LAKE PONTCHARTRAIN, LA.
AND VICINITY

LAKE PONTCHARTRAIN HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 19
GENERAL DESIGN

ORLEANS AVENUE OUTFALL CANAL

IN THREE VOLUMES
VOLUME II

US Army Corps of Engineers
New Orleans District

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA
AUGUST 1988

SERIAL NO. 76

ORLEANS AVENUE CANAL
FLOOD PROTECTION IMPROVEMENT PROJECT

OLB PROJECT NO. 2048-0278 DEI PROJECT NO. 1006

ENGINEERING CORRESPONDENCE LOG

	Dates	To	From	Topic
	6/28/85	OLB	USACE	Design Memo Services - concurrence and add to geotechnical scope.
*	9/26/85	DEI	Eustis	Draft Geotechnical Report - Transmit
	10/2/85	USACE	DEI	Draft Geotechnical Report - Transmit
*	11/5/85	USACE	DEI	Additional Geotechnical report copy - Transmit
*	1/16/86	USACE	DEI	Design Memorandum - Transmit
*	2/4/86	USACE	DEI	Pump Station, conceptual design calculations
	2/10/86	DEI	USACE	Geotechnical Report - 1st Review Comments
	4/22/86	USACE	Eustis	Geotechnical analysis of Sheet Pile Wall - transmit.
	5/13/86	DEI	USACE	T-wall-size criteria (Phone)
	6/3/86	DEI	USACE	Design Memorandum - 1st review comments.
	6/9/86	DEI	USACE	Sheet Pile Wall - review recommendations.
	6/12/86	USACE	DEI	Floodwall thickness 12" minimum - relief request
*	6/12/86	USACE	DEI	USACE design soil shear strength, and landside water surface criteria - request for
*	6/12/86	USACE	DEI	T-wall at 30" Waterline, drawing and calculations - transmit

* This correspondence has not been reproduced for inclusion in this report. Its inclusion is not considered to be necessary for a technical review and copies of the deleted correspondence can be obtained from the New Orleans District's files.

	Dates	To	From	Topic
	6/25/86	DEI	USACE	Geotechnical, design soil shear strength and design phreatic water surface criteria - transmit
*	6/26/86	DEI	USACE	Floodwall thickness, 12 inch minimum criteria - reply
	6/30/86	Eustis	DEI	Geotechnical Report, Feb. 10 and June 3, 1986 comments - reply to (partial)
*	7/9/86	USACE	DEI	Preliminary Bridge Modification drawings - transmit
*	7/18/86	DEI	USACE	T-wall at 30" Waterline - pile capacity, sheet pile tip and unbalanced earth force information
*	8/6/86	USACE	DEI	T-wall at 30" Waterline - structural review comments
*	8/9/86	USACE	Eustis	Confirmation of June 25, 1986 data
	8/12/86	USACE	DEI	Design Memorandum - reply to June 3, 1986 comments and Geotechnical Report - partial reply to Feb. 10, 1986 comments (via Eustis June 30, 1986 letter)
	8/13/86	USACE	DEI	T-wall design, load factor value - clarification request
*	8/25/86	USACE	DEI	R. E. Lee Bridge Modifications, revised concept preliminary drawings and calculations-transmit
	8/28/86	DEI	USACE	T-wall design, load factor value-confirmation
*	9/22/86	DEI	USACE	R. E. Lee Bridge Modifications - review comments to Aug. 25 submittal.
*	10/2/86	DEI	USACE	Pile Load Test requirement (phone)
*	11/5/86	USACE	DEI	Geotechnical Report - Eustis reply of Oct. 30, 1986 to USACE remaining comments of Feb. 10, 1986 and June 25, 1986 - transmit.

	Dates	To	From	Topic
*	11/10/86	USACE	DEI	T-wall at Waterline - length of wall question
*	11/17/86	DEI	USACE	Pump Station - seepage protection (meeting notes)
*	12/1/86	DEI	Modjeski and Masters	Pump station - backflow study scope and (phone)
*	12/3/86	DEI	USACE	T-wall at Waterline - length of wall requirement
*	12/15/86	DEI	Eustis	Pump Station - pile lateral load analyses
*	12/31/86	DEI	Eustis	Pump Station, geotechnical analyses - engineering estimate for
*	1/7/87	USACE	DEI	Phase I Preliminary Plans, specification outline and cost estimate - first submittal
	1/12/87	DEI	USACE	Geotechnical Report - Comments to Aug. 12 and Nov. 5 submittals
*	1/14/87	USACE	DEI	Survey books No. 1-5 - transmit copies
*	1/22/87	USACE	DEI	DM Plan and Profile drawings (10) and Preliminary Phase Plan and Profile drawings - transmit
*	1/30/87	USACE	DEI	Cross Section sheets (8) with additional elevations - transmit
*	2/13/87	DEI	USACE	Design Flowline and Bridge Head Losses - tabulation
*	2/26/87	DEI	Eustis	Geotechnical Report - pile load capacity at bridges
	3/16/87	USACE	Eustis	Geotechnical, Piezometric readings - tabulation
*	5/13/87	USACE	DEI	Orleans Avenue, existing retaining wall - drawings transmit

	Dates	To	From	Topic
*	7/7/87	USACE	DEI	R. E. Lee Bridge Modifications, corrected drawings and calculations - transmit
	8/7/87	DEI	USACE	Phase I Preliminary Plans and R. E. Lee Bridge Modifications - review comments
*	9/11/87	Eustis	DEI	Existing Levee Section, to be retained for analyses
*	9/11/87	USACE	DEI	Bridge Modifications (3), revised cost estimate - transmit
	10/6/87	USACE	DEI	Geotechnical Report - Eustis reply of Sept. 28, 1987 to comments of Jan. 12, 1987 and Aug. 7, 1987
	12/3/87	DEI	USACE	Geotechnical Report - additional comments to Aug. 12, 1986 and Nov. 5, 1986 submittals
*	12/11/87	DEI	USACE	T-wall, size criteria (phone)
*	12/24/87	DEI	USACE	Design Flowlines and Bridge Head Losses with low water weirs - tabulations
	2/4/88	USACE	DEI	Phase I Preliminary Plans and calculations revised per Aug. 7, 1987 comments - transmit
*	3/25/88	DEI	USACE	New design criteria for T-wall design
	3/31/88	DEI	USACE	Preliminary Plans Phase I - review comments plus new design criteria for cantilever I-wall design
	4/7/88	USACE	DEI	T-wall and Anchored Bulkhead Alternatives, Stas. 50 to 90: Stability Analysis - submittal
	4/26/88	DEI	USACE	T-wall and Anchored Bulkhead - review comments

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

June 28, 1985

Engineering Division
Projects Engineering Section

JUL 8 1985

Mr. Earl J. Magner, Jr.
Chief Engineer
The Board of Levee Commissioners
Orleans Levee District
Suite 202 - Administration Building
New Orleans Lakefront Airport
New Orleans, Louisiana 70126

Dear Mr. Magner:

Reference is made to your June 20, 1985, letter concerning Lake Pontchartrain and Vicinity Hurricane Protection Project - Orleans Avenue Outfall Canal, London Avenue Outfall Canal, and 17th Street Outfall Canal with enclosed material for our review and comment.

The information provided at your office during the June 19, 1985 meeting has been reviewed, and we offer the following comments:

1. We have no comment relative to the scope of services for your design memorandum work at London Avenue and Orleans Avenue Canals.

2. The topographic survey scope of services is sufficient for our design purposes and meets the Corps requirements for design memorandum scope designs.

3. The Geotechnical scope of services for Orleans Avenue is sufficient for our needs, except for the need for piezometric data. We request that you provide the check borings that were discussed and requested during the June 19, 1985 meeting. The number and locations are shown on the enclosure plans. Attached to the plans, please find a description of the locations and type boring and piezometric data needed at each of the Orleans and London Avenue Canals.

FILE 1006
1005 - LONDON AVE

xc DEI 7/15/85

WB
JH
TS

It is noted that the scope of work for Geotechnical Services for London Avenue Canal has not been developed. However, if the scope of the London Avenue Canal program is similar to the Orleans Avenue Canal, then the level of detail is sufficient for our GDM design purposes. We request that you furnish the London Avenue Canal scope of services to this office once you have developed it.

We are reviewing the reports on the 17th Street Outfall Canal furnished in your June 20, 1985 letter. We will furnish our comments to you as soon as they are available.

Should you have any questions concerning the enclosed plans and boring requirements, please contact Mr. Vann Stutts, telephone number 838-2614.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosures

October 2, 1985

Mr. Van Stutts, Project Coordinator
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Avenue Canal
Flood Protection Project
OLB Project No. 2048-0304
DEI Project No. 1006

Dear Mr. Stutts:

Attached herewith please find one copy of the draft geotechnical engineering report and one set of existing cross-sections as requested for your review and comment.

Your prompt review of the enclosed material will be greatly appreciated. Should you have any questions or need additional information please call us.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve

JH/mnh

Enclosures

cc: Mr. Earl J. Magner, Jr.
Chief Engineer
Mr. Ed Bailey
Assistant Chief Engineer
Orleans Levee Board

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

February 10, 1986

Engineering Division
Projects Engineering Section

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your October 2, 1985, letter concerning the draft geotechnical engineering report on the Orleans Avenue Outfall Canal and your November 5, 1985 letter in which you provided an additional copy of the geotechnical report to aid in our review. As requested, we reviewed this report furnished in your letter and have the following comments to offer:

1. No analyses were presented for the required flood protection at the various bridge crossings or across the canal at the pumping station. These analyses should be provided for our review. If floodgates are used at the bridge crossings, then deep seated analyses and sheetpile cutoff wall analyses should be presented.

2. Shear strength and wet density profiles should be furnished for each different subsoil reach.

3. Shear strength and wet density values used for the pile capacities at Harrison Avenue, Filmore Avenue, and Robert E. Lee Blvd. bridges should be shown.

4. The S-Case parameters and the tailwater elevation used in the I-wall analyses should be shown.

5. If an I-wall option is to be investigated at "the zone of interference" at Crystal Street (approx. west side Sta. 115+00), analyses should be presented. I-wall analyses should be presented for the I-walls north of Robert E. Lee Blvd. shown in the DEI plan profile dated 11 October 1985.

6. The factor of safety for the gross levee section should be 1.30, not the minimum factor of safety of 1.20 as mentioned in paragraph 27, page 8, of the draft report. 1006

WB
JH
TS TMS 2/13/86

7. The factor of safety for levee stability analysis at the water pipeline crossing at Sta. 44+40 should be 1.50 and should apply to 60 feet of levee on either side of the pipeline.

8. Comparisons of sections before the raising of the Orleans Avenue Canal east side levee and sections furnished by DEI were made. The settlement of the 2-ft. landside enlargement ranged from .5 ft. to 1.7 ft. The maximum anticipated settlement of 2.5 ft. stated in the report on page 8, paragraph 27, for a 14.8 ft. landside enlargement appears to be too low.

9. The elevation after settlement for the levee sections with a 1-ft. overbuild and the future amount of overbuild needed to obtain a final net section should be presented for each reach.

10. The ground surface elevations used in the stability analyses do not represent the ground surface elevations shown in the sections furnished by DEI.

11. The piezometric headline used in the sand layers when the canal water elevation is at -5.0 NGVD should be shown.

12. In areas where a landside enlargement is to be used, the existing levee should be degraded so that a F.S. = 1.3 can be maintained.

13. The UU tests at the back of Appendix B do not correspond to the values listed in the summary of laboratory test results at the beginning of Appendix B.

14. The existing cross sections furnished by DEI do not extend as far out as the proposed levee sections.

15. There are some questions concerning the method of analysis for the cantilever I-wall between Sta. 50+00 and Sta. 90+00 on the west side of the canal. I recommend a meeting between your A&E (Eustis Engineering) and personnel from my Foundations and Materials Branch to discuss the method used.

16. Pile tests should be performed in accordance with COE procedures. Enclosed please find example compression test and tension test schedules.

EXAMPLE SCHEDULES FILED WITH PROJECT SPECIFICATIONS GUIDELINE TMS

17. The average shear strength trend as stated in paragraph 25, page 7, should not be used. The shear strength trend should be selected in accordance with EM 1110-2-1902 such that two-thirds of the test values exceed the values for each embankment zone and foundation layer.

Major change if we do this.

18. The shear strength test values along the west levee are significantly lower than the shear strength test values along the east levee between Sta. 0+00 to Sta. 90+00. These shear strength values would preclude the use of an average shear strength value for the east and west levee between Sta. 0+00 to 90+00.

19. It is our understanding that the canal capacity will be enlarged. If the canal bottom is dredged, the clay layer would not remain in place as mentioned in paragraph 28, page 9. The sand strata would then be directly exposed and the effects of underseepage on stability should be considered.

major problem if canal is enlarged.

20. It is not apparent how bridge piles which extend above the canal bottom can have "a nominal 2-ft. cutoff below the existing ground surface," as stated in paragraph 36 on page 11. This should be clarified.

21. Additional comments on the design shear strengths and piezometric headline are dependent on soil testing from check borings now at our Waterways Experiment Station and on additional piezometric observations. The last piezometric data provided my office was in October 1985.

I trust that the foregoing is responsive to your needs. If we can be of further assistance in this matter, please let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosure

PARTNERS

J. BRES EUSTIS
REG. C. E.

CHARLES A. BRAGG (1918-1979)
REG. C. E.

JOHN W. ROACH, JR.
REG. C. E.

GERALD A. BRAGG
REG. C. E.

LLOYD A. HELD, JR.
REG. C. E.

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

BORINGS • TESTS • ANALYSES

3011 28TH STREET
METAIRIE, LOUISIANA 70002

P. O. BOX 8708
METAIRIE, LOUISIANA 70011

PHONE (504) 834-0157

OFFICERS

EUSTIS ENGINEERING CO., INC.
ASSOCIATED WITH
EUSTIS ENGINEERING CO.
CHAIRMAN OF THE BOARD
J. BRES EUSTIS
PRESIDENT
JOHN W. ROACH, JR.
CORP. VICE-PRESIDENT AND
CHIEF ADMINISTRATIVE OFFICER
GERALD A. BRAGG
VICE PRESIDENT AND
CHIEF ENGINEER
LLOYD A. HELD, JR.

22 April 1986

D. E. I.

U.S. Army Corps of Engineers
Post Office Box 6267
New Orleans, Louisiana 70160

Attention Mr. Ronald Elmer

Gentlemen:

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

In accordance with your request, we are forwarding to you details of our analyses for the WESTSIDE sheetpile wall between Station 50+00 and Station 90+00 on the west side of Orleans Canal. We understand these data will be reviewed by the Foundations and Materials Branch staff before a meeting during the week of 28 April 1986 between representatives of the New Orleans District, Design Engineering, Inc. and Eustis Engineering Company.

Enclosed with this letter are the detailed hand calculations and computer output for this sheetpile wall. Results of these calculations are shown on the analyses presented in Figure 5 of our report.

If you require any further information or clarification of this letter or its enclosures, do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING COMPANY

By Lloyd A. Held, Jr. 1006
Lloyd A. Held, Jr.

W. W. Gwyn:bh
Enclosures
Copy w/Enclosures to:
Design Engineering, Inc.
Attention Mr. Walter Baudier
E. Berkley Traughber and Associates
Attention Mr. E. Berkley Traughber
The Board of Levee Commissioners of the Orleans Levee District
Attention Mr. Ed Bailey

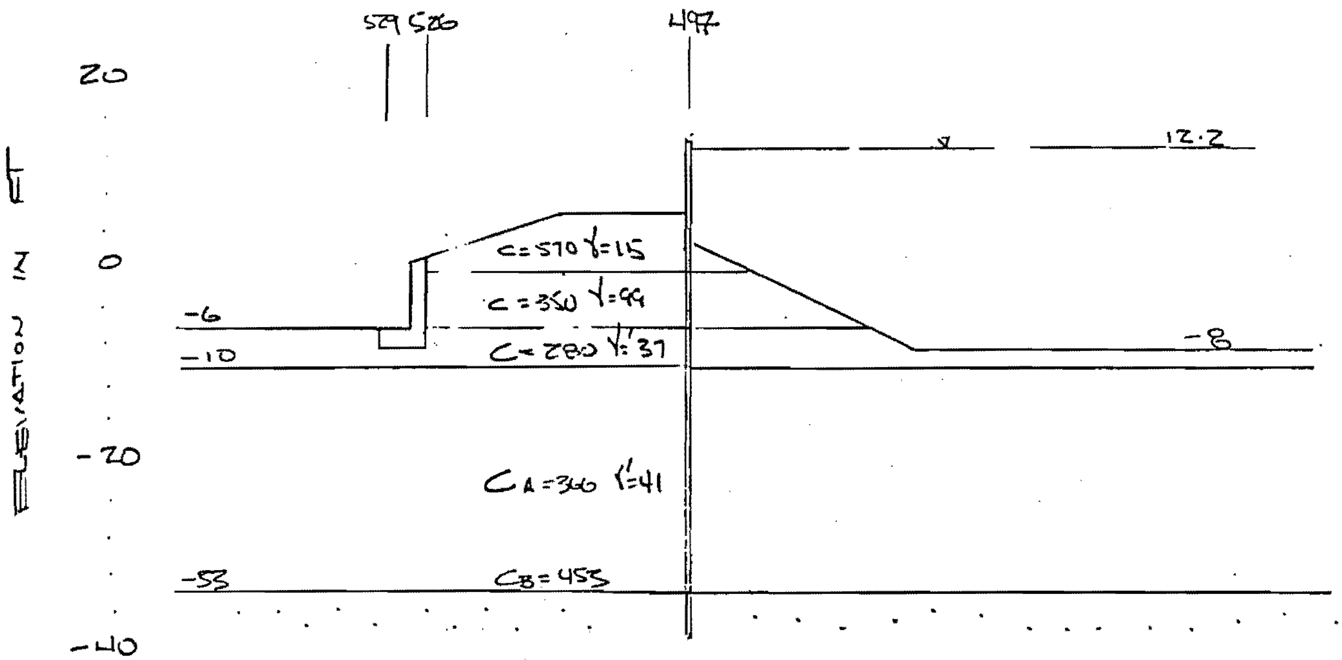
WB
JH
TS

USTIS ENGINEERING COMPA
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Date 9/23/85

Project ORLEANS CANAL Job 9155

Subject SHEETPILE WALL ANALYSIS By WMG
WESTSIDE STA 50+00 TO 90+00



NET PRESSURE COMPUTATION AT TOP OF SAND (EL -33.0)

ASSUME $\phi = 30°$ $K_A = 0.33$
$K_P = 3.0$

$N_P = -P_A + P_P - F_W$

$= -[(23)(41) + (2)(37)]\,0.33 + [(23)(41) + (4)(37)]\,3.0 - (18.2)(62.4)$

$= 1797\ \#/FT$

THE INCREASE PER FT OF PENETRATION ($\gamma' = 60$)

$\Delta N_P = (60)(3 - 0.33)$
$= 160.2\ \#/FT/FT$

$N_P = 1797 + 160.2d$, WHERE d = PENETRATION INTO SAND

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Date

Project Job

Subject By

DISTRIBUTION OF WALL FORCES

AT 6.0 : $\Sigma D - \Sigma R = (1/2)(6.2)^2(62.5)$
$= 1201$

AT 0.0 : $\Sigma D - \Sigma R^* = (1/2)(12.2)^2(62.5) - (29)(350)$

* CONSERVATIVELY DISREGARD D_A & R_A FROM SOIL WEDGE BELOW → SEE COMPUTER RUN

STRATUM	NF $\Sigma D - \Sigma R$	F ADD'TL FORCE REQ'D FOR F.S. = 1.3**	ΔN_F	ΔN_F /FT
12.2 TO 6.0	1201	—	1201	+194***
6.0 TO 0.0	-5498	—	-6699	-1117
0.0 TO -6.0	-837	1997	+4661	+777
-6.0 TO -10.0	+203	4037	+1040	+260
-10 TO -17.0	+387	6233	+184	+26
-17 TO -25	-1967	6607	-2354	-294
-25 TO -33	-7219	1718	-5252	-656

** F.S. = 1.3 = $\Sigma R / \Sigma D - F$
*** TO BE DISTRIBUTED AS A TRIANGULAR LOAD

USTIS ENGINEERING COMPA
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Date

Project ______ Job

Subject ______ By

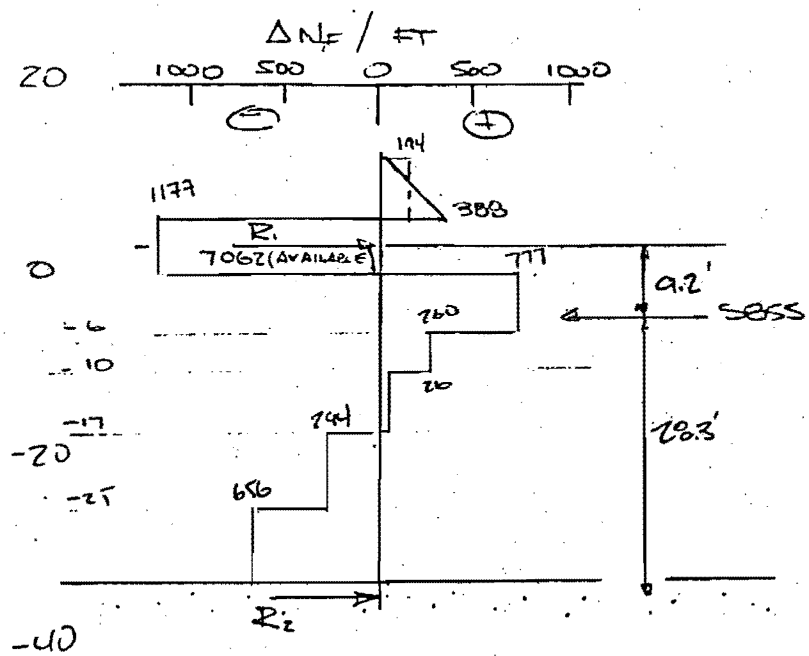
PENETRATION INTO SAND MUST DEVELOP A MINIMUM 6607#/FT IN ORDER TO ACHIEVE F.S. = 1.3

$$\therefore\ 6607 = \frac{(d)}{2}\left[1797 + 160.2d + 1797\right]$$
$$= d(1797 + 80.1d)$$
$$= -82.5 + 22.4d + d^2$$

$$d = \frac{-22.4 \pm \sqrt{22.4^2 - 4(1)(-82.5)}}{2}$$

$\cong$ 3.0 FT REQ'D TO PROVIDE A 1.3 FACTOR OF SAFETY w/RESPECT TO HORIZONTAL FORCE

INVESTIGATE SHEETPILE SECTION BY SIMPLE BEAM ANALYSIS

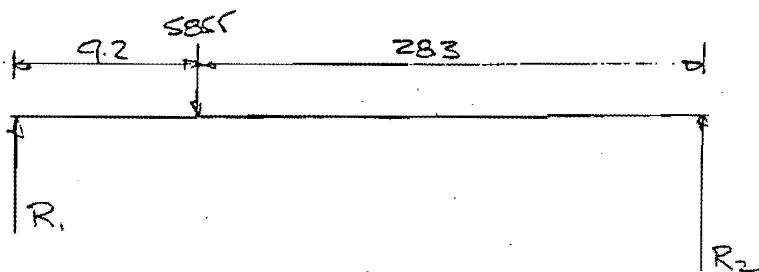


USTIS ENGINEERING COMPA
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Date

oject | Job

Subject | By



$(R_1)(37.5) = (5855)(28.3)$

$R_1 = 4418 \leq$ AVAILABLE 7062 OK.

AT ZERO SHEAR: $M_{MAX} = (4418)(9.2)$
$= 40645$ FT LBS/FT

```
JRLEANS CANAL
REACH I WEST LANDSIDE
9 510 510 0.1
0 62.5 62.5 0 0 0 0
0 115 115 570 570 570 570
0 99 99 350 350 350 350
0 99 99 280 280 280 280
0 37 37 280 280 280 280
0 41 41 306 306 333 333
0 41 41 363 363 393 393
0 41 41 428 428 453 453
33 60 60 0 0 0 0
0 12.2 497 12.2 497.1 6 510 6
526 1 526.1 -5 526.2 -6 1000 -6
9999.9 0
0 -8 473 -8 478 -6 480 -5
491 0 497 3 497.1 6 510 6
526 0 9999.9 0
0 0 473 -8 491 0 526 0
9999.9 0
0 -8 473 -8 480 -5 526.1 -5
9999.9 0
0 -8 473 -8 478 -6 526.2 -6
9999.9 0
0 -10 1000 -10 9999.9 0
0 -17 1000 -17 9999.9 0
0 -25 1000 -25 9999.9 0
0 -33 1000 -33 9999.9 0
0 -40 1000 -40 9999.9 0
4 -6 497 497 520 1
526
5 -10 497 497 526.2 1
529
6 -17 497 497 526.2 1
529
7 -25 497 497 526 1
529
8 -33 497 497 526.2 1
529
```

.CT.   WEDGE 497.00 FT. FROM ORIGIN ***

**** PASSIVE   WEDGE 529.00 FT. FROM ORIGIN ***

$$FS = \frac{RA= 18052.5 + RB= 14496.0 + RP= 19180.0}{DA= 59048.9 - DP= 14540.3} = \frac{SUM\ R= 51728.5}{SUM\ D= 44508.6} = 1.162$$

WEDGE LOCATED ACT	PAS	FAIL ELEV	RESISTING FORCES RA	RB	RP	SUM R	DRIVING FORCES DA	-DP	SUM D	FACTOR OF SAFETY
497	526	-6.0	4060.	8120.	102.	12282.	11487.	42.	11445.	1.073
497	529	-10.0	5417.	8960.	2240.	16617.	17116.	296.	16820.	.988
497	529	-17.0	8154.	10656.	6524.	25334.	28053.	2333.	25721.	.985
497	529	-25.0	12250.	12576.	12332.	37158.	42316.	7124.	35191.	1.056
497	529	-33.0	18052.	14496.	19180.	51728.	59049.	14540.	44509.	1.162

ELAPSED CPU TIME   43.4 SECONDS $ 8.69   FOR USER GWYN

<u>MEMORANDUM</u>

TO: File 1006 ✓

FROM: Tom Smith

RE: "Inverted T" Floodwall
Orleans Avenue Canal

DATE: May 13, 1986

In reply to my request for USCE criteria for sizing and design of concrete "Inverted T" type floodwall, Jorge Romero (862-2645) offered the following.

Base Size:	Thickness - 2'-6" min. Width - 8'-0" min.
Cut-off Sheet Pile:	Embedment - 9"
Concrete Pile:	Embedment - 9"
Stem Size:	Thickness at top - 12" min. Stem is usually battered about 1/24 on one face to reduce cost and give required thickness at base.
Deflection:	Cap horizontal movement - 1/2" max. as determined by Hrennkoff analysis.
Joints Spacing:	40' max., 30' preferred

TMS/mnh

TmS

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

June 3, 1986

Engineering Division
Projects Engineering Section

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your January 16, 1986, letter submitting your Design Memorandum on the Orleans Avenue Canal Flood Protection Project for our review. This document is, as we understand it, intended to support preparation of plans and specifications for improving the levees along the Orleans Canal to meet standards for the Lake Pontchartrain, La. & Vicinity Hurricane Protection Project (LP&VHPP). As you know, much of what is contained in the document relies for support on a geotechnical report submitted to us in October 1985 for review, and commented on by us in our letter dated February 10, 1986. Discussions concerning our comments on the geotechnical report have continued, but there remain numerous of those comments which have not been adequately addressed to date. Our comments on your design memorandum, therefore, must at this time be regarded as preliminary and tentative, pending resolution of our comments on the geotechnical report.

As you are aware, credit under the LP&VHPP for any work done in connection with upgrading the levees along the Orleans Canal is dependent upon the outcome of our GDM studies. We are scheduled to complete those studies by August 1987. As we have indicated in the past, our preliminary work indicates that the fronting floodgate solution would provide the authorized hurricane protection at lower cost than improvement of the existing parallel levees. However, we recognize your preference for the improved levees solution, and for this reason urge that your GDM be completed at the earliest practicable date, in order that all of your views regarding solution of the Orleans Canal problem may be fully reflected in the preparation of our GDM.

With the foregoing background, we offer herein our tentative comments on your GDM as a basis for expediting the completion of that document. 1006

WB
JH
TS TmS 6/10/86

1. The Organization of Report chapter should reference the geotechnical investigation report and the report should be attached as an appendix to this design memorandum.

2. Preliminary unconsolidated undrained triaxial test results have been received from our Waterways Experiment Station and have been furnished to your soils consultant. It appears that some of the design shear strengths used in the Draft Geotechnical Engr Report on Orleans Ave. Outfall Canal by Eustis Engr are high. Reference comment 17 in our February 10, 1986 letter.

3. Comparisons of present cross sections to cross sections from 1971 indicate a settlement of the I-walls on the west levee. The new I-walls along the canal should be overbuilt 0.5' for settlement.

4. Page IV-I, paragraph A - The wall transition from sta. 118+00 to sta. 124+00 should be identified and reflected in this paragraph.

5. The NOD presently requires a minimum steel thickness of 5/16-inch for floodgate skinplates and 3/8-inch for all other steel (including sheet piling). The sheet piling type SL2, which is proposed for Reaches E-1 through E-6 and Reach W-6 (or about 11,538 linear feet), is unacceptable.

6. The NOD also limits structural deflections for pile founded T-walls to 1/2-inch at the pile cap (base slab).

7. Page IV-I, paragraph IV.B.1. - It should be noted that, in addition to the allowable bending stress F_b being reduced, other allowables are reduced. See EM 1110-1-2101 (Encl).

8. Page IV-I, paragraph IV.B.2. - Assuming that this paragraph is for steel sheet piling, ASTM A328 should be referenced in lieu of the ASTM for steel pipe piles (A252). Also, the allowable bending stress for ASTM A328 sheet piling is 20 ksi. See EM 1110-2-2906 (Encl).

9. Page IV-2, paragraph c.3.,the F.S. of 1.25 should be based on total weights.

10. Page IV-2, paragraph c.4., we recommend that the coefficient of lateral earth pressure, K, for piles in tension in sand is .75 for displacement piles and .5 for nondisplacement piles unless values are obtained from pile tests.

11. Page IV-2, paragraph IV.D.2 - It should be noted that the first two sentences are not USCE requirements as the chapter introduction infers. The recommendation for settlement is by Eustis Engineering. Reference comments 8 & 9 in our February 10, 1986 letter.

12. Page V-1, paragraph A, bottom of page, NOD's interpretation of the sand stratum along the Orleans Ave Outfall Canal is: The top of the dense sand stratum varies from El -6.0 NGVD to El -14.0 NGVD, from the pumping station to station 30+00. From sta. 30+00 to sta 50+00, the top of the dense sand stratum varies from El -11.5 NGVD to El -29.0 NGVD. However, above the dense sand stratum is a loose sand and a clayey sand which varies from El -9.0 NGVD to El -19.0 NGVD. From sta. 50+00 to sta. 90+00, the top of the dense sand stratum ranges from El -20.5 NGVD to El -35.5 NGVD. A silty sand stratum overlies the dense sand layer. At sta. 51+80 the silty sand stratum has a top elevation of -13.0 NGVD. From sta. 90+00 to the lakefront, the top of the dense sand stratum varies from El - 32.0 NGVD to El - 36.5 NGVD, with lenses and layers of silty to clayey sand above that layer.

13. Page V-2, paragraph 3 - U.S. Army Corps of Engrs. parameters do not require that seepage paths be sealed with walls of some type. U.S. Army Corps of Engrs. parameters require seepage control measures. The principal measures are (a) cutoffs (b) landside seepage berms (c) pervious toe trenches (d) floodside impervious blankets and (e) pressure relief wells.

14. Page V-2, paragraph 3 - Piezometer readings were furnished by Eustis Engineering to my office in a letter dated 5 Nov 85; however, those readings did not include canal water elevations or the results from falling head tests. This information and any piezometer readings taken since then are needed.

15. Page V-3, paragraph 1 - The level of existing top of fill ranges from El 4.5 NGVD to El 6.0 NGVD; therefore, 8 to 10 feet of additional height is required.

16. Page V-4, paragraph 4, figure 2, and figure 7 - The draft geotechnical report has a tip elevation of -37.5 NGVD for the I-wall between sta. 50+00 and sta. 90+00, whereas figures 2 and 7 show a tip elevation of -33 NGVD. Reference comment 15 in our February 10, 1986 letter.

17. Figure 3, Typical East Levee Modification, Sta. 3+54 to Sta. 89+75 - The natural ground surface of approximately El 0.0 NGVD shown on the landside is not indicative of the natural ground surface between Sta. 3+54

and sta. 89+75.75 east levee. The natural ground surface varies between El 0.0 NGVD and El -5.0 NGVD from sta. 3+54 to sta. 89+75.75 east levee.

18. The draft geotechnical report for this project did not include analyses for the levee floodwall combination proposed in Reaches E-6, W-6, E-7, and W-7. These analyses should be presented. Reference comment 5 in our February 10, 1986 letter. The stability and settlement analyses for the proposed west levee near the canal (Reach W-6) should also be presented. Also, the location where the levee fill material will be obtained from should be specified.

19. Figure 2 - The proposed elevation limits for coating the steel sheet piling with coal tar epoxy should be provided. It should be noted that the use of the coal tar epoxy, in lieu of the requirements of para. IV.D.1, is only permitted in this reach.

20. Figure 5 - It appears that this proposed section is for the west side, and not the east side as shown. This should be resolved.

21. According to the Draft Geotechnical Report prepared for this job, the levee fill will be either CL or CH but, according to the cost estimates, the fill will be Sandy-Clay. This discrepancy should be resolved.

22. On pages V11 and V12, the cost estimate for the I-wall sheetpiling for Reach W-4 and Reach W-5 should be for a length of 51.5 ft. corresponding to a tip elevation of -37.5 NGVD.

23. It is suggested that another bridge modification alternative be investigated. This alternative would consider a new bridge at the present bridge's level while incorporating headwalls and waterproofing similar to alternative 2. This would appear to be a feasible alternative since, according to this report, only 20% of the cost ($397,000 for Filmore Ave.) for the new raised bridge is for the bridge itself, with the remaining 80% attributable to the approaches.

24. The report recommends the modification of bridges by sealing joints and the use of walls and anchors. Analyses should be presented for the above alternative.

25. Reference figure 7, a. - It is suggested that another alternative be investigated for storing the roller gate. In some cases, we have found that an I-wall in combination with an adjacent pile-founded concrete slab is more economical than a pile-founded T-wall. The additional

sheet piling cost from the difference between stability and seepage requirements can be offset by the savings associated with the elimination of the protected side slab concrete and with only providing piles (possibly even timber) to support the dead weight of the gate, and not to resist the overturning of the monolith due to the horizontal water load.

26. Reference figure 7, b. - A stabilization slab should be added beneath the T-wall monolith(s). The NOD normally provides a 4-inch thick stabilization slab.

27. Reference paragraph VI.C-

a. The method of testing and repairing the existing copper waterstops should be provided.

b. A seepage cutoff that attaches to the existing end bents will be required. This should be discussed.

c. The details of grouting the waterstops to the existing bridge while having the waterstops cast into the precast concrete wall panel should be presented.

d. The method of installing vertical waterstops between adjacent precast concrete wall panels should also be discussed.

e. Based on preliminary calculations (see 7.c below), additional studs are required to anchor the bridge deck to the existing girders. The method of installing these additional studs should be presented.

28. Reference figure 8-

a. The details of connecting the existing copper waterstop to the new waterstop should be provided.

b. It appears that the clear distance between the existing 12-inch piles and the proposed 16-inch piles is insufficient. Consideration should be given to increasing the clear distance, thereby resulting in an increase to the size of the concrete cap.

29. On page VI-22, the note at the bottom appears to be in error, since 6 pile anchors appear to be inappropriate at the end bents.

30. Reference chapter VII, paragraph VII A, and figure 15 - The draft geotechnical report for this project did not include any analysis for this reach and the I-wall at the I-610 bridge.

31. On figure 15, the bottom of the concrete cap for method 2 should be 2 feet below the ground surface as required by paragraph IV.D.1.

32. Reference figure 16-

a. Modification at 30" Dia. Waterline, Sta 44+44 - No seepage analysis or deep seated analysis was presented in the draft soils report for the T-wall at the 30" diameter waterline.

b. Since there is an obvious interference problem between the existing wall and the proposed 14-inch piles, complete removal of the existing wall will be required in this reach.

c. The thickness of the base slab appears to be insufficient. A thickness of 2.5 feet should be used unless calculations are presented which justify a reduced thickness.

d. There may be a pile interference problem between the existing pile(s) for the waterline support and the proposed 14-inch piles. This should be investigated.

33. Reference paragraph VII.G.-

a. The method for preventing seepage along the top of the existing cutoff wall and syphon structure should be provided.

b. The method of providing wall stability across the drainage syphon width should be discussed.

34. Reference paragraph VII.H. - Since the two designs are considered "a complex undertaking "and" beyond the scope of this report," cost estimates and alternative comparisons appear premature. The design for this work should be provided to this office for our review.

35. Reference figure 19 - Connecting of the discharge pipe to the proposed floodwall is unacceptable. Independent

anchorage for this pipe will be required.

36. Reference figure 20 - Utilizing the sluice gate/floodwall structure for supporting the discharge lines is unacceptable. Support structures and connection details, which will prevent the transfer of any loads to this control/floodwall structure, will be required.

37. Reference Appendix A-

a. The tip elevation of the sheet pile seepage cutoff at the bridges should be shown.

b. The sheet pile tip elevation for the I-610 bridge modification differs from that shown on Fig. 15. This discrepancy should be resolved.

c. The sheet pile tip elevation for the floodwalls north of Robert E. Lee Blvd. should be shown.

38. Regarding the cost estimates contained in this GDM, as we noted in our letter of April 11, 1985 (See Appendix B, page B-3), the actual credit to the Orleans Levee District for the flood protection provided at the Orleans Avenue Outfall Canal will be determined after completion of our General Design Memorandum Number 19. This document will provide the basis for the determination of the degree to which the features contained in the subject GDM meet the requirements of the Federal project. Based on the above, our review of the cost estimates contained in the subject GDM was limited to checks of major items and to review the adequacy of unit prices. It should be noted that the subject GDM does not properly address all of the stability and other design problems associated with the required flood protection for the Orleans Avenue Outfall Canal. The resolution of these problems could have a significant impact on the total project cost.

39. Reference chapter V-

a. The unit prices for the sheet piling for Reaches W-1 through W-5 appear to be high, based on bidding results for similar sheet piling on Corps projects in the New Orleans area. Type PZ-27 sheet piling is furnished and installed with a unit price range from $13.00 to $15.00 per square foot. Therefore, it is suggested that the unit price for PZ-27, 35 feet long, be changed from $560 to $510 per linear foot and for PZ-27, 47 feet long, be changed from

$765 to $710 per linear foot.

b. The unit prices for demolition of the existing wall within Reaches W-1 through W-5 appear to be too low when compared to both actual and estimated costs on Corps projects. It is suggested that this demolition work be estimated at a unit price of $100 per linear foot, and not the $35 per linear foot shown.

40. Reference chapter VII - The estimate presented for the final protection at the pumping station is unacceptable. A more detailed estimate should be presented with the results of the investigation described in comment 36 above.

41. Reference chapter VIII-

a. Paragraph A.1.e., on Reach W-6, should also mention the I-wall required at the fire station and at Crystal St., which was mentioned on pages V-7 and V-8.

b. Pages VIII-5 to VIII-7 - An overbuild of 1 foot is less than the maximum settlement of 2.5 feet stated in the soils report; therefore, the cost of future maintenance should be stated.

c. If pile tests are to be performed, costs should be included.

42. In order to expedite the upcoming review effort, the preliminary design submitted for our review should include complete design calculations for each typical item, including the specialty items. Calculations should include summaries of I-wall moments and deflections for each different reach and summaries of T-wall pile loads (calculated by the Hrennikoff Method) and base slab deflections for each different monolith. Also, several engineering documents which are needed by DEI to pursue preliminary and final design are enclosed and are as follows:

a.	EM 1110-1-2101	Working Stresses for Structural Design
b.	EM 1110-2-2000	Standard Practice for Concrete
c.	EM 1110-2-2102	Waterstops
d.	EM 1110-2-2103	Details of Reinforcement - Hydraulic Structures

e. EM 1110-2-2502 Retaining Walls
f. EM 1110-2-2906 Design of Pile Structures and Foundations

43. Preliminary design calculations were informally submitted to this office and the following comments are offered to expedite the upcoming calculation reviews:

a. <u>I-Wall Deflection Calculations.</u> The concept presented is acceptable to this office except that the moment of inertia used should be in units of in^4/ft and not in^4/pile.

b. <u>Slender Walls Program Description.</u> While we have no objections to utilizing this program if modified to reflect the criteria in ETL 1110-2-265, sample hand calculations must be submitted to demonstrate that the computer results are satisfactory.

c. <u>Bridge Modification Calculations.</u>

(1) The minimum allowable thickness for concrete floodwalls is 12 inches. See EM 1110-2-2502.

(2) According to ETL 1110-2-265, the reinforcement ratio, p, should be checked against 0.25 times p_b. If this ratio is greater than 0.25 times pb, deflection calculations must be checked.

(3) Minimum shear reinforcement, as provided by Sections 11.10.8 and 11.5.5.1 of ACI, is required since V_u exceeds 1/2 of V_c.

(4) The concept of the threaded bar strap appears to be unstable when attached to a similar strap on the opposite side of the bridge since the pressure diagrams will not always be exactly equal.

(5) Fig. 8 and the sketch on page 7 do not match. This discrepancy should be resolved.

(6) For preliminary designs, pile reactions should be calculated using either the Culmann's or Vetter's Method. Final design should utilize the Hrennikoff Method. See EM 1110-2-2906.

(7) It is not apparent as to the purpose of the key area located below the waterstop on the precast

headwall panel. The intent should be specified.

(8) The minimum acceptable concrete cover for floodwalls is 3 inches. See EM-1110-2-2103.

(9) The method for calculating the bending stress in the headwall is inappropriate since biaxial bending occurs in the precast headwall.

I trust that the foregoing is responsive to your needs. If we can be of further assistance in this matter, please let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosures

Copy furnished:
Mr. Ed Bailey
Chief Engineer
Board of Levee Commissioners
Orleans Levee District
Suite 202, Administration Building
New Orleans Lakefront Airport
New Orleans, Louisiana 70126

The details of the analysis for the sheet pile wall between station 50+00 to station 90+00 west side of Orleans Avenue Outfall Canal have been reviewed. We recommend that the ground water elevation used on the protected side for the I-wall analysis along Orleans Avenue Outfall Canal be 0.0 NGVD at the I-wall and at the natural ground surface at the embankment toe. The embankment section (elevation and width) used in the analysis should represent the minimum field conditions. Upon completion of your evaluation of design shear strengths, a shear strength plot should be furnished to us for review.

It is recommended that NAVFAC DM-7, May 1982, particularly figure 9 on page 7.2-71, be used as a guide to determine passive pressures against an I-wall where the critical wedge is not against the wall. The factor of safety used should be 1.5 applied to the soil design shear strengths.

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ROUTING AND TRANSMITTAL SLIP Date 9 JUNE 86

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. Mr. John Holtquist (DET)		

Circulate	✓	For Your Information		See Me
Comment		Investigate		Signature
Coordination		Justify		

REMARKS

John,
Please find enclosed our response to a review of the analysis provided by Eustis.
Also two copies of the two forms you requested. I would suggest giving Eustis our response and if any questions contact FEMBR directly.

File 1006
WB ✓
JH ✓
TS

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
Ronald Elmer NOD LMNED-SP	227
	Phone No. 862-2648

5041-102

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

☆ U.S. G.P.O. 1980-311-156/27

June 12, 1986

Mr. Frederic M. Chatry
Chief, Engineering Division
Department of the Army
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Avenue Canal Flood Protection Improvement Project
DEI Project No. 1006

Dear Mr. Chatry:

As you know, for the past 1-1/2 to 2 months we have been attempting to resolve the issue of the acceptability of the design shear strengths proposed by the project geotechnical consultant, Eustis Engineering Company, Inc. With your assistance and the cooperation of the Corp's foundation section personnel, we have to date been able to clarify some of the differences discussed at our original review meeting. However, in order to complete our review and prepare our response to the Corp's review comments of the geotechnical report, we find ourselves in need of additional information. The needed information is the design soil shear strengths that the Corps has developed for the Orleans Avenue Canal Flood Protection Improvement Project. Your cooperation in forwarding this information to us as soon as possible will assist in expediting our response to your comment letter.

Another matter not covered in your comment letter has just recently been brought to our attention and we feel it deserves immediate attention. As we understand it, the Corps is modifying the geotechnical design criteria to include an additional analysis parameter. This parameter, which establishes the landside water surface elevation at elevation 0.00 NGVD, is to be used for analysis of levee stability and of floodwall design. This new criteria could severely impact the design and subsequently the construction cost of this project.

We are therefore asking for clarification from your office as to whether this is in fact a required design criteria or not.

Your cooperation and timely response in this matter will be appreciated.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

JH/mnh

cc: Mr. C. E. Bailey, Chief Engineer

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

June 25, 1986

D. E. I.

Engineering Division
Projects Engineering Section

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your June 12, 1986, letter concerning the Orleans Avenue Canal Flood Protection Improvement Project. As requested, please find enclosed the shear strength design lines that will be used in our design studies for the GDM on the Orleans Avenue Outfall Canal Project.

Reference is further made to the second paragraph of your letter. We recommend use of 0.0 NGVD or the elevation of the ground, which ever is lower.

In developing a phreatic water surface for design, we would assume that the operating floodside stage of 0.0 NGVD is constant within the embankment cross section. If the natural ground is lower than 0.0 NGVD, the phreatic water surface landward of the embankment would be assumed to be at the elevation of natural ground. See the attached sketch.

I trust the foregoing is responsive to your needs. If I can be of further assistance, please let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosures

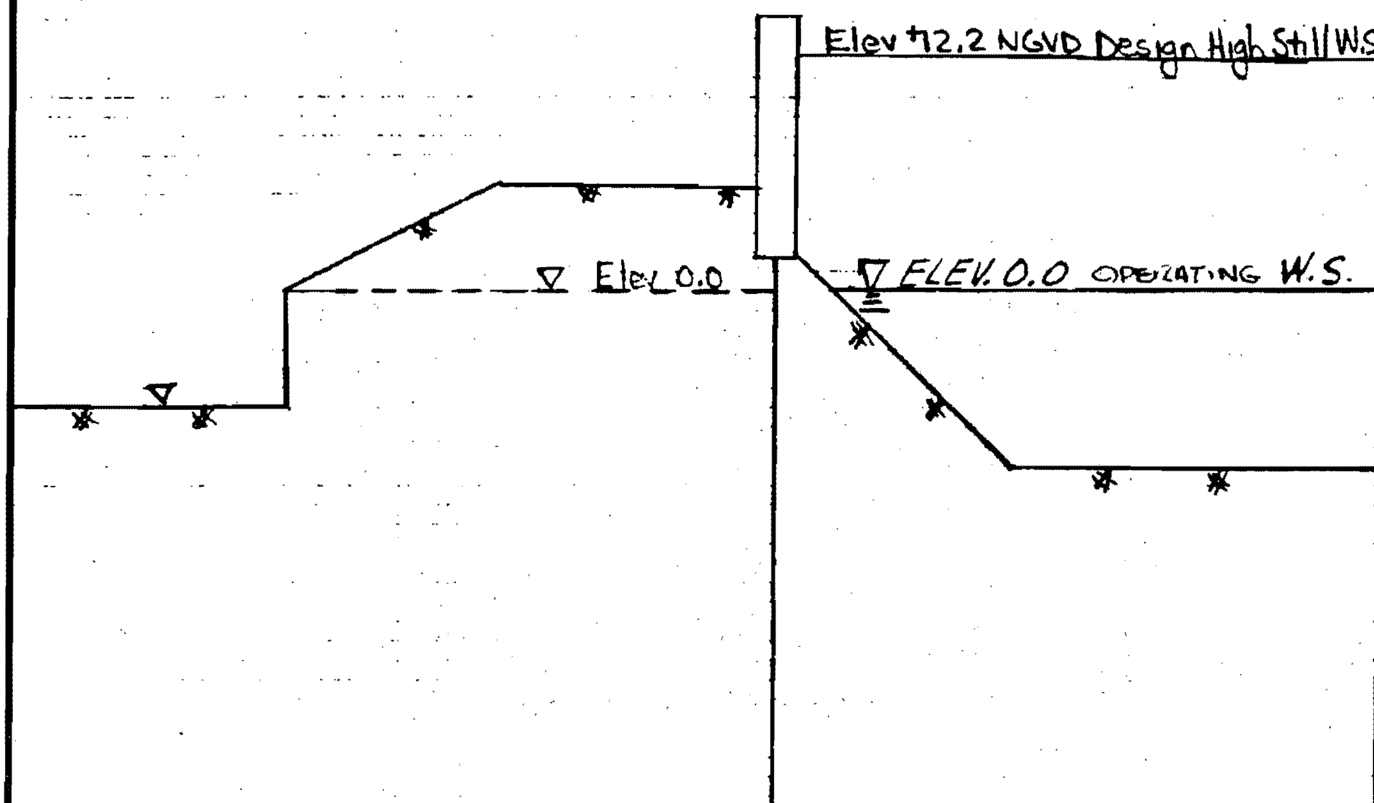
FILE 1006

WB ✓
JH ✓
TS TMS

COMPUTATION SHEET

PROJECT ORLEANS AVE OUTFALL CANAL	PAGE OF	COMPUTED BY	DATE 6/86
SUBJECT GDM PHREATIC WATER SURFACE		CHECKED BY	DATE

ORLEANS AVE OUTFALL CANAL



N.T.S.

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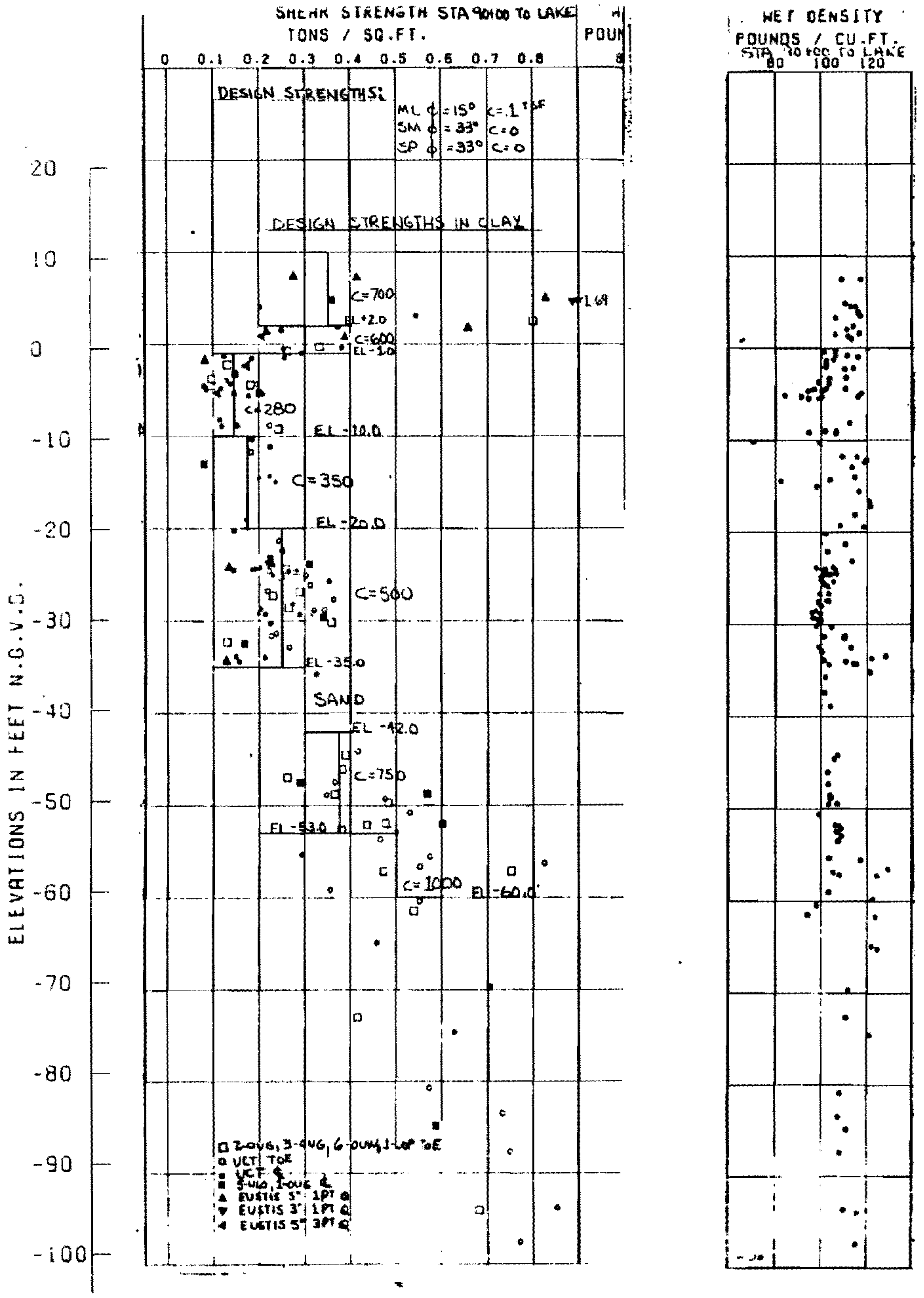

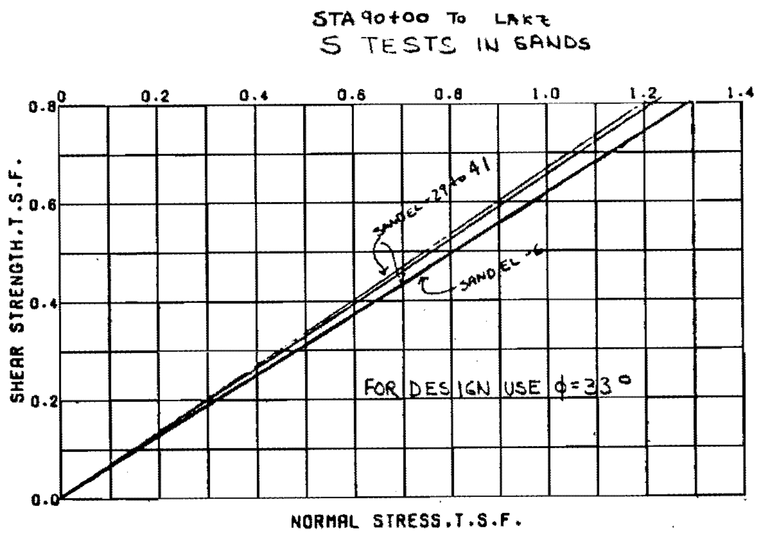

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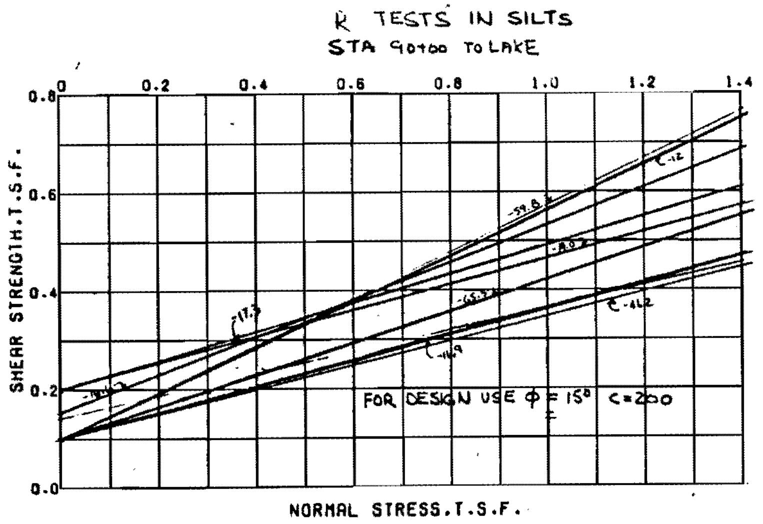


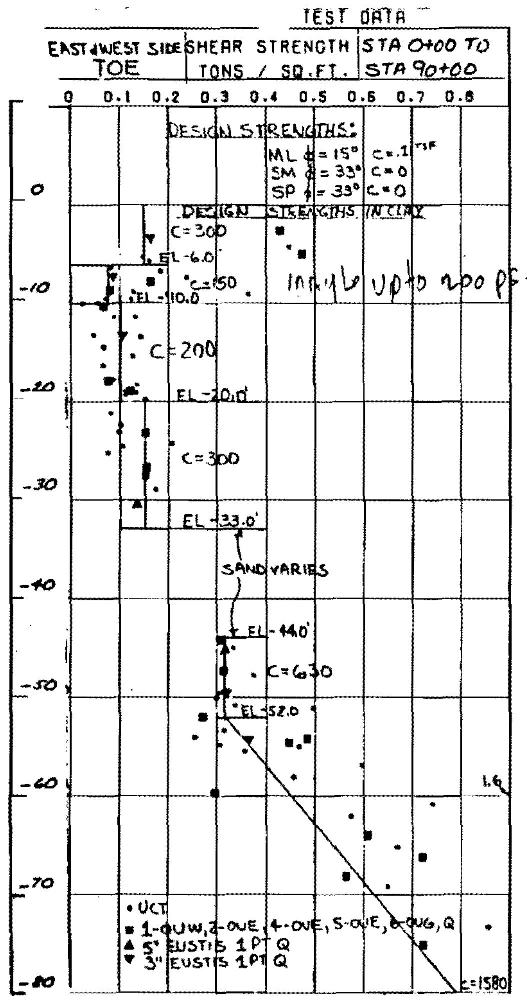
SHEAR STRENGTH DATA

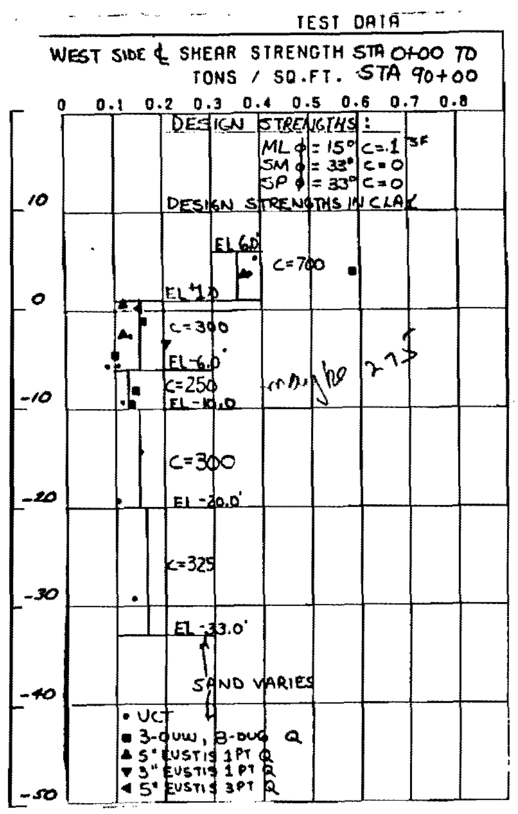
ORLEANS AVE OUTFALL CANAL
STA 90+00 TO LAKE
DESIGN SHEAR STRENGTHS

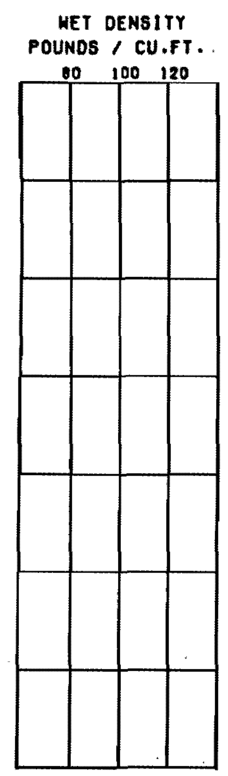
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

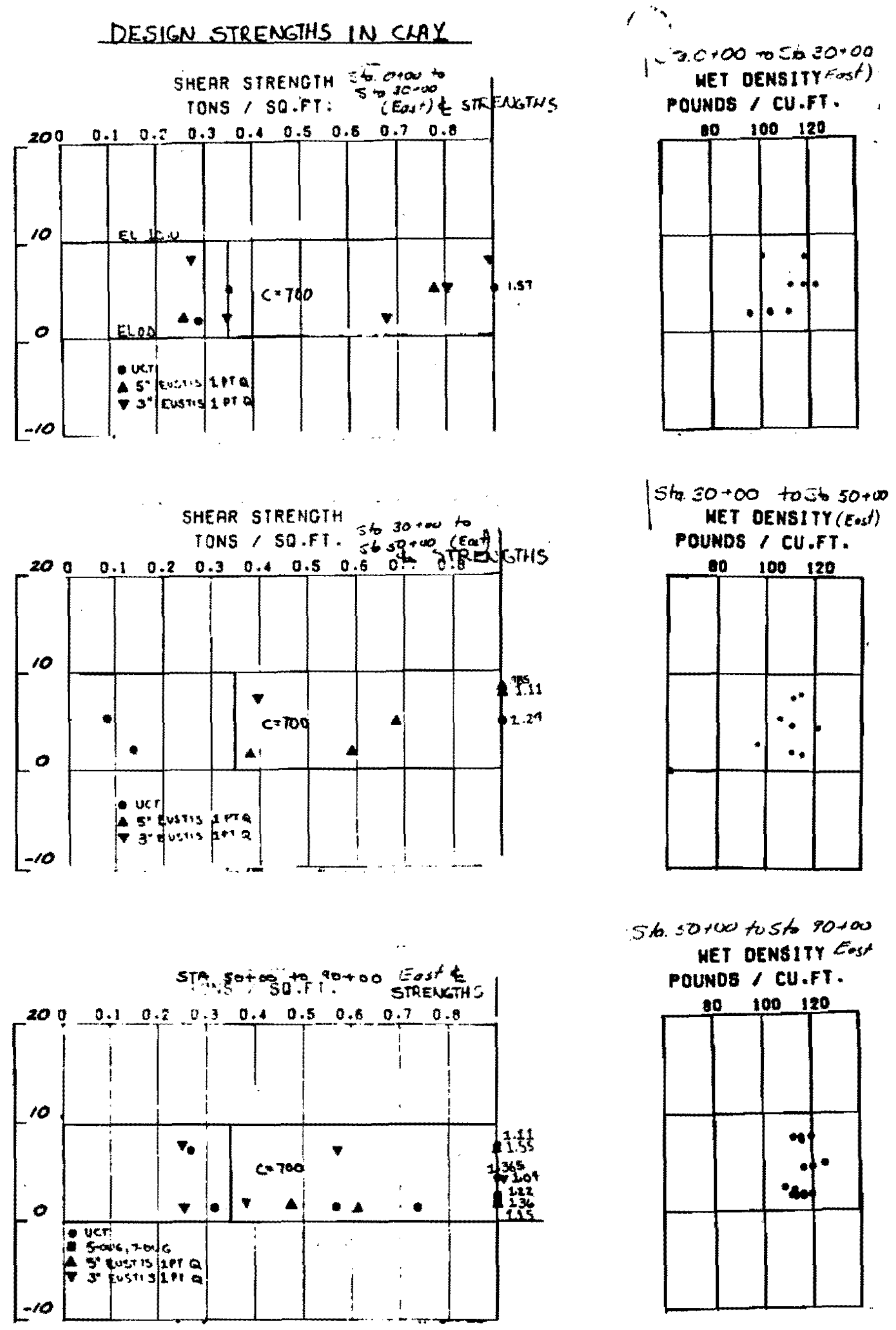
DATE

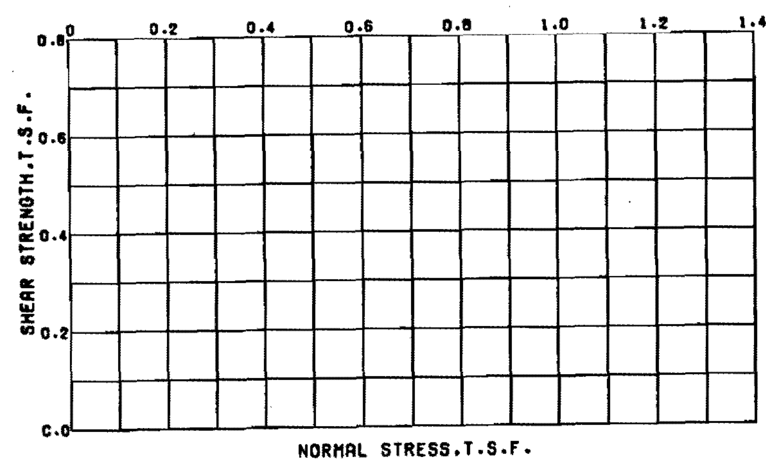
FILE NO











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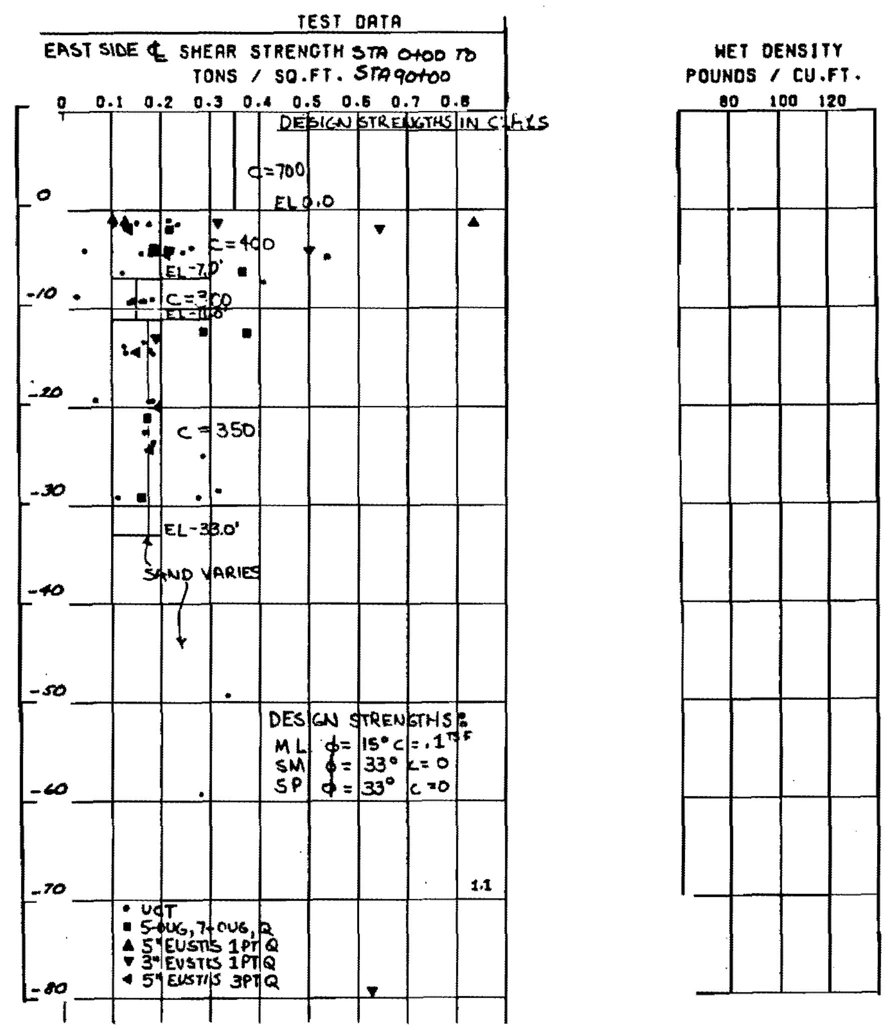
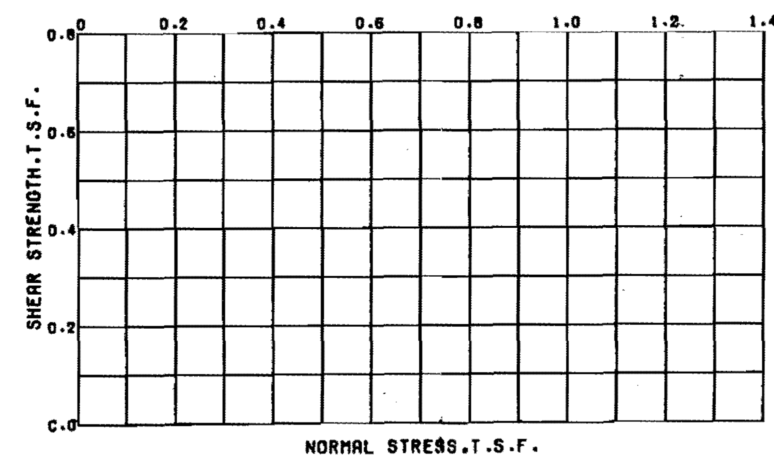




SHEAR STRENGTH DATA

ORLEANS AVE OUTFALL CANAL
STA 0+00 TO STA 90+00
DESIGN SHEAR STRENGTHS

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

DATE

FILE NO.

EUSTIS ENGINEERING
GEOTECHNICAL ENGINEERS
3011 28th Street • Metairie, Louisiana 70002 • 504-834-0157

30 June 1986

Design Engineering Inc.
Suite 205
3330 West Esplanade
Metairie, Louisiana 70002

Attention Mr. John Holtgreve

FILE 1006
WB
JH
JS TMS

Gentlemen:

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
New Orleans, Louisiana
OLB Project No. 2048-0304

Reference is made to the U.S. Army Corps of Engineers letters dated 10 February 1986 and 3 June 1986 with comments pertaining to Eustis Engineering's draft geotechnical engineering report and Design Engineering Inc.'s General Design Memorandum for the subject project. Comments pertaining to the geotechnical aspects for the project that can be addressed at this time follow in this letter. Resolution of other comments that depend upon ongoing discussions with or input from the U.S. Army Corps of Engineers will be addressed as soon as possible.

Draft Geotechnical Investigation

Comment 2. Shear strength design parameters are presently being discussed with the U.S. Army Corps of Engineers. These data will be provided after final design parameters have been agreed upon.

Comment 3. These data are appended as Enclosure 1.

Comment 4. The "S" case design parameters and tail water elevations used for the I-wall analyses and in the draft report are shown on Enclosures 2 and 3.

Comment 5. Appropriate I-wall analyses are appended to this letter as Enclosures 4, 5 and 6 and have been previously furnished to DEI.

Comment 6. It is our understanding that a full levee section is required only on the west side of Orleans Canal north of Robert E. Lee Boulevard. Our sections will be modified to incorporate a minimum factor of safety of 1.3 for the gross levee section and the text of the final report modified accordingly.

Comment 7. Appropriate stability and seepage analyses have been furnished DEI in Eustis Engineering's letter dated 9 June 1986. We wish to point out that analyses furnished at that time are subject to revision depending upon resolution of comments pertaining to design shear strength parameters.

Comment 8. We understand that a landside enlargement will only be used on the west side of Orleans Canal and off of Robert E. Lee Boulevard and settlement estimates for other reaches are not required.

Comment 9. Our estimate of the average settlement for the Reach II levee west of Robert E. Lee Boulevard is 1.0 to 1.5 feet. Our estimate of the average settlement for the Reach III levee west of Robert E. Lee Boulevard is 1.5 to 2.0 feet. The foundation conditions in these reaches are very heterogeneous and settlement at any location will vary from the average estimate. We recommend raising the levee crown when settlement has progressed to net grade.

Comment 10. Ground surface elevations used in stability analyses were developed from cross-section overlays from which the general lowest ground surface elevation was determined in any particular reach. Lower ground surface elevations may exist in localized areas and may require filling. These should be addressed during development of plans and specifications.

Comment 11. The piezometric head used in the sand layers for the canal side analyses is at el -5.0 NGVD and reflects end-of-construction conditions assumed for the stability analyses.

Comment 12. Degraded levee sections, if required, will be provided following resolution of comments pertaining to the design shear strengths.

Comment 13. The triaxial compression test reports presented at the back of Appendix B reflect the results of unconsolidated undrained triaxial tests performed on samples obtained from 5-in. diameter borings. The unconsolidated undrained triaxial compression shear tests listed under the Summary of Laboratory Test Results at the front of Appendix B represent separate one-point triaxial tests performed on samples obtained from both 3-in. and 5-in. diameter borings.

Comment 15. We have forwarded to the U.S. Army Corps of Engineers details of our calculations and assumptions relative to this particular sheetwall design in our letter of 22 April 1986. We have since received an informal reply and are presently waiting formal recommendations on design procedures from the U.S. Army Corps of Engineers.

Comment 17. The recommendations outlined in EM1110-2-1902 reflect criteria for the design of earth filled dams where design shear strengths are developed primarily on the basis of 3-point unconsolidated undrained triaxial (UU) test data for the end-of-construction condition. Shear strengths selected for the reaches of the Orleans Canal project are based primarily on unconfined compression (UC) test data. We would note that the statistical scatter from UC test data is generally greater than that of UU test data, and, when unsaturated samples are tested, UC tests yield lower values of shear strength than 3-point UU test data. Considering that UC test data are primarily used to develop shear strength trends for these reaches and that these data theoretically yield a statistical average less than comparable UU data, Eustis Engineering does not believe it appropriate to use the criteria outlined in EM1110-2-1902.

Comment 18. Borings taken along the west levee were generally taken at the toe of the existing levee and do not reflect shear strengths beneath the levee section itself. Samples obtained from these borings are sensitive to disturbance during shear strength testing. These considerations have been discussed with the U.S. Army Corps of Engineers. We are presently waiting on recommendations from the U.S. Army Corps of Engineers relative to design shear strength parameters. When these are received, we will re-evaluate appropriate analyses.

Comment 20. This statement is not correct in our report. It will be deleted from the final text.

General Design Memorandum Comments

Comment 10. Eustis Engineering has analyzed precast concrete piles loaded in tension assuming a coefficient of lateral earth pressure of 0.7. This succeeds the U.S. Army Corps of Engineers requirements stated in this paragraph.

Comment 11. See Comments 8 and 9 above.

Comment 14. Falling head tests on piezometers were not recorded and are not available at this time. Eustis Engineering is accumulating piezometer data for a subsequent seepage study. As this data is accumulated, copies will be forwarded to the U.S. Army Corps of Engineers.

Comment 18. Appropriate analyses have been furnished DEI. See Comment 5 above. From a geotechnical standpoint, there is no need to specify the location where levee fill material will be obtained for this project. Eustis Engineering assumes this will be the responsibility of the contractor with materials meeting the requirements outlined in the draft report of our geotechnical investigation.

Comment 30. The required penetration for the I-wall is el -20.4. This is not substantially different (el -21.0) from that required for the remaining portion of Reach I. Only the critical analyses was presented as representative of the entire Reach.

We hope these fulfill your immediate needs relative to the resolution of comments. If we can be of further assistance or you require further clarification of this letter, please do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING

Lloyd A. Held, Jr.

Lloyd A. Held, Jr.

W. W. Gwyn:bh

Enclosures 1 through 6

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

PILE CAPACITY DESIGN PARAMETERS

HARRISON AVENUE (BORING 16)

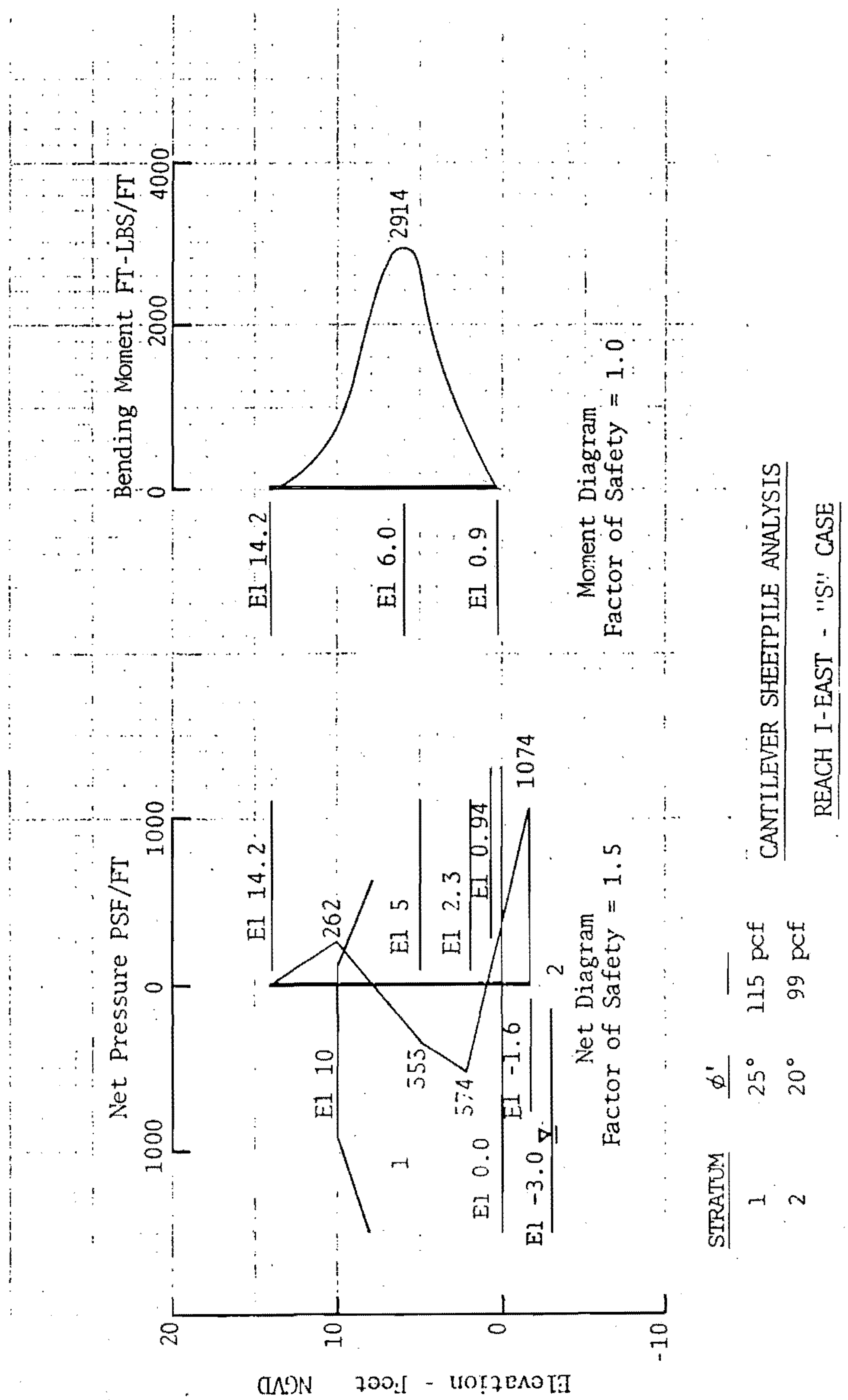
Depth in Feet	N (Blows/Ft)		Ø Degrees	Cohesion in PSF	γ PCF
0-2	--	Cutoff	--	---	102
2-10	--		--	500	70
10-28	--		--	250	96
28-32	9		13	---	120
32-38	14		16	---	120
38-40	23		21	---	120
40-43	23		21	---	120
43-45	50		30	---	120
45-50	12		13	---	120
50-60	--		--	600	104

FILMORE AVENUE (BORING 25)

Depth in Feet	N (Blows/Ft)		Ø Degrees	Cohesion in PSF	γ PCF
0-2	--	Cutoff	--	---	110
2-10	--		--	500	110
10-34	--		--	280	87
34-36	21		22	---	120
36-40	--		--	500	100
40-41	--		--	500	100
41-45	14		16	---	120
45-50	12		15	---	120
50-60	--		--	600	103
60-70	--		--	600	104

ROBERT E. LEE (BORING 38)

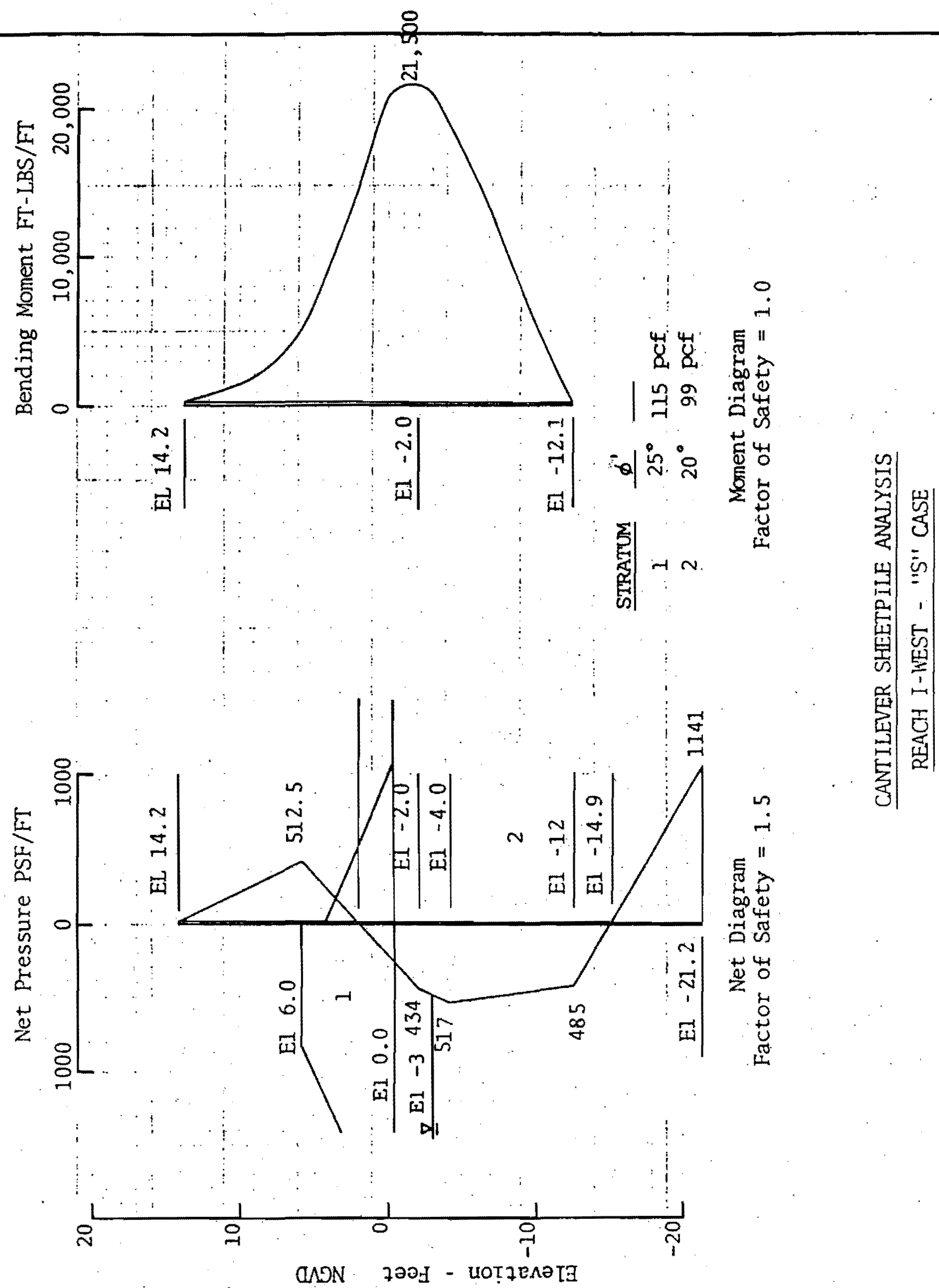
Depth in Feet	N (Blows/Ft)		Ø Degrees	Cohesion in PSF	γ PCF
0-2	--	Cutoff	--	---	106
2-8	--		--	1000	106
8-30	--		--	333	87
30-40	--		--	450	98
40-44	--		--	500	98
44-45	13		16	---	120
45-50	13		16	---	120
50-54	13		16	---	120
54-60	--		--	600	104
60-70	--		--	580	104



Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana
Design Engineering, Inc., Metairie, Louisiana

Enc. 2

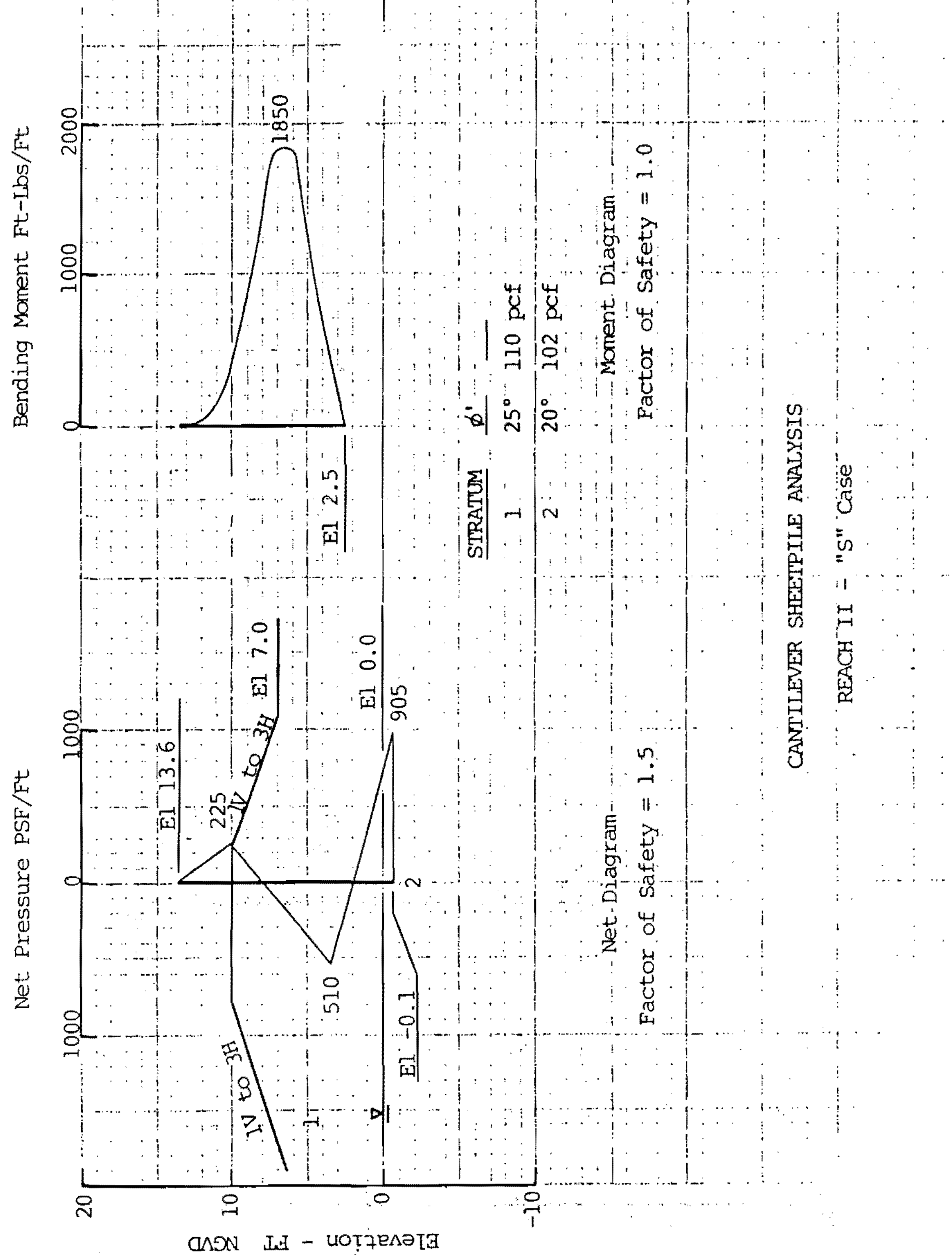


Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

Enc. 3



Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB PROJECT NO. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

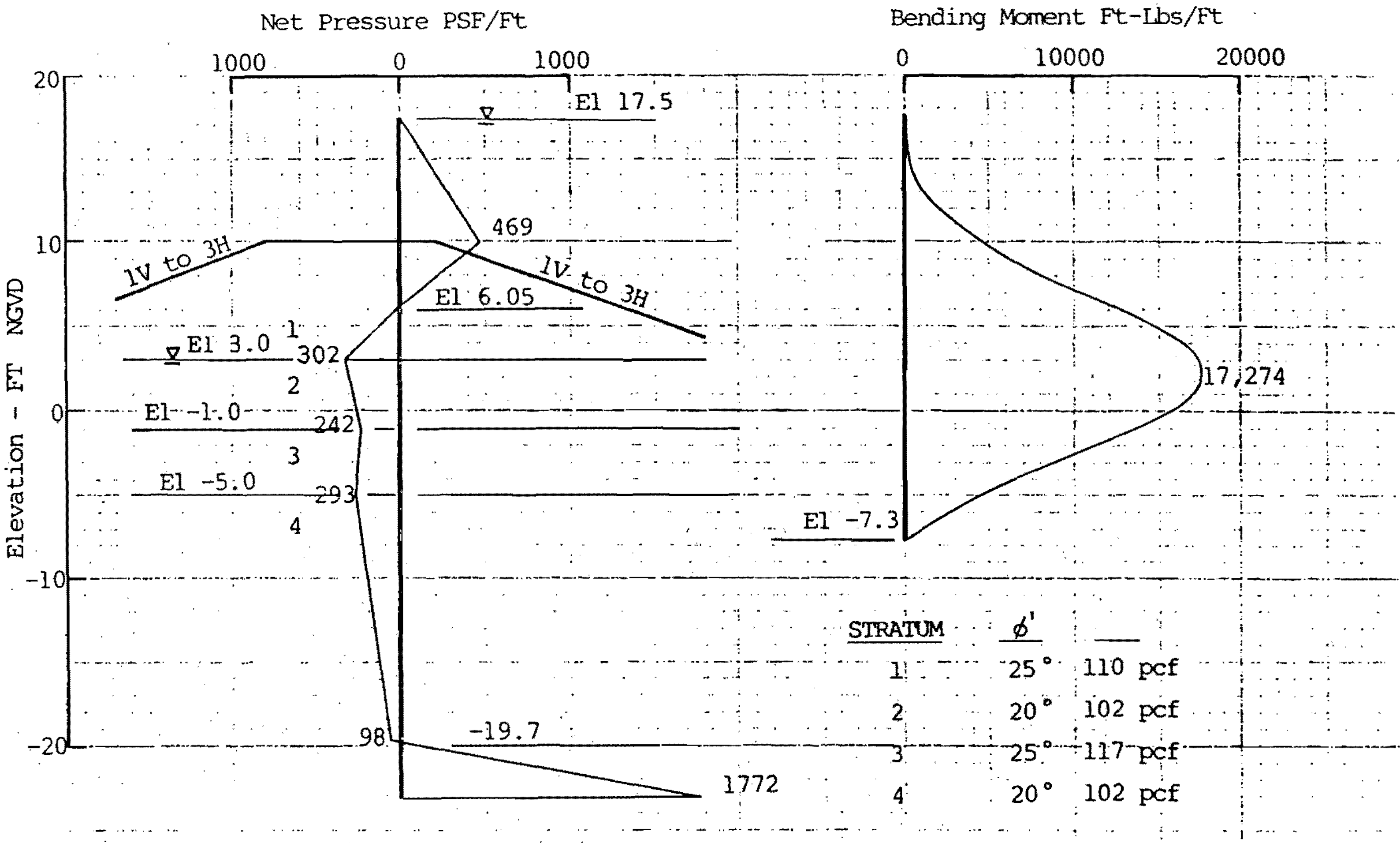
Design Engineering, Inc., Metairie, Louisiana

Enc. 4

Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana



STRATUM	ϕ'	
1	25°	110 pcf
2	20°	102 pcf
3	25°	117 pcf
4	20°	102 pcf

Net Diagram
Factor of Safety = 1.5

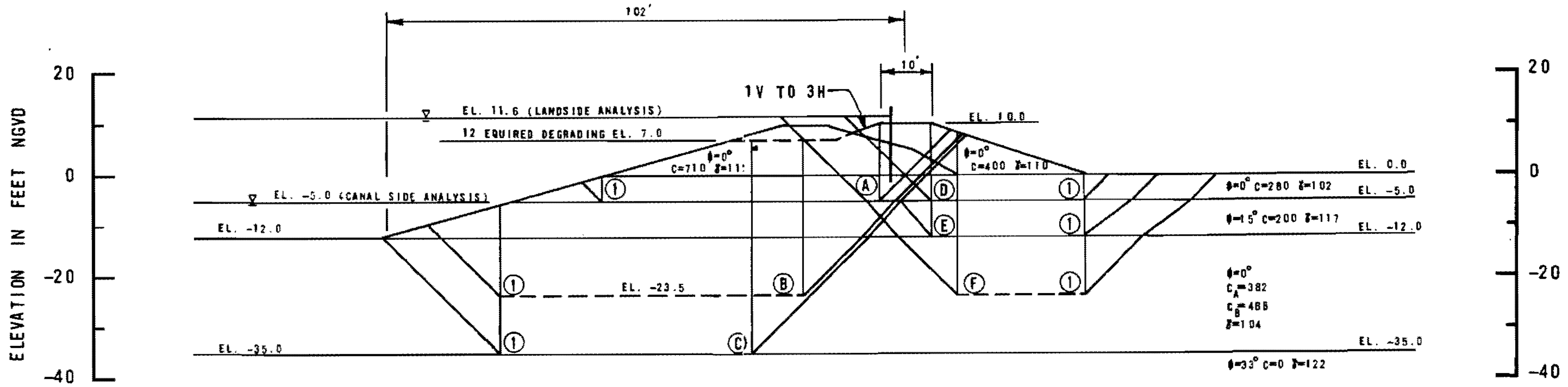
Moment Diagram
Factor of Safety = 1.0

CANTILEVER SHEETPILE ANALYSIS

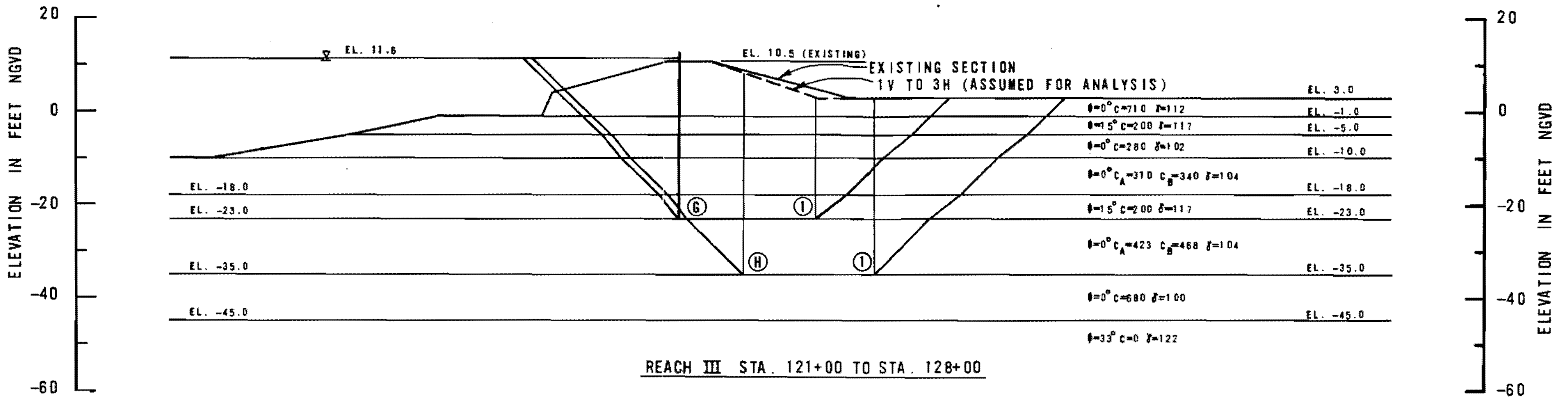
REACH III - "S" Case

Enc. 5

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS



REACH II STA. 90+00 TO STA. 118+00



REACH III STA. 121+00 TO STA. 128+00

SLIP SURFACE			DRIVING FORCE			RESISTING FORCE				FACTOR OF SAFETY
NUMBER		ELEV.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R/\Sigma D$
A	1	-5	12020	997	11023	12589	15372	2190	30151	2.74
B	1	-23.5	57155	16593	40562	27087	22882	9082	59051	1.46
C	1	-35	102310	42946	59364	36537	23353	17572	77462	1.30
D	1	-5	13353	1275	12078	11932	8363	2800	23095	1.91
E	1	-12	27641	7711	19930	17221	8880	8347	34448	1.73
F	1	-23.5	61899	29871	32028	23572	9550	16136	49258	1.54
G	1	-23	58557	36822	21735	20056	11491	22710	54257	2.50
H	1	-35	105970	78090	27880	29408	20077	32854	82339	2.95

NOTE: FOR LANDSIDE ANALYSES THE PIEZOMETRIC HEAD IN THE FOUNDATION STRATA IS ASSUMED TO BE AT EL. 11.6 FLOODSIDE OF THE SHEETPILE WALL AND AT THE GROUND SURFACE ELEVATION LANDSIDE OF THE SHEETPILE WALL.

FOR CANAL SIDE ANALYSES THE PIEZOMETRIC HEAD IN THE FOUNDATION STRATA IS ASSUMED TO BE AT THE LOW WATER ELEVATION.

LEGEND

γ=SATURATED UNIT WEIGHT IN POUNDS PER CU. FT.
C=COHESION IN POUNDS PER SQ. FT.
C_A=AVERAGE COHESION IN POUNDS PER SQ. FT. IN VERTICAL REACH OF STRATUM.
C_B=COHESION IN POUNDS PER SQ. FT. ALONG HORIZONTAL PLANE AT BOTTOM OF STRATUM.
Φ=ANGLE OF INTERNAL FRICTION IN DEGREES.
R=HORIZONTAL FORCE DUE TO SOIL SHEAR STRENGTH.
D=HORIZONTAL COMPONENT OF SOIL WEIGHT IN WEDGE.
SUBSCRIPT A REFERS TO ACTIVE WEDGE.
SUBSCRIPT B REFERS TO CENTRAL BLOCK.
SUBSCRIPT P REFERS TO PASSIVE WEDGE.
PIEZOMETRIC SURFACE.
STABILITY BASED ON LMVD METHOD OF PLANES.

GEOTECHNICAL INVESTIGATION
ORLEANS LEVEE DISTRICT
ORLEANS AVENUE OUTFALL CANAL
OLB PROJECT NO. 2048-0304
NEW ORLEANS, LOUISIANA

REACH II & REACH III STABILITY ANALYSES
LEVEE & I WALL ALTERNATIVE

FOR
THE BOARD OF LEVEE COMMISSIONERS
OF THE ORLEANS LEVEE DISTRICT
NEW ORLEANS, LOUISIANA

DESIGN ENGINEERING, INC.
METAIRIE, LOUISIANA

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

ENCLOSURE 6

August 12, 1986

Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160-0267

ATTN: Engineering Division
Projects Engineering Section

Re: Orleans Avenue Canal
Flood Protection Improvement Project
OLB Project No. 2048-0278
DEI Project No. 1006

Gentlemen:

Reference is made to the U.S. Army Corps of Engineers (USCOE) letters dated June 3, 1986 and February 10, 1986 with comments pertaining to Design Engineering, Inc.'s General Design Memorandum and Eustis Engineering's draft geotechnical engineering report for the referenced project. Comments pertaining to the geotechnical engineering report review that can be addressed at this time are included in the attached Eustis Engineering letter dated June 30, 1986 and as discussed below. Resolution of other comments that depend on ongoing discussion with the USCOE or require further analysis will be addressed as soon as possible.

Design Memorandum Jun 3 1986

Comment 1. The table of contents and Organization of Report chapter will be modified and the geotechnical report will be attached as an appendix to the Design Memorandum.

Comment 2. This comment has been addressed by Eustis Engineering. Reference Comment 17 of the attached Eustis Engineering letter dated June 30, 1986.

Comment 3. The new I-walls will be overbuilt by 0.5 feet for settlement as recommended. The Design Memorandum will be revised to include this requirement in design parameters.

Comment 4. The 600 foot transition length in the design elevation of the levee/floodwall approaching the lakefront will be added to paragraph A as a design parameter.

Comment 5. The minimum steel thickness of 3/8-inch for structural steel and sheet piling will be included as a design parameter. Presently floodgates are not included in this project, but should a change in design recommendations be required the minimum steel thickness of 5/16-inch for skinplates will be included in the design parameters. The recommendation to use SL2 piling as shown will be revised.

Comment 6. The limit of 1/2-inch of structural deflection for pile founded T-walls will be added to the design parameters.

Comment 7. The clarification, that allowables other than F_b will be reduced per EM 1110-1-2101, will be added to the design parameters.

Comment 8. The ASTM reference will be corrected and the allowable bending stress for A328 sheet piling will be noted as 20 KSI in the design.

Comment 9. The design S.F. against blow-out criteria will be revised to state "based on total weights".

Comment 10. See page 3 of Eustis Engineering's letter dated June 30, 1986.

Comment 11. The text will be modified to indicate that the settlement allowance recommendation is by Eustis Engineering.

Comment 12. The descriptive paragraph of the sand stratam will be modified to include the USCOE interpretation.

Comment 13. Statement regarding methods of sealing of seepage paths in text will be modified to include other measures.

Comment 14. See page 3, comment 14 of Eustis Engineering's letter dated June 30, 1986.

Comment 15. Existing information on variations of level of top of fill on West side will be reviewed and appropriate changes in wall height made as required.

Comment 16. The I-wall tip elevation on West side will be revised in the Design Memorandum per recommendation of soil consultant pending review of soil shear strengths.

Comment 17. The variation in natural ground elevation on the East side will be noted.

Comment 18. The analyses for the levee floodwall combinations in the referenced reaches are contained in Comment 5 of the June 30, 1986 Eustis Engineering letter. Source of levee fill will be handled in Bid Phase.

Comment 19. The elevation limits for coating the steel sheet piling will be shown in Figure 2.

Comment 20. The section orientation will be corrected for the East side as required.

Comment 21. Fill material will be CL or CH.

Comment 22. Cost Estimate will be revised for correct length of sheet pile.

Comment 23. A bridge modification similar to the alternative suggested is now proposed. This modification considers a new bridge deck on existing bridge girders plus headwalls and waterproofing. Cost should not exceed Alternative 2.

Comment 24. Complete preliminary calculation and drawings for the modification of the bridges will be submitted as they are completed.

Comment 25. Floodgates are not the recommended method of flood protection at the bridges. Based on safety and maintenance, the Client (Orleans Levee Board) prefers not to install floodgates at these bridges. This cost analysis is no longer pertinent to the project.

Comment 26. The figure will be modified to include the 4-inch thick stabilization slab as recommended.

Comment 27.

(a) The existing bridge deck will be removed and new water stops installed. Testing of existing copper water stops no longer necessary.

(b) Seepage cut-off walls that attach or seal to the end bents will be provided at each bridge.

(c) The precast wall design has been abandoned. The new bridge headwalls, floodwalls and decks will be cast-in-place concrete. Grouting of horizontal waterstops will not be required.

(d) Precast design no longer under consideration so installing vertical waterstops at joints will not be a problem.

(e) Existing bridge decks will be removed and the required additional studs will be welded to the exposed existing girders before new deck is poured.

Comment 28.

(a) The design depicted in Figure 8 has been abandoned and a new bridge modification design is being prepared which will not include copper waterstop.

(b) See Comment (a) above, pile layout revised in new design.

Comment 29. The descriptive note at bottom of cost estimate will be corrected.

Comment 30. See Comment 30 on page 4 of Eustis Engineering's letter dated June 30, 1986.

Comment 31. The drawings will be corrected to show concrete extending 2 feet below ground surface.

Comment 32.

(a) The seepage and stability analysis for T-wall at 30" diameter waterline was submitted for review June 12, 1986.

(b) Changes have been made on Preliminary Plans to avoid interference between existing wall and proposed T-wall piles.

(c) T-wall base thickness has been changed to 2'-6".

(d) Pile orientation has been redesigned to avoid conflicts between waterline support and T-wall piles.

Comment 33. Methods for preventing seepage along top of existing cutoff wall and providing wall stability will be developed.

Comment 34. Preliminary design for flood protection at the Pump Station is being prepared and will be submitted for review as soon as possible.

Comment 35. If method 1 of flood protection is selected, independent anchorage and support of the discharge pipe will be provided which will not rigidly connect pipe to wall.

Comment 36. Independent anchorage/support will be provided if protection method 2 is chosen.

Comment 37.

(a) Tip elevations of sheet pile have been shown at the bridges on Plan and Profile Drawings.

(b) The difference in tip elevation of sheet pile at I-610 will be corrected.

(c) Tip elevations of sheet pile have been shown at floodwalls north of R. E. Lee.

Comment 38. Information only, does not require a response.

Comment 39.

(a) Sheet piling cost estimate will be revised as required.

(b) The recommended demolition cost of $100.00 per linear foot seem high to cut off sheet pile and allow to fall into canal.

Comment 40. A more detailed cost estimate will be provided when design at Pumping Station is complete.

Comment 41.

(a) Will add to Chapter VIII paragraph A.1.e. the pertinent information pertaining to I-wall at the Fire Station and at Crystal St..

(b) The need for future levee maintenance costs will be mentioned.

(c) Cost of test piles will be added to project.

Comment 42. Complete design calculations will be furnished as they are completed.

Comment 43.

(a) Approved concept for I-wall deflection will be used in design.

(b) Hand calculations will be provided for any computer program used to demonstrate that results are satisfactory.

(c) Bridge Modification Calculations

(1) A minimum of 12 inches for thickness on walls will be used.

(2) The reinforcement ratio, p, will be checked against, 0.25 pb.

(3) Shear reinforcement will be used if V_u exceeds 1/2 V_c.

(4) Concept of threaded bar straps has been abandoned.

(5) Concept of wall support has been revised.

(6) Pile reactions will be calculated using Hrennikoff Method.

(7) Concept of wall has been revised.

(8) Concrete cover for floodwalls will be 3 inches minimum.

(9) Concept of headwall has been revised.

Draft Geotechnical Investigation Feb 10 1986

Comment 1. The information concerning these analyses will be provided to the Corps when study of these specific areas have been completed by Design Engineering, Inc. and Eustis Engineering.

We trust these responses to your comments are satisfactory. We will furnish the remainder of the responses as soon as they are completed. Revised copies of the design memorandum pages along with pertinent design drawings will be furnished following modification to the existing design memorandum.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve

JH/mnh

Enclosures

cc: Mr. C. E. Bailey

August 13, 1986

Mr. Frederic M. Chatry
Chief, Engineering Division
Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Canal Flood Protection Project
OLB Project No. 2048-0278
DEI Project No. 1006

Dear Mr. Chatry:

We are in the process of developing a full reply to the tentative review comments contained in your August 6, 1986 letter pertaining to the proposed T-wall section at the 30-inch pipeline crossing of the Orleans Avenue Canal for the above referenced project.

In order to complete this reply an additional clarification relating to one of the comments is required. This clarification directly applies to comment No. 7. "In accordance with ETL 1110-1-265 a 1.9 load factor should be used for all design in lieu of the 1.5 load factor used."

We used a 1.5 load factor for dead load and a 1.9 factor for water pressure and uplift. This was in accord with our copy of the ETL. We were told that the use of the 1.9 factor for all loads was authorized in a separate memorandum. Our question is whether the use of the 1.9 factor for dead load is indeed mandatory or is it discretionary.

Admittedly the design calculations are measurably simplified by use of a common factor for all loadings as recommended. But this 26% increase in dead load can substantially effect structures with high dead load to external load ratios. Also our previous design of the bridge modifications must be corrected if the dead load factor is required to be 1.9 in lieu of 1.5.

Please send us a copy of the memorandum which authorized the change of load factors in ETL 1110-2-265.

Your early consideration of this request will be appreciated.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

JH/TS/ab

cc: Mr. C. E. Bailey, Chief Engineer

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

RECEIVED
SEP 3 1986
D. E. I.

REPLY TO
ATTENTION OF:
Engineering Division
Projects Engineering Section

August 28, 1986

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your August 13, 1986 letter requesting clarification of one of our comments contained in our August 6, 1986 letter pertaining to the proposed T-wall section at the 30-inch pipeline crossing of the Orleans Avenue Canal.

As requested please find enclosed a copy of the memorandum of the meeting held on October 22, 1985. It was at this meeting that the requirement for using the Corps modified strength design as per ETL 1110-2-265 but utilizing a load factor of 1.9 for all loads was made. However, for the T-wall design in question, a multiple load factor of 1.5 for dead load and 1.9 for live loads is acceptable provided the results obtained are compatible with the Working Stress Method of Design.

I trust that the foregoing is responsive to your needs. If I can be of further assistance in this matter, please let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosure

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JH ✓
TS ✓
MS 9/3

October 24, 1985

MEETING MEMORANDUM

Project:	Pontchartrain Beach Flood Protection Orleans Levee Board Project No. 2040-0204 DEI Project No. 1008 URS Project No. 565-04-73
Location:	Corps of Engineers - New Orleans Dist.
Meeting Date:	October 22, 1985
Time:	2:00 p.m.

Attendees:	Ron Elmer	C.O.E.
	Van Stutts	C.O.E.
	Jorge Romero	C.O.E.
	Jim Richardson	C.O.E.
	Janice Hote	C.O.E.
	John Holtgreve	DEI
	Tai Chen	URS
	Bruce Adams	URS

Topics of Discussion:

1) Net design elevations for the east and west ends of the project at the connections to the existing levees were verified to be 17.5 NGVD at each location.
2) By copy of this memorandum, URS is transmitting three (3) copies of DEI's conceptual design to the Corps.
3) Should the project geotechnical investigations determine that settlement along the project will approach 6 inches or greater, consideration should be given to installing the concrete caps after the over-built earthen sections have had time to settle through a phased construction schedule.
4) Where piling will be used in the project the Corps' preference is for prestressed precast concrete square piles as per their standard detail.
5) Structural design will involve the use of the Corps modified strength design as per Corps ETL 1110-2-265, but utilizing a load factor of 1.9 for all loads.
6) The gates for this project should be designed for combined hydrostatic and wave loading. Wind loading shall be considered for dry conditions. Swing gates should be the most cost efficient and easiest to design for this application rather than the roller gate type. The swing gate should be supported from a cantelever I-wall similar to the Corps' gate 5 shown in DM No. 13.

Encl.

7) In designing the pile foundations all lateral loading shall be from the gate to the bearing columns at each end of the gate. These gate monoliths will be designed as one section with vertical and batter piles beneath the wall-column sections and vertical piles only beneath the opening gated section. For pile load design, use service loads then apply load factors to develop design of the above structure. For pile design analysis, use Corps' Hrenicoff program. Corps will aid URS in use of program provided URS prepares correct input data.

8) Review of the geotechnical report by the Corps' should take approximately 2 weeks. In order to expedite such review, 3 copies of the report should be provided to the Corps.

Prepared by: Bruce H Adams
Bruce H. Adams, URS

Distribution: Attendees
Mr. Ed Bailey, OLB
Mr. Earl Magner, OLB
URS Company Files

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

January 12, 1987

RECEIVED
JAN 21 1987
D. E. I.

Engineering Division
Projects Engineering Section

Mr. John Holtgreve
Design Engineering, Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your August 12, 1986 and November 5, 1986 letters which provided responses to our comments on the geotechnical report and the general design memorandum on the Orleans Avenue Outfall Canal. You indicated in your August 12, 1986 letter that your response was a partial resolution of our comments and that resolution of comments not contained in the August 12 letter would be forthcoming. We had completed our review of your August 12 submittal and had not received any further resolution of the comments not addressed in that submittal. At your request we withheld our response until Eustis Engineering was able to complete their responses to our original comments. The Eustis Engineering responses were contained in your November 5, 1986 letter.

We have reviewed the two referenced submittals and offer the following:

For comments 9, 10, 11 and 15 made by Eustis Engineering in the August 12, 1986 submittal we offer:

Comment 9. Comparison of costs for a gross grade of 1 foot over net grade and future levee raising of .5 foot to 1 foot versus a gross grade of 1.5 feet to 2 feet over final net grade should be made.

Comment 10. Lower ground surfaces do exist in certain areas especially between station 50+00 and station 90+00 on the east side. These problem areas should be dealt with now so that a proper assessment of impacts on costs can be made. In this reach in particular these impacts could be substantial.

Comment 11. If the sand layers are not connected to the canal then the piezometric head for the canal side analyses may be higher than EL -5.0.

Comment 15. We recommend that NAVFAC DM-7, May 1982, particularly figure 9 on page 7.2-71, be used as a guide to determine passive pressures against an I-wall where the critical wedge

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is not against the wall. The factor of safety should be 1.5 applied to the soil design shear strengths.

For comments 10, 30, 37 and 39 made by DEI on the GDM in the August 12, 1986 submittal we offer;

9 DM COMMENTS

Comment 10. We assume that in the response by Eustis Engineering to which you refer the word "succeed" is in error and the word exceed was intended. If design criteria used by Eustis Engineering exceed Corps criteria then any resulting cost increase would not be creditable.

I-610 BRIDGE

Comment 30. The sheet pile tip elevation of -10 was shown in figure 15 and stated in chapter VII, paragraph VIIA of the GDM. A sheet pile tip elevation of -20 was used for Reach I west side of the canal while a tip elevation of -1 was used for the east side of the canal in the Draft Soils Engineering Report. Neither of these tip elevations agree with the tip elevation used in the GDM. We do not understand Eustis Engineering's response.

Comment 37. The sheet pile tip elevation at the bridge locations should be added to appendix A for clarity.

Comment 39. If it is your intent to dispose of the existing concrete cap on the floodside slope of the embankment and to serve as slope protection, the placement and sizing of the demolished concrete cap must meet Corps specifications.

For the November 5, 1986 submittal we offer the following;

1. Stability analyses were presented for the west side I-wall sections Sta. 0+00 to Sta. 90+00 with critical failure surfaces at the I-Wall tip. No analyses were presented to show if the I-Wall tip is adequate for a critical slope stability failure surface located above the tip.

2. No settlement analyses were presented for the reach II or reach III levee. The estimate of 1.0 to 1.5 feet of settlement for the reach II levee appears to be low.

3. Borings 15, 16 and 17 show the sand layer below EL. -18 in reach I, Sta. 30+00 to Sta. 50+00. Lowering the sand layer from EL. -17 will result in a factor of safety less than 1.30 for the east levee.

4. Between Sta. 93+97 and Sta. 128+82 on the east side there are areas of silt in the levee embankment. Seepage analyses should be made to determine if the I-Wall tip elevations are adequate for piping.

5. The elevations of the height of protection shown in the transition reach where the parallel system on the canal ties in with the lakefront levees appear to be in error. Find enclosed (Encl 1) profiles for the east and west side within the transition

reach which should be used.

6. Reference enclosures 1, 2, and 3 of your submittal. The Ø values used for the S-case should be 23° for clays and 30° for silts.

7. Please find enclosed wave force diagrams to be used along the canal from the lakefront levee to the end of the transition to determine whether the critical design case is (a) the stillwater level plus 2 feet freeboard with a factor of safety equal to 1.5 or (b) the stillwater level and a wave force with the factor of safety equal to 1.25. Enclosure 2 is a wave force diagram for the floodwall near the entrance to the canal, station 123+00 to 128+67; top of the floodwall is 17.5 or 18.0 feet NGVD and the base of the floodwall is at elevation +10.5. Enclosure 3 is a wave force diagram for the end of the floodwall transition near station 118+67; top of the wall is at elevation 13.6 and the base at elevation 9.5. Enclosure 4 is for a floodwall on a base of 9.5 in the reach from station 123+00 to 128+67. This diagram in conjunction with encl 3 can be used to interpolate the wave forces linearly along the transition reach of the floodwall, stations 118+67 to 123+00. Enclosures 2 and 4 can be used between stations 123+00 to 128+67 to linearly extrapolate wave forces where the elevation at the base of the floodwall varies from 9.5 and 10.5.

8. Reference enclosure 12 of your submittal. This enclosure shows the cutoff wall on the west side carrying an unbalanced load. The manner in which the cutoff wall will resist the unbalanced load should be presented.

9. It is our understanding that Eustis Engineering has been evaluating and analyzing piezometric data. It must be pointed out that depending on the results of this analysis the design sections presented may be affected.

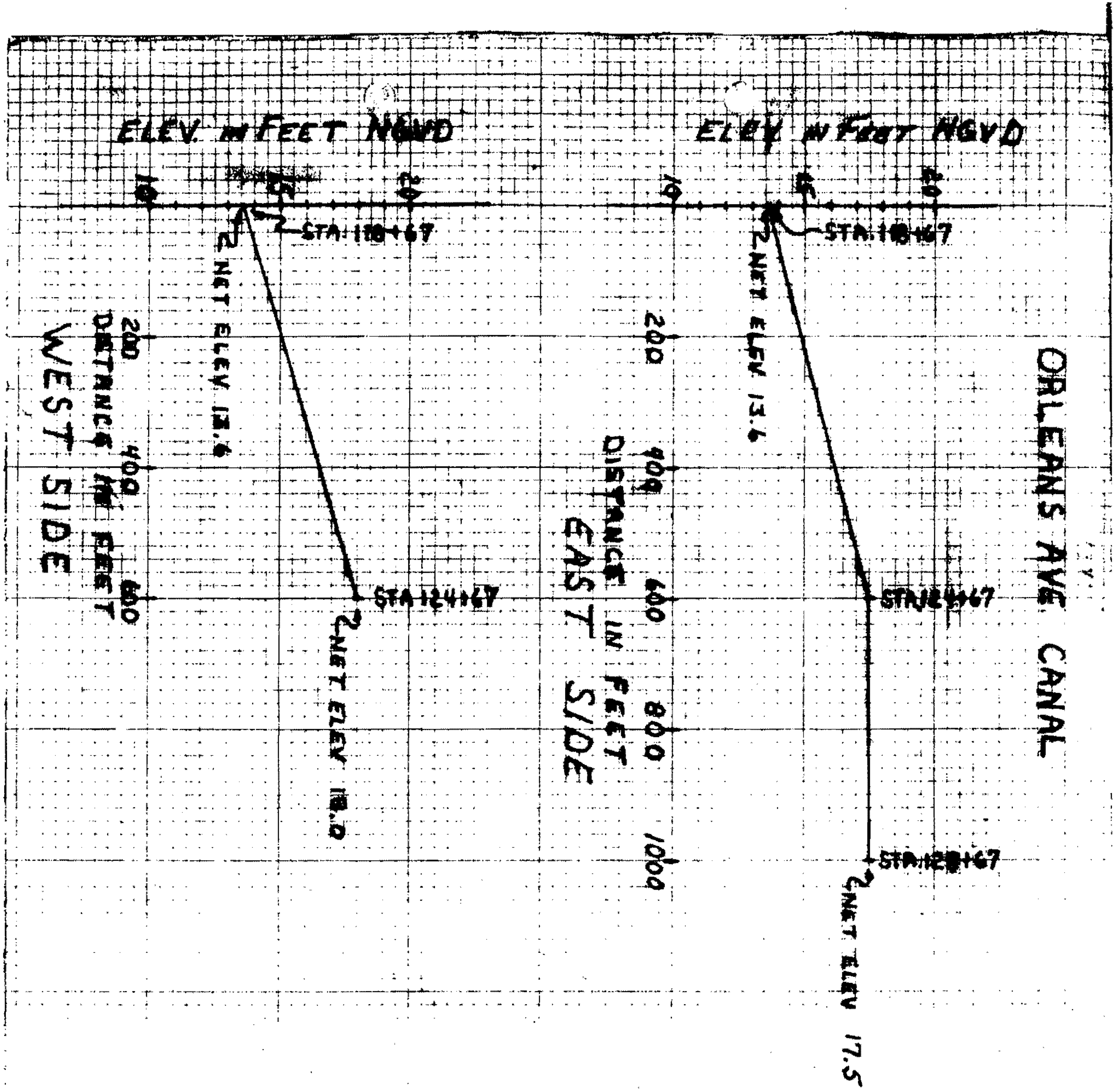
10. Eustis Engineering has indicated that additional cross-sections extending past the proposed levee sections have been developed by your office. It would be appreciated if those additional sections could be provided to us.

I trust the foregoing is responsive to your needs. If I can be of further assistance in this matter let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

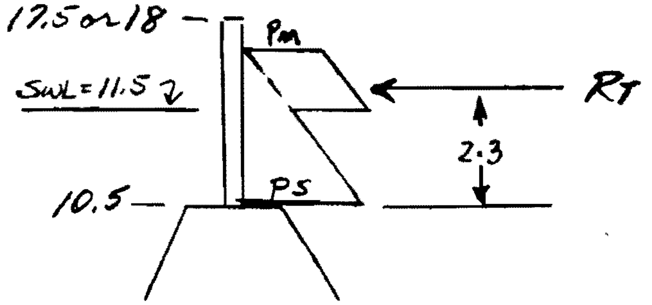
Enclosures


ORLEANS AVE. CANAL
WEST SIDE
ELEV. IN FEET NGVD
10
15
20
DISTANCE IN FEET
200
400
600
STA. 118+67
NET ELEV 13.6
STA. 124+67
NET ELEV 18.0
EAST SIDE
ELEV. IN FEET NGVD
10
15
20
DISTANCE IN FEET
200
400
600
800
1000
STA. 118+67
NET ELEV 13.6
STA. 124+67
STA. 128+67
NET ELEV 17.5

Encl 1

COMPUTATION SHEET

PROJECT Lake Port & [illegible] Hi Level Plan	PAGE 1 OF	COMPUTED BY JMH	DATE 13 Sep 86
SUBJECT Orleans Avenue Outfall Canal		CHECKED BY	DATE



$H_B = 5.0$ ft

$T = 7.3$ sec

$d_s = 11.5 - 10.5 = 1.0$

$h_c = .78 H_B = 3.9$

$d_B = H_B/.78 = 6.4$

$p_s = w(d_s + h_c) = 64(1+3.9) = 315$ #/ft²

$p_m = w d_B/2 = 64(6.4)/2 = 205$ #/ft²

$R_s = p_s(d_s + h_c)/2 = 315(1+3.9)/2 = 770$ #/ft

$R_m = p_m h_c = 205(3.9) = 800$ #/ft

$R_T = R_s + R_m = 770 + 800 = 1570$ #/ft

$M_s = R_s(d_s + h_c)/3 = 770(1+3.9)/3 = 1260$ ft #/ft

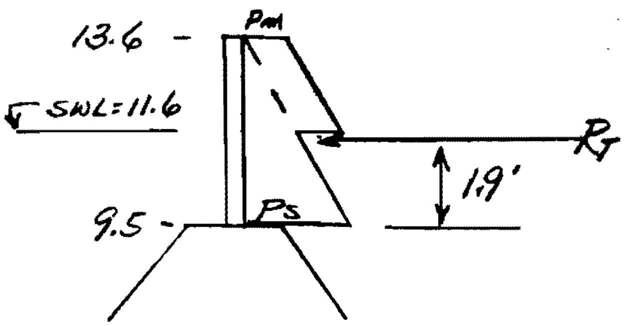
$M_m = R_m(d_s + h_c/2) = 800(1 + 3.9/2) = 2360$ ft #/ft

$M_T = M_s + M_m = 1260 + 2360 = 3620$ ft #/ft

$R_{T_{ELEV}} = \frac{M_T}{R_T} = \frac{3620}{1570} = 2.3 + 10.5 = 12.8$ ft ngvd

Encl 2

PROJECT Lake Pont. & Vic. - Hi Level Plan	PAGE 2 OF	COMPUTED BY JMH	DATE 15 Sep 86
SUBJECT Orleans Avenue Outfall Canal		CHECKED BY	DATE



$H_B = 2.7$ ft

$T = 7.3$ sec

$d_S = 11.6 - 9.5 = 2.1$

$h_c = .78(H_B) = 2.1$

$h' = 13.6 - 11.6 = 2.0$

$d_B = H_B/.78 = 3.5$

$p_S = w(d_S + h_c) = 64(2.1 + 2.1) = 270\ \#/ft^2$

$p_m = w d_B/2 = 64(3.5)/2 = 110\ \#/ft^2$

$R_S = p_S(d_S + h')/2 = 270(2.1 + 2)/2 = 550\ \#/ft$

$R_m = p_m h' = 110(2) = 220\ \#\ ft$

$R_T = R_S + R_m = 550 + 220 = 770\ \#/ft$

$M_S = R_S(d_S + h')/3 = 550(2.1 + 2)/3 = 750$ ft#/ft

$M_m = R_m(d_S + h'/2) = 220(2.1 + 2/2) = 680$ ft#/ft

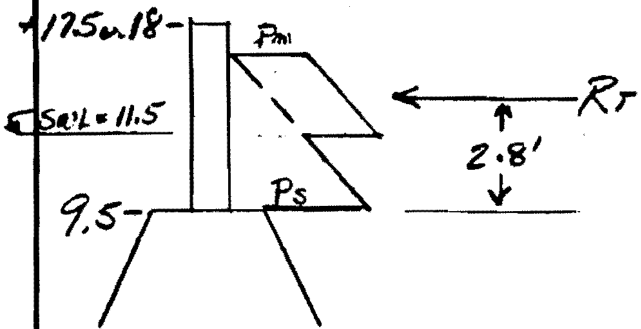
$M_T = M_S + M_m = 750 + 680 = 1430$ ft#/ft

$R_{T_{ELEV}} = \frac{M_T}{R_T} = \frac{1430}{770} = 1.9 + 9.5 = 11.4$ ft ngvd

Encl 3

COMPUTATION SHEET

PROJECT Lake Pont. & Vic. - Hi Level Plan	PAGE 3 OF	COMPUTED BY JMH	DATE 15 Sep 86
SUBJECT Orleans Avenue Outfall Canal		CHECKED BY	DATE



$H_B = 5.0$ ft.
$T = 7.3$ sec
$d_s = 11.5 - 9.5 = 2.0$
$h_c = .78\, H_B = .78(5) = 3.9$
$d_B = \frac{H_B}{.78} = \frac{5.0}{.78} = 6.4$

$p_s = w(d_s + h_c) = 64(2+3.9) = 380\ \#/ft^2$
$p_m = w d_B/2 = 64(6.4)/2 = 205\ \#/ft^2$
$R_s = p_s(d_s + h_c)/2 = 380(2+3.9)/2 = 1120\ \#/ft$
$R_m = p_m h_c = 205(3.9) = 800\ \#/ft$
$R_T = R_s + R_m = 1120 + 800 = 1920\ \#/ft$
$M_s = R_s(d_s + h_c)/3 = 1120(2+3.9)/3 = 2200$ ft#/ft
$M_m = R_m(d_s + \frac{h_c}{2}) = 800(2 + \frac{3.9}{2}) = 3160$ ft#/ft
$M_T = M_s + M_m = 2200 + 3160 = 5360$ ft#/ft

$R_{T_{ELEV}} = \frac{M_T}{R_T} = \frac{5360}{1920} = 2.8 + 9.5 = 12.3$ ft ngvd.

Encl. 4

EUSTIS ENGINEERING
GEOTECHNICAL ENGINEERS
3011 28th Street • Metairie, Louisiana 70002 • 504-834-0157

16 March 1987

U.S. Army Corps of Engineers
New Orleans District
Engineering Division
Post Office Box 60267
New Orleans, Louisiana 70160

Attention Mr. Ron Elmer

Gentlemen:

Piezometric Data
Orleans Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

As requested, we are forwarding data accumulated on piezometers and piezometer readings for the subject project.

Enclosure 1 is a summary of piezometer installation data. Enclosure 2 summarizes piezometer readings taken for the project.

If we can be of further assistance, please do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING

Lloyd A. Held, Jr.

Lloyd A. Held, Jr.

LAH:kdl

Enclosures

EE 9444

xc Design Engineering, Inc.
Attention John Holtgreve
E. Berkley Traughber and Associates
Attention Berkley Traughber

FILE 1006
WB ✓
JH ✓
MS ✓
TS T.S. took copy

PIEZOMETER INSTALLATION

Piezometer	Location	Elevation In Feet - NGVD Riser	Tip
P-1	Levee C/L	11.7	-21.3
P-2	Levee Toe	2.5	-17.5
P-3	±200' L.S. of C/L	1.0	-19.0
P-4	Levee C/L	12.5	-11.5
P-5	Levee Toe	7.4	- 9.6
P-6	±200' L.S. of C/L	5.4	-11.6

PIEZOMETER INSTALLATIONS

ORLEANS OUTFALL CANAL
OLB PROJECT NO. 2048-0304
NEW ORLEANS, LOUISIANA

PIEZOMETER DATA

Date	Orleans Canal Stages In Feet - NGVD		Piezometer Readings In Feet					
	Robert E. Lee Boulevard	Harrison Avenue	P-1	P-2	P-3	P-4	P-5	P-6
4/23/86	0.91	0.95	20.56	11.23	9.23	11.67	6.23	11.67
5/07/86	1.9	1.9	20.58	11.33	9.29	11.21	6.50	Broken
5/26/86	1.2	1.3	20.83	11.58	9.67	11.33	6.58	Broken
6/02/86	1.70	1.75	21.04	11.09	9.71	11.17	6.42	6.21
6/25/86	1.60	1.62	20.19	10.79	8.83	11.17	6.42	6.08
7/16/86	0.98	1.18	20.58	11.17	9.13	11.85	7.13	6.37
8/06/86	0.98	0.85	20.67	11.29	9.38	12.04	7.33	6.79
8/20/86	0.60	0.60	19.92	10.46	8.42	11.77	6.96	6.42
9/16/86	1.7	1.7	20.42	11.08	9.13	11.13	6.33	6.08
10/23/86	2.3	2.3	20.60	11.29	9.33	10.69	6.13	5.96
12/10/86	1.95	1.80	19.71	10.29	8.27	10.75	6.08	5.46

PIEZOMETER DATA

ORLEANS OUTFALL CANAL
OLB PROJECT NO. 2048-0304
NEW ORLEANS, LOUISIANA

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

RECEIVED
AUG 1987
D. E. I.

REPLY TO
ATTENTION OF:
Engineering Division
Projects Engineering Section

August 7, 1987

Mr. John Holtgreve
Design Engineering Incorporated
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference your letter of January 7, 1987 and your subsequent letter of transmittal dated July 7, 1987, both concerning Orleans Ave. Outfall Canal. Your January 7, 1987 letter provided preliminary plans for parallel protection from Robert E. Lee Blvd. to the lake and the proposed modifications to the bridges at Robert E. Lee Blvd., Harrison Ave., and Filmore Ave. The July 7, 1987 letter addressed comments from my office dated September 22, 1986. The preliminary plans are based on the Orleans Avenue Outfall Canal Soils Report by Eustis Engineering and the Orleans Avenue Canal Design Memorandum by your office. Several of our comments on those reports pertinent to these preliminary plans have not been satisfactorily resolved. Please refer to my letter dated January 12, 1987, in particular our response to Eustis Engineering's comment number 9, as well as comment numbers 2, 4, 5, 6, and 7. We have reviewed your two latest submittals and offer the following comments.

1. Sheet 7. "End West B/L" should be "End East B/L".

2. Sheet 8. There is no note following the number "1" under "Notes".

3. Sheet 9. The toe of the enlarged west levee is shown extending into the canal approximately between sta. 99+10 and sta. 101+10. The levee stability analysis must be revised since the levee fill cannot be semicompacted under water.

SENT TO EUSTIS 8/18

4. Sheet 11. The existing lakefront levee on the west side of the canal has been raised recently. The levee net elevation is 18.0 ft., not 17.5 ft. as shown. The new crown elevation and section should be shown on the west side profile.

1006

WB ✓
JH ✓ 8/7/87
TS ✓ 8/17/87
MS ✓ HAS COPY

5. Sheet 12. The minimum elevation of the levee crown for the two levee sections is +9.0; however, the I-wall stability analyses used by Eustis Engineering showed an elevation of +10.0. I-wall stability analyses should be furnished for a levee crown elevation of +9.0.

6. Sheets 12 and 13. A minimum crown width of 8 ft. is shown in the three levee sections; however, the crown width used by Eustis Engineering in their I-wall stability analyses was 10 ft. I-wall stability analyses for 8 ft. crown widths should be furnished. The existing levee sections from sta. 117+00 to sta. 129+24 have levee crown elevations that vary from +9.0 to +13.0. A crown elevation of +10.0 was used by Eustis Engineering for their flood side stability analyses. Flood side stability analyses should be presented with the highest crown elevation for each reach.

7. Sheet 14. Eustis Engineering analyzed 1V on 3H levee embankment slopes, but sections 1 through 3 have 1V on 4H flood side slopes; levee stability analyses should be presented for a levee embankment with 1V on 4H side slopes. On section 3, the net elevation for the west side levee at the end of the transition should be +18.0.

8. Sheets 16 and 22. Direction of flow should be shown to give definition to pump side and lake side.

9. Sheet 24. A copy of the plans for the existing siphon should be provided.

10. Sheet 24. No analyses were presented for the floodwalls above the east or west siphon.

11. Sheet 24, Section B. The levee enlargement and floodwall are being placed on the existing siphon. Analyses should be presented to demonstrate if the siphon pile foundation is adequate for the increased loading.

12. Sheet 24, Section C. The existing levee section should be degraded so that rainwater does not collect against the new floodwall.

13. Sheet 25, Section B. An excavation plan should be shown for the new floodwall and concrete struts over the siphon.

14. Sheets 15, 16, 17, 18, 20, 21, and 22. Top of I-wall elevations should be labeled "gross" or changed to reflect net elevations.

15. Reference the subject of floodproofing the Robert E. Lee Blvd. bridge. The pile capacities furnished by Eustis Engineering were for natural ground at elevation +10.0 and 0.0, but the bottom of the canal is elevation -9.0. Pile capacity curves for piles located in the center of the canal, for all three bridges, should be furnished.

16. No analyses were presented for floodproofing the Harrison Avenue and Filmore Avenue bridges. Unlike the Robert E. Lee Blvd and Filmore Avenue bridges, some of the Harrison Avenue bridge piling will be replaced; consequently, the maximum non-hurricane loading analyses should also be presented for Harrison Avenue bridge.

17. Page 6 of calculations. The "Dead load Mom" used is for a continuous beam of equal spans. The spans are not of equal lengths.

18. Page 7 of calculations. ρ exceeds the maximum ρ allowable in accordance with ETL 1110-2-265, which is 0.0073.

19. Page 16 of calculations. "Group Comb I & II" appears to include impact load. Therefore, the factors listed should be denoted as such.

20. Pages 23 & 24 of calculations. Under "Allowable Bending Stress", the calculations use a moment due to dead load and uplift, only. The stresses due to live loading and impact should be checked.

21. Page 25 of calculations. Under "Pull-Out Tension For Studs", your office should check EM 1110-1-2101, para 7.a. for an allowable concrete tension stress of $1.2\sqrt{(f'c)}$

22. Page 26 of calculations. Under "Work out No. of Studs Required", your office should check the requirements of AISC para 1.11, entitled "Composite Construction".

23. Page 42 of calculations. Concerning calculations on the design of steel in the wall, a check of ACI requirements for distribution of reinforcing steel in deep members should be made.

