APPENDIX C

Engineering

Appendix C
Engineering

As part of the MRGO Deep draft De-authorization study, several engineering-related tasks were assessed. These included: A) an assessment of channel conditions following Hurricane "Katrina"; B) an assessment of O&M dredging quantities and costs required for the restoration of the navigation channel to both partial and full authorized dimensions; C) an assessment of the anticipated shoaling rates within various reaches of the channel, based upon historical dredging records for MRGO channel dredging dating back to the initial construction of the channel and O&M dredging ceased, as well as the timeline for various reaches of the channel to shoal in to depths ranging from -36' to -12'; D) development of conceptual plans for construction of a closure of the MRGO channel in the vicinity of Bayou La Loutre, as well as O&M of said closure; E) an assessment of impacts to navigation and possible alternative routes for navigation interests; and F) Hydraulic considerations for recommended plan. The reach of the channel that was studied, as directed by Congress, runs from the GIWW southeast to the Gulf of Mexico. This analysis does not consider the reach of the channel from Mile 60 to 66 which is contiguous with the GIWW. While some of the findings of these investigations are reported in the main report, this appendix details the procedures and assumptions that were followed to reach those findings. This appendix is intended as supporting information and does not include fully formulated plans or other information considered during the preliminary phase of the study.

Description of Background on the MRGO, Existing Condition, Future Without De-Authorization, Alternative 1, 2, & 3

This appendix supports the description of background on the MRGO, existing conditions, future without de-authorization, and Alternative 1, 2, & 3 that appear in the Main Report. Background on the MRGO and existing conditions are presented in the Main Report Sections S.4, S.13, 1.4 and 3.0. The future without de-authorization and Alternatives 1, 2, & 3 are described in the Main Report Section 2.5.

Background on the MRGO and Existing Conditions

Direct costs of construction, operation, and maintenance of the MRGO have been funded by the Federal government. These direct costs have totaled over $580 million since 1958.
The average annual operations and maintenance expenditures for the MRGO were $12.5 million (in 2000 dollars). However, following tropical storms and hurricanes, supplemental expenditures have often been required to return the MRGO to the authorized dimensions. Since 1998, the $12.5 million has not allowed for dredging of the channel to its full-authorized dimensions. The GIWW Reach has not been dredged since 1998. From 1998 to 2005, the Inland Reach was maintained to a minimum 300-foot bottom width; the Sound Reach to a minimum 450-foot bottom width; and the Bar Channel to a minimum 500-foot bottom width. There has been no channel maintenance dredging in any reach of the MRGO since Hurricane Katrina in 2005. Sections of the MRGO experienced severe shoaling during Hurricane Katrina, leading to a current controlling channel depth of approximately 22 feet.

O&M Costs Determinations, Dredging (Future Without De-authorization)
Due to shoaling the current controlling depth of the MRGO channel is approximately 22 feet. However, to determine whether it is economically feasible to maintain the project and evaluate the environmental impacts for various levels of maintenance including closure, the future without de-authorization is assumed to be a project maintained at the authorized dimensions. Under the future without de-authorization, following the restoration of the channel to its full dimensions, it would be maintained at a 500-foot bottom width for the 50-year period of analysis. A 600-foot bottom width would be maintained within the Bar Channel. However, future maintenance operations would depend on funding availability.

Assuming navigation on the MRGO remains a feasible option, the cost to restore and maintain a navigable channel was analyzed. Prior to initiating ongoing operations and maintenance, the channel must first be returned to the depth at which it will be maintained. For this study, several depths and widths were considered:

- 36' x 500' (mile 0.0 to 60) [authorized dimensions];
  38' x 600' (mile -9.4 to 0.0) [authorized dimensions];
- 32' x 500' (mile -9.4 to 60);
- 28' x 500' (mile -9.4 to 60);
- 24' x 500' (mile -9.4 to 60);
- 20' x 500' (mile -9.4 to 60);
- 16' x 500' (mile -9.4 to 60);
- 14' x 500' (mile -9.4 to 60);
- 12' x 500' (mile -9.4 to 60);

- 36' x 300' (mile -9.4 to 60);
- 32' x 300' (mile -9.4 to 60);
- 28' x 300' (mile -9.4 to 60);
- 24' x 300' (mile -9.4 to 60);
- 20' x 300' (mile -9.4 to 60);
- 16' x 300' (mile -9.4 to 60);
- 14' x 300' (mile -9.4 to 60);
- 12' x 300' (mile -9.4 to 60);

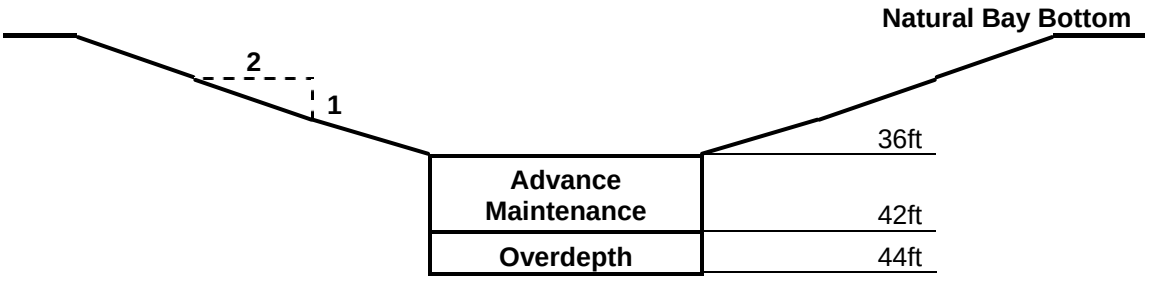
The dimensions above relate to channel bottom dimensions. Side slopes of 1V:2H were applied to all the templates emanating from the toe of the channel until it intersects natural bay-bottom elevation.

In addition to computing dredge quantities for returning the channel to the above dimensions, an additional quantity was included to provide for advanced maintenance dredging, which is conducted to sustain navigable dimensions between dredging events, and allowable over-depth which accounts for the inaccuracies of the dredging process. Based upon past dredging practices which in turn are based upon historical shoaling rates, the following additional depths were added to the depths above for various reaches of the channel.

- 6 ft. (mile 60 to 23)
- 8 ft. (mile 23 to 0)
- 4 ft. (mile 0 to -9.4)

Figure ENG1 shows the template employed for the 36'x300' channel between miles 0 and 23.

Fig ENG1: Dredging template for 36x300 channel between mile 0 and 23.



Channel surveys taken between May and June 2006 were used to create a surface indicative of the current elevations within the channel. Any material that is contained within the template would be dredged, and thereby forms the quantity reported under the initial construction to return the channel to a given operating depth.

Emergency Channel Restoration Costs:
During an MRGO Stakeholders meeting held at the Corps' New Orleans District, the New Orleans District was requested to determine what the cost would be to restore navigation within the channel and enable users to navigate a 30' channel in the MRGO. The New Orleans District, prepared cost estimates for dredging two shoaled areas within the channel: Mile 16.4 to 8.0 (cutterhead dredge) and mile -4.6 to -6.8 (hopper dredge). Depths considered were 30', 32', 34' and 36'. These depths included advance maintenance, and overdepth was considered in the unit costs. For each of these depths, dredging cost per cubic yard and mobilization and demobilization (mob/demob) costs for both cutterhead and hopper dredges were calculated. For the cutter head dredge the mob/demob cost was approx $1,100,000 and the dredging cost per cubic yard ranged from $1.83 at 36 feet to $4.36 at the 30-foot alternatives. For the hopper dredge, the mob/demob cost was approx $250,000 and the dredging costs ranged from $3.61 at 36 feet to $4.73 at the 30-foot alternatives. All cost estimates are based on October 2006 price levels.

The unit costs above were utilized in determining costs for returning the channel to an operating depth of 36 feet. Prior to using these costs, a couple of assumptions were made:

- Disposal operations for this contract represent typical disposal operations for the entire channel. In other words, a cutter head dredge is used for dredging the channel from mile 60 to 0 and hopper dredge is used for dredging of material from 0 to -9.4. Although costs associated with cutter head dredging different segments of the channel will vary based upon specific disposal plans (i.e. some reaches requiring dikes whereas others will be unconfined and within open waters; and variances in pumping distances), these differences were not considered under this report. This report assumed a variance in costs based solely on quantity.

- Dredges operate under an average daily cost; it was assumed the lowest cost for the cutterhead was $1.80/CY and $3.50/CY for the hopper (based on October 2006 price levels).
- The unit prices applied to dredge quantities, which fell between those quantities determined in the estimates prepared by MVN, was prorated.
- A time constraint for returning the channel to an operating depth was not considered. Therefore, the assumption was made that a single cutter head dredge and a single hopper dredge would be utilized. Once time constraints are set and production rates for various dredges assumed, a determination as to the number of dredges required to complete the work can be determined.

Table ENG1 and ENG2 show the calculations (quantities and unit costs) that were used in determining costs for restoration of the channel to widths of 300' and 500' and at varying depths.

Table ENG1: Initial Construction Quantities and Costs for 300-foot wide channel (based on October 2006 price levels).

Depth	Quantity	Type	Mob/Demob	Unit $ per Cubic Yard	Total Cost
300x36:	3,500,000	hopper	250000	3.5	$12,500,000.00
	27,100,000	cutter	1100000	1.8	$49,880,000.00
	30,600,000				$62,380,000.00
300x32:	1,500,000	hopper	250000	3.5	$5,500,000.00
	12,900,000	cutter	1100000	1.8	$24,320,000.00
	14,400,000				$29,820,000.00
300x28:	500,000	hopper	250000	4	$2,250,000.00
	6,300,000	cutter	1100000	1.8	$12,440,000.00
	6,800,000				$14,690,000.00
300x24:	0	hopper	0	--	$0.00
	2,400,000	cutter	1100000	2.5	$7,100,000.00
	2,400,000				$7,100,000.00
300x20:	0	hopper	0	--	$0.00
	400,000	cutter	1100000	5.8	$3,420,000.00
	400,000				$3,420,000.00
300x16:	0	hopper	0	--	$0.00
	87	cutter	1100000	--	$0.00
	87				$0.00

As discussed previously, for the past several years prior to Hurricane Katrina the channel has been maintained to reduced dimensions in some reaches. The estimated cost to return the channel to 36 feet deep by 300 foot bottom width in all reaches is $62,380,000 based on October

2006 price levels. For this de-authorization study, although no current plans exist to dredge the MRGO, it is important to estimate these costs for comparison purposes in evaluating future alternatives for modifying the channel (see Table ENG1). Average annual operations and maintenance (O&M) costs to maintenance dredge a single shipping lane in the Inland Reach and authorized width in other reaches after restoration to these dimensions are $12.5 million (based on historic operations and maintenance expenditures).

Table ENG2: Initial Construction Quantities and Costs for 500ft wide channel (based on October 2006 price levels).

Depth	Quantity	Type	Mob/Demob	Unit $ per Cubic Yard	Total Cost
500x36:	10,000,000	hopper	250000	3.5	$35,250,000.00
	52,500,000	cutter	1100000	1.8	$95,600,000.00
	62,500,000				$130,850,000.00
500x32:	3,400,000	hopper	250000	3.5	$12,150,000.00
	29,900,000	cutter	1100000	1.8	$54,920,000.00
	33,300,000				$67,070,000.00
500x28:	1,200,000	hopper	250000	4	$5,050,000.00
	14,500,000	cutter	1100000	1.8	$27,200,000.00
	15,700,000				$32,250,000.00
500x24:	300,000	hopper	250000	5	$1,750,000.00
	5,600,000	cutter	1100000	1.8	$11,180,000.00
	5,900,000				$12,930,000.00
500x20:	0	hopper	0	--	$0.00
	1,200,000	cutter	1100000	4.4	$6,380,000.00
	1,200,000				$6,380,000.00
500x16:	0	hopper	0	--	$0.00
	78,414	cutter	1100000	9	$1,805,726.00
	78,414				$1,805,726.00

The New Orleans District recently analyzed surveys, quantified and prepared cost estimates for restoration of the entire MRGO Ship Channel project (Miles 66 to -9) to its full, authorized dimensions. Due to the extensive shoaling in the channel, the work was broken out into ten (10) individual contracts. The cost estimates were based upon the assumption that all material dredged from the inland portion of the MRGO (Miles 66 to 27) would be placed in the adjacent south bank confined disposal sites due to numerous oyster leases along the north bank as well as land rights issues. For the material dredged between Miles 27 and -4, the material would be used for either wetland creation or restoration of Breton Island. All material dredged between Miles 66 and -3.4 would be accomplished by hydraulic cutter head dredge. Material dredged between

Miles -3.4 and -9, would be excavated by hopper dredge and transported to the EPA ODMDS (Ocean Dredged Material Disposal Site) just south of the MRGO Bar Channel. Quantities were based upon surveys performed in Feb/Mar 2007 and are as follows:

Table ENG3: Dredged Quantities and Costs (based on October 2006 price levels)

Reach	Depth	Quantity	Type	Mob/Demob	Total Cost
Mile 60 to 27	500x-40: (Includes Adv Maintenance)	14,900,000	Cutterhead	$3,800,000 Mob/Demob for 4 contracts	$34,555,620
Mile 27 to 23 and 23 to 20	500x-40 (Miles 27 to 23) and 500x-42 (Miles 23 to 20): (Includes Adv Maintenance)	3,850,000	Cutterhead	$950,000 Mob/Demob for 1 contract	$7,453,750
Mile 20 to (-)3.4	500x-42 (Miles 20 to 0) and 600x-40 (Miles 0 to (-)3.4): (Includes Adv Maintenance)	33,460,000	Cutterhead	$4,120,000 Mob/Demob for 4 contracts	$68,122,875
Mile (-)3.4 to (-)9	600x-40 (Miles (-)3.4) to (-)9: (Includes Adv Maintenance)	4,000,000	Hopper	$250,000 Mob/Demob for 1 contract	$20,312,500
	TOTALS	56,210,000			$130,444,870

NOTE: All costs in the above table include a 25% contingency.

Based on the calculations presented in table ENG3, the estimated cost to return the channel to authorized dimensions (36 feet deep by 500 foot bottom width; 38 feet deep by 600 foot bottom width in Bar Channel) is $130,444,870 based on October 2006 price levels.

Ongoing O&M Quantities:

A key component in determining future O&M dredging quantities is deciding on a future shoaling rate or rate at which material will be deposited in the channel. This rate can sometimes be determined through system modeling which typically takes years to perform. Due to the time constraint imposed on this study, the USACE used shoaling rates determined in a 2004 MRGO Re-evaluation study, which were based on historical dredging events. These shoaling rates were determined for each mile of the channel at various depths and widths and then summarized into reaches. The rate of shoaling between mile 6 and mile 23 was approximately the same as the previous study. As such, an average shoaling rate for this reach of channel was assumed. A review of these summaries revealed little differences in the rates amongst the different channel configurations. For this reason, this study assumed a constant shoaling rate for various reaches

that are independent of channel depth and width. These reaches and their associated average shoaling rates are shown in Table ENG4.

Once the shoaling rate was determined, the frequency in which dredging must occur to maintain the required depth is calculated. For this, two assumptions were made. First, each reach would shoal uniformly at the shoaling rate for that reach. Second, the entire dredging prism (advance maintenance and allowable overdepth) would shoal to project depth before dredging occurred.

Table ENG4: Average Shoaling Rates and Dredging Frequencies by Mile.

Mile Marker	Shoaling rate (ft/yr)	Prism (ft)	Freq (yrs)
-8 to -9	0.7	4	5.7
6 to -8	1.7	6	3.5
23 to 6	2.5	8	3.2
27 to 23	1.2	6	5
35 to 27	0.6	6	10

After determining the shoaling rate, the year at which the first cycle of dredging will begin must be determined. This target year was determined in two parts. The first part was determining how many years shoaling would occur in the channel before deposition filled the channel to the bottom of the dredging prism. The second part was applying the time frame for the dredging prism to shoal to project grade; that is, the frequency between contracts.

To determine part one, the centerline elevation of the channel was determined at each mile using May/June 2006 survey data. These centerline elevations were then averaged to determine an average channel elevation for a given reach. Refer to Table ENG5.

Table ENG5: Average Channel Depths by Reach in June 2006.

Mile Marker	Avg C/L Elevations (MLG)
-8 to -9	- 36.5
6 to -8	-34.8
23 to 6	-31.2
27 to 23	-38.7
35 to 27	-39.3

These average depths were then compared to the bottom elevation of the dredging prism for various depths to determine whether immediate dredging of that reach was required, and if not, how many feet the channel needed to shoal before deposition entered the dredging prism. If the current elevation was deeper than the bottom elevation of the dredging prism, the difference in these two elevations was divided by the shoaling rate for that reach to determine how soon before deposition entered the dredging prism. The results of this analysis are reported in Table ENG6:

Table ENG6: No. of Years before Shoaling Starts Taking Place within the Dredging Prism.

	Channel Depth							
Mile	36	32	28	24	20	16	14	12
-8 to -9	0	0.8	7.5	0	0	0	0	0
6 to -8	0	0	0.7	4.1	7.4	10.8	0	0
23 to 6	0	0	0	0	1.3	2.9	3.7	4.5
27 to 23	0	0.4	2.8	5.1	7.5	9.8	11.0	12.2
36 to 27	0	1.9	7.6	13.3	19.0	24.7	27.6	30.4

The second part of determining when dredging would be required for any given reach or depth is to add together the years shown in Table ENG6 to the frequency of dredging shown in Table ENG4. As an example, for a 24 ft deep channel between mile 36 and 27 the first dredging contract would be required in year 23.3 [(13.3 + 10) (*Table ENG6 + Table ENG4)]*. For calculation purposes the assumption was made that if Congress directed the channel to be dredged as a result of this report, dredging would not commence until 2008. Therefore, for those depths that shoaling to the bottom of the dredging prism will take at least 2 years, the base year from which the first contract will begin was assumed to be 2006. For those depths that shoaling to the bottom of the dredging prism will take less than 2 years, the base year from which the first contract will begin is assumed to be 2008.

<u>Ongoing O&M dredging costs:</u>
To determine ongoing O&M dredging costs, the same costing information used for the initial construction cost was utilized. Due to the overlap of data regarding the dredging prism and dredging quantity calculations, a sensitivity analysis of the cost versus quantities was undertaken to determine if the hopper dredge and cutter head quantities could be combined into a single quantity at a given rate. The result of this analysis showed that a combined quantity at $2.00/CY, using the mob/demob cost for a cutter head dredge, resulted in a less than 3% difference in the total cost than if the quantities are separated using different unit prices per dredge. With the exception of the change in the unit price to a constant $2.00/CY all the same assumptions outlined above still apply.

The cost of each contract per reach per depth was then computed by multiplying the total volume within the dredging prism by $2.00/CY and adding the mob/ demob cost. For reaches such as mile 27 to 6, at the 12-foot depth, an assumption was made that only a portion of the reach would require dredging. In these cases, only half of the dredging prism quantity was used in determining the contract cost for that reach. This assumption was based upon a review of natural bay-bottom elevations within Breton Sound. Differences in elevations reported by various resources did not allow for a definitive extent for calculating quantities for dredging. However, to capture the effects of deeper water across Breton Sound, especially when considering shallow depth plans, a percentage approach was adopted.

The last step in determining yearly contract costs is to recognize that O&M funding typically is linear for maintenance dredging of channels such as the MRGO. For this reason, high dollar contracts such as would exist for channel mile 23 to 6 at 36 ft ($16.9M), especially when combined with a contract for mile 6 to -8 ($10.8M) in the same year would be broken up into two or three years.

Options and Cost Determinations (Alternatives 1 & 2)
The following sections detail the procedures employed in determining the costs of the various options and opportunities investigated.

Salinity Control Weir at La Loutre:
Under this option, a weir would be constructed near the Bayou La Loutre Ridge to allow passage of shallow-draft vessels. The MRGO would be constricted to 125-feet wide by 14 feet deep. The weir configuration likely would consist of earthen dam sections and pile-supported, reinforced concrete T-wall structures that extend from the shoreline and tie into a weir structure. The weir would be a pile-supported, reinforced concrete U-frame structure with a 125-foot wide clear opening and a sill at Elevation -14.0 NAVD.

Table ENG7 outlines the items that were considered in estimating the cost of this structure.

Table ENG7: Cost data for Salinity Weir.

WEIR STRUCTURE (Sill El -14) Comparative Quantity and Cost Data Per Sector Gate Based on October 2006 Price Levels					
Item No.	**Description**	**Unit**	**Unit Price**	**Quantity**	**Amount**
1	Mobilization and Demobilization	Lump Sum	Lump Sum	1	$1,140,000
2	Cofferdam-Steel Sheet Piling 70'	SF	$35	326,000	$11,410,000
3	Cofferdam-Sand Fill	CY	$40	12,709	$508,356
3	Cofferdam-Dewatering	Lump Sum	Lump Sum	1	$760,000
4	Structure Excavation	CY	$12	54,889	$658,667
5	Piling-24"diameter steel pipe piles	LF	$200	20,267	$4,053,333
6	Pile Test	Each	$50,000	1	$63,333
7	Tension Connectors	Each	$250	63	$15,833
8	Sheetpile Cutoffs - Gate Structure	SF	$30	8,000	$240,000
9	Stabilization Concrete	CY	$250	1,100	$275,000
10	Crushed Stone	Ton	$40	1,600	$64,000
11	Concrete in Base Slabs	CY	$650	3,399	$2,209,278
12	Concrete in Walls	CY	$900	1,056	$950,000
13	Crushed Stone Bedding	Ton	$60	3,589	$215,333
14	Armor Stone	Ton	$60	8,867	$532,000
15	Tie-in Floodwall 200 ft ea side for 400 ft total	LF	$15,200	400	$6,080,000
16	Structure Backfill	CY	$15	25,333	$380,000
17	Treated Timber Piling in Guidewalls	LF	$26	10,556	$274,444
18	Treated Fender Timbers	BF	$4	63,333	$228,000
19	Fender System Hardware	Lump Sum	Lump Sum	1	$29,556
20	Steel Sheet Pile Dolphins	Each	$460,000	4	$1,840,000
21	Needle Beams and Needles	Lump Sum	Lump Sum	1	$211,111
22	Earthen Dam Fill	CY	$30	300,000	$9,000,000
	Construction Cost (incl. 25% contingency)				**$51,422,800**
	Engineering and Design				**$2,850,800**
	Supervision and Administration				**$4,113800**
	Total Cost				**$58,387,400**

Salinity Control Gate at La Loutre:
Under this option, a gated structure would be constructed downstream of the La Loutre Ridge that would allow passage of shallow-draft vessels. The gated structure would have a sill at Elevation -14.0 NAVD, a 125-foot wide opening, and would be designed for hydraulic loadings proportional to its height. The gate would normally be closed to reduce saltwater intrusion, but would be opened for passage of vessels. The gate would need to be able to operate under both direct and reverse heads; so it is envisioned that the gate would either be a sector gate or a barge gate. The sector gate option is presented in this report because its use is more widespread throughout south Louisiana, but during design, the barge gate option should be explored. The gate could be operated on-site by a gate master, or remotely with the use of video cameras and a PLC system configured to operate via the internet. Depending on how often the gate is operated, power will need to be supplied to the site.

Table ENG8 outlines the items that were considered in estimating the cost of this structure.

Storm Protection Gate at La Loutre:
This option comprises the same structural components and earthwork as the above option for the salinity control gate at La Loutre, a sector gate with tie-in T-wall and earthen dam. The difference between these two options is the gate operating parameters. With this option, the gate would not be operated to control salinity, but would only be operated to close the canal for a tropical storm event. There are some cost savings relative to the salinity control gate option because the gate would be operated infrequently. The most significant cost savings should be with respect to the maintenance cost of the gates and the gate monoliths. Since the gates would be operated less frequently compared to the salinity control gate option, there should be a longer interval between de-waterings of the monolith to perform major maintenance work on the gates. Another advantage of this option is that it may be possible to operate the gates using a diesel-powered generator instead of having to supply power to the site. However, this would likely preclude remote operation of the gates since the generator would need to be started on-site to power the gate drive systems.

With minimal differences between this option and that of the salinity control gate, at this level of cost estimating the construction costs are assumed to be the same as those for the salinity control gate.

