LAKE PONTCHARTRAIN, LA. AND VICINITY

LAKE PONTCHARTRAIN HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 15
GENERAL DESIGN

NEW ORLEANS EAST LAKEFRONT LEVEE PARIS ROAD TO SOUTH POINT

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA
April, 1985

SERIAL NO. 50

#9

2606 4916

TC 203 N46 L3 P16 no. 15 1985

LMVED-TD (DAEN-ECE-B) 3d End Mr. Bardwell/jae/5925
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

DA, Lower Mississippi Valley Division, CE, Vicksburg, MS 39180-0080
23 SEP '85

TO: Commander, New Orleans District, ATTN: LMNED-SP

Satisfactory.

FOR THE COMMANDER:

William R. Hill for
FRED H. BAYLEY III
Chief, Engineering Division

CF:
DAEN-ECE-B/w 10 cy of ea End

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-ECE-B

24 July 1985

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

1. Reference 1st endorsement LMVED-TD, 19 June 1985, on letter LMNED-SP, 26 April 1985, subject as above.

2. The comments in the following paragraphs are furnished for appropriate action.

3. Paragraph 50. There is no indication that the comparison between rubble and gabions considered the long-term maintenance costs. Maintenance of gabions can be considerably more expensive than maintenance of rubble revetment. Gabions are susceptible to both corrosion and vandalism. Corroded gabions may also present a safety hazard if the public has access to the revetment. Debris may also wear holes in the cages.

4. Paragraph 58, General Operation and Maintenance.

a. The operation and maintenance estimate ($12,500/year) is too low. The basis for this estimate should be provided along with engineering analysis as per EM 1110-2-1301.

b. The operation and maintenance manual will be provided to the locals after completion of the project. Any engineering issues involved in procedures to be incorporated into the operation and maintenance manual should be addressed in this report (see Appendix A of ER 1110-2-1150 for guidance).

5. Appendix A.

a. Section I.

(1) Paragraph 5b. The text should state, "the two storms which occurred in September of 1915 and September 1947 ...", instead of "These three storms ..."

DAEN-ECE-B
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

(2) Paragraph 7e. Technical Report No.4 is obsolete and should not be used. It has been superceded by the Shore Protection Manual, 4th Edition, 1984. Wave characteristics for the design hurricane should be checked to ensure that they conform to current state-of-the-art.

(3) Paragraph 7g, Residual Flooding. The conclusion of "... no material flooding ..." due to overtopping should be supported with additional documentation. Also, the residual flooding information in reference should be provided.

b. Section III, Item (26). The reference should be Shore Protection Manual, 4th Edition (2 volumes), 1984.

FOR THE COMMANDER:

Jack R Thompson
for WILLIAM N. McCORMICK, JR.
Chief, Engineering Division
Directorate of Engineering and
Construction

LMVED-TD (DAEN-ECE-B/24 Jul 85) 1st End Mr. Bardwell/jae/5925
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

DA, Lower Mississippi Valley Division, CE, Vicksburg, MS 39180-0080

01 AUG 85

TO: Commander, New Orleans District, ATTN: LMNED-SP

Referred for action.

FOR THE COMMANDER:

William R. Hill for
FRED H. BAYLEY III
Acting Chief, Engineering Division

LMNED-SP (DAEN-ECE-B/24 Jul 85) 2d End Mr. Stutts/dn/2614
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

DA, New Orleans District, Corps of Engineers, P. O. Box 60267, New Orleans, LA 70160-0267 22 Aug 85

TO: Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

The proposed disposition of comments presented in the basic letter of this chain of correspondence is as follows:

a. Cmt 3, para 50. Concur, please refer to response g, page 8, LMNED-SP (LMNED-SP/26 Apr 85) 2d End dated 31 Jul 85. We are forwarding for your consideration by separate chain, a report entitled "Gabion Structures in Saltwater and Tidal Conditions," dated July 1985. This report was prepared by Maccaferri Gabions, Inc. The report submits data on existing structures which have been in service for as much as 20 years. The manufacturer claims that the structure is "performing well and it has been virtually maintenance free." The report is furnished for your consideration as there are perhaps other projects where application of this product would be more cost effective than a conventional rubble structure.

b. Cmt 4.a. The estimated O&M cost for the subject levee and associated foreshore protection ($12,500 per year) was based upon mowing the levee approximately six times per year and spraying the "foreshore protection" once a year. The foreshore protection, as designed, should last for the life of the project, and therefore, no replenishment cost has been considered.

c. Cmt 4.b. Concur. The project features covered in this DM include: levees, two short reaches of floodwalls where pipelines exist, and foreshore protection. A recommended schedule for mowing the levee and spraying defoliates on the foreshore protection will be contained in the operations and maintenance manual.

d. Cmt 5.a.1. In para 5b of Appendix A, this sentence should read, "These three storms occurred during September in 1915(4), 1947(5), and 1957. The storm tracks for the 1915 and 1947 hurricanes are shown on Plates A-4 and A-5, respectively."

e. Cmt 5.a.2. The Lake Pontchartrain, LA, and Vicinity Hurricane Protection Project has been under design and construction for nearly 20 years. For calculations involving waves, we have used the wave height and period forecasting methodology contained in Technical Report No. 4

LMNED-SP (DAEN-ECE-B/24 Jul 85) 2d End
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

which was the state-of-the-art design manual at the time the hurricane characteristics were developed. We recognize that TR 4 yields higher significant waves and longer periods than the current SPM. As indicated in the table and computations provided in LMVED-TD, 2d End, subject as above, runup values for the previous SPM's do not differ significantly from TR 4's values. Given the modest variation in the wave runup with methodology vintage, we have opted for consistency in design throughout the project. We have carefully reviewed this and other jobs to ensure that this approach does not significantly differ with current design criteria.

f. Cmt 5.a.3. Residual flooding information for the Paris Road to South Point levee reach, as well as the remainder of the Lake Pontchartrain Hurricane Protection Project, is presented in Appendix A of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, Reevaluation Study, July 1984.

g. Cmt 5.b. Concur.

FOR THE COMMANDER:

William B. Seale
FREDERIC M. CHATRY
Chief, Engineering Division

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

REPLY TO
ATTENTION OF:

LMNED-SP 26 April 1985

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - High Level Plan - Design Memorandum No. 15, General Design - New Orleans East Lakefront Levee - Paris Road to South Point

Commander, Lower Mississippi Valley Division
ATTN: LMVED-TD

1. The subject design memorandum is submitted for review and approval and has been prepared generally in accordance with the provisions of Appendix A of EC 1110-2-193, dated 20 April 1979.

2. A summary of the current status of the Section 404 (b)(1) evaluation, environmental analysis, and cultural resources investigation is as follows:

a. A Section 404 (b)(1) Public Notice was issued 28 March 1984 and State Water Quality Certification was received 29 June 1984.

b. No endangered or threatened species will be affected by the recommended construction.

c. An Environmental Impact Statement (EIS) for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project included the levee construction, and was filed with the Council on Environmental Quality on 17 January 1975. A Draft Supplement to this EIS was filed with the Environmental Protection Agency (EPA) in December of 1983, and assessed the impacts associated with increased levee height for high level protection. The Final Supplemental EIS was filed with EPA on 7 December 1984; formal approval (Record of Decision) was obtained on 7 February 1985.

d. A cultural resources survey was conducted along the project right-of-way in 1982 by New World Research, Inc.; no significant cultural resources were located. The survey included all project features except the mobilization site flotation channels. Historical research has indicated the potential of significant historic shipwrecks in the flotation channels. Thus, a remote sensing survey of the channels will be conducted in FY 85 prior to construction contract award.

3. The use of water conservation measures in the construction and operation of this project has been investigated. The interdisciplinary team review of the report found that no opportunities for water conservation measures exist.

4. In accordance with LMVED-TS letter dated 5 February 1981, this report has been reviewed by the District Security Officer. There were no review comments to be incorporated in the report.

5. This report was scheduled to be submitted to LMVD by 28 February 1985. This delay will not cause a delay in the start of construction provided final approval of this report is obtained by 30 June 1985.

6. Approval of the report as a basis for preparation of plans and specifications is recommended.

Eugene S Witherspoon
EUGENE S. WITHERSPOON
Colonel, CE
Commanding

Enclosure
(16 cys fwd sep)

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

STATUS OF DESIGN MEMORANDUMS

Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Approved 18 Oct 67
	Part III - Lakeshore	Approved 6 Mar 69
	Part IV - Chalmette Extension	Approved 1 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee	Approved 29 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	Approved 10 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Approved 19 Sep 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Pass Complex	Approved 19 Sep 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Approved 18 Aug 71

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	1/
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5A, Citrus Lakefront Levees - IHNC to Paris Road	Approved 12 Jul 76
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5B, New Orleans East Lakefront Levees - Paris Road to South Point	Approved 5 Dec 72
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5C, Orleans Parish Outfall Canals - West of the IHNC	1/
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5D, Orleans Parish Lakefront Levees, Orleans Marina	Approved 24 May 78
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Approved 4 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	1/
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 8, IHNC Remaining Levees	Approved 6 Jun 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 9, New Orleans East Levee from South Point to GIWW	Approved 1 May 73

1/ This Design Memorandum is no longer applicable due to the recommended change from a Barrier Plan of protection to a High Level Plan of protection. A High Level Plan Design Memorandum will be prepared for this project feature.

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 10, Jefferson Parish Lakefront Levees	1/
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension	Approved 31 Jan 67
4	Lake Pontchartrain Barrier Plan, and Chalmette Area Plan, GDM, Florida Avenue Complex, IHNC	Approved 31 Oct 80
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre Control Structures	Approved 29 Oct 68
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	2/
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	2/
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Approved 20 Dec 73
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	2/
10	Lake Pontchartrain Barrier Plan, Corrosion Protection	Approved 21 May 69
12	Sources of Construction Materials	Approved 30 Aug 66

1/ This Design Memorandum is no longer applicable due to the recommended change from a Barrier Plan of protection to a High Level Plan of protection. A High Level Plan Design Memorandum will be prepared for this project feature.

2/ Due to the recommendation for a change from the Barrier Plan of protection to a High Level plan of protection, this Detailed Design Memorandum is no longer applicable.

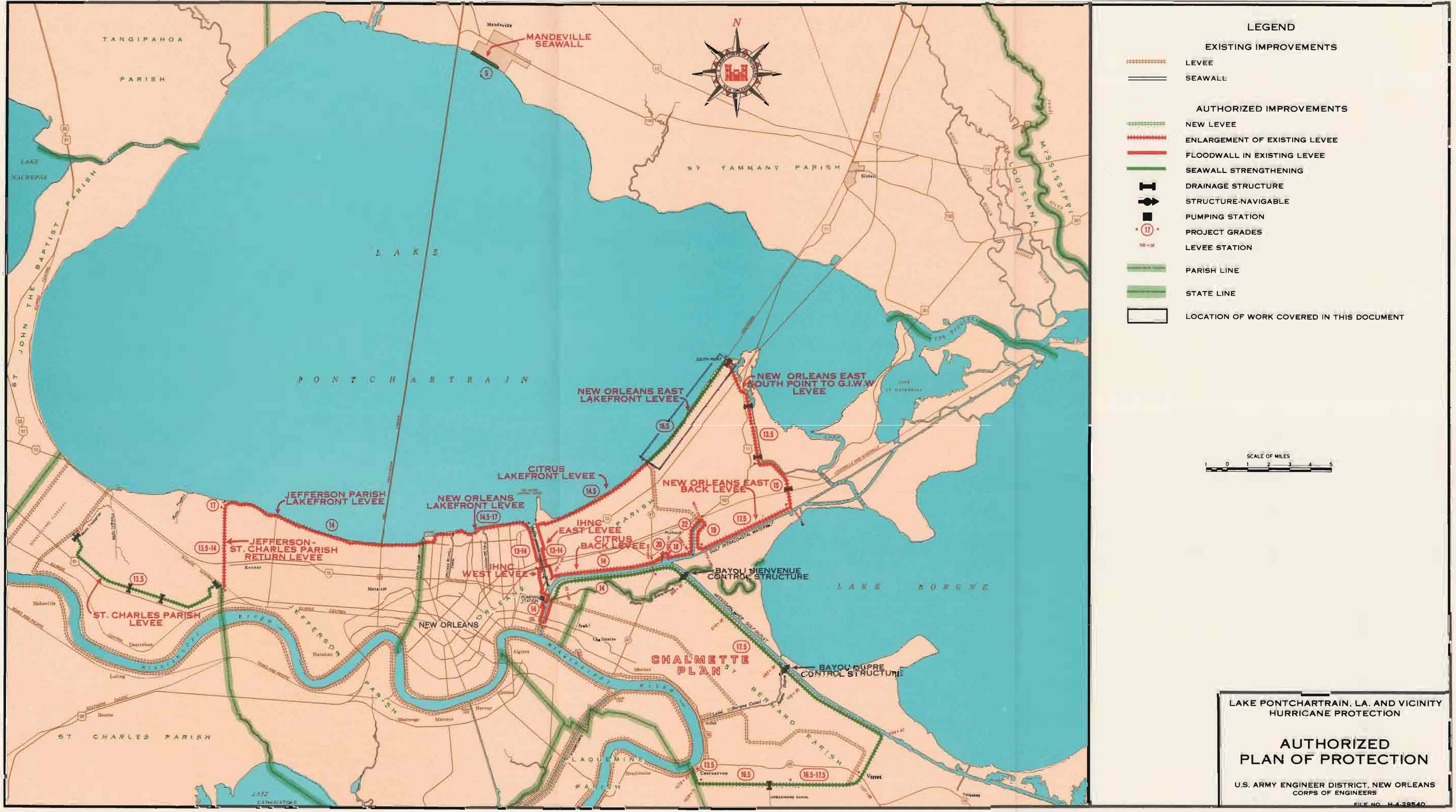
STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
1	Lake Pontchartrain, Louisiana and Vicinity, and Mississippi River - Gulf Outlet, Louisiana, GDM, Seabrook Lock	Approved 4 Nov 70
2	Lake Pontchartrain, Louisiana and Vicinity, and Mississippi River - Gulf Outlet, Louisiana, DDM, Seabrook Lock	Approved 17 Apr 81
Report	Lake Pontchartrain Barrier Plan, Seabrook Lock Breakwater	3/
12	Lake Pontchartrain and Vicinity, Louisiana, Sources of Construction Materials (Revised)	Approved 23 Oct 79
13	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Lakefront Levee West of IHNC	Submitted Nov 84
13	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Lakefront Levee West of IHNC - Supplement No. 1 - Orleans Marina Floodwall	unscheduled
14	Lake Pontchartrain, La. & Vicinity, High Level Plan, Citrus Lakefront Levee IHNC to Paris Road	Approved 11 Oct 84
14	Lake Pontchartrain, La. & Vicinity, High Level Plan, Citrus Lakefront Levee IHNC to Paris Road - Supplement No. 1 - New Orleans Lakefront Airport and Lincoln Beach	unscheduled

3/ Since the Seabrook Lock is a part of the Barrier Plan of protection and it has been recommended to construct a High Level Plan, the need for Seabrook Lock under the High Level Plan is not required. However, construction of Seabrook Lock under the Mississippi River Gulf Outlet project remains an unresolved issue at this time.

STATUS OF DESIGN MEMORANDUM (cont'd)

Design Memo No.	Title	Status
15	Lake Pontchartrain, La. & Vicinity, High Level Plan, New Orleans East Lakefront Levee, Paris Road to South Point	Submitted Apr 85
16	Lake Pontchartrain, La. & Vicinity, High Level Plan, New Orleans East Levee, South Point to GIWW	unscheduled
17	Lake Pontchartrain, La. & Vicinity, High Level Plan, Jefferson Parish Lakefront Levee and Jefferson/ St. Charles Parish Return Levee	Scheduled Oct 86
18	Lake Pontchartrain, La. & Vicinity, High Level Plan, St. Charles Parish Levee (North of Airline Highway Alinement)	Scheduled Sep 87
19	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canals (London Avenue and Orleans Avenue Outfall Canals)	Scheduled Apr 86
20	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal (Metairie Relief Canal)	unscheduled
21	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal Detailed Design Memorandum (London Avenue Canal)	Scheduled Nov 87
22	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal Detailed Design Memorandum (Orleans Avenue Canal)	Scheduled Mar 88
23	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Outfall Canal Detailed Design Memorandum (Metairie Relief Canal)	unscheduled


LEGEND
EXISTING IMPROVEMENTS
LEVEE
SEAWALL
AUTHORIZED IMPROVEMENTS
NEW LEVEE
ENLARGEMENT OF EXISTING LEVEE
FLOODWALL IN EXISTING LEVEE
SEAWALL STRENGTHENING
DRAINAGE STRUCTURE
STRUCTURE-NAVIGABLE
PUMPING STATION
PROJECT GRADES
LEVEE STATION
PARISH LINE
STATE LINE
LOCATION OF WORK COVERED IN THIS DOCUMENT
SCALE OF MILES
1 0 1 2 3 4 5
N
MANDEVILLE SEAWALL
Mandeville
TANGIPAHOA PARISH
ST. TAMMANY PARISH
Slidell
LAKE MAUREPAS
ST. JOHN THE BAPTIST PARISH
LAKE PONTCHARTRAIN
LOUISIANA
MISSISSIPPI
LAKE ST. CATHERINE
NEW ORLEANS EAST LAKEFRONT LEVEE
NEW ORLEANS EAST SOUTH POINT TO G.I.W.W. LEVEE
SOUTH POINT
CITRUS LAKEFRONT LEVEE
NEW ORLEANS EAST BACK LEVEE
JEFFERSON PARISH LAKEFRONT LEVEE
NEW ORLEANS LAKEFRONT LEVEE
IHNC EAST LEVEE
CITRUS BACK LEVEE
IHNC WEST LEVEE
JEFFERSON-ST. CHARLES PARISH RETURN LEVEE
Kenner
Metairie
ST. CHARLES PARISH LEVEE
PUMPING STATION
NEW ORLEANS
ORLEANS PARISH
JEFFERSON PARISH
BAYOU BIENVENUE CONTROL STRUCTURE
LAKE BORGNE
GULF INTRACOASTAL WATERWAY
MISSISSIPPI RIVER GULF OUTLET
CHALMETTE PLAN
ST. BERNARD PARISH
BAYOU DUPRE CONTROL STRUCTURE
Chalmette
Arabi
Algiers
Gretna
Harvey
Marrero
Westwego
Harahan
Destrehan
Luling
Hahnville
Boutte
ST. CHARLES PARISH
PLAQUEMINES PARISH
LAKE CATAOUATCHE
Caernarvon
Verret
Violet
Lake Borgne Canal
17
13.5-14
14
14.5-17
14.5
16.5
13.5
15
17.5
22
18
20
13-14
13.5
16.5
16.5-17.5
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
AUTHORIZED PLAN OF PROTECTION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-4-29540

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

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APPENDICES

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PERTINENT DATA

Location of project		Southeastern Louisiana in Orleans Parish along south shore of Lake Pontchartrain from Paris Road to South Point
Datum Plane		National Geodetic Vertical Datum (NGVD)1/
Hydrologic data		
Temperature:	Maximum monthly	90.6 degrees Fahrenheit
	Minimum monthly	45.3 degrees Fahrenheit
	Average annual	69.5 degrees Fahrenheit
Annual precipitation:	Maximum	83.54 inches
	Minimum	40.11 inches
	Average	61.55 inches
Hydraulic design criteria-tidal		
Design hurricane-Standard Project Hurricane (SPH)		
Frequency		1 in 300 years
Central Pressure Index (CPI)		27.6 inches of mercury
Maximum 5-min. average wind speed		100 m.p.h.
Radius of maximum winds		30 miles
Average forward speed		6 knots
Stillwater level		11.5 feet
Levees		
Method of construction		Hauled, semi-compacted clay fill
Levee length (approx.)		6.3 miles
Crown elevation (varies)		18.0' to 18.5'
Crown width		15 feet
Floodwall		
Floodwall length (approx.)		463 feet
Top Elevation		18.0

1/ Elevations herein are in feet referred to National Geodetic Vertical Datum (NGVD) unless otherwise noted.

PERTINENT DATA (cont'd)

Rights-of-way

No additional rights-of-way required. Existing Barrier Plan rights-of way are sufficient to construct the Plan recommended in this GDM.

Estimated First Cost	
Federal	$15,300,000
Non-Federal	0 1/
Total	$15,300,000
Economics	
Benefit-to-cost ratio (project)	4.2 to 1
Benefit-to-cost ratio (New Orleans-Jefferson separable project area)	5.0 to 1

1/ Local interests have sufficient credits from other reaches of the Lake Pontchartrain and Vicinity Hurricane Protection Project such that a cash contribution will not be required for this reach.

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PROJECT AUTHORIZATION

1. Authority.

a. Public Law. Public Law 298, 89th Congress, 1st Session, approved 27 October 1965, authorized the "Lake Pontchartrain, Louisiana, and Vicinity," hurricane protection project, substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 231, 89th Congress, 1st Session, except that the recommendations of the Secretary of the Army in that document shall apply with respect to the Seabrook Lock feature of the project.

b. House Document. The report of the Chief of Engineers dated 4 March 1964 printed in House Document No. 231, 89th Congress, 1st Session, submitted for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers and the concurring report of the Mississippi River Commission for those areas under its jurisdiction. The report of the Board of Engineers for Rivers and Harbors stated: "For protection from hurricane flood levels, the reporting officers find that the most suitable plan would consist of a barrier extending generally along US Highway 90 from the easternmost levee to high ground east of the Rigolets, together with floodgates and a navigation lock in the Rigolets, and flood and navigation gates in Chef Menteur Pass; construction of a new lakeside levee in St. Charles Parish extending from the Bonnet Carre Spillway guide levee to and along the Jefferson Parish line; extension upward of the existing riprap slope protection along the Jefferson Parish levee; enlargement of the levee landward of the seawall along the 4.1 mile lakefront, and construction of a concrete-capped sheetpile wall along the levee west of the Inner Harbor Canal in New Orleans; raising the rock dikes and landward gate bay of the planned Seabrook lock; construction of a new levee lakeward of the Southern Railway extending from the floodwall at New Orleans Airport to South Point; enlargement of the existing levee extending from US Highway 90 to the Gulf Intracoastal Waterway, thence westward along the waterway to the Inner Harbor Canal, together with riprap slopes along the canal; construction of a concrete capped sheetpile wall along the east levee of the Inner Harbor Canal between the Gulf Intracoastal Waterway and the New Orleans Airport..."

c. BERH Recommendation. The report of the Chief of Engineers stated: "The Board (of Engineers for Rivers and Harbors) recommends authorization for construction essentially as planned by the reporting officers....I concur in the recommendation of the Board of Engineers for Rivers and Harbors."

2. Purpose and Scope. This memorandum presents the essential data, assumptions, criteria, and computations for developing the plan design and cost estimate for constructing the "High Level Plan" (i.e., no barriers in the Chef Menteur and Rigolets Passes), New Orleans East Lakefront levee, Paris Road to South Point, for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project. The recommended design contained in this DM reflects the least costly method of modifying the existing barrier plan levee so that a high level plan of protection can be achieved.

3. Local Cooperation.

a. Flood Control Act of 1965 (Public Law 89-298). The conditions of local cooperation pertinent to this GDM and as specified in the report of the Board of Engineers for Rivers and Harbors and concurred by the report of the Chief of Engineers are as follows:"...That the barrier plan for protection from hurricane floods of the shores of Lake Pontchartrain...be authorized for construction,...Provided that prior to construction of each separable independent feature local interest furnish assurances satisfactory to the Secretary of the Army that they will, without cost to the United States:

"(1) Provide all lands, easements, and rights-of-way, including borrow and spoil disposal areas, necessary for construction of the project;

"(2) Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction works;

"(3) Hold and save the United States free from damages due to the construction works;

"(4) Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (1) and (2) above and a cash contribution presently estimated at $14,384,000 for the barrier plan...to be paid either in a lump sum prior to initiation of construction or in installments at least annually in proportion to the Federal appropriation prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any part of the cash contribution, accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined;

"(5) For the barrier plan, provide an additional cash contribution equivalent to the estimated capitalized value of operation and maintenance of the Rigolets navigation lock and channel to be undertaken by the United States, presently estimated at $4,092,000, said amount to be paid either in a lump sum prior to initiation of construction of the barrier or in installments at least annually in proportion to the Federal appropriation for construction of the barrier;

"(6) Provide all interior drainage and pumping plants required for reclamation and development of the protected areas;

"(7) Maintain and operate all features of the works in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates, approach channels, drainage structures, drainage ditches or canals, floodwalls, seawalls, and stoplog structures, but excluding the Rigolets navigation lock and channel and the modified dual purpose Seabrook lock; and

"(8) Acquire adequate easements or other interest in land to prevent encroachment on existing ponding areas unless substitute storage capacity or equivalent pumping capacity is provided promptly, provided that construction of any of the separable independent features of the plan may be undertaken independently of the others, whenever funds for that purpose are available and the prescribed local cooperation has been provided...."

b. Water Resources Development Act of 1974 (Public Law 93-251). The local interest payment procedures outlined in the original conditions of local cooperation were modified in 1974 as follows: "The hurricane-flood protection project on Lake Pontchartrain, Louisiana, authorized by Section 204 of the Flood Control Act of 1965 (Public Law 89-298) is hereby modified to provide that non-Federal public bodies may agree to pay the unpaid balance of the cash payment due, with interest, in yearly installments. The yearly installments will be initiated when the Secretary determines that the project is complete, but in no case shall the initial installment be delayed more than ten years after the initiation of project construction. Each installment shall not be less than one twenty-fifth of the remaining unpaid balance plus interest on such balance, and the total of such installments shall be sufficient to achieve full payment, including interest, within twenty-five years of the initiation of project construction."

4. Project Document Investigations. Studies and investigations made in connection with the report on which authorization is based (House Document No. 231, 89th Congress, 1st Session) consisted of: research of information which was available from previous reports and existing projects in the area; extensive research in the history and records of hurricanes; damage and characteristics of hurricanes; extensive tidal hydraulics investigations involving both office and model studies relating to the ecological impact of

the project on Lakes Pontchartrain and Borgne; an economic survey; and survey scope design and cost studies. A public hearing was held in New Orleans on 13 March 1956 to determine the views of local interests.

5. Investigations Made Subsequent to Project Authorization. In December 1977, a Federal court injunction was issued stopping construction of portions of the authorized project. The injunction was issued on the basis that the 1975 final Environmental Impact Statement (EIS) for the Lake Pontchartrain project was inadequate. The court directed, among other things, that the EIS be rectified to include adequate development and analysis of alternatives to the then ongoing proposed action. The results of these studies are contained in a three volume report entitled "Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, Reevaluation Study", dated July 1984. The reevaluation report recommended a "tentatively selected" high level plan of protection. This recommendation necessitated the preparation of this report and the engineering and environmental studies discussed herein. Surveys and studies accomplished in preparing this GDM include the following:

a. Alternative plan studies to develop alternative methods of construction required to optimize the proposed plan of protection;

b. Aerial and hydrographic surveys;

c. Soils investigations including undisturbed type borings and associated laboratory investigations;

d. Detailed design studies for alternative plans (including stability analyses);

e. Tidal hydraulic studies required for establishing design grades for protective works based on revised hurricane parameters furnished subsequent to project authorization by the National Weather Service;

f. Real Estate requirements;

g. Detailed cost estimates for the proposed plan of protection as well as alternative plans and necessary utility relocations;

h. Environmental effects and evaluations;

i. A comprehensive public meeting for the "tentatively selected" high level plan held on 12 April 1984.

6. Planned Future Investigations. Upon satisfactory approval of this GDM, additional detailed Engineering Designs and Specifications will be prepared to support construction of this project feature. Some additional field surveys are anticipated at this time to support these designs.

7. Local Cooperation Requirements. The conditions of local cooperation as specified in the authorizing laws are quoted in paragraph 3. These conditions are applicable to the "Barrier Plan." A post authorization report for a "High Level Plan" recommended that assurances be amended. A complete list of local assurance items (as amended) are set forth as follows:

a. Provide all lands, easements, and rights-of-way, including borrow and spoil-disposal areas necessary for construction, operation, and maintenance of the project; and

b. Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities required by the construction of the project; and

c. Hold and save the United States free from damages due to the construction works; and

d. Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (a) and (b) above and a cash contribution as presently estimated below, to be paid either in a lump sum prior to initiation of construction or in installments at least annually in proportion to the Federal appropriation prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any part of the cash contribution, accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined:

COST TO ORLEANS LEVEE DISTRICT
($1,000,000's)

	FIRST COST 1/	LOCAL SHARE
ORLEANS LEVEE DISTRICT		
Citrus New Orleans East	112.5	33.8
New Orleans	249.1	74.7
TOTAL	361.6	108.5

1/ Cost to complete after October 1979; October 1981 price levels.

e. This item has been deleted in full:

Provide an additional cash contribution equivalent to the estimated capitalized value of maintenance and operation of the Rigolets navigation lock and channel to be undertaken by the United States, presently estimated at $3,816,000, the final determination to be made after construction is complete, said amount to be paid either in a lump sum prior to initiation of construction of the barrier or in installments at least annually in proportion to the Federal appropriation for construction of the barrier, and

f. Provide all interior drainage and pumping plants required for reclamation and development of the protected areas; and

g. Maintain and operate all features of the project in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates and approach channels, drainage structures, drainage ditches or canals, floodwalls, and stoplog structures (the remainder of this item is deleted); and

h. Acquire adequate easements or other interest in land to prevent encroachment on existing ponding areas unless substitute storage capacity or equivalent pumping capacity is provided promptly; and

i. Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646; and

j. Assume the responsibility to pay its share of the non-Federal project costs (the remainder of this item is deleted); and

k. As a minimum, adhere to the payment schedule of the deferred payment plan, the apportionment of costs to be made as actual costs, values, and schedules are determined. The first payment under the deferred payment plan was due on 1 October 1976, with subsequent payments being due on 1 October of each succeeding year, up to and including 1 October 1990. Interest is charged on the unpaid balance during this period at the rate of 3.225 percent per annum. Cash contributions required subsequent to 30 September 1991 shall be computed in accordance with the basic 30 percent requirement stipulated in Section 204 of the Flood Control Act of 1965, Public Law 89-298 and House Document 231, 89th Congress; and

l. Recognizes that subsections (b), (c), and (e) of Section 221 of the "Flood Control Act of 1970", Public Law 91-611 shall apply to paragraph (k) above. This agreement is subject to and shall become effective upon the approval of the Secretary of the Army; and

m. Comply with Section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352, that no person shall be excluded from participation in, denied the benefits of, or subjected to discrimination in connection with the Project on the grounds of race, creed, or national origin.

8. Status of Local Cooperation. The following subparagraphs capsulize the history of assurances for local cooperation on the Lake Pontchartrain barrier plan project. With the pending change to a high level plan of protection and approval of the revised EIS, amended or supplemental assurances will be requested from the local assuring agencies for this project. The Record of Decision approving the revised EIS, giving environmental clearance on the Lake Pontchartrain high level plan was signed by the Director of Civil Works on 7 February 1985.

a. Assurances from the Board of Levee Commissioners of the Orleans Levee District for the Barrier Plan portion of the project, of which the Orleans Marina Floodwall is a part, were originally accepted on 10 October 1966. Because of the rising non-Federal cost of participation and the widespread benefits to be derived by surrounding parishes, the Orleans Levee District requested assistance in carrying out the assurances. Accordingly, the Governor of the State of Louisiana by Executive Order Number 80, dated 5 March 1971, designated the Louisiana Department of Public Works as the local coordinating agency. Through this procedure the Orleans Levee District, the Pontchartrain Levee District, and the St. Tammany Parish Police Jury were designated the assurers of local cooperation for the portions of the subject project within their respective jurisdictions. The designation was under the authority of Section 81, Title 38, Louisiana Revised Statutes of 1950.

b. Assurances from the Board of Levee Commissioners of the Orleans Levee District were accepted on 16 September 1971; assurances from the Pontchartrain Levee District were accepted on 7 October 1971. Due to the reluctance of the St. Tammany Parish Police Jury to furnish required assurances of local cooperation for that portion of the project within St. Tammany Parish, the Governor of the State of Louisiana executed assurances on behalf of the St. Tammany Parish Police Jury on 8 May 1972 under authority of Section 81, Title 38, Louisiana Revised Statutes of 1950.

c. Recognizing the increasing burden of providing required matching local funds, Representative F. Edward Hebert sponsored Congressional legislation to defer required local payments over an extended period of time. This legislation was enacted in March 1974 as Section 92 of the Water Resources Development Act of 1974. This Act modified the authorizing law by providing that non-Federal public bodies may agree to pay the unpaid balance of their required cash payment due, with interest, in annual installments in accordance with a specified formula. A plan for the application of the provisions of this legislation is now being implemented.

d. We have received the necessary agreements, legal opinions, and resolutions from the Orleans Levee District, jointly from the Lake Borgne Basin Levee District and the St. Bernard Parish Police Jury, and from the Pontchartrain Levee District approving the deferred payment plan and incorporating the requirements of Public Law 91-646 ("Uniform Relocation and Real Property Acquisition

Policies Act of 1970") and items (b), (c), and (e) of Section 221 of the "Flood Control Act of 1970", Public Law 91-611. We have also received the required agreements, legal opinions, and assurances from the Louisiana Department of Transportation, Office of Public Works and the Governor of Louisiana stating that the Office of Public Works is now the local sponsor on behalf of the St. Tammany Parish Police Jury and that the Office of Public Works will lend financial assistance, when required, to the Pontchartrain Levee District. All of these agreements and assurances (under the "Barrier Plan") are currently being reviewed by the Government and, where necessary, supplemental language developed to accommodate the recommended change to a high level plan.

9. Views of Local Interests. The Orleans Levee District is the agency responsible for providing local interest assurances for this feature of the project. The plan presented herein was coordinated in detail with the Orleans Levee District engineering staff and bears the approval of that agency. The intention and capability of this sponsor to provide the required non-Federal contribution for this feature have been amply demonstrated, in fact, considerable work on other completed features of the overall project has already been accomplished by this sponsor.

LOCATION OF PROJECT AND TRIBUTARY AREA

10. Project Location. The New Orleans East Lakefront levee segment of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project, as shown on Plate 1, is located in southeastern Louisiana in the New Orleans East area and parallels the shoreline of Lake Pontchartrain on the landside of the Southern Railroad embankment. The project area covered in this memorandum is located in Orleans Parish.

11. Tributary Area. The tributary area of Lake Pontchartrain varies in character from flat tidal marsh at or near sea level to upland areas of significant relief with natural ground elevations as high as 250 feet above National Geodetic Vertical Datum (NGVD)1/. Runoff from within the project area drains into either Lake Borgne or Lake Pontchartrain, generally by pumping from within the protected areas on the south shore of Lake Pontchartrain, although some developed areas located on alluvial ridges in St. Charles and St. Bernard Parish are drained by gravity. In addition to runoff from the project area, Lake Pontchartrain receives the runoff of 4,700 square miles located to the north and west of the lake. During major floods on the Mississippi River and its tributaries, floodflows may be diverted from the Mississippi River to Lake Pontchartrain through the Bonnet Carre Spillway, a controlled overbank floodway constructed under the Flood Control, Mississippi River and Tributaries project.

1/ Elevations contained herein are in feet referred to National Geodetic Vertical Datum unless otherwise noted.

PROJECT PLAN

12. General. The project, as shown on the flyleaf map, consists of two separate and distinct major features-the Chalmette Area Plan and the Lake Pontchartrain High Level Plan. This memorandum is concerned only with a segment of the latter, the New Orleans East Lakefront levee from Paris Road to South Point. The overall Lake Pontchartrain High Level Plan is described in "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project" Reevaluation Study dated July 1984.

13. New Orleans East Lakefront Levee, Paris Road to South Point. This levee is located along the New Orleans East lakefront of Lake Pontchartrain and extends from the junction of Paris Road and Hayne Boulevard to a point just southward of South Point, Louisiana. This levee segment adjoins the Citrus lakefront levee, IHNC (Inner Harbor Navigation Canal) to Paris Road on its west end, and the New Orleans East levee, South Point to GIWW (Gulf Intracoastal Waterway) on its east end. The project plan presented herein provides for raising the existing Barrier Plan levee from its current design net grade of 14.0 NGVD to 18.5 NGVD from baseline Station 331+50 to 364+50 and 18.0 NGVD from baseline Station 365+00 to 663+48.28 at South Point. Refer to plan and profile plates 2 through 7 for details. The existing Barrier Plan levee is located just landward of the Southern Railway System railroad embankment and is laterally contiguous with that embankment for the majority of the reach. The proposed high level plan enlargement will be accomplished within the existing levee rights-of-way. The existing Barrier Plan levee will be enlarged using hauled clay material. This clay will be obtained from a borrow pit on the bottom of Lake Pontchartrain in the vicinity of Howze Beach on the north shore of the lake. Supporting designs for the approximately 6.3 miles of levee are detailed in the subject GDM. Drainage for the depression between the railroad embankment and the levee is provided by means of catch basins and culverts spaced at 600-ft. intervals. The existing drainage facilities were constructed under the Barrier Plan construction program. The improvements described herein for the High Level Plan will not interfere with these existing drainage facilities. There is, however, a requirement to extend the length of the 12" corrugated metal pipes by varying lengths ranging from 20 to 50 feet (see plate 14 for details). The extension is necessary in order to pass the drainage through the proposed foreshore protection which is to be placed on the lakeside of the railroad embankment. The Barrier Plan construction for the New Orleans East lakefront reach also called for foreshore protection but no construction work on this project feature had been accomplished before the recommendation to abandon the Barrier Plan and construct a high level plan was made. The function of the riprap blanket that is to be placed on the lakeside of the railroad embankment is to protect the levee indirectly by protecting the railroad embankment from daily wave and backwash erosion, thus insuring the levee's integrity when a hurricane strikes. The railroad embankment serves as a wave berm and therefore reduces the

height of wave runup. Foreshore protection is required over much of the New Orleans Lakefront reach (from baseline Station 364+50 to baseline Station 661+70). No foreshore protection is required in the Little Woods area as the lake shoreline is sufficiently removed from the railroad embankment and the height of the land area between the embankment and the lake is adequate to preclude wavewash from attacking the railroad embankment during normal storm activity. The Little Woods reach begins at approximate baseline Station 331+50 and extends to baseline Station 364+50.

14. Departures from Project Document Plan. Departures from the project document plan are discussed in detail in paragraph 14, page 7 of GDM No. 2 Supplement No. 5B, "New Orleans East Lakefront Levee-Paris Road to South Point". The proposed plan of protection recommended herein builds on the barrier plan of protection and does not structurally or procedurally depart from the barrier plan (i.e., alinements and methods of protection are one for one the same). The high level plan, of course, requires a higher levee and floodwall to protect against the design storm. Departures of the plan recommended herein from the plan recommended in the Lake Pontchartrain, Louisiana, and Vicinity, Reevaluation Study are also minor. The Reevaluation Report recommended an all earthen levee and foreshore protection. The plan of protection calls for a haul clay levee with a net crest elevation of 16.5 ft. NGVD and a crown width of 20 feet. Available soils data used to design the Reevaluation Study levee plan showed that a large protected side stability berm would be required. New soils borings obtained during the preparation of this GDM indicate an improvement in soils strength and the protected side berm has been reduced accordingly. The plan recommended herein represents the most cost effective means of providing an SPH high level plan of protection for the project area.

HYDROLOGY AND HYDRAULICS

15. Hydrology and Hydraulics.

a. General. The Hydrology and Hydraulics Analysis Design Memorandum for the Lake Pontchartrain Barrier Plan was presented in a series of three separate reports entitled "Design Memorandum No. 1" and subtitled "Part I - Chalmette, Part II - Barrier, and Part III - Lakeshore". Part I - Chalmette was approved on 27 October 1966; Part II - Barrier was approved on 18 October 1967; and Part III - Lakeshore was approved on 6 March 1969. These documents present detailed descriptions and analyses of the tidal hydraulic methods and procedures used in the tidal hydraulic design of the features of the Plan and include the essential data, assumptions, and criteria used and results of studies which provide the bases for determining surges, routing, wind tides, runup, overtopping, and frequencies. The criteria applicable to this levee feature and the hydraulic design of the drainage facilities in this levee reach are presented in Appendix A of this memorandum.

b. Surface Drainage. Construction of the proposed levee and foreshore protection recommended herein will not affect existing surface drainage patterns. Only minor modifications to existing area storm and sanitary sewer utilities are required. Interior drainage is discussed in Appendix A.

GEOLOGY

16. Physiography. The project area is located within the Central Gulf Coastal Plain on the extreme eastern flank of the Mississippi River deltaic plain. The primary physiographic features of the study area include Lake Pontchartrain, many smaller lakes and ponds, lagoons, bayous, canals, abandoned distributaries, and small natural levees. Relief in the area is very slight with elevations ranging from a few feet below mean sea level in the marshlands to a few feet above mean sea level along the narrow natural levees of the abandoned distributaries.

17. General Geology. Near the end of the Pleistocene Epoch, when sea level was about 400-450 feet below its present level, the Mississippi River was located to the west of the study area. During this period, the uppermost Pleistocene surface within the study area was exposed to subaerial erosion. About 12,000 years ago, sea level began to rise, inundation of this Pleistocene erosional surface occurred, and initiation of the deposition of Holocene sediments began in a nearshore gulf environment. The Mississippi River then began to migrate laterally back and forth across the alluvial valley, prograding seaward as well as aggrading. About 2,800 years ago the Mississippi River system shifted to the St. Bernard delta complex and began a series of progradations to the south of the project area. As the river adjusted to a steeper gradient course, the Bayou Sauvage distributary complex was formed and subsequently became the primary source for transporting sediments to the project area. Deposition at first was concentrated in a depression between the older St. Bernard Delta lobes and Pine Island, a relict beach trend to the north. Pine Island was gradually buried by distributary deposits of Bayou Sauvage which ultimately crossed the beach trend to the north and deposited the sediments existing in the project area. Deposition continued at a decreasing rate until about 700 years ago. By this time the Mississippi River had shifted south and west to the Plaquemine-Modern and Lafourche Delta complexes. Finally, the levee systems constructed along the Mississippi River eliminated seasonal flooding of lands adjacent to the river, and, consequently, the annual sediment supply formally introduced into the project area was halted. As a result, the land masses formed

from sediments transported to the area by the shifting network of distributaries are presently in a state of retreat and deterioration.

