ENGINEERING APPENDIX A

APPENDIX 6

QUANTITIES – ALTERNATIVE ANALYSIS

Brazos River Floodgates Feasibility Study
Alternative 2a - Major Rehab Existing Structure
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
2	**Major Rehabilitation (Quantities are for Existing West and East Gates)**		
	Existing Sector Gates (2 sector gates, 4 leafs)		
	1. Remove and Rehab Sector Gate (2 gates, 4 leafs, east & west channel)	365	TON
	- Assume Gate Major Rehabilitation Work Costs 50% of New Cost		
3	**Raise/Relocate Gate Operator Buildings**		
	Raise Exist. West and East Gate Operator Buildings 4 feet higher		
	1. Raise Operator Building with New Foundation	2	LS
4	**Modify (Raise) Gate Machinery Pits**		
	Raise Exist. West and East Gate Machinery Pits 4 feet higher		
	1. Raise Machinery Pit with New Foundation	4	LS
5	**Channel Maintenance Structure**		
	Add Channel Maintenance Structure to help with navigation		
	1. Install a Dolphin Alignment Structure at the River Side for Each Gate	2	LS
6	**Modify Guide Walls**		
	Replace Existing Timber Rub Facing with UHMW Panels		
	Remove Exist. Timber Facing on Guidewalls (incl. hardware)		
	1. West Gate 12"x12" Timbers	13,680	SF
	2. East Gate 12"x12" Timbers	10,260	SF
	Total =	23,940	SF
	Rub Face UHMW Panels Mounted to Steel Plate Attached to Exist. Sheet Pile Face		
	1. West Gate Rub Face UHMW Panel (2 3/4" thick)	13,680	SF
	2. East Gate Rub Face UHMW Panel (2 3/4" thick)	10,260	SF
	Total =	23,940	SF
	1. West Gate Steel Plate (5/8" thick)	13,680	SF
	2. East Gate Steel Plate (5/8" thick)	10,260	SF
	Total =	23,940	SF
7	**Mechanical**		
	1. Replace All Operating Machinery for Each Gate	2	LS
8	**Electrical**		
	1. Replace All Electrical Equipment for Each Gate	2	LS

Major Rehabilitation of the exiting floodgates is expected to include the following management measures:

MR - Major Rehab of the Floodgates (includes repair/replacement of damaged components, repainting, and replacement of cathodic protection)
RO - Raise/Relocate Gate Operator Buildings
MP - Modify (Raise) Gate Machinery Pit Location
MG - Modify Guidewalls
CS - Channel Maintenance Structures

Note: The most recent BRFG rehabilitation contract (W912HY11C0009) was for $9.6M, lasted 6 years and was completed in mid-2017.

Existing Gate:

Each gate (lb) = 364,500 (2 leafs)
Each gate (ton) = 182.3 (2 leafs)
Two gates removed (ton) = **365** (4 leafs)

Guide wall rub face: Use UHMW sheets attached to steel plate mounted to sheet pile face. WT steel vertical guide for steel plate attachment to sheet pile face. The total height of UHMW panels and steel plate estimated at 9 feet tall. 2 3/4" thick UHMW sheet attached to 5/8" thick steel plate. UHMW attached to steel plate with 1" diameter bolts with 1' x 1' bolt spacing grid. The length of rub face below is the same as the lengths of guide wall above, only difference is the specific location to the gate is broken down.

Guide Wall Rub Face Lengths (ft)

West Gate	Northwest	400
	Northeast	360
	Southwest	430
	Southeast	330
Total length (ft) =		1,520

East Gate	Northwest	210
	Northeast	360
	Southwest	220
	Southeast	350
Total length (ft) =		1,140

All Walls Total length (ft) = 2,660

Guide Wall Rub Face Area (ft2)

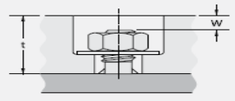
West Gate	13,680
East Gate	10,260
Total Area (ft2) =	23,940

Ultra High Molecular Weight Polyethylene (UHMW-PE)

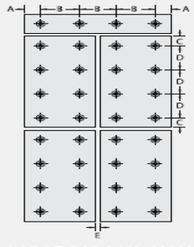
WEAR ALLOWANCES

APPLICATION	t (mm)	W* (mm)	BOLT
Light duty	30	3 – 5	M16
Medium duty	40	7 – 10	M16 – M20
	50	10 – 15	
Heavy duty	60	15 – 19	M24 – M30
	70	18 – 25	
	80	22 – 32	
Extreme duty	90	25 – 36	M30 – M36
	100	28 – 40	

* Where allowances are typical values, actual wear allowance may vary due to fixing detail. Small increases in facing thickness can greatly extend service life for minimal extra cost. [Units: mm]



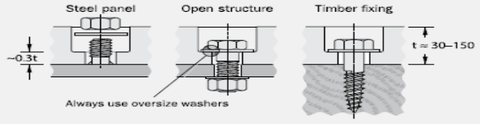
TYPICAL DIMENSIONS



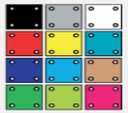
A	45 – 80
B	250 – 350
C	45 – 80
D	300 – 450
E	5 – 10

[Units: mm]

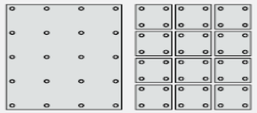
Dimensions will depend on pad thickness and application.



LARGE PADS VS SMALL PADS



The standard color is black, but UHMW-PE is available in many other colours if required.



Larger pads are usually more robust but smaller pads are easier and cheaper to replace.

Brazos River Floodgates Feasibility Study
Alternative 3a - Move Gates Farther Back in Exist. Channel
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
2	**Demolition (Quantities are for existing West and East Gates)**		
	Existing Sector Gates (2 sector gates, 4 leafs)		
	1. Remove and Salvage Sector Gate (2 gates, 4 leafs, east & west channel)	365	TON
	2. Remove and Dispose Gate Foundation (2 gates)	15,310	CY
	3. Remove and Dispose Timber Piles (2 gates)	1,970	EA
	Guide Walls		
	1. Remove and Salvage Guide Walls (8 walls, east & west channel)	4,324	TON
3	**Excavation and Fill**		
	Move Gates Farther Back in Existing Channel		
	Excavation		
	1. Excavate Existing West Gate Channel	268,700	CY
	2. Excavate Existing East Gate Channel	181,800	CY
	3. Excavate West Bypass Channel	863,200	CY
	4. Excavate East Bypass Channel	888,800	CY
	Excavation Total =	2,202,500	CY
	Fill		
	1. Fill Existing Channel to Create Vessel Channel, West Gate	188,300	CY
	2. Fill Existing Channel to Create Vessel Channel, East Gate	201,000	CY
	Fill Total =	389,300	CY
	Riprap (3' Thick Layer)	8,000	TON
4	**Cofferdam (Cofferdam placed around sector gates, 2 gates, 2 dams)**		
	1. Excavation	35,600	CY
	2. Sand and Fill	12,600	CY
	3. Waler System - WF Members	440	TN
	4. Sheet Piles - AZ 38-700N	105,280	SF
	5. Internal Bracing (Struts) - 24" Dia. X 0.625" Thk.	4,600	LF
	6. King Post Piling (Piles 30" Dia. X 0.625" Thk.)	3,400	LF
	7. Support Piling 24" Dia. X 0.625" Thk.	4,200	LF
	8. Misc. Steel	10	TN
	9. Temporary Dewatering System	2	LS
	10. Removal of Cofferdam	2	LS
5	**Concrete Structure and Gate (Quantities are for 2 sector gates, 4 leafs)**		
	Sector Gate Monolith		
	1. Sand and Gravel Bedding	3,400	CY
	2. Tremie Concrete - Seal Slab	9,000	CY
	3. Reinforced Concrete Base Slab	17,800	CY
	4. Reinforced Concrete Monolith	8,000	CY
	5. Pilings:		
	a. Pilings - Vertical Spiral Piles - 30" Dia. X 0.625" Thk.	40,200	LF
	b. Pilings - Batter Spiral Piles - 30" Dia. X 0.625" Thk.	44,838	LF
	6. Tension Connection	550	EA
	7. Bulkhead Slots - Stainless Steel w/Seals (Embedded in Monolith)	200	LF
	8. Ladder Slots - Stainless Steel w/Ladders (Embedded in Monolith)	100	LF
	Sector Gate		
	1. Sector Gates	1,136	TN
	2. Pintles and Hinges (King post)	2	LS
	3. Sector Gate Protection Fenders	2,360	LF
	4. Gate Seals, Seal Bearing Surfaces and Gate Track	2	LS
	5. Cathodic Protection	2	LS
6	**Maintenance Dewatering System**		
	Sector Gate Dewatering System (Maintenance Bulkhead)		
	1. Maintenance Bulkhead	633	TN
	2. Maintenance Bulkhead Storage Platform		
	a. Steel Framing	294	TN
	b. Piling Supports		
	1. Pilings - 36" Dia. X 0.625" Thk.	2,816	LF
7	**Guide Walls**		
	Sheet Pile Guide Wall Tied Back to Sheet Pile Anchors		
	All Sheet Pile PZ-35 Unless Noted Otherwise		
	1. West Gate North Guide Wall	63,840	SF
	2. West Gate South Guide Wall	63,840	SF
	3. East Gate North Guide Wall	47,880	SF
	4. East Gate South Guide Wall	47,880	SF
	Total =	223,440	SF
	Guide Wall Hardware		
	Total Guide Wall Hardware (All walls)	499	TN
	Rub Face UHMW Sheets Mounted to Steel Plate Attached to Sheet Pile Face		

