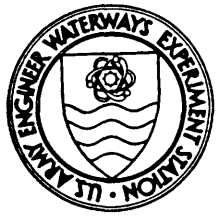
DRP-6-02
May 1996



Dredging Research Technical Notes

A DRP Product Guide

Purpose

This technical note summarizes products investigated and developed by the Dredging Research Program (DRP) that are available to the dredging community. A complete bibliography of DRP publications and other technical transfer products, such as videos and personal computer (PC) programs, is provided. Details are also furnished on how the DRP products and product information and guidance can be obtained.

DRP products are designed to provide assistance to persons involved in all aspects of dredging, including project design and management, planning, engineering, contracting, and equipment design.

Background

Established by the U.S. Army Corps of Engineers in fiscal year 1988 and ending in fiscal year 1994, the DRP was a 7-year program with the objective of developing products through applied research and development to reduce the cost of dredging operations. The DRP addressed a wide and diverse range of dredging problems, resulting in the development of equipment and instrumentation, software, and operational monitoring and management procedures. DRP work units were grouped into five Technical Areas (TAs). The titles and objectives of the five TAs are given in Table 1.

Additional Information

For additional information concerning the contents of this technical note contact the author, Ms. Terri L. Prickett, (601) 634-2337, or the manager of the Dredging Research Program, Mr. E. Clark McNair, (601) 634-2070.

US Army Engineer Waterways Experiment Station
3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Table 1 Technical Areas and Objectives		
Technical Area No.	**Title**	**Objectives**
1	Analysis of Dredged Material Placed in Open Water	To investigate the short- and long-term fate of dredged material disposed in open water.
2	Material Properties Related to Navigation and Dredging	To investigate assessment of material properties and characteristics of bottom sediments and rock material to be dredged.
3	Dredge Plant Equipment and System Processes	To investigate new dredging equipment and systems and provide guidance for improvement of existing dredging equipment.
4	Vessel Positioning, Survey Controls, and Dredge Monitoring Systems	To evaluate and develop equipment systems that monitor and report hopper dredge activities, an accurate positioning system for dredging and hydrographic surveying, and a real-time system for measuring tide and wave conditions at offshore project sites.
5	Management of Dredging Projects	To provide tools, procedures, and information to enhance the ability of managers of dredging projects and programs to evaluate existing management options or to assess new ones.

Product Descriptions

The products (tools, techniques, and technological advances) resulting from DRP research are briefly described below, arranged by Technical Area.

Technical Area 1 - Analysis of Dredged Material Disposed in Open Water

The PLUme MEasurement System (PLUMES) is a field data collection system that measures suspended sediment concentration and three-dimensional fluid velocities at dredging or disposal sites. The remote sensing PLUMES consists of a commercially available broadband acoustic doppler current profiler (five-beam) with computer hardware and software for data acquisition and postprocessing. The PLUMES also requires a horizontal positioning system and can be used to monitor shallow- or deep-water disposal operations [POC: Michael W. Tubman].

Acoustic Resuspension Measurement System (ARMS) is a portable underwater instrument/electronics system that includes an ensemble of specialized underwater sensors to accurately measure in situ properties of the bottom-boundary layer (sediment entrainment and erosion/accretion) above dredged material mounds in open-water disposal areas. The ARMS acquires field boundary layer data for dredged material site designation and monitoring [POC: Norman W. Scheffner].

Sea Bed Drifters are low-technology monitoring devices that can be used to map current patterns and provide information on sediment movement from disposal sites [POC: Edward B. Hands].

STFATE is a PC program designed to predict the short-term fate of dredged material from several minutes to a few hours after disposal from a barge or hopper dredge. STFATE calculates suspended sediment concentrations and also computes the bottom footprint of the disposed dredged material mound from a single disposal operation [POC: Billy H. Johnson].

LTFATE is a PC program that computes the long-term stability of a dredged material disposal mound in open water as a function of waves, currents, depths, geometry, and material comprising the mound [POC: Norman W. Scheffner].

MDFATE is a PC program that combines LTFATE and STFATE computations to simulate dynamic building and erosion of mounds resulting from multiple disposal operations. MDFATE addresses questions on site capacity and dispersive characteristics of dredged material disposed in open water [POC: Billy H. Johnson].

COSED1V is a PC model used to assess the potential for cohesive sediment dispersion from a disposal site where conditions may result in the entrainment of fluid mud. Theoretical developments from COSED1V have been incorporated into LTFATE to allow for long-term computation of cohesive sediment mounds [POC: Allen M. Teeter].

NMLONG (Numerical Model for Simulating the Longshore Current) is a PC program that calculates the longshore current across a barred profile to aid in estimation of longshore sand transport and evolution of longshore bars [POC: Norman W. Scheffner].

Predictive techniques were refined for evaluating the potential of sands for beach nourishment. This new methodology predicts an equilibrium beach profile resulting from placement of an arbitrary volume of material with an arbitrary grain-size distribution on a profile of arbitrary shape and grain-size distribution [POC: Norman W. Scheffner].

ADCIRC (Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries) is a long-wave hydrodynamic finite element model for long-term computation of tidal constituents and storm surge information over very large computational domains. ADCIRC was developed for use in investigating the long-term dispersive or nondispersive characteristics of existing or proposed open-water disposal sites [POC: Norman W. Scheffner].

A tidal constituent database was generated with ADCIRC that provides simulated time series of tidal elevation and current for any location along the U.S. east and west coasts, Gulf of Mexico, and Caribbean Sea. Generated data can be input into the LTFATE model or any application requiring tidal forcing data [POC: Norman W. Scheffner].

A tropical storm database was generated with ADCIRC that provides simulated surge elevations and currents along the east and Gulf coasts and Puerto Rico [POC: Norman W. Scheffner].

Height, Period, Direction PREprocessor (HPDPRE) and Height, Period, Direction SIMulation (HPDSIM) are PC programs that generate long time sequences of simulated wave data. These data can be input to LTFATE to determine how a dredged material mound behaves over time as well as other applications that require simulated wave information [POC: Norman W. Scheffner].

