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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.
TX-90/1194-1F

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle
Optimum Disposal Methods for Use on the Gulf Intercoastal Waterway

5. Report Date
November 1989

6. Performing Organization Code

7. Author(s)
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8. Performing Organization Report No.
Research Report 1194-1F

9. Performing Organization Name and Address
Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

10. Work Unit No.

11. Contract or Grant No.
Study No. 2-10-88-9-1194

12. Sponsoring Agency Name and Address
Texas State Department of Highways and Public Transportation; Transportation Planning Division
P.O. Box 5051
Austin, Texas 78763

13. Type of Report and Period Covered
Final - September 1987
November 1989

14. Sponsoring Agency Code

15. Supplementary Notes
Research performed for the State of Texas.
Research Study Title: Optimum Disposal Methods for Use on the Gulf Intracoastal Waterway

16. Abstract

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17. Key Words
Dredging, Methodology, Waterway, Optimum disposal methods, Gulf Intracoastal Waterway.

18. Distribution Statement
No restrictions. This document is available to the public through the
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

19. Security Classif. (of this report)
Unclassified

20. Security Classif. (of this page)
Unclassified

21. No. of Pages
121

22. Price

Form DOT F 1700.7 (8-69)

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OPTIMUM DISPOSAL METHODS FOR USE ON THE GULF INTRACOASTAL WATERWAY

by

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Kelly Wooters
and
Dock Burke

Research Study Number 2-10-88-9-1194
Optimum Disposal Methods for Use
on the Gulf Intracoastal Waterway

Sponsored by

Texas State Department of Highways
and Public Transportation

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November 1989

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METRIC (SI*) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

LENGTH

Symbol	When You Know	Multiply By	To Find	Symbol
in	inches	2.54	millimetres	mm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km

AREA

in²	square inches	645.2	millimetres squared	mm²
ft²	square feet	0.0929	metres squared	m²
yd²	square yards	0.836	metres squared	m²
mi²	square miles	2.59	kilometres squared	km²
ac	acres	0.395	hectares	ha

MASS (weight)

oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

VOLUME

fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft³	cubic feet	0.0328	metres cubed	m³
yd³	cubic yards	0.0765	metres cubed	m³

NOTE: Volumes greater than 1000 L shall be shown in m³.

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

APPROXIMATE CONVERSIONS TO SI UNITS

LENGTH

Symbol	When You Know	Multiply By	To Find	Symbol
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi

AREA

mm²	millimetres squared	0.0016	square inches	in²
m²	metres squared	10.764	square feet	ft²
km²	kilometres squared	0.39	square miles	mi²
ha	hectores (10 000 m²)	2.53	acres	ac

MASS (weight)

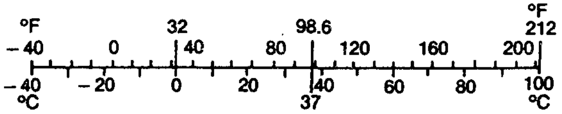
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T

VOLUME

mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m³	metres cubed	35.315	cubic feet	ft³
m³	metres cubed	1.308	cubic yards	yd³

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



These factors conform to the requirement of FHWA Order 5190.1A.

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* SI is the symbol for the International System of Measurements

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SUMMARY

The Gulf Intracoastal Waterway (GIWW) has important state and national economic, energy, and defense uses. Dredging is used to maintain a navigable channel and create problems of how best to dispose of dredged material.

This study develops a methodology to evaluate how best to dispose of this dredged material along specific areas of the GIWW. The methodology has three major parts: (1) completing a dredged material placement assessment for each alternative; (2) determining the feasibility of each alternative; and (3) comparatively evaluating the results. The dredged material placement assessment includes an explanation of the engineering aspects of the disposal alternative, the societal and legal aspects of the alternative, the environmental effects, and the costs/benefits of the alternative.

After the assessment is completed, this qualitative analysis is transformed and evaluated quantitatively. A list of the factors important to a disposal project is rated on a scale of -2 to +2. The results are averaged to obtain an engineering rating, a societal rating, an environmental rating, and an economic rating. These four ratings are averaged to obtain a final feasibility rating. Each rating is given equal weight in the final feasibility rating so that no one factor outweighs the other three.

The rating system is somewhat subjective, so the alternatives actually separate into three groups. Group I are very positive ratings for alternatives which are ideally cost-effective, environmentally acceptable, beneficial uses. Group II includes very negative ratings for undesirable alternatives which are objectionable to many people for many reasons. Group III are intermediate values generally reflecting traditional methods and/or new innovative alternatives which are costly or difficult to engineer. After the ratings have been ranked, the choice of a disposal alternative is made from the selection in the highest group which is best for a specific site.

Some of the alternatives considered are traditional dredging disposal methods, beneficial uses of dredged material, and innovative methods of disposal that address site specific needs. Traditional methods consist of alternatives such as unconfined discharge in bay waters, open water disposal, and leveed areas. Beneficial uses have become appealing

since the dredged material can be disposed of in an environmentally and economically acceptable manner and also used as a natural resource that benefits society. The Corps of Engineers has identified 10 broad categories of beneficial uses based on the functional use of the dredged material at the disposal site (U. S. Army Corps of Engineers 1987). These alternatives include habitat development and beach nourishment, both of which are frequently encouraged by resource agencies. Innovative uses can be more costly, but are required in some environmentally sensitive areas. An example of an innovative disposal alternative is the application of oil spill cleanup technology to dredging sites.

Specific reaches of the GIWW used to test the methodology developed in this study include High Island, Redfish Bay, Chocolate Bay, and a 30 km area near Port Mansfield, Texas. The methodology can be adapted for general use to implement coastal zone management policy.

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ABSTRACT

This study develops a methodology to determine optimum disposal methods for dredging operations. It differs from previous assessment methods because it bases an optimum solution on both technical and nontechnical factors. The methodology has three components: (1) a dredged material placement assessment that considers various engineering, societal, environmental, and economic aspects of dredging; (2) a feasibility rating assessment that quantitatively transforms the qualitative analysis; and (3) an analysis component which summarizes the results. Case sites used to test the methodology are located along the Gulf Intracoastal Waterway in Texas and include High Island, Redfish Bay, Chocolate Bay, and a 30 km area near Port Mansfield.

IMPLEMENTATION STATEMENT

The Texas State Department of Highways and Public Transportation periodically is authorized funds for acquiring needed sites for dredged material placement. This project gives justification for requesting these funds on a timely basis and early enough that the sites can be acquired before development severely inflates the value of the sites. Some specific examples by sites:

Port Mansfield to Land Cut.

In the northernmost reaches of this stretch, the dredged material should be placed on shore. Sites on North Padre Island and on the mainland are underdeveloped and may hopefully be selected and purchased or leased at a reasonable price at this time. The other reaches would not require land purchase since the state owns the bay bottom.

Redfish Bay.

We have shown that a concept of pumping and storing dredged material on the northern or backside of Live Oak Ridge is a good alternative. Sites to the north of the new Aransas Pass to Rockport highway are suitable and undeveloped at this time. After the highway is completed and the new Navy Base developed at Ingleside, development in this area will escalate and prices will rise. Purchase of at least two major sites (one for the eastern reach and one for the western reach) would be prudent.

Chocolate Bayou.

The creation of islands for shoreline protection would not require land purchase since the state owns the bay bottom.

High Island.

In the eastern zone, the transport of material inland to a higher elevation disposal area showed promise. This concept used the right of way for Highway 72 north of High Island to transport the dredged material by pipeline and to return the salt water drainage to the Gulf Intracoastal Waterway. Maintaining this option would involve purchasing or leasing a sizeable parcel of land approximately five miles inland from the Gulf Intracoastal Waterway.

We explored in depth the concepts of redesignating existing dredge disposal areas as interim storage areas, with them being periodically emptied--the material therein transferred offshore or inland and the sites reused. Existing Corps of Engineers leases for dredging sites do not allow for emptying and reuse. The state should decide which sites are suitable for the reuse concept and purchase the old disposal sites. Since this land is of limited residual value to the landowner, purchase should be possible at a reasonable price.

DISCLAIMER

The material presented in this paper was assembled during a research project sponsored by the Texas State Department of Highways and Public Transportation. The views, interpretations, analyses and conclusions expressed or implied in this report are those of the authors. They do not represent a standard, policy or recommended practice established by the sponsor.

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1.0 INTRODUCTION

1.1 Study Approach

This study develops a methodology to evaluate optimal dredged material disposal methods. Four particular reaches along the Gulf Intracoastal Waterway (GIWW) are used as case studies to test the model. The methodology focuses on the needs of the Texas State Department of Highways and Public Transportation, Port Authorities, Corps of Engineers, environmental assessment personnel, land assessors, and other institutional personnel associated with coastal zone management policy along the GIWW in Texas. A stepwise procedure to evaluate the alternatives for dredged material disposal is documented, along with the discussion of the methodology, so it can be adapted for general use.

1.2 Background

Texas is the largest maritime state in the United States, and the GIWW links much of its maritime traffic. The GIWW is 645 km long and runs parallel to the coast of Texas. Each year approximately one-fourth of the navigation channel must be dredged to provide safe and efficient operational conditions (Appendix 7.1).

Colonel John A. Tudela, Galveston District Engineer for the U.S. Army Corps of Engineers, warned of "economic disaster for Texas and the nation" if the GIWW is not maintained (News Release No. 27 1989). Maintenance dredging must continue because of the significant energy and defense importance of the navigation system. The question of how best to dispose of dredged material becomes crucial when other aspects of the waterway, such as its recreational, ecological, and legal considerations, are balanced with dredging operations.

Importantly, the route of the GIWW leads through wetlands which are productive and ecologically sensitive areas of the Texas coast. These wetlands are nurseries for commercially valuable finfish and shellfish and nesting or feeding grounds for waterfowl, mammals, and reptiles (Texas State Department of Highways and Public Transportation 1986).

Dredging disposal alternatives for the region can be divided into three groups: traditional dredging disposal methods, beneficial uses of dredged material, and innovative methods of disposal that address site specific needs. Traditional methods consist of alternatives such as unconfined discharge in bay waters, open water disposal, and leveed areas. Beneficial uses have become appealing since the dredged material can be disposed of in an environmentally and economically acceptable manner and also used as a natural resource that benefits society. The Corps of Engineers has identified 10 broad categories of beneficial uses based on the functional use of the dredged material at the disposal site (U. S. Army Corps of Engineers 1987). These alternatives include habitat development and beach nourishment which are encouraged by resource agencies. Innovative alternatives can be more costly, but are required in some environmentally sensitive areas. An example of an innovative disposal alternative is the application of oil spill cleanup technology to dredging sites.

1.3 Related Research

The environmental impacts of dredging were studied as part of a national research program in the 1970s. The Corps of Engineers led the Dredged Material Research Program (DMRP) to obtain basic information on various types of dredged material and possible alternatives to existing disposal methods (Saucier et al. 1978). The DMRP studies include methodologies for choosing between wetland, upland, island and aquatic habitat development (Smith 1978); deciding on the appropriate agricultural use (Gupta et al. 1978); determining design characteristics of dredged material containment areas (Palermo et al. 1978); selecting reusable disposal sites (Raster et al. 1978); and selecting upland disposal sites (SCS Engineers 1977). Each of these methodologies is only for use after an alternative has been chosen and specific site needs occur.

Conrad and Pack (1978) devised an economic methodology to determine land value and associated benefits from dredged material containment. This methodology is designed to provide guidance for a project, not to select appropriate disposal alternatives. The New York District of the Corps of Engineers has a methodology for evaluating disposal sites, but its scope is limited to upland sites (Leslie et al. 1980). The methodology devised by Glover and Herbich (1989) arbitrarily weighs wetland protection and site capacity two to three times higher than other factors used to determine optimum alternatives.

The methodology developed in the research reported here evaluates all possible disposal alternatives and bases an optimum solution on both technical and nontechnical factors. This is somewhat distinctive from past research efforts. This study is more comprehensive in scope than previous studies, and the model that is proposed will be consistent in weighing factors from which the optimal solution is developed.

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2.0 DREDGED MATERIAL DISPOSAL ALTERNATIVES

2.1 Traditional Methods

Traditional dredged material disposal methods are usually most common for an area, but they sometimes have unacceptable environmental effects. An example is unconfined discharge in bay waters which can create emergent islands that are considered undesirable in some cases. Dredged Material Containment Areas (DMCA) are leveed areas usually close to the channel which have a limited capacity, depending on the height of the levees which is typically 3-4 meters (Figure 2.1). After these areas are filled, it is often difficult to find new land or other disposal areas near the dredge site for future disposal operations. Such is the case along the GIWW in Texas. Open water disposal is also a traditional method. But, this method is being regulated more every year so that it cannot be depended on as a long-term disposal option.

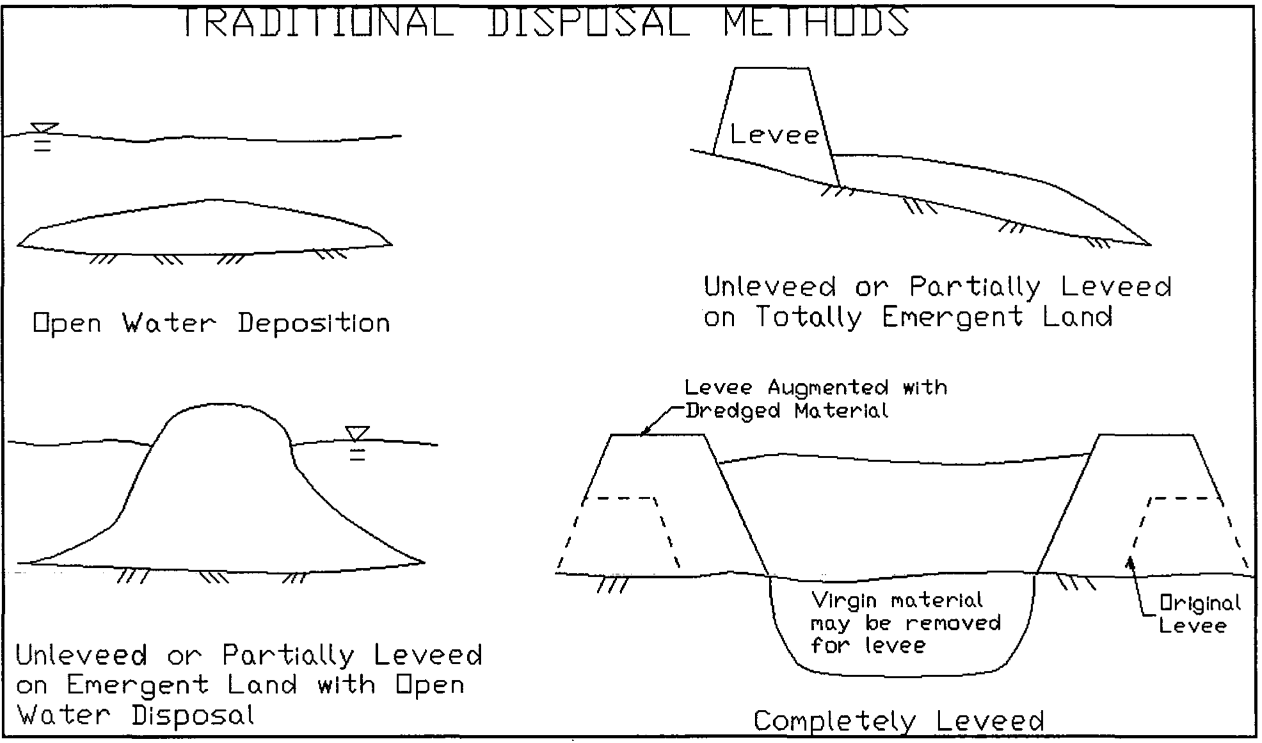

Figure 2.1. Traditional Disposal Alternatives.

Table 2.1. Beneficial uses of dredged material.

1. Habitat development
   - A. Wetland
   - B. Upland
   - C. Island
   - D. Aquatic
   - E. Other

2. Beach nourishment

3. Aquaculture

4. Parks and recreation
   - A. Commercial
   - B. Noncommercial

5. Agriculture, forestry and horticulture

6. Strip mine reclamation and solid waste management

7. Shoreline stabilization and erosion control

8. Construction and industrial use
   - A. Port development
   - B. Airports
   - C. Urban
   - D. Residential

9. Material transfer
   - A. Fill
   - B. Dikes
   - C. Levees
   - D. Parking lots
   - E. Roads

10. Multiple purpose

2.2 Beneficial Uses

Beneficial uses of dredged material are appealing since dredged material can be disposed of in a manner that is environmentally and economically acceptable and that also accrues natural resource benefits to society. A list of the beneficial uses from the Army Corps of Engineers manual, The Engineering and Design of the Beneficial Uses of Dredged Material is given in Table 2.1. The habitat development and beach nourishment options are encouraged by many resource agencies, such as the National Marine Fisheries Service.

2.3 Innovative Alternatives

2.3.1 **Interim Storage**

Historically, dredged material containment areas have been designed to be ultimate disposal sites. However, as concern for wetlands increases and the availability of disposal sites decreases, it will be necessary to design temporary storage or containment areas that can be reused after ultimate disposal sites are determined. These *interim storage* sites would be used during regular maintenance dredging operations and when they reach capacity, the material at the temporary site will be moved to its ultimate disposal site (Figure 2.2).

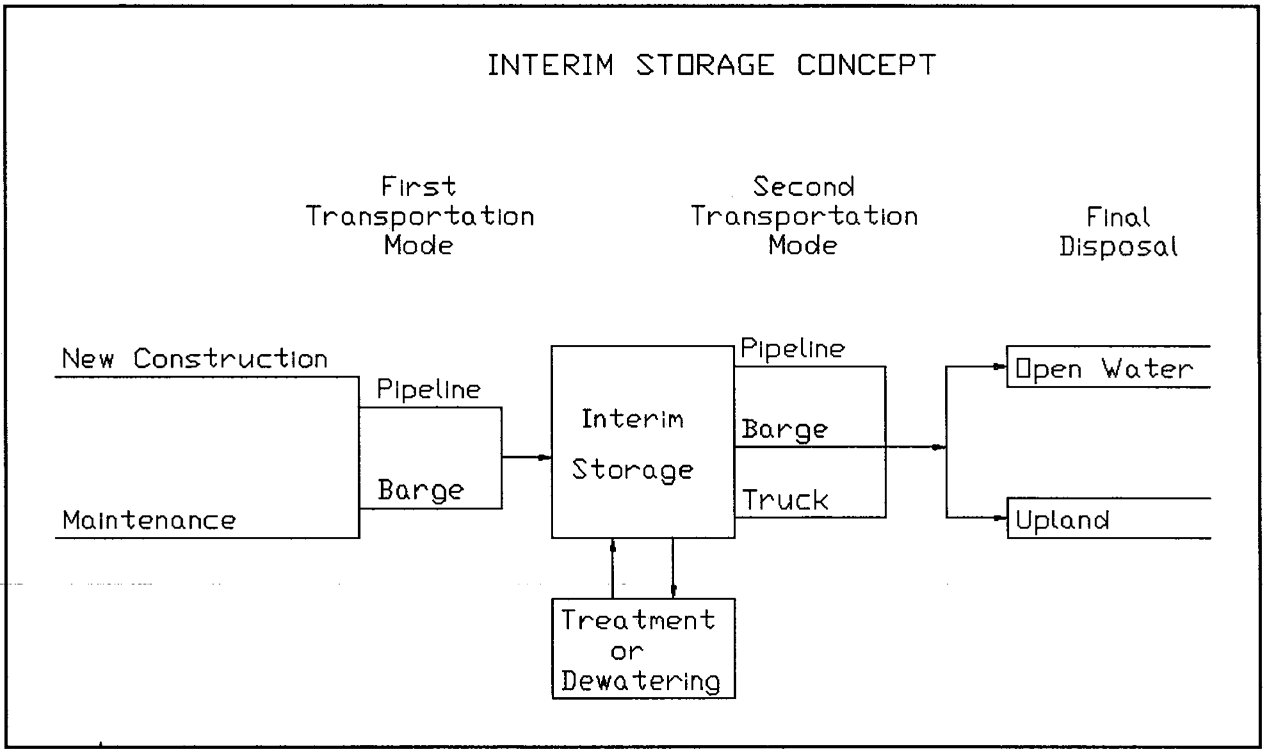

Figure 2.2. Interim Storage.