24. Page 51 of calculations. "Mom" has a math error (2,918.4 ft.-lbs. should be 3,699 ft.-lbs.). In addition, the moment calculation used is for a continuous beam of equal spans. The spans are not of equal lengths.

25. The calculations should address AASHTO para 3.24.9, entitled "Unsupported Transverse Edges", and para 3.6, entitled "Traffic Lanes" (including para 3.7.1.2).

26. Water stops should be placed so as to allow reinforcing to be placed on both sides.

I trust the foregoing is responsive to your needs. If I can be of further assistance in this matter, please let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

October 6, 1987

Mr. Ron Elmer, Project Coordinator
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Avenue Canal
Flood Protection Improvement Project
Geotechnical Review Comments
OLB Project No. 2048-0304
DEI Project No. 1006

Dear Mr. Elmer:

Enclosed herewith are three (3) copies of the Eustis Engineering response letter dated September 28, 1987. This response replies to the USACE comment letter dated January 12, 1987. The USACE January 12 comment letter addressed the Eustis Engineering submittals transmitted on August 12, 1986 and November 5, 1986. Several responses made by Design Engineering, Inc. on the General Design Memorandum which were included in the August 12th submittal are not pertinent to Eustis Engineering and are not responded to. Specifically these are comments, 10, 30, 37 and 39. These comments will be responded to in the near future by submittals from Design Engineering, Inc.

Also this response letter replies to several USACE comments in letter dated August 7, 1987 which regard the geotechnical aspects of the above referenced project. Specifically, USACE comments 3, 4, 5 and 6 of the August 7th letter are responded to. The remaining comments in this letter are not relative to geotechnical aspects and will be responded to in the near future by submittals from Design Engineering, Inc.

We believe this response letter is complete in that it answers all of the outstanding USACE comments which are relative to the geotechnical report for the project.

Should you have any questions, please do not hesitate to call us.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve, P.E.
Vice President

JH/mnh

Enclosures

cc: Mr. C. E. Bailey (w/1 copy)
Dr. E. B. Traughber (w/1 copy)
Mr. Lloyd Held (w/o encl.)
Eustis Engineering

EUSTIS ENGINEERING
GEOTECHNICAL ENGINEERS
3011 28th Street • Metairie, Louisiana 70002 • 504-834-0157

28 September 1987

Design Engineering, Inc.
Suite 205
3330 West Esplanade
Metairie, Louisiana 70002

File 1006

Attention Mr. John Holtgreve

WB
JH
TS

Gentlemen:

Geotechnical Investigation
U.S. Army Corps of Engineers Review Comments
General Design Memorandum
Orleans Avenue Outfall Canal
New Orleans, Louisiana

Reference is made to the U.S. Army Corps of Engineers (USACE) letter of 12 January 1987. The following is our resolution of the review comments in our geotechnical report and comments pertaining to the geotechnical aspects of your General Design Memorandum contained in that letter.

August 12, 1986 Submittal

Comment 9. Our estimate of levee setback and landside berm requirements for a 2-ft overbuild above net grade are shown below. Please refer to Enclosures 10 and 11 of our letter dated 30 October 1986. Setback distances tabulated below are in addition to the dimensions shown on those enclosures.

Reach	Net Grade (NGVD)	Landside Setback Distance: Centerline In Feet	Landside Setback Distance: Landside Toe In Feet	Required Canalside Berm Elev (NGVD)
I	13.6	10	20	3.0
II	17.5	10	20	5.0
III	18.0	15	30	5.5

Encl

These estimates are for cost comparison purposes. Should this alternative be selected, detailed stability analyses will have to be performed.

Comment 10. We understand Design Engineering, Inc. (DEI) will provide for raising low areas in the final plans and specifications.

Comment 11. Piezometric data presently being accumulated indicate hydrostatic levels in the Beach deposits along Orleans Canal to be below el -5.0. Piezometric data north of Robert E. Lee Boulevard for Reaches II and III indicate hydrostatic levels in the near surface silt and sandy silt strata to vary between approximate el 1.0 and el -1.0 and below the landside surface elevation. These strata, however, are not critical to our stability analyses. We have checked our analyses for these reaches assuming the piezometric heads within these strata to be at the landside surface elevation. Computer printouts of these analyses are appended as Enclosures 1 and 2.

Comment 15. Our analyses indicate translational failure planes incorporating passive wedges beyond the landside face of the I walls cannot generate unbalanced forces sufficient to shear the sheetpile section. Results of these analyses are shown on Enclosure 3. Therefore, our sheetpile analyses assume a rotational cantilever sheetpile failure resisted by passive pressures mobilized adjacent to the sheetpile wall. This is the analysis we have previously submitted. Enclosure 4 is a reanalysis of the translational stability of the wall assuming the most critical failure plane generated from the sheetpile tip.

November 5, 1986 Submittal

Comment 1. As discussed in our response to Comment 15 above, unbalanced soil forces above the sheetpile tip cannot shear the sheetpile section. Therefore, the tip elevation of the sheetpile will determine the depth of the failure surface. Enclosure 3 shows the results of our worst case analysis for Reach I - West, Station 50+00 to Station 90+00.

Comment 2. Computer analyses and assumptions are appended as Enclosure 5.

Comment 3. Borings 15 and 17 on the east side of this reach show the top of sand to be el -17.2 and el -18.7. We have modified the design section for the area in the vicinity of Boring 17 to consider the sand at el -18.7 from Station 40+00 to Station 50+00. Stability I-wall analyses for this reach are shown on Enclosure 6.

Comment 4. We have provided on Enclosure 7 a flow net analysis applicable to these areas. Our analyses indicate the minimum sheetpile penetration within Reaches II and III will provide a minimum factor of safety of 4.0 against a piping failure considering an all-silt embankment and foundation.

Comment 5. Our stability analyses for the Reach III levee (Station 121+00 to Station 127+00) considering a net grade at el 18.0 are shown on Enclosure 8.

Comment 6. Our assumption of 20° for consolidated drained shear strengths in some clay strata considers the high organic content present in these deposits. Our assumption of 25° for the silt strata reflects their high clay content. We feel these values are appropriate and recommended them for design.

Comment 7. Enclosure 9 is a summary of wave load interpolations based on data supplied to Eustis Engineering by the USACE in their letter of 12 January 1987 and at the locations requested by DEI. Analyses summarized on Enclosure 9 assume soil parameters previously used for these reaches and an 8-ft wide crown at the indicated elevations.

Comment 8. Enclosure 10 indicates the net pressure available to support a sheetpile cutoff below el -33.0. We recommend simple beam loading and the pressure distribution shown on Enclosure 10 to determine the reaction at the top of the sheetpile and sheetpile section.

Comment 9. Concur.

Comment 10. We understand these will be forwarded by DEI.

Reference is made to USACE's letter dated 7 August 1987. The following is our resolution of the review comments pertaining to the geotechnical aspects of your Phase I plan and specifications.

Comment 3. See Enclosure 11 for the stability analyses of this section.

Comment 4. See Enclosure 8 for the stability analysis of the levee with a net grade at el 18.0.

Comment 5. See Enclosure 9 for the results of the I-wall analysis for a levee crown at el 9.0 in this reach.

Comment 6.

a) See Enclosure 9 for the results of I-wall analyses considering an 8-ft wide crown.

b) Enclosure 10 of Eustis Engineering's letter of 30 October 1986 indicates a factor of safety of 1.31 for the existing levee having a crown at el 10.0 in Reach II (Stations 90+00 to 118+00). Therefore, all sections within this reach having crowns above el 10.0 should be degraded to el 10.0 to achieve an approximate 1.30 factor of safety. Enclosure 8 of this indicates a factor of safety of 1.34 for the existing levee having a crown at el 11.0 in Reach III (Stations 121+00 to 127+00). Therefore, all sections within this reach having crowns above el 11.0 should be degraded to el 11.0 to achieve the approximate factor of safety of 1.30.

We hope this fulfills your immediate needs. If you require further information or clarification, please do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING

Lloyd A. Held, Jr.

Lloyd A. Held, Jr.

W. W. Gwyn:bh

Enclosures 1 Through 14

EE 9155

FILE NAME = STABIIIF
11:29 AM THU., 20 AUG., 1987

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0010 ORLEANS CANAL
0010 REACH III FLOODSIDE
0010 10 1 2 1
0010 500
0010 0 62.5 0 0
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ASSUMES PIEZOMETRIC HEAD
AT EL 20 IN NEAR
SURFACE SILT STRATA

ENCLOSURE 1
(Sheet #1)

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-35.0	98868.	34412.	0.	163489.	3.84
510.0	-35.0	101881.	35148.	0.	160989.	3.61
515.0	-35.0	103576.	36728.	0.	158489.	3.50
520.0	-35.0	103900.	38227.	0.	155989.	3.46
525.0	-35.0	102748.	39475.	0.	153489.	3.51
530.0	-35.0	100161.	40531.	0.	150989.	3.64
535.0	-35.0	94576.	41550.	0.	148489.	4.00
540.0	-35.0	88033.	41782.	0.	145989.	4.52
545.0	-35.0	80956.	40674.	0.	143489.	5.25

CRIT. ACTIVE LOC 520.0 FT., EL -35.0 FT., DA 103900. LBF.,
RA 38227. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-35.0	42036.	20096.	0.	38617.	1.57
580.0	-35.0	43304.	20205.	0.	29937.	1.46
560.0	-35.0	47307.	21743.	0.	20000.	1.41
531.0	-35.0	58572.	25234.	0.	5500.	1.52

* * END * *

ENCLOSURE 1
(Sheet #2)

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -23.0 FT., DP 13792. LBF.
RP 8095. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-23.0	55143.	25358.	0.	103224.	3.31
510.0	-23.0	56756.	26734.	0.	100724.	3.15
515.0	-23.0	56925.	27913.	0.	98224.	3.11
520.0	-23.0	55682.	28943.	0.	95724.	3.17
525.0	-23.0	53062.	29889.	0.	93224.	3.34
530.0	-23.0	49195.	29548.	0.	90724.	3.63
535.0	-23.0	42473.	28231.	0.	88646.	4.36
540.0	-23.0	36341.	25676.	0.	86659.	5.34

CRIT. ACTIVE LOC 515.0 FT., EL -23.0 FT., DA 56925. LBF.,
RA 27913. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-23.0	13794.	8095.	0.	29827.	1.53
580.0	-23.0	14858.	8919.	0.	24915.	1.47
560.0	-23.0	17470.	11339.	0.	19091.	1.48
531.0	-23.0	24884.	14236.	0.	7963.	1.56

* * STRATUM 9, TEST PLANE 505. FT., EL. -35.0 FT. TO 900. FT.
EL. -35.0 FT.

P.H.L. 1 USED STRA. 9 AND 1 USED STRA. 10

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-35.0	4091.	2375.	500.	1114.	500.
368.0	-35.0	4091.	2375.	500.	1115.	500.
415.0	-35.0	5796.	2375.	500.	2222.	500.
425.0	-35.0	5796.	2375.	500.	2221.	500.
465.0	-35.0	4378.	2375.	500.	1301.	500.
470.0	-35.0	4203.	2375.	500.	1187.	500.
495.0	-35.0	4875.	2375.	500.	1624.	500.
505.0	-35.0	4875.	2375.	500.	1623.	500.
530.0	-35.0	4087.	2375.	500.	1112.	500.
531.0	-35.0	3643.	2375.	500.	823.	500.
554.0	-35.0	3526.	2375.	500.	747.	500.
570.0	-35.0	3175.	2375.	500.	519.	500.
SHEAR STRENGTHS ARE EQUAL 500.0 LBF AT DIST. 574.6 FT.						
600.0	-35.0	2978.	2375.	500.	391.	391.
1000.0	-35.0	2977.	2375.	500.	391.	391.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -35.0 FT., DP 42032. LBF.
RP 20095. LBF.

ENCLOSURE 1
(Sheet #3)

531.0	-18.0	1810.	1313.	350.	333.	333.
554.0	-18.0	[illegible]	1313.	350.	[illegible]	302.
570.0	-18.0	[illegible]	1313.	350.	[illegible]	208.
600.0	-18.0	1145.	1313.	350.	155.	155.
1000.0	-18.0	1144.	1313.	350.	155.	155.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -18.0 FT., DP 6608. LBF.
RP 5600. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-18.0	40147.	21197.	0.	72417.	2.96
510.0	-18.0	41440.	22744.	0.	70667.	2.84
515.0	-18.0	41296.	24106.	0.	68917.	2.84
520.0	-18.0	39801.	25427.	0.	67167.	2.96
525.0	-18.0	36949.	25735.	0.	65417.	3.19
530.0	-18.0	33258.	25475.	0.	63667.	3.55
535.0	-18.0	27323.	23610.	0.	61996.	4.40

CRIT. ACTIVE LOC 510.0 FT., EL -18.0 FT., DA 41440. LBF.,
RA 22744. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-18.0	6609.	5600.	0.	24175.	1.51
580.0	-18.0	7519.	6560.	0.	20723.	1.47
560.0	-18.0	9751.	8159.	0.	16359.	1.49
531.0	-18.0	14988.	9646.	0.	7349.	1.50

* * STRATUM 8, TEST PLANE 505. FT., EL. -23.0 FT. TO 900. FT.
EL. -23.0 FT.

P.H.L. 1 USED STRA. 8 AND 1 USED STRA. 9

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-23.0	2843.	1625.	526.	500.	500.
368.0	-23.0	2843.	1625.	526.	500.	500.
415.0	-23.0	4548.	1625.	983.	500.	500.
425.0	-23.0	4548.	1625.	983.	500.	500.
465.0	-23.0	3130.	1625.	603.	500.	500.
470.0	-23.0	2955.	1625.	556.	500.	500.
495.0	-23.0	3627.	1625.	736.	500.	500.
505.0	-23.0	3627.	1625.	736.	500.	500.
530.0	-23.0	2839.	1625.	525.	500.	500.
SHEAR STRENGTHS ARE EQUAL 500.0 LBF AT DIST. 530.2 FT.						
531.0	-23.0	2395.	1625.	406.	500.	406.
554.0	-23.0	2278.	1625.	375.	500.	375.
570.0	-23.0	1927.	1625.	281.	500.	281.
600.0	-23.0	1730.	1625.	228.	500.	228.
1000.0	-23.0	1729.	1625.	228.	500.	228.

ENCLOSURE 1
(Sheet #4)

425.0	-10.0	3131.	813.	280.	350.	280.
465.0	-10.0	[illegible]	813.	280.	[illegible]	280.
470.0	-10.0	[illegible]	813.	280.	[illegible]	280.
495.0	-10.0	2210.	813.	280.	350.	280.
505.0	-10.0	2210.	813.	280.	350.	280.
530.0	-10.0	1422.	813.	280.	350.	280.
531.0	-10.0	978.	813.	280.	350.	280.
554.0	-10.0	861.	813.	280.	350.	280.
570.0	-10.0	510.	813.	280.	350.	280.
600.0	-10.0	313.	813.	280.	350.	280.
1000.0	-10.0	312.	813.	280.	350.	280.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -10.0 FT., DP 781. LBF
RP -0. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-10.0	21518.	17964.	0.	110600.	6.20
510.0	-10.0	21836.	19318.	0.	109200.	6.10
515.0	-10.0	20730.	20239.	0.	107800.	6.42
520.0	-10.0	18615.	19979.	0.	106400.	7.09
525.0	-10.0	15729.	19209.	0.	105000.	8.31
530.0	-10.0	12790.	16211.	0.	103600.	9.98
535.0	-10.0	8516.	13213.	0.	102200.	14.92

CRIT. ACTIVE LOC 510.0 FT., EL -10.0 FT., DA 21836. LBF.,
RA 19318. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-10.0	781.	0.	0.	25200.	2.11
580.0	-10.0	969.	1600.	0.	19600.	1.94
560.0	-10.0	2137.	2970.	0.	14000.	1.84
531.0	-10.0	4342.	4250.	0.	5880.	1.68

* * STRATUM 7, TEST PLANE 505. FT., EL. -18.0 FT. TO 900. FT.
EL. -18.0 FT.

P.H.L. 1 USED STRA. 7 AND 1 USED STRA. 8

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-18.0	2258.	1313.	350.	453.	350.
368.0	-18.0	2258.	1313.	350.	453.	350.
415.0	-18.0	3963.	1313.	350.	910.	350.
425.0	-18.0	3963.	1313.	350.	910.	350.
465.0	-18.0	2545.	1313.	350.	530.	350.
470.0	-18.0	2370.	1313.	350.	483.	350.
495.0	-18.0	3042.	1313.	350.	663.	350.
505.0	-18.0	3042.	1313.	350.	663.	350.
530.0	-18.0	2254.	1313.	350.	452.	350.

ENCLOSURE 1
(Sheet #5)

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-5.0	916.	500.	311.	280.	280.
368.0	-5.0	916.	500.	312.	280.	280.
415.0	-5.0	2621.	500.	768.	280.	280.
425.0	-5.0	2621.	500.	768.	280.	280.
465.0	-5.0	1203.	500.	388.	280.	280.
470.0	-5.0	1028.	500.	342.	280.	280.
495.0	-5.0	1700.	500.	522.	280.	280.
505.0	-5.0	1700.	500.	521.	280.	280.
530.0	-5.0	912.	500.	310.	280.	280.
SHEAR STRENGTHS ARE EQUAL 280.0 LBF AT DIST. 530.3 FT.						
531.0	-5.0	468.	500.	191.	280.	191.
554.0	-5.0	351.	500.	160.	280.	160.
570.0	-5.0	0.	500.	66.	280.	66.
STRATUM 5 STARTS FAILURE POSSIBLE FROM DIST. 570.0 FT.						
600.0	-5.0	0.	500.	66.	999999.	66.
1000.0	-5.0	-0.	500.	66.	999999.	66.

ASSUMED CRIT. PASSIVE LOC. 550.0 FT., EL. -5.0 FT., DP 558. LBF.
RP 1104. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-5.0	12456.	16518.	0.	10638.	2.38
510.0	-5.0	12139.	17439.	0.	9238.	2.40
515.0	-5.0	10810.	17179.	0.	7838.	2.55
520.0	-5.0	8713.	16410.	0.	6438.	2.94
525.0	-5.0	6563.	13412.	0.	5038.	3.26
530.0	-5.0	4720.	10414.	0.	3638.	3.64

CRIT. ACTIVE LOC 505.0 FT., EL -5.0 FT., DA 12456. LBF.,
RA 16518. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
531.0	-5.0	884.	1582.	0.	7247.	2.19

* * STRATUM 6, TEST PLANE 505. FT., EL. -10.0 FT. TO 900. FT.
EL. -10.0 FT.

P.H.L. 1 USED STRA. 6 AND 1 USED STRA. 7

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-10.0	1426.	813.	280.	350.	280.
368.0	-10.0	1426.	813.	280.	350.	280.

ENCLOSURE 1
(Sheet #6)

P.H.L 1 USED STRA. 9 AND 1 U) STRA. 10

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-35.0	4091.	2375.	500.	1114.	500.
368.0	-35.0	4091.	2375.	500.	1115.	500.
415.0	-35.0	5796.	2375.	500.	2222.	500.
425.0	-35.0	5796.	2375.	500.	2221.	500.
465.0	-35.0	4378.	2375.	500.	1301.	500.
470.0	-35.0	4203.	2375.	500.	1187.	500.
495.0	-35.0	4875.	2375.	500.	1624.	500.
505.0	-35.0	4875.	2375.	500.	1623.	500.
530.0	-35.0	4087.	2375.	500.	1112.	500.
531.0	-35.0	3643.	2375.	500.	823.	500.
554.0	-35.0	3526.	2375.	500.	747.	500.
570.0	-35.0	3175.	2375.	500.	519.	500.
SHEAR STRENGTHS ARE EQUAL 500.0 LBF AT DIST. 574.6 FT.						
600.0	-35.0	2978.	2375.	500.	391.	391.
1000.0	-35.0	2977.	2375.	500.	391.	391.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -35.0 FT., DP 42032. LBF.
RP 20095. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
425.0	-35.0	132332.	39679.	0.	203489.	2.92
430.0	-35.0	137522.	41255.	0.	200989.	2.75
435.0	-35.0	140989.	42551.	0.	198489.	2.64
440.0	-35.0	142835.	43756.	0.	195989.	2.58
445.0	-35.0	142951.	44675.	0.	193489.	2.56
450.0	-35.0	141356.	45338.	0.	190989.	2.58
455.0	-35.0	138163.	45952.	0.	188489.	2.65
460.0	-35.0	133267.	46323.	0.	185989.	2.77
465.0	-35.0	126779.	46659.	0.	183489.	2.95
470.0	-35.0	118909.	46280.	0.	180989.	3.22

CRIT. ACTIVE LOC 445.0 FT., EL -35.0 FT., DA 142951. LBF.,
RA 44675. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-35.0	42036.	20096.	0.	76117.	1.40
580.0	-35.0	43304.	20205.	0.	67437.	1.33
560.0	-35.0	47307.	21743.	0.	57500.	1.30
531.0	-35.0	58572.	25234.	0.	43000.	1.34

* * STRATUM 5, TEST PLANE 505. FT., EL. -5.0 FT. TO 550. FT.
EL. -5.0 FT.

P.H.L. 1 USED STRA. 5 AND 1 USED STRA. 6

* * STRATUM 8, TEST PLANE 425. FT., EL. -23.0 [illegible].. TO 900. FT.
EL. -23.0 FT.

P.H.L. 1 USED STRA. 8 AND 1 USED STRA. 9

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-23.0	2843.	1625.	526.	500.	500.
368.0	-23.0	2843.	1625.	526.	500.	500.
415.0	-23.0	4548.	1625.	983.	500.	500.
425.0	-23.0	4548.	1625.	983.	500.	500.
465.0	-23.0	3130.	1625.	603.	500.	500.
470.0	-23.0	2955.	1625.	556.	500.	500.
495.0	-23.0	3627.	1625.	736.	500.	500.
505.0	-23.0	3627.	1625.	736.	500.	500.
530.0	-23.0	2839.	1625.	525.	500.	500.

SHEAR STRENGTHS ARE EQUAL 500.0 LBF AT DIST. 530.2 FT.

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
531.0	-23.0	2395.	1625.	406.	500.	406.
554.0	-23.0	2278.	1625.	375.	500.	375.
570.0	-23.0	1927.	1625.	281.	500.	281.
600.0	-23.0	1730.	1625.	228.	500.	228.
1000.0	-23.0	1729.	1625.	228.	500.	228.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -23.0 FT., DP 13792. LBF.
RP 8095. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
425.0	-23.0	82427.	31067.	0.	143224.	2.66
430.0	-23.0	85696.	32133.	0.	140724.	2.52
435.0	-23.0	87259.	32961.	0.	138224.	2.44
440.0	-23.0	87142.	33588.	0.	135724.	2.42
445.0	-23.0	85404.	34121.	0.	133224.	2.45
450.0	-23.0	81986.	34458.	0.	130724.	2.54
455.0	-23.0	77004.	34674.	0.	128224.	2.71
460.0	-23.0	70873.	34017.	0.	125724.	2.94
465.0	-23.0	63867.	33135.	0.	123224.	3.28

CRIT. ACTIVE LOC 440.0 FT., EL -23.0 FT., DA 87142. LBF.,
RA 33588. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-23.0	13794.	8095.	0.	67327.	1.49
580.0	-23.0	14858.	8919.	0.	62415.	1.45
560.0	-23.0	17470.	11339.	0.	56591.	1.46
531.0	-23.0	24884.	14236.	0.	45463.	1.50

ENCLOSURE
(Sheet #8

* * STRATUM 9, TEST PLANE 425. FT., EL. -35.0 FT. TO 900. FT.

600.0	-10.0	781.	0.	0.	46200.	1.67
580.0	-10.0	69.	1600.	0.	10600.	1.58
560.0	-10.0	2137.	2970.	0.	35000.	1.52
531.0	-10.0	4342.	4250.	0.	26880.	1.43

* * STRATUM 7, TEST PLANE 425. FT., EL. -18.0 FT. TO 900. FT.
EL. -18.0 FT.

P.H.L. 1 USED STRA. 7 AND 1 USED STRA. 8

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-18.0	2258.	1313.	350.	453.	350.
368.0	-18.0	2258.	1313.	350.	453.	350.
415.0	-18.0	3963.	1313.	350.	910.	350.
425.0	-18.0	3963.	1313.	350.	910.	350.
465.0	-18.0	2545.	1313.	350.	530.	350.
470.0	-18.0	2370.	1313.	350.	483.	350.
495.0	-18.0	3042.	1313.	350.	663.	350.
505.0	-18.0	3042.	1313.	350.	663.	350.
530.0	-18.0	2254.	1313.	350.	452.	350.
SHEAR STRENGTHS ARE EQUAL 350.0 LBF AT DIST. 530.9 FT.						
531.0	-18.0	1810.	1313.	350.	333.	333.
554.0	-18.0	1693.	1313.	350.	302.	302.
570.0	-18.0	1342.	1313.	350.	208.	208.
600.0	-18.0	1145.	1313.	350.	155.	155.
1000.0	-18.0	1144.	1313.	350.	155.	155.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -18.0 FT., DP 6609. LBF.
RP 5600. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
425.0	-18.0	64157.	24794.	0.	100417.	2.27
430.0	-18.0	67005.	26045.	0.	98667.	2.16
435.0	-18.0	68146.	27047.	0.	96917.	2.11
440.0	-18.0	67692.	28001.	0.	95167.	2.11
445.0	-18.0	65530.	28713.	0.	93417.	2.17
450.0	-18.0	61795.	29414.	0.	91667.	2.30
455.0	-18.0	56759.	29232.	0.	89917.	2.49
460.0	-18.0	50836.	28940.	0.	88167.	2.77

CRIT. ACTIVE LOC 435.0 FT., EL -18.0 FT., DA 68146. LBF.,
RA 27047. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
600.0	-18.0	6609.	5600.	0.	50425.	1.35
580.0	-18.0	7519.	6560.	0.	46973.	1.33
560.0	-18.0	9751.	8159.	0.	42609.	1.33
531.0	-18.0	14988.	9646.	0.	33599.	1.32

ENCLOSURE 1
(Sheet #9)

CRIT. ACTIVE LOC 43[illegible].0 FT., EL -5.0 FT., DA [illegible]7133. LBF.,
RA 20033. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
531.0	-5.0	884.	1582.	0.	28247.	1.77

* * STRATUM 6, TEST PLANE 425. FT., EL. -10.0 FT. TO 900. FT.
EL. -10.0 FT.

P.H.L. 1 USED STRA. 6 AND 1 USED STRA. 7

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-10.0	1426.	813.	280.	350.	280.
368.0	-10.0	1426.	813.	280.	350.	280.
415.0	-10.0	3131.	813.	280.	350.	280.
425.0	-10.0	3131.	813.	280.	350.	280.
465.0	-10.0	1713.	813.	280.	350.	280.
470.0	-10.0	1538.	813.	280.	350.	280.
495.0	-10.0	2210.	813.	280.	350.	280.
505.0	-10.0	2210.	813.	280.	350.	280.
530.0	-10.0	1422.	813.	280.	350.	280.
531.0	-10.0	978.	813.	280.	350.	280.
554.0	-10.0	861.	813.	280.	350.	280.
570.0	-10.0	510.	813.	280.	350.	280.
600.0	-10.0	313.	813.	280.	350.	280.
1000.0	-10.0	312.	813.	280.	350.	280.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -10.0 FT., DP 781. LBF.
RP -0. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
425.0	-10.0	40641.	21051.	0.	133000.	3.86
430.0	-10.0	42253.	22042.	0.	131600.	3.70
435.0	-10.0	42182.	22833.	0.	130200.	3.70
440.0	-10.0	40494.	23534.	0.	128800.	3.84
445.0	-10.0	37313.	23749.	0.	127400.	4.14
450.0	-10.0	33161.	23457.	0.	126000.	4.62
455.0	-10.0	28277.	22241.	0.	124600.	5.34
460.0	-10.0	23644.	20049.	0.	123200.	6.27

CRIT. ACTIVE LOC 435.0 FT., EL -10.0 FT., DA 42182. LBF.,
RA 22833. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS

ENCLOSURE 1
(Sheet #10

FILE NAME = STABOUT
11:24 AM THU., 20 AUG., 1987

* STABILITY WITH UPLIFT *

ORLEANS CANAL
REACH III FLOODSIDE

10 STRATA
11 PROFILES
1 VERTICALS
UPLIFT WITH 1 PIEZOMETRIC GRADE LINES

* * STRATUM 5, TEST PLANE 425. FT., EL. -5.0 FT. TO 550. FT.
EL. -5.0 FT.

P.H.L. 1 USED STRA. 5 AND 1 USED STRA. 6

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-5.0	916.	500.	311.	280.	280.
368.0	-5.0	916.	500.	312.	280.	280.
415.0	-5.0	2621.	500.	768.	280.	280.
425.0	-5.0	2621.	500.	768.	280.	280.
465.0	-5.0	1203.	500.	388.	280.	280.
470.0	-5.0	1028.	500.	342.	280.	280.
495.0	-5.0	1700.	500.	522.	280.	280.
505.0	-5.0	1700.	500.	521.	280.	280.
530.0	-5.0	912.	500.	310.	280.	280.
SHEAR STRENGTHS ARE EQUAL 280.0 LBF AT DIST. 530.3 FT.						
531.0	-5.0	468.	500.	191.	280.	191.
554.0	-5.0	351.	500.	160.	280.	160.
570.0	-5.0	0.	500.	66.	280.	66.
STRATUM 5 STARTS FAILURE POSSIBLE FROM DIST. 570.0 FT.						
600.0	-5.0	0.	500.	66.	999999.	66.
1000.0	-5.0	-0.	500.	66.	999999.	66.

ASSUMED CRIT. PASSIVE LOC. 550.0 FT., EL. -5.0 FT., DP 558. LBF.
RP 1104. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
425.0	-5.0	28317.	19242.	0.	33038.	1.92
430.0	-5.0	29133.	20033.	0.	31638.	1.85
435.0	-5.0	28331.	20734.	0.	30238.	1.88
440.0	-5.0	26038.	20949.	0.	28838.	2.00
445.0	-5.0	22771.	20657.	0.	27438.	2.21
450.0	-5.0	18775.	19442.	0.	26038.	2.56

ENCLOSURE 1
(Sheet #11)

```
FILE NAME =  STABIIF
                    11:10 AM  THU., 20  AUG., 1987

0010 ORLEANS CANAL
0010 REACH II FLOODSIDE STABILITY
0010 9 1 2 1
0010 500
0010 0 110 400 400
0010 0 62.5 0 0
0010 0 112 700 700
0010 0 112 600 600
0010 0 102 280 280
0010 15 117 200 200
0010 0 104 350 350
0010 0 104 500 500
0010 33 122 0 0
0010 0 0 408 0 447 14.6 457 14.6
0010 480 5 495 10 505 10
0010 530 2 538 0 556 -5 1000 -5
0010 9999.9 0
0010 0 0 467 0 480 5 495 10
0010 505 10 530 2
0010 538 0 556 -5 1000 -5 9999.9 0
0010 0 0 467 0 480 5 495 10
0010 505 10 530 2
0010 538 0 582 -12 1000 -12 9999.9 0
0010 0 0 467 0 472 2 530 2
0010 538 0 582 -12 1000 -12 9999.9 0
0010 0 0 538 0 582 -12 1000 -12
0010 9999.9 0
0010 0 -5 556 -5 582 -12 1000 -12
0010 9999.9 0
0010 0 -12 1000 -12 9999.9 0
0010 0 -20 1000 -20 9999.9 0
0010 0 -35 1000 -35 9999.9 0
0010 0 -42 1000 -42 9999.9 0
0010 0 0 1000 0 9999.9 0
0010 1 1 1 1 1 1 1 1 1 1 1 1
0010 1 1 1 1 1 1
0010 5 457.1 -5 550 -5 3
0010 556 540 538
0010 6 457.1 -12 580 -12 3
0010 580 560 538
0010 5 505 -5 550 -5 3
0010 556 540 538
0010 6 505 -12 580 -12 3
0010 580 560 538
0010 7 457.1 -20 900 -20 3
0010 580 560 538
0010 7 505 -20 900 -20 3
0010 580 560 538
```

ASSUMES PIEZOMETRIC HEAD AT EL 0.0 IN NEAR SURFACE SILT STRATA

ENCLOSURE 2
(Sheet #1)

[illegible]	-20.0	2181.	1250.	350.	500.	350.
447.0	-20.0	3767.	1250.	350.	500.	350.
457.0	-20.0	[illegible]7.	1250.	350.	[illegible]	350.
467.0	-20.0	[illegible]08.	1250.	350.	[illegible]0.	350.
472.0	-20.0	3082.	1250.	350.	500.	350.
480.0	-20.0	2721.	1250.	350.	500.	350.
495.0	-20.0	3281.	1250.	350.	500.	350.
505.0	-20.0	3281.	1250.	350.	500.	350.
530.0	-20.0	2385.	1250.	350.	500.	350.
538.0	-20.0	2161.	1250.	350.	500.	350.
556.0	-20.0	1651.	1250.	350.	500.	350.
582.0	-20.0	1270.	1250.	350.	500.	350.
1000.0	-20.0	1269.	1250.	350.	500.	350.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -20.0 FT., DP 8357. LBF.
RP 5600. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-20.0	44879.	21948.	0.	138250.	4.54
510.0	-20.0	46715.	23811.	0.	136500.	4.33
515.0	-20.0	46869.	25522.	0.	134750.	4.31
520.0	-20.0	45220.	26864.	0.	133000.	4.49
525.0	-20.0	41950.	27525.	0.	131250.	4.89
530.0	-20.0	37625.	27008.	0.	129500.	5.54
535.0	-20.0	32576.	25418.	0.	127750.	6.56
540.0	-20.0	27846.	21617.	0.	126000.	7.86

CRIT. ACTIVE LOC 515.0 FT., EL -20.0 FT., DA 46869. LBF.
RA 25522. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
580.0	-20.0	8388.	5600.	0.	22750.	1.40
560.0	-20.0	10758.	6646.	0.	15750.	1.33
538.0	-20.0	16998.	9514.	0.	8050.	1.44

* * END * *

ENCLOSURE 2
(Sheet #2)

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-20.0	2161.	1250.	350.	500.	350.
408.0	-20.0	2161.	1250.	350.	500.	350.
447.0	-20.0	3767.	1250.	350.	500.	350.
457.0	-20.0	3767.	1250.	350.	500.	350.
467.0	-20.0	3308.	1250.	350.	500.	350.
472.0	-20.0	3082.	1250.	350.	500.	350.
480.0	-20.0	2721.	1250.	350.	500.	350.
495.0	-20.0	3281.	1250.	350.	500.	350.
505.0	-20.0	3281.	1250.	350.	500.	350.
530.0	-20.0	2385.	1250.	350.	500.	350.
538.0	-20.0	2161.	1250.	350.	500.	350.
556.0	-20.0	1651.	1250.	350.	500.	350.
582.0	-20.0	1270.	1250.	350.	500.	350.
1000.0	-20.0	1269.	1250.	350.	500.	350.

ASSUMED CRIT. PASSIVE LOC. 900.0 FT., EL. -20.0 FT., DP 8357. LBF.
RP 5600. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
457.1	-20.0	57612.	22868.	0.	155015.	3.73
462.1	-20.0	60133.	24076.	0.	153265.	3.53
467.1	-20.0	60656.	25110.	0.	151515.	3.48
472.1	-20.0	59025.	25669.	0.	149765.	3.57
477.1	-20.0	55440.	26099.	0.	148015.	3.82
482.1	-20.0	50240.	26075.	0.	146265.	4.25
487.1	-20.0	45502.	25618.	0.	144515.	4.73
492.1	-20.0	42077.	24667.	0.	142765.	5.13

CRIT. ACTIVE LOC 467.1 FT., EL -20.0 FT., DA 60656. LBF.,
RA 25110. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
580.0	-20.0	8388.	5600.	0.	39515.	1.34
560.0	-20.0	10758.	6646.	0.	32515.	1.29
538.0	-20.0	16998.	9514.	0.	24815.	1.36

* * STRATUM 7, TEST PLANE 505. FT., EL. -20.0 FT. TO 900. FT.
EL. -20.0 FT.

P.H.L. 1 USED STRA. 7 AND 1 USED STRA. 8

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-20.0	2161.	1250.	350.	500.	350.

* * STRATUM 6, TEST PLANE 505. FT., EL. -12.0 FT. TO 580. FT.
EL. -12.0 FT.

P.H.L. 1 USED STRA. 6 AND 1 USED STRA. 7

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-12.0	1329.	750.	355.	350.	350.
408.0	-12.0	1329.	750.	355.	350.	350.
447.0	-12.0	2935.	750.	785.	350.	350.
457.0	-12.0	2935.	750.	785.	350.	350.
467.0	-12.0	2476.	750.	662.	350.	350.
472.0	-12.0	2250.	750.	602.	350.	350.
480.0	-12.0	1889.	750.	505.	350.	350.
495.0	-12.0	2449.	750.	655.	350.	350.
505.0	-12.0	2449.	750.	655.	350.	350.
530.0	-12.0	1553.	750.	415.	350.	350.
538.0	-12.0	1329.	750.	355.	350.	350.
SHEAR STRENGTHS ARE EQUAL 350.0 LBF AT DIST. 538.7 FT.						
556.0	-12.0	819.	750.	218.	350.	218.
582.0	-12.0	438.	750.	116.	350.	116.
1000.0	-12.0	437.	750.	116.	350.	116.

ASSUMED CRIT. PASSIVE LOC. 580.0 FT., EL. -12.0 FT., DP 1537. LBF.
RP 125. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
505.0	-12.0	25242.	19260.	0.	20822.	1.70
510.0	-12.0	25758.	20770.	0.	19072.	1.65
515.0	-12.0	24524.	22004.	0.	17322.	1.72
520.0	-12.0	21993.	21614.	0.	15572.	1.82
525.0	-12.0	18567.	21097.	0.	13822.	2.06
530.0	-12.0	14808.	17532.	0.	12072.	2.24
535.0	-12.0	11595.	13776.	0.	10322.	2.41

CRIT. ACTIVE LOC 510.0 FT., EL -12.0 FT., DA 25758. LBF.,
RA 20770. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
580.0	-12.0	1537.	125.	0.	19072.	1.65
560.0	-12.0	2239.	1823.	0.	15803.	1.63
538.0	-12.0	5773.	5994.	0.	9800.	1.83

* * STRATUM 7, TEST PLANE 457. FT., EL. -20.0 FT. TO 900. FT.
EL. -20.0 FT.

P.H.L. 1 USED STRA. 7 AND 1 USED STRA. 8

ENCLOSURE 2
(Sheet #4)

DIS.	EL.	DP	RP	DB	RB	FS
(FT)	(FT)	(LBF)	(LBF)	(LBF)	(LBF)	
580.0	-12.0	1537.	125.	0.	35837.	1.60
560.0	-12.0	2239.	1823.	0.	32568.	1.59
538.0	-12.0	5773.	5994.	0.	26565.	1.71

* * STRATUM 5, TEST PLANE 505. FT., EL. -5.0 FT. TO 550. FT.
EL. -5.0 FT.

P.H.L. 1 USED STRA. 5 AND 1 USED STRA. 6

ASSUMED FAILURE SURFACE DATA

DIST.	ELEV.	WT.	UPLIFT	STR 1	STR 2	STR USED
(FT)	(FT)	(LBF)	(LBF)	(LBF)	(LBF)	(LBF)
0.0	-5.0	510.	313.	280.	253.	253.
408.0	-5.0	510.	313.	280.	253.	253.
SHEAR STRENGTHS ARE EQUAL 280.0 LBF AT DIST. 410.4 FT.						
447.0	-5.0	2116.	313.	280.	683.	280.
457.0	-5.0	2116.	313.	280.	683.	280.
467.0	-5.0	1657.	313.	280.	560.	280.
472.0	-5.0	1431.	313.	280.	500.	280.
480.0	-5.0	1070.	313.	280.	403.	280.
495.0	-5.0	1630.	313.	280.	553.	280.
505.0	-5.0	1630.	313.	280.	553.	280.
530.0	-5.0	734.	313.	280.	313.	280.
SHEAR STRENGTHS ARE EQUAL 280.0 LBF AT DIST. 534.4 FT.						
538.0	-5.0	510.	313.	280.	253.	253.
556.0	-5.0	0.	313.	280.	116.	116.
582.0	-5.0	0.	313.	280.	116.	116.
1000.0	-5.0	-0.	313.	280.	116.	116.

ASSUMED CRIT. PASSIVE LOC. 550.0 FT., EL. -5.0 FT., DP 111. LBF.
RP 730. LBF.

ACTIVE WEDGE DATA

DIST.	ELEV.	DA	RA	DB	RB	FS
(FT)	(FT)	(LBF)	(LBF)	(LBF)	(LBF)	
505.0	-5.0	12122.	14650.	0.	11679.	2.25
510.0	-5.0	12022.	16398.	0.	10279.	2.30
515.0	-5.0	10678.	16396.	0.	8879.	2.46
520.0	-5.0	8439.	16394.	0.	7479.	2.95
525.0	-5.0	5962.	13100.	0.	6079.	3.40
530.0	-5.0	3908.	9807.	0.	4679.	4.01

CRIT. ACTIVE LOC 505.0 FT., EL -5.0 FT., DA 12122. LBF.,
RA 14650. LBF.

DIS.	EL.	DP	RP	DB	RB	FS
(FT)	(FT)	(LBF)	(LBF)	(LBF)	(LBF)	
556.0	-5.0	0.	-0.	0.	12513.	2.24
540.0	-5.0	787.	1947.	0.	9681.	2.32
538.0	-5.0	997.	2190.	0.	9191.	2.34

ENCLOSURE 2
(Sheet #5)

CRIT. ACTIVE LOC 462.1 FT., EL -5.0 FT., DA 20122. LBF., RA 13500. LBF.

DIS. (FT)	EL. (FT)	DP (LBF)	RP (LBF)	DB (LBF)	RB (LBF)	FS
556.0	-5.0	0.	-0.	0.	24525.	1.89
540.0	-5.0	787.	1947.	0.	21693.	1.92
538.0	-5.0	997.	2190.	0.	21203.	1.93

* * STRATUM 6, TEST PLANE 457. FT., EL. -12.0 FT. TO 550. FT.
EL. -12.0 FT.

P.H.L. 1 USED STRA. 6 AND 1 USED STRA. 7

ASSUMED FAILURE SURFACE DATA

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-12.0	1329.	750.	355.	350.	350.
408.0	-12.0	1329.	750.	355.	350.	350.
447.0	-12.0	2935.	750.	785.	350.	350.
457.0	-12.0	2935.	750.	785.	350.	350.
467.0	-12.0	2475.	750.	662.	350.	350.
472.0	-12.0	2250.	750.	602.	350.	350.
480.0	-12.0	1889.	750.	505.	350.	350.
495.0	-12.0	2449.	750.	655.	350.	350.
505.0	-12.0	2449.	750.	655.	350.	350.
530.0	-12.0	1553.	750.	415.	350.	350.
538.0	-12.0	1329.	750.	355.	350.	350.

SHEAR STRENGTHS ARE EQUAL 350.0 LBF AT DIST. 538.7 FT.

DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
556.0	-12.0	819.	750.	218.	350.	218.
582.0	-12.0	437.	750.	116.	350.	116.
1000.0	-12.0	437.	750.	116.	350.	116.

ASSUMED CRIT. PASSIVE LOC. 580.0 FT., EL. -12.0 FT., DP 1537. LBF. RP 125. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
457.1	-12.0	35394.	19128.	0.	37587.	1.68
462.1	-12.0	36466.	19897.	0.	35837.	1.60
467.1	-12.0	35449.	20327.	0.	34087.	1.61
472.1	-12.0	32549.	20736.	0.	32337.	1.72
477.1	-12.0	28169.	20086.	0.	30587.	1.91
482.1	-12.0	22896.	19977.	0.	28837.	2.29
487.1	-12.0	19716.	18119.	0.	27087.	2.49

CRIT. ACTIVE LOC 462.1 FT., EL -12.0 FT., DA 36466. LBF., RA 19897. LBF.

ENCLOSURE 2
(Sheet #6)

FILE NAME = STABOUT
11:07 AM THU., 20 AUG., 198/

* STABILITY WITH UPLIFT *

ORLEANS CANAL
REACH II FLOODSIDE STABILITY

9 STRATA
10 PROFILES
1 VERTICALS
UPLIFT WITH 1 PIEZOMETRIC GRADE LINES

* * STRATUM 5, TEST PLANE 457. FT., EL. -5.0 FT. TO 550. FT.
EL. -5.0 FT.

P.H.L. 1 USED STRA. 5 AND 1 USED STRA. 6

ASSUMED FAILURE SURFACE DATA

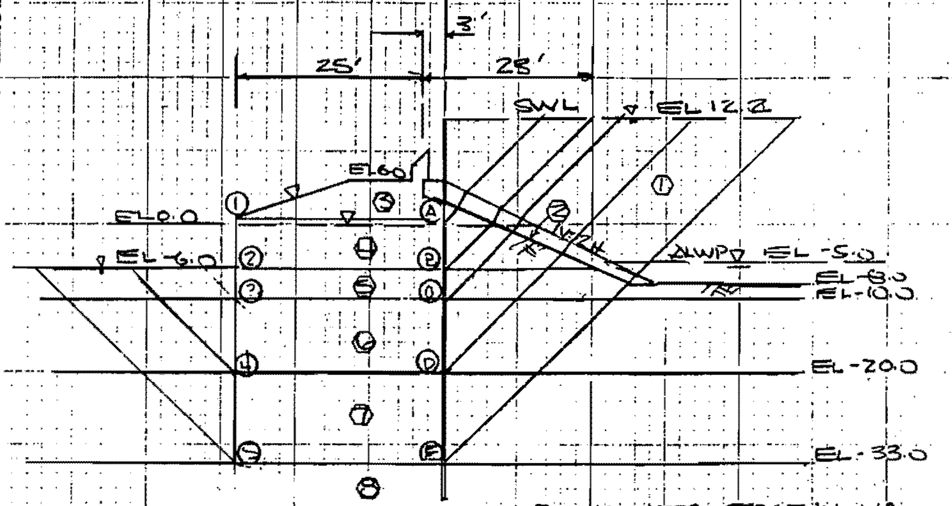
DIST. (FT)	ELEV. (FT)	WT. (LBF)	UPLIFT (LBF)	STR 1 (LBF)	STR 2 (LBF)	STR USED (LBF)
0.0	-5.0	510.	313.	280.	253.	253.
408.0	-5.0	510.	313.	280.	253.	253.
SHEAR STRENGTHS ARE EQUAL 280.0 LBF AT DIST. 410.4 FT.						
447.0	-5.0	2116.	313.	280.	683.	280.
457.0	-5.0	2116.	313.	280.	683.	280.
467.0	-5.0	1657.	313.	280.	560.	280.
472.0	-5.0	1431.	313.	280.	500.	280.
480.0	-5.0	1070.	313.	280.	403.	280.
495.0	-5.0	1630.	313.	280.	553.	280.
505.0	-5.0	1630.	313.	280.	553.	280.
530.0	-5.0	734.	313.	280.	313.	280.
SHEAR STRENGTHS ARE EQUAL 280.0 LBF AT DIST. 534.4 FT.						
538.0	-5.0	510.	313.	280.	253.	253.
556.0	-5.0	0.	313.	280.	116.	116.
582.0	-5.0	0.	313.	280.	116.	116.
1000.0	-5.0	-0.	313.	280.	116.	116.

ASSUMED CRIT. PASSIVE LOC. 550.0 FT., EL. -5.0 FT., DP 111. LBF.
RP 730. LBF.

ACTIVE WEDGE DATA

DIST. (FT)	ELEV. (FT)	DA (LBF)	RA (LBF)	DB (LBF)	RB (LBF)	FS
457.1	-5.0	19676.	12411.	0.	25091.	1.95
462.1	-5.0	20122.	13500.	0.	23691.	1.89
467.1	-5.0	18681.	14483.	0.	22291.	2.02
472.1	-5.0	15797.	14494.	0.	20891.	2.30
477.1	-5.0	11788.	14753.	0.	19491.	3.00
482.1	-5.0	7998.	12614.	0.	18091.	3.99

ENCLOSURE 2
(Sheet #8)



○ INDICATES STRATUM NO.
SEE ENCLOSURE 12 FOR SOIL PROPERTIES

FAILURE SURFACE	ΣD	ΣR*	ΣD − ΣR
Ⓐ ①	4415	11203	− 6788
Ⓑ ②	12867	6483	6384
Ⓒ ③	18757	8030	10727
Ⓓ ④	32510	10330	22180
Ⓔ ⑤	48305	35433	12872

* ASSUME FACTOR OF SAFETY = 1.5 IN SHEAR STRENGTH PARAMETERS

ALLOWABLE SHEAR (ASSUME A328 STEEL)

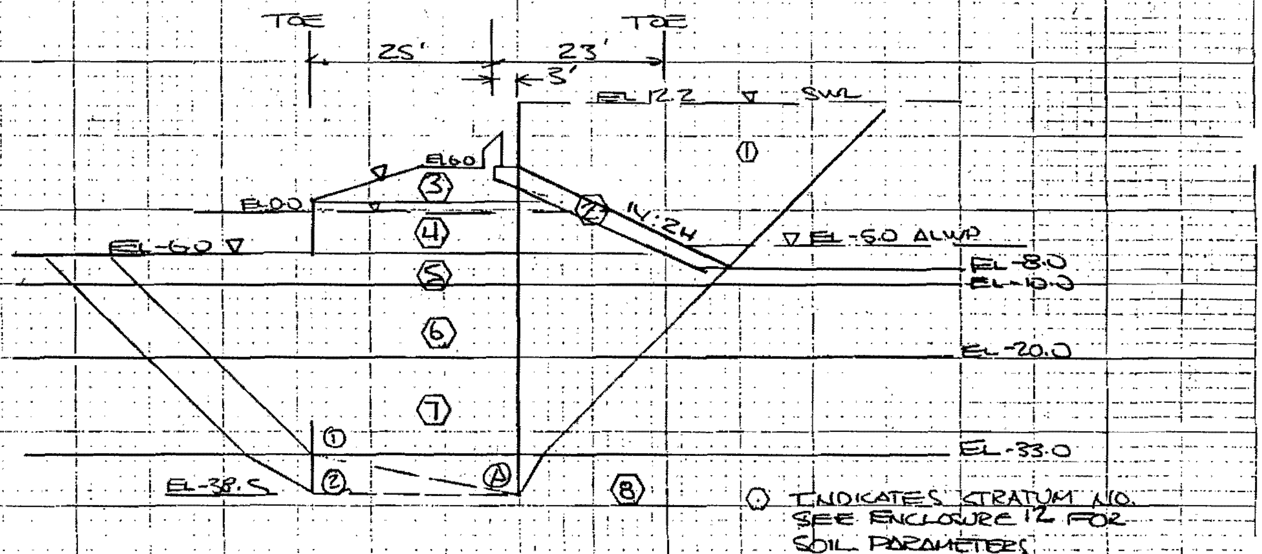
$f_y = 38{,}500$ PSI
$f_s = (0.4)(38500)$
$= 15{,}400$ PSI

$A_s = 11.91 \text{ in}^2/\text{PILE}$
$= 7.94 \text{ IN}^2/\text{FT}$

$F_s = (7.94)(15400)$
$= 122{,}276$ LBS/FT OF WALL $>> 22180$

I-WALL ANALYSES
REACH I WEST STA 50+00 TO 90+00
ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LA

ENCLOSURE 3



○ INDICATES STRATUM NO.
SEE ENCLOSURE 12 FOR
SOIL PARAMETERS

FAILURE SURFACE	D_A	D_P	D_B	R_A	R_B	R_P	F.S.
A 1	109584	37169	23345	20265	30949	13240	1.31
A 2	109534	53821	—	20265	33964	26839	1.45

LEVEE STABILITY ANALYSES
REACH I-WEST STA 50+00 TO 90+00

ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LOUISIANA

ENCLOSURE 4.

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

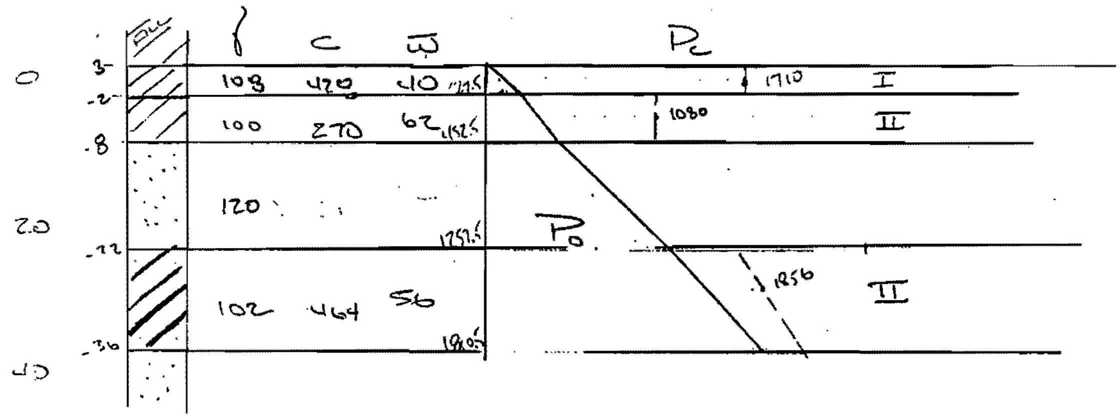
Page

Date

Project Orleans Avenue Outfall Canal Job 3155

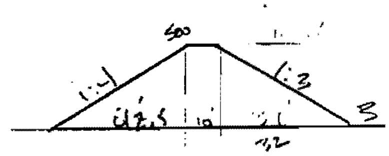
Subject Settlement of Reach III - West Levees By

B-44, 46 & 48



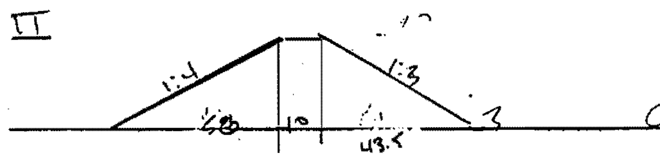
Stratum	RR	CR	P_c
I	0.038	0.19	1710
II	0.053	0.26	1080
III	0.050	0.25	1856

Case I



Grade = 13.6

Case II



Grade = 17.5

ENCLOSURE 5
(Sheet #1)

X	Y	Z	CONSOLIDATION SETTLEMENT
505.00	0.00	2.50	.26048
505.00	0.00	8.00	.58900
505.00	0.00	18.00	0.00000
505.00	0.00	32.00	.68599
505.00	0.00	TOTAL	1.53547
549.00	0.00	2.50	.08431
549.00	0.00	8.00	.07268
549.00	0.00	18.00	0.00000
549.00	0.00	32.00	.13967
549.00	0.00	TOTAL	.29666

FILE NAME = SETTIII
8:37 AM MON., 23 JUNE, 1986

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0001 ORLEANS CANAL
0002 REACH III WEST
0003 1 1 2 4
0004 505 0 549 0
0005 2.5 8 18 32
0006 100000 0.5 3
0007 2
0008 442 58
0009 1760
0010 1
0011 500 10
0012 1760
0013 3
0014 510 44
0015 1760
0016 62.5 0
0017 5 108 2.7 0.5 100000 40
0018 6 100 2.7 0.5 100000 62
0019 14 120 2.7 0.5 100000 20
0020 14 102 2.7 0.5 100000 56
0021 2
0022 2
0023 0.038 0.19 1710
0024 2
0025 0.053 0.26 1080
0026 3
0027 0
0028 2
0029 0.05 0.25 1856
```

STRATUM	Z	SUB. WT.	DRY WT.	Eo	% SAT.	WC%	SPEC.GRAV
1	2.50	45.5000	77.1429	1.1875	90.95	40.0000	2.7000
2	8.00	37.5000	61.7284	1.7337	96.55	62.0000	2.7000
3	18.00	57.5000	100.0000	.6875	78.55	20.0000	2.7000
4	32.00	39.5000	65.3846	1.5809	95.64	56.0000	2.7000

	WATER	TOTAL STRESSES		EFFECTIVE STRESSES	
Z	PRESSURE	VERTICAL	HORIZONTAL	VERTICAL	HORIZONTAL
2.50	156.2500	270.0000	270.0000	113.7500	113.7500
8.00	500.0000	840.0000	840.0000	340.0000	340.0000
18.00	1125.0000	1980.0000	1980.0000	855.0000	855.0000
32.00	2000.0000	3534.0000	3534.0000	1534.0000	1534.0000

ENCLOSURE 5
(Sheet #3)

ORLEANS CANAL

REACH III WEST

CO-ORDINATES X	Y	Z	DIRECTIONAL STRESSES X\R	Y\T	Z	EXCESS PORE PRESSURE	EPSILON Z
505.0	0.0	2.5	1500.6743	1628.3223	1755.9705	1628.3225	.0019
505.0	0.0	8.0	1062.4990	1378.9963	1695.4937	1378.9963	.0047
505.0	0.0	18.0	609.1958	1062.8684	1516.5410	1062.8684	.0068
505.0	0.0	32.0	307.2379	789.4114	1271.5850	789.4115	.0072

HORIZONTAL DISP. = 0.00000 VERTICAL DISP. = 0.00000

549.0	0.0	2.5	288.3821	245.3182	202.2543	245.3182	-.0006
549.0	0.0	8.0	409.7200	322.6074	235.4948	322.6074	-.0013
549.0	0.0	18.0	453.5434	389.9402	326.3370	389.9402	-.0010
549.0	0.0	32.0	386.1610	405.3506	424.5403	405.3507	.0003

HORIZONTAL DISP. = 0.00000 VERTICAL DISP. = 0.00000

ENCLOSURE 5
(Sheet #4)

X	Y	Z	CONSOLIDATION SETTLEMENT
505.00	0.00	2.50	.20629
505.00	0.00	8.00	.40578
505.00	0.00	18.00	0.00000
505.00	0.00	32.00	.42647
505.00	0.00	TOTAL	1.03854
549.00	0.00	2.50	.00086
549.00	0.00	8.00	.00941
549.00	0.00	18.00	0.00000
549.00	0.00	32.00	.03666
549.00	0.00	TOTAL	.04693

FILE NAME = SETTII
8:41 AM MON., 23 JUNE, 1986

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ORLEANS CANAL
REACH II WEST
1 1 2 4
505 0 549 0
2.5 8 18 32
100000 0.5 3
2
457 43
1276
1
500 10
1276
3
510 32
1276
62.5 0
5 108 2.7 0.5 100000 40
6 100 2.7 0.5 100000 62
14 120 2.7 0.5 100000 20
14 102 2.7 0.5 100000 56
2
2
0.038 0.19 1710
2
0.053 0.26 1080
3
0
2
0.05 0.25 1856
```

STRATUM	Z	SUB. WT.	DRY WT.	Eo	% SAT.	WC%	SPEC.GRAV
1	2.50	45.5000	77.1429	1.1875	90.95	40.0000	2.7000
2	8.00	37.5000	61.7284	1.7337	96.55	62.0000	2.7000
3	18.00	57.5000	100.0000	.6875	78.55	20.0000	2.7000
4	32.00	39.5000	65.3846	1.5809	95.64	56.0000	2.7000

	WATER	TOTAL STRESSES		EFFECTIVE STRESSES	
Z	PRESSURE	VERTICAL	HORIZONTAL	VERTICAL	HORIZONTAL
2.50	156.2500	270.0000	270.0000	113.7500	113.7500
8.00	500.0000	840.0000	840.0000	340.0000	340.0000
18.00	1125.0000	1980.0000	1980.0000	855.0000	855.0000
32.00	2000.0000	3534.0000	3534.0000	1534.0000	1534.0000

ENCLOSURE 5
(Sheet #6)

ORLEANS CANAL

REACH II WEST

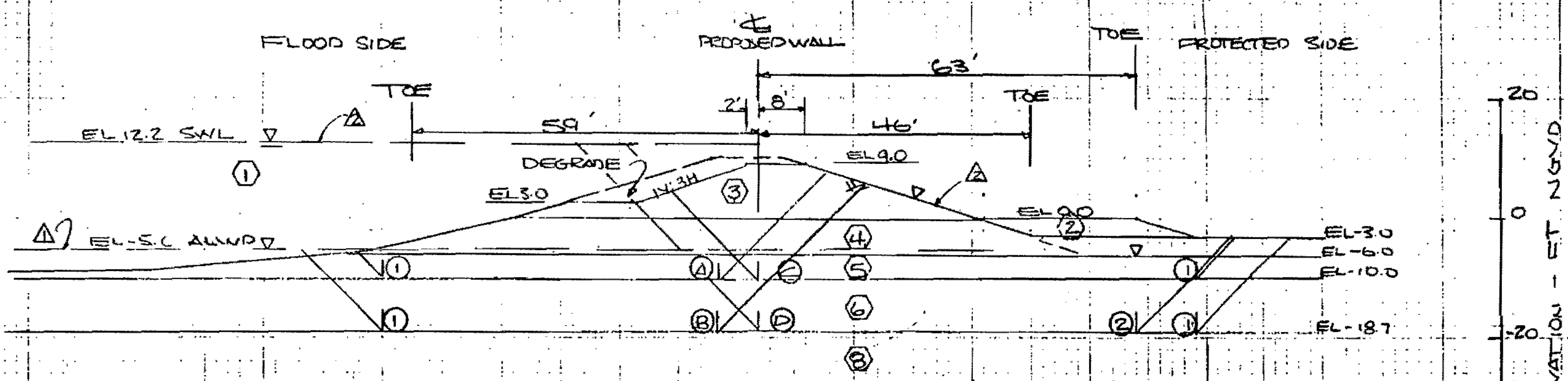
CO-ORDINATES			DIRECTIONAL STRESSES			EXCESS PORE	EPSILON
X	Y	Z	X\R	Y\T	Z	PRESSURE	Z
505.0	0.0	2.5	1050.3479	1161.1968	1272.0457	1161.1968	.0017
505.0	0.0	8.0	683.0499	948.1066	1213.1628	948.1064	.0040
505.0	0.0	18.0	340.5319	692.5570	1044.5820	692.5570	.0053
505.0	0.0	32.0	147.3111	489.2801	831.2491	489.2802	.0051

HORIZONTAL DISP. = 0.00000 VERTICAL DISP. = 0.00000

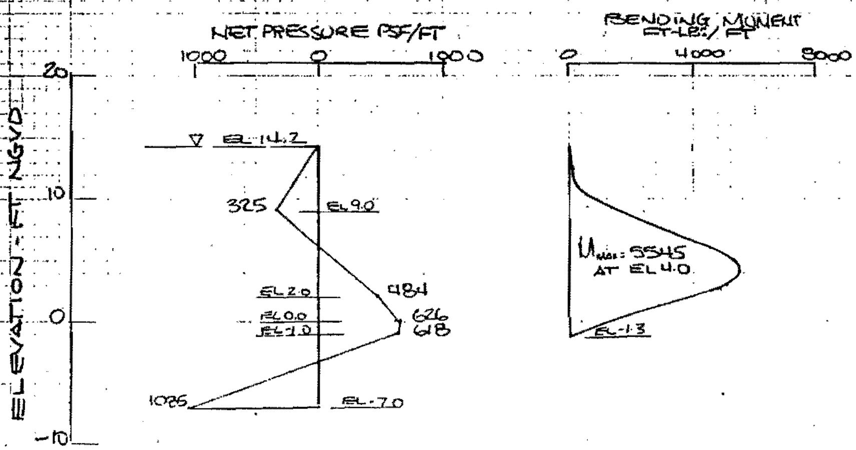
549.0	0.0	2.5	76.8163	39.0063	1.1964	39.0063	-.0006
549.0	0.0	8.0	198.3603	111.1725	23.9846	111.1725	-.0013
549.0	0.0	18.0	268.6341	185.5550	102.4758	185.5549	-.0012
549.0	0.0	32.0	239.3924	217.9873	196.5823	217.9873	-.0003

HORIZONTAL DISP. = 0.00000 VERTICAL DISP. = 0.00000

ENCLOSURE 5
(Sheet #7)



FAILURE SURFACE	D_A	D_P	ΣD	R_A	R_B	R_P	ΣR	F.S.
A 1	19247	1260	17987	18209	12313	1401	31923	1.77
B 1	38743	9174	29569	20920	15158	4668	40746	1.38
C 1	22194	2426	19769	13776	13795	3000	30571	1.55
D 1	43611	12314	31297	19808	14313	6480	40601	1.30
D 2	43611	13798	29813	19808	12515	6480	38803	1.30



PIEZOMETRIC HEAD IN FOUNDATION SAND STRATUM

△ FLOODSIDE ANALYSIS

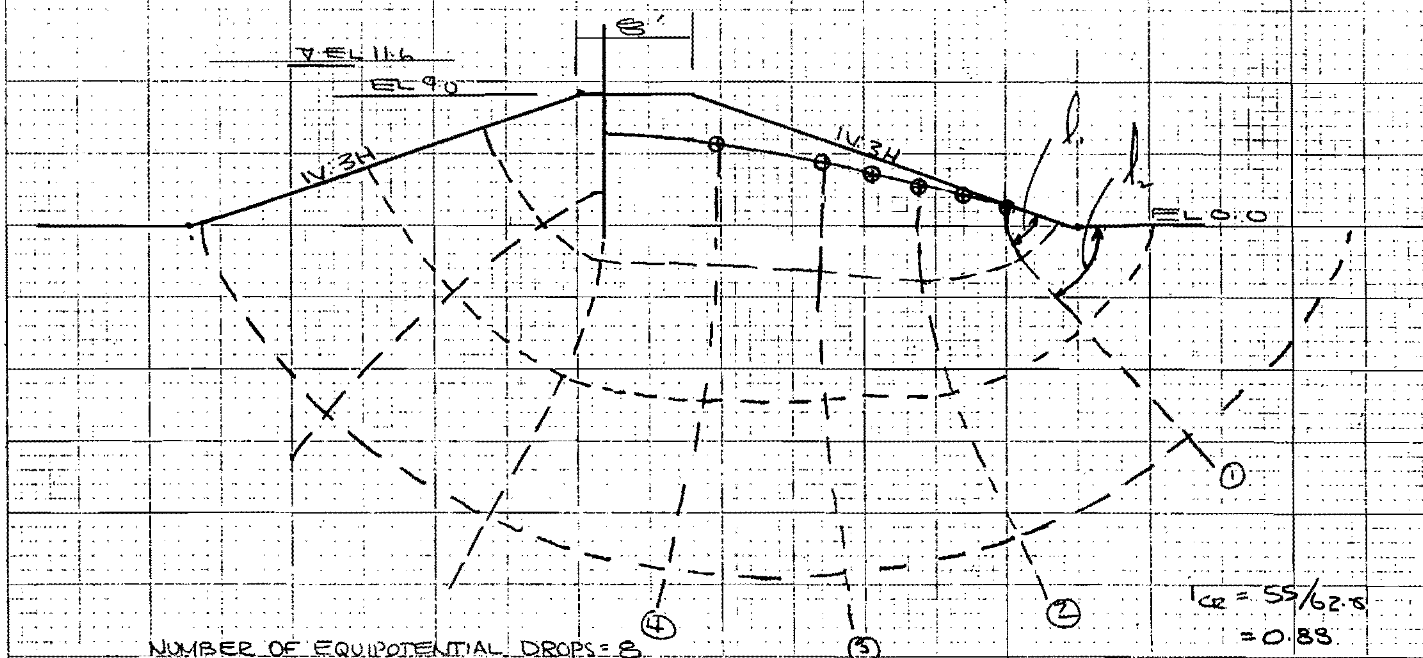
△ LANDSIDE ANALYSIS

○ STRATUM NO. SEE ENCLOSURE 12 FOR SOIL PARAMETERS

LEVEE STABILITY
&
CANTILEVER I-WALL ANALYSES
REACH I-EAST STA 40+00 TO 50+00

ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LOUISIANA

ENCLOSURE 6



NUMBER OF EQUIPOTENTIAL DROPS = 8

Δh/DROP = 11.6/8
= 1.45'

EQUIPOTENTIAL	ELEV
①	1.45
1.5	2.17
②	2.90
2.5	3.62
③	4.35
④	5.80

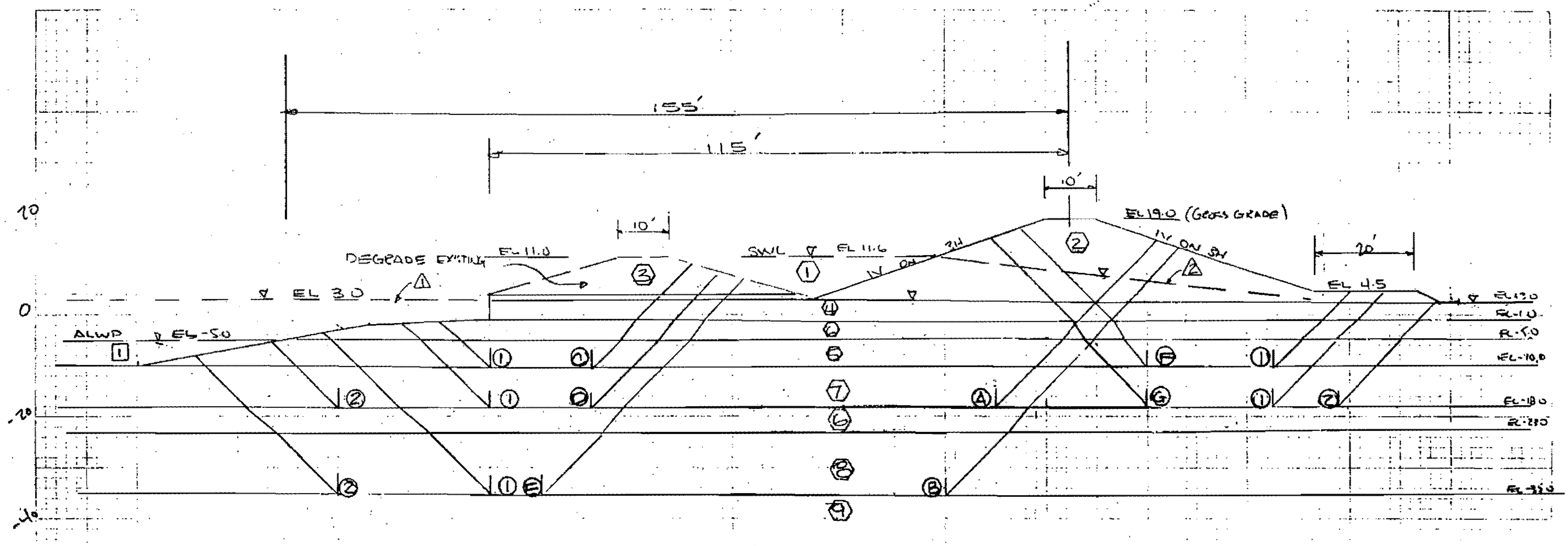
PIPING ANALYSIS

AT l_1 $i = \Delta h / l_1 = (1.45 - 0.90)/3$
$= 0.18$ (F.S. = 4.9)

AT l_2 $i = 1.45/6.5 = 0.22$ (F.S. = 4.0)

FLOW NET
REACH III - STA 121+00 TO 127+00
ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LA

ENCLOSURE 7



FAILURE SURFACE		D_A	D_P	ΣD	R_A	R_B	R_P	ΣR	F.S.
A	1	69745	14988	54757	27415	35349	9646	72410	1.32
A	2	69745	9751	59994	27415	44359	8159	79933	1.33
B	1	144807	58572	86235	45099	45500	25234	115833	1.34
B	2	144807	47307	97500	45099	60000	21743	126842	1.30
C	1	23953	4342	19611	20187	5880	4250	30617	1.56
D	1	44141	14988	29153	23682	7349	9646	40677	1.40
E	2	107732	47307	60425	39192	20000	21743	80935	1.34
F	1	43585	13020	30565	22320	7000	11987	41307	1.35
G	1	69865	29128	40737	26530	8750	17803	53083	1.30
G	2	69865	26972	42893	26530	13300	16531	56361	1.31

PIEZOMETRIC HEAD IN FOUNDATION SILT & SAND STRATA
△1 FLOODSIDE ANALYSIS
△2 LANDSIDE ANALYSIS

○ STRATUM NO. - SEE ENCLOSURE 14 FOR SOIL PARAMETERS

LEVEE STABILITY ANALYSES
REACH III STA 121+00 TO STA 127+00
EL 11.0 EXISTING LEVEE
EL 18.0 PROPOSED LEVEE

ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LOUISIANA

ENCLOSURE 8

WAVE LOAD INTERPOLATION

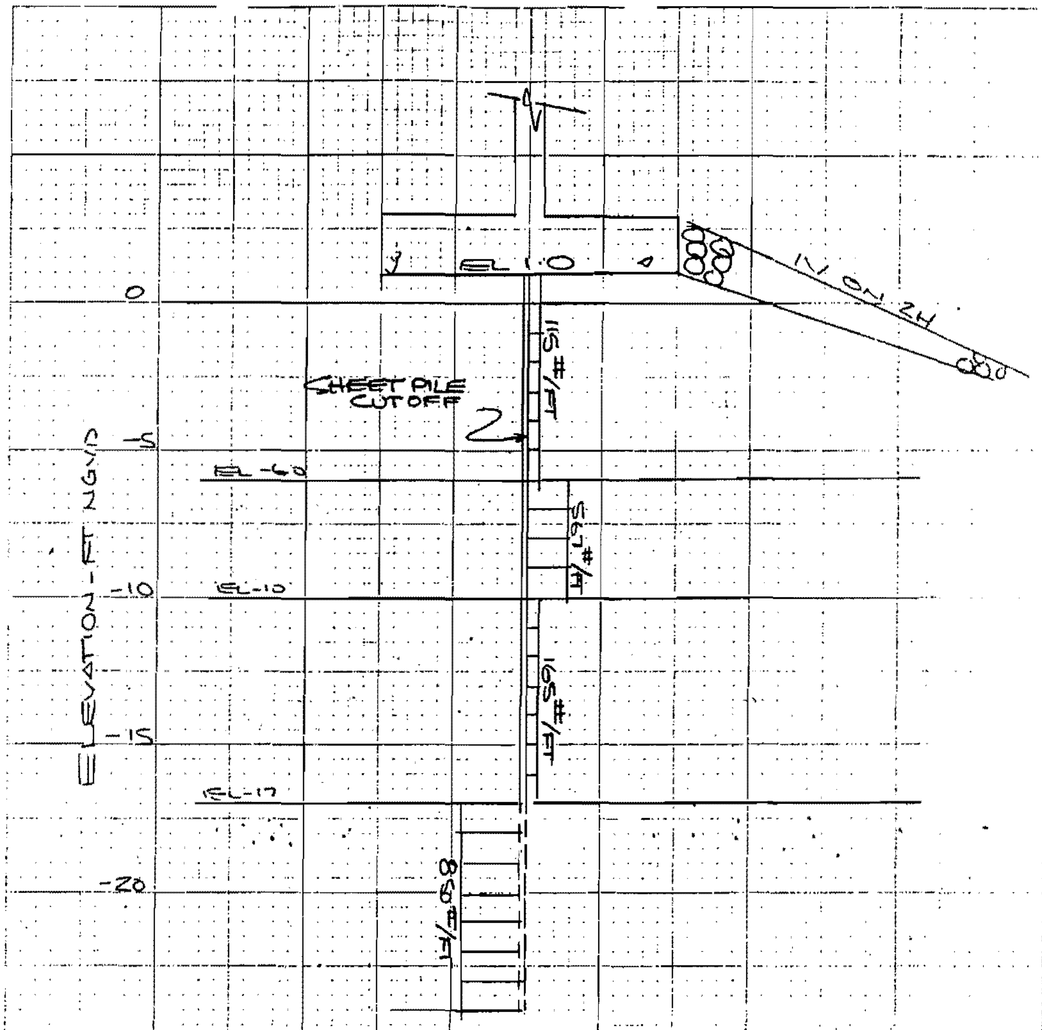
Station	Crown Elevation Analyzed FT-NGVD	Dynamic Wave Load LBS/FT	Centroid Of Wave Load FT-NGVD
To 117+00	9.0	N/A	N/A
To 119+00	9.5	1020	12.4
To 121+00	9.5	1407	12.5
To 123+00	9.5	1795	12.5
123+00 +	11.0	1570	12.8

SUMMARY OF CANTILEVER I-WALL ANALYSES

	With Wave Loads		Without Wave Loads	
Station	Tip (F.S.=1.25) FT-NGVD	Moment (F.S.=1.0) FT-LBS/FT	Tip (F.S.=1.5) FT-NGVD	Moment (F.S.=1.0) FT-LBS/FT
To 117+00	N/A	N/A	-5.1	3970
To 119+00	-2.9	6636	-2.7	2779
To 121+00	-4.6	9639	-2.7	2779
To 123+00	-6.3	12743	-2.7	2779
123+00 +	-1.8	7501	2.9	659

DYNAMIC WAVE LOAD SUMMARY
AND
CANTILEVER I-WALL ANALYSES SUMMARY

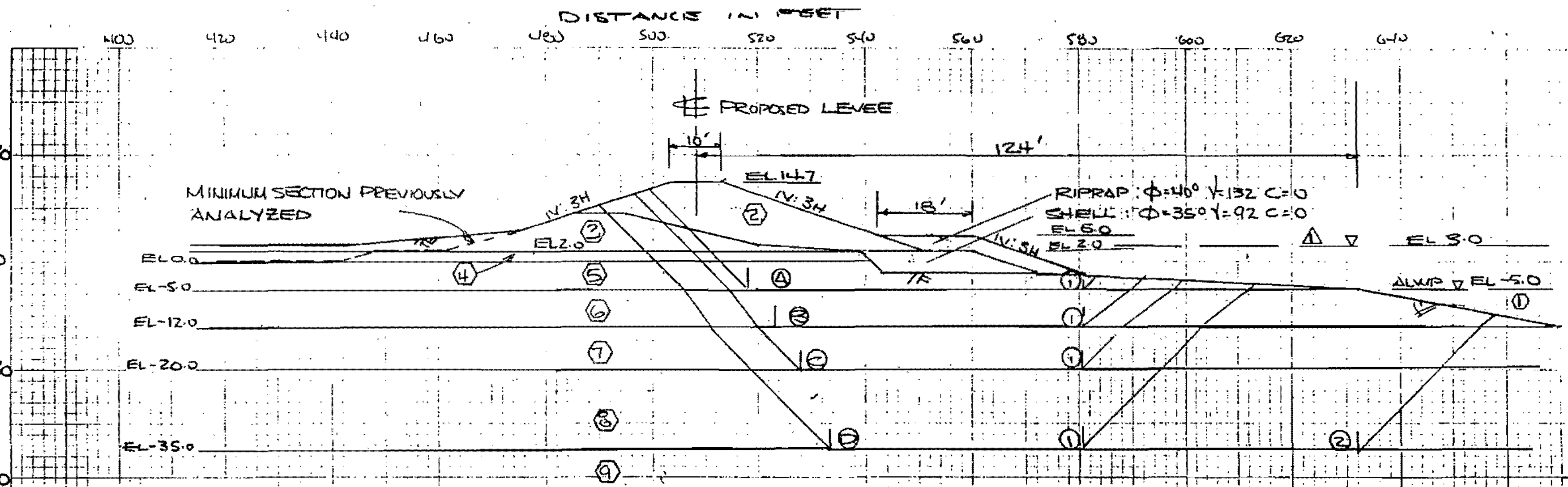
ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LOUISIANA



DISTRIBUTION OF SOIL PRESSURES
PIPELINE CROSSING
VICINITY STA 44+44 (WEST)

ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LOUISIANA

ENCLOSURE 10



FAILURE SURFACE	D_A	D_P	ΣD	R_A	R_B	R_P	ΣR	FACTOR OF SAFETY
A 1	20553	433	20120	16949	16888	1587	35434	1.76
B 1	36486	5109	31377	23571	24664	4803	53058	1.69
C 1	59561	15829	43732	27431	18550	11620	57601	1.31
D 1	119748	53353	66395	41275	24000	26153	91426	1.38
D 2		43894	75854		49466	22233	112972	1.49

Δ PHREATIC SURFACE ASSUMED IN FOUNDATION SILT STRATUM

⬡ INDICATES STRATUM NO. SEE ENCLOSURE 13 FOR SOIL PARAMETERS

STABILITY ANALYSES
FLOODSIDE ENLARGEMENT
REACH II STA 90+00 TO STA 118+00

ORLEANS AVENUE OUTFALL CANAL
NEW ORLEANS, LA.

ENCLOSURE 11

Orleans Outfall Canal
New Orleans, Louisiana

DESIGN PARAMETERS
REACH I
STA. 0+00 TO 90+00

EAST SIDE PARAMETERS

Stratum	Material	Friction Angle (Degrees)	Unit Weight (PCF)	Unit Cohesion (PSF)				Phi Angle*
				Centerline		Toe		
				Average	Bottom	Average	Bottom	
1	Water	0	62.5	0	0	0	0	
2	Fill	0	110	400	400	400	400	23°
3	Fill	0	115	700	700	700	700	25°
4	Clay	0	99	400	400	300	300	20°
5	Clay	0	99	300	300	150	150	20°
6	Clay	0	102	350	350	200	200	20°
7	Clay	0	102	350	350	300	300	20°
8	Sand	33	122	0	0	0	0	

*Consolidated drained "S" case design parameters used for cantilever sheet pile analyses.

Orleans Outfall Canal
New Orleans, Louisiana

DESIGN PARAMETERS
REACH I
STA. 0+00 TO 90+00

WEST SIDE PARAMETERS

				Unit Cohesion (PSF)				
				Centerline		Toe		
Stratum	Material	Friction Angle (Degrees)	Unit Weight (PCF)	Average	Bottom	Average	Bottom	Phi Angle*
1	Water	0	62.5	0	0	0	0	0
2	Riprap	40	132	0	0	0	0	0
3	Fill	0	115	700	700	700	700	25°
4	Clay	0	99	300	300	300	300	20°
5	Clay	0	99	250	250	150	150	20°
6	Clay	0	102	300	300	200	200	20°
7	Clay	0	102	325	325	300	300	20°
8	Sand	33	122	0	0	0	0	33°

*Consolidated drained "S" case design parameters used for cantilever sheet pile analyses.

Orleans Outfall Canal
New Orleans, Louisiana

DESIGN PARAMETERS
REACH II AND III
STA. 90+00 TO 127+00

Stratum	Material	Friction Angle Degrees	Unit Weight PCF	Unit Cohesion PSF Average	Unit Cohesion PSF Bottom	Phi Angle*
1	Water	0	62.5	0	0	--
2	Fill	0	110	400	400	23
3	Fill	0	112	700	700	25
4	Clay	0	112	600	600	23
5	Clay	0	102	280	280	20
6	Silt	15	117	200	200	25
7	Clay	0	104	350	350	23
8	Clay	0	104	500	500	--
9	Sand	33	122	0	0	--

*Consolidated drained "S" case design parameters used for cantilever sheet pile analyses.

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

December 3, 1987

Engineering Division
Projects Engineering Section

FILE 1006
WB
JH
TS

Mr. John Holtgreve
Design Engineering, Incorporated
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference your letter of October 6, 1987 providing Eustis Engineering's responses to comments contained in our letters of January 12, 1987 and August 7, 1987 concerning the Orleans Avenue Canal. We have reviewed these responses and offer the following comments.

12 August 1986 Submittal

1. Comment 11. We recommend a piezonmetric headline of EL -3.0NGVD in the buried beach sand, Sta 0+00 to Sta 90+50.

2. Comment 15. We have performed stability analyses of passive wedges adjacent to the wall and passive wedges beyond the wall. The F.S. of wedges beyond the wall are below 1.0 and are substantially below the F.S. of wedges adjacent to the wall. The passive pressures in your cantilever sheetpile wall analysis are not the critical passive pressures against the wall. The passive pressures in the cantilever sheetpile analysis must incorporate the passive wedges beyond the wall.

5 November 1986 Submittal

1. Comment 1. We do not consider that a cantilever sheetpile wall provides protection against a deep stability failure.

2. Comment 4. The number of drops should be 7, which would lower the F.S. and require a lower sheetpile tip penetration.

3. Comment 7. There should be a 600 ft transition from the west canal lakefront levee Sta 124+87 Net Grade EL 18.0 NGVD to Sta 118+87 Net Grade EL 13.6 NGVD. From the east canal lakefront levee Sta 128+67 to Sta 124+67 the Net Grade is El 17.5 NGVD. From Sta 124+67 to Sta 118+67 there is a 600 ft transition from Net Grade EL 17.5 NGVD to Net Grade EL 13.6 NGVD.

4. <u>Comment 8.</u> Prior to the structural evaluation of the proposed inverted T-wall, the design calculations should be presented. These calculations should include (but not limited to) the following:

a. Transfer of sheetpile loading to T-wall (including tension due to skin friction along the sheet pile).

b. Stresses in sheet piling.

c. Loading on inverted T-wall.

d. Pile loading (3-D pile analysis).

e. T-wall stresses.

I trust the foregoing is responsive to your needs. If I can be of further assistance in this matter, please let me know.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

February 4, 1988

Mr. Van Stutts, Project Coordinator
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Avenue Canal
Flood Protection Improvement Project
Earthwork and Structural Review Comments
OLB Project No. 2048-0304
DEI Project No. 1006

Dear Mr. Stutts:

Enclosed herewith are three (3) sets of revised preliminary plans for Phase I of the above referenced project submitted for your review and approval. We also enclose one copy of the calculations which are pertinent to this work.

These plans and calculations have been revised to resolve review comments in the letter from USACE dated August 7, 1987.

A summary of the resolution of the individual review comments is as follows:

Comment No. 1 - "End West B/L" changed to "End East B/L on Sheet Seven (7).

Comment No. 2 - Note number "1" has been added on Sheet Eight (8).

Comment No. 3 - A new section has been developed for the condition where levee toe extends into the canal on Sheet Nine (9). See Typical Section Sheet 15 and Eustis Enclosure 11, transmitted under separate cover dated October 6, 1987.

Comment No. 4 - The levee on the west side of the canal on Sheet 11 has been raised to a net elevation of +18.0 NGVD to agree with the existing lakefront levee. A revised analysis is presented on Eustis Enclosure Eight

(8), transmitted under separate cover dated October 6, 1987.

Comment No. 5 - The I-wall stability analysis for the two levee sections on Sheet 12 have been revised for a minimum crown elevation of +9.0 NGVD and a width of eight feet. See Eustis Enclosure Nine (9), transmitted under separate cover dated October 6, 1987.

Comment No. 6 - The I-wall stability analysis for the two levee sections approaching the lake shown on Sheet 12 and 13 from Sta. 117+00 to Sta. 129+24 have been revised for minimum levee crown elevations of +9.5 NGVD and +11.0 NGVD respectively for a crown width of eight (8) feet which match the existing levee sections. Where required the crown will be degraded to agree with the proper minimum elevation. See the analysis presented on Eustis Enclosure Nine (9), transmitted under separate cover dated October 6, 1987 which shows crown elevation and wave load condition.

Comment No. 7 - The levee embankment floodside slopes have been changed to 1V on 3H on Sheet 14 to agree with analysis prepared by Eustis Engineering. The elevation of Section Three (3) has been corrected similar to comment four (4) above.

Comment No. 8 - The direction of flow in the canal has been added to Sheets 16, 19 and 22 to distinguish between the pump side and lake side of the bridges.

Comment No. 9 - A copy of the plans for the existing siphon is attached for reference to Sheet 24.

Comment No. 10 - The analyses of floodwalls above the east and west siphon should be taken from Eustis Enclosure Nine (9), transmitted November 5, 1986. A levee crown elevation of +10.0 NGVD with a pile tip elevation -2.0 NGVD applies.

Comment No. 11 - The levee enlargement and floodwall are being placed above the existing siphon. An analysis will be presented to demonstrate that the siphon pile foundation is adequate for the increased overburden loading from the existing elevation of +9.0 NGVD to the proposed elevation of +10.5 NGVD.

Comment No. 12 - The existing levee section will be degraded so that rainwater does not collect against the new floodwall. See Sheet 24.

Comment No. 13 - The concept for the floodwall at the siphon has been revised and the necessity for concrete struts has been eliminated.

Comment No. 14 - The top of I-wall elevations have been labeled as "gross" and "net" to clarify intent on the bridge modification drawings.

Comment No. 15 - Pile capacities for floodproofing the three bridges have been calculated for a canal bottom elevation of -9.0 NGVD for piles located near the center of the canal. See the attached letter from Eustis Engineering dated February 26, 1987.

Comment No. 16 - The analyses for floodproofing the Harrison Avenue and Filmore Avenue bridges are now presented in the attached calculation submittal.

The following comments, 17-26, pertain to the R. E. Lee Bridge analysis.

Comment No. 17 - The calculation on page 6 has been revised. The beams have been repositioned on this bridge to provide more nearly equal spans so that the calculations for a continuous beam of equal spans apply.

Comment No. 18 - The thickness of the deck slab has been increased from 8-1/2 inches to 9-1/2 inches so that the reinforcement "p" value on page seven (7) will not exceed the allowable (0.0073) in accordance with ETL 1110-2-265.

Comment No. 19 - "Group Comb I & II" does include impact and the factors listed have been more clearly denoted as such on page number 16 of the calculations.

Comment No. 20 - The additional moment due to the live load and impact have been added to the moment due to dead load and uplift under the "Allowable Bending Stress" calculation on pages 23 and 24.

Comment No. 21 - Under "Pull-out Tension for Studs" on page 25 of the calculations, the allowable working stress capacity of 1.2 f'c has been checked per EM 1110-1-2101, paragraph 7.1 in addition to the ultimate strength capacity.

Comment No. 22 - The check for "No. of Studs Required" under the requirements of AISC paragraph 1.11 "Composite Construction" has been completed on page 36A-B. This requirement was less than required by AASHTO.

Comment No. 23 - For the design of steel in the wall, a check of ACI requirements for distribution of reinforcing steel in deep members has been made on page 43.a.

Comment No. 24 - The math error in the "Mom" calculation on page 51 has been corrected. The moment with new beam spacing is 2634 ft-lbs in lieu of 2918.4 ft-lbs as previously shown.

In addition the beams have been repositioned on this bridge to provide for more nearly equal spans, so that calculations for a continuous beam of equal spans do apply.

Comment No. 25 - Diaphragms have been added to address AASHTO paragraph 3.24.9, titled "Unsupported Transverse Edges". The lane load (uniform load per linear foot combined with a concentrated load) as addressed in AASHTO paragraph 3.6 entitled "Traffic Lanes" and paragraph 3.7.1.2 is not critical for the span lengths of this bridge. This is clearly illustrated in the tables which have been added following page 45.

Comment No. 26 - The waterstops have been located to allow reinforcing to be placed on both sides per the recommendation made.

Replies to outstanding GDM comments contained in the USACE letter dated January 12, 1987 are as follows. (Reference DEI letter of August 12, 1986, and USACE letter of June 3, 1986 for source of these comments.)

Comment No. 10 - USACE recommends a coefficient of lateral earth pressure, K, for piles in tension in sand of 0.75 for displacement piles unless values are obtained from pile tests (June 3, 1986).

Eustis Engineering has analyzed precast concrete piles loaded in tension assuming a coefficient of 0.70. This exceeds the USACE requirements (August 12, 1986).

If design criteria used by Eustis Engineering exceeds Corps criteria then any resulting cost increase would not be creditable (January 12, 1987).

DEI has elected to use the recommendation of its geotechnical consultant for piles loaded in tension. If there is a difference in pile length which results from this, it is understand that the cost difference will not be creditable to High Level Protection funding.

Comment No. 30 - The sheet pile tip elevation shown in figure 15 and stated in paragraph VIIA of the GDM (at I-610 Bridge) has been changed to agree with the tip elevations in the Soils Engineering Report. This change is also shown on the preliminary drawings for Phase II of the project submitted November 25, 1987.

Comment No. 31 - The sheet pile tip elevations at the bridge locations and north of R. E. Lee Boulevard have been added to the current plan and profile sheets.

Comment No. 39b - The demolition of the existing concrete cap on the west side of the canal will either be disposed of on the floodside slope of the embankment to serve as slope protection with placement and sizing of the demolished concrete to meet Corps specifications or it will be removed from the site by the contractor. The type of demolition will be reflected in the cost estimate. Your recommendation would be appreciated.

The remaining comments in the letter from the USACE dated January 12, 1987, were resolved by the letter from Eustis Engineering transmitted to the USACE October 6, 1987.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgréve, P.E.
Vice President

JH/TS/mnh

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

RECEIVED
APR 5 1988
D.E.I.

REPLY TO
ATTENTION OF

March 31, 1988

Engineering Division
Project Engineering Section

Mr. John Holtgreve
Design Engineering Incorporated
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your February 4, 1988 letter concerning Orleans Avenue Canal Flood Protection Improvement Project, Earth Work and Structural Review Comments DEI Project No. 1006.

We have reviewed the preliminary plans for the Orleans Avenue Outfall Canal. The plans are based on the Orleans Avenue Outfall Canal Soils Report and Supplemental Soils Analyses by Eustis Engineering. As stated in the above referenced letter, the preliminary plans which you submitted for our review incorporated our comment of August 7, 1987. However, we must remind you that we have not received responses to our review comments on the above referenced Eustis Engineering soils report. Our comments were furnished by letter dated December 3, 1987. Satisfactory resolution of these comments may affect some of the designs contained in the subject plans. Therefore, we would encourage you to contact Eustis Engineering regarding our December 3, 1987 comments so that we can resolve those comments before resubmitting the subject plans.

In-so-far as the subject preliminary plans are concerned, we offer the following general comments:

a. Reference our February 5, 1988 meeting concerning new design criteria for Cantilever I-wall design attended by yourself and Mr. Tom Smith from DEI and representatives from OLB, Eustis Engineering and Traughber and Associates, Inc. The subject I-wall sections must be analyzed using the new design criteria. The following design guidance was furnished at the February 5, 1988 meeting:

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Q-Case

F.S. = 1.5 with water to flowline or SWL
F.S. = 1.25 with SWL and waveload for hurricane protection levees.
F.S. = 1.0 with water to SWL + 2 ft freeboard for hurricane protection levees.

S-Case

F.S. = 1.2 with water to flowline or SWL + waveload (if applicable) for hurricane protection levees

Select the maximum penetration from the above analysis. If the penetration to head ratio is less than about 3:1, increase it to 3:1 or to that required by the S-Case, F.S. = 1.5, whichever results in the least penetration. Use SWL or flowline to calculate for penetration to head ratio.

b. It is noted on the plans that the floodwall just south of Robert E. Lee Boulevard is shown as I-Wall. As was discussed at our recent meeting of March 14, 1988, for the alignment shown, this reach of wall must be T-Wall or a suitable alternative.

Specific comments concerning the individual plan sheets are detailed below:

a. Sheet 2; "General Symbols Existing."

1. "Drainage Culvert (Under 36' 0)" should change the '0' to 'Ø'.

2. "Drainage Culvert (36" and Over)" should add the symbol 'Ø' after the '36".

3. "Baseline Station Marker (RRS, IR, CN, GIP)" has an undefined term - 'GIP'.

b. Sheet 3.

1. Due to the lack of contrast between the print (lettering, etc.) and the images shown, this print needs to be revised for clarity.

2. The baseline station at the beginning and end of each reach should be added.

c. Sheet 4.

1. Due to the configuration of the I-Wall at the bridge, the effects of the deflection of the I-Wall relative to the bridge and the ability of the L-Type waterstop to maintain positive cutoff should be evaluated.

2. The "Manholes To Be Raised" is not clear. If the manholes are part of an open system, the manholes would require positive cutoff.

3. The proposed 1'-9" reinforced concrete cap is not adequate for the PZ-27 section.

4. Please furnish the analyses for the sheetpile wingwall tip El. -23.0 located at Robert E. Lee Boulevard.

d. Sheet 5.

1. The curves shown near stations 99 + 00 and 105 + 35 do not appear practical for I-Wall cap forming and/or allowed by the steel sheeting.

2. Due to an apparent error, part of the existing levee crown is shown to be 15' wide. This crown width should be verified.

3. Ref. para. b.1. above.

e. Sheet 7.

2. Ref. para. C.3. above.

f. Sheet 8.

1. The proposed 1'-9" reinforced concrete cap is not adequate for the PZ-27 or PZ-40 sections.

2. Ref. para. C.1. above.

g. Sheet 12.

1. Section at Sta. 117+00 to 123+00 (Transition) does not match the plans for the referenced stations. The elevation varies from 15.47 to 18.00 gross and many of the net elevations on the plans are not shown.

2. Sta 117+00 to 123+00 (Transition). The existing levee does not have to be degraded to EL 9.5 NGVD with respect to levee stability requirements.

h. Sheet 13.

1. The wall extends beyond the end station 124+00.

2. The section should give more detail, i.e. the type of sheeting, coating, batter, elevations of the earth, earth slopes that would be beneficial in evaluating this section.

i. Sheet 17.

1. Reinforcing in sidewalk and wall is not shown, you should therefore reference sheet 18 for this information.

2. The bottom of the slab is shown even with the bottom of the girder's top flange, but the design composite section uses the bottom of the slab even with the top of the girder's top flange. A correction to the design calculations or the drawings is required.

j. Sheet 18.

1. "Elevation/Section Bent 2, 3, and 4". The 12" Diaphram appears to limit inspection and maintenance of bolts at the existing bents.

2. "Section Through The End Bent".

a. The placement of the L-Type waterstop and the waterstop's ability to function with deflection of the I-Wall should be reevaluated.

b. The sill should be placed only under the concrete cap to eliminate potential loading from the soil.

c. The 6" approach slab does not appear designed to carry the required traffic loading while supported by the bent. This should be reevaluated.

3. "Elevate Bent 1."

a. The L-Type waterstop is not adequate to assure positive cutoff with potential deflection of the I-Wall.

b. A 4" spacing through the center of the reinforced concrete cap above the "Piles (New)" should be defined.

4. "Waterstop Details"; "Section A-A"; The proposed reinforcing in the filler should be defined.

k. Sheet 19.

1. "Plan"; The statement "Exist. Conc. Cap 2'- 0" x 1' - 10" Deep with Timber Piles to be removed" and the statement "Exist. Timber Piles To Be Cut At Mud Line" seem to be a contradiction and should be clarified.

2. "Elevation"; The possible need for filter cloth and/or bedding material under the armorflex should be evaluated.

3. Note; "* Adjust Pavement At Ends of Bridge To Fit New Bridge Deck Grades" should be added to this drawing as it appears on both Robert E. Lee and Filmore bridges.

l. Sheet 20.

1. The bottom of the slab is shown even with the bottom of the girder's top flange, but the design composite uses the bottom of the slab even with the top of the girder's top flange. The 3" CLR dimension indicates that the slab stops short of the bottom of the flange but the 8 1/2" depth shows otherwise. Either the design or the drawings should be corrected.

m. Sheet 21.

1. "Joint Detail at End Bents" Ref. para. i.2. above.

2. "Typical Section At Wall Walk and New Cap".

a. The 1/8" gap shown on the 1 1/4" Ø Bolt connection requires that the design account for the effect on the 12" x 14" concrete post and movement of the deck during uplift conditions. This should be verified.

b. Longitudinal reinforcing is shown incorrectly. This should be corrected.

3. "Elevation - Bent 1" and "Section Through End Bent."

a. Ref. para. j.2. a. above.

b. Ref. para. j.2. b. above.

c. Ref. para. j.2. c. above.

4. "Elevation Bent 1."

a. Ref. para. j.3.a. above.

b. Ref. para. j.3.b. above.

5. Waterstop Details.

a. "Section A-A Detail 1"; Ref. para. j.5. above.

b. "Section B-B"; The 6'-0" Walk is inconsistent with the design and the other dimensions of the walk.

n. Sheet 22.

1. Plan

a. The required 3 bulb waterstop at the end bents could be difficult (as well as expensive) to have manufactured. Therefore, possible alternatives should be evaluated.

b. "Remove Exist. As Required" implies that some of the steel sheeting and cap is not removed. This should be clarified.

2. Elevation; Ref. para. i.2. above.

o. Sheet 23.

1. Ref. para. i.2. above.

2. "Detail-Connection To Existing Piles" does not show any details. This should be corrected.

p. Sheet 24.

1. "Section through End Bent."

a. Due to deflection of the end bent and possible shearing of the small area of concrete containing the 3-bulb waterstop in the end bent, an expansion joint-which would allow for adequate movement between the approach and the end bent-should be provided.

b. Due to possible shearing in the block referred to in the above paragraph, shear type reinforcing should be provided.

2. "Elevation Bent 1."

a. Ref. para. j.3.a. above.

b. There is an unidentified space through the center of the concrete cap above the "PPC Piles".

3. Reinforcing for additional column on the end bent should be shown.

q. Sheet 25.

1. The syphon manhole is on the floodside and is subject to water above the top of the manholes. There does not appear to be any positive cutoff.

2. The possible seepage between the syphon and the proposed I-Wall where it crosses the syphon should be investigated.

3. Since the existing syphon penetrates the flood protection, its adequacy for the designed flood conditions should be evaluated.

r. Sheet 26. Ref. all subparagraphs of o. above.

s. Sheets 27-29. Utilities which are to be relocated should be noted as such on drawings. If the new location of the utilities is known, they should be shown on drawings.

t. Sheet 31. Ref. para. C.3. above.

u. Sheet 33. The proposed 1'-9" reinforced concrete cap is not adequate for the PZ-40 section used.

v. General.

1. A note should state that the contractor's sheet pile layout will be submitted for approval.

2. The baseline azimuths should be shown on all plans.

3. The proposed reinforcing details should be shown for typical reinforced concrete capped I-Walls.

4. More details as to the spacing and location of studs on girders should be shown.

The subject February 4, 1988 letter also enclosed for our review a copy of the structural calculations for floodproofing the bridges over the Orleans Avenue Canal. Our review comments for these documents are enclosed.

Should you have any questions concerning the above comments, please contact Mr. Vann Stutts at (504) 862-2614.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosures

Robert E. Lee Bridge

Structural Comments to Flood Proofing Design Calculations by DEI

1. Page 16: In combining the load cases I and III, the dead load is included in both cases; this doubles the dead load factor and reduces the uplift moment. This should be corrected.

2. Page 36: The design should cover the placement of studs on the girders in accordance with AISC eq. 1.11-7 and $q = 15.6$ k for $f'_c = 3.0$ in lieu of the 18.0 k as used.

3. Page 41: The 5-foot spans should be checked as a deep member (Only the 25' span was checked).

4. Pile Design: A 3-D pile analysis is required for the bridge piles for all possible critical

Encl

loading combinations.

5. Pile Cap: Loading on the pile cap should address AASHTO paragraph 3.11.3.

6. Page 85: According to AISC para. 1.6.3, the reduction factor $(1 - f_t \frac{A_b}{T_b})$ is used for A325 and A490 bolts, not the proposed A307 bolts. The slotted connection shown on the drawing requires an A325 or A490 bolt.

7. Diaphragms: No design calculation are presented for the proposed diaphragms. (See DEI's response to our comment 25)

8. Bridge Deck: The bridge deck should be analyzed for the unshored construction case, including the cantilevered sidewalk with the wall.

Harrison Avenue Bridge

Structural Comments
to
Flood Proofing Design Calculations by DEI

1. The origin or validity of Table 1 is not Known. Being hydraulic in content, we offer no comment.

2. Page 14: The maximum moment obtained by the computer appears low when compared to the AASHTO approx. formula. It should be verified that the maximum moment is being used for design.

3. Page 31c: The end span has a continuous section and should be analyzed as such.

4. Page 33c: The 5-foot span should be checked as a deep flexural member (Only the 28' span was checked.

Harrison Ave. Bridge (Con't)

5. Page 36: The statement that "moments on the exterior and interior girders are not too different" should be reevaluated since the difference in the composite sections appear significant. In addition, the stresses at the bottom of girder for dead load should use the W18 stiffness value due to the unshored construction condition.

6. Pile Design: The pile spacing presented (3' on centers for 14" piles) would require a pile capacity reduction (see attached). Disposition of existing piles should be addressed by F & M Br. (These calculation state removal and also remaining).

7. Page 67: A 3-D pile analysis is required for all piles with all critical loading conditions

Harrison Ave. Bridge (Con't)

8. Page 84: The construction case should be evaluated.

9. No design calculations are included to insure compliance with AASHTO paragraph 3.24.9, "Unsupported Transverse Edges".

Filmore Avenue Bridge

Structural Comments to Flood Proofing Design Calculations by DEI

1. Para. 1.b. (no page No.): 'Deck Slab Design; ** Group Load Comb III' states that "since uplift and live load act in opp. direction, this combination is not expected to be critical." This case should be evaluated to insure that it is not the critical case.

2. Page 27: "To Work out the moments on Girder Due to Uplift" uses two separate analyses. These analyses should be reevaluated to obtain the actual support reactions within the same system and also to verify the assumption that the existing bents take 15% of the loading.

<u>Filmore Ave. Bridge (Con't)</u>

3. <u>Page 32:</u> This analysis should include a check for the possibility of additional deflection due to dead loads in accordance with AASHTO para. 3.11.

4. <u>Page 36:</u> The analysis used may not produce the maximum number of studs required by ACI since the actual moments from zero to maximum could occur in a short span and require closer spacing of studs. This should be reevaluated.

5. <u>Page 64:</u> The analysis for "Deep Member" notes a 10-foot member yet the span to the existing bent is only 6 feet. This should be verified. In additio the cases being checked should be identified.

6. <u>Page 71:</u> The same section properties as used for exterior and interior do not appear accurate

due to the difference in the concrete section.

7. Page 103: The reference "Less than 194.8[1k] for Gravity loading, P. 108" should be explained and corrected since no reference to a 194.8[1k] is found on page 108.

8. Page 104: The live load diagram states that the existing bent is "for buoyancy only". If this is assumed, the RA equation would have to be revised due to span length changes.

9. Page 106: The 61.42 used in "Max Girder Reaction (LL)" should be explained.

10. Page 107: The diagram and loads use to "Check Bent Cap For Gravity Loads" should be identified.

11. Page 113: It should be shown that the designed

condition represents the most critical of all the loading conditions.

12. Page 122: The use of 125% for maximum allow compression should be explained. In addition, the allowable tension in a corrosive condition should be $3\sqrt{f_c'}$ in lieu of the $6\sqrt{5000}$ as used.

13. Page 205: An analysis of the bolt connections on the girders and the tension pile connections should be shown.

14. Pile Design: A 3-D pile analysis is required for all pile bents with all critical loading conditions.

15. The construction case should be analyzed.

April 7, 1988

Mr. Van Stutts
U. S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Avenue Canal
Flood Protection Improvement
OLB Project Nos. 2048-0424
DEI Project No. 1006

Dear Mr. Stutts:

This letter serves to record our transmittal of two geotechnical figures titled "Stability Analyses; T-wall Alternative, STA 50+00 to STA 90+00" and "Anchored Bulkhead Alternative, STA 50+00 to STA 90+00" which apply to the above referenced project.

This transmittal was made during the conference meeting held in your office which was attended by several of your staff engineers, Bill Gwyn of Eustis Engineering and Tom Smith and myself representing Design Engineering, Inc.

Your prompt review of the soil loading diagrams shown on these two exhibits is requested. In order to expedite the progress of this project we have initiated the structural analysis of the wall system and have assumed the loads indicated on the exhibits are correct.

Thank you for your attention.

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve, P.E.
Vice President

JH/TMS/mnh

cc: Mr. Bill Gwyn

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

RECEIVED
APR 1988

D. E. I.

April 26, 1988

Engineering Division
Project Engineering Section

Mr. John Holtgreve
Design Engineering Incorporated
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your April 7, 1988 letter concerning the Orleans Avenue Canal Flood Protection Improvement OLB Project Nos. 2048-0424, DEI Project No. 1006.

We have reviewed the stability analyses for the T-Wall and Anchored Bulkhead Alternatives proposed for Station 50+00 to station 90+00 and offer the following observations:

Foundation Design

1. The wedge method can be used to determine a net pressure diagram by equating the difference in earth forces between any two intervals under question. Stability analyses used to determine the wedge forces in the T-Wall and anchored wall diagram should be presented for review.

2. The reaction force at EL +1.0 for the T-Wall should include the contribution of the water pressure above EL +1.0 since the net pressure diagram for the sheetpile wall subtracts the water pressure above EL +1.0.

3. The lateral resistance for the T-Wall foundation piles in the active and passive wedges should be presented.

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4. The active wedge for the anchored wall should extend below EL -33.0 to the elevation where summation of the moments at the anchor force equals 0. The pile load capacity for the precast concrete piles will be lower due to the active wedge intersecting the piles at a lower elevation.

Structural Design

1. The analysis should evaluate all individual members, functions, and reactions to reassure their campatibility as a single functioning unit.

2. Due to possible loading and/or loss of lateral soil resistance along the support piles within the active or passive wedges, these possible modes of failure should be evaluated.

Should you have any questions concerning the above comments, please contact Mr. Van Stutts (504) 862-2614.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

DESIGN MEMORANDUM

NOVEMBER, 1985

Orleans Avenue Canal Flood Protection Improvement Project

SUBMITTED TO:

Board of Levee Commissioners
Orleans Levee District

SUBMITTED BY:

Design Engineering, Inc.

THIS DRAWING HAS BEEN REDUCED 5 X

ORLEANS AVENUE CANAL

FLOOD PROTECTION IMPROVEMENT PROJECT

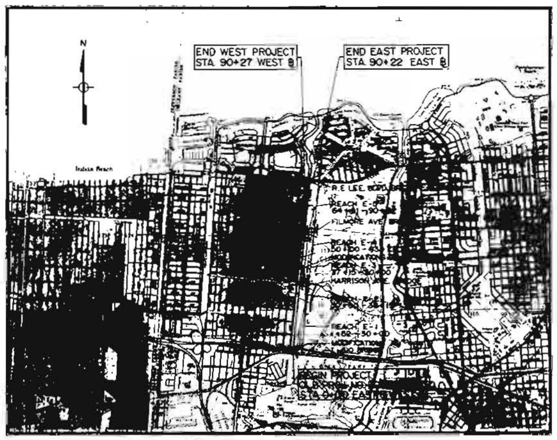
ORLEANS PARISH, LOUISIANA

PRELIMINARY PLANS

ORLEANS LEVEE DISTRICT BOARD OF COMMISSIONERS

EMILE W. SCHNEIDER	PRESIDENT
JOHN H. ROSS	VICE - PRESIDENT
LAMBERT BOISSIERE, JR.	COMMISSIONER
JEROME P. DICKHAUS	COMMISSIONER
JOHNNY JACKSON, JR.	COMMISSIONER
STEVEN O. MEDO, JR.	COMMISSIONER
GEORGE TALBOT, JR.	COMMISSIONER
FRANK J. UDDO	COMMISSIONER

PHASE II CONSTRUCTION INCLUDES REACH E-1 THRU E-5 AND W-1 THRU W-6 AND MODIFICATIONS AT I-610 BRIDGE AND AT 30" WATERLINE



PROJECT LOCATION MAP

SCALE IN FEET

INDEX TO SHEETS

APPROVALS:

DESIGN ENGINEERING, INC DATE

C. F. BAILEY - CHIEF ENGINEER - ORLEANS LEVEE BOARD DATE

OCTOBER, 1987

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

O.L.B. PROJECT NO. 2048-0278
D.E.I. PROJECT NO. 1006/86

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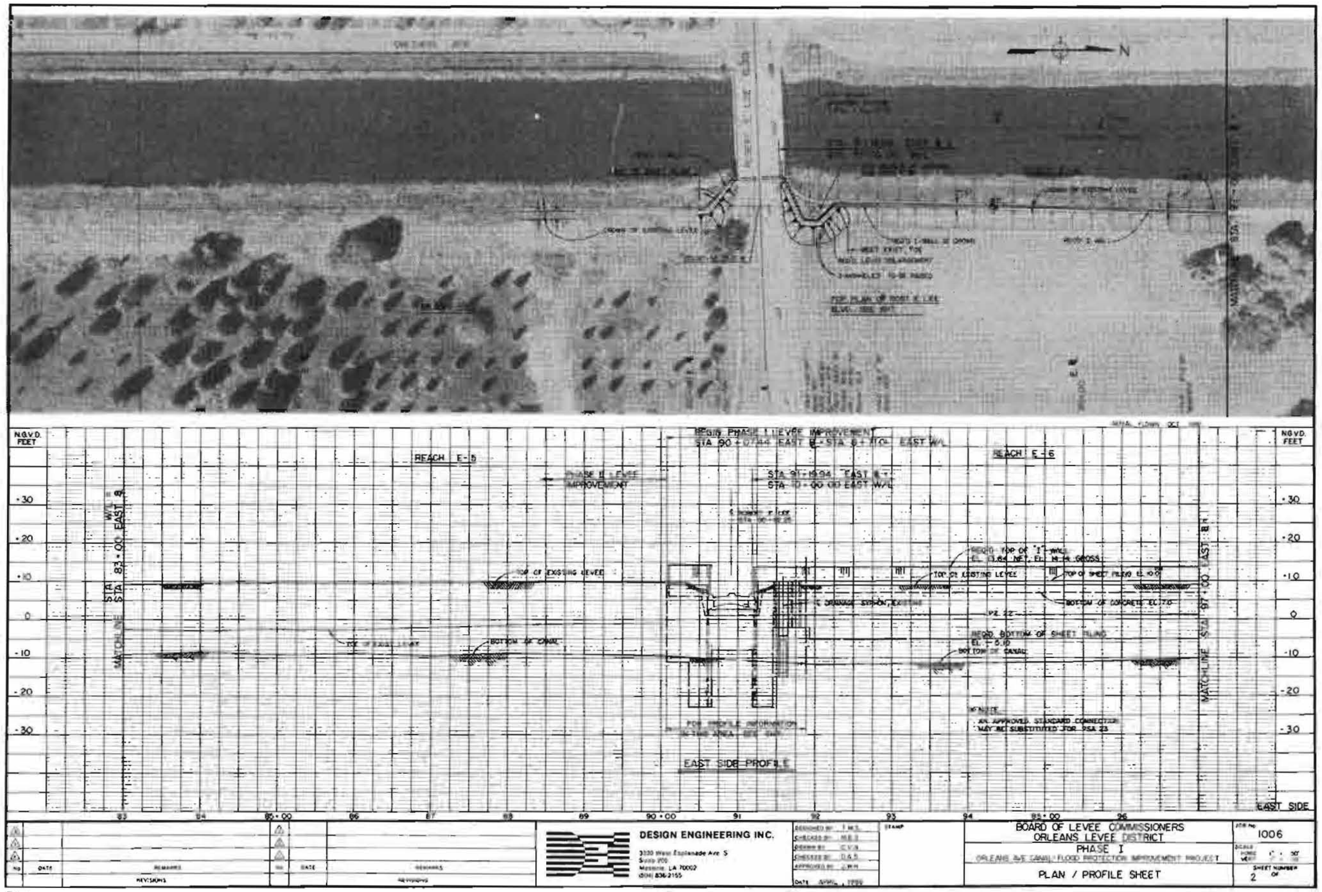

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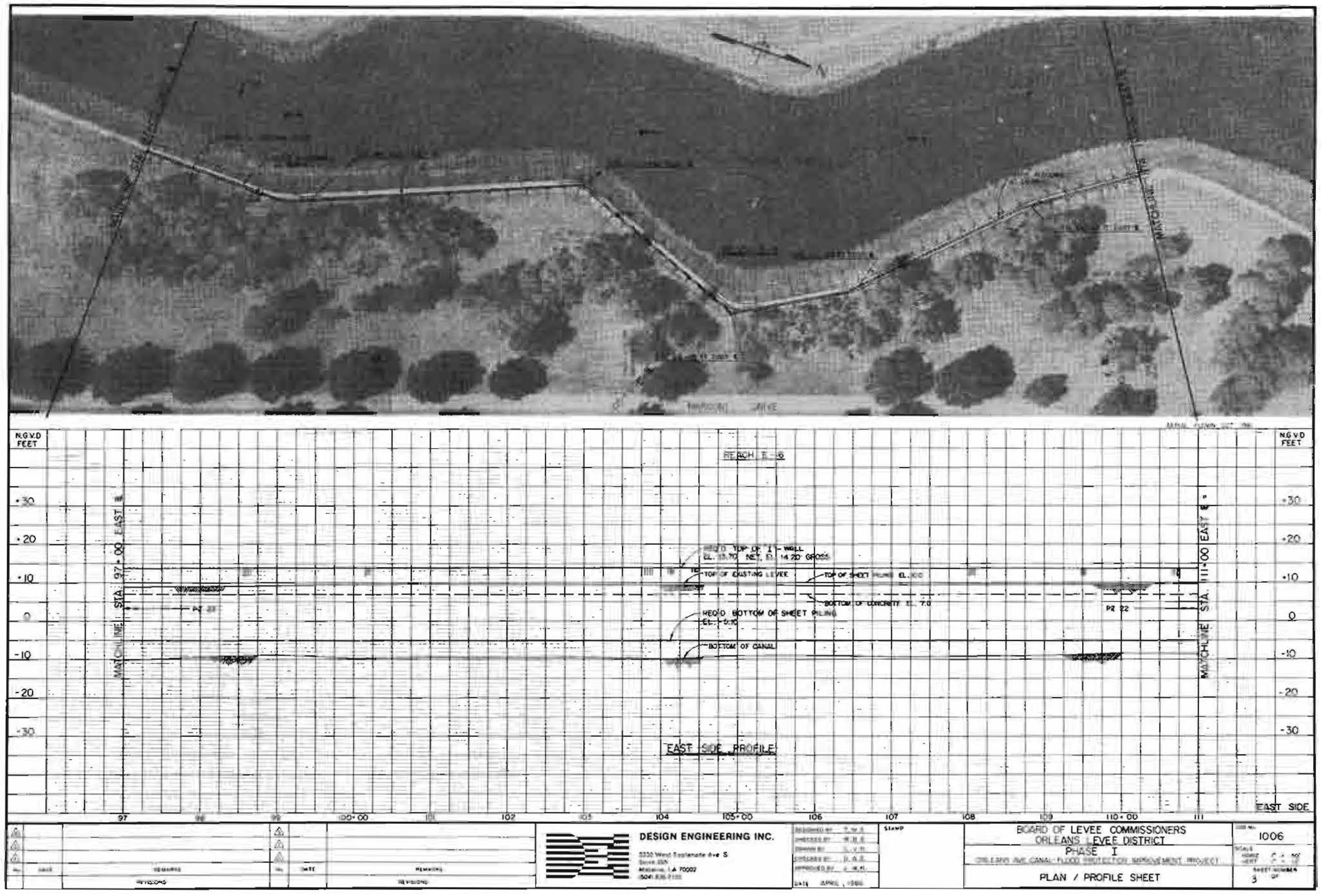

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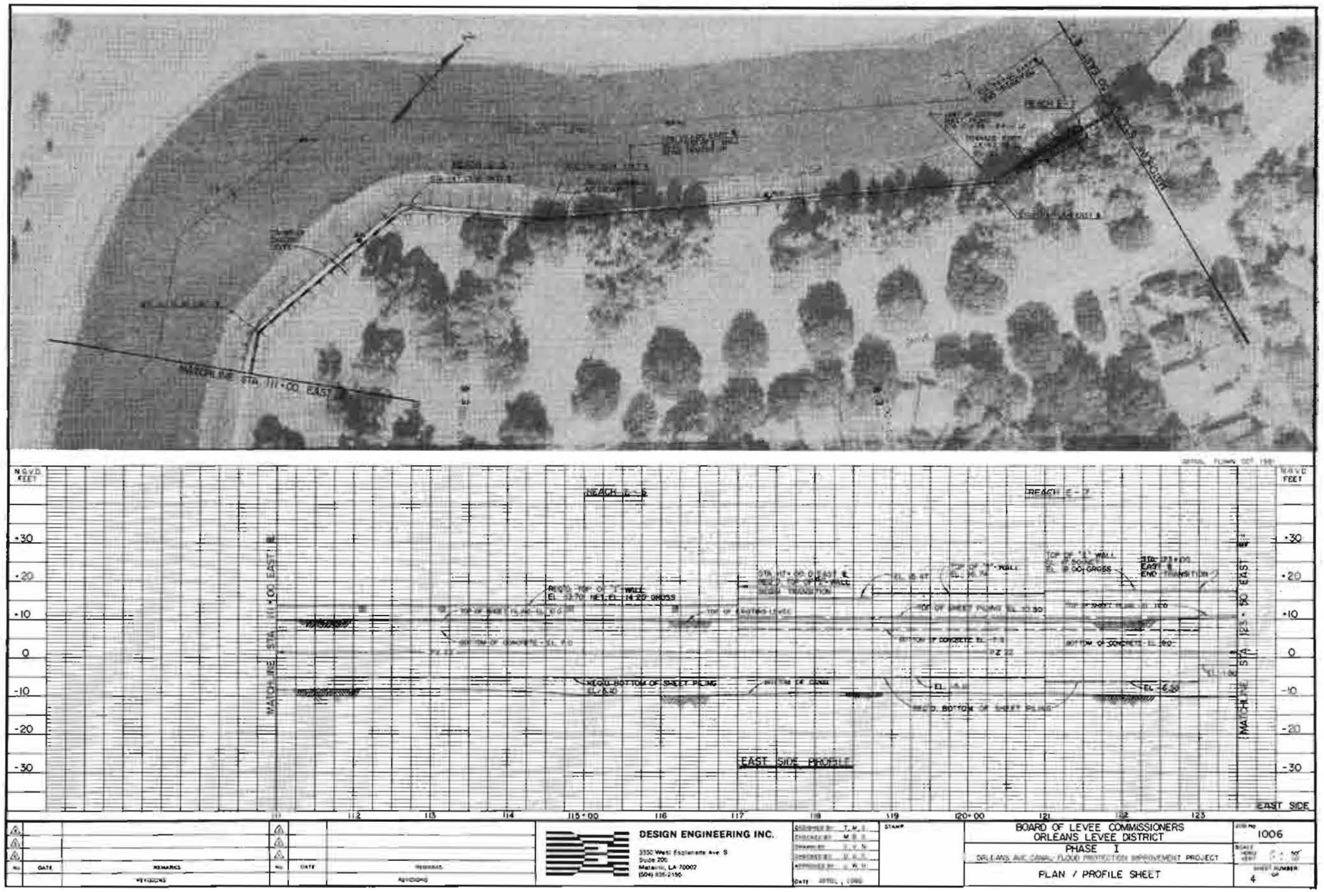

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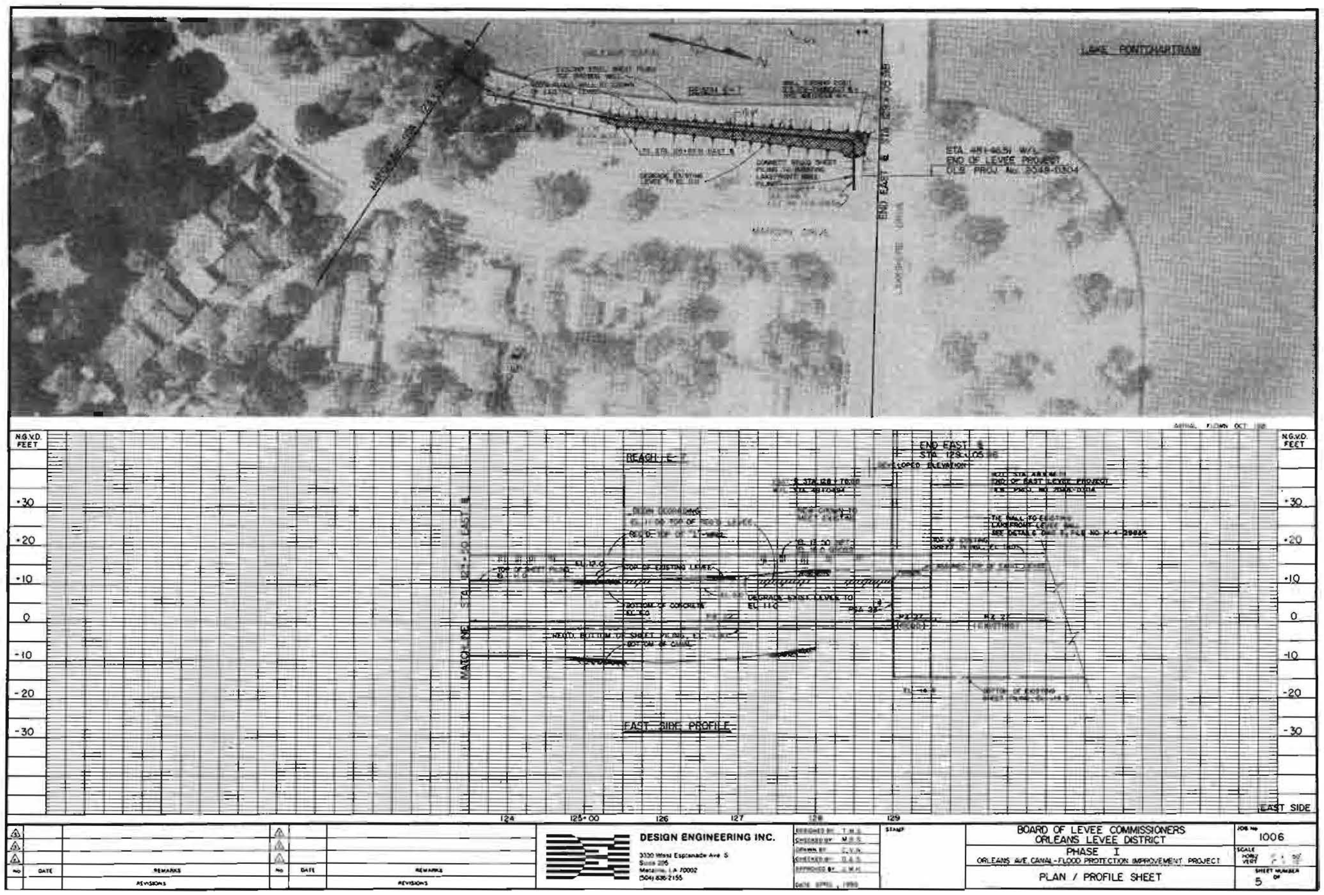

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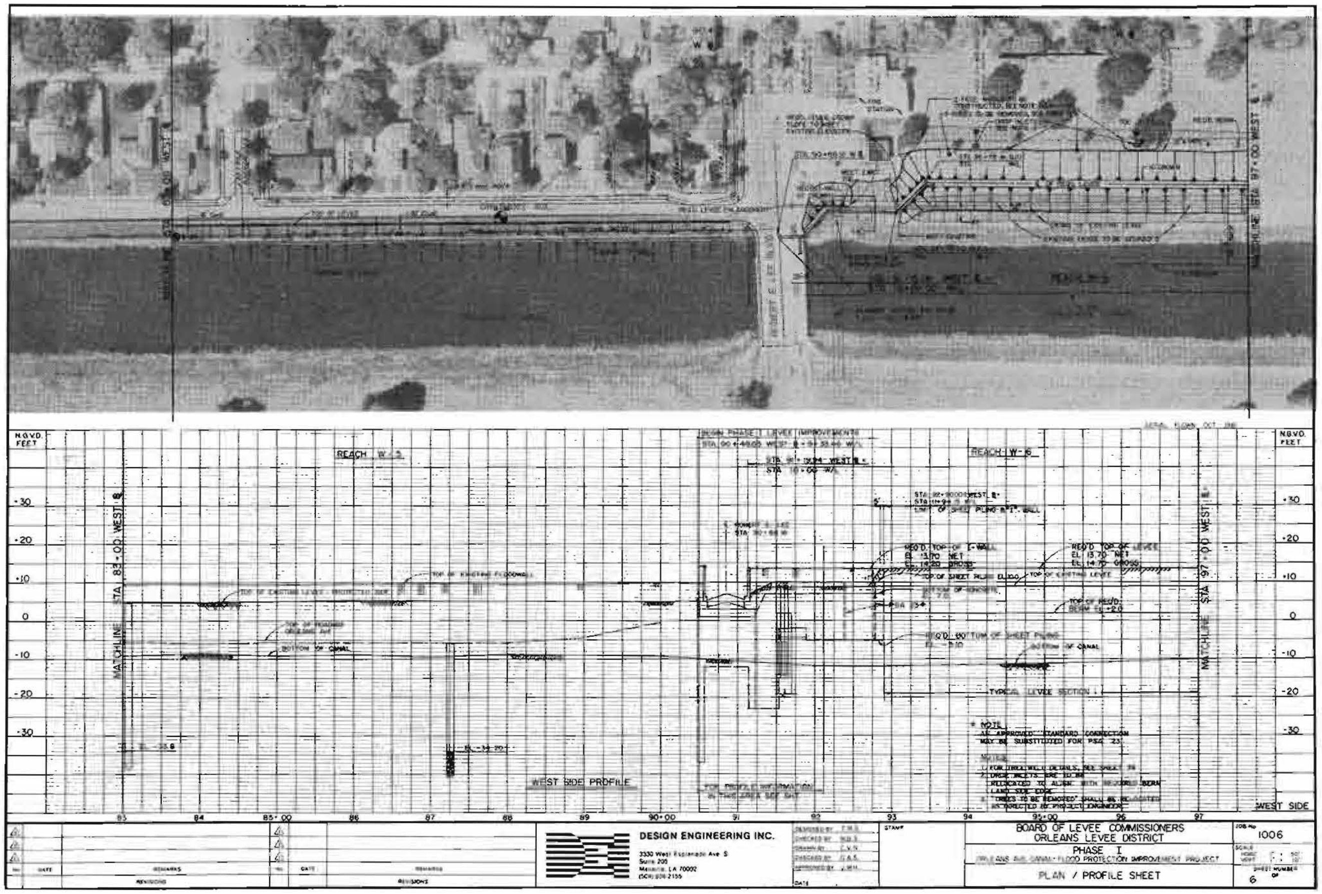

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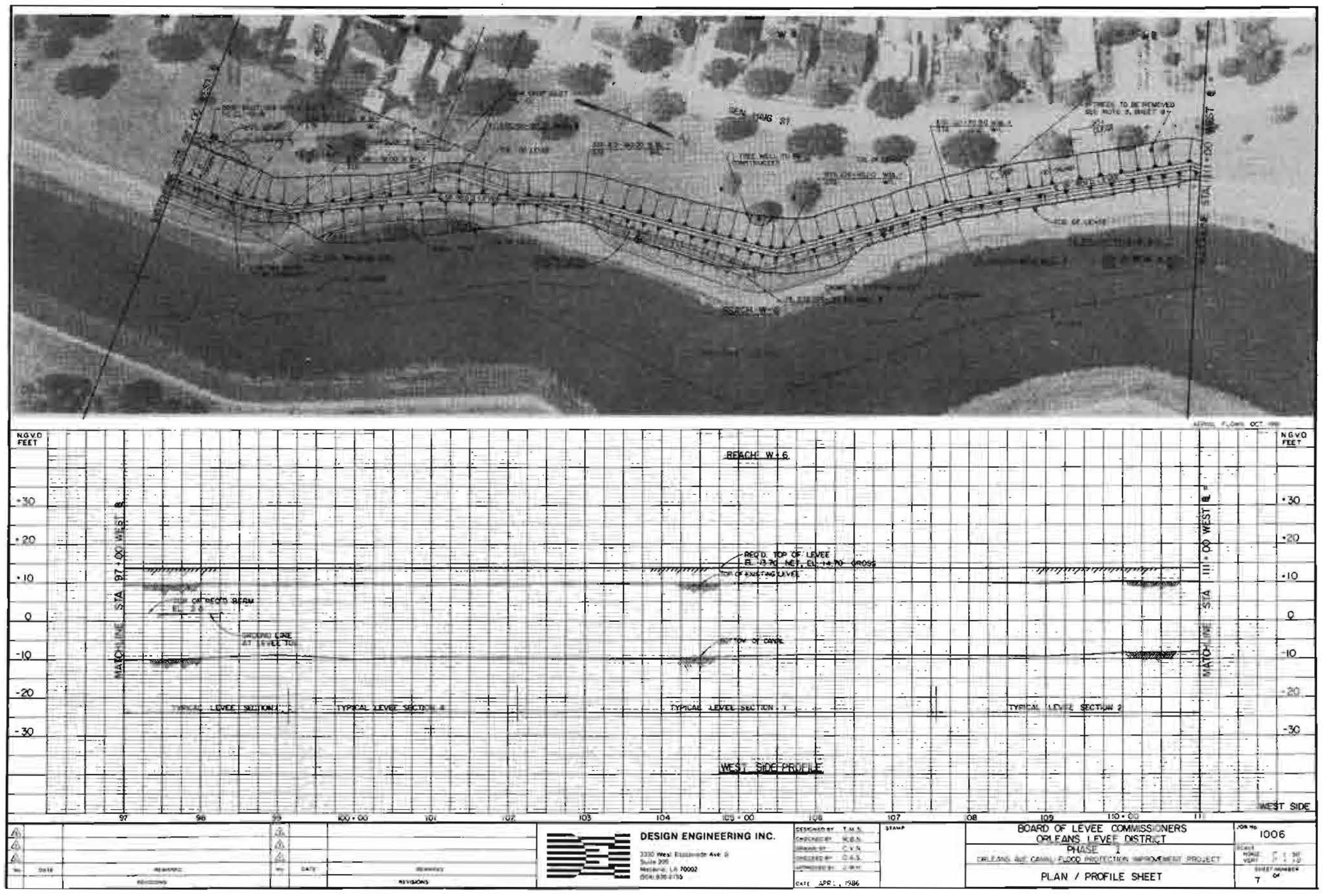

