Freeport Harbor Channel Improvement Project, Brazoria County, Texas
Draft Integrated General Reevaluation Report and Environmental Assessment
Appendix K
DREDGE MATERIAL MANAGEMENT PLAN

March 2017

1 DREDGED MATERIAL MANAGEMENT PLAN

1.1 PURPOSE

The goal of this Dredged Material Management Plan (DMMP) is to develop a placement plan that will accommodate the placement of new work and maintenance dredged material over 50 years associated with the Freeport Harbor Channel Improvement Project General Revaluation Report (FHCIP GRR). Dredged material management planning for all Federal harbor projects is conducted by USACE to ensure that dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, are economically justified, and to ensure that long-term placement facilities are available. Ultimately, the DMMP identifies specific measures necessary to manage the volume of material likely to be dredged within the FHCIP project over the 50-year period of analysis included in the GRR.

This DMMP considers maintenance and new work dredging volume associated with the FHCIP GRR including: Existing channel to 46 feet MLLW; Proposed Turning Notch, Channel Widening, and Bend Easing to 46 feet MLLW. All new work dredging has an advanced maintenance depth of 2 feet and an allowable overdepth of 1 foot.

1.2 PLACEMENT AREAS

Dredged material placement areas near Freeport Harbor are shown in Figure 1. The Maintenance Ocean Dredged Material Disposal Site (ODMDS) and Placement Area 1 (PA1) are being considered as potential disposal sites in this DMMP. With the recommendation that all maintenance material be placed in the ODMDS, the overall volume of sediment requiring upland confined storage drops dramatically.

This DMMP considers the placement area requirements specifically for the GRR project features and was developed in a manner that avoids potential conflicts with the placement area needs outlined in the DMMP previously developed as part of the 2012 FHCIP Feasibility Study (USACE, 2012b).

1.2.1 MAINTENANCE OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS)

The Maintenance ODMDS is located in the Gulf of Mexico, approximately 2.5 miles southwest from the mouth of the Jetty Channel and approximately 3 miles from shore. The site is located in a dispersive offshore environment with approximately 1,129 acres of bottom area. Due to its dispersive nature, the site can be assumed to have unlimited capacity. Coordinates of control points for the Maintenance ODMDS are presented in Table 1. The maintenance ODMDS previously had restrictions that limited placement to material from certain reaches of the channel. However, currently, 40 CFR Part 228.14 allows material from the entire channel to be placed offshore in the ODMDS.

Table 1 – Maintenance ODMDS Control Points

Control Point Number	Cartesian Coordinates (NAD83, Texas South Central, US Survey Feet)	
	Easting	Nothing
1	3,163,694	13,530,298
2	3,166,836	13,527,077
3	3,157,888	13,518,349
4	3,154,745	13,521,570

1.2.2 PLACEMENT AREA 1

PA1 is located in Freeport roughly 0.5 mile south of State Highway 36 and approximately 1,000 feet east of the Brazos River Diversion Channel (USACE 2012a). The PA is approximately 320 acres, with a perimeter length of approximately 20,310 linear feet. Existing ground elevation is approximately 21 feet NAVD (North American Vertical Datum of 1988) with a dike height of 25 feet NAVD. While the existing capacity of PA1 is approximately 0.8 mcy, the PA is estimated to provide up to 3.4 mcy of capacity if the dikes are raised to 31.5 feet NAVD. This DMMP proposes a dike elevation increase to 31.5 feet NAVD for PA1. This height includes 3 feet for ponding and freeboard above the targeted bulk dredged fill height.