Table ENG8: Cost data for Salinity Gate

SECTOR GATE STRUCTURE (Sill El -14)					
Comparative Quantity and Cost Data Per Sector Gate					
Based on October 2006 Price Levels					
Item No.	**Description**	**Unit**	**Unit Price**	**Quantity**	**Amount**
1	Mobilization and Demobilization	Lump Sum	Lump Sum	1	$1,140,000
2	Cofferdam-Steel Sheet Piling 70'	SF	$35	326,000	$11,410,000
3	Cofferdam-Sand Fill	CY	$40	12,709	$508,356
3	Cofferdam-Dewatering	Lump Sum	Lump Sum	1	$760,000
4	Structure Excavation	CY	$12	54,889	$658,667
5	Piling-24"diameter steel pipe piles	LF	$200	20,267	$4,053,333
6	Pile Test	Each	$50,000	1	$63,333
7	Tension Connectors	Each	$250	63	$15,833
8	Sheetpile Cutoffs - Gate Structure	SF	$30	8,000	$240,000
9	Stabilization Concrete	CY	$250	1,100	$275,000
10	Crushed Stone	Ton	$40	1,600	$64,000
11	Concrete in Base Slabs	CY	$650	10,626	$6,906,900
12	Concrete in Walls	CY	$900	2,111	$1,900,000
13	Crushed Stone Bedding	Ton	$60	3,589	$215,333
14	Armor Stone	Ton	$60	8,867	$532,000
15	Tie-in Floodwall 200 ft ea side for 400 ft total	LF	$15,200	400	$6,080,000
16	Structure Backfill	CY	$15	25,333	$380,000
17	Treated Timber Piling in Guidewalls	LF	$26	25,000	$650,000
18	Treated Fender Timbers	BF	$4	150,000	$540,000
19	Fender System Hardware	Lump Sum	Lump Sum	1	$70,000
20	Steel Sheet Pile Dolphins	Each	$460,000	4	$1,840,000
21	Needle Beams and Needles	Lump Sum	Lump Sum	1	$500,000
22	Steel Sector Gates	Tons	$6,000	211	$1,266,667
23	Mechanical Systems	Lump Sum	Lump Sum	1	$358,889
24	Electrical Systems	Lump Sum	Lump Sum	1	$190,000
25	Control House	Each	$50,000	1	$50,000
26	Earthen Dam Fill	CY	$30	300,000	$9,000,000
	Construction Cost (incl. 25% contingency)				**$62,085,400**
	Engineering and Design				**$3,405,800**
	Supervision and Administration				**$4,966,800**
	Total Cost				**$70,461,900**

Assessment of Additional Closure Alternatives (Alternatives 1 & 2)

In March 2007, the USACE, New Orleans district (MVN) performed a preliminary assessment for potential closure alternatives to be constructed immediately south of the Bayou La Loutre crossing. This included consultation with dredging industry representatives to get their professional opinions and recommendations on potential construction procedures. The Bayou La Loutre site for a potential closure structure was selected due to (1) minimized channel width at this site, (2) the historic ridge crossing may provide the best possible foundation conditions for a closure, (3) minimized thickness of maintenance material accretion at the site, and (4) this site provides maximum potential to minimize salt water intrusion resulting from the MRGO channel.

In an effort to move forward with any potential closure design, a site specific survey and boring plan has been prepared and requested. The results of these requests will determine the quality of potential earthen borrow at the site, and geotechnical parameters to design stability, settlement, consolidation and structure template aspects. Topographic surveys will mandate requirements for the bank line tie-ins. Upon receipt of these data sets, final analysis and recommendations can be made as to construction materials and design parameters.

Based on existing data, including borings taken for preparation of the MRGO GDM, and historic knowledge of the project site, a preliminary design and quantification of the following alternatives was prepared. Each design option was forwarded to our Cost Engineering Section for preparation of a cost estimate. Designs to date included plans for a total channel closure.

Dredged-In earthen closure

Assumed borrow from the MRGO below the depth of the authorized navigation channel. Assuming (1) suitable borrow material is found between elevations -50 and -70, (2) a 300-foot corridor centered on the MRGO centerline is made available and (3) a bulking factor of 2.0, an approximate 3 mile reach of borrow corridor would be needed. Due to the potential less-than-desirable characterization of the borrow source, this option includes rock toe dikes on both the upstream and downstream ends of the closure section, perpendicular to the MRGO, to assist in retention of materials and to better manage the ultimate side slopes of the closure section. The contractor would be mandated to pump in a 300-foot-wide crown structure, maintaining 1V on 30H side slopes. The requirements for consolidation of the dredged material mandated the assumption that at least two construction lifts would be required to construct this effort. Seeding and fertilizing the resulting berm was included in the cost estimate. The costs for the phased dredge-in closure are in Tables ENG9 and ENG10 below (based on October 2006 price levels).

Table ENG9: Estimated Costs for Phased Dredge-in Closure (First Lift)

Project: RECON Estimate - MRGO CLOSURE
Dredged in closure of MRGO w/stone containment dikes to reduce losses.

FIRST LIFT

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$890,000.00	$890,000.00
0002	Dredging	1,600,000	CY	$1.83	$2,928,000.00
0003	Stone Placement - Toe Dikes	45,000	TON	$39.60	$1,782,000.00
0004	Clearing Grubbing (Overbanks)	4	ACRE	$4,050.00	$16,200.00

SUBTOTAL:	$5,616,200.00
Contingencies(25%)	$1,404,050.00
SUBTOTAL:	$7,020,000.00
E&D	$386,100.00
S&A	$561,600.00
TOTAL:	$7,967,700.00
SAY:	**$7,970,000.00**

Table ENG10: Estimated Costs for Phased Dredge-in Closure (Second Lift)

Project: RECON Estimate - MRGO CLOSURE
Dredged in closure of MRGO w/stone containment dikes to reduce losses.

SECOND LIFT

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$990,000.00	$990,000.00
0002	Dredging	900,000	CY	$1.84	$1,656,000.00
0003	Tie-in Shaping (barge haul as required from South Bank Disposal Area)	40,000	CY	$34.00	$1,360,000.00
0004	Mulch, Seed, Fertilize	4	ACRE	$3,000.00	$12,000.00

SUBTOTAL:	$4,018,000.00
Contingencies(25%	$1,004,500.00
SUBTOTAL:	$5,023,000.00
E&D	$276,265.00
S&A	$401,840.00
TOTAL:	$5,701,105.00
SAY:	**$5,701,000.00**

At this stage, concerns remain as to a) the exact number of lifts that would be required in order to achieve the above specified section due to the nature of the borrow material in the MRGO channel which consists primarily of soft to medium clays, b) the ability to be able to armor a closure of this scale, as well as the uncertainty as to when armoring could be installed due to the geotechnical characteristics of the soil, and c) the uncertainty of the fate of an all earthen closure in the event of a severe storm event.

Barged in earthen closure

This procedure assures a better source of construction materials, and being mechanically placed allows for steeper side slopes and a smaller crown width in the design process. Cost of barged in material greatly increases cost of closure structure. Again, only fertilizing and seeding was included in this original estimate; stone paving was assumed for any required repairs. Section reduced to 200-foot crown and 1v on 10H side slopes. Consolidation of placed material again a concern, but only one lift was included in this preliminary estimate. The costs for the barged-in closure structure are in Table ENG11 below (based on October 2006 price levels).

Table ENG11: Estimated Costs for Barged in Closure

Project: RECON Estimate - MRGO CLOSURE

Barged in Closure of MRGO

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$500,000.00	$500,000.00
0002	Earthen Closure Construction	800,000	CY	$33.00	$26,400,000.00
0003	Clearing and grubbing (Overbank)	4	ACRE	$4,050.00	$16,200.00
0004	Tie-In Shaping	15,000	CY	$2.00	$30,000.00
0004	Mulch, Seed, Fertilize	5	ACRE	$3,000.00	$15,000.00

SUBTOTAL:	$26,961,200.00
Contingencies(25%)	$6,740,300.00
SUBTOTAL:	$33,701,500.00
E&D	$1,853,582.50
S&A	$2,696,120.00
TOTAL:	$38,251,202.50
SAY:	**$38,251,000.00**

Somewhat similar in nature to the dredged-in earthen closure alternative, this alternative also presents similar concerns such as a) the possible need for additional lift(s), b) the ability to be able to armor a closure of this scale, as well as the uncertainty as to when armoring could be installed, and c) the uncertainty of the fate of an all earthen closure in the event of a severe storm event.

Total Rock Closure

A total rock closure assures better control of placed material. It eliminates the concern of consolidation of earthen construction materials. The total rock closure assumed a 25-foot to 30-foot crown width, with 1V on 2.5H side slopes. Stability analysis and any need for stability berms will be conducted upon receipt of site data. This alternative would result in less concern due to the need for structure erosion maintenance. Quarry run stone would be specified to increase fines in the mix, minimizing voids and reducing salt water intrusion. Based on assumptions made, this was the least costly alternative.

The costs for stone closure structures are in Table ENG12 (based on October 2006 price levels). The costs presented in Table ENG12 represent those assumed under Alternative 1 (a total stone closure structure constructed in one construction effort). The costs for Alternative 2 (a total stone closure structure constructed in two phases) were derived from those presented in Table ENG 12. The costs for Alternative 2 are presented in the Main Report in Table 2.2. Differences between the costs for Alternative 1 and Alternative 2 are due to the costs associated with two sets of mobilization/demobilization, engineering and design, construction management, and contingency costs associated with two construction efforts under Alternative 2 versus one construction effort under Alternative 1.

Table ENG12: Estimated Costs for Total Rock Closure

Project: RECON Estimate - Total Rock Closure of MRGO
South of Bayou La Loutre
St. Bernard Parish, LA

Item	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$66,100.00	$66,100.00
0002	Stone Placement - Channel Proper	265,000	TON	$39.60	$10,494,000.00
0003	Stone Placement - Overbank Tie-ins	5,000	TON	$48.60	$243,000.00
0004	Clearing and Grubbing (Overbank)	4	Acre	$4,050.00	$16,200.00

SUBTOTAL:	$10,819,300.00
Contingencies(25%)	$2,704,825.00
SUBTOTAL:	$13,524,125.00
E&D	$743,826.88
S&A	$1,081,930.00
TOTAL:	$15,349,881.88
SAY:	**$15,350,000.00**

A maintenance plan and associated costs were developed for the total stone closure (see Table ENG13). These costs result in an estimated average OMRR&R cost of $136,000 per year (Alternative 1). The estimated average OMRR&R cost for Alternative 2 is $133,800 per year

because the year 5 maintenance cost for the weir (Phase I construction of the total stone closure under Alternative 2) would be lower than that for the completed stone closure structure under Alternative 1.

Table ENG13: <u>Maintenance for Total Stone Closure</u>

Stone Closure: O&M Yr 5	Net Tons:	200,000	
ITEM		$$/CY	Costs
Mob and Demob			$66,000
O&M Year 5 -Tons (2%/Yr)	20,000	$40	$792,000
		Subtotal:	$858,000
	25%	Cont	$214,500
		Subtotal:	$1,072,500
		E&D	$172,500
		S&A	$98,670
		Total:	$1,340,000

Stone Closure: O&M Yrs 15, 25, 35 and 45	Net Tons:	200,000	
ITEM		$$/CY	Costs
Mob and Demob			$66,000
O&M Every Following 10 Yrs (1%/Yr)	20,000	$40	$792,000
		Total:	$858,000
	25%	Cont	$214,500
		Subtotal:	$1,072,500
		E&D	$172,500
		S&A	$98,670
		Total:	$1,340,000

<u>Cellular sheet pile closure</u>

A cellular sheet pile closure consists of sand-filled cellular sheet pile structures with stone berm on either side, which provides a less permeable solution than the total rock closure, but at potentially twice the cost. It is also the least natural of all proposed solutions. Locals seem to be envisioning restoration of the historic La Loutre ridge. The cost for a cellular sheet pile closure structure is shown in Table ENG14 below (based on October 2006 price levels).

Table ENG14: Estimated Costs for a Cellular Sheet Pile Closure

Project: RECON Estimate - MRGO Closure Structure

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$150,000.00	$150,000.00
CELL CONSTRUCTION					
0002	PS 31, GR 50 Steel Sheet Pile	225,441	SF	$50.00	$11,272,050.00
0003	PZ-35 Steel Sheet Pile	1,800	SF	$45.00	$81,000.00
CELL FILL					
Sand		47,826	CY	$27.00	$1,291,302.00
Reinforced Concrete Cap		3,990	CY	$500.00	$1,995,000.00
SITE WORK					
R650 Rock Berms		148,112	TONS	$39.60	$5,865,235.20

SUBTOTAL:	$20,654,587.20
Contingencies(25%)	$5,163,646.80
SUBTOTAL:	$25,818,234.00
E&D	$1,420,002.87
S&A	$2,065,458.72
TOTAL:	$29,303,695.59
SAY:	**$29,304,000.00**

Alternative Navigation Route(s) in the Event of Excessive IHNC Lock Downtime (Alternative 1)

Currently, the MRGO serves as an alternate access route for shallow-draft vessels transiting the GIWW in the event of an extensive shutdown of the IHNC lock. Shallow- draft vessels, transiting from the east along the GIWW towards the IHNC, are currently able to access the MRGO, the MRGO/ Baptiste Alternate Route through Breton Sound, Baptiste Collette to Venice, LA, and the Mississippi River at Venice, LA to the GIWW at Algier's Lock. The same route is accessible to those vessels transiting easterly along the GIWW. In the event the MRGO channel were to be de-authorized and totally closed off, and the IHNC Lock should be shutdown for an extensive period of time, an alternate access route would be required for shallow-draft vessels to transit the GIWW from Port Isabel, TX to Apalachicola, FL. The most immediate and shortest means of access would be via the MRGO. If the MRGO were to be totally closed off just downstream of Bayou La Loutre, an emergency access channel through the closure could be constructed, if authorized, to provide temporary access between the GIWW and the Mississippi River via the MRGO. In order for this to transpire, an emergency channel 125' wide at elevation -14' MLG with 1V on 2H slopes, would be constructed. At this time, based upon preliminary

costs and consideration of constructability issues, the total stone closure would be the selected plan. With that being the case, the cost for the removal of stone to provide the above specified shallow-draft channel is estimated at approximately $110,000 based on October 2006 price levels (see Table ENG15 below for cost estimate).

Table ENG15: Estimated Costs for Removal of Stone to Provide Shallow-Draft Navigation

Project: RECON Estimate - Emergency Removal of Stone From MRGO Rock Closure
To Provide Navigation Weir

Weir to be 125' wide by -14' depth W/1V on 2H slopes

Item	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$37,100.00	$37,100.00
0002	Stone Removal	15,000	TON	$2.60	$39,000.00

SUBTOTAL:	$76,100.00
Contingencies(25%)	$19,025.00
SUBTOTAL:	$95,125.00
E&D	$6,563.63
S&A	$8,751.50
TOTAL:	$110,440.13
SAY:	**$110,000.00**

Upon the re-opening of the IHNC lock, the temporary shallow-draft navigation gap in the closure would be closed-off with stone. The cost to close-off the shallow-draft navigation channel in the stone closure is estimated at approximately $1,107,000 based on October 2006 price levels. (See Table ENG16 below for cost estimate)

Table ENG16: Estimated Costs to Close the Shallow-Draft Navigation Channel

Project: RECON Estimate - Closure of Emergency Navigation Weir
(Assuming Weir to be 125' wide by -14' depth W/1V on 2H slopes)

Item	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$66,100.00	$66,100.00
0002	Stone Placement	16,700	TON	$39.60	$661,320.00

SUBTOTAL:	$727,420.00
Contingencies(25%)	$181,855.00
SUBTOTAL:	$909,275.00
E&D	$114,556.50
S&A	$83,653.30
TOTAL:	$1,107,484.80
SAY:	**$1,107,000.00**

It should be noted, however, that all of the alternative closure plans evaluated could be modified to provide a temporary shallow-draft navigation channel in the event of an emergency, such as an extensive shutdown of the IHNC lock, and that all could be closed-off once that emergency period has ended.

Costs for Real Estate, Relocations, Removal of Aids to Navigation (Alternative 1, 2, & 3)

Real estate costs including lands and damages were calculated by MVN Real Estate Division and are described in Appendix E. These real estate costs include administrative costs associated with de-authorization which are common to Alternative 1, 2, & 3. Acquisition costs are also included for Alternative 1 & 2. There are no relocations required for Alternative 1, 2, or 3..

The one-time cost for removal of aids to navigation is common to Alternative 1, 2, & 3. This one-time cost is estimated to be $700,000. This estimated cost was approved by the Coast Guard. The scope is to remove channel markers and aids to navigation that would no longer be required following de-authorization.

Hydraulic Considerations for Stone Closure (Alternative 1)

MRGO Closure Structure Design. The design of the closure structure needs to specify crown height and width, stone gradation and side slopes. Often considerations (for example bearing capacity or slope stability) other than the hydraulic minimums will govern the design.

Crest Height. The crest height at a minimum should be the height of the surrounding land so that increasing water levels are not channeled to preferentially flow over the crest and possibly erode the structure. A crest elevation of 5 feet NAVD88 (2004.65) was selected. Since the surrounding marsh is 2 to 3 feet NAVD88 (2004.65), the crest elevation has to be 4 feet NAVD88 (2004.65) at a minimum. The crest elevation of 5 feet NAVD88 (2004.65) is high enough that only tropical events will over top it. A lower crest would allow high tides from winter frontal passages to overtop the crest. Another consideration is the selection of the crest elevation is the uncertainty in the settlement and subsidence calculations. A final crest elevation of 4 feet NAVD88 (2004.65) would be sufficient to prevent overtopping from winter storms but a one foot settlement to 3 feet NAVD88 (2004.65) would not be adequate. Thus the selected crest elevation of 5 feet NAVD88 (2004.65) is adequate even if there were to be a foot of settlement beyond what was estimated by our geotechnical engineers.

Crest Width. The minimum crest width for a rock structure should be at least three rock sizes. Assuming a 36 inch cap rock the minimum crest width would be around 10 feet. The width should be larger than this because it would reduce wave overtopping flows on the back side.

Stone gradation. The stone gradation should be quarry run with lots of fines so as to reduce the permeability of the material. The gradation should also have a large fraction so as to provide stability against wave and storm attack. There should be sufficient 24 to 36 inch stone to provide a good revetment (or if finer stone is used in the core, the surface should be protected with a cover of riprap). Piping will not be an issue with the use of quarry run rock for this application. Obviously for a dam impounding a high level of water an impermeable fill would be required. However, the closure structure will have only small head differences across the structure. Professional judgment suggests that the velocities would be very small and that piping would not be an issue with quarry run rock.

MISSISSIPPI RIVER GULF OUTLET

DEEP DRAFT DE-AUTHORIZATION STUDY

ENGINEERING APPENDIX

NOVEMBER 2007

NEW ORLEANS DISTRICT

MISSISSIPPI RIVER GULF OUUTLET
DEEP DRAFT DE-AUTHORIZATION STUDY

ENGINEERING APPENDIX

1. Geotechnical Site Investigations. Two (2) 120-foot and one (1) 76-foot undisturbed borings (5-inch diameter) were taken in June 2007. All three borings were taken along the proposed alignment of the closure structure with two drilled on the top of each MRGO bank and the third was drilled near the centerline of the MRGO channel. Continuous 5-inch Shelby tube samples were taken in clay strata while split spoon sampling was performed in sand layers. Laboratory tests performed on these samples include visual description/classification, moisture content, Atterberg Limits, unconfined compression, triaxial shear, and consolidation tests. This data is included in this report and has been used to select soil parameters for the geotechnical analysis presented herein. At the time of this writing, five laboratory consolidation tests are being finalized on boring CB-2U, however, consolidation testing has been completed on the other 2 borings and these were used for the settlement estimates included in this report. The maximum extent of the borings varied from El. -116.0 to -119.1. The location of the three undisturbed borings are shown on Plate 2. The boring logs for all three are shown on Plates 3 through 5.

2. Site Geology. The MRGO Closure profile is located approximately 2500 feet southeast of Bayou La Loutre oriented southwest to northeast across the MRGO. The southwestern portion of the profile contains fill material overlying natural levee deposits. The northeastern portion of the profile contains natural levee material overlying swamp. Fill deposits generally consist of soft to very soft clays, silty sands and sand with wood, roots, organics, and shells. Located beneath the fill deposits are natural levee deposits. Natural levee deposits are approximately 12 feet thick in the southwest and approximately 20 feet thick in the northeast. The natural levee deposits range from approximately +2 to –18 feet in elevation. Swamp deposits are located beneath the natural levee deposits. Swamp deposits are up to 8 feet thick and range from approximately –17 to -25 feet in elevation. These deposits consist of very soft to medium, organic clay and clay with wood, peat, and shell fragments. Point bar deposits underlie the swamp deposits throughout the profile. Point bar deposits range from 18 feet to 39 feet in thickness range from -22 to -62 feet in elevation. Point bar deposits consist of clay, silty clay, silt, silty sand, sandy silt, and sand, coarsening with depth. Interdistributary deposits are located beneath the point bar deposits throughout the profile. Interdistributary deposits consist of very soft to medium clays with minor amounts of silt, shell fragments, and organics. These deposits range from in thickness from 6 to 16 feet and from -44 to -68 feet in elevation. Prodelta deposits, characterized by medium clays with minor shell fragments, underlie interdistributary deposits throughout the profile. These deposits are approximately 44 feet thick and range from -60 to -111 feet in elevation. Nearshore gulf deposits underlie prodelta deposits in the southwestern portion of the profile. Nearshore gulf deposits generally consist of silty clay, silty sand, and sand with shells. Nearshore gulf deposits are approximately three feet thick and range from -111 to -114 feet in elevation. Beneath nearshore gulf deposits

are Pleistocene deposits characterized by oxidized, stiff to very stiff clays and silty clays with areas of silt, silty sand and sand, and concretions. Pleistocene deposits are at least 100 feet thick and are located at approximately -105 feet in elevation in the northeastern part of the profile. The geologic profile along the proposed closure alignment is shown on plate 6.

The study site contains Fausse soils which are very poorly drained soils that are clayey throughout; in saline swamps (US Soil Conservation Service, 1984).

Groundwater is at or near the surface in the study area. Point bar deposits are likely hydraulically connected to the MRGO.

Long-term relative subsidence resulting mainly from compaction of Holocene sediments, is estimated at 0.5 feet per century. Eustatic sea level is predicted to rise an additional 1.3 feet over the next century (IPCC, 2001). Therefore, the natural, long-term, relative subsidence rate at the project site is estimated to be 1.8 feet per century.

3. Geotechnical Design Parameters. The design shear strengths and unit weights for the proposed foundation were based on the results of unconsolidated-undrained triaxial compression tests (Q-tests), unconfined compression tests (UCT) and unit weight testing. The design shear strengths, unit weights, and stratification are presented on plate 7. Shear strengths for the natural levee and swamp layers range from 250 to 450 pounds-per-square-foot (psf). For the interdistributary and pro-delta clay deposits, the shear strengths initiate at 380 psf and generally increase with depth from El. -43 to -110 with a noticeable increase (~300 psf) occurring at the approximate interface between the two deposits. The wet unit weights for the clays vary from 105 to 117 pounds-per-cubic-foot (pcf). Design parameters for the silty sand point bar deposit was conservatively estimated to be γ=122 pcf and ϕ=30°.

4. Geotechnical Design Procedure, Methodology and Recommendations. The minimum closure section required to meet the objectives of the project was developed by Hydraulics and Hydrology Branch and Civil Branch. This section consisted of a net crest El. +5.0, side slopes of 1 V on 2 H, and a crest widths of 12-feet. The closure will be over built to an intial grade of El. +7 to accommodate future settlement. The foundation conditions and existing elevation along the alignment varied considerably from Fill, Natural Levee, Swamp, Point Bar to Interdistributary and from Elevation +2 to -43, respectively. To properly consider these variations, the stability analyses were conducted at four different grade levels – El. 0, -18, -36 and -43. The Hurricane Protection System Slope Stability Criteria dated 14 August 2007 was utilized for this project since its success will be measured by its survivability during a hurricane event. This required analyses by Method of Planes and the Spencer's Analysis. The factors of safety utilized for this phase are sufficient for the feasibility level cost estimate. The design utilized two loading cases, one with water at El. 0 for each side and one with an extreme water case with water at the top of the closure crest at El. +7 with low water on the opposite side. The section is symmetrical about the centerline since the extreme case can develop on

either side – the Lake Borgne side or the Gulf of Mexico side. The following table summarizes the results of all stability analyses:

	Method of Planes			
	Low Water Case El. 0		Extreme Case High Water EL. +7 Low Water EL. 0	
Existing Grade Elevation	$FS_{(minimum)}$	FS	$FS_{(minimum)}$	FS
-43	1.30	1.36	1.20	1.25
-36	1.30	1.32	1.20	1.20
-18	1.30	1.32	1.20	1.20
0	1.30	1.37	1.20	1.21

	Spencer's				Required Footprint Distance Toe to Toe, ft.
	Low Water Case El. 0		Extreme Case High Water EL. +7 Low Water EL. 0		
Existing Grade Elevation	$FS_{(minimum)}$	FS	$FS_{(minimum)}$	FS	
-43	1.50	1.51	1.40	1.40	444
-36	1.50	1.78	1.40	1.65	364
-18	1.50	1.65	1.40	1.46	174
0	1.50	1.60	1.40	1.42	58

The stability analyses plates showing the controlling method of analyses for each grade level for both loading cases are presented on plates 8 through 15.