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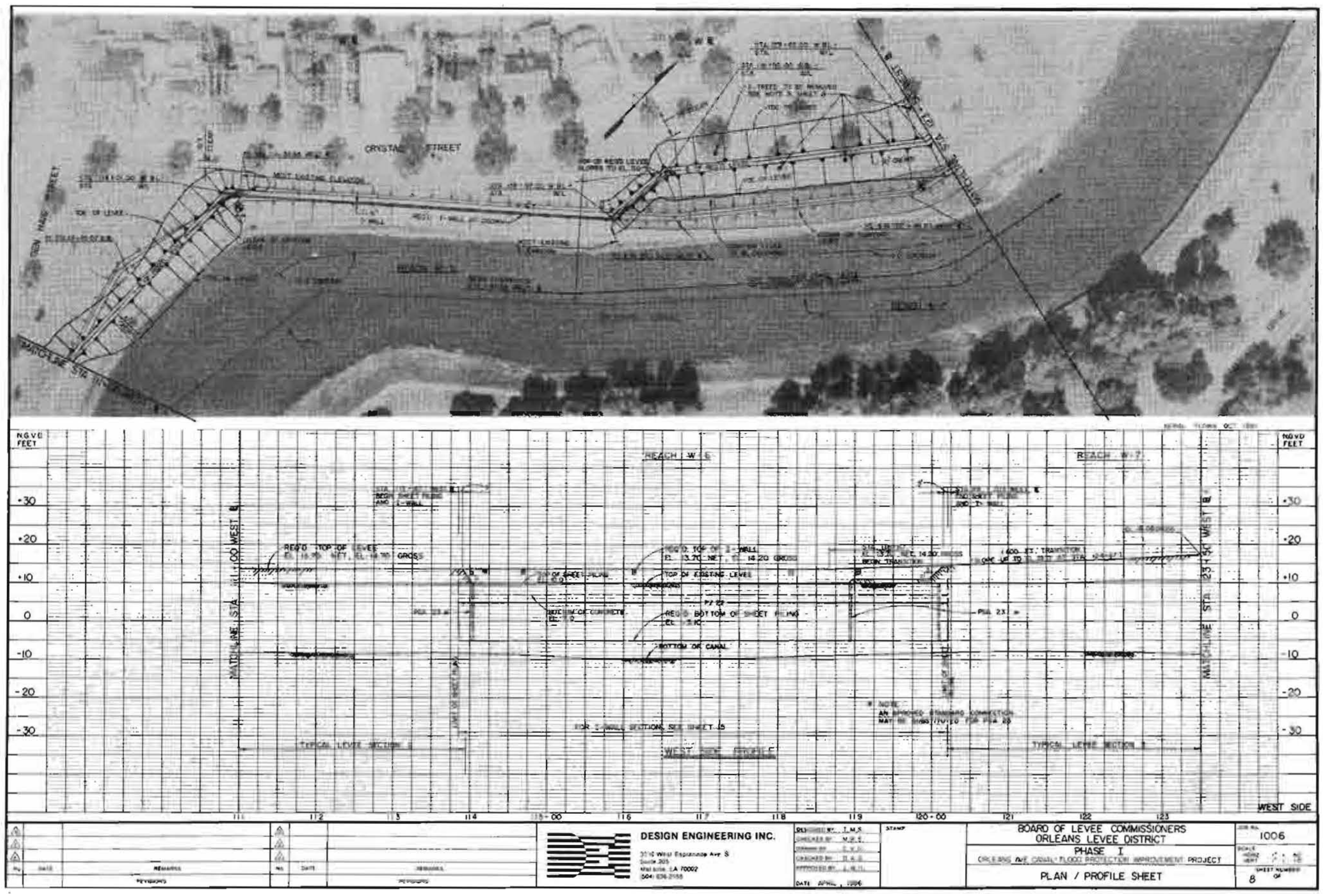

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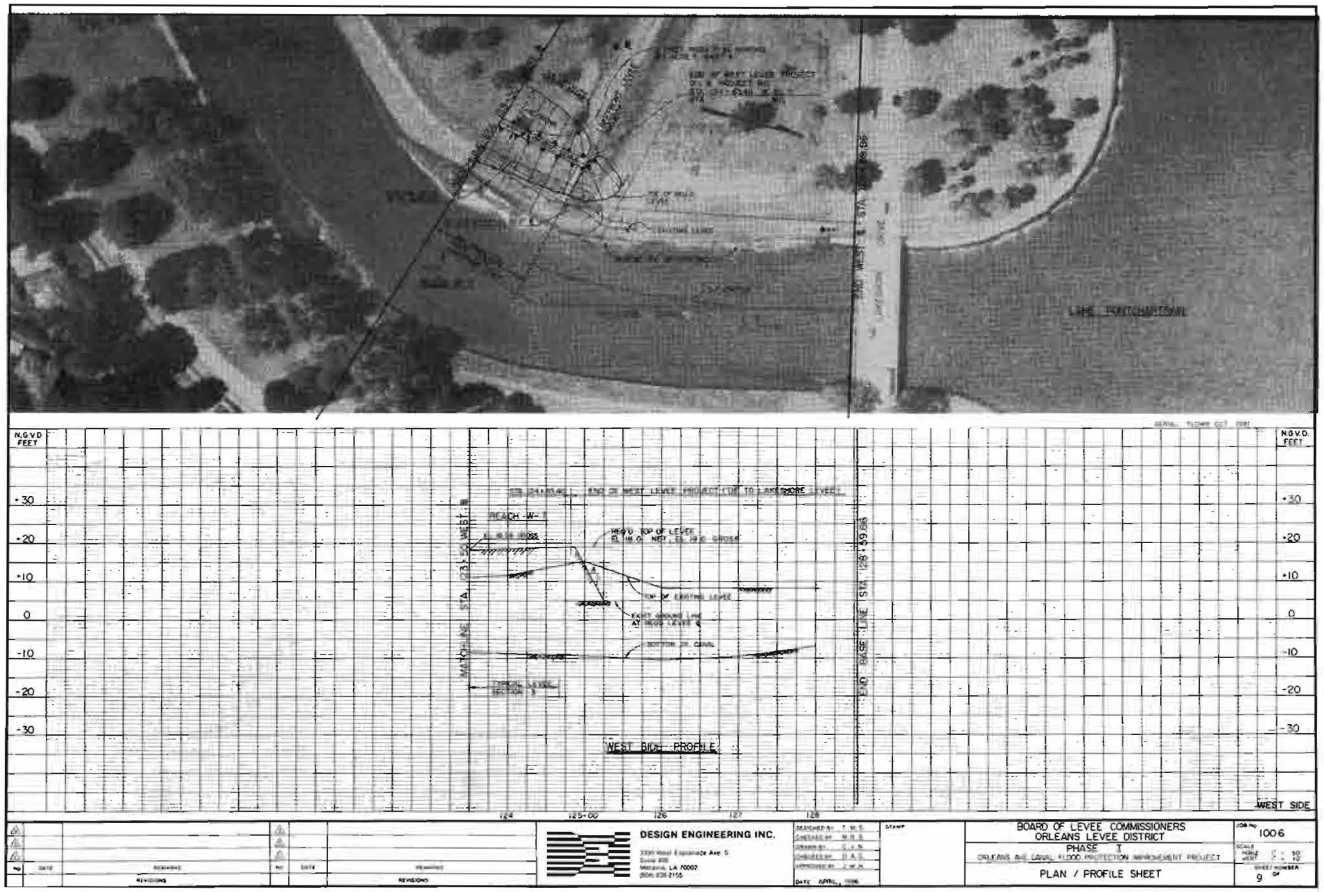

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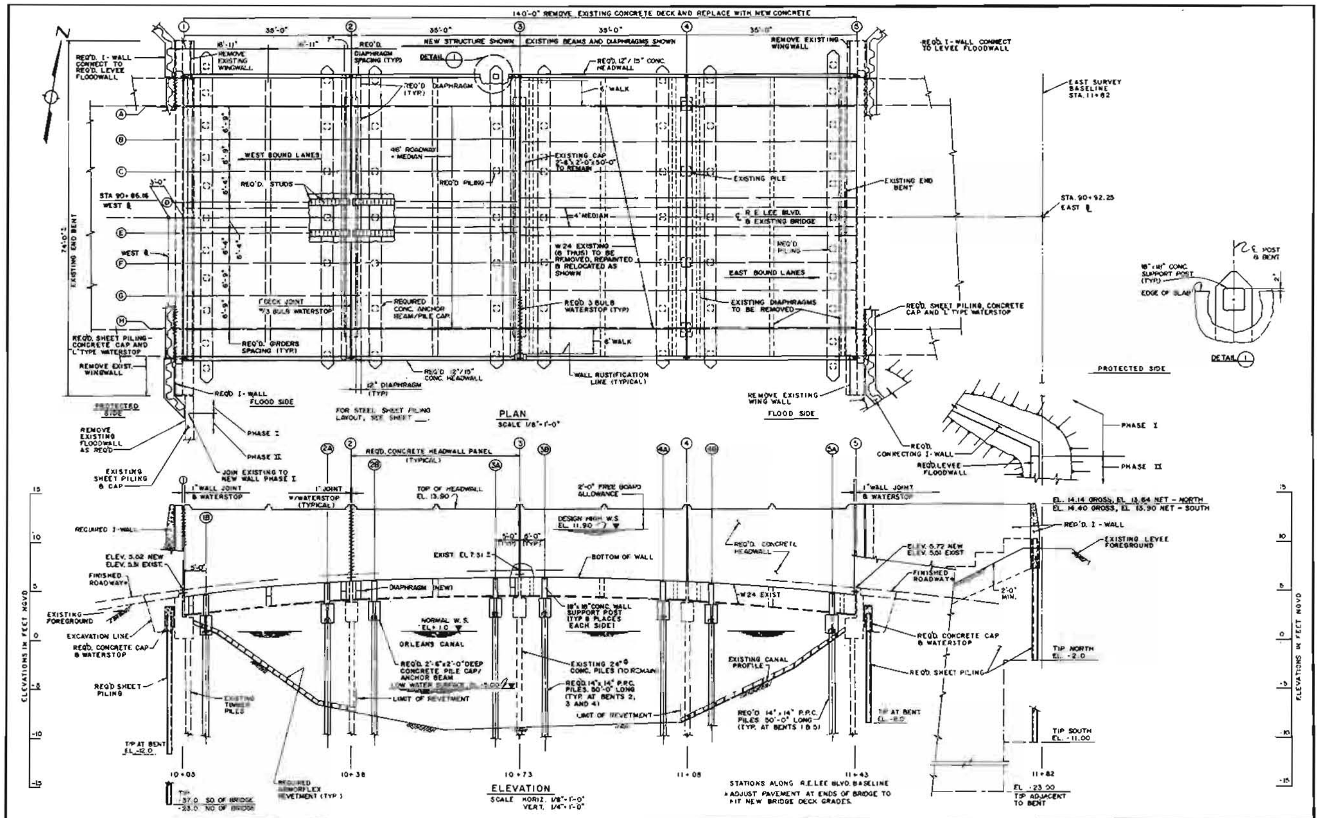

DESIGN ENGINEERING INC. 3330 West Esplanade Ave. S. Suite 205 Metairie, LA 70002 (504) 836-2155	DESIGNED BY MBS CHECKED BY TMS DRAWN BY RHB CHECKED BY TMS APPROVED BY DATE	STAMP	BOARD OF LEVEE COMMISSIONERS ORLEANS LEVEE DISTRICT PHASE I ORLEANS AVE CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT R.E. LEE BLVD. BRIDGE MODIFICATION PLAN & ELEVATION
			JOB No. 1006 SCALE AS SHOWN SHEET NUMBER 10 OF

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		REVISIONS			REVISIONS

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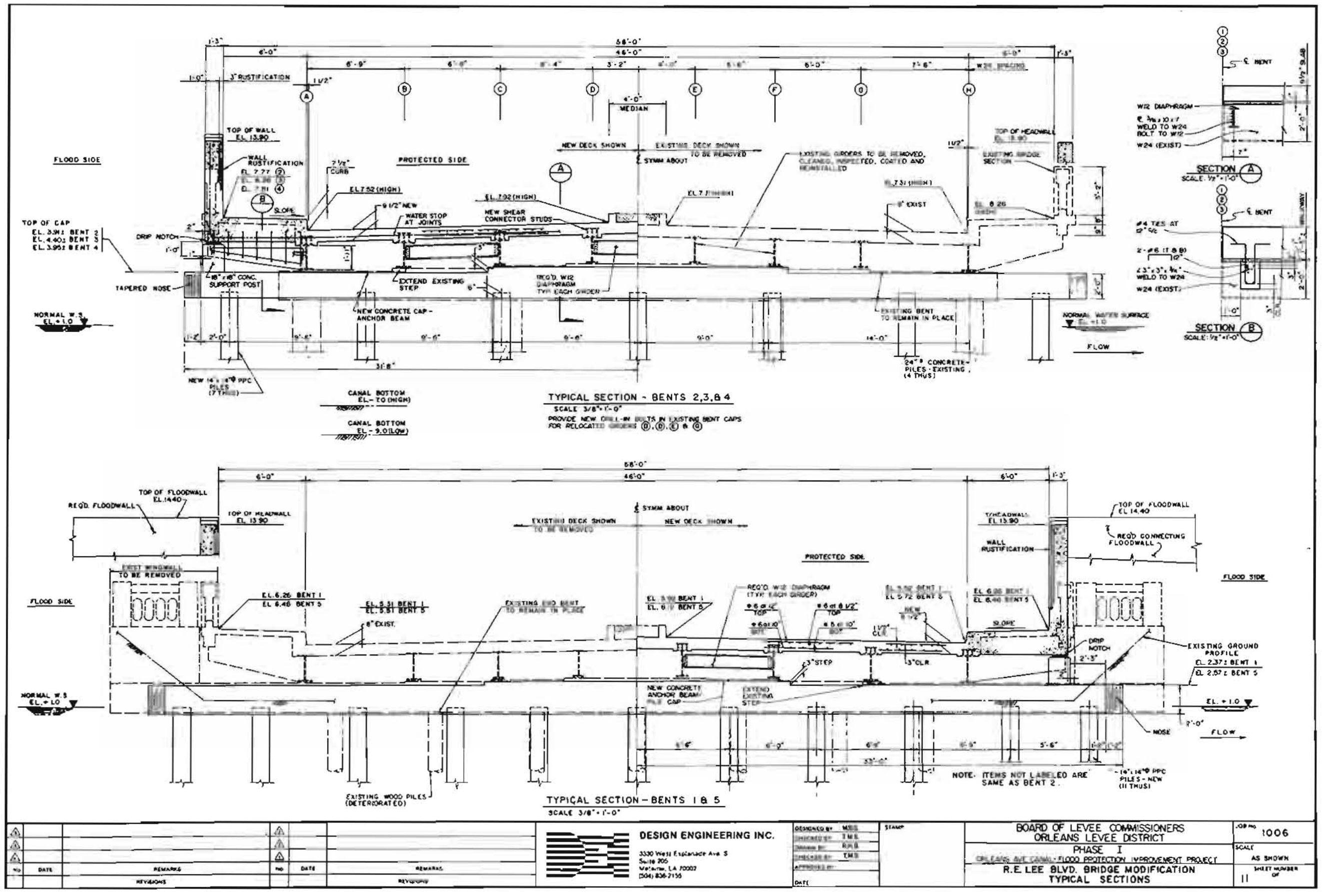

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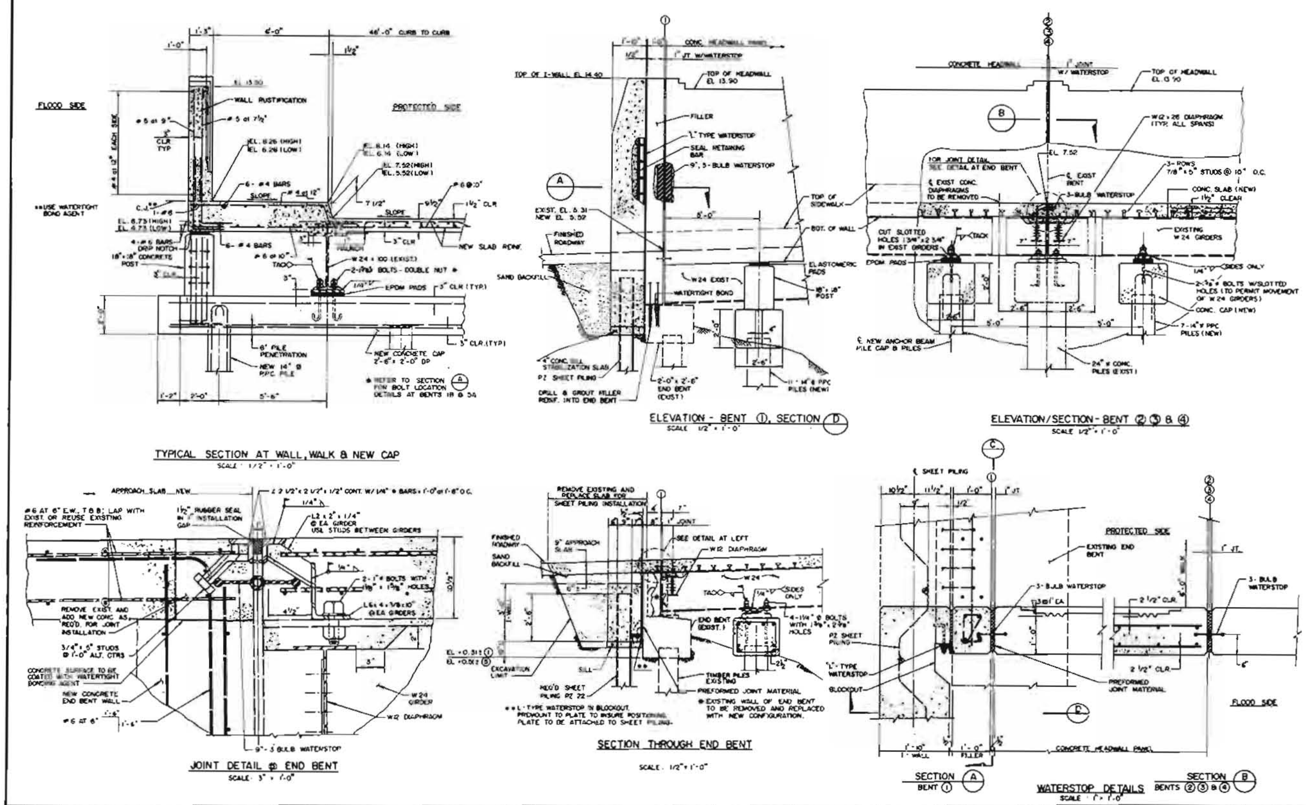

TYPICAL SECTION AT WALL, WALK & NEW CAP
SCALE: 1/2" = 1'-0"

ELEVATION - BENT ①, SECTION Ⓓ
SCALE: 1/2" = 1'-0"

ELEVATION/SECTION - BENT ② ③ & ④
SCALE: 1/2" = 1'-0"

JOINT DETAIL @ END BENT
SCALE: 3" = 1'-0"

SECTION THROUGH END BENT
SCALE: 1/2" = 1'-0"

SECTION Ⓐ BENT ①

WATERSTOP DETAILS
SCALE: 1" = 1'-0"

SECTION Ⓑ BENTS ② ③ & ④

No.	DATE	REMARKS	No.	DATE	REMARKS
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REVISIONS			REVISIONS		

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3330 West Esplanade Ave. S
Suite 205
Metairie, LA 70002
(504) 836-2155

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DRAWN BY: C.V.N.
CHECKED BY: T.M.B.
APPROVED BY:
DATE

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
R.E. LEE BLVD. BRIDGE MODIFICATION
SECTIONS & DETAILS

JOB No. 1006
SCALE: AS SHOWN
SHEET NUMBER: 12 OF

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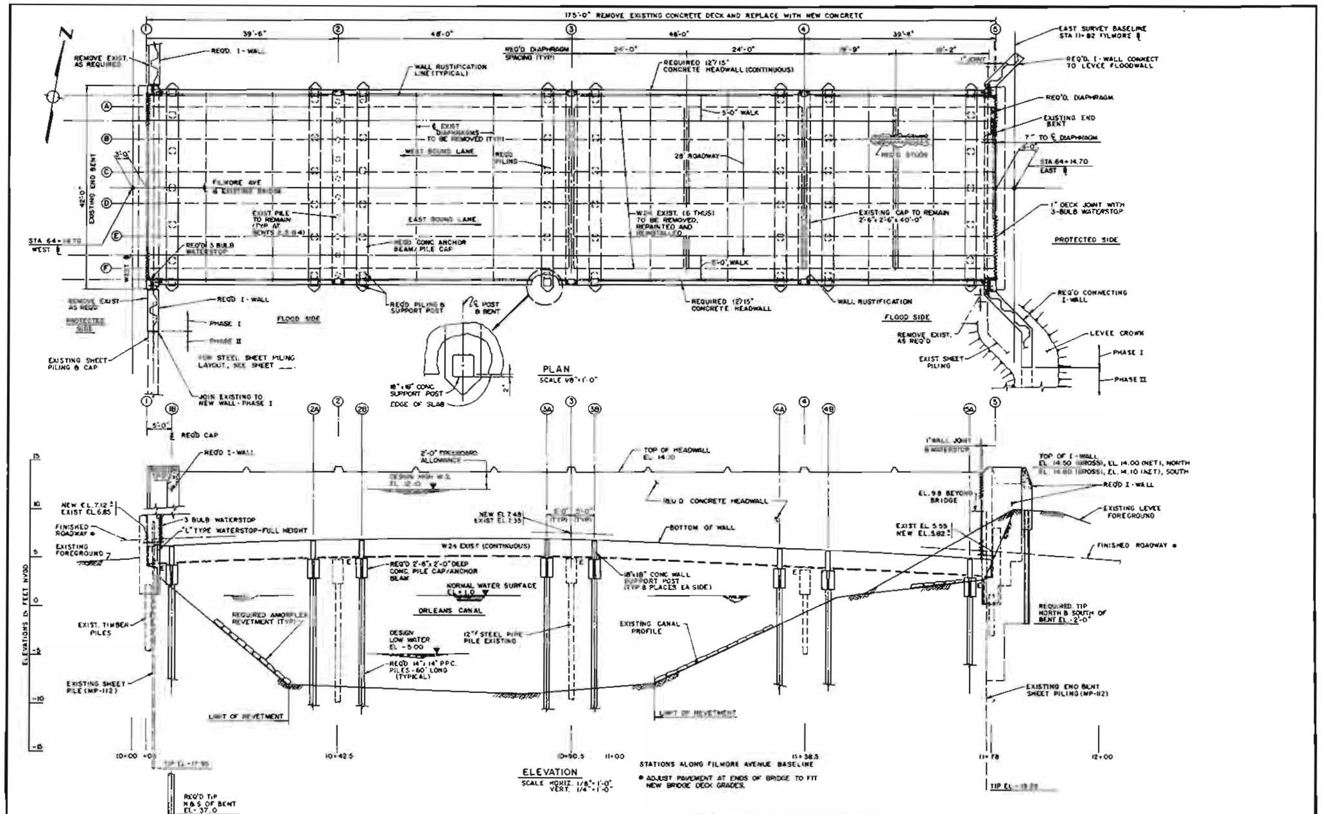

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3330 West Esplanade Ave. S.
Suite 306
Metairie, LA 70002
(504) 838-2155

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DRAWN BY W.H.B.
CHECKED BY T.M.S.
APPROVED BY
DATE

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BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
FILMORE AVENUE BRIDGE MODIFICATION
PLAN AND ELEVATION

JOB No. 1006
SCALE AS SHOWN
SHEET NUMBER 13 OF

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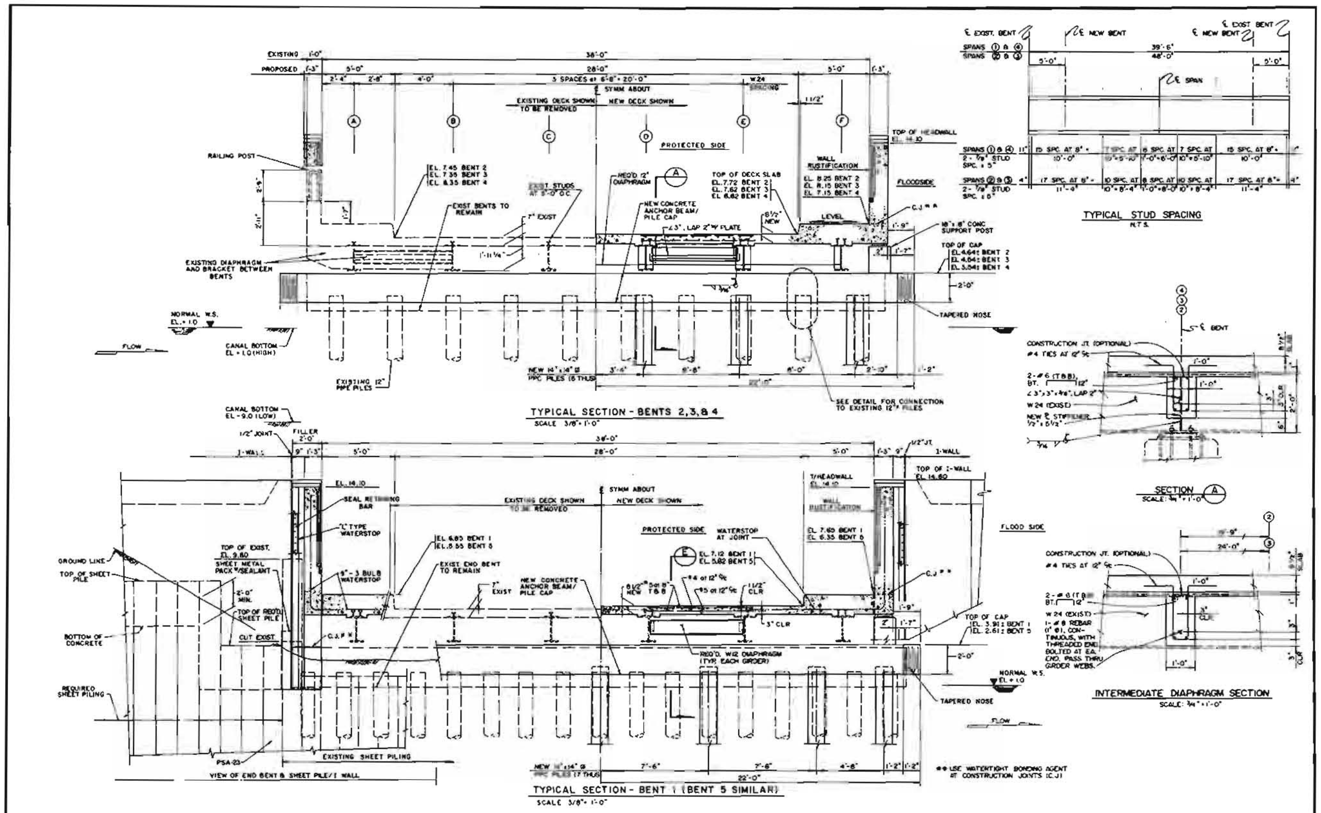

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		REVISIONS			REVISIONS

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3330 West Esplanade Ave. S
Suite 205
Metairie, LA 70002
(504) 836-2155

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CHECKED BY: T.M.S.
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BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
FILMORE AVENUE BRIDGE MODIFICATION
TYPICAL SECTIONS

JOB No. 1006
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SHEET NUMBER 14 OF

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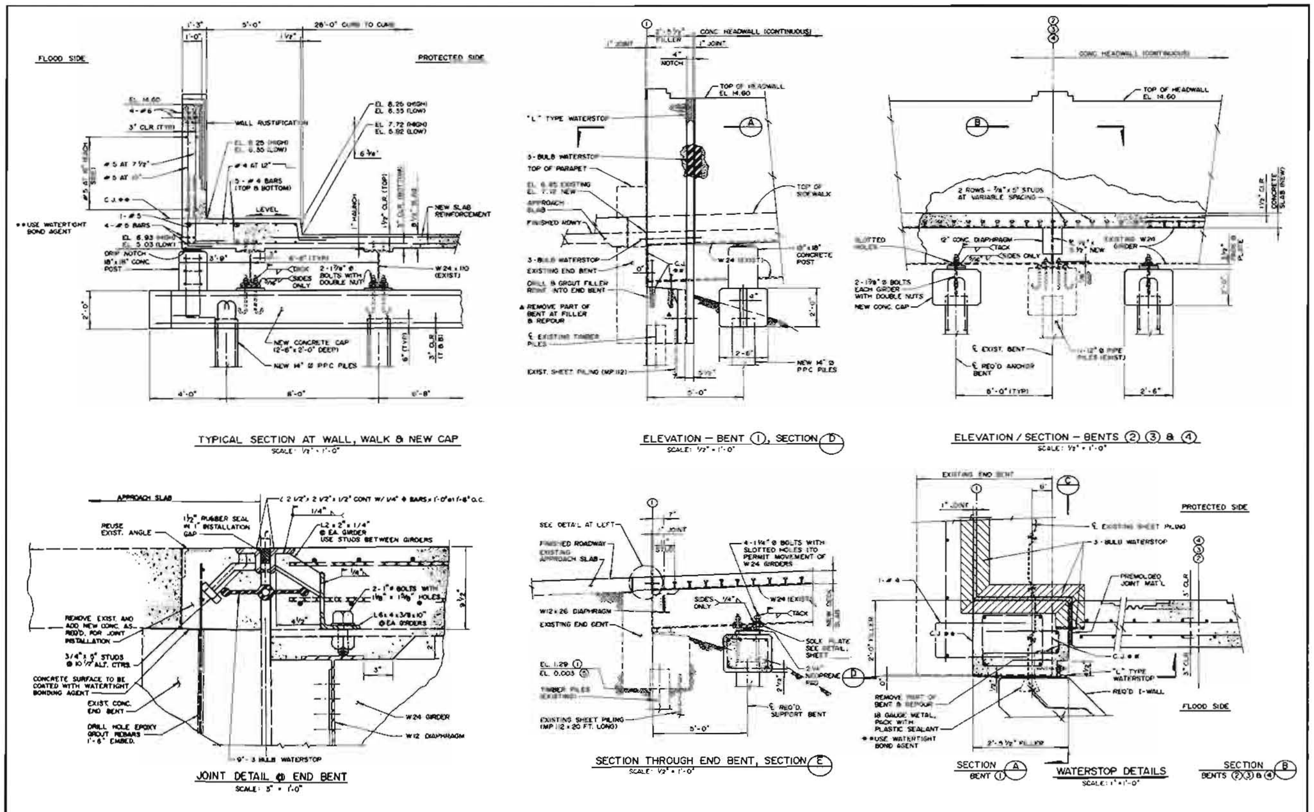

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		REVISIONS			REVISIONS

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Suite 205
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(504) 836-2155

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ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE. CANAL – FLOOD PROTECTION IMPROVEMENT PROJECT
FILMORE AVE. BRIDGE MODIFICATION
SECTION & DETAILS

JOB No. 1006
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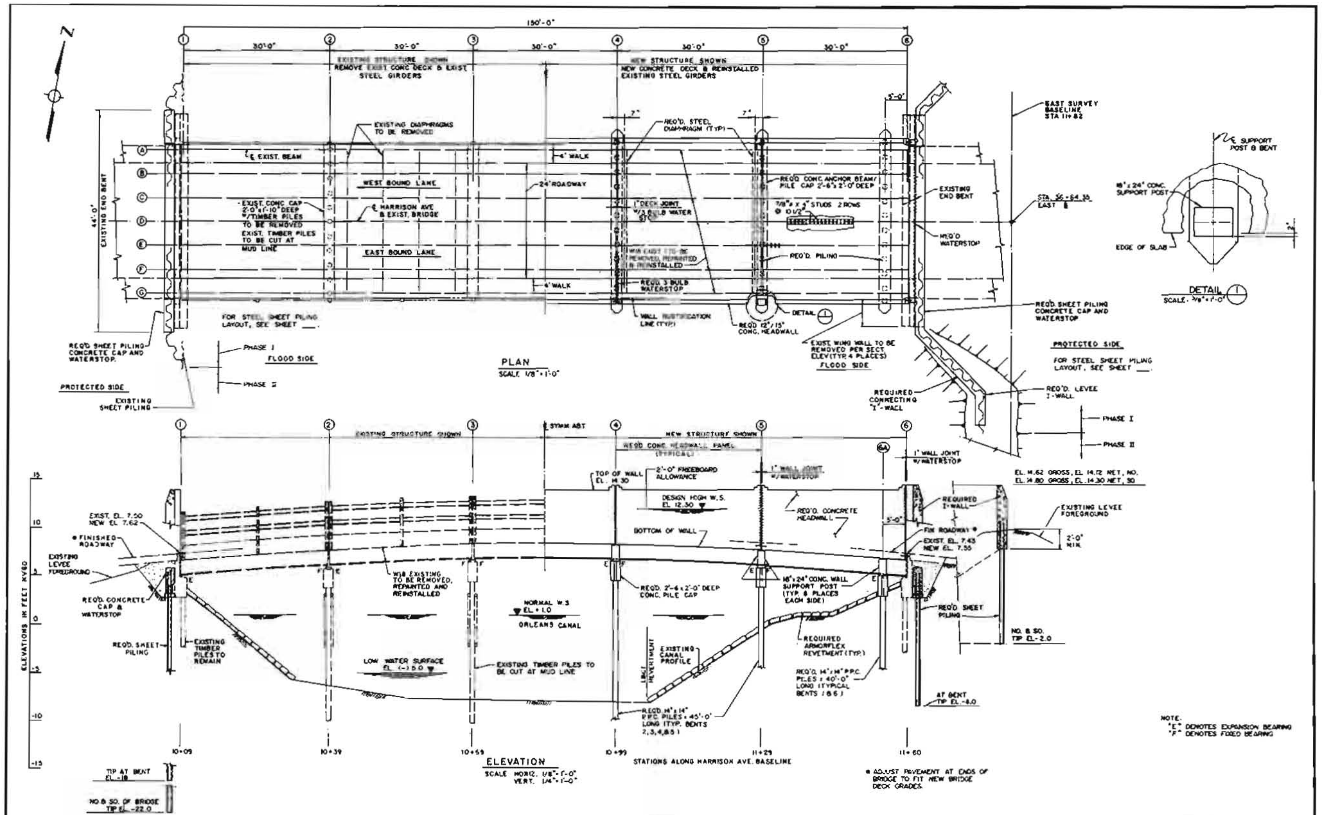

NO.	DATE	REMARKS	NO.	DATE	REMARKS
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Suite 205
Metairie, LA 70002
(504) 836-2136

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BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
HARRISON AVENUE BRIDGE MODIFICATION
PLAN AND ELEVATION

JOB No. 1006
SCALE AS SHOWN
SHEET NUMBER 16 OF

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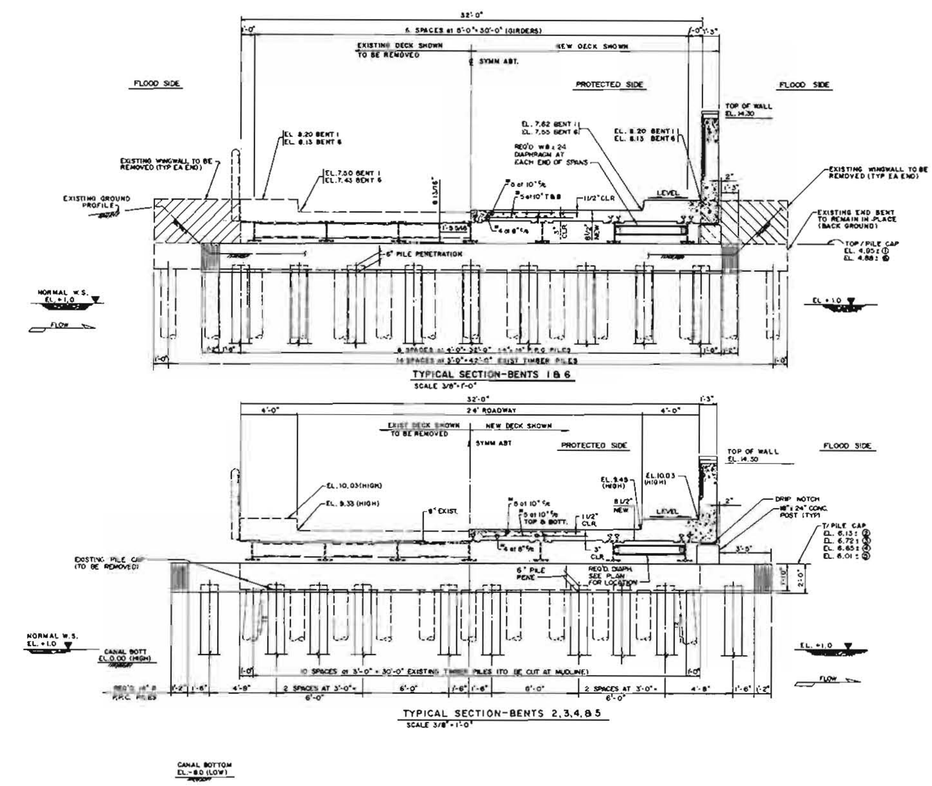

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		REVISIONS			REVISIONS

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3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 838-2156

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DRAWN BY: R.H.B.
CHECKED BY: M.B.S.
APPROVED BY:
DATE

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BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE. CANAL – FLOOD PROTECTION IMPROVEMENT PROJECT
HARRISON AVENUE BRIDGE MODIFICATION
TYPICAL SECTIONS

JOB No. 1006
SCALE AS SHOWN
SHEET NUMBER 17 OF

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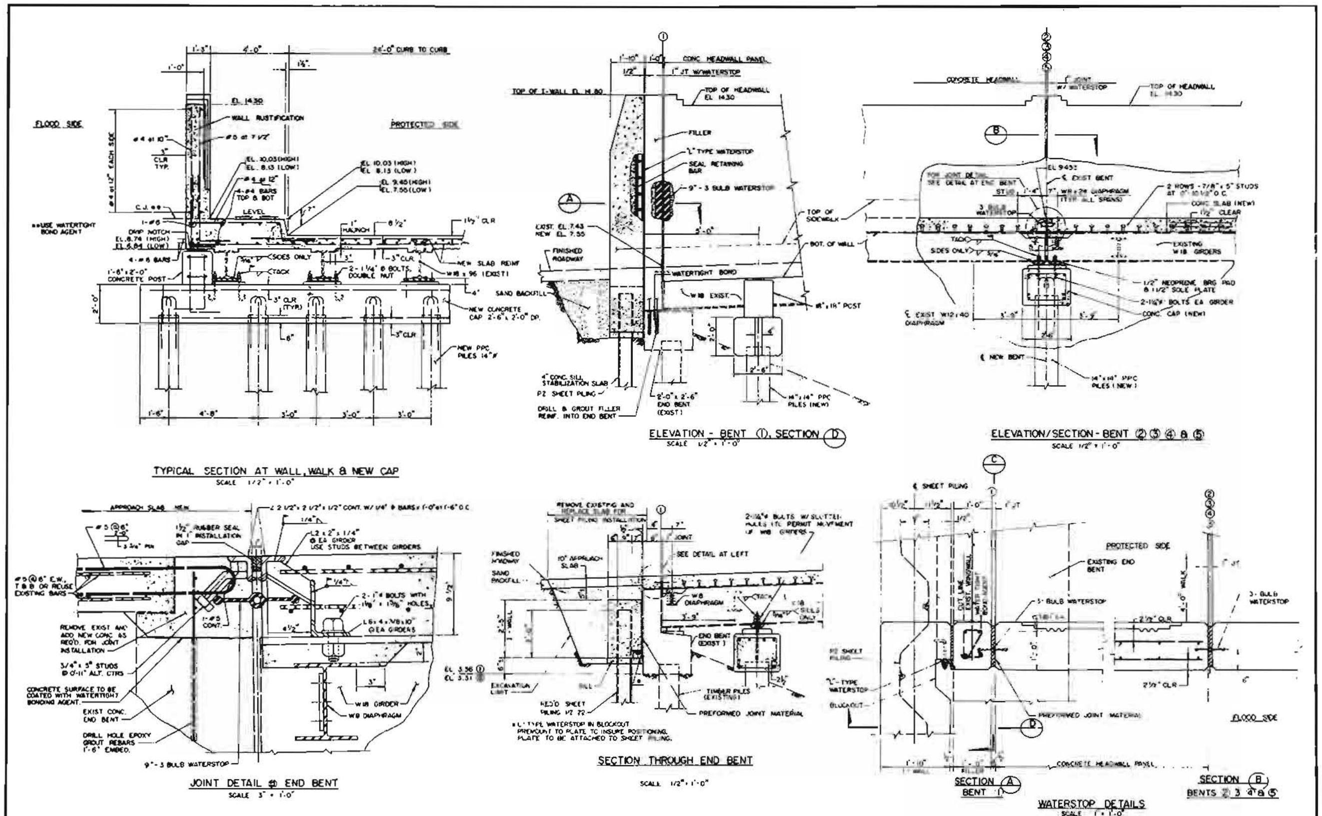

DESIGN ENGINEERING INC. 3330 West Esplanade Ave. S. Suite 206 Metairie, LA 70002 (504) 836-2155	BOARD OF LEVEE COMMISSIONERS ORLEANS LEVEE DISTRICT PHASE I ORLEANS AVE CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT HARRISON AVE. BRIDGE MODIFICATION SECTION & DETAILS
DESIGNED BY: MBS CHECKED BY: TMS DRAWN BY: CVN CHECKED BY: TMS	JOB No. 1006 SCALE AS SHOWN SHEET NUMBER 18

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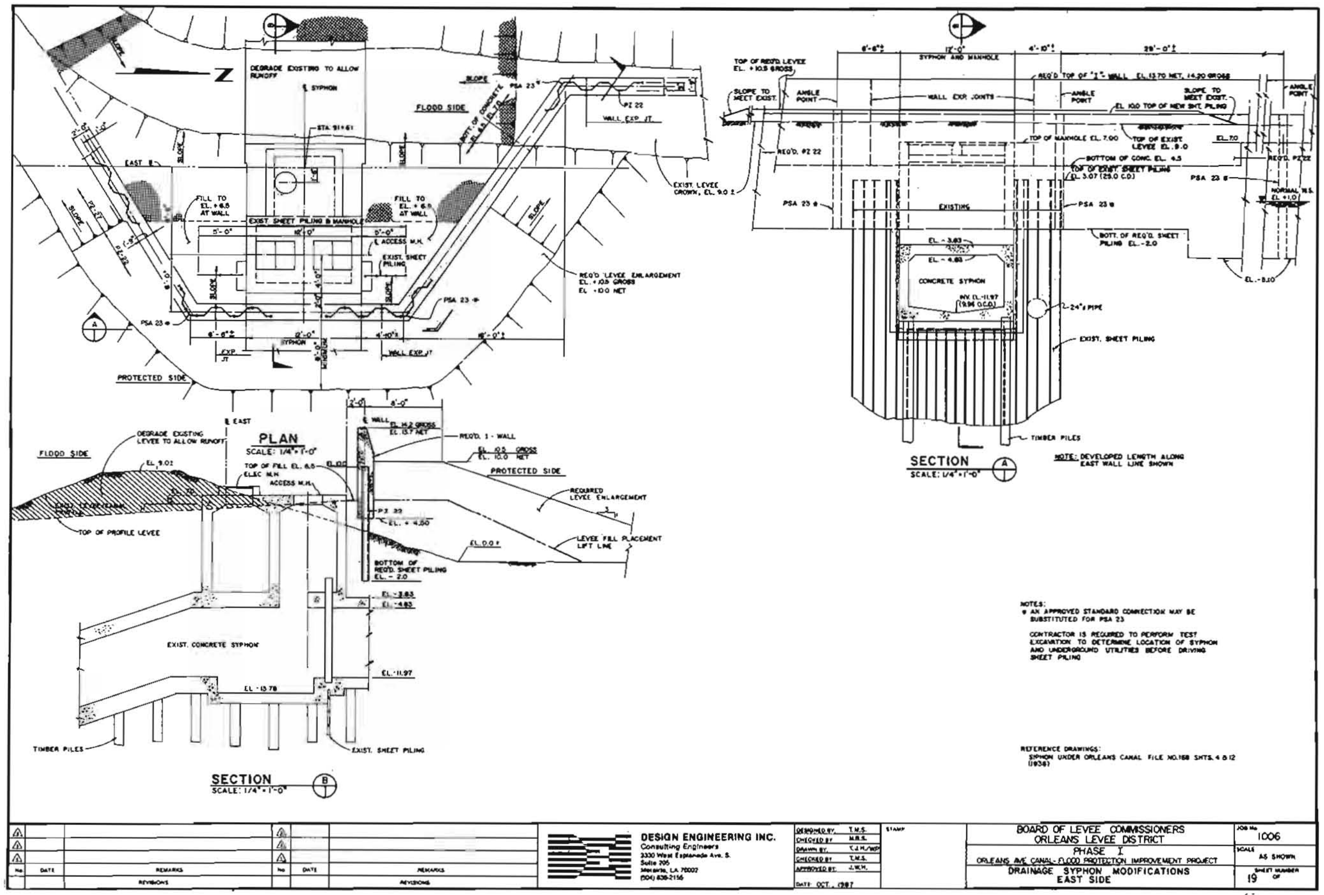

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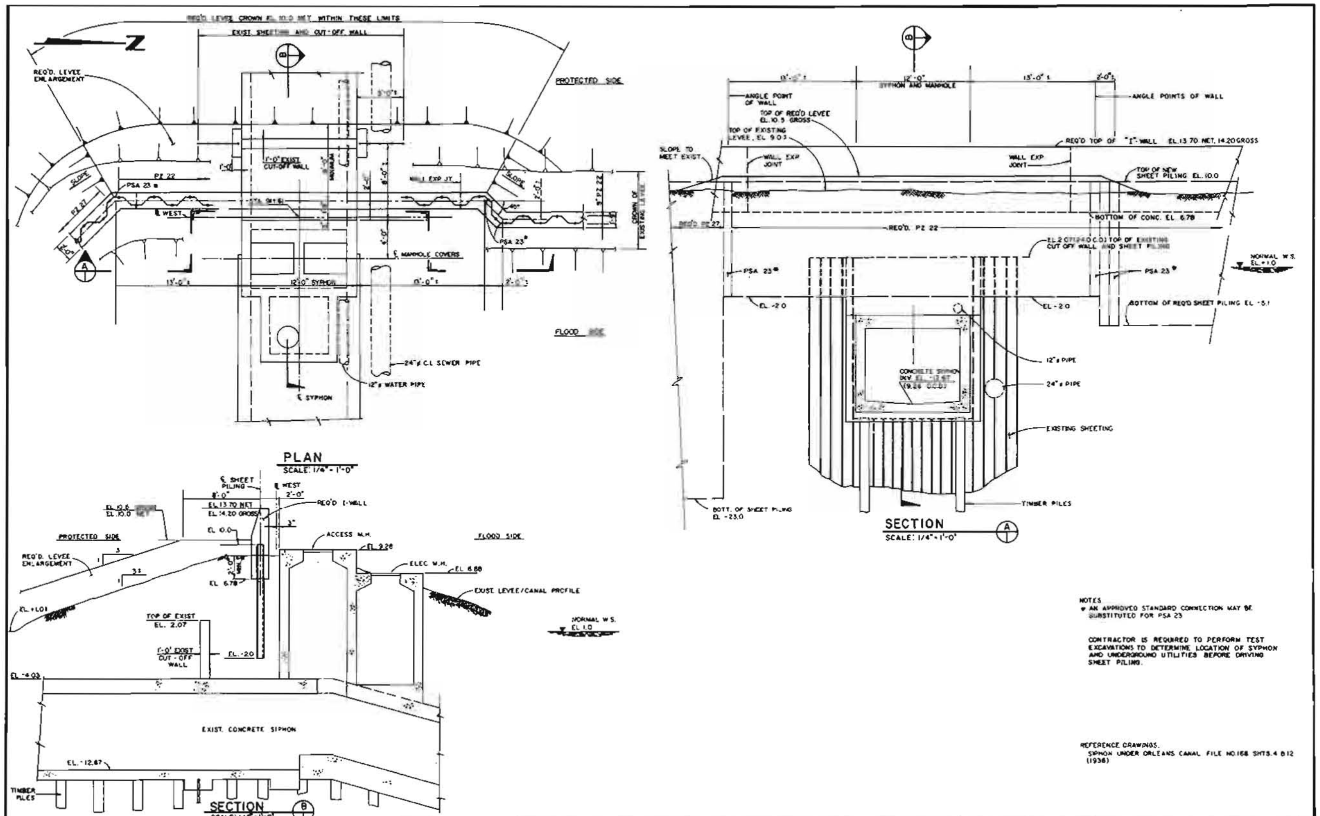

NOTES
* AN APPROVED STANDARD CONNECTION MAY BE SUBSTITUTED FOR PSA 23

CONTRACTOR IS REQUIRED TO PERFORM TEST EXCAVATIONS TO DETERMINE LOCATION OF SYPHON AND UNDERGROUND UTILITIES BEFORE DRIVING SHEET PILING.

REFERENCE DRAWINGS.
SIPHON UNDER ORLEANS CANAL FILE NO.168 SHTS.4 & 12 (1936)

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY	T.M.S.
CHECKED BY	M.B.S.
DRAWN BY	T.J.H.
CHECKED BY	T.M.S.
APPROVED BY	J.W.H.
DATE	OCT., 1987

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
DRAINAGE SYPHON MODIFICATIONS
WEST SIDE

JOB No. 1006
SCALE AS SHOWN
SHEET NUMBER 20 OF

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		REVISIONS			REVISIONS

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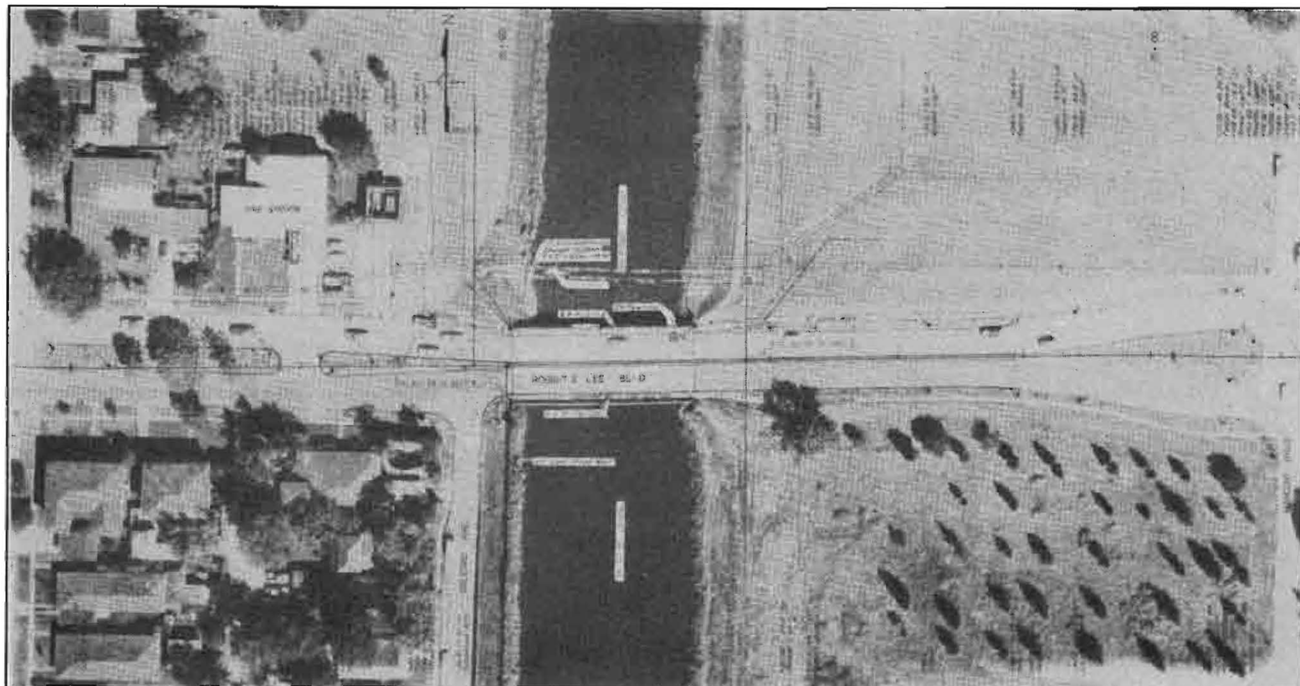

REFERENCE DRAWINGS

ELECTRIC FEEDER GRAPHIC	N ORLEANS PUB SERV	390-… (FEB 1973)
PROPOSED TELEPHONE CONDUIT	SO CENT BELL TEL CO	…357 (NOV 1970)
SEWER AND WATER LOCATIONS	SEWERAGE & WATER BRD	236 (UNDATE)
DRAINAGE SYPHON	ORLEANS LEVEE BOARD	… (1936)

No.	DATE	REMARKS

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DESIGN ENGINEERING INC.
2330 West Esplanade Ave. S
Suite 205
Metairie, LA 70002

DESIGNED BY T.M.S.

DATE

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BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT

PHASE I
ORLEANS AVE CANAL FLOOD PROTECTION IMPROVEMENT PROJECT

UTILITY LOCATIONS
ROBERT E LEE BLVD. BRIDGE

JOB No. 1006

SCALE 1" = 30'

SHEET NUMBER 21

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REFERENCE DRAWINGS:
N. ORLEANS PUB. SERV. # 384-484-P4 (SEPT 1972)

DESIGN ENGINEERING INC.	BOARD OF LEVEE COMMISSIONERS ORLEANS LEVEE DISTRICT	1006
	PHASE I	
	UTILITY LOCATIONS FILMORE AVE. BRIDGE	22

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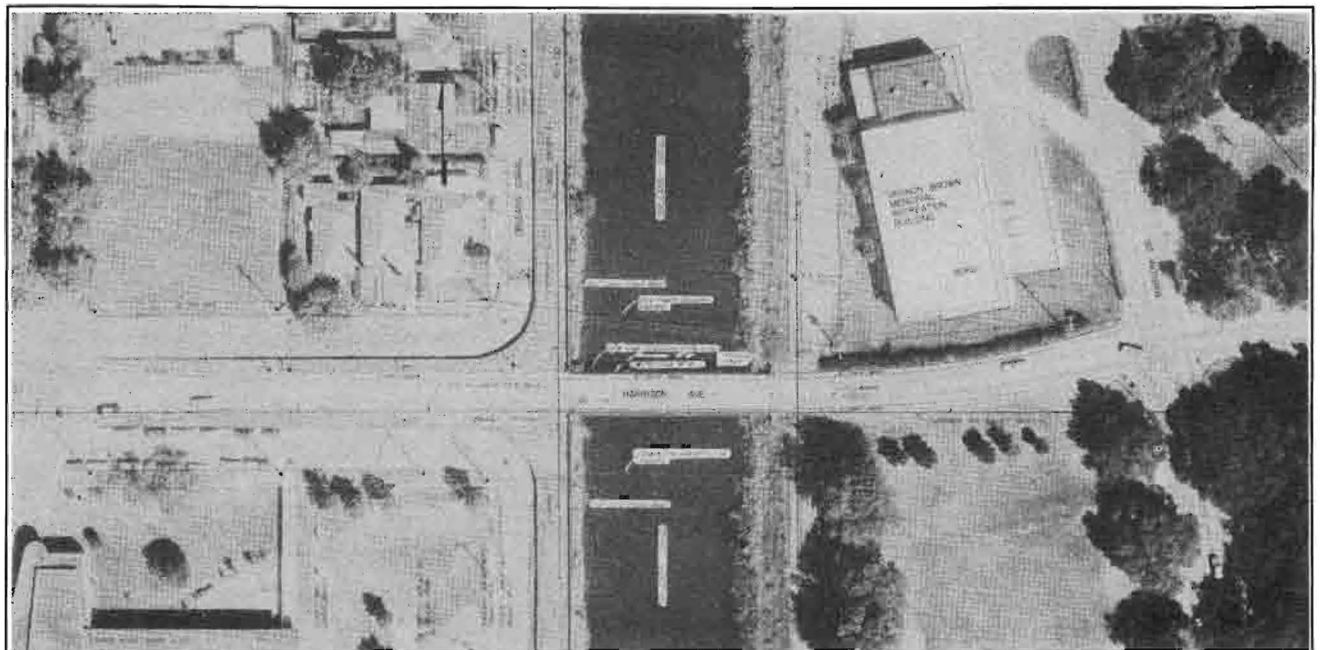

REFERENCE DRAWINGS

PROPOSED 2" H.P. STEEL GAS MAIN — N. ORLEANS PUB. SERV. # 5-2600-C (8-21-1985)

ELECTRIC FEEDER GRAPHIC — N. ORLEANS PUB. SERV. # 389-994-F4 (SEPT. 1972)

No	DATE	REMARKS	No	DATE	REMARKS
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REVISIONS			REVISIONS		

DESIGN ENGINEERING INC.
3330 West Esplanade Ave. S
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: F.W.S.
CHECKED BY: R.B.S.
DRAWN BY: C.V.H.
CHECKED BY: D.A.B.
APPROVED BY: J.B.H.
DATE

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE I
ORLEANS AVE. CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
UTILITY LOCATIONS
HARRISON AVE. BRIDGE

JOB No. 1006
SCALE 1" = 30'
SHEET NUMBER 23 OF

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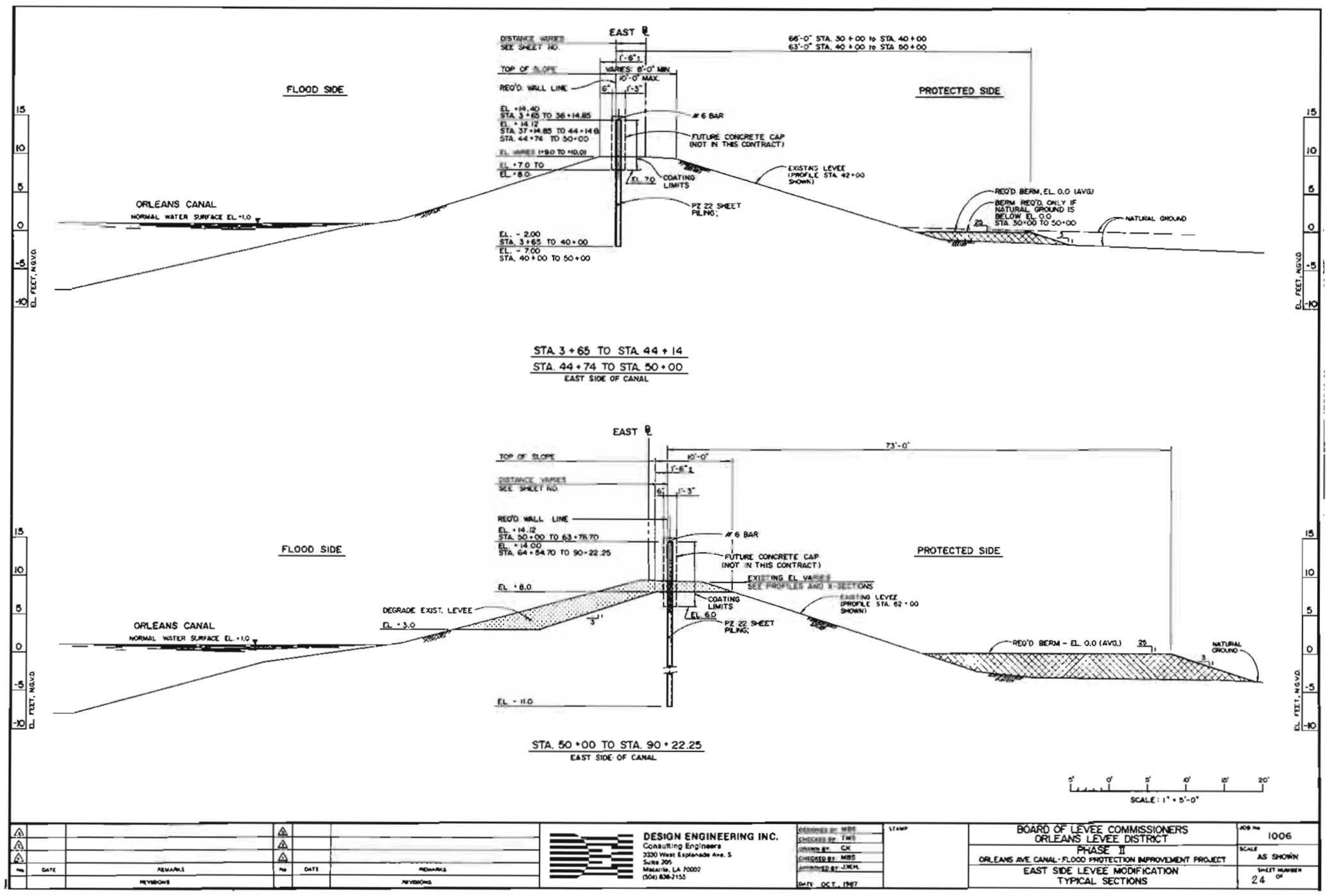

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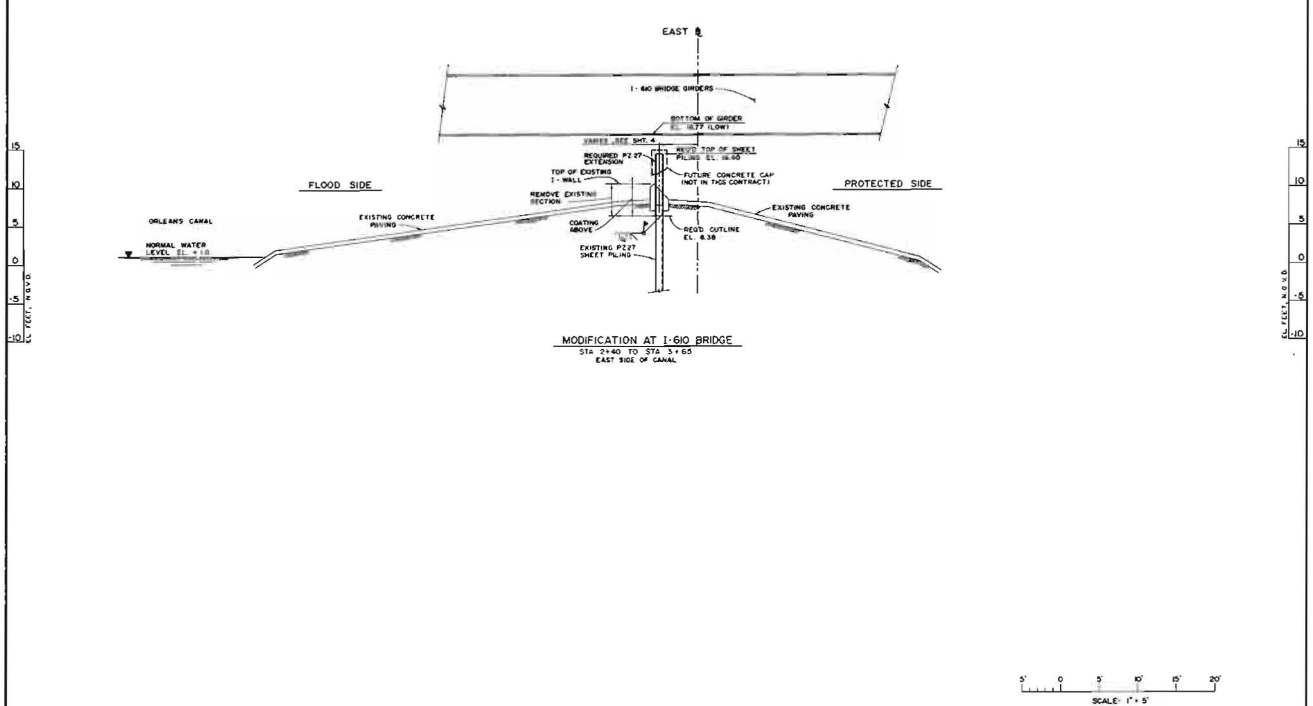

MODIFICATION AT I-610 BRIDGE
STA 2+40 TO STA 3+65
EAST SIDE OF CANAL

No.	DATE	REMARKS	No.	DATE	REMARKS
3			3		
2			2		
1			1		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: M.B.S.
CHECKED BY: T.M.S.
DRAWN BY: W.J.P.
CHECKED BY: M.B.S.
APPROVED BY: J.W.H.
DATE: OCT., 1987

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BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
PHASE III
ORLEANS AVE. CANAL - FLOOD PROTECTION IMPROVEMENT PROJECT
EAST SIDE LEVEE MODIFICATION
TYPICAL SECTIONS

JOB No. 1006
SCALE AS SHOWN
SHEET NUMBER 25 OF

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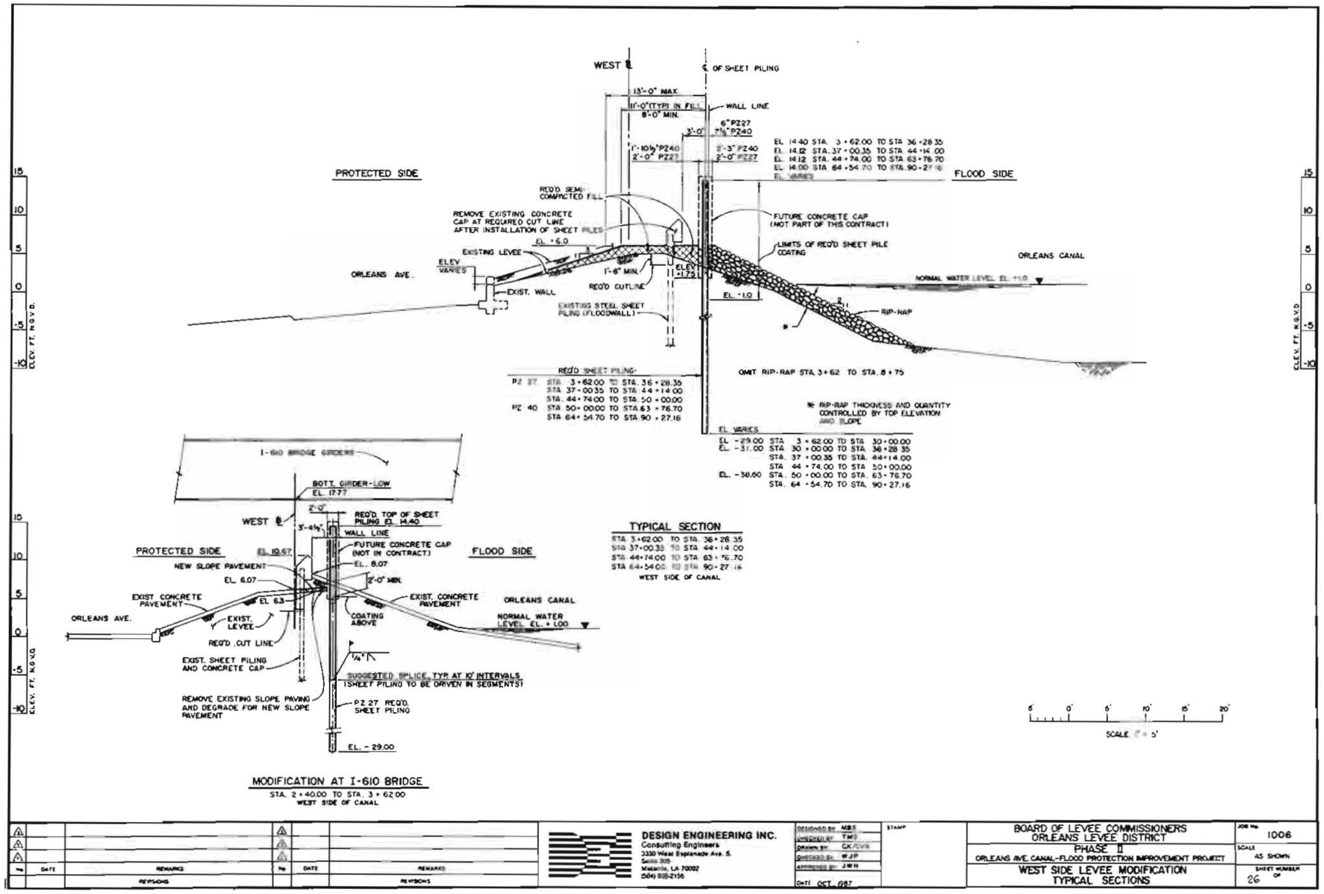

November 4, 1985

Mr. C. E. Bailey, Chief Engineer
Board of Levee Commissioners
Orleans Levee District
Suite 202, Administration Building
New Orleans Lakefront Airport
New Orleans, Louisiana 70126

Re: Orleans Avenue Canal
Flood Protection Improvement Project
Design Memorandum
OLB Job No. 2048-0278
DEI Project No. 1006

Dear Mr. Bailey:

In accordance with the terms of our Agreement with the Orleans Levee Board of February 25, 1985 as authorized by the Board of Commissioners on January 23, 1985, we are pleased to submit ten copies of the referenced Design Memorandum.

We have concluded that the proposed Orleans Avenue Canal Flood Improvement Project will require a total initial funding of $15,750,400 through the fiscal year 1989. When the U.S. Army Corps of Engineers decides on the type of flood protection improvement, i.e., Butterfly Valves or Parallel Levee Protection System, the Corps has stated in correspondence that they will share 70% of the least cost project that meets its objectives. Conceivably, parallel flood protection, which is currently favored by the Orleans Levee Board and the New Orleans Sewerage and Water Board, could be the project selected. The Final Parallel Plan acceptable to the Corps is estimated to cost approximately $20,846,800 of which the Orleans Levee Board would be required to fund 30% or approximately $6,254,000 less credits for levee property owned by the Board. The funds expended on construction and engineering by the time of acceptance would be creditable.

The most important part of your decision and its effect is as follows:

1. Should the Orleans Levee Board accept the idea of Butterfly Valves at the mouth of the canal, the interior levees would have to be raised to the height of the required flood protection to prevent flooding inside of the system or city. This results from the need to pump rain water out of the city.

   In which case the Board would be required to fund 30% of the valve structure and 100% of the levees behind the valve structure. As you are aware, the valve structures and associated levees were previously estimated to cost approximately $20,000,000.

2. If the Orleans Levee Board chooses to pursue the parallel flood protection and raise the levees the entire length of the canals, participation by the U.S. Army Corps of Engineers will be a maximum of 70% of the "least cost acceptable project". There are some lengths of the Orleans Avenue Canal Project that will require further review by the U.S. Army Corps of Engineers. At the present time, the Orleans Levee Board's consultant team is satisfied that the project as proposed in the Design Memorandum meets prudent engineering practice. However, the Corps sometimes requires a different method of calculation than we are of the opinion is required. Should the Corps require alterations in our opinions of engineering practice, the cost of parallel flood protection along the Orleans Avenue Canal could change upwardly. We point out that in the 17th Street Canal project this was not the case and the Corps has accepted with reservation the proposed flood control concept without requiring major changes in the engineering design.

It is our opinion and recommendation, that the best alternative and most efficient cost project is the proposed Parallel Levee Flood Protection Improvement project.

For your convenience, the Executive Summary provides a summary of the purpose of the Design Memorandum, the basic findings, the recommended solutions, construction cost, and scheduling as well as a description of funding sources.

We appreciate the opportunity to work with the Orleans Levee Board on this important project and look forward to beginning the Design Phase of the improvements.

With best regards, I am

Yours very truly,

DESIGN ENGINEERING, INC.

Walter Baudier
President

WB:mnh

Enclosures

ORLEANS AVENUE CANAL

FLOOD PROTECTION IMPROVEMENT PROJECT

DESIGN MEMORANDUM

Prepared for:

THE BOARD OF LEVEE COMMISSIONERS OF THE
ORLEANS LEVEE DISTRICT
NEW ORLEANS, LOUISIANA

Prepared by:

DESIGN ENGINEERING, INCORPORATED
Consulting Engineers
3330 West Esplanade Avenue, Suite 205
Metairie, Louisiana 70002

DEI Job No. 1006
OLB Project No. 2048-0278

November, 1985

ORLEANS AVENUE CANAL
FLOOD PROTECTION IMPROVEMENT PROJECT
DEI PROJECT NO. 1006-85

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ORLEANS AVENUE CANAL
FLOOD PROTECTION IMPROVEMENT PROJECT
DEI PROJECT NO. 1006-85

LIST OF FIGURES

ORLEANS AVENUE CANAL
FLOOD PROTECTION IMPROVEMENT PROJECT
DEI PROJECT NO. 1006-85

LIST OF TABLES

CHAPTER I

Executive Summary

I. EXECUTIVE SUMMARY

The Orleans Avenue Canal - Flood Protection Improvement Project is part of a larger effort by the Orleans Levee Board to increase the level of flood protection of the City of New Orleans along its northern boundary from storm-induced high tides in Lake Pontchartrain. This project is included in the U.S. Army Corps of Engineers (USCE) High Level Plan for Lake Pontchartrain Louisiana and Vicinity, which was completed by the USCE in March, 1984. The Orleans Levee Board accepted the USCE plan in July, 1985.

Design Engineering, Inc., a firm specializing in civil engineering with extensive experience in planning and construction of projects of the type proposed in this project, was retained as the engineering consultant to assist both the Orleans Levee Board (OLB) and the U.S. Army Corps of Engineers (USCE) in development of the best solution for increased protection. As directed by OLB, the primary goal is "to provide maximum protection for the least dollar amount with interim construction".

This Design Memorandum is the first phase of the design process necessary for the successful completion of the project. In keeping with the primary goal, every effort has been made to evaluate alternative solutions, to select the most economical solution, to evaluate the increase in level of protection provided by each of the recommended construction items, to schedule the construction of improvements so as to maximize the increase in level of protection, and to achieve the maximum improvement for the dollars spent.

Complete field surveying of the entire length of the levee protection system, accomplished concurrently with the Design Memorandum, disclosed that the level of protection is the most deficient at the three bridges crossing the Orleans Avenue Canal. The levees north of Robert E. Lee Boulevard, subject to storm-induced waves, are the second most deficient segments of the system. The remaining levee/floodwall lengths south of Robert E. Lee Boulevard are the least deficient. The level of protection at the three bridges varies from 8.5 to 6.5 feet below the USCE recommended level, the levees north of Robert E. Lee Boulevard vary from 7.0 to 5.0 feet below the recommended level, and the levees south of Robert E. Lee Boulevard vary from 4.7 to 3.8 feet below the recommended level.

Based on the foregoing, we have, after consultation with the Chief Engineer, divided the project into three identifiable parts. While distinct, they may be, during the construction process, often overlapping and are as follows:

- The first phase, titled Phase I - Interim Protection, is proposed to include improvement of the levee system north of Robert E. Lee Boulevard and modification to the canal crossings at Harrison Avenue, Filmore Avenue, and Robert E. Lee Boulevard. It is anticipated, depending on final design development, that this cost will be approximately $4,845,300.

- The second phase, titled Phase II - Interim Protection, which will be designed concurrently with the first phase, consists of improvements to the levee system south of Robert E.Lee Boulevard. Interim modifications to Pumping Station No. 7 are also proposed to be included in this contract. The recommended improvements are currently estimated to be $10,592,600.

- The final phase, titled Phase III - Final Protection, includes the capping of steel I-wall from Robert E. Lee Boulevard south to Pumping Station No. 7 and other improvements that may be required by the U.S. Army Corps of Engineers. The estimated cost of the Final Phase is $5,408,900 and is intended to be constructed when the Corps of Engineers accepts a final design for the project and further agrees to fund the accepted project on a 70%-30% basis. During the course of plan development, the plans for the final phase will be designed for incorporation of this phase of the project with the interim project. Project cost is summarized in the following tabulation.

<u>Project Cost Summary</u>

Phase I - Interim Protection	$ 4,845,300
Phase II - Interim Protection	10,592,600
Phase III - Final Protection	5,408,900
TOTAL ESTIMATED PROJECT COST	$20,846,800

<u>Orleans Levee District's Interim Cost</u>

Phase I - Interim Protection	$ 4,845,300
Phase II - Interim Protection	10,592,600
Phase III - Final Protection	312,500
Orleans Levee District Estimated Interim Cost	$15,750,400

Total Interim Funds for Orleans Canal Improvements

Series 1984 Bond Issue	$11,157,000
Orleans Canal Relocation (FY 87)	208,000
Orleans Canal Raising (FY 87)	148,000
	$11,513,000
Required Adjustment to Funding	$ 4,237,400

As provided in the Series 1984A Levee Improvement Bond Issue, "The estimates are based on preliminary information and may deviate from the final construction cost. Factors that affect the final construction cost are inflation and ultimate final design criteria imposed by other entities.

"Therefore changes in inflationary factors, cost in interest rates and final design criteria may require alterations in the construction cost." Based on the foregoing paragraphs, we recommend adjusting the project funding by $4,237,400.

The design parameters set by the U.S. Army Corps of Engineers impacts the cost of the project upwardly. Offsetting this increased cost is the credit available to the Levee Board as a result of U.S. Governmental participation in the High Levee Protection Plan. The final design accepted by the U.S. Army Corps of Engineers will result in a 70%-30% sharing of the cost of the project.

When the U.S. Army Corps of Engineers proceeds with the Final Plan, the Orleans Levee Board will receive an estimated credit of 70% of the approved Interim Plan cost or approximately $11,025,280 against Final Plan Construction cost. In addition, credit will also include the value of property used in the final approved plan.

During the course of the study some of the more important issues that required resolution are the following:

- The bridge closure system involves the constructing of walls adjacent to the existing bridge rails, sealing the bridge structure and providing for uplift pressure. This alternative was selected over floodgates, box culverts and raising the bridge for cost, community disruption, and road system continuty.

- We recommend the use of concrete capped sheet piling to develop higher protection along the entire east side and most of the west side of Orleans Canal versus earthen levees. This was a result of the required setback from the canal's edge by design criteria developed in the soil analysis portion of the study.

Should the alternative earthern levees be choosen, hundreds of trees and 50 to 60 acres of public recreational areas would be destroyed. When viewed against a total increase in cost of approximately $500,000, the recommended solution is an I-wall system.

- The only section recommended as an earthern embankment is from Robert E. Lee Boulevard to the USCE levee along Lakeshore Parkway on the west side of the canal. One exception is a 500 foot reach of the levee adjacent to Crystal Street. In this area, the levee setback encroaches on the street and would require a retaining wall or an I-wall in the alternative. After consultation with the Engineering Department of the Board, we recommend an I-wall thereby removing the need for a retaining wall at the edge of the street.

- The final consideration was the method used to secure Pumping Station No. 7, interim versus final plan. We have concluded that, in the Interim, the Levee Board, without having to reconstruct the station floodwall, could provide temporary security against most rising tides.

There are however two critical geotechnical design considerations that are not yet resolved and are currently under review by the USCE. The two items are:

1. The deep seated stability analysis for a floodwall along the west side of the canal from Robert E. Lee Boulevard to a point approximately 4000 feet south of the Boulevard; and,

2. The seepage analysis of the underlying sand strata for the canal project.

The analysis of Item 1 above as recommended by Eustis Engineering Co., has been incorporated in the design of the west floodwall. The geotechnical engineers are confident that their recommendations will be favorably reviewed by the USCE.

Item 2, seepage analysis, is presently under field investigation by the geotechnical engineers. Preliminary findings indicate that the water level on the land side of the levee is not effected by the high water level in the canal and was measured on October 31, 1985, the highest recently recorded water level.

Once these studies are completed and each item has been reviewed by the USCE, final project determinations will be made. However, it must be realized, that adverse findings by USCE could increase the project cost as much as 20%.

In conclusion, the proposed plan addresses the existing soil and embankment conditions of the Orleans Avenue Canal and proposes a solution to providing Interim Hurricane Protection with a view towards satisfying the U.S. Army Corps of Engineers requirements for incorporation in the Lake Pontchartrain, Louisiana, and Vicinity Hurricane and Flood Protection Plan. Should the Levee Board choose to proceed with this proposal the plan could become a creditable project, but more importantly will come to fruition years before the U.S. Army Corps of Engineers completes its study. We, therefore, recommend that the Board take any action necessary to implement the project as assurance against rising water resulting from hurricane conditions.

TABLE I - 1

SUMMARY OF ESTIMATED PROJECT COSTS
ORLEANS AVENUE CANAL--FLOOD PROTECTION IMPROVEMENT PROJECT

PHASE I - INTERIM PROTECTION
(BRIDGE MODIFICATIONS AND LAKE LEVEES)

MOBILIZATION/DEMOBILIZATION	$35,000		
LEVEE-FLOODWALL, REACH E-6, E-7, W-6 & W-7(W/ CONC. I-WALLS)	$2,406,000		
BRIDGE MODIFICATIONS (W/ CONTINGENCY)	$1,500,000		
CONSTRUCTION COST BEFORE CONTINGENCY	$3,941,000		
CONTINGENCY (15.0%)	$366,000		
CONSTRUCTION COST INCLUDING CONTINGENCY		$4,307,000	
ENGINEERING--INCL. DESIGN MEMO. (6.5%)	$280,000		
TESTING (1.0%)	$43,000		
SURVEYING (1.5%)	$64,600		
INSPECTION (2.5%)	$107,700		
GEOTECHNICAL ENGINEERING (1%)	$43,000		
		$538,300	
SUBTOTAL--PROJECT COST			$4,845,300

PHASE II - INTERIM PROTECTION
(LEVEES SOUTH OF ROBERT E. LEE BLVD. AND SPECIAL CONDITIONS)

MOBILIZATION/DEMOBILIZATION	$55,000		
LEVEE-FLOODWALL, REACH E-1 TO E-5	$1,250,000		
LEVEE-FLOODWALL, REACH W-1 TO W-5	$6,335,000		
MODIFICATION AT I-610 BRIDGE	$262,000		
MODIFICATION AT 30" WATERLINE	$34,000		
MODIFICATION AT PUMPING STATION NO. 7	$102,000		
OVERHEAD ELECTRIC LINES RELOCATION (NOPSI)	$150,000		
CONSTRUCTION COST BEFORE CONTINGENCY	$8,188,000		
CONTINGENCY (15.0%)	$1,228,200		
CONSTRUCTION COST INCLUDING CONTINGENCY		$9,416,200	
ENGINEERING--INCL. DESIGN MEMO. (6.5%)	$612,000		
TESTING (1.0%)	$94,000		
SURVEYING (1.5%)	$141,000		
INSPECTION (2.5%)	$235,400		
GEOTECHNICAL ENGINEERING (1%)	$94,000		
		$1,176,400	
SUBTOTAL--PROJECT COST			$10,592,600

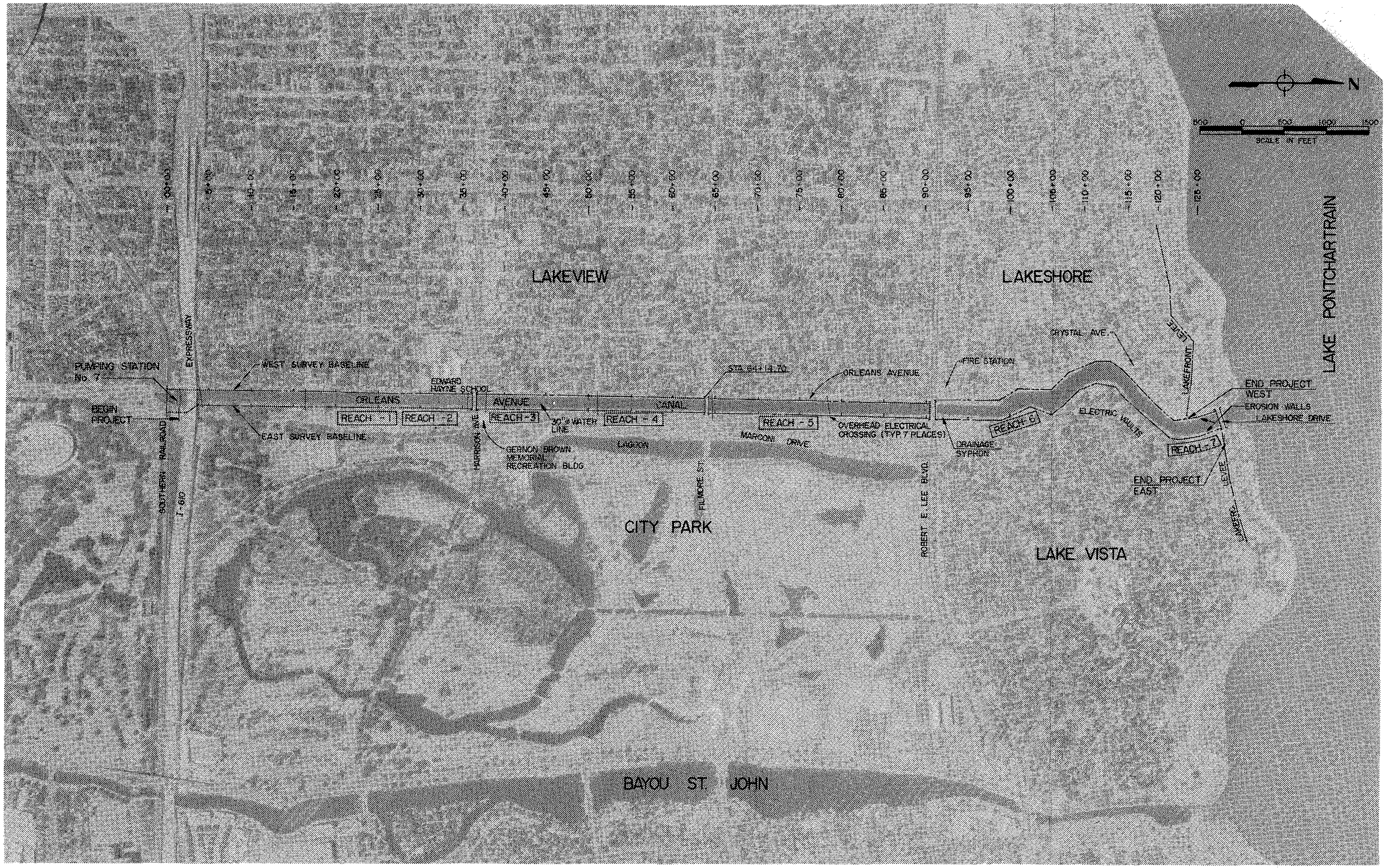
TOTAL PROJECT COST: I N T E R I M   P R O T E C T I O N $15,437,900

TABLE I - 1

SUMMARY OF ESTIMATED PROJECT COSTS
ORLEANS AVENUE CANAL--FLOOD PROTECTION IMPROVEMENT PROJECT

FINAL PROTECTION (CONCRETE I-WALLS & CLOSURE AT PUMPING STATION NO. 7)			
MOBILIZATION/DEMOBILIZATION	$10,000		
CONCRETE I-WALL, REACH W-1 TO W-5	$2,636,000		
CONCRETE I-WALL, REACH E-1 TO E-5	$833,000		
CONCRETE I-WALL, PUMPING STATION NO. 7 * *	$51,000		
FLOODWALL, PUMPING STATION NO. 7	$402,000		
SLUICE GATES, PUMPING STATION NO. 7	$300,000		
CONSTRUCTION COST BEFORE CONTINGENCY	$4,181,000		
CONTINGENCY (15.0%)	$627,200		
CONSTRUCTION COST INCLUDING CONTINGENCY		$4,808,200	
ENGINEERING--INCL. DESIGN MEMO. (6.5%)	$312,500		
TESTING (1.0%)	$48,000		
SURVEYING (1.5%)	$72,000		
INSPECTION (2.5%)	$120,200		
GEOTECHNICAL ENGINEERING (1%)	$48,000		
		$600,700	
SUBTOTAL--PROJECT COST			$5,408,900
TOTAL PROJECT COST			$20,846,800
ESTIMATED PROPERTY CREDIT (ESTIMATED SQUARE FOOT COST IS $3.50)	$4,454,000		

* * NOTE: COST OF $51,000 FOR CONCRETE I-WALLS AT PUMPING STATION NO. 7 NOT APPLICABLE, IF FLOODWALL IS BUILT.



AERIAL PHOTOGRAPH TAKEN OCT. 1981

No	DATE	REMARKS	No	DATE	REMARKS
△			△		
△			△		
△			△		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T. M. S.
CHECKED BY:
DRAWN BY: C. V. N.
CHECKED BY: D. A. S.
APPROVED BY: J. W. H.
DATE: AUGUST, 1985

STAMP

ORLEANS AVENUE CANAL
FLOOD PROTECTION IMPROVEMENT PROJECT
AERIAL PROJECT MAP

FIGURE 1

JOB No. 1006
SCALE AS NOTED
SHEET NUMBER
OF

CHAPTER II

Introduction

II. INTRODUCTION AND SCOPE

A. Project Name

Orleans Avenue Canal
Flood Protection Improvement Project
Orleans Levee Board Project 2048-0278

B. Project Description and Scope of Work

The Orleans Avenue Canal - Flood Protection Improvement Project is part of a larger effort to increase the level of the enclosing levees around the City of New Orleans along its northern boundary with Lake Pontchartrain.

This flood protection project is located near the south shore of Lake Pontchartrain and borders the New Orleans City Park and the residential subdivisions of Lakeview, Lake Shore and Lake Vista. The canal, which is a major drainage artery for the mid-city area of New Orleans, is flanked by existing floodwalls and levees. The project is approximately 12,500 feet long and includes over 25,000 feet of existing floodwalls and levees. (See Figure 1.) Unfortunately, the existing floodwall and levee system are below the flood protection elevation required by the Corps of Engineers High Level Flood Protection Plan.

The levee system must be raised to provide flood protection to the required elevation. Design Engineering, Inc. was retained as the engineering consultant to give assistance to the Orleans Levee Board (OLB) on technical and construction aspects of this project.

The purpose of the first phase of this project, the Design Memorandum, is to develop and evaluate preliminary concepts for raising the elevation of the Orleans Canal Levee/Floodwall system to the elevations recommended by the U. S. Army Corps of Engineers (USCE) High Level Plan.

The project begins at the discharge basin of Drainage Pumping Station No. 7 of the New Orleans Sewerage and Water Board which is located at Florida Avenue and the Orleans Avenue Canal. The project extends north from that point approximately 12,500 feet to junction points with the Orleans Parish Lakefront levees along Lake Pontchartrain. The flood protection levees and floodwalls along both sides of the canal are included within the scope of this project, thereby involving approximately 25,000 linear feet of levee/floodwall improvement. The levees and floodwalls along each side of the canal will be evaluated and the most feasible method of providing the required flood protection will be developed.

Within the project length there are three (3) bridges spanning the canal and levees. These bridges are located on Filmore Avenue, Robert E. Lee Boulevard and Harrison Avenue. Each bridge will be analyzed and the most feasible method of providing the required flood protection will be developed.

In addition to the above major considerations, there are several special conditions that required individual assessments. These special conditions are:

* The building wall and discharge basin walls at Pumping Station No. 7;

* The limited clearance beneath the I-610 bridge;

* The 30-inch diameter waterline crossing;

* The Gernon Brown Memorial Gymnasium;

* Five electric transformer vaults and enclosures;

* The drainage syphon north of Robert E. Lee Blvd.;

* The levee toe erosion prevention walls near the lake; and

* Backflow prevention at Pumping Station No. 7.

Each of these items will be individually studied and solutions to facilitate the necessary protection improvement will be developed and evaluated.

The scope of work also includes the taking of soil borings and geotechnical engineering analysis; topographical surveying; aerial photography; preparation of drawings showing existing levee profiles; study and recommendations of alternate methods for raising the existing levees and flood protection at the bridges; obtaining record drawings of existing infrastructure; coordination with respective city, parish and state agencies and utility owners; preparation of estimated project costs; coordination of planned improvements with other agencies; preparation of the design and construction schedule for implementing the work; and documentation of the above by a written report. This scope of work is in accordance with items detailed in the proposal from Design Engineering, Inc. dated February 12, 1985.

CHAPTER III

Organization of Report

III. Organization of Report

The development of this Design Memorandum begins with a thorough study of existing conditions, including the taking of fifty-two soil test borings and geotechnical engineering analysis based on the soil properties; topographical surveying to locate nearby existing utilities, to define existing levee-floodwall-canal profiles at 100-foot intervals and to confirm elevations of the existing bridge crossings; aerial photography, including the adjacent neighborhoods and "strip maps" detailing the canal and levees; and obtaining pertinent record drawings of the existing bridges crossing the canal, the pumping station, the drainage syphon under the canal, and the waterline crossing the canal; as well as drawings of the NORD recreation building and the NOPSI electric vault buildings near to the levee.

Next the improvement design parameters or requirements were sought out and recorded. The design parameters developed by the U. S. Army Corps of Engineers (USCE) must be complied with in order for the project to be considered creditable. The USCE has established the preliminary still water design elevations with "Backwater Computation" of 12 June 85. These computations were based on a lake level of +11.5 NGVD and flows in the canal of 3250 cfs and 4550 cfs. A copy of this preliminary analysis is attached in the Appendix of this report. A freeboard allowance, as indicated in the Design Parameters section, is added to the still water elevation to establish the required design protection elevations. Material strength allowables and soil properties factors of safety promulgated by USCE complete this section.

The report divides the protection system into the major categories of: Typical Levee-Floodwall Modifications, Bridge Modifications and Special Condition Modifications. These categories include the various aspects of the Orleans Canal flood protection system and a complete study of these individual categories ensures that an overall evaluation of flood protection to the High Level Plan elevations will be included within this report. Alternatives for raising the elevations of the typical levee-floodwall system, modifying the bridges crossing the canal and handling the special conditions are developed using USCE design parameters.

Alternative methods to provide the necessary flood protection were studied for both the east and west levee/floodwall systems. Two alternatives for both the east levee and the west levee were studied between Pumping Station No. 7 and Robert E. Lee Blvd. From Robert E. Lee Blvd. to the lake the earthen levee alternative in combination with toe retaining walls (where required to avoid interferences) and the floodwall at the crown of the existing levee alternative were investigated.

Five alternative modifications of the bridges were investigated because of the more complex set of variables and determinants involved. Then each of the special conditions was addressed and solutions for each condition are proposed.

Each of the alternatives was compared and the most feasible alternative was recommended. In addition to technical considerations, the estimated cost of each alternative was prepared and utilized during the decision-making process.

A summary of the total estimated project cost, including major construction items, engineering fees, testing fees, resident inspection fees and surveying fees is also presented. Separation of construction into interim (minimum by Levee Board) and final (with U. S. Army Corps of Engineers participation) phases are discussed and the costs of the two phases are tabulated individually. The report next presents a bar chart schedule indicating project design and construction timing.

A section summarizing additional information requirements which will be needed to complete the final design documents is included at the end of the report. The Appendix to the report includes all the design parameter documentation and backup plus letters from other public agencies relative to various aspects of this project.

CHAPTER IV

Design Parameters

IV. DESIGN PARAMETERS

The design parameters listed below are promulgated by the U. S. Army Corps of Engineers and are used by the USCE to design the protection facilities for the Lake Pontchartrain High Level Plan project. Most of these parameters were transmitted in written form and copies are contained in the Appendix. All of these parameters must be complied with in the design of protection elements in order for the project to be rated as creditable by the Corps of Engineers.

A. Design Water Elevation - Elevations are in Feet, NGVD

1. Design High Water
   (Preliminary Backwater Computation 12 June, 1985)*

Stations	For Levees**	For Walls***	Freeboard
Lakeft. to Sta.118+00	11.54	18.00	6'-6"(Wave)
118+00 to 90+86	11.64	13.64	2'-0"
90+86 to 64+14	11.80	13.80	2'-0"
64+14 to 36+64	11.97	13.97	2'-0"
36+64 to 1+52(PS No.7)	12.21	14.21	2'-0"

*Preliminary backwater computation was furnished by USCE, see Appendix.

**Levees are required to have a crown elevation equal to design high water plus freeboard allowance, but may be designed for forces from high water without freeboard.

***The elevation shown includes the freeboard allowance.

2. Design Low Water

   Elevation -5.0 throughout the project length.

B. Material Strength (for Floodgates and Walls)

1. Structural Steel: A36; F_b = 19.8 ksi (.55 F_y).

2. Floodwall Piling: A252 Grade 2; F_b = 18.0 ksi;
   Deflection at Top = D = 1 1/2" Max.*

*This is an unwritten design requirement of the USCE.

3. Structural Concrete: Design per ETL 1110-2-265.

C. Soil Properties Factors of Safety

1. Slope Stability: 1.3 ratio of resisting forces to driving forces.

2. Sheet Pile Wall Design

   a. For Penetration: 1.5 applied to shear strength
   b. For Bending Moment: 1.0 of shear strength

   Note: Use critical of "Q" (undrained) or "S" (drained) soil shear strength.

3. Against Blow-out: 1.25.

4. Piles in Tension: lateral pressure coefficient, K, of 0.60

5. T-walls and Gates, Deep Seated Stability Analysis: 1.3 factor of safety.

No reductions in factors of safety for load duration (short) or (un)likelihood of occurrence are allowed.

In Slope Stability analysis the "method of planes" is used in accordance with the U. S. Army Corps of Engineers' LMVD guidelines.

For T-walls and Gates sheet pile penetration is based on an acceptable seepage analysis.

D. Other Design Parameters

1. Concrete I-wall portion of sheet piling floodwalls shall be embedded 2'- 0" min. into earthen fill or existing ground.

2. The levee elevations developed in the report are final levee elevations. A net overbuild of one foot will be required as per geotechnical recommendations. Maximum levee side slopes shall not exceed 2.7 to 1.

CHAPTER V

Typical Levee Floodwall Modifications

V. TYPICAL LEVEE - FLOODWALL MODIFICATIONS

A. General

The long lengths of typical levee-floodwall along both sides of the Orleans Avenue Canal have been divided into seven segments or reaches in this report for both tabulation purposes and the possible phased construction of the project. (See Figure 1.) The end points of the reaches are developed from the major interruptions in the typical profiles; namely, the three roadway bridges crossing the canal plus the required change in protection elevation at Sta. 118+00 near the lake. Also the two major changes in subsoil stratography at Sta. 30+00 and Sta. 50+00 are used as end points of reaches.

The required protection elevations are derived from the preliminary "Backwater Computation" dated 12 June 85 (See Appendix) by the U. S. Army Corps of Engineers with the prescribed freeboard allowance added. The required elevations are stepped at the end points of the reaches with the highest elevation required within the reach being used throughout each reach.

This Design Memorandum incorporates the geotechnical engineering analysis recommendations presented in the Draft Copy of the "Geotechnical Investigation" dated 26 September 1985 prepared by Eustis Engineering Company. The final copy of the Geotechnical Investigation will be produced following OLB and USCE review.

The geotechnical engineering investigation indicates there are four major reaches of subsurface soil stratigraphy along the length of the project. The approximate location of dividing lines between the stratigraphy are: Sta. 30.00, Sta. 50.00 and Sta. 90.00. (Since Sta. 90+00 is very close to the Robert E. Lee Boulevard bridge, it was not used as a separate reach end point.)

In general, the soil strengths for levee/floodwall improvement purposes become weaker in each reach proceeding from the Pumping Station toward the Lake. The level of the top of the underlying sand strata is the most critical reach determinant.

From the Pumping Station to Sta. 30+00 there exists a stratum of dense sand with a top of approximately EL-12.0 NGVD. From Sta. 30+00 to 50+00 the top of the sand stratum slopes to

EL-19.0 NGVD. From Stas. 50+00 to 90+00 the top of the sand stratum ranges from EL-23.0 NGVD to -33.0 NGVD. From Sta. 90+00 to the Lakefront the top of the sand stratum is constant at approximately EL-34.0 NGVD.

The layers of clay soil above the sand exhibit approximately the same properties throughout except for the much weaker layer of recently (1927) dredged fill encountered from Sta. 90+00 to the Lakefront. More complete soil information is contained in the Geotechnical Investigation.

The strata of sand underlying the project indicate that there may possibly be a subsurface water seepage pathway. U. S. Army Corps of Engineers' parameters require that seepage pathways be sealed with walls of some type. A seepage test and analysis program is being performed as a part of the geotechnical investigation program to determine if a seepage pathway does, in fact, exist. The results of this analysis are not yet available. Previous analyses of similar conditions in the 17th Street Canal have shown that seepage is not a problem in the 17th Street Canal.

If, however, the tests at Orleans Avenue Canal show that there is a seepage pathway, a cut-off wall will have to be added at a greatly increased cost to the project. No estimate of this potential cost has been developed.

B. West Levee - Floodwall South of R. E. Lee Blvd. (Reach W-1 through W-5)

The existing flood protection along the west side of the Orleans Avenue Canal from Pumping Station No. 7 to Robert E. Lee Boulevard is a combination of earthen levee, toe retaining wall and sheet pile floodwall. The close proximity of Orleans Avenue and limited right-of-way have made the combination necessary when, in the past, the level of protection was raised. The top of the existing flood protection is at approximately EL 10.0 NGVD, which is about four feet below the elevation required for the USCE High Level Plan. The length and type of sheet piling used to construct the existing floodwall are unknown. From conversations with Orleans Levee Board personnel, it is known that the type of sheeting and depth of sheet pile penetration vary throughout the project length.

Two possible earthen levee alternatives were considered to raise the protection level. The level of existing top of fill is approximately EL 6.0 NGVD, therefore eight feet of additional height is required. One alternative would have required fill placement over Orleans Avenue and abandonment of the existing roadway. The other alternative would have required fill placement into the Orleans Avenue Canal and subsequent excavation on the opposite side of the canal to replace the lost drainage flow area.

After brief study of the possible fill alternatives, it became obvious that installation of a new floodwall with a top elevation corresponding to the required USCE elevation is the best alternative for raising the level of protection on the west side.

Positioning of the proposed floodwall was then studied. Two locations for the proposed wall were condsidered: (1) the wall would be placed on the canal side of the existing wall; and, (2) the wall would be placed on the landside of the existing wall. Construction of the wall on the canal side rather than the land side of the existing wall will require about five feet longer reach from the work base on Orleans Avenue pavement, but this will not cause installation problems.

Geotechnical engineering analysis indicates that a heavier and longer length of sheet piling would have to be used if the new wall was positioned on the landside of the existing sheet pile wall. The longer sheet piling is necessary due to the fact that there will be less earthen fill to resist the design high water pressure if the wall is positioned on the land side. A sheet pile length of 35 feet will be required for a canal side placement and a sheet pile length of 12 feet longer will be required for a land side placement. The added cost of land side piling is approximately $175 per linear foot.

Placement of the new wall on the canal side will require a 14-foot length of concrete I-wall which is five feet longer than the I-wall required for a landside sheet pile placement. This added cost is appoximately $100 per linear foot. Placement of the new wall on the canal side will result in a per foot savings of approximately $75.00. Also placement of the new wall on the canal side will permit easier maintenance mowing of the landside levee. Based on the preceding factors, the new wall is positioned on the canal side of the existing sheet pile wall. (See Figure 2.) PZ-27 sheet pile has been preliminarily selected for the wall design.

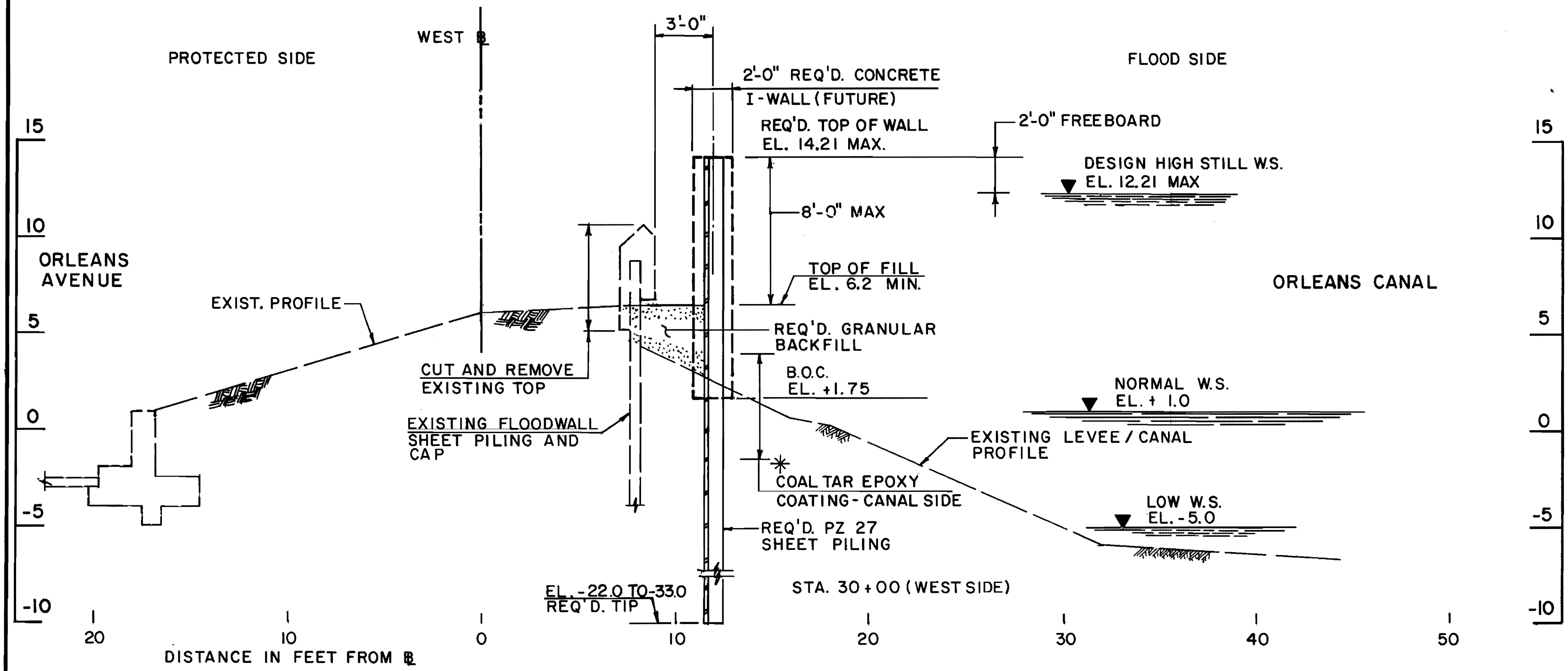
A minimum construction tolerance of three feet is assumed between the face of the existing wall and the centerline of the new wall. This distance allows adequate space for forming the concrete I-wall portion of the floodwall. This distance also allows access space for cutting equipment necessary for removal of the top of the existing wall.

The new wall projects almost eight feet above the level of existing earthen fill. The combined levee/sheet pile wall is designed for deep seated stability with a safety factor of 1.3. The wall penetration is determined with a safety factor of 1.5 and bending moment with a safety factor of 1.0. These factors of safety meet the USCE design parameters for soil properties.

The USCE deflection criteria requires that PZ 27 steel sheet pile be used. From Sta. 1+52 to Sta. 50+00 a sheet pile penetration to EL-21.0 NGVD is required. From Sta. 50+00 to Sta. 90+00 the tip must be lowered to EL-33.0 NGVD to satisfy stability requirements.

The deep seated stability analysis for the levee/floodwall from Sta. 50+00 to Sta. 90+00 yeilded a safety factor of approximatly 1.0. This factor is less than the 1.3 safety factor required. The geotechnical engineering consultant has recommended extending the sheet piling into the underlying sand strata to obtain the required resisting force and improve the safety factor to the 1.3 value. This recommendation is subject to review by the USCE. If this recommendation is not approved a T-wall will have to be constructed in this reach at substancially increased cost to the project.

The concrete encasement of the upper section or I-wall portion is a corrosion preventative and appearance improvement measure recommended by the U. S. Army Corps of Engineers. Due to the high cost of the concrete work and because an equal flood protection value can be assigned to the sheet pile wall extended up to the required top of wall elevation without the concrete I-wall, the I-wall may be omitted from the first phase of construction. The I-wall can be added at some



ELEVATIONS IN FEET, NGVD.

WEST LEVEE - FLOODWALL STA. 3+54.50 TO STA. 89+78.53

SCALE: 1" = 5'

✳ NOTE:

COAL TAR EPOXY COATING RECOMMENDED LIEU OF 2 FEET CONCRETE EMBEDMENT INTO SOIL.

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

FIGURE 2

TYPICAL WEST LEVEE MODIFICATION
STA. 3+54 TO STA. 89+78

DRAWN BY	DESIGNED BY	DATE	JOB NO.	SHEET NO.
T. J. H.	T. M. S.	AUG. 85	1006	OF

future date, as construction funds become available. However, the I-wall will be included in the design, and could also be included in the bid documents as an alternate bid item.

The existing concrete cap and a section of steel sheet piling will be removed. This removal will eliminate a water entrapment zone between the two walls.

Estimated construction costs for the West Levee - Floodwall between Pumping Station No. 7 and Robert E. Lee Boulevard are as tabulated in Table V-1 for Reaches W-1 through W-5.

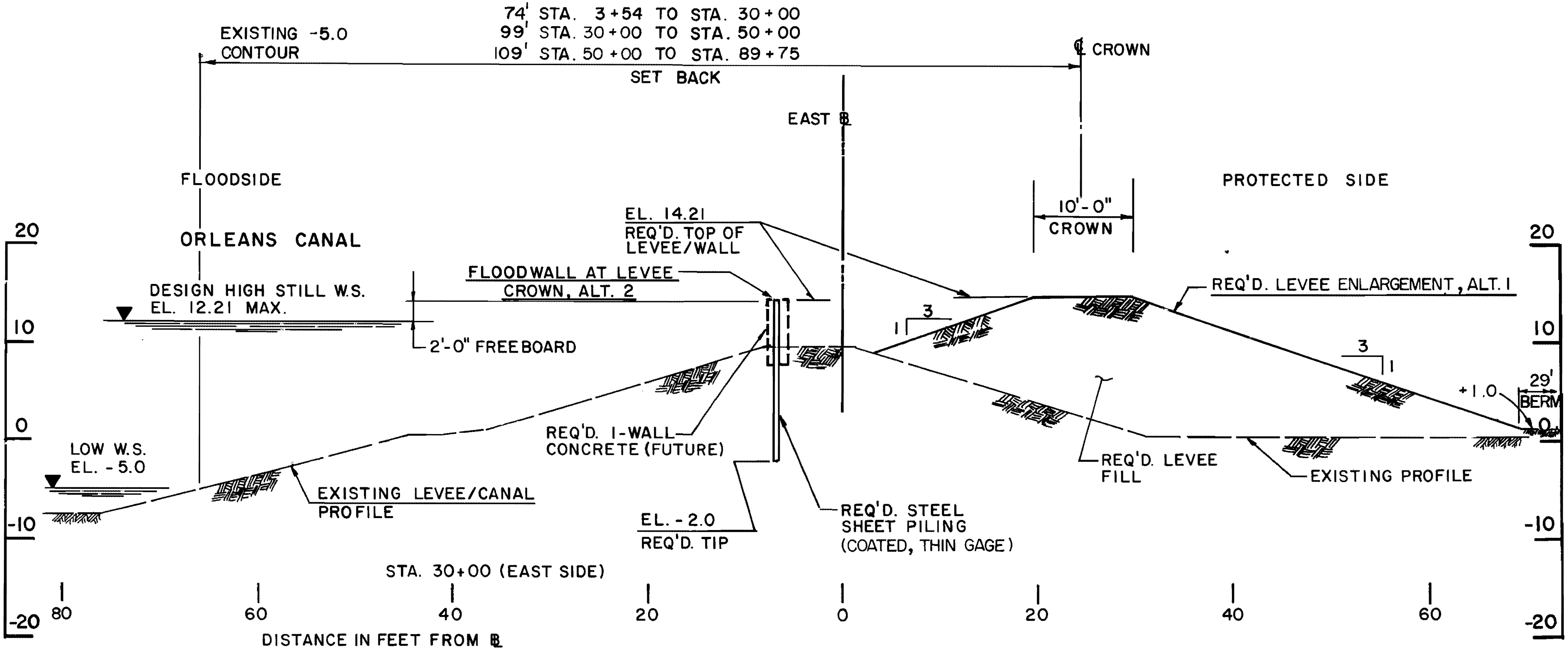
The West Levee-Floodwall will be constructed using equipment positioned and traveling on Orleans Avenue. Damage to the existing pavement is anticipated and cost for repair of Orleans Avenue pavement has been included. Segments of Orleans Avenue will be closed to traffic when work is proceeding adjacent to that segment.

C. <u>East Levee South of R. E. Lee Blvd.</u>
(Reach E-1 through E-5)

The existing levee on the east side of the Orleans Avenue Canal south of Robert E. Lee Blvd. is a full earthen levee. When the levee was previously raised, earthen fill was added to bring the levee up to the then required elevations. The existing levee is about four feet below the elevation required by the USCE High Level Plan.

Two alternatives were considered to provide the required level of protection. The first alternative was to add earthen fill to the existing levee, sloped to a stable configuration and set-back as required by the design parameters. The second alternative was to add a floodwall to the existing levee crown. This wall would project about four feet above the existing levee. (See Figure 3.)

Analysis of the two alternatives was made and estimated costs were determined. Based on the estimated construction cost the floodwall alternative is more favorable. The cost for earthen fill addition varied from $180 to $450 per linear foot - average $315 - while the cost of the floodwall was estimated as $250 per linear foot ($150 for sheet piling plus $100 for the concrete I-wall).



EAST LEVEE OR I-WALL STA. 3+54 TO STA. 89+75.75

SCALE: 1" = 10'

NOTES: 1. ELEVATIONS ARE IN FEET, NGVD.
2. EITHER ALTERNATE I OR ALTERNATE 2 MAY BE USED.

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

FIGURE 3

TYPICAL EAST LEVEE MODIFICATION
STA. 3+54 TO STA. 89+75

DRAWN BY	DESIGNED BY	DATE	JOB NO.	SHEET NO.
T. J. H.	T. M. S.	AUG. '85	1006	OF

Another disadvantage of the earthen fill choice is the additional land area required on the land side of the levee and the consequent loss of numerous trees which are near the existing toe of slope. (See Figure 3.) The area of land required for fill is under the jurisdiction of City Park, a public agency of the City of New Orleans, and is now used as green space. Since the green space character of the land will not be altered by additional levee fill this disadvantage is greatly mitigated. However, the earthen levee fill addition will require removal of approximately 300 trees ranging in size from 4 inch diameter to 38 inches diameter. Of the 300 trees which would require removal, approximately 70 are oak trees. The oak trees would have to be replaced on a ten-for-one basis as agreed to on previous projects involving City Park and the Orleans Levee Board. The significant cost of this replacement program and the disruption caused by the tree replacement makes selection of the floodwall even more favorable.

The floodwall alternative greatly reduces the cost of the levee improvements at the Gernon Brown Recreation Building. Along this section of levee the level of protection can be increased without the need of an expensive toe retaining wall for the full length of the building. For further explanation, see the write-up in the Special Conditions chapter.

The levee/canal location relative to the 250-foot wide apparent right-of-way is shown in the plan profile sheets contained in the Appendix.

Estimated construction costs for the East Levee between Pumping Station No. 7 and Robert E. Lee Boulevard are as tabulated in Table V-2 for Reaches E-1 through E-5.

D. <u>East and West Levees North of R. E. Lee Blvd.</u> (Reach E-6 and N-6)

The existing levees on both the east and west sides of the Orleans Avenue Canal north of Robert E. Lee Blvd. are full earthen levees.

These levees are part of the aesthetically sensitive green space park zone bordering the Lake Shore and Lake Vista residential communities. The area east of the canal is also used as an extension of City Park and has several athletic fields located there. For this reason, the option of a floodwall to raise the level of protection was not considered a feasible alternative in this reach. An alternative whereby the levee improvements would be accomplished by earthen fill wherever possible was first investigated.

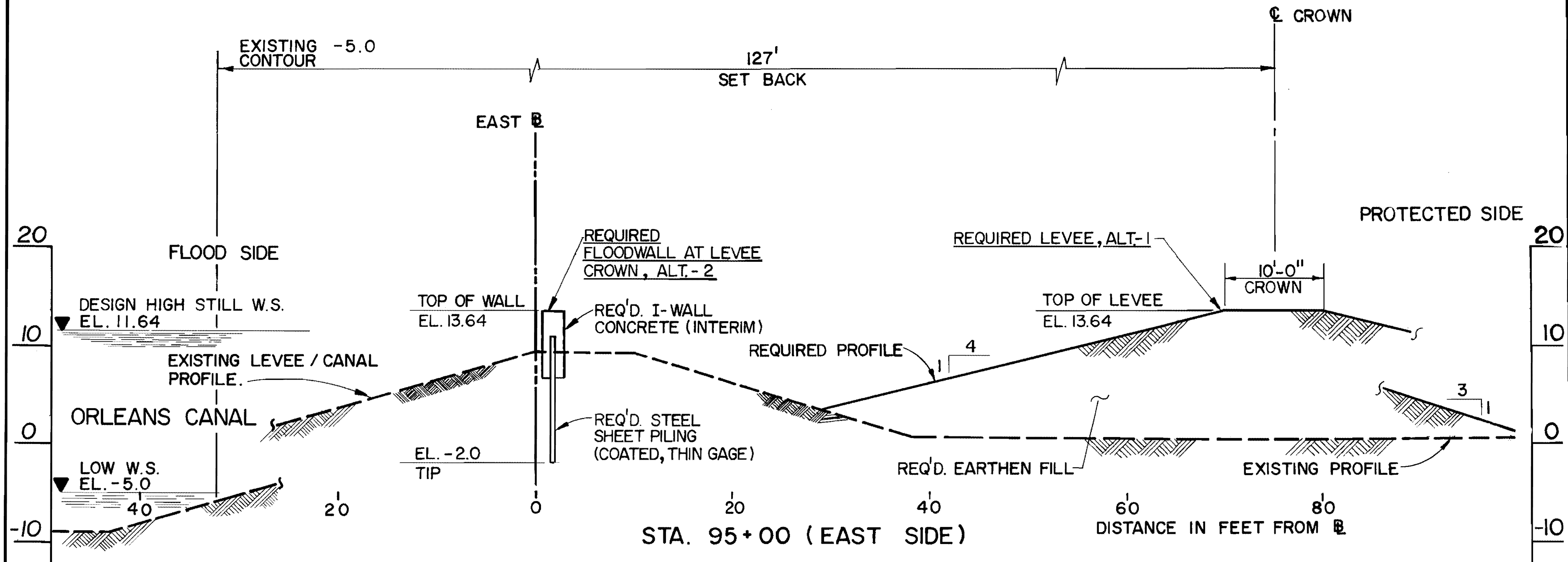
Earthen fill added to the existing levee and sloped to a stable configuration as indicated by the design parameters required considerable additional land area for the increased earthen levee section. (See Figure 4.) This was due to the weaker subsoil strength and consequent increase in set-back distance. Also, there will be a consequent loss of approximately 60 trees which are near the existing toe of slope. A great majority of these trees are along the east levee.

The loss of trees and required land area was reduced along the proposed levees north of Sta 99+00. Since this reach of canal is wider than the section south of Sta 99+00 some realignment or shifting of the levees nearer to the center of the existing canal is possible. (See Figure 5).

Due to the larger than expected levee set-back distance required and large number of trees that would be lost; a second alternative of a floodwall at the crown of the existing levee was investigated for the east levee in Reach E-6. With the floodwall alternative no additional land area is required nor will any trees be lost. The cost of the floodwall alternative is $250 per linear foot and the cost of the earthen fill alternative is $216 per linear foot in Reach E-6. The three electric vaults near the toe of the levee will not have to be relocated with the floodwall alternative saving approximately $180,000 relocation cost.

The floodwall alternative is recommended in Reach E-6. In consideration of the aesthetics of this park-like area, the addition of the I-wall concrete to improve the appearance of the exposed portion of the wall is recommended for construction with the Interim Protection improvements.

A floodwall at the crown of the west levee 170 feet in length is proposed opposite the fire station building to avoid interference.



EAST LEVEE STA. 91+57 TO STA. 118+00

SCALE : 1" = 10'

(WEST LEVEE IS SIMILIAR)

NOTES : 1. EITHER ALTERNATE-1 OR ALTERNATE-2 MAY BE USED.
2. ELEVATION IN FEET, NGVD.

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FIGURE 4				
TYPICAL EAST LEVEE MODIFICATION STA. 91+57 TO STA. 118+00				
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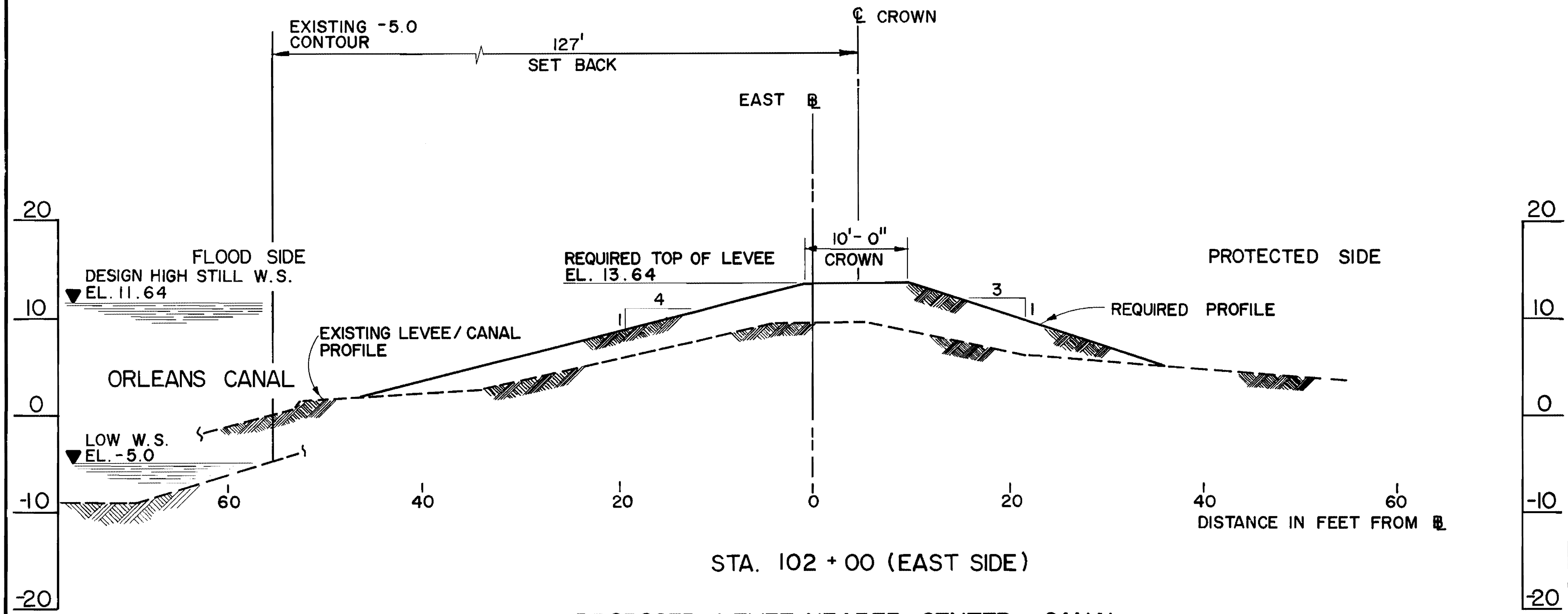

STA. 102 + 00 (EAST SIDE)

PROPOSED LEVEE NEARER CENTER CANAL

EAST LEVEE STA. 99 + 00 TO STA. 118 + 00

SCALE : 1" = 10'

ELEVATION IN FEET, N.G.V.D.

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FIGURE 5

TYPICAL EAST LEVEE MODIFICATION
STA. 99 + 00 TO STA. 118 + 00

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A floodwall at the crown of the west levee 500 feet in length is proposed to avoid interference with Crystal Avenue from Stas. 114+00 to 119+00.

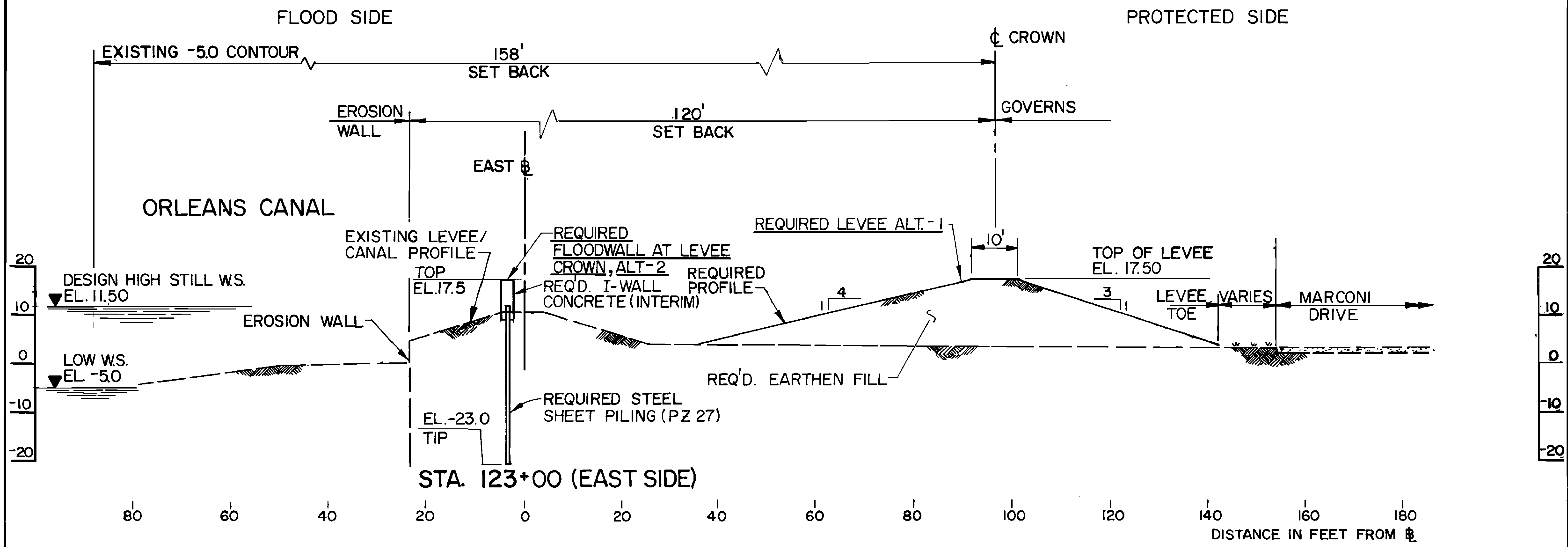
The estimated construction cost for the East and West Levees between Robert E. Lee Blvd. and Station 118+00 are as tabulated in Table V-3 for Reaches E-6 and W-6.

E. Lakefront Approach Levees
(Reach E-7 and W-7)

As required by the U. S. Army Corps of Engineers design parameters, the canal levees must be raised as they approach the lakefront to provide additional freeboard to protect against storm waves. The freeboard requirement for storm waves is 6'6" at the lakefront levees. The design high still water surface at the lakefront is EL 11.50 NGVD, therefore the required top of protection is EL 18.00 NGVD. A transition freeboard requirement extends for a length of six hundred feet from the lakefront levee line south along the canal. The curved alignment and canal channel will dissipate the storm wave at approximately Sta. 118+00. The levees will be sloped down to the lower freeboard requirement level in 600 feet from Stas. 124+00 to 118+00. The length of storm wave levee transition was provided by the Corps of Engineers. (See Appendix.)

The existing east and west levees approaching the lakefront are earth fill and have a top elevation from five to seven feet below the required protection level. There are levee toe erosion prevention walls on the canal sides of both levees.

Since the option of a floodwall was originally not applicable for aesthetic reasons in this reach, additional earth fill to raise the existing levee to the required level was first investigated. Geotechnical engineering analysis requires a levee crown setback of 158 feet from the existing -5.0 contour or 120 feet from the toe erosion wall, whichever governs (See Figure 6). As a consequence of the higher required level of protection and large setback dimension, considerably more ground for additional levee fill will be required at the landside toe in this reach. Approximately 70 trees near the existing levee toe will be lost and the oak trees will be replaced on the ten-for-one formula basis.



EAST LEVEE STA. 121+00 TO STA. 128+00

SCALE – 1" = 20'- 0"

(WEST LEVEE IS SIMILIAR)

NOTES: 1. EITHER ALTERNATIVE-1 OR ALTERNATIVE-2 MAY BE USED
2. ELEVATION IN FEET, N.G.V.D.

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FIGURE 6

TYPICAL EAST LEVEE MODIFICATION
STA. 121+00 TO STA. 128+00

DRAWN BY	DESIGNED BY	DATE	JOB NO.	SHEET NO.
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Most of the trees that would be lost with the earth fill alternative are along the east levee, the alternative of a floodwall at the levee crown was investigated for the east levee. Geotechnical engineering analysis requires a PZ-27 steel sheet piling section with a tip elevation of -23.0 NGVD be used.

The average cost of the earth fill alternative is $388 per linear foot in Reach E-7 and the estimated cost of the floodwall alternative is $810 per linear foot ($645 for sheet piling and $165 for concrete I-wall). The estimated construction cost increase for the floodwall alternative, including the concrete I-wall, is approximately $500,000. The electric vaults do not have to be relocated with this alternative and the saving of this cost may be credited.

The floodwall alternative is recommended in Reach E-7 to reduce the number of lost trees. In consideration of the aesthetics of this park like area, the addition of I-wall concrete to improve the appearance at the exposed portion of the wall is recommended with the Interim Protection improvements.

A floodwall at the crown of the levee 300 feet in length is required on the east levee near the end of the project to avoid interference with Lakeshore Drive and Marconi Drive.

The estimated construction cost for the East and West Levees as they approach the lakefront is as tabulated in Table V-4 for Reaches E-7 and W-7.

TABLE V - 1

TYPICAL WEST SIDE LEVEE MODIFICATIONS
CONSTRUCTION COST ESTIMATE

WEST SIDE, REACH W-1, STA 3+54 TO STA 30+00 (2646 L.F.)

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FLOODWALL SHEET PILING (PZ27 X 35FT. LG.)	LF	2,646	560	$1,481,760
GRANULAR FILL (BEHIND WALL TO EL. 6.20)	CY	1,620	12	$19,440
DEMOLITION OF EXISTING WALL	LF	2,646	35	$92,610
REPAIR OF ORLEANS AVE. (24FT. WIDTH)	LF	2,646	60	$158,760
SUBTOTAL	(LF)	(2,646)	(662)	$1,752,570
CONCRETE I-WALL (12'X 14')	LF	2646	315	$833,490
SUBTOTAL	(LF)	(2,646)	(977)	$2,586,060

WEST SIDE, REACH W-2, STA 30+00 TO STA 36+20.72 (621 L.F.)

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FLOODWALL SHEET PILING (PZ27 X 35FT. LG.)	LF	621	560	$347,760
GRANULAR FILL (BEHIND WALL TO EL. 6.20)	CY	380	12	$4,560
DEMOLITION OF EXISTING WALL	LF	621	35	$21,735
REPAIR OF ORLEANS AVE. (24FT. WIDTH)	LF	621	60	$37,260
SUBTOTAL	(LF)	(621)	(662)	$411,315
CONCRETE I-WALL (2' X 14')	LF	621	315	$195,615
SUBTOTAL	(LF)	(702)	(977)	$606,930

TABLE V - 1

WEST SIDE, REACH W-3, STA 37+32.97 TO STA 50+00 (1249 L.F.)

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FLOODWALL SHEET PILING (PZ27 X 35FT. LG.)	LF	1,249	560	$699,440
GRANULAR FILL (BEHIND WALL TO EL. 6.00)	CY	740	12	$8,880
DEMOLITION OF EXISTING WALL	LF	1,249	35	$43,715
REPAIR OF ORLEANS AVE. (24FT. WIDTH)	LF	1,249	60	$74,940
SUBTOTAL	(LF)	(1,249)	(662)	$826,975
CONCRETE I-WALL (12'X 14')	LF	1249	315	$393,435
SUBTOTAL	(LF)	(1,249)	(977)	$1,220,410

WEST SIDE, REACH W-4, STA 50+00 TO STA 63+68.03 (1368 L.F.)

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FLOODWALL SHEET PILING (PZ27 X 47FT. LG.)	LF	1,368	765	$1,046,520
GRANULAR FILL (BEHIND WALL TO EL. 5.90)	CY	810	12	$9,720
DEMOLITION OF EXISTING WALL	LF	1368	35	$47,880
REPAIR OF ORLEANS AVE. (24FT. WIDTH)	LF	1368	60	$82,080
SUBTOTAL	(LF)	(1,368)	(867)	$1,186,200
CONCRETE I-WALL (2' X 14')	LF	1,368	315	$430,920
SUBTOTAL	(LF)	(1,368)	(1,182)	$1,617,120

TABLE V - 1

WEST SIDE, REACH W-5, STA 64+92.33 TO STA 89+78.53 (2486 L.F.)

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FLOODWALL SHEET PILING (PZ27 X 47FT. LG.)	LF	2,486	765	$1,901,790
GRANULAR FILL (BEHIND WALL TO EL. 5.80)	CY	1,500	12	$18,000
DEMOLITION OF EXISTING WALL	LF	2486	35	$87,010
REPAIR OF ORLEANS AVE. (24FT. WIDTH)	LF	2486	60	$149,160
SUBTOTAL	(LF)	(2,486)	(867)	$2,155,960
CONCRETE I-WALL (2' X 14')	LF	2,486	315	$783,090
SUBTOTAL	(LF)	(2,486)	(1,182)	$2,939,050

TOTAL WEST LEVEE, SOUTH OF R.E.LEE BLVD. WITHOUT I-WALL	$6,333,020
CONCRETE I-WALL	$2,636,550
TOTAL WEST LEVEE, SOUTH OF R.E.LEE BLVD. INCLUDING I-WALL	$8,969,570

TABLE V-2

TYPICAL EAST SIDE LEVEE MODIFICATIONS
CONSTRUCTION COST ESTIMATE, REACH E-1 THROUGH E-5

EAST SIDE, REACH E-1, STA 3+59 TO STA 30+00 (2641 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF	2,641	150	$396,150
CONCRETE I-WALL (2' X 6')	LF	2,641	100	$264,100
SUBTOTAL	(LF)	(2,641)	(250)	$660,250

EAST SIDE, REACH E-2, STA 30+00 TO STA 36+11.85 (611 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF	611	150	$91,650
CONCRETE I-WALL (2' X 6')	LF	611	100	$61,100
SUBTOTAL	(LF)	(611)	(250)	$152,750

EAST SIDE, REACH E-3, STA 37+41.85 TO STA 50+00 (1240 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF	1,240	150	$186,000
CONCRETE I-WALL (2' X 6')	LF	1,240	100	$124,000
SUBTOTAL	(LF)	(1,240)	(250)	$310,000

TABLE V - 2

EAST SIDE, REACH E-4, STA 50+00 TO STA 63+59.20 (1359 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF	1,359	150	$203,850
CONCRETE I-WALL (2' X 6')	LF	1,359	100	$135,900
SUBTOTAL	(LF)	(1,359)	(250)	$339,750

EAST SIDE, REACH E-5, STA 65+01.20 TO STA 89+75.75 (2475 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF	2,475	150	$371,250
CONCRETE I-WALL (2' X 6')	LF	2,475	100	$247,500
SUBTOTAL	(LF)	(2,475)	(250)	$618,750

TOTAL EAST LEVEE SOUTH OF R.E.LEE BLVD. (W/O I-WALL)	$1,248,900
CONCRETE I-WALL	$832,600
TOTAL EAST LEVEE SOUTH OF R.E.LEE BLVD.(INCLUDING I-WALL)	$2,081,500

TABLE V - 3

TYPICAL LEVEE MODIFICATIONS
CONSTRUCTION COST ESTIMATE, REACH E-6 AND W-6

EAST SIDE, REACH E-6, STA 91+57.75 TO STA 117+00.00 (2542 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF.	2542	150	$381,300
I-WALL CONCRETE (2' X 6' AVG.)	LF	2542	100	$254,200
SUBTOTAL	(LF)	(2,542)	(217)	$635,500

WEST SIDE, REACH W-6, STA 91+51.66 TO STA 118+87.00 (2735 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
LEVEE RAISING MATERIAL (SANDY-CLAY,IN-PLACE MEASURE)	CY	37,055	12	$444,660
FINISH GRADING	SY.	22,467	0.3	$6,740
FLOODWALL SHEET PILING (SL2 X 16 FT. LG.)	LF.	670	150	$100,500
TURFING (SEEDING,FERTILIZER,MULCHING)	AC.	4.6	1500	$6,900
TREE REPLACEMENT (10 FOR 1)	EA.	10	100	$1,000
TOE RETAINING WALL	EA.	350	200	$70,000
I-WALL CONCRETE (2' X 5.5'AVG.)	LF	670	92	$61,640
SUBTOTAL	(LF)	(2,735)	(218)	$691,440

TOTAL EAST AND WEST LEVEES NORTH OF R.E.LEE BLVD.	$1,326,940

TABLE V - 4

TYPICAL LEVEE MODIFICATIONS
CONSTRUCTION COST ESTIMATE, REACH E-7 AND W-7

EAST SIDE, REACH E-7, STA 117+00.00 TO STA 128+00.00 (1100 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
FLOODWALL SHEET PILING (PZ27 X 40 FT. LG. AVG.)	LF.	1170	645	$754,650
I-WALL CONCRETE (2' X 8.5' AVG.)	LF	1170	165	$193,050
SUBTOTAL	(LF)	(1,170)	(810)	$947,700

WEST SIDE, REACH W-7, STA 118+87 TO STA 124+87.00 (600 L.F.)

