Appendix D

Dredged Material Management Plan

APPENDIX D

ENVIRONMENTAL IMPACT STATEMENT
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT, TEXAS
DREDGED MATERIAL MANAGEMENT PLAN

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

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APPENDIX D
SABINE-NECHES WATERWAY, TEXAS AND LOUISIANA
CHANNEL IMPROVEMENT PROJECT
DREDGED MATERIAL MANAGEMENT PLAN

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ACRONYMS

AO	allowable overdepth
BU	beneficial use
CG	Construction General
CIP	Channel Improvement Project
CPT	cone penetrometer testing
cy	cubic yards
DAMP	Disposal Area Management Plan
DMMP	Dredged Material Management Plan
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Development Center
FEIS	Final Environmental Impact Statement
FFR	Final Feasibility Report
GIWW	Gulf Intracoastal Waterway
HTRW	hazardous, toxic, and radioactive waste
ICT	Interagency Coordination Team
JCND	Jefferson County Navigation District
LPP	Locally Preferred Plan
mcy	million cubic yards
NWP	New Work Plan
O&M	operations and maintenance
ODMDS	Ocean Dredged Material Disposal Sites
PA	placement area
PED	Preconstruction Engineering and Design
psf	per square foot
SH	State Highway
SNND	Sabine Neches Navigation District (SNND
SNWW	Sabine-Neches Waterway
TCB	Turner Collier Braden, Inc.
TPWD	Texas Parks and Wildlife Department
TxDOT	Texas Department of Transportation
URS	URS Corporation
USACE	U.S. Army Corps of Engineers

1.0 PURPOSE

The purpose of the Dredged Material Management Plan (DMMP) is to guide the Federal and non-Federal sponsors in the placement of material to be dredged from the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) for the 50-year period of analysis. This DMMP would apply to both construction (new work) and maintenance dredging.

The DMMP was developed by the U.S. Army Corps of Engineers (USACE), Galveston District, the Sabine Neches Navigation District (SNND), and the SNWW Interagency Coordination Team (ICT). The DMMP includes the use of construction and maintenance material for marsh restoration and Gulf shore nourishment, and modification of existing practices for the remaining construction and maintenance material.

2.0 DESCRIPTION OF EXISTING AND CIP

2.1 EXISTING SNWW PROJECT

The existing Sabine-Neches Waterway (SNWW) extends from the Gulf of Mexico through a jettied entrance at the mouth of Sabine Pass through Port Arthur, and up the Neches River into Beaumont, Texas (Drawing G-01 in Appendix 1 of the Final Feasibility Report [FFR]). It is 63.8 miles in length and has a 40-foot authorized depth. Channel dimensions for the 40-foot project are shown in Table 2-1.

Table 2-1: Existing 40-Foot Authorized Channel Dimensions

Reach	Station	to	Station	Bottom Width (feet)	Project Depth (feet MLT)	Channel Depth (feet MLT)	Allowable Overdepth (feet)	Side Slope
Sabine Bank Channel	95+734		18+000	800	42	44	2	1V/2H
Sabine Pass Outer Bar	18+000		0+000	800	42	44	2	1V/10H
Sabine Pass Jetty Channel	–214+88		0+00	800–500	40	42	2	1V/2H
Sabine Pass Channel	0+00		296+24	500	40	42	2	1V/2H
Port Arthur Canal	0+00		326+24	500	40	42	1	1V/2H
Sabine-Neches Canal	0+00		593+69	400	40	42	1	1V/2H
Neches River Channel	0+00		978+60	400	40	42	2	1V/2H
Taylor Bayou								
Entrance Channel	0+00		19+05	275–678	40	42	1	1V/2H
East Turning Basin	0+00		17+65	420	40	42	1	1V/2H
West Turning Basin	19+05		31+10	600	40	42	1	1V/2H
Connecting Channel	31+10		61+30	200–250	40	42	1	1V/2H
Taylor Bayou Turning Basin	61+30		96+00	1000	40	42	1	1V/2H

Channel Depth includes Advance Maintenance depth – there is a constant 2 feet for the entire waterway.
Existing stationing applies to this table.
^Entrance Channel and East and West Turning Basins are also called “Port Arthur Turning Basins.”

2.2 PROPOSED SNWW CIP

The SNWW CIP would deepen the navigation channel to 48 feet and extend the channel an additional 13.2 miles into the Gulf of Mexico (Drawing G-02 in Appendix 1 of the FFR), resulting in a total SNWW CIP length of 77 miles (Table 2-2). Proposed project channel reaches are illustrated in drawings C-01 through C-12 in Appendix 1 of the FFR. The Channel to Orange is considered part of the SNWW system but it is not a part of this study.

Table 2-2: Proposed SNWW CIP 48-Foot Project Dimensions

Reach	Station	to	Station	Bottom Width (feet)	Project Depth (feet)	Side Slope
Extension Channel	165+443		95+734	700	50	1V/2H
Sabine Bank Channel	95+734		25+800	700	50	1V/2H
	25+800		23+300	700–800	50	1V/2H
	23+300		18+000	800	50	1V/2H
Sabine Pass Outer Bar	18+000		0+000	800	50	1V/10H
Sabine Pass Jetty Channel	–214+88		0+00	500–800	48	1V/2H
Sabine Pass Channel	0+00		296+25	1355–500	48	1V/2H
Port Arthur Canal	0+00		325+84	1660–500	48	1V/2H
Sabine-Neches Canal	0+00		592+94	1050–400	48	1V/2H
Neches River Channel	0+00		980+00	400–1413	48	1V/2H
Taylor Bayou						
Entrance Channel	0+00		25+27	406–764	48	1V/2H
East Turning Basin	0+00		17+65	532–354	48	1V/2H
West Turning Basin	25+27		41+30	776	48	1V/2H
Connecting Channel	41+30		71+50	470–250	48	1V/2H
Taylor Bayou Turning Basin	71+50		106+25	1000	48	1V/2H

3.0 GEOTECHNICAL INVESTIGATIONS

The level of geotechnical engineering performed for this report is fully sufficient to substantiate the recommended plan. Additional investigations and analyses, briefly outlined in Section 6.0 in accordance with ER 1110-2-1150, Appendix C-4, would be performed during both the Preconstruction Engineering and Design (PED) and Construction General (CG) phases of the project, and documented in a Design Documentation Report before each feature is constructed.

3.1 REGIONAL AND SITE GEOLOGY

3.1.1 Regional Geology

The project site, as shown on Drawing G-01 in Appendix 1 of the FFR, is located in the Coastal Plain physiographic province of Texas. This region contains marine sediments, mainly younger Holocene deposits overlay older Pleistocene deposits. More-recent riverine overwash deposits overlay the Holocene sediments in floodplains in the Neches and Sabine rivers. The subdivision of the Coastal Plain in which the project lies is called the Coastal Prairie. This area is characterized by low-lying flat land and has evolved to its present conditions by erosion, deposition, compaction, and subsidence, all of which are still active. Gradual faulting continues as Pleistocene and older Gulf basin sediments continue to compact.

3.1.2 Site Geology

The site geology is characterized by modern marine deposits overlaying recent Holocene deposits that in turn overlay the Beaumont and Lissie formations of the Pleistocene Series. The modern deposits are generally normally consolidated clays, silts, and fine sands that were deposited through natural overwash and sedimentation processes or through man-made depositional processes. The recent deposits of the Holocene consist of silts, clays, silty sands, clayey sands, and clayey silts that exhibit the characteristics of normally to lightly overconsolidated materials. These deposits are generally encountered to depths of 30 to 40 feet.

Beaumont Clay is the predominant Pleistocene formation whose eroded surface forms the upper limit of stiff to very stiff clay material. It is red, yellow, and brown calcareous stiff clay that weathers into black or gray soil at the surface. Lenses of fine-grained, poorly graded sand and silt and a few calcareous nodules are sometimes encountered in this formation. The clay fraction is composed of montmorillonite (generally with calcium as the exchangeable cation), kaolinite, illite, and finely ground quartz, in that order of prevalence. The high percentage of montmorillonite accounts for the high shrink-swell potential of the material. Previous desiccation of the clays results in significant overconsolidation to great depths, with preconsolidation pressure approaching 3 tons per square foot. In addition to preconsolidating the soil, the desiccation process, along with occasional rewetting, has resulted in a network of fissures and slickensides that are now closed but that represent potential planes of weakness within the stratum. The thicknesses of these clays range from 25 to 400 feet. The Lissie Formation underlies the Beaumont and consists primarily of sands and silty sands.

3.2 FIELD EXPLORATION

Limited field investigations were conducted for this project. Those conducted were limited to cone penetrometer testing along the proposed levee alignments at selected placement areas. In addition, probings were taken at selected environmental features to evaluate near-surface foundation issues. The majority of the subsurface data for the project was compiled from existing data – data from the channel that were collected for the 40-foot project and data from placement areas that have been collected during periodic levee-raising projects. Site subsurface data are presented on drawings F-1 through F-6 in Appendix 1 of the FFR. Recommendations for additional geotechnical investigation, both project channel and placement areas along with associated laboratory testing are provided in Section 6.0.

3.2.1 Core Borings and Laboratory Testing

Where noted on the plans, core borings were previously drilled to explore the subsurface conditions along the channel and at some placement areas. Unless otherwise indicated, the borings were drilled to obtain 3-inch-diameter undisturbed continuous samples of cohesive materials and split-spoon, disturbed samples of cohesionless materials. Consistencies of cohesive materials were determined in the field using a pocket penetrometer or a Torvane Shear test apparatus. Where cohesionless materials were encountered, disturbed samples were taken at approximately 5-foot depth intervals during the performance of standard penetration tests.

Laboratory testing was generally conducted on representative samples. Tests on cohesive materials consisted of determining moisture content, unit dry weight, sieve analyses, liquid limit, and plastic limit. Sieve analyses were performed on typical samples of cohesionless materials. The results of these tests were used to classify the various material layers. Unconsolidated undrained shear strengths of typical samples of cohesive materials were determined in the laboratory by performing unconfined compression tests, single point Unconsolidated Undrained “Q” Triaxial compression tests, and Torvane Shear tests.

