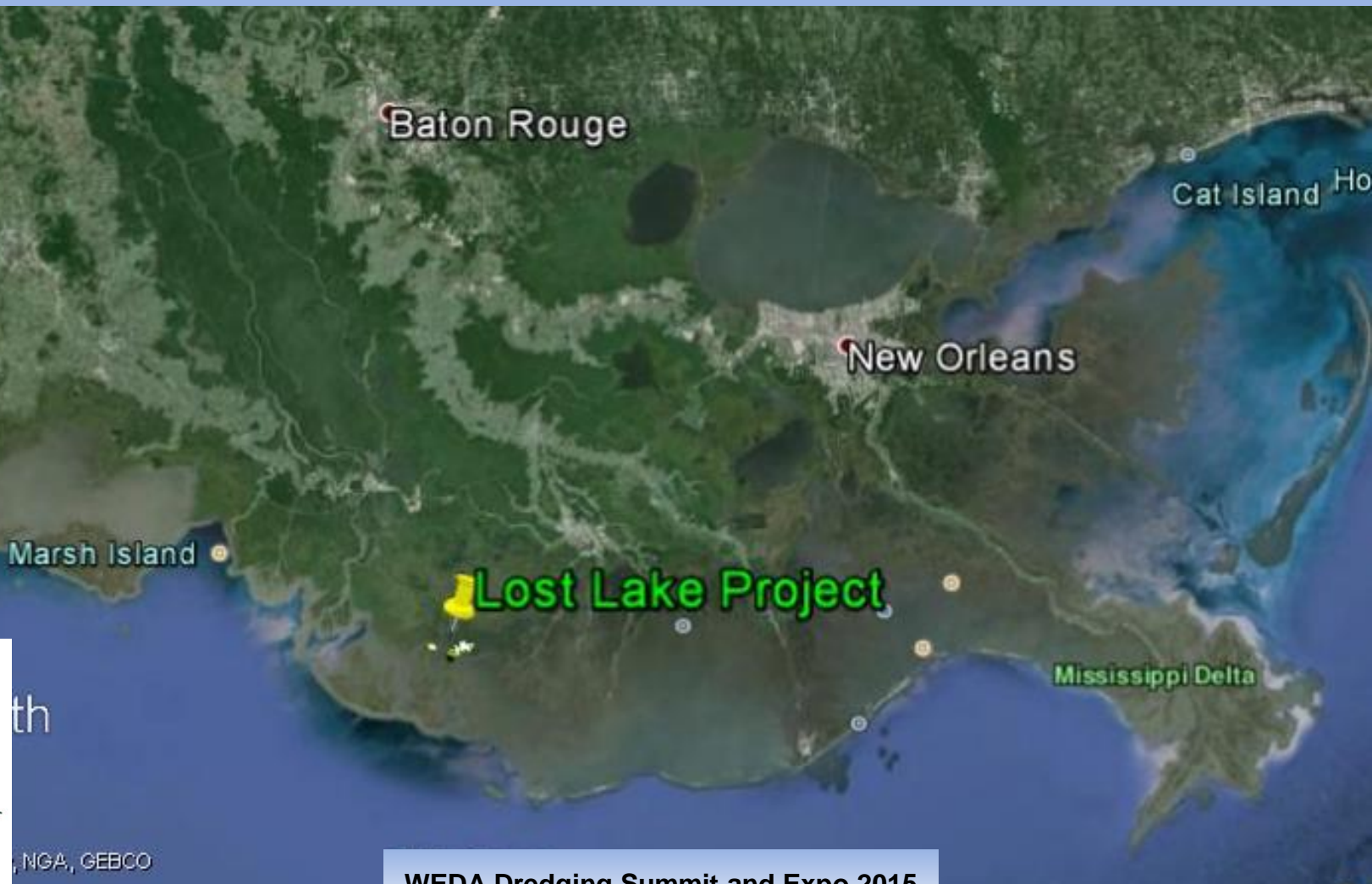


A CASE STUDY ON THE ENGINEERING AND DESIGN OF THE LOST LAKE MARSH CREATION AND HYDROLOGIC RESTORATION PROJECT

FUNDED BY THE COASTAL WETLANDS PLANNING, PROTECTION, RESTORATION ACT

S. M. Haynes (CPRA) and K. J. Roy (USFWS)



Project Status

Approved Date: 2010 **Project Area:** 7,312 acres
Approved Funds: \$31.4 M **Total Est. Cost:** \$34.6 M
Net Benefit After 20 Years: 452 acres
Status: Engineering and Design
Project Type: Marsh Creation
PPL #: 19

Problems

Significant marsh loss has occurred between Lake Pagie and Bayou DeCade to the point that little structural framework remains separating those two waterbodies. Northeast of Lost Lake, interior marsh breakup has resulted in large, interior ponds where wind/wave energy continues to result in marsh loss. West of Lost Lake, interior breakup has occurred as a result of ponding and the periodic entrapment of higher salinity waters during storm events.



Geotechnical Boring and Survey Layout

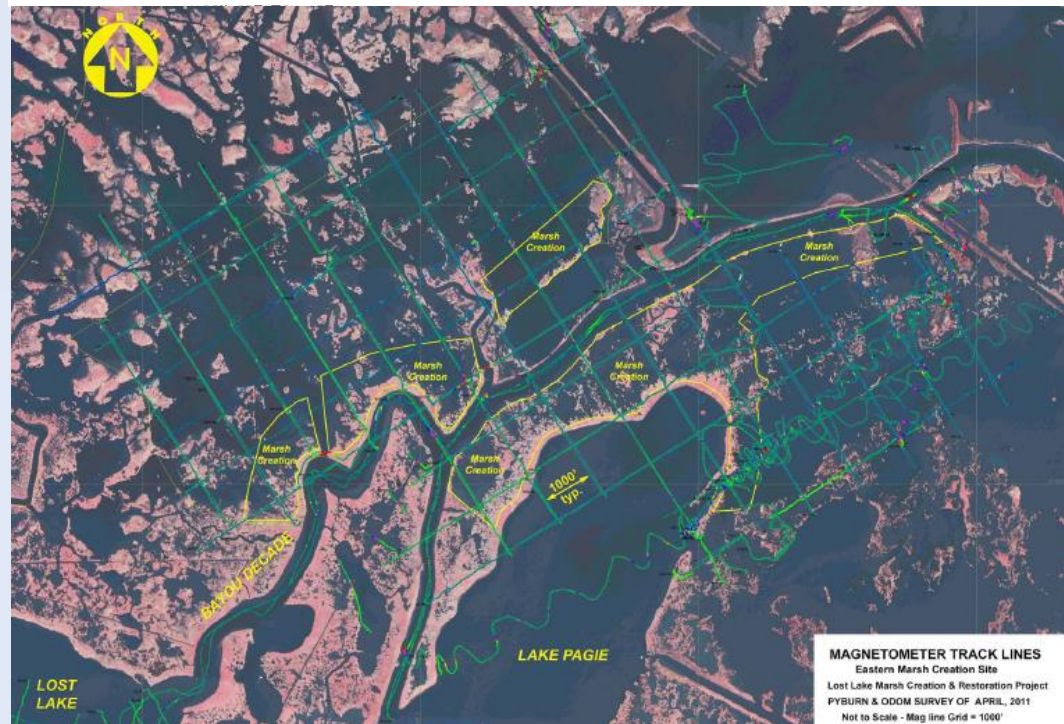
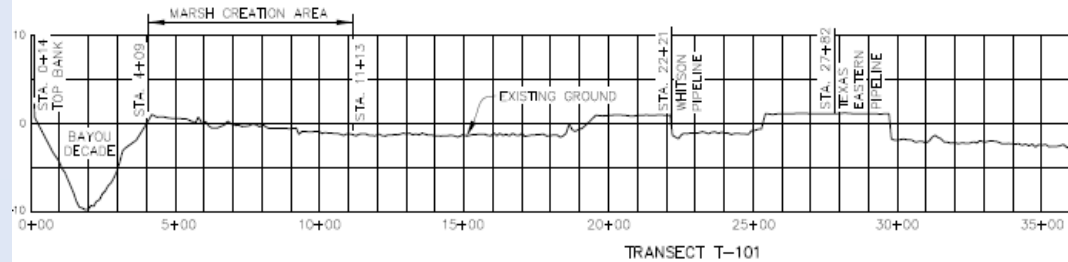


Field Data

Drilled Date	5/17/2011	Site	5/17/2011	Total Depth (ft)	54	Logged By	DAS	Checked By	VT	Client	GeoEngineers, Inc.	Drilling Method	Rotary Wash
Surface Elevation (ft)	2.4	Hammer Data	Safety Hammer/Cuthead	140 (ft) / 30 (ft) Drop	Drilling Equipment	Piston-Mounted Drill Rig							
Latitude	N29° 21' 33.4"	System Datum	Geographic	NAD83 (feet)	Georeferenced	Depth to Water: ft							
Longitude	W91° 08' 33.3"	Notes: See Figure A-1 for explanation of symbols. Cement-bentonite grout backfill top 25 feet.											