18. Subsidence and erosion. The project area lies in a region of active subsidence and downwarping which was initiated during the Pleistocene Epoch. The Pleistocene surface has been downwarped toward the south and west from zero feet at the Pleistocene outcropping on the north shore of Lake Pontchartrain to about 500 feet near the edge of the continental shelf, about 80 miles south of New Orleans. Consolidation of sediments on both a regional and local scale is a principal contributor to the area subsidence. The overall rate of regional subsidence has been about 0.78 (238 mm) feet/century. Local subsidence, within the project area, has not been critical to date because land reclamation projects have not developed into this portion of eastern Orleans Parish and the area still maintains some natural drainage and a relatively high-water table. However, the Lake Pontchartrain shoreline in this area is eroding faster than any other area in the eastern portion of the Pontchartrain Basin, which may be attributed to the relatively young unconsolidated sediments. These rates of shoreline erosion vary from 2.1 feet in 18 years on the western end of the project area near Paris Road, to 7.6 feet and 13.0 feet in 14 years at South Point and Pointe aux Herbes, respectively. Average shoreline retreat for Lake Pontchartrain is 5.4 feet per year.

19. Investigations performed. A series of fifteen 5-inch undisturbed borings to a maximum depth of 81.5 feet were made for this project. Eleven of the borings were drilled on the centerline of the levee. The others were drilled on or near the toe of the levee. In addition, the logs of exploratory borings made prior to the previous construction phase, as well as other project borings, were used to determine subsurface geologic and foundation conditions. Aerial photographs and geologic maps of the area were also used in conjunction with data derived from the borings.

20. Foundation conditions. The subsurface along the project alinement is represented by the soil and geologic profile on plate 17. Generally, the area consists of Holocene deposits varying in elevation from approximately -40.00 ft. NGVD @ Station 364+50 to -25.0 ft. NGVD @ Station 593+50. These deposits are predominately unconsolidated, saturated, low strength clays with some silts and silty sands. The deposits are indicative of a nearshore gulf geologic environment overlain by a deltaic interdistributary environment. Artificial fill, consisting of a sand core overlain by a semi-compacted clay cap, was placed along the levee centerline from -10.0 ft. NGVD to +15.0 ft. NGVD. The entire sequence of Holocene deposits is underlain throughout the project area by sediments of the Pleistocene Epoch. These sediments are deposited in a marine or deltaic environment and are generally interbedded and interfingered clays, silts, and silty sands with occasional massive sand bodies. The Pleistocene deposits are more consolidated and durable than the overlying Holocene deposits

because of higher cohesive strength, lower water contents, and less pore space. Therefore, the Pleistocene deposits provide the best load bearing strata in the area.

21. Mineral resources. Gas pipelines, originating from the south, cross the eastern and western portions of the project area, but oil and gas production, common to other areas around New Orleans, is not presently found in the immediate vicinity of the project area. Any future exploration or production of these natural resources will not be adversely affected by the project, nor will the project be adversely affected by oil and gas operations.

22. Conclusion. The subsurface investigations and analyses of all existing and new data indicate that geologic conditions for construction are good. Because of the compressive nature of the surficial marsh and the underlying interdistributary deposits throughout a majority of the project, some settlement can be expected in conjunction with most levee enlargement operations.

SOURCES OF CONSTRUCTION MATERIALS

23. Sources of construction materials. In addition to the information presented in this memorandum relative to borrow area locations and materials, information relating to material sources is also contained in Design Memorandum No. 12, Revised "Sources of Construction Materials" approved 23 October 1979.

FOUNDATIONS INVESTIGATION AND DESIGN

24. General. This section covers the soils and foundation investigation, including the design for the enlargement of earthen levees, the design of foreshore protection dikes, and the construction of floodwalls along the New Orleans East Lakefront Levee from Paris Road to South Point. The project extends from baseline Station 331+50 at the intersection of Paris Road and Haynes Boulevard to baseline Station 661+70 in the vicinity of South Point.

25. Field Investigation.

a. A total of 15 new undisturbed borings were taken and tested by the Corps of Engineers for this project. Eleven were taken along the centerline of the levee (borings 1-SPU, 3-SPU, 5-SPU, 7-SPU, 8-SPU, 9-SPU, 11-SPU, 13-SPU, 15-SPU, 17-SPU, and 18-SPU), and four were taken 120 feet to the landside of the levee centerline (borings 2-SPU, 6-SPU, 12-SPU, and 14-SPU). All of these borings were taken to a depth of approximately 80 feet. Their respective boring logs are presented on plates 18 through 32.

b. Additional old borings that were considered in the design were:

(1) 1-ULN, 2-ULN, and 3-ULN (For reference see Design Memorandum No. 2, General Design Supplement 5B, dated June 1972).

(2) 2A-ULN and 3A-ULN. These borings were taken following the completion of General Design Supplement 5B. They are located 15 feet to the lakeside of the south rail and were used for foreshore protection design. The logs of these borings are presented on plates 33 and 34.

26. Laboratory Tests. Visual classifications were made on all samples obtained from the borings. Water contents were determined for all cohesive samples. Consolidation (C) tests, Unconfined Compression (UCT), Unconsolidated-Undrained (Q), Consolidated-Undrained (R), and Consolidated-Drained (S) shear tests were performed on samples that were considered representative of soils encountered. Liquid and plastic limits were determined for all cohesive samples on which consolidation and shear tests were performed. The results of these tests are shown on plates 18 through 32 and also on the detailed test data sheets included in Appendix B of this report. Additional test results are presented in the design supplement report referenced above. Test results which were available for Borings 2A-ULN and 3A-ULN are presented on plates 33 and 34.

27. Foundation and Soil Conditions. The soil types and general stratifications along the project alinement are shown on the soil and geologic profile which is based on the new centerline borings and is presented as plate 17. Design shear strengths of borings used individually are shown on plates 18 through 34. Design stratigraphies are shown on the respective stability plates. In cases where related borings were used, design shear strengths and stratigraphies are presented jointly as is shown on plates 35, 36, 37, and 38.

28. Levee.

a. General. A conventional earthen levee enlargement will be the main protective feature of the project. The levee will be constructed by enlarging the existing levee. Construction will consist of the placement of semicompacted clay fill on the existing levee to the design grades and sections.

b. Shear Stability. Using minimum composite sections based on recently taken survey cross sections, slopes and berm distances for the new levee were designed for the following conditions: No standing water due to hurricane drawdown on the floodside with anticipated failure toward the floodside; and water level to project hurricane wind tide level (WTL) elevation 11.5 on the floodside; water to elevation 0.0 on the protected side and anticipated failure toward the protected side. The stability of the levee was determined by the method of planes analysis, using the design (Q) shear strengths and applying a minimum factor of safety of approximately 1.3. In the vicinity of the two pipeline crossings, a minimum factor of safety of 1.5 was applied as is normally required. This criterion was met except in the analysis of the protected side stability at Collins pipeline. Here the existing factor of safety, taking into account the existing pipeline cover, was 1.39 but, due to the fact that the levee has stood for approximately 2 years without stability problems and that no additional loads will be introduced, a minimum factor of safety of 1.5 is not required in this instance. Piezometric headlines for all lakeside runs were chosen to reflect normal lake levels. The critical condition of lake water experiencing hurricane drawdown is considered such a temporary condition, it is unlikely that the uplift pressures on the lake side would decrease as a result. Headlines for all protected side runs were chosen to reflect the lowest level of standing water on the protected side and the wind tide level on the lake side. Due to the substantial clay cover between the levee and the existing railroad embankment, it was considered reasonable that the uplift pressures would dissipate from the wind tide level elevation at the embankment to the protected side elevation of 0.0 due to head losses through the embankment and foundation materials. For simplicity, a linear decrease was assumed. Refer to Plates 39 through 63 for a presentation of stability analyses.

c. Settlement. Settlement analyses indicate that the gross grade levee crown will settle from 1 to 4-1/2 feet depending on the location within the overall project length. This settlement includes allowances for shrinkage and lateral spread. To compensate for this long term settlement the levee crown will be overbuilt or "grossed" as indicated on the stability plates.

29. Foreshore Protection.

a. General. Foreshore protection will be constructed along most of the New Orleans East Lakefront Reach. No foreshore protection will be placed in the Little Woods area, Station 331+50 to Station 364+50, (see paragraph 13 for reasons for not placing rock in this area). Throughout the remaining length of the job, a stone dike will be constructed for foreshore protection.

b. Foreshore Protection Shear Stability. Using minimum composite sections based on existing cross sections along the levee floodside, the stability of the foreshore protection was analyzed by the method of planes, using design (Q) shear strengths. A safety factor of 1.3 was used except in the immediate vicinity of the two pipeline crossings where a minimum safety factor of 1.5 was used. Refer to the lakeside analyses for foreshore shear stabilities.

c. Settlement. Using consolidation data from the available lakeside borings, settlement due to the foreshore protection dike was analyzed. Settlement of the adjacent railroad embankment due to the protection dike was calculated to be 0.26 feet while settlement under the dike itself was calculated to be 0.5 feet. The latter calculation includes an allowance for lateral spread.

To compensate for this expected long term settlement, the protection dike will be "grossed" 0.5 feet as shown on the lakeside stability analyses.

30. Design Procedure.

a. General. Based on changes in ground surface profile, (Q) design strengths and geologic profile, the entire project length from Stations 331+50 to 661+70 was subdivided into subreaches as follows:

Reach IA - Little Woods	Sta 331+50 to 364+50
Reach IB	Sta 364+50 to 390+00 and 398+25 to 436+50
Reach II-Collins Crossing	
a. Main levee tie-in	Sta 390+00 to 392+36 and 396+04 to 398+25
b. Pipeline crossing and transitions	Sta 392+36 to 396+04
Reach III	Sta 436+50 to 456+50
Reach IV	Sta 456+50 to 539+50
Reach V	Sta 539+50 to 567+50
Reach VI	Sta 567+50 to 588+60 and 597+14 to 611+50
Reach VII - Southern Natural Gas Pipeline Crossing	
a. Pipeline crossing and transitions	Sta 588+60 to 595+50
b. Main levee tie-in	Sta 595+50 to 597+14
Reach VIII	Sta 611+50 to 636+70
Reach IXA	Sta 636+70 to 655+00
Reach IXB	Sta 655+00 to 661+70

Each individual subreach was analyzed for settlement and stability as described above. Similar reaches were combined for presentation of final analyses as follows:

Reach IA - Little Woods	Sta 331+50 to 364+50 Plates 39 and 40
Reach I-B	Sta 364+50 to 390+00 and 398+25 to 436+50 Plates 41 and 42

Reach II - Collins Crossing

a. Main levee tie-in		Sta 390+00 to 392+36 and 396+04 to 398+25 Plates 43 and 44
b. Pipeline crossing and transitions		Sta 392+36 to 396+04 Plates 45, 46, and 47
Reach III		Sta 436+50 to 456+50 Plates 48 and 49
Reach V	Typical of	Sta 456+50 to 556+50 Plates 50 and 51
Reach VI	Typical of	Sta 556+50 to 588+50 and 597+14 to 636+70 Plates 52 and 53

Reach VII - Southern Natural Gas Crossing

a. Pipeline crossing and transitions	Sta 588+50 to 595+50 Plates 54 through 57
b. Main levee tie-in	Sta 595+50 to 597+14 Plates 58 and 59
Reach IXA	Sta 636+70 to 655+00 Plates 60 and 61
Reach IXB	Sta 655+00 to 661+70 Plates 62 and 63

b. Special Considerations.

(1) The Collins pipeline crossing warranted additional consideration. Soft clays in the crossing closure area are expected to settle 4.5 feet. The large landside berms necessary for this much overbuild would require the acquisition of new rights-of-way on the order of 300 feet and the relocation of the existing landside drainage canal. Accordingly, other, more cost effective, alternatives were sought. These included the use of a two-lift construction sequence or the use of an I-wall. Two-lift construction, it was determined, would also require the acquisition of additional right-of-way for stability berms. Based on cost comparison it was decided that the construction of an I-wall would be the cheapest alternative for use at the Collins pipeline crossing.

(a) The required penetration for the stability of the sheet pile wall was determined by a cantilever I-wall analysis using the soil parameters derived from borings taken in the pipeline crossing area. The wall was analyzed for both the short-term (Q) case and the long-term (S) case. The analyses were performed using a factor of safety of 1.25 with static water at the wind tide level elevation of 11.5 NGVD and a daynamic wave force. Of the two cases, the long-term (S) case gave the deepest penetration requirement. This analysis is presented on plate 47.

(b) The penetration required to satisfy a Lane's Weighted Creep Ratio of 2.5 was determined as well. The deeper penetration of the two analyses (cantilever I-wall and creep ratio) was given as El. -9.0 by the weighted creep ratio analysis. A tip elevation of -13.0 is recommended in order to give penetration through the sand core into the soft clays. A penetration of 3 feet was considered sufficient for the purposes of seepage cutoff. Since no static water loads will be placed on the sheet pile wall, a method of planes analysis was done on the existing levee only. These analyses are presented on plates 45 and 46, with the location of the sheet pile shown for reference only.

(c) The material which presently provides cover for Collins pipeline will be replaced following installation of the sheet pile wall. When expected settlements due to existing foundation loads within the crossing area is substantially complete, additional material will be placed and reshaped to provide the minimum 1-foot cover required over the entire pipeline. The sheet pile wall will not be capped until settlement in the adjoining main levee tie-ins (Sta 390+00 to 392+36 and Sta 396+04 to 398+25) is substantially complete as well, so as to minimize differential settlements which could be damaging to the concrete cap.

(2) The design for the Southern Natural Gas Pipeline includes the placement of a protective cover over the existing pipeline.

(3) Method of Planes analyses were run to determine the location of the flotation channel with respect to the proposed levee and dike sections. Minimum distances were provided based on two sections: Collins main levee tie-ins for stability with respect to the largest levee section and Reach IXB for stability with respect to the largest dike section. These analyses are presented on plates 64 and 65.

31. <u>Sources of Borrow Materials</u>. The levee will be constructed of semi-compacted clay fill which will be obtained from a borrow area of Pleistocene clays in the bottom of Lake Pontchartrain along the north shore. The material will be transported by barges, stockpiled, hauled, and placed in the levee. See plates 66 and 67 for locations and soil boring sections of the borrow area in the lake.

32. Sequence of Construction.

General. Three contracts will be utilized for the levee enlargement and construction of the foreshore protection dike as described in the schedule for design and construction, paragraph 56.

a. Levee. The levee will be constructed in one phase as described below:

Clay material will be hauled, via barge and truck, from Howze Beach borrow area to the job site. Spreading equipment on the existing levee will construct the levee enlargement along the entire reach. Levee enlargement will not be required in the vicinity of the Collins Company pipeline crossing offset levee. The construction of a sheet pile cutoff wall in this area will be as shown on design sections on plate 9. Construction of the levee will be as shown on the design sections on plates 8, 10, and 11.

b. Floodwall Capping. Concrete capping of the steel sheet pile cutoff wall in the vicinity of Collins pipeline crossing will be accomplished after a 4-year settlement time for settlement of levee and sheet pile is complete.

c. Foreshore Protection Dike. The foreshore protection dike will be constructed in four phases as described below:

(1) Phase One. Construction of the access flotation channel will consist of excavation and stockpiling of material in the disposal area adjacent to the channel. Access will be perpendicular to the shoreline and the foreshore protection dike alinement.

(2) Phase Two. Construction of the lateral flotation channel will consist of excavation and stockpiling of the material adjacent to and lakeward of the channel. The flotation channel will parallel the lake shoreline and the foreshore construction limits. Flotation channel excavation will not be allowed within 50 feet of Collins and Southern Natural Gas pipelines located at approximate Stations 396+04 and 590+75, respectively.

(3) Phase Three. Construction of the typical foreshore protection dike will proceed either concurrent with lateral flotation construction, or after the flotation channel is excavated. Construction materials can be barged to the jobsite where barged-mounted cranes probably will proceed with placement of stone material into the design sections.

(4) Phase Four. Upon completion of the foreshore dike construction, the contractor will be required to backfill the access and lateral flotation channels with available material stockpiled in the disposal area during the initial channel excavation.

33. Levees. The existing levee was constructed to the grades and sections outlined in the Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 5B, New Orleans East Lakefront Levee. This existing project levee will be enlarged using hauled clay material. The levee enlargement will extend from the junction of Paris Road and Hayne Boulevard (B/L Station 331+50) to the western edge of Collins Pipeline offset levee (B/L Station 392+36) and continue again from the eastern edge (B/L Station 396+04) to South Point, Louisiana (B/L Station 661+70). The new levee embankment will make a smooth transition into the ends of the new I-wall (see Plate 9 for I-wall alinement) located within the levee alinement at the Collins Pipeline offset levee (B/L Station 392+36 to B/L Station 396+04). The centerline of the proposed levee enlargement will be referenced from the southernmost rail of the Southern Railway System's mainline track, a distance of 63 feet, except in the vicinity of the Southern Natural pipeline, where the levee centerline will be located 135 feet south of the southernmost rail, and in Reach IXA where the presence of a spur track and the required additional right-of-way necessitate positioning the levee centerline 75 feet south of the southernmost rail. The existing drainage ditch between the railroad embankment and floodside levee toe which now serves the project area (B/L Station 331+50 to B/L Station 661+70.46) shall be redressed to original grade upon completion of levee enlargement construction to allow drainage to existing catch basins. The general location and alinement of the proposed levee are shown on plate 1. The alinement plan and profile of the levee and features continguous thereto are shown on plates 2 through 7. Typical Levee Design sections are shown on plates 8, 10, and 11.

34. Foreshore Protection Dike. No foreshore protection dike work will be accomplished from Paris Road (B/L Station 331+50), extending eastward along the Little Woods campsite shoreline, to baseline Station 364+50. The foreshore protection dike, full section, presented herein will extend from baseline Station 364+50 to the end of the railroad embankment eastward of baseline Station 661+70.46 (Vicinity South Point). The foreshore protection dike design consists of four sections as shown on plates 12, 13, and 14. Hydraulic design criteria require a net grade of elevation 7.0 for the project reach, with a minimum section of 12 inch thick graded stone No. 1 core material and 3-foot thick graded stone No. 2 for armor layer. The net grade elevation 7.0 will be constructed between baseline Station 436+50 and baseline Station 556+00 and from baseline Station 655+00 to baseline Station 661+70.46 (Vicinity South Point). It will be necessary to construct a modified foreshore dike between baseline Station 364+50 and baseline Station 436+00 and from baseline Station 556+00 to baseline Station 655+00 to a net grade of elevation 8.0, in order to maintain the minimum stone design thickness on the abnormal existing ground conditions. The general location and alinement of the proposed foreshore protection dike are shown on plate 1. The alinement plan and profile of the foreshore protection dike and features continguous thereto are shown on plates 2 through 7.

35. Floodwall from B/L Station 392+36 to B/L Station 396+04. I-type floodwall consisting of a steel sheet pile cutoff wall with a concrete cap will be constructed in the vicinity of the Collins Pipeline Company's 16-inch pipeline crossing.

a. Phase One. Construction will consist of driving the steel sheet piling in the existing levee crown as shown on plate 9. Where the sheet pile alinement intersects the 16-inch pipeline (vicinity of B/L Station 394+05), a 5-foot section of pipe will be removed, steel sheet piling driven, and then pipe section replaced. The elevation of the top of the sheet pile wall will be 18.0 feet and the tip elevation will be -13.0 feet.

b. Phase Two. Construction will consist of the construction of the concrete capping to elevation 18.0 on the steel sheet pile after the sheet pile settlement is essentially complete.

The general location and alinement of the proposed sheet pile wall are shown on plate 1. The detailed alinement plan and profile of the I-wall is shown on plate 3. Typical I-wall design section is shown on plate 9.

METHOD OF CONSTRUCTION

36. Recommended Levee Construction Plan. The recommended plan of construction consists of enlarging to design grade, as shown on plates 8, 10, and 11, the existing levee with a semicompacted clay cover from baseline Station 331+50 to baseline Station 661+70, excluding the Collins Pipeline Company vicinity (B/L Station 392+36 to baseline Station 396+04). The levee will be constructed by barging the borrow material to an unloading site (stockpile area vicinity B/L Station 663+00) on the shoreline of Lake Pontchartrain, located between the existing railroad trestle and the drainage structure (B/L Station 665+00) at South Point. The barged clay material will be truck-hauled via the existing levee, from the unloading site to the area of placement. A total of three contracts will be let to complete all of the construction work. There will be one contract for each type of construction: levee protection, foreshore protection, and floodwall capping.

37. Drainage Facilities. Additional length of drainage culvert will be added to each existing corrugated metal pipe between baseline Station 364+50 and baseline Station 661+70.46, with the first one at baseline Station 368+00 and the last one at baseline Station 656+00. The drainage culverts will consist of 12-inch diameter corrugated metal pipes, sloped approximately 1 vertical on 60 horizontal under the foreshore protection dike. Coupling of the existing pipe to the new section will be by connecting bands, either the huggar or corrugated type. Details of these drainage culverts and the locations are shown on plate 14.

38. Recommended Foreshore Protection Dike Construction Plan. All foreshore protection work will be accomplished from the lakeside of the railroad embankment. Construction materials, including graded stone No. 1 and graded stone No. 2, will be transported by barge to the site of placement along the shoreline of Lake Pontchartrain. Graded stone No. 2 will be used as required to provide a firm base with a minimum thickness of 12 inches. Once the base is constructed, barge-mounted draglines and equipment working on the base will commence shaping of the graded stone No. 2 and placement of the graded stone No. 1 layer. See plate 12 for graded revetment chart criteria.

39. Flotation Channel Plan. Excavation of perpendicular access flotation channels will be required to provide adequate flotation access to begin construction of the main Lateral Flotation Channel. The channel will be near the lake shoreline and parallel the foreshore dike alinement, excluding pipeline crossing areas. All material excavated for flotation during the Paris Road to South Point foreshore protection construction will be stockpiled in the lake adjacent to the flotation channels. The material will be used to backfill the flotation channels upon completion of the foreshore work. For the Access Flotation Channel and the main Lateral Flotation Channel typical sections and dimensions, see plate 15. Excavation for flotation will not be allowed within 50 feet either side of the pipelines located in the vicinity of baseline Stations 394+05 and 593+00. Barge-mounted construction equipment will be required to float around pipeline crossings. For the general location of these areas, see plan and profile plates 2 through 7.

ACCESS ROADS

40. Access Roads. Vehicular access to the levee construction site is available at each end of the levee alinement. Access at the west end of the job is the intersection of Paris Road and Hayne Boulevard. Access at the east end can be obtained from Interstate Highway 10 by a shell road on the toe of the South Point to GIWW levee (see plates 2 and 7). Floating plant can reach the project area by Lake Pontchartrain. The Southern Railway System parallels the proposed foreshore work and the proposed levee enlargement.

STRUCTURAL DESIGN

41. Criteria for Structural Design. The structural designs presented herein comply with standard engineering practice and criteria set forth in Engineeering Manuals and Engineering Technical Letters for civil works construction published by the Office of the Chief of Engineers, subject to modifications indicated by engineering judgement and experience to meet local conditions.[1/]

[1/] The floodwall design is similar to the design presented in the Lake Pontchartrain Barrier Plan Citrus Lakefront Levee-IHNC to Paris Road, Design Memorandum No. 2, General Design, Supplement No. 5A, approved July 1976.

42. Basic Data. Basic data relevant to the design of the protective works are shown in the following table:

TABLE 1
RELEVANT STRUCTURAL DESIGN DATA

a.	Water elevations	Elevation (feet N.G.V.D.)
	Wind tide level (Lake Pontchartrain)	11.5
	Landside of Floodwall	0.0
b.	Floodwall Net Grade (stationing refers to B/L)	Elevation (feet N.G.V.D.)
	I-wall (Sta. 392+36 to Sta 396+04)	18.0
c.	Unit weights	Lb. per cu ft
	Water	64.0
	Concrete	150
	Earth	See Plates 18 through 65
d.	Design loads	Lb. per cu ft
	Earth pressures (lateral)	See Plate 47
	Wind loads	50 p.s.f.
	Water loads	See Plate 47

43. Design Methods

Reinforced concrete. The design of reinforced concrete structures is in accordance with the requirements of the strength design method of the current ACI Building Code, as modified by the guidelines of "Strength Design Criteria for Reinforced Concrete Hydraulic Structures", ETL 1110-2-265 dated 15 September 1981. The basic minimum 28-day compressive strength concrete will be 3,000 psi. For convenient reference, pertinent stresses are tabulated below:

TABLE 2
PERTINENT STRESSES FOR REINFORCED CONCRETE DESIGN

Reinforced concrete	
f'c	3,000 psi
fy (grade 40 steel)	40,000 psi
Maximum flexural reinforcement	0.25 x balance ratio
Minimum flexural reinforcement	200/fy

44. I-type Floodwall.

a. General. The I-wall will consist of steel sheet piling driven into the existing ground and, in some cases, into a new embankment. The upper portion of the sheet piling will be capped with concrete. The sheet piling will be driven to the required depth with 1 foot of the sheet piling extending above the finished ground elevation. The concrete portion of the floodwall will extend from 2 feet below the finished ground elevation to the required protection height. For details, see plates 3 and 9.

b. Loading Cases. In the design of the I-wall, one loading case was considered as follows:

FS used = 1.25 with static water at the SWL and a dynamic wave force.

c. Joints. Expansion joints in the I-wall will be spaced approximately 30 feet apart, adjusted to fall at sheet pile interlocks. To compensate for expansion, contraction, or displacement, three-bulb waterstops and premolded expansion joint fillers will be provided.

45. Cathodic Protection and Corrosion Control.

Cathodic protection for steel sheet piling. All steel sheet piling will be bonded together to obtain electrical continuity and no corrosion protection measures will be provided. Cathodic protection can be installed in the future if the need arises. The sheet piles will be bonded together with a no. 6 reinforcing bar welded to the top of each pile. Flexible jumpers insulated with cross-linked polyethylene will be welded or brazed to adjacent sheet piles at the monolith joints 3 inches below the bottom of the concrete.

REAL ESTATE REQUIREMENTS

46. General. All rights-of-way and construction easements required to construct the high level plan levee and foreshore protection described in this GDM have previously been acquired for barrier plan construction by the Local Sponsor (Orleans Levee District). No additional easements are required to accomplish the proposed action detailed in this GDM. There will be no acquisitions by the United States. Right-of-way and construction easement limits are shown on plan and profile plates 2 through 7.

RELOCATIONS

47. General. Under the authorizing law, local interests are responsible for the accomplishment of "...all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction work,..."

48. Southern Natural Gas Company Pipelines. In the vicinity of baseline Station 593+00, one 20-inch, one 24-inch, and one 30-inch Southern Natural Gas Company high pressure gas lines, which pass over the existing levee alinement, will remain at their present elevations (see plan and profile plate 6 for general location). During levee construction, these pipelines will be covered with a minimum of 1 foot of earth material in accordance with pipeline levee criteria.

49. Collins Pipeline Company Pipeline. In the vicinity of baseline Station 394+05, one 16-inch Collins Pipeline Company fluids line, which crosses over the existing levee crown, will also remain at its current elevation. The Collins area will require a steel sheet pile cutoff wall with a concrete cap. See plate 3 for I-wall alinement and general details.

OTHER PLANS CONSIDERED

50. Other Plans Considered. Two alternative methods of providing foreshore protection were considered during the preparation of this GDM, the recommended rubble revetment plan and a Gabion Revetment Plan. Cost studies indicated that the two plans have essentially the same cost with the Gabion Plan being only slightly greater in cost than the rubble revetment plan. Because both alternatives satisfy the desired project objective of providing foreshore protection, it is recommended that both alternatives be detailed in the Plans and Specifications for this project feature. The Gabion revetment plan should be listed as an equivalent alternative to the rubble revetment plan. It is felt that this action may stimulate competition in the bid process and potentially result in cost savings to the project.

COORDINATION WITH OTHER AGENCIES

51. General. As previously mentioned, the State of Louisiana, Department of Public Works, was appointed project coordinator for the State by the Governor of Louisiana. This agency has functioned to coordinate the needs, desires, and interests of state agencies and the Corps of Engineers. The Orleans Levee District will provide the local cooperation for this feature of the hurricane protection project. The project plan presented herein is acceptable to both of the above agencies. The entire Lake Pontchartrain hurricane protection project, including this project feature, has been discussed at numerous public and private meetings since its authorization. Such meetings have been held before regional, state, local, community, social, and educational organizations and have served generally to inform the public of the proposed works, to explain project functions, and to solicit the public viewpoint. The latest public meeting was held in New Orleans on 12 April 1984. The project has also been described and

discussed in press and by communications media, as well as organizational and individual correspondence. This public meeting was held as part of the continuing coordination required for input to the Draft Supplemental Environmental Impact Statement (DSEIS) on the Lake Pontchartrain project as a whole. Comments received in connection with the proposed action described in this GDM are contained in Appendix C. The official response to each of these comments is also displayed in Appendix C.

ENVIRONMENTAL ASSESSMENT

52. General. The project is within the Mississippi Deltaic plain and is characterized by near sea level elevations. The dominant topographic feature is Lake Pontchartrain, a large, shallow body of water lying within an extensive estuarine complex. About 3 miles of the lake edge and shoreline would be affected by this work. The impact would be both temporary and long term. Most environmental features, including biological, recreational, cultural, and socioeconomic, would return to normal after construction.

a. Biological. The New Orleans East Lakefront is bordered by partially drained, fresh to intermediate marsh which has been isolated from tidal interchange with Lake Pontchartrain by a system of levees and railroad embankments since 1958. The lakeward margins of this marsh grade to scrub-shrub habitat. Due to the lack of tidal interchange, the marsh provides little biological or nutrient input to the lake. Lakeward of the levee, the lakefront area is characterized by shallow, nearshore water depths (2-3 feet) which gradually deepen to 10-12 feet approximately 200-300 feet off shore. The nearshore topography is also typified by occasional narrow sand and shell beaches with sparse patches of submerged vegetation occurring sporadically along the reach. Submerged vegetation along the reach is comprised of infrequent occurrences of Ruppia, Vallisneria, and Najas.

At the easternmost portion of the proposed levee reach near South Point, there are approximately 40-50 acres of remnant marsh located lakeward of the existing levee and railroad embankment.

The impacts associated with the construction along this reach can be placed in two categories: (1) those associated with actual placement of the rock foreshore protection, and (2) those related to the access channels required to implement the placement.

The actual placement of the rock would cover approximately 42 acres. Approximately 70% of the acreage impacted would be lake bottom with the remainder being adjacent brackish marsh. While benthic habitat would be covered by the rock placement, it is not expected to eliminate the habitat entirely. The rock is expected to cause compaction of the underlying soils which may alter the types of benthic species that could inhabit the area. However, with the additional surface area provided by the rock-water interface, it is expected that an overall increase in fish food organisms would be available. Some benthics would be eliminated while others would adapt to the new habitat or be displaced to adjacent habitat. In addition, some loss of resting and feeding areas for wading birds and shorebirds is expected due to the reduction or elimination of remnant beach sites along the reach.

Temporary increases in turbidity are expected during placement of the foreshore protection material, but no long-term effects are anticipated. Some nearshore submerged vegetation would be lost as a result of the construction; however, this habitat is not presently of high quality and therefore no adverse long-term effects are expected.

The construction associated with the excavation of the barge access channels would impact approximately 215 acres of lake and nearshore waters. Excavation of the channel itself would impact an estimated 80 acres of benthic habitat and another 10 acres of brackish marsh. The dredged material from the channel would be placed lakeward of the channel and cover an additional 125 acres of benthic habitat. The channel would be backfilled after construction is completed. The estimated time for completion of construction is 18 months. While 80 acres of benthic habitat would be temporarily removed from production, recovery is expected to be relatively rapid and complete due to shallow depth of the excavation. While initial recolonization would result in a different species composition, recovery to near preconstruction conditions should result as the site ages. Recovery could be enhanced if the backfill is accomplished as quickly as possible in order to reduce the probability of water quality problems. Approximately 10 acres of brackish marsh would be lost due to excavation, but could be restored if backfilled to an elevation which would remain near the water surface following subsidence. The remaining 125 acres of benthic habitat disturbed by the dredged material placement is expected to recover rapidly due to the short period of time it would be covered.

Water quality disturbances are anticipated to be minor resulting from increases in turbidities, temporary increases in nearshore salinities (from excavation), lowered dissolved oxygen, and some possible localized increases in coliform bacteria during excavation due to residual untreated wastes entering the lake around the lakefront camps. Approximately 300-400 feet off shore along the eastern portion of the reach, viable beds of Rangia clams are apparent. However, the construction is not expected to affect this area. Construction could be temporarily disruptive to the nearshore fish community due to turbidity and poor water quality. Full recovery of the nearshore fishery is expected following construction.

In summary, the effects of the construction should be temporary, short term, and both the habitat and associated user species should return to near preconstruction conditions.

b. Cultural. A cultural resources survey was conducted along the project right-of-way in 1982 by New World Research, Inc.; no significant cultural resources were located. The survey included all project features except the mobilization site flotation channels. Historical research has indicated the potential of significant historic shipwrecks in the flotation channels. Thus, a remote sensing survey of the channels will be conducted in late FY 85.

c. Recreation. Current recreational use along this project reach is predominantly delegated to few camp-type recreational dwellings along the western portion of the work area. These recreational structures, situated in Lake Pontchartrain, are used as a base for fishing, crabbing, skiing, and participation in other water-oriented recreation. Project construction will temporarily disrupt activities and services to all camps. Walkways existing within the construction right-of-way would be temporarily removed. Other recreational uses include bank fishing and crabbing in the vicinity of South Point. These activities will be disrupted during levee construction. However, impacts will be short lived and temporary. Upon completion, normal activity is expected to resume.

d. Socioeconomic. The New Orleans East lakefront levee is an element of the overall Lake Pontchartrain Hurricane Protection Plan designed to prevent the effects of overflows from a project hurricane. The process of levee construction and drainage maintenance has historically been the method used for land development and flood protection in the New Orleans urbanized areas. Since 1964, as many as nine tropical storms reaching hurricane force have passed through Louisiana's gulf coast (including Hurricanes Betsy and Camille) causing heavy damage and loss of life in the New Orleans area. The economic life of the area is supported largely by port activities, tourist trade, regional market activities, the production of minerals (including crude petroleum, natural gas, sulfur, natural gas liquids, and shell), commercial fishing, shipbuilding, and related service industries. The six parishes designated by the Bureau of the Census in 1983 as the New Orleans Metropolitan Statistical Area (MSA) include Jefferson, Orleans, St. Bernard, St. Charles, St. John the Baptist, and St. Tammany Parishes. Portions of Plaquemines Parish are also designated as part of the New Orleans Urbanized Area. The statistical designation of the Port of New Orleans also includes the entire stretch of the Mississippi River adjacent to Plaquemines Parish. The combined population of the New Orleans MSA and Plaquemines Parish in 1980 totaled 1,283,000. In June of 1984, the estimated civilian labor force in this area totaled 600,700 while employment was 548,925, resulting in an 8.6 percent unemployment rate; it was somewhat less than the 9.4 percent unemployment figure for the state. In 1981, per capita personal income for the 7-parish area was approximately $10,860, slightly higher than the $9,517 estimate for the entire state. Appendix B of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project Reevaluation Report provides a general assessment of socioeconomic impacts of remaining work through a brief outline of 16 social and economic parameters. In addition to the economic cost of remaining work, minor adverse impacts would probably include the following: temporary reductions in leisure opportunities and increased noise from the construction and development; reduced aesthetic values to the extent that changes in the existing landscape would occur; and community cohesion could be adversely affected to the extent that competition for land resources could be encouraged. One of the major benefits of completing the new project, however, could also be an increase in community cohesion resulting from the improved security provided by additional flood protection. The remaining work would provide net benefits to land use, property values, and business and industrial activity, as well as benefits to employment, housing, local tax revenues, public facilities and services, and overall community and regional growth.

53. Environmental Impact Statement. The final Environmental Impact Statement (EIS) for the entire Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, was filed with the President's Council on Environmental Quality on 17 January 1975. A draft supplement to this EIS was filed with the Environmental Protection Agency (EPA) in December of 1983. The Draft Supplement assessed the impacts associated with increased levee height for a high level plan of protection for the New Orleans East Lakefront project reach. The final Supplement to this EIS was filed with EPA on 7 December 1984; formal approval (Record Decision) was obtained on 7 February 1985.

ESTIMATE OF COST

54. General. Based on January 1985 price levels, the estimated first cost for constructing the New Orleans East high level plan levee, foreshore protection, and floodwall is $15,300,000. This estimate consists of $12,765,000 for levees and floodwalls, $1,235,000 for engineering and design, and $1,300,000 for supervision and administration. There are no costs associated with relocations of utilities or additional right-of-way requirements as discussed in paragraphs 46 through 49 . The detailed estimate of first cost is shown in Table 3.

TABLE 3
DETAILED ESTIMATE OF FIRST COST
(January 1985 Price Levels)

Cost Acct. No.	Item	Quantity	Unit	Unit Price	Cost
				$	$
11.1	Levee Enlargement (Sta. 331+50 to Sta. 661+70 B/L)				
	Mob. and Demob.	Lump Sum	Lump Sum	-	50,000
	Clearing (80 acres)	Lump Sum	Lump Sum	-	40,000
	Embankment (semi-compacted)	450,000	C.Y.	12.00	5,400,000
	Fertilizing, Seeding, and Mulch	80	Acres	600.00	48,000
	Subtotal				5,538,000
	Contingencies (20%±)				1,108,000
	Subtotal				6,646,000
30	Engineering and Design (9.8%±)				631,000
31	Supervision and Administration (10.2%±)				678,000
	Total				7,955,000
11.2	Floodwall (Sta. 392+36 to Sta. 396+04 B/L)				
	PHASE I				
	Steel Sheet Piling (PZ-27)	13,632	S.F.	12.50	170,400
	Steel Sheet Piling (PZ-23)	154	S.F.	15.00	2,310
	Subtotal				172,710
	Contingencies (25%±)				43,290
	Subtotal				216,000
30	Engineering and Design (12%±)				26,000
31	Supervision and Administration (10%±)				22,000
	Total				264,000

TABLE 3 (cont'd)

Cost Acct. No.	Item	Quantity	Unit	Unit Price $	Cost $
	PHASE II (After settlement of sheet pile)				
	Mob. and Demob.	Lump sum	L.S	-	12,000
	Reinforced Concrete, I-Wall	173	C.Y.	300.00	51,900
	Structural Excavation	140	C.Y.	7.00	980
	Structural Backfill	70	C.Y.	10.00	700
	Waterstops, 3-Bulb Type	71	L.F.	30.00	2,130
	Subtotal				67,710
	Contingencies (25%±)				17,290
	Subtotal				85,000
30	Engineering and Design (12%±)				10,500
31	Supervision and Administration (10%±)				8,500
	Total				104,000
11.3	Foreshore Protection				
	Mob. and Demob.	Lump Sum	L.S.	-	100,000
	Clearing (41 acres)	Lump Sum	L.S.	-	40,000
	Graded Stone No. 1	172,000	Ton	17.00	2,924,000
	Graded Stone No. 2	49,000	Ton	16.50	808,500
	Installation of Drain Pipe - 12" CMP (Approx. 1,450 l.f.)	Linear Feet	L.F.	30.00	43,500
	Lateral Flotation Channel (approx. 1,208,000 c.y.)	Lump Sum	L.S.	0.75	906,000
	Subtotal				4,822,000
	Contingencies (20%±)				996,000
	Subtotal				5,818,000
30	Engineering and Design (9.8%±)				567,500
31	Supervision and Administration (10.2%±)				591,500
	Total				6,977,000
	Total Project Cost				15,300,000

55. Comparison of Estimates. The current estimate of $15,300,000 for the high level plan for New Orleans East Lakefront Levee and foreshore protection represents a decrease of $23,121,000 when compared to the PB-3 estimate effective 1 October 1984. The PB-3 estimate is based on cost estimates contained in the "Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project Reevaluation Study" dated July 1984, escalated to October 1984 price levels. Table 4 shows a comparison by accounts of remaining incremental costs necessary to complete the high level plan New Orleans East Lakefront Levee and foreshore protection. The substantial decrease in cost for the plan recommended herein is solely due to the much reduced size of levee necessary to provide project protection. Paragraph 14 of this GDM explains the reasons for this decrease. The reduced levee size also enables the proposed levee and foreshore protection to be constructed within the existing rights-of-way and the use of short reaches of floodwall at pipelines eliminates any relocations cost for this project reach. The estimates shown for engineering and design and supervision and administration are based on an analysis of actual work necessary to construct the plan recommended herein rather than applying a fixed percentage to the construction cost.

