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Coastal and Hydraulics Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Dredging Operations and Environmental Research Program

Demonstration Project on Dredging and Marsh Development Using a Flexible-Discharge Dustpan Dredge at Head of Passes/Southwest Pass Mississippi River

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Final report

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ABSTRACT: The navigation channel of the Mississippi River in the vicinity of the Head of Passes (HOP) downstream of New Orleans is an area where significant dynamic shoaling occurs. During the traditional high-water period in the spring, the shoaling in this area occurs rapidly and can represent a hazard to deep-draft vessel traffic. The shoaling must be removed rapidly to maintain adequate channel depth. Currently, dredging of the channel at HOP is conducted using hopper dredges, primarily due to their mobility. Hydraulic dredges with conventional spudding systems and floating discharge pipelines, such as cutterhead dredges, are considered a safety hazard in this area due to their inability to rapidly (and consistently) move out of the way of vessel traffic. Unfortunately, hopper dredges simply move the dredged material out of the channel and redeposit it in open-water disposal sites at the heads of Pass A Loutre and South Pass. There are two disadvantages to this technique. First, the disposal sites periodically become so filled with material that the hoppers cannot bottom dump dredged material at the sites. The dredged material must be handled again at additional cost to provide sites for hopper disposal. Secondly, there is no beneficial use of the dredged material. Hopper dredges can use direct pump-out to place material beneficially in adjacent shallow open-water areas for marsh restoration, but this is considered costly and has never been done before at the HOP.

This report presents the demonstration results of the dustpan dredge *Beachbuilder* using a flexible discharge at the Head of Passes/Southwest Pass on the Mississippi River in June 2002. Dustpan dredges equipped with a flexible-discharge floating hose and sufficient pumping capacity potentially have the mobility required for safe passage of vessel traffic and can economically pump dredged material the distances required for placement in a beneficial use scenario such as marsh construction. This report details and discusses the project activities, operational characteristics of the *Beachbuilder*, and feasibility of using a flexible-discharge dustpan dredge to augment the hydraulic dredging capabilities of the U.S. Army Corps of Engineers on the Mississippi and other rivers. The goal of this report is to use the project results to identify potential opportunities for reducing overall costs for channel maintenance and increasing beneficial use of dredged materials during dredging Corps navigation projects.

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Conversion Factors, Non-SI to SI Units of Measurement

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

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic yards	0.7645549	cubic meters
degrees Fahrenheit	5/9	degrees Celsius or kelvins[1]
feet	0.3048	meters
horsepower (550 foot-pounds force per second)	745.6999	watts
inches	25.4	millimeters
knots (international)	0.5144444	meters per second
miles (U.S. statute)	1.609347	kilometers
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
tons (force)	8,896.443	newtons

[1] To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: C = (5/9)(F – 32). To obtain kelvin (K) readings, use: K = (5/9)(F – 32) + 273.15.

Preface

The U.S. Army Engineer Research and Development Center has responsibility under the Innovative Technologies (IT) Focus Area of the Dredging Operation and Environmental Research (DOER) Program to identify and evaluate innovative dredging and dredged material management technologies. The DOER IT Focus Area partnered with the U.S. Army Engineer District, New Orleans (MVN), Louisiana Department of Natural Resources (LDNR), and U.S Army Engineer Division, Mississippi Valley (MVD), to demonstrate and evaluate the innovative use of a flexible-discharge dustpan dredge to beneficially place the dredged material for marsh restoration.

U.S. Army Engineer Research and Development Center (ERDC) participants in the demonstration were Messrs. James Clausner and Timothy Welp from the Coastal and Hydraulics Laboratory (CHL). Contract support was provided by Dr. Bobbie Folsom of the Environmental Laboratory (EL), ERDC, and Ms. Renee Conn of the U.S. Army Engineer District, Vicksburg. Mr. Steve Jones, MVD, and Mr. George Boddie, LDNR, contributed to overall coordination of the demonstration. OA Systems personnel included Messrs. Douglas Thompson, Norman Francigues, and Clark McNair. MVN demonstration participants included Ms. Joaquin Mujica, Mr. Tim Axtman, Ms. Linda Mathies, Ms. Heather Jennings, Mr. Ron Legendre, Mr. Jerry Hutson, Ms. Jimmie Scarabin, Mr. Bruce Bivona, and Mr. Charles Freeman. Capt. Michael Lorino coordinated the Mississippi River Pilot Association activities. Weeks Marine, Inc., participants included Messrs. Mike Peacock, Charlie Granger, and Steven Chatry, and Crew of the dredge *Beachbuilder*. Helicopter support for aerial photography was graciously provided by the U.S. Coast Guard (USCG) Station New Orleans. Two over-flights were conducted in an HH-65 Dolphin helicopter CG6507 manned by Lieutenant Commander Nelson, Lieutenant Harper Phillips, Lieutenant Ricardo Alonso, and Second Class Petty Officer Johnson.

This study was performed under the general supervision of Mr. Thomas Richardson, Director, CHL; and Dr. Robert Engler, Technical Director of Civil Works R&D and the DOER Program, EL.

COL James R. Rowan, EN, was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

1 Introduction

Purpose

The purpose of this report is to present the demonstration results of the dust-pan dredge *Beachbuilder* using a flexible discharge at the Head of Passes/ Southwest Pass on the Mississippi River (Figure 1) in June 2002. The report details and discusses the project activities, operational characteristics of the *Beachbuilder*, and feasibility of using a flexible-discharge dustpan dredge to augment the hydraulic dredging capabilities of the U.S. Army Corps of Engineers (USACE) on the Mississippi and other rivers. The goal of this report is to use the project results to identify potential opportunities for reducing overall costs for channel maintenance and increasing beneficial use of dredged materials during dredging Corps navigation projects.

Background

The navigation channel of the Mississippi River in the vicinity of the Head of Passes (HOP) is an area where significant dynamic shoaling occurs (Figure 1). In Fiscal Year (FY) 2002, approximately 5.5 million cu yd[1] was placed in Pass A Loutre. At HOP, the increased cross-sectional area provided by Pass A Loutre and South Pass results in lower currents that allow much of the river's sediment load to be deposited. During the traditional high-water period in the spring, shoaling in this area occurs rapidly and can represent a hazard to deep-draft vessel traffic. The shoaling must be removed rapidly to maintain adequate channel depth. Currently, dredging of the channel at HOP is conducted using hopper dredges, primarily due to their mobility. Hydraulic dredges with conventional spudding systems and floating discharge pipelines, such as cutterhead dredges, are considered a safety hazard in this area due to their inability to rapidly move out of the way of vessel traffic. Unfortunately, hopper dredges simply move the dredged material out of the channel and redeposit it in open-water disposal sites at the heads of Pass A Loutre and South Pass. There are two disadvantages to this technique. First, the disposal sites periodically become so filled with material that the hopper dredges' drafts prevent them from dumping dredged material at the sites. The dredged material must be handled again at additional cost to provide sites for hopper disposal. Second, there is no beneficial use of the dredged material. Hopper dredges can use direct pump-out to place

[1] A table of factors for converting U.S. customary units to metric (SI) is presented on page vi.

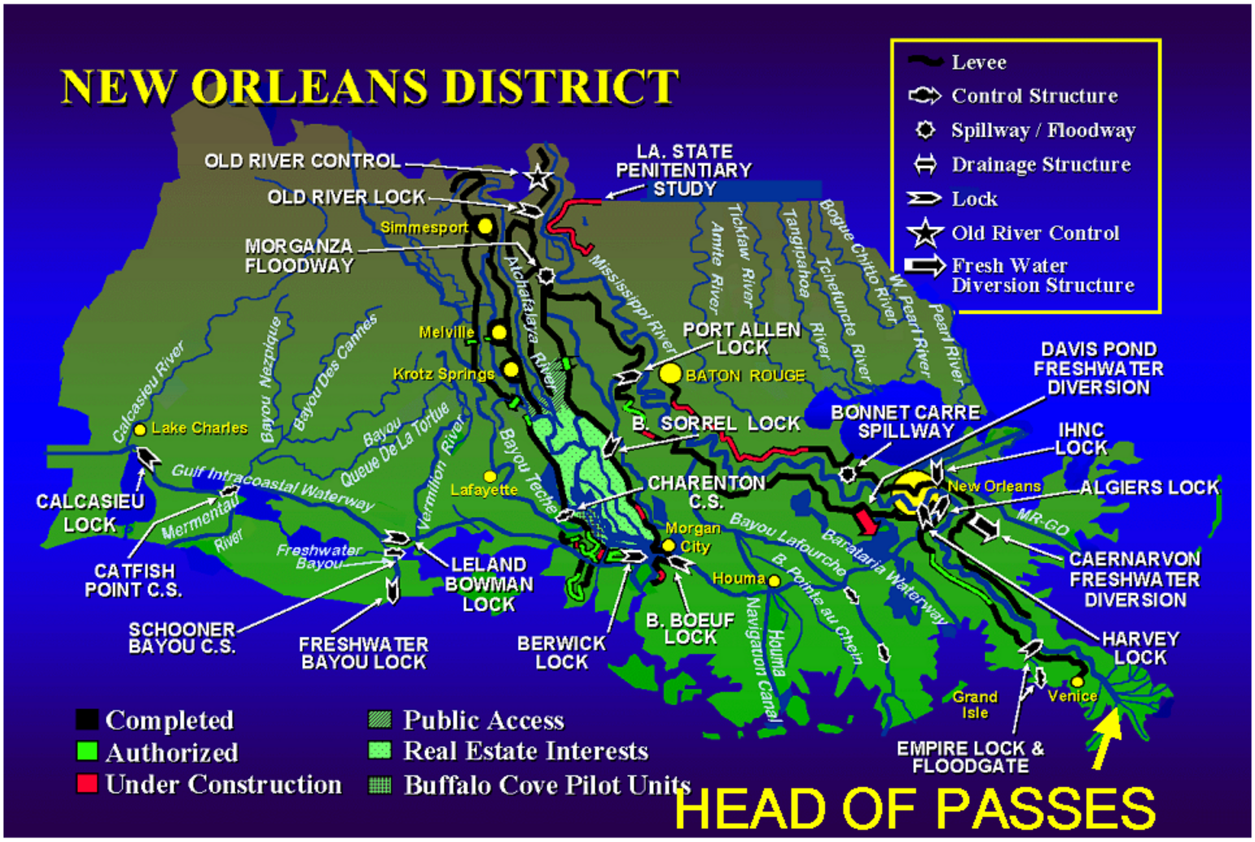

Figure 1. Head of Passes, Mississippi River, Louisiana

material beneficially in adjacent shallow open-water areas for marsh restoration, but this is considered costly and has never been done before at the HOP. Furthermore, during the periods of rapid shoaling when as many as four hopper dredges are needed to maintain authorized project depths, taking a hopper out of service to use in pump-out for marsh restoration would/could compromise viability of the navigation channel.

Dustpan dredges equipped with a flexible-discharge floating hose and sufficient pumping capacity potentially have the mobility required for safe passage of vessel traffic and can economically pump dredged material the distances required for placement in a beneficial use scenario such as marsh construction. The use of a flexible-discharge dustpan dredge at the HOP has been proposed in the past,[1] but effective operation under the vessel traffic and high current conditions typically found at the HOP in the spring had not been proven and was of concern. As a result, the Corps' New Orleans District (the agency responsible for navigation channel maintenance in this section of the Mississippi River) determined that an operational research demonstration project was required in the HOP area along Southwest Pass. The demonstration's objective was to verify the effectiveness of a flexible-discharge dustpan dredge in safely conducting dredging operations while placing the dredged material for the beneficial use of marsh creation.

[1] U.S. Army Engineer District, New Orleans. (1998). "Assessment of coastwide Louisiana maintenance dredging capabilities under the Federal Standard," New Orleans, LA.

The U.S. Army Engineer Research and Development Center (ERDC) has responsibility under the Innovative Technologies (IT) Focus Area of the Dredging Operations and Environmental Research (DOER) Program to identify and evaluate innovative dredging and dredged material management technologies. Under this program, ERDC works with USACE Division and District Offices to plan, conduct, and evaluate field demonstrations of high potential technologies. During FY01, the Lower Mississippi River Division (MVD) and the New Orleans District (MVN) requested the DOER IT Program to partner in the demonstration and evaluation of use of a flexible-discharge dustpan dredge in the HOP area. Jointly, the USACE agencies developed a scope of work (SOW) and specifications for the demonstration project. Additionally, the Louisiana Department of Natural Resources (LDNR) teamed with the USACE in planning and sponsoring the demonstration project. The LDNR provided a major portion of project funding under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) (*http://www.cfda.gov/public/viewprog.asp?progid=448*). CWPPRA was designed to produce restoration projects that create, restore, protect, and enhance coastal wetlands in Louisiana. The MVN Operations Division and the DOER Program provided additional funding.

The proposed project was considered an innovative application of existing technology. It was decided that the demonstration should be conducted at the head of Southwest Pass under as typical river and navigation conditions as possible during spring when high water results in the greatest current velocities. This site and time period would present the most difficult conditions to typically be encountered in this area of the Mississippi River. There is a bend in the channel at the head of Southwest Pass forcing vessel traffic to “crab” across the channel to make the turn, thus requiring more of the channel width. (Crabbing is a term used to describe the condition where the vessel’s heading is different from its actual course.) Shoals build up rapidly in this area, and significant sediment is deposited along the inside of the bend. High current velocities put a strain on anchors, cables, push boats, and discharge lines.

The objectives for the demonstration project were to:

a. Demonstrate safe navigation and dredging operations of the flexible-discharge dustpan dredge on the Mississippi River in the HOP area.

b. Demonstrate sufficient production capability to dredge and place material in a designated marsh construction site.

The first objective was of primary importance, and if it could not be met, the project was to be terminated. The dustpan dredge had to be able to work safely and effectively with no disruption or interference with, or hazard to, normal vessel traffic. The second objective included collection of sufficient data to support determination of the cost effectiveness of the technology. The State of Louisiana prefers the beneficial use of dredged material to restore wetlands over open-water disposal of the material.

The SOW detailed a number of project requirements to be met during the demonstration:

Dredge Operational Requirements

- Dredge to a minimum depth of 60 ft below the water surface resulting in a minimum channel depth of -51 ft mean low gulf (MLG).
- Pump the dredged material up to a total distance of 15,000 ft.
- Achieve competitive dredging production rates with stoppages required for normal vessel traffic passage.

Navigational Requirements

- Utilize total length of flexible floating pipe during dredging and moving up and down, and across the channel.
- Maneuver into desired dredge cut both cross channel (across the total channel width) and longitudinally (up and down the channel).
- Maneuver dredge safely to allow for normal vessel traffic passage.

Dredged Material Discharge/Placement Requirements

- Establish discharge pipeline across dike, adjacent pasture, and existing wetlands to designated placement point(s) (see Figure 2) with minimum possible impact on existing marsh.
- Install and operate discharge pipeline with minimal leaks in existing marsh.
- Secure discharge pipeline in current using anchor system.
- Operate and safely maneuver discharge pipeline in the Mississippi River under typical conditions to allow for passage of both shallow-draft and deep-draft vessels.
- Pump and place dredged material so as to create a suitable marsh area with minimal impact to existing marsh.

It was determined that the evaluation of these requirements was the key to determining demonstration success, and for assessing the feasibility of implementing this technology in future maintenance dredging programs for this area.

Dredging activities were to be conducted in the spring of 2002 to coincide with the normal period of high water on the Mississippi. The dredge was to operate over a continuous 5-day period, 24 hr per day, with an option for up to 3 additional days of dredging based on the success of the project and time required to meet the project requirements. The first 24-hr period of operation was to consist of equipment mobility demonstration and equipment checkout.

ERDC enlisted the assistance of OA Systems Corporation (OAS) to provide support in developing the project and conducting the field activities. Based on the SOW requirements, OAS determined that the *Beachbuilder* was the only U.S.-owned dustpan dredge with the required pumping capabilities. Under the existing OAS task order contract, a rental agreement with Weeks Marine, Inc., was negotiated for use of the *Beachbuilder* in the demonstration project. Several meetings and numerous telephone conferences were conducted including MVD, MVN, ERDC, OAS, Weeks Marine, and the Associated Branch Pilots (Bar Pilots) from the Port of New Orleans personnel to define and concur on proposed field activities. It was suggested and agreed that River Pilot Association pilots would be hired to man the *Beachbuilder* pilot house on a 24-hr basis to monitor vessel traffic and keep the leverman appraised of vessel traffic movement. Having a pilot onboard during the entire demonstration while the dredge was operating (a condition not usually required for hydraulic pipeline dredging contracts) helped ensure the safety of dredge and crew, and allowed the pilots an opportunity to observe and comment on the feasibility of this type of dredging methodology. OAS and Weeks Marine prepared a proposal for the demonstration project. A delivery order was issued to OAS in March 2002 to begin the project.

A meeting was held at the MVN office on 8 March 2002 with MVN, ERDC, OAS, and Weeks Marine personnel in attendance. Final technical details of the project were discussed and directions given as required on right-of-way, dredging reaches, anchor lines, pipeline placement, safety requirements, visitors, operations data, surveying, and assignment of MVN Area Office inspectors. The site activities were originally scheduled for late April or early May 2002. The project was delayed due to resolution of funding issues, repair and maintenance on the *Beachbuilder*, and availability of the floating hose, which was being used on another project. Weeks Marine installed new bow winches and high strength wire rope on the *Beachbuilder* in preparation for the demonstration project.

Weeks Marine started mobilizing equipment to the project site during the last week of May 2002. A project kick-off meeting was held at the Venice Area Sub Office on 3 June 2002 and included MVN, OAS, and Weeks Marine personnel. Project activities, schedule, and safety issues were discussed. Recent surveys of the project area conducted by MVN were presented. Based on the shoaling detailed in the survey results, three channel reaches were identified and prioritized for dredging operations (Figure 2). Prioritization was based on physical location of the reach and minimizing the requirement for movement of the submerged line. The northernmost reach at the head of the bend in the channel at the HOP was identified for initiation of the equipment mobility demonstration. Vessel traffic in this area generally steered in a straight line prior to initiating a turn through the bend, and thus was deemed somewhat safer with respect to vessel traffic flow and proximity of the vessel traffic to the *Beachbuilder* while dredging in the channel. Once it was demonstrated to all concerned parties that the *Beachbuilder* could safely maneuver back and forth across the channel, *Beachbuilder* was to move downriver and work in a reach located in the bend where greater shoaling generally occurs. At the conclusion of the meeting, Weeks Marine was directed to initiate site activities in preparation for dredging.