Elevation (feet)	FIELD DATA					MATERIAL DESCRIPTION	LABORATORY DATA								
	Interval Recovered (ft)	Shovelcut	Collected Sample	Sample Name	Water Level		Void Content, % (SS)	Compressive Strength (lb/sq)	Crushing Resistance (psi)	Shrinkage, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Flow Value (LV)	Shrinkage Ratio (SR)	Shrinkage Limit (SL), %
0						Zero (0) feet top of deck									
0						Water surface at EL. 40.44 feet									
0						Mudline at EL. -1.56 feet									
5	1					Very soft gray organic clay	102	36.8	0.06	0.17	12	140	110	0.241	
5	2					Very soft gray organic clay	120	37.6	0.10	0.29	10	140	110	0.226	
5	3					Very soft gray organic clay	119	38.8	0.06	0.40	14			0.298	
5	4					Very soft gray organic clay	147	32.7	0.07	0.52	15			0.264	
5	5					Very soft gray organic clay	129	36.2	0.07	0.63	14	129	96	0.298	
5	6					Very soft gray organic clay (Field Vane Strength = 0.039 kSF)	114	37.4	0.08		14			0.291	
5	7					Very soft gray organic clay	129	41.1	0.07	0.66	15	131	100	0.295	
5	8					Very soft gray organic clay	130	36.2	0.05		13	121	96	0.311	
5	9					Very soft gray organic clay (Field Vane Strength = 0.028 kSF)								0.317	
5	10					Very soft gray clay with organic matter and shells	130	43	0.07		14	100	75	0.241	
5	11					Very soft gray clay with organic matter	90	45.4	0.08		15	100	96	0.311	
5	12														

Log of Boring B-3




MAGNETOMETER TRACK LINES
 Eastern Marsh Creation Site
 Lost Lake Marsh Creation & Restoration Project
 PYBURN & ODOM SURVEY OF APRIL, 2011
 Not to Scale - Mag line Grid = 1000'

Tidal Datum

Using the Modified Range Ratio Method (NOAA 2003)

Tidal Datum Calculations (USGS Gage 0738165067)	FT NAVD88
MHW_C = 19 Year Mean High Water At Control Station	1.38
MTL_C = 19 Year Mean Tide Level At Control Station	0.83
MLW_C = 19 Year Mean Low Water At Control Station	0.29
MR_C = 19 Year Mean Tide Range At Control Station	1.09
TL_C = Mean Tide Level For The Observation Period At Control Station	0.88
R_C = Mean Tide Range For The Observation Period At Control Station	1.04
TL_S = Mean Tide Level For The Observation Period At Subordinate Station	0.90
R_S = Mean Tide Range For The Observation Period At Subordinate Station	1.12

Existing healthy marsh at +1.14 Ft. NAVD88



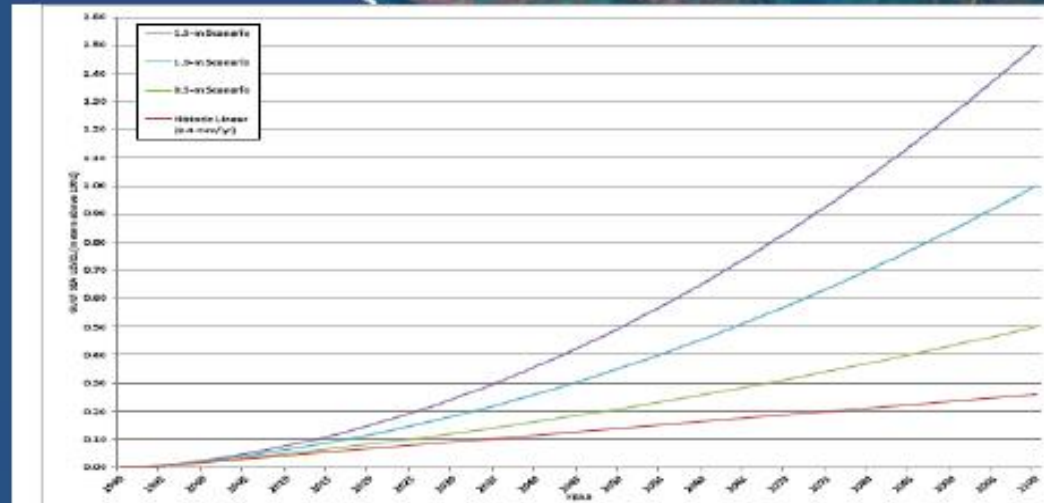
Relative Sea Level Rise

(DeMarco et. al. 2012)

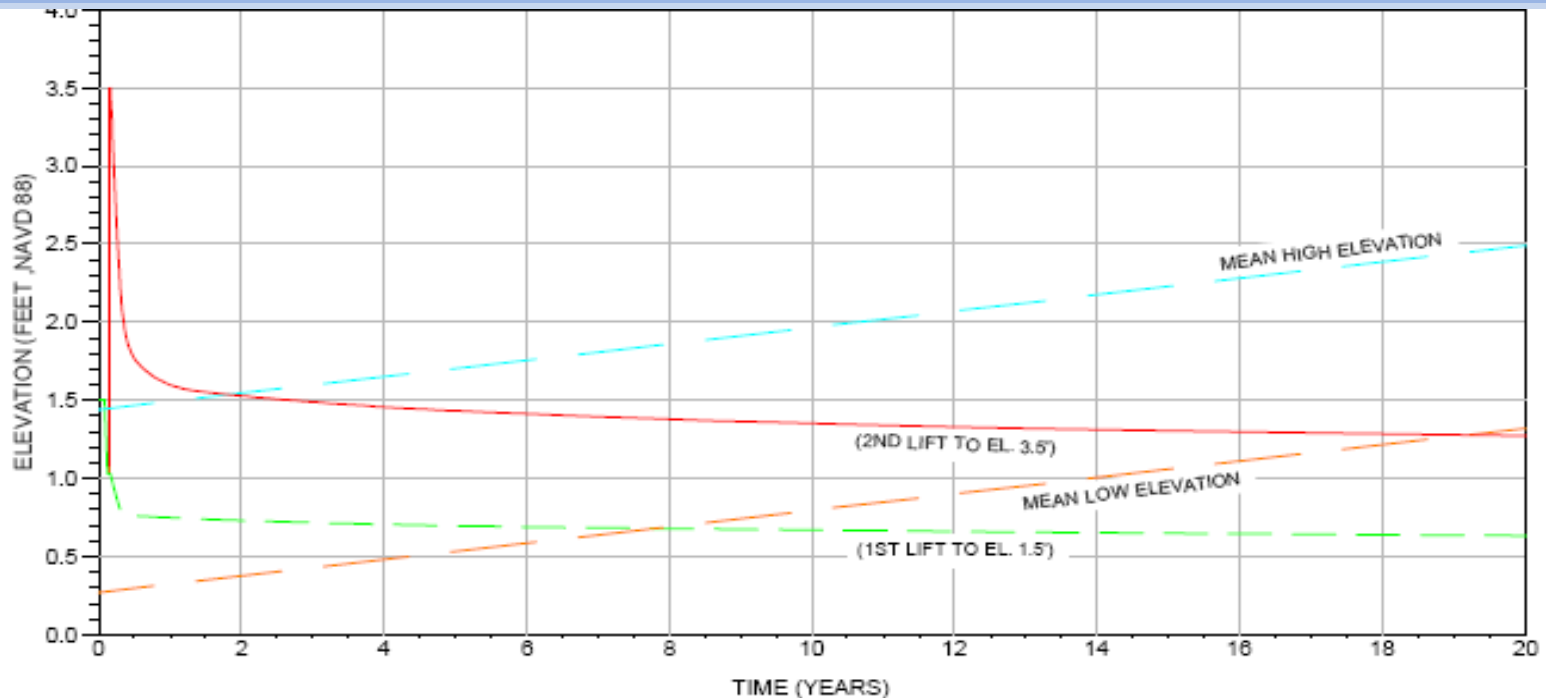


Subsidence Ranges (2012 Master Plan)

- ◆ 1, 0 mm/yr
- ◆ 2, 2-5 mm/yr
- ◆ 3, 2-9 mm/yr
- ◆ 4, 2-10 mm/yr
- ◆ 5, 2-35 mm/yr
- ◆ 6, 3-35 mm/yr
- ◆ 7, 2-35 mm/yr
- ◆ 8, 2-35 mm/yr
- ◆ 16, -3 - -2 mm/yr (Salt Domes)
- ◆ 17, 1-6 mm/yr (S.W. Polders)
- ◆ 9, 6-35 mm/yr
- ◆ 10, 6-25 mm/yr
- ◆ 11, 3-10 mm/yr
- ◆ 12, 15-35 mm/yr
- ◆ 13, 6-20 mm/yr
- ◆ 14, 3-10 mm/yr
- ◆ 15, 1-15 mm/yr



