APPENDIX L

ENGINEERING APPENDIX

Appendix L
ENGINEERING

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Section 1

INTRODUCTION

Introduction

This Engineering Appendix outlines the engineering and design work done to support the preparation of the Integrated Feasibility Report and Environmental Impact Statement for the Louisiana Coastal Area (LCA) - Amite River Diversion Canal (ARDC) Modification Element of the Section 7006(e)(3) Ecosystem Restoration Projects Study in Ascension and Livingston Parishes, Louisiana.

Background

The study area contains approximately 19,000 acres of bald cypress-tupelo swamp habitat in the western Maurepas Swamp. The area includes the ARDC, a 10.6-mile-long flood control channel between the Amite and Blind Rivers which was completed in 1964. Dredged material excavated during channel construction was deposited in spoil banks on either side of the canal. These spoil banks have disrupted the natural hydrologic regime in the proposed study area, resulting in a reduction in biomass production and soil accumulation as well as an increase in relative subsidence.

Prior studies have documented degradation in the bald cypress-tupelo swamp adjacent to the ARDC and have demonstrated a need for ecosystem restoration of this swamp habitat through the reconnection of a natural hydrologic regime. The proposed project involves restoration of impaired swamp habitat within the study area by gapping the spoil banks along the ARDC, promoting hydrologic exchange between flows within the ARDC and the adjacent swamp habitat.

Without implementation of the proposed project, the bald cypress-tupelo swamps within the study area would convert to unstable freshwater marsh, which in turn would convert to open water. Prior studies have estimated that without implementation of the proposed project, canopy cover within the study area would degrade to less than 33 percent within 20 years and 50 percent of the swamp habitat would be lost within 60 years.

Project Objectives

The purpose of the ARDC Modification project is to restore the ecosystem in the ARDC area on the adjacent bald cypress-tupelo swamp habitat by gapping the existing spoil banks on either side of the canal. The proposed project will be evaluated for its potential to prevent future bald cypress-tupelo swamp degradation and conversion, to restore sheet flow impaired by the dredged material berm, and to protect vital socioeconomic and public resources.

The proposed project would work independently of, but synergistically with, other LCA near-term critical features. This includes the LCA Small Diversion at Hope Canal, LCA Small Diversion at Convent/Blind River, coastal restoration projects proposed under other authorities, including the Livingston Parish Coastal Impact Assistance Program (CIAP) project Hydrologic Restoration in Swamps West of Lake Maurepas, the U.S. Army Corps of Engineers (USACE) project Comite River Diversion, and the Pontchartrain Levee District (PLD) project Amite River and Tributaries Ecosystem Restoration Feasibility Study. Together these projects would provide a holistic approach to restoration of impaired swamp habitat throughout the western Maurepas Swamp. The goal of this project is to reverse the trend of degradation in the western portion of the Maurepas Swamp, contribute to the overall goal of achieving a sustainable coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus the Nation. Project objectives include the following:

- Prevent habitat conversion and future land loss;
- Establish hydrologic connectivity to allow for seasonal wetting and drying, so that the swamps are drained, promoting seedling germination, establishment, and survival;
- Introduce nutrient and sediment to swamps;
- Promote water circulation to improve water quality;
- Increase swamp vegetation productivity;
- Restore and preserve fish and wildlife habitat; and
- Protect vital socioeconomic resources including cultures, community, infrastructure, business and industry, and flood protection features;
- Vegetative planting and nutria control.

Section 2

HYDRAULICS AND HYDROLOGY

Section 2

HYDRAULICS AND HYDROLOGY

GENERAL

Biological, topographical, and hydrological data was collected as needed to support the development of a hydrologic and hydraulic (H&H) model that was used to characterize existing conditions and model the future-without-project scenario as well as future-with-project scenarios. The model is a one-dimensional, unsteady-state Hydraulic Engineering Centers River Analysis System (HEC-RAS) model to simulate water levels and movement within the project area. The model is intended to answer the following concerns regarding the proposed gapping alternatives:

- Whether water will leave the conveyance channel and flow to and from the swamp;
- The effect of the proposed gapping on the hydraulics and water levels in a portion of the swamp;
- The effect of the proposed gapping on flood risk in the study area.

ANNEX

Hydraulics and Hydrology

H&H Modeling Summary

Taylor Engineering used the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) program to model the No Action Plan and the With Project Plan. The development of the models is to simulate the flow in the proposed channels and stage duration data in the benefit areas.

Due to time and funding constraints for this study, HEC-RAS (1-D, unsteady state) was selected for the analysis. Due to the accelerated schedule for the project, only existing data was used; no new stage data was collected. The HEC-RAS model was used to support the WVA of the proposed project. The model results are used to quantify flow/exchange and flooding duration (Variable V_3) in the WVA calculations.

HEC-RAS Model Calibration

The HEC-RAS unsteady state routine simulates channels and adjacent floodplain swamps as a one-dimensional hydrodynamic system. Taylor Engineering used U. S. Geological Survey (USGS) stream gage data for the upstream boundary condition (inflow hydrograph) and for the downstream boundary condition (stage hydrograph). During the calibration process, the initial attempts to calibrate the model used a channel and vertical N-values. N-values were adjusted to very high values in an attempt to simulate observed flow patterns. The computed stages in the storage areas were compared to gage data in the swamp. The best fit of the computed stages when compared to the gage data was achieved when the flow between the ARDC and the swamp was simulated using a culvert for low flow and a weir to simulated high flow conditions. No data was available to validate the model. Chapter 2 describes the development of the HEC-RAS model, calibrated with 2005 data from two Louisiana Coastal Protection and Restoration Authority (CPRA) swamp gages.

HEC-RAS Model Simulation of Alternative Plans The HEC-RAS models were developed and used to support the WVA. Water Regime (variable V3) in the WVA considers the flood duration and the flow/exchange. The flooding duration categories are Seasonal, Temporary, Semi-permanent, and Permanent. The Flow/Exchange categories are High, Moderate, Low, and None. Output data from the HEC-RAS was used to estimate the consecutive number of days was used as an indicator of flood duration and the computed discharge in the proposed channels was used as an indicator for the flow/exchange.

To simulate the No Action Plan and the ARDC modification, Taylor Engineering conducted long-term hydrologic simulations of the study area based on average daily discharge and daily stages for the 10-year period from January 1, 1999 to December 31, 2008. Extracted estimates of flood and drying days established the current or baseline conditions needed to evaluate the proposed alternatives. Chapter 3 describes the HEC-RAS modeling for the No Action Plan and the With Project Plan, which represented seven different alternatives, and presents the results.

Tables 1 through 3 present model results for the No Action Plan and the With Project Plan. Table 1 presents a summary of the computed flows in the exchange channels. Tables 2 and 3 present a comparison of stage duration (in days) for the swamp storage areas in SE-1 and NE-2. Table 2 combines results for the two exchange channels in this area. Table 2 shows that the With Project Plan increases the percentage of days in SE-1 with Water Surface Elevation (WSE) at or below 1.0 foot from 6 to 37%. Table 3 shows the With Project Plan increases the number of days with WSE at or below 1.0 foot from 7 to 48% in NE-2.

Table 1 Computed Flow

With Project (no flow in the No Action Plan)					
Exchange Channel	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	6330	5298	4812	4368	4035
% time of inflow	23%	22%	29%	28%	28%
Volume outflow (ac-ft/yr)	6874	7160	3392	3696	4088
% time of outflow	77%	78%	71%	72%	72%

Table 2 Stage Duration, Storage Area SE-1

No Action						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	213	2283	2742	2935	3059	3151
% time at or below WSE	6%	62%	75%	80%	84%	86%
Consecutive Days at or below WSE	73	120	138	164	203	204
With Project						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	1352	2390	2770	2950	3070	3160
% time at or below WSE	37%	65%	76%	81%	84%	86%
Consecutive Days at or below WSE	114	121	152	164	203	205

Table 3 Stage Duration, Storage Area NE-2

No Action						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	241	2306	2834	3027	3144	3233
% time at or below WSE	7%	63%	78%	83%	86%	88%
Consecutive Days at or below WSE	64	148	184	203	204	205

With Project						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	1750	2501	2865	3032	3153	3236
% time at or below WSE	48%	68%	78%	83%	86%	89%
Consecutive Days at or below WSE	117	150	185	204	204	205

Relative Sea Level Rise

Taylor Engineering evaluated the potential hydrologic impact on the No Action Plan and the modification alternatives for estimates of relative sea level rise (RSLR) in accordance with guidance provided by the USACE, New Orleans District. Chapter 4 describes the analysis of RSLR effects on the alternative plans and provides the results.

Taylor Engineering reran the HEC-RAS models for the No Action Plan and the With Project Plan for 2061 (Year-50) for the three RLSR cases by adding 1.5, 1.9, and 3.2 feet to the Amite River at Maurepas hydrograph downstream boundary condition. Tables 4, 5, and 6 present model results. Table 4 includes the previous results (Year 1) for computed flows in the exchange channels versus computed Year 50 flows for low, intermediate, and high RSLR. Tables 5 and 6 provide similar comparisons of stage durations for the previously computed Year 1 versus Year 50 low, intermediate, and high RSLR for the No Action Plan and With Project Plan in SE-1 and NE-2, respectively.

Table 4 demonstrates that as stages increase in Lake Maurepas due to RSLR, the flow in the proposed new exchange channels increase.

Tables 5 and 6 show that RSLR will dramatically reduce the stage duration below 1.0 foot with both the No Action Plan and the With Project Plan. The percentage of days with WSE below 1.0 foot in the SE-1 and NE-2 areas falls from 37 and 48%, respectively, to zero under all three RSLR cases.

Table 4 Computed Exchange Channel Flows with RSLR

With project with no RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	6330	5298	4812	4368	4035
% time of inflow	23%	22%	29%	28%	28%
Volume outflow (ac-ft/yr)	6874	7160	3392	3696	4088
% time of outflow	77%	78%	71%	72%	72%
With Project with 50 years of Low rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	23175	20734	14522	13503	12903
% time of inflow	35%	34%	54%	53%	52%
Volume outflow (ac-ft/yr)	32635	35202	7291	8187	8894
% time of outflow	65%	66%	46%	47%	48%
With Project with 50 years of Intermediate rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	28332	25659	15172	14131	13480
% time of inflow	36%	35%	56%	55%	54%
Volume outflow (ac-ft/yr)	41868	45382	7324	8397	9234
% time of outflow	64%	65%	44%	45%	46%
With Project with 50 years of High rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	36013	33138	15622	14617	14028
% time of inflow	39%	38%	56%	54%	52%
Volume outflow (ac-ft/yr)	57802	63338	74145	9374	11222
% time of outflow	61%	62%	44%	46%	48%

Table 5 Stage Duration with RSLR, Storage Area SE-1

	No Action Plan						With Project Plan					
Without RSLR												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	213	2283	2742	2935	3059	3151	1352	2390	2770	2950	3070	3160
% time at or below WSE	6%	62%	75%	80%	84%	86%	37%	65%	76%	81%	84%	86%
Consecutive Days at or below WSE	73	120	138	164	203	204	114	121	152	164	203	205
With Project with Low rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	15	60	89	120	0	8	62	104	162	206
% time at or below WSE	0%	0%	0%	2%	2%	3%	0%	0%	2%	3%	4%	6%
Consecutive Days at or below WSE	0	0	2	7	9	12	0	2	7	10	16	22
With Project with Intermediate rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	3	7	0	0	3	12	24	38
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
Consecutive Days at or below WSE	0	0	0	0	1	2	0	0	1	3	3	3
With Project with High rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Consecutive Days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0

Table 6 Stage Duration with RSLR, Storage Area NE-2

	No Action Plan						With Project Plan					
Without RSLR												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	241	2306	2834	3027	3144	3233	1750	2501	2865	3032	3153	3236
% time at or below WSE	7%	63%	78%	83%	86%	88%	48%	68%	78%	83%	86%	89%
Consecutive Days at or below WSE	64	148	184	203	204	205	117	150	185	204	204	205
With Project with Low rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	2	63	140	205	285	0	11	77	144	214	289
% time at or below WSE	0%	0%	2%	4%	6%	8%	0%	0%	2%	4%	6%	8%
Consecutive Days at or below WSE	0	2	8	12	17	22	0	5	8	12	17	22
With Project with Intermediate rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	1	19	40	60	0	0	4	23	42	66
% time at or below WSE	0%	0%	0%	1%	1%	2%	0%	0%	0%	1%	1%	2%
Consecutive Days at or below WSE	0	0	1	3	3	8	0	0	2	3	3	5
With Project with High rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1	1.1	1.2	1.3	1.4	1.5	1	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Consecutive Days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0

Table 7 presents estimates of the time in years to permanent inundation for the No Action Plan and With Project Plan (conditions are nearly the same for both swamp areas). These estimates do not consider a rate for biomass and mineral sediment accretion. Biomass and mineral sediment accretion could extend the timeline until permanent inundation.

Table 7 Years to Permanent Inundation

RSLR Case	RSLR Year 50	No Action	With Project
Low Rate	1.5 feet	14 years	40 years
Intermediate Rate	1.9 feet	12.5 years	31 years
High Rate	3.2 feet	8 years	17 years

Flood Risks

Finally, Taylor Engineering used 1-, 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year return period inflow flood hydrographs as the upstream boundary to model potential impacts of the alternatives on flood conditions. For purposes of flood analysis, the downstream boundary was set to a constant elevated stage of 2.0 feet North American Vertical Datum (NAVD)-88 (2006.81). The USACE Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS), developed for the Amite River and Tributaries Amite River Ecosystem Restoration Feasibility Study, computed the inflow hydrographs. Chapter 5 describes the flood impact analysis and provides the results.

Figures 1 and 2 present stage hydrographs for the 100-year flood event for two swamp areas, SE-1 and NE-2. The hydrograph plots compare the stages for the No Action Plan and the With Project Plan. Figure 1 shows that the project increases peak stage in SE-1 by 0.37 foot. Figure 2 indicates that the project does not change the peak stage in storage area NE-2.

Figures 3 and 4 illustrate the project impact on 100-year flood stages at two channel locations, Amite River near Old River and ARDC near Amite River. Figures 3 and 4 show that that the project reduces peak stage at the Amite River near Old River by 0.27 foot, and at ARDC near Amite River by 0.49 foot.

Simulations of the 1-, 2-, 5-, 10-, 25-, 50-, 200-, and 500-year storm events show similar trends in flood impacts: slight increases in stage for the swamp areas and slight decreases in stage for the Amite River and ARDC.

The qualitative nature of these results is consistent with the increased exchange between the ARDC and the swamp for the With Project Plan. Results, however, overstate the magnitude of the With Project impact given the way the model represents the swamp. During a flood event, flow characteristics in overbanks (swamp) change from off-channel storage to conveyance.

The proposed plan features will not restrict flow in the ARDC or in the swamps adjacent to the ARDC. Therefore there would not be an increase in the risk of flooding within the study area. Additionally, increased flood risks would not occur for any nearby businesses and residences as a result of all proposed actions.

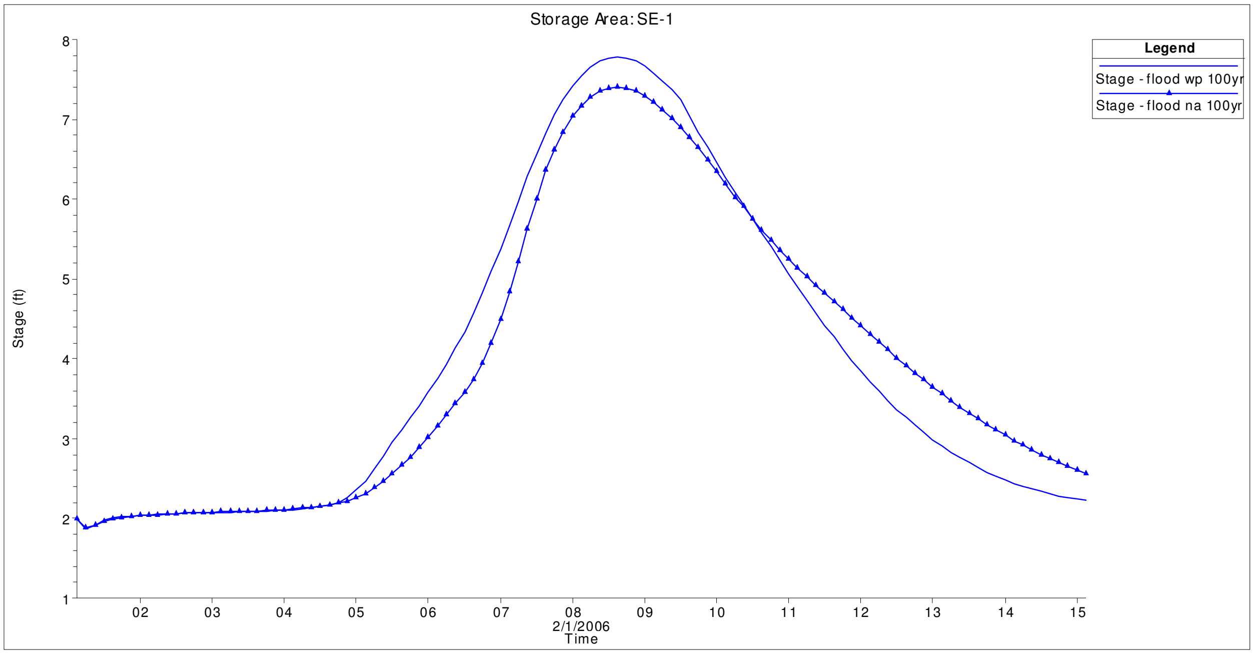


Figure 1 Storage Area SE-1

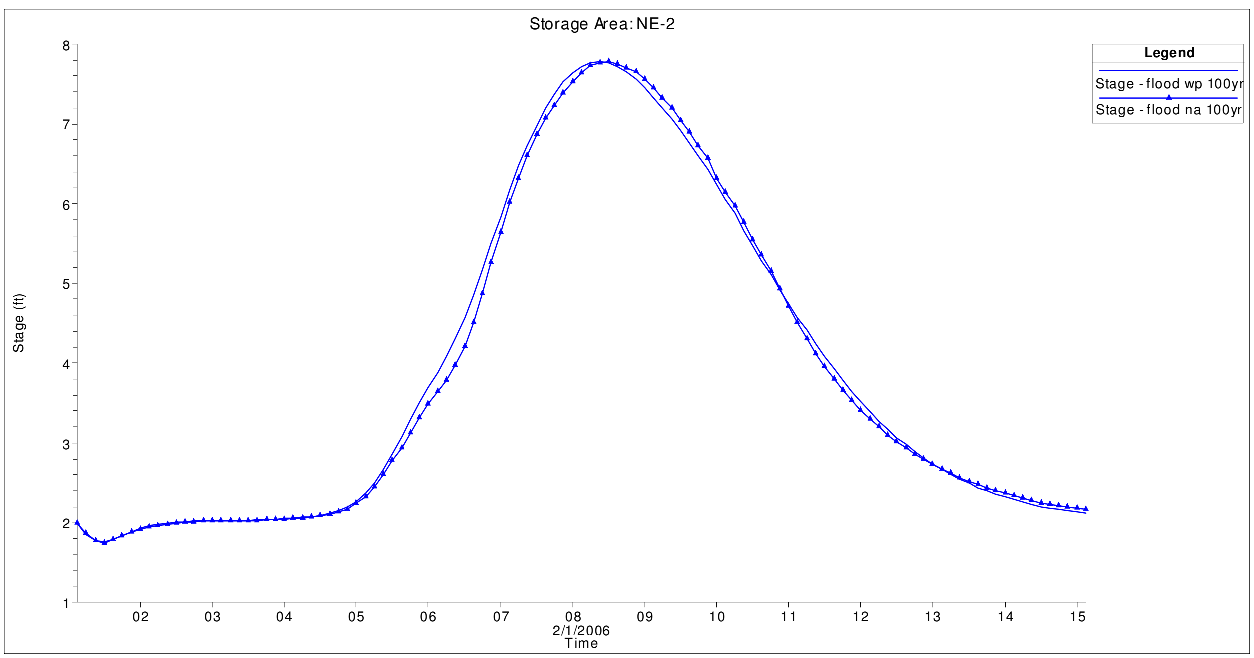


Figure 2 Storage Area NE-2

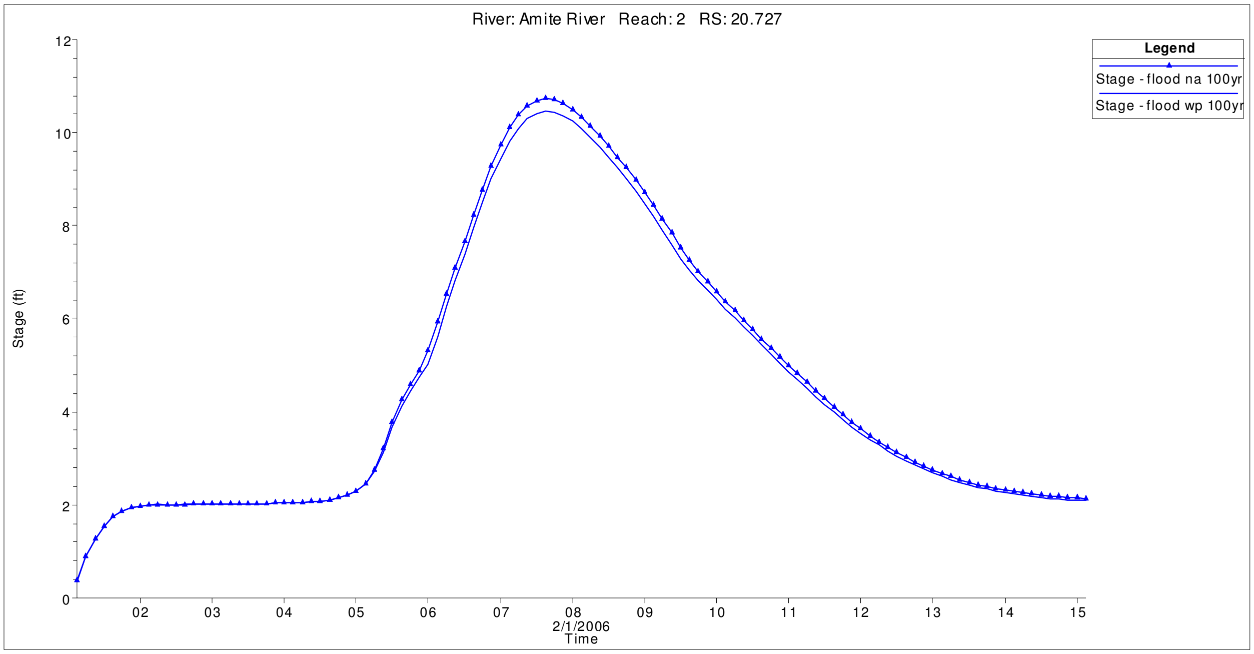


Figure 3 Amite River near Old River

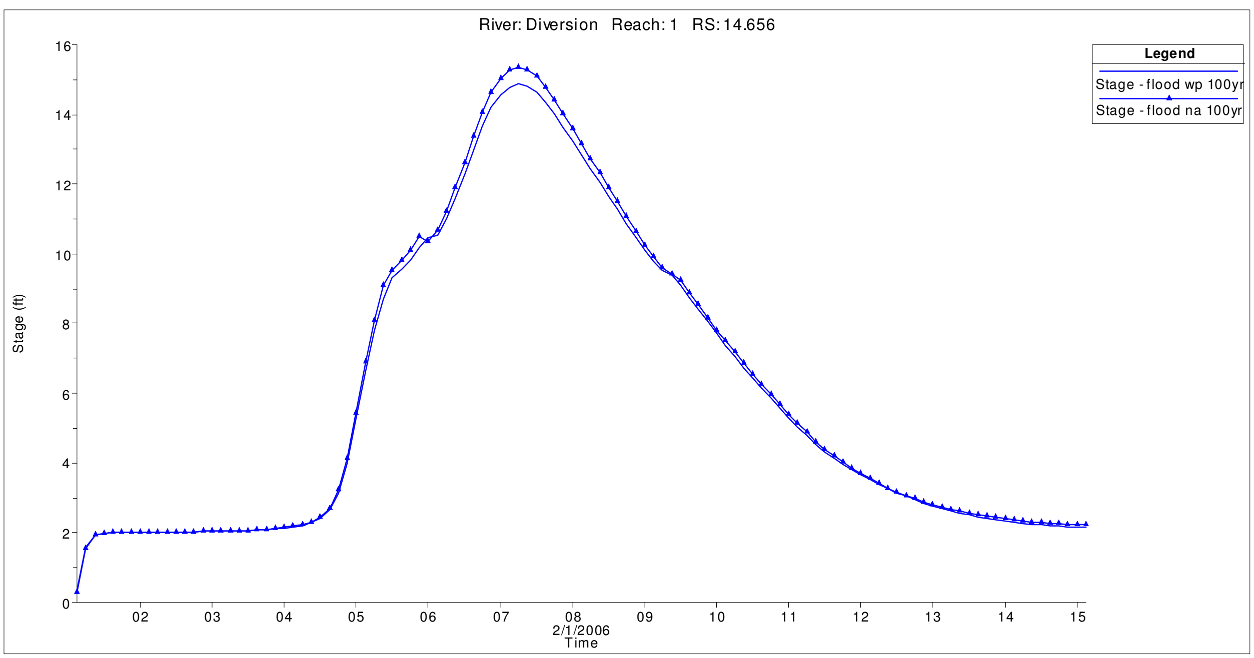


Figure 4 ARDC near Amite River

Conclusions

The results of the analysis show that the proposed new exchange channels can meet the hydrodynamic objectives of the project. The proposed new exchange channels would improve the conveyance of ARDC water into the swamp, and allow a more natural wetting and drying cycle in the swamp. The effect of RSLR would reduce the improvements in swamp dry periods, with eventual permanent inundation.

The proposed exchange channels may cause a minor increase in peak flood stages in the swamps near the ARDC, and a minor decrease in peak flood stages in the Amite River and ARDC. The Amite River Diversion Canal Modification project would not increase the flood risk.

J. Anthony Cavell, P.L.S., C.Fed.S.

August 12, 2009

George W. Hudson, P.E.,
Senior Engineer
Taylor Engineering, Inc.
2133 Silverside Drive, Suite C
Baton Rouge, Louisiana 70808

Dear George:

We have measured and analyzed over 500 points along routes selected by Taylor Engineering. These points were compared to the vertical values for those locations according to the Digital Elevation Model that was based on the Louisiana LiDAR. The topographic information for this survey is referenced to the North American Vertical Datum of 1988 (NAVD88) and the National Geodetic Datum of 1983 (NAD83). Those along the diversion canal were not able to be compared due to acute changes in the topography since the LiDAR was taken, leaving over 300 points to analyze.

The result of our analysis is that the LiDAR based DEM passes at the 0.8 foot level the National Map Accuracy Standards (NMAS) test for agreement with the vertical data based on the LSU GULFNet Reference System. Please see the diagram attached. The mean difference is only 0.01 foot down. I think no adjustment to the LiDAR DEM is suggested by our measurements along the roadways.

This report will follow in hard-copy form accompanied by digital records on CD or DVD media.

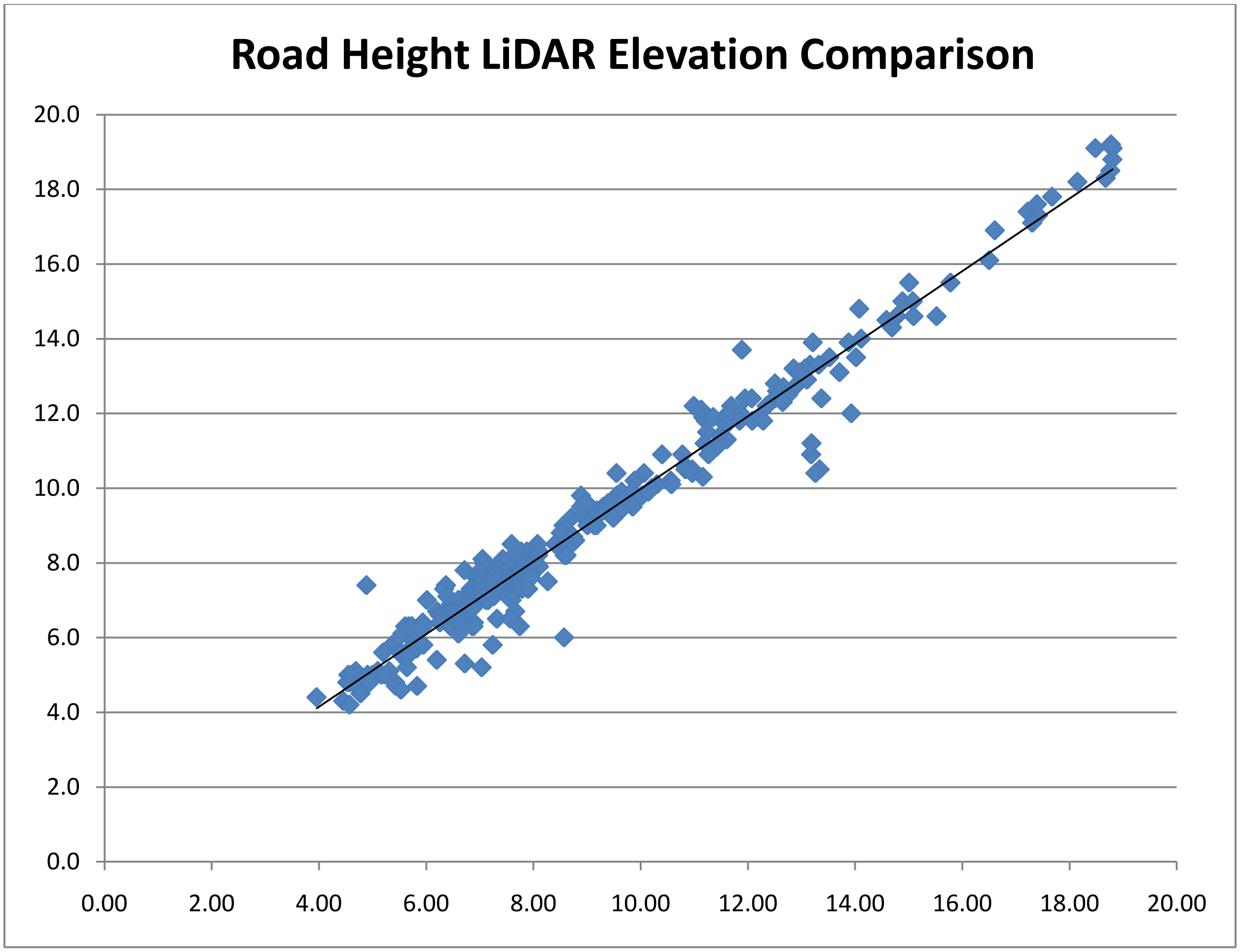
If I can be of further service, please don't hesitate to call.

Yours truly,

J. Anthony Cavell, P.L.S., C.Fed.S.

Enclosure

11646 Rue Concord – Baton Rouge, LA 70810 – (225) 218-4011



Count	318
Average	-0.01
Count (.4)	209.00
% <= 0.4	66%
Count (.8)	287.00
% <= 0.8	90%

Top of Water and Staff measurements

					m	**ft**
Staff	EPA-B				-0.131	-0.43
					m	**ft**
Staff	EPA-RR				-0.287	-0.94
CDT	**Name**	**Northing**	**Easting**	**Elevation**	**m**	**ft**
6:49pm	PV tow	202587.506	1049067.756	0.131	0.131	0.43
7:36pm	H16-tow	196710.137	1054712.238	0.137	0.137	0.45
8:36pm	Clio-tow	200718.155	1069887.085	0.139	0.139	0.46
Wednesday July 15, 2009						

Benchmarks measured or set

Point listing				
Name	Northing	Easting	Elevation	Feature Code
NEWR2.62	190622.470	1049308.163	6.345	mon
ClioTBM	200609.449	1069713.118	11.714	tbm
PV TBM	202595.105	1049025.429	12.827	tbm
H16 TBM	196813.804	1053404.566	15.714	tbm
TBM RR-OS	191629.615	1062314.669	6.555	tbm
TBM SE1-2-OS	191648.860	1061542.706	8.176	tbm
TBMSE1-1	191623.641	1059937.287	7.396	tbm
TBMBridge	191939.941	1056962.321	10.928	tbm

Hydrology and Hydraulics Final Report in Support of Louisiana Coastal Area, Amite Diversion Canal Modifications Ecosystem Restoration Feasibility Study

Ascension and Livingston Parishes, LA

January 2010

Hydrology and Hydraulics
Final Report

In Support of
Louisiana Coastal Area
Amite River Diversion Canal Modification
Ecosystem Restoration Feasibility Study

Prepared for

Louisiana Office of Coastal Protection and Restoration
450 Laurel Street
Baton Rouge, LA 70804

by

George Hudson, P.E.

Taylor Engineering, Inc.
2133 Silverside Drive, Suite C
Baton Rouge, LA 70808

January 2010

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1.0 INTRODUCTION

The Amite River Diversion Canal Modification Ecosystem Restoration Feasibility Study is being conducted under the federally authorized Louisiana Coastal Area program (Water Resources Development Act, 2007), under a cooperative agreement between the U.S. Army Corps of Engineers (USACE) and the Louisiana Office of Coastal Protection and Restoration (OCPR, formerly Louisiana Department of Natural Resources, Office of Coastal Restoration). OCPR contracted with Taylor Engineering to develop a one-dimensional hydrodynamic model to evaluate existing conditions (No Action Plan) and proposed restoration alternatives (With Project Plan) for the feasibility study (FS). Taylor Engineering worked as part of a Project Delivery Team (PDT) comprised of project managers, scientists, engineers from the OCPR and USACE, local university experts on the Maurepas Swamp, and representatives of the FS lead contractor, GEC, Inc. Taylor Engineering collected field and survey information in support of the analysis with help from Environmental Coastal and Safety Inc. and Anthony Cavell, P.L.S.

The restoration alternatives developed by the PDT consist of proposed openings in the elevated man-made banks of the Amite River Diversion Canal (ARDC). The hydrodynamic model quantifies the exchange between the ARDC and the adjacent bald cypress-tupelo swamp for existing and alternative conditions, together with estimates of anticipated stage duration over a 10-year period. Model results should facilitate further assessment of ecological impacts of alternative plans.

1.1 Study Area

Figure 1.1 (prepared by GEC) shows the limits of the 36 square-mile study area, which lies within the regional western Maurepas Swamp. The study area contains approximately 19,000 acres of subsiding, degraded bald cypress tupelo swamp. In 1963, the USACE constructed the ARDC — a 10.6-mile-long man-made channel — to divert excess flood water from Amite River to Blind River. Blind River discharges into Lake Maurepas approximately 4.8 miles downstream from its confluence with the ARDC. Made from ARDC excavated material at the time of construction, the elevated banks on both sides of the ARDC disrupt the natural hydrologic regime.

The topographic data (based on LIDAR) shows the natural ground elevation in the study area ranges from 1 to 3 feet NAVD-88. [A check of the LIDAR elevation in the study area indicated that for purposes of this study, the LIDAR is compatible with other elevation references to the current vertical datum, NAVD-88 (2006.81).] The natural elevation of the swamp sits just above the mean high water level of Lake Maurepas, 1.0 feet NAVD-88 (2006.81). Some very mild rises, one or two feet above the swamp floor, are present. The overall study area has a mild topographic slope to the south and southeast. The larger channels, such as the Amite River, Blind River, Old River, Bayou Chene Blanc, and Petite Amite River, have typically created their own, very low natural banks, only about one to three feet above the swamp. Exchange via numerous small, shallow sloughs that penetrate the natural low banks dominates the natural exchange between the larger channels and the swamp.

A major regional river, the Amite River drains the Baton Rouge metropolitan area. Its watershed, which extends northward into southwestern Mississippi, encompasses an area of over 1,800 square miles. Lake Maurepas, a coastal water body enclosing over 90 square miles, connects to the Gulf of Mexico via Pass Manchac and Lake Pontchartrain. Lake Maurepas is subject to coastal astronomical and meteorological tides.

The study area and regional swamps are the product of geologically recent Holocene alluvial deposition. Post-glacial rising sea levels, and associated drowning of the lower Mississippi River valley over the last 10,000 years, have created and reworked the vast coastal deltas and river floodplains of southeast Louisiana. Similar processes, at a much smaller scale, occurred at the mouth of the Amite River. The combination of Mississippi River and Amite River depositional processes formed and sustained the western Maurepas Swamp before human intervention. Modification of regional hydrology over the last two centuries has substantially reduced the natural nourishment of the swamp, prevented mineral sediment introduction, and impaired vegetation productivity and the generation and maintenance of organic substrate. One major aspect of the swamp degradation has been the inability of the ground level to keep pace with the natural subsidence of the fine, poorly consolidated deltaic and alluvial sediments.

The inflow hydrograph from Amite River and stages in Lake Maurepas influence present-day stage, discharge, and the duration of flood and dry conditions in the study area. A recent Amite River flood event occurred with heavy rainfall in the upper watersheds during Tropical Storm Allison in 2001. This river-dominated flood raised swamp water surface elevations (WSE) to over 4 feet NAVD-88. Hurricanes Rita in 2004 and Ike in 2008 both produced high stages in Lake Maurepas on the order of 5 feet NAVD-88. Hurricane Juan in 1985 produced even higher stages in Lake Maurepas. Low stages occur in the Amite River and Lake Maurepas sporadically between the late spring and fall. When low flows in the Amite River basin combine with extended periods of northerly winds, the stage in Lake Maurepas drops and causes substantial drainage of the swamps.

1.2 Overview of Modeling

Taylor Engineering used the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) program to model study area flow and stages. The HEC-RAS unsteady state routine simulates channels and adjacent floodplain swamps as a one-dimensional hydrodynamic system. The model treats the swamp adjacent to the ARDC as a storage area. HEC-RAS uses Modified Plus or level pool routing to simulate a storage area. HEC-RAS does not simulate two-dimensional flow patterns in the swamp. Taylor Engineering used U. S. Geological Survey (USGS) stream gage data for the upstream boundary condition (inflow hydrograph) and for the downstream boundary condition (stage hydrograph). Chapter 2 describes the development of the HEC-RAS model, calibrated with 2005 data from two OCPR swamp gages.

To simulate the No Action Plan and the ARDC modification, Taylor Engineering conducted long-term hydrologic simulations of the study area based on average daily discharge and daily stages for the 10-year period from January 1, 1999 to December 31, 2008. Extracted estimates of flood and drying days established the current or baseline conditions needed to evaluate the proposed alternatives. Chapter 3 describes the HEC-RAS modeling for the No Action Plan and the With Project Plan, which represented seven different alternatives, and presents the results.

Taylor Engineering evaluated the potential hydrologic impact on the No Action Plan and the modification alternatives for estimates of relative sea level rise (RSLR) in accordance with guidance provided by the USACE, New Orleans District. Chapter 4 describes the analysis of RSLR effects on the alternative plans and provides the results.

Finally, Taylor Engineering used 1-, 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year return period inflow flood hydrographs as the upstream boundary to model potential impacts of the alternatives on flood conditions. For purposes of flood analysis, the downstream boundary was set to a constant elevated stage of 2.0 feet NAVD-88 (2006.81). The USACE Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS), developed for the Amite River and Tributaries Amite River Ecosystem Restoration Feasibility Study, computed the inflow hydrographs.. Chapter 5 describes the flood impact analysis and provides the results.

Chapter 6 presents conclusions from the hydrologic and hydraulic analysis of the ARDC modification alternatives.

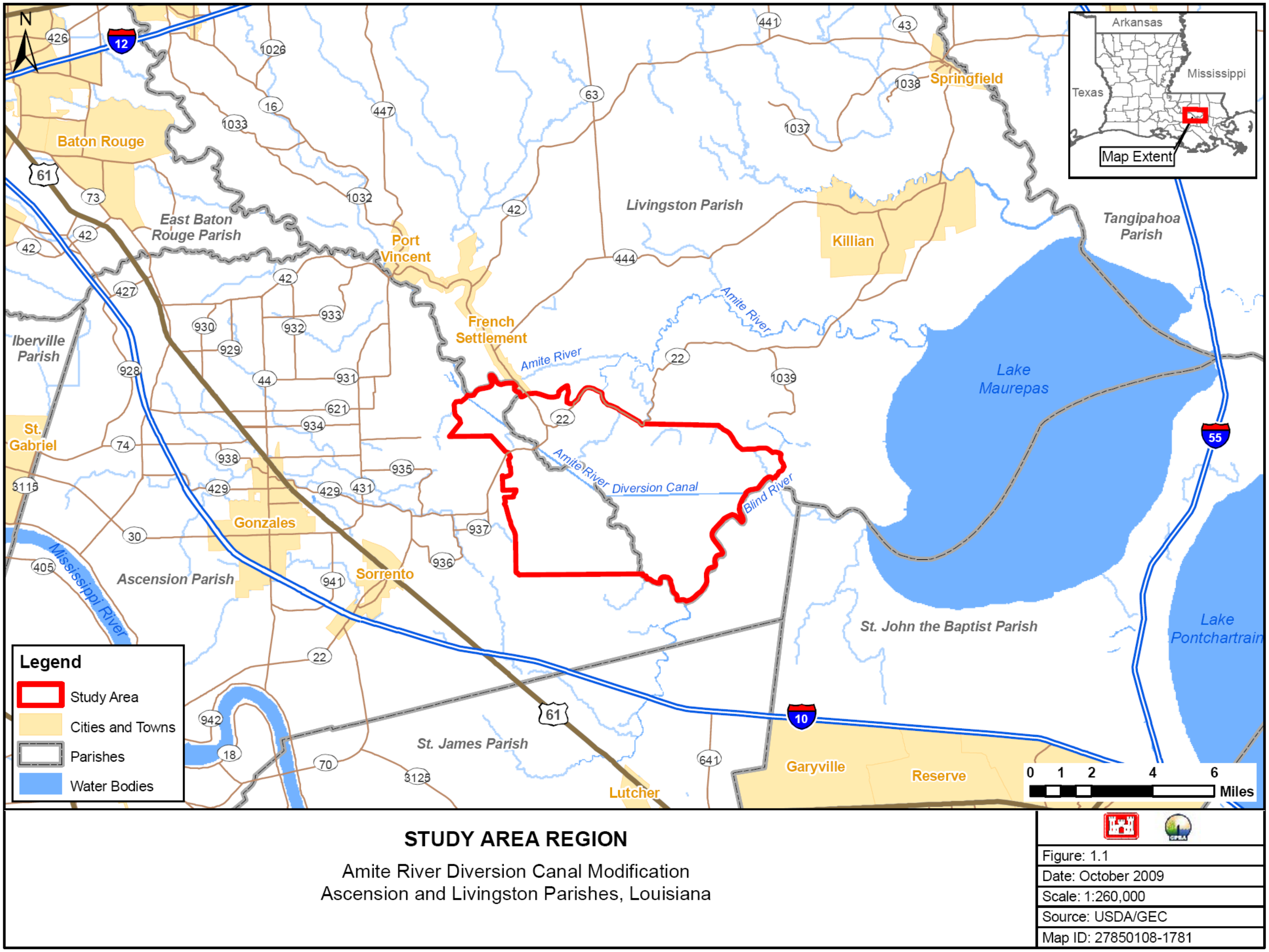

Figure 1.1 Study Area

2.0 HYDROLOGICAL MODEL DEVELOPMENT AND CALIBRATION

2.1 Model Development and Geometry

The HEC-RAS one-dimensional model simulates daily flows and stages in the study area, including the exchange between major channels and the surrounding swamp. A review of the OCPR gage data for 2005 shows the model had to simulate the hydrological conditions from stage as low as -1.0 feet NGVD to a high as 5.0 feet NGVD. In order to simulate these conditions, the model geometry incorporated eight major river reaches and six major swamp storage areas. Streams and storage areas in the HEC-RAS geometry file for the current conditions (calibration model) include

- Amite River, from upstream of the ARDC to Lake Maurepas
- Amite River Diversion Canal, from its confluence with Amite River to Blind River
- Blind River, from the Petite Amite River to Lake Maurepas
- Petite Amite River, from the ARDC to Blind River
- Petite Amite River, north of the ARDC to storage area NW-2
- Old River, from Amite River to Chinquapin Canal
- Chinquapin Canal, from Old River to Bayou Chene Blanc
- Bayou Chene Blanc, from Chinquapin Canal to Blind River
- Storage areas North West 2 (NW-2), North East 1 (NE-1), North East 2 (NE-2) South West 2 (SW-2), South East 1 (SE-1), and South East 2 (SE-2)

Natural ridges, man-made features such as an abandoned railroad embankment and the ARDC banks, and streams that provide a source of water during high stages or high flow provided fixed points to delineate storage areas. Lateral structures, culverts, and connections in the model simulate flow into and out of the storage areas.

Figure 2.1 presents the HEC-RAS geometry file for the calibration model.

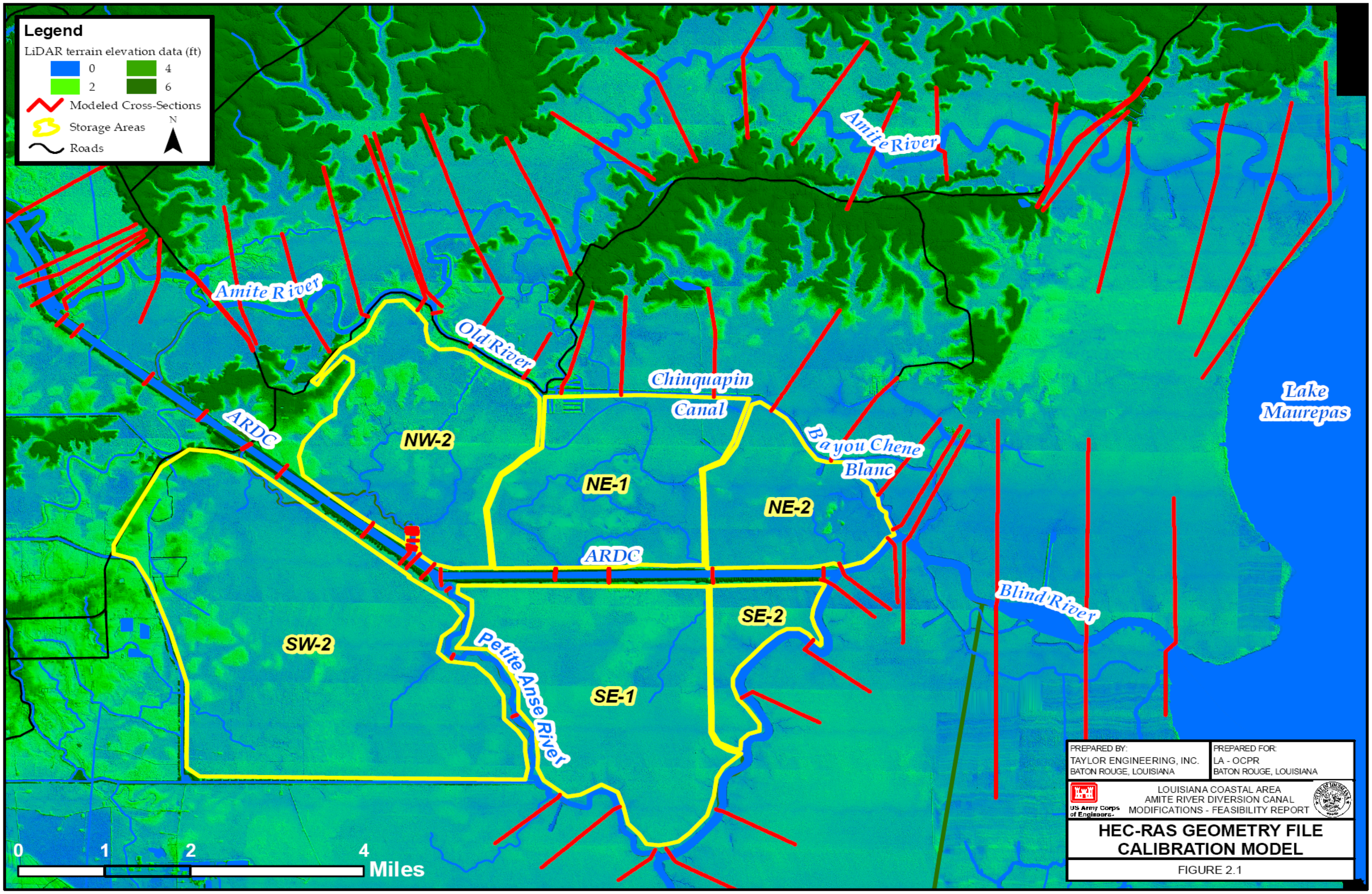

Figure 2.1 HEC-RAS Geometry File Calibration Model

2.2 Key Model Features

Storage areas and hydraulic connections were used to simulate flow and stages in the swamp. HEC-RAS uses Modified Plus or level pool routing to compute stages in a storage area. A one-dimensional model, HEC-RAS does not simulate flow circulation within the swamp.

Generally, the exchange between the study area channels (the ARDC, rivers, bayous, and sloughs) and the swamp remains very slow at low stages and increases significantly at high stages. Banks associated with natural streams and areas of sediment deposition, with elevations ranging from 1.2 to 3 feet, contain the swamp storage areas. For low flow conditions, culverts (and associated equations) maintain continuity of flow and stabilize the unsteady state simulation. For high stage overbank flow conditions between the channels and the swamp, weir features (and associated equations) perform a similar function. Weirs represent high stage conveyance at lateral structures, storage area connections, and road embankments. Model calibration entailed adjusting weir lengths and weir elevations to obtain a best fit when comparing the model output to the observed stage data.

2.3 Model Boundary Conditions

The following mean daily stage data (2005) from two USGS gages provided the upstream and downstream boundary conditions for model calibration.

- Amite River at Port Vincent, Louisiana. The mean daily discharge data for this gage represents the upstream inflow boundary condition.
- Amite River at Highway 22 near Maurepas, Louisiana. The mean daily stage for this gage represents the downstream stage boundary conditions, i.e., the stage in Lake Maurepas.

Taylor Engineering arranged for surveying of the USGS gages and adjusted the stage data to NAVD-88 (2006.81). Table 2.1 lists information for these two regional USGS gage stations, together with a third gage at French Settlement. Figure 2.2 shows the locations of the three USGS gages. Figure 2.3 includes hydrographs for the USGS gages adjusted to NAVD-88 (2006.81).

Table 2.1 List of USGS Gages

Station No.	Station Name	Data	Dates	Peak Stage*
7380120	Amite River at Port Vincent	Flow and stage	10/1984 to present	12.73 ft NGVD-29, June 11, 2001; 14.65 ft NGVD-29, April 9, 1983 obtained from observation
07380200	Amite River near French Settlement	Stage	1950 – 1992 1996 to present	7.40 ft NGVD-29, April 29, 1977
07380215	Amite River at Hwy 22 near Maurepas	Stage	1998 to present	5.40 ft NAVD-88, August 13, 2008

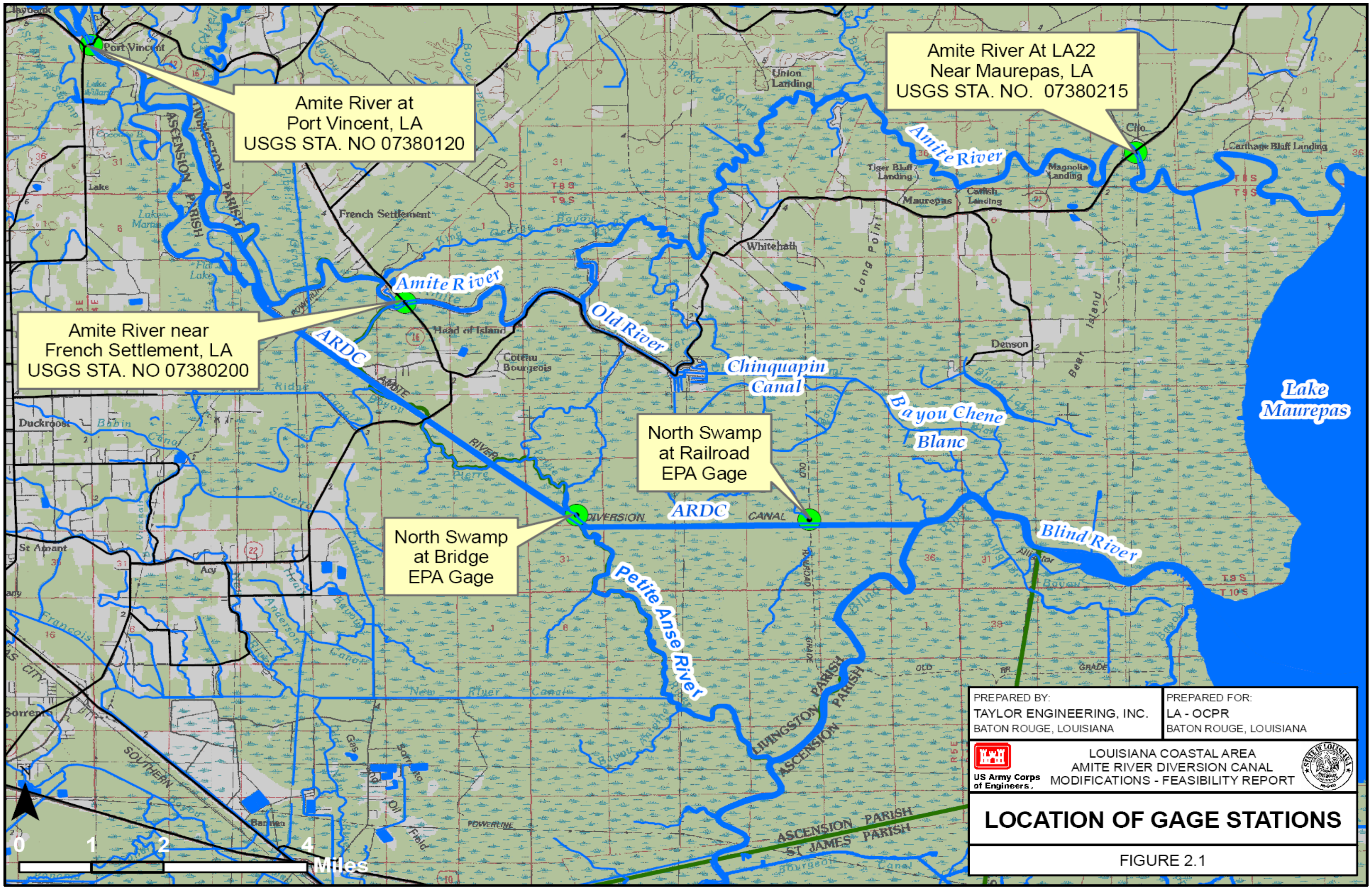

Figure 2.2 Location of Gage Stations

2.4 Model Calibration Data

Taylor Engineering used data from two swamp gages installed and operated by OCPR in 2005, to calibrate model parameters. The gage labeled “North Swamp at Bridge” — located near the bridge over the Petite Amite River, north of the ARDC — represents a swamp area with good hydraulic connection to the ARDC. The gage labeled “North Swamp at Railroad” — located near an abandon railroad embankment, north of the ARDC — represents an area with no connection to the ARDC. Figure 2.2 (above) shows the locations of the OCPR gages North Swamp at Bridge and North Swamp at Railroad.

At the time of installation, OCPR and USEPA placed staff gages at each station with the continuous recording gages referenced to the zero level on the staff gage. Taylor Engineering inspected the gage locations in 2009, including staff gages at the North Swamp at Bridge and North Swamp at Railroad, and arranged for surveying the two swamp staff gages in order to adjust the stage records to NAVD-88 (2006.81). OCPR provided the continuous stage data for the gages from January 21, 2005 through December 1, 2005 and Taylor Engineering corrected the data to NAVD-88 (2006.81). Figure 2.3 includes the 2005 stage data for the two OCPR swamp gages, adjusted to NAVD-88 (2006.81).

The Amite River gages show low stages for several weeks during a dry period in May 2005. Both OCPR swamp gages — North Swamp at Railroad and North Swamp at Bridge — show stages below the typical natural ground elevations, 1.0 to 1.2 feet NAVD-88 (2006.81), during the period. The gages allowed for water level measurements below the local ground surface. The swamp gages show that surface water levels for this period reflect substantial draining of free standing water from the swamp and the influence of shallow groundwater elevations.

Taylor Engineering used the mean daily stage for the third regional USGS gage, Amite River near French Settlement, as part of an overall evaluation of model performance.

2.5 Calibration Results

From the above model geometry and boundary conditions, the HEC-RAS model simulated the January 21, 2005 through December 1, 2005 period. HEC-RAS computed flows and stages at each cross section and for each storage areas. Figures 2.4 and 2.5 present comparisons of the observed and computed stages for North Swamp at Bridge and the North Swamp at Railroad. Calibration results show the following:

- The model cannot simulate below grade (groundwater) swamp WSE in May 2005.
- The model produces slightly higher average (0.12 foot) WSE for the North Swamp at Bridge than the observed data.
- The model produces slightly higher average (0.01 foot) WSE for the North Swamp at Railroad than the observed data.