ITEMS	UNIT	QUANTITY	PRICE	AMOUNT
LEVEE RAISING MATERIAL (SANDY-CLAY,IN-PLACE MEASURE)	CY	10,518	12	$126,216
FINISH GRADING	SY.	5,521	0.3	$1,656
TURFING (SEEDING,FERTILIZER,MULCHING)	AC.	1.1	1500	$1,650
TREE REPLACEMENT (10 FOR 1)	EA.	10	100	$1,000
SUBTOTAL	(LF)	(600)	(218)	$130,522

TOTAL EAST AND WEST LEVEES APPROACHING LAKE $1,078,222

CHAPTER VI

Bridge Modifications

VI. BRIDGE MODIFICATIONS

A. General

The three roadways crossing the Orleans Canal are significantly lower than the elevation required to provide high level protection. Therefore, the bridges must be modified in some way in order to maintain the levee system's creditable status. The level of protection that must be provided is the design high water surface elevation plus two feet of freeboard. Because of the more complex set of variables and determinants involved, five possible alternatives are investigated in detail in this report which will provide the required protection. The five bridge modification alternatives considered are:

1. Floodgates
2. Seal Joints, Walls and Anchors
3. Precast Concrete Box Culverts
4. New Raised Bridges
5. New Cast-in-Place Concrete Box Culverts

The major determinants in the alternatives are project cost, hydraulic characteristics or canal flow area provided and traffic conditions during high water. Minor determinants are traffic conditions and neighborhood disturbance during construction, appearance, construction and design complexity/difficulty and maintenance cost. (See Table VI-2 for Summary of Determinants.) Each of the alternatives is described and the determinants compared in the following six sections. From the comparisons, conclusions and recommendations are made in a succeeding chapter.

Since the three existing bridges are very similar, a work plan involving careful study at one location and extrapolation or approximation at the other two locations was adopted. The bridge at Filmore Avenue was selected for careful study since it has the lowest elevation of the three and would most clearly disclose the engineering design and construction problems. See Tables VI-2, VI-3, VI-4 and VI-5 for results of Filmore Avenue bridge study.

The three existing bridges are short span, steel girder structures with reinforced concrete decks.

Overall widths vary from 32' to 60' and lengths vary from 151' to 175'. The construction dates of the bridges range from 1939 to 1965. The roadway surface elevations at the ends of the bridges vary from EL 5.55 to EL.7.50 NGVD. (See Figures 10, 11 and 12).

Although at present the bridges appear to be in excellent condition, at some point in time, they will reach their useful life point and replacement will become necessary. As this point in time is approached, alternatives which utilize the existing bridge structure will be less favorable than they are considered in this report. For instance, the valuation of a new replacement bridge structure could be deducted from the cost of the Raised Bridge Alternative if the bridge cost was absorbed by the city as part of the bridge replacement program.

The accuracy of unit prices used for quantified material items are critical to valuation of construction cost of the alternatives. Inaccuracies in unit prices are mitigated where the same material items (and unit prices) are used, but if material items are not similar valuations will not be comparable between different alternatives. In order to make valuations more comparable, several sources of unit prices were reviewed. Among these sources were: local construction contractors; the U.S. Army Corps of Engineers; the Louisiana Department of Transportation's Weighted Average Unit Prices; the Orleans Levee Board's previous construction contracts and previous similar reports.

Temporary detour bridges to maintain traffic flow patterns during the construction period were not included in any of the alternatives. It is presumed that the bridge modifications could be performed "one at a time" and traffic flow could be detoured to bridges not under construction. (See Figure 1, Project Map.) The cost of detour bridges is excessive and also the right-of-way is very limited at each site.

For proper comparison, each of the alternatives should include an equal length of protection along the levees. The Floodgate Alternative requires the longest length; therefore, a floodwall sheet piling cost has been added to the other alternatives to equalize the lengths.

The following sections of this chapter describe each of the five alternative modifications investigated for the three canal crossings.

B. Floodgate Alternative

Description

The first alternative bridge modification investigated is the construction of movable flood gates at each end of the bridges. These gates connect to the adjacent levee earthen fill or floodwall, as appropriate, and when closed during storm condition provide the required high level protection across the existing, below-gradient bridges. Water would flow over the existing bridge structures but not outside the containment provided by the gates. The bridge beams are bolted to the piers; therefore, the bridge decks would not be displaced by an overtopping high water occurrence.

The floodgates must be sliding or rolling type rather than swing type gates. Swing type gates would have to swing open onto the bridge structures and this mode of swing is not considered feasible. The top of the gates must be two feet above the design high still water surface elevation to fulfill the freeboard requirement. (See Figure 7.)

Determinants

The estimated project cost is the lowest of the alternatives investigated ($408,000 for the Filmore Avenue Bridge). There would be little construction or design complexity. Hydraulic conditions are favorable. The reduction in canal flow area is unchanged from the existing condition and is due solely to the physical characteristics of the existing bridge. (See Table VI-4.)

The Floodgate Alternative utilizes the existing bridges without modification. Under storm or high water conditions the gates would be closed and traffic flow would be prevented from using the bridges. During construction, traffic disruption will be significant but little disturbance to the near neighborhood will occur. Appearance of the finished gate structures when open, as is the normal condition, will be unobtrusive since the gates will align with and tie or fold into the adjacent levee sections. If the high water level is increased, increasing the height of the gates will be moderate in cost.

Advantages and Disadvantages

The primary advantage of the Floodgate Alternative is the low construction cost. Also, the hydraulic conditions are favorable and there is no design or construction complexity.

The major disadvantage is that the bridges would be closed to traffic during high water conditions. Also, the gates must physically be closed by the Orleans Levee Board personnel in times of emergency, adding to the already large number of gate closings that must be done during highwater events. Also, maintenance of the gates is continuous and, although of low dollar amount, this cost is the highest of all the alternatives.

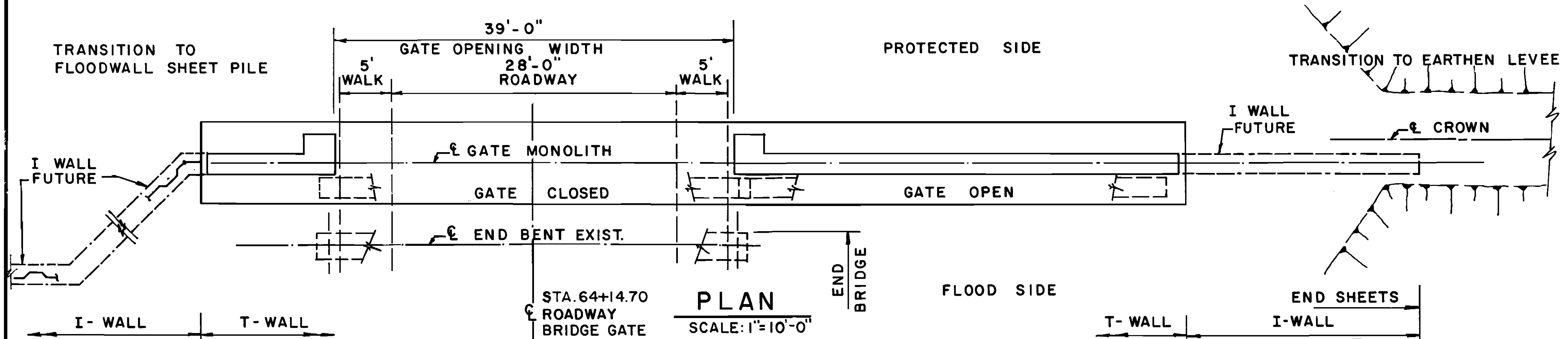
C. Seal Joints, Walls and Anchors Alternative

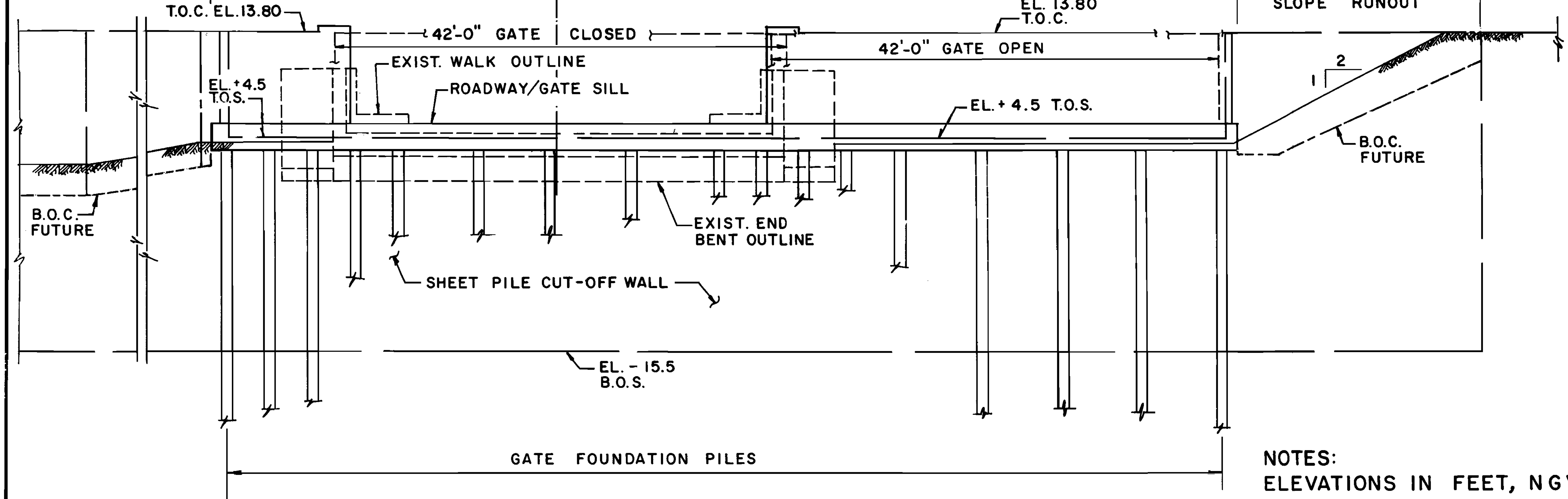
Description

The next alternative modification investigated involves watertight sealing of the existing bridge deck joints, constructing headwalls along both sides of the bridges and providing anchorage against the buoyancy force on the submerged structures. This modification converts the existing bridges into culvert structures. (See Figure 8.)

All of the joints of the existing bridges already have 26-gauge copper strip waterstops cast into the concrete decks. No additional material installation should be required to make these existing joints watertight under the low head requirements of this project. A minor cost allowance for testing and repair has been provided for assurance. Also, the existing deck drop-drains must be connected/manifolded to a common drain pipe with a shut-off check valve at the end to provide a true watertight deck. The existing bridge decks will be made watertight from end bent to end bent.

New headwalls must be constructed which connect to the bridge deck and extend up two feet above the design high still water surface elevation to fulfill the freeboard requirement. Due to the low existing elevation of the bridge decks, relatively high free standing walls are required. For instance, a maximum wall height of 8.4 feet above





ELEVATION - FLOODSIDE
SCALE: 1" = 10'

NOTES:
ELEVATIONS IN FEET, NGVD

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Suite 205
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FIGURE 7

FLOODGATE ALTERNATIVE
PLAN AND ELEVATION
FILMORE AVE. CROSSING-STA. 64+14.70

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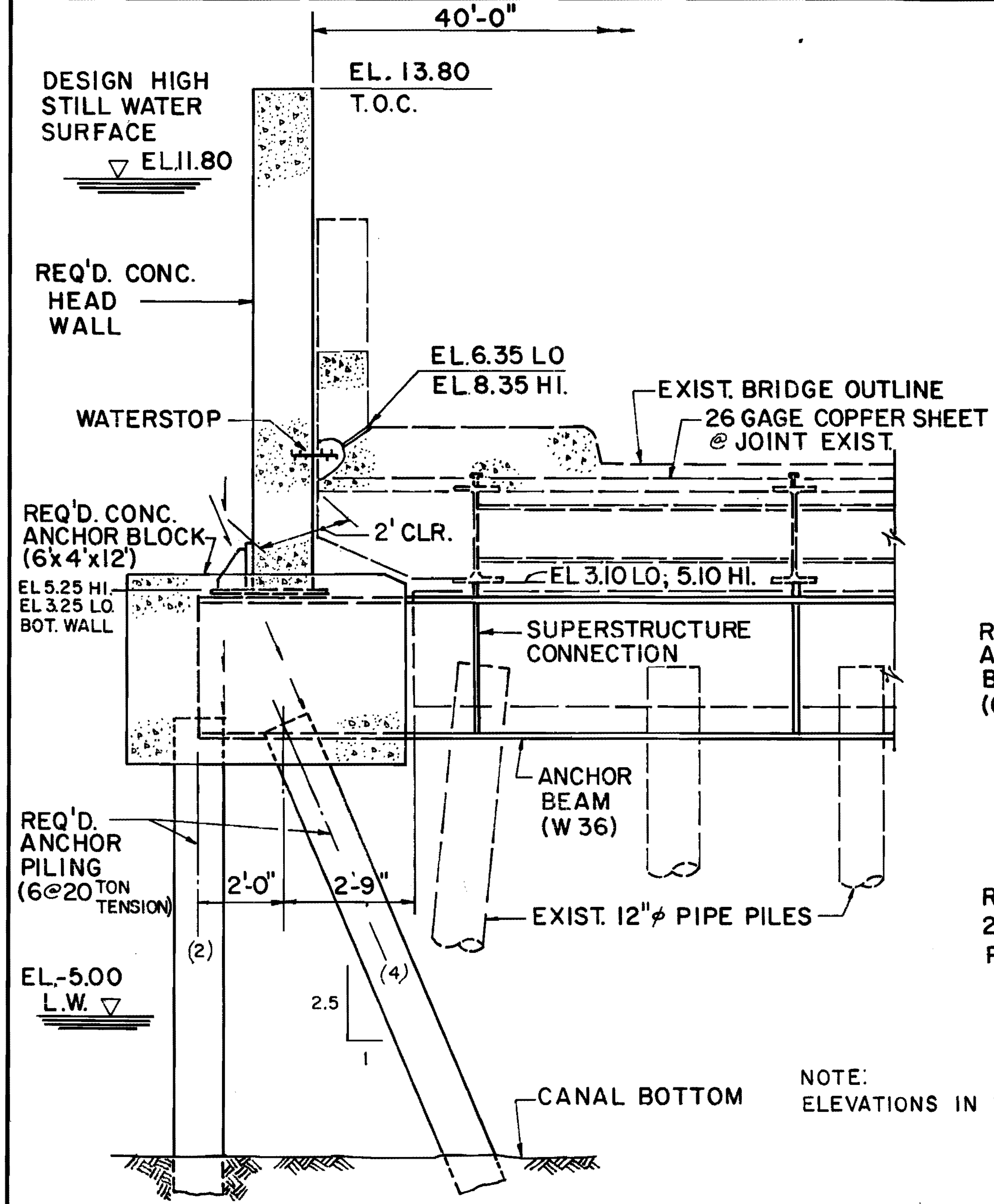
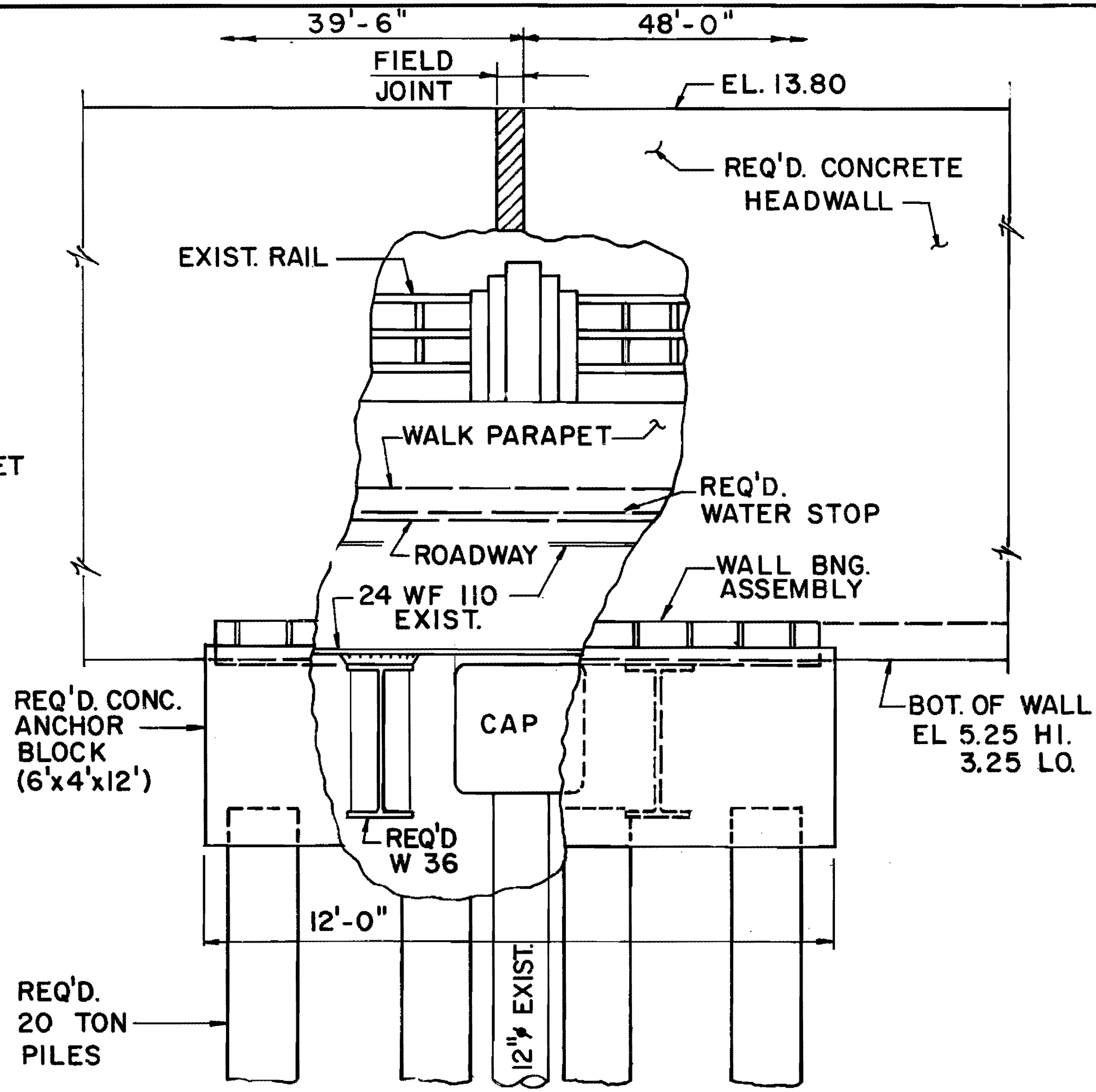


ELEVATION - CROSS SECTION
SCALE: 3/8" = 1'-0"

NOTE:
ELEVATIONS IN FEET, NGVD



ELEVATION - SIDE VIEW
SCALE: 3/8" = 1'-0"

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FIGURE 8

SEAL JOINTS, WALLS, ANCHORS ALTERNATIVE
ELEVATION AND SECTION
FILMORE AVE. CROSSING - STA. 64+14.70

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the bridge deck is required at Filmore Avenue. The additional load [about 1,000 pounds per linear foot (plf)] could not be added to the existing exterior bridge girders and cantilevered walkways without major additional strengthening. Therefore, independent walls alongside the bridges are proposed.

The new headwalls will be supported by separate concrete foundations constructed along the bridge sides and below the decks. The walls will be linked by water stops to the bridge deck and tied into the adjacent earthen fill levee or floodwall. The wall foundations can be combined with the concrete anchor blocks which act as hold down weights and provide the connection between the required anchor beams and anchor piling, thus effecting a multi-utilization arrangement. By selecting independent walls, the cost of removing the existing railing is avoided and the economy of using precast concrete walls is introduced.

The buoyant force anchorage system, required to prevent bridge flotation when the water rises to the anticipated maximum high level, consists of two heavy steel wide flange beams at each existing bent which are connected to the bridge girders, the concrete anchor blocks and the anchor piling which connect the system to the substrata. (See Figure 8.) This system, placed at each bent, is capable of withstanding the calculated uplift forces at the design high still water level.

The construction required with this alternative does not impede the maintenance and inspection of the existing bridge girders. Also, replacement of the existing bridge is possible without removal of the modification construction.

Determinants

At Filmore Avenue the estimated cost is approximately 30 percent (%) higher than the lowest of the alternatives ($538,000.). There is a high degree of design complexity in the wall and wall supports as proposed. Finite element analysis may be required to satisfy reviewing agency criteria. There are no other significant design problems. The driving of piling close to the side of the existing bridges will require extra precautions. Welding underneath the bridges to connect the anchor beams to the bridge girders will also be difficult. Grouting in waterstops and erecting the large headwalls will present construction problems, none of which is insurmountable. However, no underwater construction is required.

Hydraulic conditions are unfavorable since added structure further reduces the canal flow area. (See Table VI-4.)

This alternative utilizes the existing bridges without modification except that anchor beams are welded to the bridge girders and waterstops are grouted into the existing deck sides. Traffic flow conditions are very favorable with a short time of one way traffic during construction and the bridge remaining open during high water conditions. The bridge's appearance with this modification would be significantly changed. The high walls will give a poor appearance to passing motorists and a fair appearance to more distant viewers.

If, in the future, the level of protection were increased, it would be very costly to raise the level of protection with this alternative.

Advantages and Disadvantages

The primary advantages of the Seal Joints, Walls and Anchors Alternative is the low construction cost and the fact that the bridges are open to traffic flow during high water. Also, there would be very little maintenance required and no OLB personnel requirement at times of high water.

The major disadvantages are the reduced canal flow areas and the radical change in appearance of the bridges. The design complexity and construction difficulty that will be a part of this alternative are also disadvantages.

D. Precast Concrete Box Culverts Alternative

Description

An alternative requiring installation of precast concrete box culverts beneath the existing bridges is next considered. Connecting headwalls are constructed to the required design high still water plus freeboard elevation. These headwalls are connected to the adjacent earthen fill levee or floodwall, as appropriate, thus providing the required high level flood protection at the bridges. This alternative utilizes the existing bridges without modification.

The box culverts can be precast in single barrel or double barrel units, the ends sealed, and the sections floated along the canal from the lake into position. This is the "float-in method".

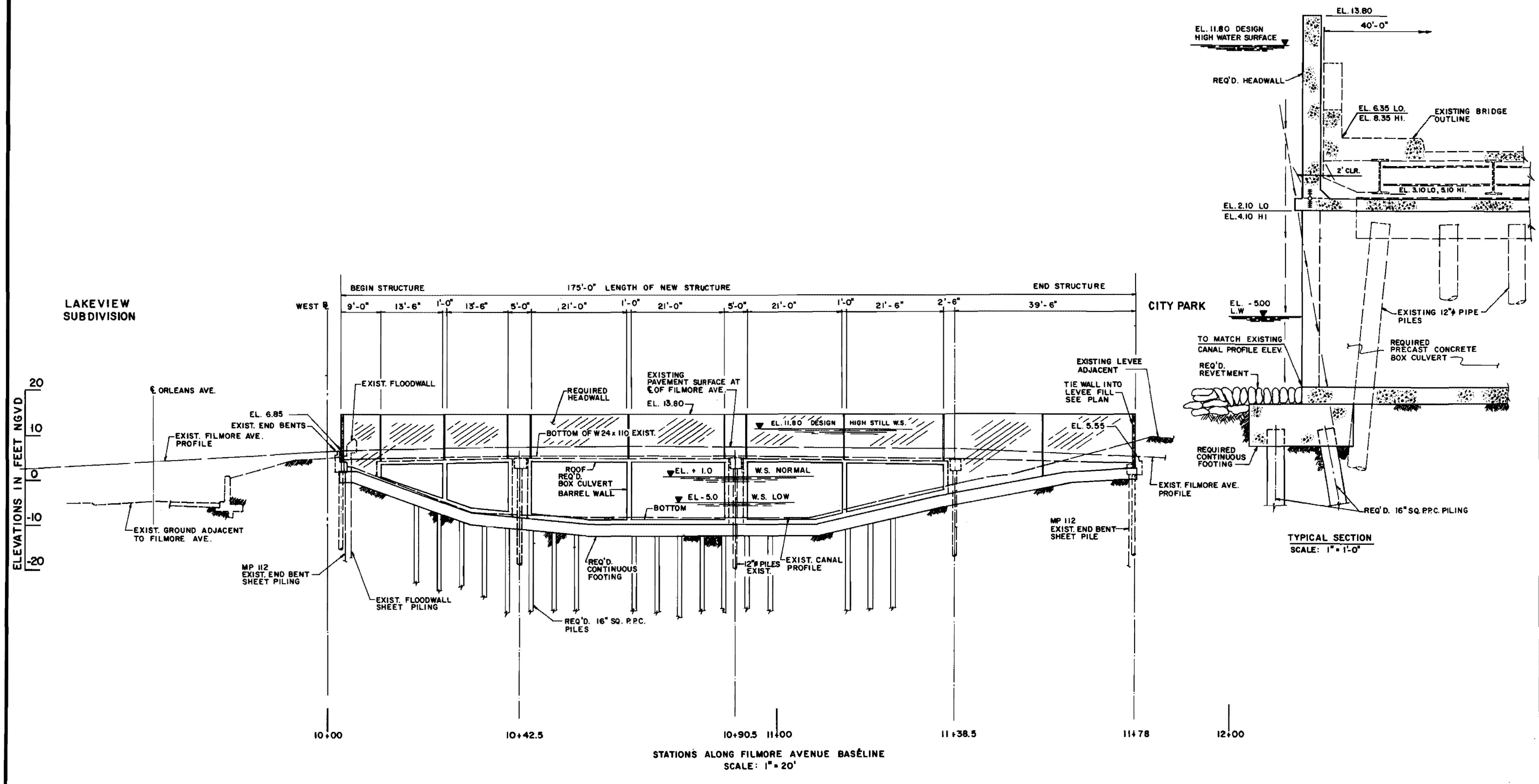
The spacing of the various bridge support bents will allow "half width" size precast box sections to be used. The two "half width" sections can be mated by post tensioning at the final locations to provide the "full width", watertight culverts. The post tensioning work is done in the wet. The precast culverts are supported on pile footings along each side of the bridge with the culverts spanning between the footings (See Figure 9). Because the box culverts are supported by their own footings, the pilings of the existing bridge are not subjected to any added loads.

An alternate to the "float-in method" of construction is to erect the box culvert with precast pieces beneath the existing bridges. The pieces are placed on footings constructed along each side of the bridge and post-tensioned into a continuous member. This alternate method requires the placement of shell, stone, or tremie concrete over the existing canal bottom due to the poor soil consistency. The concrete post-tensioning work is done in the wet.

Both methods of construction of precast box culverts require the construction of the lower portions of headwalls at the bents in the wet unless cofferdams are used. Cofferdam construction, with the precast box culverts in place will be complex and expensive. Another option is to precast the short lengths of the lower portions of headwalls and tie the precast walls to the box culverts with epoxy grout in the wet. Concrete block mats are placed at both ends of the culvert to prevent erosion of the canal bottom.

<u>Determinants</u>

The estimated construction cost is about double the Floodgate or Seal Joints Alternatives ($932,500 for the Filmore Avenue Bridge). The construction difficulty is extreme with many unknowns and underwater work is also involved. There are no previous projects in the area where this method of construction for this application



PRECAST CONCRETE BOX CULVERT ALTERNATIVE
SECTION AT FILMORE AVENUE CROSSING LOOKING NORTH

NOTES:
EXISTING BRIDGE TO REMAIN IN PLACE
ALL CONCRETE JOINTS TO HAVE WATER STOPS

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DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T. M. S.
CHECKED BY:
DRAWN BY: T. H.
CHECKED BY:
APPROVED BY:
DATE: AUGUST, 1985

STAMP

PRECAST CONCRETE BOX CULVERT ALTERNATIVE
ELEVATION AND SECTION
FILMORE AVENUE CROSSING - STA. 64+14.70

FIGURE 9

JOB No. 1006
SCALE 1" = 20'
SHEET NUMBER OF

has been used. Much of the design, and complexities thereof, would be assumed by the precast contractor as is the common practice.

The hydraulic conditions are poorest of all the alternatives. (See Table VI-4.) Since the box culverts must fit under the bridge and between bents and because headwalls are necessary, the canal flow area is significantly reduced.

The Precast Box Culvert Alternative utilizes the existing bridges without modification. Traffic conditions are very favorable since during storm or high water conditions the bridges would remain open to traffic. There would be no traffic disruption during the construction period except possibly when the upper headwall is constructed. There will be very little neighborhood disruption since much of the work will be performed off-site.

Appearance of the finished construction will be slightly better than the Seal Joints Alternative with the same high walls on each side of the bridges but with the absence of the large anchor block masses on each side of the bridges. If, in the future the high water level is increased, the modification cost would be high, requiring not only raising the wall height, but also strengthening the existing wall and culvert junction for the increased water pressure.

Advantages and Disadvantages

The precast concrete box culvert has few advantages. The fact that the bridges would be open to traffic during high water conditions is its main advantage. Also, the fact that there would be little traffic disruption and little disturbance to the local neighborhood during construction are lesser advantages. The low maintenance requirement is also an advantage.

Primary among the many disadvantages are the higher project cost and the smallest hydraulic flow area of the alternatives considered. The construction difficulties, including work in the wet, the many unknowns, and the lack of previous similar experience are important disadvantages. A feature that would almost rule out this scheme is that, with the box culvert in place, it will not be possible to paint or inspect the existing bridge steel girders. A maintenance inspection access could be provided to solve one of the problems; however, maintenance painting of the structure would remain extremely difficult at best.

E. New Raised Bridge Alternative

Description

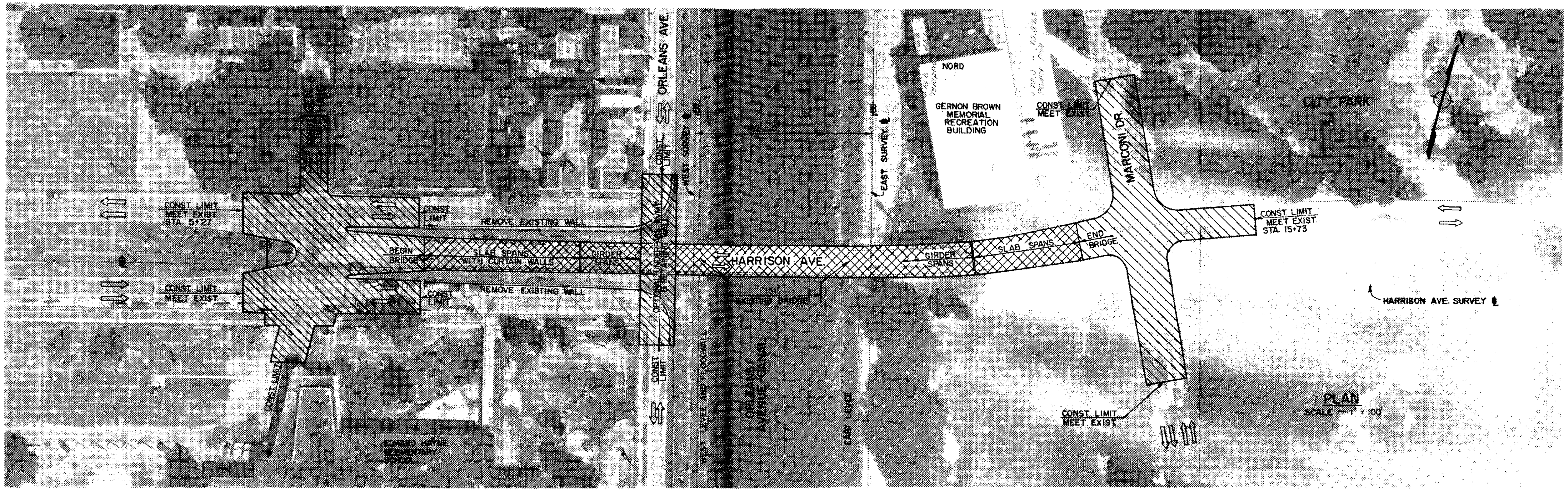
This alternative proposes removal of the existing bridges and construction of new replacement bridges at higher elevations. Under this alternative the top of the bridge decks are set at the design high still water surface elevation (EL +11.80 NGVD at Filmore Ave.) along the lines of the east and west levees. (See Figures 10, 11 & 12.)

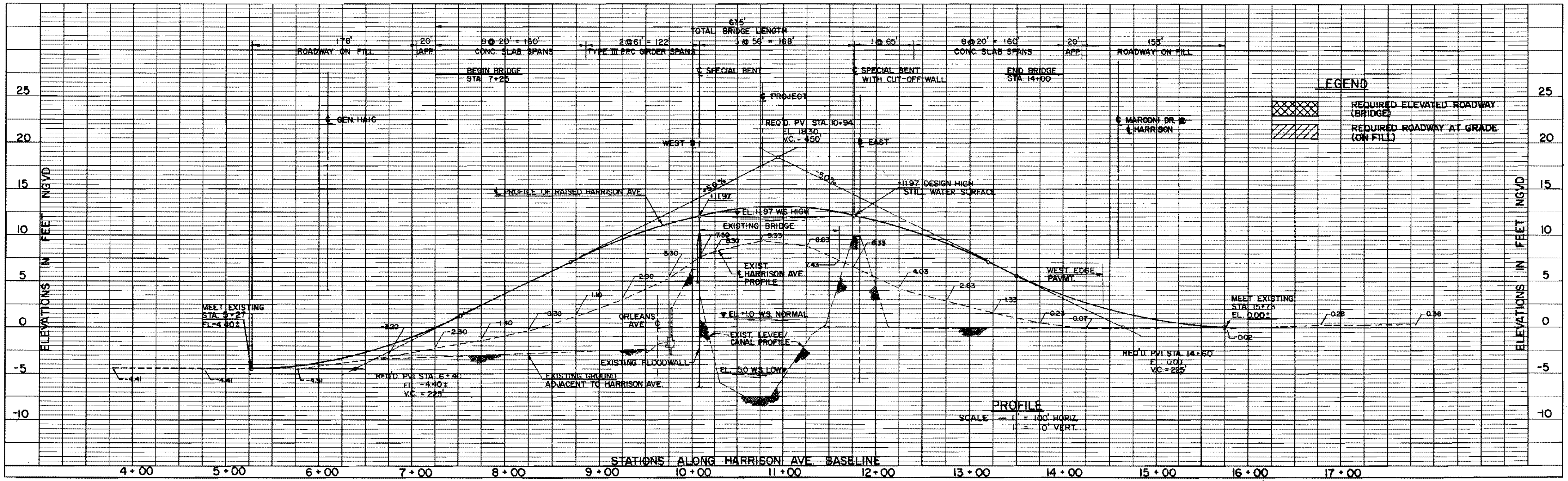
The proposed deck elevation has been economically selected. It is below the "water clear" elevation - the design high water plus freeboard elevation (EL +13.80 NGVD at Filmore Avenue) - but not so low as to require buoyant force anchorage. By using this lower deck elevation, a total approach bridge length reduction of 120 feet is effected - approximately 15% of the total length - compared to higher "water clear" elevation.

The freeboard height requirement will be satisfied by constructing the bridge barrier railings to the proper freeboard elevation and connecting them to the abutting earthen fill levees or floodwalls. Also the bridge deck joints will be sealed, deck drains manifolded, and special bents at levees will be designed as a combination T-wall/bent to provide the required high level flood protection. (See Figure 13.) In effect, the bridges in this alternative become an integral part of the levee system.

With this selection, water may on occasion rise above the bridge decks, but will not flow through the deck joints or into the surrounding land areas. This selection costs significantly less than a "water clear" bridge deck elevation and has a minimum effect on canal flow area while still providing the required flood protection. Some other features descriptive of the Raised Bridge Alternative are listed as follows:

- The bridges must be raised about 8 feet above the existing structures. Therefore, long approach bridges must be built to meet the existing grade.





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DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

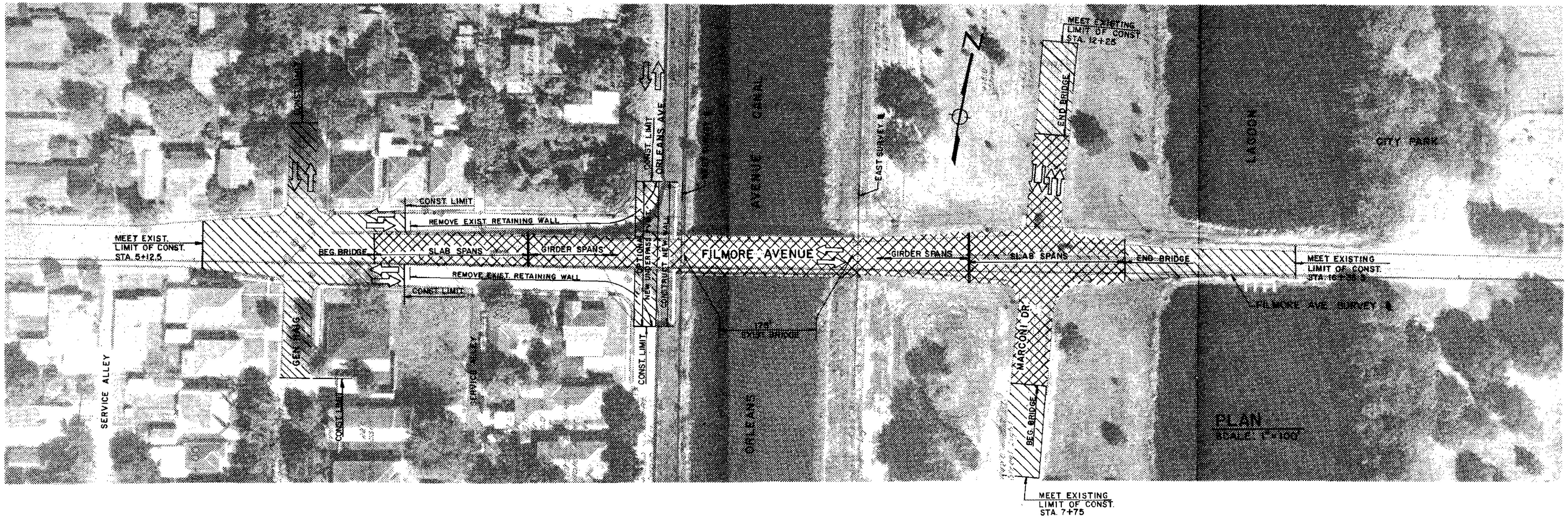
DESIGNED BY: T.M.S.
CHECKED BY: J.W.H./D.S.
DRAWN BY: P.M.K.
CHECKED BY: D.A.S/T.M.S.
APPROVED BY: J.W.H.
DATE: AUGUST 1985

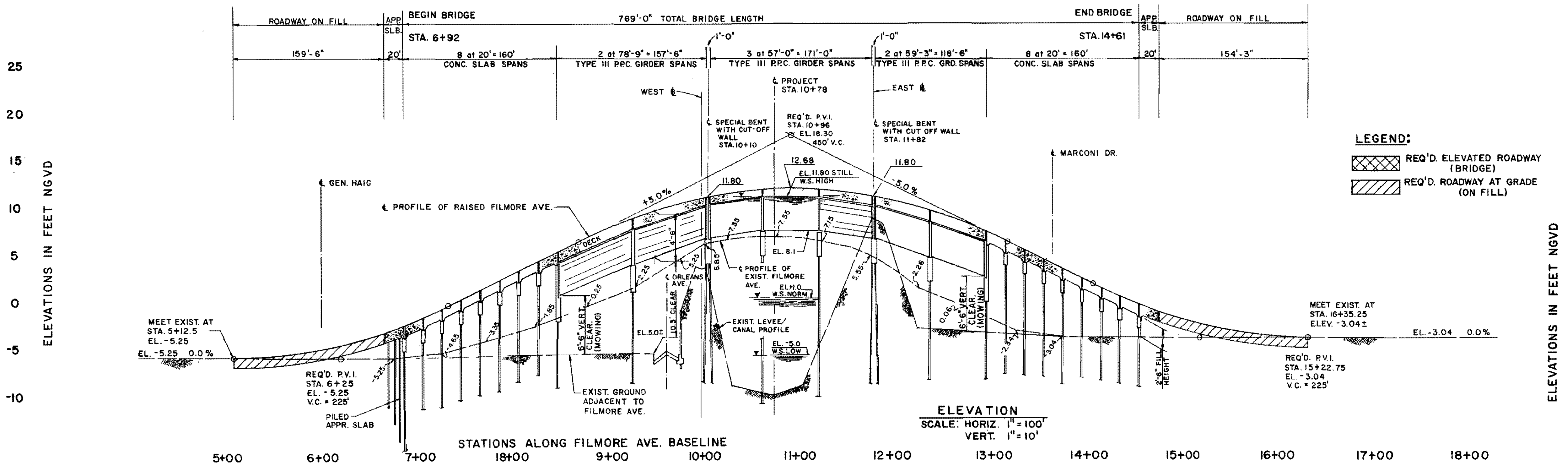
STAMP

HARRISON AVENUE - STA. 36+64.35
RAISED BRIDGE ALTERNATIVE
PLAN AND PROFILE

FIGURE 10

JOB No. 1006
SCALE VERT. 1" = 10'-0" HORIZ. 1" = 100'-0
SHEET NUMBER
OF





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DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T.M.S.
CHECKED BY: J.W.H./D.S.
DRAWN BY: T.J.H.
CHECKED BY: D.A.S./T.M.S.
APPROVED BY: J.W.H.
DATE:

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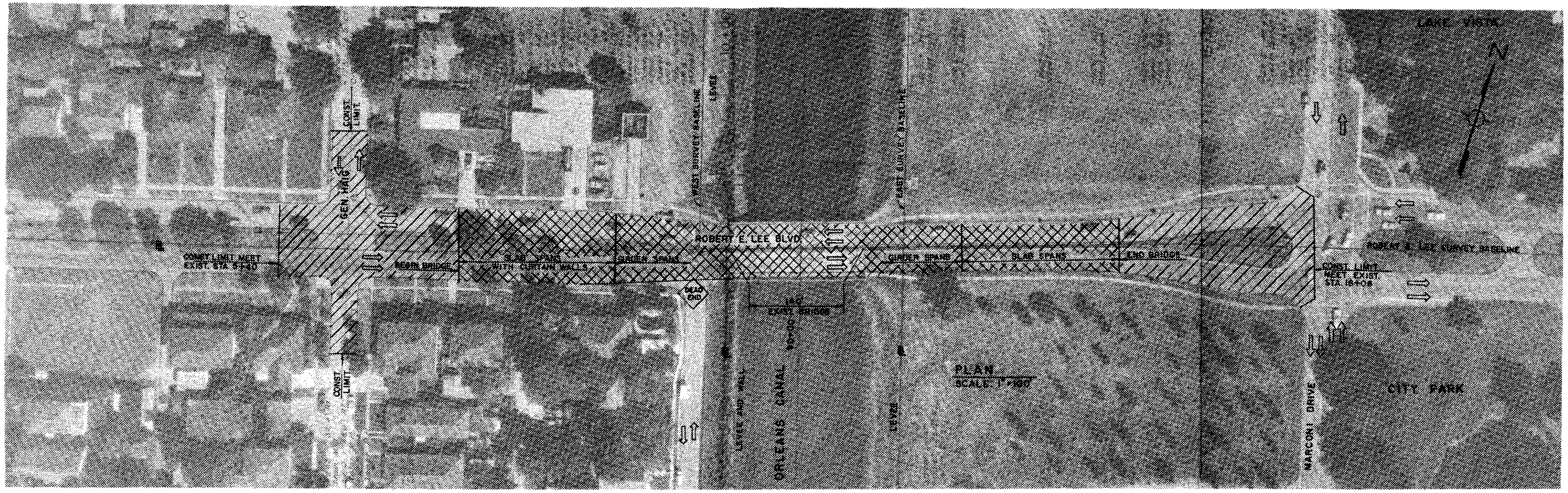
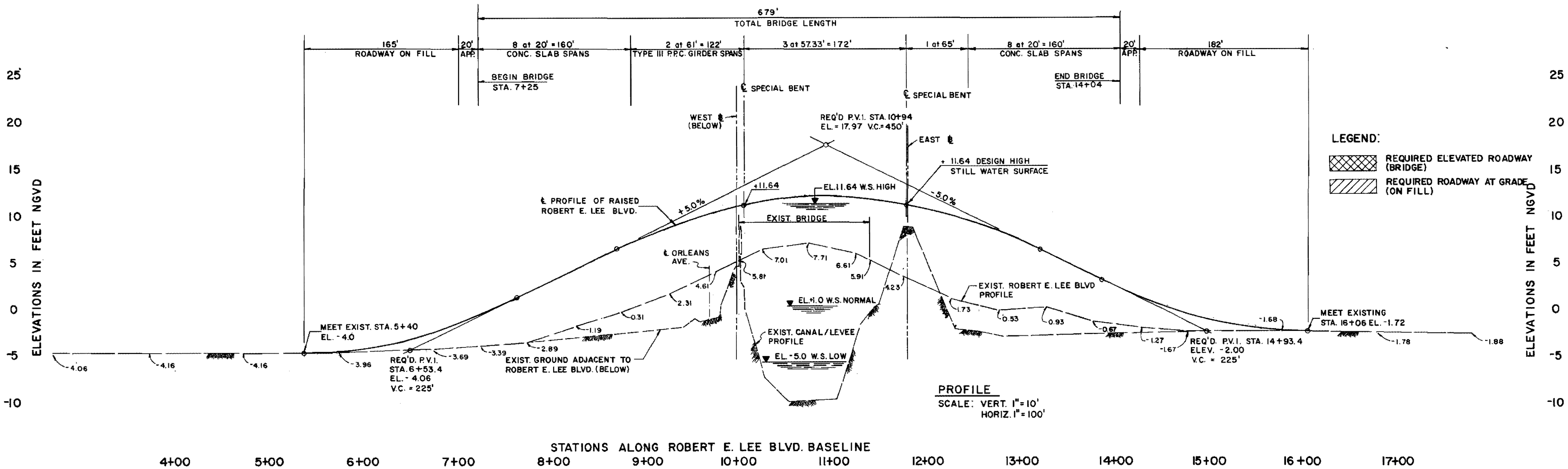
NEW RAISED BRIDGE ALTERNATIVE
PLAN AND ELEVATION
FILMORE AVE. CROSSING - STA. 64+14.70

FIGURE 11

JOB No. 1006
SCALE 1" = 10' VERT. 1" = 100' HORIZ.
SHEET NUMBER OF





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DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T.M.S.
CHECKED BY: J.W.H.
DRAWN BY: T.J.H.
CHECKED BY:
APPROVED BY:
DATE:

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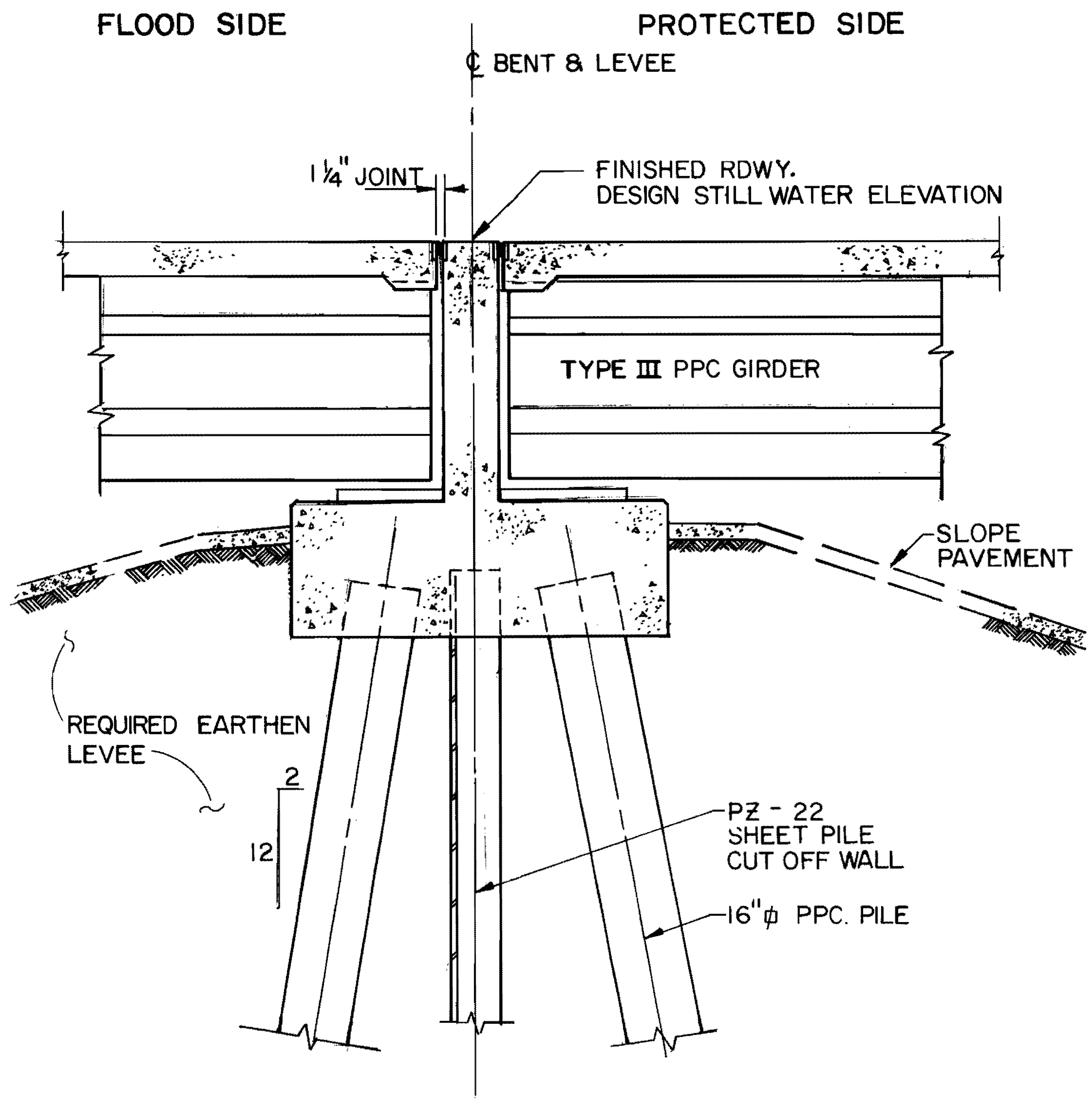
NEW RAISED BRIDGE ALTERNATIVE
PLAN AND PROFILE
ROBERT E. LEE BLVD. CROSSING - STA. 90+86.16

FIGURE 12

JOB No. 1006
SCALE VERT. 1" = 10' HORIZ. 1" = 100'
SHEET NUMBER OF



SPECIAL INTERMEDIATE BENT ELEVATION

SCALE — 3/8" = 1'-0"

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

FIGURE 13

RAISED BRIDGE ALTERNATIVE
SPECIAL INTERMEDIATE BENT

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P.M.K.	T.M.S.	AUG. 85	1006	

- Long spans were selected since they are more economical than the existing short spans. Also hydraulic conditions benefit with correspondingly fewer bents in the waterway.

- Prestressed precast concrete (PPC) girders were selected as more cost-effective than steel girders.

- Type III PPC girders were selected to optimize the canal flow area during storm conditions.

- With this alternative Orleans Avenue can optionally be routed under the raised roadways, thereby improving traffic circulation in the area of the bridges. (This has been done at the I-610 bridge near the pumping station.)

- A 5% grade of approach roadways has been used. This is considered the maximum acceptable grade. If a steeper grade is used, project cost could be slightly reduced.

Determinants

The estimated project cost is of a higher order of magnitude ($1,985,000 for the Filmore Avenue Bridge) than other alternatives. This cost is about four times the cost of Floodgates or Seal Joints Alternatives and twice the Box Culvert Alternative. Since the bridges are raised about 8 feet, long approach bridges must be built. Fully 80% of the cost is attributable to these approach portions. Significant cost is added at locations where Marconi Drive is closer to the canal because Marconi Drive must also be raised.

The design and construction are much larger in scope, but has little complexity. The hydraulic condition is the best of all the alternatives (See Table VI-4.) Also, with fewer bents and less superstructure in the water, the structure is less prone to damage due to high water and floating debris.

The existing bridge is totally removed with this alternative. Some cost credit could be given for the new structure life extension, but this has not been included. Traffic may use the bridge during high water conditions since it is sealed. Traffic flow during most of the construction period will be completely stopped. Traffic can be routed to adjacent bridges if staggered bridge construction schedules are used. Also, traffic on the connecting roads will be adversely affected for shorter periods. Disturbance to the near neighborhoods during construction will be extreme with this larger scale project.

The proposed "all concrete" bridge will have lesser maintenance requirement than the existing steel bridges. The appearance of the proposed bridge will be the best of all alternatives, being of normal accepted bridge configuration. If the high water elevation is raised, the height of barrier side rails will have to be increased to provide needed protection. This will be moderate in cost.

Advantages and Disadvantages

The primary advantages of the New Raised Bridge Alternative are that it has the most favorable hydraulic conditions and the bridge will remain open to traffic flow during high water. Also, the maintenance cost is the least of the alternatives and Orleans Levee Board personnel are not required at times of high water. The new bridge will have an extended life over alternates which utilize the existing bridges. The normal appearance is also an advantage. Finally, the optional routing of Orleans Avenue traffic under the new bridges would benefit traffic conditions.

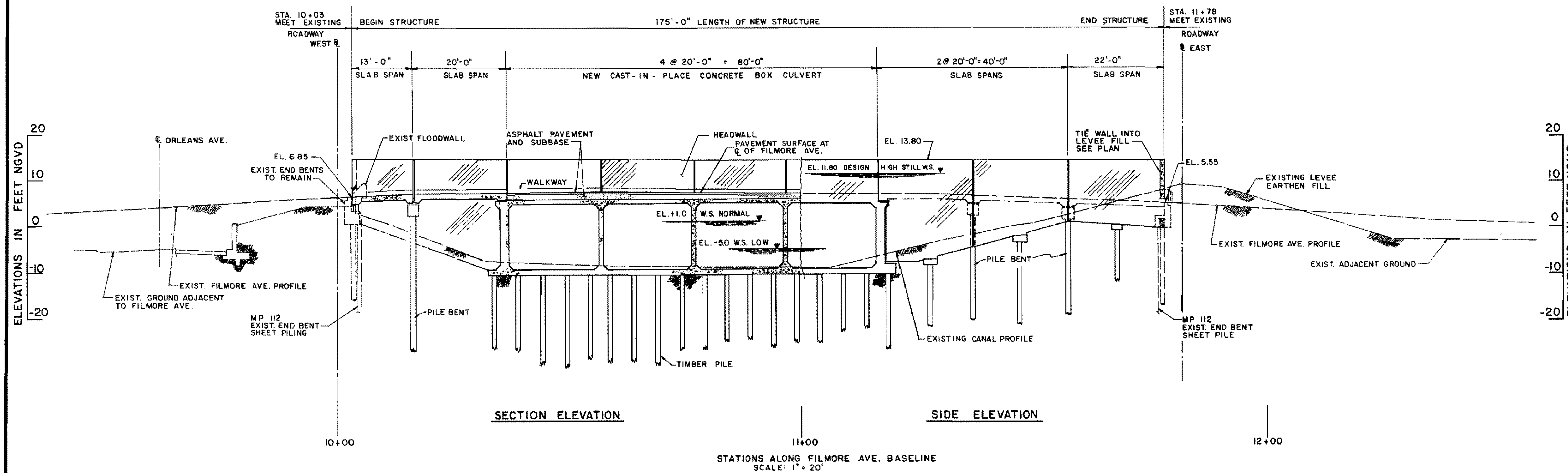
The major disadvantage is the much higher project cost. The larger scale of construction activity, traffic disruption, and neighborhood disturbance during construction are also disadvantages.

F. New Cast-In-Place Concrete Box Culverts Alternative

Description

The final alternative bridge modification is a box culvert constructed of cast-in-place concrete that replaces the existing bridges. This box culvert is pile-supported and new roadway pavement is constructed across the top of the concrete culvert. (See Figure 14.)

A large portion of the construction is below water surface, including all the support piling, the bottoms and half the walls of the box culverts. Economy requires that this significant work be done in the "dry". Therefore, sheet pile



NEW CAST-IN-PLACE CONCRETE BOX CULVERT ALTERNATIVE
SECTION AT FILMORE AVENUE CROSSING LOOKING NORTH

NOTES:
EXISTING BRIDGE TO BE REMOVED.
ALL JOINTS BETWEEN LEVEE WALLS TO HAVE WATERSTOPS.

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DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T.M.S.
CHECKED BY: J.W.H.
DRAWN BY: T.H.
CHECKED BY:
APPROVED BY:
DATE:

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NEW CAST-IN-PLACE CONCRETE
BOX CULVERT ALTERNATIVE
FILMORE AVE. CROSSING

FIGURE 14

JOB No. 1006
SCALE 1" = 20'
SHEET NUMBER
OF

cofferdams large enough to construct one concrete box culvert barrel at a time are required. The methods and procedures of cofferdam installation would have to be reviewed and approved by the Sewerage and Water Board during the design phase since the cofferdams affect canal flow area.

Upon completion of the box culverts, asphalt sub-base and pavement courses will be placed on top of the culverts. Asphalt sub-base and pavement are used because they are less expensive and easier to construct than concrete slab spans, the other alternate.

The grade of the new roadway is selected to match the existing roadway so that no modification of the approach roadway or connecting streets is involved. This is a decision based on economy. An alternate with the new roadway raised was investigated. The cost was higher than the Raised Bridge Alternative because of the much higher cost of box culverts over pier and girder type bridges. The conclusion is, therefore that, if the grade is raised, it would be more economical to adopt the Raised Bridge rather than the Box Culvert Alternative.

High headwalls are constructed along each side of the roadways to the required design high still water plus freeboard elevation. These walls are tied into the adjacent levee floodwalls or earthen fill, as appropriate, to prevent water from flowing onto the roadways and through the slots in the levees at the canal crossings. This headwall configuration, very similar to that used for the Seal Joints Alternative, provides the required flood protection.

In this alternative the portions of canal with sloping bottom are closed to flow to reduce the box culvert cost. The head loss due to this reduction in flow area is very small due to the short length of the culvert.

Concrete block matting is included at the end of each box culvert to prevent canal bottom erosion, which is a possibility when canal flows are increased, with accompanying turbulence and increased velocity through the reduced flow area of the box culvert.

Determinants

The estimated project cost is about two and one-half times the Floodgate or Seal Joints Alternative and 30% higher than the Precast Concrete Box Culvert Alternative ($1,192,100 for the Filmore Avenue Bridge). There is some design complexity. Construction difficulty is more than Floodgates or Seal Joints Alternatives but much less than the Precast Box Culvert option. The canal flow area through the culverts is less than the three alternatives where the existing bridge remains in place. (See Table VI-4.)

The existing bridge is removed and replaced with a new structure, so some credit for extended life could be assigned to this alternative. Traffic conditions and disturbance to the near neighborhood during construction are similar to the Raised Bridge Alternative. Traffic flow across the canal will be stopped during construction and disturbance to the neighborhood will be noteworthy although not as severe as in the Raised Bridge option. Maintenance requirement will be negligible with this all-concrete structure.

Appearance of the finished construction will be similar to the Precast Concrete Box Culvert option - high walls on each side of the crossings. If the high water level is raised, the modification cost would be high, requiring not only raising the wall heights but also strengthening the existing wall and culvert junction.

Advantages and Disadvantages

The New Cast-In-Place Concrete Box Culvert Alternative has few advantages. The fact that the bridges would be open to traffic during high water events is its principal advantages. The low maintenance requirement and lack of Orleans Levee Board personnel attention during storm conditions are also advantages.

Primary among the disadvantages is the higher project cost. The construction difficulty, larger scale of construction activity, and neighborhood disturbance that will be caused are also disadvantages. The fact that the avenues will be closed for lengthy construction periods, although temporary in nature, is a serious disadvantage.

G. Comparison of Bridge Alternatives

From the determinants, advantages, and disadvantages recorded in the previous sections, the following comparisons of bridge modification alternatives are presented.

One of the alternatives allows high water to flow over the existing roadways; three of the alternatives result in culvert-type structures, forcing high water under the roadways; and one of the alternatives raises the roadway grades, allowing high water to pass below the structure decks.

The Floodgate Alternative Modification allows high water to flow over the existing bridge roadways. It has a high rank in all the major determinant categories except for the fact that the bridges would be closed to traffic during storm high water conditions. This is a serious disadvantage. The Floodgate Alternative has the lowest project cost amounts; provides the largest canal flow areas, except for the Raised Bridges Alternative; and is not aesthetically objectionable. The fact that Orleans Levee Board personnel must physically close the gates at times of emergency is serious disadvantage.

Of the three alternatives that make the structures function as a culvert by the installation of high walls along the sides of the roadways, the Seal Joints, Walls and Anchors Alternative ranks best. It has an approximate 50% lower construction cost than the Cast-in-Place Concrete Box Culvert Alternative. For this alternative, the canal flow area is more than the Concrete Box Culvert options and it will cause less neighborhood disturbance during construction.

The Precast Concrete Box Culvert Alternative is not a viable alternative since, if it is constructed, the existing bridge steel girders cannot be maintained. Also, the New Cast-in-Place Alternative is only about 25% higher in construction cost; therefore, if a Box Culvert option were to be selected, the Cast-in-Place Culvert would be favored.

The Raised Bridge Alternative allows high water to pass below the structure decks, providing the largest flow area, but is almost four times higher in construction cost than the Seal Joints Alternative. The higher order cost results from the extensive approach bridge and roadway work required with raising of the bridge deck grades. Fully 80% of the cost of this alternative results from the cost of constructing the new approaches.

The cost of the Floodgate Alternative and the Seal Joints Alternative are the two lowest amounts. The other alternatives are from two to four times greater.

The Seal Joints Alternative is relatively less costly on the shorter Robert E. Lee Blvd. and Harrison Avenue crossings than on the Filmore Avenue crossing. In fact, on the short Harrison Avenue crossing the Seal Joints Alternative is slightly less costly than the Floodgate Alternative, and at the wider Robert E. Lee Blvd. the Seal Joints Alternative is only slightly more costly than Floodgates.

Further comparisons of the determinants of the alternatives are presented in Tables VI-2, VI-3, VI-4 and VI-5 following this section.

See Table VI-1 for comparison of construction costs of the five alternative bridge modifications.

TABLE VI-1

BRIDGE MODIFICATION ALTERNATIVES

CONSTRUCTION COST COMPARISON

ALTERNATIVE	CROSSING (DIMENSIONS)			TOTAL COST-3 BRIDGES
	R.E. LEE BLVD. (60'X 140')**	FILMORE AVE.* (40'X 175')	HARRISON AVE. (32'X 151')**	
FLOODGATES	$612,000	$408,000	$326,000	$1,346,000
SEAL JOINTS, WALLS AND ANCHORS	$645,000	$538,000	$317,000	$1,500,000
CONCRETE BOX CULVERT-PRECAST	$1,120,000	$932,500	$643,500	$2,696,000
NEW RAISED BRIDGE	$2,980,000	$1,985,000	$1,588,000	$6,553,000
NEW CONC. BOX CULVERT-C.I.P.	$1,430,000	$1,192,100	$822,900	$3,445,000

* SEE TABLES VI-6 THROUGH VI-10 FOR DETAILED COST ESTIMATES OF FILMORE AVENUE CROSSING.

** PROJECT COSTS FOR R. E. LEE BLVD. AND HARRISON AVE. ARE APPROXIMATED FROM FILMORE AVE. COSTS AND DIMENSIONS OF STRUCTURES.

TABLE VI-2

BRIDGE MODIFICATION ALTERNATIVES

TYPICAL SUMMARY OF DETERMINANTS

FILMORE AVENUE CROSSING

DETERMINANTS	ALTERNATIVES					REMARKS
	FLOODGATES	SEAL JOINTS, WALLS, ETC.	PRECAST CONC. BOX CULVERT	NEW RAISED BRIDGES	NEW CIP CONC. BOX CULVERT	
MAJOR DETERMINANTS						
1. PROJECT COST RATIO	1.00	1.32	2.28	4.86	2.92	FLOODGATES=1.0
2. HYDRAULIC CONDITIONS **						
2.1 FLOW AREA % -W.S. AT EL. 4.25	98	90	77	100	65	% OF UNOBSTRUCTED
2.2 FLOW AREA % -W.S. AT EL. 9.25	61	56	48	100	43	% OF UNOBSTRUCTED
2.3 FLOW AREA % -W.S. AT EL. 11.80	69	45	38	88	34	% OF UNOBSTRUCTED
3. TRAFFIC CONDITION AT HIGH WATER	CLOSED	OPEN	OPEN	OPEN	OPEN	
MINOR DETERMINANTS						
A. TRAFFIC DISRUPTION	MINOR	MINOR	OPEN	CLOSED	CLOSED	DURING CONSTRUCTION
B. NEIGHBORHOOD DISTURBANCE	LITTLE	SOME	LITTLE	EXTREME	MORE	DURING CONSTRUCTION
C. CONSTRUCTION DIFFICULTY	LITTLE	SOME	EXTREME	LARGE SIZE	MORE	
D. DESIGN COMPLEXITY	LITTLE	MOST	MORE	LARGE SIZE	SOME	
E. MAINTENANCE COST	MOST	LITTLE	*	LEAST	LITTLE	
F. COST TO RAISE LEVEL	MODERATE	HIGH	HIGH	MODERATE	HIGH	UNLIKELY NEED
G. APPEARANCE	UNOBTRUSIVE	FAIR TO POOR	GOOD TO FAIR	BEST	GOOD	JUDGMENTAL
H. OLB PERSONNEL AT STORM	REQUIRED	NONE	NONE	NONE	NONE	
I. EXISTING BRIDGES	UTILIZE	UTILIZE	UTILIZE	REMOVE	REMOVE	

* MAINTENANCE INSPECTION AND PAINTING OF EXISTING BRIDGE GIRDERS IMPAIRED

** ELEVATIONS ARE IN FEET - N.G.V.D.

TABLE VI-3

BRIDGE MODIFICATION ALTERNATIVES - TYPICAL COST COMPARISON

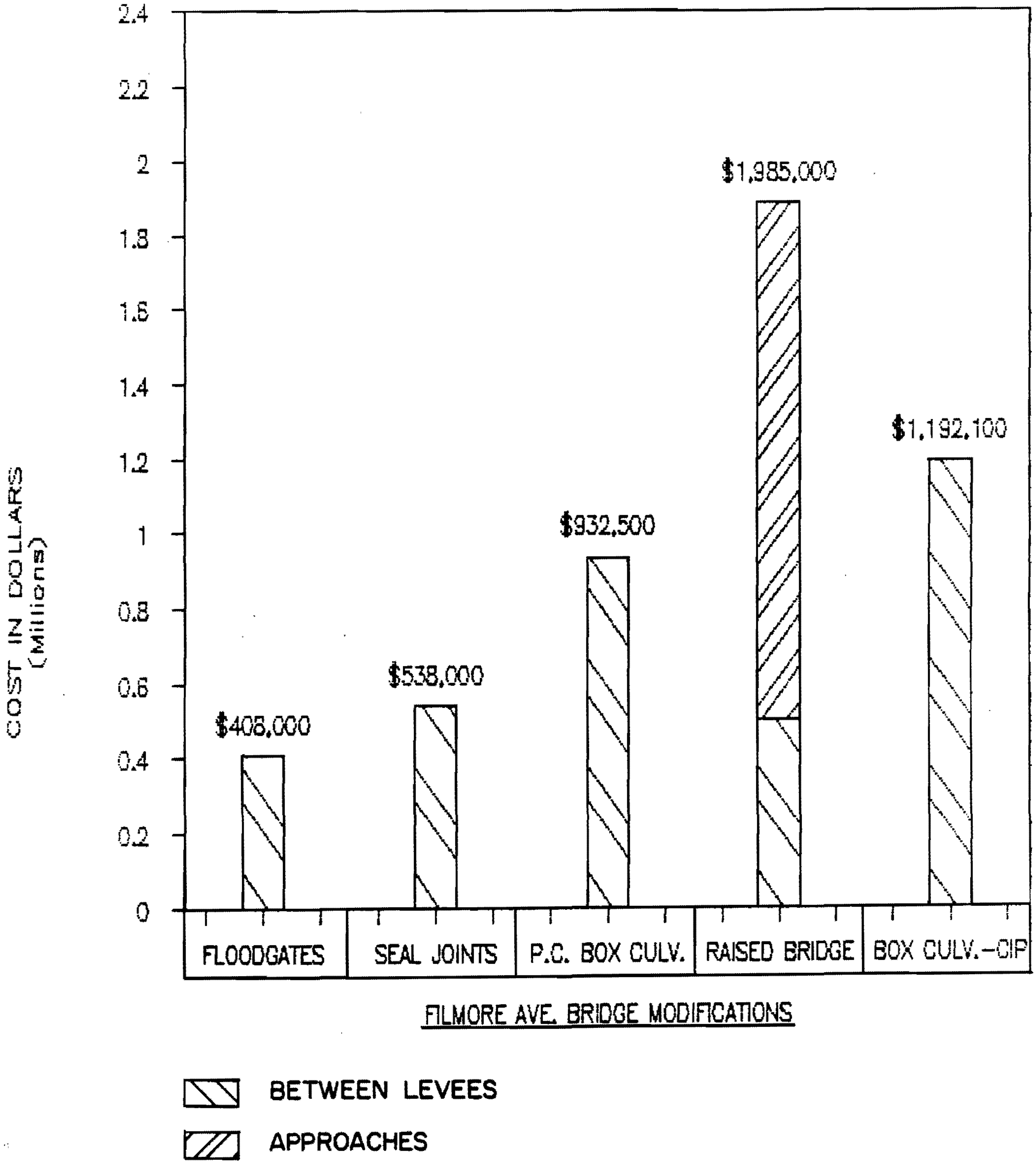


TABLE VI-3

TABLE VI-4

BRIDGE MODIFICATION ALTERNATIVES

TYPICAL FLOW AREA COMPARISON

FILMORE AVENUE CROSSING

WATER SURFACE ELEVATION	ALTERNATIVES					
	FLOODGATES EXIST. BRIDGE	SEAL JOINTS, WALLS, ETC.	PRECAST CONC. BOX CULVERT	NEW CIP CONC. BOX CULVERT	NEW RAISED BRIDGE	UNOBSTRUCTED CHANNEL
4.25 FT. N.G.V.D. (BOT. OF EXIST. BMS.)	1488 98%	1364 90%	1167 77%	988 65%	1508 100%	1508 100%
9.25 FT. N.G.V.D. (TOP OF EXIST. PARAPET)	1488 61%	1364 56%	1167 48%	1036 43%	2428 100%	2428 100%
11.80 FT. N.G.V.D. (HIGH STILL WATER SURFACE)	2102 69%	1364 45%	1167 38%	1036 34%	2672 88%	3042 100%

NOTES:

1. FLOW AREAS ARE IN SQUARE FEET. PERCENTAGE SHOWN IS PERCENT OF UNOBSTRUCTED CHANNEL.

2. N.G.V.D. = NATIONAL GEODETIC VERTICAL DATUM

TABLE VI-5

BRIDGE MODIFICATION ALTERNATIVES - TYPICAL FLOW AREA COMPARISON

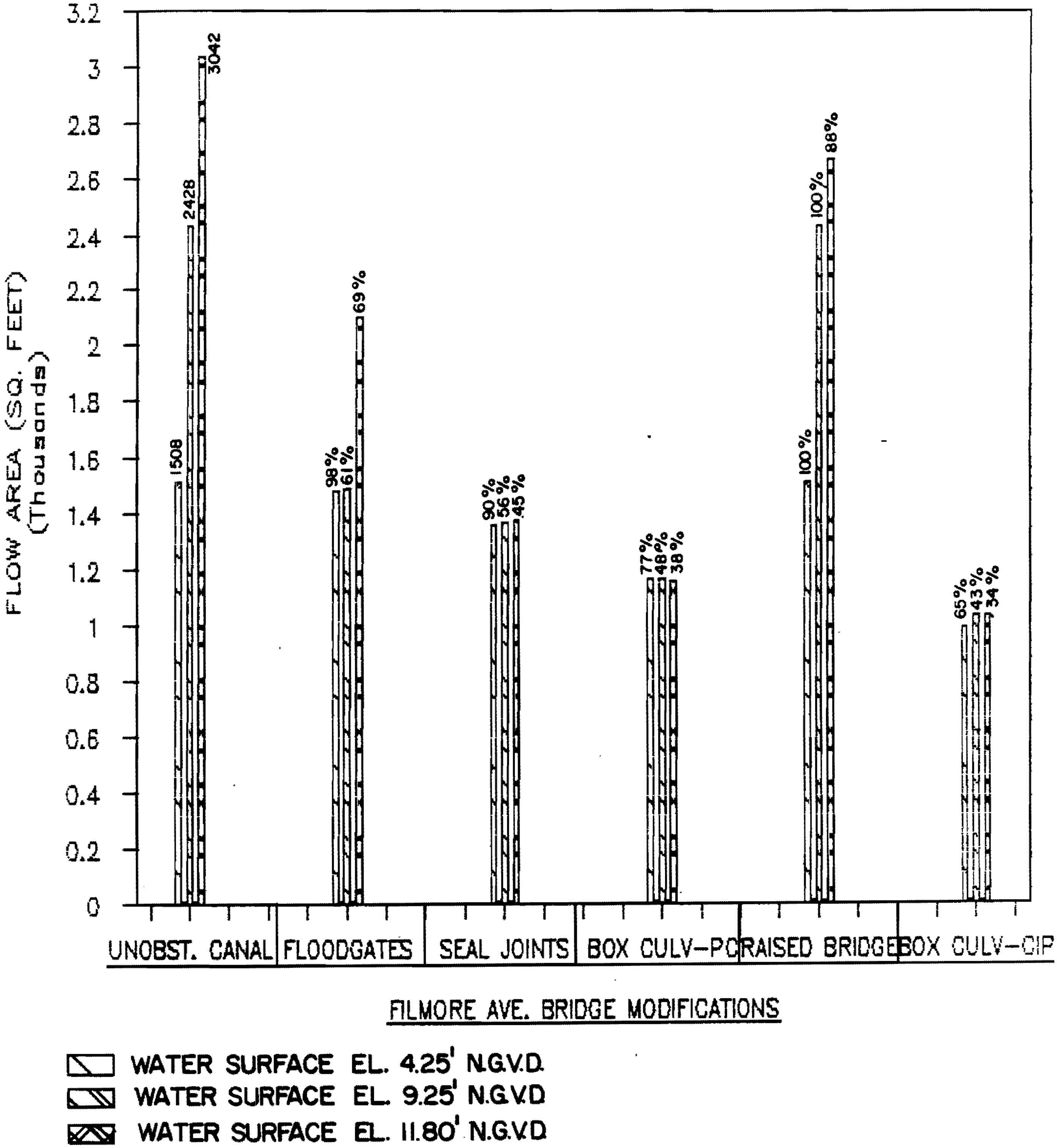


TABLE VI-5

TABLE VI-6

BRIDGE ALTERNATIVE -CONSTRUCTION COST ESTIMATE
"FLOODGATES"

FILMORE AVENUE BRIDGE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FOUNDATION				
Excavation	CY	250	10	$ 2,500
Piles - 16" SQ.PPC (50 Ft.Lg. at 20T)	EA	96	1,250	120,000
Sheet Piling (PZ22x20 Ft.Lg.)	LF	192	300	57,600
Concrete Sill/Ftg.	CY	144	200	28,800
Tracks	LF	168	20	3,400
WALL				
Concrete Walls & Posts w/Reinf	CY	82	350	28,700
Sheet Piling (I-Wall Future) (PZ22x30 Ft.Lg.)	LF	83	450	37,000
GATE				
A36 Steel	LBS	33,600	2	67,000
Seals-Neoprene	LS	LS	8,000	8,000
Rollers, Locks, Inserts	LS	LS	8,000	8,000
OTHER ITEMS				
Utility Modifications	LS	LS	10,000	10,000
Contingencies (10%)				37,000

TOTAL (For 2 Gates)..............$408,000

Note: The Floodgate Alternative includes 2 gates - each gate is 42 ft. long by 9 ft. high with a 39 ft. clear opening. The gate and sill footing is 96 ft. long by 8 ft. wide. The total structure includes 83 ft. of I-wall for a total length of 266 ft. along the levees.

TABLE VI-7

BRIDGE ALTERNATIVE -CONSTRUCTION COST ESTIMATE
"SEAL JOINTS, WALLS AND ANCHORS"

FILMORE AVENUE BRIDGE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
ANCHOR SYSTEM				
Superstructure Connection	LS	48	-	$ 25,000
A36 Steel (8-W36's)	LB	81,000	1.75	141,800
Concrete Block/Wall Support (10 Locations)	CY	85	300	25,500
Piles - 16" SQ.PPC (60 Ft.Lg. at 20T)	EA	48	1,500	72,000
Added Girder-Deck Studs	EA	None	50	NA
HEADWALL				
Concrete Walls (2-12" Thick)	CY	135	300	40,500
Base Connections	LS	10	-	10,000
Waterstop + Chip	LF	350	14	4,900
Floodwall Sheet Piling (PZ22x30 Ft.Lg.)	LF	186	450	83,800
SEAL JOINTS				
Test Existing Copper Strip	LF	200	20	4,000
Repair Allowance	LF	50	170	8,500
OTHER ITEMS				
Remove End Bent Walls	EA	4	500	2,000
Manifold Drains	LS			25,000
Utility Modifications	LS			25,000
Slope Pavement	SF			
Contingencies (15%)				70,000
			TOTAL	$538,000

Note: The Seal Bridge Alternative includes a bridge deck area that is 40 ft. wide and 175 ft. long, including a 28 ft. roadway with 6 ft. walks. The headwall is 350 ft. (175 ft. each side) long and 9.5 ft. high. Also included are 8-6 pile anchors supporting 8-44 ft. long W36 steel beams. The total length along the levees is 266 ft. which includes 186 ft. of floodwall.

TABLE VI-8

BRIDGE ALTERNATIVE - CONSTRUCTION COST ESTIMATE
"PRECAST CONCRETE BOX CULVERT"

FILMORE AVENUE BRIDGE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
FOUNDATION				
Excavation Underwater	LS	(600 cy)		$75,000
Piles - 16" SQ.PPC (50 Ft.Lg. at 20T)	EA	76	1,250	95,000
Footing	CY	200	400	80,000
BOX CULVERT				
Bottom Slab (12"tk.)	CY	285	400	114,000
Walls (12"tk.)	CY	160	500	80,000
Roof (9"tk.)	CY	220	500	110,000
Waterstop (12)	LF	504	7	3,500
HEADWALL				
Walls	CY	125	350	43,800
Waterstop (2)	LF	350	7	2,500
Sheet Piling, Floodwall	LF	186	450	83,800
Filler Walls at Sides	CY	10	350	3,500
REVETMENT				
Concrete Block Mats (6 ft. ea. side x 175')	SF	2,100	4	8,400
OTHER ITEMS				
Manifold Drains	LS	LS	25,000	25,000
Utility Modifications	LS	LS	25,000	25,000
Add Concrete Block Mats	SF	7,000	4	28,000
Contingencies (20%)				155,000
TOTAL				$932,500

Note: The Precast Concrete Box Culvert Alternative includes a bridge deck area that is 40 ft. wide and 175 ft. long, including a 28 ft. roadway with 6 ft. walks. The headwall length is 350 ft. (175 ft. each side) long and 10 ft. high. The flow area provided is 1,167 sq.ft. The total length along the levees is 266 ft. which includes 186 ft. of floodwall.

TABLE VI-9

BRIDGE ALTERNATIVE - CONSTRUCTION COST ESTIMATE
"NEW RAISED BRIDGE"

FILMORE AVENUE BRIDGE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
MAIN BRIDGE (173'X40')				
Superstructure	SF	6,920	16.50	114,180
Substructure	SF	6,920	18.50	112,020
GIRDER SPANS (276'X40')				
Superstructure	SF	11,040	16.50	182,160
Substructure	SF	11,040	17.50	193,200
SLAB SPANS (320'X40')				
Superstructure	SF	12,800	9.50	121,600
Substructure	SF	12,800	16.50	211,200
Curtain Walls	LF	640	120.00	76,800
ROADWAY ON FILL (355'X40')				
Approach Slabs	SF	1,600	15.50	24,800
Embankment Roadway	SF	12,600	7.50	94,500
DEMOLITION (175'X40')	LS	LS	200,000.00	200,000
SHEET PILING, FLOODWALL	LF	186	450.00	83,800
MODIFY CONNECTING ROADS				
Gen. Haig & Orleans Ave.	LF	170	300.00	51,000
Marconi Drive (Portion is Raised)	LF	400	750.00	300,000
Orleans Ave. w/Wall (Optional)	LF	150	550.00	
OTHER ITEMS				
Utility Modifications	LS	LS	40,000.00	40,000
Contingencies (10%)				180,000
TOTAL				$1,985,260

Note: The Raised Bridge Alternative includes a 40'x173' Main Bridge, 40'x596' Approach Bridge, 40'x355' Fill Roadway, and 725 L.F. Connecting Roads. The total length along the levees is 266' which includes 186' of floodwall.

TABLE VI-10

BRIDGE ALTERNATIVE - CONSTRUCTION COST ESTIMATE
"NEW CAST-IN-PLACE CONCRETE BOX CULVERT"

FILMORE AVENUE BRIDGE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
DEMOLITION				
Existing Bridge (40'x 175')	LS	LS	200,000	200,000
BOX CULVERT (140'x40')				
Excavation (3')	LS	LS	20,000	20,000
Timber Piles (50' Lg.)	EA	261	750	200,000
Concrete Bottom (18")	CY	315	400	126,000
Concrete Walls (1x86'x40'Lg.)	CY	127	500	63,700
Concrete Roof (18")	CY	311	500	155,500
Waterstops (16x40 tk.)	LF	640	7	4,500
Concrete Block Mats	SF	2,100	4	8,400
HEADWALLS				
Walls (7.9'high avg.x176'Lg.x2)	CY	103	300	30,900
Waterstop	LF	352	7	2,500
Floodwall Sheet Piling (PZ22x30 Ft.Lg.)	LF	186	450	83,800
ROADWAY				
Asphalt Subbase (2'tk.)	CY	415	35	14,500
Asphalt Pavement (4")	SY	435	15	6,500
Walkways (6'x24"tk. x 350'Lg.)	CY	47	100	4,700
CONCRETE SLAB SPANS				
Slab Spans	SF	1,440	9.50	13,700
Bents	SF	1,440	16.50	23,800
Curtain Walls	LF	72	120	8,600
OTHER ITEMS				
Utility Modifications	LS	LS	25,000	25,000
Contingencies (20%)				200,000
TOTAL				$1,192,100

Note: The Cast-in-Place Concrete Box Culvert Alternative includes a 40'x175' Deck Area, 28' Roadway w/6' Walks, 176'long x 7.9' high Walls and provides 1,525 sf. of flow area. The total length along the levees is 266' which includes 186' of floodwall.

CHAPTER VII

Special Condition Modifications

VII. SPECIAL CONDITION MODIFICATIONS

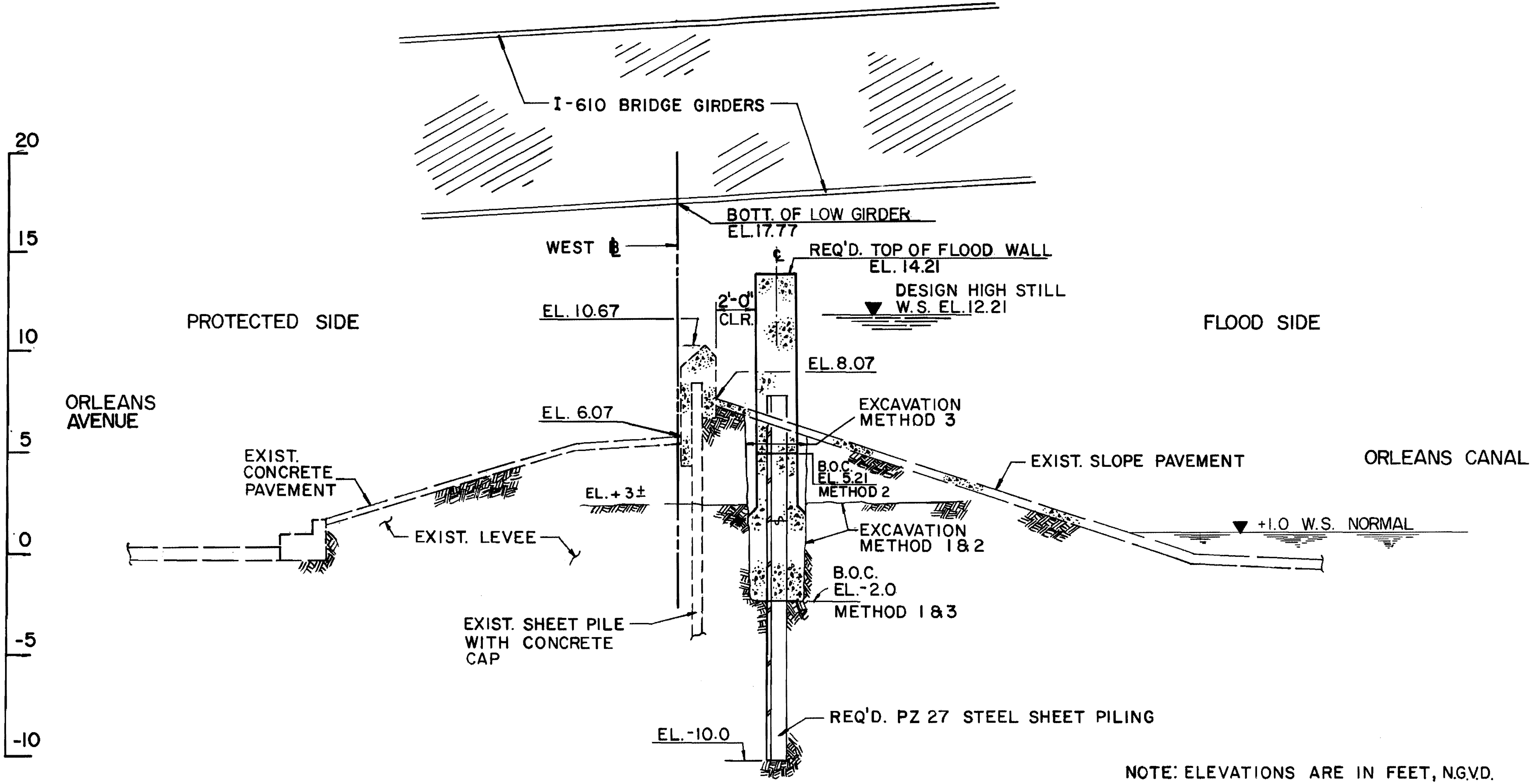
A. Modification at I-610 Bridge

The I-610 Interstate Highway bridge crossing the Orleans Canal near Pumping Station No. 7 (Sta 2+99.5) has a minimum bottom of girder elevation of +16.86 NGVD. This elevation is about 2.5 feet above the required top of floodwall at this location. The existing floodwalls have a top elevation of about EL +10.6, which is lower than required by about 3.5 feet. Therefore, a new sheet pile with a new top floodwall elevation of +14.21 NGVD is proposed. (See Figure 15.) Fortunately, the bridge does not have to be modified in any way since it clears the top of the new floodwall.

The installation of new steel sheet pile for the floodwall cannot be done with conventional driving equipment and is a difficult construction item due to the limited "headroom". There are actually two separate headroom problems. One is to find a crane which can operate in the limited clearance (about 16 feet) under the I-610 bridge at Orleans Avenue and at Marconi Drive and also reach the 40-45 foot distance required to install the wall. The other problem is to install the floodwall with only 2.5 feet of clearance between the top of the proposed wall and the bottom of the low bridge girder.

There is agreement among local contractors that, although difficult, this work can be done. A small "cherry picker" type hydraulic crane will meet the necessary clearance requirements and can reach the required distance. This crane will have only one work line, which means each activity must be done with the one line in lieu of the two normally available. Also, the minimum head room for driving sheet pile using a small hammer is about 7 feet, therefore, a concrete I-wall upper section must be used.

Three possible methods of installing the floodwall are described below. Method 1 is the "excavation method". The entire top of the levee, about 25 feet in width and 110 feet in length, is excavated and the existing wall is removed. This platform type excavation is carried from the present elevation of +8 down to EL+3.0 NGVD. Then a five foot deep by two foot wide trench will be



WEST LEVEE ELEVATION AT I-610 BRIDGE

SCALE: 1" = 5'

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FIGURE 15

MODIFICATION AT I-610 BRIDGE
STA. 2+99.50

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excavated to EL-2.0 NGVD along the floodwall alignment. Twelve-foot long sections of PZ27 are then lowered into the trench and driven to tip EL-10.0 NGVD using a small drop or vibratory hammer. After completion of driving of the entire under-bridge area, a reinforced concrete I-wall about 16 feet deep is constructed from EL-2.0 to EL +14.21 NGVD. The area is then backfilled roughly to its original shape, leaving approximately 6 feet of I-wall projecting. With the levee excavated, a temporary measure will be required to maintain flood protection in the event of high water. Sand bags stacked on the platform type excavation from EL+3.0 to +8.0 NGVD is one type of temporary protection.

Method 2 is the "splice method". It is similar to Method 1, except that 6-foot long PZ27 sections are butt-welded to the driven sections. This brings the top of the steel sheet piling up to EL+8.0 NGVD. A shorter 9-foot high reinforced concrete I-wall is then constructed.

Method 3 is the "slide and drive" method. A narrow two foot wide trench is excavated down to EL-2.0 NGVD beneath the entire bridge width and extended several feet beyond on one side. Twelve-foot long sections of PZ27 are then lowered into the trench at the one side and slid under the bridge one pile at a time as subsequent sections are interlocked and lowered into the trench. When the entire string in in proper horizontal alignment, a small drop hammer is used to drive the sheets to EL-10.0. A 16 foot deep reinforced concrete I-wall is then constructed from EL-2.0 to EL+14.21 as in Method 1. Since the levee is not excavated, a temporary flood protection measure is not required. (See Figure 15.)

The Contractor should be given the option to choose his preferred installation method for this portion of the work. The preliminary cost estimate used in the tabulation is based on Method 2 and assumes an installed cost of steel sheet piling three times the cost of conventional construction.

Substantial cost savings can be obtained if the existing sheet pile wall could be utilized. Details of its construction will be investigated in the design phase to see if it could be reused.

B. Modification at 30" Waterline

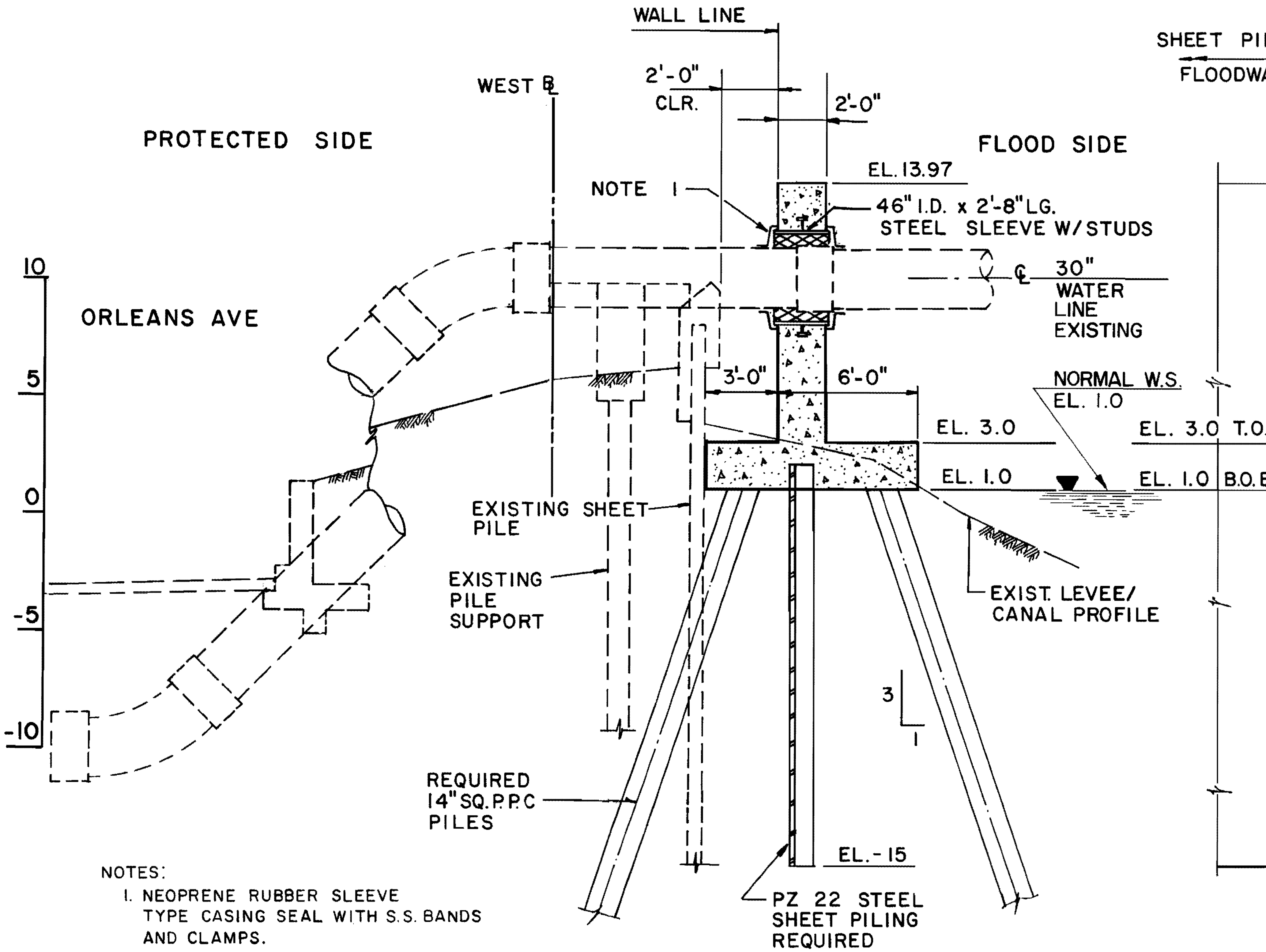
The 30-inch diameter steel water pipeline crossing the canal at Station 44+44 is about 4 feet below the level of protection required at this location. In order to provide the required protection and to prevent any damage to the waterline, pile supported T-walls with top at the required level of protection are proposed on both the east and west levees. The pipeline will pass through an oversized steel sleeve cast in the T-wall. The annular opening between the pipeline and the sleeve will be closed with neoprene rubber sleeve-type casing seals and packed with plastic sealant allowing independent movement of the pipeline. (See Figure 16.)

C. Modification at Gernon Brown Memorial Recreation Building

The gymnasium and recreation building located north of Harrison Avenue near Sta. 39+00 is close to the the existing levee toe. To avoid interference with the building and associated walk space and parking area, a floodwall along the existing levee crown rather than additional earthen fill is recommended to raise the level of protection in this reach. The sheet pile floodwall will provide the increased flood protection and will not interfere with the building.

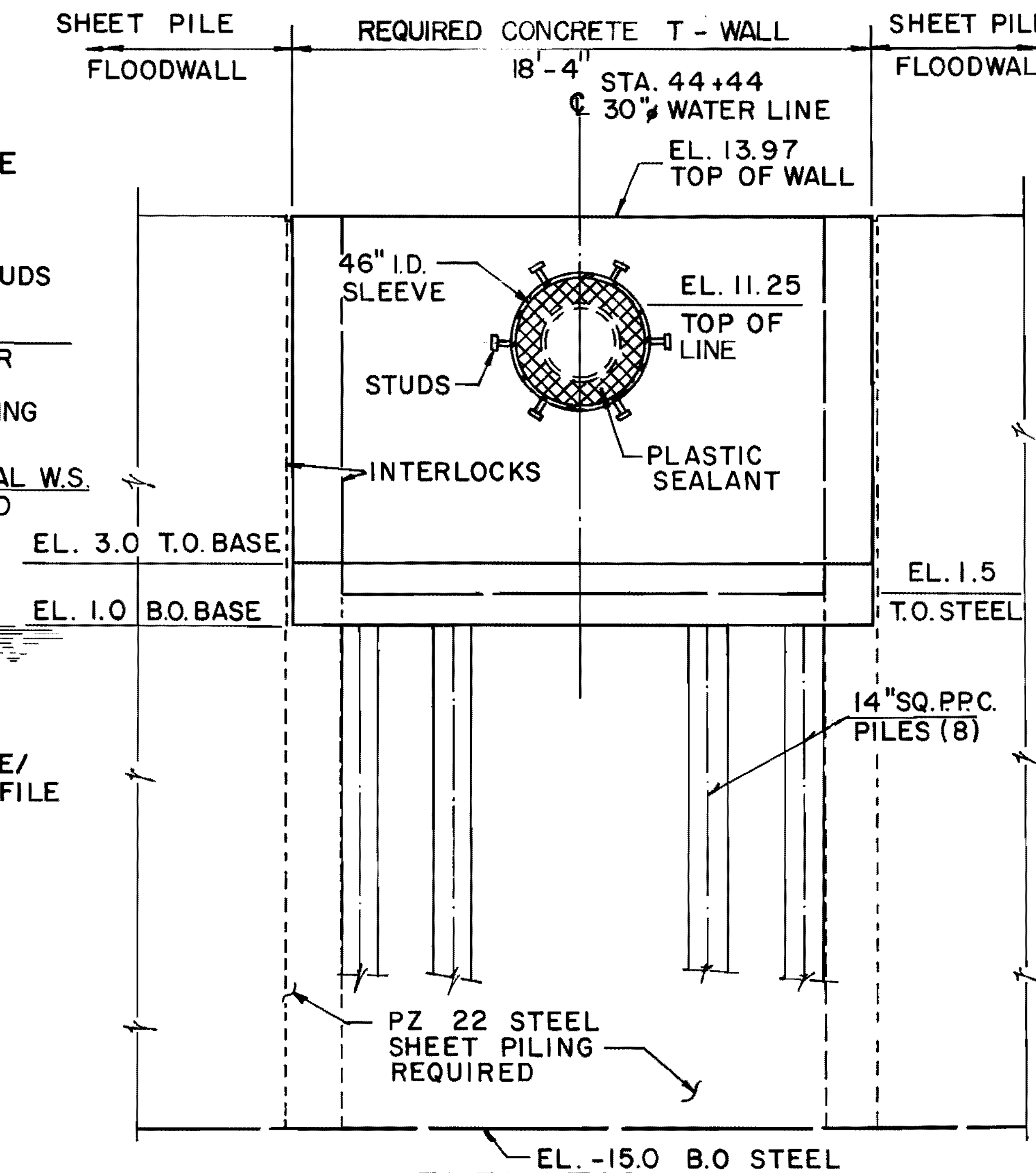
This wall would project only about 4.5 feet above the existing levee crown. A wall of this type would cost about $150 per linear foot for light-weight, coated steel sheet piling and $100 per linear foot for the concrete I-wall upper section. No additional earthen fill would be required with this solution. (See Figure 17 for the proposed modification at Gernon Brown Memorial Building.)

The cost is based on the I-wall along the crown of the levee and has been included in Reach E-3 of the Typical Levee Modifications.



NOTES:
1. NEOPRENE RUBBER SLEEVE TYPE CASING SEAL WITH S.S. BANDS AND CLAMPS.
2. ELEVATIONS ARE IN FEET, N.G.V.D.

WEST LEVEE SECTION AT 30" DIA. WATER LINE
SCALE: 1"= 5'



ELEVATION
SCALE: 1"= 5'

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FIGURE 16

MODIFICATION AT 30" DIA. WATER LINE
STA. 44+44

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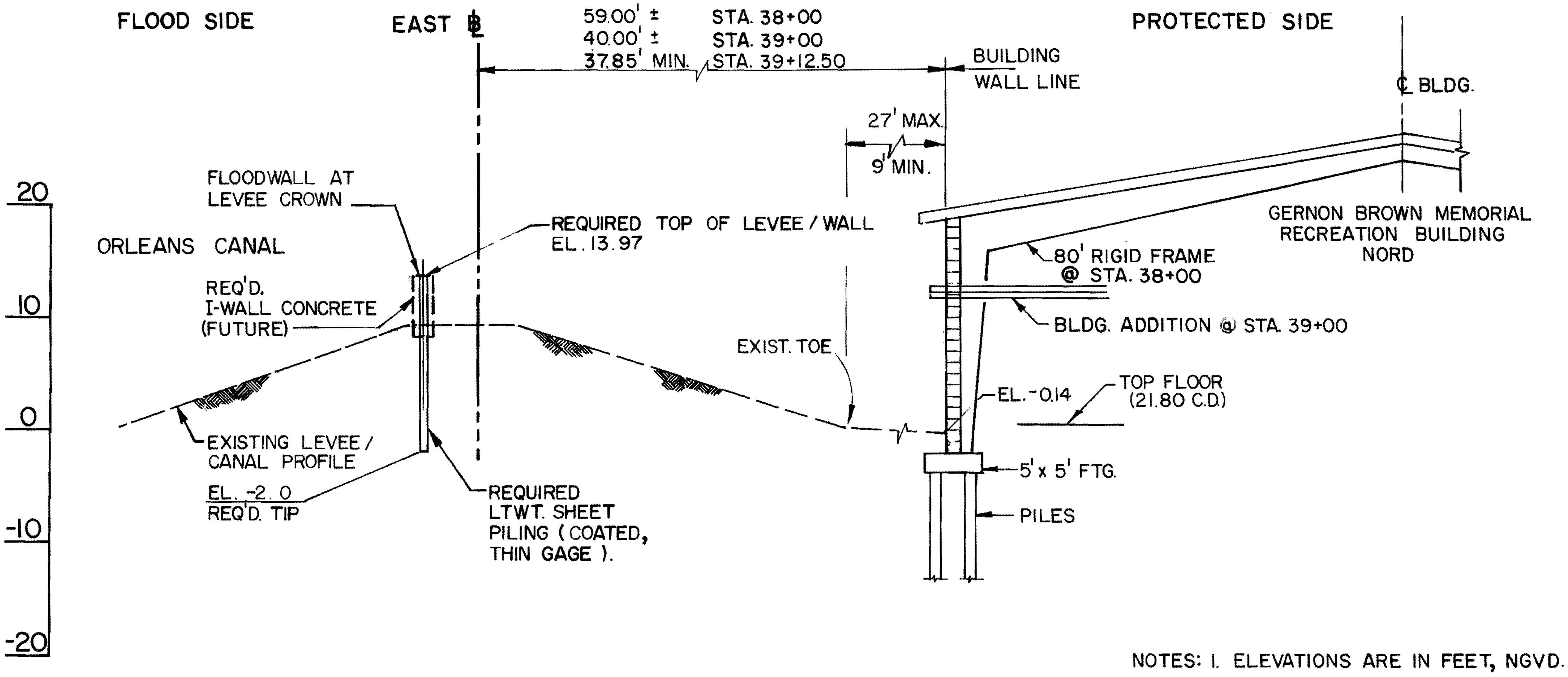

NOTES: 1. ELEVATIONS ARE IN FEET, NGVD.

EAST LEVEE ELEVATION AT GERNON BROWN MEMORIAL BUILDING

SCALE – 1" = 10'

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FIGURE 17

MODIFICATION AT G. BROWN MEMORIAL BUILDING STA. 39+00

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D. Modification at Electric Vault Buildings

There are five large electric transformer vaults housed in 12'x16' brick enclosures near the existing east levee toe between Robert E. Lee Boulevard and Lakeshore Drive (Sta. 100+00 to 125+00). These electrical vaults are located from 10' to 36' distance from the top of the east levee crown. A sixth vault is located 119'off of the levee crown and should not be affected by the levee construction. (See Plan and Profile Sheets 8 and 10 in Appendix.)

The two vaults nearest the lake are within the levee reach proposed to be raised to EL+18.00 NGVD. The remaining three vaults are in the zone where the levee is to be raised to EL 13.6 NGVD. The close proximity of the levee to these vaults indicates they will all have to be relocated when the levee is raised, if the earthen fill alternative is selected.

Contact has been made with New Orleans Public Service, Inc., the owners of the vaults. They have supplied drawings descriptive of the vaults. They estimate relocation costs to be $30-40,000 per vault plus conduit relocation of $250 per foot with 100-foot minimum. We have approximated the relocation cost to be $60,000 per vault for budget purposes.

There would be a substantial savings if any of the vaults did not require relocation. A change of levee alignment wherein the existing landside toe was maintained and the canal side toe was shifted towards the center of the canal when the levee was raised may avoid the vault relocation requirement. A minimum canal cross-section must be maintained, but the meandering courses of both of the levees in this reach does indicate some shifting would be acceptable.

The adoption of the alternative of a floodwall at the crown of the existing levee for this reach of modification would nullify the need for relocation of the vaults.

E. Modification at Pumping Station No. 7 (Interim)

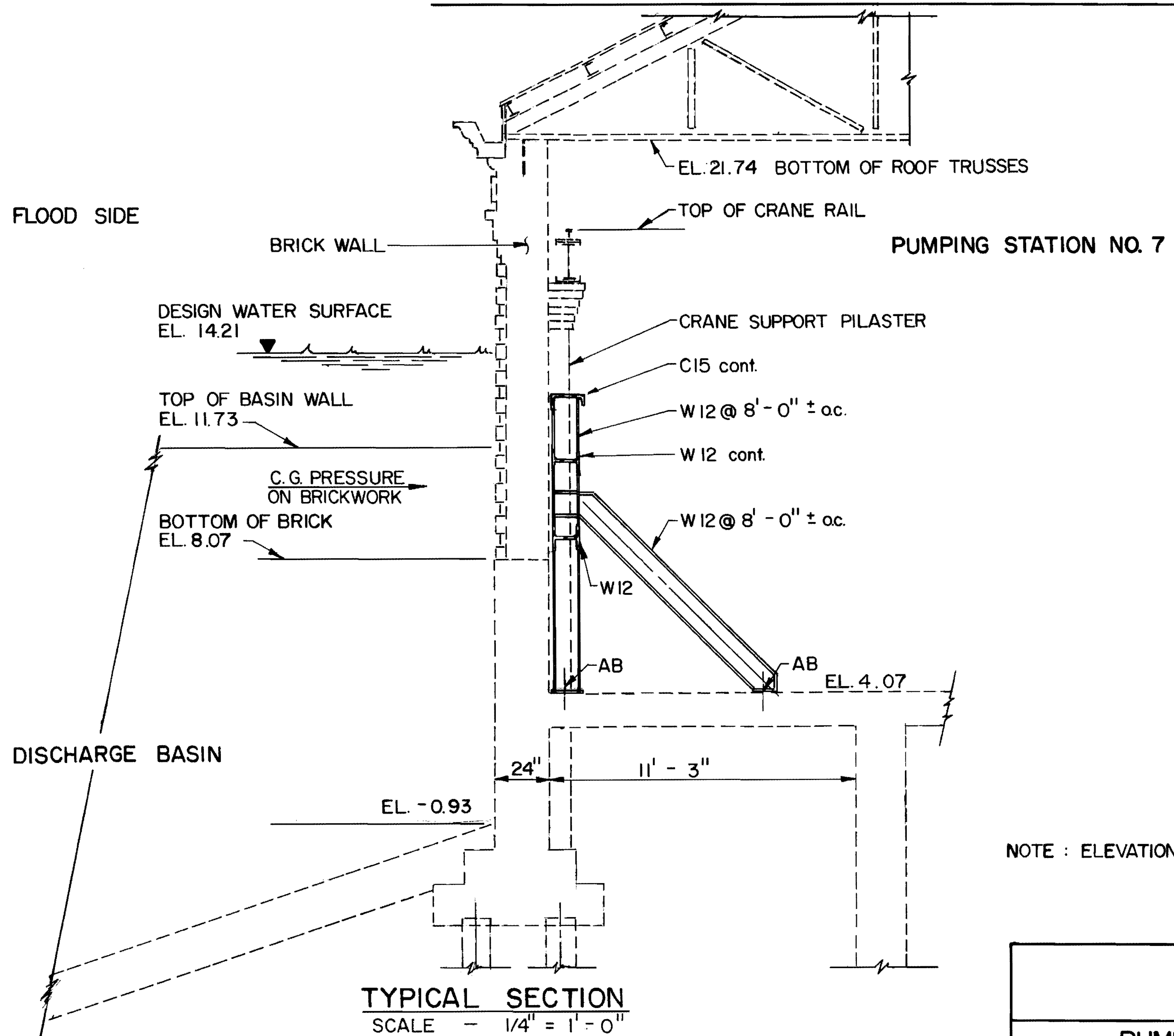
The required interim levee system modifications at the pumping station consist of raising the level of protection of the discharge basin sheet pile/concrete cap walls and the reinforced concrete walls abutting the pumping station building, as well as insuring that the strength of the building's brick wall facing the canal is sufficient to resist flood loads.

The existing discharge basin sheet pile/concrete cap walls have a top elevation of +10.63 NGVD on the east and +10.57 NGVD on the west side. These existing basin walls between the I-610 Bridge and the Pumping Station structure are about 3'-8" below the required flood protection level of EL+14.21 NGVD. Therefore, new sheet pile walls with a top elevation of +14.21 NGVD are proposed.

The existing reinforced concrete walls abutting the pumping station building have a top elevation of +11.59 NGVD on the east side and +12.03 NGVD on the west side. These walls are about 2'-7" maximum below the required level of EL+14.21 NGVD. Therefore, cast-in-place concrete extensions to the walls are proposed with a top elevation of +14.21 NGVD. Holes for grouting in reinforcing steel dowels will be drilled into the existing top of the walls. An epoxy coating will be applied to the surface of the existing top of wall concrete to assure bond to new concrete. If necessary, neoprene rubber waterstops can be used between the existing top of wall concrete and the new wall extension concrete to assure watertightness.

The brick walls of the pumping station have a bottom elevation of +6.90 NGVD. This is 7.31 feet below the required level of protection. Therefore, the walls must withstand the hydrostatic pressure of 7.31 feet of water. The existing brick wall has no windows or other openings (the window openings were filled with brickwork under a previous Sewerage and Water Board contract). The brickwork is approximately 2 feet thick. With the brick wall "spanning" to the roof trusses at elevation EL 20.58 NGVD the maximum tension stress in the brick work will be 27 psi under the required hydrostatic load. The weight of brick above the point of maximum wall tension imposes a compression stress of only 8 psi; therefore, there will be tension stress in the brickwork. Since the brickwork cannot, for design purposes, be relied upon under tension stress, a strengthening steel grillage is proposed. (See Figure 18.)

In order to provide the required hydrostatic load capacity the Sewerage and Water Board has proposed a new exterior floodwall to be added along the building wall facing the canal. This new



TYPICAL SECTION
SCALE – 1/4" = 1'-0"

NOTE : ELEVATIONS IN FEET, N.G.V.D.

PER DWG. 7209-W-9

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FIGURE 18

PUMPING STATION NO. 7
BRICK WALL REINFORCEMENT

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floodwall would be constructed in the center portion of the building length a short distance away from the brickwall in conjunction with proposed new discharge piping. There is a similiar floodwall at the 17th Street Canal Pumping Station. If this wall is constructed some of the strengthening steel grillage proposed above could be omitted.

F. Back Flow Prevention at Pumping Station No. 7 (Interim)

The three existing large (14-foot diameter) horizontal drainage pumps and related discharge pipes at Pumping Station No. 7 present a possible pathway for high water in the Orleans Canal to backflow through the pumping station and cause flooding of the surrounding area. However, even though this backflow pathway exists, backflow could occur only if the pumps were non-operative.

The Sewerage and Water Board of New Orleans has installed a backflow suppression system to prevent backflow occurrence. It is an air pressure injection system. This system is capable of raising the air pressure in the empty upper loop of the discharge pipe and pump casing to a value greater than the hydrostatic head pressure developed by design high water levels.

The air pressure injection system requires a reservoir of water to be in the suction basin to be operational. Except for the need of the reservoir of water in the suction basin, this system is highly reliable as a backflow preventer, and the Sewerage and Water Board is very confident in the operation of this system.

The Sewerage and Water Board has also installed a pump impeller stop mechanism that will provide a resistance to backflow and the discharge pipes have vacuum breakers to prevent syphon effects.

G. Modification at Drainage Syphon

The large drainage syphon structure built underneath the canal bottom about forty feet north of the bridge at Robert E. Lee Boulevard must be given special consideration to integrate it into the protection improvement project. The concrete box syphon is approximately 12'-6" wide by 10'-0" deep and has a top elevation of -4.0 NGVD as it crosses the crown of the existing levees. Steel sheet piling are cast into the sides of the concrete structure and project out from the concrete a short distance. These sheet pilings are installed near the access manways at the crown of the existing levees and act as cut-off walls for the syphon.

To include this structure in the flood protection, it is proposed to extend the floodwall that is required for the Bridge Modification at Robert E. Lee Boulevard to connect with the existing sheet piling cast into the sides of the syphon concrete. The floodwall will then be further extended to tie into the earthen levees which are set back a considerable distance from the existing levees. (See Plan and Profile Sheet 7 in the Appendix.)

The cost of the improvement at the syphon has been included in the construction cost estimate for Typical Levee Improvements for Reaches E-6 and W-6.

H. Modification at Pumping Station No. 7 (Final)

In addition to the Interim Protection provided at Pumping Station No. 7 by discharge basin wall improvement, building wall reinforcement and backflow suppression system detailed in the preceding sections; more positive improvements that will meet the "creditable" criteria of the USCE are proposed for the "Final" flood protection improvements phase.

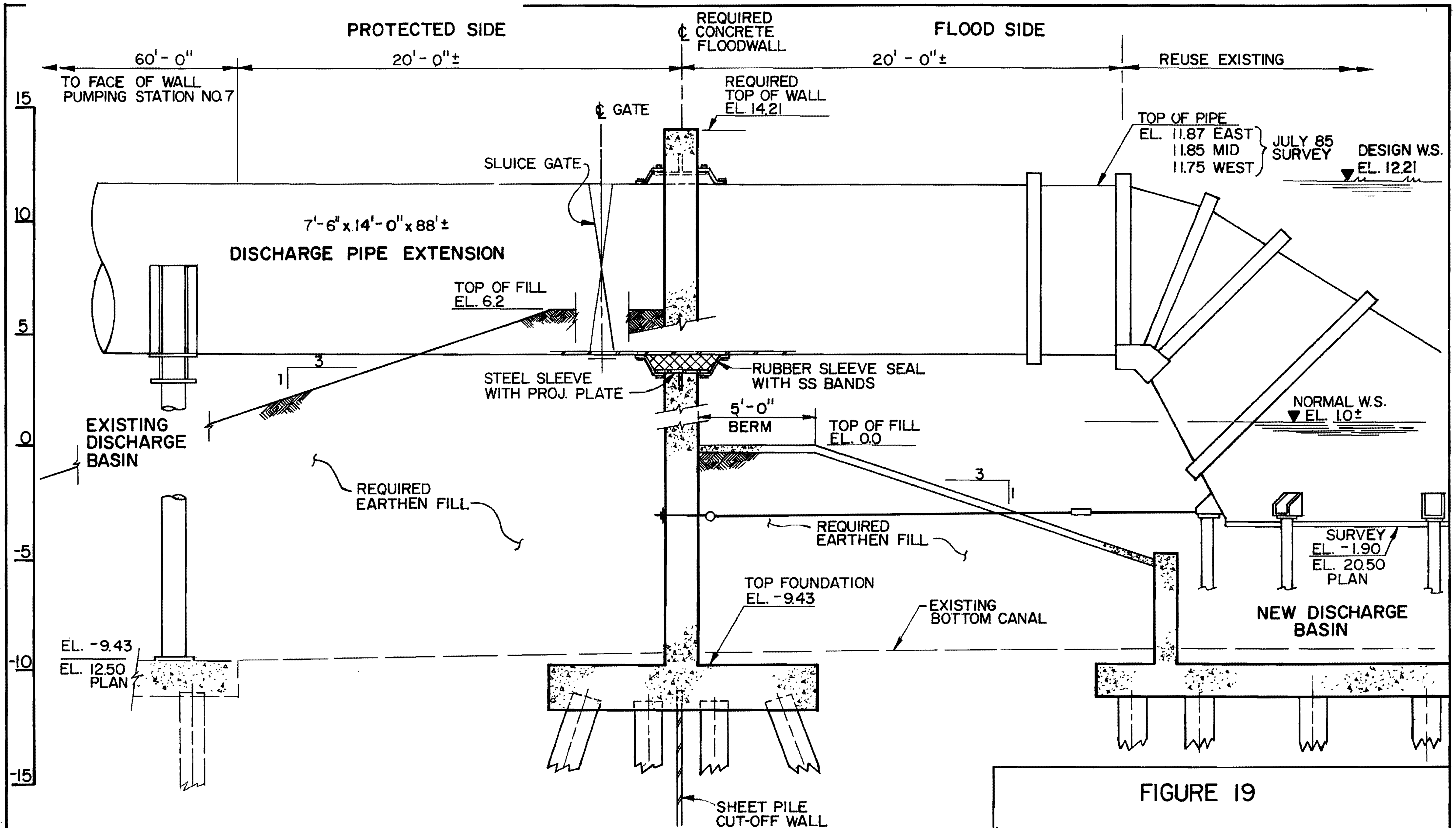
A floodwall/levee structure is proposed across the full width of the discharge basin about 80 feet north of the pumping station wall line. The three large discharge pipes will be extended and will pass through the floodwall/levee. The pipes will have closing sluice gates installed near the floodwall. With these additional constructions, positive flood protection and backflow prevention will be assured at the pumping station.

The floodwall/levee structure will consist of a pile- supported cantilevered, concrete floodwall with earthen fill on both the pumping station side and the canal or lake side. The height of fill on each side will be economically selected to best balance the forces on the concrete floodwall with design high water and design low water conditions. The length of the structure will be approximately 200 feet. The floodwall will have a top of concrete elevation of +14.21 NGVD, corresponding to the required level of protection needed at this location. The top of foundation for the floodwall will be at EL -9.43 NGVD which corresponds to top of concrete across the existing discharge basin. The floodwall will therefore have an overall height of 23.64 feet.

The characteristics of the large (14-foot diameter) drainage pumps will not allow raising of the discharge pipelines over the top of the floodwall/levee structure. Therefore the discharge pipes will be passed through the structure and sealed to the concrete portion to assure watertightness. Large sluice gates will be constructed a short distance from the floodwall on the pumping station side which will positively close the backflow path through the discharge pipelines should the need for this occur.

The design of the floodwall/levee structure and large sluice gates at the discharge pipelines is a complex undertaking and is beyond the scope of this report. For this report an outline sketch has been developed for the approximate cost estimate and concept discussion purposes. (See Figure 19.)

Anticipating the possible objection of the Sewerage and Water Board of New Orleans to the concept illustrated in Figure 19, another concept was developed and is illustrated in Figure 20. The estimated cost for either improvement appears to be nearly the same; therefore, regardless of which concept is finally accepted the magnitude of cost should remain the same.



TYPICAL SECTION
SCALE — 1/4" = 1'-0"

ELEVATIONS ARE IN FEET, N.G.V.D.

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FIGURE 19

MODIFICATION AT PUMPING STATION NO. 7 (FINAL) - OPTION 1

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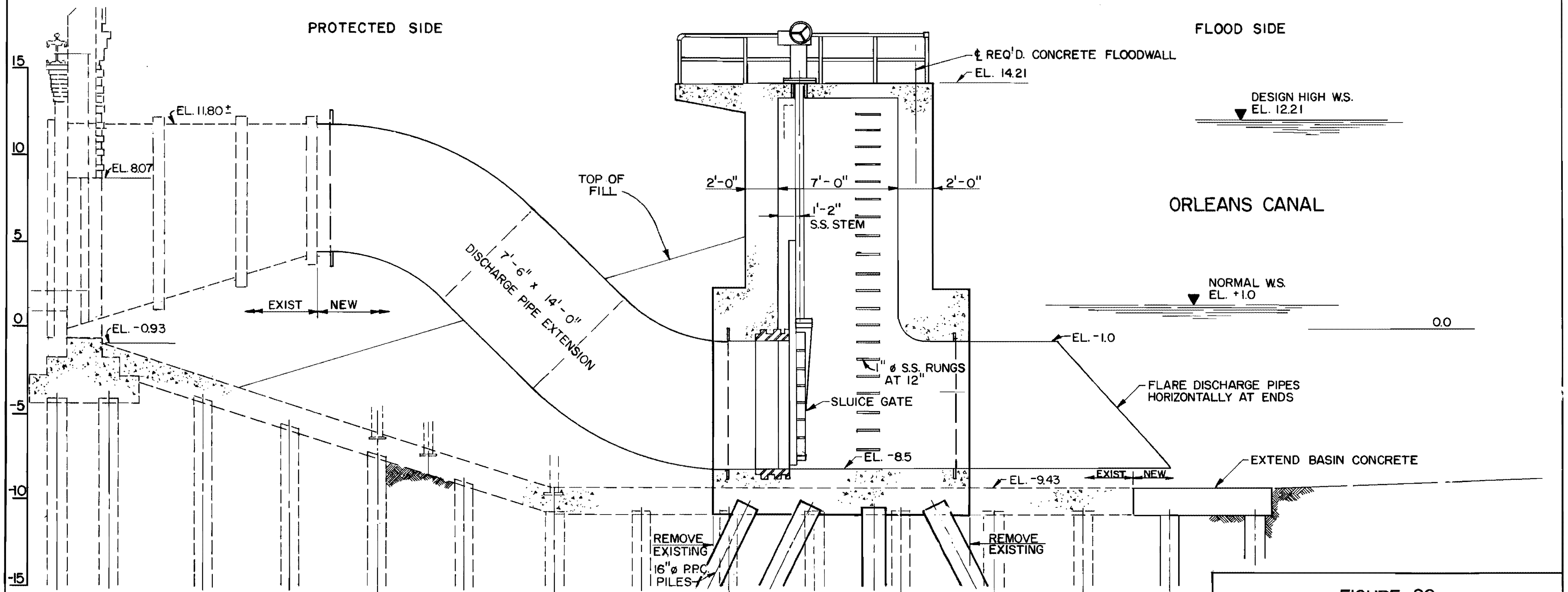

SECTION AT DISCHARGE PIPES WITH SLUICE GATE

ELEVATIONS ARE IN FEET, N.G.V.D.
REF. DWG. 7208-W-9

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FIGURE 20

MODIFICATION AT PUMPING STATION NO. 7 (FINAL) - OPTION 2

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TABLE VII-1

SPECIAL CONDITION MODIFICATIONS
CONSTRUCTION COST ESTIMATE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
I-610 BRIDGE; STA 2+99.50 (220 L.F.)				
Trench + Grout	CY	400	100	40,000
Floodwall Sheet Piling (PZ27 X 18 ft. lg.)	LF	220	810	178,000
Concrete I-Wall (2' X 9' X 220')	CY	147	300	44,000
Subtotal	(LF)	(220)	(1,190)	$262,000
30" DIAMETER WATERLINE; STA 44+44 (36.7 L.F.)				
Piles - 14" sq. PPC (40 ft. lg. at 15T)	EA	16	500	8,000
Concrete T-Wall Bases (2' X 9' X 18'-4" lg.)	CY	25	200	5,000
Concrete T-Wall Walls (2' X 11' X 18'-4" lg.)	CY	30	350	10,500
Sheet Piling (PZ22 X 17 ft. lg.)	LF	37	250	9,250
Sleeves and Seals (48" Dia.)	EA	2	500	1,000
Subtotal	(LF)	(36.7)	(920)	$33,750
GERNON BROWN MEMORIAL RECREATION BLDG. (NORD); STA 39+00 (290 L.F.) (Included in Reach E-2)				
ELECTRIC VAULTS (NOPSI); STAS 100+00 to 125+00 (1300 L.F.)				
Relocation of Vaults (NOPSI Estimate)	EA	5	35,000	175,000
Conduit Relocation	LF	500	250	125,000
Subtotal	(LF)	(1,300)	(230)	$300,000

TABLE VII-1 - (continued)

SPECIAL CONDITION MODIFICATIONS
CONSTRUCTION COST ESTIMATE

ITEMS	UNIT	QUANTITY	UNIT PRICE	AMOUNT
PUMPING STATION NO. 7 (INTERIM); STAS 1+52.50 TO 2+44.50 (184 L.F.)				
Brick Wall Reinforcment (Steel Grillage)	LF	160	100	16,000
Sheet Piling (PZ27 X 30 lg.)	LF	180	450	81,000
Concrete I-Wall (2' X 9'-6 high)	LF	180	285	Future
Concrete Wall Extension (EL 11.63/12.03 to 14.21)	LF	76	60	4,500
Subtotal w/o Concrete I-Wall	(LF)	(184)	(552)	$101,500
Concrete I-Wall (2' x 9'-6" high) (Final)	LF	180	285	$ 51,300
Subtotal with Concrete I-Wall	(LF)	(184)	(830)	$152,800
EROSION WALLS NEAR LAKE; STAS 123+00 TO 128+70				
- Erosions Walls to Remain in Place, see "Lakefront Approach Levees"-				
DRAINAGE SYPHON; STA 90+60				
- Drainage Syphon tie-in cost included in Levee Reach E-6 and W-6 -				
MODIFICATION AT PUMPING STATION NO 7 (FINAL)				
Floodwall	LF	160		402,000
Sluice Gates	EA	3	100,000	300,000
		SUBTOTAL		$702,000±

CHAPTER VIII

Recommendations and Estimated Cost Summary

VIII. RECOMMENDATIONS AND ESTIMATED COST SUMMARY

A. Recommendations

From the engineering study performed during the development of this Design Memorandum, the following major construction recommendations are made to provide flood protection along the Orleans Avenue Canal required by the USCE High Level Plan.

1. Typical Levee - Floodwall Modifications:

   a. A new sheet pile floodwall should be constructed on the westside of the Orleans Avenue Canal between Pumping Station No. 7 and Robert E. Lee Blvd. (Reaches W-1 through W-5). This new wall should be installed on the canal side of the existing wall. The cost of installing this wall is estimated to be $6,335,000.

   b. The concrete I-wall upper section of the new westside floodwall ("Final" protection improvements) should be omitted from the initial phase of construction to reduce the project cost of Interim Protection. The cost to install the concrete I-wall is estimated to be $2,636,000.

   c. A new floodwall at the crown of the existing levee should be used on the eastside levee of Orleans Avenue Canal to raise the existing levee to the new required elevations from Pumping Station No. 7 to Robert E. Lee Blvd. (Reaches E-1 through E-5). The cost for this construction is estimated to be $1,250,000.

   d. The concrete I-wall upper section of the new eastside floodwall ("Final" protectionl improvements) should be omitted from the first phase of construction to reduce the cost of Interim Protection. The cost to install the concrete I-wall is estimated to be $833,000.

e. Additional earthen fill should be used on the westside levee to raise the existing levees from Robert E. Lee Blvd. to Sta. 118+00. (Reach W-6.) The cost for this construction is estimated to be $662,000.

f. A floodwall at the crown of the existing levee should be used on the eastside levee from Robert E. Lee Blvd. to Sta. 118+00. (Reach 6.) The cost for this construction, including the concrete I-wall, is estimated to be $636,000.

g. Additional earthen fill should be used on the westside to raise the existing levees to the required storm wave freeboard levels from Sta. 118+00 to Sta. 125+00. (Reach W-7.) The cost for this construction is estimated to be $131,000.

h. A floodwall at the crown of the existing levee should be used on the eastside from Sta. 118+00 to Sta. 128+00. (Reach E-7.) The cost for this construction, including the concrete I-wall, is estimated to be $948,000.

i. Study should be undertaken in the Final Design Phase to reduce the area of land required for additional fill by aligning the levees closer to the center of the canal in Reach W-6 (Robert E. Lee Blvd. to Sta. 118+00).

j. The levees/floodwalls near the lake, Reaches E-7 and W-7, subject to the higher storm wave freeboard should be constructed as soon as possible because the elevations of the existing protection are more deficient than are the levees and floodwalls in other reaches. The existing levees near the lake vary from 7.0 feet to 5.0 feet below the level recommended by USCE.

2. Bridge Modifications:

a. The Seal Joints, Walls and Anchors alternative should be used at the Harrison Avenue, Filmore Avenue and Robert E. Blvd. crossings to provide the required flood protection. The construction cost is estimated to be $317,000, $538,000, $645,000 for Harrison Avenue, Filmore Avenue and Robert E. Lee Boulevard respectively.

b. The Bridge Modifications should be constructed as soon as possible because the elevations of the existing level of protection at the crossings vary from 4.50 feet to 2.50 feet lower than the adjacent existing levees along the canal and vary from 8.5 feet to 6.5 feet below the level recommended by the USCE.

B. Estimated Project Cost Summary

The Estimated Project Cost includes the general item costs of mobilization/demobilization of contractor's equipment, a 15% contingency added to the estimated construction cost to provide an allowance for items not included in the estimate, and the professional service fees of engineering, material testing, surveying and resident inspection engineer plus geotechnical or soil engineering services. With the addition of these general item costs to the estimated construction costs the all-inclusive or estimated total project costs are obtained. These total project costs can be used to budget funds from the financing available with good assurance that allocated amounts will be adequate to complete the entire amount of work in a phase of the project.

The Estimated Project Cost Summary for the Orleans Avenue Canal - Flood Protection Improvement Project has been broken into three separate phases consistent with the variable existing deficiency of the system, the financing available and the actual increase in level of flood protection that is achieved by the various proposed improvements.

Phase I - Interim Protection includes upgrading of the most deficient portions of the levee system in harmony with the Recommendations Section. This phase includes the improvement of levees nearest to the Lake (north of Robert E. Lee Boulevard), which are subject to the higher level of flood water caused by storm waves; and the Bridge Modifications, which have a level of protection from 4.5 to 2.5 feet lower than the existing adjacent levee/floodwall system. The total project cost for this construction is estimated to be $4,815,000. The relocation cost of moving the five existing electric vaults near the east levee in Reaches E-6 and E-7 has been omitted from the estimated amount since relocation is not required with the floodwall alternative.

Phase II - Interim Protection includes upgrading the entire remaining system not included in Phase I. Namely, this phase includes the new floodwall sheet piling on both the east and west sides of the canal from Robert E. Lee Boulevard south to Pumping Station No. 7; the Special Conditions encountered at the I-610 bridge and the 30" diameter waterline; the interim improvements at Pumping Station No. 7; and, the relocation of existing overhead electric distribution lines which will be required for driving of steel sheet piling. The total project cost for this construction is estimated to be $10,526,000.

The Final Protection phase includes items required by the USCE for corrosion protection, appearance improvement, or achievement of a higher degree of reliability than that required by OLB parameters. These items include installation of the concrete I-walls on the new floodwall sheet piling along both the east and west sides of the canal from Robert E. Lee Boulevard south to Pumping Station No. 7 and the Floodwall and Sluice Gates comprising the Final Modification at Pumping Station No. 7. The total project cost for this construction is estimated to be $5,375,000.

The total project cost for both Phase I and Phase II - Interim Protection is $15,342,000. The total project cost of the Orleans Avenue Canal - Flood Protection Improvement Project, including the Final Protection measures, is $20,717,000. The Estimated Property Credit based on the "footprint" of the existing levee is $4,454,000 based on 1,272,600 square feet of right-of-way at $3.50 per square foot acquisition cost. Therefore, the Grand Total Cost, including Land Acquisition, is $25,171,000. See Table VIII-1 for complete tabulation of Project Costs.