Public environmental groups and resource agencies historically have accepted the interim storage concept for oil and hazardous material spill residue. Thus interim storage for dredged material is likely to be more fully considered as a future disposal alternative. In some cases, the ultimate disposal area can be changed to an interim storage area.

The existing easements for these disposal areas do not provide for the removal and replacement of dredged material. Since this material has little value, the state should be able to either purchase a new modified easement or purchase the land at reasonable prices through condemnation. It is desirable to own the area to ensure uninterrupted use in the future.

Innovative techniques will be required to remove the material from the interim storage areas. Regular maintenance dredging is a large operation for a short amount of time, while emptying the area is a small operation of longer duration. The technology is different for each. Currently, the technology does not exist to remove the material in an efficient, cost-effective manner, but the technology can be developed with further research.

Although this method of handling the dredged material is not presently suitable for most dredging projects because of the high cost associated with double handling the material, it is vital in environmentally sensitive areas where no land is available for further containment areas and other options are poor alternatives.

2.3.2 **Protective Islands**

Emergent islands next to the waterway have been deemed undesirable by resource agencies in Texas. However, if specially designed, leveed islands were placed adjacent to the waterway in certain locations where coastal erosion was a major problem, erosion would decrease on the mainland. The protective islands would dissipate the wave energy that would otherwise erode the shoreline (Figure 2.3).

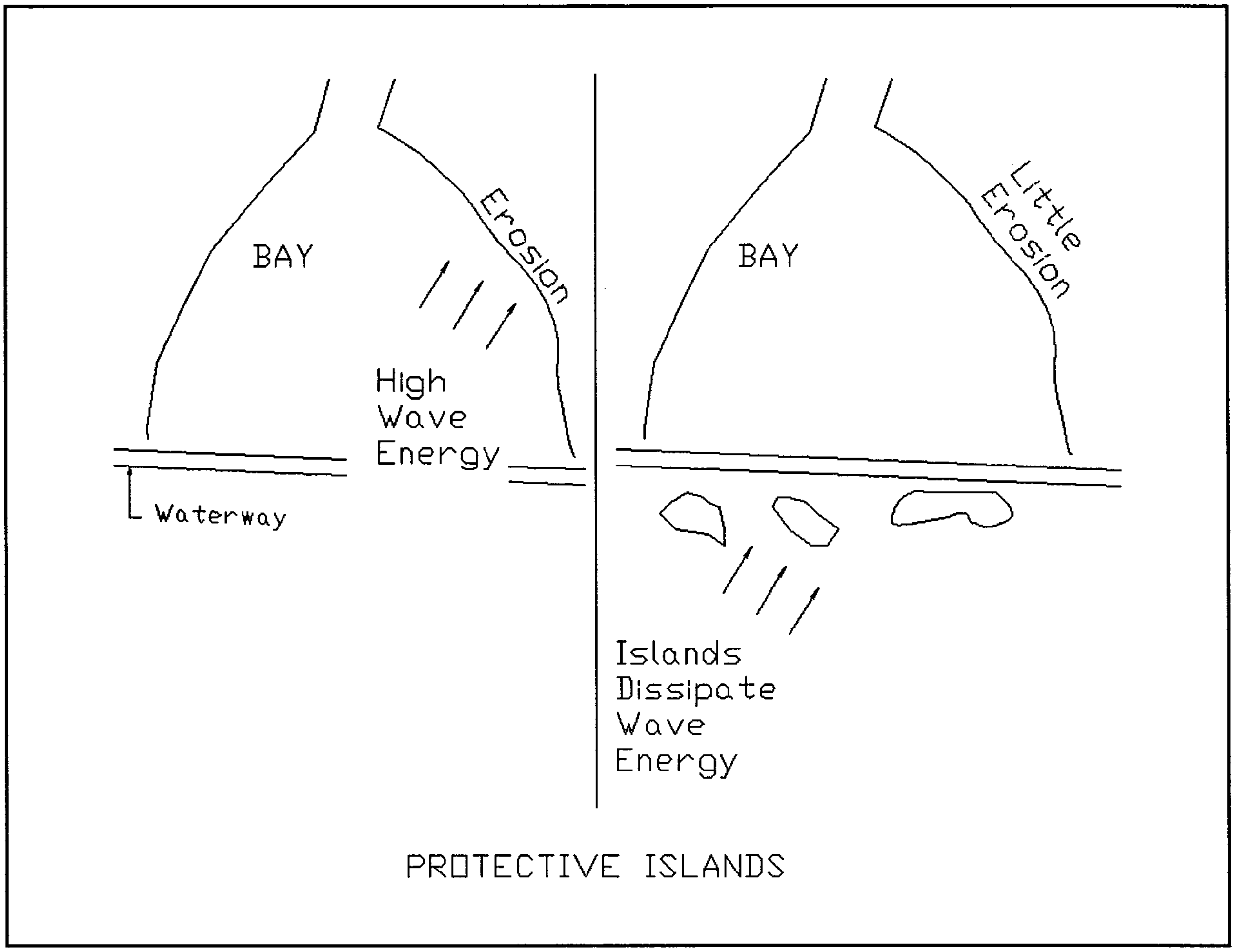

Figure 2.3. Schematic of Protective Island Concept.

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3.0 METHODOLOGY

3.1 Introduction

The methodology to determine an optimum disposal method is categorized into three activities: (1) complete a dredged material placement assessment for each alternative to be considered; (2) determine the feasibility of each alternative; and (3) analyze and summarize the alternatives in a rank order.

The distance being analyzed should be segmented into regions of 8-10 km long because that is the mechanical limitation from which a dredge can economically pump dredged material to a disposal site. A region may be smaller if prevailing environmental conditions exist that prevent the transport of the material further (e.g., a ship channel cutting through the area). The study site can be one region or many regions, depending on the length of the region that must be dredged.

3.2 Dredged Material Placement Assessment

The dredged material placement assessment is an explanation of the engineering aspects of the disposal alternative, the societal and legal aspects of the alternative, the environmental effects, and the costs/benefits of the alternative (Figure 3.1). Some of the important factors to consider when conducting an assessment are listed in Table 3.1. This list expands to include any particular constraints within a specific area.

The engineering portion of the assessment should consider all aspects of the operations--from design to disposal. Following are examples of important parts of this assessment. The physical requirements for the disposal facility should be determined and then a site must be selected. The distance from the dredging operation is important because booster pumps are required to pump dredged material after about 5 km and efficiencies decrease. The treatment of the material can constrain the size and configuration of a site. Life expectancy of a site should be as long as possible to meet the long-term dredging needs. Long-term maintenance should be considered because it is important for habitat management and it should be anticipated. Monitoring the facility beyond the normal practices of the Corps of Engineers will be a constraint to that alternative. Site size and

DREDGED MATERIAL PLACEMENT ASSESSMENT

Alternative:

Engineering considerations and constraints:

Societal considerations and constraints:

Environmental considerations and constraints:

Economic considerations and constraints:

Figure 3.1. Aspects to consider in conducting a dredged material placement assessment.

configuration must be within reason; that is, the site cannot be so large as to inhibit dewatering of the area before the next dredging cycle. Construction feasibility is important because if the alternative is selected, then it must be implemented. Disposal facility design and operating characteristics must be compatible. The technical coordination of the disposal plan with the productive use plan or subsequent disposal is vital because maintenance dredging must occur on schedule for the waterway to remain navigable.

Societal considerations reflect the regional concerns of the people. The proposed alternative should be acceptable to society and conform to regulatory and other legal requirements. Social considerations are difficult to quantify; however, disposal alternatives should be safe.

Table 3.1. Dredged material placement assessment factors (Walsh and Malnasian, 1978 and Leslie et al., 1980).

Engineering considerations and constraints

1. physical requirements for disposal facilities
2. distance from dredging
3. treatment of dredged material
4. life expectancy
5. long-term maintenance
6. monitoring of the facility
7. site size and configuration
8. construction feasibility
9. disposal facility design and operating characteristics
10. technical coordination of disposal plan with productive use plan or subsequent disposal

Societal considerations and constraints

1. social acceptability of the facility
2. conformance with regulatory requirements
3. social costs/benefits (nonmonetary)
4. safety

Environmental considerations and constraints

1. destruction/creation of productive habitats
2. effects on water quality
3. environmental impacts of proposed use
4. persistence of impacts
5. alteration of existing character

Economic considerations and constraints

1. economic benefits of the project
2. capital costs
3. engineering and construction costs
4. dredged material transport costs
5. operating and maintenance costs

Considerations and constraints for the environmental assessment ensure the quality of the land and water around the dredging project both during and after the project. Productive habitats should be created, not destroyed. Water quality should not be compromised. Ideally, the environmental impacts of the proposed use should be positive and if they are not, then the persistence of those impacts should be short term. The existing character of sensitive habitats should not be altered or if so, should be mitigated.

Economics is always a key factor. The items which should be considered in the assessment include economic benefits, capital costs (including site acquisition), engineering and construction costs, dredged material transport costs, and operating and maintenance costs.

The assessment also includes a comparison of the cost of the proposed alternative to the cost of the current disposal method. This is achieved by defining a potential cost coefficient as

$$\frac{\text{estimated cost for proposed disposal method}}{\text{cost of current disposal method}}$$

This potential cost coefficient will be used to determine the economic rating.

3.3 Feasibility Determination for Each Disposal Alternative

All of the factors listed in the dredged material placement assessment are quantified into a feasibility rating. Each rating is given equal weight. The ratings are obtained by evaluating each assessment factor on a scale of -2 to +2, based on the criteria in Table 3.2. The results are averaged and placed on a more convenient scale range of -5 to +5. This scaling upwards is accomplished by multiplying the original assessment value by a factor of 2.5. The feasibility rating is the average of an engineering rating, societal rating, environmental rating, and economic rating.

For the engineering rating, -5 is not feasible and +5 is most realizable. The social and environmental scale is -5 for adverse, 0 for neutral, and +5 for beneficial.

The economic rating is determined by the scale shown in Table 3.3. An equation was originally used for this rating, but it controlled the entire feasibility rating. The methodology was revised and the table was created so that the rating is more in balance with the other three ratings. If an alternative method costs exactly the same amount as the current disposal method, then the economic rating is 0. The less expensive the alternative as compared to the current method, the greater is the rating up to a maximum of 5. Conversely, the more costly the alternative as compared to the current method, the lesser is the rating down to a minimum of -5.

The total feasibility rating is the average of these four individual ratings. The choice to give them each equal weight was not inadvertent. This method limits bias to any one sector or interest group--engineers, the public, the environmentalists and/or contractors. The feasibility rating is a tool that considers all disposal options in a relatively objective manner from a given set of technical criteria that can be reused to obtain consistent results. Personal bias is minimized because of the various criteria and ranges that can be assigned to their relative values.

Table 3.2. Scales for determining ratings.

	Engineering Rating	Societal Rating	Environmental Rating
+2	most realizable with readily available technology	beneficial to society	beneficial to the environment
+1	realizable	beneficial to some	beneficial to the environment at the cost of destroying some less productive habitat
0	possible, but requiring advance plan design and/or technology	neutral	neutral
-1	possible, but extremely difficult	adverse for a short period of time	adverse for a short period of time
-2	not feasible	adverse	adverse

3.4 Analysis

Given the effort at developing an objective assessment methodology as just described, the ratings are still somewhat subjective. However, the results will show how the alternatives cluster into three basic groups. The high numbers (>1) are the best alternatives that tend to be the beneficial uses that are cost-effective. The middle range of numbers (-1 to +1) are the alternatives that include more traditional methods that do not harm the environment or have adverse impacts on society. This range also includes the more innovative alternatives that may be more costly or difficult to engineer. The low numbers (<-1) are the alternatives which should not be considered any longer because they are objectionable to many people for many reasons.

3.5 Example

This is an example of the calculations required to determine the feasibility rating.

Engineering Considerations and Constraints

2	1.	physical requirements for disposal facilities
2	2.	distance from dredging
1	3.	treatment of dredged material
0	4.	life expectancy
0	5.	long-term maintenance
0	6.	monitoring of the facility
1	7.	site size and configuration
2	8.	construction feasibility
1	9.	disposal facility design and operating characteristics
0	10.	technical coordination of disposal plan with productive use plan or with subsequent disposal

sum of factors = 9
engineering rating = average of factors x 2.5
engineering rating = (9/10) x 2.5 = 2.3

Societal considerations and constraints

1	1.	social acceptability of the disposal option
2	2.	conformance with regulatory requirements
1	3.	social costs/benefits (nonmonetary)
1	4.	safety

sum of factors = 5
societal rating = average of factors x 2.5
societal rating = (5/4) x 2.5 = 3.1

Environmental considerations and constraints

1 1. destruction/creation of productive habitats
1 2. effects on water quality
1 3. environmental impacts of proposed use
1 4. persistence of impacts
1 5. alteration of existing character

sum of factors = 5
environmental rating = average of factors x 2.5
environmental rating = (5/5) x 2.5 = 2.5

Economic considerations and constraints

1 potential cost coefficient

from Table 3.3, economic rating = 0

The total feasibility rating is the average of the engineering rating, societal rating, environmental rating, and economic rating.

feasibility rating = (2.3 + 3.1 +2.5 + 0) / 4 = 2.0

Table 3.3. Economic rating scale.

Potential Cost Coefficient	Economic Rating	Potential Cost Coefficient	Economic Rating
7.01 +	-5	0.81 - 0.99	1
5.51 - 7.0	-4	0.61 - 0.8	2
4.01 - 5.5	-3	0.41 - 0.6	3
2.51 - 4.0	-2	0.21 - 0.4	4
1.01 - 2.5	-1	0 - 0.1	5
1	0		

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4.0 CASE STUDIES

Case studies on the GIWW to test this methodology were: Port Mansfield to Land Cut, Redfish Bay, Chocolate Bay, and High Island. Each site tested different aspects of this new model. The Port Mansfield to Land Cut site was a channel through a shallow bay with no circulation. Redfish Bay site was unique because of the grass flats that compose the bay. Chocolate Bay is a shallow, productive bay. At High Island, the waterway cuts through wetlands and all of the existing containment areas are filled to capacity. The following sections give the details of each site and provide optimum disposal options based on the methodology previously discussed.

4.1 Port Mansfield to Land Cut

4.1.1 **Site description**

Shallow bay disposal methods were used historically to dispose of dredged material from Port Mansfield to Land Cut, but unconfined disposal has been recently criticized and needed to be reevaluated. The dredging frequency is approximately 2 years and consists of about 30 km (Figure 4.1).

Upland areas have prairie potholes and wetlands which limit the disposal options. Rare clam infauna exist on the back slopes of disposal areas in the sand and oolite shoal areas. These include the *Anomalocardia*, *Tellina*, and *Mulinia* species. Characteristic species for the enclosed bay, restricted bay, and grassflats are listed in Table 4.1.

The Port Mansfield area is very large, so it was divided into three distinct regions for analysis (Figure 4.2). The GIWW for Region 1 extends for about 14 km and has a depth of about 2.4 to 3.0 meters. Region 3 is the shallowest reach (<0.6 m) and much is above sea level. It extends about 4 kilometers. Region 2 (about 12 km) contains underwater berms which can be as shallow as 0.5 meters. These berms were created during earlier dredging cycles and have become productive grass flats which are supported by the nutrients provided by each dredging cycle.

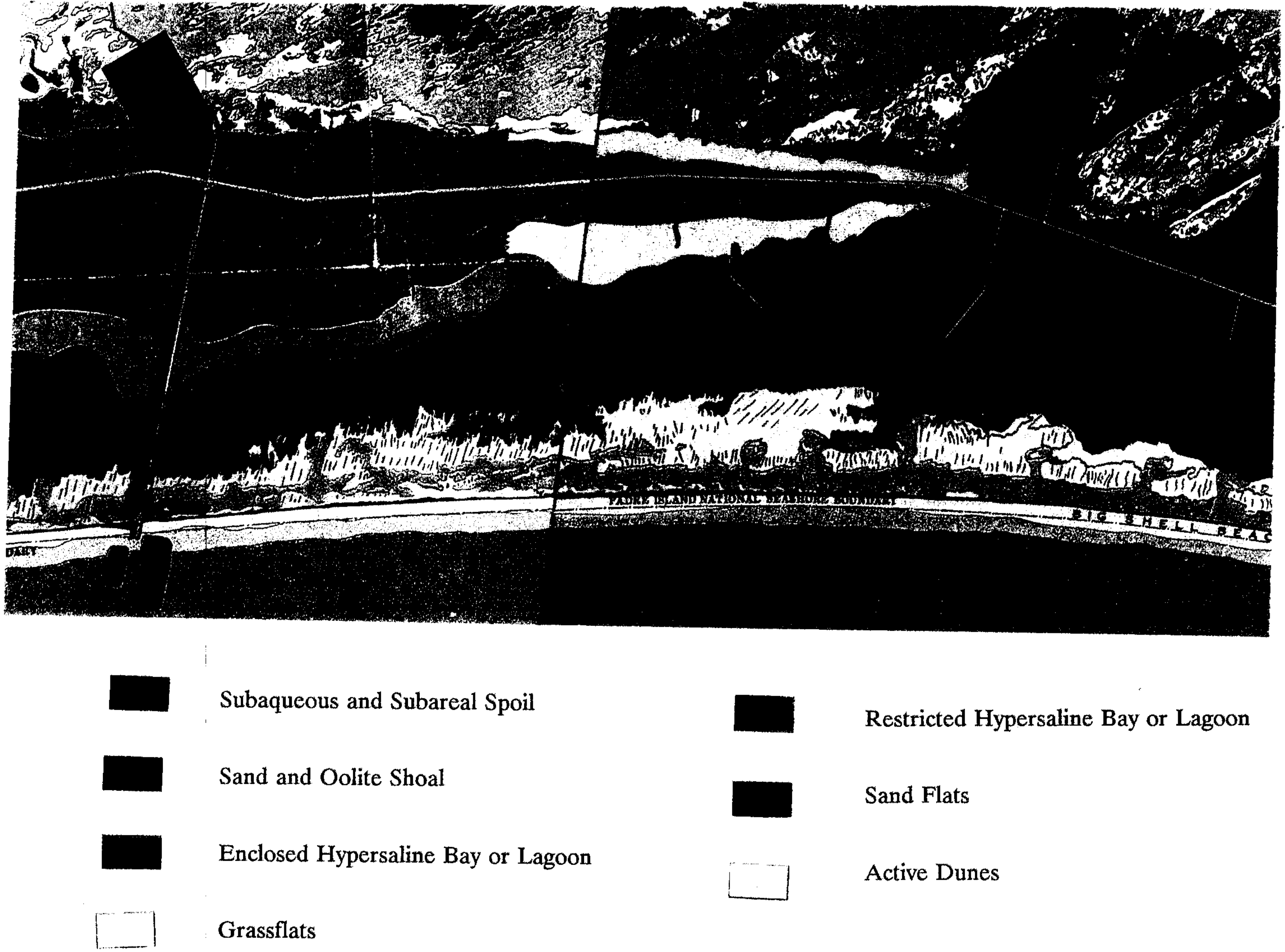

Figure 4.1. Port Mansfield to Land Cut (Brown *et al*. 1980 and Brown *et al*. 1976).

Table 4.1. Port Mansfield to Land Cut characteristic species (Brown et al.,1980 and Brown et al.,1976).

