the following reservoir:

Reservoir	County	State
Kenney	Garfield	Colorado

UPPER COLORADO

BUREAU OF RECLAMATION

Paonia Reservoir Resurvey - Paonia Reservoir was resurveyed in June. It was the first survey since 1969. A total of 2,753 acre-feet of sediment were deposited in the 19.4 years since the previous survey. This equates to a sediment yield rate of 0.603 acre-feet per square mile per year for the period. A survey report will be published in 1989.

Towaoc Canal Scour Studies - There are three cross drainage sites requiring siphons in Reach 1 of the Towaoc Canal. Hydraulic studies and scour computations at these crossings gave the following results:

Canal Station	100-year Scour (feet)
70 + 97	3
382 + 00	9
464 + 00	6

UPPER COLORADO REGION

GEOLOGICAL SURVEY

Colorado Headwaters Subregion

1. Suspended-sediment data are being collected on a once-a-week basis at Colorado River near Cameo, CO, in cooperation with the Colorado River Water Conservation District.

2. Suspended-sediment data are being collected on a bimonthly basis at Colorado River near Colorado-Utah State line as a part of the National Stream Quality Accounting Network (NASQAN).

3. Suspended-sediment and bedload data are being collected throughout the year at Muddy Creek at Kremmling, CO, in cooperation with Colorado River Water Conservation District (discontinued October 1, 1988).

Gunnison Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Gunnison River near Grand Junction, CO, as a part of NASQAN.

Upper Colorado-Dolores Subregion

1. Suspended-sediment data are being collected on a bimonthly basis level at Colorado River near Cisco, UT, as part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Dolores River near Cisco, UT, as a part of NASQAN.

Great Divide-Upper Green Subregion

1. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Green River near La Barge, WY, as part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at Green River near Green River, WY, as a part of the Federal Collection of Basic Records Program.

White-Yampa Subregion

1. Suspended-sediment data were obtained once a week at Yampa River near Maybell, CO.

2. Suspended-sediment data are being collected on a 6-week and storm-event basis at Savery Creek near Savery, WY, in cooperation with the Wyoming Water Department Commission.

3. Periodic suspended-sediment and bedload data are being collected during the snowmelt runoff period in cooperation with the Wyoming Water Department Commission at the following stations:

Battle Creek near Encampment, WY
East Fork Savery Creek near Encampment, WY
Big Sandstone Creek near Savery, WY

4. Suspended-sediment data are being collected on a daily basis for the nonwinter season at Muddy Creek near Baggs in cooperation with the Wyoming Water Research Center.

5. Suspended-sediment data are being collected quarterly at Williams Fork River at mouth near Hamilton, CO, in cooperation with Moffat County.

6. Suspended-sediment and bedload data are being collected six times per year at the following sites in the coal mining region of the Yampa River basin:

Middle Creek above Dam Site near Oak Creek, CO
Yampa River above Dam Site near Oak Creek, CO
Martin Creek above Dam Site near Oak Creek, CO
Little Morrison Creek above Dam Site near Oak Creek, CO

These stations are operated in cooperation with the Upper Yampa Water Conservancy District.

7. Suspended-sediment data are being collected quarterly at several stations in the Piceance Creek basin to monitor the potential impact of oil shale development.

Piceance Creek below Rio Blanco, CO (periodic)
Piceance Creek tributary near Rio Blanco, CO (periodic)
Piceance Creek above Ryan Gulch, CO (periodic)

These stations are operated in cooperation with Rio Blanco County.

8. Suspended-sediment data are being collected on a comprehensive level at White River near Watson, UT, in cooperation with the Utah Department of Natural Resources.

9. Suspended-sediment data are being collected on a daily basis during spring, summer, and fall at Yampa River near Oak Creek, CO, in cooperation with the Upper Yampa Conservancy District.

Upper Colorado Subregion

1. Suspended-sediment data are being collected on a comprehensive level primarily during the runoff season at West Divide Creek near Raven, CO, in cooperation with the Colorado River Water Conservation District.

Lower Green Subregion

1. Suspended-sediment data are being collected on a monthly basis at San Rafael River near Green River, UT, in cooperation with the U.S. Bureau of Reclamation (USBR).

2. Suspended-sediment data are being collected on a monthly basis at Price River near Woodside, UT, in cooperation with the USBR.

3. Suspended-sediment data are being collected on a bimonthly basis at Green River at Green River, UT, as part of NASQAN.

Upper Colorado-Dirty Devil Subregion

1. Suspended-sediment data are being collected on a monthly basis at Colorado River at Lees Ferry, AZ, as part of NASQAN and Arizona Department of Environmental Quality.

2. Suspended-sediment data are being collected on a monthly basis at Bull Creek near Hanksville, UT, in cooperation with the U.S. Bureau of Land Management.

San Juan Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Vallecito Creek near Bayfield, CO, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a daily basis at Animas River at Farmington, NM, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at San Juan River at Shiprock, NM, as a part of NASQAN.

4. Bedload data are being collected on a comprehensive level at East Fork San Juan River above Sandy Creek near Pagosa Springs, CO.

5. Suspended-sediment data are being collected on a quarterly basis at San Juan River near Bluff, UT, as part of NASQAN.

6. Suspended-sediment data are being collected on a monthly basis at Montezuma Creek near Bluff, UT, in cooperation with the U.S. Bureau of Land Management.

Special Studies

1. A study to determine relations between sediment production and peak discharge for a storm-runoff event continued in Wyoming. Existing sediment data are being used in the study.

2. A study in cooperation with the Yellowjacket Water Conservancy District to define the sediment characteristics in the White River will entail collecting suspended-sediment data 10 to 12 times per year at the following sites:

North Fork White River at Buford, CO
South Fork White River at Buford, CO
White River above Coal Creek near Meeker, CO
White River below Meeker, CO
White River above Crooked Wash near Rangely, CO
Boise Creek near Rangely, CO

3. Two studies continue in the analysis phase to determine total sediment load at potential reservoir sites.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Building, FB-44
300 West Congress
Tucson, AZ 85701

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
2617 East Licolnway
Cheyenne, WY 82001

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

District Chief, WRD
U.S. Geological Survey
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

UPPER COLORADO REGION

SOIL CONSERVATION SERVICE

1. Public Law-566

Work continued on sedimentation/erosion/water quality studies on the Orderville - Muddy Creek Watershed Reconnaissance.

LOWER COLORADO

BUREAU OF RECLAMATION

Pinto Creek Scour and Degradation Study - An aggregate source is needed to provide 340,000 yd^3 of aggregate for the modification of Theodore Roosevelt Dam. One potential source is the Pinto Creek streambed upstream of the new reservoir high waterline. Because of the potential for headcut, an analysis was prepared for the potential degradation in the vicinity of the Highway 88 bridge crossing Pinto Creek. It was concluded that the streambed degradation at the bridge would be unacceptable and that a streambed control structure would be required. A local scour analysis was done to aid in the design of the streambed control structure. Local scour for the 100-year flood was estimated to vary from 4 to 13 feet depending upon the configuration of the gravel excavation, and the width of the control structure.

Granite Reef Aqueduct - Reach 11 Sediment Studies - Because of urbanization of the areas up slope of the Granite Reef Aqueduct, a revised flood and sediment study was undertaken to evaluate the adequacy of the flood detention basins. The 50-year sediment deposition estimates are:

Detention Area	50-year Sediment Accumulation (acre-feet)
1	1,350
2	1,260
3	1,010
4	1,150

A sediment yield rate curve was used in these determinations.

LOWER COLORADO REGION

GEOLOGICAL SURVEY

Lower Colorado-Lake Mead Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at the following sites as part of the National Stream Quality Accounting Network (NASQAN):

Virgin River at Littlefield, AZ
Muddy River above Lake Mead near Overton, NV

2. Suspended-sediment data are being collected monthly on a flow event basis, in cooperation with the U.S. Bureau of Land Management, at the following sites:

Pahranagot Wash near Moapa, NV
Meadow Valley Wash near Rox, NV
Las Vegas Wash above detention basin near N. Las Vegas, NV

Little Colorado Subregion

1. Suspended-sediment data are being collected on a monthly basis at Little Colorado River at Greer in cooperation with Arizona Department of Environmental Quality.

2. Suspended-sediment data are being collected on a daily basis in cooperation with the U.S. Corps of Engineers (COE) at Little Colorado River near Joseph City, AZ.

3. Suspended-sediment data are being collected on a flow-event basis at Leroux Wash near Holbrook, AZ, in cooperation with the COE.

4. Suspended-sediment data are being collected on a bimonthly basis at Zuni River above Black Rock Res., NM, in cooperation with the U.S. Bureau of Indian Affairs.

Lower Colorado Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bill Williams near Planet, AZ, in cooperation with the U.S. Bureau of Reclamation (USBR), the COE, and the city of Scottsdale, AZ.

2. Suspended-sediment data are being collected on a bimonthly basis as part of NASQAN at Colorado River below Hoover Dam, AZ.

3. Suspended-sediment data are being collected on a bimonthly basis at Colorado River below Parker Dam, AZ, in cooperation with the Arizona Department of Environmental Quality.

4. Suspended-sediment data are being collected monthly at Colorado River at NIB above Morelos Dam near Andrade, CA, as part of NASQAN and Arizona Department of Environmental Quality.

Upper Gila Subregion

1. Suspended-sediment data are being collected on a quarterly and storm-event basis at Mongollon Creek near Cliff, NM, as a part of the National Hydrologic Benchwork Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Gila River near Redrock, NM, as part of NASQAN.

3. Suspended-sediment data are being collected on a monthly basis at San Francisco River near Clifton, AZ, in cooperation with the Arizona Department of Environmental Quality.

4. Suspended-sediment data are being collected on a monthly basis at Gila River at Calva, AZ, as a part of NASQAN and Arizona Department of Environmental Quality.

Middle Gila Subregion

1. Suspended-sediment data are being collected on a bimonthly basis as a part of NASQAN at the San Pedro River at Charleston, AZ.

2. Suspended-sediment data are being collected on a monthly basis at Gila River at Kelvin, AZ, and San Pedro River below Aravaipa Creek, near Mammoth, AZ, in cooperation with the USBR.

Lower Gila Subregion

1. Suspended-sediment data are being collected on a monthly basis in cooperation with the USBR at:

Agua Fria River near Rock Springs, AZ
Agua Fria River below Lake Pleasant, AZ

2. Suspended-sediment data are being collected on a bimonthly basis as a part of NASQAN and in cooperation with the Arizona Department of Environmental Quality at:

Gila River above diversions at Gillespie Dam, AZ
Gila River at Dome, AZ

Salt Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Wet Bottom Creek near Childs, AZ, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis as a part of NASQAN and the Arizona Department of Environmental Quality at:

Salt River near Roosevelt, AZ
Verde River below Tangle Creek, AZ
Gila River near Dome, AZ

3. Suspended-sediment data are being collected on a monthly basis in cooperation with the Arizona Department of Environmental Quality at:

Pinal Creek near Globe, AZ
Verde River near Clarkdale, AZ
Oak Creek at Redrock Crossing, AZ
Salt River below Stewart Mountain Dam, AZ
Verde River below Bartlett Dam, AZ

Special Studies

1. A long-term, ongoing statewide program in Nevada of investigations of sediment and debris transported by flash floods continued during 1985.

For additional information about U.S. Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Building
301 West Congress Street, FB-44
Tucson, AZ 85701

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 227
705 North Plaza Street
Carson City, NV 89701

District Chief, WRD
U.S. Geological Survey
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

SOIL CONSERVATION SERVICE

1. Reservoir Sediment Surveys
   Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Millet Swale	Navajo	Arizona
Sunny Cove	Maricopa	Arizona

GREAT BASIN REGION

GEOLOGICAL SURVEY

Bear Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bear River near Corinne, UT, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a comprehensive level in cooperation with the Utah Department of Natural Resources at:

Bear River at Idaho-Utah State line
Little Bear River below Davenport Creek near Avon, UT
Bear River near Collinston, UT

Great Salt Lake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Red Butte Creek at Fort Douglas, near Salt Lake City, UT, as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a quarterly basis at Weber River near Plain City, UT, and at Jordan River at Salt Lake City, UT, as a part of NASQAN.

Escalante - Sevier Lake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Sevier River near Lynndyl, UT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a comprehensive level at Sevier River at Hatch, UT, in cooperation with the Utah Department of Natural Resources.

Black Rock Desert-Humboldt Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Humboldt River near Carlin, NV, as part of NASQAN.

Central Lahontan Subregion

1. Suspended-sediment data are being collected at the following sites as part of NASQAN:

Walker River near Wabuska, NV (bimonthly)
Carson River near Fort Churchill, NV (quarterly)
Truckee River near Nixon, NV (quarterly)

2. Total sediment data are collected monthly or more frequently during runoff events at the following sites as part of the Lake Tahoe Stream Monitoring Program (in cooperation with the Tahoe Regional Planning Agency):

Third Creek near Crystal Bay, NV
Incline Creek near Crystal Bay, NV
Glen Brook Creek near Glen Brook, NV
Logan House Creek near Glen Brook, NV

3. Suspended-sediment data are being collected twice-yearly at the following sites in cooperation with the U.S. Army Corps of Engineers:

Martis Creek at Highway 267 near Truckee, CA
Martis Creek Lake near Truckee, CA
Martis Creek near Truckee, CA

4. As part of the Tahoe Monitoring Program, suspended-sediment data are being collected from five streams that drain into Lake Tahoe. The relation of sediment discharge to algae growth in the lake is being studied by the University of California at Davis. The sediment data collection program is in cooperation with the California Department of Water Resources and the University of California at Davis, and includes the following daily sediment stations:

Upper Truckee River at South Lake Tahoe
General Creek near Meeks Bay
Blackwood Creek near Tahoe City
Ward Creek at Highway 89
Trout Creek near Tahoe Valley

5. Suspended-sediment data are being collected on a periodic basis at Sagehen Creek near Truckee, in cooperation with the University of California at Davis.

Central Nevada Desert Basins Subregion

1. Suspended-sediment data are being collected quarterly at Steptoe Creek near Ely, NV, and South Twin River near Round Mountain, NV, as part of the National Hydrologic Benchmark Network.

Special Studies

1. A long-term, ongoing statewide program of investigations of sediment and debris transport by flash floods continued during 1988.

2. A long-term investigation of sediment and debris hazards related to flooding is in the fifth investigative year at the Nevada Test Site.

For additional information about U.S. Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 224
705 North Plaza Street
Carson City, NV 89701

District Chief, WRD
U.S. Geological Survey
1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

District Chief, WRD
U.S. Geological Survey
Room W-2234, Federal Building
2800 Cottage Way
Sacramento, CA 95825

District Chief, WRD
U.S. Geological Survey
230 Collins Road
Boise, ID 83702

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determination of sediment yields were made in the following watershed:

a. River Basin Investigation

Major Drainage	Watershed	County	State
Truckee River	Evans Creek	Washoe	NV

b. Resource Conservation and Development

Major Drainage	Watershed	County	State
Carson River	Silver Springs	Lyon	NV

2. Emergency Watershed Protection

   a. An emergency sedimentation reconnaissance on a wildlife site was conducted in Emigration Canyon, Salt Lake County, Utah

   b. An emergency sedimentation reconnaissance was conducted on a wildlife site near the town of Alpine, Utah County, Utah

3. Special Studies

   A sediment/erosion resource inventory was conducted in Box Elder County, Utah.

PACIFIC NORTHWEST

BUREAU OF RECLAMATION

Oroville-Tonasket Pumping Plants - Settling basins were designed for five pumping plants which pump from the Okanogan River into pressure irrigation distribution systems. The settling basins were originally sized based upon one dimensional mathematical modeling. When the basin dimensions were fixed in specifications design, each of the basins was modeled using a two dimensional model. The basins will trap 70 percent of the suspended material of 0.032 mm diameter.

PACIFIC NORTHWEST REGION

CORPS OF ENGINEERS

North Pacific Division

Portland District

Sedimentation Surveys.

