NATIONAL WETLANDS INVENTORY AND THE NATIONAL WETLANDS RESEARCH CENTER PROJECT REPORT FOR: GALVESTON BAY

I. INTRODUCTION

The U.S. Fish & Wildlife Service's National Wetlands Inventory is producing maps showing the location and classification of wetlands and deepwater habitats of the United States. The Classification of Wetlands and Deepwater Habitats of the United States by Cowardin et al. is the classification system used to define and classify wetlands. Upland classification will utilize the system put forth in, A Land Use and Land Cover Classification System For Use With Remote Sensor Data, by James R. Anderson, Ernest E. Hardy, John T. Roach, and Richard E. Witmer. Photo interpretation conventions, hydric soils lists and wetland plants lists are also available to enhance the use and application of the classification system.

The purpose of the report to users is threefold: (1) to provide localized information regarding the production of NWI maps, including field reconnaissance with a discussion of imagery and interpretation; (2) to provide a descriptive crosswalk from wetland codes on the map to common names and representative plant species; and (3) to explain local geography, climate, and wetland communities.

II. FIELD RECONNAISSANCE

Field reconnaissance of the work area is an integral part for the accurate interpretation of aerial photography. Photographic signatures are compared to the wetland's appearance in the field by observing vegetation, soil and topography. This information is weighted for seasonality and conditions existing at the time of photography and at ground truthing.

Project Area

The project area is located in the southeastern portion of Texas along the coast. Ground truthing covered specific quadrangles of each 1:100,000 including Houston NE, Houston SE, Houston NW, and Houston SW (See Appendix A, Locator Map).

Field Trip Dates

July 16-20, 1990; July 16-19, 1991; September 12-19, 1991

Field Personnel

Todd Mecklenborg	Geonex Martel, Inc. St. Petersburg, Florida July 16-20, 1990; September 12-17, 1991
Warren Hagenbuck	U.S. Fish and Wildlife Service, Region II Albuerque, New Mexico July 16-18, 1990
Curtis Carley	U.S. Fish and Wildlife Service, Region II Albuerque, New Mexico July 16-20, 1990; July 16-19, 1991; September 12-19, 1991
Larry Handley	U.S. Fish and Wildlife Service NASA - Slidell Computer Complex Slidell, Louisiana July 16-20, 1990; July 16-19, 1991; September 12-16, 1991
William A. White	Bureau of Economic Geology Austin, Texas July 16-19, 1990; July 16-19, 1991; September 12-19, 1991
Jeff Pane	Bureau of Economic Geology Austin, Texas July 16-19, 1990
Warren Pulich, Jr.	Texas Parks and Wildlife Department Austin, Texas July 18-19, 1990
Ronald G. Bisbee	U.S. Fish and Wildlife Service Brazoria National Wildlife Refuge, Texas July 17, 1990
Richard Antonette	U.S. Fish and Wildlife Service Brazoria National Wildlife Refuge, Texas July 17, 1990
Ed Jackson	U.S. Fish and Wildlife Service Anchauc National Wildlife Refuge, Texas July 18, 1990
Mike Lange	U.S. Fish and Wildlife Service Brazoria National Wildlife Refuge, Texas July 16-19, 1991
Jim E. Neaville	U.S. Fish and Wildlife Service Anchauc National Wildlife Refuge, Texas July 13-14, 1991

Aerial Photography

Type:	Color Infrared Transparencies	
Scale:	1:65,000 NASA	
Dates:	Houston NE	November 06, 1988 December 05, 1989 December 10, 1989 December 12, 1989
	Houston SE	December 10, 1989 December 12, 1989
	Houston NW	November 06, 1988 December 10, 1989
	Houston SW	November 11, 1987 December 10, 1989 December 12, 1989

Collateral Data

United States Geological Survey 7'5" topographic quadrangles

United States Geological Survey 1:250,000 topographic map

Soil Conservation Service soil surveys of the following Texas Counties: Brazoria, Chambers, Galveston, and Harris.