DEMOLITION

Existing Gate:
Each gate (lb) = 364,500 (2 leafs)
Each gate (ton) = 182.3 (2 leafs)
Two gates removed (ton) = **365** (4 leafs)

Conc. Foundation, one gate (cy) = **7,655** Foundation, wing walls, approach aprons

Contract Bid Documents used 25 feet timber pile length for bidding purposes. **985** Piles per gate

Total weight guide walls, one gate (lb) = **4,323,700** **Quantities based on East Gate Guide Wall take off, Guide Walls B5, B6, B7, B8, West Gate guide wall similar.**
Total weight walls, one gate (ton) = **2,162** Weight is steel material: sheet pile, anchor bar, waler, wall contact, pile cap, tangent plate, fender plate

Wall No	Guide Wall Sht Pile (sf)	Anchor Wall Sht Pile (sf)	Total (sf)
B5	25,243	12,067	37,310
B6	21,736	10,076	31,812
B7	13,184	6,486	19,670
B8	13,184	6,486	19,670
			108,462

Note: The bypass channels would likely be turned into barge mooring/storage channels after construction, similar to the existing Texas Barge and Boat facility on Alignment C. Alignment C was the bypass channel during the construction of the existing BRFG facility, and now a portion of it has been turned into the existing Texas Barge and Boat facility.

SEE BOTTOM OF SPREADSHEET FOR EXCAVATION AND FILL QUANTITIES

Excavation Disposal Note: The current plan for the disposal of excavation material is to use the existing placement areas (PA) located along the GIWW.

Placement Areas No. 88 and 89 are the closest to the Brazos Floodgates and they were reported to have combined remaining capacity of approximately 3.8 million cubic yards.

Based on SGCP* Gulf Side Sector Gate, 46.5' x 110' Sector Gate
Foundation = 116' x 260'
***Similar Gulf Coast Project**

Brazos Sector Gate 31' x 125'

Cofferdam Note: Prior to cofferdam construction, install guide walls and fill in the wet to create vessel chamber and land adjacent to gates. Cofferdam placed around each sector gate, 2 gates, 2 cofferdams. The intent is to build the guide walls first, so that the temporary cofferdam will be reduced in length and will be less expensive. The temporary cofferdam will be installed between the permanent guide walls, and then dewatered in order to perform the monolith and sector gate construction work in the dry.

Perimeter of cofferdam (ft) = 752

Estimate for sheet pile that half of height is embedded and half the height is above mudline, estimate sheet pile length of 70 feet. Estimate the length of King post piling to be embedded 50 feet and 35 feet above mudline, for length of 85 feet. Estimate that 20 King posts are required. Estimate the length of support piling to be 70 feet, half the length is embedded. Estimate that 30 support piling are required. The lengths and quantity estimated above is a rough estimate and may change based on geotechnical conditions. Geotechnical conditions have not been evaluated, propose use of well points for dewatering system.

The construction cofferdam would be designed and detailed by the construction contractor. However, it is anticipated that the cofferdam would include some larger diameter piles (king posts) to help support the lateral loads on the cofferdam. Typically the internal bracing (struts) would weld to the larger diameter piles (king posts) for lateral support. Some smaller diameter support piles are also anticipated to be required to help vertically support and reduce the unbraced length of the internal bracing members.

This estimated sand and fill quantity is a minor item to help provide a stable work surface floor within the cofferdam and to fill in any holes where the geotechnical conditions may require overexcavation to reach a stable subgrade.

Based on SGCP Gulf Side Sector Gate, 46.5' x 110' Sector Gate → **Pile Lengths (ft)** **Sector Gate Weight (ton) = 537**
Foundation = 116' x 260' **Vertical = 169** **No of vertical piles = 134**
Batter = 178 **No of batter piles = 141**

Brazos Sector Gate 31' x 125' (2 gates, 4 leafs)

No of vertical piles = **268** Vertical pile length (ft) = **150** <= Enter vertical value, batter will be calculated
No of batter piles = **282** Batter pile length (ft) = **159**
3v:1h

The weight per enclosed volume of a sector gate leaf was calculated for several existing projects including the existing Brazos sector gate. The data results are as follows, Brazos 6.2 lb/ft3 (pcf), IHNC 6.7 pcf, and SGCP 4.8 pcf. The average weight per enclosed volume for these projects is 5.9 pcf. The estimated weight of the new Brazos sector gate leaf is based on this similar project average of 5.9 pcf for the proposed 31' x 125' gate. The estimated weight of the proposed sector gate (2 leafs) is 568 tons. IHNC refers to the Inner Harbor Navigation Canal project. The top of the gates will match the top of the wall elevation +16.00 NAVD88 which matches the Colorado River Locks, which were recently surveyed.

Based on SCGP Gulf Side Sector Gate, 46.5' x 110' Sector Gate. Maintenance bulkheads provide 29 feet of water protection. The bulkheads are 110' feet long and to be placed across the channel opening. 5 bulkheads stacked on top of each other used at each end of monolith, total of 10 units to perform maintenance on a sector gate. Each bulkhead weighs 63 tons. Provide one complete set (10 units) for one gate, maintenance performed on one gate at a time.

The maintenance bulkhead storage platform is estimated to require a total deck area of approximately 18,060 square feet in order to store 10 bulkhead sections stacked 2 high. The required footprint on the platform would be for 5 bulkheads. The exact plan configuration of the storage platform would depend on the land available and how the USACE would like to store/arrange the bulkheads. One possible platform deck configuration would be 54 feet wide for 255 feet and 33 feet wide for 130 feet. Typical pile lengths are 88 feet for the maintenance bulkhead storage platform.

Since the guide walls must retain fill soil, use sheet pile guide walls similar to the type currently in use, sheet pile face tied back to sheet pile used as anchor. Quantities based on quantity take off of existing East gate guide walls B5, B6, B7, and B8, raised 6 feet to match top of wall elevation +16.00 NAVD88 at the Colorado River Locks, which were recently surveyed.

See Demolition Above for Sheet Pile Area Breakout
<=For Existing Wall sections B5, B6, B7, B8

Existing East Guide Wall Lengths (ft)	
Wall section B5	487
B6	408
B7	257
B8	257
Total length (ft) =	1,409

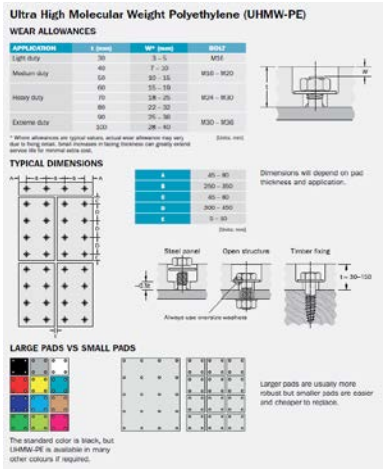
Exist.Guide Wall Take Off Weight (lb)	
PZ 35 sheet pile	3,796,100
Anchor bar	170,470
Waler	140,990
Wall contact	29,196
Pile cap	114,870
Tangent wall plate	42,385
Fender plate	29,661
Total Steel Weight (lb) =	4,323,700

Hardware weight per foot (lb/ft)
375

Brazos River Floodgates Feasibility Study
Alternative 3a - Move Gates Farther Back in Exist. Channel
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
	1. West Gate Rub Face UHMW Panel (2 3/4" thick)	13,680	SF
	2. East Gate Rub Face UHMW Panel (2 3/4" thick)	10,260	SF
	Total =	23,940	SF
	1. West Gate Steel Plate (5/8" thick)	13,680	SF
	2. East Gate Steel Plate (5/8" thick)	10,260	SF
	Total =	23,940	SF
8	**Mechanical**		
	1. Rack and Pinion System	2	LS
9	**Electrical**	2	LS



Existing Weight per Linear Foot of Sheet Pile Guide Wall (lb/ft) = **3,069**

Use sheet pile 56 feet total face sheet length (56 sf per linear foot) plus 50% wall face area for anchor sheet.

For Alternative 3a at New Location Farther Back in Existing Channel

		New Guide Wall Lengths (ft)	New Guide Wall Area (sf)	New Guide Wall Hardware (ton)
West Gate	North	760	63,840	143
	South	760	63,840	143
East Gate	North	570	47,880	107
	South	570	47,880	107
	Total length (ft) =	2,660	Total Area (sf) = 223,440	Total Weight (ton) = 499

Guide wall rub face: Use UHMW sheets attached to steel plate mounted to sheet pile face. WT steel vertical guide for steel plate attachment to sheet pile face. The total height of UHMW panels and steel plate estimated at 9 feet tall. 2 3/4" thick UHMW sheet attached to 5/8" thick steel plate. UHMW attached to steel plate with 1" diameter bolts with 1' x 1' bolt spacing grid. The length of rub face below is the same as the lengths of guide wall above, only difference is the specific location to the gate is broken down.