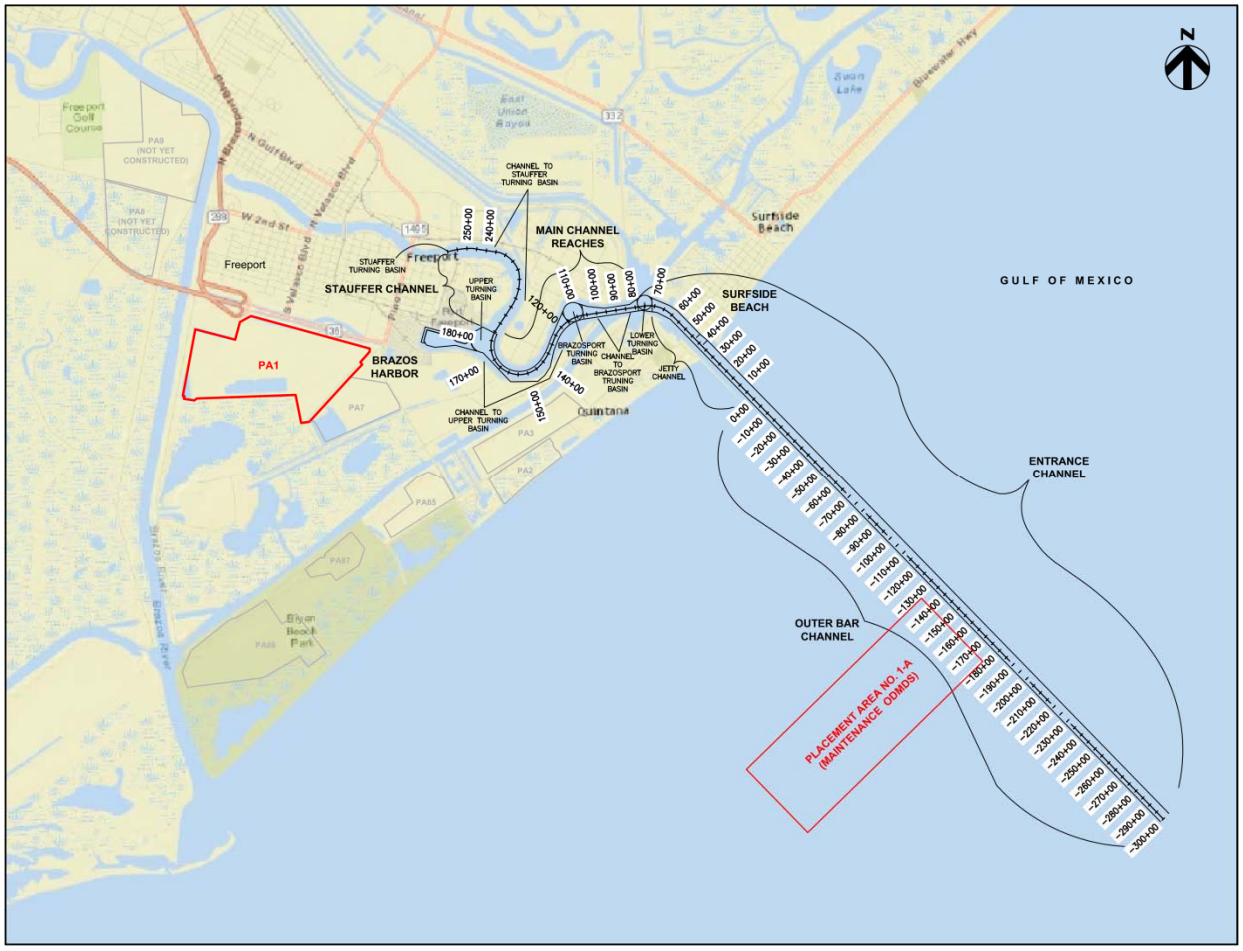

Figure 1 – Dredged Material Placement Areas at Freeport Harbor

1.3 DREDGED MATERIAL FACTORS

1.3.1 BULKING FACTOR

The bulking factor is a design parameter primarily used to develop containment dike height requirements for each dredge event. 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.

$$\text{Bulking Factor} = \frac{\text{(Volume of Material in Placement Area)}}{\text{(Volume of Material in Channel prior to Dredging)}}$$

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 this project, dredging will primarily be conducted hydraulically. The new work dredging for this project will consist of about 80 to 90 percent clays (of primarily stiff consistency with some traces of silts or clayey silts), and about 10 to 20 percent sands of various densities, based on available boring data from the Upper Turning Basin on out to sea.

