APPENDIX

Site No.	Latitude, Longitude	County	Bay System	Descriptive location	Date planted	Project Objectives	Design Criteria/ Type of Restoration	Size (ha)	Geomorphology	Lithology of substrate	Tidal zones	Elevation range	Tidal range	Salinity	*Vegetation*	Relative sea level rise rates (Subsidence + regional Sea-level Rise) (Subsidence from Gabrysch and Coplin, 1990)	Exposure :	Historical Erosion/ Accretion	Recent Erosion/ Accretion	Protection from wave energy	*Results/Comments*	Source of Restoration Information/Originator
1	29 34 30, 94 33 10; 29 33 15, 94 31 40; 29 32 30, 94 31 20; 29 33 00, 94 29 40; 29 33 15, 94 28 55	Chambers	East Bay	Five sites, north shore, Anahuac National Wildlife Refuge	1974	Determine which resident saline species can be used to control shore erosion in bays and estuaries	Trial transplantings of 12 species along bay shore; culms, stems, or rhizomes and associated roots planted by hand; row spacing 1 m, plants 0.6 m; one site graded to 10:1 slope; local use of wave-stilling device		Estuarine shoreline fringe marsh; Site I: gentle sloping shoreline; Site II: steep-cut bank along shoreline, water line at base; Site III: gentle sloping shoreline	Loam or clay loam, locally sandy; local shell veneer 5 cm or more thick	Three zones, lower - permanently inundated; middle - mean low to mean high tide; upper - inundated by abnormally high tide		< 0.45 m	water <2,500-18,000 ppm; soil 2,500-12,000ppm	*Arundo donax, Avicennia geminans, Distichlis spicata, Spartina spartinae, Spartina alterniflora and others*	0.62 cm/yr	Site I SE fetch 1.6 km; Site II SE fetch 6.2 km; Site III SE fetch > 9.5 km; Site IV protected area behind shoreline	0 to 0.86 m/yr erosion 1930-1982		Wave stilling device used at one site	Smooth cordgrass and black mangrove well adapted for lower and middle zones; s altgrass adaptable for middle zone if protected from waves; gulf cordgrass well adapted for upper zone; mechanical sloping not successful; temporary wave-stilling device success	Dodd and Webb (1975) USACOE, CERC MR 8-75
2	29 33 15, 94 28 55	Chambers	East Bay	North shoreline of East Bay approx. 0.5 mi SE of mouth of Oyster Bayou, Anahuac NWR	1975	Establishment of saline plant species behind wave-stilling device	Transplantings on 2 percent slope behind wave-stilling device		Estuarine shoreline fringe marsh; 1 percent slope	Loam and clay loam	Zones above and below mean high water; inundation of lower plantings < 2 hr daily; inundation of highest plants infrequent with mean of 0.3 hr daily	Approx. 3-72 cm	< 0.45 m	water <2,500-18,000 ppm; soil 2,500-12,000ppm	*Spartina alterniflora Spartina spartinae, Spartina patens, Distichlis spicata, Juncus roemerianus*	0.62 cm/yr	Artificially protected		0.15 m vertical accretion directly behind barrier	wave-stilling device constructed of two tiers of tires strung on a cable	Smooth cordgrass survived & produced behind wave stilling device; marshay cordgrass, gulf cordgrass, and saltgrass > 80 % survival above MHW at lowest planted elevation (0.46 m, inundation < 2hrs daily); survival of all species <50% at highest elevation	Webb and Dodd (1978): USACOE, CERC MR 78-1
3	29 33 45, 94 29 15	Chambers	East Bay	North shoreline of East Bay, 0.35 mi W of mouth of Oyster Bay	1973	Test plant species for bay shoreline stabilization, develop planting techniques, test wave-stilling device, and determine costs	Transplantings behind wave-stilling device	0.405	Estuarine shoreline fringe marsh	Loam and clay loam	Intertidal and above MHW			water <2,500-18,000 ppm; soil 2,500-12,000ppm	*Spartina alterniflora Spartina patens, Spartina spartinae*	0.62 cm/yr	Artificially protected	1-2 m/yr erosion			Erosional shoreline, many plants were washed out	Webb (1977) TAMU-Galveston, Dissertation; Matthews and Minello (1994)