Guide Wall Rub Face Lengths (ft)

West Gate	Northwest	400	East Gate	Northwest	210
	Northeast	360		Northeast	360
	Southwest	430		Southwest	220
	Southeast	330		Southeast	350
	Total length (ft) =	1,520		Total length (ft) =	1,140

All Walls Total length (ft) = 2,660

Guide Wall Rub Face Area (ft2)

West Gate	13,680
East Gate	10,260
Total Area (ft2) =	23,940

CHANNEL EXCAVATION

	Location	Area (ft2)	Volume (yd3)		
Exist.channel excavated to open channel	West channel north	169,830	113,300	268,700	
	West channel south	232,990	155,400		
	East channel north	85,120	56,800	181,800	
	East channel south	187,500	125,000		
	West bypass	1,294,800	863,200		
	East bypass	1,333,100	888,800		
	Sum =	**3,303,340** ft2	**2,202,500** yd3		Average depth of excavation used = 18 ft

FILL EXISTING CHANNEL

	Location	Area (ft2)	Volume (yd3)	
For new gate locations	West channel	282,370	188,300	
	East channel	301,370	201,000	
	Sum =	**583,740** ft2	**389,300** yd3	Average depth of fill used = 18 ft

US Army Corps of Engineers
New Orleans District

Brazos River Floodgates Feasibility Study
Alternative 3a.1: 3a East + Open Exist. Channel West
Quantities Estimate

Designed By JK
Checked By GK
11-Oct-2017

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
2	**Demolition (Quantities are for existing West and East Gates)**		
	Existing Sector Gates (2 sector gates, 4 leafs)		
	1. Remove and Salvage Sector Gate (2 gates, 4 leafs, east & west channel)	365	TON
	2. Remove and Dispose Gate Foundation (2 gates)	15,310	CY
	3. Remove and Dispose Timber Piles (2 gates)	1,970	EA
	Guide Walls		
	1. Remove and Salvage Guide Walls (8 walls, east & west channel)	4,324	TON
3	**Excavation and Fill**		
	Move Gates Farther Back in Existing Channel		
	Excavation		
	1. Excavate Existing West Gate Channel	268,700	CY
	2. Excavate Existing East Gate Channel	181,800	CY
	3. Excavate West Bypass Channel	431,600	CY
	4. Excavate East Bypass Channel	888,800	CY
	Excavation Total =	1,770,900	CY
	Fill		
	1. Fill Existing Channel to Create Vessel Channel, West	0	CY
	2. Fill Existing Channel to Create Vessel Channel, East Gate	201,000	CY
	Fill Total =	201,000	CY
4	**Cofferdam (Cofferdam placed around sector gates, 1 gate, 1 dam)**		
	1. Excavation	17,800	CY
	2. Sand and Fill	6,300	CY
	3. Waler System - WF Members	220	TN
	4. Sheet Piles - AZ 38-700N	52,640	SF
	5. Internal Bracing (Struts) - 24" Dia. X 0.625" Thk.	2,300	LF
	6. King Post Piling (Piles 30" Dia. X 0.625" Thk.)	1,700	LF
	7. Support Piling 24" Dia. X 0.625" Thk.	2,100	LF
	8. Misc. Steel	5	TN
	9. Temporary Dewatering System	1	LS
	10. Removal of Cofferdam	1	LS
5	**Concrete Structure and Gate (Quantities are for 1 sector gate, 2 leafs)**		
	Sector Gate Monolith		
	1. Sand and Gravel Bedding	1,700	CY
	2. Tremie Concrete - Seal Slab	4,500	CY
	3. Reinforced Concrete Base Slab	8,900	CY
	4. Reinforced Concrete Monolith	4,000	CY
	5. Pilings:		
	a. Pilings - Vertical Spiral Piles - 30" Dia. X 0.625" Thk.	20,100	LF
	b. Pilings - Batter Spiral Piles - 30" Dia. X 0.625" Thk.	22,419	LF
	6. Tension Connection	275	EA
	7. Bulkhead Slots - Stainless Steel w/Seals (Embedded in Monolith)	100	LF
	8. Ladder Slots - Stainless Steel w/Ladders (Embedded in Monolith)	50	LF

DEMOLITION

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Conc. Foundation, one gate (cy) = **7,655** Foundation, wing walls, approach aprons

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Weight is steel material: sheet pile, anchor bar, waler, wall contact, pile cap, tangent plate, fender plate

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Perimeter of cofferdam (ft) = 752

Estimate for sheet pile that half of height is embedded and half the height is above mudline, estimate sheet pile length of 70 feet. Estimate the length of King post piling to be embedded 50 feet and 35 feet above mudline, for length of 85 feet. Estimate that 20 King posts are required. Estimate the length of support piling to be 70 feet, half the length is embedded. Estimate that 30 support piling are required. The lengths and quantity estimated above is a rough estimate and may change based on geotechnical conditions. Geotechnical conditions have not been evaluated, propose use of well points for dewatering system.

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Foundation = 116' x 260'

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3v:1h

	Sector Gate		
	1. Sector Gates	568	TN
	2. Pintles and Hinges (King post)	1	LS
	3. Sector Gate Protection Fenders	1,180	LF
	4. Gate Seals, Seal Bearing Surfaces and Gate Track	1	LS
	5. Cathodic Protection	1	LS
6	**Maintenance Dewatering System**		
	Sector Gate Dewatering System (Maintenance Bulkhead)		
	1. Maintenance Bulkhead	633	TN
	2. Maintenance Bulkhead Storage Platform		
	a. Steel Framing	294	TN
	b. Piling Supports		
	1. Pilings - 36" Dia. X 0.625" Thk.	2,816	LF
7	**Guide Walls**		
	Sheet Pile Guide Wall Tied Back to Sheet Pile Anchors		
	All Sheet Pile PZ-35 Unless Noted Otherwise		
	1. West Gate North Guide Wall	0	SF
	2. West Gate South Guide Wall	0	SF
	3. East Gate North Guide Wall	47,880	SF
	4. East Gate South Guide Wall	47,880	SF
	Total =	95,760	SF
	Guide Wall Hardware		
	Total Guide Wall Hardware (All walls)	214	TN
	Rub Face UHMW Sheets Mounted to Steel Plate Attached to Sheet Pile Face		
	1. West Gate Rub Face UHMW Panel (2 3/4" thick)	0	SF
	2. East Gate Rub Face UHMW Panel (2 3/4" thick)	10,260	SF
	Total =	10,260	SF
	1. West Gate Steel Plate (5/8" thick)	0	SF
	2. East Gate Steel Plate (5/8" thick)	10,260	SF
	Total =	10,260	SF
8	**Mechanical**		
	1. Rack and Pinion System	1	LS
9	**Electrical**	1	LS

The weight per enclosed volume of a sector gate leaf was calculated for several existing projects including the existing Brazos sector gate. The data results are as follows, Brazos 6.2 lb/ft3 (pcf), IHNC 6.7 pcf, and SGCP 4.8 pcf. The average weight per enclosed volume for these projects is 5.9 pcf. The estimated weight of the new Brazos sector gate leaf is based on this similar project average of 5.9 pcf for the proposed 31' x 125' gate. The estimated weight of the proposed sector gate (2 leafs) is 568 tons. IHNC refers to the Inner Harbor Navigation Canal project. The top of the gates will match the top of the wall elevation +16.00 NAVD88 which matches the Colorado River Locks, which were recently surveyed.

Based on SCGP Gulf Side Sector Gate, 46.5' x 110' Sector Gate. Maintenance bulkheads provide 29 feet of water protection. The bulkheads are 110' feet long and to be placed across the channel opening. 5 bulkheads stacked on top of each other used at each end of monolith, total of 10 units to perform maintenance on a sector gate. Each bulkhead weighs 63 tons. Provide one complete set (10 units) for one gate, maintenance performed on one gate at a time.

The maintenance bulkhead storage platform is estimated to require a total deck area of approximately 18,060 square feet in order to store 10 bulkhead sections stacked 2 high. The required footprint on the platform would be for 5 bulkheads. The exact plan configuration of the storage platform would depend on the land available and how the USACE would like to store/arrange the bulkheads. One possible platform deck configuration would be 54 feet wide for 255 feet and 33 feet wide for 130 feet. Typical pile lengths are 88 feet for the maintenance bulkhead storage platform.

Since the guide walls must retain fill soil, use sheet pile guide walls similar to the type currently in use, sheet pile face tied back to sheet pile used as anchor. Quantities based on quantity take off of existing East gate guide walls B5, B6, B7, and B8, raised 6 feet to match top of wall elevation +16.00 NAVD88 at the Colorado River Locks, which were recently surveyed.

See Demolition Above for Sheet Pile Area Breakout
<=For Existing Wall sections B5, B6, B7, B8

Existing East Guide Wall Lengths (ft)		
Wall section B5		487
	B6	408
	B7	257
	B8	257
Total length (ft) =		1,409

Exist.Guide Wall Take Off Weight (lb)	
PZ 35 sheet pile	3,796,100
Anchor bar	170,470
Waler	140,990
Wall contact	29,196
Pile cap	114,870
Tangent wall plate	42,385
Fender plate	29,661
Total Steel Weight (lb) =	4,323,700

Hardware weight per foot (lb/ft)
375

Existing Weight per Linear Foot of Sheet Pile Guide Wall (lb/ft) = **3,069**

Use sheet pile 56 feet total face sheet length (56 sf per linear foot) plus 50% wall face area for anchor sheet.