Bailey, Robert G., (1980), Description of the Ecoregions of the United States, U.S. Department of Agriculture

Hydric Soils List of the State of Texas, (1985), Soil Conservation Service

Wetland Plant List of the State of Texas, (1986), U.S. Fish and Wildlife Service

W.L. Fisher, J.H. McGowen, L.F. Brown, Jr., and C.G. Groat, (1972), Environmental Geologic Atlas of The Texas Coastal Zone - Galveston-Houston Area, Bureau of Economic Geology, Austin, Texas 78712

P. Lazatine, Common Wetland Plants of Southeast Texas, U.S. Army Corps of Engineers District, Galveston, Texas

III. PHYSICAL DESCRIPTION OF PROJECT AREA

Geography

The study area is located in the southeastern portion of Texas along the coastal zone south of the Beaumont-Port Arthur Area and north of the Bay City-Freeport Area. The Texas shoreline is characterized by interconnecting natural waterways, restricted bays, lagoons, and estuaries, low to moderate freshwater inflow, long and narrow barrier islands, and extremely low tidal ranges.

Broad areas of relatively flat coastal plain occur inland from coastal marshes and between wooded belts along rivers and minor streams. The coastal plain is gently inclined gulfward at about five feet or less per mile. Extensive marsh covers areas less than five feet above sea level that stretch along the landward side of West Bay, East Bay, the Trinity River Delta, and Lower Trinity River Valley. These marsh areas are commonly flooded by hurricane or storm tides.

The two major river valleys within the work area are the Trinity and the San Jacinto. Several minor streams drain across the coastal plain: Clear Creek, Chocolate Bayou, Dickinson Bayou, Halls Bayou and Bastrop Bayou. Oyster Creek lies in the westernmost part of the area but does not flow within an incised valley as do all of the above mentioned drainages.

Bailey describes this area as falling into two major classifications. The Southeastern Mixed Forest Province is characterized by flat Coastal Plains having gentle slopes and local relief of less than thirty meters. Most of the numerous streams are sluggish; and marshes, lakes, and swamps are numerous. The Oak-Bluestem Parkland section of the Prairie Parkland Province covers an area over which prairie and deciduous forest alternate. The topography is mostly gently rolling plains.

Climate

Mild winters and hot humid summers are characteristic of this area. Average annual rainfall in the Galveston area ranges from 51.5 inches per year in Chambers County to 41.8 inches per year in Galveston County. It is rather evenly distributed throughout the year, but peaks slightly in midsummer or early spring when it falls mostly during thunderstorms. Temperature ranges from a winter average minimum low of 43° F in January to a summer average maximum high of 94° F in July.

Two principal wind regimes dominate the Texas Coastal Zone. Persistent southeasterly winds occurring from March through November control deposition and erosion along barrier islands. Short lived but strong northerly winds from December through February push bay water high into marshes and onto sandflats fringing the back side of Bolivar Peninsula and Galveston Island. Northerly winds and accompanying rains also effectively combine to mix and lower bay salinity as river water enters the bay system.

Vegetation

Vegetation that inhabits the lower coastal areas and river valleys require a perennially wet substrate that has a permanently high water table. This area supports an extensive marsh-swamp system. The marsh areas are primarily grassy vegetation where as the swamps are associated with wooded vegetation. The marsh areas are discernable further by the frequency and intensity of exposure to waters of varying salinity.

Closed brackish marshes occur between Smith Point and the Anahauc National Wildlife Refuge. These low lying marshes are frequently inundated by bay water during storms because of their position relative to the bay margin. These areas support salt-tolerant plant species associated with brackish and fresh to brackish vegetation.

Fresh to brackish marshes occur along mainland shorelines of bay-estuary-lagoon systems and tidal creeks where there is a mixing of fresh and saline water. During prolonged periods of drought or excessive rainfall the vegetative communities will migrate according to the degree of salinity present. Generally toward the bays salt-tolerant plants will become increasingly dominant. Toward the mainland, or heads of deltas, fresh water plants will become dominant.

