8 Sediment Model Testing of Proposed Relocation of PAs 232, 233, and 234

The validated sediment model was used to estimate the effects of moving without confinement and moving with confinement several dredged material placement areas along the GIWW in Lower Laguna Madre. PAs were moved for the purpose of reducing sediment-plume impingement on seagrass areas and dispersion of sediment back into the GIWW channel. Model results indicated that relocation of PA 233 and 234 would reduce channel shoaling as compared to their present location. Model tests were performed in which PAs 233 and 234 were moved into the deep, bare area of Lower Laguna Madre west of the GIWW and confined there. PA 232 was moved to the east of the GIWW into deeper water. Confining the sites obstructed flow somewhat and caused local increases in current speed and ambient suspended-sediment concentration.

Introduction

Located about six nautical miles north of Port Isabel at geographic coordinates 26°10' N and 97°15' W, designated placement areas (PA) 232, 233, and 234 are within an area of heavy GIWW maintenance dredging as discussed in Chapter 1. The locations of existing PAs are shown in Figure 92. The PA 233 and 234 sites receive most of the disposal volume from the maintenance dredging in the adjacent channel reach, and PA 232 receives the least of the three sites. PA 232 was moved to the east side of the GIWW to an area that appeared on aerial photos to be too deep for seagrass. Analyses of the maintenance dredging histories of PA 233 and 234 are presented in Chapter 1. There have been concerns that PA 233 is too dispersive and that material from the site re-enters the channel. Tests were performed with PAs 233 and 234 moved to the west farther from the GIWW. As an ultimate solution to sediment dispersion from sites 233 and 234, confined sites were also tested.

Methods

Currents from the hydrodynamic model were examined to determine ebb- and flood-tidal phase flow paths. The surface-area requirements for the proposed relocated sites were estimated by CESWG. The proposed sites were configured and installed into the numerical model mesh and aligned with flow paths to the