TABLE VIII - 1

SCHEDULE OF ESTIMATED PROJECT COST (PHASE CONSTRUCTION)

ORLEANS AVENUE CANAL--FLOOD PROTECTION IMPROVEMENT PROJECT

DESCRIPTION	COST	EXTENSION
PHASE I - INTERIM PROTECTION		
MOBILIZATION/DEMOBILIZATION	$35,000	
		$35,000
LEVEE-FLOODWALL:		
REACH E-6 (INCLUDING CONC. "I"-WALL)	$636,000	
REACH E-7 (INCLUDING CONC. "I"-WALL)	$948,000	
REACH W-6	$691,000	
REACH W-7	$131,000	
		$2,406,000
BRIDGE MODIFICATIONS (INCLUDES CONTINGENCY):		
HARRISON AVENUE	$317,000	
FILMORE AVENUE	$538,000	
ROBERT E. LEE BLVD.	$645,000	
		$1,500,000
ESTIMATED CONSTRUCTION COST	$3,941,000	$3,941,000
CONTINGENCY (15% EXC. BRIDGE MODIFICATION)	$366,000	
CONSTRUCTION SUBTOTAL		$4,307,000
ENGINEERING--INCL. DESIGN MEMO. (6.5%)	$280,000	
TESTING (1.0%)	$43,000	
SURVEYING (1.5%)	$64,600	
INSPECTION (2.5%)	$107,700	
GEOTECHNICAL ENGINEERING SERVICES (1.0%)	$43,000	
		$538,300
TOTAL PROJECT COST: PHASE I - INTERIM PROTECTION		$4,845,300

TABLE VIII - 1

SCHEDULE OF ESTIMATED PROJECT COST (PHASE CONSTRUCTION)

ORLEANS AVENUE CANAL--FLOOD PROTECTION IMPROVEMENT PROJECT

DESCRIPTION		COST	EXTENSION
PHASE II - INTERIM PROTECTION			
MOBILIZATION / DEMOBILIZATION		$55,000	
			$55,000
LEVEE - FLOODWALL:	REACH W-1 TO W-5	$6,335,000	
	REACH E-1 TO E-5	$1,250,000	
			$7,585,000
SPECIAL CONDITIONS:	I-610 BRIDGE	$262,000	
	30" WATER LINE	$34,000	
	OVERHEAD ELECTRIC LINES	$150,000	
	P.S. NO. 7 WALLS(INTERIM)	$102,000	
			$548,000
ESTIMATED CONSTRUCTION COST		$8,188,000	$8,188,000
CONTINGENCY (15.0%)		$1,228,200	
CONSTRUCTION SUBTOTAL			$9,416,200
ENGINEERING--INCL. DESIGN MEMO. (6.5%)		$612,000	
TESTING (1.0%)		$94,000	
SURVEYING (1.5%)		$141,000	
INSPECTION (2.5%)		$235,400	
GEOTECHNICAL ENGINEERING SERVICES (1.0%)		$94,000	
			$1,176,400
TOTAL PROJECT COST: PHASE II - INTERIM PROTECTION			$10,592,600

SUMMARY OF ESTIMATED INTERIM PROTECTION PROJECT COST

TOTAL PROJECT COST: PHASE I - INTERIM PROTECTION	$4,845,300
TOTAL PROJECT COST: PHASE II - INTERIM PROTECTION	$10,592,600
TOTAL PROJECT COST: INTERIM PROTECTION	$15,437,900

TABLE VIII - 1

SCHEDULE OF ESTIMATED PROJECT COST (PHASE CONSTRUCTION)

ORLEANS AVENUE CANAL--FLOOD PROTECTION IMPROVEMENT PROJECT

DESCRIPTION			COST	EXTENSION
FINAL PROTECTION (AS REQ'D. FOR USCE APPROVAL)				
MOBILIZATION / DEMOBILIZATION			$10,000	
				$10,000
CONCRETE I-WALLS:	REACH W-1 TO W-5		$2,636,000	
	REACH E-1 TO E-5		$833,000	
	PUMPING STATION NO. 7	**	(51,000)	
				$3,469,000
P.S. NO. 7 MODIFICATIONS(FINAL):				
FLOODWALL			$402,000	
BACKFLOW PREVENTION			$300,000	
				$702,000
ESTIMATED CONSTRUCTION COSTS			$4,181,000	$4,181,000
CONTINGENCY (15.0%)			$627,200	
				$4,808,200
ENGINEERING--INCL. DESIGN MEMO. (6.5%)			$312,500	
TESTING (1.0%)			$48,000	
SURVEYING (1.5%)			$72,000	
INSPECTION (2.5%)			$120,200	
GEOTECHNICAL ENGINEERING SERVICES (1.0%)			$48,000	
				$600,700
TOTAL PROJECT COST: FINAL PROTECTION				$5,408,900

SUMMARY OF ESTIMATED TOTAL PROTECTION PROJECT COST

TOTAL: PHASE I - INTERIM PROTECTION	$4,845,300
TOTAL: PHASE II - INTERIM PROTECTION	$10,592,600
TOTAL: FINAL PROTECTION	$5,408,900
TOTAL PROJECT COST: ORLEANS AVENUE CANAL FLOOD PROTECTION IMPROVEMENT PROJECT	$20,846,800
ESTIMATED PROPERTY CREDIT	$4,454,000

** COST OF $51,000 FOR CONCRETE I-WALLS AT P.S. NO. 7 NOT APPLICABLE, IF FLOODWALL BUILT.

CHAPTER IX

Schedule of Construction and Design

IX. SCHEDULE OF CONSTRUCTION AND DESIGN

The Schedule of Construction and Design presents a logical sequence and time frame for accomplishing the major tasks in the Orleans Avenue Canal - Flood Protection Improvement Project. In conformance with the Recommendations section, the construction of improvements to the protection system which are most seriously deficient are included in the first construction contract. The construction of improvements which are less deficient will be included in a following contract. The improvements which are required for USCE creditability and which do not raise the level of protection of the system are grouped for construction in the last contract. (See Figure 21.)

The division of the improvement tasks according to deficiency of segments was first presented in a letter to the Orleans Levee Board (OLB) from Design Engineering, Inc. on September 11, 1985. The matter was discussed and agreement reached in a meeting between OLB personnel and Design Engineering, Inc. on September 20, 1985. (See Appendix.)

Phase I - interim protection improvements include the levee segments north of Robert E. Lee Boulevard and the Bridge Modifications. Construction work on the levee segments and bridge modifications can proceed simultaneously. The work at the three individual bridge crossings will be phased to permit detour of traffic to adjacent bridges, thereby minimizing area-wide traffic disruption.

Final design of the construction plans, preparation of contract documents, advertising for and receiving bids and awarding of construction contract is anticipated to require sixteen months. Construction work is anticipated to require one year due to the necessity for phased construction of the bridge improvments.

Phase II - interim protection improvements include the levee segments south of Robert E. Lee Boulevard and three special condition modification improvements. The work on the east and west floodwalls can proceed simultaneously and the work at the three special condition locations can proceed in sequence. The much heavier and longer sheet piling used on the west floodwall will require the longest period of construction time. Work on the west floodwall will therefore be the critical time determinant. Relocation of the existing overhead electric distribution lines will have to be coordinated with sheet pile driving.

PREPARED BY: DESIGN ENGINEERING, INC.
DATE PREPARED: OCTOBER 1985

FIGURE 21
PROJECT SCHEDULE
ORLEANS AVENUE CANAL
FLOOD PROTECTION IMPROVEMENT PROJECT

TASK	APR-JUNE 1985	JULY-SEPT 1985	OCT-DEC 1985	JAN-MARCH 1986	APR-JUNE 1986	JULY-SEPT 1986	OCT-DEC 1986	JAN-MARCH 1987	APR-JUNE 1987	JULY-SEPT 1987	OCT-DEC 1987	JAN-MARCH 1988	APR-JUNE 1988	JULY-SEPT 1988	OCT-DEC 1988	JAN-MARCH 1989
STUDY ASSIGNMENTS																
AUTHORIZATION AND AGREEMENT	*															
DESIGN MEMORANDUM	)======	===========	=====)													
GEOTECHNICAL INVESTIGATION		)====)														
FIELD SURVEYS	)======	===)														
REVIEW BY O.L.B.			)++)													
REVIEW BY OTHER AGENCIES			)++ ++	+++++)												
PHASE I - INTERIM PROTECTION																
PRELIMINARY DESIGN			)=	===========	======+++)											
GEOTECHNICAL ANALYSIS					)==)											
FINAL DESIGN & SPECIFICATIONS					)=	===========	==========	==+++)								
ADVERTISE FOR & RECEIVE BIDS								)++)								
REVIEW BIDS & AWARD CONTRACT								)+	++)							
CONSTRUCTION:																
ELEC. VAULTS (5) RELOCATION								)========	=)							
LEVEES N. OF R.E. LEE BLVD.									)=======	===========	===)					
FILMORE AVE. CROSSING									)=======	===)						
DRAINAGE SYPHON										)=====)						
R.E. LEE BLVD. CROSSING										)===	==========)					
HARRISON AVE. CROSSING												)======	===)			
CLEAN-UP										)=)	)=)	)=)	)=)			
PHASE II - INTERIM PROTECTION																
PRELIMINARY DESIGN					)===	==========	==========	====+++)								
GEOTECHNICAL ANALYSIS							)=	====)								
FINAL DESIGN & SPECIFICATIONS								)===	==========	=======+++)						
DESIGN FINAL PROTECTION ALTS.									)=====	==========	===+++)					
ADVERTISE FOR & RECEIVE BIDS											)++)					
REVIEW BIDS & AWARD CONTRACT												)++)				
CONSTRUCTION:																
WEST FLOODWALL												)=====	==========	==========	==========	===)
EAST FLOODWALL													)=	==========	==========)	
O.H. LINES (7) RELOCATION												)==	==========	==========	==========	=)
SPECIAL CONDITIONS (3)												)=====	==========	==========	===)	
FINAL PROTECT. ALTERNATIVES														)------	----------	-----)
CLEAN-UP/PVMT. REPAIR															)==)	)==))--)
FINAL PROTECTION(IF SEPARATE BID)																
CONTRACT DOCUMENTS													)======)			
ADVERTISE FOR & RECEIVE BIDS														)++)		
REVIEW BIDS & AWARD CONTRACT														)++)		
CONSTRUCTION:																
CONCRETE "I"-WALLS														)==	==========	==========)
FLOODWALL & GATES @ P.S. #7														)==	==========	==========)

LEGEND

)====)	WORK PERIODS
)++++)	REVIEW AND APPROVAL PERIODS
)----)	EARLY CONSTRUCTION OF FINAL PROTECTION ALTERNATIVES
)+)¦ ¦)=)	DEPENDANT ACTIVITIES

FIGURE 21

Construction equipment will be positioned on Orleans Avenue to drive sheet piling along the west floodwall. Segments of Orleans Avenue will be closed to traffic when work is proceeding adjacent to each segment. Damage to the pavement of Orleans Avenue is anticipated and repairs to the pavement will be made when work on the west floodwall is completed.

Final design, including Final Protection improvements, preparation of specifications, advertising for and receiving bids and awarding of constructing contract is anticipated to require twenty-two months. Construction work is anticipated to require one year and is governed by the time required to drive piling for the west floodwall.

Final Protection improvements include the concrete I-walls atop both the east and west floodwalls south of Robert E. Lee Boulevard and the modifications at Pumping Station No. 7 (Final). The final design of the Final Protection improvements will be performed concurrently with design of Phase II - Interim Protection. The Final Protection improvements will be included as alternates in the bid documents for Phase II - Interim Protection.

If funding is available, Final Protection improvements can then be awarded and completed with the Phase II - Interim Protection contract. There are some work items that will be reduced or eliminated from Phase II - Interim Protection if Final Protection improvements are constructed at the same time. The length of sheet piling can be reduced if the I-wall of Final Protection is constructed. Also the Interim modifications at Pumping Station No. 7 can be eliminated if Final Protection improvements are constructed. Total construction cost is therefore less if the Final Protection improvements are built with the Phase II - Interim Protection improvements.

If funding is not available, the Final Protection improvements will be advertised and bid when funding is available and constructed under a separate contract.

Assembly of separate contract documents, advertising and receiving bids and awarding of construction contract is anticipated to require four months. Construction work is anticipated to require seven months.

CHAPTER X

Additional Information Required

X. ADDITIONAL INFORMATION REQUIRED

This section lists the currently known additional information that will be required to complete the Final Design Phase of the Orleans Avenue Canal - Flood Protection Improvement Project.

Two geotechnical aspects, critical to this project, are currently being investigated. One is the seepage characteristics of the underlying sand strata; the other is the creditability of extending the steel sheet piling into the firm sand layer to improve the deep seated stability factor of safety of the west levee from Sta. 50+00 to Sta. 90+00. The results of both of these studies are required.

As the Design Memorandum was being developed several additional special conditions requiring geotechnical engineering analysis were noted. They are: the floodwall at Crystal Street, the floodwall at the crown of the west levee at the Fire Station, and the floodwall at the crown of the east levee near Lakeshore Drive. Additional geotechnical analysis of the Special Condition at the I-610 bridge is warranted due to the high cost and difficulty of construction at this location.

Approval will be required from the Sewerage and Water Board for the measures proposed for backflow prevention (Final Protection) at Pumping Station No. 7. Also, the installation of the building wall reinforcement for Interim Protection will require approval from the Sewerage and Water Board. The proposed movement of the levees north of Sta. 99+00 nearer to the center of the existing canal will require review and approval by the Sewerage and Water Board.

Field investigation to determine the type and condition of the existing sheet piling at the Drainage Syphon north of Robert E. Lee Boulevard is required. Also the type and length of existing sheet piling on the west levee beneath the I-610 bridge should be determined by field investigation.

In addition to the specifically mentioned tasks, it is necessary that all parties affected by the proposed construction, including the Orleans Levee District, U.S. Army Corps of Engineers, City of New Orleans Department of Streets, New Orleans Sewerage and Water Board and the Louisiana Department of Transportation and Development review the proposed levee/floodwall, bridge crossing and special condition improvements and other issues addressed in this report, and accept the common solutions.

Appendices

APPENDIX

TABLE OF CONTENTS

APPENDIX - TABLE OF CONTENTS (Continued)

Appendix A

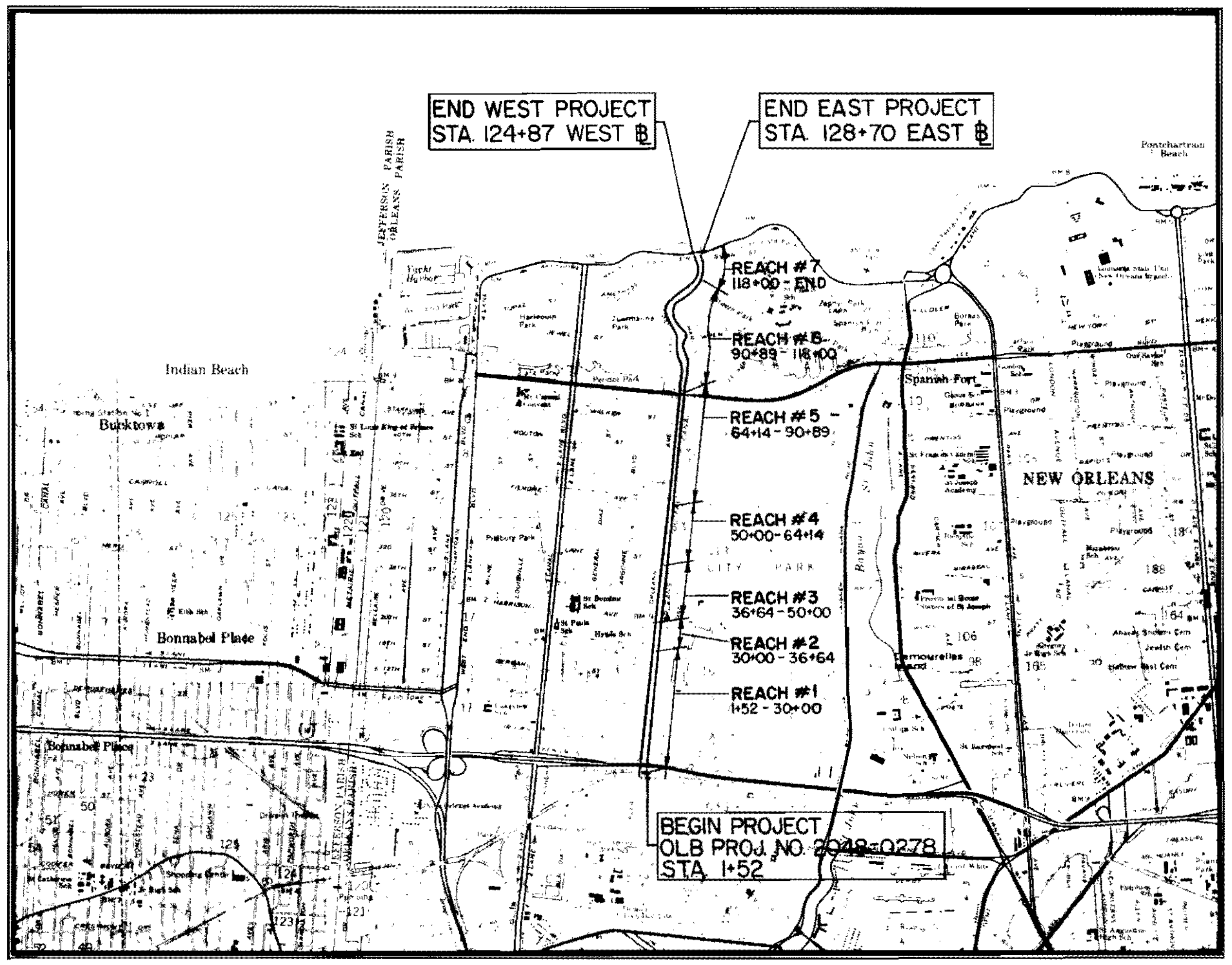
ORLEANS AVENUE CANAL

FLOOD PROTECTION IMPROVEMENT PROJECT

ORLEANS PARISH, LOUISIANA

ORLEANS LEVEE DISTRICT
BOARD OF COMMISSIONERS

EMILE W. SCHNEIDER	PRESIDENT
JOHN H. ROSS	PRESIDENT PRO TEM
WAYNE C. DUCOTE	COMMISSIONER
GEORGE TALBOT, JR.	COMMISSIONER
FRANK J. UDDO	COMMISSIONER
JOHN HAMMOND	COMMISSIONER
SIDNEY J. BARTHELEMY	COMMISSIONER



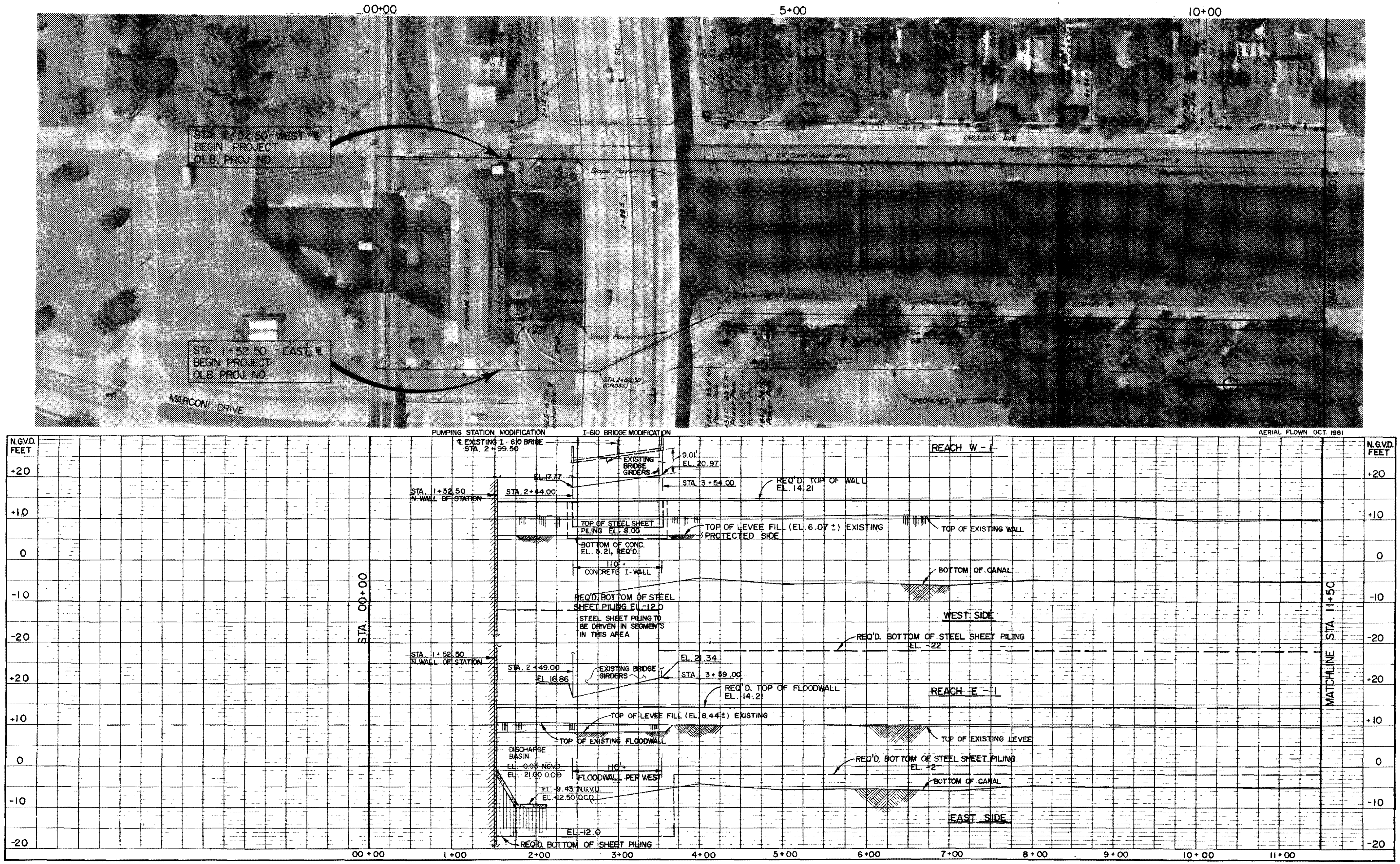
PROJECT LOCATION MAP

1000 0 1000 2000 3000
SCALE IN FEET

SEPTEMBER 1985

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

O.L.B. PROJECT NO. 2048-0278
D.E.I. PROJECT NO. 1006/85



No.	DATE	REMARKS	No.	DATE	REMARKS
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△			△		
△			△		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

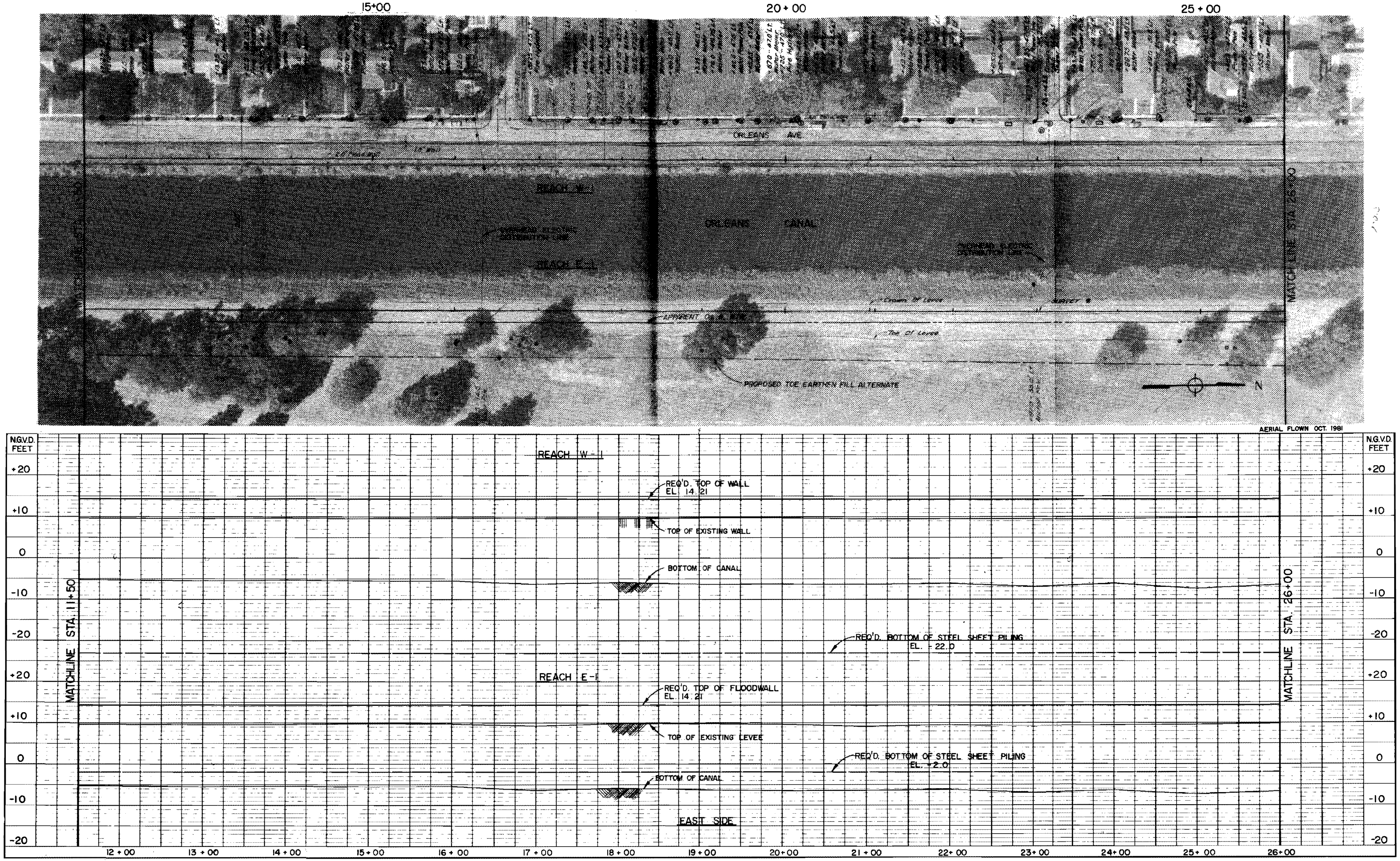
DESIGNED BY: T.M.S.
CHECKED BY: J.W.H.
DRAWN BY: C.V.N.
CHECKED BY: D.A.S.
APPROVED BY: J.W.H.
DATE: OCTOBER, 1985

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 1 OF



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2			5		
1			4		
		REVISIONS			REVISIONS

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Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

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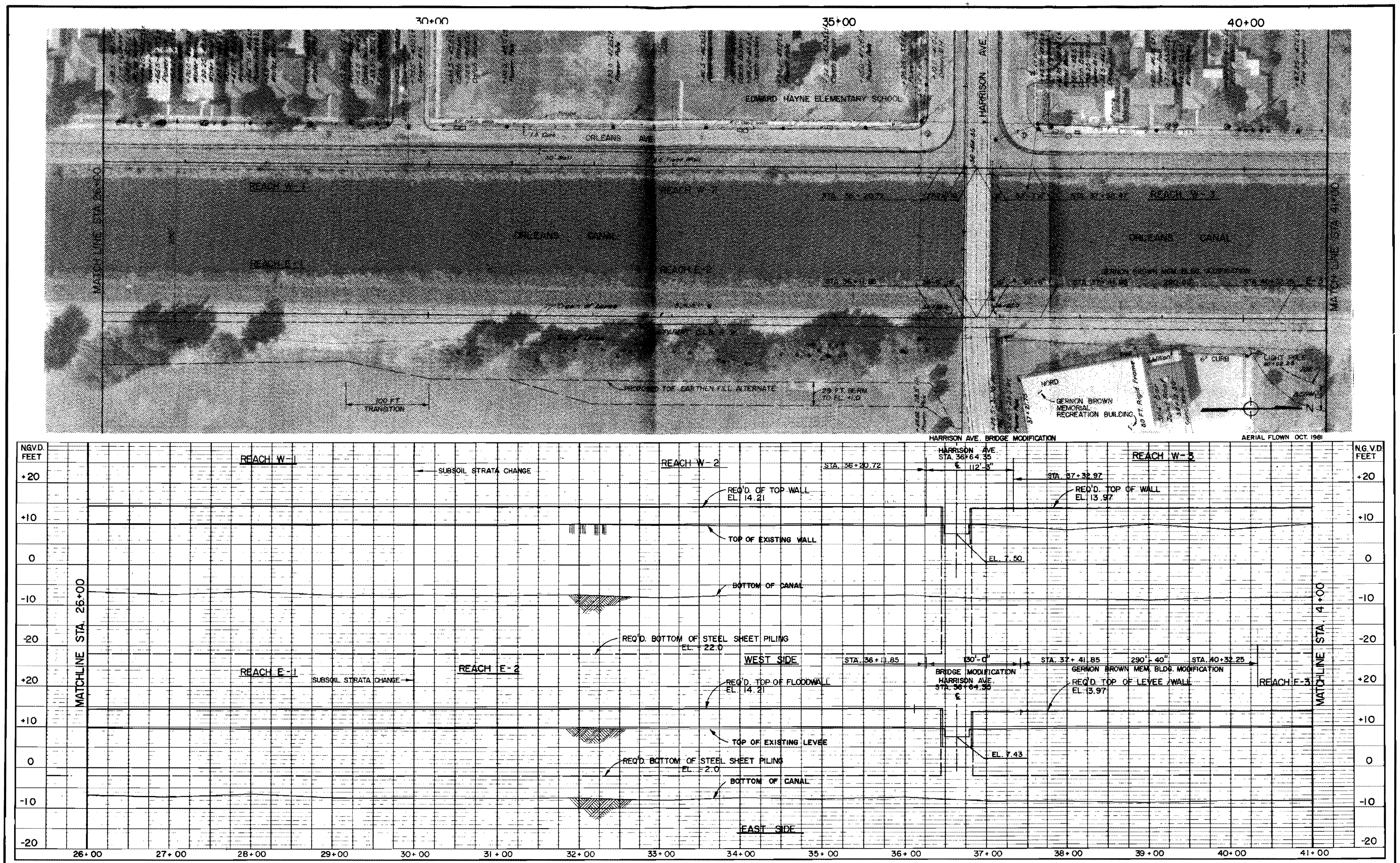
BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 2 OF



No	DATE	REMARKS	No	DATE	REMARKS
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

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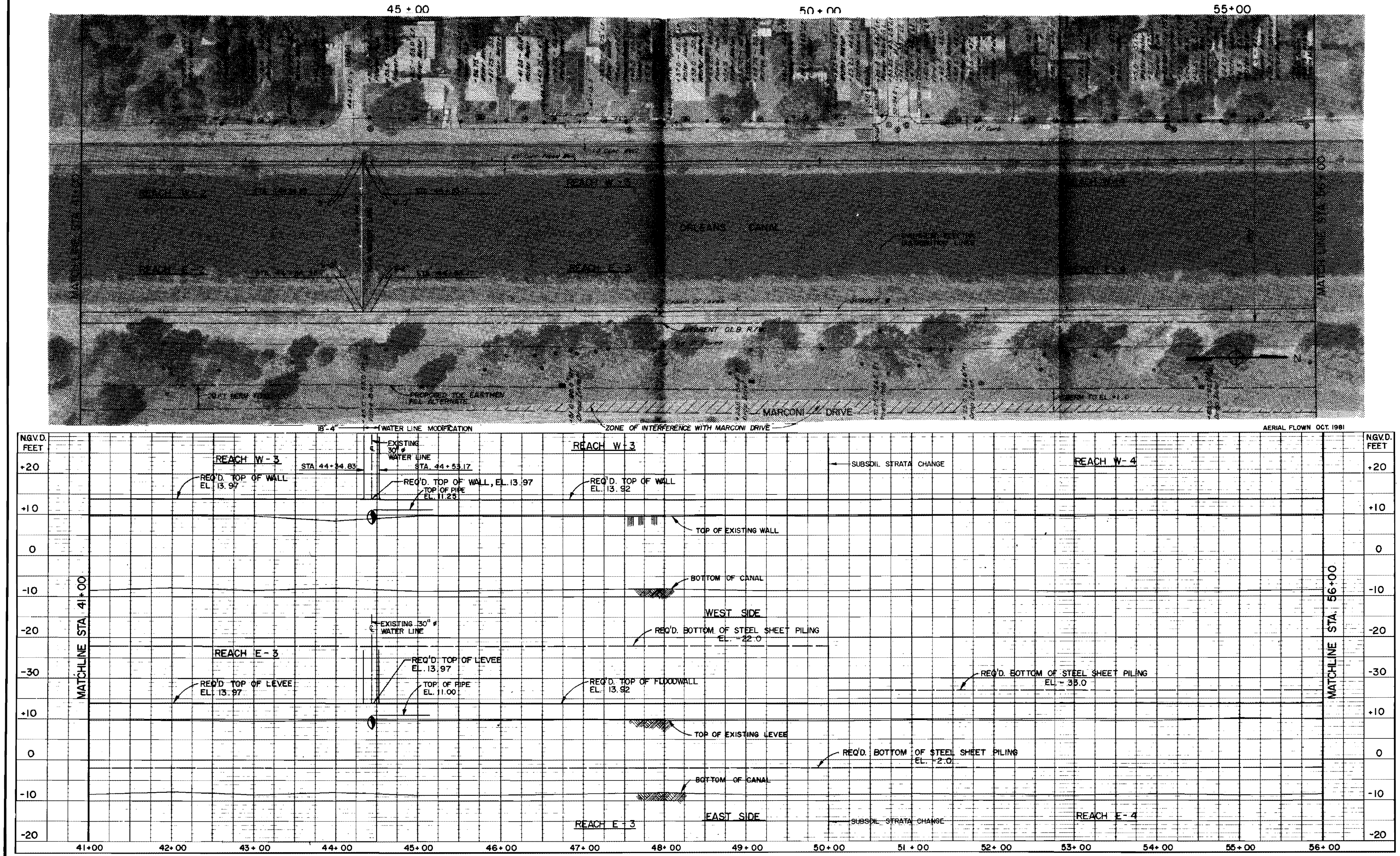
CHECKED BY: J.W.H.
DRAWN BY: C.V.N.
CHECKED BY: D.A.S.
APPROVED BY: J.W.H.
DATE: OCTOBER, 1985

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 3 OF



No	DATE	REMARKS	No	DATE	REMARKS
△			△		
△			△		
△			△		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T.M.S.
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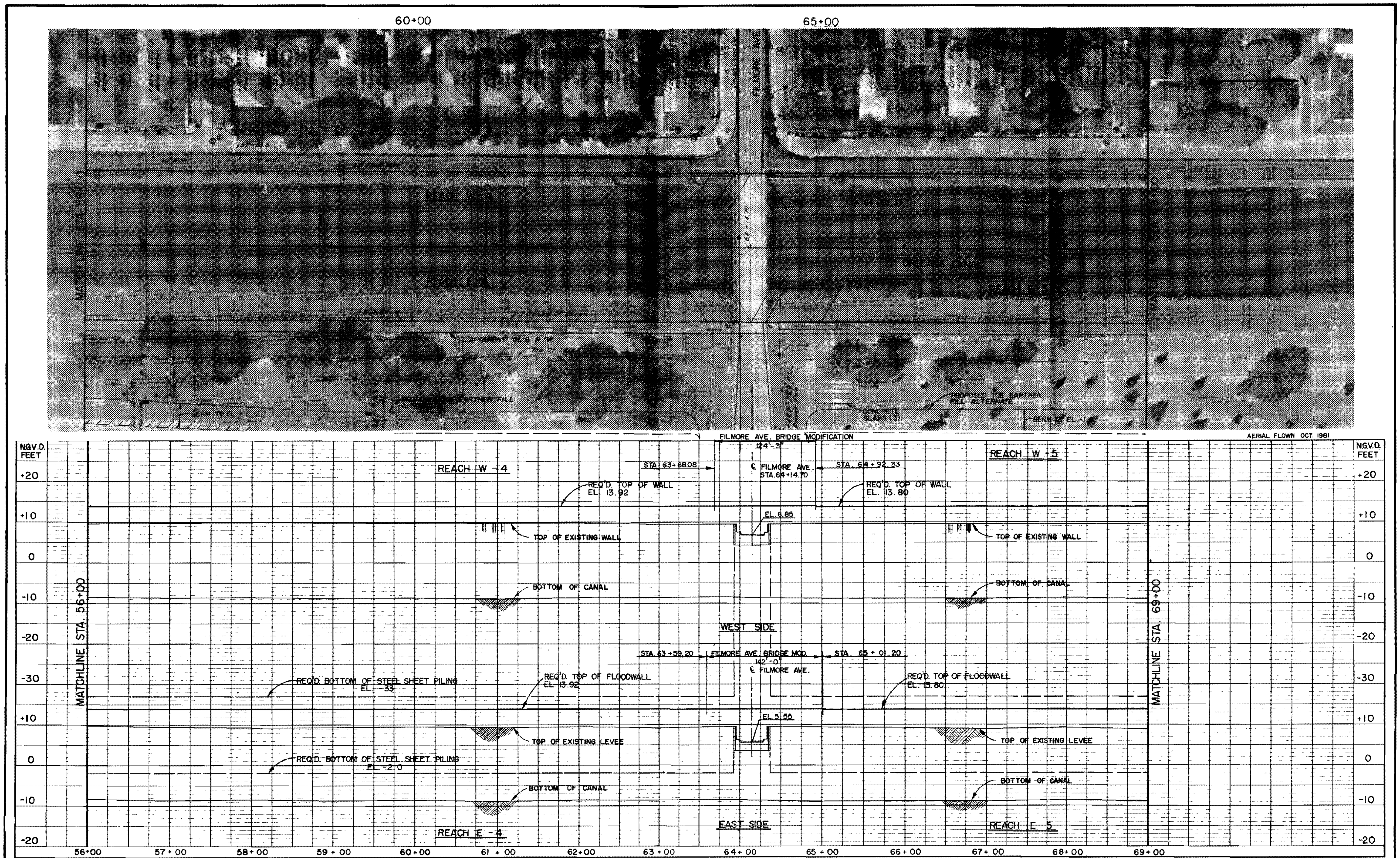
DRAWN BY: C.V.N.
CHECKED BY: D.A.S.
APPROVED BY: J.W.H.
DATE: OCTOBER, 1985

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 4 OF



No	DATE	REMARKS	No	DATE	REMARKS
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REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

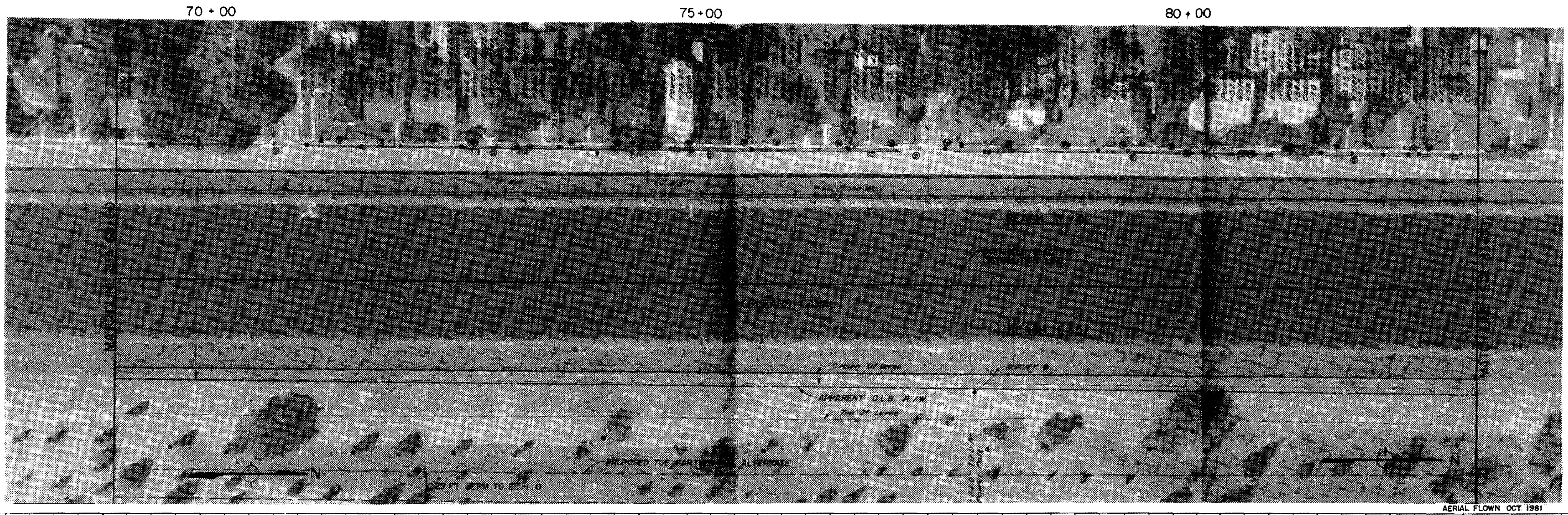
DESIGNED BY: T. M. S.
CHECKED BY: J. W. H.
DRAWN BY: C. V. N.
CHECKED BY: D. A. S.
APPROVED BY: J. W. H.
DATE: OCTOBER, 1985

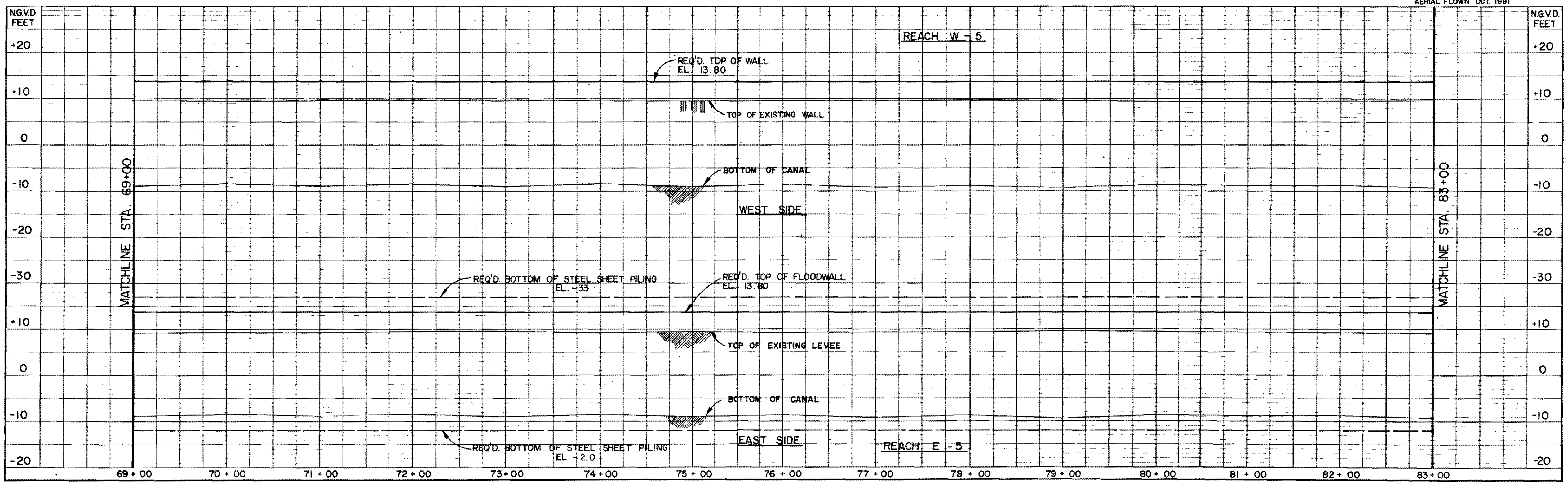
STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 5 OF





No	DATE	REMARKS	No	DATE	REMARKS
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REVISIONS			REVISIONS		

DESIGN ENGINEERING INC.
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3330 West Esplanade Ave. S.
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Metairie, LA 70002
(504) 836-2155

DESIGNED BY: T.M.S.
CHECKED BY: J.W.H.
DRAWN BY: C.V.N.
CHECKED BY: D.A.S.
APPROVED BY: J.W.H.
DATE: OCTOBER, 1985

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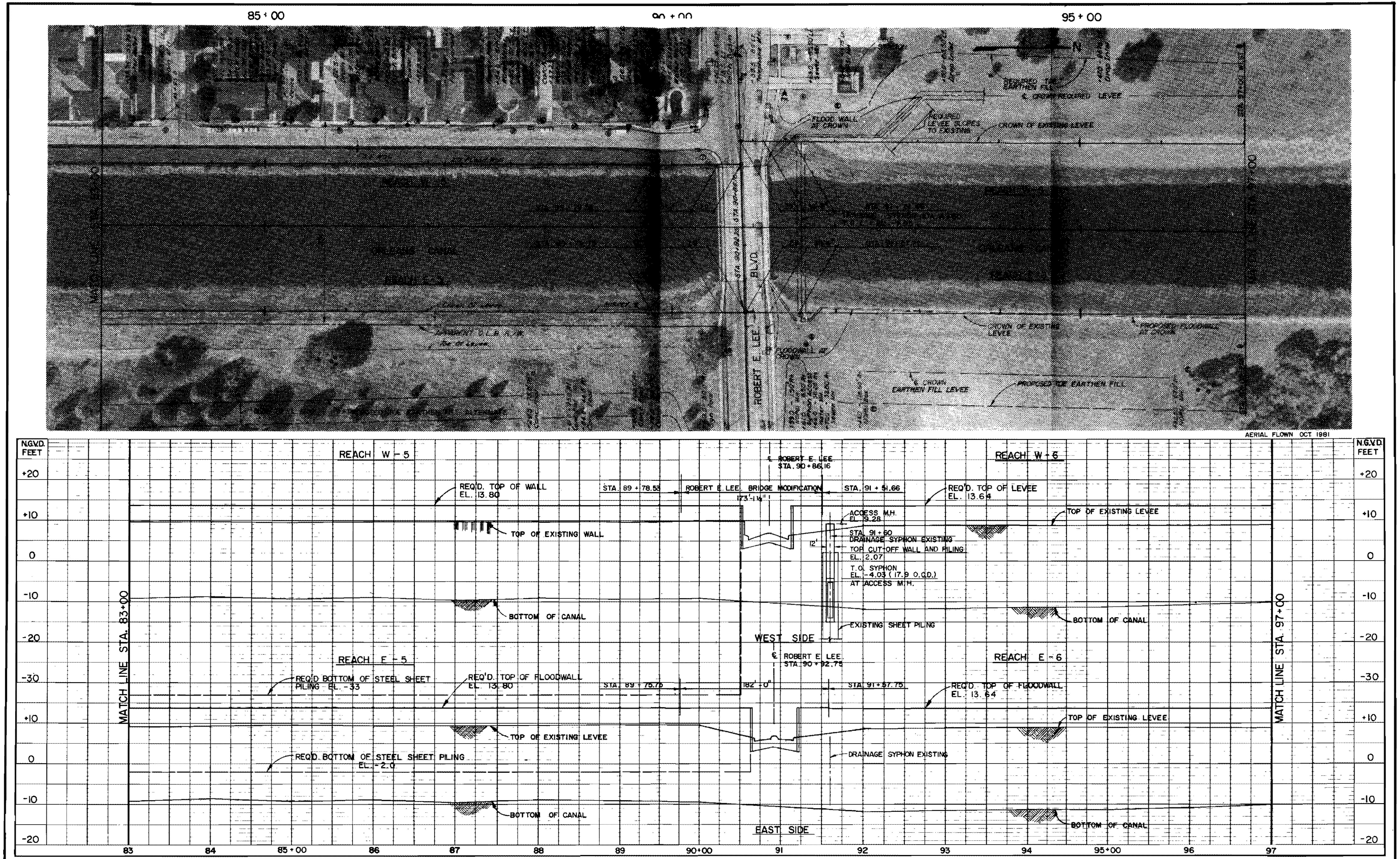
BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ.: 1" = 50' VERT.: 1" = 10'
SHEET NUMBER 6 OF



No	DATE	REMARKS	No	DATE	REMARKS
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

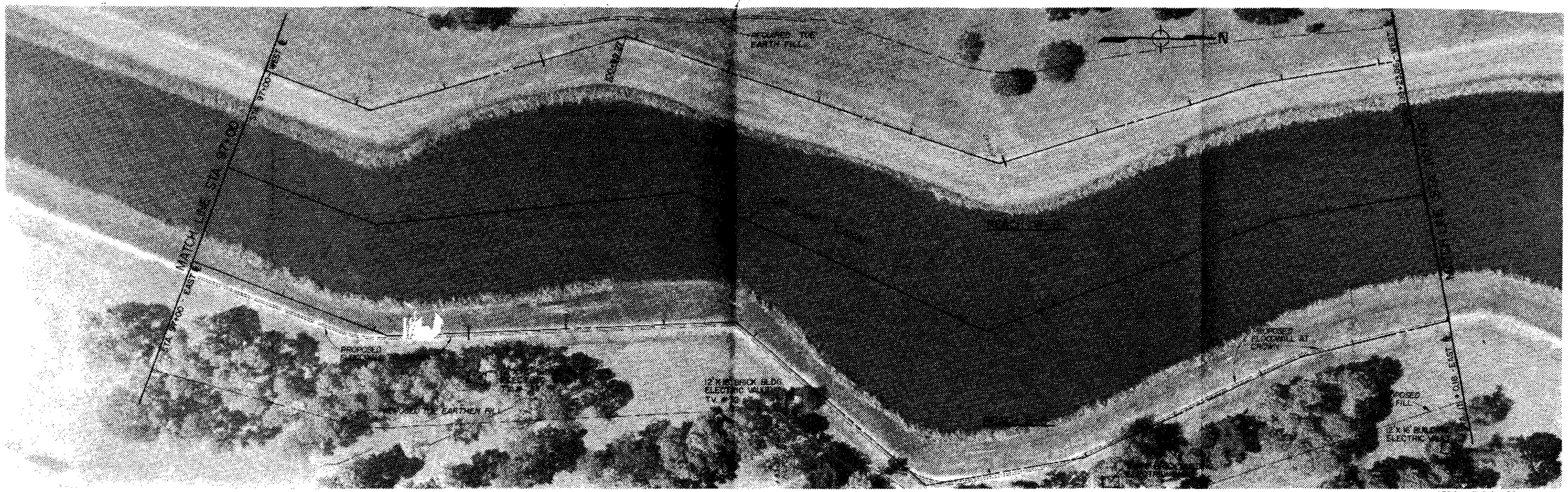
DESIGNED BY: T.M.S
CHECKED BY: J.W.H.
DRAWN BY: P.K.M./CVN.
CHECKED BY: D.A.S.
APPROVED BY: J.W.H.
DATE: OCTOBER, 1985

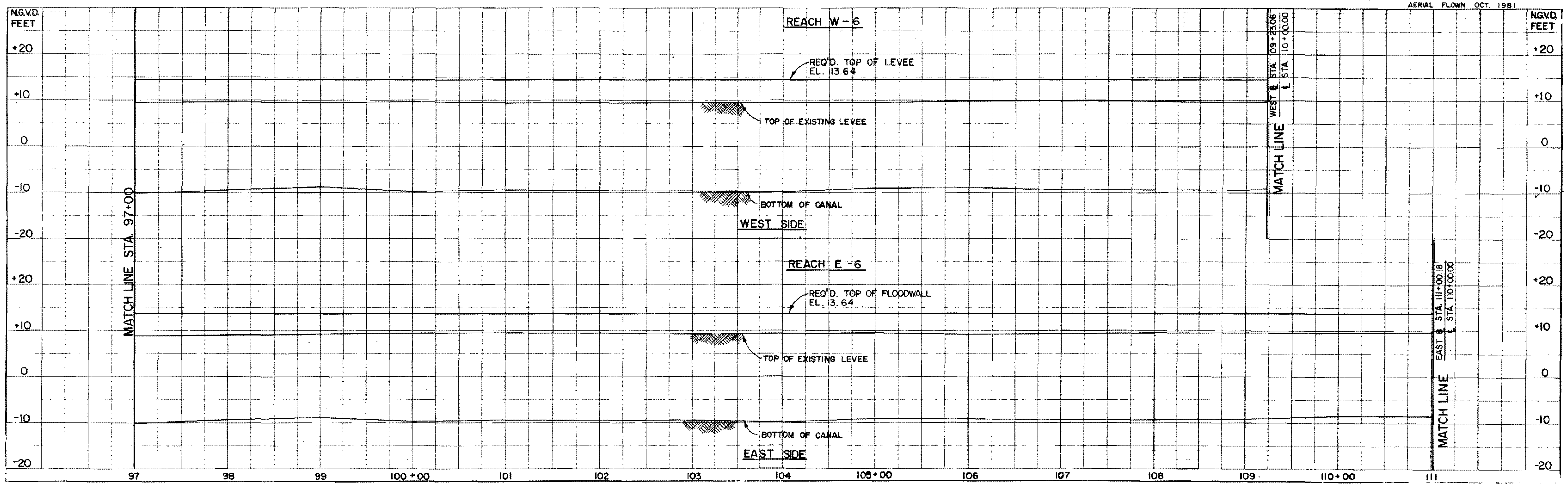
STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 7 OF





No	DATE	REMARKS	No	DATE	REMARKS
△			△		
△			△		
△			△		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

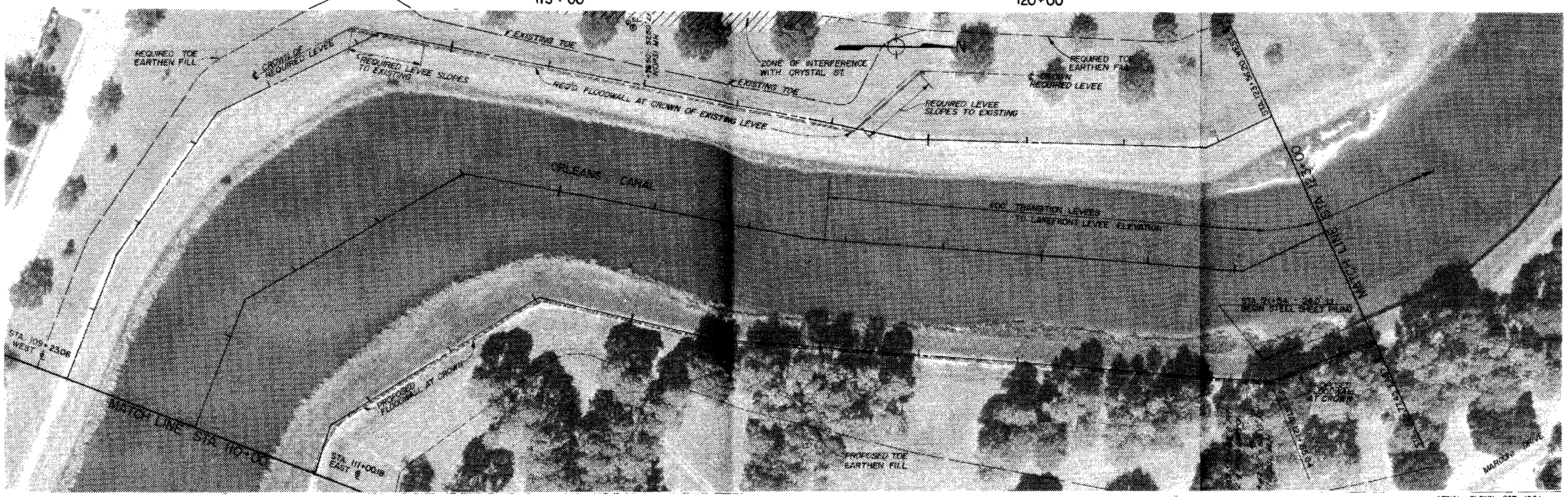
DESIGNED BY T. M. S.
CHECKED BY J. W. H.
DRAWN BY P. K. M.
CHECKED BY D. A. S.
APPROVED BY J. W. H.
DATE: OCTOBER, 1985

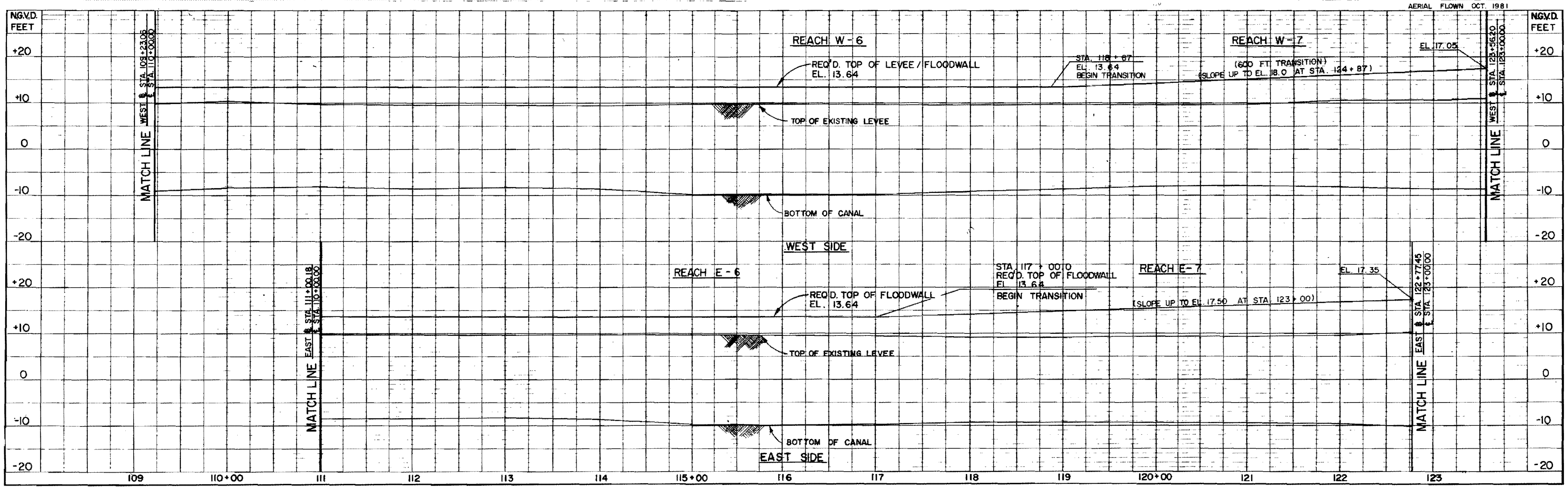
STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 8 OF





No	DATE	REMARKS	No	DATE	REMARKS
△			△		
△			△		
△			△		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 836-2155

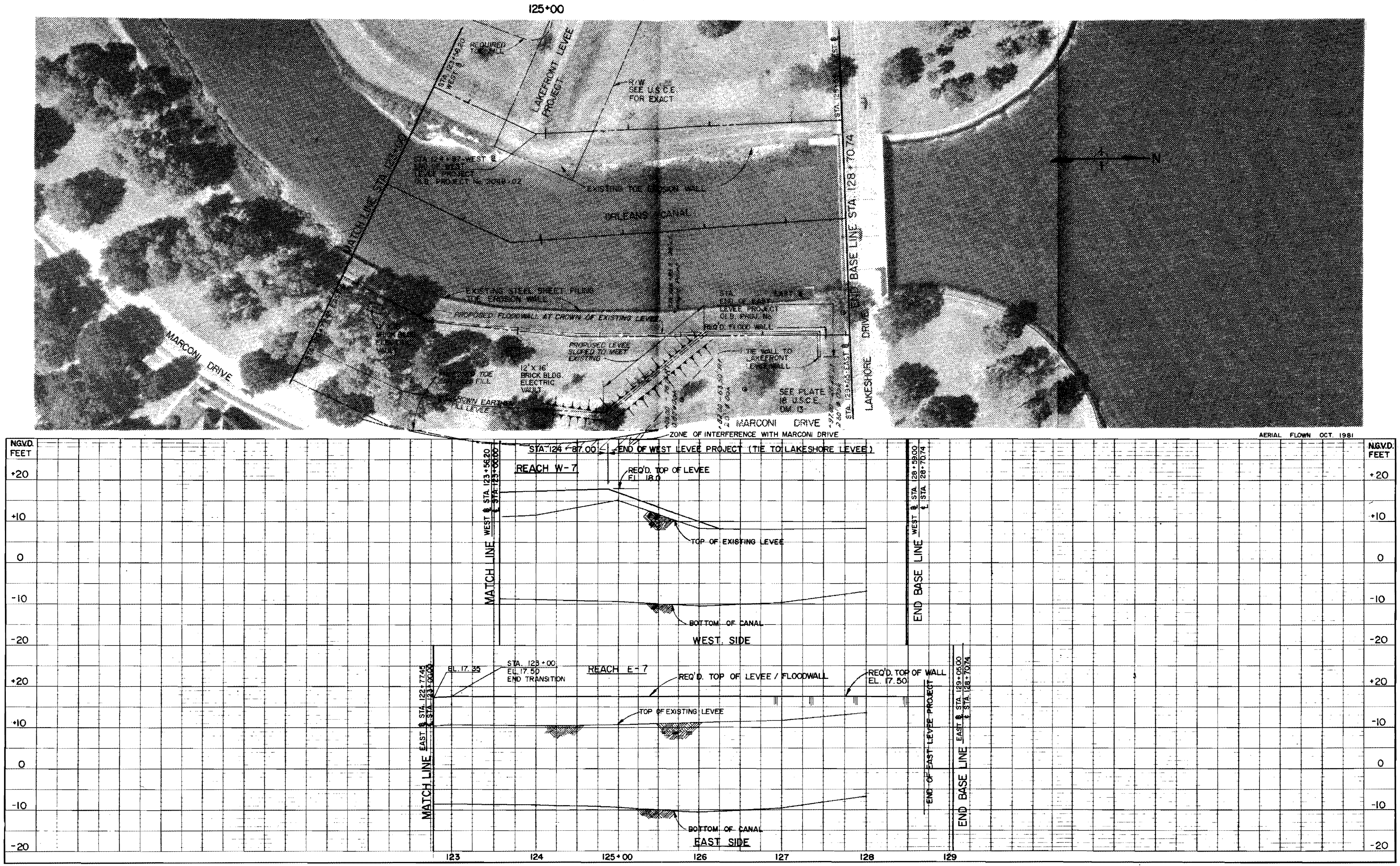
DESIGNED BY	T. M. S.
CHECKED BY	J. W. H.
DRAWN BY	P. K. M.
CHECKED BY	D. A. S.
APPROVED BY	J. W. H.
DATE:	OCTOBER , 1985

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 9 OF



No	DATE	REMARKS	No	DATE	REMARKS
3			3		
2			2		
1			1		
		REVISIONS			REVISIONS

DESIGN ENGINEERING INC.
Consulting Engineers
3330 West Esplanade Ave. S.
Suite 205
Metairie, LA 70002
(504) 838-2155

DESIGNED BY	T.M.S.
CHECKED BY	J.W.H.
DRAWN BY	P.K.M.
CHECKED BY	D.A.S.
APPROVED BY	J.W.H.
DATE OCTOBER, 1985	

STAMP

BOARD OF LEVEE COMMISSIONERS
ORLEANS LEVEE DISTRICT
ORLEANS PARISH, LOUISIANA
ORLEANS AVE. CANAL-FLOOD PROTECTION IMPROVEMENT PROJECT

PLAN / PROFILE SHEET

JOB No. 1006
SCALE HORIZ. 1" = 50' VERT. 1" = 10'
SHEET NUMBER 10 OF

Appendix B

March 27, 1985

Mr. Frederic M. Chatry
Chief, Engineering Division
Department of the Army
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

RE: Orleans Canal Flood Protection Project
OLB Project No.
DEI Project No. 1006

Dear Mr. Chatry:

Our firm has been retained by the Orleans Levee District to provide engineering services with respect to the design of flood protection improvements for the Orleans Canal. It is our understanding that the Orleans Levee District desires to design this project in accordance with Corps of Engineers design criteria. By following Corps guidelines, the Orleans Levee District hopes to increase the probability that the project will be found suitable for incorporation into the Lake Pontchartrain La. and Vicinity project.

Pursuant to the above, we are requesting that your office provide us with design criteria and other pertinent information as follows:

1. Hydraulic Design Criteria
2. Design Criteria for Floodwalls
3. Soils Information
4. Design Criteria and Standards for Floodgates
5. Design Criteria for Earthen Structures

We would appreciate the opportunity to discuss this project with you and your technical staff at your earliest opportunity.

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

Thank you for your cooperation and we look forward to meeting with you in the near future.

With best regards, I remain,

Sincerely,

John Holtgreve

John Holtgreve

JH/tg

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

REPLY TO
ATTENTION OF:

April 11, 1985

RECEIVED
APR 1? 1985
D. E. I.

Engineering Division
Structural Design Section

Mr. John Holtgreve
Design Engineering, Incorporated
3330 West Esplanade Avenue
Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your letter of March 27, 1985, in which you requested design requirements and details for flood protection along the Orleans Avenue Canal. We are pleased to work with you to ensure that your designs are consistent with applicable Corps criteria and procedures. This will maximize the probability that the features involved will ultimately be found suitable for incorporation into the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. Actual credit will be determined after completion of our General Design Memorandum Number 19, which document will provide the basis for a determination as to the degree to which the features designed by you meet the requirements of the Federal project.

Pursuant to the above, we offer the following:

1. Hydraulic Design Criteria.

a. Low water elevation in Orleans Avenue Canal is -5.0 National Geodetic Vertical Datum (NGVD).

b. Still water elevation in Lake Pontchartrain under hurricane condition is 11.5 NGVD.

c. A hydraulic gradient between the lake and the pumping station must be calculated for the water elevation in the canal.

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WB ✓
DS. ✓

Copy of letter to JH & DS.
Return plan to JH

2. Soils Information.

a. Soil Boring Logs. See Enclosure 1.

b. Lab Test Reports. See Enclosure 2.

c. Location of Soil Borings. See Enclosure 3.

3. Design Criteria for Floodwalls.

a. Foundation design criteria:

(1) I-Walls. A factor of safety of 1.5 is applied to the design shear strength as follows:

the cohesion developed = cohesion/factor of safety;

ϕ developed = arctan (tan ϕ available/factor of safety).

Using the resulting shear strengths, net lateral water and earth pressure diagrams are determined for movement toward each side of the sheet pile. Using these distributions of pressure, the summation of horizontal forces is equated to zero for various tip penetrations. At these penetrations summations of overturning moments about the tip of the sheet pile are determined. The required depths of penetration to satisfy the stability criteria are determined as those where the summation of moments is equal to zero.

(2) T-Walls and Gates.

a. Steel Sheet Pile Cutoff. A steel pile cutoff will be used beneath the gates and T-walls to provide protection against seepage during a hurricane. The sheet pile penetration is based on an acceptable seepage analysis.

b. Deep Seated Stability Analysis. A conventional stability analysis utilizing a 1.30 factor of safety incorporated into the soil parameters is performed for a pile supported floodwall or gate as explained in enclosure 4.

c. Pile Capacities. For pile supported structures where no pile tests are anticipated, a safety factor of 3.0 will be applied to ultimate calculated capacities to determine actual service pile lengths. For jobs where pile tests are anticipated, a safety factor of 2.0 will be used to determine actual service piles lengths, based on the results of the pile tests.

d. For structural design criteria of reinforced concrete, see enclosure 5.

4. Design Criteria and Standards for Floodgates. Gates are to be designed by the working stress method using an allowable bending stress of F =0.55 Fy, using A36 steel. Consider 2 cases for design of each gate:

Case I. Water to top of the gate.

Case II. Wind Load of 50 pounds per square foot (psf) on the gate.

I am forwarding a copy of this letter to Mr. Earl J. Magner.

If you have any questions concerning the soils and foundation informa tion provided, please contact Mr. Jim Richardson (838-1031). If you have any other questions or would like to arrange to meet with us to discuss this project, feel free to contact Mr. Jorge Romero (838-2645) of this office.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosures

US Army Corps of Engineers
Washington, D.C. 20314

DAEN-CWE-D

Engineer Technical
Letter No. 1110-2-265

15 September 1981

Engineering and Design
STRENGTH DESIGN CRITERIA FOR REINFORCED CONCRETE HYDRAULIC STRUCTURES

1. Purpose. This ETL provides guidance for designing reinforced concrete hydraulic structures by the strength design method.

2. Applicability. This ETL applies to all field operating activities having Civil Works responsibilities.

3. References.

a. EM 1110-1-2101, Working Stresses for Structural Design.

b. EM 1110-2-2902, Conduits, Culverts, and Pipes.

c. "Building Code Requirements for Reinforced Concrete (ACI 318-77)," American Concrete Institute, Box 19150, Redford Station, Detroit, MI 48219.

d. "Commentary on Building Code Requirements for Reinforced Concrete (ACI 318-77)," American Concrete Institute, Box 19150, Redford Station, Detroit, MI 48219.

e. Liu, Tony C., "Strength Design of Reinforced Concrete Hydraulic Structures, Report 1: Preliminary Strength Design Criteria," Technical Report SL-80-4, July 1980, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180.

f. Liu, Tony C. and Gleason, Scott, "Strength Design of Reinforced Concrete Hydraulic Structures, Report 2: Design Aids for Use in the Design and Analysis of Reinforced Concrete Hydraulic Structural Members Subjected to Combined Flexure and Axial Loads," Technical Report SL-80-4 , September 1981, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180.

g. Liu, Tony C., "Strength Design of Reinforced Concrete Hydraulic Structures, Report 3: T-Wall Design, "Technical Report SL-80-4, September 1981, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180.

4. Discussion. The current guidance for designing concrete hydraulic structures is contained in EM 1110-1-2101, dated 1 November 1963. The basic method of design in EM 1110-1-2101 is the working stress method in accordance with the ACI Building Code with several listed modifications. Since 1963 the structural engineering profession has gradually been adopting the strength design approach in lieu of the working stress method in the structural design practice. EM 1110-1-2101 permits the use of the strength design method, but it does not provide adequate guidance for proportioning structural members of

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ENCLOSURE 5

SUBJECT TO CORRECTION

hydraulic structures for strength and serviceability requirements. To assure adequate strength and serviceability for reinforced concrete hydraulic structures, the load factors have to be increased, limits have to be set on the strength and amount of reinforcement, and limits have to be set on the strain capacity of the concrete. The inclosed strength design criteria are based on research conducted at the Structures Laboratory, U.S. Army Engineer Waterways Experiment Station (WES), and from extensive input from a task group of structural engineers assembled by the Office, Chief of Engineers. Work is proceeding on refining these basic criteria to account for the special loading and service characteristics of particular types of structures.

5. Design Aids. Reference 3f. contains design aids for use in the design and analysis of reinforced concrete hydraulic structural members subject to combined uniaxial bending and axial load. These design aids are based on the strength design criteria contained herein.

6. Special Designs. Consultation with and approval by DAEN-CWE is required when:

a. Reinforcement with a yield strength in excess of Grade 60 is used.

b. Reinforcement ratios in excess of $0.50\rho_b$ are used.

c. Shear strengths are based on the results of tests.

7. Action. Pending revision of EM 1110-1-2101, reinforced concrete hydraulic structures should be designed with the strength design method in accordance with the current ACI Building Code, except as specified in the inclosed guidance. Plain concrete and prestressed concrete are not covered in this ETL.

FOR THE COMMANDER:

1 Incl
as

LLOYD A. DUSCHA, P.E.
Chief, Engineering Division
Directorate of Civil Works

Q = 3850/4550 SWS = 11.5

SUMMARY PRINTOUT

	SECNO	CWSEL	Q
LAKE	127.000	11.50	3250.00
	127.000	11.50	4550.00
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	126.000	11.54	3250.00
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	88.500	11.74	4550.00

1
12 JUN 85 9:54:24 PAGE 18

PRELIMINARY

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	78.000	11.77	4550.00
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	63.250	11.82	4550.00
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	62.250	11.71	3250.00
	62.250	11.89	4550.00
FILMORE	61.750	11.71	3250.00
	61.750	11.89	4550.00

E>

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COED 00C116A
E>P 59

T1 BACKWATER COMPUTATION WITH LAKE AT 11.5 NGVD
T2 ORLEANS OUTFALL CANAL  (EXISTING CONDITIONS) * D ALETTE 18 JUN 85 *
T3       Q = 3250/4550 SWS = 11.5
J1       1                                                              3250     11.5
J2       1               -1
J3      38       1       43
NC 0.020    0.020    0.020      0.1      0.3
X1127.00       15      0.0      197
GR  7.54     0.00     0.54     12.3     -1.0       15     -2.0       25     -3.0       30
GR  -3.8       60     -4.8       80     -6.4      110     -6.8      130     -6.4      160
GR  -5.5      163     -6.0      170     -1.4      182     0.54      184     7.95      197
X1126.50        0        0        0       50       50       50
SB  1.10     1.56      2.6        0      140        6     2063      2.5     -6.0     -6.0
X1126.00        0        0        0       50       50       50
X2       0        0        1     7.64    10.46
BT       6     0.00    10.53     7.64       17    10.51     7.64       40    10.57     7.64
BT      76    10.61     7.64      129    10.62     7.64      197    10.46     7.64
X1125.50        0        0        0       50       50       50
NC 0.035    0.035     0.03
X1123.00       20       43      195      250      250      250
GR  11.1     0.00     10.9        5      3.4       32      2.5       43      0.3       49
GR  -2.9       53     -4.6       55     -6.0       60     -8.5       80     -7.5      120
GR  -5.0      140     -3.7      160     -1.9      180      0.3      190      1.7      195
GR   2.8      215      3.9      225      7.2      236     10.6      244     10.8      249
X1121.00        0        0        0      200      200      200
X1108.00       19       41      230     1300     1300     1300
GR   9.5      0.0      8.7        6      3.0       28      2.2       41      0.3       43
GR  -2.9       53     -4.6       55     -6.0       60     -8.5       80     -7.5      120
GR  -5.0      140     -3.7      160     -1.9      180      0.3     226.      1.9      230
GR   3.3      241      4.1      248      9.4      264      9.5      270
X1 89.00       20      5.6      139     1810     1810     1810
GR 10.29      0.0      4.9      0.0      4.9      3.3      4.1      5.5      1.1        6
GR   0.5     10.2     -3.1       20     -6.5       28     -8.1       40     -8.8       50
GR  -9.1       60     -9.5       75     -9.2       90     -6.9      110     -2.9      120
GR  0.50      134      1.5    137.5      2.5      139      7.1      149      9.4      157
X1 89.34        0        0        0       56       56       56
SB  1.10     1.56      2.6        0       67        6     1580        3     -9.0     -9.0
X1 88.90        0        0        0       44       44       44
X2       0        0        1      8.5     7.11
BT       6        0      7.2      6.5     18.5      7.2      6.5     34.9     7.88      6.5
BT      70     8.24      6.5      105      7.9      6.5      124     7.11      6.5
X1 88.50        0        0        0       40       40       40
X1 78.00        0        0        0     1050     1050     1050
X1 63.25       19       13      144     1475     1475     1475
GR 10.30        0    10.30        4     10.3        6      4.2        7      2.5       13
GR   0.4       15     -3.8       25     -8.7       45     -8.4       65     -8.4       90
GR  -7.6      115     -5.3      138     -4.3      138     -1.7      140      0.4      148
GR   1.7      144      1.9      164      8.8      176      9.2      180
X1 62.75        0        0        0       50       50       50
SB  1.10     1.56      2.6        0       85        3     1850     8.33     -8.5     -8.5
X1 62.25        0        0        0       50       50       50
X2       0        0        1     6.68     7.75
BT       5        6      9.0     6.28       55      9.4     6.88       90     9.33     6.81
BT     138     6.67     5.95      180     7.75     5.03
X1 61.75        0        0        0       50       50       50
X1 48.00       18       11      141     1376     1376     1376
GR 10.57      0.0    10.57        5      3.7        6      8.5       11      0.7       16
GR  -3.0       26     -8.7       47     -9.1       60     -6.9       94     -2.8      180
E>
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PRELIMINARY

PRELIMINARY

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GR   9.4   171
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X1 35.25     0     0     0    50    50    60
SB  1.10  1.56   2.6     0    55     4  1610   3.8  -8.5  -8.5
X1 34.93     0     0     0    32    32    32
X2     0     0     1  8.83 11.57
BT     6    10 10.01  8.83    40 11.01  8.83    70 11.50  9.39
BT   100  11.5  9.32   130 11.01  8.83   160 10.01  7.83
X1 34.25     0     0     0    68    68    68
X1 24.00     0     0     0  1025  1025  1025
X1  3.00    15    17   146  2100  2100  2100
GR 11.52   0.0 11.52     4   8.2     5   2.2    17   0.7    21
GR  -3.0    26  -8.7    47  -9.1    69  -6.9    94  -2.5   120
GR   0.7   140   1.2   145   1.7   150   9.1   170   9.6   176
X1  0.00     0     0     0   300   300   300
EJ
T1 PROFILE 2
T2 ELEVATION AT LAKE 11.5 NGVD
T3 ORLEANS CANAL
J1     1
J2    15          -1

ER
EOT..
E>
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ROUTING AND TRANSMITTAL SLIP

TO (Name, office symbol or location)	INITIALS	CIRCULATE
1 Mr. John Holtgreve	DATE	COORDINATION
2	INITIALS	FILE
RECEIVED	DATE	INFORMATION
3 JUN 18 1985	INITIALS	NOTE AND RETURN
	DATE	PER CONVERSATION
4 D.E.I.	INITIALS	SEE ME
	DATE	SIGNATURE

REMARKS

Per your telephone request.

Preliminary Backwater Computation with Lake at 11.5 NGVD Orleans Outfall Canal

FILE 1006

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A. Laurent	6/12/85
	PHONE 838-2423

OPTIONAL FORM 41
AUGUST 1967
GSA FPMR (41 CFR) 100-11.206

*U.S.G.P.O.: 1980-0-311-156/4 5041-101

PRELIMINARY

	48.000	11.73	3250.00
	48.000	11.93	4550.00
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	35.250	11.76	3250.00
	35.250	11.97	4550.00
HARRISON	34.930	11.81	3250.00
	34.930	12.00	4550.00
	34.250	11.81	3250.00
	34.250	12.08	4550.00
	24.000	11.83	3250.00
	24.000	12.18	4550.00
	3.000	11.88	3250.00
	3.000	12.20	4550.00
	0.000	11.88	3250.00
PUMP STA No.7	0.000	12.21	4550.00

1
12 JUN 85   9:54:24   PAGE 19

SUMMARY OF ERRORS AND SPECIAL NOTES

1
12 JUN 85   9:56:21   PAGE 1

THIS RUN EXECUTED 12 JUN 85   9:56:23

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DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

June 28, 1985

Engineering Division
Projects Engineering Section

JUL 8 1985

Mr. Earl J. Magner, Jr.
Chief Engineer
The Board of Levee Commissioners
Orleans Levee District
Suite 202 - Administration Building
New Orleans Lakefront Airport
New Orleans, Louisiana 70126

Dear Mr. Magner:

Reference is made to your June 20, 1985, letter concerning Lake Pontchartrain and Vicinity Hurricane Protection Project - Orleans Avenue Outfall Canal, London Avenue Outfall Canal, and 17th Street Outfall Canal with enclosed material for our review and comment.

The information provided at your office during the June 19, 1985 meeting has been reviewed, and we offer the following comments:

1. We have no comment relative to the scope of services for your design memorandum work at London Avenue and Orleans Avenue Canals.

2. The topographic survey scope of services is sufficient for our design purposes and meets the Corps requirements for design memorandum scope designs.

3. The Geotechnical scope of services for Orleans Avenue is sufficient for our needs, except for the need for piezometric data. We request that you provide the check borings that were discussed and requested during the June 19, 1985 meeting. The number and locations are shown on the enclosure plans. Attached to the plans, please find a description of the locations and type boring and piezometric data needed at each of the Orleans and London Avenue Canals.

FILE L 1006
21005 - LONDON AVE

DIST.
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XC DEI 7/15/85

It is noted that the scope of work for Geotechnical Services for London Avenue Canal has not been developed. However, if the scope of the London Avenue Canal program is similar to the Orleans Avenue Canal, then the level of detail is sufficient for our GDM design purposes. We request that you furnish the London Avenue Canal scope of services to this office once you have developed it.

We are reviewing the reports on the 17th Street Outfall Canal furnished in your June 20, 1985 letter. We will furnish our comments to you as soon as they are available.

Should you have any questions concerning the enclosed plans and boring requirements, please contact Mr. Vann Stutts, telephone number 838-2614.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Enclosures

The NOD field data required for Orleans Avenue and London Avenue Outfall Canals from the Orleans Levee District's consultants are:

ORLEANS AVENUE OUTFALL CANAL

a) Four undisturbed 5-in diameter continuous sampling borings.

1.) 1℄ levee 50 ft. depth and 1 toe 40 ft. depth boring 300 feet south of Robert E. Lee Blvd. on east side of canal.

2.) 1℄ levee 50 ft. depth boring 200 feet south of Filmore Avenue on east side of canal.

3.) 1℄ levee 40 ft. depth 1800 feet south of Harrison Avenue on west side of canal.

b) Piezometric data from piezometers installed in the buried beach sand at one representative cross section of the canal. Corresponding canal water elevations at the site of the piezometers.

LONDON AVENUE OUTFALL CANAL

a) Two undisturbed 5-in diameter continuous sampling borings.

1.) 1℄ levee 50 ft. depth boring 200 feet north of Filmore Avenue on east side of canal.

2.) 1℄ levee 50 ft. depth boring 200 feet north of Virgil Blvd on west side of canal.

b) Piezometric data from piezometers installed in the buried beach sand at one representative cross section of the canal. Corresponding canal water elevations at the site of the piezometers.

Tubes from the undisturbed borings are to be furnished to the NOD Soils & Material Testing Section. Please contact Mr. Vernon Leufroy, telephone 733-5000, in advance to make arrangement for tubes.

July 17, 1985

Mr. Frederic M. Chatry
Chief, Engineering Division
Department of the Army
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

RE: Orleans Canal Flood Protection Project
OLB Project No. 2048-0278
DEI Project No. 1006

Dear Mr. Chatry:

Your previous correspondence to us dated April 11, 1985 omitted mention of the required freeboard allowance to be used in our Design Memorandum Report for high level flood protection on the Orleans Canal.

Subsequent calls to the U.S. Army Corps of Engineers' personnel yielded the recommendation that a freeboard height of three (3) feet should be added to the predicted extreme maximum still water level in the Orleans Canal for setting the top elevation of high level protection levees, walls and gates.

This conflicts with the freeboard height of two (2) feet established in the engineering study previously performed on the very similar 17th Street Canal which was dated April, 1985. Furthermore, the Board of Levee Commissioners of the Orleans Levee District has accepted the recommendations of this report and are proceeding with that project according to the recommendations.

We are endeavoring to develop the most economic scheme in our report to the Orleans Levee Board. Please carefully

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

review your base criteria and notify us of the minimum freeboard allowance that can be used to provide creditable high level protection along the long canals from the drainage pumping stations to Lake Pontchartrain.

With best regards, I remain

Yours very truly,

DESIGN ENGINEERING, INC.

John Holtgreve

JH/drb

cc: Mr. Earl Magner

October 2, 1985

Mr. Van Stutts, Project Coordinator
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Re: Orleans Avenue Canal
Flood Protection Project
OLB Project No. 2048-0304
DEI Project No. 1006

Dear Mr. Stutts:

Attached herewith please find one copy of the draft geotechnical engineering report and one set of existing cross-sections as requested for your review and comment.

Your prompt review of the enclosed material will be greatly appreciated. Should you have any questions or need additional information please call us.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve

JH/mnh

Enclosures

cc: Mr. Earl J. Magner, Jr.
Chief Engineer
Mr. Ed Bailey
Assistant Chief Engineer
Orleans Levee Board

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

Appendix C

April 26, 1985

Mr. Wes Busby
Sewerage and Water Board
of New Orleans
1300 Perdido Street
New Orleans, Louisiana 70165

RE: Orleans Canal Flood Control Project
DEI Project No. 1006

Dear Mr. ~~Parker~~: Busby

Our firm has been engaged by the Orleans Levee District to provide Engineering Services for the above referenced project.

Attached is a copy of a city map showing the limits of the project. Please provide us with the locations of any facilities you may have in the affected areas.

It is very important that we receive this information as soon as possible as we are working under a very tight time schedule.

Thank you for your cooperation in this matter and please call us should you have any questions.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve, P.E.

JH/tg

Attachment

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

April 26, 1985

Mr. Chuck Gibson
Cox Cable New Orleans, Inc.
2120 Canal Street
New Orleans, Louisiana 70112

RE: Orleans Canal Flood Control Project
DEI Project No. 1006

Dear Mr. [redacted] Gibson

Our firm has been engaged by the Orleans Levee District to provide Engineering Services for the above referenced project.

Attached is a copy of a city map showing the limits of the project. Please provide us with the locations of any facilities you may have in the affected areas.

It is very important that we receive this information as soon as possible as we are working under a very tight time schedule.

Thank you for your cooperation in this matter and please call us should you have any questions.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve, P.E.

JH/tg

Attachment

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

April 26, 1985

Mr. John Lozes
Assistant Director of Engineering
New Orleans Public Service
P.O. Box 60340
New Orleans, Louisiana 70160

RE: Orleans Canal Flood Control Project
DEI Project No. 1006

Dear Mr. ~~Parker~~ Lozes

Our firm has been engaged by the Orleans Levee District to provide Engineering Services for the above referenced project.

Attached is a copy of a city map showing the limits of the project. Please provide us with the locations of any facilities you may have in the affected areas.

It is very important that we receive this information as soon as possible as we are working under a very tight time schedule.

Thank you for your cooperation in this matter and please call us should you have any questions.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve, P.E.

JH/tg

Attachments

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

April 26, 1985

Mr. Joe Neathamer
South Central Bell Telephone Company
4101 Pauger Street
New Orleans, Louisiana 70122

RE: Orleans Canal Flood Control Project
DEI Project No. 1006

Dear Mr. ~~Parker~~: Neathamer

Our firm has been engaged by the Orleans Levee District to provide Engineering Services for the above referenced project.

Attached is a copy of a city map showing the limits of the project. Please provide us with the locations of any facilities you may have in the affected areas.

It is very important that we receive this information as soon as possible as we are working under a very tight time schedule.

Thank you for your cooperation in this matter and please call us should you have any questions.

With best regards, I remain

Sincerely,

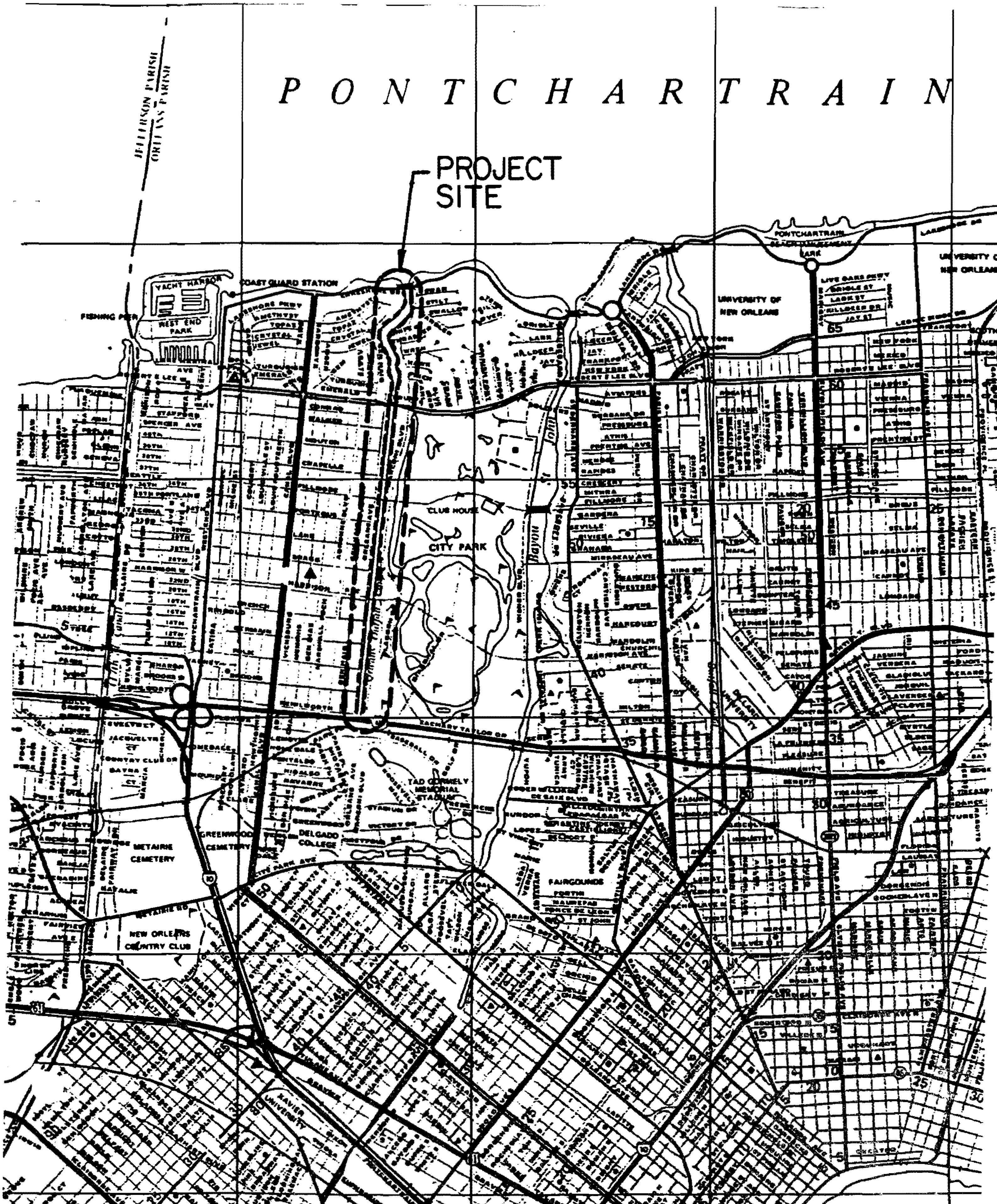
DESIGN ENGINEERING, INC.

John Holtgreve, P.E.

JH/tg

Attachment~~s~~

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155


PONTCHARTRAIN
PROJECT SITE
JEFFERSON PARISH
ORLEANS PARISH
YACHT HARBOR
COAST GUARD STATION
FISHING PIER
WEST END PARK
UNIVERSITY OF NEW ORLEANS
CLUB HOUSE
CITY PARK
TAD GORMLEY MEMORIAL STADIUM
DELGADO COLLEGE
METAIRIE CEMETERY
GREENWOOD CEMETERY
NEW ORLEANS COUNTRY CLUB
FAIRGROUNDS
XAVIER UNIVERSITY

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

RECEIVED
AUG 7 1985
D.E.I.

REPLY TO
ATTENTION OF

August 1, 1985

Engineering Division
Projects Engineering Section

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your July 17, 1985, letter concerning Orleans Canal Flood Protection Project, OLD Project No. 2048-0278 DEI Project No. 1006, and freeboard requirements for same.

We have reviewed the basic criteria which we furnished to the Orleans Levee District in connection with the High Level Plan Project for the 17th Street Canal and find that the 2-foot freeboard requirement is correct. We regret that conflicting data was given to your office by phone for the Orleans Ave Canal. The 2-foot freeboard requirement should also be applied to both the Orleans and London Ave Canals.

A copy of this letter is being furnished to Mr. Earl J. Magner, Jr., Chief Engineer, The Board of Levee Commissioners, Orleans Levee District, Suite 202 - Administration Building, New Orleans Lakefront Airport, New Orleans, Louisiana 70126.

We will, in the future, confirm by writing information of this type which is given over the phone. Hopefully this will help us avoid problems of this type.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

FILE 1006
DISTRIBUTION
WB
JH
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DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

RECEIVED
SEP 30 1985
D. E. I.

REPLY TO
ATTENTION OF:

September 24, 1985

Engineering Division
Projects Engineering Section

Mr. John Holtgreve
Design Engineering, Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Dear Mr. Holtgreve:

Reference is made to your September 10, 1985 letter, concerning the Orleans Canal Flood Protection Project, DEI Project No. 1006, in which you requested our input to enable you to complete your ongoing study.

Relative to the first item requested, you should use a 600-foot transition for the lateral levees on either side of the canal. The transition should drop the levee elevation from their intersection height with the lakefront levees (18.0 ft. NGVD) to a minimum height which provides two feet of freeboard above the maximum flowline (elevation 13.6 ft. NGVD).

The second item that you requested is enclosed. Plates 2, 12 through 17, and 23 were taken from GDM No. 4, Florida Avenue Complex, IHNC. These plates show a typical sluice gate layout. In addition, plans for the detail design of the sluice gate structures on the discharge culverts of the new Florida Avenue pumping station can be obtained through the Orleans Levee District from Pepper & Associates (OLB Project No. 78-M-13-5).

I trust that the foregoing will satisfy your needs. If you have any questions concerning this material, please contact Mr. Vann Stutts, Phone: 862-2614.

Sincerely,

William B. Soak
for Frederic M. Chatry
Chief, Engineering Division

FILE 1006
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JS Tom S 9/30

Enclosure

April 26, 1985

Mr. G. Joseph Sullivan
General Superintendent
Sewerage and Water Board
of New Orleans
City Hall, City Central
Room 5w02
New Orleans, Louisiana 70165

RE: Orleans Canal Flood Protection
Improvement Project
OLB Contract No. 2048-0278
DEI Project No. 1006

Dear Mr. Sullivan:

Our firm has been engaged by the Orleans Levee District to provide engineering services for the above referenced project. As part of the project, the Levee Board has required that levee improvements be compatible, as much as possible, with the existing facilities and proposed improvements of the Sewerage and Water Board.

Pursuant to the above we are requesting that your office provide us with the following information:

* Plans and specifications of existing Sewerage and Water Board facilities.

* Design Criteria of proposed projects.

* Hydraulic Design requirements, such as,

  a) Minimum and maximum canal x-section.
  b) Water surface gradient.
  c) Max water levels during pumping conditions.
  d) Other data pertinent to project.

* Structural Design requirements.

We would appreciate the opportunity to discuss this project with you at your earliest convenience. Since we are presently operating under a very tight time schedule, your

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

prompt attention in this matter would be greatly appreciated.

Thank you for your cooperation and please call us should you have any questions.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve, P.E.

JH/tg

April 30, 1985

Mr. Frank Heroy
Chief Design Engineer
Louisiana Department of Transportation
and Development
P.O. Box 94245
Baton Rouge, Louisiana 70804-9245

RE: Orleans Canal Flood Protection Project
DEI Project No. 1006

Dear Mr. Heroy:

Our firm has been retained by the Orleans Levee District to provide engineering services with respect to the design of flood protection improvements for the Orleans Canal. Project limits are generally defined on the attached map.

Pursuant to the above, we are requesting that your office provide us with the following information:

* Record drawings of I-610 bridge crossing the Orleans Canal.

* Plans of Proposed Modifications to the structure, if any.

* Plans of other facilities which may be affected by the levee improvement project.

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

We will be happy to discuss this project with you at your convenience and should you have any questions please call us.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve, P.E.

Jh/tg

Attachment

April 30, 1985

Mr. Joseph Buscher
Administrative Office
City Park
New Orleans, Louisiana 70119

RE: Orleans Canal Flood Control Project
DEI Project No. 1006

Dear Mr. Buscher:

Our firm has been engaged by the Orleans Levee District to provide engineering services for the above referenced project.

Attached is a city map showing the limits of the projects. Please provide us with the location of any facilities you may have in the affected areas.

Your prompt attention in this matter will be appreciated and should you have any questions please call us.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgreve, P.E.

JH/tg

Attachment

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

Robert G. Graves
Secretary

Department of Transportation and Development

~~XXXXXXXXXXXXXXXXXXXXXXXXXX~~
BATON ROUGE, LA. 70804-9245
P.O. Box 94245

Edwin W. Edwards
Governor

(504)342-7511

May 3, 1985

Route
JH ✓
WB ✓
TS

RE: New Orleans By-Pass Highway I-610
I-610 Over Orleans Outfall Canal

Design Engineering, Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Attention: Mr. John Holtgreve

Dear Sir:

As per your letter dated April 30, 1985, we are pleased to send you the as-built plans for the I-610 Bridge crossing the Orleans Canal. This is a partial set of plans comprised of the following sheets: 3AC, 15, 135, 138, 139, 147, 148, 149, 198 and 202. This office is not aware of any planned modifications to this structure or other facilities maintained by this Department on this canal.

Very truly yours,

F. M. Heroy Jr.

FRANK M. HEROY, JR.
CHIEF DESIGN ENGINEER

FMH,jr:klc

Attachment

cc: Mr. Louis A. Garrido
Mr. James McGrew

RECEIVED
MAY 8 1985

D. E. I.

File
1006

South Central Bell
4101 Pauger Street
New Orleans, Louisiana 70122
(504) 245-5420 or 282-0203

Route

JH
D.S.

May 6, 1985

Mr. John Haltgreve, P.E.
Design Engineering, Inc.
3330 West Esplanade Avenue
Suite 205
Metairie, Louisiana 70002

Dear Mr. Haltgreve:

Please be advised that South Central Bell does not have any facilities that parallel the Orleans Canal from Filmore Avenue to the lakefront.

As was previously discussed, a copy of your letter and drawing were sent to Mr. Al Lunn, 3500 N. Causeway Boulevard, telephone number 832-6655, for his perusal.

If you require any further assistance, please contact me at 245-5420.

Yours truly,

Mrs. S. A. Oser

Mrs. S. A. Oser
Engineer - OSP

SAO/lm

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May 14, 1985

Mr. Harold Gorman, Director
Department of Streets
City of New Orleans
1300 Perdido, Room 6W02
New Orleans, LA 70112

RE: Orleans Avenue Canal Levee and Floodwall Improvements
Orleans Levee Board Project No. 2048-0278
DEI Project No. 1006

Dear Mr. Gorman:

Our firm has been retained by the Orleans Levee District to provide engineering services on the above referenced project. As shown on the attached map, the subject project extends from Lake Pontchartrain to the Sewage and Water Board Pumping Station No. 7, near I-610. As part of our work, we are to investigate different methods to include the bridge crossings into the flood protection system. In general, the basic requirement of the flood protection project involves raising the elevation of the existing levee system to a minimum elevation of +14.5 feet m.s.l.

Since the existing canal crossings are significantly lower than the proposed levee height, some method of incorporating these structures into the proposed levee improvement will have to be developed. Several methods, such as floodgates, bridge sealing, construction of new bridges, replacement of bridge with culverts, etc., are presently being considered. Based on the preliminary investigation installation of floodgates may be the most economically feasible method of increasing the flood protection at the bridge locations.

However, there is one drawback associated with using floodgates. When the floodgates are closed, the bridge will also be closed to vehicular and pedestrian traffic for the duration of the high water event. Please review these canal crossings and determine from a traffic and safety standpoint, if any of these bridges should remain open during high water events.

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

We will be happy to meet with you at your convenience to discuss this matter and should you have any questions please feel free to call me.

Your prompt attention in this matter will be greatly appreciated.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

John Holtgréve, P.E.

JH/drb

Attachment

NEW ORLEANS PUBLIC SERVICE MIDDLE SOUTH UTILITIES SYSTEM

New Orleans Public Service Inc.

POST OFFICE BOX 60340

NEW ORLEANS, LOUISIANA 70160

595-2362

AREA CODE 504 XXXXXXX

317 BARONNE STREET

ENGINEERING DEPARTMENT

July 18, 1985

RECEIVED
JUL 23 1985
D.E.I.
ab

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade
Suite 205
Metairie, Louisiana 70002

Re: Flood Protection Improvement
Project - Orleans Canal
DEI Project No. 1006

Dear Mr. Holtgreve:

In response to your July 9, 1985 letter pertaining to the referenced project, we are forwarding for your use and information two (2) copies each of the following New Orleans Public Service Inc. (NOPSI) electric prints:

5162
5164
5182

These prints indicate existing NOPSI electric facilities along the Orleans Canal levee between Robert E. Lee and Lakeshore Drive.

If I can be of any further assistance, please let me know.

Very truly yours,

R. E. Roberts
Division Engineer

RER:mca
Enclosures

FILE 1006
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WB
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TS TWS
DS

July 23, 1985

Mr. Harold Gorman
Director
Department of Streets
City of New Orleans
1300 Perdido, Room 6W02
New Orleans, LA 70112

RE: Orleans Avenue Canal Levee
and Floodwall Improvements
Orleans Levee Board Project No. 2048-0278
DEI Project No. 1006

Dear Mr. Gorman:

As indicated in our previous correspondence to you dated May 14, 1985, we have been retained by the Orleans Levee District to provide engineering services for the referenced project. As part of our services, we have been requested to coordinate our design efforts with city agencies to insure that improvements planned by other agencies can be incorporated into the flood protection project.

Please notify us, as soon as possible, of any projects that your office is considering that may be affected by the flood protection project.

We will be happy to meet with you to discuss this matter or should you have any questions please call us.

With best regards, I remain

Sincerely,

DESIGN ENGINEERING, INC.

John Holtgreve

JH/drb

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

MEMORANDUM

TO: File 1006

FROM: John Holtgreve

RE: Orleans Avenue Canal
Flood Protection Project - R.O.W. Plans

DATE: July 26, 1985

I spoke with Earl Magner concerning right-of-way plans for the Orleans Avenue Canal and according to him no such plans are available. He suggested that we assume the levee toe is the end of the Levee Board property and that, on the east side, the property beyond the toe is owned by City Park. He also said he would ask Steve King to look through the plans to see if there were any plans available.

Steve called the next day to tell me that he did not find anything at all that indicated the canal right of way. He said that he would send copies of two drawings that showed Orleans Avenue and the canal. We received these drawings on July 26, 1985.

Roy Anslem is also searching for the property line information. He has not been very successful in finding any information on the canal either. Roy did, however, find a plot that showed the Orleans Canal right-of-way and Orleans Avenue right-of-way having a total width of 250 feet. This information will be plotted on the drawings.

JH/drb

NEW ORLEANS PUBLIC SERVICE INC.
POST OFFICE BOX 60340
NEW ORLEANS, LOUISIANA 70160

ENGINEERING DEPARTMENT

AREA CODE 504 XXXXXXX 595-2362
317 BARONNE STREET

D. E. I.

September 9, 1985

Mr. John Holtgreve
Design Engineering Inc.
3330 West Esplanade, Suite 205
Metairie, Louisiana 70002

Subject: Flood Protection Improvement Project
Orleans Canal
DEI Project No. 1006

Dear Mr. Holtgreve:

In response to your July 16, 1985 letter concerning the subject project, we have reviewed the existing New Orleans Public Service Inc. (NOPSI) overhead electrical power lines crossing the Orleans Canal within the project limits and our comments are as follows:

Please refer to enclosed copies of NOPSI Distribution Maps 384-484-P4 and 384-492-P4 which have been marked in red to indicate proposed temporary rearrangements of existing overhead electric distribution lines to accommodate the construction of the subject project. These temporary lines would be installed and removed as required to provide for the orderly progression of construction with minimum interruption to electric service.

The approximate NOPSI charges for the installations and removals of the existing and temporary replacement power lines are as follows:

Three Phase Primary Circuits	3,700 ckt. ft. @ $26 per ckt. ft.	$ 96,200
Single Phase Primary Circuits	2,860 ckt. ft. @ $18 per ckt. ft.	51,480
		$147,680

or approximately $150,000 Total

For coordination with NOPSI on the subject project up until the contract is let, please contact our representative as follows:

Mr. George A. Miller, Jr.
NOPSI Engineering
Telephone 595-2322

FILE 1006
DISTRIBUTION
WB
JH ✓
TS TMS

Mr. John Holtgreve
Page two
September 9, 1985

When the contractor has been selected, he should contact the following NOPSI representative for field coordination:

Mr. John A. Schultz
NOPSI Electric Distribution Construction
Telephone 595-3839

Approximately two (2) weeks notification is required to arrange for planned disconnection of the electric circuits.

If you have any questions or need additional information, please let me know.

Yours very truly,

Ronald E. Roberts

R. E. Roberts
Division Engineer

RER:mca
Enclosures

PARTNERS

J. BRES EUSTIS
REG. C. E.

CHARLES A. BRAGG (1916-1979)
REG. C. E.

JOHN W. ROACH, JR.
REG. C. E.

GERALD A. BRAGG
REG. C. E.

LLOYD A. HELD, JR.
REG. C. E.

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

BORINGS • TESTS • ANALYSES
3011 28TH STREET
METAIRIE, LOUISIANA 70002
P. O. BOX 8708
METAIRIE, LOUISIANA 70011
PHONE (504) 834-0157

OFFICERS

EUSTIS ENGINEERING CO., INC.
ASSOCIATED WITH
EUSTIS ENGINEERING CO.
CHAIRMAN OF THE BOARD
J. BRES EUSTIS
PRESIDENT
JOHN W. ROACH, JR.
CORP. VICE-PRESIDENT AND
CHIEF ADMINISTRATIVE OFFICER
GERALD A. BRAGG
VICE PRESIDENT AND
CHIEF ENGINEER
LLOYD A. HELD, JR.

26 September 1985

File 1006

Design Engineering Inc.
Suite 205
3330 West Esplanade
Metairie, Louisiana 70002

Attention Mr. John Holtgreve

Gentlemen:

Draft of Report
Geotechnical Investigation
OLB Project No. 2048-0304
New Orleans, Louisiana

As instructed by your Mr. John Holtgreve, we are enclosing three copies of a draft of our engineering report for the subject project. Following your review and approval, we will issue the final report.

Yours very truly,

EUSTIS ENGINEERING COMPANY

By Lloyd A. Held, Jr.
Lloyd A. Held, Jr.

LAH:bh

Enclosures

Robert G. Graves
Secretary

Department of Transportation and Development

P. O. BOX 9179
BRIDGE CITY, LA. 70094
624-1103

Edwin W. Edwards
Governor

September 27, 1985

DISTRICT NO. 02

RECEIVED
SEP 30 1985
D. E. I.

Design Engineers, Inc.
3330 West Esplanade Ave.
Suite 205
Metairie, Louisiana 70002

Attention: Mr. Thomas Smith

Dear Mr. Smith:

Attached are Plan Sheets indicating general bridge plan and steel sheet pile retaining wall at the Orleans Avenue Outfall Canal. AT I-610 BRIDGE.

If additional information is needed, please advise.

Very truly yours,

J. C. McGREW
DISTRICT ADMINISTRATOR

BY:

W. T. TAYLOR, JR.
DIST. CONST. ENGR.

ENCLOSURES:

TITLE	SHT NO.
GEN BRIDGE PLAN & ELEVATION	135
ROADWAY PLAN STA 76 TO 88	14
DETAILS OF SHEET PILE WALL EAST SIDE ONLY	70

FILE 1006
DISTRIBUTION
WB
JH
TS TMS 9/30

WTT/db

Appendix D

CONFERENCE RECORD

DATE: June 7, 1985

FILE NO.: 1006-35

SUBJECT: Orleans Avenue Canal
Flood Protection Improvement Project
Design Memorandum Report

ATTENDANCE: Mr. Earl Magner - OLB
Mr. John Holtgreve - DEI
Mr. Thomas Smith - DEI

PROGRESS - REVIEW MEETING

The purpose of this meeting was to apprise the Orleans Levee Board (OLB) representative of the status of Design Engineering, Inc. (DEI) progress to date and to review and receive comments on the basic engineering criteria, assumptions and general outline of the Design Memorandum Report. A preliminary draft of the report containing exhibits illustrating DEI engineering concepts was prepared for this meeting and a copy was given to OLB. The list of topics and exhibits reviewed with summary of comments received is briefly presented as follows:

1.0 CONTACT WITH OTHER AGENCIES:

1.1 Sewerage and Water Board - They have not as yet responded to several DEI requests for the required Orleans Canal flow characteristics.

1.2 U.S. Army Corp. of Engineers - Mr. Cecil Soileau of USCE has developed the water surface elevation profile to be used along the length of the canal for various discharge rates from the pumping station. Mr. Soileau said that he would furnish this information to us.

1.3 Utilities - Information requested has been received from NOPSI, SCB and S&WB and DEI is working on locations.

1.4 City Park - The Park has not been contacted thus far. When details concerning the Park are firm they will be contacted.

1.5 New Orleans Recreation Department - NORD has transmitted the plans for Gernon Brown Gym building. A retaining wall is proposed at the toe of the raised levee where the building would intersect the toe.

1.6 Bridges - Plans for all the bridges crossing the canal have been obtained.

2.0 REPORT OUTLINE:

The appendix of the report will include pertinent correspondence from outside/other agencies.

3.0 COST ESTIMATE DATA:

Prices obtained from USCE tend to be higher than bid prices on past OLB projects.

4.0 I-WALL:

4.1 Safety Factor may be reduced from USCE required figures for interim protection. The minimum acceptable is 1.15. However, whatever is constructed must be consistent with a permanent solution, (i.e. creditable).

4.2 OLB does not want elevations reduced but strength safety factor can be reduced.

4.3 Do not "lock-in" a reduced safety factor.

4.4 OLB wishes maximum protection for least dollar amount with interim construction.

4.5 DEI will study alternatives and make an illustration to clarify interaction of safety factor, cost, construction phasing, and options for the I-wall.

5.0 TYPICAL LEVEE SECTION:

5.1 Future increase in flow area/section data proposed by S&WB has not been received.

5.2 The stability of the existing retaining wall along Orleans Avenue should be checked for the new water surface elevation conditions.

6.0 LEVEE NEAR LAKE:

USCE probably will give required wave height data. In the interim, DEI will assume logical data and adjust when USCE data furnished.

7.0 BRIDGE ALTERNATIVES:

7.1 Filmore Avenue bridge is the lowest. It has a roadway surface elevation of 5.55' at the East levee baseline. This compares with a required flood gate or wall elevation of about 14.5'. Other bridges are slightly higher.

7.2 Three alternative solutions at Filmore bridge have been cost estimated. These were briefly described ~~in~~ to OLB.

7.3 The "Raise the Bridge" alternatives were sketched and briefly discussed.

8.0 USCE CRITERIA:

A memo dated April 11, 1985, presenting the basic criteria to be used had been received from the USCE. Clarification concerning design water surface elevation for levees and walls still needs confirmation. DEI will obtain these clarifications.

TMS/drb

September 11, 1985

Mr. Earl J. Magner, Jr.
Chief Engineer
Board of Levee Commissioners
Orleans Levee District
Suite 202, Administration Building
New Orleans Lakefront Airport
New Orleans, Louisiana 70126

RE: Orleans Avenue Canal and Levee Raising
DEI Project No. 1005-18

We are considering a phased construction project for the Orleans Canal flood protection project. Under consideration at this time are two schemes that would increase the level of flood protection in the shortest time. These are:

1) Raise the levee from Robert E. Lee to the lake and increase flood protection at the Robert E. Lee bridge at the Orleans Canal; and,

2) Provide flood protection to the high levee plan roadway crossing at Harrison Avenue and Filmore Avenue in addition to (1) above.

3) Complete the project subsequent to (1) and/or (2) above in 36 months.

We would like the opportunity to discuss this with you in detail. Please advise of a time.

With best regards, I am

Yours very truly,

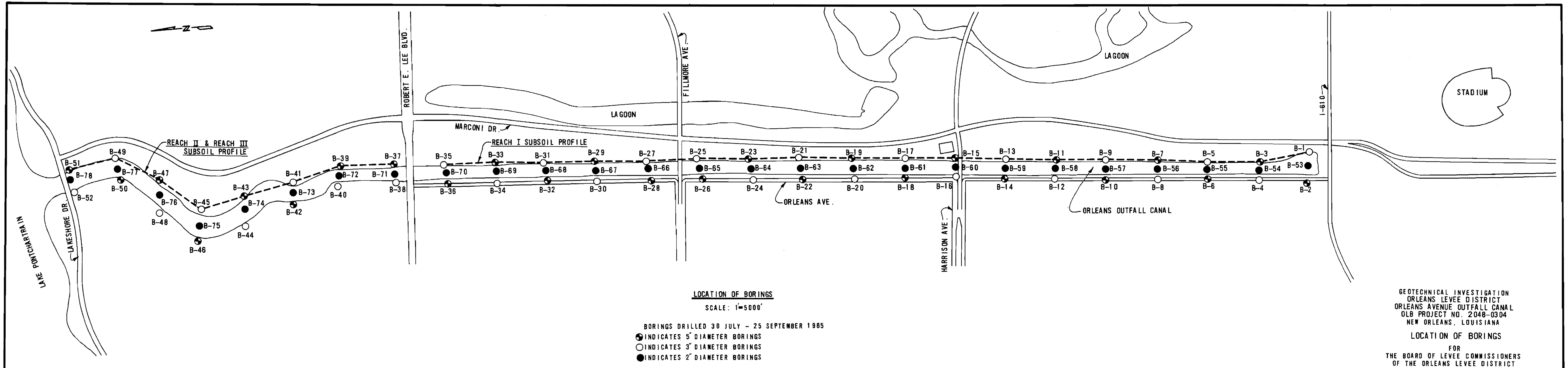
DESIGN ENGINEERING, INC.

Walter Baudier

WB:drb

Design Engineering Inc.
3330 West Esplanade, Suite 205, Metairie, Louisiana 70002, (504) 836-2155

APPENDIX A



LOCATION OF BORINGS

SCALE: 1"=5000'

BORINGS DRILLED 30 JULY - 25 SEPTEMBER 1985

◐ INDICATES 5" DIAMETER BORINGS
○ INDICATES 3" DIAMETER BORINGS
● INDICATES 2" DIAMETER BORINGS

GEOTECHNICAL INVESTIGATION
ORLEANS LEVEE DISTRICT
ORLEANS AVENUE OUTFALL CANAL
OLB PROJECT NO. 2048-0304
NEW ORLEANS, LOUISIANA

LOCATION OF BORINGS

FOR
THE BOARD OF LEVEE COMMISSIONERS
OF THE ORLEANS LEVEE DISTRICT
NEW ORLEANS, LOUISIANA

DESIGN ENGINEERING, INC.
METAIRIE, LOUISIANA

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
SEPTEMBER 1985 METAIRIE, LA.

FIGURE 1

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

BORING LOCATIONS AND ELEVATIONS

Boring Number	Elevation NGVD	Station	Baseline Offset
1	9.94	4+18	17' Southwest
2	- 1.70	4+36	23' Left
3	10.04	8+61	5' Left
4	- 1.54	9+00	23' Left
5	9.88	14+26	4' Left
6	5.60	14+17	4' Right
7	9.98	18+22	5' Left
8	- 1.77	18+67	24.5' Left
9	9.83	24+57	4.5' Left
10	5.73	24+94	2' Left
11	9.83	27+97	4' Left
12	- 1.27	28+38	24' Left
13	9.83	31+80	2' Left
14	- 3.30	31+38	28' Left
15	9.81	37+54	2' Left
16	- 1.24	37+58	24.5' Left
17	9.81	41+65	2' Left
18	- 1.60	41+40	23' Left
19	10.01	47+40	1.5' Left
20	- 1.87	47+31	25' Left
21	9.71	53+20	0.5' Left
22	- 4.47	51+80	25' Left
23	9.56	57+97	1' Right
24	- 4.27	58+44	25' Left
25	9.61	62+88	1.5' Right
26	- 4.27	62+73	25' Left
27	9.06	64+27	5' Right
28	- 5.48	67+33	25' Left
29	9.81	72+40	5' Right
30	- 5.29	72+22	25' Left

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

BORING LOCATIONS AND ELEVATIONS
(Continued)

Boring Number	Elevation NGVD	Station	Baseline Offset
31	9.71	77+27	5.5' Right
32	- 6.21	77+24	25' Left
33	9.26	82+90	6' Right
34	4.70	83+01	3.5' Left
35	9.16	87+34	4.5' Right
36	- 5.20	87+26	25' Left
37	9.04	93+97	1.5' Left
38	8.89	93+67	-----
39	9.14	98+52	11' Right
40	9.69	90+08	1.5' Left
41	9.22	103+37	-----
42	9.49	103+44	-----
43	9.42	107+69	3' Left
44	9.90	106+80	-----
45	9.67	113+33	-----
46	9.45	114+05	8' Right
47	9.19	118+76	2' Left
48	9.65	117+92	-----
49	10.39	123+77	-----
50	10.09	123+03	-----
51	12.89	128+82	1.5' Left
52	8.59	128+20	4' Right

LOG OF BORING

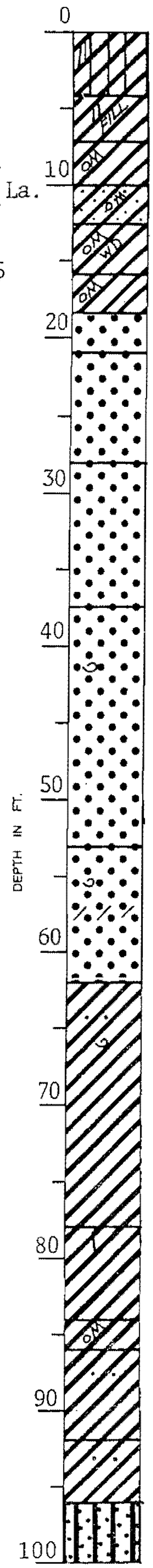
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

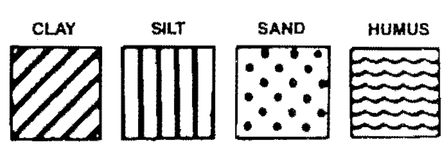
Boring No. 1 **Soil Technician** A. J. Mayeux **Date** 17 September 1985
Ground Elev. 9.94 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0	4.0	Stiff tan & gray silty clay w/silt		
					pockets		
2	5.0	5.5	4.0	7.0	Stiff gray & tan clay w/silt pockets		
					& fill		
3	8.0	8.5	7.0	10.0	Medium stiff gray & tan clay w/organic		
					matter		
4	11.0	11.5	10.0	12.5	Soft gray sandy clay w/organic matter		
5	14.0	14.5	12.5	16.0	Medium stiff gray clay w/organic matter		
					& wood		
6	17.0	17.5	16.0	18.5	Medium stiff gray clay w/some organic		
					matter		
7	18.5	20.0	18.5	21.0	Dense gray sand	10	43
8	21.0	22.5	21.0		Very dense gray sand	12	50=10"
9	23.5	25.0			Ditto	13	50=10"
10	26.0	27.5		28.0	Ditto	11	50=9"
11	28.5	30.0	28.0		Medium dense gray sand	6	21
12	33.5	35.0		37.5	Ditto	6	29
13	38.5	40.0	37.5		Dense gray sand w/shell fragments	11	48
14	43.5	45.0			Ditto	10	32
15	48.5	50.0		53.0	Ditto	10	38
16	53.0	53.5	53.0		Medium dense gray sand w/shell	5	11
					fragments & clay layers		
17	58.5	60.0		62.0	Ditto	5	14
18	63.5	65.0	62.0		Medium stiff gray clay w/sand pockets	1	5
					& shell fragments		
19	69.0	69.5			Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.



Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 1 (Cont'd) Soil Technician A. J. Mayeux Date 17 September 1985

Ground Elev. 9.94 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
20	74.0	74.5		78.0	Medium stiff gray clay w/sand pockets		
					& shell fragments		
21	79.0	79.5	78.0	84.0	Stiff gray clay w/silt lenses		
22	84.0	84.5	84.0	86.0	Stiff gray clay w/organic matter		
23	89.0	89.5	86.0	92.0	Stiff greenish-gray & tan clay w/sand		
					pockets		
24	94.0	94.5	92.0	96.0	Very stiff greenish-gray & tan clay		
					w/sand pockets		
25	98.0	99.5	96.0	100.0	Compact tan & gray sandy silt	8	26

DEPTH IN FT.

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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Remarks:

CLAY SILT SAND HUMUS

Predominant type shown heavy. Modifying type shown light.

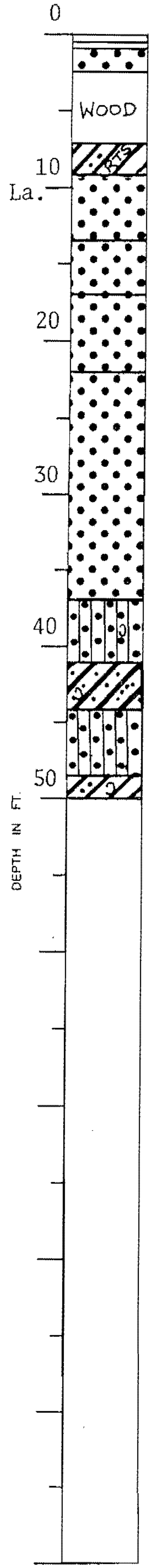
LOG OF BORING
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 2 Soil Technician George Hardee Date 21 September 1985

Ground Elev. -1.70 Datum NGVD Gr. Water Depth

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.3	Asphalt w/gravel		
			0.3	1.0	Medium compact shells		
1	1.0	2.5	1.0	2.5	Dense tan fine sand	11	36
2	5.5	7.0	2.5	7.0	Wood	2	7
3	8.5	9.0	7.0	9.0	Medium stiff gray clay w/sand pockets		
					& roots		
4	9.0	10.5	9.0		Dense gray fine sand	2	30
5	11.5	13.0		13.5	Ditto	8	45
6	14.0	15.5	13.5	17.0	Very dense gray fine sand	12	50=9"
7	18.5	20.0	17.0	22.0	Dense gray fine sand	5	31
8	23.5	25.0	22.0		Very dense gray fine sand	11	50=8"
9	28.5	30.0			Ditto	14	50=9"
10	33.5	35.0		37.0	Ditto	14	50=8"
11	38.5	40.0	37.0	41.0	Medium dense gray silty sand w/shells	9	18
12	43.0	44.0	41.0	44.0	Medium stiff gray sandy clay w/shells		
					& large sand pockets		
13	44.0	45.5	44.0	48.5	Medium dense gray silty sand	1	25
14	48.5	50.0	48.5	50.0	Medium stiff gray clay w/sand pockets	4	3
					& shells		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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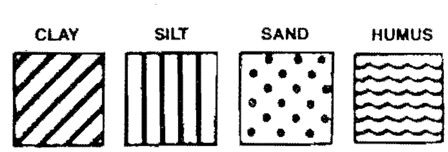


Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

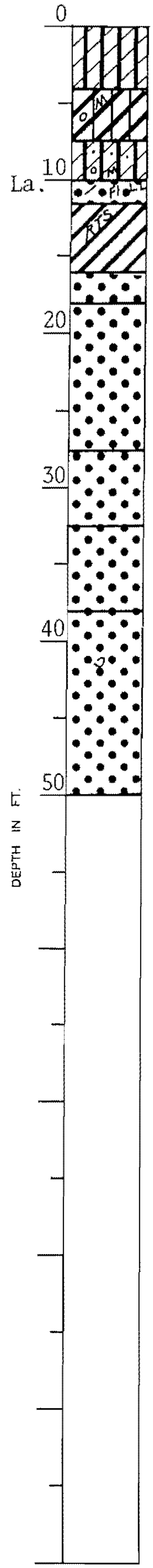
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie Louisiana

Boring No. 3 **Soil Technician** A. J Mayeux **Date** 3 September 1985

Ground Elev. 10.04 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	3.0	0.0	4.0	Compact tan & gray clayey silt		
2	5.0	6.0	4.0	7.5	Medium stiff gray & tan silty clay		
					w/some organic matter		
3	8.0	9.0	7.5	10.0	Loose dark brown clayey silt w/sand		
					layers & organic matter		
4	11.0	11.5	10.0	11.5	Loose tan sand w/some clay (fill)		
5	14.0	15.0	11.5	16.0	Soft gray clay w/roots		
6	16.0	17.5	16.0	18.0	Very dense gray sand	12	50=10"
7	18.5	20.0	18.0		Dense gray sand	12	35
8	21.0	22.5			Ditto	6	31
9	23.5	25.0		27.5	Ditto	10	42
10	28.5	30.0	27.5	32.5	Medium dense gray sand	5	22
11	33.5	35.0	32.5	38.0	Dense gray sand	10	35
12	38.5	40.0	38.0		Medium dense gray sand w/shell	5	25
					fragments		
13	43.5	45.0			Ditto	8	30
14	48.5	50.0		50.0	Ditto	8	27



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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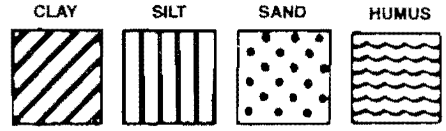
CLAY SILT SAND HUMUS



Remarks: 5" Diameter Boring

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

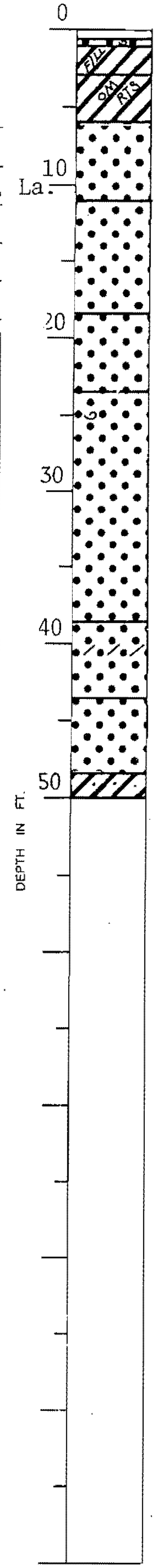
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 4 Soil Technician R. Elkins Date 19 September 1985

Ground Elev. -1.54 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
			0.0	0.5	Asphalt		
			0.5	1.0	Medium compact tan & white sand &		
					shells		
1	1.5	2.5	1.0	3.0	Medium stiff gray & tan clay		
					w/miscellaneous fill		
2	4.0	5.0	3.0	6.0	Soft gray clay w/organic matter & roots		
3	6.0	7.5	6.0		Dense gray sand	5	34
4	8.5	10.0		11.0	Ditto	8	34
5	11.0	12.5	11.0		Very dense gray sand	12	50=10"
6	13.5	15.0		18.5	Ditto	26	50=5
7	18.5	20.0	18.5	23.5	Dense gray sand	10	35
8	23.5	25.0	23.5		Very dense gray sand w/shell fragments	19	50=10"
9	28.5	30.0			Ditto	25	50=6"
10	33.5	35.0		38.5	Ditto	15	50=8"
11	38.5	40.0	38.5	43.5	Medium dense gray sand w/clay layers	5	16
12	43.5	45.0	43.5	48.5	Dense gray sand	12	41
13	48.5	50.0	48.5	50.0	Very soft gray clay w/sand layers	2	4



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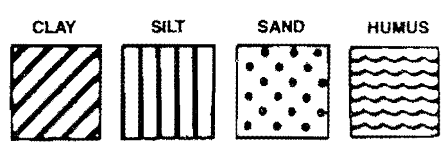
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

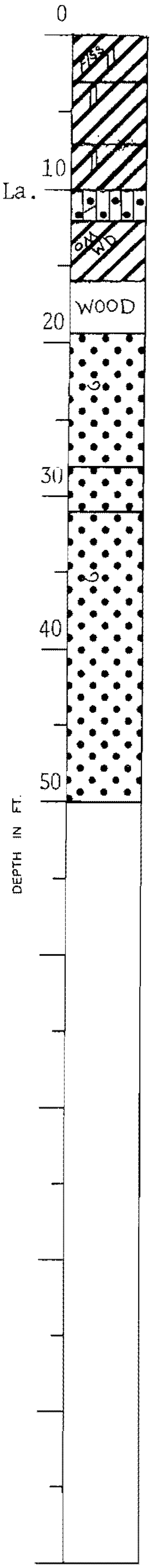
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304. New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 5 Soil Technician A. J. Mayeux Date 16 September 1985

Ground Elev. 9.88 Datum NGVD Gr. Water Depth See Text

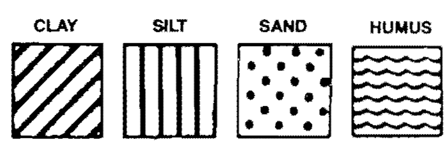
Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0	3.0	Medium stiff brown & gray fissured		
					clay w/silt pockets		
2	5.0	5.5	3.0	7.0	Very stiff tan & gray clay w/silt		
					pockets		
3	8.0	8.5	7.0	10.0	Medium stiff gray clay w/silt pockets		
	11.0	11.5	10.0	12.0	Loose tan silty sand w/clay		
4	14.0	14.5	12.0	16.0	Soft gray clay w/organic matter & wood		
5	16.0	17.5	16.0	19.5	Wood w/some clay	4	18
6	19.5	21.0	19.5		Dense gray sand w/shell fragments	8	32
7	22.0	23.5			Ditto	10	35
8	25.0	26.5		28.0	Ditto	12	40
9	28.5	30.0	28.0	31.0	Very dense gray sand	15	50=10"
10	33.5	35.0	31.0		Dense gray sand w/shell fragments	13	37
11	38.5	40.0			Ditto	15	40
12	43.5	45.0			Ditto	14	38
13	48.5	50.0		50.0	Ditto	6	34



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

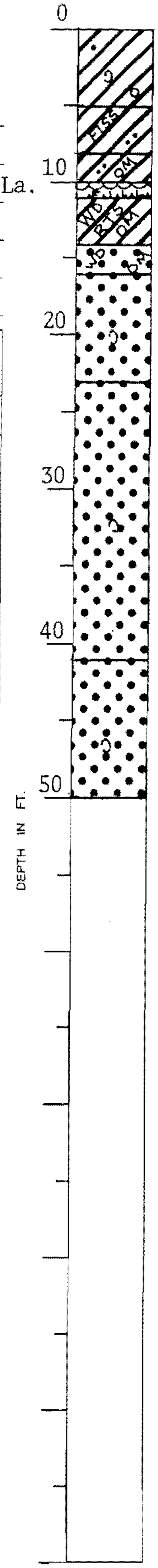
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 6 Soil Technician A. J. Mayeux Date 21 September 1985

Ground Elev. 5.60 Datum NGVD Gr. Water Depth

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	3.0	0.0	5.0	Medium stiff brown & gray clay w/sand,		
					shell fragments & gravel (fill)		
2	5 0	6.0	5.0	8.0	Soft brown & gray fissured clay w/sand		
					pockets		
3	8.0	9.0	8.0	10.0	Soft dark gray clay w/sand pockets &		
					organic matter		
			10.0	11.0	Humus & miscellaneous fill		
4	11.0	12.0	11.0	14.0	Very soft gray clay w/wood, roots &		
					organic matter		
5	14.0	15.5	14.0	16.0	Medium dense gray sand w/wood &	2	28
					organic matter		
6	16.5	18.0	16.0		Medium dense gray sand w/shell	4	10
					fragments		
7	19.0	20.5		23.0	Ditto	6	22
8	23.5	25.0	23.0		Dense gray sand w/shell fragments	15	46
9	28.5	30.0			Ditto	11	31
10	33.5	35.0			Ditto	10	34
11	38.5	40.0		41.0	Ditto	5	33
12	43.5	45.0	41.0		Medium dense gray sand w/shell	6	19
					fragments		
13	48.5	50.0		50.0	Ditto	4	19



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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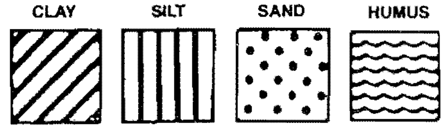
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

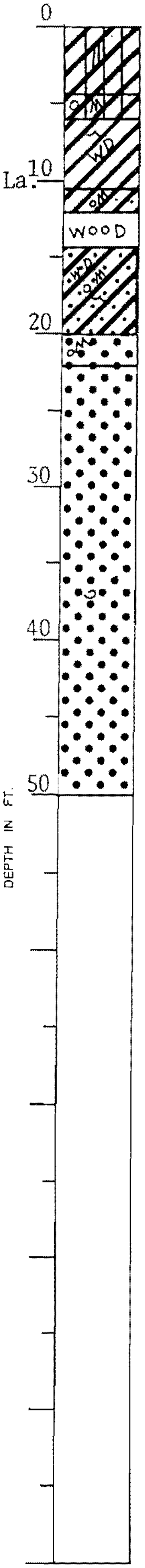
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 7 Soil Technician A. J. Mayeux Date 31 August 1985

Ground Elev. 9.98 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	3.0	0.0	4.5	Stiff tan & gray silty clay w/silt		
					pockets		
2	5.0	6.0	4.5	6.0	Stiff gray & tan silty clay w/organic		
					matter		
3	8.0	9.0	6.0	10.5	Medium stiff dark gray clay w/humus &		
					wood		
4	11.0	12.0	10.5	12.0	Very soft gray clay w/organic matter		
					& sand pockets & layers		
			12.0	14.5	Wood		
5	18.5	19.0	14.5	20.0	Extremely soft gray sandy clay w/wood,		
					organic matter & humus		
6	20.0	21.5	20.0	22.0	Dense gray sand w/some organic matter	8	35
7	22.5	24.0	22.0		Dense gray sand	12	38
8	25.0	26.5			Ditto	8	38
9	28.5	30.0			Ditto	15	37
10	33.5	35.0			Ditto	8	35
11	38.5	40.0			Dense gray sand w/shell fragments	12	42
12	43.5	45.0			Ditto	12	45
13	48.5	50.0		50.0	Ditto	12	46



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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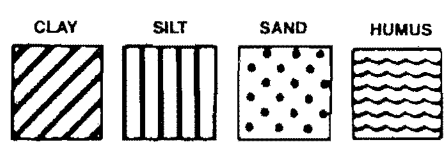


Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

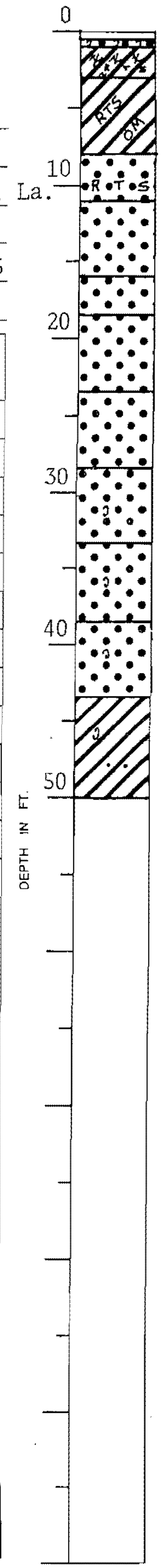
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 8 Soil Technician R. Elkins Date 19 September 1985

Ground Elev. -1.77 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.5	Asphalt		
			0.5	1.0	Medium compact tan & white sand & shells		
1	1.0	2.0	1.0	3.0	Soft to medium stiff gray & brown		
					clay w/organic clay layers, roots &		
					humus		
2	4.5	5.5	3.0	8.0	Very soft brown & gray clay w/roots &		
					organic matter		
3	8.5	10.0	8.0	11.0	Dense gray sand w/roots	3	36
4	11.0	12.5	11.0		Medium dense gray sand	7	28
5	13.5	15.0		16.0	Ditto	4	19
6	16.0	17.5	16.0	18.5	Very dense gray sand	15	50=9"
7	18.5	20.0	18.5	23.5	Medium dense gray sand	6	28
8	23.5	25.0	23.5	28.5	Very dense gray sand	14	50=8"
9	28.5	30.0	28.5	33.5	Dense gray sand w/shell fragments	10	43
10	33.5	35.0	33.5	38.5	Loose gray sand w/shell fragments	5	8
11	38.5	40.0	38.5	43.5	Medium dense gray sand w/shell	8	22
					fragments		
12	43.5	45.0	43.5		Medium stiff gray clay w/shell	1	2
					fragments & sand pockets		
13	48.0	49.0		50.0	Medium stiff gray clay w/shell		
					fragments		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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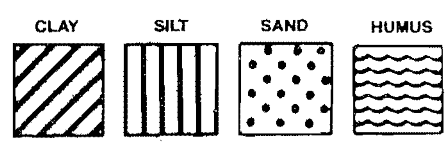
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

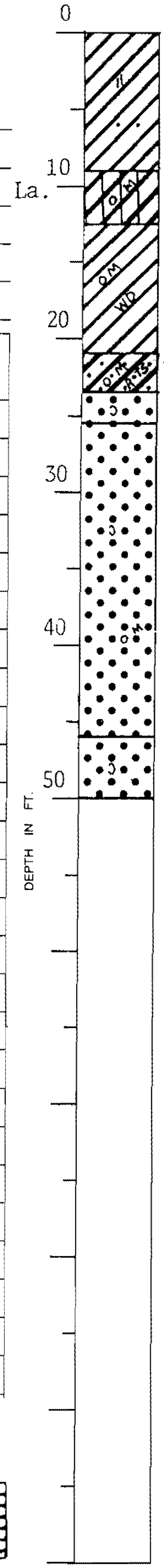
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 9 Soil Technician A. J. Mayeux Date 16 September 1985

Ground Elev. 9.83 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	2.5	0.0		Stiff tan & gray clay w/silt & sand		
					pockets		
2	5.0	5.5			Ditto		
3	8.0	8.5		9.0	Ditto		
4	11.0	11.5	9.0	12.5	Medium stiff gray silty clay w/organic		
					matter		
5	14.0	14.5	12.5		Soft gray clay w/organic matter & wood		
6	19.0	19.5		21.0	Ditto		
7	23.0	23.5	21.0	23.5	Soft gray sandy clay w/organic matter		
					& roots		
8	23.5	25.0	23.5	25.5	Dense gray sand w/shell fragments	7	36
9	26.0	27.5	25.5		Medium dense gray sand w/shell	6	26
					fragments		
10	28.5	30.0			Medium dense gray sand w/some organic	7	23
					matter		
11	33.5	35.0			Ditto	5	17
12	38.5	40.0			Ditto	5	13
13	43.5	45.0		46.0	Ditto	3	16
14	48.5	50.0	46.0	50.0	Medium dense gray sand w/shell fragments	4	16



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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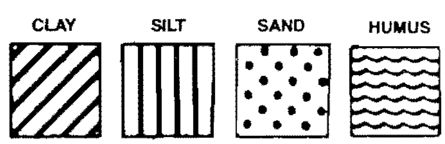


Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

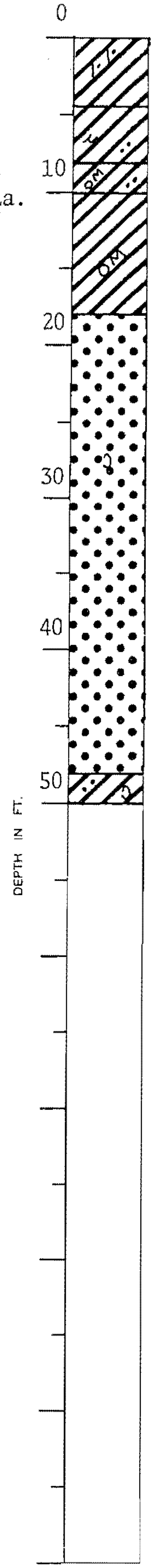
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 10 Soil Technician A. J. Mayeux Date 21 September 1985

Ground Elev. 5.73 Datum NGVD Gr. Water Depth



Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	3.0	0.0	4.5	Medium stiff brown & gray clay w/silty		
					sand pockets		
2	5.0	6.0	4.5	8.0	Very soft to soft brown clay w/humus		
					& sand pockets		
3	8.0	9.0	8.0	10.0	Very soft dark gray clay w/organic		
					matter & sand pockets		
4	11.0	12.0	10.0		Very soft brown & gray clay w/organic		
					matter		
5	15.0	16.0		18.0	Very soft brown & gray clay w/humus		
					& roots		
6	18.5	20.0	18.0		Medium dense gray sand	2	16
7	21.0	22.5			Ditto	5	18
8	23.5	25.0			Medium dense gray sand w/shell	3	15
					fragments		
9	26.0	27.5			Ditto	3	15
10	28.5	30.0			Ditto	4	22
11	33.5	35.0			Ditto	6	18
12	38.5	40.0			Ditto	6	20
13	43.5	45.0		48.0	Ditto	8	22
14	48.5	50.0	48.0	50.0	Soft gray clay w/sand pockets & shell	3	3
					fragments		

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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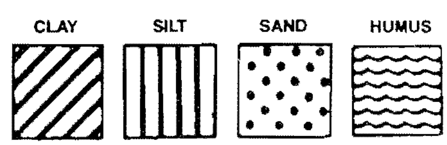
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

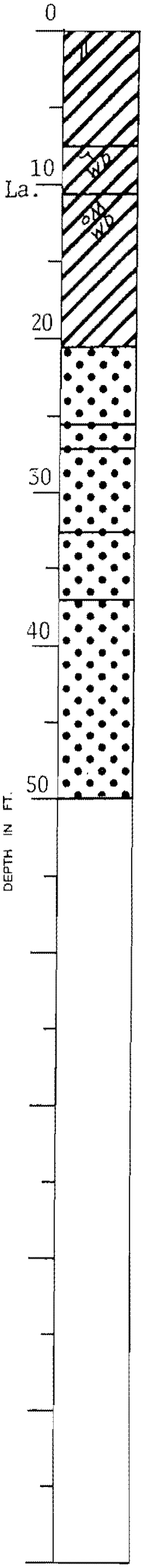
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering Inc., Metairie, Louisiana

Boring No. 11 Soil Technician A. J. Mayeux Date 31 August 1985

Ground Elev. 9.83 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	3.0	0.0		Stiff tan & gray clay w/silt pockets		
2	5.0	6.0		7.5	Ditto		
3	8.0	9.0	7.5	10.5	Medium stiff dark gray clay w/humus		
					& wood		
4	11.0	12.0	10.5		Soft gray clay w/organic matter & wood		
5	14.0	15.0		20.5	Ditto		
6	22.5	24.0	20.5	25.5	Dense gray sand	7	37
7	25.0	26.5	25.5	27.0	Very dense gray sand	9	50=10"
8	27.5	29.0	27.0		Dense gray sand	13	40
9	30.5	32.0		32.5	Ditto	12	38
10	33.5	35.0	32.5	37.0	Medium dense gray sand	5	21
11	38.5	40.0	37.0		Dense gray sand	11	24
12	43.5	45.0			Ditto	8	32
13	48.5	50.0		50.0	Ditto	10	37



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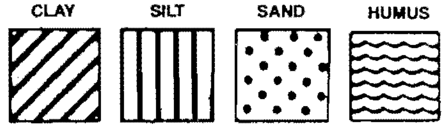
Remarks:

CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

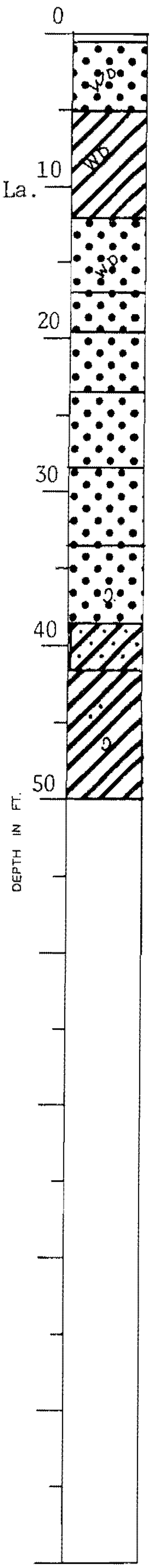
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 12 Soil Technician R. Elkins Date 19 September 1985

Ground Elev. -1.27 Datum NGVD Gr. Water Depth

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.5	Asphalt		
1	3.0	4.5	0.5	5.0	Loose gray sand w/wood	3	10
2	5.0	6.5	5.0		Very soft gray clay w/wood	1	2
	7.5	8.5			Ditto		
3	10.5	11.5		12.0	Ditto		
4	12.0	13.5	12.0		Loose gray sand w/wood	1	7
5	14.5	16.0		17.0	Ditto	1	7
6	17.0	18.5	17.0	19.5	Medium dense gray sand	3	12
7	19.5	21.0	19.5	23.5	Loose gray sand	2	8
8	23.5	25.0	23.5	28.5	Medium dense gray sand	5	28
9	28.5	30.0	28.5	33.5	Dense gray sand	10	37
10	33.5	35.0	33.5	38.5	Medium dense gray sand w/shell	2	18
					fragments		
11	38.5	40.0	38.5	41.5	Soft gray sandy clay	7	6
12	43.0	44.0	41.5		Medium stiff gray clay w/sand pockets		
					& shell fragments		
13	48.0	49.0		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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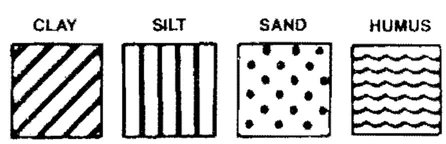
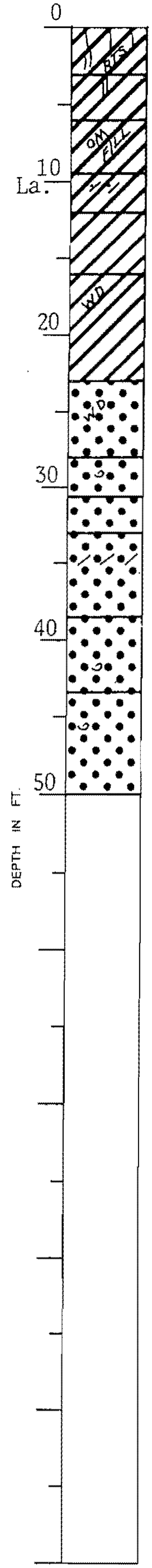
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 13 **Soil Technician** R. Elkins **Date** 9 September 1985

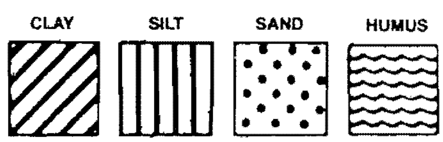
Ground Elev. 9.83 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	1.5	2.5	0.0	3.0	Medium stiff brown clay w/silt layers		
					& pockets & grass roots		
2	4.5	5.5	3.0	6.0	Very soft tan & gray clay w/silt		
					pockets		
3	7.5	8.5	6.0	9.5	Soft brown clay w/organic matter (fill)		
4	10.5	11.5	9.5	12.0	Soft dark gray clay w/sandy clay		
					pockets		
5	13.5	14.5	12.0	16.0	Medium stiff gray clay		
6	18 0	19.0	16.0	23.0	Soft gray & tan clay w/wood		
7	23.0	24.0	23.0	28.0	Loose gray fine sand w/wood		
8	28.0	29.5	28.0	30.5	Medium dense gray fine sand w/trace	8	16
					of shell fragments		
9	30.5	32.0	30.5	33.0	Dense gray fine sand	10	37
10	33.0	34.5	33.0		Medium dense gray fine sand w/clay	3	13
					layers		
11	35.5	37.0		38.5	Medium dense gray fine sand	4	16
12	38.5	40.0	38.5	43.5	Dense gray fine sand w/shell fragments	8	45
13	43.5	45.0	43.5		Very dense gray fine sand w/shell	14	50=7"
					fragments		
14	48.5	50.0		50.0	Ditto	18	50=10"

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

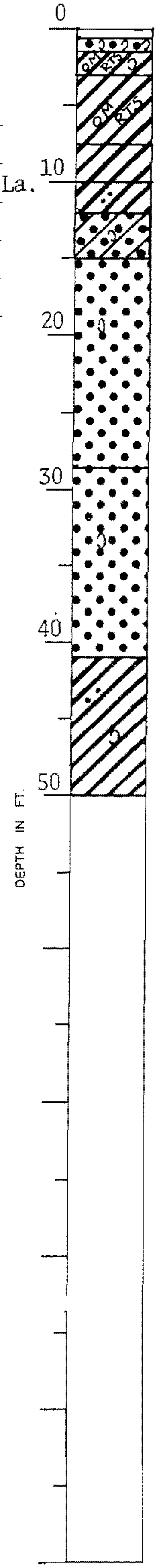
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 14 Soil Technician A. J. Mayeux Date 20 September 1985

Ground Elev. -3.30 Datum NGVD Gr. Water Depth

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
			0.0	0.5	Asphalt		
			0.5	1.5	Sand & shell fill		
1	2.0	3.0	1.5	3.0	Soft black & gray clay w/organic matter,		
					roots & shell fragments		
2	5.0	6.0	3.0	7.5	Very soft gray & black clay w/organic		
					matter & roots		
3	8.0	9.0	7.5	10.0	Soft gray clay		
4	11.0	12.0	10.0	12.0	Very soft gray clay w/sand pockets		
5	12.0	13.5	12.0	15.0	Loose gray clayey sand w/shell	1	5
					fragments		
6	15.0	16.5	15.0		Medium dense gray sand w/shell	3	11
					fragments		
7	18.5	20.0			Ditto	7	19
8	21.0	22.5			Ditto	3	11
9	23.5	25.0		28.5	Ditto	5	16
10	28.5	30.0	28.5		Dense gray sand w/shell fragments	6	32
11	33.5	35.0			Ditto	10	48
12	38.5	40.0		41.0	Ditto	10	35
13	43.5	45.0	41.0		Medium stiff gray clay w/sand pockets	3	6
					& shell fragments		
14	49.0	50.0		50.0	Ditto		

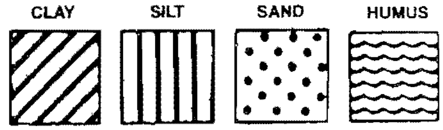


*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks:

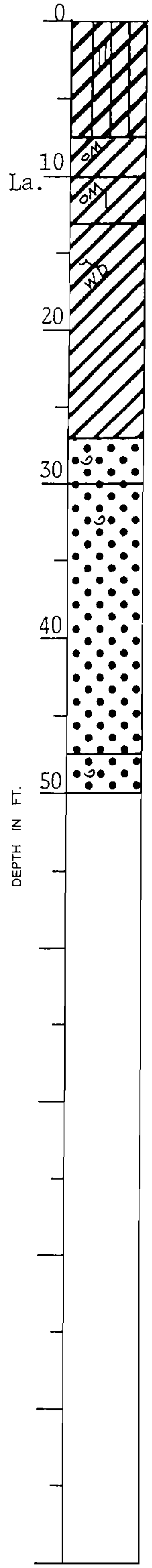
CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 15 Soil Technician A. J. Mayeux Date 31 August 1985

Ground Elev. 9.81 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	3.0	0.0		Extremely stiff tan & gray silty clay		
					w/silt pockets		
2	5.0	6.0		7.5	Ditto		
3	8.0	9.0	7.5	10.0	Medium stiff gray & tan clay w/organic		
					matter		
4	11.0	12.0	10.0	13.0	Very soft gray clay w/organic matter		
					& silt		
5	14.0	15.0	13.0		Soft gray clay w/humus & wood		
6	19.0	20.0		27.0	Ditto		
7	27.5	29.0	27.0	30.0	Loose gray sand w/shell fragments		
8	30.0	31.5	30.0		Medium dense gray sand w/shell	4	20
					fragments		
9	32.5	34.0			Ditto	5	16
10	35.0	36.5			Ditto	5	19
11	38.5	40.0			Ditto	9	27
12	43.5	45.0		47.5	Ditto	10	35
13	48.5	50.0	47.5	50.0	Dense gray sand w/shell fragments	14	45

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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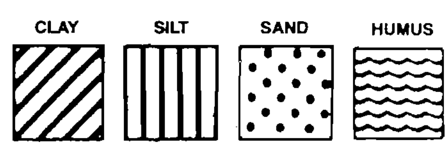


Remarks: 5" Diameter Boring

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

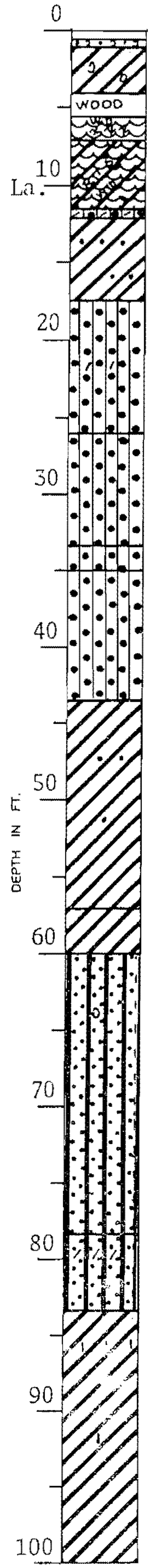
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 16 Soil Technician S. Porta & R. Elkins Date 20 September 1985

Ground Elev. -1.24 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	0.0	0.5	0.0	0.5	Asphalt		
	0.5	1.0	0.5	1.0	Shells & sand		
1	2.5	3.0	1.0	4.0	Medium stiff brown & gray clay w/shells		
					& gravel		
	4.0	5.5	4.0	5.5	Wood		
2	5.5	6.0	5.5	7.0	Soft brown humus w/wood & organic clay		
					layers		
3	8.5	9.0	7.0	11.5	Soft brown organic clay w/roots & wood		
4	11.5	12.0	11.5	12.0	Loose gray silty sand w/clay pockets		
					& layers		
5	12.0	13.5	12.0	17.5	Very soft gray clay w/sand layers &		
					pockets		
6	17.5	18.0	17.5		Loose gray silty sand w/clay pockets		
7	18.0	19.5			Ditto	2	9
8	20.5	22.0			Ditto	3	9
9	23.5	25.0		26.0	Ditto	3	13
10	26.0	27.5	26.0		Medium dense gray silty sand	2	15
11	28.5	30.0		33.5	Ditto	6	23
12	33.5	35.0	33.5	35.0	Very dense gray silty sand	9	50=10"
13	38.5	40.0	35.0	43.5	Loose greenish-gray silty sand	9	12
14	43.5	45.0	43.5		Soft gray clay w/sand pockets	1	2
15	49.5	50.0			Medium stiff gray clay w/sand pockets		
					& sand		
16	54.5	55.0		57.0	Medium stiff gray clay		
17	59.5	60.0	57.0	60.0	Stiff greenish-gray & tan clay		
					(Continued)		



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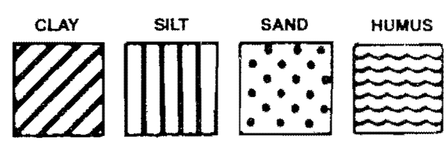

Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 16 (Cont'd) **Soil Technician** S. Porta & R. Elkins **Date** 20 September 1985

Ground Elev. -1.24 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
18	60.0	61.0	60.0		Medium dense gray sandy silt w/shell		
					fragments		
19	61.0	62.5			Medium dense gray sandy silt	6	15
20	63.5	65.0			Ditto	8	17
21	66.0	67.5			Ditto	6	15
22	68.5	70.0			Ditto	5	27
23	73.5	75.0		78.5	Ditto	11	22
24	78.5	80.0	78.5	83.5	Medium dense gray & tan sandy silt	6	22
					w/clay layers		
25	83.5	85.0	83.5		Stiff gray clay w/silt layers	3	5
26	88.0	89.0			Stiff gray clay w/silt lenses		
27	93.0	94.0			Ditto		
28	98.0	99.0		100.0	Ditto		

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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Remarks:

CLAY SILT SAND HUMUS

Predominant type shown heavy. Modifying type shown light.