Salt marshes along the back sides of coastal barriers, on the flood delta associated with San Luis Pass and along the mainland side of West Bay and Bastrop Bay are kept perennially wet by ocean derived salt. This marsh type can be further divided into: low marsh, characterized by pure stands of smooth cordgrass inundated daily; and high marsh, inundated almost daily supporting a numerous collection of largely succulent halophytes that show an orderly succession toward higher and more saline substrates.

Fresh water marshes and swamps mainly occur in abandoned channels and cutoffs associated with present day and older river systems and floodplains. These areas are perennially inundated by fresh water characterized by vegetation intolerant of saline water.

Soils

The soils within the study area are typical of the Western Gulf Coastal Zone. Deep, Nonsaline Soils of the Mainland lie in broad, nearly level areas far enough inland where they are not affected by salt. They are generally poorly drained soils with a high water table. Deep, Saline Soils of the Marshland are similar with broad, nearly level and poorly drained soils associated with a high water table. These soils are affected by tides and salt due to the proximity to open water bodies and have a high hazard of flooding from storms. The Deep, Nonsaline Soils of the Barrier Island are nearly level to gently undulating. They are composed of beaches and barrier sand dunes with wet sands behind the dunes. These soils are excessively drained to poorly drained.

IV. DESCRIPTION OF WETLAND HABITATS IN PROJECT AREA

A comprehensive wetland plant list and a table of wetland classification codes and water regimes are included in this section for reference.

Marine

Marine areas include unconsolidated bottom, unconsolidated shore (beaches), and rocky shore (jetties). The mean range of the tide is approximately one foot. Nonvegetated open water over lying the Texas-Louisiana Shelf will be labeled (M1UBL). The unconsolidated shore is mostly irregularly flooded (M2USP) with a narrow zone of regularly flooded shore (M2USN). These are composed primarily of sand and shell fragments. The granite jetties along the coast will be labeled rocky shore irregularly flooded artificial substrate (M2RSPr).

Estuarine

The estuarine system consists of many types of wetland habitats. Unconsolidated bottom (E1UBL) occurs in the numerous bays and adjacent salt marshes. Unconsolidated shore is often found in areas of intertidal sand flats as well as within the salt marshes. Water regimes for this community range from irregularly exposed (E2USM), regularly flooded (E2USN) to irregularly flooded (E2USP). The aquatic beds observed in this system were predominantly seagrasses (Thalassia testudinum, Halodule wrightii) and will be labeled (E1AB3L). There were also signatures present on the low water condition photography that will be labelled (E1AB5L) to indicate unknown aquatic bed possibly algae and other organic material.

The emergent areas closest to the coast consists of regularly flooded (E2EM1N) salt tolerant grasses. These communities are mainly comprised of Spartina alterniflora, Juncus roemerianus, and Distichlis spicata habitats. Behind the regularly inundated zone, the irregularly flooded (E2EM1P), lies vegetation communities of Spartina patens, Batis maritima, Paspalum vaginatun, Salicornia virginica, Borrichia frutescens, and Monanthochloe littoralis to name a few.

The scrub-shrub vegetation is not as extensive as the emergent vegetation. Plant species in these areas will generally be irregularly flooded (E2SSIP) in a transitional zone between the emergent communities and upland habitat. Baccharis halimifolia, Iva frutescens, and Sesbania drummondii will occur in these areas.

Lacustrine

Water bodies greater than 20 acres are included in this system with both limnetic and littoral subsystems represented. Numerous lakes and reservoirs exist within the study area. Major bodies of water include Lake Anuhauc, Lake Charlotte, and Highlands Reservoir.

The nonvegetated water bodies are labeled limnetic or littoral unconsolidated bottom (L1UB or L2UB), depending on the water depth present. Vegetated bodies of water will be classified with the subclass of rooted or floating aquatic bed (L1AB3, L2AB3 or L1AB4, L2AB4). The impounded modifier (h) will be utilized on bodies of water impounded by locks or any artificial means. An artificially flooded modifier (k) will be utilized in situations resulting from water control by means of pumps or siphons.