1. Reservoir Surveys. Mount st. Helens Sedimentation Retention Structure (SRS). This structure became operational on 19 November 1987 when the diversion conduit was closed. Water was impounded to a maximum depth of 50 feet and extended almost a mile upstream. The fine-grain sediments were trapped in the pool immediately upstream of the dam, and the coarse grain (bed material) were trapped in the delta which rapidly formed upstream of the pool. The delta formed at a slope of 0.0057 (.6 of original slope) and trapped approximately 6 mcy during the initial year. Surveys to monitor the delta formation and the gradations and characteristics of the deposits, and to measure the depth and volume of deposition will be done each year after the winter storms.

2. Channel Surveys.

a. Toutle/Cowlitz River. Channel surveys included bed material samples along the full reach of this river system, suspended sediment samples in the Cowlitz River at Kelso, repeated cross-section surveys of the Cowlitz and lower Toutle Rivers; and water-surface levels of the lower Cowlitz River during flood times.

In addition, the Portland District partially funded the USGS gaging stations on the Toutle River at Tower Road and Kid Valley.

The above data was used in monitoring the impacts of the SRS, and in determining the levels of flood protection along the Lower Cowlitz River.

b. Columbia River. These surveys included velocity and suspended sediment measurements, bed load sampling, and hydrographic surveys. This data was used to monitor the effectiveness of experimental equipment for skimming the top of sand waves, to monitor the impacts of ship waves on erosion of shoreline dredged disposal areas, and to study shoaling problems and disposal options for maintenance dredging of the Columbia River navigation channel.

3. Equipment Used. Most sediment samples and water measurements were taken with standard P-61, P-63, D-74, and BM-54, and Ponar samplers, Helley-Smith bedload catcher, Price velocity meters, and a velocity-azimuth-depth assembly (VADA). Hydrographic surveys were made by special survey boats equipped with electronic fathometers.

Walla Walla District

Sedimentation Surveys

1. Lower Granite Pool. Studies continued through 1988 in an attempt to find a permanent, long-term solution to the progressive loss of freeboard due to sediment build-up in Lower Granite pool. This past year marked the first in a 5-year test and monitoring program in which the impacts of dredging and in-water disposal are being evaluated as one of several possible long-term solutions. As part of this test 900,900 cubic yards of sediment were dredged during the period January-March from the Clearwater confluence area of the Snake River upstream of River Mile 138.34. This material was then deposited by split bottom scow in a mid-depth site located at River Mile 120.4 and a deep-water site at River Mile 119. The spread of disposal material and changes in grain size distribution were monitored at the disposal sites and four control sites in the reservoir. Additional data collected to support the sedimentation study were as follows:

a. A acoustical sub-bottom survey was performed in an attempt to accurately determine the depth of sediment deposition since project completion in 1975. the survey covered the existing ranges between Red Wolf bridge and the dam and 7 additional ranges below River Mile 120. the survey yielded little useful information due to interference by methane gas bubbles in the sediment.

b. A direct-measurement technique using a sediment spud proved to be successful where acoustical methods had failed, and was used to determine sediment depths, validate previous surveys, in the reach of the reservoir between Chief Timothy Island (River Mile 130) and Lower Granite Dam.

c. Over sixty sediment density samples were taken in the Lower Clearwater River and in the Snake River from the confluence downstream to Lower Granite dam. these samples revealed a much lower sediment density than had previously been estimated with a very high gas content.

d. Detailed surveys and one-foot contour-interval maps were developed to define post disposal conditions at the disposal sites between River Mile 118 and 121 and to define the pre-dredge channel bottom for the 1989 effort between River Mile 135 and 138. Existing sediment ranges were also resurveyed between the confluence and Red Wolf bridge (River Mile 137.17).

e. Core samples were collected over a wide area extending upstream and downstream of the disposal area to define the spread of sediment from the disposal area.

2. Jackson Hole. Data collection which will support future studies in erosion and sedimentation potential in the Snake and Gros Ventre Rivers near Jackson, Wyoming, continued in 1988. A total of 11 new ranges were established and surveyed between Highway 26 and the downstream end of the Federal Levee Project. These ranges coincided with locations for sections 101-111 in the 1975 Flood Hazard Information study. Ten new ranges were established and surveyed on the Gros Ventre River between the mouth and the federal park boundary. All existing sediment ranges within the Federal Levee reaches were resurveyed in the fall.

3. Schultz Bar. Sediment deposition at a wide reach of the Snake River and Schultz Bar is gradually filling in the river channel and creating a navigation hazard. In early 1988, 15,000 CY of sand was dredged from the

channel and deposited on land near the old air strip. Twenty-six new ranges were established and surveyed in late 1987 and early 1988 between Schultz Bar Lower Granite Dam in an attempt to identify the source of sediment which is depositing and reducing navigation channel depths at Schultz Bar. Evaluation of this data was in progress in 1988 and should be completed in 1989.

4. Asotin Creek. Studies identifying the effect of sediment deposited since completion of the Lower Granite Project on the water surface profile at the mouth of Asotin Creek were completed in 1988.

PACIFIC NORTHWEST REGION

GEOLOGICAL SURVEY

Kootenai-Pend Oreille-Spokane Subregion

1. Suspended-sediment data are being collected on a periodic basis at South Fork Coeur d'Alene River at Cataldo, ID, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a daily basis by a PS-69 at Kootenai River at Porthill, ID, as part of the U.S. Geological Survey waterways-treaty program, and as part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Hayden Creek below North Fork, near Hayden Lake, ID, as part of the National Hydrologic Benchmark Network.

Upper Columbia Subregion

1. Suspended-sediment data are being collected in cooperation with the U.S. Environmental Protection Agency on a daily basis at:

Clark Fork at Deer Lodge, MT
Clark Fork at Turah Bridge near Bonner, MT

and on a periodic basis at:

Little Blackfoot River near Garrison, MT
Flint Creek near Drummon, MT
Rock Creek near Clinton, MT
Blackfoot River near Bonner, MT

2. Daily suspended-sediment data was collected from June to September at the following sites under a Federal Energy Regulatory Commission permit with Montana Power Company:

Blackfoot River near Bonner, MT
Clark Fork above Missoula, MT

3. Suspended-sediment data are being collected on a bimonthly basis in cooperation with the Bureau of Indian Affairs at the following stations:

Little Bitterroot River near Cemas Prairie, MT
Crow Creek at mouth near Ronan, MT
Mission Creek at National Bison Range at Moiese, MT
Jocko River at Dixon, MT
Flathead River at Perma, MT

4. Suspended-sediment data are being collected at the following sites as part of NASQAN:

Clark Fork below Missoula, MT (bimonthly)
Flathead River at Columbia Falls, MT (quarterly)

5. Suspended-sediment data are being collected on a daily basis at Flathead River at Flathead, British Columbia, in cooperation with the Environment Canada as part of the U.S. Geological Survey watersheds-treaty program.

6. Suspended-sediment data are being collected on a periodic basis at Columbia River at Northport, WA, at Columbia River at Vernita Bridge, near Priest Rapids Dam, WA, and at Okanogan River at Malott, WA, as a part of NASQAN.

7. Suspended-sediment data are being collected on a periodic basis at Andrews Creek near Mazama, WA, as a part of the National Hydrologic Benchmark Network.

8. Suspended-sediment data are being collected on a quarterly basis at Columbia River at Richland, WA, in cooperation with the U.S. Department of Energy.

9. Suspended-sediment data are being collected monthly and weekly during spring runoff at Clark Fork near Cabinet, ID, in cooperation with the Idaho State Department of Health and Welfare.

Yakima Subregion

1. Suspended-sediment data are being collected periodically at Yakima River near Union Gap, WA, and at Yakima River at Kiona, WA, as part of NASQAN and NAWQA.

2. Suspended-sediment data are being collected on a periodic basis at Yakima River at Cle Elum, WA, Yakima River at Umtanum, WA, Naches River at North Yakima, WA, Sulphur Creek Wasteway near Sunnyside, WA, and Yakima River near Grandview, WA, as a part of NAWQA.

Upper Snake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Cache Creek near Jackson, WY, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment and bedload data are collected weekly during spring runoff at Granite Creek and Little Granite Creek near Bondurant, WY, and Pacific Creek at Moran, WY, as part of a special research project.

3. Suspended-sediment data are being collected on a bimonthly basis at Snake River near Heise, ID, as a part of NASQAN.

4. Suspended-sediment data are being collected on a bimonthly basis at Snake River above Jackson Lake at Flagg Ranch, WY, in cooperation with Grand Teton National Park.

Middle Snake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Snake River at King Hill, ID, and Boise River near Parma, ID, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Big Jacks Creek near Bruneau, ID, as a part of the National Hydrologic Benchmark Network.

Lower Snake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Salmon River near White Bird, ID, and Clearwater River at Spalding, ID, as part of NASQAN.

2. Suspended-sediment data are being collected at Snake River at Burbank, WA, as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic basis from Minam River at Minam, OR, as a part of the National Hydrologic Benchmark Network.

Middle Columbia Subregion

1. Suspended-sediment samples are being collected on a periodic basis at John Day River near McDonald Ferry, OR, and at Deschutes River near Biggs, OR, as a part of NASQAN.

Lower Columbia Subregion

1. Suspended-sediment data are being collected on a periodic basis at Columbia River at Warrendale, OR, as a part of NASQAN.

Willamette Subregion

1. Suspended-sediment data are being collected on a periodic basis from Tualatin River at West Linn, OR, and at Willamette River at Portland, OR, as a part of NASQAN.

Oregon-Washington Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Rogue River near Agness, OR, Siuslaw River near Mapleton, OR, Nehalam River near Foss, OR, Chehalis River at Porter, WA, and at Queets River near Clearwater, WA, as a part of NASQAN, and at South Umpqua River at Roseberg, OR, in cooperation with Douglas County and as a part of NASQAN.

Puget Sound Subregion

1. Suspended-sediment data are being collected on a periodic basis at Skagit River near Mount Vernon, WA, and at Puyallup River at Puyallup, WA, as a part of NASQAN.

Special Studies

1. Suspended-sediment, bed-material, and bedload data are being collected on a periodic basis at the following stations:

Green River above Beaver Creek near Kid Valley, WA
South Fork Toutle River at Camp 12 near Toutle, WA
North Fork Toutle River at Kid Valley, WA
Toutle River at Tower Road near Silver Lake, WA
Muddy River below Clear Creek near Cougar, WA
Clearwater River near mouth, near Cougar, WA

Automatic pumping sediment samplers are also operated at most sites. The goal is to compute daily sediment discharges and to continue evaluation of the sediment systems of streams affected by the 1980 eruption of Mount St. Helens.

Instrumentation research is an ongoing part of the sediment-transport studies in the Toutle River. In situ suspended-sediment analyzers were installed at both the North Fork Toutle River near Kid Valley and Toutle River at Tower Road sites. Data from these instruments are being compared to traditional laboratory analysis of suspended-sediment samples. Depth sounding of the mobile streambed continued at the North Fork Toutle River at Kid Valley. Observations of dune migration in fine gravel were summarized in a technical paper. Measurements of dune celerity throughout a storm-runoff event were made with the use of dual depth sounders. Design and construction of an observation platform was completed on the right bank of the research site at Kid Valley. Longitudinal depth sounding from the platform will facilitate measurements of bedload, velocity profiles, and suspended-sediment profiles during rapidly changing flows.

2. Channel geometry data are being collected at 20 sites to support research on erosional processes and evolution of the drainage system. An enlarged data-collection program for 1990 is in the formulation stages that would document 10 years of post-eruption recovery at Mount St. Helens.

Sediment-transport and hydraulic data are being collected at stations in the Toutle River basin to describe vertical and horizontal profiles of suspended sediment and velocity. Bedload samples are being collected with enlarged Helley-Smith samplers at several sites. These samples are being compared with samples from several other bedload samplers, including two Helley-Smith configurations, two Chinese bedload samplers, and the VUV sampler. Results of these comparisons should result in suggested bedload samplers for a variety of stream environments. A compilation report containing hydraulic, sediment-transport, and bed-material data for 1980-84 for the Toutle River system was published. Several bedload equations are being tested for use on steep streams. Two reports on these comparisons are in preparation. Methods are continuing to be developed for understanding variations in sediment discharge in time and space. To improve the control of measuring and sampling equipment, stayline are used at the cableways at North Fork Toutle River above Bear Creek, North Fork Toutle River at Kid Valley, Toutle River at Tower Road gaging stations, and Muddy River below Clear Creek near Cougar, WA.

Hydrologic hazard research in volcanic terrain centered around understanding the mechanics, frequency, and magnitude of debris flows originating on the volcanos. Debris flows transport vast amounts of sediment and are only now starting to be recognized and understood. The project office hosted an interdivisional workshop on debris-flow modeling at St. Anthony Falls Hydraulics Lab, Minneapolis, MN. The study on Mount Rainier was in full operation during 1987 and will culminate in a major professional paper and several journal articles that are in the review stage.

The sedimentation activities covered in the hydrologic hazards of the Mount Hood project fall into two main categories:

(1) Mapping of deposits emplaced through both volcanic (lahars, pyroclastic flows) and nonvolcanic (jokulhlaups, avalanches) means. Deposits are being mapped to provide volume and inundation information and are being stratigraphically located to provide frequency of event information.

(2) Investigation of areas of hydrothermal alteration high on the edifice. Areas of intense alteration are considered to be weak areas of the mountain and subject to collapse and subsequent initiation of clay-rich mass movements. Areas of alteration are being located, mapped, and sampled.

Debris flow monitoring and landslide initiation research are planned for field studies in China under cooperative arrangements between research colleagues at the WRD project office at the Cascades Volcano Observatory in Vancouver, WA, and colleagues in China. Laboratory research on debris-flow rheology was started at the project office by testing rotational shear vane viscometers. Several reports on mass-movement and debris flow rheology are in various stages of completion.

A study to define the sediment sources and processes causing turbidity in the Bull Run watershed was planned in 1987 and started in April 1988. Recent forest management activities have caused concern of possible water supply degradation. Turbidity is a parameter of key importance. Following thorough analysis of existing data, an enhanced monitoring effort using battery-operated continuous turbidimeters will begin. Magnetic minerals from soil profiles, stream channels, and reservoir deposits will be analyzed to determine possible turbidity sources.

3. A steep-slope hydrodynamic computer model is being documented in a paper "Mass-conserving method of characteristics for streamflow modeling" by W. B. Sikonia. The model is intended as the basis for a dynamic sediment transport computer model for rivers in mountainous terrain, such as that found in the Pacific Northwest. The paper describes a new numerical method that conserves mass while preserving the desirable features of the method of characteristics.

4. The effects of three sediment control alternatives were evaluated in a report "Sediment transport in the Lower Puyallup, White, and Carbon Rivers of Western Washington" by W. B. Sikonia. The comparison was made by modeling the influence of each alternative using sediment transport computer model HEC-6 of the U.S. Army Corps of Engineers (COE). The model was modified for the study to enhance numerical approximations of sediment transport, deposition, and scour, in order to better match observed data. The model showed that sediment traps were somewhat effective but inefficient at controlling sand deposition downstream, and were ineffective in alleviating localized gravel deposition. The current practice of gravel mining appears to be a reasonable approach for removing widely dispersed gravel deposits. Nonintervention appears most appropriate for those river reaches that are actually degrading rather than aggrading.

5. The Cascades Volcano Observatory, Vancouver, WA, conducts a training activity on sediment-sampling field techniques each year in October. The training is conducted on behalf of the Water Resources Division, but a few slots are reserved for cooperator and other Federal agency personnel to attend. The total attendance at each training session is limited to 24 students.

6. The Cascades Volcano Observatory is involved in a study in southern Oregon on the effects of wildfire on erosion in the Cow Creek basin. The study is being conducted in cooperation with the U.S. Fish and Wildlife Service.

7. The Makah Indian Tribe began collecting suspended-sediment samples during the summer of 1988 on the main stem of the Sieku River, on a tributary in the river's middle reach, and on one of the major forks of the Sieku River in the upper reaches, Clallam County, WA. The Indian personnel were trained by the U.S. Geological Survey personnel and have been loaned Survey sampling equipment. The samples will be analyzed by the Survey at the Cascades Volcano Observatory sediment laboratory in Vancouver, WA. The analyses will include both concentrations and sand/silt size splits. The purpose of this study is to determine the effects that sediment from the roadway along the Sieku River

has on the river and the fishery. The Makah Tribe has agreed to furnish results of the analyses to the Survey upon request.