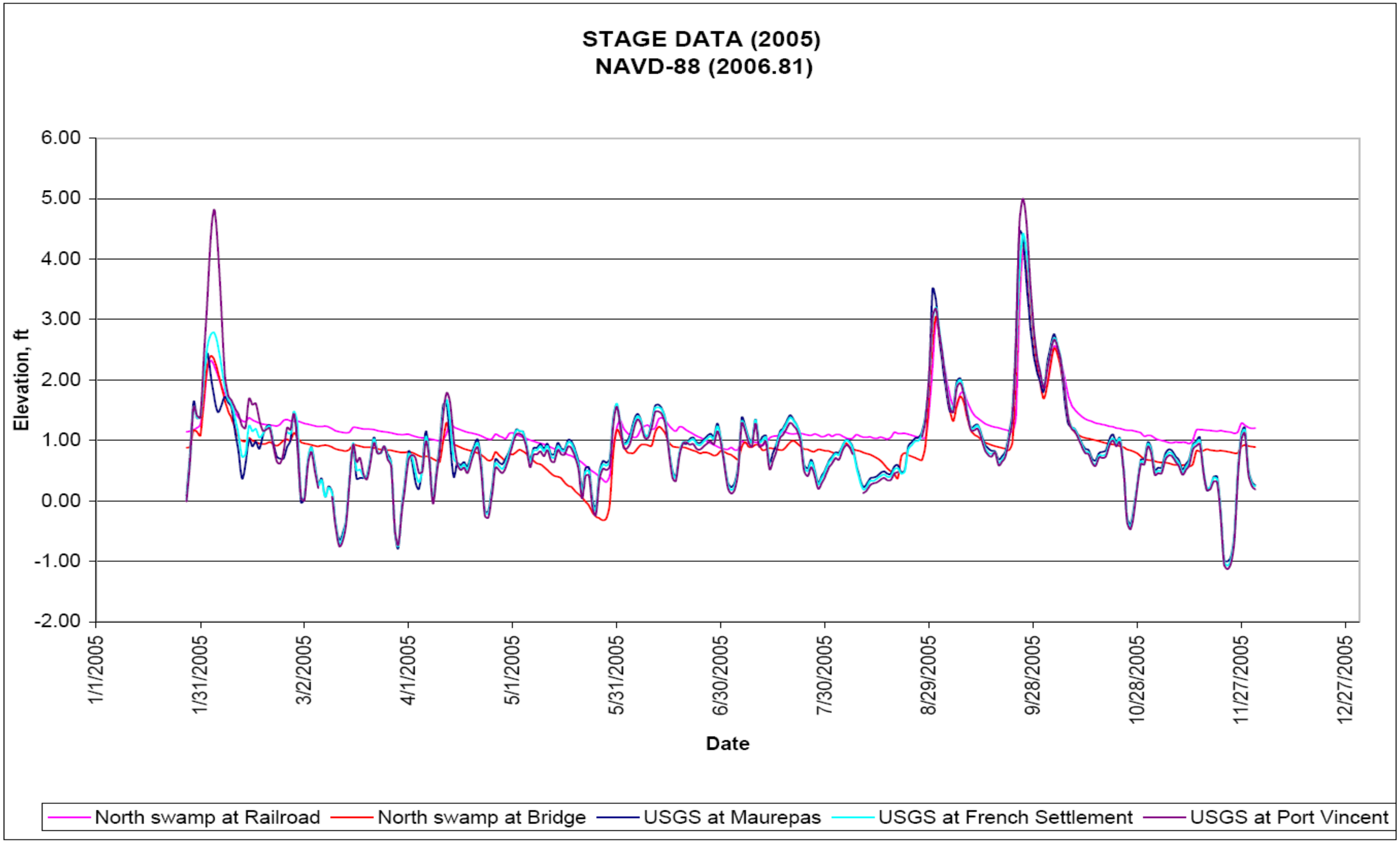

Figure 2.3 Stage Data NAVD-88 (2006.81)

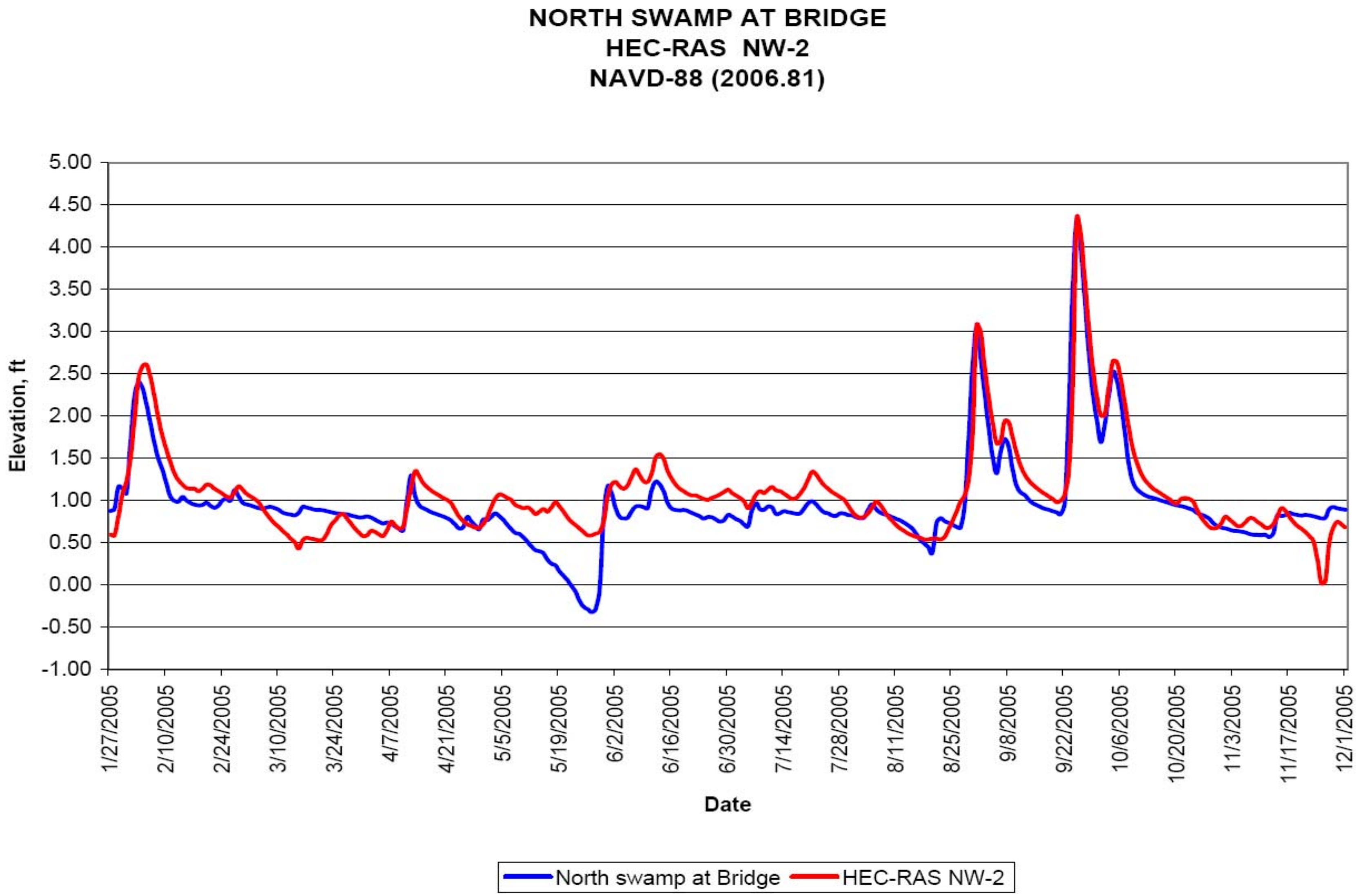

Figure 2.4 HEC-RAS Model and North Swamp at Bridge

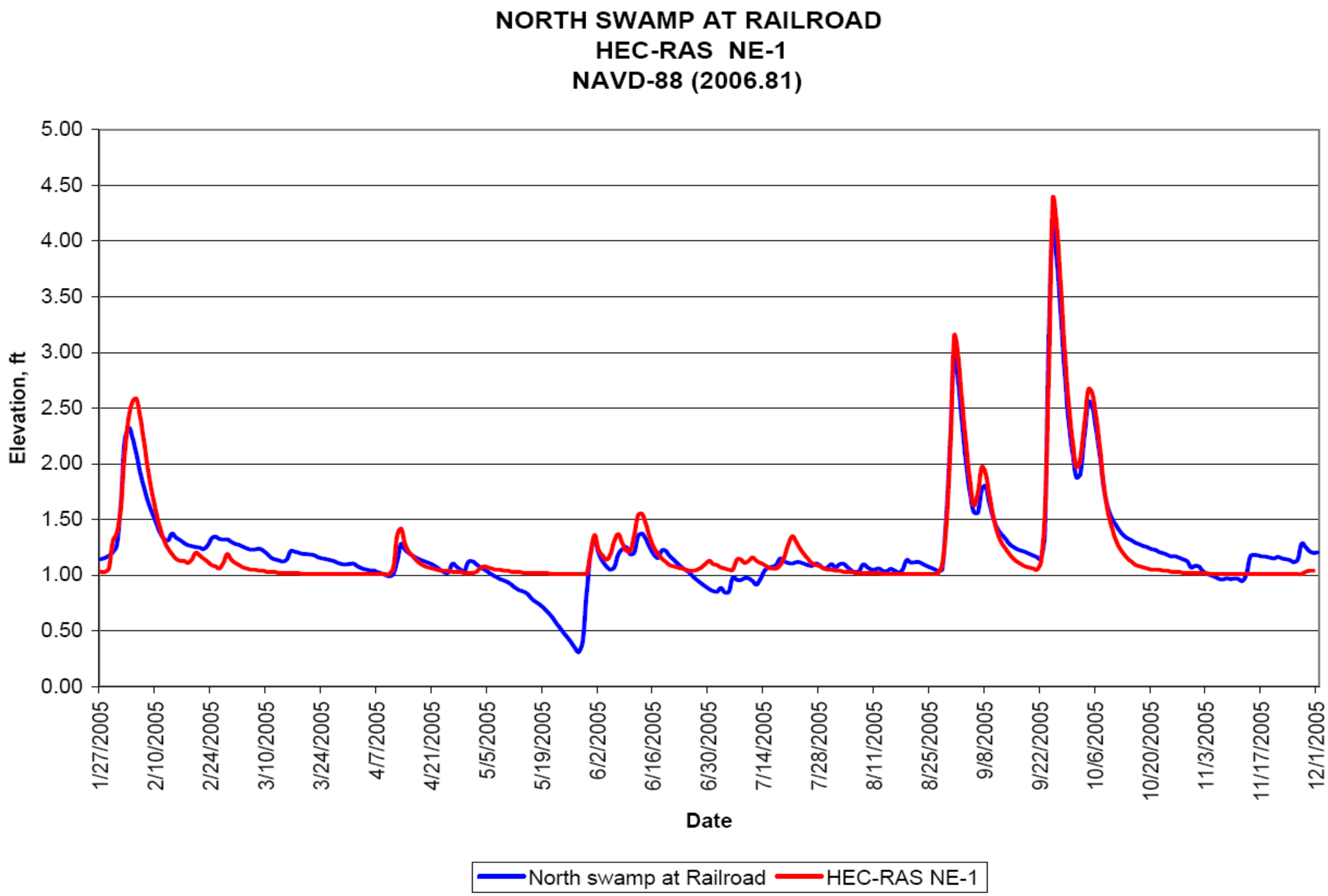

Figure 2.5 HEC-RAS Model and North Swamp at Railroad

3.0 SIMULATION OF ALTERNATIVE PLANS

3.1 General

The PDT developed conceptual alternatives to restore the hydrologic exchange between the ARDC and adjacent swamp in accordance with the federal authorization for the project and previous preliminary reconnaissance-level studies (GEC, 2008) The basic objective of the alternatives is to improve the hydraulic connection between the ARDC and the surrounding swamp, and thereby improve the swamp habit. The improved hydraulic connection should enhance inflow from the ARDC into the swamp and associated enrichment of swamp nutrients and sediments. The improved connection should also facilitate swamp drainage during periods of low flow and stages on the ARDC and Lake Maurepas, and thereby extend dry periods necessary for vegetation productivity.

3.2 Conceptual Design of Alternatives

The PDT conducted field investigations, held meetings, and discussed the nature and functioning of existing sloughs that control the present hydraulic exchange between major channels and the swamp. The characteristics of the existing sloughs provide a reasonable guide for the hydraulic design of new, self-sustaining channels. The proposed exchange channels should ideally mimic natural slough conveyance and the discharge from the swamps during periods of low flow and low stages.

Several natural sloughs surveyed during the field investigation provide the geometry of typical self-sustaining exchange channels, including the cross-sectional area (width and depth of opening) and length into the swamp. A comparison of the bathymetry of these natural sloughs with the size of the swamp area they appeared to drain — based on LIDAR data — helped to develop the following template for the proposed exchange channels:

- Beginning at the ARDC, a 20-foot bottom width opening
- Invert elevation of -5 feet NAVD-88 (2006.81)
- Top width of approximately 70 feet
- 3 horizontal to 1 vertical side slopes throughout
- Length from ARDC up into swamp of several thousand feet
- Tapering to a cross section with a 10-foot bottom width at the upper end of the channel
- Minimum invert elevation of -1 foot NAVD-88 (2006.81) in the upper channel
- Minimum top width of approximately 30 feet in the upper channel

Figure 3.1 illustrates the design for a proposed new exchange channel.

The PDT identified five locations for the new exchange channels based on degraded swamp areas that are converting to marsh, as well as other design constraints such as the existing residential development near the ARDC. Located within two storage areas, SE-1 and NE-2, the five proposed exchange channels include SE-1-1, SE-1-2, NE-2-1, NE-2-2, and NE-2-3.

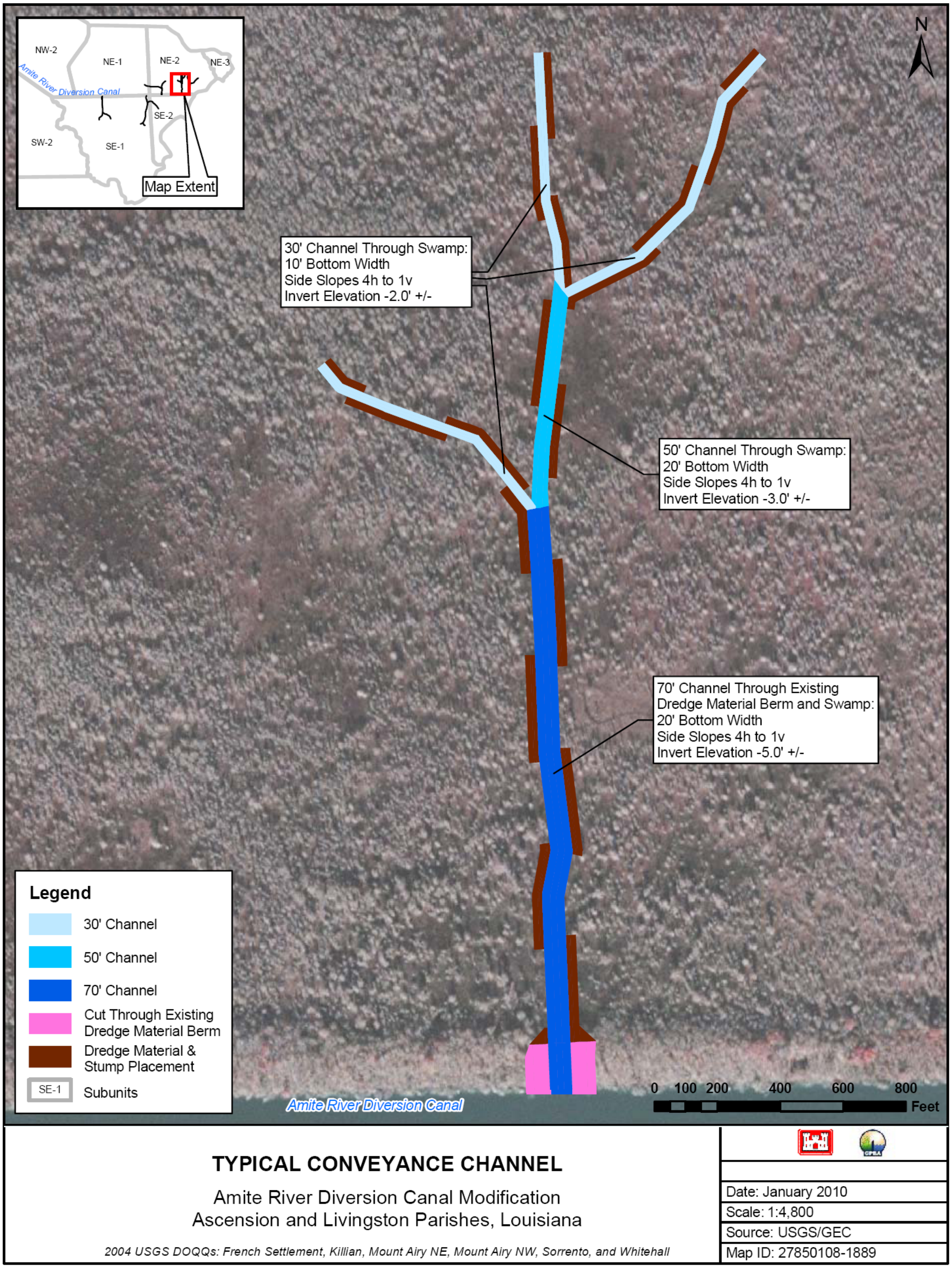

Figure 3.1 Typical Channel

The PDT then developed the seven alternatives in the list below. Each alternative represents selected combinations of the five channel locations and the benefit areas. Figures 3.2 through 3.8 (prepared by GEC) present the plan features and show the locations of the proposed exchange channels.

- Alternative 33: on the north side of the ARDC, three exchange channels (NE-2-1, NE-2-2, and NE-2-3) extending into storage area NE-2
- Alternative 34: on the south side of the ARDC, a single exchange channel (SE-1-2) extending into storage area SE-1
- Alternative 35: on the south side of the ARDC and west of Alternative 34, a single exchange channel (SE-1-1) extending into storage area SE-1
- Alternative 36: four exchange channels that combine Alternative 33 and Alternative 34
- Alternative 37: two exchange channels that combine Alternative 34 and Alternative 35
- Alternative 38: four proposed exchange channels that combine Alternative 33 and Alternative 35
- Alternative 39: five exchange channels that combine Alternative 33 and Alternative 37

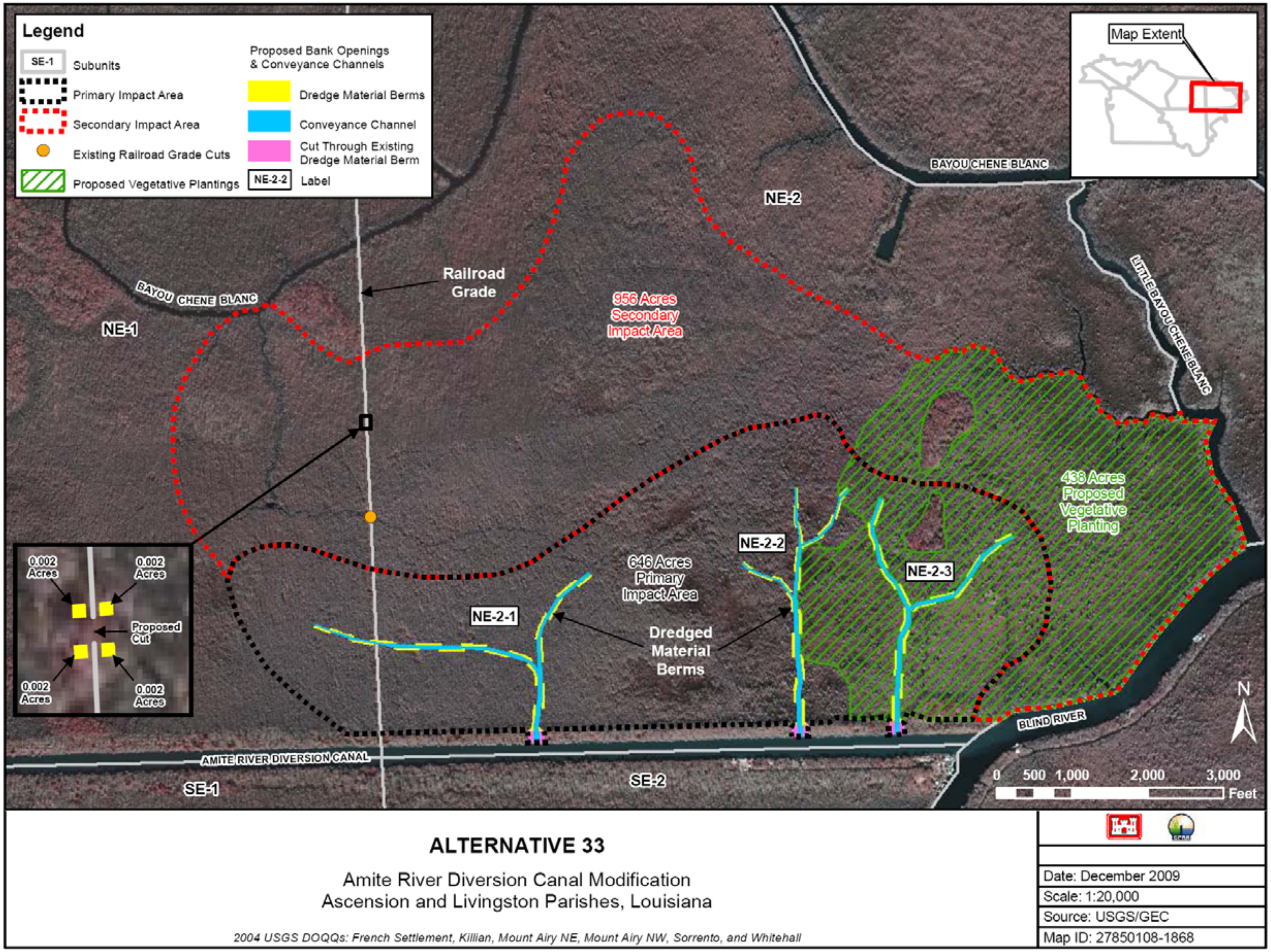

Figure 3.2 Alternative 33

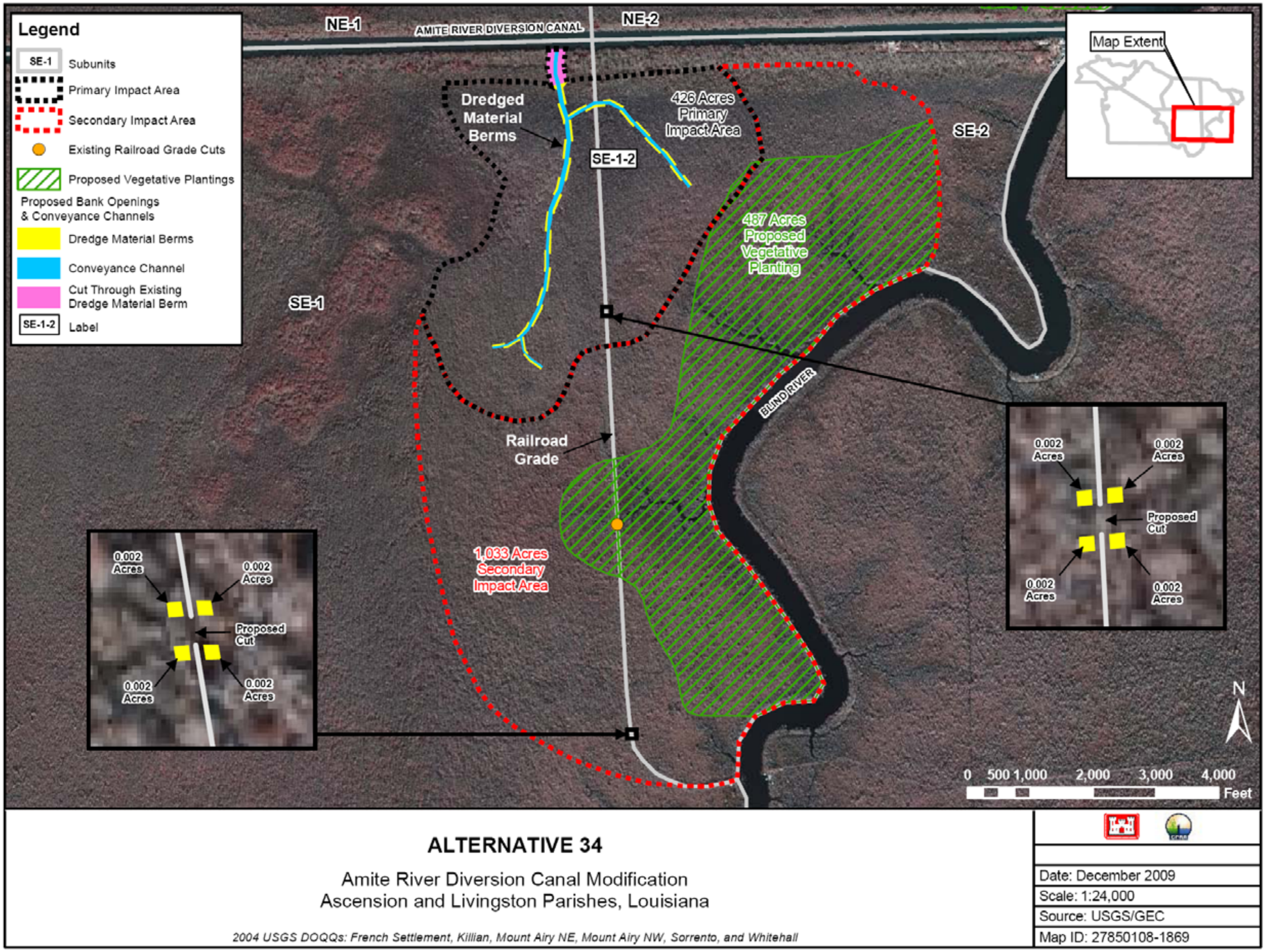

Figure 3.3 Alternative 34

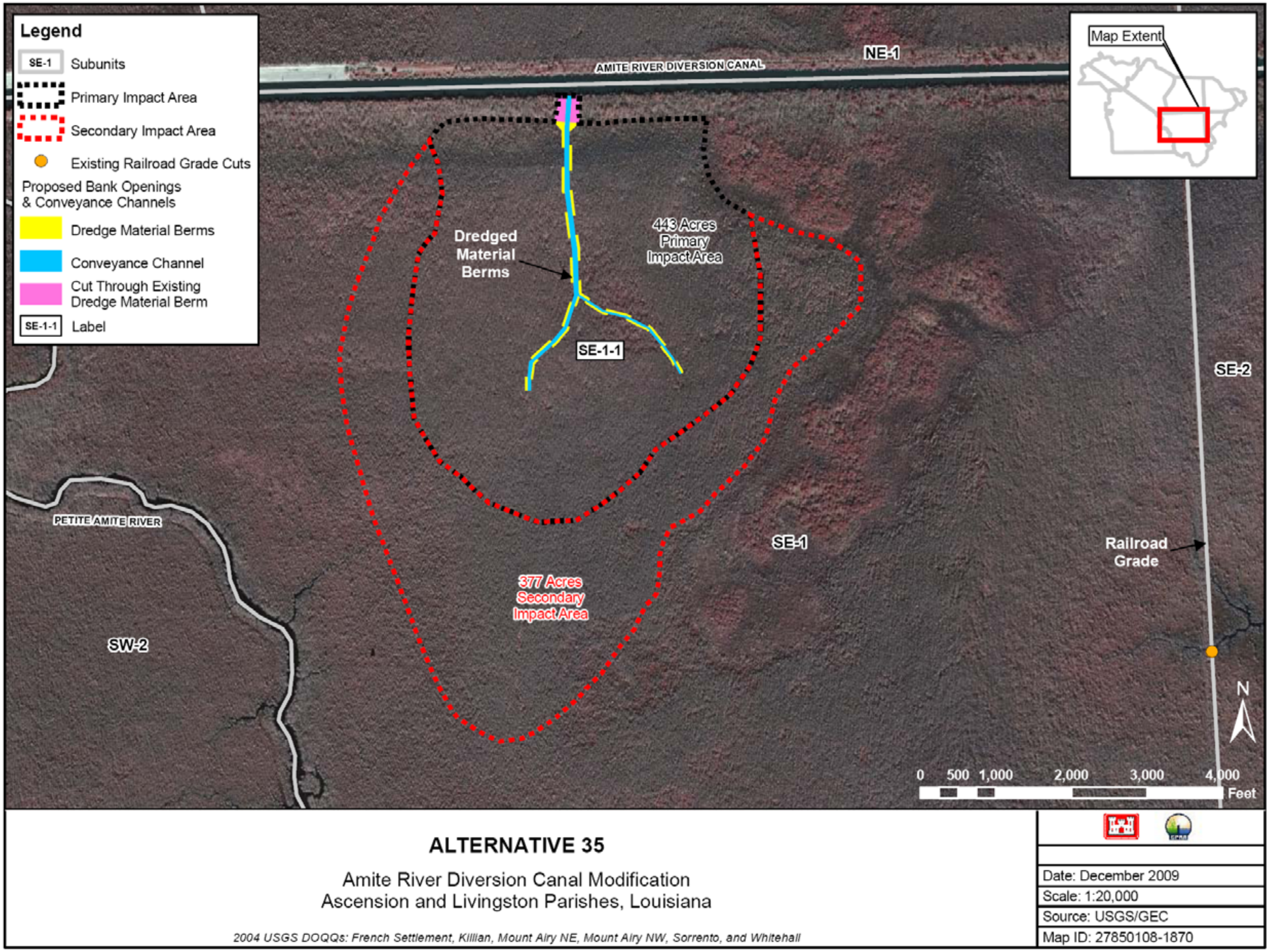

Figure 3.4 Alternative 35

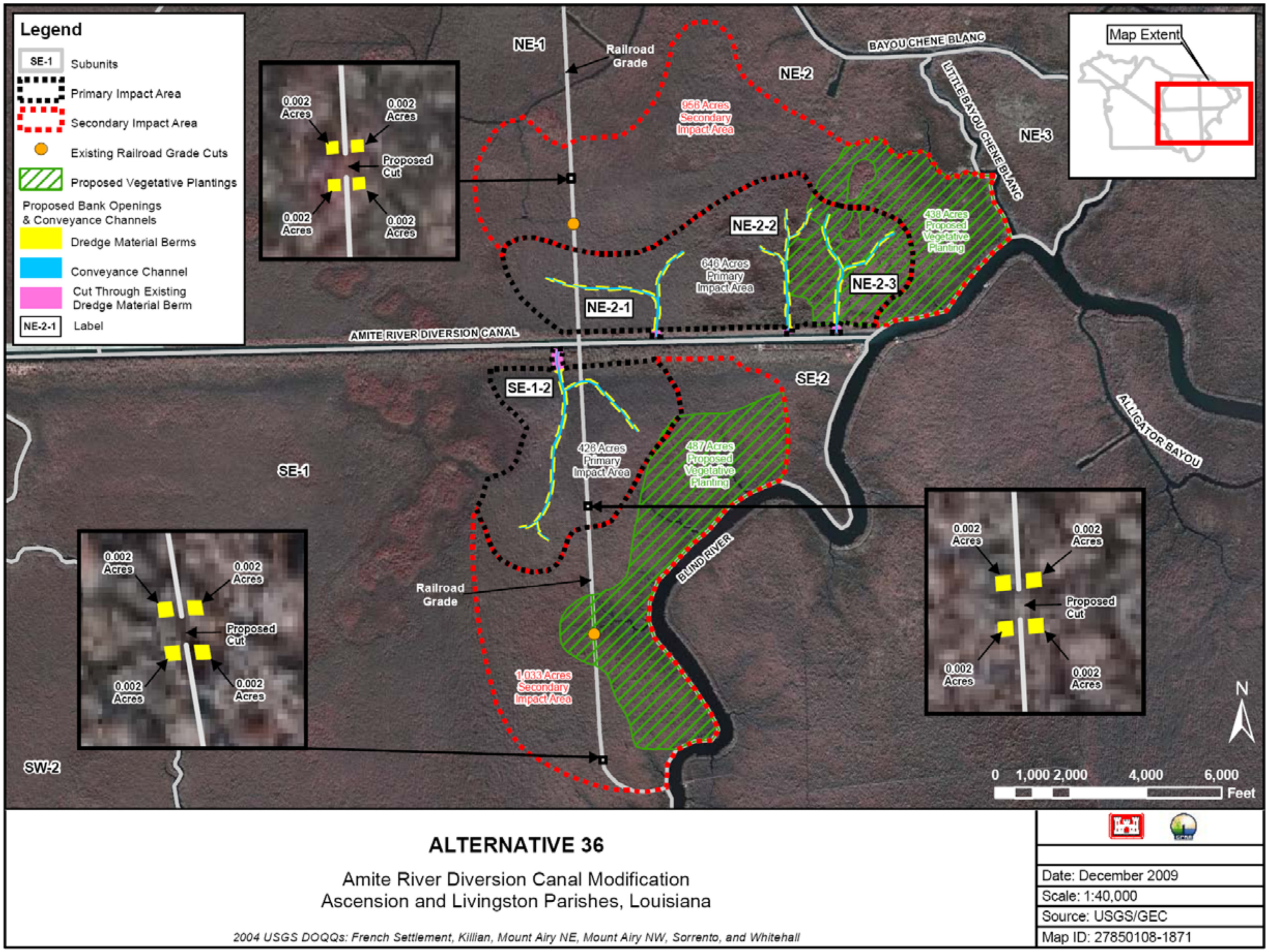

Figure 3.5 Alternative 36

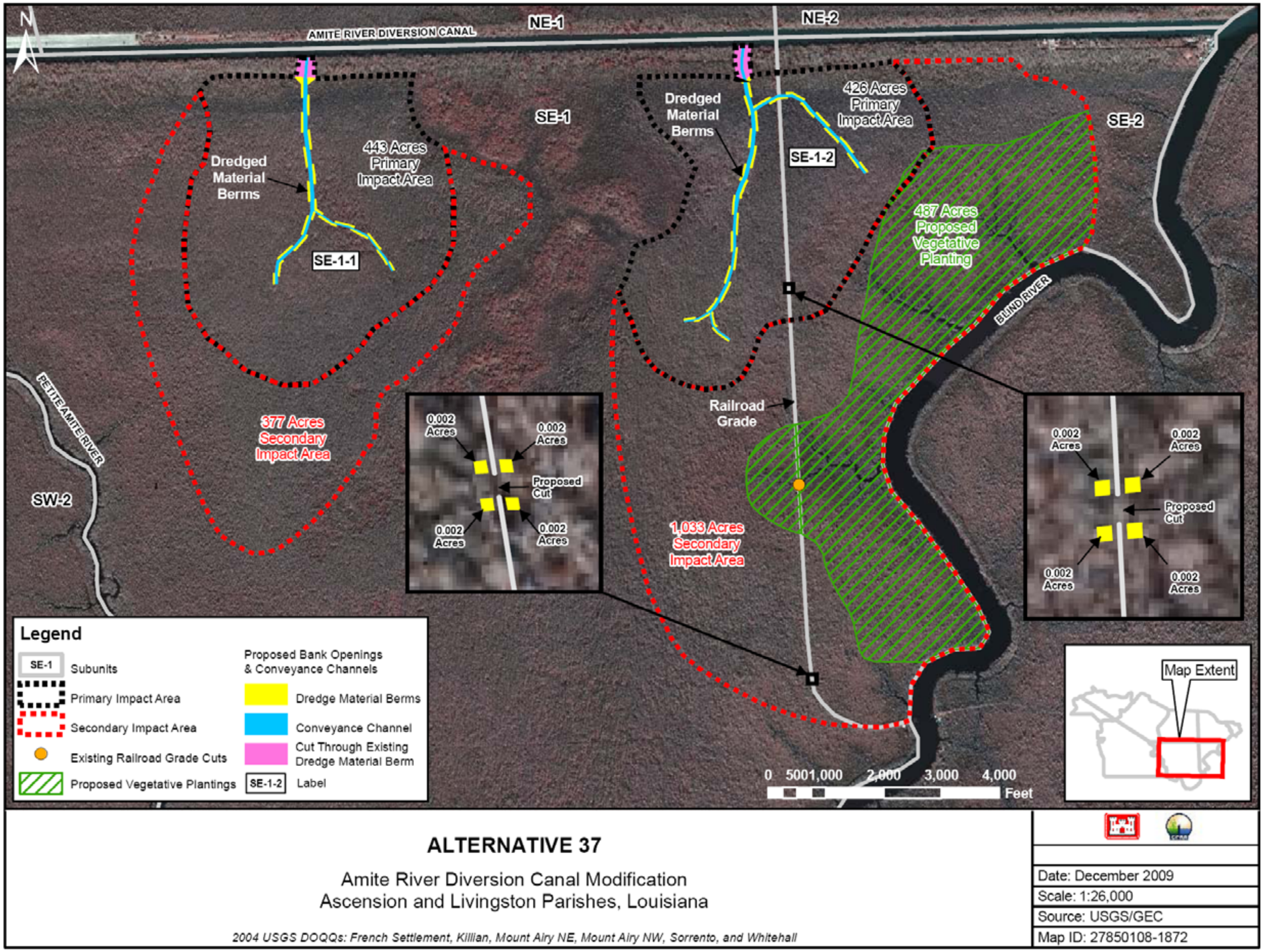

Figure 3.6 Alternative 37

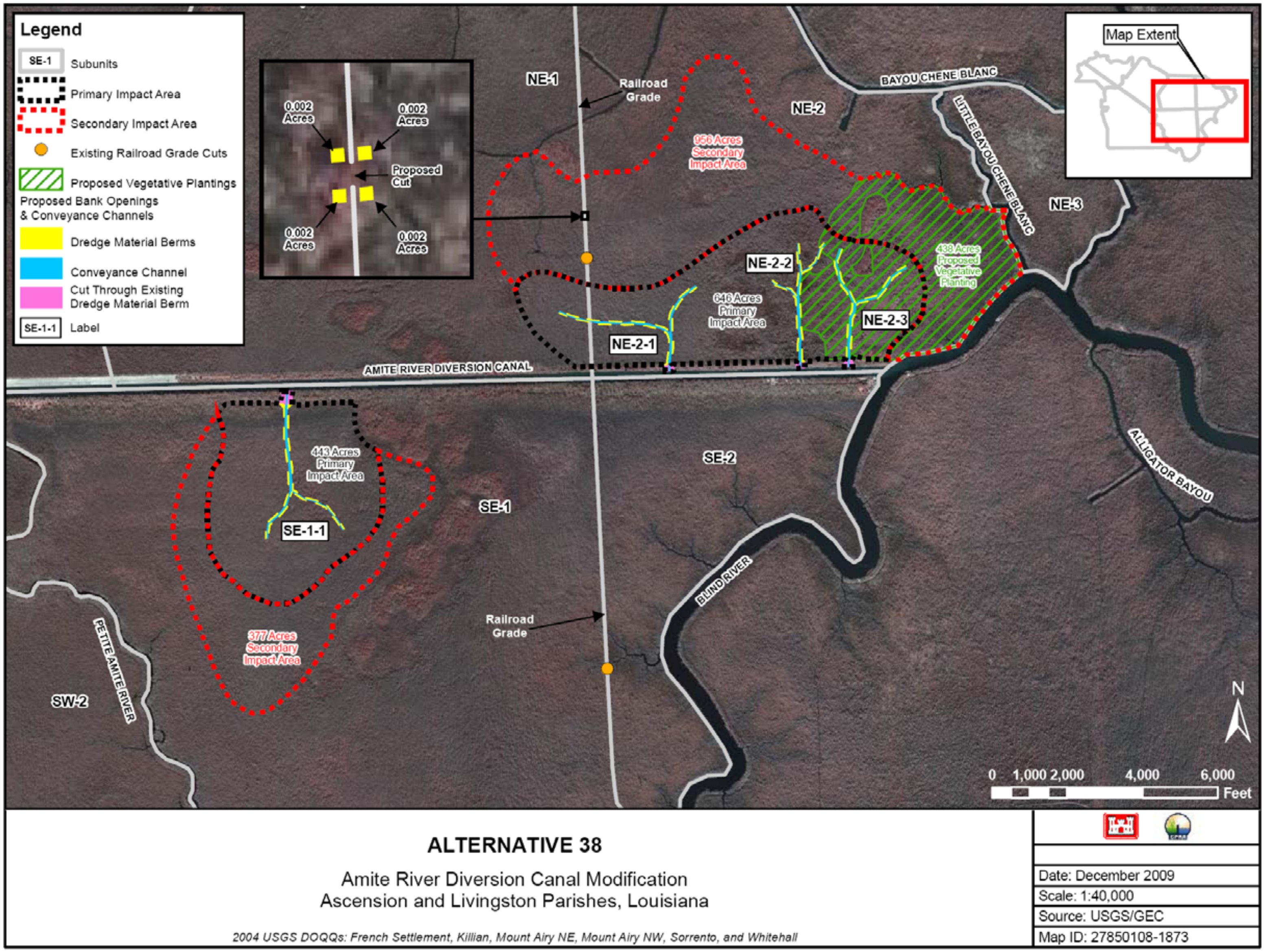

Figure 3.7 Alternative 38

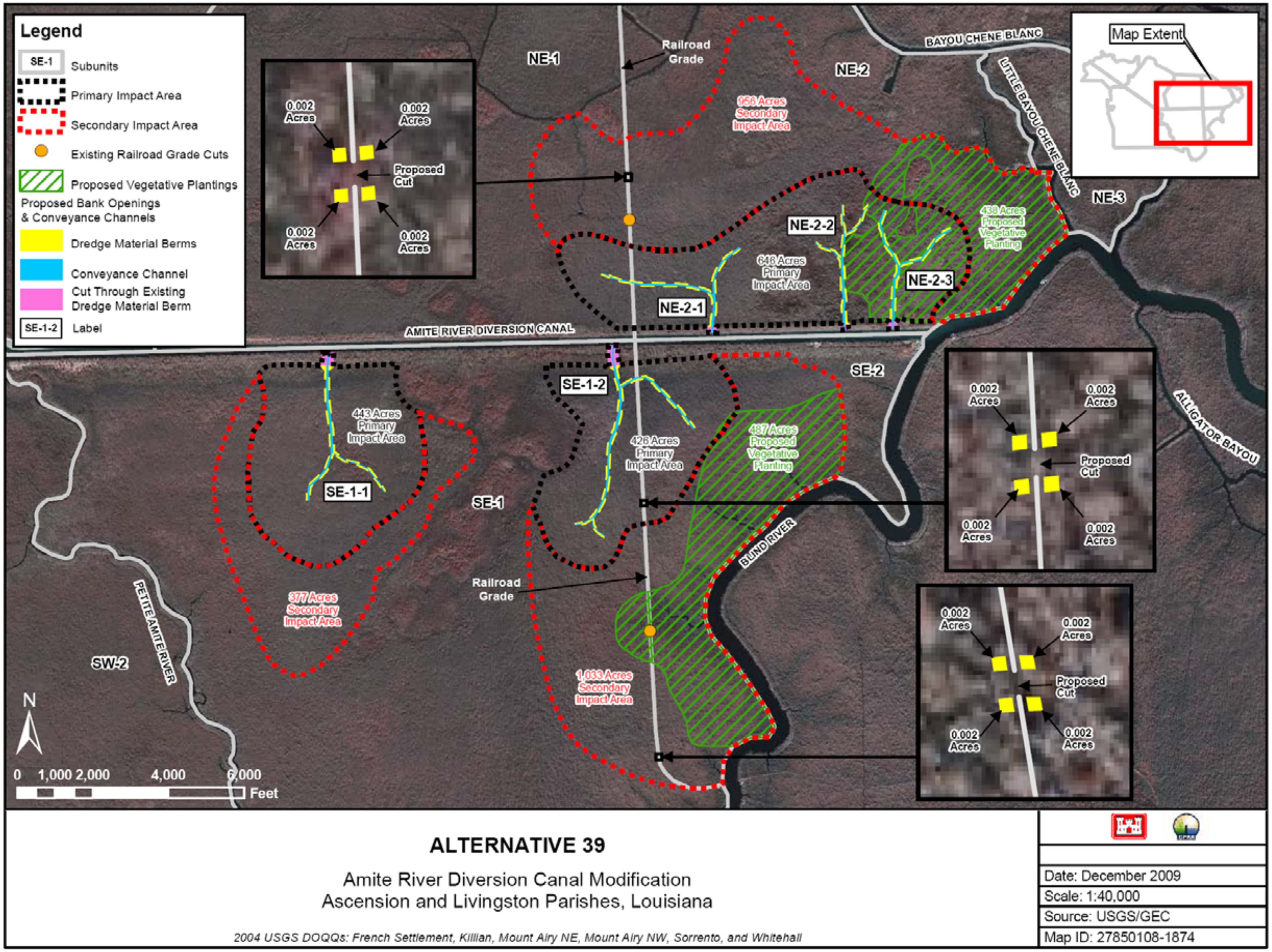

Figure 3.8 Alternative 39

3.3 Geometry File Development

Taylor Engineering developed HEC-RAS geometry files for the No Action Plan and With Project Plan. The geometry of the No Action Plan reflects the existing channels and storage area conditions, as represented in the previously described geometry for the calibration model. The model of the No Action Plan provides base-line conditions for comparison to the alternative plans.

Several factors contributed to the creation of the With Plan geometry file. First, the flow volume and the flow rate through each of the five individual exchange channels is insignificant compared to the total volume, discharge, and the stage in the ARDC. Second, the hydraulic performance of each proposed exchange channel is independent of the others. As such, the With Project geometry file includes all five exchange channels used to analyze the seven alternatives. In the single With Project geometry file, Taylor Engineering slightly increased the size of storage areas NE-2 and SE-1, and correspondingly decreased the size of storage areas NE-1 and SE-2, to capture some of the impact of the proposed degradation of the railroad embankments. Figure 3.9 illustrates the With Project Plan geometry file.

The HEC-RAS geometry file for the With Project Plan represents each proposed exchange channel from the intersection of the ARDC; each exchange channel extends into the swamp for several hundred feet, with cross-sectional dimensions as described above. As with the existing conditions (No Action Plan) model, a road embankment and a culvert crossing the exchange channel represent flow control between the ARDC and the swamp storage area in the new exchange channels. The road embankment and culvert allow simulation of the exchange of flow between the channel and the swamp under both high flow (overbank flow) and low flow (normal conditions).

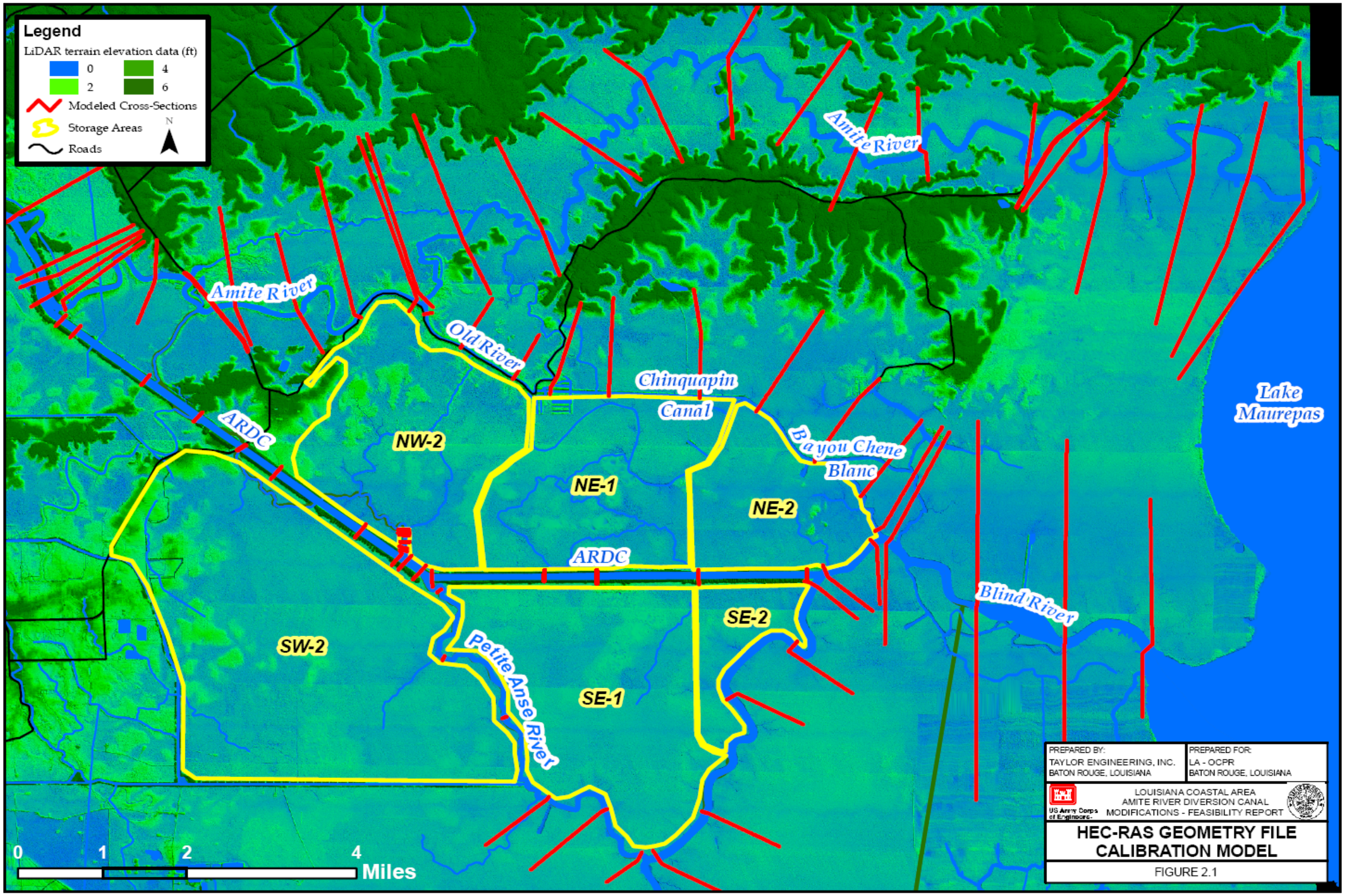

Figure 3.9 HEC-RAS Geometry File for with Project Plan

3.4 Model Boundary Conditions

The hydrological analysis of the No Action Plan and the With Project Plan must consider the possible effects of three other federal projects authorized for construction within the Amite River and the Blind River Watersheds. These three projects include two feasibility studies — the LCA Small Diversion at Convent/Blind River and the LCA Small Diversion at Hope Canal — and a flood risk reduction project — the Amite River and Tributaries (AR&T), Comite River Diversion Canal — currently under construction.

Given the control exerted by the Amite River and Lake Maurepas on study area water levels, the selection of any particular model boundary condition greatly influences the model results. Therefore, Taylor Engineering recommended evaluating the No Action Plan and the restoration alternatives by simulating conditions over a very long timeframe, and assessing the impact to episodic flood and dry conditions in the swamp storage areas. Based on data availability for the upstream (Amite River at Port Vincent) and downstream (Amite River at Maurepas) boundary conditions, Taylor Engineering selected the historical 10-year period of January 1, 1999 to December 31, 2008.

Upstream boundary conditions incorporate the inflow hydrographs from the Blind River Diversion Project and the Hope Canal Diversion Project. The combined inflow hydrographs for the Blind River and the Hope Canal diversions were input into the HEC-RAS model at the confluence of Petite Amite River and Blind River. The LCA Small Diversion at Convent/Blind River and the LCA Small Diversion at Hope Canal projects are currently a feasibility study and the hydraulic design and operating plans have not been determined. The USACE, New Orleans District provided hydraulic design information concerning the design flows and the operating plans. The following summarizes the hydraulic design for the Blind River Diversion and the Hope Canal Diversion projects:

LCA Small Diversion at Convent/Blind River

- Design discharge (January through May) – 1000 to 2500 cubic feet per second (cfs) with 1500 cfs estimated as a good planning discharge rate
- Design discharge (June through November) – 500 cfs
- Diversion flows pulsed 15 days with and 15 days without flow

LCA Small Diversion at Hope Canal

- Design discharge (January through May) – 2000 cfs
- Design discharge (June through November) – 500 to 1500 cfs

- Diversion flows pulsed 10 days with and 20 days without flow
- Approximately 50% of the flow diverted to Blind River

The combined inflow hydrograph for the diversion flows from the Blind River and the Hope Canal diversion projects totals 3,000 cfs (January through May) and 1,500 cfs (June through November).

Taylor Engineering also incorporated the Comite River Diversion Canal project in the Amite River inflow boundary. The Comite River Diversion Canal is designed to divert approximately 50% of the Comite River flow during a flood event. (The Comite River enters the Amite River in Denham Springs, Louisiana, well above the study area.) During low flow periods (flows less than approximately 1,200 cfs), no flow is diverted out of the Comite River. Results from the existing HEC-HMS and HEC-RAS models for the Amite River basin indicate that the Comite River Diversion Canal will reduce flow on the Amite River by approximately 7% during flood events. Taylor Engineering therefore adjusted the Amite River at Port Vincent boundary inflow downward by 7% for flood events.

3.5 Model Results

Tables 3.1 present model results for the No Action Plan and the With Project Plan. Table 3.1a presents a summary of the computed flows in the exchange channels. Table 3.1b and 3.1c present a comparison of stage duration (in days) in swamp storage areas SE-1 and NE-2. Table 3.1b combines results for the two exchange channels in this area. Table 3.1b shows that the With Project Plan increases the percentage of days in SE-1 with WSE at or below 1.0 foot from 6 to 37%. Table 3.1c shows the With Project Plan increases the number of days with WSE at or below 1.0 foot from 7 to 48% in NE-2.

Table 3.1a Computed Flow

With Project (no flow in the No Action Plan)					
Exchange Channel	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	6330	5298	4812	4368	4035
% time of inflow	23%	22%	29%	28%	28%
Volume outflow (ac-ft/yr)	6874	7160	3392	3696	4088
% time of outflow	77%	78%	71%	72%	72%

Table 3.1b Stage Duration, Storage Area SE-1

No Action						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	213	2283	2742	2935	3059	3151
% time at or below WSE	6%	62%	75%	80%	84%	86%
Consecutive Days at or below WSE	73	120	138	164	203	204
With Project						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	1352	2390	2770	2950	3070	3160
% time at or below WSE	37%	65%	76%	81%	84%	86%
Consecutive Days at or below WSE	114	121	152	164	203	205

Table 3.1c Stage Duration, Storage Area NE-2

No Action						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	241	2306	2834	3027	3144	3233
% time at or below WSE	7%	63%	78%	83%	86%	88%
Consecutive Days at or below WSE	64	148	184	203	204	205
With Project						
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654
Total days at or below WSE	1750	2501	2865	3032	3153	3236
% time at or below WSE	48%	68%	78%	83%	86%	89%
Consecutive Days at or below WSE	117	150	185	204	204	205

4.0 RELATIVE SEA LEVEL RISE

4.1 General

Given the hydrologic influence of tidal Lake Maurepas and the regional subsidence conditions, relative sea level rise (RSLR) could affect the computed flows in the proposed exchange channels and the stage durations shown in Tables 3.1. In response to this concern, the PDT evaluated the potential impact of RSLR on the restoration alternative. The evaluation adhered to guidelines established in Incorporating Sea Level Change Considerations in Civil Works Programs, EC 1165-2-211, (USACE, 2009a).

4.2 Estimates of RSLR

The USACE guidance requires an assessment of project performance based on three estimates (low, intermediate, and high) of sea level rise. The low estimate reflects the local historic rate for the study area, based on long-term local gage data. The intermediate and high estimates reflect a combination of the local historic subsidence rate with either the modified NRC Curve I or the NRC Curve III estimate of eustatic sea level rise.

The USACE, New Orleans District prepared RSLR estimates in accordance with EC 1165-2-211 for LCA projects Amite River Diversion Canal and Convent/Blind River Diversion (USACE, 2009b). These estimates of RSLR account for both the eustatic rate of sea level rise and the local subsidence rate. The following paragraphs summarize the USACE's documentation of those estimates.

4.2.1 Low Rate

The USACE used the USACE gage at West End at Lake Pontchartrain to calculate a representative historic rate for the project area. Daily stage data from 1959 to 2009 indicate a rate of 9.20 mm/yr (0.0302 ft/yr; see Figure 4.1) with a standard error of the linear trend line of 0.65 foot.

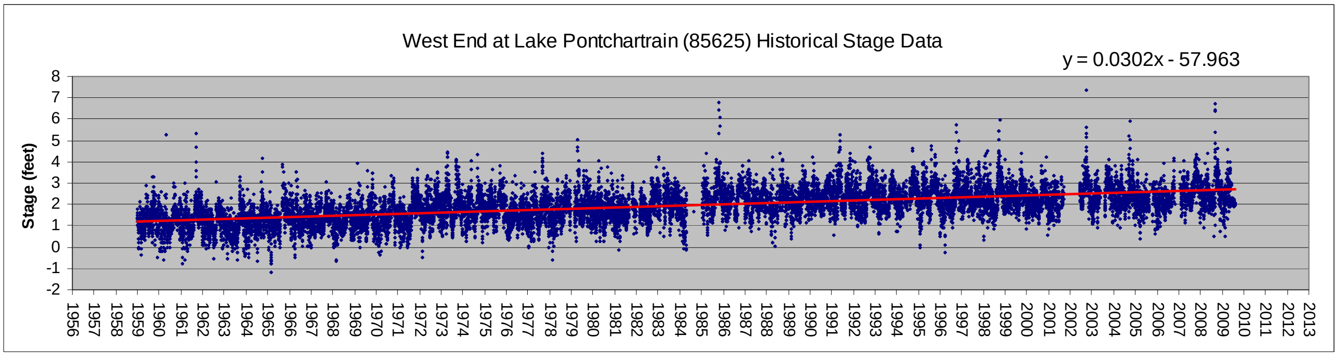

Figure 4.1 Plot of Historic Rate from Daily Stage Data

Using the rate of 9.20 mm/yr, a starting year of 2012, and a 50-year project life, the USACE projects a sea-level rise of 1.5 feet for 2062. The rate of 9.20 mm/yr includes both the eustatic seal level rise and the local subsidence contributions to the estimated total RSLR.

4.2.2 Intermediate and High Rates

To estimate the local subsidence rate for the project area, the USACE subtracted the global eustatic rate (1.7 mm/yr) from the local sea level rate or

Local subsidence rate = 9.20 mm/yr – 1.7 mm/yr = 7.50 mm/yr.

The following formula yields an estimate of the total rise in eustatic sea level for the project life for the intermediate and high rate cases of sea level rise:

$$E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

where:

b = the acceleration factor for each curves, or 2.36E-5 and 1.005E-4, respectively,

t_1 = the time in years between the project's construction date and 1986, and

t_2 = the time between a future date at which one wants an estimate for sea-level rise and 1986.

These eustatic estimates, when added to the local subsidence estimate, yield the total sea-level rise for the intermediate and high rate cases.

Table 4.1 presents a summary of the estimated total sea-level rise in five-year increments through the project life of 50-years for each case. Figure 4.2 shows the estimated sea-level rise for each case.

Table 4.1 Summary of Five-year Sea Level Rise for Each Case (USACE, 2009, Estimated Sea Level Rise for Amite River Diversion and Convent/Blind River Diversion LCA Projects)

Project year	Low Rate (feet)	Intermediate Rate (feet)	High Rate (feet)
2012	0.0	0.0	0.0
2017	0.2	0.2	0.2
2022	0.3	0.3	0.5
2027	0.5	0.5	0.8
2032	0.6	0.7	1.1
2037	0.8	0.9	1.4
2042	0.9	1.1	1.7
2047	1.1	1.3	2.0
2052	1.2	1.5	2.4
2057	1.4	1.7	2.8
2062	1.5	1.9	3.2

4.3 Impact of RSLR

Taylor Engineering reran the HEC-RAS models for the No Action Plan and the With Project Plan for 2062 (Year-50) for the three RLSR cases by adding 1.5, 1.9, and 3.2 feet to the Amite River at Maurepas hydrograph downstream boundary condition. Tables 4.2, 4.3, and 4.4 presents model results. Table 4.2 includes the previous results (Year 1) for computed flows in the exchange channels versus computed Year 50 flows for low, intermediate, and high RSLR. Tables 4.3 and 4.4 provide similar comparisons of stage durations for the previously computed Year 1 versus Year 50 low, intermediate, and high RSLR for the No Action Plan and With Project Plan in SE-1 and NE-2, respectively.

Table 4.2 demonstrates that as stages increase in Lake Maurepas due to RSLR, the flow in the proposed new exchange channels increase.

Tables 4.3 and 4.4 show that RSLR will dramatically reduce the stage duration below 1.0 foot with both the No Action Plan and the With Project Plan. The percentage of days with WSE below 1.0 foot in the SE-1 and NE-2 areas falls from 37 and 48%, respectively, to zero under all three RSLR cases.