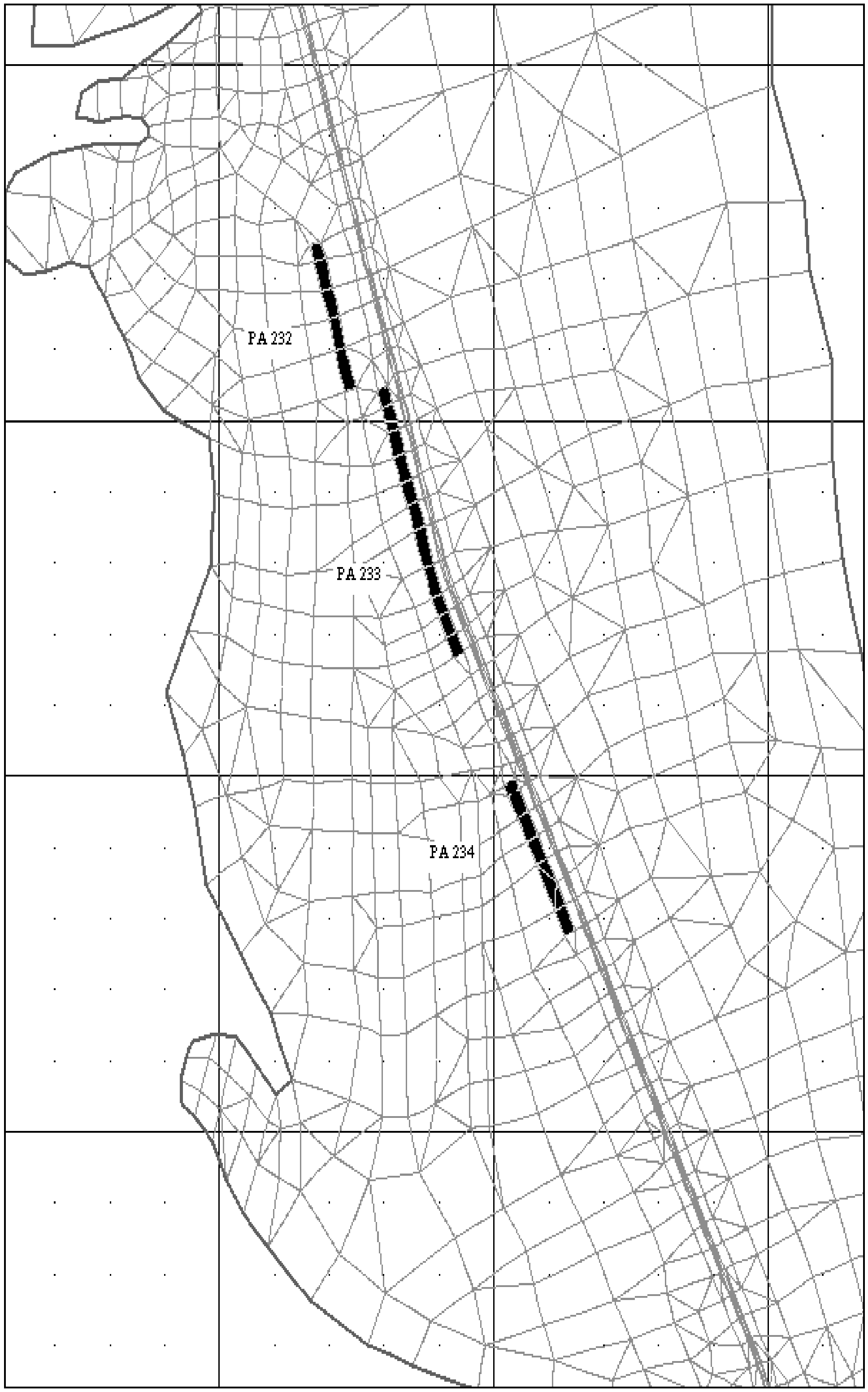

Figure 92. Existing PA 232 to 234 sites with 5,000 m grid lines and 1,000 m grid points overlain. Site PA 232 was displaced to the west in the model because of very shallow water existing at the designated site

extent possible. The model mesh was refined somewhat to accommodate PA geometry and to better compute currents. A single mesh was structured to contain all necessary geometry so that PAs could be individually disposed into and simulations compared. The proposed PA 232 was installed directly across the GIWW to the east of the original site. The proposed PAs 233 and 234 were installed farther to the west, away from the GIWW in deeper water and aligned with the flow. Proposed relocation sites are shown in Figure 93.

The amount of material disposed in the model was based on the historical median disposal volume. The areas and disposal volumes of the existing PA sites are given in Table 45.

Table 45
Existing PA Areas and Disposal Rates in the Model

		Median Disposal Volume	
PA	Area, m^2	m^3	cyds
232	456,572	37,200	48,974
233	848,915	297,600	391,590
234	521,590	162,600	213,897

Unlike the base simulations which relied on field information to estimate the disposal footprints, the designated PA area boundaries were used in these tests to set disposal footprints.

The disposed material was assumed to have a solids content of about 660 dry-kg/m^3. The dredged-material placement in the model consisted of two parts. Seventy percent of the total material at each site was placed in the bed, and the remaining thirty percent was initially suspended in the water column within the placement areas as a plume. The grain-size distribution of the component parts and total disposed material used by the model were based on analyses on channel sediments and are presented in Table 37. The disposed material contained a sand fraction, which the model transported in suspension under certain conditions. No bedload transport was calculated in the model.

Annual model simulations were made. A base run was simulated without disposal to gauge ambient resuspension in the model. The three original PAs were simulated individually to prevent overlap of turbid plumes. The three relocated open-water PAs were simulated individually. The confined PAs 233 and 234 were simulated together as a worst case scenario of the effects of confined sites on currents and ambient resuspension. The proposed relocated PA areas are given in Table 46.

The placement was simulated to occur on 1 April 1995. The bed placement was accomplished in 24 simulated hours in the model. The suspended plume was formed as a constant flux into the water column over 119 hours, or roughly 5 days, starting 1 April 1995. The simulation continued until 1 September 1995