8. Plans have been finalized to measure discharge and collect suspended-sediment samples during selected storm events in the significant small tributaries to the Lower Granite Reservoir on the lower Snake River in the vicinity of Clarkston, WA, and Lewiston, ID. The suspended-sediment samples will be collected in support of a study to determine suspended-sediment loads entering the reservoir directly from the tributaries. The study will be conducted in cooperation with the COE, Walla Walla, WA.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
230 Collins Road
Boise, ID 83702

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 428
301 So. Park Avenue, Drawer 10076
Helena, MT 59626-0076

State Chief, WRD
U.S. Geological Survey
847 NE 19th Avenue
Suite 300
Portland, OR 97232

State Chief, WRD
U.S. Geological Survey
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

District Chief, WRD
U.S. Geological Survey
P.O. Box 1125
Cheyenne, WY 82003

PACIFIC NORTHWEST REGION

SOIL CONSERVATION SERVICE

1. Studies of erosion and sediment damages and determinations of sediment yields were made in the following watersheds:

River Basin Investigations

Major Drainage	Watershed	County	State
Pacific Ocean	Sequim Bay	Clallam	Washington

Sources of contributing sediment which are being deposited in Sequim Bay and contributing to the water quality degradation were identified.

2.. Reservoir Sedimentation Surveys

Reservoir	County	State
Howard Sediment Basin	Columbia	Washington
Hovrud Sediment Basin	Columbia	Washington

The two desilting basins are located on two major side drainages of the Tucannon River. They were consturcted as water quality demonstration projects in cooperation with Washington State Department of Ecology, local agencies and landowners.

3. Erosion and Non-point Pollution Studies

Subregion	County	State
Middle Snake	Malheur	Oregon

Erosion rates and sediment yield were determined for the Fletcher Gulch Watershed.

4. Special Studies

a. Columbia River landslides were studies in Franklin County, Washington. Imhoff Cone procedures were performed to determine the amount of suspended sediment entering the Columbia River. Fourteen sample sites were located discharge points at the base of actively advancing landslides and were sampled monthly during a twelve month period. Nitrate levels, conductivity, and flow rates were also evaluated monthly for each sample site. Total sediment entering the Columbia River from the landslide was estimated at 11,000 tons for 1988.

b. The following special study report was prepared.
Streambed Sampling Analysis, Tucannon Waterhed Washington, November 1988.

CORPS OF ENGINEERS

South Pacific Division

Los Angeles District

Reservoir Sedimentation. "Reservoir Sedimentation Summary" sheets (ENG Form 1787), for Big Tujunga and Puddingstone Flood Control Basins; Aliso and Carriage House Debris Basins were completed.

Sediment Sampling Stations. The following sediment sampling stations are operated by the USGS and supported by the District: Santa Ana River at Mentone, CA (Gage No. 11051500); Santa Ana River near E St., San Bernardino County, CA (Gage No. 11059300); Santa Ana River at Santa Ana, Orange County, CA (Gage No. 11078000); Little Colorado River and Holobrook, AZ near Joseph City (Gage No. 09397000).

Office Activities

1. An analysis of sediment discharge into the Pacific Ocean was completed as part of the Coast of California Storm and Tidal Waves Study (CCSTWS). The river sediment study addressed the San Diego Region, encompassing the streams and watersheds draining to the California coast from the Mexican border to Dana Point. The results of the river sediment study provide an estimate of the average annual sediment discharge for existing watershed conditions as well as the total sediment loads for the hypothetical 2-, 10-, 25-, 50-, 100- and 200-year frequency floods. The third and final phase was completed by the Architect-Engineer firm of Simons, Li and Associates.

2. A comprehensive sedimentation study of the Rillito River in Tucson, Arizona was completed as part of the Rillito River General Design Memorandum. The purpose of the study was to identify the impact of the proposed channel stabilization project on aggradation and degradation in the Rillito River and in the Santa Cruz River and to provide information to assist in the hydraulic design of the project. The study included a detailed, quantitative investigation of historical streambank erosion and streambed aggradation and degradation, an equilibrium slope analysis, and a detailed sediment routing analysis. The study was conducted by the Architect-Engineer firm of Simons, Li and Associates.

3. A detailed hydraulic design study of a comprehensive channel stabilization project on the Rillito River in Tucson, Arizona was undertaken as part of the Rillito River General Design Memorandum. The purpose of the study was to develop the final design of soil cement bank protection and invert stabilizers to control streambank erosion and streambed degradation on the entire 12-mile length of the Rillito River. The design study was undertaken by the Architect-Engineer firm of Simons, Li and Associates and utilized information from the sedimentation study discussed in paragraph 2 above.

4. A comprehensive sedimentation study of the San Francisco River at Clifton, Arizona was conducted as part of the Clifton, Arizona General Design

Memorandum. The purpose of the study was to provide information to assist in the hydraulic design of the levee project. The study involved a detailed sediment routing analysis and an assessment of potential channel widening utilizing river regime relations. The initial study was conducted by the Waterways Experiment Station and is currently being modified in-house to reflect present channel conditions as indicated on recently completed topographic mapping.

5. A planning-level sedimentation study of San Timoteo Creek, California, was completed as part of a feasibility report on including channel improvements on San Timoteo Creek as part of the Santa Ana River Project. The purpose of the study was to assess the impacts on sedimentation in the Santa Ana River as the result of constructing channel improvements on San Timoteo Creek without constructing a debris basin upstream. The study included a sediment budget analysis and a preliminary detailed sediment routing analysis.

6. A planning-level sedimentation study of Flamingo Wash and Tropicana Wash in Las Vegas, Nevada, was initiated as part of the Las Vegas Wash and Tributaries Feasibility Study. The work completed to date includes initial field reconnaissance, study planning, follow-up field reconnaissance to obtain samples of the streambed and streambank material, and sieve analysis of the samples.

Sacramento District

Sediment Sampling. Routine samples of lake outflows were collected and analyzed for suspended sediment at Black Butte, Pine Flat, Kaweah, Success and Isabella Lakes. For analyses, grab samples obtained in one-gallon containers were used. U.S. Geological Survey maintain and publish discharge record.

Sediment Studies.

1. Bear River Basin, Utah, Wyoming, and Idaho - Reconnaissance. A reconnaissance level study is being conducted to evaluate 24 reservoir sites (existing and proposed) throughout the Bear River Basin. One facet of the study is to determine the sediment storage capacity of each reservoir and to evaluate the effective life of each. A sediment yield study was conducted to determine the expected load delivered to each reservoir, to assess the sedimentation problem, and to determine need for additional study. This study involved the following four phases; a) literature search of reports, studies and maps with information on data influencing sediment yield in the vicinity of each reservoir, b) data evaluation and tabulation from available literature, c) field reconnaissance to supplement gaps in the available data, and d) perform P.S.I.A.C. sediment yield computations. The draft sediment yield report was completed in July 1988.

2. Cache Creek Basin, California - GDM. The proposed project involves enlarging the outlet channel of Clear Lake in the upper part of the basin (i.e., watershed) and enlarging the existing sediment basin in the lower basin. A Sediment Engineering (S.E.) Investigation was conducted to evaluate the impact of proposed upper basin project features on the creek channel morphology through Capay Valley, downstream of Clear Lake. A final report, outlining the results of the S.E. Investigation, was issued in March 1988. An

erosion mitigation study based on the results of the SEI will be initiated in FY 89.

3. Corte Madera Creek, California - Construction. The project consists of channel improvements to Corte Madera Creek located in Marin County, California. Units 1-3 of the project were completed in 1971. Unit 4 would extend the project upstream but has not been constructed. The concrete-lined channel portion of Unit 2-3 has reduced channel capacity due to sediment deposition. A sediment monitoring program in the concrete-lined channel in conjunction with an HEC-6 analysis of the entire project was initiated in October 1987 and continued in FY 88. The study will evaluate the capacity of the concrete-lined channel with completion of Unit 4 and a periodic maintenance program to remove accumulated sediments. The study will also evaluate the effectiveness of a proposed sediment trap in Unit 4 and if the walls of the concrete-lined channel require raising to restore the design channel capacity. The HEC-6 analysis will be completed in FY 89.

4. Coyote and Berreyessa Creeks, California - GDM. The proposed flood control project is located in the cities of San Jose and Milpitas, California immediately south of the San Francisco Bay in the Santa Clara Valley. The recommended project includes overflow channels and offset levees on Coyote Creek, and concrete-lined channels and offset and berm system on Berreyessa Creek. In June of 1988, a field reconnaissance was conducted to review the proposed project features and to evaluate existing sediment conditions. Sediment samples were taken from several sites on each creek and were tested for gradations (September 1988) for later use.

5. Dry Creek-Roseville, California - Feasibility. The proposed flood control project is located in Placer county near and through the city of Roseville. This project consists of channel excavation, levees and floodwalls designed to contain floodwaters resulting from continuing urbanization of the adjacent lands. A reconnaissance level sediment engineering investigation was conducted in June of 1988 with the assistance provided by personnel from the U.S. Army Waterways Experiment Station under the Water Operations Technical Support Program (WOTS). The purpose of the investigation was to review the project design, construction and maintenance operations, and to develop methodologies for designing a stable and environmentally sensitive channel.

6. Guadalupe River, California - GDM. The project consists of channel improvements to the Guadalupe River as it flows through the City of San Jose. The upstream reach of the project will have a concrete-lined bypass channel with the flow split controlled by weirs on both the bypass channel and natural channel. It is anticipated that deposition will occur upstream of the weirs and erosion in the downstream channel. A sediment study of project effects will be completed in FY 89.

7. Kaweah/Success Projects - Feasibility. An investigation is being conducted into raising Terminous Dam (Lake Kaweah and Success Dam). Also under investigation is a new dam on Dry Creek which would be interconnected via a tunnel with Lake Kaweah. A sediment study will be conducted in FY 89 to evaluate the effects of dam raising and the construction of a new dam or the downstream channel stability.

8. Little Dell Lake, Utah - GDM. The Little Dell Lake, Utah Project is

located on Dell creek in Salt Lake County approximately 8 miles east of Salt Lake City. The project will provide flood control, M&I water supply, and recreational benefits to the Salt Lake City Area. An integral part of the project is the Parleys Creek Diversion Conduit, which diverts flows from Parleys Creek into Little Dell Lake. In 1987, a sediment engineering investigation was performed to evaluate the impact of sediment load on the diversion basin conduit and intake. A streamflow and sediment monitoring program was conducted on Parleys Creek during the 1987 snowmelt and cloudburst season. This data and additional data from adjacent drainage basins was analyzed and a report prepared by the USGS. The study also determined the size of the upstream sediment basin and was completed in FY 88. A sediment study to determine channel degradation downstream of the Little Dell outlet works will be completed in FY 89.

9. Sacramento River Geomorphic Study - Construction. Bank protection measures on the Sacramento River are proposed for two reaches: In the Butte Basin flowage area, the vicinity of the Butte Basin "flow split" area; and Chico Landing to Red Bluff. The purpose of these measures is to preserve the historical division of flows into the main leveed floodway of the Sacramento River and into the natural overflow area of Butte Basin. Due to changes to the Sacramento River course in this vicinity, concern has been raised that this division of flow might change, possibly routing floodflows in excess of design capacity down to leveed floodway and endangering the integrity of the overall Sacramento River flood control system. In the Chico Landing to Red Bluff reach, bank protection measures are proposed as part of an overall comprehensive program for channel stabilization. Detailed geomorphic studies continued this year regarding these questions. A final (Phase 1) report on the Butte Basin reach was completed this year.

10. Wildcat Creek - Sediment Basin, California - Construction. The wildcat flood control project delivers flood flows through the cities of San Pablo and Richmond, California to the San Pablo Bay. The project features include excavated channel, levees, floodwalls, and a sediment debris basin. The sediment basin was originally designed as a symmetrioal straight-through catchment basin with a 180 foot bottom width. Right-of-way constraints shifted the entrance alignment of the basin, resulting in a radioally skewed basin shape. A two-dimensional hydrodynamic sediment transport study was conducted with the assistance of the HEC to evaluate the sediment deposition and collection capabilities of the irregularly shaped basin. The study objective focused on the temporal and spatial movement of sediment deposits and their effect on the basin trap efficiency.

San Francisco District

Sediment Studies.

1. Alcatraz Dredge Material Disposal Site. As first reported in 1985, numerous studies were implemented as a result of sediment accumulation at the Alcatraz disposal site. In July 1985, all study activities related to the disposal of dredged material were consolidated into the Disposal Management Program (DMP). Quarterly bathymetric surveys are continuing at the Alcatraz site. Survey data to date have indicated retention and accumulation of disposed material at the Alcatraz site.

District sediment transport studies continue to address both short-term and long-term transport of disposal material. At the request of the District, the Waterways Experiment Station (WES) completed a numerical simulation of disposal at Alcatraz using the computer model "Disposal from Instantaneous Dump (DIFID)" to determine the short-term fate of discharged dredged materials. To address the long-term goal, the computer model "TABS II" was used to simulate long-term hydrodynamic circulation and sediment transport. WES's activities are described in their Technical Report HL-88-27, entitled "San Francisco Bay: Monitoring System for Dredged Material Disposal and Hydraulic Transport", dated November 1988. In October 1988, the District collected prototype low-flow data from San Francisco Bay for purposes of setting boundary conditions for the TABS II model. Prototype high-flow data will be collected at the time when such runoff occurs.

A report entitled "Study to Investigate Reducing the Federal Dredging Requirements in San Francisco Bay", dated October 1988, was prepared for the District by Ogden Beeman & Associates, Inc. The purpose of the study was to identify methods by which channel maintenance dredging on four navigation projects on San Francisco Bay might be reduced, with the ultimate goal of reducing the use of the dredge disposal sites at Alcatraz and Carquinez Strait. The four navigation projects studied are: Richmond Harbor, Mare Island Strait, Oakland Outer and Inner Harbors, and Alameda Naval Air Station. Copies of this report are available in the District's Special Studies Branch.

2. San Lorenzo River Study. Using the results of a sediment analysis completed by WES in 1987, the District initiated a General Investigation reconnaissance study in 1988 for purposes of increasing the channel capacity of the San Lorenzo River Federal Flood Control Project in Santa Cruz, California. Since its construction in 1959, deposition of sediments has significantly lowered the flood-carrying capacity of the channel. Alternatives being studied in the reconnaissance report include adding floodwalls to the existing levees and the excavation of the accumulated sediments from the channel bottom. The deposition of sediment in the San Lorenzo River Flood Control Project, constructed in 1962, has substantially reduced the flood-carrying capacity of the project. WES was contracted in 1985 to analyze the actual carrying capacity of the river during various flood events using the sediment model HEC-6, with special emphasis on re-creating the January 1982 flood event which was estimated to have a return frequency of about once in thirty years. WES was also asked, as a part of the study, to determine the average annual sediment load based on 47 years of record using the calibrated HEC-6 model. Based on the results of the WES study, the District published a report in March 1987 proposing various alternative plans to return the flood control channel to its original capacity. A reconnaissance study will be conducted in 1988-89 to evaluate structural, non-structural and dredging alternatives. A feasibility study is scheduled to start in FY 1989.

CALIFORNIA REGION

GEOLOGICAL SURVEY

North Coastal Subregion

1. Suspended-sediment and bedload data are being collected in Redwood National Park to evaluate the sediment transport rates caused by both natural processes and logging activities within the park. Data collection began in 1973 in cooperation with the National Park Service. The Park Service is using this data to develop management practices that will reduce erosion rates. The current sampling network includes the following stations:

Redwood Creek near Blue Lake (daily)
Lacks Creek near Orick (monthly)
Redwood Creek above Panther Creek (monthly and storm event)
Panther Creek near Orick (monthly)
Coyote Creek near Orick (monthly)
Little Lost Man Creek near Orick (monthly)
Redwood Creek at Orick (daily)

2. Suspended-sediment data are being collected on a daily basis and bedload data on a periodic basis at Grass Valley Creek at Fawn Lodge near Lewiston and at Trinity River below Limekiln Gulch near Douglas City, in cooperation with the U.S. Bureau of Reclamation (USBR).

3. Suspended-sediment data are being collected on a quarterly basis at Elder Creek near Branscomb, as part of the National Hydrologic Benchmark Network, and at Smith River near Crescent City, as part of National Stream Quality Accounting Network (NASQAN).