Riverine

Three riverine subsystems are found within the work area; Tidal (R1), Lower Perennial (R2) and Intermittent (R4). The major drainages discharging into the bay are the Trinity and San Jacinto Rivers. Ditches large enough to be delineated are identified with the (x) modifier attached (ie. R2UBHx or R4SBFx).

Palustrine

Palustrine areas include unconsolidated bottom, unconsolidated shore, aquatic bed, emergent, scrub-shrub and forested. Naturally occurring ponds are identified as unconsolidated bottom permanently or semipermanently flooded (PUBH or PUBF). Excavated or impounded ponds and borrow pits are labeled with their respective modifier (PUBHx or PUBHh).

The emergent areas bordering the estuarine vegetation and estuarine rivers were typically influenced by the tide and vegetated by a variety of species. Extensive semipermanently (PEM1F, PEM1T) and seasonally (PEM1C, PEM1R) flooded emergent marsh communities occur around Galveston Bay's perimeters which included the following plant species: Alternanthera phloxeroides, Cyperus articulates, Phragmites australis, Sagittaria falcata, Scirpus americanus, Scirpus californicus, Typha sp. and Zizaniopsis miliacea.

The scrub-shrub wetlands observed were often seasonally flooded dominated by Salix nigra, Sapium sebiferum and Sesbania drummondii (PSS1C). Temporarily and semipermanently flooded scrub-shrub habitat also occur with similar species present both tidally and nontidally influenced within this system. Tamarix gallica will be labelled (PSS2A or PSS2C) depending on the water conditions present.

Forested areas semipermanently flooded were represented by Taxodium distichum and will be labeled (PFO2F). The temporarily and seasonally flooded forest incorporate a large mixture of tree species (PFO1A, PFO1C). Celtis occidentalis, Fraxinus pennslyvanica, Gledistia aquatica, Liquidambar styraciflua and Sapium sebiferum were commonly observed in these areas. A split subclass will be utilized when there are both needle-leaved and broad-leaved deciduous species exist (PFO2/1 or PFO1/2).

OBSERVED WETLAND VEGETATION

	Scientific Name	Common Name
AQUATIC BED		
	Halodule wrightii	shoalgrass
	Nelumbo lutea	american lotus
	Ruppia maritima	widgeongrass
	Thalassia testudinum	turtlegrass
EMERGENT		
	Alternanthera philoxeroides	alligator weed
	Ammania coccinea	tooth cup
	Andropogon glomeratus	broomsedge
	Aster tenuifolius	marsh aster
	Bacopa caroliniana	lemon bacopa
	Bacopa monnieri	coast bacopa
	Batis maritima	saltwart
	Borrichia frutescens	sea oxeye daisy
	Crinum americanum	swamp lily
	Cyperus articulatus	jointed flatsedge
	Distichlis spicata	saltgrass
	Echinochloa crusgalli	water millet
	Eleocharis parvula	dwarf spikerush
	Eleocharis quadrangulata	squarestem spike rush
	Eleocharis sp.	spikerush
	Eupatorium coelestinum	mist flower
	Frimbristylis castanea	saltmarsh frimbristylis
	Heliotropium curassavicum	seaside heliotrope
	Hydrocotyle bonariensis	pennywort
	Juncus roemerianus	black needlerush
	Limonium nashii	sea lavender
	Lobelia cardinalis	cardinal flower
	Ludwigia leptocarpa	anglestem waterprimrose
	Ludwigia peploides	perennial waterprimrose
	Lycium carolinianum	wolfberry
	Mikania scandeus	climbing hemp
	Monanthochloe littoralis	shoregrass, salt flat grass
	Paspalum vaginatum	seashore paspalum
	Phragmites australis	common reed
	Pluchea camphorata	stinkweed
	Sagittaria falcata	coastal arrowhead
	Sagittaria lancifolia	bulltongue
	Salicornia virginica	glasswort
	Scirpus americanus	common three square/ olney's bulrush
	Scirpus californicus	california bulrush
	Scirpus robustus	alkali bulrush
	Solidago sempervirens	seaside goldenrod