3.2.2 Off-channel Probings

Probings, using a 1.5-inch-diameter, capped PVC pipe, were conducted off channel in selected areas intended for restoration features. These probings were used to evaluate the open-water foundation conditions. These data were used to estimate the thickness of soft bay-bottom mud and determine how much displacement may occur during hydraulic fill construction. This information was incorporated into the conceptual level design of these features.

3.2.3 Cone Penetrometer Testing

Cone penetrometer testing (CPT) was conducted at selected placement areas (PAs) in 2002 to evaluate levee and levee foundation conditions. PAs 5, 8, 9, 11, 12, 13, 14, 23, 24, 25, and 27B were evaluated. Except at PA 25, the CPTs were conducted by the USACE Vicksburg District using their in-house, truck-mounted electric cone penetrometer. At PA 25, CPTs were conducted by Fugro, Inc. under subcontract to URS Corporation (URS). URS also reviewed the data and prepared soil profile drawings. These data were used to develop embankment design recommendations and to provide recommendations for additional exploratory studies.

At PA 9, in addition to taking CPTs along the perimeter levees, URS performed in situ vane shear tests at selected locations in PA 9 to confirm the Nk value selected for analysis of the CPT field data.

3.3 DESIGN CONSIDERATIONS

3.3.1 Selection of Preliminary Design Parameters

The geotechnical design parameters used to develop the features presented in this feasibility study are varied and range from the traditional geotechnical parameters for shear strength and consolidation to hydraulic dredging parameters for bulking, retention, and shrinkage. These preliminary design parameters were developed from a variety of sources. These sources include contractor work by URS, recent in-house experience with the construction of hydraulic levees, historic in-house data associated with dredged material placement, and local knowledge based on the historic performance of foundation soils at specific placement areas.

3.3.2 Shoaling Rate

Shoaling rates for the new channel were developed by the USACE's Coastal and Hydraulics Laboratory at the Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi (Reference 1). The study evaluated the existing reaches and calculated a combined shoaling factor. Initially this study was developed for a 50-foot-deep channel. Subsequently, the model was revised to reflect the 48-foot channel. The conclusion of this report states that annual dredging quantity in the SNWW would increase from an average of 8.1 million cubic yards (mcy) per year (407 mcy over 50 years) for the current 40-foot project to 13.0 mcy per year (650 mcy over 50 years) for the proposed 48-foot project. Three of the reaches evaluated are located offshore of the jetties. On average, the shoaling increased by 12 percent through the offshore portion of the waterway due primarily to the increased length of the offshore channel. These new shoaling rates have been used to develop the DMMP.

3.3.3 Bulking Factor

The bulking factor is a design parameter primarily used to develop levee height requirements. The factor is greater than 1 and generally ranges between 1.3 and 1.8. The bulking process is a result of the structural disruption of the dredged sediments and the entrainment of water into the sediments during dredging. This factor is traditionally defined as the ratio of the volume occupied by the dredged material in the placement area immediately after completion of dredging to the volume occupied by the same material in the channel before dredging. The amount of bulking varies with the type of sediments and the method of dredging (mechanical or hydraulic). Other factors that affect bulking include size of dredge, horsepower, and residence time in the pipeline. For dredged material placed in upland PAs or used in environmental features, dredging would be conducted hydraulically. Sediments include both new work clay and sand and maintenance materials. Some maintenance materials reportedly contain high sand contents. Generally, fine-grained sediments bulk more (exhibit a larger bulking factor) than coarse-grained sediments, and maintenance material bulks more than new work. Bulking occurs during dredging operations. Upon completion of pumping, the PA is dewatered, and shrinkage of the newly placed dredge sediments begins. The bulked volume in conjunction with freeboard and ponding requirements is calculated to develop the required levee crest elevations.

$$\textit{Bulking Factor} = \frac{\textit{(Volume of Dredged Material in Placement Area)}}{\textit{(Volume in Channel Prior to Dredging)}}$$

Bulking factors for each reach of the SNWW were developed by URS using available geotechnical data from channel borings. These values ranged from 1.8 in the reaches where clay predominated to 1.2 where more coarse-grained materials were encountered.

3.3.4 Retention Factor

The retention factor is a parameter used in the design of hydraulically constructed levees. The design of hydraulic levees includes the evaluation of the dredge fill material, levee foundation, site conditions, and construction methods (type, size, and horsepower of dredge and pipeline distance). Typically, the design provides a final levee template that incorporates all of these components through the use of a retention factor. This factor quantifies the fact that not 100 percent of the actual dredged quantity would fall within the desired template while constructing a hydraulic levee. A retention factor is therefore calculated as the ratio of the apparent volume of retained fill divided by the actual dredged quantity:

$$\textit{Retention Factor} = \frac{\textit{(Volume of Retained Fill)}}{\textit{(Actual Dredging Quantity)}}$$

The retention factor is a single number that includes allowances for material degradation (i.e., clay ball degradation), displacement of the foundation, depth of water, amount and distribution of sand within the dredge cut, the dredging operation itself (type and size of dredge, number of booster pumps, type of cutterhead used, and control of the cutterhead), and relative difference between the design template and the natural angle of repose of the dredge fill.

Hydraulic levees would be utilized on this project for restoration features. These marsh restoration features would be constructed in water depths ranging from 2 to 5 feet. Based on the District's experience with similar construction projects on the Houston Ship Channel (Atkinson Island and Mid Bay Marsh), retention factors typically range from 0.35 to 0.45. These values have been incorporated into preliminary design for this plan. Additional design documentation for these features is located in Reference 2. During final design of these features, the retention factor along with other design parameters would be reevaluated using site-specific data.

Hydraulic levees are also planned for new levee construction at new upland PAs. At these sites, the contractor is afforded more control over the dredge fill because the fill surface is emergent. The use of dredged material for construction can be maximized by building containment dikes ("potato rows") on the inside of the PA and other specific construction methods. Similar projects have been constructed on the Houston Ship Channel (Spillman Island and Alexander Island). Retention factors ranging from 0.60 to 0.70 are expected with these construction methods.

3.3.5 Shrinkage Factor

The shrinkage factor is a design parameter used to evaluate the long-term storage capacity of a PA for use in developing the DMMP. It is defined as the ratio of the long-term volume occupied by a certain quantity of dredged material in a PA, to the volume it occupied in the channel prior to dredging. Generally, this parameter is associated with maintenance material, but may also be associated with new work material.

$$Shrinkage\ Factor = \frac{(\ Long\ -\ term\ Volume\ -\ Disposal\ \ Area\ )}{(Volume\ Occupied\ -\ Channel\ \ Before\ Dredging)}$$

This factor is a measure of volume change between dredging and the long-term condition. As with the retention factor, the shrinkage factor includes allowances for material type and degradation and the dredging operation (type and size of dredge, number of booster pumps, type of cutterhead used, and control of the cutterhead). Additional components that contribute to the shrinkage factor include consolidation of the dredged material due to self weight and desiccation, climatological conditions, and maintenance, including drainage and usage schedule of the PA.

Determination of a precise shrinkage factor for a PA can be a complex task and includes modeling the consolidation and desiccation shrinkage based on laboratory test data, climatological data, drainage characteristics, and operational characteristics. Based on the District’s experience along the SNWW, shrinkage factors generally range from 0.55 to 0.75, with coarse-grained material exhibiting less shrinkage. Along this waterway, PAs usage varies from 2 to 6 years per cycle. In addition, very little maintenance (i.e., dewatering) is conducted on the PAs between cycles.

3.3.6 Shear Strength

Shear strength values have been considered for two conditions – channel slopes and placement area levee/embankment slopes. Where channel slopes would be excavated for the new template, long-term drained shear strengths are generally considered critical. Under these conditions, pore pressures increase with time as the excavated material is relieved of the overburden pressure. This increase in pore pressure reduces the shear strength of the soil. Where fill slopes are located such as the levee slopes of PAs, undrained shear strengths are generally considered critical. Under these conditions, pore pressures increase immediately as the foundation is surcharged with new fill. These elevated pore pressures reduce the shear strength of the soil. Overtime, pore pressures dissipate and some strength gain is realized.

Shear strength values and associated design parameters for channel slopes were derived from available subsurface data including boring logs and laboratory test data. Reviewed data included borings along the project channels, borings taken in association with referenced bridges, and borings taken in association with the hurricane flood protection levee.

Shear strength values and associated design parameters for new levee and raised levee construction at the upland placement areas were developed by URS from newly taken CPTs. These data included undrained shear strengths of the cohesive soils. The undrained shear strength assigned to the weakest layers was 500 pounds per square foot (psf). The shear strength of the dredged material was assumed to increase slightly with consolidation over time. An undrained shear strength of 700 psf was assigned to the partially consolidated dredged material. The shear strength of cohesionless soils was based on correlations between CPT data and angle of internal friction.

Recommendations for additional investigation and laboratory testing to refine the design parameters are provided in Section 6.0.

3.3.7 Consolidation

Foundation settlement was evaluated where new levees are planned and where levee raisings are planned. Settlement characteristics of the founding soils were developed from existing subsurface data including soil borings and CPT. Laboratory consolidation tests were not available for review, and no additional testing was conducted for this study. Instead, empirical consolidation relationships were used based on the observed consistency of field samples taken from soil borings and CPT results.

3.4 SLOPE STABILITY AND FOUNDATION CONCERNS

3.4.1 Project Channels

The project channels include three reaches offshore of the Sabine Pass jetties and five reaches onshore (Table 3-1). The existing slope angles for these channels would be maintained for the proposed deepening. Slope angles of 1V:2H are utilized on all channels except the Sabine Pass Outerbar where the slope angle is 1V:10H. The onshore reaches would be deepened to 48 feet while the offshore reaches would be deepened to 50 feet. The channel bottom width onshore is generally 400 feet, while the offshore is generally 700 feet.

Table 3-1: Reaches of the SNWW

Offshore Reaches	Onshore Reaches
Extension Channel	Sabine Pass Channel
Sabine Bank Channel	Port Arthur Canal (including Taylor Bayou)
Sabine Pass Outerbar	Sabine-Neches Canal
Sabine Pass Jetty Channel	Neches River Channel

Channel slope stability was generally evaluated by assessing the performance of the existing slopes through a review of the historic cross-section surveys. In addition, four typical channel cross sections were analyzed by URS for stability using the Modified Bishop analyses. Results indicated that adequate factors of safety were maintained with the deepened channel.