Development of containment dike height requirements on this project was based on a bulking factor of about 1.3 for maintenance material and about 2 for the portion of new work material anticipated to go into a slurry state before final discharge at the disposal sites. The remaining portion of new work material that will come out of the dredge pipe in the form of solid clay fragments (informally referred to as "clay balls") or segregate from the dredge mixture soon after discharge (such as sands) is anticipated to remain fairly close to the original density from the channel.

1.3.2 RETENTION FACTOR

For calculations and quantities produced on this project, the definition adopted for the term "retention factor" is the fraction of new work material from the channel that, when dredged to the site, retains a degree of consistency from the original in situ state necessary for use as fill materials for hydraulic containment dike and containment dike foundation construction or future borrow for future mechanical containment dike construction; and that, when pumped to the site, tends to accumulate or stack within the general vicinity of the end of the dredge pipe

$$\text{Retention Factor} = \frac{\text{(Volume of Dredged Material Suitable for Containment Dike Fill Material)}}{\text{(Annual Dredging Quantity)}}$$

Variables that can influence this factor include original in situ material properties and consistencies, size of dredge, type and control of cutter head, horsepower, and pump distance. For feasibility level, a retention factor of about 0.5 was assumed for this project.

1.3.3 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.

$$\text{Shrinkage Factor} = \frac{\text{(Long-term Volume in Disposal Area)}}{\text{(Volume in Channel Prior to Dredging)}}$$

Items that affect the shrinkage include the soil composition, pan of evaporation rate, consolidation, desiccation, climatological conditions, drainage efficiency or dewatering measures implemented, and dredging schedule of maintenance material placed at the sites. Determination of a precise shrinkage factor for a placement area can be a complex task and include modeling the consolidation and desiccation

shrinkage based on laboratory test data, climatological data, drainage characteristics, and operational characteristics. For feasibility level, the development of the long-term storage capacity and containment dike height requirements on this project was based on a shrinkage factor of about 0.65 for maintenance material.

1.4 DREDGED MATERIAL CLASSIFICATION

Dredged materials to be removed for the FHCIP GRR were classified by reach. Soil classifications were generally in accordance with Table B-2, "Material Factor" of ER 1110-2-1300. Based on historical boring logs within the vicinity of each reach, the dredged material was classified as soft silty clay, soft silty sand, or soft sandy clay. The results of the calculations by each reach are indicated in Table 2. Due to lack of boring data, soil classification was not performed for the new work on the Stauffer Channel. Historical shoaling data were applied to classify the materials by reach for the future (50-year) maintenance disposal. This information is provided in Table 4.

Table 2 – Classification of New Work Dredged Material Volumes at Freeport Harbor Channel

Reach	From Station	To Station	Soft Silty Sand (cy)	Soft Silty Clay (cy)	Soft Sandy Clay (cy)	Total Quantity (cy)
Bend Easing	147+00	159+85	0	0	1,478,000	**1,478,000**
Turning Notch	175+77	181+41	0	106,000	0	**106,000**
Channel Widening	142+28	184+20	106,000	29,000	15,000	**150,000**
Total New Work Dredged Material at Freeport Harbor Channel	**142+28**	**184+20**	**106,000**	**134,000**	**1,490,000**	**1,734,000**

1.5 DREDGED MATERIAL QUANTITIES

The quantity of new work material for the proposed GRR widening at Freeport Harbor to achieve Alternative 2 at the Freeport Harbor Channel is approximately 1.734 mcy, as classified in Table 2 The quantities were determined using the average end area method.

The quantity of maintenance material to be removed over the 50-year GRR 46 ft project life is estimated to be approximately 15.3 mcy, as presented in Table 4. These quantities were determined by reviewing maintenance dredging contracts within the project area for the last 20 years and applying an incremental increase in dredging due to the widened and deepened channel (HDR, 2016). This quantity includes 120,000 cy of maintenance dredged material estimated to be removed from the Lower Stauffer Channel. Lacking historical dredging records within the Lower Stauffer Channel, sedimentation rates (within the Lower Stauffer Channel) were estimated by reviewing maintenance dredging requirements within the adjacent portion of the Freeport Harbor main channel.