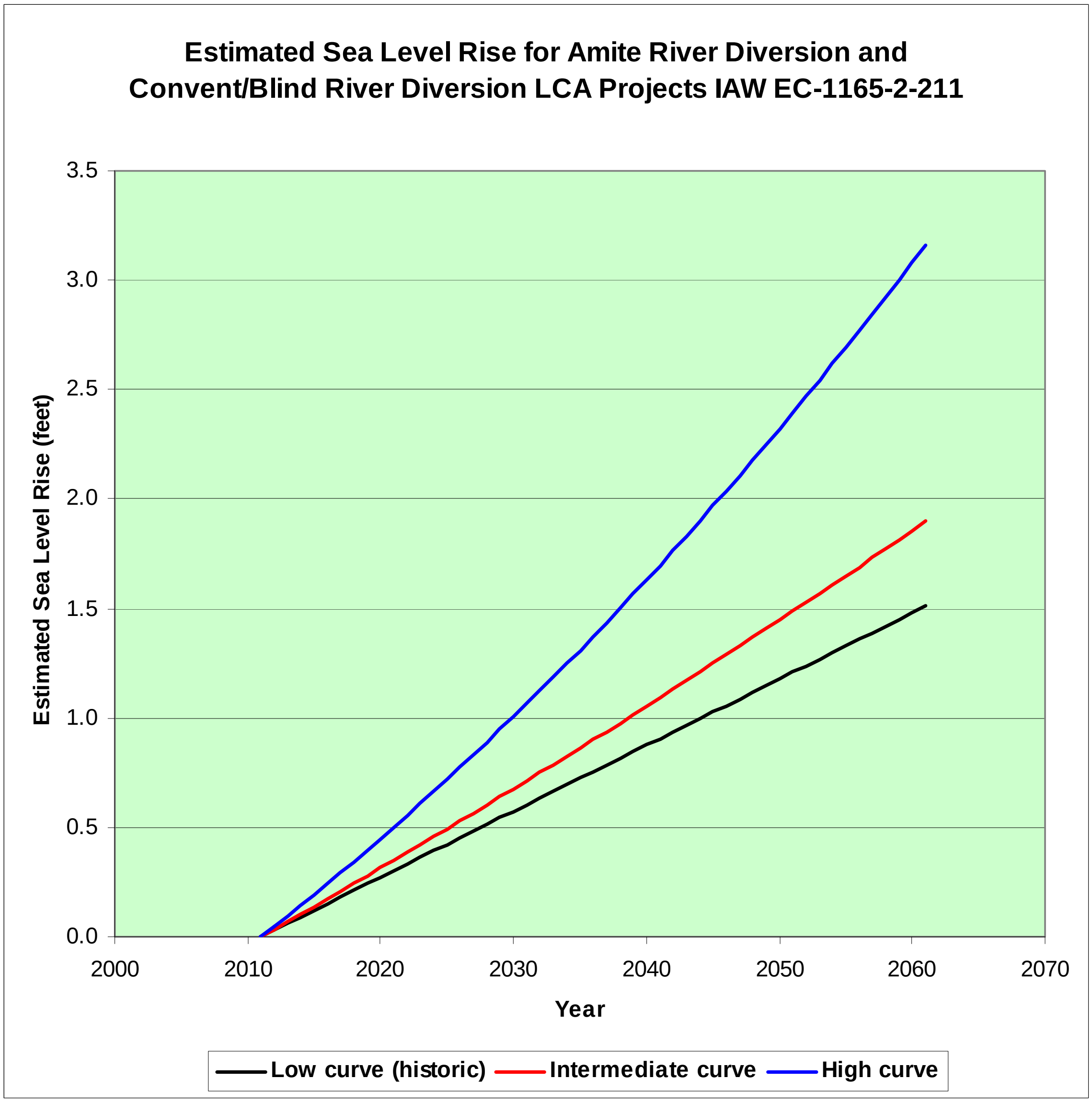

Figure 4.2 Plot of Sea Level Rise for Each Case (USACE, 2009, Estimated Sea Level Rise for Amite River Diversion and Convent/Blind River Diversion LCA Projects)

Table 4.2 Computed Exchange Channel Flows with RSLR

With project with no RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	6330	5298	4812	4368	4035
% time of inflow	23%	22%	29%	28%	28%
Volume outflow (ac-ft/yr)	6874	7160	3392	3696	4088
% time of outflow	77%	78%	71%	72%	72%
With Project with 50 years of Low rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	23175	20734	14522	13503	12903
% time of inflow	35%	34%	54%	53%	52%
Volume outflow (ac-ft/yr)	32635	35202	7291	8187	8894
% time of outflow	65%	66%	46%	47%	48%
With Project with 50 years of Intermediate rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	28332	25659	15172	14131	13480
% time of inflow	36%	35%	56%	55%	54%
Volume outflow (ac-ft/yr)	41868	45382	7324	8397	9234
% time of outflow	64%	65%	44%	45%	46%
With Project with 50 years of High rate of RSLR					
Reach (cut)	SE1-1	SE1-2	NE2-1	NE2-2	NE2-3
Storage area	SE-1	SE-1	NE-2	NE-2	NE-2
Volume Inflow (ac-ft/yr)	36013	33138	15622	14617	14028
% time of inflow	39%	38%	56%	54%	52%
Volume outflow (ac-ft/yr)	57802	63338	74145	9374	11222
% time of outflow	61%	62%	44%	46%	48%

Table 4.3 Stage Duration with RSLR, Storage Area SE-1

	No Action Plan						With Project Plan					
Without RSLR												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	213	2283	2742	2935	3059	3151	1352	2390	2770	2950	3070	3160
% time at or below WSE	6%	62%	75%	80%	84%	86%	37%	65%	76%	81%	84%	86%
Consecutive Days at or below WSE	73	120	138	164	203	204	114	121	152	164	203	205
With Project with Low rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	15	60	89	120	0	8	62	104	162	206
% time at or below WSE	0%	0%	0%	2%	2%	3%	0%	0%	2%	3%	4%	6%
Consecutive Days at or below WSE	0	0	2	7	9	12	0	2	7	10	16	22
With Project with Intermediate rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	3	7	0	0	3	12	24	38
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
Consecutive Days at or below WSE	0	0	0	0	1	2	0	0	1	3	3	3
With Project with High rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Consecutive Days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.4 Stage Duration with RSLR, Storage Area NE-2

	No Action Plan						With Project Plan					
Without RSLR												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	241	2306	2834	3027	3144	3233	1750	2501	2865	3032	3153	3236
% time at or below WSE	7%	63%	78%	83%	86%	88%	48%	68%	78%	83%	86%	89%
Consecutive Days at or below WSE	64	148	184	203	204	205	117	150	185	204	204	205
With Project with Low rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	2	63	140	205	285	0	11	77	144	214	289
% time at or below WSE	0%	0%	2%	4%	6%	8%	0%	0%	2%	4%	6%	8%
Consecutive Days at or below WSE	0	2	8	12	17	22	0	5	8	12	17	22
With Project with Intermediate rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	1	19	40	60	0	0	4	23	42	66
% time at or below WSE	0%	0%	0%	1%	1%	2%	0%	0%	0%	1%	1%	2%
Consecutive Days at or below WSE	0	0	1	3	3	8	0	0	2	3	3	5
With Project with High rate of RSLR (50 years)												
Water Surface Elevation (WSE) feet	1.0	1.1	1.2	1.3	1.4	1.5	1.0	1.1	1.2	1.3	1.4	1.5
Total Days in Simulation	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654	3654
Total days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0
% time at or below WSE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Consecutive Days at or below WSE	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.5 presents estimates of the time in years to permanent inundation for the No Action Plan and With Project Plan (conditions are nearly the same for both swamp areas). These estimates do not consider a rate for biomass and mineral sediment accretion. Biomass and mineral sediment accretion could extend the timeline until permanent inundation.

Table 4.5 Years to Permanent Inundation

RSLR Case	RSLR Year 50	No Action	With Project
Low Rate	1.5 feet	14 years	40 years
Intermediate Rate	1.9 feet	12.5 years	31 years
High Rate	3.2 feet	8 years	17 years

5.0 FLOOD RISK

5.1 General

Flooding problems in the study area are primarily associated with high discharges and stages on the Amite River. (Back- water flooding can affect the study area due to high coastal storm driven stages on Lake Maurepas.) FEMA Flood Insurance Rate Maps show that study area Base Flood Elevations (BFE) range from 6 to 9 feet NAVD-88.

Taylor Engineering used the HEC-RAS geometry models described in Chapter 3 to assess potential impacts to current flood risk in the study area by comparing flood stages for the No Action Plan versus With Project Plan. The HEC-RAS models of the study area simulate the swamps as storage areas and connect the storage area to the ARDC with the proposed exchange channels. These models simulate the flow into and out of the swamp (storage area) under low-to-normal flow and stage conditions. During a major flood event, flow characteristics change from off channel storage to conveyance. This model does not treat the swamp areas as conveyance features.

5.2 Boundary Conditions

To analyze flood impacts, Taylor Engineering developed flow hydrographs for nine return period storms (1-, 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year), each with seven-day duration. U.S. Weather Bureau Technical Paper No. 40 (TP-40) and National Weather Service HYDRO-35 provided values of rainfall intensity and duration. HEC-HMS and HEC-RAS models of the Amite River watershed (Taylor Engineering, 2009) were used to compute the inflow hydrographs. The inflow hydrographs used for the upstream boundary conditions were computed upstream of the ARDC. Local inflow hydrographs from within the study area (36 square miles) are insignificant compared to the peak discharge and runoff volume from the Amite River watershed upstream of the ARDC (1,769 square miles). This insignificance precluded the need to factor in local runoff inflows.

As with other simulations, Taylor Engineering used Lake Maurepas as the downstream boundary, and employed an elevated, constant stage of 2.0 feet NAVD-88 (2006.81) for the analysis of all storm events. The average daily stage for the Amite River at Maurepas gage for the 10-year period of January 1, 1999 to December 31, 2008, adjusted to NAVD-88 (2006.81), is 0.76 foot and the mean high water is 1.0 foot.

5.3 Model Results

Figures 5.1 and 5.2 present stage hydrographs for the 100-year flood event for two swamp areas, SE-1 and NE-2. The hydrograph plots compare the stages for the No Action Plan and the With Project Plan. Figure 5.1 shows that the project increases peak stage in SE-1 by 0.37 foot. Figure 5.2 shows that the project does not change the peak stage in storage area NE-2.

Figures 5.3 and 5.4 illustrate the project impact on 100-year flood stages at two channel locations, Amite River near Old River and ARDC near Amite River. Figures 5.3 and 5.4 show that that the project reduces peak stage at the Amite River near Old River by 0.27 foot, and at ARDC near Amite River by 0.49 foot.

Simulations of the 1-, 2-, 5-, 10-, 25-, 50-, 200-, and 500-year storm events show similar trends in flood impacts: slight increases in stage for the swamp areas and slight decreases in stage for the Amite River and ARDC.

The qualitative nature of these results is consistent with the increased exchange between the ARDC and the swamp for the With Project Plan. Results, however, overstate the magnitude of the With Project impact given the way the model represents the swamp. During a flood event, flow characteristics in overbanks (swamp) change from off-channel storage to conveyance. Results show that the proposed project would not increase the risk of flooding along the Amite River and ARDC.

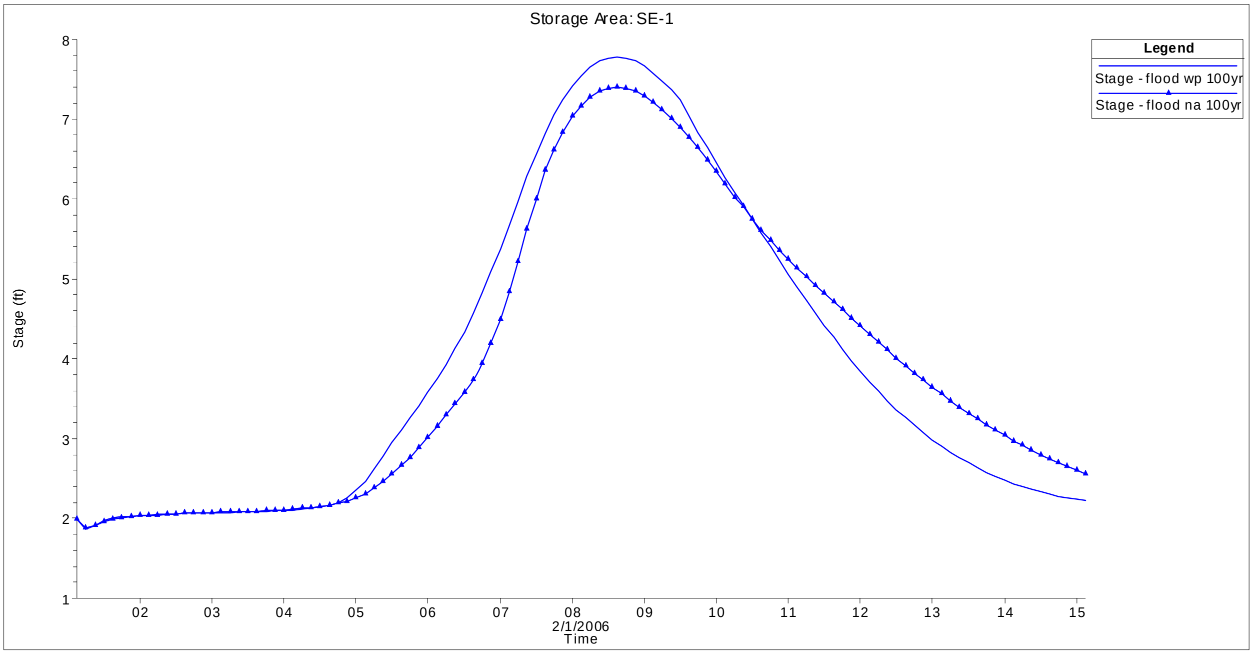

Figure 5.1 Storage Area SE-1

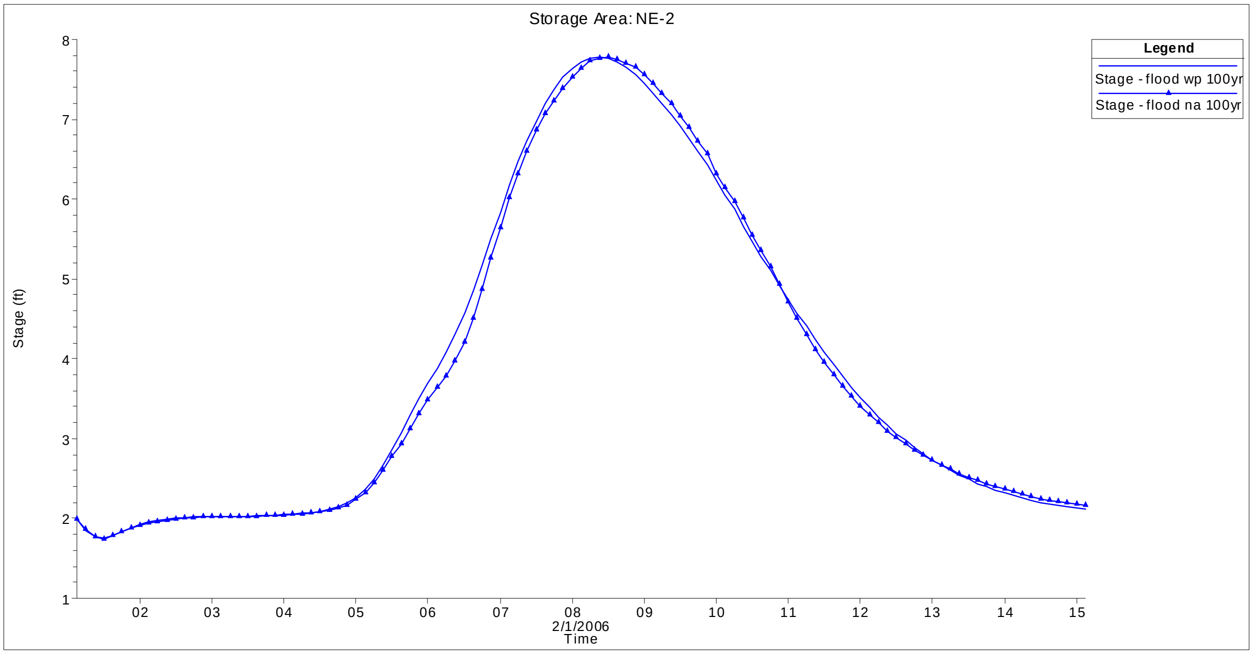

Figure 5.2 Storage Area NE-2

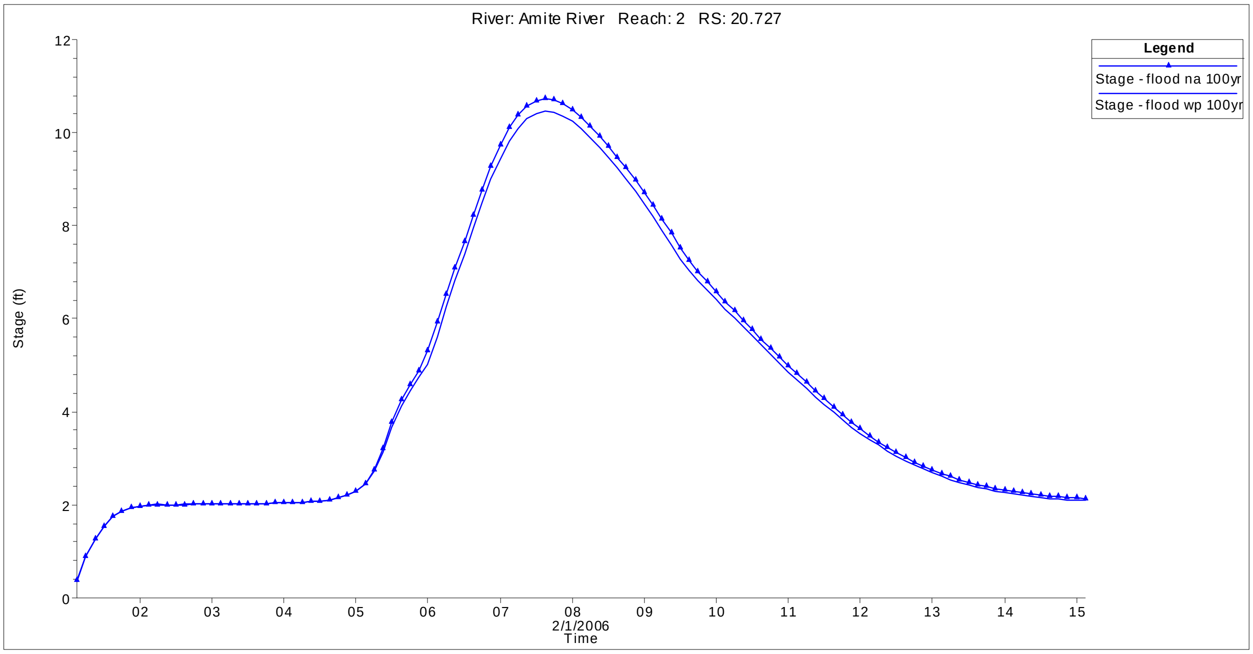

Figure 5.3 Amite River near Old River

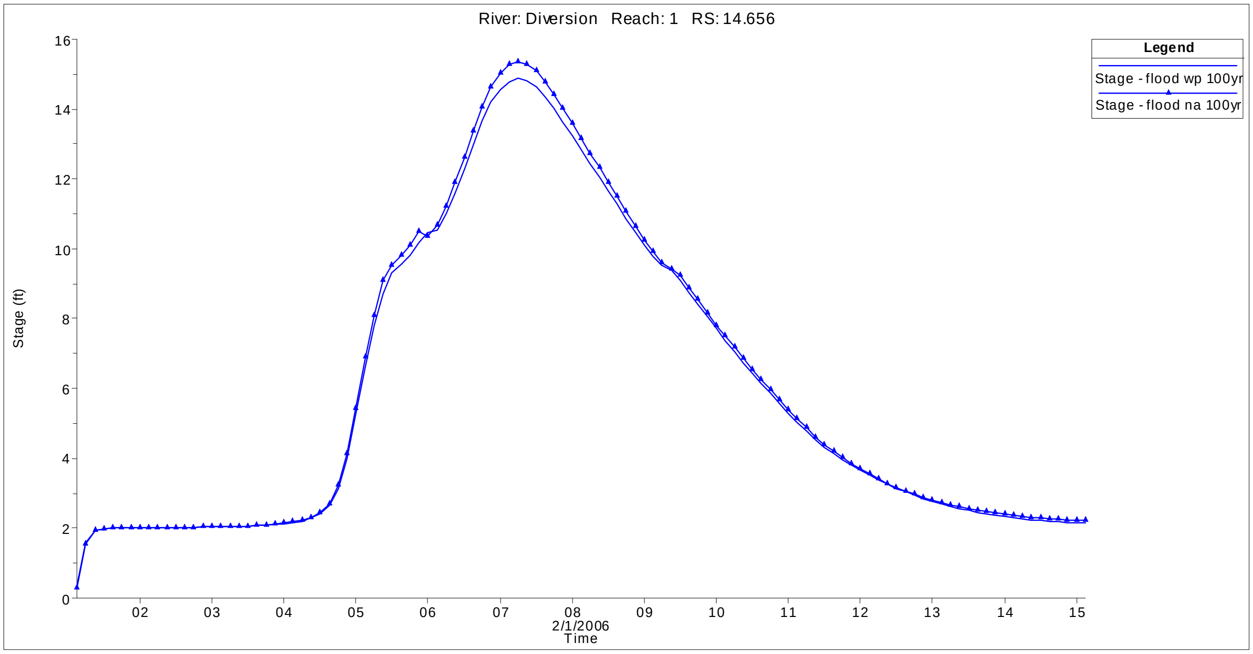

Figure 5.4 ARDC near Amite River

6.0 CONCLUSIONS

The results of the analysis show that the proposed new exchange channels can meet the hydrodynamic objectives of the project. The proposed new exchange channels would improve the conveyance of ARDC water into the swamp, and allow a more natural wetting and drying cycle in the swamp. The effect of RSLR would reduce the improvements in swamp dry periods, with eventual permanent inundation.

The proposed exchange channels may cause a minor increase in peak flood stages in the swamps near the ARDC, and a minor decrease in peak flood stages in the Amite River and ARDC. The Amite River Diversion Canal Modifications would not increase the flood risk.

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Section 3

SURVEY DATA

Existing Surveys

Survey data was collected within the study area as part of the USACE Amite River and Tributaries project in 1956. The data collected gave cross sections and general dimensions for the ARDC, the Amite and Blind Rivers, and the dredged material berms (Survey Annex).

Surveys Obtained

Surveys were obtained inside the study area (Figure 1) of two relict cuts which exist in the eastern portion of subunit SE-2, along Blind River. The surveys collected the cross-sectional dimensions of the relict cuts in order to mimic these dimensions with the proposed bifurcated conveyance channels. The surveys were conducted in two phases. First, GEC obtained a rough estimate of these dimensions, during a site visit in August, 2009. The results of this investigation allowed for the preliminary design process to be conducted, while a full survey of the cuts was in the contract acquisition processes (Figures 1.2 to 1.6). After the initial survey was completed, the full survey was conducted by Shread-Kuyrkendall and Associates in September, 2009 (Figures X – X). The complete survey report is located in the Survey Annex.

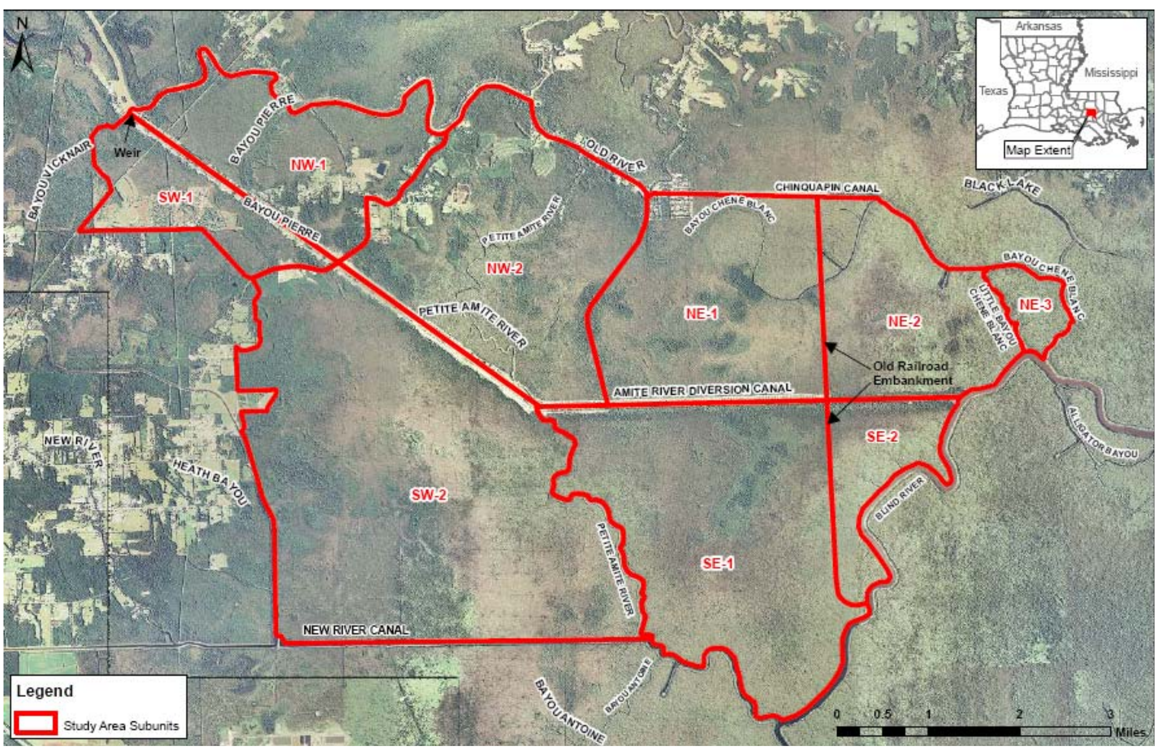

Figure 1. Study Area

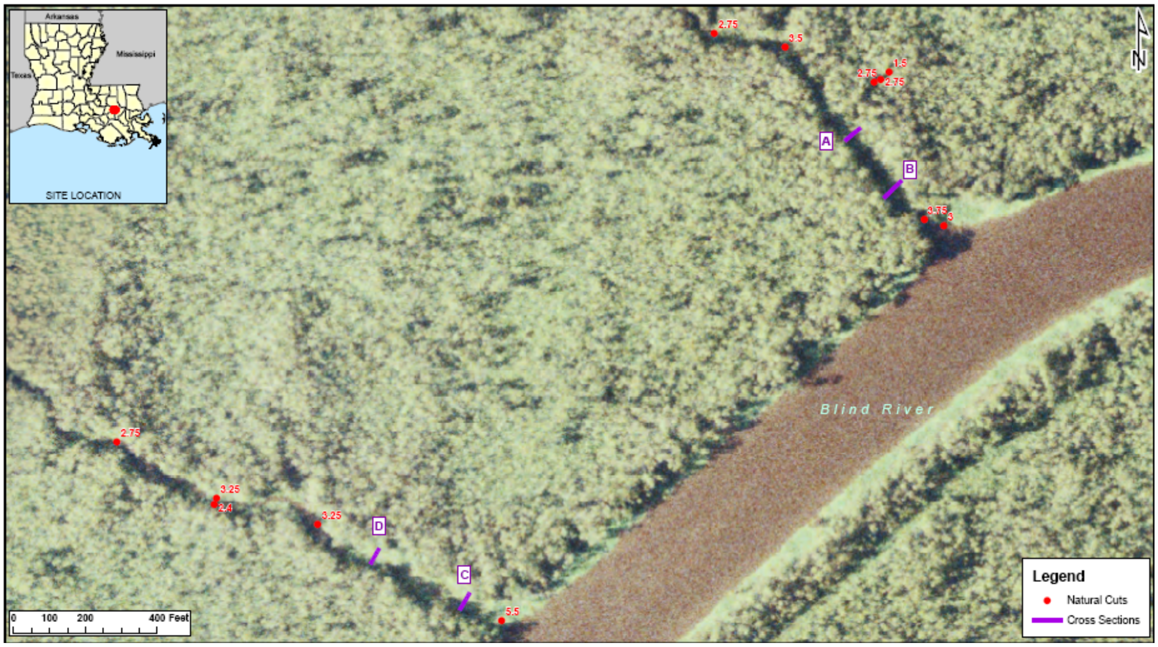

Figure 2. Relict Cut Cross Section Locations

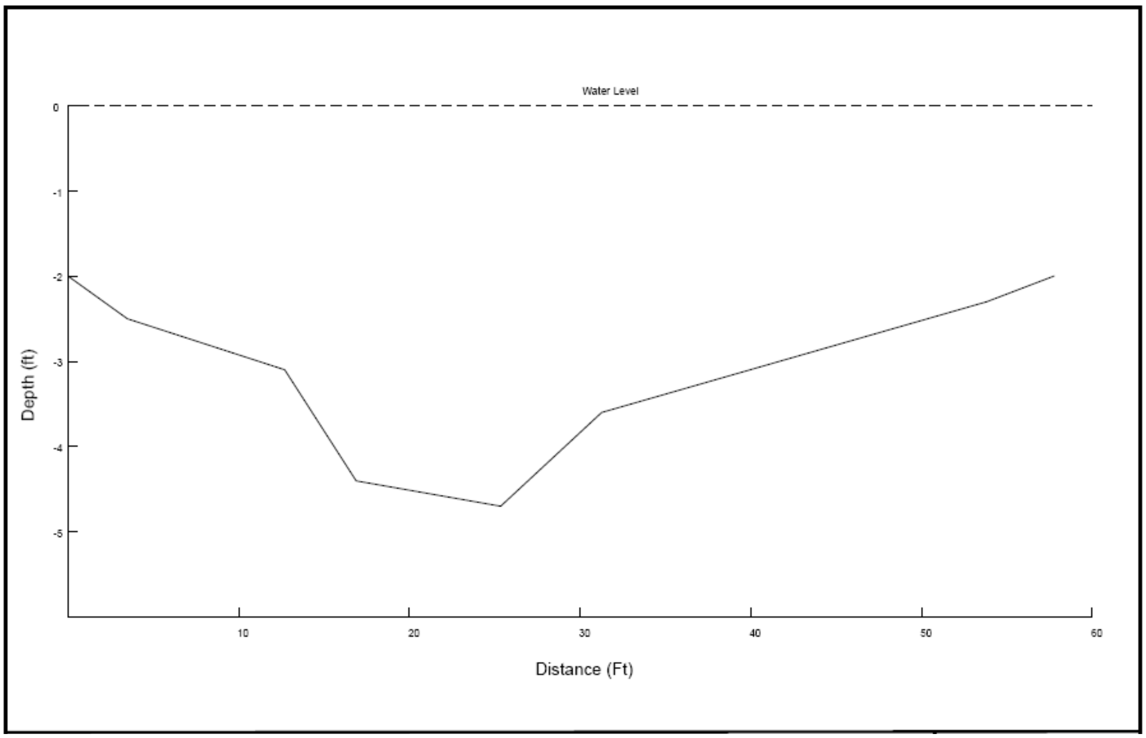

Figure 3. Relict Cut Cross Section A

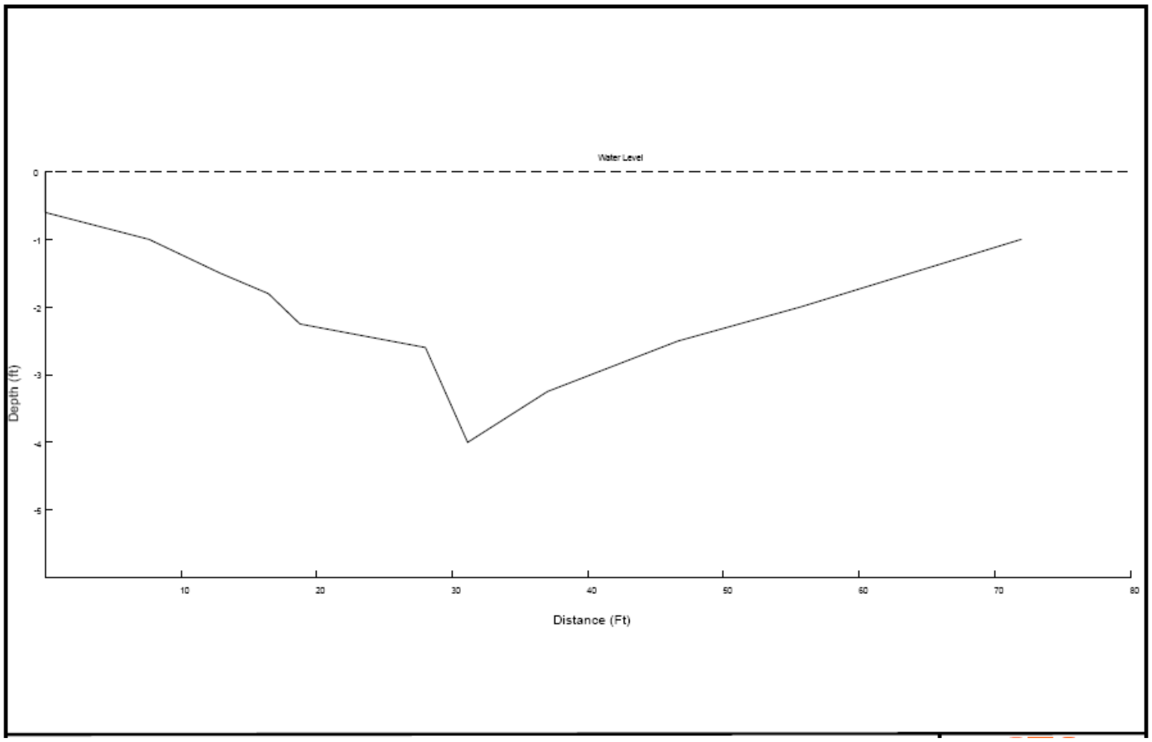

Figure 4. Relict Cut Cross Section C

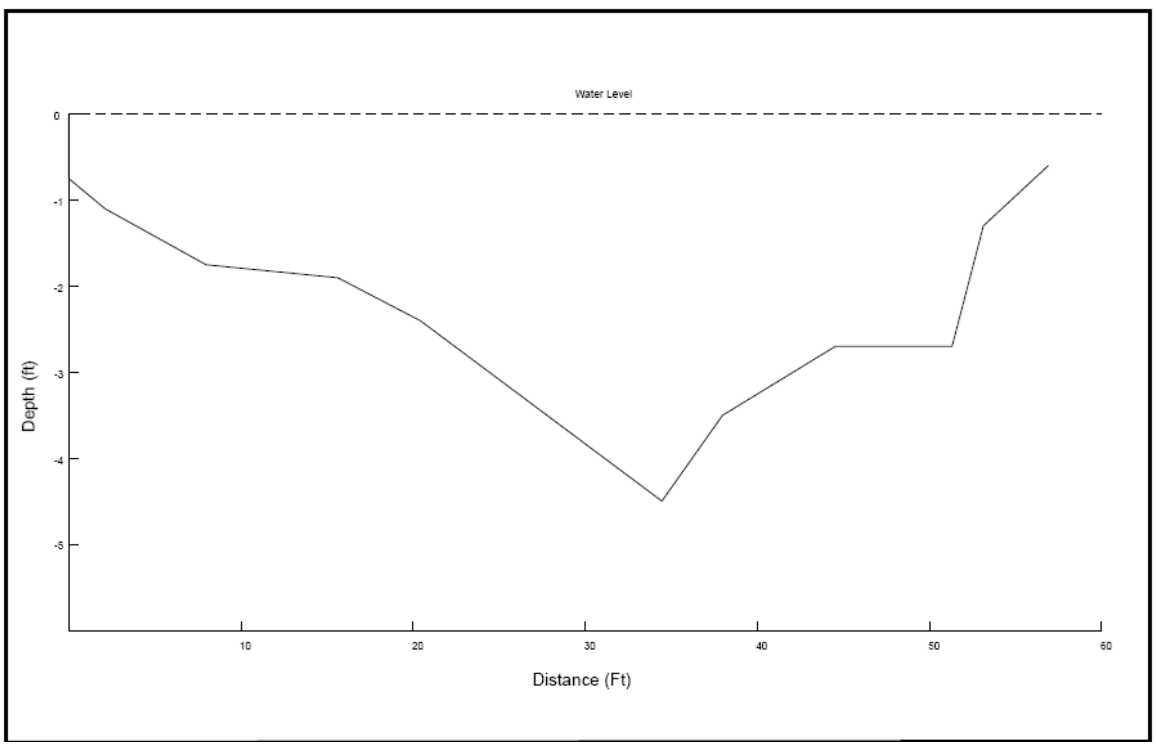

Figure 5. Relict Cut Cross Section D

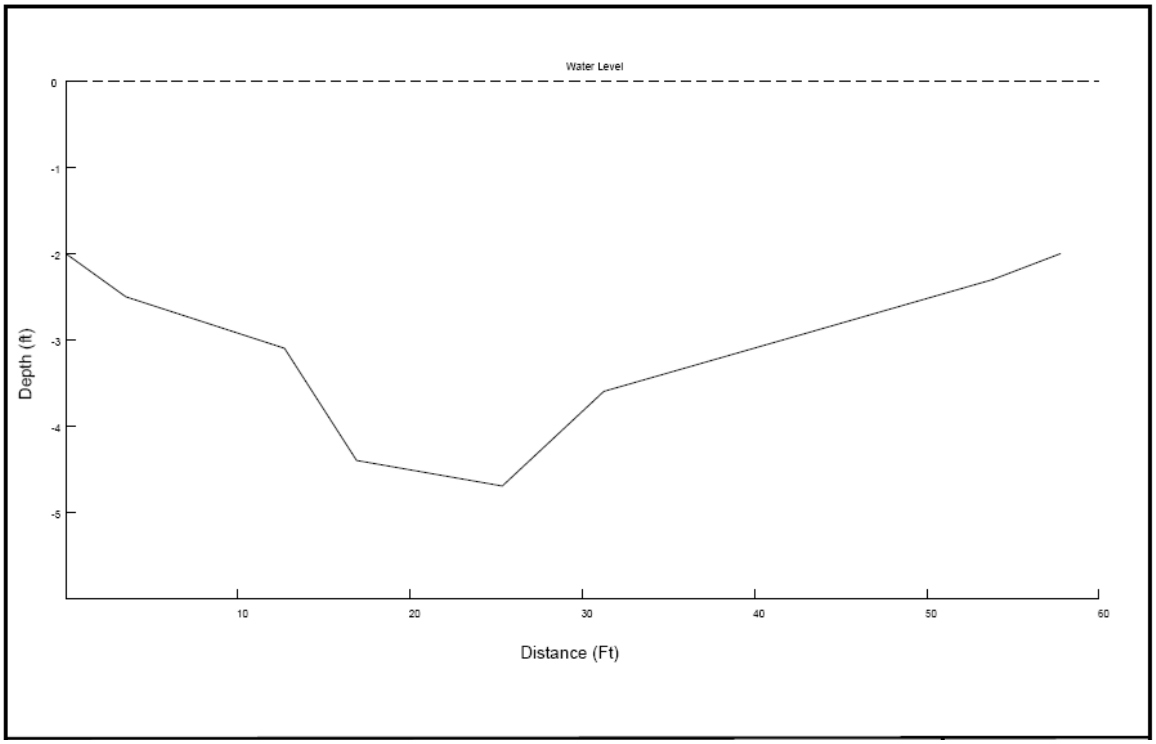

Figure 6. Relict Cut Cross Section D

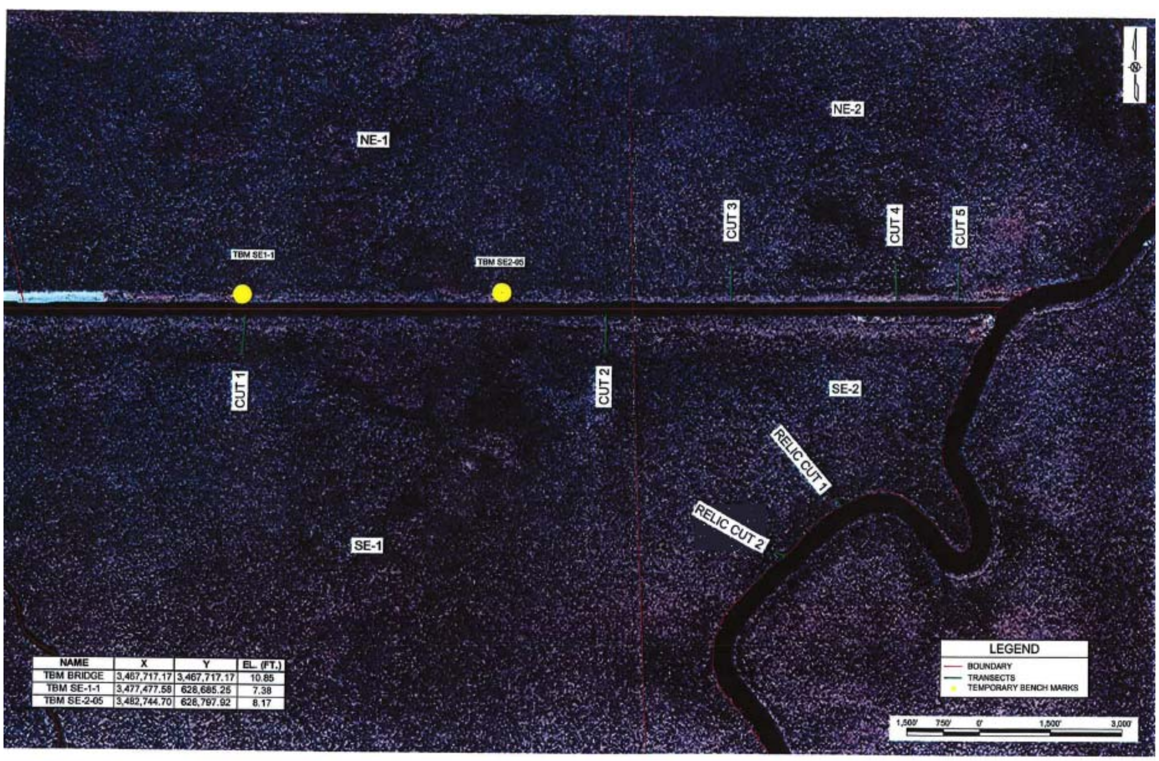

Figure 7. Cross Section Locations for Full Survey

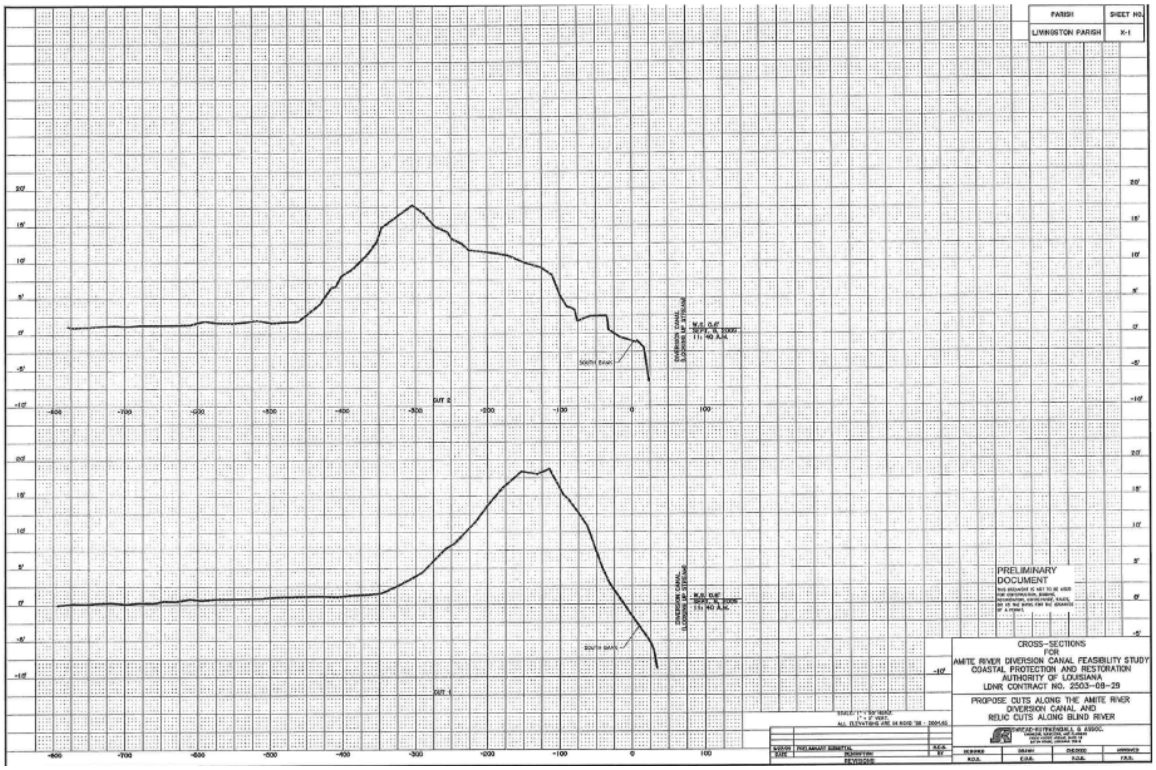

Figure 8. Cross Section of Dredged Material Berm on South Bank

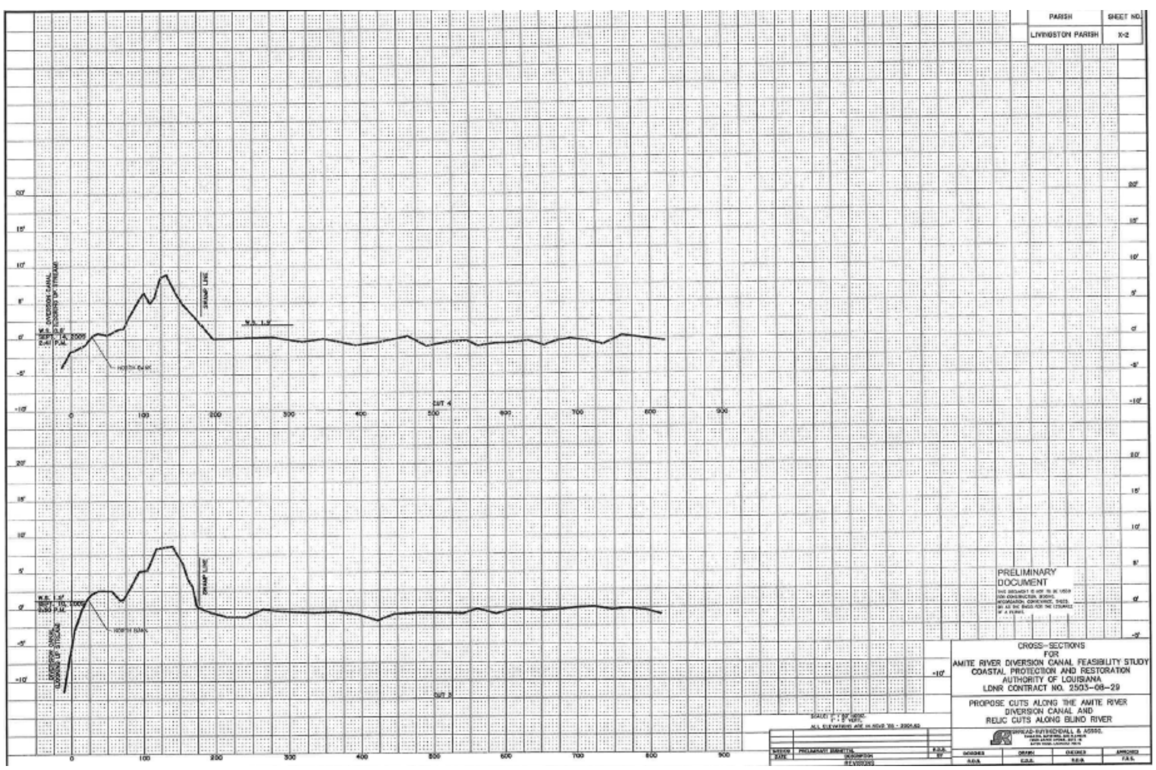

Figure 9. Cross Sections of Dredged Material Berm on North Bank

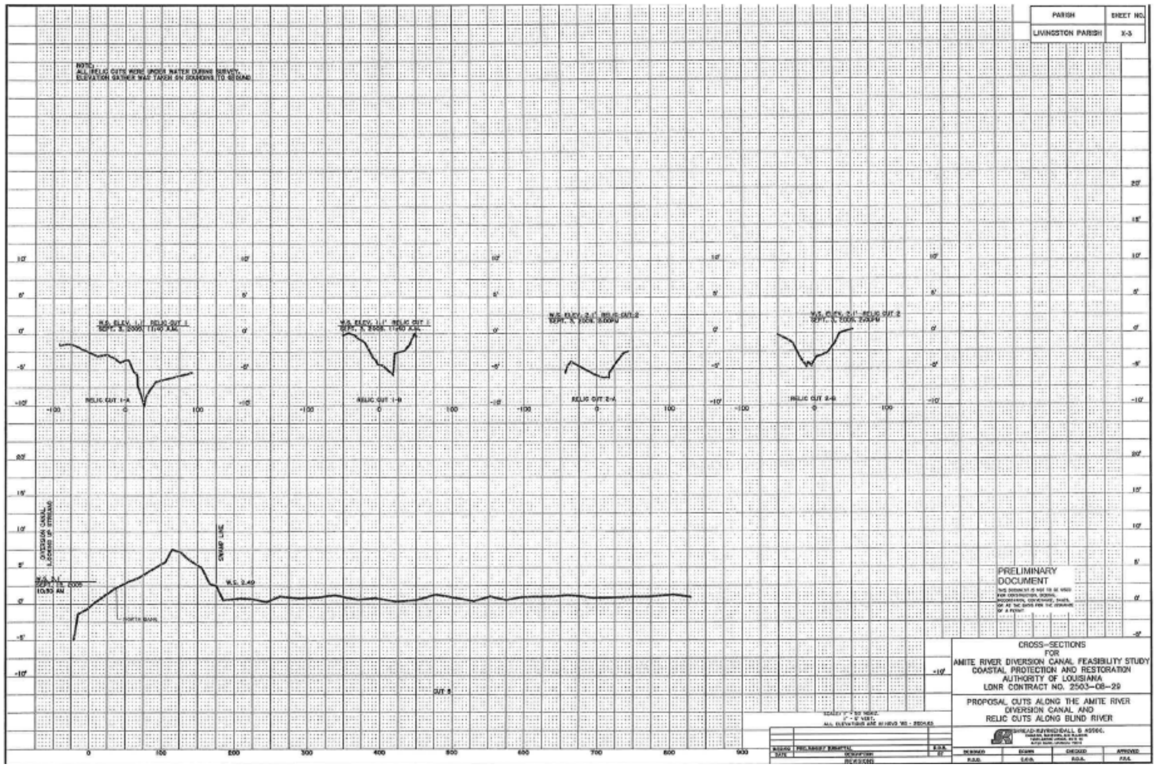

Figure 10. Relict Cut Cross Sections

ANNEX

Survey Data

SURVEY REPORT for
AMITE RIVER DIVERSION CANAL
FEASIBILITY STUDY

Proposed Cuts along the Amite River Diversion Canal
And Relic Cuts along the Blind River

LDNR Contract No. 2503-08-29

SEPTEMBER 28, 2009

Prepare for:

Coastal Protection and Restoration Authority of Louisiana

STATE OF LOUISIANA
FRANK ROBERT STAGG
REG. No. 04529
REGISTERED
PROFESSIONAL
LAND SURVEYOR

9/28/09

FINAL REPORT

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SURVEY REPORT For

AMITE RIVER DIVERSION CANAL FEASIBILITY STUDY

Survey of Proposed Cuts along the Amite River Diversion Canal And Relic Cuts along the Blind River

Coastal Protection and Restoration Authority of Louisiana

FINAL REPORT – SEPTEMBER 28, 2009

Contents

AMITE RIVER DIVERSION CANAL FEASIBILITY STUDY
Survey of Proposed Cuts along the Amite River Diversion Canal
And Relic Cuts along the Blind River

FINAL REPORT – SEPTEMBER 28, 2009

Section 1: Methodology Report

Coastal Protection and Restoration Authority of Louisiana

PROJECT DESCRIPTION

Louisiana Department of Natural Resources Number 2503-08-29: Survey of proposed cuts along the Amite River Diversion Canal and the Blind River located in Sections 25, 33, 34, & 36, Township 9 South, Range 5 East, and Section 2, Township 10 South, Range 5 East Greensburg Land District, Livingston Parish, Louisiana. On August 19, of 2009, Shread Kuyrkendall and Associates was requested to perform a topographic and bathymetric survey of five proposed cross section locations along the Amite Diversion Canal and four cross section locations at two existing relic cuts along Blind River. A copy of the project scope of work as provided by The Department of Natural Resources is attached in Section 2 of this report.

PROJECT CONTROL

Three temporary survey control monuments for the project were provided by the Louisiana Department of Natural Resources and included horizontal and vertical control datum to be used to establish locations and elevations for the project. The control survey vertical datum is referenced NAVD88 (2004.65). The following project control monuments were provided and used on the project.

Designation	Northing/Y	Easting/X	Elevation
TBM SE1-2-OS	628767.96	3482744.70	8.18'
TBM Bridge	629722.96	3467717.22	10.93'
TBMSE1-1	628685.23	3477477.58	7.40'

KEY PERSONNEL

Wayne Craddock, Field Party Chief
Roy Neal, Field Party Chief
Jimmy Roberts, Field Party Chief
Ralph Burgess, LSI, Project Coordination
Lucas Hudspeth. BS, Survey Processing
Mark Hughes, LSI, Support
Andy Shread, EI, Support
James Parton, AutoCAD
Frank R. Stagg, P.L.S., Project Manager

TASKS

Each of the five cross section locations along the Amite Diversion Canal, Cuts 1 through 5, were to profile a given eight hundred foot transect located ten feet within the water edge, across the existing spoil bank and out into the swamp. Elevations along the transect were obtained at approximate twenty-five foot intervals.

Cross section locations for the Relic Cuts along Blind River, Cuts 1 and 2, were to profile a given one hundred foot transect. Elevations along the transect were obtained at approximate fifteen foot intervals. .

Latitude and longitudes for each transect location were provided by Louisiana Department of Natural Resources as referenced in the Scope of Work shown in Section 2 of this report.

CHRONOLOGICAL SUMMARY OF THE WORK

August 19, 2009	Project Management
August 24, 2009	Project Management
August 27, 2009	Project Reconnaissance
August 29, 2009	Project Reconnaissance
August 31, 2009	Control Survey Calibration

September 2, 2009	Cut Transect Sight Lines
September 3, 2009	Cut Transect Sight Lines
September 4, 2009	Cut Transect Sight Lines
September 8, 2009	Control Cut 1
September 9, 2009	Control Cut 2
September 10, 2009	Control Cut 3
September 14, 2009	Control Cut 4
September 15, 2009	Control Cut 5
September 16, 2009	Project Processing
September 17, 2009	Project Processing
September 18, 2009	Project Processing
September 21, 2009	Project Processing
September 22, 2009	Draft Submittal
September 28, 2009	Final Submittal

EQUIPMENT USED FOR DATA COLLECTION

Sokkia GSR 2700 RSX GPS Unit

Sokkia Set330R

SKA Field Book No. 89179-1

Microstation Inroads – Data Processing

Drawing files – AutoCadd

PROCEDURES AND PROCESSING

Upon completion of project reconnaissance, field crews located the controlling temporary benchmarks provided for the project. The location and elevations of the control marks were verified within the project accuracy and precision requirements and the location of each of the required transects were subsequently established. Control points for each transect were set using Sokkia GSR 2700 RSX GPS. Satellite geometry was not beneficial to use GPS to obtain cross section points because of the clearstory at the project site, thus, these control points were used for occupation and back azimuth with a conventional Sokkia Set330R. Water surface elevations were obtained and used to confirm elevations established for transect control points. Field crew cut sight lines to collect cross-section data along the transects.

The required transects for the Relic Cuts were completely submerged and transect control points were not established. Field crews utilizing the Sokkia GSR 2700 RSX GPS confirmed the established water surface elevation as verification and established the location and elevations of the transects for the Relic Cuts.

The field surveys were performed under third order accuracy. Field data was processed using Microstation Inroads and cross sections were drafted using AutoCadd. A report was generated in Inroad that identifies point no., State Plane Coordinates (LSZ, ft.), NAVD88 elevation (ft.), and description.

Section 2: RFP/Scope of Work

SCOPE OF SERVICES
TOPOGRAPHIC AND BATHYMETRIC SURVEY

LCA Amite River Diversion Canal Feasibility Study
August 18, 2009

1.0 INTRODUCTION

The Office of Coastal Protection and Restoration (OCPR) of the Coastal Protection and Restoration Authority of Louisiana (CPRA) is responsible for monitoring, maintaining, and operating projects that restore, create, enhance, and maintain coastal wetlands in Louisiana. Tasked with these functions, OCPR is actively developing restoration projects along Louisiana's coasts. The primary goal of the project is to allow floodwaters to introduce additional nutrients and sediment into western Maurepas Swamp through the construction of gaps in the existing dredged material banks of the Amite River Diversion Canal (ARDC). The exchange of flow would occur during flood events on the river and from the runoff of localized rainfall events. This feature would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

This Scope of Services will provide survey cross-section data to aid in the development and analysis of all proposed project alternatives. Specifically, the contractor shall furnish survey cross-sections for the areas stipulated for each proposed alternative to assist the LCA project team with the development of project costs and to aid in the design process for the Amite River Diversion Canal Modification Project before September 22, 2009.

2.0 LOCATION & ACCESS

This Project is located in the Maurepas Swamp portion of LCA Subprovince 1, west of Lake Maurepas and north of the I-10 corridor (Figure1, Appendix A). The locations of the specific survey cross-sections to be occupied by the Contracting Party are graphically illustrated in Figure 2 of Appendix A.

3.0 SCOPE OF WORK

3.1 Control

The Contracting Party shall conduct all surveying activities using three Bench Marks (TBMs) established by Anthony Cavell utilizing CORS stations and GPS RTK. The locations and elevations of the TBMs are provided in section 3.2.3.

3.2 Survey Overview

This scope of services includes the gathering of cross-sections along 5 proposed cuts in the ARDC spoil bank and two relic cuts along the left descending bank of Blind River as depicted in Figure 2 of Appendix A. Elevation data collected as part of this scope will be used to develop the design and cost for all proposed cuts for the ARDC Modification Project.

3.2.1 Cross-Sections for Proposed Cuts

- Cross-sections for areas of the spoil bank, north and south of the Amite River Diversion Canal will be determined (Figure 2, Appendix A).
- The limits of the cross-sections should be from a point within the canal and 10 ft from the bank, to a point 800 ft. perpendicular into the swamp and beyond the shoreline of the canal.
- All breakpoints between these limits should be accounted for to ensure that all major elevation changes are incorporated into the cross-section.
- Locations along the Amite River Diversion Canal in which cross-sections should be taken are found in Table 1 and Figure 2 (Appendix A).

Table 1. Transect Coordinates for Cross-Sections of Proposed Cuts

Location	DMSLat	DMSLong
Cut 1	30°13'33.94"N	90°42'38.03"W
Cut 1	30°13'25.95"N	90°42'38.76"W
Cut 2	30°13'34.47"N	90°41'12.12"W
Cut 2	30°13'26.46"N	90°41'12.28"W
Cut 3	30°13'44.88"N	90°40'42.46"W
Cut 3	30°13'36.86"N	90°40'42.3"W
Cut 4	30°13'44.99"N	90°40'2.83"W
Cut 4	30°13'36.98"N	90°40'2.58"W
Cut 5	30°13'45.06"N	90°39'47.87"W
Cut 5	30°13'37.04"N	90°39'48.06"W

If vegetation allows GPS RTK surveys shall be referenced to the North American Vertical Datum of 1988 (NAVD 88) and will utilize Geoid03 (2004.65) to determine orthometric heights. The data shall be reported in feet to one decimal place. If conventional survey techniques are necessary, the three TBM's listed in section 3.2.3 will be used to establish the water elevation in the diversion canal and this water surface elevation will be used as the vertical control for the cross sections.