A more detailed analysis of channel slope stability was conducted at the Port Arthur Canal along the alignment of the hurricane flood protection levee as well as at the three bridge locations. This effort was conducted to determine the potential impact to these structures as a result of the channel deepening. These studies revealed potential impacts with corresponding resolutions (Table 3-2).

Table 3-2: Channel Stability Analyses along the SNWW

Location (owner)	Potential Impacts	Resolution
Port Arthur Canal and Sabine-Neches Canal – Hurricane Flood Protection Levee (JCND)	Destabilize toe of hurricane flood protection levee	Shift channel centerline away from the hurricane flood protection levee
Sabine-Neches Canal – Martin Luther King Bridge (TxDOT)	Undermine pile cap and expose tops of piles, destabilize pier protection	Construction of a hardened structure to protect pile cap, piles, and piers
Neches River Channel – Rainbow Bridge (TxDOT)	Destabilize pier protection system	Replace pier protection system
Neches River Channel – Memorial Bridge (TxDOT)	Destabilize pier protection system	Replace pier protection system

JCND = Jefferson County Navigation District
TxDOT = Texas Department of Transportation

3.4.2 Upland Placement Areas

Both existing and new upland PAs would be used for this project. At the existing PAs, new work material would be hydraulically stockpiled on the interior of the levees. Conceptually, this footprint would extend 100 feet into the interior and would ring the levee. It is expected that this stockpile would displace soft material at the interior toe of the levee and create a stable platform on which to build subsequent levees. At the new PAs, the new work material would be used to build hydraulic levees.

After initial construction with new work material, the design of the final perimeter levee heights for the next 50 years was guided by the results of the slope stability analyses. Conceptual level slope stability analyses were conducted by URS on the levees using the Modified Bishop Method and Taylor's Charts. Analyses were performed for each PA for the selected critical section using the least favorable subsurface conditions encountered at the PA as determined using the CPT data. The overall stability of the PAs (i.e., limit on the maximum height) was controlled by the strength of the partially consolidated dredged material. The levee setbacks were selected to provide an acceptable factor of safety with the anticipated relatively low strength of the partially consolidated dredged material. The minimum factor of safety was found to be 1.2 for slope heights not greater than 40 feet above the levee toe for the design slopes and assumed setbacks. Details of the conceptual level design by URS are included in references 7 and 8. More-detailed analyses of the various slope configurations would be required during subsequent levee-raising efforts for specific PAs.

3.4.3 Beneficial Use Features

Preliminary design for the marsh restoration and nourishment sites was conducted in part by Turner Collie & Braden, Inc. (TCB) in the document Feasibility Site Concept Beneficial Use (BU) Development

(Reference 2). The preliminary design of other features was conducted in-house. These designs included hydraulic levees, foundations, consolidation of dredged material, and slope stability. More-detailed design would be conducted during subsequent PED phases.

3.5 CONSTRUCTION ISSUES

3.5.1 Excavatability

The proposed deepening would entail dredging new work material. Based on a review of limited existing soil boring data taken during previous studies, the material would range from very soft to very stiff clay and loose to dense sand. No rock is anticipated, and blasting would not be required.

The new work material within the offshore reaches (sections 4, 3, 2, 1, A, B, C, and D) and the adjacent onshore reaches (sections 5 and 6) is likely to consist of soft clay with pockets of stiff clay; some sand may also be encountered. These reaches are located within the historic delta region of the Sabine and Neches rivers where normally lightly consolidated materials are located. Materials in this area may vary as the rivers' discharge meandered through the deltaic zone.

New work material within the onshore reaches of the Port Arthur and Sabine-Neches canals (sections 7, 8, 9, 10, and 11) would likely consist of stiff to very stiff clay. These canals are part of the land cut section of the waterway and were excavated early in the 1900s. The stiff consistency of this material can be attributed to the overconsolidation pressure of the material that was previously overlying the canals.

The Neches River channel is located upstream of the Sabine-Neches canal. The new work material for this channel (sections 12 through 18) would vary from stiff clay to medium-dense sand. These variations can be attributed to the historic meanders of the Neches River, although sand was more abundant in the soil samples from sections 15, 16, 17, and 18. In addition, historically the maintenance dredging in these reaches has contained significant amounts of sand.

Throughout the waterway, conventional dredging plants may be used to dredge the new work material. However, in order to achieve the intent of the new work plan (i.e., stockpiling new work material and building hydraulic levees), larger dredge plants may be required to minimize the degradation of the stiff new work clays (clayball material). Plant requirements should be clearly identified in developing the plans and specifications for this work,

3.5.2 Dredging

Channel deepening of the inshore reaches would require the use of pipeline dredges of sufficient size and power to pump the new work materials to the areas indicated. Hopper dredges would be required to utilize the offshore sites and be capable of precise location and discharge of loads. The dredging industry has sufficient plants and equipment available in this area as well as nationwide, which are capable of accomplishing this work.

3.5.3 Placement Areas

Much of the material to be dredged would consist of new work material made up of stiff clays. The current New Work Plan (NWP) identifies this material to be used for levee building, where new levees are planned, or stockpiling, where existing levees are located. In stockpiled areas, the objective is to use the more dense new work material to displace soft foundation materials on the inside of the existing levees and thus provide a stable platform for future levee raisings. In addition, material may be borrowed from these stockpiles for future levee raisings.

While the new work material is expected to "stack" and be well suited for the proposed construction, specific dredging practices may influence the degree to which this material would stack. These practices include pump distances, pump size, and handling of the pump discharge. Pipeline dredges of sufficient size and power would be required to excavate and pump new work dredged materials to and completely along the inside of the existing perimeter levees. This would require constant monitoring and moving of the dredge discharge pipeline to ensure that the new work clay balls are properly stacked and placed in the proper location along the existing levee side slopes. Stacking of materials in discharge corridors, other than along the inside slopes of existing levees, may be allowed, depending upon the final preparation of plans and specifications for each particular reach of channel. Care should be taken in developing the first contract, plans and specifications to dredge new work material, to ensure that the intent of the NWP is achieved.

3.5.4 Beneficial Use Features

The BU features have been identified to receive both new work and maintenance dredged materials and are further discussed in Section 5.3. With the exception of the shoreline nourishment features, these sites would generally consist of marsh restoration features. Difficult access (shallow water) would be encountered at each of the marsh restoration sites. These conditions would require the use of marsh buggies, marsh backhoes, and other pontoon-supported equipment, and airboats. In addition, the size of the sites may limit discharge capacity into the feature and may require the use of Y-valves for more-efficient use of the dredge plant.

4.0 DREDGED MATERIAL QUANTITIES

4.1 NEW WORK MATERIAL

The term "new work" refers to the material below the existing SNWW channel template, which is needed to be removed in order to increase to the new project depth. The new work material quantities were calculated using an overall surface *.dtm generated by the InRoads software program. The surface is a 3-D representation of the existing SNWW conditions for year 2001. Each channel or canal had its own existing template and proposed template. The template is a trapezoidal shape, defined by bottom width and side slopes. The proposed new template also includes a standard advance maintenance and the allowable overdepth per reach (see tables 4-2 and 4-3). New work material volumes by reach and proposed PAs (the NWP) are presented in Table 4-1.

Table 4-1: Sabine-Neches Waterway New Work Dredging Volumes for 48-foot LPP Plan

<table>
<tr><th>Channel Reach</th><th>Channel Stations</th><th>Water-way Section</th><th>New Work Material Designation (PA #)</th><th>Estimated New Work Dredged Volume (cy)**</th><th>New Work Material Construction</th><th>New Work Material Used for Construction Volume (cy)</th><th>New Work Material Surplus Volume (cy)</th></tr>
<tr><td rowspan="4">Sabine Bank Extension</td><td>165+443 to 150+500</td><td>D</td><td>PA D (Offshore)</td><td>4,201,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>150+500 to 132+000</td><td>C</td><td>PA C (Offshore)</td><td>4,648,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>132+000 to 114+000</td><td>B</td><td>PA B (Offshore)</td><td>5,296,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>114+000 to 95+734</td><td>A</td><td>PA A (Offshore)</td><td>4,592,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Sabine Bank Channel</td><td>95+734 to 53+000</td><td>1</td><td>PA 1 (Offshore)</td><td>8,307,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Sabine Bank Channel</td><td>53+000 to 18+000</td><td>2</td><td>PA 2 (Offshore)</td><td>7,051,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Sabine Outer Bar</td><td>18+000 to 0+000</td><td>3</td><td>PA 3 (Offshore)</td><td>5,923,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Sabine Pass Jetty Channel</td><td>–214+88 to 0+00</td><td>4</td><td>PA 4 (Offshore)</td><td>2,978,000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td rowspan="3">Sabine Pass Channel</td><td>0+00 to 186+00</td><td>5</td><td>PA 5 (N and S)</td><td>4,459,600</td><td>New Hyd. levee; 400-foot-wide stockpile</td><td>3,104,137</td><td rowspan="3">1,093,593</td></tr>
<tr><td rowspan="2">186+00 - 296+25</td><td rowspan="2">6</td><td>PA 5B</td><td rowspan="2">2,263,600</td><td>400-foot-wide stockpile</td><td>1,362,051</td></tr>
<tr><td>PA 5C</td><td>400-foot-wide stockpile</td><td>1,163,419</td></tr>
<tr><td rowspan="4">Port Arthur Canal</td><td>0+00 –240+00</td><td>7</td><td>PA 8</td><td>5,026,000</td><td>Stockpile in southwest corner</td><td>5,026,000</td><td>0</td></tr>
<tr><td rowspan="3">240+00 –325+84</td><td rowspan="3">8*</td><td>PA 8</td><td rowspan="3">6,671,200</td><td>Stockpile in southwest corner</td><td>3,691,462</td><td>0</td></tr>
<tr><td>PA 9A</td><td>300-foot-wide stockpile</td><td>1,898,938</td><td>0</td></tr>
<tr><td>PA 9B</td><td>300-foot-wide stockpile</td><td>1,080,800</td><td>0</td></tr>
<tr><td rowspan="2">Sabine-Neches Canal</td><td>0+00 –170+00</td><td>9</td><td>PA 8</td><td>3,092,000</td><td>Stockpile in northeast corner</td><td>3,092,000</td><td>0</td></tr>
<tr><td>170+00 –592+91</td><td>10</td><td>PA 11</td><td>8,852,000</td><td>Stockpile in north-south corners</td><td>8,852,000</td><td>0</td></tr>
</table>

