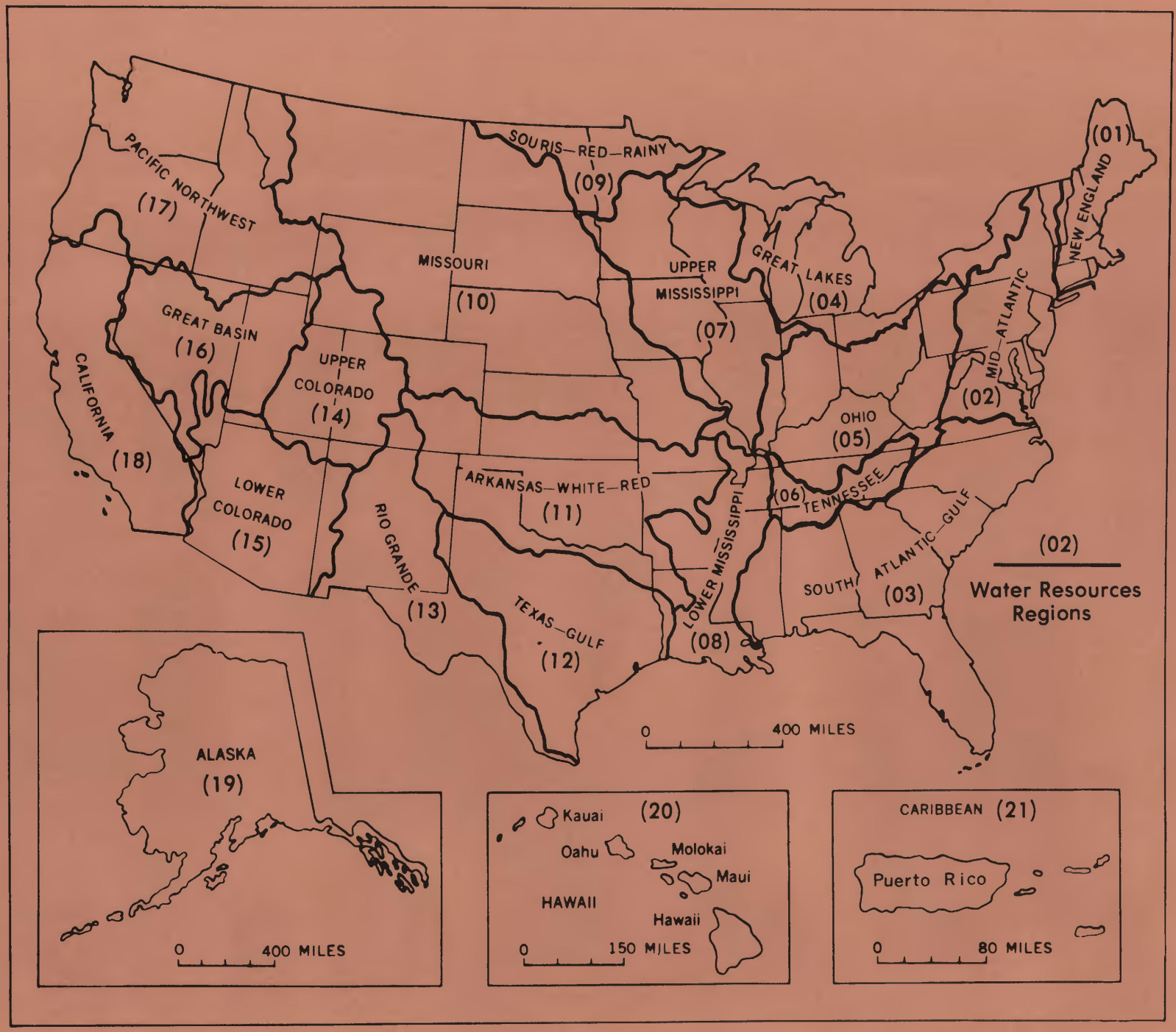
INTERAGENCY ADVISORY COMMITTEE ON WATER DATA

NOTES ON SEDIMENTATION ACTIVITIES CALENDAR YEAR 1989

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



Water Resources Regions of the United States

NOTES ON SEDIMENTATION ACTIVITIES CALENDAR YEAR 1989

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

DEPARTMENT OF THE INTERIOR
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Water Resources Division
Office of Water Data Coordination
417 National Center
Reston, Virginia 22092

September 1990

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.

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ORGANIZATION: Wyoming Water Research Center
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Interagency Advisory Committee on Water Data
Annual Subcommittee Report
Fiscal Year 1989

Subcommittee Name: Sedimentation

Chairman FY 1989: G. Douglas Glysson
Agency: U.S. Geological Survey
Telephone: 703/648-5019

Chairman FY 1990: Don Clarke
Agency: USDA- Soil Conservation Service
Telephone: 202/382-0136

Accomplishments During the Year

The Subcommittee met six times during the year, once in joint session with the Technical Committee on Sedimentation in Denver, CO and five times in Washington, D.C. The Technical Committee met twice, in Denver, CO and Minneapolis, MN.

The Subcommittee sponsored a symposium on river sedimentation models. The symposium was held in Denver, CO and was attended by over 100 scientist and engineers. The Subcommittee also had presentation on river models given to it at its regular meeting by Dr. Ted Yang, Bureau of Reclamation and by Dr. Vincent Lai, USGS. The work group on Sedimentation Models, Chaired by Dr. Shou-shan Fan, Federal Energy Regulatory Commission, produced a summary of all the models presented to the Subcommittee over the past two years. The report was published this year.

Planning continued this year on the Fifth Federal Interagency Sedimentation Conference. The Dates of the Conference were changed at the request of the Riviera Hotel. The new dates are March 18-21, 1991. The call for papers was issued in May and it is anticipated that about 200 papers will be presented at the conference. Robert Joyce, TVA, is serving as Chairman of the Conference. A agreement was reached with CB Display Service INC. of Las Vegas to serve as exhibitor contractor for the Conference's commercial exhibit.

Planning was done on preparing a symposium on bridge scour to be held in October, 1989. Dr. Charles Woo, Department of Transportation, is chairing the work group that will organize the meeting. About 200 participants and 25 papers are expected for the two and one half day symposium. Papers presented at the meeting will be published in FY 1990.

The National Park Service and the U.S. Fish and Wildlife Service were asked to join the subcommittee. Both accepted and have named representatives. The National Science Foundation has expressed interest in the subcommittee and has sent a representative to several of the meetings and is expected to formally join the Subcommittee next year.

The Technical Committee on Sediment oversees the Federal Interagency Sedimentation Project (FISP) at the St. Anthony Falls Hydraulics Laboratory in Minneapolis, NM. Joe Beverage (FISP) spent several weeks in China discussing instrumentation needs and development. Work on the development and field testing of the U shape vibrating tube for measuring sediment concentration continued. Three U tubes were in place in the field and being tested by the USGS. Additional sites are being considered. At the invitation of Jack King, Forest Service (FS) and Chairman of the Technical Committee, representatives of Environment Canada attended both meetings and reported on the ongoing sediment activities in Canada. Dr. Robert Thomas, FS, is doing an additional data reduction and evaluation study of the bedload data collected during the calibration tests performed on the Helley-Smith bedload sampler. Results of this evaluation will be available next year. John Skinner, FISP Project Chief, chairs a work group that is updating Chapter 3, Sediment, of the National Handbook of Recommended Methods for Water Data Acquisition. The DH-89 Sampler was developed this year. The DH-89 is an autoclavable cable-suspended sampler that uses the D-77 cap and a quart bottle and can be used to collect depth integrated biological and microbiological samples from a bridge or cableway. The valve system in the head of the P-61 point integrating suspended sediment samplers has been modified to use a pinch valve, instead of a rotating cylinder to closed and open the sampler nozzle. This new valve will allow the P-61 to be used to collect samples for trace metal analysis. The project is working on development of a dredge type, bed material sampler that will exclude bedload from the sample. The Bureau of Reclamation and USGS have done field testing of this new sampler.

Reports Published:

The following reports and papers were published during FY 89:

"Comparison: US-P61 and Delft Bottle sediment sampler", ASCE Journal of Hydraulic Engineering
"Model B sediment concentration gage--factors influencing its readings and a formula for correcting its errors", Report JJ
"Notes on Sediment Activities, Calendar Year 1988"
"Twelve Selected Computer Stream Sedimentation Models Developed in the United States"

At the ASCE Hydraulics Divisions Meeting in August 89, the Subcommittee Sponsored two sessions on "Sedimentation Studies in Selected Federal Agencies". G. Douglas Glysson, Subcommittee Chairman, moderated the sessions and the following papers were presented:

"One Hundred Years of Sedimentation Studies by the US Geological Survey", by G. Douglas Glysson, USGS
"History of the Federal Interagency Sedimentation Project", by John Skinner, USGS
"Erosion and Sedimentation Research in the ARS", by N. L. Colman, K. G. Renard, and A. R. Robinson
"Corps of Engineers' Mississippi River Sediment Studies", by Elba A. Dardeau, Jr.,COE
"The Tennessee Valley Authority: A Half-Century Sedimentation Experience", by Robert T. Joyce, TVA
"Applications and Research in Sediment Delivery and Routing Models in the USDA-Forest Service", by M. Dean Knington and Rhey M. Solomon
"Lesions from Ten Years Experience in 2D Modeling", by W. H. McAnally, Jr., COE
"Methods to Predict Cropland Ephemeral Gully Erosion", by W. H. Merkel, D. E. Woodward, and C. D. Clarke, SCS
"An Overview of Computer Stream Sedimentation Models", by Shou-shan Fan, FERC

Action Plan for Coming Year

The Subcommittee plans on meeting six times in the coming year, including a joint meeting in April in Las Vegas with the Technical

committee to plan for the Sedimentation Conference. The Technical Committee plans to meet twice during FY 90.

The subcommittee will sponsor a Bridge Scour Symposium on October 17-19, 1989 and publish the proceeding of the meeting.

Planning for the 1991 Sedimentation Conference will continue and the papers will be selected in December, 1989.

The Notes on Sedimentation Activities for Calendar year 1989 and the five year summary of Reservoir Survey 1980-85 will be published.

Revision of Chapter Three of the National Handbook will be completed and submitted to the Federal Advisory Committee on Water Data for acceptance and publication.

Recommendation:

None

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.

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 Salmon River near East Hampton, 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 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
10 Causeway, Room 926
Boston, MA 02222-1040

NEW ENGLAND REGION

SOIL CONSERVATION SERVICE

1. A reservoir sedimentation survey was made in the following reservoir:

RESERVOIR	COUNTY	STATE
Mt. Zircon	Oxford	ME
Washington Lake	Providence	RI

MID ATLANTIC REGION

CORPS OF ENGINEERS

North Atlantic Division

Baltimore District

Sediment Survey - A land use inventory of the East Sidney watershed using an approach developed by the Tennessee Valley Authority, was conducted under contract by the Tennessee Valley Authority. This study employs low-level aerial photography to allow development of layered maps depicting erosion potential, major off-channel drainage, and their confluence with streams and land uses. With this land use data, the study is able to predict the erosion potential in the watershed. The district may apply this method to other projects in the future.

New York District

The District conducted sediment tests at the following locations.

Project name	Grain Size	Bulk Sediment	Elutriate	Bioassay	Bioaccumulation	E.P. Toxicity
Fort Chester Harbor, NY	X	X	X	X	X	X
Mattituck Harbor, NY	X	X	X	X	X	X
Hudson River, NY -Albany to Castleton	X	X	X	-	-	X
New York Harbor, NY - Gravesend Bay Anchorage	X	X	X	X	X	-
NY & NJ Channels -Mile 0 to 10, Raritan Bay Reach	X	X	X	X	X	-
Newark Bay, Hackensack and Passaic Rivers, NJ -Hackensack River -Mile 0 to 4	X	X	X	X	X	X
Raritan River, NJ -South Channel	X	X	X	X	X	X
Matawan Creek, NJ	X	X	X	X	X	X
Keyport Harbor, NJ	X	X	X	X	X	X
Shoal Harbor & Compton Creek, NJ	X	X	X	X	X	X
Shrewsbury River, NJ	X	X	X	X	X	X

MID-ATLANTIC REGION

GEOLOGICAL SURVEY

Richelieu Subregion

1. Suspended-sediment data are being collected on a quarterly 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, and Hudson river near Fort Miller, 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 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.

3. Bottom material data (carbon, metals, organochlorine pesticides) are being collected at about 16 subregion sites in New Jersey on a yearly schedule.

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.

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 1989 from the Little Conestoga Creek near Morgantown and near Churchtown, and from a 25-acre corn and alfalfa field that

was selected for conservation treatment with best management practices. Automatic samplers are used at each of the sites.

2. Suspended-sediment data are being collected using manual equipment from the Conestoga River at Conestoga, PA, and Cordorus Creek at Pleasureville, PA, as part of a study of nutrient discharges. Base-flow samples are collected monthly. Samples are also collected three times per storm for approximately 50% of all storm events.

3. Samples of reservoir bottom materials and the "slurries" at the water-sediment interface will be collected as part of a project to evaluate nutrient and other chemical loads associated with resuspendable sediment in reservoirs on the lower Susquehanna River.

4. Suspended-sediment data are being collected with automatic samplers from Brush Run and Bald Eagle Creek, two 200-acre agricultural basins in the noncarbonate region of southeastern Pennsylvania. Base-flow samples are collected monthly using manual samplers and storm-event samples are collected using automatic samplers. The study is designed to evaluate the effects of best management practices on sediment and nutrient discharge.

5. Suspended-solids data are being collected daily at Rappahanock River near Fredricksburg, VA, Mattaponi River near Beulahville, VA, Pamunkey River near Hanover, VA, James River at Cartersville, VA, and Appomattox River at Matoaca, VA, in cooperation with the Virginia Water Control Board.

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. A study 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
Lake Champlain	Lower Lake Champlain	Misc.	Addison	VT
Juniata River	Yellow Creek	Yellow Creek	Bedford and Blair	PA

b. River Basin Studies

Major Drainage	Watershed	Stream	County	State
Potomac River	Rock and Marsh Creeks		Adams	PA
Potomac River	Conococheaque & Antietam Creeks		Franklin and Adams	PA

2. Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Noxontown	New Castle	DE
Marsh Creek, PA-600	Tiago	PA
South Fork Site 5	Hardy	WV
South Fork Site 15	Pendelton	WV

3. Special Studies

Comprehensive monitoring and evaluation projects are continuing in the LaPlatte River Watershed, Chittenden County, Vermont and in the St. Albans Bay Watershed, Franklin County, Vermont. These are long term projects to evaluate the effects of installing Best Management conservation practices on sediment yields and nutrient yields.

A roadbank and streambank erosion inventory was conducted in the Beaver Brook watershed, Herkimer County, New York.

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 these cross sections was taken during 1988.

Mobile District

Sedimentation Surveys. The sedimentation range networks in Lake Lanier on the Chattahoochee River and Lake Seminole on the Chattahoochee and Flint Rivers were resurveyed during the year. 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.

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 at 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
	Town Creek at Nettleton, MS
	Twentymile Creek at Guntown, MS
	Twentymile Creek at Mantachie, MS

Bed material samples were collected at numerous study sites and gaging stations within the Mobile District. Grain size analyses were utilized in bed load computations, stability analysis, and environmental studies 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. The collection of suspended and bed load samples to define the sedimentological processes in the bendways continued periodically throughout the year.

2. Apalachicola, Chattahoochee, and Flint Rivers. River flows and suspended sediment load continued to be monitored at seven locations in compliance with the "Apalachicola, Chattahoochee and Flint Rivers Navigation Maintenance Plan." Special emphasis was placed on data collection during flooding.

Savannah District

Dredging Survey. District performed examination and before and after dredging surveys in Savannah and Brunswick Harbors and in the Atlantic Intracoastal Waterway (AIWW) between Hilton Head, S.C. and Fernandina Beach, Florida. Annual surveys for Savannah and Brunswick Harbors were also published in 1989. 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 1989:

Project	No. of Surveys	
Savannah Harbor	7	
Brunswick Harbor	6	
Atlantic Intracoastal Waterway	3	
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 in the 2 years

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 northeastern 6,000 feet of Carolina Beach. Estimates of sediment accumulation in the trap since the last nourishment operation have not been made at this time.

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. The State of N.C. is presently constructing a terminal groin at the north end of Pea Island to stop the southward migration of the inlet. Also, approximately 114,000 cubic yards of dredged material from the navigation channel was placed on the north end of Pea Island in 1989.

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 1990.

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 Edisto River near Givhans, 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 five 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 site 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 two 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 Bogue 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 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.

4. 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.

5. 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 the North Carolina Department of Environment, Health, and Natural Resources (EHNR), with additional assistance from the Beaufort and Hyde County Soil and Water Conservation Districts.

6. A bathymetric study to determine the extent of sediment deposition in Lake Michie, a water supply for the city of Durham, originally scheduled for the summer of 1989, was postponed until February 1990. 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

SOUTH ATLANTIC - GULF REGION

SOIL CONSERVATION SERVICE

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

a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Apalachicola	Little Kolomoki-Factory Creeks (continuation)	Tribs to the Chattahoochee River	Early	GA
	North Lanier (continuation)	Chestatee & Chattahoochee Rivers	White Hall Lumpkin	GA
	Chickasawhatchee Creek (continuation)	Flint River	Terrell	GA
Ogeechee	Upper Lotts Cr. (continuation)	Lotts Creek	Bullock	GA
	Ogeechee area (continuation)	Ogeechee R. Tributaries	Screven	GA
Withlacoochee	Piscola Creek (continuation)	Piscola Creek	Thomas Brooks	GA
Oconee	Upper Oconee Basin	North Oconee Middle Oconee River Apalachee R.	Barrow Clarke Greene Gwinnett Hall Jackson Morgan Oconee Walton	GA
Mobile-Tombigee	Town Creek	Town Creek	Lee Union Pontotoc Prentiss	MS
Sanatee-Cooper	Llyes Creek	Lyles Creek	Catawba	NC
Santee-Cooper	Sandy Run	Sandy Run	Cleveland Rutherford	NC
Ashley-Combahee-Edisto River Basin	Coosawhatchie Jackson	Coosawhatchie-& Jackson	Allendale	SC

Major Drainage	Watershed	Stream	County	State
Ashley-Combahee-Edisto River Basin	Ridge	Shaw Creek & South Fork of Edisto River	Aiken Edgefield Saluda	SC
Ashley-Combahee-Edisto River Basin	South Edisto	South Fork of Edisto River	Aiken Bamberg Barnwell	SC
Santee River Basin	Stoney Fork--South Fork	Stoney Fork & South Fork - Tribs. to Fishing Creek	Chester York	SC
Savannah River Basin	Tokeena	Beaverdam Cr. & Concecross Cr. Tribs. to Seneca & Tuglaoo River	Anderson Oconee	SC
Pee Dee River	Woodrow	Trib. to Cowpen Swamp & Black River	Lee	SC

b. Special Resource Studies

(1). Major Drainage	Watershed	Stream	County	State
Mobile-Tombigbee	Twenty-Mile-Donivan Creek Browns Creek Mantachie Bogue Fala, & Bogue Eucaba Creeks	East Fork	Monore Prentiss Itawamba Lee	MS

(2). Project	Watershed	County	State
Meridian Naval Air Station	Sowashee Undefined	Lauderdale Kemper, Neshoba	MS

GREAT LAKES REGION

CORPS OF ENGINEERS

North Central Division

Buffalo District

Ashtabula River Sedimentation Study. A sedimentation analysis was performed of the upper 5,000 feet of the Ashtabula River. The purpose of the study was to determine maintenance quantities and dredging intervals. A similar sedimentation study was performed of the lower river in 1988, however, different project alternatives were analyzed for this study. A revised version of HEC-6 was used for this analysis. The modified version has the capability to erode silt and clay based on a critical erosion shear stress and an erosion rate coefficient. The model was calibrated by using the thalwegs of selected representative cross-sections from the 1969 soundings as the starting channel profile and cross-sections and running the simulation for 19 years. The calibrated sediment data were combined with each of the 5 project geometries for the dredging alternatives as well as the historical flow duration data. Dredging intervals were based on how long that it would take any reach of the dredged channel to accumulate sediment to the critical project depth. Each alternative was run for the 50-year project life, and simulated dredging was performed at the appropriate time interval to determine the total maintenance quantity.

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 East Harbor, Cattaraugus Creek Harbor, Olcott Harbor, Buffalo Harbor, Cleveland Harbor.