Combined Settlement of Marsh Fill Self Weight and Subgrade



ELEVATION (FEET, NAVD 88)								
	0 DAYS	60 DAYS	6 MONTHS	1 YEAR	5 YEARS	10 YEARS	20 YEARS	LONG TERM
1ST LIFT	1.50	1.02	0.76	0.75	0.70	0.66	0.63	0.59
2ND LIFT		3.50	1.73	1.58	1.43	1.34	1.26	1.16

**SETTLEMENT
ELEVATION VS. TIME (B-7)**

Lost Lake Marsh Creation and Hydrologic
Restoration Project (TE-72)
Terrebonne Parish, Louisiana

GEOENGINEERS 

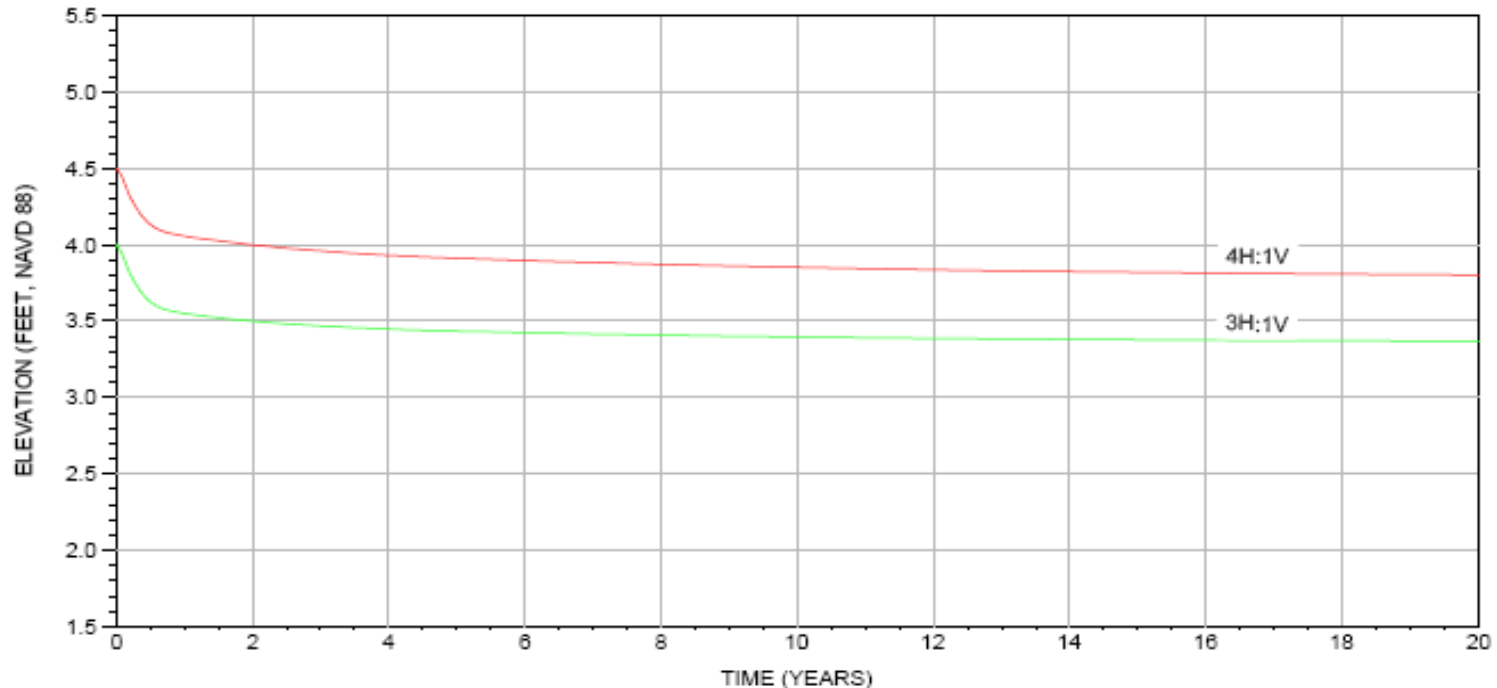
Figure 1

Marsh Construction Fill Elevations

Marsh Creation Area	Construction Marsh Fill Elevation (Feet NAVD 88)		Vertical Tolerance (Inches)
	Lift 1	Lift 2	
1	+1.5 (Maximum)	+3.5 (Maximum)	-6.0
2A	+1.5 (Maximum)	+3.5 (Maximum)	-6.0
2B	+1.5 (Maximum)	+3.5 (Maximum)	-6.0
2C	+1.5 (Maximum)	+3.5 (Maximum)	-6.0
3	+2.5 (Maximum)	N/A	-6.0

Earthen Containment Dike Settlement

One Dimensional Consolidation Theory



ELEVATION (FEET, NAVD 88)								
RATIO	0 DAYS	6 MONTHS	1 YEAR	2 YEAR	5 YEAR	10 YEAR	20 YEAR	LONG TERM
4H:1V	4.5	4.10	4.05	4.00	3.91	3.84	3.80	3.78
3H:1V	4.0	3.69	3.55	3.50	3.43	3.39	3.37	3.36

CONTAINMENT DIKE SETTLEMENT ELEVATION VS. TIME (B-13)

Lost Lake Marsh Creation and Hydrologic
Restoration Project (TE-72)
Terrebonne Parish, Louisiana