Construction settlement estimates were solely based upon previous experience in this type of soil environment. Factors influencing the estimates were depth of swamp deposits and quantity of organics present in the borings. The estimates for construction settlement ranged from 25% to 50% of the closure rock quantity. For sections considered where the closure is founded at or below El. -26, which is the approximate top of the point bar deposits, construction settlement is estimated at 25% of the rock quantity. For sections considered above this level, construction settlement is estimated to range between 40% to 50% of the rock quantity due to the presence of swamp deposits and organic material.

A consolidation settlement estimate was conducted for two grade levels, one at the base of the closure at El. -43 and one at the upper bank where the closure will be founded upon the top of the swamp deposits at El. -18. For the lower grade level, the total consolidation settlement is estimated to be 3.1–feet. To account for lateral spread, 25% of this value is added for a total ultimate settlement of 3.8-feet. Since the channel has been excavated, approximately 44% of this settlement is from recompression and the remaining 56% is from virgin compression. For the upper grade level at El. -18, the total consolidation settlement is estimated to be 3.6–feet. To account for lateral spread, 25% of this value is added for a total ultimate settlement of 4.5-feet. Since the channel has been excavated, approximately 35% of this settlement is from recompression and the remaining 65% is from virgin compression. The time rate of settlement was estimated for both levels. The lower level was assumed to consist of one-way drainage to the surface interface with the rock closure. The upper level consist of two consolidating layers, the lower stratum with one-way drainage up to the point-bar silty sand and the upper stratum with double drainage up to the surface closure interface and below to the point-bar silty sand.

Two subsequent lifts are required to assure the closure grade will not settle below El. +4 except for the tie-in section on the upper bank shows some settling below this grade for a period of four years. One 3-foot lift is required at year 6 and another subsequent 3-foot lift is required at year 13. A settlement curve showing the required lifts is shown on plate 16. Considering all lifts, the total settlement during the 50-year life is estimated at approximately 8-feet.

5. List of Plates (Located at End of Engineering Appendix).

Plate 3 - Undisturbed Boring CB-1U
Plate 4 - Undisturbed Boring CB-2U
Plate 5 - Undisturbed Boring CB-3U
Plate 6 - Soil and Geologic Profile
Plate 7 - Shear Strengths and Unit Weights
Plate 8 - Spencer’s Analysis Extreme Load Case El. -43
Plate 9 - Spencer’s Analysis Low Water Load Case El. -43
Plate 10 - Method of Planes Extreme Load Case El. -36
Plate 11 - Method of Planes Low Water Load Case El. -36
Plate 12 - Method of Planes Extreme Load Case El. -18
Plate 13 - Method of Planes Low Water Case El. -18
Plate 14 - Method of Planes Extreme Load Case El. 0
Plate 15 - Method of Planes Low Water Case El. 0
Plate 16 - Settlement Curves with Lift Construction
Plate 17 - Soil Boring Legend

6. Reserved.

7. MRGO Closure - H&H Input. A crest elevation of 5 feet NAVD88 (2004.65) was selected. This elevation is a compromise between the desire to reduce costs with a lower crest elevation and the desire to reduce the incidence of overtopping. The crest elevation of necessity needs to be higher than the surrounding marsh. If the structure were lower than the surrounding marsh, the structure would function as a weir with concentrated flows funneled over its crest. Since the surrounding marsh is 2 to 3 feet NAVD88 (2004.65), the crest elevation has to be 4 feet NAVD88 (2004.65) at a minimum. The crest elevation of 5 feet NAVD88 (2004.65) is high enough that only tropical events will over top it. A lower crest would allow high tides from winter frontal passages to overtop the crest. Another consideration is the selection of the crest elevation is the uncertainty in the settlement and subsidence calculations. A final crest elevation of 4 feet NAVD88 (2004.65) would be sufficient to prevent overtopping from winter storms but a one foot settlement to 3 feet NAVD88 (2004.65) would not be adequate. Thus the selected crest elevation of 5 feet NAVD88 (2004.65) is adequate even if there were to be a foot of settlement beyond what was estimated by our geotechnical engineers.

A crest width of 12 feet is necessary so that the crest width is at a minimum equal to three stone diameters. The stone is the "A" gradation which was chosen because of its low cost, availability and suitability. This well graded stone will have a low porosity and a low permeability. Piping is not an issue because there will not be large head across the structure. There were questions as to whether the quarry run stone would be erosion resistant to 1) velocities as the closure was almost complete and 2) waves. Basic calculations confirm that this riprap gradation is sufficiently erosion resistant. Using standard stone formulations the minimum W50 for a 5000 pound max graded rip-rap is 1000 pounds. The computed the spherical D50 was calculated to be 2.3 feet which was determined to be adequate for a velocity of 18 feet per second as a channel bottom lining. ACES was used to determine the wave height that would require a 5000 pound max stone graded riprap. A wave slightly larger than 4 feet on a 1 on 2 slope will require a grade rip-rap with a 5000 pound maximum stone. A four foot wave will not occur at the site until there is 6.5 feet of water over the marsh (which is at elevation 2.0), so it would be with a surge of 8.5 which would be over the structure. Thus a four foot wave would not break directly upon the structure.

8. Proposed Construction Procedure for Total Stone Closure. Site specific soil borings, topographic, and hydrographic surveys were obtained and processed for this construction effort. A drawing depicting the locations of boring obtained is attached at the end of this write-up. A construction baseline for horizontal control has been mathematically established on the south shore of the MRGO, along the existing high spoil bank. Stationing of the channel alignment begins with zero (0+00) at this baseline and ascends towards the north bank of the channel. The proposed channel closure structure originates at approximate station 3+00, with the southern end of the overbank tie-in. The proposed channel closure foot print ends at station 16+90 with the northern end of the overbank tie-in. A drawing showing the location and footprint of the proposed closure as well as quantity calculations used to estimate the bid quantities for this work are enclosed after this write-up.

A crest elevation of 5 feet NAVD88 (2004.65) was selected for final target elevation of the closure structure. This elevation is a compromise between the desire to reduce costs with a lower crest elevation and the desire to reduce the incidence of overtopping. The crest elevation of necessity needs to be higher than the surrounding marsh. If the structure were lower than the surrounding marsh, the structure would function as a weir with concentrated flows funneled over its crest. Since the surrounding marsh along the north bank of the MRGO is 2.0 to 3.0 feet NAVD88 (2004.65), the crest elevation has to be 4 feet NAVD88 (2004.65) at a minimum. The crest elevation of 5 feet NAVD88 (2004.65) is high enough that only tropical events will over top it. A lower crest would allow high tides from winter frontal passages to overtop the crest.

The following elements of construction are required for completion of this construction effort:

a. Crushed Stone Blanket. The proposed closure structure will be constructed of limestone, meeting all required slopes, grades, and berms as formalized during hydraulic and geotechnical evaluation. A normal concern during rock placement in open waters is for scour of the channel bottom during the construction process due to water velocities passing the site. To alleviate this concern, the first order of work will mandate construction of a 4' thick crushed stone blanket from waters edge to waters edge. This blanket would provide some level of reinforcement for the additional rock placement and in addition would result in a scour blanket during the construction time period. As the blanket basically displaces required rock quantity in the dike proper, no appreciable additional cost should result in this effort. The blanket will be specified at 4' thick covering the entire footprint of the dike and berm section in addition to covering the channel side slopes up to the waters edge. Approximately 80,000 tons of crushed stone will be required. Crushed stone or gravel shall also meet the properties listed in Table 1.

TABLE 1
PHYSICAL REQUIREMENTS FOR CRUSHED STONE

Property	ASTM	Requirements
GRADATION	C-136	
Percent passing 4-inch sieve		100% by weight
Percent Passing No. 4 sieve		15% by weight, max.
Percent passing No. 200 sieve		5% by weight, max.
UNIT WEIGHT (Dry Rodded Weight)	C-29	75 pcf min., 100 pcf max.
SPECIFIC GRAVITY OF PARTICLES	C-127	2.0 min.

b. Overbank Extensions. On either bank of the MRGO, overbank extensions of the closure structure will be constructed to constrict flow during high water events and prevent flanking of the channel closure. On the south bankline, an existing spoil bank exists at an elevation of approximately +10.0 NAVD88. The south overbank extension will tie in to this geographic feature, resulting in an extension length of approximately 150 feet. Site specific surveys taken for this construction effort reveal no significant topographic features on the north bank of the MRGO, except for an existing foreshore dike existing along the shoreline at approximate elevation +4.0. Ground in the immediate vicinity beyond this foreshore dike is approximate elevation +2.0 NAVD88. The north overbank extension will be carried approximately 250 feet landward of the MRGO bankline. The ground lines will be excavated 2 feet deep over a 40 foot bottom width along the dike alignment. Material excavated from this trench will be side cast adjacent to the work.

(1) Overbank Geotextile Reinforcement Fabric. The ground lines will be excavated 2 feet over a 40 foot bottom width prior to placement of a 350# geotextile reinforcement fabric. A table of physical requirements for reinforcement geotextile is shown in Table 2. The approximate length of geotextile fabric required is 500 linear feet (175' south bank and 275' north bank). The fabric will extend approximately 5' either side of the excavated trench, resulting in a bid quantity of 2,500 yards of geotextile reinforcement. Overlaps will not be measured for payment.

TABLE 2
PHYSICAL REQUIREMENTS FOR REINFORCEMENT GEOTEXTILE

Physical Property	Test Procedure	Acceptable Test Results
Tensile strength in machine direction (*)	ASTM D 4595	350 pounds minimum at 5% strain
Seam Strength (**)	ASTM D 4884	100 pounds per inch minimum
Elongation at break	ASTM D 4595	10 percent minimum in any principle direction
Apparent Opening Size (AOS)	ASTM D 4751	No finer than the U.S. Standard Sieve No. 70 and no coarser than the Standard Sieve No. 30

(2) Overbank Stone Placement. Rock will be placed over the fabric in the trench to key in the structure, and then the dike proper will be constructed to elevation +7.0 NAVD88. Stability berms extending 9 feet either side of the dike will be required, at a

minimum thickness of 2 feet. The overbank structures will be constructed to the template shown in Figure 1. Approximate quantity of rock required for these tie-ins will be 6,500 tons. The overbank stone will be specified at a 650# topsize gradation (24" stone). The criticality of salt water prevention is not as critical in this reach of stone placement, as water will be flowing overbank when stages reach this level. The 24" stone size may result in better ease of handling when working overbank, and better fit the template size of this smaller dike section. Required stone gradation is attached at the end of this write-up.

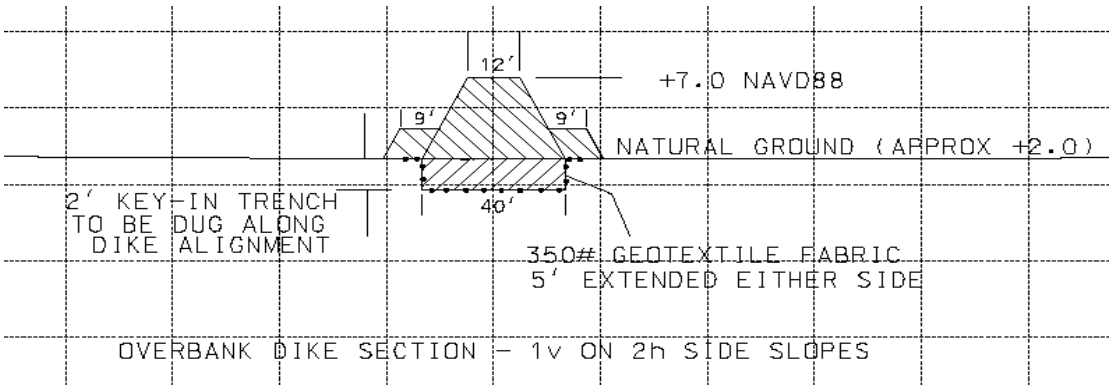


Figure 1. Overbank Cross Section

(3) Clearing Requirements. The area of land to be used in the construction of the overbank structures includes the fabric footprint (50 feet) plus a construction access corridor running adjacent to the structure. This corridor will likely be required in placement of stone away from the channel, where normal dragline operations will not reach. Assuming a 30' construction corridor basically doubles the overbank footprint, resulting in approximately 0.8 acres of impact. As the majority of this is on the north bank marsh area, very little clearing effort is anticipated. The excavation of the required trench will be included in the clearing price for preparation of the construction site. Use 1 acre for the bid sheet quantity.

c. Closure Structure. Well graded quarry run "A" stone will be specified for the closure structure. This gradation will minimize voids in the section, resulting in minimal salt water intrusion through the structure. The structure footprint includes the dike proper at a crown width of 12 feet and 1vertical on 2 horizontal side slopes, and stability berms of various elevations and widths based on geotechnical analysis. The structure will be built from the base up in a "lift" construction manner; incorporating approximately 5 foot lifts. Each lift will be completed across the entire structure footprint. This will better insure structure stability and hydraulic flow considerations during construction. Geotechnical analysis anticipates that construction during settlement will likely vary dependent upon location within the dike footprint. It is anticipated that less settlement will occur in the middle portion of the MRGO, and will increase in the softer materials closer to the shorelines. Projected settlements of 25% and 50% respectively were used in these reaches to calculate required stone quantities. The -26.0 NAVD88 bottom contour

was used to delineate between the two reaches, which is the elevation at which point bar deposits exist. The approximate quantity of "A" stone required for this effort is 305,000 tons. A gradation curve is attached at the end of this write-up. Typical cross sections of the proposed construction are also attached.

d. Maintenance Cycles. Maintenance needs were evaluated for long term upkeep of the closure structure. Based on the settlement curves found in the geotechnical section of this report, maintenance lifts were required at year 6 and approximately year 14. The first lift and the second subsequent lift will both be 3-foot lifts. Three (3) additional maintenance events are anticipated at 10 year cycles, namely years 25, 35 and 45. These maintenance events will cover general bankline scour and over topping wash of the structure as well as any localized failures which may occur between the maintenance intervals. Quantities for the first 2 lifts were developed based upon settlement curves provided by the Geotechnical Branch. These curves called for a 3' lift which was applied over the crown width of 12', straddling one side slope of the stone closure and extending from top of bank to top of bank of the MRGO channel. In addition, as maintenance could possible be required along the opposite slope of the closure, an average thickness of 2' of required stone, also extending from top of bank to top of bank of the MRGO channel, was used for developing quantities. For the three (3) additional maintenance events that could be anticipated at 10 year cycles, an average thickness of 2' of required stone, extending from top of bank to top of bank of the MRGO channel, was used. Quantities and cost estimates for anticipated O&M are included in the Cost Engineering section of this report.

9. Cost Estimates.

a. The cost estimate for the MRGO total closure structure was prepared utilizing MII software. The estimated costs were based upon an analysis of each line item evaluating quantity, production rate, and time, together with the appropriate equipment, labor and material costs. All of the construction work is common to the New Orleans District. In addition, all labor, equipment and materials are typical of this type of construction and are currently available. The site is readily accessible by marine equipment via the GIWW.

b. Lands and damages were calculated by MVN Real Estate Division. The real estate costs include administrative and acquisitions costs for de-authorization and closure of the channel.

c. There are no relocations required for this project.

d. Quantities were provided by MVN Engineering Divisions (Civil Branch) and were based on 50-foot cross section intervals. The design analysis was performed by MVN Engineering Division (Geotechnical Branch) using the Spencer's Method and new hurricane protection system design criteria.

e. This estimate assumes that the contractor will be working 10 hours days, 7 days a week. Equipment rates were taken from the USACE EP-1110-1-8, Region III, 2007.

f. Labor rates were based on historical rates taken from contractor payrolls for local jobs. All material prices were based on quotes received from suppliers with local sales tax applied.

g. Included in the construction feature is a cost for removal of aids to navigation. The scope is to remove channel markers and aids to navigation that would no longer be required along the de-authorized portion of the MRGO channel. This cost was approved by the Coast Guard.

h. The Engineering and Design (E&D) percentage rate includes such costs as project management, engineering, planning, designs, investigations, studies, reviews, value engineering and engineering during construction (EDC). A percentage of 5.5% was used because the type of work is typical to the New Orleans District and because material costs for the stone make up such a large percentage of the total construction cost.

i. The S&A rates for USACE civil works districts historically range between 7.5 and 10%. A percentage of 8% within the historical range was selected.

j. Field office overhead was based on historical ranges of 9% to 12%. The higher range of 12% is used to account for the additional cost of marine based operations and special equipment such as crew boats and survey boats.

k. Home office overhead was based on 8% which is within the historical range used by New Orleans District.

l. Profit was calculated by the Weighted Guidelines Method.

m. Bond was assumed to be 1%.

n. A contingency rate of 26.7% was developed by first looking at the recommended rate of 20% for feasibility level studies over $10,000,000 as shown in ER 1110-2-1302 and then looking at the various high risk issues.

o. Escalation was calculated using EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS). Escalation was calculated to the mid-point of construction which is currently estimated at October 2008.

p. Costs associated with the closure structure are 100% federal except LERRDS and OMRR&R which are 100% non-federal. The acquisition cost for the closure structure is 100% non-federal and is noted as such in the specific folder for lands and damages.

q. Costs associated with the de-authorization of the channel are 100% federal. The cost for removal of aids to navigation falls within this category and is noted as such in the estimate.

r. The operations and maintenance estimates were developed using unit costs from historical bid data of recent stone dike repairs in the New Orleans area. The quantities were developed based on the long term consolidation settlement which is estimated to require two (2) subsequent lifts at approximately years 6, 14, and every 10 years thereafter.

SURFACE 1: mrc0407
SURFACE 2: temp

FEASIBILITY LEVEL RUN FOR +7.0 CROWN HEIGHT
12' CROWN, SPENCER METHOD - EXTREME CASE

BASELINE STATION NUMBER	STATION FILL AREA	STATION FILL VOLUME	BOTTOM DEPTH MID-SECT	PERCENT FOR SETTLEMENT	NEAT LINE TONS	TONS PLUS SETTLEMENT	BOTTOM WIDTH	BOTTOM AREA	TONS CRUSHED STONE	
0+00.00	0.00	0								
0+50.00	0.00	0								
1+00.00	0.00	0								
1+50.00	0.00	0								
2+00.00	0.00	0								
2+50.00	0.00	0								
3+00.00	1.18	1	5	150.00%	2	2				
3+50.00	55.95	53	3	150.00%	82	375 (Adjusted)				SOUTH BANK TIE-IN
4+00.00	117.70	161	2	150.00%	250	375				
4+50.00	118.14	218	1	150.00%	338	508				1,260
5+00.00	268.40	358	-2	150.00%	556	834				
5+50.00	349.53	572	-4	150.00%	888	1,332	100	0	0	
6+00.00	531.87	816	-7	150.00%	1,267	1,900	100	5000	1150	
6+50.00	1226.36	1,628	-12	150.00%	2,527	3,791	152	6300	1449	
7+00.00	3352.28	4,239	-26	150.00%	6,582	9,873	330	12050	2771.5	
7+50.00	5055.01	7,785	-32	125.00%	12,086	15,108	350	17000	3910	
8+00.00	6335.86	10,547	-36	125.00%	16,374	20,468	365	17875	4111.25	
8+50.00	7419.25	12,736	-38	125.00%	19,773	24,716	430	19875	4571.25	
9+00.00	8386.33	14,637	-41	125.00%	22,724	28,405	440	21750	5002.5	
9+50.00	8896.41	16,003	-42	125.00%	24,845	31,056	440	22000	5060	
10+00.00	8945.25	16,520	-42	125.00%	25,647	32,059	440	22000	5060	
10+50.00	8887.28	16,512	-42	125.00%	25,635	32,044	440	22000	5060	
11+00.00	8605.69	16,197	-42	125.00%	25,146	31,432	440	22000	5060	
11+50.00	8181.72	15,544	-41	125.00%	24,132	30,165	430	21750	5002.5	
12+00.00	7325.55	14,359	-38	125.00%	22,292	27,865	426	21400	4922	
12+50.00	6312.65	12,628	-36	125.00%	19,605	24,506	416	21050	4841.5	
13+00.00	4855.15	10,341	-31	125.00%	16,054	20,067	345	19025	4375.75	
13+50.00	2600.14	6,903	-21	150.00%	10,717	16,075	182	13175	3030.25	Closure
14+00.00	642.26	2,302	-8	150.00%	3,574	5,361	100	7050	1621.5	

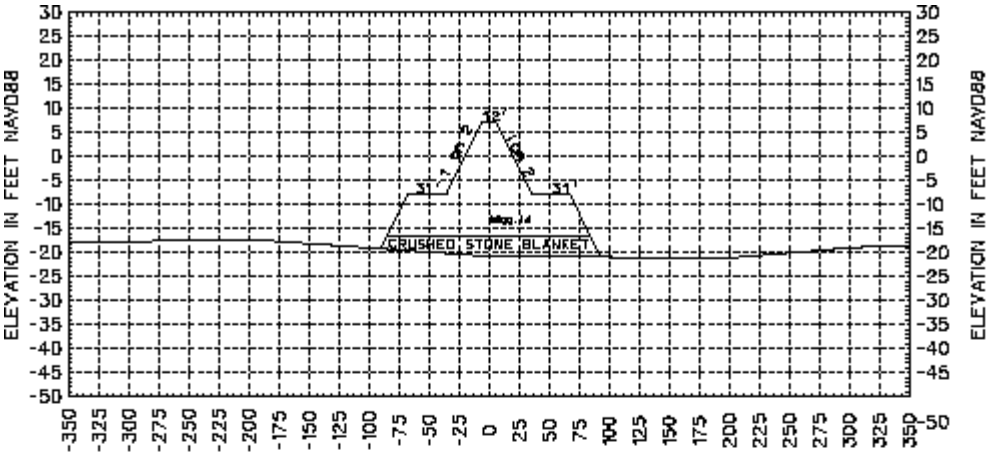
14+50.00	108.22	695	2	150.00%	1,079	1,618	100	5000	1150	358,675
15+00.00	108.18	200	2	150.00%	311	466				
15+50.00	114.79	206	2	150.00%	320	480				
16+00.00	119.13	217	2	150.00%	337	505				
16+50.00	120.98	222	2	150.00%	345	517				NORTH BANK TIE-IN
17+00.00	121.21	224	2	150.00%	348	522				2,489
17+50.00	0.00	0								
18+00.00	0.00	0								
		182,824			283,834	362,424			68,149	
							Plus 10,000 for Bankline Tie-Ins		10,000	
									78,149	

SO:
FABRIC =
Bottom of Trench measurement (40') + 5' overlaps each side x length of overbanks + overlap into MRGO (250+150+25+25)
Which equals: (50' * 450')/ 9 ft per yd = 2,500 yards

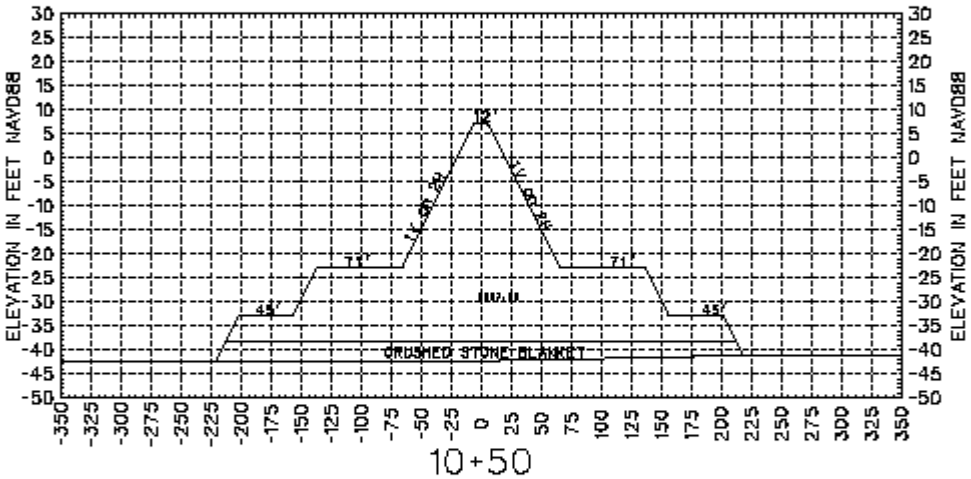
CRUSHED STONE=
4' paving of underwater footprint (defined in column J above) + additional 10,000 tons to accommodate nearshore paving outside footprint.
Which equals: 68,149 + 10,000 = 78,149. Use 80,000 tons.
No settlement is calculated on the crushed stone feature - all settlement will be accomodated in the closure stone quantity.