ENCLOSED BAY

- Mollusca
  - Bivalvia
    - *Abra aequalis*
- Polychaeta
    - *Armandia maculata*
    - *Cossura delta*
    - *Sigambra tentaculata*
    - *Mediomastus californiensis*

RESTRICTED BAY

- Mollusca
  - Bivalvia
    - *Tellina tampaensis*
    - *Anomalocardia auberiana*
- Polychaeta
    - *Scoloplos foliosus*
- Crustacea
    - *Hargeria rapax*

GRASSFLAT

- Mollusca
  - Bivalvia
    - *Laevicardium mortoni*
    - *Tagelus plebeius*
    - *Cumingia tellinoides*
  - Gastropoda
    - *Caecum pulchellum*
    - *Bittium varium*
  - Polychaeta
    - *Capitella capitata*
    - *Melinna maculata*
    - *Chone duneri*
    - *Prionospio heterobranchia*
    - *Syllis cornuta*
    - *Eteone heteropoda*
- Crustacea
    - *Ampelisca abdita*
    - *Hargeria rapax*
    - *Cymadusa compta*
    - *Oxyurostylis salinoi*

4.1.2 **Summary of Results**

The results of the Port Mansfield to Land Cut area are listed in Table 4.2. The assessments for each disposal option are presented in Appendix 7.3. Each assessment discusses the alternative in terms of engineering, societal, environmental, and economic considerations and constraints. Factors within each of these categories are quantitatively ranked and averaged.

The best options are the ones with a feasibility rating greater than +1. All alternatives with positive ratings are considered acceptable alternatives, but the highest one or a combination of the highest two are the optimum solutions. For example, Region 3

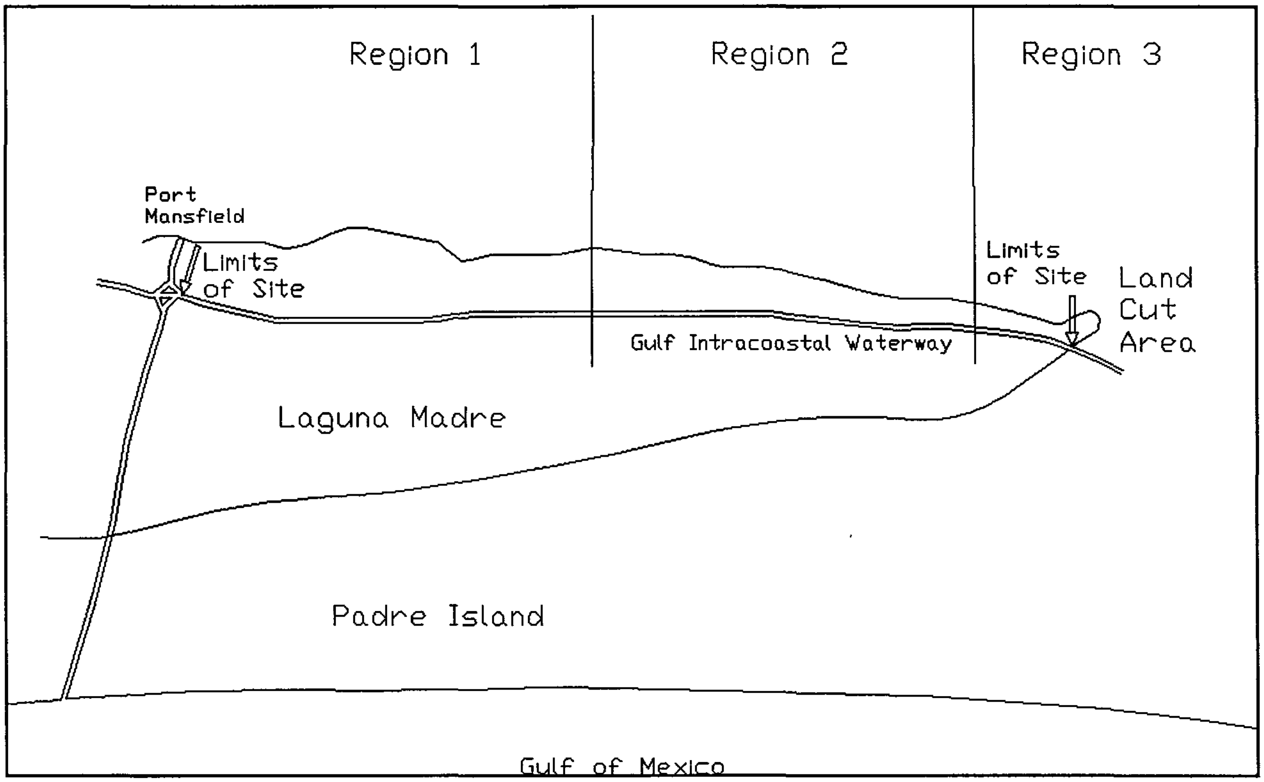

Figure 4.2. Port Mansfield to Land Cut Regions.

feasibility ratings indicate that maintaining rookery islands would be the best disposal option, but this alternative is only available for some of the dredging that the rookery islands do not need any more material. Therefore, the best recommendation for disposal methods are as follows: construct underwater levees next to the channel for Regions 1 and 2 and maintain rookery islands for Region 3 when requested by the Audubon Society and transport the material to the mainland during the other cycles.

Table 4.2. Summary of feasibility ratings for Port Mansfield to Land Cut.

Region 1

Feasibility Rating	Alternative
0.8	Underwater levees
0.3	Transport to mainland
-0.2	Create habitat islands in bay waters
-0.3	Thin layer disposal in bay
-1.0	Traditional unconfined bay disposal

Region 2

Feasibility Rating	Alternative
0.8	Underwater levees
0.7	Transport to mainland
-0.2	Create habitat islands in bay waters
-0.3	Thin layer disposal in bay
-1.0	Traditional unconfined bay disposal

Region 3

Feasibility Rating	Alternative
2.0	Maintain rookery islands
0.5	Transport to mainland
-0.2	Create habitat islands in bay waters
-0.3	Thin layer disposal in bay
-1.0	Traditional unconfined bay disposal

4.2 Redfish Bay

4.2.1 Site Description

Redfish Bay (Figure 4.3) consists of grassflats less than two meters deep. The current disposal sites are unleveed within these grassflats. This portion of the waterway is dredged approximately every seven to eight years.

Some of the characteristic species of the area are listed in Table 4.3. Grasses located in the bay include *Halodule beaudettei*, *Ruppia maritima*, *Thalassia testudinum*, *Halophila engelmanni*, and *Cymodocea filiformis*. Some mangrove marshes with *Avicennia germinans* predominant are found in the eastern portion of the bay. Oysters are scattered throughout the bay. The area is divided into two regions for determining the disposal option (Figure 4.4).

Table 4.3. Characteristic species in Redfish Bay (White et al. 1983),

- GRASSFLAT
  - Mollusca
    - Pelecypoda
      - *Lucina pectinata*
    - Gastropoda
      - *Bittium varium*
      - *Odostomia impressa*
  - Polychaeta
    - *Prionospio heterbranchia*
    - *Capitella capitata*
    - *Streblospio benedicti*
  - Crustacea
    - *Elasmopus levis*
    - *Cymodoce faxoni*
- INLET INFLUENCED
  - Mollusca
    - Pelecypoda
      - *Mulinia lateralis*
      - *Lyonsia hyalina floridana*
      - *Nuculana acuta*
      - *Tellina texana*
    - Gastropoda
      - *Turbonilla sp.*
      - *Acteocina canaliculata*
    - Scaphopoda
      - *Dentalium texasianum*
  - Polychaeta
    - *Clymenella torquata*
  - Spinunculida
    - *Phascolion strombi*

Intracoastal

Figure 4.3. Redfish Bay (White et al. 1983).

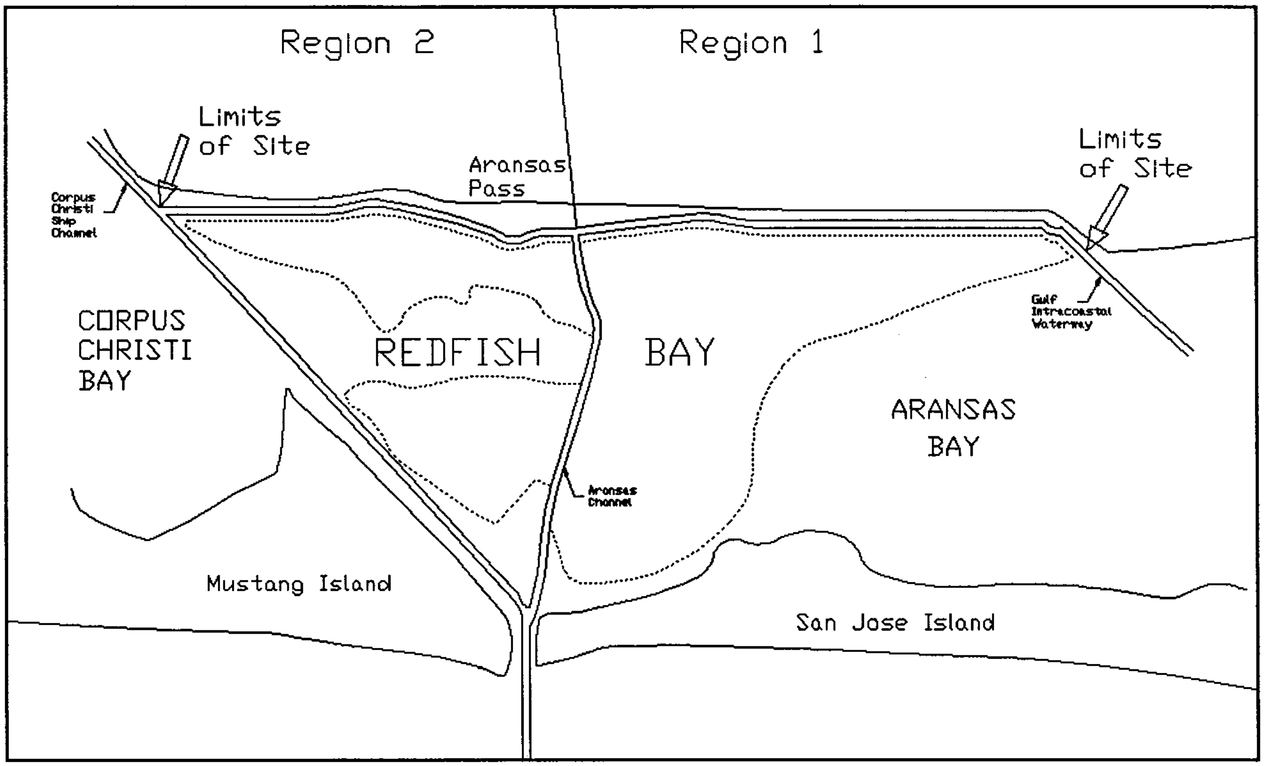

Figure 4.4. Redfish Bay Regions.

4.2.2 Summary of Results

The alternatives with their corresponding feasibility ratings for the Redfish Bay site are listed in Table 4.4. The assessments for each disposal option are listed in Appendix 7.4 which includes a discussion of engineering, societal, environmental, and economic considerations and constraints. Factors within each of these categories are quantitatively ranked and averaged.

The alternative selected should have a feasibility rating greater than +1. In the Redfish Bay area, alternatives exist with this high feasibility rating so they are the preferred disposal methods. The recommendations for Region 1 include a combination of diking upland storage areas across Live Oak Ridge and placing levees around former disposal areas in the bay. Diking upland storage areas over Live Oak Ridge provides the best solution for Region 2.

Table 4.4. Summary of feasibility ratings for Redfish Bay.

REGION 1

Feasibility Rating	Alternative
1.7	Dike upland storage areas (next to GIWW)
1.7	Levee former disposal areas in bay
1.0	Dike upland storage areas (over Live Oak Ridge)
0.8	Thin layer disposal in bay
0.2	Create habitat islands in Redfish Bay
-0.6	Traditional offshore disposal
-0.8	Levee new areas in grass flats
-1.0	Traditional unconfined discharge in grass flats

REGION 2

Feasibility Rating	Alternative
1.0	Dike upland storage areas (over Live Oak Ridge)
0.2	Thin layer disposal in bay
0.2	Create habitat islands in Redfish Bay
-0.6	Traditional offshore disposal
-0.8	Levee new areas in grass flats
-1.0	Traditional unconfined discharge in grass flats

4.3 Chocolate Bay

4.3.1 **Site description**

Chocolate Bay (Figure 4.5) is surrounded by marsh. The current disposal method is in the shallow waters of the bay. This unconfined discharge is being eliminated. The site is small enough that only one region is needed to characterize alternative dredging options (Figure 4.6).

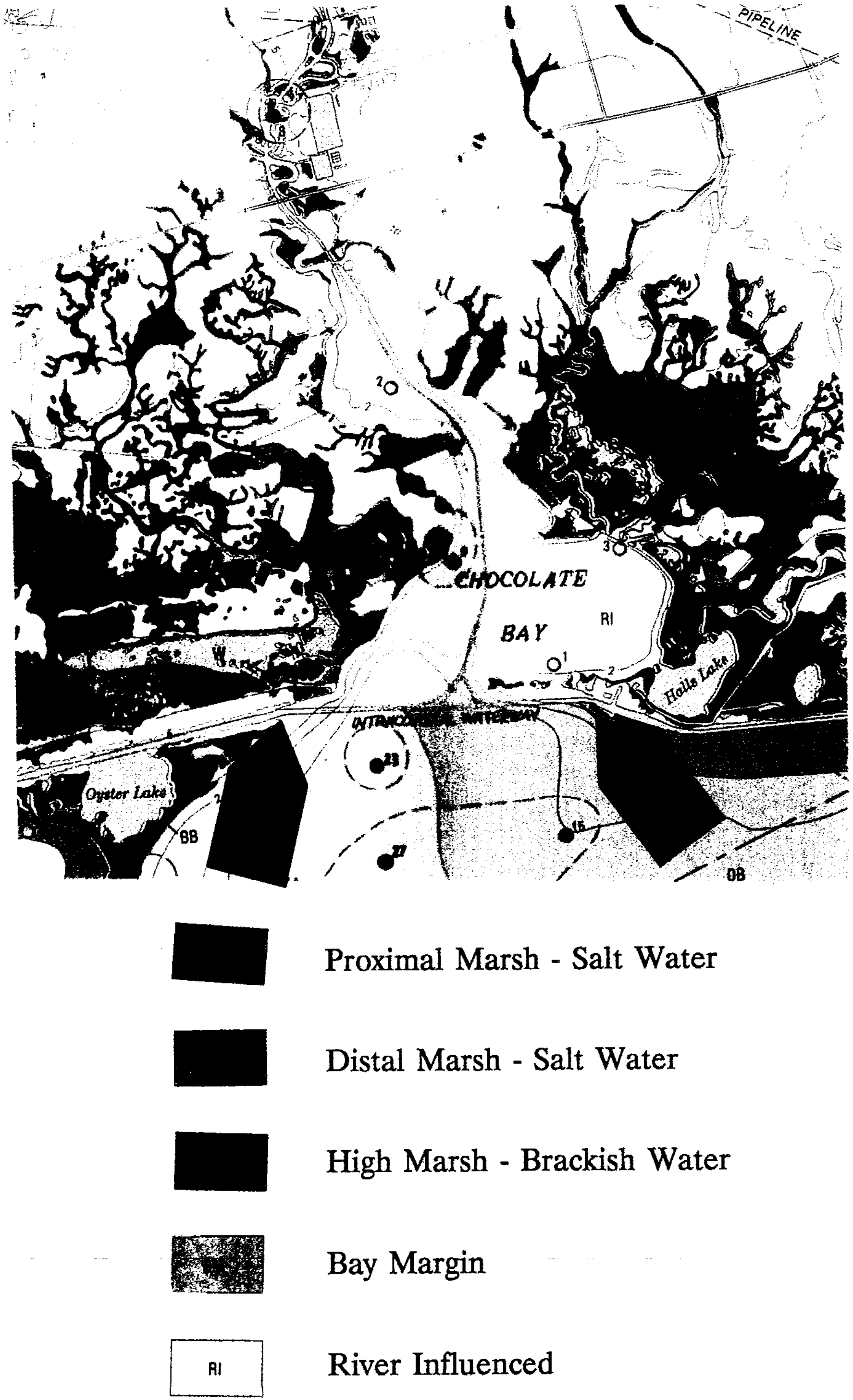

Figure 4.5. Chocolate Bay (White et al. 1985).

Intracoastal

The marshes on shore include *Spartina spartinae*, *Spartina patens*, *Borrichia frutescens*, *Distichlis spicata*, *Scirpus maritimus*, *Scirpus americanus*, *Scirpus californicus*, and *Juncus* spp. Selected macroinvertebrate species located in the bay are listed in Table 4.5.

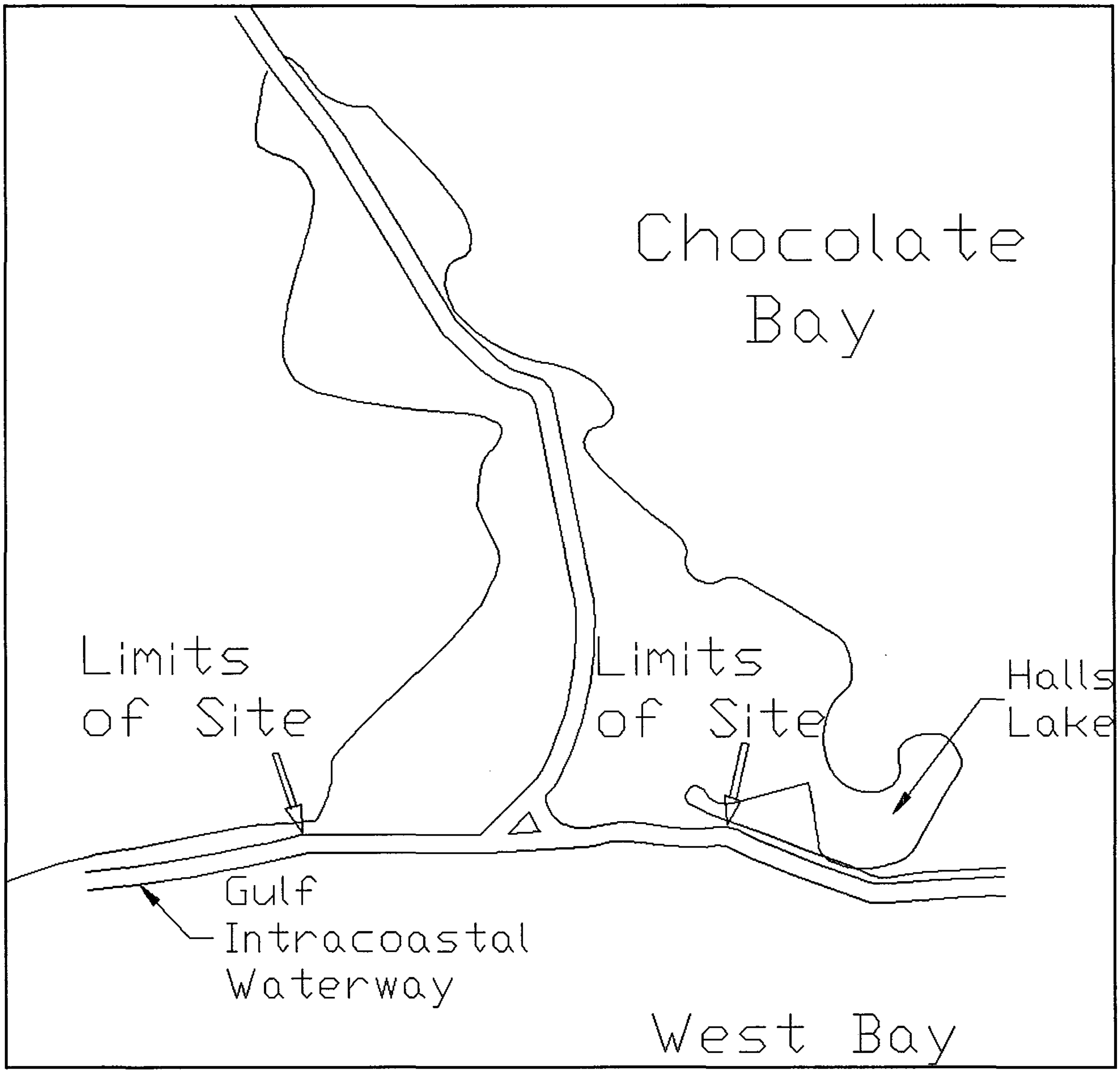

Figure 4.6. Chocolate Bay regions.