TABLE 4
COMPARISON OF ESTIMATES
(Remaining Incremental Costs)

Feature	PB-3 (eff Oct 84)	GDM (Jan 85 Prices)	Difference GDM & PB-3
	$	$	$
11 Levees & Floodwalls	27,285,000	12,765,000	-14,520,000
30 Engineering & Design	3,300,000	1,235,000	- 2,065,000
31 Supervision & Administration	2,700,000	1,300,000	- 1,400,000
SUBTOTAL	33,285,000	15,300,000	-17,985,000
01 Lands & Damages	1,196,000	0	- 1,196,000
02 Relocations	3,940,000	0	- 3,940,000
SUBTOTAL	5,136,000	0	- 5,136,000
TOTAL PROJECT COST	38,421,000	15,300,000	-23,121,000

SCHEDULE FOR DESIGN AND CONSTRUCTION

56. Schedule for Design and Construction. The schedule is as follows:

Contracts	P&S Start	P&S Complete	Construction Advertise	Construction Award	Construction Complete	Estimated Construction Cost 1/ $
Levee Enlargement and Driving Sheetpile -Phase I Floodwall (Sta. 331+50 to 661+70 B/L)	May85	Dec85	Feb86	Apr86	Aug87	7,492,000
Foreshore Protection (Sta. 365+00 to approx. 661+70 B/L)	Feb85	May85	Jun85	Aug85	Aug87	6,350,000
Floodwall Capping -Phase II Floodwall (Sta. 392+36 to 396+04 B/L)	Oct91	Mar92	May92	Jul92	Dec92	93,000
Total						13,935,000

57. Funds Required by Fiscal Year. To maintain the schedule for design and construction of the New Orleans East Lakefront Levee - Paris Road to South Point and Foreshore Protection, Federal funds will be required by fiscal years as follows:

Funds Required FY 85	$ 800,000
Funds Required FY 86	4,900,000
Funds Required FY 87	9,496,000
Funds Required FY 88	-
Funds Required FY 89	-
Funds Required FY 90	-
Funds Required FY 91	-
Funds Required FY 92	10,000
Funds Required FY 93	94,000
TOTAL	$15,300,000

1/ This cost includes contingencies, Federal and Non-Federal construction costs, and Federal and Non-Federal supervision and inspection (S&I) costs (S&I costs constitute 90% (±) of the supervision and administration costs).

OPERATION AND MAINTENANCE

58. General. The New Orleans East Lakefront levee will be maintained and operated at the expense of local interests as a feature of local cooperation for the project. The estimate of the annual operation and maintenance costs for the levee and foreshore protection features which are detailed in this GDM are as follows:

Levee and Foreshore Protection	$12,500/year

ECONOMICS

59. Economic Justification. The current economic analysis for the entire Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project is contained in the Reevaluation Study entitled "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project," dated December 1983. Based on October 1983 price levels and at the project interest rate of 3 1/8 percent, the benefit-cost ratio for the project as a whole is 4.2 to 1. The Reevaluation Study also breaks out the separable economic areas of the project for incremental justification. The New Orleans East Lakefront reach is a part of the New Orleans East economic area. The computed benefit-cost ratio for the New Orleans East area is also 4.2 to 1.

FEDERAL AND NON-FEDERAL COST BREAKDOWN

60. Federal and Non-Federal Cost Breakdown. The breakdown of the high level plan construction cost for the work described in this GDM are shown in Table 5 below:

TABLE 5
FEDERAL AND NON-FEDERAL COST BREAKDOWN
JANUARY 1985 PRICE LEVELS

Item	Federal	Non-Federal	Total
Levees & Foreshore Protection	$15,300,000	0 1/	$15,300,000

1/ Local interests have sufficient credits from other reaches of the Lake Pontchartrain and Vicinity Hurricane Protection Project such that a cash contribution will not be required for this reach.

WATER CONSERVATION MEASURES

61. General. The use of water conservation measures in the construction and operation of work covered by the GDM were investigated during the preparation of this report. Because of the nature of the construction activity planned for the New Orleans East Lakefront reach, it was concluded that the required construction does not afford the opportunity to use these measures. Furthermore, land use activities for the lands protected by this levee reach are not expected to change materially over the project life. The area in question is a highly developed urbanized area containing industrial, commercial, and residential development. Usage of potable water is not expected to increase as a result of project construction.

RECOMMENDATIONS

62. Recommendations. The plan of improvement for the high level plan presented herein consists of 6.3 miles of levee enlargement along the New Orleans East lakefront from Paris Road to South Point. This plan includes suitable provisions for erosion protection. This plan is considered to be the most economical means of providing high level plan, SPH - project protection and is recommended for approval as a basis for preparing plans and specifications for this project reach.

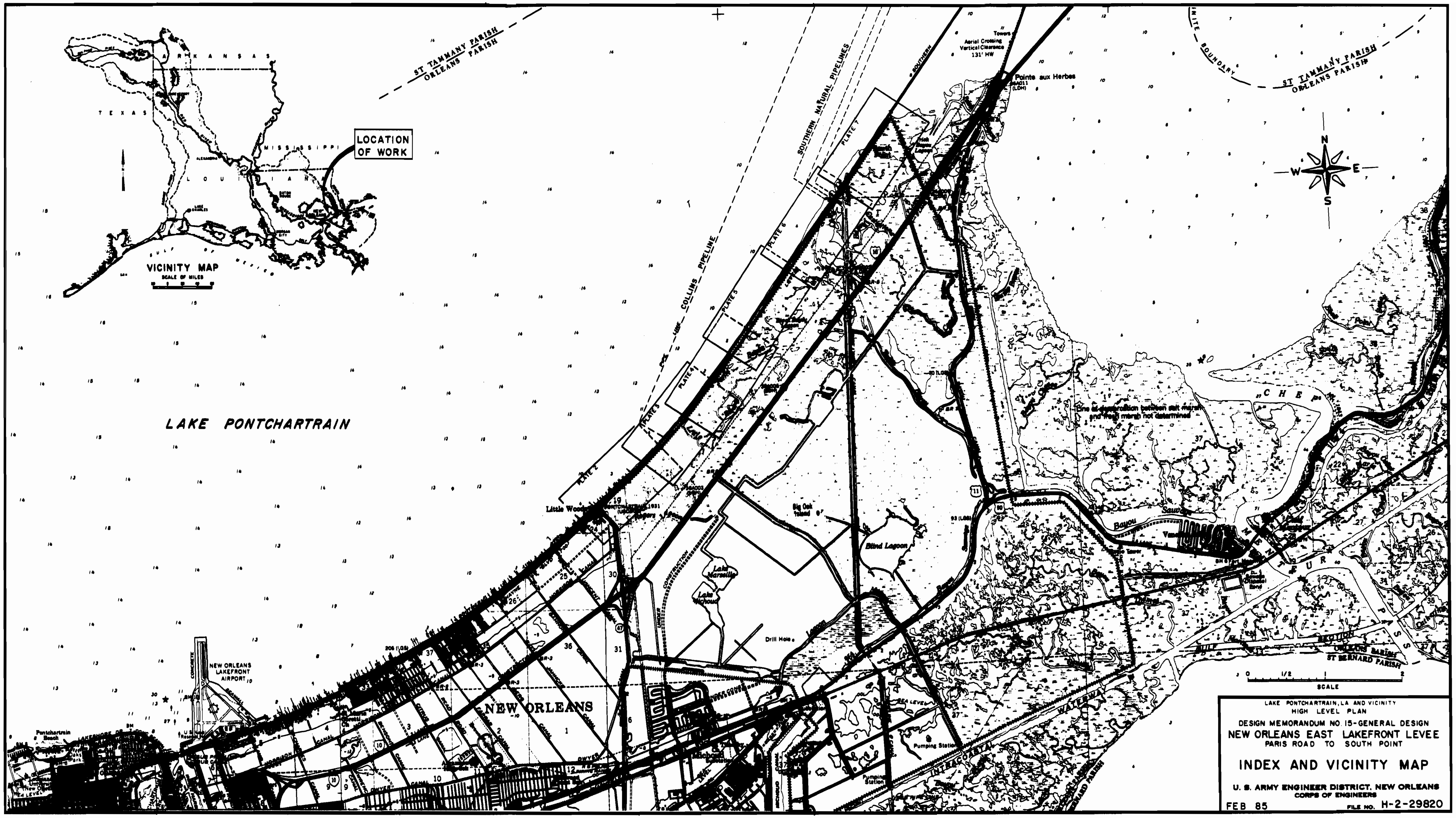
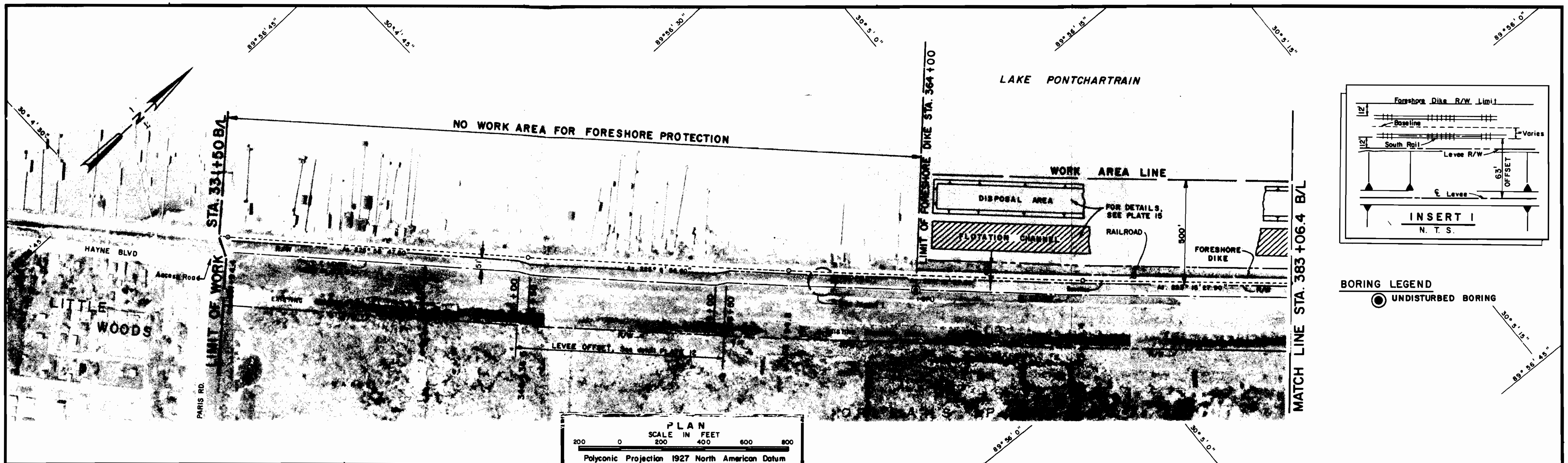
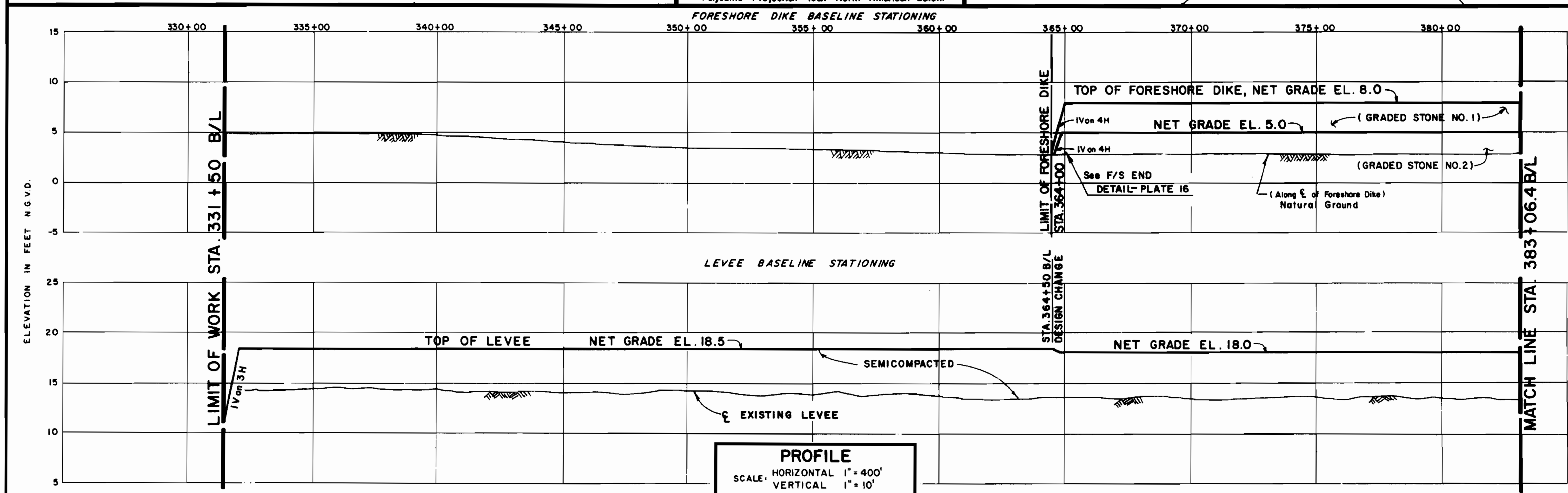

LAKE PONTCHARTRAIN
VICINITY MAP
SCALE OF MILES
LOCATION OF WORK
ARKANSAS
TEXAS
MISSISSIPPI
LOUISIANA
ST TAMMANY PARISH
ORLEANS PARISH
SOUTHERN NATURAL PIPELINES
COLLINS PIPELINE
Pointe aux Herbes
Towers
Aerial Crossing
Vertical Clearance
131' HW
NEW ORLEANS LAKEFRONT AIRPORT
NEW ORLEANS
Little Woods
Big Oak Island
Blind Lagoon
Lake Maraille
Drill Hole
Pumping Station
Bayou Sauvage
INTRACOASTAL WATERWAY
ORLEANS PARISH
ST BERNARD PARISH
Line of demarcation between salt marsh and fresh marsh not determined
N
S
E
W
SCALE
LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
INDEX AND VICINITY MAP
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85
FILE NO. H-2-29820

PLATE 1





NOTES:

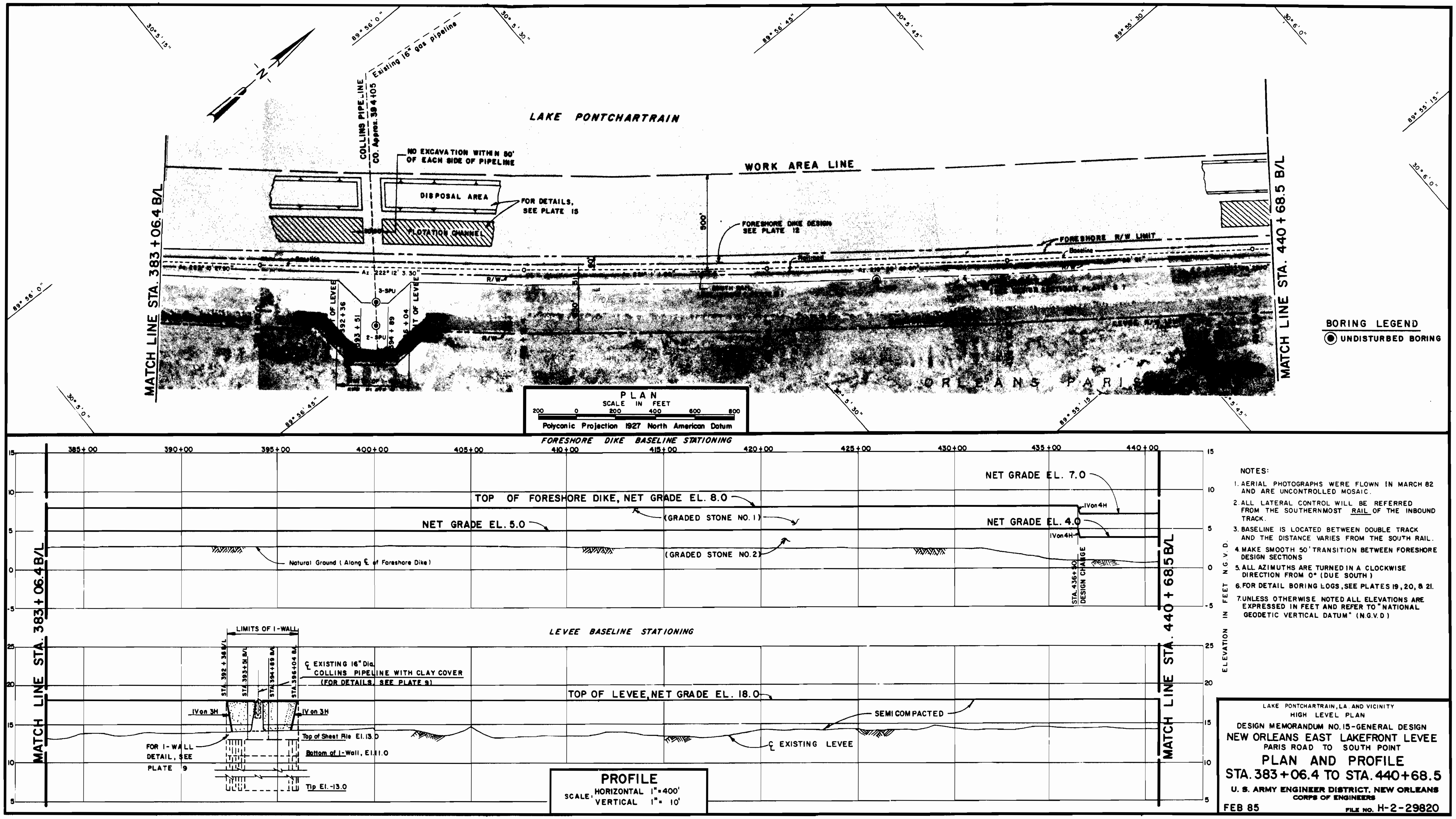
1. AERIAL PHOTOGRAPHS WERE FLOWN IN MARCH 82 AND ARE UNCONTROLLED MOSAIC.
2. ALL LATERAL CONTROL WILL BE REFERRED FROM THE SOUTHERNMOST RAIL OF THE INBOUND TRACK.
3. BASELINE IS LOCATED BETWEEN DOUBLE TRACK AND THE DISTANCE VARIES FROM THE SOUTH RAIL.
4. SEE PLATE 8 FOR LEVEE DESIGN SECTION.
5. FOR DETAIL BORING LOGS SEE PLATE 18.
6. FORESHORE DIKE DESIGN SECTIONS ARE SHOWN ON PLATES 12 THRU 14.
7. ALL AZIMUTHS ARE TURNED IN A CLOCKWISE DIRECTION FROM 0° (DUE SOUTH)
8. UNLESS OTHERWISE NOTED, ALL ELEVATIONS ARE EXPRESSED IN FEET AND REFER TO "NATIONAL GEODETIC VERTICAL DATUM (N.G.V.D.)

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PLAN AND PROFILE
STA. 331+50 TO STA. 383+06.4

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

FEB 85 FILE NO. H-2-29820



NOTES:

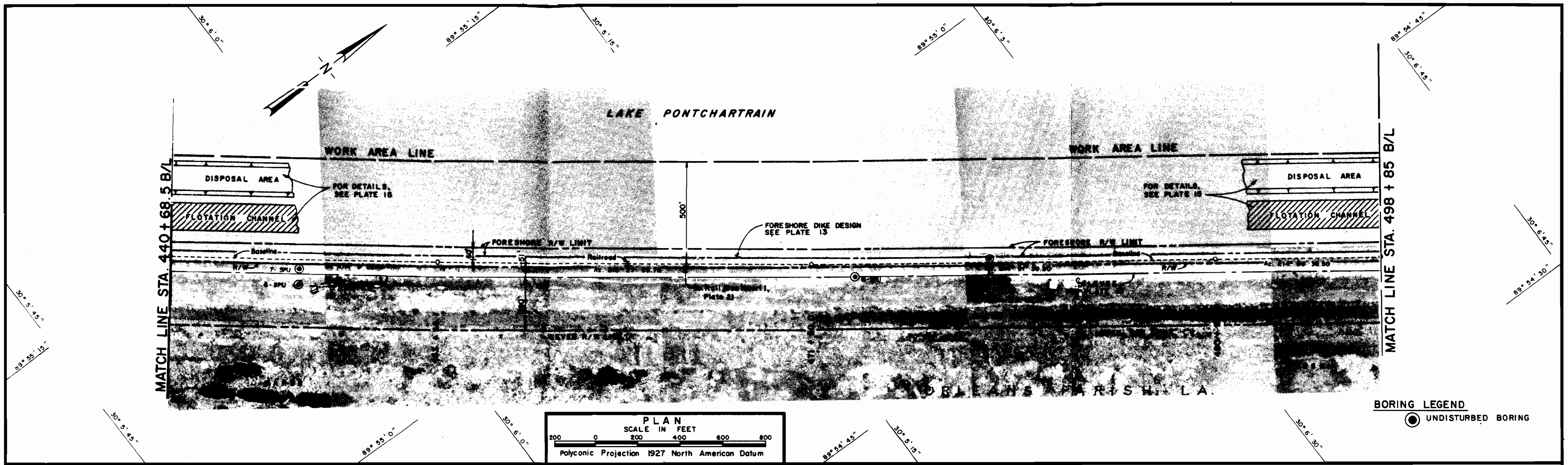
1. AERIAL PHOTOGRAPHS WERE FLOWN IN MARCH 82 AND ARE UNCONTROLLED MOSAIC.
2. ALL LATERAL CONTROL WILL BE REFERRED FROM THE SOUTHERNMOST RAIL OF THE INBOUND TRACK.
3. BASELINE IS LOCATED BETWEEN DOUBLE TRACK AND THE DISTANCE VARIES FROM THE SOUTH RAIL.
4. MAKE SMOOTH 50' TRANSITION BETWEEN FORESHORE DESIGN SECTIONS
5. ALL AZIMUTHS ARE TURNED IN A CLOCKWISE DIRECTION FROM 0° (DUE SOUTH)
6. FOR DETAIL BORING LOGS, SEE PLATES 19, 20, & 21.
7. UNLESS OTHERWISE NOTED ALL ELEVATIONS ARE EXPRESSED IN FEET AND REFER TO "NATIONAL GEODETIC VERTICAL DATUM" (N.G.V.D.)

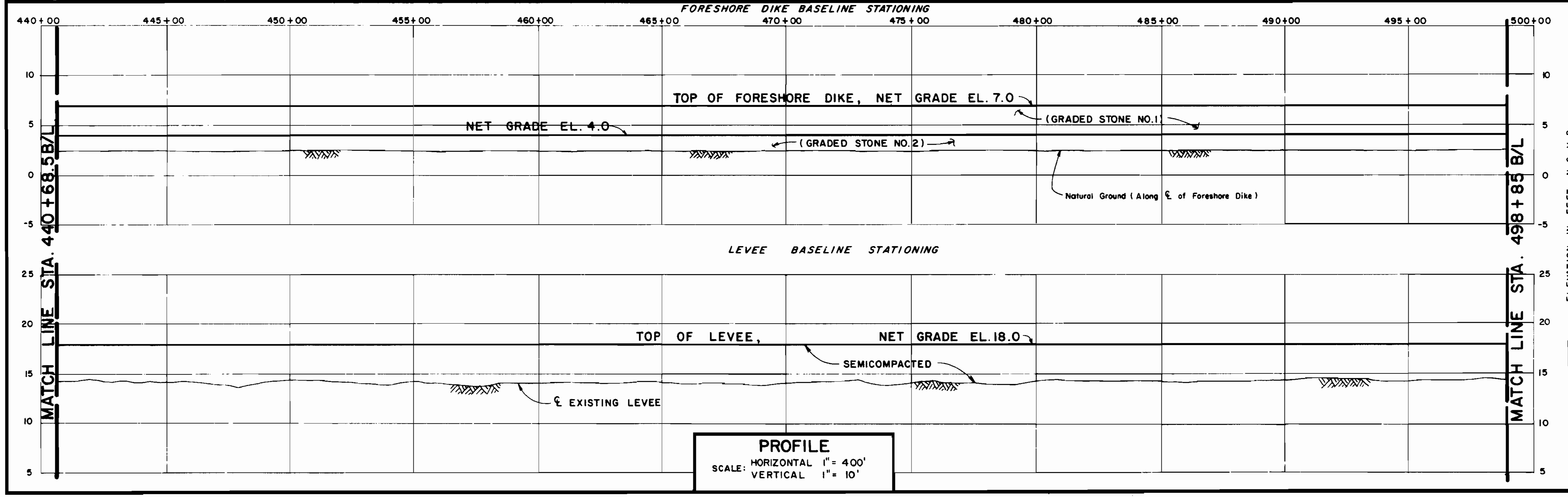
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PLAN AND PROFILE
STA. 383+06.4 TO STA. 440+68.5

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85 FILE NO. H-2-29820

PLATE 3





NOTES:

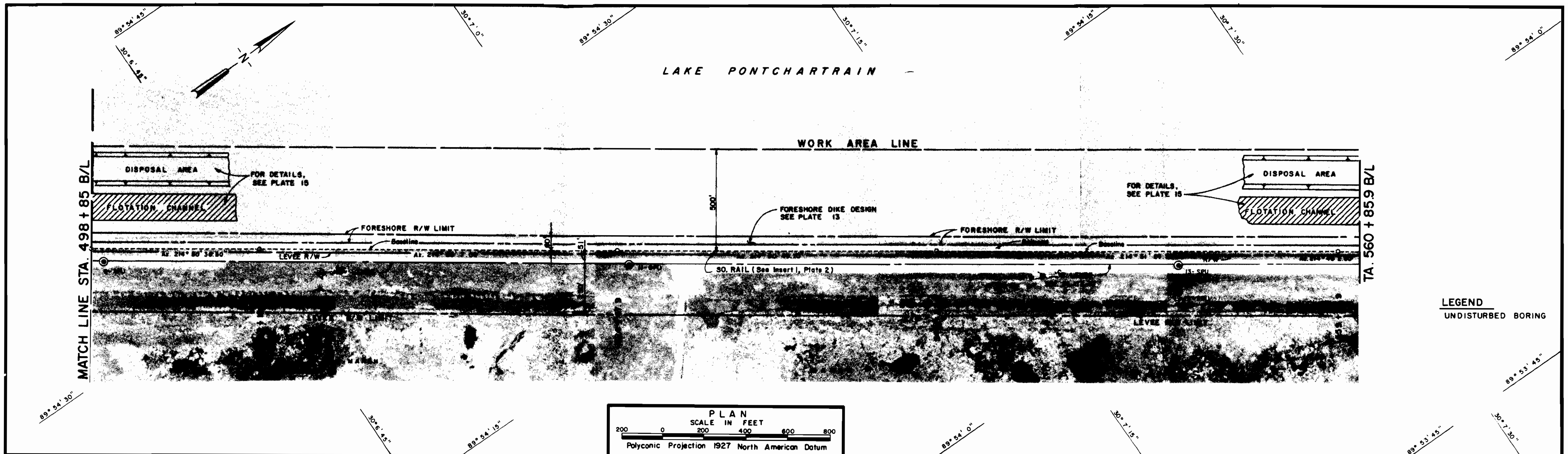
1. AERIAL PHOTOGRAPHS WERE FLOWN IN MARCH 82 AND ARE UNCONTROLLED MOSAIC.
2. ALL LATERAL CONTROL WILL BE REFERRED FROM THE SOUTHERNMOST RAIL OF THE INBOUND TRACK.
3. BASELINE IS LOCATED BETWEEN DOUBLE TRACK AND THE DISTANCE VARIES FROM THE SOUTH RAIL.
4. FOR DETAIL BORING LOGS, SEE PLATES 22, 23, 24, & 33.
5. ALL AZIMUTHS ARE TURNED IN A CLOCKWISE DIRECTION FROM 0° (DUE SOUTH)
6. UNLESS OTHERWISE NOTED ALL ELEVATIONS ARE EXPRESSED IN FEET AND REFER TO "NATIONAL GEODETIC VERTICAL DATUM" (N.G.V.D)

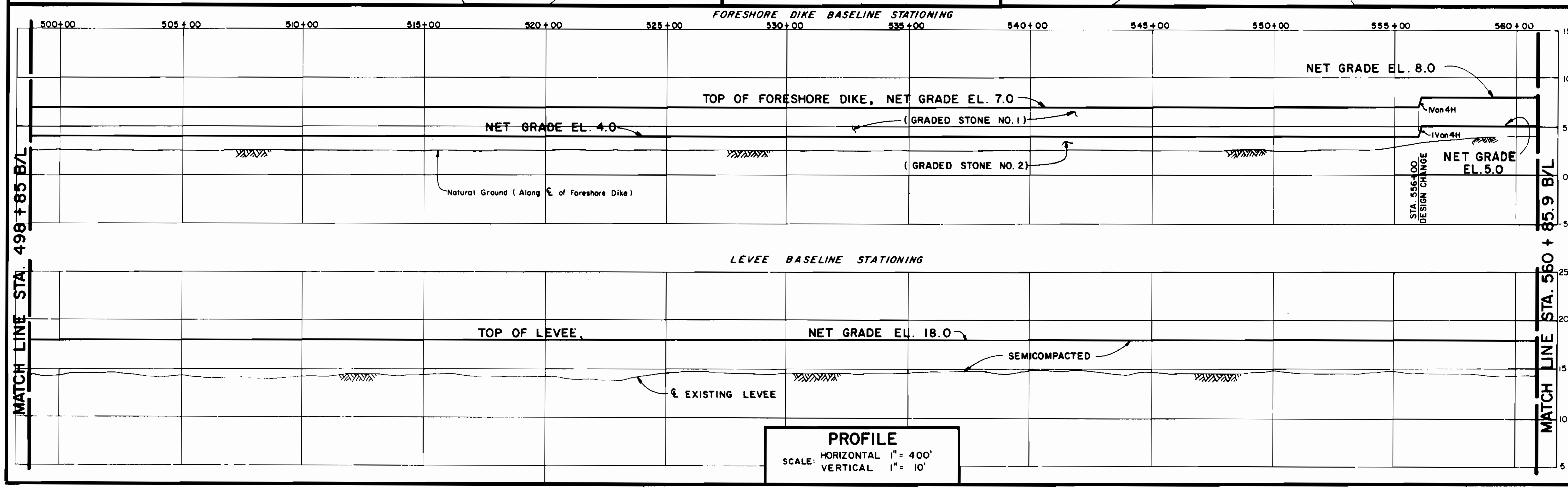
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PLAN AND PROFILE
STA. 440+68.5 TO STA. 498+85

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

FEB 85 FILE NO. H-2-29820





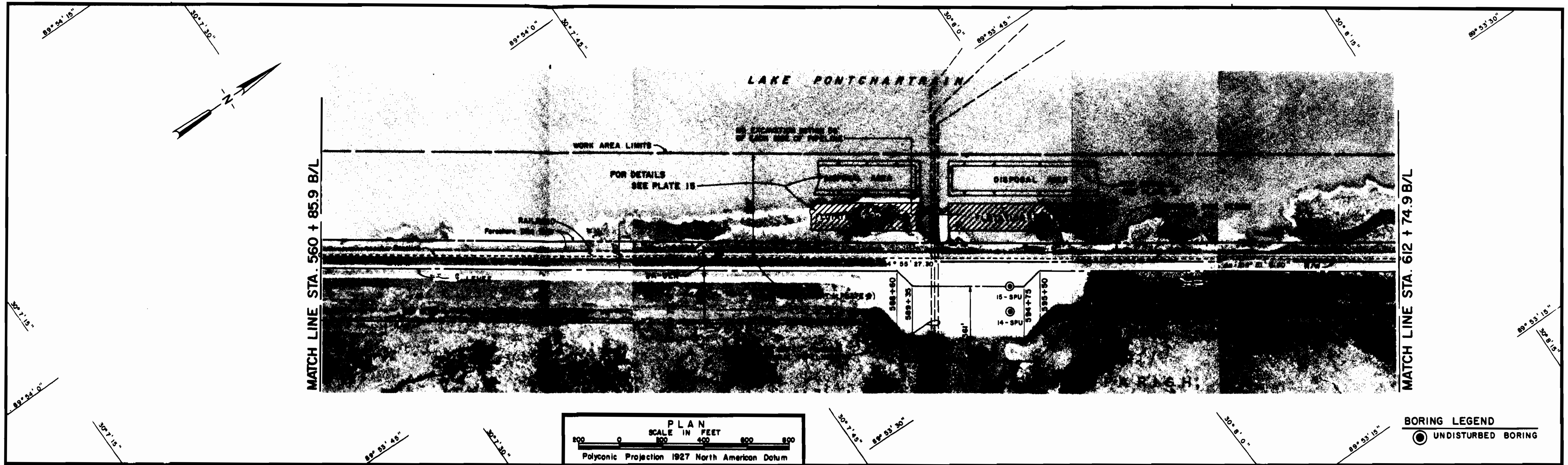
NOTES:

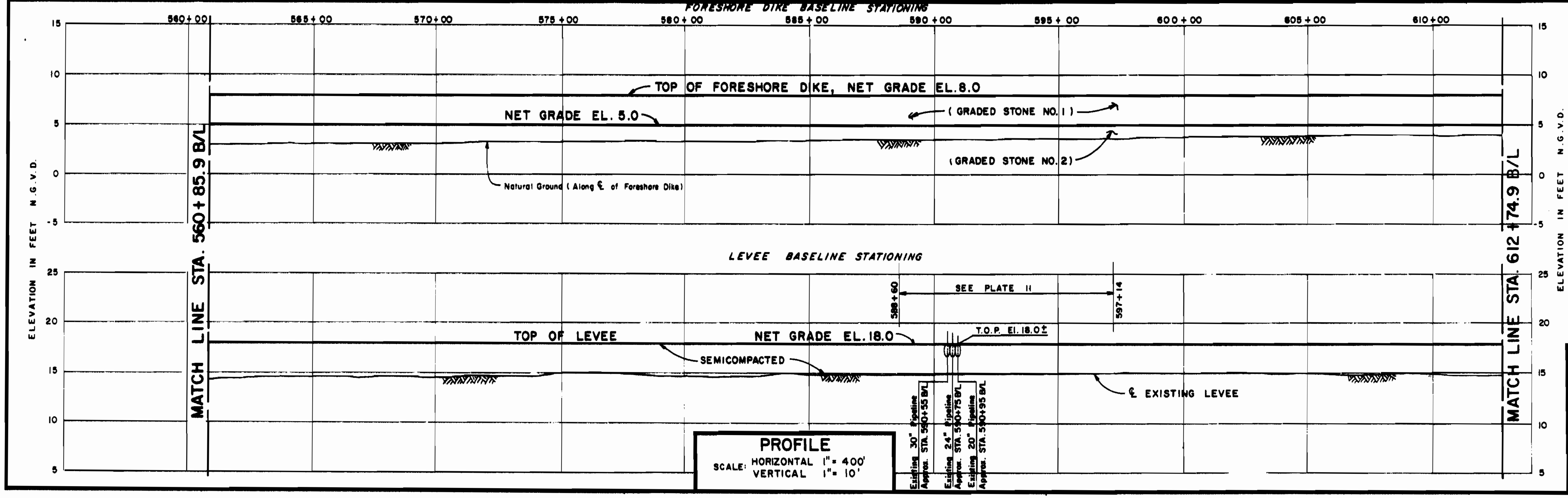
1. AERIAL PHOTOGRAPHS WERE FLOWN IN MARCH 82 AND ARE UNCONTROLLED MOSAIC.
2. ALL LATERAL CONTROL WILL BE REFERRED FROM THE SOUTHERNMOST RAIL OF THE INBOUND TRACK.
3. BASELINE IS LOCATED BETWEEN DOUBLE TRACK AND THE DISTANCE VARIES FROM THE SOUTH RAIL.
4. FOR DETAIL BORING LOGS, SEE PLATES 25 THRU 28.
5. ALL AZIMUTHS ARE TURNED IN A CLOCKWISE DIRECTION FROM 0° (DUE SOUTH)
6. UNLESS OTHERWISE NOTED ALL ELEVATIONS ARE EXPRESSED IN FEET AND REFER TO "NATIONAL GEODETIC VERTICAL DATUM" (N.G.V.D)
7. MAKE SMOOTH 50' TRANSITION BETWEEN FORESHORE DIKE DESIGN SECTIONS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PLAN AND PROFILE
STA. 498+85 TO STA. 560+85.9

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85 FILE NO. H-2-29820





NOTES:

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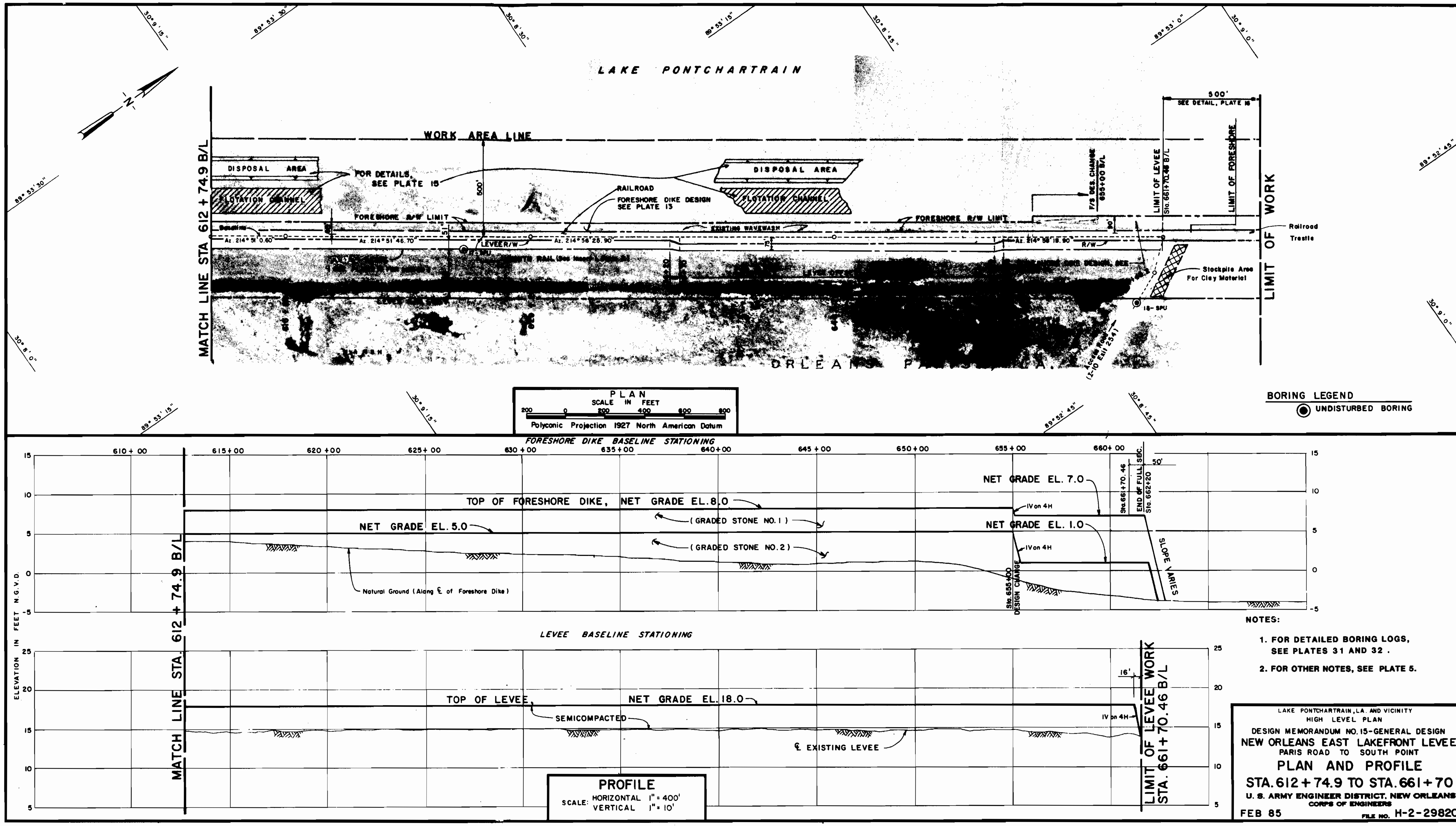
2. ALL LATERAL CONTROL WILL BE REFERRED FROM THE SOUTHERNMOST RAIL OF THE INBOUND TRACK.
3. BASELINE IS LOCATED BETWEEN DOUBLE TRACK AND THE DISTANCE VARIES FROM THE SOUTH RAIL.
4. FOR DETAILED BORING LOGS, SEE PLATES 29, 30, & 34.
5. FOR OTHER NOTES, SEE PLATE 5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PLAN AND PROFILE
STA. 560+85.9 TO STA. 612+74.9
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85 FILE NO. H-2-29820



NOTES:

1. FOR DETAILED BORING LOGS, SEE PLATES 31 AND 32.
2. FOR OTHER NOTES, SEE PLATE 5.

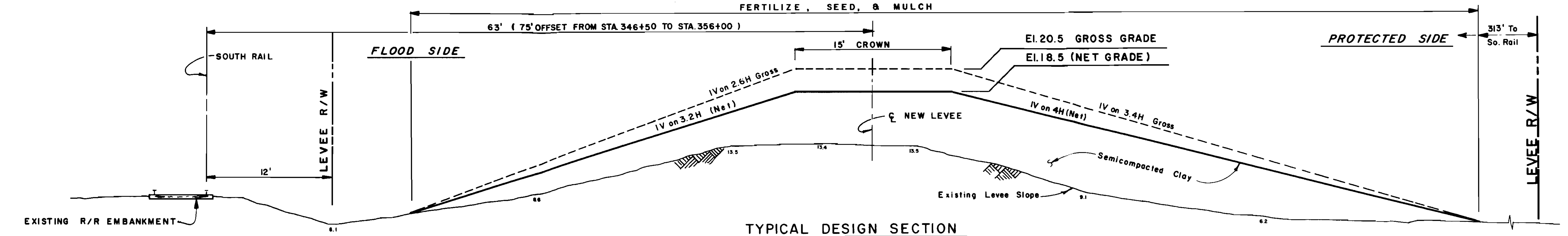
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PLAN AND PROFILE