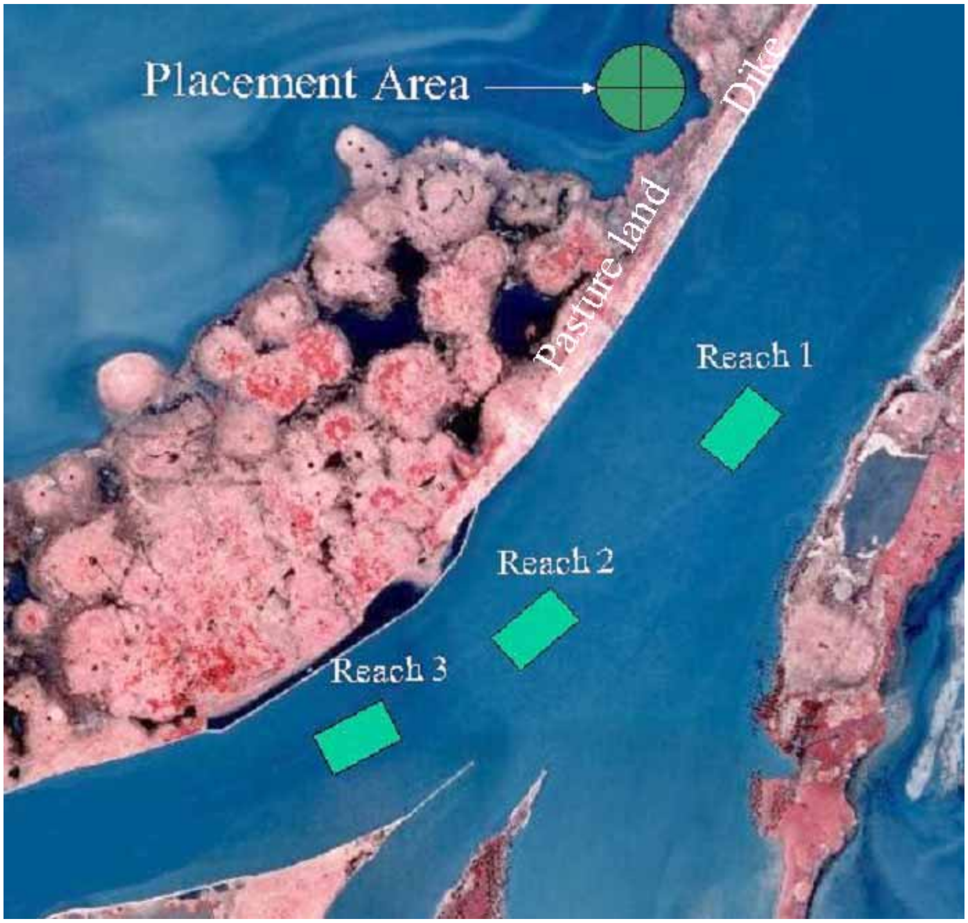

Figure 2. General locations of flexible-dustpan demonstration dredging reaches and dredged material placement area, Head of Passes, Mississippi River, Louisiana

2 Project Description

Site Location

The dustpan dredge demonstration project was conducted at the HOP on the Mississippi River (Figure 1). MVN established the dredging limits for the demonstration project between Mile 1.0 above HOP and Mile -0.5 below HOP (Figure 2). Mile 1.0 is located approximately 1 mile downriver from Pilottown. This area includes the bend where the navigation channel enters Southwest Pass. The project channel width in this area is 750 ft with a design depth of -45 ft MLG. The project area was divided into three dredging reaches. Reach 1 extended from Station (Sta) 3+00 to 18+00 (or Range 26 to Range 21) (Figure 3); Reach 2 extended from Sta 42+00 to 61+00 (or Range 15 to Range 10); and Reach 3 extended from Sta 69+00 to 84+00 (or Range 8 to Range 4). Reach 1 was selected as the starting location for demonstration of equipment mobility, as it presented the least difficult navigational area. The project plan specified working Reach 1, Reach 2, and Reach 3 in sequence to minimize downtime for moving the “hard point” and adding submerged line.

The marsh creation area where the dredged material was to be placed was located on the west side of the river at Mile 1.6 above HOP. The area was in open water immediately west of the dike/adjacent pasture upland and existing wetlands (see Figure 2). The distance across the upland and wetlands to reach this area was relatively small, minimizing the amount of discharge pipe required to reach the placement area. MVN requested that a minimal amount of open water be left between the wetlands and placed dredged material.

Site Conditions

During the demonstration project, the Mississippi River was at above-average high stages due to heavy rains on the Ohio River Valley in late spring 2002. The maximum measured current during the project was approximately 7 ft/sec. The high sediment load resulted in the continuous deposition of large amounts of sediment at the HOP causing rapid formation of shoals. Four hopper dredges were working continuously in this area to remove shoals before they could impact navigation. The largest amount of shoaling was predominantly on the inside of the bend. MVN survey results from 5 June 2002 illustrate this point by showing maximum shoaling of approximately 6 ft in Reach 1, and 20 feet in Reaches 2 and 3 (see Figure 3).

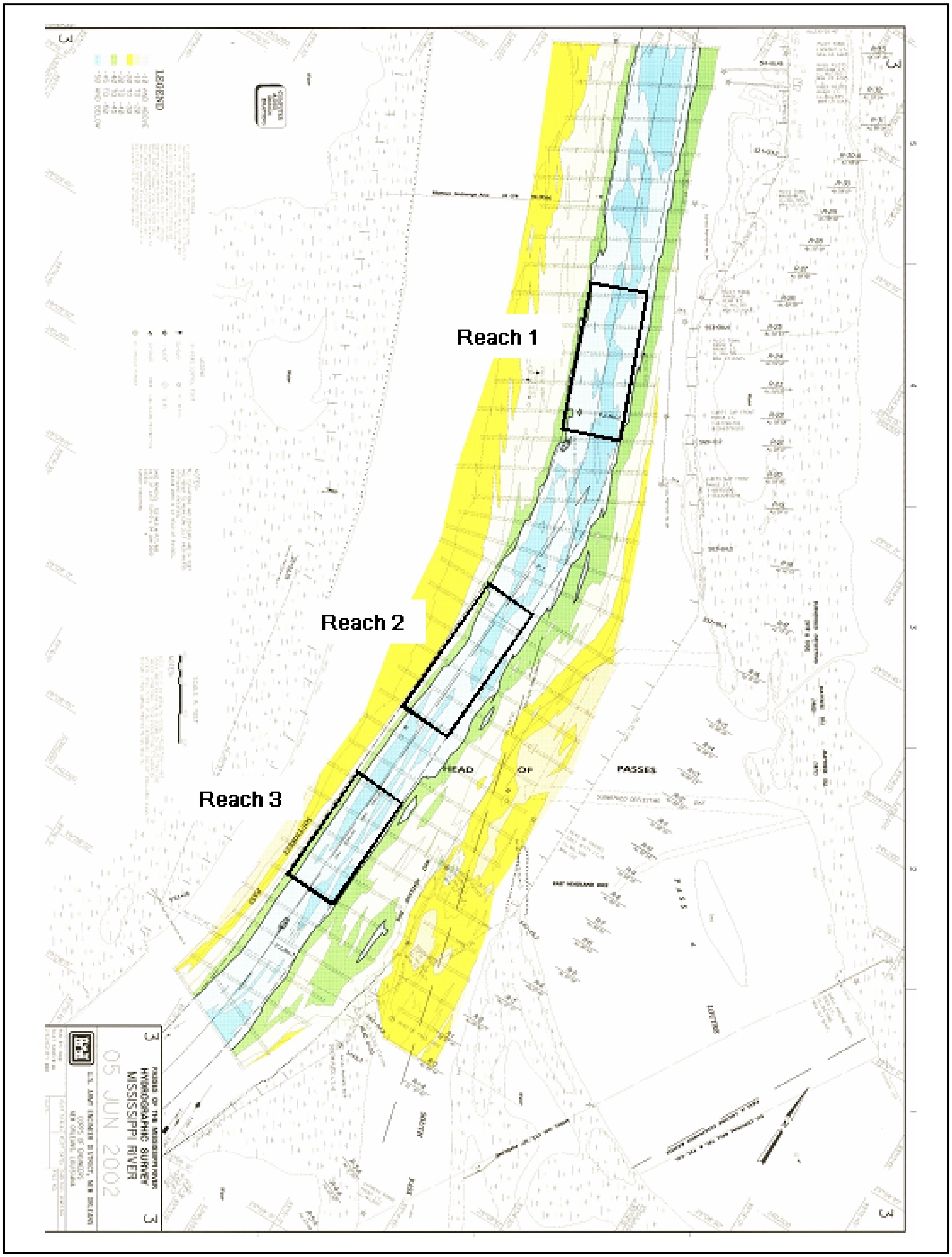

Figure 3. MVN hydrographic survey at HOP, 5 June 2002

The water depth in the placement area ranged from 4 to 6 ft. The dike, adjacent pasture uplands, and wetlands separating the river and the placement area were approximately 900 ft wide consisting of a rock face adjacent to the river and the remainder a sandy soil with a maximum elevation approximately 2 to 3 ft above the river surface. The soil portion of the pasture was vegetated with short grass, small bushes, and marsh grass adjacent to the open water on the west side. River vessel traffic during the demonstration project was typical according to the river pilots. Vessel traffic averaged 20 to 25 deep-draft vessels per 24-hr period.

The passing vessel traffic was not evenly spaced. Several times during the project, two deep-draft vessels passed abreast in the area of the channel where the *Beachbuilder* was working (Photo 1). There were periods of up to 3 hr with no deep-draft vessel traffic. The deep-draft vessel traffic tended to navigate toward the outside of the bend, or left descending bank (LDB) side of the channel, while making their turn into or out of Southwest Pass. Due to cross currents caused by flows into Pass A Loutre and South Pass, pilots on the deep-draft vessels going downstream tend to swing the vessels' bows more toward the right descending bank (RDB) side (thereby occupying more of the channel cross section while crabbing around the bend entering Southwest Pass) to compensate for the ships' tendency to be pulled toward the LDB side of the channel (see illustration in Figure 4).

The U.S. Coast Guard posted a Notice to Mariners about the demonstration. Shallow-draft vessel traffic consisted of tugs, shrimp boats, work boats, fishing boats, and pleasure boats. This vessel traffic moved unimpeded both in and out of the channel during dredging operations. Outside the channel, shallow-draft vessel traffic moved across the submerged line that ran along the RDB side of the river up to the shoreline. No count of shallow-draft vessel traffic was maintained during the project.

Atmospheric conditions during the demonstration project were typical for the season and recorded in the daily Report of Operations Engineer Form 4267. Daytime temperatures ranged from the upper 80's to lower 90's (degrees Fahrenheit). Periodic thundershowers were prevalent in the afternoons. Winds were generally light to moderate (maximum of 10 knots) with gusts associated with thundershowers. Visibility during the demonstration was approximately 10 miles with no occurrence of significant fog events.

Project Equipment

The dustpan dredge *Beachbuilder* used for the demonstration project is a nonself-propelled dredge. The dredge hull is approximately 300 ft long and 75 ft wide (see Photo 2). The maximum draft of the dredge is approximately 8.5 ft. The maximum dredging depth of the *Beachbuilder* is approximately 70 ft with a ladder length of 104 ft. The dustpan head is 40 ft wide (see Photo 3). The ladder on the *Beachbuilder* is equipped with a submerged pump that transfers the sediment from the head to twin pumps on deck (see Photos 4 and 5). Total pumping horsepower capability is approximately 9,000 hp (two 3,600-hp dredge pumps

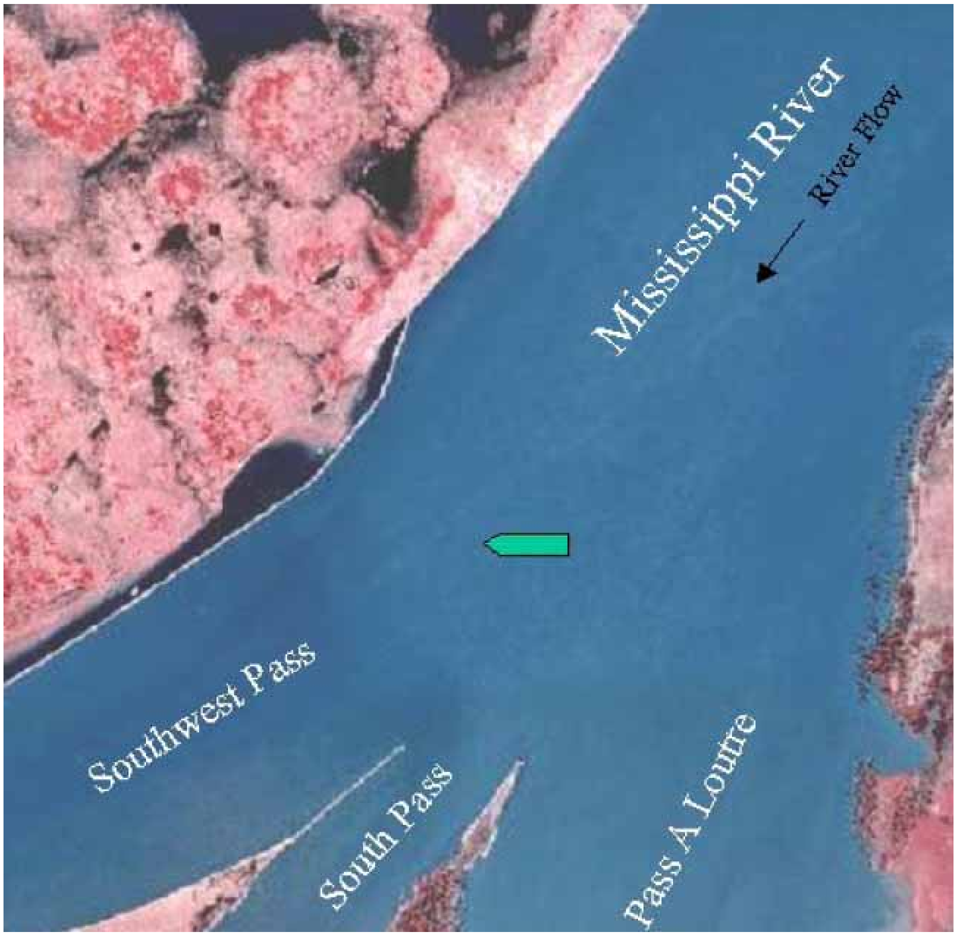

Figure 4. Downstream-bound vessel "crabbing" around HOP

and an 1,800-hp ladder pump). Dredge (hull) pump discharge diameters are 30 in. The *Beachbuilder* was designed to conduct beach nourishment projects where long-distance pumping is required. During the demonstration, the ladder pump and only one of the two hull pumps were required to pump slurry to the placement site.

The *Beachbuilder* normally operates using wire rope to advance into a cut. The dredge is equipped with six winches (three forward and three aft) that pull against 11,000-lb Stephris anchors to effect movement (see Photo 6). Due to the strong current and requirement for rapid movement, a tug was connected to the stern to help maneuver the dredge (see Photo 7). During the project, it was determined that with the aid of the tug, the dredge could be advanced using only two forward winches. Also during the project, a second tug was connected to the starboard side of the dredge to aid in maneuvering the dredge into and out of the channel (see Photo 8). A typical dustpan dredge is self-propelled and primarily advances into the bank using two forward anchor wires. Stern or bow thrusters are used to help maintain station.

The *Beachbuilder* is equipped with a large engine room housing the pump engines and electrical generator, an equipment control room, a small galley, two small offices, an electrical room, and a pilot house. There are no crew's quarters on the dredge. The pilot house contains the leverman station (see Photo 9) and computer monitors showing equipment gauges, dredge position relative to the work area, and dustpan head elevation (see Photo 10). Project hydrographic survey data are uploaded to a proprietary computer program that develops an area contour plot. The contour plot is integrated with a navigation program that includes real-time Differential Global Positioning System (DGPS) signal input and outputs a visual image of the dredge location with respect to the channel limits and elevation contours, all of which are displayed on a computer monitor. A continually updated image of the dredge track is also displayed. The dustpan head elevation (corrected for the river stage) and position are shown relative to the channel profile. This system provides the leverman a real-time display of dredge location and dustpan head elevation relative to the required area of operation. The survey data and resultant contour plot are updated at least once a day.

The discharge pipe on the *Beachbuilder* was attached to flexible floating hose (see Photo 11) that allowed the dredge to move across and up and down the channel. The maximum floating hose line length was made up of 47 30-ft sections for a total length of 1,410 ft (see Photo 12). This length of pipeline allowed the dredge to move across the full width of the channel and up and down the channel approximately 1,500 ft. This particular line length was selected to allow maximum lateral and longitudinal dredge mobility in the channel and also to minimize the hydrodynamic drag forces acting on the line especially as it was deployed more perpendicular to the current flow. Each section had an inside diameter of 30 in. (750 mm) and a bladder on the outside with sufficient buoyancy to float the hose when filled with dredged material. An anchor barge (or skidder) and a small tug were used to hold the floating hose in position to reduce the stress on the hose connections due to the strong current (see Photo 13). The floating hose was connected to a hard point. The hard point is an anchored floating adapter used to connect the floating hose to the submerged line. The hard point was anchored by a 10,000-lb Danforth anchor and was moved and re-anchored as required to allow the dredge to work in specific reaches. In moving the hard point, steel pipe was added or subtracted to the submerged line side of the hard point to reach the new anchor point.

The steel pipe ran submerged on the bottom of the river (called submerged line) from the hard point to the dike. The total length of submerged line ranged from 4,320 to 7,920 ft during the project based on the hard point location. The shore line steel pipe ran across the dike, pasture, and existing wetlands into the designated placement area. As the placed dredged material built up above the surface of the water in the marsh area, additional shore line was added to extend the placement further into the designated placement area (see Photo 14). Two hydraulic backhoes mounted on swamp tracks (swamp buggies) were used to move the pipe and build temporary dikes to direct discharge flow (see Photo 15). Other than the use of these temporary dikes to direct discharge flow, no other containment dikes were used in the placement process.

