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NEARSHORE BOTTOM CURRENTS OFF VIRGINIA BEACH, VIRGINIA

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CONTRACT REPORT

ON

NEARSHORE BOTTOM CURRENTS OFF VIRGINIA BEACH, VIRGINIA

Contract No.'s - NAOSU-P-68-1595
DACW-65-69-C-0019

Between the
Norfolk District, U. S. Army Corps of Engineers
and
Virginia Institute of Marine Science

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Morris L. Brehmer

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PURPOSE OF STUDY

The Virginia Institute of Marine Science instituted a study of the nearshore currents in the Atlantic Ocean off Virginia Beach, Virginia in December 1967 under Contract No. NAOSU P-68-1595 and continued under Contract DACW-65-69-C-0019 through March 1970. The program was designed to determine the net current patterns in the area and attempted to determine the physical parameters responsible. The net current patterns determined could then be utilized to determine the fate of dredge spoil material discharged from hopper dredges at a disposal site located in the vicinity of latitude 36° 48', longitude 75° 54', or 3 nautical miles offshore.

METHODS

A transect was established parallel to and approximately 3 miles offshore from the beach from the junction buoy (CBJ) off Cape Henry to False Cape. Stations were established at 2 mile intervals along the transect. Woodhead Sea Bed Drifters (Insul-Tab, Inc., Woburn, Mass.) were released at each of the stations at regular intervals during aerial over-flights and at times of opportunity from Virginia Institute of Marine Science vessels and from Corps of Engineer hopper dredges.
utilizing the spoil disposal area. A total of 3551 drifters was released during the program. Each drifter was stamped with identifying information and an offer of a 50 cent reward for return to the Virginia Institute of Marine Science with information as to time and point of recovery. All information was recorded on computer forms for future punching and storage prior to analyses.

Data from the recoveries were analyzed to determine the net trajectory from the point of release to the point of recovery, days adrift, rate of bottom drift, and the vector of the trajectory.

An attempt was made to follow the actual drift patterns by attaching a sonic capsule to stems of modified drifters and following the movement with a vessel mounted hydrophone (Smith-Root, Inc., 155 Western Avenue West, Seattle, Wash.). This program was abandoned after 2 attempts when it was concluded that the rate of drift was too low to draw short term inferences regarding trajectories.

Returns were analyzed according to periods between release and recovery dates in fifteen day periods from 0 to 45 days. The data indicated, however, that after 15 days following release, some recoveries indicated unrealistic directional net movement because of displacement by the beach drift system. This was exemplified in a number of instances where one or more drifters stranded within a 15 day period, whereas, the remainder of the set stranded much later but at points widely divergent from
the direction established by the first drifters to strand. For that reason, we feel that the most reliable data came from recoveries within the time frame of 15 days.

RESULTS

During the period December 1967 through April 1968 a Corps of Engineer hopper dredge was utilizing the disposal area off Virginia Beach. Bundles of five sea bed drifters were released after the dredge had emptied twice each day during the period of operation. A total of 660 drifters were released during this phase.

The data indicate that a shift in the net nearshore current patterns occurred during this five month period (Fig. 1).

During December the inferred drift indicated a strong southerly current set. The pattern changed in January to a more inshore direction. The results of the February and April returns inferred a strong northwesterly set.

Wind vectors were computed for the December-February period from data obtained from the U. S. Dept. of Commerce facility at the Chesapeake Light Tower located 14 miles off Cape Henry (Fig. 2).

Wind vector data for December 1967 do not indicate that a strong displacement factor or subsurface counter current was responsible for the inferred southerly trajectory that was observed during the month. During January 1968 the wind
Figure 1. Net trajectory of sea bed drifters released at spoil disposal site as indicated by beach recovery locations.
Figure 2. Wind vectors computed from Chesapeake Light Tower Data (U.S. Dept. Commerce).
patterns were inconsistent as the net drifter trajectory tended to shift more inshore. In February, wind patterns were characterized by a strong northwesterly component and the inferred drifter trajectory was more strongly directed towards the northeast.

The drifter release program was interrupted during the summer of 1968 by a change in the hopper dredge schedule.

The drifter release program was re-initiated in the fall of 1969 under a design which included aerial releases at stations along a transect parallel to shore to augment releases at times of opportunity from vessels utilizing the spoil disposal area. This pattern permitted an evaluation of nearshore bottom currents along the entire lower Virginia Coast. The reduced data for a 15 month period from January 1969 through March 1970 are given in Appendix A.