STA. 612+74.9 TO STA. 661+70

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

FEB 85 FILE NO. H-2-29820

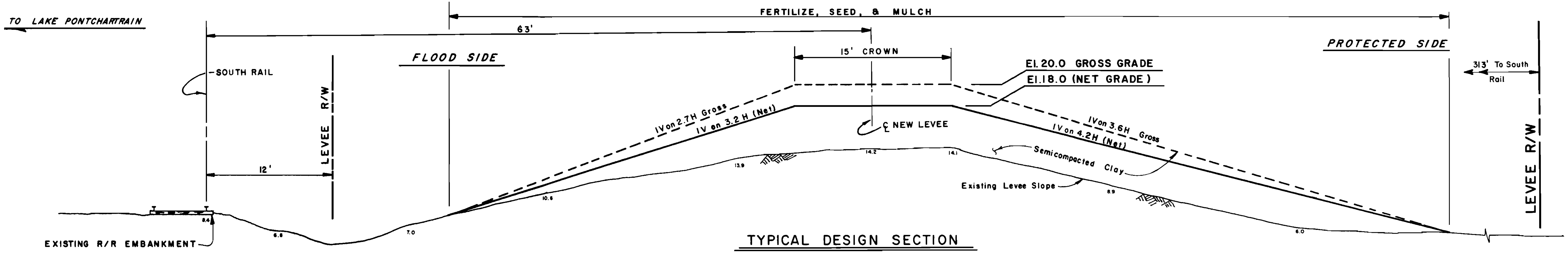


TYPICAL DESIGN SECTION

APPROX. STA. 331+50 B/L TO APPROX. STA. 364+50 B/L
(Not To Scale)

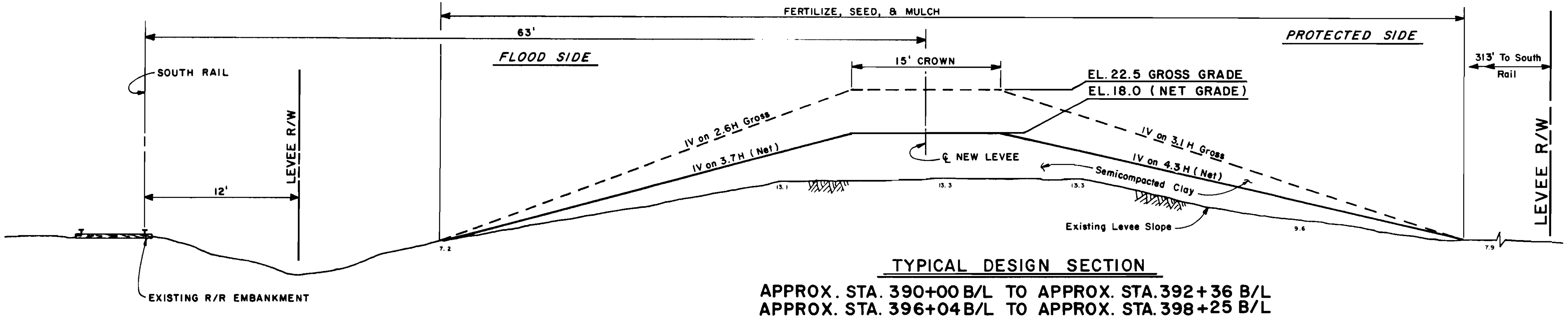
TO INTERIOR DRAINAGE DITCH

TO LAKE PONTCHARTRAIN



TYPICAL DESIGN SECTION

APPROX. STA. 364+50 B/L TO APPROX. STA. 390+00 B/L
APPROX. STA. 398+25 B/L TO APPROX. STA. 436+50 B/L
(Not To Scale)



TYPICAL DESIGN SECTION

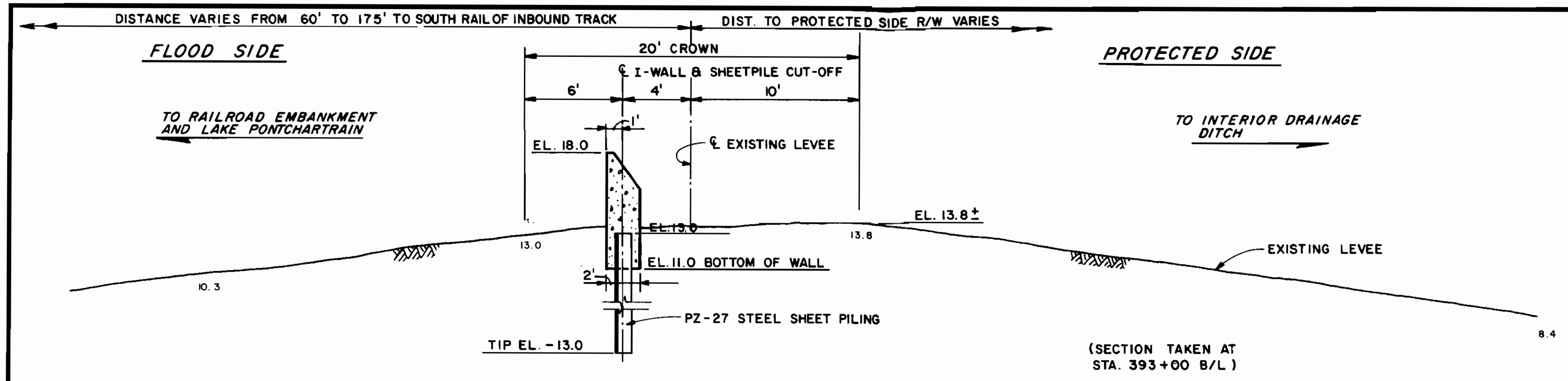
APPROX. STA. 390+00 B/L TO APPROX. STA. 392+36 B/L
APPROX. STA. 396+04 B/L TO APPROX. STA. 398+25 B/L
(Not To Scale)

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

LEVEE DESIGN SECTIONS

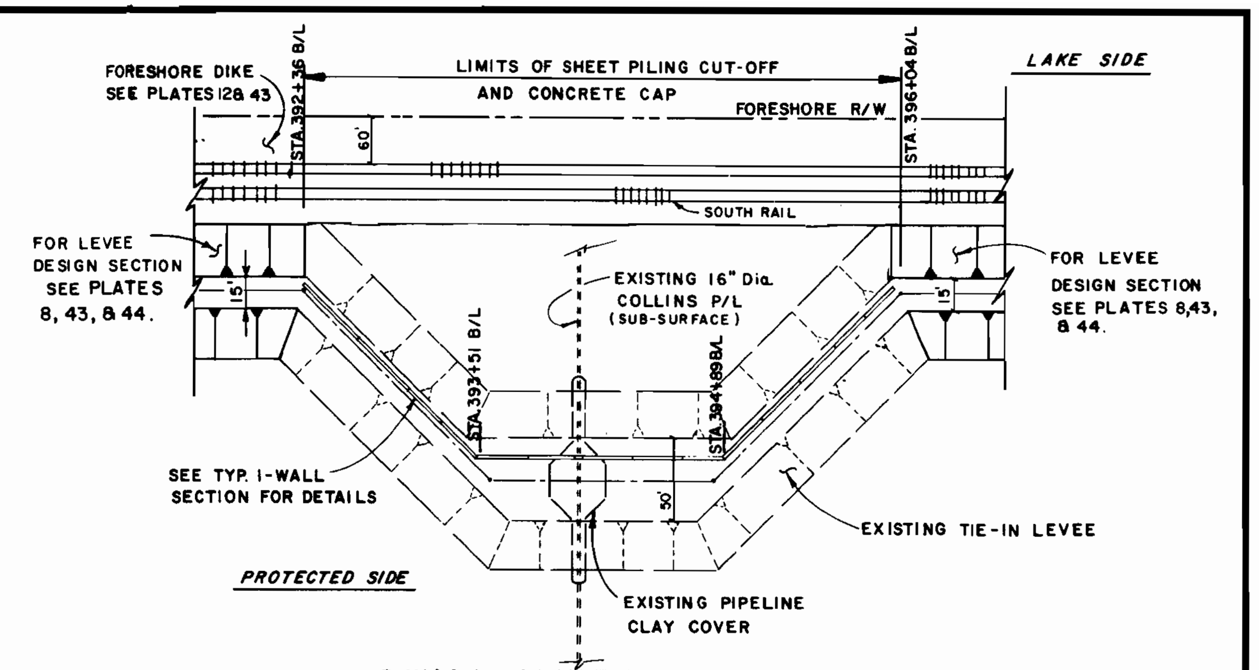
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB 85 — FILE NO. H-2-29820



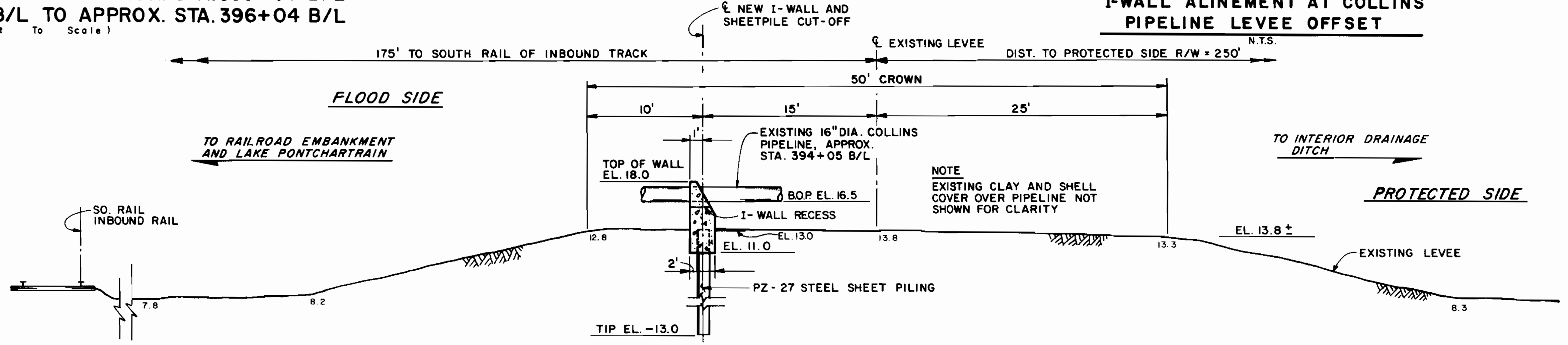
TYPICAL I-WALL SECTION AT TIE-IN LEVEE

APPROX. STA. 392+36 B/L TO APPROX. STA. 393+51 B/L
APPROX. STA. 394+89 B/L TO APPROX. STA. 396+04 B/L
(Not To Scale)



I-WALL ALINEMENT AT COLLINS PIPELINE LEVEE OFFSET

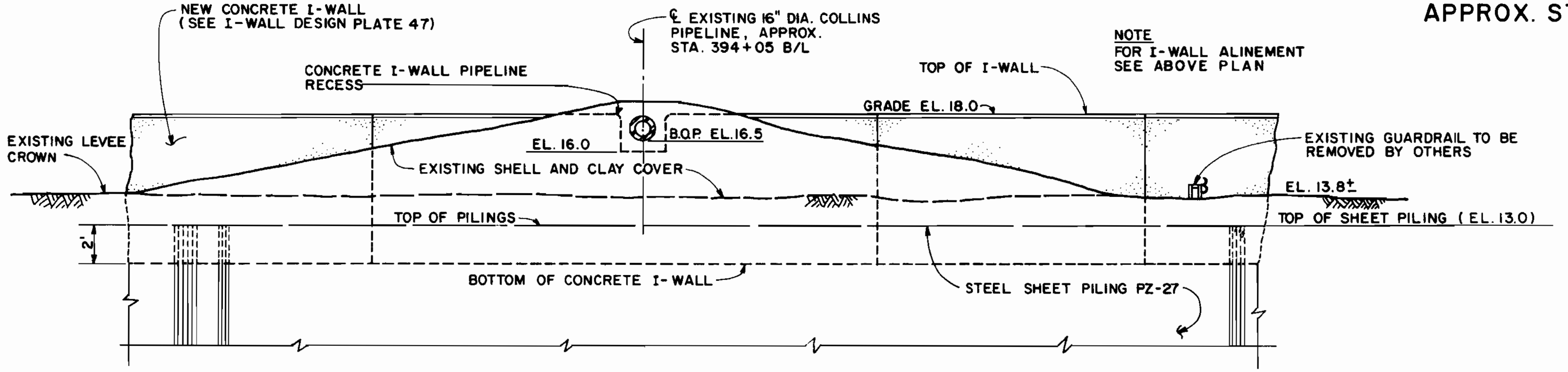
N.T.S.



(SECTION TAKEN AT STA. 394+00 B/L)

TYPICAL I-WALL SECTION AT P/L CROSSING

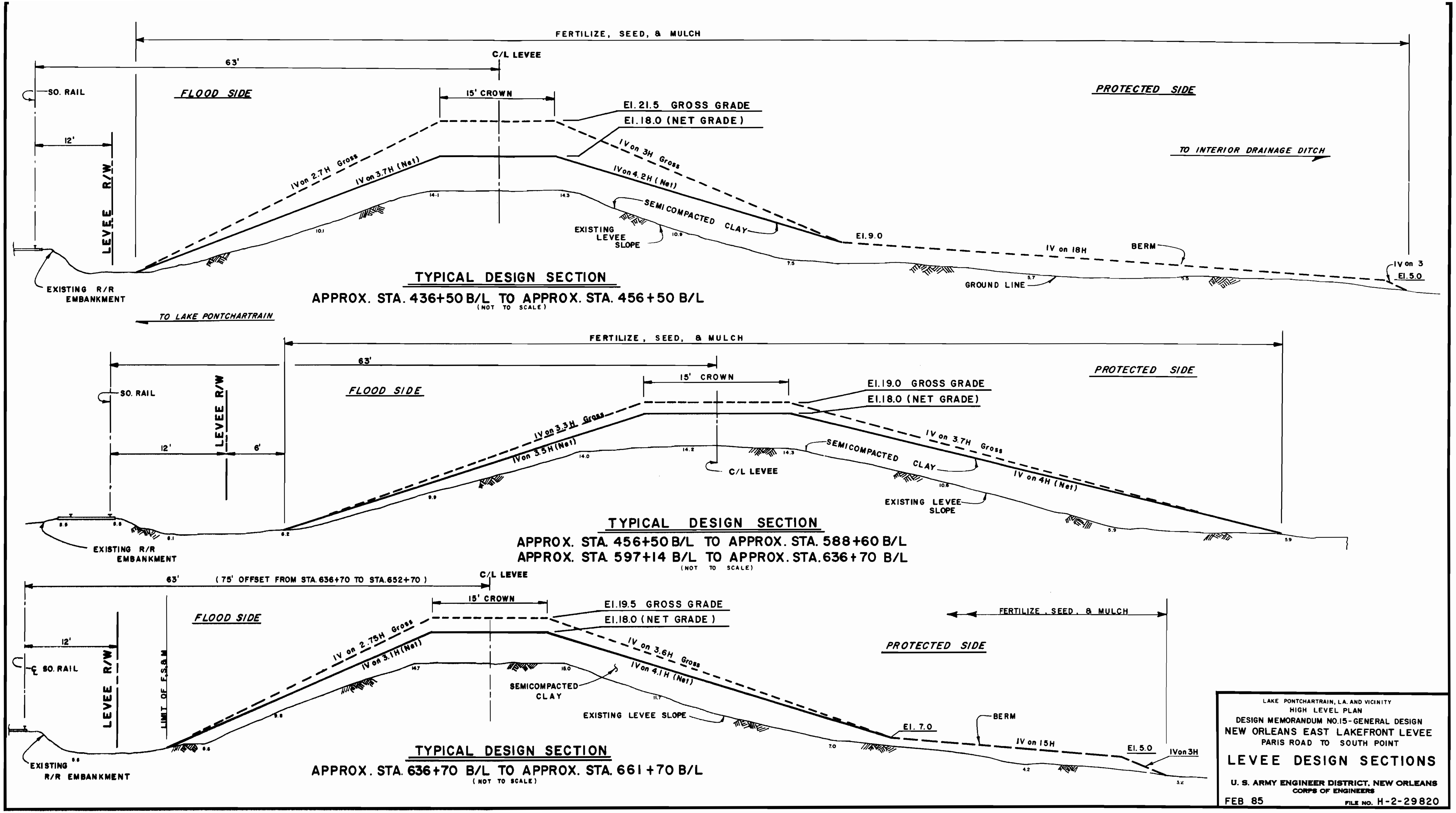
APPROX. STA. 393+51 B/L TO APPROX. STA. 394+89 B/L
(Not To Scale)

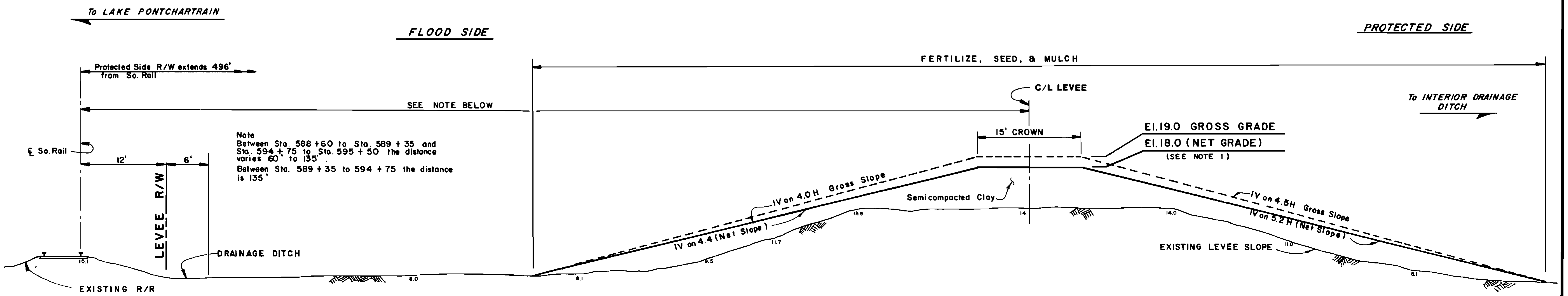


PROFILE ALONG C/L OF EXISTING LEVEE

(EXISTING EARTHEN COVER AT PIPELINE CROSSING)
(Not To Scale)

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
I-WALL DESIGN SECTION
(COLLINS CO. PIPELINE)
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85 FILE NO. H-2-29820


FERTILIZE, SEED, & MULCH
63'
C/L LEVEE
SO. RAIL
FLOOD SIDE
15' CROWN
PROTECTED SIDE
El. 21.5 GROSS GRADE
El. 18.0 (NET GRADE)
12'
LEVEE R/W
1V on 2.7H Gross
1V on 3.7H (Net)
1V on 3H Gross
1V on 4.2H (Net)
TO INTERIOR DRAINAGE DITCH
SEMICOMPACTED CLAY
EXISTING LEVEE SLOPE
El. 9.0
1V on 18H
BERM
1V on 3
El. 5.0
GROUND LINE
EXISTING R/R EMBANKMENT
TYPICAL DESIGN SECTION
APPROX. STA. 436+50 B/L TO APPROX. STA. 456+50 B/L
(NOT TO SCALE)
TO LAKE PONTCHARTRAIN
FERTILIZE, SEED, & MULCH
63'
SO. RAIL
LEVEE R/W
FLOOD SIDE
15' CROWN
PROTECTED SIDE
El. 19.0 GROSS GRADE
El. 18.0 (NET GRADE)
12'
6'
1V on 3.3H Gross
1V on 3.5H (Net)
1V on 3.7H Gross
1V on 4H (Net)
SEMICOMPACTED CLAY
C/L LEVEE
EXISTING LEVEE SLOPE
EXISTING R/R EMBANKMENT
TYPICAL DESIGN SECTION
APPROX. STA. 456+50 B/L TO APPROX. STA. 588+60 B/L
APPROX. STA. 597+14 B/L TO APPROX. STA. 636+70 B/L
(NOT TO SCALE)
63' (75' OFFSET FROM STA. 636+70 TO STA. 652+70)
C/L LEVEE
15' CROWN
El. 19.5 GROSS GRADE
El. 18.0 (NET GRADE)
FLOOD SIDE
FERTILIZE, SEED, & MULCH
PROTECTED SIDE
12'
℄ SO. RAIL
LEVEE R/W
LIMIT OF F.S.&M.
1V on 2.75H Gross
1V on 3.1H (Net)
1V on 3.6H Gross
1V on 4.1H (Net)
SEMICOMPACTED CLAY
EXISTING LEVEE SLOPE
El. 7.0
BERM
1V on 15H
El. 5.0
1V on 3H
EXISTING R/R EMBANKMENT
TYPICAL DESIGN SECTION
APPROX. STA. 636+70 B/L TO APPROX. STA. 661+70 B/L
(NOT TO SCALE)
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LEVEE DESIGN SECTIONS
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85
FILE NO. H-2-29820



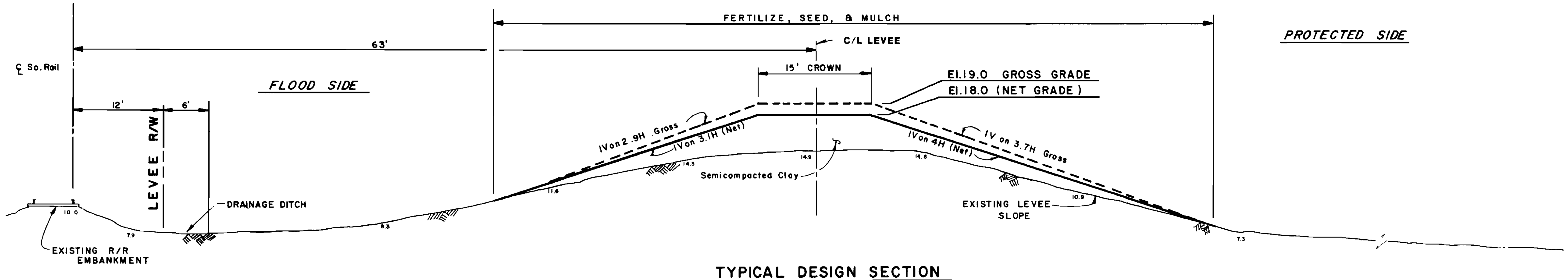
NOTE: FOR DETAIL OF PIPELINE CROSSING , SEE PLATES 56 AND 57

TYPICAL DESIGN SECTION

APPROX. STA. 588+60 B/L TO APPROX. STA. 595 +50 B/L

(SO. NATURAL GAS PIPELINE CROSSING)

NOT TO SCALE



TYPICAL DESIGN SECTION

APPROX. STA. 595+50 B/L TO APPROX. STA. 597+14 B/L

(TIE-IN LEVEE)

NOT TO SCALE

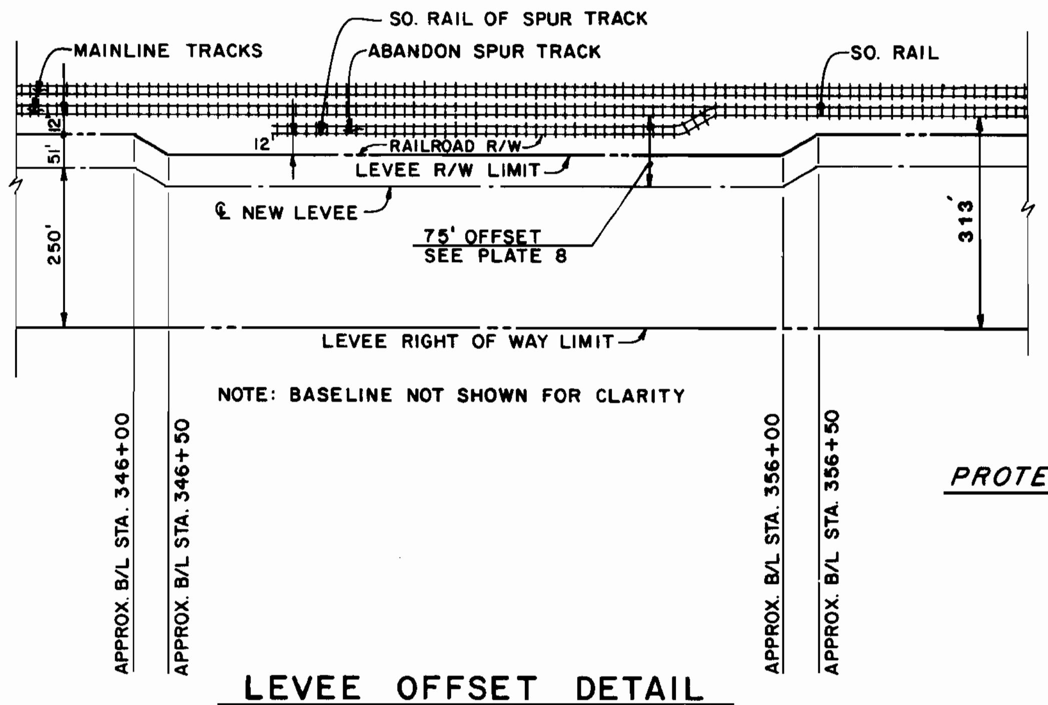
NOTE:
1. 1 Foot Minimum Earthen Cover Will Be Placed Over Pipelines, Both On The Levee Crown, As Well As The Landside And Lakeside Slopes.
2. For pipeline cover see stability plate 56.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

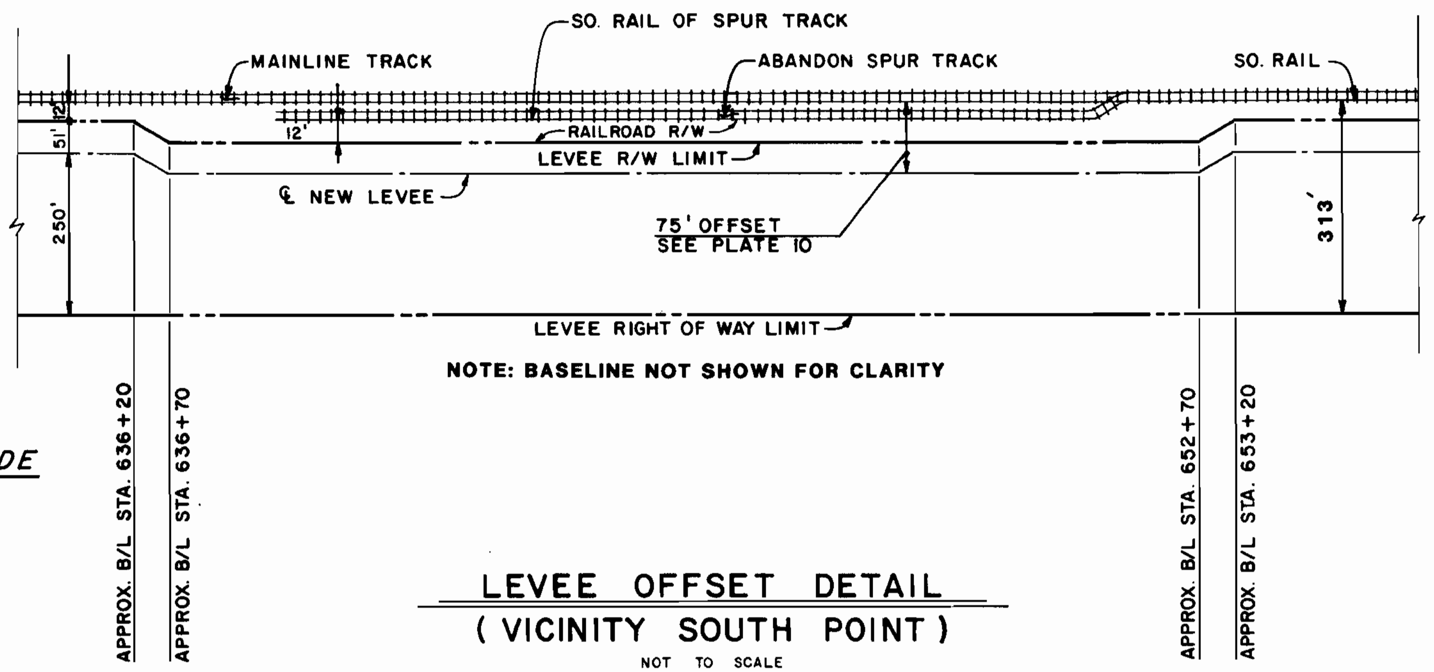
LEVEE DESIGN SECTIONS (SO. NATURAL PIPELINE)

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

FEB 85 FILE NO. H-2-29820



LEVEE OFFSET DETAIL
(VICINITY PARIS ROAD)
NOT TO SCALE



LEVEE OFFSET DETAIL
(VICINITY SOUTH POINT)
NOT TO SCALE

GRADED REVETMENT CHART

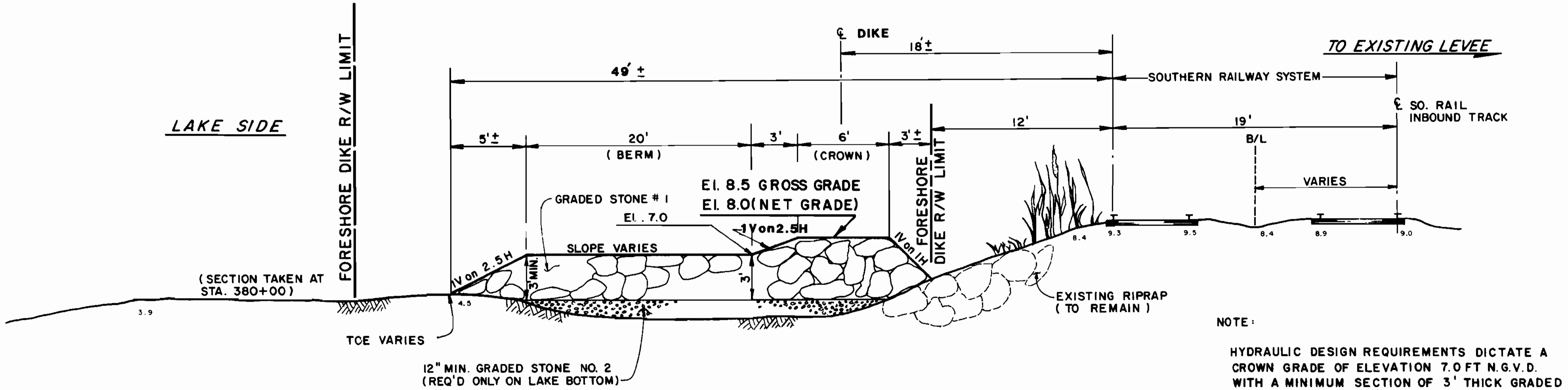
GRADED STONE NO. 1

PERCENT LIGHTER BY WEIGHT (SSD)	STONE WEIGHT (POUNDS)
100	2200 – 900
50	930 – 400
15	460 – 130

GRADED STONE NO. 2

PERCENT LIGHTER BY WEIGHT (SSD)	STONE WEIGHT (POUNDS)
10C	25 – 10
50	10 – 5
15	5 – 2

(SATURATED SURFACE DRY)



TYPICAL FORESHORE DIKE SECTION
APPROX. STA. 364+50 B/L TO APPROX. STA. 436+50 B/L
NOT TO SCALE

NOTE:

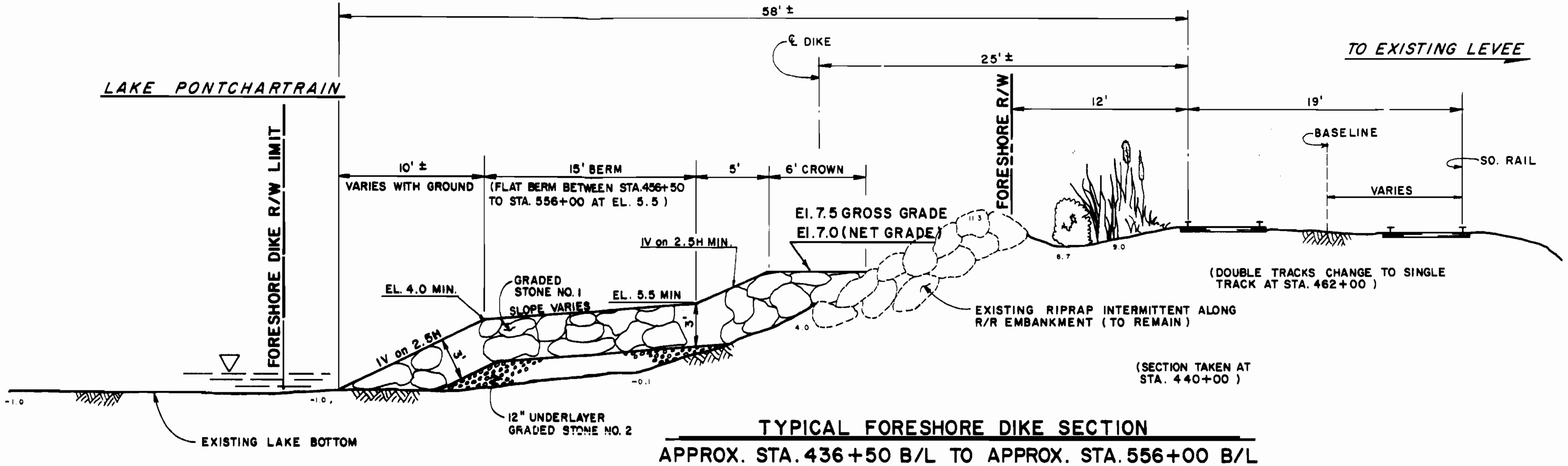
HYDRAULIC DESIGN REQUIREMENTS DICTATE A CROWN GRADE OF ELEVATION 7.0 FT N.G.V.D. WITH A MINIMUM SECTION OF 3' THICK GRADED STONE NO. 1 AND 12" THICK GRADED STONE NO. 2. THEREFORE, BASED ON EXISTING GROUND CONDITIONS THE CROWN GROSS GRADE FOR THIS REACH WILL BE El. 8.5 WITH NET GRADE OF El. 8.0.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

FORESHORE DESIGN SECTION

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

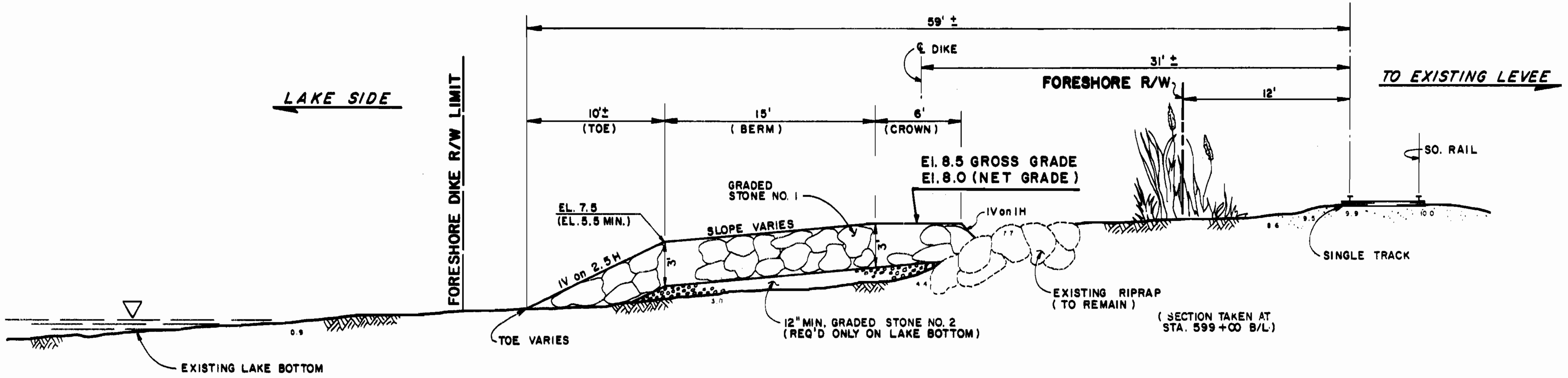
FEB 85 FILE NO. H-2-29820



TYPICAL FORESHORE DIKE SECTION

APPROX. STA. 436+50 B/L TO APPROX. STA. 556+00 B/L

NOT TO SCALE



NOTE:
BASELINE NOT SHOWN FOR CLARITY

TYPICAL FORESHORE DIKE SECTION

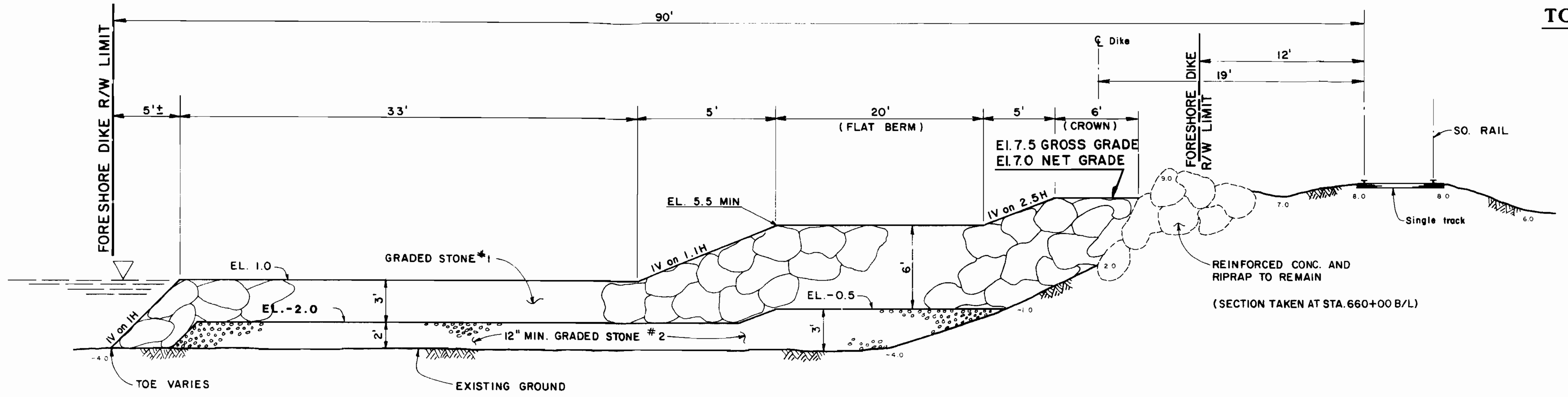
APPROX. STA. 556+00 B/L TO APPROX. STA. 655+00 B/L

NOT TO SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

FORESHORE DESIGN SECTION

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB 85 FILE NO. H-2-29820



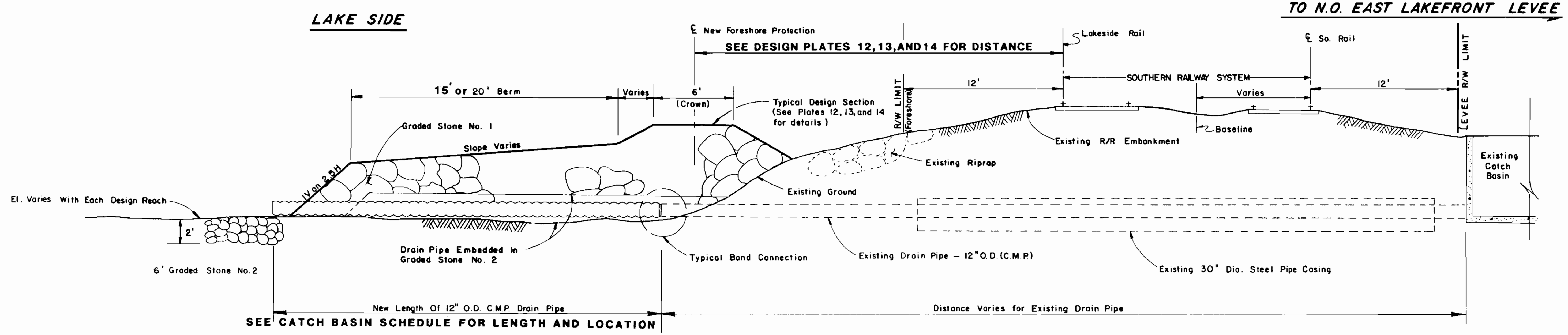
TYPICAL FORESHORE DIKE SECTION

APPROX. STA. 655+00 B/L TO APPROX. STA. 661+70 B/L

NOT TO SCALE

(VICINITY OF SOUTH POINT)

CATCH BASIN SCHEDULE	
APPROX. B/L STATIONS	
40' Length 12" C.M.P.	512 + 00
368 + 00	518 + 00
374 + 00	524 + 00
380 + 00	530 + 00
386 + 00	536 + 00
392 + 00	542 + 00
398 + 00	548 + 00
404 + 00	554 + 00
410 + 00	20' Length 12" C.M.P.
416 + 00	560 + 00
422 + 00	566 + 00
428 + 00	572 + 00
434 + 00	578 + 00
30' Length 12" C.M.P.	584 + 00
440 + 00	590 + 00
446 + 00	596 + 00
452 + 00	602 + 00
458 + 00	608 + 00
464 + 00	614 + 00
470 + 00	620 + 00
476 + 00	626 + 00
482 + 00	632 + 00
488 + 00	638 + 00
494 + 00	644 + 00
500 + 00	650 + 00
506 + 00	50' Length 12" C.M.P.
	656 + 00