A variety of support equipment was used during the demonstration project. The tug *Delta Eagle* (3,000 hp; see Photo 16) was originally connected to the stern of the *Beachbuilder* to simulate the self-propelled characteristics of a conventional dustpan dredge. Due to the swift current and problems with the anchors slipping, the *Delta Eagle* was replaced by the *Delta Pacer* (4,200 hp; see Photo 17). The *Delta Eagle* was then connected to the starboard side of the *Beachbuilder* to help maneuver the dredge in and out of the channel. The *Delta Eagle* was later replaced with the *Matthew* (3,000 hp; see Photo 18), a Weeks Marine tug. Two smaller tugs, the *Delta Fox* (900 hp; see Photo 19) and *Delta Robin* (600 hp; see Photo 20), were used to move several support barges including one equipped with a 55-ton capacity crane (Weeks 553) used to lift pipe (see Photo 21) and a small A-frame barge (or stiff-leg derrick) used to move anchors and the hard point (see Photo 22). The tugs were also used to hold the floating hose in position. A small tug, the *Marie* (300 hp; see Photo 23), was used to ferry personnel and help move the small barges.

Additional equipment included a quarters barge for Weeks Marine personnel equipped with a galley where meals were prepared (see Photo 24). The quarters barge was anchored in South Pass just below the HOP. Two 42-ft crew boats, the *Cheyenne* and the *Flying Cloud*, were used to transport Corps, OAS, and Weeks Marine personnel along with visitors between Venice, the *Beachbuilder*, the dike near the placement area, and the quarters boat. The hydrographic survey boat used by Weeks Marine was the *Sabine* and the MVN daily channel surveys were conducted by the *John Bopp*, *W-46*, *Laborde*, and *OB-173*.

Project Operations

3 and 4 June 2002

As previously noted, Weeks Marine initiated mobilization activities during the last week of May 2002. Mobilization activities continued after the kick-off meeting on 3 June. Before-dredging (BD) surveys of the three river channel reaches and the placement areas in the marsh were conducted by the contractor. On 3 and 4 June, Weeks personnel completed laying the submerged line and extended the shore line across the dike, pasture, and existing wetlands and into the designated placement area.

5 June 2002

On 5 June, Weeks personnel set the hard point to work in Reach 1 and connected the floating hose to the hard point (see Photo 25) and the *Beachbuilder* discharge line. Water was pumped through the floating hose, submerged line, and shore line pipe to the placement area to test pumps and piping connections. Weeks personnel, accompanied by an MVN inspector, surveyed the submerged line elevations to confirm that the pipeline had not caused any shoaling or scour to occur.

During the afternoon, the *Beachbuilder's* wire cable was extended and the anchors set. Although the winches could spool approximately 2,500 ft of 1.5-in.-thick wire rope, no more than 2,200 ft was unspooled during the demonstration. Conventional dustpan dredges typically spool longer wire lengths (i.e., 5,000-ft lengths). Initially, five anchors were set. Three anchors were set upstream of the dredge, two on the RDB side of the channel and one on the LDB side across the channel. Two anchors were set downstream of the dredge on the RDB side of the channel (Figure 5). As a result, only one wire cable stretched across the channel. Each cable was tensioned to test the corresponding anchor set. The *Beachbuilder's* winches automatically advance at an adjustable, pre-set tension. Several of the anchors did not hold when tension was applied to the associated cable. The leverman continued testing the anchor-holding capacity until a suitable combination of cable tension (approximately 1,200 psi) and power from the push tug was determined to allow forward movement of the dredge. Once all equipment was deemed operational, the mobility demonstration was initiated at 2145 hr on 5 June in Reach 1.

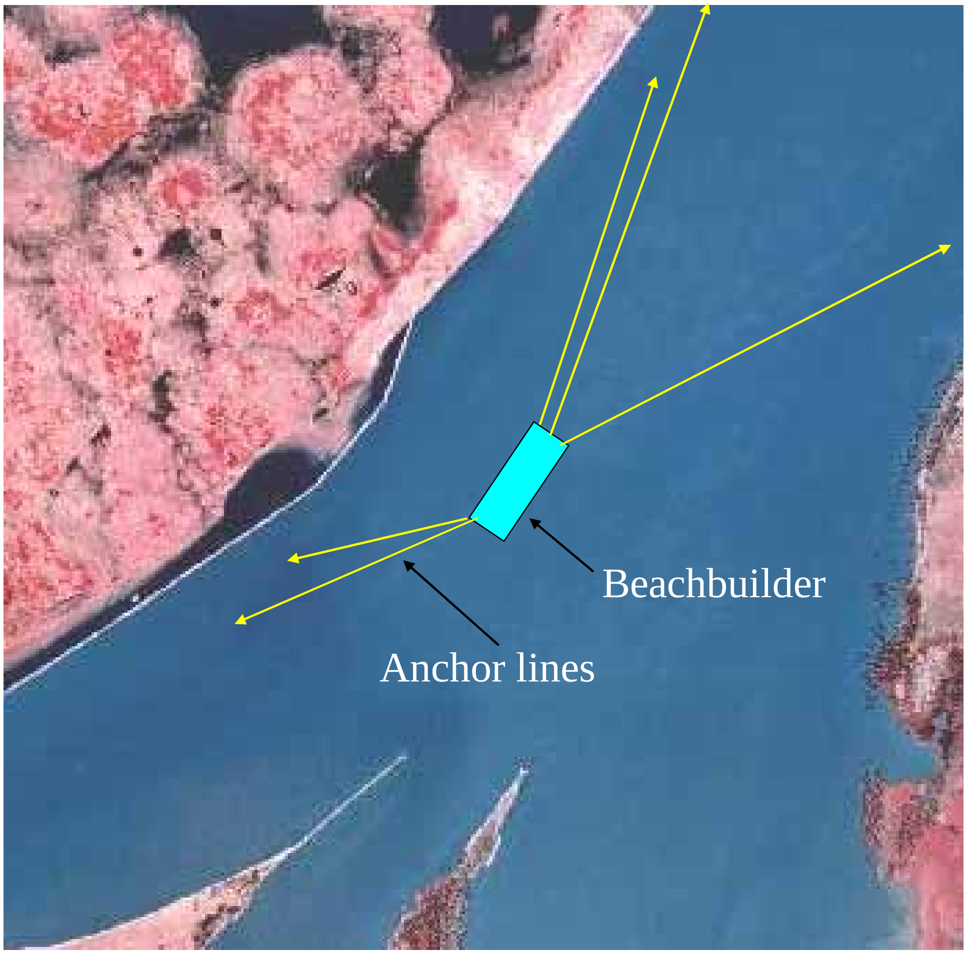

Figure 5. Initial *Beachbuilder* anchor deployment configuration

The *Beachbuilder* was moved out into the channel near the centerline (CL) and back to the RDB side of the channel with no problems. The USACE, Mississippi River Bar Pilot, and contractors all agreed that the dustpan's maneuverability with the flexible floating hose was adequate to proceed with the demonstration. Actual dredging started at 2235 hr along the RDB side toe of the channel in Reach 1. After 25 min pumping, instrumentation indicated possible plugging of a portion of the dustpan. The dustpan was raised for inspection and two pans were found to be plugged with stiff clay. The clay was removed using pry bars and a high-pressure water hose. Dredging resumed after a downtime of 2 hr 15 min. Both before and after dredging sediment samples indicated the presence of silty sand in this area. Because the dredge production data collection system was not yet operational (depth of dustpan in particular), the specific reason that the dustpan was clogged with clay in this instance is not known. It could have been possible that the dustpan exceeded project depth and got into new work (clayey) material. On subsequent pan plugging events with clay, review of the dustpan x-, y-, z-positioning data indicated that the dustpan was deeper than project depth or slightly outside the channel toe. This condition probably placed the dustpan into new work (clayey) material that is not representative of the channel's maintenance material (silty sand) in that area.

6 June 2002

Operations continued during the early morning of 6 June with shutdowns occurring to allow for vessel traffic passage. The *Beachbuilder* made several 750-ft channel parallel cuts on the RDB side of the channel. While conventional dustpan dredges typically operate on longer wire cable sets (with respective impacts on production rates), a 750-ft cut was the optimal length for the *Beachbuilder* based on the available wire cable spooled on the winches. The upstream anchors had to be reset several times because they were dragging downstream. The dredge was shut down for 20 min to add one section of shore line in the placement area.

During the morning of 6 June, a meeting was held with Weeks and OAS personnel to discuss the anchor movement problem. Weeks personnel suggested that a larger tug with more horsepower would provide additional propulsion capability to the dredge thus reducing the strain on the anchors. The anchors would be used for steering and the tug would provide the main thrust for moving forward into a cut. It was agreed to mobilize a larger tug, the *Delta Pacer*, and move the *Delta Eagle* to the starboard side of the dredge near the bow to increase the cross-channel maneuverability of the dredge. With the new tug arrangement, the center forward and two aft anchors could be eliminated. This would provide much better maneuverability and a faster response time in moving across the channel. The *Delta Pacer* arrived at the project site in the late afternoon on 6 June and replaced the *Delta Eagle*.

On the afternoon of 6 June, the full channel width maneuverability demonstration was conducted. The *Beachbuilder* was moved to the LDB side of the channel in Reach 1 stretching the floating hose across the channel. Pumping was initiated on a cut adjacent to the LDB side channel toe. At 1640 hr, a simulated vessel traffic approach was announced. Pumping was ceased, the ladder raised, and the *Beachbuilder* began moving to the RDB side of the channel. The *Beachbuilder* was clear of the channel at 1651 hr, a total of 11 min.

During this period, the MVN notified the USACE, OAS, and Weeks Marine personnel aboard the *Beachbuilder* that a shoal was building rapidly just upstream of Reach 1. The MVN decided to mobilize a hopper dredge to this area and requested that the *Beachbuilder* cease operations in Reach 1 because the hopper dredge required portions of Reach 1 for access to the shoaled area. At 1651 hr dredging was ceased, and the *Beachbuilder* moved further to the RDB side of the channel. All anchors were retrieved and plans were made to move the *Beachbuilder* to Reach 2. Weeks Marine personnel started work on breaking the submerged line and moving the hard point to Reach 2. Operations were terminated at dusk due to potential safety issues. Total downtime for 6 June was 17 hr 35 min.

7 June 2002

Work on adding additional submerged line and moving the hard point resumed at daylight on 7 June. Sections of steel pipe were added and submerged on the RDB side of the channel extending the discharge line to the selected location for the hard point in Reach 2. Operations were terminated at dusk on 7 June (resulting in a total downtime of 24 hr) and resumed at daylight on 8 June.

8 June 2002

Weeks Marine personnel completed setting the hard point at mid-morning on 8 June. The floating hose was connected to the hard point and two upstream anchors were set, one on each side of the channel. Water was pumped through the discharge line to test equipment and pipeline integrity.

Dredging was initiated in Reach 2 at 1230 hr on 8 June. The *Beachbuilder* was configured with the *Delta Pacer* as the push boat and the *Delta Eagle* on the starboard side. The dredge made adjacent 750-ft-long cuts in Reach 2 south of the hard point working across the channel from the RDB side of the channel to the LDB side. Dredging continued on a 24-hr basis. The total downtime for 8 June was 14 hr 5 min. In addition to the time required to reset the hard point, the main engine shut down eight times for a total downtime of 50 min and dredging was stopped to add a length of shore line (35 min).

Vessel traffic passage was accomplished by dropping the starboard bow cable, the one across the channel, as the vessel traffic approached, and picking the cable back up after the vessel traffic cleared. By free-spooling the winch, the cable dropped to the bottom of the channel and went slack within 5 sec. With the additional power from the *Delta Pacer*, the *Beachbuilder* was able to continue dredging with the starboard bow cable slack for vessel traffic passage. After consultation with various river pilots, it was decided that the *Beachbuilder* could safely dredge during the passage of vessel traffic without moving if the *Beachbuilder* was dredging in the RDB half of the channel and the vessel traffic could pass in the LDB half of the channel. The *Beachbuilder* would cease operations and move back to the RDB side if it was dredging in the LDB half of the channel, if two vessels were passing each other in the channel, or if the river pilot in command of the vessel requested additional clearance. This policy was successfully practiced during the remainder of the demonstration project.

In addition to the vessel traffic moving up and down the river, up to four hopper dredges were working in the HOP area during the dustpan demonstration project. They worked both immediately upstream and downstream of the area being dredged by the *Beachbuilder*. They discharged at the head of Pass A Loutre. No interference between the two operations was noted other than the requested shift from Reach 1 on 6 June noted above.

9 June 2002

Dredging operations continued on 9 June. A malfunctioning sensor resulted in main engine shutdown five times for a total downtime of 50 min during the early morning hours. This problem was resolved by 1200 hr.

Additional downtime resulted from adding shore pipe (2 hr 25 min lost time) and cleaning out pans clogged with clay (2 hr 5 min lost time). Day-to-day hydrographic surveys showed that the channel bottom shifted rapidly, which made accurate production rates hard to determine; therefore, it was determined that the surveyed placement area volume would provide the most accurate measure of dredge production. Total lost time for 9 June was 8 hr 30 min. The sensor for the velocity meter malfunctioned and was replaced. The average cut face ranged from 5 to 6 ft thick on 9 June 2002.

10 June 2002

On 10 June, the *Beachbuilder* continued dredging operations in Reach 2. In the morning, the dredge was tracked into the RDB side toe of the channel resulting in the plugging of the port side of the dustpan head with heavy clay. After dark, the dredge operated on the RDB side of the channel to optimize safe operating conditions. Downtime totaled 8 hr 40 min, including adding seven lengths of shore line (3 hr 40 min), ship vessel traffic (1 hr 20 min), moving anchors (55 min), cleaning clay out of pans (1 hr 20 min), and repositioning the dredge eight times (50 min). Two deep-draft vessels passed abreast of the work area at 1740 hr. The cut-face thickness ranged from 2 to 6 ft.

11 June 2002

On 11 June, the *Beachbuilder* continued dredging operations in Reach 2. Shoaled areas across the channel width identified from surveys conducted on 10 June were dredged making short, parallel advances from the RDB side to the LDB side across the areas. Cut-face thicknesses ranged from 4 to 10 ft. After dark the dredge operated further on the RDB side of the channel to optimize safe operating conditions. Total downtime during this day was 7 hr 20 min, which included repositioning the dredge nine times (1 hr 50 min), adding shore pipe (4 hr 15 min), and cleaning out a massive log from ladder pump (20 min). Two deep-draft vessels passed abreast of the work area at 0530 hr.

12 June 2002

The *Beachbuilder* continued dredging operations in Reach 2 upstream of the hard point on 12 June. The central section of the dustpan head was found to be plugged with several logs when checked at 0730 hr. The logs were finally extracted with a chain and hoist, and operations continued. Dredging was generally conducted in the RDB half of the channel with cut-face thicknesses ranging from 2 to 8 ft. Operations were interrupted for anchor movement, addition of shore line at the placement area, and vessel traffic passage. Downtime totaled 5 hr 30 min, including repositioning dredge nine times (1 hr 10 min), raising and adding shore line (1 hr 35 min), and cleaning the clay and timber from two center pans (2 hr 45 min).

13 June 2002

The last day of dredging operations was 13 June. The *Beachbuilder* worked in Reach 2 upstream of the hard point. Cut-face thicknesses ranged from 5 to 9 ft. Downtime for the day totaled 6 hr 15 min, including cleaning clay from pan (2 hr), repositioning the dredge five times for a total of 50 min, time to un-snag anchor wire from floating hose (1 hr 20 min), and vessel traffic (35 min). During a late afternoon inspection of the placement area, USACE and OAS personnel discovered several least tern and American avocet nests containing eggs. The nests had been constructed some distance from the active placement point and were not being disturbed. Dredging operations were terminated at 2100 hr on 13 June when the contract dredging period was completed.

Weeks Marine immediately initiated project demobilization. Anchors were removed. The submerged line was recovered, and the shore line across the dike and in the placement area was removed. The two marsh buggies initiated final grading of the placement area. On 14 June, operations in the placement area were terminated at the request of the MVN due to the numerous bird nests discovered in the area. There was concern that the operations might destroy some of the eggs.

The dike right-of-way area was regraded and the rock dike repaired. After-dredging surveys of the work areas in the river channel and the placement area in the marsh were conducted. All vessels, equipment, and personnel were demobilized from the site.

3 Data Collection Program

The data collection program was designed to provide information for evaluating the dredging methodology's ability to meet the two primary objectives developed for the demonstration project:

a. Demonstrate safe navigation and dredging operations of the flexible-discharge dustpan dredge on the Mississippi River in the HOP area.

b. Demonstrate sufficient production capability to dredge and place material in a designated marsh construction site.

The various onboard-dredge, dredging prism, and placement area parameters monitored during the demonstration are listed in Table 1. In addition, pilots of the Associated Branch Pilots (Bar Pilots) of the Port of New Orleans who stood watch on the *Beachbuilder* during the demonstration were asked their opinion about the navigation safety aspects of operating this type of dredge on the river. A survey of participating Associated Branch Pilots is included in Appendix B.

Table 1
Data Collection Parameters

Onboard *Beachbuilder*	Dredging Prism	Placement Area
Date, Time	River stage	Hydrographic surveys
Slurry pipeline velocity	River surface currents	
x-,y-,z-positioning of dustpan	Hydrographic surveys	
Pump vacuum	Sediment samples	
Discharge pressure		
Production rate		
Slurry density		
USACE daily logs		
Daily dredging report		
Form 4267 Daily Report		

Onboard *Beachbuilder* Data

The onboard dredge data listed in Table 1 were collected and analyzed primarily to determine this dredging methodology's operating characteristics. Quantification of these operating characteristics is useful for evaluating how well the project met the stated objectives, and whether or not the dredge met the project requirements listed in Chapter 1.