Table 4.5. Species located in Chocolate Bay.

RIVER INFLUENCED

- Mollusca
  - Gastropoda
    - *Texadina barretti*
  - Bivalvia
    - *Macoma mitchelli*
    - *Mulinia lateralis*
- Polychaeta
    - *Parandalia fauveli*
    - *Scoloplos fragilis*
    - *Paraprionospio pinnata*
    - *Glycinde solitaria*

4.3.2 **Summary of Results**

The Chocolate Bay alternatives with their feasibility ratings are listed in Table 4.6. The assessments for each disposal option are presented in Appendix 7.5. Each alternative has a qualitative and quantitative analysis in terms of engineering, societal, environmental, and economic considerations and constraints.

Protective islands received the highest feasibility rating of +1.2. This alternative has a positive rating greater than +1, indicating that it would be a good alternative to implement.

Table 4.6. Summary of feasibility ratings for Chocolate Bay.

Feasibility Rating	Alternative
1.2	Protective islands
0.1	Thin layer disposal in bay waters
-0.2	Upland disposal
-1.0	Unconfined discharge in bay

4.4 High Island

4.4.1 **Site Description**

The High Island site (Figure 4.7) has an extremely high shoaling rate and must be dredged every 18 months because of the high siltation. The greatest cause of siltation is bank erosion (Herbich 1975). The ships passing along the waterway generate waves in their wake; and since the sediment on shore is so fine, even small waves cause erosion.

The Corps of Engineers is not allowed to spend money to protect the banks, so the siltation problem will continue. Therefore, the need for disposal sites will continue. Since this is an environmentally sensitive area with the surrounding wetlands, a possible solution could be to control the siltation which creates the high dredging frequency.

The waterway goes through brackish-water and brackish-to-fresh-water marshes. The area has nutria, muskrat, rare mink, snakes, waterfowl, and various plant species (Table 4.7). The High Island area is divided into two regions (Figure 4.8).

Table 4.7. Plant species in the High Island area (Fisher et al., 1973).

BRACKISH - TO FRESH - WATER MARSH

	Common name
Spartina spartinae	coastal sacahuista
Spartina patens	marsh hay cordgrass
Spartina cynosuroides	big cordgrass
Spartina alterniflora	cordgrass
Scirpus spp.	bullrush
Typha latifolia	cattail
Juncus spp.	rushes

BRACKISH-WATER MARSH

	Common name
Spartina patens	marsh hay cordgrass
Spartina cynosuroides	big cordgrass
Distichlis spicata	saltgrass
Juncus spp.	rushes

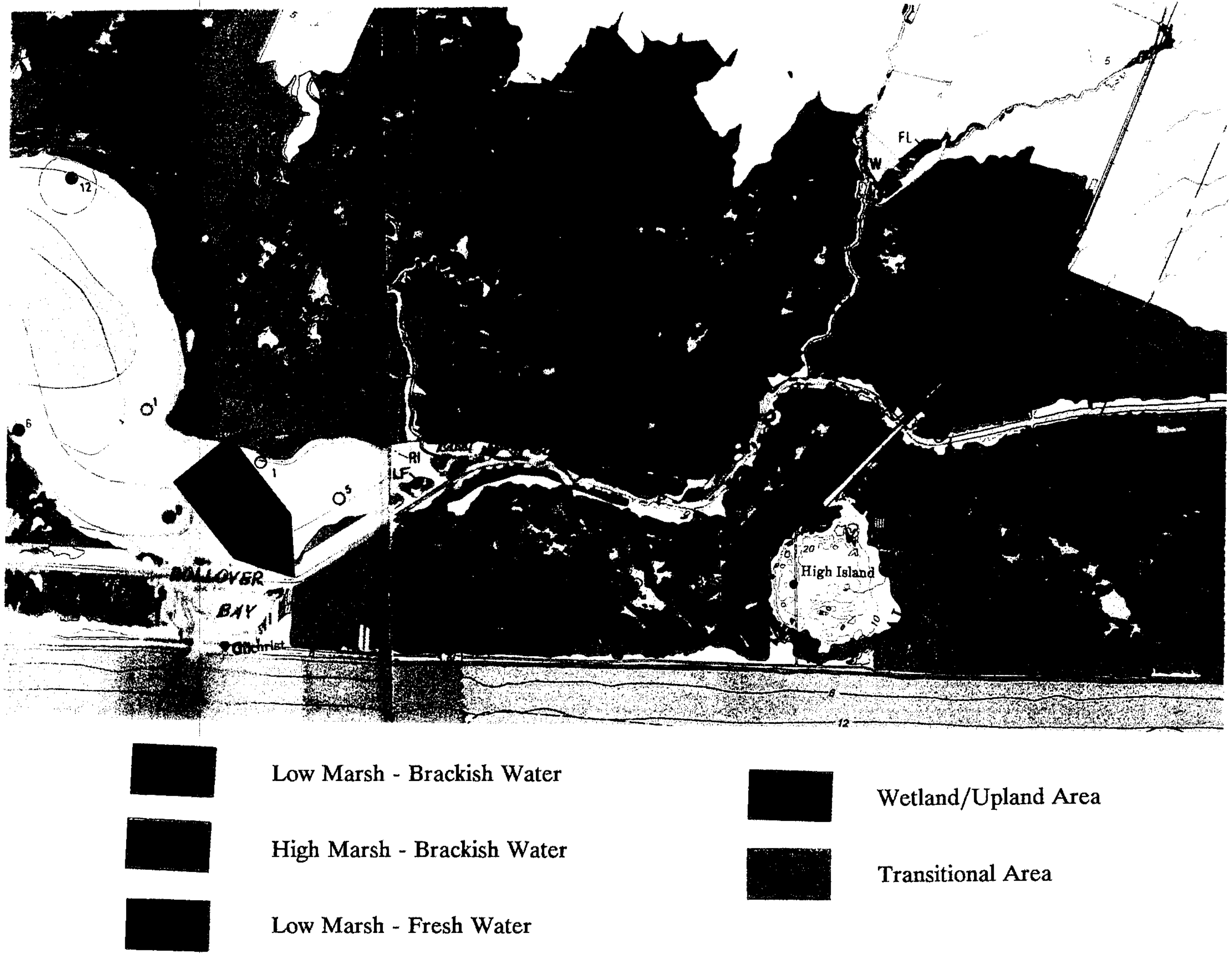

Figure 4.7. High Island (White et al. 1987 and White et al. 1985).

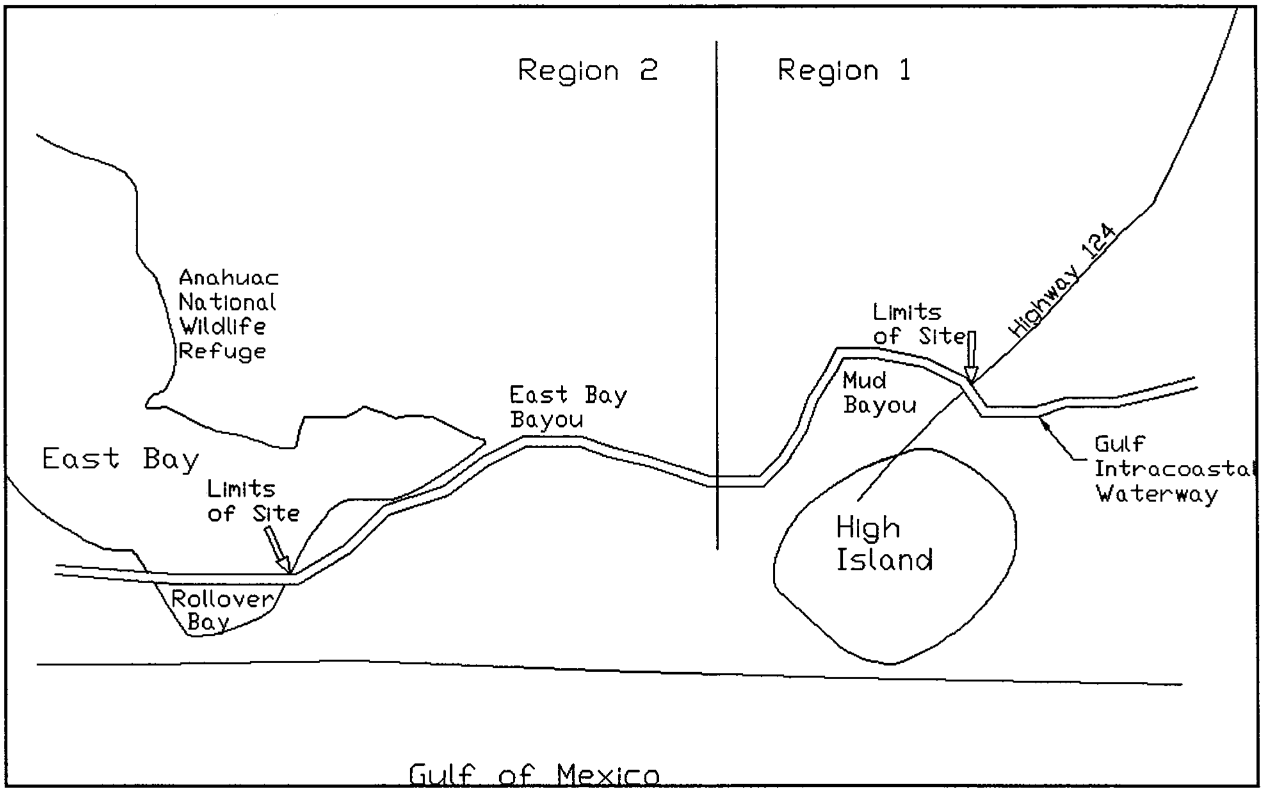

Figure 4.8. High Island Regions.

4.4.2 Summary of Results

The alternatives with their respective feasibility ratings for the High Island area are listed in Table 4.8. The assessments for each disposal option are presented in Appendix 7.6 which includes a discussion in terms of engineering, societal, environmental, and economic considerations and constraints. Factors within each of these categories are quantitatively ranked and averaged.

The results for the High Island area indicate that no solution is optimal. All of the feasibility ratings are negative and therefore considered inferior choices. Mitigation is recommended for a temporary solution until further research can improve the interim storage concept into a working alternative or until the state of Texas sponsors some erosion control, such as riprap along the channel in this area.

Table 4.8. Summary of feasibility ratings for High Island.

REGION 1

Feasibility Rating	Alternative
-0.1	Transport to inland disposal with salt water return
-0.1	Dewatering and consolidation
-0.1	Expand existing containment areas up
-0.1	Expand existing containment areas outward
-1.6	Beach nourishment
-1.8	Hopper dredge disposal
-1.9	Interim storage
-2.0	Traditional offshore disposal
-2.2	Agriculture
-2.3	Build new diked storage areas in wetlands
-2.8	Berms

REGION 2

Feasibility Rating	Alternative
-0.1	Dewatering and consolidation
-0.1	Expand existing containment areas up
-0.1	Expand existing containment areas outward
-1.0	Thin layer disposal in bay waters
-1.5	Create habitat islands in bay waters
-1.6	Beach nourishment
-1.8	Traditional unconfined discharge in bay waters
-1.8	Hopper dredge disposal
-1.9	Interim storage
-2.0	Wetland habitat development
-2.0	Traditional offshore disposal
-2.2	Agriculture
-2.3	Build new diked storage areas in wetlands
-2.8	Berms

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The GIWW has important economic, energy, and defense uses at the state and national level. Dredging is used to maintain a navigable channel. A problem exists of how best to dispose dredged material. Dredged material storage problems vary for different reaches of the GIWW. The study of separate reaches provides data to select the most desirable type of storage method that would produce the least damaging impact to the coastal natural resources and still be an economical method of disposal.

This study develops a new methodology to evaluate how best to dispose of this dredged material along specific areas of the GIWW. The methodology has three major parts: (1) completing a dredged material placement assessment for each alternative; (2) determining the feasibility of each alternative; and (3) comparatively evaluating the results.

Specific reaches of the GIWW used to test the methodology developed in this study include High Island, Redfish Bay, Chocolate Bay, and a 30 km area near Port Mansfield, Texas. The methodology can be adapted for general use to implement coastal zone management policy. The recommended solutions for the sites in this study are summarized in Table 5.1.

The methodology has several desirable components for determining optimum disposal options. It could be improved by expanding the assessment to include factors of direct impact on plants and animals as opposed to the indirect impacts such as effects on habitats. A specific example of this is the smothering of oysters during disposal operations.

The methodology is developed to be used by people with a wide range of backgrounds. The assessments are essentially subjective in nature, but the quantitative bias is reduced by having a large number of factors and an equal weighing of these factors in determining the final feasibility rating. It is designed to determine the optimum disposal option for a given reach, but the methodology can also be used among the various agencies to determine where communication gaps exist to facilitate the implementation of the disposal options. For example if the Parks and Wildlife Department and the State Department of Highways and Public Transportation determines very different feasibility ratings using this methodology they need to compare results and locate the differences in order to agree on an option.

5.1. Summary of recommended solutions.

Recommendations

Port Mansfield to Land Cut
    Underwater levees - region 1 and 2
    Maintain rookery islands and transport to mainland - region 3

Redfish Bay
    Dike upland storage areas next to GIWW and
    Levee former disposal areas - region 1
    Dike upland storage areas over Live Oak Ridge - region 2

Chocolate Bay
    Protective islands

High Island
    Mitigation - both regions

5.2 Suggestions for Further Research

It is recommended that further research be performed in the High Island area to find a viable solution that is environmentally sound. Interim storage is a good recommendation for a starting point in that research. It is also suggested that erosion control be considered as a means of reducing the dredging frequency and amount of material to be disposed in that area. Finally, additional work is needed to further validate and refine the assessment methodology.

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Intracoastal

7.0 APPENDIX

7.1 History of the Gulf Intracoastal Waterway in Texas

The construction of the GIWW in Texas took many years to authorize and complete. The first step in constructing the GIWW in Texas was the Rivers and Harbors Act of 1873 which authorized funds to survey in Texas "for connecting the inland waters along the margin of the Gulf of Mexico . . . to the Rio Grande river, in Texas, by cuts and canals." On January 10, 1901, Spindletop oil field south of Beaumont, Texas, blew in a spectacular gusher. This birth of Texas petroleum industry brought with it a new future for navigable waters along the Gulf Coast. A survey in 1905 and 1906 prompted legislators to approve 1.5 m deep by 12 m wide channel from Corpus Christi to Aransas Pass, from Aransas Pass to Pass Cavallo, and from the Brazos River to West Galveston Bay. All of these channels were dredged by 1909. The Brazos River to Matagorda Bay improvements were authorized in 1910. Wars had the greatest impact on the construction of the Gulf Intracoastal Waterway (GIWW) in Texas. During periods when the nation was engaged in military conflicts, the movement of personnel, troops, and defense materials increased greatly. These heavy transportation demands emphasized the need for protected inland transportation and called attention to existing inadequacies. Both world wars prompted legislation to improve the intracoastal waterway. Authorization for the extension of the intracoastal canal to Louisiana and Texas followed World War I and authorization to enlarge and complete the intracoastal waterway from Apalachee Bay, Florida to Brownsville, Texas followed the outbreak of World War II. During World War II, German submarines in waters skirting the eastern and Gulf shores of the United States demonstrated the vulnerability of coastwise traffic as they sank more than two dozen merchant ships in the Gulf of Mexico. Towboats, tugs, and barges moved tremendous quantities of strategic commodities essential to wartime production along the protected inland waterways (Alperin 1983). After World Water I, Congress appropriated funds for a 3 m by 30 m intracoastal waterway to extend to Galveston, which was completed in 1934. During World War II, the Second Supplemental National Defense Appropriation Act of 1942 authorized a continuous waterway with minimum dimensions of 3 m by 38 m, extending from Carrabelle, Florida, to Corpus Christi, Texas, by 1945 (Alperin 1977). The main channel of the Texas Gulf Intracoastal Waterway had been 75 years in the making by its completion in 1949. Subsequent improvements have involved various modifications and enlargements, relocations of channels, and the addition of many branch channels.

Without the Gulf Intracoastal Canal Association, the GIWW may have never been built. The Association began in 1905 when a group of businessmen in Victoria, Texas, organized the Interstate Inland Waterway League pledged to the goal of a continuous system that would tie together the 28,800 km (18,000 miles) of navigable waters extending from the Great Lakes, through the Mississippi Valley, and along the Louisiana and Texas coastlines (Alperin 1983). The league later changed its name to the "Intracoastal Canal Association of Louisiana and Texas" and finally, as it is known today, to the "Gulf Intracoastal Canal Association." This association has always remained exclusively identified with the waterway. The organization has served as the leading proponent of the GIWW by performing such acts as camping on the doorstep of the nation's Capitol and prodding sluggish county governments to donate necessary rights-of-way and to rebuild bridges (Alperin 1983). The Association's greatest triumphs are the Rivers and Harbors Act in 1942, which authorized a continuous Louisiana-Texas waterway from New Orleans to Galveston, and legislation in 1942 authorizing an enlarged channel extending from Florida west to the vicinity of the Mexican border.

The GIWW has tremendous economic impact on the state of Texas. It carried almost 73 million tons of commodities valued at over $21 billion in 1986. Approximately 110,000 jobs in Texas were either directly or indirectly related to the shipment of goods through the Port of Houston alone (Garrett and Burke 1989). The inland waterways support many activities other than those directly linked to manufacturing, oil production, and commerce. It provides access to sport and commercial fishing and recreational activities year round. The Texas coast recreational activities include sport fishing, pleasure boating, swimming, camping, picnicking, and sightseeing. The expenditures of these recreationists have a significant impact on the economy of the coastal region as well as the rest of the state and amount to over $586 million annually (Garrett and Burke 1989).

The direct economic contributions to the state of Texas attributable to the GIWW include port revenues, payrolls and revenues of the water transportation industries, and direct expenditures made to improve and maintain the waterway. The indirect economic contributions include mining, petroleum refining, and chemical industries, sport fishing, commercial fishing, and recreational activity. These indirect contributions totalled over $675 million in 1986 (Garrett and Burke 1989). The continued economic importance of the GIWW is dependent on its ability to function smoothly. The state cannot afford to allow any section of the waterway to become inoperable.

7.2 Definition of factors used in determining the feasibility rating

Engineering considerations and constraints:

1. physical requirements for disposal facilities - does the area in concern contain the ideal location as far as soil, land features, etc., required for the proposed alternative;
2. distance from dredging - is the disposal area located within a reasonable and engineering attainable distance from the dredge site;
3. treatment of dredged material - will the spoil material require any treatment for the proposed use, such as dewatering;
4. life expectancy - does the alternative provide a long-term solution to the disposal problem (say 50 years);
5. long-term maintenance - will the proposed use require any long-term maintenance;
6. monitoring of the facility - will the spoil area need monitoring other than that already provided by the U. S. Army Corps of Engineers;
7. site size and configuration - is the size and configuration of the area suitable for the material being disposed and the method of disposal;
8. construction feasibility - will it be feasible to construct the site;
9. disposal facility design and operating characteristics - is the site designed so that it will be accessible if needed or shaped the way it is required for a particular use; and
10. technical coordination of disposal plan with productive use plan or subsequent disposal--the disposal operation should not interfere with the planned use or with any subsequent disposal operations.

Societal considerations and constraints:

1. social acceptability of the facility - will the public accept the disposal alternative;
2. conformance with regulatory requirements - does the alternative meet all requirements of the federal, state, and local governments;
3. social costs/benefits (nonmonetary) - recreation, aesthetics of the area, etc.; and
4. safety - will the alternative cause harm to anyone.