1.6 PLACEMENT PLANS

Placement plans are required to ensure that there is sufficient capacity within the designated placement areas necessary to contain both the new work dredged materials from the widening and deepening of the channel as well as future maintenance material from the repeated dredging of the channel to maintain navigable project depths over a 50-year period.

1.6.1 NEW WORK DREDGED MATERIAL PLACEMENT PLAN

All dredged material for GRR new work, totaling approximately 1.734 mcy, is designated for placement at PA1 by transfer through pipeline. For Placement Area capacity assessment purposes, this DMMP also considers an additional 270,000 cy of WIK dredging that is expected to emerge from new work at the Lower Stauffer Channel as part of the FHCIP. The Lower Stauffer Channel will be improved based on the WRRDA 2014 authorization (WRRDA, 2014).

To consider the material expansion for placement purposes, a combined expansion factor of 1.425 was calculated and applied based on the information in Section 1.3, resulting in a bulked volume of approximately 2.47 mcy. Note that for long term Placement Area assessments, the expansion factor was calculated as 1.13. Table 3 contains the placement plan for new work dredged material.

Table 3 – Placement Plan for New Work Dredged Material

Reach	Stations		In-place Vol. (cy)	Expansion Factor	Expanded Vol. (cy)	Disposal Site
	From	To				
Bend Easing	147+00	159+85	1,478,000	1.425	2,106,150	PA1
Turning Notch	175+77	181+41	106,000	1.425	151,050	PA1
Channel Widening	142+28	184+20	150,000	1.425	213,750	PA1
Total New GRR Work Dredged Material	**142+28**	**198+50**	**1,734,000**	**1.425**	**2,470,950**	**PA1**
Lower Stauffer Channel (WIK)*	184+20	198+50	270,000	1.425	384,750	PA1

* Not part of the GRR, provided for PA capacity assessment purposes only.

1.6.2 50-YEAR MAINTENANCE PLACEMENT PLAN

After the completion of new work dredging for the Freeport GRR and the Lower Stauffer Channel, the project will require periodic maintenance dredging to retain navigability. It is estimated that the Freeport Harbor Channel (Stations 71+52 to 184+20) will receive an annual shoaling volume of approximately 316,000 cy (HDR, 2016) pursuant to the implementation of the GRR features. Additionally, it is estimated that the Lower Stauffer Channel will receive an annual shoaling rate of approximately 2,500 cy. This DMMP is based on maintenance dredging in 3-year cycles for reaches below Station 184+20 and 12-year cycles for reaches above Station 184+20., resulting in a total dredged volume of approximately 15.3 mcy.

All maintenance dredged volume is designated for placement at the Maintenance ODMDS. Table 4 contains the 50-year placement plan for the maintenance dredged material.

Table 4 – 50-Year Placement Plan for Maintenance Dredged Material

Reach	Stations		Annual Vol. (cy)	Cycle Length (year)	Vol. per Cycle (cy)	No. of Cycles	Total Vol. (cy)	Disposal Site
	From	To						
Bend Easing	147+00	159+85	30,900	3	92,700	16	1,483,200	Maintenance ODMDS
Turning Notch	175+77	181+41	10,800	3	32,400	16	518,400	Maintenance ODMDS
Channel Widening	142+28	184+20	12,900	3	38,700	16	619,200	Maintenance ODMDS
Existing Harbor Channel	71+52	184+20	261,000	3	783,000	16	12,528,000	Maintenance ODMDS
Lower Stauffer Channel	184+20	198+50	2,500	12	30,000	4	120,000	Maintenance ODMDS
Total Maintenance Dredged Material	**71+52**	**198+50**	**318,100**	**VARIES**			**15,268,800**	**Maintenance ODMDS**