In January and February a distinct gyre existed to the south of the junction buoy which extended almost to Rudee Inlet. Drifters released at the upper stations had a net trajectory towards the northwest while these released from Stations 6 through 11 had an inferred southerly set.

In March 1969 the recovery data indicated the presence of net inshore currents from all stations except at Station 10. No recoveries were reported within 15 days of the release dates of the drifters released at stations 8, 9 and 11.

Data from returns of drifters released along the transect from April through August 1969 indicated a net inshore and
slightly northerly set of the bottom currents. Vector lines that appeared to cross other lines were interpreted to indicate that the drifters had been carried through intersection points by longshore currents near the beach.

During the period September 1969 through January 1970 the pattern observed the previous January and February appeared to redevelop with a northerly net set of the nearshore bottom currents at the northern and middle reaches of the transect and an inferred southerly set inshore from the southern stations. During February and March 1970 the inferred drift from all stations was almost directly shoreward.

Sea bed drifter returns from the spoil disposal site were treated separately because of the large number of releases resulting from hopper dredge activities. In addition aerial releases were made at station 5 on each fly-over.

A total of 495 returns was recovered within 15 days on drifters released at the disposal site. These were analyzed to determine the net trajectory from the point of release to the point of recovery (Fig. 3).

The data indicate that the inferred drift was usually in a westerly or northwesterly direction. Recoveries south of Sandbridge Beach accounted for only 5% of the total and these resulted primarily from releases made during the fall and winter months.

The area from Sandbridge Beach to Dam Neck was the recovery
Figure 3. Percentage of sea bed drifters recovered from the beaches of Virginia and North Carolina from releases made at Station 5.
site for 22% of the drifters released at Station 5. This beach is heavily utilized by persons engaged in recreational activities and the probability of a unit being recovered and returned after stranding is very high as compared to the area to the south.

The area directly inshore from the disposal site contains fewer miles of beach and a high percentage is restricted to the public. Only 8% of the drifters released at Station 5 were recovered on the beach from Dam Neck to Rudee Inlet.

Only 10% of the drifters released at the disposal site were recovered on the beach from Rudee Inlet to 50th Street. However, the high recovery percentage to the north of 50th Street (55%) would appear to indicate that a longshore current may exist which carried the drifters beyond the area.

SUMMARY

The data collected during the study appear to confirm the presence of the clockwise eddy in the Atlantic Ocean south of Cape Henry. This non-tidal current pattern had previously been described in the Virginia Beach, Virginia, Erosion Control Study (U. S. Congress, 1953) as apparently extending approximately 3-4 miles south of Cape Henry. Harrison, Brehmer, and Stone (CERC Technical Memo No. 5, 1964) postulate that the Rudee Inlet area may represent the southern limit of the current pattern.

By utilizing 11 stations on a transect from 3 miles off Cape Henry to 3 miles off False Cape the data from this study indicated that during the fall and winter months the northerly
non-tidal bottom drift extends from Cape Henry to the Rudee Inlet area. Below this point the data indicate a southerly set which transported the sea bed drifters to the beaches south of Rudee Inlet. During the summer months, however, the drifter recovery data inferred that the non-tidal drift patterns had an inshore set as far south as False Cape.

Drifter returns from the area now utilized as a spoil disposal indicate a net northwesterly drift during most of the spring, summer, and fall months. Assuming that the bed load drift would have the same general trajectory (but not speed) as the drifters, the data infer that a high percentage of the settleable solids deposited in the area would be transported by the non-tidal current components to the beaches of Virginia Beach. The data also indicated that some refluxing of material removed from the channels and deposited in the spoil disposal area may occur.
APPENDIX A

VECTORS INDICATING DIRECTION AND MAGNITUDE OF SEA BED DRIFTER RETURNS FROM UNITS RELEASED ON A TRANSECT OFF-SHORE FROM CAPE HENRY TO FALSE CAPE, VIRGINIA.
APRIL 1969

1 cm. = 2 drifters

- 1-15 days
- 16-30 days
- 31-45 days
JULY 1969

1 cm. = 2 drifters

- 1-15 days
- 16-30 days
- 31-45 days