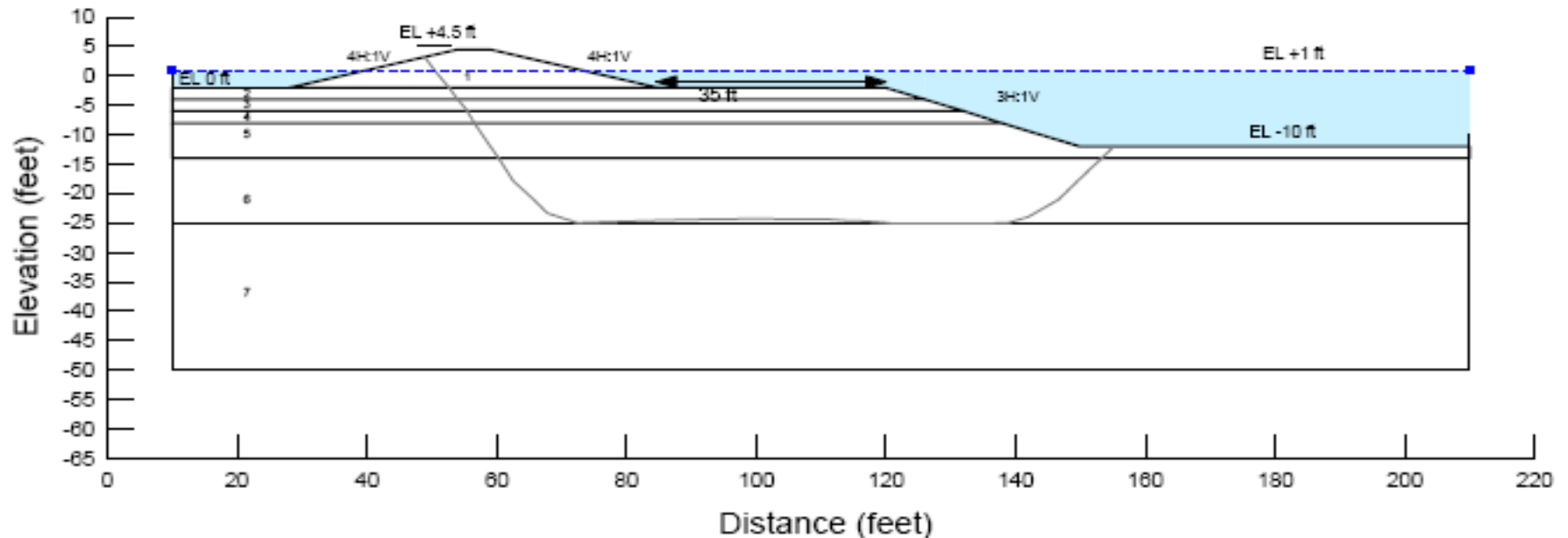
Figure
II-B14

Slope Stability of Containment Dikes and Terraces

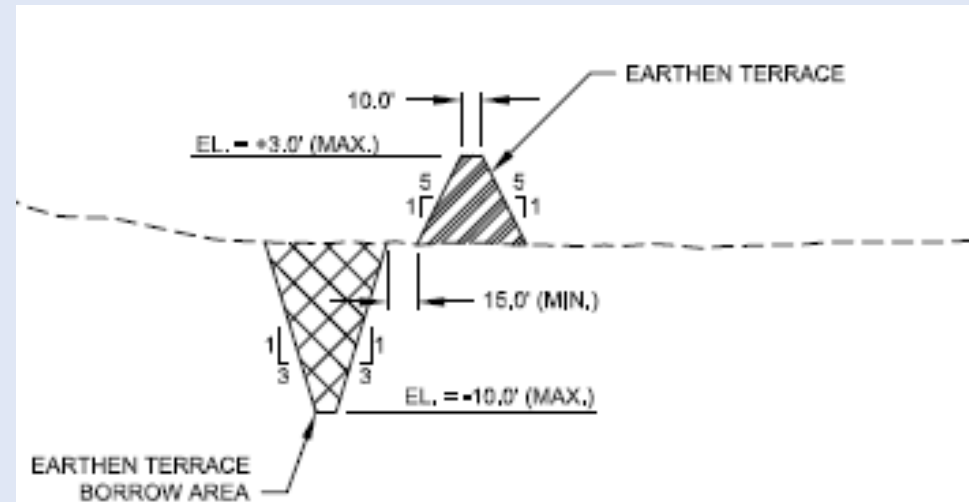
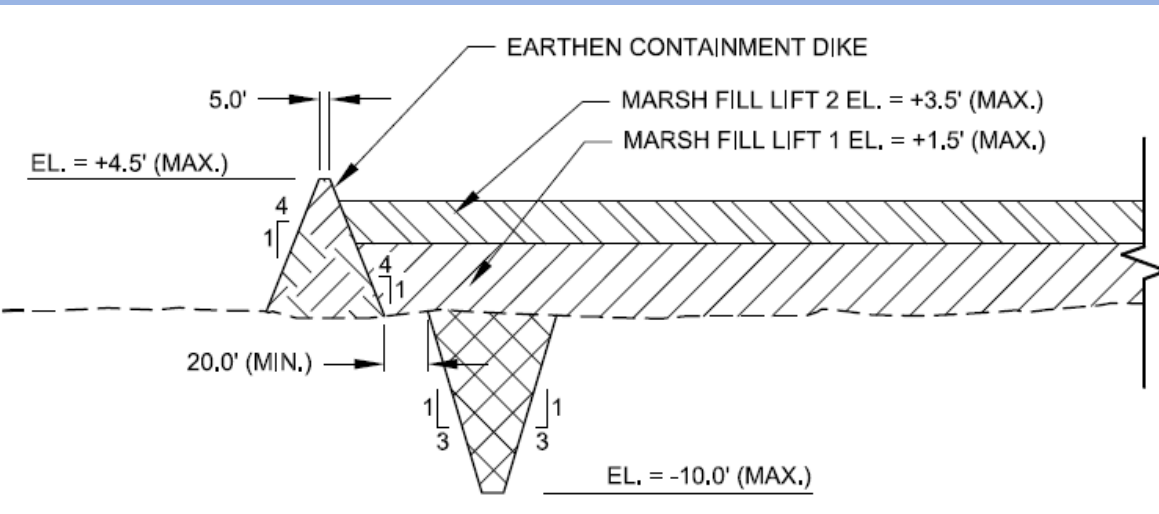
Spencer's Method

Name: 1. Containment Dike Fill Unit Weight: 85 pcf Cohesion': 60 psf Phi': 0 °
Name: 2. Clay-1 Unit Weight: 105 pcf Cohesion': 370 psf Phi': 0 °
Name: 3. OL-1 Unit Weight: 80 pcf Cohesion': 110 psf Phi': 0 °
Name: 4. Peat Unit Weight: 80 pcf Cohesion': 110 psf Phi': 0 °
Name: 5. Clay - 2 Unit Weight: 92 pcf Cohesion': 80 psf Phi': 0 °
Name: 6. Clay - 3 Unit Weight: 92 pcf Cohesion': 80 psf Phi': 0 °
Name: 7. Clay - 4 Unit Weight: 92 pcf Cohesion': 170 psf Phi': 0 °