4	29 34 30, 94 36 40	Chambers	East Bay	Lake Robinson; SW side along levee	1989, 1990		Transplantings salt marsh	0.6	Lacustrine shoreline fringe marsh		Intertidal				*Spartina alterniflora*				Erosion severe on levee banks where no plants		80 % shoot survival 2 yr after planting; cattle have damaged and inhibited spreading of vegetation	Matthews and Minello (1994); Mr. Eddie Seidensticker, NRCS
5	29 20 52, 94 49 27	Galveston	Galveston Bay	Little Pelican Island southern portion (N of GIWW)	1983			2.833	Estuarine spit		Intertidal				*Spartina alterniflora*	1.7 cm/yr (1983-1987); 1.60 cm/yr (1964-1973)					Buried by dredged material when dike broke	Matthews and Minello (1994); Mr. Andreas Mager, Jr., NMFS/COE
6	29 22 00, 94 53 00	Galveston	Galveston Bay	Snake Island, SE facing shoreline; 0.25 mi W of Texas City Channel and Harbor				0.405			Intertidal				*Spartina alterniflora*	1.23 cm/yr (1983-87); 1.93 cm/yr (1964-1973)					No published results	Matthews and Minello (1994); Dr. James W. Webb, TAMU-Galveston/COE
7	29 21 00, 94 49 35	Galveston	Galveston Bay	Pelican Spit; along S shore of westward projection of NW spit	1992			2.024	Estuarine spit		Intertidal				*Spartina alterniflora*	1.7 cm/yr (1983-1987); 1.60 cm/yr (1964-1973)					No published results, but field observations in 1997 indicated successful development of smooth cordgrass	Matthews and Minello (1994); Mr. Charles E. Belaire, Belaire Consulting, Inc., Rockport, TX/COE, NMF
8	29 21 00, 94 49 36	Galveston	Galveston Bay	Pelican Spit; along S shore of westward projection of NW spit; extension of site 8	1992			1.214	Estuarine spit		Intertidal				*Spartina alterniflora*	1.7 cm/yr (1983-1987); 1.60 cm/yr (1964-1973)					See site 8 above	Matthews and Minello (1994); Mr. Charles E. Belaire, Belaire Consulting, Inc., Rockport, TX/COE, NMF
9	29 20 47, 94 49 50	Galveston	Galveston Bay	Pelican Spit, N extension of NW corner of Pelican Spit	1987		Transplantings on 1-m centers	2.61	Estuarine spit		Intertidal				*Spartina alterniflora*	1.7 cm/yr (1983-1987); 1.60 cm/yr (1964-1973)					Excellent survival and growth of plants	Matthews and Minello (1994); Mr. Charles E. Belaire, Belaire Consulting, Inc., Rockport, TX; Mr. G. Galbraith, Espey-Huston & Associates, Inc.
10	29 25 10, 94 43 57	Galveston	East Bay	N shore of Bolivar Peninsula, 8 km E of Houston Ship Channel	1977	Establish salt marsh and upland vegetation on dredged material; evaluate 2 transplant dates, fertilizer rates, elevation differences	Transplantings on unconfined dredged material at different elevations and fertilizer treatments; half protected behind sandbag breakwater; fence for protection against large mammals	7.3	Barrier peninsula, bay shoreline, graded to 0.7% slope	Sand 88-98%	Intertidal plantings at 3 different elevations; range <15.2 to >76 cm above msl	Intertidal to supratidal; 0-1.14 m above msl; changes after grading & erosion 0.06-0.37 m	mean 0.30 m		*Spartina alterniflora Spartina patens*		N-NE fetch approximately 14 km; NW fetch 42 km	2.1 m/yr (1850-1930); accretionary from disposal of dredge material after 1930	Accretion of 15 cm silt and clay occurred on plot behind sandbag dike	Sandbag breakwater	Best growth of *Spartina alterniflora* at 0.06-0.21 m above MSL (inundated 60-87% of time); best growth of *Spartina patens* at 0.37 m above MSL (inundated <30% of time); sprigging better than seeding; attained 50 percent vegetative cover	Matthews and Minello (1994); Webb(1977); Allen et al. (1978); Webb and Dodd (1988)/COE
11	29 21 00, 94 53 40	Galveston	Galveston Bay	Swan Lake; along N half of E margin of Swan Lake	1992	Creation of salt marsh habitat and wave barrier to protect created and existing marshes	Transplantings at 1-m spacing on dredged material; protected with parachute fencing	1.41	Estuarine lake	Predominantly silt and clay	Intertidal plantings		mean 0.3 m		*Spartina alterniflora*	1.23 cm/yr (1983-87); 1.93 cm/yr (1964-1973)	SE fetch about 8 km	Loss of 100 ha of marsh 1963-1989	Evidence of accretion behind wave barrier	Riprap wave barrier	There is evidence that created marsh expanding and colonizing new sediments	Lanier and Associates, 1991; Sipocz and Swafford, 1995