4. Suspended-sediment data are being collected on a bimonthly basis at Klamath River near Klamath, Russian River near Guerneville, and at Eel River at Scotia, as part of NASQAN.

5. Suspended-sediment and bedload data are being collected on a periodic basis at Little Grass Valley Creek near Lewiston and Grass Valley Creek near French Gulch, in cooperation with the USBR.

Sacramento Basin Subregion

1. Suspended-sediment data are being collected on a daily basis at Feather River near Gridley and at Sacramento River at Freeport, in cooperation with the California Department of Water Resources.

2. Suspended-sediment data are being collected on a bimonthly basis at Sacramento River at Keswick, as part of NASQAN.

Report: Harmon, J. G., 1988, Streamflow, sediment discharge, and streambank erosion in Cache Creek, Yolo County, California, 1953-86: U.S. Geological Survey Water-Resources Investigations Report 88-4188.

North Lahontan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Susan River at Susanville, as part of NASQAN.

San Francisco Bay Subregion

1. Suspended-sediment and bedload data are being collected in the Cull Creek and San Lorenzo Creek Basins to document sediment transported into Cull Creek and Don Castro Reservoirs, respectively, and to test erosion control procedures. Data collection began in the 1979 water year, in cooperation with Alameda Country Flood Control and Water Conservation District, and includes the following stations:

San Lorenzo Creek above Don Castro Reservoir near Castro Valley (daily)
Cull Creek above Cull Creek Reservoir near Castro Valley (daily)
Cull Creek Tributary No. 4 above CC Reservoir (storm event)

2. Suspended-sediment data are being collected on a bimonthly basis at Napa River near Napa, as part of NASQAN.

3. Bed-material data are being collected once per year at 9 stations in the Guadelupe River basin, as part of the Santa Clara County Water Quality Study. Data collection began in 1982, in cooperation with the Santa Clara Valley Water District.

4. Suspended-sediment, bedload, and bed-material data are being collected on a periodic basis at Corte Madera Creek at Kentfield, as part of a sediment monitoring program with the U.S. Army Corps of Engineers (COE). Bed-material data are being collected twice per year at five additional sites.

5. Suspended-sediment data are being collected once per year at eight stations in the Golden Gate National Recreation Area, as part of a water-quality study with the National Park Service. Data collection began in 1986.

San Joaquin Basin Subregion

1. Suspended-sediment data are being collected on a daily basis at San Joaquin River at Vernalis, in cooperation with the California Department of Water Resources.

2. Suspended-sediment data are being collected on a quarterly basis at Mokelumne River at Woodbridge, as part of NASQAN, and at Merced River at Happy Isles Bridge near Yosemite, as part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected at 12 stations on a biweekly basis as part of the data-collection program for the San Joaquin River Water Quality Study. Data collection began in 1985 in cooperation with the USBR.

Central Coastal Subregion

1. Suspended-sediment and bedload data are being collected on a periodic basis at San Antonio River near Lockwood, and at Nacimiento River near Bryson, in cooperation with Monterey County Flood Control and Water Conservation District.

2. Suspended-sediment data are being collected on a bimonthly basis at Salinas River near Chular and on a quarterly basis at Pajaro River at Chittenden, as part of NASQAN.

Tulare Basin and South Lahontan Subregions

1. Suspended-sediment data are being collected on a bimonthly basis at Kings River below NF near Trimmer and Kern River at Kernville, as part of NASQAN.

South Coastal Subregion

1. Suspended-sediment data are being collected once per year at 4 stations in the Santa Monica Mountains, as part of the Santa Monica Mountains Water Quality Study. Data collection began in 1982 in cooperation with the National Park Service.

2. Suspended-sediment data are being collected on a daily basis and monthly estimates of bedload discharge are made at San Juan Creek at San Juan Capistrano, in cooperation with the California Department of Boating and Waterways.

3. Suspended-sediment data are being collected on a daily basis at Santa Ana River near Mentone and on a periodic basis at Santa Ana River near San Bernardino and Santa Ana River at Santa Ana, in cooperation with the COE.

4. Suspended-sediment and bedload data are being collected on a periodic basis, in cooperation with the California Department of Boating and Waterways and the COE, at the following stations:

Arroyo Trabuco at San Juan Capistrano
San Luis Rey River at Oceanside
San Diequito River near Del Mar
San Mateo Creek at San Onofre
San Onofre Creek near San Onofre

5. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Santa Ana River below Prado Dam, in cooperation with Orange County Environmental Management Agency.

6. Suspended-sediment data are being collected on a periodic basis at Ventura River near Ventura, in cooperation with California Department of Boating and Waterways.

7. Suspended-sediment data are being collected on a quarterly basis at Los Angeles River at Long Beach and Santa Clara River at Los Angeles-Ventura County Line, as part of NASQAN.

Colorado Desert Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Alamo River near Calipatria as part of NASQAN.

For additional information about U.S. Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
2800 Cottage Way
Sacramento, CA 95825

CALIFORNIA REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment yields and determinations of sediment damaged were made in the following watersheds:

a. Public La-566

Major Drainage	Watershed	County	State
San Joaquin River	Sand, Wahtoke, Long, Negro, Wooton, & Traver Creeks	Freson Tulare	CA
Truckee River	Evans Creek	Reno	NV

b. River Basin Investigations

Major Basin	Watershed	County	State
San Joaquin River	Polonio Franciscian & Bitterwater Creeks	Kern	CA
Sacramento River	Indian, Wolf, Lights, & Last Chance Creeks	Plumas	CA

c. Flood Plain Management Studies

Major Basin	Watershed	County	State
E. Fork Russian River	Potter Valley	Mendocino	CA

2. Special Studies

A. Land Treatment/Sediment Basin Study was conducted on Los Osos and Cherry Creeks (tributaries of Morro Bay) in San Luis Obispo County, California.

ALASKA REGION

GEOLOGICAL SURVEY

Yukon Subregion

1. Suspended-sediment data are being collected on a periodic basis at the Yukon River at Pilot Station, AK, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected periodically at the Tanana River at Nenana, AK, as part of NASQAN.

3. Suspended-sediment and bedload data are being collected on a periodic basis at Lignite Creek above mouth near Healy, AK, as part of the Federal CBR program.

4. A cooperative study with the U.S. National Park Service was Initiated July 1988 to Collect periodic suspended-sedimemt and bedload data, and to test the use of radio transmitters in tracking coarse bed material on the Toklat River at Toklat in Denali National Park.

Southwest Subregion

1. Suspended-sediment data are being collected on a periodic basis at Kuskokwim River at Crooked Creek, AK, as part of NASQAN.

South-Central Region

1. A cooperative study with the Alaska Department of Transportation and Public Facilities was initiated in 1986 to determine annual suspended-sediment inflow to Campbell Lake via Campbell Creek. Suspended-sediment and bedload data were obtained at three sites during the 1988 water year.

Report: Lipscomb, S. W., 1988, Sediment discharge data for the lower reach of Campbell Creek, Anchorage, Alaska: U.S. Geological Survey Open-File Report 88-81, 12 p.

2. A cooperative program with the Municipality of Anchorage, Department of Health and Human Services was initiated in 1988, to collect daily suspended-sediment data at little Campbell creek at Nathan Drive near Anchorage and Chester Creek at Arctic Boulevard at Anchorage as part of a long-term sediment monitoring study.

3. Suspended-sediment data are being collected on a periodic basis at Talkeetna River near Talkeetna, AK, as part of the National Hydrologic Benchmark Network.

4. Suspended-sediment data are being collected on a periodic basis at Copper River near Chitina, AK, as a part of NASQAN.

Southeast Subregion

1. As part of the cooperative program with the U.S. Forest Service, suspended-sediment data are being collected on a periodic basis at the Greens Creek near Juneau, AK.

2. Suspended-sediment data are being collected on a periodic basis at the Stikine River near Wrangell, AK, as part of NASQAN.

For additional information about U.S. Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
4230 University Drive, Suite 201
Anchorage, AK 99508-4664

HAWAII REGION

GEOLOGICAL SURVEY

Hawaii Subregion

1. Suspended-sediment data are being collected bimonthly at Honolii Stream near Papaikou, Hawaii, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected bimonthly at Wailuku River at Hilo, Hawaii, as a part of National Stream Quality Accounting Network (NASQAN).

Maui Subregion

1. Suspended-sediment data are being collected bimonthly at Kahakuloa Stream near Honokohau, Maui, as a part of NASQAN.

Molokai Subregion

1. Suspended-sediment data are being collected bimonthly at Halawa Stream near Halawa, Molokai, as a part of NASQAN.

Oahu Subregion

1. Suspended-sediment data are being collected at the following sites:

Waikele Stream, Waipahu, Oahu, on a daily basis as part of the Federal CBR program.

Kalihi Stream, at Kalihi, Oahu, quarterly as a part of NASQAN.

Kamooalii Stream near Kaneohe, Oahu, on a daily basis in cooperation with the U.S. Army Corps of Engineers.

2. In cooperation with Hawaii State Department of Transportation, daily suspended-sediment data are being collected at the following stations on Oahu:

North Halawa Stream near Aiea
Right Branch of Kamooalii Stream near Kaneoha
Luluku Stream near Kaneohe
South Fork Kapunahala Stream at Kaneoha
Haiku Stream near Heeia

Kauai Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Waimea River at Waimea, Hawaii, as a part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
P.O. Box 50166
Honolulu, HI 96850

CARIBBEAN REGION

CORPS OF ENGINEERS

South Atlantic Division

Jacksonville District

Suspended Sediment Sampling. Intermittent collection of sample were achieved at Rio Piedras (2 stations); at Quebrada Josefina; at Rio Puerto Nuevo, Puerto Rico in cooperation with the U.S. Geological Survey in relation to debris basin design for concrete channel protection project.

CARIBBEAN REGION

GEOLOGICAL SURVEY

Puerto Rico Subregion

1. Suspended-sediment data are being collected on a bimonthly basis when flow is above normal at 59 sites in cooperation with the Puerto Rico Environmental Quality Board (PREQB).

2. Suspended-sediment data are being collected on a bimonthly basis at the following sites as a part of the National Stream Quality Accounting Network (NASQAN):

Río de la Plata at Toa Alta, PR
Río Grande de Manatí near Manatí, PR
Río Grande de Anlasco near San Sebastián, PR
Río Grande de Patillas near Patillas, PR

3. Suspended-sediment data are being collected on a weekly basis and during high flows at Río Tanamá near Utuado, PR, in cooperation with PREQB.

4. Suspended-sediment data are being collected on a daily basis at Río Rosario near Hormigueros PR, in cooperation with the U.S. Army Corps of Engineeers (COE).

Special Studies

1. Suspended-sediment data are being collected on a weekly basis and during high flows at the following sites in cooperation with PREQB, COE, Puerto Rico Department of Natural Resources (PRDNR), and Puerto Rico Aqueduct and Sewer Authority (PRASA) to determine the sediment load from those small basins to Lago Loíza, a water-supply reservoir:

Quebrada Blanca at Jagual, PR
Quebrade Salvatierra near San Lorenzo, PR
Quebrade Caimito near Juncos, PR
Quebrada Maney near Guarbo, PR
Río Turabo Borinquen, PR

2. Suspended-sediment data are being collected on a daily basis at the following sites in cooperation with PREQB, PRASA, PRDNR, and COE as part of a project to determine the sediment load at these three proposed dam sites:

Río Cayaguas at Cerro Gordo, PR
Río Valenciano near San Lorenzo, PR
Río Grande de Loi,za at Quebrada Arenas, PR

3. Suspended-sediment data are being collected daily at the following sites in cooperation with PREQB, PRDNR, PRASA, and COE to determine total sediment input from Río Grande de Loíza Basin to Lago Loíza reservoir:

Río Grande de Loíza at Caguas, PR
Río Gurabo at Gurabo, PR

4. Bed-material samples will be collected twice a year at the following sites in cooperation of PREQB, PRDNR, PRASA, and COE as part of a project to determine the total bed-material discharge from these subbasins to Lago Loíza:

Río Grande de Loíza at Quebrada Arenas, PR
Quebrada Blanca at Jagual, PR
Quebrada Salvatierra near San Lorenzo, PR
Río Cayaguas at Cerro Gordo, PR
Río Turabo at Borinquen, PR
Río Grande de Loíza at Caguas, PR
Quebrada Caimito near Juncos, PR
Río Valenciano near Juncos, PR
Quebrada Mamey near Gurabo, PR
Río Gurabo at Gurabo, PR

5. Daily suspended-sediment data and annual bed-material samples are being collected at the following sites in cooperation with the COE to determine total sediment input to San Juan Bay through Río Puerto Nueveo:

Río Piedres at Senorial, PR
Río Piedres at Río Piedres, PR
Río Piedres at Hato Rey, PR
Quebrada Jose Fina at Pinero Ave, PR

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
G. P. O. Box 4424
San Juan, PR 00936

CARIBBEAN REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following watersheds:

a. Public Law 566

Major Drainage	River	State
Guyanes	Limones	Puerto Rico

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CORPS OF ENGINEERS

The Hydrologic Engineering Center

Sedimentation activities at the HEC during calender year 1988 focused upon improvements to, and applications of, the numerical model HEC-6, "Scour and Deposition in Rivers and Reservoirs". Through coordination with the Waterways Experiment Station (WES) a combined WES/HEC version of HEC-6 that contains developments and enhancements to the program made by WES over the last decade was prepared. It is planned that in 1989 this new version will replace the one previously supported by HEC. This program was generalized for use on Corps Harris computers and used for workshops in the HEC training course, "Sediment Transport in Rivers and Reservoirs", held 11-22 July 1988. Work was started on writing an entirely new users manual and creating a microcomputer version of the model.

In October of 1988, the HEC changed its policy regarding software distribution and support for certain programs. We now only provide these services to Federal Offices as this service is readily available in the private sector for other users. This new policy applies to HEC-6. This changes will allow HEC to devote more resources to software improvement and development.

The HEC began preparation of a Corps Engineer Manual on "River Hydraulics". This manual will contain a Chapter on "Water Surface Profiles within Movable Boundary Streams."

Assistance was provided to the Sedimentation Subcommittee of the Interagency Advisory Committee on Water Data in development of the "Second Seminar on Stream Sedimentation Models" held in Denver, Colorado, Oct. 19-20 1988. A paper entitled "Status of HEC-6, Scour and Deposition in Rivers and Reservoirs, January 1989" was prepared and provided to that committee.

A paper entitled "Review of the U.S. Army Corps of Engineers Involvement with Alluvial Fan Flooding Problems" was prepared and presented at The Association of State Floodplain Managers Conference on "Arid West Issues" held in Las Vegas, Oct. 19-21 1988.

Project applications of HEC-6 performed at the HEC included the following:

1. Cache Creek, California. This study used HEC-6 to simulate the response of a meandering stream to upstream flow regulation. The numerical modeling was supplemented with a thorough geomorphic study. The study was completed and a comprehensive report prepared.

2. Kaskaskia River, Illinois. This study is an update of a previous application that seeks to predict the impacts of a navigation project on upstream stream behavior and future dredging requirements. The study was completed and a final report prepared.

3. HEC continued to provide assistance to Corps District offices in the analysis of potential river channel stability problems and sediment issues. Work was performed on the rivers located below the Terminus and Success Dams near Visalia, California, and on the Truckee River in Reno, Nevada.

CORPS OF ENGINEERS

Waterways Experiment Station

Title of Study:

Field Measurement of Sediment Transport Rates in the Nearshore Zone

Point of Contact:

Ms. Kathryn Gingerich, CEWES-CR-P

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

All coastlines

Location:

Lake Michigan

Objectives:

Accurate field measurements of sediment transport rates in the surf zone are lacking. The primary reason is the hostile environment of the surf zone, and the inadequacy of previous measurement techniques. The purpose of this study is to develop measurement techniques for the transport rate and collect comprehensive and synoptic data on the sediment transport rate and its forcing agents (waves, currents, and winds).