Project	No. of Stations	Type of Test
Buffalo Harbor, New York	22	Particle Size Analysis, Bulk Chemistry (Inorganic & Organic), Sediment Bioassay,
Cleveland Harbor, Ohio		Sediment Bioassay, Particle Size Analysis, Hydrometer Test, Bulk Chemistry (Organic & Inorganic), Elutriate Testing
East Harbor, Ohio	6	Bulk Chemical Analysis (Organic and Inorganic), Elutriate, Particle Size Analysis
Olcott Harbor, New York	7	Particle Size Analysis, Sediment Bioassay, Bulk Chemical Analysis (Organic & Inorganic), Elutriate Testing

Cattaraugus Creek, New York	4	Particle Size Analysis, Bulk Chemical Analysis (Organic and 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
Times Beach, Buffalo, New York Food Chain Studies	Fish and Bird Chemical Analysis for PCB, PAH, Metals Contamination
Presque Isle, Pennsylvania	Beach Sand Testing included Bulk Chemical Analysis, Particle Size, and Fecal Coliform
Ashtabula Open-Lake Disposal Site, Ohio	Benthic Organism Surveys, Bulk Chemical Analyses, Particle Size, Bottom Topography Survey

3. Discussion of the Project.

a. Ashtabula Harbor. Studies being made to determine if polluted sediments covered with clean sediments are moved and if PCB's released.

b. Times Beach, Buffalo, New York. The U.S. Fish and Wildlife Service conducted detailed fish inventories and sampling at the Times Beach CDF in 1988. A number of fish, vegetation (algae, pondweed), birds, ducks, and crawfish were analyzed for metals, PCB's, and PAH's.

c. 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.

d. Buffalo Harbor, New York. Bulk chemical and acute bioassay tests showed that quality of sediments have improved since last sampled in 1981, but they are still highly polluted and require confined disposal.

e. Cleveland Harbor, Ohio. Column settling tests were conducted to obtain data for design of settling basin and overflow weir in confined disposal facility.

f. East Harbor, Ohio. Sediments sampled and tested at proposed new Federal navigation channel.

g. Olcott Harbor, New York. Sediments sampled and tested at proposed new Federal navigation channel.

h. Cattaraugus Harbor, New York. Sediment sampled and tested at Federal navigation channel.

Chicago District

Indiana Harbor, Indiana - The District funded a study by Indiana University Northwest Environmental Research Laboratory in relation to maintenance dredging of Indiana Harbor. Nine sediment core samples were taken from locations in the Calumet River Branch, Lake George Branch, mainstream canal, and anchorage and maneuver basin. Three large sediment composite grab samples were taken from locations in the Calumet River Branch, mainstream canal, and anchorage and maneuver basin. 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 spring 1990. The report will be available in District files.

The District prepared a draft Environmental Impact Statement (EIS) for dredging sediment from Indiana Harbor and Canal. This draft EIS is anticipated to be available for public review in 1990.

Waukegan Harbor, Illinois - The district has been working with USEPA on a proposed clean-up plan for contaminated sediments in the Superfund site at Waukegan Harbor, Illinois. A consent decree between USEPA, Outboard Marine Corporation and the State of Illinois sets forth the remedial action for the site, which has PCB concentrations exceeding 10,000 ppm. Since October 1989, the District has been reviewing the design of Canonie Environmental Services for the clean-up, and indicating to the USEPA whether approval is recommended for the portion of the design reviewed.

The District prepared a draft EIS for the proposed Waukegan Harbor, Illinois, Confined Dredge Material Disposal Facility. This draft EIS is anticipated to be available for public review in 1990.

Michigan City/Trail Creek - The capping of Michigan City Confined Disposal Facility is planned to be done in the spring of 1990.

Chicago Area Confined Disposal Facility - Sediment samples were collected and analyzed in 1989 as part of routine monitoring of Chicago Area CDF sediment disposal operations.

Assessment and Remediation of Contaminated Sediments (ARCS) Program - The District has been participating in this USEPA program investigating the cleanup of contaminated sediments throughout the Great Lakes. The District has been represented on the Engineering/Technology Work Group of ARCS and will collect a 100-gallon sample of Indiana Harbor and Canal sediment in early 1990.

Soundings in 1989 - Soundings were taken on the following federal waterways in 1989: Michigan City/Trail Creek, Burns International Harbor, Burns Small Boat Harbor, Chicago River, Waukegan Harbor, and the portions of the Calumet River which were dredged.

Detroit District

Sediment Sampling Activities. Environmental Analysis. In 1989, sediment samples were obtained as part of a routine, periodic sediment testing program

at the following locations for environmental analysis:

Big Bay, MI
Bolles Harbor, MI
Clinton River, MI
Duluth-Superior, MN-WI
Grand Haven, MI (CDF)
Kawkawlin, MI
Kewaunee, WI (CDF)
Kaweenaw Waterway, MI
Menominee, MI
Milwaukee, WI
Monroe, MI
Oconto, WI
Port Austin, MI
Saginaw River, MI
Saugatuck, MI
St. Clair River

Sediments were analyzed for metals, PCBs, pesticides, nutrients, and physical parameters. Water samples were also collected concurrently to conduct elutriate testing.

Sedimentation Surveys. Operations and Maintenance Surveys. In 1989, hydrographic surveys were completed at Great Lakes harbors, channels and rivers (see listing below). Condition surveys were made at 76 locations to record the bathymetry of navigable waters. The results of the surveys were compiled and disseminated to the public in "Notice to Mariners" bulletins if there were significant changes affecting navigation. Twenty-three "Prior" and twenty-three "After" surveys were made in support of O&M maintenance dredging operations. "Prior" surveys were conducted to determine the shoaling conditions before scheduled dredging. "After" surveys were conducted to confirm that the required dredging depth was achieved.

Algoma, WI
Alpena, MI
Arcadia, MI
Au Sable, MI
Bayfield, MI
Belle River, MI
Big Bay, MI
Big Suamico, WI
Black River(Gogebic), MI
Black River(Port Huron), MI
Bolles Harbor, MI
Caseville, MI
Channels in the Straits of Mackinac, MI
Charlevoix, MI
Cheboygan, MI
Clinton River, MI
Cornucopia, WI
Detroit River, MI
Duluth-Superior, MN-WI
Frankfort, MI
Grand Haven, MI
Grand River, MI
Grand Traverse, MI
Grays Reef, MI
Green Bay, MI
Greilickville, MI
Hammond Bay, MI
Harbor Beach, MI
Harrisville, MI
Holland, MI
Kenosha, WI
Kewaunee, WI
Knife River, MN
Lac La Belle, MI
Lake St. Clair, MI
Leland, MI
Lexington, MI
Little Kaukauna, WI
Little Lake, WI
Ludington, MI
Mackinaw City, MI
Manistee, MI
Manitowoc, WI
Menasha, WI
Menominee, MI & WI
Milwaukee, WI
Monroe, MI
Muskegon, MI
New Buffalo, MI
Ontonagon, MI
Pensaukee, WI
Pentwater, MI
Pine River, MI
Point Mouillee, MI
Point Lookout, MI
Portage Lake, MI
Port Austin, MI
Port Sanilac, MI
Port Washington, WI
Port Wing, WI
Rapide Croche, WI
Rouge River, MI
Saginaw River, MI
St. James Harbor, Beaver Island, MI
St. Joseph, MI
St. Marys River, MI
Saugatuck, MI
Saxon, WI
Sebewaing, MI
Sheboygan, WI
South Haven, MI
Sturgeon Bay & Lake Michigan Ship Canal, WI
Tawas, MI
Two Harbors, MN
Two Rivers, WI
White Lake, MI

Special Studies.

1. 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. Bioassessment testing was conducted on a number of samples representative of sediments encountered during dredging projects. The laboratory effects of several studies have been completed. Draft reports are being prepared and are expected to undergo review and comment in 1990.

2. Saginaw Confined Disposal Facility. Sediment samples of areas to be dredged in the upper Saginaw River were taken for use in sizing a CDF. The samples were tested to determine the settling and consolidation characteristics of the sediments.

3. Upper Saginaw River. The District conducted further sediment testing to characterize the movement of contaminants after recent flooding. The testing detected elevated concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin and 2,3,7,8-tetrachlorodibenzofuran in a number of samples. Confirmation analysis verified the previous laboratory's results.

4. Lower Fox River Lock and Dam System. In cooperation with the Wisconsin Department of Natural Resources, thirty-three sediment samples were collected on Lake Butte des Morts, Lake Winnebago and the Fox River as part of a disposition study for the lock and dam system.

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).

2. Suspended and bedload (Helley-Smith) sediment and bed-material data are being collected at three sites on North Fish Creek near Ashland, WI, in cooperation with Wisconsin Department of Natural Resources.

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, at Menasha, WI, at Fox River at Kaukauna, WI, and at Fox River at Little Rapids, 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, MI

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. Suspended-sediment data are being collected on a quarterly basis at Saginaw River at Saginaw, MI, in cooperation with the Detroit District Corps of Engineers

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 Milan, 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

GREAT LAKES REGION

SOIL CONSERVATION SERVICE

1. A reservoir sedimentation survey was made in the following reservoir.

Lake	County	State
Black Lake	St. Lawrence	NY

OHIO REGION

CORPS OF ENGINEERS

OHIO RIVER DIVISION

Huntington District

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 1989.

2. Dewey Lake, Johns Creek, Kentucky. Suspended sediment data were collected from the Johns Creek at Meta, Kentucky, monitoring station during 1989. Data collection at Caney Creek gaging station was not conducted in 1989.

3. R. D. Bailey lake, Guyandot River, West Virginia. Suspended sediment data were collected from the Clear Fork and the Baileysville monitoring stations in 1989.

4. Yatesville Lake, Blaine Creek, Kentucky. Suspended sediment data were collected from the Blaine Creek at Blaine, Kentucky monitoring station in 1989.

Louisville District

Sedimentation Surveys.

1. West Fork Lake, Mill Creek, Ohio. Survey data for West Fork Lake was gathered in December and is currently being compiled by survey personnel.

2. Cagles Mill Lake, Mill Creek Indiana. The Cagles Mill Lake sedimentation report was approved in September 1989. Results showed the total sediment accumulation in the lake below elevation 637.5 to be 3495 acre-feet. The survey revealed the rate of accumulation to be 0.36 acre-foot/square mile/year. This is almost double the initial estimated rate of 0.2 acre-foot/square mile/year.

3. Nolin Lake, Nolin River, Kentucky. The Nolin Lake sedimentation report was approved in December 1989. Total sediment accumulation below summer pool is 3055 acre-feet. The annual rate of sedimentation was determined to be 0.29 acre-foot/square mile/year, slightly more than half of the originally designed 100 year project life rate of 0.5 acre-foot/square mile/year.

4. Carr Fork Lake, Carr Fork Creek, Kentucky. The sediment structure on Defeated Creek was determined to have accumulated 38 acre-feet of sediment. The Litt Carr structure has accumulated 53 acre-feet of sediment. A study to determine the best method for returning the Litt Carr structure to an effective sediment trap.

Nashville District

Sedimentation Surveys.

1. Cordell Hull Lake, Cumberland River, Tennessee. The second sedimentation resurvey was conducted in June 1988. The sedimentation rate since the original survey of September 1973 is 0.47 acre-feet/square mile/year. The design rate was 0.3 acre-feet/square mile/year. A full resurvey is planned for 1993. A report of the 1988 resurvey has been completed and will be sent to the Division in April 1990.

2. J. Percy Priest Lake, Stones River, Tennessee. A report on Percy Priest Reservoir's second sedimentation resurvey has been completed and will be forwarded to the Division in April 1990. This resurvey was conducted in July 1986 and showed a deposition rate of 0.48 acre-feet/square mile/year from September 1967 to July 1986. The design rate was 0.4 acre-feet/square mile/year. A partial resurvey is planned for 1992.

3. Laurel River Lake, Laurel River, Kentucky. Sedimentation deposition from the original survey of October 1978 to the first resurvey of September 1985 was 0.85 acre-feet/square mile/year. The project design rate was 0.3 acre-feet/square mile/year. During project design it was stated that the deposition would take 2,000 years before the inactive pool would be filled with sediment. At the present rate, based on the resurvey, the inactive pool volume will be equalled in 1,015 years. The deposition report has been completed and will be forwarded to the Division in May 1990.

4. Old Hickory Reservoir, Cumberland River, Tennessee. A draft report of the resurvey in September 1985 showed deposition occurring from June 1954 to 1985 equal to five percent of the original reservoir storage volume. Cross sections of some tributaries showed significant deposition but did not produce significant reservoir volume loss. A study to verify the deposition was conducted. The report will be forwarded to the Division in May 1990.

5. Wolf Creek Reservoir, Cumberland, Kentucky. A sedimentation range network was established in 1950. Additional ranges were established in 1963, 1979, and 1984. The first full resurvey was conducted in October 1986. Computations since the full resurvey show deposition along the mainstem to equal 1.3 percent of the reservoir's original volume. A report on sedimentation in the reservoir will be submitted to the Division in May 1990.

Pittsburgh District

Sedimentation Surveys.

1. Conemaugh River Lake, Conemaugh River, Pennsylvania. A detailed sedimentation report for the 1982 survey was submitted in 1985. Resolution of the Division and headquarter's comments is waiting for the district's anticipated sediment removal activities that will be based on a study by the Waterways Experiment Station.

2. East Branch Clarion River Lake, East Branch Clarion River, Pennsylvania. A selected range sedimentation survey was completed in FY 1987. The report was submitted in FY 1989.

3. Allegheny Reservoir, Allegheny River, Pennsylvania. A selected range sedimentation survey was completed in FY 1987. The report was submitted in FY 1990.

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

5. Woodcock Creek Lake, Woodcock Creek, Pennsylvania. A selected range sedimentation survey was completed in FY 1988. A report will be submitted in FY 1991.

6. Union City Reservoir, French Creek, Pennsylvania. A selected range sedimentation survey was completed in FY 1988. A report will be submitted in FY 1991.

22 7. Youghiogheny Lake, Youghiogheny River, Pennsylvania. A selected range sedimentation survey was completed in FY 1989. A report will be submitted in FY 1991.

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 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 Kanawha River at Winfield, WV, as a part of NASQAN.

2. 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 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.

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
Bennetts Fork at Middlesboro, KY (discontinued September 1989)
Stony Fork at Middlesboro, KY (discontinued September 1989)
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
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 Alpine, 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.

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

SOIL CONSERVATION SERVICE

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

a. Public Law-566

Major Drainage	Watershed	Stream	County	States
Little Kanawha	Reedy Creek	Reedy Creek	Wirt & Roane	WV
Wabash River	Senachwine Creek	Honey Creek	Vigo	IN
Kentucky River	North Fork	Boone Fork Cr.	Letcher	KY

2. Reservoir sedimentation surveys were made in the followirg reservoirs:

Reservoir	County	States
Decker Lake	Miami	OH
East Fork of Buck Creek -- Tullis Site	Champaign	OH
East Fork of Buck Creek -- Wilson Site	Champaign	OH
Sippo Lake	Summit	OH
Lake Santee	Decatur	IN

3. Special Studies

a. Erosion and sedimentation watershed models were constructed for Indian Lake Watershed, Four Mile Creek Watershed, and West Fork of Wills Creek Watershed in Ohio.

b. Erosion rates and sediment yields were calculated for a 25- county area in west-central Indiana. The Ephemeral Gully Erosion Model (EGEM) was used to determine land voided and depreciated in each county.

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.

3. Suspended-sediment data are being collected monthly and on a stormevent basis by the U.S.Geological Survey at 2 sites on the Clinch River, TN, and 2 sites on the Powell River, TN, as part of a study to define the variability in suspended sediment and nutrients in the two basins. One site on each river is equipped with an automatic pump-sampler.

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
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

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
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

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 obtain and analyze sediment core samples from 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. All composites were analyzed for PCBs, and a priority pollutant scan was conducted on selected samples. The analyses were performed to provide data to assess the degree of contamination of the sediments. The contract report was released by the District in October 1989. The report verified the existence of substantially lower level of PCB's throughout the main portion of the federal navigation channel than were originally found in 1980 and 1983. Based on the findings of the report, the District has requested from USEPA Region 5 the reclassification of sediments in portions of the river from "toxic" to "polluted". The report is available in the 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. Eighteen 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. Field surveys at Coralville Reservoir were completed in the fall of 1988. Field checks of contractor data and computations will be completed during 1990. A field survey for Saylorville Reservoir is scheduled to begin 1990.

St. Paul District

Sediment Load Measurements. Both suspended and bedload measurements were conducted daily at four 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; at Mankato, MN on Minnesota River; at Winona, MN on Mississippi River and at McGregor, IA on Mississippi River.

Sedimentation Surveys. The following surveys were obtained to study sedimentation on Mississippi River backwater areas.

1. Finger Lakes Environmental Management Program Project, Pool 5, Mississippi River

   a. Type of Survey. Topographic

   b. Elements Measured. Deposit depths

   c. Survey Scope. To determine local backwater sediment deposition

   d. Available Reports. Finger Lakes EMP Definite Project Report

2. Bussey Lake Environmental Management Program Project, Pool 10, Mississippi River

a. Type of Survey. Reconnaissance, Topographic

b. Elements Measured. Sediment deposit depths, sediment particle sizes

c. Survey Scope. To determine local backwater sediment deposition

d. Available Reports. Bussey Lake EMP Definite Project Report

3. Indian Slough Environmental Management Program Project, Pool 4, Mississippi River

a. Type of Study. Reconnaissance, Topographic

b. Elements Measured. Sediment deposit depths, sediment particle sizes

c. Survey Scope. To determine local backwater sediment deposition and characteristics

d. Available Reports. Indian Slough EMP Definite Project Report

4. Drury Island Environmental Management Program Project, Pool 4, Mississippi River

a. Type of Study. Reconnaissance

b. elements Measured. Sediment particle sizes

c. Survey Scope. To determine local backwater sediment characteristics

d. Available Reports. Unpublished

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 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 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-Turkey Subregion

Suspended-sediment data are being collected weekly and on an event basis in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau at Roberts Creek above Saint Olaf, Iowa and at Big Spring near Elkader, Iowa.

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 Department of Natural Resources, Geological Survey Bureau:

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 Shelbina, 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 at Grafton, 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 Cuivre 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 bimonthly basis at Meramac River near Eureka, MO, as part of NASQAN.

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 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.

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
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
5957 Lakeside Boulevard
Indianapolis, IN 46254

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

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 watershed:

a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Mackinaw River	Lake Bloomington	Money Creek	McLean	IL
Lower Ill. River	Senachwine Creek	Senachwine Creek	Peoria	IL
Lower ILL. River	Lake Mauvaise Terre-Morgan L.	Mauvaise Terre Cr.	Morgan	IL
LaMoine River	Argyle Lake	Unnamed East East Fork Tributary	McDonough	IL
Root River	Upper North Br. Root River	North Branch Root River	Olmsted Mower	MN
Mississippi	Des Moines	Brushy Creek	Guthrie	IA
Mississippi	Skunk	North Skunk	Marshall	IA

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Morgan Lake	Morgan	IL
Lake Mauvaise Terr	Morgan	IL

3. Special Studies

a. A geomorphic analysis of channel stability was initiated in Lazarus Creek in Lac Qui Parle and Yellow Medicine Counties, Minnesota.

b. A qualitative assessment and report of sediment sources and deposition was performed on Cranberry Creek in Dunn and Pepin Counties, Wisconsin.

LOWER MISSISSIPPI REGION

CORPS OF ENGINEERS

Lower Mississippi Valley Division

Bed material samples were taken in September 1989 at approximately 2 mile intervals on the lower Mississippi River between the mouth of the Ohio River (mile 956) and Head of Passes (mile 0). A total of 504 samples were taken using drag samplers and a BM-54. In 1990, the samples will be analyzed and compared to similar samples taken by the Waterways Experiment Station in the 1930's.

Memphis District

Monthly sediment sampling continued at the 15 stations (Established for the purpose of St. Francis River O&M. 9 stations are sampled November through June and 6 stations are sampled during the entire year, and one of these stations maintains daily observations.) previously established in the St. Francis Basin and the station (Established for the purpose of aid in flood control design.) 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 sampling was initiated at Old River Low Sill Structure Outflow Channel on semimonthly basis.

3. 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. The district is currently studying the diversion of suspended and bed sediment at the latitude of Old River. These studies are being funded by the supporting interests in the Vidalia Hydropower Plant venture. The studies include data collection and modeling of Old River Control Outflow Channel using HEC-6.

The district was involved in the development of an operation agreement between the Corps and the Vidalia Hydropower Plant partnership. The agreement sets guidelines and requirements for the diversion and measurement of both flow and

sediments by the Hydropower interests, with the desired end being the maintenance of current standards.