COhesive sediment eRODibility assEssment (CORODE) is a PC program that employs various laboratory data sets to describe sediment erodibility characteristics as well as erosion test shear stress, eroding fluid conditions, and erosion test device configuration [POC: Allen M. Teeter].

HPROFILE is a PC-based numerical model that predicts velocity differences caused by sudden changes in bathymetry such as a dredged material mound or trench. HPROFILE can be used to determine whether material will be eroded or transported from the disposal site [POC: Allen M. Teeter].

Wave-Current-Sediment TRANSport (WCTRANS) is a computer program that predicts bottom sediment transport (bed load and suspended load) in the coastal zone [POC: Norman W. Scheffner].

Empirical BERM (EBERM) PC program estimates the physical stability of berms built with specific size granular materials and exposed to various erosive forces [POC: Edward B. Hands].

Technical Area 2 - Material Properties Related to Navigation and Dredging

A Fluid Mud Survey System estimates required and actual dredging volumes from condition and pre- and post-dredging surveys and augments acoustic depth surveys in navigation channels obstructed by fluid mud accumulation. The system integrates a towed sled that defines bottom sediments in conjunction with a dual-frequency acoustic fathometer. Sled sensors include depth (hydrostatic pressure), material density (nuclear transmission), tilt (inclinometers), and cable tension (strain gages). This system works with conventional hydrographic survey positioning equipment and software [POC: Allen M. Teeter].

An acoustic impedance (AI) method of subbottom profiling was developed to remotely and rapidly determine characteristics of subbottom marine sediments. The AI system includes commercially available high-resolution geophysical profiling systems operating at frequencies below 12 kHz along with post-processing software and is incorporated with digital terrain modeling techniques to provide computations of volume and material type to be removed by dredging [POC: Robert F. Ballard].

GEOtechnical factors in DREDGing (GEODREDG) is a knowledge-based expert system consisting of three PC WINDOWS-driven programs [POC: W. Milton Myers].

a. GEOSITE (GEOtechnical SITE investigation methods) offers guidance for the selection of subsurface investigation equipment and methods for sediments assumed to be present.

b. GEOCLASS (GEOtechnical soil CLASSification) provides guidance to identify, describe, and classify soil samples.

c. DREDGABL provides guidance in determining the dredgeability of sediments at a site in terms of the geotechnical descriptors of the sediments.

The Drilling Parameter Recorder, a commercially available equipment system, is capable of monitoring and recording parameters associated with drill rig response as cores are taken in a rock mass. Associated software analyzes and interprets the parameters to determine the specific energy of drilling and in situ unconfined compressive strength [POC: Hardy J. Smith].

The Point Load Test (PLT) was adapted for quick onsite determination of the unconfined compressive strength of rock material to be dredged using easily portable equipment. The PLUCS (Point Load Index and Unconfined Compressive Strength) database system is companion software to the PLT and stores, retrieves, and compares rock test data [POC: Hardy J. Smith].

Technical Area 3 - Dredge Plant Equipment and System Processes

Recommendations for trailing suction draghead design modifications to increase productivity were developed through laboratory and field testing. Also, a diamond-shaped draghead design was developed for protection of sea turtles from hopper dredging activities [POC: Glynn E. Banks].

Hydraulic design guidance for fluidizers was developed to augment sand-bypassing activities for use in stabilizing and maintaining a navigable channel [POC: James E. Clausner].

An improved sand-bypassing eductor system was designed to reduce problems with deployment and retrieval and clogging with debris and was tested for performance along with other commercially available eductors. Commercial submersible pumps were also tested for performance [POC: James E. Clausner].

A portable single-point mooring buoy for hopper dredge direct pumpout was designed so that dredged material could be placed in previously inaccessible areas and increase the beneficial uses of dredged material [POC: James E. Clausner].

A hopper production monitoring system was developed to monitor solids density and payload. Two instrumentation systems (described below) are included [POC: Stephen H. Scott].

a. Acoustic sensors and pressure transducers to measure the level of dredged material in the hopper.

b. Electrical resistivity probes to measure vertical solids density in a dredge hopper.

The Automated Load Monitoring System (ALMS) is a PC program that automates the hopper production monitoring system [POC: Stephen H. Scott].

Technical Area 4 - Vessel Positioning, Survey Controls, and Dredge Monitoring Systems

The Automated Real-Time Tidal Elevation System (ARTTES) provides real-time vertical water-level control for offshore survey and dredging operations requiring tidal data [POC: Andrew W. Garcia].

The Vertical Motion System (VMS-II) is a second-generation frequency domain-based inertial system that uses commercially available sensors and eliminates phase lag to provide real-time estimates of vertical motion for hydrographic survey applications [POC: Andrew W. Garcia].

An On-The-Fly Differential Global Positioning System (OTF-DGPS) is a carrier phase-based positioning system using commercially available equipment. The OTF-DGPS provides real-time three-dimensional positions with horizontal and vertical accuracies better than 1 dm (4 in.) and makes real-time tide corrections for hydrographic survey and dredging applications [POC: Steve DeLoach].

The Silent Inspector (SI) system automatically logs data from instruments generally maintained aboard hopper dredges. The SI provides summaries of these data in both report and graphical form to better assess contractor performance and adherence to contract terms [POC: James R. Rosati].

Guidance on dredge production meter systems (an instrumentation plan) was developed from equipment evaluations for performance and accuracy and from a comparative survey. Proper planning and use of dredge production meters can increase production and improve overall efficiency in hopper and pipeline dredges during dredging operations [POC: Stephen H. Scott].

PC-based data-acquisition systems (DAS) were developed for dredge production meter data collection, real-time processing, and data display. The DAS are designed to operate unattended and continuously [POC: Stephen H. Scott].

A Dragarm Monitoring System (DAMS) monitors hopper dredge dragarms and provides visual display of the dragarm position and ship draft and list [POC: Stephen H. Scott].