Table 4-1 Cont'd)

Channel Reach	Channel Stations	Water-way Section	New Work Material Designation (PA #)	Estimated New Work Dredged Volume (cy)**	New Work Material Construction	New Work Material Used for Construction Volume (cy)	New Work Material Surplus Volume (cy)
Neches River Channel	0+00 –96+00	11	PA 12	1,628,000	100-foot-wide stockpile	1,135,764	74,029
			PA 13		100-foot-wide stockpile	418,207	
	96+00 – 58+00	12	PA 14	698,000	100-foot-wide stockpile	522,906	–362,241
			PA 16		100-foot-wide stockpile	537,335	
	158+00 –292+00	13	Old River Cove	4,882,000	Marsh BU	4,882,000	0
	292+00 –422+00	14	PA 18	2,213,000	100-foot-wide stockpile	870,540	49,295
			PA 18A		New Hyd. Levee	293,164	
			Bessie Heights East		Hyd. Levee System	1,000,000	
	422+00 –522+00	15	PA 21	2,611,000	100-foot-wide stockpile	397,094	1,739,808
			PA 23A		New Hyd. Levee	474,098	
	522+00 –716+00	16	PA 23	4,106,000	400-foot-wide stockpile	2,728,359	–1,766,345
			PA 24		400-foot-wide stockpile	2,624,786	
			PA 24A		New Hyd. Levee	519,200	
	716+00 –776+00	17	PA 25	2,845,000	200-foot-wide stockpile	2,263,932	20,009
			PA 25A		New Hyd. levee; 100-foot-wide stockpile	561,060	
	776+00 –980+00	18	PA 25	6,031,000	50-foot-wide stockpile	421,197	96,456
			Rose City East		Hyd. Levee System	2,100,000	
			PA 26		400-foot-wide stockpile	1,773,504	
			PA 27A		200-foot-wide stockpile	1,136,376	
			PA 27C		New Hyd. Levee	283,200	
			PA 27D		New Hyd. Levee	220,267	
TOTAL				98,374,400		54,433,796	944,604

* Includes new material from Taylor Bayou (0+00 to 106+25).
** New work volume includes additional advance maintenance and proposed allowable overdepth.
cy = cubic yards

4.1.1 Allowable Overdepth

An additional depth outside the required template is permitted to allow for inaccuracies in the dredging process. District commanders may dredge a maximum of 2 feet of Allowable Overdepth in coastal regions and in inland navigation channels (ER 1130-2-520, *Navigation and Dredging Operations and Maintenance Policies)*. This additional dredging allowance is referred to as a dredging tolerance, or allowable overdepth (AO). AO for the existing channel varied between 1 to 2 feet AO. The proposed waterway would contain a constant 2 feet AO for the entire length (Table 4-2).

Table 4-2: Allowable Overdepth
Existing and Proposed Project

Reach	Allowable Overdepth (feet)
Port Arthur Canal (0+00 to 290+00)	1
Increase to Maximum Allowed	2
**Port Arthur Junction	1
Increase to Maximum Allowed	2
Taylor Bayou (Old Sta. 31+10 to 106+25, East TB)	1
Increase to Maximum Allowed	2
Sabine-Neches Canal (40+00 to 592+91)	1
Increase to Maximum Allowed	2
Neches River Channel (0+00 to 320+00)	1
Increase to Maximum Allowed	2
Neches River Channel (320+00 to 440+00)	1
Increase to Maximum Allowed	2
Neches River Channel (440+00 to 978+00)	1
Increase to Maximum Allowed	2

4.1.2 Nonpay Dredging

Nonpay dredging is dredging outside the paid AO that may occur due to such factors as unanticipated variations in substrate, incidental removal of submerged obstructions, or wind or wave conditions. There are no known conditions that would indicate that the contractor would require extensive dredging in order to cut the proposed channel template. Thus, the new work volumes do not include any estimate of nonpay dredging.

4.1.3 Non-Federal Dredging

Non-Federal dredging quantities vary throughout the length of the waterway. The non-Federal dredging quantity is defined as a percentage of the channel shoaling by section and can be found in Table 4-4. The non-Federal dredge quantity is based on the presence of local facilities, the square foot of the facility, and the shoaling rate of the adjacent channel. The non-Federal quantities are placed within the same placement areas for each waterway section.

4.2 ADVANCE MAINTENANCE

Advance maintenance consists of dredging deeper than the authorized channel dimensions so as to provide for the accumulation and storage of sediment. In critical and fast-shoaling areas, it is required to avoid frequent redredging and to ensure the reliability and least overall cost for operating and maintaining the project authorized dimensions. The existing waterway has a constant 2-foot advance maintenance depth. This 2 feet was assumed to remain constant for the proposed waterway. During Detail Design phase, an analysis was performed to determine any changes in dredging frequencies and if additional advance maintenance would be required. Results are presented in Table 4-3. The proposed advance maintenance increase is the depth that is required to allow the proposed dredging frequency to remain the same as the existing operations and maintenance (O&M) dredging frequency. The additional advance maintenance depths were calculated in 1-foot increments. Channel sections with additional advance maintenance are indicated on project maps in the Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS).

Table 4-3: Advance Maintenance Increase

Reach	Proposed Advance Maintenance Increase (feet)
Outer Bar Channel (0+000 to 18+000)	4
Sabine Pass Channel (100+00 to 180+00)	3
Sabine Pass Channel (230+00 to 295+61)	3
Port Arthur Canal (0+00 to 290+00)	1
Port Arthur Junction (as shown on Drawing C-21 in Appendix 1 of the FFR)	5
Port Arthur Canal (285+00 to 326+37)	5
Taylor Bayou (0+00 to 41+20)	5
Taylor Bayou (31+10 to 106+25, East TB)	1
Sabine-Neches Canal (0+00 to 40+00)	5
Sabine-Neches Canal (31+10 to 592+91)	1
Neches River Channel (440+00 to 978+00)	2

4.3 DREDGING FREQUENCY

The dredging cycle of a channel is defined by the average number of years between the O&M dredging operations for a historical period. Each channel or canal has its own dredging frequency. The District's Dredging Histories Database Management System contains this information and is the major source for the ERDC's Sediment Study Report. It is assumed for the new project that the dredging frequency would not change and would remain identical to the existing waterway. Frequency can be seen in Table 4-4.

4.4 PREDICTED SHOALING RATES

The ERDC desktop study for sediment-related problems produced shoaling estimates based on entire reaches, and therefore, an adjustment was performed on the ERDC values to approximate the dredging sections. These dredging sections are defined as shown on the drawings and used for the construction contracts. Using the assumption that shoaling is linearly uniform along the width and length, the breakout for the following dredging sections can be seen in Table 4-4.

Table 4-4: Predicted Shoaling by Dredging Sections

Channel	Dredging Section	Channel Reach	O&M Cycle Frequency (year)	Shoaling cy/Cycle
Extension Channel	Section D	Stations 165+443 to 150+500	4	647,000
Extension Channel	Section C	Stations 150+500 to 132+000	4	801,000
Extension Channel	Section B	Stations 132+000 to 114+000	4	779,000
Extension Channel	Section A	Stations 114+000 to 95+734	4	791,000
Sabine Bank Channel	Section 1	Stations 95+734 to 53+000	4	1,508,000
Sabine Bank Channel	Section 2	Stations 53+000 to 18+000	2	3,131,000
Sabine Pass Outer Bar Channel	Section 3	Stations 18+000 to 0+000	1	4,473,000
Sabine Pass Jetty Channel	Section 4	Stations –214+88 to 0+00	5	1,352,700
Sabine Pass Channel	Section 5	Stations 0+00 to 186+00	3	977,900
Sabine Pass Channel	Section 6	Stations 186+00 to 296+25	3	1,195, 900
Port Arthur Canal	Section 7	Stations 0+00 to 240+00	3	2,148,600
Port Arthur Canal	Section 8*	Stations 240+00 to 325+84	2	1,939,200
Sabine-Neches Canal	Section 9	Stations 0+00 to 170+00	2	1,317,000
Sabine-Neches Canal	Section 10	Stations 170+00 to 592+91	4	3,360,000
Neches River Channel	Section 11	Stations 0+00 to 96+00	3	669,000
Neches River Channel	Section 12	Stations 96+00 to 158+00	3	432,000
Neches River Channel	Section 13	Stations 158+00 to 292+00	3	934,000
Neches River Channel	Section 14	Stations 292+00 to 422+00	4	1,163,000
Neches River Channel	Section 15	Stations 422+00 to 522+00	6	965,000
Neches River Channel	Section 16	Stations 522+00 to 716+00	6	1,879,000
Neches River Channel	Section 17	Stations 716+00 to 776+00	6	581,000
Neches River Channel	Section 18	Stations 776+00 to 980+00	6	1,976, 100

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

4.5 MAINTENANCE MATERIAL QUANTITIES

The 50-year quantity of maintenance material from the existing 40-foot project (Base Plan) is shown in Table 4-5. The quantity was determined by reviewing maintenance dredging contracts within the project area and applying an incremental increase due to the widened and deepened channel. Shoaling rates for the new channel were developed by the USACE's Coastal and Hydraulics Laboratory at ERDC in Vicksburg, Mississippi. Annual dredging quantity in the SNWW would increase from an average of 8.1 mcy for the current 40-foot project to 13.0 mcy for the proposed 48-foot project. Material from four of the reaches (Extension Channel, Sabine Bank Channel, Sabine Pass Outerbar Channel, and Sabine Pass Jetty Channel) is placed in Ocean Dredged Material Disposal Sites (ODMDSs) as described in Appendix B of the FEIS. The Environmental Protection Agency (EPA) must formally designate the four new ODMDSs A–D located along the Extension Channel before they can be used. The Gulf Shore BU Feature (TX 8-11 and LA 5-2/6-2), described in Section 5.3.5 below, was found to be a least-cost measure and it has been adopted for Section 5 of the Sabine Pass Channel as part of the Base Plan.