For Alternative 3a at New Location Farther Back in Existing Channel

New Guide Wall Lengths (ft)		
West Gate	North	0
	South	0
East Gate	North	570
	South	570
Total length (ft) =		1,140

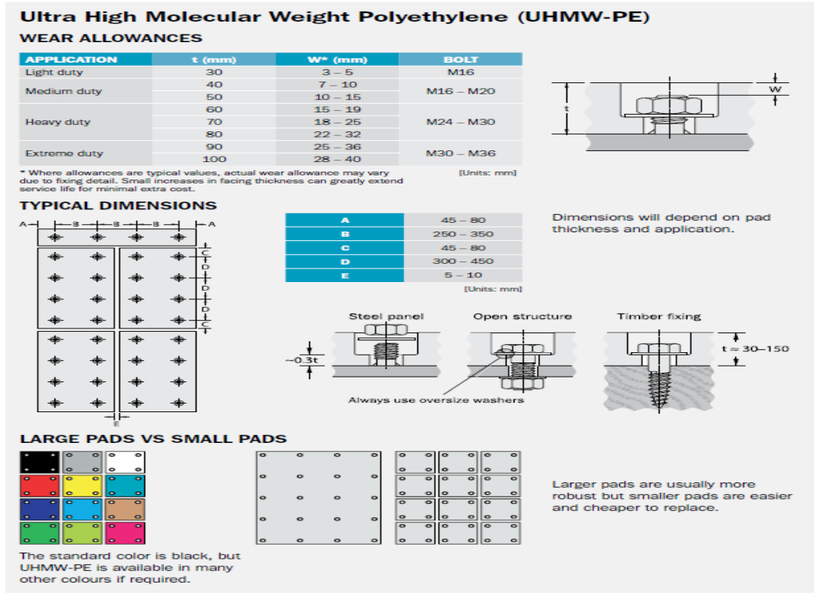
New Guide Wall Area (sf)	
North	0
South	0
North	47,880
South	47,880
Total Area (sf) =	95,760

New Guide Wall Hardware (ton)	
North	0
South	0
North	107
South	107
Total Weight (ton) =	214

Guide wall rub face: Use UHMW sheets attached to steel plate mounted to sheet pile face. WT steel vertical guide for steel plate attachment to sheet pile face. The total height of UHMW panels and steel plate estimated at 9 feet tall. 2 3/4" thick UHMW sheet attached to 5/8" thick steel plate. UHMW attached to steel plate with 1" diameter bolts with 1' x 1' bolt spacing grid. The length of rub face below is the same as the lengths of guide wall above, only difference is the specific location to the gate is broken down.

Guide Wall Rub Face Lengths (ft)		
West Gate	Northwest	0
	Northeast	0
	Southwest	0
	Southeast	0
Total length (ft) =		0

East Gate	Northwest	210
	Northeast	360
	Southwest	220
	Southeast	350
Total length (ft) =		1,140



Ultra High Molecular Weight Polyethylene (UHMW-PE)

WEAR ALLOWANCES

APPLICATION	t (mm)	W* (mm)	BOLT
Light duty	30	3 – 5	M16
Medium duty	40	7 – 10	M16 – M20
	50	10 – 15	
Heavy duty	60	15 – 19	M24 – M30
	70	18 – 25	
	80	22 – 32	
Extreme duty	90	25 – 36	M30 – M36
	100	28 – 40	

* Where allowances are typical values, actual wear allowance may vary due to fixing detail. Small increases in facing thickness can greatly extend service life for minimal extra cost. [Units: mm]

TYPICAL DIMENSIONS

A	45 – 80
B	250 – 350
C	45 – 80
D	300 – 450
E	5 – 10

[Units: mm]

Dimensions will depend on pad thickness and application.

LARGE PADS VS SMALL PADS

The standard color is black, but UHMW-PE is available in many other colours if required.

Larger pads are usually more robust but smaller pads are easier and cheaper to replace.

Guide Wall Rub Face Area (ft2)

West Gate	0
East Gate	10,260
Total Area (ft2) =	10,260

All Walls Total length (ft) = 1,140

CHANNEL EXCAVATION

Exist.channel excavated to open channel

Location	Area (ft2)	Volume (yd3)	
West channel north	169,830	113,300	268,700
West channel south	232,990	155,400	
East channel north	85,120	56,800	181,800
East channel south	187,500	125,000	
West bypass	647,400	431,600	
East bypass	1,333,100	888,800	
Sum =	**2,655,940** ft2	**1,770,900** yd3	

Average depth of excavation used = 18 ft

FILL EXISTING CHANNEL

For new gate locations

Location	Area (ft2)	Volume (yd3)
West channel	0	0
East channel	301,370	201,000
Sum =	**301,370** ft2	**201,000** yd3

Average depth of fill used = 18 ft

Brazos River Floodgates Feasibility Study
Alternative 9a - Open Channel on Alignment C without Gates
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
	Demolition (Quantities are for existing West and East Gates)		
	Existing Sector Gates (2 sector gates, 4 leafs)		
	1. Remove and Salvage Sector Gate (2 gates, 4 leafs, east & west channel)	365	TON
	2. Existing Gate Foundation and Piles to **Remain** (2 gates)	0	CY
2	**Excavation and Fill**		
	Open Channel on Alignment C, Fill Existing Channels		
	1. Excavate New West Open Channel	908,200	CY
	2. Excavate New East Open Channel	695,600	CY
	Excavation Total =	1,603,800	CY
	1. Fill Existing West Vessel Channel	108,200	CY
	2. Fill Existing East Vessel Channel	63,400	CY
	Fill Total =	171,600	CY
3	**Electrical**		
	Site Electrical	1	LS
	Real Estate Acquisition and Relocation for Alignment C		

DEMOLITION **Remove only Gates for Alternative 9a**

Existing Gate:

Each gate (lb) = 364,500 (2 leafs)
Each gate (ton) = 182.3 (2 leafs)
Two gates removed (ton) = **365** (4 leafs)

CHANNEL EXCAVATION

Alignment C through existing barge facility.
The area is partially excavated.

CADD channel excavation overlaid with aerial image of existing channel outline
West channel currently not being used, East channel is occupied, West requires more excavation (subtract less)

	Location	Area (ft2)		Area (ft2)	
Existing channel areas:	West channel	353,525	Use 75% of area for depth of excavation	265,144	Subtract this area from CADD value
(Barge facility)	East channel	550,000	Use 90% of area for depth of excavation	495,000	**(Area already excavated)**

	Location	Area (ft2)		Location	Area (ft2)	Volume (yd3)
Channel excavation	West channel	1,627,310	Channel Excavation	West channel	1,362,166	908,200
required from CADD	East channe	1,538,370		East channel	1,043,370	695,600
				Sum =	**2,405,536** ft2	**1,603,800** yd3

Average depth of excavation used = 18 ft

FILL EXISTING CHANNEL

	Location	Area (ft2)	Volume (yd3)
At existing gates	West channel	162,260	108,200
	East channel	95,090	63,400
	Sum =	**257,350** ft2	**171,600** yd3

Average depth of fill used = 18 ft

Brazos River Floodgates Feasibility Study
Alternative 9b - New Gates on Alignment C w/o Sediment Contrc
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
2	**Demolition (Quantities are for existing West and East Gates)**		
	Existing Sector Gates (2 sector gates, 4 leafs)		
	1. Remove and Salvage Sector Gate (2 gates, 4 leafs, east & west channel)	365	TON
	2. Remove and Dispose Gate Foundation (2 gates)	15,310	CY
	3. Remove and Dispose Timber Piles (2 gates)	1,970	EA
	Guide Walls		
	1. Remove and Salvage Guide Walls (8 walls, east & west channel)	4,324	TON
3	**Excavation and Fill**		
	New Gates on Alignment C		
	1. New West Channel Excavation	697,900	CY
	2. New East Channel Excavation	476,500	CY
	Excavation Total =	1,174,400	CY
	1. Fill for New Gate Location, West Gate	98,700	CY
	2. Fill for New Gate Location, East Gate	88,200	CY
	3. Fill Existing West Vessel Channel	108,200	CY
	4. Fill Existing East Vessel Channel	63,400	CY
	Fill Total =	358,500	CY
	Riprap (3' Thick Layer)	8,000	TON
4	**Cofferdam (Cofferdam placed around sector gates, 2 gates, 2 dams)**		
	1. Excavation	35,600	CY
	2. Sand and Fill	12,600	CY
	3. Waler System - WF Members	440	TN
	4. Sheet Piles - AZ 38-700N	105,280	SF
	5. Internal Bracing (Struts) - 24" Dia. X 0.625" Thk.	4,600	LF
	6. King Post Piling (Piles 30" Dia. X 0.625" Thk.)	3,400	LF
	7. Support Piling 24" Dia. X 0.625" Thk.	4,200	LF
	8. Misc. Steel	10	TN
	9. Temporary Dewatering System	2	LS
	10. Removal of Cofferdam	2	LS
5	**Concrete Structure and Gate (Quantities are for 2 sector gates, 4 leafs)**		
	Sector Gate Monolith		
	1. Sand and Gravel Bedding	3,400	CY
	2. Tremie Concrete - Seal Slab	9,000	CY
	3. Reinforced Concrete Base Slab	17,800	CY
	4. Reinforced Concrete Monolith	8,000	CY
	5. Pilings:		
	a. Pilings - Vertical Spiral Piles - 30" Dia. X 0.625" Thk.	40,200	LF
	b. Pilings - Batter Spiral Piles - 30" Dia. X 0.625" Thk.	44,838	LF
	6. Tension Connection	550	EA
	7. Bulkhead Slots - Stainless Steel w/Seals (Embedded in Monolith)	200	LF
	8. Ladder Slots - Stainless Steel w/Ladders (Embedded in Monolith)	100	LF
	Sector Gate		
	1. Sector Gates	1,136	TN
	2. Pintles and Hinges(King post)	2	LS
	3. Sector Gate Protection Fenders	2,360	LF
	4. Gate Seals, Seal Bearing Surfaces and Gate Track	2	LS
	5. Cathodic Protection	2	LS
6	**Maintenance Dewatering System**		