The district, in anticipation of the initial operation of the Vidalia Hydropower Plant, established a sedimentation range in the Old River Low Sill Structure Outflow Channel. Provisions were also made to establish a range in the power plant outflow channel upon commencement of operation. These ranges will be included in the hydropower sediment diversion monitoring program.

In conjunction with the Comite River diversion project, the district developed HEC-6 models of both the Comite River and the proposed diversion channel. These models were used to study sedimentation trends with and without the project in place. The results of the study performed with these models were presented in the project General Design Memorandum.

During the month of October 1989, the district collected bed material samples at 15 locations in East Baton Rouge Parish. The samples were taken in conjunction with the Amite River and Tributaries project with the intent of evaluating possible future sedimentation.

The district investigation of methods for diverting sediments from the lower Mississippi River was completed. The investigations resulted in estimates of sediment volume diverted and acres of marshlands created. These estimates will be incorporated in the Louisiana Land Loss/Marsh Creation Study report.

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

A computer Data Base System for storing, retrieving, and analyzing sediment data is in the process of being relocated to new computer system.

St. Louis District

Sedimentation Investigations.

1. The data collected with the first resurvey of the sedimentation ranges at Mark Twain Lake has not been finalized into report form due to lack of funding. If funds become available, the report will be completed this year.

2. An innovative underwater dike, called a Bendway Weir, has been constructed in the Middle Mississippi River at approximate river mile 23.0(miles above the Ohio River). The weirs have been designed to rearrange the sediment fallout within bendways, which should produce a more efficient navigation channel around the bendway. Prototype monitoring is showing that favorable movement of sediment has already been initiated.

3. The district has become involved in a multi-agency study concerning a comprehensive erosion and sediment study of the Middle Fork of the Salt River upstream of Mark Twain Lake. The five year study will investigate the impacts of erosion and sediment movement on the land, stream, and lake environments. Mark Twain Lake was selected as one of five lakes in the country to be studied.

Sediment Load Measurements. Monthly sampling of temperature, turbidity, total solids, suspended solids, dissolved solids were done at the following locations.

1. Cannon Damsite at Hwy A Bridge, Salt River, Missouri. (Station established for the purpose of Mark Twain Lake O&M General.)

2. Lake Shelbyville T.W., Kaskaskia River, Illinois. (Station established for the purpose of Lake Shelbyville O&M General.)

3. Carlyle Dam T.W., Lower Kaskaskia River, Illinois. (Station established for the purpose of Carlyle Lake O&M General.)

4. Hwy 14W Bridge, Big Muddy River, Illinois. (Station established for the purpose of Rend Lake O&M General.)

5. St. Louis Harbor, Mississippi River, Illinois. (Station established for the purpose of St. Louis Harbor Study.)

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 1989. 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. The sediment study to determine the impact of the influx of sediment from bank caving above Shreveport, LA, on the Red River Waterway system was completed. The study included 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 was included. The results of the study indicate a heavy sediment contribution from bank caving upstream of Shreveport. The study also concluded that the completion of revetment work upstream of Shreveport would greatly reduce the contribution of bank caving. However, even this reduced quantity of material passing Shreveport could result in significant maintenance dredging requirements within the Waterway reach.

b. During 1989, the expanded Red River sediment sampling program initiated during 1988 continued. This expanded program is required in order

to obtain sufficient sediment data to insure the effective design of project features. Prior to 1988, suspended sediment samples were taken at random time intervals at Fulton, AR, Shreveport, LA and Alexandria, LA. The expanded program 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.

c. During 1989, hinge pool operation studies for Lock and Dam No's. 4 and 5 were initiated. These studies are required to determine the most effective hinge pool operation for enhancement of sediment transport within these two pools.

d. During 1989, the work on the TABS-2 numerical model for Lock and Dam No. 4 was essentially completed. A TABS-2 numerical model study for the upstream approach to Lock and Dam No. 5 was initiated. The purpose of this study is to evaluate sedimentation tendencies and current direction and velocities after a major change was made in the design of the upstream lock approach.

e. The movable bed model for Lock and Dam No. 3 was reactivated to evaluate deposition tendencies resulting from changes in the design of the upstream and downstream channels.

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. Geomorphic and sediment transport studies were continued in 1989 for Hickahala Creek, Abiaca Creek, Long Creek, and Black Creek watersheds as part of the development of technical work plans for these watersheds. Geomorphic and sediment transport studies were completed for Batupan Bogue and Hotophia Creek.

b. Automatic suspended-sediment sample stations have been installed in 6 of the 15 DEC watersheds. Stations on Batupan Bogue, Otoucalofa Creek, Hickahala Creek, Senatobia Creek, and Hotophia Creek have been operational for approximately 5 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.

3. Sardis Lake Resurvey. Seven sediment index ranges for Sardis Lake were resurveyed in 1988. Due to heavy workload and manpower shortages, analysis to determine if a resurvey of all the sediment ranges is needed was not completed in 1989. The analysis will be completed in 1990.

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).

Lower Mississippi-St. Francis Subregion

1. Suspended-sediment data are being collected on a daily basis at St. Francis River, Saco, MO.

2. 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, 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, 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 Port Vincent 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 bimonthly at Atchafalaya River at 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

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
Mississippi River near St. Francisville, LA, as part of NASQAN and in cooperation with the U.S. Army Corps of Engineers (COE).

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 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).

Simon, Andrew, 1989, The discharge of sediment in channelized alluvial streams: Water Resources Bulletin, v. 25, no. 6, p.1177-1188.

3. 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.

Bazemore, D. E., and Hupp, C. R., 1989, Wetland sedimentation in relation to a highway crossing, Big Sandy River, West Tennessee: (Abs.), Abstracts With Program, Second Tennessee Hydrology Symposium, August 1989, Nashville.

4. 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.

Yurewicz, M. C., Carey, W. P. and Garrett, J. W., 1988, Streamflow and water quality for the three major tributaries to Reelfoot Lake, West Tennessee; October 1987 - March 1988: U.S. Geological Survey Open-File Report 88-311.

5. In cooperation with the Tennessee Department of Transportation, the U.S. Geological Survey is conducting a study to investigate the hydraulic and channel characteristics which led to the collapse of the US 51 bridge over the Hatchie River. Historical data including suspended-sediment discharges, channel geometries, hydraulic and hydrologic data were used. Bed-material samples and additional channel surveys were also collected.

6. As part of a statewide study in Tennessee to assess the frequency of scour-critical bridges, the U.S. Geological Survey, in cooperation with the Tennessee Department of Transportation is collecting bed-material samples at 40 sites in this region for the purpose of modeling potential bridge scour.

Simon, Andrew, Outlaw, G. S., and Thomas, Randy, 1989, Evaluation, modeling, and mapping of potential bridge-scour conditions, West Tennessee: Proceedings, National Bridge Scour Symposium, 1989, McLean, Virginia.

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
Old River Auxillary Structure (Inflow)
Old River Auxillary Structure (Outflow-1988, deleted 1989)
and bed material only at Mississippi River at river mile 312.

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 gross erosion, sediment yields, or sediment damages were made for the following watersheds:

a. Public Lass -566

Major Drainage	Watershed	Stream	County	State
Tangipahoa	Tangipahoa	Tangipahoa	Pike, Amite	MS
Obion River	Beaver Creek	Beaver Creek	Carroll	TN

2. Special geomorphologic study of channel erosion and sediment transport was made by U.S.G.S. for SCS for the following activity.

a. Public Law - 566

Major Drainage	Watershed	Stream	County	State
Hatchie River	Cane Creek	Cane Creek	Lauderdale	TN

SOURIS-RED-RAINY REGION

CORPS OF ENGINEERS

North Central Division

St. Paul District

Sediment loads were measured by the U.S. Geological Survey near Kindred, ND on Sheyenne 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

SOURIS--RED--RAINY REGION

SOIL CONSERVATION SERVICE

1. Special Studies

   a. Training for the measurement of ephemeral gullies (concentrated flow erosion) was provided to personnel involved in river basin inventories.

   b. Ephemeral gully erosion was estimated for the Des Lacs-Souris River Basin Study.

MISSOURI

BUREAU OF RECLAMATION

Platte River Survey and Bed Material Sampling -

A 150-mile reach of the Platte River from Chapman, Nebraska to North Platte, Nebraska was the focus of a field data collection program during August through November 1989. About 91 transects, some over a mile wide, were surveyed for future use in mathematical modeling of sediment transport in the Platte. Additionally, about 200 bed material samples representative of the river bed in this reach were collected in November 1989. This data will also be used in future sediment transport studies.

North Platte River Cross Section Survey and Bed Material Sampling -

A survey of eight river cross sections and collection of bed material samples was conducted on the North Platte River near Casper, Wyoming in November 1989. This data will be used to develop water surface profiles and compute bed material transport of the North Platte for use in designing modifications to the Evansville/Brookhurst Water Plant Intake.

Fullerton and Elba Canal Scour Studies, Loup River Basin, Nebraska -

Maximum depths of scour for design of Fullerton and Elba canals and laterals siphons and pipe crossings are as follows:

Stream	Scour Depth, feet
Auger Creek	7.5
Munson Creek	13.0
Davis Creek	9.0
N. Loup River	4.5

The recommended depths reflect local scour due to the 100-year flood peaks. The data does not reflect future bed elevation loss due to degradation for Auger or Munson Creeks.

Loretto Reservoir -

The proposed Loretto damsite is near the Beaver Creek at Loretto, Nebraska, gauging station. The average annual discharge for the 18-year record is 60,790 acre-feet. It was assumed that the 4-year sediment record (1947 - 1950) was representative of long-term runoff conditions. The average annual suspended sediment is 71,700 tons. The estimated 50- and 100-year sediment accumulations in Loretto Reservoir are 3,275 and 6,550 acre-feet, respectively.

Inland Lakes Reservoir Survey -

A bathymetric survey of Lake Minatare near Scottsbluff, Nebraska was conducted during April 1989. A contour map and area capacity tables for this reservoir were completed in December 1989.

Cherry Creek Reservoir -

An estimate of sediment inflow to the proposed Cherry Creek Reservoir in the Yellowstone River Basin in eastern Montana was developed using a sediment yield rate estimate of 0.27 acre-foot/mi^2/yr. This yield rate was calculated using reservoir survey data from three reservoirs in the Tongue and Powder River Basins and the drainage area estimate of 383 mi^2 for the proposed reservoir. The resulting annual sediment inflow is 104 acre-feet, with 50- and 100-year accumulations of 5,200 acre-feet and 10,400 acre-feet.

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 collect monthly points and bed samples on the main stem of the Missouri River at St. Joseph, Kansas City, and Herman, Missouri. The remaining two stations are located on the Smoky Hill River. One station is located below Kanopolis Lake to measure outflowing materials, and the other is an inflow station to Kanopolis Lake. At the end of the fiscal/water year, the inflow station was closed by the district's procurement and contract office. Sediment personnel became aware of this non-contract renewal in reviewing belated laboratory analysis reports. The outflow station was discontinued after becoming aware of the status of the inflow station.

Lake Reservoir Sediment Activities.

1. Harlan County Lake.

a. The third resurvey of Harlan County Lake was finalized during this reporting period. The three Republican River main stem ranges located in the flood pool above Alma, Nebraska and the two multi-purpose pool ranges located on Prairie Dog Creek were completed. All 14 river channel degradation ranges were resurveyed. Because of the lack of maintenance, nearly all of these degradation ranges had to be re-established and re-monumented prior to surveying the channel geometry.

b. Two sets of aerial photographs were taken during the same time frame that the lake was resurveyed. The photos were collected while the water surface elevation was slightly more than 8 feet below the multi-purpose pool. One set of photograph was collected at a scale of 1 inch equals 2000 feet for developing an overall mosaic, while the second set, scaled at 1 inch equals 400 feet, was collected for studying the retreat of the scarped banks along the lake perimeter from the dam to Alma, Nebraska.

c. Samples of lake bottom material deposits were collected in cross-sections along the range lines extending from the dam through those main-stem and tributary range lines which have been inundated by the highest pool or overbank flows since the 1972 resurvey. Because of a low multi-purpose pool during the sample collection, several undisturbed samples were collected in areas which, because of project operations, experience alternating wet and dry periods. It appears that a large volume of the deposits are due to the retreat of the perimeter bank lines. Undisturbed samples of the loess bluff bank materials were also taken. Specific weight of the insitu loess bank deposits are about 105 pounds per cubic foot, while the inundated reworked bank material's specific weight averages between 35 and 40 pounds per cubic foot. This change in specific weights amounts to an equivalent hypothetically volumetric ratio between 2.5 and 3.0 to 1.0.

2. Long Branch Lake. The first resurvey for this lake was performed during this reporting period. All of the degradataion and aggradation ranges were surveyed. Field checking of the lake hydrographic sounding was accomplished during the time when sediment samples of the deposits were being collected. Capacity and area revisions have been computed and accepted. New tables have been developed and distributed to the Water Control Section and other interested parties.

3. Smithville Lake. The first resurvey for this lake was also performed during this reporting period. During the time of hydrographic sounding of the lake ranges, personnel from this office accompanied the survey crew to insure adequate and proper calibration of the equipment. However, because of inherent inaccuracies, the soundings were again spot-checked in the field during the collection of deposit samples. Capacity and area computations have been finalized and accepted. New tables were developed and distributed to the Water Control Section and interested parties.

4. Pomona Lake. Nearly all the aggradation ranges were completely resurveyed during this period. The range exceptions were isolated headwater flood pool ranges which had not experienced overbank flows since the first resurvey or had not shown any visible signs of change. This was the second lake resurvey of the aggradation ranges, but no degradation ranges were resurveyed at this time. Samples of the deposits were collected and sounding verification made. Capacity and area computations will be performed at later date.

5. Perry Lake. A partial resurvey of this lake was performed by sediment personnel and funded by the State of Kansas Water Office through the Planning Division. Multi-purpose pool ranges, along with a few selected flood-pool ranges were resurveyed. A new capacity and area table was computed for the multi-purpose pool, with extensions into the flood-pool, based on previous surveys. The Water Office was also given the results of a study extrapolating the loss of the multi-purpose pool over future time based on the results of this survey and previous surveys, as well as cursory surveys.

Special Studies.

1. 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 below the project monitored extends some 40 miles into the Osage River arm of the LOZ. Bank erosion monitoring sites were located downstream 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. To date, data have been collected through the operation of five units with a high LOZ pool elevation. Numerous similar data collections have also been performed during continuous flood evacuation releases. All of the flood evacuation and power generation point velocity and sediment physical data have been reduced, plotted, and have had empirical equations developed from a best fit regression analysis for each of the collection sites monitored. Standard error and "Student's" "t" statistical analyses were also performed to develop confidence limits and test the precision of the collected data.

Presently, the bank erosion sites' accumulated measurement files are being processed through programs developed to compare incremental bank area changes against other pertinent and associated collected data.

2. Kansan River Commercial Dredge Monitoring. The Bureau of Mines, (Denver, Colorado office), performed a literature review study and prepared a report of their findings. The District had recently submitted it's draft EIS

for review and comment. This report was received for the District's use and review after the closing date for EIS comments. Upon reviewing the report, it was perceived that the study was highly biased and would have a damaging effect on the impending action about to be instituted under the Corps' regulatory authority. It appears that the Bureau of Mines elected to base their findings on the opposing arguments to the District's and its consultant' studies and findings. A meeting with the author of the report has resolved some of the apparent misconceptions and will be followed with a detailed written response addressing specific problems with the report. However, it is uncertain how to rectify the perceived damage generated by the Bureau's report because of the wide review dissemination.

OMAHA DISTRICT

Special Studies.

1. Sedimentation Study - Thurman to Hamburg, Iowa. A reconnaissance study was conducted under the Section 205 program (Small Flood Control Project) to: analyze sediment yields for drainage areas between the cities of Thurman and Hamburg in Southwest, Iowa; discuss sediment impacts on existing sediment retention structures and drainage collector ditches; and provide recommendations to alleviate sedimentation programs in the basin. High sediment yields in the study area long ago filled sediment retention basins, allowing sediment to pass through and continue downstream to the Missouri River flood plain where it deposits in the flatter gradient drainage ditches. Restoring the existing retention basins and drainage ditches, combined with more extensive soil conservation practices were recommended to help alleviate the problem.

2. Skunk Creek Recreation Site Analysis, Lake Sakakawea. A site located on Skunk Creek Bay of Lake Sakakawea, adjacent to Fort Berthold Indian Reservation, was evaluated for possible recreation site development. This assessment was undertaken as part of a supplement to the lakes' master plan. Factors considered in the evaluation were bank erosion, littoral processes, and delta encroachment.

3. Lake Francis Case Aggradation Study. This study, completed under A-E contract, documented basic observations and trends of geomorphic data at Lake Francis Case (Fort Randall Reservoir) and the White River, since 1953. It was completed per EM 1110-2-4000 (Sedimentation Investigations of Rivers and Reservoirs), and has been published as MRD Sediment Memoranda No.9.

4. Whetstone Creek, SD. An analysis of the past, present and future flood conditions on the South Fork of the Whetston Creek was conducted to asses project impacts upon flooding upstream of the government property line. The water surface elevation for existing conditions was found to be higher than that of pre-dam conditions over the entire study reach. It was determined that the higher existing water surface elevations are the result of aggradation in Whetstone Creek bay and the backwater effects from Lake Francis Case. Acquisition of the flood-affected lands was recommended and a flood boundary map provided to Real Estate.

5. River Ranch Resort. Sediment deposition and shoreline erosion were evaluated for a proposed resort/hotel complex called River Ranch Resort. The proposed project is located on the west bank of Lake Francis Case across from the city of Chamberlain, South Dakota. It was concluded that (a) reservoir aggradation will not be a serious problem well into the next century; (b) the effects of littoral transport are minimal because of the relatively deep offshore depths; and (c) that the shoreline must be protected from the effects of wind-wave action.

6. South Platte River Arm Reconnaissance Report - Chatfield Lake. A sedimentation reconnaissance survey was conducted for Chatfield Lake. Results of the analysis indicate that the rate of aggradation in the South Platte River Arm of the reservoir is essentially as projected at the time of construction. It was further concluded that the current rate of aggradation should not contribute to problems experienced at the Plum Creek tributary arm.

7. Bear Creek. An erosion and sedimentation report was completed for the Bear Creek Lake project in Colorado. The report supplements the Bear Creek Lake Master Plan.

8. Fort Yates. Shoreline erosion problems at Fort Yates, North Dakota and near the Fort Yates irrigation intake were evaluated. This investigation was undertaken out of concerns raised by the Standing Rock Sioux Indian Tribe at a July 1987 meeting between the tribe and the Corps. The results will be used to evaluate proposed remedial measures.

9. Lake Sharpe. Two reports were completed for the Lake Sharpe Master Plan. The first report addressed sediment deposition, littoral drift and shoreline erosion for the lake in general. The second report addresses sediment and erosion problems at eighteen specific recreation areas.

10. Salt Creek Area-Capacity Reports. Area-capacity reports for six Salt Creek Project Lakes were contracted to an A-E firm. These lakes are Olive Creek, Wagon Train, Stagecoach, Conestoga, Twin Lakes and Branched Oak. March 1990 is the scheduled completion date.

11. Johnson Lake Section 22 (Planning Assistance to States) Hydrographic Surveys. Twelve range lines were set up and surveyed at Johnson Lake near Lexington, Nebraska. The data was used to create an underwater contour map of the Lake for the state of Nebraska under the Section 22 program.

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 monitors, computes, and publishes sediment load records at these stations under a cooperative stream gaging program. 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. Sediment data from this source is used to monitor 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 monthly.

4. Bismark, North Dakota. Nine groundwater wells in the Bismark vicinity were read monthly by the U.S. Geological Survey. Due to budget restriction, reading will be made on a quarterly basis in 1990.

5. 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.

6. Buford-Trenton Irrigation District. Fourteen wells were read monthly during the irrigation season and quarterly during the remainder of the year to monitor the effect of Missouri River stage increases on local groundwater levels.

7. Yellowstone Confluence. Sixteen 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 basis during the irrigation season and quarterly the remainder of the year.

8. 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. Oahe Project. One hundred and twenty one ranges from Oahe Dam to approximately 10 miles above Bismark, ND were surveyed under A-E contract. This survey included ranges on the Cannonball, Grand, Moreau and Cheyenne Rivers. The data collected will be used to update reservoir area and capacity volumes for use in the day-to-day operation of Oahe Dam. It will also be used for shoreline erosion analysis and for determining aggradation trends in the lake and headwater tributary areas. In addition to the survey, bed samples were collected for the Corps by the U.S. Geological Survey. An inspection trip was made to examine the erosion problems at Fort Yates.