TYPICAL DRAIN PIPE EXTENSION DETAIL

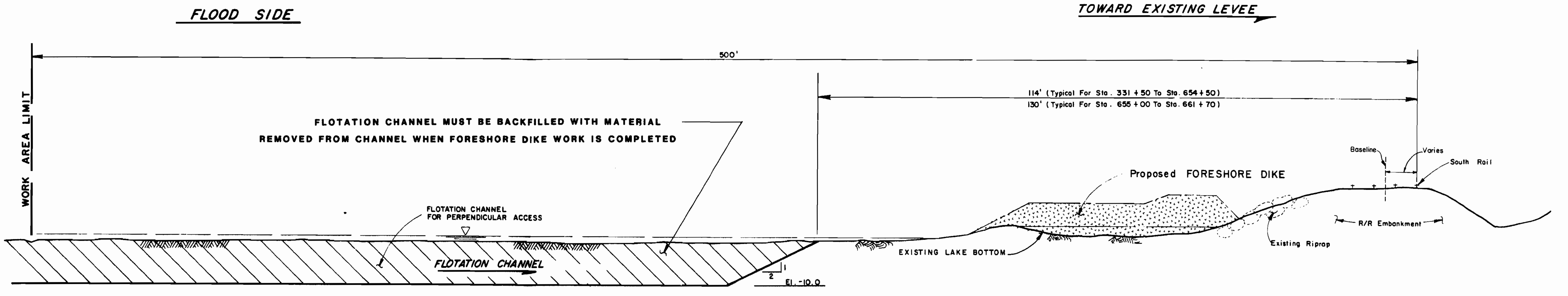
NOT TO SCALE

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

FORESHORE DESIGN SECTION

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

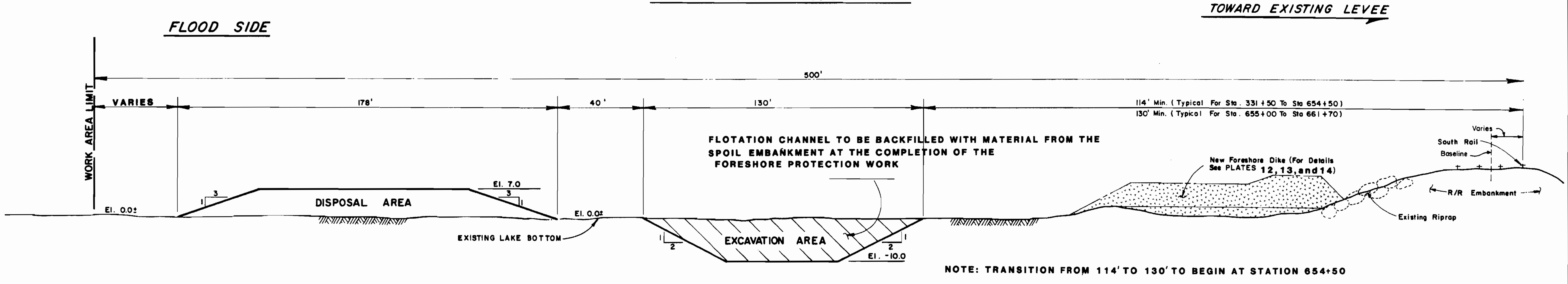
FEB 85 FILE NO. H-2-29820



PROFILE ALONG FLOTATION CHANNEL

NOT TO SCALE

VICINITY OF STA. 367 + 00, STA. 493 + 00
AND STA. 661 + 00 B/L



DESIGN SECTION FOR LATERAL FLOTATION CHANNEL

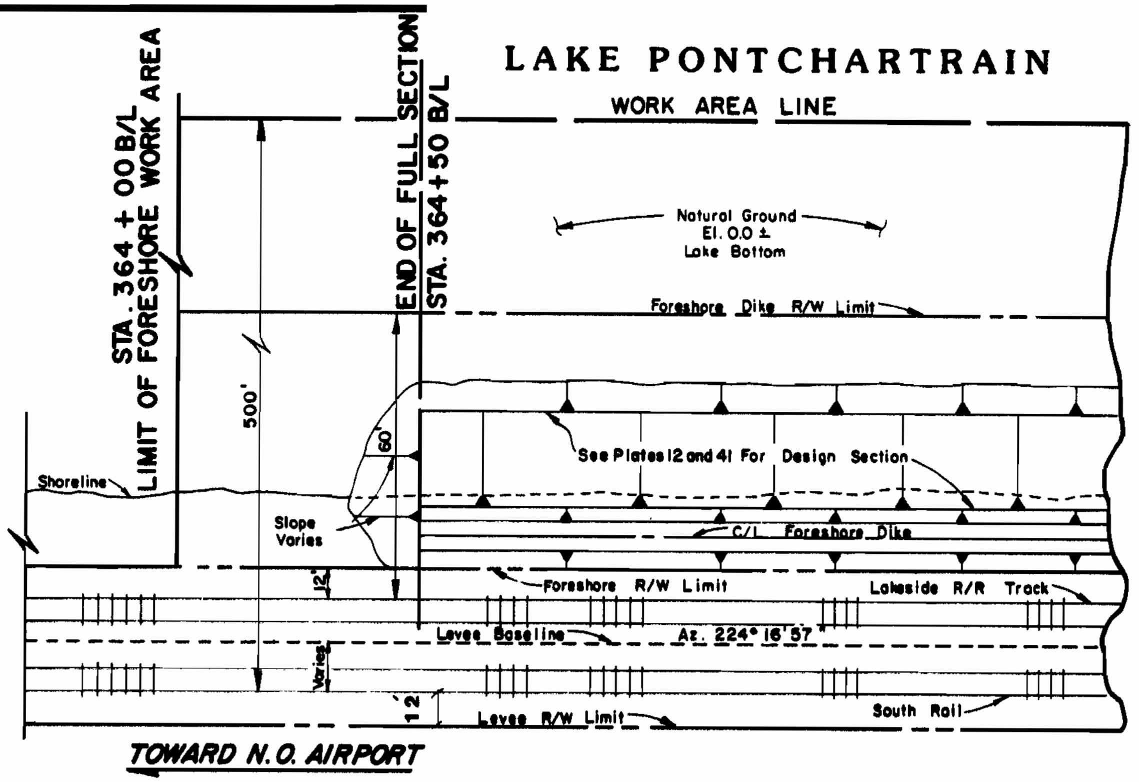
NOT TO SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 – GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

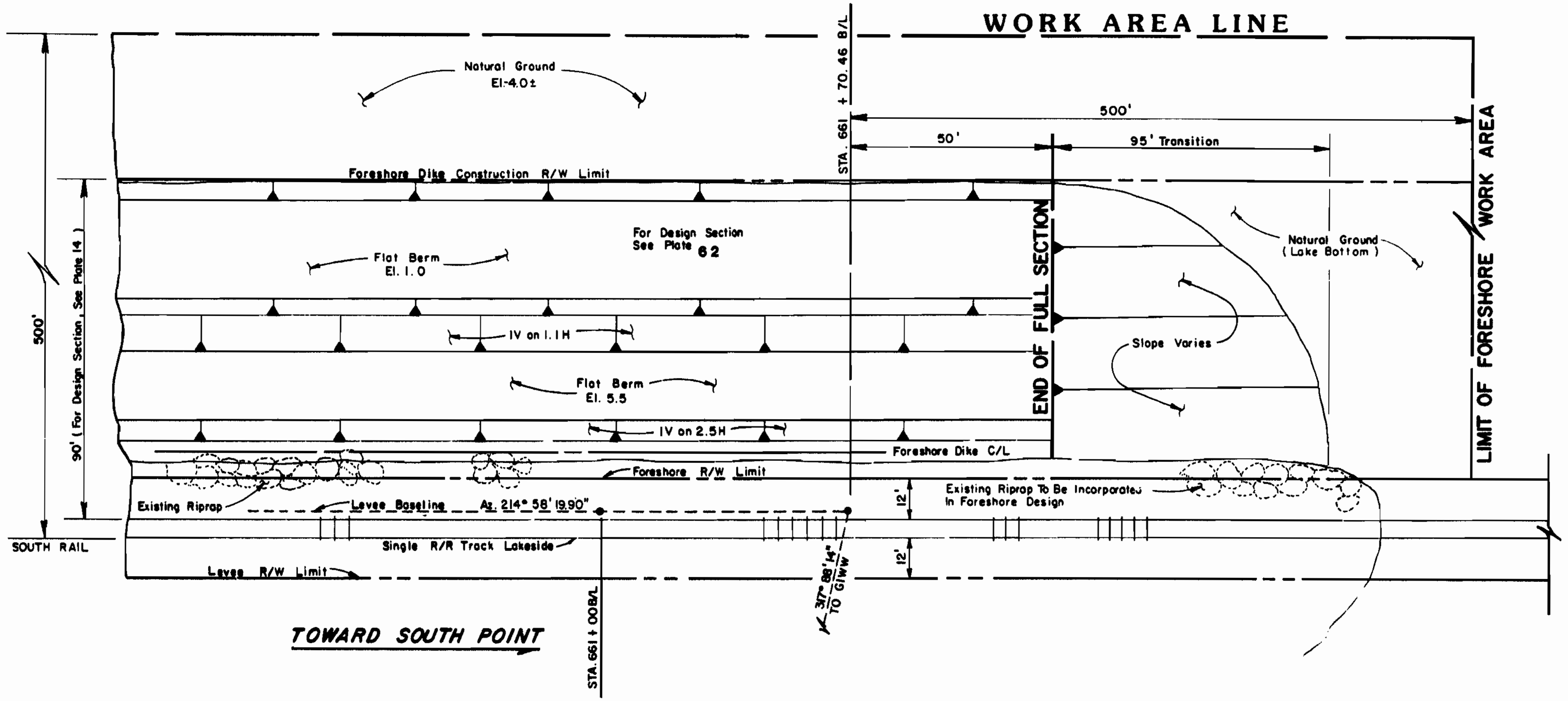
TYPICAL FLOTATION CHANNEL

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

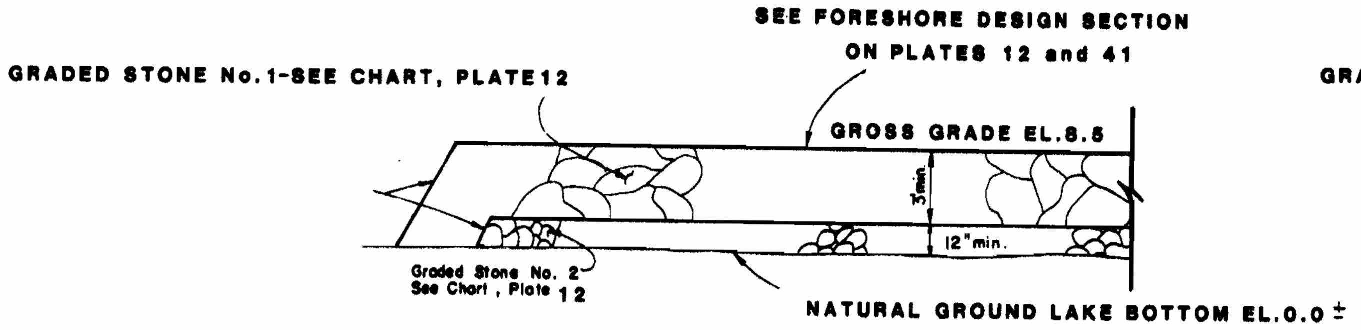
FEB 85 FILE NO. H-2-29820



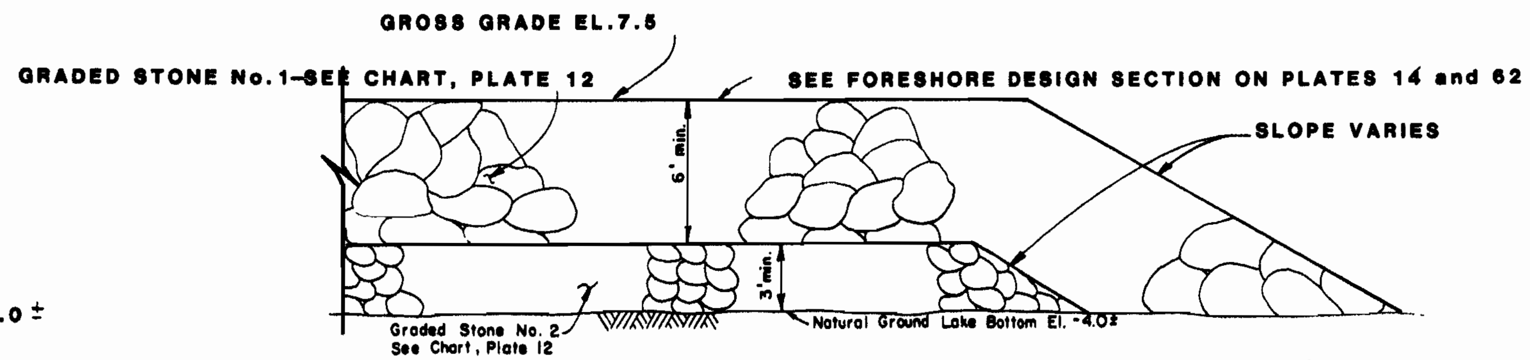
PLAN OF FORESHORE DIKE
(VICINITY OF STA. 364 + 50 B/L)
NOT TO SCALE



PLAN OF FORESHORE DIKE
(VICINITY STA 661 + 70 B/L)
NOT TO SCALE



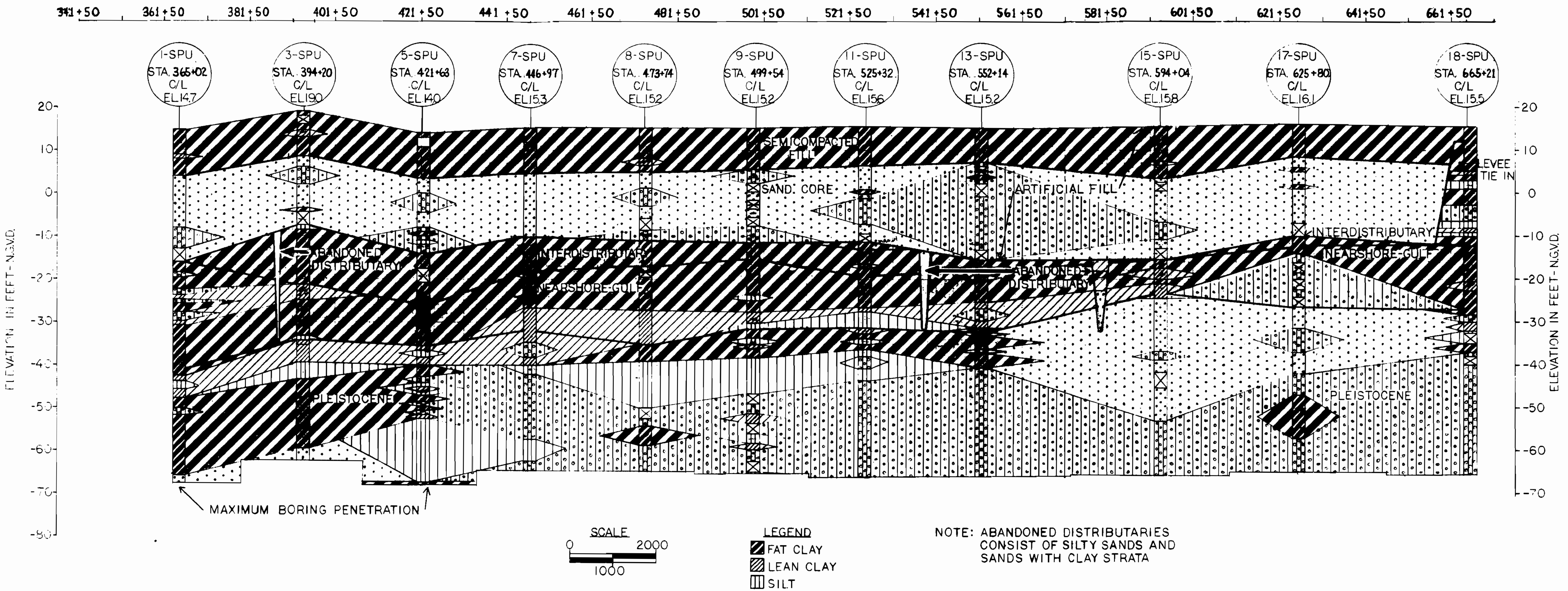
FORESHORE DIKE END DETAIL
(VICINITY OF STA. 364 +50 B/L)
NOT TO SCALE



NOTE: END OF FORESHORE DIKE, TRANSITION TO NATURAL GROUND.

FORESHORE DIKE END DETAIL
(VICINITY STA. 661 + 70 B/L)
NOT TO SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
FORESHORE DIKE END DETAILS
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 85 FILE NO. H-2-29820



LEGEND
- FAT CLAY
- LEAN CLAY
- SILT
- SILTY SAND
- SAND
- NO SAMPLE

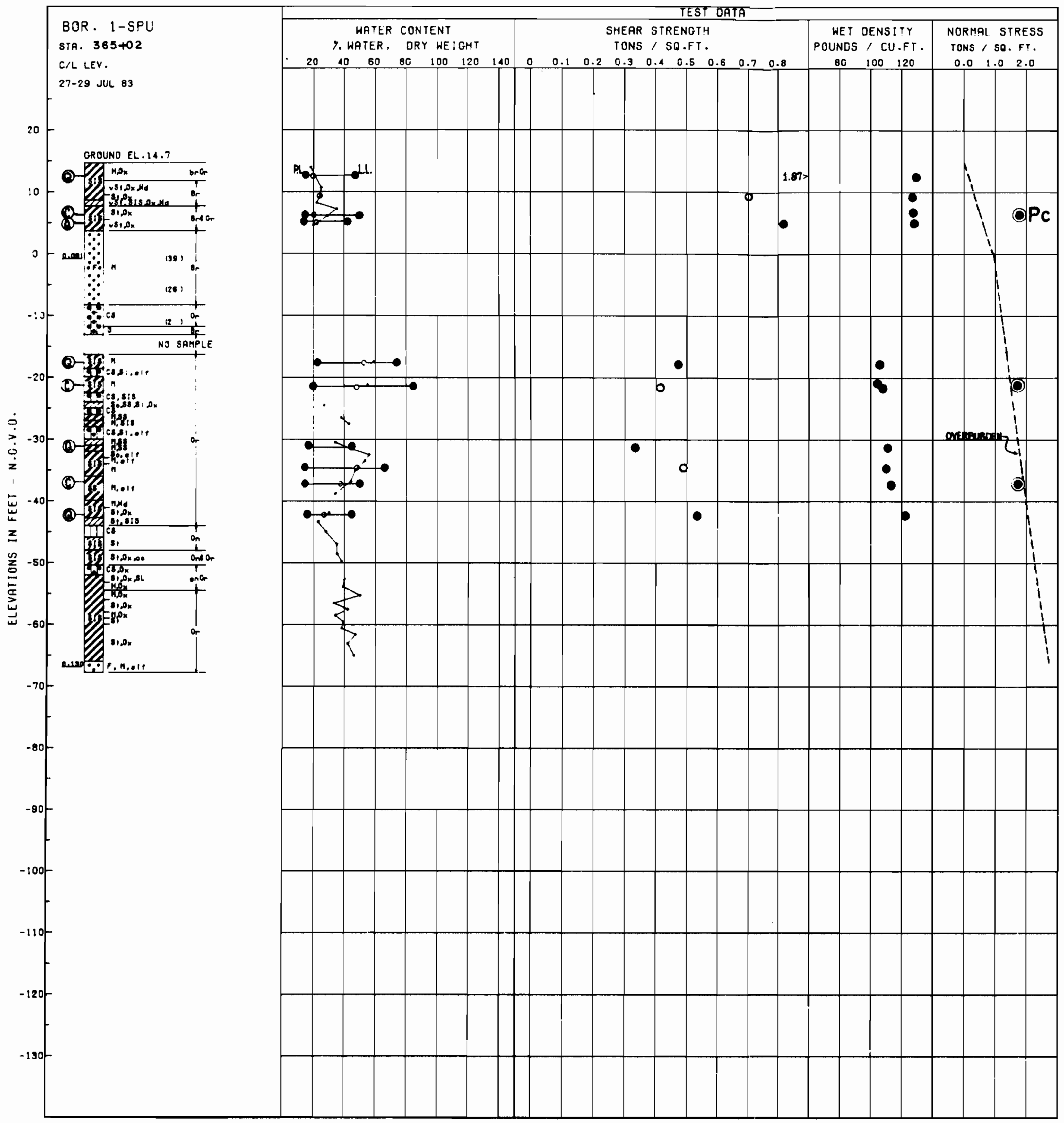
NOTE: ABANDONED DISTRIBUTARIES CONSIST OF SILTY SANDS AND SANDS WITH CLAY STRATA

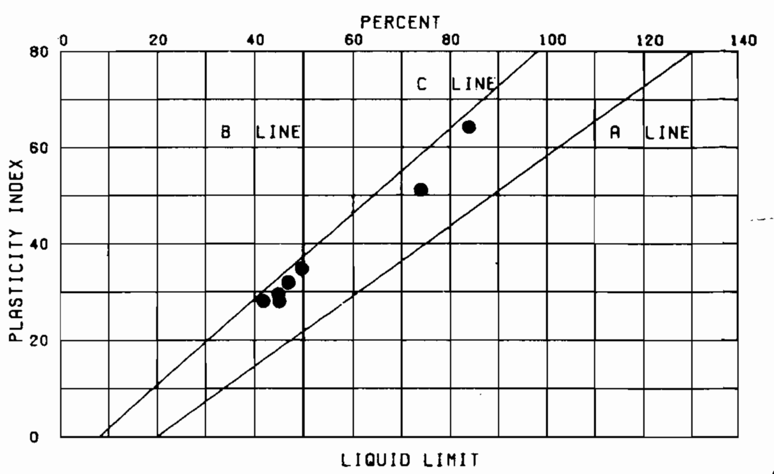
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

SOIL AND GEOLOGIC PROFILE ALONG LEVEE CENTERLINE

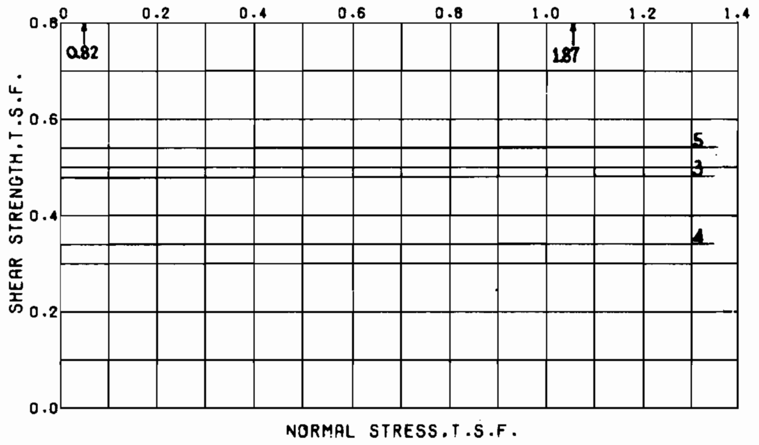
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



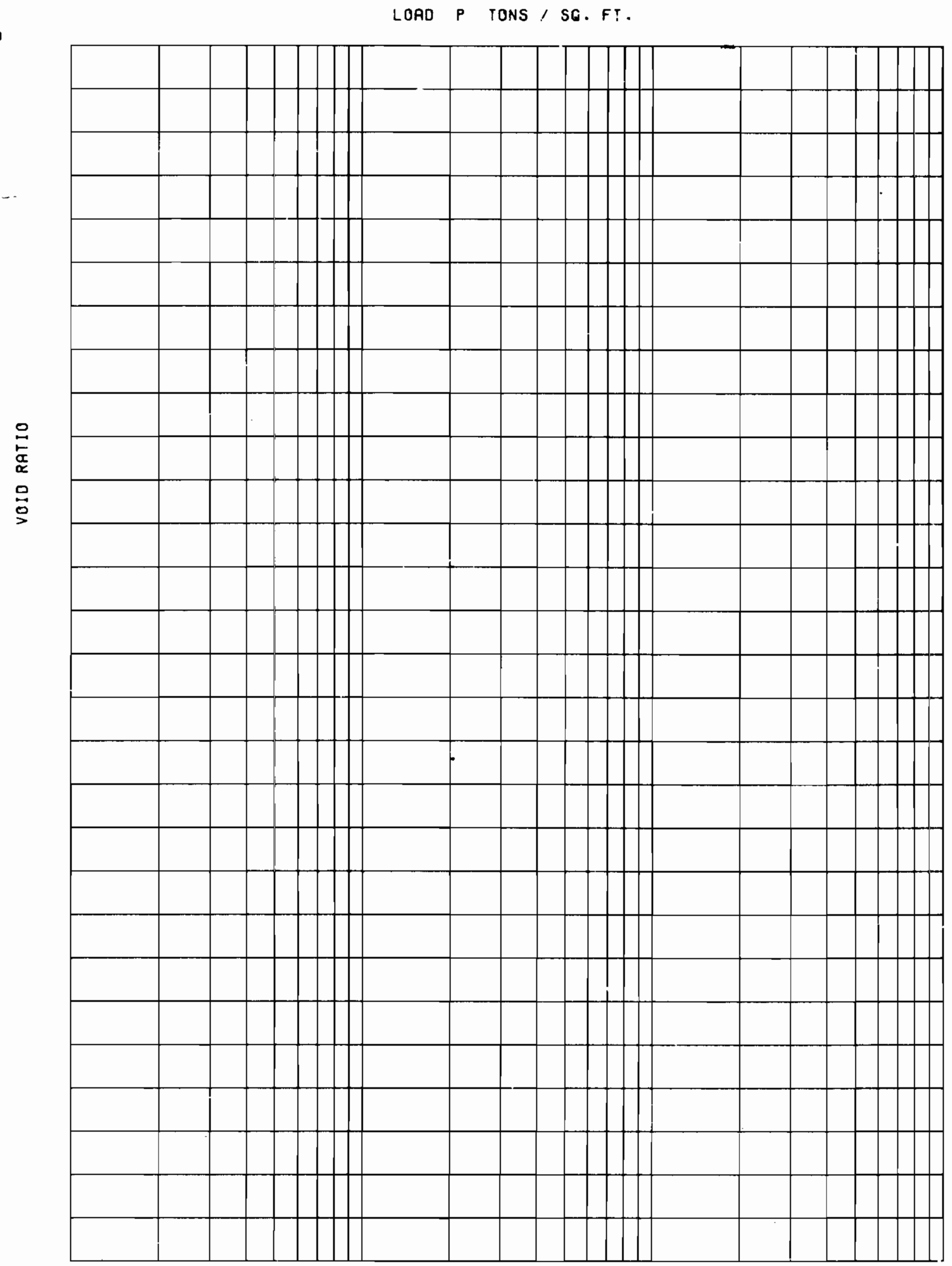


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	12.5	Q	0°	1.87	CL
2	5.0	Q	0°	0.82	CL
3	-17.8	Q	0°	0.48	CH
4	-31.3	Q	0°	0.34	CL
5	-42.3	Q	0°	0.54	CL



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE 2

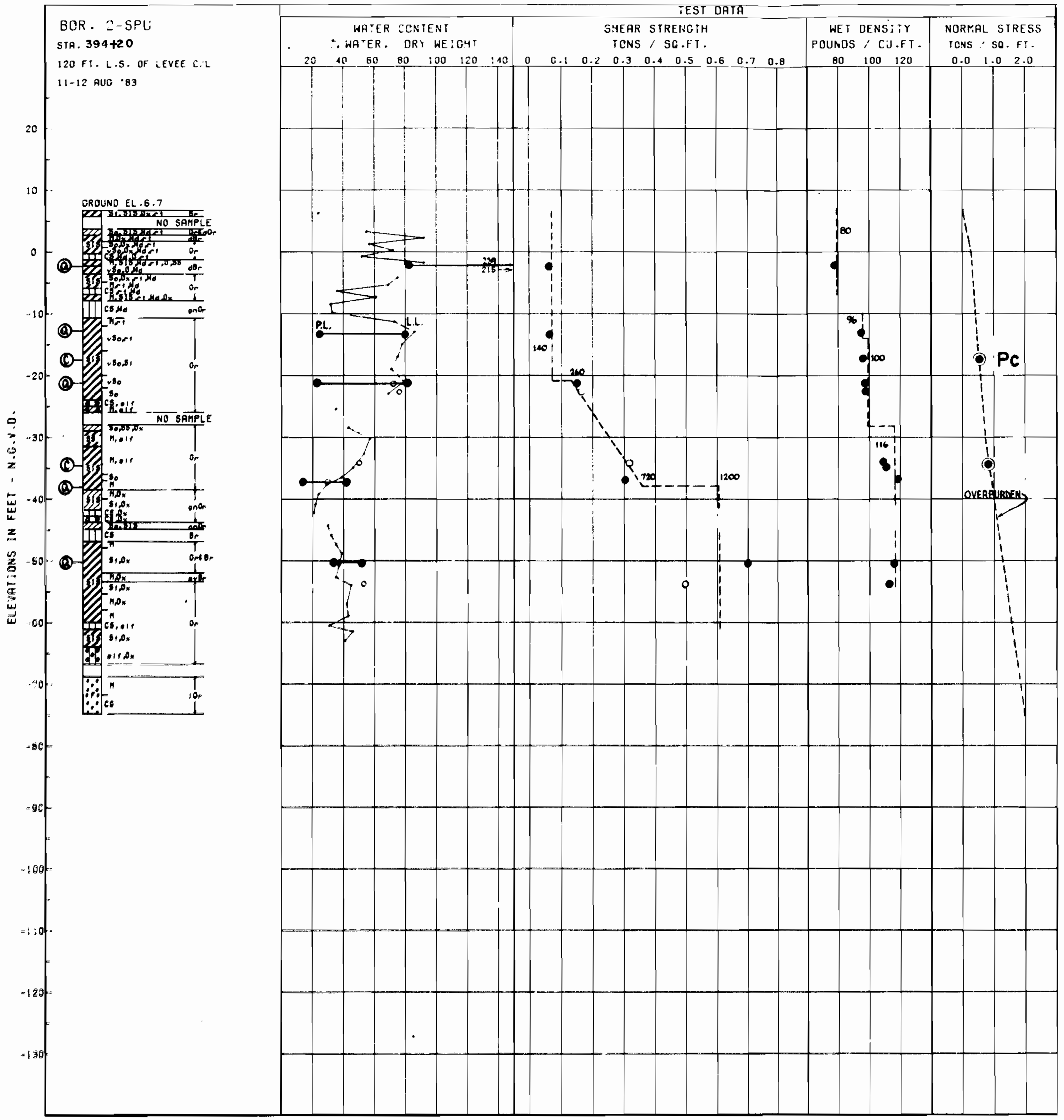
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

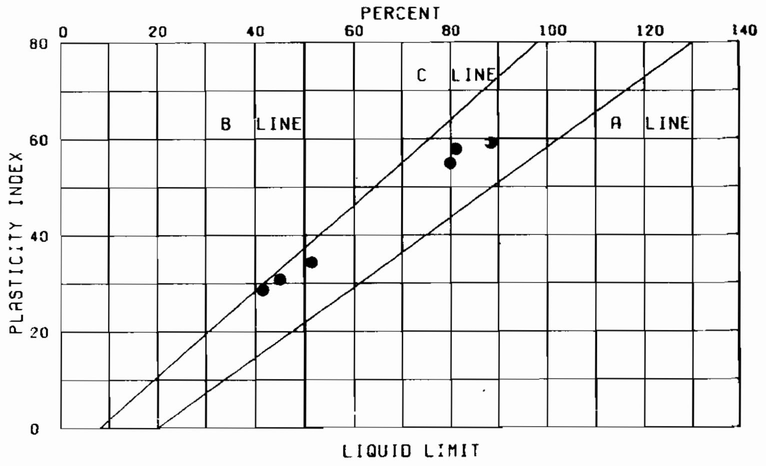
UNDISTURBED BORING

1-SPU

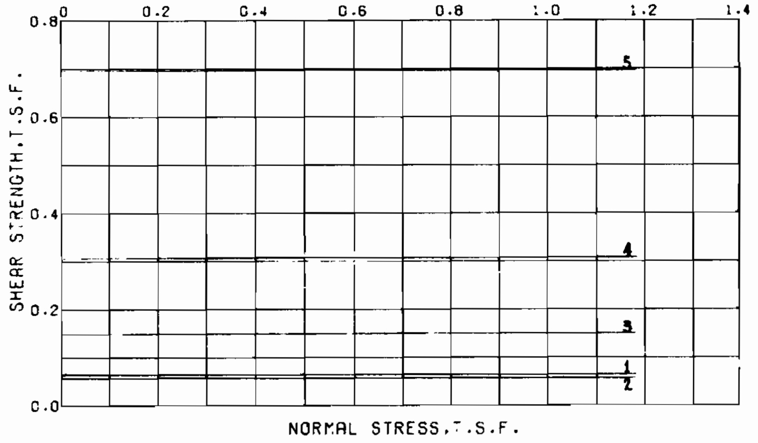
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



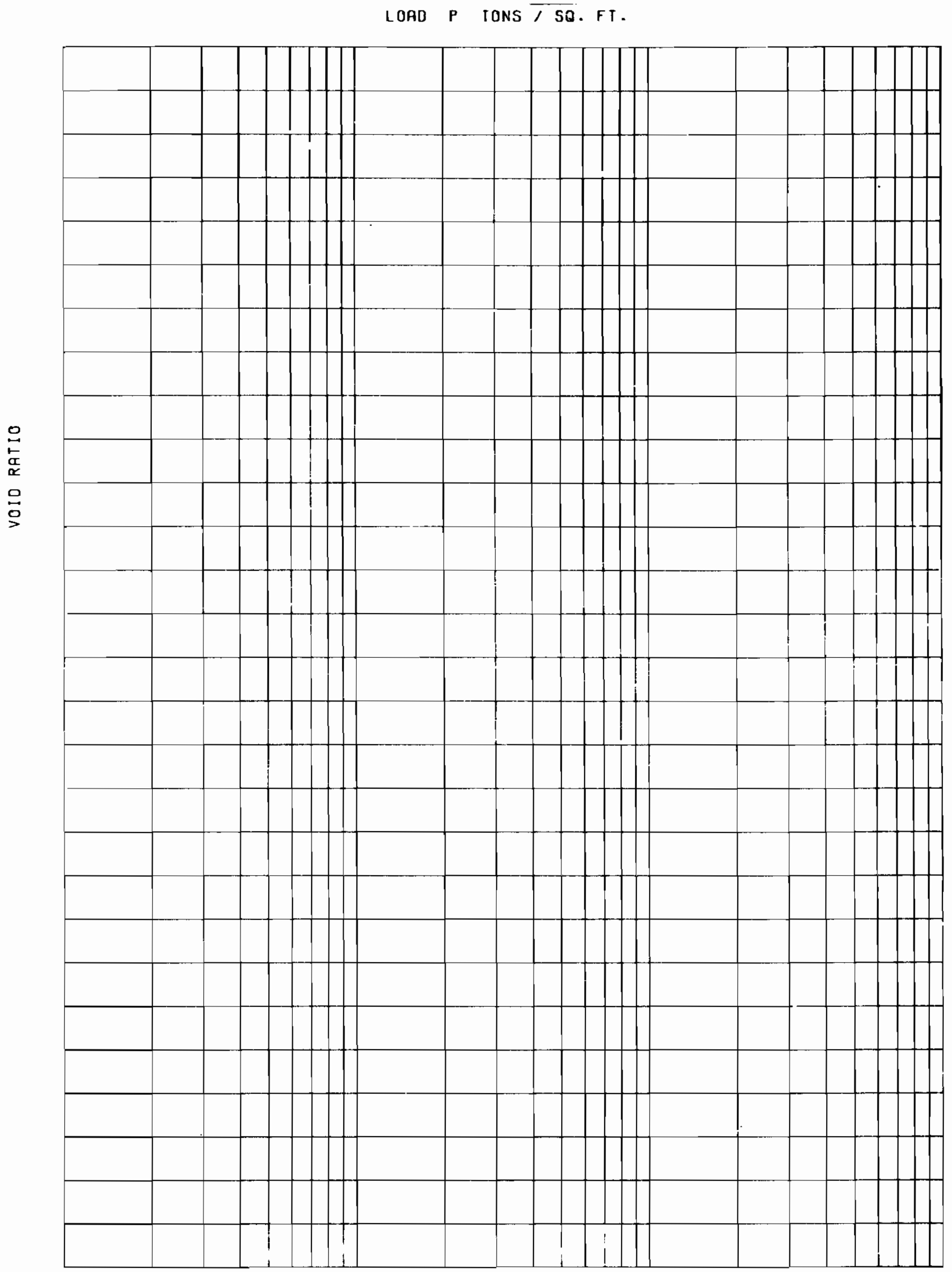


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-2.4	Q	0°	0.067	CH
2	-13.3	Q	0°	0.062	CH
3	-21.3	Q	0°	0.15	CH
4	-37.7	Q	0°	0.304	CL
5	-50.3	Q	0°	0.695	CH



CONSOLIDATION DATA

O - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE 3

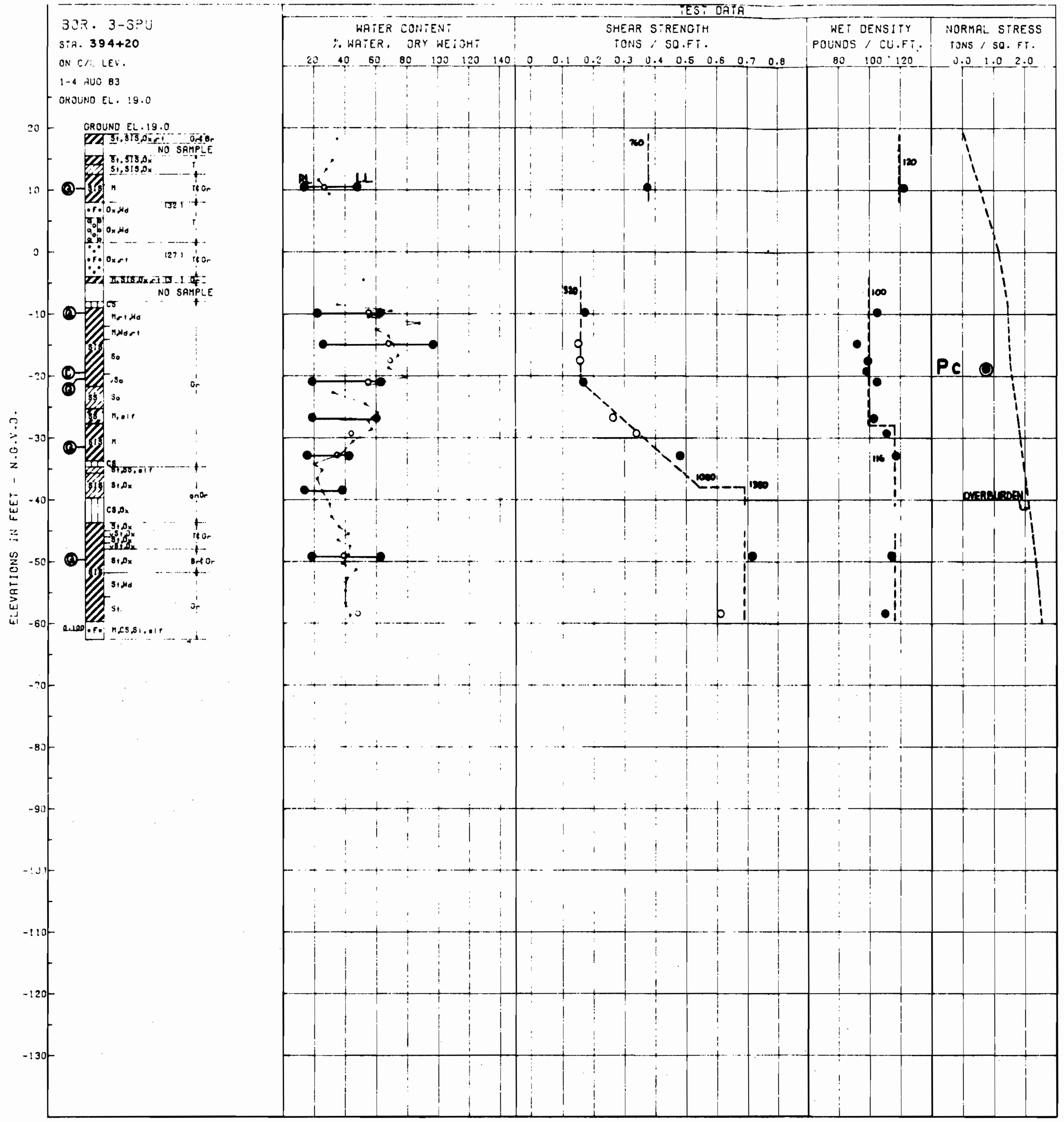
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

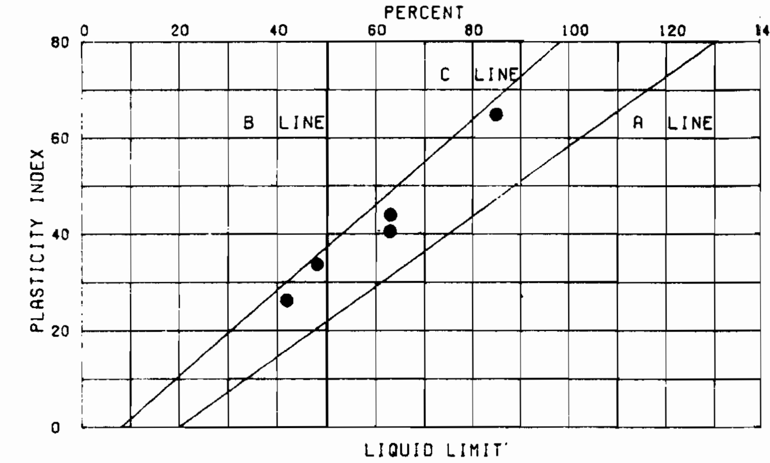
UNDISTURBED BORING

2-SPU

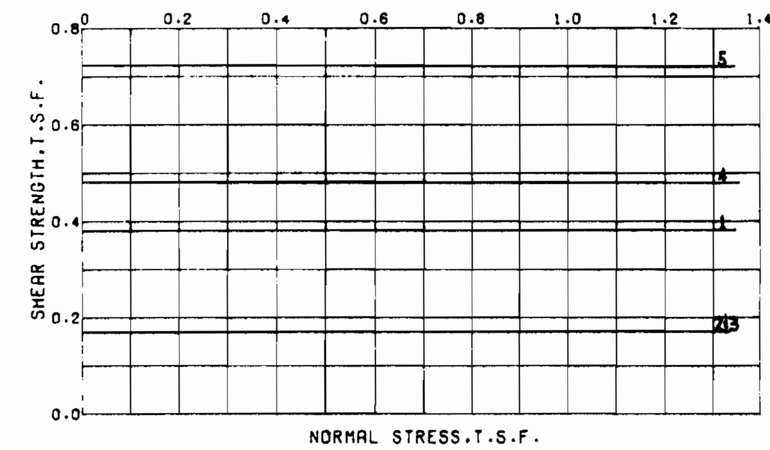
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