The Small Boat Hydrographic System (SBS) is a commercially available package consisting of several multitasking computer programs designed to support hydrographic surveying activities. Modules have been added to the SBS to add position and depth information to tie into the fluid mud survey system described under TA 2 [POC: Stephen H. Scott].

Technical Area 5 - Management of Dredging Projects

General guidance in capping technologies was developed for designing, executing, and monitoring capped features in open-water disposal sites [POC: Michael R. Palermo].

Design guidance for nearshore berm creation and behavior was developed to evaluate berms as disposal options and to develop site-specific berm configurations [POC: Cheryl B. Pollock].

Fluidizing or water injection dredging systems were evaluated as a low-cost alternative to traditional dredging for appropriate locations [POC: James E. Clausner].

Guidance on open-water disposal site management provides information for developing and implementing effective monitoring and management plans for those sites [POC: James E. Clausner].

The Corps of Engineers' "Red Book," *The Hopper Dredge: Its History, Development and Operation*, will be updated to include a compilation of major events since publication of the book in 1954. The title of the updated chronicle is *The Corps of Engineers Hopper Dredging, 1954-1994* [POC: Gary C. Lynch].

The 1953 Engineer Manual (EM) 1125-2-312, *Manual of Instructions for Hopper Dredge Operations and Standard Reporting Procedures*, was modernized to reflect changes in policies, definition of terms, and reporting forms. This updated EM also includes information for sidecasting dredges [POC: James E. Clausner].

A benefits analysis was conducted that determined the known and potential cost savings resulting from use of DRP products within each District [POC: James E. Clausner].

DRP Products for Information Transfer

The DRP uses a wide range of products to convey research results to the Corps dredging community. Standard publication products include documentary reports (Instruction, Technical, and Contract reports), Miscellaneous Papers, and Technical Notes. Video reports are also available that highlight specific DRP

projects and accomplishments. Numerous PC programs were developed for use of DRP technology in specific situations (for example, prediction and assessment). The variety of DRP products is described in *Dredging Research Technical Notes* DRP-6-01 (Tillman 1993).

DRP Assistance

DRP technology transfer activities to the Corps dredging community are continuing under the Dredging Operations Technical Support (DOTS) Program. The DOTS Program is funded through the Environmental Effects of Dredging Programs (EEDP) at the Waterways Experiment Station (WES) by Headquarters, U.S. Army Corps of Engineers (HQUSACE), Dredging and Navigation Branch (CECW-OD), and is designed to facilitate the dissemination of dredging and dredged material disposal research technology to the field. Activities of the DOTS Program now include DRP products technical assistance, user workshops, technical notes, and information exchange bulletins. Requests for DOTS assistance may be sent to: U.S. Army Engineer Waterways Experiment Station, ATTN: Mr. Thomas R. Patin, DOTS Program Manager, CEWES-EE-A, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, telephone (601) 634-3444 or e-mail patint@ex1.wes.army.mil.

How to Obtain DRP Information

DRP Contacts

The Program Manager, Technical Area Managers, and Principal Investigators were key personnel in the DRP team and now serve as points of contact for information pertaining to DRP technology. The roles of DRP personnel are discussed in *Dredging Research Technical Notes* DRP-6-01 (Tillman 1993). Table 2 provides the names of all current DRP contacts for information on DRP products.

Publications

Publications of WES and other Corps offices are distributed primarily to Department of Defense agencies and certain other agencies having an interest in the work reported. Copies of reports remaining after the initial distribution are available without charge to Federal Government agencies and the general public on request until the supply of the particular item is exhausted. Requests for DRP reports, Miscellaneous Papers, Video Reports, and Technical Notes may be sent to: U.S. Army Engineer Waterways Experiment Station, ATTN: Reports Distribution Office (CEWES-IM-R), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199; telephone (601) 634-2571 or (601) 634-2696.

Reports not available through WES can be purchased from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; telephone, (703) 487-4650. Costs of hard copies or microfiche of these reports are available from NTIS on request. Most

DRP reports (Instruction, Technical, and Contract) and Miscellaneous Papers listed in the following bibliography are accompanied by AD numbers required by NTIS for ordering.

For Internet users, access to DRP publications is available via the WES home page (**http://bigfoot.cerc.wes.army.mil/c180.html**).

Table 2
Key Personnel
Dredging Research Program

	Office	Office Symbol	Telephone No.
Program Management			
E. Clark McNair	Program Manager, Coastal Engineering Research Center	CEWES-CP-D	(601) 634-2070
Lyndell Z. Hales	Assistant Manager, Coastal Engineering Research Center	CEWES-CP-D	(601) 634-3207
Karen R. Wood	Coastal Engineering Research Center	CEWES-CP-D	(601) 634-4271
Technical Managers			
Billy H. Johnson (Area 1)	Hydraulics Laboratory	CEWES-HR-M	(601) 634-3425
Don C. Banks (Area 2)	Geotechnical Laboratory	CEWES-GS	(601) 634-2630
William D. Martin (Area 3)	Hydraulics Laboratory	CEWES-HE-E	(601) 634-4157
George P. Bonner (Area 4)	Instrumentation Services Division	CEWES-JV-Z	(601) 634-2538
Thomas W. Richardson (Area 5)	Coastal Engineering Research Center	CEWES-CD	(601) 634-2019
Principal Investigators			
	DRP Work Unit	**Technical Area**	**Telephone No.**
Norman W. Scheffner CEWES-CR-P	Calculation of Boundary Layer Properties (Noncohesive Sediments)	1	(601) 634-3220
	Numerical Simulation Techniques for Evaluating Long-Term Stability of Dredged Material Disposed in Open Waters	1	
Michael W. Tubman CEWES-CD-P	Measurement of Entrainment and Transport (Noncohesive Sediments)	1	(601) 634-3009

(Continued)