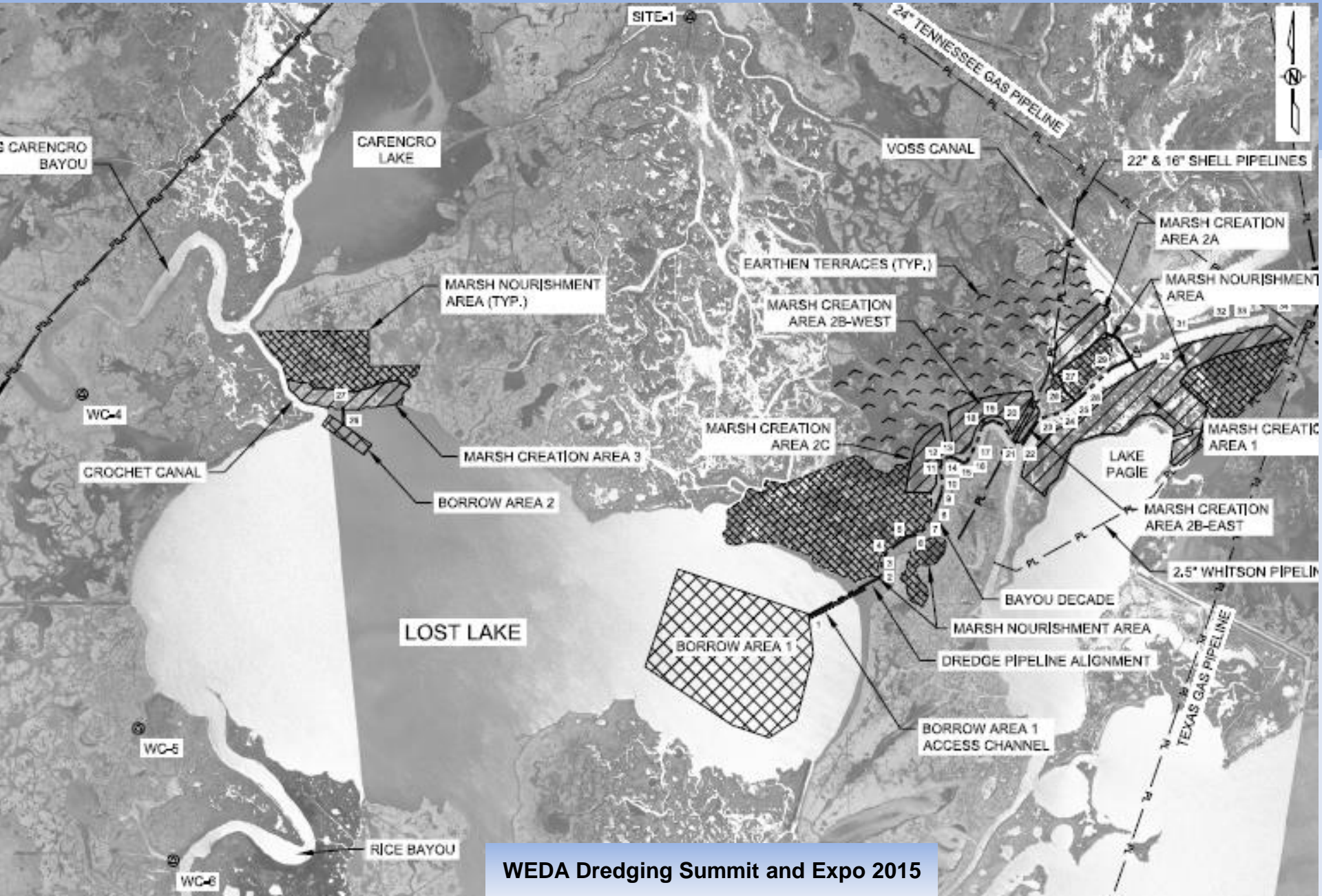
FOS: 1.16



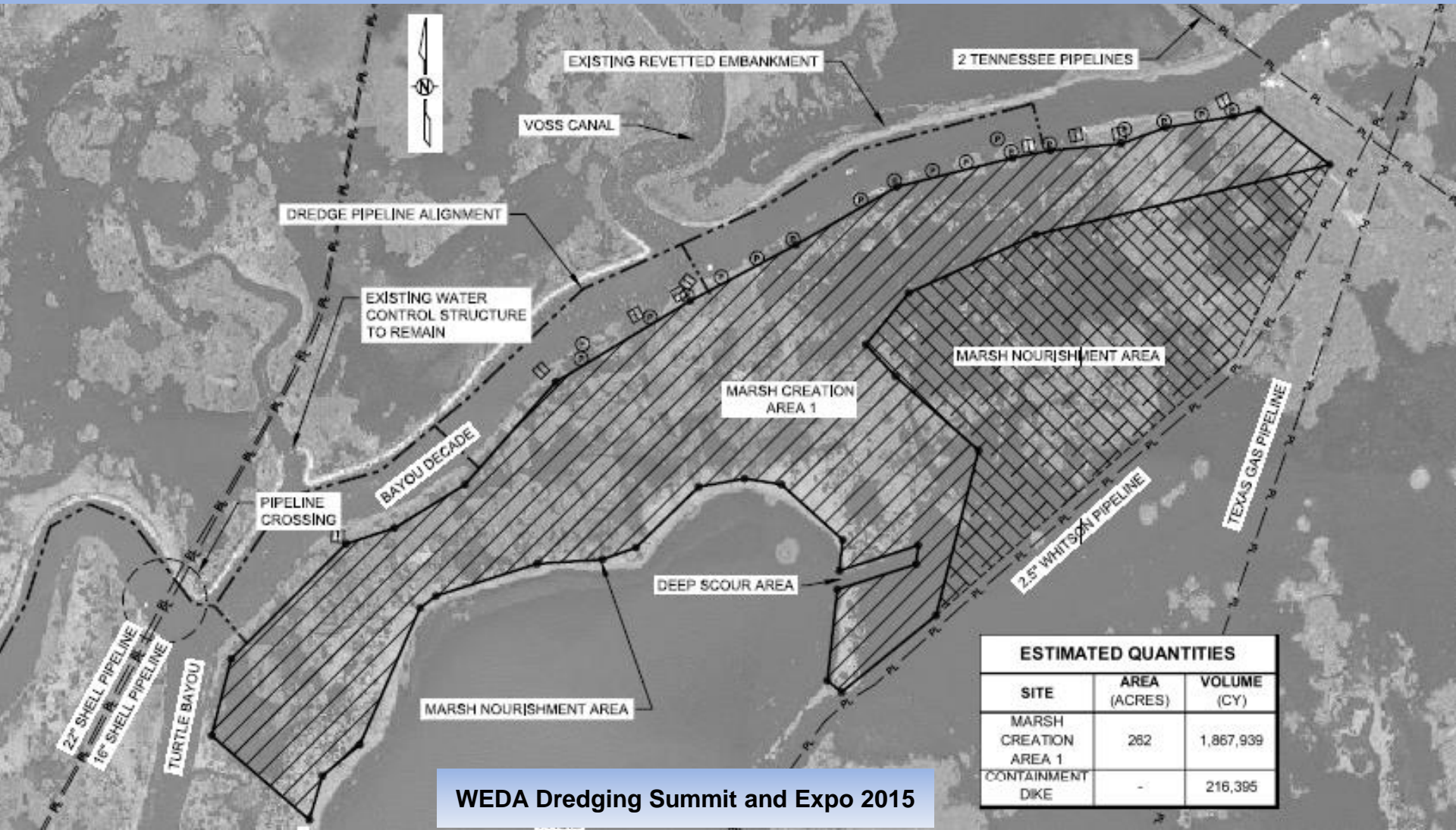
Marsh Creation Area and Terrace Profiles



Project Plan

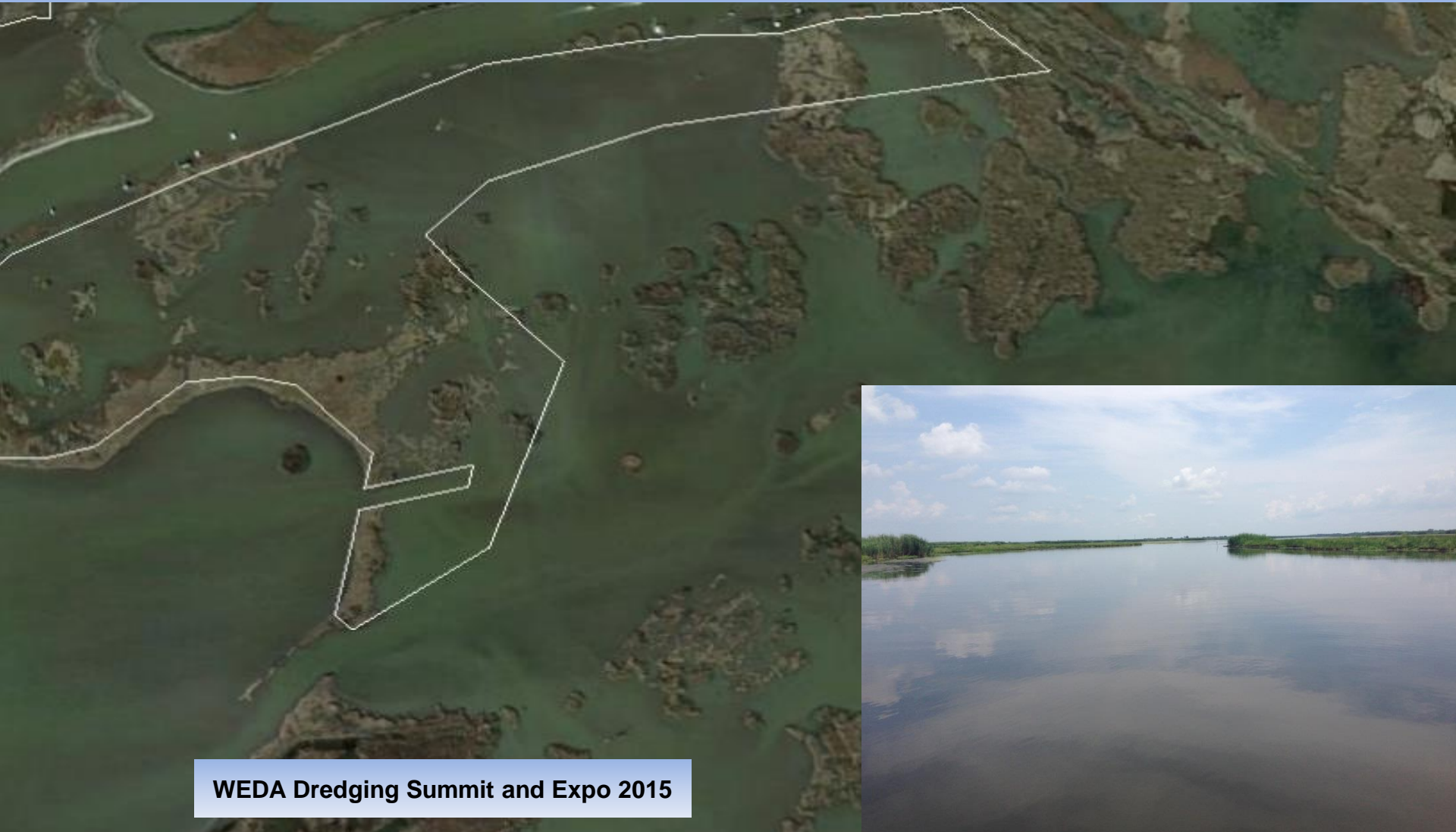