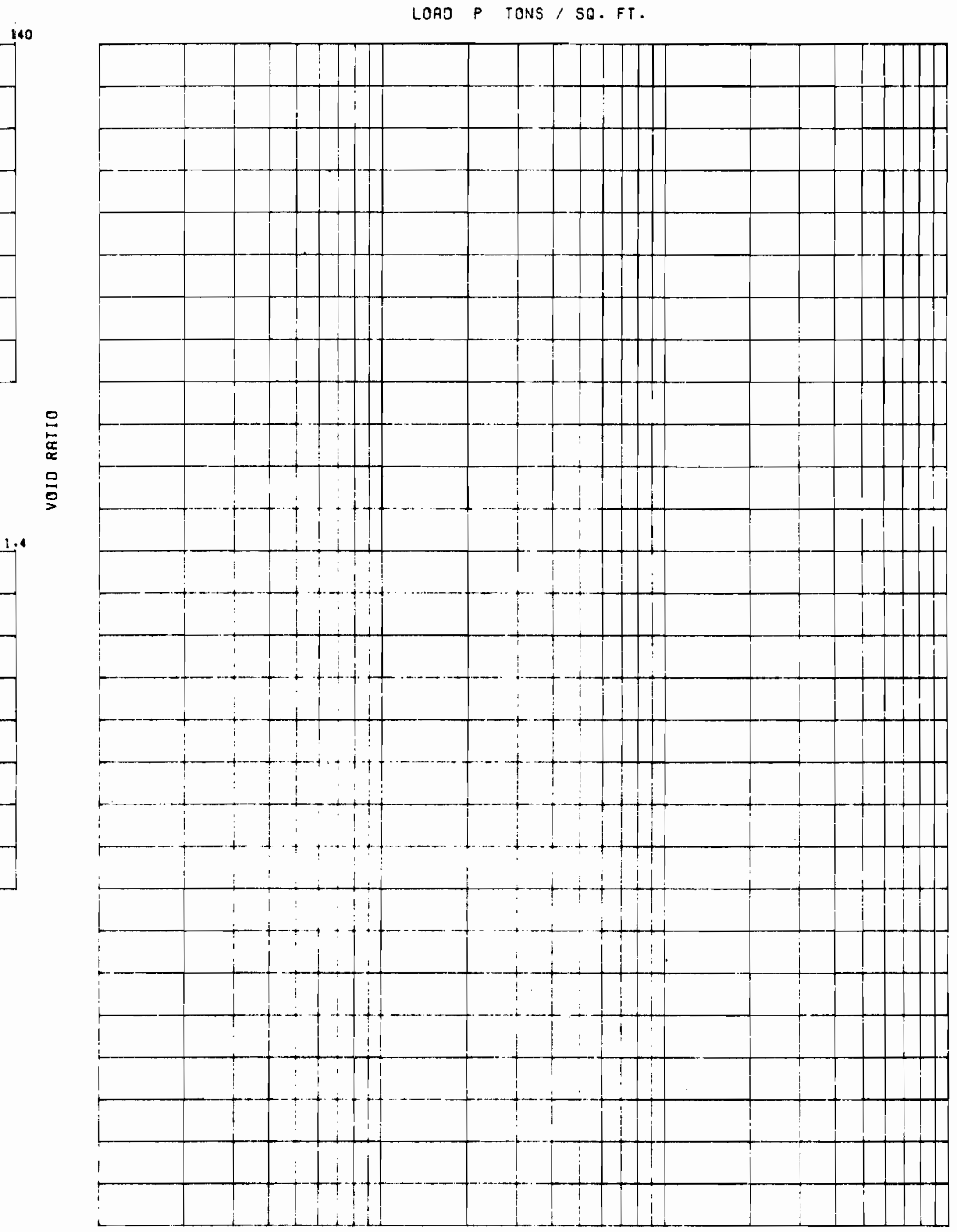


PLASTICITY CHART



SHEAR STRENGTH DATA

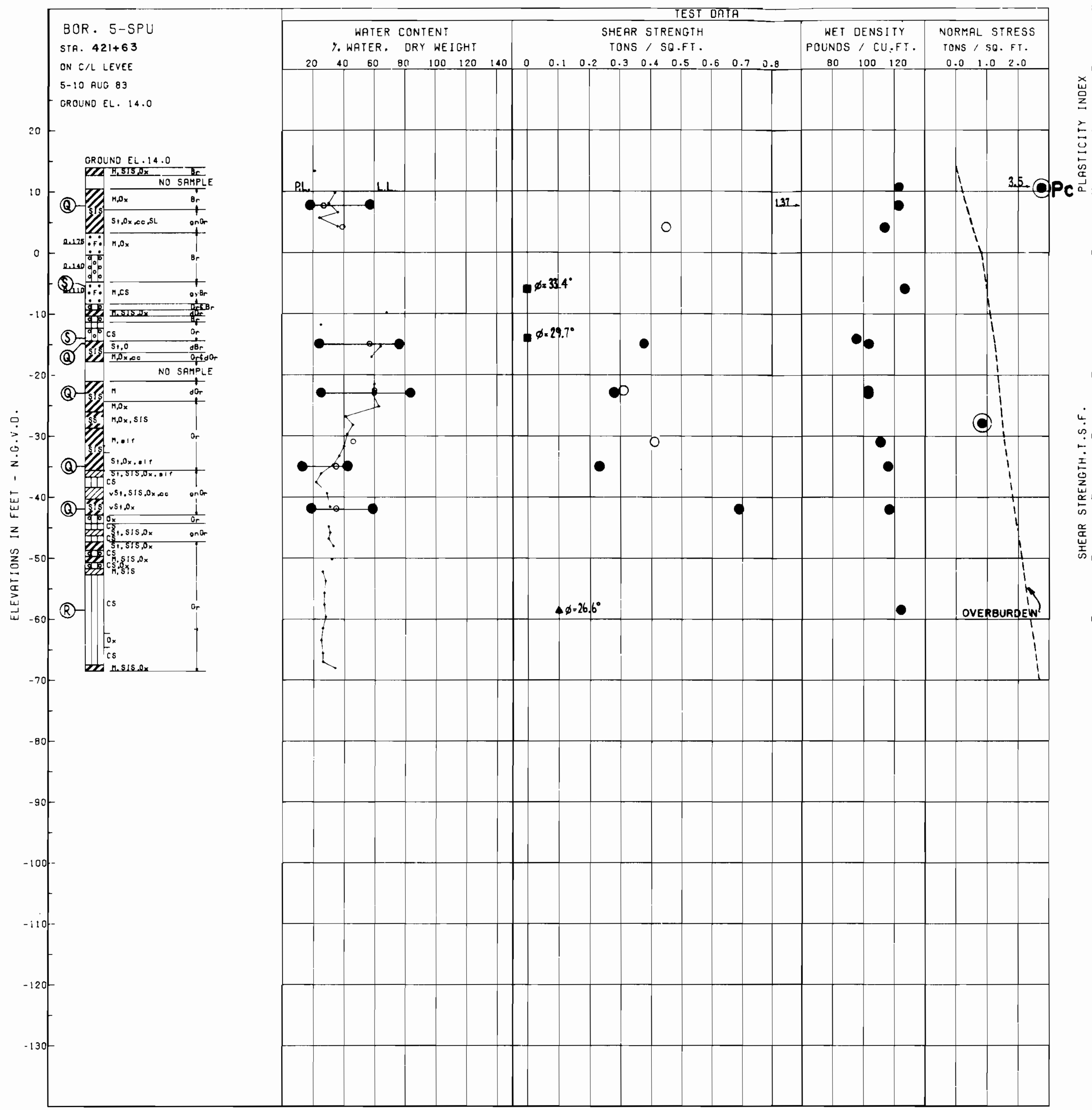
ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	10.4	Q	0°	0.38	CH
2	-9.8	Q	0°	0.17	CH
3	-21.0	Q	0°	0.17	CH
4	-32.9	Q	0°	0.48	CL
5	-49.1	Q	0°	0.72	CH

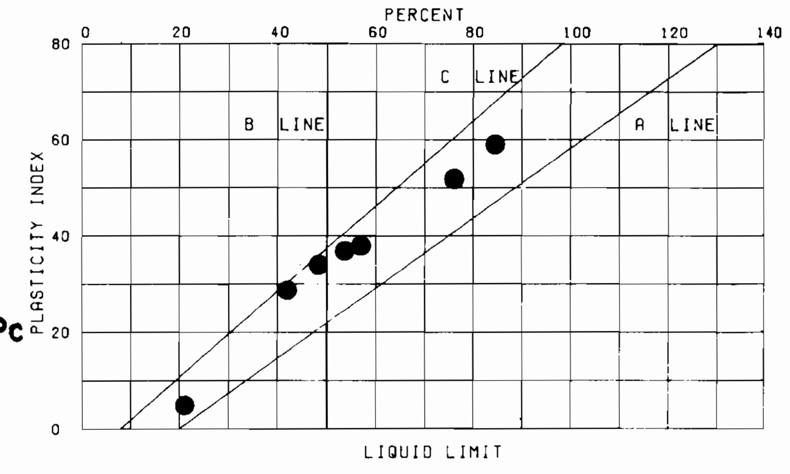


CONSOLIDATION DATA

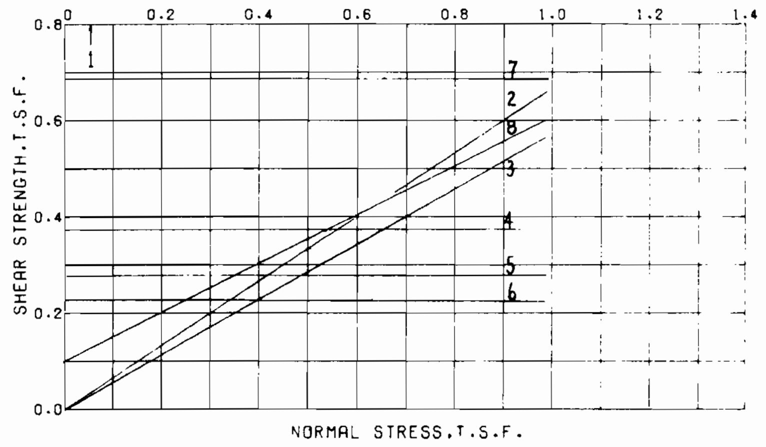
○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 3

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
UNDISTURBED BORING
3-SPU
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



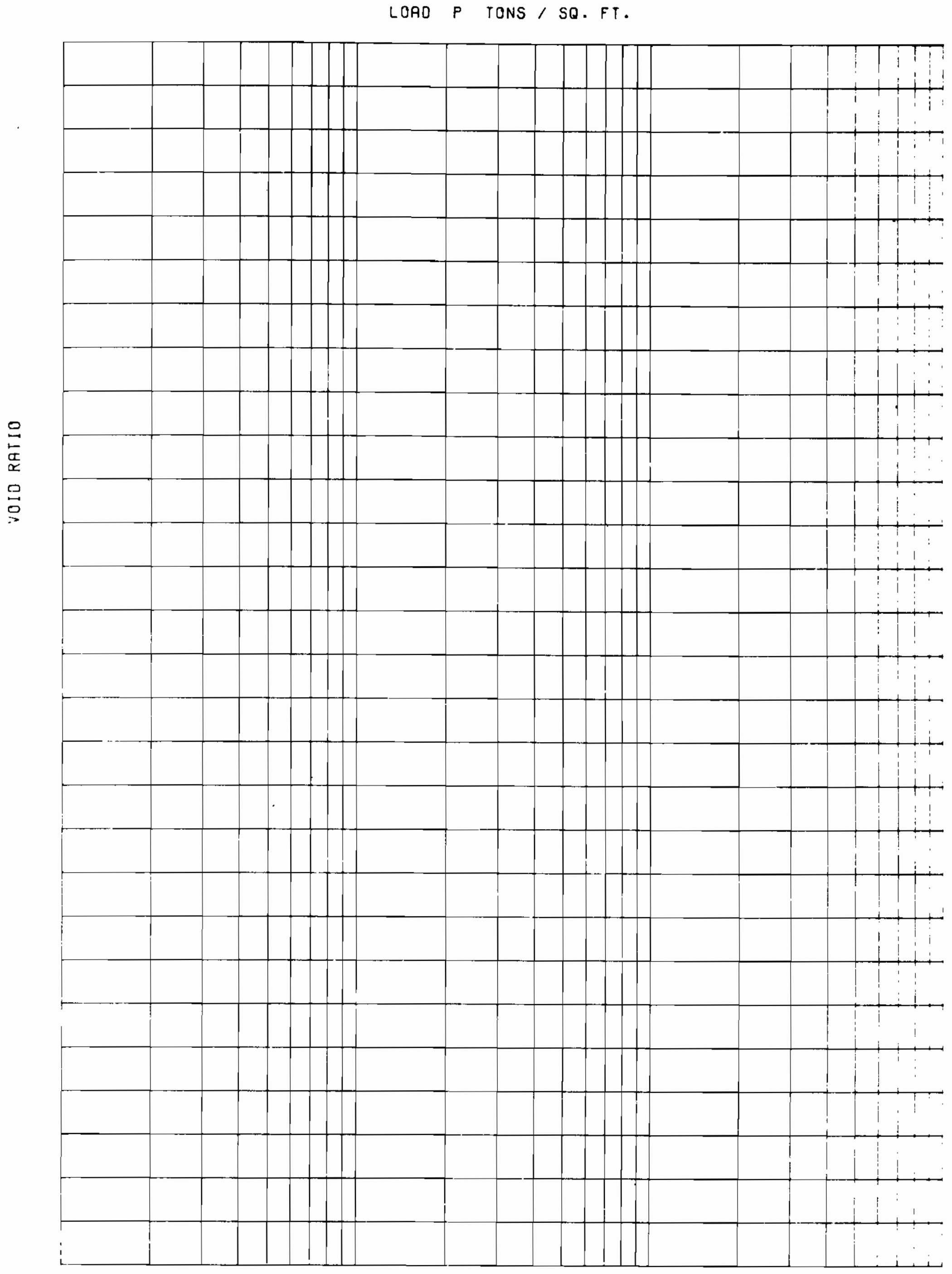


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	7.9	Q	0°	1.370	CH
2	-6.0	S	33.4°	0.0	SP
3	-14.0	S	29.7°	0.0	OH
4	-15.0	Q	0°	0.376	CH
5	-23.1	Q	0°	0.280	CH
6	-34.8	Q	0°	0.230	CL
7	-41.9	Q	0°	0.690	CH
8	-58.5	R	26.6°	0.10	CL-ML



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE 9
FOR LOCATION OF BORING SEE PLATE 3

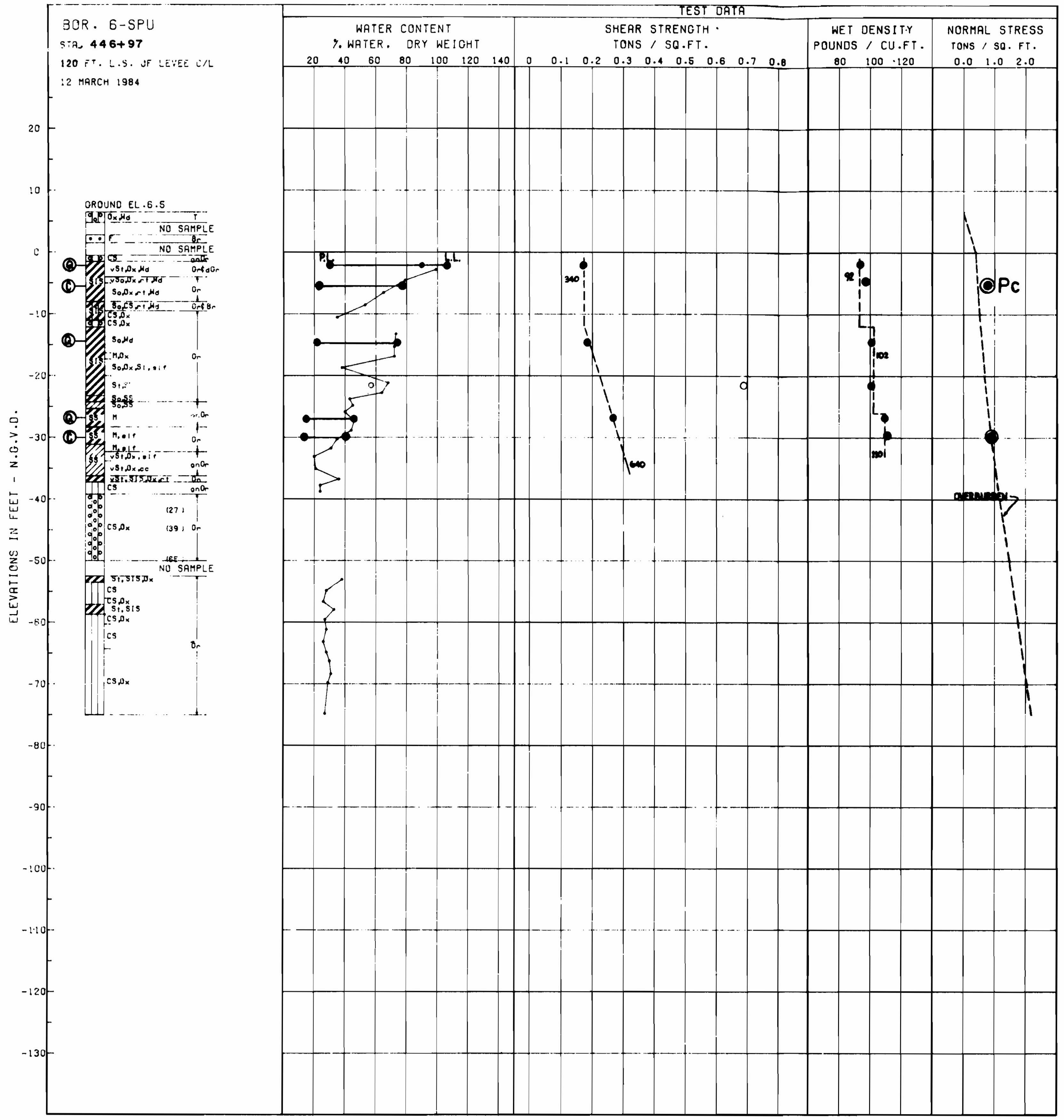
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

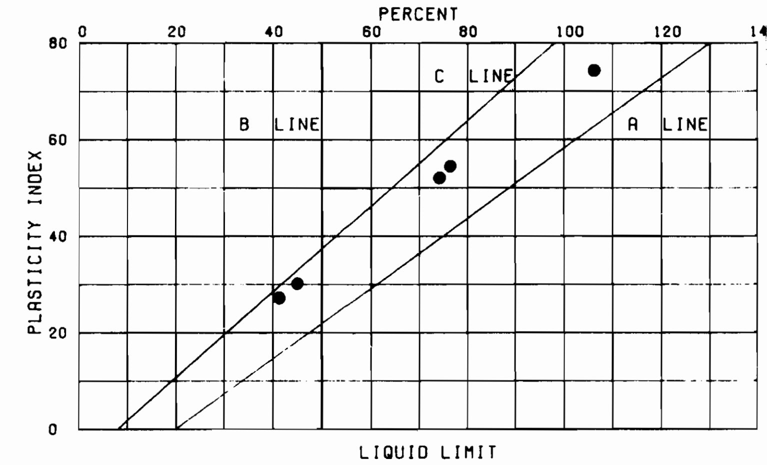
UNDISTURBED BORING

5-SPU

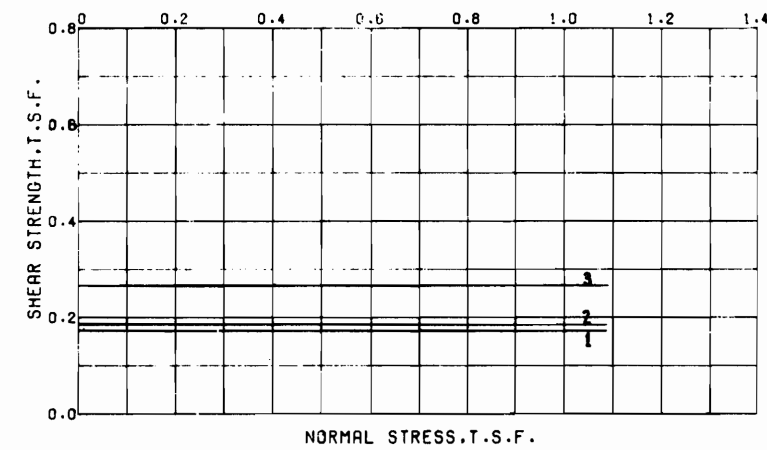
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820





PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
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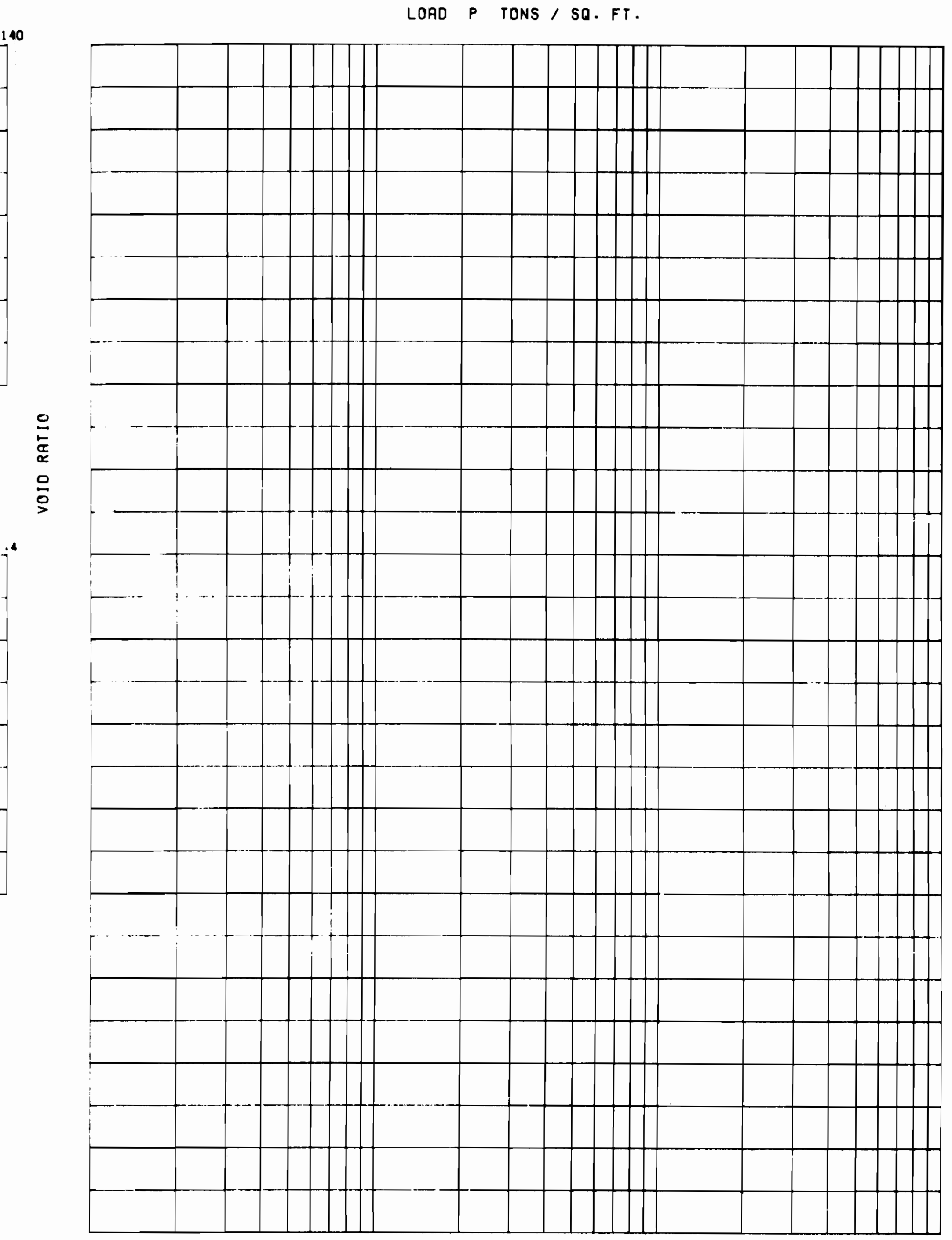
2	-14.5	Q	0°	0.187	CH
3	-26.7	Q	0°	0.267	CH



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

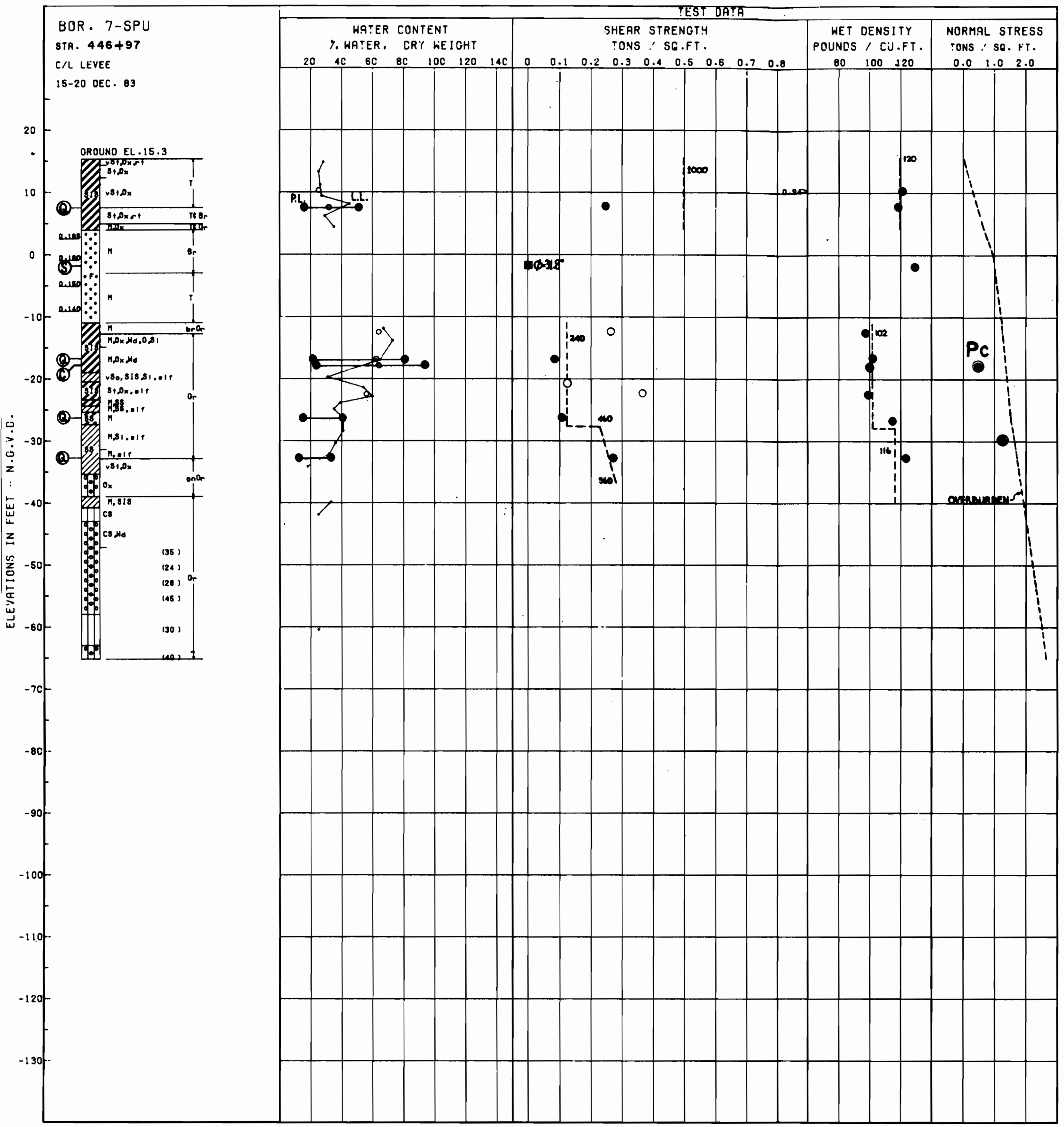
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 4

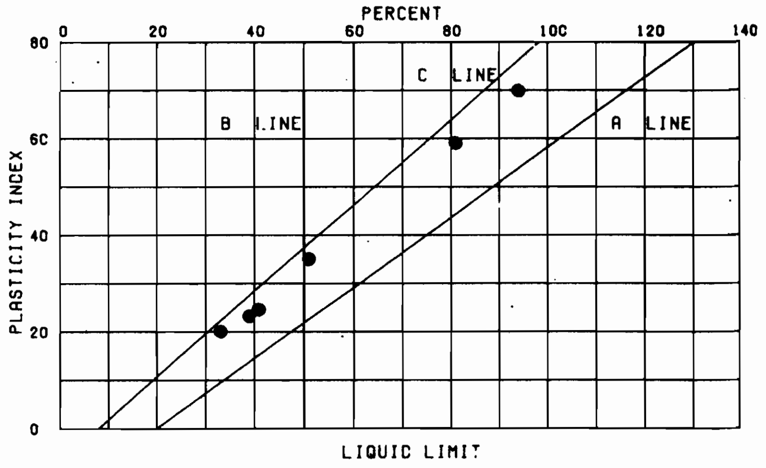
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

UNDISTURBED BORING
6-SPU

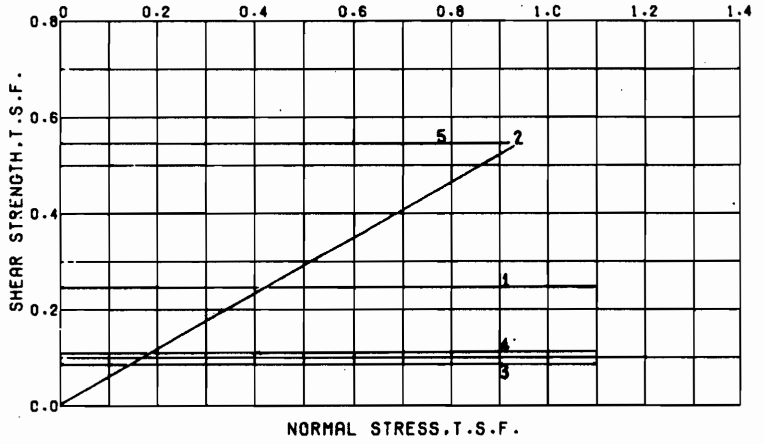
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985   FILE NO. H-2-29820



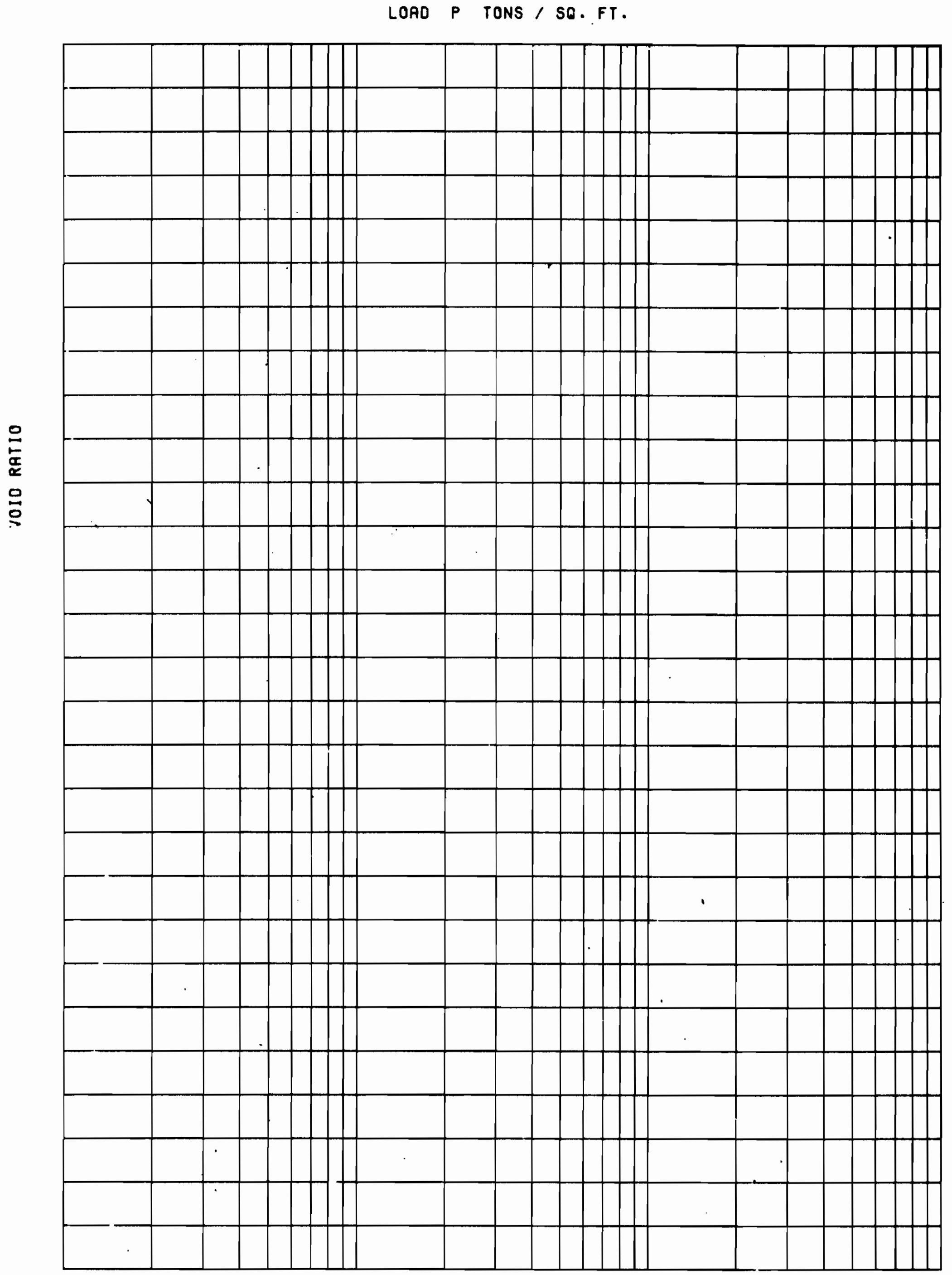


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	7.72	Q	0°	0.248	CH
2	-1.68	S	31.8°	0.0	SM
3	-16.58	Q	0°	0.089	CH
4	-26.10	Q	0°	0.11	CL
5	-32.70	Q	0°	0.545	CL



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

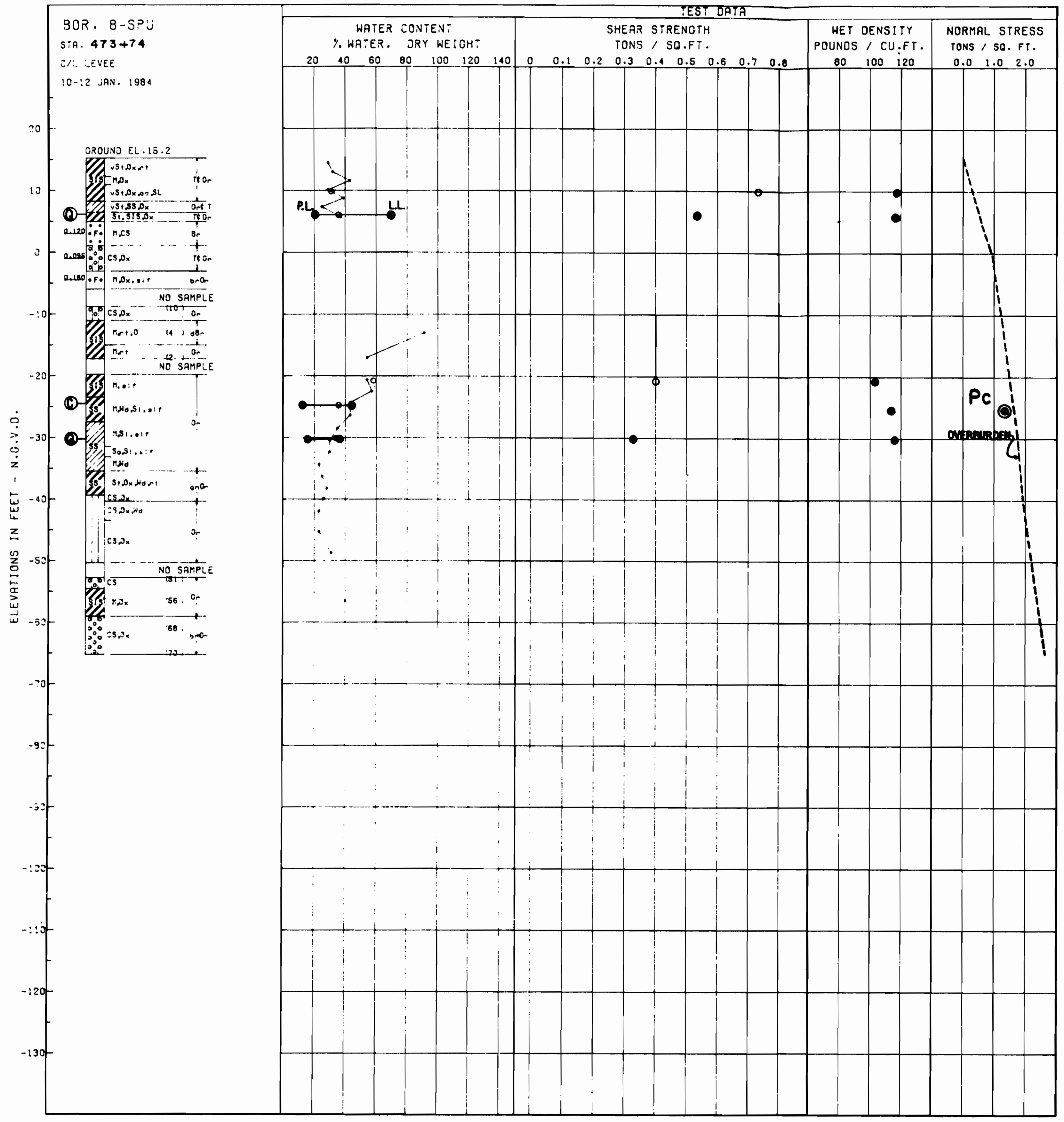
FOR LOCATION OF BORING SEE PLATE 4

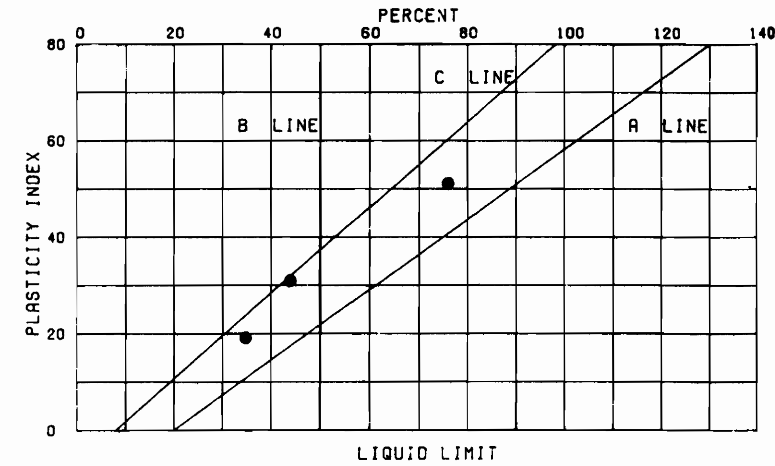
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

UNDISTURBED BORING
7-SPU

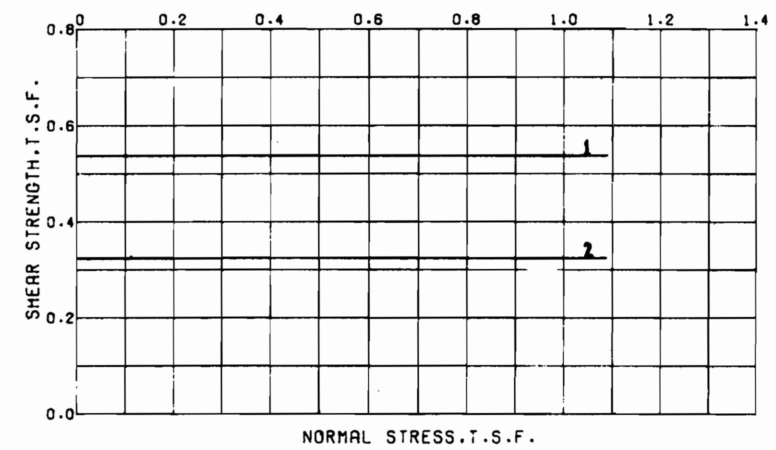
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