2. Big Ben Project. Twenty-two ranges near Pierre, SD were surveyed under A-E contract. The data will be used to analyze delta growth and update reservoir area and capacity volumes, contingent upon a survey of the lower 12 ranges of Lake Sharpe. Bed samples where collected in the headwaters of Lake Sharpe reservoir from the Oahe Dam downstream to approximately Antelope Creek. An inspection trip was made to 18 recreation areas to examine erosion and/or sedimentation problems.

3. Fort Randall Project. Seventeen cross sections of Whetstone Creek were surveyed under A-E contract. This data was used to assist in a model analysis to predict future flood conditions on Whetstone Creek and to ascertain the project's influence upon historical flood conditions on the creek.

4. Gavins Point Project. Six ranges were surveyed under low flow conditions in the spring and eight ranges were surveyed with higher flow

conditions in the summer. These detailed surveys included ground elevations, multiple velocity measurements at each range line, sediment identification and ground cover descriptions. The data will be used for a model analysis to study fisheries habitat. These survey were completed with the cooperation of Corps of Engineers, U.S. Geological Survey and the Nebraska Games and Parks.

5. Salt Creek Project. Scheduled reconnaissance survey were completed at Olive Creek and Bluestem Lakes. These reconnaissance surveys will be used to plan the next full survey of these reservoirs.

6. Bear Creek Project. A field investigation of the Bear Creek Project was conducted to collect shoreline erosion and sedimentation data. Shoreline erosion was determined not to be a significant problem on the lake. Sediment aggradation on the Bear and Turkey Creek inflows is essentially as predicted, but may accelerate with continued development in the basin. The Bear Creek Master Plan was updated to reflect this information.

7. Standing Bear Lake Resurvey. All 17 sediment ranges at Standing Bear Lake were located and resurveyed in 1989. Data will be used to update the area and capacity changes in the lake. A report will be completed in 1990.

8. Bad River Surveys. All six sediment ranges on the Bad River were resurveyed in 1989. The data will be used in a Bad River Aggradation Study scheduled for 1990 completion. An additional three ranges were established for use in the Fort Pierre Floodplain Study.

9. South Platte River Surveys (A). The sixteen temporary sediment ranges located on the South Platte River between Highway 375 and the confluence with Bear Creek were resurveyed by Tri-Lakes Project personnel. The data will update aggradation and degradation projections for the upcoming South Platte River Channel Improvements O & M Manual.

10. South Platte River Surveys (B). An additional eight ranges were established in the Littleton Floodplain Park reach of the South Platte River in 1989. The cross section data from these ranges was used to help develop habitat improvement structures in the reach.

11. Garrison Hydrographic Surveys. Hydrographic surveys of 23 sediment ranges in the Lake Sakakawea headwaters reach in North Dakota were completed under A-E contract. This additional data will be used to compute the change in reservoir area-capacity and for the upcoming Garrison Headwaters Study.

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, 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 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 at Grand River at Little Eagle, SD, and Moreau River near Whitehorse, SD, as a part of NASQAN.

3. 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 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, Bad River near Fort Pierre, SD, and White River near Oacoma, 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 bimonthly 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.

6. Suspended-sediment data are being collected on a flow-event basis at North Platte River at North Platte, NE, in cooperation with the U.S. Bureau of Reclamation (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.

3. Suspended-sediment data are being collected on a storm-event basis at South Platte River at Roscoe, NE, in cooperation with the USBR.

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.

3. Suspended-sediment data are being collected on a flow-event basis at Platte River at Brady, NE, in cooperation with the USBR.

4. Suspended-sediment data are being collected on a flow-event basis at Platte River near Overton, NE, in cooperation with the USBR.

5. Suspended-sediment data are being collected on a flow-event basis at Platte River near Grand Island, NE, in cooperation with the USBR.

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 Department of Natural Resources, Geological Survey Bureau.

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 Prairie Dog Creek above Keith Sebelius Lake, KS, and White Rock Creek near Burr Oak, KS, in cooperation with the Kansas Water Office.

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.

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 Frankfort, 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 Muscotah, 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. Four stations were equipped with Manning samplers and were operated during the non-winter season 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 82001

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

MISSOURI 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
Little Nemaha	South Branch	L. Nemaha R.	Johnson, Lancaster, Otoe	NE
Missouri	Pershe-Hinkson	Perche-Hinkson	Boone Howard Randolph	MO
Missouri River	Town Branch	Town Branch	Gentry	MO
Missouri River	Fork Grand	West Fork	Andrew Gentry Nodaway Worth	MO
Missouri River	E. Fork Grand	East Fork	Harrison Worth Ringgold Union	MO
Missouri River	Little Sioux	Moville	Woodbury	IA
Missouri River	Little Sioux	So. Garfield	Plymouth	IA
Missouri River	Little Sioux	Rock Creek	Woodbury	IA
Missouri River	Little Sioux	Reynolds Creek	Woodbury	IA
Missouri River	Little Sioux	Garfield	Woodbury	IA
Missouri River	Little Sioux	Elk Creek	Ida	IA
Missouri River	Mosquito Cr.	Mosquito Cr.	Harrison	IA
Missouri River	Thompson Cr.	Twelve Miles Cr.	Union	IA
Missouri River	Boyer Cr.	Mill-Picayune	Harrison	IA
Missouri River	Maple Cr.	Barber Hollow	Monona	IA
Missouri River	Upper Delaware & Tributaries	Delaware River	Brown Nemaha Jackson	KS
Powder River	N. Fk. Crazy Woman	Crazy Woman	Johnson	WY

b. River Basin Investigations

Major Basin	Basin Reported	State
Platte River & Niobrara River	Sandhills Cooperative Study	NE
Statewide	Nebraska Watershed Evaluation Cooperative River Basin Study	NE

c. Resource Conservation and Development

Project Name	County	State
Shultz Roadside Critical Area Treatment	Holt	NE
Short Pine Critical Area Treatment	Rock	NE

d. Flood Plain Management Studies

Project Name	County	State
Wahoo Creek	Saunders	NE

e. Conservation Operations

Major Drainage	Watershed	County	State
South Platte River	Threemile Creek	Park	CO

This study was a joint effort of SCS and the Colorado Department of Wildlife to evaluate sediment production from the drainage basin of Threemile Creek above a valuable fishery lying along the South Platte River between the dam at Spinney Mountain Reservoir and the upper end of Elevenmile Canyon Reservoir.

South Platte River	17 Springs Draw	Logan	CO

This study was a joint effort of SCS and the North Sterling Canal Company to evaluate sediment production from various sources above an irrigation reservoir and a debris reservoir on the former Dickinson Ranch.

2. Reservoir Sediment Survey

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Dickinson Irrigation	Logan	CO
Dickinson Debris	Logan	CO
Klondike	Lyon	IA
Basch	Johnson	WY
Kingsbury-Todd NO. 1	Johnson	WY
Tass	Johnson	WY

3. Special Studies

a. A channel stability and sedimentation study of Hanson Lake Watershed in Sarpy County was done.

b. Classes were given in erosion and sedimentation processes as part of Basic Resources Concepts, a course for newer SCS employees. Three sessions were taught.

c. Training was provided in use of the following models, AGNPS, SWRRB, GLEAMS, and EPIC. Water quality concepts in the planning process were also provided.

d. Nebraska SCS contract specifications for conducting reservoir sedimentation surveys were provided to South Dakota.

e. Preliminary assessments of erosion and sedimentation problems were performed in Flat Creek Watershed and Post Oak Creek Watersehd in Missouri.

f. The Missouri SCS, in conjunction with the Missouri Department of Natural Resources--Division of Public Drinking Water, conducted surveys of ten water supply reservoirs in northern Missouri to determine the effects of sediment deposition on water storage capacities. The surveys were in response to concern over water quantity in light of three years of drought. Reservoirs surveyed included: King City (3 reservoirs), Jamesport, Bethany, Monroe City (2 reservoirs), Moberly, Wyanconda, and Higbee.

g. Channel bank erosion was estimated for the Bad River as part of a sedimentation and water quality study for the Bad River Basin, South Dakota.

h. An assessment of downstream sediment effects of planned Southfork Watershed, Kansas, floodwater retaring structures was performed. This was done to determine potential changes in gravel bars which are habitat for a threatened and endangered fish speicies.

i. The effects of applied construction practices and planned floodwater retarding structures were assessed in the Upper Delaware & Tributatiees and Doyle Creek Watersehds, Nebraska. These studies were performed to determine what conservation practices are needed to meet state water quality standard.

ARKANSAS-WHITE-RED REGION

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sediment Load Measurements. Suspended sediment load measurements were made at two stations (Arkansas River below John Martin Reservoir, CO., and Purgatoire River below Trinidad Lake near Trinidad, CO.) in the region. They are obtained for O&M purposes.

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, and Blue Mountain Reservoirs. Pools 3 and 4 of the McClellan Kerr Navigation System were surveyed.

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 Red River. The concentration in percent of weight records were maintained.

Tulsa District

Sedimentation Surveys. Detailed sedimentation resurveys were completed on Keystone and Birch Lakes, Oklahoma, and El Dorado Lake, Kansas. The FY 88 contract for Keystone was completed in January and the FY 89 contracts for Mirch and El Dorado were completed in August. The results of these resurveys are scheduled to be completed in FY 91. A detailed sedimentation resurvey of Santa Rosa Lake, New Mexico, for Albuquerque District was performed. An investigation of the sediment deposition in Hulah Lake, Oklahoma, was initiated and the field work will be completed in early 1990.

Sediment Load Measurements. The suspended sediment sampling program consists of 45 operational stations with 37 stations being in the Arkansas River Basin and 8 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	Pawnee, OK
	Canadian Riv	Calvin, OK
	Caney Riv	Ramona, OK
	Cimarron Riv	Perkins, 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	Alva, 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. The Reservoir Sediment Data Summaries (ENG Form 1787) for the 1988 reconnaissance resurvey of Elk City Lake, Kansas, and the 1986 detailed resurvey of Kaw Lake, Oklahoma, were completed and forwarded to the Division office for approval. Sediment estimates and forecasts are being performed as needed. The transfer of historical data from the Division Honeywell computer to an in-house system is nearing completion; one major program on the Honeywell system has yet to be converted. The hydrographic survey system software was updated in September by the manufacturer. Hydrographic survey techniques were used in conjunction with the Oklahoma Lake Patrol to search for a sunken boat on Lake Keystone and to evaluate the entrance channel to the outlet works of Skiatook Lake. Two contracts were awarded during 1989, the first was for processing the Reservoir Sediment Data Summary for Wister Lake and the second was for the reevaluation of the segmental surface area data of Lake Texoma, Oklahoma and Texas. The surface area data was required for processing the results of the 1984-85 sediment resurvey of the lake. The updated sediment yield study for the Upper Little Arkansas River was completed in the early months 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 Security, 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:

Cow Creek near Lyons, KS
North Fork Ninnescah River above Cheney Reservoir, KS
South Fork Ninnescah River near Murdock, KS

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-month basis at Little Arkansas River at Valley Center, KS, Arkansas River at Arkansas City, KS, Whitewater River at Towanda, KS, and Walnut River at Winfield, KS, in cooperation with the U.S. Army Corps of Engineers (COE).

Upper Cimarron Subregion

1. Suspended-sediment data are being collected at Cimarron River near Kenton, OK, Cimarron River near Englewood, KS, (discontinued September 1987) 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, (discontinued September 1988) and Little River near Bowlegs, OK, (discontinued September 1988) 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 on a bimonthly basis at Arkansas River at James W. Trimble Lock and Dam 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.

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

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, and at Prairie Dog Town Red River near Wayside, TX, 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 Maurika, 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.

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

ARKANSAS-WHITE RED REGION

SOIL CONSERVATION SERVICE

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

a. Public Law 566

Major Drainage	Watershed	Stream	County	State
Red River	Little Beaver	L. Beaver Buckhorn Hell Stage Stand Rock Morton	Grady Stephens Cotton	OK
Red River	Cow Creek	Cow Creek	Stephens	OK
Red River	Lugert-Altus	Bitter Creek Stinking Creek	Jackson Greer	OK OK
Arknasas River	Brazil Creek	Brazil Creek Wild Horse Owl Rock Jefferson	LeFlore Haskell Latimer	OK
Cimarron River	Wild Horse	Wild Horse	Payne	OK
Red River	Upper Elk	Upper Elk	Beckham	OK
N. Canadian River	Six Mile Creek	Six Mile	Canadian	OK
Red River	Lugert -Altus		Jackson Greer	OK
Arkansas River	Hickory Cr.	Hickory Cr.	Newton	MO
Arkansas River	Doyle Cr.	Doyle Cr.	Marion Harvey	KS

b. Watershed *Investigation Studies* - P.L. 534

Major Basin	Study Area	State
Washita River	Ft. Cobb	OK

c. River Basin Investigations

Major Basin	Basin Reported	State
Red River	Southwest Oklahoma	OK

BUREAU OF RECLAMATION

Comanche Creek Reservoir -

Estimates of sediment inflow and disposition for the proposed Comanche Creek reservoir were done in 1989. The Comanche Creek watershed is part of the contributing drainage area of Choke Canyon Reservoir. The sediment yield rate of 0.031 acre-foot/mi^2/yr used in the design of Choke Canyon Dam and Reservoir was applied to the Comanche Creek site. Two reservoir sites were evaluated:

Site	Drainage Area (mi^2)	Trap Efficiency (percent)	Sediment Accumulation 25-yr (acre - feet)	Sediment Accumulation 50-yr (acre - feet)
Original	1584	85	1045	2090
Alternate	1497	80	930	1860

Comanche Creek is tributary to the Nueces River.

CORPS OF ENGINEERS

Southwestern Division

Fort Worth District

Dr. Max Spindler, an associate professor at the University of Texas at Arlington, was hired as a summer employee to complete his work on developing a computer program to distribute sediment in the district's reservoirs. This work is still in progress.

Galveston District

A total of 218 in-place 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	26
Gulf Intracoastal Waterway	112
Sabine-Neches Waterway	18
Houston Ship Channel	39
Freeport Harbor	6
Corpus Christi Ship Channel	9
Galveston Barbor	4
Channel to Trinity & Anahuac	4
Total	218

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 the cross-sections on Mason Creek was made in FY 89 to determine the amount of sediment accumulation in Barker Reservoir. If the reservoir sediment budget is approved, sediment surveys will be scheduled for FY 90 through FY 92 as needed.

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 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

TEXAS GULF REGION

SOIL CONSERVATION SERVICE

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

a. Public Law 566

Lower Aquilla Hackberry Watershed Erosion and Sedimentation Studies and Investigations. Ephemeral and perennial (classic) gullies and sheet and rill erosion. (Brazos River in Hill and McLennan Counties, Texas).

b. Special Resource Studies

Lower Colorado River Authority Contract in progress for erosion and sedimentation studies. (Colorado River, Texas).

BUREAU OF RECLAMATION

Velarde Community Ditches -

In June 1988, cross drainage peak discharges and scour estimates were computed for the Chavez Arroyo Crossing without a grade control structure. Design changes led to the analysis of scour at this crossing assuming a sheet piling grade control was installed.

The following table provides the estimated scour depth just downstream from a sheet piling cutoff at the Chavez Arroyo crossing of the Alcalde Acequia.

Flood Peak	Natural Scour (ft)	Scour With Cutoff (ft)
10-year	2.0	4.4
25-year	2.7	5.7
100-year	3.4	6.7

Cross drainage studies of five stream crossings on the Los Chicos Acequia were completed in February 1989. Scour depths for 10-, 25-, 50-, and 100-year floods at each crossing structure were computed. The following table summarizes the estimated scour depths calculated by the Blench depth regime method:

Crossing	100-year scour (feet)
1	4.8
2	5.9
3	5.3
4	5.0
5 (Canada de las Entranas)	3.2

Gallegos Pumping Plant Discharge Line -

Scour depth estimates for the 25-, 50-, and 100-year floods for a pipeline crossing were computed using a relationship developed by Bureau of Reclamation for the Navajo Indian Irrigation Project in New Mexico. The following table summarizes the recommended scour depth estimates:

Flood Peak Discharge, ft^3/s	Flood Frequency (year)	Scour Depth (feet)
250	25	3.3
330	50	3.4
400	100	3.5

Elephant Butte Reservoir Area Capacity Tables -

Between the reservoir surveys of 1980 and 1988, 45,300 acre-feet of sediment have accumulated in Elephant Butte Reservoir. Since the reservoir's initial filling in 1915, 570,000 acre-feet of sediment have been trapped. The average annual rate of accumulation since 1915 is 7,800 acre-feet and 5,660 acre-feet since 1980.

November 1989 Survey of Elephant Butte Reservoir -

A portion of Elephant Butte Reservoir was surveyed in November 1989 to supplement data collected in 1988. This new information will be used to develop contour maps and cross sections of the reservoir and conveyance channel for use in design studies for modifications to the conveyance channel.

Scour Modeling of Santa Domingo Reach of Rio Grande -

The Bureau of Reclamation's STARS model was used to simulate flow hydraulics through the Santa Domingo reach of the Rio Grande. The streamtube hydraulics were used along with empirical methods to estimate local scour and design riprap bank protection. The design was based on field measurements of channel cross sections taken at two discharges: 7,000 ft^3/s and 10,000 ft^3/s. The use of streamtubes to model lateral velocity variation can lead to increased design reliability and economy.

Lake Sumner Survey -

Lake Sumner, located on the Pecos River in east-central New Mexico, was surveyed in May 1989. Area capacity tables will be developed from this survey data during 1990.

RIO GRANDE REGION

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sedimentation Surveys

1. A hydrographic survey was conducted at Santa Rosa Lake on the Pecos River in August 1987. This resurvey was considered a partial survey with a complete hydrographic and aerial survey being done in August 1989. The purpose of the survey was to determine the changes in reservoir storage capacity. The initial sediment survey report, describing and analyzing the reservoir sedimentation resurvey at Santa Rosa Lake, is scheduled for completion in calendar year 1990.

2. The new elevation-area-capacity table for Santa Rosa Lake is scheduled for adoption in April 1990.

3. 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 reservoir storage capacity. The initial sediment survey report, describing and analyzing the reservoir sedimentation resurvey at Two Rivers Reservoir, is scheduled for completion in February 1990.

4. The new elevation-area-capacity tables for Two Rivers Reservoir were scheduled to be adopted in March 1990.

Sediment Load Measurements.

1. 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.

2. Bed material samples were collected at Santa Rosa Lake during each of the hydrographic surveys. The samples were analyzed to percent sediment, water content, density, and grain size. The results of the bed samples analyzed show 42.5 percent silt, 40.1 percent clay, 17.4 percent sand, wet unit weight 27.4 lbs/cu ft and a dry unit weight of 64.8 lbs/cu ft.

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 at the following stations at this indicated frequency in cooperation with the New Mexico Interstate Stream Commission:

Rio Pueblo De Taos below Los Cordovas, NM (bi-monthly)
Rio Grande below Taos Junction Bridge near Taos, NM (quarterly)
Embudo Creek at Dixon, NM (bi-monthly)
Rio Chama near La Puente, NM (bi-monthly)

2. Suspended-sediment data are being collected at the following stations at this indicated frequency in cooperation with the Bureau of Indian Affairs:

Rio Lucero near Arroyo Seco, NM (bi-monthly)
Rio Chama near Chamita, NM (quarterly)
Rio Grande at Santa Clara, NM (quarterly)

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 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 (COE).

5. 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.

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

7. 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.

8. 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 and U.S. Bureau of Reclamation (USBR).

9. 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.

10. 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.

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

12. 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.

13. 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
8011 Cameron Road
Austin, TX 78753

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

BUREAU OF RECLAMATION

Paonia Reservoir Area/Capacity -

New area-capacity tables, based upon field data collected by project and Denver Office personnel and analysis performed in the Denver Office, have been developed for Paonia reservoir.

Between the reservoir surveys of 1969 and 1988, 2,750 acre-feet of sediment have accumulated in Paonia Reservoir. Since the reservoir's initial filling in 1961, 3,490 acre-feet of sediment have been trapped. The average annual rate of accumulation since 1961 is 131 acre-feet and 142 acre-feet/yr have accumulated since 1969. For the 236 mi^2 contributing watershed, the corresponding sediment yield rates are 0.56 acre-foot/mi^2 and 0.60 acre-foot/mi^2. Paonia reservoir, with a capacity to inflow ratio of 0.21 has a low trap efficiency for fine-grained sediments.