CLOSURE STONE=
The quantity in column G above from waters edge to waters edge (excludes overbank tie-in reaches) less crushed stone quantity.
Which equals: 358,675 - 68,149 = 290,526 Tons
This number already includes 25% and 50% respectively for settlement. Due to the use of the well graded "A" stone gradation, an additional 5% is added for potential losses during construction. 290,526 * 1.05 = 305,052 tons.
Use 305,000 tons.

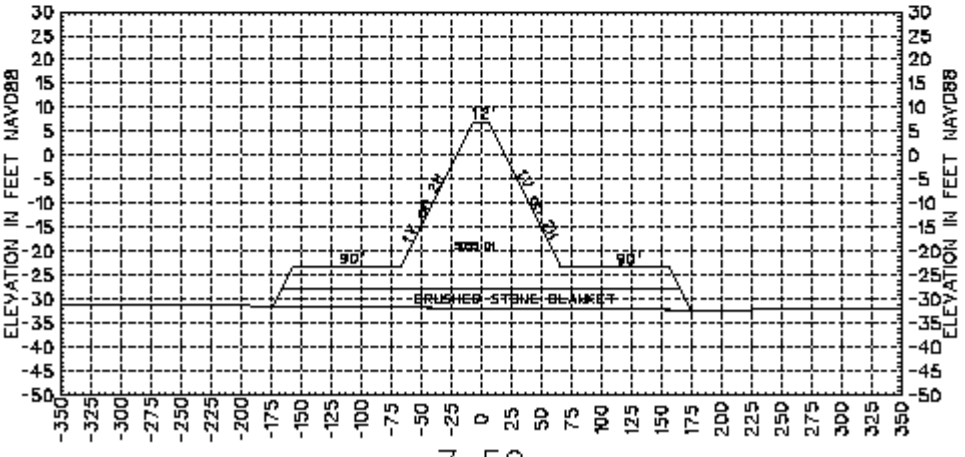
OVERBANK TIE-INS=
The numbers in column L above do not totally address the tie-in needs. Additnl stone is needed for filling the 2' trench by 40' bottom width. and for recently added berms 9' either side of tie-in dike.
Additional Stone (Trench) = (400' Length * 40' Width * 2' Depth) * 115 #/cf / 2000 #/ton = 1,840 tons
Additional Stone (berms) = (400' Length * 2 both side * 9' width * 2' thickness * 115 #/cf / 2000 #/ton = 828 tons
Tie-In Stone equals: 1,260 (Column L south) + 2,489 (column L north) + 1,840 Additional + 828 Additional = 6,417 tons. Use 6,500 tons



13+50



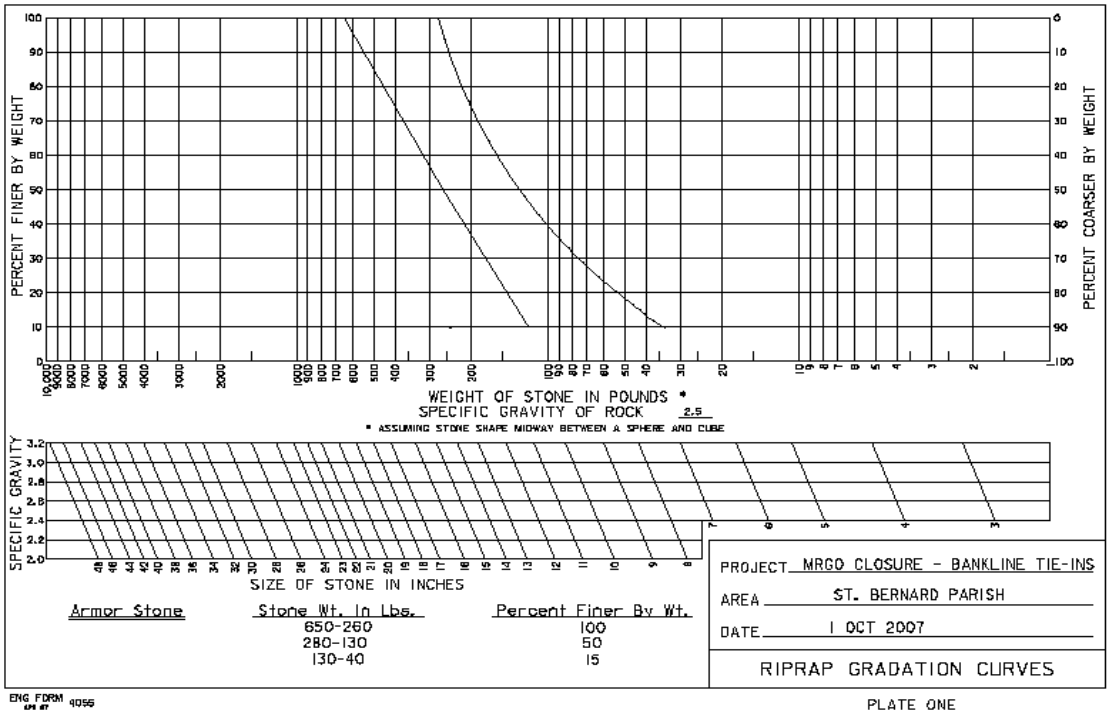
10+50

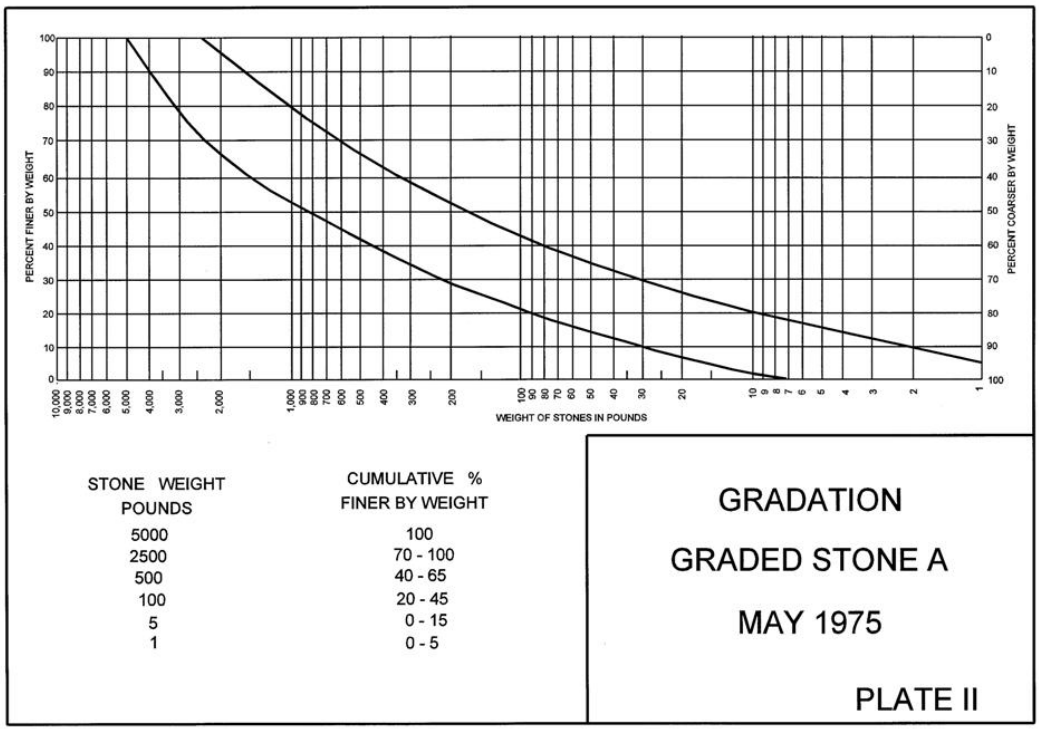


7+50

TYPICAL SECTIONS

Stone Gradation Curves.





MISSISSIPPI RIVER GULF OUTLET
DEEP DRAFT DE-AUTHORIZATION STUDY

ENGINEERING APPENDIX
ANNEX I - COST ENGINEERING DATA

REASONABLE CONTRACT ESTIMATE

Project: Total Rock Closure
OF MRGO
South of Bayou La Loutre
St. Bernard Parish, Louisiana

Item	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
0001	Mobilization and Demobilization	1	LS	$85,000.00	$85,000.00
0002	Stone Placement - Channel Proper "A" Stone	305,000	TON	$38.60	$11,773,000.00
0003	Stone Placement - Overbank Tie-ins 650#	6,500	TON	$62.10	$403,650.00
0004	Crushed Stone Blanket 4-in	80,000	TON	$42.50	$3,400,000.00
0005	Geotextile Separator Fabric 350#	2,500	SY	$12.60	$31,500.00
0006	Clearing and Grubbing (Overbank)	1	LS	$11,000.00	$11,000.00

TOTAL:	**$15,704,150**
E&D	**$863,728**
S&A	**$1,256,332**
	$17,824,211
Contingency (26.7%)	**$4,759,064**
TOTAL	**$22,583,275**

MRGO Stone Closure: O&M Yr 6			
ITEM		$$/CY	Costs
Mob and Demob			$75,000
O&M Year 6 -Tons	20,000	$55	$1,100,000
		Subtotal:	$1,175,000
	26.7%	Cont	$313,725
Notes:		Subtotal:	$1,488,725
Assumes placing an average of 3'			
of 650# stone, along one face/slope		E&D	$172,500
of closure (~67') and 12' crown. Also		S&A	$136,963
accomodates possible O&M on			
opposite side of closure (avg 2' thick-		Total:	$1,800,000
ness).			

MRGOStone Closure: O&M Yr 14			
ITEM		$$/CY	Costs
Mob and Demob			$75,000
O&M Year 14 -Tons	20,000	$55	$1,100,000
		Total:	$1,175,000
	26.7%	Cont	$313,725
Notes:		Subtotal:	$1,488,725
Assumes placing an average of 3'			
of 650# stone, along one face/slope		E&D	$172,500
of closure (~67') and 12' crown. Also		S&A	$136,963
accomodates possible O&M on			
opposite side of closure (avg 2' thick-		Total:	$1,800,000
ness).			

MRGOStone Closure: O&M Yrs 24, 34 and 44			
ITEM		$$/CY	Costs
Mob and Demob			$75,000
O&M Every Following 10 Yrs	15,000	$55	$825,000
		Total:	$900,000
	26.7%	Cont	$240,300
Notes:		Subtotal:	$1,140,300
Assumes placing an average of 2'			
of 650# stone, along both slopes		E&D	$172,500
of closure (~134') and 12' crown.		S&A	$104,908
		Total:	$1,420,000

MISSISSIPPI RIVER GULF OUTLET
DEEP DRAFT DE-AUTHORIZATION STUDY

ENGINEERING APPENDIX
ANNEX II - MII (M2) COST ESTIMATE

Total Closure Feasibility

This estimate is for a total rock closure across the Mississippi River-Gulf Outlet to be constructed immediately south of the Bayou La Loutre crossing.

Estimated by	Eric Salamone
Designed by	Keith O'Cain/Richard Broussard
Prepared by	
Preparation Date	10/10/2007
Effective Date of Pricing	10/1/2007
Estimated Construction Time	Days

This report is not copyrighted, but the information contained herein is For Official Use Only.

Designed by
Keith O'Cain/Richard Broussard
Estimated by
Eric Salamone
Prepared by

Design Document	
Document Date	9/12/2007
District	New Orleans District
Contact	Chris Monnerjahn (504) 862-2415
Budget Year	2007
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
Supplies
Real Estate
Relocations
E&D
S&A

Timeline/Currency

Preparation Date	10/10/2007
Escalation Date	10/1/2007
Eff. Pricing Date	10/1/2007
Estimated Duration	0 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Equipment EP07R03: MII Equipment Region 3 2007

03 SOUTHEAST

Sales Tax	9.00
Working Hours per Year	1,530
Labor Adjustment Factor	0.83
Cost of Money	5.75
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.090
Gas	2.600
Diesel Off-Road	2.440
Diesel On-Road	2.700

Shipping Rates

Over 0 CWT	10.26
Over 240 CWT	9.59
Over 300 CWT	8.41
Over 400 CWT	7.64
Over 500 CWT	4.49
Over 700 CWT	4.36
Over 800 CWT	4.99

Date	Author	Note
10/9/2007		This estimate is for a total rock closure across the MRGO to be constructed immediately south of the Bayou La Loutre crossing. A constricted reach of the channel was chosen for the structure. All materials, supplies, labor and equipment are typical of this type of construction and currently available. The site is readily accessible by marine equipment via the GIWW. Major project features include a 4' crushed stone base followed by an "A" stone closure dike section with berms. For the overbank portions tying into the shore, the area will first be cleared, top 2' demucked and cast adjacent, then geotextile placed and finally the stone closure section constructed using 650# stone. The rock closure section consists of a 12-foot wide crest at elevation +7.0 NAVD88, side slopes of 1V on 2H and berms at 2 levels. QUANTITIES Quantities were provided by MVN Civil Branch and were based on 50' cross section intervals. The design analysis was performed by MVN Geotechnical Branch using the Spencer's Method and new hurricane protection system design criteria. The quantity for the Channel "A" stone includes factors for construction settlement and losses ranging from 25% in the center of the dike to 50% at the edges of the channel. Settlement at the edges is greater due to building more on the existing soft marshy bottom. An additional 5% was added for potential losses during construction. CONSTRUCTION DURATION The contract duration is approximately 270 calendar days. It includes 90 days for the contractor to wait on his stone order to arrive. The actual construction will take approximately 180 days. WORK SCHEDULE This estimate assumes that the contractor will be working 10 hours days, 7 days a week. EQUIPMENT Rates used were based from the USACE EP-1110-1-8, Region III, 2007. LABOR Labor rates were based on historical rates taken from contractor payrolls for local jobs. MATERIAL QUOTES Current price quotes for the stone items and the geotextile were provided by suppliers. CONTRACTING PLAN This estimate assumes that there will be one prime contractor that performs the work. The assumption is based on the working plan of past rock jobs performed for the New Orleans District. At this time, the acquisition plan is unknown. It is assumed that the contract will be advertised as unrestricted. INDIRECT COSTS Field Office Overhead was based on historical ranges of 9% to 12%. The higher range of 12% is used to account for the additional cost of marine based operations and special equipment such as crewboats and surveyboats. Home Office Overhead was based on 8% which is in the historical range used by New Orleans District. Profit was calculated by the Weighted Guidelines Method. Bond was assumed to be 1%. CONTINGENCY & ESCALATION A contingency rate of 26.7% was developed by first looking at the recommended rate of 20% for feasibility level studies over $10,000,000 as shown in ER 1110-2-1302

Date	Author	Note
10/9/2007		and then looking at the various high risk issues. The aquisition plan is unknown at this time; however, if the job was advertised as a set-aside, then the total contract price would increase due to subcontractor markups. Competition for rock jobs is typically limited; therefore, depending on the timing of the advertisement, the contract cost could be higher than anticipated. Variation of the quantities was considered based on the settlement factors and the chance of the contractor placing rock out of section. The designers were consulted to get a feel for their confidence levels in the analysis, design and quantity calculations. Escalation was calculated using EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS). FEDERAL/NON-FEDERAL COSTS Costs associated with the closure structure are 100% federal except LERRDS and OMRR&R which are 100% non-federal. The acquisition cost for the closure structure is 100% non-federal and is noted as such in the specific folder for Lands and Damages. Costs associated with the de-authorization of the channel are 100% federal. The cost for removal of aids to navigation falls within this category and is noted as such in the estimate.

Direct Cost Markups	**Category**	**Method**
Productivity	Productivity	Productivity
Overtime	Overtime	Overtime

	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*7.00*	*8.00*	*1.00*	*10.00*	*0.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*28.57*	*(42.86)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*Yes*		
Sunday	*2.00*	*Yes*		

Sales Tax	TaxAdj	Running % on Selected Costs
MatlCost		
Rock Delay	MiscDirect	Running % on Selected Costs
LaborCost		

Contractor Markups	**Category**	**Method**
JOOH	JOOH	Running %
HOOH	HOOH	Running %
Profit	Profit	Profit Weighted Guidelines

Guideline	*Value*	*Weight*	*Percentage*
Risk	*0.080*	*20*	*1.60*
Difficulty	*0.080*	*15*	*1.20*
Size	*0.030*	*15*	*0.45*
Period	*0.056*	*15*	*0.84*
Invest (Contractor's)	*0.075*	*5*	*0.38*
Assist (Assistance by)	*0.120*	*5*	*0.60*
SubContracting	*0.120*	*25*	*3.00*
Total		*100*	*8.07*

Bond	Bond	Running %
Excise Tax	Excise	Running %

Owner Markups	**Category**	**Method**
Contingency	Contingency	Contract %
Escalation	Escalation	Escalation

StartDate	*StartIndex*	*EndDate*	*EndIndex*	*Escalation*
10/1/2007	*666.19*	*10/1/2008*	*681.52*	*2.30*

SIOH	SIOH	Running %

Description	ContractCost	Contingency	Escalation	ProjectCost
Project Summary	**19,925,211**	**4,759,064**	**567,738**	**25,252,013**
01 Lands and Damages	**1,401,000**	**0**	**32,223**	**1,433,223**
04 Dams	**16,404,150**	**4,193,008**	**473,735**	**21,070,893**
30 Engineering and Design	**863,728**	**230,616**	**25,170**	**1,119,514**
31 Construction Management	**1,256,332**	**335,441**	**36,611**	**1,628,384**

Description	Quantity	UOM	CostToPrime	PrimeCMU	ContractCost
Project Indirect Summary			**15,521,102**	**3,701,996**	**19,925,211**
01 Lands and Damages	**1**	**LS**	**1,401,000**	**0**	**1,401,000**
04 Dams	**1**	**EA**	**12,000,041**	**3,701,996**	**16,404,150**
30 Engineering and Design	**1**	**LS**	**863,728**	**0**	**863,728**
31 Construction Management	**1**	**LS**	**1,256,332**	**0**	**1,256,332**

Description	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUser1	CostToPrime
Project Direct Summary	**224,816**	**530,471**	**2,534,663**	**9,388,658**	**23,548**	**15,521,102**
01 Lands and Damages	**0**	**0**	**0**	**0**	**0**	**1,401,000**
04 Dams	**224,816**	**530,471**	**2,534,663**	**9,388,658**	**23,548**	**12,000,041**
30 Engineering and Design	**0**	**0**	**0**	**0**	**0**	**863,728**
31 Construction Management	**0**	**0**	**0**	**0**	**0**	**1,256,332**

Description	UOM	Quantity	CostToPrime	PrimeCMU	ContractCost	OwnerMarkup	ProjectCost
Construction Summary			**12,000,041**	**3,701,996**	**16,404,150**	**4,666,743**	**21,070,893**
			12,000,041.0316		*16,404,149.9990*		*21,070,892.6838*
04 01 Main Dam	**EA**	**1.0000**	**12,000,041**	**3,701,996**	**16,404,150**	**4,666,743**	**21,070,893**
04 01 01 Mobilization and Demobilization	**LS**	**1.0000**	**64,532**	**19,908**	**85,000**	**25,172**	**110,172**
			64,531.8116		*85,000.0046*		*110,171.9909*
Mob & Demob	**EA**	**1.0000**	**64,532**	**19,908**	**85,000**	**25,172**	**110,172**
			64,531.8116		*85,000.0046*		*110,171.9909*
Mob & Demob	**EA**	**1.0000**	**64,532**	**19,908**	**85,000**	**25,172**	**110,172**
			11,935,509.2200		*15,619,149.9944*		*20,244,620.6929*
04 01 42 Earth and Rockfill Dam	**EA**	**1.0000**	**11,935,509**	**3,682,088**	**15,619,150**	**4,625,471**	**20,244,621**
			11,935,509.2200		*15,619,149.9944*		*20,244,620.6929*
04 01 42 02 Sitework	**EA**	**1.0000**	**11,935,509**	**3,682,088**	**15,619,150**	**4,625,471**	**20,244,621**
			29.4973		*38.6000*		*50.0310*
04 01 42 02 Stone Placement - Channel Proper "A" Stone	**TON**	**305,000.0000**	**8,996,689**	**2,775,466**	**11,773,000**	**3,486,468**	**15,259,468**
			47.4484		*62.1000*		*80.4904*
04 01 42 02 Stone Placement - Overbank Tie-Ins 650#	**TON**	**6,500.0000**	**308,414**	**95,145**	**403,650**	**119,537**	**523,187**
			32.4772		*42.5000*		*55.0860*
04 01 42 02 Crushed Stone Blanket 4-in	**TON**	**80,000.0000**	**2,598,178**	**801,534**	**3,400,000**	**1,006,879**	**4,406,879**
			9.5936		*12.6000*		*16.3314*
04 01 42 02 Geotextile Separator Fabric 350#	**SY**	**2,500.0000**	**23,984**	**7,399**	**31,500**	**9,328**	**40,828**
04 01 42 02 Clearing and Grubbing (Overbanks)	**LS**	**1.0000**	**8,244**	**2,543**	**11,000**	**3,258**	**14,258**
04 01 99 Removal of Aids to Navigation	**LS**	**1.0000**	**0**	**0**	**700,000**	**16,100**	**716,100**

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
Detailed estimate			**116,378.69**	**556,198.62**	**2,328,981.25**	**9,388,657.50**	**23,547.82**	**1,401,000.00**	**863,728.49**	**1,256,332.28**	**15,521,101.81**
01 Lands and Damages	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,401,000.00**	**0.00**	**0.00**	**1,401,000.00**
			0.0000	*0.0000*	*0.0000*	*0.0000*					*1,401,000.0000*
Lands and Damages	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,401,000.00**	**0.00**	**0.00**	**1,401,000.00**
			0.0000	*0.0000*	*0.0000*	*0.0000*					*125,000.0000*
De-Authorization of Channel	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**125,000.00**	**0.00**	**0.00**	**125,000.00**
USR Disposal of Easements	LS	1.0000	0.00	0.00	0.00	0.00	0.00	125,000.00	0.00	0.00	125,000.00
(Note: Administrative Costs)											
			0.0000	*0.0000*	*0.0000*	*0.0000*					*1,276,000.0000*
Closure Structure	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,276,000.00**	**0.00**	**0.00**	**1,276,000.00**
USR Acquisition Costs	LS	1.0000	0.00	0.00	0.00	0.00	0.00	1,276,000.00	0.00	0.00	1,276,000.00
(Note: Costs are 100% non-federal)											
			116,378.6936	*556,198.6207*	*2,328,981.2500*	*9,388,657.5000*					*12,000,041.0316*
04 Dams	**EA**	**1.0000**	**116,378.69**	**556,198.62**	**2,328,981.25**	**9,388,657.50**	**23,547.82**	**0.00**	**0.00**	**0.00**	**12,000,041.03**
			116,378.6936	*556,198.6207*	*2,328,981.2500*	*9,388,657.5000*					*12,000,041.0316*
04 01 Main Dam	**EA**	**1.0000**	**116,378.69**	**556,198.62**	**2,328,981.25**	**9,388,657.50**	**23,547.82**	**0.00**	**0.00**	**0.00**	**12,000,041.03**
04 01 01 Mobilization and Demobilization	**LS**	**1.0000**	**10,082.88**	**37,867.36**	**0.00**	**8,625.00**	**4,559.82**	**0.00**	**0.00**	**0.00**	**64,531.81**
(Note: This item is for all equipment, labor, and mateiral required for mobilization and demobilization. 3 days are allowed for mobilization and 2 days are allowed for demobilization for a total of 5 days. 3-900 HP tugs and 4 deck barges shall mobilize all necessary equipment.)											
			10,082.8800	*37,867.3557*	*0.0000*	*8,625.0000*					*64,531.8116*
Mob & Demob	**EA**	**1.0000**	**10,082.88**	**37,867.36**	**0.00**	**8,625.00**	**4,559.82**	**0.00**	**0.00**	**0.00**	**64,531.81**
			10,082.8800	*37,867.3557*	*0.0000*	*8,625.0000*					*64,531.8116*
Mob & Demob	**EA**	**1.0000**	**10,082.88**	**37,867.36**	**0.00**	**8,625.00**	**4,559.82**	**0.00**	**0.00**	**0.00**	**64,531.81**
			0.0000	*0.0000*	*0.0000*	*0.0000*					*0.0000*
round	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**560.22**	**0.00**	**0.00**	**0.00**	**0.00**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*560.2200*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
USR round	EA	1.0000	0.00	0.00	0.00	0.00	560.22	0.00	0.00	0.00	0.00
Mob & Demob	**LS**	**1.0000**	**10,082.88**	**37,867.36**	**0.00**	**8,625.00**	**3,999.60**	**0.00**	**0.00**	**0.00**	**64,531.81**