Environmental considerations and constraints:

1. destruction/creation of productive habitats;
2. effects on water quality;
3. environmental impacts of proposed use - how will the alternative affect the area around it, such as will it create drainage problems or will it change circulation patterns in a bay;
4. persistence of impacts; and
5. alteration of existing character - will the existing area be irrevocably changed and will it be for the benefit or at the cost of the public?

Economic considerations and constraints:

1. economic costs/benefits of the project - will the project help/harm fishing industry, farming, or any other industry affected by the disposal operation;
2. capital costs;
3. engineering and construction costs;
4. dredged material transport costs; and
5. operating and maintenance costs.

7.3 Port Mansfield to Land Cut Raw Data

Alternative: Create habitat islands in bay waters.

Engineering considerations and constraints: The dredged material would be placed in a diked area to form an island which would be utilized by wildlife--primarily colonial nesting waterbirds. In reality, the island will consist of high upland areas for habitat surrounded by wetlands. After the island is created, a minimal amount of maintenance will be required to replace the material which will erode. The island must be permanently emergent at high water levels with a slope no greater than 3:100. A layer of shells can be placed over the island if the material is not coarse enough. If maintenance dredged material is to be used in the future to replace material, then the dredging must not occur during nesting season.

Societal considerations and constraints: The island would be utilized by some rare/endangered species, such as white faced ibis, American osprey, and western snowy plover. This is trading fishery habitat for bird habitat.

Environmental considerations and constraints: The island must be placed far enough from shore to prevent predators from reaching the island. The island must have long-term maintenance to keep it productive. The alternative trades fish habitat for bird habitat. Future maintenance dredging operations can use the same island to control vegetation growth, provide nutrients for the vegetation, and to control erosion.

Economic considerations and constraints: The transport distance is minimal, so the transport costs will be low. The layer of shells that will probably be needed will be expensive.

Alternative: Create habitat islands in bay waters.

Region 1	Region 2	Region 3	
			Engineering Considerations and Constraints
1	1	1	1. physical requirements for disposal facilities
2	2	2	2. distance from dredging
1	1	1	3. treatment of dredged material
1	1	1	4. life expectancy
0	0	0	5. long-term maintenance
0	0	0	6. monitoring of the facility
2	2	2	7. site size and configuration
1	1	1	8. construction feasibility
1	1	1	9. disposal facility design and operating characteristics
0	0	0	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
			Societal considerations and constraints
0	0	0	1. social acceptability of the disposal option
0	0	0	2. conformance with regulatory requirements
0	0	0	3. social costs/benefits (nonmonetary)
0	0	0	4. safety
			Environmental considerations and constraints
-1	-1	-1	1. destruction/creation of productive habitats
0	0	0	2. effects on water quality
-1	-1	-1	3. environmental impacts of proposed use
-1	-1	-1	4. persistence of impacts
-1	-1	-1	5. alteration of existing character
			Economic considerations and constraints
1.5	1.5	1.5	potential cost coefficient
			Summary:
2.3	2.3	2.3	Engineering Rating
0.	0.	0.	Societal Rating
-2.0	-2.0	-2.0	Environmental Rating
-1.0	-1.0	-1.0	Economic Rating

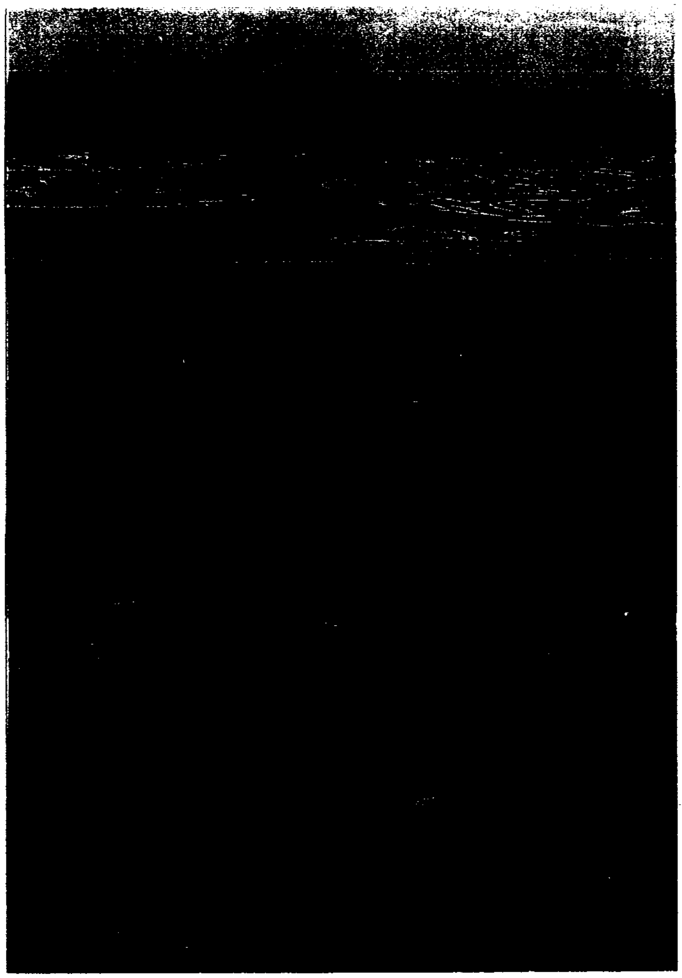
Alternative: Maintain rookery islands.

Engineering considerations and constraints: In Region 1 this is feasible because the rookery islands are next to the waterway and transport distance is minimal. Since no islands exist in Regions 2 and 3, this is not an alternative for these regions.

Societal considerations and constraints: The Audubon Society requests that material be placed on these islands during some dredging cycles so the islands will continue to support waterfowl life.

Environmental considerations and constraints: By placing the material on these islands, vegetation can be controlled. The dredged material also acts as a nutrient source for the vegetation on the islands.

Economic considerations and constraints: This is an economical alternative for Region 1, since the rookery islands are next to the waterway and easily accessible.



Alternative: Maintain rookery islands.

Region 1

Engineering Considerations and Constraints

2	1. physical requirements for disposal facilities
2	2. distance from dredging
1	3. treatment of dredged material
0	4. life expectancy
0	5. long-term maintenance
0	6. monitoring of the facility
1	7. site size and configuration
2	8. construction feasibility
1	9. disposal facility design and operating characteristics
0	10. technical coordination of disposal plan withproductive use plan or with subsequent disposal

Societal considerations and constraints

1	1. social acceptability of the disposal option
2	2. conformance with regulatory requirements
1	3. social costs/benefits (nonmonetary)
1	4. safety

Environmental considerations and constraints

1	1. destruction/creation of productive habitats
1	2. effects on water quality
1	3. environmental impacts of proposed use
1	4. persistence of impacts
1	5. alteration of existing character

Economic considerations and constraints

1	potential cost coefficient

Summary:

2.3	Engineering Rating
3.1	Societal Rating
2.5	Environmental Rating
0.	Economic Rating

Alternative: Thin layer disposal in bay waters.

Engineering considerations and constraints: Dredged material must be dispersed over a wide area. Conventional cutterhead equipment could be modified for this alternative. The discharge pipe should be capable of moving in a large arc (about 300 degrees) and the swivel joint should be relocated often (about once every hour) to ensure dispersal of the material.

Societal considerations and constraints: Since the material is silty and will create high turbidity during the dredging cycle, the public will not favor this disposal option.

Environmental considerations and constraints: The disposal is a nutrient source to seagrasses in region 2. The Corps of Engineers has been disposing in that area for more than 40 years and the seagrasses are thriving. Emergent islands may eventually form since the bay does not flush the material out to sea. In region 1, this alternative would cause the shallow area to become emergent so it would be detrimental to the environment. In region 3, the disposal would not harm nor help anything.

Economic considerations and constraints: This is an economical alternative since transport distances are minimal.

Alternative: Thin layer disposal in bay.

Region 1	Region 2	Region 3	
			Engineering Considerations and Constraints
1	1	1	1. physical requirements for disposal facilities
2	2	2	2. distance from dredging
0	0	0	3. treatment of dredged material
0	0	0	4. life expectancy
1	1	1	5. long-term maintenance
0	0	0	6. monitoring of the facility
1	1	1	7. site size and configuration
1	1	1	8. construction feasibility
0	0	0	9. disposal facility design and operating characteristics
2	2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
			Societal considerations and constraints
-1	-1	-1	1. social acceptability of the disposal option
0	0	0	2. conformance with regulatory requirements
-1	-1	-1	3. social costs/benefits (nonmonetary)
0	0	0	4. safety
			Environmental considerations and constraints
-1	-1	-1	1. destruction/creation of productive habitats
0	0	0	2. effects on water quality
-1	-1	-1	3. environmental impacts of proposed use
0	0	0	4. persistence of impacts
0	0	0	5. alteration of existing character
			Economic considerations and constraints
1.2	1.2	1.2	potential cost coefficient
			Summary:
2.0	2.0	2.0	Engineering Rating
-1.3	-1.3	-1.3	Societal Rating
-1.0	-1.0	-1.0	Environmental Rating
-1.0	-1.0	-1.0	Economic Rating

Alternative: Traditional unconfined bay disposal.

Engineering considerations and constraints: The material would be placed next to the waterway by hydraulic dredge.

Societal considerations and constraints: Unconfined disposal is not accepted by the public in this area.

Environmental considerations and constraints: This method arbitrarily covers bay bottom. In region 1, emergent islands would form and productive bay bottom would be lost.

Economic considerations and constraints: This is a cheap alternative.

Alternative: Traditional unconfined bay disposal.

Region 1	Region 2	Region 3	
			Engineering Considerations and Constraints
2	2	2	1. physical requirements for disposal facilities
2	2	2	2. distance from dredging
2	2	2	3. treatment of dredged material
0	0	0	4. life expectancy
2	2	2	5. long-term maintenance
0	0	0	6. monitoring of the facility
1	1	1	7. site size and configuration
2	2	2	8. construction feasibility
1	1	1	9. disposal facility design and operating characteristics
1	1	1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
			Societal considerations and constraints
-2	-2	-2	1. social acceptability of the disposal option
-1	-1	-1	2. conformance with regulatory requirements
-2	-2	-2	3. social costs/benefits (nonmonetary)
0	0	0	4. safety
			Environmental considerations and constraints
-2	-2	-2	1. destruction/creation of productive habitats
-1	-1	-1	2. effects on water quality
-2	-2	-2	3. environmental impacts of proposed use
-1	-1	-1	4. persistence of impacts
-2	-2	-2	5. alteration of existing character
			Economic considerations and constraints
1.0	1.0	1.0	potential cost coefficient
			Summary:
3.3	3.3	3.3	Engineering Rating
-3.1	-3.1	-3.1	Societal Rating
-4.0	-4.0	-4.0	Environmental Rating
0.	0.	0.	Economic Rating

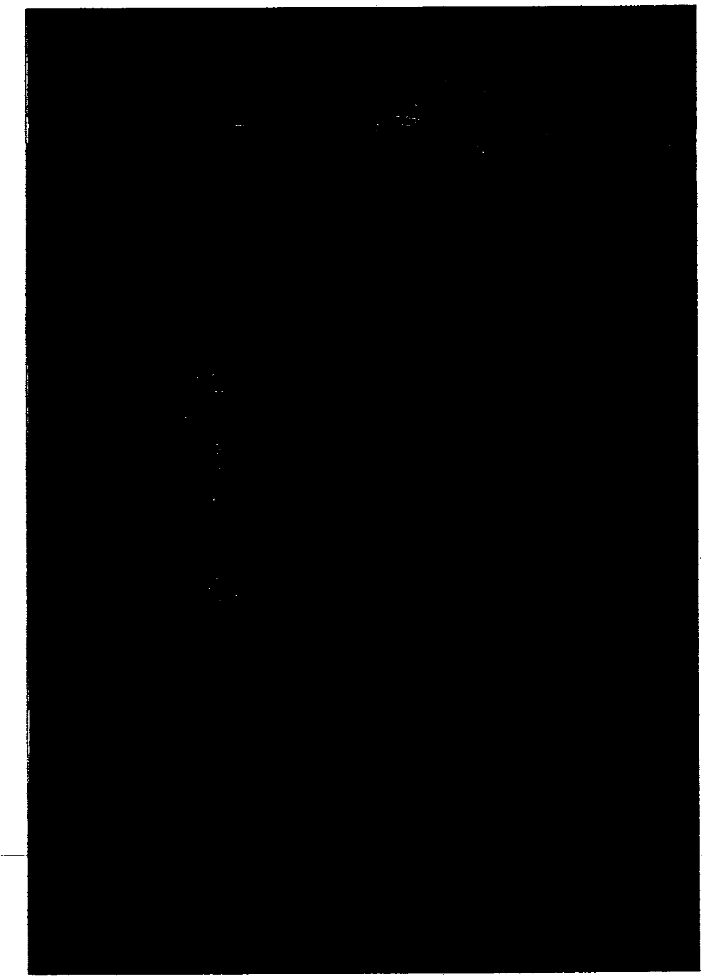
Alternative: Transport to mainland.

Engineering considerations and constraints: This is a feasible alternative for all three regions. Diked containment areas would be located in upland areas.

Societal considerations and constraints: Diked upland containment areas are acceptable disposal options to the public. No potential beneficial use exists.

Environmental considerations and constraints: This option would eliminate any destruction of bay bottom. The containment area has no potential beneficial use.

Economic considerations and constraints: The transport distance is different for each of the three regions. Region 1 has the shortest transport distance and, therefore, will be the cheapest.



Alternative: Transport to mainland

Region 1	Region 2	Region 3	
			Engineering Considerations and Constraints
-1	-1	1	1. physical requirements for disposal facilities
-1	-1	1	2. distance from dredging
2	2	2	3. treatment of dredged material
1	1	1	4. life expectancy
2	2	2	5. long-term maintenance
1	1	1	6. monitoring of the facility
1	1	1	7. site size and configuration
2	2	2	8. construction feasibility
0	0	0	9. disposal facility design and operating characteristics
1	1	1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
			Societal considerations and constraints
0	0	0	1. social acceptability of the disposal option
1	1	1	2. conformance with regulatory requirements
0	0	0	3. social costs/benefits (nonmonetary)
1	1	1	4. safety
			Environmental considerations and constraints
0	0	0	1. destruction/creation of productive habitats
0	0	0	2. effects on water quality
0	0	0	3. environmental impacts of proposed use
0	0	0	4. persistence of impacts
0	0	0	5. alteration of existing character
			Economic considerations and constraints
2.5	2.0	1.5	potential cost coefficient
			Summary:
2.0	2.0	3.0	Engineering Rating
1.3	1.3	1.3	Societal Rating
0.	0.	0.	Environmental Rating
-1.0	-1.0	-1.0	Economic Rating

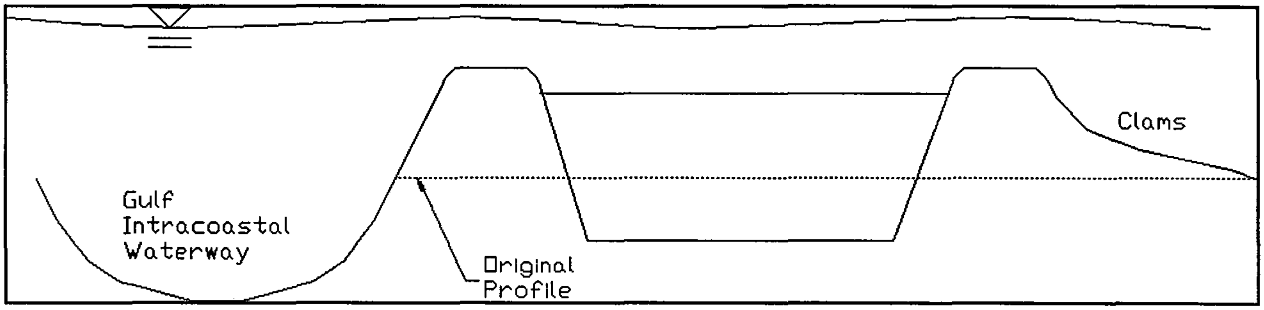
Alternative: Underwater levees.

Engineering considerations and constraints: These underwater levees would be formed using material from within the proposed disposal site, thereby creating additional disposal area (see figure below). The levees would be constructed to end 0.5 to 0.75 meters below the water surface. These underwater levees have been used in Long Island. This is only feasible in regions 2 and 3 because region 1 is too shallow to construct the levees.

Societal considerations and constraints: This would eliminate unconfined discharge which has been opposed by the public.

Environmental considerations and constraints: The disposal area would remain underwater and productive. Seagrasses will grow on the top of the levees and on the spoil material.

Economic considerations and constraints: This is an inexpensive alternative since the sites are located next to the waterway which minimizes transport distance.



Alternative: Underwater levees.

Region 2	Region 3	
		Engineering Considerations and Constraints
2	2	1. physical requirements for disposal facilities
2	2	2. distance from dredging
2	2	3. treatment of dredged material
1	1	4. life expectancy
1	1	5. long-term maintenance
0	0	6. monitoring of the facility
2	2	7. site size and configuration
0	0	8. construction feasibility
1	1	9. disposal facility design and operating characteristics
2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	0	1. social acceptability of the disposal option
1	1	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
1	1	4. safety
		Environmental considerations and constraints
-1	-1	1. destruction/creation of productive habitats
0	0	2. effects on water quality
0	0	3. environmental impacts of proposed use
0	0	4. persistence of impacts
0	0	5. alteration of existing character
		Economic considerations and constraints
1.3	1.3	potential cost coefficient
		Summary:
3.3	3.3	Engineering Rating
1.3	1.3	Societal Rating
-0.5	-0.5	Environmental Rating
-1.0	-1.0	Economic Rating

SUMMARY OF INITIAL ASSESSMENT
Port Mansfield to Land Cut Region 1

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Create habitat islands in bay waters	2.3	0.	-2.05	-1.0	-0.2
Thin layer disposal in bay	2.0	-1.3	-1.0	-1.0	-0.3
Traditional unconfined bay disposal	3.3	-3.1	-4.0	0.	-1.0
Transport to mainland	2.0	1.3	0.	-1.0	0.6
Underwater levees	3.3	1.3	-0.5	-1.0	0.8

SUMMARY OF INITIAL ASSESSMENT
Port Mansfield to Land Cut Region 2

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Create habitat islands in bay waters	2.3	0.	-2.05	-1.0	-0.2
Thin layer disposal in bay	2.0	-1.3	-1.0	-1.0	-0.3
Traditional unconfined bay disposal	3.3	-3.1	-4.0	0.	-1.0
Transport to mainland	2.0	1.3	0.	-1.0	0.6
Underwater levees	3.3	1.3	-0.5	-1.0	0.8

SUMMARY OF INITIAL ASSESSMENT
Port Mansfield to Land Cut Region 3

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Create habitat islands in bay waters	2.3	0.	-2.05	-1.0	-0.2
Maintain rookery islands	2.3	3.1	2.5	0.	2.0
Thin layer disposal in bay	2.0	-1.3	-1.0	-1.0	-0.3
Traditional unconfined bay disposal	3.3	-3.1	-4.0	0.	-1.0
Transport to mainland	2.0	1.3	0.	-1.0	0.8

7.4 Redfish Bay Raw Data

Alternative: Create habitat islands in Redfish Bay.

Engineering considerations and constraints: The dredged material would be placed in a diked area to form an island which would be utilized by wildlife--primarily colonial nesting waterbirds. In reality, the island will consist of high upland areas for habitat surrounded by wetlands. After the island is created, a minimal amount of maintenance will be required to replace the material which will erode. The island must be permanently emergent at high water levels with a slope no greater than 3:100. A layer of shells can be placed over the island if the material is not coarse enough. If maintenance dredged material is to be used in the future to replace material, then the dredging must not occur during nesting season.

Societal considerations and constraints: The island would be utilized by some rare/endangered species such as white faced ibis, American osprey, and western snowy plover. This is trading fishery habitat for bird habitat.