Table 2 (Continued)			
Principal Investigators (Continued)			
	DRP Work Unit	**Technical Area**	**Telephone No.**
Allen M. Teeter CEWES-HE-P	Calculation of Boundary Layer Properties (Cohesive Sediments)	1	(601) 634-2820
	Measurement of Entrainment and Transport (Cohesive Sediments)	1	
Billy H. Johnson CEWES-HR-M	Numerical Simulation Techniques for Evaluating Short-Term Stability of Dredged Material Disposed in Open Waters	1	(601) 634-3425
Edward B. Hands CEWES-CD-SE	Field Techniques and Data Analysis to Assess Fate of Open-Water Disposal Deposits	1	(601) 634-2088
Robert F. Ballard CEWES-GG	Rapid Measurements of Properties of Consolidated Sediments	2	(601) 634-2201
W. Milton Myers CEWES-GS-S	Descriptors for Bottom Sediments to Be Dredged	2	(601) 634-2640
Hardy J. Smith CEWES-GS-R	Descriptors for Rock Materials to Be Dredged	2	(601) 634-2431
Allen M. Teeter CEWES-HE-P	Measurement and Definition of Navigable Depth in Fluff and Fluid Mud	2	(601) 634-2820
Glynn E. Banks CEWES-HE-E	Improved Draghead Design	3	(601) 634-3597
James E. Clausner CEWES-CD-SE	Improved Eductors for Sand Bypassing	3	(601) 634-2009
	Dredging Equipment for Nearshore and Onshore Placement	3	
Stephen H. Scott CEWES-HE-E	Technology for Monitoring and Increasing Dredge Payloads in Fine-Grained Sediments	3	(601) 634-4286
	Production Meter Technology	4	
Andrew W. Garcia CEWES-CD-P	Integrated Vertical Control System	4	(601) 634-3555
Steve DeLoach CETEC-TL-SP	Horizontal/Vertical Positioning System Utilizing GPS Satellite Constellation	4	(703) 355-3026
(Continued)			

Table 2 (Concluded)			
Principal Investigators (Continued)			
	DRP Work Unit	**Technical Area**	**Telephone No.**
James R. Rosati CEWES-CD-P	Silent Inspector	4	(601) 634-2022
Gary C. Lynch CEWES-HR-N	Dredge Plant Manuals	5	(601) 634-4165
James E. Clausner CEWES-CD-SE	Open Water Placement Site Planning, Design, and Operation	5	(601) 634-2009
Michael R. Palermo CEWES-EE-P	Capping Technology	5	(601) 634-3753
Cheryl B. Pollock CEWES-CD-SE	Berm Design Guidance	5	(601) 634-4029
Terri L. Prickett CEWES-CD-P	Dredging Technology Transfer	Program Management	(601) 634-2337

Dredging Research Program Bibliography

Instruction Reports

IR DRP-94-1, "DREDGABL: Geotechnical Factors in Dredgeability," S. Joseph Spigolon, October 1994 [AD Number A286724].

IR DRP-95-1, "LTFATE: A Model to Investigate the Long-Term Fate and Stability of Dredged Material Disposal Sites," Norman W. Scheffner, Michelle M. Thevenot, James R. Tallent, and John Mason, May 1995 [AD Number A294892].

IR DRP-95-2, "Silent Inspector User's Manual," Jeffrey M. Cox, Paul Maresca, and Andrea Jarvela, October 1995 [AD Number A303275].

Technical Reports

TR DRP-90-1,"Practices and Problems Associated with Economic Loading and Overflow of Dredge Hoppers and Scows," Michael R. Palermo and Robert E. Randall, October 1990 [AD Number A229528].

TR DRP-90-2, "Results of Monitoring the Disposal Berm at Sand Island, AL; Report 1, Construction and First Year's Response," Edward B. Hands, December 1990 [AD Number A231838].

TR DRP-91-1, "NMLONG: Numerical Model for Simulating the Longshore Current," Nicholas C. Kraus and Magnus Larson, June 1991 [AD Number A239856].

TR DRP-91-2, "Simulation of Time Sequences of Wave Height, Period, and Direction," Leon E. Borgman and Norman W. Scheffner, August 1991 [AD Number A241211].

TR DRP-91-3, "Mobile, Alabama, Field Data Collection Project, 18 August - 2 September 1989; Report 1, Dredged Material Plume Survey Data Report," Nicholas Kraus (editor), September 1991 [AD Number A242580].

TR DRP-92-1, "Feasibility of a Kinematic Differential Global Positioning System," David E. Wells and Alfred Kleusberg, March 1992 [AD Number A248953].

TR DRP-92-2, "Global Positioning System Bibliography," Wendlynn Wells, David E. Wells, and Alfred Kleusberg, March 1992 [AD Number A248954].

TR DRP-92-3, "Boundary Stresses and Velocity Profiles in Estuarine Flows; Report 1, Interim Calculation Methods," William McAnally and Earl J. Hayter, September 1992 [AD Number A265298].

TR DRP-92-4, "Laboratory Testing of Methods to Increase Hopper Dredge Payloads: Model Hopper Bin Facility and Centrifugal Solids Concentrator,"

Stephen H. Scott, Walter Pankow, and Thad C. Pratt, August 1992 [AD Number A257270].

TR DRP-92-5, "Analysis of Cross-Shore of Natural Longshore Bars and Material Placed to Create Longshore Bars," Magnus Larson and Nicholas C. Kraus, September 1992 [AD Number A257968].

TR DRP-92-6, "ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 1, Theory and Methodology of ADCIRC-2EEI and ADCIRC-3DL," Richard A. Luettich, Jr., Joannes J. Westerink, and Norman W. Scheffner, November 1992 [AD Number A261608].

TR DRP-92-6, "ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 2, User's Manual for ADCIRC-2DDI," Joannes J. Westerink, C. A. Blain, Richard A. Luettich, Jr., and Norman W. Scheffner, January 1994 [AD Number A276150].

TR DRP-92-6, "ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 3, Development of a Tidal Constituent Database for the Western North Atlantic and Gulf of Mexico," Joannes J. Westerink, Richard A. Luettich, Jr., and Norman W. Scheffner, June 1993 [AD Number A268685].