3.2.2 Cross-sections for Relic Cuts

- Multiple cross-sections should be obtained for two relic cuts that occur on the left descending bank of the Blind River (Figure 2, Appendix A).
- A cross-section, perpendicular to the cut, should be obtained 20 feet from the mouth of the relic cut at the point in which it intersects with Blind River. Another perpendicular cross-section shall be obtained 200 feet into the swamp from the mouth of the cut. Each cross-section should depict the elevations for 50 feet in both directions from the centerline of the cut at the designated location.

Table 2. Transect Coordinates for Cross-Sections of Relict Cuts

Location	DMSLat	DMSLong
Relic Cut 1	30°12'55.26"N	90°40'15.2"W
Relic Cut 1	30°12'54.66"N	90°40'16.11"W
Relic Cut 1	30°12'56.83"N	90°40'16.57"W
Relic Cut 1	30°12'56.24"N	90°40'17.48"W
Relic Cut 2	30°12'45.2"N	90°40'29.18"W
Relic Cut 2	30°12'44.31"N	90°40'29.67"W
Relic Cut 2	30°12'45.98"N	90°40'31.02"W
Relic Cut 2	30°12'45.09"N	90°40'31.52"W

3.2.3 Temporary Benchmarks

	Northing/Y	Easting/X	Elevation
TBM SE1-2-OS	628767.96	3482744.70	8.18'
TBM Bridge	629722.96	3467717.22	10.93'
TBMSE1-1	628685.23	3477477.58	7.40'

4.0 DELIVERABLES

4.1 Methodology Report

The Methodology Report shall be in Microsoft Word format, or approved equal, and written to the compact disc (CD). The hard copies shall be signed and stamped by the Registered/Professional Land Surveyor in the State of Louisiana who was directly involved with the project. The hard copies shall be bound in the GPS Survey Report.

The report shall contain but not be limited to the following information:
(Include dates for each job task and key personnel involved)

- ***Project Description***
- ***Chronological Summary of the Work***
- ***Information on Secondary Monuments used as reference stations***
- ***Quality control procedures (elevation check)***
- ***Equipment used for data collection***
- ***Downloading and Processing procedures***

4.2 Field Notebook Records

The information to be included in the field notebook will be as follows:

- ***Project Name***
- ***Date of Survey***
- ***Crew Members***
- ***Base Monument Names***
- ***Sketch of Location***
- ***Survey point numbers, descriptions, and elevations observed***

4.3 Drawing Files

Drawings, depicting the cross-sections, elevations, and all appropriate break-points, shall be completed and provided as a requirement of this scope. All variables shall be clearly labeled and accurately plotted. The drawing files shall be in digital format such as AutoCAD (*.dwg or *.dxf) and written to compact disc (CD) along with hard copies each bound in the final Survey Report and folded to fit within the 8½" x 11" methodology report.

Additional information to be included on the Cross-Section drawings will be as follows:

- ***Project Name***
- ***Contractor Name***
- ***Horizontal and Vertical Datum***
- ***Drawing Date***
- ***Drawing Scale***
- ***North Arrow***

4.4 Survey Data

The survey data results shall be reported in Microsoft Excel format arranged in columns and written to compact disc (CD). The file will contain the following columns: Point #, State Plane Coordinates (LSZ,ft), NAVD 88 elevation (ft), and description.

The Contracting Party shall prepare and deliver one (1) draft copy of the deliverables (including the inserted CD) described above to CPRA/OCPR by September 22, 2009. This draft copy will be sent to the following CPRA/OCPR representative for review:

Tye Fitzgerald
CPRA/OCPR
450 Laurel St., Suite 1501
Baton Rouge, LA 70801

TEL: (225) 342-4496
FAX: (225) 342-6801

Drafts will be reviewed by CPRA/OCPR and four (4) final deliverables will be delivered to CPRA/OCPR one week after receipt of comments.

5.0 CERTIFICATION

All deliverables shall be certified by a professional land surveyor licensed by the State of Louisiana.

SURVEY REPORT For

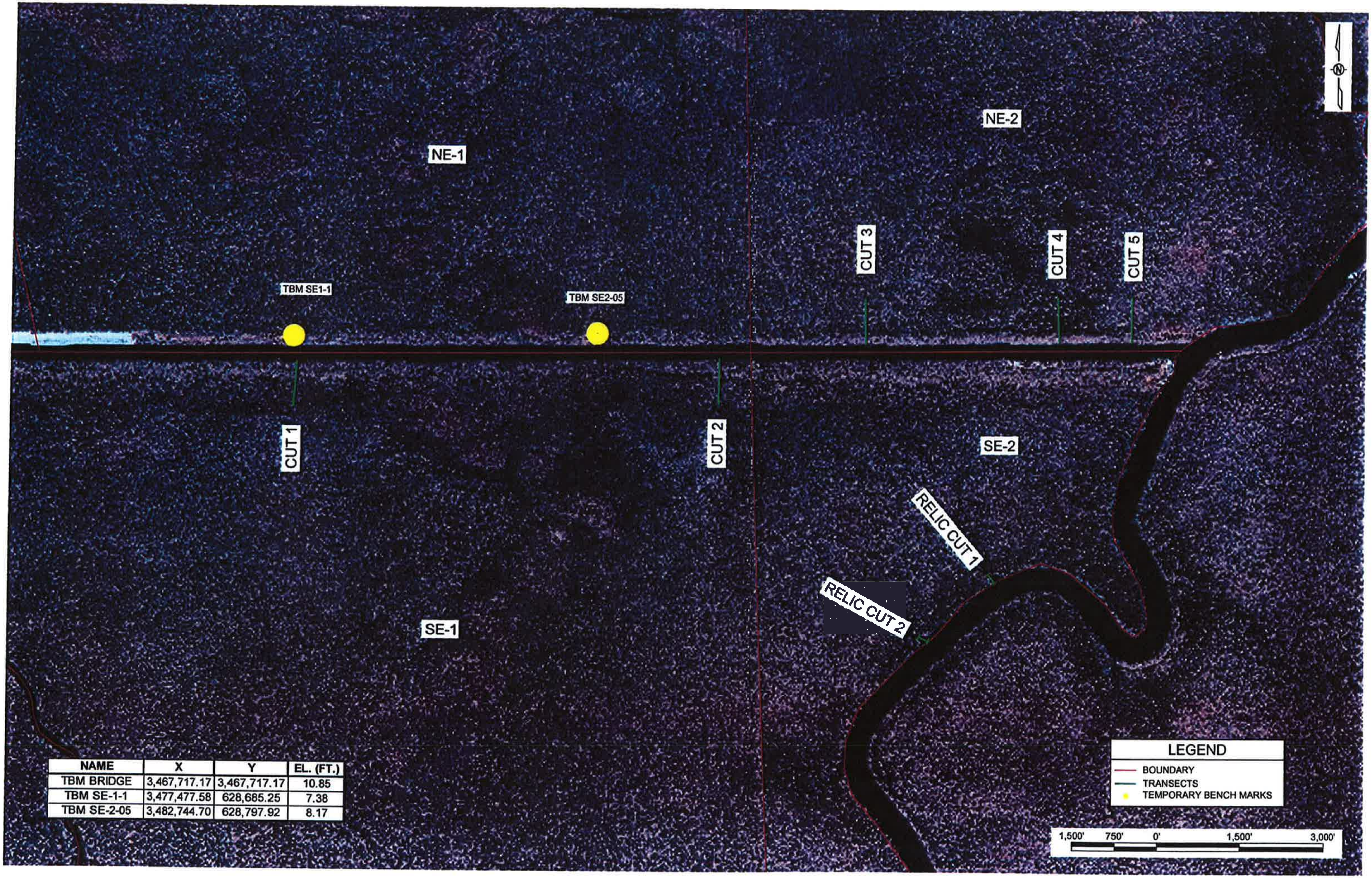
AMITE RIVER DIVERSION CANAL FEASIBILITY STUDY

Survey of Proposed Cuts along the Amite River Diversion Canal
And Relic Cuts along the Blind River

Coastal Protection and Restoration Authority of Louisiana

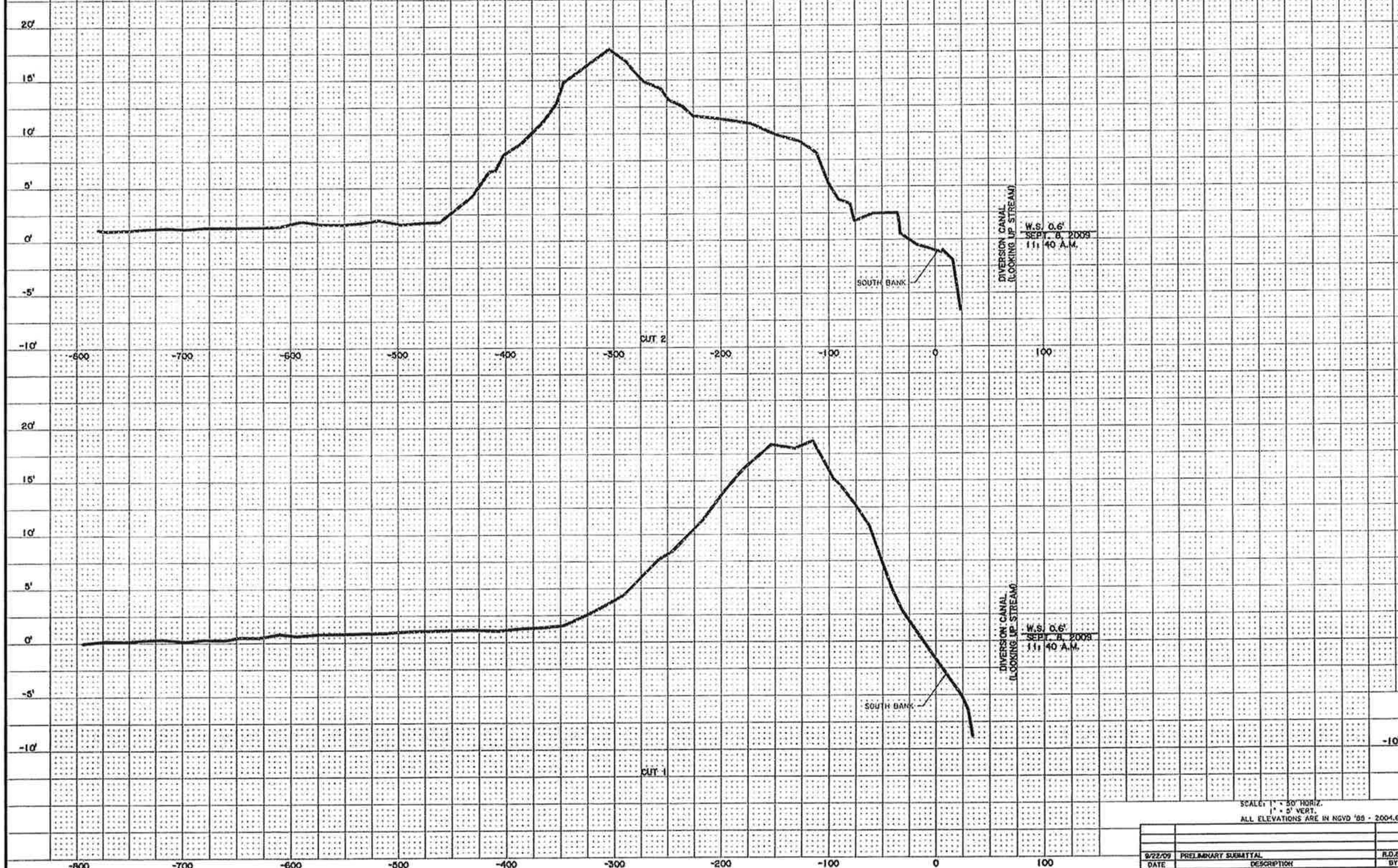
FINAL REPORT – SEPTEMBER 28, 2009

Section 3: Cross sections



NAME	X	Y	EL. (FT.)
TBM BRIDGE	3,467,717.17	3,467,717.17	10.85
TBM SE-1-1	3,477,477.58	628,685.25	7.38
TBM SE-2-05	3,482,744.70	628,797.92	8.17

PARISH	SHEET NO.
LIVINGSTON PARISH	X-1



PRELIMINARY DOCUMENT

THIS DOCUMENT IS NOT TO BE USED FOR CONSTRUCTION, BIDDING, RECORDATION, CONVEYANCE, SALES, OR AS THE BASIS FOR THE ISSUANCE OF A PERMIT.

SCALE: 1" = 50' HORIZ.
1" = 5' VERT.
ALL ELEVATIONS ARE IN NGVD '88 - 2004.65

DATE	DESCRIPTION	BY
9/22/09	PRELIMINARY SUBMITTAL	R.D.B.

REVISIONS

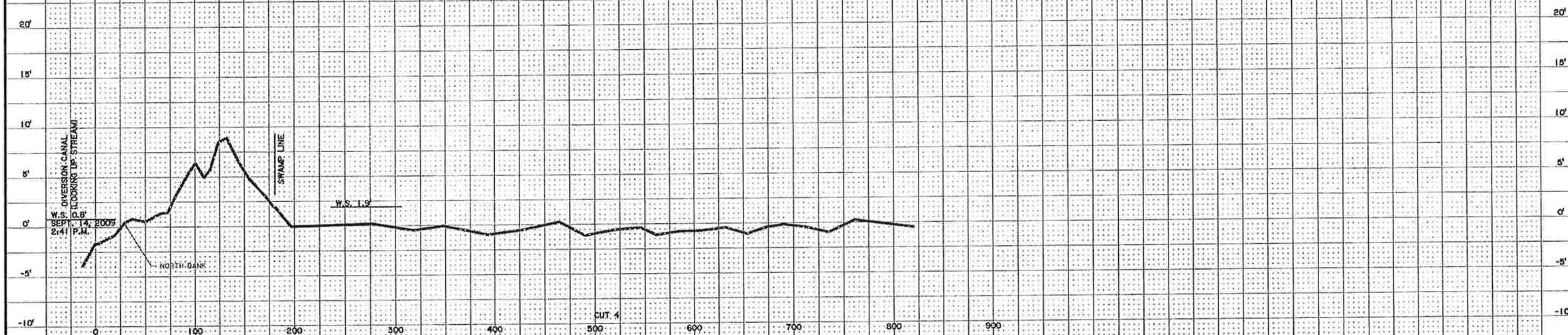
CROSS-SECTIONS
FOR
AMITE RIVER DIVERSION CANAL FEASIBILITY STUDY
COASTAL PROTECTION AND RESTORATION
AUTHORITY OF LOUISIANA
LDNR CONTRACT NO. 2503-08-29

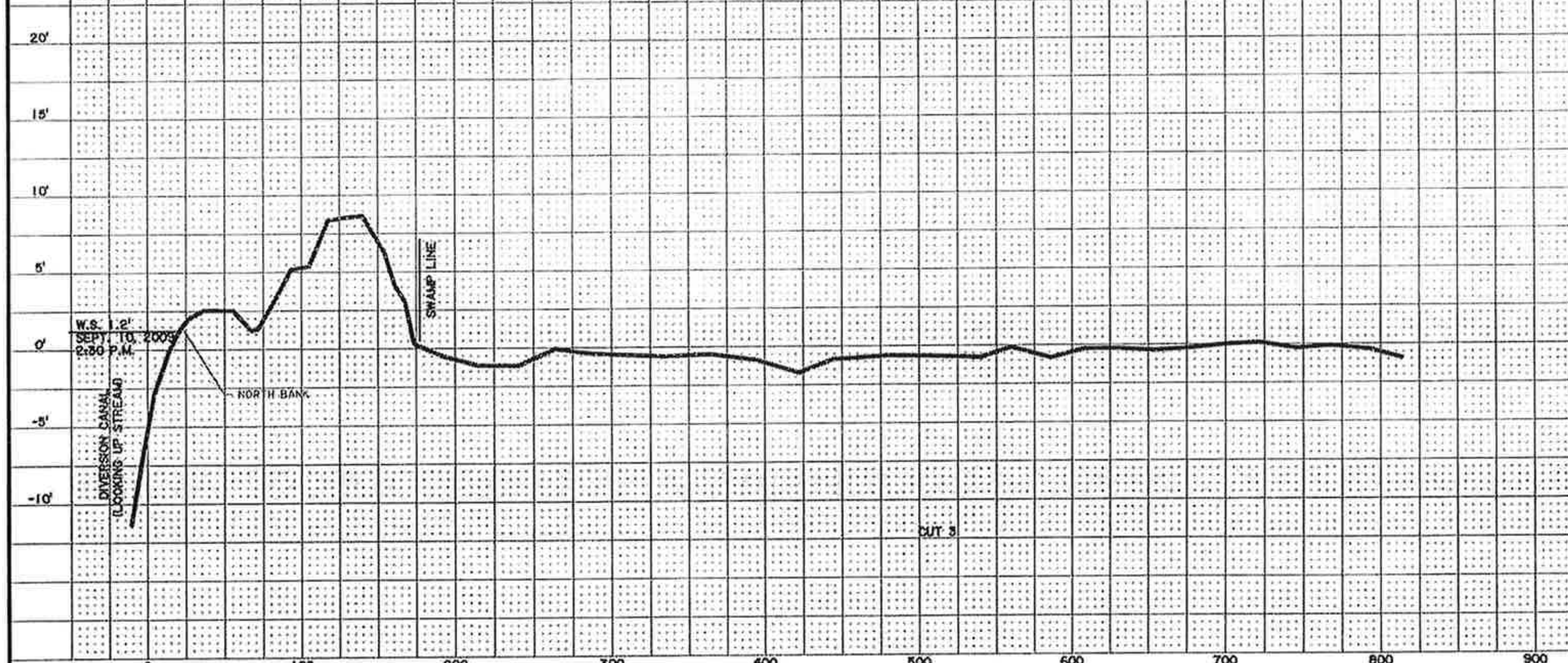
PROPOSE CUTS ALONG THE AMITE RIVER
DIVERSION CANAL AND
RELIC CUTS ALONG BLIND RIVER

SHREAD-KUYRKENDALL & ASSOC.

DESIGNED	DRAWN	CHECKED	APPROVED
R.D.B.	E.D.B.	R.D.B.	F.R.S.

PARISH	SHEET NO.
LIVINGSTON PARISH	X-2





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1" = 5' VERT.

ALL ELEVATIONS ARE IN NGVD '88 - 2004.65

DATE	DESCRIPTION	BY
9/22/09	PRELIMINARY SUBMITTAL	R.D.B.

REVISIONS

CROSS-SECTIONS
FOR
AMITE RIVER DIVERSION CANAL FEASIBILITY STUDY
COASTAL PROTECTION AND RESTORATION
AUTHORITY OF LOUISIANA
LDNR CONTRACT NO. 2503-08-29

PROPOSE CUTS ALONG THE AMITE RIVER
DIVERSION CANAL AND
RELIC CUTS ALONG BLIND RIVER

SHREAD-KUYRKENDALL & ASSOC.

DESIGNED	DRAWN	CHECKED	APPROVED
R.D.B.	E.D.B.	R.D.B.	F.A.S.

SURVEY REPORT For

AMITE RIVER DIVERSION CANAL FEASIBILITY STUDY

Survey of Proposed Cuts along the Amite River Diversion Canal And Relic Cuts along the Blind River

Coastal Protection and Restoration Authority of Louisiana

FINAL REPORT – SEPTEMBER 28, 2009

Section 4: Survey Data

Datum: Horz. - Louisiana State Plane South Zone Feet (1702)
Vertical – NAVD '88 (2004.65)

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2296,627613.17766383,3485034.02679894,1.2,ELEVATION SHOT
2297,627597.71381530,3485033.58128771,1.3,ELEVATION SHOT
2298,627577.29840320,3485032.45506061,1.2,ELEVATION SHOT
2299,627561.72334203,3485032.40132382,1.0,ELEVATION SHOT

2300,627539.45682359,3485031.28733445,1.0,ELEVATION SHOT
2301,627531.15105079,3485032.03945135,1.1,ELEVATION SHOT
1,628767.96000000,3482744.70000000,8.2,CONTROL BENCHMARK
2,629722.96000000,3467717.22000000,10.9,CONTROL BENCHMARK
3,628685.23000000,3477477.58000000,7.4,CONTROL BENCHMARK
2_1,629722.92220000,3467717.16260000,11.5,TEMPORARY BENCHMARK
2A,629722.89620000,3467717.18900000,11.6,TEMPORARY BENCHMARK
3_1,628685.19290000,3477477.62010000,8.0,TEMPORARY BENCHMARK
3A,628685.27310000,3477477.55960000,7.9,TEMPORARY BENCHMARK
1_1,628767.91490000,3482744.68350000,8.8,TEMPORARY BENCHMARK
1A,628767.86270000,3482744.61050000,8.9,TEMPORARY BENCHMARK
2B,629722.82470000,3467717.12420000,11.7,TEMPORARY BENCHMARK
2C,629722.85560000,3467717.09880000,11.6,TEMPORARY BENCHMARK
3B,628685.16510000,3477477.50110000,8.0,TEMPORARY BENCHMARK
3C,628685.20230000,3477477.52670000,8.2,TEMPORARY BENCHMARK
1B,628767.89150000,3482744.54280000,8.8,TEMPORARY BENCHMARK
1C,628767.80800000,3482744.50580000,8.9,TEMPORARY BENCHMARK
10,629865.36370000,3467242.88260000,10.6,PRIMARY CONTROL POINT
10A,629865.35230000,3467242.89980000,10.5,PRIMARY CONTROL POINT
10C,629825.55800000,3467293.41080000,11.3,CONTROL POINT REFERNCE MARK
10D,629862.67500000,3467303.57460000,12.1,CONTROL POINT REFERNCE MARK
10E,629896.36540000,3467294.90930000,13.8,CONTROL POINT REFERNCE MARK
1000,629785.86760000,3467225.15080000,0.9,ELEVATION SHOT WITH NOTE
2D,629722.99890000,3467717.20050000,11.5,TEMPORARY BENCHMARK
102,628685.22600000,3477477.56260000,8.2,TOPO POINT
3D,628685.17710000,3477477.52650000,8.1,TEMPORARY BENCHMARK
103,628679.97360000,3477117.90280000,8.0,TOPO POINT
103A,628680.01120000,3477117.87960000,8.0,TOPO POINT
1D,628767.88040000,3482744.52620000,8.8,TEMPORARY BENCHMARK
302,628341.83840000,3487505.73100000,1.0,TOPO POINT
303,628333.11250000,3487976.74920000,1.9,TOPO POINT
402,628368.34810000,3490909.34890000,2.4,TOPO POINT
403A,628368.33600000,3490909.34830000,2.4,TOPO POINT
402A,628368.33600000,3490909.34830000,2.4,TOPO POINT
403,628371.20990000,3491200.95760000,2.8,TOPO POINT
403A_1,628371.20310000,3491200.92860000,2.8,TOPO POINT
502,628384.40930000,3492732.55630000,3.3,TOPO POINT
502A,628384.38220000,3492732.55660000,3.2,TOPO POINT
503,628253.08430000,3493098.08160000,2.4,TOPO POINT
503A,628253.06610000,3493098.11010000,2.4,TOPO POINT
1001,628387.52060000,3492736.54260000,1.2,ELEVATION SHOT WITH NOTE
1002,628533.66240000,3475914.46870000,6.3,CONTROL BENCHMARK
1002A,628533.66590000,3475914.45410000,6.3,CONTROL BENCHMARK

202,628752.45660000,3484931.98970000,6.8,TOPO POINT
204,628771.83000000,3484537.87950000,7.2,TOPO POINT
204_1,628771.94430000,3484537.92110000,7.1,TOPO POINT
1003,628362.83630000,3493234.45300000,0.7,ELEVATION SHOT WITH NOTE
205,628771.81790000,3484537.90460000,7.0,TOPO POINT
204A,628771.81790000,3484537.90460000,7.0,TOPO POINT
204B,628771.78020000,3484537.93610000,6.9,TOPO POINT
202_1,628752.40920000,3484931.89240000,7.1,TOPO POINT
202A,628752.32480000,3484931.88810000,7.3,TOPO POINT
102B,628685.14400000,3477477.54100000,8.0,TOPO POINT
102C,628685.15600000,3477477.51260000,7.9,TOPO POINT
103B,628680.04160000,3477117.91430000,7.8,TOPO POINT
103C,628680.02730000,3477117.92820000,7.9,TOPO POINT
1004,629787.95160000,3467241.17470000,0.7,ELEVATION SHOT WITH NOTE
DC 10,629865.32280000,3467242.89240000,10.4,PRIMARY CONTROL POINT
DC 10A,629865.32340000,3467242.84960000,10.3,PRIMARY CONTROL POINT
604,624534.78580000,3489856.64850000,0.6,TOPO POINT
604_1,624534.75250000,3489861.36240000,1.6,TOPO POINT
2000,624511.06240000,3489862.88970000,-0.4,ELEVATION SHOT
1005,628368.73130000,3493234.52950000,1.0,ELEVATION SHOT WITH NOTE
2_2,629722.92220000,3467717.16260000,11.5,TEMPORARY BENCHMARK
3_2,628685.19290000,3477477.62010000,8.0,TEMPORARY BENCHMARK
1_2,628767.91490000,3482744.68350000,8.8,TEMPORARY BENCHMARK
403A_2,628371.20310000,3491200.92860000,2.8,TOPO POINT
204_2,628771.94430000,3484537.92110000,7.1,TOPO POINT
102_1,628685.16900000,3477477.56610000,7.4,TOPO POINT
103_1,628680.07190000,3477118.03600000,7.3,TOPO POINT
104,628680.06630000,3477118.01430000,7.1,TOPO POINT
10000,624377.58520000,3489974.81990000,1.1,ELEVATION SHOT WITH NOTE
10001,624367.68240000,3489979.61900000,-5.4,WATER BOTTOM SHOT
10002,624380.52850000,3489994.00010000,-6.4,WATER BOTTOM SHOT
10003,624394.45230000,3490009.28000000,-5.3,WATER BOTTOM SHOT
10004,624406.20860000,3490011.24870000,-6.7,WATER BOTTOM SHOT
10005,624411.60460000,3490017.71010000,-7.8,WATER BOTTOM SHOT
10006,624422.02330000,3490031.76070000,-7.1,WATER BOTTOM SHOT
10007,624426.31450000,3490034.83680000,-5.3,WATER BOTTOM SHOT
10008,624430.50420000,3490040.72200000,-3.7,WATER BOTTOM SHOT
10009,624434.51730000,3490038.88720000,-3.1,WATER BOTTOM SHOT
10010,624441.25240000,3490046.62680000,-4.0,WATER BOTTOM SHOT
10011,624449.52300000,3490054.57250000,-3.4,WATER BOTTOM SHOT
10012,624455.42420000,3490057.51460000,-2.9,WATER BOTTOM SHOT
10013,624466.70960000,3490064.36270000,-3.1,WATER BOTTOM SHOT
10014,624474.36220000,3490072.66780000,-2.6,WATER BOTTOM SHOT
10015,624482.55580000,3490077.12530000,-2.2,WATER BOTTOM SHOT

10016,624490.59270000,3490079.91480000,-1.8,WATER BOTTOM SHOT
10017,624497.93600000,3490082.66440000,-1.5,WATER BOTTOM SHOT
10018,624506.13920000,3490084.32830000,-1.4,WATER BOTTOM SHOT
10019,624516.76880000,3490085.19650000,-1.6,WATER BOTTOM SHOT
10020,624519.23430000,3490083.53470000,-1.4,WATER BOTTOM SHOT
10021,624571.53770000,3489943.19630000,-0.2,WATER BOTTOM SHOT
10022,624568.16760000,3489935.99320000,0.1,WATER BOTTOM SHOT
10023,624560.57470000,3489923.92600000,-0.7,WATER BOTTOM SHOT
10023_1,624565.05060000,3489927.61850000,0.4,WATER BOTTOM SHOT
10024,624556.05820000,3489917.36190000,-0.4,WATER BOTTOM SHOT
10025,624551.88160000,3489912.78440000,-2.2,WATER BOTTOM SHOT
10026,624546.36130000,3489906.12430000,-2.6,WATER BOTTOM SHOT
10027,624546.03750000,3489895.21990000,-3.4,WATER BOTTOM SHOT
10028,624529.84810000,3489885.64990000,-2.8,WATER BOTTOM SHOT
10029,624528.32200000,3489879.50360000,-2.2,WATER BOTTOM SHOT
10030,624520.91980000,3489876.26380000,-2.9,WATER BOTTOM SHOT
10031,624514.18590000,3489872.04560000,-1.6,WATER BOTTOM SHOT
10032,624513.51970000,3489867.41630000,-0.6,WATER BOTTOM SHOT
10033,624512.35920000,3489864.38620000,0.0,WATER BOTTOM SHOT
10034,624561.70540000,3489863.84120000,-5.7,WATER BOTTOM SHOT
10035,624528.44940000,3489905.50930000,-3.6,WATER BOTTOM SHOT
10036,624529.37260000,3489906.34450000,-6.4,WATER BOTTOM SHOT
10037,624502.86490000,3489934.90480000,-4.3,WATER BOTTOM SHOT
10038,624486.96930000,3489954.57870000,-3.4,WATER BOTTOM SHOT
10039,624471.64720000,3489976.96910000,-3.0,WATER BOTTOM SHOT
10040,624449.37960000,3489999.10790000,-3.6,WATER BOTTOM SHOT
10041,624435.67060000,3490016.88710000,-4.8,WATER BOTTOM SHOT
10042,624413.00090000,3490028.27210000,-10.1,WATER BOTTOM SHOT
10043,624411.67950000,3490027.65280000,-8.9,WATER BOTTOM SHOT
10044,623391.43710000,3488845.77380000,-5.5,WATER BOTTOM SHOT
10045,623390.78160000,3488845.86550000,-5.4,WATER BOTTOM SHOT
10046,623395.69990000,3488829.65960000,-3.9,WATER BOTTOM SHOT
10047,623381.77860000,3488824.87230000,-4.7,WATER BOTTOM SHOT
10048,623374.22530000,3488807.31740000,-5.6,WATER BOTTOM SHOT
10049,623362.57340000,3488788.85640000,-6.1,WATER BOTTOM SHOT
10051,623350.27460000,3488772.01390000,-2.8,DITCH CENTERLINE 1
10052,623356.24680000,3488780.51990000,-4.2,WATER BOTTOM SHOT
10054,623343.95700000,3488767.98260000,-2.5,WATER BOTTOM SHOT
10055,623471.84390000,3488682.09040000,-0.2,WATER BOTTOM SHOT
10056,623378.87940000,3488637.57490000,0.5,ELEVATION SHOT
10057,623394.86370000,3488645.97370000,-0.1,WATER BOTTOM SHOT
10058,623400.20550000,3488651.04770000,-1.5,WATER BOTTOM SHOT
10059,623408.44390000,3488656.77620000,-2.8,WATER BOTTOM SHOT
10060,623416.80380000,3488659.30470000,-3.2,WATER BOTTOM SHOT
10061,623420.97760000,3488664.22180000,-3.3,WATER BOTTOM SHOT
10062,623436.11950000,3488663.86520000,-4.7,WATER BOTTOM SHOT

10063,623443.45890000,3488670.82250000,-3.3,WATER BOTTOM SHOT
10064,623452.57280000,3488672.63240000,-1.5,WATER BOTTOM SHOT
10065,623456.41880000,3488678.15190000,-1.0,WATER BOTTOM SHOT
10066,623448.25720000,3488632.76450000,-4.1,WATER BOTTOM SHOT
10067,623438.46390000,3488649.93700000,-4.2,WATER BOTTOM SHOT
10068,623420.39940000,3488682.51620000,-4.3,WATER BOTTOM SHOT
10069,623420.41520000,3488682.59180000,-4.6,WATER BOTTOM SHOT
10070,623409.42300000,3488706.79870000,-4.5,WATER BOTTOM SHOT
10071,623395.14750000,3488734.58240000,-4.4,WATER BOTTOM SHOT
10072,623381.96110000,3488765.58700000,-4.3,WATER BOTTOM SHOT
10074,623361.18660000,3488802.22640000,-5.8,WATER BOTTOM SHOT
10073_1,623356.54210000,3488793.83660000,-6.2,WATER BOTTOM SHOT
10074_1,623327.84500000,3488804.60300000,-10.9,WATER BOTTOM SHOT
10075,623345.40870000,3488835.75200000,-14.1,WATER BOTTOM SHOT
10076,623350.00880000,3488815.61760000,0.8,ELEVATION SHOT WITH NOTE
10077,628345.02440000,3493227.80350000,0.8,ELEVATION SHOT WITH NOTE
503_2,628515.97820000,3492576.60050000,1.7,TOPO POINT
402_2,628368.34210000,3490909.34860000,1.7,TOPO POINT
502_2,628384.39580000,3492732.55640000,2.6,TOPO POINT
403_2,628371.20650000,3491200.94310000,2.1,TOPO POINT
404,628759.02880000,3491142.80930000,9.0,TOPO POINT
304,628635.84490000,3487655.63200000,2.5,TOPO POINT
305,628635.84490000,3487661.81710000,2.5,TOPO POINT
2500,628619.12552162,3491150.82230793,-3.9,ELEVATION SHOT
2501,628631.69490435,3491148.83834013,-1.7,ELEVATION SHOT
2502,628634.71733908,3491148.56416501,-1.7,ELEVATION SHOT
2503,628651.31910884,3491145.47824059,-0.8,ELEVATION SHOT
2504,628661.83325985,3491145.37378525,0.5,ELEVATION SHOT
2505,628668.83281552,3491145.37990216,0.8,ELEVATION SHOT WITH NOTE
2506,628681.52388178,3491147.62212052,0.5,ELEVATION SHOT
2507,628680.11840975,3491147.58574593,1.9,ELEVATION SHOT WITH NOTE
2508,628697.55221887,3491145.76193144,1.4,ELEVATION SHOT
2509,628704.58870476,3491145.38588643,1.4,LEVEE TOE 1
2510,628712.32657593,3491144.56101580,3.1,ELEVATION SHOT
2511,628726.60451346,3491144.76436905,5.5,ELEVATION SHOT
2512,628732.47949912,3491144.57076263,6.4,ELEVATION SHOT
2513,628741.13641868,3491144.03343714,5.0,ELEVATION SHOT
2514,628746.98379604,3491142.96797029,5.6,ELEVATION SHOT
2515,628756.02330764,3491143.00716832,8.5,LEVEE TOP 1
2516,628764.38623335,3491142.64831949,8.9,LEVEE TOP 2
2517,628776.78319408,3491143.42421300,6.4,ELEVATION SHOT
2518,628787.10857263,3491142.17317126,4.8,ELEVATION SHOT
2519,628798.37024171,3491141.77319243,3.5,ELEVATION SHOT
2520,628805.22171080,3491141.74311219,2.8,ELEVATION SHOT

2521,628810.97118997,3491141.69128298,1.6,LEVEE TOE 2
2522,628812.88471388,3491141.61665912,1.9,ELEVATION SHOT WITH NOTE
2523,628828.66349871,3491139.56432213,-0.0,ELEVATION SHOT
2524,628844.44734178,3491140.87502791,-0.0,ELEVATION SHOT
2525,628882.99684377,3491139.25994731,1.3,ELEVATION SHOT
2526,628908.34177168,3491139.03486355,0.2,ELEVATION SHOT
2527,628950.07555884,3491138.60914377,-0.5,ELEVATION SHOT
2528,628979.50113438,3491134.82556099,-0.1,ELEVATION SHOT
2529,629025.50081015,3491134.29283643,-1.0,ELEVATION SHOT
2530,629058.00912490,3491136.87428636,-0.5,ELEVATION SHOT
2531,629096.40941235,3491130.58880554,0.3,ELEVATION SHOT
2532,629122.15748657,3491132.77368106,-1.1,ELEVATION SHOT
2533,629152.52558641,3491133.09892203,-0.5,ELEVATION SHOT
2534,629177.62740197,3491129.83511562,-0.4,ELEVATION SHOT
2535,629193.15796696,3491130.88308847,-1.1,ELEVATION SHOT
2536,629217.77375599,3491129.85295429,-0.8,ELEVATION SHOT
2537,629237.51920307,3491128.67306112,-0.7,ELEVATION SHOT
2538,629263.78282865,3491127.28235925,-0.4,ELEVATION SHOT
2539,629285.60184773,3491127.76354656,-1.1,ELEVATION SHOT
2540,629304.52298099,3491126.97146534,-0.4,ELEVATION SHOT
2541,629322.18865628,3491127.92858027,-0.2,ELEVATION SHOT
2542,629344.54865213,3491125.86618449,-0.5,ELEVATION SHOT
2543,629366.82414362,3491126.59286542,-1.0,ELEVATION SHOT
2544,629392.87644089,3491123.87720696,0.2,ELEVATION SHOT
2545,629416.20044453,3491123.06894133,-0.2,ELEVATION SHOT
2546,629451.52531340,3491120.77452556,-0.5,ELEVATION SHOT
504,628778.56274572,3492422.56891852,6.9,TOPO POINT
2547,628647.06452724,3492421.44439997,-0.7,ELEVATION SHOT WITH NOTE
2548,628627.48945795,3492425.58565368,-4.9,ELEVATION SHOT
2549,628633.55911184,3492422.26521768,-1.4,ELEVATION SHOT
2550,628654.32082328,3492420.08272742,0.0,ELEVATION SHOT
2551,628683.22204595,3492421.72374485,2.0,ELEVATION SHOT
2552,628683.24269589,3492421.66523314,3.1,ELEVATION SHOT WITH NOTE
2553,628703.89737613,3492420.90804576,3.1,ELEVATION SHOT WITH NOTE
2554,628716.13918936,3492422.06124949,3.5,LEVEE TOE 1
2555,628735.17234486,3492422.90457078,4.7,ELEVATION SHOT
2556,628754.54959300,3492423.01969447,5.8,ELEVATION SHOT
2557,628763.94718216,3492422.82357747,7.5,LEVEE TOP 1
2558,628776.25658470,3492422.57892026,7.1,LEVEE TOP 2
2559,628786.17624004,3492422.26658360,6.2,ELEVATION SHOT
2560,628804.52646253,3492422.92371393,5.0,ELEVATION SHOT
2561,628815.51064668,3492424.31985465,2.8,ELEVATION SHOT
2562,628824.28003190,3492425.20861723,2.5,LEVEE TOE 2
2563,628833.57781924,3492424.73005067,0.5,ELEVATION SHOT
2564,628856.30203487,3492424.52857825,0.8,ELEVATION SHOT

2565,628873.42622760,3492424.86268598,0.7,ELEVATION SHOT
2566,628893.56540658,3492425.93046791,0.3,ELEVATION SHOT
2567,628911.40997506,3492425.94867946,1.0,ELEVATION SHOT
2568,628938.24468603,3492426.98851986,0.7,ELEVATION SHOT
2569,628963.22942280,3492427.55549736,0.9,ELEVATION SHOT
2570,628987.17248816,3492428.16559949,1.2,ELEVATION SHOT
2571,629019.04548644,3492428.62986472,0.6,ELEVATION SHOT
2572,629042.96407220,3492429.26347489,0.8,ELEVATION SHOT
2573,629071.09849376,3492430.08084837,0.3,ELEVATION SHOT
2574,629098.72665057,3492430.74215308,0.5,ELEVATION SHOT
2575,629126.44668720,3492431.92236733,1.3,ELEVATION SHOT
2576,629153.29614176,3492432.92061286,0.8,ELEVATION SHOT
2577,629178.43742609,3492434.16807718,0.4,ELEVATION SHOT
2578,629201.30075038,3492435.00562874,1.0,ELEVATION SHOT
2579,629223.77121925,3492435.87408870,0.5,ELEVATION SHOT
2580,629243.51779081,3492435.74678768,0.9,ELEVATION SHOT
2581,629259.34480173,3492436.06239385,1.0,ELEVATION SHOT
2582,629288.73334844,3492437.34267474,1.0,ELEVATION SHOT
2583,629306.94205456,3492437.42900724,1.1,ELEVATION SHOT
2584,629325.12370601,3492437.97747290,1.0,ELEVATION SHOT
2585,629342.57055842,3492439.32317549,0.8,ELEVATION SHOT
2586,629368.37313105,3492439.34842746,0.8,ELEVATION SHOT
2587,629398.55728983,3492440.44178237,0.9,ELEVATION SHOT
2588,629419.42826840,3492440.75114230,0.9,ELEVATION SHOT
2589,629454.09234165,3492441.26263009,1.2,ELEVATION SHOT
2590,629477.85833467,3492442.01869252,0.9,ELEVATION SHOT
2400,628587.81134019,3487658.16611024,-11.4,ELEVATION SHOT
2401,628594.98399337,3487658.28248246,-7.2,ELEVATION SHOT
2402,628602.92772454,3487658.19660207,-2.9,ELEVATION SHOT
2403,628612.85127575,3487657.33554841,-0.0,ELEVATION SHOT
2404,628619.45603167,3487660.52144126,1.2,WATER'S EDGE 1
2405,628619.23374799,3487661.24656378,1.2,ELEVATION SHOT
2406,628625.07928239,3487661.01863674,2.0,ELEVATION SHOT WITH NOTE
2407,628635.01950888,3487661.83702945,2.5,ELEVATION SHOT
2408,628654.21800281,3487662.90407175,2.5,ELEVATION SHOT
2409,628665.76903586,3487661.55188461,1.2,ELEVATION SHOT
2410,628670.19271764,3487662.36007878,1.3,LEVEE TOE 1
2411,628682.30538182,3487661.74706896,3.4,ELEVATION SHOT
2412,628691.69262773,3487662.05488475,5.2,ELEVATION SHOT
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2415,628727.42234631,3487659.95786931,8.5,ELEVATION SHOT
2416,628738.61428902,3487659.84156609,8.6,LEVEE TOP 2
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2418,628759.78193901,3487659.14497768,4.1,ELEVATION SHOT

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CORPS OF ENGINEERS

U.S. ARMY

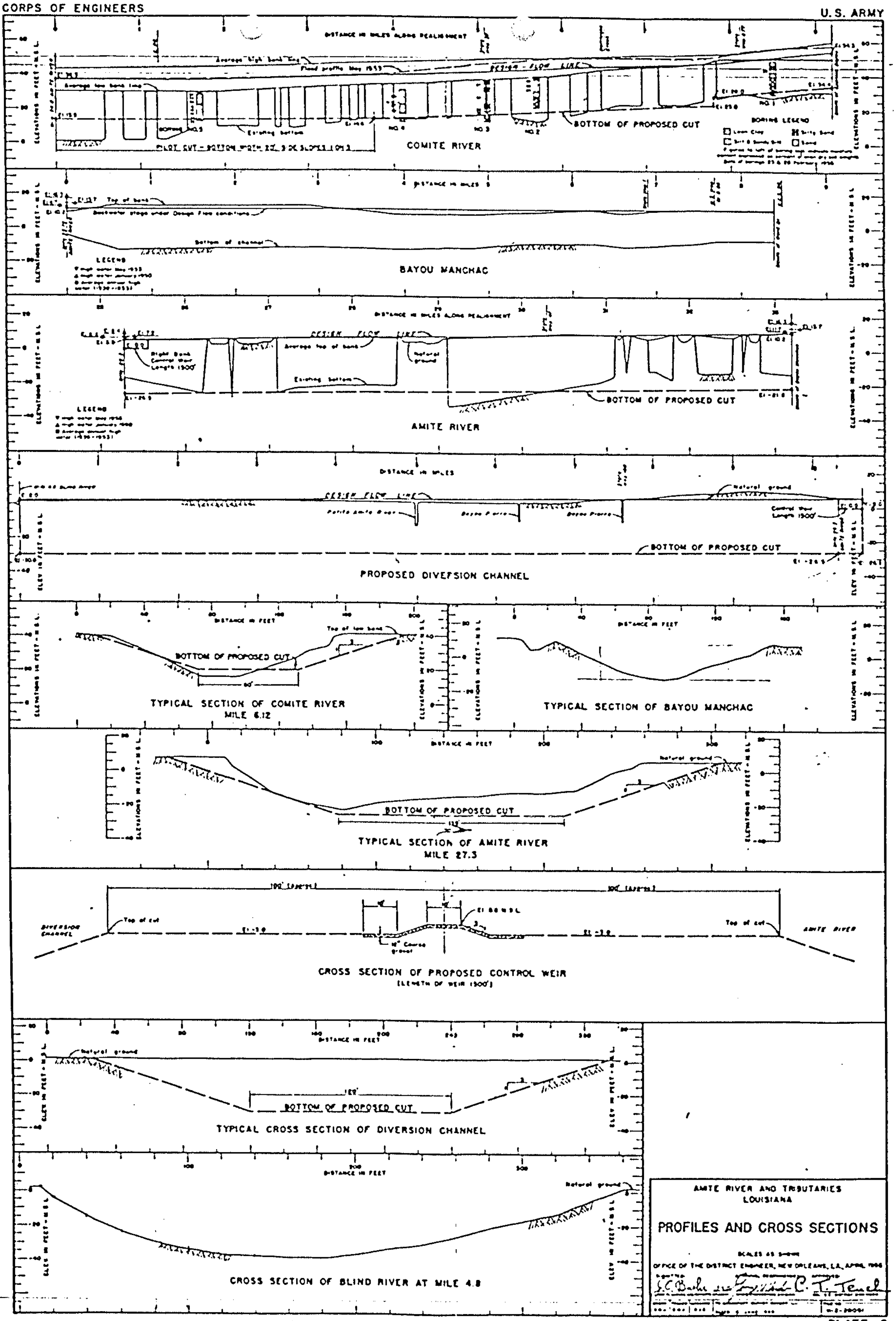
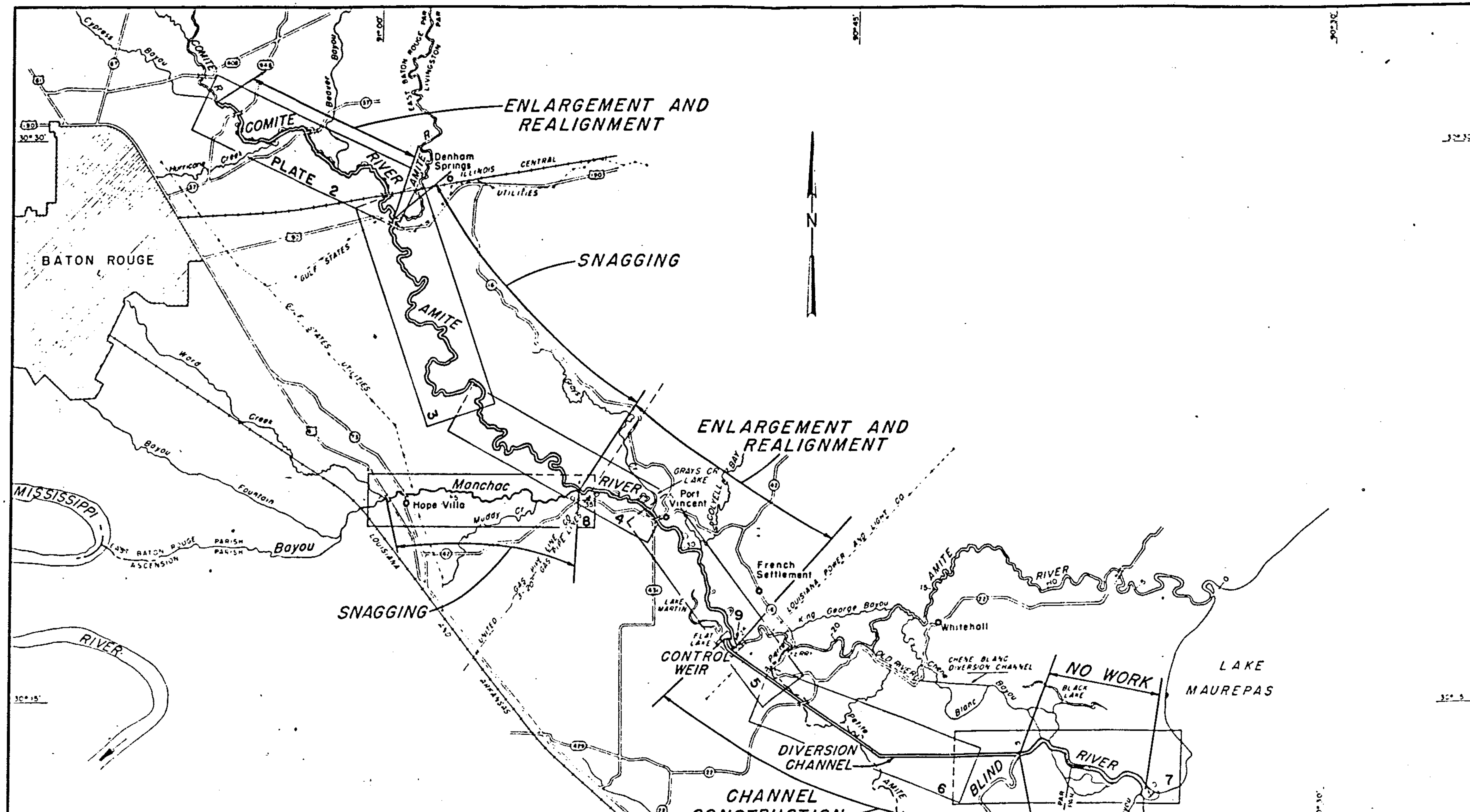


PLATE 2



AMITE RIVER AND TRIBUTARIES
LOUISIANA

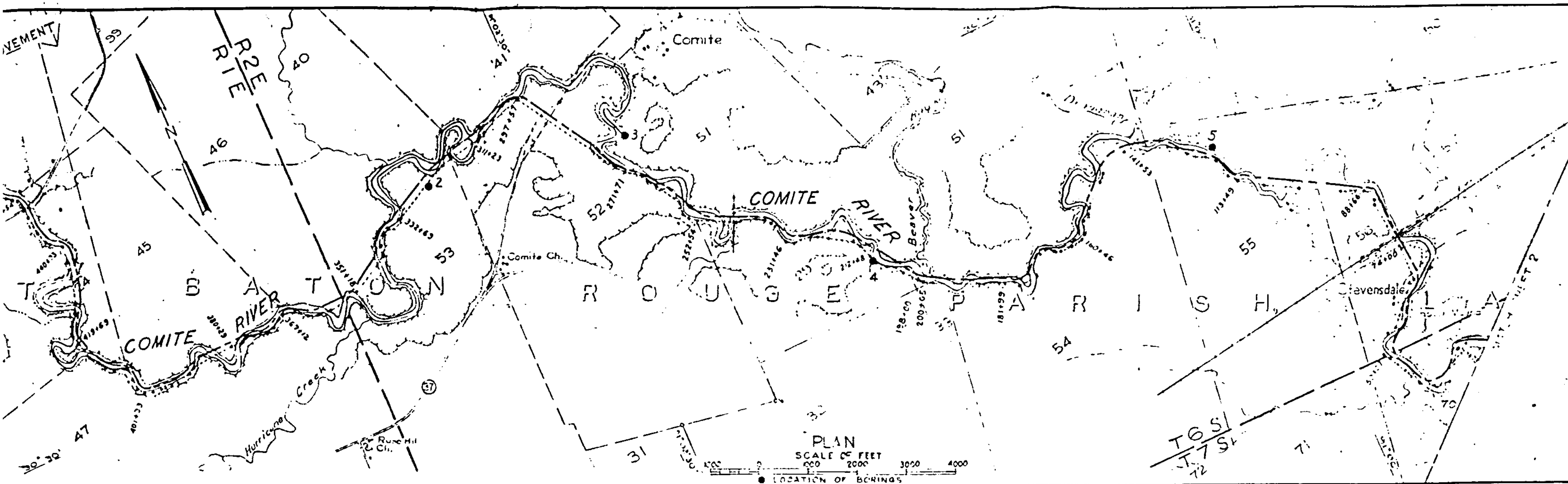
GENERAL DESIGN MEMORANDUM NO. 1

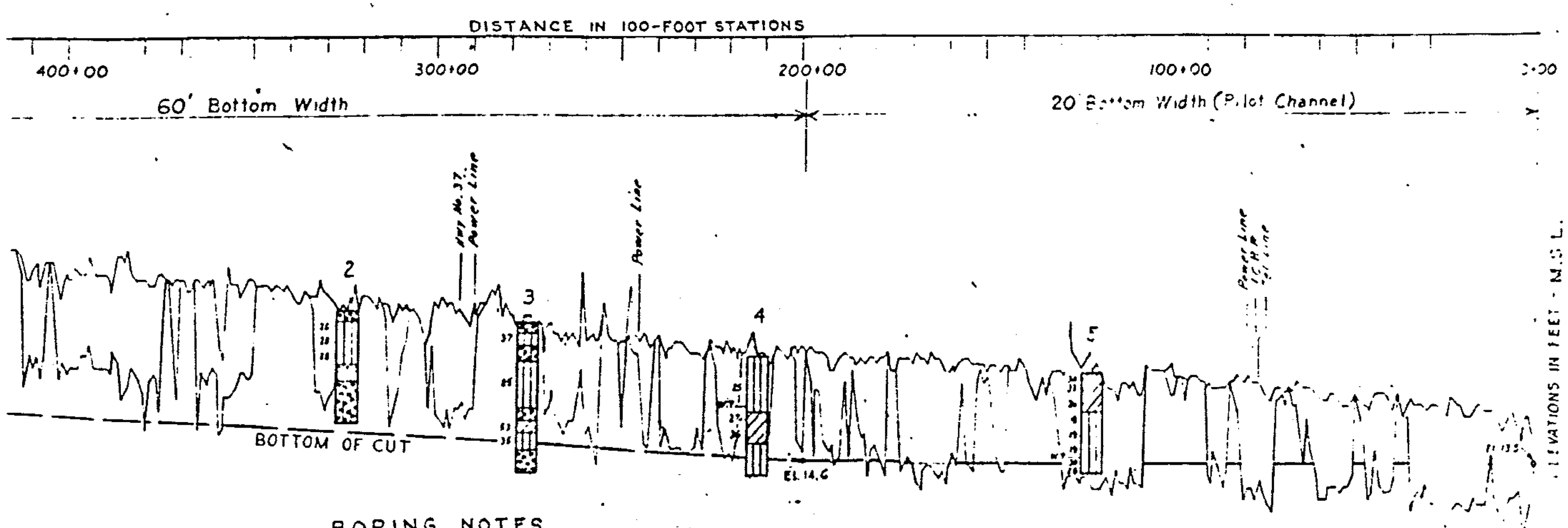
GENERAL MAP

IN ONE SHEET
SCALE OF MILES

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA
NOVEMBER 1956 FILE NO H-2-20631

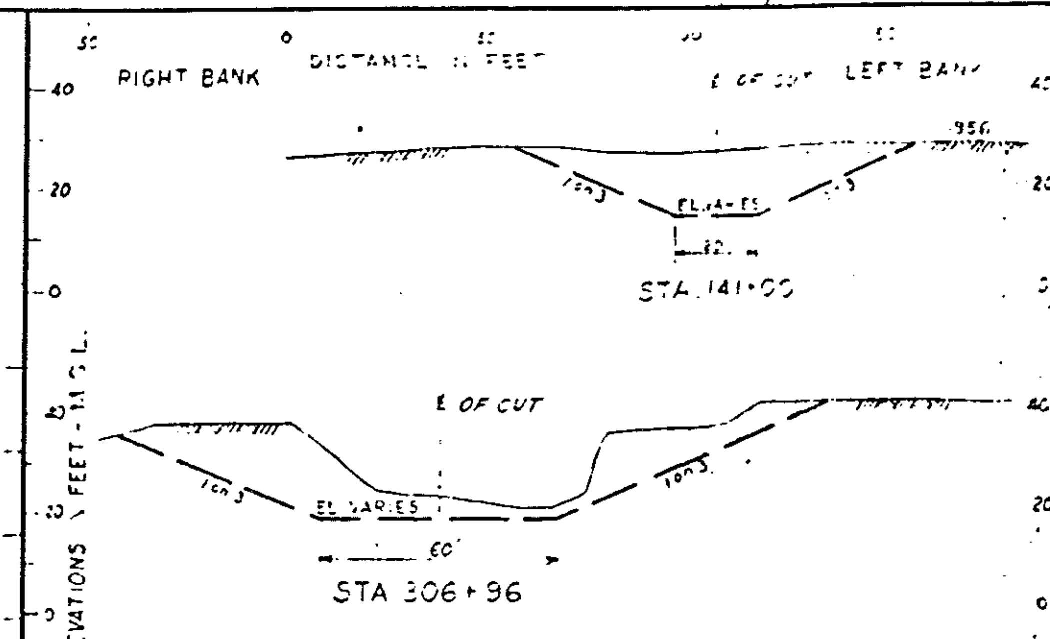
PLATE 1





PROFILE

Date of Borings



COMITE RIVER
TYPICAL CROSS SECTIONS

rly graded) (SP)

graded (SW)

atter

BORING NOTES

Figures to left of boring logs indicate water content expressed as percent of oven dry soil weights.

BORING NOS:

Comite River; Nos. 1-5 made with 4" twan post hole auger.

Amite River; Nos. 1-19 and Control Weir No. 1; made with 1⅞" I.D. core barrel sampler.

Diversion Channel; Nos. 1A, 2A, 4A-9A and 11A-14, 1B, 2B and 4B, 1C-4C made with 4" post hole auger.