Environmental considerations and constraints: The island must be placed far enough from shore to prevent predators from reaching the island. The island must have long-term maintenance to keep it productive. The alternative trades fish habitat for bird habitat. Future maintenance dredging operations can use the same island to control vegetation growth, provide nutrients for the vegetation, and to control erosion.

Economic considerations and constraints: The transport distance is minimal so the transport costs will be low. The layer of shells that will probably be needed will be expensive.

Alternative: Create habitat islands in bay waters.

Region 1	Region 2	
		Engineering Considerations and Constraints
0	0	1. physical requirements for disposal facilities
0	0	2. distance from dredging
1	1	3. treatment of dredged material
1	1	4. life expectancy
1	1	5. long-term maintenance
0	0	6. monitoring of the facility
2	2	7. site size and configuration
1	1	8. construction feasibility
1	1	9. disposal facility design and operating characteristics
1	1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
1	1	1. social acceptability of the disposal option
1	1	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
1	1	4. safety
		Environmental considerations and constraints
-1	-1	1. destruction/creation of productive habitats
0	0	2. effects on water quality
-1	-1	3. environmental impacts of proposed use
-1	-1	4. persistence of impacts
-1	-1	5. alteration of existing character
		Economic considerations and constraints
2	2	potential cost coefficient
		Summary:
2.0	2.0	Engineering Rating
1.9	1.9	Societal Rating
-2.0	-2.0	Environmental Rating
-1.0	-1.0	Economic Rating

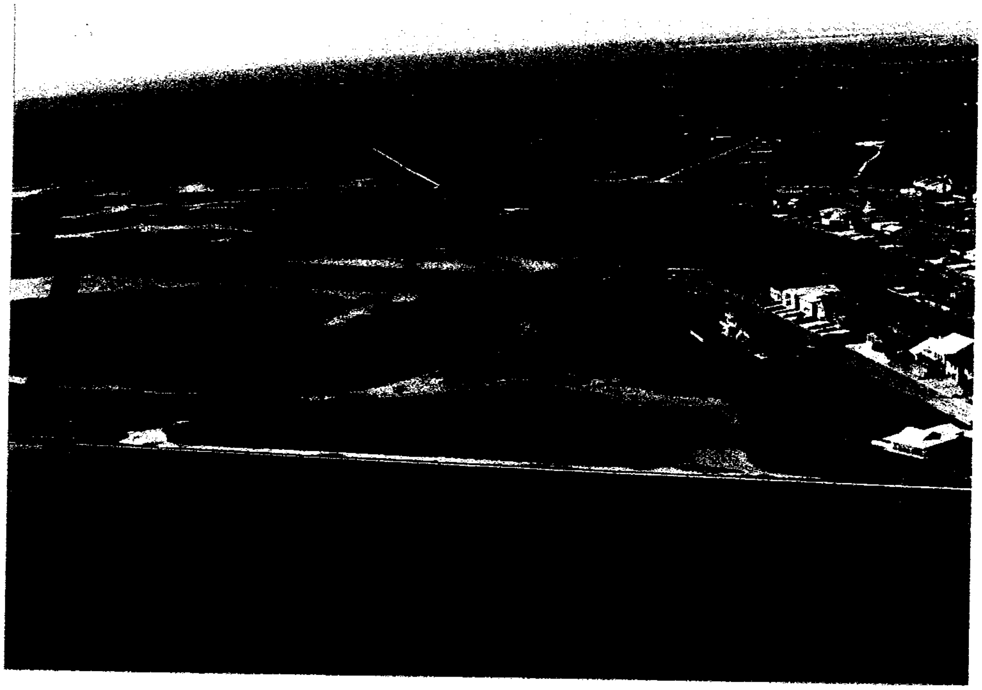
Alternative: Dike upland storage areas (next to GIWW).

Engineering considerations and constraints: The sites considered are: (1) the area next to City by the Sea and (2) the area next to Palm Harbor. These sites are located adjacent to the waterway so the transport distance for the material is minimal. A typical upland dredged material containment area will be constructed. It will have a long life due to the long time period between dredging cycles and the size of the areas.

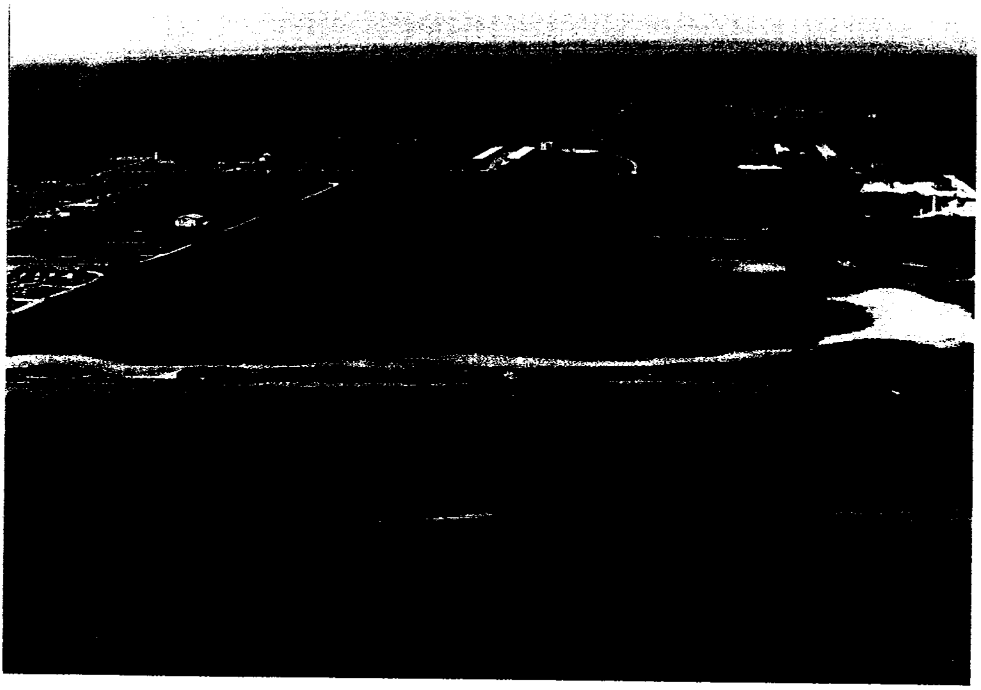
Societal considerations and constraints: Using these sites will protect the grass flats from further destruction. Upland storage is a recognized traditional method.

Environmental considerations and constraints: No harmful impacts, yet no beneficial uses.

Economic considerations and constraints: The sites are next to the GIWW in region 1, so the transport distance is minimal. No feasible areas exist near region 2. This land is prime real estate so it will be very expensive to purchase the land.



City by the Sea



Palm Harbor

Alternative: Dike upland storage areas (next to GIWW).

Region 1

Engineering Considerations and Constraints

2	1.	physical requirements for disposal facilities
2	2.	distance from dredging
2	3.	treatment of dredged material
2	4.	life expectancy
2	5.	long-term maintenance
2	6.	monitoring of the facility
2	7.	site size and configuration
2	8.	construction feasibility
2	9.	disposal facility design and operating characteristics
2	10.	technical coordination of disposal plan with productive use plan or with subsequent disposal

Societal considerations and constraints

1	1.	social acceptability of the disposal option
1	2.	conformance with regulatory requirements
0	3.	social costs/benefits (nonmonetary)
1	4.	safety

Environmental considerations and constraints

0	1.	destruction/creation of productive habitats
0	2.	effects on water quality
0	3.	environmental impacts of proposed use
0	4.	persistence of impacts
0	5.	alteration of existing character

Economic considerations and constraints

10	potential cost coefficient

Summary:

5.0	Engineering Rating
1.9	Societal Rating
0.0	Environmental Rating
-5.0	Economic Rating

Alternative: Dike upland storage areas (over Live Oak Ridge).

Engineering considerations and constraints: The transport distance is large, but attainable. For region 2, the salt water would have to be returned to the Redfish Bay in a separate pipeline (which could be placed next to the slurry pipe). In region 1, the salt water could drain naturally to the back bay by gravity. The life of the area would depend solely on the amount of land purchased. Dikes would be used to contain the material.

Societal considerations and constraints: Using these sites will protect the grass flats from further destruction. Upland storage is a recognized traditional method.

Environmental considerations and constraints: No harmful impacts on the local water quality if the brine is returned to the bay, yet no beneficial uses.

Economic considerations and constraints: The transport distance is long so the cost will be high. The cost of the land in region 1 will be low, while the cost for region 2 will be slightly higher. The cost of the return pipe will increase costs even more.

Alternative: Dike upland storage areas (over Live Oak Ridge).

Region 1	Region 2	
		Engineering Considerations and Constraints
1	1	1. physical requirements for disposal facilities
-1	-1	2. distance from dredging
2	2	3. treatment of dredged material
2	2	4. life expectancy
2	2	5. long-term maintenance
2	2	6. monitoring of the facility
2	2	7. site size and configuration
2	2	8. construction feasibility
2	2	9. disposal facility design and operating characteristics
2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
1	1	1. social acceptability of the disposal option
1	1	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
1	1	4. safety
		Environmental considerations and constraints
0	0	1. destruction/creation of productive habitats
0	0	2. effects on water quality
0	0	3. environmental impacts of proposed use
0	0	4. persistence of impacts
0	0	5. alteration of existing character
		Economic considerations and constraints
2	4	potential cost coefficient
		Summary:
4.0	4.0	Engineering Rating
1.9	1.9	Societal Rating
0.0	0.0	Environmental Rating
-1.0	-2.0	Economic Rating

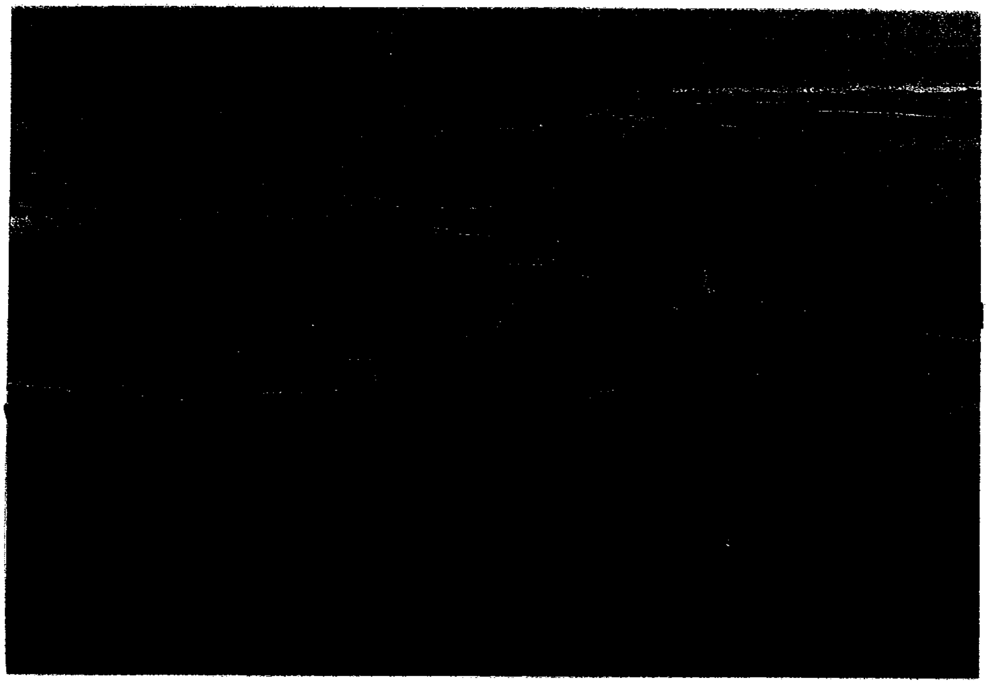
Alternative: Levee former disposal areas in bay.

Engineering considerations and constraints: The site is next to the channel and easily accessible from region 1. The site considered is the area at the point closest to Aransas Bay. This is a very large area and will have a long life since maintenance dredging is only once every 6 to 10 years. Levees will be placed around the edges of the emergent land mass.

Societal considerations and constraints: Since the area has been used in the past, no opposition should arise to using the areas since the levees will prevent further spread of the material and destruction of the grass flats.

Environmental considerations and constraints: Levying the area will prevent further spread of the material and destruction of the grass flats. The area has been used before so no new areas will be affected.

Economic considerations and constraints: The area is next to the GIWW so the transport distance is minimal for region 1. It should cost no more to continue using the site than current costs.



Alternative: Levee former disposal areas in bay.

Region 1

Engineering Considerations and Constraints

2	1. physical requirements for disposal facilities
2	2. distance from dredging
2	3. treatment of dredged material
2	4. life expectancy
2	5. long-term maintenance
2	6. monitoring of the facility
2	7. site size and configuration
2	8. construction feasibility
2	9. disposal facility design and operating characteristics
2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal

Societal considerations and constraints

1	1. social acceptability of the disposal option
1	2. conformance with regulatory requirements
0	3. social costs/benefits (nonmonetary)
1	4. safety

Environmental considerations and constraints

0	1. destruction/creation of productive habitats
0	2. effects on water quality
0	3. environmental impacts of proposed use
0	4. persistence of impacts
0	5. alteration of existing character

Economic considerations and constraints

1	potential cost coefficient

Summary:

5.0	Engineering Rating
1.9	Societal Rating
0.0	Environmental Rating
0.0	Economic Rating

Alternative: Levee new areas in grass flats.

Engineering considerations and constraints: Very easy to do and close to the waterway. The life of this alternative may be short due to increasing regulations to protect open waters.

Societal considerations and constraints: This will not be accepted by the public because of the destruction of the grass flats.

Environmental considerations and constraints: This will kill important habitats.

Economic considerations and constraints: It is an economical alternative.

Alternative: Levee new areas in grass flats.

Region 1	Region 2	
		Engineering Considerations and Constraints
2	2	1. physical requirements for disposal facilities
2	2	2. distance from dredging
2	2	3. treatment of dredged material
2	2	4. life expectancy
2	2	5. long-term maintenance
2	2	6. monitoring of the facility
2	2	7. site size and configuration
2	2	8. construction feasibility
2	2	9. disposal facility design and operating characteristics
2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-2	-2	1. social acceptability of the disposal option
-2	-2	2. conformance with regulatory requirements
-2	-2	3. social costs/benefits (nonmonetary)
0	0	4. safety
		Environmental considerations and constraints
-2	-2	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-2	-2	3. environmental impacts of proposed use
-2	-2	4. persistence of impacts
-2	-2	5. alteration of existing character
		Economic considerations and constraints
1	1	potential cost coefficient
		Summary:
5.0	5.0	Engineering Rating
-3.8	-3.8	Societal Rating
-4.5	-4.5	Environmental Rating
0.0	0.0	Economic Rating

Alternative: Traditional offshore disposal.

Engineering considerations and constraints: Placing the material in the ocean will be difficult since the pipes must pass through the surf (an extremely difficult task). The life expectancy would be short because ocean dumping is becoming increasingly regulated.

Societal considerations and constraints: The Ocean Dumping Act protects the oceans so ocean dumping is becoming increasingly regulated by government agencies and is not accepted by the public. The material will create high turbidity on shore.

Environmental considerations and constraints: This will cause an increase of suspended solids in the area of disposal. Before dumping, it must be determined that no susceptible creatures (i.e. oysters) are in the disposal area. The silty material will create high turbidity for a long period of time.

Economic considerations and constraints: Very expensive to pump the material through the surf.

Alternative: Traditional offshore disposal.

Region 1	Region 2	
		Engineering Considerations and Constraints
1	1	1. physical requirements for disposal facilities
-1	-1	2. distance from dredging
2	2	3. treatment of dredged material
0	0	4. life expectancy
2	2	5. long-term maintenance
2	2	6. monitoring of the facility
2	2	7. site size and configuration
-2	-2	8. construction feasibility
0	0	9. disposal facility design and operating characteristics
2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	0	1. social acceptability of the disposal option
0	0	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
2	2	4. safety
		Environmental considerations and constraints
-1	-1	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-1	-1	3. environmental impacts of proposed use
1	1	4. persistence of impacts
1	1	5. alteration of existing character
		Economic considerations and constraints
10	10	potential cost coefficient
		Summary:
2.0	2.0	Engineering Rating
1.3	1.3	Societal Rating
-0.5	-0.5	Environmental Rating
-5.0	-5.0	Economic Rating

Alternative: Traditional unconfined discharge in grassflats.

Engineering considerations and constraints: Place the material in the grassflats using a hydraulic pipeline. Since the open waters are being increasingly protected, this option may not be available in a few years.

Societal considerations and constraints: This will be met with objection from the public and resource agencies because of the destruction of more grass flats.

Environmental considerations and constraints: This will destroy the grass flats and will create high turbidity during the disposal operations which may harm the productive habitat.

Economic considerations and constraints: This is an economical alternative.

Alternative: Traditional unconfined discharge in grass flats.

Region 1	Region 2	
		Engineering Considerations and Constraints
2	2	1. physical requirements for disposal facilities
2	2	2. distance from dredging
2	2	3. treatment of dredged material
2	2	4. life expectancy
2	2	5. long-term maintenance
2	2	6. monitoring of the facility
2	2	7. site size and configuration
2	2	8. construction feasibility
2	2	9. disposal facility design and operating characteristics
2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-2	-2	1. social acceptability of the disposal option
-2	-2	2. conformance with regulatory requirements
-2	-2	3. social costs/benefits (nonmonetary)
0	0	4. safety
		Environmental considerations and constraints
-2	-2	1. destruction/creation of productive habitats
-2	-2	2. effects on water quality
-2	-2	3. environmental impacts of proposed use
-2	-2	4. persistence of impacts
-2	-2	5. alteration of existing character
		Economic considerations and constraints
1	1	potential cost coefficient
		Summary:
5.0	5.0	Engineering Rating
-3.8	-3.8	Societal Rating
-5.0	-5.0	Environmental Rating
0.0	0.0	Economic Rating

SUMMARY OF INITIAL ASSESSMENT
Redfish Bay Region 1

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Create habitat islands in bay waters	2.0	1.9	-2.0	-1.0	0.2
Dike upland storage areas (next to GIWW)	5.0	1.9	0.	-5.0	0.5
Dike upland storage areas (over Live Oak Ridge)	4.0	1.9	0.	-1.0	1.2
Levee former disposal areas in bay	5.0	1.9	0.	0.	1.7
Levee new areas in grass flats	5.0	-3.8	-4.5	0.	-0.8
Thin layer disposal in bay	3.8	1.3	-1.0	-1.0	0.8
Traditional offshore disposal	2.0	1.3	-0.5	-5.0	-0.6
Traditional unconfined discharge in grass flats	5.0	-3.8	-5.0	0.	-1.0

SUMMARY OF INITIAL ASSESSMENT
Redfish Bay Region 2

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Create habitat islands in bay waters	2.0	1.9	-2.0	-1.0	0.2
Dike upland storage areas (over Live Oak Ridge)	4.0	1.0	0.	-2.0	1.0
Levee new areas in grass flats	5.0	-3.8	-4.5	0.	-0.8
Thin layer disposal in bay	3.3	1.3	-1.0	-3.0	0.2
Traditional offshore disposal	2.0	1.3	-0.5	-5.0	-0.6
Traditional unconfined discharge in grass flats	5.0	-3.8	-5.0	0.	-1.0

7.5 Chocolate Bay Raw Data

Alternative: Protective Islands.

Engineering considerations and constraints: Form a leveed disposal area next to the GIWW. It is leveed so the material will not settle back into the channel, and the material will not disperse to undesired areas. This will reduce the shoaling rates in this reach of the GIWW since material in the West Bay ends up in the channel and the eroded material from the mainland ends up in the channel.

Societal considerations and constraints: These islands will protect the mainland from erosion by dissipating the wave energy before it reaches shore. This will be beneficial to the people using the shore for recreation and business.

Environmental considerations and constraints: These islands would not be destroying any new bottom area because emergent islands have been present in the past. Thus the operation would only be putting back what was previously existing. This alternative will help prevent erosion.

Economic considerations and constraints: This is a very cheap alternative because transport distance is minimal.