The slurry density and pipeline velocity, production rate, x-, y-, z-positioning of dustpan, pump vacuum, discharge pressure, and date and time parameters were sampled every 10 sec. Prior to the demonstration, the contractor was already using these parameters for dredge operation optimization (described in Chapter 2). Minor software modifications by the contractor merged these parameters into a common data stream provided to the USACE in a single, comma-delimited data string for analyses. The header for this data string consists of the following parameters and engineering units:

> Date, time, pump vacuum (inches of mercury), pump 1 discharge pressure (psig), pump 2 discharge pressure (psig), slurry specific gravity, slurry velocity (ft/s), production rate (yd^3/hr), dustpan easting (ft), dustpan northing (ft), dustpan elevation (in ft referenced to MLG), and river stage (ft).

Horizontal position (x-,y-coordinates) of the dustpan was determined by a DGPS and reported in State Plane Coordinates. The z-coordinate (dustpan depth) was calculated by measuring the dustpan depth relative to water level, then correcting that value with the river stage referenced to MLG. Dustpan depth relative to water surface was calculated by measuring the ladder angle with an inclinometer and, by working through geometric relations between the measured inclination angle and ladder geometries, producing a depth value. This value was then corrected for draft and reported as depth relative to water surface. This relative water depth was adjusted to MLG datum by river stage values manually entered from readings taken from the MVN river stage board at Pilot Town.

The slurry density was measured by a nuclear density meter (Photo 26) and pipeline velocity by a electromagnetic flow meter. The instantaneous production rate (reported in cubic yards per hour) was calculated for each sample from the slurry density and velocity values. Pump vacuum and discharge pressures were measured by pressure transducers mounted on the pipeline. Date and time values were taken from the data collection computer clock set to the local time zone. The leverman logs and daily observation logs were manually recorded by USACE and contractor personnel in the leverman's room.

Dredging Prism Data

The dredging prism data listed in Table 1 were collected to reference the dustpan digging elevation and hydrographic surveys to MLG and define hydrodynamic conditions in which the dredging was conducted (respectively river stage and current measurements), to determine sediment type and grain size in Reaches 1 and 2 (sediment samples), and to determine production rates and identify shoaling (before dredge (BD) and after dredge (AD) hydrographic surveys).

River Stage Data

As previously mentioned, river stage values were manually entered from readings taken from the MVN river stage board at Pilot Town. Dredging activities were in the spring of 2002 to coincide with the normal period of high water on the Mississippi. The stage hydrograph in Figure 6 from MVN's Venice, LA, Sta 01480 (located at Mississippi River at Mile 10.7 referenced to the National Geodetic Vertical Datum (NVGD)) shows the river high/low stage cycles over last 9 years (maximum allowable number of years to plot by the analysis routine). In Figure 7, the expanded plot of the Venice Station river stages (from January through July), it can be seen that the highest river stage attained during the demonstration (3-13 June 2002) was 4.95 ft NGVD. This is the highest river stage recorded since 20 Jan 1983, when a river stage of 5.15 ft was measured. While not as high as the record maximum river stage measured at 9.11 ft from a watermark left by the hurricane of 17 Aug 1969, the maximum river stage measured during the demonstration confirms that the dredge was indeed tested in high water!

River Current Data

The river surface currents were measured by a FP201 Global Flow Probe, manufactured by Global Water (Photo 27). The flow probe is an impellor current meter that measures average water velocity. Due to the limited scope of the current meter, all measurements were taken near the surface at a water depth of approximately 3 ft. The flow probe uses true velocity averaging at a sampling frequency of 1 Hz to calculate the average velocity over the time interval that the impellor was in the water, and also measures and records the maximum (or burst) velocity sampled at 1 Hz. The probe was deployed from the bow of the survey vessel while tied up alongside the anchor points, and later in the demonstration off the dustpan gantry at the bow of the *Beachbuilder* (while stationary) from various locations in the channel (Photo 28). The impellor was immersed for approximately one-half minute to measure the average and burst current velocities. The current measurement positions and velocities are presented in Table 2.

Hydrographic Survey Data

The BD, during dredging, and AD hydrographic surveys of the dredge site were conducted by MVN and the contractor's survey crews using DGPS and echo sounders at 200 KHz (as per standard MVN survey specifications). Data were furnished to the USACE in a structured ASCII format on magnetic media.

Sediment Sample Data

Sediment samples were collected by a drag bucket sampler from the approximate center of each dredging reach as per MVN specifications. The BD sample 1 from Reach 1 (BD01) was collected 5 June 2003 from the CL Sta 9+00 at -48 ft

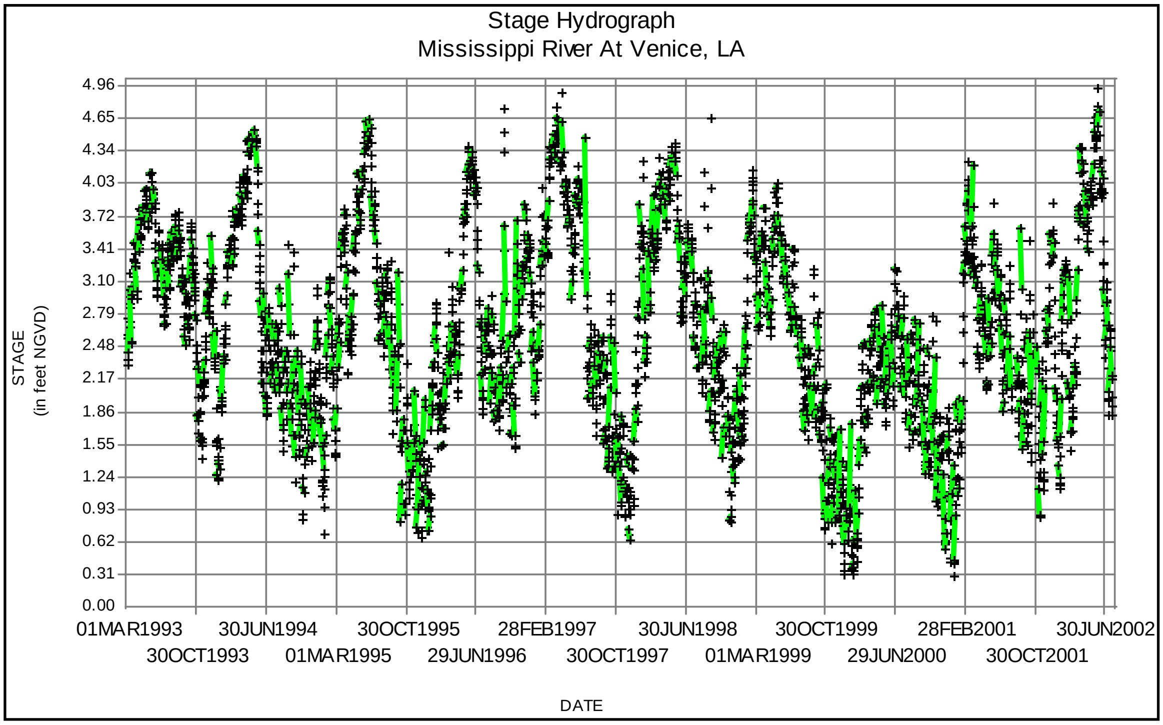

Figure 6. Venice Station stage hydrograph (March 1993 – July 2001)

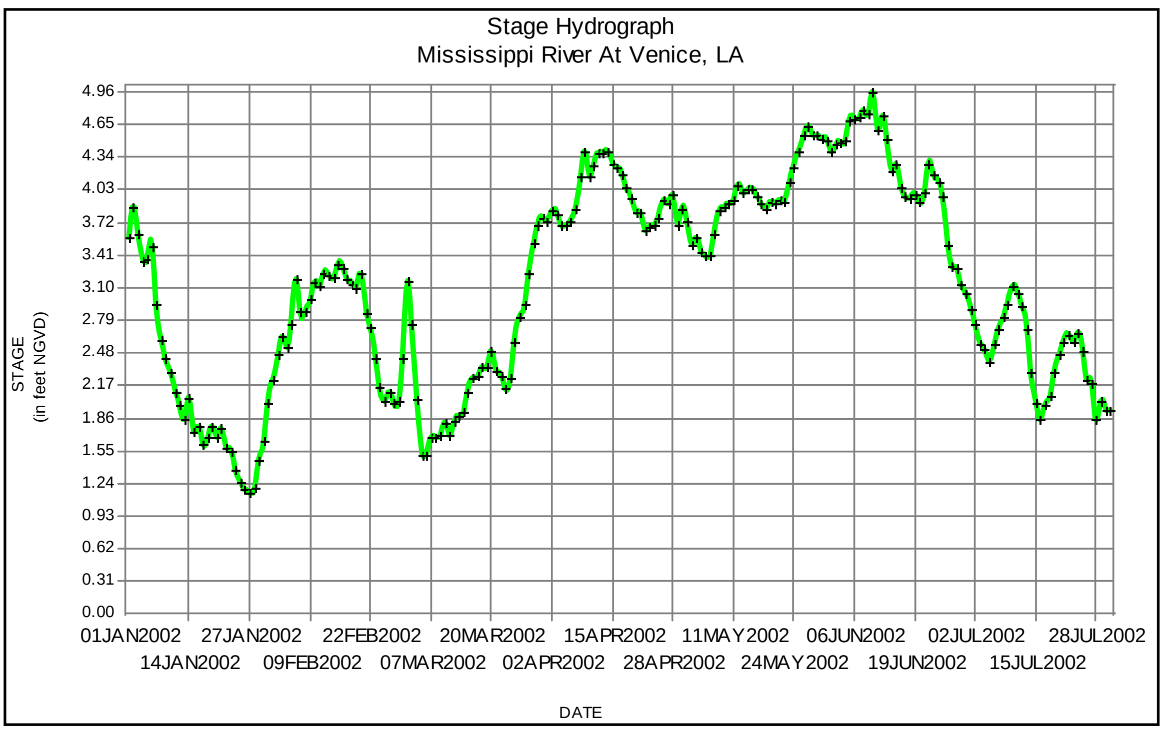

Figure 7. Venice Station stage hydrograph (January 2002 – July 2002)

Table 2
Current Measurements and Locations

Date	Time	Velocity Max, ft/s	Velocity Avg, ft/s	Easting ft	Northing ft	River Stage ft MLG	Comments
5 June	1300	7.0	6.1			5.0	
6 June							
7 June							
8 June	0850		3.0			5.4	
	1700		4.2			5.6	
9 June	0800	3.9	3.0			5.5	
	1539	5.1	3.9	243276	3944105	5.5	Taken from stationary dredge/survey configuration from CL of channel prism #2
10 June	1035	5.0	3.5	243921	3944055	5.9	CL of channel off gantry
	1025	4.0	3.4	243925	3943751	5.9	Range 300 of stbd bow (approx due west from CL reading off gantry)
	1445	6.1	5.3	244185	3943971	5.5	Range 88, Sta 49+97
11 June	0720	3.5	2.7	244730	3943227	5.5	Off gantry
	1641	6.3	5.3	243435	3944100	5.3	Off gantry
12 June	0745	2.8	2.4	243257	3943883	5.3	Off gantry
13 June	0645	3.7	3.1	243528	3943775	5.4	Off gantry

MLG (x = 3,943,667 y = 248,228). BD sample 2 from Reach 2 (BD02) was also collected on 5 June 2003 from Station 51+50 at -47 MLG (x = 3,944,058 y = 244,041). Both BD01 and BD02 were classified as a silty sand (American Association of State Highway and Transportation Officials) with median grain sizes of 0.0752 mm and 0.157 mm, respectively. The AD sample 1 from Reach 1 (AD01) was collected 8 June 2003 from the CL Sta 9+00 at -50 ft MLG (x = 3,943,674 y = 248,213). AD sample 2 from Reach 2 (AD02) was collected on 14 June 2003 from Sta 51+50 (x = 3,944,060 y = 244,041) (no depth recorded). AD01 and AD02 were also classified as silty sand with median grain sizes of 0.108 mm and 0.100 mm, respectively.

Placement Area Data

BD and AD placement site surveys were conducted by the contractor’s survey crew and inspected by MVN, using airboats, mobile DGPS for horizontal positioning, and spirit leveling for vertical control. Cross sections were extended over the anticipated limits of material placement at 100-ft intervals centered on the discharge location. All cross sections were oriented (tied) normal to the baseline with readings taken at least every 20 ft along the cross section and adjusted to the nearest 0.1 ft. Data were furnished to the USACE in a structured ASCII format on magnetic media.

4 Dredging Operational Characteristics Analyses

This chapter presents the dredge's operational characteristics analyses. These analyses were conducted to determine the *Beachbuilder's* ability to dredge and place material in a designated marsh construction site, and to provide MVN with production information. This information can be used as a basis for future cost estimates to evaluate the feasibility of using this dredging method at the HOP and other sections on the Mississippi River. These analyses are presented to address the following aspects:

Dredge Maneuvering Characteristics:

- Actual time interval required to move the hard point.
- Actual time intervals required for handling anchors.
- Delay intervals when dredging is halted for vessel passage categorized for different locations (i.e., RDB or LDB halves of the channel) and vessel sizes.
- Amount of time required to back down and reposition for each cut.
- Cross-channel maneuvering capabilities (lateral maneuvering speed)
- Results of pilot survey regarding dustpan use in navigation channel.

Dredge Production Characteristics:

- Individual advance rates per cut and average rates for entire project.
- Average bank height for each advance.
- Total production and production rate for each advance.
- Average production rates for entire demonstration.
- Estimation of high and low range of average production rates.
- Time-series plots of production.

Dredge Maneuvering Characteristics

The dredge maneuvering characteristics were determined by calculating the respective characteristic components from data reduced from several sources, including: the contractor's daily dredge report and daily submittals on Engineer Form 4267 "Report of Operations – Pipeline, Dipper, or Bucket Dredges," supplemental notes taken by USACE and contractor personnel, and from the time-series data of the dredge or dustpan x-, y-, z-position and slurry density and velocity. Some minor time discrepancies were noted between these different data sources. These discrepancies are due primarily to different personnel manually logging the entries at different times.

Relocating the hard point

The time interval for moving the hard point from Reach 1 to Reach 2 that consisted of adding 3,600 ft of submerged line was 43 hr 45 min (time from dredge shutdown at 1645 on 6 June to startup at 1230 on 8 June). To determine a "typical" time interval that could be used for future project planning and estimating, this interval should be adjusted by evaluating the effects of two factors: work was suspended during the hours of darkness due to crew safety concerns of this first-time demonstration, and the move was made before it was scheduled because of the request to relocate the dredge due to the rapidly developing shoal (described in Chapter 2). Once experience is gained on operating at night and a safety hazard risk analysis is performed, the night-time operating restriction may be lifted. The amount of time that work was delayed (due to darkness) on moving the hard point consisted of 5 hr 18 min on 6 June, 10 hr on 7 June, and 5 hr 45 min on 8 June, for a total of 21 hr 3 min. The subtraction of the night-time hours from the total interval results in 22 hr 42 min to float the submerged line (fill with air), disassemble, add sections, and move the hard point. This time could have been further reduced if the contractor had planned for the move by having the additional pipe connected and standing by. The contractor estimated that had the move been planned with the additional submerged pipe and handling equipment standing by, the total time to move the fixed point would have taken approximately 12 hr.

Anchor handling

The anchors were handled for three basic reasons during the demonstration: to initially set them in Reach 1, to reposition anchors that were dragged during the tension-setting tests and during dredging, and to reposition the anchors in Reach 2. There was one instance where the cross-channel anchor outside the LDB channel toe was impeding a hopper dredge placing material into the disposal site in Pass A Loutre, and the anchor was promptly repositioned. The anchor-handling times depended on the availability of the tugs, where the anchors were being moved from and to, vessel traffic impacting the cross-channel anchor handling, and (where precise anchor positioning was required, i.e., ensuring the anchor was placed outside the channel) availability of the survey vessel. Seven anchor-handling events were logged. Durations ranged from

10 to 50 min. Statistics from this sample population are an average time of 30 min, median time of 30 min, and a mode of 20 min. One anchor-handling event was not included in the sample population. On 13 June the dredge was being repositioned when the partially lowered dustpan became snagged on the starboard bow anchor wire and it took 1 hr 20 min to clear. This solitary event was excluded due to its nonrepresentative nature. During the entire demonstration time span of 192 hr, time logged for handling anchors (4 hr 50 min) was 2.5 percent of that total. During the last five demonstration days (after relocating to Reach 2) when dredging operations were more routine, the anchor-handling time (2 hr 5 min) was reduced to 1.8 percent of the total 117 hr available.

Passing vessel delays

Dredging delays caused by passing vessels depended on the passing vessel types, sizes, numbers, travel directions, and dredge position in the channel relative to the passing traffic. During the first few days, the operating procedures for when a vessel passed *Beachbuilder* evolved as experience was gained. During this initial period, the dredge was primarily working on the RDB side of the channel and was stopping and moving for any significant-sized vessel traffic.

CL stationing and ranges were used in the daily dredge reports to record dredge positions; therefore, most future dredge position descriptions in this report will be also be described in these terms (e.g., Sta 18+50, Range 255). Stations are distances along the channel CL. Ranges, or offset coordinates, are lateral distances from the channel CL and carry plus/minus coordinate values. MVN ranges (or offsets) are positive to the right of the channel CL (and negative to the left of CL) looking toward increasing stationing (or downstream). For example, with the 700-ft-wide channel at HOP, a range of 0 (R 0) will lay right on the channel CL, R 375 is on the RDB side toe of the channel, and an R -375 lies on the LDB channel toe (see Figure 8).

On 8 June the dredge was operating around R 335, or close to the RDB toe of the channel. For deeper draft vessels passing (with the concurrence of the pilots on the dredge and passing vessel), the dredge would drop the cross-channel wire to the bottom and continue dredging as the vessel passed. For shallower draft vessels (approximately 15 ft and less) the *Beachbuilder's* pilot would usually ask the passing vessel to steer to the negative range side of the channel (LDB side) and the cross-channel anchor wire would not be slackened as the vessel passed over the wire.

On 9 June the dredge started to work on the channel CL (R0). After starting to dredge on Sta 60+00 R 0 at 1355, the dredge continued working until 1524 (total dredging time of 1 hr 29 min) when it was moved to Sta 53+00 R 365 because of vessel traffic. After consultation with the pilot who estimated when the next deep-draft vessel would pass, it was decided to continue dredging at Sta 52+30 R 365 to be able to optimize dredging time as opposed to having a short time to dredge before the next deep-draft vessel passed. At 1600, after the deep-draft vessel passed, the dredge was moved back out to Sta 53+00 R 0, where it dredged until 1640 (total dredging time of 40 min) when it was moved again back to Sta 52+80 R 365 for the next deep-draft vessel passing.