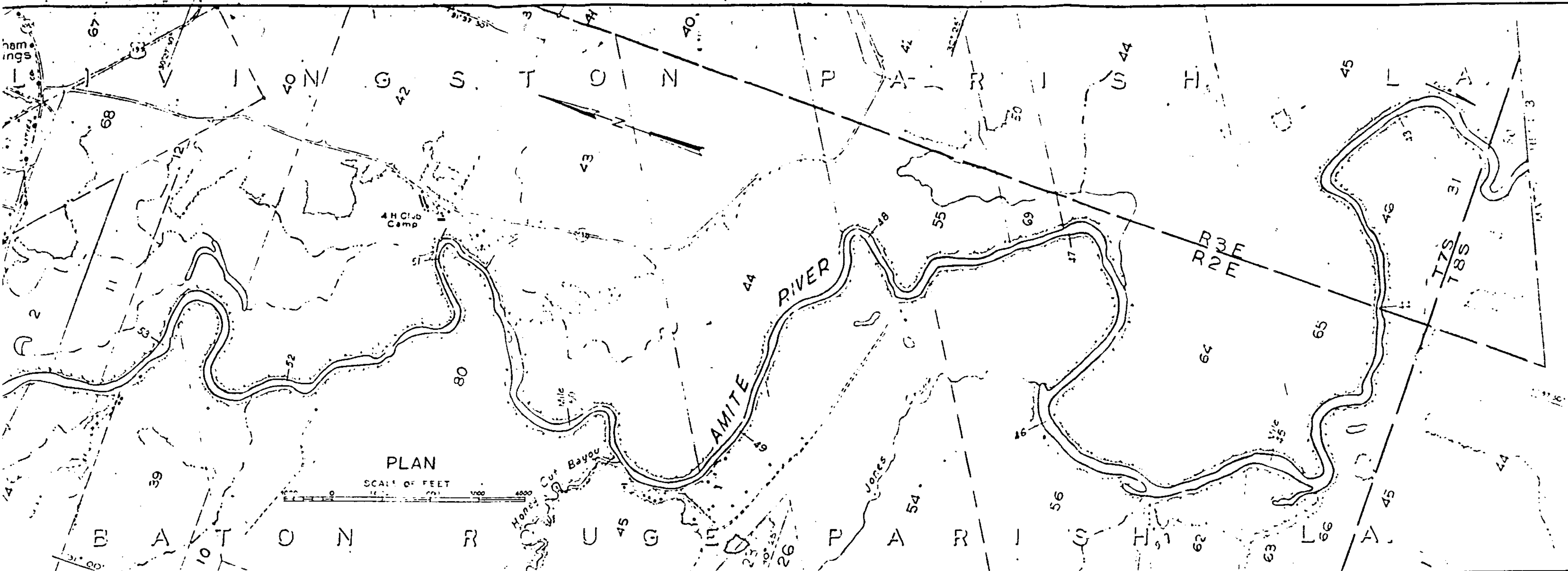
AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO 1

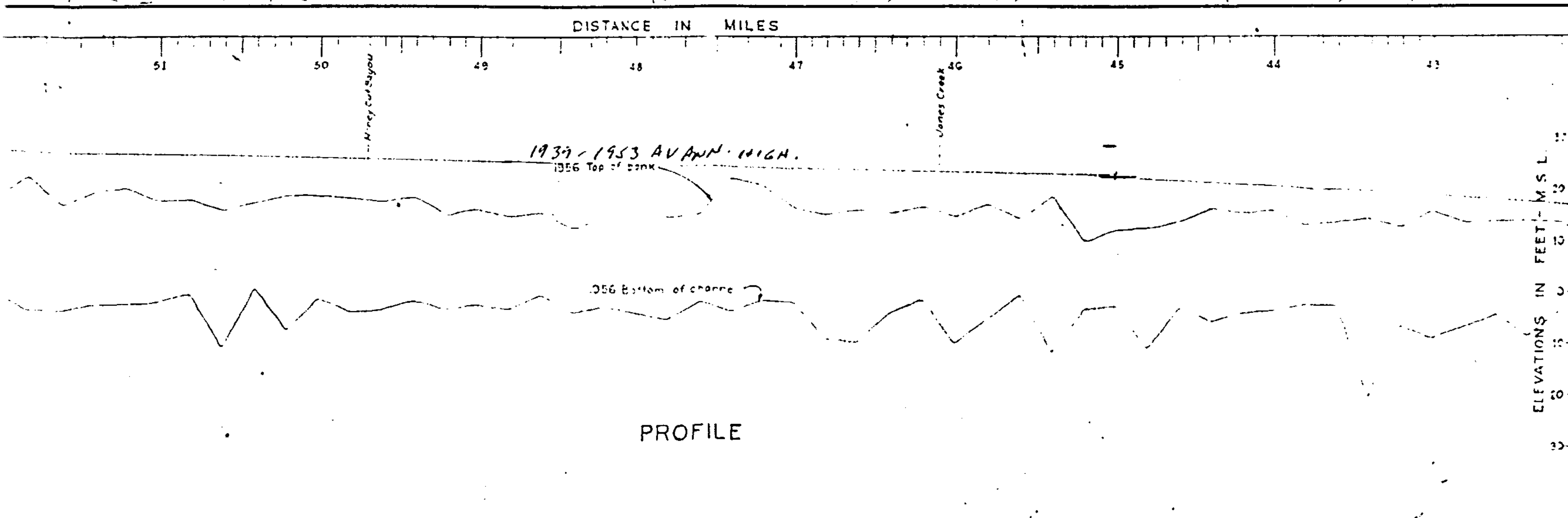
COMITE RIVER

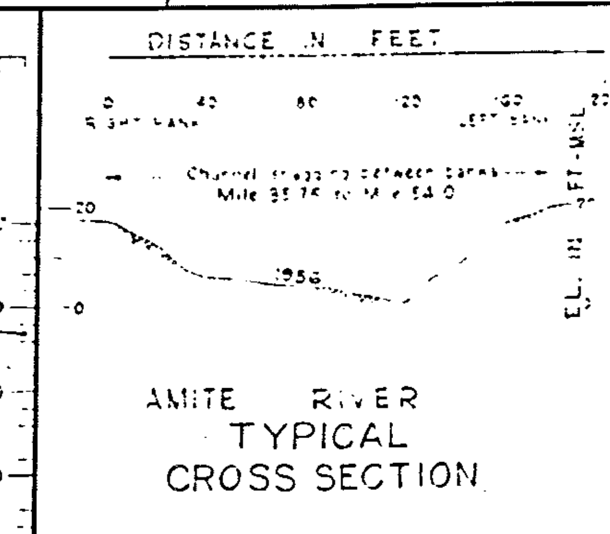
SHEET [illegible] OF 7 SHEETS
SCALES AS SHOWN

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
NOVEMBER [illegible] FILE NO H-2-23681

PLATE 2





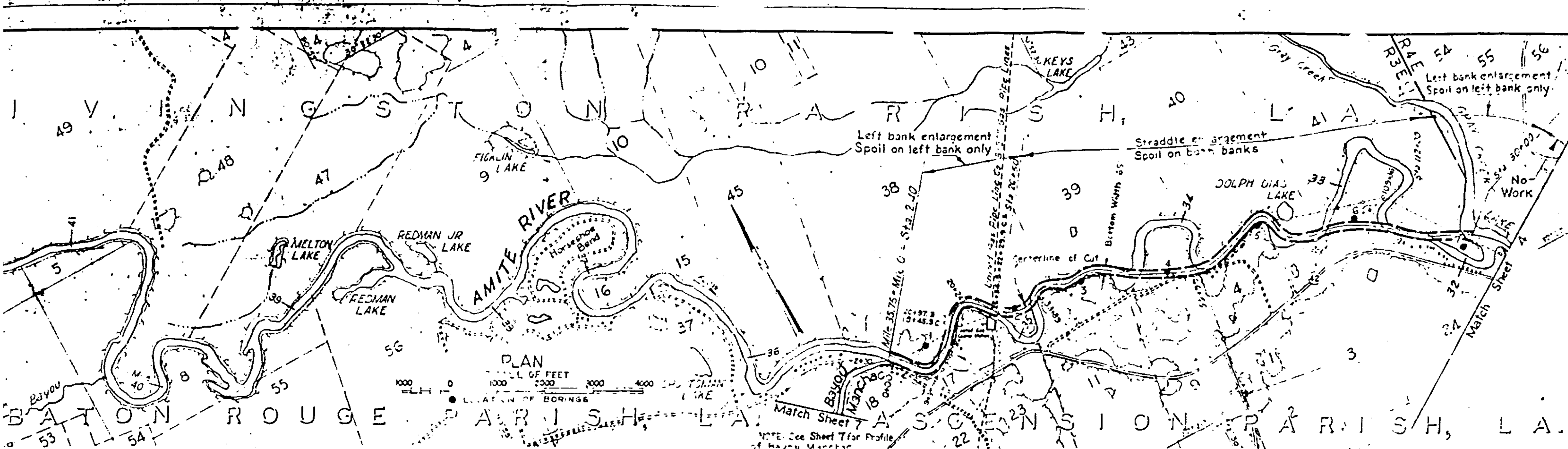


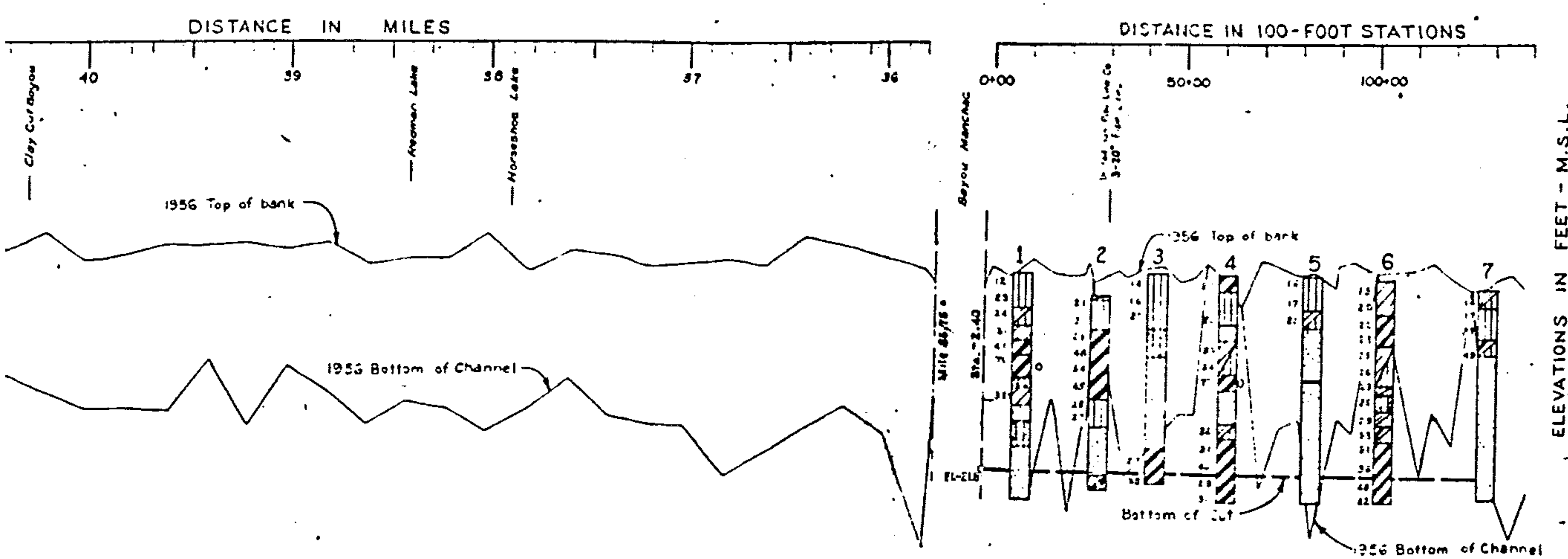
GENERAL DESIGN MEMORANDUM
COMITE AND AMITE RIVERS

SCALES AS SHOWN

U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA

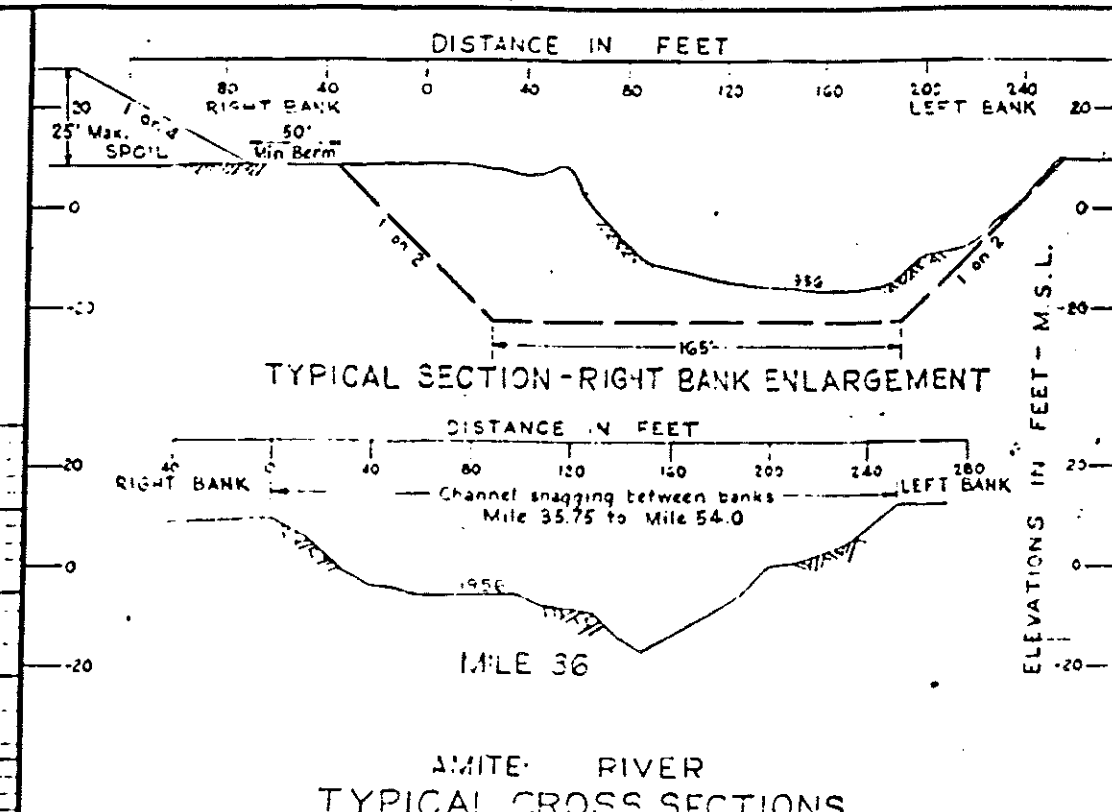
PLATE 3





PROFILE

NOTE:
Date of Borings: No.1, Aug 6, 1956; No.2, Aug. 7, 1956; No. 3, Aug. 10, 1956; No 4, Aug. 10-11, 1956; No 5, Aug. 11, 1956; No. 6, Aug. 12, 1956; and No. 7, Aug. 13-14, 1956.
For Boring Log Legends and Notes see Sheet 1.

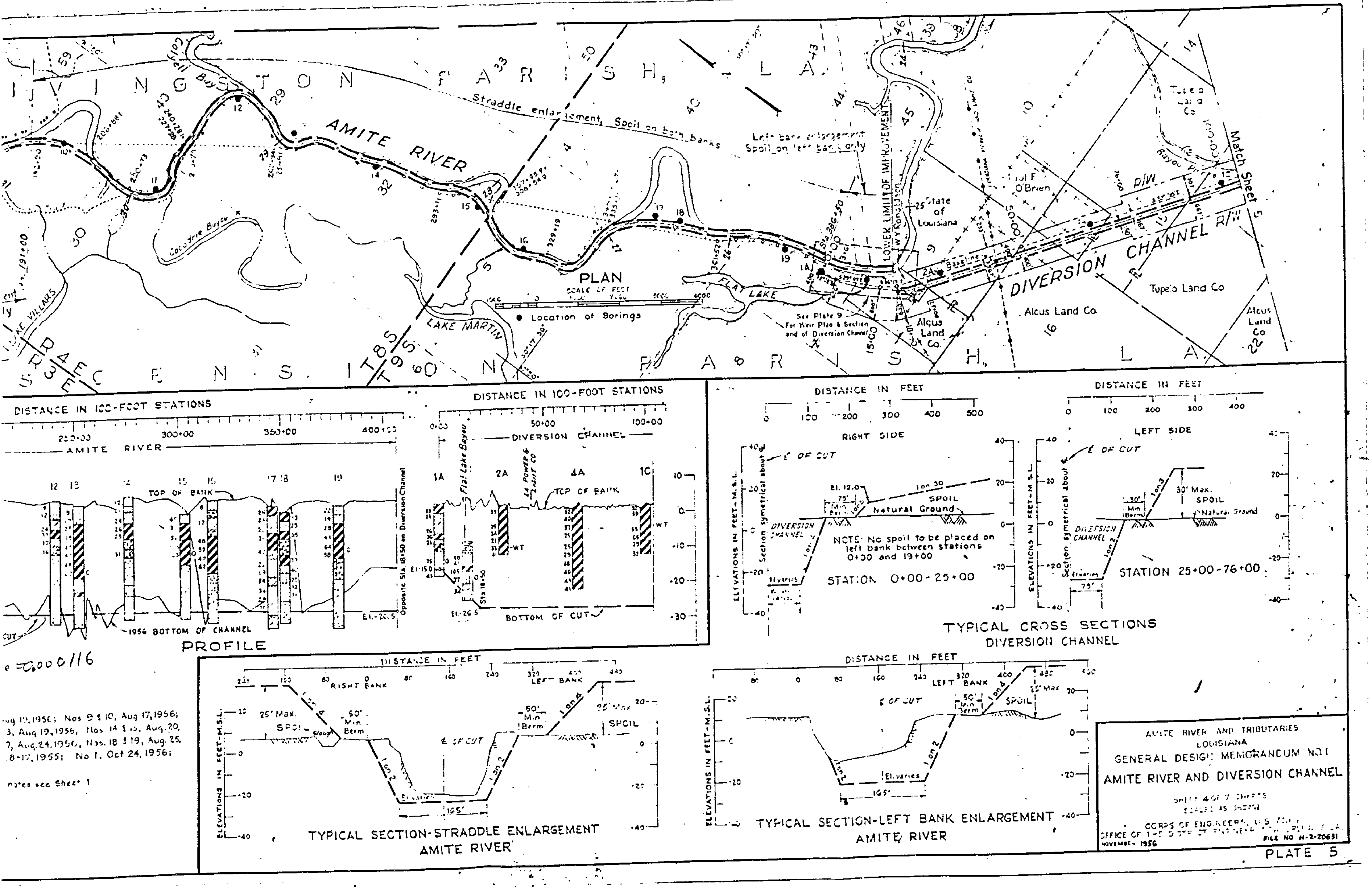


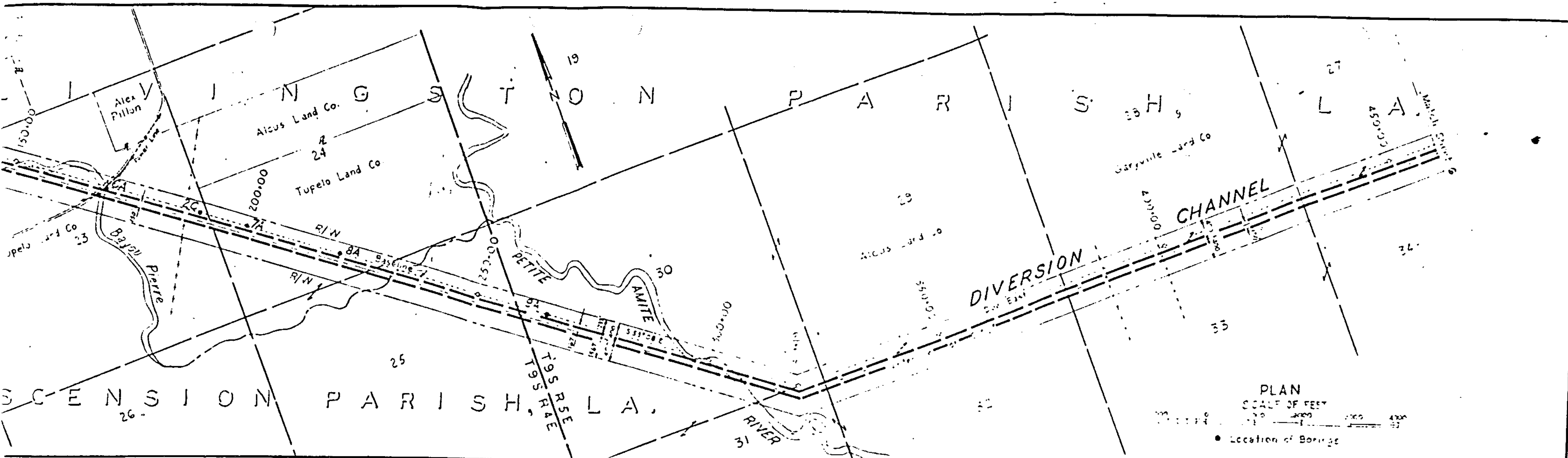
AMITE RIVER
TYPICAL CROSS SECTIONS

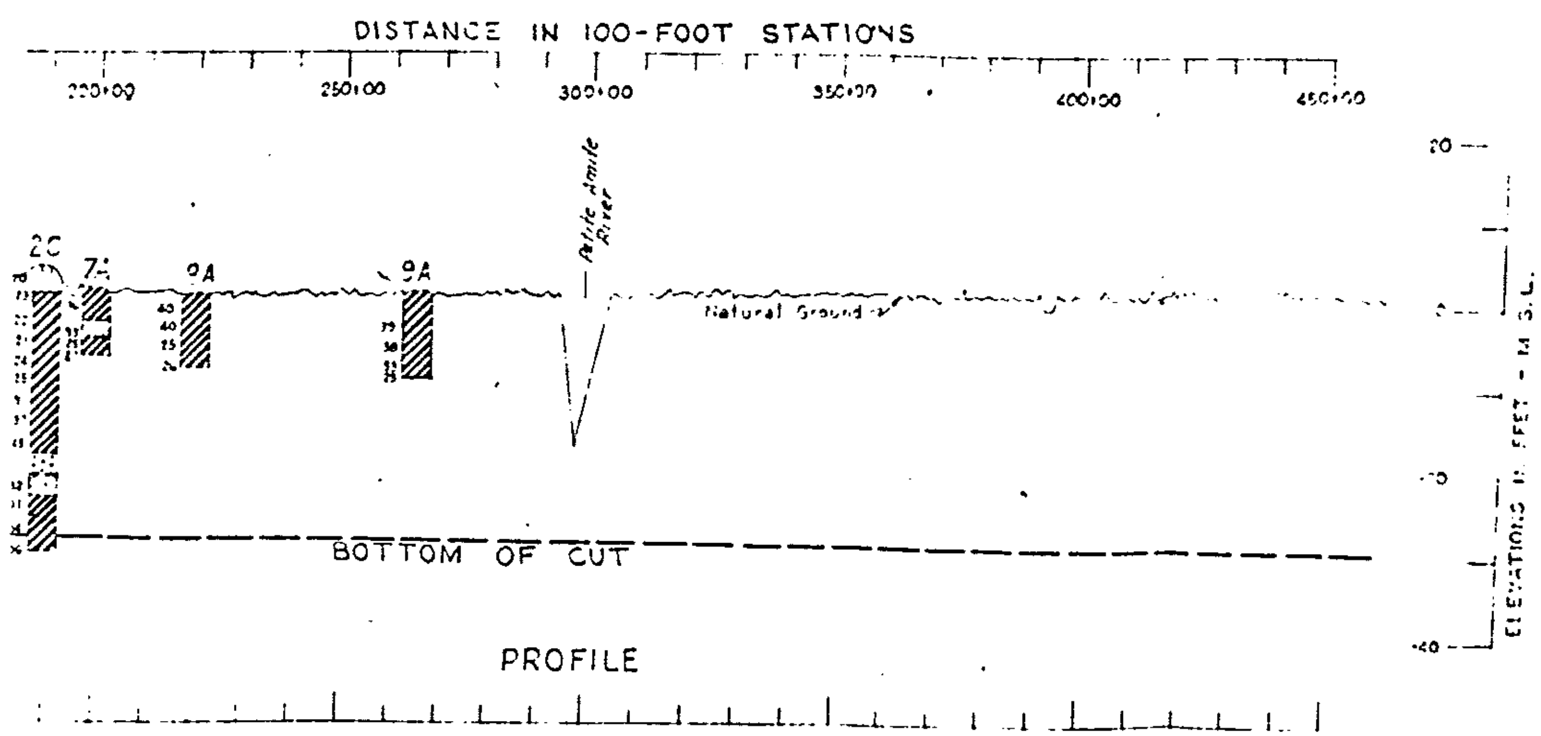
AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO.
AMITE RIVER AND BAYOU MANCHAC

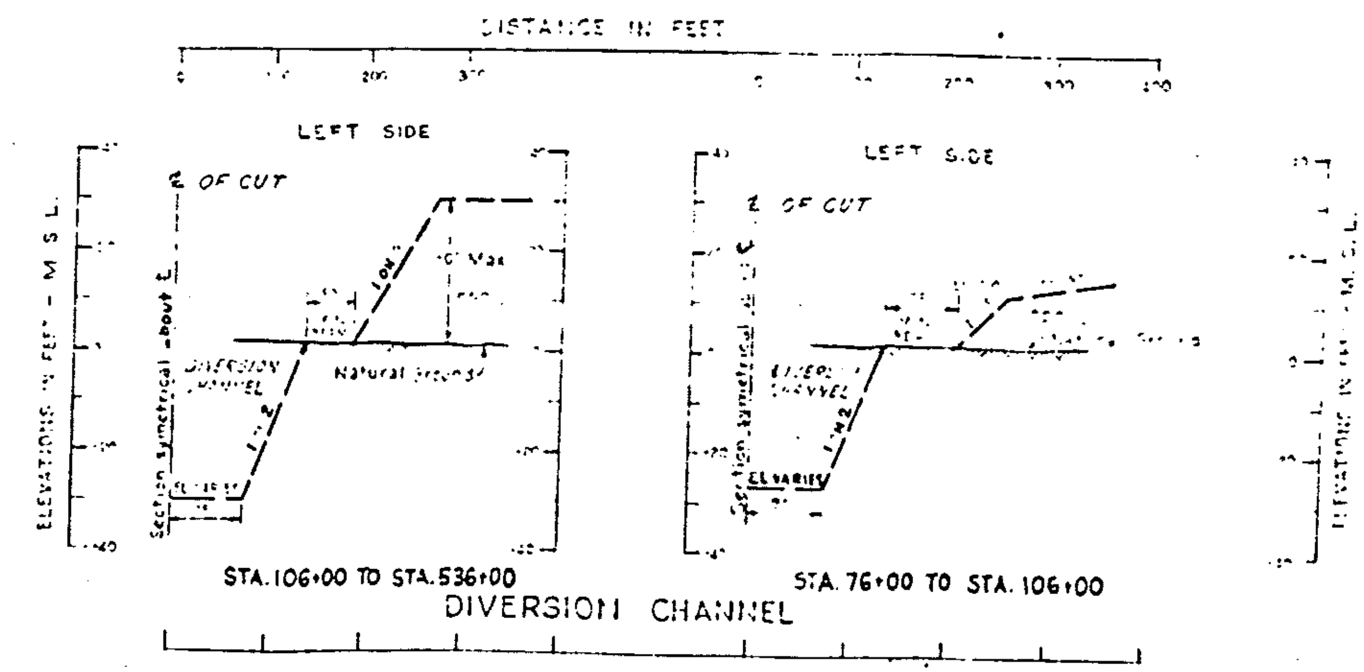
SHEET 3 OF SHEETS

CORPS OF ENGINEERS, U.S. ARMY
NOVEMBER 1956


LIVINGSTON PARISH, LA.
AMITE RIVER
Straddle enlargement, Spoil on both banks
Left bank enlargement Spoil on left bank only
LOWER LIMIT OF IMPROVEMENT
DIVERSION CHANNEL
FLAT LAKE
LAKE MARTIN
Cocodrie Bayou
Match Sheet 5
State of Louisiana
Tupelo Land Co
Alcus Land Co.
PLAN
SCALE OF FEET
● Location of Borings
See Plate 9 For Weir Plan & Section and of Diversion Channel
ASCENSION PARISH, LA.
DISTANCE IN 100-FOOT STATIONS
AMITE RIVER
DIVERSION CHANNEL
TOP OF BANK
1956 BOTTOM OF CHANNEL
BOTTOM OF CUT
PROFILE
DISTANCE IN FEET
RIGHT SIDE
LEFT SIDE
℄ OF CUT
NOTE: No spoil to be placed on left bank between stations 0+00 and 19+00
STATION 0+00-25+00
STATION 25+00-76+00
ELEVATIONS IN FEET-M.S.L.
Section symmetrical about ℄
TYPICAL CROSS SECTIONS
DIVERSION CHANNEL
RIGHT BANK
LEFT BANK
25' Max. SPOIL
50' Min Berm
1 on 2
1 on 4
El. varies
165'
TYPICAL SECTION-STRADDLE ENLARGEMENT
AMITE RIVER
TYPICAL SECTION-LEFT BANK ENLARGEMENT
AMITE RIVER
AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO.1
AMITE RIVER AND DIVERSION CHANNEL
CORPS OF ENGINEERS, U.S. ARMY
NOVEMBER 1956
PLATE 5







NOTE
Date of borings Nos. 5A to 9A Nov 8-?, 1955
No. 2C July 30, 1956.
For Boring Log Legend and Notes see Sheet 1.

AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO. 1
DIVERSION CHANNEL
SHEET 5 OF 7 SHEETS
SCALE AS SHOWN
CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA
NOVEMBER 1956
FILE NO. [illegible]

PLATE 6

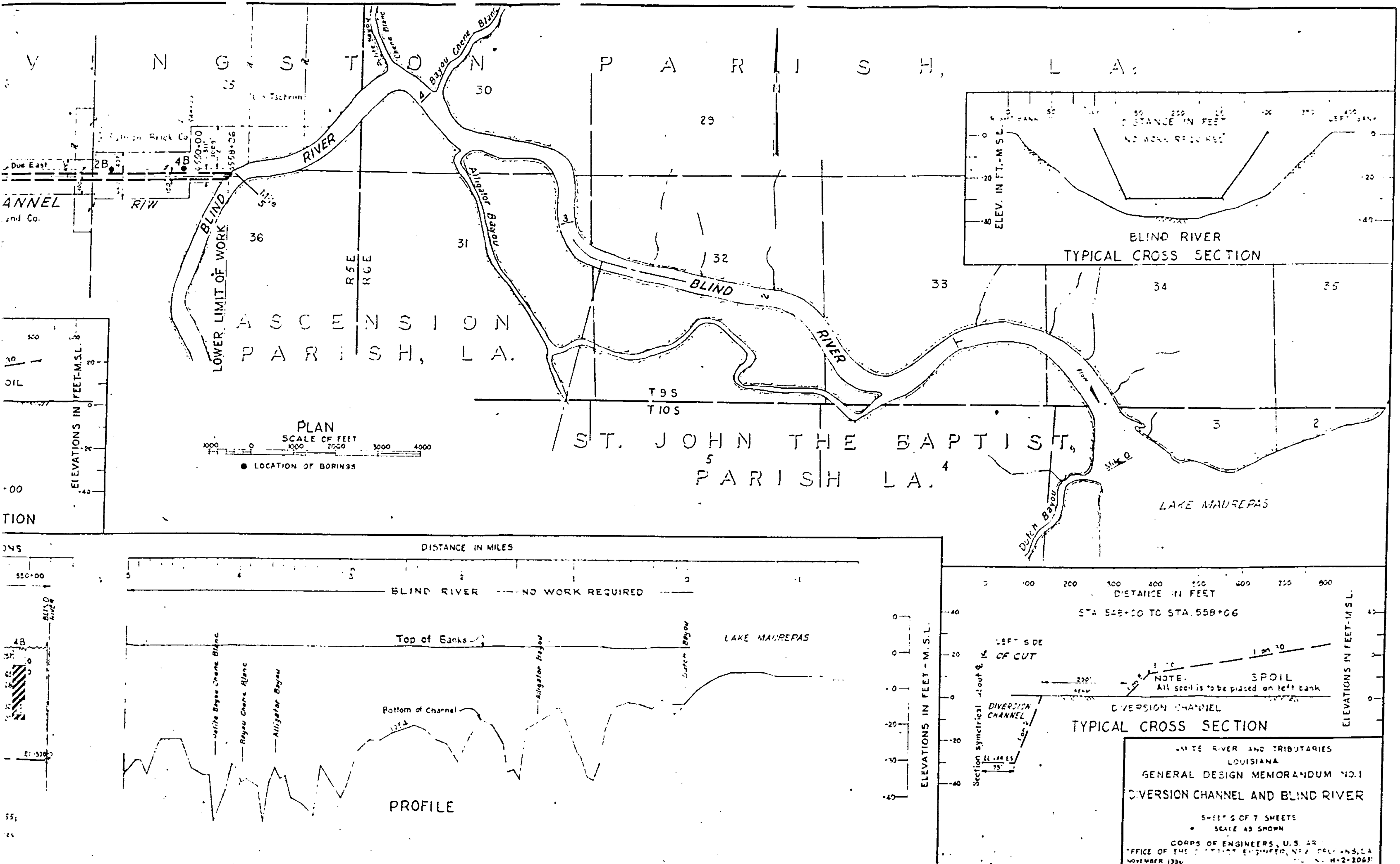
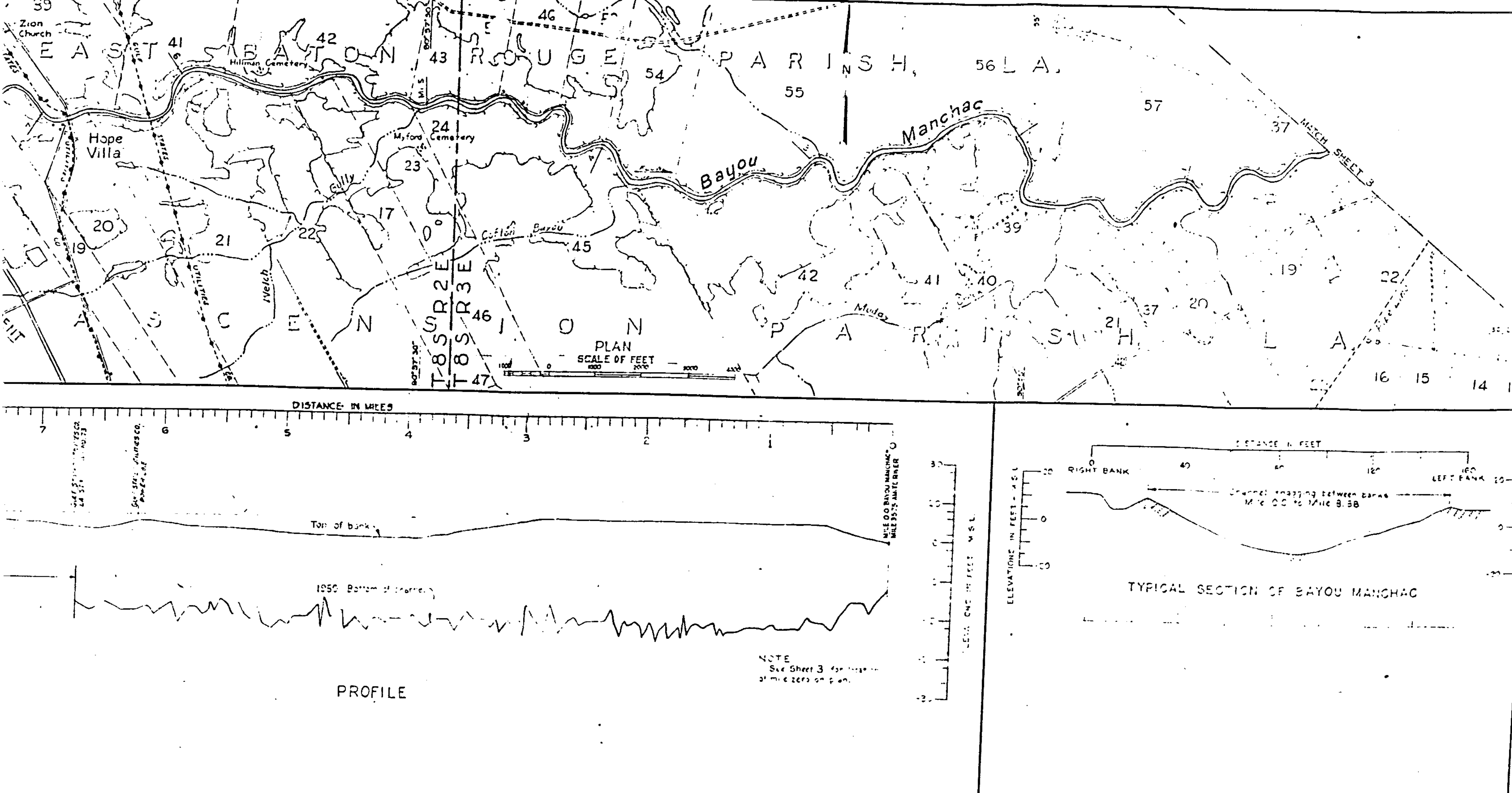

LIVINGSTON PARISH, LA.
ASCENSION PARISH, LA.
ST. JOHN THE BAPTIST PARISH LA.
BLIND RIVER
Bayou Chene Blanc
Alligator Bayou
Dutch Bayou
LAKE MAUREPAS
LOWER LIMIT OF WORK
R5E R6E
T9S
T10S
Due East
RIW
PLAN
SCALE OF FEET
1000 0 1000 2000 3000 4000
LOCATION OF BORINGS
BLIND RIVER
TYPICAL CROSS SECTION
DISTANCE IN FEET
NO WORK REQUIRED
ELEV. IN FT.-M.S.L.
DISTANCE IN MILES
BLIND RIVER ---NO WORK REQUIRED
Top of Banks
Bottom of Channel
PROFILE
ELEVATIONS IN FEET-M.S.L.
STA. 548+00 TO STA. 558+06
LEFT SIDE OF CUT
NOTE: All spoil is to be placed on left bank
SPOIL
DIVERSION CHANNEL
TYPICAL CROSS SECTION
AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO.1
DIVERSION CHANNEL AND BLIND RIVER
SCALE AS SHOWN
CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.

PLATE 7



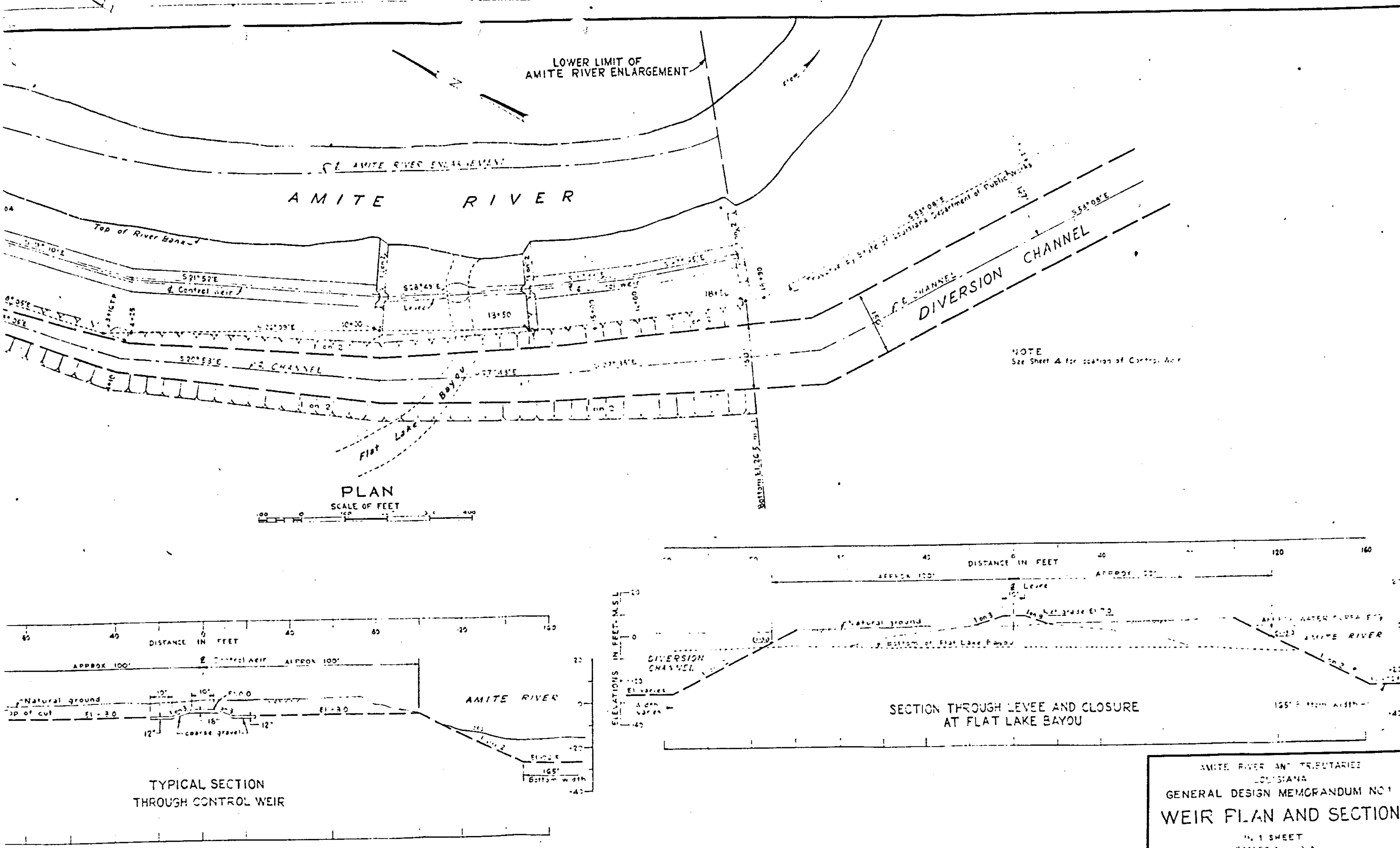
AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO I

BAYOU MANCHAC

SHEET 7 OF 7 SHEETS
SCALED AS SHOWN

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
NOVEMBER 1956

PLATE 8



AMITE RIVER AND TRIBUTARIES
LOUISIANA
GENERAL DESIGN MEMORANDUM NO 1
WEIR PLAN AND SECTION
IN 1 SHEET
CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.

PLATE 9

Section 4

GEOLOGY

Geology

The study area is located in the Maurepas Basin, a component of the Lake Pontchartrain Basin, which is located near the southern terminus of the Mississippi Alluvial Plain physical province. Surface deposits within the Lake Pontchartrain Basin are of Holocene age and are typified by saturated clayey soils with a thin organic surface layer. These Holocene deposits typically overlay Pleistocene alluvial terrace deposits of fine-grained sands and silts derived from alluvium deposited by the proto-Mississippi and other coastal river systems during recent sea level lowstand intervals. Holocene and Pleistocene deposits are underlain by approximately 34,000 feet of sediment and sedimentary rock. These sediments record the outward progression of the Gulf Coastal Plain, and in the case of Pleistocene sediments, the outward building of the Mississippi and proto-Mississippi River Complex. Rivers and streams within the study area exhibit a meandering regime rather than the entrenched or braided regimes observed in areas with higher gradients. Common geomorphologic features in this regime include crevasse splays, point bars, floodplains, abandoned channels, abandoned courses, and backswamps/flood basins. Backswamp/flood basin features are predominant in the vicinity of the study area.

Topography in the western Maurepas Swamp is nearly level, with elevations ranging from mean sea level (msl) to approximately three feet above msl. Topographic survey data collected for the LCA Small Diversion at Hope Canal project immediately east of the study area indicated that point elevations in the surveyed area typically exhibited a random pattern within the narrow range of 0.0 to 1.0 feet North American Vertical Datum, 1988 (NAVD 88), with an average elevation of approximately 0.5 feet NAVD 88. Light Detection and Ranging (LiDAR) data for the study area indicate that the spoil banks along the Amite River Diversion Canal (ARDC) form the topographic high point therein, with an elevation range of approximately 15-20 feet NAVD 88. Developed areas and upland sites, which comprise a minority of land surface within the study area and are primarily located in the western study area, exhibit an average elevation of approximately 5.0 feet NAVD 88. Hydrograph data collected by the Louisiana Department of Natural Resources (LDNR) in 2005 document a gentle gradient from west to east of approximately eight inches in the eastern study area between the Petite Amite and Blind rivers in the direction of Lake Maurepas. A relic railroad grade that traverses the eastern study area from north to south also forms a local topographic high point, with an average elevation of approximately 2.0 feet NAVD 88. Topographic low points within the study area are occupied by sloughs or channels. Channels present within the study area include the ARDC; the Amite, Petite Amite, and Blind rivers; and Bayous Chene Blanc and Pierre. The ARDC was originally dredged to a channel depth of 30 feet below msl. Invert elevations in the ARDC measured by the USACE in its 1985 survey of the Amite River and Tributaries Federal navigation project range from -36 feet to -27 feet National Geodetic Vertical Datum, 1929 (NGVD 29). The Amite River in the vicinity of the study area has invert elevations ranging from -23 to -20 feet NGVD 29. Invert elevations for the Blind River range from -39.5 to -37.0 feet NAVD 88 between the confluence with the Petite Amite River and the confluence with the ARDC, respectively. The Petite Amite River has an invert elevation of -20.5 feet NAVD 88 approximately three miles upstream from the confluence with the Blind River. No bathymetric data are available for Bayous Chene Blanc or Pierre.

Soils are a dominant factor in substrate formation, which in turn influences the type of vegetation communities and land use that may be found within a given area. Of particular concern are prime farmland soils. The U.S. Department of Agriculture (USDA) defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. Soils within the study area are typically hydric clays or mucks that are frequently or continuously flooded. Soils in the Barbary series comprise a plurality within the study area, and substantial quantities of soils within the Fausse and Maurepas series are also present. Four soils within the study area are classified as prime farmland. These soils (Colyell silt loam; Olivier silt loam, 0-1 percent slopes; Olivier silt loam, 1-3 percent slopes; Springfield silt loam) have physical and chemical characteristics that make them ideal for crop production; however, the soils are not present in sufficient quantities within the study area to make them available for crop production. Consequently, these soils do not meet the requirements of prime farmland as defined by the USDA within the study area.

Section 5

GEOTECHNICAL INVESTIGATION

Geotechnical investigations have not been conducted at this time. A Scope of Work has been developed and is approved. The appropriate investigation and analysis is planned to be completed during the Preliminary Engineering and Design phase of this project (PED).

Geotechnical Assumption & Criteria

In the process of developing preliminary designs of proposed alternative plans for the Louisiana Coastal Area Amite River Diversion Canal (LCA ARDC) Modification project, some geotechnical assumptions were made. First, it was assumed that if the cross sections for the proposed conveyance channels were to mimic the cross sectional makeup of relict cuts, found near Blind River, the proposed channels would maintain a hydrologic equilibrium by maintaining flow rates large enough to prevent the buildup of sediments within the channel over the lifespan of the project. Secondly, it was assumed that with a 3H:1V slope and seeding and mulching, the slopes along the dredged material berm openings would remain stable. This is based on the assumption that the berm material is primarily composed of clay, allowing for increased slope stability. The existing slopes on the dredged material berm are between 2:1 and 3:1 and have remained stable. Therefore, until a geotechnical investigation can be completed, it is reasonable to assume that a slope of 3:1 cut into the berm as an opening would remain stable.

Geotechnical Uncertainties

Until a full geotechnical investigation is performed in the PED phase of the project, uncertainties will exist with the assumptions made regarding material placement and slope stability. It is assumed that when material from excavation is placed within the project area, it will be stable enough to create habitat at an elevation sufficient to sustain bottomland hardwood tree species. However, if the material does not maintain the required elevations, a shift in the tree species to be utilized for these plantings will be made to those suitable for a freshwater swamp. Additionally, the stability of channel and placement area slopes will not be known until the full results of a slope stability analysis are completed.

Planned Geotechnical Investigations

A Scope of Work for a planned geotechnical investigation to support the planning and design of the LCA ARDC Modification project has been developed. The investigation will be conducted, during the Preliminary Engineering and Design phase of the project (PED). Investigations will be performed in accordance with USACE geotechnical investigation standards (EM 1110-1-1804, Chapter F, paragraphs 6-5 through 6-7). Lab testing will be conducted in accordance with ER 1110-1-8100 and ER 1110-1-261. The Contracting Party's equipment shall use a fixed-piston type sampling method (Hvorslev fixed-piston or equivalent). An undisturbed type piston sampler shall utilize a minimum of 5- inch Shelby Tubes (5" O.D., approx. 4-3/4" I.D.) that are a minimum of 54 inches in length with sealing caps. The Contractor shall perform global slope stability analyses, soil classification under the Unified Soil Classification System, as well as Triaxial Shear and Consolidated Undrained analysis.

Survey for Geotechnical Investigations

In conjunction with the geotechnical investigation, a land survey will be conducted. The survey will include additional cross sections of the dredged material berm, along with the proposed conveyance channels. The limits of the cross-sections in the spoil bank should be 200' from the center of the proposed cut (for a total cross-section width of 400'). The limits of the cross-sections not in the spoil bank should be 100' from the center of the proposed cut (for a total cross-section width of 200'). Additional cross-sections will be taken on the spoil bank perpendicular to the spoil bank along the centerline of the proposed cuts. The cross section should be approximately 125' on either side of the center of the spoil bank (for a total cross-section width of 250') at the 3 proposed cut locations on the north side of the ARDC and should show all significant break points of the spoil bank. An additional cross section should be approximately 300' on either side of the center of the spoil bank (for a total cross-section width of 600') at the proposed eastern-most cut on the south side of the ARDC and should show all significant break points of the spoil bank. An additional cross section should be approximately 200' on either side of the center of the existing spoil bank (for a total cross-section width of 400') at the proposed western-most cut on the south side of the ARDC and should show all significant break points of the existing spoil bank. All breakpoints between these limits should be accounted for to ensure that all major elevation changes are incorporated into the cross-section. The Contracting Party shall conduct all surveying activities using three Bench Marks (TBMs) established by Anthony Cavell utilizing Continually Operating Reference Stations (CORS) stations and Global Positioning System Real time Kinematic (GPS RTK).

Section 6

CONCEPTUAL DESIGN ALTERNATIVES EXPLORED

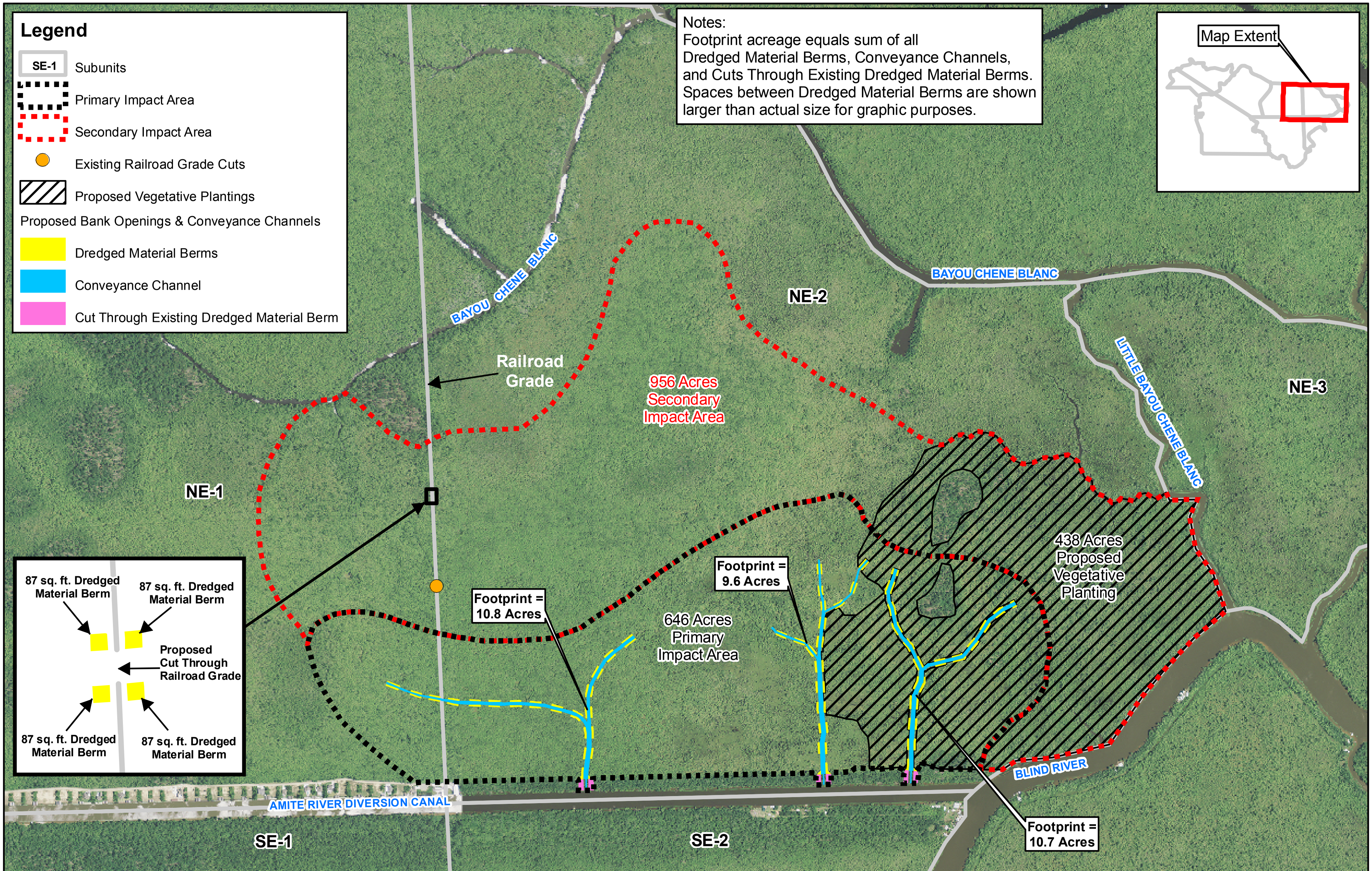
3.0 Alternative 33 (TSP) (NE-1/NE-2)

Alternative 33 (Figure 1) includes:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost channel in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1, NE-2, and the ARDC.
- Dredged material (5.0 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- One cut would be created in the railroad grade approximately 0.9 miles north of the ARDC to improve sheet flow.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 5.0 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.

Three natural low areas or relict channels have been identified as potential bank opening and conveyance channel sites. Openings would enable impounded water to be drained from the swamp and provide hydrologic connectivity between the swamp and the ARDC. Additionally, the placement of a cut in the railroad grade would provide further hydrologic connectivity between NE-1 and NE-2. Openings would promote the introduction of freshwater, sediments, and nutrients into the swamp and allow the oxidation of sediments and removal of toxic metabolites. This alternative is anticipated to improve the degraded swamp and decrease the transition to marsh and ultimately, open water. This alternative represents the minimum effort that would meet the goals and objectives of the project. Alternative 33 would benefit approximately 1,602 acres of existing freshwater swamp, recreate 144 acres of freshwater swamp from freshwater marsh, and create 5.0 acres of upland habitat from dredged material placement.

All excavation through the dredged material berms, as well as the conveyance channels through the swamp, would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. Several existing channels were surveyed for depth, dimension, and profile. These channels have existed for quite some time without any maintenance. The cross-sections include a 70-foot wide cut section with benches through dredged material berm, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches was designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. The quantities associated with each alternative are found in Table 1. Table 2 summarizes the features associated with each alternative within the final array. A typical depiction of the conveyance channels is found in Figure 6.



ALTERNATIVE 33

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

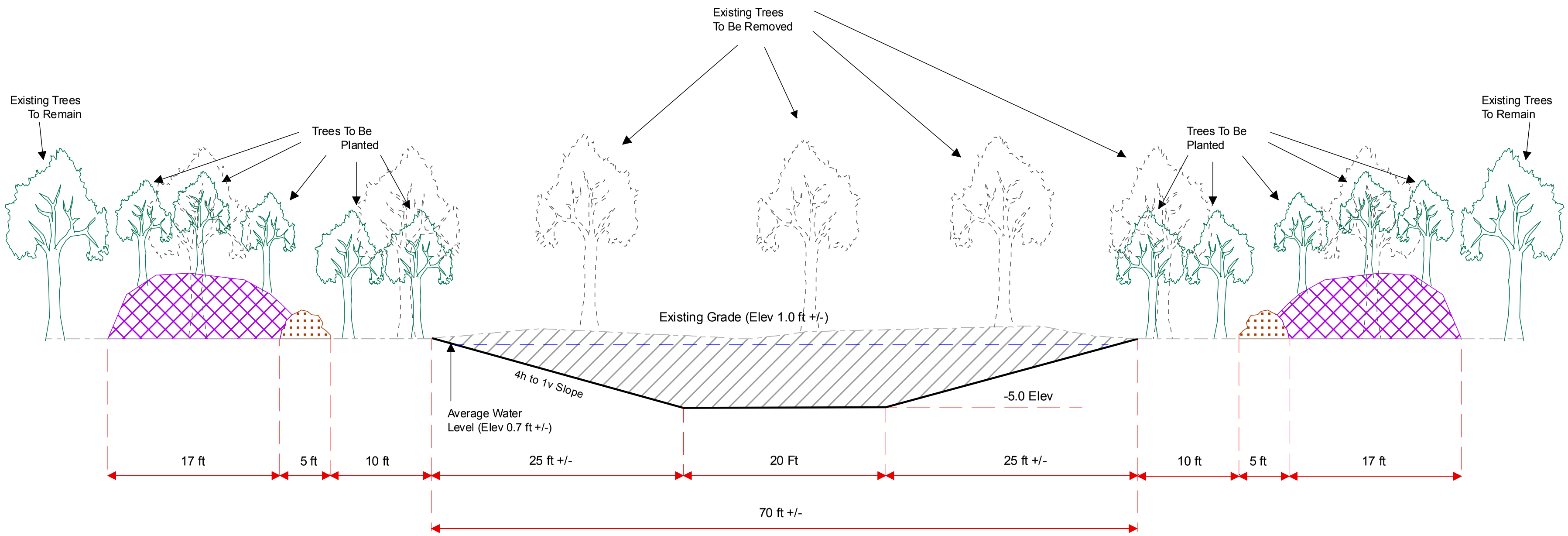
Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 1
Date: December 2009
Scale: 1:24,000
Source: USGS/GEC
Map ID: 27850108-1868

Table 1. Alternative Quantities

Alternative	Footprints (Acres)						Excavation (Cubic Yards)*		
	Berm		Swamp						
	Slopes & Benches	Channel	Channel	10' Gaps and Stumps	Material Placement	Total	Dredged Material Berm Cut	Channel Cut	Total
33 1	.8	0.8	17.8	5.8	5.0	31.2	13,753	81,694	95,447
34 2	.5	0.9	9.6	3.1	2.7	18.8	27,867	45,873	73,740
35 1	.8	0.6	6.6	2.1	2.2	13.3	25,527	34,941	60,468
36 4	.3	1.7	27.4	8.8	7.8	50.0	41,620	127,567	169,187
37 4	.3	1.5	16.2	5.2	4.9	32.1	53,394	80,814	134,208
38 3	.6	1.4	24.4	7.9	7.2	44.5	39,280	116,635	155,915
39 6	.1	2.3	34.0	11.0	9.9	63.3	67,147	162,508	229,655

* Does not include changes in volume due to excavation.