Table 4-5: 50-Year Maintenance Material Base Plan *

(SNWW FEASIBILITY STUDY – 40-FOOT PROJECT – 50-YEAR DMMP SUMMARY)

Channel Reach	Channel Stations	Waterway Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	50-Year Maintenance Material Total (cy)
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	2,512,800	4	12	30,153,600
	53+000 to 18+000	2	PA 2 (Offshore)	1,722,400	4	12	20,668,800
Sabine Pass Outer Bar Jetty Channel	18+000 to 0+000	3	PA 3 (Offshore)	1,993,700	1	50	99,685,000
Sabine Pass Jetty Channel	-215+59 to 0+00	4	PA 4 (Offshore)	1,138,500	5	10	11,385,000
Sabine Pass Channel	0+00 to 186+00	5	TX 8-11/LA 5-1/6-1	860,100	3	16	13,761,600
	186+00 to 295+60	6	PAs 5N, 5S, 5B, and 5C	1,051,800	3	16	16,828,800
Port Arthur Canal*	0+00 to 240+00	7	PA 8	1,890,000	3	16	30,240,000
	240+00 to 326+24	8*	PAs 8, 9, and 9A	2,320,350	2	25	58,008,750
Sabine-Neches Canal	0+00 to 170+00	9	PA 8	1,219,400	2	25	30,485,000
	170+00 to 592+91	10	PA 11	2,469,800	4	12	29,637,600
Neches River Channel	0+00 to 96+00	11	PAs 12 and 13	491,900	3	16	7,870,400
	96+00 to 158+00	12	PA 14	317,700	3	16	5,083,200
	158+00 to 292+00	13	PAs 16 and 17	686,600	3	16	10,985,600
	292+00 to 422+00	14	PAs 18 and 21	855,000	4	12	10,260,000
	422+00 to 522+00	15	PAs 23 and 23A	771,900	6	8	6,175,200
	522+00 to 716+00	16	PA 24	1,380,500	6	8	11,044,000
	716+00 to 776+00	17	PA 25	426,960	6	8	3,415,680
	776+00 to 980+00	18	PAs 25A, 26, 27A, 27C, and 27D	1,451,700	6	8	11,613,600
							407,301,830

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

5.0 BORROW AND DISPOSAL

5.1 PLANNING CONSIDERATIONS

The utilization of borrow material and the handling of disposal material is a complex order for this project given the length of channel improvements. An ODMDS plan (Appendix B of the SNWW CIP FEIS) and this DMMP, which includes an NWP, have been developed to evaluate borrow and disposal requirements of specific areas of the SNWW. These reports contain detailed information pertaining to the utilization of specific existing and new PAs and BU sites for disposal of new work and maintenance dredged materials. The placement plan for both new work and maintenance material incorporates BU features developed by the ICT. Engineering criteria for the DMMP were developed in-house with preliminary reports provided by URS (Reference 7). The ODMDS was developed by PBS&J in consultation with the EPA (Reference 3). These plans are summarized in the following paragraphs. Additional details can be found under the separate reports.

The dredged material management along the waterway was evaluated based on 22 subdivided dredging sections. Eight of these sections were located offshore, with Section 4 located at the jetties; sections 3, 2, and 1 extending offshore, within the existing channel alignment; and sections A, B, C, and D extending farther offshore as the channel extension for the new alignment. Fourteen dredging sections were located inshore, with Section 5 located upstream of the jetties and Section 18 located at the terminus of the channel at the Beaumont turning basin on the Neches River. These dredging sections were developed for cost-estimating purposes for the feasibility report. Actual dredging sections for contracting and construction may vary from those identified herein.

In developing the DMMP, a variety of uses, including BU, construction material, and general disposal, were identified for the dredged material, both new work and maintenance. Preliminary designs, including assumptions and quantity requirements, for these uses are presented in the DMMP and NWP and are briefly discussed in the following paragraphs. The following prioritization of use was established in developing these documents:

a. New hydraulic levee construction (highest priority for new work material)
b. Stockpile new work material along the interior of existing levees for future use
c. Feature construction with new work material for restoration and nourishment sites
d. Feature construction with maintenance material for restoration and nourishment sites
e. General disposal of new work and maintenance material in PAs

The DMMP was used as a tool to distribute both the new work and maintenance dredged materials for the feasibility level design. It is anticipated that this plan would change over time as scope or priorities change and contracts are developed. These changes would be reflected during subsequent PED phases, and changes affecting restoration and nourishment sites would be coordinated with the SNWW ICT to ensure that obligations for offsetting impacts of the SNWW CIP are fulfilled.

5.2 UPLAND PLACEMENT AREA DESCRIPTIONS

5.2.1 Overview

Sixteen PAs would be used to manage the CIP's new work and maintenance material over a 50-year period, as described below (Table 5-1). Twelve of these PAs are currently used on the existing project, while four PAs are currently not utilized. Two new cells to two existing PAs have been proposed. All of these PAs are confined with water discharged from the sites via controlled spillways to outfall canals and drainage ditches. For purposes of the DMMP and NWP, the levees are assumed to be at least 4 feet above the interior PA elevation. At some PAs, a stockpile of new work material would ring the perimeter levees as identified in the NWP. The stockpile would serve to displace soft material and provide a stable platform for future levee raising and also provide a material source for subsequent levee construction. Where new levees are required, hydraulic fill levees would be constructed using new work material. The design template provides a 100-foot crest width, 3:1 side slopes, and a 6-foot height. The locations of each PA are shown on drawings C-1 through C-12 in Appendix 1 of the FFR.

Table 5-1: Upland PAs for the Preferred Alternative

Placement Area	Additional Cell(s)	Size (acres)	Associated Waterway Section
5	N&S, B, C	957	Sabine Pass Channel (sections 5 and 6)
8		3,570	Port Arthur Canal (sections 7 and 8) Sabine-Neches Canal (Section 9)
9A	B	481	Port Arthur Canal (Section 8)
11		2,170	Sabine-Neches Canal (Section 10)
12		355	Neches River Channel (Section 11)
13		140	Neches River Channel (Section 11)
14		255	Neches River Channel (Section 12)
16		288	Neches River Channel (Section 12)
17		316	Not Used for New Work Material
18	A*	432	Neches River Channel (Section 14)
21		135	Neches River Channel (Section 15)
23	A**	773	Neches River Channel (sections 15 and 16)
24	A*	575	Neches River Channel (Section 16)
25	A**	820	Neches River Channel (sections 17 and 18)
26**		192	Neches River Channel (Section 18)
27	A, C**D**	270	Neches River Channel (Section 18)

* = New cells (PAs 18A and 24A), which enlarge existing PAs.
** = Undeveloped cells.

5.2.2 Levee Raisings

The DMMP identifies periodic levee raisings to accommodate specific dredging cycles. A summary of the final levee design elevations as developed for this study is presented in Table 5-2. A 4-foot levee raising was assumed for each increment. A maximum levee height of 40 feet was assumed. In developing the DMMP, minimal interior dewatering was assumed. Current practice along the waterway does not include the use of an active Disposal Area Management Plan (DAMP) in which trenching and dewatering methods are used to maximize shrinkage and thus maximize storage within upland PAs. Therefore, in developing the DMMP for the FFR, it was assumed that DAMPing would not be used. A shrinkage factor of 0.80 was assumed. A regular DAMPing program has been used at select PAs on the Houston Ship Channel, and shrinkage factors on the order of 0.45 have been achieved.

Table 5-2: Summary of Placement Area Final Levee Design Elevations

PA	Assumed Initial Elevation	Final Elevation	Change in Height (feet)	PA	Assumed Initial Elevation	Final Elevation	Change in Height (feet)
5	18	26	8	18A	8	16	8
8	15	27	12	21	12.5	20.5	8
9A	28	36	8	23	13.5	17.5	4
9B	17	41	24	23A	8	12	4
11	11.2	23.2	12	24	14	30	16
12	24	28	4	24A	8	28	20
13	19	31	12	25	10	12	4
14	13	29	16	25A	8	20	12
16	13.5	21.5	8	26	22	34	12
17	12	20	8	27A	26	38	12
18	16	20	4	27C, D	17	29	12

5.2.3 LPP Placement Plans

The new work material placement plan for the proposed 48-foot LPP is summarized in Table 4.1. The 50-year plan for maintenance material is presented in Table 5-3. Plans for the utilization of each PA through the project life are provided below. The 16 existing PAs that would be used for the CIP are discussed first, followed by the two new PA cells that would be needed. The location of each PA is shown on drawings C-1 through C-12 in Appendix 1 of the FFR.

5.2.3.1 Existing PAs

Placement Area Nos. 5 (N&S), 5B, and 5C

PAs 5 (N&S), 5B, and 5C are located on the east bank of the Sabine Pass Channel in Louisiana and bounded on the east by State Highway (SH) 82 and marshlands. The combined PA consists of 957 acres and is located as shown on Drawing C-09 in Appendix 1 of the FFR. The area would be used to place approximately 6.7 mcy of new work dredged materials from the sections 5 and 6 of the Sabine Pass Channel portion of the project. Prior to placement of new work material, the existing levees would be initially raised about 5.5 feet and new levee reaches raised to match raised existing levees, to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. Three cells would have all the new work materials stockpiled, with berm widths approximately 400 feet placed around the existing levee perimeter. The PA would be used for management of maintenance material from Section 6. The maintenance material from Section 5 would be used for environmental features TX 8-11 and LA 5-2/6-2 – Shoreline Nourishment.