Alternative: Protective Islands.

	Engineering Considerations and Constraints
2	1. physical requirements for disposal facilities
2	2. distance from dredging
2	3. treatment of dredged material
2	4. life expectancy
1	5. long-term maintenance
1	6. monitoring of the facility
1	7. site size and configuration
2	8. construction feasibility
2	9. disposal facility design and operating characteristics
0	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
	Societal considerations and constraints
1	1. social acceptability of the disposal option
1	2. conformance with regulatory requirements
1	3. social costs/benefits (nonmonetary)
1	4. safety
	Environmental considerations and constraints
-1	1. destruction/creation of productive habitats
0	2. effects on water quality
0	3. environmental impacts of proposed use
1	4. persistence of impacts
-1	5. alteration of existing character
	Economic considerations and constraints
1.2	potential cost coefficient
	Summary:
3.8	Engineering Rating
2.5	Societal Rating
-0.5	Environmental Rating
-1.0	Economic Rating

Alternative: Thin layer disposal in bay waters.

Engineering considerations and constraints: Chocolate Bay is too shallow for this alternative. West Bay could be utilized. Conventional cutterhead equipment could be modified for this alternative. The discharge pipe should be capable of moving in a large arc (about 300 degrees) and the swivel joint should be relocated often (about once every hour) to ensure dispersal of the material.

Societal considerations and constraints: Recreational traffic would not be interrupted.

Environmental considerations and constraints: San Luis Pass will allow for flushing of the material. This is already a turbid area, so an increase would not be noticed.

Economic considerations and constraints: This is an economical alternative.

Alternative: Thin layer disposal in bay waters.

	Engineering Considerations and Constraints
1	1. physical requirements for disposal facilities
2	2. distance from dredging
0	3. treatment of dredged material
2	4. life expectancy
2	5. long-term maintenance
0	6. monitoring of the facility
0	7. site size and configuration
1	8. construction feasibility
0	9. disposal facility design and operating characteristics
2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
	Societal considerations and constraints
-1	1. social acceptability of the disposal option
0	2. conformance with regulatory requirements
0	3. social costs/benefits (nonmonetary)
1	4. safety
	Environmental considerations and constraints
-1	1. destruction/creation of productive habitats
0	2. effects on water quality
-1	3. environmental impacts of proposed use
0	4. persistence of impacts
0	5. alteration of existing character
	Economic considerations and constraints
1.2	potential cost coefficient

Summary:

2.5	Engineering Rating
0.	Societal Rating
-1.0	Environmental Rating
-1.0	Economic Rating

Alternative: Unconfined discharge in bay.

Engineering considerations and constraints: The material would be discharged at random as the area is dredged. The material would disperse over a wide area.

Societal considerations and constraints: Unconfined discharge is not acceptable by many people.

Environmental considerations and constraints: This alternative would not allow for a buildup of material that would be beneficial, but instead the material will disperse and create undesigned and undesirable emergent islands.

Economic considerations and constraints: This is an economical alternative.

Alternative: Unconfined discharge in bay.

Engineering Considerations and Constraints

2 1. physical requirements for disposal facilities
2 2. distance from dredging
2 3. treatment of dredged material
-1 4. life expectancy
2 5. long-term maintenance
0 6. monitoring of the facility
2 7. site size and configuration
2 8. construction feasibility
2 9. disposal facility design and operating characteristics
2 10. technical coordination of disposal plan with productive use plan or with subsequent disposal

Societal considerations and constraints

-2 1. social acceptability of the disposal option
-1 2. conformance with regulatory requirements
-2 3. social costs/benefits (nonmonetary)
-1 4. safety

Environmental considerations and constraints

-2 1. destruction/creation of productive habitats
-1 2. effects on water quality
-1 3. environmental impacts of proposed use
-2 4. persistence of impacts
-2 5. alteration of existing character

Economic considerations and constraints

1 potential cost coefficient

Summary:

3.8 Engineering Rating

-3.8 Societal Rating

-4.0 Environmental Rating

0. Economic Rating

Alternative: Upland disposal.

Engineering considerations and constraints: Transport distance is long, but attainable. Diked disposal areas would be built in the areas surrounding the bay beyond the wetlands.

Societal considerations and constraints: Contained upland disposal is an accepted disposal option.

Environmental considerations and constraints: Some wetlands would be destroyed to place the material upland.

Economic considerations and constraints: This would be a costly alternative because of the long transport distance and the problems that arise when placing pipes through the wetlands to the disposal site.

Alternative: Upland disposal.

	Engineering Considerations and Constraints
-1	1. physical requirements for disposal facilities
-1	2. distance from dredging
2	3. treatment of dredged material
1	4. life expectancy
1	5. long-term maintenance
1	6. monitoring of the facility
0	7. site size and configuration
-1	8. construction feasibility
0	9. disposal facility design and operating characteristics
2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
	Societal considerations and constraints
0	1. social acceptability of the disposal option
1	2. conformance with regulatory requirements
0	3. social costs/benefits (nonmonetary)
0	4. safety
	Environmental considerations and constraints
-1	1. destruction/creation of productive habitats
0	2. effects on water quality
0	3. environmental impacts of proposed use
0	4. persistence of impacts
0	5. alteration of existing character
	Economic considerations and constraints
4	potential cost coefficient

Summary:

1.0	Engineering Rating
1.9	Societal Rating
-0.5	Environmental Rating
-3.0	Economic Rating

SUMMARY OF INITIAL ASSESSMENT
Chocolate Bay

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Protective Islands	3.8	2.5	-0.5	-1.0	1.2
Thin layer disposal in bay waters	2.5	0.	-1.0	-1.0	0.1
Unconfined discharge in bay	3.8	-3.8	-4.0	0.	-1.0
Upland disposal	1.0	1.9	-0.5	-3.0	-0.2

7.6 High Island Raw Data

Alternative: Agriculture.

Engineering considerations and constraints: The dredged material could be treated for salinity (e.g. add lime) and then placed over fields. The material would be hauled by truck to the field. This alternative cannot be done by hydraulic pipeline dredges which are used in Texas.

Societal considerations and constraints: The material can only be placed on range land due to high salinity.

Environmental considerations and constraints: The material is full of nutrients, but also has high salinity.

Economic considerations and constraints: Transport distance and means will make this an expensive alternative.

Intracoastal

Alternative: Agriculture.

Region 1	Region 2	
		Engineering Considerations and Constraints
-1	-1	1. physical requirements for disposal facilities
-2	-2	2. distance from dredging
-2	-2	3. treatment of dredged material
-1	-1	4. life expectancy
1	1	5. long-term maintenance
1	1	6. monitoring of the facility
-1	-1	7. site size and configuration
-1	-1	8. construction feasibility
0	0	9. disposal facility design and operating characteristics
-1	-1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-1	-1	1. social acceptability of the disposal option
1	1	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
1	1	4. safety
		Environmental considerations and constraints
-1	-1	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-1	-1	3. environmental impacts of proposed use
-1	-1	4. persistence of impacts
-1	-1	5. alteration of existing character
		Economic considerations and constraints
10	10	potential cost coefficient
		Summary:
-1.8	-1.8	Engineering Rating
0.6	0.6	Societal Rating
-2.5	-2.5	Environmental Rating
-5.0	-5.0	Economic Rating

Alternative: Beach Nourishment.

Engineering considerations and constraints: Dredged material is not compatible with existing beach material; however, it can be placed from shore outward to create a whole new area for recreational purposes. The quality of the material is low; so it will take many years to settle and consolidate. The site can be used for many years with natural vegetation invading between dredge cycles. When the area is the desired size, lightweight recreation facilities (baseball diamonds, volleyball courts, picnic tables, etc.) can be built. Stabilization of the area is necessary to provide safety for users of the facility. Dredged material can even be silt, clay, and fines (as at Aquatic Park in Toronto, Canada). It will be difficult to cross Highway 87 since the material must pass under the highway through a culvert or over the highway under a temporary bridge.

Societal considerations and constraints: Due to the silty material, the area will not naturally be safe due to lack of a good foundation (will have to stabilize). Disposal area will not really be accepted since the quality of the material is poor.

Environmental considerations and constraints: The benefits of creating the new land must outweigh the cost of destroying ocean bottom. Pipes will have to be placed through some wetland areas, and this will be opposed by the public and resource agencies. Concern will exist over whether the material might be polluted or leaching may occur.

Economic considerations and constraints: This will increase shoreline length, providing for more shoreline utilization. Crossing Highway 87 will increase costs slightly. If a permanent line is placed to the area, then the costs will decrease for each maintenance cycle. However, it will cost a lot to make the soil stable so the area will be safe.

Alternative: Beach nourishment.

Region 1	Region 2	
		Engineering Considerations and Constraints
-1	-1	1. physical requirements for disposal facilities
-1	-1	2. distance from dredging
1	1	3. treatment of dredged material
2	2	4. life expectancy
-1	-1	5. long-term maintenance
-1	-1	6. monitoring of the facility
1	1	7. site size and configuration
-1	-1	8. construction feasibility
-1	-1	9. disposal facility design and operating characteristics
-1	-1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-1	-1	1. social acceptability of the disposal option
0	0	2. conformance with regulatory requirements
-1	-1	3. social costs/benefits (nonmonetary)
-1	-1	4. safety
		Environmental considerations and constraints
0	0	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-1	-1	3. environmental impacts of proposed use
0	0	4. persistence of impacts
1	1	5. alteration of existing character
		Economic considerations and constraints
5	5	potential cost coefficient
		Summary:
-0.8	-0.8	Engineering Rating
-1.9	-1.9	Societal Rating
-0.5	-0.5	Environmental Rating
-3.0	-3.0	Economic Rating

Alternative: Berms.

Engineering considerations and constraints: A berm is a man-made submerged feature offshore which dissipates wave energy. A berm becomes a permanent bottom feature which enhances marine life and supplies material to nourish the beach. The berm is placed parallel to shore with dimensions 3-4.5 meters high, up to 1600 meters long, and up to 600 meters wide (Langan 1987). It will be hard to create a berm with the silty material dredged at this location. The site can be used indefinitely since the material is moved in the littoral process, which makes room for more material to be placed at this location in the future. It is extremely difficult to place material that must pass through the surf; therefore, the engineering rating will be low.

Societal considerations and constraints: When the berm is created, then it will not only nourish the beach, but it will also dissipate the energy from the waves that would normally be used to erode the beaches. The silty material used to create the berm will result in a cloud of suspended solids. This undesirable turbidity in the water near the beaches will not be acceptable to the public.

Environmental considerations and constraints: Nourishing this beach has already been recommended by the National Marine Fisheries Service in 1983. However, due to the nature of this material, the berm will not become a permanent bottom feature which nourishes the beach, but will instead become a cloud of suspended solids.

Economic considerations and constraints: Pumping material through the surf is cost prohibitive.

Alternative: Berms.

Region 1	Region 2	
		Engineering Considerations and Constraints
-2	-2	1. physical requirements for disposal facilities
-2	-2	2. distance from dredging
2	2	3. treatment of dredged material
0	0	4. life expectancy
-2	-2	5. long-term maintenance
-1	-1	6. monitoring of the facility
-2	-2	7. site size and configuration
-2	-2	8. construction feasibility
-1	-1	9. disposal facility design and operating characteristics
-1	-1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-2	-2	1. social acceptability of the disposal option
1	1	2. conformance with regulatory requirements
-1	-1	3. social costs/benefits (nonmonetary)
0	0	4. safety
		Environmental considerations and constraints
-1	-1	1. destruction/creation of productive habitats
-2	-2	2. effects on water quality
0	0	3. environmental impacts of proposed use
0	0	4. persistence of impacts
-1	-1	5. alteration of existing character
		Economic considerations and constraints
10	10	potential cost coefficient
		Summary:
-2.8	-2.8	Engineering Rating
-1.3	-1.3	Societal Rating
-2.0	-2.0	Environmental Rating
-5.0	-5.0	Economic Rating

Alternative: Build new diked storage areas in wetlands.

Engineering considerations and constraints: Diked areas could be built in the wetland areas next to the waterway for use as dredged material containment areas. The material used to construct the dikes must be hauled to the area because the existing wetland material would not have enough stability.

Societal considerations and constraints: This is not a socially acceptable alternative due to the loss of wetlands.

Environmental considerations and constraints: Ecological losses would be tremendous since the wetlands would be lost forever.

Economic considerations and constraints: It is expensive to build the dikes since the material must be hauled to the area.

Alternative: Build new diked storage areas in wetlands.

Region 1	Region 2	
		Engineering Considerations and Constraints
2	2	1. physical requirements for disposal facilities
2	2	2. distance from dredging
2	2	3. treatment of dredged material
2	2	4. life expectancy
2	2	5. long-term maintenance
-2	-2	6. monitoring of the facility
2	2	7. site size and configuration
-1	-1	8. construction feasibility
1	1	9. disposal facility design and operating characteristics
-2	-2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-2	-2	1. social acceptability of the disposal option
-2	-2	2. conformance with regulatory requirements
-2	-2	3. social costs/benefits (nonmonetary)
0	0	4. safety
		Environmental considerations and constraints
-2	-2	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-2	-2	3. environmental impacts of proposed use
-2	-2	4. persistence of impacts
-2	-2	5. alteration of existing character
		Economic considerations and constraints
5	5	potential cost coefficient
		Summary:
2.0	2.0	Engineering Rating
-3.8	-3.8	Societal Rating
-4.5	-4.5	Environmental Rating
-3.0	-3.0	Economic Rating

Alternative: Create habitat islands in bay waters.

Engineering considerations and constraints: Dredged material would be placed in a diked area to form an island in Rollover Bay or East Bay which would be utilized by wildlife--primarily colonial nesting waterbirds. In reality, the island will consist of high spots for habitat surrounded by wetlands. After the island is created, a minimal amount of maintenance will be required to replace the material which will be eroded by wind and tides. The island must be permanently emergent at high water levels with a slope no greater than 3:100. A layer of shells can be placed over the island for the material to be coarse enough. If maintenance dredged material is to be used in the future to replace material removed by erosion, then the dredging must not occur during nesting season. This is not a feasible alternative for region 1 due to distance limitations.

Societal considerations and constraints: The island would be utilized by some rare/endangered species such as white faced ibis, American osprey, and western snowy plover. It is always approved by society to protect rare/endangered species. Resource agencies think Texas has enough habitat islands, so they will oppose the idea.

Environmental considerations and constraints: The island must be placed far enough from shore to prevent predators from reaching the island. The island must have long-term maintenance to keep it productive. Destroying fish habitat to create bird habitat is a trade-off for this alternative.

Economic considerations and constraints: For region 2 this is a cost-effective alternative. The layer of shells will be expensive to place.

Alternative: Create habitat islands in bay waters.

Region 2

Engineering Considerations and Constraints

-1	1.	physical requirements for disposal facilities
-1	2.	distance from dredging
0	3.	treatment of dredged material
1	4.	life expectancy
-1	5.	long-term maintenance
-1	6.	monitoring of the facility
1	7.	site size and configuration
1	8.	construction feasibility
1	9.	disposal facility design and operating characteristics
-1	10.	technical coordination of disposal plan with productive use plan or with subsequent disposal

Societal considerations and constraints

-1	1.	social acceptability of the disposal option
0	2.	conformance with regulatory requirements
0	3.	social costs/benefits (nonmonetary)
1	4.	safety

Environmental considerations and constraints

-1	1.	destruction/creation of productive habitats
-1	2.	effects on water quality
-1	3.	environmental impacts of proposed use
-1	4.	persistence of impacts
-1	5.	alteration of existing character

Economic considerations and constraints

5	potential cost coefficient

Summary:

-0.3	Engineering Rating
0.	Societal Rating
-2.5	Environmental Rating
-3.0	Economic Rating

Alternative: Dewatering and Consolidation.

Engineering considerations and constraints: Can use densification techniques to speed up dewatering and consolidation so the area can be reused in a shorter amount of time than if left to drain naturally. This will extend the use of a containment area, but not very long.

Societal considerations and constraints: Disposal area will be reused faster which has public appeal.

Environmental considerations and constraints: Can use existing areas.

Economic considerations and constraints: Desiccation is by far the cheapest densification technique followed by seepage consolidation, underdrainage, underdrainage with partial vacuum, and temporary surcharge techniques. It will be expensive to provide the continuous maintenance required for desiccation or to place the layer of sand required for underdrainage.

Alternative: Dewatering and consolidation.

Region 1	Region 2	
		Engineering Considerations and Constraints
1	1	1. physical requirements for disposal facilities
1	1	2. distance from dredging
-1	-1	3. treatment of dredged material
-2	-2	4. life expectancy
-1	-1	5. long-term maintenance
1	1	6. monitoring of the facility
0	0	7. site size and configuration
-1	-1	8. construction feasibility
0	0	9. disposal facility design and operating characteristics
1	1	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	0	1. social acceptability of the disposal option
2	2	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
2	2	4. safety
		Environmental considerations and constraints
1	1	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
0	0	3. environmental impacts of proposed use
0	0	4. persistence of impacts
1	1	5. alteration of existing character
		Economic considerations and constraints
5	5	potential cost coefficient
		Summary:
-0.3	-0.3	Engineering Rating
2.5	2.5	Societal Rating
0.5	0.5	Environmental Rating
-3.0	-3.0	Economic Rating

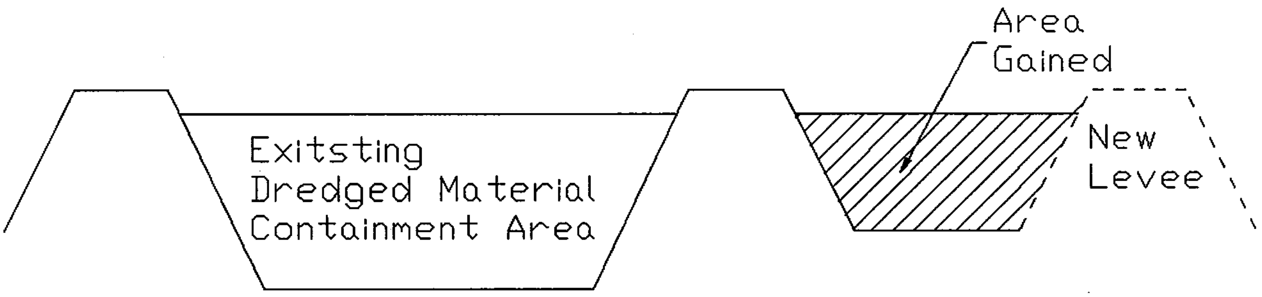
Alternative: Expand Existing Containment Areas Outward.

Engineering considerations and constraints: Expand the existing containment areas along the waterway outward by building new levees (see figure below). This would give a very limited space that would fill up in just a few dredging cycles. The new areas would be behind the old areas which are harder to reach with a pipeline.

Societal considerations and constraints: Diked containment areas such as these do not have wide public appeal. The adjacent wetlands would not be harmed.

Environmental considerations and constraints: Low marsh exists around the proposed areas so these environmentally sensitive areas cannot be harmed.

Economic considerations and constraints: If a small dredge is used, then this is a very cost-effective alternative.



Alternative: Expand existing containment areas outward.