Legend

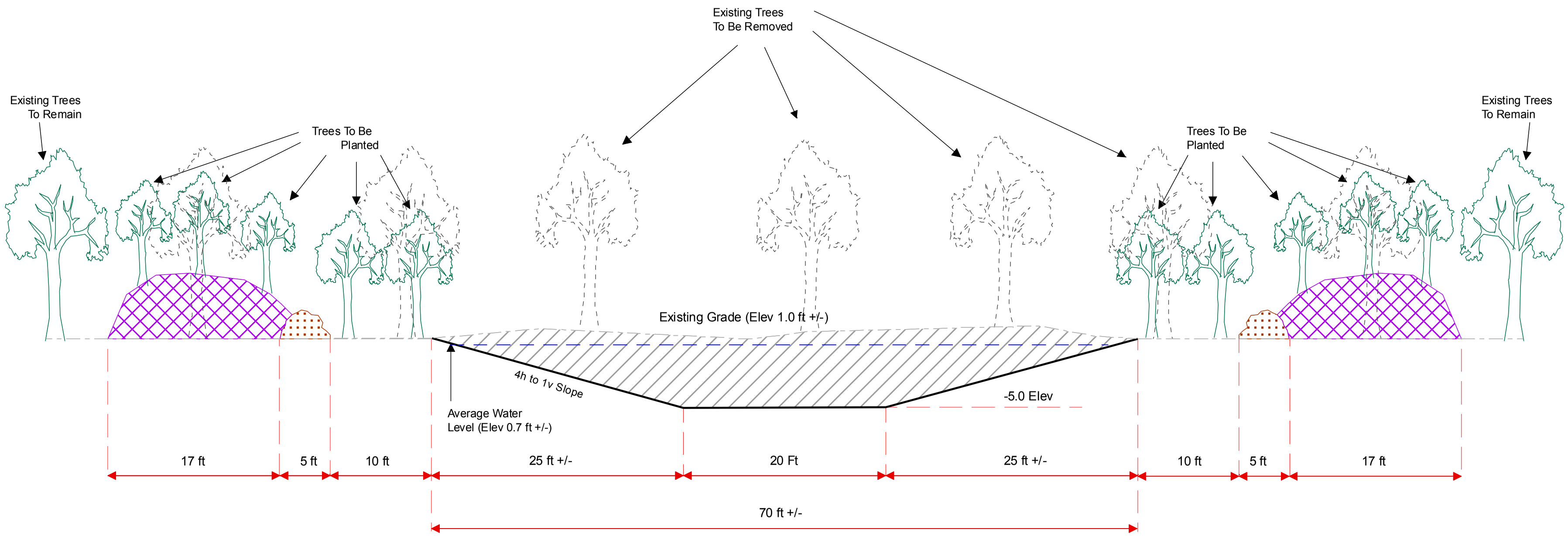
- Existing Grade
- Dimensions
- Average Water Level
- Channel Cut
- Dredge Material Placement
- Stumps
- Dredge Area

Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 70 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 2
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741



Legend

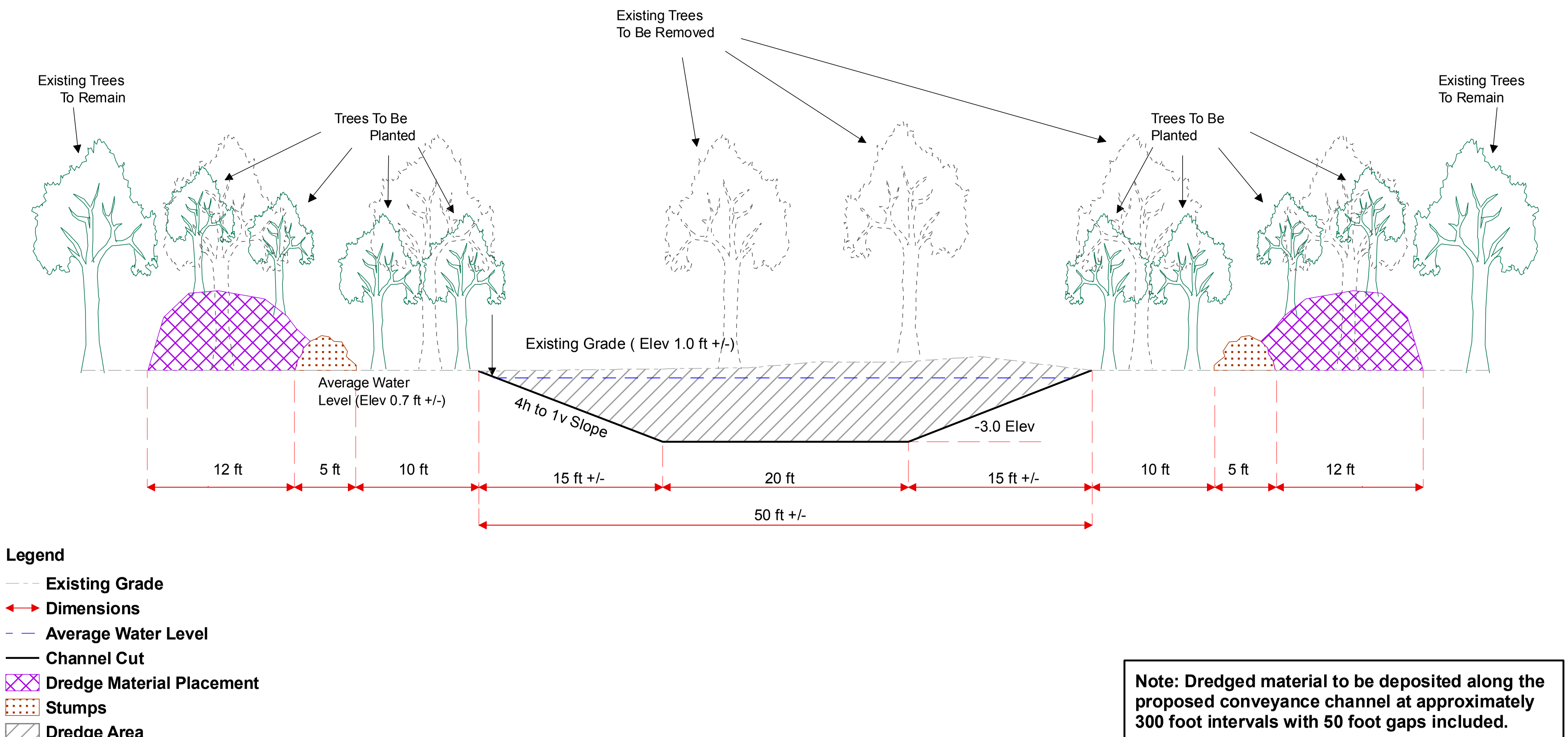
- Existing Grade
- Dimensions
- Average Water Level
- Channel Cut
- Dredge Material Placement
- Stumps
- Dredge Area

Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 70 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 3
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741

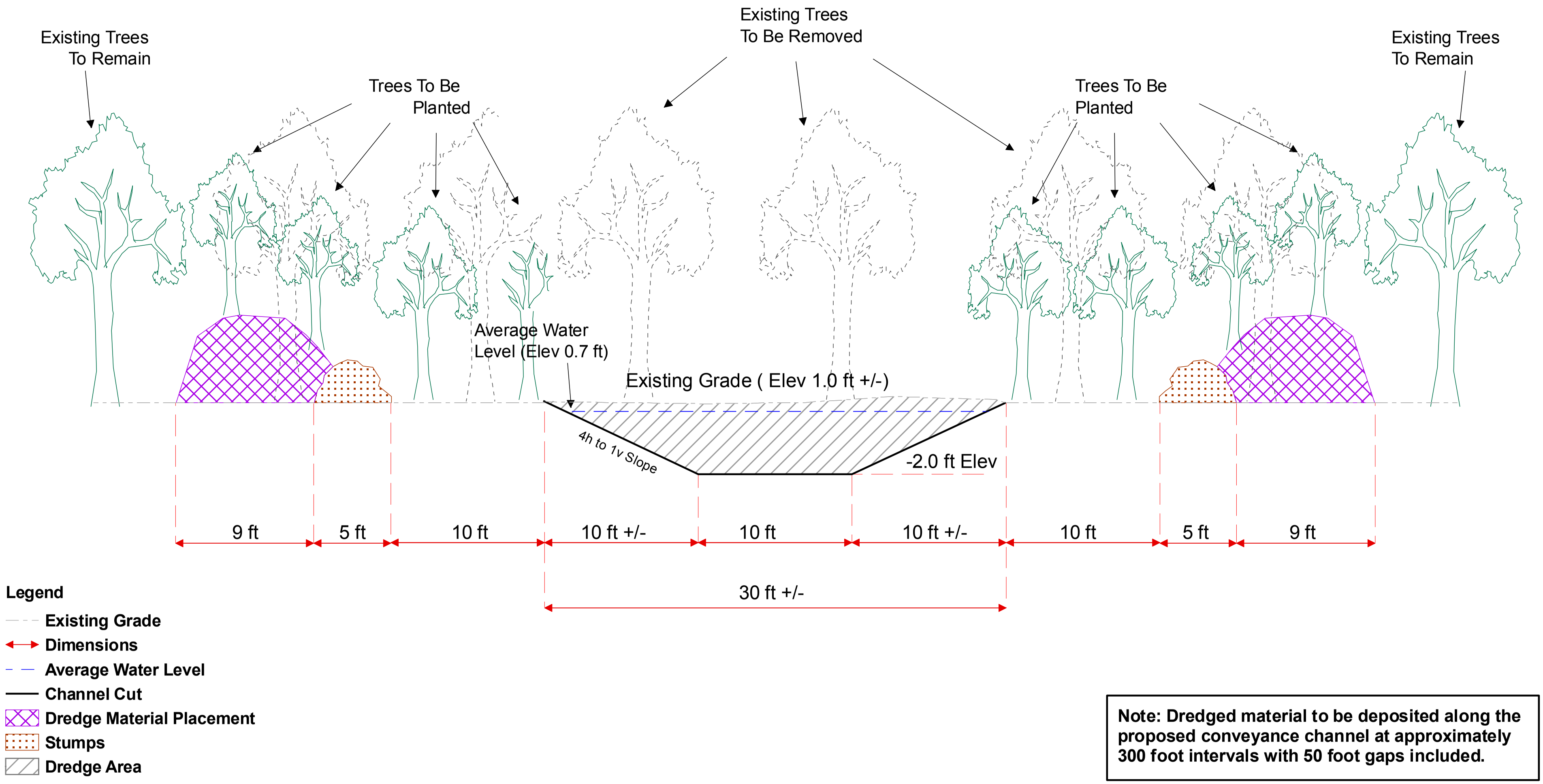


Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 50 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 4
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741

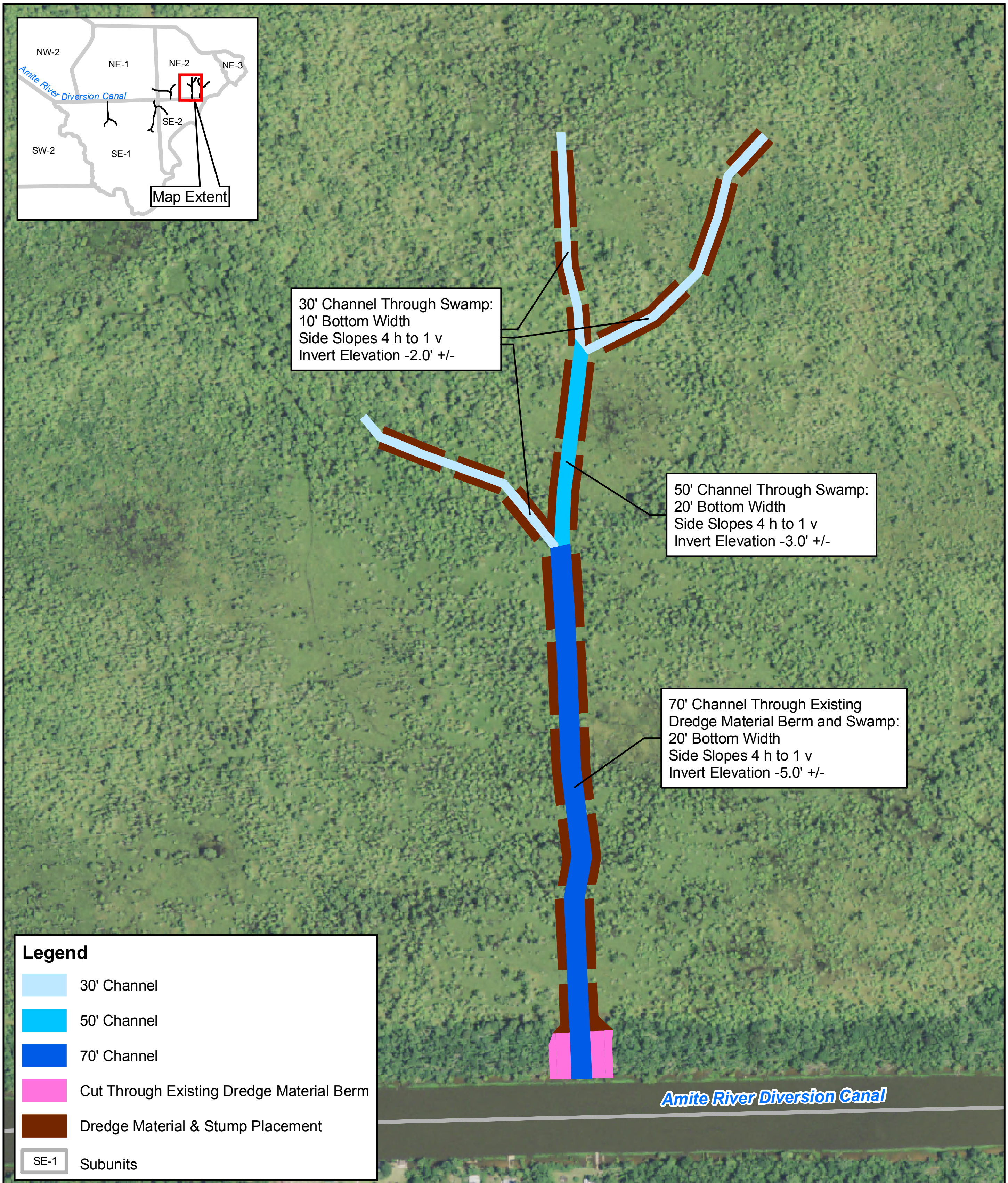


Note: Dredged material to be deposited along the proposed conveyance channel at approximately 300 foot intervals with 50 foot gaps included.

Typical 30 ft. Cross Section through ARDC Native Swamp

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Figure: 5
Date: January 2010
Not to Scale
Source: GEC
Map ID: 27850108-1741



TYPICAL CONVEYANCE CHANNEL

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 6
Date: January 2010
Scale: 1:5,600
Source: USDA/GEC
Map ID: 27850108-1889

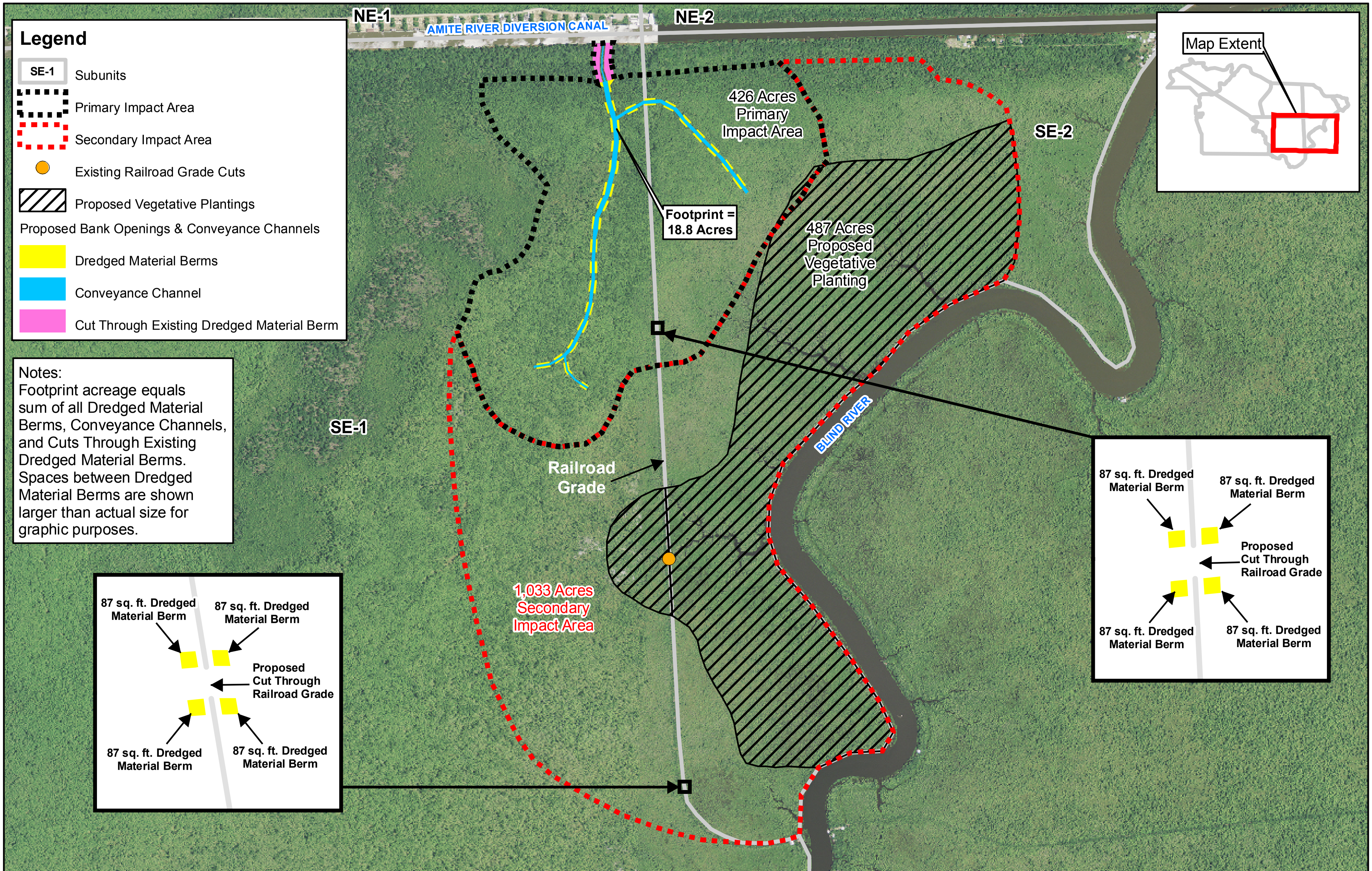
3.4.3 Alternative 34 (SE-1/SE-2)

Features of Alternative 34 (Figure 7) include:

- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 to add connectivity between SE-1 and SE-2, and the ARDC.
- Dredged material (2.7 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 2.7 acres of dredged material berm.
- Two cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles south of the ARDC. The second cut would be approximately 2.0 miles south of the ARDC.
- Vegetative plantings of freshwater swamp tree species within 487 acres of the swamp floor.

The opening in the south bank of the ARDC coupled with the two gaps in the railroad grade would facilitate hydrologic connectivity between the ARDC, SE-1, and SE-2. These openings would promote an influx of fresh water, nutrients, and sediments into these areas, which would help flush high salinity waters from the swamp, restore the degraded swamp habitat, and reverse the transition to marsh and open water. Alternative 34 would benefit approximately 1,459 acres of existing freshwater swamp, recreate 146 acres of freshwater swamp from freshwater marsh, and create 2.7 acres of upland habitat from dredged material placement.

All excavation to take place for the cuts through the dredged material berms as well as the conveyance channels through the swamp would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. Table 1 gives specific quantities and areas associated with the construction of the final array of alternatives. Table 2 summarizes the features associated with each alternative within the final array.



ALTERNATIVE 34

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 7
Date: December 2009
Scale: 1:24,000
Source: USGS/GEC
Map ID: 27850108-1869

3.4.4 Alternative 35 (SE-1)

Features of Alternative 35 (Figure 8) include:

- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1.
- Dredged material (2.2 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 2.2 acres of the dredged material berms.

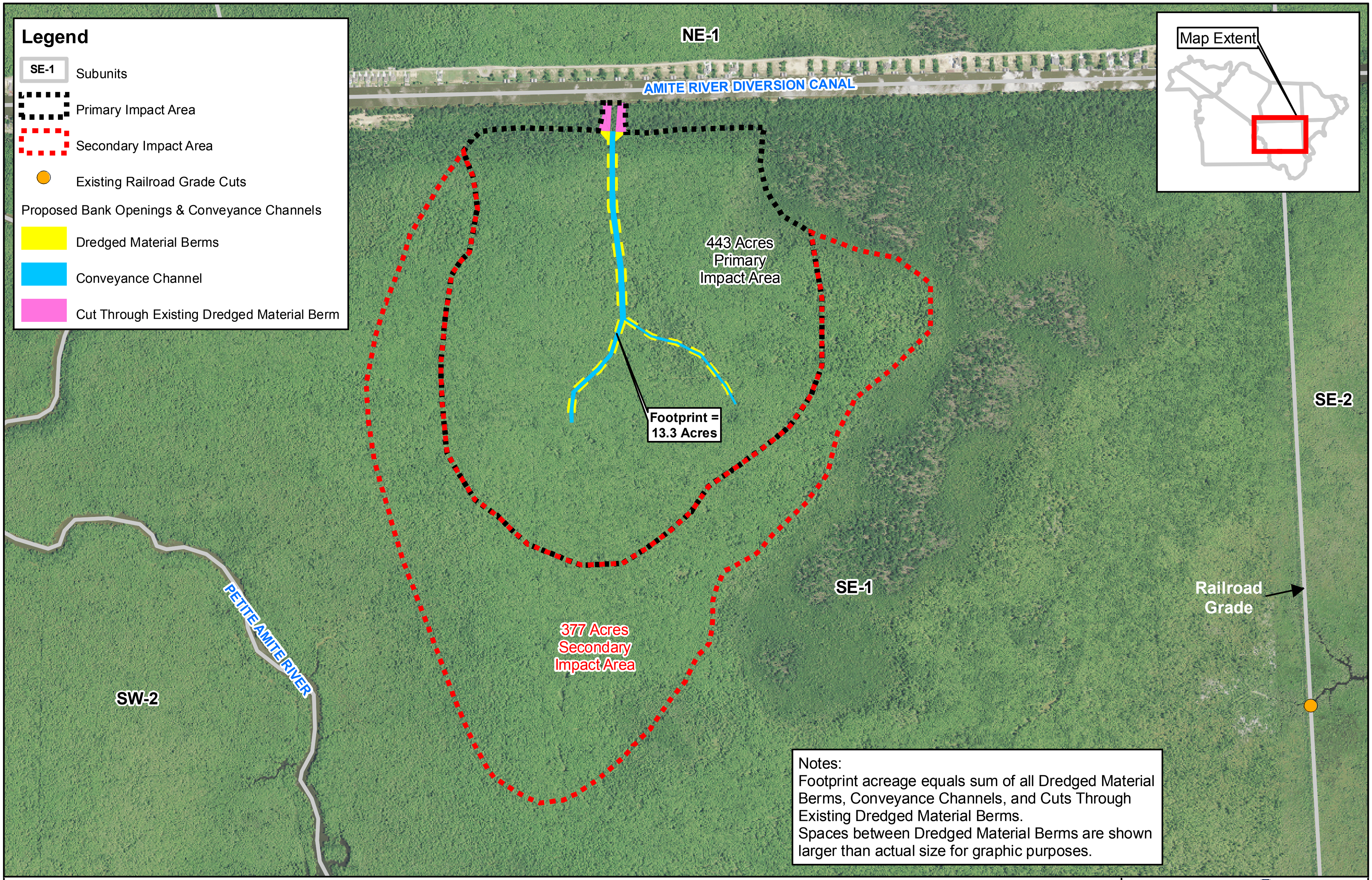
The opening would promote an influx of fresh water, nutrients, and sediments into these areas, which would help flush high salinity waters from the swamp, improve the degraded swamp habitat, and decrease the transition to marsh and open water. Alternative 35 would benefit approximately 820 acres of existing freshwater swamp and create 2.2 acres of upland habitat from dredged material placement.

All excavation to take place for the cuts through the dredged material berms as well as the conveyance channels through the swamp would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. Table 1 gives specific quantities and areas associated with the construction of the final array of alternatives. Table 2 summarizes the features associated with each alternative within the final array.

3.4.5 Alternative 36 (NE-1/NE-2, SE-1/SE-2)

Features of Alternative 36 (Figure 9) include:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2, and the ARDC.
- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 to add connectivity between SE-1 and SE-2, and the ARDC.

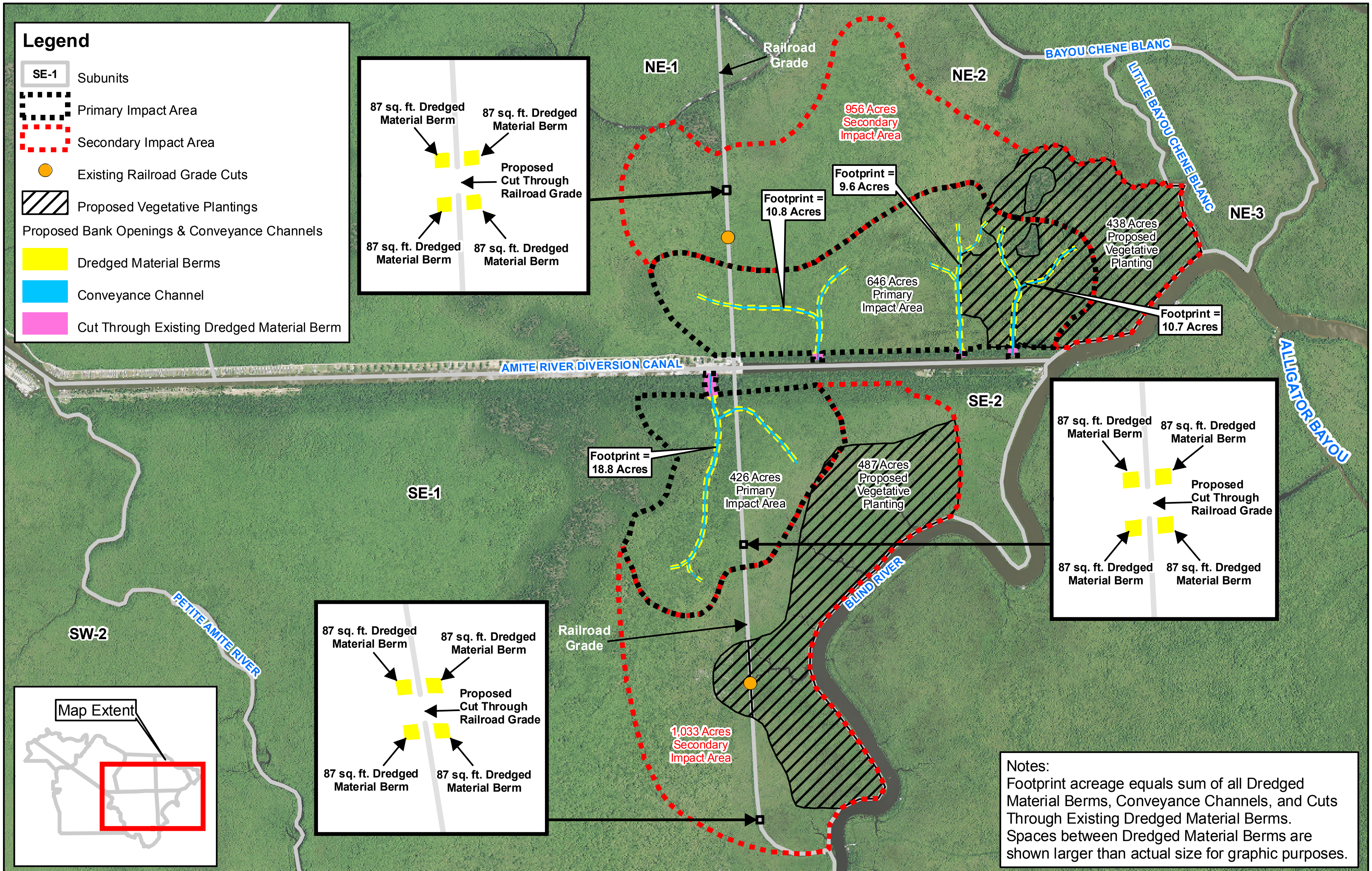


ALTERNATIVE 35

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 8
Date: December 2009
Scale: 1:20,000
Source: USGS/GEC
Map ID: 27850108-1870



ALTERNATIVE 36

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 9
Date: February 2010
Scale: 1:40,000
Source: USGS/GEC
Map ID: 27850108-1871

- Dredged material (7.8 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Three cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles north of the ARDC. The second cut would be approximately 0.9 miles south of the ARDC. The third cut would be approximately 2 miles south of the ARDC.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 7.8 acres of the dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 925 acres of the swamp floor.

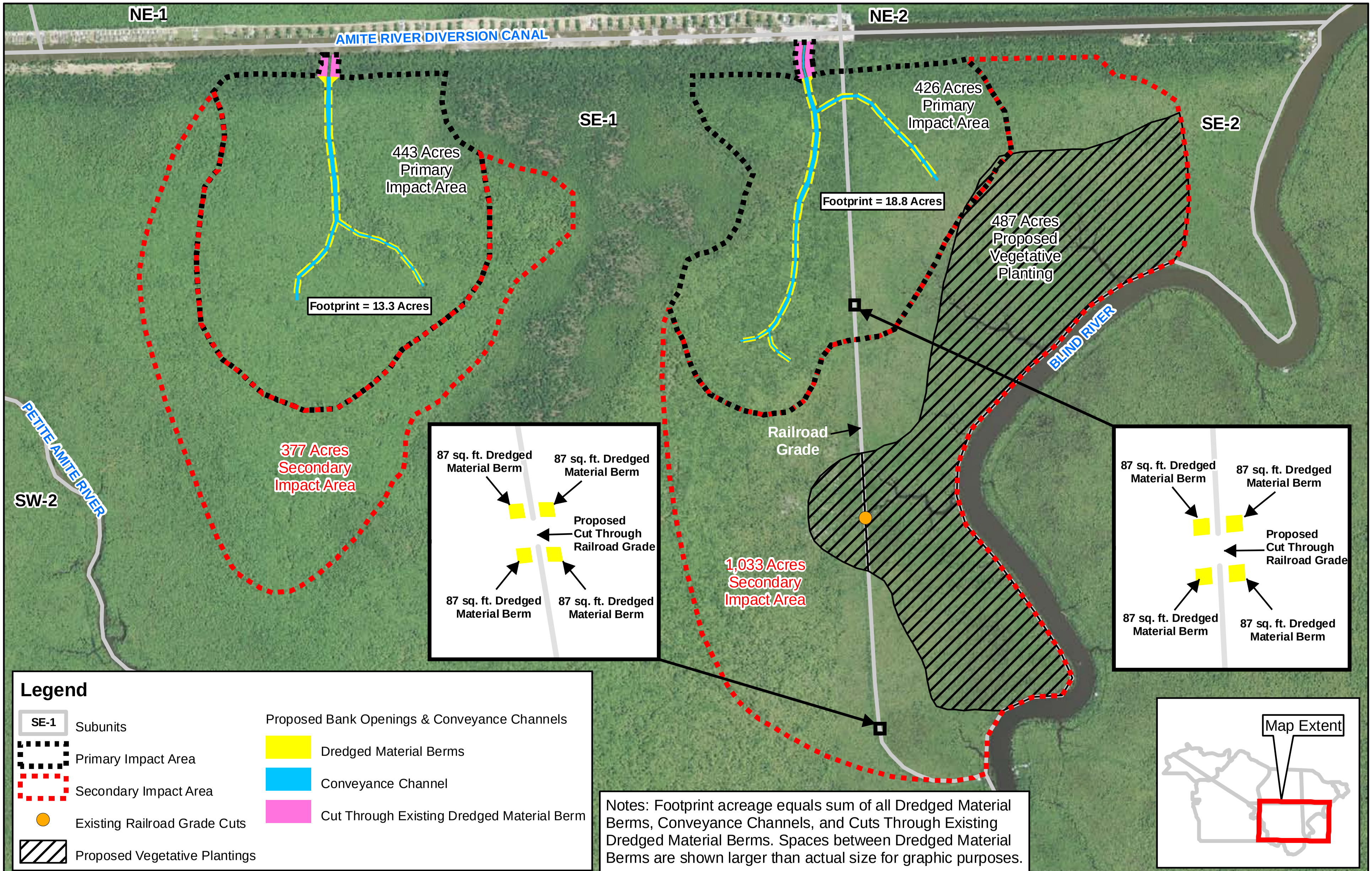
The openings would restore hydrologic connectivity of the habitats north and south of the ARDC with the ARDC. North of the ARDC, proper drainage of impounded waters in NE-2 would promote the restoration of the degraded swamp and the decreasing of marsh to swamp forest. South of the ARDC, the swamp habitats would benefit from the influx of fresh water, nutrients, and sediments. Alternative 36 would benefit approximately 3,061 acres of existing freshwater swamp, recreate 290 acres of freshwater swamp from freshwater marsh, and create 7.8 acres of upland habitat from dredged material placement.

All excavation to take place for the cuts through the dredged material berms as well as the conveyance channels through the swamp would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. Table 1 gives specific quantities and areas associated with the construction of the final array of alternatives. Table 2 summarizes the features associated with each alternative within the final array.

3.4.6 Alternative 37 (SE-1/SE-2, SE-1)

Features of Alternative 37 (Figure 10) include:

- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 to add connectivity between SE-1 and SE-2, and the ARDC.
- One bank opening and conveyance channel in the south bank of the ARDC in SE-1.



Notes: Footprint acreage equals sum of all Dredged Material Berms, Conveyance Channels, and Cuts Through Existing Dredged Material Berms. Spaces between Dredged Material Berms are shown larger than actual size for graphic purposes.

ALTERNATIVE 37

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 10
Date: February 2010
Scale: 1:26,000
Source: USGS/GEC
Map ID: 27850108-1872

- Two cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles south of the ARDC. The second cut would be approximately 2.0 miles south of the ARDC.
- Dredged material (4.9 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 4.9 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 487 acres of the swamp floor.

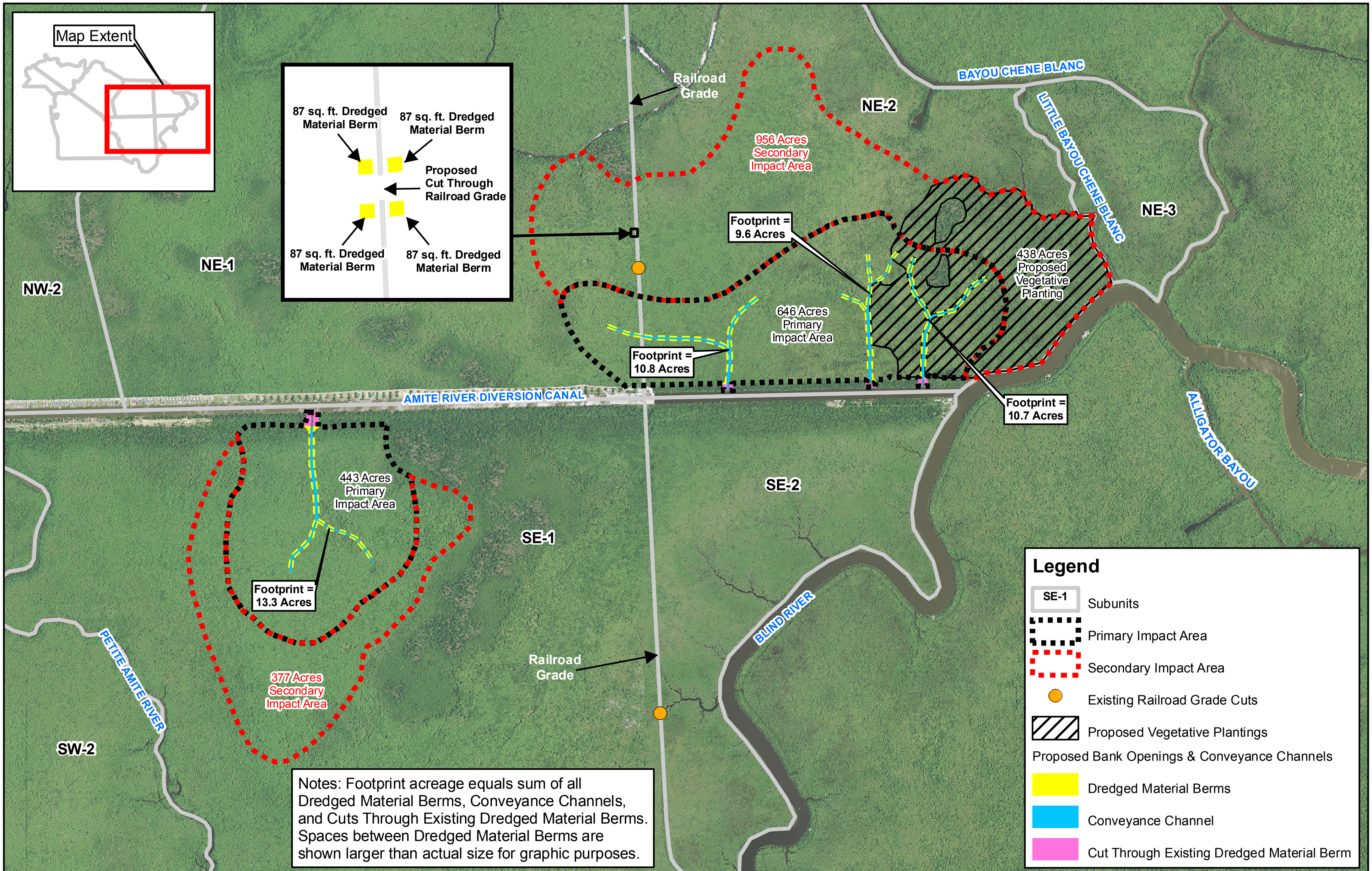
The openings would restore hydrologic connectivity of the area south of the ARDC with the ARDC. Subunits SE-1 and SE-2 would benefit from the influx of fresh water, nutrients, and sediments. This would maintain the swamp forests in SE-1 and improve the degraded swamp forest in the eastern portion of SE-1 and in SE-2, as well as decrease the transition from swamp to marsh to ultimately open water in SE-2. Alternative 37 would benefit approximately 2,279 acres of existing freshwater swamp, recreate 146 acres of freshwater swamp from freshwater marsh, and create 4.9 acres of upland habitat from dredged material placement.

All excavation to take place for the cuts through the dredged material berms as well as the conveyance channels through the swamp would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp.

3.4.7 Alternative 38 (NE-1/NE-2, SE-1)

Features of Alternative 38 (Figure 11) include:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2.
- One bank opening and conveyance channel in the south bank of the ARDC in SE-1.
- One cut would be created in the railroad grade approximately 0.9 miles north of the ARDC to improve sheet flow.



Notes: Footprint acreage equals sum of all Dredged Material Berms, Conveyance Channels, and Cuts Through Existing Dredged Material Berms. Spaces between Dredged Material Berms are shown larger than actual size for graphic purposes.

ALTERNATIVE 38

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 11
Date: February 2010
Scale: 1:40,000
Source: USGS/GEC
Map ID: 27850108-1873

- Dredged material (7.2 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Vegetative plantings of bottomland hardwood/freshwater swamp tree species on 7.2 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 438 acres of the swamp floor.

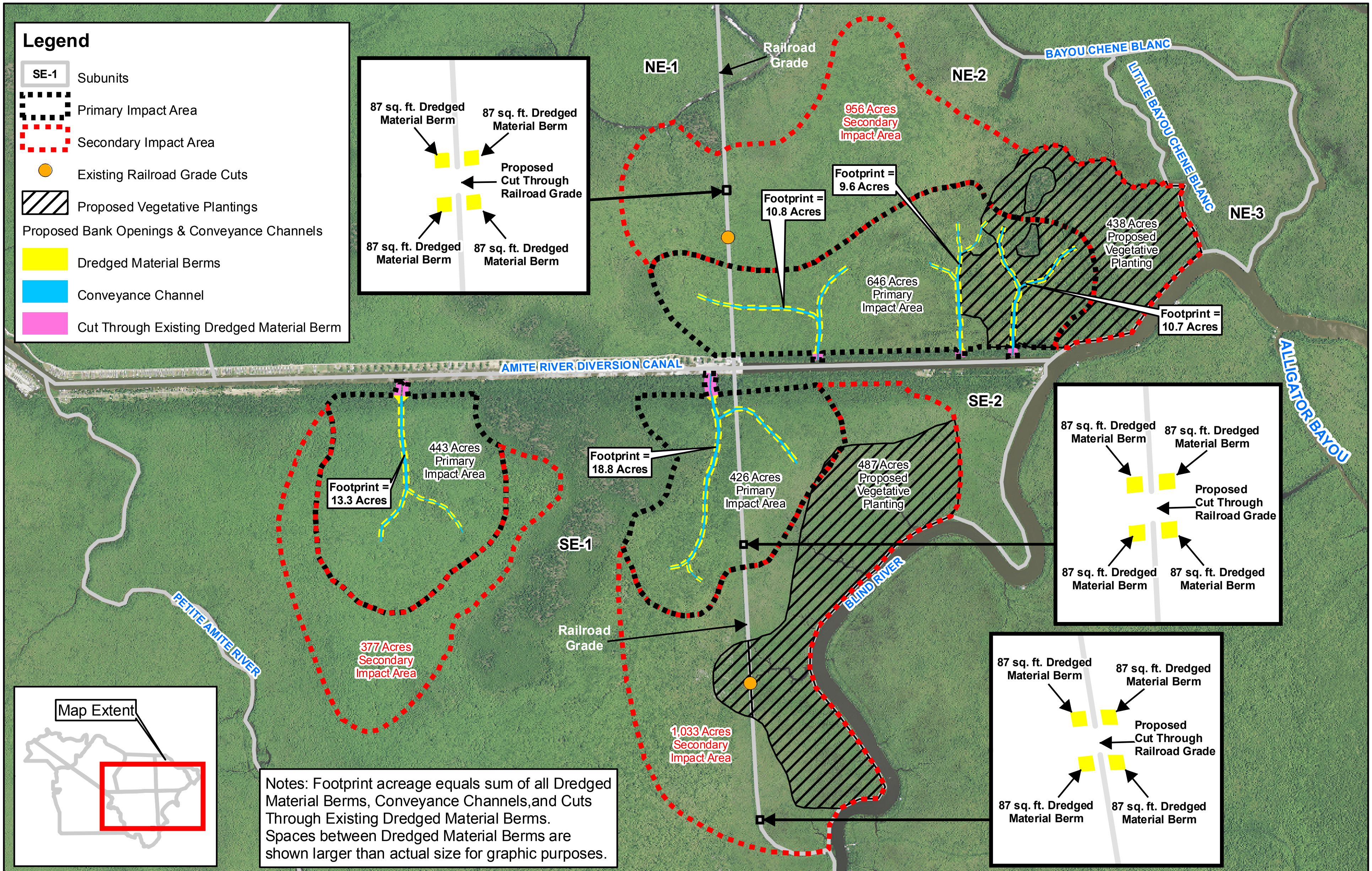
Implementation of this alternative would restore the hydrologic connectivity of NE-1, NE-2, and SE-1 with the ARDC. Within NE-1 and NE-2, the benefits would consist of proper drainage of impounded waters from NE-2, improvement of the degraded swamp, and decreasing the transition from swamp to march to ultimately open water. The cut in the south bank of ARDC would restore the hydrologic connectivity of the ARDC with SE-1 and help to maintain the health of the swamp forest along the western portion of SE-1. Alternative 38 would benefit approximately 2,422 acres of existing freshwater swamp, recreate 144 acres of freshwater swamp from freshwater marsh, and create 7.2 acres of upland habitat from dredged material placement.

All excavation to take place for the cuts through the dredged material berms as well as the conveyance channels through the swamp would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. Table 1 gives specific quantities and areas associated with the construction of the final array of alternatives. Table 2 summarizes the features associated with each alternative within the final array.

3.4.8 Alternative 39 (NER) (NE-1/NE-2, SE-1/SE-2 – All Subunits Combined)

Features of Alternative 39 (Figure 12) include:

- Three dredged material bank openings and three bifurcated conveyance channels in the north bank of the ARDC in NE-2 with the westernmost cut in the north bank of the ARDC also extending through the railroad grade into NE-1 to add connectivity between NE-1 and NE-2.
- One dredged material bank opening and one bifurcated conveyance channel in the south bank of the ARDC in SE-1 with the conveyance channel extending through the railroad grade into SE-1 to add connectivity between SE-1 and SE-2, and the ARDC.



ALTERNATIVE 39

Amite River Diversion Canal Modification
Ascension and Livingston Parishes, Louisiana

Image: 2009 Livingston Parish USDA-FSA-APFO NAIP MrSID Mosaic

Figure: 12
Date: February 2010
Scale: 1:40,000
Source: USGS/GEC
Map ID: 27850108-1874

- One opening and one conveyance channel in the south bank of the ARDC in SE-1.
- Dredged material (9.9 acres) from the bank openings and the conveyance channel would be sidecast on both sides of the proposed channel. Gaps will be left in the disposal berms so sheet flow is not reduced.
- Three cuts would be created in the railroad grade to improve sheet flow. One cut would be approximately 0.9 miles north of the ARDC. The second cut would be approximately 0.9 miles south of the ARDC. The third cut would be approximately 2 miles south of the ARDC.
- Vegetative plantings of bottomland hardwood / freshwater swamp tree species on 9.9 acres of dredged material berms.
- Vegetative plantings of freshwater swamp tree species within 925 acres of the swamp floor.

Implementation of this alternative would restore the hydrologic connectivity between NE-1, NE-2, SE-1, and SE-2 with the ARDC. This alternative would provide the maximum effort to restore hydrologic connectivity of the wetlands to the ARDC. Alternative 39 would benefit approximately 3,881 acres of existing freshwater swamp, recreate 290 acres of freshwater swamp from freshwater marsh, and create 9.9 acres of upland habitat from dredged material placement.

All excavation to take place for the cuts through the dredged material berms as well as the conveyance channels through the swamp would be based on four design cross-sections (Figures 2 through 5). These cross-sections were developed in an effort to mimic natural, existing cuts within the study area, which have been determined to be self-maintaining. The cross-sections include a 70-foot wide cut section with benches, a 70-foot wide cut section, a 50-foot wide cut section and a 30-foot wide cut section. The 70-foot cut section with benches is designed to allow increased amounts of flow to pass beyond the existing dredged material berm during high-water events. The material dredged from the existing berms would be placed along the swamp-side of the excavated cut as new bottomland hardwood habitat. All material dredged during construction of the conveyance channels would be placed along the channels, with gaps included, to allow sufficient sheet flow to be conveyed from the swamp. Table 1 gives specific quantities and areas associated with the construction of the final array of alternatives. Table 2 summarizes the features associated with each alternative within the final array.

3.5 COMPARISON OF ALTERNATIVE PLANS

Of the seven alternatives that make up the final array, three are individual alternatives, while the other four are combinations of these three. The effects of the alternatives within the final array were evaluated against the Future Without Project (FWOP) Project condition (The No-Action Alternative) in order to determine their overall impact over the 50-year period of analysis. Alternatives were then compared to each other. This includes environmental impacts to significant resources, benefits, costs and contributions to project goals, planning objectives and constraints, contributions to the Federal objective, and the P&G's four evaluation criteria (completeness, effectiveness, efficiency and acceptability). A comparison of the features included in each alternative within the final array is found in Table 2.

Table 2. Comparison of Final Array of Alternatives

Alternative	North Bank Openings	South Bank Openings	Railroad Grade Openings	Berm Plantings (Acres)	Swamp Plantings (Acres)
33	3	0	1	5.0	438
34	0	1	2	2.7	487
35	0	1	0	2.2	0
36	3	1	3	7.8	925
37	0	2	2	4.9	487
38	3	1	1	7.2	438
39	3	2	3	9.9	925

Section 7

DESIGN

Design Assumptions

In the process of developing preliminary designs of proposed alternative plans for the LCA ARDC Modification project, some design assumptions were made. First, it was assumed that if the cross sections for the proposed conveyance channels were to mimic the cross sectional makeup of relict cuts, found near Blind River, the proposed channels would maintain a hydrologic equilibrium by maintaining flow rates large enough to prevent the buildup of sediments within the channel over the lifespan of the project. Secondly, it was assumed that with a 3H:1V and 4H:1V slope and seeding and mulching, the slopes along the dredged material berm openings would remain stable. Two slope dimensions were specified for portions on the proposed conveyance channels, depending on the overall width of channel desired for each reach. The slope dimensions will be revised upon completion of a full geotechnical investigation and slope stability analysis, during the PED phase of the project. This is based on the assumption that the berm material is primarily composed of clay, allowing for increased slope stability. The alignment of the conveyance channels are based on preliminary data and LIDAR data. Once all pertinent information is gathered, such as geotechnical investigation and a full topographic survey, the final alignment and platform of the conveyance channels will be adjusted accordingly. This information will not be available until the Plans and Specifications phase of the project.

Erosion Control Requirements

In order to ensure that sediments do not leave the project area during construction, best management practices (BMPs) will be implemented. These BMPs include the use of silt fencing, hay bales and seeding and mulching in the appropriate locations.

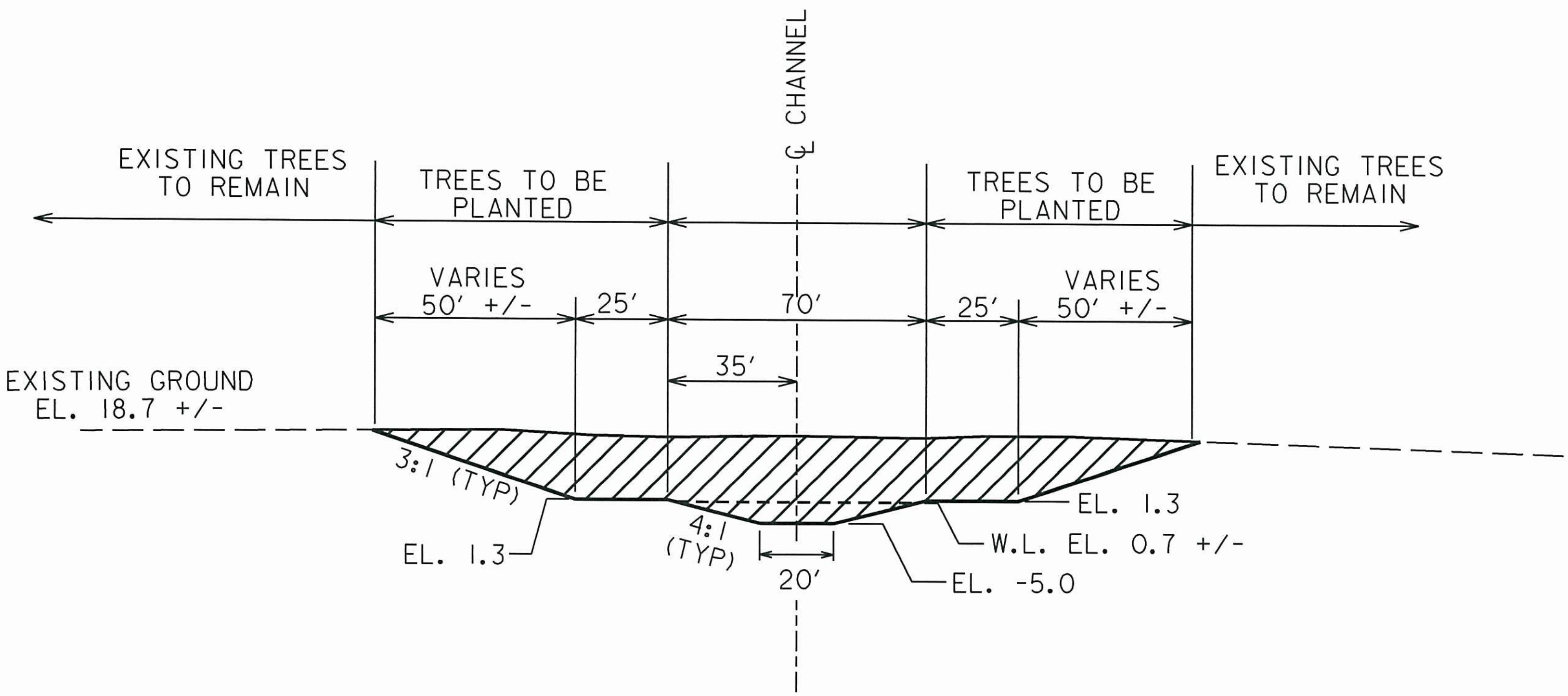
Silt fencing would be utilized along the perimeter of the construction footprint to trap free flowing sediment and hay bales would be placed in flow areas which tend to collect excessive amounts of sediments. Seeding and mulching would be used to minimize sediment runoff in the areas of cut on the existing ARDC spoil bank.

Preliminary cost estimates for the final array of alternatives included the use of these BMPs. During the plans and specifications phase of the project the quantities and layout for these implementations will be further determined.

Design Cross Sections

To scale cross sections depicting the proposed cuts through the dredged material berm and for the conveyance channels are found in Figures 1 through 4. Sections depicting the proposed Type 1 and Type 2 cuts through the existing railroad grade can be found in Figure 5.

CROSS-SECTIONS



70 ft Berm Through Spoil Bank

Figure:	1
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Scale:	1" = 50'
Source:	
Map ID:	

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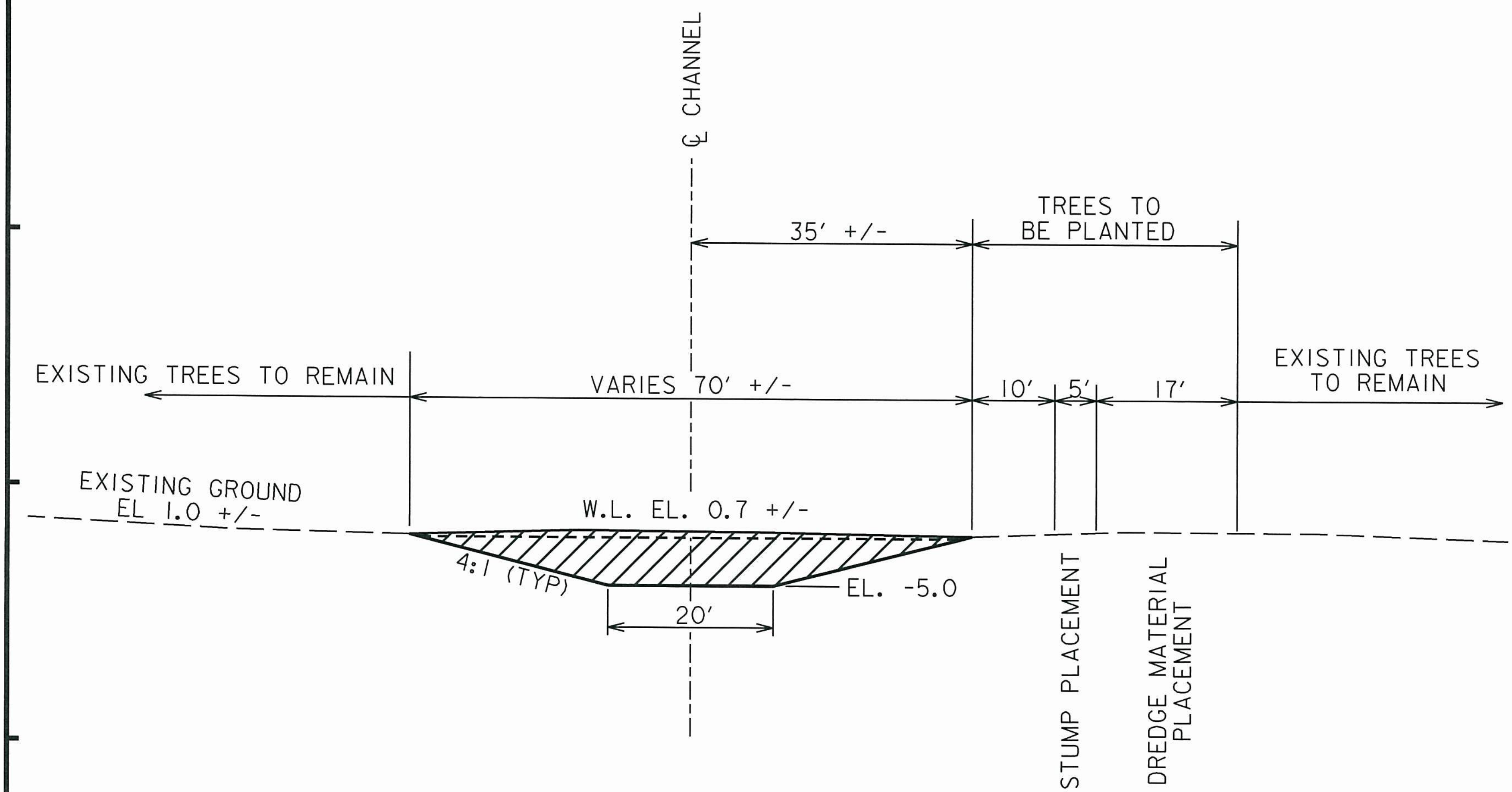

70 ft Berm Through Native Swamp

Figure:	2
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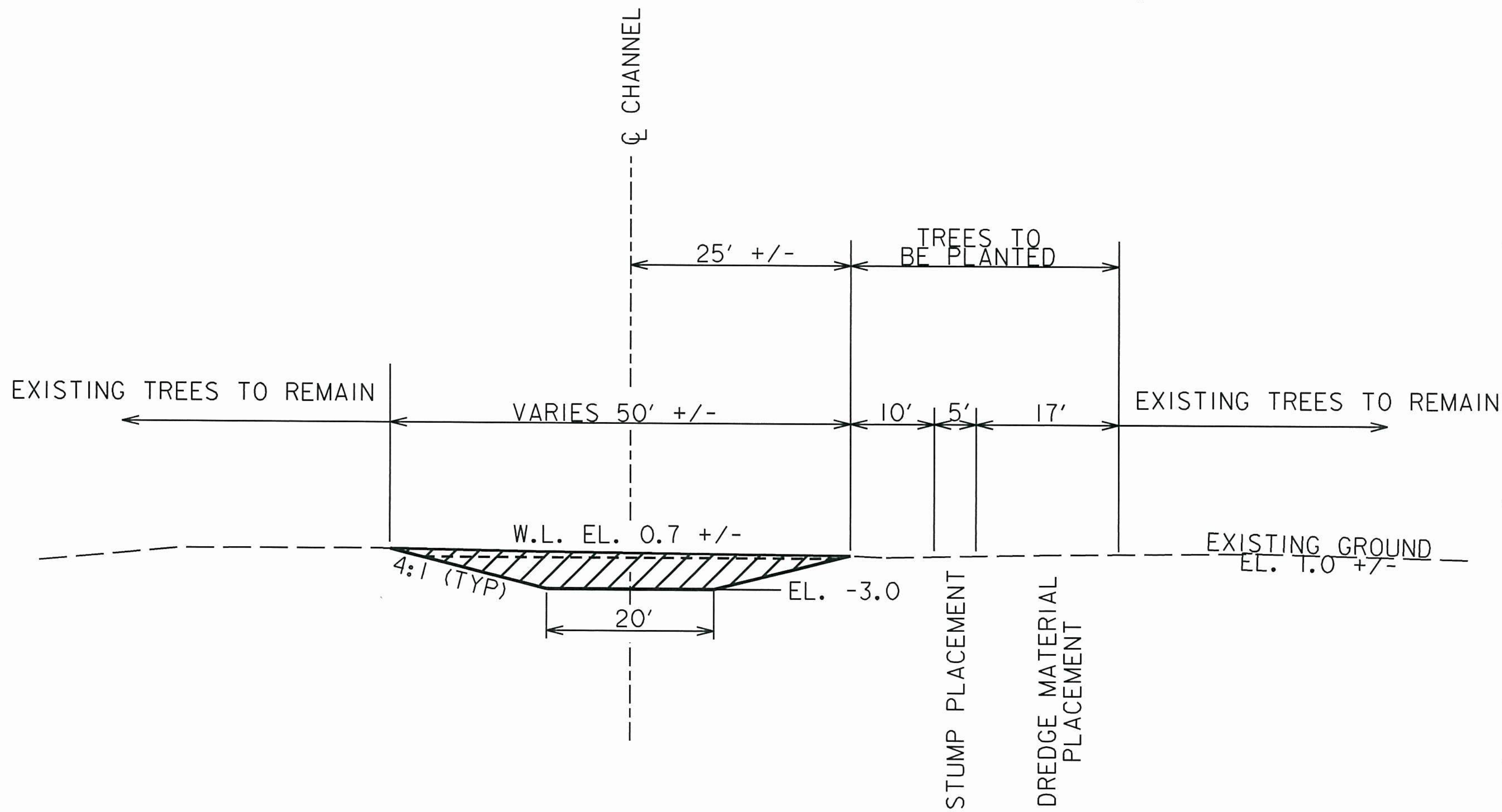
Scale:	1" = 20'
Source:	
Map ID:	

...\DGN\Section02_70ft Native.dgn 1/6/2010 10:39:41 AM



50 ft Berm Through Native Swamp

Figure:	3
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Scale:	1" = 20'
Source:	
Map ID:	

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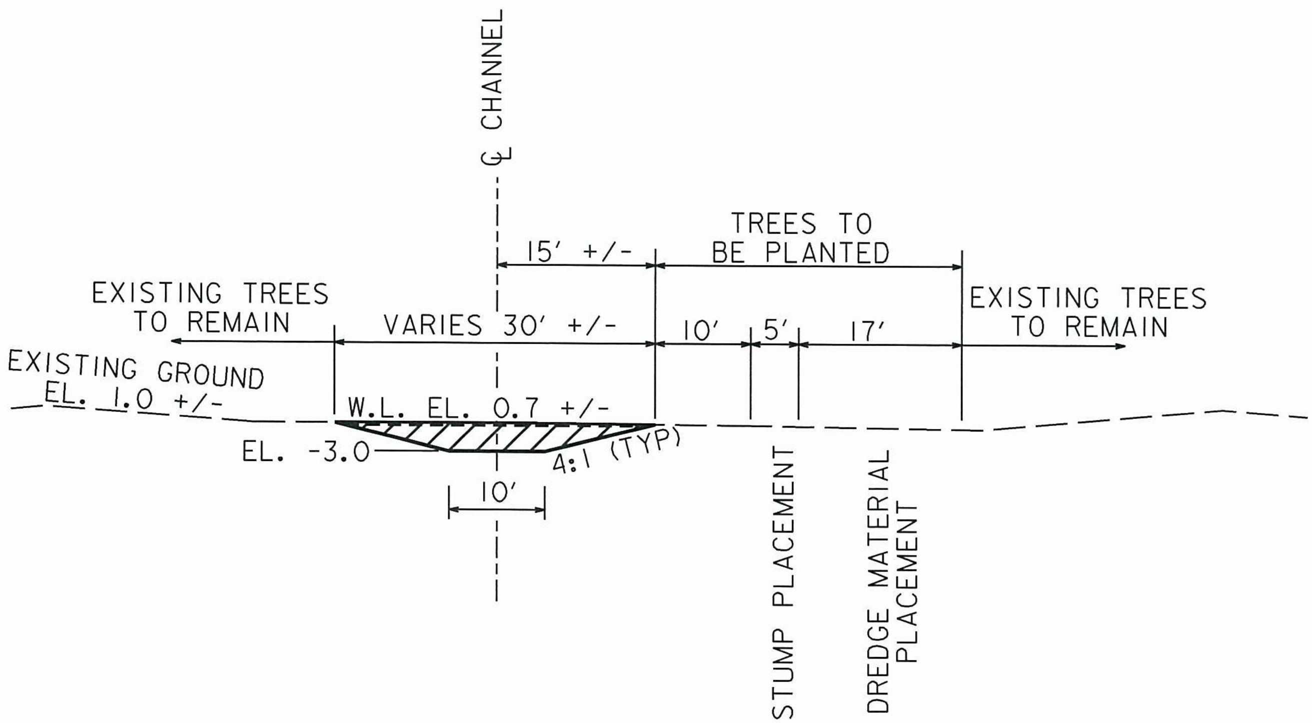

30 ft Berm Through Native Swamp

Figure:	4
Date:	01-05-2010
Scale:	1" = 20'
Source:	
Map ID:	

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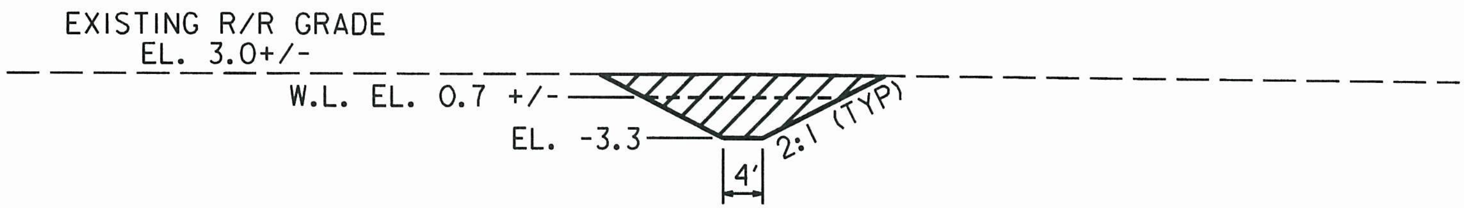
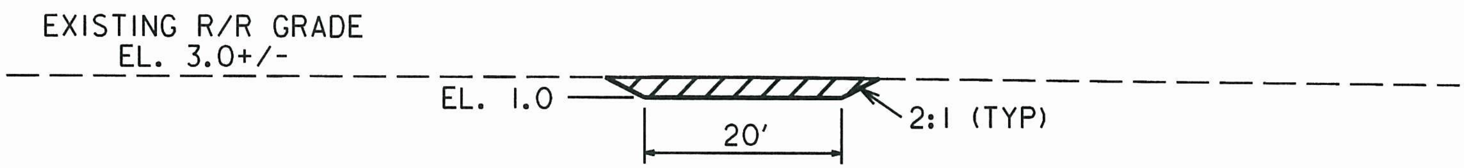


RAILROAD GRADE CUT TYPE 1

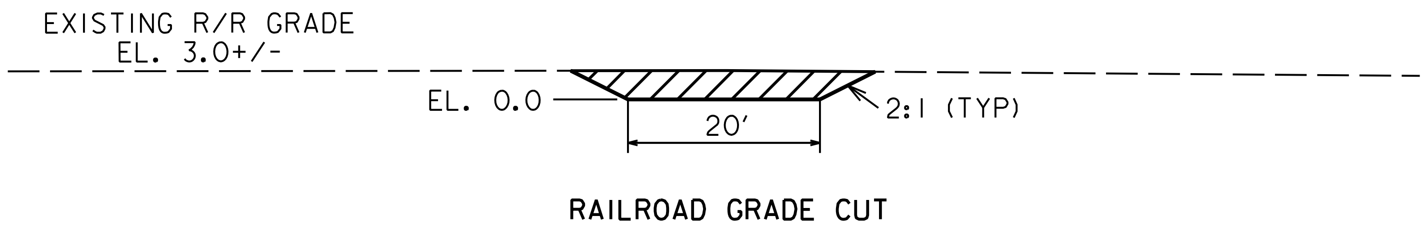


RAILROAD GRADE CUT TYPE 2

Cut Through Existing Railroad Grade

Figure: 5
Date: 01-05-2010
Scale: 1" = 20'
Source:
Map ID:

...\Section05_Railroad Cuts.dgn 1/6/2010 5:38:40 PM



Cut Through Existing Railroad Grade

Figure: 5
Date: 01-05-2010
Scale: 1" = 20'
Source:
Map ID:

...\Section05_Railroad Cuts.dgn 3/16/2010 4:23:44 PM

Section 8

CONSTRUCTION PROCEDURES

Construction Procedures

It is estimated that the earthmoving portion of construction for the recommended plan (Alternative 33) would take approximately six months. This duration includes the mobilization and demobilization of the required equipment and laborers, construction of all three cuts through dredged material berms and conveyance channels, one cut through existing railroad grade. The first implementation of vegetative plantings within the appropriate swamp and bottomland hardwood habitat will take approximately a year. A secondary implementation of vegetative plantings will be required at a later date, depending on the mortality rate of the first plantings. The second phase will last approximately a year as well.