DEMOLITION

Existing Gate:

Each gate (lb) = 364,500 (2 leafs)
Each gate (ton) = 182.3 (2 leafs)
Two gates removed (ton) = **365** (4 leafs)

Conc. Foundation, one gate (cy) = **7,655** Foundation, wing walls, approach aprons

Contract Bid Documents used 25 feet timber pile length for bidding purposes. **985** Piles per gate

Total weight guide walls, one gate (lb) = **4,323,700**
Total weight guide walls, one gate (ton) = **2,162**

Quantities based on East Gate Guide Wall take off, Guide Walls B5, B6, B7, B8, West Gate guide wall similar.
Weight is steel material: sheet pile, anchor bar, waler, wall contact, pile cap, tangent plate, fender plate

Wall No	Guide Wall Sht Pile (sf)	Anchor Wall Sht Pile (sf)	Total (sf)
B5	25,243	12,067	37,310
B6	21,736	10,076	31,812
B7	13,184	6,486	19,670
B8	13,184	6,486	19,670
			108,462

SEE BOTTOM OF SPREADSHEET FOR EXCAVATION AND FILL QUANTITIES

Excavation Disposal Note: The current plan for the disposal of excavation material is to use the existing placement areas (PA) located along the GIWW. Placement Areas No. 88 and 89 are the closest to the Brazos Floodgates and they were reported to have combined remaining capacity of approximately 3.8 million cubic yards.

Based on SGCP* Gulf Side Sector Gate, 46.5' x 110' Sector Gate
Foundation = 116' x 260'
***Similar Gulf Coast Project**
Brazos Sector Gate 31' x 125'

Cofferdam Note: Prior to cofferdam construction, install guide walls and fill in the wet to create vessel chamber and land adjacent to gates. Cofferdam placed around each sector gate, 2 gates, 2 cofferdams. The intent is to build the guide walls first, so that the temporary cofferdam will be reduced in length and will be less expensive. The temporary cofferdam will be installed between the permanent guide walls, and then dewatered in order to perform the monolith and sector gate construction work in the dry.

Perimeter of cofferdam (ft) = 752

Estimate for sheet pile that half of height is embedded and half the height is above mudline, estimate sheet pile length of 70 feet. Estimate the length of King post piling to be embedded 50 feet and 35 feet above mudline, for length of 85 feet. Estimate that 20 King post are required. Estimate the length of support piling to be 70 feet, half the length is embedded. Estimate that 30 support piling are required. The lengths and quantity estimated above is a rough estimate and may change based on geotechnical conditions. Geotechnical conditions have not been evaluated, propose use of well points for dewatering system.

The construction cofferdam would be designed and detailed by the construction contractor. However, it is anticipated that the cofferdam would include some larger diameter piles (king posts) to help support the lateral loads on the cofferdam. Typically the internal bracing (struts) would weld to the larger diameter piles (king posts) for lateral support. Some smaller diameter support piles are also anticipated to be required to help vertically support and reduce the unbraced length of the internal bracing members.

This estimated sand and fill quantity is a minor item to help provide a stable work surface floor within the cofferdam and to fill in any holes where the geotechnical conditions may require overexcavation to reach a stable subgrade.

Based on SGCP Gulf Side Sector Gate, 46.5' x 110' Sector Gate
Foundation = 116' x 260'

→ **Pile Lengths (ft)**
Vertical = 169
Batter = 178

Sector Gate Weight (ton) = 537
No of vertical piles = 134
No of batter piles = 141

Brazos Sector Gate 31' x 125' (2 gates, 4 leafs)

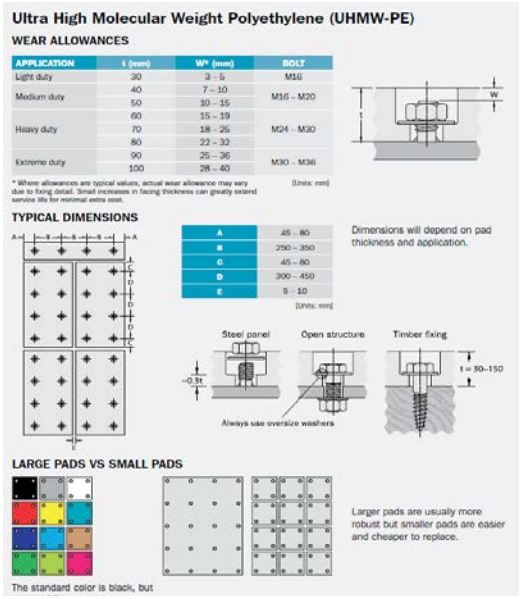
No of vertical piles = 268 Vertical pile length (ft) = 150 <= Enter vertical value, batter will be calculated
No of batter piles = 282 Batter pile length (ft) = 159

The weight per enclosed volume of a sector gate leaf was calculated for several existing projects including the existing Brazos sector gate. The data results are as follows, Brazos 6.2 lb/ft3 (pcf), IHNC 6.7 pcf, and SGCP 4.8 pcf. The average weight per enclosed volume for these projects is 5.9 pcf. The estimated weight of the new Brazos sector gate leaf is based on this similar project average of 5.9 pcf for the proposed 31' x 125' gate. The estimated weight of the proposed sector gate (2 leafs) is 568 tons. IHNC refers to the Inner Harbor Navigation Canal project. The top of the gates will match the top of the wall elevation +16.00 NAVD88 which matches the Colorado River Locks, which were recently surveyed.

Brazos River Floodgates Feasibility Study
Alternative 9b - New Gates on Alignment C w/o Sediment Contrc
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
	Sector Gate Dewatering System (Maintenance Bulkhead)		
	1. Maintenance Bulkhead	633	TN
	2. Maintenance Bulkhead Storage Platform		
	a. Steel Framing	294	TN
	b. Piling Supports		
	1. Pilings - 36" Dia. X 0.625" Thk.	2,816	LF
7	**Guide Walls**		
	Sheet Pile Guide Wall Tied Back to Sheet Pile Anchors		
	All Sheet Pile PZ-35 Unless Noted Otherwise		
	1. West Gate North Guide Wall	63,840	SF
	2. West Gate South Guide Wall	63,840	SF
	3. East Gate North Guide Wall	47,880	SF
	4. East Gate South Guide Wall	47,880	SF
	Total =	223,440	SF
	Guide Wall Hardware		
	Total Guide Wall Hardware (All walls)	499	TN
	Rub Face UHMW Sheets Mounted to Steel Plate Attached to Sheet Pile Face		
	1. West Gate Rub Face UHMW Panel (2 3/4" thick)	13,680	SF
	2. East Gate Rub Face UHMW Panel (2 3/4" thick)	10,260	SF
	Total =	23,940	SF
	1. West Gate Steel Plate (5/8" thick)	13,680	SF
	2. East Gate Steel Plate (5/8" thick)	10,260	SF
	Total =	23,940	SF
8	**Mechanical**		
	1. Rack and Pinion System	2	LS
9	**Electrical**	2	LS



Based on SCGP Gulf Side Sector Gate, 46.5' x 110' Sector Gate. Maintenance bulkheads provide 29 feet of water protection. The bulkheads are 110' feet long and to be placed across the channel opening. 5 bulkheads stacked on top of each other used at each end of monolith, total of 10 units to perform maintenance on a sector gate. Each bulkhead weighs 63 tons. Provide one complete set (10 units) for one gate, maintenance performed on one gate at a time.

The maintenance bulkhead storage platform is estimated to require a total deck area of approximately 18,060 square feet in order to store 10 bulkhead sections stacked 2 high. The required footprint on the platform would be for 5 bulkheads. The exact plan configuration of the storage platform would depend on the land available and how the USACE would like to store/arrange the bulkheads. One possible platform deck configuration would be 54 feet wide for 255 feet and 33 feet wide for 130 feet. Typical pile lengths are 88 feet for the maintenance bulkhead storage platform.

Since the guide walls must retain fill soil, use sheet pile guide walls similar to the type currently in use, sheet pile face tied back to sheet pile used as anchor. Quantities based on quantity take off of existing East gate guide walls B5, B6, B7, and B8, raised 6 feet to match top of wall elevation +16.00 NAVD88 at the Colorado River Locks, which were recently surveyed.