Fill Area 1



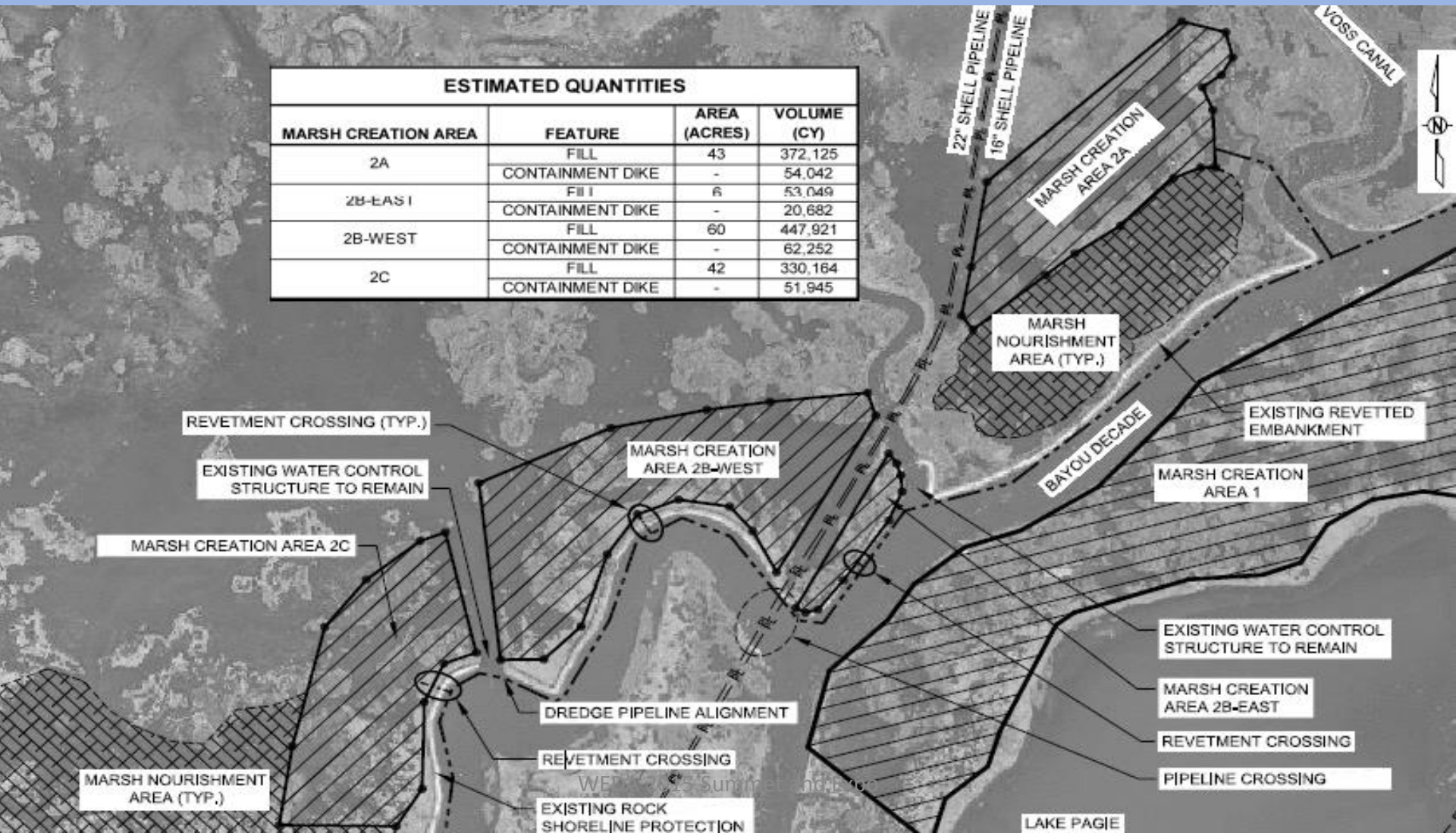
ESTIMATED QUANTITIES		
SITE	AREA (ACRES)	VOLUME (CY)
MARSH CREATION AREA 1	262	1,867,939
CONTAINMENT DIKE	-	216,395