Table 5-3: SNWW Feasibility Study – 48-Foot Project – 50-Year DMMP Summary

Channel Reach	Channel Stations	Waterway Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	Dredging Cycle Schedule	50-Year Maintenance Material Total (cy)
Sabine Bank Extension	165+443 to 150+500	D	PA D (Offshore)	647,000	4	12	Cycle 1 through 12	7,764,000
	150+500 to 132+000	C	PA C (Offshore)	801,000	4	12	Cycle 1 through 12	9,612,000
	132+000 to 114+000	B	PA B (Offshore)	779,000	4	12	Cycle 1 through 12	9,348,000
	114+000 to 95+734	A	PA A (Offshore)	791,000	4	12	Cycle 1 through 12	9,492,000
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	1,508,000	4	12	Cycle 1 through 12	18,096,000
Sabine Bank Channel	53+000 to 18+000	2	PA 2 (Offshore)	3,131,000	2	25	Cycle 1 through 25	78,275,000
Sabine Outer Bar	18+000 to 0+000	3	PA 3 (Offshore)	4,473,000	1	50	Cycle 1 through 50	223,650,000
Sabine Pass Jetty Channel	–214+88 to 0+00	4	PA 4 (Offshore)	1,352,700	5	10	Cycle 1 through 10	13,527,000
Sabine Pass Channel	0+00 – 186+00	5	TX 8-11,	977,900	3	16	LA 5-6: Cycle 1, 3, 5, 7, 9, 11, 13, 15	15,646,400
			LA 5-6				TX 8-11: Cycle 2, 4, 6, 8, 10, 12, 14, 16	
	186+00 – 296+25	6	PA 5 (N and S)	824,700	3	16	Cycle 1 through 16	13,195,200
			PA 5B	243,700	3	16	Cycle 1 through 16	3,899,200
			PA 5C	127,500	3	16	Cycle 1 through 16	2,040,000
Port Arthur Canal	0+00 – 240+00	7	PA 8	2,148,600	3	16	Cycle 1 through16	34,377,600
	240+00 – 325+84	8*	PA 8	1,317,000	2	25	Cycle 1 through 25	32,925,000
			PA 9A	311,100	2	25	Cycle 1 through 25	7,777,500
			PA 9B	311,100	2	25	Cycle 1 through 25	7,777,500
Sabine-Neches Canal	0+00 – 170+00	9	PA 8	1,317,000	2	25	Cycle 1 through 25	32,925,000
	170+00 – 592+91	10	PA 11	3,360,000	4	12	Cycle 1 through 12	40,320,000

Table 5-3 (Cont'd)

Channel Reach	Channel Stations	Waterway Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	Dredging Cycle Schedule	50-Year Maintenance Material Total (cy)
Neches River Channel	0+00 – 96+00	11	PA 12	479,800	3	16	Cycle 1 through 16	7,676,800
			PA 13	189,200	3	16	Cycle 1 through 16	3,027,200
	96+00 – 158+00	12	PA 14	432,000	3	16	Cycle 1 through 16	6,912,000
	158+00 – 292+00	13	PA 16, TX 5-2	445,400	3	16	TX 5-2: Cycle 1–9, PA 16: Cycle 10–16	7,126,400
			PA 17, TX 5-2	488,600	3	16	TX 5-2: Cycle 1–9, PA 17: Cycle 10–16	7,817,600
	292+00 – 422+00	14	PA 18, TX 5-2	740,500	4	12	TX 5-2: Cycle 1–7, PA 18: Cycle 8–12	8,886,000
			PA 18A, TX 5-2	145,600	4	12	TX 5-2: Cycle 1–7, PA 18A: Cycle 8–12	1,747,200
			PA 21, TX 5-2	276,900	4	12	TX 5-2: Cycle 1–7, PA 21: Cycle 8–12	3,322,800
	422+00 – 522+00	15	PA 23, TX 5-2	629,200	6	8	TX 5-2: Cycle 1–4, PA 23: Cycle 5–8	5,033,600
			PA 23A, TX 5-2	335,800	6	8	TX 5-2: Cycle 1–4, PA 23A: Cycle 5–8	2,686,400
	522+00 – 716+00	16	PA 24	1,267,900	6	8	Cycle 1 through 8	10,143,200
			PA 24A	611,100	6	8	Cycle 1 through 8	4,888,800
	716+00 – 776+00	17	PA 25	581,000	6	8	Cycle 1 through 8	4,648,000
	776+00 – 980+00	18	PA 25A, TX 3-1E	542,900	6	8	TX 3-1E: Cycle 1, PA 25A: Cycle 2–8	4,343,200
			PA 26, TX 3-1E	595,600	6	8	TX 3-1E: Cycle 1, PA 26: Cycle 2–8	4,764,800
			PA 27A, TX 3-1E	397,100	6	8	TX 3-1E: Cycle 1, PA 27A: Cycle 2–8	3,176,800
			PA 27C, TX 3-1E	269,900	6	8	TX 3-1E: Cycle 1, PA 27C: Cycle 2–8	2,159,200
			PA 27D, TX 3-1E	170,600	6	8	TX 3-1E: Cycle 1, PA 27D: Cycle 2–8	1,364,800
*Includes maintenance material from Taylor Bayou (0+00 to 106+25)						**50-Year Maintenance Material Total**		**650,372,200**

Placement Area No. 8

PA 8 is located in Sabine Lake and is bounded by Sabine Lake to the east and Pleasure Island to the west. Reportedly, all but the far west side of this PA has been constructed of dredged material. The far west side of the PA was part of the original Sabine Lake shoreline before the waterway was dredged in the early 1900s. The PA is approximately 3,570 acres in size and is located as shown on drawings C-06, 07, and 08 in Appendix 1 of the FFR. Approximately 5.0 mcy of new work material from Section 7 would be dredged to this site. Approximately 3.7 mcy of new material would be dredged from a portion of Section 8 of the Port Arthur Canal and 3.9 mcy from Section 9 of the Sabine-Neches Canal. Prior to placement of new work material, the existing levees would be initially raised 1 foot to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. The new work material would be stockpiled within the southwest corner of the PA from Section 7 and Section

8 and the northeast corner from Section 9. The PA has also been designated to handle about 2.1 mcy of maintenance material from Section 7 on a 3-year cycle and about 2.6 mcy of maintenance material from sections 8 and 9 on a 2-year cycle.

Placement Area No. 9A and 9B

PA 9A is located on the west bank of the Port Arthur Turning Basin near the junction of the Gulf Intracoastal Waterway (GIWW) and Taylor Bayou. This placement area is approximately 318 acres in size and is located as shown on Drawing C-07 in Appendix 1 of the FFR. Placement Area No. 9B is located adjacent to and west of PA 9A at the intersection of the GIWW and Taylor Bayou. It is rectangular and encompasses about 163 acres with a perimeter of 8,200 linear feet as shown on Drawing C-07 in Appendix 1 of the FFR. Based on dated aerial photographs, the site appears to be ringed with a short levee. PA 9A, along with PA 9B, would be used to contain approximately 3.0 mcy of new work dredged material from predominantly from Taylor Bayou (Section 8). This material would be stockpiled (berm widths approximately 300 feet) around the existing levee along the entire perimeter of PAs 9A and 9B. Prior to placement of new work material at 9B, the existing levees would be initially raised about 2 feet to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. PA 9A does not require a levee lift. Approximately 311,000 cy each of maintenance material would be placed in PAs 9A and 9B on a 2-year cycle.

Placement Area No. 11

PA 11 is located in Sabine Lake and is bound on the west by Pleasure Island. Like PA 8, PA 11 was apparently constructed of dredged material except along the west side of the island. The far west side of the PA was part of the original Sabine Lake shoreline before the waterway was dredged in the early 1900s. The SNND has photographs illustrating this land cut and the original shoreline. This PA is about 2,170 acres in size and is located as shown on drawings C-05 and C-06 in Appendix 1 of the FFR. It would be used to stockpile approximately 8.8 mcy of new work dredged material (at the north and south corners of the PA) from Section 10 and contain 3.4 mcy of maintenance dredged material from Section 10 of the Sabine-Neches Canal portion of the project. Section 10 would be dredged on a 4-year cycle.

Placement Area No. 12

PA 12 is located on the west side of an abandoned section of the Sabine-Neches Canal. It is bounded to the west by SH 87, on the north by PA 13, and to the south by low-lying areas and marshes. This placement area is 355 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 1.1 mcy of new work dredged material would be stockpiled in PA 12 around the existing levee along the perimeter, using a berm width of 100 feet. PA 12 would be used to contain 480,000 cy of maintenance dredged material per 3-year cycle from Section 11.

Placement Area No. 13

PA 13 is located on the south bank of the Neches River. It is bounded on the south by PA 12, on the west by SH 87, and on the east by a county road and a waterfront development area. The placement area is 140 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 400,000 cy of new work dredged material would be stockpiled in PA 13. PA 13 would be used to contain

190,000 cy of maintenance dredged material per 3-year cycle from Section 11 of the Neches River Channel portion of the project.

Placement Area No. 14

PA 14, located on the south bank of the Neches River, is bounded by a refinery to the north, marshlands to the south, a wastewater effluent ditch and SH 87 to the east, and an outfall canal to the west. This placement area is 255 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 525,000 cy of new work dredged material from Section 12 would be stockpiled within PA 14 around the existing levee along the perimeter, using a berm width of 100 feet. PA 14 would be used to contain 430,000 cy of maintenance dredged material per 3-year cycle from Section 12. The levee at PA 14 would require an initial 2 feet levee lift.

Placement Area No. 16

PA 16 is on the south bank of the Neches River and is enclosed by marshlands to the east, south, and west. This placement area is 288 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 540,000 cy of new work dredged material will be stockpiled in PA 16. PA 16 would be used to contain approximately 450,000 cy of maintenance dredged material per 3-year cycle from Section 13. However, the PA would not be utilized for maintenance material placement until year 30 of the 50-year plan. Material from the first nine maintenance dredging cycles would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2), including a large portion of available new work material from Section 14 during the initial deepening. The levee for PA 16 would require an initial 2.5 feet levee lift.

Placement Area No. 17

PA 17 is located on the south bank of the Neches River and is bordered by marshlands on the south and east and by marsh and industrial development to the west. This placement area is 316 acres in size and is located as shown on Drawing C-03 in Appendix 1 of the FFR. Beginning in year 30, it would be used to contain approximately 490,000 cy of maintenance dredged material per 3-year cycle from Section 13. Material from the first nine dredging cycles would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2). PA 17 is not planned to be used for new work material placement.

Placement Area No. 18

PA 18, located on the north bank of the Neches River, is bounded by the Neches River to the southwest and marshlands to the northeast. This placement area is 361 acres in size and is located as shown on Drawing C-03 in Appendix 1 of the FFR. Approximately 870,000 cy of new work dredged material from Section 14 would be stockpiled and placed in PA 18. Beginning in target year 32, PA 18 would be used to contain approximately 740,000 cy of maintenance dredged material per 4-year cycle from Section 14. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2). New work material placed in PA 18 would be stockpiled, berm width of approximately 100 feet, around the existing levee along the perimeter.