On 10 June the dredge was moved back to Sta 53+02 R 0 at 1136 and dredged until 1322 (total dredging time 1 hr 46 min) when it was moved for passing vessel traffic back to Sta 52+80 R 285. At 1622 the *Beachbuilder* moved over to Sta 51+45 R -373 and dredged till 1656 (total dredging time of 34 min) when it stopped on Sta 48+75 R -378, then relocated to Sta 51+89 R 125 and continued dredging on the positive range side for the rest of the day.

After the most recent hydrographic survey was loaded into *Beachbuilder's* dredge monitoring system on 11 June, it was decided that the priority dredging locations in Reach 2 would be the "high (shoal) spots" located on the negative range side during the day. This tactic was based on the experience from the previous day that longer, continuous advances on the negative range side of the channel were not possible with the volume of deep-draft vessels passing. The screen shot of the dredge monitoring system with updated bathymetry is shown in Figure 8. These high spots were dredged in the following sequence.

a. The dredge worked 39 min (Sta 58+50 R -130 to Sta 57+85 R -140) (Figure 8 shows the dredge working on this high spot), then moved to Sta 59+45 R 140 (with a 5-min transit time) due to two oncoming deep-draft vessels for a vessel-delay-induced dredge transit time of 11 min. The *Beachbuilder* was back dredging when the cross-channel wire was dropped twice for the 39.3-ft and 23.4-ft draft vessels without interruption to dredging. It advanced to Sta 51+90 R 140 when it was relocated to dredge another high spot (with a 5-min transit time).

b. The *Beachbuilder* was able to work/dredge 52 min (Sta 58+25 R -140 to Sta 54+65 R -140) when oncoming vessel traffic once again required a dredge repositioning to Sta 55+20 R 140 (10-min transit). There it dredged for 40 min while three deep-draft vessels passed over the cross-channel anchor lying on the bottom without interrupting dredging at the repositioned location.

c. After the deep-draft vessels passed, the dredge was relocated to Sta 58+25 R -140 (5-min transit time) and dredged to Sta 54+64 R -140 for 55 min before again being moved for oncoming vessel traffic. The *Beachbuilder* set back to Sta 55+20 R 140 (for a 5-min transit time) and dredged to Sta 51+90 R 140 for 35 min until the deep-draft ship passed.

d. The dredge was repositioned to Sta 60+00 R -95 with a 5-min transit time, plus 5-min delay waiting on one of the hopper dredges to move. There it dredged for 1 hr 25 min to Sta 52+00 R -125 until another oncoming passing vessel required repositioning to Sta 60+00 R -55 (with a 15-min transit time).

e. Once on station, it advanced to Sta 52+25 R -55, dredging for 1 hr 45 min when oncoming vessel traffic required repositioning again and the cycle repeated.

This cycle was basically repeated on 12 June when the dredge worked on the minus range side. On 13 June, the dredge stayed in the positive range channel side to optimize dredge production in the thicker face on that side without the numerous resetting delays. The dredging sequence for 11 June was listed in detail to illustrate the following points:

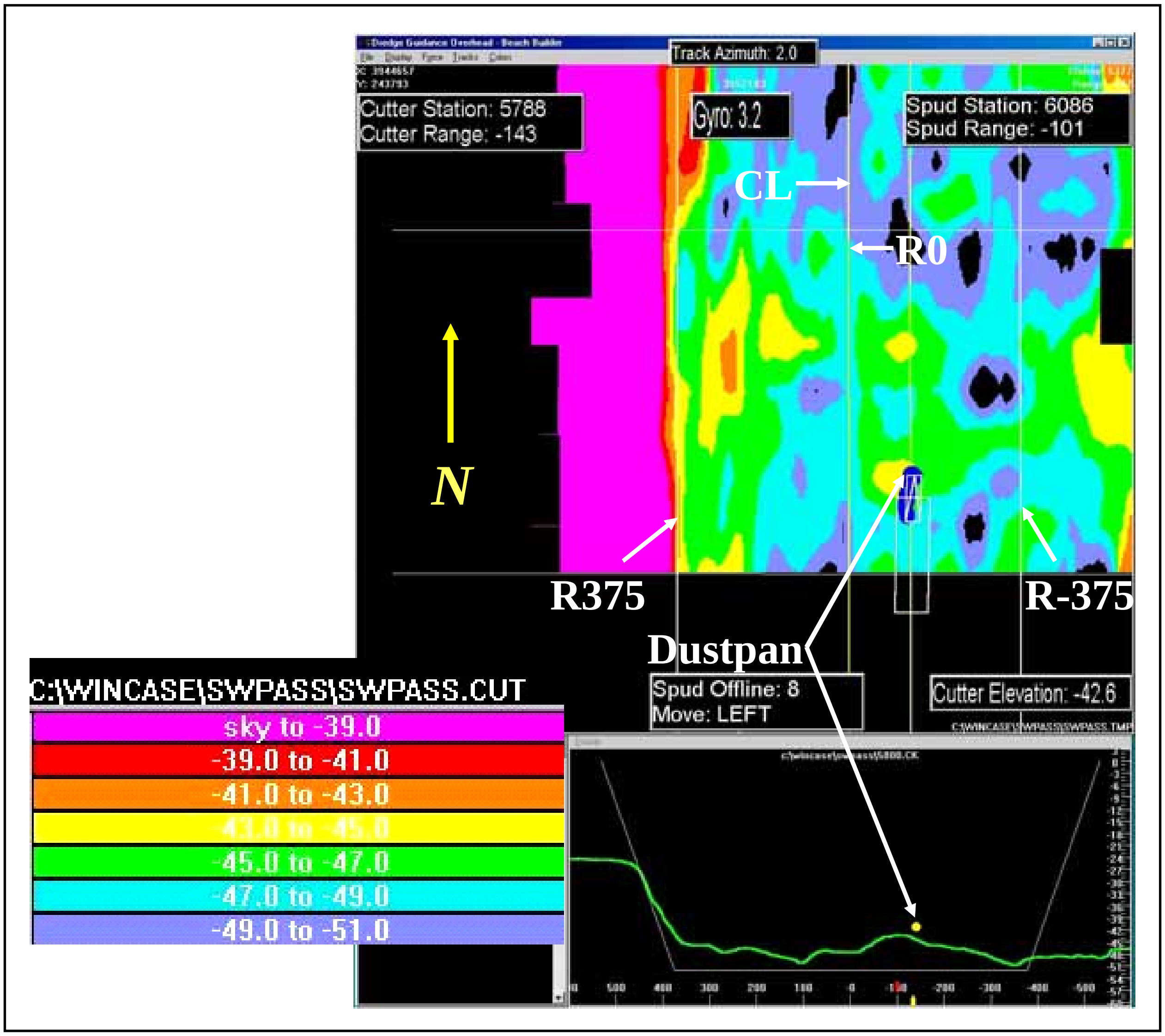

Figure 8. Weeks Marine dredge positioning system (with ranges, CL, and dustpan positions annotated)

a. With any dredging position with an approximate range R > +100 ft, the deep-draft vessels could pass with no interruption to dredging because just the cross-channel wire was dropped to allow the vessels to pass. During the time the wire was dropped, there was no significant decrease in production noted on the density meter (usually 2 to 4 min long for one passing vessel). The length of time required to release tension on the cross-channel wire and drop it to the bottom was less than 5 sec.

b. Given the volume of deep-draft vessels passing during the demonstration (in 6 days 143 vessels with drafts greater than 20 ft passed), the *Beachbuilder* could not dredge in the negative range (LDB) side of the channel for a continuous interval longer that 1 hr 45 min. The number of deep-draft vessels passing during the demonstration was estimated to be slightly below average (as per communication with Captain Michael Lorino, President of the Mississippi River Bar Pilots Association).

c. When moved for passing vessels, the dredge was usually relocated to enable it to keep dredging with as little downtime as possible rather than standing by for vessel traffic. The decision to relocate to dredge another position was influenced by the number of deep-draft vessels and the times between passings. If just one vessel was going to pass, the dredge could move aside, then immediately reoccupy the same digging position, but if several vessels were going to pass within a short time, then the dredge would start digging in a new location.

On 11 June when the *Beachbuilder* was dredging the high spots in the negative ranges (total time of 10 hr 20 min), it took 55 min to reposition the dredge six times (average of 9.2 min per move), and 5 min of downtime was due to a delay from hopper dredge maneuvering. This resulted in a vessel delay percentage of approximately 9 percent.

During the total demonstration duration (192 hr), a total of 8 hr was logged as delay due to vessel traffic (4.2 percent of the total). During the last five demonstration days (after relocating to Reach 2) when the crew had become more familiar with this dredging method and dredging operations were more routine, the logged vessel delay time (2 hr 29 min) consisted of 2.1 percent of the total 117 hr available.

Time required to back the dredge down and reposition (reset) for each cut

The time required and distances traveled to back down and reposition the dredge for successive cuts were calculated from the resets identified in the daily dredge logs by station and range. These resets' start and stop positions, linear distances, respective times, and transit speeds are shown in Table 3. Entries that included additional tasks completed along with the reset (i.e., add pipe, clean dustpan, etc.) were excluded from these calculations due to the intent to calculate an average transit speed based solely on reset time. Reset speeds ranged from 9 ft/min to 198 ft/min. The average reset speed for 37 resets was 74 ft/min, with a median of 55.5 ft/min. The total time required to conduct these maneuvers was 5 hr and 20 min. One reason for the wide range of speeds is that on some of the setbacks the floating hose required more repositioning by the tugs. Three resets and respective times were identified from the daily dredge report that included additional tasks, i.e., adding shore pipe that increased the total time for resets to 7 hr 10 min.

Cross-channel maneuvering capabilities

The ability of the dredge to move (laterally) across the channel is a major element in analyzing this type of dredge's operational feasibility regarding navigation safety. Table 4 lists 14 individual lateral moves made by the *Beachbuilder* during the demonstration. These lateral moves are described by respective date, start/stop times and positions, linear distance traveled by the dredge, move time, and transit speed. The time used to calculate transit velocity

Table 3
Reset Times and Transit Speeds of *Beachbuilder*

From		To		Linear Distance	Reset Time	Transit Speed
Sta	Range	Sta	Range	ft	min	ft/min
1430	495	1850	255	484	10	48
1270	255	1850	345	587	15	39
5720	355	5940	286	231	15	15
5250	285	6000	135	765	5	153
5250	135	6000	15	760	5	152
5190	365	5300	0	381	10	38
4875	0	5300	415	594	5	119
3250	285	5220	95	1,979	10	198
4990	95	5370	375	472	5	94
5150	375	5180	-135	511	10	51
5150	375	5180	135	242	10	24
4765	135	4980	95	219	5	44
4765	95	5050	15	296	5	59
4830	15	5275	175	473	5	95
4760	175	5275	135	517	5	103
4765	215	5250	255	487	10	49
4840	295	5370	340	532	20	27
5785	-140	5945	140	322	5	64
5510	145	5825	-140	425	10	42
5465	-140	5520	140	285	5	57
5190	140	6000	-95	843	5	169
5200	-125	6000	-55	803	15	54
5225	-55	5935	175	746	10	75
5240	175	5920	215	681	15	45
5575	215	6050	-15	528	10	53
5440	-15	5580	215	269	5	54
5240	215	5450	-15	311	5	62
5240	-14	5450	-135	242	5	48
5135	-135	5900	-135	765	10	77
5400	95	5975	55	576	5	115
5330	55	6000	-215	722	10	72
5330	-215	6045	-295	719	5	144
5240	335	6015	265	778	10	78
5220	295	6000	295	780	5	156
5660	295	6000	255	342	10	34
4665	335	5150	175	511	15	34
4880	175	4920	255	89	10	9
				Average Velocity =		74 ft/min

Table 4 Cross-Channel Maneuvering Capabilities										
Date	Start Time	Stop Time	From		To		Linear Distance ft	Move Time min	Transit Speed ft/min	Raise Dustpan min
			Easting	Northing	Easting	Northing				
6/6/2002	1620:08	1635:01	3943808	247532.4	3944079	248039.9	575	14.88	39	
6/9/2002	1534:02	1541:03	3944041	243941.3	3943686	243956.1	355	7.01	51	
6/9/2002	1603:47	1608:18	3943699	243986.9	3944018	243879	337	4.57	74	0.5
6/10/2002	908:44	915:05	3944062	243990.7	3943769	244044.3	298	5.35	56	
6/10/2002	940:30	944:51	3943812	244062.8	3944062	243915.5	291	4.35	67	
6/10/2002	1024:09	1032:51	3943760	244015.6	3944078	243921.4	332	8.70	38	
6/10/2002	1111:39	1122:01	3944064	243914.3	3943701	244092.8	404	10.36	39	1.5
6/10/2002	1128:02	1133:33	3943770	244045.1	3944063	243910.8	322	5.51	58	
6/10/2002	1657:30	1702:21	3944425	244310.2	3943949	244002	567	4.85	117	0.5
6/10/2002	1722:04	1724:55	3943931	244129.5	3943789	244179.6	15	2.84	53	0.83
6/10/2002	1726:05	1728:46	3943819	244146.1	3943932	244120.4	116	2.68	43	
6/10/2002	1734:37	1738:27	3943927	244155.6	3943696	244172.8	232	3.83	61	0.83
6/11/2002	1547:50	1551:30	3944180	243723.6	3943921	243646.3	271	3.66	74	0.66
6/12/2002	1518:33	1521:44	3944253	243855	3943934	243610.8	402	2.80	143	0.83
						Average lateral move velocity			**65 ft/min**	

does not include the additional time required to pull the dustpan out of sediment to allow the dredge to move without damaging the ladder. The dustpan "pull out" times were calculated from the time-series data. When dredging in thinner faces, the dustpan could be pulled up to a depth where the dredge could start moving in approximately 0.5 min, whereas when dredging in the thicker faces (greater than 10 ft), it required approximately 1.5 min or more to clear the material. With a minimum transit speed of 38 ft/min and maximum of 143 ft/min, the average lateral transit speed for all 14 moves was 65 ft/min. The time variations were primarily a function of total distance traveled by the dredge, and the ease (or difficulty) of correctly positioning the floating hose. The fastest speeds occurred on 10 and 12 June (117 and 143 ft/min, respectively), which was later in the demonstration after experience had been gained in executing this maneuver and when the dredge was moved from one extreme side of the CL to the other. Given the channel width of 750 ft, at the average speed (65 ft/min) it would take 11.5 min for the dredge to cross from toe to toe. Using the two maximum rates of lateral speed logged (117 ft/min and 143 ft/min), the *Beachbuilder* could completely cross the channel as quickly as 6.4 min and 5.2 min, respectively.

Results of Associated Branch Pilot survey regarding dustpan use in navigation channel

Ten pilots responded to the survey sent to the Associated Branch Pilots of New Orleans. Of these ten, two had only heard about the demonstration and offered no opinion on the demonstration. Another one had heard about the demonstration and piloted a vessel past the *Beachbuilder* as it operated and would agree that a dustpan dredge (like the *Beachbuilder* used in the demonstration) with propulsion and flexible discharge would present an acceptable risk to navigation if the dredge worked on just one side, or half, of the channel at a time (not have the flexible discharge extended across the entire channel width). Two others who piloted vessels past the dredge during the demonstration agreed and strongly agreed that a dredge like the *Beachbuilder* presented an acceptable risk to navigation at the HOP without any operational modifications. The remaining five pilots who responded to the survey had both stood a watch on the dredge and had piloted a vessel past her during the demonstration. Of these five, one strongly agreed and three agreed that the *Beachbuilder* presented an acceptable risk to navigation at the HOP without any operational modifications. The remaining pilot would strongly agree that the *Beachbuilder* presented an acceptable risk to navigation at the HOP if it was restricted to dredging only the RDB side in the reach from 1 mile Above Head of Passes to 1 mile Below Head of Passes. The reason behind this restriction was that if a (especially outbound) vessel lost propulsion power, the current flowing into Pass A Loutre would cause the vessel to move toward the LDB side and become a hazard to a dredge working there if it could not move out of the way. Other pilots who stood a watch on the *Beachbuilder* and were verbally interviewed also expressed this concern.

Dredge Production Characteristics

The dredge production characteristics were analyzed by reducing the data from the contractors' daily dredge report and daily submittals on Engineer Form 4267, supplemental notes taken by USACE and contractor personnel, the time-series data of the dustpan's x-, y-, z-positions, slurry density and velocity readings, calculated production rate in cubic yards per hour, and bathymetry data taken by daily hydrographic survey. Calculated production characteristics calculated include advance rates, approximate bank heights, and various types of production rates.