Summary of Accomplishments:

A comprehensive nearshore processes experiment was conducted during September, 1988 on Lake Michigan. Previous studies were conducted on the Atlantic and Gulf coasts, and data from the Great Lakes environment were sought to diversify the data base. Personnel from numerous district and division offices, the University of Michigan, the University of Washington, and staff members from the Coastal Engineering Research Center joined to execute the experiment. Data collected during the study are presently being analyzed. Reports that document results from prior experiments (DUCK85 and SUPERDUCK) are being published. Data from all the field experiments are being used to develop a more accurate sediment transport rate formula. Analysis is continuing and results are very positive.

Title of Study:

Shoreline Change Modeling: Coast of California Storm and Tidal Waves Study, San Diego Region

Point of Contact:

Dr. N. Kraus, CEWES-CR

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

All coastlines

Objectives:

The Los Angeles District requested assistance in developing planning and design tools for use in solving coastal engineering problems in southern California. The following numerical models are being developed by WES staff for the San Diego region of southern California: nearshore wave transformation, shoreline change, and beach erosion. All models are being designed for use on super mini-computers, and scaled-down versions are being created for use on personal computers (PC). The PC-based models are intended for use by district engineers in making preliminary evaluations of local project alternatives.

Summary of Accomplishments:

Nearshore wave models have been developed for the three cells that make up the San Diego region: Oceanside, Mission Bay, and Silver Strand. The shoreline change model for Oceanside has been developed and is being calibrated and verified. Work on the other change and beach erosion models is ongoing. All model development will be completed during calendar year 1989.

Title of Study:

Advance Maintenance in Rivers

Point of Contact:

Mr. Brad Comes, CEWES-HR-M

Conducted for:

Headquarters, U.S. Army Corps of Engineers

Water Resources Region:

All inland navigation channels and harbors

Objectives:

The overall objective of this investigation is to evaluate the effectiveness of advance maintenance dredging in reducing dredging frequency and associated costs in inland channel and harbor maintenance and to establish guidelines for governing this practice.

Summary of Accomplishments:

A visit was made to the Mobile District Office to review their files on the Buena Vista Bar Reach on the Tenn-Tom Waterway. A one-dimensional HEC-6 sedimentation model of this reach is under development.

A contract to Dr. Jay R. Lund, Assistant Professor, Department of Civil Engineering, University of California, Davis, was initiated. This contract is a joint effort with a work unit in the Dredging Research Program. The first year of the contract involves developing methods and the appropriate software for economic optimization of advance maintenance dredging. Equipment mobilization and demobilization, disposal costs, exhaustion of disposal sites, risk to navigation capacity and sedimentation rates will be used as input to the model.

Title of Study:

Barrier Island Sedimentation Studies

Point of Contact:

Dr. D. K. Stauble

Water Resources Region:

All barrier coastlines

Objectives:

The purpose of the Barrier Islands Sedimentation Study (BISS) over the past few years has been to evaluate the evolution of barrier islands and associated inlet and marsh systems and to predict the geomorphic development of these areas. A new processes-response approach to the understanding of barrier island processes and interaction with coastal engineering projects will be undertaken in the next two years to summarize the past studies and to produce a needed product to aid Districts in planning and design.

Summary of Accomplishments:

"Wave dissipation on a barred beach: a method for determining sand bar morphology" was a technique developed to remotely measure the scales and morphology of natural sand bars. A Data Summary Report documents a study carried out in conjunction with the SUPERDUCK experiment to examine the variability of beach sedimentology during and after a major storm. Last of a series of TR's in cooperation with NOS, presenting maps and historical geomorphic analysis of shoreline change along the U.S. East Coast was completed for the South Carolina coast. Sediment sampling techniques for characterization of native beach were studied with a unique data set from Ocean City, MD.

Title of Study:

Flood Control Channel Research Program

Point of Contact:

Mr. W. A. Thomas, CEWES-HR

Conducted for:

Headquarters, U.S. Army Corps of Engineers

Objectives:

Develop stable flood-control channel design guidance for use in the design offices of the Corps of Engineers

Summary of Accomplishments:

The Corps of Engineers initiated a major research effort to provide design guidance for local flood protection projects. Channels are often soft bottom, and some modification to the width, depth, slope, hydraulic roughness, or plan form is required to provide flood protection. Methods to predict deposition and the erosion of streambed and banks are being assembled for use in hydraulic design studies.

Title of Study:

Geomorphic Development of the Northern New Jersey Beaches

Point of Contact:

Ms. Laurel T. Gorman

Water Resources Region:

Northern New Jersey

Objectives:

The study aim is to provide an analytic evaluation of the geologic and geomorphic data source along the northern coast of New Jersey. An assessment and identification of key elements in the geomorphic process/system are described as well as spatial and temporal evaluation of historic shoreline movement.

Summary of Accomplishments:

A summary of the geomorphic processes are presented in the main text and augmented with diagrams, graphs, and tables that include sediment trends, sea level history, historic shoreline movement, storm effects, offshore conditions. These data sets were collected for the coastline located between Sandy Hool and Manasquan, New Jersey. An evaluation of the scheduled beach erosion control plan and the impacts on the geomorphic system was discussed.

Title of Study:

Scour at Coastal Structures

Point of Contact:

Dr. J. Fowler, CEWES-CW-P

Water Resources Region:

Coastlines with sediment transport

Location:

Field Research Facility, Duck, NC

Objectives:

To evaluate state-of-the-art technology of scour at coastal structures and to define/improve limits of accuracy and applicability of movable-bed physical model of same.

Summary of Accomplishments:

A survey on coastal scour problems and existing theory was completed. An annotated bibliography on scour and modeling of scour was completed in draft.

Modifications to the 6-ft-wide flume in building 6006 were completed to increase/improve the wave generating capability of this facility. Waves of up to 1.6 feet (2 sec period) at 4 feet depth can now be utilized.

Numerous two-dimensional (wave flume) tests were conducted at mid-scale (1:7.5) to study/predict scour of a sand wedge fronting a concrete dike. The prototype data were a set of large wave tank (prototype scale) tests which were conducted in the Federal Republic of Germany at the University of Hannover by H. Dette and K. Uliczka in 1985. Results to data are very promising and indicate that good results are obtained with mid-scale undistorted studies scaled by the fall velocity parameter (wT/Ho). For this expression, w is the fall velocity, T is wave period, and Ho the deep water wave height. A draft Coastal Engineering Technical Note on CERC capabilities/appropriate situations for such models has been prepared and is currently being reviewed.

Title of Study:

Sand Wave Degradation Technique for Navigation Channels

Point of Contact:

M. Granat, CEWES-HE-E

Water Resources Region:

Navigable Waterways with Noncohesive Sediment Supplies

Location:

Columbia River

Objectives:

To evaluate alternative and innovative dredging techniques to quickly degrade sand wave crests that encroach upon controlling depths of inland and coastal waterways.

Summary of Accomplishments:

A negotiated Broad Agency Announcement (BAA) contract was undertaken with Western-Pacific Dredging Company, Division of Riedel International, Inc., to conduct field tests of their "mobile sediment resuspension system." Field testing of their equipment was conducted on selected navigation channel sand waves in the Columbia River between river miles 80 and 100 during the period 26 September and 7 October 1988.

The U.S. Army Engineer District, Portland, supported this project during the field testing and subsequent data analysis tasks. Their survey vessel Norman Bray, instrumented with a Ross multi-transducer survey channel system provided predredge and postdredge survey information. Suspended sediment samples were collected during the testing period dredging operation. Predredge and postdredge surface sediment grab samples were also collected from selected san wave locations.

Data analysis and evaluation are underway to assess the production rates and efficiency of the equipment. This work is being accomplished under the Improvement of Operation and Maintenance Techniques Research Program of the Corps of Engineers Civil Works Research Program sponsored by the Office, Chief of Engineers, U.S. Army.

Title of Study:

Accurate Measurements of Near-Bed Velocities and Concentrations

Point of Contact:

Ms. T. Dozier, CEWES-HE-S

Water Resources Region:

Data Acquisition in Rivers, Estuaries, and Near-Shore Regions

Objectives:

Improve channel shoaling studies and the determination transport rates and reduce the costs of these studies by developing cost effective methods for accurate measurement of near-bed current velocities, bed shear stresses, and sediment concentrations.

Summary of Accomplishments:

A literature review of methods and instruments for sensing near-bottom phenomena has been conducted and a report summarizing the findings has been drafted. The purpose of this report is to discuss considerations when collecting data for sediment studies and to present some of the methods and instrumentation that is available and their limitations.

A workshop was held for researchers and Corps personnel to meet and discuss new developments and Corps needs in data collection and other research in the area of cohesive sediment transport. The proceedings of this workshop are being published and will be made available to Corps technology users.

Several sensors for measuring hydraulic and sediment parameters near the bed have been constructed or obtained and these have been tested in the laboratory. A boundary layer profiler have been constructed using these sensors and data analysis from its first field deployment is being conducted.

Flume studies of movement of near-bottom cohesive suspensions and preliminary field exercises have been completed. The purpose of these studies has been to better define near bottom processes and to identify methods and instruments that will better measure these processes.

Title of Study:

Measurement of Entrainment and Transport

Point of Contact:

W. H. McAnally, CEWES-HE

Water Resources Region:

Tidal Waters

Objectives:

Provide improved methods for measuring and calculating cohesive and mixed sediment entrainment and transport in tidal flows, so that predictions of dredged material movement out of open water placement sites can be better measured and predicted.

Summary of Accomplishments:

Flume tests are underway to provide a lab data set of entrainment of realistic sediment mixtures. Field data from past site-specific measurement programs have been digitized and analysis has begun. Collaboration with researchers in Great Britain has been initiated to share research results. A set of interim guidelines have been drawn up for calculating boundary shear stresses in tidal-dominated waters.

ENVIRONMENTAL PROTECTION AGENCY

Washington, DC

Flushing and Scouring Flows for Habitat Maintenance in Regulated Streams

The objective of this report was to develop and provide information concerning the feasibility of maintaining aquatic and riparion habitats downstream from dams by managing reservoir releases to flush deposits of streambed sediment or scour encroaching channel vegetation.

The investigation for the report was conducted in four parts: (1) development of a typology to classify situations where a controlled flushing or scouring flow could be applied beneficially, to classify methods for predicting or evaluating their effects, and to classify their different purposes; (2) review of past success or failure at flushing or scouring stream channels for habita maintenance; (3) review of methods used to predict flushing or scouring flow requirements; and (4) preparation of two case studies to illustrate the potential benefits and liabilities.

The case studies of streambed flushing and scouring flows prepared generally confirm the State of the art as reported by other recent investigations. While the office, laboratory and field methods for predicing the flow requirements have become increasingly sophisticated, the reliability of methodologies based either on theories of instream flow regime or on sediment transport mechanics is still inadequate, or at least untested. A further uncertainty is presented by difficulties in predicting the future contributions of different sediment-size fractions coming from disturbed watersheds to the tributaries feeding the mainstem stream below the dam.

Recommendations continue to be made using rudimentary guidelines, for instance prescribing a certain level of flow that matches some historical interval of recurrence or duration of occurrence, or merely requesting some proportion of the mean annual discharge rate. Ideally, if sediment transport models can be improved over their present predictive capability, then their output could be coupled with instream flow models used to project the increase of aquatic habitat values expected from the stream-flushing operations of reservoirs.

Among many conclusions drawn from the case studies, a number stand out in importance:

- It is essential to establish an actual ecological need for a flushing or scouring flow, as well as the possible economic and environmental trade-offs, before proceeding to predict or prescribe the requirements.

- Legal and institutional constraints, particularly the legislative, judicial and contractual obligations placed upon reservoir storage, should be examined when considering flushing or scouring flows and their alternatives.

- Predictive and evaluative methods should be selected which are compatible with site-specific conditions, such as the watershed characteristics, instream flow regime, bed material composition, and channel morphology.

- It is wise to compare results of several methodologies, which could vary by one or even two orders of magnitude, when predicting flushing or scouring flow requirements, and, if possible, provide field verification.

- An awareness for the assumptions and limitations inherent in any predictive methodology is important because sediment transport mechanics and channel maintenance theory are still in an early stage of development.

The case studies should help to comprehend the appropriate path of future work necessary to advance the benefits of streambed flushing and scouring in concert with other practices for managing sediment and vegetation in regulated streams.

For additional information, contact Lowell E. Keup, Criteria and Standards Division, Office of Water, EPA, Washington, DC 20460, telephone 202-475-7305.

Status of Efforts to Develop Sediment Quality Criteria

EPA's Office of Water Regulations and Standards has been actively pursuing the development of numerical sediment criteria. These criteria are intended to assist in assessing the toxicity of and to aid in making decisions concerning contaminated sediments. These criteria are driven by biological and human health effects and are intended to be as protective as existing water quality criteria.

EPA's Science Advisory Board (SAB) has recently reviewed the approach for developing sediment criteria for non-ionic organic contaminants. A report summarizing the findings of the SAB review is expected to be released in June of this year. EPA is planning on submitting the method for generating sediment criteria for metal contaminants to the SAB in 1991. In addition, to the development of sediment criteria efforts are underway to develop guidance on appropriate regulatory applications of developed criteria. Resources are also being focus on establishing standardized bioassays that could be used independently of or in conjunction with sediment criteria. These bioassays are intended to be used to identify chronic effects and bioaccumulation associated with marine and freshwater sediments.

For additional information, contact Christopher Zarba, Standards Branch, Office of Water, USEPA, Washington, DC 20460; telephone 202-475-7326 - (FTS) 475-7326.

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Environmental Processes and Effects Research
Environmental Research Laboratory
Athens, Georgia

Equilibrium Partitioning of Contaminants to Sediments

The Environmental Research Laboratory in Athens, Georgia has been actively developing theoretically-based quantitative relationships for predicting the partitioning behavior of neutral organics, ionizable organics and metal/metalloid contaminants with natural sediments. These relationships are presently being incorporated into computer models designed for exposure and risk assessment, remedial action evaluation, development of sediment quality criteria and other Agency environmental management requirements.

The partitioning behavior of neutral organic contaminants is currently treated using organic carbon/octanol-water partition coefficient relationships obtained from the literature. Our laboratory's present effort focuses on analyzing the error and quantifying the uncertainty associated with applying these procedures to natural aquatic systems. For additional information contact Steve McCutcheon, 404-546-3301 (FTS 250-3301).

The partitioning behavior of anionic (negatively charged) organic contaminants has been demonstrated to be poorly described by organic carbon/octanol-water relationships. A new model has been developed, and is being tested in the laboratory, that may be applicable to a wide variety of contaminants. For more information, contact Chad Jafvert, 404-546-3149 (FTS 250-3149).

A comprehensive framework for predicting the partitioning behavior of metal species (both cations and anions) and metal-organic complexes is being incorporated into the MINTEQA2 geochemical speciation model. For more information, contact Nick Loux, 404-546-3174 (FTS 250-3174).

Modeling the Release of Organic Contaminants from Confined Disposal Facilities

The Center for Exposure Assessment Modeling, at the Environmental Research Laboratory in Athens, Georgia has been actively developing and/or evaluating theoretically based quantitative methods for predicting the release of organic contaminants from Confined Disposal Facilities (CDFs). These methods are being incorporated into computer models designed for exposure assessment in order to estimate releases, conduct risk assessments, evaluate remedial action alternatives, and fulfill other agency requirements.

Confined disposal involves the placement of dredged materials into a facility prepared to contain them, normally incorporating a dike to enclose and area for containment where the material settles and consolidates. The facilities may be upland or placed in open water. Since the 1960's, approximately half of the material dredged from the Great Lakes has been disposed of in CDFs and approximately 30 of these facilities have been constructed in the Great Lakes. On a national scale, approximately 30 percent of the 290 to 370 million cubic m of material removed annually from Federal navigation channels to maintain authorized depths is placed in CDFs. This figure includes the majority of

maintenance dredging for the Atlantic and Gulf Coast harbors and waterways and numerous harbors on the Great Lakes.

Contaminant exposure can occur within a CDF and through its releases. The aquatic, wetland and upland habitats that develop in CDF's are often rapidly colonized and may support prolific wildlife communities that have a high probability of exposure to contaminants. Contaminant exposure may also result due to releases from CDFs. Although CDFs were designed to contain polluted sediment, they generally provide for carrier water to be released from the containment area. These releases and, in the case of in-lake CDFs, the exchanges of contaminants with the lake (or estuary) waters in which they are located, may result in mass transfers of contaminants outside the CDF's and exposure concentrations to organisms which are of environmental significance.