Placement Area No. 21

PA 21 is located on the north bank of the Neches River and is bounded by marsh areas to the east and north and an oxbow (abandoned portion of the river) to the west. This PA is 135 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. PA 21 would be used to place approximately 400,000 cy of new work material to be dredged from Section 15. This material would be stockpiled, berm width of approximately 100 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet of levee lift. Beginning in target year 32, PA 21 would be used to contain approximately 280,000 cy of maintenance dredged material from Section 14 on a 4-year cycle. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 23

PA 23 is located on the south bank of the Neches River. It is bounded by the Neches River on the north, marshlands on the west, railroad tracks on the south, and Smith Bluff on the east. This PA is 504 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. PA 23 would be used to place approximately 2.7 mcy of the new work material from Section 16. This material would be stockpiled, berm width of approximately 400 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet of levee lift. Beginning in target year 30, PA 23 would be used to contain approximately 630,000 cy of maintenance dredged material from Section 15 on a 6-year cycle. Initial material (from the first four dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 23A

PA 23A is located adjacent to and south of PA 23. This site is about 269 acres in size as shown on Drawing C-02 in Appendix 1 of the FFR. A pipeline corridor is located at the junction between PA 23 and PA 23A. PA 23A would be used to place approximately 470,000 cy of new work material from Section 15. Beginning in target year 30, PA 23A would be used to contain approximately 340,000 cy of maintenance dredged material from Section 15 on a 6-year cycle. Initial material (from the first four dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 24

PA 24 is located on the north bank of the Neches River and is bounded by the Neches River to the west, the MARAD Reserve Fleet Anchorage to the south, and marshlands to the northeast. This PA is 388 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. Approximately 2.6 mcy of new work dredged material from Section 16 would be stockpiled in PA 24 around the existing levee along the perimeter, at a berm with of approximately 400 feet. PA 24 would be used to contain approximately 1.3 mcy of maintenance dredged material from Section 16 on a 6-year cycle.

Placement Area No. 25

PA 25 is located on the west bank of the Neches River and is bounded by privately maintained canals on the north and south, and by a railroad on the west. This PA is 645 acres in size and is located as shown on Drawing C-01 in Appendix 1 of the FFR. Approximately 2.7 mcy of new work dredged material from sections 17 and 18 would be stockpiled in PA 25, around the existing levee along the perimeter at a berm width of approximately 250 feet. The levee would require an initial 2 feet levee lift. It would be used to contain approximately 580,000 cy of maintenance dredged material from Section 17 on a 6-year cycle.

Placement Area No. 25A

PA 25A is located adjacent to and west of PA 25. The site is about 175 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. Approximately 560,000 cy of new work material from Section 18 would be placed and stockpiled in PA 25A at a berm width of approximately 100 feet. PA 25A would contain approximately 540,000 cy of maintenance dredged material from Section 18 on a 6-year cycle. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E).

Placement Area No. 26

PA 26 is located on the north bank of the Neches River and is bounded on the northeast by Star Bayou and on the west by an oxbow. The Port Arthur Area office indicated that this PA was previously used and should be adequate for use on this project. Aerial photographs, supported by a site visit from district representatives, indicated that the levees are substantially adequate for the first filling. The site is about 192 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. PA 26 would be used to place approximately 1.8 mcy of new work material from Section 18. This material would be stockpiled, berm width of approximately 400 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet levee lift. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E). Additionally, PA 26 would contain approximately 600,000 cy of maintenance dredged material from Section 18 on a 6-year cycle.

Placement Areas No. 27A, 27C, and 27D

PAs 27A, 27C, and 27D are located on the north bank of the Neches River and are bounded on the east and west by marshland and on the west by industry. PA 27A is 128 acres, PA 27C is 87 acres, and PA 27D is 55 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. PAs 27A, 27C, and 27D would be used to place approximately 1.6 mcy of the new work material from Section 18. This material would be stockpiled, berm width of approximately 200 feet, around the existing levee perimeter of PA 27A. In addition, the levee would require an initial levee lift of 2 feet. PAs 27C and 27D would have hydraulic levees constructed. These three PAs would contain approximately 840,000 cy of maintenance dredged material from Section 18 on a 6-year cycle. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E).

5.2.3.2 New PAs

The project utilizes two new upland confined sites to manage new work material from the deepening and maintenance material through the 50-year design period, as described in the following paragraphs.

Placement Area No. 18A

PA 18A is located adjacent to and east of PA 18, at the south end of PA 18. The area is about 71 acres in size as shown on Drawing C-03 in Appendix 1 of the FFR. A new dewatering structure with conveyance ditches would be constructed. In addition to providing additional capacity, this PA would allow more-efficient use of the existing PA 18. The existing ground appears to be flat. New hydraulic levees would be constructed at the site with a lift of 8 feet to a final elevation of 16 feet. PA 18A would receive approximately 300,000 cy of new work material from Section 14. This PA would contain approximately 150,000 cy of maintenance dredged material from Section 14 on a 4-year cycle. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 24A
PA 24A is located adjacent to and north of PA 24. This PA is 187 acres in size and is located as shown on Drawing C-01 in Appendix 1 of the FFR. PA 24A would receive approximately 300,000 cy of new work material from Section 16. It would be used to contain approximately 610,000 cy of maintenance dredged material from Section 16 on a 6-year cycle.

5.3 Beneficial Use Features

5.3.1 Conceptual Design Development

The feasibility/conceptual level designs of the marsh restoration and shoreline nourishment sites were developed in-house and through a contractor (Table 5-4). The designs for some components of the Neches River BU Feature (Rose City East, Bessie Heights East) and the Gulf Shore BU Feature were developed by TCB (Reference 2). These designs included discussions of specific feature and constructability issues such as adequacy of foundation materials, hydraulic levee construction, levee protection, pumping distances, interior filling, circulation development, and plantings. TCB designs were used as the general concept for marsh restoration and shoreline nourishment, but actual plans for the CIP are somewhat different. New work dredged material would be utilized at three BU features (Rose City East, Bessie Heights East, and Old River Cove). Maintenance dredged material would also be used at four features (Rose City East, Bessie Heights East, Texas Point shoreline nourishment, and Louisiana Point shoreline nourishment).

Table 5-4: Summary of Environmental Restoration Sites

	Feature #	BU Feature	Component
New Work Material	TX 3-1E	Neches River BU Feature	Rose City East Marsh Restoration
	TX 5-2		Bessie Heights East Marsh Restoration
	TX 6-1A		Old River Cove Marsh Restoration
Maintenance Material	TX 3-1E	Neches River BU Feature	Rose City East Marsh Restoration
	TX 5-2		Bessie Heights East Marsh Restoration
	TX 8-11	Gulf Shore BU Feature	Texas Point Shoreline Nourishment
	LA 5-1/6-1		Louisiana Point Shoreline Nourishment

Conceptual designs for the measures and BU features were done during the Plan Formulation Phase. The terms “minimization” and “mitigation” are used throughout this appendix to refer to measures that were studied to avoid or compensate impacts from the deepening project. Over 300 minimization and mitigation alternatives were evaluated. General assumptions were used. The least-cost methods were generally used in developing designs. It was assumed that no relocations would be necessary and that rights-of-way and rights-of-entry would be available. Specific field and design data were provided by the Environmental Section. During the Detailed Design phase, the selected mitigation and BU features were individually evaluated and updated. Final measures for mitigation measures can be seen as shown in the FFR, FEIS, and Engineering drawings in Appendix 1 of the FFR. The majority of the measures are for marsh restoration as BU sites and mitigation measures, and these sites are accessible by water. Swamp accessible machinery would be required during construction. Hydraulic levees would be built with the new work dredged material at several sites. The dredge pipeline routes are assumed to be the shortest distance to the middle of the site. Levee side slopes have some type of slope protection: riprap, concrete cellular mats, and/or vegetation. Marsh fill would occur with selective placement of dredged material within the marsh site boundary. Marsh fill can be new work or maintenance material, depending on the measure. Where plantings occur, it is assumed that abundant local species are available. During PED, each site would be analyzed for local drainage requirements, so as not to impede existing area drainage. Also during PED, final marsh designs would be optimized for constructability. The complete descriptions and details can be found in planning documents. Site locations can be found in drawings C-01 through C-28 in Appendix 1 of the FFR.

5.3.2 Neches River BU Feature – Rose City

The conceptual plan calls for restoration of 345 acres of fresh marsh, improvement of 72 acres of shallow water, and nourishment of 151 acres of existing marsh in two construction events (first construction and first maintenance cycle). New work material (approximately 2.1 mcy) from Section 18 would be used to restore 225-acres of marsh and to construct hydraulic containment levees and higher-elevation features. Maintenance material (approximately 540,000 cy) from the first maintenance cycle from Section 18 would be used to restore an additional 120 acres of marsh.

The Rose City East Marsh Restoration Feature is shown on Drawing C-01 in Appendix 1 of the FFR. The marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

5.3.3 Neches River BU Feature – Bessie Heights East

The conceptual plan is to restore 679 acres of brackish and 1,190 acres of intermediate marsh, improve 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. The marsh would be constructed with maintenance material originating from Section 13 during the first nine maintenance cycles, Section 14 during the first seven maintenance cycles, and Section 15 during the first four maintenance cycles. Approximately 1.0 mcy of new work material from Section 14 would be used to build the hydraulic containment levee.

The Bessie Heights East site is located within the much larger Bessie Heights Marsh (Drawing C-24 in Appendix 1 of the FFR). This was a natural emergent marsh that over time has seen the majority of its marsh acreage convert to open water. The site is located on Texas Parks and Wildlife Department (TPWD) property and privately owned land. Bessie Heights East totals 3,180 acres. The revision to the feasibility study design caused Bessie Heights West to be deleted.

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

5.3.4 Neches River BU Feature – Old River Cove

The Old River Cove site TX 6-1 is located north of the Neches River on property owned by TPWD (Drawing C-25 in Appendix 1 of the FFR). Approximately 5.0 mcy of new work material from Section 13 would be used to construct hydraulic levees and restore 639 acres of brackish marsh, improve 139 acres of shallow-water habitat, and nourish 432 acres of existing marsh, as suspended fine-grained sediments disperse beyond restored emergent marsh areas. Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora.