12	29 20 30, 94 58 20	Galveston	West Bay; Highland Bayou	Approx. 4.8 km up Highland Bayou at Highland Bayou Park west of I-45	1993	Establish 12.55 ha wetland as mitigation by Motco Trust Group; in conjunction with recreational park development by city of LaMarque, Galveston County, and Texas Parks and Wildlife Department	Establish new wetlands adjacent to existing wetlands at three locations; Wetland area A 6.5 ha, B 3.6 ha, and C 2.4 ha	12.55	Tidally influenced bayou						*Spartina alterniflora*	1.38 cm/yr (1983-1987); 3.63 cm/yr (1964-1973)		Approximately 100 ha of marsh lost to submergence 1950s-1989 along Highland Bayou adjacent to site			Wetland complex still under development; land surface scraped and prepared as specified, a nusery developed, and vegetation transplanted; expansion of wetland plants successful at some locations, and inhibited at others	Dr. James W. Webb, Texas A&M-Galveston
13	29 33 25, 95 01 20	Harris	Galveston Bay	Tidal pool, just NE of Clear Lake channel causeway	1990	Habitat creation		0.405	Tidal pool near mouth of estuarine lake		Intertidal				*Spartina alterniflora*	1.7 cm/yr (1983-1987); 6.17 cm/yr (1964-1973)					70% vegetative cover attained; soil compaction by heavy construction equipment delayed marsh growth locally; condition of marsh varies annually depending on water circulation	Matthews and Minello (1994); Dr. James W. Webb, Texas A&M-Galveston/TX DOT; Linda Shead (GBF)
14	29 22 30, 94 50 00	Galveston	Galveston Bay	North shore Texas City Dike	1979	Establish salt marsh on maintenance dredged material	Transplantings on dredged material behind protective levee; plantings at 0.5 and 1 m spacings	1.2	Leveed, filled estuarine area	Silt and clay	Intertidal	Median elevation near that of natural marsh	mean 0.30 m	mean between 15,000-25,000 ppm for surrounding bay waters	*Spartina alterniflora*	1.00 cm/yr (1983-1987); 1.93 cm/yr (1964-1973)	N fetch 30 km		Erosion severe	Rip rap levee constructed after erosion of clay levee	Approximately 90% survival; resembled natural marsh after two growing seasons; spacing of 1m adequate; open spaces invaded by seedlings	Webb (1982) citing Robert Bass (USACOE)
15	29 39 15, 94 57 40	Galveston	Galveston Bay	Atkinson Island Beneficial Uses Group (BUG) site	1993 site preparation; 1995 planted	Identify environmental and design parameters and management requirements for creating marsh	Transplantings on dredged material behind protective levees; plantings at various spacings	89	Leveed, filled estuarine area with 2 ponds	Silt and clay	Intertidal to supratidal	+0.6 m msl	mean 0.30 m		*Spartina alterniflora Spartina patens, Spartina spartinae*	1.00 cm/yr (1983-1987); 4.48 cm/yr (1964-1973)	SE fetch 20 km	> 2 m/yr (1850s-1930s)	Erosion severe	Levee protected along different segments with vegetation, Geoweb, Geotube, Pyramat	The Geotube (woven geotextile tube filled with dredged sediments) provided best levee protection; transplanting recommendation — combination of broadcasting treated seed and planting 1-gal containers of plants on 24-ft centers around perimeter of site	Seidensticker and Webb (1995); Port of Houston Authority and USACOE (1995)
16	29 35 10, 95 04 15	Harris	Galveston Bay; Clear Lake	Armand Bayou on margin of Armand Bayou Nature Center	1995 (June - growing season)	Establish intertidal salt-brackish marsh in area where previous marsh subsided	Transplantings at 1 m centers on dredged fill; protected by earthen berm and brush fench; two 3-3.6 m wide openings;borrow area 45 m from margin of site; 17,000 cu yds of fill	3	Submerged bayou margin with depths from 0.15 to 0.76 m before filled; fill material banked by earthen berm; one pond retained in deepest part of marsh area	Silty-clay	Intertidal	+0.6 m MLT			*Spartina alterniflora*	1.7 cm/yr (1983-1987); 6.17 cm/yr (1964-1973)	SSE fetch 1.5 km	Loss of marsh from subsidence 1950s to 1970s		Earthen berm flanked at approximately 10 m by brush fence	Rapid spread of *Spartina alterniflora* over one growing season	John Huffman, TGLO; Mark Kramer, Armand Bayou Nature Center