OBSERVED WETLAND VEGETATION
Cont'd

Scientific Name	Common Name
EMERGENT (continued)	
Sphenoclea zeylanica	chicken spike
Spartina alterniflora	smooth cordgrass
Spartina cynosuroides	big cordgrass
Spartina patens	saltmeadow cordgrass
Spartina pectinata	prairie cordgrass
Spartina spartinae	gulf cordgrass
Suaeda linearis	seepweed
Typha sp.	cattail
Vigna luteola	cow pea
Zizaniopsis miliacea	giant cutgrass
SCRUB-SHRUB	
Baccharis halimifolia	saltbush
Forestiera acuminata	swamp privet
Iva frutescens	marsh elder
Sesbania drummondii	raddlebox
Tamarix gallica	salt cedar
FORESTED	
Acer rubrum	red maple
Betula nigra	river birch
Celtis occidentalis	hackberry
Fraxinus pennslyvanica	green ash
Gleditsia aquatica	water locust
Liquidambar styraciflua	sweetgum
Planera aquatica	water elm
Platanus occidentalis	sycamore
Populus deltoides	eastern cottonwood
Salix nigra	black willow
Sapium sebiferum	chinese tallow
Taxodium distichum	bald cypress
Ulmus crassifolia	cedar elm

WETLAND CLASSIFICATION CODES AND WATER REGIME DESCRIPTIONS

Table - Cowardin Classification Codes and Descriptions

NWI CODE WATER REGIME	NWI DESCRIPTION	COMMON DESCRIPTION	CHARACTERISTIC VEGETATION
M1UB (L)	Marine, subtidal unconsolidated bottom	Gulf of Mexico	Unconsolidated bottom
M2US (P,N,M)	Marine, intertidal unconsolidated bottom	Marine, barrier islands	Unconsolidated shore
M2RS (P)	Marine, intertidal rocky shore	Marine breakers, beach stabilizers	Jetties
E1UB (L)	Estuarine, subtidal unconsolidated bottom	Estuarine bays, Estuarine rivers	Unconsolidated bottom
E1AB (L)	Estuarine, subtidal aquatic bed	Estuarine bays	Thalassia testudinum Halodule wrightii
E2US (P,N,M)	Estuarine, intertidal unconsolidated shore	Estuarine bay, tidal flats, salt flats	Unconsolidated shore
E2EM (P,N)	Estuarine, intertidal emergent	Estuarine bay marshes	Spartina alterniflora Juncus roemerianus Batis maritima
E2SS (P)	Estuarine, intertidal scrub-shrub	Estuarine scrubs	Iva frutescens Baccharis halimifolia
R1UB (V)	Riverine, tidal, unconsolidated bottom	Rivers	Unconsolidated bottoms
R1SB (T)	Riverine, tidal, streambed	Streams	Unconsolidated bottoms
R2UB (H)	Riverine, lower perennial, unconsolidated bottom	Rivers	Unconsolidated bottoms
R4SB (C,F)	Riverine, intermittent streambed	Streams, creeks	Unconsolidated bottoms