DEPTH IN FT.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

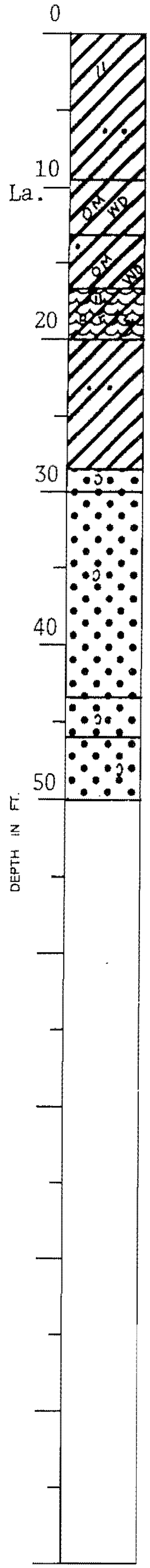
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 17 Soil Technician A. J. Mayeux Date 16 September 1985

Ground Elev. 9.81 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	2.5	0.0		Stiff to very stiff tan & gray clay		
					w/silt & sand pockets		
2	5.0	5.5			Ditto		
3	8.0	8.5		9.5	Ditto		
4	11.0	11.5	9.5	13.0	Soft gray clay w/organic matter & wood		
5	14.0	14.5	13.0	16.5	Soft gray clay w/sand, organic matter		
					& wood		
6	19.0	19.5	16.5	20.0	Soft gray organic clay w/silt pockets		
					& roots		
7	24.0	24.5	20.0	28.5	Soft gray clay w/sand pockets		
8	29.0	29.5	28.5	30.0	Very loose gray sand w/shell fragments		
9	30.0	31.5	30.0		Medium dense gray sand w/shell fragments	4	16
10	32.5	34.0			Ditto	3	11
11	35.0	36.5			Ditto	5	13
12	38.5	40.0		43.5	Ditto	5	14
13	43.5	45.0	43.5	46.0	Dense gray sand w/shell fragments	8	34
14	48.5	50.0	46.0	50.0	Medium dense gray sand w/shell fragments	7	17



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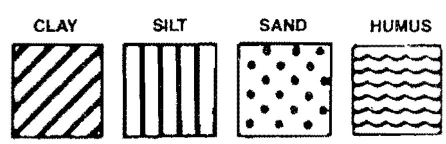
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

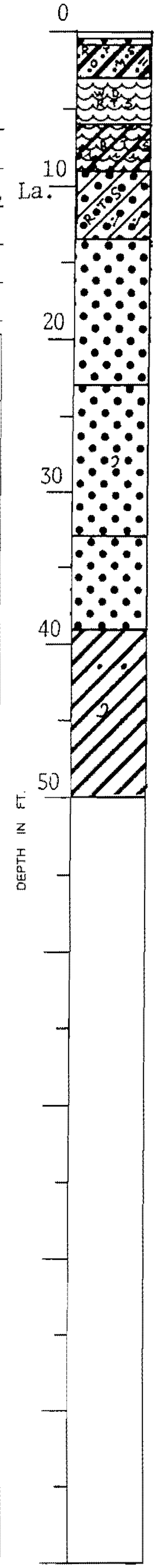
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc , Metairie, Louisiana

Boring No. 18 Soil Technician George Hardee Date 20 September 1985

Ground Elev. -1.60 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.5	Asphalt w/gravel		
			0.5	0.9	Very loose gray coarse sand		
1	1.0	2.5	0.9	3.0	Medium stiff dark gray sandy clay	1	5
					w/roots, organic matter & clay pockets		
2	5.5	6.0	3.0	6.0	Loose brown humus w/wood & roots		
3	8.0	8.5	6.0	9.0	Very soft brown organic clay w/roots		
					& humus layers		
4	11.5	12.0	9.0	13.5	Loose gray clayey sand w/roots & sandy		
					clay pockets		
5	15.5	17.0	13.5		Loose gray fine sand	2	5
6	18.0	19.5			Ditto	1	5
7	20.5	22.0		23.0	Ditto	2	9
8	23.0	24.5	23.0		Medium dense gray fine sand	4	12
9	25.5	27.0			Medium dense gray fine sand w/shells	2	19
10	28.5	30.0		33.0	Medium dense gray fine sand	7	30
11	33.5	35.0	33.0	39.0	Very dense gray fine sand	12	50=8"
12	38.5	40.0	39.0		Medium stiff gray clay	8	4
13	43.5	44.5			Medium stiff gray clay w/sand pockets		
					& shells		
14	48.5	49.5		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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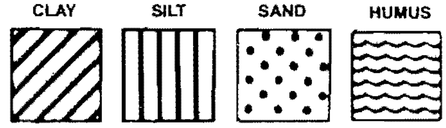
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

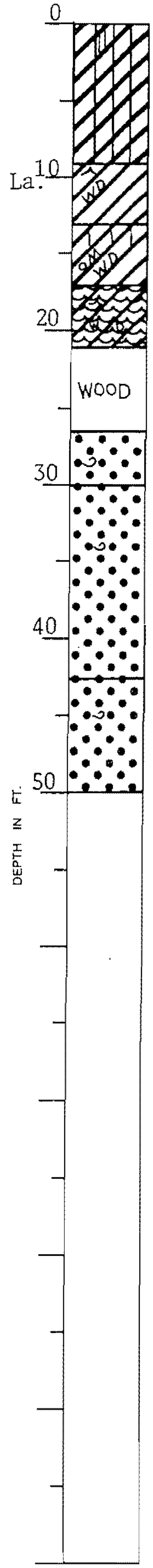
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc , Metairie, Louisiana

Boring No. 19 Soil Technician A. J. Mayeux Date 28 August 1985

Ground Elev. 10.01 Datum NGVD Gr. Water Depth See Text



Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	3.0	0.0		Stiff tan & gray silty clay w/silt		
					pockets		
2	5.0	6.0			Ditto		
3	8.0	9.0		9.0	Ditto		
4	11.0	12.0	9.0	13.0	Very soft dark gray clay w/humus & wood		
5	14.0	15.0	13.0	17.0	Extremely soft brown & gray clay w/silt		
					layers, organic matter & wood		
6	19.0	20.0	17.0	21.0	Very soft black organic clay w/humus		
					& wood		
	24.0	25.0	21.0	26.5	Wood w/organic matter & clay		
7	27.5	29.0	26.5	30.0	Very loose gray sand w/shell fragments	1	4
8	30.0	31.5	30.0		Loose gray sand w/shell fragments	3	9
9	32.5	34.0			Ditto	2	8
10	35.0	36.5			Ditto	4	6
11	38.5	40.0		42.5	Ditto	3	9
12	43.5	45.0	42.5		Medium dense gray sand w/shell	6	17
					fragments		
13	48.5	50.0		50.0	Ditto	7	18

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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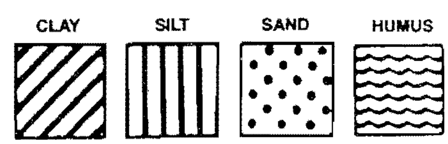
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

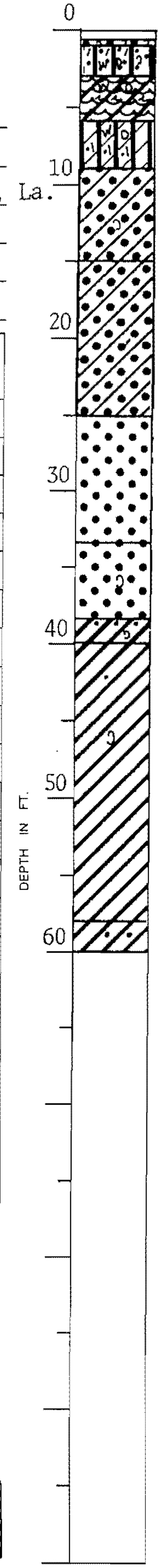
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 20 Soil Technician R. Elkins Date 20 September 1985

Ground Elev. -1.87 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.5	Asphalt		
			0.5	1.0	Medium compact tan & white sand & shells		
1	1.5	2.5	1.0	3.0	Loose gray sandy silt w/clay layers		
					& shells & wood		
2	4.5	5.5	3.0	6.0	Soft gray organic clay w/wood & humus		
					layers		
3	7.5	8.5	6.0	9.0	Loose gray clayey silt w/sandy silt		
					layers & wood		
4	10.5	11.5	9.0		Loose gray clayey sand w/shell fragments		
5	13.5	14.5		15.0	Ditto		
6	18.0	19.0	15.0		Very loose gray clayey sand w/trace of		
					clay		
7	20.0	21.5			Very loose gray clayey sand	2	6
8	22.5	24.0		25.0	Ditto	1	4
9	25.0	26.5	25.0		Medium dense gray sand	2	18
10	27.5	29.0			Ditto	3	11
11	30.0	31.5		33.5	Ditto	5	17
12	33.5	35.0	33.5	38.5	Dense gray sand w/shell fragments	8	39
13	38.5	40.0	38.5	40.0	Soft gray clay w/sand layers & shell	1	3
					fragments		
14	43.0	44.0	40.0		Medium stiff gray clay w/sand lenses		
					& shell fragments		
15	48.0	49.0			Ditto		
16	53.0	54.0			Ditto		
17	57.0	58.0		58.0	Ditto		
					(Continued)		



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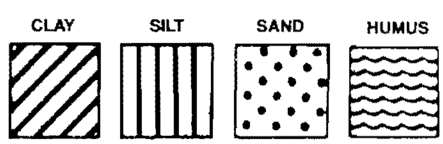
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 20 Soil Technician R. Elkins Date 20 September 1985

Ground Elev. (Cont'd) -1.87 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
18	58.0	59.0	58.0	60.0	Very stiff greenish-gray & tan clay		
					w/sand pockets		

DEPTH IN FT.

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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Remarks:

CLAY SILT SAND HUMUS

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

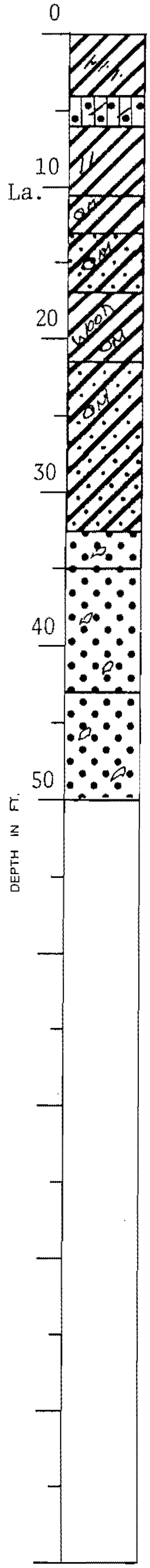
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 21 Soil Technician A. J. Mayeux Date 16 September 1985

Ground Elev. 9.71 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0	4.0	Medium stiff gray & tan clay w/clayey		
					sand layers		
2	5.0	5.5	4.0	6.0	Loose tan silty sand w/clay		
3	8.0	8.5	6.0	10.5	Stiff gray & tan clay w/silt pockets		
4	11.0	11.5	10.5	13.0	Soft gray clay w/organic matter, silt		
					& wood		
5	14.0	14.5	13.0	17.0	Medium stiff gray sandy clay w/organic		
					matter		
6	19.0	19.5	17.0	21.5	Soft gray clay w/wood & organic matter		
7	24.0	24.5	21.5		Medium stiff gray sandy clay w/some		
					organic matter		
8	29.0	29.5		32.5	Ditto		
9	32.5	34.0	32.5	35.0	Medium dense gray sand w/shell	5	17
					fragments		
10	35.0	36.5	35.0		Loose gray sand w/shell fragments	4	6
11	38.5	40.0		43.0	Ditto	2	8
12	43.5	45.0	43.0		Medium dense gray sand w/shell	3	11
					fragments		
13	48.5	50.0		50.0	Ditto	9	21



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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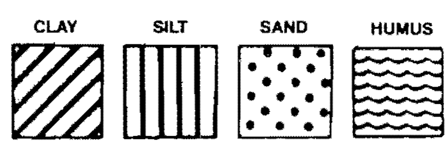
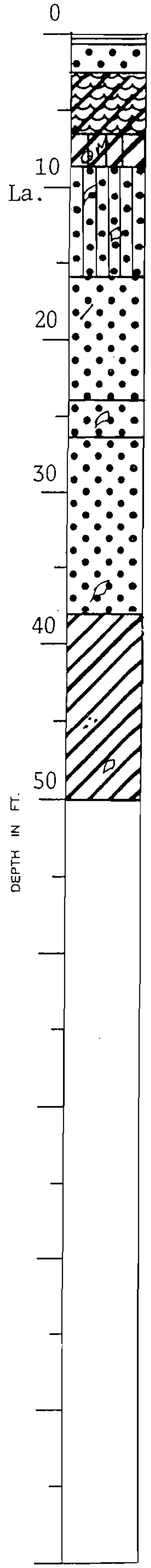
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 22 Soil Technician George Hardee Date 20 September 1985

Ground Elev. -4.47 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.1	Asphalt w/gravel		
			0.1	0.6	Concrete		
1	1.0	2.5	0.6	2.5	Very loose tan fine sand	1	2
2	4.5	5.5	2.5	6.5	Soft brown & gray organic clay w/roots		
					& clay layers		
3	8.0	8.5	6.5	8.5	Soft gray silty clay w/roots, organic		
					matter & sand layers		
4	10.5	11.5	8.5		Medium dense gray silty sand w/shell		
					fragments		
5	14.5	15.0		16.0	Ditto		
6	18.0	18.5	16.0		Loose gray fine sand w/trace of clay		
7	18.5	20.0			Loose gray fine sand	3	8
8	21.0	22.5		24.0	Ditto	3	10
9	23.5	25.0	24.0	26.5	Very loose gray fine sand w/shells	3	3
10	26.0	27.5	26.5		Medium dense gray fine sand	2	11
11	28.5	30.0			Ditto	5	16
12	33.5	35.0		38.0	Medium dense gray fine sand w/shells	7	18
13	38.5	40.0	38.0		Medium stiff gray clay	1	2
14	43.5	44.5			Medium stiff gray clay w/sand pockets		
					& shells		
15	48.5	49.5		50.0	Ditto		

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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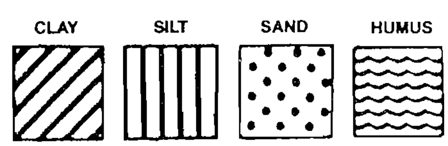
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

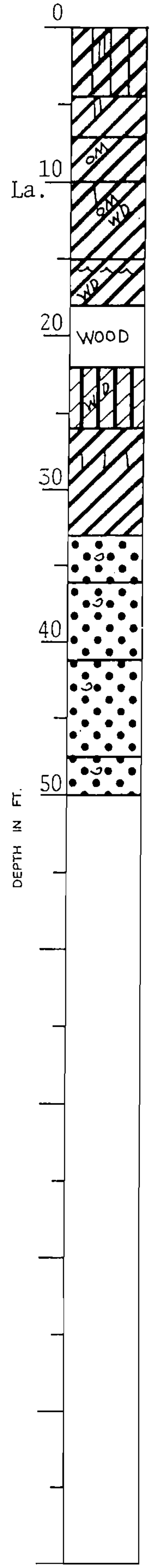
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 23 Soil Technician A. J. Mayeux Date 27 August 1985

Ground Elev. 9.56 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	3.0	0.0	4.5	Very stiff tan & gray silty clay		
					w/silt pockets		
2	5.0	6.0	4.5	7.0	Very stiff gray & tan clay w/silt		
					pockets		
3	8.0	9.0	7.0	10.0	Stiff gray clay w/some organic matter		
4	11.0	12.0	10.0		Soft gray clay w/silt, organic matter		
					& wood		
5	14.0	15.0		15.0	Ditto		
6	16.0	17.0	15.0	18.0	Very soft gray clay w/humus layers		
					& wood		
			18.0	22.0	Wood w/organic matter & some clay		
7	24.0	25.0	22.0	26.0	Loose gray clayey silt w/wood		
8	29.0	30.0	26.0	33.0	Soft gray clay w/silt layers		
9	33.5	35.0	33.0	36.0	Medium dense gray sand w/shells	7	21
10	36.0	37.5	36.0		Very loose gray sand w/shells	3	5
11	38.5	40.0		41.0	Ditto	2	3
12	41.0	42.5	41.0		Medium dense gray sand w/shell	5	21
					fragments		
13	43.5	45.0		47.5	Ditto	5	21
14	48.5	50.0	47.5	50.0	Loose gray sand w/shell fragments	4	9



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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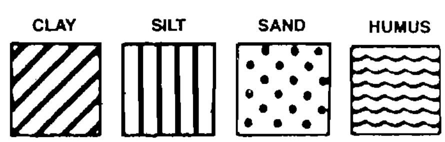
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

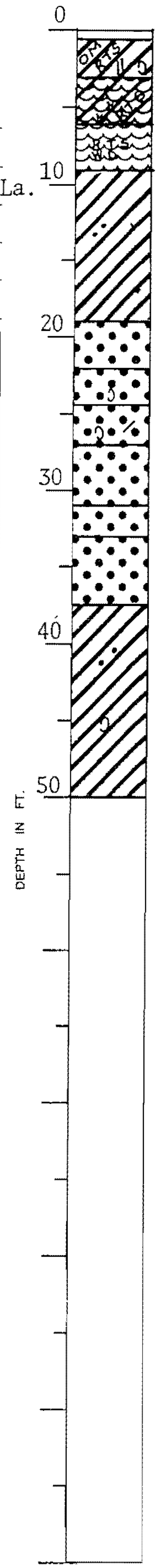
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 24 Soil Technician George Hardee Date 21 September 1985

Ground Elev. -4.27 Datum NGVD Gr. Water Depth

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
			0.0	0.5	Concrete		
1	2.5	3.0	0.5	3.0	Medium stiff gray clay w/organic matter,		
					roots, silt pockets & shells		
2	5.0	6.0	3.0	6.0	Very soft dark gray organic clay		
					w/humus pockets & roots		
3	8.5	9.0	6.0	9.0	Loose brown humus w/roots & wood layers		
4	10.5	11.5	9.0		Very soft gray clay w/sand pockets		
5	13.5	14.5			Ditto		
6	18.0	19.0		19.0	Ditto		
7	20.0	21.5	19.0	22.0	Medium dense gray fine sand	3	12
8	22.5	24.0	22.0	24.5	Loose gray fine sand w/shells	2	7
9	25.0	26.5	24.5	27.0	Very loose gray fine sand w/shells &	1	4
					trace of clay		
10	27.5	29.0	27.0	31.0	Medium dense gray fine sand	6	12
11	30.5	32.0	31.0	33.0	Dense gray fine sand	7	34
12	33.5	35.0	33.0	37.5	Medium dense gray fine sand	7	18
13	38.5	40.0	37.5		Medium stiff gray clay	1	2
14	43.5	44.5			Medium stiff gray clay w/sand pockets		
					& shells		
15	48.5	49.5		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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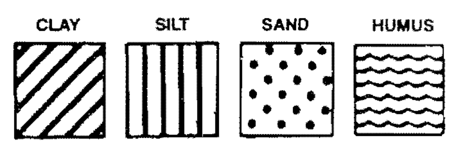
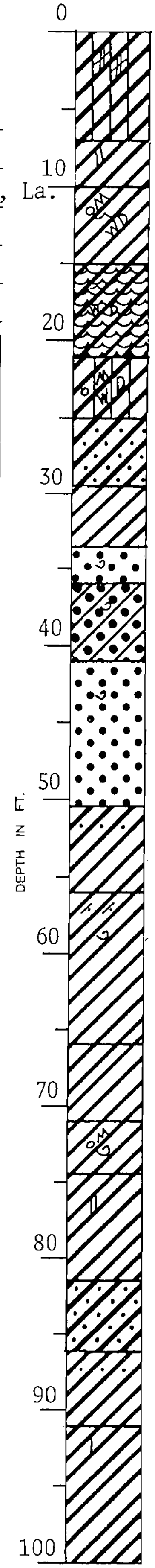


Predominant type shown heavy. Modifying type shown light.

Remarks:

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 25 Soil Technician A. J. Mayeux Date 12 September 1985

Ground Elev. 9.61 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	2.5	0.0		Very stiff tan & gray silty clay		
					w/clayey silt pockets		
2	5.0	5.5		7.0	Ditto		
3	8.0	8.5	7.0	10.0	Medium stiff gray & tan clay w/silt		
					pockets		
4	11.0	11.5	10.0		Soft gray clay w/organic matter, humus		
					& wood		
5	14.0	14.5		15.0	Ditto		
6	19.0	19.5	15.0	21.0	Soft black organic clay w/humus & wood		
7	24.0	24.5	21.0	25.0	Very soft gray silty clay w/organic		
					matter & wood		
8	29.0	29.5	25.0	29.5	Soft gray sandy clay		
9	32.0	32.5	29.5	33.5	Soft gray clay		
10	33.5	35.0	33.5	36.0	Medium dense gray sand w/shell	7	21
					fragments		
11	36.0	37.5	36.0		Very loose gray clayey sand w/shells	1	2
12	38.5	40.0		41.0	Ditto	1	3
13	41.0	42.5	41.0		Medium dense gray sand w/shell	6	15
					fragments		
14	43.5	45.0			Ditto	3	13
15	48.5	50.0		50.5	Ditto	3	11
16	53.5	55.0	50.5	56.0	Medium stiff gray clay w/sand layers	2	5
17	59.0	59.5	56.0		Medium stiff gray clay w/clayey sand		
					pockets & shell fragments		
18	64.0	64.5		66.0	Ditto		
19	69.0	69.5	66.0	71.0	Medium stiff gray clay		

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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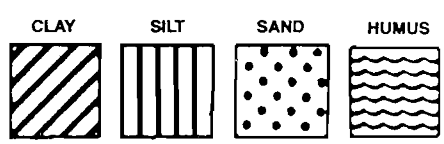

Predominant type shown heavy. Modifying type shown light.

Remarks:

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 25 (Cont'd) Soil Technician A. J. Mayeux Date 12 September 1985

Ground Elev. 9.61 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
20	74.0	74.5	71.0	74.5	Medium stiff greenish-gray clay		
					w/organic matter & shells		
21	79.0	79.5	74.5	81.5	Very stiff greenish-gray clay w/silt		
					pockets		
22	84.5	85.5	81.5	86.0	Stiff greenish-gray & tan sandy clay		
23	89.0	89.5	86.0	91.0	Stiff tan & gray clay w/sand layers		
24	94.0	94.5	91.0		Stiff tan & gray clay w/silt lenses		
25	99.0	99.5		100.0	Ditto		

DEPTH IN FT.

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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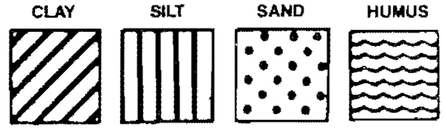
CLAS SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

Remarks:

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal

OLB Project No. 2048-0304, New Orleans, Louisiana

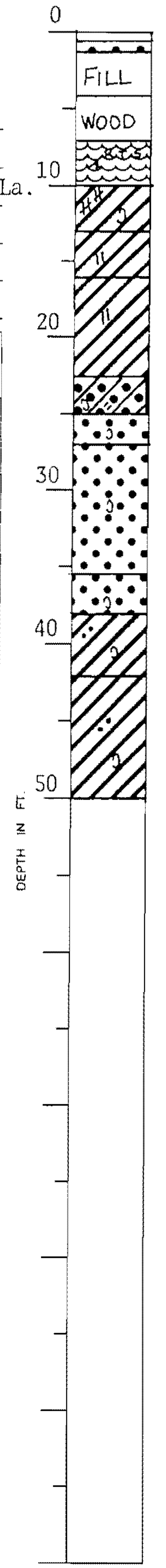
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

Boring No. 26 Soil Technician A. J. Mayeux Date 20 September 1985

Ground Elev. -4.27 Datum NGVD Gr. Water Depth

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.5	Concrete		
			0.5	1.25	Sand & shell fill		
1	3.0	4.0	1.25	4.0	Wood, organic matter, clay,		
					miscellaneous fill		
	5.0	6.0	4.0	7.0	Wood w/humus & organic matter		
2	7.0	8.0	7.0	10.0	Very soft brown humus w/organic clay		
					& roots		
3	11.0	12.0	10.0	13.0	Very soft gray clay w/clayey silt		
					pockets & shell fragments		
4	14.0	15.0	13.0	16.0	Soft gray clay w/silt pockets		
5	19.0	20.0	16.0	22.5	Very soft gray clay w/silt pockets		
6	24.0	25.0	22.5	25.0	Very loose gray clayey sand w/shell		
					fragments & clay pockets		
7	25.0	26.5	25.0	27.0	Very loose gray sand w/shell fragments	1	4
8	27.5	29.0	27.0		Medium dense gray sand w/shell	4	20
					fragments		
9	29.5	31.0			Ditto	4	19
10	33.0	34.5		35.5	Ditto	4	19
11	35.5	37.0	35.5	38.0	Loose gray sand w/shell fragments	2	8
12	38.5	40.0	38.0	42.0	Soft gray clay w/sand pockets & shell	1	3
					fragments		
13	44.0	45.0	42.0		Medium stiff gray clay w/sand pockets		
					& shell fragments		
14	49.0	50.0		50.0	Ditto		



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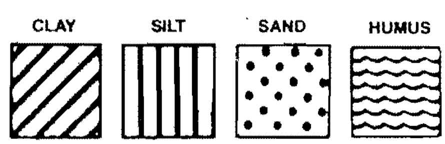


Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal

OLB Project No. 2048-0304, New Orleans, Louisiana

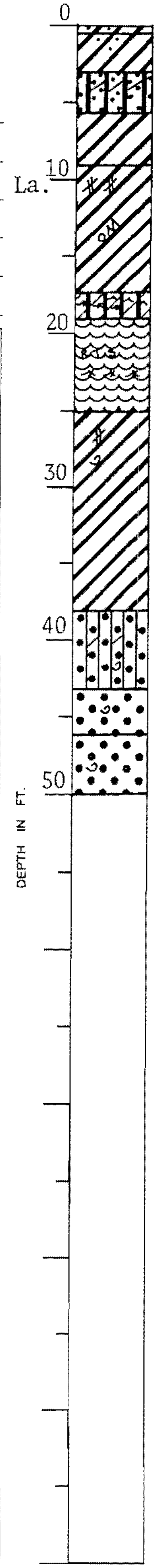
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

Boring No. 27 Soil Technician A. Croal, Jr. Date 31 August 1985

Ground Elev. 9.06 Datum NGVD Gr. Water Depth See Text

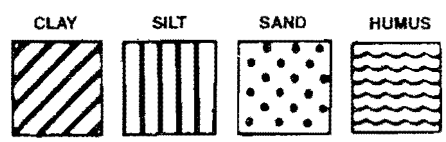
Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	0.0	0.5	0.0	0.5	Medium stiff brown & gray clay w/fine sand pockets & grass roots		
2	1.7	2.5	0.5	3.0	Medium stiff tan & gray clay w/many fine sand pockets & lenses		
3	4.7	5.5	3.0	5.5	Medium compact tan & gray sandy silt w/thin clay layers		
4	7.7	8.5	5.5	9.0	Medium stiff tan & gray clay		
5	10.7	11.5	9.0		Stiff gray clay w/few clayey silt pockets		
6	13.7	14.5		17.5	Stiff gray clay w/trace of organic matter		
7	18.2	19.0	17.5	19.0	Loose gray clayey silt w/organic clay & humus layers		
8	23.2	24.0	19.0	25.0	Loose brown humus w/roots & organic clay layers		
9	28.2	29.0	25.0		Soft gray clay w/clayey silt lenses & shell fragments		
10	33.2	34.0		38.0	Soft gray clay w/few shell fragments		
11	38.2	39.0	38.0		Dense gray silty sand w/clay pockets & shell fragments		
12	42.2	43.0		43.0	Ditto		
13	43.5	45.0	43.0	46.0	Medium dense gray fine sand w/shell fragments	4	24
14	46.0	47.5	46.0		Medium dense gray silty sand w/shell fragments	6	14
15	48.5	50.0		50.0	Ditto	3	11



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

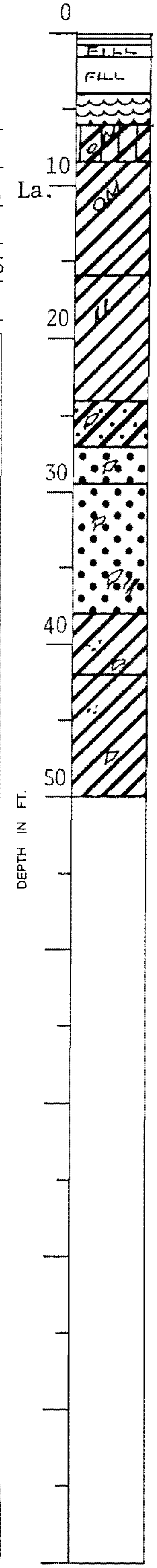
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orlean , La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 28 **Soil Technician** A. J. Mayeux **Date** 19 September 1985

Ground Elev. -5.48 **Datum** NGVD **Gr. Water Depth** See Text

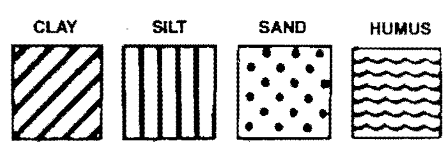
Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.2	Asphalt		
			0.2	0.7	Concrete		
			0.7	1.5	Fill (sand & shells)		
			1.5	4.0	Miscellaneous fill (wood, clay, organic		
					matter & shells)		
1	4.5	5.5	4.0	6.0	Extremely soft black humus w/roots &		
					wood		
2	7.5	8.5	6.0	8.5	Extremely soft gray silty clay		
					w/organic matter & wood		
3	11.0	12.0	8.5		Very soft gray clay w/some organic		
					matter		
4	14.0	15.0		16.0	Ditto		
5	19.0	20.0	16.0	24.0	Very soft gray clay w/silt lenses		
6	24.0	25.0	24.0	27.0	Soft gray sandy clay w/shell fragments		
7	27.0	28.5	27.0	29.5	Loose gray sand w/shell fragments	1	7
8	29.5	31.0	29.5		Medium dense gray sand w/shell	5	17
					fragments		
9	32.5	34.0			Ditto	4	14
10	35.0	36.5		38.0	Medium dense gray sand w/some clay	3	10
11	38.5	40.0	38.0	42.0	Soft gray clay w/sand pockets & shell	1	3
					fragments		
12	44.0	45.0	42.0		Medium stiff gray clay w/sand pockets		
					& shell fragments		
13	49.0	50.0		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

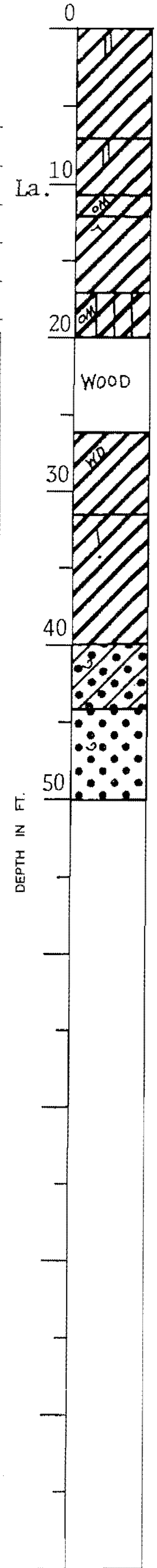
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 29 Soil Technician A. J. Mayeux Date 27 August 1985

Ground Elev. 9.81 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	3.0	0.0		Very stiff brown & gray clay w/silt		
					pockets		
2	5.0	6.0		7.0	Ditto		
3	8.0	9.0	7.0	10.5	Medium stiff gray & tan clay w/silt		
					pockets		
4	11.0	12.0	10.5	12.0	Stiff gray clay w/organic matter		
5	14.0	15.0	12.0	17.0	Soft dark gray clay w/humus		
6	19.0	20.0	17.0	20.0	Soft dark gray silty clay w/organic		
					matter		
7	24.0	25.0	20.0	26.0	Wood w/clay, organic matter & silt		
8	29.0	30.0	26.0	31.5	Extremely soft gray clay w/wood		
9	34.0	35.0	31.5		Soft gray clay w/silt lenses		
10	39.0	40.0		40.0	Soft gray clay w/sand lenses		
11	43.0	44.0	40.0	44.0	Loose gray clayey sand w/shell		
					fragments		
12	44.0	45.5	44.0		Medium dense gray sand w/shell	5	20
					fragments		
13	46.0	47.5			Ditto	5	22
14	48.5	50.0		50.0	Ditto	6	16



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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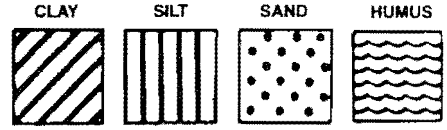
CLAY SILT SAND HUMUS



Remarks: 5" Diameter Boring

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

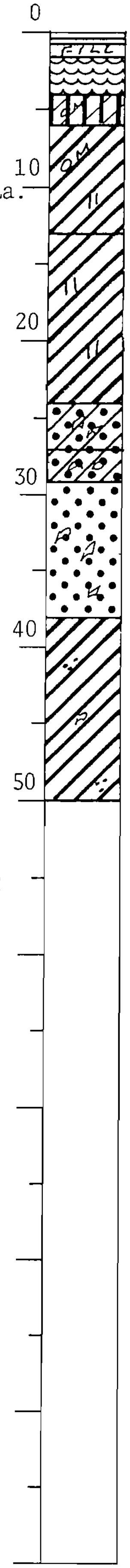
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 30 Soil Technician A. J. Mayeux Date 19 September 1985

Ground Elev. -5.29 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
			0.0	0.2	Asphalt		
			0.2	0.7	Concrete		
			0.7	1.5	Fill (sand & shells)		
1	2.0	2.5	1.5	4.0	Loose brown humus		
2	5.0	5.5	4.0	6.0	Loose gray clayey silt w/organic matter		
					& wood		
3	8.0	8.5	6.0		Very soft gray clay w/organic matter		
					& silt		
4	11.0	11.5		13.0	Ditto		
5	14.0	14.5	13.0		Soft gray clay w/silt lenses		
6	19.0	19.5		24.0	Ditto		
7	24.0	24.5	24.0	27.0	Loose gray clayey sand w/shell fragments		
8	27.5	29.0	27.0	29.0	Ditto	2	7
9	29.0	30.5	29.0		Medium dense gray sand w/shell fragments	6	19
10	31.5	33.0			Ditto	6	19
11	34.0	35.5		38.0	Ditto	4	12
12	38.5	40.0	38.0		Medium stiff gray clay w/sand pockets	1	4
					& shell fragments		
13	44.0	44.5			Ditto		
14	49.0	49.5		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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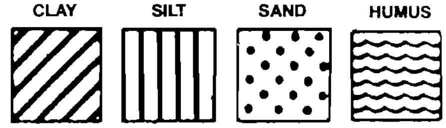
Remarks:

CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

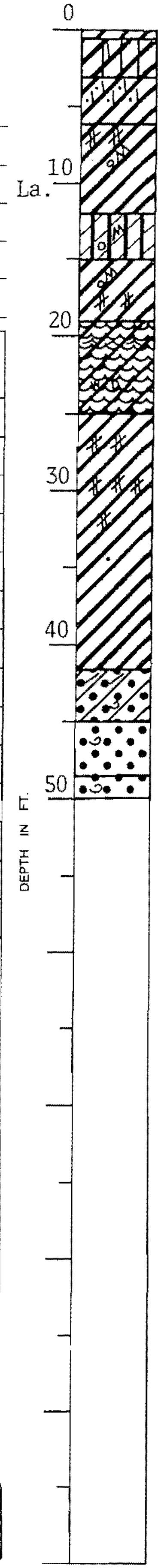
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 31 Soil Technician A. Croal, Jr. Date 31 August 1985

Ground Elev. 9.71 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	0.0	0.5	0.0	0.5	Very stiff tan & gray clay		
2	1.7	2.5	0.5	3.0	Hard tan & gray silty clay w/silt lenses		
3	4.7	5.5	3.0	6.0	Very stiff tan & gray clay w/sandy silt pockets & layers		
4	7.7	8.5	6.0		Medium stiff tan & gray clay w/clayey silt pockets		
5	10.7	11.5		12.0	Medium stiff tan & gray clay w/trace of organic matter		
6	13.7	14.5	12.0	15.0	Very loose gray clayey silt w/trace of organic matter		
7	18.2	19.0	15.0	19.0	Medium stiff gray clay w/organic matter & clayey silt pockets		
8	23.2	24.0	19.0	25.0	Soft gray organic clay w/humus layers & wood		
9	28.2	29.0	25.0		Soft gray clay w/clayey silt pockets & layers		
10	33.2	34.0			Soft gray clay w/clayey silt pockets & lenses		
11	38.2	39.0		41.5	Soft gray clay w/few fine sand lenses		
12	43.2	44.0	41.5	45.0	Very loose to loose gray clayey sand w/clay pockets & shell fragments		
13	45.0	46.5	45.0	48.5	Medium dense gray fine sand w/shell fragments	6	26
14	48.5	50.0	48.5	50.0	Medium dense gray silty sand w/shell fragments	3	12



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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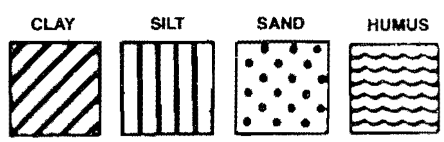
Remarks:

CLASS SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

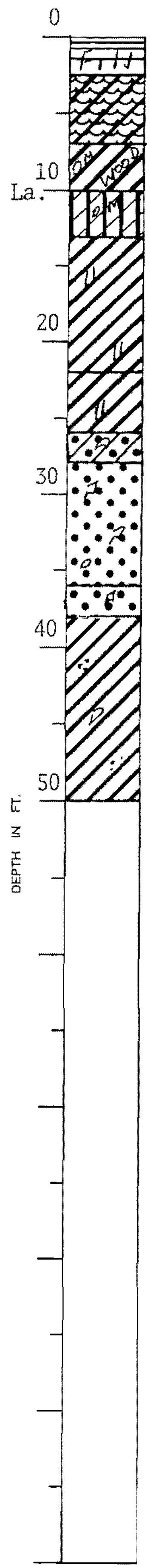
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 32 Soil Technician A. J. Mayeux Date 19 September 1985

Ground Elev. -6.21 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.2	Asphalt		
			0.2	0.7	Concrete		
			0.7	1.5	Fill (sand & shells)		
			1.5	2.5	Fill (miscellaneous wood, shells, etc.)		
1	3.0	4.0	2.5	7.0	Soft brown organic clay w/wood & roots		
2	7.0	8.0	7.0	10.0	Soft gray clay w/organic matter & wood		
3	11.0	12.0	10.0	13.0	Loose gray clayey silt w/trace of		
					organic matter		
4	15.0	16.0	13.0		Very soft gray clay w/silt lenses		
5	19.0	20.0		22.0	Ditto		
6	24.0	25.0	22.0	26.0	Soft gray clay w/silt lenses		
7	26.5	28.0	26.0	28.0	Loose gray clayey sand w/shell	2	7
					fragments		
8	28.5	30.0	28.0		Medium dense gray sand w/shell	6	29
					fragments		
9	31.0	32.5			Ditto	6	22
10	33.5	35.0		36.0	Ditto	3	14
11	36.0	37.5	36.0	38.0	Loose gray sand w/shell fragments	2	7
12	38.5	40.0	38.0		Medium stiff gray clay w/sand pockets	1	4
					& shell fragments		
13	44.0	45.0			Ditto		
14	49.0	50.0		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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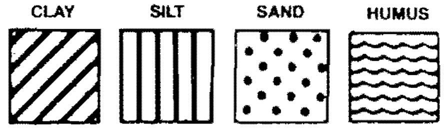
CLAY SILT SAND HUMUS



Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

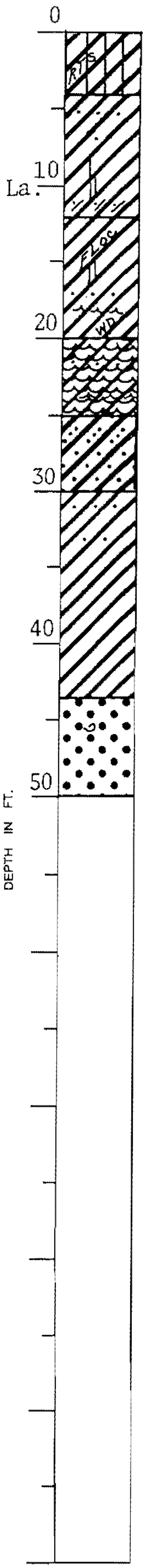
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 33 **Soil Technician** R. Elkins **Date** 2 August 1985

Ground Elev. 9.26 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	1.5	2.5	0.0	4.0	Hard tan & gray silty clay w/roots		
2	4.5	5.5	4.0		Stiff to very stiff gray & tan clay		
					w/sand layers & lenses		
3	7.5	8.5			Stiff to very stiff gray & tan clay		
					w/silt lenses & pockets		
4	10.5	11.5		12.0	Stiff to very stiff gray & tan clay		
					w/sandy clay & sand layers		
5	13.5	14.5	12.0		Soft to medium stiff dark gray		
					flocculated clay w/silt pockets		
6	18.0	19.0		20.0	Soft to medium stiff dark gray		
					flocculated clay w/sand layers, humus		
					layers & wood		
7	23.0	24.0	20.0	25.0	Soft brown organic clay w/sand layers		
					& humus		
8	28.0	29.0	25.0	30.0	Medium stiff gray sandy clay w/sand		
					layers		
9	33.0	34.0	30.0		Soft gray clay w/sand layers & pockets		
10	38.0	39.0		43.5	Ditto		
11	43.5	45.0	43.5		Dense gray sand w/few shell fragments	7	48
12	46.0	47.5			Ditto	11	44
13	48.5	50.0		50.0	Ditto	11	39



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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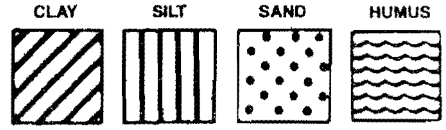
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

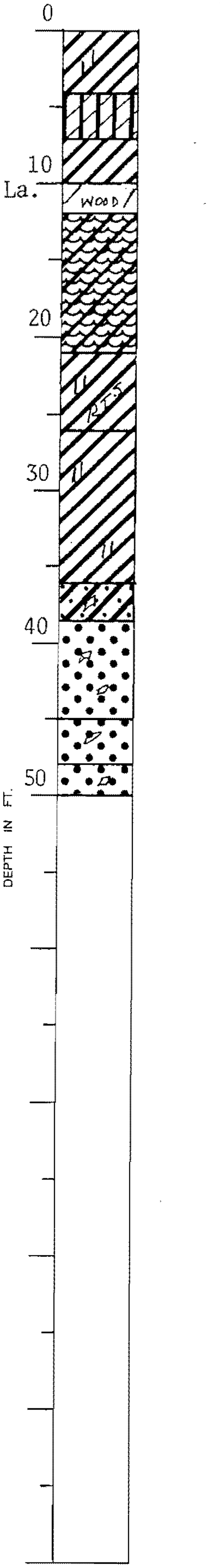
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 34 Soil Technician A. J. Mayeux Date 17 September 1985

Ground Elev. 4.70 Datum NGVD Gr. Water Depth See Text

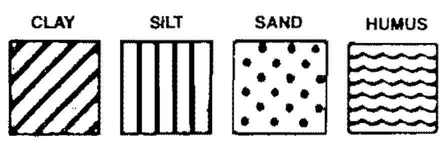
Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	2.5	0.0	4.0	Stiff tan & gray clay w/silt pockets		
					& fill		
2	5.0	5.5	4.0	7.0	Medium compact gray & tan clayey silt		
					w/wood		
3	8.0	8.5	7.0	10.0	Soft gray clay		
	11.0	11.5	10.0	12.0	Wood w/some clay		
4	14.0	14.5	12.0		Soft gray & brown organic clay w/wood		
					& humus		
5	19.0	19.5		21.0	Ditto		
6	24.0	24.5	21.0	26.0	Very soft gray clay w/silt & roots		
7	29.0	29.5	26.0		Soft gray clay w/silt lenses		
8	34.0	34.5		36.0	Ditto		
9	38.0	38.5	36.0	38.5	Soft gray sandy clay w/shell fragments		
10	38.5	40.0	38.5		Medium dense gray sand w/shell	6	25
					fragments		
11	41.0	42.5			Ditto	4	16
12	43.5	45.0		45.0	Ditto	3	11
13	46.0	47.5	45.0	48.0	Loose gray sand w/shell fragments	3	7
14	48.5	50.0	48.0	50.0	Loose gray sand w/shell fragments &	2	5
					clay layers		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

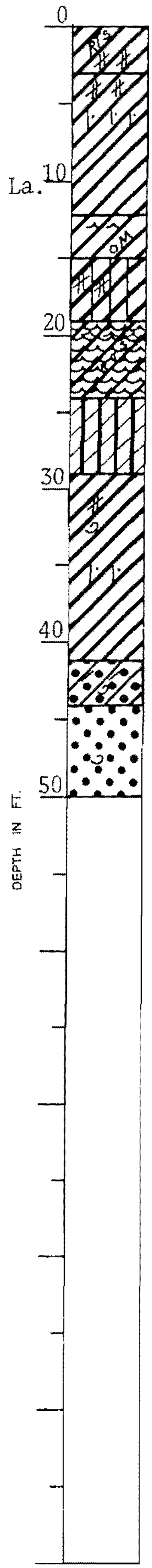
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 35 **Soil Technician** A. Croal, Jr. **Date** 31 August 1985

Ground Elev. 9.16 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	0.0	0.5	0.0		Stiff tan & gray clay w/grass roots		
2	1.7	2.5		3.0	Stiff tan & gray clay w/clayey silt		
					pockets		
3	4.7	5.5	3.0		Stiff gray clay w/clayey silt pockets		
					& silty sand layers		
4	7.7	8.5			Stiff gray clay w/clayey silt pockets		
5	10.7	11.5		12.0	Ditto		
6	13.7	14.5	12.0	15.0	Soft dark gray clay w/humus pockets		
					& organic matter		
7	18.2	19.0	15.0	19.0	Soft dark gray silty clay w/clayey silt		
					pockets		
8	23.2	24.0	19.0	24.0	Soft brown & gray organic clay w/humus		
					layers & few roots		
9	28.2	29.0	24.0	29.0	Very loose gray clayey silt		
10	33.2	34.0	29.0		Soft to medium stiff gray clay w/few		
					clayey silt lenses & shells		
11	38.2	39.0		41.0	Soft to medium stiff gray clay w/few		
					silty sand pockets		
12	43.2	44.0	41.0	44.0	Very loose to loose clayey sand w/clay		
					pockets & shell fragments		
13	45.0	46.5	44.0		Medium dense gray fine sand w/shell	5	18
					fragments		
14	48.5	50.0		50.0	Ditto	5	13



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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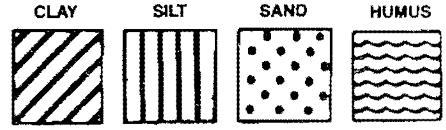
Remarks:



Predominant type shown heavy. Modifying type shown light.

4.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

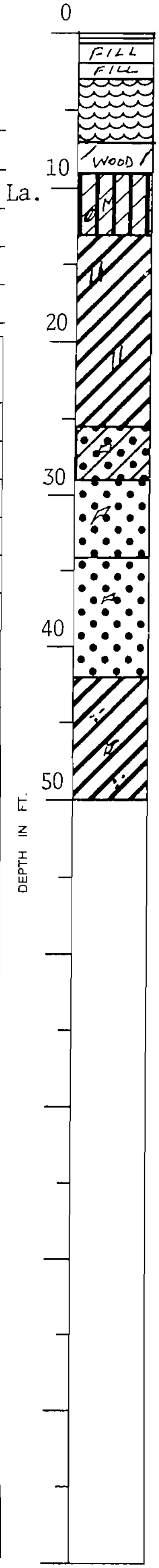
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 36 Soil Technician A. J. Mayeux Date 18 September 1985

Ground Elev. -5.20 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
			0.0	0.2	Asphalt		
			0.2	0.7	Concrete		
			0.7	2.0	Fill (sand & shells)		
	2.0	3.0	2.0	3.0	Miscellaneous fill		
1	5.0	6.0	3.0	7.0	Extremely soft black & brown humus		
					w/wood & roots		
	8.0	9.0	7.0	9.0	Wood w/humus & clay		
2	11.0	12.0	9.0	13.0	Loose gray clayey silt w/organic matter		
3	14.0	15.0	13.0		Very soft to soft gray clay w/silt		
					lenses		
4	19.0	20.0			Ditto		
5	24.0	25.0		25.5	Ditto		
6	28.0	29.0	25.5	29.0	Loose gray clayey sand w/shell		
					fragments		
7	29.0	30.5	29.0		Medium dense gray sand w/shell	3	23
					fragments		
8	31.5	33.0		34.0	Ditto	4	18
9	34.0	35.5	34.0		Loose gray sand w/shell fragments	3	7
10	38.5	40.0		42.0	Ditto	1	5
11	43.5	45.0	42.0		Medium stiff gray clay w/sand pockets	2	4
					& shell fragments		
12	49.0	50.0		50.0	Ditto		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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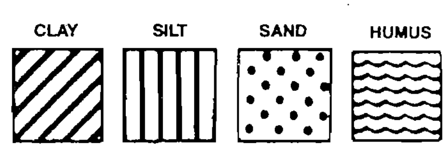
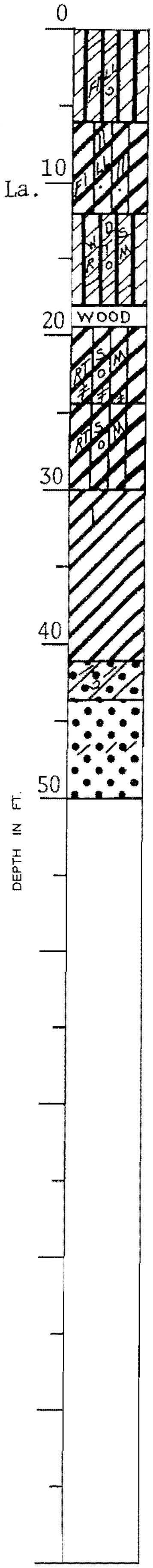
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc. Metairie, Louisiana

Boring No. 37 **Soil Technician** George Hardee **Date** 1 August 1985

Ground Elev. 9.04 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	1.0	1.5	0.0		Medium compact to compact brown clayey		
					silt w/clay pockets (fill)		
2	1.5	3.0			Medium compact to compact brown clayey	8	25
					silt		
3	4.0	5.5		6.0	Medium compact to compact brown clayey	10	14
					silt w/shells, brick, glass, etc.		
4	8.3	9.0	6.0		Medium stiff to stiff brown silty		
					clay w/bricks & silt pockets		
					(fill)		
5	11.3	12.0		12.0	Medium stiff to stiff brown silty clay		
					w/sand & silt pockets		
6	14.3	15.0	12.0		Loose dark gray clayey silt w/roots		
					& organic matter		
7	17.0	18.0		18.0	Loose dark gray clayey silt w/clay		
					layers, roots & wood		
			18.0	19.5	Wood		
8	23.5	24.5	19.5	24.5	Soft brown silty clay w/roots & silty		
					clay layers & organic matter		
9	28.5	29.5	24.5	30.0	Soft gray silty clay w/roots & organic		
					matter		
10	33.5	34.5	30.0		Soft gray clay w/silt lenses		
11	38.5	39.5		41.0	Soft gray clay		
12	42.5	43.5	41.0	43.5	Loose gray clayey sand w/clay pockets		
					& shells		
13	44.0	45.5	43.5		Medium dense gray fine sand	4	12
14	46.5	48.0			Ditto	5	18

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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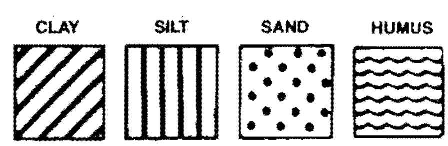
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie Louisiana

Boring No. 37 Soil Technician George Hardee Date 1 August 1985

Ground Elev. (Cont'd) 9.04 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
15	48.5	50.0		50.0	Medium dense gray fine sand w/clay layers	9	22

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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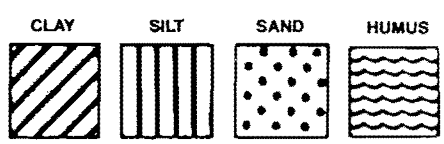
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

DEPTH IN FT.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

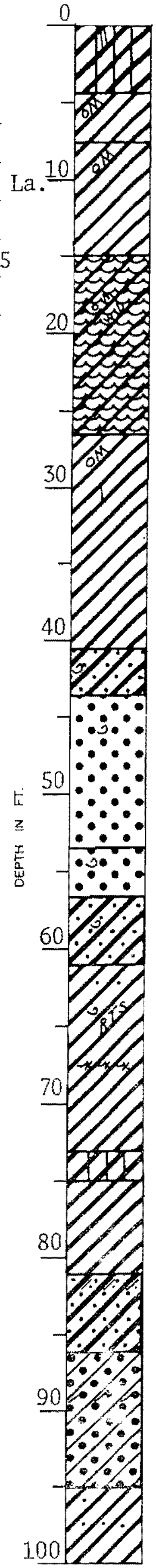
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 38 Soil Technician A. J. Mayeux & George Hardee Date 5-6 September 1985

Ground Elev. 8.89 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	2.5	0.0	4.5	Stiff gray & tan silty clay w/silt		
					pockets		
2	5.0	5.5	4.5	7.5	Stiff brown clay w/organic matter		
3	8.0	8.5	7.5		Soft gray clay w/organic matter		
4	11.0	11.5			Ditto		
5	14.0	14.5		15.0	Ditto		
6	19.0	19.5	15.0		Soft brown organic clay w/organic		
					matter & wood		
7	24.0	24.5		26.5	Ditto		
8	29.0	29.5	26.5		Soft gray clay w/organic matter		
9	34.0	34.5			Soft gray clay w/silt lenses		
10	39.0	39.5		40.5	Ditto		
11	42.0	42.5	40.5	43.5	Soft gray sandy clay w/shell fragments		
12	43.5	45.0	43.5		Medium dense gray sand w/shell	5	13
					fragments		
13	46.0	47.5			Ditto	4	11
14	48.5	50.0		53.5	Ditto	5	15
15	53.5	55.0	53.5	56.5	Loose gray sand w/shell fragments	3	8
16	58.5	60.0	56.5	61.0	Soft gray sandy clay w/shell fragments	2	5
17	64.0	64.5	61.0		Medium stiff gray clay w/sand pockets		
					& shell fragments		
18	68.5	69.5		73.0	Medium stiff gray clay w/roots &		
					organic clay layers		
19	73.5	74.5	73.0	75.0	Medium stiff light gray silty clay		
20	78.5	79.5	75.0	81.0	Stiff greenish-gray clay		
					(Continued)		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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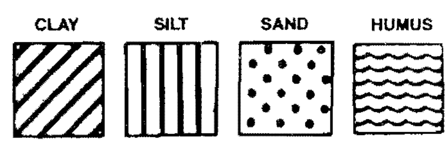
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 38 Soil Technician A. J. Mayeux & George Hardee Date 5-6 September 1985

Ground Elev. (Cont'd) 8.89 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
21	83.5	84.5	81.0	86.0	Stiff greenish-gray sandy clay w/clayey sand pockets		
22	89.5	90.0	86.0		Medium dense gray & tan clayey sand w/clay layers		
23	94.0	94.5		95.0	Ditto		
24	98.5	99.5	95.0	100.0	Medium stiff gray clay w/sand lenses & layers		

DEPTH IN FT.

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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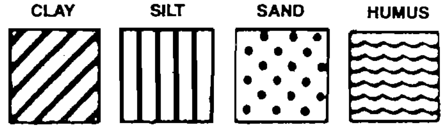
Remarks:

CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

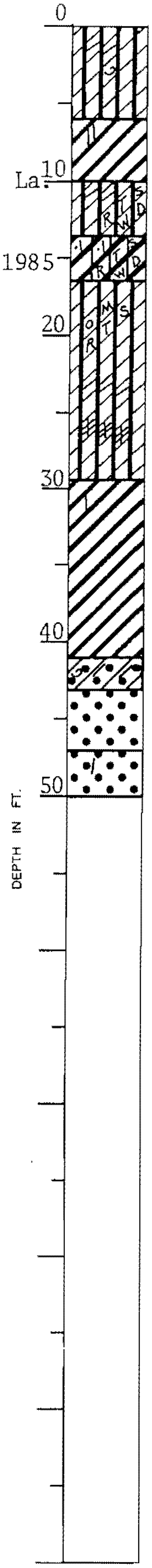
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 39 Soil Technician George Hardee Date 31 July & 1 August 1985

Ground Elev. 9.14 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0		Medium compact tan & gray clayey silt		
					w/clay pockets & shells		
2	5.5	6.0		6.0	Medium compact tan & gray clayey silt		
3	6.0	7.5	6.0		Medium stiff gray & tan clay	2	6
4	9.5	10.0		10.0	Medium stiff gray & tan clay w/silt		
					pockets		
5	12.5	13.0	10.0	13.5	Loose gray clayey silt w/clay pockets,		
					roots & wood		
6	14.5	15.5	13.5	16.5	Soft brown silty clay w/sandy silt		
					pockets, roots, wood & organic matter		
7	18.5	19.5	16.5		Loose to very loose gray clayey silt		
					w/organic matter & roots		
8	23.5	24.5			Loose to very loose gray clayey silt		
					w/organic matter, roots & clay layers		
9	28.5	29.5		29.5	Loose to very loose gray clayey silt		
					w/silty clay & clay layers		
10	33.5	34.5	29.5		Soft gray clay w/silt lenses		
11	38.5	39.5		41.0	Ditto		
12	41.5	42.5	41.0	43.0	Loose gray clayey sand w/shells & clay		
					pockets		
13	43.0	44.5	43.0	47.0	Loose gray fine sand	2	5
14	47.0	48.5	47.0		Medium dense gray fine sand	4	15
15	48.5	50.0		50.0	Medium dense gray fine sand w/silt	5	27



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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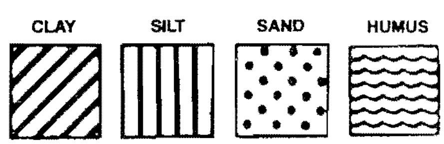
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal

OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

Boring No. 40 **Soil Technician** A. J. Mayeux **Date** 5 September 1985

Ground Elev. 9.69 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0		Very stiff gray & tan clay w/silt		
					pockets		
2	5.0	5.5		7.0	Ditto		
3	8.0	8.5	7.0	10.0	Medium stiff gray clay w/some organic		
					matter		
4	11.0	11.5	10.0	12.0	Soft gray clay w/organic matter		
5	14.0	14.5	12 0	17.0	Very soft brown & gray clay w/wood &		
					organic matter		
6	19.0	19.5	17.0	21.5	Very loose gray silty sand w/organic		
					matter		
7	24.0	24.5	21.5		Soft to medium stiff gray clay		
					w/organic matter		
8	29.0	29.5			Ditto		
9	34.0	34.5			Soft to medium stiff gray clay w/silt		
					lenses		
10	39.0	39.5		42.5	Ditto		
11	44.0	44.5	42.5	44.5	Soft gray sandy clay w/shell fragments		
12	44.5	46.0	44.5	46.5	Loose gray sand w/shell fragments	3	9
13	46.5	48.0	46.5		Medium dense gray sand w/shell	4	12
					fragments		
14	48.5	50.0		50.0	Ditto	5	13

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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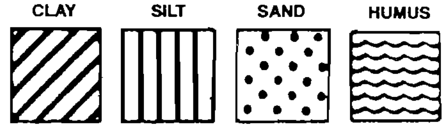
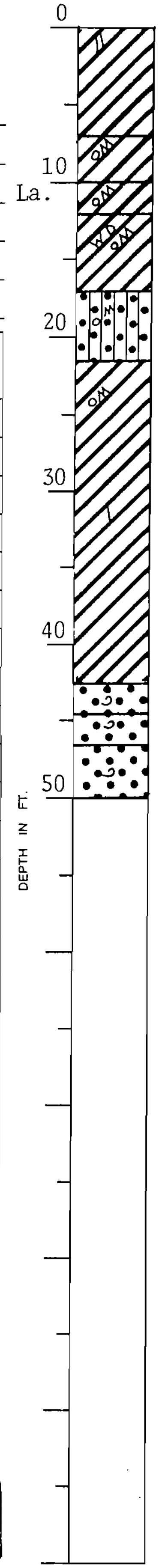
Remarks:



Predominant type shown heavy. Modifying type shown light.



LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

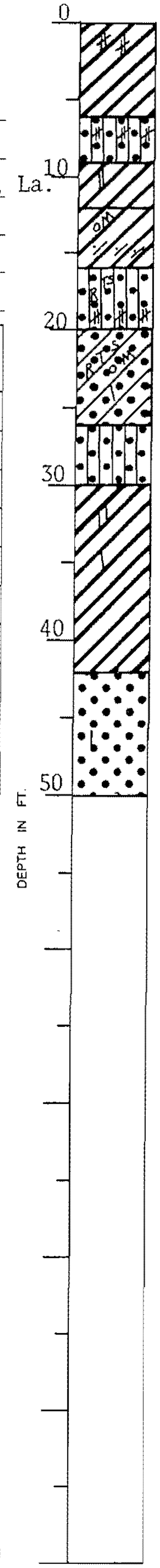
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 41 **Soil Technician** George Hardee **Date** 31 August 1985

Ground Elev. 9.22 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	1.5	2.5	0.0		Stiff gray & tan clay w/clayey silt		
					pockets & brick fragments		
2	4.5	5.5		6.0	Stiff gray & tan clay w/clayey silt		
					pockets		
3	7.5	8.5	6.0	9.0	Medium dense tan & gray silty sand		
					w/clayey silt layers		
4	10.5	11.5	9.0	12.0	Medium stiff gray & tan clay w/silt		
					pockets		
5	13.5	14.5	12.0	16.0	Very soft gray clay w/organic matter		
					& sandy clay layers		
6	18.5	19.5	16.0	20.0	Loose gray silty sand w/roots & clayey		
					silt layers		
7	23.5	24.5	20.0	26.0	Loose gray clayey sand w/roots, organic		
					matter & silt		
8	28.5	29.5	26.0	30.0	Medium dense gray silty sand		
9	33.5	34.5	30.0		Soft gray clay w/silt pockets		
10	38.5	39.5		42.0	Soft gray clay w/silt lenses		
11	44.5	45.0	42.0		Medium dense gray fine sand		
12	45.0	46.5			Ditto	6	16
13	48.5	50.0		50.0	Medium dense gray fine sand w/silt	6	13



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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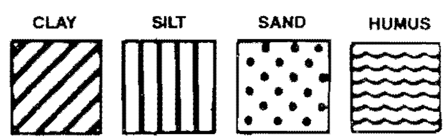
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

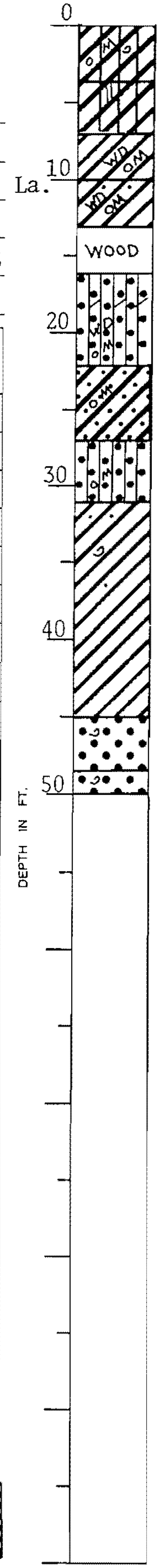
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 42 Soil Technician A. J. Mayeux Date 4-5 September 1985

Ground Elev. 9.49 Datum NGVD Gr. Water Depth See Text

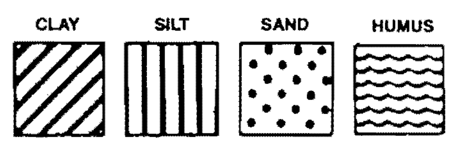
Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	2.0	3.0	0.0	3.5	Medium stiff gray & tan silty clay		
					w/organic matter & shells		
2	5.0	6.0	3.5	7.0	Medium stiff tan & gray silty clay		
					w/silt pockets		
3	8.0	9.0	7.0	10.0	Medium stiff tan & gray clay w/wood		
					& organic matter		
4	11.0	12.0	10.0	13.0	Very soft gray clay w/sand pockets,		
					wood & organic matter		
	14.0	15.0	13.0	16.0	Wood w/clay & organic matter & sand		
5	19.0	20.0	16.0	22.0	Loose gray silty sand w/clay layers,		
					wood & organic matter		
6	24.0	25.0	22.0	27.0	Soft gray sandy clay w/organic matter		
7	29.0	30.0	27.0	31.0	Loose gray silty sand w/organic matter		
8	34.0	35.0	31.0		Medium stiff gray clay w/sand pockets		
					& shell fragments		
9	39.0	40.0			Medium stiff gray clay w/sand lenses		
10	44.0	45.0		45.0	Medium stiff gray clay w/shell fragments		
11	45.0	46.5	45.0	48.5	Loose gray sand w/shell fragments	3	9
12	48.5	50.0	48.5	50.0	Medium dense gray sand w/shell fragments	3	12



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

WHILE THIS LOG OF BORING IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT ITS RESPECTIVE LOCATION ON THE DATE SHOWN, IT IS NOT WARRANTED THAT IT IS REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal

OLB Project No. 2048-0304, New Orleans, Louisiana

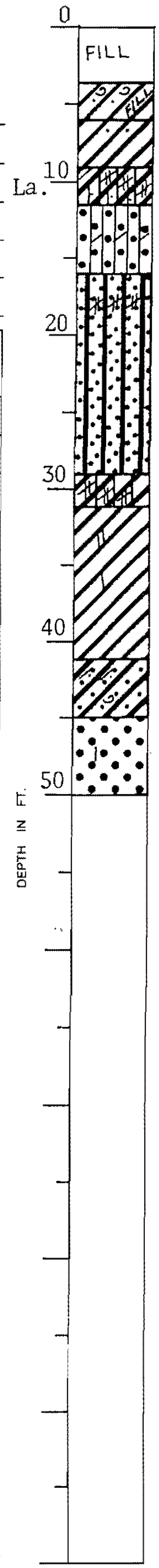
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

Boring No. 43 Soil Technician George Hardee Date 31 July 1985

Ground Elev. 9.42 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.5	3.0	0.0	3.5	Medium compact gray & tan miscellaneous		
					fill, clayey silt, shells, gravel &		
					wood		
2	4.5	5.5	3.5	6.0	Medium stiff gray clay w/shells & sand		
					pockets (fill)		
3	8.5	9.0	6.0	9.0	Medium stiff gray & tan clay w/sand		
					pockets		
4	10.5	11.5	9.0	11.5	Very soft gray silty clay w/clay lenses,		
					clayey silt & silty sand layers		
5	13.5	14.5	11.5	16.0	Loose gray silty sand w/clay layers		
6	16.5	17.5	16.0		Loose gray sandy silt w/clayey silt		
					layers		
7	19.5	20.5			Loose gray sandy silt		
8	23.5	24.5			Loose gray sandy silt w/clayey silt		
					layers		
9	25.0	26.5		29.0	Ditto	2	5
10	28.5	30.0	29.0	31.0	Soft gray silty clay w/clayey silt	4	3
					layers		
11	33.5	34.5	31.0		Soft gray clay w/silt pockets		
12	38.5	39.5		41.0	Soft gray clay w/silt lenses		
13	43.5	44.5	41.0	45.0	Soft gray sandy clay w/clayey sand		
					pockets & shells		
14	45.0	46.5	45.0		Medium dense gray fine sand	5	17
15	48.5	50.0		50.0	Medium dense gray fine sand w/silt	6	20



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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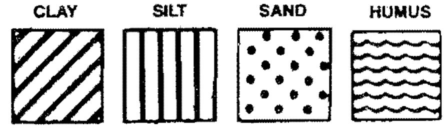
Remarks: 5" Diameter Boring

CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

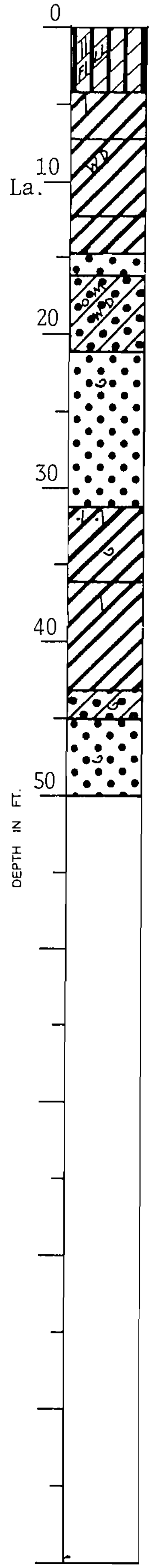
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 44 Soil Technician A. J. Mayeux Date 12 September 1985

Ground Elev. 9.90 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0	4.0	Medium compact to compact tan clayey		
					silt w/silt pockets & fill		
2	5.0	5.5	4.0	7.0	Medium stiff tan & gray clay w/silt		
					lenses		
3	8.0	8.5	7.0		Soft tan & gray clay w/wood		
	11.0	11.5		12.0	Ditto		
4	14.0	14.5	13.0	14.5	Soft gray clay		
5	14.5	16.0	14.5	16.0	Very loose gray sand	1	4
6	19.0	19.5	16.0	21.0	Loose gray clayey sand w/organic matter		
					& wood		
7	24.0	24.5	21.0		Very loose gray sand w/shells		
8	29.0	29.5		31.0	Ditto		
9	34.0	34.5	31.0	36.0	Soft gray clay w/sandy silt pockets &		
					shell fragments		
10	39.0	39.5	36.0	43.0	Soft gray clay w/silt lenses		
11	44.0	44.5	43.0	45.0	Loose gray clayey sand w/shell		
					fragments		
12	45.0	46.5	45.0		Medium dense gray sand w/shell	4	13
					fragments		
13	48.5	50.0		50.0	Ditto	3	11



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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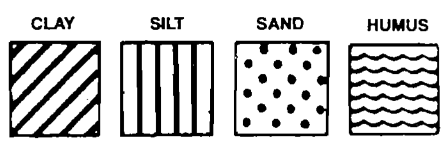


Predominant type shown heavy. Modifying type shown light.

Remarks:

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

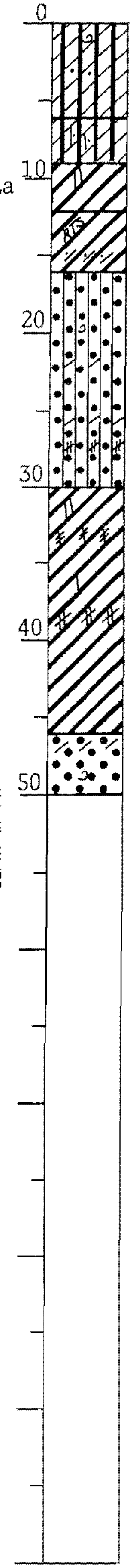
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La
Design Engineering, Inc , Metairie, Louisiana

Boring No. 45 **Soil Technician** George Hardee **Date** 31 August 1985

Ground Elev. 9.67 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	1.5	2.5	0.0		Very compact tan & gray clayey silt w/shells		
2	5.0	5.5		6.0	Very compact tan & gray clayey silt w/sand pockets & shells		
3	7.5	8.5	6.0	9.0	Loose tan & gray clayey silt w/silty sand pockets		
4	10.5	11.5	9.0	12.0	Soft gray & tan clay w/silt pockets		
5	13.5	14.5	12.0	16.0	Soft gray clay w/roots & sandy clay layers		
6	18.5	19.5	16.0		Medium dense dark gray silty sand w/shells & clay pockets		
7	23.5	24.5			Medium dense dark gray silty sand w/clay layers		
8	28.5	29.5		30.0	Medium dense dark gray silty sand w/clayey silt & clay layers		
9	33.5	34.5	30.0		Soft gray clay w/silt pockets & silty clay layers		
10	38.5	39.5			Soft gray clay w/silt lenses		
11	43.5	44.5		46.0	Soft gray clay w/silt pockets & clayey silt layers		
12	49.5	50.0	46.0	50.0	Loose gray fine sand w/clay layers & shells		



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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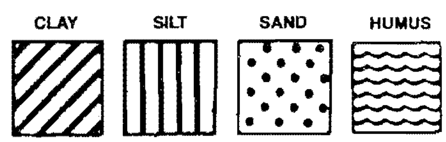


Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

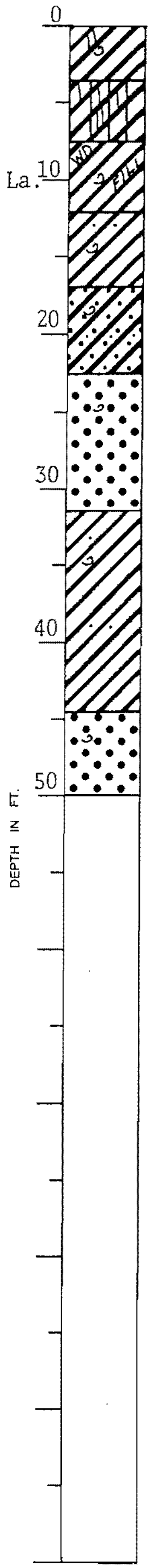
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048 0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 46 Soil Technician A. J. Mayeux Date 4 September 1985

Ground Elev. 9.45 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	3.0	0.0	3.5	Medium stiff gray & tan clay w/silt		
					pockets & shells		
2	5.0	6.0	3.5	7.5	Very stiff tan & gray silty clay w/silt		
					layers & pockets		
3	8.0	9.0	7.5	12.0	Soft tan & gray clay w/brick, wood &		
					shells (fill)		
4	14.0	15.0	12.0	17.0	Very soft gray clay w/sand pockets		
					& shell fragments		
5	19.0	20.0	17.0	22.5	Soft gray sandy clay w/shells & sand		
					layers		
6	24.0	25.0	22.5		Very loose gray sand w/shell fragments		
7	29.0	30.0		31.5	Ditto		
8	34.0	35.0	31.5		Soft to medium stiff gray clay w/sand		
					lenses & shell fragments		
9	39.0	40.0			Ditto		
10	43.5	44.5		44.5	Soft to medium stiff gray clay w/shell		
					fragments & sand pockets		
11	45.0	46.5	44.5		Loose gray sand w/shell fragments	3	9
12	48.5	50.0		50.0	Ditto	4	10



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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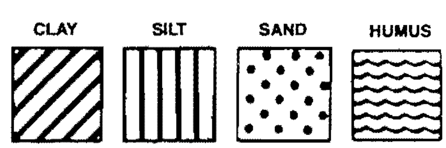
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La
Design Engineering Inc., Metairie, Louisiana

Boring No. 47 **Soil Technician** George Hardee **Date** 30-31 July 1985

Ground Elev. 9.19 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	1.0	2.0	0.0	2.0	Medium compact tan & gray clayey silt		
					w/shells & clay pockets		
2	2.0	3.5	2.0	4.0	Extremely stiff gray & tan clay	6	16
					w/shells & sand pockets		
3	5.0	6.0	4.0		Stiff to very stiff brown & gray		
					fissured clay w/shells & sand pockets		
4	7.5	8.5		8.5	Stiff to very stiff brown & gray		
					fissured clay w/shells & silty clay		
					layers		
5	11.0	11.5	8.5	12.0	Medium stiff to stiff tan & gray clay		
					w/silt pockets & sand layers		
6	14.0	15.0	12.0		Soft gray clay w/shells, sand pockets		
					& layers		
7	16.5	17.5			Soft gray clay		
8	19.5	20.5		23.5	Soft gray clay w/sand layers & shells		
9	24.0	25.0	23.5		Loose gray silty sand w/shells & clay		
					layers		
10	28.5	29.5		30.0	Loose gray silty sand w/shells & clayey		
					silt layers		
11	33.5	34.5	30.0		Soft gray clay w/silt lenses, pockets		
					& shell fragments		
12	38.5	39.5		41.5	Medium stiff gray clay w/sand pockets		
					& shell fragments		
13	43.5	44.5	41.5	44.5	Loose gray clayey sand w/clay pockets		
					& shells		
14	44.5	46.0	44.5	46.5	Medium dense gray fine sand	4	21

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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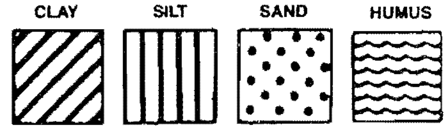
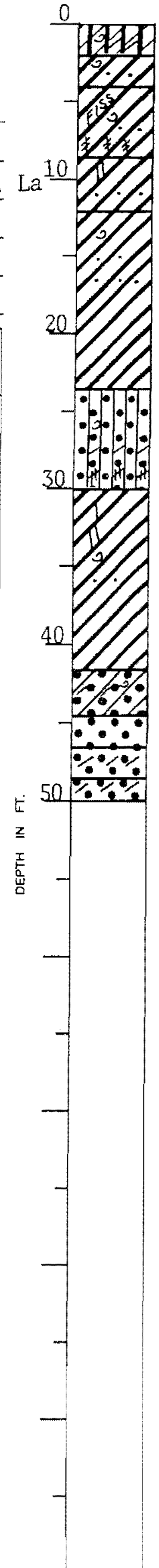
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.



LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 47 (Cont'd) Soil Technician George Hardee Date 30-31 July 1985

Ground Elev. 9.19 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
15	47.0	48.5	46.5	48.5	Loose gray fine sand w/clay layers	4	8
16	48.5	50.0	48.5	50.0	Medium dense gray fine sand w/clay	7	30
					layers		

DEPTH IN FT.

*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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Remarks: 5" Diameter Boring

CLAY SILT SAND HUMUS

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

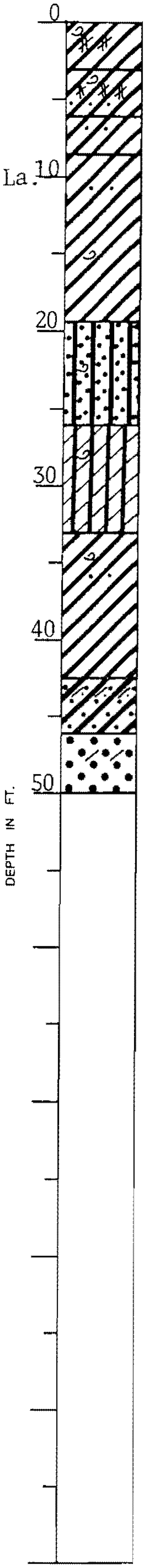
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 48 **Soil Technician** George Hardee **Date** 6 September 1985

Ground Elev. 9.65 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	1.5	2.5	0.0	3.0	Hard tan & gray clay w/shells & clayey		
					silt pockets		
2	4.5	5.5	3.0	6.0	Stiff brown clay w/shells, clayey silt		
					& sand layers		
3	7.5	8.5	6.0	8.5	Medium stiff gray & tan clay w/sand		
					pockets		
4	10.5	11.5	8.5		Soft gray clay w/sand pockets		
5	13.5	14.5			Ditto		
6	18.5	19.5		19.5	Soft gray clay w/sand pockets & shell		
					fragments		
7	24.5	25.0	19.5	26.0	Very loose gray sandy silt w/shells		
8	28.5	29.5	26.0	33.0	Very loose gray clayey silt w/shells		
9	33.5	34.5	33.0		Soft gray clay w/shells & sand pockets		
10	38.5	39.5		42.5	Soft gray clay		
11	43.5	44.5	42.5	46.0	Soft gray sandy clay w/clayey sand		
					layers		
12	47.5	48.5	46.0		Medium dense gray fine sand w/clay		
					pockets		
13	48.5	50.0		50.0	Ditto	5	10



*Number in first column indicates number of blows of 140-lb. hammer dropped 30 in. required to seat 2-in. O. D. splitspoon sampler 6 in. Number in second column indicates number of blows of 140-lb. hammer dropped 30 in. required to drive 2-in. O. D. splitspoon sampler 1 ft. after seating 6 in.

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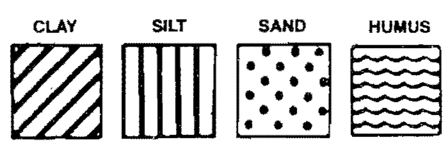


Remarks:

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

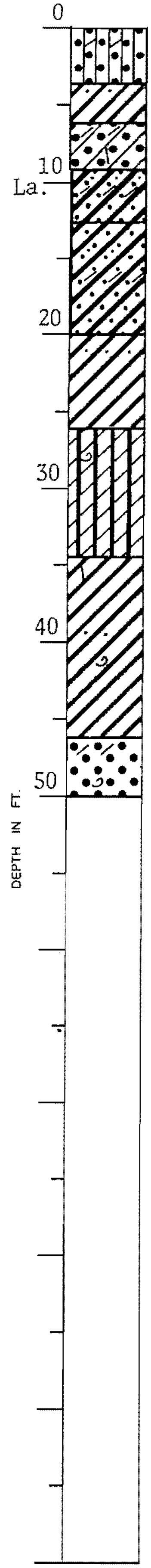
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 49 **Soil Technician** George Hardee **Date** 31 August 1985

Ground Elev. 10.39 **Datum** NGVD **Gr. Water Depth** See Text

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
1	1.5	2.5	0.0	3.5	Medium dense tan silty sand w/clay pockets		
2	4.5	5.5	3.5	6.0	Hard tan & gray clay w/sand pockets & brick fragments		
3	8.0	8.5	6.0	9.0	Medium dense tan & gray clayey sand w/clay pockets & silt		
4	10.5	11.5	9.0	12.5	Medium stiff tan & gray sandy clay w/sand & clay layers		
5	13.5	14.5	12.5		Very soft gray sandy clay w/sand pockets & clay layers		
6	18.5	19.5		20.0	Very soft gray sandy clay w/clay layers		
7	23.5	24.5	20.0	26.0	Soft gray clay w/sand layers		
8	28.5	29.5	26.0		Very loose gray clayey silt w/shells		
9	33.5	34.5		34.5	Ditto		
10	38.5	39.5	34.5		Soft to medium stiff gray clay w/silt lenses		
11	43.5	44.5		46.0	Soft to medium stiff gray clay w/sand pockets & shell fragments		
12	48.5	49.5	46.0	50.0	Loose to medium dense gray fine sand w/clay pockets & shell fragments		



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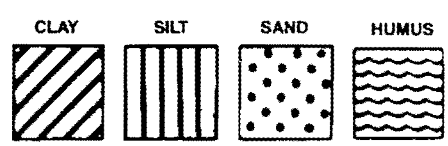
Remarks:



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

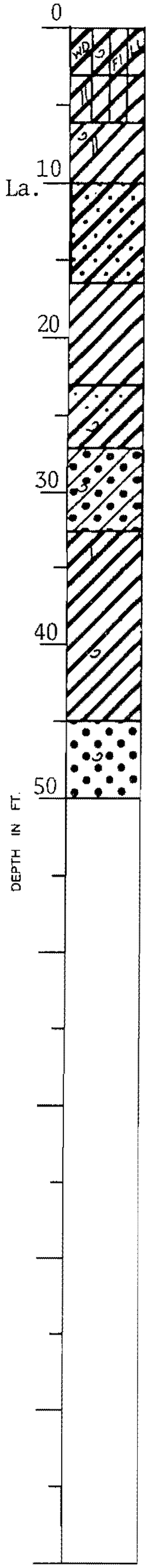
Name of Project: Orleans Levee District Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 50 Soil Technician A. J. Mayeux Date 3-4 September 1985

Ground Elev. 10.09 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.5	3.0	0.0	3.0	Medium stiff gray silty clay w/wood,		
					shells, brick, etc. (fill)		
2	5.0	6.0	3.0	6.0	Stiff tan & gray silty clay w/silt		
					pockets		
3	8.0	9.0	6.0	10.0	Medium stiff tan & gray clay w/shells		
					& silt pockets		
4	13.5	15.0	10.0	16.5	Soft gray sandy clay	1	4
5	19.0	20.0	16.5	23.0	Very soft gray clay		
6	24.0	25.0	23.0	27.0	Extremely soft gray clay w/sand layers,		
					pockets & shells		
7	29.0	30.0	27.0	32.5	Loose gray clayey sand w/shell		
					fragments		
8	34.0	35.0	32.5		Soft gray clay w/silt lenses		
9	39.0	40.0			Ditto		
10	44.0	45.0		45.0	Soft gray clay w/shell fragments		
11	45.0	46.5	45.0		Loose gray sand w/shell fragments	2	7
12	48.5	50.0		50.0	Ditto	1	5



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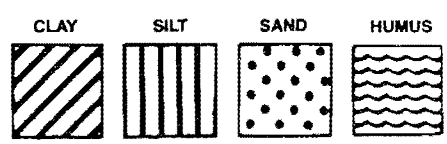


Remarks: 5" Diameter Boring

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

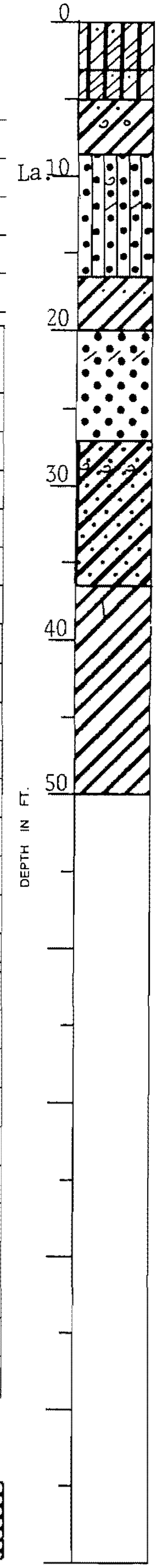
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 51 Soil Technician George Hardee Date 30 July 1985

Ground Elev. 12.89 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	1.0	2.5	0.0	3.0	Medium compact tan & gray clayey silt	5	14
					w/sand & clay pockets		
2	3.5	5.0	3.0	5.0	Loose tan & gray clayey silt w/sand	4	8
					& clay pockets		
3	5.5	6.0	5.0		Very stiff to hard gray & tan clay		
					w/sand pockets, bricks & cinders		
4	6.0	7.5			Ditto	4	15
5	7.5	8.5		8.5	Very stiff to hard gray & tan clay		
					w/shells, gravel, bricks & sand		
					pockets		
6	8.5	10.0	8.5		Medium dense gray & tan silty sand	8	18
					w/shells		
7	11.0	12.5			Medium dense gray & tan silty sand	3	15
					w/shells & clay pockets		
8	13.5	15.0		16.5	Medium dense gray & tan silty sand	3	18
					w/clay pockets		
9	18.5	20.0	16.5	20.0	Soft gray clay w/sand layers	1	6
10	25.0	26.5	20.0	27.0	Loose gray fine sand w/clay layers	3	5
11	28.5	29.5	27.0		Soft gray sandy clay		
12	33.5	34.5		36.5	Soft gray sandy clay w/shell layers		
13	38.5	39.5	36.5		Medium stiff gray clay w/silt lenses		
14	43.5	44.5			Ditto		
15	48.5	49.5		50.0	Ditto		



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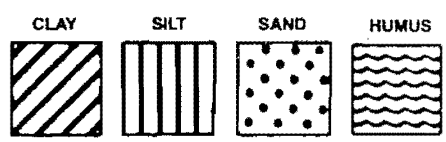
Remarks: 5" Diameter Boring



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

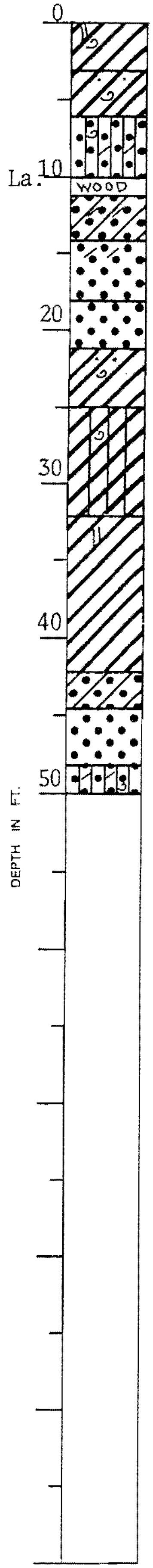
Name of Project: Orleans Levee District Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. 52 Soil Technician George Hardee Date 6 September 1985

Ground Elev. 8.59 Datum NGVD Gr. Water Depth See Text

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
1	2.0	2.5	0.0	3.0	Very stiff tan & gray clay w/silt pockets, shells & brick fragments		
2	4.5	5.5	3.0	6.0	Soft gray clay w/sand pockets & shells		
3	8.5	9.0	6.0	10.0	Loose gray silty sand w/shells & clay pockets & bricks		
			10.0	11.0	Wood		
4	12.0	13.0	11.0	14.0	Loose gray clayey sand w/clay pockets		
5	15.0	16.0	14.0		Medium dense gray fine sand w/clay pockets		
6	16.0	17.5		18.0	Medium dense gray fine sand	2	11
7	18.5	20.0	18.0	21.0	Loose gray fine sand	3	7
8	23.5	24.5	21.0	25.0	Soft gray clay w/sand pockets & shell fragments		
9	28.5	29.5	25.0	32.0	Soft gray silty clay w/shells		
10	33.5	34.5	32.0		Soft gray clay w/silt pockets		
11	38.5	39.5		42.0	Soft gray clay		
12	43.5	44.5	42.0	44.5	Loose gray clayey sand		
13	45.0	46.5	44.5	48.0	Medium dense gray fine sand	4	21
14	48.5	50.0	48.0	50.0	Loose gray silty sand w/clay pockets & shells	3	6



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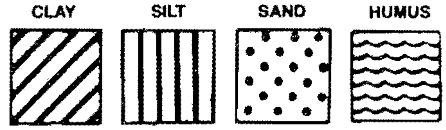
Remarks:

CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

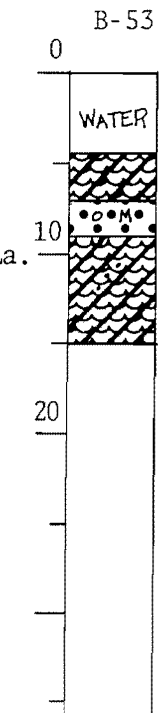
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

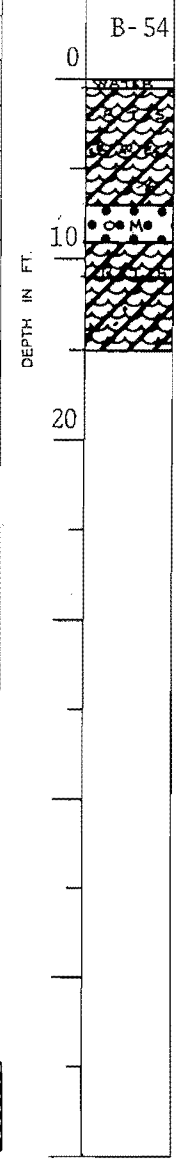
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ **Soil Technician** George Hardee **Date** 25 September 1985

Ground Elev. ______ **Datum** ______ **Gr. Water Depth** ______

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 53		
			0.0	4.5	Water		
1	6.5	7.0	4.5	7.0	Very loose gray organic clayey sand		
2	8.5	9.0	7.0	9.0	Very loose gray fine sand w/organic		
					matter		
3	10.5	11.0	9.0		Very soft gray organic clay w/sand		
					layers		
4	12.5	13.0			Ditto		
5	14.5	15.0		15.0	Ditto		
					BORING 54		
			0.0	0.5	Water		
			5.0	7.0	Extremely loose leaves, roots & organic		
					clay		
1	8.5	9.0	7.0	9.0	Loose gray fine sand w/organic matter		
2	10.5	11.0	9.0	11.0	Loose gray organic clayey sand		
					w/organic clay layers		
3	12.5	13.0	11.0		Very soft gray organic clay w/roots		
					& sand pockets		
4	14.5	15.0		15.0	Ditto		





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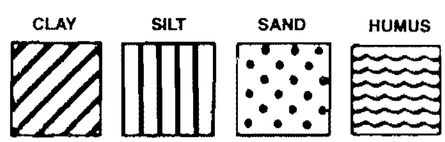
Remarks: ______



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

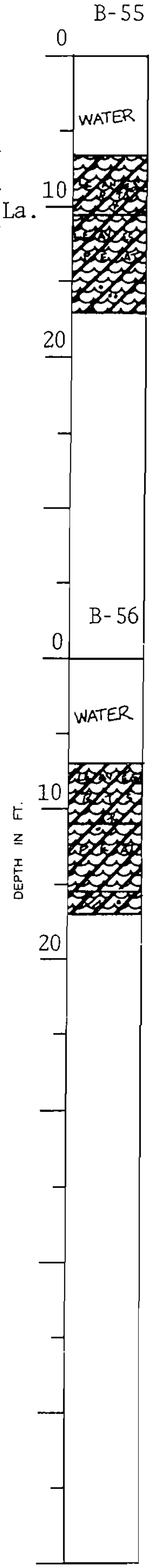
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ________ Soil Technician George Hardee Date 25 September 1985

Ground Elev. ________ Datum ________ Gr. Water Depth ________

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 55		
			0.0	6.5	Water		
1	10.5	11.0	6.5	11.5	Extremely loose leaves, roots & organic		
					clay		
2	12.5	13.0	11.5		Very soft gray organic clay w/leaves,		
					peat & sand		
3	14.5	15.0			Very soft gray organic clay w/sand		
					pockets		
4	16.5	17.0		17.0	Ditto		
					BORING 56		
			0.0	7.0	Water		
1	8.5	9.0	7.0		Extremely loose leaves, roots & organic		
					clay		
2	10.5	11.0		11.0	Ditto		
3	12.5	13.0	11.0		Very soft gray organic clay w/trace of		
					sand & much peat		
4	14.5	15.0		15.5	Very soft gray organic clay w/trace of		
					sand		
5	16.5	17.0	15.5	17.0	Loose gray organic clayey sand w/clay		
					pockets		



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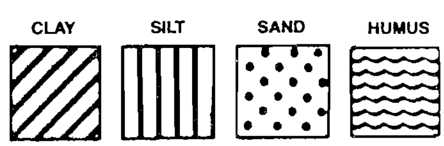


Predominant type shown heavy. Modifying type shown light.

Remarks: ____________________

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

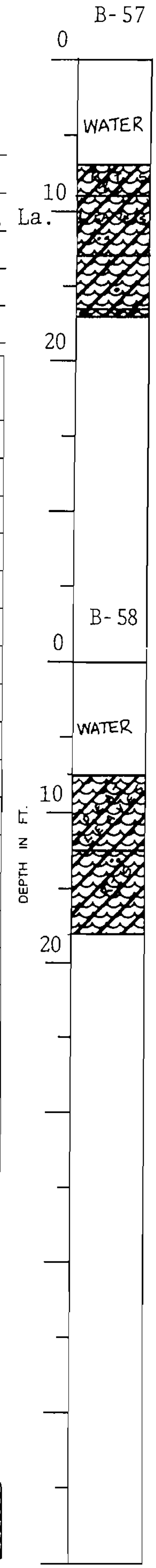
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ________ **Soil Technician** George Hardee **Date** 25 September 1985

Ground Elev. ________ **Datum** ________ **Gr. Water Depth** ________

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 57		
			0.0	7.0	Water		
1	8.5	9.0	7.0	9.0	Extremely loose leaves, roots & organic		
					clay		
2	10.5	11.0	9.0		Extremely soft gray organic clay		
					w/leaves & sand pockets		
3	12.5	13.0		13.0	Ditto		
4	14.5	15.0	13.0	16.5	Very soft gray organic clay w/trace of		
					sand		
5	16.5	17.0	16.5	17.0	Loose gray organic clayey sand		
					BORING 58		
			0.0	7.5	Water		
1	9.5	10.0	7.5		Extremely soft gray organic clay w/much		
					peat & leaves		
2	11.5	12.0		12.5	Ditto		
3	13.5	14.0	12.5		Very soft gray organic clay w/sand		
					pockets		
4	15.5	16.0			Very soft gray organic clay w/roots		
					& sand pockets		
5	17.5	18.0		18.0	Very soft gray organic clay w/sand		
					pockets		



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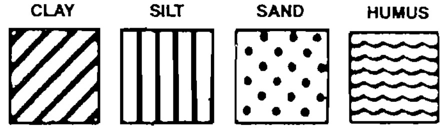
Remarks: ________



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

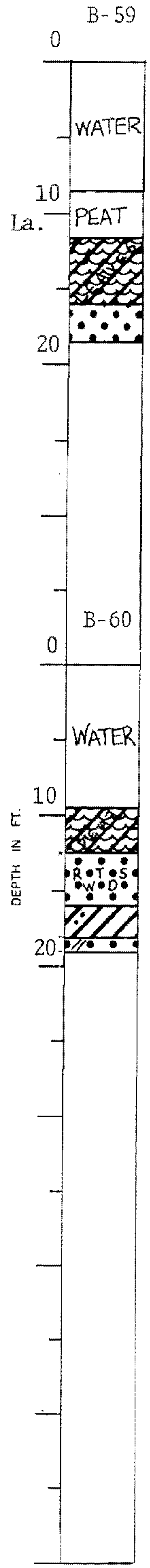
EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician George Hardee Date 24 September 1985

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 59		
			0.0	8.5	Water		
1	10.5	11.0	8.5	11.5	Very loose peat w/organic clay (leaves,		
					grass & roots)		
2	12.5	13.0	11.5		Very soft gray organic clay w/leaves		
3	14.5	15.0		16.0	Very soft gray organic clay		
			16.5	17.5	Loose gray fine sand		
					BORING 60		
			0.0	9.5	Water		
1	11.5	12.0	9.5	12.5	Extremely soft gray organic clay w/much		
					peat		
2	15.5	16.0	12.5	16.0	Loose gray fine sand w/roots & wood		
3	17.5	18.0	16.0	18.0	Soft gray clay w/sand pockets		
4	18.5	19.0	18.0	19.0	Loose gray fine sand w/clay pockets		



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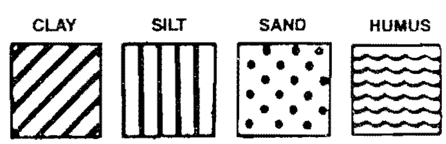


Remarks: ______

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

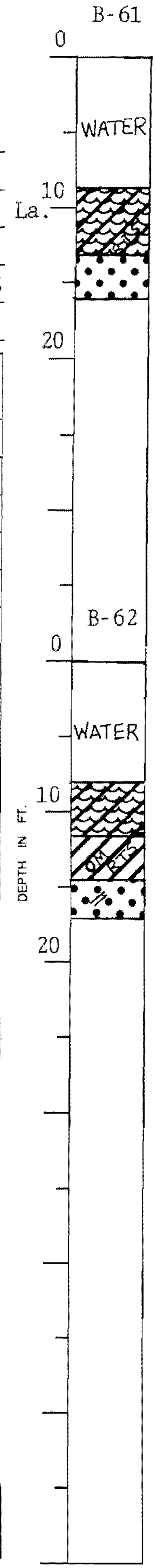
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician George Hardee Date 24 September 1985

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	Sample Depth — Feet From	Sample Depth — Feet To	Depth Stratum Feet From	Depth Stratum Feet To	Visual Classification	*Standard Penetration Test	
					BORING 61		
			0.0	8.5	Water		
1	9.5	10.0	8.5		Extremely soft gray organic clay		
2	11.5	12.0		13.0	Extremely soft gray organic clay		
					w/roots		
			13.0	16.0	Loose gray fine sand		
					BORING 62		
			0.0	8.0	Water		
1	9.5	10.0	8.0	11.5	Extremely soft gray organic clay		
2	11.5	12.0	11.5		Very soft gray clay w/organic matter &		
					roots		
3	13.5	14.0		14.5	Ditto		
4	16.5	17.0	14.5	17.0	Loose gray fine sand w/clay pockets		



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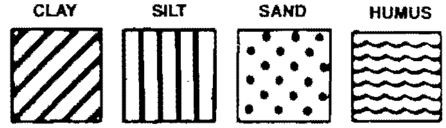
Remarks: ______



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

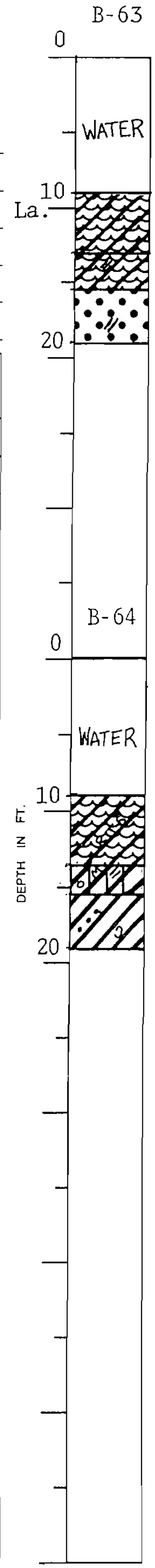
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician George Hardee Date 24 September 1985

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 63		
			0.0	9.0	Water		
1	10.5	11.0	9.0		Extremely soft dark gray organic clay		
2	12.5	13.0		13.0	Extremely soft dark gray organic clay		
					w/clay pockets		
3	14.5	15.0	13.0	15.5	Very soft dark gray organic clay		
4	16.5	17.0	15.5		Loose gray fine sand w/clay pockets		
5	18.5	19.0		19.0	Ditto		
					BORING 64		
			0.0	9.0	Water		
1	10.5	11.0	9.0		Extremely soft dark gray organic clay		
					w/roots		
2	12.5	13.0		13.5	Ditto		
3	14.5	15.0	13.5	15.5	Very soft gray silty clay w/organic		
					matter & clay layers		
4	16.5	17.5	15.5		Very soft gray clay w/sand layers &		
					shells		
5	18.5	19.0		19.0	Ditto		



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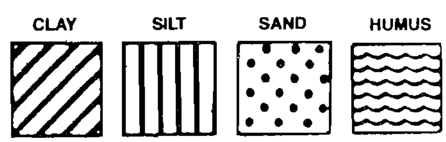


Remarks: ______

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS

METAIRIE, LA.

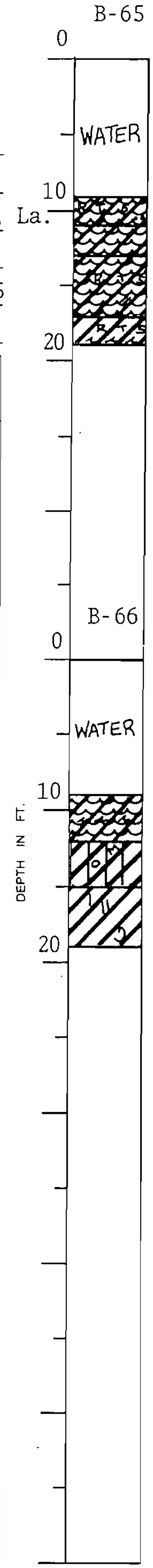
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ________ Soil Technician George Hardee Date 24 September 1985

Ground Elev. ________ Datum ________ Gr. Water Depth ________

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 65		
			0.0	9.0	Water		
1	10.5	11.0	9.0	11.0	Extremely soft black organic clay		
					w/roots & sand pockets		
2	12.5	13.0	11.0	13.0	Extremely soft dark gray organic clay		
3	14.5	15.0	13.0		Very soft gray organic clay w/roots &		
					clay pockets		
4	16.5	17.0		17.0	Very soft black organic clay w/roots		
					& clay pockets		
5	18.5	19.0	17.0	19.0	Very soft gray clay w/roots & humus		
					layers		
					BORING 66		
			0.0	9.0	Water		
1	11.5	12.0	9.0	12.0	Very soft dark gray organic clay		
					w/humus layers		
2	14.5	15.0	12.0	15.0	Soft gray silty clay w/organic matter		
3	16.5	17.0	15.0		Very soft gray clay w/silt lenses &		
					pockets		
4	18.5	19.0		19.0	Very soft gray clay w/silt pockets &		
					shells		



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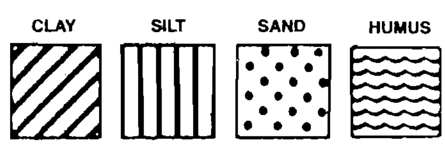
Remarks: ________



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

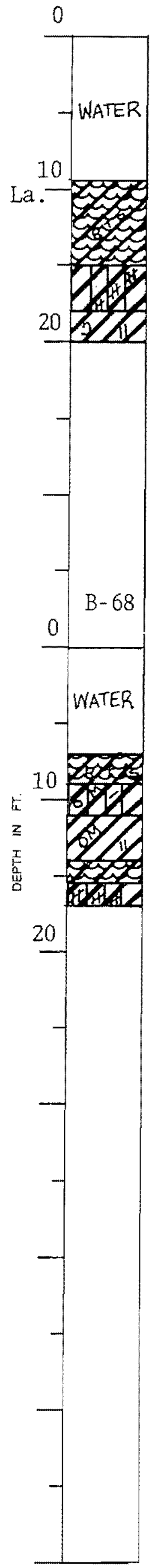
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician George Hardee Date 24 September 1985

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 67		
			0.0	9.5	Water		
1	11.5	12.0	9.5		Extremely soft dark gray organic clay		
2	14.5	15.0		15.0	Extremely soft dark gray organic clay		
					w/roots		
3	17.0	17.5	15.0	18.0	Soft gray silty clay w/clayey silt		
					layers		
4	19.5	20.0	18.0	20.0	Very soft gray clay w/shells & silt		
					pockets		
					BORING 68		
			0.0	7.0	Water		
1	8.5	9.0	7.0	9.0	Very soft dark gray organic clay		
					w/roots		
2	10.5	11.0	9.0	11.0	Very soft gray silty clay w/organic		
					matter & clay lenses		
3	12.5	13.0	11.0	14.0	Very soft gray clay w/organic matter		
					& silt pockets		
4	14.5	15.0	14.0	15.5	Very soft to soft gray organic clay		
5	16.5	17.0	15.5	17.0	Soft gray silty clay w/clayey silt		
					layers		

B-67



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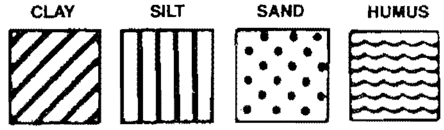
Remarks: ______

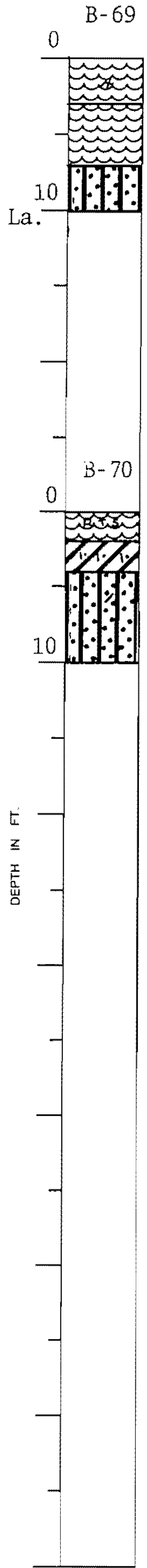
CLAY SILT SAND HUMUS



Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician R. Elkins Date 23 September 1985

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 69		
1	1.5	2.0	0.0	3.0	Very soft brown & gray humus w/organic		
					clay		
2	3.5	4.0	3.0		Very soft brown humus		
3	5.5	6.0		7.0	Ditto		
4	7.5	8.0	7.0		Very loose gray sandy silt		
5	9.5	10.0		10.0	Ditto		
					BORING 70		
1	1.5	2.0	0.0	2.0	Very soft brown humus w/roots		
2	3.5	4.0	2.0	4.0	Very soft gray clay w/silty sand		
					layers		
3	5.5	6.0	4.0		Very loose gray sandy silt w/clay		
4	7.5	8.0			Very loose gray sandy silt		
5	9.5	10.0		10.0	Ditto		

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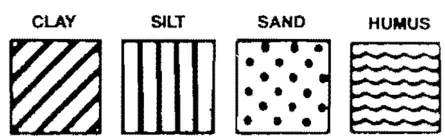

Remarks: ______

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician A. Croal, Jr. Date 10 September 1985

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 71		
			0.0	12.0	Water		
1	13.5	14.0	12.0		Extremely soft gray clay w/organic		
					matter		
2	14.5	15.0		15.0	Extremely soft gray clay		
			15.0		Loose gray fine sand		
					BORING 72		
			0.0	11.0	Water		
1	12.5	13.0	11.0	13.0	Extremely soft gray clay w/organic		
					matter		
			13.0		Loose gray fine sand		

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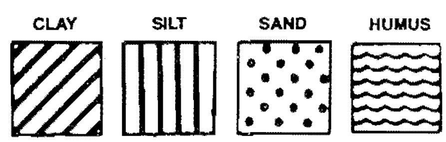
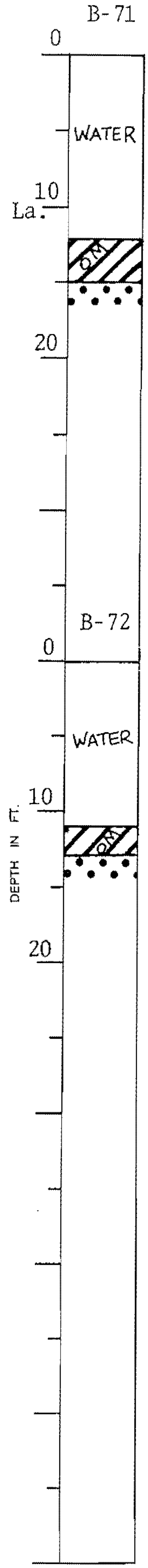


Remarks: ______

Predominant type shown heavy. Modifying type shown light.



LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

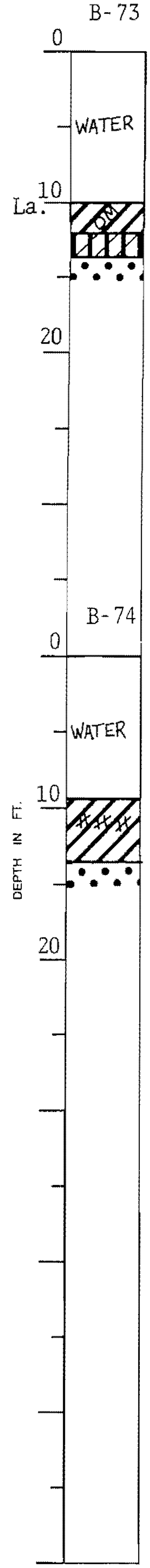
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ________ Soil Technician A. Croal, Jr. Date 10 September 1985

Ground Elev. ________ Datum ________ Gr. Water Depth ________

Sample No.	SAMPLE Depth — Feet From	SAMPLE Depth — Feet To	DEPTH STRATUM Feet From	DEPTH STRATUM Feet To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 73		
			0.0	10.0	Water		
1	11.5	12.0	10.0	12.0	Extremely soft gray clay w/trace of		
					organic matter		
2	13.0	13.5	12.0	13.5	Very loose gray clayey silt		
			13.5		Loose gray fine sand		
					BORING 74		
			0.0	9.5	Water		
1	11.0	11.5	9.5		Very soft gray clay		
2	13.0	13.5		13.5	Very soft gray clay w/clayey silt		
					layers		
			13.5		Loose gray fine sand		



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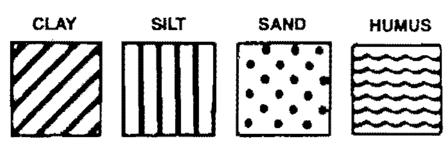


Predominant type shown heavy. Modifying type shown light.

Remarks: ________

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

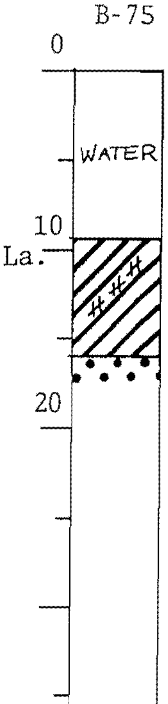
Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

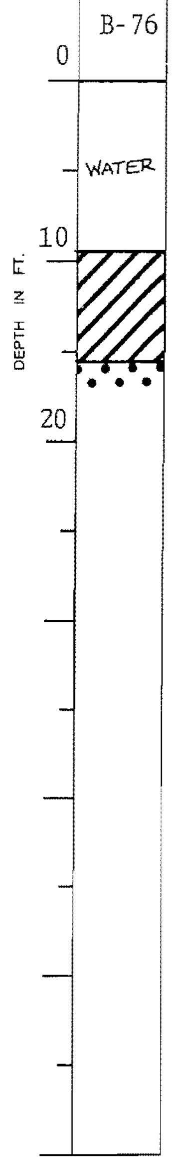
For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ________ Soil Technician A. Croal, Jr. Date 10 September 1985

Ground Elev. ________ Datum ________ Gr. Water Depth ________

Sample No.	SAMPLE Depth — Feet		DEPTH STRATUM Feet		VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
	From	To	From	To			
					BORING 75		
			0.0	9.5	Water		
1	11.0	11.5	9.5		Very soft gray clay		
2	13.0	13.5			Ditto		
3	15.0	15.5		16.0	Very soft gray clay w/clayey silt		
					layers		
			16.0		Loose gray fine sand		
					BORING 76		
			0.0	9.5	Water		
1	11.0	11.5	9.5		Very soft gray clay		
2	13.0	13.5			Ditto		
3	15.0	15.5		15.5	Ditto		
			15.5		Loose gray fine sand		





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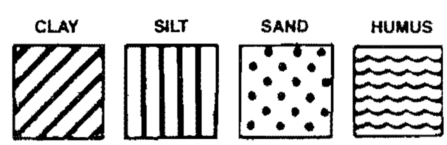
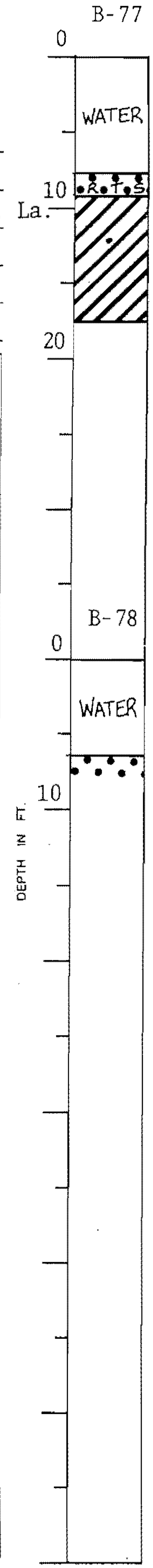


Remarks: ________

Predominant type shown heavy. Modifying type shown light.

LOG OF BORING

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.



Name of Project: Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

Boring No. ______ Soil Technician A. Croal, Jr. Date 10 September 1185

Ground Elev. ______ Datum ______ Gr. Water Depth ______

Sample No.	SAMPLE Depth — Feet From	To	DEPTH STRATUM Feet From	To	VISUAL CLASSIFICATION	*STANDARD PENETRATION TEST	
					BORING 77		
			0.0	7.5	Water		
1	8.5	9.0	7.5	9.0	Very loose gray fine sand w/roots		
2	10.0	10.5	9.0		Very soft gray clay w/fine sand lenses		
3	11.5	12.0			Ditto		
4	13.0	13.5			Very soft gray clay		
5	14.5	15.0			Ditto		
6	17.0	17.5		17.5	Very soft to soft gray clay		
					BORING 78		
			0.0	6.5	Water		
			6.5		Loose gray fine sand		

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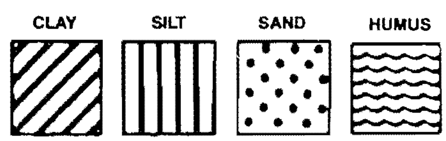
Remarks: ______



Predominant type shown heavy. Modifying type shown light.