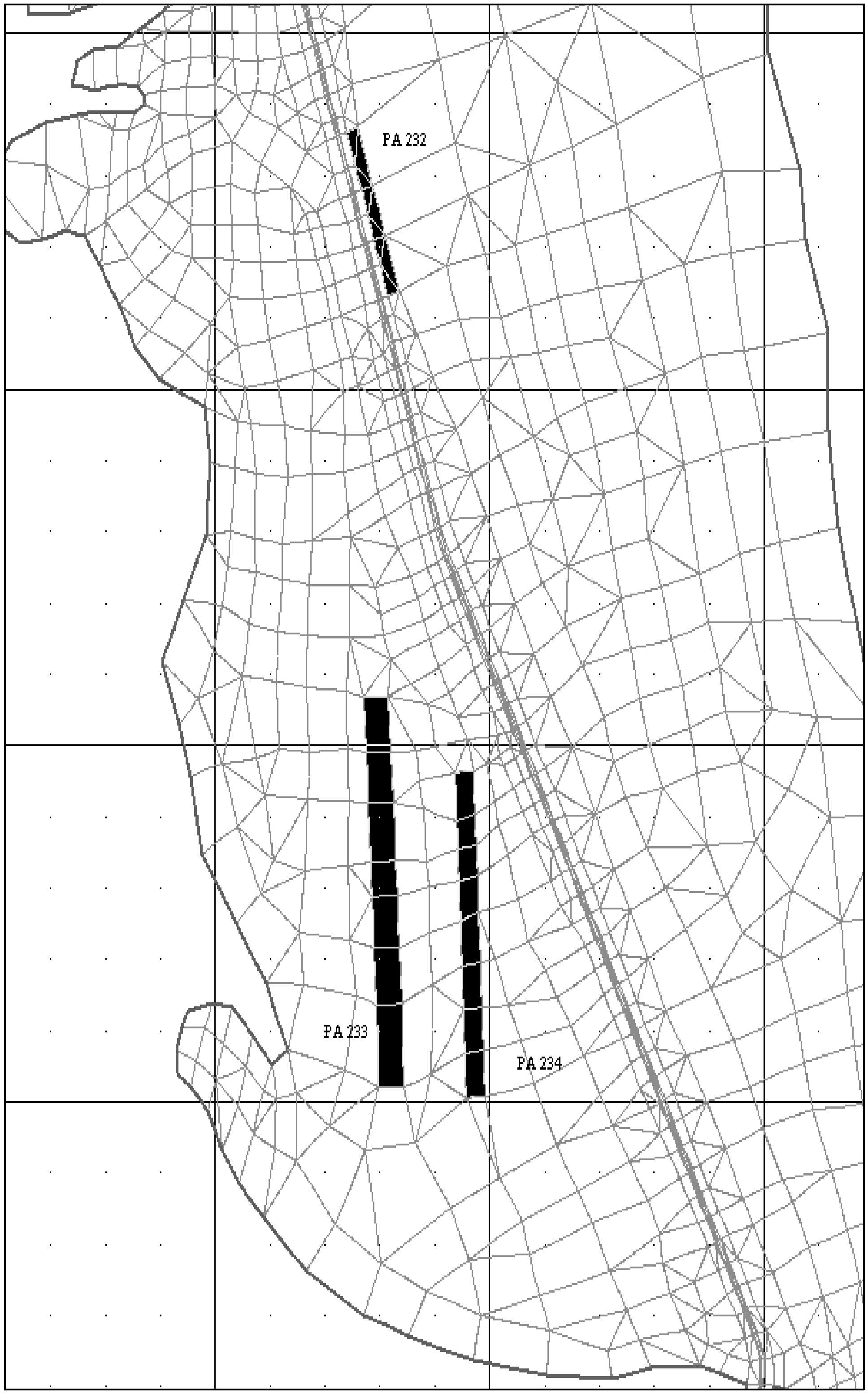

Figure 93. Proposed relocated PA 232 to 234 sites

and then wrapped back to 1 September 1994 and continued until 1 April 1995 for a total simulation time of one year.

Table 46 Relocated PA Areas in the Model	
Placement Area Designation	Area, m^2
232	511,968
233	2,507,121
234	1,318,730

Model boundary conditions were the same as those applied in Chapter 7 for the base simulations. Tidal and wind-driven currents were calculated as in the base simulations, combined with wind-wave shear stresses, and used to calculate sediment erosion, deposition, and transport for the simulation period of one year. Suspended load only were calculated. Scenarios with and without dredged material placement were simulated.