Towaoc Canal Scour Studies - Reach 2

Scour estimates for drainage crossings of Reach 2 of the Towaoc Canal were completed in 1989. The study evaluated the intermittent streams that are most likely to interfere with the canal and siphons. The following table summarizes local scour along the canal.

Canal Station (ft)	Scour Estimate (ft)
750+00	7.0
875+50	3.0
991+00	5.0

Stoddard Diversion Dam, Weber River, Utah -

Water diverted from the Weber River at Stoddard Dam flows into the Gateway Canal for use in power generation and municipal facilities. Using daily flow data for the Weber River gauge near Gateway, Utah and diversion records provided by the Weber Basin Water Conservancy District, the sediment trap efficiency of various settling basin configurations were tested.

Settling basin modeling (using the Bureau of Reclamation's SETSIZE computer model) was completed for seven basin configurations.

The greatest trap efficiency for sand and silt occurs with the longest and widest basin, 2,000 feet by 70 feet. Silt removal of about 40 percent during most runoff conditions (24 percent under maximum diversion conditions) can be anticipated for this basin. Essentially, all of the sand is trapped with this basin configuration.

Green River Below Flaming Gorge Reservoir -

The response of the Green River channel to hydrologic changes induced by the presence of Flaming Gorge Dam was studied using comparative analysis of the channel from historical aerial photography, published sediment and flow records, and sediment data collected during 1986-1988. The emphasis of this study was the present-day sediment transport regime of the Green and the potential for future channel change.

The Green River from river mile 237 to river mile 310 apparently reached a new equilibrium in terms of channel width between 1964 and 1974. Further downstream, from river mile 94 to river mile 121, a new equilibrium in channel width was reached between 1964 and 1981. Subsequent high flows have resulted in an increase in average channel width at both locations as measured on aerial photographs taken in 1986 and 1987.

Bed-material sediment transport in the Green has attained a quasi-equilibrium at the present time with the river transporting just the load supplied to it. This was determined for the reach from Green River, Utah, at river mile 120 to river mile 310 near Jensen, Utah. Data from Geological Survey gauges on the Green and its primary tributaries as well as sediment data collected at three sites for this study were used in this determination.

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. 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.

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

5. 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.

6. 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.

7. 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.

8. 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 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.

UPPER COLORADO 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	County	State
White River	Red Wash	Rio Blanco	CO
Strawberry River	Rabbit Gulch	Duchesne	UT

This project was a joint effort of SCS and the Colorado Water Users Associations Number One in Rangely, Colorado, to make estimates of erosion and sediment yield in the Red Wash drainage basin in order to establish sediment storage requirements at a proposed dam and reservoir site on Red Wash, as well as to obtain estimates of damages from sediment and soluble salts to downstream areas including Kenny Reservoir on the White River.

b. River Basin Investigation

With data already available, an estimate of erosion and sediment yield for the entire drainage basin of the White River above Kenney Reservoir (Colorado) was made under existing conditions. Various projections were made for future conditions.

2. Reservoir Sedimentation Survey

A reservoir sedimentation survey was made in the following reservoir:

Reservoir	County	State
Kenney	Rio Blanco	CO

A report was made on a partial reservoir sedimentation survey (April 1988) on Kenney Reservoir on the White River upstream form Rangely, Colorado.

3. Speical Studies
A proposal was submitted to target planning efforts in the Colorado River Basin with a sedimentation reconnaissance using the Pacific Southwest Interagency Committee (PSIAC) Sediment Yield Procedure.

BUREAU OF RECLAMATION

Buttes Reservoir -

A sedimentation study for Buttes Dam and Reservoir was prepared by the Arizona Projects Office of the Bureau of Reclamation in 1975. This study was a flow-duration, sediment rating curve analysis prepared from the data available at that time for the Gila River at Kelvin, Arizona gauging station. Because there has been significant additional streamflow and suspended sediment data collected since that time, a new look at the analysis was conducted.

The following conclusions were arrived at during the course of this study:

1. The annual sediment yield rate of the Gila River at the Kelvin gauge is 0.495 acre-foot/mi^2 for the 5,125 mi^2 basin.

2. The average annual sediment load at the Buttes Damsite is 3,758,900 tons. This equates to 2,634 acre-feet of compacted sediment.

3. The 100-year sediment accumulation in a Buttes Reservoir having an initial capacity of 329,000 acre-feet is 256,100 acre-feet.

4. A typical yearly operation at the Ashurst-Hayden Diversion Dam would result in the diversion of 2,877,040 tons of sediment (2,263 acre-feet of uncompacted sediment).

5. Approximately 854 acre-feet of sediment could be removed from the Pima Lateral with a settling basin having dimensions of 4,650 feet long, 650 foot bottom width, 16 feet deep, and 1.5:1 side slopes.

Coolidge Dam and San Carlos Reservoir -

The impact of sedimentation on the storage capacity of San Carlos Reservoir during the remaining useful life of Coolidge Dam was investigated. Estimated sediment distribution within the reservoir for the years 1990, 2050, and 2090 is as follows:

Deposit Year	Sediment Volume (acre-feet)	Elevation of Sediment at Dam
1990	158,000	2389.7
2050	312,000	2423.2
2090	414,000	2439.6

Area-capacity estimates for these years have also been developed using the original area-capacity information (from 1923) and additional survey data collected in 1966.

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 daily basis in cooperation with the U.S. Corps of Engineers (COE) at Little Colorado River near Joseph City, AZ.

2. Suspended-sediment data are being collected on a flow-event basis at Leroux Wash near Holbrook, AZ, in cooperation with the COE.

3. Suspended-sediment data are being collected on a bimonthly basis at Zuni River above Black Rock Res., NM, and Rio Nutria near Ramah, NM, in cooperation with the U.S. Bureau of Indian Affairs (BIA).

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 Gila River at head of Safford Valley, near Solomon, 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

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 5-year study of the mobility of radionuclides and other selected trace elements in the Little Colorado River basin of Arizona and New Mexico started in July 1988. Suspended-sediment data are collected on a flow-event basis at the following stations:

Puerco River at Church Rock, New Mexico
Puerco River near Manuellito, New Mexico
Black Creek below West Fork near Houck, Arizona
Puerco River at Chambers, Arizona
Zuni River above Black Rock Reservoir, New Mexico
Little Colorado River at Woodruff, Arizona
Little Colorado River near Joseph City, Arizona
Little Colorado River at Grand Falls, Arizona
Little Colorado River near Cameron, Arizona

2. A long-term, ongoing statewide program in Nevada of investigations of sediment and debris transported by flash floods continued during 1989.

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 224
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

LOWER COLORADO REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages, sedimentation, erosion, water quality, and determination of sediment and salt yields.

River Basin Investigation
Upper Virgin River Basin - Iron, Washington, and Kane Counties, Utah.

2. Special Studies

A proposal was submitted to target rangeland planning efforts for erosion, sediment control, and salt reduction in the Colorado River Basin, with a sedimentation reconnaissance using the Pacific Southwest Interagency Committee (PSIAC) Sediment Yield Procedure.

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

3. Suspended-sediment data are being collected on a bi-monthly basis at Bear River at Border, WY as part of the National Stream Quality Accounting Network (NASQAN).

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. Suspended-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
Glenbrook Creek near Glenbrook, NV
Logan House Creek near Glenbrook, NV
Edgewood Creek near Stateline, 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 1989.

2. A long-term investigation of sediment and debris hazards related to flooding is in the sixth 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

GREAT BASIN REGION

SOIL CONSERVATION SERVICE

1. Determinations of sediment yields at proposed flood control structures were made in the following Watersheds:

   a. Public Law 566

Major Drainage	Watershed	County	State
Railroad Canyon	Humbolt R	Humbolt	NV
Water Canyon			
Harmony Canyon			

   (This project is flood protection project for the southeastern portion of the town of Winnemucca.)

   b. Resource Conservation and Development

Major Drainage	Watershed	County	State
Lake Lahontan	Silver Springs	Lyon	NV
Carson River	Clear Creek	Washoe	NV

   (This study was made by SCS in cooperation with Carson City County and Nevada Department of Transportation to determine sediment yield from highway cuts and streambank erosion on Clear Creek.)

2. Reservoir Sedimentation Survey

A reservoir sedimentation survey was made in the following reservoir:

Reservoir	Watershed	County	State
Vernon	Vernon Creek	Tooele	Utah

3. Special Studies

   a. Weber River Basin, Rees Creek Watersehd - sedimentation, erosion, water quality, rangeland improvement, single landowners small watershed land treatment work (Conservation Operations).

   b. EWP - Fire on Forest Service land upstream from major urban development, debris flow analysis, Mapleton, Utah County, Utah.

   c. EWP - Follow-ups work on Emigration Canyon-Affleck Park fire of 1988, debris flow analysis, Salt Lake City, Salt Lake County, Utah.

d. EWP - Fire on Forest Service land upstream of a majcr urban area, debris flow analysis, Olympus Cove, Salt Lake City, Salt Lake County, Utah.

BUREAU OF RECLAMATION

Milltown Hill Dam and Reservoir -

Four reservoir sizes were proposed for this site on Elk Creek near Drain, Oregon. The average annual sediment inflow to Milltown Hill Reservoir is estimated to be about 9.9 acre-feet. This estimate is based on suspended sediment records collected by the Geological Survey at the gauge near Drain. The computed sediment yield rate is 0.348 acre-foot/mi^2/yr for this 104 mi^2 basin. This rate is based upon a suspended sediment rating curve developed from 289 data points. The following table summarizes sediment accumulation for each of the four proposed reservoir alternatives.

Alternative	Sediment accumulation 50 year	100 year
Normal water surface elevation of 775 ft	480 acre-feet	955 acre-feet
36,000 acre-feet capacity	480 acre-feet	960 acre-feet
14,300 acre-feet capacity	460 acre-feet	920 acre-feet
4,930 acre-feet capacity	420 acre-feet	840 acre-feet

PACIFIC NORTHWEST REGION

CORPS OF ENGINEERS

North Pacific Division

Portland District

Sedimentation Surveys.

1. Reservoir Surveys. Monitoring of sediment deposits behind the Mount St. Helens Sediment Retention Structure (SRS) continued in 1989. Sediment range surveys showed 3.6 mcy of deposition during WY 1989, bring the total volume trapped since November 1987 to 9.3 mcy. Sediment samples indicate the bulk of the deposits are in the 0.25mm to 16mm size range, with silt and clay making up about 5 percent of the deposits. Sediment range surveys and material sampling will continue on an annual basis.

2. Channel Surveys.

a. Toutle/Cowlitz River. Channel surveys included bed material samples, 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 Cowlitz River cross-section surveys were used to design 2.2 mcy of dredging for flood protection. The data was used in monitoring the impacts of the SRS, and in determining the levels of flood protection along the Lower Cowlitz River that was dredged in 1988.

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 off 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 bed samplers, Helley-Smith bedload sampler, Price velocity meters, and a velocity-azimuth-depth assembly (VADA) directional meter. Hydrographic surveys were made by special survey boats equipped with electronic fathometers.

Seattle District

Sedimentation Surveys.

1. Thirteen previously established sedimentation ranges in the Chief Joseph Dam (Columbia River) reservoir were resurveyed.

2. four additional ranges in the Chief Joseph Dam powerhouse forebay were surveyed and monumented for future reference.

3. Six ranges were surveyed in the Columbia River at the mouth of Foster Creek immediately downstream from the Chief Joseph Dam powerhouse to assess the effect of the existing Foster Creek delta on power operations. The delta which resulted from a large flood on Foster Creek in March 1989, did not appear to have a significant effect on Chief Joseph Dam tailwater in the range of normal power operations.

Walla Walla District

Sedimentation Surveys.

1. Lower Granite Pool. The hydrologic analysis for a cursory study addressing the effects of long-term sediment build-up on the level of protection provided by the Lewiston levees was completed in April. Studies are continuing to determine a permanent, long-term solution. This year marks the second in a 5-year test and monitoring program in which the environmental effects of in-water disposal of dredged material are being evaluated. As part of this test, 1,001,563 cubic yards (cy) of sediment were removed from the Snake River channel between River Miles (RM) 136 and 138. In addition, two test pits were dug in the prereservoir gravel bed of the river in order to test for contaminants, determine physical characteristics, and estimate production rates. The excavated sediment was deposited in two locations: (1) a deep-water fill, and (2) a near-shore island construction project. Field data collected in support of the above studies are as follows:

a. Sediment ranges were resurveyed in the areas affected by dredging. The disposal sites were resurveyed, and one-foot contour interval maps were developed indicating the postdisposal channel bed geometry.

b. Sediment samples were collected to monitor changes in grain size and depth of deposited sediment at the two disposal sites and four reference sites.

c. Consolidation tests were run on 10, 3-inch core samples, which were collected between RM 108 and RM 127, in order to estimate the rate of consolidation of natural sediment in the reservoir.

d. The United States Geological Survey collected sediment and water discharge data on six small, ungaged tributaries downstream of the Anatone and Spalding gaging sites on the Snake and Clearwater Rivers. A report on the results was nearing completion at the end of this year.

2. Schultz Bar. Condition surveys were performed between RM 100.7 and RM 101.9 on the Snake River to determine the geometry of a large sandbar which is encroaching on the navigation channel.

PACIFIC NORTHWEST REGION

GEOLOGICAL SURVEY

Kootenai-Pend Oreille-Spokane Subregion

1. Suspended-sediment data are being collected on a bimonthly 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.

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
Blackfoot River near Bonner, MT
Clark Fork above Missoula, MT

and on a periodic basis at:

Little Blackfoot River near Garrison, MT
Flint Creek near Drummond, MT
Rock Creek near Clinton, MT

2. 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 Camas 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

3. 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)

4. 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.

5. 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.

6. 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.

7. 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.

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 and bedload data during spring runoff 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 periodically 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. 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.

4. The Makah Indian Tribe began in 1988 and continued in 1989 collecting suspended-sediment samples 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.

5. A study was conducted during the 1989 water year to estimate suspended-sediment loads from small tributaries into Lower Granite Reservoir on the lower Snake River in the vicinity of Clarkston, WA, and Lewiston , ID. Suspended-sediment samples, which were collected during February through June, 1989, were analyzed for sediment concentrations and sand/silt splits. The suspended-sediment and stream-discharge data that were collected and estimates of suspended-sediment loads for some of the tributaries were furnished to the Corps of Engineers, Walla Walla (WA) District in January 1990.

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
2617 East Lincolnway
Cheyenne, WY 82001

District Chief, WRD
U.S. Geological Survey
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

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, and Animas River at Cedar Hill, NM on a quarterly basis, in cooperation with NMISC.

3. Suspended-sediment data are being collected on a quarterly basis at San Juan River at Shiprock, NM, as a part of NASQAN, and Chaco River near Waterfolow, NM, in cooperation with U.S. Bureau of Reclamation.

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 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

2. 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 Lincolnway
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

PACIFIC NORTHWEST REGION

SOIL CONSERVATION SERVICE

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

a. Public Law 566

Major Drainage	Watershed	County	State
Yakima River	N. Whitstrain	Benton	WA
Columbia River	Salmon Creek	Clark	WA
Snake River	Overstreet 1]	Malheur	OR
Snake River	Clearwater River	Lewis Nez Perce Clearwater	ID

b. River Basin Investigation

Puget Sound	Deschutes R.	Thurston	WA

c. Resource Conservation & Development

Pacific Ocean	Hoquiam River	Hoquiam	WA

d. Conservation Operations

Subregion	Watershed	County	State
Lower Snake	Milton-Freewater	Umatilla	OR

2. Reservoir Sedimentation Surveys

Reservoir	County	State
Howard Sediment Basin	Columbia	WA
Hovrud Sediment Basin	Columbia	WA

These two desilting basins are located on two major side drainages of the Tucannon River. They were constructed as water quality demonstration projects in cooperation with Washington State Department of Ecology, local agencies, and landowners.

3. Special Studies

Major Drainage	Watershed	County	State
Snake River	Lower Granite Reservoir	Nez Perce	ID

This study is a joint effort with the Army Corps of Engineers to evaluate impacts of the 1985 Food Security Act on erosion and sedimentation in the Lower Granite Reservoir drainage area and is presently in preliminary draft form.

1] Part of pre-authorization report.

CALIFORNIA

BUREAU OF RECLAMATION

Cachuma Reservoir Survey -

Cachuma reservoir near Santa Barbara, California, was surveyed in February 1989. New area-capacity information and contour maps of this reservoir will be developed in 1990.

CORPS OF ENGINEERS

South Pacific Division

Los Angeles District

Reservoir Sedimentation. "Reservoir Sedimentation Summary" sheets (ENG Form 1787), for Cogswell Flood Control Basin and Eaton Wash Flood Control Basin were completed.

Sediment Sampling Stations. The following sediment sampling stations are operated by the USGS and supported by the District: 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. A detailed hydraulic design study of a comprehensive channel stabilization project on the Rillito River in Tucson, Arizona, was completed 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 Architect-Engineer firm of Simons, Li and Associates and utilized information from a sedimentation study prepared by the same firm in 1988.

2. A comprehensive sedimentation study of the San Francisco River at Clifton, Arizona, was completed 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 was modified in-house to reflect present channel conditions as indicated on recently completed topographic mapping.

3. A planning-level sedimentation study of Flamingo Wash and Tropicana Wash in Las Vegas, Nevada, was continued as part of the Las Vegas Wash and Tributaries Feasibility Study. The work completed to date includes initial field reconnaissance, study planning, follow-up reconnaissance to obtain samples of the streambed and streambank material, sieve analysis of the samples, and general qualitative analysis to support the conceptual hydraulic design of four debris basins and four detention basins. This study will continue into 1990 with quantitative analysis.

4. A detailed sedimentation study was initiated for Nogales Wash at the community of Chula Vista in Nogales, Arizona, as part of the Nogales Wash Analysis of Design. The purpose of the study is to assist in the hydraulic design of the channel improvement project. The study includes a detailed, qualitative analysis of aggradation and degradation trends in the project reach.

5. A detailed sedimentation study was initiated for the San Luis Rey River at Oceanside, California, as part of the San Luis Rey Revised Supplemental General Design Memorandum. The purpose of the study is to assess the feasibility of proposed modifications to the levee project currently under construction. The modifications are necessitated by extensive sand and gravel mining that has taken place in the upper end of the project reach subsequent to the completion of the project design. The study included a detailed

sediment routing through the entire project reach for various scenarios of inflowing sediment load. This study will be completed in 1990 when the design modifications for the project are finalized.

Sacramento District

Sediment Studies.

1. 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 Investigation (SEI) 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 SEI, was issued in March 1988. An erosion mitigation study based on the results of the SEI was completed in FY 89.

2. Caliente Creek, California - Feasibility. The proposed project is located in Southern California near the Town of Bakersfield and consists of a flood detention reservoir and downstream flood control channels. An SEI was initiated in FY 1989 to ascertain previous sediment yield estimates of the reservoir watershed. The SEI will include a geomorphic reconnaissance and analysis of the watershed. The proposed damsite is located at the outlet of the Caliente Creek alluvial fan.

3. Corte Madera Creek, California - Construction. The project consists of channel improvements to Corte Madera Creek located in Marine 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 Units 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 concrete-lined channel require raising to restore the design channel capacity. The HEC-6 analysis was completed in FY 89.

4. Coyote and Berryessa 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 Berryessa 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. SEIs of both creeks will be completed in FY 1990. The SEI's will be conducted to evaluate potential impacts of sediment on project performance and potential project impacts on the sediment on transport characterizes of each stream course.

5. Guadalupe River, California, 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 was completed in FY 89.

6. 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 was completed in FY 89 evaluating the effects of dam raising and the construction of a new dam on the downstream channel stability.

7. 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 SEI 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 was completed in FY 89.

8. Napa River, California - GDM. The proposed flood control project is located in Northern California in the Town of Napa and extends several miles through the Town of Napa. An SEI was initiated in FY 1989 to address potential impacts of sediment on project performance. Elements of the SEI include a geomorphic analysis of the study areas and numerical simulation of sediment transport using computer program HEC-6.

9. Sacramento River Geomorphic Study - Construction. Bank protection measures on the Sacramento River are proposed for two reaches: In the Butts 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 Sacrament 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 I) report on the Butte Basin reach was completed in FY 1989. A Final (Phase II) report on the Colusa to Red Bluff reach will be completed in FY 1990.

10. Truckee River, Nevada - GDM. The proposed project is located in the Reno-Sparks metropolitan area and extends along an approximate six mile reach of the Truckee River as well as up several tributaries. The flood control project will include levees, floodwalls and some channel excavation. An SEI was initiated in FY 1989 to address potential impacts of sediment on project performance. Elements of the SEI include a geomorphic analysis of the study area and numerical simulation of sediment transport through the study reach using computer program HEC-6. Bed material sediments range up to small boulder in size.