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
			140.0400	*525.9355*	*0.0000*	*0.0000*	*55.5500*	*0.0000*	*0.0000*	*0.0000*	*776.4835*
USR Mobilization	HR	72.0000	10,082.88	37,867.36	0.00	0.00	3,999.60	0.00	0.00	0.00	55,906.81
(Note: All hourly EP equipment will be at the ownership rate. The tugs and barges will be at the fully operated rate.)											
			0.0000	*0.0000*	*0.0000*	*200.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*200.0000*
USR Daily Deck Barge	DAY	5.0000	0.00	0.00	0.00	1,000.00	0.00	0.00	0.00	0.00	1,000.00
(Note: This item is for a daily deck barge.)											
			0.0000	*0.0000*	*0.0000*	*325.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*325.0000*
USR Daily Spud Barge	DAY	5.0000	0.00	0.00	0.00	1,625.00	0.00	0.00	0.00	0.00	1,625.00
			0.0000	*0.0000*	*0.0000*	*200.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*200.0000*
USR Daily Deck Barge	DAY	5.0000	0.00	0.00	0.00	1,000.00	0.00	0.00	0.00	0.00	1,000.00
(Note: This item is for a daily deck barge.)											
			0.0000	*0.0000*	*0.0000*	*200.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*200.0000*
USR Daily Deck Barge	DAY	5.0000	0.00	0.00	0.00	1,000.00	0.00	0.00	0.00	0.00	1,000.00
(Note: This item is for a daily deck barge.)											
			0.0000	*0.0000*	*0.0000*	*1,500.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*1,500.0000*
USR Mobilization & Demobilization for Marsh Backhoe	EA	2.0000	0.00	0.00	0.00	3,000.00	0.00	0.00	0.00	0.00	3,000.00
(Note: mobilization/demobilization charge quoted by Wilco Marsh Buggies. $1500 each way. The backhoe will be loaded onto a deck barge to reach the jobsite.)											
			0.0000	*0.0000*	*0.0000*	*200.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*200.0000*
USR Daily Deck Barge	DAY	5.0000	0.00	0.00	0.00	1,000.00	0.00	0.00	0.00	0.00	1,000.00
(Note: This item is for a daily deck barge.)											
			106,295.8136	*518,331.2650*	*2,328,981.2500*	*8,680,032.5000*					*11,935,509.2200*
04 01 42 Earth and Rockfill Dam	**EA**	**1.0000**	**106,295.81**	**518,331.26**	**2,328,981.25**	**8,680,032.50**	**18,988.00**	**0.00**	**0.00**	**0.00**	**11,935,509.22**
			106,295.8136	*518,331.2650*	*2,328,981.2500*	*8,680,032.5000*					*11,935,509.2200*
04 01 42 02 Sitework	**EA**	**1.0000**	**106,295.81**	**518,331.26**	**2,328,981.25**	**8,680,032.50**	**18,988.00**	**0.00**	**0.00**	**0.00**	**11,935,509.22**
			0.2578	*1.2541*	*5.1500*	*22.1662*					*29.4973*

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
04 01 42 02 Stone Placement - Channel Proper "A" Stone	**TON**	**305,000.0000**	**78,616.16**	**382,515.14**	**1,570,750.00**	**6,760,700.00**	**9,694.96**	**0.00**	**0.00**	**0.00**	**8,996,689.12**
(Note: This item is for all equipment, labor, materials and supplies for the delivery and installation of stone material to the specified limits. A dragline mounted on a spud barge shall be used. The rock below elevation -10.0 can be raked off the barge and allows for a faster production rate and still allows the barges to float over. The rock above elevation -10.0 is assumed to be placed at a slower, more typical rate for rock dikes/foreshore protection.)											
			0.3546	*1.7254*	*5.1500*	*22.2329*					*30.1993*
Above Water Construction	**TON**	**60,000.0000**	**21,276.36**	**103,522.36**	**309,000.00**	**1,333,975.00**	**1,500.00**	**0.00**	**0.00**	**0.00**	**1,811,958.64**
(Note: This item of work is to place rock material within the specified lines and grades above elevation -10.0. A dragline mounted on a spud barge working at a rate of 165 tons/hour will accomplish this task. The quantity based on the typical section is approximately 60,000 tons including settlement.)											
			0.3546	*1.7254*	*5.1500*	*22.0000*	*0.0250*	*0.0000*	*0.0000*	*0.0000*	*29.9664*
USR Above Water Construction	TON	60,000.0000	21,276.36	103,522.36	309,000.00	1,320,000.00	1,500.00	0.00	0.00	0.00	1,797,983.64
			0.0000	*0.0000*	*0.0000*	*325.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*325.0000*
USR Daily Spud Barge	DAY	43.0000	0.00	0.00	0.00	13,975.00	0.00	0.00	0.00	0.00	13,975.00
(Note: 15% time delay is added to this item to account for weather and waiting on stone. 37 days for stone placement + 15% = 43 days)											
			0.2340	*1.1387*	*5.1500*	*22.1499*					*29.3254*
Subaqueous Construction	**TON**	**245,000.0000**	**57,339.80**	**278,992.77**	**1,261,750.00**	**5,426,725.00**	**7,350.00**	**0.00**	**0.00**	**0.00**	**7,184,730.48**
(Note: This item of work is to place rock material within the specified lines and grades below elevation -10.0. A dragline mounted on a spud barge working at a rate of 250 tons/hour will accomplish this task.)											
			0.2340	*1.1387*	*5.1500*	*22.0000*	*0.0300*	*0.0000*	*0.0000*	*0.0000*	*29.1755*
USR Subaqueous Construction	TON	245,000.0000	57,339.80	278,992.77	1,261,750.00	5,390,000.00	7,350.00	0.00	0.00	0.00	7,148,005.48
			0.0000	*0.0000*	*0.0000*	*325.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*325.0000*
USR Daily Spud Barge	DAY	113.0000	0.00	0.00	0.00	36,725.00	0.00	0.00	0.00	0.00	36,725.00
(Note: 15% time delay is added to this item to account for weather and waiting on stone. 98 days for stone placement + 15% = 113 days)											
			0.0000	*0.0000*	*0.0000*	*0.0000*					*0.0000*
round	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**844.96**	**0.00**	**0.00**	**0.00**	**0.00**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*844.9600*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
USR round	EA	1.0000	0.00	0.00	0.00	0.00	844.96	0.00	0.00	0.00	0.00

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
			1.1649	*5.2855*	*16.0000*	*22.4050*					*47.4484*
04 01 42 02 Stone Placement - Overbank Tie-Ins 650#	**TON**	**6,500.0000**	**7,571.85**	**34,355.56**	**104,000.00**	**145,632.50**	**1,715.07**	**0.00**	**0.00**	**0.00**	**308,414.49**
(Note: This item is for all equipment, labor, material, and supplies for the placement of rock on the banks for tie-in into the natural land contours. A dragline mounted on a spud barge shall place rock on the banks where a backhoe will load trucks for placement along the work alignment. The backhoe shall work at a production rate of 100 ton/hr. A 900 HP tug shall move the plant from one side of the MRGO to the other.)											
			1.1649	*5.2855*	*16.0000*	*22.4050*					*47.4484*
Overbank Tie-Ins	**TON**	**6,500.0000**	**7,571.85**	**34,355.56**	**104,000.00**	**145,632.50**	**1,625.00**	**0.00**	**0.00**	**0.00**	**308,414.49**
			0.8923	*3.0586*	*16.0000*	*22.0000*	*0.2500*	*0.0000*	*0.0000*	*0.0000*	*44.4208*
USR Overbank Tie Ins	TON	6,500.0000	5,799.95	19,880.94	104,000.00	143,000.00	1,625.00	0.00	0.00	0.00	288,735.04
(Note: This item is for placing stone on the banks to tie the rock dike into the bankline.)											
			0.0000	*0.0000*	*0.0000*	*325.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*325.0000*
USR Daily Spud Barge	DAY	8.1000	0.00	0.00	0.00	2,632.50	0.00	0.00	0.00	0.00	2,632.50
(Note: 15% time delay is added to this item to account for weather and waiting on stone. 7 days for stone placement + 15% = 8.1 days)											
			0.2726	*2.2269*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*2.6226*
USR Overbank Tie In Dragline	TON	6,500.0000	1,771.90	14,474.62	0.00	0.00	0.00	0.00	0.00	0.00	17,046.95
			0.0000	*0.0000*	*0.0000*	*0.0000*					*0.0000*
round	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**90.07**	**0.00**	**0.00**	**0.00**	**0.00**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*90.0700*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
USR round	EA	1.0000	0.00	0.00	0.00	0.00	90.07	0.00	0.00	0.00	0.00
			0.2340	*1.1387*	*8.0000*	*22.1503*					*32.4772*
04 01 42 02 Crushed Stone Blanket 4-in	**TON**	**80,000.0000**	**18,723.20**	**91,099.68**	**640,000.00**	**1,772,025.00**	**5,248.26**	**0.00**	**0.00**	**0.00**	**2,598,177.61**
(Note: This item of work is to place rock material within the specified lines and grades below elevation -10.0. A dragline mounted on a spud barge working at a rate of 250 tons/hour will accomplish this task.The rock can be raked off the barge and allows for a faster production rate and still allows the barges to float over. There is no crushed stone placed on the overbank. No settlement was calculated on the crushed stone because all settlement will be accomodated by the closure stone.)											
			0.2340	*1.1387*	*8.0000*	*22.1503*					*32.4772*
Subaqueous Construction	**TON**	**80,000.0000**	**18,723.20**	**91,099.68**	**640,000.00**	**1,772,025.00**	**4,960.00**	**0.00**	**0.00**	**0.00**	**2,598,177.61**

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
			0.0000	*0.0000*	*0.0000*	*325.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*325.0000*
USR Daily Spud Barge	DAY	37.0000	0.00	0.00	0.00	12,025.00	0.00	0.00	0.00	0.00	12,025.00
(Note: 15% time delay is added to this item to account for weather and waiting on stone. 32 days for stone placement + 15% = 37 days)											
			0.2340	*1.1387*	*8.0000*	*22.0000*	*0.0620*	*0.0000*	*0.0000*	*0.0000*	*32.3269*
USR Subaqueous Construction-crushed stone	TON	80,000.0000	18,723.20	91,099.68	640,000.00	1,760,000.00	4,960.00	0.00	0.00	0.00	2,586,152.61
round	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**288.26**	**0.00**	**0.00**	**0.00**	**0.00**
USR round	LS	1.0000	0.00	0.00	0.00	0.00	288.26	0.00	0.00	0.00	0.00
			0.5538	*1.0868*	*5.6925*	*0.6300*					*9.5936*
04 01 42 02 Geotextile Separator Fabric 350#	**SY**	**2,500.0000**	**1,384.60**	**2,716.89**	**14,231.25**	**1,575.00**	**1,616.98**	**0.00**	**0.00**	**0.00**	**23,983.99**
(Note: This item of work includes equipment, material, supplies and labor to place the geotextile on the overbanks under the stone. It will be placed by a backhoe and laborers. Quantity is approximately 1528 SY on the North side and 972 SY on the South side.)											
			0.5538	*1.0868*	*5.6925*	*0.6300*					*9.5936*
Geotextile Placement	**SY**	**2,500.0000**	**1,384.60**	**2,716.89**	**14,231.25**	**1,575.00**	**1,500.00**	**0.00**	**0.00**	**0.00**	**23,983.99**
			0.5538	*1.0868*	*0.0000*	*0.0000*	*0.6000*	*0.0000*	*0.0000*	*0.0000*	*2.7588*
USR Geotextile Placement	SY	2,500.0000	1,384.60	2,716.89	0.00	0.00	1,500.00	0.00	0.00	0.00	6,896.93
			0.0000	*0.0000*	*0.0000*	*325.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*325.0000*
USR Daily Spud Barge	DAY	3.0000	0.00	0.00	0.00	975.00	0.00	0.00	0.00	0.00	975.00
			0.0000	*0.0000*	*0.0000*	*200.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*200.0000*
USR Daily Deck Barge	DAY	3.0000	0.00	0.00	0.00	600.00	0.00	0.00	0.00	0.00	600.00
(Note: This item is for a daily deck barge.)											
			0.0000	*0.0000*	*4.9500*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*5.3955*
USR Geotextile material only	SY	2,875.0000	0.00	0.00	14,231.25	0.00	0.00	0.00	0.00	0.00	15,512.06
(Note: includes 15% increase for laps)											
round	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**116.98**	**0.00**	**0.00**	**0.00**	**0.00**

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
USR round	LS	1.0000	0.00	0.00	0.00	0.00	116.98	0.00	0.00	0.00	0.00
04 01 42 02 Clearing and Grubbing (Overbanks)	**LS**	**1.0000**	**0.00**	**7,644.00**	**0.00**	**100.00**	**712.73**	**0.00**	**0.00**	**0.00**	**8,244.01**
(Note: This item of work includes equipment and labor to remove the brush/debris from the overbanks in preparation of geotextile and stone placement. It is assumed that approximately 2' of marsh/muck will be removed and will be cast adjacent to the worksite. 3 days are allowed for a marsh backhoe to perform the work. Time is included for a tug and spud barge to move the backhoe from one side of the chnnel to the other.)											
Clearing and Grubbing (Overbank)	**LS**	**1.0000**	**0.00**	**7,644.00**	**0.00**	**100.00**	**500.01**	**0.00**	**0.00**	**0.00**	**8,244.01**
			0.0000	*2,300.0000*	*0.0000*	*0.0000*	*166.6700*	*0.0000*	*0.0000*	*0.0000*	*2,466.6700*
USR Clearing and Grubbing (Overbank)	DAY	3.0000	0.00	6,900.00	0.00	0.00	500.01	0.00	0.00	0.00	7,400.01
			0.0000	*124.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*124.0000*
USR 900 HP Tug	HR	6.0000	0.00	744.00	0.00	0.00	0.00	0.00	0.00	0.00	744.00
(Note: Allow 1/2 day for tug to move the equipment from one side of the channel to the other side.)											
			0.0000	*0.0000*	*0.0000*	*200.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*200.0000*
USR Daily Deck Barge	DAY	0.5000	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	100.00
(Note: This item is for a daily deck barge to relocate the equipment from one side of the channel to the other.)											
			0.0000	*0.0000*	*0.0000*	*0.0000*					*0.0000*
round	**EA**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**212.72**	**0.00**	**0.00**	**0.00**	**0.00**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*212.7200*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
USR round	EA	1.0000	0.00	0.00	0.00	0.00	212.72	0.00	0.00	0.00	0.00
04 01 99 Removal of Aids to Navigation	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**700,000.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
(Note: This item of work is for the Coast Guard to remove the channel markers and aids to navigation that would no longer be needed along the de-authorized portion of the channel. This cost is associated with de-authorization of the channel.)											
USR Removal of aids to navigation	LS	1.0000	0.00	0.00	0.00	700,000.00	0.00	0.00	0.00	0.00	0.00
30 Engineering and Design	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**863,728.49**	**0.00**	**863,728.49**
Engineering and Design	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**863,728.49**	**0.00**	**863,728.49**

Description	UOM	Quantity	LaborCost	EQCost	MatlCost	SubBidCost	Supplies	Real Estate	E&D	S&A	CostToPrime
USR Engineering and Design	LS	1.0000	0.00	0.00	0.00	0.00	0.00	0.00	863,728.49	0.00	863,728.49
31 Construction Management	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,256,332.28**	**1,256,332.28**
Construction Management	**LS**	**1.0000**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,256,332.28**	**1,256,332.28**
USR Construction Management	LS	1.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,256,332.28	1,256,332.28

Description	MemberType	MemberRate	ManHours	LaborCost	EQHours	EQCost	CrewHours	CrewCost
Crew Backup			**7,890.0455**	**116,378.69**	**5,318.8409**	**556,198.62**	**1,921.6364**	**672,577.31**
Prime Contractor		**0.00**	**7,890.0455**	**116,378.69**	**5,318.8409**	**556,198.62**	**1,921.6364**	**672,577.31**
			0.0000	*0.0000*	*1.0000*	*124.0000*		*124.0000*
USR 900 HP Tug			0.0000	0.00	6.0000	744.00	6.0000	744.00
USR 900 HP Tug	*Non-EP Rental / Average*	*124.00*			*1.0000*	*124.00*		
			4.0000	*58.5100*	*2.5000*	*284.6865*		*343.1965*
USR Above Water Construction			1,454.5455	21,276.36	909.0909	103,522.36	363.6364	124,798.73
USR Oiler	*Journeyman*	*12.50*	*1.0000*	*12.50*				
USR Laborer	*Journeyman*	*12.50*	*2.0000*	*25.00*				
USR Peo-Dragline	*Journeyman*	*21.01*	*1.0000*	*21.01*				
GEN C85Z2410 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 7.0 CY (5.3 M3), 250 TON (227 MT), 100' (30.5 M) BOOM (ADD BUCKET)	*EP / Average*	*214.27*			*1.0000*	*214.27*		
EP B35HE028 BUCKET, DRAGLINE, 6.0 CY, MEDIUM WEIGHT	*EP / Average*	*8.42*			*1.0000*	*8.42*		
USR 900 HP Tug	*Non-EP Rental / Average*	*124.00*			*0.5000*	*62.00*		
			0.0000	*0.0000*	*1.0000*	*230.0000*		*230.0000*
USR Clearing and Grubbing (Overbank)			0.0000	0.00	30.0000	6,900.00	30.0000	6,900.00
USR Marsh Backhoe with Operator	*Non-EP Rental / Average*	*230.00*			*1.0000*	*230.00*		
			5.0000	*69.2300*	*1.5000*	*135.8443*		*205.0743*
USR Geotextile Crew			100.0000	1,384.60	30.0000	2,716.89	20.0000	4,101.49
USR Peo-Backhoe	*Journeyman*	*19.23*	*1.0000*	*19.23*				
USR Laborer	*Journeyman*	*12.50*	*4.0000*	*50.00*				
EP H25CA027 HYDRAULIC EXCAVATOR, CRAWLER, 75,700 LBS, 2.09 CY BUCKET, 21.58' MAX DIGGING DEPTH	*EP / Average*	*73.84*			*1.0000*	*73.84*		
USR 900 HP Tug	*Non-EP Rental / Average*	*124.00*			*0.5000*	*62.00*		
			9.0000	*140.0400*	*10.0000*	*525.9355*		*665.9755*
USR Mobilization			648.0000	10,082.88	720.0000	37,867.36	72.0000	47,950.24
USR Laborer	*Journeyman*	*12.50*	*2.0000*	*25.00*				
USR Peo-Dragline	*Journeyman*	*21.01*	*1.0000*	*21.01*				
USR Peo-Backhoe	*Journeyman*	*19.23*	*1.0000*	*19.23*				
USR Peo-Dozer	*Journeyman*	*17.30*	*1.0000*	*17.30*				
USR Oiler	*Journeyman*	*12.50*	*1.0000*	*12.50*				
USR Truck Driver	*Journeyman*	*15.00*	*3.0000*	*45.00*				

Description	MemberType	MemberRate	ManHours	LaborCost	EQHours	EQCost	CrewHours	CrewCost
GEN C85Z2410 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 7.0 CY (5.3 M3), 250 TON (227 MT), 100' (30.5 M) BOOM (ADD BUCKET)	*EP / Standby*	*67.73*			*1.0000*	*67.73*		
EP B35HE028 BUCKET, DRAGLINE, 6.0 CY, MEDIUM WEIGHT	*EP / Standby*	*3.02*			*1.0000*	*3.02*		
EP H25CA027 HYDRAULIC EXCAVATOR, CRAWLER, 75,700 LBS, 2.09 CY BUCKET, 21.58' MAX DIGGING DEPTH	*EP / Standby*	*19.45*			*1.0000*	*19.45*		
EP T15CA024 TRACTOR, CRAWLER (DOZER), 110 HP, POWERSHIFT, W/3.37 CY SEMI-U BLADE (ADD ATTACHMENTS)	*EP / Standby*	*8.76*			*1.0000*	*8.76*		
EP T55CA008 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 18 CY, 25 TON, 4X4, REAR DUMP	*EP / Standby*	*18.33*			*3.0000*	*54.99*		
USR 900 HP Tug	*Non-EP Rental / Average*	*124.00*			*3.0000*	*372.00*		
			6.0000	*89.2300*	*3.7500*	*305.8606*		*395.0906*
USR Overbank Tie In			390.0000	5,799.95	243.7500	19,880.94	65.0000	25,680.89
USR Laborer	*Journeyman*	*12.50*	*2.0000*	*25.00*				
USR Peo-Backhoe	*Journeyman*	*19.23*	*1.0000*	*19.23*				
USR Truck Driver	*Journeyman*	*15.00*	*3.0000*	*45.00*				
EP H25CA027 HYDRAULIC EXCAVATOR, CRAWLER, 75,700 LBS, 2.09 CY BUCKET, 21.58' MAX DIGGING DEPTH	*EP / Average*	*73.84*			*0.2500*	*18.46*		
EP T55CA008 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 18 CY, 25 TON, 4X4, REAR DUMP	*EP / Average*	*75.13*			*3.0000*	*225.40*		
USR 900 HP Tug	*Non-EP Rental / Average*	*124.00*			*0.5000*	*62.00*		
			1.5000	*27.2600*	*2.0000*	*222.6865*		*249.9465*
USR Overbank Tie In Dragline			97.5000	1,771.90	130.0000	14,474.62	65.0000	16,246.52
USR Peo-Dragline	*Journeyman*	*21.01*	*1.0000*	*21.01*				
USR Oiler	*Journeyman*	*12.50*	*0.5000*	*6.25*				
GEN C85Z2410 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 7.0 CY (5.3 M3), 250 TON (227 MT), 100' (30.5 M) BOOM (ADD BUCKET)	*EP / Average*	*214.27*			*1.0000*	*214.27*		
EP B35HE028 BUCKET, DRAGLINE, 6.0 CY, MEDIUM WEIGHT	*EP / Average*	*8.42*			*1.0000*	*8.42*		
			4.0000	*58.5100*	*2.5000*	*284.6865*		*343.1965*
USR Subaqueous Construction			5,200.0000	76,063.00	3,250.0000	370,092.45	1,300.0000	446,155.45
USR Oiler	*Journeyman*	*12.50*	*1.0000*	*12.50*				
USR Peo-Dragline	*Journeyman*	*21.01*	*1.0000*	*21.01*				
USR Laborer	*Journeyman*	*12.50*	*2.0000*	*25.00*				

Description	MemberType	MemberRate	ManHours	LaborCost	EQHours	EQCost	CrewHours	CrewCost
GEN C85Z2410 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 7.0 CY (5.3 M3), 250 TON (227 MT), 100' (30.5 M) BOOM (ADD BUCKET)	*EP / Average*	*214.27*			*1.0000*	*214.27*		
EP B35HE028 BUCKET, DRAGLINE, 6.0 CY, MEDIUM WEIGHT	*EP / Average*	*8.42*			*1.0000*	*8.42*		
USR 900 HP Tug	*Non-EP Rental / Average*	*124.00*			*0.5000*	*62.00*		

Description	LaborRate	BaseWage	Travel	Overtime	TaxableFringe	WCI	NonTaxFringe	Subsistence	Total
Labor Backup		**116,378.69**	**0.00**	**30,368.71**	**0.00**	**30,913.09**	**0.00**	**0.00**	**205,850.37**
Prime Contractor	**LaborCost 1**	**116,378.69**	**0.00**	**30,368.71**	**0.00**	**30,913.09**	**0.00**	**0.00**	**205,850.37**
		12.5000	*0.0000*		*0.0000*		*0.0000*	*0.0000*	*22.5471*
USR Laborer	LaborCost1	46,015.91	0.00	12,632.49	0.00	12,222.98	0.00	0.00	83,002.09
		12.5000	*0.0000*		*0.0000*		*0.0000*	*0.0000*	*22.2872*
USR Oiler	LaborCost1	22,101.70	0.00	6,057.33	0.00	5,870.77	0.00	0.00	39,406.78
		19.2300	*0.0000*		*0.0000*		*0.0000*	*0.0000*	*30.4169*
USR Peo-Backhoe	LaborCost1	3,019.11	0.00	466.99	0.00	801.95	0.00	0.00	4,775.45
		17.3000	*0.0000*		*0.0000*		*0.0000*	*0.0000*	*24.0893*
USR Peo-Dozer	LaborCost1	1,245.60	0.00	0.00	0.00	330.86	0.00	0.00	1,734.43
		21.0100	*0.0000*		*0.0000*		*0.0000*	*0.0000*	*37.4343*
USR Peo-Dragline	LaborCost1	37,831.37	0.00	10,376.24	0.00	10,048.96	0.00	0.00	67,405.54
		15.0000	*0.0000*		*0.0000*		*0.0000*	*0.0000*	*23.1778*
USR Truck Driver	LaborCost1	6,165.00	0.00	835.67	0.00	1,637.58	0.00	0.00	9,526.08