NWI CODE WATER REGIME	NWI DESCRIPTION	COMMON DESCRIPTION	CHARACTERISTIC VEGETATION
L1UB (H,V)	Lacustrine, limnetic, unconsolidated bottom	Lakes	Unconsolidated bottom
L2UB (H,V)	Lacustrine, littoral, unconsolidated bottom	Lakes	Unconsolidated bottom
L2AB (H,V)	Lacustrine, littoral, aquatic bed	Lake Marshes	Nelumbo lutea Ruppia maritima
PUB (F,H)	Palustrine, Unconsolidated bottom	Ponds, borrow pits, or impoundments	Unconsolidated bottom
PAB (F,H)	Palustrine, aquatic bed	Ponds or deep marshes	Nelumbo lutea
PEM (A,C,F,S,R,T)	Palustrine, emergent	Meadows, marshes, depressions, or drainage areas	Scripus californicus Sagittaria lancifolia Alternanthera philoxeroides
PSS (A,C,F,S,R,T)	Palustrine, scrub-shrub	Willow thicket, river banks	Sesbania drummondii
PFO (A,C,F,S,R,T)	Palustrine, forested	Floodplains, depressions or meadow rims	Liquidambar styraciflua Taxodium distichum

V. WATER REGIME DESCRIPTION

Non-Tidal

(A) Temporarily Flooded -- Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Plants that grow both in uplands and wetlands are characteristic of this water regime.

(C) Seasonally Flooded -- Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is extremely variable, extending from saturated to a water table well below the ground surface.

(F) Semipermanently Flooded -- Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land's surface.

(G) Intermittently Exposed -- Suface water is present throughout the year except in years of extreme drought.

(H) Permanently Flooded -- Water covers land surface throughout the year in all years.

Tidal

(L) Subtidal -- The substrate is permanently flooded with tidal water.

(M) Irregularly Exposed -- The land surface is exposed by tides less often than daily.

(N) Regularly Flooded -- Tidal water alternately floods and exposes the land surface at least once daily.

(P) Irregularly Flooded -- Tidal water floods the land surface less often then daily.

(S)* Temporarily Flooded -- Tidal

(R)* Seasonally Flooded -- Tidal

(T)* Semipermanently Flooded -- Tidal

(V)* Permanently Flooded -- Tidal

* These water regimes are only used in tidally influenced, freshwater systems.

VI. IMAGERY

Overall imagery for the Galveston Bay study area is of good quality. The resolution is good and tones are easily differentiated within wetlands. Wetlands in the field appeared to be similar to their condition on the photos. The annual non-persistent emergent vegetation on the unconsolidated flats of the Trinity Delta were an exception to this. Also more extensive communities of aquatic beds were observed in mid-growing season that did not appear as extensive on the winter photography.

VII. SPECIAL MAPPING PROBLEMS

The Anahauc National Wildlife Refuge and the property managed by Ducks Unlimited require special attention. The Anahauc National Wildlife Refuge, located in Frozen Point and High Island 7.5 minute quads, implement an extensive water management program for waterfowl habitat. With the assistance of Jim Neaville (Refuge Biologist) special care was taken to incorporate the management practices. The artifically flooded modifier (k) was used in marshes that are managed with a seasonal or semipermanent water regime.

Ducks Unlimited was also mapped according to the vegetation and salinity. The property is managed to maintain a low salinity and water level to encourage a brackish marsh community. The area is located north of the Trinity Bay in the Cove 7.5 minute quad.

VIII. MAP PREPARATION

The wetland classification that appears on the National Wetlands Inventory (NWI) Base Map (Figure 1) is in accordance with Cowardin et al. (1977). The delineations were produced through stereoscopic interpretation of 1:65,000 scale color infrared photography. The majority of the photography was taken during the winter of 1989.

Field checks of areas found within Houston NE, SE, NW, and SW were made prior to the actual delineation of wetlands. Field check sites were selected to clarify varying signatures found on the photography. These photographic signatures were then identified in the field using vegetation types and soil types, as well as additional input from field personnel.

Collateral data included USGS topographic maps, SCS soil surveys, climate, vegetation, and ecoregional information.

The user of the map is cautioned that, due to the limitation of mapping primarily through aerial photointerpretation, a small percentage of wetlands may have gone unidentified. Since the photography was taken during a particular time and season, there may be discrepancies between the map and current field conditions. Changes in landscape which occurred after the photography was taken would result in such discrepancies.

Aerial photointerpretation and drafting were completed by Geonex Martel, Inc., St. Petersburg, Florida.