Individual advance rates per cut and average rates for entire project

The individual advance rates were calculated using the start and stop times and positions from dredge advances that did not experience significant delays. The total time, linear distance traveled (calculated from start and stop coordinates), and advance speed of each individual advance are listed in Table 5. These advances were calculated for times of relatively uninterrupted dredging intervals to determine advance rates without delays (i.e., adding shore line, cleaning pump, etc.). Because of the experimental nature of this project, advance distances ranged from 17 ft to 773 ft in length. A minimum advance rate of 0.9 ft/min and maximum rate of 15.1 ft/min (the advance on 6 June at 1633 is deemed too short and early in the demonstration to be counted) were logged during the demonstration with an average advance rate (based on 68 advances) for the entire demonstration of 5.8 ft/min. The average advance rate of the *Beachbuilder* while at Reach 1 from start of dredging to stop including all delays (i.e., anchor handling,

Table 5
***Beachbuilder* Advance Rates and Production**

	Time		From		To							
Date	Start	Stop	Easting	Northing	Easting	Northing	Linear Advance Distance ft	Time min	Advance Speed ft/min	Production Volume yd^3	Production Rate yd^3/hr	Face Height ft
6/6/2002	1221:43	1256:49	3943731	247434.8	3943604	247792.7	380	35.09	10.8	1,339	2,290	4
6/6/2002	1311:41	1347:48	3943600	247793.6	3943522	247975.3	198	36.00	5.5	955	1,592	4
6/6/2002	1633:01	1640:12	3944092	248016.6	3943976	248106.9	147	7.50	19.6	230	1,842	4
6/8/2002	1230:18	1439:41	3943669	243231.5	3943690	243371.1	141	129.60	1.1	4,556	2,109	17
6/8/2002	1449:33	1845:13	3943685	243379.4	3943701	243609.5	231	235.20	1.0	6,815	1,738	5
6/8/2002	1851:44	1938:53	3943707	243609.8	3943706	243651.6	42	46.80	0.9	1,395	1,789	2
6/8/2002	1949:05	2021:00	3943716	243658.8	3943717	243686.4	28	31.80	0.9	1,018	1,921	4
6/8/2002	2057:36	208:27	3943707	243696.4	3943721	243961.6	266	309.80	0.9	10,109	1,958	17
6/9/2002	252:06	550:17	3943702	243281.6	3943720	243973.9	693	177.80	3.9	8,882	2,997	12
6/9/2002	620:53	753:39	3943749	243297.8	3943767	243478.2	181	92.80	2.0	967	625	11
6/9/2002	958:55	1226:28	3943747	243267.2	3943770	243948.9	682	94.00	7.3	3,417	2,181	12
6/9/2002	1403:27	1534:32	3943973	243229	3944018	243936.2	709	91.20	7.8	4,115	2,708	5
6/9/2002	1543:14	1604:27	3943689	243965.3	3943704	243972.8	17	21.20	0.8	1,073	3,036	20
6/9/2002	1609:58	1643:03	3944050	243898.1	3944036	244124	226	32.60	6.9	1,207	2,221	4
6/9/2002	1708:38	1911:10	3943668	243257.4	3943698	243790.6	534	121.80	4.4	6,821	3,360	4
6/9/2002	1943:56	2141:44	3943675	243718.9	3943722	244068.8	353	118.20	3.0	5,580	2,832	20
6/9/2002	2243:37	032:45	3943667	243796.3	3943714	244076.9	284	109.20	2.6	5,103	2,804	20
6/10/2002	058:10	115:42	3943711	244089.8	3943710	244113.9	24	18.00	1.3	410	1,365	19
6/10/2002	314:26	844:49	3943683	243760.3	3943709	244378.6	619	331.20	1.9	18,199	3,297	20
6/10/2002	1138:24	1226:43	3944059	243895	3944057	244315.9	421	49.20	8.6	2,233	2,723	3
6/10/2002	1235:44	1321:32	3944016	243989.2	3943996	244293.5	305	46.00	6.6	1,967	2,566	6
6/10/2002	1406:31	1413:42	3944334	243880	3944334	243933.2	53	8.00	6.7	225	1,686	3.5
6/10/2002	1421:03	1457:29	3943960	243976.5	3943989	244181.4	207	36.00	5.7	1,739	2,898	3.5
6/10/2002	1501:00	1528:14	3944412	243791.4	3944432	244015.7	225	27.00	8.3	1,093	2,430	2
6/10/2002	1622:45	1657:50	3944422	244036.2	3944388	244308.7	275	35.00	7.8	1,078	1,847	5

(Sheet 1 of 3)

Table 5 (Continued)

Date	Time		From		To		Linear Advance Distance ft	Time min	Advance Speed ft/min	Production Volume yd^3	Production Rate yd^3/hr	Face Height ft
	Start	Stop	Easting	Northing	Easting	Northing						
6/10/2002	1704:52	1721:54	3943930	244003.6	3943934	244128.8	125	17.00	7.4	784	2,766	6
6/10/2002	1729:16	1735:07	3943933	244103.3	3943901	244166.1	71	6.00	11.8	266	2,657	4
6/10/2002	1739:18	1747:09	3943688	244173.9	3943680	244193.9	22	8.00	2.7	478	3,584	7
6/10/2002	1757:41	1855:11	3943929	244157.8	3943934	244414.3	257	57.00	4.5	2,601	2,738	6
6/10/2002	1859:21	1924:46	3943973	244211	3943964	244421.9	211	26.00	8.1	978	2,256	5
6/10/2002	1929:26	1944:09	3944012	244115.2	3944023	244341.6	227	15.00	15.1	600	2,399	4
6/10/2002	1950:30	1956:51	3943884	243913.7	3943880	243932.1	19	6.50	2.9	181	1,669	5
6/10/2002	2027:37	2226:47	3943889	243945.4	3943901	244438.3	493	119.00	4.1	4,872	2,456	3
6/10/2002	2233:38	2245:00	3943920	243900.3	3943906	243980.8	82	11.00	7.4	539	2,941	3
6/10/2002	2251:21	109:04	3943847	243932.3	3943850	244393.2	461	138.00	3.3	4,204	1,828	5
6/11/2002	117:36	506:34	3943798	243943	3943808	244410	467	228.00	2.0	6,768	1,781	7
6/11/2002	538:01	736:51	3943757	243895.4	3943776	244363.1	468	121.00	3.9	4,329	2,146	8
6/11/2002	939:46	1138:05	3943709	243832.7	3943766	244315.6	486	118.80	4.1	4,774	2,411	15
6/11/2002	1300:32	1321:25	3944160	243296.2	3944173	243401.8	106	21.00	5.1	861	2,459	8
6/11/2002	1348:31	1441:09	3943894	243257	3943910	243661.8	405	51.80	7.8	2,302	2,667	5.5
6/11/2002	1450:01	1548:00	3944188	243360.3	3944175	243722.4	362	58.00	6.2	2,633	2,724	6
6/11/2002	1552:41	1627:37	3943906	243647.6	3943908	244010.7	363	35.20	10.3	1,653	2,818	4
6/11/2002	1635:58	1803:42	3944139	243182.3	3944141	243887.2	705	88.00	8.0	3,973	2,709	8.5
6/11/2002	1813:24	2000:12	3944086	243212.9	3944094	243932	719	107.00	6.7	8,130	4,559	4.5
6/11/2002	2200:55	100:35	3943862	243269.9	3943857	243942.9	673	178.80	3.8	5,266	1,767	7
6/12/2002	116:48	154:04	3943827	243285.5	3943827	243487.3	202	38.00	5.3	1,270	2,006	3
6/12/2002	211:57	255:24	3943826	243498.5	3943820	243608	110	43.00	2.6	962	1,342	6
6/12/2002	305:06	420:08	3944037	243155.8	3944053	243753.9	598	75.00	8.0	3,360	2,688	4
6/12/2002	426:49	537:40	3943831	243641.5	3943842	243950.8	309	70.80	4.4	2,375	2,012	5
6/12/2002	541:41	602:54	3944031	243744.6	3944060	243948.2	206	21.00	9.8	1,086	3,104	4
6/12/2002	606:45	641:40	3944179	243712.9	3944195	244048.6	336	35.00	9.6	1,705	2,923	4

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Table 5 (Concluded)

Date	Time		From		To		Linear Advance Distance ft	Time min	Advance Speed ft/min	Production Volume yd^3	Production Rate yd^3/hr	Face Height ft
	Start	Stop	Easting	Northing	Easting	Northing						
6/12/2002	651:42	657:43	3943941	243240.2	3943950	243246.3	11	6.00	1.8	145	1,454	3
6/12/2002	1022:14	1208:11	3943932	243196.7	3943962	243964.6	768	105.00	7.3	3,929	2,245	3
6/12/2002	1215:42	1323:53	3943975	243217.3	3943990	243787.8	571	68.00	8.4	2,544	2,245	3
6/12/2002	1331:55	1517:23	3944247	243196.3	3944273	243838.8	643	105.20	6.1	3,486	1,988	4
6/12/2002	1611:23	1719:34	3944317	243138.1	3944340	243478.2	341	69.20	4.9	2,045	1,773	4
6/12/2002	1913:47	119:27	3943664	243211.5	3943691	243968.5	757	365.20	2.1	6,003	986	7.5
6/13/2002	316:20	509:09	3943700	243187.2	3943726	243959.6	773	112.80	6.9	4,138	2,201	10
6/13/2002	522:32	535:14	3943735	243202.1	3943713	243266.2	68	12.00	5.6	151	755	8
6/13/2002	537:24	634:23	3943732	243261.1	3943720	243665.8	405	56.80	7.1	1,675	1,769	7
6/13/2002	642:35	756:57	3943774	243515.2	3943800	243976.9	462	74.00	6.2	1,933	1,567	8
6/13/2002	803:08	901:37	3943748	243526.8	3943769	243989	463	59.00	7.8	3,978	4,045	6
6/13/2002	908:39	943:44	3943775	243208.8	3943787	243544.6	336	35.00	9.6	1,145	1,963	5
6/13/2002	1221:26	1300:43	3943725	244041.1	3943737	244301.7	261	40.00	6.5	1,229	1,844	9
6/13/2002	1311:14	1558:11	3943708	244316.6	3943747	244533.2	220	167.20	1.3	8,060	2,892	15
6/13/2002	1646:11	1712:56	3943887	244061.8	3943892	244437.6	376	27.20	13.8	1,622	3,579	6
6/13/2002	1716:27	1735:20	3943711	244434.6	3943743	244490.7	65	19.00	3.4	1,113	3,515	7
6/13/2002	1742:11	1848:52	3943908	244278.9	3943912	244719.8	441	67.00	6.6	3,156	2,826	3
6/13/2002	1854:23	2101:35	3943810	244291.3	3943809	244602.6	311	127.00	2.5	4,242	2,004	8
							22,994 **Sum Total Advance**	5,450 **Sum Total Time**	5.8 **Average Speed**	208,068 **Total Volume**	2,346 **Average Production**	7.3 **Average Height**

(Sheet 3 of 3)

vessel delay, etc.) was 1.6 ft/min. This value was based on the dredge's total advance distance (taken from the daily dredge report due to incomplete dredge time-series data from 5 and 6 June) of 1,715 ft during 18 hr 17 min. The average advance rate of *Beachbuilder* at Reach 2 was 2.9 ft/min based on an advance distance (calculated from the dredge time-series data) of 22,271 ft over 128.5 hr. The average advance rate during the entire demonstration was 2.1 ft/min (23,984 ft of advance over 192 hr). This rate compares fairly well with the average advance rate of 2.4 ft/min in the final daily dredge log calculated from manually entered values.

Average bank height for each advance

Advance rates are based on bank height, type of material, current, and winch uptake so as not to plug the pump. Assuming a constant relative density of sand in the dredging prisms (and that the dustpan was in new work material when it was clogged by clay), the advance rate is primarily determined by bank height. An estimated *approximate* bank height is also included for each advance in Table 5. These heights were estimated by personnel on the dredge during demonstration and by review of hydrographic surveys, but the dynamic, complex shoaling nature of HOP and the inability to accurately measure an average height for an entire advance make these very rough estimates. The bank heights dredged during the demonstration ranged from 2 ft to 20 ft with the higher face predominantly on the RDB side of the channel (see Figure 8). As expected, when some of the thicker faces were being dredged, the slower advance rates were encountered, but with the inaccuracies inherent in estimating average bank height with the methods used, this relationship was not constant throughout the demonstration with the heights estimated in Table 5.

Total production and production rate for each advance

Calculation of the total production and average production rate of each advance was based on the calculated cubic-yards-per-hour parameter in the time series provided by the contractor. Data collection problems were experienced at the beginning of the demonstration that precluded dredge data from being recorded until 6 June at 1140. This lapse in data collection covered a pumping time duration of 5 hr 31 min when comparing the (time-series) calculated dredging time to the values reported on the daily dredge report and Form 4267. The cubic-yards-per-hour parameter value, recorded every 10 sec, was multiplied by the sampling interval (10 sec) to determine the volume (in cubic yards per hour) dredged for that time interval. By this method, the total production for the entire demonstration was approximately 265,000 cu yd. It was decided that the dynamic shoaling nature at HOP would reduce the accuracy of production numbers derived from the channel hydrographic surveys; therefore, the measured volume of material placed in the marsh was used as the most correct volume. The original gross volume in the final Form 4267 reported was 248,500 cu yd, but the credited volume determined by the placement area surveys was approximately 178,000 cu yd. Assuming a 20 percent loss in fines in runoff, the (placement area surveyed) volume was adjusted up to a gross volume of approximately 222,000 cu yd. The volume of material dredged during the data collection lapse of 5.51 hr on the first 2 days of the demonstration was (after accounting for the over-reporting gross volumes reported in Form 4267) estimated to be 14,000 cu yd.

The nuclear density meter and flow meter were not calibrated for the site-specific conditions at HOP. In order to adjust the (production meter) totalized volume calculated with the time-series data, the (placement area survey volume plus 20 percent fines) gross volume of 222,000 cu yd was reduced by 14,000 cu yd to approximately 208,000 cu yd and the 10-sec cubic-yards-per-hour (production meter) readings adjusted accordingly so the totalized time-series-calculated production volume equaled 208,000 cu yd as shown in Table 5. The adjusted production values per advance are also listed in Table 5. The production rate per advance was calculated by dividing the volume dredged per advance by the total advance time. The highest production rate obtained during the demonstration was 4,600 cu yd/hr while advancing 719 ft, and the average production rate from all the advances in Table 5 was approximately 2,300 cu yd/hr.

During the demonstration, the ladder pump and only one of the two hull pumps were used to pump slurry the required distances. Because the two hull pumps were connected in series, the unpowered pump introduced significant head losses into the hydraulic circuit, and the dredge’s production numbers were influenced by this operating condition.

Average production rates

The average production rate of the entire demonstration between the beginning and end of dredging (192 hr) to move 222,000 cu yd was approximately 1,200 cu yd/hr or approximately 28,000 cu yd/day. The average production rate per each reach (with delays incorporated) was calculated by totalizing the (time-series-calculated) volumes and dividing by the total time spent at each reach. The *Beachbuilder* spent a total of 17.75 hr (between start and stop of dredging) at Reach 1 dredging approximately 16,500 cu/yd (14,000 cu yd estimated from Form 4267 plus 2,500 cu yd calculated from time-series data) for an average production rate of 931 cu yd/hr. A total of 128.5 hr was spent at Reach 2 dredging approximately 206,000 cu yd for an average production rate of 1,600 cu yd/hr (or approximately 38,400 cu yd/day). The average production rate per pumping hour was approximately 2,300 cu yd/hr.

Factors affecting high and low range of average production rates

Estimates of high and low production rates that the *Beachbuilder* could achieve while working in the two halves of the channel (LDB and RDB sides) pumping the same distance as the demonstration (10,820 ft) are presented. These estimates are based on the assumption that the dredge remains at one reach (does not include relocating the hard point). The impact on pumping time by relocating the hard point is further discussed in Chapter 6. As described above, the dredge can work almost completely uninterrupted in the RDB side of the channel. On the last day of the demonstration (13 June) *Beachbuilder* worked the RDB side to establish a production rate for the dredge just working on this side of the channel with limited vessel traffic delays. From 0537 to 2101, in 10 advances the dredge moved approximately 28,000 cu yd in 15.4 hr (working between Ranges 175 and 335 in bank heights estimated from 3 to 15 ft) for an average production rate of 1,800 cu yd/hr. The maximum production rate per advance of 4,000 cu yd/hr in 463 ft was also achieved during this interval.

To estimate the dredge's low production rate while working on the LDB side of the channel, the time *Beachbuilder* worked on the negative range side of the channel on 11 June (as described in detail above) to dredge the high spots was used as a limiting factor. The *Beachbuilder* could not stay in the negative range (LDB) side of the channel longer that 1.75 hr because it would have to move to accommodate passing deep-draft vessels. Assuming that the dredge could stay on that side of the channel for 1.75 hr and then would be forced to relocate to the RDB side (assume 7 min), wait for vessel traffic (assume 5 min), then re-establish location in the LBD side again (again 7 min), the total amount of time just to move and wait for vessel traffic over a 24-hr period would be 3.41 hr. Taking the average production rate of *Beachbuilder* in Reach 2 (1,600 cu yd/hr or approximately 38,600 cu yd/day) as a first approximation of a "standard production rate," the daily production of a dredge working in the LDB side would be reduced by the time required to keep moving for passing vessels. So instead of 38,600 cu yd/day, the dredge would move only 33,000 cu yd/day, or have an hourly production rate of 1,400 cu yd/hr.

Time-series plots of production

Two examples of the *Beachbuilder*'s time-series production data are given in Figures 9 and 10. Figure 9 illustrates a 486-ft advance made on 11 June 2002, with an average production rate of 2,411 cu yd/hr, which is fairly representative of the average production rate from all the advances in Table 3 at 2,346 cu yd/hr. The y-axis scale is in cubic yards per the dredge's advance every 10 sec. Figure 10 shows the *Beachbuilder's* daily production on 13 June 2002, with the y-axis scale in cubic yards per hour, that was calculated and reported in (the x-axis) 10-sec increments.