Fill Area 1



Fill Areas 2A, 2B and 2C

ESTIMATED QUANTITIES			
MARSH CREATION AREA	FEATURE	AREA (ACRES)	VOLUME (CY)
2A	FILL	43	372,125
	CONTAINMENT DIKE	-	54,042
2B-EAST	FILL	6	53,049
	CONTAINMENT DIKE	-	20,682
2B-WEST	FILL	60	447,921
	CONTAINMENT DIKE	-	62,252
2C	FILL	42	330,164
	CONTAINMENT DIKE	-	51,945



REVETMENT CROSSING (TYP.)

EXISTING WATER CONTROL STRUCTURE TO REMAIN

MARSH CREATION AREA 2C

MARSH CREATION AREA 2B-WEST

DREDGE PIPELINE ALIGNMENT

REVETMENT CROSSING

MARSH NOURISHMENT AREA (TYP.)

EXISTING ROCK SHORELINE PROTECTION

22" SHELL PIPELINE

16" SHELL PIPELINE

BAYOU DECADE

VOSS CANAL

LAKE PAGIE

MARSH CREATION AREA 1

EXISTING REVETTED EMBANKMENT

EXISTING WATER CONTROL STRUCTURE TO REMAIN

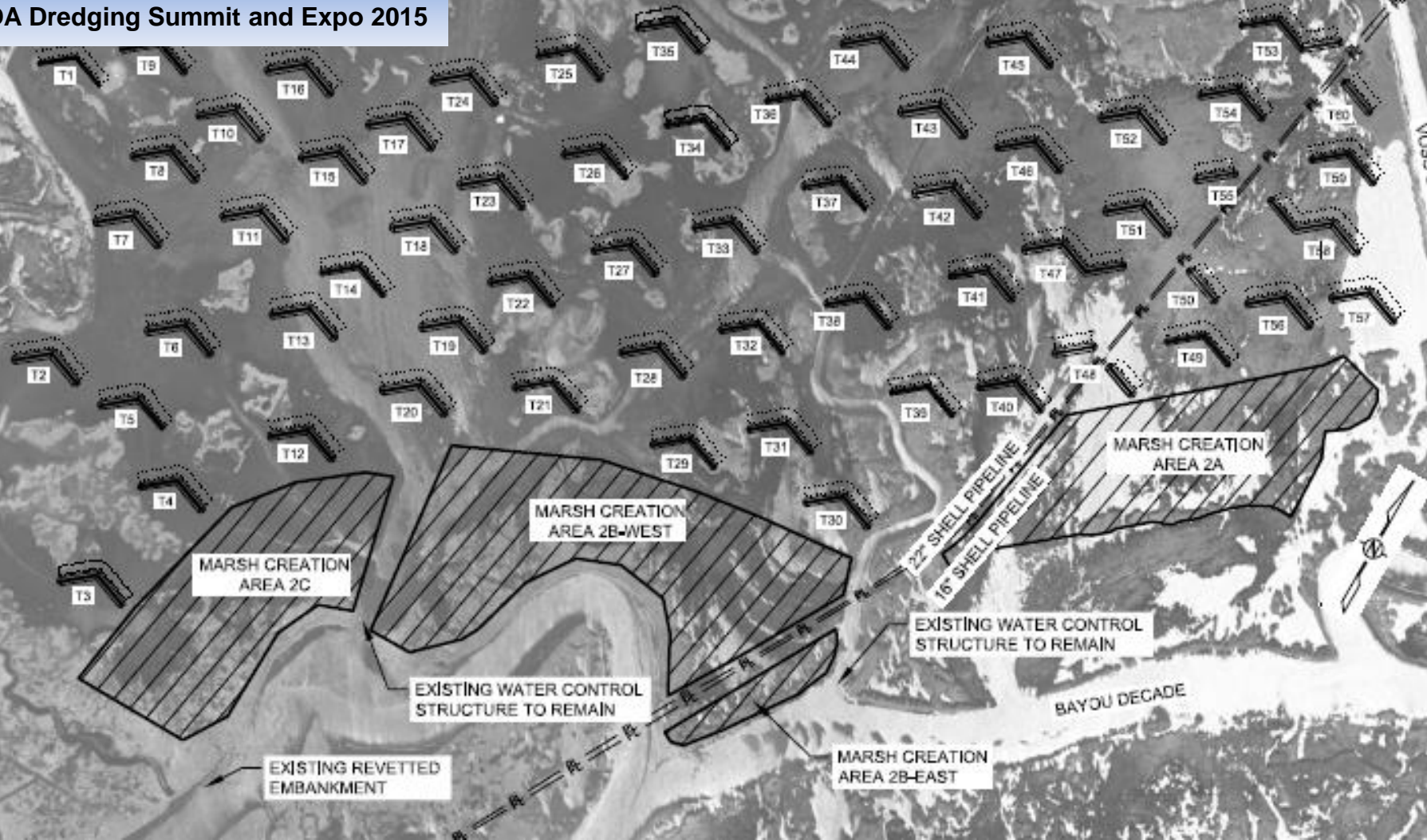
MARSH CREATION AREA 2B-EAST

REVETMENT CROSSING

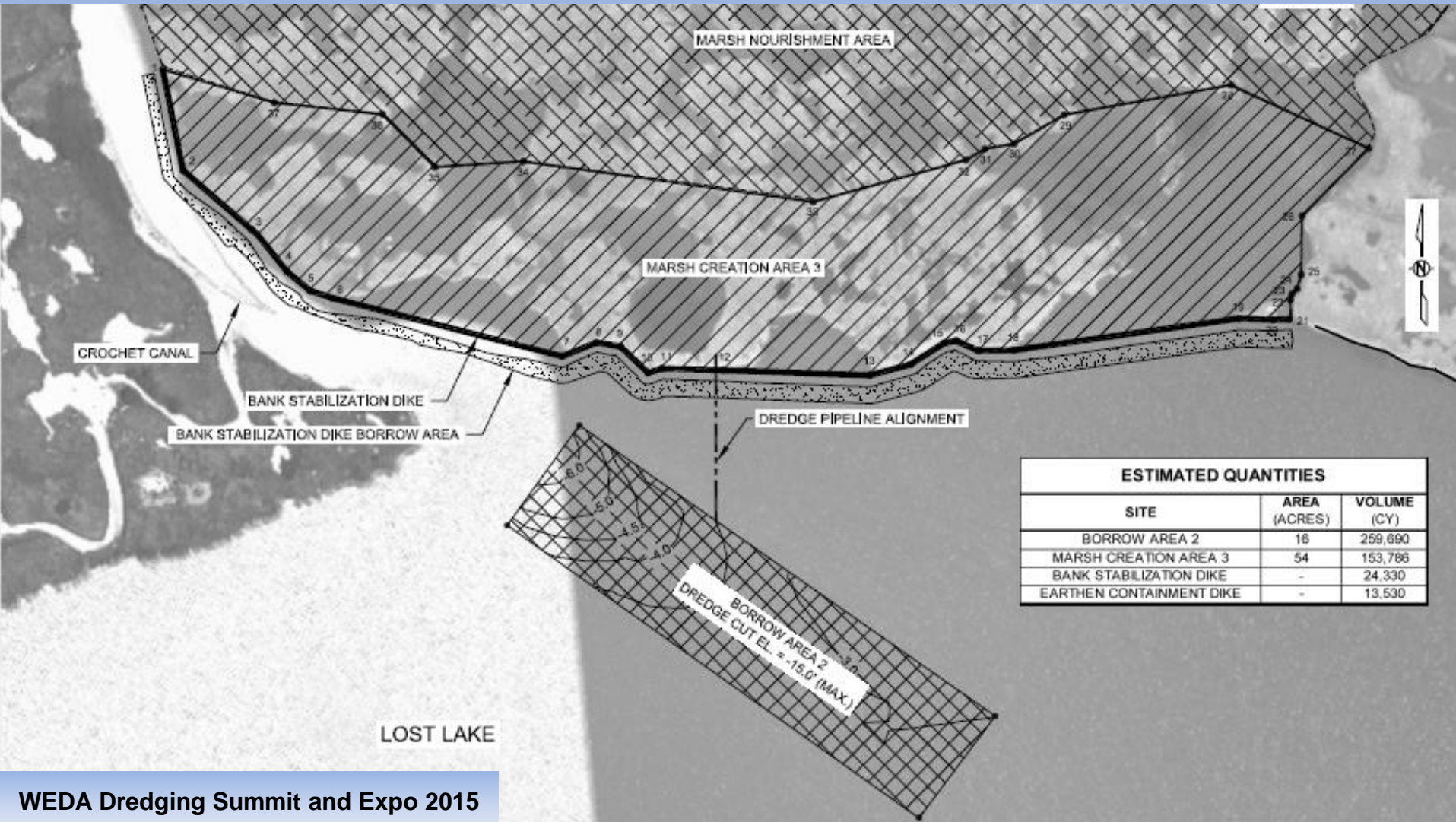
PIPELINE CROSSING

Earthen Terraces

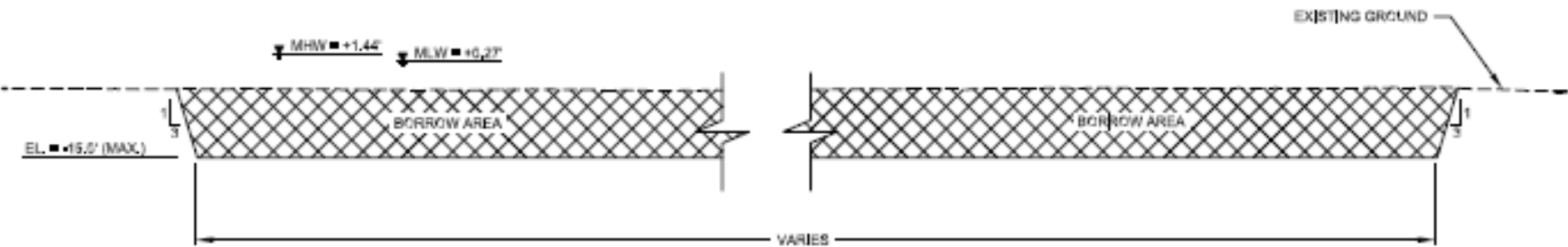
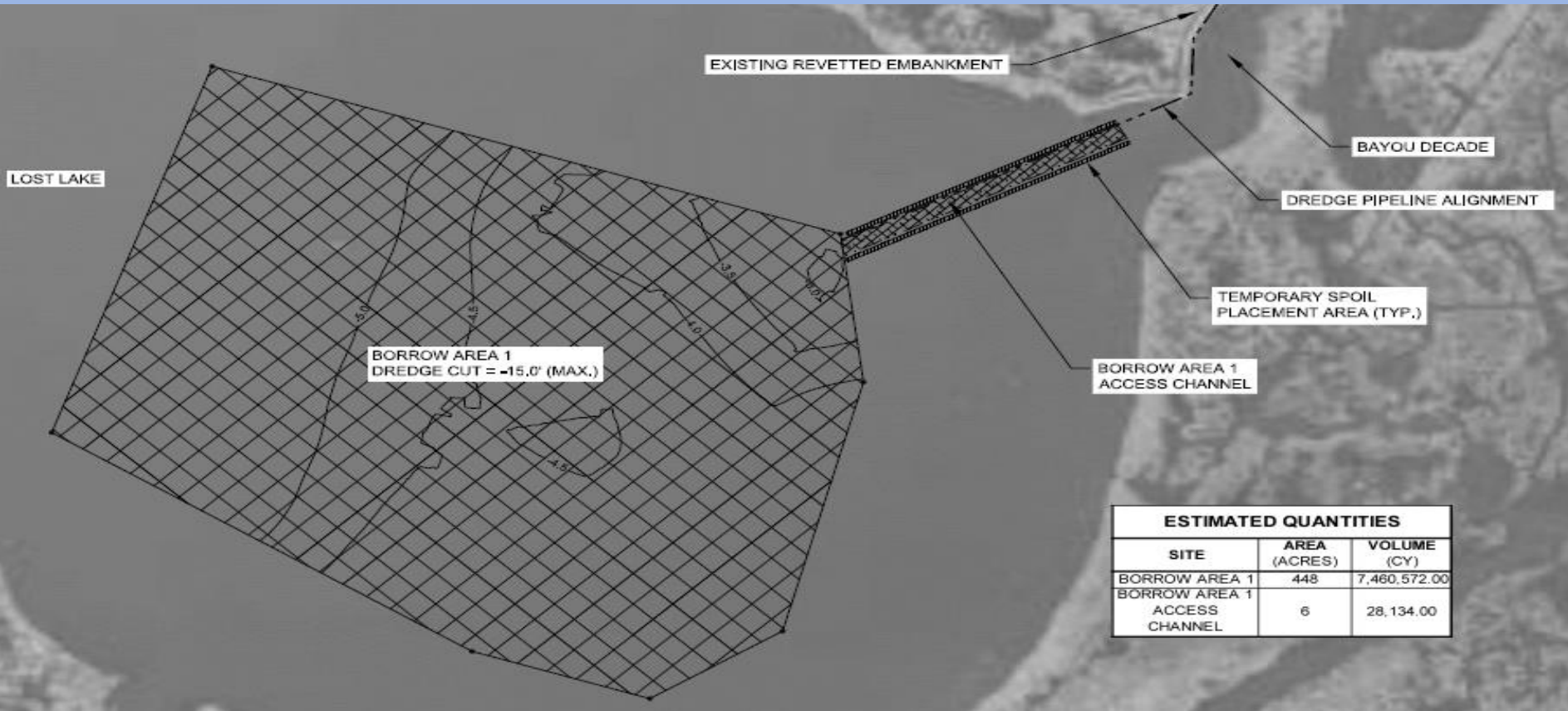
WEDA Dredging Summit and Expo 2015