Once the appropriate equipment is mobilized to the project site via trucks and barges, construction of the gaps through the dredged material berms would commence by clearing and grubbing the designated footprints of construction on the north side of the ARDC. Stumps are to be removed from the portions of excavation within the proposed channels, but only trees would be cleared along the benches, 10-foot buffers and dredged material and stump placement areas. Cleared trees would be placed in the same area with the stumps and dredged material. Once clearing is completed at one cut location the equipment would be mobilized to another cut location so excavation could begin.

Excavation of the cuts within the existing dredged material berms and the proposed conveyance channels would be carried out by two short-reach, amphibious excavators. As the equipment cuts its way into the cut locations, the dredged material would be placed on the sides of the cuts and conveyance channels with 50-foot gaps placed between the deposited material, every 300 feet. The excavated cuts and channels would serve as the area in which equipment would move in and out of the construction area.

Upon completion of the excavation, vegetative plantings would be carried out within the predetermined areas of the swamp and material placement. Approximately 173 trees per acre would be planted. Each area planted would consist of approximately 10 percent 1-gallon potted, 15 percent 3-gallon potted, and 75 percent bare-root seedlings. Cypress and tupelo gum would be planted within the swamp floor areas and hardwoods such as live oaks and sweet gum would be planted on both the newly created and existing dredged material berms. Nutria guards would be required on every tree planted in order to ensure a reasonable success rate. It is expected that the replanting of 50 percent of these areas would be necessary within a few years of the conclusion of cut and channel construction. No relocations of infrastructure or utilities would be required during construction of the Alternative 33 (TSP).

Section 9

OMRR&R

Operations, Maintenance, Repair, Replacement, and Rehabilitation

Operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) requirements for the Alternative 33 (TSP) include a yearly inspection of the cut locations and conveyance channels to ensure no flow interruption occurs, resulting from natural occurrences such as wind-blown debris or fallen trees. Upon inspection it would be determined if clearing and snagging or some other appropriate remedial operation is necessary to restore the required conveyance within the features of Alternative 33 (TSP).

It is understood that the conveyance channels would be naturally altered over time, eventually reaching a state of hydrologic equilibrium similar to the relict channels that the conveyance channels were designed to mimic. These changes would most possibly result in changes to the geomorphology of the channel along with a transition to a more meandering channel makeup and would not reduce the expected benefits of Alternative 33 (TSP). Therefore, it is anticipated that little to no attempt to maintain the depth or shoreline geometry of the conveyance channels would be necessary. The non-Federal sponsor would be required to enforce any restrictions as identified in the easements to ensure that the benefits of Alternative 33 (TSP) are retained. Table 1 shows a breakdown of the OMRR&R costs.

Table 1

Alternative	Inspection Cost (Annual)	Clearing and Snagging (Every 5 years)	
		Mobilization	Clearing and Snagging
33 (TSP)	$2,000	$20,000	$21,000
34	$2,000	$20,000	$7,000
35	$2,000	$20,000	$7,000
36	$2,000	$20,000	$28,000
37	$2,000	$20,000	$14,000
38	$2,000	$20,000	$28,000
39	$2,000	$20,000	$35,000

Operations and maintenance costs are assumed to last for the 50-year period of analysis.

Section 10

COST ESTIMATES

Cost Estimates for Final Array of Alternatives

The following cost estimates were developed during the planning process as a means of evaluating each restoration alternative and for use with the Institute for Water Resources (IWR) Planning Suite analysis. Table 1 lists the costs estimated for Alternatives 33 through 39 (Final Array). Table 1 shows a summary of the items associated with each cost estimate. Table 2 depicts the relationship between cost and benefits for the final array of alternatives. The detailed cost estimates for the final array of alternatives are found in the Cost Annex of this Appendix.

Table 1. Summary of Costs Estimates for the Final Array

Item	Alt. 33	Alt. 34	Alt. 35	Alt. 36	Alt. 37	Alt. 38	Alt. 39
Mob/Demob	$250,000	$150,000	$150,000	$300,000	$200,000	$300,000	$350,000
Earthwork	$462,000	$332,000	$262,000	$788,000	$583,000	$698,000	$1,050,000
Erosion Protection	$46,000	$23,000	$23,000	$69,000	$45,000	$69,000	$92,000
Vegetative Plantings	$819,000	$906,000	$6,000	$1,720,000	$909,000	$822,000	$1,730,000
Surveying	$54,000	$22,000	$22,000	$70,000	$70,000	$70,000	$86,000
Markups	$631,000	$564,000	$176,000	$1,152,000	$695,000	$756,000	$1,289,000
Planning Eng. & Design	$189,000	$169,000	$53,000	$346,000	$209,000	$227,000	$387,000
Construction Management	$110,000	$99,000	$31,000	$202,000	$122,000	$132,000	$226,000
Total Construction Costs	$2,560,000	$2,270,000	$720,000	$4,650,000	$2,830,000	$3,070,000	$5,210,000
(25% Contingency)	$640,000	$568,000	$180,000	$1,160,000	$708,000	$768,000	$1,300,000
Real Estate	$136,000	$144,000	$62,000	$259,000	$185,000	$178,000	$301,000
Total First Costs*	$3,340,000	$2,980,000	$962,000	$6,070,000	$3,720,000	$4,020,000	$6,810,000
Interest During Construction**	$440,000	$390,000	$126,000	$797,000	$489,000	$528,000	$894,000
Total Construction Cost	$3,780,000	3,370,000	$1,090,000	$6,870,000	$4,210,000	$4,550,000	$7,700,000
Annual OMRR&R Costs	$10,000	$7,000	$7,000	$11,000	$8,000	$11,000	$12,000
Average Annual Costs**	$197,000	$174,000	$61,000	$351,000	$217,000	$236,000	$394,000

***First Quarter 2010 Dollars**
**** Average annual costs were determined over the six-year construction period with a discount rate of 4.375%**

Table 2. Costs and Benefits of the Final Array

Alternative	Acres of Benefit	AAHUs	Total Construction Cost	Annualized Cost*	Annualized Cost/AAHU
35*	820	334	$1,090,000	$61,000	$180
38*	2,422	1,013	$4,550,000	$236,000	$230
37	2,279	922	$4,210,000	$217,000	$240
39*	3,881	1,602	$7,700,000	$394,000	$250
36	3,061	1,268	$6,870,000	$352,000	$280
33	1,602	679	$3,780,000	$197,000	$290
34	1,459	589	$3,370,000	$174,000	$300

Cost Estimate Assumptions and Contingencies

Mobilization/Demobilization

It was assumed that a majority of the equipment used each day would be held at a temporary loading/unloading zone. Therefore, this equipment would be barged in and out on an as-needed basis. A base estimate of $150,000 was used for the Mobilization and Demobilization costs (One cut) with an extra $50,000 for each additional cut. A D-6 dozer, two amphibious short-reach excavators, and a log skidder will be hauled in via a truck and trailer. A barge, to be utilized for on-water work, will be brought in via a tug boat as well. The costs were determined from the 2008 MII costbook and included equipment and labor. A productivity of 100% was assumed for the Mob/Demob.

Earthwork

Cut Excavation

This is the amount of earthwork needed to dig through the dredged material berm and into the swamp for each alternative. The material will be removed by using a D-6 dozer and two amphibious sort-reach excavators. The short reach excavators have a reach of 30 feet in one direction and a 2.5 cubic yard bucket. The cycle time for these excavators is 120 cubic yards per hour. Short-reach excavators were chosen due to the larger buckets they provide. Once the dredged material berm and the interior swamp are cleared of trees and brush, both excavators will dig their way into the construction area. The excavated material will be placed on both sides of the new cut and conveyance channels. Gaps of approximately 50 feet in width will be placed throughout the material placement areas to ensure that hydrologic flow is maintained throughout the area. The unit cost was obtained by using the equipment's cycle times and calculating the duration required for creating the proposed cuts and conveyance channels. It was assumed that an 80% productivity level would be achieved during this portion of construction. To accommodate the superintendent over a six month period an added sustenance cost of $6,720 will be included to the MCACES estimate (6 months x 4 weeks x 5 days x $56 per day). The per diem rate of $56.00 per day for Baton Rouge, LA. was used. The quantity was determined by GIS and cross-sections. The unit cost was calculated to be $3.41 per cubic yard of material excavated.

Clearing & Grubbing

This cost included the clearing of all brush/trees and the removal of stumps within the project footprint before excavation begins. Only the channel portions of the excavation through the existing dredged material berms and the swamp floor would require full clearing and grubbing, however the entire area was used for calculation of this cost item to account for the brush removal and any additional cutting of trees into smaller lengths. The stumps within the areas designated for material placement would not be removed. The removed trees will be placed within the surrounding swamp along the conveyance channels in a manner which ensures hydrologic flow remains. The stumps removed from the newly-excavated conveyance channels will be placed along the spoil placement areas. The unit cost was taken from the MII costbook for 2008. The area to be cleared was derived from GIS analysis.

Tree Removal

Tree Removal would take place along the footprint of all excavated channels, areas designated for material placement and the associated 10-foot gaps. Tree removal would also take place along the benches to be created within the existing dredged material berms. All stumps outside the channel would remain or be covered with the dredged material. The unit cost was taken from the MII costbook for 2008. The area to be cleared was derived from GIS analysis.

Erosion Protection

Seeding & Mulching

This price includes the seeding & mulching of the cut through the existing dredged material berms along the ARDC. The area to be seeded was determined by GIS analysis. The unit price was taken from the MII 2008 costbook.

Fertilizer

All areas to be seeded were determined to need fertilizer. It was estimated that each existing spoil bank cut would need approximately ten 50-pound bags of fertilizer for fertilization of the slopes. The unit price was taken from the MII 2008 costbook.

Temporary Silt Fencing

Silt fencing would be used to stop sediment form leaving the construction site in the areas surrounding the cut through the existing dredged material berms. Based on GIS analysis it was determined that approximately 1,000 feet was needed for each cut. The unit price was taken from the MII 2008 costbook.

Temporary Hay or Straw Bales

Hay bales would be used to control erosion or the loss of sediment in the low-lying areas for proposed cuts through the existing dredged material berms. It was estimated that 50 bales were needed for each cut. The unit price was taken from the MII 2008 costbook.

Vegetative Plantings

Trees (Dredged Material Berms)

A cost of $10.00 per 3-gallon potted seedlings and a cost of $4.00 per 1-gallon potted seedling were assumed. A unit price of $0.15 per bare-root seedling was assumed. It was determined that an initial planting would consist of 15 percent 1-gallon potted seedlings and 10 percent 3-gallon potted seedlings. Also included in the primary planting were 75 percent bare-root seedlings. A secondary planting of numbers totaling 50 percent of the primary planting was assumed. When planting 173 trees per acre (Including secondary planting), 26 would be 1- gallon potted, 17 would be 3-gallon potted, and 124 would be bare-root seedlings. This equates to a per acre cost of $295. The area was determined through GIS analysis.

Trees (Swamp Floor)

A cost of $10.00 per 3-gallon potted seedlings and a cost of $4.00 per 1-gallon potted seedling were assumed. A unit price of $0.15 per bare-root seedling was assumed. It was determined that an initial planting would consist of 15 percent 1-gallon potted seedlings and 10 percent 3-gallon potted seedlings. Also included in the primary planting were 75 percent bare-root seedlings. A secondary planting of numbers totaling 50 percent of the primary planting was assumed. When planting 173 trees per acre (Including secondary planting), 26 would be 1- gallon potted, 17 would be 3-gallon potted, and 124 would be bare-root seedlings. This equates to a per acre cost of $295. The area was determined through GIS analysis.

Nutria Control/Labor

Nutria control is to be implemented for all vegetative planting within the swamp and on the dredged material berms. Nutria control, including installation and planting labor for all seedlings, would be implemented at a cost of $9.00 per seedling for all plantings and each type (Swamp/Berms). This equates to a per acre cost of $1,553.

Contingency

A 25% contingency was applied to the total construction cost to take into account unforeseen issues that may arise during construction. The contingency was added as a baseline for planning purposes as was the previous policy for developing preliminary costs estimates. Because the contingency was applied consistently to all alternatives this would not affect the CE/ICA analysis. A cost risk analysis was conducted before the feasibility phase is completed to determine the true contingency required (59%). This 59% contingency was utilized for the MCACES estimated on the NER and TSP. A cost contingency was not applied to the monitoring costs, resulting in an overall contingency of 31 % for the project.

Final Design & Construction

Planning, Engineering and Design (PED)

It was assumed that the PED costs would be approximately 12% of the total project construction cost.

Construction Management (CM)

It was assumed that the CM costs would be approximately 7% of the total project construction cost for the preliminary cost estimates.

Real Estate

Real Estate Costs were provided based on the project footprints and easement requirements. Because this cost is not normally included in the total construction costs, a separate 25% contingency was applied.

Annualized Costs

This cost was determined by an economist at GEC. The current interest rate of 4.375% was applied over a one year construction period to determine the appropriate annualized cost.

Monitoring Costs

The estimated cost for the monitoring program is $2,971,200 for the first 10 years following the completion of project construction. The details behind the Adaptive Management and Monitoring costs are located in Appendix I.

Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) Costs

The OMRR&R costs would include yearly inspections and clearing & snagging costs for the channels when needed. It is assumed that the channels would require clearing and snagging every five years. A yearly inspection cost of $1000 per day for two days is assumed each year ($2000 a year). In order to clear & snag an amphibious excavator would be needed at $350 per hour, including labor. It is assumed that clearing & snagging would take 20 hours per cut. An additional mobilization and demobilization of $20,000 is included as well.

MCACES Assumptions and Contingencies

In order to obtain a more thorough analysis of the costs associated with the recommended plan, a Micro-Computer Aided Cost Estimating System (MCACES) cost estimate was conducted on the recommended plan. Table 4 presents the Total Project Cost Summary Sheet for the MCACES estimate for the Tentatively Selected Plan (Alternative 33). This estimate included all items previously listed in the cost estimates for the final array, with the addition of various project-specific considerations such as contingencies and localized cost items such as sales tax and labor rates. Most items listed in the MCACES report were obtained from the 2008 English Costbook. Additional user defined costs were also provided for items not found in the Costbook. These items include:

- Earthmoving
- Crew Boat Costs
- Tug Boat Rental
- Vegetative Plantings

All labor costs were adjusted to match current costs in Livingston Parish, Louisiana. A contingency of 59% was determined based on a risk analysis as shown in this Appendix. The costs for construction were escalated to 2011 dollars as shown in Table 4. The overall cost of the recommended plan was estimated to be $8,540,000. The full MCACES report is found in the Cost Annex of this Appendix.

Table 3. Cost Apportionment for the Tentatively Selected Plan

Item	Federal	Non-Federal	Total
Construction	$2,890,000	$1,560,000	$4,450,000
S&A	$261,000	$140,000	$401,000
PED	$347,000	$187,000	$534,000
LERDDs	$117,000	$63,000	$180,000
Monitoring	$1,930,000	$1,040,000	$2,970,000
Total*	$5,550,000	$2,990,000	$8,540,000

S&A – Supervision and Administration (Construction Management)
PED – Planning, Engineering, and Design
LERRD – Lands, Easements, Rights-of-Way, Relocations, and Disposal Areas
* Costs include escalation in 2010 Dollars and Contingencies.

Total Project Cost Summary

Project: LCA Amite River Diversion Canal Modification
Location: Livingston Parish, LA
Document: The project cost reflects the scope and schedule in the NEPA report.
Contract: Total of TSP, Alternative 33

District: MVN
POC: Puls, Jonathan

Date: 21-Jul-10
Page: 1 of 1

Program Year (Budget EC): 2011
Effective Price Level Date: 1 Jan 10

WBS Number	Civil Works Feature & Sub-Feature Description	Effective Price level-Unit Price Estimate: Cost $K	Cntg %	Cntg $K	Total $K	Esc %	Cost $K	Cntg $K	Total $K	FULLY FUNDED PROJECT ESTIMATE: Mid Pt Date	Esc %	Cost $K	Cntg $K	Total $K
9	CHANNELS & CANALS	$ 2,591	59%	$ 1,529	$ 4,120	1.0%	$ 2,618	$ 1,544	$ 4,162	Apr-15	8.1%	$ 2,801	$ 1,653	$ 4,453
06	FISH AND WILDLIFE	$ 2,971	0%	$ -	$ 2,971	0.0%	$ 2,971	$ -	$ 2,971		0.0%	$ 2,971	$ -	$ 2,971
	CONSTRUCTION ESTIMATE TOTALS:	$ 5,562		$ 1,529	$ 7,091	1.0%	$ 5,589	$ 1,544	$ 7,133	Apr-15	8.1%	$ 5,772	$ 1,653	$ 7,425
01	LANDS AND DAMAGES	$ 113	59%	$ 67	$ 180	0.0%	$ 113	$ 67	$ 180	Sep-12	0.0%	$ 113	$ 67	$ 180
30	PLANNING, ENGINEERING & DESIGN	$ 311	59%	$ 183	$ 494	1.0%	$ 314	$ 185	$ 499	Apr-15	8.1%	$ 336	$ 198	$ 534
31	CONSTRUCTION MANAGEMENT	$ 233	59%	$ 138	$ 371	1.0%	$ 236	$ 139	$ 374	Apr-15	8.1%	$ 252	$ 149	$ 401
	PROJECT COST TOTALS:	$ 6,219	31%	$ 1,916	$ 8,136	0.6%	$ 6,251	$ 1,935	$ 8,187		4.1%	$ 6,473	$ 2,066	$ 8,539

Project Manager

Chief Cost Engineer

ESTIMATED FEDERAL COST:	5,551
ESTIMATED NON-FEDERAL COST:	2,989
ESTIMATED TOTAL PROJECT COST:	**8,539**

Cost Risk Analysis

In an effort to identify the applicable cost and schedule risks inherent with implementation of the TSP (Alternative 33), much of the process found within the USACE guidance was utilized. Once all potential areas of risk were agreed upon by the evaluation team, a Risk Register was created to help qualify and quantify the potential impacts of these risks. A Monte Carlo simulation was run on the registry, which yielded the applicable cost contingency to use for estimating construction costs of the TSP. For this study it was determined that the appropriate contingency to use is 59 percent. This cost contingency was not applied to monitoring costs due to existing contingencies already found within this cost account. This resulted in an overall project contingency of 31%. More details on the Cost Risk Analysis are found in the Cost Annex of this Appendix.

ANNEX

Cost

Costs Estimates for Final Array

Table 1. Cost Estimate for Alternative 33 (TSP)

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$250,000.00	$250,000
Earthwork				
Cut Excavation	cy	95,447	$3.41	$325,474
Clearing & Grubbing	acre	19	$5,600.00	$106,400
Clearing of Trees (No Stump Removal)	acre	13	$2,300.00	$29,900
Erosion Protection				
Seeding & Mulching	sy	60,000	$0.60	$36,000
Fertilizer	lb	1,500	$0.40	$600
Temporary Silt Fencing	lf	3,000	$2.50	$7,500
Temporary Hay or Straw Bales	ea	150	$15.00	$2,250
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	5	$295.00	$1,475
Trees (Swamp Floor)	acre	438	$295.00	$129,210
Nutria Control	acre	443	$1,553.00	$687,979
Construction Costs				**$1,576,788**
Surveying	ls	1	$54,000.00	$54,000
Markups***	%		40%	$630,715
Planning, Engineering and Design	%		12%	$189,215
Construction Management	%		7%	$110,375
Subtotal				**$2,561,093**
Construction Contingency Cost (25%)			25%	$640,273
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$136,000.00	$136,000
Total Project Construction Cost				**$3,337,367**
Interest During Construction (6 Yr Const.)				$438,029
Total Estimated Cost				$3,775,396
Total Estimated Cost Rounded				**$3,780,000**
Annualized Cost (50 yr, 4.375% Interest)				$187,173
Annual Operations and Maintenance*				$9,513
Total Average Annual Cost				$196,686
Rounded Annualized Cost				**$197,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

Table 2. Cost Estimate for Alternative 34

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$150,000.00	$150,000
Earthwork				
Cut Excavation	cy	73,740	$3.41	$251,453
Clearing & Grubbing	acre	11	$5,600.00	$61,600
Clearing of Trees (No Stump Removal)	acre	8	$2,300.00	$18,400
Erosion Protection				
Seeding & Mulching	sy	30,000	$0.60	$18,000
Fertilizer	lb	500	$0.40	$200
Temporary Silt Fencing	lf	1,500	$2.50	$3,750
Temporary Hay or Straw Bales	ea	50	$15.00	$750
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	3	$295.00	$885
Trees (Swamp Floor)	acre	487	$295.00	$143,665
Nutria Control	acre	490	$1,553.00	$760,970
Construction Costs				**$1,409,673**
Surveying	ls	1	$21,600.00	$21,600
Markups***	%		40%	$563,869
Planning, Engineering and Design	%		12%	$169,161
Construction Management	%		7%	$98,677
Subtotal				**$2,262,981**
Construction Contingency Cost (25%)			25%	$565,745
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$144,000.00	$144,000
Total Project Construction Cost				**$2,972,726**
Interest During Construction (2 Yr Const.)				$390,170
Total Estimated Cost				$3,362,896
Total Estimated Cost Rounded				**$3,370,000**
Annualized Cost (50 yr, 4.375% Interest)				$166,723
Annual Operations and Maintenance*				$6,948
Total Average Annual Cost				**$173,671**
Rounded Annualized Cost				**$174,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

Table 3. Cost Estimate for Alternative 35

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$150,000.00	$150,000
Earthwork				
Cut Excavation	cy	60,468	$3.41	$206,196
Clearing & Grubbing	acre	7	$5,600.00	$39,200
Clearing of Trees (No Stump Removal)	acre	7	$2,300.00	$16,100
Erosion Protection				
Seeding & Mulching	sy	30,000	$0.60	$18,000
Fertilizer	lb	500	$0.40	$200
Temporary Silt Fencing	lf	1,500	$2.50	$3,750
Temporary Hay or Straw Bales	ea	50	$15.00	$750
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	3	$295.00	$885
Trees (Swamp Floor)	acre	0	$295.00	$0
Nutria Control	acre	3	$1,553.00	$4,659
Construction Costs				**$439,740**
Surveying	ls	1	$21,600.00	$21,600
Markups***	%		40%	$175,896
Planning, Engineering and Design	%		12%	$52,769
Construction Management	%		7%	$30,782
Subtotal				**$720,786**
Construction Contingency Cost (25%)			25%	$180,197
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$62,000.00	$62,000
Total Project Construction Cost				**$962,983**
Interest During Construction (6 Yr Const.)				$126,392
Total Estimated Cost				$1,089,375
Total Estimated Cost Rounded				**$1,090,000**
Annualized Cost (50 yr, 4.375% Interest)				$54,008
Annual Operations and Maintenance*				$6,948
Total Average Annual Cost				**$60,956**
Rounded Annualized Cost				**$61,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

Table 4. Cost Estimate for Alternative 36

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$300,000.00	$300,000
Earthwork				
Cut Excavation	ls	169,187	$3.41	$576,928
Clearing & Grubbing	acre	29	$5,600.00	$162,400
Clearing of Trees (No Stump Removal)	acre	21	$2,300.00	$48,300
Erosion Protection				
Seeding & Mulching	sy	90,000	$0.60	$54,000
Fertilizer	lb	2,000	$0.40	$800
Temporary Silt Fencing	lf	4,500	$2.50	$11,250
Temporary Hay or Straw Bales	ea	200	$15.00	$3,000
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	8	$295.00	$2,360
Trees (Swamp Floor)	acre	925	$295.00	$272,875
Nutria Control	acre	933	$1,553.00	$1,448,949
Construction Costs				**$2,880,862**
Surveying	ls	1	$70,200.00	$70,200
Markups***	%		40%	$1,152,345
Planning, Engineering and Design	%		12%	$345,703
Construction Management	%		7%	$201,660
Subtotal				**$4,650,770**
Construction Contingency Cost (25%)			25%	$1,162,693
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$259,000.00	$259,000
Total Project Construction Cost				**$6,072,463**
Interest During Construction (6 Yr Const.)				$797,011
Total Estimated Cost				$6,869,473
Total Estimated Cost Rounded				**$6,870,000**
Annualized Cost (50 yr, 4.375% Interest)				$340,569
Annual Operations and Maintenance*				$10,796
Total Average Annual Cost				**$351,365**
Rounded Annualized Cost				**$351,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

Table 5. Cost Estimate for Alternative 37

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$200,000.00	$200,000
Earthwork				
Cut Excavation	ls	134,208	$3.41	$457,649
Clearing & Grubbing	acre	15	$5,600.00	$84,000
Clearing of Trees (No Stump Removal)	acre	18	$2,300.00	$41,400
Erosion Protection				
Seeding & Mulching	sy	60,000	$0.60	$36,000
Fertilizer	lb	1,000	$0.40	$400
Temporary Silt Fencing	lf	3,000	$2.50	$7,500
Temporary Hay or Straw Bales	ea	100	$15.00	$1,500
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	5	$295.00	$1,475
Trees (Swamp Floor)	acre	487	$295.00	$143,665
Nutria Control	acre	492	$1,553.00	$764,076
Construction Costs				**$1,737,665**
Surveying	ls	1	$70,200.00	$70,200
Markups***	%		40%	$695,066
Planning, Engineering and Design	%		12%	$208,520
Construction Management	%		7%	$121,637
Subtotal				**$2,833,088**
Construction Contingency Cost (25%)			25%	$708,272
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$185,000.00	$185,000
Total Project Construction Cost				**$3,726,360**
Interest During Construction (6 Yr Const.)				$489,085
Total Estimated Cost				$4,215,444
Total Estimated Cost Rounded				**$4,210,000**
Annualized Cost (50 yr, 4.375% Interest)				$208,990
Annual Operations and Maintenance*				$8,230
Total Average Annual Cost				**$217,220**
Rounded Annualized Cost				**$217,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

Table 6. Cost Estimate for Alternative 38

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$300,000.00	$300,000
Earthwork				
Cut Excavation	ls	155,915	$3.41	$531,670
Clearing & Grubbing	acre	19	$5,600.00	$106,400
Clearing of Trees (No Stump Removal)	acre	26	$2,300.00	$59,800
Erosion Protection				
Seeding & Mulching	sy	90,000	$0.60	$54,000
Fertilizer	lb	2,000	$0.40	$800
Temporary Silt Fencing	lf	4,500	$2.50	$11,250
Temporary Hay or Straw Bales	ea	200	$15.00	$3,000
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	7	$295.00	$2,065
Trees (Swamp Floor)	acre	438	$295.00	$129,210
Nutria Control	acre	445	$1,553.00	$691,085
Construction Costs				**$1,889,280**
Surveying	ls	1	$70,200.00	$70,200
Markups***	%		40%	$755,712
Planning, Engineering and Design	%		12%	$226,714
Construction Management	%		7%	$132,250
Subtotal				**$3,074,155**
Construction Contingency Cost (25%)			25%	$768,539
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$178,000.00	$178,000
Total Project Construction Cost				**$4,020,694**
Interest During Construction (6 Yr Const.)				$527,716
Total Estimated Cost				$4,548,410
Total Estimated Cost Rounded				**$4,550,000**
Annualized Cost (50 yr, 4.375% Interest)				$225,497
Annual Operations and Maintenance*				$10,796
Total Average Annual Cost				$236,293
Rounded Annualized Cost				**$236,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

Table 7. Cost Estimate for Alternative 39 (NER)

Item	Unit	Estimated Quantity	Unit Price	Estimated Cost
Mobilization & Demobilization	ls	1	$350,000.00	$350,000
Earthwork				
Cut Excavation	ls	229,655	$3.41	$783,124
Clearing & Grubbing	acre	37	$5,600.00	$207,200
Clearing of Trees (No Stump Removal)	acre	27	$2,300.00	$62,100
Erosion Protection				
Seeding & Mulching	sy	120,000	$0.60	$72,000
Fertilizer	lb	2,500	$0.40	$1,000
Temporary Silt Fencing	lf	6,000	$2.50	$15,000
Temporary Hay or Straw Bales	ea	250	$15.00	$3,750
Vegetative Plantings				
Trees (Dredged Material Berm)	acre	10	$295.00	$2,950
Trees (Swamp Floor)	acre	925	$295.00	$272,875
Nutria Control & Labor	acre	935	$1,553.00	$1,452,055
Construction Costs				**$3,222,054**
Surverying	ls	1	$86,400.00	$86,400
Markups***	%		40%	$1,288,821
Planning, Engineering and Design	%		12%	$386,646
Construction Management	%		7%	$225,544
Subtotal				**$5,209,465**
Construction Contingency Cost (25%)			25%	$1,302,366
Real Estate				
Land Costs (Easements/Access/Leases)**	ls	1	$301,000.00	$301,000
Total Project Construction Cost				$6,812,831
Interest During Construction (6 Yr Const.)				$894,184
Total Estimated Cost				**$7,707,016**
Total Estimated Cost Rounded				**$7,700,000**
Annualized Cost (50 yr, 4.375% Interest)				$382,092
Annual Operations and Maintenance*				$12,079
Total Average Annual Cost				$394,171
Rounded Annualized Cost				**$394,000**

Estimates are in 2010 Dollars; Costs are preliminary estimates for planning purposes only and do not represent a fully funded cost estimate.
Average Annual Cost based upon 50 yr project life, 4.375% interest, and 6 year construction period
Interest During Construction Rate = ((1.04375 ^ 2) -1) * .5
* Additional Mobilization/Demobilization Cost of $20,000 Required for All Implementations
** 25% Contingency Included
*** Markups include Home Office and Job Office Overhead (10% each), Profit (10%), Bond (1%), and Subcontractors (Approx 8%)

ANNEX 10-1

Total Project Cost Summary

Project	LCA Amite River Diversion Canal Modification
Location:	Livingston Parish, LA
Document	The project cost reflects the scope and schedule in the NEPA report.
Contract	Total of TSP, Alternative 33
District	MVN
POC	Puls, Jonathan
Date	21-Jul-10
Page	1 of 1

Program Year (Budget EC): 2011
Effective Price Level Date: 1 Jan 10

WBS Number	Civil Works Feature & Sub-Feature Description	Effective Price level-Unit Price Estimate Cost $K	Cntg %	Cntg $K	Total $K	Esc %	Cost $K	Cntg $K	Total $K	FULLY FUNDED PROJECT ESTIMATE Mid Pt Date	Esc %	Cost $K	Cntg $K	Total $K
9	CHANNELS & CANALS	$ 2,591	59%	$ 1,529	$ 4,120	1.0%	$ 2,618	$ 1,544	$ 4,162	Apr-15	8.1%	$ 2,801	$ 1,653	$ 4,453
06	FISH AND WILDLIFE	$ 2,971	0%	$ -	$ 2,971	0.0%	$ 2,971	$ -	$ 2,971		0.0%	$ 2,971	$ -	$ 2,971
	CONSTRUCTION ESTIMATE TOTALS:	$ 5,562		$ 1,529	$ 7,091	1.0%	$ 5,589	$ 1,544	$ 7,133	Apr-15	8.1%	$ 5,772	$ 1,653	$ 7,425
01	LANDS AND DAMAGES	$ 113	59%	$ 67	$ 180	0.0%	$ 113	$ 67	$ 180	Sep-12	0.0%	$ 113	$ 67	$ 180
30	PLANNING, ENGINEERING & DESIGN	$ 311	59%	$ 183	$ 494	1.0%	$ 314	$ 185	$ 499	Apr-15	8.1%	$ 336	$ 198	$ 534
31	CONSTRUCTION MANAGEMENT	$ 233	59%	$ 138	$ 371	1.0%	$ 236	$ 139	$ 374	Apr-15	8.1%	$ 252	$ 149	$ 401
	PROJECT COST TOTALS:	$ 6,219	31%	$ 1,916	$ 8,136	0.6%	$ 6,251	$ 1,935	$ 8,187		4.1%	$ 6,473	$ 2,066	$ 8,539

Project Manager

Chief Cost Engineer

ESTIMATED FEDERAL COST: **5,551**
ESTIMATED NON-FEDERAL COST: **2,989**

ESTIMATED TOTAL PROJECT COST: 8,539

US Army Corps
of Engineers

New Orleans District

Amite River Diversion Canal Modification Project
Ascension and Livingston Parishes, Louisiana

Cost Narrative Report
Draft Submittal

July, 2010

Amite River Diversion Canal Modification Project
Cost Narrative

1. Project Description

a. General: Title VII of the Water Resources Development Act (WRDA) 2007 authorizes the Louisiana Coastal Area (LCA) program. The authority includes requirements for comprehensive coastal restoration planning, program governance, project modification investigations, a Science and Technology (S&T) program, restoration project construction, a program for beneficial use of dredged material, feasibility studies for restoration plan components, and other program elements.

b. Purpose: The LCA ARDC Integrated Feasibility Study is being developed as a supplement to the *Louisiana Coastal Area (LCA) Louisiana Ecosystem Restoration: Comprehensive Coast-wide Ecosystem Restoration Study* (LCA Near-term Restoration Plan) and is intended to meet the requirements of the Water Resources Development Act (WRDA) of 2007, Section 7006(e). This feasibility study is anticipated to result in a Chief of Engineers Report containing a recommended LCA ARDC Plan (Plan). The Plan addresses systematic restoration of bald cypress-tupelo swamp in areas affected by the ARDC, and considers measures to prevent future bald cypress-tupelo swamp degradation and conversion, restore sheet flow impaired by dredged material bank construction, and protect vital socioeconomic and public resources. The Plan addresses ecosystem restoration exclusively, and does not impair or alter the flood control capabilities of the ARDC. The Plan is independent of, but synergistic with, other LCA near-term critical features, as well as coastal restoration projects proposed under other authorities to provide a holistic approach to restore impaired swamp habitat in the western Maurepas Swamp.

c. Design Features: Features include dredge material berm cuts, railroad grade cuts, conveyance channel cuts, vegetative clearing, and vegetative plantings.

2. Basis of Estimate

a. Basis of Design: LCA ARDC Integrated Feasibility Report and Draft Supplemental Environmental Impact Statement (DSEIS) and the ARDC Phase 1 Environmental Site Assessment. This project's site plan is presented in Section 6 of Appendix L of the LCA ARDC Integrated Feasibility Report and DSEIS.

b. Basis of Quantities: The estimate is based on the overall quantities provided by the designer. These overall quantities along with additional detailed quantity estimates are presented in Section 6 of Appendix L of the LCA ARDC Integrated Feasibility Report and DSEIS.

3. Design and Construction Schedule

Milestone	Baseline Date
Begin Pre Construction Engineering and Design	August 2010
Initiation of Monitoring Program	November 2010
USACE and non-Federal sponsor negotiate PPA	April 2012
Complete Plans and Specifications	January 2012
Real Estate Acquisition	August 2012
Award Contract	October 2012
Construction Start	May 2012
Complete Construction- Earthwork	November 2012
Complete 1st Vegetation Planting	April 2015
Complete 2nd Vegetation Planting	April 2018
Turnover Project to Local Sponsor	August 2018
Complete Monitoring Program	March 2023

a. Overtime: Overtime is included in the estimate for this project.

b. Construction Windows: It is estimated that civil construction of the project will take approximately nine months to complete. Competition of the first and second vegetative plantings will take approximately four years (including time for site assessments).

4. Contracting Plan

It is assumed that the project will be contracted to one prime construction contractor and one sub contractor for the vegetative plantings.

5. Project Construction

a. Site Access: The construction laborers, equipment, and other personnel will be staged in an area with access to the ARDC, most likely along LA-22 or north of the study area. The necessary equipment will be transported in and out via barge on an as-needed basis. Laborers will be transported in and out of the project area via crew boats on a daily basis.

b. Borrow Areas: There is no requirement for borrow material to be brought in from outside the project area. All excavated material resulting from construction of the project will be placed within the project footprint.

c. Construction Methodology:

1) Mobilization: This cost item includes the mobilization and demobilization of two amphibious, short-reach excavators, a D6 Dozer, a log skidder, a barge, and a crew boat.

This cost item includes the rental cost for the equipment and labor required to haul the construction equipment to and from the job site. It is assumed that one truck driver and a laborer is needed for each truck used to haul equipment. This item also includes the costs for transporting the work crew in and out of the construction area with a crew boat.

The crew boat will be used to transport workers to and from the construction area on a daily basis. Prices provided by Hackco, Inc. http://hackcoinc.com/ 337-762-4703. Price includes captain, mob/demob, fuel, 1 crew boat throughout construction (22 weeks @ 7 days/week rental = 154 days). Prices are for the first quarter of 2010. 1 laborer will be used for daily work on the barge, for a total of 840 hours (40 hours x 21 weeks). A work barge is to be used for transporting equipment during construction. The barge will be needed for 21 weeks @ 7days/week = 147 days.

2) The appropriate construction areas will be cleared of trees and stumps before excavation of the cuts and conveyance channels begins. Some areas of the construction footprint do not require that the stumps be removed (Sloped and disposal areas). All stumps will be removed from the proposed conveyance channel excavation sites. This cost item represents the removal of trees within the proposed construction footprint. All trees will be disposed of on-site by selectively cutting the trees into smaller sections and leaving them in the interior swamp in a manner that does not impeded hydrologic flow.

3) All cuts and channels will be excavated from the ARDC into the swamp areas. Excavation will proceed from the ARDC into the swamp via the cuts and conveyance channels as they are constructed. The conveyance channels will be the primary means of transportation during construction.

For two amphibious, short-reach excavators (2.5 CY bucket) @ $285/hr (Rental price provided by MVN, price includes crew), with a cycle time of 120 CY/hr of material handled. A 50-minute hour and a 80% productivity markup were used for this calculation (95,477 CY/120 CY/hr = 796 hr * 1.17 * 1.2 = 1,118 hrs). This gives an overall unit cost of $3.33 per cubic yard (1,118 hrs x $285 = $318,630, $318,630/95,477 CY = $3.33). To accommodate the superintendent over a six month period an added sustenance cost of $6,720 will be included to the MCACES estimate (6 months x 4 weeks x 5 days x $56 per day). The per diem rate of $56.00 per day for Baton Rouge, LA. was used. This raised the unit cost to $3.41 per cubic yard. This cost was obtained for the first quarter of 2010.

4) Material will be placed along the sides of the newly-constructed conveyance channels as depicted in Section 3 of the LCA ARDC Integrated Feasibility Report and DSEIS. Two amphibious, short-reach excavators will remove the material from the proposed conveyance channel locations. Stumps from the channels will also be placed along the appropriate disposal sites.

5) Vegetative plantings will be implemented within the appropriate areas in two phases. Plantings will be implemented with a density of 173 trees per acre. The trees to be planted will consist of approximately 15% 1-gallon potted seedlings, 10% 3-gallon potted

seedlings and 75% bare-root seedlings. Nutria guards will be installed on all planted trees. It is assumed that approximately 50% of the initial planting will need to be replanted with a two year period of the initial plantings.

This item represents the primary and secondary plantings to be implemented on the newly created dredged material berms upon completion of the earthmoving phase of construction. A cost of $10.00 per 3 gal. potted plant, $4.00 per 1 gal. potted plant, and $0.15 per seedling was assumed. It was determined that an initial planting consisting of 15% 1 gal. potted plants, 10% 3 gal. potted plants, and 75% bare-root seedlings would be implemented. An initial planting will begin 7 months after the earthmoving phase of construction is completed. A secondary planting of approximately 50% of the size of the initial planting will begin 23 months after the initial planting is completed. When planting 173 trees per acre (Including secondary planting), 26 will be 1 gallon potted, another 17 will be 3 gallon potted and 129 will be bare-root for each acre planted. This equates to a per acre cost of $295. The cost including installing nutria guards is $1,533 per acre. This includes the labor required for planting the trees, purchasing the nutria guard materials, and installing the guards. Productivity is already accounted for with the 50% replanting. Prices provided by NCRS via the USFWS (Last Quarter 2009).

6) Surveying - It is assumed that a four-man crew will need to work with the following breakdown: 3 days of mobilization per cut, 5 days per cut to layout the construction footprint, 4 days per cut to produce as-builts. This is assumed to be done at 80% productivity. This gives 30 days of work at an estimated cost of $1,500 per day, at 80% efficiency for a total of $54,000. This quote was provided by Jim Smith of the Stanley Group for the first quarter of 2010 (225-388-4208).

6. Lands and Damages

This cost item includes the Lands & Damages involved with the implementation of the proposed action. No land will be purchased outright, but conservation, depositional, and flowage easements will be required. A 59% contingency (as determined by the a risk analysis) will be added to these costs. Details behind these costs may be found in Appendix J of the LCA ARDC Integrated Report.

7. Planning, Engineering, and Design (PED)

These costs include the planning, engineering, and design required before construction of the LCA ARDC project is to commence. It was estimated that this cost would be 12% of the total estimated construction costs. A 59% contingency (based on a risk analysis) will be added to this cost item.

8. Construction Management (CM)

These costs include the construction management required during construction of the LCA ARDC project. It was estimated that this cost would be 9% of the total estimated construction costs. A 59% contingency (based on a risk analysis) will be added to this cost item.

9. Fish and Wildlife

This costs item includes the monitoring of project performance and for the project area, once construction is completed. Monitoring will be conducted for the first ten years upon completion of construction. This cost was determined from an Adaptive Management and Monitoring Report, which is included in Appendix I of the LCA ARDC Integrated Report. An escalation of 2.6% is included for this cost item, therefore no escalation was applied within the Total Project Cost Summary Sheet.

10. Environmental Concerns

To ensure that sediments do not leave the construction site during construction, Best Management Practices including hay bales, silt fencing, and seeding and mulching will be implemented.

11. Effective Dates for Labor, Equipment, and Material Pricing

The labor, equipment, and material pricing were developed using the MCACES 2008 English Unit Cost Library, 2008 Labor Library, and the 2008 Equipment Library and the 2008 Equipment Library (Region III) for the base estimate. The base estimate has been currently updated with current market wage rates for Livingston Parish, Louisiana, current quoted material prices, production rates, fuel prices and specialty equipment costs in Louisiana. The index pricing data has been prepared in June, 2008 dollars based on the data listed below and escalated to February 2010 dollars.

a. Labor and Equipment Productivity: The estimate includes an overall Production Index of 80 percent on selected items which is based on anticipated project difficulty, method of construction, labor availability, supervision, job conditions, weather, and expected delays. The productivity is built into the unit cost for some items as stipulated in the item description.

12. Project Mark ups

a. Escalation The project costs were determined in 2010 dollars and escalated to February 2011 dollars as shown in Section 10 of Appendix L of the LCA ARDC report.

b. Contingency A risk analysis was performed in accordance with ER 1110-2-1302. The risk registry developed for this project is located in Section 10 Appendix L of the LCA ARDC report. This analysis suggested a contingency of 59% be applied to the final constructions costs, before Planning, Engineering and Design along with Construction Management were added.

This is the MCACES Cost Estimate for the LCA Amite River Diversion Canal Modification Project. The purpose of this project is to restore natural hydrologic connectivity between the ARDC and the surrounding swamp habitat. It is proposed that five cuts, along with conveyance channels, be placed in the existing dredged material berm to allow sediment and nutrient exchange throughout the area and to reduce impoundment.

Estimated by Jonathan Puls & Robert Manes
Designed by GEC, Inc.
Prepared by Jonathan Puls & Robert Manes
Preparation Date 12/17/2009
Effective Date of Pricing 12/17/2009
Estimated Construction Time Days

Description	Quantity	UOM	ContractCost	ProjectCost	C/O
Project Cost Summary Report			**6,219,286**	**6,219,286**	
			2,590,980.06	*2,590,980.06*	
09 09 - Construction Costs	**1.00**	**EA**	**2,590,980**	**2,590,980**	
			400,010.40	*400,010.40*	
09-01 09-01 Mob & Demob, Contractor	**1.00**	**EA**	**400,010**	**400,010**	
			245,719.32	*245,719.32*	
09-01-01 09-01-01 Mob/Demob Equipment to be Towed	**1.00**	**EA**	**245,719**	**245,719**	
			245,719.32	*245,719.32*	
09-01-01-01 09-01-01-01 Mob/Demob Crew Boat	**1.00**	**EA**	**245,719**	**245,719**	
			1,830.50	*1,830.50*	
09-01-02 09-01-02 Mob/Demob Equipment to be Hauled and Operated	**1.00**	**EA**	**1,831**	**1,831**	
			502.49	*502.49*	
09-01-02-01 09-01-02-01 Mob/Demob Log Skidder	**1.00**	**EA**	**502**	**502**	
			502.49	*502.49*	
09-01-05-01 09-01-02-02 Mob Marsh Backhoe	**2.00**	**EA**	**1,005**	**1,005**	
			323.03	*323.03*	
09-01-02-02 09-01-02-03 Mob/Demob D6 Dozer	**1.00**	**EA**	**323**	**323**	
			20,160.40	*20,160.40*	
09-01-03 09-01-03 Workers	**1.00**	**EA**	**20,160**	**20,160**	
			132,300.18	*132,300.18*	
09-01-04 09-01-04 Mob/Demob Equipment	**1.00**	**EA**	**132,300**	**132,300**	
			209,698.53	*209,698.53*	
09-02 09-02 Site Preperation	**1.00**	**EA**	**209,699**	**209,699**	
			432,902.89	*432,902.89*	
09-03 09-03 Earthwork	**1.00**	**EA**	**432,903**	**432,903**	
			115,896.41	*115,896.41*	
09-04 09-04 Erosion Protection	**1.00**	**EA**	**115,896**	**115,896**	
			1,360,670.73	*1,360,670.73*	
09-05 09-05 Vegetative Planting	**1.00**	**EA**	**1,360,671**	**1,360,671**	
			71,801.10	*71,801.10*	
09-06 Surveying	**1.00**	**EA**	**71,801**	**71,801**	
			113,000.00	*113,000.00*	
01 - Lands & Damages	**1.00**	**EA**	**113,000**	**113,000**	
			2,971,200.00	*2,971,200.00*	
06 - Fish & Wildlife	**1.00**	**EA**	**2,971,200**	**2,971,200**	

Description	Quantity	UOM	ContractCost	ProjectCost	C/O
			310,918.00	*310,918.00*	
30 - PED	**1.00**	**EA**	**310,918**	**310,918**	
			233,188.00	*233,188.00*	
31 - Construction Management	**1.00**	**EA**	**233,188**	**233,188**	

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
Project Direct Costs Report				**101,629**	**398,924**	**158,411**	**4,695,862**	**0**	**5,354,825**	
				101,629.13	*398,923.53*	*158,411.25*	*1,067,555.57*		*1,726,519.48*	
09 09 - Construction Costs	**1.00**	**EA**	**Prime Contractor**	**101,629**	**398,924**	**158,411**	**1,067,556**	**0**	**1,726,519**	

(Note: The overall construction for this project involves the excavation of three cuts, along with bifurcated conveyancve channels, through the dredged material berms and the interior swamp habitat, respectively. The dredged material will be placed along the existing berm, along the proposed conveyance channels, in order to maintain sheet flow throughout the area. Once these cuts and channels are excavated and the construction area is allowed to settle, two phases of vegetative plantings will be implemented for portions of the interior swamp and for all of the dredged material placed during construction. The productivity of this construction project is assumed to be 80% for specific cost items associated with this cost estimate. It is estimated that construction will begin in the last quarter of 2012. The TPCS found in Appendix L of the combined report gives the overall project costs along with all associated contigencies and escalation.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				15,599.24	*285,239.63*	*0.00*	*0.00*		*300,838.86*	
09-01 09-01 Mob & Demob, Contractor	**1.00**	**EA**	**Prime Contractor**	**15,599**	**285,240**	**0**	**0**	**0**	**300,839**	

(Note: This cost item includes the mobilization and demobilization of two amphibious, short-reach excavators, a D6 Dozer, a log skidder, a barge, and a crew boat. This cost item includes the renatal cost for the equipment and labor required to haul the construction equipment to and from the job site. It is assumed that one truck driver and a laborer is needed for each truck used to haul equipment. This item also includes the costs for transporting the work crew in and out of the construction area with a crew boat.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				0.00	*184,800.00*	*0.00*	*0.00*		*184,800.00*	
09-01-01 09-01-01 Mob/Demob Equipment to be Towed	**1.00**	**EA**	**Prime Contractor**	**0**	**184,800**	**0**	**0**	**0**	**184,800**	

(Note: This cost item represents the cost for renting a crew boat to use during construction.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				0.00	*184,800.00*	*0.00*	*0.00*		*184,800.00*	
09-01-01-01 09-01-01-01 Mob/Demob Crew Boat	**1.00**	**EA**	**Prime Contractor**	**0**	**184,800**	**0**	**0**	**0**	**184,800**	

(Note: The crew boat will be used to transport workers to and from the construction area on a daily basis.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				0.00	*1,200.00*	*0.00*	*0.00*		*1,200.00*	
USR Mob/Demob Crew Boat	154.00	DAY	Prime Contractor	0	184,800	0	0	0	184,800	E

(Note: The crew boat will be used to transport workers to and from the construction area on a daily basis. Prices provided by Hackco, Inc. Prices provided by Hackco, Inc. http://hackcoinc.com/ 337-762-4703 Includes captain, mob/demob, fuel, 1 crew boat is needed throughout construction (22 weeks @ 7 days/week rental = 154 dyas) Prices are for the first quarter of 2010.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				437.05	*939.63*	*0.00*	*0.00*		*1,376.68*	
09-01-02 09-01-02 Mob/Demob Equipment to be Hauled and Operated	**1.00**	**EA**	**Prime Contractor**	**437**	**940**	**0**	**0**	**0**	**1,377**	

(Note: This cost item represent the Mob/Demob of the equipment to be hauled to the job site. This equipment includes a log skidder, two hydraulic excavators and a D6 dozer.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				116.55	*261.36*	*0.00*	*0.00*		*377.91*	
09-01-02-01 09-01-02-01 Mob/Demob Log Skidder	**1.00**	**EA**	**Prime Contractor**	**117**	**261**	**0**	**0**	**0**	**378**	

(Note: This cost item is for the Mob/Demob of a log skidder.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				58.27	*130.68*	*0.00*	*0.00*		*188.96*	
RSM 015436500100 Mobilization or demobilization, dozer, loader, backhoe or excavator, above 250 H.P., up to 50 miles	2.00	EA	Prime Contractor	117	261	0	0	0	378	N

(Note: The quantity is given as two to account for both the mobilization and the demobilization. Labor and equipment is included in the cost.)