17	29 44 55, 95 03 00	Harris	Galveston Bay; north margin of Scott Bay	Brownwood Marsh Restoration Project; Peninsula between Scott and Crystal Baye north of Houston Ship Channel	July -Aug 1995	Establish wetland and upland habitat system for wildlife utilization in Brownwood subdivision as mitigation for French Limited Superfund Site	24 ha wetland system of high and low marshes, 3 tidal inlets, channels, freshwater pond, and forested islands; Site graded to elevations of natural marshes in area; basal area of transplants 7.5 -10 cm in size planted at approx. 3 m centers	13.3 marsh; 8.6 low marsh, 4.7 high marsh; 5.8 open channel	Intertidal interior wetland system surrounded by protective levee with tidal inlets, designed marsh slopes1%, tidal channel banks slopes 5% , upland islands	Silt and clay, muddy sand	+15 cm to -15 cm	Marsh + 15 cm to - 15 cm; channel varies from - 0.7 to - 1.2 m	0.3 m		*Spartina alterniflora* (8.6 ha); *Spartina patens* (4.7 ha)	1.7 cm/yr (1983-1987); 9.56 (1964-1973)	Wetlands not exposed to waves; surrounded by buffer zone including protective berm; southeast shore of buffer zone exposed to 4 km fetch	Condemnation of site due to historical high rates of subsidence and flooding	Minimal erosion of wetlands, berms, and channel entrances; berm on northern side breached by tidal activity	Levee, concrete culvert and bridge structures over tidal channels; concrete rip-rap along southeast exposed side and tidal inlets	July 1996 (1yr); transplants 85-90% survival, 20% cover overall, locally 70-85% cover *S. alterniflora*; new shoots extended 3 -4.5 m from original plug; limited grazing *S. alterniflora* by grass carp or nutria; spread of volunteer plants in fresh areas	French Limited; Crouch Environmental Sevices, Inc.; City of Baytown
18	29 42 30, 94 59 40	Harris	Galveston Bay; Tabbe Bay	Bayland Park Marina on northern margin of Tabbe Bay near mouth of Goose Creek between Houston Ship Channel and Highway 146	1996 (April and May) (Spread on backside, Hwy side, of island volunteer in part, circa1995	Salt marsh creation in conjunction with marina development	Transplantings at 1 m spacing, on fill material graded to 1% slopes in intertidal zone; additional plantings at higher elevations and slopes	4.4	Natural peninsula with high topographic relief at head of small bay in San Jacinto River entrenched valley	Clay, sandy clay	Intertidal to supratidal	plantings at 0.15 to 0.45 m above msl	0.3 m		*Alterniflora, Spartina vermillion*	1.7 cm/yr (1983-1987); 7.02 cm/yr (1964-1973)	> 6 km SE fetch across shallow Tabbe Bay; some areas exposed to ship wakes		Local scouring of sediment and uprooting of plants behind riprap	Riprap placed along bayward margin of marsh	Rapid growth and spread of planted vegetation; some loss due to scouring and erosion behind riprap placed along shore	Randall-Porterfield Architects, Inc. plans
19	29 19 27, 94 57 17	Galveston	West Bay	Sandefer marsh; located on edge of Jones Bay (West Bay) near Hithcock Texas	1992	Site restoration and habitat creation	Transplantings spaced at 2 m + on reclaimed well pad and access road	1.5	Bay margin with gentle slopes and local ridge- and swale-like topography from shaping of fill material	Silt and clay	Intertidal		0.3 m		*Spartina alterniflora Spartina patens, Spartina spartinae, Distichlis spicata*	1.0 cm/yr (1983-1987)	Low exposure to waves	Historical loss of marsh due to subsidence		Natural protection from waves by shallow bay conditions	Good survival and spread of transplants overall	Jakubik & Associates, Inc., 1991; Webb, 1993, 1994

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