Fill Area 3 / Borrow Area 2



Borrow Area 1 and Access Channel



Hydraulic Dredge Access to Borrow Area 1

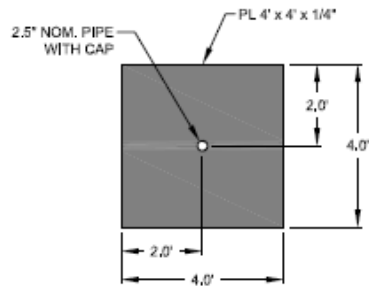


WEDA Dredging Summit and Expo 2015

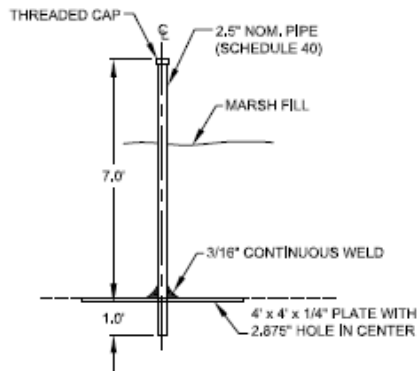


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Settlement Plates

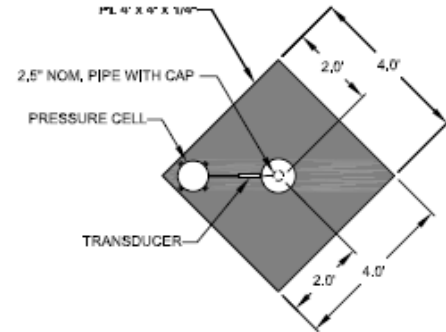


PLAN VIEW

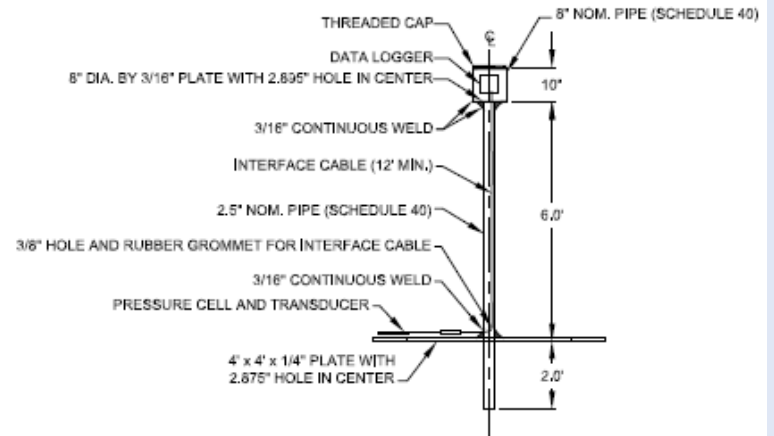


PROFILE VIEW

**MARSH CREATION AREA
SETTLEMENT PLATE**
NOT TO SCALE



PLAN VIEW



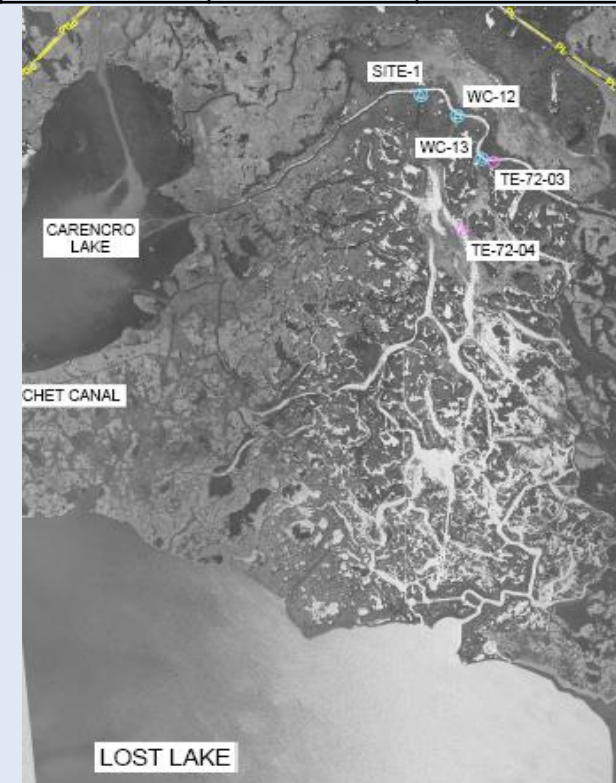
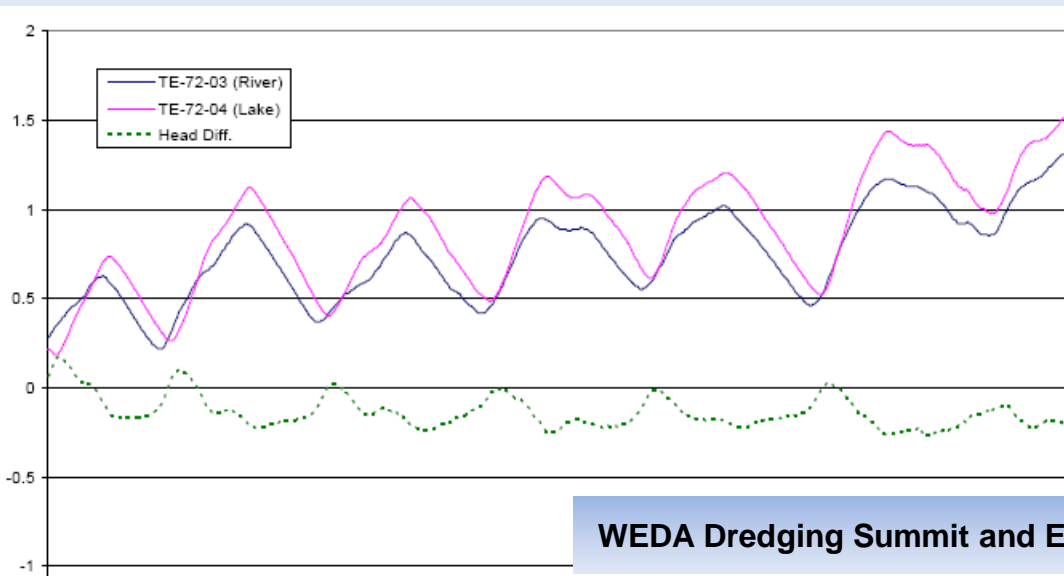
PROFILE VIEW

**INSTRUMENTED
SETTLEMENT PLATE**
NOT TO SCALE

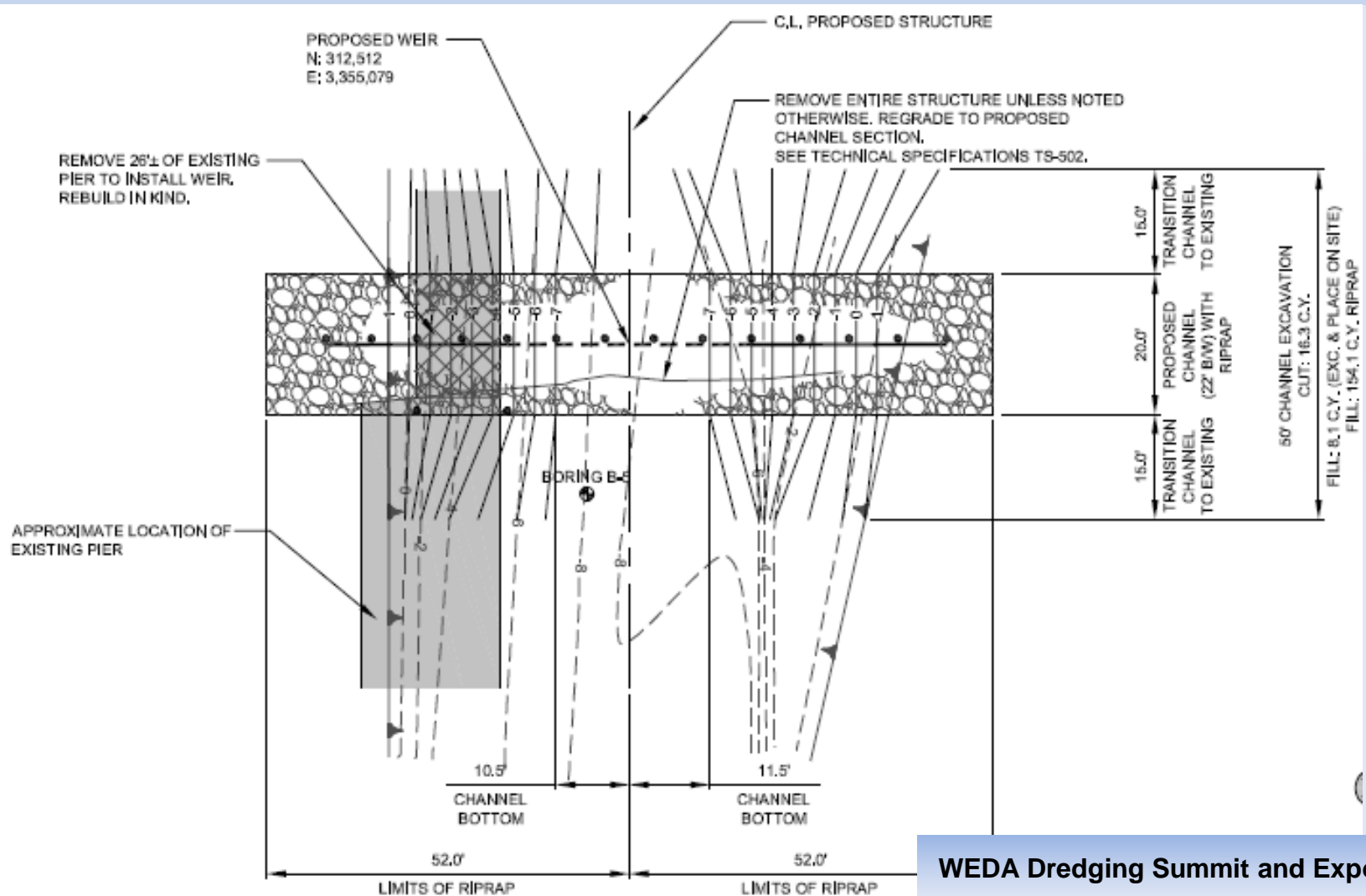
Water Control Structures



Water Level Collected 2011-2012					
Water Control Structure	Average Flow (cfs)	Average Positive Flow (cfs)	Max Positive Flow (cfs)	Average Negative Flow (cfs)	Max Negative Flow (cfs)
WC-1	1	28	350	27	497
WC-4	0	7	182	7	260
WC-5	229	610	1,981	380	1,675
WC-6	(2)	39	564	42	803



Typical Water Control Structure Plan



Typical Water Control Structure Profile