Sedimentation Surveys. Routine samples of lake outflows at Black Butte Lake, Pine Flat Lake, Lake Kaweah, Success Lake and Isabella Lake were collected and analyzed for suspended sediment during the year monthly. Discharge record are maintained and published by U.S. Geological Survey.

San Francisco District

Sediment Studies.

1. Maintenance of harbors and channels. As first reported in 1985, numerous studies have been conducted as a result of sediment accumulation at the Alcatraz disposal site. During 1989, the frequency of bathymetric surveys at this location was changed from quarterly to monthly. Finding from these data in 1989 indicate that less retention is occurring at the Alcatraz site because of restrictions imposed by disposal management.

In order to address the long-term transport of disposal material, the computer model "TABS II" has been used by WES to simulate long-term hydrodynamic circulation and sediment transport. During 1989, WES analyzed 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. Until resolution of the Long Term Management Study (LTMS), no other sediment transport studies will be conducted.

A study to address the economic impacts of not dredging Federal projects in San Francisco Bay was undertaken in 1989 for the District by Ogden Beeman & Associates, Inc. A final report is expected to be given to the District in June 1990.

2. Tidal Barrier. Using the results of a sediment analysis completed by WES in 1989 for the Marine County Shoreline Feasibility Study, the District has concluded that the base of the tidal barrier proposed to be located in the San Rafael Canal will be kept free from sediments that could interfere with barrier gate closures. It was additionally concluded that increased velocities that enter and leave the tidal barrier could result in erosion to the bottom sediment in the immediate vicinity of the structure. More detailed sedimentation studies are planned for future phases of the study.

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.

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.

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.

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 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.

2. 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

3. 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.

4. Suspended-sediment data are being collected on a periodic basis at Ventura River near Ventura and Santa Clara River at Montalvo in cooperation with California Department of Boating and Waterways.

5. Suspended-sediment data are being collected on a quarterly basis at Los Angeles River at Long Beach 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. Determinations of sediment yield at proposed flood control structures were made in the following watersheds:

a. Public Law 566

Major Drainage	Watershed	County	State
San Joaquin River	Sands Creek	Fresno Tulare	CA
Colorado River	McCoy Wash	Riverside	CA
Lake Mendocino Cold Creek Diversion from Eel River	Lake Medocino	Mendocino	CA

2. Reservoir Sedimentation Surveys

Reservoir	County	State
Antelope Lake	Plumas	CA

(This reservoir sediment survey was done by the State Department of Water Resources staff in Red Bluff, CA. An SCS erosion inventory and sediment yield study was done above the lake the previous year.)

Morro Bay	San Luis Obispo	CA

(A bathymetric survey of the bay was done by Phil Williams and Associates from San Francisco, CA. An SCS Erosion Inventory and Sediment Yield Study was done above the lake the previous year.)

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 data and bedload data are being collected on a periodic basis at Lignite Creek above mouth near Healy, AK, as part of a cooperative study with the Alaska Divison of Geological and Geophysical Surveys.

4. A cooperative study with the Denali National Park, initiated July 1988 to collect periodic suspended-sediment and bedload data, and to test the use of radio transmitters in tracking coarse bed material on the Toklat River at Toklat, AK, in Denali National Park, was continued in 1989.

Southwest Subregion

1. Suspended-sediment data are being collected on a periodic basis at the Kuskokwim River at Crooked Creek, AK, as part of NASQAN.

South-Central Region

1. A cooperative program with the Municipality of Anchorage, Department of Health and Human Services, initiated in 1988 to collect suspended-sediment data at Little Campbell Creek at Nathan Drive near Anchorage, AK, and Chester Creek at Arctic Boulevard, AK, as part of a long-term sediment monitoring study, was continued in 1989.

2. Suspended-sediment data are being collected on a periodic basis at Talkeetna River near Talkeetna, AK, as part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a periodic basis at the Copper River near Chitina, AK, as a part of NASQAN.

Southeast Subregion

1. 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

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sedimert yield were made in the following watersheds.

Conservation Operations

Major Drainage	Watershed	Borough	State
Matanuska River	Matanuska	Matanuska-Susitna	AK

The Matanuska River is a typical glacially fed, aggraded, braided stream. From one year to the next, the multiple channels frequently branch into new channels, shifting the erosion forces. Due to shifting to some particularly damaging locations, concerns have been raised on both short-term and long-term solutions. An evaluation of the erosion and sedimentation concerns and available data to evaluate the Matanuska River was documented by Frank Reckendorf, Sedimentation Geologist, WNTC, in a Special Report.

2. Special Studies

Kenai River Streambank Erosion Special Report by Frank Reckendorf, December 1989.

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 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 Anasco 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 and as a data base to be used in a rainfall-runoff-sediment model.

Quebrada Blanca at Jagual, PR
Quebrade Salvatierra near San Lorenzo, PR

2. Suspended-sediment data are being collected bi-weekly 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
Río Grande de Loíza below dam site, PR

3. 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

4. Suspended-sediment data are being collected biweekly and during high flows at the following sites in cooperation with PREQB and PRASA to determine sediment budgets for several reservoirs:

Río de La Plata at Comerio, PR
Río de La Plata below La Plata Dam, PR
Río Toa Vaca above Lago Toa Vaca, PR
Río Bayamen below Lago Cidra, 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

ARIZONA

Research activities at the Aridland Watershed Management Research Unit in Tucson, Arizona include the following:

1. Sediment yield estimates over a nine-year period for a small gullied watershed, were partitioned to account for main gully contribution, tributary gully contribution, and upland erosion. These estimates were based on precise measurements of gully cross sections, comparisons of sediment yields of small gullied and ungullied watersheds and USLE soil loss estimates. The main gully contributed about 50% of the total sediment yield. Estimates of upland erosion ranged from about 20% of the total based on the USLE to 40% based on comparison with an adjacent ungullied watershed. The remainder (10% to 30%) was attributed to contribution from tributary gullies.

2. The Revised Universal Soil Loss Equation (RUSLE) computer program has been completed and the new handbook is undergoing review prior to an early 1990 release.

3. Hydrologic components of the USDA Water Erosion Prediction Project (WEPP) developed include a storm rainfall disaggregation scheme to allow daily rainfall input into infiltration models, an approximate routing technique comparable to the kinematic wave equations, and improved computations for spatially varied flow. Parameter optimization methods were developed to identify WEPP model parameters from field data. The prototype version of the WEPP representative profile version was delivered to SCS, FS, and BLM in August, 1989.

4. An event oriented, physically based, kinematic runoff and erosion model, called KINEROS has been completed and model documentation is in press. This model describes the processes of interception, infiltration, surface runoff, and erosion from small agricultural and urban watersheds. The watershed is represented by a cascade of planes and channels; and the partial differential equations describing overland flow, channel flow and erosion, and sediment transport are solved by finite difference techniques. Spatial variability of rainfall and infiltration, runoff, and erosion parameters can be accommodated. KINEROS may be used to determine the effects of various artificial features such as urban developments, small detention reservoirs, or lined channels on flood hydrographs and sediment yield.

For additional information contact David A. Woolhiser, Research Leader, USDA-ARS, Aridland Watershed Management Research Unit, Pacific West Area, 2000 E. Allen Road, Tucson, AZ 85719.

USDA-AGRICULTURAL RESEARCH SERVICE

COLORADO

Research Activities within the Hydro-Ecosystem Research Unit in Fort Collins, Colorado include the following:

1. The simplified process (SP) model for runoff and sediment yield from unit surfaces (Hartley, D. M. 1987. Simplified process model for water and sediment yield from single storms, part I - model formulation, Transactions of the ASAE, 30(3):710-717 and Hartley, D. M., 1987. Simplified process model for water and sediment yield from single storms, part II - performance, Transactions of the ASAE 30(3):718-723) has received further testing on using rainfall, runoff and soil loss data from 15 different hillslope treatments in northeast Thailand. The model correctly ranks the sediment yield potential of the treatments without calibration, however results of the tests show that accurate runoff prediction on coarse textured soils requires field infiltrometer data. Currently the model is being incorporated as an upland sediment sub-model of the SIMPLE watershed model (Kouwen, N., 1986. SIMPLE- A watershed model for flood forecasting. Users' Manual. Department of Civil Engineering, University of Waterloo, Waterloo, Ontario, 92 pp.) Testing of the resultant watershed runoff and sediment yield model with 12 years of data from a watershed in Alberta, Canada will be carried out in 1990. SP documentation and a computer diskette containing Fortran-77 source code, sample data set and output can be obtained by contacting David M. Hartley, USDA-ARS, Hydro-Ecosystem Research Unit, P.O. Box E, Fort Collins, CO 80522.

2. A dimensionally consistent, simple and efficient mathematical model of the time and space distribution of raindrop induced shear stress has been developed and validated with experimental data. (Hartley, D. M. 1990. Boundary shear stress induced by raindrop impact. Ph. D. dissertation, Department of Civil Engineering, Colorado State University, Fort Collins, CO, 193 pp.) The model can be used to estimate the shear field caused by erosive raindrops and demonstrates that under some conditions raindrops produce very intense, short-duration boundary shear stress pulses. For example, a 3.0 mm diameter raindrop striking a 2.0 mm water layer is estimated to cause a peak boundary shear stress in excess of 80 N/m^2. This is 40 times the magnitude of the boundary shear stress caused by uniform flow on a 10% slope at the 2.0 mm depth. The raindrop induced peak shear occurs approximately 1.0 msec after impact and subsides to 5% of the peak value after 12 msec. The location of the peak boundary shear stress is approximately one drop radius from the center of impact. Boundary shear stresses are less than 5% of the peak value at distances greater than 7.0 drop radii. The algebraic boundary shear stress model developed in this study allows rapid calculation of the raindrop induced boundary shear stress field for any combination of drop size and water layer depth.

3. Sediments eroded from a plot during and after simulated rainfall events of varying intensity and duration were collected using the indoor rainfall simulation facility at the National Soil Erosion Lab, West Lafayette, IN. The two soils that were evaluated, a silt loam and a silty clay, had both been cropped for over 25 years. Sediments were analyzed for aggregate size distribution, aggregate stability, and

particle size analysis. Aggregates within each of the size classes were analyzed for total organic C, N and P content, labile N and P, and humic acid/fulvic acid ratio. The results of the rainfall events on the silt loam have been reported in a manuscript that has been submitted for publication. We found that throughout both the 100 and 200 mm/hr rainfall events, eroded sediments were enriched in total organic N, total organic P, and labile P. However, these eroded sediments were consistently depleted in labile organic N. Estimates of labile organic N loss based on original soil properties overestimated actual losses by 14 to 300%. The data suggest that degradation of soil N fertility by water erosion may be less severe than is suggested by the degree of loss of total soil organic N.

4. A theoretically based, physically verified model of channel headcut migration has been developed. The model is scaled toward rills in agricultural fields but is applicable to larger channels carrying intermittent flow such as gullies or arroyos. Observation shows that, if present in a given channel reach, a headcut produces the dominant proportion of total sediment load, yet no present erosion models include headcut erosion. Model inputs are channel slope, flow rate, drop height and soil resistant strength. Two modes of headcut retreat are possible, depending on whether erosion dominates just upstream or just downstream of the headcut. Correlation between the computer and physical model is good in the range tested. The model is currently being converted to parametric form so that a criterion for mode of failure can be derived. Several more physical model runs are planned to expand the range of verification.

For additional information, contact Donn G. DeCoursey, Research Leader, USDA-ARS, Hydro-Ecosystem Research Unit, Northern Plains Area, P. O. Box E, Fort Collins, CO 80522.

GEORGIA

1. Measurements were made of runoff, erosion, and transport of soil and nutrients from test plots under simulated rainfall in the Fall Line Red Hills portion of the Coastal Plain in Georgia. Tillage treatments on these plots were conventional, intermediate, and no-till. Crops were grain sorghum followed by winter wheat. It was observed from the measurements that, immediately following planting of winter wheat, runoff and erosion from the plots with simulated rainfall was less for conventional and intermediate tillage than for no-till. However, for later simulated rains after a soil crust had formed, runoff and erosion was greater for conventional and intermediate tillage.

2. Studies were conducted of dissolved and suspended sediment concentrations and loads in streamflow from Coastal Plain watersheds with mixed crop/forest land use on watershed uplands and with forested riparian zones. It was concluded that suspended sediment concentrations in these streams are quite low, that dissolved solids are the primary component of total solids, and that loads of both components are primarily a function of flow volume.

3. An evaluation of rainfall erosivity characteristics in peninsular Florida was conducted. Long-term daily rainfall records were related to the rainfall erosion-index of the USLE. It was found that a single erosion-index distribution region is adequate for central and southern Florida. Design values for annual total and maximum one-day EI, and a revised map of average annual rainfall erosivity were developed. This provides for extending applicability of the USLE to soil erosion modeling in peninsular Florida.

4. Probability distributions of soil loss and rainfall retention rates were computed for different seasons, crops, and watershed physical characteristics using rainfall, runoff, and soil loss data from field watersheds in the Southern Piedmont. A comparison of these probability distributions showed that soil loss risks are greater for the summer than for the winter crop season and greater for soybeans than for corn. Considerable soil loss risk reduction was also observed for watershed physical characteristics associated with reduced land slope and terrace and grassed waterway installation. Risk of low rainfall retention was found to be less for the winter crop season than for the summer season. Rainfall retention risks for the winter crop season appeared to be unaffected by crop and watershed differences. For the summer crop season, however, risk of low rainfall retention was observed to be slightly higher for soybeans than for corn and slightly lower for fields with terraces, grassed waterways, and lesser slopes.

For additional information contact Adrian W. Thomas, Research Leader, USDA-ARS, Southeast Watershed Research Laboratory, South Atlantic Area, P. O. Box 946, Tifton, GA 31793.

GEORGIA

Research activities at the Southern Piedmont Conservation Research Center, Watkinsville, Georgia include the following:

1. Runoff has been near nil on conservation tillage watersheds during the drought prone 1980's. Runoff events between summer of 1984 and fall of 1989 were less than 25 mm each. Above normal rainfall distribution began in April, 1989 and has continued in to 1990. A 100 year return event storm (143 mm with an EI of 2375 MJ·mm/ha·h) occurred on Sept. 30 and Oct. 1, 1989. Tillage intensity and duration caused runoff on 4 small research watersheds to vary from 14.0 to 36.1 mm. Intensive double-cropped conservation tillage (up to 15 years) on watersheds of similar slopes partitioned approximately 50% less rainwater into runoff than those with conventional tillage management. Flume measured sediment of conservation-tilled watersheds continue to remain below 0.05 Mg $ha^{-1}yr^{-1}$.

For additional information contact G. W. Langdale, USDA-ARS, Southern Piedmont Conservation Research Center, South Atlantic Area, P.O. Box 555, Watkinsville, GA 30677.

NATIONAL SOIL EROSION RESEARCH LABORATORY
WEST LAFAYETTE, INDIANA

Research activities at the National Soil Erosion Research Laboratory in West Lafayette, Indiana include the following:

1. WEPP project continues to move ahead. The WEPP model was delivered to action agencies in August, 1989, and the implementation period which continues through 1992 has begun. During the 1989-1992 period, the WEPP technology delivered will be improved, verified, and validated for use in the national prediction model. WEPP model is a result of activities by ARS scientists all over the United States, and by the Action Agency personnel-including Soil Conservation Service, Forest Service, and Bureau of Land Management of the U.S. Department of Interior.

2. Indoor laboratory experiments were conducted by using a 4m long flume, with a parabolic cross-section and adjustable slope, to investigate sediment transport capacity of shallow concentrated flow under influence of simulated rainfall. Degree of coarseness of the transported material was related to degree of equilibrium of flow condition for a given sediment supply rate and rainfall intensity on the flume bed. Uniqueness of the sediment transport rate for a given supply rate, particle size distribution and rainfall rate was also investigated. A two-year field study on transport and deposition of nonuniform sediment was completed. Rainfall intensity appeared to have a strong effect on sediment transport, particularly for silt loam soil. Further studies under more controlled laboratory conditions are needed, in which flow depth and rainfall intensity can be independently changed. A portable, field laser scanner to measure soil roughness at programmable grids down to mm scales was developed. This measurement technology has been transferred to other USDA units for erosion related works. Soil roughness was expressed as a function of scale. The scale dependent roughness function is used to develop the concept of in situ measurement of aggregate/clod stability and crust strength against erosive forces. The effects of pH and electrolyte concentration on particle interaction in three soil clays were determined.

For additional information contact John M. Laflen, Research Leader, USDA-ARS-MWA, National Soil Erosion Research Laboratory, Purdue University, SOIL Bldg., West Lafayette, Indiana 47907.

IOWA

Research activities at the Deep Loess Research Station of the Cropping Systems and Water Quality Research Unit in Treynor, Iowa, and Columbia, Missouri:

Precipitation, runoff, and erosion from three corn-cropped watersheds in the deep loess soil region of southwest Iowa were measured from storm events during the 15-year period 1974-1988. The data were summarized in three seasonal periods which represented the early crop establishment (P-1), crop maturation (P-2), and crop residue (P-3) periods. Two of the watersheds were ridge tilled with a till-planter and one of these watersheds was also terraced. The third watershed was tilled conventionally.

Average annual precipitation was above the long-term average for P-2 and was near the long-term average for P-1 and P-3. Period P-1 was a period of high intensity storms and high erosion potential because of tillage for seed bed preparation and lack of substantial plant canopy cover.

Average annual surface runoff from the till-plant watersheds was less than that from the conventional-till watershed during the entire crop growing season which included periods P-1 and P-2. During these seasonal periods average annual surface runoff from the contour ridge-till (CRT) watershed was about 1/3 of that from the contour conventional-till (CCT) watershed, and surface runoff from the ridge-till, terraced (RTT) watershed was about 2/3 of that from the CCT watershed. Average annual surface runoff in P-3 was similar among the watersheds.

In all seasonal summary periods the average annual sheet-rill erosion from the ridge-till watersheds (CRT and RTT) was less than that from the conventional-till (CCT) watershed. The greatest amount of seasonal period erosion occurred in P-1 from each watershed. Erosion from the ridge-till watersheds was over 90% less than that from the CRT watershed in this period of high erosion potential. Erosion from the terraced RTT watershed was less than that from the nonterraced, CRT watershed each season.

For additional information contact E. Eugene Alberts, Acting Research Leader, Cropping Systems and Water Quality Research Unit, Agricultural Engineering Building, University of Missouri, Columbia, MO 65211.

MARYLAND

Research activities at the Hydrology Laboratory Research Program in Beltsville, Maryland include the following:

1. Airborne laser profile data, collected at aircraft altitudes between 50 and 200 m over simulated gullies and analyzed using a moving average filter, clearly showed the location, depth, and cross section of simulated gullies as small as 20 to 70 cm wide and 10 to 30 cm deep. A study was made in a predominately shrub rangeland to determine canopy cover using the airborne laser profiler to measure the distance between the aircraft and the soil surface or plant canopy. Comparing the total number of laser pulses with pulses reflected by the canopy, canopy cover was calculated to range between 17 and 42% for shrubs greater that 0.5 m tall on seven 940 m segments. Airborne estimates of canopy cover are similar to field measurements of 19 to 43% made using the line intercept method along the same segments. Stream channel cross sections have been measured using airborne laser data. These examples show the potential of this technology to measure landscape factors and to provide data for estimating upland soil loss and the potential impact of this soil loss on water quality.

2. A comparison of 6 concurrent Landsat TM and MSS scenes was made to determine the usefulness of digital data for estimating suspended sediment and temperature in the surface water of an agricultural lake. Either TM or MSS data provided good estimates of surface suspended sediments in the lakes. The advantage of using MSS rather than TM data would be the ability to monitor larger areas with significantly less data. TM data provide an ability to monitor much smaller lakes and reservoirs. TM thermal data allow accurate estimates of surface water temperature to be made. These estimates of temperature could be useful in estimating the water balance in small agricultural watersheds.

For additional information contact A. Rango, Research Leader, USDA-ARS Hydrology Laboratory, Building 007, BARC-W, Beltsville, Maryland 20705

MISSISSIPPI

Research activities at the USDA National Sedimentation Laboratory in Oxford, Mississippi include the following:

1. The highly beneficial value of conservation tillage practices in reducing soil erosion continued to be shown by plot and watershed data. The 1987-1989 average annual soil loss from no-till grain sorghum on 5% slopes was 0.1 and 2.1 t/acre for 0.02-acre plots with no-till cropping history and conventional-till cropping history, respectively. Average annual soil loss for conventional-till and reduced-till grain sorghum during the same period was 4.0 and 3.0 t/acre, respectively. The 1985-1989 average annual soil loss for no-till and ridge-till grain sorghum on 5% sloping, 0.25-acre, contoured plots was 0.5 and 0.9 t/acre, respectively. During the first four years (1983-1986) of a long-term productivity study, conventional-till soybeans exceeded no-till yields by 20, 14, 3 and 11%, but were 16, 40 and 15% less than no-till yields in 1987, 1988 and 1989, respectively.