Description	Manufacturer	Model	Depr/Rntl	FCCM	Ownership	Fuel	FOG	TireWear	TireRepair	Operating	Total
Equipment Backup			**282,297.16**	**39,015.40**	**321,312.56**	**44,701.96**	**3,740.35**	**1,435.09**	**178.67**	**209,157.99**	**530,470.55**
Prime Contractor			**282,297.16**	**39,015.40**	**321,312.56**	**44,701.96**	**3,740.35**	**1,435.09**	**178.67**	**209,157.99**	**530,470.55**
			2.1918	*0.8257*	*3.0175*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*3.0175*
EP B35HE028 BUCKET, DRAGLINE, 6.0 CY, MEDIUM WEIGHT	HE HENDRIX MANUFACTURING COMPANY, INC.	TS	157.81	59.45	217.26	0.00	0.00	0.00	0.00	0.00	217.26
			4.3836	*0.4718*	*4.8554*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*3.2117*	*8.0670*
EP B35HE028 BUCKET, DRAGLINE, 6.0 CY, MEDIUM WEIGHT	HE HENDRIX MANUFACTURING COMPANY, INC.	TS	7,577.58	815.56	8,393.14	0.00	0.00	0.00	0.00	5,551.81	13,944.95
			11.8051	*7.6415*	*19.4467*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*19.4467*
EP H25CA027 HYDRAULIC EXCAVATOR, CRAWLER, 75,700 LBS, 2.09 CY BUCKET, 21.58' MAX DIGGING DEPTH	CA CATERPILLAR INC. (MACHINE DIVISION)	330CL	849.97	550.19	1,400.16	0.00	0.00	0.00	0.00	0.00	1,400.16
			23.6103	*4.3664*	*27.9766*	*16.7921*	*2.0767*	*0.0000*	*0.0000*	*42.5925*	*70.5691*
EP H25CA027 HYDRAULIC EXCAVATOR, CRAWLER, 75,700 LBS, 2.09 CY BUCKET, 21.58' MAX DIGGING DEPTH	CA CATERPILLAR INC. (MACHINE DIVISION)	330CL	855.87	158.28	1,014.15	608.71	75.28	0.00	0.00	1,543.98	2,558.13
			5.4590	*3.2992*	*8.7582*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*8.7582*
EP T15CA024 TRACTOR, CRAWLER (DOZER), 110 HP, POWERSHIFT, W/3.37 CY SEMI-U BLADE (ADD ATTACHMENTS)	CA CATERPILLAR INC. (MACHINE DIVISION)	D-5M XL	393.05	237.54	630.59	0.00	0.00	0.00	0.00	0.00	630.59
			11.4069	*6.9217*	*18.3286*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*18.3286*
EP T55CA008 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 18 CY, 25 TON, 4X4, REAR DUMP	CA CATERPILLAR INC. (MACHINE DIVISION)	D25D	2,463.90	1,495.08	3,958.98	0.00	0.00	0.00	0.00	0.00	3,958.98
			22.8138	*3.9551*	*26.7689*	*15.2256*	*1.0110*	*7.3595*	*0.9163*	*45.3976*	*72.1665*
EP T55CA008 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 18 CY, 25 TON, 4X4, REAR DUMP	CA CATERPILLAR INC. (MACHINE DIVISION)	D25D	4,448.70	771.24	5,219.94	2,968.99	197.14	1,435.09	178.67	8,852.54	14,072.47

Description	Manufacturer	Model	Depr/Rntl	FCCM	Ownership	Fuel	FOG	TireWear	TireRepair	Operating	Total
			34.7683	*32.9590*	*67.7273*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*67.7273*
GEN C85Z2410 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 7.0 CY (5.3 M3), 250 TON (227 MT), 100' (30.5 M) BOOM (ADD BUCKET)	ZZ GENERIC EQUIPMENT	999	2,503.32	2,373.05	4,876.37	0.00	0.00	0.00	0.00	0.00	4,876.37
			69.5366	*18.8328*	*88.3694*	*23.7900*	*2.0062*	*0.0000*	*0.0000*	*111.7700*	*200.1394*
GEN C85Z2410 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 7.0 CY (5.3 M3), 250 TON (227 MT), 100' (30.5 M) BOOM (ADD BUCKET)	ZZ GENERIC EQUIPMENT	999	120,203.52	32,555.01	152,758.52	41,124.26	3,467.93	0.00	0.00	193,209.67	345,968.19
			124.0000	*0.0000*	*124.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*124.0000*
USR 900 HP Tug	XX NO SPECIFIC MANUFACTURER		135,943.45	0.00	135,943.45	0.00	0.00	0.00	0.00	0.00	135,943.45
			230.0000	*0.0000*	*230.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*230.0000*
USR Marsh Backhoe with Operator	XX NO SPECIFIC MANUFACTURER		6,900.00	0.00	6,900.00	0.00	0.00	0.00	0.00	0.00	6,900.00

Description	Page
Library Properties	**i**
Project Notes	**ii**
Markup Properties	**iv**
Project Summary	**1**
01 Lands and Damages	1
04 Dams	1
30 Engineering and Design	1
31 Construction Management	1
Project Indirect Summary	**2**
01 Lands and Damages	2
04 Dams	2
30 Engineering and Design	2
31 Construction Management	2
Project Direct Summary	**3**
01 Lands and Damages	3
04 Dams	3
30 Engineering and Design	3
31 Construction Management	3
Construction Summary	**4**
04 01 Main Dam	4
04 01 01 Mobilization and Demobilization	4
Mob & Demob	4
Mob & Demob	4
04 01 42 Earth and Rockfill Dam	4
04 01 42 02 Sitework	4
04 01 42 02 Stone Placement - Channel Proper "A" Stone	4
04 01 42 02 Stone Placement - Overbank Tie-Ins 650#	4
04 01 42 02 Crushed Stone Blanket 4-in	4
04 01 42 02 Geotextile Separator Fabric 350#	4
04 01 42 02 Clearing and Grubbing (Overbanks)	4
04 01 99 Removal of Aids to Navigation	4
Detailed estimate	**5**
01 Lands and Damages	5
Lands and Damages	5
De-Authorization of Channel	5
Closure Structure	5
04 Dams	5
04 01 Main Dam	5
04 01 01 Mobilization and Demobilization	5
Mob & Demob	5
Mob & Demob	5
round	5
Mob & Demob	5
04 01 42 Earth and Rockfill Dam	6

Description	Page
04 01 42 02 Sitework	6
04 01 42 02 Stone Placement - Channel Proper "A" Stone	6
04 01 42 02 Stone Placement - Channel Proper "A" Stone	7
Above Water Construction	7
Subaqueous Construction	7
round	7
04 01 42 02 Stone Placement - Overbank Tie-Ins 650#	8
Overbank Tie-Ins	8
round	8
04 01 42 02 Crushed Stone Blanket 4-in	8
Subaqueous Construction	8
round	9
04 01 42 02 Geotextile Separator Fabric 350#	9
Geotextile Placement	9
round	9
04 01 42 02 Clearing and Grubbing (Overbanks)	10
Clearing and Grubbing (Overbank)	10
round	10
04 01 99 Removal of Aids to Navigation	10
30 Engineering and Design	10
Engineering and Design	10
31 Construction Management	11
Construction Management	11
Crew Backup	**12**
Prime Contractor	12
Labor Backup	**15**
Prime Contractor	15
Equipment Backup	**16**
Prime Contractor	16

MISSISSIPPI RIVER GULF OUTLET
DEEP DRAFT DE-AUTHORIZATION STUDY

ENGINEERING APPENDIX
ANNEX III - PLATES

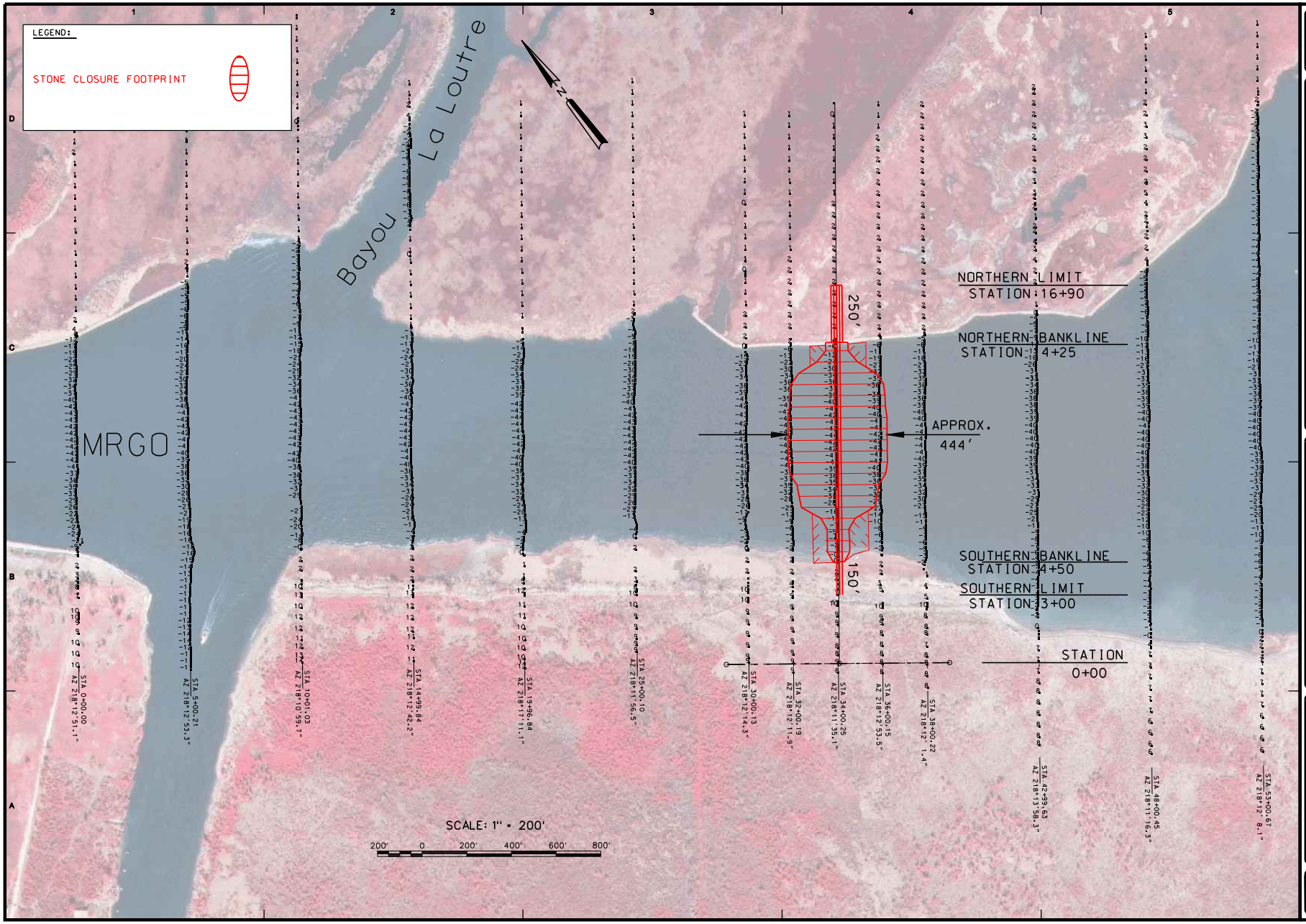

LEGEND:
STONE CLOSURE FOOTPRINT
MRGO
Bayou La Loutre
NORTHERN LIMIT
STATION 16+90
NORTHERN BANKLINE
STATION 14+25
APPROX.
444'
250'
150'
SOUTHERN BANKLINE
STATION 4+50
SOUTHERN LIMIT
STATION 3+00
STATION
0+00
STA 0+00.00
AZ 218°12'51.1"
STA 5+00.21
AZ 218°12'53.3"
STA 10+01.03
AZ 218°10'59.7"
STA 14+99.84
AZ 218°12'42.2"
STA 19+96.84
AZ 218°11'11.1"
STA 25+00.10
AZ 218°11'56.5"
STA 30+00.13
AZ 218°12'14.3"
STA 32+00.19
AZ 218°12'11.9"
STA 34+00.25
AZ 218°11'35.1"
STA 36+00.15
AZ 218°12'53.5"
STA 38+00.22
AZ 218°12' 1.4"
STA 42+99.63
AZ 218°13'58.3"
STA 48+00.45
AZ 218°11'16.3"
STA 53+00.67
AZ 218°12' 8.1"
SCALE: 1" = 200'
200' 0 200' 400' 600' 800'
US ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MISSISSIPPI VALLEY DIVISION
MRGO
DEEP DRAFT DEAUTHORIZATION STUDY
STONE CLOSURE AT BAYOU LA LOUTRE
ST. BERNARD PARISH, LA
FEASIBILITY
PLAN VIEW
SHEET IDENTIFICATION NUMBER
01

PLATE 01

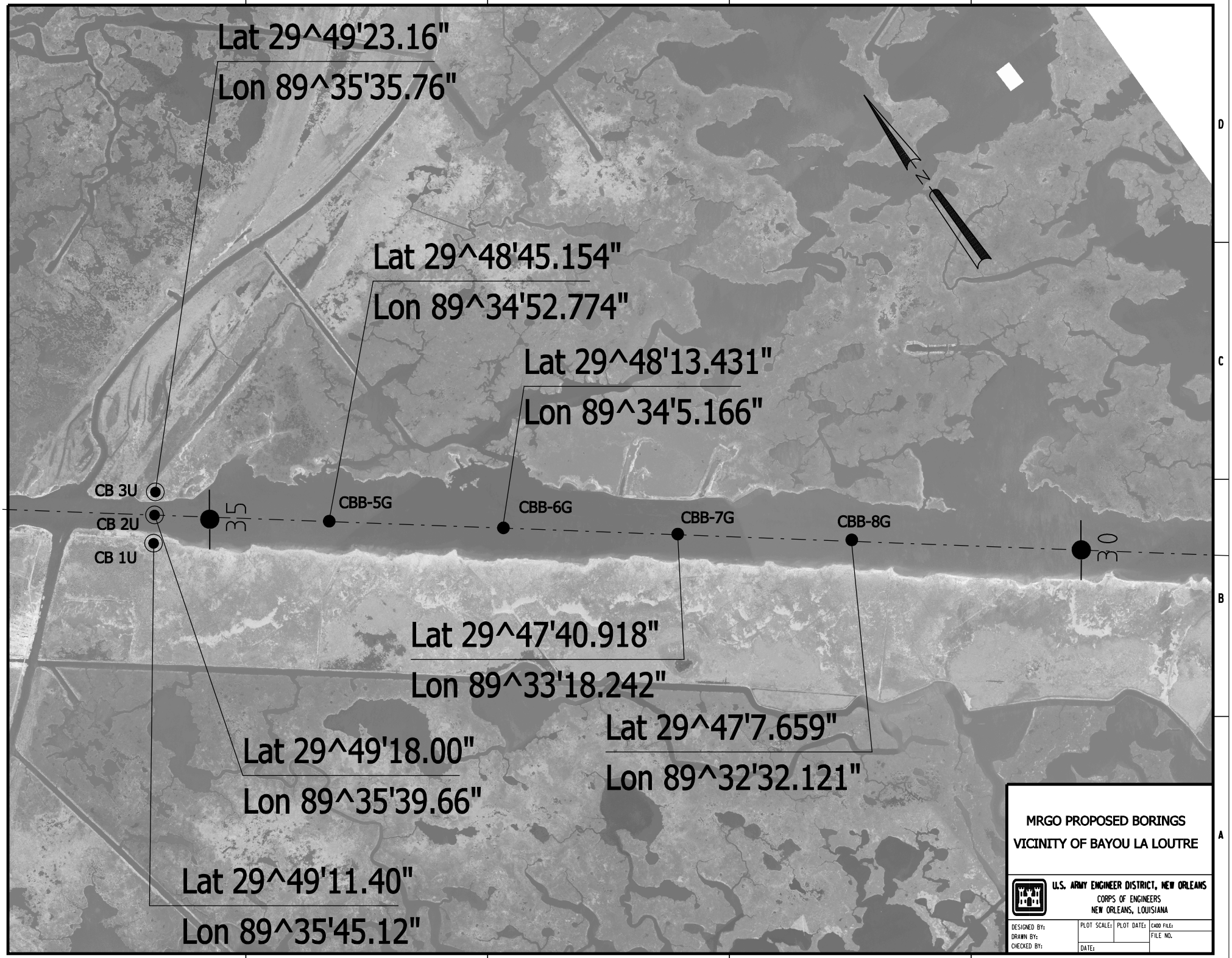
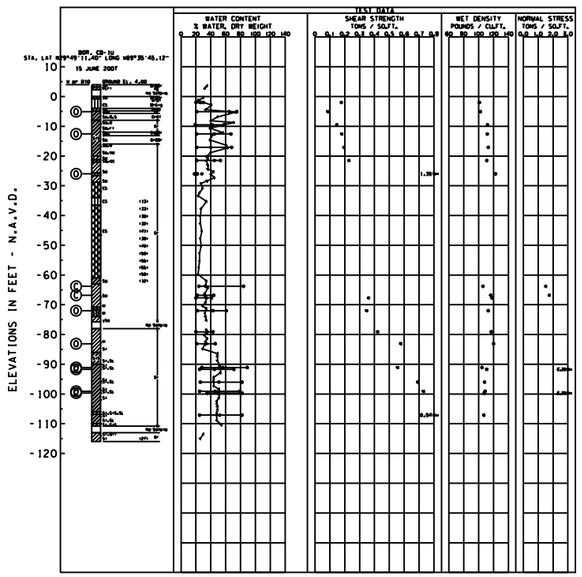
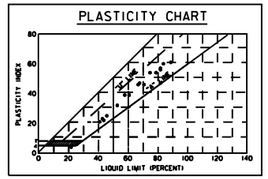

Lat 29^49'23.16"
Lon 89^35'35.76"
Lat 29^48'45.154"
Lon 89^34'52.774"
Lat 29^48'13.431"
Lon 89^34'5.166"
CB 3U
CB 2U
CB 1U
35
CBB-5G
CBB-6G
CBB-7G
CBB-8G
30
Lat 29^47'40.918"
Lon 89^33'18.242"
Lat 29^47'7.659"
Lon 89^32'32.121"
Lat 29^49'18.00"
Lon 89^35'39.66"
Lat 29^49'11.40"
Lon 89^35'45.12"
N
MRGO PROPOSED BORINGS
VICINITY OF BAYOU LA LOUTRE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA
DESIGNED BY:
DRAWN BY:
CHECKED BY:
PLOT SCALE:
PLOT DATE:
CADD FILE:
FILE NO.
DATE:

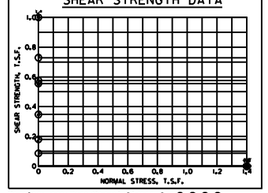
PLATE02



PLASTICITY CHART



SHEAR STRENGTH DATA



Warnings: non-zero Normal Stress for ⑥, ⑦, ⑧, ⑨

NOTES

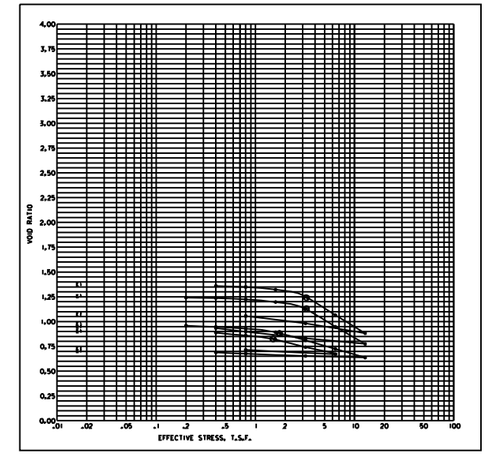
- O - (UC) UNCONFINED COMPRESSION TEST
- ■ - (U) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- A - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- □ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

LL PL PI ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

TABULAR TEST DATA

ENVELOPE NO.	E_{L_1}	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-5.1	R	0.0	0.086	CH
2	-12.4	R	0.0	0.180	CH
3	-26.0	R	0.0	1.388	ML
4	-77.0	R	0.0	0.347	CH
5	-83.1	R	0.0	0.576	CL
6	-91.1	R	0.0	0.866	CH
7	-99.1	R	0.0	0.725	CH
8	-53.8	C	0.0	0.000	CL
9	-66.8	C	0.0	0.000	CL
10	-91.7	C	0.0	0.000	CH
11	-95.7	C	0.0	0.000	CH



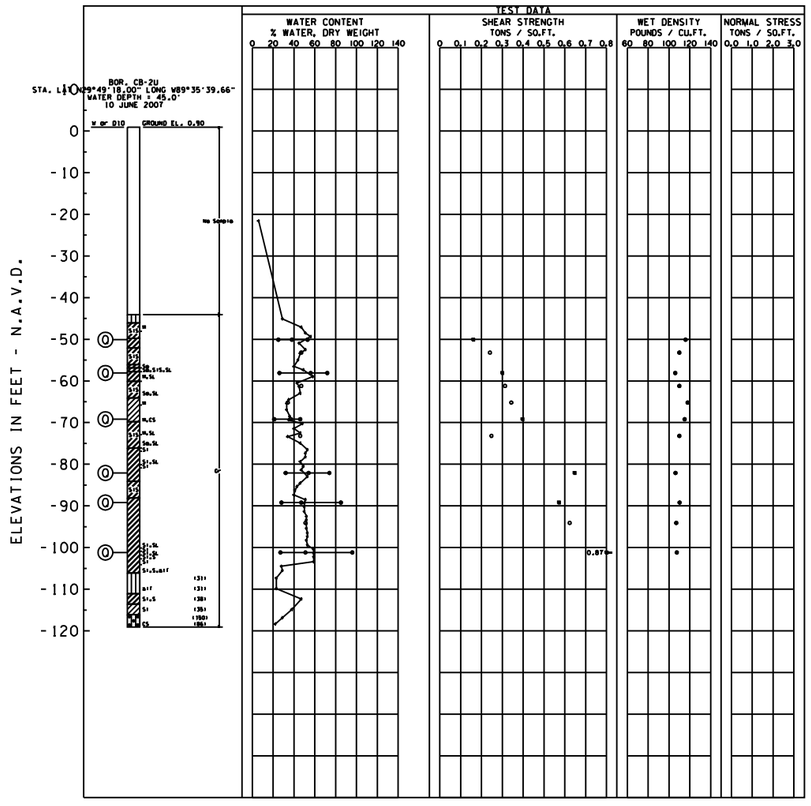
MRGO CLOSURE
ST. BERNARD PAR., LOUISIANA

UNDISTURBED BORING
BOR. CB-1U

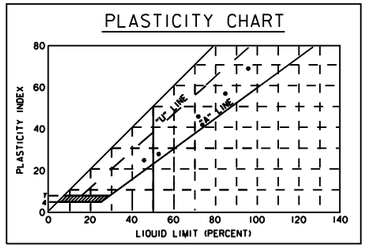
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY:	Simmons	PLOT SCALE: 20x1	PLOT DATE: 11OCT2007	CADD FILE NO.
DRAWN BY:	HOSSS			PLT NO. X
CHECKED BY:	Simmons	DATE: 11 OCT 2007		

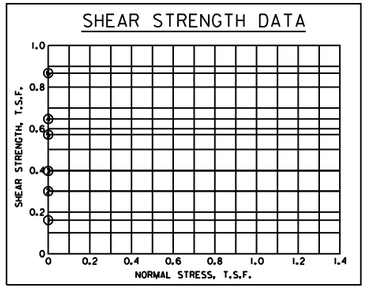
PLATE 3



PLASTICITY CHART



SHEAR STRENGTH DATA



TABULAR TEST DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-50.1	0	0.0	0.161	CH
2	-58.1	0	0.0	0.300	CH
3	-69.2	0	0.0	0.397	CL
4	-82.1	0	0.0	0.647	CH
5	-89.2	0	0.0	0.572	CH
6	-101.2	0	0.0	0.867	CH

NOTES

- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (O) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ▲ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- ⊡ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST
- ω_P ——○—— ω_N ——●—— ω_L ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

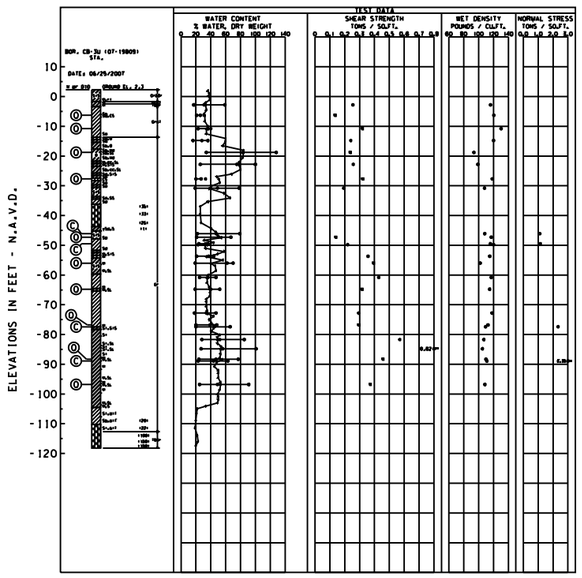
MRGO CLOSURE
ST. BERNARD PH., LOUISIANA

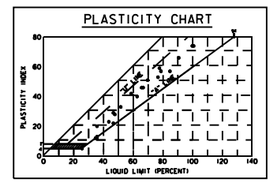
UNDISTURBED BORING
BOR. CB-2U

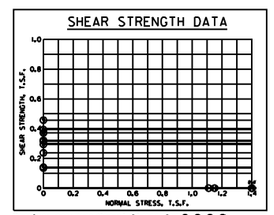
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY:	BORNANNO	PLOT SCALE: 20:1	PLOT DATE: 11OCT2007	CADD FILE: CB-2U.DGN
DRAWN BY:	WOODS			FILE NO. X
CHECKED BY:	BORNANNO	DATE: 11 OCT 2007		