Several levels of models have already been developed, including screening and intermediate levels. For more information, contact Steve McCutcheon 404-546-3301 (FTS 250-3301).

Sediment Transport Modeling in Green Bay, Lake Michigan

The Center for Exposure Assessment Modeling, at the Environmental Research Laboratory in Athens, Georgia has been actively applying hydrodynamic and sediment transport models to Green Bay, Lake Michigan. These applications are part of a collaborative effort with the Great Lakes National Program Office, the Environmental Research Laboratory in Duluth, Minnesota, and other organizations to pilot the use of mass balance approaches for exposure assessment in large lakes. In addition, the models will allow evaluation of proposed remedial alternatives for the Green Bay/Fox River system.

A three-dimensional hydrodynamics code is being coupled to a recently developed model of the transport of cohesive sediments in order to provide input to fate and exposure models for organic contaminants. Field and laboratory studies are presently being conducted to support these modeling efforts. For more information, contact Steve McCutcheon 404-546-3301 (FTS 250-3301).

Cohesive Sediment Transport Modeling

The Center for Exposure Assessment Modeling (CEAM), at the Environmental Research Laboratory in Athens, Georgia has been actively involved in the development of quantitative methods for predicting the transport of cohesive sediments in both fresh and estuarine waters. These methods are currently being incorporated into operational, multi-dimensional hydrodynamics computer models. Since cohesive sediments may have large impacts on the transport and ultimate distribution of contaminants, these integrated models will be very useful in contaminant exposure and risk assessment, remedial action evaluation (particularly the no-action alternative), and in fulfilling other agency requirements.

Modeling approaches currently under cooperative development include: (1) a two-dimensional (depth-averaged), finite element, cohesive sediment transport model at Clemson University; and (2) a three-dimensional hydrodynamic and

cohesive sediment transport model at the University of Florida. The two-dimensional model is designed primarily for application in estuaries and includes descriptions of the erosion, dispersion, aggregation, deposition and consolidation of cohesive sediments. The three-dimensional effort not only expands model power necessary for many systems, but also includes refined methods for predicting the flocculation of cohesive sediments. Both modeling approaches are being tested by the CEAM through application on several waterbodies. For more information, contact Steve McCutcheon 404-546-3301 (FTS 250-3301).

United States Environmental Protection Agency - Environmental Research Laboratory (Gulf Breeze, Florida)

1. The Gulf Breeze Laboratory is investigating the anaerobic dehalogenation of chlorinated phenolic in sediments from pulp and paper milling waste. Chlorinated phenolic compounds can alter and stress ecological processes. Their accumulation in anaerobic sediments present the possibility that microbial populations can be adapted to their degradation. Primary enrichments inoculated with aquatic sediment exposed to waste from this industry rapidly degraded chlorinated phenolic compounds indicating the presence of an adapted population and the potential for in situ degradation. Stable anaerobic bacterial consortia with high degradative activity toward these compounds were obtained. Using both consortia and pure cultures isolated from these consortia, we will study the metabolic pathways and biochemical mechanisms involved in degradation of chlorinated phenolic compounds. The information obtained will enable us to determine the feasibility of using anaerobic biodegradation to reclaim environmental areas heavily contaminated with this type of industrial pollution. For additional information contact Dr. Hap Pritchard ERL/GB, Sabine Island, Gulf Breeze, FL 32561.

2. The Gulf Breeze Laboratory is investigating the effects of bioturbation on the fate and transport of toxic compounds in sediment. Laboratory microcosm studies will be used to assess the significance of bioturbation activities on the transport of toxic compounds from both the water column and previously contaminated sediment (simulating dredged materials) into sediment beds. Results from these tests will be used in a mathematical model to predict movements of both dissolved chemicals (from water column and interstitial water) and chemicals sorbed to sediment. Once in the sediment, redox gradients are expected to be primarily responsible for the control of microbial degradation. The interrelationship between biodegradation, bioturbation, and redox potential will be established. Field enclosure studies will be used to verify the results of laboratory microcosm tests and model predictions. For additional information contact Dr. James Clark, ERL/GB, Sabine Island, Gulf Breeze, FL 32561.

3. The Gulf Breeze Laboratory is investigating PCB biodegradation in sediments. Concerns over the toxicity and bioaccumulation of PCB's in commercially important estuarine organisms and the fear of eventual exposure to humans, have intensified efforts to establish reasonable, cost-effective and ecologically safe options for remediation of polluted areas. Information on environmental and microbiological factors that enhance the extent and rate of PCB biodegradation under laboratory conditions will be provided by conducting feasibility studies. Evaluation of this information for its potential application to the biological clean-up (bioremediation) of PCB's in estuarine sediments will be conducted as data is generated. An ultimate objective of this work is to

develop bench scale treatment systems using contaminated sediments from various sites. Recent studies have shown that pure cultures of aerobic bacteria, isolated for their ability to utilize biphenyl, exhibit considerable differences in their PCB-degradative competence. Some isolates demonstrate superior ability to act on a range of PCB's having wide variation in chlorine content and substitution patterns; others are considerably more limited in their action. These studies demonstrate a potential for microbiological degradation of PCB's with an indication of the feasibility of biological remediation of contaminated soils. For additional information contact Dr. Hap Pritchard, ERL/GB, Sabine Island, Gulf Breeze, FL 32561.

4. The Gulf Breeze Laboratory is investigating system-level effects of estuarine benthic communities to determine effects of toxicants on estuarine macrobenthic organisms that colonize and form communities on substrata in the laboratory and field. Estuarine sediments may serve as sinks for toxic chemicals. Most species that comprise the faunal communities of estuarine benthic systems enter as settling larvae. This study is designed to describe how contaminated sediments or water modify the composition of benthic communities. Previous research efforts have focused on planktonic larvae in the field or in the laboratory colonizing sand in groups of replicate aquaria. This project will now include organic (mud) substrates. Sediment-source contaminates and waterborne exposures will be studied for single chemicals and complex chemical mixtures. For additional information contact Dr. James Clark, ERL/GB, Sabine Island, Gulf Breeze, FL 32561.

5. The Gulf Breeze Laboratory is studying biodegradation process for use in exposure assessment models of pesticides in estuarine sediments. A combination of laboratory and field data will be used to validate the mathematical description of biodegradation processes in the WASTOX model. Laboratory studies using intact components from the field will relate partition coefficient, sorption, bioavailability, biodegradation, and bioturbation to transport phenomena in natural systems and describe these phenomena mathematically. Environmental factors (sediment concentration, temperature, and final electron acceptor) that control biodegradation mechanisms of pesticides in sediments will be incorporated into process descriptors of biological fate. Laboratory test data will be used for model predictions of pesticide fate in an actual field site. For additional information contact Dr. Hap Pritchard ERL/GB, Savine Island, FL 32561.

6. The Gulf Breeze Laboratory is developing methods for assessing risks from contaminated sediments by developing rooted marsh plants as assay species. The response of marsh plants and their uptake of contaminants from sediments will be studied. Artificial sediments designed to simulate natural sediments will be formulated from commercially available clay, silt, sand, and organic matter. Relevant physical and chemical characteristics, such as pH, eH, cation exchange capacity, and particle size distribution, will be measured. Two plant species, Spartina alterniflora (estuarine) and

Echinochloa crusgalli (freshwater) will be the initial test species. Seed germination and plant growth in uncontaminated natural and artificial sediments will be evaluated. After initial basic research is completed, seeds will be exposed to selected toxicants in natural and artificial sediments. Toxicants will include pesticides, other toxic substances, and liquid complex wastes. Contaminated field sediments will be planted with seeds when available. For additional information contact Dr. James Clark, ERL/GB, Sabine Island, Gulf Breeze, FL 32561.

FEDERAL HIGHWAY ADMINISTRATION

The Federal Highway Administration (FHWA) concentrated its activities on five major areas: evaluation of embankment stability subject to flood overtopping, control of stream instability at highway crossings, bridge scour studies, control of sediment produced by highway construction, and control of highway water quality. Major efforts were carried out by staff and contract research, and by the various studies in the Highway Planning and Research program (HRP) and in the National Cooperative Highway Research Program (NCHRP). Following is a description of ongoing studies in 1988 in each of the five major areas.

Evaluation of Embankment Stability Subject to Flood Overtopping - The objectives of these studies are to evaluate stability of embankments subject to flood overtopping and to determine expected rates of erosion when damages do occur. Various types of embankment materials and various types of protective measures are considered for these studies. In the overall design framework for highway stream crossings, these studies provide guidelines for risk analysis and lowest total expected cost design.

A. Simons, Li and Associates (SLA) continued a study sponsored jointly by FHWA and the U.S. Bureau of Reclamation (BOR) to investigate measures for "Overtopping Damage Minimization." This study is a follow-up to a completed FHWA study on Embankment Damage due to Flood Overtopping. The draft final report was reviewed and approved. It includes results of 38 full-scale hydraulic tests of selected commercially available embankment protection systems. The report will be published in 1989. Additional work is current underway to investigate cable-tied block systems in more detail. The additional work is being done under the FHWA contract but is sponsored by the BOR, TVA and SCS.

Control of Stream Instability at Highway Crossings - The objectives of these studies are to evaluate the significance of natural stream adjustments on the structural integrity of highway crossings, to provide techniques for resolving the impact of these changes, then to provide guidelines for measures to mitigate stream instability at highway stream crossings.

A. Sponsored by FHWA, the USGS completed a study on "Evaluation of Design Practices for Riprap Used in Protection of Highway Crossings." Two reports from that study were published in 1986. FHWA awarded a follow-up implementation contract to the Sutron Corporation to revise the FHWA hydraulic engineering circular (HEC-11) on riprap design procedures based on the USGS results. A draft of that circular was updated, reviewed and approved. It will be published in 1989.

B. FHWA was conducting a small scale laboratory study to determine riprap sizes needed to protect bridge piers from scour. Experiments for plain bed conditions were completed and results will be published in a Transportation Research Record. Additional work is currently underway for existing scour hole conditions. It is anticipated that smaller riprap can be used for existing scour holes due to the energy dissipation that occurs in the scour hole.

Bridge Scour Studies - The objective of these studies is to investigate expected scour at bridges. Goals include developing procedures for assessing

vulnerability of bridge scour, developing an improved sediment transport model, and developing prediction equations for pier, abutment and contraction scour at bridges.

A. Field scour studies were being sponsored by Arkansas, Arizona, Louisiana, Ohio, Oklahoma, Delaware, Virginia, Maryland, Tennessee, and Washington State using either State or HP&R funds. Most of these studies are aimed at reconnaissance prior to flooding and scour monitoring during flooding to document field data. Data from these studies will be fed into the national scour study described in B below. Exceptions to the general nature of these studies are Louisiana and Tennessee. The Louisiana study which was conducted by Louisiana State University focused on developing a computerized system for the organization, analysis and display of field collected scour data. The Tennessee study is focused on assessing vulnerability of bridges to scour in the western part of the State.

B. The USGS continued the bridge scour study "Performance of Bridges during Flooding," sponsored by the FHWA. This 3½ year study, awarded in September 1987, was intended to assemble a response team to monitor bridge scour wherever floods might occur in this country. The response team would work with study leaders in the individual States that have scour studies to standardize data collection and serve as a national repository of data.

C. Simons and Associates continued the NCHRP study (Project 15-11) "Hydraulic Analysis of Bridges on Streams with Moveable Beds and Banks" which will develop a sediment transport model that utilizes the stream tube concept proposed by Molinas. The three year study was awarded during the summer of 1987.

D. A Virginia HPR study "Major Factors Affecting the Performance of Bridges during Flooding," investigated the feasibility of analyzing soil borings and other site data after a flood to reconstruct the amount of scour that may have occurred during a flood. Data collection and analysis were completed. A draft final report was being prepared.

Control of Sediment Produced by Highway Construction - This problem consists of two stages: during construction and just after construction.

A. During construction and after completion of highway construction, immediate and adequate protection against erosion can be provided for slopes and other roadside areas affected by grading. In most regions of the country this has been accomplished with the use of erosion control fabrics and the proper establishment and maintenance of roadside vegetation. There are currently seven States conducting nine studies designed to reduce erosion through improved vegetation establishment and maintenance, and through the use of improved erosion control fabrics. The participating States are Arizona, California, Colorado, Indiana, Tennessee, Oklahoma, and Washington.

B. In addition to the foregoing studies supported by States in the HP&R program, a contractual effort was started through the FHWA's Federal Land program. At North Dakota State University an investigation of the

corrective repair of road edge scour for grassed highway shoulders was started.

Control of Highway Water Quality - The objectives of these studies are to monitor the highway water pollution parameters, to determine their source and their impact on the environment, and to devise cost-effective means to control them.

A. The FHWA administrative contract to identify effective alternatives for mitigating highway stormwater runoff pollution was completed by Versar, Inc., of Springfield, Virginia in 1986. This state of the practice study developed an interim design guide for four mitigation practices: Overland flow through grassed swales, retention basins, infiltration basins and wetlands. It also identified effective and noneffective design and operational practices for mitigation of highway runoff pollution. A guideline manual along with an executive summary, literature summary and research report were established in 1986, and are available from NTIS. Work was continued in 1988 to incorporate the guidelines into a Hydraulic Engineering Circular.

B. In order to draw together the results of all the research on characterization of highway stormwater runoff, FHWA contracted with Woodward Clyde Consultants to develop a "Deign Procedure to Estimate Pollutant Loading from Highway Stormwater Runoff." This study was completed with a computer model to estimate pollutant loading and to evaluate the potential impact to water resources. The final report will be published in 1989.

C. An FHWA administrative contract research study, "Retention, Detention and Overland Flow for Pollutant Removal from Highway Stormwater," was completed by Versar, Inc., Springfield, Virginia. This research developed performance criteria for mitigation measures using this subject removal mechanism. Laboratory tests and design for laboratory and field validations were conducted. The draft final report was prepared and is being reviewed.

D. An FHWA administrative contract research study, "Guidelines for Protective Systems for Spills of Hazardous Materials on the Highway System," was continued by the Kansas State University of Manhattan, Kansas. This investigation will focus on areas of high risk where spills could result in severe, long term or permanent consequences. The emphasis of the research is on developing implementable procedures and guidelines for effective, practical, and feasible protective systems. Part of the draft final report is being reviewed.

E. In the FHWA's Federal Lands program for roads in Indian reservations, national forests, national parks, and Bureau of Land Management, land areas concerns over the degradation of water quality from road areas have been noted from excavated acid producing materials brought to the surface as a result of road construction or rehabilitation. The University of Tennessee is currently under contract to investigate the cost-effective management of such materials and thus prevent or neutralize leaching of deleterious low pH runoff from excavated acid soil materials.

Under the National Cooperative Highway Research Program an overview study "Factors to be Considered by Highway Agencies in the Identification and Remediation of Hazardous Waste Sites" was completed and the final report published in 1988. Implementation of this and other related efforts should result in fewer toxic discharges of pollutants from highway runoff into nearby receiving water.

NCHRP Report 310 "Dealing with Hazardous Waste Sites - A Compendium for Highway Agencies," Transportation Research Board, National Research Council, Washington, DC, September 1988.

F. Nine States continued 13 investigations on effects of highway design, operation, and maintenance on water quality impacts and means to reduce such impacts.

Arizona, "Porous Pavements for Control of Highway Runoff."

California, "Effect of Bridge Repainting Operations on the Environment."

California, "Use of Vegetation to Reduce the Toxicity of Stormwater Runoff."

California, "Reducing the Volume of Hazardous Waste from Bridge Repainting."

Florida/USGS, "Wetlands for Stormwater Treatment."

Florida/USGS, "Impacts of Stormwater Management Practices on Ground Water."

Florida, "Effects of Structural Changes on Water Quality Efficiency."

Massachusetts, "Effectiveness of Highway Drainage Features for Control of Ground Water Pollution."

Ohio, "Effects of Highway Deicing Chemicals on Shallow Unconsolidated Aquifers in Ohio."

Pennsylvania, "Analyses of Pollution Controls for Bridge Painting."

Tennessee, "Deposition of Sediments in Wetlands of Bridge Crossings."

Virginia, "Field Performance of Porous Asphaltic Pavement."