2. Simulated rainfall at an intensity of 64 mm/h was applied to 3.4 x 10.7 m plots during 60-minute initial, 30-minute wet and 30-minute very wet runs. Treatments included tillage of two diskings on plots with corn residue, wheat residue and no-crop residue. Soil losses, adjusted to a 4% slope, from corn, fallow and wheat plots over three replications averaged 4.88, 8.07 and 0.77 t/ha, respectively, during the initial 60-minute runs; 2.73, 3.95 and 0.45 t/ha, respectively, during the 30-minute wet runs; and 2.91, 4.63 and 0.51 t/ha, respectively, during the 30-minute very wet runs. Total soil loss from the two hours of rainfall averaged 10.52, 16.65 and 1.73 t/ha for corn, fallow and wheat, respectively. Extremely low soil losses from the wheat plots compared to corn and fallow plots occurred because two diskings were sufficient to incorporate corn residues but left substantial amounts of wheat residues on the surface. Effects of surface cover were removed by using mulch factor adjustments for average surface cover of 15, 79 and 0% for corn, wheat and fallow plots, respectively. This resulted in very similar values for adjusted soil losses for all treatments, indicating that incorporation of different amounts and kinds of residues had little effect on soil loss.

3. Computer programs that can predict the erosion from agricultural fields have been developed which can produce a great amount of data for analysis. A method has been developed to convert the output data into a visual display as data is computed by the programs. This will mean a faster method of understanding the data because visual displays can show much more data in a short period than any other method. The output data in the visual format can also be saved one picture at a time, thus saving storage space on a computer or the need to print the data on paper.

4. The simulated results from the erosion models CREAMS, SWRRB, EPIC, ANSWERS, and AGNPS were compared with measured data of runoff and sediment yield on an annual and storm rainfall event basis. Results were obtained from three separate watersheds located in Mississippi. The comparisons showed that no one model worked well in every situation of runoff and sediment yield on the watersheds. On an annual basis CREAMS and AGNPS best predicted the measured results in most situations. All of the models

except ANSWERS gave reasonable predictions of runoff and sediment yield from individual rain storms.

5. The sediment-trapping effectiveness of grass buffer strips during intense rainstorms was determined by sampling sediment-laden runoff above and below areas of established ryegrass and fescue. Runoff rates between 11 and 55 l/min. per m of strip were studied for strip lengths of 1.5, 3.0, and 6.1 m. For the 1.5-m strips, 40 to 80% of the sediment reaching the strip was trapped, and 72 to 95% was trapped for the 3.0- and 6.1-m long strips. More than 89% of the sediment larger than 250 μm was trapped by all lengths. Overall trapping effectiveness of the strips decreased as runoff rate increased, due mainly to less trapping of sediment smaller than 125 μm.

6. A mathematical model, ROWERO, has been developed to simulate the transport of eroded sediment along rowcrop furrows during rainstorms on flatland fields. Nonuniform sediment of 10 size-density groups is routed along the furrow by solving the continuity equation for sediment. Results provide information on sediment loss rate and size distribution of the sediment from the furrow as well as detailed information on deposition along the furrow. Simulations can be run for different furrow lengths, furrow gradients, row spacings, soils, and rain intensities to show the effects on sediment loss rate and sediment size distribution.

7. Cropland erosion results in the accumulation of iron nodules at the surface of some loess soils in amounts related to depth of past erosion. Analyses of soil samples from the lower Mississippi River Valley showed that severely eroded soils contain approximately four times more of these nodules than do slightly eroded soils. Results from a rainfall simulator study showed that the accumulations occur because iron nodules are more resistant to disruption by raindrops than soil aggregates which are broken down and eroded offsite. These data permit a more accurate estimation of past erosion and its effect on soil productive potential.

8. Erosion from no-till planted soybean was less than half that from conventional-tilled soybean for both drilled and 36-in rows. Soil losses from an hour of intense simulated rain on a 6%, 240-ft slope ranged from 0.5 tons/acre for rowed no-till to 2.6 tons/acre for the drilled, conventional-tilled condition. These losses were less than normal because of an algal skin on the soil surface due to a very wet month prior to these tests. However, when the young soybeans were cultivated for weed control, soil losses were much greater, totaling 25 tons/acre for rowed conventional tillage and 15 tons/acre for the rowed, no-till planted condition.

9. The effect of past erosion on erodibility of a fragipan soil was evaluated on three sites with a long history of cultivation and on a virgin site. Intense simulated rainstorms totaling 6.4 inches were applied to small, tilled plots. Soil losses averaged 36, 32, and 26 tons/acre for the cultivated sites that had soil depths of 23, 17, and 8 inches, respectively, remaining above the fragipan. Losses from the virgin site of 39-inch soil depth averaged 14 tons/acre.

10. The erosion-control effectiveness of four management practices for row crop production was tested on a 4% slope in early summer. A series of intense simulated rainstorms plus simulated runoff were applied to (1) conventional soybean, (2) no-till soybean, (3) soybean double cropped with wheat and (4) no-till grain sorghum. Soil losses from the three conservation practices were less than 15% of the losses from conventional management, showing that they are very effective in erosion control for the crops tested.

11. Manning's *n* values were determined for three stream channels in two complex watersheds in North Mississippi. The study covered a wide range of channel conditions and flow parameters. A representative storm from each channel was selected for this report. Results of this study show that channel *n* values change considerably as a runoff event progresses. Also, *n* values do not always follow the same pattern for streams of similar drainage complexity. The variation of resistance is apparently from changes in the effective channel roughness caused by modification of the channel bed configuration and by differing degrees of bank submergence as the runoff event progresses.

12. The Clauser scale is an adequate overall scaling parameter for velocity defect profiles in both clear-water and sediment-suspending water flows in open channels. It allows such profiles to be compared to assess the effect of suspended sediment on river flow. The Clauser scale is a mathematically-defined parameter widely used in aerodynamics, but never before used in sedimentary fluid mechanics. Velocity defect profiles plotted in Clauser coordinates show similitude for like bulk flow Richardson numbers, regardless of the particle size of the sediment in suspension. The Clauser parameter scales both inner (near-bed) and outer (far-bed) flow regions appropriately, while the Richardson number completely accounts for particle size effects and the influence of concentration gradient.

13. Frequency functions for the transport of sands in Goodwin Creek were defined as the rate of contribution to the sand load with stage. The frequency increases with stage to an approximate constant value indicating that the high, infrequent stages are dominant contributors to the sand load. The sand load for a given time period is almost proportional to the peak stage for that period. Extreme but infrequent events have significant impacts on the transport of bed material and also on channel stability.

14. Transport of bed material in the near bed region continues to be a crucial key in a process-based model for sediment transport. A model has been developed that gives reasonable distributions of sediment in transport in the near bed region, but experimental verification will be extremely difficult. Experiments will be started soon that will include attempted measurements in the near bed region and that will at least permit comparison of measured load with integrals of the predicted distributions.

15. Recent sediment accumulation rates were measured in Moon Lake, a large (10.1 km^2) Mississippi River oxbow lake in northwestern Mississippi. Moon Lake, which receives channeled inflow from an intensively cultivated

soybean, rice, and cotton watershed (166 km^2) and limited overland flow from surrounding lands, exhibited depositional patterns that were associated with (1) points of inflow, (2) flow patterns, and (3) lake morphology. From 1954 to 1965, 70 percent of the lake bottom experienced accumulation rates greater than 2 cm/yr. Accumulation rates exceeded 4 cm/yr in areas of delta formation. Changes in cropping systems during the 1960s, from cotton to soybeans and rice which require less cultivation, resulted in significantly ($\alpha = 0.01$) less sediment accumulation during the period 1965-1982 when 86 percent of the lake averaged less than 2 cm/yr sediment deposition. Sediment accumulation and lake water quality were affected by a corridor of wetlands which filtered agricultural drainage. This information is being used by watershed planners in the Mississippi River alluvial delta.

16. Small watershed reservoirs were shown to be efficient management practices for reducing offsite pollution from agriculture. Water quality parameters taken over a 5 year period in the loess hills of Mississippi showed inflow in winter and spring increased reservoir concentrations of phosphorus (from nondetectable to 1 mg/L), nitrate-nitrogen (from nondetectable to 1 mg/L), and suspended sediments (from 30 to over 300 mg/L). Storm related inflow was found to be the driving force behind short term limnological and water quality cycles. Multiple chlorophyll peaks indicated rapid phytoplankton response to runoff related nutrient loading when summer pasture cover reduced sediment input. Chlorophyll *a* ranged from <10 mg/m^3 in winter to >100 mg/m^3 in summer. All nutrient and suspended sediment concentrations were significantly correlated ($P < .001$) with precipitation and storm runoff and were significantly ($P < .05$) higher than normal concentrations. Trap efficiency during storms averaged above 70% for suspended sediment, phosphorus, and nitrogen flushed into the pond. This buffering capability of agricultural impoundments makes them excellent tools for managing intensive agricultural runoff and improving downstream water quality.

17. Simulated rainfall was applied to 1-m^2 forest floor plots in a 45-yr-old loblolly pine (*Pinus taeda L.*) plantation using a multiple-intensity simulator. On Day 1, 127.0 mm was applied and on Day 2, 76.2 mm. Deionized water (mean Ph 5.3) and simulated acid rain (mean Ph 4.2) were applied to two separate, replicate plots. The simulated acid rain reduced NH_4-N concentrations in runoff from 0.08 to 0.04 mg L^{-1} but did not affect TOC or PO_4-P. Nutrient flux during nonacid rainfall applications for TOC, PO_4-P, NH_4-N, and NO_3-N were, respectively, 5.2, 0.003, 0.021, and 0.006 mg m^{-2} mm^{-1} of applied rainfall. The Ph was higher in runoff than in the applied acid rainfall but lower than in the applied nonacid rainfall.

18. Methyl parathion and permethrin were applied to mature cotton plants with conventional hydraulic nozzles and rotary atomizer controlled-droplet applicators with soybean oil, soybean oil plus water, or water as the carrier. Insecticide load on foliage and several other weather variables were measured during the 49-h period following insecticide application. Cumulative rather than mean values for weather variables were used in regression analysis. Cumulative relative humidity was the overall best predictor for insecticide disappearance from cotton foliage. This information is needed for the development of reliable predictive models

for pesticide disappearance from crops under highly variable environmental conditions.

19. The efficacy of three finished formulations of fenvalerate, applied aerially using low-volume technology, for season-long borer control in sugarcane was determined. Fenvalerate residue levels in the upper portion of the sugarcane foliage were significantly higher immediately after application and at all sampling times thereafter for the oil/water treatments compared to the oil-alone and water-alone treatments. Also, fenvalerate dissipated more slowly from the foliage receiving the oil/water treatments. All three fenvalerate treatments had similar but minor effects on beneficial non-target arthropods and all treatments provided > 85% sugarcane borer control. Lower fenvalerate application rates using the oil/water technology could potentially be used to provide excellent borer control and would be environmentally safer.

20. Seasonal trends were observed in the relationships between concentration of fine sediment in transport and stage for the Goodwin Creek watershed. However, the concentration of sands revealed no seasonal effects indicating that the sand bed serves as a source or sink of sand to compensate for seasonal differences in the supply rate from the watershed.

21. Large variations in the size and transport rate of sand and gravel on Goodwin Creek were documented for periods when flow in the channel was steady. Transport rates varied from near zero to about five times the mean rate during one steady flow period. These findings have important implications for sampling coarse sediment on streams. Large errors in predicted sediment transport rates could result if sampling techniques do not allow for this variability.

22. Total sediment transport load of Goodwin Creek was calculated for the period from 10/01/84 to 9/30/88, using transport relations derived from sample data for the fines (< 0.06 mm), sand (0.06-2 mm) and gravel (> 2 mm). Net erosion rates for the watershed from the calculated total sediment loads ranged from 1.3 to 7.4 (mean = 3.3) tons/acre/year. Predicted bed load transport rates from three published transport relations compared poorly with the derived transport relation. It was concluded that the collection of samples is still necessary to accurately calculate total sediment load.

23. As a part of the research on unstable streams, man-made pools below grade-control (low-drop) structures and naturally occurring scour-hole pools were sampled for fish composition. Two hill land streams were chosen because of the presence of grade-control structures used as structural management practices for control of channel erosion from head cutting and because the region has been included in a comprehensive land treatment and channel stability project (Demonstration Erosion Control Project (DEC) of the Yazoo Basin). Differences in the fisheries characteristics of the two pool habitats were expected because of the differences in their relative stability, bottom substrate, and pool life expectancy. Fish length frequency distributions indicated stable reproducing populations of both game and nongame species of fish in man-made pools although they yielded somewhat fewer species. While such pools will not support heavy sport fishing pressure, drop structure pools have several advantages over most

natural scour holes in their fisheries characteristics. They also offer protection from stream channel degradation while providing additional habitat diversity.

For additional information contact C. K. Mutchler, Laboratory Director, USDA-ARS, Sedimentation Laboratory, P. O. Box 1157, Oxford, MS 38655.

NEBRASKA

Research activities of the Soil and Water Conservation Research Unit at the University of Nebraska-Lincoln, Nebraska, include the following:

1. Sediment transport capacity for shallow overland flow was represented as a quadratic function of downslope distance using the assumption of a linear increase in overland flow discharge with downslope distance and an approximation to the Yalin equation for sediment transport capacity. The simplified equation for sediment transport applies to complex topography having uniform soil and management characteristics. The simplified equation accurately approximated the Yalin equation when calibrated using the average of the hydraulic shear stresses at the end of the actual profile. The simplified equation is useful in deriving closed-form solutions to the governing erosion equations for steady state conditions and reduces the computational time when numerical solutions are required.

For additional information, contact James F. Power, Research Leader, USDA-ARS, University of Nebraska, Room 122 Keim Hall, Lincoln, NE 68583-0915.

OKLAHOMA

Research activities at the Water Quality and Watershed Research Laboratory in Durant, Oklahoma include the following:

1. A LANDSAT remote sensing technique was developed and used to classify turbidity in a pilot study involving 16 lakes in central Oklahoma. Using this methodology, lake areas impacted by specified levels of turbidity were quantified. In cooperation with State of Oklahoma Agencies, this effort was expanded and is currently being used to assess over 650,000 acres of surface water involving all public lakes over 100 acres in the entire state.

2. Aggregation of clay particles is an important process affecting the persistence of turbidity in lakes and ponds, and may affect the quantitative determination of suspended clay concentrations by remote sensing techniques. Lakes in south central Oklahoma ranging from low to high turbidity were sampled over a 2 year period in conjunction with LANDSAT overpasses of the area, i.e., at 16 day intervals. Size distributions of the suspended clays were determined by photon correlation spectroscopy when the clay concentration was >30 mg L-1, the lower concentration limit for this method. Mean particle diameters in different lakes ranged from 430 to 2000 nm before dispersion, and from 360 to 930 nm after dispersion with ultrasonic vibration. Particle aggregation increased with increasing concentration of dissolved solids in the lakes. Particle size had little effect on the reflectance of light in the wave length range generally used for remote sensing of suspended sediment.

3. Concentrations and amounts of sediment, nitrogen and phosphorus in surface runoff water were determined for Conventional Till, Reduced Till, and No Till wheat (Triticum aestivum) watersheds in the High Plain, Reddish Prairie, and Rolling Red Plain land resource areas of Oklahoma and Texas. During the four to six-year study periods, RT and NT practices were superior to CT for reducing sediment and particulate nutrient discharge. Mean annual discharge in kg/ha ranged from 230 to 15,900 for sediment, 2.2 to 23.6 for total N, and 0.68 to 6.4 for total P. Irrespective of tillage practice, annual soluble nutrient losses in surface runoff water tended to be small, often <1 kg/ha N or P. Successful prediction of soluble P, total P, and total N losses was achieved using appropriate kinetic desorption and enrichment ratio procedures. Soluble N in runoff posed no particular water quality problem, but recommended P levels were exceeded, even from baseline, unfertilized grassland watersheds. With regard to groundwater quality, elevated levels of nitrate (e.g., 34 mgN/L maximum) were observed on one Reddish Prairie NT watershed.

4. The role of sediment-bound or particulate phosphorus (P) in agricultural runoff in accelerating the biological productivity of surface water can be assessed if the biological availability of particulate P is known. Previous research has shown amounts of P extracted from deposited river and lake sediments by 0.1M NaOH to be correlated with P uptake by the algae Selanastrum capricornutum. Research is being conducted to investigate a modification of this extraction to allow routine quantification of potentially bioavailable particulate P content of runoff. In the proposed method, 20 mL of unfiltered runoff is shaken with 180 mL of 0.11M NaOH for 17 h and bioavailable P concentration calculated by subtraction of the

soluble P concentration of the runoff sample. Growth of P-starved S. capricornutum, incubated for up to 27 d with runoff sediment from nine watersheds, as the sole P source, was correlated with potentially bioavailable P content of the added sediment. A constant amount of P was extracted from runoff sediment by NaOH over a range in sediment concentration of the extraction medium equivalent to that observed for 95% of the runoff events. If the sediment concentration of runoff exceeds 20 g/L, a smaller runoff sample is used in the extraction. The results indicate the applicability of the proposed extraction method to quantify the bioavailability of particulate P transported in agricultural runoff.

5. Control of phosphorus (P) transport in agricultural runoff is of prime importance in limiting accelerated eutrophication. The transport of P in runoff from 22 unfertilized and fertilized grassed and cropped watersheds in Oklahoma and Texas was measured over a 7- to 11-year period. Soluble P (SP) concentration of runoff from unfertilized watersheds was an inverse linear function of suspended sediment concentration, with soil P sorption capacity and labile P content accounting for differences between watershed locations. Particulate P (PP) and bioavailable P (BIOP, algal available P) content of runoff sediment was also an inverse linear function of suspended sediment concentration. PP accounted for the major proportion (84%) of total P transported from the cropped watersheds and 48% from native grass. Conservation tillage of wheat reduced sediment (14-fold) and associated PP (6-fold) and BIOP (9-fold) transport, compared to conventionally tilled wheat, although SP transport increased (2-fold). The PP and BIOP concentration of individual runoff events were accurately predicted using the relationship between soil loss and P enrichment. These results demonstrate the importance of soil erosion in determining the amounts of both SP and PP forms transported in runoff.

For additional information contact Frank R. Schiebe, Laboratory Director, USDA-ARS, Water Quality and Watershed Research Laboratory, P. O. Box 1430, Durant, OK 74702.

OREGON

Research activities at the Columbia Plateau Conservation Research Center in Pendleton, Oregon include the following:

1. An experiment was conducted to evaluate the effects of 4 rates of surface applied straw mulch on infiltration, runoff, and erosion. Surface residue densities of 0, 25, 50, 75, and 100 percent cover were tested using simulated rainfall on 3.33 m^2 plots with a 29 mm/h input rate. The bare plots were replicated 4 times. An analysis of variance of the bare plots indicated no difference in infiltration or runoff volumes when compared to the mulched plots. This can be explained by the presence of a slowly permeable layer below the tillage depth and by the high organic matter of this soil. The analysis also indicated no difference in sediment volume between the bare plots and the 25% cover plot. This suggests that smaller amounts of surface mulch (less than 25%) are of little value in erosion control and is a significant departure from the commonly accepted exponential relationship used to estimate surface residue effects on erosion. The data from this and earlier, similar experiments exhibit a variance which is large enough to limit the predictive usefulness of the data.

2. The 1988-89 winter produced somewhat less erosion than the mean of the previous 11 years at the permanent Kirk erosion site. Measured erosion on the continuous fallow plots was 14 t/ha compared with an average of 39 t/ha. For the winter wheat plots, the observed erosion was 2 t/ha in contrast to an 11 year average of 4 t/ha. No erosion was observed in 3 of the 12 years on the fallow plots and 5 of the 12 years on the winter wheat plots. This is much less erosion than predicted using current technology and is less than the soil loss tolerance even though this land is classified as highly erodible. For the 1989-90 winter, plot size has been reduced to 3 m^2 with 2 replications per treatment. This has simplified plot maintenance and will provide better control when soil management treatments are imposed.

For additional information contact John Zuzel, Hydrologist, USDA-ARS, Columbia Plateau Conservation Research Center, P. O. Box 370, Pendleton, OR 97801.