TR DRP-92-6, "ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 4, Hurricane Storm Surge Modeling Using Large Domains," C. A. Blain, Joannes J. Westerink, Richard A. Luettich, Jr., and Norman W. Scheffner, August 1994 [AD Number A283868].

TR DRP-92-6, "ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 5, A Tropical Storm Database for the East and Gulf of Mexico Coasts of the United States," Norman W. Scheffner, David J. Mark, C. A. Blain, Joannes J. Westerink, and Richard A. Luettich, Jr., August 1994 [AD Number A288576].

TR DRP-92-6, "ADCIRC: An Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries; Report 6, Development of a Tidal Constituent Database for the Eastern North Pacific," J. L. Hench, Richard A. Luettich, Jr., Joannes J. Westerink, and Norman W. Scheffner, February 1995.

TR DRP-92-7, "Tylers Beach, Virginia, Dredged Material Plume Monitoring Project, 27 September to 4 October 1991," Michelle M. Thevenot, Terri L. Prickett, and Nicholas C. Kraus (editors), December 1992 [AD Number A261036].

TR DRP-92-8, "Preliminary Design for Dredged Material Placement Physical Modeling Facilities," Mills Soldate, James R. Pagenkopf, and Michael R. Morton, December 1992 [AD Number A260186].

TR DRP-93-1, "Development and Verification of Numerical Models for Predicting the Initial Fate of Dredged Material Disposed in Open Water; Report 1, Physical Model Tests of Dredged Material Disposed from a Split-hull

Barge and Multiple Bin Vessel," Billy H. Johnson, Dinah N. McComas, Darla C. McVan, and Michael J. Trawle, May 1993 [AD Number A270476].

TR DRP-93-1, "Development and Verification of Numerical Models for Predicting the Initial Fate of Dredged Material Disposed in Open Water; Report 2, Theoretical Developments and Verification Results," Billy H. Johnson and Moira T. Fong, February 1995 [AD Number A292040].

TR DRP-93-2, "Improvements to the Automated Real-Time Tidal Elevation System," Leon J. Borgman, Andrew W. Garcia, and Todd L. Walton, October 1993 [AD Number A273150].

TR DRP-94-1, "Understanding and Interpreting Seabed Drifter (SBD) Data," Donald T. Resio and Edward B. Hands, January 1994 [AD Number A277022].

TR DRP-94-2, "Water Jets as a Draghead Enhancement Device; Hydraulic Model Investigation," Noble J. Brogden, Glynn E. Banks, and John A. Ashley, June 1994 [AD Number A282884].

TR DRP-94-3, "Plume Measurement System (PLUMES) Calibration Experiment," Atle Lohrmann and Craig Huhta, August 1994 [AD Number A284594].

TR DRP-94-4, "Monitoring of Waves and Currents Near the Alabama Dredged Material Mounds," David D. McGehee, James P. McKinney, William E. Grogg, and Edward B. Hands, September 1994 [AD Number A285292].

TR DRP-94-5, "Improving Site Characterization for Rock Dredging Using a Drilling Parameter Recorder and the Point Load Test," Hardy J. Smith, September 1994 [AD Number A286725].

TR DRP-94-6, "Improved Eductors for Sand Bypassing," Gregory L. Williams, James E. Clausner, and Peter J. Neilans, November 1994 [AD Number A290665].

TR DRP-94-7, "Correlating Seabed Drifter Weights to Sand Threshold Conditions in Wave and Wave/Current Environments," Edward B. Hands and Charles K. Sollitt, December 1994.

TR DRP-95-1, "Plume Measurement System (PLUMES) Technical Manual and Data Analysis Procedures," Michael W. Tubman, February 1995 [AD Number A292918].

TR DRP-95-2, "Laboratory and Field Investigations of Technologies for Hopper Dredge Production and Process Monitoring," Stephen H. Scott, Jeffrey Jorgeson, Monroe B. Savage, Jr., and Cary B. Cox, February 1995 [AD Number A294003].

TR DRP-95-3, "A Technique to Assess the Characteristics of Bottom and Sub-bottom Marine Sediments," Richard G. McGee, Robert F. Ballard, Jr., and David D. Caulfield, April 1995 [AD Number A295105].

TR DRP-95-4, "Influence of Domain Size and Grid Structure on the Response Characteristics of a Hurricane Storm Surge Model," C. A. Blain, Joannes J. Westerink, Richard A. Luettich, Jr., and Norman W. Scheffner, March 1995 [AD Number A296489].

TR DRP-95-5, "Descriptors for Bottom Sediments to Be Dredged: Summary Report for Work Unit No. 32471," Lyndell Z. Hales, July 1995 [AD Number A298856].

TR DRP-95-6, "Impact of Near-Bottom Currents on Dredged Material Mounds near Mobile Bay," Scott Douglass, Donald T. Resio, and Edward B. Hands, July 1995 [AD Number A299432].

TR DRP-95-7, "Material Properties Related to Navigation and Dredging: Summary Report for Technical Area 2," Lyndell Z. Hales, September 1995 [AD Number A301847].

TR DRP-95-8, "Dredging Research Program Benefits Analysis," F. H. (Bud) Griffis, Charles E. Jetmar, Sotiris Pagdadis, and Russell K. Tillman, November 1995 [AD Number A302295].

TR DRP-95-9, "Vessel Positioning, Survey Controls, and Dredge Monitoring Systems: Summary Report for Technical Area 4," Lyndell Z. Hales, November 1995 [AD Number A303283].

TR DRP-95-10, "Dredge Plant Equipment and System Processes: Summary Report for Technical Area 3," Lyndell Z. Hales, December 1995 [AD Number A304167].

TR DRP-96-1, "Silent Inspector System Technical Manual," Jeffrey M. Cox, Paul Maresca, and James Rosati III, February 1996 [AD Number A304931].

TR DRP-96-2, "Management of Dredging Projects; Summary Report for Technical Area 5," Lyndell Z. Hales, February 1996.