1.7 BENEFICIAL USE OPPORTUNITIES

In accordance with existing Federal policy and guidance, the potential for BU of the limited quantity of new work material that would be generated by construction of the TSP was given additional consideration beyond the previous USACE (2012c) study. The BU analysis is focused on the limited amount of new work material from the TSP features (1,730,000 cubic yards – primarily soft sandy clay). Based on a review of aerial photography, the nearest potential marsh restoration area is a small degraded marsh area in the southern Oyster Creek watershed, adjacent to the GIWW and just east of the project area (Figure 2). The pumping distance to this area from the Bend Easing feature is about 3.1 miles. The Bend Easing is the TSP feature closest to the BU area and contains the largest amount of new work material. It is possible that approximately 8 acres of marsh could be constructed with the available material. The pumping distance from the Bend Easing feature to PA 1 (the upland, confined placement area identified for material from this area) is about 2.3 miles. The PAs or BU areas selected in the DMMP are those, which provide the needed capacity at the lowest cost per cubic yard. Based solely on pumping distance, the least-cost disposal option would be PA 1 since the closest potential BU site is about 30 percent farther than the proposed upland site (PA 1). The TSP placement area selection is based upon the least-cost, environmentally acceptable alternative. However, the BU plan could be recommended if the NFS or other interested entity were willing to fund the difference (increase) in placement and construction costs over the least cost placement plan for the TSP.

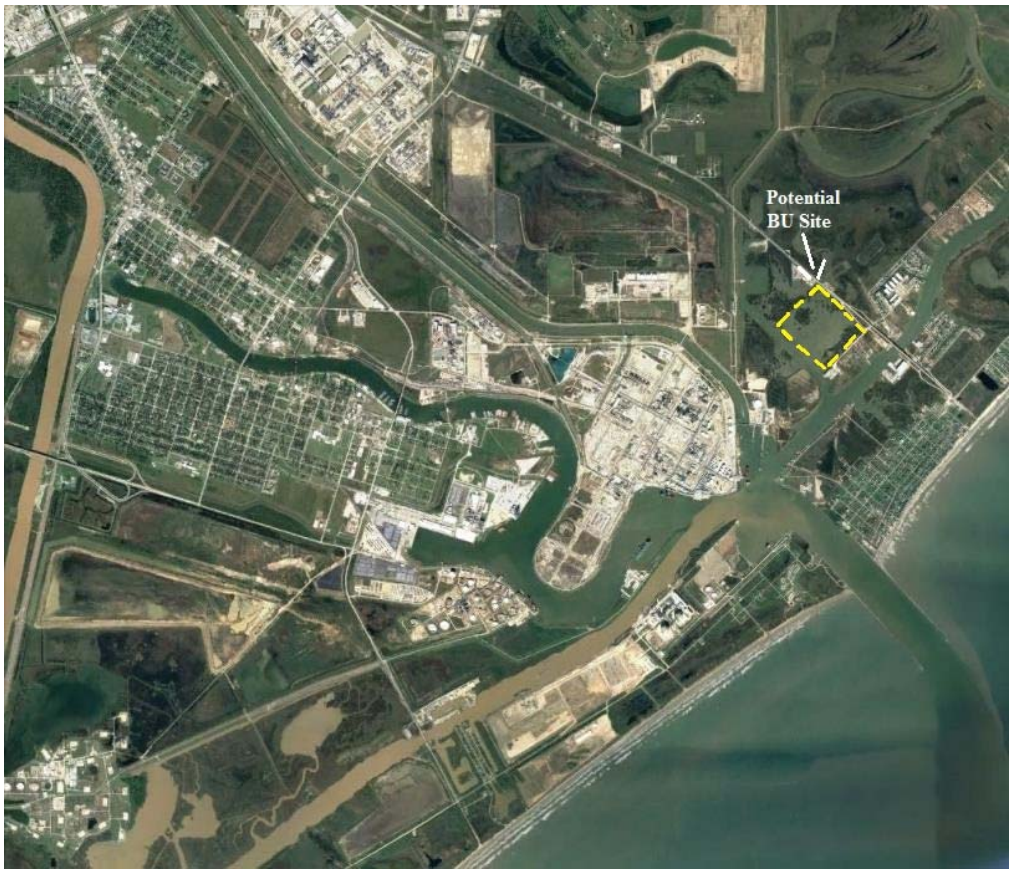

Figure 2 – Potential BU Site

1.8 REFERENCES

HDR Engineering Inc. 2012; "Dredged Material Placement Area Capacity Assessment." HDR Project 173803 presented at the Meeting with Freeport LNG, Freeport, TX; February 24, 2012.

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