5.3.5 Gulf Shore BU Feature (Texas and Louisiana Points)

The shoreline nourishment sites (TX 8-11 and LA 5-2/6-2) are located on the east and west sides of the Sabine Pass jetties (Drawing C-27 in Appendix 1 of the FFR). Each area begins approximately 0.5 mile from the respective jetty and extends about 3.5 miles away. The land on the Texas side is part of the Texas Point National Wildlife Refuge, while the land on the Louisiana side is privately owned. The conceptual plan calls for placing maintenance material at the shoreline in an unconfined manner. The material would be placed using a pipeline dredge from Section 5 (approximately 1.0 mcy) of the Sabine Pass Channel. Placement would alternate between the Louisiana and Texas shorelines with each complete maintenance cycle, so that each side receives material every 6 years for the 50-year period of analysis, or eight placement episodes. The plan anticipates that much of the material would be redistributed into the littoral system.

5.4 OFFSHORE PLACEMENT AREAS

The project would utilize existing offshore placement sites termed ODMDSs to manage materials from the CIP and maintenance dredging through the 50-year period of analysis. Four existing ODMDSs (1–4) and four new sites (A–D) would be used. New work and maintenance quantities for the 50-year project are provided in Appendix B to the ODMDS FEIS and the Site Management and Monitoring Plan, which is attached as an exhibit to Appendix B of the FEIS.

6.0 ADDITIONAL BORINGS AND LABORATORY TESTING PROGRAM

6.1 SUBSURFACE INVESTIGATIONS

Limited subsurface data were used to develop the feasibility level designs for the project features. Additional explorations to obtain subsurface data would be required to verify and/or revise design assumptions for final design of these features subsequent to the authorization of the project during the PED phase. These explorations would include soil borings, CPTs, and probings. Initial recommendations for exploration and lab testing requirements were developed by URS for channel and placement area concerns and by TCB for environmental restoration concerns (see Reference 2). The initial recommendations were revised to reflect the final feasibility plan. A summary of these recommendations is presented in Table 6-1.

Table 6-1: Summary of Additional Subsurface Explorations

	Soil Borings (number – LF)	CPTs
Channel	84 – 4,720	n/a
Placement Areas	84 – 2,520	224, 11,208
Environmental Features	60 – 1,200	n/a

6.2 LABORATORY TESTING

Laboratory testing would also be required during the PED phase to verify design assumptions regarding the behavior of the foundation and dredged materials. A summary of anticipated lab tests is provided in Table 6-2. While an estimated cost for additional laboratory testing was provided for the feasibility cost estimate, specific quantities of tests would be developed during subsequent exploration and design tasks.

6.3 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE EVALUATION

Information on hazardous, toxic, and radioactive waste (HTRW) sites in the project area was conducted by PBS&J in June 2002; this is summarized in the FEIS. Information from this report was used to determine the probability and severity of encountering HTRW problems at PAs and restoration sites.

Based upon the HTRW assessment and additional in-house research, it has been determined that there are presently no known HTRW sites that would impact the SNWW CIP with the exception of sites of unknown significance in PA 17. Current regulatory agency investigations around PA 17 are being monitored by USACE. If the Environmental Protection Agency investigations identify problems within PA 17, the affected area would be removed from the PA. In the event that investigations of identified sites within PA 17 do not provide sufficient information, waste identification and delineation investigations would have to be conducted by the non-Federal sponsor. If remediation is recommended, PA 17 would be resized to remove areas requiring remediation or abandoned.

Table 6-2: Summary of Additional Laboratory Tests

Moisture content
Atterberg Limits
Grain-size analysis
Consolidation
Triaxial shear
Unconfined compression
Density
Column settling
Self-weight consolidation
Void ratio

7.0 CONSTRUCTION

7.1 CONTRACT SCHEDULE

Fifteen construction contracts are planned. Contracts 1–5 would be constructed with hopper dredges and contracts 6–12 with hydraulic pipeline dredges. The dredging contracts would be accomplished over a period of about 6 years. The ecological mitigation contracts (13–15) would be accomplished early in the construction sequence. Dredging for the mitigation contracts does not involve the use of new work or maintenance material from the SNWW Preferred Alternative. Refer to the FEIS for a description of this work. The proposed sequence for dredge and construction is shown in Table 7-1.

7.2 CONSTRUCTION METHOD

The construction would utilize a combination of traditional and relatively new dredging techniques. Equipment used to dredge the channels would be those traditionally employed: hopper dredges in the offshore reaches and hydraulic pipeline dredges in the other reaches. Disposal of the new work material would be in conventional upland PAs and offshore PAs, as well as the innovative, nontraditional dredging technique of placement into marshes and adjacent shorelines. These techniques are mandated due to the requirements of the mitigation and DMMP restoration and nourishment features. Contracts would be written to not only emphasize the removal of material from the channel, but also emphasize successful completion of mitigation and restoration features so that they would perform to intended purposes.

Table 7-1: Construction Contract Schedule

Contract No.	Contract Schedule	Construction Start (Month/FY)	Construction Finish (Month/FY)
	Hopper Dredging:		
1	**Sabine Bank Extension**	October 2012	January 2013
	Section D Station 165+000 to 165+443		
	Section C Station 165+443 to 132+000		
2	Section B Station 132+000 to 114+000	February 2013	July 2014
	Section A Station 114+000 to 95+734		
3	**Sabine Bank Channel**	October 2015	August 2015
	Section 1 Station 95+734 to 53+000		
4	**Sabine Pass Outer Bar & Bank Channels**	October 2016	March 2017
	Section 2 Station 53+000 to 18+000		
	Section 3 Station 18+000 to 0+000		
5	**Sabine Pass Jetty Channel**	April 2017	September 2017
	Section 4 Station -214+88 to 0+00		
	Pipeline Dredging:		
6	**Sabine Pass Channel**	October 2016	January 2018
	Section 5 Station 0+00 to 186+00		
	Section 6 Station 186+00 to 296+25		
7	**Port Arthur Canal**	October 2012	July 2015
	Section 7 Station 0+00 to 240+00		
	Section 8 Station 240+00 to 325+84		
	Taylor Bayou Basin Area:		
8	**Sabine-Neches Canal**	April 2017	September 2018
	Section 9 Station 0+00 to 170+00		
9	Section 10 Station 170+00 to 592+94	April 2014	May 2017
10	**Neches River Channel**	October 2012	March 2014
	Section 11 Station 0+00 to 96+00		
	Section 12 Station 95+00 to 158+00		
	Section 13 Station 158+00 to 292+00		
11	Section 14 Station 292+00 to 422+00	April 2015	July 2018
	Section 15 Station 422+00 to 522+00		
	Section 16 Station 522+00 to 716+00		
12	Section 17 Station 716+00 to 776+00	October 2012	March 2015
	Section 18 Station 776+00 to 980+00		
13	**Mitigation for Willow Bayou, Louisiana**	October 2015	May 2018
14	**Mitigation for West Black Bayou, Louisiana**	October 2012	February 2014
15	**Mitigation for East Black Bayou, Louisiana**	October 2014	May 2015

7.3 MATERIAL SOURCES AND MATERIAL INVESTIGATIONS

Materials utilized for this project would consist primarily of dredged material, both new work and maintenance. These materials would be used to construct new levees, raise existing levees, create stockpiles, marsh restoration, and shoreline nourishment. In addition, minor amounts of riprap would be used for shoreline protection at selected PAs and for erosion control at outlet structures for all of the PAs.

Dredged material sources were evaluated using existing subsurface data as previously discussed. These data were used to determine various parameters for designing hydraulic levees, filling marsh cell and placement areas, and other related hydraulic structures. Some assumptions were made, based on previous experience with similar materials, regarding degradation of material during dredging operations, material losses during construction, and consolidation of new work and maintenance materials. These assumptions are based on both material types and construction methods. Deviations from these assumptions may impact the quantity of available material for construction. As such, additional investigation of the dredged material sources would be required for final design as discussed in Section 4.3. Furthermore, the final design documents should identify specific construction methods and monitoring methods to ensure that the desired construction outcome is achieved.

The structures and features presented herein are primarily associated with levees related to PAs and levees related to restoration features. These structures and features were sized to accommodate the proposed channel depth (48 feet). The specific types of dredged material would be confirmed during future evaluations as identified in Section 5.0. However, if the project is modified from the one identified in the report, the quantity of specific dredged material would change, and this change should be reflected in the specific design features of this study. That is, if a channel less than 48 feet is authorized, less material would be available for use, and thus the size of the associated features should be reduced accordingly.

Neither soil borings nor laboratory testing were conducted to study the proposed deepening for this feasibility study. Instead, existing data from previous projects were used to evaluate the new work materials. Subsurface data were collected at specific existing placement areas as well as at proposed environmental restoration features. These data are provided in referenced reports.

8.0 <u>REFERENCES</u>

1. *Desktop Study for Sediment-Related Problems at Sabine-Neches Project,* dated June 2005.
2. *Sabine-Neches Waterway Feasibility Site Concept Beneficial Use Development*, Turner Collie and Braden, Inc., July 14, 2003.
3. *Environmental Impact Statement, Sabine-Neches Waterway, Channel Improvement Project, Texas, Ocean Dredged Material Disposal Site Designation*, PBS&J, January 2006.
4. *Hurricane Flood Protection Design Memorandum No. 2 (General Design Memorandum),* Volumes I and II, March 1965.
5. *Design Memorandum No. 2 (Sabine-Neches Waterway, Texas, 40-foot Project and Channel to Echo, Bridge Replacement at Port Arthur, dated May 1964),* prepared by Modjeski and Masters, Inc.

6. *Excel Spreadsheet, SNWN Geotech 30 accts.xls*, outline of additional soil boring and laboratory testing requirements, May 8, 2006.
7. *Sabine-Neches Waterway, 50-foot Project, Dredged Material Management Plan,* prepared by URS Group, Inc., dated April 30, 2004.
8. *Sabine-Neches Waterway, Texas Feasibility Report, Draft Submission of Geotechnical Portion of Engineering Appendix*, prepared by URS Group, Inc. dated August 2004.