See Demolition Above for Sheet Pile Area Breakout

Existing East Guide Wall Lengths (ft)	
Wall section B5	487
B6	408
B7	257
B8	257
Total length (ft) =	1,409

Exist.Guide Wall Take Off Weight (lb)	
PZ 35 sheet pile	3,796,100
Anchor bar	170,470
Waler	140,990
Wall contact	29,196
Pile cap	114,870
Tangent wall plate	42,385
Fender plate	29,661
Total Steel Weight (lb) =	4,323,700

<=For Existing Wall sections B5, B6, B7, B8

Hardware weight per foot (lb/ft)
375

Existing Weight per Linear Foot of Sheet Pile Guide Wall (lb/ft) = **3,069**

Use sheet pile 56 feet total face sheet length (56 sf per linear foot) plus 50% wall face area for anchor sheet.

For Alternative 9c, New Gates on Alignment C with Sediment Control

	New Guide Wall Lengths (ft)	
West Gate	North	760
	South	760
East Gate	North	570
	South	570
Total Length (ft) =		2,660

New Guide Wall Area (sf)	
North	63,840
South	63,840
North	47,880
South	47,880
Total Area (sf) =	223,440

New Guide Wall Hardware (ton)	
North	143
South	143
North	107
South	107
Total Weight (ton) =	499

Guide wall rub face: Use UHMW sheets attached to steel plate mounted to sheet pile face. WT steel vertical guide for steel plate attachment to sheet pile face. The total height of UHMW panels and steel plate estimated at 9 feet tall. 2 3/4" thick UHMW sheet attached to 5/8" thick steel plate. UHMW attached to steel plate with 1" diameter bolts with 1' x 1' bolt spacing grid. The length of rub face below is the same as the lengths of guide wall above, only difference is the specific location to the gate is broken down.

Guide Wall Rub Face Lengths (ft)		
West Gate	Northwest	400
	Northeast	360
	Southwest	430
	Southeast	330
Total length (ft) =		1,520

East Gate	Northwest	210
	Northeast	360
	Southwest	220
	Southeast	350
Total length (ft) =		1,140

All Walls Total length (ft) = 2,660

Guide Wall Rub Face Area (ft2)	
West Gate	13,680
East Gate	10,260
Total Area (ft2) =	23,940

CHANNEL EXCAVATION

CADD channel excavation overlaid with aerial image of existing channel outline

Brazos River Floodgates Feasibility Study
Alternative 9b - New Gates on Alignment C w/o Sediment Contrc
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit

UHMW-PE is available in many other colours if required.

Alignment C through existing barge facility.
The area is partially excavated.

West channel currently not being used, East channel is occupied, West requires more excavation (subtract less)

	Location	Area (ft2)		Area (ft2)	
Exist. channel areas:	West channel	353,600	Use 75% of area for depth of excavation ⇨	265,200	Subtract this area from channel excavation
(Barge facility)	East channel	550,000	Use 90% of area for depth of excavation	495,000	**(Area already excavated)**

(Alignment C)	Location	Area (ft2)
Channel excavation	West channel	1,312,000
required from CADD	East channel	1,209,700
Exist.channel excavated to open channel (Alignment A)	West channel north	169,830
	West channel south	232,990
	East channel north	85,120
	East channel south	187,500

⇨

Channel Excavation	Location	Area (ft2)	Volume (yd3)	
	West channel	1,046,800	697,900	
	East channel	714,700	476,500	
	West channel north	169,830	113,300	268,700
	West channel south	232,990	155,400	
	East channel north	85,120	56,800	181,800
	East channel south	187,500	125,000	
	Sum =	**2,436,940** ft2	**1,624,900** yd3	

Average depth of excavation used = 18 ft

FILL FOR NEW GATE LOCATIONS

	Location	Area (ft2)	Volume (yd3)
For the new gate locations	West Gate	295,950	98,700
	East Gate	264,420	88,200
	Sum =	**560,370** ft2	**186,900** yd3

Average depth of fill used = 9 ft

Brazos River Floodgates Feasibility Study
Alternative 9c - New Gates on Alignment C w/ Sediment Control
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
2	**Demolition (Quantities are for existing West and East Gates)**		
	Existing Sector Gates (2 sector gates, 4 leafs)		
	1. Remove and Salvage Sector Gate (2 gates, 4 leafs, east & west channel)	365	TON
	2. Remove and Dispose Gate Foundation (2 gates)	15,310	CY
	3. Remove and Dispose Timber Piles (2 gates)	1,970	EA
	Guide Walls		
	1. Remove and Salvage Guide Walls (8 walls, east & west channel)	4,324	TON
3	**Excavation and Fill**		
	New Gates on Alignment C		
	1. New West Channel Excavation	697,900	CY
	2. New East Channel Excavation	476,500	CY
	3. Excavate Existing West Gate Channel	268,700	CY
	Excavation Total =	1,443,100	CY
	1. Fill for New Gate Location, West Gate	98,700	CY
	2. Fill for New Gate Location, East Gate	88,200	CY
	3. Fill Existing East Vessel Channel	63,400	CY
	Fill Total =	250,300	CY
	Riprap (3' Thick Layer)	8,000	TON
4	**Cofferdam (Cofferdam placed around sector gates, 2 gates, 2 dams)**		
	1. Excavation	35,600	CY
	2. Sand and Fill	12,600	CY
	3. Waler System - WF Members	440	TN
	4. Sheet Piles - AZ 38-700N	105,280	SF
	5. Internal Bracing (Struts) - 24" Dia. X 0.625" Thk.	4,600	LF
	6. King Post Piling (Piles 30" Dia. X 0.625" Thk.)	3,400	LF
	7. Support Piling 24" Dia. X 0.625" Thk.	4,200	LF
	8. Misc. Steel	10	TN
	9. Temporary Dewatering System	2	LS
	10. Removal of Cofferdam	2	LS
5	**Concrete Structure and Gate (Quantities are for 2 sector gates, 4 leafs)**		
	Sector Gate Monolith		
	1. Sand and Gravel Bedding	3,400	CY
	2. Tremie Concrete - Seal Slab	9,000	CY
	3. Reinforced Concrete Base Slab	17,800	CY
	4. Reinforced Concrete Monolith	8,000	CY
	5. Pilings:		
	a. Pilings - Vertical Spiral Piles - 30" Dia. X 0.625" Thk.	40,200	LF
	b. Pilings - Batter Spiral Piles - 30" Dia. X 0.625" Thk.	44,838	LF
	6. Tension Connection	550	EA
	7. Bulkhead Slots - Stainless Steel w/Seals (Embedded in Monolith)	200	LF
	8. Ladder Slots - Stainless Steel w/Ladders (Embedded in Monolith)	100	LF
	Sector Gate		
	1. Sector Gates	1,136	TN
	2. Pintles and Hinges(King post)	2	LS
	3. Sector Gate Protection Fenders	2,360	LF
	4. Gate Seals, Seal Bearing Surfaces and Gate Track	2	LS
	5. Cathodic Protection	2	LS
6	**Maintenance Dewatering System**		

DEMOLITION

Existing Gate:

Each gate (lb) = 364,500 (2 leafs)
Each gate (ton) = 182.3 (2 leafs)
Two gates removed (ton) = **365** (4 leafs)

Conc. Foundation, one gate (cy) = **7,655** Foundation, wing walls, approach aprons

Contract Bid Documents used 25 feet timber pile length for bidding purposes. **985** Piles per gate

Total weight guide walls, one gate (lb) = **4,323,700**
Total weight guide walls, one gate (ton) = **2,162**

Quantities based on East Gate Guide Wall take off, Guide Walls B5, B6, B7, B8, West Gate guide wall similar.
Weight is steel material: sheet pile, anchor bar, waler, wall contact, pile cap, tangent plate, fender plate

Wall No	Guide Wall Sht Pile (sf)	Anchor Wall Sht Pile (sf)	Total (sf)
B5	25,243	12,067	37,310
B6	21,736	10,076	31,812
B7	13,184	6,486	19,670
B8	13,184	6,486	19,670
			108,462

SEE BOTTOM OF SPREADSHEET FOR EXCAVATION AND FILL QUANTITIES

Excavation Disposal Note: The current plan for the disposal of excavation material is to use the existing placement areas (PA) located along the GIWW. Placement Areas No. 88 and 89 are the closest to the Brazos Floodgates and they were reported to have combined remaining capacity of approximately 3.8 million cubic yards.

Based on SGCP* Gulf Side Sector Gate, 46.5' x 110' Sector Gate
Foundation = 116' x 260'
***Similar Gulf Coast Project**

Brazos Sector Gate 31' x 125'

Cofferdam Note: Prior to cofferdam construction, install guide walls and fill in the wet to create vessel chamber and land adjacent to gates. Cofferdam placed around each sector gate, 2 gates, 2 cofferdams. The intent is to build the guide walls first, so that the temporary cofferdam will be reduced in length and will be less expensive. The temporary cofferdam will be installed between the permanent guide walls, and then dewatered in order to perform the monolith and sector gate construction work in the dry.

Perimeter of cofferdam (ft) = 752

Estimate for sheet pile that half of height is embedded and half the height is above mudline, estimate sheet pile length of 70 feet. Estimate the length of King post piling to be embedded 50 feet and 35 feet above mudline, for length of 85 feet. Estimate that 20 King post are required. Estimate the length of support piling to be 70 feet, half the length is embedded. Estimate that 30 support piling are required. The lengths and quantity estimated above is a rough estimate and may change based on geotechnical conditions. Geotechnical conditions have not been evaluated, propose use of well points for dewatering system.