Region 1	Region 2	
		Engineering Considerations and Constraints
-2	-2	1. physical requirements for disposal facilities
1	1	2. distance from dredging
2	2	3. treatment of dredged material
-2	-2	4. life expectancy
1	1	5. long-term maintenance
1	1	6. monitoring of the facility
-2	-2	7. site size and configuration
0	0	8. construction feasibility
1	1	9. disposal facility design and operating characteristics
2	2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	0	1. social acceptability of the disposal option
0	0	2. conformance with regulatory requirements
-1	-1	3. social costs/benefits (nonmonetary)
1	1	4. safety
		Environmental considerations and constraints
0	0	1. destruction/creation of productive habitats
0	0	2. effects on water quality
-2	-2	3. environmental impacts of proposed use
0	0	4. persistence of impacts
0	0	5. alteration of existing character
		Economic considerations and constraints
1	1	potential cost coefficient
		Summary:
0.5	0.5	Engineering Rating
0.	0.	Societal Rating
-1.0	-1.0	Environmental Rating
0.0	0.0	Economic Rating

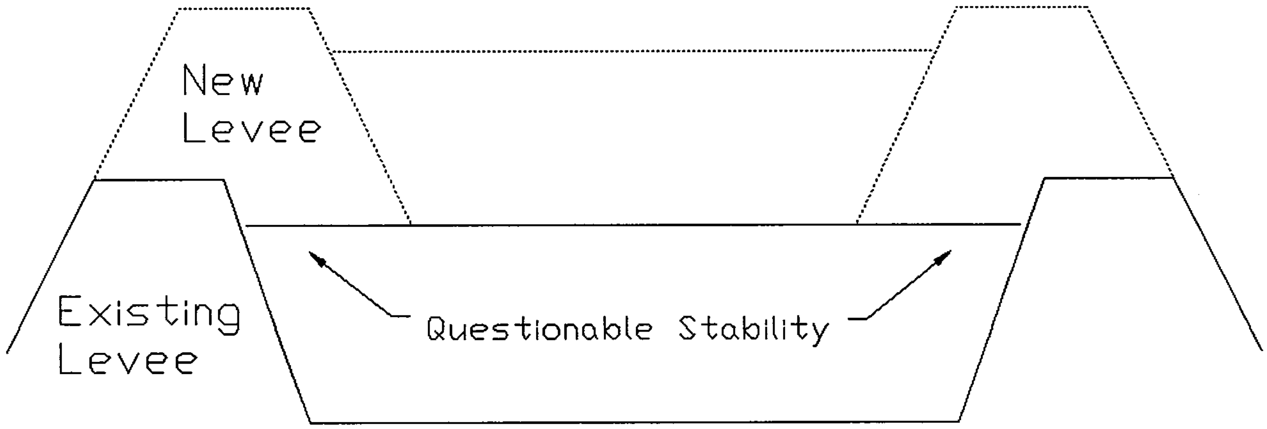
Alternative: Expand existing containment areas up.

Engineering considerations and constraints: Build new dikes within the existing containment areas and continue to place dredged material in the areas. Each time a dike is built up, some area is lost since the new levee must be placed within the existing containment area. The new levee cannot be tall due to lack of stability in the foundation (see figure below). This will produce a limited amount of area for disposal of dredged material.

Societal considerations and constraints: This storage option has no potential beneficial use.

Environmental considerations and constraints: This alternative does not harm anything new since the new containment areas are inside existing containment areas, but has no potential beneficial use.

Economic considerations and constraints: The dikes will become more and more expensive for less and less area.



Alternative: Expand existing containment areas up.

Region 1	Region 2	
		Engineering Considerations and Constraints
-1	-1	1. physical requirements for disposal facilities
1	1	2. distance from dredging
2	2	3. treatment of dredged material
-2	-2	4. life expectancy
2	2	5. long-term maintenance
1	1	6. monitoring of the facility
-2	-2	7. site size and configuration
-1	-1	8. construction feasibility
0	0	9. disposal facility design and operating characteristics
0	0	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	0	1. social acceptability of the disposal option
2	2	2. conformance with regulatory requirements
-1	-1	3. social costs/benefits (nonmonetary)
1	1	4. safety
		Environmental considerations and constraints
0	0	1. destruction/creation of productive habitats
0	0	2. effects on water quality
0	0	3. environmental impacts of proposed use
-1	-1	4. persistence of impacts
0	0	5. alteration of existing character
		Economic considerations and constraints
2	2	potential cost coefficient
		Summary:
0.	0.	Engineering Rating
1.2	1.2	Societal Rating
-0.5	-0.5	Environmental Rating
-1.0	-1.0	Economic Rating

Alternative: Hopper dredge disposal.

Engineering considerations and constraints: A shallow draft hopper dredge has approximately 460 m^3 capacity, with a 50% solids efficiency only 230 m^3 of solids per trip. Since High Island is half way between Port Arthur and Galveston entrances, the dredge would have 95 km roundtrip of nonproductive time. A small segment of 250,000 m^3 would take a year to dredge and with an 18 month maintenance cycle, it could become difficult to coordinate.

Societal considerations and constraints: The dredge would be aggravate this high traffic area, so safety would decrease.

Environmental considerations and constraints: No adverse or beneficial results.

Economic considerations and constraints: Cost is about $13/$m^3$.

Alternative: Hopper dredge disposal.

Region 1	Region 2		
		Engineering Considerations and Constraints	
-2	-2	1.	physical requirements for disposal facilities
-2	-2	2.	distance from dredging
2	2	3.	treatment of dredged material
0	0	4.	life expectancy
2	2	5.	long-term maintenance
-1	-1	6.	monitoring of the facility
0	0	7.	site size and configuration
0	0	8.	construction feasibility
0	0	9.	disposal facility design and operating characteristics
-2	-2	10.	technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints	
0	0	1.	social acceptability of the disposal option
1	1	2.	conformance with regulatory requirements
-1	-1	3.	social costs/benefits (nonmonetary)
-2	-2	4.	safety
		Environmental considerations and constraints	
-1	-1	1.	destruction/creation of productive habitats
-1	-1	2.	effects on water quality
-1	-1	3.	environmental impacts of proposed use
0	0	4.	persistence of impacts
-1	-1	5.	alteration of existing character
		Economic considerations and constraints	
5	5		potential cost coefficient
		Summary:	
-0.8	-0.8		Engineering Rating
-1.3	-1.3		Societal Rating
-2.0	-2.0		Environmental Rating
-3.0	-3.0		Economic Rating

Alternative: Interim Storage.

Engineering considerations and constraints: The site can be reused, but it must continually be under construction to remove the material after it has consolidated and dispose of it elsewhere. A waterway off the main channel must be trenched to allow for a dredge to work without interrupting traffic on the waterway. The site must be designed so heavy equipment can have access to the material in the containment area.

Societal considerations and constraints: Instead of the dredging projects lasting a few months out of the year, they will never cease. The public may not approve of seeing heavy equipment in the area continuously.

Environmental considerations and constraints: The noise will never cease in this area as the small dredge works continuously to empty the area for the next use. Water quality will deteriorate from the barges continually being there, spilling the material and creating turbidity.

Economic considerations and constraints: It will cost considerably more than double just to manage the two dredging contracts. The mobilization cost to obtain a hopper dredge for the work of moving the material out of the containment area will be tremendous since this type of dredge is not normally used in Texas. The trenches must be dug and continuously dredged to allow for the double handling of the material.

Alternative: Interim storage.

Region 1	Region 2	
		Engineering Considerations and Constraints
2	2	1. physical requirements for disposal facilities
2	2	2. distance from dredging
-2	-2	3. treatment of dredged material
2	2	4. life expectancy
-2	-2	5. long-term maintenance
2	2	6. monitoring of the facility
-2	-2	7. site size and configuration
-2	-2	8. construction feasibility
-2	-2	9. disposal facility design and operating characteristics
-2	-2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
-2	-2	1. social acceptability of the disposal option
2	2	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
0	0	4. safety
		Environmental considerations and constraints
0	0	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-1	-1	3. environmental impacts of proposed use
-1	-1	4. persistence of impacts
0	0	5. alteration of existing character
		Economic considerations and constraints
15	15	potential cost coefficient
		Summary:
-1.0	-1.0	Engineering Rating
0.0	0.0	Societal Rating
-1.5	-1.5	Environmental Rating
-5.0	-5.0	Economic Rating

Alternative: Thin Layer Disposal in Bay Waters.

Engineering considerations and constraints: The discharge pipe should be capable of moving in a large arc (about 300 degrees) and the swivel joint should be relocated often (about once every hour) to ensure dispersal of the material. This is not a feasible alternative for region 1 due to distance limitations.

Societal considerations and constraints: Recreational traffic would not be interrupted.

Environmental considerations and constraints: It must not be a thick layer. It has been observed that a thin layer creates no detectable differences in the macrofauna community (Fowl River, Alabama, Test Case). A broad recolonization should occur over the disposal area in approximately 3 weeks. Due to the quality of the material, water quality will be adversely affected during disposal.

Economic considerations and constraints: This method has been found to be economical (Fowl River, Alabama, Test Case). The pipeline to the bay (either Rollover Bay or East Bay) will be approximately 3 miles at the furthest point from dredging to disposal for region 2.

Alternative: Thin layer disposal in bay waters.

Region 2

	Engineering Considerations and Constraints
-1	1. physical requirements for disposal facilities
-1	2. distance from dredging
0	3. treatment of dredged material
1	4. life expectancy
1	5. long-term maintenance
-1	6. monitoring of the facility
1	7. site size and configuration
0	8. construction feasibility
1	9. disposal facility design and operating characteristics
0	10. technical coordination of disposal plan with productive use plan or with subsequent disposal

	Societal considerations and constraints
-1	1. social acceptability of the disposal option
0	2. conformance with regulatory requirements
0	3. social costs/benefits (nonmonetary)
0	4. safety

	Environmental considerations and constraints
0	1. destruction/creation of productive habitats
-1	2. effects on water quality
-1	3. environmental impacts of proposed use
0	4. persistence of impacts
-1	5. alteration of existing character

	Economic considerations and constraints
4	potential cost coefficient

Summary:

0.3	Engineering Rating
-0.6	Societal Rating
-1.5	Environmental Rating
-2.0	Economic Rating

Alternative: Traditional offshore disposal.

Engineering considerations and constraints: Place the material offshore using a hydraulic pipeline or hopper dredge. Since the ocean dumping is becoming increasingly regulated, this option may not be available in a few years. It will be extremely difficult to pass material through the surf for transport to the ocean.

Societal considerations and constraints: The Ocean Dumping Acts protects the oceans so ocean dumping is becoming increasingly regulated by government agencies and is frowned upon by citizens. The silty material will create high turbidity where disposed.

Environmental considerations and constraints: This will cause an increase of suspended solids in the area of disposal, so before dumping, it must be determined that no susceptible creatures (i.e. oysters) are in the disposal area. The silty material will create high turbidity for a long period of time.

Economic considerations and constraints: Pumping material through the surf is cost prohibitive. It is also costly to pass pipes under or over Highway 87.

Alternative: Traditional offshore disposal.

Region 1	Region 2	
		Engineering Considerations and Constraints
-2	-2	1. physical requirements for disposal facilities
-2	-2	2. distance from dredging
-2	-2	3. treatment of dredged material
0	0	4. life expectancy
0	0	5. long-term maintenance
1	1	6. monitoring of the facility
0	0	7. site size and configuration
-2	-2	8. construction feasibility
-2	-2	9. disposal facility design and operating characteristics
-2	-2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	0	1. social acceptability of the disposal option
0	0	2. conformance with regulatory requirements
0	0	3. social costs/benefits (nonmonetary)
0	0	4. safety
		Environmental considerations and constraints
0	0	1. destruction/creation of productive habitats
-1	-1	2. effects on water quality
-1	-1	3. environmental impacts of proposed use
1	1	4. persistence of impacts
1	1	5. alteration of existing character
		Economic considerations and constraints
10	10	potential cost coefficient
		Summary:
-2.8	-2.8	Engineering Rating
0.	1.3	Societal Rating
0.0	0.0	Environmental Rating
-5.0	-5.0	Economic Rating

Alternative: Traditional unconfined discharge in bay waters.

Engineering considerations and constraints: As the material is dredged, it is discharged into either Rollover Bay or West Bay. The material must be placed far enough from the channel to prevent resettling in the channel. This is only feasible for region 2 due to distance limitations

Societal considerations and constraints: Unsightly emergent islands may form which are not aesthetically pleasing to the public.

Environmental considerations and constraints: Emergent islands may form and interfere with the normal movement of water in the bay. The silty material will have adverse effects on the water quality.

Economic considerations and constraints: It is inexpensive to implement this alternative for region 2.

Alternative: Traditional unconfined discharge in bay waters.

Region 2

	Engineering Considerations and Constraints
-1	1. physical requirements for disposal facilities
-1	2. distance from dredging
2	3. treatment of dredged material
0	4. life expectancy
2	5. long-term maintenance
0	6. monitoring of the facility
1	7. site size and configuration
1	8. construction feasibility
0	9. disposal facility design and operating characteristics
0	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
	Societal considerations and constraints
-2	1. social acceptability of the disposal option
-2	2. conformance with regulatory requirements
-1	3. social costs/benefits (nonmonetary)
0	4. safety
	Environmental considerations and constraints
-2	1. destruction/creation of productive habitats
-2	2. effects on water quality
-2	3. environmental impacts of proposed use
-1	4. persistence of impacts
-1	5. alteration of existing character
	Economic considerations and constraints
1.3	potential cost coefficient

Summary:

1.0	Engineering Rating
-3.1	Societal Rating
-4.0	Environmental Rating
-1.0	Economic Rating

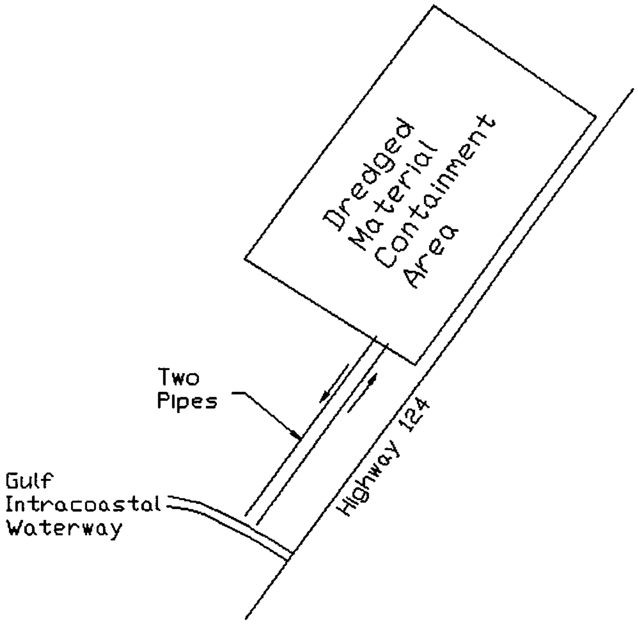
Alternative: Transport to inland disposal area with salt water return.

Engineering considerations and constraints: Place two pipelines along Highway 124 to an inland disposal site (see figure below). One pipe will carry the dredged material to the site, while the other will return the salt water back to the salt marshes (two pipes are required since dredging occurs 24 hours/day). Pumps must have high head since the pumping distance is very long. This is not a feasible alternative for region 2 due to distance limitations.

Societal considerations and constraints: This alternative has no potential beneficial use.

Environmental considerations and constraints: The salt water return should eliminate any adverse effects on water quality.

Economic considerations and constraints: The transportation costs will be high since the pumping distance is approximately 8 km. By using Highway 87 right-of-way to place the pipes, easement will not be required. For Region 1, this is about an 8 km pumping distance which is expensive, but achievable.



Alternative: Transport to inland disposal with salt water return.

Region 1

		Engineering Considerations and Constraints
-1	1.	physical requirements for disposal facilities
-1	2.	distance from dredging
2	3.	treatment of dredged material
2	4.	life expectancy
2	5.	long-term maintenance
2	6.	monitoring of the facility
0	7.	site size and configuration
0	8.	construction feasibility
-1	9.	disposal facility design and operating characteristics
1	10.	technical coordination of disposal plan with productive use plan or with subsequent disposal
		Societal considerations and constraints
0	1.	social acceptability of the disposal option
2	2.	conformance with regulatory requirements
0	3.	social costs/benefits (nonmonetary)
0	4.	safety
		Environmental considerations and constraints
0	1.	destruction/creation of productive habitats
0	2.	effects on water quality
0	3.	environmental impacts of proposed use
0	4.	persistence of impacts
0	5.	alteration of existing character
		Economic considerations and constraints
5		potential cost coefficient
		Summary:
1.5		Engineering Rating
1.3		Societal Rating
0.		Environmental Rating
-3.0		Economic Rating

Alternative: Wetland Habitat Development.

Engineering considerations and constraints: Place material in specified areas of Bolivar Peninsula to create new wetlands. The area may need to be seeded if natural establishment of plants does not occur within a reasonable amount of time. After the area is established it will not be available for future disposal operations. This is not a feasible alternative for region 1 due to distance limitations.

Societal considerations and constraints: Creation of desirable biological communities has considerable public appeal. This can be used in mitigation (create twice as much as destroyed in other areas).

Environmental considerations and constraints: Desirable biological communities would be created. The mud flats which would be destroyed are generally low production areas.

Economic considerations and constraints: Transportation costs for the dredged material will be very high, even for region 2.

Alternative: Wetland habitat development.

Region 2

	Engineering Considerations and Constraints
-1	1. physical requirements for disposal facilities
-2	2. distance from dredging
-1	3. treatment of dredged material
-2	4. life expectancy
-1	5. long-term maintenance
-1	6. monitoring of the facility
0	7. site size and configuration
-1	8. construction feasibility
-1	9. disposal facility design and operating characteristics
-2	10. technical coordination of disposal plan with productive use plan or with subsequent disposal
	Societal considerations and constraints
0	1. social acceptability of the disposal option
0	2. conformance with regulatory requirements
0	3. social costs/benefits (nonmonetary)
0	4. safety
	Environmental considerations and constraints
-1	1. destruction/creation of productive habitats
0	2. effects on water quality
-1	3. environmental impacts of proposed use
-1	4. persistence of impacts
-1	5. alteration of existing character
	Economic considerations and constraints
5	potential cost coefficient
	Summary:
-3.0	Engineering Rating
0.	Societal Rating
-2.0	Environmental Rating
-3.0	Economic Rating

SUMMARY OF INITIAL ASSESSMENT
High Island Region 1

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Agriculture	-1.8	0.6	-2.5	-5.0	-2.2
Beach Nourishment	-0.8	-1.9	-0.5	-3.0	-1.6
Berms	-2.8	-1.3	-2.0	-5.0	-2.8
Build New Diked Storage Areas in Wetlands	2.0	-3.8	-4.5	-3.0	-2.3
Dewatering and Consolidation	-0.3	2.5	0.5	-3.0	-0.1
Expand Existing Containment Areas Outward	0.5	0.	-1.0	0.	-0.1
Expand Existing Containment Areas Up	0.	1.2	-0.5	-1.0	-0.1
Hopper Dredge Disposal	-0.8	-1.3	-2.0	-3.0	-1.8
Interim Storage	-1.0	0.	-1.5	-5.0	-1.9
Traditional Offshore Disposal	-2.8	0.	0.	-5.0	-2.0
Transport to Inland Disposal With Salt Water Return	1.5	1.3	0.	-3.0	-0.1

SUMMARY OF INITIAL ASSESSMENT

High Island Region 2

Alternative	Engineering Rating	Societal Rating	Environmental Rating	Economic Rating	Feasibility Rating
Agriculture	-1.8	0.6	-2.5	-5.0	-2.2
Beach Nourishment	-0.8	-1.9	-0.5	-3.0	-1.6
Berms	-2.8	-1.3	-2.0	-5.0	-2.8
Build New Diked Storage Areas in Wetlands	2.0	-3.8	-4.5	-3.0	-2.3
Create Habitat Islands in Bay Waters	-0.3	0.	-2.5	-3.0	-1.5
Dewatering and Consolidation	-0.3	2.5	0.5	-3.0	-0.1
Expand Existing Containment Areas Outward	0.5	0.	-1.0	0.	-0.1
Expand Existing Containment Areas Up	0.	1.2	-0.5	-1.0	-0.1
Hopper Dredge Disposal	-0.8	-1.3	-2.0	-3.0	-1.8
Interim Storage	-1.0	0.	-1.5	-5.0	-1.9
Thin Layer Disposal in Bay Waters	0.3	-0.6	-1.5	-2.0	-1.0
Traditional Offshore Disposal	-2.8	0.	0.	-5.0	-2.0
Traditional Unconfined Discharge in Bay Waters	1.0	-3.1	-4.0	-1.0	-1.8
Wetland Habitat Development	-3.0	0.	-2.0	-3.0	-2.0