APPENDIX B

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 1

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Stiff brown & gray clay w/silt pockets	20.5	93 7	112.9	3210*
4	11.0	Soft gray sandy clay w/trace of organic matter	25.2	95.9	120.1	705
6	17.0	Medium stiff gray clay w/roots	56.6	65.7	102.8	1640

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 3

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2 0	Compact tan & gray clayey silt	16.9	100.8	117.8	2735*
2	5.0	Medium stiff tan & gray silty clay w/large sandy silt pockets & shells	38.9	72.3	100.5	1405
3	8.0	Loose dark brown clayey silt w/organic matter & sand	21.4	79.6	96:7	535*
5	14.0	Soft gray clay w/sand pockets & roots	43.1	75.4	107.9	830

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 4

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.0	Soft gray clay w/organic matter & roots	76.1	54.4	95.7	645

BORING 5

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Medium stiff brown & gray fissured clay w/many silt pockets	24.0	89.1	110.5	1085*
2	5.0	Very stiff tan & gray clay w/silt pockets	25.1	98.2	122.9	6295
3	8.0	Medium stiff dark gray clay w/silt pockets	33.8	78.0	104.4	1370*
4	14.0	Soft gray clay w/roots & trace of organic matter	84.5	49.6	91.6	730

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 6

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Medium stiff brown & gray clay w/sand pockets, shell fragments & gravel (fill)	35.9	81.2	110.3	1510
3	8.0	Soft dark gray clay w/sand pockets & organic matter	68.2	59.9	100.8	510
4	11.0	Very soft gray clay w/organic matter & roots	75.0	55.6	97.3	350

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 7

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Stiff tan & gray silty clay w/partings	18.9	----	-----	----
3	8.0	Medium stiff dark gray clay w/silty sand layers	40.0	74.0	103.6	1020*
4	11.0	Very soft gray clay w/silty sand layers	50.3	66.1	99.4	495*
5	18.5	Extremely soft gray sandy clay w/roots	44.0	77.7	111.9	115

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

Geotechnical Investigation
Orleans Levee District
Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 8

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.5	Very soft brown & gray clay w/roots & organic matter	115.8	38.7	83.4	330
13	48.0	Medium stiff gray clay w/sand layers & pockets	50.4	68.0	102.2	1270*

BORING 9

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Stiff tan & gray clay w/silt pockets	24.6	95.4	118.9	3545*
3	8.0	Stiff gray & tan clay w/silt pockets	28.6	86.8	111.6	2705*
4	11.0	Medium stiff dark gray silty clay w/trace of organic matter	37.3	74.4	102.2	1265*
5	14.0	Soft gray clay w/organic clay layers & wood	140.6	31.2	75.1	760*
7	23.0	Soft gray sandy clay w/organic matter & roots	35.9	81.3	110.5	760*

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 10

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Medium stiff brown & gray clay w/silty sand pockets	26.4	91.3	115.4	1440*
2	5.0	Very soft to soft brown & tan fissured clay w/sand & humus pockets	66.5	58.8	97.9	460*
3	8.0	Very soft dark gray clay w/sand pockets & organic matter	40.7	77.0	108.3	460*
4	11.0	Very soft brown & gray clay w/organic matter	145.0	32.4	79.5	425
5	15.0	Very soft brown & gray clay w/organic matter & roots	120.1	38.2	84.1	450

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SUMMARY OF LABORATORY TEST RESULTS

BORING 11

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Stiff tan & gray clay w/silt pockets	25.0	95.0	118.7	3100*
3	8.0	Medium stiff dark gray clay w/organic matter & sand pockets	50.0	64.1	96.1	1135
4	11.0	Soft gray clay w/silty sand layers	54.5	66.1	102.1	930

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SUMMARY OF LABORATORY TEST RESULTS

BORING 13

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	1.5	Medium stiff brown clay w/clayey silt pockets	24.1	90.0	111.6	1585*
2	4.5	Very soft tan & gray clay	34.7	78.6	105.8	315
3	7.5	Soft brown clay w/sand pockets & trace of organic matter (fill)	53.6	63.2	97.1	545
4	10.5	Soft dark gray clay w/clayey silt pockets & trace of sand	44.4	72.1	104.2	860
5	13.5	Medium stiff gray clay w/clayey sand pockets	45.4	73.0	106.2	1045

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SUMMARY OF LABORATORY TEST RESULTS

BORING 14

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Soft brown & gray clay w/organic matter, roots & shell fragments	125.8	36.0	81.2	600
2	5.0	Very soft gray & brown clay w/organic matter & roots	123.4	37.4	83.5	----
3	8.0	Soft gray clay	73.1	56.0	97.0	520
4	11.0	Very soft gray clay w/sand pockets	33.8	85.8	114.7	270

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SUMMARY OF LABORATORY TEST RESULTS

BORING 15

Sample No	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Extremely stiff tan & gray silty clay	15.5	99.7	115.2	8425*
3	8.0	Medium stiff tan & gray clay w/silt pockets	28.5	86.6	111.3	1520*
4	11.0	Very soft gray clay w/organic matter	52.7	66.4	101.5	410
5	14.0	Soft gray clay w/organic matter & roots	94.1	45.2	87.7	635

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SUMMARY OF LABORATORY TEST RESULTS

BORING 16

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.5	Medium stiff gray clay w/clayey sand layers, shells & organic matter (fill)	33.1	----	-----	----
2	5.5	Soft brown humus w/organic clay, decayed wood & roots	276.4	18.1	68.3	730
3	8.5	Very soft brown organic clay w/humus layers & decayed roots	210.8	23.2	72.0	485
15	49.5	Medium stiff gray clay w/sand pockets & shell fragments	51.0	68.7	103.7	1350
17	59.5	Stiff greenish-gray & tan clay w/sand pockets	23.2	99.8	122.9	2965
26	88.0	Stiff gray clay w/silt lenses	48.2	72.8	107.9	2615
28	98.0	Ditto	39.5	80.9	112.8	2550

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SUMMARY OF LABORATORY TEST RESULTS

BORING 17

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Very stiff tan & gray clay w/silt pockets	25.8	96.5	121.4	4965
4	11.0	Soft dark gray clay w/silt pockets	55.2	61.9	96.0	595
5	14.0	Soft gray clay w/organic matter layers & sand pockets	73.6	53.6	93.1	755
6	19.0	Soft brown organic clay w/silt pockets & roots	191.1	25.2	73.4	670
7	24.0	Soft gray clay w/many sand pockets	36.7	81.2	111.0	695

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SUMMARY OF LABORATORY TEST RESULTS

BORING 18

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
3	8.0	Very soft brown organic clay w/humus layers & roots	229.1	21.9	72.0	280
13	43.5	Medium stiff gray clay w/sand pockets & shell fragments	55.3	65.8	102.2	1260*

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SUMMARY OF LABORATORY TEST RESULTS

BORING 19

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Stiff tan & gray silty clay	21.2	98.7	119.6	3945*
2	5.0	Ditto	32.3	83.5	110.5	2725*
3	8.0	Stiff tan & gray silty clay w/silt pockets & lenses	29.5	89.7	116.1	2365*
4	11.0	Very soft dark gray clay w/sand pockets & organic matter	50.7	62.4	94.0	410*
5	14.0	Extremely soft brown & gray clay w/large sand pockets	51.4	67.0	101.4	160
6	19.0	Very soft black organic clay w/humus layers	196.8	24.4	72.5	725

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SUMMARY OF LABORATORY TEST RESULTS

BORING 20

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	1.5	Soft dark gray clay w/sandy silt layers, humus pockets, decayed wood & shells (fill)	43.3	69.9	100.2	655*
3	7.5	Loose gray clayey silt w/decayed roots	39.0	78.2	108.6	680*
5	13.5	Loose gray clayey sand w/shell fragments	26.2	99.5	125.5	500*
14	43.0	Medium stiff gray clay w/sand pockets	54.7	65.5	101.3	1320
16	53.0	Medium stiff gray clay w/sand pockets & few shell fragments	59.1	64.3	102.2	1225
18	58.0	Very stiff greenish-gray & tan clay w/sand pockets	20.6	106.5	128.5	6380

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SUMMARY OF LABORATORY TEST RESULTS

BORING 21

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Medium stiff gray & tan clay w/clayey sand layers	34.8	82.7	111.5	1000*
3	8.0	Stiff gray & tan clay w/silt pockets	29.5	87.2	113.0	2255
4	11.0	Soft gray clay w/organic matter & trace of sand	52.6	60.5	92.4	515
5	14.0	Medium stiff gray sandy clay w/silty clay layers	25.8	98.7	124.1	1995*
6	19.0	Soft gray clay w/organic matter, roots & wood	117.3	38.7	84.1	585
8	29.0	Medium stiff gray sandy clay w/shell fragments	29.1	93.2	120.4	----

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SUMMARY OF LABORATORY TEST RESULTS

BORING 22

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.5	Very soft brown & gray organic clay w/humus layers & roots	173.2	28.4	77.5	490
4	10.5	Medium dense gray silty sand w/shell fragments	26.3	99.7	125.9	1880*
14	43.5	Medium stiff gray clay w/sand pockets & shell fragments	54.4	66.9	103.4	1190

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BORING 23

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Very stiff tan & gray silty clay	14.4	101.2	115.8	6305*
2	5.0	Very stiff gray & tan clay w/silt pockets	25.8	95.7	120.3	5460
3	8.0	Stiff gray clay w/silt pockets	33.3	86.9	115.8	2945
4	11.0	Soft gray clay w/organic matter & silt pockets	45.5	69.0	100.3	500
5	14.0	Soft gray clay w/clayey silt lenses, layers & organic matter	37.8	78.9	108.8	755*
6	16.0	Very soft gray clay w/organic clay layers	97.1	44.4	87.4	490
7	24.0	Loose gray clayey silt w/roots	35.1	82.5	111.4	630
8	29.0	Soft gray clay w/silty sand pockets & shell fragments	53.7	68.4	105.1	735

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SUMMARY OF LABORATORY TEST RESULTS

BORING 24

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
5	13.5	Very soft gray clay w/sand pockets	56.8	65.8	103.3	360
6	18.0	Ditto	73.1	56.3	97.4	405
14	43.5	Medium stiff gray clay w/sand pockets & shell fragments	65.0	59.8	98.7	1505

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SUMMARY OF LABORATORY TEST RESULTS

BORING 25

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Very stiff tan & gray silty clay w/clayey silt pockets	25.2	93.3	116.9	4165*
3	8.0	Medium stiff tan & gray clay w/clayey silt pockets	28.2	86.4	110.8	1000*
4	11.0	Soft dark gray silty clay w/organic matter & roots	43.2	61.2	87.6	----
6	19.0	Soft black organic clay w/humus, roots & wood	198.7	24.4	73.0	540
7	24.0	Soft gray silty clay w/much organic matter & wood	76.4	50.3	88.6	500
9	32.0	Soft gray clay w/silt pockets	63.4	61.0	99.6	655
17	59.0	Medium stiff gray clay w/clayey sand pockets & shell fragments	53.8	66.9	102.9	1350
19	69.0	Medium stiff gray clay	50.6	69.3	104.3	1125
21	79.0	Very stiff greenish-gray clay w/clayey silt pockets	19.5	105.7	126.3	4505
23	89.0	Stiff tan & gray clay w/silt pockets	33.3	86.1	114.8	2000*
25	99.0	Stiff greenish-gray & tan clay w/silt lenses	37.9	82.5	113.7	2510

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SUMMARY OF LABORATORY TEST RESULTS

BORING 26

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	7.0	Very soft brown humus w/organic clay & roots	244.3	20.6	71.1	355
3	11.0	Very soft gray clay w/clayey silt pockets & few shell fragments	46.4	72.7	106.4	490
4	14.0	Soft gray clay w/silt pockets	68.5	58.5	98.6	530
5	19.0	Very soft gray clay w/silt pockets	86.8	51.9	96.9	390
6	24.0	Very loose gray clayey sand w/clay pockets & shell fragments	38.1	80.7	111.5	255*
14	49.0	Medium stiff gray clay w/sand pockets & shell fragments	54.0	68.1	104.9	1250

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SUMMARY OF LABORATORY TEST RESULTS

BORING 27

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	1.7	Medium stiff tan & gray clay w/silty sand lenses, layers & roots	22.5	94.4	115.6	1065
3	4.7	Medium compact tan & gray sandy silt w/silty clay layers	22.2	93.6	114.4	1090*
4	7.7	Medium stiff gray & tan clay w/silt pockets	31.3	87.1	114.4	1275
6	13.7	Stiff gray clay w/silt pockets	29.6	90.0	116.6	2145
7	18.2	Loose gray clayey silt	37.2	82.3	113.0	840*
8	23.2	Loose brown humus w/organic clay layers & roots	235.8	19.7	66.0	745
9	28.2	Soft gray clay w/sandy silt pockets & few shell fragments	56.1	65.7	102.5	710
12	42.2	Dense gray silty sand w/trace of clay & few shell fragments	26.6	99.2	125.6	3695*

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SUMMARY OF LABORATORY TEST RESULTS

BORING 28

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	4.5	Extremely soft brown humus w/roots	138.5	35.3	84.1	110
2	7.5	Extremely soft gray & brown silty clay w/organic matter & wood	61.4	60.4	97.5	180
4	14.0	Very soft gray clay w/shell fragments & few roots	58.1	63.9	101.1	435
5	19.0	Very soft gray clay w/silt lenses	74.9	54.2	94.8	415
12	44.0	Medium stiff gray clay w/sand pockets	65.7	59.2	98.1	1215

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SUMMARY OF LABORATORY TEST RESULTS

BORING 29

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Very stiff brown & gray clay w/clayey silt pockets & trace of organic matter	24.7	96.4	120.2	4445
3	8.0	Medium stiff gray clay w/clayey silt pockets	25.8	89.8	113.0	1905*
4	11.0	Stiff gray clay w/many clayey silt lenses, layers & pockets	29.0	89.3	115.3	3340*
5	14.0	Soft dark gray clay w/trace of organic matter	50.9	66.0	99.6	720
6	19.0	Soft dark gray silty clay w/organic matter & decayed wood	56.4	60.3	94.4	715
8	29.0	Extremely soft gray clay w/silt pockets, shell fragments & roots	47.3	73.5	108.3	245
10	39.0	Soft gray clay w/silt lenses	69.9	57.7	98.1	835

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SUMMARY OF LABORATORY TEST RESULTS

BORING 30

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Loose brown humus	403.9	11.2	56.3	355*
2	5.0	Loose gray clayey silt w/silty clay layers, roots & organic matter	37.5	79.5	109.3	535*
3	8.0	Very soft gray clay w/trace of organic matter	49.2	68.3	101.8	410*
4	11.0	Very soft gray clay w/silt pockets	50.4	69.3	104.2	265
5	14.0	Soft gray clay w/silt pockets	59.0	63.0	100.1	520
7	24.0	Loose gray clayey sand w/clay pockets & shell fragments	32.5	84.7	112.3	360
14	49.0	Medium stiff gray clay w/sand lenses & pockets	53.6	66.0	101.3	1045*

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SUMMARY OF LABORATORY TEST RESULTS

BORING 31

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	1.7	Hard tan & gray silty clay	12.0	----	-----	----
4	7.7	Medium stiff tan & gray clay w/silt pockets	26.9	84.9	107.8	1530*
6	13.7	Very loose gray clayey silt w/trace of organic matter	39.2	76.7	106.8	455*
8	23.2	Soft gray organic clay w/decayed wood & clay layers	161.5	29.1	76.0	655
10	33.2	Soft gray clay w/clayey silt lenses & layers	49.8	70.6	105.7	740
12	43.2	Very loose gray clayey sand w/shell fragments	29.4	93.2	120.6	420*

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SUMMARY OF LABORATORY TEST RESULTS

BORING 32

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	3.0	Soft brown organic clay	187.8	26.2	75.4	790
2	7.0	Soft dark gray clay w/roots & organic matter	89.2	47.4	89.7	565
3	11.0	Loose gray clayey silt	38.0	78.7	108.6	845*
4	15.0	Very soft gray clay	62.2	61.6	100.0	330
5	19.0	Very soft gray clay w/silt pockets	61.5	61.7	99.6	295
6	24.0	Soft gray clay	75.5	54.8	96.2	525*
14	49.0	Medium stiff gray clay w/sand pockets & shell fragments	55.7	66.5	108.5	1425

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SUMMARY OF LABORATORY TEST RESULTS

BORING 33

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI
1	1.5	Hard tan & gray silty clay w/roots	12.7	----	-----	----			
3	7.5	Very stiff gray & tan clay w/silt lenses & pockets	23.5	96.9	119.6	4600*			
5	13.5	Soft dark gray flocculated clay w/silt pockets	46.5	70.1	102.7	980			
7	23.0	Soft brown organic clay w/silty clay layers	130.1	34.8	80.0	500	118	32	86
9	33.0	Soft gray clay w/clayey silt layers, lenses, pockets & decayed shells	53.1	67.4	103.2	745			

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

Geotechnical Investigation
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Orleans Avenue Outfall Canal
OLB Project No. 2048-0304
New Orleans, Louisiana

For: The Board of Levee Commissioners of the Orleans Levee District
New Orleans, Louisiana

Design Engineering, Inc., Metairie, Louisiana

SUMMARY OF LABORATORY TEST RESULTS

BORING 34

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Medium compact gray & tan clayey silt w/trace of wood & shells	30.0	84.1	109.3	1250*
3	8.0	Soft dark gray clay w/silt pockets	48.9	64.4	96.0	815*
4	14.0	Soft gray & brown organic clay w/humus & roots	152.7	30.8	77.7	545
5	19.0	Soft dark gray & brown organic clay w/humus & clayey silt layers	95.6	44.2	86.5	600
6	24.0	Very soft gray clay w/silt pockets & few shell fragments	61.0	61.9	99.7	410
8	34.0	Soft gray clay	75.5	55.2	96.8	545

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 35

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	1.7	Stiff tan & gray clay w/clayey silt layers & pockets	26.2	91.9	115.9	2290*
4	7.7	Stiff gray clay w/clayey silt layers & lenses	22.6	95.7	117.3	2440*
5	10.7	Ditto	30.1	89.1	115.9	2560*
7	18.2	Soft dark gray silty clay w/organic matter	70.0	52.8	89.8	640
9	28.2	Very loose gray clayey silt w/silty clay layers	47.0	71.8	105.5	385
11	38.2	Medium stiff gray clay	70.9	57.3	98.0	1105

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 36

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	5.0	Extremely soft black & brown humus w/organic clay & roots	212.0	23.5	73.2	215
3	14.0	Very soft gray clay w/silt pockets & shell fragments	64.3	60.7	99.7	435
5	24.0	Soft gray clay	75.7	54.3	95.4	700
6	28.0	Loose gray clayey sand w/shell fragments	28.2	93.2	119.5	345*
12	49.0	Medium stiff gray clay w/shell fragments & sand pockets	58.8	63.3	100.5	1010

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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New Orleans, Louisiana

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SUMMARY OF LABORATORY TEST RESULTS

BORING 37

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	1.5	Compact brown clayey silt w/silty clay & roots (fill)	9.1	----	-----	----
4	8.3	Medium stiff brown silty clay w/sandy silt (fill)	26.5	----	-----	----
6	14.3	Loose dark gray clayey silt w/organic matter	38.4	78.4	108.5	630
8	23.5	Soft brown silty clay w/much organic matter	98.2	41.9	82.9	795
10	33.5	Soft gray clay w/silt & sand pockets & decayed shell fragments	56.1	66.2	103.3	575

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SUMMARY OF LABORATORY TEST RESULTS

BORING 38

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Stiff brown clay w/clayey sand pockets	34.6	78.8	106.0	2165
4	11.0	Soft gray clay w/organic matter lenses & silty sand pockets	55.6	65.4	101.8	660
6	19.0	Soft brown organic clay w/humus & roots	198.1	23.8	70.9	745
8	29.0	Soft gray clay w/clayey silt pockets & decayed shells	59.4	63.9	101.9	570
10	39.0	Soft gray clay w/clayey silt lenses	70.8	57.2	97.7	890
17	64.0	Medium stiff gray clay w/decayed shells	54.0	67.3	103.7	1175
19	73.5	Medium stiff light gray silty clay w/trace of sand	23.3	99.0	122.1	1835
20	78.5	Stiff greenish-gray clay	39.9	79.7	111.5	2825
21	83.5	Stiff light gray sandy clay	24.9	97.2	121.4	2515

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SUMMARY OF LABORATORY TEST RESULTS

BORING 39

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
4	9.5	Medium stiff gray & tan flocculated clay w/silt pockets	53.0	66.3	101.4	1015
6	14.5	Soft brown silty clay w/roots & much organic matter	105.6	40.7	83.7	835
8	23.5	Very loose gray clayey silt w/roots	34.0	----	-----	----
10	33.5	Soft gray clay w/silt lenses & layers	53.1	67.4	103.2	755
11	38.5	Soft gray clay w/silt lenses	69.5	58.2	98.6	835

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SUMMARY OF LABORATORY TEST RESULTS

BORING 40

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Very stiff tan & gray clay w/large clayey sand layers	30.8	87.9	115.0	6715*
4	11.0	Soft gray clay w/trace of organic matter	54.8	67.9	105.2	740
5	14.0	Very soft brown & gray clay w/organic matter & roots	56.8	65.2	102.2	345
8	29.0	Soft gray clay w/silt pockets & shell fragments	52.8	70.7	108.1	700
9	34.0	Soft gray clay w/silt lenses	51.9	68.1	103.4	820
10	39.0	Ditto	68.6	58.1	98.0	850

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 41

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.5	Stiff tan & gray clay w/silt lenses & layers	22.2	93.3	114.0	3485*
4	10.5	Medium stiff gray & tan clay w/silt pockets	56.2	65.3	102.0	1015
6	18.5	Loose gray silty sand w/trace of clay & shells	28.8	96.6	124.5	620*
8	28.5	Medium dense silty sand w/decayed shells	31.6	87.6	115.2	1060*
10	38.5	Soft gray clay w/silt lenses	67.3	58.9	98.6	800

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SUMMARY OF LABORATORY TEST RESULTS

BORING 42

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Medium stiff tan & gray silty clay w/clayey silt pockets	27.1	85.7	109.0	1100*
3	8.0	Medium stiff tan & gray clay w/silty sand lenses & pockets	42.7	74.3	106.0	1000
4	11.0	Very soft gray clay w/silty sand pockets	57.3	65.0	102.3	330*
5	19.0	Loose gray silty sand w/clayey silt layers & trace of organic matter	39.7	79.2	110.7	635*
8	34.0	Medium stiff gray clay w/clayey silt pockets	53.8	67.9	104.4	1140
9	39.0	Medium stiff gray clay w/silt lenses	65.8	60.4	100.2	1165

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SUMMARY OF LABORATORY TEST RESULTS

BORING 43

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF		Unconfined Compressive Strength PSF
				Dry	Wet	
2	4.5	Medium stiff gray clay w/sand pockets & much shells (fill)	24.8	----	-----	----
3	8.5	Medium stiff gray & tan clay w/sandy silt pockets	34.6	83.7	112.7	1565*
4	10.5	Very soft gray silty clay w/clayey silt & silty sand layers	33.9	86.4	115.7	495
11	33.5	Soft gray clay w/silty sand pockets & vertical layers	46.8	72.1	105.9	540*
13	43.5	Soft gray sandy clay w/clayey sand, clay layers & shell fragments	34.2	85.4	114.6	515*

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SUMMARY OF LABORATORY TEST RESULTS

BORING 44

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Medium stiff tan & gray clay	43.9	70.2	101.0	----
3	8.0	Soft tan & gray clay w/clayey silt & sand pockets	45.6	72.8	106.0	----
4	14.0	Soft gray clay w/fine sandy silt pockets	71.9	56.3	968	535
9	34.0	Soft gray clay w/sandy silt pockets & few shell fragments	54.8	67.2	104.0	900
11	44.0	Loose gray clayey sand w/shell fragments	32.5	87.4	115 8	----

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SUMMARY OF LABORATORY TEST RESULTS

BORING 45

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	1.5	Very compact tan & gray clayey silt w/shells	15.9	----	-----	----
3	7.5	Loose tan & gray clayey silt	25.1	82.8	103.5	520*
5	13.5	Soft gray clay w/silt lenses	55.6	66.1	102.9	525
7	23.5	Medium dense dark gray silty sand	34.5	88.1	118.5	1100*
9	33.5	Soft gray clay w/sandy silt pockets & few shell fragments	48.3	70.9	105.2	885*
11	43.5	Soft gray clay w/clayey silt pockets & few shell fragments	58.5	63.8	101.1	600

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 46

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
1	2.0	Medium stiff gray & tan clay w/silty clay layers, pockets & shell fragments	24.5	93.6	116.6	1650*
3	8.0	Soft gray & tan clay w/sand pockets, lenses & shells	37.4	80.5	110.6	845*
4	14.0	Very soft gray clay w/sand lenses, pockets & shell fragments	63.0	61.4	100.1	460
8	34.0	Medium stiff gray clay w/silt pockets & shell fragments	50.6	70.1	105.6	1070
10	43.5	Soft gray clay w/sand pockets & shell fragments	36.3	83.9	114.3	510

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 47

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
4	7.5	Stiff brown & gray fissured clay w/silt pockets & decayed shells	33.4	86.9	116.0	2615*
6	14.0	Soft gray clay w/shells	32.6	87.9	116.5	355
8	19.5	Soft gray clay	69.6	58.3	98.9	915
11	33.5	Soft gray clay w/silt lenses	51.0	70.3	106.1	770
12	43.5	Soft gray clay w/sand pockets & few shell fragments	57.2	65.7	103.3	625

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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New Orleans, Louisiana

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SUMMARY OF LABORATORY TEST RESULTS

BORING 48

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.5	Stiff brown clay w/silty sand layers & pockets	27.0	80.3	101.9	----
4	10.5	Soft gray clay w/clayey sand pockets	48.4	71.7	106.4	865
6	18.5	Soft gray clay w/shell fragments & sand pockets	50.8	70.2	105.9	620
10	38.5	Soft gray clay	63.4	61.4	100.4	815

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New Orleans, Louisiana

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SUMMARY OF LABORATORY TEST RESULTS

BORING 49

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.5	Hard tan & gray clay w/sandy silt layers, brick & shell fragments	16.0	----	-----	----
4	10.5	Medium stiff tan & gray sandy clay w/decayed shells	25.7	95.7	120.3	1535
6	18.5	Very soft gray sandy clay w/few shell fragments	37.8	80.7	111.2	455
8	28.5	Very loose gray clayey silt w/some shells	39.5	81.8	114.2	280*
10	38.5	Medium stiff gray clay w/silt lenses	65.2	60.4	99.8	1115

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SUMMARY OF LABORATORY TEST RESULTS

BORING 50

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	5.0	Stiff gray & tan silty clay w/sandy silt layers & shells	15.7	95.0	109.9	3290*
3	8.0	Medium stiff gray & tan clay w/sand pockets	38.3	80.2	110.9	1500
5	19.0	Very soft gray flocculated clay	77.5	53.2	94.4	475
6	24.0	Extremely soft gray clay w/large clayey sand pockets & shells	48.5	70.0	103.9	----
8	34.0	Soft gray clay w/sand pockets	59.3	64.2	102.2	920
10	44.0	Soft gray clay w/sand pockets & shell fragments	42.3	77.3	110.1	845

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.

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SUMMARY OF LABORATORY TEST RESULTS

BORING 51

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF		Unconfined Compressive Strength PSF	Atterberg Limits		
				Dry	Wet		LL	PL	PI
5	7.5	Very stiff gray & tan clay w/silt pockets, shells, brick & sand (fill)	26.9	----	-----	----			
11	28.5	Soft gray sandy clay w/few shell fragments	34.7	85.8	115.5	720			
13	38.5	Medium stiff gray clay w/silt lenses	67.0	60.3	100.7	1410	96	25	71
15	48.5	Ditto	67.1	60.2	100.6	1310			

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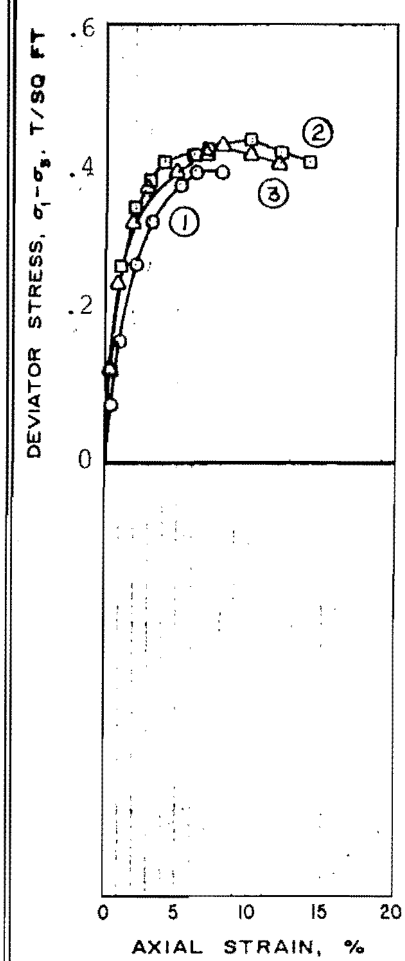
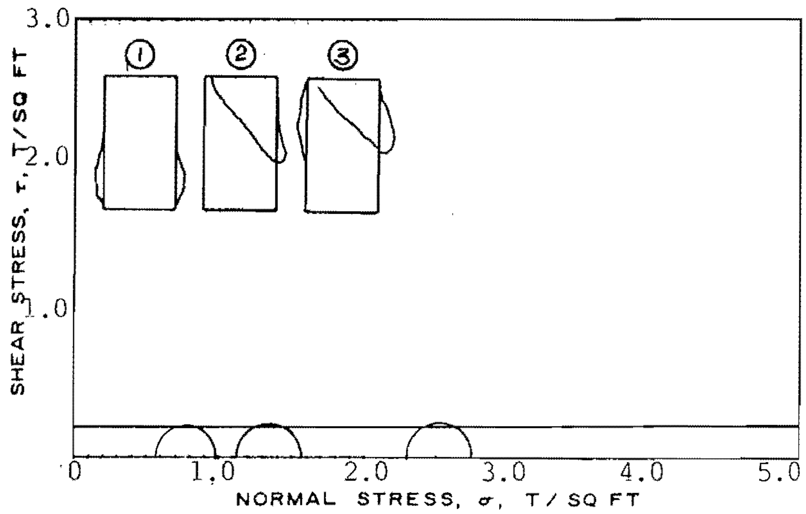
SUMMARY OF LABORATORY TEST RESULTS

BORING 52

Sample No.	Depth In Feet	Classification	Water Content Percent	Density PCF Dry	Density PCF Wet	Unconfined Compressive Strength PSF
2	4.5	Soft gray clay w/sand pockets	31.9	88.0	116.0	810
4	12.0	Loose gray clayey sand	23.5	100.2	123.7	615*
8	23.5	Soft gray clay w/silty sand layers	70.9	57.4	98.1	950
10	33.5	Soft gray clay w/clayey silt lenses	52.1	69.1	105.1	915
12	43.5	Loose gray clayey sand w/shell fragments & clay pockets	29.2	91.1	117.7	610*

*Unconsolidated Undrained Triaxial Compression Test - One Specimen; Confined at the approximate overburden pressure.





TEST NO.			1	2	3	
INITIAL	WATER CONTENT %	w_o	40.8	41.0	40.9	
	VOID RATIO	e_o	1.13	1.16	1.15	
	SATURATION %	S_o	98	97	97	
	DRY DENSITY, LB/CU FT	γ_d	79.7	78.8	79.0	
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	40.8	41.0	40.9	
	VOID RATIO	e_f	1.13	1.16	1.15	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.58	1.15	2.30	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{max}$	0.40	0.44	0.43	
TIME TO FAILURE, MIN		t_f	12	20	16	
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.22 T/SQ FT

METHOD OF SATURATION ______

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

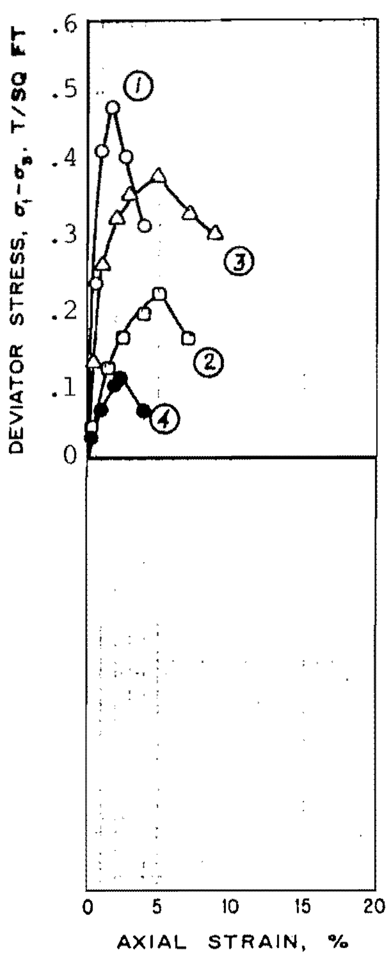
TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed		
CLASSIFICATION Soft gray & tan clay w/sand pockets & roots			
LL	PL	PI	G_s 2.72 Est.

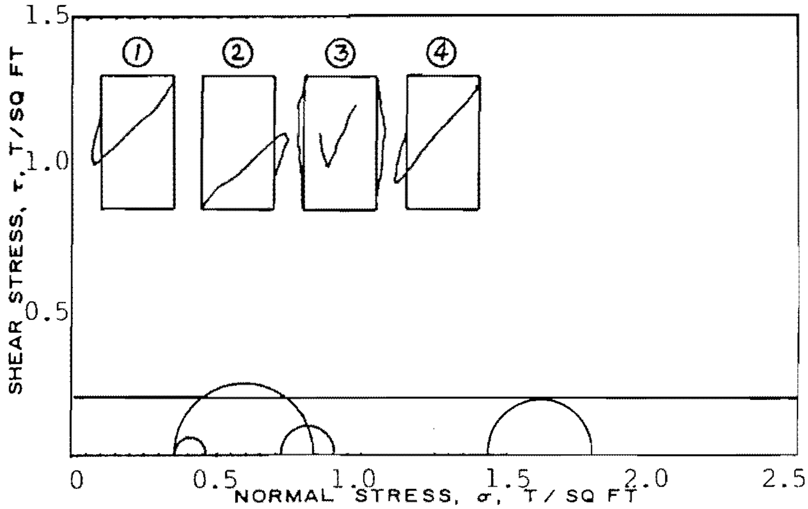
REMARKS ______

PROJECT Orleans Levee District	
Orleans Avenue Outfall Canal	
AREA New Orleans, Louisiana	
BORING NO. 3	SAMPLE NO. 5
DEPTH 14.0' - 15.0'	DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





TEST NO.			1	2	3	4
INITIAL	WATER CONTENT %	w_o	62.9	50.3	54.8	53.2
	VOID RATIO	e_o	1.84	1.38	1.64	1.53
	SATURATION %	S_o	94	100	92	100
	DRY DENSITY, LB/CU FT	γ_d	60.2	71.8	64.8	67.7
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	62.9	50.3	54.8	53.2
	VOID RATIO	e_f	1.84	1.38	1.64	1.53
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.36	0.72	1.44	0.36
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{max}$	0.48	0.22	0.38	0.11
TIME TO FAILURE, MIN		t_f	3	10	10	5
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	0.5
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	1.39
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	3.00

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.20 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

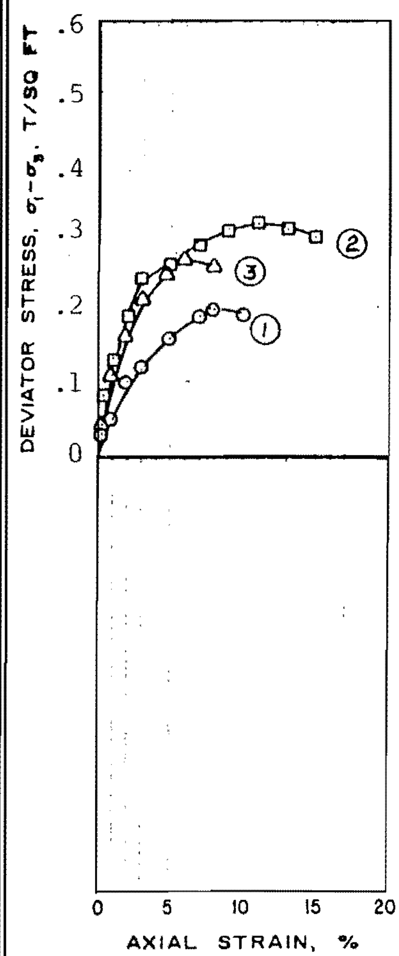
TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed			
CLASSIFICATION Soft brown & gray fissured clay w/sand pockets				
LL	PL	PI		G_s 2.74 Est.

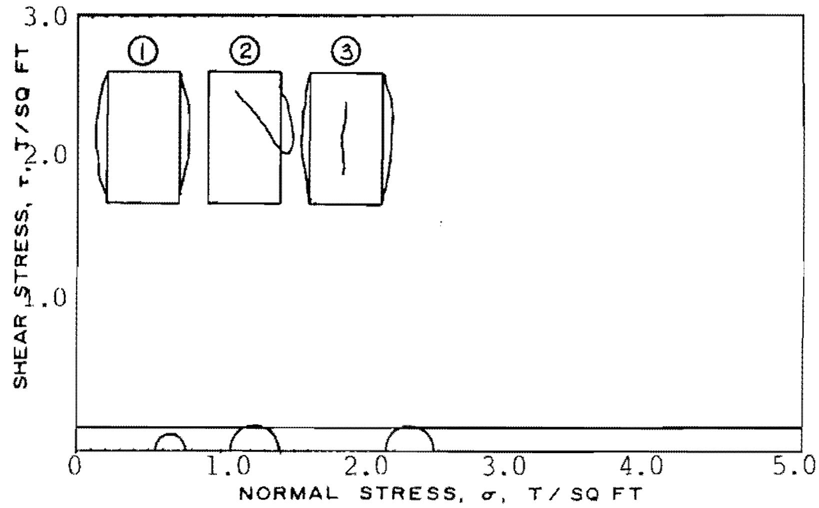
REMARKS

PROJECT Orleans Levee District	
Orleans Avenue Outfall Canal	
AREA New Orleans, Louisiana	
BORING NO. 6	SAMPLE NO. 2
DEPTH 5.0' - 6.0'	DATE 9/23/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.14 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

			TEST NO.	1	2	3	
INITIAL	WATER CONTENT	%	w_o	65.0	65.0	71.1	
INITIAL	VOID RATIO		e_o	2.04	1.92	2.27	
INITIAL	SATURATION	%	S_o	86	91	85	
INITIAL	DRY DENSITY, LB/CU FT		γ_d	55.4	57.6	51.5	
BEFORE SHEAR	WATER CONTENT	%	w_c				
BEFORE SHEAR	VOID RATIO		e_c				
BEFORE SHEAR	SATURATION	%	S_c				
BEFORE SHEAR	FINAL BACK PRESSURE, T/SQ FT		u_o				
FINAL	WATER CONTENT	%	w_f	65.0	65.0	71.1	
FINAL	VOID RATIO		e_f	2.04	1.92	2.27	
MINOR PRINCIPAL STRESS, T/SQ FT			σ_3	0.54	1.08	2.16	
MAX DEVIATOR STRESS, T/SQ FT			$(\sigma_1 - \sigma_3)_{max}$	0.20	0.32	0.27	
TIME TO FAILURE, MIN			t_f	16	22	12	
RATE OF STRAIN, PERCENT/MIN				0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT							
ULT DEVIATOR STRESS, T/SQ FT			$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.			D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.			H_o	3.00	3.00	3.00	

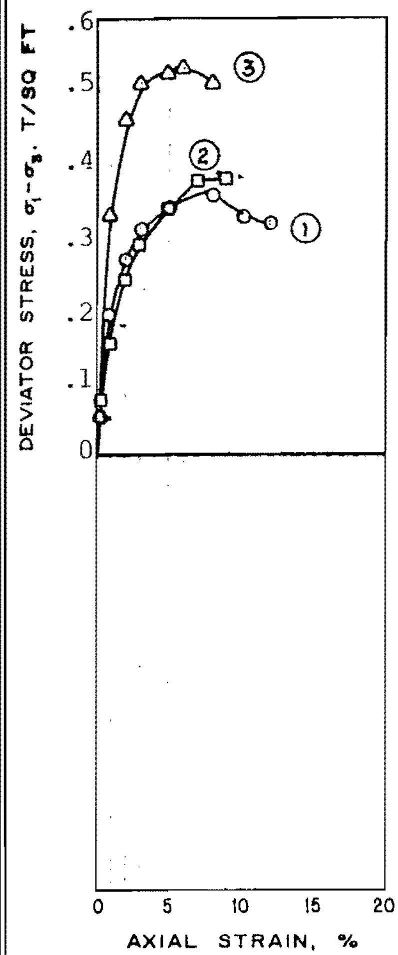
TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed		
CLASSIFICATION Soft black clay w/organic matter & silt pockets			
LL	PL	PI	G_s 2.70 Est.

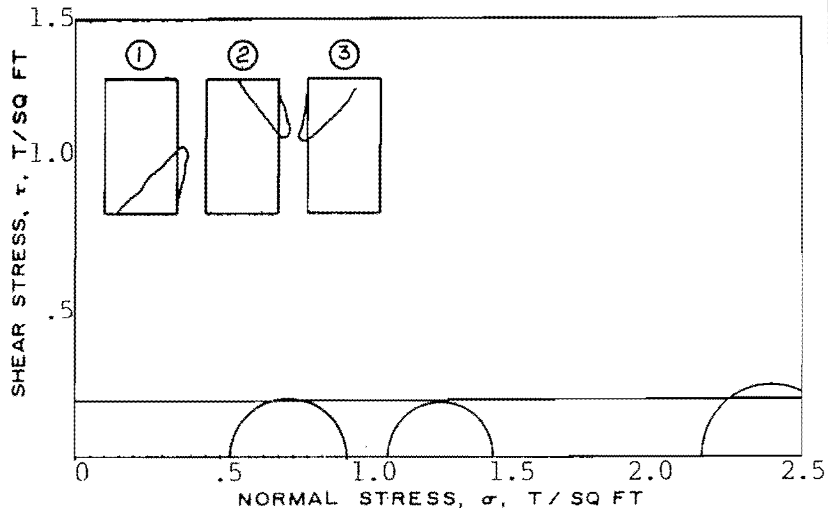
REMARKS

PROJECT	Orleans Levee District
	Orleans Avenue Outfall Canal
AREA	New Orleans, Louisiana
BORING NO. 23	SAMPLE NO. 4
DEPTH 11.0' - 12.0'	DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.19 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

			1	2	3	
TEST NO.			1	2	3	
INITIAL	WATER CONTENT %	w_o	51.3	50.8	50.2	
	VOID RATIO	e_o	1.43	1.39	1.42	
	SATURATION %	S_o	98	100	96	
	DRY DENSITY, LB/CU FT	γ_d	70.0	71.1	70.2	
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	51.3	50.8	50.2	
	VOID RATIO	e_f	1.43	1.39	1.42	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.54	1.08	2.16	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.36	0.38	0.53	
TIME TO FAILURE, MIN		t_f	16	14	12	
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

TYPE OF TEST UU | TYPE OF SPECIMEN Undisturbed

CLASSIFICATION Soft gray clay w/sand pockets & shell fragments

LL | PL | PI | G_s 2.72 Est.

REMARKS

PROJECT Orleans Levee District
Orleans Avenue Outfall Canal

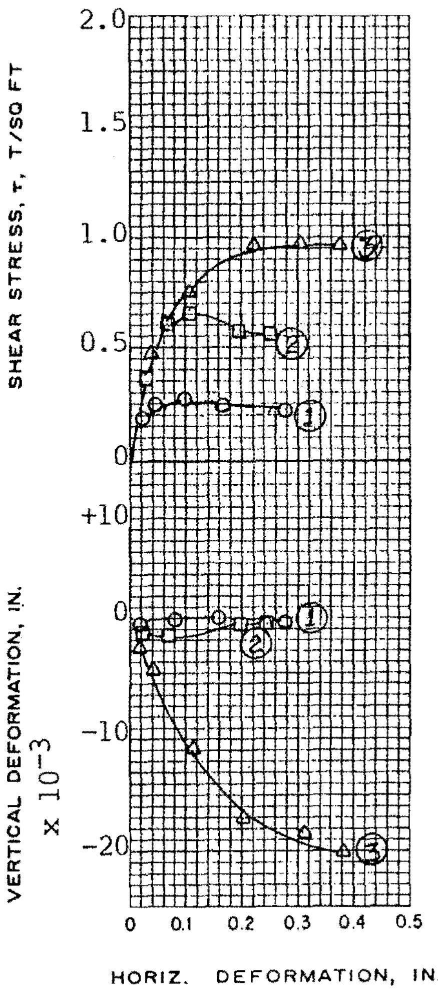
AREA New Orleans, Louisiana

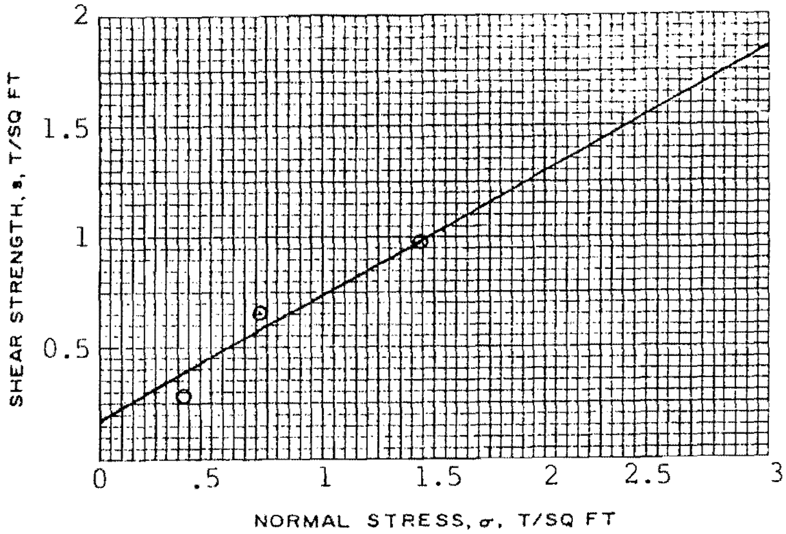
BORING NO. 23 | SAMPLE NO. 8

DEPTH 29.0' - 30.0' | DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





SHEAR STRENGTH PARAMETERS

ϕ' = 29°

TAN ϕ' = 0.554

c' = 0.17 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

				1	2	3	
TEST NO.				1	2	3	
INITIAL	WATER CONTENT	%	w_o	17.3	21.6	23.1	
	VOID RATIO		e_o	0.619	0.659	0.743	
	SATURATION	%	S_o	75	89	84	
	DRY DENSITY, LB/CU FT		γ_d	104.0	101.6	96.6	
VOID RATIO AFTER CONSOLIDATION			e_c	0.612	0.630	0.647	
TIME FOR 50 PERCENT CONSOLIDATION, MIN			t_{50}				
FINAL	WATER CONTENT	%	w_f	21.3	24.4	23.9	
	VOID RATIO		e_f	0.613	0.630	0.610	
	SATURATION	%	S_f	94	100	100	
NORMAL STRESS, T/SQ FT			σ	0.36	0.72	1.44	
MAXIMUM SHEAR STRESS, T/SQ FT			τ_{max}	0.27	0.66	0.97	
ACTUAL TIME TO FAILURE, MIN.			t_f	202	210	606	
RATE OF STRAIN, IN./MIN				.0005	.0005	.0005	
ULTIMATE SHEAR STRESS, T/SQ FT			τ_{ult}	0.23	0.54	0.97	

TYPE OF SPECIMEN Undisturbed — 3.0 IN. SQUARE — 1.0 IN. THICK

CLASSIFICATION Stiff tan & gray silty clay w/clay & sandy silt layers & pockets

LL 42 | PL 15 | PI 27 | G_s 2.70

REMARKS

PROJECT Orleans Levee District

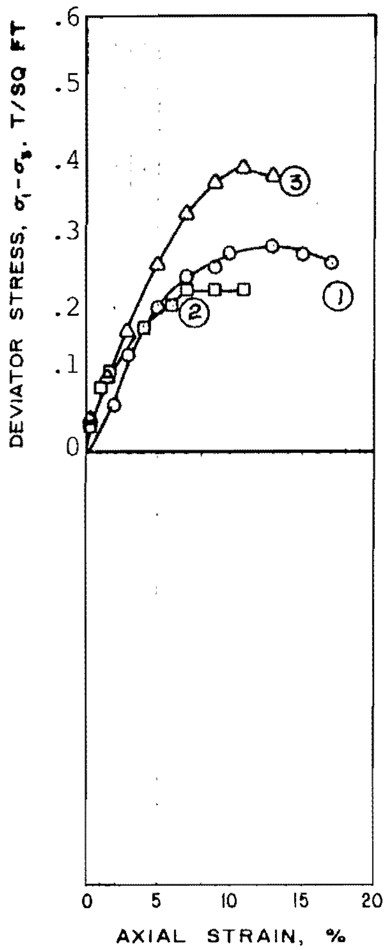
Orleans Avenue Outfall Canal

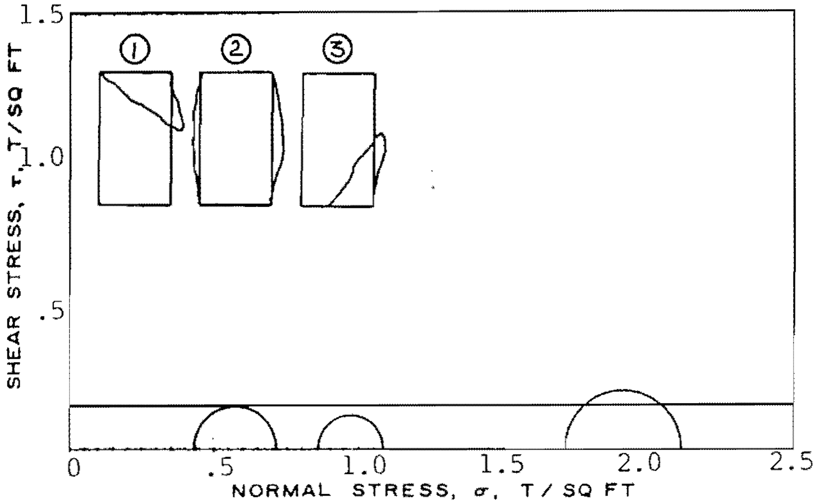
AREA New Orleans, Louisiana

BORING NO. 29 | SAMPLE NO. 2

DEPTH EL 5.0 | DATE 9/24/85

DIRECT SHEAR TEST REPORT





TEST NO.			1	2	3	
INITIAL	WATER CONTENT %	w_o	81.2	79.7	89.1	
	VOID RATIO	e_o	2.36	2.26	2.55	
	SATURATION %	S_o	93	95	94	
	DRY DENSITY, LB/CU FT	γ_d	50.1	51.6	47.5	
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	81.2	79.7	89.1	
	VOID RATIO	e_f	2.36	2.26	2.55	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.43	0.86	1.73	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.28	0.22	0.39	
TIME TO FAILURE, MIN		t_f	26	14	22	
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.15 T/SQ FT

METHOD OF SATURATION ______

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

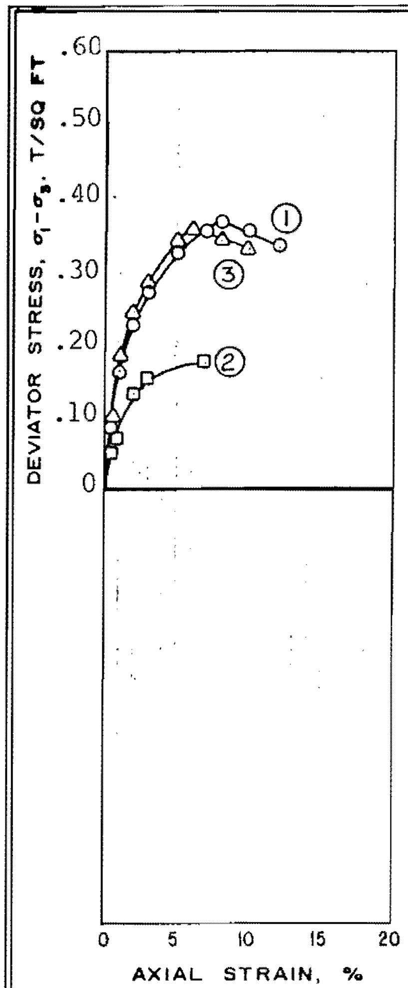
TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed				
CLASSIFICATION Soft dark gray silty clay w/organic matter & sand lenses					
LL	PL	PI		G_s	2.70 Est.

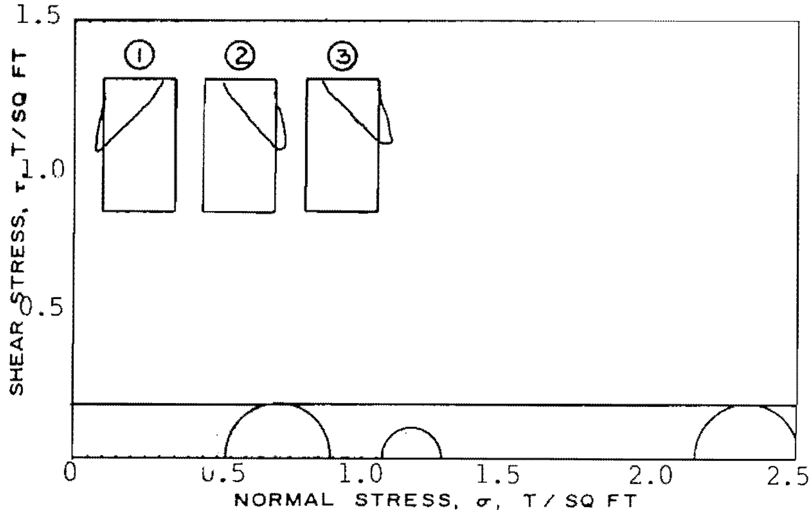
REMARKS ______

PROJECT	Orleans Levee District		
	Orleans Avenue Outfall Canal		
AREA	New Orleans, Louisiana		
BORING NO.	33	SAMPLE NO.	7
DEPTH	23.0' - 24.0'	DATE	9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





TEST NO.			1	2	3	
INITIAL	WATER CONTENT %	w_o	60.1	59.8	59.5	
	VOID RATIO	e_o	1.64	1.67	1.70	
	SATURATION %	S_o	100	98	95	
	DRY DENSITY, LB/CU FT	γ_d	64.3	63.7	62.9	
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	60.1	59.8	59.5	
	VOID RATIO	e_f	1.64	1.67	1.70	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.54	1.08	2.16	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.36	0.17	0.35	
TIME TO FAILURE, MIN		t_f	16	14	12	
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.18 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed				
CLASSIFICATION Soft gray clay w/silt lenses					
LL	PL	PI		G_s 2.72 Est.	

REMARKS

PROJECT Orleans Levee District

Orleans Avenue Outfall Canal

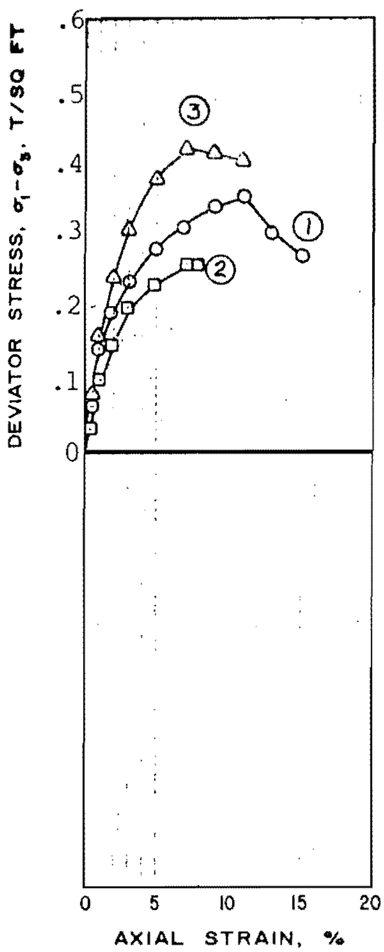
AREA New Orleans, Louisiana

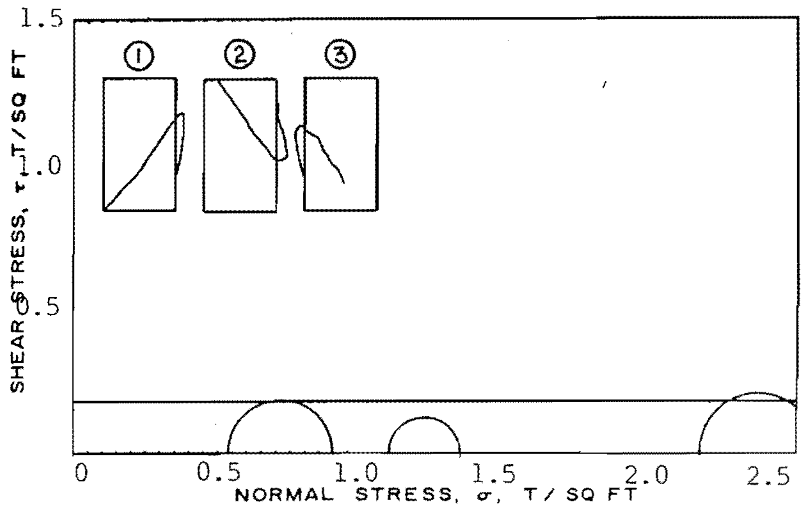
BORING NO. 33 | SAMPLE NO. 9

DEPTH 33.0' - 34.0' | DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





TEST NO.			1	2	3	
INITIAL	WATER CONTENT %	w_o	43.9	49.6	38.3	
	VOID RATIO	e_o	1.20	1.42	1.15	
	SATURATION %	S_o	99	94	90	
	DRY DENSITY, LB/CU FT	γ_d	76.7	69.6	78.4	
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	43.9	49.6	38.3	
	VOID RATIO	e_f	1.20	1.42	1.15	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.54	1.08	2.16	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.35	0.26	0.42	
TIME TO FAILURE, MIN		t_f	22	14	14	
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.18 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF TEST UU

TYPE OF SPECIMEN Undisturbed

CLASSIFICATION Soft gray clay w/silty sand, clayey silt pockets & some shells

LL | PL | PI | G_s 2.70 Est.

REMARKS

PROJECT Orleans Levee District

Orleans Avenue Outfall Canal

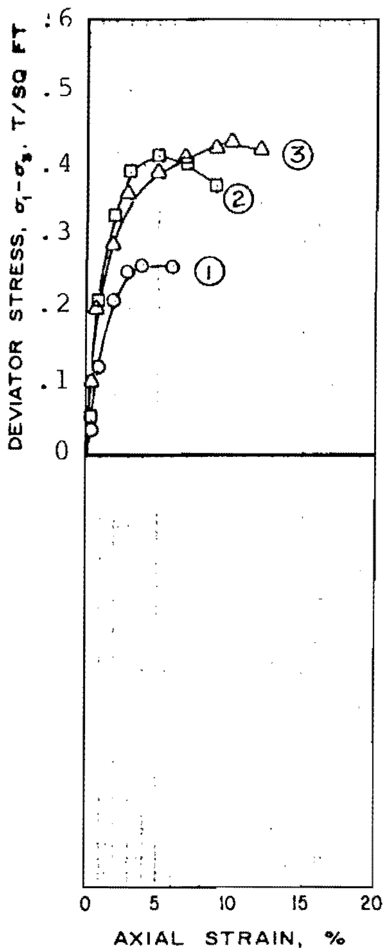
AREA New Orleans, Louisiana

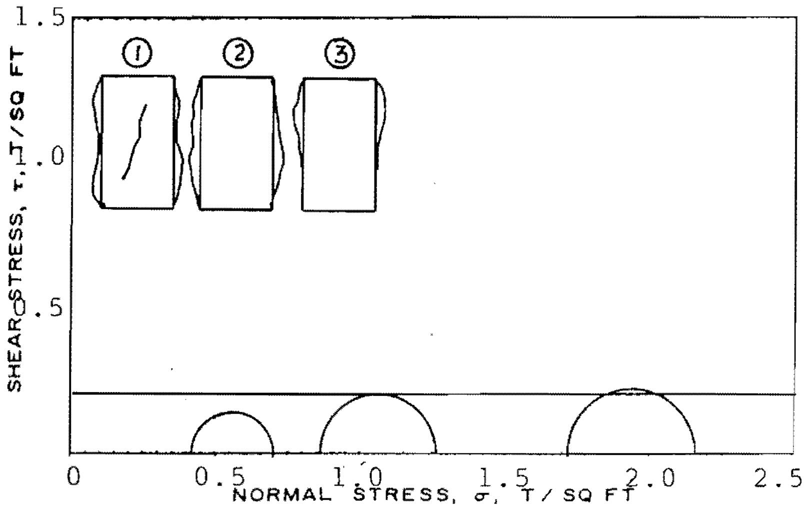
BORING NO. 42 SAMPLE NO. 4

DEPTH 11.0' - 12.0' DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





TEST NO.			1	2	3	
INITIAL	WATER CONTENT %	w_o	39.7	43.4	38.1	
	VOID RATIO	e_o	1.10	1.18	1.08	
	SATURATION %	S_o	97	99	95	
	DRY DENSITY, LB/CU FT	γ_d	80.2	77.2	81.0	
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	39.7	43.4	38.1	
	VOID RATIO	e_f	1.10	1.18	1.08	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.43	0.86	1.73	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.26	0.41	0.43	
TIME TO FAILURE, MIN		t_f	8	10	20	
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.21 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed			
CLASSIFICATION Soft gray & tan clay w/sand pockets				
LL	PL	PI		G_s 2.70 Est.

REMARKS

PROJECT Orleans Levee District
Orleans Avenue Outfall Canal

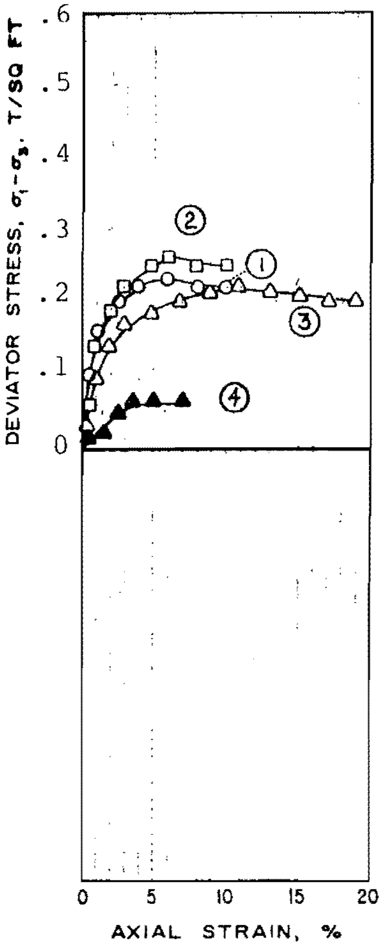
AREA New Orleans, Louisiana

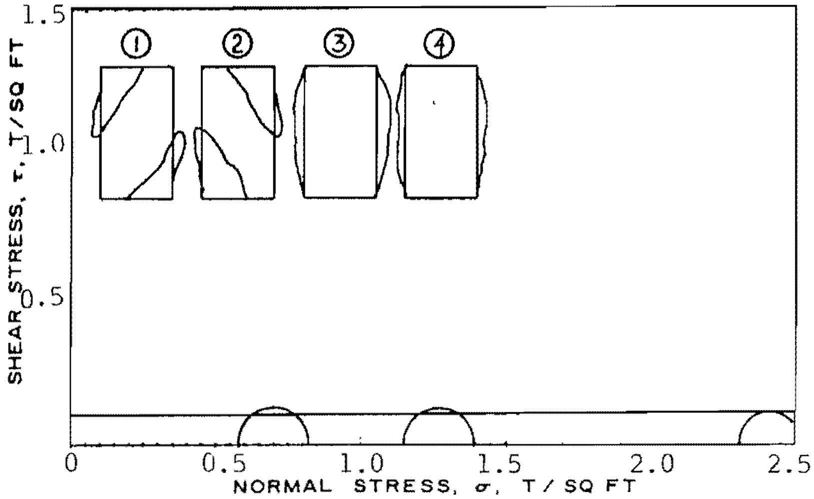
BORING NO. 46 SAMPLE NO. 3

DEPTH 8.0' - 9.0' DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA





TEST NO.			1	2	3	4
INITIAL	WATER CONTENT %	w_o	78.6	77.2	64.6	69.2
	VOID RATIO	e_o	2.15	2.12	1.82	1.96
	SATURATION %	S_o	100	100	97	97
	DRY DENSITY, LB/CU FT	γ_d	54.2	54.9	60.6	57.8
BEFORE SHEAR	WATER CONTENT %	w_c				
	VOID RATIO	e_c				
	SATURATION %	S_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
FINAL	WATER CONTENT %	w_f	78.6	77.2	64.6	69.2
	VOID RATIO	e_f	2.15	2.12	1.82	1.96
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.58	1.15	2.30	2.30
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{max}$	0.23	0.26	0.22	0.06
TIME TO FAILURE, MIN		t_f	12	12	22	6
RATE OF STRAIN, PERCENT/MIN			0.5	0.5	0.5	0.5
EFFECTIVE NORMAL STRESS, T SQ FT						
ULT DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ult}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	1.39
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	3.00

SHEAR STRENGTH PARAMETERS

ϕ = 0

TAN ϕ = 0

c = 0.11 T/SQ FT

METHOD OF SATURATION

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF TEST UU	TYPE OF SPECIMEN Undisturbed				
CLASSIFICATION Soft gray clay w/sand pockets & shells					
LL	PL	PI		G_s 2.74 Est.	

REMARKS

PROJECT Orleans Levee District
Orleans Avenue Outfall Canal

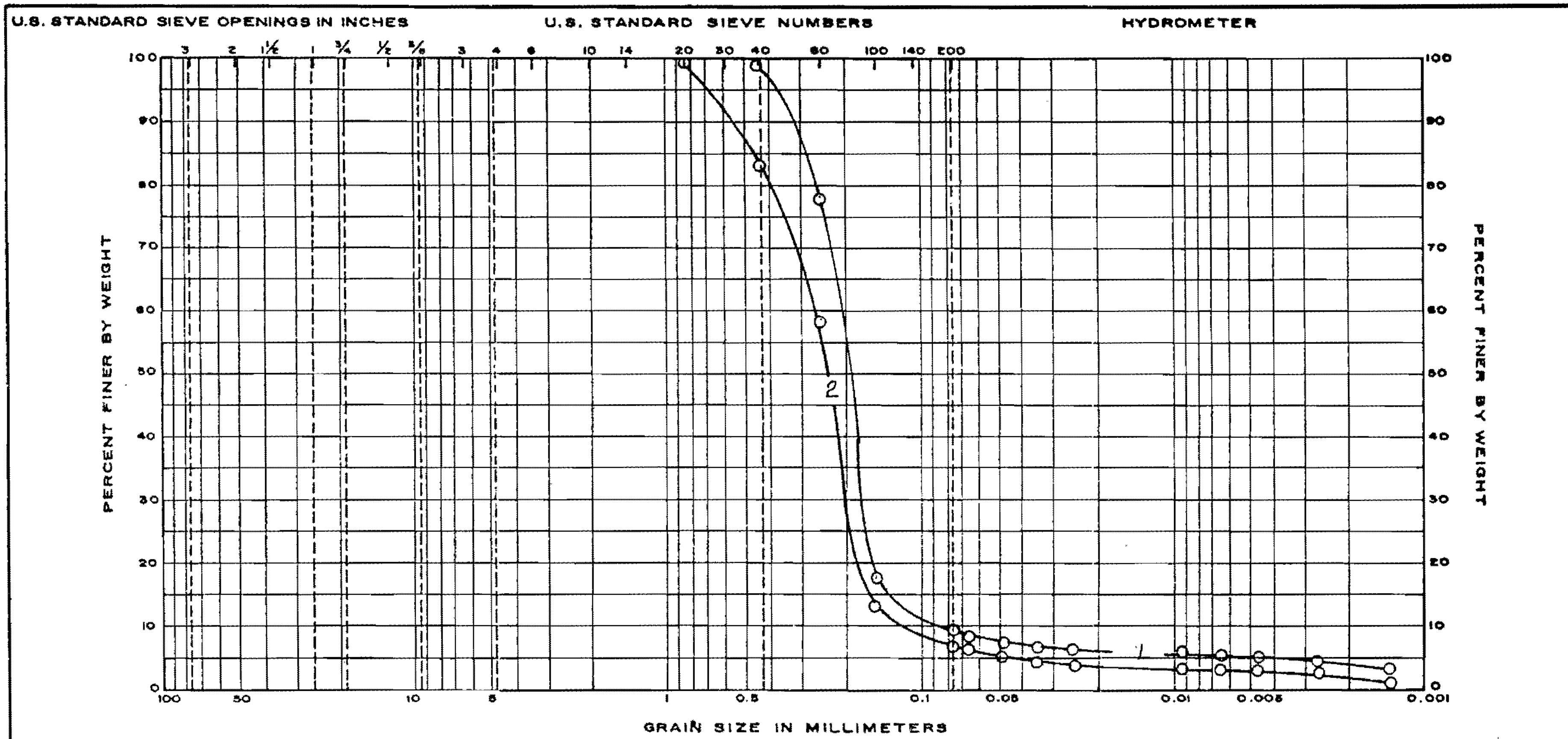
AREA New Orleans, Louisiana

BORING NO. 46 — SAMPLE NO. 4

DEPTH 14.0 - 15.0 — DATE 9/21/85

TRIAXIAL COMPRESSION TEST REPORT

EUSTIS ENGINEERING COMPANY
SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LOUISIANA



UNIFIED	GRAVEL		SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE		
AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
1	3	6	16.0 - 18.0				
2	3	10	28.5 - 30.0				

PROJECT Geotechnical Investigation

Orleans Levee District, Orleans Avenue Outfall Canal

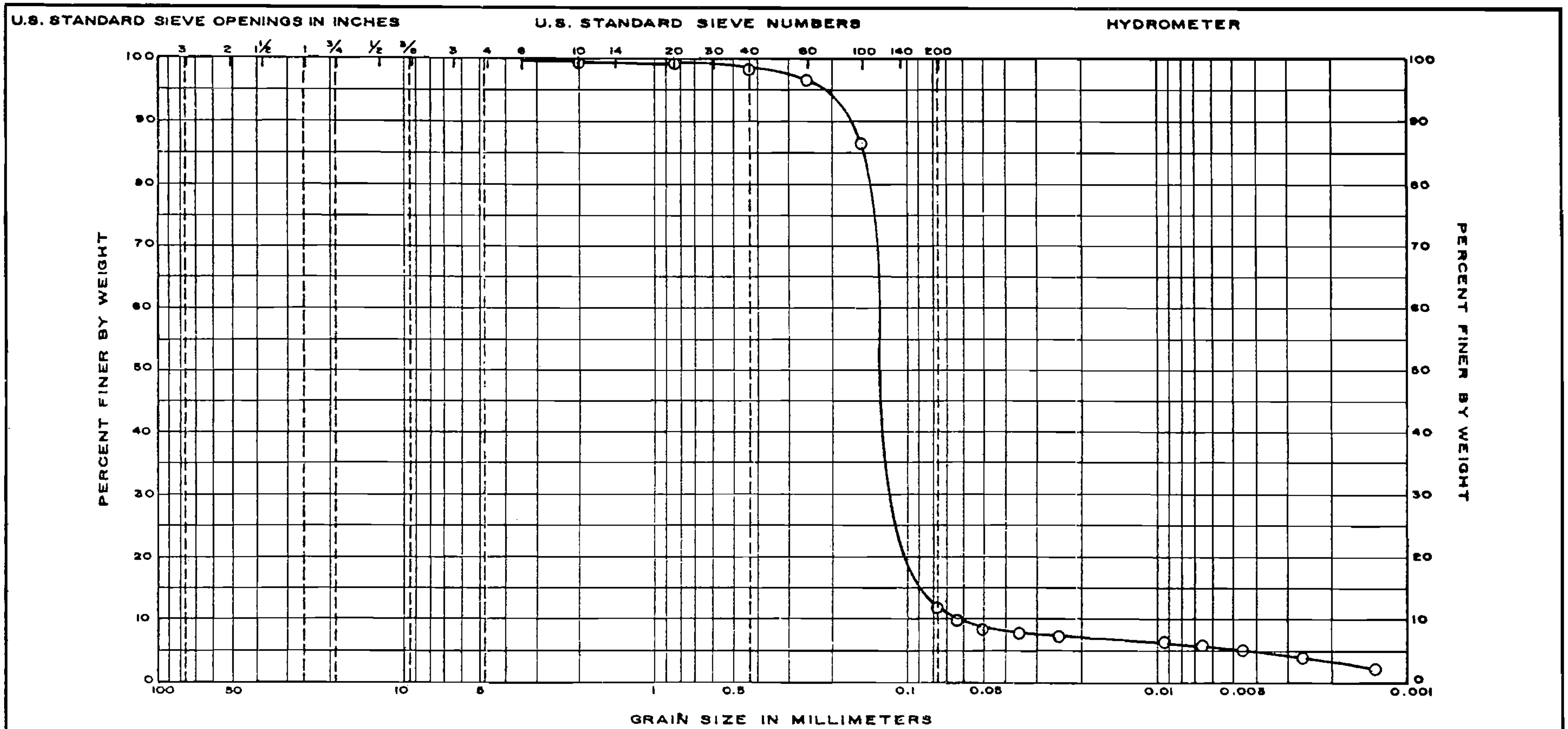
OLB Project No. 2048-0304, New Orleans, Louisiana

For: The Board of Levee Commissioners

of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.



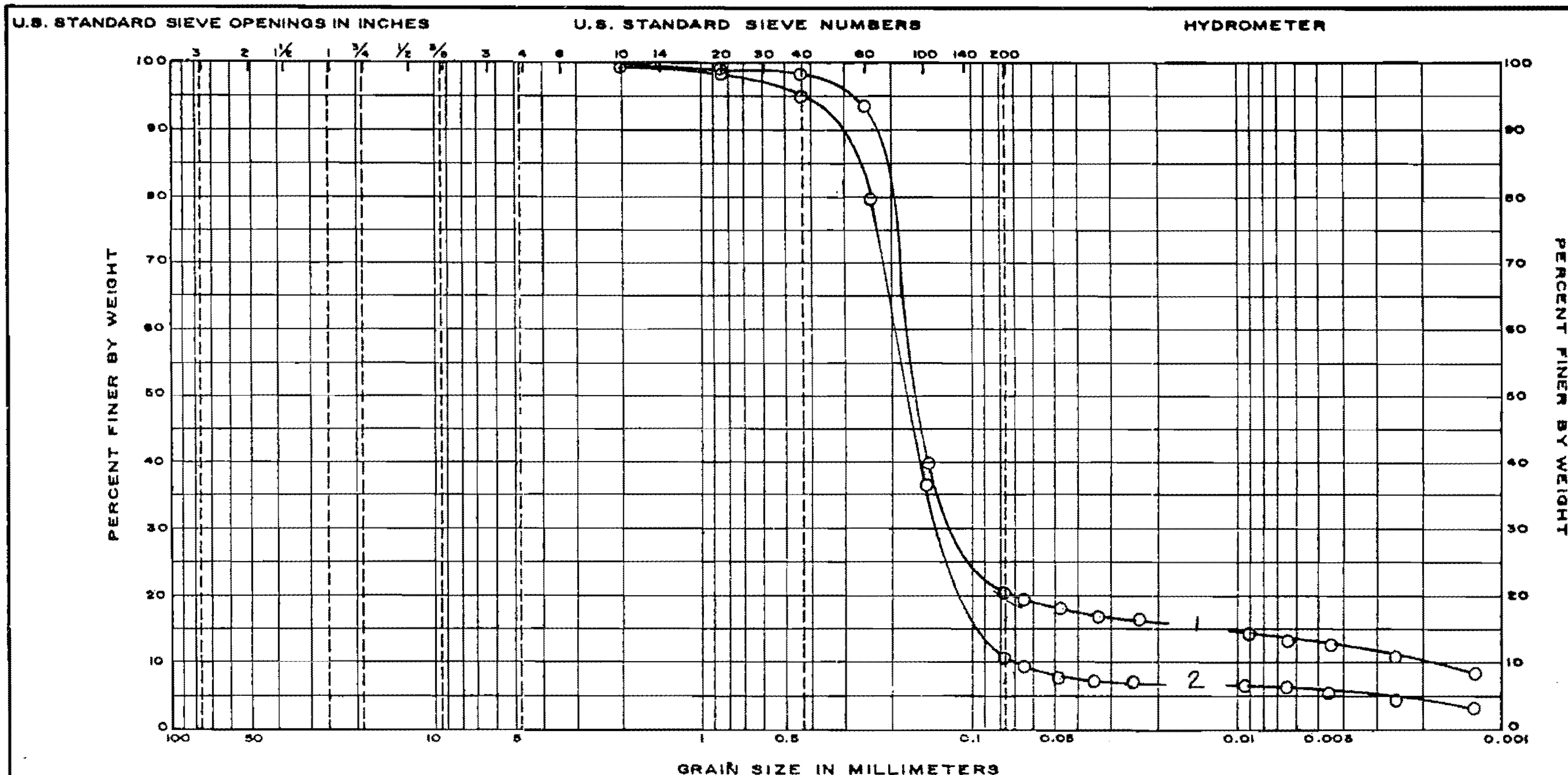
UNIFIED	GRAVEL		SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE		
AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	3	14	48.5 - 50.0				

PROJECT Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana
For: The Board of Levee Commissioners
of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.



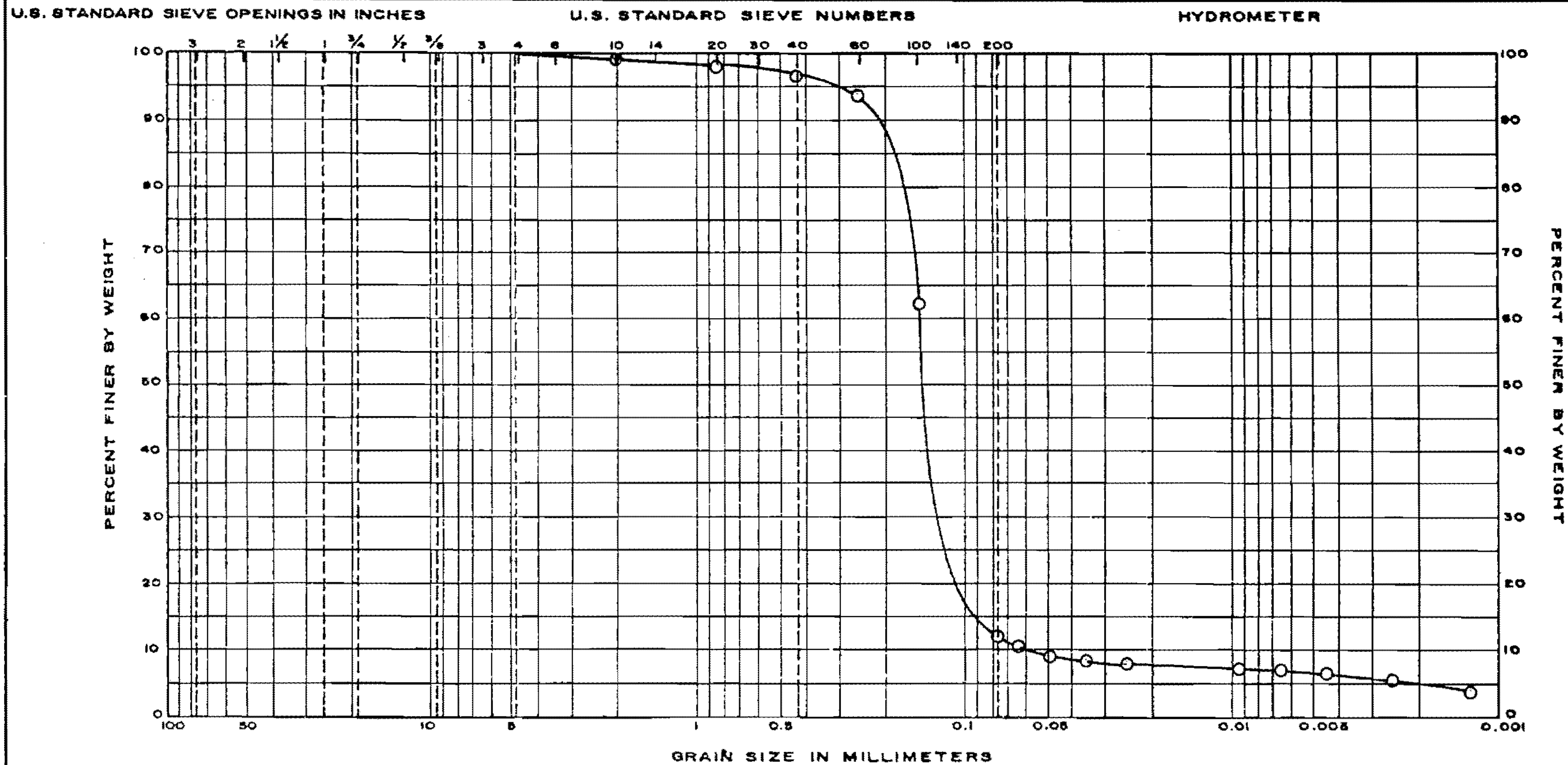
UNIFIED	GRAVEL: COARSE	GRAVEL: FINE	SAND: COARSE	SAND: MEDIUM	SAND: FINE	SILT OR CLAY	
AASHO	GRAVEL: COARSE, MEDIUM	GRAVEL: FINE	SAND: COARSE	SAND: FINE		SILT	CLAY

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
1	19	7	27.5 - 29.0				
2	19	11	38.5 - 40.0				

PROJECT Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana
For: The Board of Levee Commissioners
of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.



UNIFIED	GRAVEL		SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE		
AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	31	14	48.5 - 50.0				

PROJECT Geotechnical Investigation

Orleans Levee District, Orleans Avenue Outfall Canal

OLB Project No. 2048-0304, New Orleans, Louisiana

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of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

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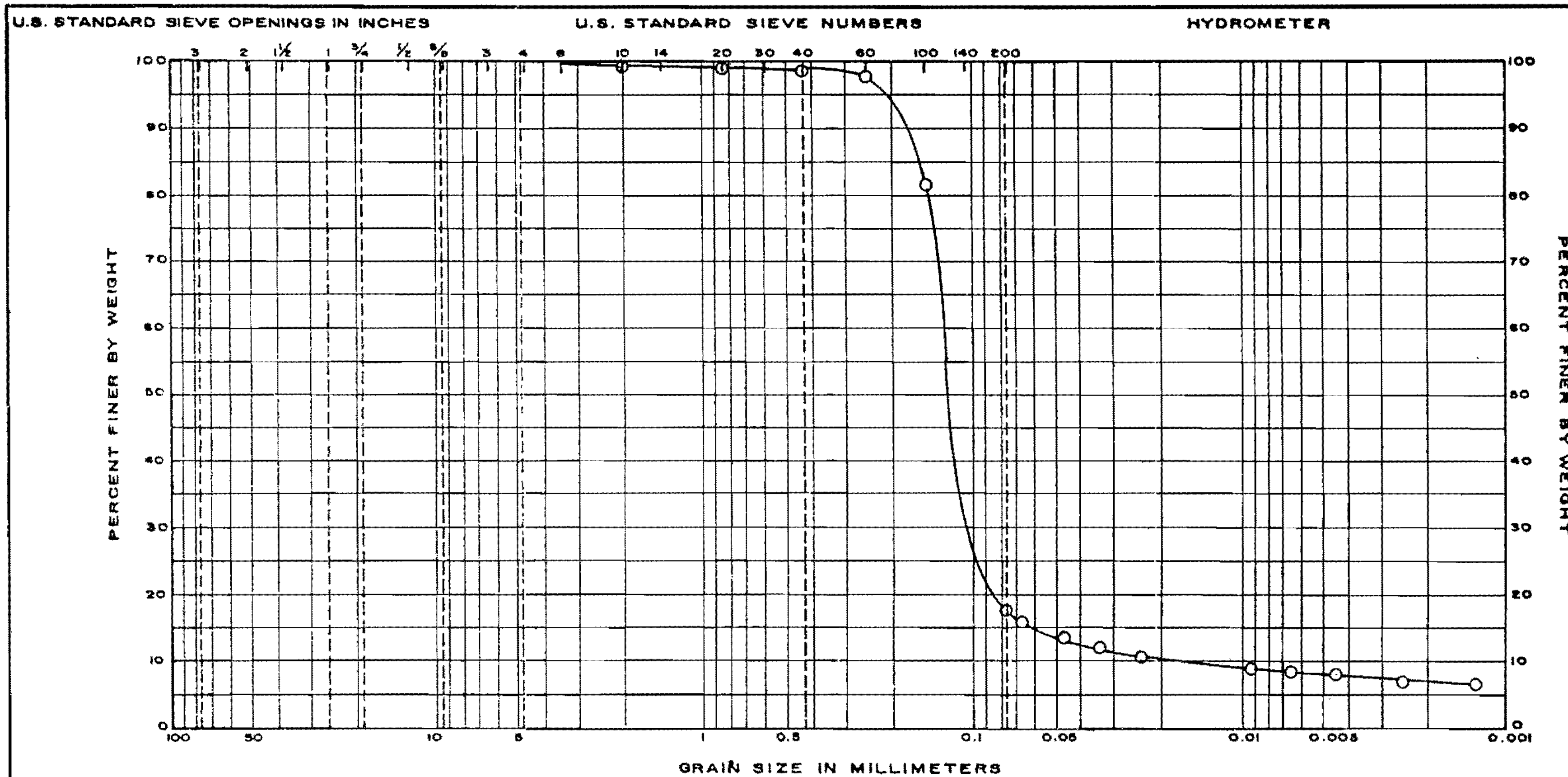
METAIRIE, LA.



UNIFIED	GRAVEL		SAND			SILT OR CLAY		
	COARSE	FINE	COARSE	MEDIUM	FINE			
AASHO	GRAVEL			SAND				
	COARSE	MEDIUM	FINE	COARSE	FINE	SILT	CLAY	

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	39	15	48.5 - 50.0				

PROJECT Geotechnical Investigation

Orleans Levee District, Orleans Avenue Outfall Canal

OLB Project No. 2048-0304, New Orleans, Louisiana

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of the Orleans Levee District, New Orleans, La.

Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
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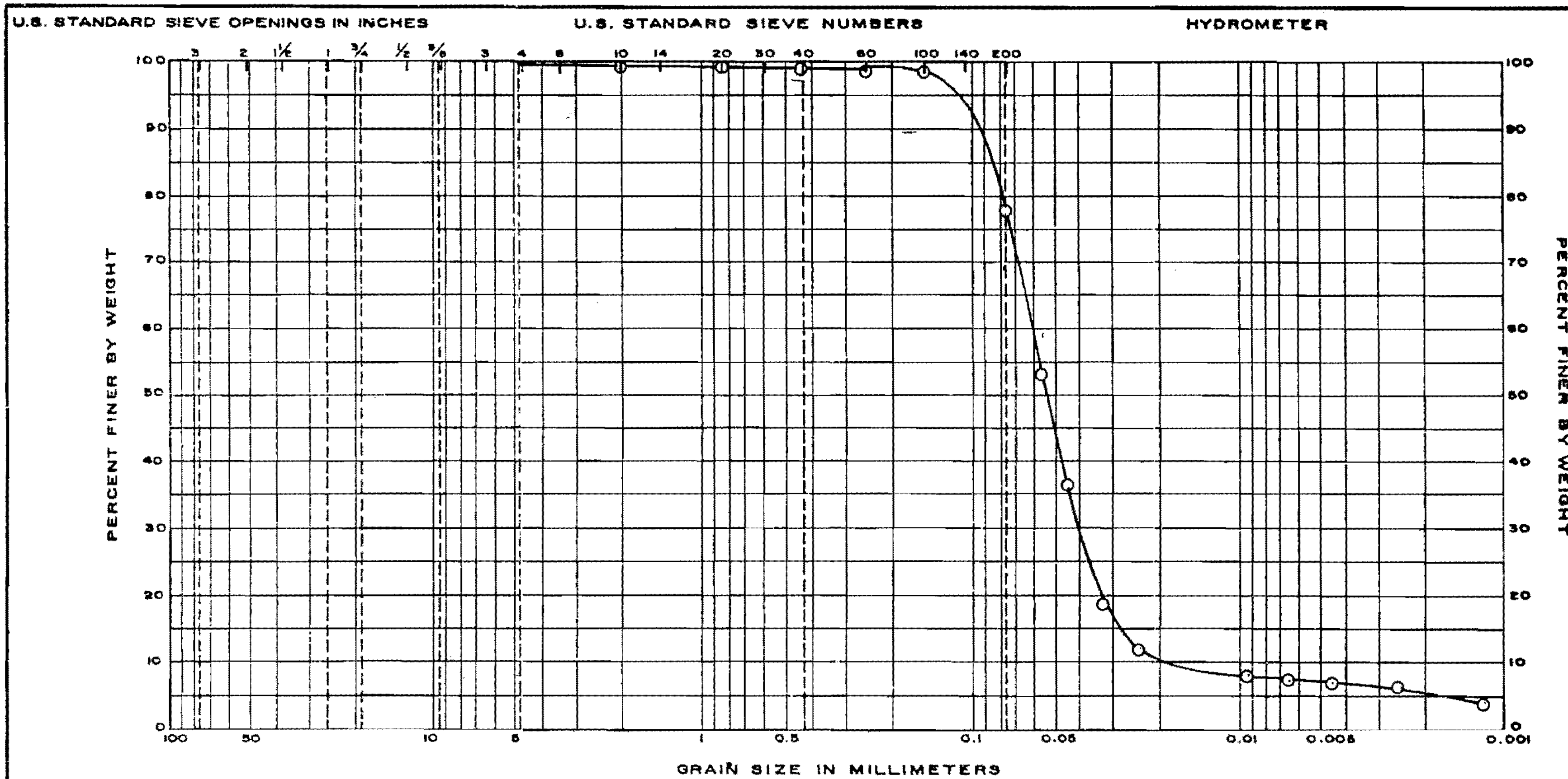
METAIRIE, LA.



UNIFIED	GRAVEL		SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE		
AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	43	7	19.5 - 20.5				

PROJECT Geotechnical Investigation

Orleans Levee District, Orleans Avenue Outfall Canal

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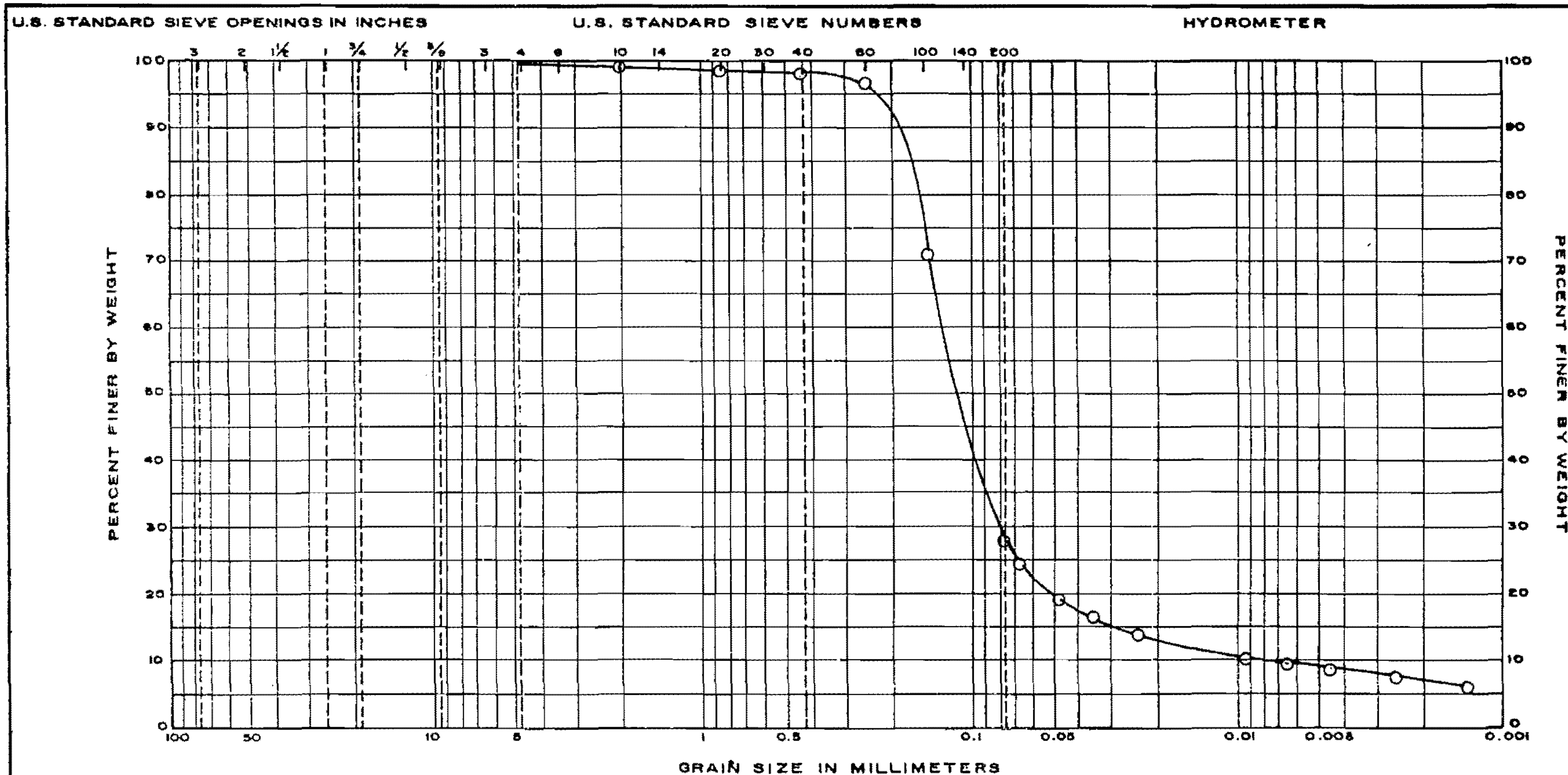
Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.



UNIFIED	GRAVEL		SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE		
AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	43	15	48.5 - 50.0				

PROJECT Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
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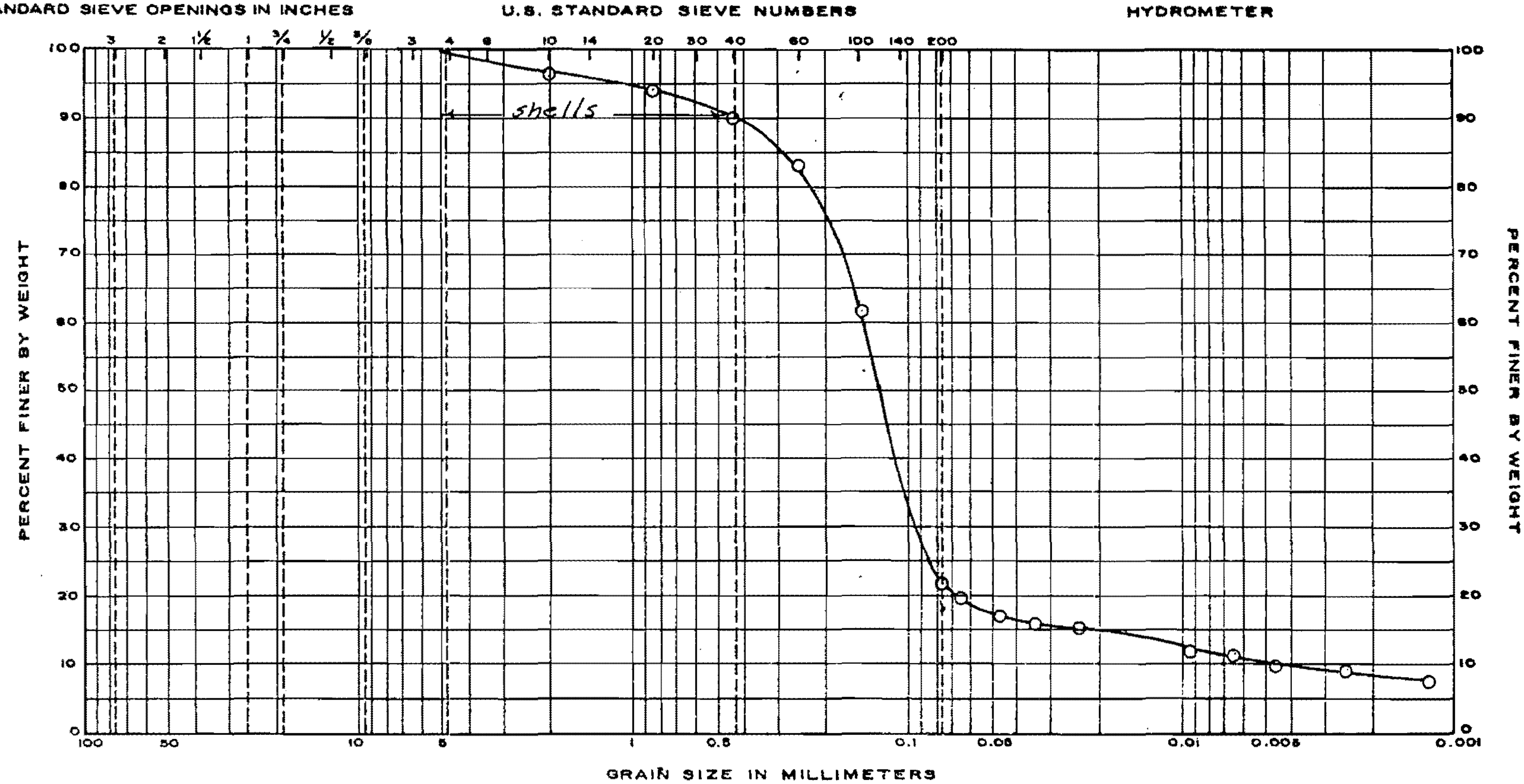
of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.



UNIFIED	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	51	6	8.5 - 10.0				

PROJECT Geotechnical Investigation
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Design Engineering, Inc., Metairie, Louisiana

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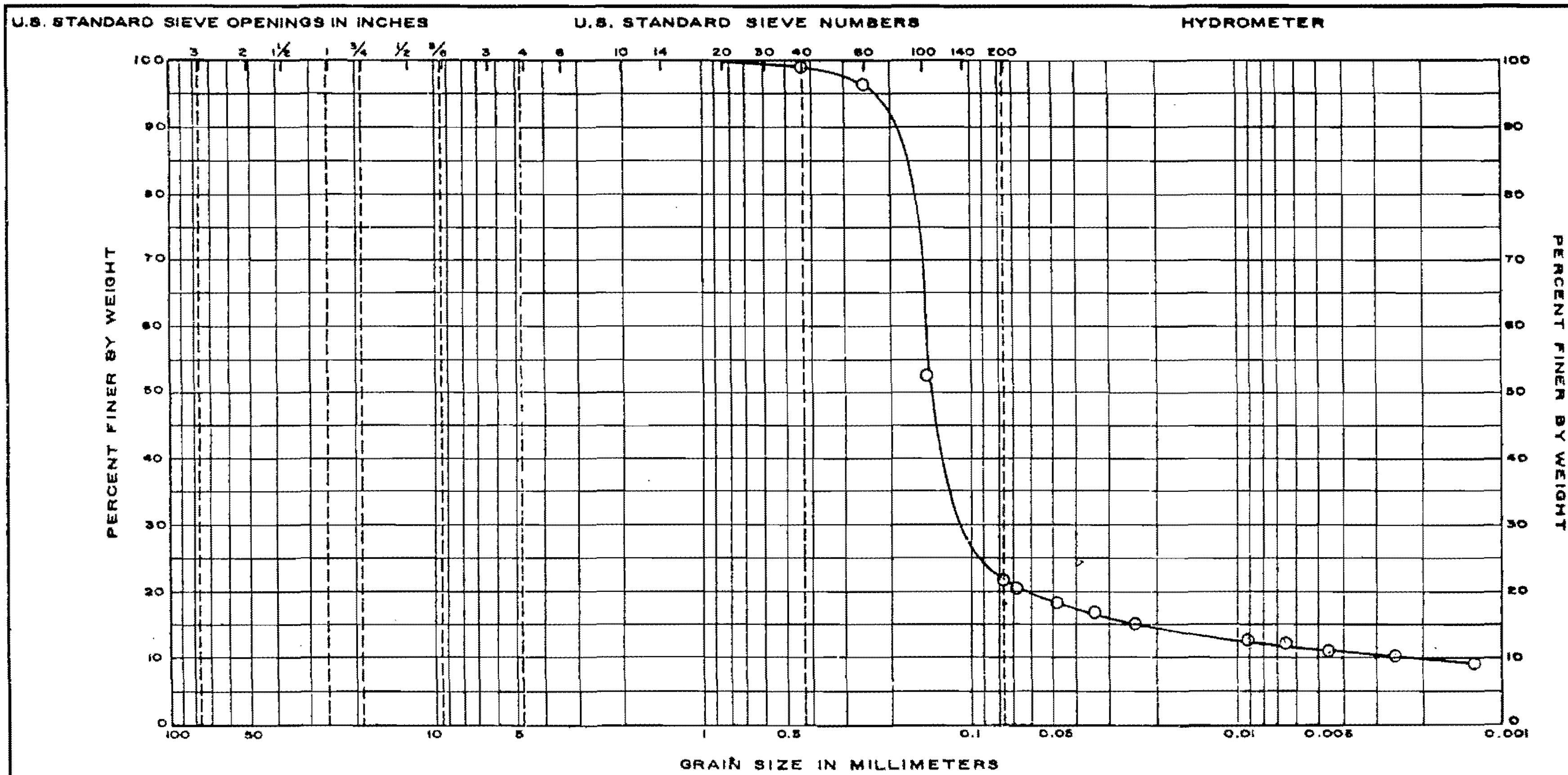
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.



UNIFIED	GRAVEL		SAND			SILT OR CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE		
AASHO	GRAVEL			SAND		SILT	CLAY
	COARSE	MEDIUM	FINE	COARSE	FINE		

GRAIN SIZE ANALYSIS

CURVE NO.	BORING NO.	SAMPLE NO.	DEPTH IN FT.	NATURAL WATER CONTENT	ATTERBERG LIMITS LL	PL	PI
	51	10	25.0 - 26.5				

PROJECT Geotechnical Investigation
Orleans Levee District, Orleans Avenue Outfall Canal
OLB Project No. 2048-0304, New Orleans, Louisiana
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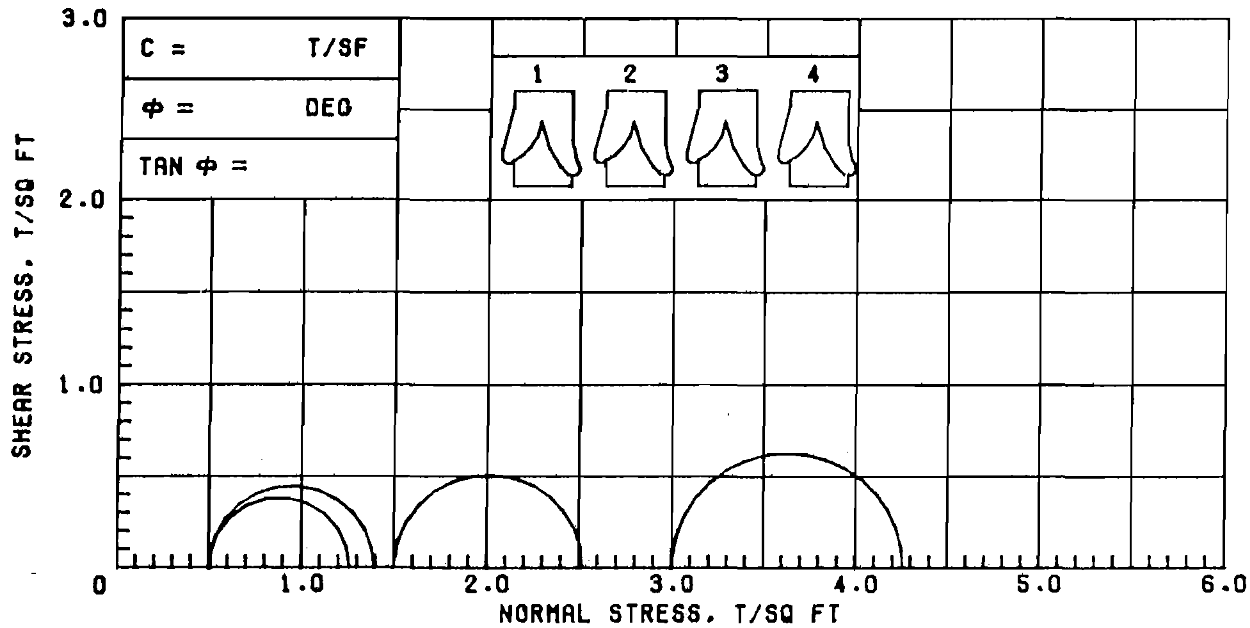
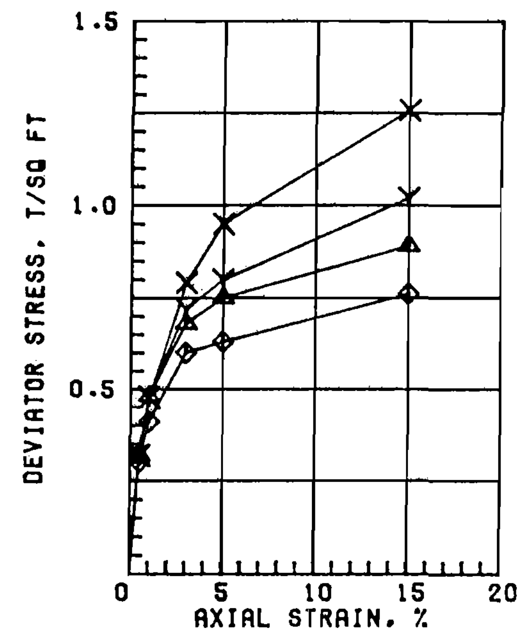
of the Orleans Levee District, New Orleans, La.
Design Engineering, Inc., Metairie, Louisiana

EUSTIS ENGINEERING COMPANY
CONSULTING FOUNDATION ENGINEERS
METAIRIE, LA.

APPENDIX C





		SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL		WATER CONTENT, %	31.8	32.9	30.1	35.4
		DRY DENSITY, PCF	87.7	86.8	89.1	84.5
		SATURATION, %	93.2	94.4	91.2	96.2
		VOID RATIO	0.921	0.941	0.891	0.994
BEFORE SHEAR		WATER CONTENT, %				
		DRY DENSITY, PCF				
		SATURATION, %				
		VOID RATIO				
		BACK PRESS., TSF				
MIN PRIN. STRESS, TSF			0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF			0.89	1.02	1.26	0.76
TIME TO FAILURE, MIN.			40	40	90	35
RATE OF STRAIN INCR.%						
INITIAL DIAMETER, IN.			1.40	1.40	1.41	1.40
INITIAL HEIGHT, IN.			3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

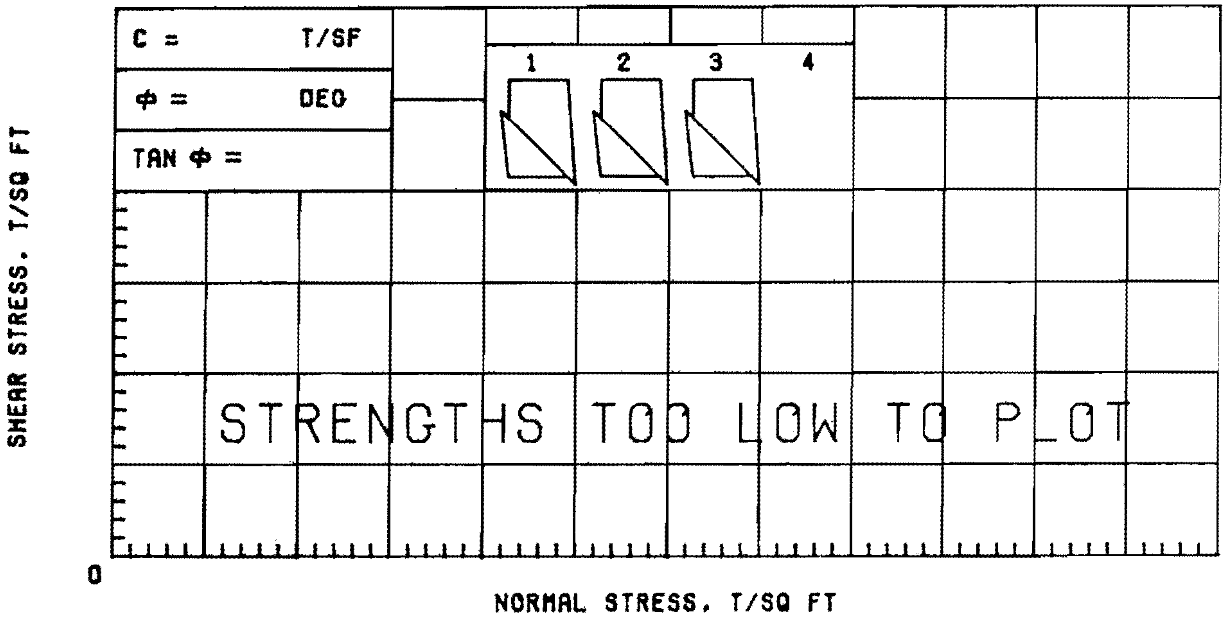
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), DARK BROWN; SILT POCKETS

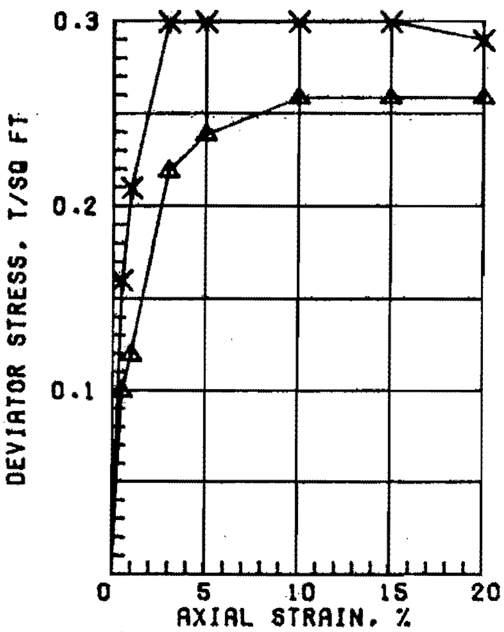
LL 58	PL 21	PI 37	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
ORLEANS PARISH OUTFALL CANALS	
BORING NO. 1-OUO	SAMPLE NO. 2-C
DEPTH/ELEV 5.4/+3.6	TECH. PJR
LABORATORY USAE WES	DATE 14 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





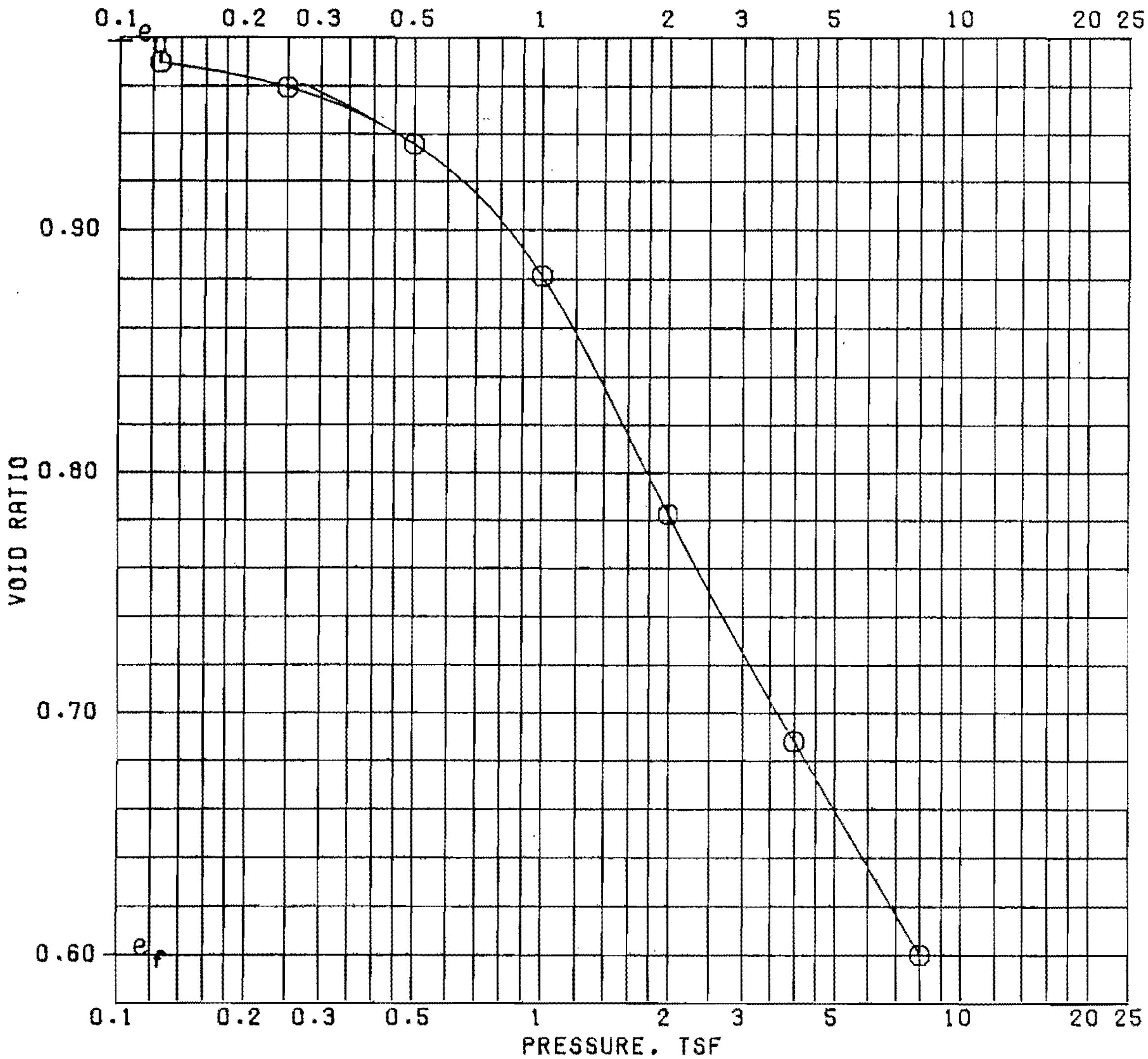
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	42.4	42.5	42.0	
	DRY DENSITY, PCF	77.2	76.9	77.4	
	SATURATION, %	96.7	96.3	96.2	
	VOID RATIO	1.184	1.192	1.179	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.26	0.30	0.30	
TIME TO FAILURE, MIN.		20	6	6	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; CLAY (CL), GRAY; SILT LENSES

LL 47	PL 15	PI 32	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 1-OUO	SAMPLE NO. 4-B
	DEPTH/ELEV 12.1/-3.1	TECH. KOC
	LABORATORY USAE WES	DATE 14 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	



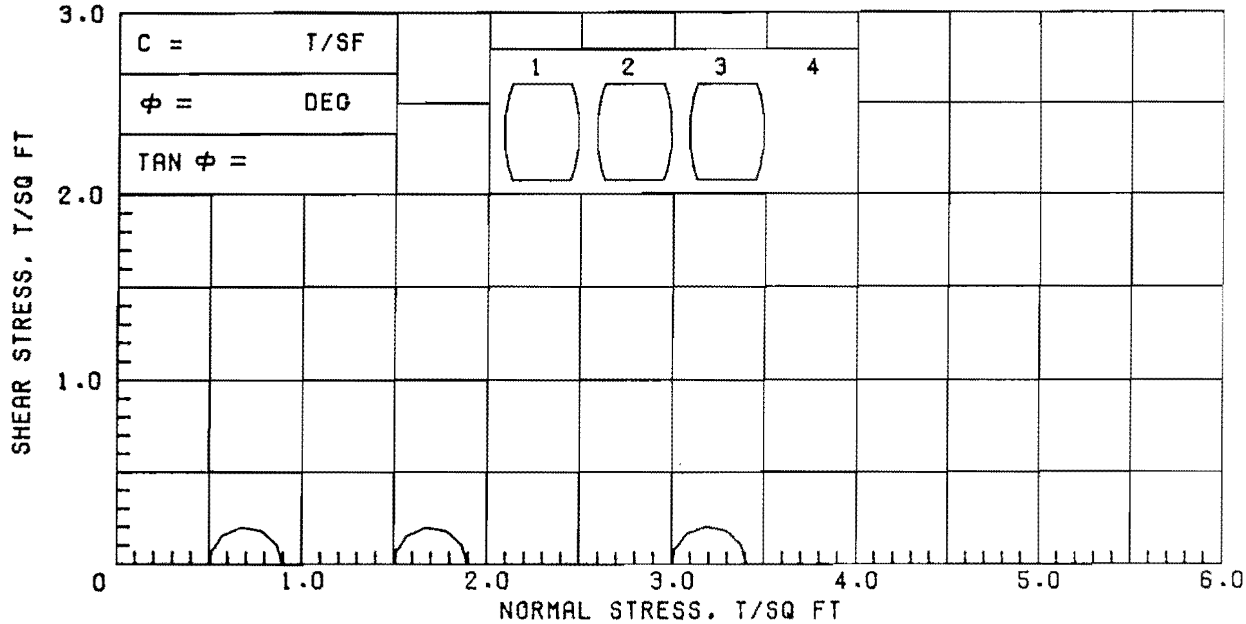
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	34.7	22.4
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	85.2	105.4
COMPRESSION INDEX		SATURATION, %	96.0	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.978	0.599
DIA. IN 4.44	HT. IN 1.136	BACK PRESSURE, TSF		

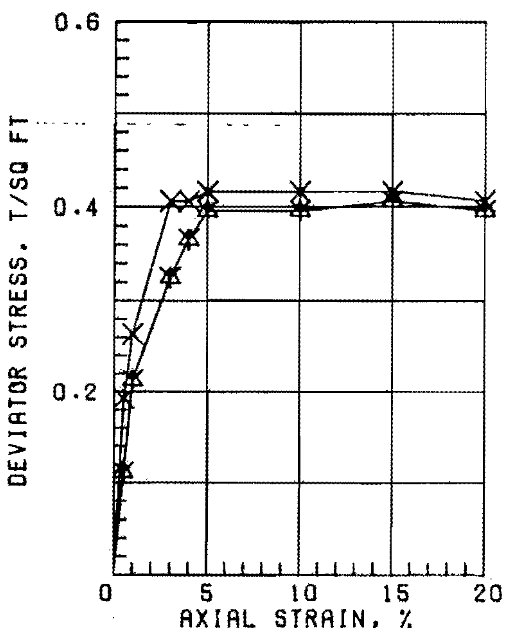
CLASSIFICATION PLASTIC CLAY (CH), GRAY; SHELL PARTICLES

LL	PL	PI	PROJECT LK. PONT. LA. & VIC. HURR. PROT.
GS 2.70 (EST)	D_{10}		ORLEANS PARISH OUTFALL CANALS
REMARKS		BORING NO. 1-OUG	SAMPLE NO. 4-C
		DEPTH/ELEV 12.8/-3.8	DATE 26 SEP 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 9





		Δ1	Y2	X3	4
SPECIMEN NO.		Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	32.1	39.2	34.7	
	DRY DENSITY, PCF	88.5	81.2	86.3	
	SATURATION, %	95.9	98.3	98.3	
	VOID RATIO	0.904	1.077	0.953	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.40	0.40	0.41	
TIME TO FAILURE, MIN.		10	10	6	
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

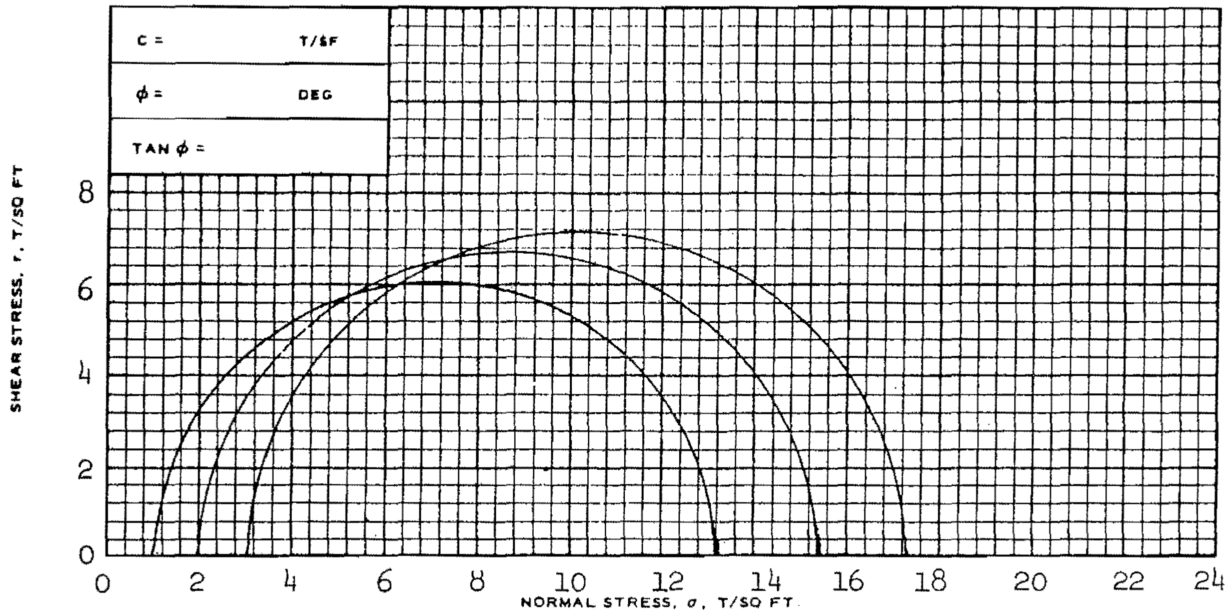
CONTROLLED-STRAIN TEST

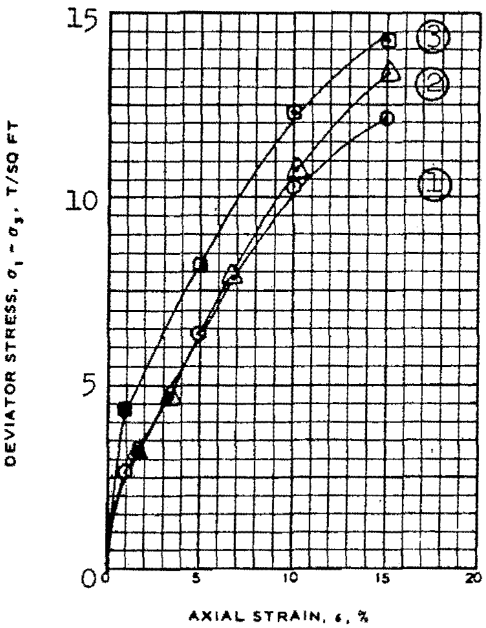
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT POCKETS

LL	PL	PI	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 1-OUG	SAMPLE NO. 4-D
	DEPTH/ELEV 14.1/-5.1	TECH. KOC
	LABORATORY USAE WES	DATE 14 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	

c =	T/SF
φ =	DEG
TAN φ =	





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o	28.7	29.8	30.0	
	DRY DENSITY LB/CU FT	γd_o	94.2	91.3	90.4	
	SATURATION, %	S_o	98.9	96.0	94.5	
	VOID RATIO	e_o	0.777	0.832	0.851	
BEFORE SHEAR	WATER CONTENT, %	w_c	30.1	30.0	31.0	
	DRY DENSITY LB/CU FT	γd_c	96.9	93.5	93.9	
	SATURATION, %	S_c	100+	100+	100+	
	VOID RATIO	e_c	0.726	0.789	0.782	
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	12.22	13.41	14.35	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	1154	1154	1154	
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.41	1.37	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SANDY SILT (ML), GRAY; SHELL PARTICLES

LL	PL	PI	G_s 2.68 (EST)	TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST R

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS

BORING NO. 1-OUG | SAMPLE NO. 6-C

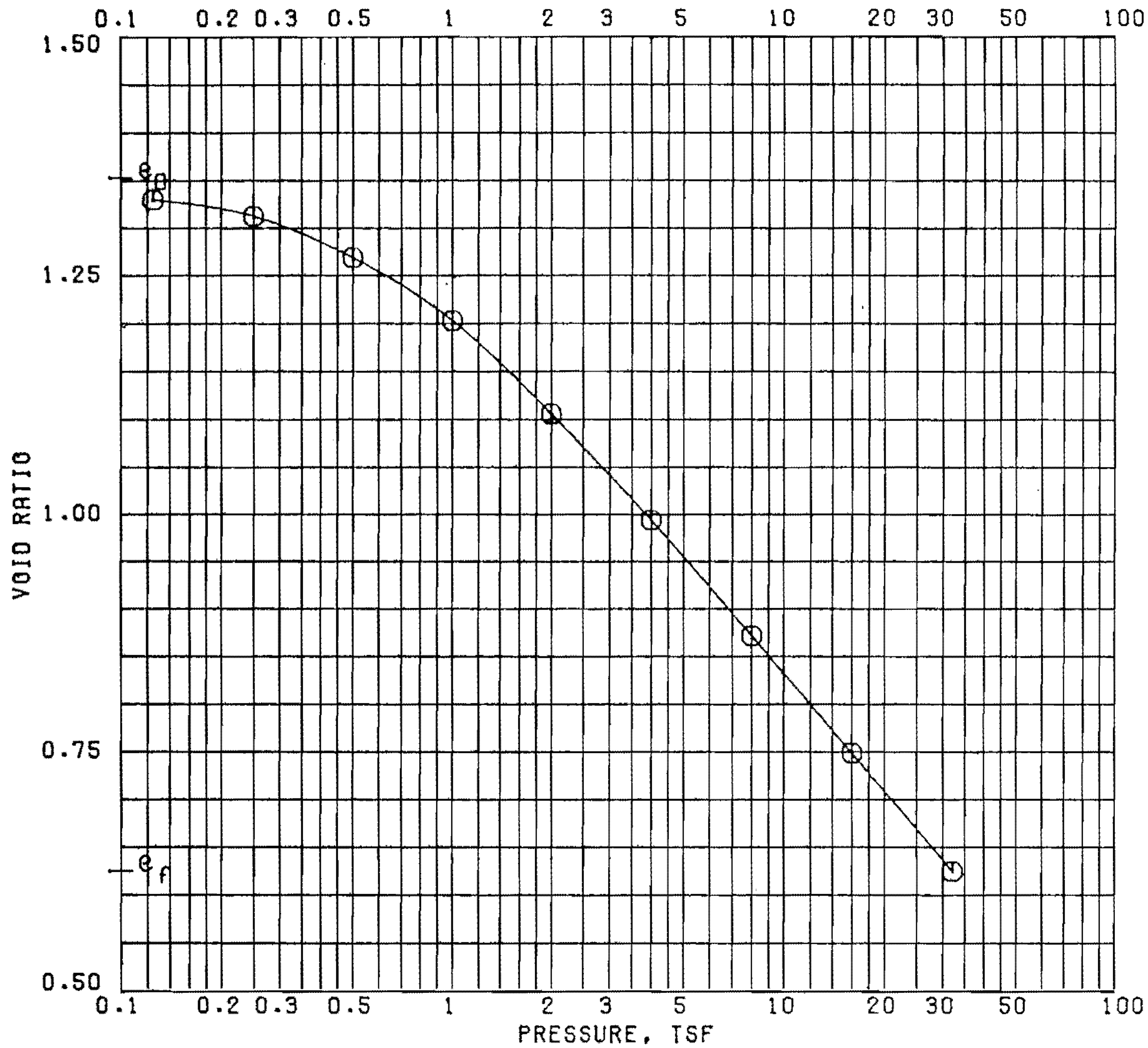
DEPTH/ELEV 21.0/-12.0

LABORATORY USAEWES | DATE 30 AUG 1984

SHEET 1 OF 2

JMS TRIAXIAL COMPRESSION TEST REPORT

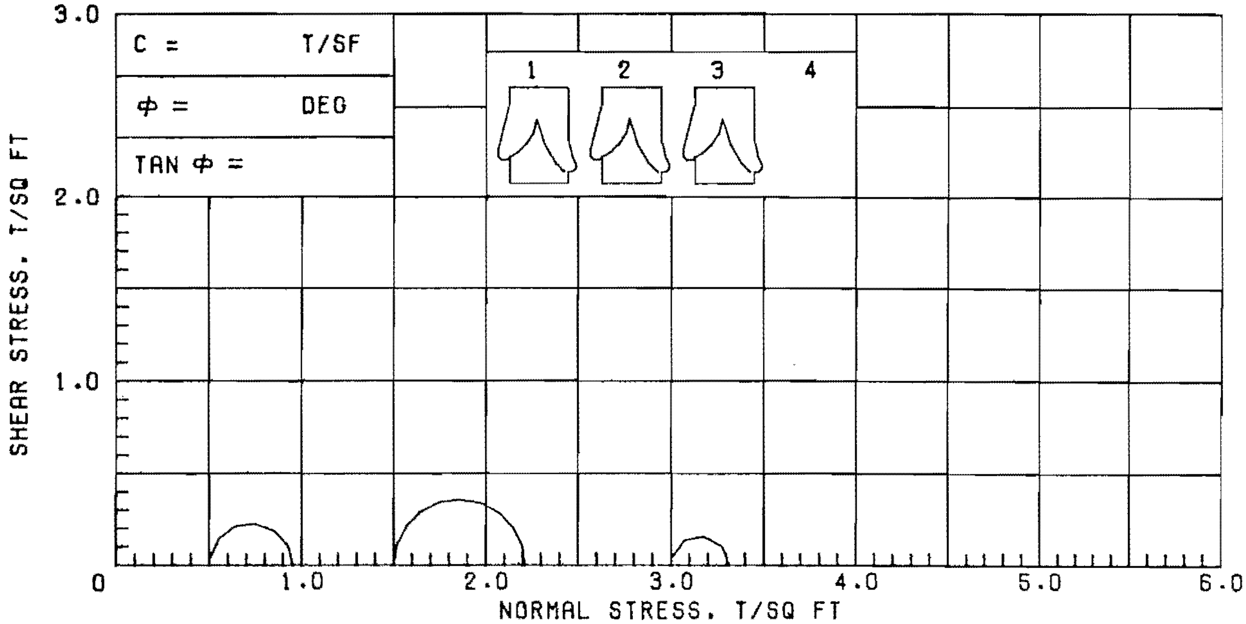
ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE

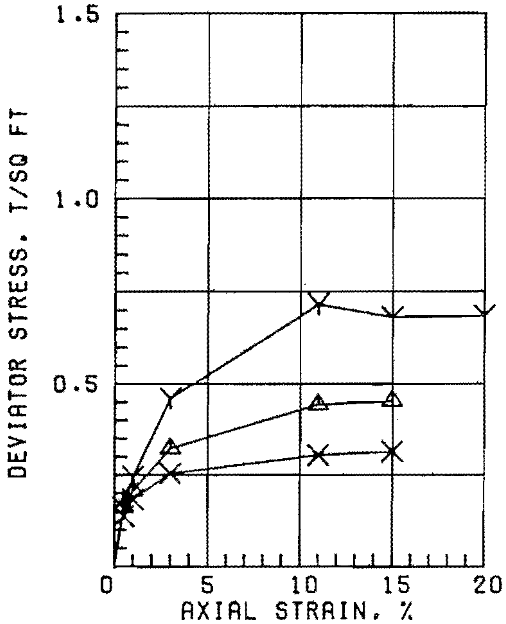


			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	48.2	27.3
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	71.7	103.9
COMPRESSION INDEX		SATURATION, %	96.2	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.351	0.623
DIA. IN 4.44	HT. IN 1.115	BACK PRESSURE, TSF		

CLASSIFICATION	PLASTIC CLAY (CH), GRAY; FINE SAND LENSES; SHELL PARTICLES	
LL / PL / PI	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
GS 2.70 (EST) / D_{10}	ORLEANS PARISH OUTFALL CANALS	
REMARKS	BORING NO. 1-OUG	SAMPLE NO. 9-B
	DEPTH/ELEV 32.5/-23.5	DATE 01 OCT 84
	CONSOLIDATION TEST REPORT	

SHEET 1 OF 11





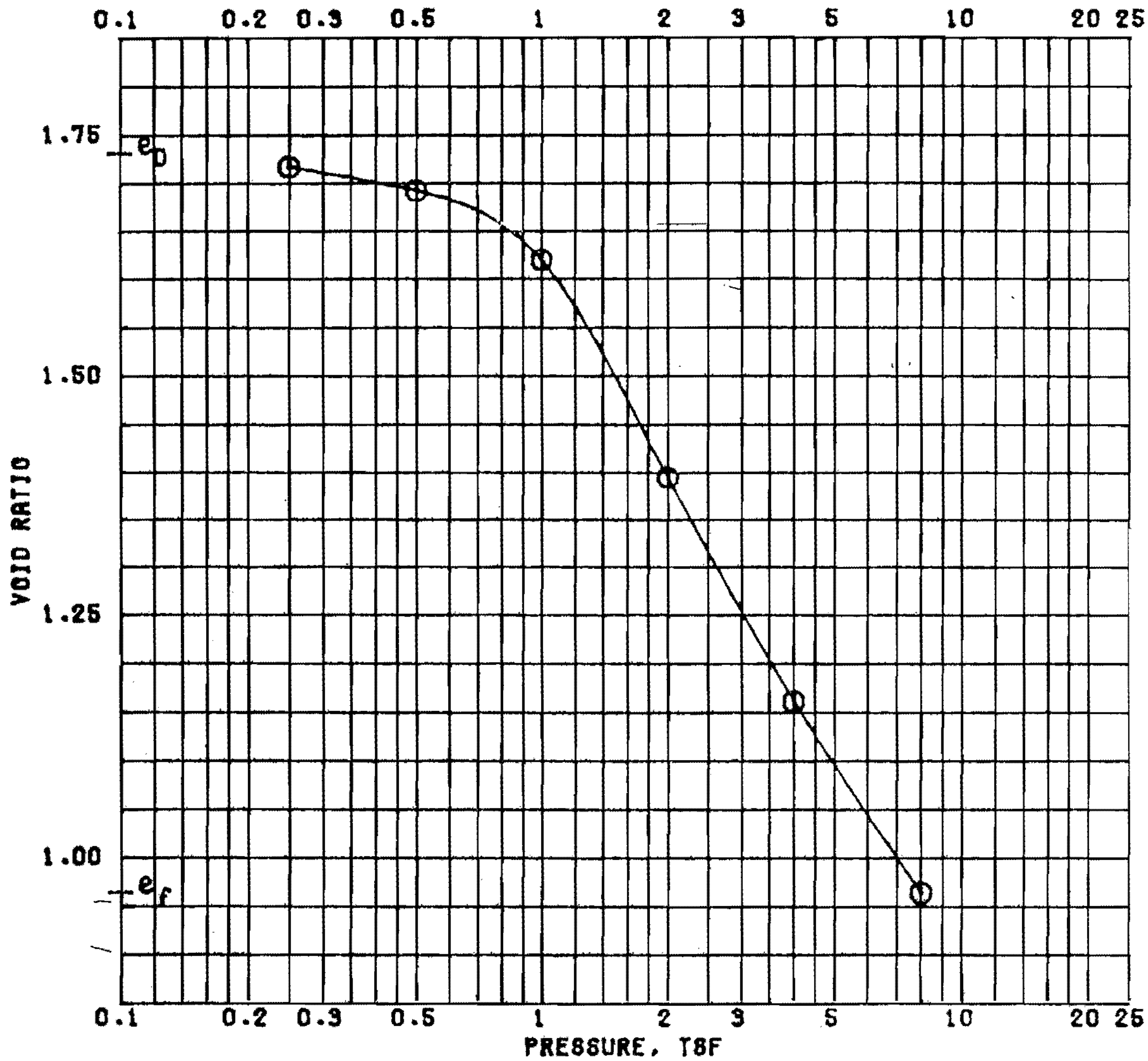
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	38.6	33.1	52.4	
	DRY DENSITY, PCF	81.3	87.2	70.4	
	SATURATION, %	97.0	95.9	100+	
	VOID RATIO	1.074	0.932	1.394	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.45	0.71	0.31	
	TIME TO FAILURE, MIN.	30	24	35	
	RATE OF STRAIN INCR,%				
	INITIAL DIAMETER, IN.	1.39	1.40	1.39	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SILT POCKETS