Washington, "Improving the Cost of Effectiveness of Highway Construction Site Erosion/Pollution Control."

If more information is desired about these research studies, inquiries should be addressed to the sponsoring agencies.

GEOLOGICAL SURVEY, CORPS OF ENGINEERS, BUREAU OF RECLAMATION,
AGRICULTURAL RESEARCH SERVICE, FEDERAL HIGHWAY ADMINISTRATION,
BUREAU OF LAND MANAGEMENT

Federal Inter-Agency Sedimentation Project
St. Anthony Falls Hydraulic Laboratory
Minneapolis, Minnesota

A point-integrating sediment sampler designed by the Project in 1961 has been redesigned to eliminate the rotary valve which sometimes jams on sediment grains. The new valve throttles the flow by pinching a section of thin-walled silicone tubing. The pinch valve works to depths of about 30 feet. Joseph Szalona, an engineer with the Sedimentation Project and James Futrell of the U.S. Geological Survey's Hydrologic Instrumentation Facility, found a special sleeve that strengthens the tube and extends its depth rating. Don Benson with the Corps of Engineers, is making two pinch-valve samplers for field testing.

The Project built and sold four of the SALT (Sampling at List Time) controllers for operating pumping samplers. SALT, which is a sampling strategy developed by Dr. Robert Thomas of the U.S. Forest Service, provides unbiased estimates of suspended-sediment discharge. Don Benson will confer with the National Park Service that bought the SALT system and then incorporate improvements that are required.

The Project developed an inexpensive suspended-sediment sampler that can be used from a bridge or boat. The body is a one-piece bronze casting that requires very little machining. The sample container is a commonly available quart glass bottle. The cap, which joins the bottle to the sampling nozzle, is molded of plastic. The entire unit weighs about 22 pounds and can be suspended from a cable. Laboratory flume tests indicate sampling rates are almost ideal. The tail section is now being tested to provide maximum stability in flowing water.

Work continued on the development of the vibrational-type sediment gages. Artwork for the printed-circuit boards has now been completed. Fifteen gages have been donated by the ARS Laboratory at Oxford, MS and these instruments have been delivered to the Project headquarters for distribution to field sites that are yet to be determined.

Three reports have been written by members of the Sedimentation Project and are in the final stages of preparation. They are: "The Model-B Sediment-Concentration Gage: Factors Influencing its Readings and a Formula for Correcting its Errors", by John Skinner; "Comparisons of the U.S. P-61 and Delft Bottle Sediment Sampler", by Joseph Beverage; and "Field Test of the D-77 Bag Sampler and the P-61 Snapshot Sampler", by Joseph Szalona.

An ASTM collaborative study of laboratory procedures for measuring concentration is being organized. The sedimentation Project is preparing the test samples that will be distributed to laboratories for analysis. Results will be processed to obtain precision and bias values for each of three methods. These values and a description of the methods will be published as an ASTM standard.

Joseph Beverage visited China in September as part of the USGS/PRC Scientific Exchange Protocol. The purpose of the trip was to exchange information on sediment-sampling equipment, sampling procedures, and laboratory instrumentation. His trip report is available from the Project Office at the St. Anthony Falls Hydraulic Laboratory in Minneapolis.

Calibration, distribution, and repair of sediment samplers and laboratory equipment continued at a brisk pace during 1988. Corps of Engineers personnel with the Sedimentation Project supplied about 97 major pieces of equipment.

U.S. GEOLOGICAL SURVEY
WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

CR098 SEDIMENT TRANSPORT PHENOMENA

TITLE: Measurement and Prediction of Sediment Transport Phenomena

PROJECT NUMBER: CR 74-098

LOCATION: Topical Research

PROJECT CHIEF: Stevens, Herbert H., Jr.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: In alluvial streams, for every different hydrologic condition, the bed configuration, sediment transport, and hydraulic characteristics mutually change to achieve quasi-equilibrium. These changes affect the ability of the stream to convey given quantities of water, accommodate navigation, transport and dilute solid and solute wastes, support aquatic biota, and perform a variety of other similar functions. As yet, the relation between pertinent hydraulic and sedimentologic variables are not completely understood. Hence, the extent to which important variables, particularly bedform roughness and sediment transport, will change in response to natural or man-induced alterations to the flow regime cannot be predicted with desired reliability. As a result, optimum utilization and management of a waterway usually is not assured. Often, modifications intended to enhance the utility of a waterway are ineffective or have adverse effects. Lack of understanding is due in part to inadequate instrumentation for measuring the bedload transport. This problem is particularly acute in areas where resources are being mined for energy development.

OBJECTIVE: Provide a more complete understanding of sedimentation phenomena in alluvial streams and the response of such streams to imposed changes through the use of improved instrumentation. In particular, consider the interrelationships between bed-form characteristics and the transport of bedload and bed-material load.

APPROACH: Initially, analyze existing data to relate bed-form characteristics to the conditions of flow and sediment transport, and develop one or more bedload samplers to permit accurate measurements of bedload transport. The development of bedload samplers will be accomplished through a comprehensive testing and calibration program with prototype samplers in a specifically designed laboratory facility capable of continuously measuring the discharge of bedload particles from 2 to 64 millimeters in diameter under different flow conditions. Later, study the characteristics of bed-forms, sediment transport, and other pertinent variables as required to meet specific needs. Use acoustic instrumentation, including side-scan sonar, to measure bed-form configuration and movement. Use suitable bedload samplers, and suspended load samplers, to define transport rates. Finally, analyze information to define criteria for predicting bed-form morphology and to provide a better understanding of sediment-transport phenomena in both sand-bed and gravel-bed streams.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

PROGRESS: Data collected during laboratory calibration of bedload samplers were used to develop a procedure to reduce the number of bedload samples required to define the mean bedload discharge. Additional refinement on the procedure is required. Two sets of computer programs for compiling measurements data and computing fluvial sediment discharge by five existing bedload discharge formulas and nine existing bed-material formulas have been developed and are available; one set of programs is for use with a minicomputer and the other set is for use on microcomputers.

REPORTS PUBLISHED:

Hubbell, D. W., and Stevens, H. H., Jr., 1987, Cascade-sieve shaker for rapid particle-size analysis of coarse sediment, in Selected Papers in Hydrologic Sciences: U.S. Geological Survey Water-Supply Paper 2310, p. 73-85.

Hubbell, D. W., Stevens, H. H., Jr., Skinner, J. V., and Beverage, J. P., 1987, Closure for new approach to calibrating bedload samplers: American Society Civil Engineers, Hydraulics Division Journal, v. 113, no. 7, p. 941-942.

CR102 SEDIMENT IN RIVERS

TITLE: Movement and Storage of Sediment in River Systems

PROJECT NUMBER: CR 75-102

LOCATION: Nationwide

PROJECT CHIEF: Meade, Robert H.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: Sediment moves through a river system in response to specific events and changing conditions in the drainage basin. The movement of sediment is usually discontinuous. Episodes of movement are separated by periods of storage that can range from less than 1 year to more than a thousand. Understanding the movement and storage of sediment in rivers is important to navigation, flood control, and other aspects of river engineering, as well as to the prediction of the fate of contaminants absorbed on sediment particles.

OBJECTIVE: Assess (1) changes in river sediment loads over periods of decades or longer and the factors (natural or artificial) that cause the changes; (2) rates at which sediment is stored in river systems and the residence times of sediment particles in storage; and (3) sources, pathways, and sinks of sediment particles in river systems.

APPROACH: (1) Assess long-term changes in sediment loads from data previously collected by U.S. Geological Survey and other agencies; (2) assess sediment storage by repeated (annual) surveys of selected river channels and by comparing old and new maps and aerial photographs of rivers and their flood plains in the upper Missouri River basin; and (3) assess sources, pathways, and sinks by intensive field studies (including tracer studies) of selected small rivers.

PROGRESS: A new project on sediment and pollutants in Mississippi River was organized and two sampling cruises between St. Louis and New Orleans were completed. A resurvey of cross sections in Powder River, Mont., showed small to moderate amount of channel change since last year. Analysis of arsenic concentration and grain size of 200 samples collected in the floodplain of Belle Fourche River, S. Dak., showed aerial and stratigraphic distributions of contaminated sediments.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

REPORTS PUBLISHED:

Marron, D. C., Nolan, K. M., and Janda, R. J., in press, Effects of logging and geology on hillslope erosion and deposition by surficial processes in the Redwood Creek basin, northwestern California, in Nolan, K. M., Kelsey, H. M., and Marron, D. C., eds., Geomorphic processes and aquatic habitat in the Redwood Creek basin, northwestern California: U.S. Geological Survey Professional Paper 1454.

Meade, R. H., in press, Movement and storage of sediment in river systems, in Lerman, A., and Meybeck, M., eds., Physical and chemical weathering in geochemical cycles: Dordrecht, Netherlands, Reidel Publishing Company.

Meade, R. H., Yuzyk, T. R., and Day, T. J., in press, Movement and storage of sediment in rivers of the United States and Canada, in Wolman, M. C., and Riggs, H. C., eds., Surface water hydrology: Geological Society of America, The Geology of North America, v. O-1.

Nolan, K. M., and Marron, D. C., in press, Response of the Redwood Creek stream channel to storms and landuse, 1936-82, in Nolan, K. M., Kelsey, H. M., and Marron, D. C., eds., Geomorphic processes and aquatic habitat in the Redwood Creek basin, northwestern California: U.S. Geological Survey Professional Paper 1454.

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Nolan, K. M., and Marron, D. C., in press, Stream channel response to the January, 1982, storm in the Santa Cruz Mountains, in Wieczorek, G. F., and Ellen, S. D., eds., Landslides, flooding and marine effects of the storm of January 3-5, 1982, in the San Francisco Bay area: U.S. Geological Survey Professional Paper 1434.

Marron, D. C., and Landon, J. A., 1987, Susceptibility to mudflows in the vicinity of Lassen Peak, California, in Subitzky, S., ed., Selected papers in the hydrologic sciences 1986: U.S. Geological Survey Water-Supply Paper 2310, p. 97-106.

Marron, D. C., 1987, Floodplain storage of metal-contaminated sediments downstream of a gold mine at Lead, South Dakota, in Averett, R. C., and McKnight, D. M., eds., Chemical quality of water and the hydrologic cycle: Chelsea, Mich., Lewis Publishers, Inc., p. 193-209.

Marron, D. C., 1988, Effects of sediment transport and depositional processes on the distribution and longevity of a metal-contaminating problem in west-central South Dakota: The Earth Scientist, v. 5, no. 2, p. 3-8.

CR105 CHANNEL MORPHOLOGY

TITLE: Effects of Water and Sediment Discharges on Channel Morphology

PROJECT NUMBER: CR 65-105

LOCATION: Topical Research

PROJECT CHIEF: Williams, Garnett P.

HEADQUARTERS OFFICE: Lakewood CO

PROBLEM: Channels of alluvial streams change with time. Bed elevations and channel widths may change, meander bends may shift both laterally and downstreamward, the sizes of the bed particles may change, instream bars may grow and migrate, and the amount and type of vegetation along the river may increase or decrease. Sometimes the change is insignificant, even over decades, but in other cases catastrophic modifications occur in minutes. The transformations can be natural or human-induced, and they can have significant effects on humans and the environment.

OBJECTIVE: Determine and analyze the influence of the major variables, particularly water and sediment discharges, governing channel morphology.

APPROACH: Study the effect of large contributions of sediment to stream channels. Make field surveys and aerial-photograph analysis, preferably time-sequential, of stream reaches that have received exceptionally large sediment inputs. Document channel response, with a view towards eventually developing a general model of channel response.

PROGRESS: Bivariate relations between annual sediment yield (tons/year drainage area) and drainage-basin area are spurious because drainage-basin area is common to both variables. Two alternative methods for portraying the annual suspended-sediment load of a river were examined. One method consists of plotting suspended-sediment load (tons/year) against distance downstream. Such plots indicate that annual suspended-sediment load does not necessarily have a linear relationship with distance. The second method consists of plotting annual suspended-sediment load against drainage-basin area. Both methods more accurately portray fundamental relations between annual sediment load and drainage-basin characteristics than does the yield-area relation because spurious correlation is avoided. The suspended-sediment loads of many rivers have been found to be in phase downstreamward from year to year when considered for time scales of 10 to 15 years.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

REPORTS PUBLISHED:

Troutman, B. M., and Williams, G. P., 1987, Fitting straight lines in the earth sciences, in Size, W. B., ed., Use and abuse of statistical methods in the earth sciences: New York and Oxford, Oxford University Press (International Association for Mathematical Geology Studies in Mathematical Geology No. 1), p. 107-128.

Williams, G. P., and Troutman, B. M., 1987, Algebraic manipulation of equations of best-fit straight lines, in Size, W. B., ed., Use and abuse of statistical methods in the earth sciences: New York and Oxford, Oxford University Press (International Association for Mathematical Geology Studies in Mathematical Geology No. 1), p. 129-141.

Williams, G. P., 1988, Paleofluvial estimates from dimensions of former channels and meanders, in Baker, V. R., Kochel, R. C., and Patton, P. C., eds., Flood Geomorphology: New York, Wiley, p. 321-334.

Williams, G. P., and Costa, J. E., 1988, Geomorphic measurements after a flood, in Baker, V. R., Kochel, R. C., and Patton, P. C., eds., Flood Geomorphology: New York, Wiley, p. 65-77.

CR187 BEDLOAD TRANSPORT RESEARCH

TITLE: Hydraulics and Mechanics of Bedload-Transport Processes

PROJECT NUMBER: CR 74-187

LOCATION: Topical Research

PROJECT CHIEF: Emmett, William W.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: Of all processes operating in river channels, and especially of those of practical concern to engineers and others interested in river channel behavior, perhaps the least knowledge is available regarding the hydraulics and mechanics of bedload transport. Before continuing advances in river channel behavior can be made, additional understanding of the behavior of bedload sediment must be made.

OBJECTIVE: (1) Define spatial and temporal variations in bedload-transport rate for a single stage of flow; (2) define change in average magnitude of transport rate over a range in flow; (3) define change in average magnitude of transport rate over a range in channel geometry; and (4) analyze the data to evaluate the applicability of available bedload equations, suggest new coefficients for the existing equations, or propose new relations for predicting rates of bedload transport.

APPROACH: Use the conveyor-belt bedload-transport facility on the East Fork River near Pinedale, Wyo., as a control to evaluate variability factors in bedload transport and to field calibrate the Helley-Smith bedload sampler; use the calibrated Helley-Smith sampler in the systematic collection of bedload samples, making concurrent measurements of streamflow characteristics from a variety of sand- and gravel-bed streams; and, within the laws of general physics, develop empirical relations of bedload transport and interpret the physical significance of these relations. Initiate a tracer study utilizing fluorescent particles at the conveyor-belt bedload-trap research facility to evaluate (1) residence time of sediment, (2) average speed of particles, (3) depth of bed material involved in transport, (4) dispersion of bed material, (5) short-term channel changes accompanying sediment trarsport, (6) influence of availability of sediment on transport rate, and other related aspects of sediment transport.

PROGRESS: Measurements of bedload transport and associated hydraulic characteristics have been completed for the East Fork River, Wyo. Equipment and procedures have been described and data are being analyzed and interpreted. In addition, six field sites have been selected and bedload data are being collected at these sites by operational units of the Water Resources Division. In addition to these six sites and the East Fork River site, data from several other sites are providing information to the core data base.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

REPORTS PUBLISHED:

Emmett, W. W., and Averett, R. C., in press, Fremont Lake, Wyoming--Some aspects of the inflow of water and sediment: U.S. Geological Survey Water-Resources Investigations Report 88-4021.

CR266 ESTUARY SEDIMENTATION/EUTROPHICATION

TITLE: Transport and Deposition of Sediments and Sediment-Borne Contaminants in Tidal Rivers and Estuaries

PROJECT NUMBER: CR 81-266

LOCATION: Topical Research

PROJECT CHIEF: Glenn, Jerry L.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: Sediments that contain large concentrations of nutrients and trace metals are accumulating rapidly in part of the tidal Potomac River, the Potomac Estuary, and the adjacent marginal embayments. Accumulations of sediments and sediment-borne contaminants may limit significantly the use of tidal waters and estuaries for commercial, recreational, and aquacultural purposes. The sediments decrease channel depths and widths to the detriment of commercial and recreational interests, and cover and destroy productive shellfish grounds. The nutrients are a factor in the development and maintenance of undesirable eutrophic conditions, including nuisance algae blooms and low levels of dissolved oxygen. Sedimentation and eutrophication problems in the Potomac are a consequence of essentially uncontrollable natural and anthropogenic influences. The problems began to develop naturally several thousand years ago when the current rise in sea level drowned the Potomac River and began the evolution of the modern tidal river-estuary system.