TR DRP-96- , "Analysis of Dredged Material Disposed in Open Water; Summary Report for Technical Area 1," Lyndell Z. Hales (in preparation).

TR DRP-96- , "The Dredging Research Program; Summary Report," Lyndell Z. Hales (in preparation).

TR DRP-96- , "A Guide to the Planning and Hydraulic Design of Fluidizer Systems for Sand Management in the Coastal Environment," Richard N. Weisman, Gerard P. Lennon, and James E. Clausner (in preparation).

TR DRP-96- , "Development and Verification of an Intrusive Hydrographic Survey System for Fluid Mud Channels," Michael P. Alexander, Allen M. Teeter, Glynn E. Banks (in preparation).

TR DRP-96- , "Field Demonstration of Water Injection Dredging," James E. Clausner, Timothy L. Welp, Teri Sardinas, Darryl D. Bishop, and Daniel Krumholtz (in preparation).

TR DRP-96- , "Technical Guidance for Subaqueous Dredged Material Capping," Michael R. Palermo, James E. Clausner, Robert E. Randall, Gregory L. Williams, and Thomas J. Fredette (in preparation).

Contract Reports

CR DRP-91-1, "Simple Models for Turbulent Wave-Current Bottom Boundary Layer Flow," Ole Secher Madsen and Palitha Nalin Wikramanayake, December 1991 [AD Number A247942].

CR DRP-92-1, "Dredge Mooring Study Conceptual Design Phase I Report," SOFEC, Inc., May 1992 [AD Number A254144].

CR DRP-92-2, "Dredge Mooring Study, Recommended Design, Phase II Report," SOFEC, Inc., May 1992 [AD Number A255947].

CR DRP-92-7, "Investigation of Real-Time Differential Global Positioning System (DGPS) Data Link Alternatives," Per K. Enge and Keith Pflieger, December 1992 [AD Number A262679].

CR DRP-92-8, "System Analysis for a Kinematic Positioning System Based on the Global Positioning System," G. Jeffery Geier, Peter V. W. Loomis, and Alfred Kleusberg, December 1992 [AD Number A262830].

CR DRP-93-1, "European Dredging Industry Overview with Emphasis on Geotechnical Descriptors," Wayne A. Dunlap, August 1993 [AD Number A273186].

CR DRP-93-2, "Rational Techniques for Evaluating the Potential of Sands for Beach Nourishment," Robert G. Dean and Jorge Abramian, August 1993 [AD Number A270735].

CR DRP-93-3, "Geotechnical Factors in the Dredgeability of Sediments; Report 1, Geotechnical Descriptors for Sediments to Be Dredged," S. Joseph Spigolon, November 1993 [AD Number A274782].

CR DRP-93-3, "Geotechnical Factors in the Dredgeability of Sediments; Report 2, Geotechnical Site Investigation Strategy for Dredging Projects; Literature Review," S. Joseph Spigolon, October 1993 [AD Number A273221].

CR DRP-93-3, "Geotechnical Factors in the Dredgeability of Sediments; Report 3, Guidance in the Geotechnical Evaluation of the Dredgeability of Sediments Using GEODREDG," S. Joseph Spigolon and Reda M. Bakeer, October 1993 [AD Number A273222].

CR DRP-93-3, "Geotechnical Factors in the Dredgeability of Sediments; Report 4, "Reducing the Impact of Contract Claims," S. Joseph Spigolon, May 1995.

CR DRP-94-1, "Hydraulically Transported Clay Balls," Stephen D. Richter and Dov Leshchinsky, April 1994 [AD Number A289096].

CR DRP-94-2, "Acoustic Resuspension Measurement System (ARMS) Instrumentation Manual," Robert E. Van Evra III and Keith W. Bedford, June 1994 [AD Number A282901].

CR DRP-94-3, "Descriptors for Granular Bottom Sediments to Be Dredged," Dov Leshchinsky, June 1994 [AD Number A283974].

CR DRP-94-4, "Fluid Mud and Water Waves: A Brief Review of Interactive Processes and Simple Modeling Approaches," A. J. Mehta, Say-Chong Lee, and Yigong Li, July 1994 [AD Number A284391].

CR DRP-94-5, "Calculation of Movable Bed Friction Factors," Palitha Nalin Wikramanayake and Ole Secher Madsen, August 1994 [AD Number A283529].

CR DRP-94-6, "Cohesive Sediment Erosion," S.-C. Lee and A. J. Mehta, November 1994 [AD Number A289526].

CR DRP-94-7, "Calculation of Suspended Sediment Transport by Combined Wave-Current Flows," Palitha Nalin Wikramanayake and Ole Secher Madsen, November 1994 [AD Numbers A289368 and A289096].

CR DRP-95-1, "GEOSITE, Geotechnical Site Investigation Methods," S. Joseph Spigolon and Reda M. Bakeer, October 1995 [AD Number A286859].

Miscellaneous Papers

(Unnumbered), "DRP Product Inventory," Russell K. Tillman, January 1991 [AD Number A268742].

MP DRP-92-1, "Dispersion Analysis of Humboldt Bay, California, Interim Offshore Disposal Site," Norman W. Scheffner, June 1992 [AD Number A268697].

MP DRP-93-1, "Use of a Simple Model to Calculate Velocity Bed Profiles Over Changing Bed Slopes," R. C. Berger, Allen Teeter, and Walter Pankow, September 1993 [AD Number A270778].

MP DRP-94-1, "Dispersion Analysis of Charleston South Carolina, Ocean Dredged Material Disposal Site," Norman W. Scheffner and James R. Tallent, March 1994 [AD Number A279942].

MP DRP-94-2, "Controlled Tests of Eductors and Submersible Pumps," James E. Clausner, Peter J. Neilans, Timothy L. Welp, and Darryl D. Bishop, September 1994 [AD Number A285387].

Technical Notes

Technical Area 1: Analysis of Dredged Material Placed in Open Waters

DRP-1-01, " Construction and Monitoring of Nearshore Placement of Dredged Material at Silver Strand State Park, San Diego, California," Leonard Juhnke, Thomas Mitchell, and Michael J. Piszker, August 1990.