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
				116.55	*261.36*	*0.00*	*0.00*		*377.91*	
09-01-05-01 09-01-02-02 Mob Marsh	**2.00**	**EA**	**Prime**	**233**	**523**	**0**	**0**	**0**	**756**	

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
Backhoe			**Contractor**							
(Note: This cost item represent the Mob/Demob cost of hauling two amphibious short-reach hydraulic excavator to be used to construct the cuts and conveyance channels. This cost includes equipment and labor.)										
				58.27	*130.68*	*0.00*	*0.00*		*188.96*	
RSM 015436500100 Mobilization or demobilization, dozer, loader, backhoe or excavator, above 250 H.P., up to 50 miles	4.00	EA	Prime Contractor	233	523	0	0	0	756	N
(Note: The quantity is given as four to account for both the mobilization and the demobilization of both excavators. Labor and equipment is included in the cost. These excavators are have a 30-foot reach and a 2.5 CY bucket. They also have a cycle time of 120 CY/hr.)										
				87.41	*155.54*	*0.00*	*0.00*		*242.95*	
09-01-02-02 09-01-02-03 Mob/Demob D6 Dozer	**1.00**	**EA**	**Prime Contractor**	**87**	**156**	**0**	**0**	**0**	**243**	
(Note: This cost item is for the Mob/Demob of a D6 dozer.)										
				43.71	*77.77*	*0.00*	*0.00*		*121.47*	
RSM 015436500020 Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P. to 250 H.P., up to 50 miles	2.00	EA	Prime Contractor	87	156	0	0	0	243	N
(Note: The quantity is given as two to account for both the mobilization and the demobilization. Labor and equipment is included in the cost.)										
				15,162.18	*0.00*	*0.00*	*0.00*		*15,162.18*	
09-01-03 09-01-03 Workers	**1.00**	**EA**	**Prime Contractor**	**15,162**	**0**	**0**	**0**	**0**	**15,162**	
(Note: This cost includes the labor needed to help with the loading/unloading of the barges on the docking and upkeep required on a daily basis.)										
				18.05	*0.00*	*0.00*	*0.00*		*18.05*	
MIL B-LABORER Laborers, (Semi-Skilled)	840.00	HR	Prime Contractor	15,162	0	0	0	0	15,162	N
(Note: 1 laborer will be used for daily work on the barge. In total (1 barge @ 840 hours).)										
				0.00	*99,500.00*	*0.00*	*0.00*		*99,500.00*	
09-01-04 09-01-04 Mob/Demob Equipment	**1.00**	**EA**	**Prime Contractor**	**0**	**99,500**	**0**	**0**	**0**	**99,500**	
(Note: This cost item represents the equipment needed for the Mob/Demob of the barge to be used during construction. A tug boat is rented to bring the barge to and from the job site before and after the earthmoving phase of construction.)										
				0.00	*400.00*	*0.00*	*0.00*		*400.00*	
MAP XX0XX700 WORK BARGE, FLAT DECK , 500 TON APPROX. 60'x 35' x 8',WOOD DECK (Mob/Demob)	147.00	DAY	Prime Contractor	0	58,800	0	0	0	58,800	E
(Note: A work barge is to be used for transporting equipment during construction. The barge will be needed for 21 weeks @ 7days/week = 147 days.)										
				0.00	*1,850.00*	*0.00*	*0.00*		*1,850.00*	
USR Tug Boat - 900 HP	22.00	DAY	Prime Contractor	0	40,700	0	0	0	40,700	E
(Note: A tug boat is required to mob/demob the barges to be used during construction and tp push the barges from one cut to another. Price obtained from B&J Tug Boat and Barge Rentals 337-912-0974, includes captain. 4 days for mob/demob, crew boat can push barge from cut to cut and to loading zone (Twin 250 hp engines). Price obtained in the first quarter of 2010.)										
				50,949.24	*106,760.34*	*0.00*	*0.00*		*157,709.57*	
09-02 09-02 Site Preperation	**1.00**	**EA**	**Prime Contractor**	**50,949**	**106,760**	**0**	**0**	**0**	**157,710**	

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
(Note: This cost item represents the general clearing of the areas to be excavated along the dredged material berms and the proposed conveyance channels. A log skidder and a laborer will be used to chainsaw the trees and the dozer and will help push them to the appropriate disposal areas. This cost includes both equipment and labor.)										
				520.48	*1,022.20*	*0.00*	*0.00*		*1,542.67*	
HNC 311313101050 Selective clearing, wet clearing, heavy brush and trees, excludes removal offsite	31.00	ACR	Prime Contractor	16,135	31,688	0	0	0	47,823	N
(Note: This cost item represents the removal of trees within the proposed construction footprint. All trees will be disposed of on-site by selectively cutting the trees into smaller sections and leaving them in the interior swamp in a manner that does not impeded hydrologic flow.)										
				1,123.05	*2,421.69*	*0.00*	*0.00*		*3,544.73*	
RSM 311110100350 Clearing & grubbing, heavy stumps, to 24" diameter, grub stumps and remove	31.00	ACR	Prime Contractor	34,814	75,072	0	0	0	109,887	N
(Note: This cost item represents the removal of all shrubs, stumps and debris within the proposed project footprint. The stumps will be piled along the proposed dredged material disposal areas. All other material will be disposed of along the swamp floor in a manner that does not impede hydrologic flow within the area.)										
				0.00	*0.00*	*0.00*	*325,576.57*		*325,576.57*	
09-03 09-03 Earthwork	**1.00**	**EA**	**Prime Contractor**	**0**	**0**	**0**	**325,577**	**0**	**325,577**	
(Note: This cost item represents the earthmoving required to construct the proposed cuts through the dredged material berms and the conveyance channels into the interior swamp. The equipment will dig their way in by utilizing the excavated channel as a means of moving into and out of the construction area. The excavators will be amphibious.)										
				0.00	*0.00*	*0.00*	*3.41*		*3.41*	
USR Mechanical Earthmoving	95,477.00	BCY	Prime Contractor	0	0	0	325,577	0	325,577	Sb
(Note: For two amphibious, short-reach excvators (2.5 CY bucket) @ $285/hr (Rental price provided by MVN, including crew and per diem), with a cycle time of 120 CY/hr of material handled. A 50-minute hour and a 80% productivity markup were used for this calcualtion (95,477 CY/120 CY/hr = 796 hr * 1.17 * 1.2 = 1,118 hrs). This gives an over all unit cost of $3.33 per cubic yard (1,118 hrs * $285 = $318,630, $318,630/95,477 CY = $3.33). The rental price used to calculate the $3.33 per CY unit price for excavating includes per diem. This accommodates the heavy equipment operators. To accommodate the superintendent over a six month period an added sustenance cost of $6,720 will be included to the MCACES estimate (6 months x 4 weeks x 5 days x $56 per day). The per diem rate of $56.00 per day for Baton Rouge, LA. was used. This raised the unit cost to $3.41 per cubic yard. This cost was obtained for the first quarter of 2010.)										
				35,080.66	*6,923.56*	*27,726.25*	*0.00*		*69,730.48*	
09-04 09-04 Erosion Protection	**1.00**	**EA**	**Sub-Contractor - Erosion Control**	**35,081**	**6,924**	**27,726**	**0**	**0**	**69,730**	
(Note: This cost item represents the implementation of silt fensing and hay bales used to prevent the loss of sediment due to construction activites. Silt fensing will be utilized along the entire perimeter of the construction area. Hay bales will be used in areas in which water tends to convey through the site. Seeding and mulching will be utilized along the newly formed slopes to limit the loss of sediments and to stabilize the slopes. These prices include equipment and labor.)										
				0.15	*0.12*	*0.30*	*0.00*		*0.56*	
RSM 329219131100 Seeding, mechanical seeding hydro or air seeding for large areas, includes lime, fertilizer and seed	60,000.00	SY	Sub-Contractor - Erosion Control	8,877	6,913	18,000	0	0	33,790	OLEM
(Note: This item represents the seeding implemented to ensure erosion reduction and stability along the newly excavated areas. This cost includes equipment and labor.)										
				2.54	*0.00*	*0.79*	*0.00*		*3.33*	
RSM 312513101120 Erosion control, silt fence, polypropylene, 3' high, includes 7.5' posts	3,000.00	LF	Sub-Contractor - Erosion Control	7,616	0	2,370	0	0	9,986	OLM
(Note: This item represents the silt fencing to be installed along the entire perimeter of the construction area to reduce the amount of sediment leaving the job site. This cost included equipment and labor.)										
				0.31	*0.00*	*0.11*	*0.00*		*0.42*	
RSM 329113161020 Soil preparation,	60,000.00	SY	Sub-Contractor -	18,564	0	6,600	0	0	25,164	OLM

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
mulching, polyethylene film, 1-1/2 mil			Erosion Control							
(Note: This item represent the mulching used along with the seeding to reduce ersoion within the work area. This cost include equipment and labor.)										
				0.19	*0.09*	*6.05*	*0.00*		*6.32*	
RSM 312513101250 Synthetic erosion control, hay bales, staked	125.00	LF	Sub-Contractor - Erosion Control	23	11	756	0	0	790	N
(Note: This item represents the hay bales to be placed in water conveynace areas throughout the construction area to reduce sediment loss due to erosion. This cost includes the nay bales and the labor to install them.)										
				0.00	*0.00*	*130,685.00*	*687,979.00*		*818,664.00*	
09-05 09-05 Vegetative Planting	**1.00**	**EA**	**Sub-Contractor - Vegetative Plantings**	**0**	**0**	**130,685**	**687,979**	**0**	**818,664**	
(Note: This cost includes the initial and secondary vegetative plantings to be implemented along newly-created dredged material placement areas and portions of the swamp floor. It includes the planting of baldcypress and tupelo gum as well as upland tree species such as live oaks.)										
				0.00	*0.00*	*295.00*	*0.00*		*295.00*	
USR Plantings (Material Only - Dredged Material Berms - 25% 1 gal., 25% 3 gal., and 50% seedlings)	5.00	ACR	Sub-Contractor - Vegetative Plantings	0	0	1,475	0	0	1,475	M
(Note: This item represents the primary and secondary plantings to be implemented on the newly created dredged material berms upon completion of the earthmoving phase of construction. A cost of $10.00 per 3 gal. potted plant, $4.00 per 1 gal. potted plant, and $0.15 per seedling was assumed. It was determined that an initial planting consisting of 15% 1 gal. potted plants, 10% 3 gal. potted plants, and 75% bare-root seedlings would be implemented. An initial planting will begin 7 months after the earthmoving phase of construction is completed. A secondary planting of approximately 50% will begin 23 months after the initial planting is completed. When planting 165 trees per acre (Including secondary planting), 25 will be 1 gal. potted, another 17 will be 3 gal. potted and 124 will be bare-root for each acre planted. This equates to a per acre cost of $283. The cost installing nutria guards is $1,485 per acre. This price includes the labor required for planting the trees and installing the gaurds, as well as the nutria guard materials. The area was determined through GIS analysis. Productivity is already accounted for with the 50% replanting. Prices provided by NCRS via the USFWS (Last Quarter 2009).)										
				0.00	*0.00*	*295.00*	*0.00*		*295.00*	
USR Plantings (Material Only - Swamp Floor - 25% 1 gal., 25% 3 gal., and 50% seedlings)	438.00	ACR	Sub-Contractor - Vegetative Plantings	0	0	129,210	0	0	129,210	M
(Note: This item represents the primary and secondary plantings to be implemented on the newly created dredged material berms upon completion of the earthmoving phase of construction. A cost of $10.00 per 3 gal. potted plant, $4.00 per 1 gal. potted plant, and $0.15 per seedling was assumed. It was determined that an initial planting consisting of 15% 1 gal. potted plants, 10% 3 gal. potted plants, and 75% bare-root seedlings would be implemented. An initial planting will begin 7 months after the earthmoving phase of construction is completed. A secondary planting of approximately 50% will begin 23 months after the initial planting is completed. When planting 165 trees per acre (Including secondary planting), 25 will be 1 gal. potted, another 17 will be 3 gal. potted and 124 will be bare-root for each acre planted. This equates to a per acre cost of $283. The cost installing nutria guards is $1,485 per acre. This price includes the labor required for planting the trees and installing the gaurds, as well as the nutria guard materials. The area was determined through GIS analysis. Productivity is already accounted for with the 50% replanting. Prices provided by NCRS via the USFWS (Last Quarter 2009).)										
				0.00	*0.00*	*0.00*	*1,553.00*		*1,553.00*	
USR Nutria Control (Material + Installation) and Planting Labor	443.00	ACR	Sub-Contractor - Vegetative Plantings	0	0	0	687,979	0	687,979	Sb
(Note: Nutria Control is to be implemented for all vegetative planting within the swamp and on the dredged material berms. Nutria control, including installation and planting labor for all seedlings, would be implemented at a cost of $9.00 per seedling for all plantings and each type (Swamp/Berms). Prices provided by NRCS via the USFWS (Last Quarter 2009).)										
				0.00	*0.00*	*0.00*	*54,000.00*		*54,000.00*	
09-06 Surveying	**1.00**	**EA**	**Prime Contractor**	**0**	**0**	**0**	**54,000**	**0**	**54,000**	
(Note: This cost item represents the survey work required during construction. Surveying will be conducted to specify the area of construction prior to the site preperation and earthmoving phases of construction. Survey work will also be conducted to ensure that all cuts and conveyance channels are constructed to specifications.)										
USR Construction Surveying	1.00	LS	Prime Contractor	0	0	0	54,000	0	54,000	Sb

Description	Quantity	UOM	Contractor	DirectLabor	DirectEQ	DirectMatl	DirectSubBid	DirectUserCost	DirectCost	C/O
(Note: It is assumed that a four-man crew will need to work with the following breakdown: 3 days of mobilization per cut 5 days per cut to layout the construction footprint 4 days per cut to produce as-builts 80% productivity This gives 30 days of work at an estimated cost of $1,500 per day, at 80% efficiency for a total of $54,000 This quote was provided by Jim Smith of the Stanley Group for the first quarter of 2010 (225-388-4208).)										
				0.00	*0.00*	*0.00*	*113,000.00*		*113,000.00*	
01 - Lands & Damages	**1.00**	**EA**		**0**	**0**	**0**	**113,000**	**0**	**113,000**	
				0.00	*0.00*	*0.00*	*113,000.00*		*113,000.00*	
USR Lands & Damages	1.00	EA		0	0	0	113,000	0	113,000	Sb
(Note: This cost item includes the Lands & Damages involved with the implementation of the proposed action. No land will be purchased outright, but conservation, depositional, and flowage easements will be required. A 37% contigency (as determined by the a risk analysis) will be added to these costs. Details behind these costs may be found in Appendix J of the LCA ARDC Integrated Report.)										
				0.00	*0.00*	*0.00*	*2,971,200.00*		*2,971,200.00*	
06 - Fish & Wildlife	**1.00**	**EA**		**0**	**0**	**0**	**2,971,200**	**0**	**2,971,200**	
				0.00	*0.00*	*0.00*	*2,971,200.00*		*2,971,200.00*	
USR Fish and Wildlife	1.00	EA		0	0	0	2,971,200	0	2,971,200	Sb
(Note: This costs item includes the monitoring of project performance and for the project area, once construction is completed. Monitoring will be conducted for the first ten years upon completion of construction. This cost was determined from an Adaptive Management and Monitoring Report, which is included in Appendix I of the LCA ARDC Integrated Report.)										
				0.00	*0.00*	*0.00*	*310,918.00*		*310,918.00*	
30 - PED	**1.00**	**EA**		**0**	**0**	**0**	**310,918**	**0**	**310,918**	
				0.00	*0.00*	*0.00*	*310,918.00*		*310,918.00*	
USR Planning, Engineerin, and Design	1.00	EA		0	0	0	310,918	0	310,918	Sb
(Note: These costs include the planning, engineering, and design required before construction of the LCA ARDC project is to commence. It was estimated that this cost would be 12% of the total estimated construction costs. A 37% contingency (based on a risk analysis) will be added to this cost item.)										
				0.00	*0.00*	*0.00*	*233,188.00*		*233,188.00*	
31 - Construction Management	**1.00**	**EA**		**0**	**0**	**0**	**233,188**	**0**	**233,188**	
				0.00	*0.00*	*0.00*	*233,188.00*		*233,188.00*	
USR Construction Management	1.00	EA		0	0	0	233,188	0	233,188	Sb
(Note: These costs include the construction management required during construction of the LCA ARDC project. It was estimated that this cost would be 9% of the total estimated construction costs. A 37% contingency (based on a risk analysis) will be added to this cost item.)										

ANNEX 10-2

US Army Corps of Engineers®

LOUISIANA COASTAL AREA - AMITE RIVER DIVERSION

RISK ANALYSIS REPORT FOR MISSISSIPPI RIVER VALLEY DISTRICT, NEW ORLEANS, LA.

Prepared for:

U.S. Army Corps of Engineers

Prepared by:

GEC, Inc.

Date: 1-21-10

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EXECUTIVE SUMMARY

This report reviews the cost risk analysis (CRA) for the Louisiana Coastal Area Amite River Diversion Canal (LCA ARDC) Modification project Integrated Feasibility Report and Environmental Impact Statement. The results of this analysis provide the applicable cost contingency to use during cost estimation, while also highlighting the risks associated with the study, design, and construction phases of the project.

The LCA ARDC Modification Project has been identified as a near-term critical feature recommended for study in the November 2004 *LCA Ecosystem Restoration Study* (2004 LCA Plan). Construction of the canal has caused a loss of hydrologic connectivity, a reduction in sediment and nutrient transport, and increased impoundment within the study area. These man-made impacts have resulted in the gradual degradation of the interior swamp habitat as it transitions to a freshwater marsh and eventually an open water habitat. The goal of this project is restore the natural hydrologic water regime within the study area, thereby improving the freshwater swamp habitat.

The CRA described in this report was implemented in an effort to determine a true contingency cost required for cost estimating and based on the risk items associated with the project. The results of this analysis are determined by qualifying and quantifying all potential cost risks and running a *Monte Carlo* simulation to produce the frequency spectrum and probability range for the applied risk costs. The cost contingency is obtained from the 80-percent contingency as determined by this analysis.

A total of 33 potential risk items were developed by the CRA team and applied to a risk registry for analysis. Assumptions were made for each risk item before running the *Monte Carlo* simulation. The result of the simulation gave a 59 percent contingency at the 80-percent confidence level.

The contingency cost for this project was utilized for a Micro Computer Aided Cost Estimation Software (MCACES) estimation of the costs associated with the recommended plan (Alternative 33). The potential cost risks developed during this analysis also serve as an indicator of how to avoid unforeseen escalation of project costs throughout project implementation and therefore, may be used as a valuable tool in all future aspect of the project study, design, and construction planning and estimation.

1. PURPOSE

The purpose of this project is to address the systematic restoration of bald cypress-tupelo swamp in areas affected by the ARDC, while considering measures to prevent future bald cypress-tupelo swamp degradation and conversion, restore sheet flow impaired by dredged material bank construction, and protect vital socioeconomic and public resources. The study area is located in the western Maurepas Swamp in the vicinity of Head of Island, Louisiana and is centered around the ARDC, a flood control channel that extends from the Amite River (at Mile 25) to the Blind River (at Mile 4.8) in Ascension and Livingston Parishes. This project would provide hydrologic restoration in the western Maurepas Swamp.

2. BACKGROUND

Since the construction of the ARDC in 1963, a large portion of the western Maurepas Swamp has been cut off from fresh water, sediments, and nutrients historically provided by the Amite River and other waterbodies in the area because of the construction of spoil banks on either side of the canal. This disruption of natural processes has prevented fresh water from circulating in the swamp during high water flow periods (which prevents nutrients and sediments from reaching the swamps), and has prevented the swamp from draining during low water flow periods (which prevents seedling germination and establishment). Consequently, the swamp is impounded, the trees are highly stressed, and little to no regeneration of bald cypress and water tupelo trees (the dominant vegetation in the western Maurepas Swamp) is occurring. These factors, combined with periodic salinity increases as a result of saline storm surge waters from hurricanes, have severely impaired the western Maurepas Swamp, which is at great risk of conversion to fresh marsh, which would ultimately convert to open water.

The Amite River Diversion Canal Modification Project has been identified as a near-term critical feature recommended for study in the November 2004 *Louisiana Coastal Area (LCA) Ecosystem Restoration Study* (2004 LCA Plan). The Project was authorized under Section 7006(e) of the Water Resources Development Act (WRDA, Public Law 110-114). The Federal sponsor for the Project is the U.S. Army Corps of Engineers (USACE) and the non-Federal sponsor is the State of Louisiana through the Louisiana Coastal Protection and Restoration Authority (CPRA).

3. REPORT SCOPE

The scope of this risk analysis report is to calculate and present the cost contingencies at the 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. This report presents the contingency results for both cost risks for all project features.

Title VII of the Water Resources Development Act (WRDA) 2007 authorizes the Louisiana Coastal Area (LCA) program. The authority includes requirements for comprehensive coastal restoration planning, program governance, project modification investigations, a Science and

Technology (S&T) program, restoration project construction, a program for beneficial use of dredged material, feasibility studies for restoration plan components, and other program elements. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005. The report includes the project technical scope and estimates, as developed and presented by (list the name of the product developer by district or design firm). Consequently, these documents serve as the basis for the risk analysis. In general terms, the construction scope consists of the following:

3.1 USACE Risk Analysis Process

This cost risk analysis (CRA) process follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering DX). The risk analysis process reflected within the risk analysis report uses probabilistic cost risk analysis methods within the framework of the Crystal Ball software. The risk analysis results are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost risk analyses should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

- ER 1110-2-1150, Engineering and Design for Civil Works Projects.
- ER 1110-2-1302, Civil Works Cost Engineering.
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works.
- Cost Risk Analysis Process guidance prepared by the USACE Cost Engineering DX.
- Memorandum from Major General Don T. Riley (U.S. Army Director of Civil Works), dated July 3, 2007.
- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.

4. METHODOLOGY/PROCESS

The CRA was conducted by a team of contractors, assembled by GEC, Inc., with varying backgrounds, which include construction, engineering, biological impacts, project management, and cost estimation. The analysis was conducted over approximately a month and a half and completed on January 11th, 2010. This CRA outcome has recieved approval by Agency Technical Review (ATR) and all comments received from this review have been backchecked and closed out.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. A parallel process may also be used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to a cost estimate to allow for items, conditions, or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Engineering DX guidance for cost risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk adverse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. Because Crystal Ball is an Excel add-in, the schedules for each option are recreated in an Excel format from their native format. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results would be provided in section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the CRA team are considered a qualitative process that results in establishing a risk register that serves as the document for the further study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire CRA team is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the CRA team and empirical data from similar projects is desirable and is considered.

A formal CRA meeting was held at GEC for the purposes of identifying and assessing risk factors. The meeting on December 7th, 2009 included capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/program managers.
- Contracting/acquisition.
- Real Estate.
- Relocations.
- Environmental.
- Civil, structural, geotechnical, and hydraulic design.
- Cost and schedule engineers.
- Construction.

The formal meeting focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location.

Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions), because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The resulting product from the CRA team's discussions is captured within a risk register as presented in section 6 for both cost risk concerns. Note that the risk register records the CRA team's risk concerns, discussions related to those concerns, and potential impacts to the current cost estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the base cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

For schedule contingency analysis, the option schedule contingency is calculated as the difference between the P80 option duration forecast and the base schedule duration. These contingencies are then used to calculate the time value of money impact of project delays that are included in the presentation of total cost contingency in section 6. The resulting time value of money, or added risk escalation, is then added into the contingency amount to reflect the USACE standard for presenting the "total project cost" for the fully funded project amount.

Schedule contingency is analyzed only on the basis of each option and not allocated to specific tasks. Based on Cost Engineering DX guidance, only critical path and near critical path tasks are considered to be uncertain for the purposes of contingency analysis.

5. KEY ASSUMPTIONS

This section presents the key assumptions utilized for the CRA. Key assumptions are those that are most likely to significantly effect the determinations and/or estimates of risk presented in the CRA. The key assumptions are important to help ensure that project leadership and other decision makers understand the steps, logic, limitations, and decisions made in the risk analysis, as well as any resultant limitations on the use of outcomes and results.

The following key assumptions were made by the CRA team.

- The total construction cost was determined by running a MCACES analysis for the recommended plan (Alternative 33).
- An Agency Technical Review will be run on the CRA results.
- There is only one construction account involved with this project.
- The 80-percent confidence contingency would be used as the resultant contingency in the CRA analysis.
- Only moderate, high, and severe risk levels were applied for the purposes of the CRA analysis.

6. RISK ANALYSIS RESULTS

This section presents the results of the CRA, including the information utilized to compile the applicable cost contingency for this project. Additional details behind the CRA are found in Appendix A of this report.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk studies and Crystal Ball risk models. A summary risk register that includes typical risk events studied (high and moderate levels) is presented in Table 1. This risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, are further refined, especially on large projects. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

In simple terms, a correlation is a dependency that exists between two risks and may be direct or indirect. An indirect correlation is one in which large values of one risk are associated with small values of the other. Indirect correlations have correlation coefficients between 0 and -1. A direct correlation is one in which large values of one risk are associated with large values of the other. Direct correlations have correlation coefficients between 0 and 1.

Correlations are important to understand the logic used in the risk analyses. The mathematical correlations used in the *Monte Carlo* simulations are as follows:

- Present any risk event correlations, addressing their relationships.
- Present the final risk register or the condensed version. At a minimum include those risk events studied (an appendix can include the complete risk register):
- Risk event identifying number.
- Risk or opportunity event.
- CRA team concerns.
- CRA team discussions.
- Project cost likelihood, impact, and risk level.

Descriptions of Risk Items Associated with the LCA ARDC Modification Project

CA-1 Acquisition Strategy Decreasing Competition
Pipeline contractors who would have the equipment and training to do projects such as this would not be interested in such a small project if other larger and more lucrative pipeline projects are available. But, if there are no other projects available, it might be done for less money.
Low: Guidance was provided by the Cost DX team to use a -10% cost impact for this risk item.

Likely: It is assumed that the likely scenario would result in an adequate amount of interested bidders for this project.

High: Guidance was provided by the Cost DX team to use a +20% cost impact for this risk item.

T-1 Unusual Specifications
If specifications are too rigid and the contractor expends significant effort to meet rigid specifications while trying to maintain a rigid time frame, this could increase project cost.

Low: The lowest potential cost would be assuming that the contractor constructed the channels properly, without adding extra manpower or effort to paying undue attention to slopes.

Likely: The most likely case is that the contractor will understand and do this appropriately.

High: There is a chance that the contractor would add extra manpower or equipment to ensure a slope that was unnecessary. This would most likely be accomplished by utilizing an extra excavator during the earthmoving phase of construction to properly compact the slopes. It is estimated they this would require an additional expenditure for 1,300 hours of equipment rental ($512,404).

C-7 Special Equipment and Equipment Availability
Special equipment is required to work in swamp areas. If pipeline contractors are busy with other work, equipment may be harder to come by. On the other hand, if no other projects are creating a demand for this equipment, it may be cheaper than normal.

Low: It was assumed that the market price for the amphibious excavators would be decreased by 10% ($51,240)
Likely: It is assumed that there would be adequate availability for amphibious equipment to work on the earthmoving phase of the project.
High: It was assumed that the market price for the amphibious excavators would be increased by 40% ($204,962).

C-8 In-Water Work

Working in water lends itself to risks that are not inherent on land, and must be considered as a part of determining risks for this project. These risks are quantified in reductions in productivity and in additional bond/insurance requirements for the contractor.

Low: It was assumed that the low and most likely cost impacts would be the same.
Likely: It was assumed that the contractor would have adequate experience with in-water work and would not require an additional markup to accommodate the risk associated with this type of work.
High: It was assumed that an additional insurance markup would be added for the prime contractor of 20% ($748,063).

C-10 Vegetative Planting Mortality

Tree mortality would result in additional costs for the project to ensure that an adequate number of trees are added in the highly-degraded areas of the swamp and dredged material placement areas.

Low: It is assumed that a reduction in vegetative plantinging of 10% would be required for the designated areas at $3,301 per acre (10% of 443 acres = 44 less acres of planting).
Likely: It is assumed that the 50% secondary plantings will be adequate to achieve the required tree densities.
High: It is assumed that an additional planting of 25% would be required for the designated areas at $3,301 per acre (25% of 443 acres = 111 additional acres of planting).

C-11 Potential Contract Modifications

If contract modifications, such as increased quantities and design modifications, are made during project construction, it could cause unexpected costs. The contractor could need additional manpower or equipment to accommodate these changes within the predetermined schedule.
Low: Per previous risk analysis, the accepted most likely amount of Mods / Claims typically adds 2% to 5.5% to overall project cost, used the low of 2%.
Likely: It is anticipated that no contract modifications will be required and therefore, there would be no additional costs resulting from this risk item.
High: Per previous risk analysis, the accepted most likely amount of Mods / Claims typically adds 2% to 5.5% to overall project cost, used the high of 5%.

ES-1 Estimate Captures Scope for All Project Features

Given the unique nature of this project, as well as the challenging terrain, it is likely that some elements will be underestimated or not taken into consideration. It is also possible for the same reasons that costs have been incorrectly overstated. This could lead to increased overall construction costs resulting from the unanticipated or miscalculated cost items.

Low: It is anticipated that the total project cost would be the same as in the most likely **scenario.**
Likely: It is anticipated that the current project cost estimates include all pertinent cost items for **this project.**
High: It is anticipated that the total project cost would increase by approximately 10% ($187,016) due to unforeseen or miscalculated project features.

E-1 Stakeholders Request Late Changes

Given that private property is involved in this project, it is possible for complications to arise, which could lead to additional design or construction considerations.

Low: It is anticipated that there would only be significant cost impacts due to this risk item, therefore no low impact would occur.

Likely: Due to the continued coordination with local landowners within the study area, it is likely that no changes will result from stakeholder requests.

High: It is anticipated that changes that result from stakeholder requests would result in a realignment of the conveyance channels or the addition of sheet piles along the cuts in the dredged material berms. This would result in a cost risk of approximately 10% of the total project costs ($374032).

E-5 Unexpected Escalation on Key Materials (Off-Road Diesel)

An unexpected rise or fall in the cost of off-road diesel could have a significant effect on the cost of this project.

Low: The five year low for this area is $1.58 a gallon for off-road diesel and $1.98 for on-road diesel (30% decrease). This reduction in fuel costs was determined unlikely, so a conservative reduction of 15% was used ($1.92/2.31).

Likely: Current average on-road/off-road diesel fuel prices are $2.72/2.26 a gallon. It has been determined that this will likely remain unchanged.

High: The five year high for this area is $4.80 a gallon (76% increase), which was a result of hurricane Katrina. It is not believed that an increase of this significance will not occur, so a conservative estimate of a 35% increase was used for off-road and on-road diesel ($3.05/3.67).

E-7 Acts of God (seismic events: volcanic activity, earthquakes, tsunamis; or severe weather: freezing, flooding or hurricane)

Hurricanes regularly strike Louisiana, and would create a significant delay and increase in price if one struck during the course of the project. Flooding on the Amite River is a possibility as well.

Low: It is anticipated that the low cost impacts resulting from this risk item would be insignificant to the overall cost of the project.

Likely: It is anticipated that there will not be a cost impact to the project costs as a result of this risk item.

High: It is anticipated that the most significant impact to the project costs, resulting from a tropical storm or hurricane, would be approximately 5% of the overall project costs ($187,015).

Table 1. Summary Risk Register

Risk No.	Risk/Opportunity Event (logic by feature, contract, responsibility)	Project Cost Likelihood*	Impact*	Risk Level*	Minimum Likely Cost ($)	Most Likely Cost ($)	Maximum Likely Cost ($)	Variance Distribution (Cost)
	Contract Acquisition Risks							
CA-1	Acquisition strategy decreasing competition	Unlikely	Critical	Moderate	$ 2,331,882.00	$ 2,590,980.00	$ 3,109,176.00	Triangular
	Technical Risks							
T-1	Unusual Specifications	Likely	Marginal	Moderate	$ 2,590,980.00	$ 2,590,980.00	$ 3,103,384.00	Triangular
	Construction Risks							
C-7	Special equipment and equipment availability	Unlikely	Significant	Moderate	$ 2,331,882.00	$ 2,590,980.00	$ 3,627,372.00	Triangular
C-8	In-water work	Likely	Marginal	Moderate	$ 2,590,980.00	$ 2,590,980.00	$ 3,109,176.00	Triangular
C-10	Vegetative planting mortality	Likely	Marginal	Moderate	$ 2,569,406.00	$ 2,590,980.00	$ 2,645,404.00	Triangular
C-11	Potential contract modifications	Unlikely	Significant	Moderate	$ 2,642,799.60	$ 2,590,980.00	$ 2,720,529.00	Triangular
	Estimate Risks							
ES-1	Estimate captures scope for all project features.	Likely	Significant	High	$ 2,590,980.00	$ 2,590,980.00	$ 2,850,078.00	Triangular
	External Risks							
E-1	Stakeholders request late changes	Unlikely	Significant	Moderate	$ 2,590,980.00	$ 2,590,980.00	$ 2,850,078.00	Triangular
E-5	Unexpected escalation on key materials	Unlikely	Significant	Moderate	$ 2,202,333.00	$ 2,590,980.00	$ 3,497,823.00	Triangular
E-7	Acts of God (seismic events: volcanic activity, earthquakes, tsunamis; or severe weather: freezing, flooding or hurricane)	Likely	Marginal	Moderate	$ 2,590,980.00	$ 2,590,980.00	$ 2,720,529.00	Triangular

***Likelihood, Impact, and Risk Level to be verified through market research and analysis**

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through

2. Concerns and Discussions elaborate on Risk/Opportunity Events and includes any

3. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for

4. Likelihood is measured as likelihood of impacting cost or schedule.

5. Impact is a measure of the event's effect on project objectives with relation to scope, cost,

6. Risk Level is the resultant of Likelihood and Impact Low, Moderate, or High. Refer to the matrix located at top of page.

7. Variance Distribution refers to the behavior of the individual risk item with respect to its

8. Correlation recognizes those risk events that may be related to one another. Care should be

9. Affected Project Component identifies the specific item of the project to which the risk directly

10. Project Implications identifies whether or not the risk item affects project cost, project

11. Results of the risk identification process are studied and further developed by the Cost

6.2 Cost Risk Contingency Results

The results of the CRA were generated by Crystal Ball are found in Table 2 and Figures 1 though 4.

Table 2. Crystal Ball Data and Results							
Minimum Likely Cost ($)	**Most Likely Cost ($)**	**Maximum Likely Cost ($)**	**Low**	**Likely**	**High**	**Percentiles**	**Forecast**
$2,331,882.00	$2,590,980.00	$3,109,176.00	$2,331,882.00	$2,590,980.00	$3,109,176.00	0%	2,302,767
$2,590,980.00	$2,590,980.00	$3,103,384.00	0	0	512,404	10%	3,126,173
$2,331,882.00	$2,590,980.00	$3,627,372.00	-259,098	0	1,036,392	20%	3,301,339
$2,590,980.00	$2,590,980.00	$3,109,176.00	0	0	518,196	30%	3,455,211
$2,569,406.00	$2,590,980.00	$2,645,404.00	-21,574	0	54,424	40%	3,572,314
$2,590,980.00	$2,590,980.00	$2,720,529.00	0	0	129,549	50%	3,695,451
$2,590,980.00	$2,590,980.00	$2,850,078.00	0	0	259,098	60%	3,817,506
$2,590,980.00	$2,590,980.00	$2,850,078.00	0	0	259,098	70%	3,955,670
$2,202,333.00	$2,590,980.00	$3,497,823.00	-388,647	0	906,843	**80%**	**4,110,994**
$2,590,980.00	$2,590,980.00	$2,720,529.00	0	0	129,549	90%	4,381,892
				2,590,980		100%	5,283,051
			Contingency =	**59%**			

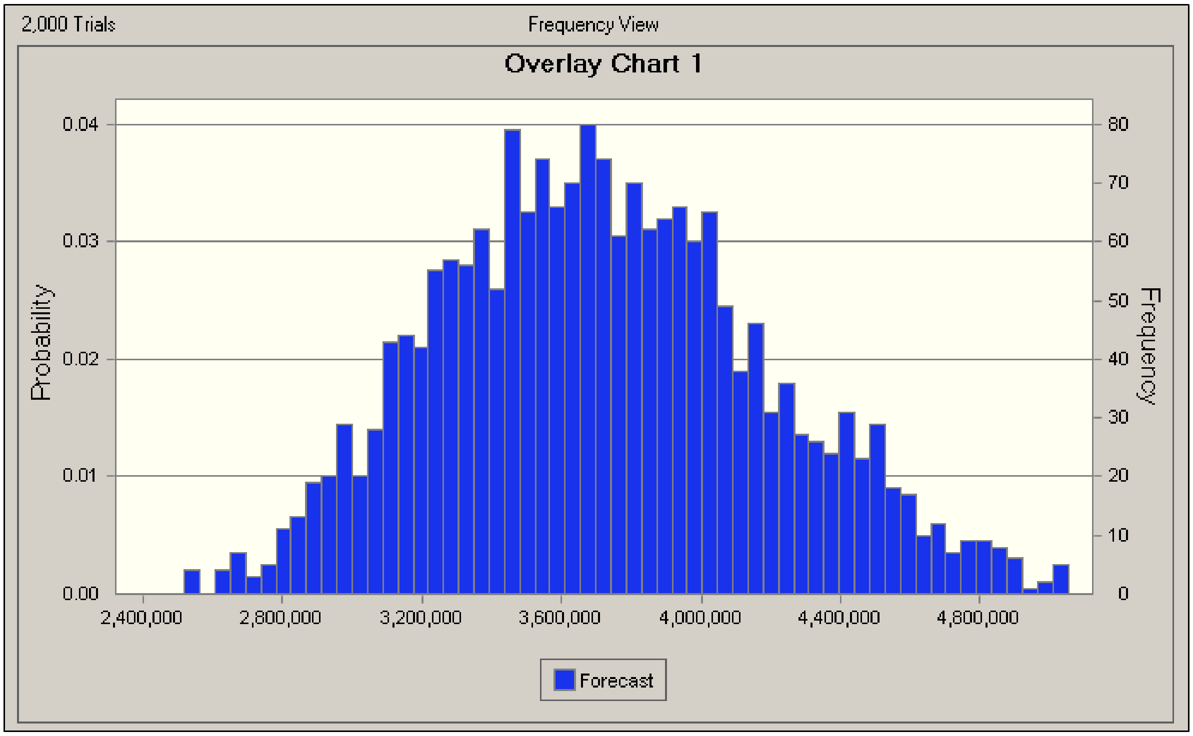


Figure 1. Frequency Results

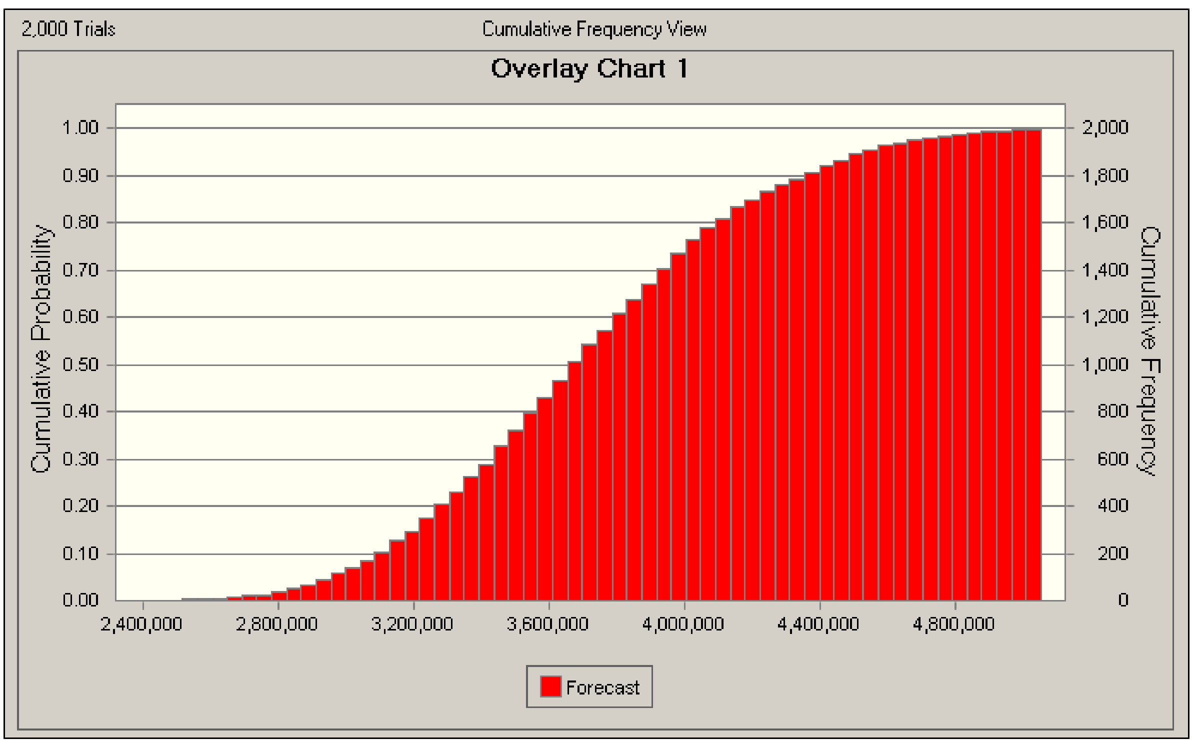


Figure 2. Cumulative Frequency Results

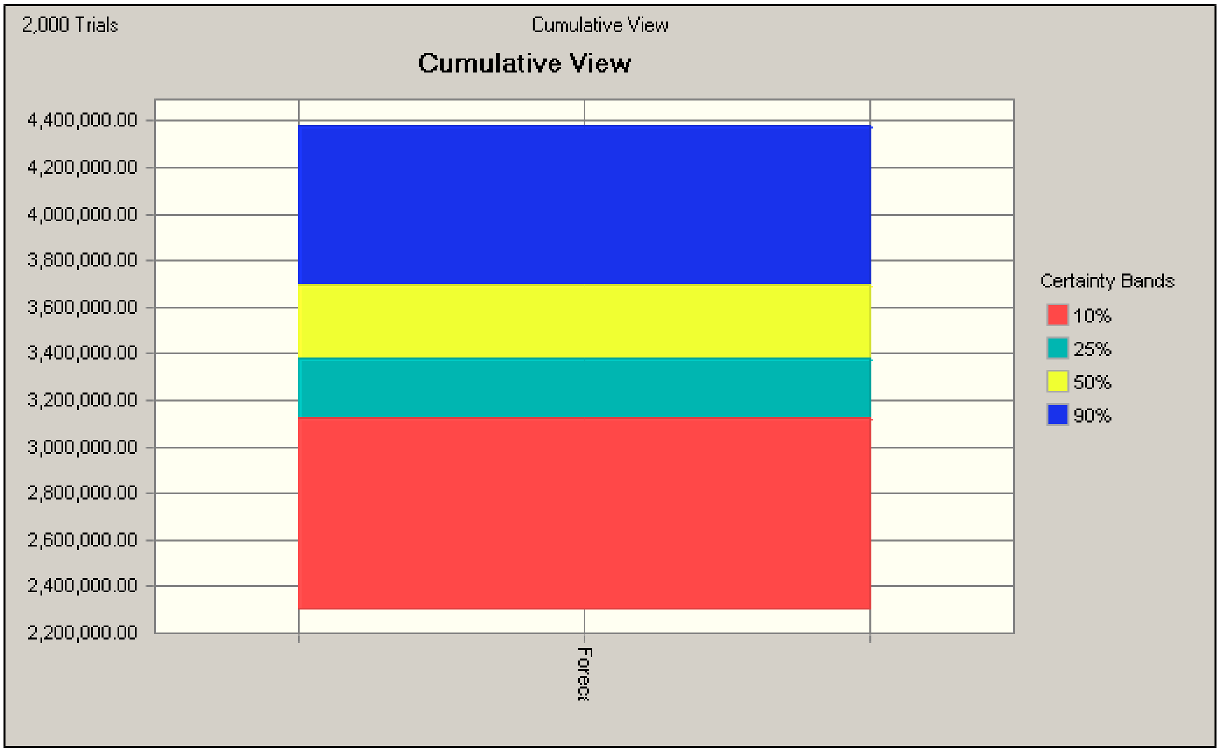


Figure 3. Cumulative Sensativity Results

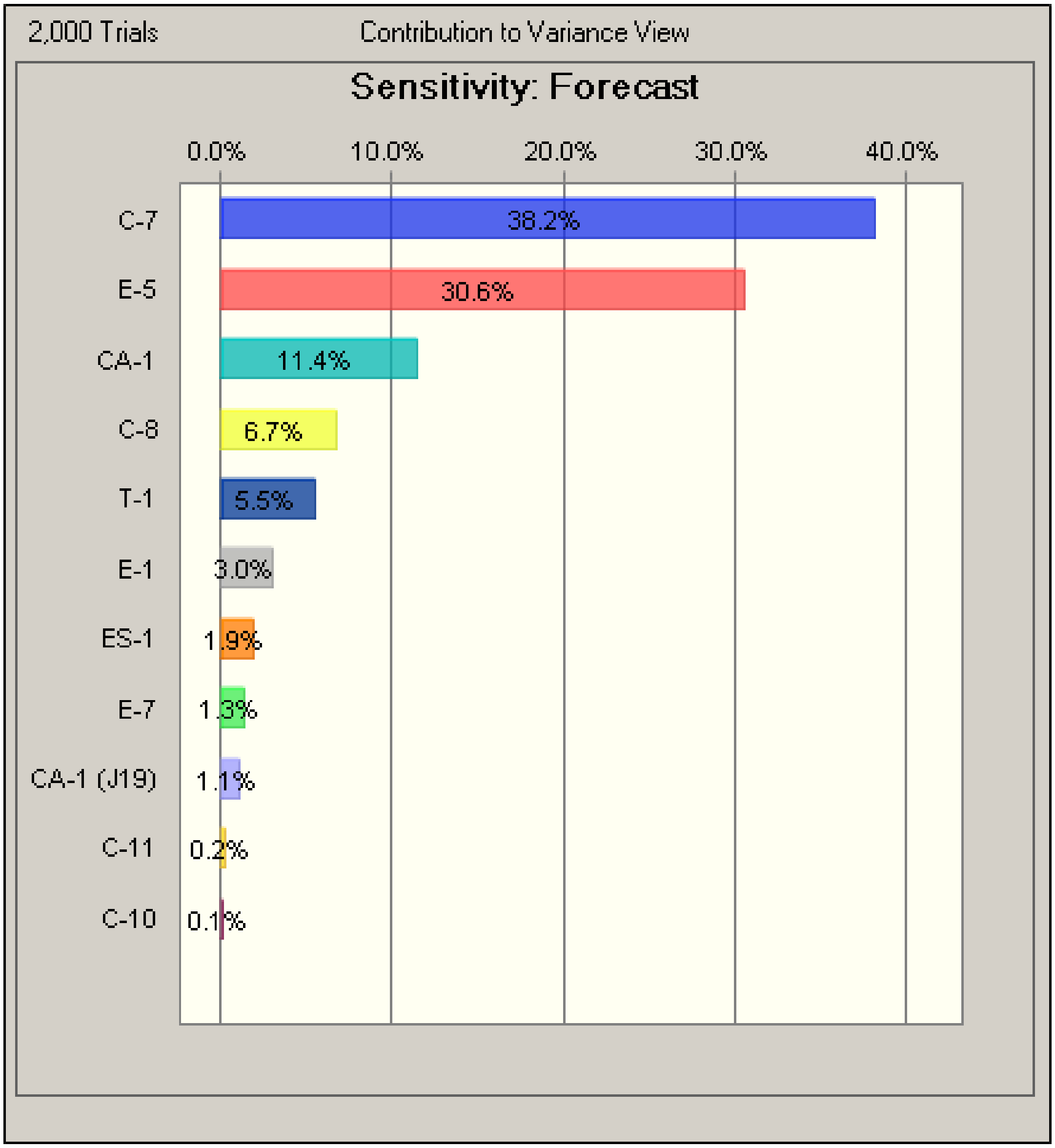


Figure 4. Sensativity Bar Chart

7. MAJOR FINDINGS/OBSERVATIONS

The CRA results presented a cost contingency of 59 percent at a confidence level of 80 percent. This contingency does not include escalation cost, which are to be applied within the Micro-Computer Aided Cost Estimating Software (MCACES) estimate for the recommended plan (Alternative 33) upon determination of the applicable contingency cost. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

8. MITIGATION RECOMMENDATIONS

Based on the findings of this analysis, a 59 percent contingency will be applied to the MCACES estimate for the recommended plan (Alternative 33). An Agency Technical Review will be performed in February, 2010 at which time comments will be addressed and the results of this analysis will be updated. The analysis performed by the CRA team, highlighted the potential risks inherent to the Amite River Diversion Canal Modification project. The results of this analysis not only help to quantify the financial risks involved with the recommended plan (Alternative 33), but they also allow the study and design team plan for these risks in an effort to mitigate the associated cost and schedule ramifications. Therefore, the following recommendations are suggested:

The scope of work for all portions of this project must be clearly defined, in an effort to minimize the chances of additional costs during construction and data analysis.

The scope should also be clearly defined during all aspects of cost analysis during the study portion of this project.

Additional emphasis needs to be placed on the plans and specifications portion of the project to ensure that the work is completed in a manor stipulated by the feasibility report and the design process.

All efforts must be made to ensure that an optimal amount of tree plantings associated with the construction of the project will succeed and therefore will not need to be replanted at a later time.

All issues involved with the mobilization and demobilization of this project must be well thought out during the plans and specifications portion of this project, due to the remote nature of the study area. This issue should also be heavily studied during the cost estimating phase of the feasibility study.

Additionally, adequate staging areas must be provided during construction to allow for the timely transport of equipment and personnel into and out of the construction site.

An emphasis must be placed on construction sequencing during the plans and specifications portion of the project to ensure the most efficient use of equipment and personnel possible during construction.

All efforts must be made to attract an adequate amount of bidders during the bidding process to ensure a competitive estimate is selected.

The appropriate estimations of weather disruptions must be made during the construction scheduling process to limit any additional cost that may result from prolonged work stoppages.

Section 11

SCHEDULE FOR DESIGN AND CONSTRUCTION

Design and Construction Schedule

A schedule will be developed for the required design, planning and construction needed for the LCA-ARDC Modification project once a signed Chief's Report is obtained in December, 2010. It was assumed that these processes would begin in January 2011. The schedule includes the following items:

- **Plans & Specifications.** This would involve the design phase of the project in which a formalized plans and specifications package is produced for any contractor willing to bid on the construction phase of the project. It is estimated that this process would take approximately a year.

- **Contract Acquisition.** This process would include the development of a contract for construction as well as the bidding and selection process. It is estimated that this process would take approximately three months.

- **Construction (Earthwork).** This represents the portion of construction required for construction of the bank openings and the bifurcated conveyance channels. This would also include any necessary mobilization and demobilization. Vegetative plantings are not included in this portion of the schedule. This process is estimated to take approximately six months.

- **Site Assessment/Planting Survival Assessment.** Upon completion of the earthmoving phase of construction a period of no activity would to take place to allow for evaluations of existing vegetative conditions, before vegetative plantings may commence. This allows for time to develop the scope of plantings, acquire the needed plants and seedlings for planting, and to allow the placed dredged material to settle. A similar assessment phase will be entered approximately 8 months after the first planting has been completed.

- **Vegetative Planting Contract Acquisition.** This process would include the development of a contract for vegetative plantings as well as the bidding and selection process. It is estimated that this process would take approximately three months. This process would most-likely be initiated twice, once for the initial plantings and a few years later for the secondary plantings.

- **Primary and Secondary Planting Contracts.** This process is composed of the initial and the secondary plantings of seedlings and potted plants in the designated areas of the project footprint. This includes mobilization and demobilization, planting, and the installation of nutria guards on each plant. It is estimated that this process would take approximately 12 months.

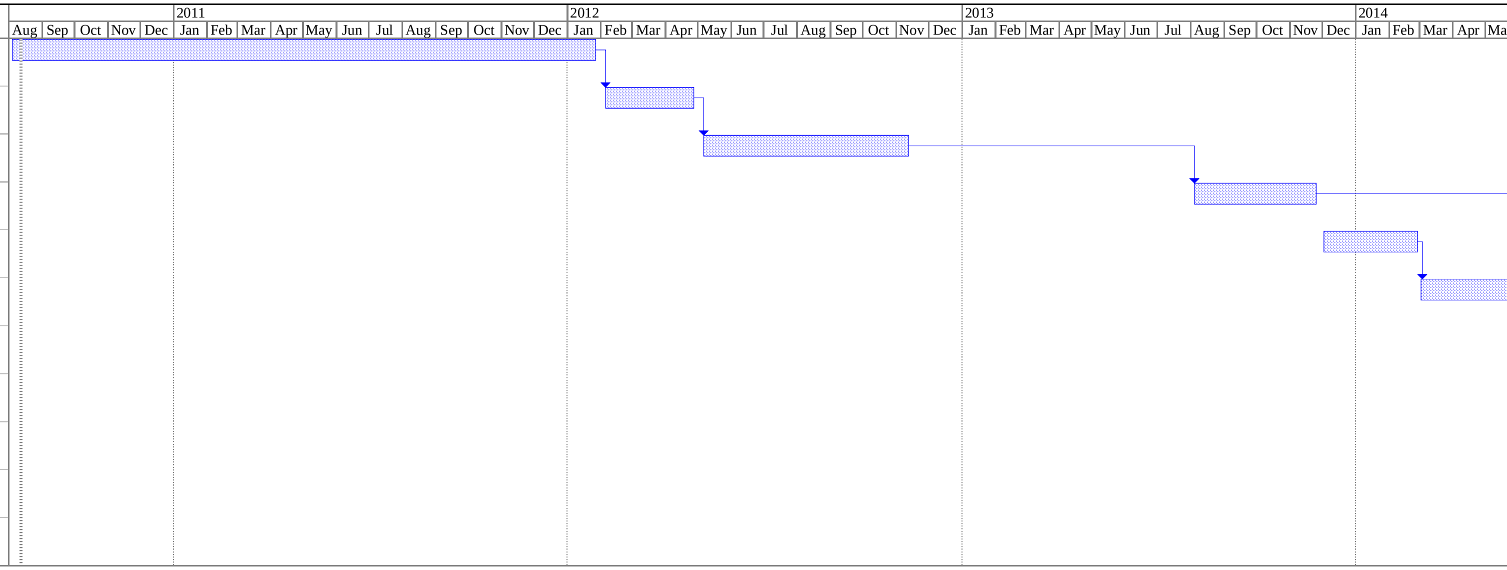
Table 1. Earthmoving Schedule

ARDC Alternative 39 Earthmoving Construction Schedule												
		Dredged Material Berm			Swamp		Equipment Utilized (Hours)					
Week*	Mob	Clear Trees	Land-Based Earthwork	Marsh Backhoe Work	Clear Trees	Marsh Backhoe Work	Log Skidder	D6 Dozer	Marsh Backhoe	Barge	Tug Boat 900hp	Crew Boat**
NTP												
2	MOB											40
3							40	40	80	40	40	40
4		Cut 1					40	40	80	40		40
5				Cut 1			40	40	80	40		40
6			Cut 1		Cut 1		40	40	80	40	20	40
7		Cut 2					40	40	80	40		40
8							40	40	80	40		40
9			Cut 2		Cut 2		40	40	80	40	20	40
10		Cut 3				Cut 1	40	40	80	40		40
11				Cut 2			40	40	80	40		40
12			Cut 3		Cut 3		40	40	80	40	20	40
13		Cut 4					40	40	80	40		40
14							40	40	80	40		40
15			Cut 4		Cut 4		40	40	80	40	20	40
16		Cut 5					40	40	80	40		40
17							40	40	80	40		40
18			Cut 5		Cut 5	Cut 2	40	40	80	40	20	40
19				Cut 3			40	40	80	40		40
20									80	40		40
21									80	40		40
22									80	40		40
23									80	40		40
24									80	40		40
25									80	40		40
26						Cut 3			80	40	20	40
27				Cut 4					80	40		40
28									80	40		40
29									80	40		40
30									80	40		40
31									80	40		40
32									80	40		40
33									80	40		40
34						Cut 4			80	40	20	40
35				Cut 5					80	40		40
36									80	40		40
37									80	40		40
38									80	40		40
39									80	40		40
40									80	40		40
41									80	40		40
42						Cut 5			80	40		40
43	Demob								80	40	40	40
						Totals	**680**	**680**	**3,280**	**1,640**	**220**	**1680**

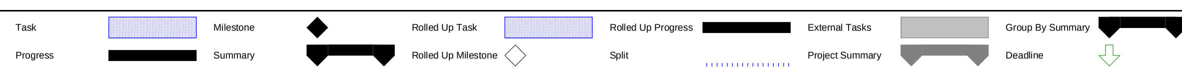
* Cells are completion by end of specific week

** Contingency Hours Added for Repairs Ect.

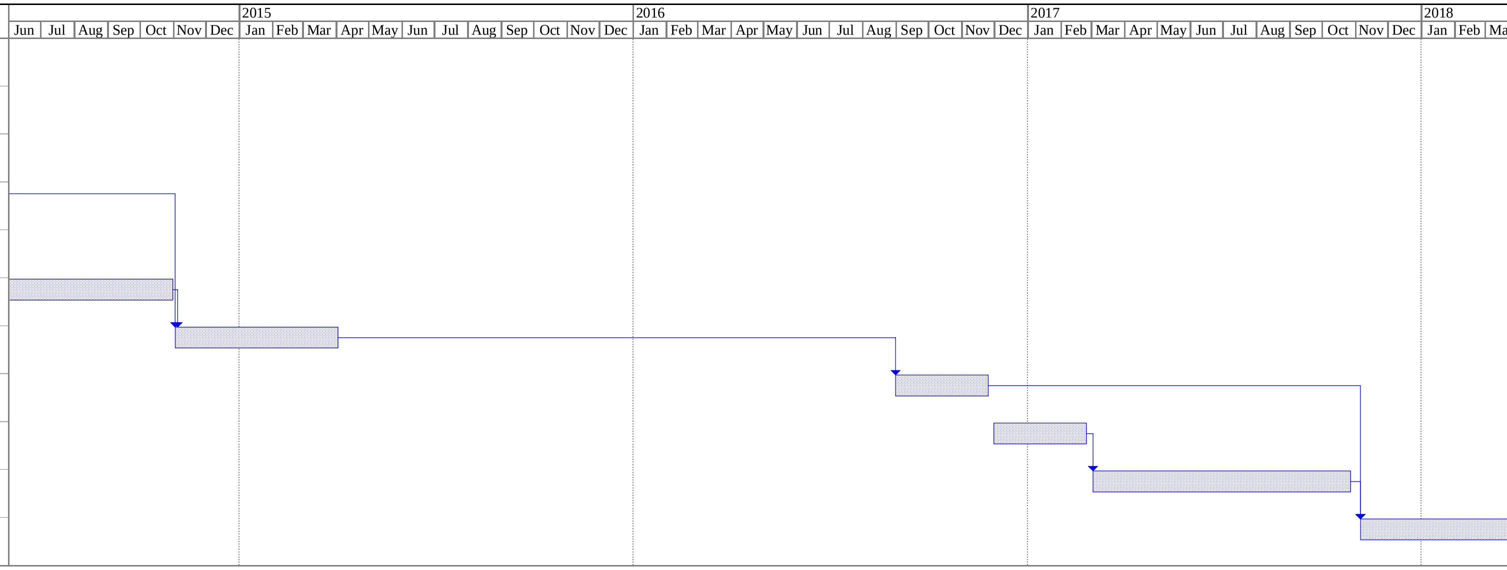
ID	Task Name
1	Plans & Specifications
2	Contract Acquisition
3	Construction (Earthwork)
4	Site Assessment
5	1st Vegetation Planting Contract Acquisition
6	1st Acquisition of Trees
7	1st Vegetation Planting Contract
8	Planting Survival Assessment
9	2nd Planting Contract Acquisition
10	2nd Acquisition of Trees
11	2nd Planting Contract



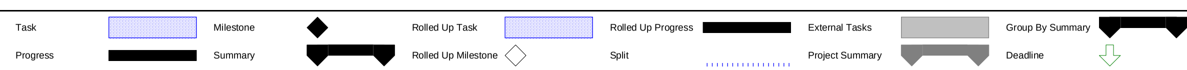
Project: ALternative (TSP)
Date: Thu 8/12/10



ID	Task Name
1	Plans & Specifications
2	Contract Acquisition
3	Construction (Earthwork)
4	Site Assessment
5	1st Vegetation Planting Contract Acquisition
6	1st Acquisition of Trees
7	1st Vegetation Planting Contract
8	Planting Survival Assessment
9	2nd Planting Contract Acquisition
10	2nd Acquisition of Trees
11	2nd Planting Contract



Project: ALternative (TSP)
Date: Thu 8/12/10



Section 12

RELOCATIONS

Relocations

No relocations of infrastructure or public services, such as water service and/or electrical service are needed for construction of the Tentatively Selected Plan (Alternative 33).