PLATE 4







Warning: non-zero Normal Stress for ①, ②, ③, ④

NOTES

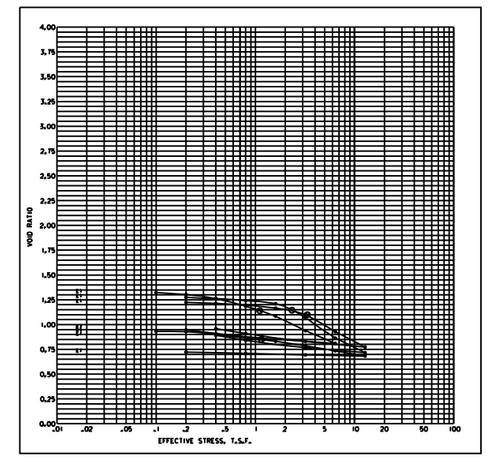
- ○ - (UC) UNCONFINED COMPRESSION TEST
- ■ - (CU) UNCONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- △ - (R) CONSOLIDATED - UNDRAINED TRIAXIAL SHEAR TEST
- □ - (S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST

LL PL NA — ATTERBERG LIMITS

BORING WAS TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE A.
FOR LOCATION OF BORINGS SEE PLATE
FOR DETAILED TEST DATA SEE

TABULAR TEST DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-6.3	D	0.0	0.135	CL
2	-10.8	D	0.0	0.115	CL
3	-19.8	D	0.0	0.237	CH
4	-27.7	D	0.0	0.321	IN
5	-47.5	D	0.0	0.160	CH
6	-56.0	D	0.0	0.353	CH
7	-64.8	D	0.0	0.316	CH
8	-75.8	D	0.0	0.296	CL
9	-88.3	D	0.0	0.457	CH
10	-95.8	D	0.0	0.371	CH
11	-46.1	C	0.0	0.000	CH
12	-49.4	C	0.0	0.000	CL
13	-77.4	C	0.0	0.000	CH
14	-88.5	C	0.0	0.000	CH



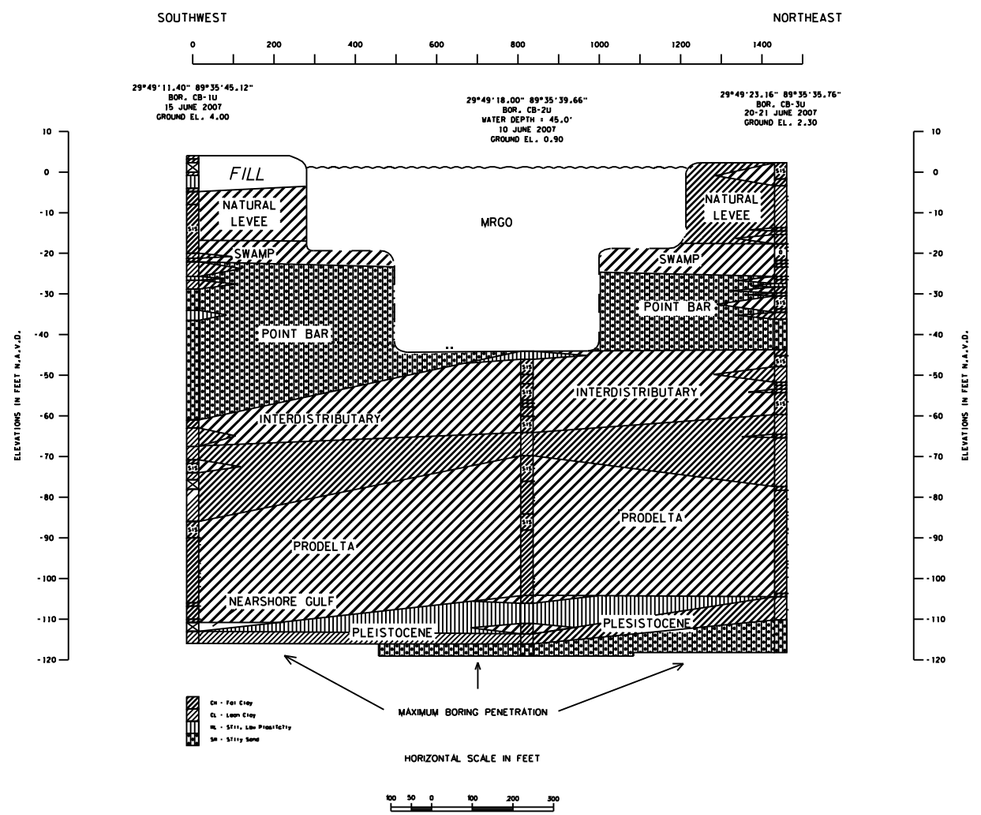
MRGO CLOSURE
ST. BERNARD PAR., LOUISIANA

UNDISTURBED BORING
BOR. CB-3U

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY:	DRAWN BY:	PLOT SCALE: 20:1	PLOT DATE: 11OCT2007	CODE: FILE:BOR-TBLPRT
DRAWN BY:	00000			FILE NO. X
CHECKED BY:	00000	DATE: 11 OCT 2007		

PLATE 5



NATURAL LEVEE - PREDOMINANTLY FAT AND LEAN CLAYS AND SILTS WITH SOME SAND LAYERS

SWAMP - PREDOMINANTLY ORGANIC CLAYS, FAT CLAYS, AND PEATS WITH WOOD, OCCASIONAL SAND, AND SILT LAYERS

POINT BAR - PREDOMINANTLY SILTY SANDS, SANDY SILTS, AND SANDS WITH OCCASIONAL CLAY LAYERS

INTERDISTRIBUTARY - INTERBEDDED LAYERS OF FAT AND LEAN CLAYS, SILTS, SILTY SANDS, AND SANDS

PRODELTA - PREDOMINANTLY A HOMOGENEOUS FAT CLAY WITH SOME LEAN CLAYS

NEARSHORE GULF - PREDOMINANTLY SAND AND SILTY SAND WITH SHELL FRAGMENTS

PLEISTOCENE - STIFF TO VERY STIFF OXIDIZED CLAYS INTERBEDDED WITH LAYERS AND LENSES OF SILTS AND SANDS

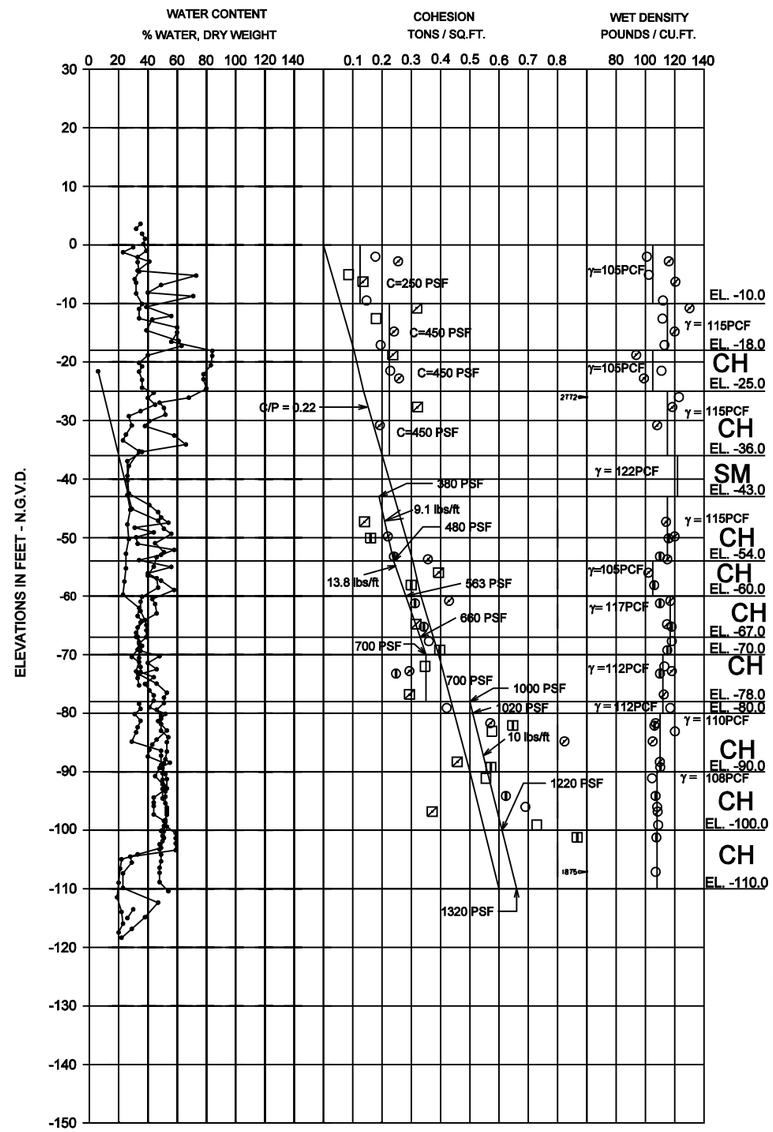
MRGO CLOSURE
ST. BERNARD PH., LOUISIANA

SOIL AND GEOLOGIC PROFILE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

DESIGNED BY: S.B. SAVAGE DRAWN BY: S.B. SAVAGE CHECKED BY: D. BRITSCH	PLOT SCALE: 1 : 20 DATE: 08/27/2007	PLOT DATE:	CADD FILE: MRGO Closure FILE NO.

PB&AEE6



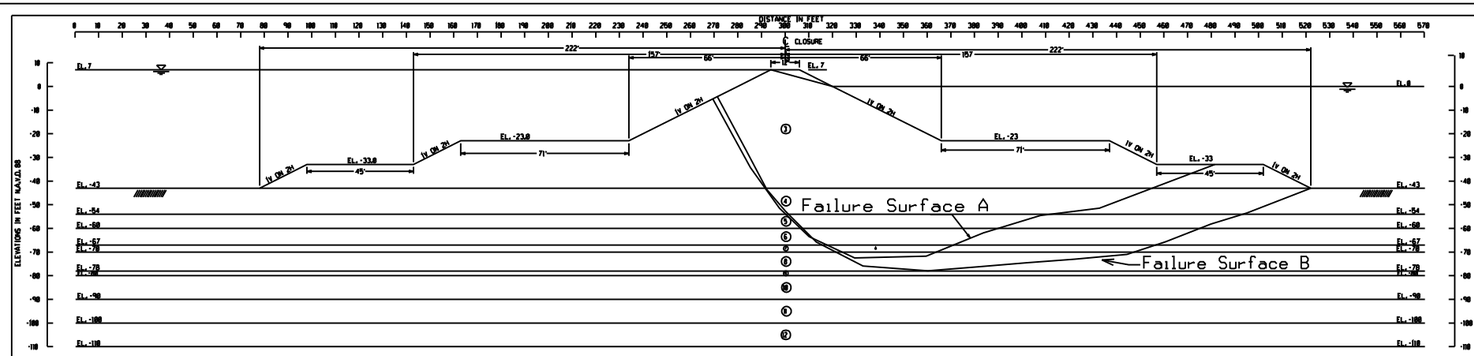
LEGEND TO TESTS

	Q	UCT	R	S	γ
CB-1U	□	○			○
CB-2U	◫	⊕			⊕
CB-3U	⊠	⊘			⊘

- UCT Test
- Q Test

MRGO CLOSURE

PLATE 7



MATERIAL NO.	SOIL TYPE	TOTAL UNIT WEIGHT (LB/F.) (GM/)	C - UNIT COHESION - (LB/F. TOP OF MATERIAL (GM/)	BOTTOM OF MATERIAL (GM/)	FRICTION ANGLE (DEGREES)
3	MUCK	132	0	0	40
4	CH	115	350	400	0
5	CH	105	481	543	0
6	CH	117	564	669	0
7	CH	117	669	799	0
8	CH	117	799	799	0
9	CH	117	1000	1024	0
10	CH	119	1029	1130	0
11	CH	119	1129	1229	0
12	CH	119	1229	1329	0
13	CH	119	1329	1329	0

Failure Surface A: Factor of safety: 1.404
Side force Inclination: -2.56 degrees

Failure Surface B: Factor of safety: 1.402
Side force Inclination: -2.88 degrees

GENERAL NOTES

CLASSIFICATION, DESCRIPTIONS, AND STRENGTHS AND UNIT WEIGHTS OF THE SOIL LAYERS SHOWN ARE THE RESULTS OF SUBSURFACE SAMPLING, SITE SAMPLING AND TESTING.

SHEAR STRENGTHS BETWEEN ADJACENT LAYERS ARE ASSUMED TO BE EQUAL TO THE LOWER THE VALUES INDICATED FOR THOSE ADJACENT LAYERS.

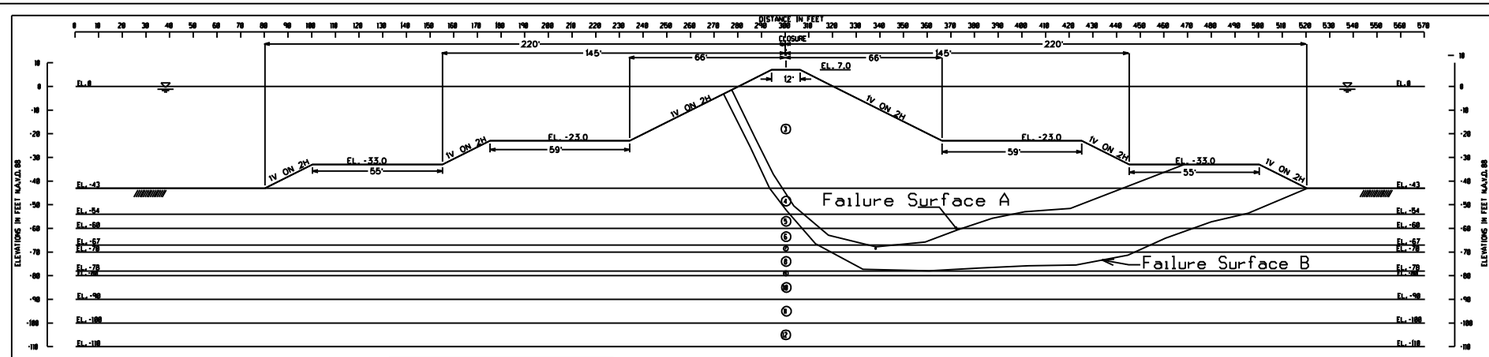
Q = SHEAR WAVE SURFACE

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. -7 FEET GROUND AT EL. -43 EXTREME CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: B



MATERIAL NO.	SOIL TYPE	TOTAL UNIT WEIGHT PCF. (GM/)	C - UNIT COHESION - PSF. TOP OF MATERIAL (GM/)	BOTTOM OF MATERIAL (GM/)	FRICTION ANGLE DEGREES
3	MOC	132	0	0	40
4	CH	115	350	400	0
5	CH	105	481	543	0
6	CH	117	564	669	0
7	CH	117	669	799	0
8	CH	117	799	799	0
9	CH	117	1000	1024	0
10	CH	119	1029	1130	0
11	CH	119	1129	1229	0
12	CH	119	1229	1329	0
13	CH	119	1329	1329	0

Failure Surface A: Factor of safety: 1.515
Side force Inclination: -1.88 degrees

Failure Surface B: Factor of safety: 1.519
Side force Inclination: -2.13 degrees

GENERAL NOTES

CLASSIFICATION, STRATIGRAPHIC, AND STRENGTH AND UNIT WEIGHTS OF THE SOIL WERE FIXED ON THE RESULTS OF INDIVIDUAL BORING, SEE BORING LOG PLATES.

MOCK STRENGTHS BETWEEN ADJACENT MATERIALS WERE ASSUMED TO BE THE SAME AS THE VALUES INDICATED FOR THOSE MATERIALS.

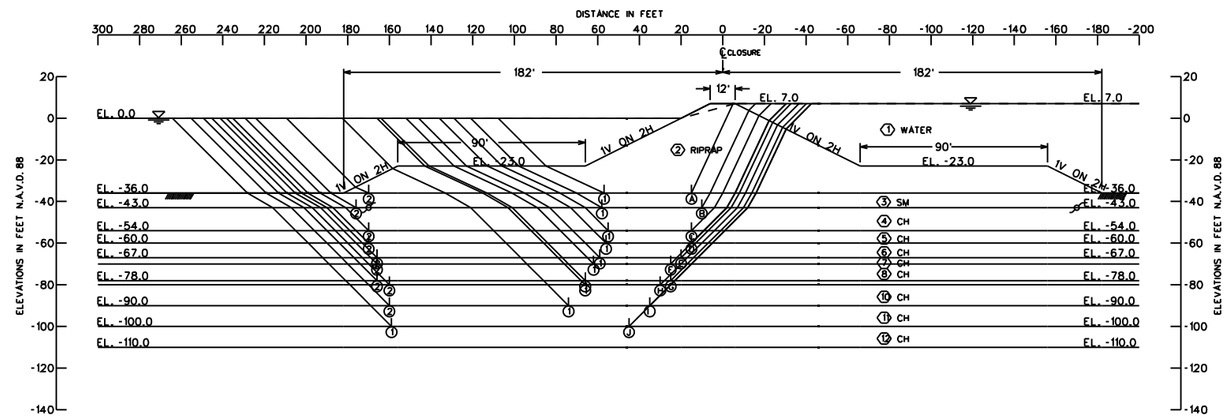
G --- GRAVE WATER SURFACE

MISSISSIPPI RIVER GULF OUTLET CLOSURE

MOCK ONE EL. -7 FEET GROUND AT EL. -43
LOW WATER CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 03-OCT-07

PLATE: 9



ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-36.0	51996	47285	23493	116284	47027	122774	69257	1.77
Ⓐ ②	-36.0	51996	105066	2171	116284	41102	159233	75182	2.12
Ⓑ ①	-43.0	67260	23040	37978	161849	72075	128278	89774	1.43
Ⓑ ②	-43.0	67260	79326	3637	161849	59598	150223	102251	1.47
Ⓒ ①	-54.0	72052	19200	46152	234856	124573	137404	110283	1.25
Ⓒ ②	-54.0	72052	74400	12395	234856	102831	158847	132025	1.20
Ⓓ ①	-60.0	71534	23083	52415	277318	157732	147032	119586	1.23
Ⓓ ②	-60.0	71534	87265	18639	277318	130942	177438	146376	1.21
Ⓔ ①	-67.0	78067	25740	60981	332844	201028	164788	131816	1.25
Ⓔ ②	-67.0	78067	96360	27207	332844	170745	201634	162099	1.24
Ⓕ ①	-70.0	84182	25900	65060	358565	221144	175142	137421	1.27
Ⓕ ②	-70.0	84182	98700	31287	358565	188726	214169	169839	1.26
Ⓖ ①	-78.0	87020	28700	76257	427930	281027	191977	146903	1.31
Ⓖ ②	-78.0	87020	98700	42487	427930	241660	228207	186270	1.23
Ⓗ ①	-80.0	94175	36720	80297	447558	297187	211192	150371	1.40
Ⓗ ②	-80.0	94175	132600	46527	447558	259974	273302	187584	1.46
Ⓘ ①	-90.0	110440	43680	101343	546064	384510	255463	161554	1.58
Ⓘ ②	-90.0	110440	140000	67927	546064	338362	318367	207702	1.53
Ⓙ ①	-100.0	133840	139080	91327	653417	428431	364247	224986	1.62

STRATUM NO.	SOIL TYPE	TOTAL UNIT WEIGHT P.C.F.	C - UNIT COHESION - P.S.F.		FRICTION ANGLE DEGREES
			CENTER OF STRATUM	BOTTOM OF STRATUM	
		VERT. 1	VERT. 1	VERT. 1	
①	WATER	62.5	0	0	0
②	RIPRAP	132	0	0	40
③	SM	122	0	0	30
④	CH	115	430	480	0
⑤	CH	105	522	563	0
⑥	CH	117	612	660	0
⑦	CH	117	680	700	0
⑧	CH	112	700	700	0
⑨	CH	112	1010	1020	0
⑩	CH	110	1070	1120	0
⑪	CH	108	1170	1220	0
⑫	CH	108	1270	1320	0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Ω -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

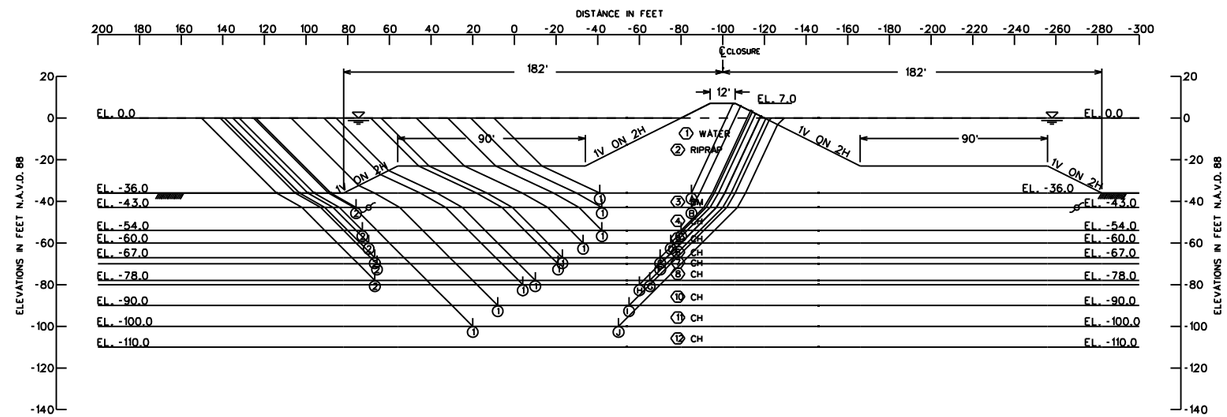
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. +7 FEET GROUND AT EL. -36
EXTREME CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: 10



ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-36.0	59305	48771	22560	116284	46768	130636	69516	1.88
Ⓑ ①	-43.0	76810	20640	37978	159225	72075	135428	87150	1.55
Ⓑ ②	-43.0	76810	76926	3637	159225	59598	157373	99627	1.58
Ⓒ ①	-54.0	86162	18240	46152	232097	123583	150554	108514	1.39
Ⓒ ②	-54.0	86162	73440	12375	232097	101744	171977	130353	1.32
Ⓓ ①	-60.0	91757	23646	52413	274722	155994	167816	118728	1.41
Ⓓ ②	-60.0	91757	81635	18639	274722	130942	192031	143780	1.34
Ⓔ ①	-67.0	98488	31020	60977	328191	200174	190485	128017	1.49
Ⓔ ②	-67.0	98488	90420	27207	328191	170207	216115	157984	1.37
Ⓕ ①	-70.0	98909	34300	65057	351772	220864	198266	130908	1.51
Ⓕ ②	-70.0	98909	95200	31287	351772	188726	225396	163046	1.38
Ⓖ ①	-78.0	105656	38500	75116	419629	280707	219272	138922	1.58
Ⓖ ②	-78.0	105656	92400	42487	419629	241121	240543	178508	1.35
Ⓗ ①	-80.0	114149	57120	76230	438863	296053	247499	142810	1.73
Ⓘ ①	-90.0	127824	70560	81428	533109	378418	279812	154691	1.81
Ⓙ ①	-100.0	142692	85400	91829	636113	463318	319921	172795	1.85

STRATUM NO.	SOIL TYPE	TOTAL UNIT WEIGHT P.C.F. VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 1	FRICTION ANGLE DEGREES
①	WATER	62.5	0	0	0
②	RIPRAP	132	0	0	40
③	SM	122	0	0	30
④	CH	115	430	480	0
⑤	CH	105	522	563	0
⑥	CH	117	612	660	0
⑦	CH	117	680	700	0
⑧	CH	112	700	700	0
⑨	CH	112	1010	1020	0
⑩	CH	110	1070	1120	0
⑪	CH	108	1170	1220	0
⑫	CH	108	1270	1320	0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