DRP-1-02, "Numerical Disposal Modeling" (revised version), Billy H. Johnson, July 1993.

DRP-1-03, "Fine Sediment Erodibility Characterization," Allen Teeter, July 1990.

DRP-1-04, "Numerical Disposal Modeling Needs Revealed by Mobile Bay Field Data," Billy H. Johnson, James R. Tallent, and Moira Fong, February 1992.

DRP-1-05, "Acoustic Resuspension Measurement System (ARMS): Announcement of Availability," Robert E. Van Evra III and Keith W. Bedford, April 1992.

DRP-1-06, "The PLUme Measurement System (PLUMES): First Announcement," Nicholas C. Kraus and Michelle M. Thevenot, April 1992.

DRP-1-07, "Erosion of Cohesive Dredged Material in Open-Water Disposal Sites," Allen Teeter, April 1992.

DRP-1-08, "Monitoring of Alabama Berms," Edward B. Hands, Mary Allison, Joy Brogdon, Renee Cox, Patricia Terrell, and Darryl Bishop, July 1992.

DRP-1-09, "Prediction of Cross-Shore Movement of Dredged Material Berms," Nicholas C. Kraus, May 1992.

DRP-1-10, "Analysis of Dredged Material Deposition Patterns," Eric Nelson and Billy H. Johnson, July 1992.

DRP-1-11, "Size Dependence in Fine-Grained Sediment Transport," Allen Teeter, December 1993.

DRP-1-12, "Simulation of Wave Height, Period, and Direction Time Series," Michelle M. Thevenot, December 1993.

DRP-1-13, "Tidal Constituent Database—East Coast, Gulf of Mexico, and Caribbean Sea," Norman W. Scheffner, April 1994.

DRP-1-14, "Water Wave Attenuation Over Nearshore Underwater Mudbanks and Mud Berms," Allen Teeter, April 1994.

DRP-1-15, "Erosion by Entrainment of Fluidized Cohesive Sediments," Allen Teeter, April 1994.

DRP-1-16, "The PLUme MEasurement System (PLUMES); A Commercially Available System," Michael Tubman, May 1994.

DRP-1-17, "Tropical Storm Database - East and Gulf of Mexico Coasts of the United States," Norm Scheffner, September 1994.

DRP-1-18, "The PLUme MEasurement System (PLUMES); Operational and Data Processing Procedures for Deep-Water Monitoring," Michael Tubman, November 1994.

DRP-1-19, "Tidal Constituent Database—West Coast of the United States and Eastern North Pacific Ocean, Norman Scheffner, January 1995.

Technical Area 2: Material Properties Related to Navigation and Dredging

DRP-2-01, "Suggested Methods for Use of the Point Load Tester in Dredging Applications," Hardy Smith, August 1990.

DRP-2-02, "Point Load and Unconfined Compression Strength Data Base," Hardy Smith, August 1991.

DRP-2-03, "Hydrologic Surveys Applicable to Dredging," Thomas Harmon and Robert Ballard, December 1991.

DRP-2-04, "The Viscous Characteristics of Channel-Bottom Muds," Allen Teeter, July 1992.

DRP-2-05, "Evaluation of New Fluid Mud Survey System at Field Sites," Allen Teeter, November 1992.

DRP-2-06, "An Inexpensive Method for Vibracoring Sands and Fine-Grained Sediments in Shallow Water," J. Bailey Smith, April 1993.

DRP-2-07, "A Rapid Geophysical Technique for Subbottom Imaging," R. F. Ballard, K. J. Sjostrom, R. G. McGee, and R. L. Leist, July 1993.

DRP-2-08, "Fluid Mud Survey Investigations at the Calcasieu Lake Entrance Channel, Louisiana," Allen Teeter, March 1994.

DRP-2-09, "Degradation of Hydraulically Transported Clay Balls," Dov Leshchinsky, Stephen D. Richter, Jack Fowler, and Paul Gilbert, August 1994.

DRP-2-10, "GEOtechnical SITE Investigation Methods (GEOSITE)," S. Joseph Spigolon and R. M. Bakeer, July 1994.

DRP-2-11, "Geotechnical Factors in DREDGeABiLity (DREDGABL)," S. Joseph Spigolon and R. M. Bakeer, July 1994.

DRP-2-12, "Geotechnical Site Investigations for Dredging Projects," S. Joseph Spigolon, January 1995.

DRP-2-13, "Geotechnical Descriptors for Dredgeability," S. Joseph Spigolon, January 1995.

Technical Area 3: Dredge Plant Equipment and System Processes

DRP-3-01, "Jet Pump Sand Bypassing, Nerang River Entrance, Australia," James E. Clausner, November 1989.

DRP-3-02, "Hopper Dredge Mooring," Thomas Chisholm, January 1990.

DRP-3-03, "Fixed Sand Bypassing Plant—An Update," James E. Clausner, September 1990.

DRP-3-04, "An Inclined-Plate Technique for Increasing the Settling Rate of Fine-Grained Sediments in Hopper Bins," Stephen H. Scott, November 1990.

DRP-3-05, "Controlled Tests of Eductors and Submersible Pumps," James E. Clausner, Timothy L. Welp, and Darryl D. Bishop, May 1992.

DRP-3-06, "Applying Ultrasonic Surface Detectors to Hopper Dredge Production Monitoring," Stephen H. Scott, August 1992.

DRP-3-07, "Applying Electrical Resistivity Methods for Measuring Dredged Material Density in Hopper Bins," Stephen H. Scott, November 1992.

DRP-3-08, "A Single-Point Mooring System for Direct Pumpout of Hopper Dredges," James E. Clausner, November 1992.

DRP-3-09, "Fluidizer System Design for Channel Maintenance and Sand Bypassing," James E. Clausner, December 1992.