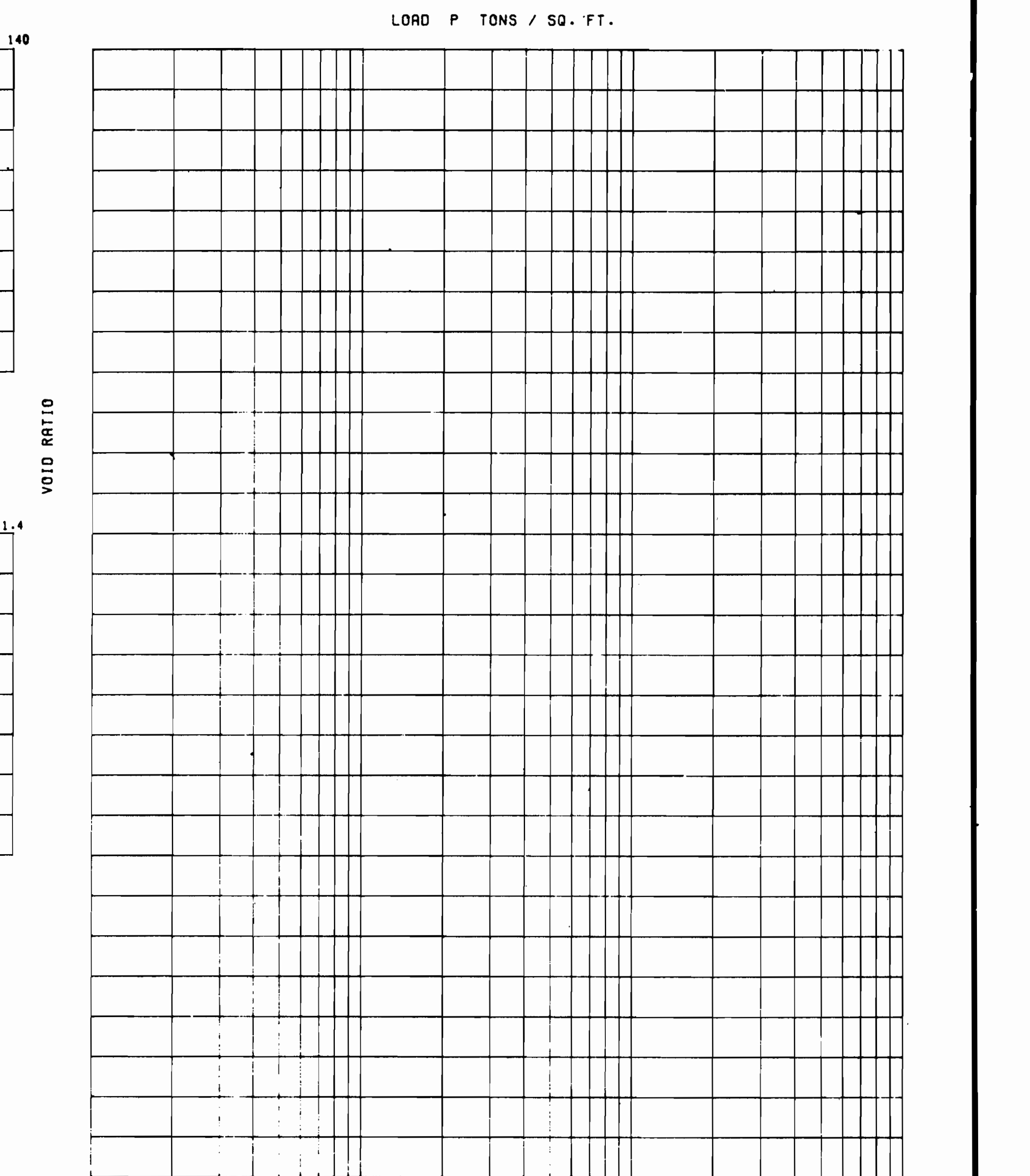


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	6.1	Q	0°	0.535	CH
2	-30.1	Q	0°	0.323	CL



CONSOLIDATION DATA

O - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 4

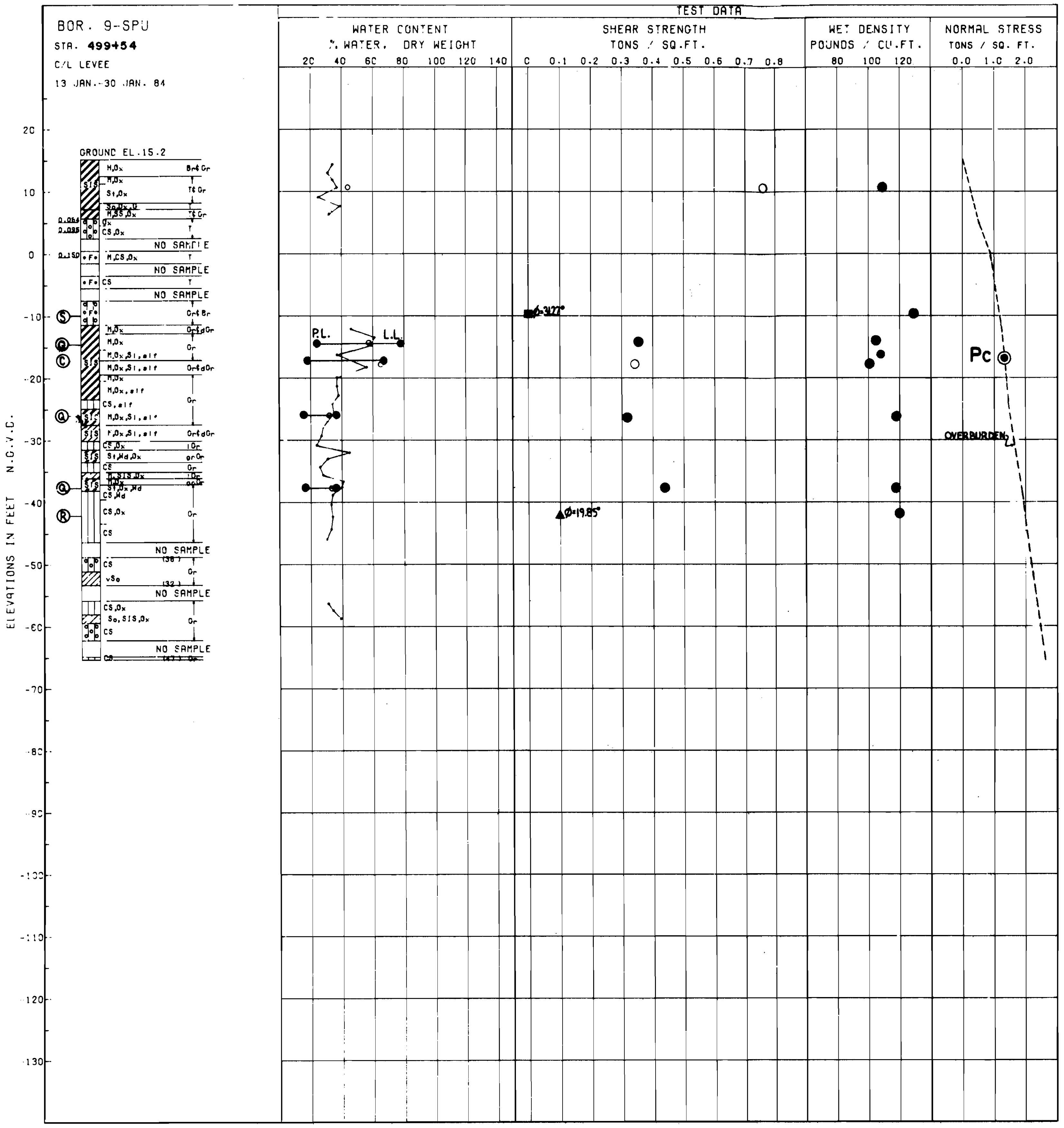
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

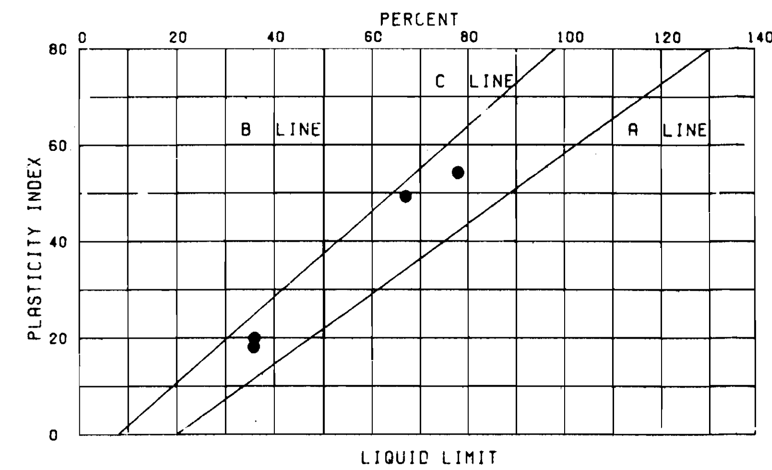
UNDISTURBED BORING

8-SPU

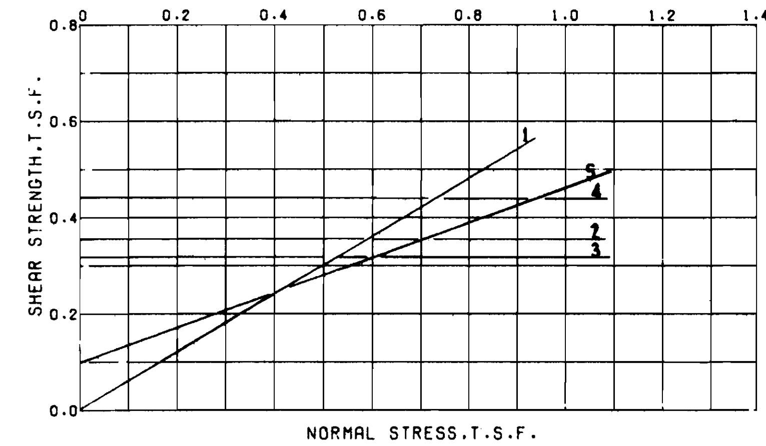
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



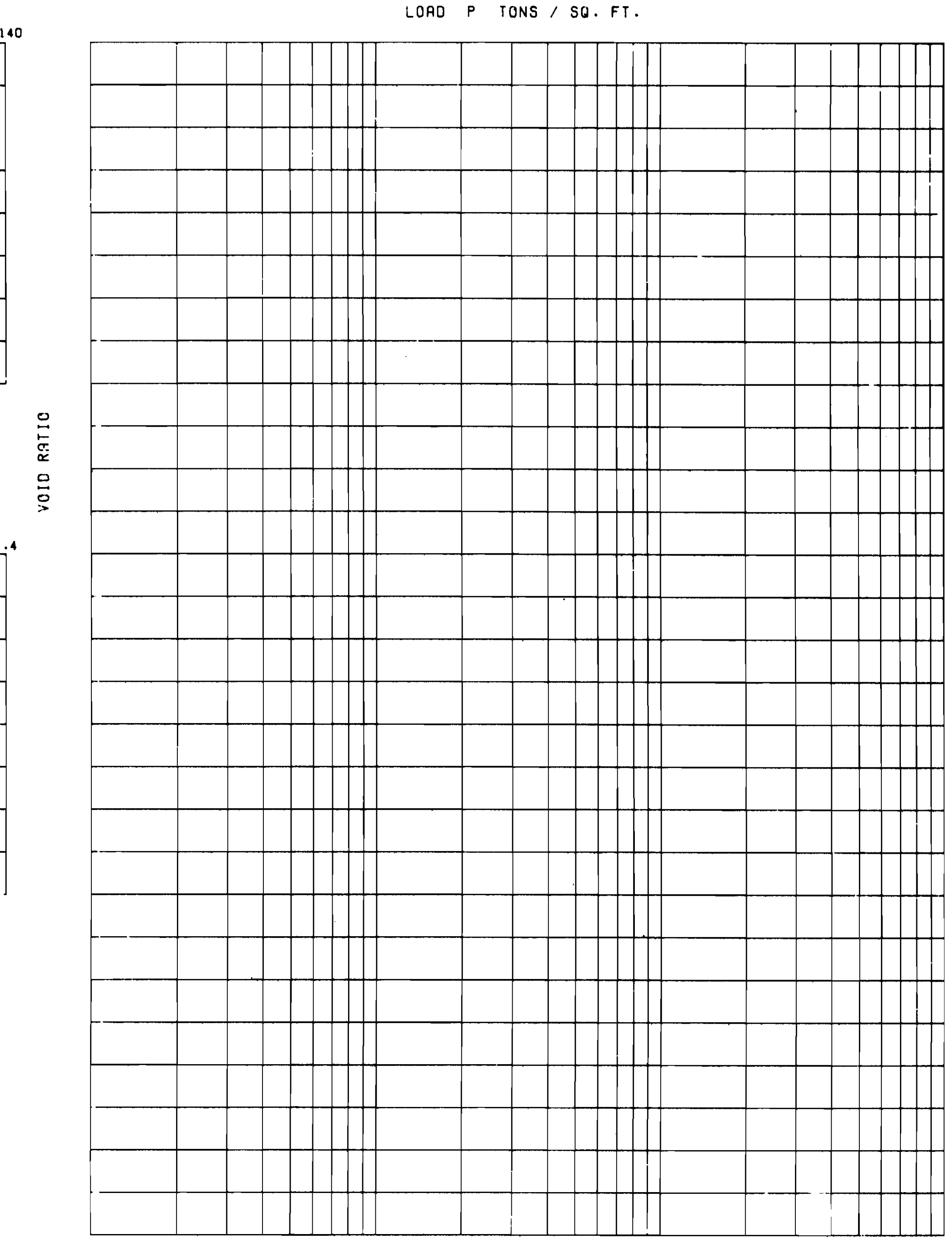


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-9.5	S	31.22°	0	SM
2	-14.0	Q	0°	0.355	CH
3	-26.1	Q	0°	0.317	CH
4	-37.6	Q	0°	0.440	CH
5	-41.8	R	19.85°	0.100	ML



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

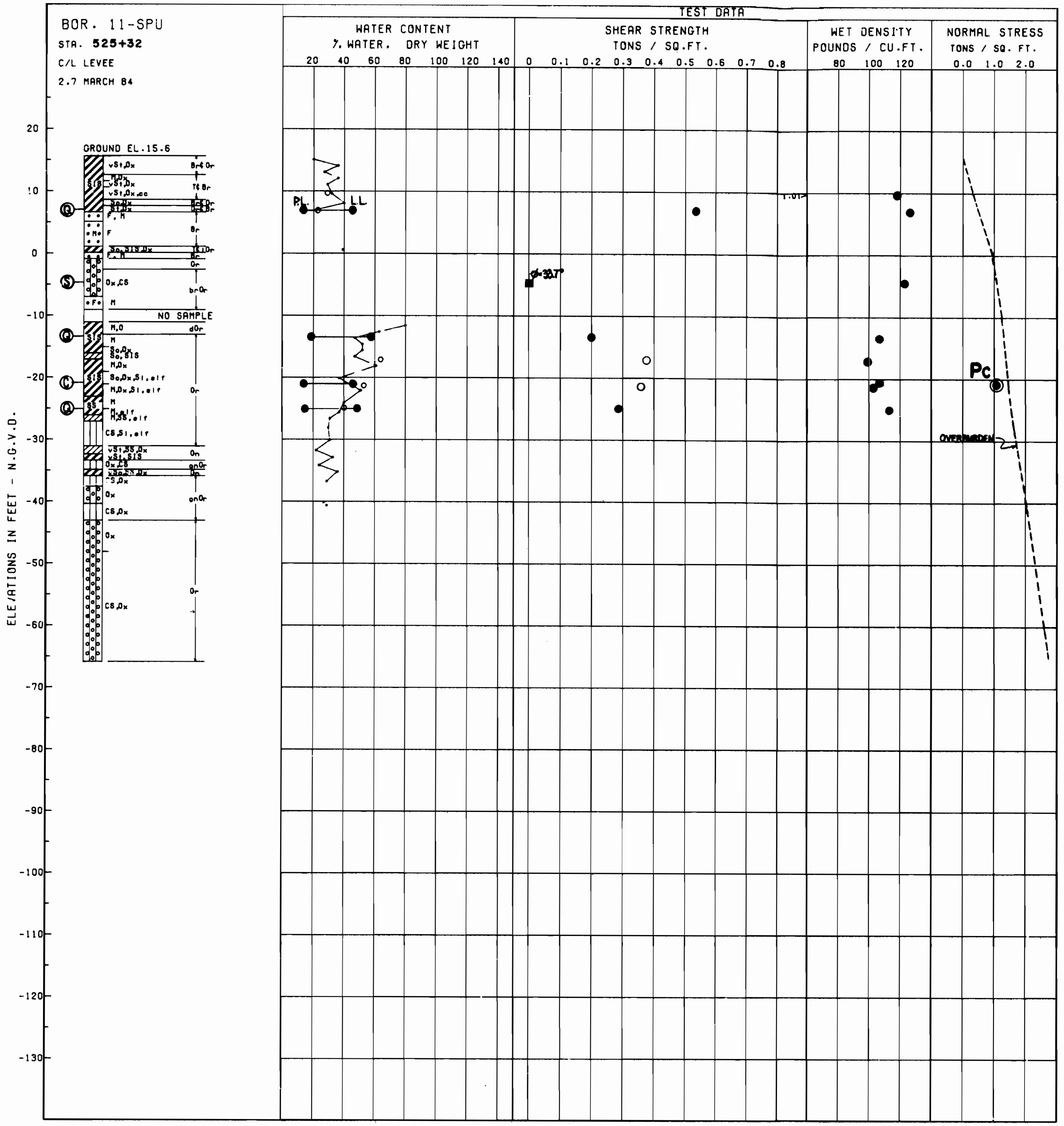
FOR LOCATION OF BORING SEE PLATE 5

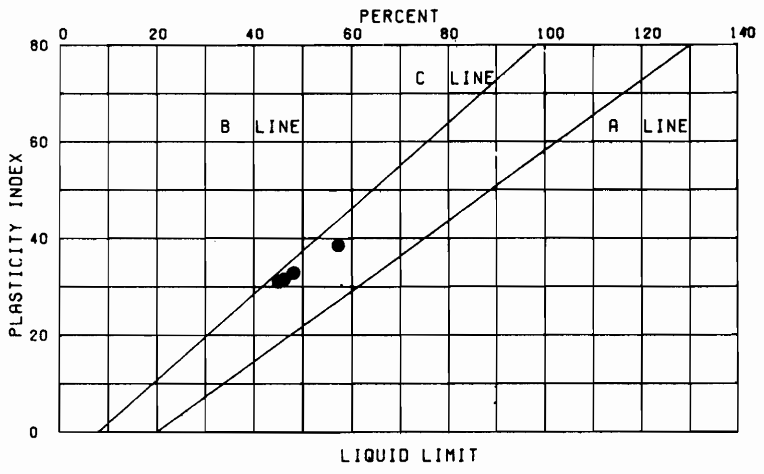
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

UNDISTURBED BORING
9-SPU

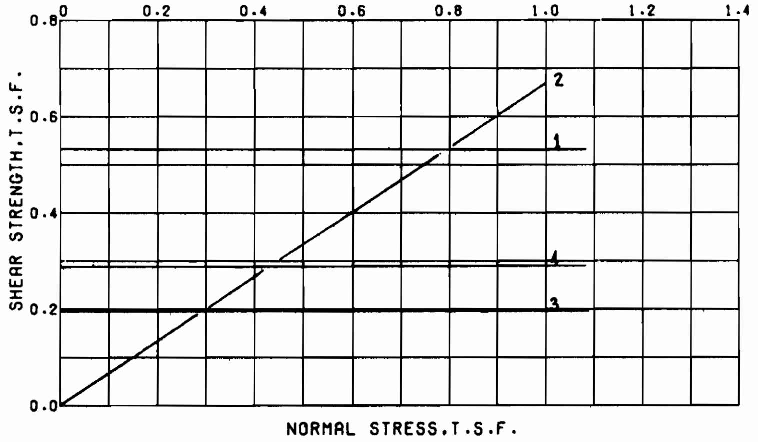
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820





PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	C - TSF	CLASS
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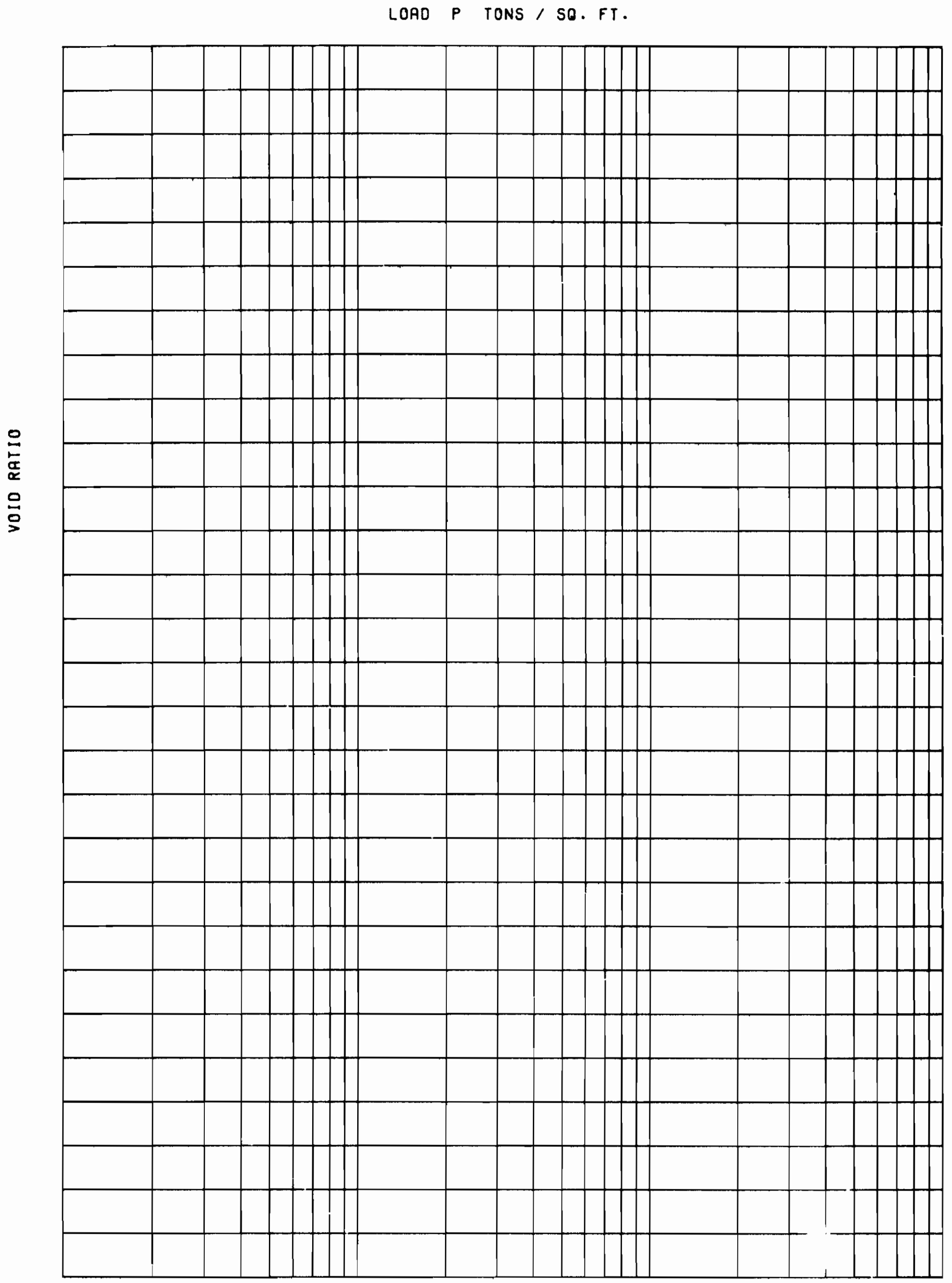
2	-4.6	S	33.7°	0.0	SM
3	-13.3	Q	0°	0.197	CH
4	-24.7	Q	0°	0.285	CH



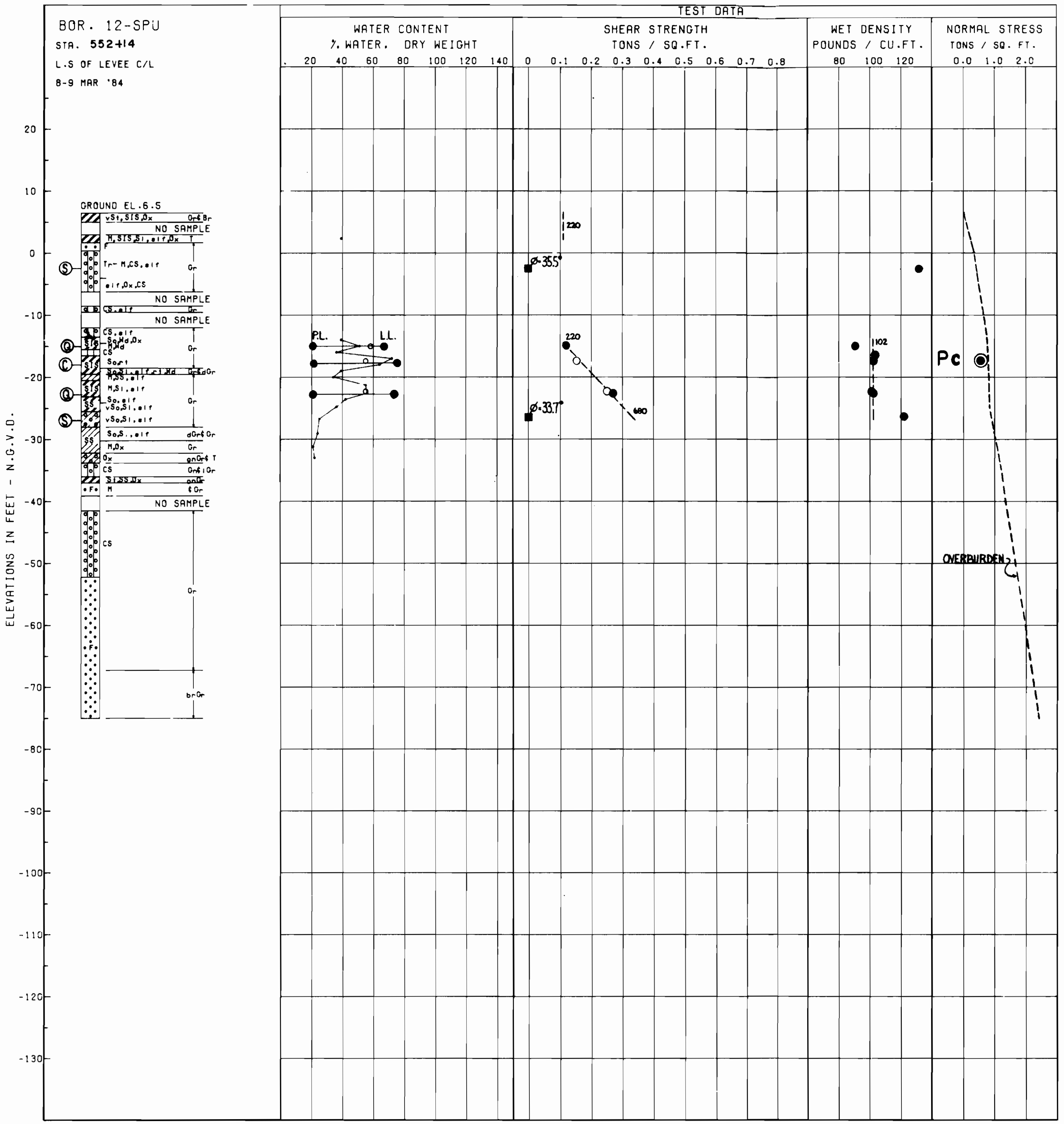
CONSOLIDATION DATA

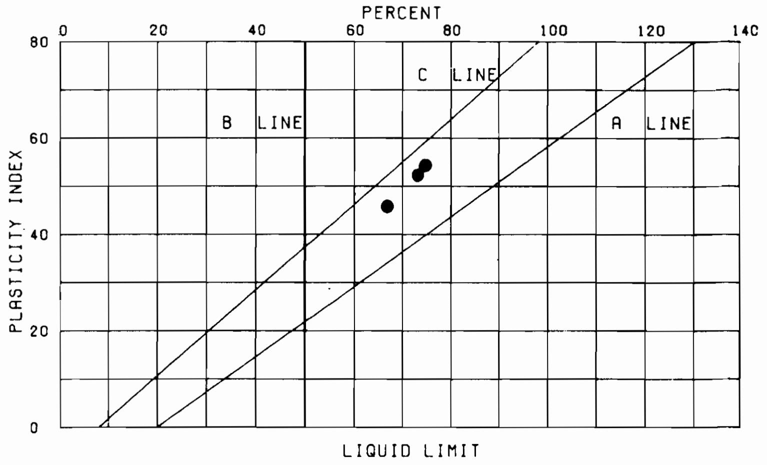
○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

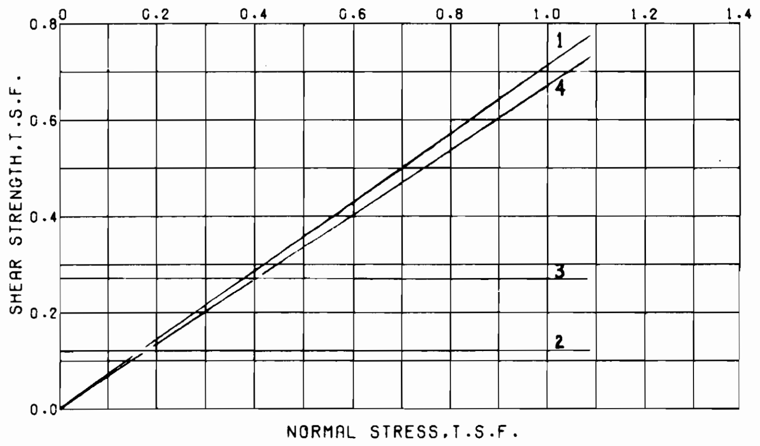
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
UNDISTURBED BORING
11-SPU
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



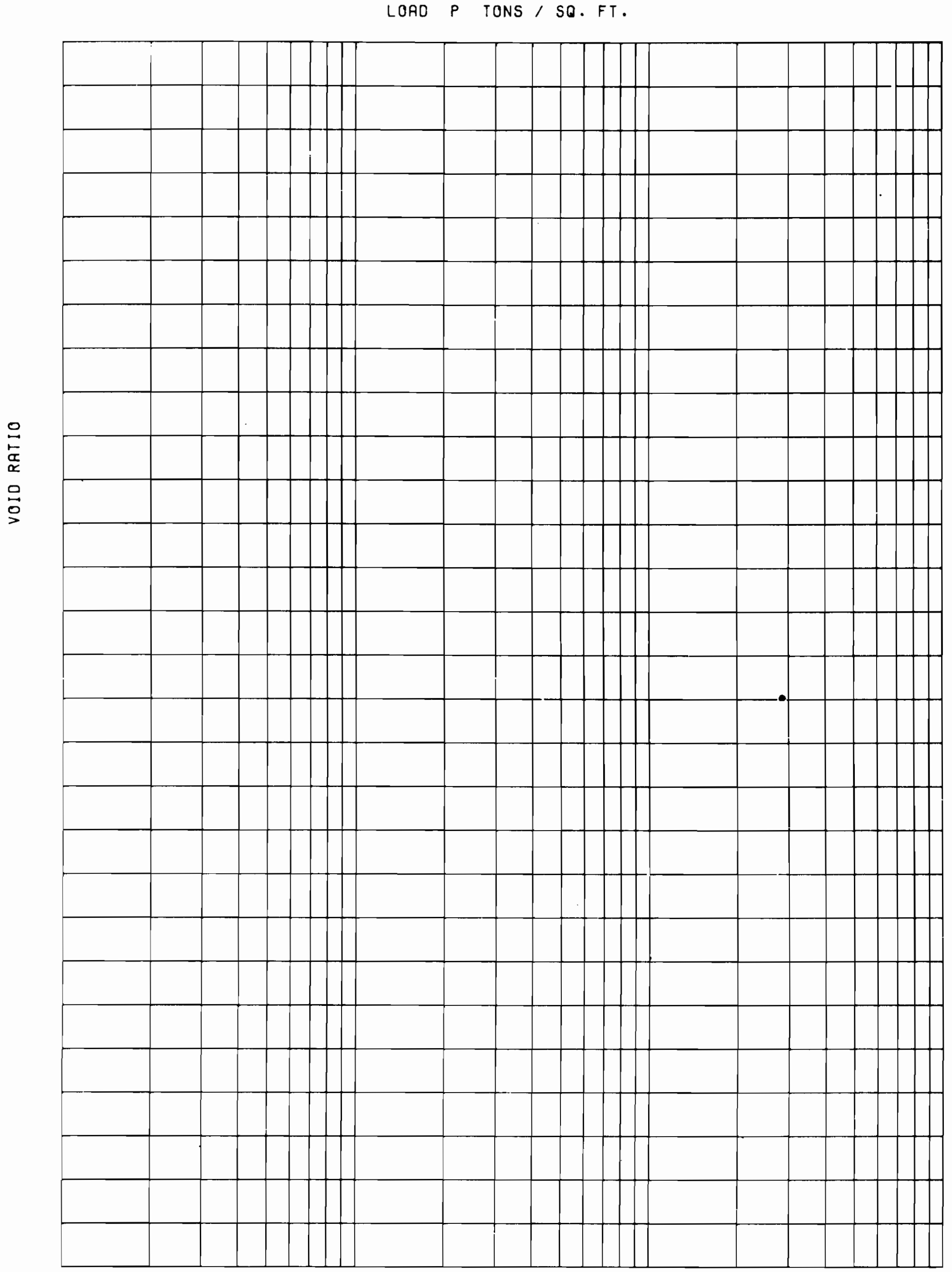


PLASTICITY CHART



SHEAR STRENGTH DATA

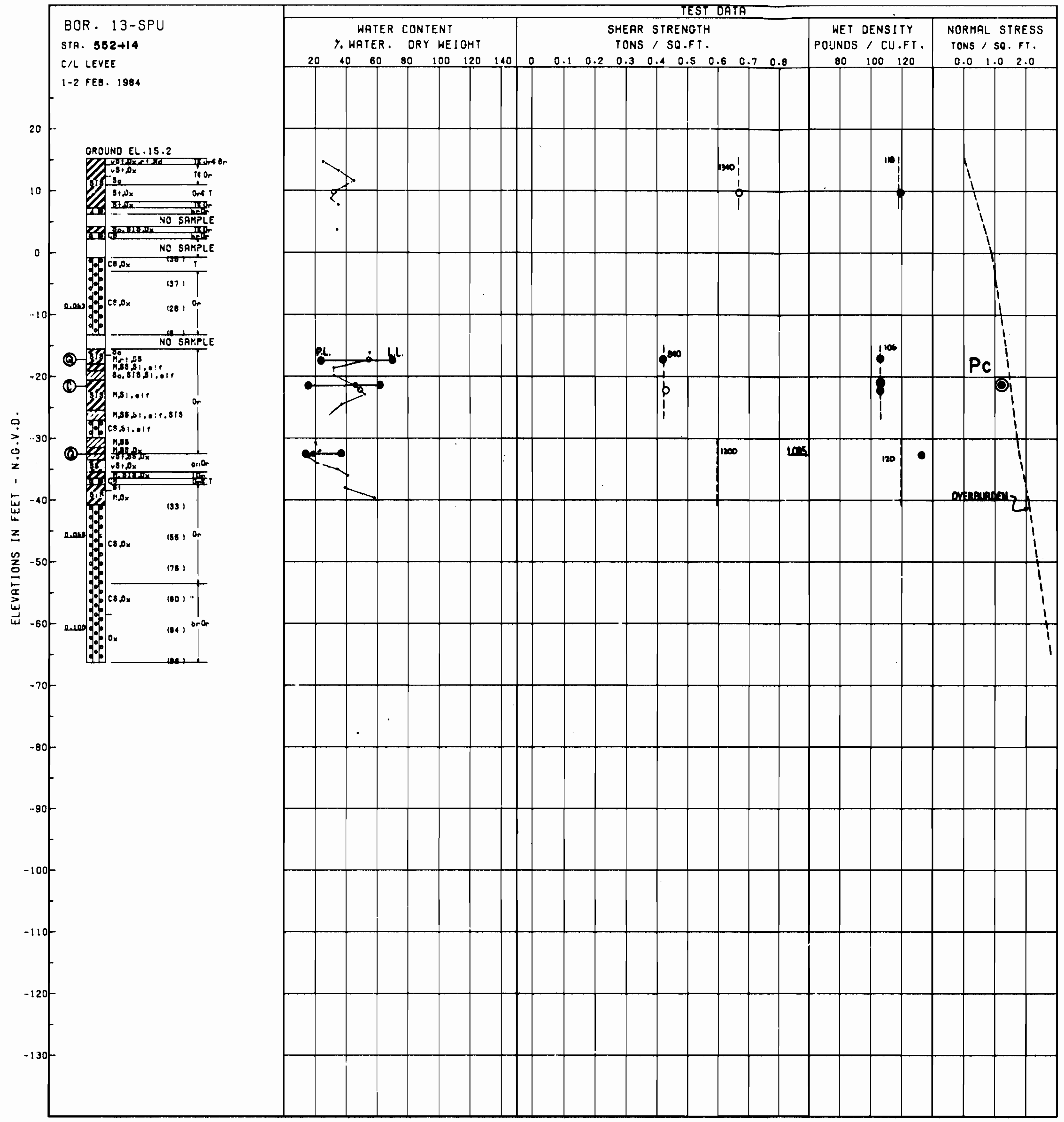
ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	- 2.5	S	35.5°	0.0	SM
2	-14.8	Q	0°	0.119	CH
3	-22.7	Q	0°	0.27	CH
4	-26.5	S	33.7°	0.0	SM

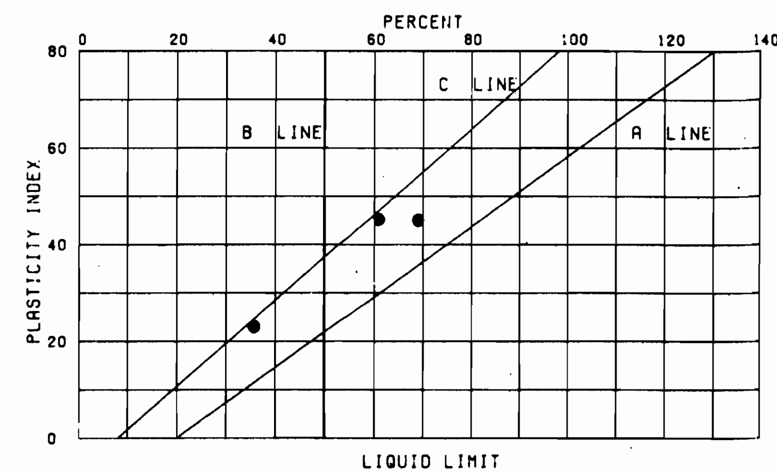


CONSOLIDATION DATA

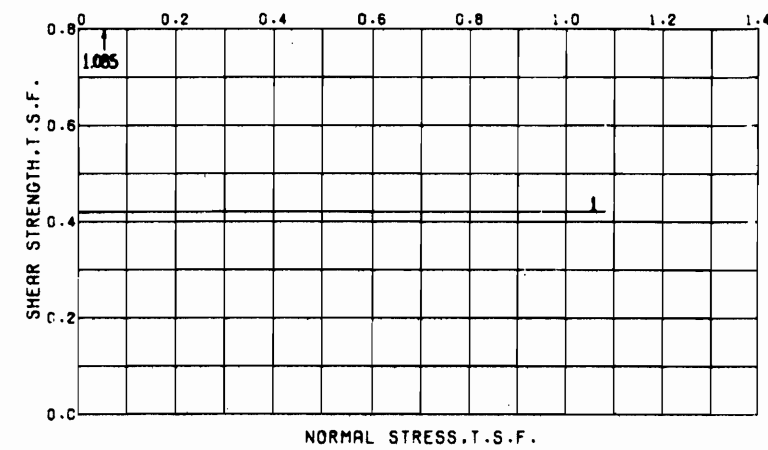
○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
UNDISTURBED BORING
12-SPU
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820





PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
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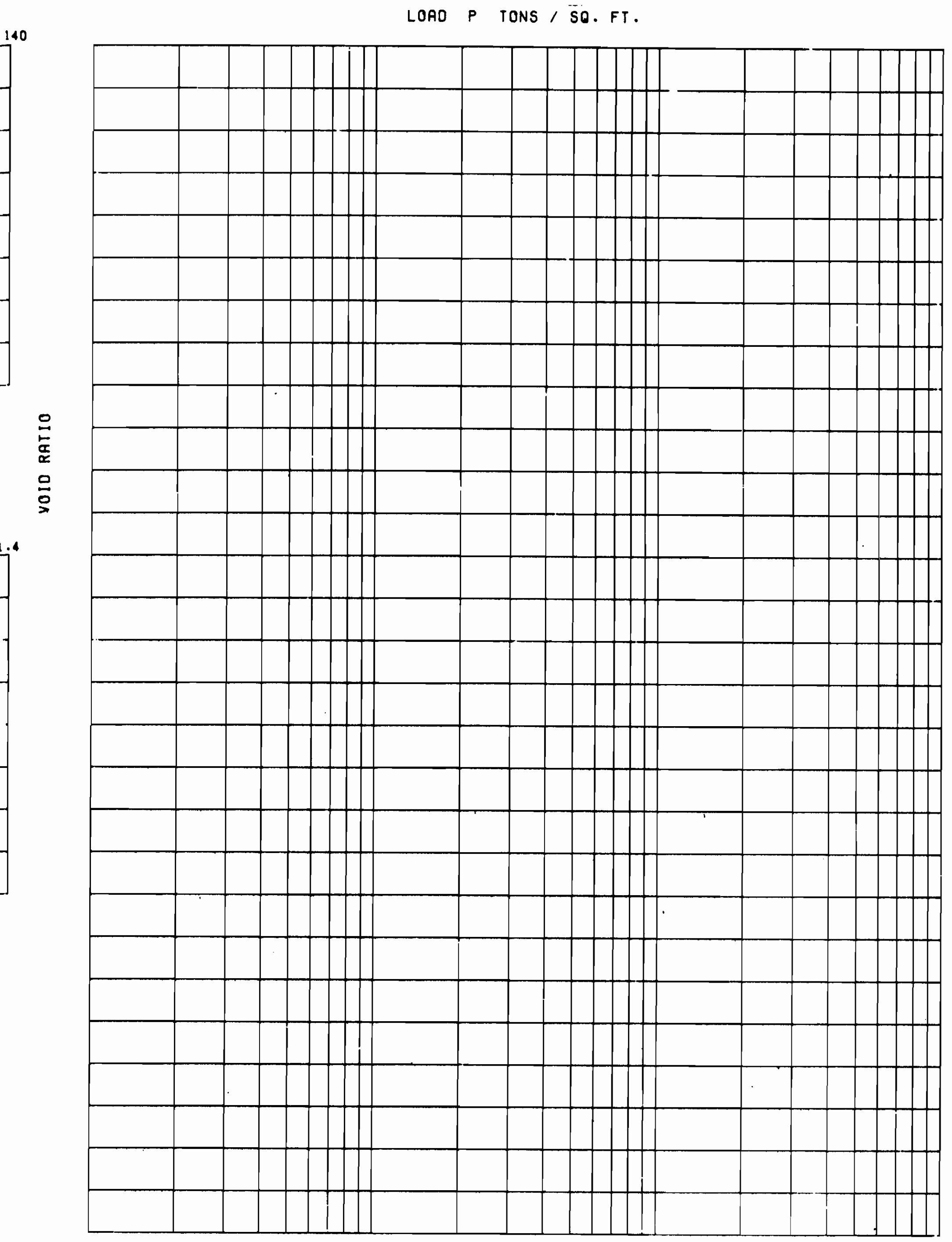
2	-32.4	Q	0°	1.085	CL