The construction cofferdam would be designed and detailed by the construction contractor. However, it is anticipated that the cofferdam would include some larger diameter piles (king posts) to help support the lateral loads on the cofferdam. Typically the internal bracing (struts) would weld to the larger diameter piles (king posts) for lateral support. Some smaller diameter support piles are also anticipated to be required to help vertically support and reduce the unbraced length of the internal bracing members.

This estimated sand and fill quantity is a minor item to help provide a stable work surface floor within the cofferdam and to fill in any holes where the geotechnical conditions may require overexcavation to reach a stable subgrade.

Based on SGCP Gulf Side Sector Gate, 46.5' x 110' Sector Gate
Foundation = 116' x 260'

→ **Pile Lengths (ft)**
Vertical = 169
Batter = 178

Sector Gate Weight (ton) = 537
No of vertical piles = 134
No of batter piles = 141

Brazos Sector Gate 31' x 125' (2 gates, 4 leafs)

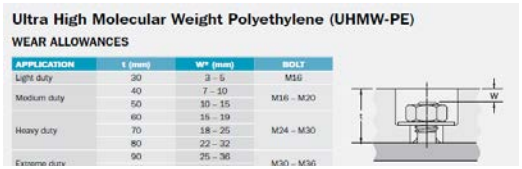
No of vertical piles = 268 Vertical pile length (ft) = 150 <= Enter vertical value, batter will be calculated
No of batter piles = 282 Batter pile length (ft) = 159

The weight per enclosed volume of a sector gate leaf was calculated for several existing projects including the existing Brazos sector gate. The data results are as follows, Brazos 6.2 lb/ft3 (pcf), IHNC 6.7 pcf, and SGCP 4.8 pcf. The average weight per enclosed volume for these projects is 5.9 pcf. The estimated weight of the new Brazos sector gate leaf is based on this similar project average of 5.9 pcf for the proposed 31' x 125' gate. The estimated weight of the proposed sector gate (2 leafs) is 568 tons. IHNC refers to the Inner Harbor Navigation Canal project. The top of the gates will match the top of the wall elevation +16.00 NAVD88 which matches the Colorado River Locks, which were recently surveyed.

Brazos River Floodgates Feasibility Study
Alternative 9c - New Gates on Alignment C w/ Sediment Control
Quantities Estimate

Designed By: JK
Checked By: GK
14-Sep-2017

Number	Number Description	Quantity	Unit
	Sector Gate Dewatering System (Maintenance Bulkhead)		
	1. Maintenance Bulkhead	633	TN
	2. Maintenance Bulkhead Storage Platform		
	a. Steel Framing	294	TN
	b. Piling Supports		
	1. Pilings - 36" Dia. X 0.625" Thk.	2,816	LF
7	**Guide Walls**		
	Sheet Pile Guide Wall Tied Back to Sheet Pile Anchors		
	All Sheet Pile PZ-35 Unless Noted Otherwise		
	1. West Gate North Guide Wall	63,840	SF
	2. West Gate South Guide Wall	63,840	SF
	3. East Gate North Guide Wall	47,880	SF
	4. East Gate South Guide Wall	47,880	SF
	Total =	223,440	SF
	Guide Wall Hardware		
	Total Guide Wall Hardware (All walls)	499	TN
	Rub Face UHMW Sheets Mounted to Steel Plate Attached to Sheet Pile Face		
	1. West Gate Rub Face UHMW Panel (2 3/4" thick)	13,680	SF
	2. East Gate Rub Face UHMW Panel (2 3/4" thick)	10,260	SF
	Total =	23,940	SF
	1. West Gate Steel Plate (5/8" thick)	13,680	SF
	2. East Gate Steel Plate (5/8" thick)	10,260	SF
	Total =	23,940	SF
8	**Mechanical**		
	1. Rack and Pinion System	2	LS
9	**Electrical**	2	LS
10	**Sediment Control or Sluice Gates**		
	1 Structure		
	Piling - 14 x 73 H-piles, 90' length	23,940	LF
	Sheetpile - PZ-22, 52.75' length	3,323	SF
	Concrete Base Slab	816	CY
	Concrete Walls and Slabs	965	CY
	Sluice Gates (Rodney Hunt with Stem and Gear Box)	3	EA
	Hand Rail, 2" Standard Aluminum Pipe	263	LBS
	Bulkheads (4)	18	TON
	Rip Rap	6,000	TON
	Tie-in Sheetpile - PZ-35, 60' length	3,600	SF
	Tie-in Embankment	2,000	CY
	Earth Dewatering Dam		
	10' Crown, 1:3 Side Slopes		
	Sand Core	3,426	CY
	2' Clay Cap	1,158	CY



Based on SCGP Gulf Side Sector Gate, 46.5' x 110' Sector Gate. Maintenance bulkheads provide 29 feet of water protection. The bulkheads are 110' feet long and to be placed across the channel opening. 5 bulkheads stacked on top of each other used at each end of monolith, total of 10 units to perform maintenance on a sector gate. Each bulkhead weighs 63 tons. Provide one complete set (10 units) for one gate, maintenance performed on one gate at a time.

The maintenance bulkhead storage platform is estimated to require a total deck area of approximately 18,060 square feet in order to store 10 bulkhead sections stacked 2 high. The required footprint on the platform would be for 5 bulkheads. The exact plan configuration of the storage platform would depend on the land available and how the USACE would like to store/arrange the bulkheads. One possible platform deck configuration would be 54 feet wide for 255 feet and 33 feet wide for 130 feet. Typical pile lengths are 88 feet for the maintenance bulkhead storage platform.

Since the guide walls must retain fill soil, use sheet pile guide walls similar to the type currently in use, sheet pile face tied back to sheet pile used as anchor. Quantities based on quantity take off of existing East gate guide walls B5, B6, B7, and B8, raised 6 feet to match top of wall elevation +16.00 NAVD88 at the Colorado River Locks, which were recently surveyed.

See Demolition Above for Sheet Pile Area Breakout
<=For Existing Wall sections B5, B6, B7, B8

Existing East Guide Wall Lengths (ft)

Wall section B5	487
B6	408
B7	257
B8	257
Total length (ft) =	1,409

Exist.Guide Wall Take Off Weight (lb)

PZ 35 sheet pile	3,796,100
Anchor bar	170,470
Waler	140,990
Wall contact	29,196
Pile cap	114,870
Tangent wall plate	42,385
Fender plate	29,661
Total Steel Weight (lb) =	4,323,700

Hardware weight per foot (lb/ft)
375

Existing Weight per Linear Foot of Sheet Pile Guide Wall (lb/ft) = **3,069**

Use sheet pile 56 feet total face sheet length (56 sf per linear foot) plus 50% wall face area for anchor sheet.

For Alternative 9c, New Gates on Alignment C with Sediment Control

New Guide Wall Lengths (ft)

West Gate	North	760
	South	760
East Gate	North	570
	South	570
Total Length (ft) =		2,660

New Guide Wall Area (sf)

North		63,840
South		63,840
North		47,880
South		47,880
Total Area (sf) =		223,440

New Guide Wall Hardware (ton)

North	143
South	143
North	107
South	107
Total Weight (ton) =	499

Guide wall rub face: Use UHMW sheets attached to steel plate mounted to sheet pile face. WT steel vertical guide for steel plate attachment to sheet pile face. The total height of UHMW panels and steel plate estimated at 9 feet tall. 2 3/4" thick UHMW sheet attached to 5/8" thick steel plate. UHMW attached to steel plate with 1" diameter bolts with 1' x 1' bolt spacing grid. The length of rub face below is the same as the lengths of guide wall above, only difference is the specific location to the gate is broken down.

Guide Wall Rub Face Lengths (ft)

West Gate	Northwest	400
	Northeast	360
	Southwest	430
	Southeast	330
Total length (ft) =		1,520

East Gate	Northwest	210
	Northeast	360
	Southwest	220
	Southeast	350
Total length (ft) =		1,140

All Walls Total length (ft) = 2,660

Guide Wall Rub Face Area (ft2)

West Gate	13,680
East Gate	10,260
Total Area (ft2) =	23,940

CHANNEL EXCAVATION

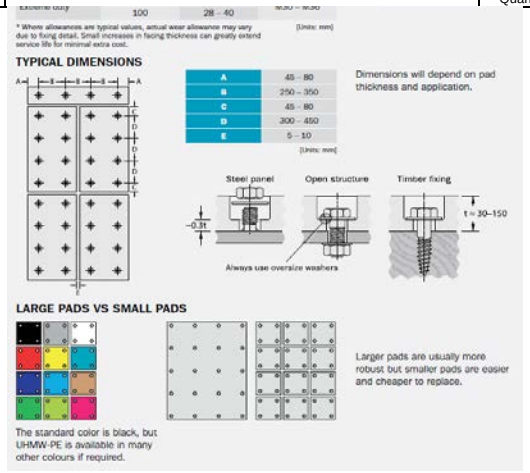
Alignment C through existing barge facility.
The area is partially excavated.