OBJECTIVE: (1) Identify modern sources of sediments and nutrients; (2) establish changes with time in sources or supply rates due to natural and anthropogenic influences; (3) determine sediment and nutrient transport and deposition patterns; (4) compute rates of accumulation and amounts of sediments and nutrients in selected hydrologic and geomorphic divisions of the Potomac system; and (5) compare supply and accumulation rates for prehistorical and historical periods with contemporary rates from concurrent transport studies.

APPROACH: Determine areal and stratigraphic distributions of sediments, nutrients, and trace metals by a combination of direct sampling (surface and core) and remote sensing (side-scan sonar and subbottom profiling). Analyze sediment samples for indicators of sources (particle size, mineralogy, nutrient and trace-metal concentrations) and accumulation rates (lead-210, carbon-14 pollen concentrations and distributions). Estimate sediment contributions from the shoreline source using a combination of field mapping, monitoring, and sampling at selected sites, and using laboratory measurements from available air photographs and maps. Integrate data with results from measurements and models of modern sediment and nutrient transport to provide past and present sediment and nutrient budgets for selected Potomac reaches.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

PROGRESS: Although phosphorus concentrations in bottom sediments collected in the transition area of the tidal Potomac system, and exposed to the water column from the estuary showed extreme variability after a short period of exposure, the variability was traced to laboratory procedures rather than to phosphorus uptake or release. In fact, preliminary analyses of new data indicate that phosphorus is released only slowly when sediments are transported from an oxic transition environment to an anoxic estuary environment. Channel margin sediments along the Mississippi River are mainly sands with a variety of surface bedforms ranging from dunes to ripples; fine sediments are found in sheltered areas or in thin deposits that accumulate on banks and bars during falling stages. Overbank deposits between the channel and the mainline levees range from fine sands on natural levees to silts and clays in abandoned channels and backswamps.

REPORTS PUBLISHED:

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CR273 HYDROLOGICAL-BIOLOGICAL INTERACTIONS

TITLE: The Interface of Hydrological and Biological Processes in Rivers

PROJECT NUMBER: CR 82-273

LOCATION: Topical Research

PROJECT CHIEF: Andrews, Edmund D.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: The geometry and pattern of river channels adjust to significant changes in the water discharge, size, and quantity of sediment supplied to the channel. When the quantity of water and sediment over a period of years remains relatively constant, the channel geometry and pattern vary about a mean or quasi-equilibrium condition. Major watershed alterations that change the supply of water, sediment, and size of sediment reaching the channel necessitate an adjustment of the channel geometry and pattern. That is, the channel is transformed from one quasi-equilibrium state to another. Between the two quasi-equilibrium states, there is a period of instability. Existing techniques for examining and predicting river channel adjustment have been developed primarily from investigation of quasi-equilibrium rivers. As a result, it is frequently possible to predict with a modest range of uncertainty the future quasi-equilibrium hydraulic characteristics of a river following a change in its watershed. The dynamics and rate of river channel adjustment during the period of instability, however, have rarely been studied and are rather poorly understood. The length of time required for the complete adjustment is commonly a few decades to a century or more. In many instances, river-channel adjustments in response to land-use activities such as surface mines, reservoirs, and urbanization, can be longer than the duration of the watershed change. In watersheds where various land use changes occur every several years, the river channel may be continually adjusting to a different supply of water and sediment, and thus, never reach a quasi-equilibrium condition. In these rivers, the period of instability is the only significant condition. Consequently, an understanding of the dynamics and rate of river channel adjustment from one quasi-equilibrium state to another is very important to managing fluvial resources. A wide range of social and economic costs may result from substantial river channel changes. One of the most frequent and important adverse impacts is damage to the aquatic ecosystem. Aquatic organisms depend on a particular combination of hydraulic characteristics (that is, their physical habitat) to meet life requirements. When a river channel adjusts to a change in its watershed, the physical habitat of the aquatic organisms in the river may be reduced or even eliminated, either during the period of instability or in the future quasi-equilibrium condition. To evaluate the biological effects of watershed alternation, hydrologists frequently need to predict the hydraulic geometry and channel pattern at various times in the future so that changes in the physical habitat can be assessed. In many ways, such an analysis of physical habitat concerns the same questions

one would address in an evaluation of the effects of channel change on engineering works, or navigation. On the other hand, certain aspects of river channel changes are of greater importance to the aquatic ecosystem than the integrity of engineering works. The primary focus of this research project is to understand the dynamics and rate of river channel change as they affect the physical habitat. The results, however, will no doubt contribute to understanding the broader question of river channel adjustment. The greatest deficiencies in our present knowledge of river channel adjustment as it relates to the aquatic ecosystem are (1) the longitudinal sorting of bed material, especially gravel, (2) the formation of gravel bars, (3) adjustment of channel width, and (4) the rates at which the several hydraulic variables adjust.

OBJECTIVE: Describe the physical processes and rate at which a river channel adjusts due to a change in the water discharge, sediment size and sediment load supplied to the channel. Concentrate, in particular, on the adjustment of those aspects of river channels known to significantly influence the aquatic ecosystem, that is, the bed material size distribution, occurrence of bars, and channel width. Describe the hydraulic processes that control these characteristics of river channels as well as the rate at which they function. Then, based upon an appreciation of these processes, formulate mathematical models of the processes as required for longitudinal routing of water and sediment. Ultimately, develop new analytical tools for describing river channel adjustment.

APPROACH: The ideal approach for this investigation would be to observe the transition of a river channel from one quasi-equilibrium state through a period of instability to another quasi-equilibrium state as a result of a known change in the supply of water and sediment. However, this is impractical because adjustment of a river chanel may extend from a few decades to a century. Instead, two basic types of field studies will be combined. First, the movement of bed material through a reach of channel will be studied in detail. These investigations will consider the transport of bed material, distance transported, and location (bed, banks, or bar) of deposition for each size fraction. By use of measured bedload and suspended-transport rates, detailed measurements of flow structure, and mapping of channel features, the movement of bed material through the study reaches will be described. To the extent possible, these observations will be generalized to formulate a physically correct model of sediment movement by size fraction. The second part of this investigation will involve reconstructing the sequence and rate of adjustment for historical examples of river channel change. Because of the lack of detailed hydraulic measurments, this portion of the investigation may, at times, be somewhat descriptive and qualitative. These observations, however, will be vitally important as they will provide the temporal context in which to view the hydraulic characteristic at a particular point in time.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

PROGRESS: An understanding of the interactions between flow over a spatially nonuniform sediment bed and the deformation of that bed is of fundamental importance to the study of rivers and estuaries. To study the salient physical processes which form the topography of erodible beds, the problem has been divided into two categories: bedforms, for which the bed instability and equilibrium morphology is primarily related to changes in vertical structure of the flow field, and bars; for which horizontal variations in the structure of the flow field are of primary importance. In each of these two cases, physically-based, predictive models for velocity and boundary shear stress fields have been developed. In the case of channel bars, the model accurately predicts flow structure through reaches with nonuniform curvature and complex bed topography. The bedform flow model treats changes in vertical flow structure associated with flow separation from a regular sequence of obstructions having gentle stoss and steep lee faces. These models have been verified using carefully collected data. The bar problem was addressed by using measurements made by other investigators; the bedform problem required the design and execution of a laboratory experiment. This bedform experiment yielded one of the most comprehensive and detailed set of velocity data over two-dimensional dune currently available. Subsequently, these models have been used to examine processes responsible for the evolution of the most common large-scale topographic features in rivers. The horizontal flow adjustment model has been used to understand the formation and stability of point bars in initially flat, curved channels, as well as the growth and equilibrium morphology of alternate bars in initially flat, straight channels. The vertical flow adjustment model has been employed to predict various aspects of the flow-bed coupling responsible for the initiation of bedforms, as well as the finite amplitude effects responsible for the height and wavelength of fully developed dunes.

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CR309 MISSISSIPPI RIVER SEDIMENT POLLUTANTS

TITLE: Sediment-Transported Pollutants in the Mississippi River

PROJECT NUMBER: CR 87-309

LOCATION: Topical Research

PROJECT CHIEF: Meade, Robert H.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: The source and fate of many pollutant substances in the Nation's largest river system are closely tied to suspended sediment. Accurate prediction of the fate of these pollutants will require more than our present understanding of the interactions between sediments and pollutants and the ways in which large rivers store and remobilize suspended sedimert.

OBJECTIVE: To define and understand (1) processes by which pollutart substances, organic and inorganic, are adsorbed onto sediment particles, (2) downstream mixing of pollutants downstream from the confluence of large tributaries with the mainstem, and (3) seasonal storage and remobilization of sediment and pollutants in the Mississippi River system.

APPROACH: Three to four boat trips per year, beginning above St. Louis and ending at New Orleans, will be made to sample 15-20 cross sections of the Mississippi River and its principal tributaries. Cross sections will be sampled with a large-volume suspended-sediment sampler by the equal-width-increment method. Suspended sediment will be concentrated and analyzed for a large number of organic and inorganic constitutents, both natural and manmade.

PROGRESS: Two sampling trips on the Mississippi between St. Louis and New Orleans were made in July-August and November-December 1987. Comprehensive new procedures were developed and tested for separating suspended sediment from large volumes of river water and for further subdividing the suspended sediment into three to four size fractions for individual chemical analyses. Initial results suggest that 0.5 percent of the United States annual production of atrazine is transported down the Mississippi River.

CR311 SEDIMENT IMPACTS FROM DISTURBED LANDS

TITLE: Geomorphic and botantical impacts of sediment due to natural and unnatural land disturbance

PROJECT NUMBER: CR 79-311

LOCATION: Topical Research

PROJECT CHIEF: Osterkamp, Waite R.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: Increased sediment yields from naturally stressed areas, such as mass-movement sites and devegetated lands, and man-stressed areas, such as mine spoils, urban areas, and agricultural lands, is one of the largest problems being addressed by agencies such as the U.S. Office of Surface Mining and U.S. Soil Conservation Service. The acquisition and interpretation of sediment data are among the most deficient areas that must be considered by these agencies. The impacts on geomorphology and botany that are caused by natural and induced sediment movement are sometimes intense; knowledge of these impacts is beneficial for understanding the effects of naturally occurring sediment movement.

OBJECTIVE: (1) Predict movement of sediment from naturally and unnaturally disturbed areas; (2) assess existing techniques and develop new ones based on geomorphic, botanical, and statistical principles as aids in improving interpretive capabilities; and (3) evaluate geomorphic, botanic, and hydrologic changes changes caused by sediment movement from disturbed areas.

APPROACH: (1) Develop techniques for determining the amounts and rates of sediment movement from disturbed areas based on factors such as land use, runoff, basin and landform morphology, and botanical indicators; (2) conduct research on the effects on landforms and vegetation of sediment movement using vegetation age, damage, and patterns of occurrence as indicators of the magnitude, frequency, and time of occurrence of destructive hydrologic events; (3) investigate the influence that ground-water movement exerts on sediment transport and changes in landforms by analyzing near-surface and subsurface rates of water and sediment movement (including piping, sapping, and seepage erosion) in dynamic hydrologic systems; and (4) conduct research on the interactions between hydrology, water chemistry, and geochemistry as determinants of sediment movement through a hydrologic system, in conjunction and close coordination with other research and District personnel.

PROGRESS: Studies of the magnitude and occurrence of debris flows on Cascade Range volcanoes are continuing. Field activities on Mount Shasta are largely completed; they have identified the frequency of occurrence of debris-flow deposits and have documented a variety of techniques useful for determining

the ages of the deposits. Final studies being made of Mount Shasta flows are considering the role that climatic factors have on the frequency of debris flows. Attention is now being shifted to Mount St. Helens and Mount Hood where similar studies will consider the role of ground-water movement to the initiation of debris flows. Channel-morphology studies are continuing in the Kansas River basin of Kansas and Nebraska, and in the Plum Creek basin of central Colorado. The Plum Creek work has demonstrated that channel narrowing results from processes of channel-island growth, in which expanding island sizes result in islands joining with each other and ultimately with the flood plain. These processes may be typical of the manner by which flood-widened sand channels of semiarid regions narrow through time. Continuing hydrologic studies of playa-lake basins on the Southern High Plains have suggested that the ephemeral lakes are active geomorphic features. A natural tracer, beryllium-ten, is present in high concentrations at depth at some sites, indicating that playa lakes may have been part of the Southern High Plains landscape since middle-Miocene time.

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CR313 SED.-WATER CHEM. IN LARGE RIVERS

TITLE: Sediment-Water Chemistry in Large River Systems: Biogeochemical, Geomorphic, and Human Controls

PROJECT NUMBER: CR 88-313

LOCATION: Topical Research

PROJECT CHIEF: Stallard, Robert F.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: Rivers are a major pathway to the ocean for erosion products and human wastes. The mechanisms that control the composition of river-borne materials are only imperfectly understood, because both erosion and the subsequent transport of material by rivers are mediated by a wide variety of highly-linked chemical, biological, and physical processes. Moreover, in developed river systems, such as those in the United States, these processes are subject to pervasive human-related perturbations. The problem is to develop a comprehensive and integrated description, through field and theoretical studies, of these processes for large river systems, in a form that is useful to researchers in many disciplines.

OBJECTIVE: Describe how the biogeochemical and physical aspects of the erosion and transport processes are reflected in the composition of river-borne materials for particular large river systems and develop general theoretical models that can be applied to rivers in general; evaluate the extent to which human activity has affected the river systems. Study how various phases, natural or human-introduced, organic or inorganic, are partitioned between solid and dissolved loads in rivers and estuaries as the result of weathering, particle surface reactions, biological uptake or release, atmospheric exchange, and storage during transit. Evaluate the dispersal pathways of river-borne substances through river systems and estuaries, into and across the coastal marine environment.

APPROACH: Assemble, primarily from maps and data bases, current and historic chemical, geomorphic, biological, and demographic data for an entire river system. Identify phenomena that are especially important in controlling the composition of phases containing the major elements (H, C, O, Na, Mg, Al, Si, S, Cl, K, Ca, Ti, Fe) and certain minor indicator elements (N, F, P, Mn, Sr, Zr) to provide the conceptual framework for solving specific research objectives. As part of these investigations, undertake field surveys, design sampling and analytical procedures, and create computer tools to manipulate and model data. Formulate smaller-scale field and laboratory studies to aid data interpretation where deemed necessary.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY AND SEDIMENT TRANSPORT

PROGRESS: Project began in FY 1988 and research is evolving from work begun at Princeton University. Sediment-water chemical interactions in the Mississippi and Orinoco river systems are being studied with emphasis on describing how the compositions of dissolved and solid loads in the mainstem and tributaries relate to the geology and geomorphology of their respective catchments. Three field trips were made on the Mississippi where the sampling program is just beginning, and one on the Orinoco, where sampling is ending. A laboratory is being established for sediment geochemistry; it will have facilities to prepare, under clean conditions, a wide variety of sediment samples for analysis by chemical dissection, x-ray diffraction, x-ray fluorescence, and particle imaging. In addition, a computer package for the interpretation of major and minor element data in rivers and ground waters is being designed; it will aid in the study of the role of weathering regime in sediment-water interaction in river catchments. Two related studies concerning weathering, erosion, and transport processes continue. One study investigates the biogeochemistry of tropical soils and examines how soil gas generation (with an emphasis on methane) is related to soil geochemistry and hydrologic regime; one field trip to Panama was undertaken during FY 1988. The other study involves collaborative work to develop an estuarine circulation model which will be used to examine the transport of sediment, nutrients, and trace metals in the Delaware and Amazon estuaries. Work also continues with five Princeton Ph.D. candidates, two in the Orinoco work, one in trace metal analysis of sediment and water, one in the soil gas study, and one in estuarine modeling.

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