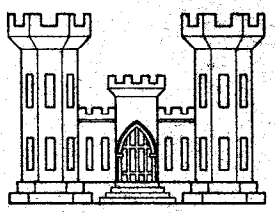

DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-78-7

FIELD STUDY OF THE MECHANICS OF THE PLACEMENT OF DREDGED MATERIAL AT OPEN-WATER DISPOSAL SITES

VOLUME I: MAIN TEXT AND APPENDICES A-I

by

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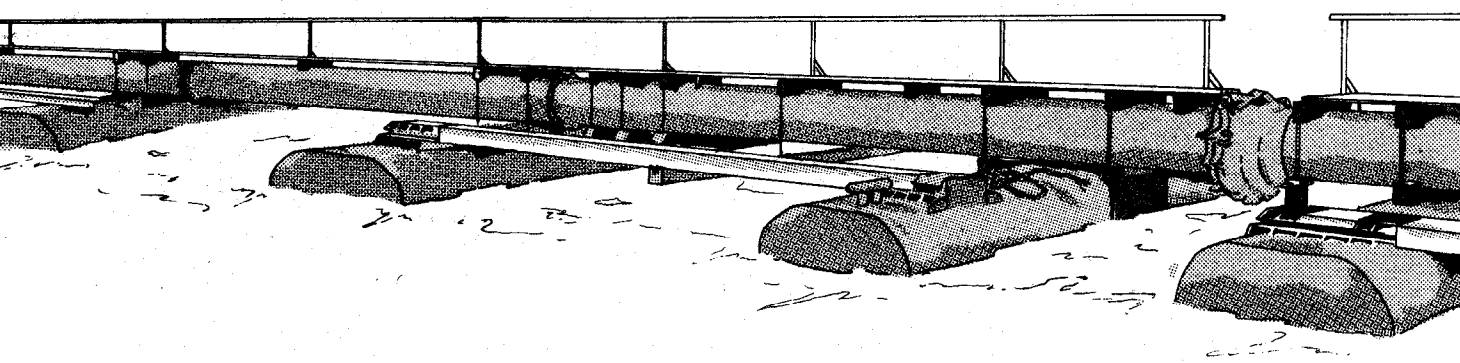

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15 June 1978

SUBJECT: Transmittal of Technical Report D-78-7

1. The technical report transmitted herewith represents the results of an investigation to observe the mechanics of the placement of dredged material at aquatic disposal sites. This study is one of the major efforts to be accomplished under Task 1B (Movements of Dredged Material) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 1B is part of the DMRP Environmental Impacts and Criteria Development Project, which is a broad, multi-faceted investigation that includes the environmental impacts and other aspects of open-water disposal of dredged material.

2. Regardless of the location or character of a disposal site, an integral part of the problem of assessing the environmental impact of open-water disposal operations is an ability to determine the spatial and temporal distribution of the dredged material following its discharge into the water. The estuarine environment may include time-dependent currents that vary significantly in three dimensions, density stratification, and depths variable in both time and space. The material itself may be a composite ranging from slow-settling extremely fine particles to fast-falling coarse particles and may include a solute fraction. All of these and many other factors contribute to the complexity of water-quality impacts associated with the open-water discharge of dredged material.

3. This report describes the methods used to follow the path of dredged material disposed in an aquatic medium and to determine how much material reaches the bottom, in what form, and how long it takes for placement processes to go to completion. The investigation determined the nature of the controlling physical processes to develop a capability for predicting the fate of dredged material released at the water surface. Observations were made over a wide range of conditions to evaluate all relevant processes. Critical physical parameters that controlled the placement of dredged material were measured at all sites and locations.

4. These field evaluations have shown that disposal activity follows a three-step process at all localities: descent through the water column, impact with the bottom, and spread of a bottom surge generated by the impact. It was found that all of the dredged material was

confined to the zone where these three processes are active. The field observations demonstrated the dependence of the placement processes on water depth, the currents at the disposal site, and the properties of the dredged material. Accurate, controlled placement is possible under a wide range of disposal site conditions. Control of the placement can be attained through selection of dredging method, design of the containing vessel, and choice of disposal site characteristics.

5. These investigations supplied field data for the calibration and evaluation of the mathematical models developed for the DMRP for predicting what will happen to the dredged material during any given disposal operation. The results of these studies are important in determining the placement of dredged material for open-water disposal. Referenced studies as well as those reported on herein will aid in determining the optimum disposal conditions and site selection for dispersion or retention within the confines of a given site.

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A field study has been made of the mechanics of the placement of dredged material at five locations, an estuarine site on the Atlantic and one on the Pacific coast, two sites in the Great Lakes, and one in the open ocean. The objective was to observe all of the processes by which dredged material is emplaced on the bottom at a disposal site.

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20. ABSTRACT (Continued).

Instrument arrays were designed to define the transit of dredged material in time and space from the moment of its release until its final deposition. Close attention was given to accurate timing of events and to the placement of instruments close to the discharging vessel. Methods used included optical transmittance, acoustic pulse echo and water flow measurements with instrument arrays, and water sampling by continuous pumping. Additional observations were made to characterize the mechanical properties of the dredged material, its quantity, and the rate at which it is released into the receiving water.

Placement proceeds by a three-step process at all localities: descent through the water column, impact with the bottom, and spread of a bottom surge generated by the impact.

The descent phase proceeds by either or both of two processes. Cohesive blocks or clods of dredged material fall at their terminal speed and arrive at the bottom intact, whereas noncohesive dredged material falls as a jet of dense fluid. The descent speed of the jet is constant and there is a large entrainment of ambient water. The dredged material is diluted about seventyfold when descent is completed.

If the impact strength of clods reaching the bottom is large, they survive impact and form a compact mound of dredged material on the disposal site. Otherwise, they disintegrate and release their contained solids to the bottom surge. This surge is formed by deflection of the descending jet by the bottom. The jet may erode the bottom in the impact area.

The bottom surge spreads radially outwards at a decreasing speed and runs until the kinetic energy left after descent and impact is dissipated. Dredged material is deposited from the surge in the form of a flat ring.

All of the dredged material is confined to the zone where these three processes are active.

The field observations demonstrate the dependence of the placement processes on water depth, the currents at the disposal site, and the properties of the dredged material. Accurate, controlled placement is possible under a wide range of disposal site conditions. Control of the placement can be attained through selection of dredging method, design of the containing vessel, and choice of disposal site characteristics.

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