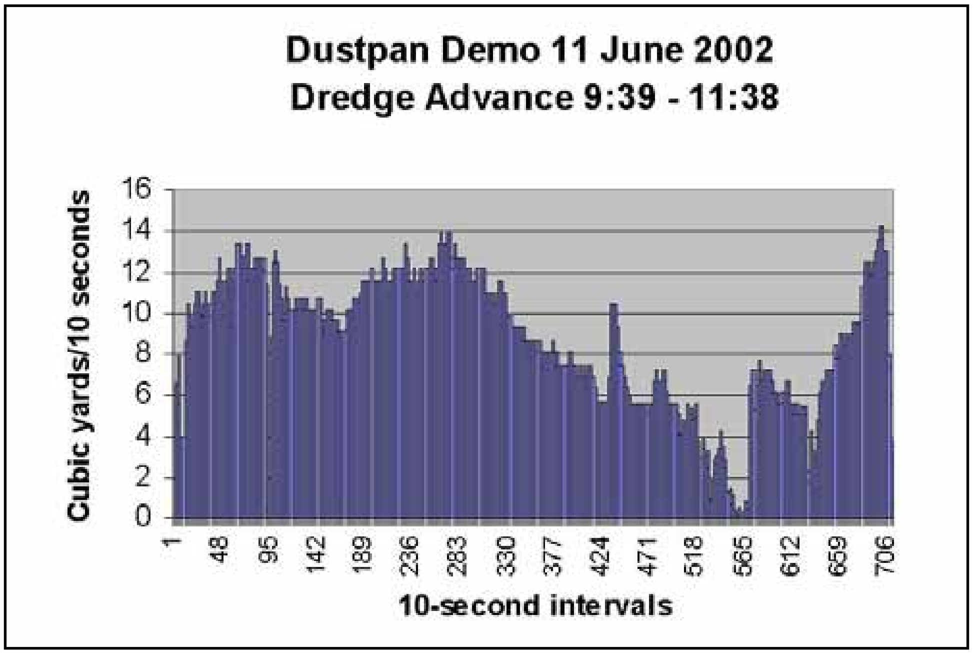

Figure 9. Example of a production time-series plot during a *Beachbuilder* advance

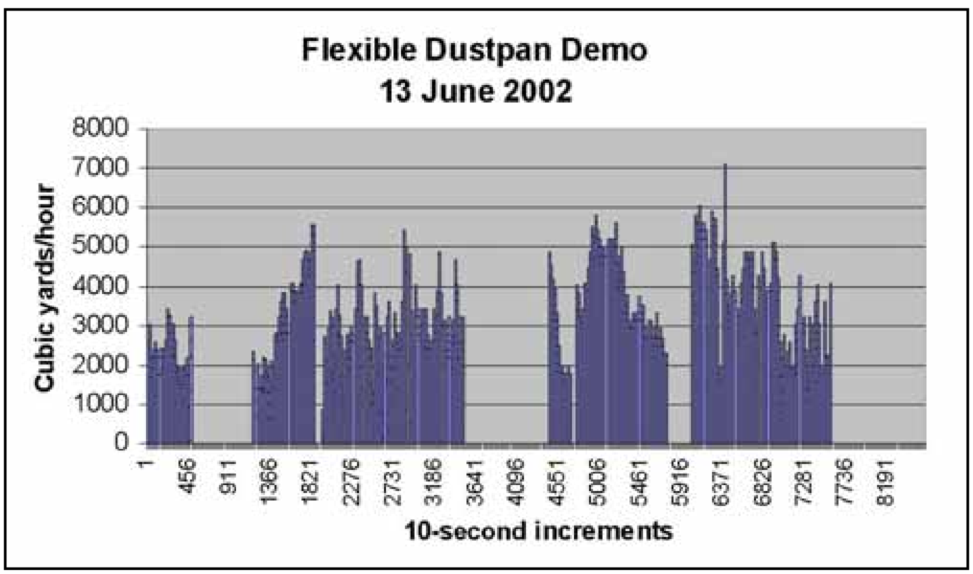

Figure 10. Time-series plot of *Beachbuilder's* production on 13 June 2002

5 Beneficial Use Analysis

The dredged material from the flexible-discharge dustpan dredge demonstration was used beneficially for wetlands restoration. It was pumped upstream, over the dike, adjacent pasture, and existing marshland, and placed in an area designated by MVN (Figure 2). The right-of-way across the dike, adjacent pasture, and existing marshland consisted of a 100-ft-wide corridor (Photo 15). As the placed dredged material built up above the surface of the water in the marsh area, additional shore line was added to extend the placement further into the marsh (see Photo 14). Two hydraulic backhoes (swamp buggies) mounted on swamp tracks were used to move the pipe and build temporary dikes to direct discharge flow (see Photo 15). Other than the temporary dikes, no other containment structures were used in the placement process.

Photographs of the BD and AD placement site are shown in Photos 29 and 30, respectively. BD and AD placement site surveys were conducted by the contractor's survey crew and inspected by MVN, using airboats, mobile DGPS for horizontal positioning, and spirit leveling for vertical control. The results from these surveys are plotted on Figures 11 and 12 (BD and AD surveys, respectively). The difference plot between the BD and AD surveys is shown in Figure 13. The dredged material deposit's footprint covers an area of approximately 20 acres. From the surveys, the contractor calculated a deposition volume of 177,700 cu yd. Assuming a 20 percent loss in fines in runoff, this volume was adjusted up to a gross volume of 222,000 cu yd. Contract specifications required that no dredged material exceed a vertical placement height of +3.5 ft MLG, but Figure 12 (referenced to the MLG datum) indicates elevations that exceed +3.5 ft. This resulted from the impact of an inspection conducted 13 June of the placement area, when USACE and OAS personnel discovered several least tern and American avocet nests containing eggs (Photo 31). The nests had been constructed some distance from the active placement point and were not being disturbed, but MVN decided to terminate the grading operations, along with the dredging operations, at 2100 hr on 13 June to preclude any damage to the nests. This rapid colonization by the least terns and American avocets, as well as other species, is an aspect that should be considered for future dredging projects of a similar nature.

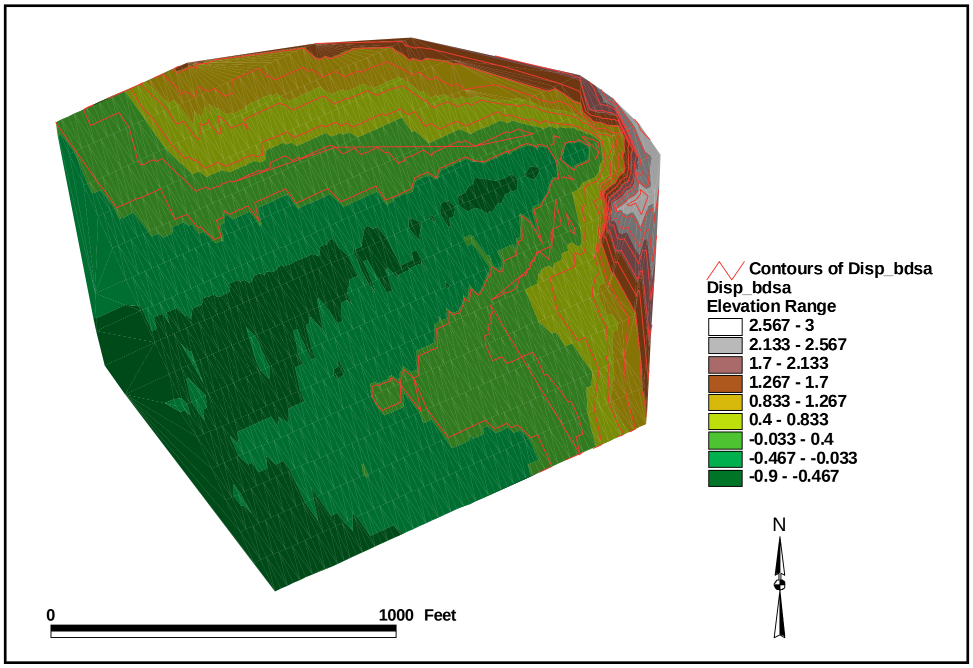

Figure 11. BD survey of placement site elevations (elevation range in feet)

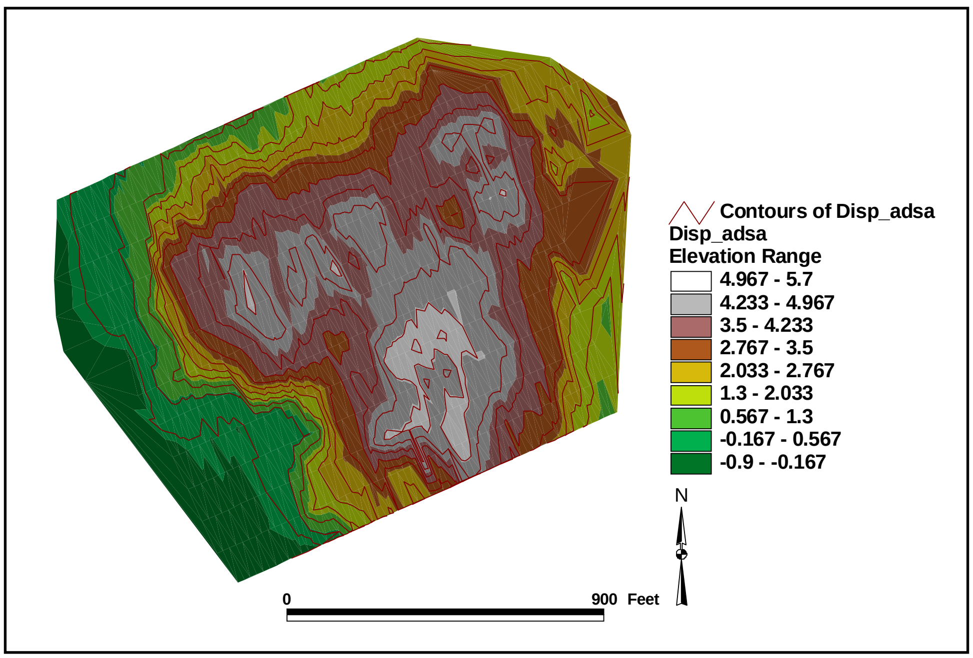

Figure 12. AD survey of placement site elevations (elevation range in feet)

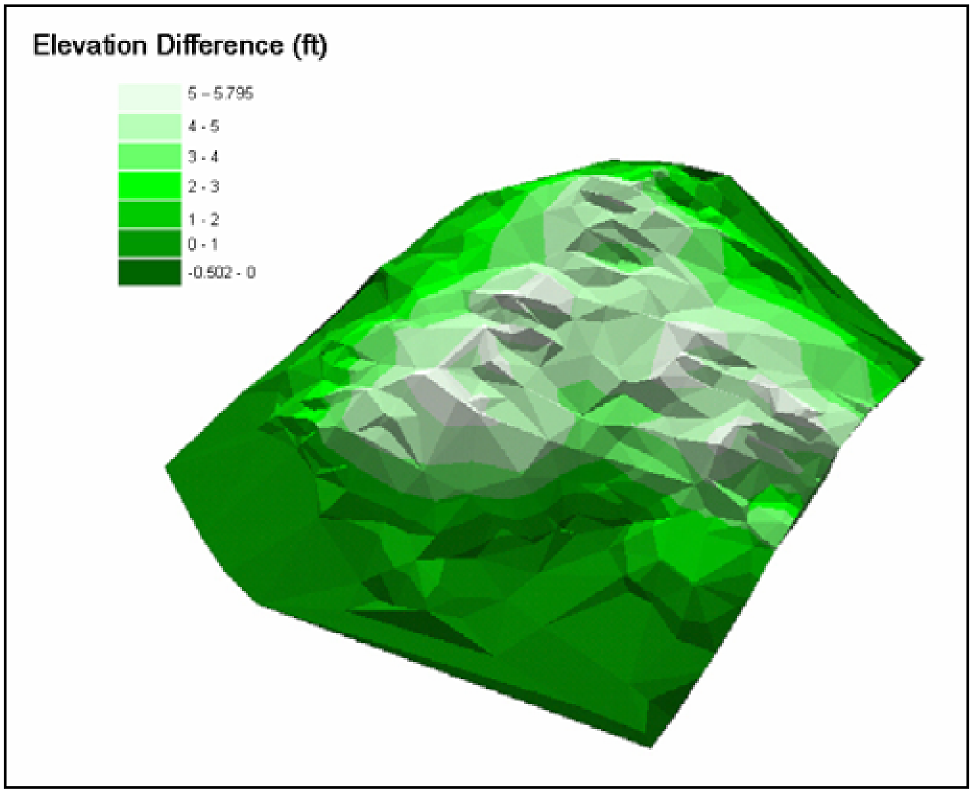

Figure 13. Difference plot between AD and BD (elevation) surveys

6 Feasibility Analyses

Potential Project Applicability

The feasibility of using this dredging methodology at HOP depends on numerous technical, economical, and social aspects. The feasibility analysis in this report primarily addresses technical aspects as outlined in "Assessment of Coastwide Louisiana Maintenance Dredging Capabilities under the Federal Standard,"[1] along with navigational safety aspects of this method.

The June 2002 flexible-dustpan dredging demonstration project illustrated that the *Beachbuilder* or a similar dustpan dredge can work safely at the HOP and move significant amounts of dredged material out of the channel and place this material for the beneficial use of marsh creation/restoration. The dredged material can be transferred long distances by pipeline over the existing dike, pastureland, and wetlands and directly discharged into shallow open-water areas without need for re-handling or construction of disposal facilities. A dustpan dredge would prove most efficient at the HOP working on the RDB side of the channel (inside of the bend) where the shoaling tends to be the greatest and the dredge can operate almost continuously while allowing passage of most deep-draft vessel traffic. Working the RDB side also removes the dredge from a potential collision hazard caused by a passing vessel that, if it were to lose propulsion power and be pulled by the current toward Pass A Loutre, would drift into the LDB side and possibly the dredge itself.

A flexible-discharge dustpan dredge would require self-propulsion capabilities similar to the *Beachbuilder* during the demonstration (provided by external tugs or with in-hull plant). The flexible-discharge floating hose allows the dredge to move across the total width of the channel but limits its movement up and down the channel (based on the total length of the floating hose). Movement beyond this range requires interruption of dredging operations while the hard point is moved and submerged line is added or removed (if only one hard point and submerged line is used as in this demonstration). As a result, the dustpan discharge line configuration, as used in this demonstration, is most efficient where continuous thick shoals are present and minimal movement of the hard point is required. The dustpan dredge would not be as efficient in addressing spot shoaling over long distances up and down the channel where frequent movement of the hard point and associated pipeline would be required. Such conditions would be more efficiently addressed using hopper dredges. The demonstration

[1] *Ibid*.

project also illustrated that a flexible-discharge dustpan dredge and hopper dredges can work safely together in the same channel reach.

Operational characteristics of this flexible-discharge dustpan dredge indicate that it could effectively work in other reaches of the Mississippi River and in other navigation channels in a long distance discharge configuration. Depending on site-specific conditions, two discharge pipeline configurations might be possible. In the long distance discharge configuration as used in the demonstration, the dustpan could work across the total width of the channel discharging to one side across the dike. In this configuration, dredging would be interrupted periodically for vessel traffic passage as the dredge would need to move when working across the channel CL. As an alternative, the dustpan could work one-half of the channel at a time discharging to that side across the dike. In this configuration, vessel traffic could pass in the other half of the channel resulting in fewer interruptions.

The results of this demonstration indicate that a flexible-discharge dustpan dredge may be feasible for use in other reaches of the Mississippi River and in other navigation types of dredging projects (with free-flowing relatively non-cohesive material) such as construction and maintenance of sediment traps. Sediment traps are being considered for use in trapping and storing sediment upriver of critical areas in navigation channels where shoaling occurs rapidly and can impact vessel traffic. Sediment traps are also being considered for use at the confluence of channels and downstream of critical shoaling areas. In these cases, shoals that develop at the confluence of navigation channels or in other critical areas can be managed by moving the sediment into the traps using technologies such as the water injection dredge or SILT Wing excavator. This provides for emergency shoal management involving small volumes of sediment without the high costs associated with mobilization of traditional dredging equipment. The traps are excavated when filled, often in association with other maintenance dredging projects or during nonpeak dredging periods such that unit dredging costs are lower.

If the flexible-dustpan dredge has a hull and winch anchoring system similar to the *Beachbuilder*, then maintenance and specific beneficial use dredging in more exposed (i.e., near coastal) project areas will be possible. The *Beachbuilder* was designed for offshore beach renourishment projects on the east coast. Its high freeboard and six-point anchor/winching system allow it to operate in approximately 7-ft-high waves and ride out 10-ft-high waves (as per Weeks Marine personnel). With this open-water operating capability, select projects involving relatively free-flowing sediments located in more exposed sites could be dredged by the flexible-discharge dustpan dredge.

Comparison to Previous Maintenance Dredging Capabilities Assessment

In December 1998, the MVN published a document entitled "Assessment of Coastwide Louisiana Maintenance Dredging Capabilities under the Federal Standard."[1] In this document, MVN assessed the need and economic feasibility of adding maintenance hydraulic dredging capability in the District. The assessment also identified opportunities for providing cost reduction in channel maintenance and enhancing the level of beneficial use of dredged material. The assessment concluded that a large dustpan dredge (30- to 38-in.-diam discharge) with a flexible discharge would best provide the capabilities needed and achieve cost savings. Such a dredge would also provide environmental benefits associated with the creation of wetlands from dredged material not otherwise being beneficially used.

In the MVN report, eight evaluation factors were used in assessing various dredge types for required maintenance dredging capabilities. The evaluation factor criteria are compared to corresponding results obtained from the *Beachbuilder* demonstration below.

Past experience with dredge type

Values in the assessment were assigned based on the level of historical experience with the various dredge plants. The MVN has past experience with dustpan dredges. The flexible-discharge dustpan demonstration project using the *Beachbuilder* provided MVN personnel with additional experience and baseline production and maneuverability data on the capabilities of a dustpan with a flexible discharge and extensive pumping resources.

Utility of dredge type and size across projects

Under this factor, the dredge is required to provide both overboard placement and long distance pumping capabilities with ease in switching between modes. In the MVN report, the overboard discharge pumping distance requirement was 3,000 ft, and the long distance pumping requirement was 15,000 ft through combined floating, submerged, and shore line. While the 15,000-ft pumping distance was not achieved during the demonstration, the maximum distance *Beachbuilder* did pump was 10,820 ft (1,320 ft floating hose, 7,920 ft submerged line, and 1,580 ft shore line). This production was accomplished using the ladder pump and only one of the two deck pumps. Weeks Marine personnel stated that with the second pump in operation, the *Beachbuilder* would be able to meet the 15,000-ft pumping requirement plus another approximate 5,000 ft (the ultimate line length would depend on the type and classification of material). Overboard placement was not demonstrated in this project, but switching between modes could be accomplished. For the shorter 3,000-ft overboard placement option, the pipeline configuration might be changed. Both the long and short pumping

[1] *Ibid*.

options would use the flexible floating hose, but for the shorter run, instead of using submerged line connected after the hard point, pontoon-mounted floating (steel) line could be used. This floating line could be connected to a spill barge anchored with spuds or anchor/haul wires.

Dredge mobility in working between dredging assignments

This factor requires the dredge be capable of quickly moving between dredging assignments (generally less than 6 hr). The limiting factor in moving the *Beachbuilder* (given the type of contract and demonstration project used) was found to be relocation of the hard point by extending the submerged line. The contractor estimated that with sufficient plant and pipe standing by, the 3,600-ft extension of submerged line and relocation of the hard point would have been be completed in 12 hr instead of 22.7 hr. Weeks Marine personnel also estimated that a (planned) shorter extension (1,000 to 2,000 ft) would take 4 to 6 hr to complete, and that a longer run (around 6,000 ft) would require about the same 12 hr as the 3,600-ft run because of the mechanics of how the extension is accomplished.