Results

Example model results and comparisons are presented as plots in Appendix C. Suspended-sediment-concentration differences (plan TSM minus base TSM) were calculated for the disposal period, the remainder of April, and monthly periods thereafter through July of the simulated year. These are shown for the existing and proposed PA 232 in Plates C1 to C10, for PA 233 in Plates C11 to C20, and for PA 234 in Plates C21 to C30. The TSM differences for the remainder of the simulation year were very small.

Annual channel shoaling rates were estimated for base and plan conditions. The base shoaling for the channel reach, extending from the inside of Brazos Santiago Pass to Port Mansfield, was 77,750 m^3 (102,000 cyds). The normalized shoaling results are presented in Table 47.

Table 47 Channel Shoaling as a Percent of the Base		
Placement Area	Existing	Proposed
None (Base)	100	-
232	101.7	101.0
233	115.7	102.8
234	109.5	102.6
Confined 233 & 234		99.5

The final bed elevation change (*delbed*) differences (plan *delbed* minus base *delbed*) are given for the end of the year simulation for existing and proposed PA 232, 233, and 234 in Plates C31 to C36. Dispersion of placed sediments from existing and proposed PAs was gauged at the end of the annual simulations, and results are presented in Table 48. The base condition had no dredged material disposal.

Table 48
Sediment Dispersion as a Percent of the Placed Material

Placement Area	Existing	Proposed
232	27.5	45.9
233	29.4	22.4
234	14.9	23.5

Current magnitudes and vectors for a typical maximum flood-tidal phase flow are shown in Plate C37 for the base condition and in Plate C38 for the confined PA plan. A plot of confined-minus-base current-magnitude differences is shown in Plate C39. Currents were increased and decreased locally around the confined sites. Comparisons between confined and base TSM indicated a consistent difference caused by the increased current magnitudes. A typical example is shown in Plate C40. The TSM differences, like the current magnitude differences generated by the confined sites, were local to the vicinity of the confined sites.

Discussion

At the existing PA 232, dredged material was placed in the model to the west of the designated location. Depths at the actual site were very shallow and material has apparently accumulated there over the years. The assumption was that the material runs to the west due to the bottom slope. The relocation of PA 232 was predicted to very slightly reduce channel shoaling, even though more sediment would be dispersed from the proposed site. Apparently, less dispersed material would re-enter the channel from the east side of the channel due to a net eastward residual flow in this area. The *delbed* plot for the relocated PA 232 shows dispersed material accumulating to the east of the site (Plate C32).

The proposed relocation of PAs 233 and 234 was predicted to reduce channel shoaling somewhat. Disposal at these existing sites increased channel shoaling 9.5 to 15.7 percent over the no-disposal condition. An indication of the disposal effect on channel shoaling can be seen in the *delbed* plot for the existing PA 233 (Plate C33). Previous model simulations have indicated that disposal of dredged material at six sites throughout Laguna Madre, including PA 233, increased channel shoaling by about 14 percent. In this PA 233 simulation, the area disposed into at the existing site is much smaller than for the base and validation simulations, as noted in the Methods section. Reducing the disposal footprint increased initial deposit thickness in the PA, which in turn appreciably reduced the dispersion of material from PA 233. Had the dispersion from PA 233 been as great in this as in previous simulations, a greater difference in channel shoaling probably would have occurred. The re-deposition of material in the channel can also be seen in the *delbed* plot for the existing PA 234 (Plate C35). Less dispersed sediment would re-enter the channel from the proposed PA 233 and 234 sites (only 2.6 to 2.8 percent more than the no-disposal condition according to Table 47).

The dispersions of material from the proposed PA 232 and 234 were greater than for the existing sites. The proposed PA 234, farther to the west of the channel, is predicted to be dispersive, while the existing site is less dispersive due to surrounding seagrass and shallow waters.

The proposed relocated sites PA 233 and 234 were predicted to be only moderately dispersive, despite their entire area being used for disposal in the model. In actual use, the areas utilized for disposal and resulting dispersion rates are expected to be somewhat less.

The confined PA 233 and 234 sites obstructed flow and increased and decreased local currents by up to about 0.16 m/sec (Plate 39). Suspended sediment increased due to the increased current velocities (Plate 40). Confining these sites was predicted to decrease channel shoaling slightly. There was no disposal of material for the confined case, and, therefore, effluent solid discharge was assumed to be insignificant.