LL 45	PL 16	PI 29	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

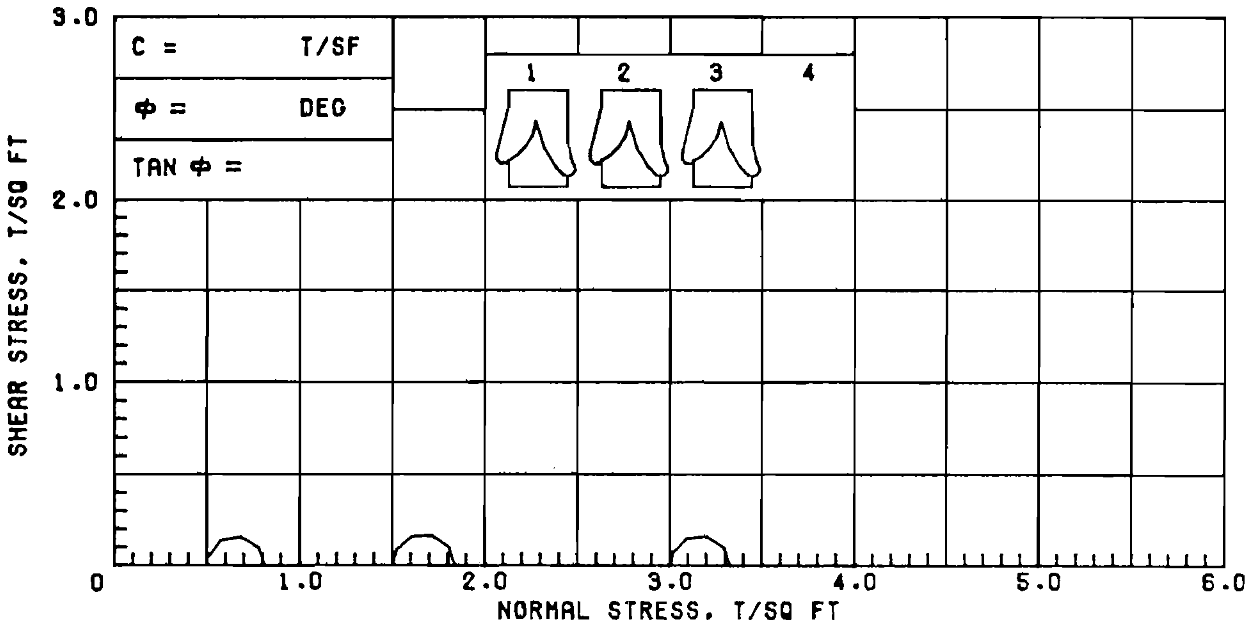
REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 1-OUG	SAMPLE NO. 9-B
	DEPTH/ELEV 32.2/-23.2	TECH. PJR
	LABORATORY USAE WES	DATE 17 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	

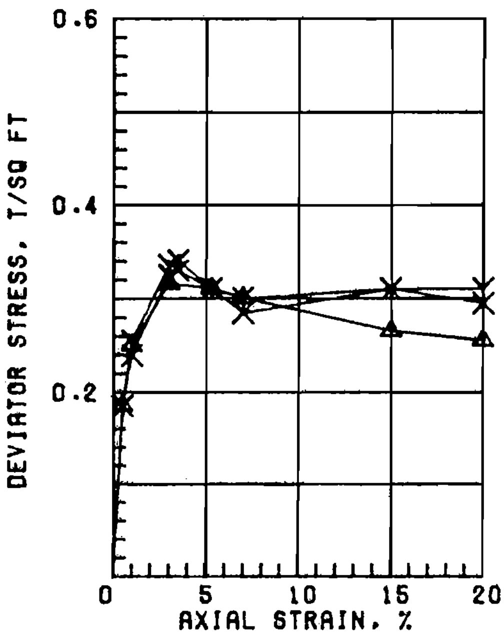


			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	62.5	36.6
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	61.7	85.9
COMPRESSION INDEX		SATURATION, %	97.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.730	0.963
DIA. IN 4.44	HT. IN 1.115	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES				
LL / PL / PI		PROJECT LK. PONR. LA.4 VIC. HURR. PROT.		
GS 2.70 (EST)	D_{10}	ORLEANS PARISH OUTFALL CANALS		
REMARKS		BORING NO. 1-OUO	SAMPLE NO. 11-B	
		DEPTH/ELEV 40.2/-31.2	DATE 20 SEP 84	

CONSOLIDATION TEST REPORT

SHEET 1 OF 8





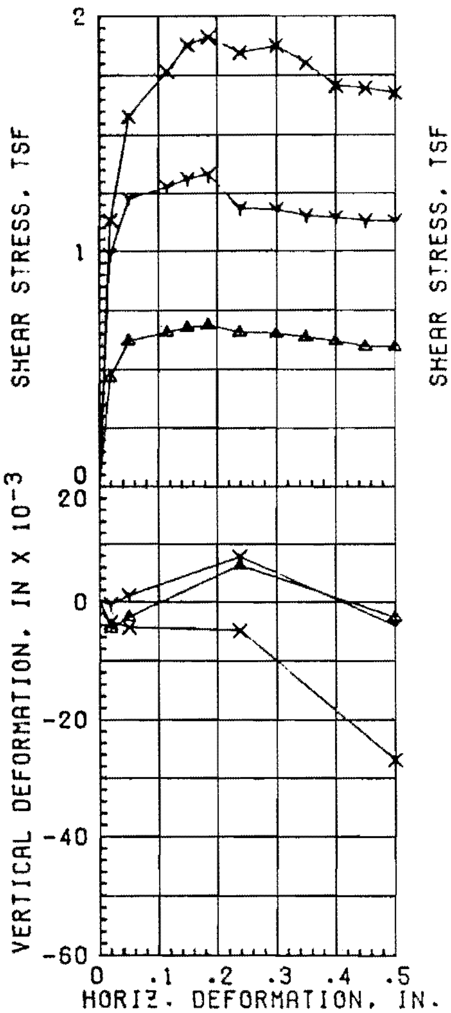
		△1	Y2	X3	4
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	71.7	71.1	71.2	
	DRY DENSITY, PCF	57.5	57.9	57.7	
	SATURATION, %	100+	100+	100.0	
	VOID RATIO	1.933	1.912	1.923	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.32	0.34	0.33	
TIME TO FAILURE, MIN.		7	24	28	
RATE OF STRAIN INCR.%			8	7	
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

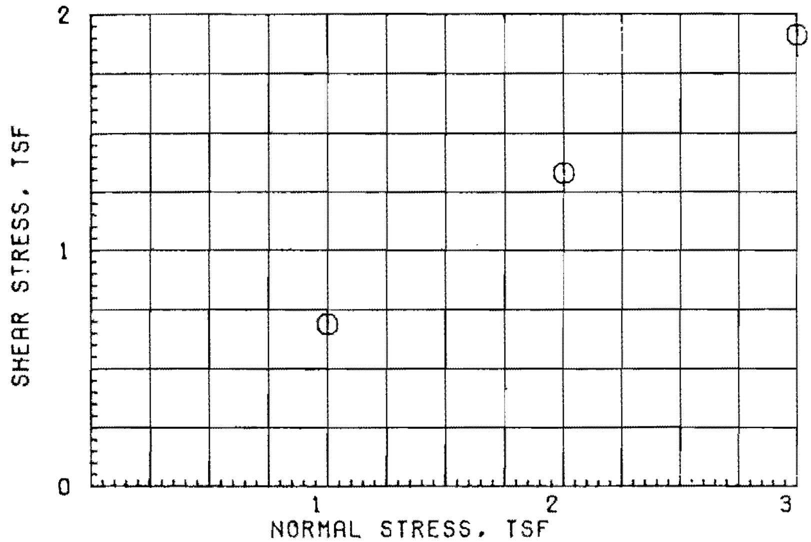
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 89	PL 29	PI 60	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 1-OUO	SAMPLE NO. 11-C
	DEPTH/ELEV 41.3/-32.3	TECH. PJR
	LABORATORY USAE WES	DATE 17 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	





		TEST NO.	1 △	2 Y	3 X	
INITAL	WATER CONTENT, %		25.9	25.2	26.1	
	VOID RATIO		0.775	0.758	0.792	
	SATURATION, %		89.3	88.9	87.9	
	DRY DENSITY, PCF		93.8	94.8	93.0	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL	WATER CONTENT, %		28.8	27.3	27.9	
	VOID RATIO					
	SATURATION, %					
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.69	1.33	1.91	
TIME TO FAILURE, MIN			978	978	978	
RATE OF STRAIN, IN/MIN			.00019	.00019	.00019	
ULTIMATE SHEAR STRESS, TSF						

Φ = ________

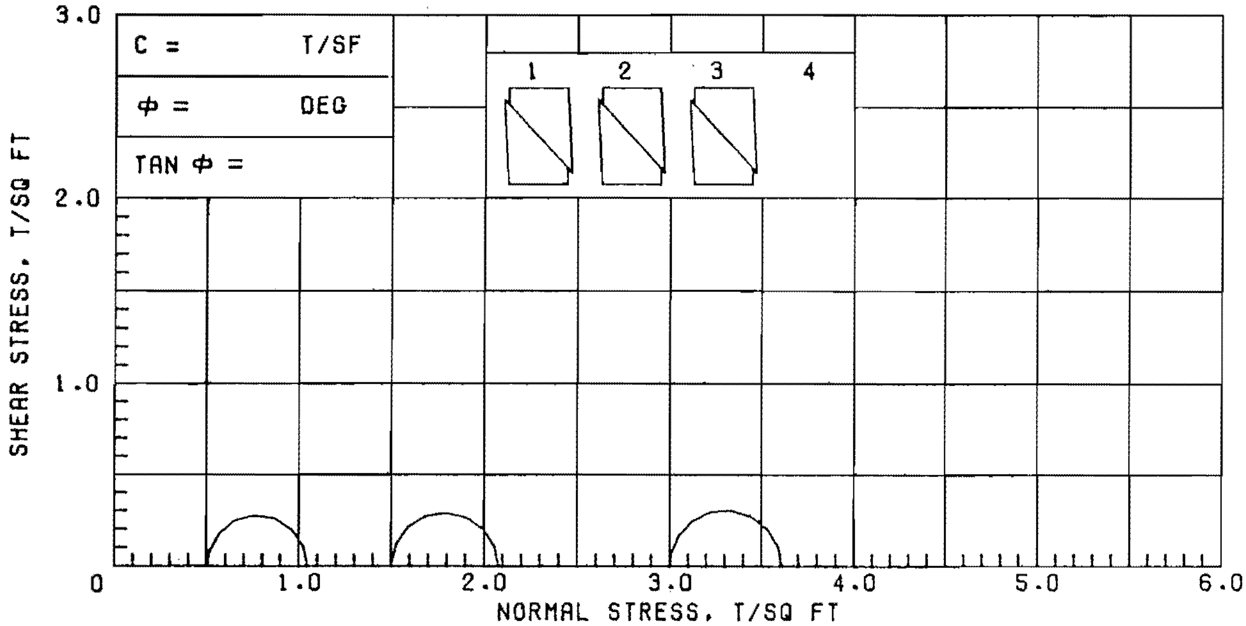
TAN Φ = ________

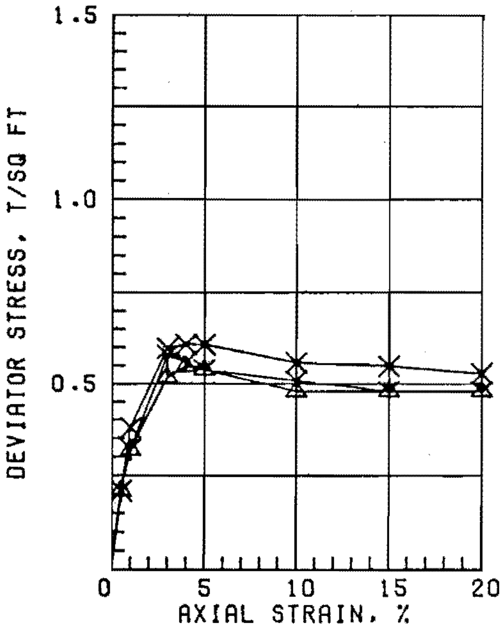
C = ________

TYPE SPECIMEN UNDISTURBED		3.00 IN. SQUARE		0.756 IN. THICK
CLASSIFICATION SILTY SAND (SM), GRAY; SHELL PARTICLES				
LL	PL	PI		GS 2.67 (EST)

REMARKS:	PROJECT LAKE PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 1-OUG	SAMPLE 12-B
	DEPTH/ELEV 44.0/-35.0	DATE 04 OCT 84

DIRECT SHEAR TEST REPORT





SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	57.7	54.0	58.7	
	DRY DENSITY, PCF	64.5	65.9	63.9	
	SATURATION, %	96.5	93.7	96.8	
	VOID RATIO	1.615	1.556	1.638	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.55	0.58	0.61	
TIME TO FAILURE, MIN.		8	6	8	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

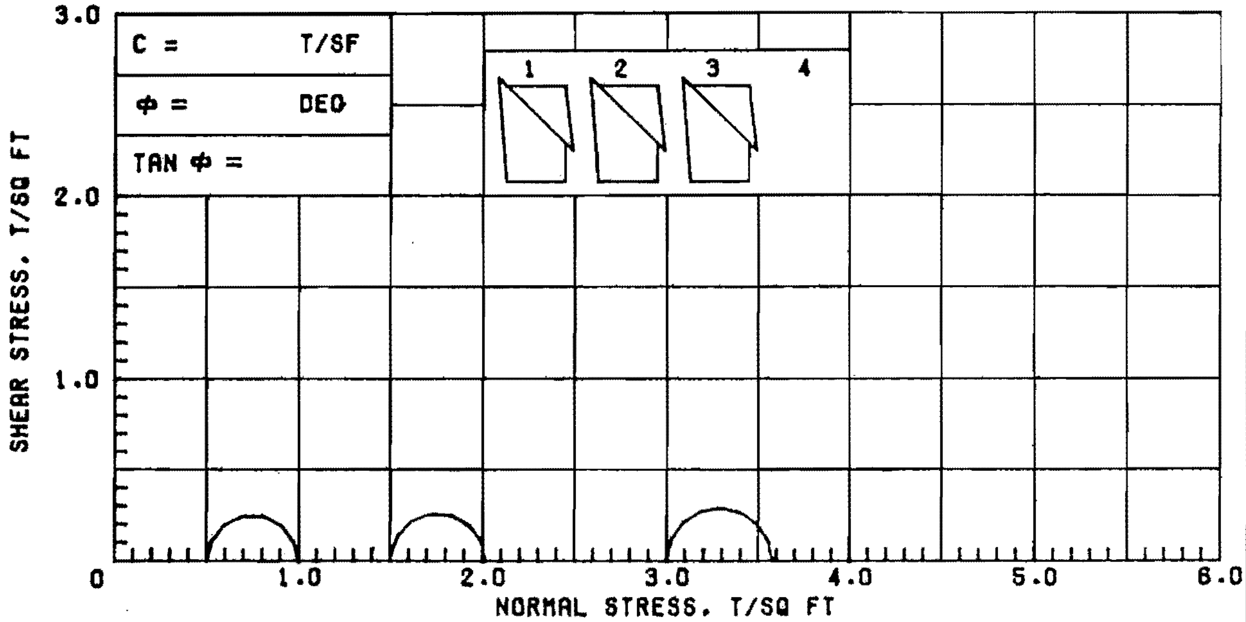
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT POCKETS

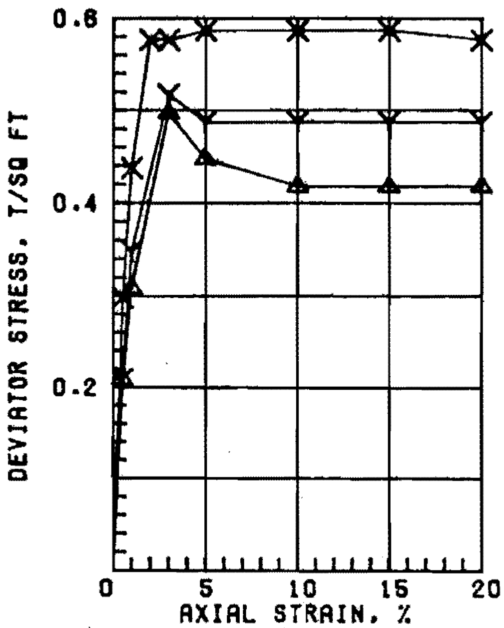
LL 102	PL 20	PI 82	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS	
BORING NO. 1-OUG	SAMPLE NO. 15-8
DEPTH/ELEV 56.4/-47.4	TECH. KOC
LABORATORY USAE WES	DATE 17 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





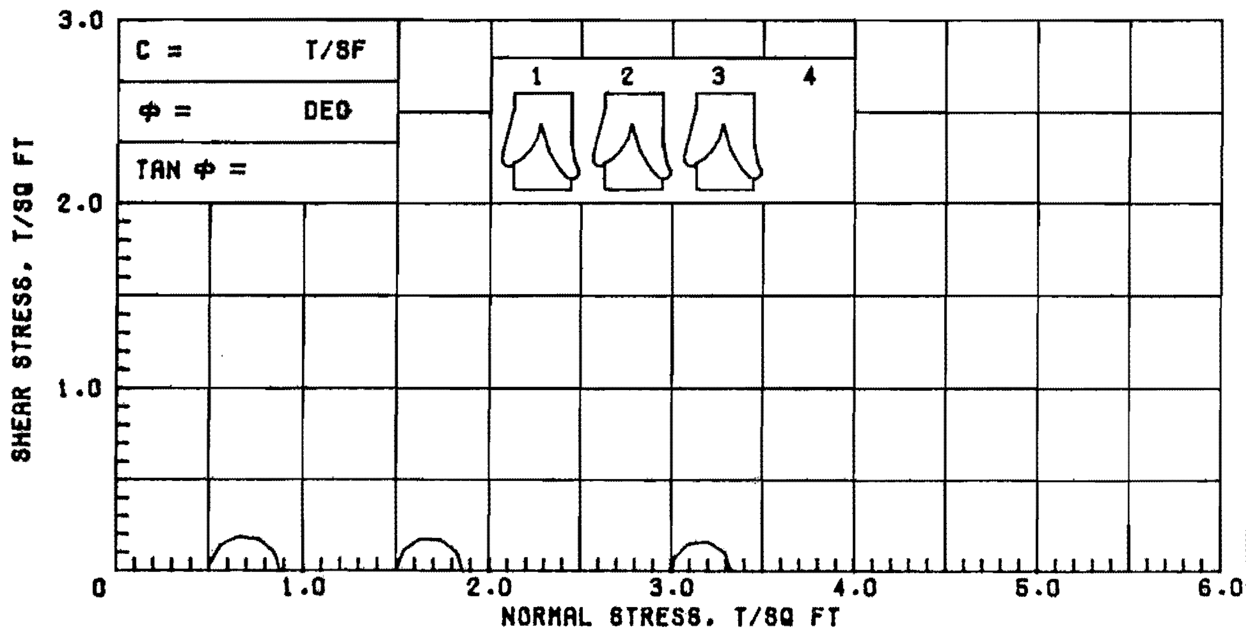
		△1	Y2	X3	4
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	41.2	41.1	42.3	
	DRY DENSITY, PCF	78.0	78.3	77.2	
	SATURATION, %	95.8	96.3	96.5	
	VOID RATIO	1.161	1.152	1.183	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.50	0.52	0.58	
TIME TO FAILURE, MIN.		6	6	4	
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

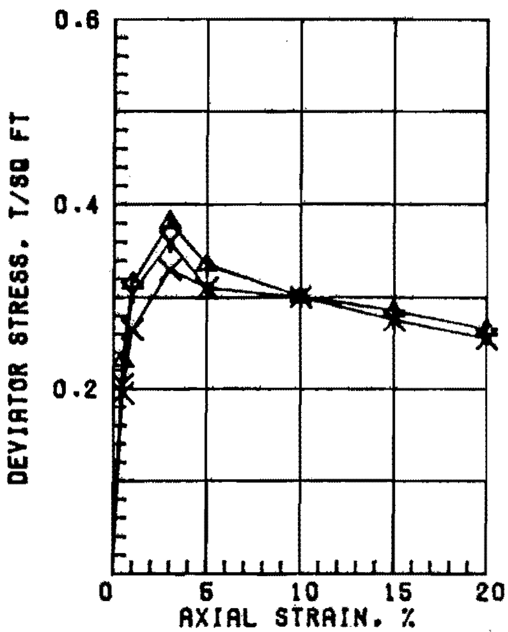
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY & BROWN MOTTLED

LL 55	PL 17	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 2-OUO	SAMPLE NO. 2-B
	DEPTH/ELEV 4.5/-0.8	TECH. KOC
	LABORATORY USAE WES	DATE 17 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	





	SPECIMEN NO.	▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	83.8	84.5	84.4	
	DRY DENSITY, PCF	51.3	51.2	51.2	
	SATURATION, %	99.0	99.6	99.6	
	VOID RATIO	2.285	2.292	2.289	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.38	0.36	0.33	
	TIME TO FAILURE, MIN.	7	21	23	
	RATE OF STRAIN INCR.%		5	8	
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

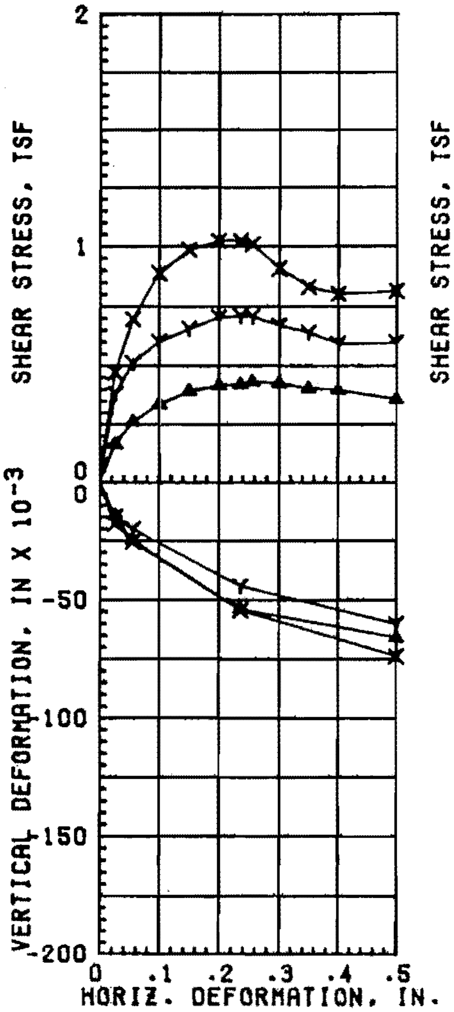
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

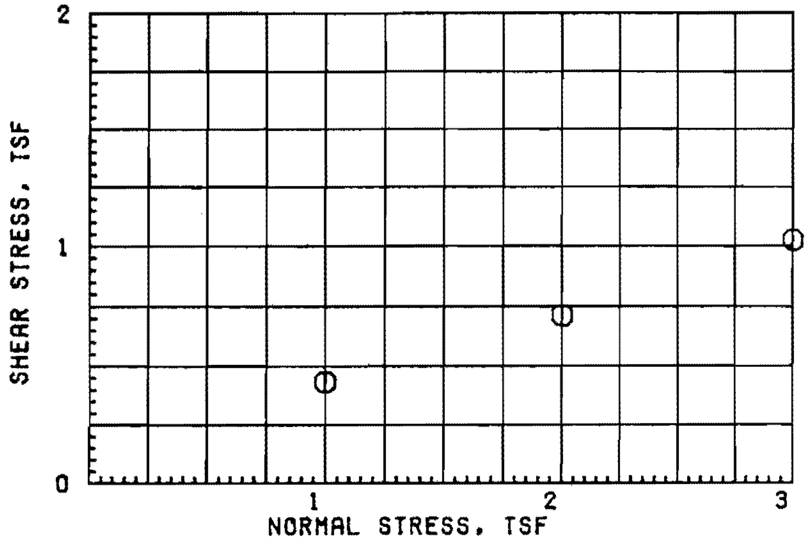
LL 64	PL 26	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
ORLEANS PARISH OUTFALL CANALS	
BORING NO. 2-OUG	SAMPLE NO. 3-B
DEPTH/ELEV 8.1/-4.4	TECH. PJR
LABORATORY USAE WES	DATE 18 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





φ = ________

TAN φ = ________

C = ________

		TEST NO.	1 ▲	2 Y	3 X	
INITAL		WATER CONTENT, %	87.9	90.2	85.8	
		VOID RATIO	2.427	2.425	2.335	
		SATURATION, %	97.8	100 +	99.2	
		DRY DENSITY, PCF	49.2	49.2	50.5	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			12	40	25	
FINAL		WATER CONTENT, %	62.6	51.1	49.7	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.43	0.71	1.02	
TIME TO FAILURE, MIN			1380	1273	1080	
RATE OF STRAIN, IN/MIN			.00019	.00019	.00019	
ULTIMATE SHEAR STRESS, TSF						

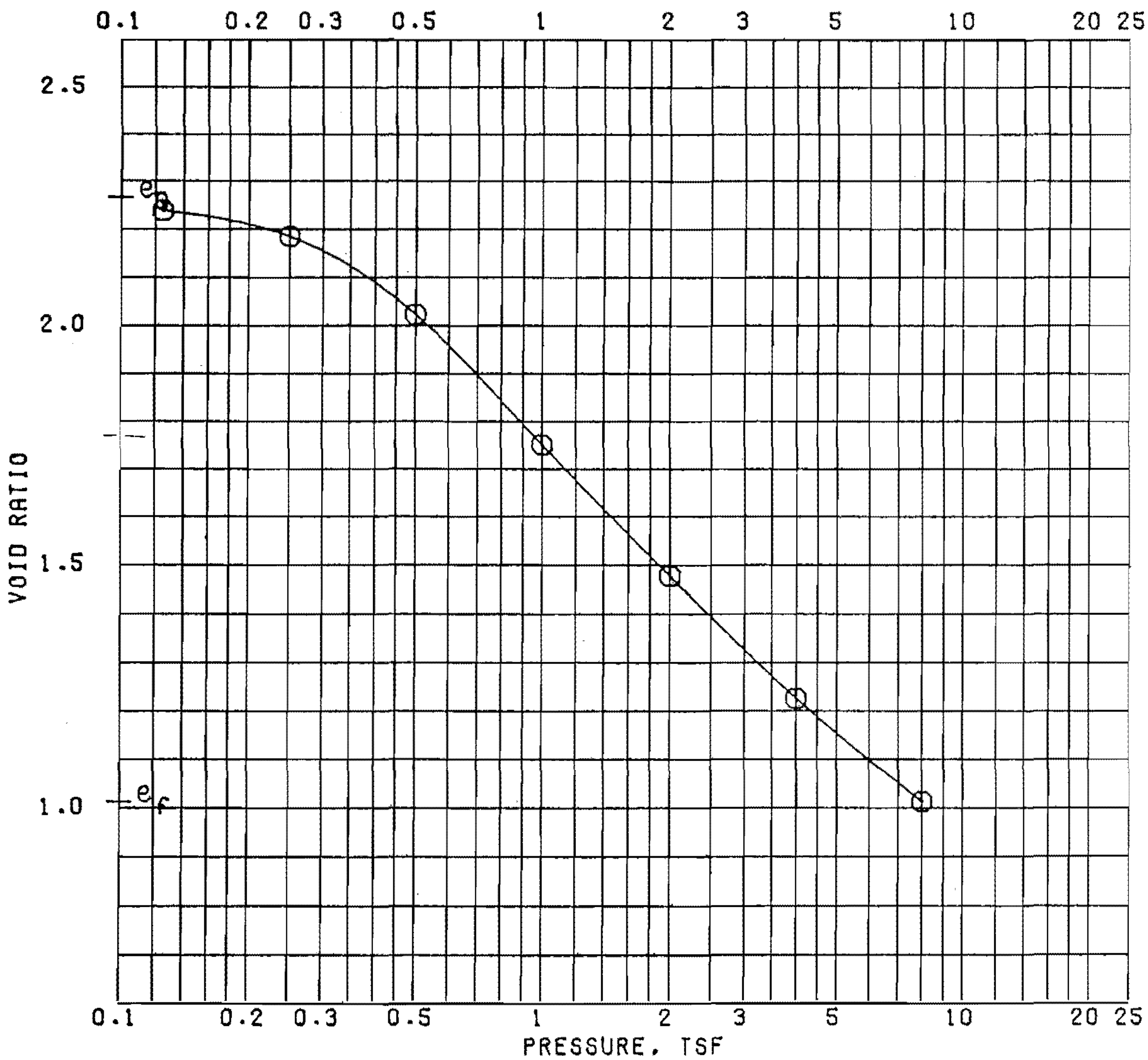
TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.756 IN. THICK

CLASSIFICATION PLASTIC CLAY (CH), GRAY

LL	PL	PI		GS 2.70 (EST)

REMARKS:	PROJECT LAKE PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 2-OUO	SAMPLE 3-C
	DEPTH/ELEV 9.3/-5.8	DATE 09 OCT 84

DIRECT SHEAR TEST REPORT

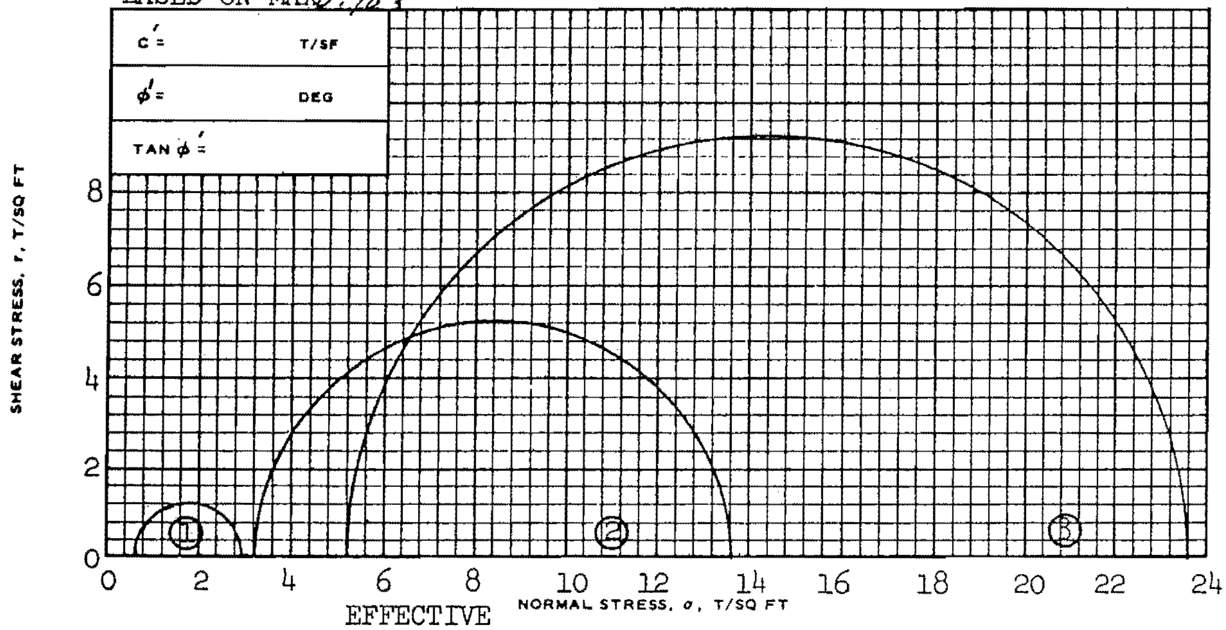


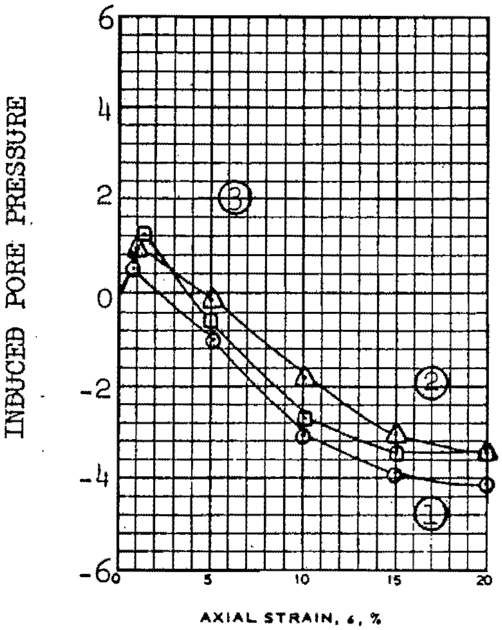
				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF			WATER CONTENT, %	80.2	40.7
PRECONSOL. PRESSURE, TSF			DRY DENSITY, PCF	51.7	83.9
COMPRESSION INDEX			SATURATION, %	95.8	100 +
TYPE SPECIMEN	UNDISTURBED		VOID RATIO	2.262	1.009
DIA. IN 4.44	HT. IN 1.117		BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY			
LL	PL	PI	PROJECT LK. PONT. LA. & VIC. HURR. PROT.
GS 2.70 (EST)	D_{10}		ORLEANS PARISH OUTFALL CANALS
REMARKS			BORING NO. 2-OUG · SAMPLE NO. 3-D
			DEPTH/ELEV 10.2/-6.5 · DATE 04 OCT 84
			CONSOLIDATION TEST REPORT

BASED ON MAX $\bar{\sigma}_1'/\bar{\sigma}_3'$

c′ =	T/SF
φ′ =	DEG
TAN φ′ =	





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/ CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.63	3.22	5.21	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.31	10.43	18.38	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.
ORLEANS PARISH OUTFALL CANALS

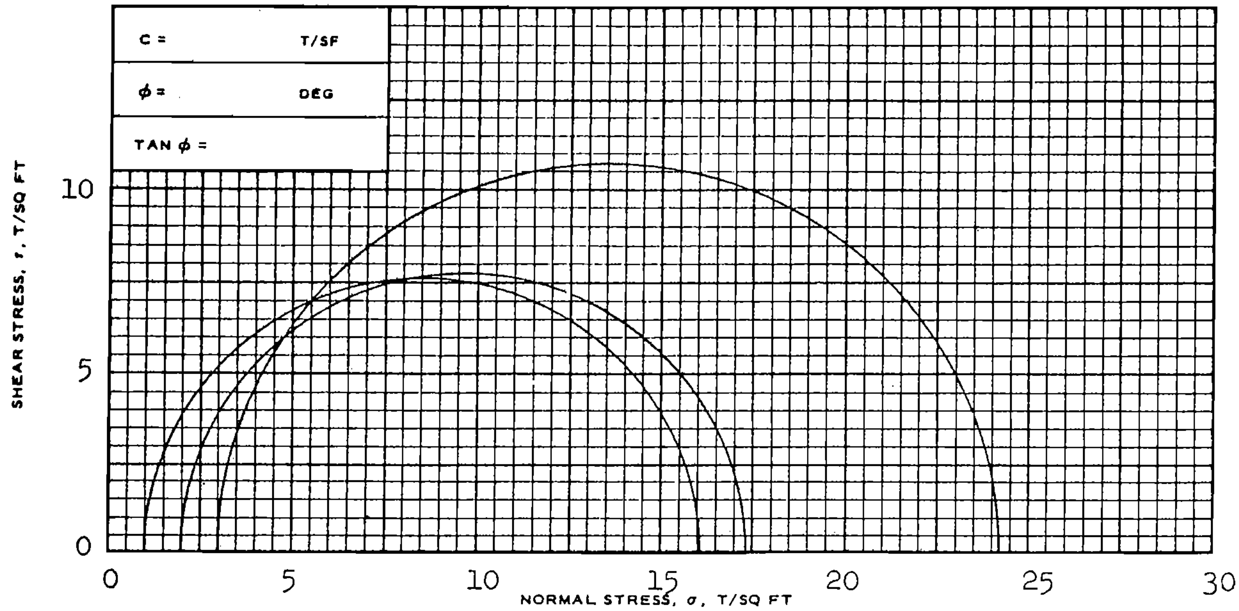
BORING NO. 2-OUG SAMPLE NO. 6-C

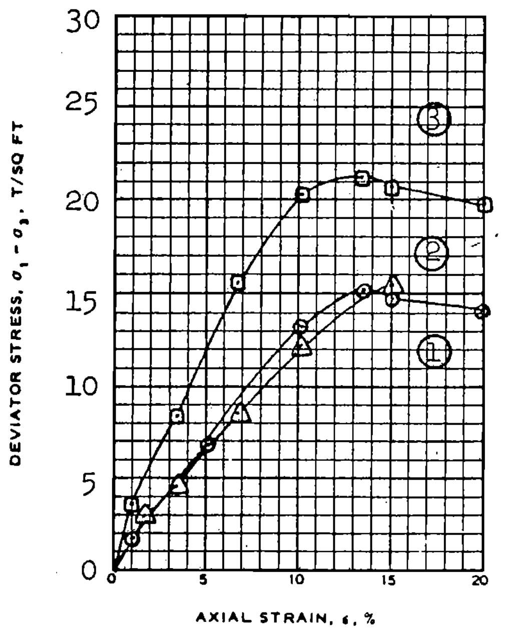
DEPTH/ELEV 21.0/-17.3

LABORATORY USAEWES DATE 5 SEP 1984

SHEET 2 OF2

JMS **TRIAXIAL COMPRESSION TEST REPORT**





SPECIMEN NO.			1	2	3
INITIAL	WATER CONTENT, %	w_o	27.7	28.0	27.9
	DRY DENSITY LB/ CU FT	γ_{d_o}	94.2	93.8	94.9
	SATURATION, %	S_o	96.0	96.2	98.6
	VOID RATIO	e_o	0.771	0.777	0.756
BEFORE SHEAR	WATER CONTENT, %	w_c	29.8	29.2	29.2
	DRY DENSITY LB/CU FT	γ_{d_c}	96.3	96.3	97.7
	SATURATION, %	S_c	100+	100+	100+
	VOID RATIO	e_c	0.730	0.730	0.706
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	15.09	15.36	21.08
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	900	1000	893
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$			
INITIAL DIAMETER, IN.		D_o	1.41	1.37	1.37
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SANDY SILT (ML), GRAY; SHELL PARTICLES

LL	PL	PI	G: 2.67 (EST)	TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST R

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS

BORING NO 2-OUG | SAMPLE NO. 6-C

DEPTH/ELEV 21.0/-17.3

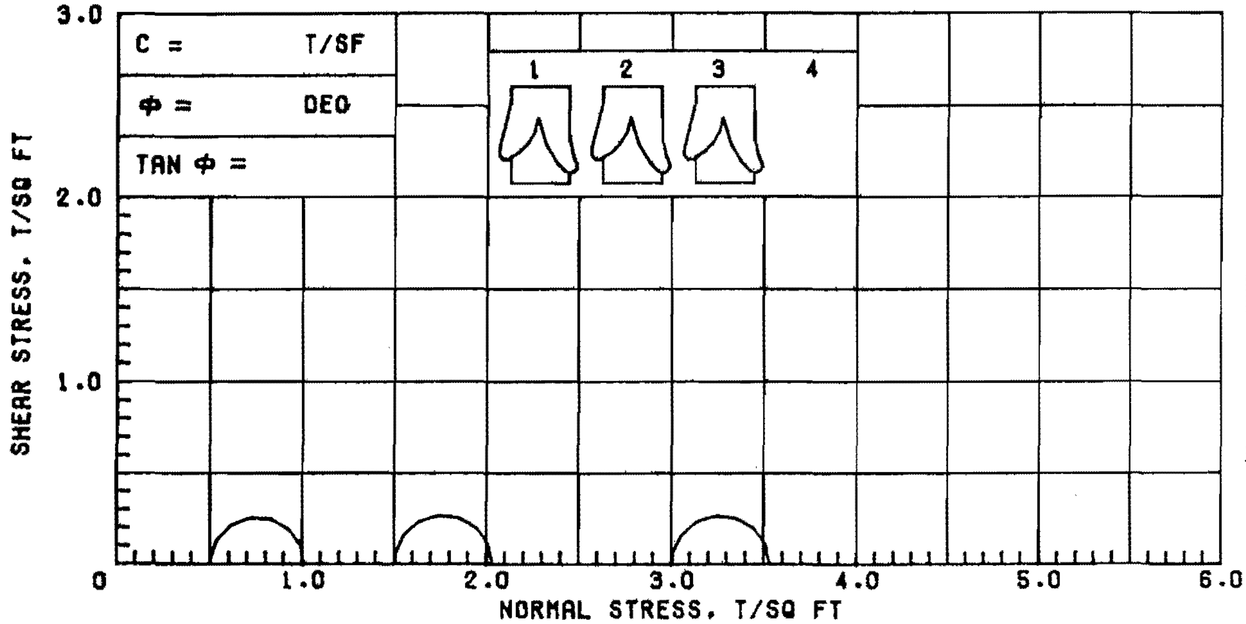
LABORATORY USAEWES | DATE 5 SEP 1984

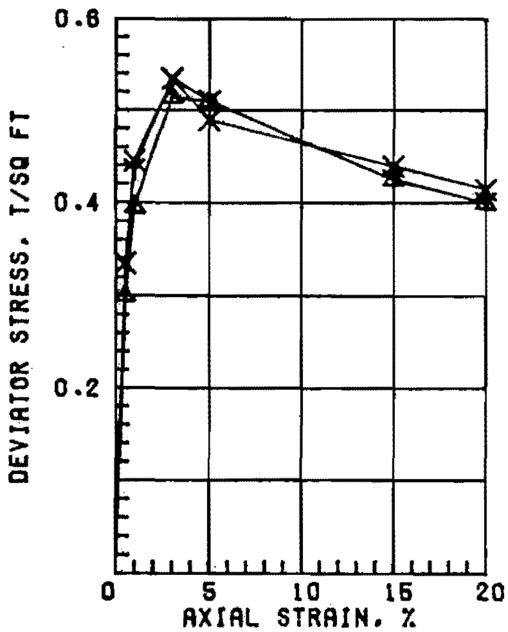
SHEET 1 OF 2

JMS

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089
REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE





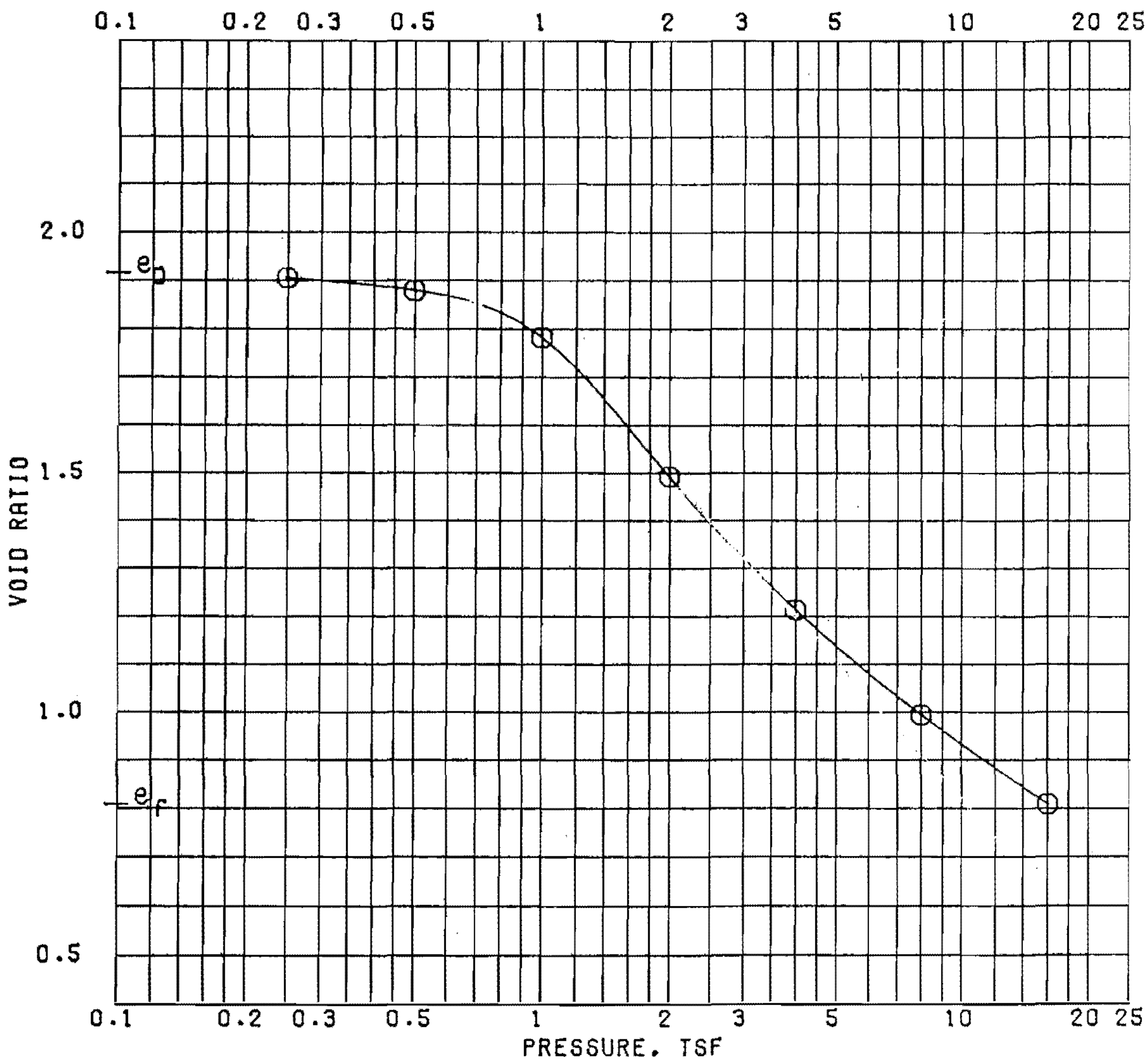
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	62.4	67.2	66.7	
	DRY DENSITY, PCF	61.8	59.8	60.0	
	SATURATION, %	97.4	99.7	99.4	
	VOID RATIO	1.730	1.820	1.811	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.51	0.53	0.53	
TIME TO FAILURE, MIN.		6	21	19	
RATE OF STRAIN INCR.%			5	7	
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 82	PL 23	PI 59	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 2-OUG	SAMPLE NO. 8-B
	DEPTH/ELEV 28.1/-24.4	TECH. PJR
	LABORATORY USAE WES	DATE 18 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	

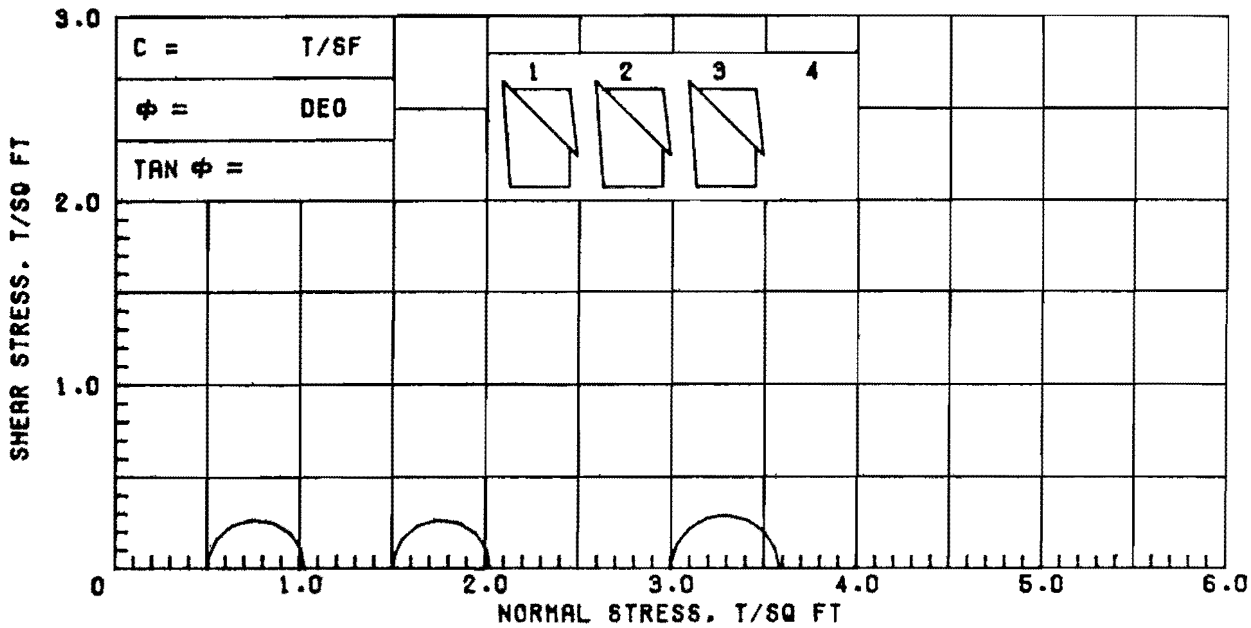


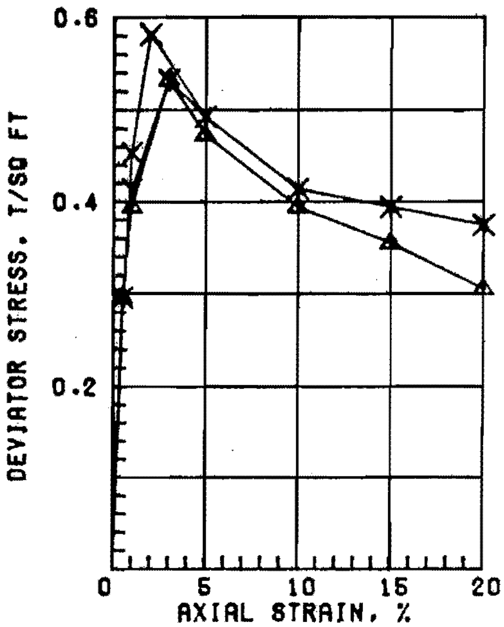
		BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF			
WATER CONTENT, %		68.9	32.9
PRECONSOL. PRESSURE, TSF			
DRY DENSITY, PCF		57.9	93.4
COMPRESSION INDEX			
SATURATION, %		97.3	100 +
TYPE SPECIMEN	UNDISTURBED		
VOID RATIO		1.912	0.805
DIA. IN 4.44	HT. IN 1.126		
BACK PRESSURE, TSF			

CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND LENSES

LL	PL	PI	PROJECT LK. PONT. LA. & VIC. HURR. PROT.
GS 2.70 (EST)	D_{10}		ORLEANS PARISH OUTFALL CANALS
REMARKS		BORING NO. 2-OUO	SAMPLE NO. 8-C
		DEPTH/ELEV 29.0/-25.3	DATE 03 OCT 84

CONSOLIDATION TEST REPORT





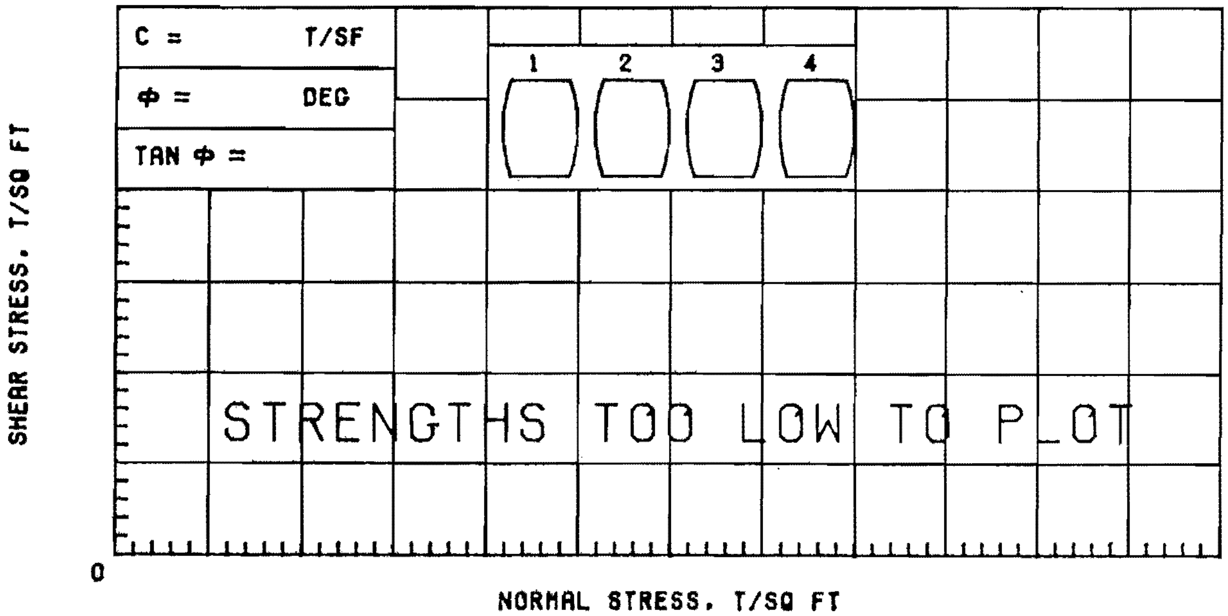
		Δ1	Y2	X3	4
SPECIMEN NO.		Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	74.3	74.9	74.9	
	DRY DENSITY, PCF	55.3	55.0	55.2	
	SATURATION, %	98.0	97.9	98.6	
	VOID RATIO	2.048	2.065	2.051	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.53	0.53	0.58	
TIME TO FAILURE, MIN.		6	6	4	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.41	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

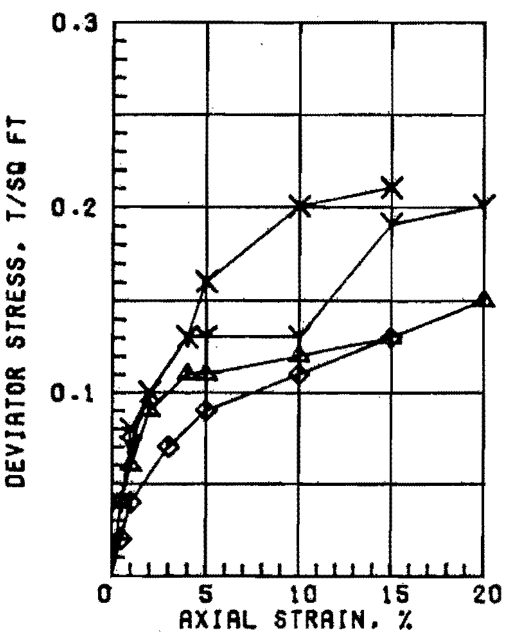
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL	PL	PI	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.
	ORLEANS PARISH OUTFALL CANALS
	BORING NO. 2-OUG SAMPLE NO. 9-B
	DEPTH/ELEV 32.2/-28.5 TECH. KOC
	LABORATORY USAE WES DATE 18 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	34.6	44.2	37.7	35.6
	DRY DENSITY, PCF	82.8	74.2	80.9	82.9
	SATURATION, %	90.2	93.8	93.9	93.0
	VOID RATIO	1.036	1.273	1.084	1.034
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.11	0.13	0.21	0.13
TIME TO FAILURE, MIN.		8	8	30	30
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	1.40
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

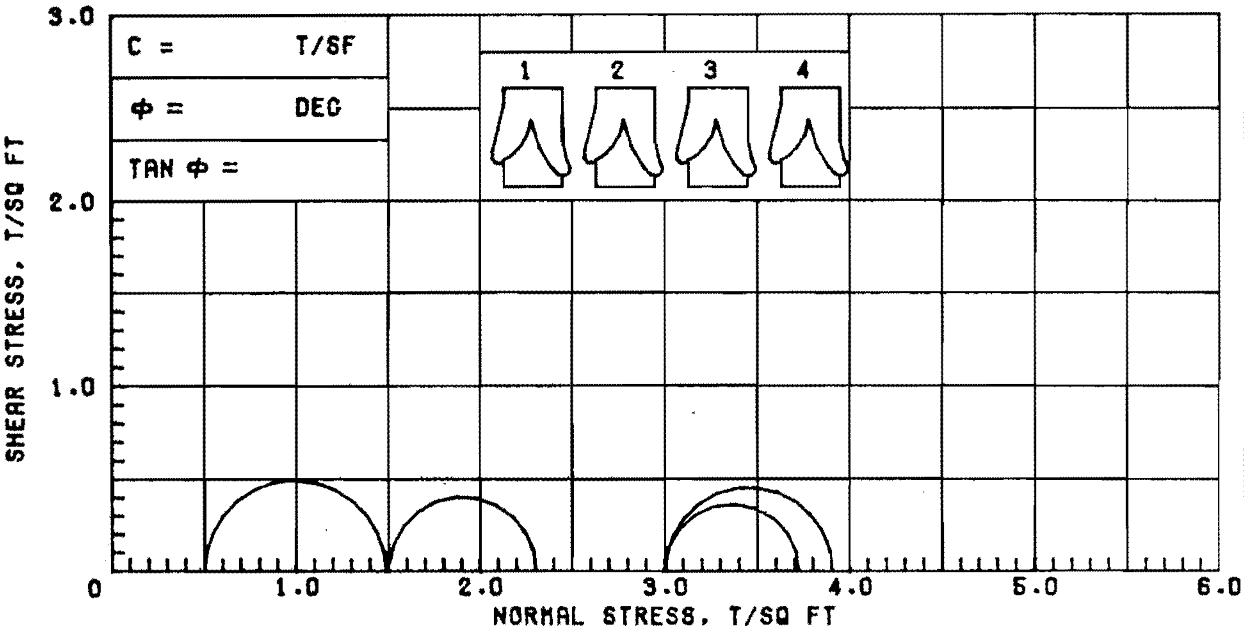
DESCRIPTION OF SPECIMENS; CLAY (CL), GRAY; SILT POCKETS & LENSES; SHELL PARTICLES

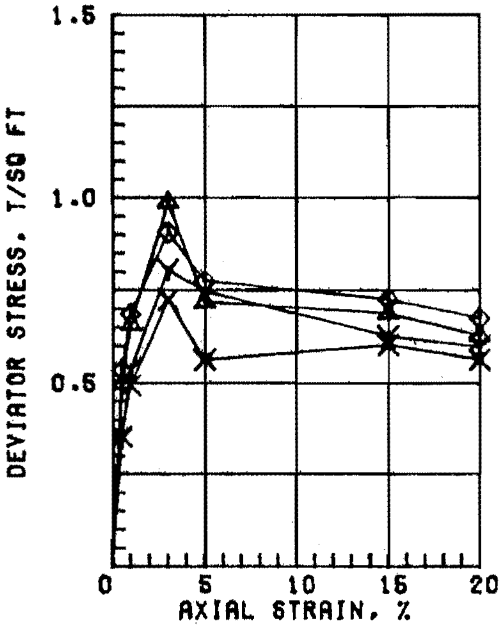
LL 39	PL 13	PI 26	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS	
BORING NO. 2-OUG	SAMPLE NO. 10-B
DEPTH/ELEV 36.0/-32.3	TECH. KOC
LABORATORY USAE WES	DATE 18 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	62.2	62.5	70.2	63.5
	DRY DENSITY, PCF	61.9	61.8	58.1	61.9
	SATURATION, %	97.4	97.6	99.8	99.6
	VOID RATIO	1.725	1.729	1.899	1.722
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	3.0
MAX. DEV. STRESS, TSF		0.99	0.81	0.73	0.91
TIME TO FAILURE, MIN.		6	24	21	18
RATE OF STRAIN INCR.%			5	7	5
INITIAL DIAMETER, IN.		1.40	1.40	1.39	1.39
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

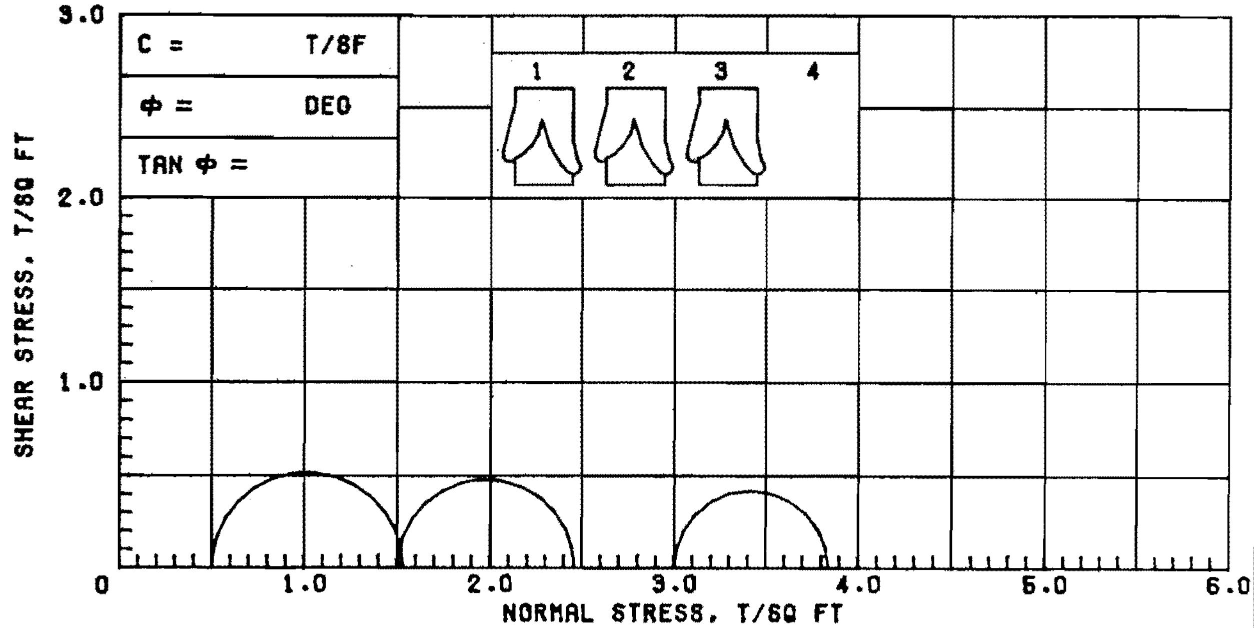
CONTROLLED-STRAIN TEST

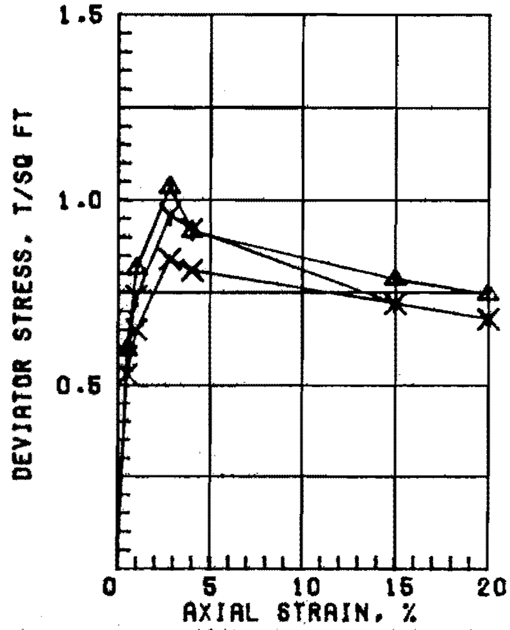
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SHELL PARTICLES; FISSURED

LL 81	PL 23	PI 58	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	
	PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS
BORING NO. 2-OUG	SAMPLE NO. 15-B
DEPTH/ELEV 55.7/-52.0	TECH. PJR
LABORATORY USAE WES	DATE 19 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		1	2	3	4
INITIAL	WATER CONTENT, %	48.1	49.8	50.8	
	DRY DENSITY, PCF	72.6	71.4	70.9	
	SATURATION, %	98.2	98.9	99.5	
	VOID RATIO	1.323	1.359	1.379	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.03	0.96	0.84	
TIME TO FAILURE, MIN.		6	20	42	
RATE OF STRAIN INCR.,%			5	4	
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

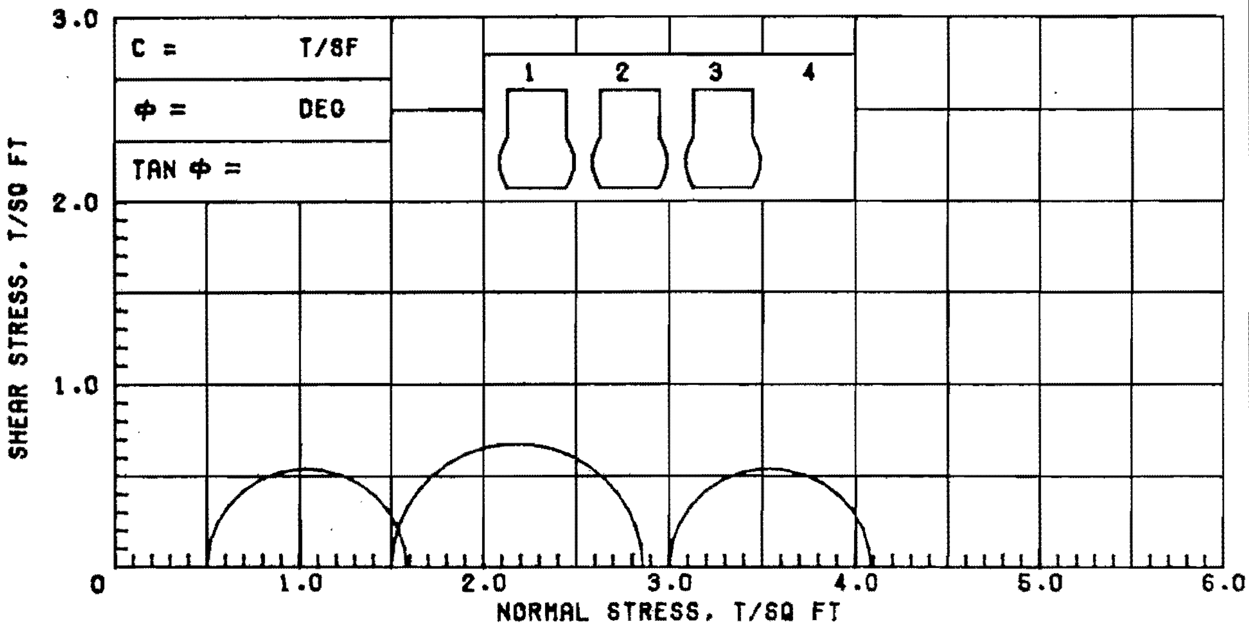
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

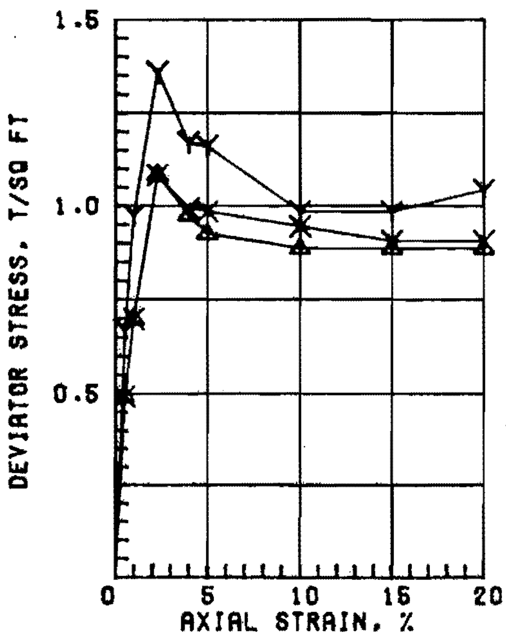
LL 70	PL 21	PI 49	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
ORLEANS PARISH OUTFALL CANALS	
BORING NO. 2-OUG	SAMPLE NO. 16-C
DEPTH/ELEV 61.0/-57.3	TECH. PJR
LABORATORY USAE WES	DATE 18 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





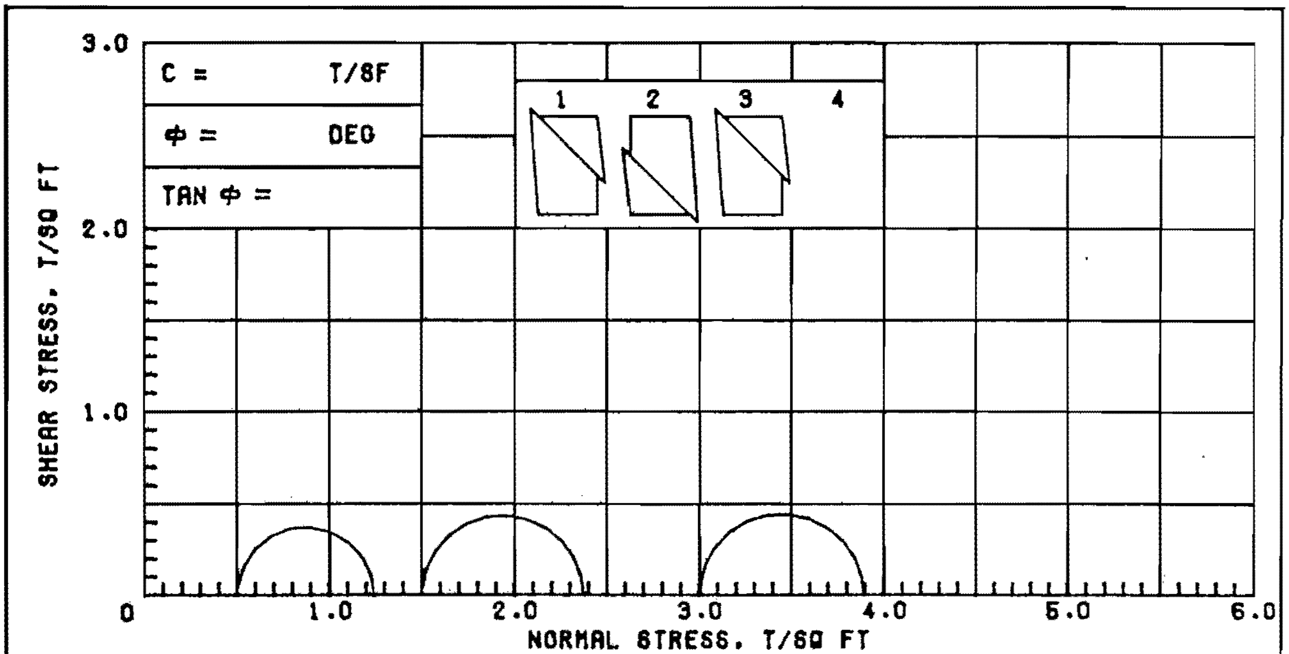
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	82.1	86.3	82.4	
INITIAL	DRY DENSITY, PCF	50.1	48.4	49.7	
INITIAL	SATURATION, %	93.7	93.8	93.0	
INITIAL	VOID RATIO	2.365	2.483	2.392	
BEFORE SHEAR	WATER CONTENT, %				
BEFORE SHEAR	DRY DENSITY, PCF				
BEFORE SHEAR	SATURATION, %				
BEFORE SHEAR	VOID RATIO				
BEFORE SHEAR	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.08	1.36	1.08	
TIME TO FAILURE, MIN.		5	5	5	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.41	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

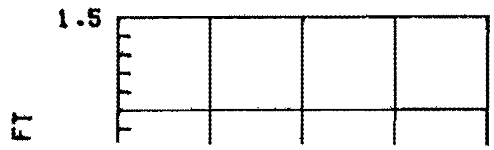
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

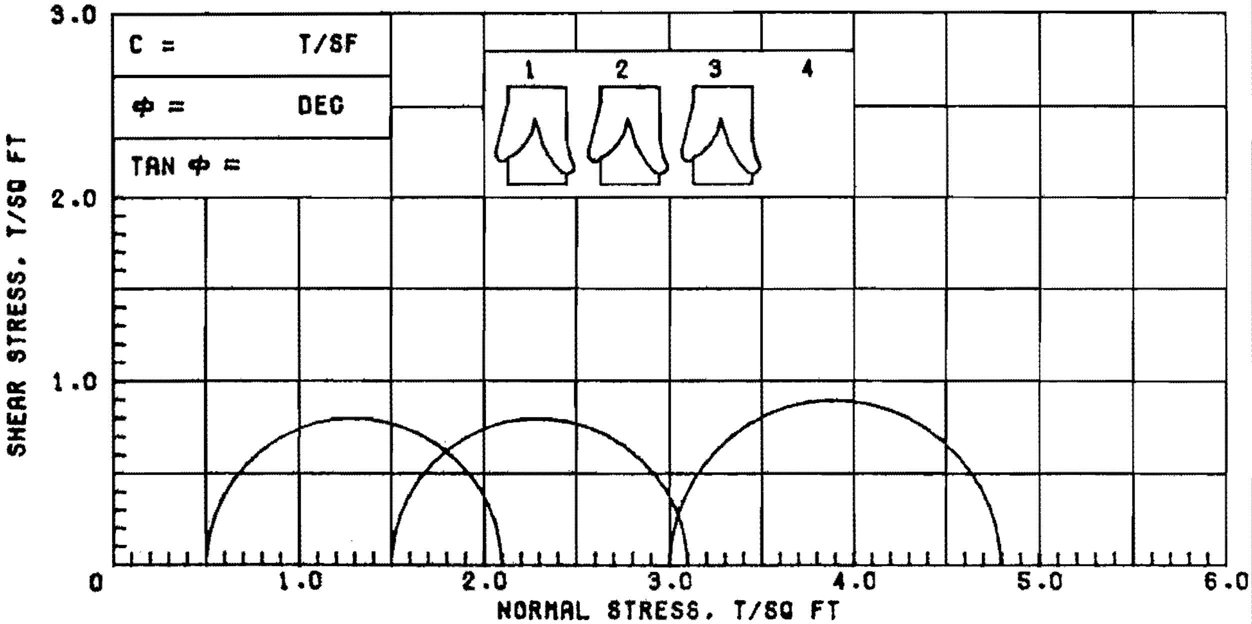
LL 124	PL 30	PI 94	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

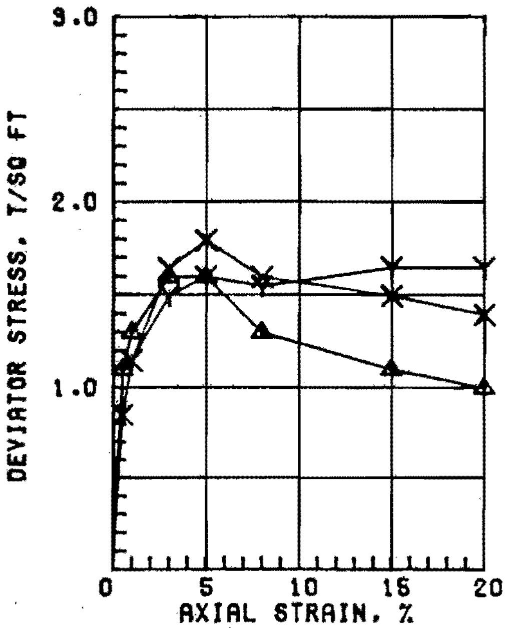
REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 2-GUG	SAMPLE NO. 17-C
	DEPTH/ELEV 65.0/-61.3	TECH. KGC
	LABORATORY USAE WES	DATE 19 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	





SPECIMEN NO.		Δ1	Y2	X3	4
ITIAL	WATER CONTENT, %	35.6	34.2	34.0	
	DRY DENSITY, PCF	84.8	85.8	85.5	





SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	38.1	38.0	38.4	
	DRY DENSITY, PCF	81.6	81.0	81.2	
	SATURATION, %	96.5	97.3	96.5	
	VOID RATIO	1.067	1.082	1.075	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.60	1.60	1.79	
TIME TO FAILURE, MIN.		7	34	22	
RATE OF STRAIN INCR.%			8	8	
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

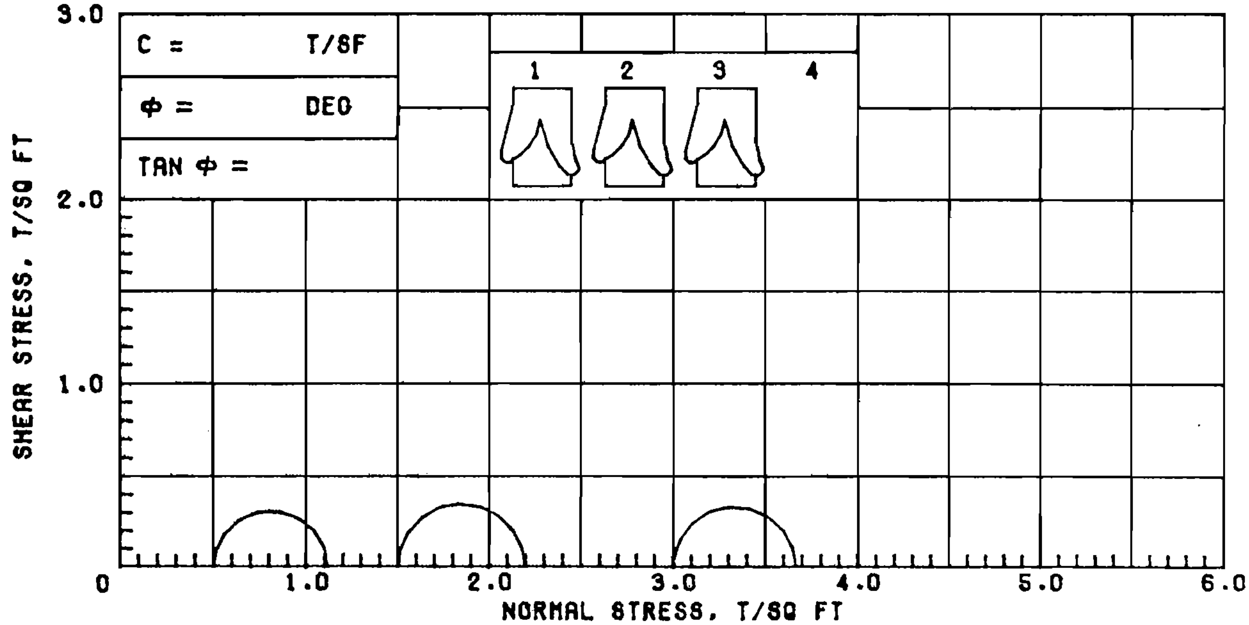
DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), BROWN

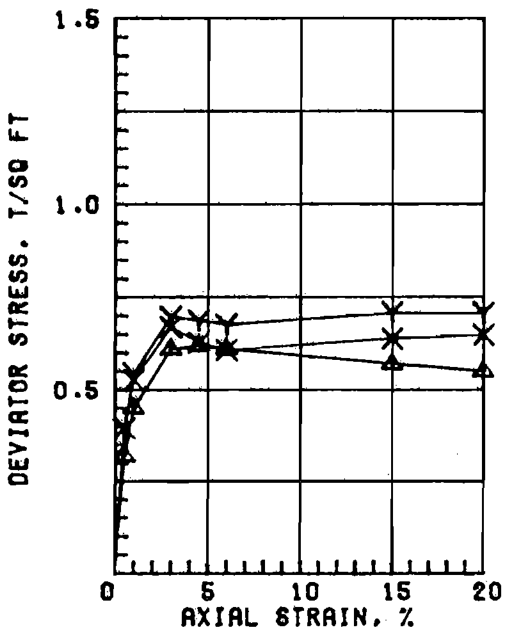
LL 74	PL 23	PI 51	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;

PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
ORLEANS PARISH OUTFALL CANALS	
BORING NO. 3-OUG	SAMPLE NO. 1-C
DEPTH/ELEV 2.0/+2.4	TECH. PJR
LABORATORY USAE WES	DATE 20 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





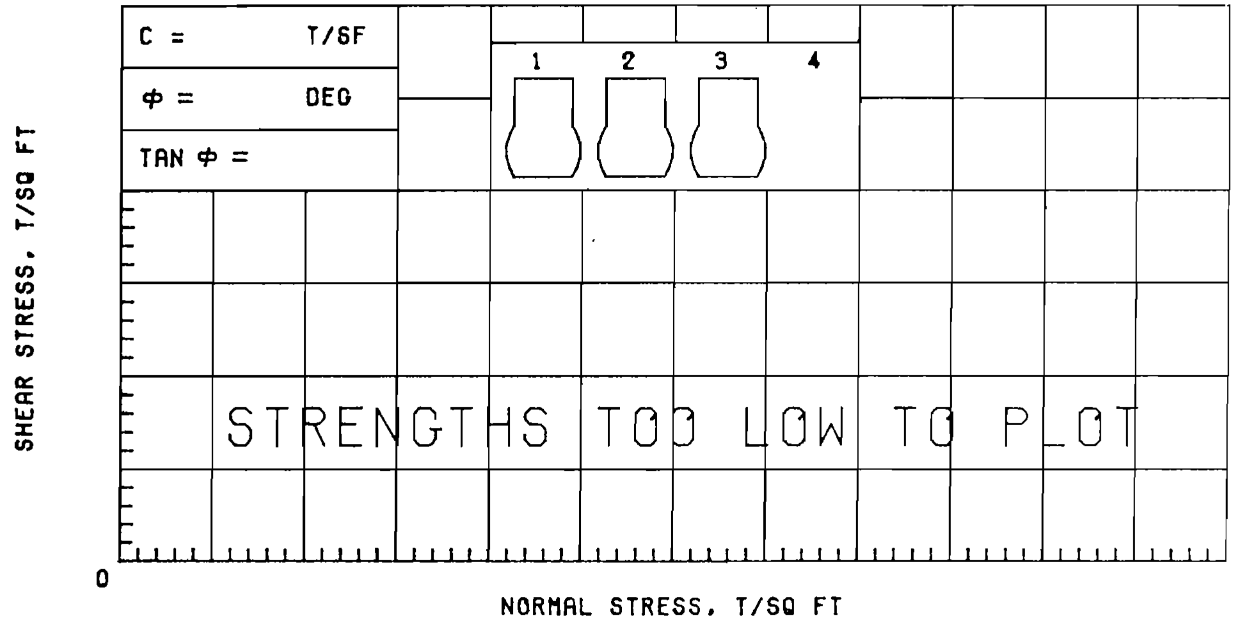
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	50.8	51.9	52.6	
	DRY DENSITY, PCF	70.2	69.6	69.2	
	SATURATION, %	97.9	98.5	98.9	
	VOID RATIO	1.401	1.422	1.437	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.62	0.70	0.67	
TIME TO FAILURE, MIN.		9	20	30	
RATE OF STRAIN INCR.%			6	6	
INITIAL DIAMETER, IN.		1.40	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

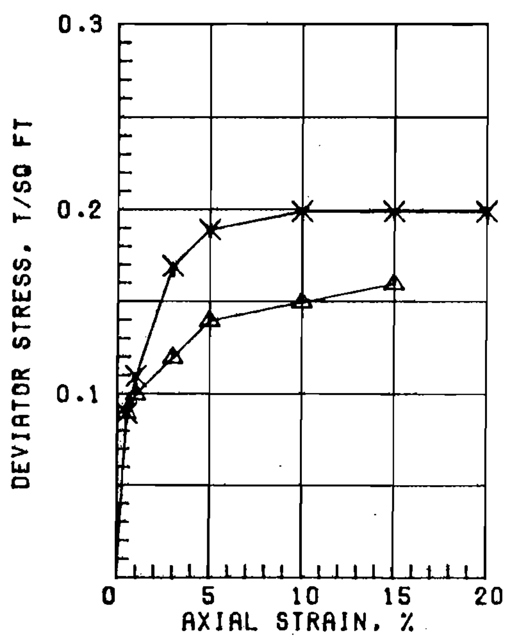
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), BROWN; SILT LENSES

LL 72	PL 24	PI 48	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 3-OUG	SAMPLE NO. 2-B
	DEPTH/ELEV 4.5/-0.1	TECH. PJR
	LABORATORY USAE WES	DATE 20 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	





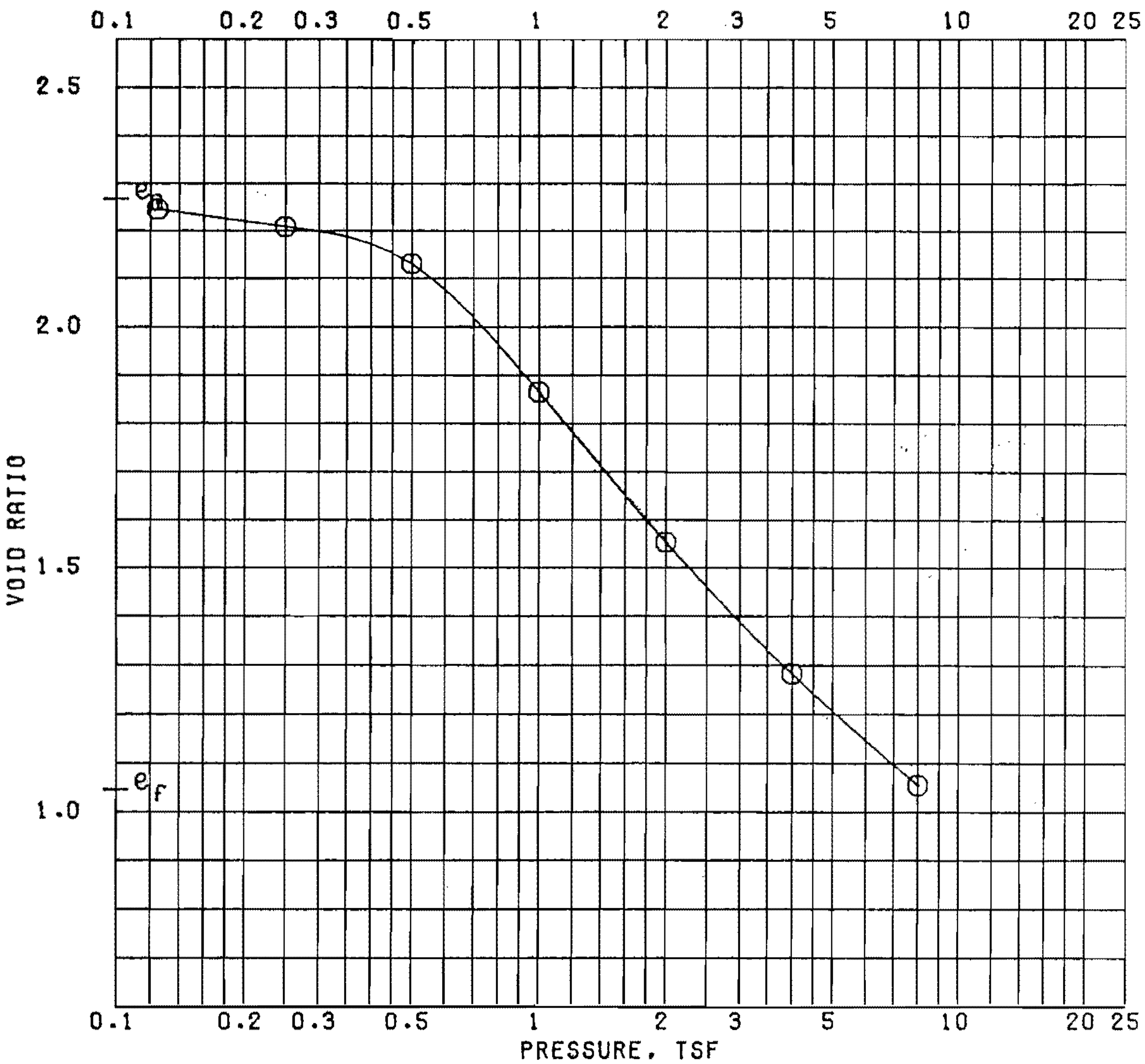
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	71.1	69.3	69.8	
	DRY DENSITY, PCF	57.0	58.2	57.8	
	SATURATION, %	98.2	98.7	98.5	
	VOID RATIO	1.955	1.895	1.914	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.16	0.20	0.20	
TIME TO FAILURE, MIN.		30	20	20	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 87	PL 25	PI 62	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	
	PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS
	BORING NO. 3-OUG — SAMPLE NO. 3-B
	DEPTH/ELEV 8.0/-3.6 — TECH. KOC
	LABORATORY USAE WES — DATE 20 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	81.4	28.5
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	51.6	82.5
COMPRESSION INDEX		SATURATION, %	97.1	73.8
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.264	1.042
DIA. IN 4.44	HT. IN 1.116	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY		
LL	PL	PI
GS 2.70 (EST)	D_{10}	

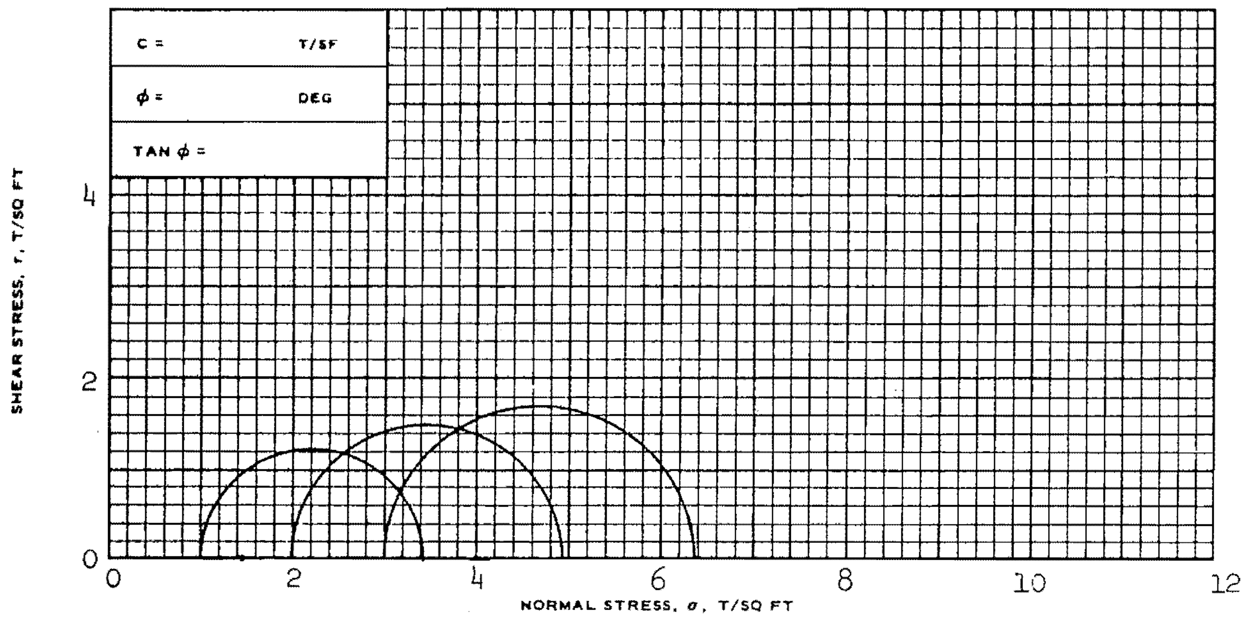
PROJECT LK. PONT. LA. & VIC. HURR. PROT.
ORLEANS PARISH OUTFALL CANALS

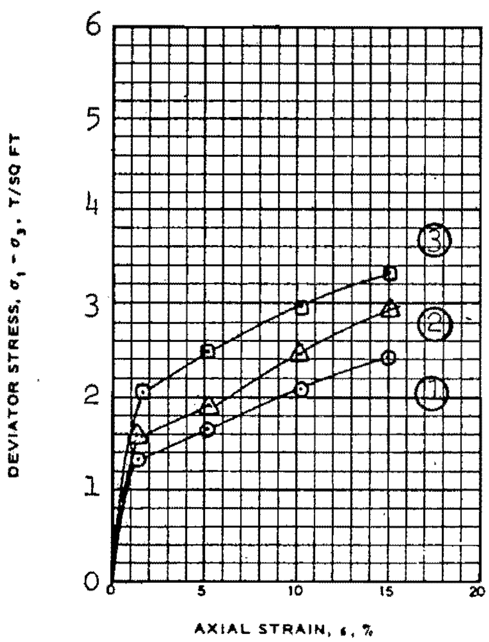
BORING NO. 3-OUG	SAMPLE NO. 3-B
DEPTH/ELEV 8.4/-4.0	DATE 02 OCT 84

REMARKS

CONSOLIDATION TEST REPORT

SHEET 1 OF 9





SPECIMEN NO.			1	2	3
INITIAL	WATER CONTENT, %	w_o	36.0	37.0	37.5
	DRY DENSITY LB/CU FT	γd_o	85.6	84.1	83.8
	SATURATION, %	S_o	100+	100+	100+
	VOID RATIO	e_o	0.947	0.982	0.990
BEFORE SHEAR	WATER CONTENT, %	w_c	34.7	33.9	33.3
	DRY DENSITY LB/CU FT	γd_c	89.0	88.1	89.7
	SATURATION, %	S_c	100+	100+	100+
	VOID RATIO	e_c	0.874	0.893	0.858
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.45	2.94	3.36
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	1000	1000	1000
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$			
INITIAL DIAMETER, IN.		D_o	1.36	1.36	1.36
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILT (ML), GRAY

LL	PL	PI	Gs 2.67 (EST)

TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST R
PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS	
BORING NO. 3-OUG	SAMPLE NO. 5-B
DEPTH/ELEV 16.3/-11.9	
LABORATORY USAEWES	DATE 06 SEP 1984

REMARKS:

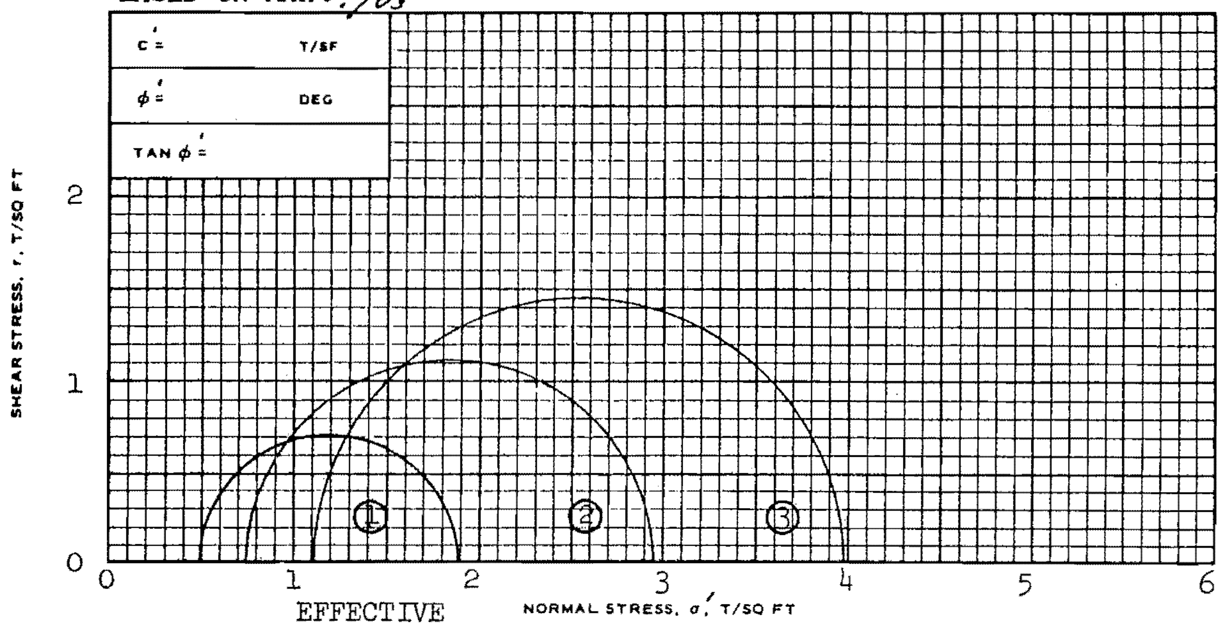
SHEET 1 OF 2

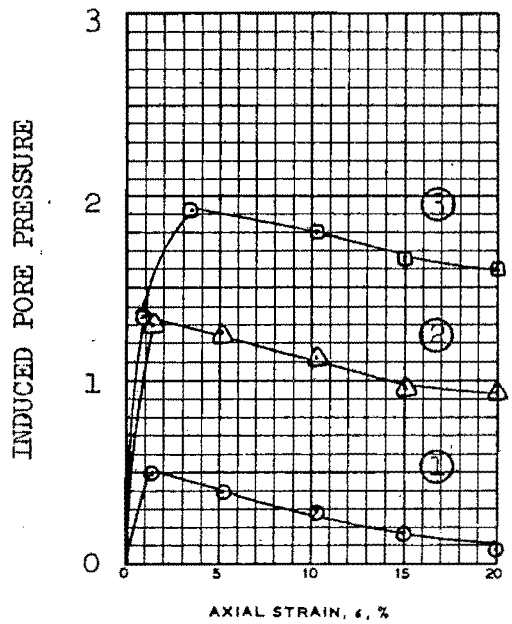
JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE

BASED ON MAX σ_1'/σ_3'

c' =	T/SF
ϕ' =	DEG
TAN ϕ' =	





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/CU FT	γ_{d_o}				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γ_{d_c}				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.50	0.74	1.11	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	1.40	2.22	2.85	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	G_s	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

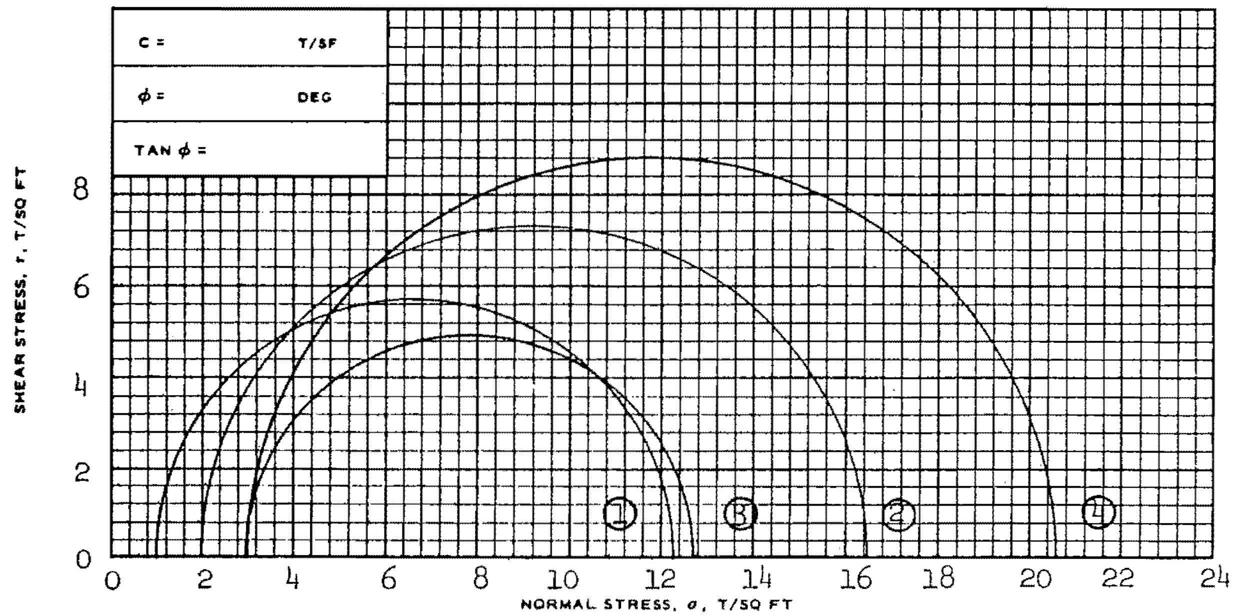
PROJECT LK. PONT. LA. & VIC. HURR. PROT.
ORLEANS PARISH OUTFALL CANALS

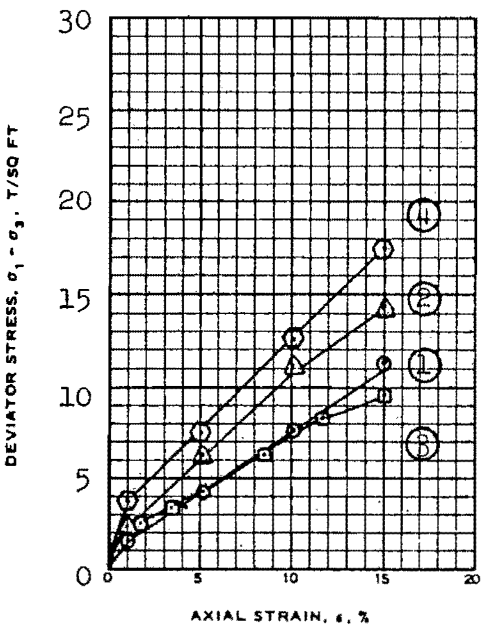
BORING NO.	3-OUG	SAMPLE NO.	5-B
DEPTH/ELEV	16.3/-11.9		
LABORATORY	USAEWES	DATE	06 SEP 1984

SHEET 2 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089
REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE





			1	2	3	4
SPECIMEN NO.			1	2	3	4
INITIAL	WATER CONTENT, %	w_o	31.5	31.2	32.1	30.8
	DRY DENSITY LB/CU FT	γd_o	91.3	91.9	88.7	92.3
	SATURATION, %	S_o	100+	100+	97.5	100+
	VOID RATIO	e_o	0.826	0.813	0.879	0.805
BEFORE SHEAR	WATER CONTENT, %	w_c	32.3	31.6	31.2	30.4
	DRY DENSITY LB/CU FT	γd_c	93.9	95.1	92.4	95.4
	SATURATION, %	S_c	100+	100+	100+	100+
	VOID RATIO	e_c	0.774	0.753	0.805	0.748
	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	4.32
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	3.0
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	11.30	14.42	9.72	17.65
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	1000	1000	1000	1000
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	1.36	1.36	1.38	1.36
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SILT (ML), GRAY

LL	PL	PI	Gs 2.67 (EST)	TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST $\overline{R}$

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.
ORLEANS PARISH OUTFALL CANALS

BORING NO. 3-OUG SAMPLE NO. 6-C

DEPTH/ELEV 21.0/-16.6

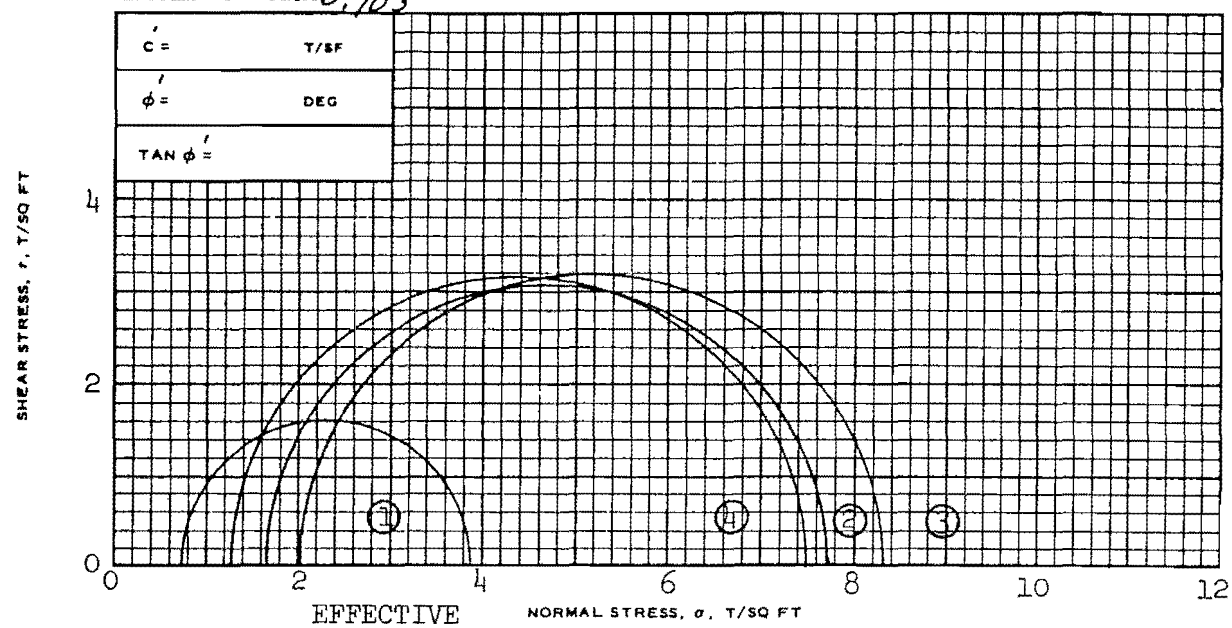
LABORATORY USAEWES DATE 20 SEP 1984

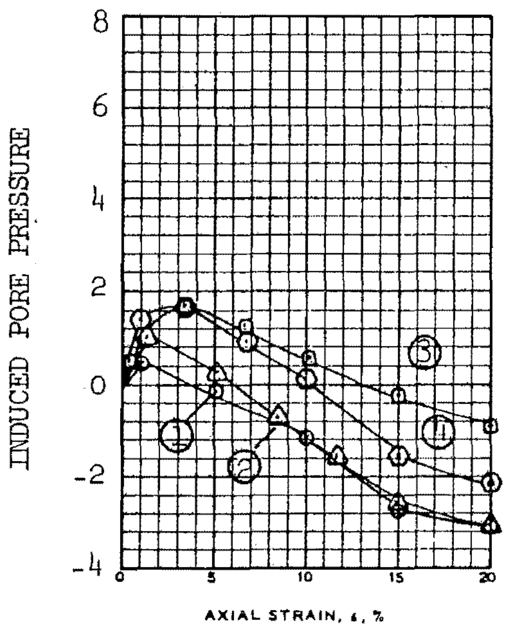
SHEET 1 OF 2

JMS TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE

BASED ON MAX σ_1'/σ_3'





SPECIMEN NO.			1	2	3	4
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/ CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.75	1.64	2.01	1.27
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	3.14	6.08	6.31	6.22
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.
ORLEANS PARISH OUTFALL CANALS

BORING NO. 3-OUG SAMPLE NO. 6-C

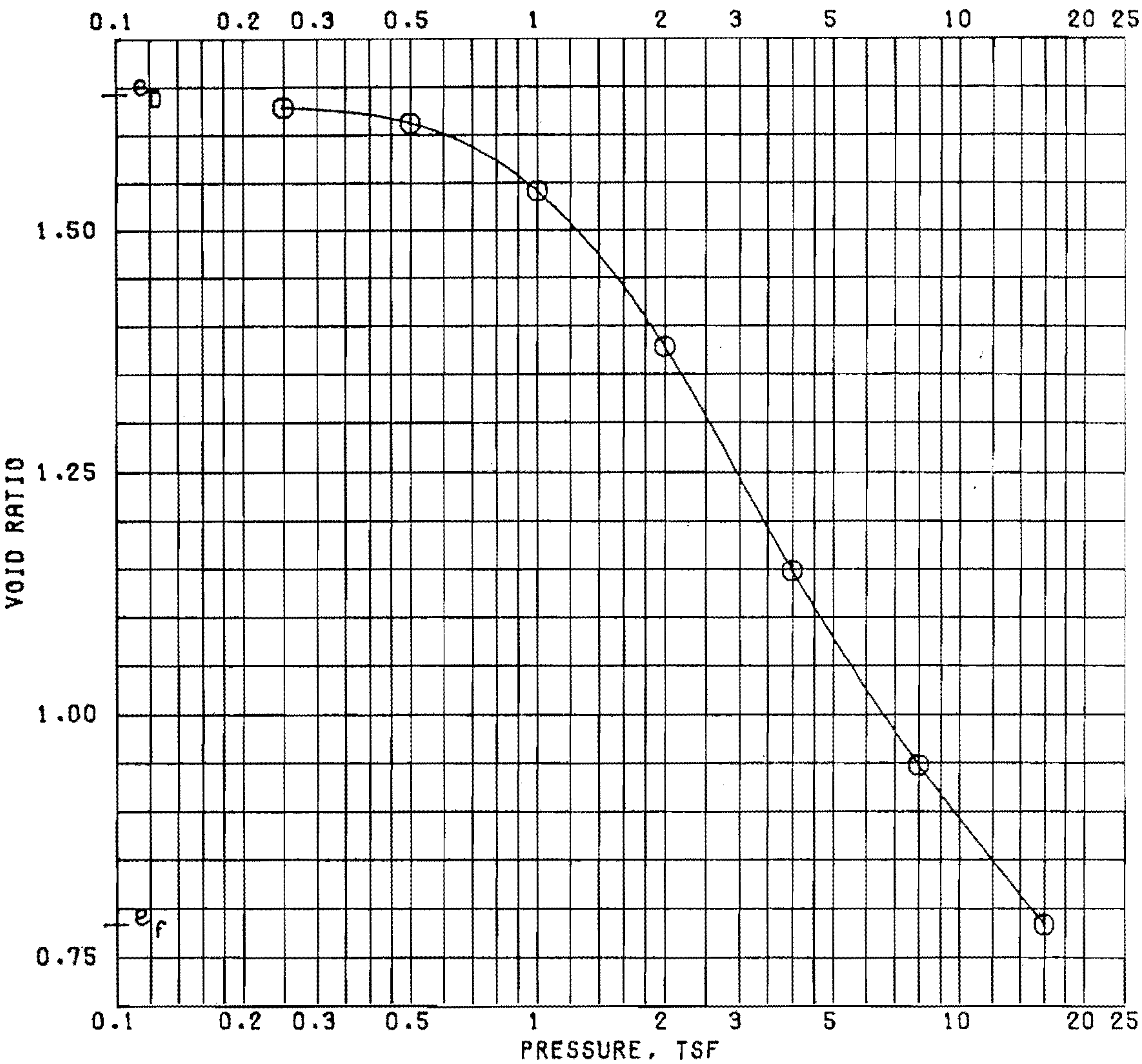
DEPTH/ELEV 21.0/-16.6

LABORATORY USAEWES DATE 20 SEP 1984

SHEET 2 OF 2

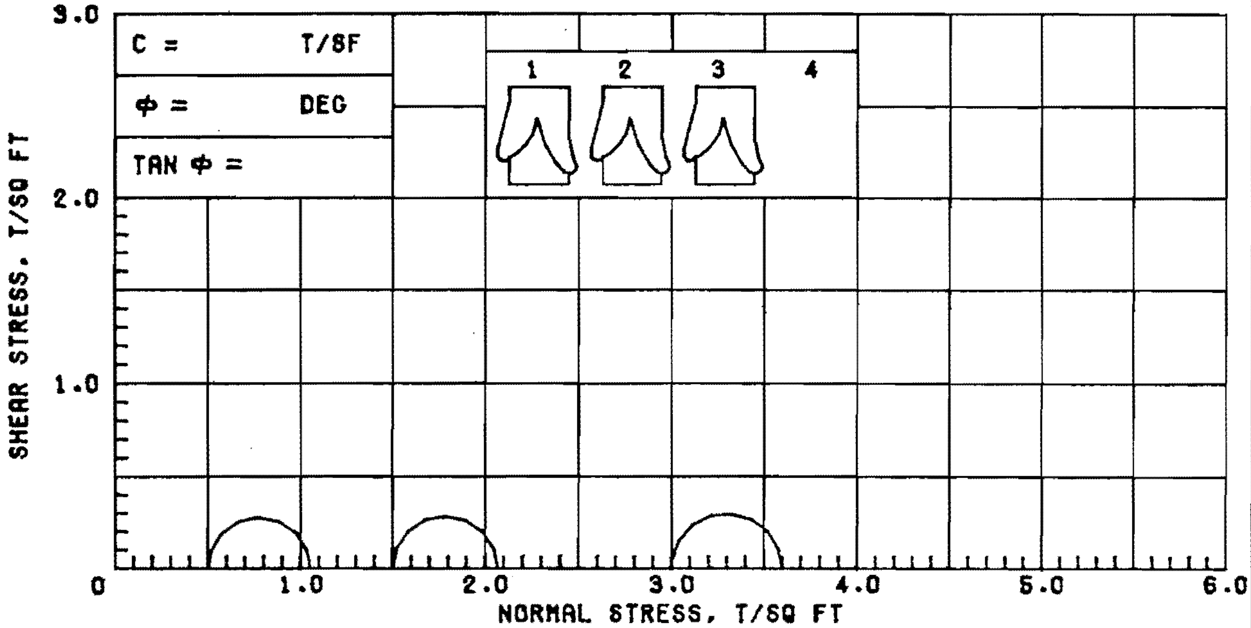
JMS TRIAXIAL COMPRESSION TEST REPORT

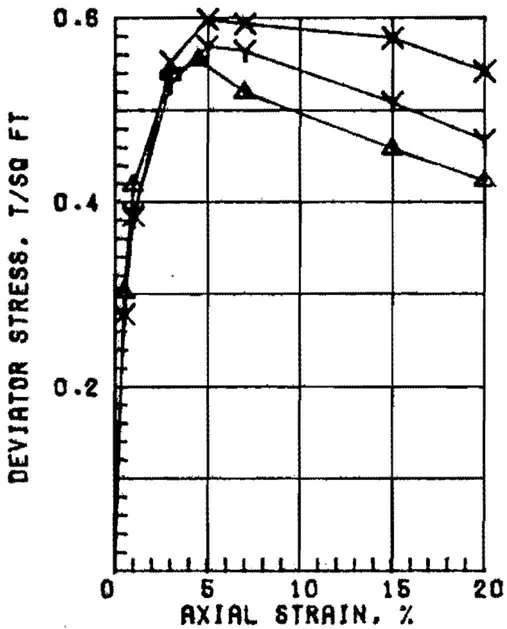
ENG FORM NO. 2089
REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	57.7	31.4
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	63.8	94.6
COMPRESSION INDEX		SATURATION, %	95.0	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.641	0.782
DIA. IN 4.44	HT. IN 1.118	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES				
LL / PL / PI		PROJECT LK. PONT. LA. & VIC. HURR. PROT.		
GS 2.70 (EST)	D_{10}	ORLEANS PARISH OUTFALL CANALS		
REMARKS		BORING NO. 3-OUG	SAMPLE NO. 8-B	
		DEPTH/ELEV 28.2/-23.8	DATE 03 OCT 84	

CONSOLIDATION TEST REPORT





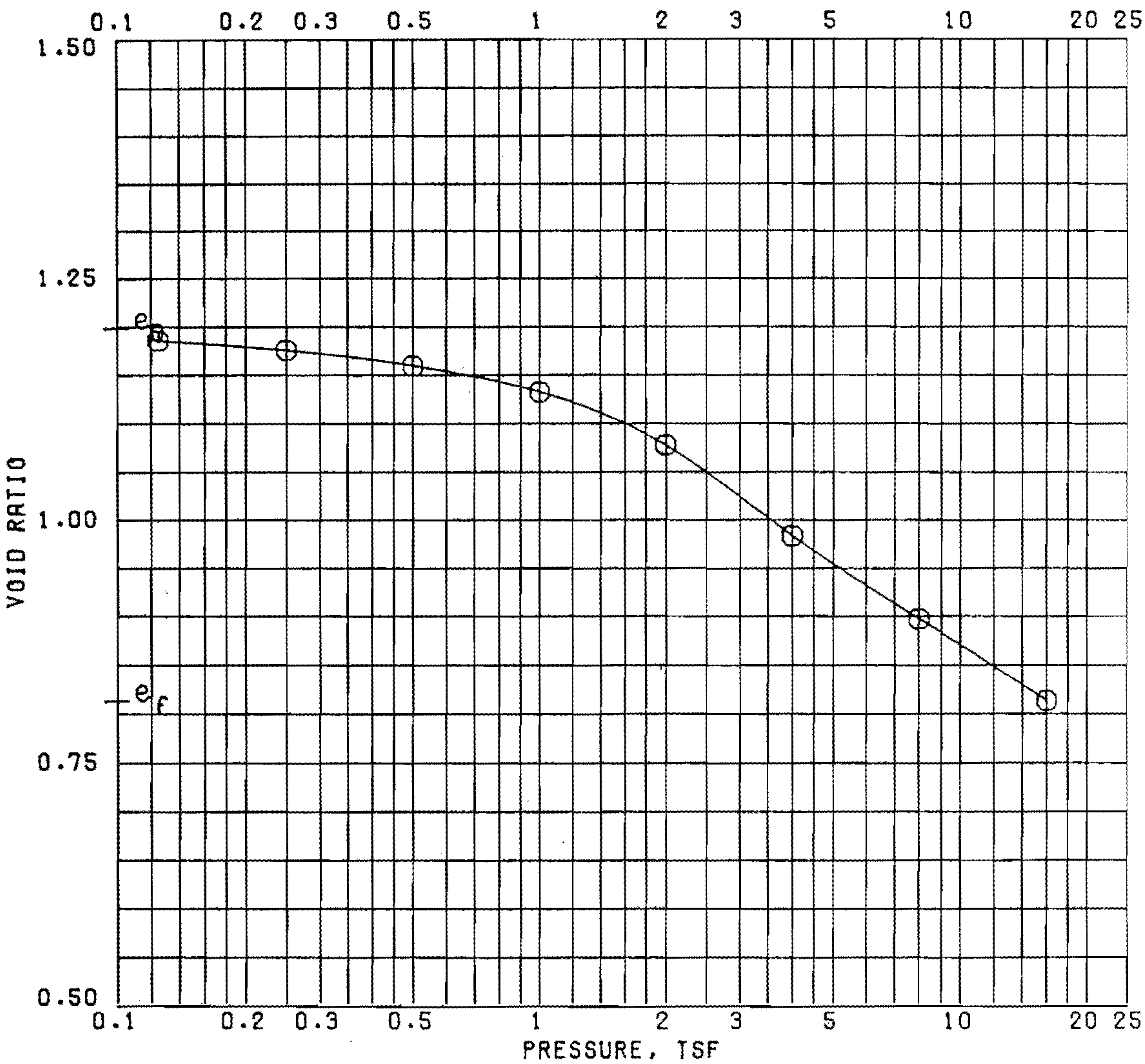
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	67.2	66.1	66.1	
	DRY DENSITY, PCF	60.4	61.0	60.8	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	1.789	1.763	1.771	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.55	0.57	0.60	
	TIME TO FAILURE, MIN.	8	21	25	
	RATE OF STRAIN INCR,%		7	7	
	INITIAL DIAMETER, IN.	1.39	1.39	1.39	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 82	PL 23	PI 59	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 3-OUO	SAMPLE NO. 6-C
	DEPTH/ELEV 29.0/-24.6	TECH. PJR
	LABORATORY USAE WES	DATE 21 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	

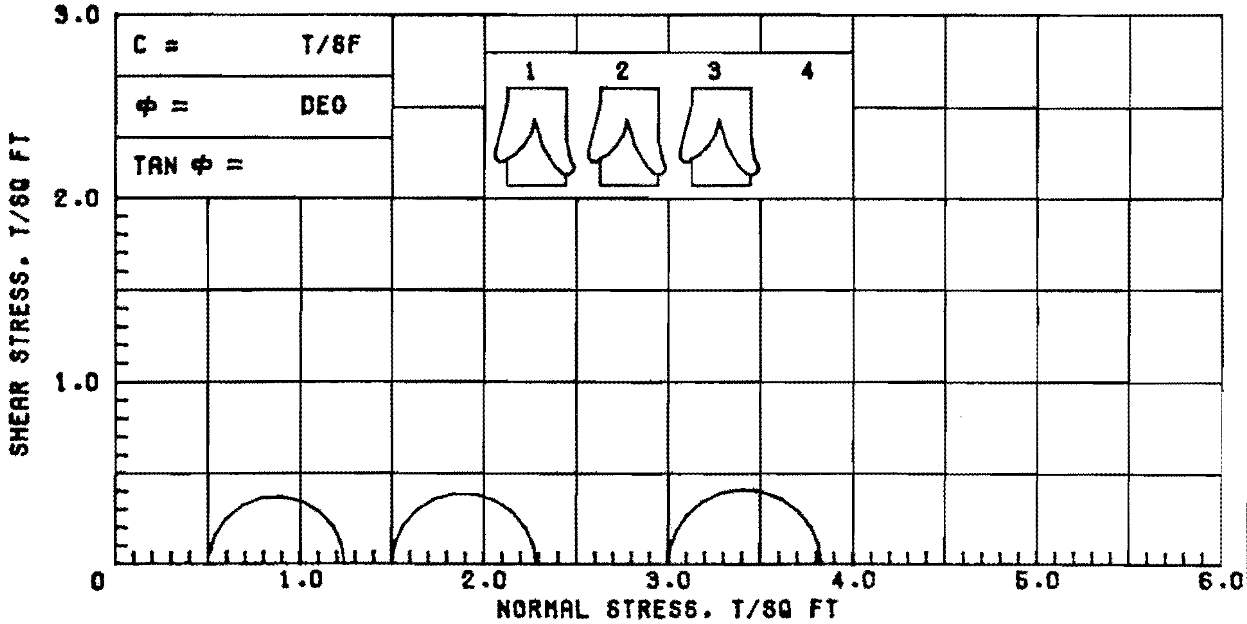


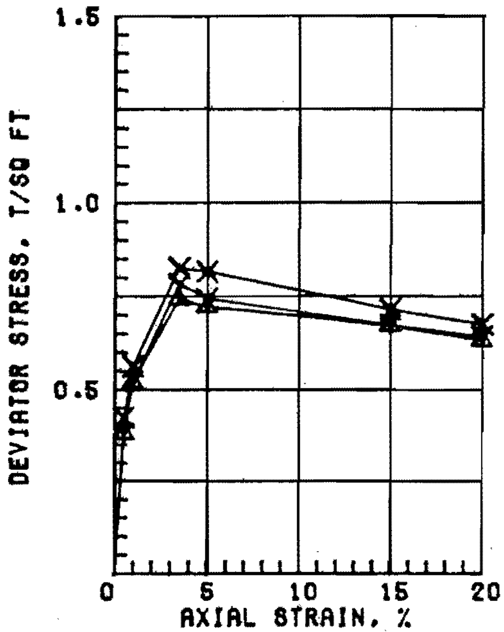
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	39.7	28.6
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	76.7	93.0
COMPRESSION INDEX		SATURATION, %	89.7	95.2
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.197	0.812
DIA. IN 4.44	HT. IN 1.142	BACK PRESSURE, TSF		

CLASSIFICATION SANDY CLAY (CL), GRAY; FINE SAND LENSES		
LL / PL / PI	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
GS 2.70 (EST) / D_{10}	ORLEANS PARISH OUTFALL CANALS	
REMARKS	BORING NO. 3-OUG	SAMPLE NO. 13-B
	DEPTH/ELEV 48.2/-43.8	DATE 04 OCT 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 10





	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	50.7	53.0	52.2	
	DRY DENSITY, PCF	69.7	68.5	68.8	
	SATURATION, %	96.5	97.9	97.2	
	VOID RATIO	1.418	1.461	1.450	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.74	0.78	0.83	
	TIME TO FAILURE, MIN.	8	21	21	
	RATE OF STRAIN INCR,%		5	5	
	INITIAL DIAMETER, IN.	1.40	1.40	1.39	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

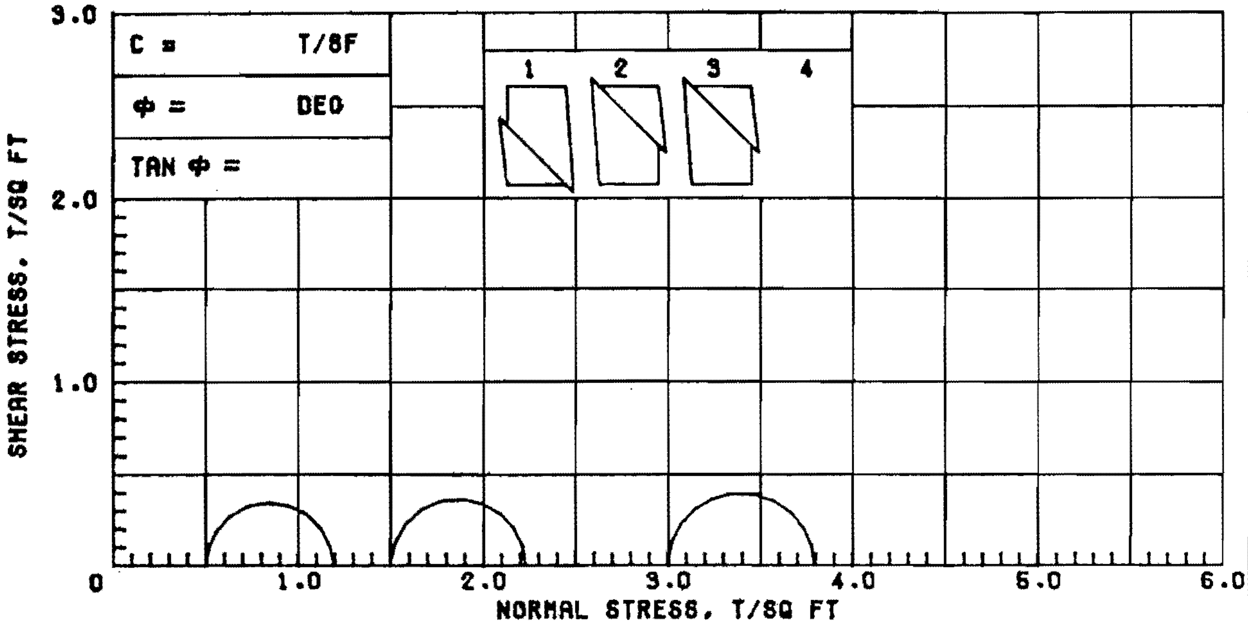
CONTROLLED-STRAIN TEST

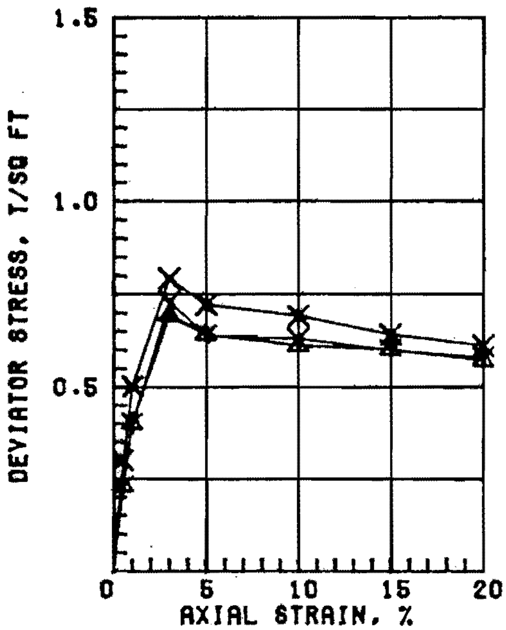
DESCRIPTION OF SPECIMENS; PLASTIC CLAY (CH), GRAY; FINE SAND LENSES

LL	PL	PI	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;	
	PROJECT LK. PONT. LA. & VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS
	BORING NO. 3-OUG — SAMPLE NO. 13-C
	DEPTH/ELEV 49.0/-44.6 — TECH. PJR
	LABORATORY USAE WES — DATE 21 SEP 84

TRIAXIAL COMPRESSION TEST REPORT





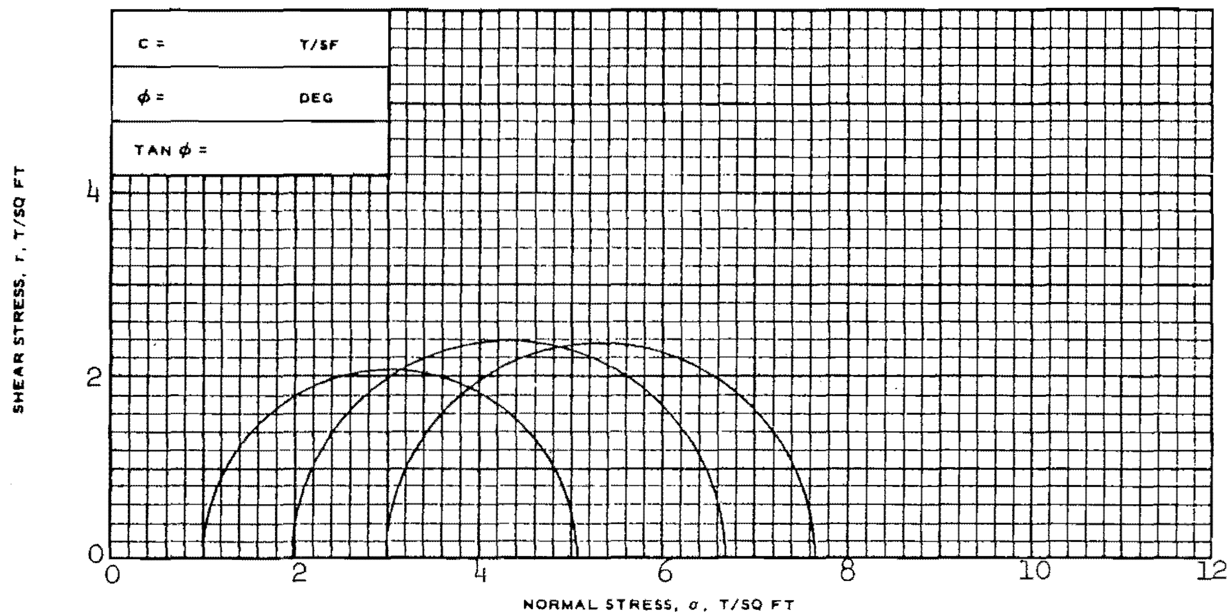
		▲1	Y2	X3	4
	SPECIMEN NO.	▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	54.6	53.4	57.7	
	DRY DENSITY, PCF	66.4	68.2	65.1	
	SATURATION, %	95.7	98.0	98.0	
	VOID RATIO	1.540	1.471	1.589	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.69	0.73	0.79	
	TIME TO FAILURE, MIN.	6	6	6	
	RATE OF STRAIN INCR,%				
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

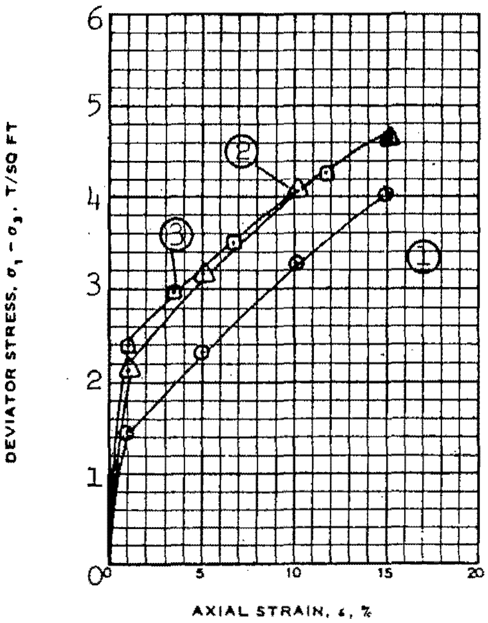
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SHELL PARTICLES

LL	PL	PI	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LK. PONT. LA. & VIC. HURR. PROT.	
	ORLEANS PARISH OUTFALL CANALS	
	BORING NO. 3-OUG	SAMPLE NO. 14-C
	DEPTH/ELEV 53.0/-48.6	TECH. KOC
	LABORATORY USAE WES	DATE 21 SEP 84
	TRIAXIAL COMPRESSION TEST REPORT	





SPECIMEN NO.			1	2	3
INITIAL	WATER CONTENT, %	w_o	26.1	27.4	26.7
	DRY DENSITY LB/ CU FT	γd_o	96.4	94.9	95.7
	SATURATION, %	S_o	95.7	96.7	96.2
	VOID RATIO	e_o	0.729	0.757	0.741
BEFORE SHEAR	WATER CONTENT, %	w_c	27.3	28.3	26.9
	DRY DENSITY LB/CU FT	γd_c	98.2	97.7	99.2
	SATURATION, %	S_c	100+	100+	100+
	VOID RATIO	e_c	0.698	0.706	0.681
	FINAL BACK PRESSURE, T/SQ FT	u_o	5.76	5.76	5.76
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	4.02	4.65	4.64
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	1071	1071	1071
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$			
INITIAL DIAMETER, IN.		D_o	1.36	1.37	1.38
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SANDY SILT (ML), LIGHT GRAY

LL	PL	PI	Gs 2.67 (EST)	TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST $\bar{R}$

REMARKS:

PROJECT LK. PONT. LA. & VIC. HURR. PROT.
ORLEANS PARISH OUTFALL CANALS

BORING NO. 3-OUG SAMPLE NO. 17 -B

DEPTH/ELEV 64.2/-59.8

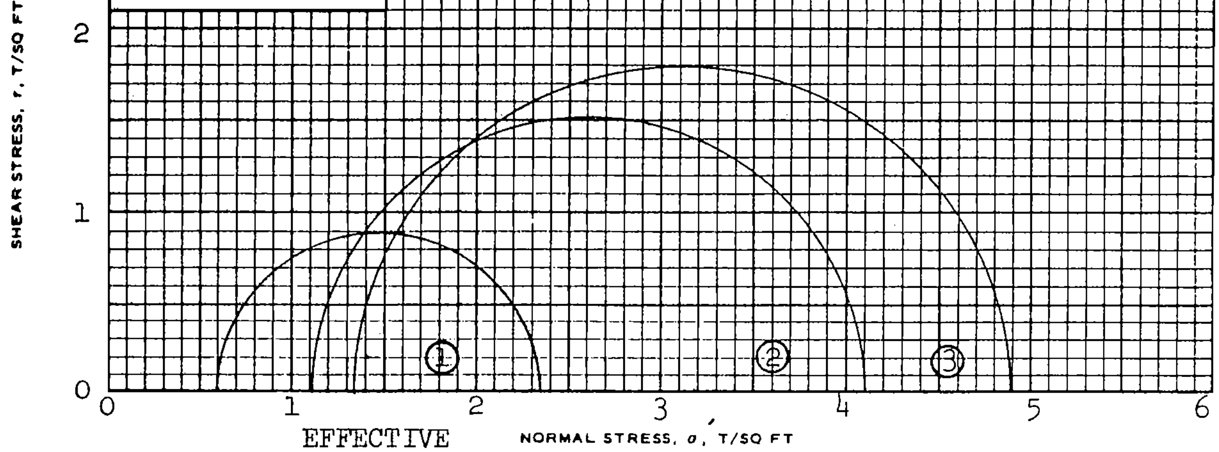
LABORATORY USAEWES DATE 18 SEPT 1984

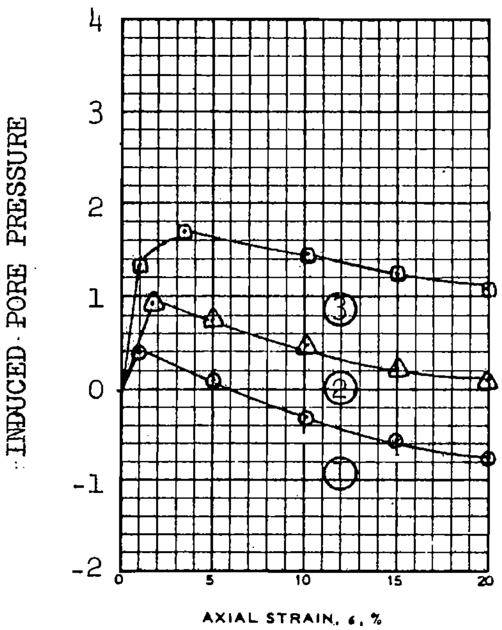
SHEET 1 OF 2

JMS TRIAXIAL COMPRESSION TEST REPORT

BASED ON MAX σ_1'/σ_3'

c' =	T/SF
ϕ' =	DEG
TAN ϕ' =	





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.60	1.12	1.35	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	1.75	2.98	3.52	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT	LK. PONT. LA.& VIC. HURR. PROT. ORLEANS PARISH OUTFALL CANALS
BORING NO. 3-OUG	SAMPLE NO. 17-B
DEPTH/ELEV 64.2/-59.8	
LABORATORY USAEWES	DATE 18 SEPT 1984

SHEET 2 OF 2

JMS TRIAXIAL COMPRESSION TEST REPORT

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