AGRICULTURAL RESEARCH SERVICE

WASHINGTON

The following research is being conducted by the Land Management and Water Conservation Research Unit at Pullman, Washington:

1. Runoff plots have been installed at the Palouse Conservation Field Station at Pullman on various crop treatments including conventionally tilled, conservation tilled, and direct stubble seeded winter wheat, and various primary tillages of wheat stubble. The purposes are (1) determine the effect of crop treatments on runoff and soil loss; (2) determine the effect of slope length on relative magnitudes of sheet and rill erosion; and (3) develop a residue effectiveness relationship. Instrumentation includes frost depth gages to determine the effect of crop treatment on frost depth and subsequent runoff and erosion during periods of thawing soils.

2. A subfactor method of determining crop management factors (C factor in the USLE) has been developed and output is being used by SCS in Idaho, Oregon, and Washington. Eleven years of runoff and erosion plot data from the Palouse Conservation Field Station at Pullman are being used to substantiate and improve the method. Work is continuing to improve the consistency of the data and to apply the method to additional crop rotations.

3. Shallow frozen soil is a major factor causing runoff and severe erosion in the Pacific Northwest and other States of the U.S. where intermittent frost occurs, but is very unpredictable due to many influences in a short time span. A detailed mathematical model has been developed and tested which computes a simultaneous solution of the vertical soil heat and water (SHAW) budget for two meters above and below the soil surface to account for the hourly impacts of climate, residues, snow cover, and tillage. This research model has proven to be quite accurate on farmland studies over four test years. Further parameter methodology and sensitivity analyses will aid in broader applications.

4. Investigations into the effect of soil freezing and thawing on soil shear strength indicate very low surface shear strength during the thawing process. A flume study, in which soil is frozen and thawed under a range of soil moisture tensions, is being conducted to determine relationships between soil loss and applied shear stress. The results of this study, which provide critical shear strength and rill erodibility data, will be used to improve winter erosion prediction with runoff/erosion models.

5. Breakpoint precipitation data are extremely sparse in the western U.S. This has necessitated calculating rainfall erosivities from an empirical relationship. A recent study indicated the feasibility of using 15- and 60-minute precipitation data to estimate EI values that would be calculated from breakpoint rainfall data. Research is being conducted to apply the method to the entire western U.S. where orographic effects and the scarcity of data have hampered efforts to improve erosion prediction.

For additional information, contact Donald K. McCool, USDA-ARS, Agricultural Engineering Department, 219 Smith Engineering Building, Washington State University, Pullman, Washington 99164-6120.

CORPS OF ENGINEERS

The Hydrologic Engineering Center

Sedimentation activities at the HEC during calender year 1989 focused upon improvements to 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. This version was released to approximately twenty Corps offices for beta testing. It is primarily being used on MOS-DOS microcomputers. An entirely new users manual and input description was prepared. This document also contains a comprehensive set of annotated example problems. An interface with the HEC Data Storage System (DSS) is being designed to allow access of DSS-stored hydrographs and graphical presentation of computed results. It is anticipated that this package will be available for general release in CY 90.

HEC prepared the draft of a Corps Engineer Manual on "River Hydraulics." This manual contains a Chapter on "Water Surface Profiles within Movable Boundary Streams."

HEC participated in the meeting at WES (27 Feb - 2 March 89) to finalize responses to field review comments on the draft Engineer Manual 1110-2-4000, "Sedimentation Investigations of Rivers and Reservoirs". This manual was finalized in Dec. 1989.

HEC participated in the fiftieth meeting of the Committee on Channel Stabilization that was held in Reno, NV. 9 to 11 May 1989.

HEC made several presentations at the Corps Sediment Management Workshop held in S. Sioux City, NE, 12-15 Sept. 1989.

HEC continued to provide assistance to Corps District offices in the analysis of potential river channel stability problems and sediment issues. Work was performed at Alamogordo, NM, Caliente Creek, CA, and on the Truckee River in Reno, Nevada.

CORPS OF ENGINEERS

Waterways Experiment Station

Title of Study:

Surf Zone Sediment Transport Processes Study

Point of Contact:

Ms. Julie D. Rosati, CEWESCR-P

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

All coastlines

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 new longshore sand transport formula, involving a threshold, was developed based on results from several field experiments and incorporated in the shoreline change simulation model GENESIS. A surf zone data acquisition system was upgraded, tested, and used in field experiments on the Atlantic, Gulf, and Lake Michigan coasts. Technical reports on a streamer trap, the DUCK '85 experiment, and a CETN on estimating sand transport rates were published. A GENESIS workshop was conducted and the draft User's Manual was completed.

Title of Study:

Shoreline Change Modeling: Coast of California Storm and Tidal Waves Study, San Diego Region

Point of Contact:

Dr. Nicholas Kraus, CEWESCR

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 transformation, long-term shoreline change, and short-term beach/dune erosion models have been developed for the three cells that make up the San Diego region: Oceanside (divided into two sub-regions), Mission Bay (divided into two sub-regions), and Silver Strand (divided into two sub-regions). The models were calibrated and verified where possible, using existing data. A final report was produced, reviewed, and will soon be published. District personnel were trained in the use of the shoreline change simulation model, GENESIS.

Title of Study:

Inlet Stability

Point of Contact:

Ms. Kathryn J. Gingerich, CEWESCR-P

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

All coastlines

Objectives:

To develop quantitative budget analysis approaches and field-oriented models to predict sediment transport and morphologic change at inlets under natural and engineered situations. Specific activities are designed to improve inlet sand management practices by providing the field with PC tools to predict channel shoaling rates, inlet hydrodynamics, and shoreline response in the vicinity of inlets.

Summary of Accomplishments:

Three chapters of the Engineering Manual "Coastal Inlet Hydrodynamics and Sedimentation" have been completed. A one-dimensional model predicting tidal current velocities at inlets was incorporated into the Automated Coastal Engineering System (ACES). Technical reports were prepared describing Corps District practices related to channel shoaling rate calculations and the utilization of geologic and historical data to analyze tidal inlet projects.

Title of Study:

Coastal Processes Assessment, Folly Beach, South Carolina

Point of Contact:

Mr. Peter Neilans, CEWESCR-P

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

South Carolina

Objectives:

The assess coastal sediment transport processes along Folly Beach, South Carolina and vicinity; develop, calibrate, and verify the shoreline change simulation model GENESIS to the coastline of Folly Island, and apply a cross-shore dune/beach erosion model (SBEACH) to investigate the response of proposed beachfills to storm and non-storm erosive forces. Assist the District in the design of a coastal storm and flood protection project.

Summary of Accomplishments:

The study was initiated in the summer of 1989, was halted after passage of Hurricane Hugo through the study area, and was resumed shortly thereafter. Pertinent information on coastal sediment transport processes at Folly Beach was collected and analyzed. The SBEACH model was developed and tested using data collected following the passage of Hurricane Hugo. Existing conditions are being evaluated with the SBEACH model by subjecting various beach profiles (and the associated structural protection on the landward side of the profile) to extreme storm surge and wave conditions.

Title of Study:

Nearshore Berm Program

Point of Contact:

T. N. McLellan

Water Resources Region:

All Coastlines

Objectives:

To better utilize available resources, time, and money, several innovative ways to beneficially use dredged material are being investigated. The current study is building a data base of nearshore berm projects to evaluate the performance of the berm's ability to augment the littoral system and/or attenuate erosive wave energy.

Summary of Accomplishments:

Nearshore berm projects for the Galveston, Mobile, New York and San Francisco Districts are currently under study to obtain a better understanding of the berm processes. In addition discussions is ongoing with the Los Angeles and Chicago Districts where berm projects are underway. "Engineering Design Consideration for Nearshore Berms" was also published outlining design techniques for nearshore berms.

Title of Study:

Kings Bay Coastal and Estuarine Physical Monitoring and Evaluation Program

Point of Contact:

Ms. Joan Pope

Water Resources Region:

Northeast Florida and Southeast Georgia

Objectives:

The program entails several components that will be evaluated over a 5-year period between 1988-1992. The major coastal study tasks include a review of the historical setting and pre-project data designed to document the long-term evolution to the project area, data collection during the 5-year program designed to identify spatial and temporal changes, and numerical modeling studies designed to extrapolate the measured process-response to future shoreline change scenarios beyond the measurement period or resolution.

Summary of Accomplishments:

Two reports, a detailed summary of historical data of St. Mary's Inlet and vicinity, and analytical predictions of Cumberland Sound sediment sources and redistribution, was delivered to the sponsor, Naval Facilities Engineering Command. Detailed analysis of historic bathymetry dating 1870 to 1974 delineated erosion and accretion patterns, sediment transport movement, and ebb shoal development. A conceptual budget was developed based on historic volume changes. Sediment sinks and sources as well geologic controls were identified for the St. Mary's inlet system. Future research efforts will address ocean shoreline evolution using numerical models, nearshore profile and sediment trends, and wave transformation model.

Title of Study:

Corte Madera Creek Numerical Sedimentation Study

Point of Contact:

Ronald R. Copeland

Water Resources Region:

Corte Madera Creek, Corte Madera, California

Summary of Accomplishments:

A technical report on sedimentation in the Corte Madera Flood Control Project was published. The report described the results of the HEC-6 numerical model investigation.

Title of Study:

Red River Waterway John H. Overton Lock and Dam Numerical Sedimentation Study

Point of Contact:

Bradkey M. Comes

Water Resources Region:

Red River Waterway, Louisiana

Summary of Accomplishments:

A technical report on sedimentation in the lock approaches was published. The report described the results of the TABS-2 numerical model investigation.

Title of Study:

The Effect of Channel Deepening on Shoaling in the Savannah Estuary

Point of Contact:

B. H. Johnson

Water Resources Region:

Savannah River Estuary, Georgia

Summary of Accomplishments:

A technical report on the effect of Savannah Harbor navigation channel deepening on channel shoaling was published. The report described the results of the LAEMSED numerical model investigation.

Title of Study:

Evaluation of Bank Erosion Potential, Clifton, Arizona

Point of Contact:

Ronald R. Copeland

Water Resources Region:

San Francisco River in vicinity of Clifton, Arizona

Summary of Accomplishments:

A technical report on long-term bank erosion potential in the San Francisco River was published. The report described the results of the sediment assessment and HEC-6 numerical model investigation.

U.S. ENVIRONMENTAL PROTECTION AGENCY
Washington, DC

Sediment Criteria

The Science Advisory Board has completed its review and issuing a very favorable report on the Equilibrium Partitioning Approach EqP for assessing sediment quality. The Subcommittee found EqP "to have major strengths in its foundation in chemical theory, its ease of calculation, and its ability to make use of existing data... The conceptual basis of the approach is supported by the Subcommittee however, its application at this time is limited. This is because a better understanding of the uncertainty around the assumptions inherent in the approach, including assumptions of equilibrium, bioavailability, and kinetics, all critical to the application of the EqP is needed." An uncertainty analyses and a guidance document to assist in the regulatory application of developed criteria are under development and expected to be completed this year. To obtain a copy of the SAB's findings report "Report of the Sediment Criteria Subcommittee of the Ecological Processes and Effects Committee - Evaluation of the Equilibrium Partitioning (EqP) Approach for Assessing Sediment Quality" contact Chris Zarba at 475-7326.

U.S. ENVIRONMENTAL PROTECTION AGENCY
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U.S. Environmental Protection Agency - Duluth, MN

The Minnesota River has long been recognized to suffer from water quality problems, particularly with pollutants associated with sediment transport. The Minnesota Pollution Control Agency is providing leadership for the study and has set as a goal a 40 percent reduction in organic nonpoint loadings by July, 1996. The initial four years is a comprehensive assessment of pollutant loadings and defining existing biological resources within the watershed. Study averages for these baseline determinations are 290 mainstream river miles, 10 tributaries, and 3 reservoirs. Lead agencies for the physical/chemical determinations are the U.S. Geological Survey, land use - Mankato State University, biology/toxics - U.S. Environmental Protectional Agency, and data management - Minnesota Pollution Control Agency. In addition, the Soil Conservation Service and Minnesota Department of Natural Resources are assisting in characterizing sediments and fishes in the watershed. This project represents an interagency effort for addressing nonpoint pollution within a major water basin. The gathered water quality and land use information will serve as a guide for statewide and local resource management decisions. For additional information, contact John W. Arthur, Environmental Research Lab-Duluth, 6201 Congdon Blvd., Duluth, MN 55804.

The Upper Illinois River Basin study is being conducted by the U.S. Geological Survey with objectives to define water quality status and trends and associate pollutant and land use with existing stream conditions. The Upper Illinois River basin drains approximately 11,000 square miles within the states of Illinois, Indiana, and Wisconsin. Convergence of these tributaries (Des Plaines, Kankakee, and Fox Rivers) form the Illinois River and is the focus for the study. USGS personnel are performing the hydrological and much of the chemical aspects of the study. The U.S. Fish and Wildlife Service, Illinois Environmental Protection Agency, and others are also actively participating in the project. The U.S. EPA is undertaking specific biological studies; ERL-Duluth in performing measurements of ambient surface water and sediment toxicity and enrichment; Region V (ESD) personnel are doing comparative benthic and fish surveys at the same locations. Thus, biotic and toxic trend assessments are being made of existing baseline conditions. Our biological findings corroborate use designations for these waterways by the state of Illinois. For additional information, contact John W. Arthur, Environmental Research Lab-Duluth, 6201 Congdon Blvd., Duluth, MN 55804.

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Notes on Sedimentation Activities

United States Environmental Protection Agency - Athens, Georgia

The USEPA Environmental Research Laboratory located in Athens, Georgia has been developing geochemical speciation based models suitable for predicting the partitioning behavior and aquatic community exposure to metal/metalloid and ionizable organic contaminants in porewater and water column environments. Based on models of partitioning in aerobic (sulfide free) environments, the complexation behavior of metal contaminants with particulate, amorphous iron oxide has been described. A pH-dependent model describing the partitioning behavior of anionic (negatively charged) organic contaminants also has been developed. For additional information contact Nicholas T. Loux, ERL-Athens (FTS-250-3174).

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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 1989 in each of the five major areas.

Evaluation of Embankment Stability Subject to Flood Overtopping - The objectives of this study 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 were evaluated. In the overall design framework for highway stream crossings, these results provide guidelines for risk analysis and lowest total expected cost design. 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. Additional work to investigate cable-tied block systems as conducted under the FHWA contract but sponsored jointly by the BOR, TVA and SCS. Two final reports will be published in 1990.

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. The revised HEC-11 "Design of Riprap Revetment" was published in March 1989.

B. A graduate research fellowship study was completed at FHWA's hydraulics lab on sizing riprap to protect bridge piers from local scour. The study included an investigation of riprap needed to stabilize existing scour holes as well as to stabilize a flat bed before scour commences. Art Parola prepared a PhD. dissertation for Penn State University based on this study in 1989. A Public Roads article and an ASCE paper based on this study are planned for 1990.

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 study, generally referred to as the National Scour 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. This study was extended from 3½ to 5 years in duration, it is scheduled for completion in 1992.

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, a subcontractor to Simons and Associates. The three year study is scheduled for completion in 1990. A preliminary workshop on this model was conducted in December 1989.

D. Virginia completed the HPR study "Major Factors Affecting the Performance of Bridges during Flooding," investigating 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. Bridge failures from the 1985 flooding in Virginia were investigated. The final report "Major Factors Affecting the Performance of Bridges during Floods," Report No. FHWA/VA-89-23 was published by the Virginia Transportation Research Council, Charlottesville, Virginia in May 1989.

E. The USGS Connecticut District Office started the study "Seismic and Radar Scour Equipment," sponsored by the FHWA. This is a continuation of a pilot study on the use of selected geophysical techniques to recreate the scour history of bridge piers and abutments. Equipment and deployment methods being evaluated include the use of color video fathometers, low frequency sonar, and ground penetrating radar for subbottom plotting and for detection of refilled scour holes.

F. The FHWA launched the Demonstration Project #80, "Bridge Inspection Techniques and Equipment," to show bridge inspectors and managers the latest technical information to improve the quality of bridge inspections. Emphasis is placed on underwater equipment including scour detection

equipment. it also promotes the use of new and innovative equipment for providing the inspector better access to bridge components, for inspecting fracture critical members, and for performing underwater inspections. A total of 25 workshops were performed in 1989 and 21 more are scheduled for 1990.

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 six States conducting eight studies designed to reduce erosion through improved vegetation establishment and maintenance, and through the use of improved erosion control fabrics. The participating States are 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. North Dakota State University continued the investigation of the corrective repair of road edge scour for grassed highway shoulders.

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 1989 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 1990.

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 final report will be published in 1990.

D. An FHWA administrative contract research study, "Guidelines for Protective Systems for Spills of Hazardous Materials on the Highway System," was completed by the Kansas State University of Manhattan, Kansas. This investigation focused 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. The draft final report was reviewed. The final report will be published in 1990.

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 continued investigation of the cost-effective management of such materials and thus prevent or neutralize leaching of deleterious low pH runoff from excavated acid soil materials.

F. Ten States continued 17 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, "Effects on Wetlands When Utilized for Treating Highway Runoff."

Florida/USGS, "Impacts of Stormwater Management Practices on Ground Water."

Florida, "Effects of Structural Changes on Water Quality Efficiency of Stormwater Detection Ponds."

Florida, "Maintenance Guidelines for Accumulated Sediments in Retention/Detention Ponds Receiving Highway Runoff."

Florida, "Design and Maintenance of Exfiltration Systems."

Florida, "Activated Carbon Filter."

Georgia, "Biodegradation of Organic Compounds."

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,
FEDERAL HIGHWAY ADMINISTRATION, BUREAU OF LAND MANAGEMENT,
AGRICULTURAL RESEARCH SERVICE, FOREST SERVICE,
TENNESSEE VALLEY AUTHORITY

Federal Inter-Agency Sedimentation Project
St. Anthony Falls Hydraulic Laboratory
Minneapolis, Minnesota

The Sedimentation Project continued to develop new instruments and techniques for automatically measuring suspended-sediment concentrations in rivers. During 1989, efforts focused on two instruments: the vibrating U-tube gage and the plummet gage. Two additional field sites--one near Portland, Colorado and the other near Tucson, Arizona--were outfitted with U-tube gages. To simplify field-installations, new hydraulic and electronic systems were designed during 1989 and are slated for testing during 1990. The plummet gage is an experimental device that has been tested only in the laboratory. It consists of a sensitive electronic balance supporting a glass weight (plummet) in a column of river water. Concentrations are obtained from records of the balance signal which are compensated for water temperature and conductivity. Preliminary results, which have been published in the article "A Reexamination of the Plummet Method for Determining Sediment Concentration" by Joseph Szalona, indicate the plummet instrument is more accurate than the U-tube under rapidly changing temperatures and concentrations.

A new valve for the P-61 point-integrating, suspended-sediment sampler was designed to improve reliability; however, engineers at the G.S. Hydrologic Instrumentation Facility found the valve sometimes failed if the sampler was struck a sharp blow or subjected to vibrations from oscillating suspension cables. The Sedimentation Project redesigned the valve and scheduled it for more testing during 1990.

Growing interests in studying chemical properties of sediments placed new requirements on traditional point- and depth-integrating sediment samplers. For example, tests showed the internal valve on the D-77 sampler releases small amounts of metals into samples and thereby produces misleading results. In an effort to overcome this problem, the Project redesigned the valve and submitted it for more chemical evaluations. The Project also contracted a commercial firm to manufacture critical sampler parts out of chemically-inert materials.

Joseph Beverage published a technical note "Comparison of the U.S. P-61 and the Delft Bottle Sediment Sampler" in the ASCE Journal of Hydraulic Engineering. John Skinner published the paper "A History of the Sedimentation Project" in the Proceedings of the Sediment Transport Modeling Symposium sponsored by the ASCE.

The Project continued to work with ASTM in efforts to standardize sampling and analyzing-techniques in sediment. During 1989, the Project prepared and submitted a standard on techniques for measuring concentrations of sediment in water samples. After the Society has voted and accepted the standard, the Project will arrange for collaborative testing of the method at several laboratories.

The Project continued to calibrate, distribute, and repair sediment samplers and laboratory analyzers. Don Benson and Luverne Fanjoy, Corps of Engineers personnel with the Project, supplied 102 major items to Federal agencies during 1989.

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, corsider 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.

Nolan, K. M., Kelsey, H. M., and Marron, D. C., in press, Summary of research in the Redwood Creek Basin, 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.

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 transport, (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.

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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 sediment.

OBJECTIVE: To define and understand (1) processes by which pollutant 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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