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I. LITERATURE CITED

U.S. Geological Survey Quadrangles

Soil Surveys of Brazoria, Chambers, Galveston and Harris Counties, Texas U.S. Department of Agriculture, Soil Conservation Service

Wetland Plants of the State of Texas 1986 U.S. Fish and Wildlife Service

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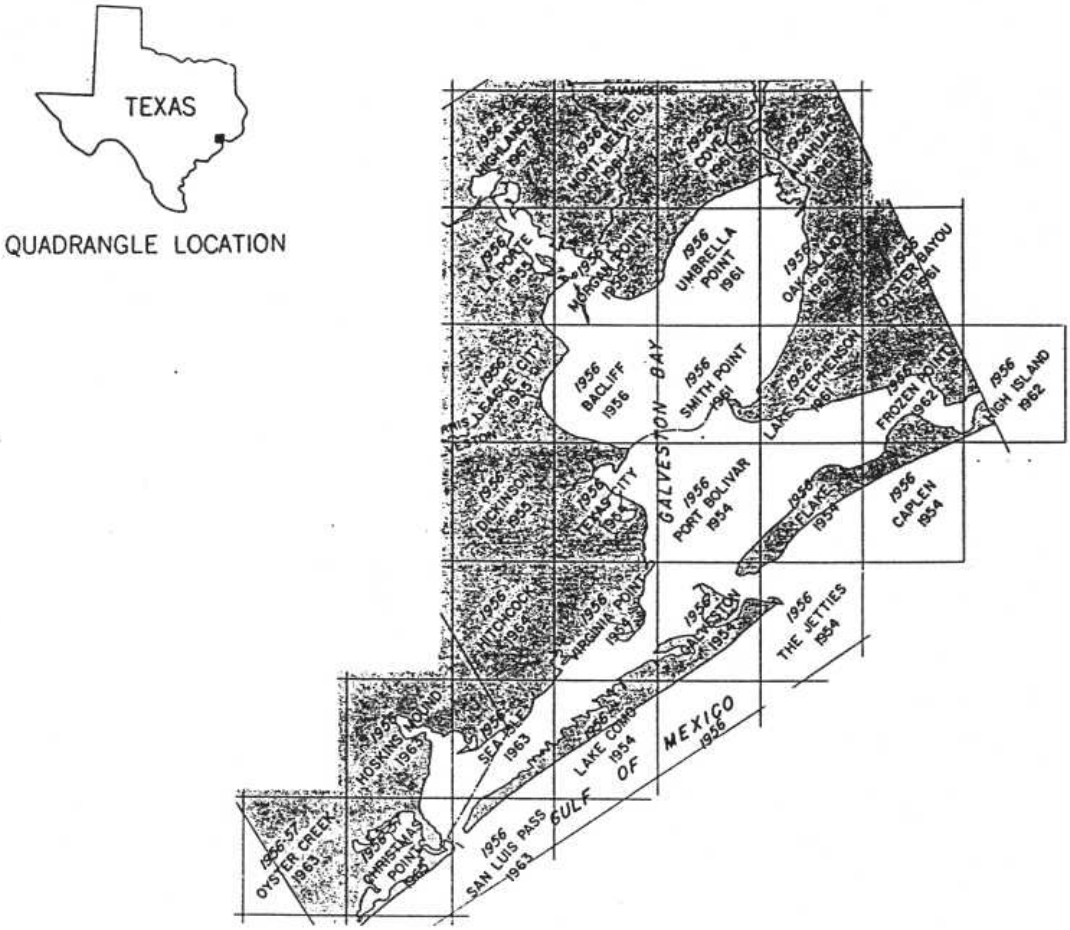
Environmental Geologic Atlas of the Texas Coastal Zone-Galveston-Houston Area, 1972 Fisher, McGowen, Brown and Groat, Bureau of Economic Geology Austin, Texas

APPENDIX A
LOCATOR MAP

Galveston-Houston Map Area