DRP-3-10, "Water Injection Dredging Demonstration on the Upper Mississippi River," James E. Clausner, Teri Sardinas, Daniel Krumholtz, and Christopher Beauvais, April 1993.

DRP-3-11, "Testing and Evaluating the DRP Automated Load Monitoring System (ALMS)," Stephen H. Scott, March 1994.

DRP-3-12, "Field Test of the Dredging Research Program (DRP) Eductor," G. L. Williams and J. E. Clausner, January 1995.

Technical Area 4: Vessel Positioning, Survey Controls, and Dredge Monitoring Systems

DRP-4-01, "Laboratory Tests of Production Meter Instruments," Virginia Pankow, November 1989.

DRP-4-02, "Application Criteria for the Automated Real-Time Tidal Elevation System (ARTTES)," Andrew W. Garcia, June 1990.

DRP-4-03, "Dredge Production Meter Survey," Virginia Pankow, November 1990.

DRP-4-04, "Field Evaluation of ENDECO Model 1029 Tide Gage," William E. Grogg, August 1991.

DRP-4-05, "Production Meter System Evaluation on the Dustpan Dredge *Jadwin*," Virginia Pankow, August 1991.

DRP-4-06, "Evaluation of Production Meter Performance in a Fine-Grained Sediment Environment," Stephen H. Scott, May 1992.

DRP-4-07, "Improvements to the Automated Real-Time Tidal Elevation System (ARTTES)," Andrew W. Garcia, May 1992.

DRP-4-08, "Stability Evaluation of the Octapod Sensor Mount," William Birkemeier, December 1993.

DRP-4-09, "A Comparison of Zero-Moment Wave Height to the Standard Deviation of a Vitel Tide Gage," Paul Trapier Puckette, April 1994.

DRP-4-10, "Real-Time Testing and Demonstration of the U.S. Army Corps of Engineers' Real-Time On-the-Fly Positioning System," Sally Frodge, Benjamin Remondi, and Dariusz Lapucha, September 1994.

Technical Area 5: Management of Dredging Projects

DRP-5-01, "Engineering Design Considerations for Nearshore Berms," Neil McLellan, January 1990.

DRP-5-02, "Interim Design Guidance for Nearshore Berm Construction," Neil McLellan, August 1990.

DRP-5-03, "Design Requirements for Capping," Michael R. Palermo, February 1991.

DRP-5-04, "Site Selection Considerations for Capping," Michael R. Palermo, November 1991.

DRP-5-05, "Equipment and Placement Techniques for Capping," Michael R. Palermo, November 1991.

DRP-5-06, "Length and End Slope Considerations, Interim Design Guidance Update for Nearshore Berm Construction," Cheryl E. Burke and Mary C. Allison, April 1992.

DRP-5-07, "Monitoring Considerations for Capping," Michael R. Palermo, Tom Fredette, and Robert Randall, June 1992.

DRP-5-08, "Berm Crest Width Consideration, Interim Design Guidance Update for Nearshore Berm Construction," Cheryl B. Pollock and Mary C. Allison, June 1993.

DRP-5-09, "Sediment Chemistry Profiles of Capped Dredged Sediment Deposits Taken 3 to 11 Years After Capping," Alex Sumeri, Thomas Fredette, Paula Kullberg, Joe Germano, Drew Carey, and Patricia Pechko, May 1994.

DRP-5-10, "Open-Water Placement of Dredged Sediment: A Framework for Site Management," Brian Walls, Sandra Lemlich, Thomas D. Wright, James E. Clausner, and David Mathis, January 1995.

DRP-5-11, "Current Corps of Engineers Data Management Practices," R. A. Price, C. R. Lee, and D. L. Brandon, January 1995.

Miscellaneous

DRP-6-01 (1993), "A Guide to the DRP," Russ Tillman, January 1993.

DRP-6-02 (1996), "A DRP Product Guide," Terri L. Prickett, May 1996.

Video Reports

DRP-90-1, "The Dredging Research Program," Robert Baylot, Jr., March 1990.

DRP-90-2, "Plume Tracking off Mobile, Alabama," Nicholas Kraus and Terri L. Prickett, March 1990.

DRP-91-1 "Submersible Pumps as an Alternative to Dredging," James E. Clausner, July 1991.

DRP-91-2, "The Silent Inspector," Russell K. Tillman, November 1991.

DRP-91-3, "Subbottom Site Characterization Using Acoustic Impedance," Robert Ballard, December 1991.

DRP-92-1, "SUPERTANK," Sally Duncan, April 1992.

DRP-92-2, "Protecting Sea Turtles Through Improved Hopper Dredge Operations," Jeff Jorgeson, April 1992.

DRP-92-3, "Dredged Material Plume Tracking off Tylers Beach in the James River, Virginia," Terri L. Prickett and Russell K. Tillman, May 1992.

DRP-92-4, "America's Ports and Waterways: Open Channels to Trade," Rod Koon and Eileen Denne, January 1993.

DRP-93-1, "Water Injection Dredging," James E. Clausner and Anne Marie Murphy, February 1993.

PC Programs

"Short-Term **FATE** of Dredged Material (**STFATE**)," Billy H. Johnson, June 1990.

"Height, Period, Direction **PRE**processor (**HPDPRE**) & Height, Period, Direction **SIM**ulation (**HPDSIM**)," Norman W. Scheffner, September 1990.

"Cohesive Sediments PC Programs (HPROF, COSED1H)," Allen Teeter, October 1990.

"Numerical Model of the **LONG**shore Current (**NMLONG**)," Nicholas Kraus, March 1991.

"**P**oint **L**oad Index and **U**nconfined **C**ompressive **S**trength Database System (**PLUCS**)," Hardy Smith, October 1991.

"**GEODREDG**: A Windows Program to Determine Dredgeability of Material (Beta Version)," Joseph Spigolon, Reda Bakeer, and Jack Fowler, September 1992.

"**Empirical BERM** Fate," Edward B. Hands, June 1993.

"Long-Term **FATE** of Dredged Material (**LTFATE**)," Norman W. Scheffner, July 1995.