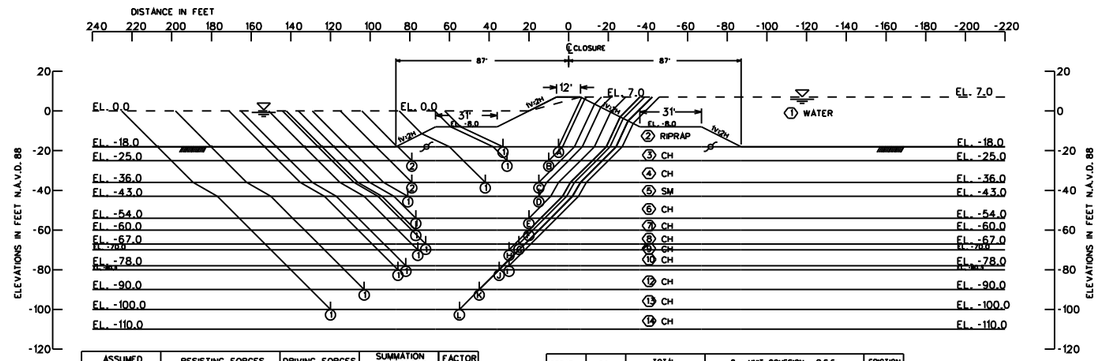
FACTOR OF SAFETY $= \frac{R_A + R_B + R_P}{D_A - D_P}$

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. +7 FEET GROUND AT EL. -36
LOW WATER CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: 11



ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-18.0	18775	12600	12764	41233	13672	44139	27561	1.60
B 1	-25.0	24546	9450	18801	66175	29345	52797	36830	1.43
B 2	-25.0	24546	31050	6315	66175	21670	61911	44505	1.39
C 1	-36.0	31849	12150	25764	113319	63153	69763	50166	1.39
C 2	-36.0	31849	28800	16200	113319	49100	76849	64219	1.20
D 1	-43.0	41917	31680	32086	149457	73213	105683	76244	1.39
E 1	-54.0	49672	27360	40824	216729	125314	117856	91415	1.29
F 1	-60.0	53168	32091	47088	257880	158667	132347	99213	1.33
G 1	-67.0	60786	31020	55656	310045	204821	147462	105224	1.40
H 1	-70.0	65815	32200	59736	333238	223620	157751	109618	1.44
I 1	-78.0	73415	36400	70936	402004	281887	180751	120117	1.50
J 1	-80.0	78765	52020	74976	419108	297574	205761	121534	1.69
K 1	-90.0	100165	64960	96376	513210	384694	261501	128516	2.03
L 1	-100.0	123566	79300	119776	618198	482730	322642	135468	2.38

STRATUM NO.	SOIL TYPE	TOTAL UNIT WEIGHT P.C.F. VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	FRICTION ANGLE DEGREES
1	WATER	62.5	0	0	0
2	RIPRAP	132	0	0	40
3	CH	105	450	450	0
4	CH	115	450	450	0
5	SM	122	0	0	30
6	CH	115	430	480	0
7	CH	105	522	563	0
8	CH	117	612	660	0
9	CH	117	680	700	0
10	CH	112	700	700	0
11	CH	112	1010	1020	0
12	CH	110	1070	1120	0
13	CH	108	1170	1220	0
14	CH	108	1270	1320	0

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

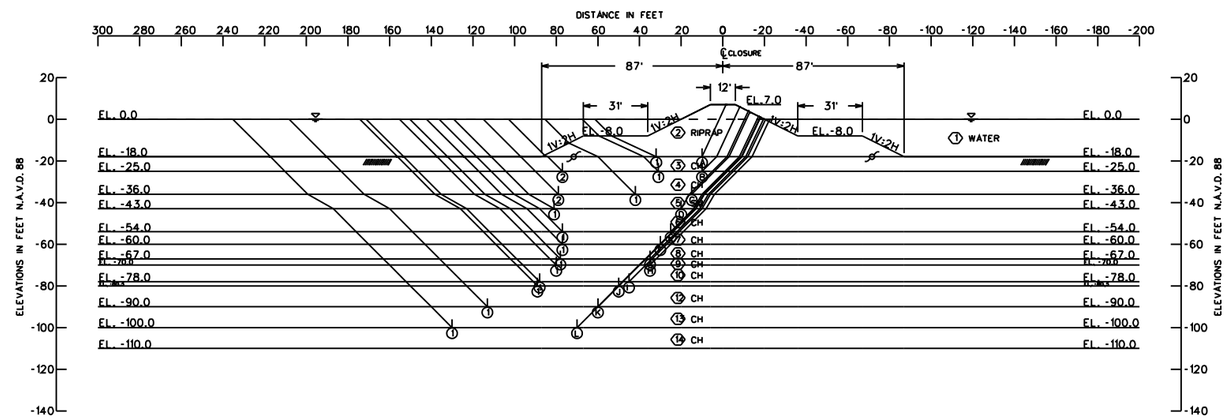
GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. -7 FEET GROUND AT EL. -18
EXTREME CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07



GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-18.0	23463	9900	12969	40108	13728	46332	26380	1.76
Ⓑ ①	-25.0	30338	9450	18800	65983	29344	58588	36639	1.60
Ⓑ ②	-25.0	30338	30150	6436	65983	22190	66924	43793	1.53
Ⓒ ①	-36.0	37192	12150	25764	111284	63153	75106	48131	1.56
Ⓒ ②	-36.0	37192	28800	16200	111284	49100	82192	62184	1.32
Ⓓ ①	-43.0	49409	29280	32086	146135	73213	110775	72922	1.52
Ⓔ ①	-54.0	55185	24960	40824	209693	125314	120969	84379	1.43
Ⓕ ①	-60.0	60763	26461	47088	248930	158667	134312	90263	1.49
Ⓖ ①	-67.0	68023	28380	55656	298745	202320	152059	96425	1.58
Ⓗ ①	-70.0	70265	31500	59736	321739	222369	161501	99370	1.63
Ⓘ ①	-78.0	82685	30100	70936	387072	281452	183721	105620	1.74
Ⓙ ①	-80.0	88652	39780	74976	404080	297556	203408	106524	1.91
Ⓚ ①	-90.0	110052	59360	96376	498166	384693	265788	113473	2.34
Ⓛ ①	-100.0	133452	73200	119775	602995	482729	326427	120266	2.71

STRATUM NO.	SOIL TYPE	TOTAL UNIT WEIGHT P.C.F.	C - UNIT COHESION - P.S.F.		FRICTION ANGLE
			CENTER OF STRATUM	BOTTOM OF STRATUM	
		VERT. 1	VERT. 1	VERT. 1	DEGREES
①	WATER	62.5	0	0	0
②	RIPRAP	132	0	0	40
③	CH	105	450	450	0
④	CH	115	450	450	0
⑤	SM	122	0	0	30
⑥	CH	115	430	480	0
⑦	CH	105	522	563	0
⑧	CH	117	612	660	0
⑨	CH	117	680	700	0
⑩	CH	112	700	700	0
⑪	CH	112	1010	1020	0
⑫	CH	110	1070	1120	0
⑬	CH	108	1170	1220	0
⑭	CH	108	1270	1320	0

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
$\underline{\nabla}$ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

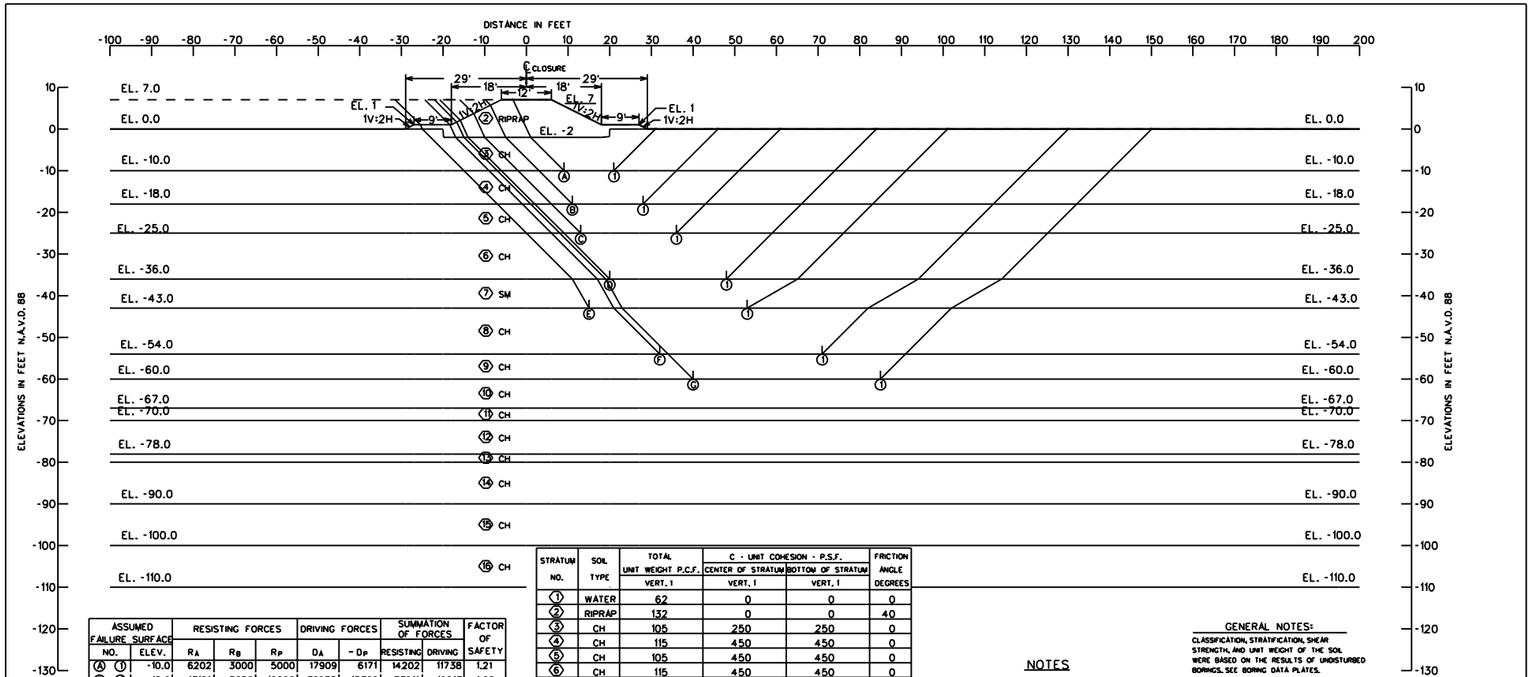
FACTOR OF SAFETY $= \frac{R_A + R_B + R_P}{D_A - D_P}$

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. +7 FEET GROUND AT EL. -18
LOW WATER CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: 13



ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-10.0	6202	3000	5000	17909	6171	14202	11738	1.21
Ⓑ ①	-18.0	13161	7650	12200	36975	17362	33011	19613	1.68
Ⓒ ①	-25.0	18580	10350	18500	57986	33691	47430	24295	1.95
Ⓓ ①	-36.0	27951	12600	28400	99217	70403	68951	28814	2.39
Ⓔ ①	-43.0	38815	18240	55393	135038	101181	112448	33857	3.32
Ⓕ ①	-54.0	46600	18720	64853	193209	161200	130173	32009	4.07
Ⓖ ①	-60.0	52945	25335	71117	230489	199623	149397	30866	4.84

STRATUM NO.	SOIL TYPE	TOTAL UNIT WEIGHT P.C.F. VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	FRICTION ANGLE DEGREES
①	WATER	62	0	0	0
②	RIPRAP	132	0	0	40
③	CH	105	250	250	0
④	CH	115	450	450	0
⑤	CH	105	450	450	0
⑥	CH	115	450	450	0
⑦	SM	122	0	0	30
⑧	CH	115	430	480	0
⑨	CH	105	522	563	0
⑩	CH	117	612	660	0
⑪	CH	117	680	700	0
⑫	CH	112	700	700	0
⑬	CH	112	1010	1020	0
⑭	CH	110	1070	1120	0
⑮	CH	108	1170	1220	0
⑯	CH	108	1270	1320	0

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Ⅺ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

GENERAL NOTES:

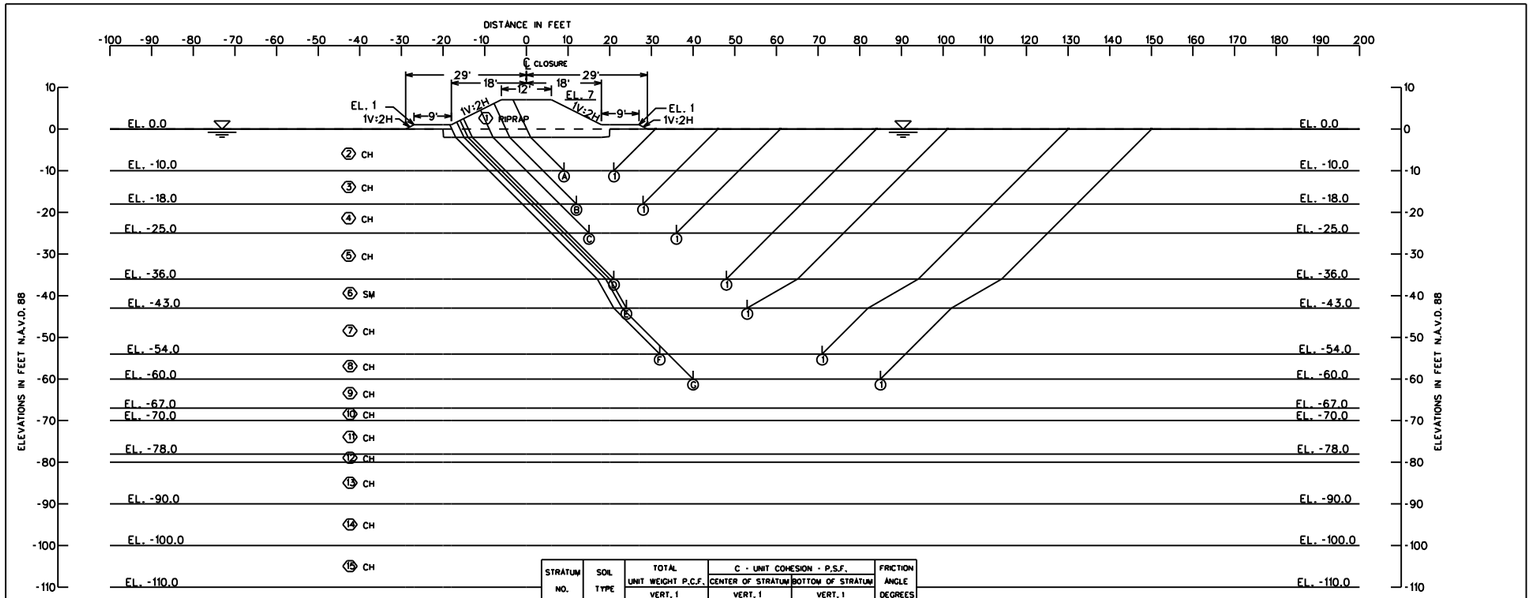
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. +7 FEET GROUND AT EL. 0
EXTREME CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: 14



ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-10.0	8085	3000	5000	17909	6171	16085	11738	1.37
B	1	-18.0	15069	7200	12200	36644	17362	34469	19282	1.79
C	1	-25.0	20084	9450	18500	56592	33691	48034	22901	2.10
D	1	-36.0	28571	12150	28400	96255	70403	69121	25852	2.67
E	1	-43.0	37956	13920	55393	128029	101181	107269	26848	4.00
F	1	-54.0	47115	18720	64853	189094	161200	130688	27894	4.69
G	1	-60.0	53539	25335	71117	227196	199623	149991	27573	5.44

STRATUM NO.	SOIL TYPE	TOTAL UNIT WEIGHT P.C.F.	C - UNIT COHESION - P.S.F. CENTER OF STRATUM	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM	FRICTION ANGLE
		VERT. 1	VERT. 1	VERT. 1	DEGREES
1	RIPRAP	132	0	0	40
2	CH	105	250	250	0
3	CH	115	450	450	0
4	CH	105	450	450	0
5	CH	115	450	450	0
6	SM	122	0	0	30
7	CH	115	430	480	0
8	CH	105	522	563	0
9	CH	117	612	660	0
10	CH	117	680	700	0
11	CH	112	700	700	0
12	CH	112	1010	1020	0
13	CH	110	1070	1120	0
14	CH	108	1170	1220	0
15	CH	108	1270	1320	0

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

GENERAL NOTES:

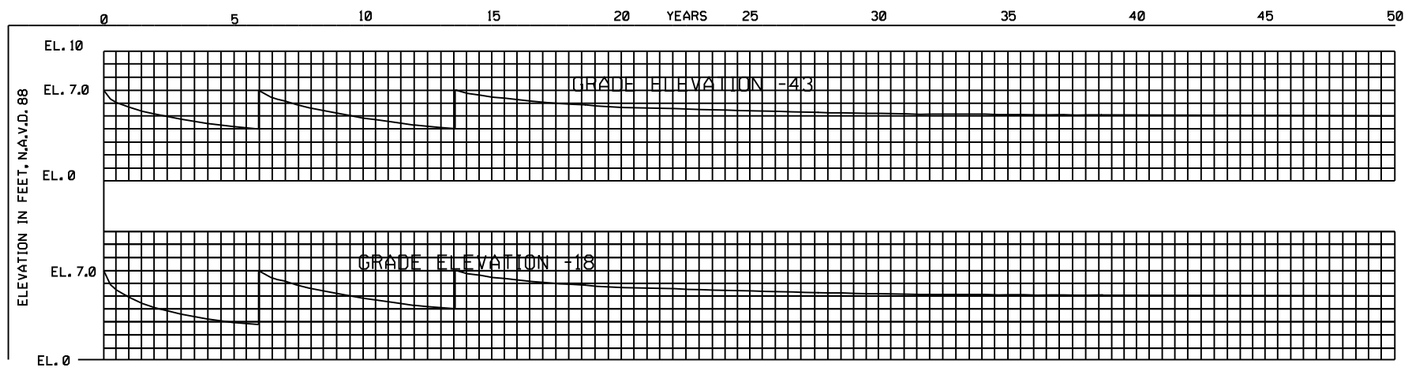
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

MISSISSIPPI RIVER GULF OUTLET CLOSURE

ROCK DIKE EL. +7 FEET GROUND AT EL. 0
LOW WATER CASE

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: 15



MISSISSIPPI RIVER GULF OUTLET CLOSURE

Settlement Curves

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS 05-OCT-07

PLATE: 16

Safety is a Part of Your Contract

UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION		TYPE	LETTER SYMBOL	SYMBOL	TYPICAL NAMES
COARSE - GRAINED SOILS More than half of material is larger than No. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size.	CLEAN GRAVEL (Little or no fines)	GW		GRAVEL, Well Graded, gravel-sand mixtures, little or no fines
			GP		GRAVEL, Poorly Graded, gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	GM		SILTY GRAVEL, gravel-sand-silt mixtures
			GC		CLAYEY GRAVEL, gravel-sand-clay mixtures
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SAND (Little or no fines)	SW		SAND, Well-Graded, gravelly sands
			SP		SAND, Poorly-Graded, gravelly sands
		SANDS WITH FINES (Appreciable amount of fines)	SM		SILTY SAND, sand-silt mixtures
			SC		CLAYEY SAND, sand-clay mixtures
FINE - GRAINED SOILS More than half of material is smaller than No. 200 sieve size.		SILTS AND CLAYS Liquid limit less than 50	ML		SILT & very fine sand, silty or clayey fine sand or clayey silt with slight plasticity
			CL		LEAN CLAY, Sandy Clay, Silty Clay, of low to medium plasticity
			OL		ORGANIC SILTS, and organic silty clays of low plasticity
		SILTS AND CLAYS Liquid limit greater than 50	MH		SILT, fine sandy or silty soil with high plasticity
			CH		FAT CLAY, inorganic clay of high plasticity
			OH		ORGANIC CLAYS of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		PEAT, and other highly organic soil
WOOD			Wd		WOOD
SHELLS			Sl		SHELLS
NO SAMPLE			NS		No Sample Retrieved

NOTE: Soils possessing characteristics of two groups are designated by combinations of group symbols.

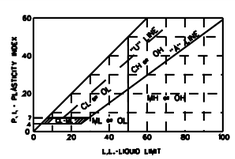
DESCRIPTIVE SYMBOLS

COLOR

COLOR	SYMBOL
TAN	T
YELLOW	Y
RED	R
BLACK	Bk
GRAY	Gr
LIGHT GRAY	lGr
DARK GRAY	dGr
BROWN	Br
LIGHT BROWN	lBr
DARK BROWN	dBr
BROWNISH-GRAY	brGr
GRAYISH-BROWN	gyBr
GREENISH-GRAY	gnGr
GRAYISH-GREEN	gyGn
GREEN	Gn
BLUE	Bl
BLUE-GREEN	BlGn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS

CONSISTENCY	COHESION IN LBS./SQ.FT. FROM UNCONFINED COMPRESSION TEST	SYMBOL
VERY SOFT	< 250	vSo
SOFT	250-500	So
MEDIUM	500-1000	M
STIFF	1000-2000	St
VERY STIFF	2000-4000	vSt
HARD	> 4000	H



PLASTICITY CHART

For classification of fine-grained soils in accordance with ASTM D 2487

MODIFICATIONS

MODIFICATION	SYMBOL
Traces	Tr
Fine	F
Medium	M
Coarse	C
Concretions	cc
Rootlets	rl
Lignite fragments	lg
Shale fragments	sh
Sandstone fragments	sds
Shell fragments	slf
Organic matter	O
Clay strata or lenses	CS
Silt strata or lenses	SS
Sand strata or lenses	SS
Sandy	S
Gravelly	G
Boulders	B
Slickensides	SL
Wood	Wd
Oxidized	Ox

NOTES:

FIGURES TO LEFT OF GENERAL TYPE BORING UNDER COLUMN "W OR D_{10}"

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm *

ON PLOT TO RIGHT OF BORING LOG: ATTERBERG LIMITS ⊕ LP ⊖ LN ⊗ LL

SYMBOLS TO LEFT OF BORING

- ▽ Ground-water surface and date observed
- Ⓒ Denotes location of consolidation test **
- Ⓢ Denotes location of consolidated-drained direct shear test **
- Ⓡ Denotes location of consolidated-undrained triaxial compression test **
- Ⓤ Denotes location of unconsolidated-undrained triaxial compression test **
- Ⓣ Denotes location of sample subjected to consolidation test and each of the above three types of shear test **
- FW Denotes free water encountered in boring or sample

FIGURES TO RIGHT OF BORING

Are values of cohesion in lbs./sq.ft. from unconfined compression tests

In parenthesis are driving resistances in blows per foot determined with a standard split spoon sampler (1 3/8" I.D., 2" O.D.) and a 140 lb. driving hammer with a 30" drop

Where underlined with a solid line denotes laboratory permeability in centimeters per second of undisturbed sample

Where underlined with a dashed line denotes laboratory permeability in centimeters per second of sample remoulded to the estimated natural void ratio

* The D_{10} size of a soil is the grain diameter in millimeters of which 10% of the soil is finer, and 90% coarser than D_{10}.

** Results of these tests are available for inspection in the U.S. Army Engineer District Office, if these symbols appear beside the boring logs on the drawings.

TYPICAL NOTES:

1. While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of the contract clause entitled "Differing Site Conditions".
2. Ground-water elevations shown on the boring logs represent ground-water surfaces encountered in such borings on the dates shown. Absence of water surface data on certain borings indicates that no ground-water data are available from the boring but does not necessarily mean that ground-water will not be encountered at the locations or within the vertical reaches of such borings.
3. Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.
4. Unless otherwise noted:
   a. Undisturbed borings, indicated by the letter "U", are taken with a 5" I.D. Piston Type Sampler.
   b. General type borings are taken with a 1 3/8" I.D. Tube Sampler and/or a 1 3/8" I.D. Split Spoon Sampler.

VALUE ENGINEERING Incentive Clauses YOUR KEY TO HIGHER PROFITS

US Army Corps of Engineers New Orleans District

SYM	DATE	DESCRIPTION

SYM	DATE	DESCRIPTION

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY: W.A.B. DATE: 1-20-2006
CHECKED BY: M.A.C. DATE: 1-20-2006
DRAWN BY: M.A.C. DATE: JAN. 2006
PLOT SCALE: 1:1.0
PLOT DATE: JAN. 03
SUBMITTED BY: APPROVED BY: DATE:
SOLICITATION NO. W912P8-99-B-0016

ZOOM/LAKE ZEMPLE FLOODWALL, LEVEES WEST OF ZEMPLE
WEST BAYOU SALE LEVEE
NORTH BANK HOUSTON
LEVEE ENLARGEMENT AND FLOODWALL
SOIL BORING LEGEND
ST. MARY PARISH, LA.

FILE NUMBER H-8-45868
PLATE 17