For the demonstration at HOP, only one hard point/submerged line/shore line was used as specified in the contract. In a (volume) unit price contract, it is conceivable that the contractor might elect to construct more than one hard point/ submerged line/shore line setup. By doing so, when the dredge is finished at one location, the floating hose could be immediately disconnected from that hard point and moved to the next assignment. Once there, the floating hose would be connected to the other hard point, allowing the dredge to maximize its effective dredging time. Evaluation of the flexible-discharge dustpan dredge mobility capabilities for this configuration is beyond the scope of this demonstration report. When pumping through the 3,000-ft-long pipeline for overboard placement projects, the use of pontoon-supported floating line could improve the dredge’s ability to move between assignments due to the higher degree of “portability” of the entire pipeline. Or, similar to the 15,000-ft pumping configuration described above, separate hard point/submerged line or pontoon floating line assemblies might be prepared and waiting for the dredge in different areas to significantly reduce transfer times between assignments.

Dredging mobility in sailing between dredging regions

This factor requires the dredge be capable of quickly moving between dredging regions (generally less than 24 hr). In the Mississippi River these regions include the HOP and Upper Southwest Pass, deep-draft crossings from Baton Rouge to New Orleans, and lower jetty and bar channels; the Mississippi River-gulf outlet bar channel; and the Calcasieu River bar channel. As discussed above, for the 15,000-ft pumping capability, the limiting factor in moving the *Beachbuilder* would be the movement of the submerged line and placement of the shore line. The pipeline construction would be required prior to arrival of the dredge. For the 3,000-ft pumping capability, the portability of taking the same pontoon-mounted floating discharge line with the dredge may achieve the mobility requirement, or having a different short line already assembled and waiting in the area may be an option. Detailed evaluation of the flexible-discharge dustpan dredge mobility capabilities for sailing between dredging regions is beyond the scope of this demonstration report.

Method and mode of materials placement

Under this factor, the dredging plant should be versatile enough to perform in both open water placement and shore placement. As discussed above, the *Beachbuilder* demonstrated a capability to conduct shore placement in a relatively long pumping distance mode. Open water (overboard) placement was not demonstrated during the demonstration.

Minimum-acceptable dredging rate per day

The controlling minimum dredging rates under this factor in the MVN report for overboard and long distance pumping are 78,000 and 24,000 cu yd/day, respectively. The overboard pumping configuration was not tested during the demonstration. With respect to long distance pumping, the *Beachbuilder* achieved an approximate average production rate of 27,800 cu yd/day pumping 222,100 cu yd (with pumping distances ranging from 6,550 ft to 10,820 ft) in 192 hr. The *Beachbuilder* pumped 10,000 ft or greater for approximately six out of the eight demonstration days while working primarily on the RDB side of the channel.

Capability for yielding to vessel passage

In the MVN report, the time projected for the dredge to yield to passing vessels under this factor is 15 to 30 min. The HOP project demonstrated that dredge downtime for vessel traffic is primarily a function of dredge position in the channel, number of vessels passing, speed and direction of vessels passing, and movement time required to allow safe passing clearance. The *Beachbuilder* was able to continue dredging in the portion of the channel adjacent to the hard point and submerged line with no downtime during passage of a single vessel by dropping the cross-channel cable and raising it after vessel passage. Forward movement into the cut was maintained during this period by the push tug. When dredging on the far side of the channel, the *Beachbuilder* required approximately 11 min to clear the channel from one toeline to the other. This transit time would be reduced the closer the dredge was working to the channel CL (less distance to travel), and/or if only one deep-draft vessel was passing because the dredge would not have to cross the entire channel to let the vessel pass. Total downtime for vessel traffic may be minimized if discharge areas are available on both sides of the channel. In the vicinity of Pass A Loutre, a discharge pipeline on the LDB side may not be an option due to its use as a hopper dredge disposal site and the potential hazard of a vessel grounding.

Challenging sea conditions

A wave height up to 10 ft was identified in this assessment factor. This wave height was not encountered during the river demonstration project, but the *Beachbuilder* has reportedly encountered similar seas in beach nourishment projects typically conducted along the east coast. As previously noted, the *Beachbuilder* was reported as being able to dredge in waves up to 7 ft high, and ride out 10-ft-high seas.

7 Conclusions and Recommendations

Conclusions

The flexible-discharge dustpan dredge demonstration project conducted in the HOP area on the Mississippi River was successful. Because the *Beachbuilder* demonstrated safe navigation and dredging operations, the objectives of the project were met. USACE personnel, contractors, and bar pilots agreed that the dredging operation was safe with respect to vessel traffic moving up and down the river. The *Beachbuilder* dredged approximately 222,000 cu yd of sediment and placed it in the designated marsh construction site. The majority of project requirements were met, although the maximum pumping distance was 10,820 ft with additional pipe available for the job; however, it was not required. Dredged material was pumped the total distance using the ladder pump and only one of the two deck pumps (5,400 hp out of a total available plant capacity of 9,000 hp). Use of the second pump would have allowed the dredge to pump the required distance of 15,000 ft. The flexible floating hose worked well with no leaks or breaks.

Beachbuilder demonstrated the capability to cease dredging and move from one side of the channel to the other in approximately 11 min when required. A continuous dredging capability was demonstrated when the *Beachbuilder* was operating in the RDB half of the channel. Single deep-draft vessel traffic could safely pass in the LDB half of the channel when the *Beachbuilder* dropped its cross-channel anchor wire and picked it back up after the vessel traffic cleared. Forward movement into the cut was maintained by the push tug. Travel back into the RDB side of the channel due to vessel traffic was conducted if dredging operations were ongoing in the LDB half of the channel, two vessels passed each other in the channel abreast of the dredging area, or if the river pilot in command of the vessel requested additional clearance.

The average production rate for the entire 192-hr-long demonstration was 1,200 cu yd/hr or 27,800 cu yd/day to dredge 222,000 cu yd. The average production rate of the dredge while advancing was 2,300 cu yd/hr, with a maximum rate achieved of 4,600 cu yd/hr. The dredge achieved an average speed of 74 ft/min to back down and reset for each cut, and had an average advance speed of 2.1 ft/min.

For this particular demonstration and location, a flexible-discharge dustpan dredge proved most efficient at the HOP working on the RDB side of the channel (inside of the bend) where shoaling tends to be greater and the dredge can operate almost continuously while allowing passage of most deep-draft vessels. Working the RDB side also removes the dredge from the potential hazard of a passing vessel losing power and drifting toward the LDB side (and dredge) by current flow into Pass A Loutre.

With use of just one hard point/discharge pipeline, the dredging of numerous spot shoals separated by relatively long distances (distances that would require the discharge line to be relocated numerous times) would be more efficiently accomplished using hopper dredges (the use of multiple hard points/discharge lines was not investigated during the demonstration). The safety aspects and operational characteristics determined by this demonstration will provide information necessary to determine if a flexible-discharge dustpan dredge will be feasible for use in other specific reaches of the Mississippi River and in other navigation types of dredging projects (with free-flowing, relatively noncohesive material) such as construction and maintenance of sediment traps.

Relevant operational characteristics of the *Beachbuilder* determined from the demonstration project were compared to corresponding criteria in the 1998 publication "Assessment of Coastwide Louisiana Maintenance Dredging Capabilities under the Federal Standard." The demonstration provided experience in the use of a flexible-discharge dustpan dredge. Although the utility of this type of dredge in pumping 15,000 ft was not directly proven, the dredge could have achieved this pumping distance as per the conclusions previously presented. Mobility-related operational characteristics from this demonstration will provide information necessary to evaluate dredge mobility in working between specific dredging assignments and in sailing between specific dredging regions. The *Beachbuilder* demonstrated the capability to conduct shore placement of dredged material in a relatively long pumping distance mode. The minimum-acceptable dredging rate of 24,000 cu yd/day in the assessment criteria was achieved by the *Beachbuilder* (27,768 cu yd/day) given the demonstration conditions previously discussed. These demonstration results identified a flexible-discharge dustpan dredge's capability for safely yielding to vessel passage, but, due to the fact that the entire project was conducted at the HOP, the dredge's capability in challenging sea conditions was not demonstrated.

Recommendations

Areas were identified where changes could improve the efficiency of the flexible-discharge dustpan dredge operation. These recommendations include both operational as well as equipment-related aspects for future flexible-discharge dustpan operations at the HOP or in other regions and applications.

The use of a contract Mississippi River Bar Pilot onboard the dredge helped ensure the government of achieving its mission to maintain safe navigation. The pilot assisted in vessel traffic coordination and allowed the leverman to concentrate more fully on maximizing dredge production (with no in-hull propulsion, the *Beachbuilder* did not require a licensed master onboard). This practice, or the use of some other suitably licensed personnel onboard the dredge (at least for a limited period of time) in future projects, would provide the same production and safety benefits.

Ensuring that the dustpan elevation stays as close to design depth as possible will minimize clogging the pans with clay. Downtime associated with clearing the pans could be reduced resulting in increased daily production rates.

By optimizing the selection of anchors in order to minimize anchor slippage, production can be improved in future projects. Such slippage results in a requirement for more frequent resetting of the anchors, mandating dredging downtime. Minimizing this downtime would result in increased daily production rates. The selection process should involve comparisons between the various anchor characteristics, i.e., holding force per pound of weight and required break out force.

The *Beachbuilder* used tugs for propulsion during the demonstration. If a flexible-discharge dustpan dredge is to be used on a project with the types of requirements reported herein, then the use of sufficiently sized propulsion units (on a barge for the *Beachbuilder* or as used in conventional dustpans) could enhance maneuverability and production. Compared to in-hull propulsion, the use of tugs introduced a longer time lag between the initial ordering of a given maneuver and the application of propulsion to achieve that order (due to time required to communicate the maneuver from dredge to tugs over the radio). Design of a more efficient propulsion system will require application of naval architecture principles to account for issues such as horsepower requirements, geometry of thruster points relative to hull weight and dimensions, etc.

The 2,500-ft-long anchor wire lengths used during the demonstration could be lengthened or pendants (wire cable extension lengths added to the drum cables' bitter ends) could be used to optimize the anchoring geometry outside the channel.

The *Beachbuilder* has a floating hose connection point on its port mid-ship side due to the reversing tide (current) conditions it usually works in on the east coast. It could be advantageous for a flexible-dustpan dredge working in a river to have a stern connection point to allow the floating hose to play out downstream in the current to minimize bending stresses and improve maneuverability. The feasibility of this suggestion would have to take into account the pumping-induced reaction forces from the discharge line being applied to the dredge, and the subsequent impacts on vessel maneuverability.

An installation of a "Y" and associated valves in the shore line would eliminate dredging downtime associated with adding additional pipe in the placement area. This modification would result in increased production rates and provide a more even distribution of dredged material lifts in the placement area.

The use of additional hardpoint/submerged line/shore line assemblies would reduce dredge relocation times.

Photo 1. Ships passing abreast at the HOP

Photo 2. *Beachbuilder* dustpan dredge

Photo 3. *Beachbuilder* dustpan head

Photo 4. *Beachbuilder* ladder pump

Photo 5. *Beachbuilder* deck pumps

Photo 6. *Beachbuilder* winch

Photo 7. Stern tug used to maneuver *Beachbuilder*

Photo 8. Starboard tug used to maneuver *Beachbuilder*

Photo 9. Leverman station on *Beachbuilder*

Photo 10. Computer monitors at leverman’s station on *Beachbuilder*

Photo 11. Discharge pipe connection on *Beachbuilder*

Photo 12. Sections of floating hose

Photo 13. Anchor barge (skidder) holding floating hose

Photo 14. Discharge pipe across dike, pasture land, and existing wetlands

Photo 15. Swamp buggy in marsh

Photo 16. Tug *Delta Eagle*

Photo 17. Tug *Delta Pacer*

Photo 18. Tug *Matthew*

Photo 19. Tug *Delta Fox*

Photo 20. Tug *Delta Robin*

Photo 21. Large crane barge (Weeks 553)

Photo 22. A-frame barge

Photo 23. Tug *Marie*

Photo 24. Quarters Barge

Photo 25. Hard point connection with floating hose

Photo 26. Nuclear density meter

Photo 27. FP201 Global Flow Probe (wand not extended)

Photo 28. Current meter being deployed off *Beachbuilder's* bow gantry

Photo 29. Before dredging aerial photo of placement site

Photo 30. After dredging aerial photo of placement site

Photo 31. Least tern nest on newly placed dredged material for wetland restoration

Appendix A
Bar Pilot Survey

Dustpan Dredge Demonstration at the Head of Passes (HOP)
June 6 – 13, 2002
Mississippi River Bar Pilot Survey

Introduction: This survey is part of the U.S. Army Corps of Engineers' ongoing effort to maintain safe navigation in the Lower Mississippi River. The Dustpan Demonstration was conducted to demonstrate safe navigation and dredging operations of the flexible discharge dustpan dredge on the Mississippi River in the HOP area while obtaining sufficient production capability to dredge and place material in a designated marsh construction site. Your assistance is needed in determining the navigation safety aspects of operating this type of dredge at the HOP, and your participation in this survey is valuable input and is greatly appreciated.

Instructions: Please circle or check the answer that **best** represents your opinion. Space is provided for supplement responses with comments if desired. If you have any questions about this survey, please don't hesitate to contact Timothy Welp (telephone 601-634-2083, email Timothy.L.Welp@erdc.usace.army.mil). After finishing the survey, please fax to (601)-634-3151, attention Timothy Welp.

Name (Optional) ______________________________________

Years of Piloting Experience? ____ years

How were you involved with the dustpan demonstration (check one or more)?

Stood a watch on the dredge's pilothouse during the demonstration _____
Piloted a vessel past the dredge during the demonstration _____
Heard about the demonstration _____
Don't know anything about it _____

1. For those of you who were involved in the dustpan demonstration, please circle the answer that **best** represents your opinion for the following statements and comment why**.**

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

The operation of a dustpan dredge (like the dredge Beachbuilder used in the demonstration) with propulsion and flexible discharge presents an acceptable risk to navigation in the vicinity of the HOP.

SA A U D SD

Why:____
____
____
____
____
____

2. If your answer to Question 1 was U (Undecided), D (Disagree) or SD (Strongly Disagree), are there any modifications that could be made to the dredging operation (i.e., limiting dredge operating area to right descending bank side-of-channel, or requiring a licensed Pilot be onboard dredge while dredging) that would change your answer to SA or A?

YES ____ NO ____

If the answer to Question 2 was yes, please list the modification(s) that would change your answer.

____
____
____
____
____
____

3. For those of you who were involved in the dustpan demonstration, please circle the answer that **best** represents your opinion for the following statements and comment why**.**

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

The operation of a dustpan dredge (like the dredge Beachbuilder used in the demonstration) with propulsion and flexible discharge presents an acceptable risk to navigation when working in other sections of the channel that don't require a deep-draft vessel to take up as much of the channel while maneuvering (i.e., at the HOP where the setup caused by Pass A Loutre and South Pass currents influence an outbound vessel).

SA A U D SD

Why:____
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____
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4. If your answer to Question 3 was U (Undecided), D (Disagree) or SD (Strongly Disagree), are there any modifications that could be made to the dredging operation (i.e., limiting dredge operating area to right descending bank side-of-channel, or requiring a licensed Pilot be onboard dredge while dredging) that would change your answer to SA or A?

YES ____ NO ____

If the answer to Question 4 was yes, please list the modification(s) that would change your answer.

____
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____
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____

5. Do you know what a cutterhead pipeline dredge is and how it works in the navigation channel?

YES ____ NO ____

6. If the answer to question 5 is yes, please circle the answer that **best** represents your opinion for the following statements and comment why**.**

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

The operation of a cutterhead pipeline dredge presents an acceptable risk to navigation in the vicinity of the HOP.

SA A U D SD

Why:____
____
____
____
____
____

7. If your answer to Question 6 was U (Undecided), D (Disagree) or SD (Strongly Disagree), are there any modifications that could be made (i.e., limiting dredge operating area to right descending bank side-of-channel, or requiring a licensed Pilot be onboard dredge while dredging), that would change your answer to SA or A?

YES ____ NO ____

If the answer to Question 7 was yes, please list the modification(s) that would change your answer.

8. If you have any comments regarding the dustpan demonstration, please list below.

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14. ABSTRACT

The navigation channel of the Mississippi River in the vicinity of the Head of Passes (HOP) downstream of New Orleans is an area where significant dynamic shoaling occurs. During the traditional high-water period in the spring, the shoaling in this area occurs rapidly and can represent a hazard to deep-draft vessel traffic. The shoaling must be removed rapidly to maintain adequate channel depth. Currently, dredging of the channel at HOP is conducted using hopper dredges, primarily due to their mobility. Hydraulic dredges with conventional spudding systems and floating discharge pipelines, such as cutterhead dredges, are considered a safety hazard in this area due to their inability to rapidly (and consistently) move out of the way of vessel traffic. Unfortunately, hopper dredges simply move the dredged material out of the channel and redeposit it in open-water disposal sites at the heads of Pass A Loutre and South Pass. There are two disadvantages to this technique. First, the disposal sites periodically become so filled with material that the hoppers cannot bottom dump dredged material at the sites. The dredged material must be handled again at additional cost to provide sites for hopper disposal. Secondly, there is no beneficial use of the dredged material. Hopper dredges can use direct pump-out to place material beneficially in adjacent shallow open-water areas for marsh restoration, but this is considered costly and has never been done before at the HOP.

(Continued)

15. SUBJECT TERMS
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This report presents the demonstration results of the dustpan dredge *Beachbuilder* using a flexible discharge at the Head of Passes/Southwest Pass on the Mississippi River in June 2002. Dustpan dredges equipped with a flexible-discharge floating hose and sufficient pumping capacity potentially have the mobility required for safe passage of vessel traffic and can economically pump dredged material the distances required for placement in a beneficial use scenario such as marsh construction. This report details and discusses the project activities, operational characteristics of the *Beachbuilder*, and feasibility of using a flexible-discharge dustpan dredge to augment the hydraulic dredging capabilities of the U.S. Army Corps of Engineers on the Mississippi and other rivers. The goal of this report is to use the project results to identify potential opportunities for reducing overall costs for channel maintenance and increasing beneficial use of dredged materials during dredging Corps navigation projects.