CADD channel excavation overlaid with aerial image of existing channel outline
West channel currently not being used, East channel is occupied, West requires more excavation (subtract less)

Brazos River Floodgates Feasibility Study
Alternative 9c - New Gates on Alignment C w/ Sediment Control
Quantities Estimate

Designed By JK
Checked By GK
14-Sep-2017

Number	Number Description	Quantity	Unit



	Location	Area (ft2)			Area (ft2)	
Exist. channel areas:	West channel	353,600	Use 75% of area for depth of excavation	⇨	265,200	Subtract this area from channel excavation
(Barge facility)	East channel	550,000	Use 90% of area for depth of excavation		495,000	**(Area already excavated)**

	Location	Area (ft2)
(Alignment C)		
Channel excavation	West channel	1,312,000
required from CADD	East channel	1,209,700
Exist.channel excavated to open channel (Alignment A)	West channel north	169,830
	West channel south	232,990
	East channel north	85,120
	East channel south	187,500

⇨ Channel Excavation

Location	Area (ft2)	Volume (yd3)	
West channel	1,046,800	697,900	
East channel	714,700	476,500	
West channel north	169,830	113,300	268,700
West channel south	232,990	155,400	
East channel north	85,120	56,800	181,800
East channel south	187,500	125,000	
Sum =	**2,436,940** ft2	**1,624,900** yd3	

Average depth of excavation used = 18 ft

FILL FOR NEW GATE LOCATIONS

	Location	Area (ft2)		Volume (yd3)	
For the new gate locations	West Gate	295,950		98,700	
	East Gate	264,420		88,200	
	Sum =	**560,370**	ft2	**186,900**	yd3

Average depth of fill used = 9 ft

CIVIL CONSTRUCTION COST ESTIMATE - ROM			SHEET 1 OF 1		
PROJECT: CRL, OPEN CHANNEL			DATE: 05 AUG 2017		
			BY: Grey		
			EST BY: Petitbon		
ITEM	DESCRIPTION	COMBO QUANTITY	UNIT	UNIT COST	AMOUNT
	BLH -DRY Enhancement (99 AC)				
1.	MOB AND DEMOB	1	JOB	$0.00	$0.00
2.	Clearing and Grubbing *Clearing and grubbing is to be completed prior to dredging the bypass channel. Trees are to be removed to ground level and stumps and roots are to be removed. All cleared material will be placed within the disposal area and burned on site. East Lock 8.5 AC, West Lock 10.5 AC*	19	AC	$0.00	$0.00
3	Bypass Channel Stone Removal *Prior to dredging, stone armoring needs to be removed. The stone will be disposed of within the disposal area. Armoring is assumed to be 2-ft thick 500lb stone. 599 tons of stone is within the East Lock.*	3,850	TONS	$0.00	$0.00
4.	Bypass Channel Dredging *If the land within the bypass channel is cleared and grubbed and the stones remove. The bypass channel can dredged via hydraulic dredge. Dredge material will be disposed of within the existing disposal area. It is assumed that the disposal area retention dikes and available capacity is suitable.*	586,700	CY	$0.00	$0.00
5.	Lock Chamber Stone Armoring Removal *To be completed prior to dredging the new channel. Assume a 50/50 split between East and West Lock for quantity.*	9,550	TONS	$0.00	$0.00
6.	New Channel Dredging *The new channel dredging will remove the remaining material between the bypass channel cut and the existing 125' wide channel. This would be completed after the existing lock structures are removed. Structures will provide quantity estimates.*	355,900	CY	$0.00	$0.00
7	Existing Gate and Wall Demolition *The limits of the new open channel will extend into the existing lock structure. Demolition will be required on the concrete approach walls, sector gate walls, sector gate removal, interior guidewall, and existing sheet pile approach walls on the river side. This is to be done only on the side of the structure with the open channel. Existing*	20,184 50,000 50' Sheet pile Remove 4 Sector Gates	CY SF JOB	$0.00 $0.00 $0.00	$0.00 $0.00 $0.00
	CONSTRUCTION SUBTOTAL:				$0.00
	E&D	6%			$0.00
	S&A	8%			$0.00
	SUBTOTAL (CONSTRUCTION + E&D + S&A):				$0.00
	CONTINGENCIES	25	%		$0.00
	TOTAL COST :				**$0.00**

US Army Corps of Engineers
New Orleans District

Colorado Locks Rehab Estimate
Matagorda, Texas
Gate Rehab and Guidewall Replacement

Designed By JMR
Checked By DPL

Number	Number Description	Quantity	Unit	
1	**Mob & Demob**	LUMPSUM	LS	
2	**Foundation**			
	Guidewall			
	18" Pipe Pile, 1/2" Wall	46,735	LF	
	Tension Connector	576	EA	
	Paint top 15 feet of pile excluding slab embedded 1'-0", Coaltar Expoxy, System 6	8,640	LF	
3	**Sector Gate**			
	Replacement Plates (ASTM A-572, Grade 50)	2,400	LBS	
	Sand Blast and Paint 8 Gates	87,600	SF	
	Paint Sector Gates, Coaltar Expoxy, System 6-A-Z			
4	**Structural Concrete**			
	Guidewall			
	Reinforced slabs	3,900	CY	
	Reinforced walls	3,150	CY	
	Machinery House			
	Concrete Soil Founded Slab, 6" thick (10'x10') - 8 total (#6@12" Middle, Each Way)	15	CY	
5	**Miscellaneous Metals**			
	Guidewall (Chamber)			
	3/4" SST Anchor Rod, with 2 Nuts and Washers, 18"	6,480	EA	
	1" SST Anchor Rod, with 2 Nuts and Washers, 18"	216	EA	
	3/8" SST Corner Plate, 6" Radius, 1'-0" top to bottom, with 2 L #5 studs 2'-0" OC	1,800	LF	
	Mooring Bollard	36	EA	
	8"x12" Reinforced Marine Composite Timber	16,200	LF	
6	**Mechanical**			
	Sector Gate			
	Rack & Pinion System - drive gear and rack sections	LUMPSUM	LS	($120,000 per gate)
	Hydraulic Rotary Motor (Hagglund Viking 63 series)			($1,000,000 total from Rachael for all items)
	Hydraulic Power Unit with redundant motor/pump assembly			
	Hydraulic Hoses			
	Local Control Panels			
	Machinery House (8 total, 1 for each gate) 10'x10'x10' Pre-fab building	LUMP SUM	LS	
7	**Electrical**			
	Lock Complex			
	Power Distribution, Back-up power, Lighting, and Lightening Systems	LUMPSUM	LS	($1,000,000 from Jabeen)
	Program Logic Control (PLC); Hardwire Back-up Controls	LUMPSUM	LS	($600,000 from Jabeen)

8	**Riverside Gate Channel Inlet Sheetpile Replacement**		
	100 feet on 4 sides; original sheet 50 foot long; New Sheet PZ-35 - 75 foot long	30,000	SF
	Paint top 20 feet, Coaltar Epoxy, System 6	8,000	LF
	UHMW-PE Panels - Heavy Duty Grade - Type 1	396	EA
	UHMW-PE Panels - Heavy Duty Grade - Type 2	168	EA
	UHMW-PE 1" Bolts	7,744	EA
	5/8" Steel Backing Plate	8,172	SF

US Army Corps of Engineers
New Orleans District

Colorado Locks Rehab Estimate
Matagorda, Texas
Riverside Gate Removal Alternative 4b.1

Designed By JMR
Checked By DPL

Number	Number Description	Quantity	Unit
1	**Mob & Demob**	LUMPSUM	LS
2	**Demolition**		
	Remove Existing Interior Guidewall	LUMPSUM	LS
	Remove 4 Existing Sector Gates	LUMPSUM	LS
	Remove Existing Control House and Machinery Buildings (4 total)	LUMPSUM	LS
	Sheet Pile Approach Wall Removal (50 ft long)	103,250	SF
	Main Structure Demolition (Vertical Walls Only)	11,180	CY
	East Side Parking Lot Slab	45	CY
	Channel Work (125')		
	Land Excavation	50,930	CY
	Dredging	34,000	CY
	Riprap (3' Layer)	4,000	TON
4	**Sector Gate (Existing Structure Rehab)**		
	Replacement Plates (ASTM A-572, Grade 50)	2,400	LBS
	Sand Blast and Paint 4 Gates	87,600	SF
	Paint Sector Gates, Coaltar Expoxy, System 6-A-Z		
5	**Structural Concrete (Existing Structure Rehab)**		
	Machinery House		
	Concrete Soil Founded Slab, 6" thick (10'x10') -4 total (#6@12" Middle, Each Way)	8	CY
6	**Mechanical (Existing Structure Rehab)**		
	Sector Gate		
	Rack & Pinion System - drive gear and rack sections	LUMPSUM	LS
	Hydraulic Rotary Motor (Hagglund Viking 63 series)		
	Hydraulic Power Unit with redundant motor/pump assembly		
	Hydraulic Hoses		
	Local Control Panels		
	Machinery House (4 total, 1 for each gate) 10'x10'x10' Pre-fab building	LUMP SUM	LS
7	**Electrical (Existing Structure Rehab)**		
	Gate Complex		
	Power Distribution, Back-up power, Lighting, and Lightening Systems	LUMPSUM	LS
	Program Logic Control (PLC); Hardwire Back-up Controls	LUMPSUM	LS