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

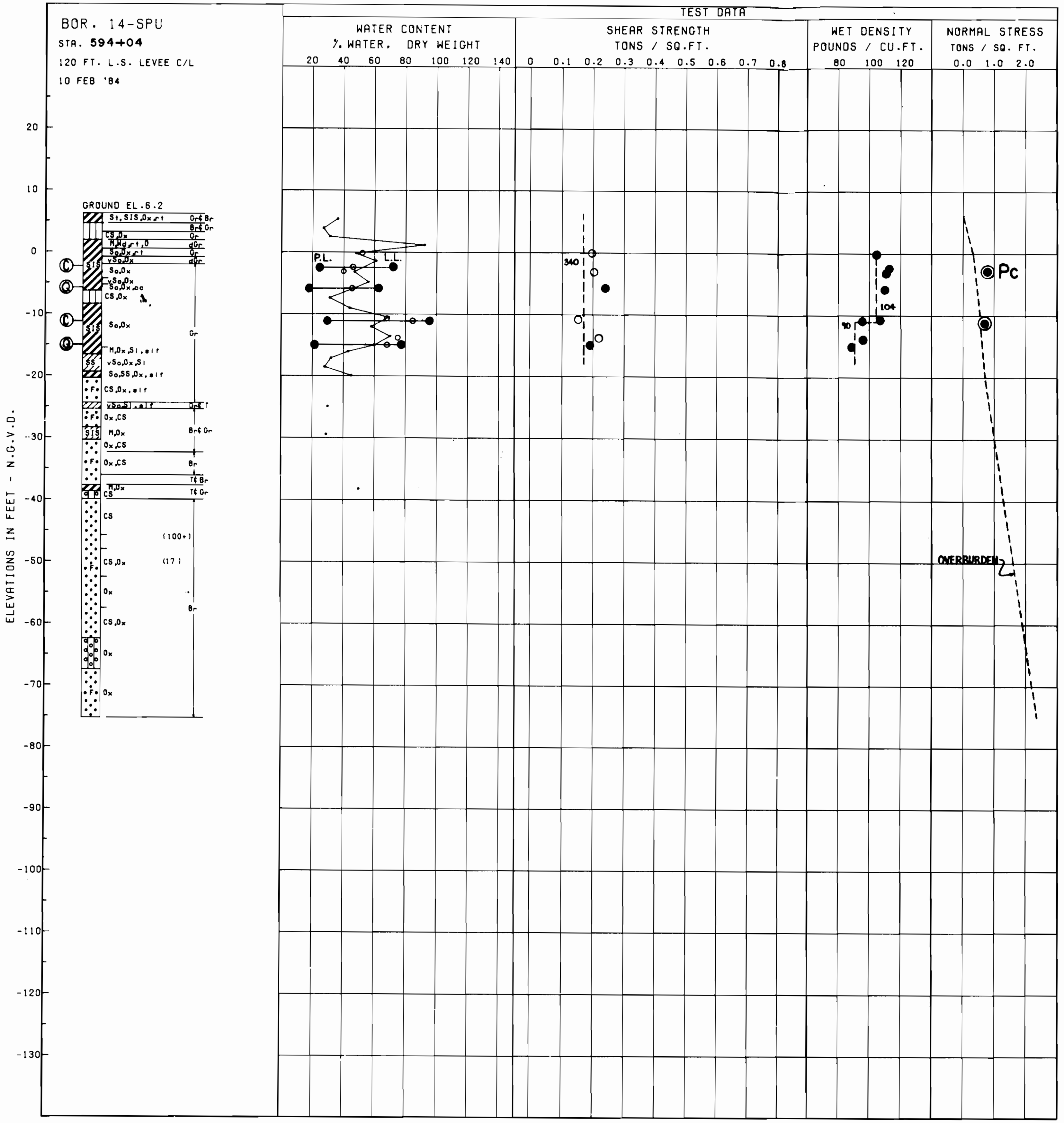
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 5

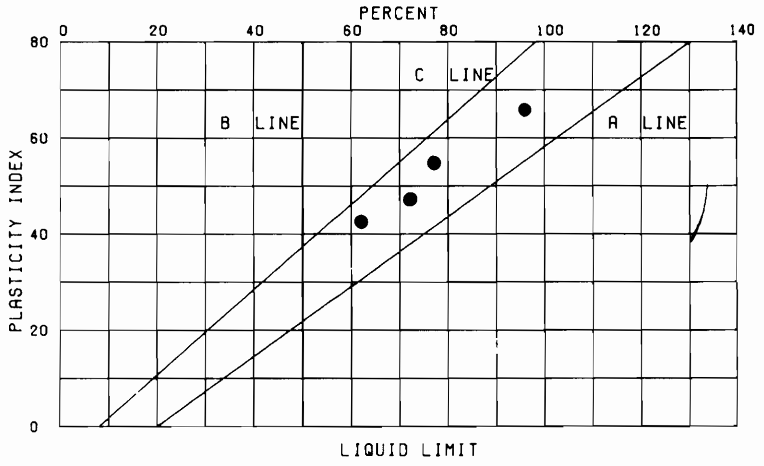
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

UNDISTURBED BORING
13-SPU

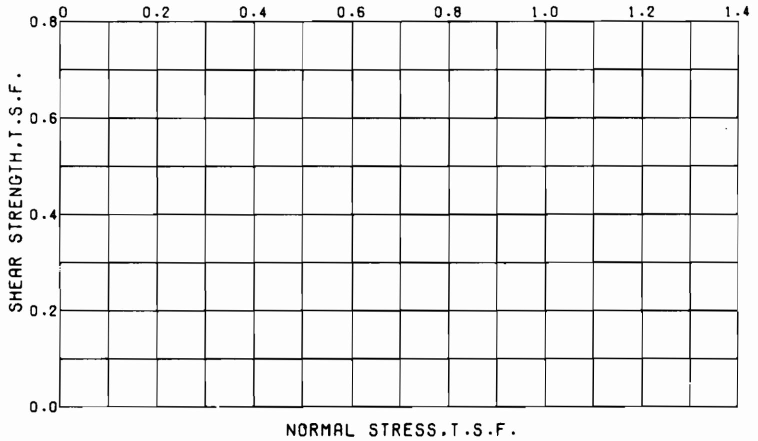
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820





PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	C - TSF	CLASS
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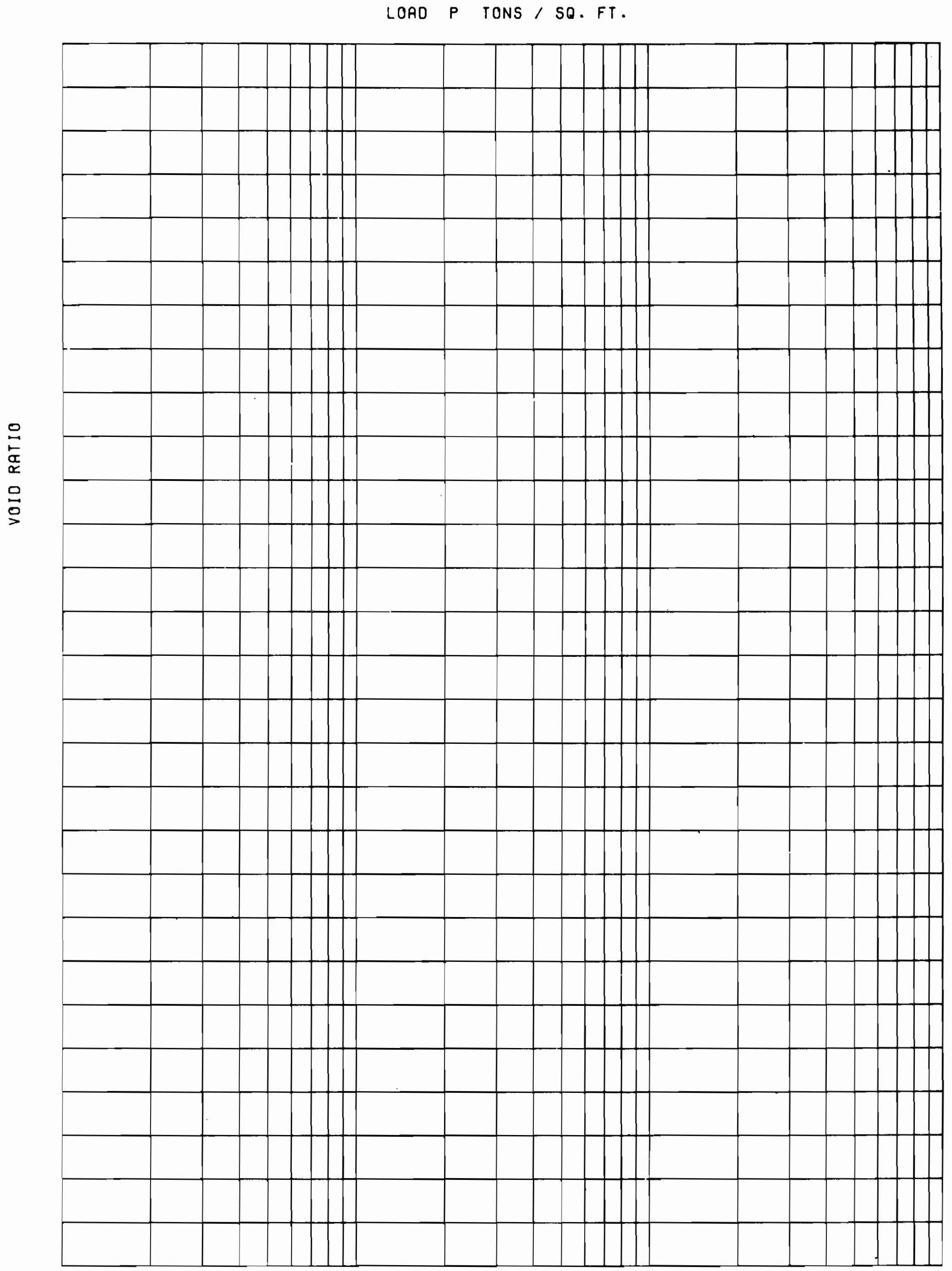
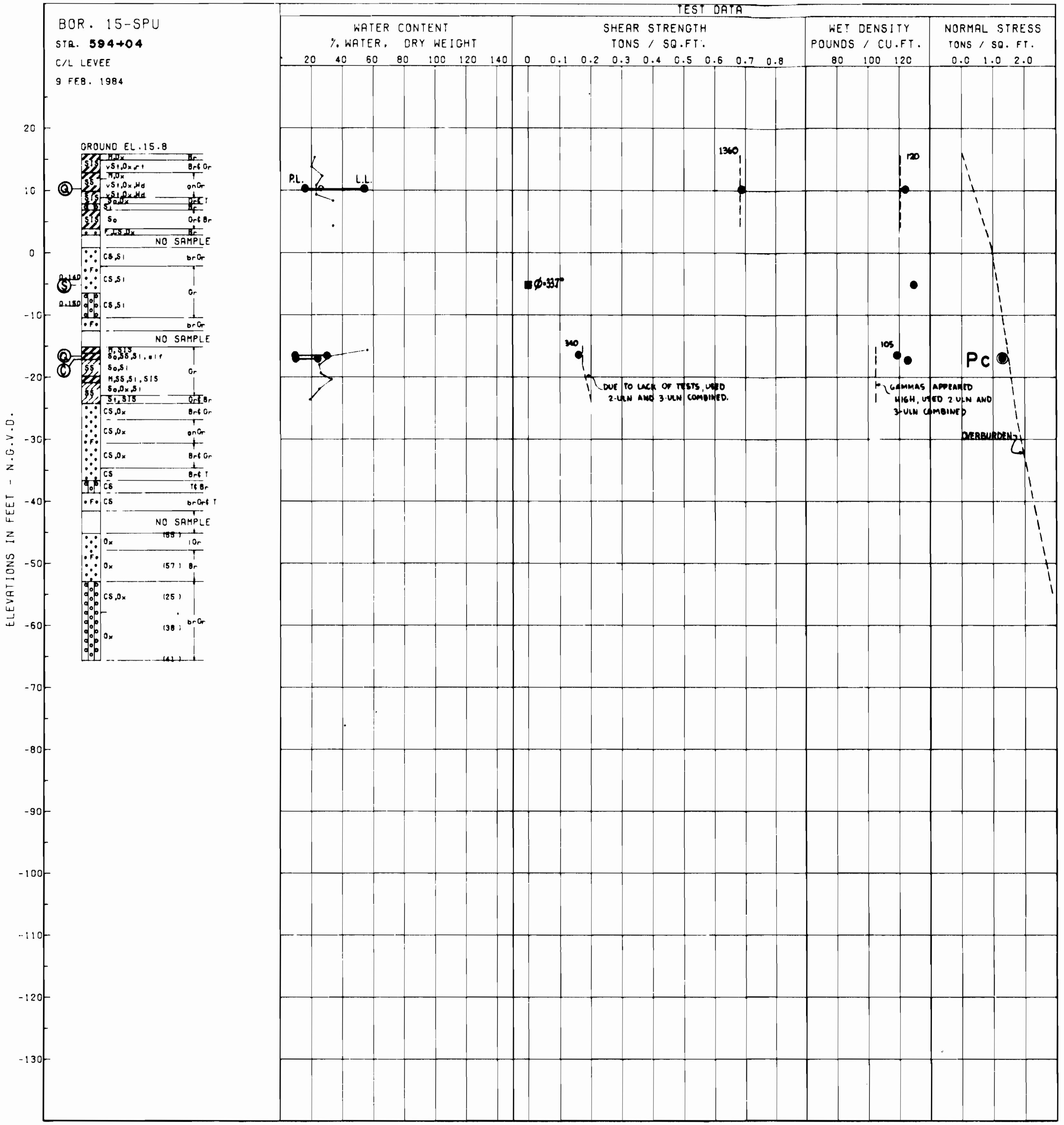
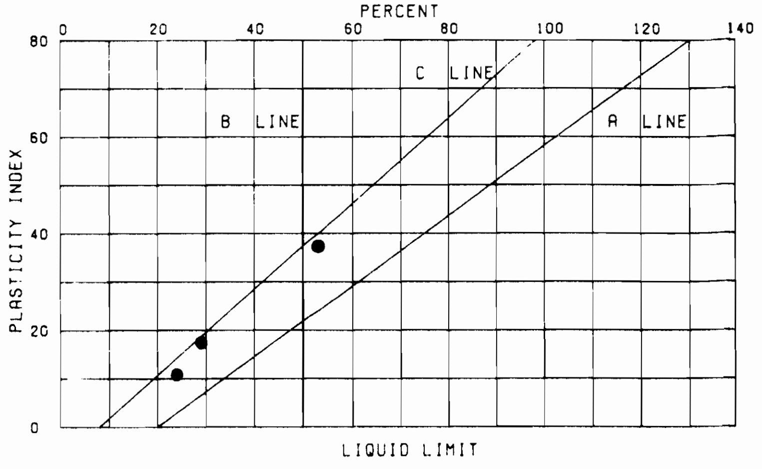


CONSOLIDATION DATA

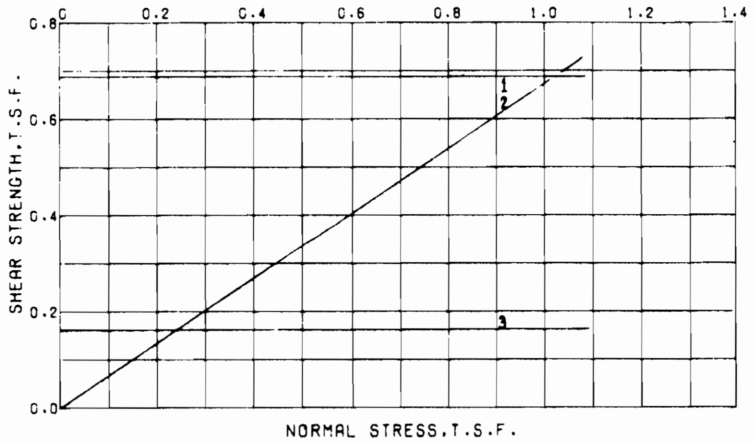
○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 6

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
UNDISTURBED BORING
14-SPU
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820





PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
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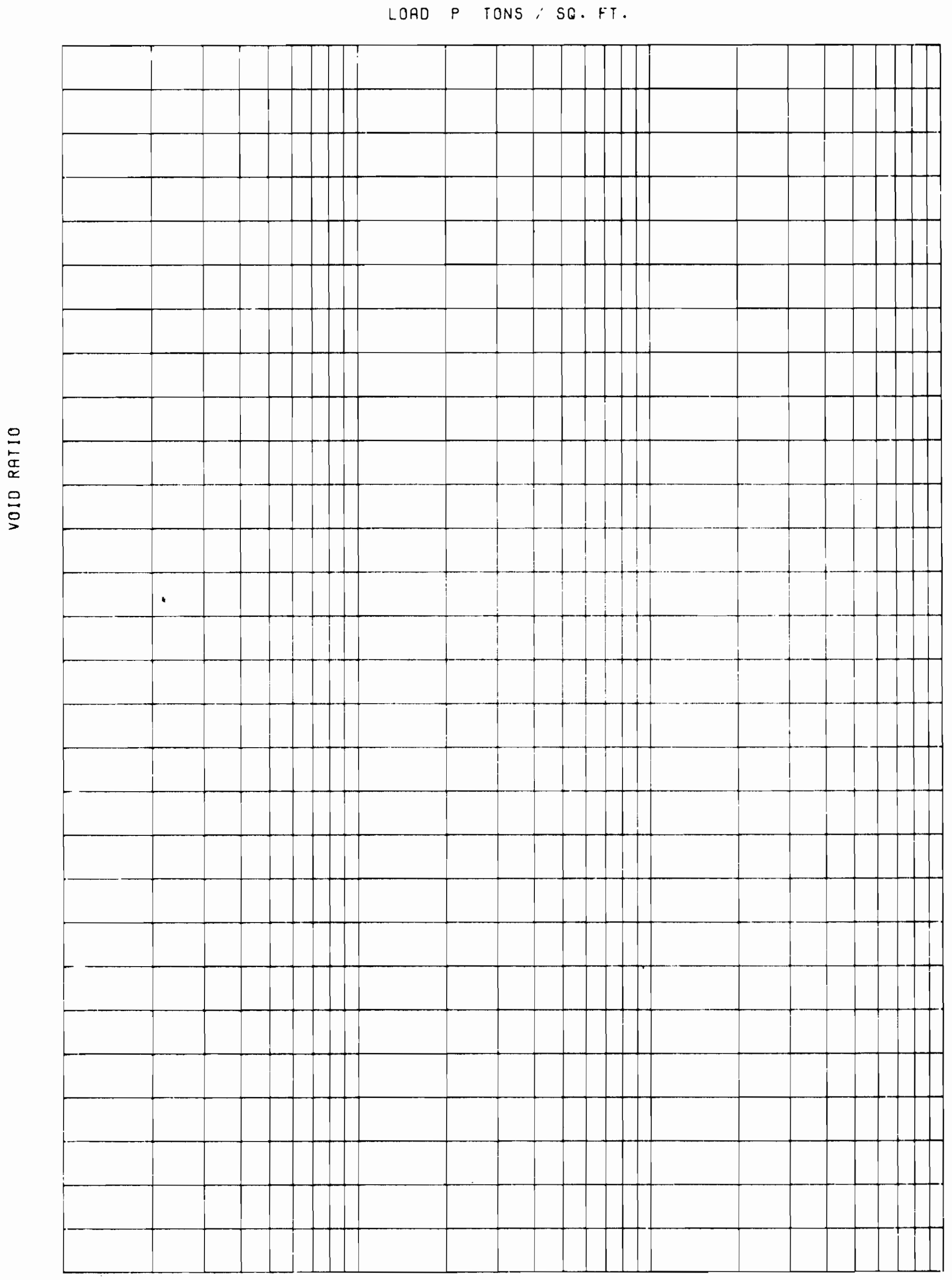
2	-5.2	S	33.7°	0.0	SC
3	-16.5	Q	0°	0.162	CL



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE 6

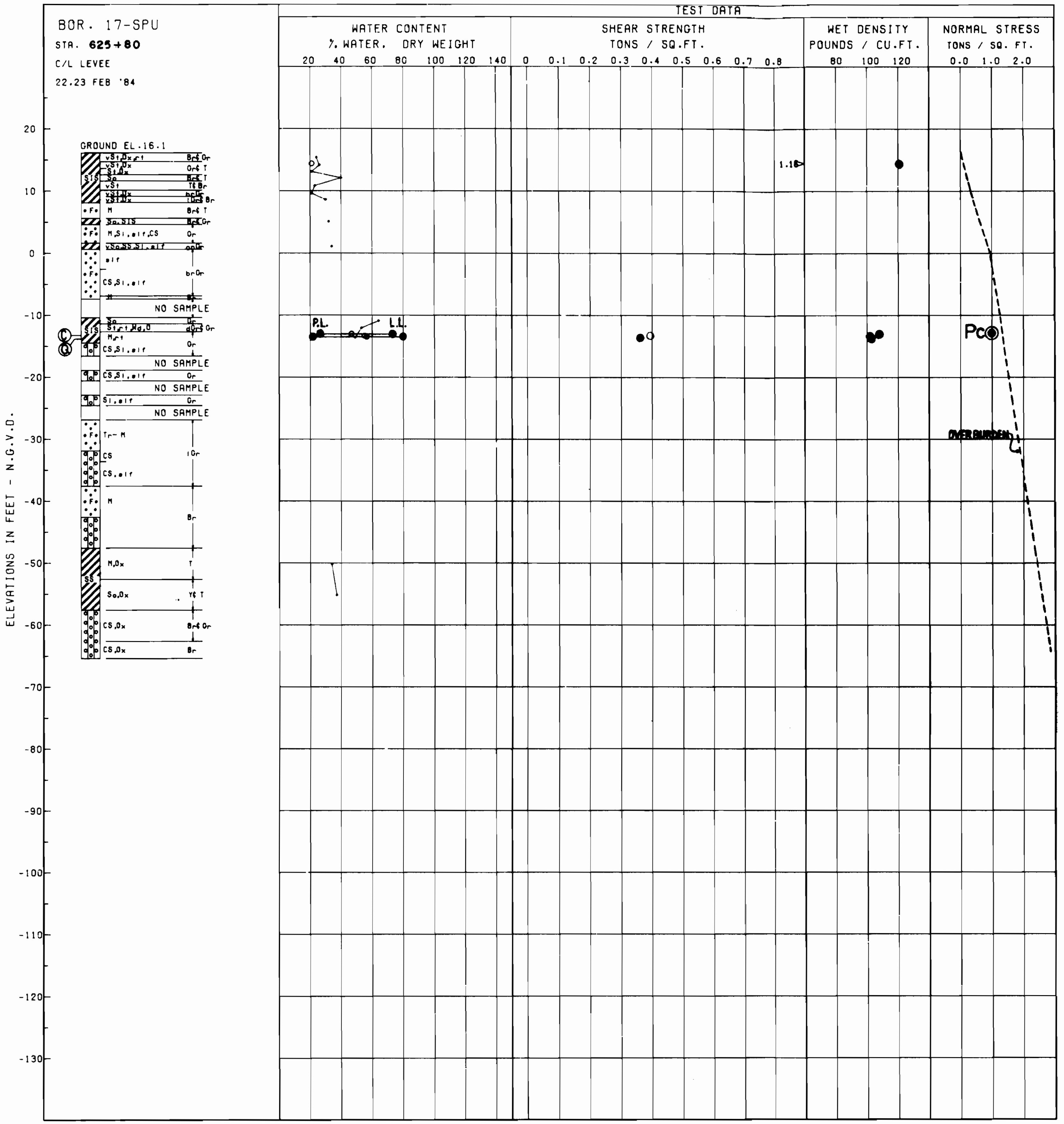
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

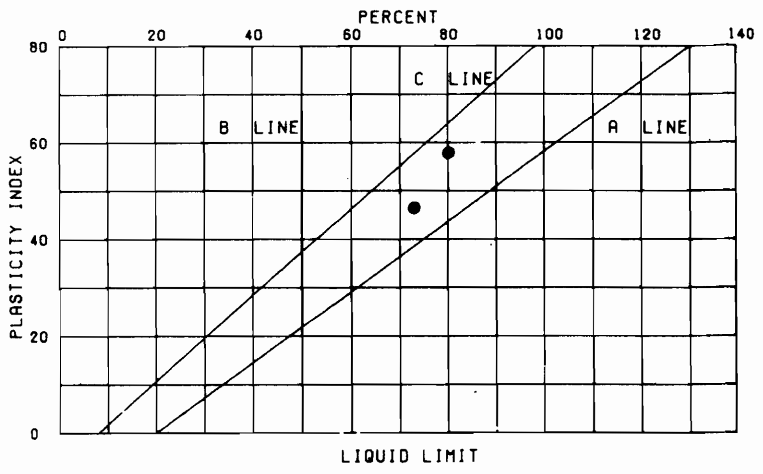
UNDISTURBED BORING

15-SPU

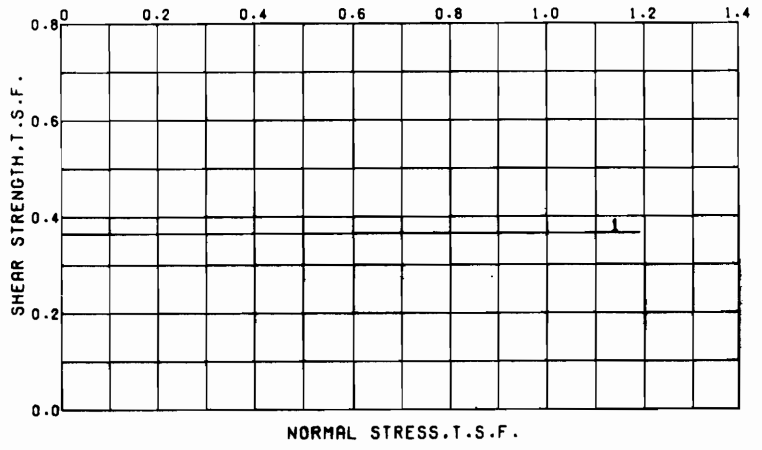
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820





PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
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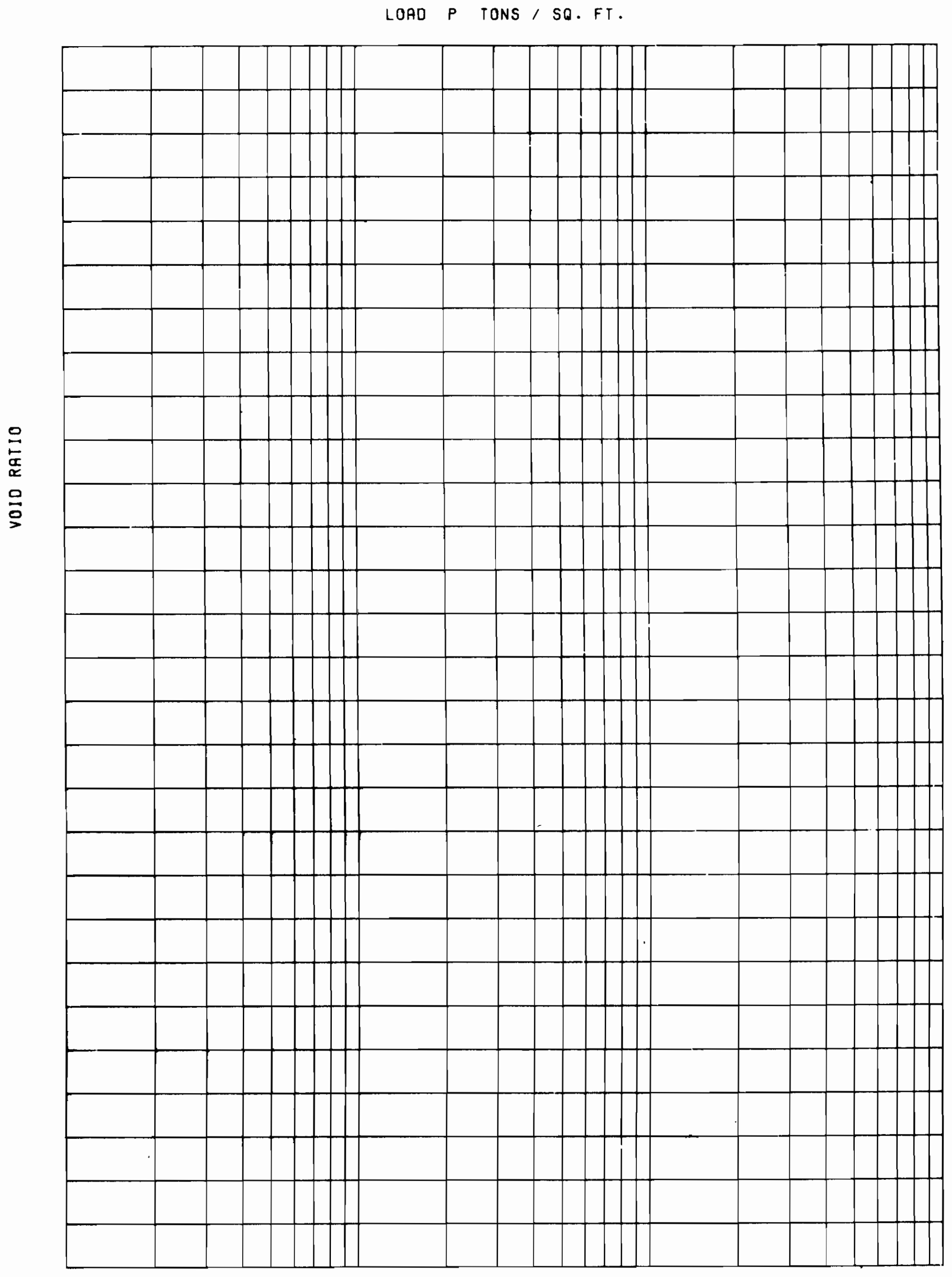


CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE 7

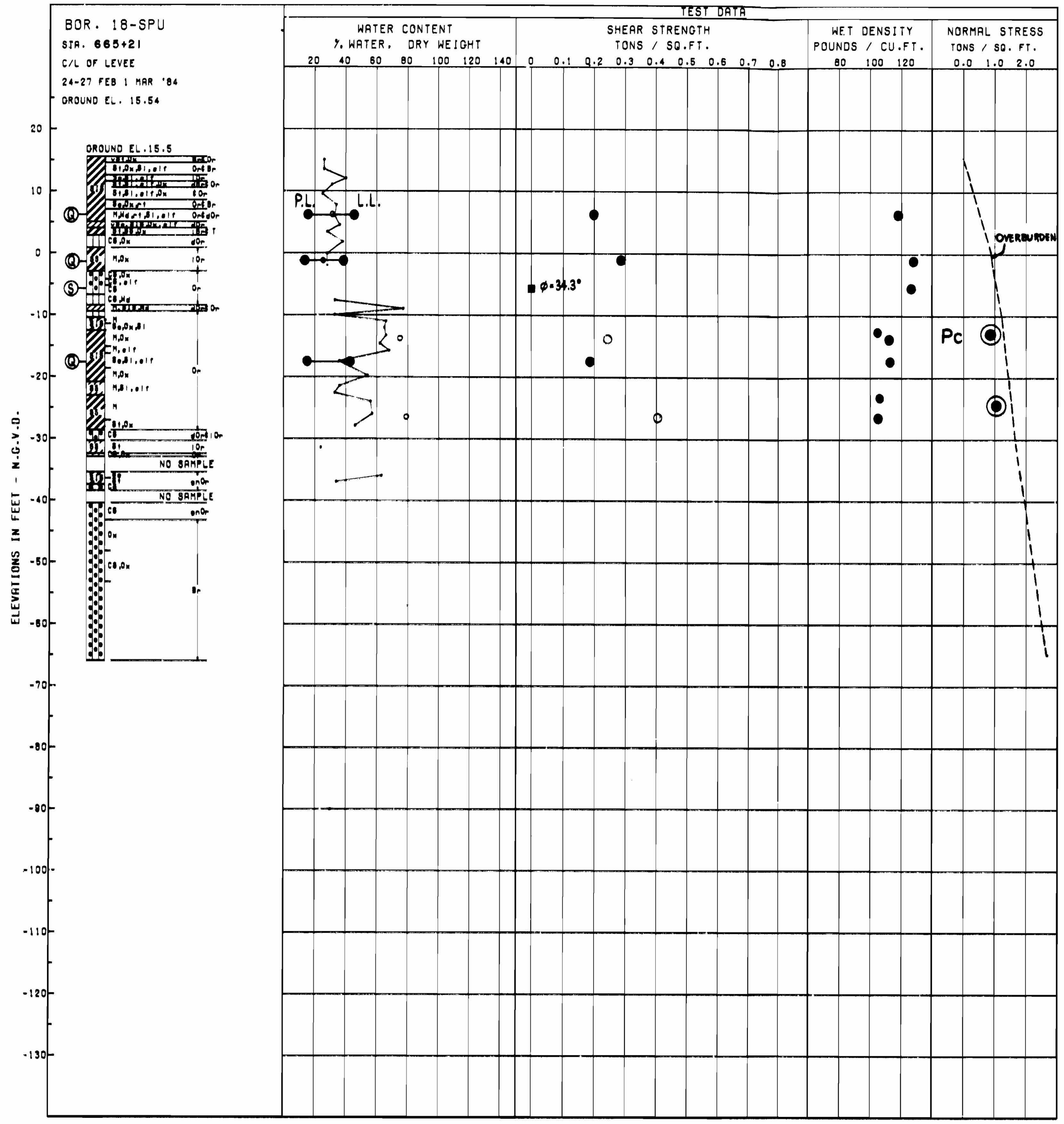
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

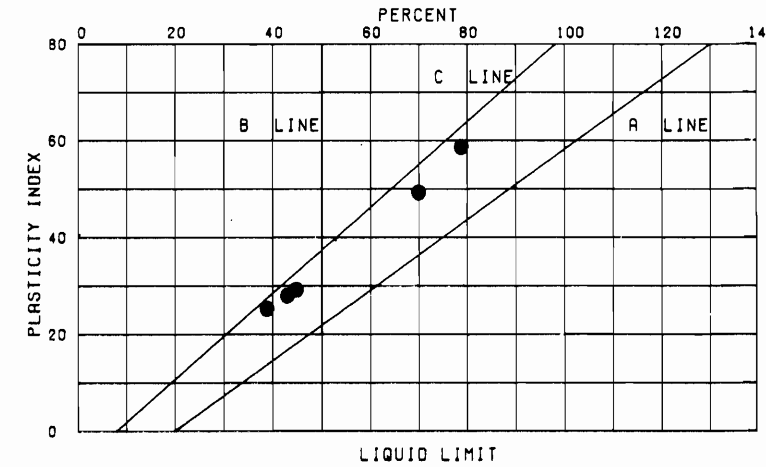
UNDISTURBED BORING

17-SPU

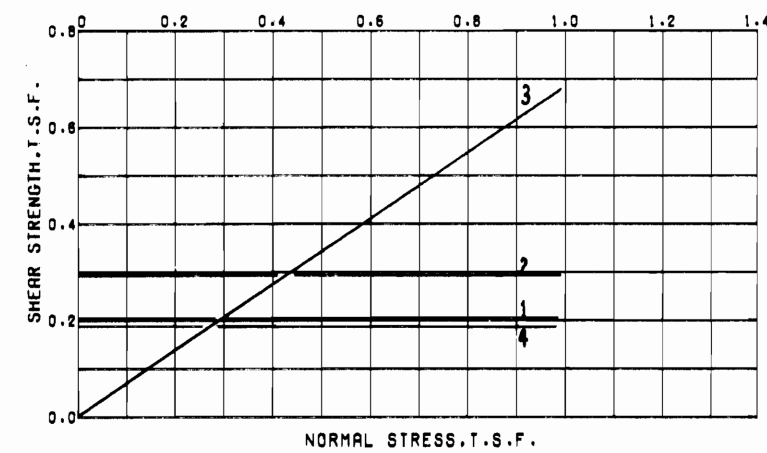
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



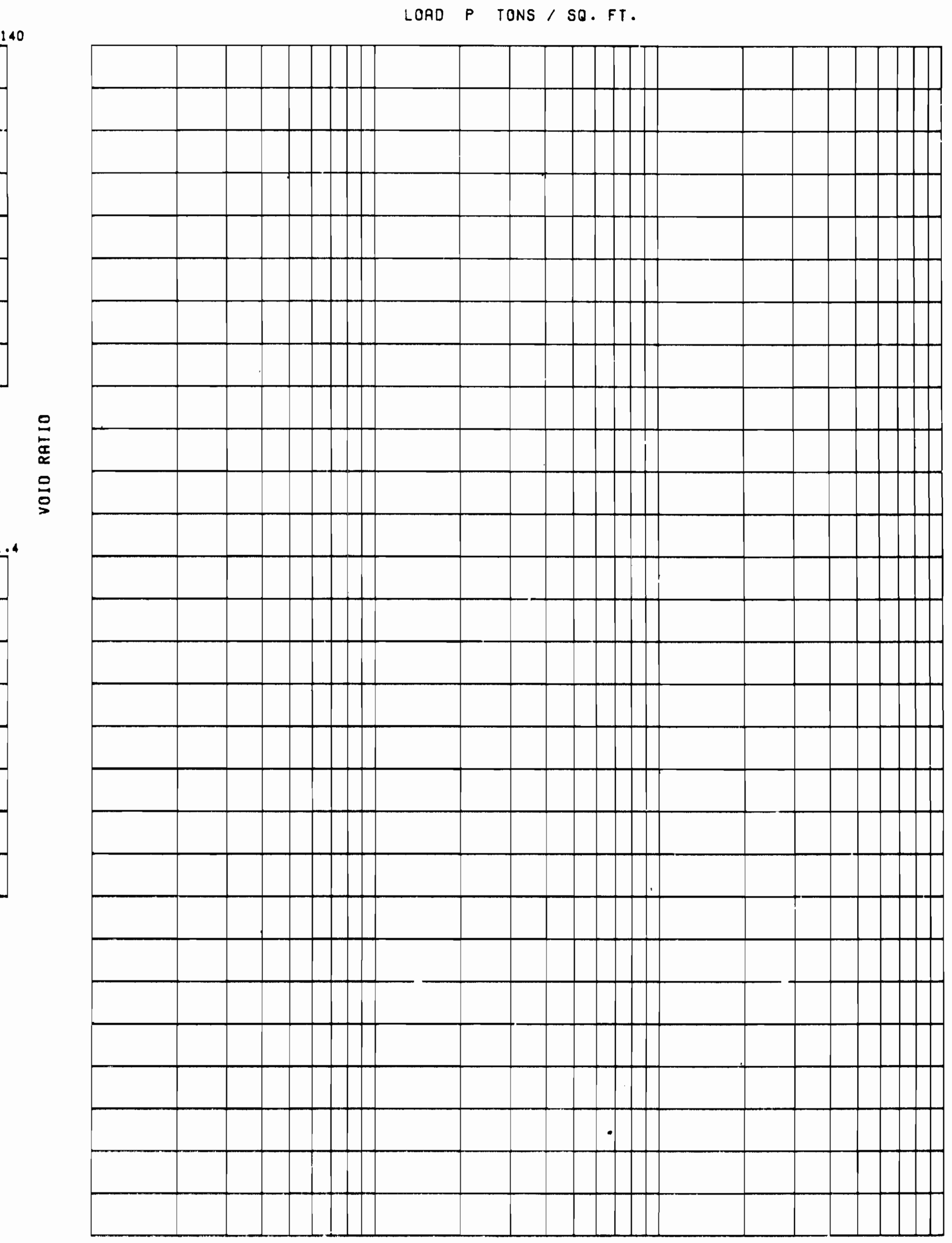


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH φ	C - TSF	CLASS
1	6.3	Q	0°	0.201	CL
2	-1.3	Q	0°	0.295	CL
3	-5.7	S	34.3°	0.0	ML
4	-17.5	Q	0°	0.187	CL



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
■ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

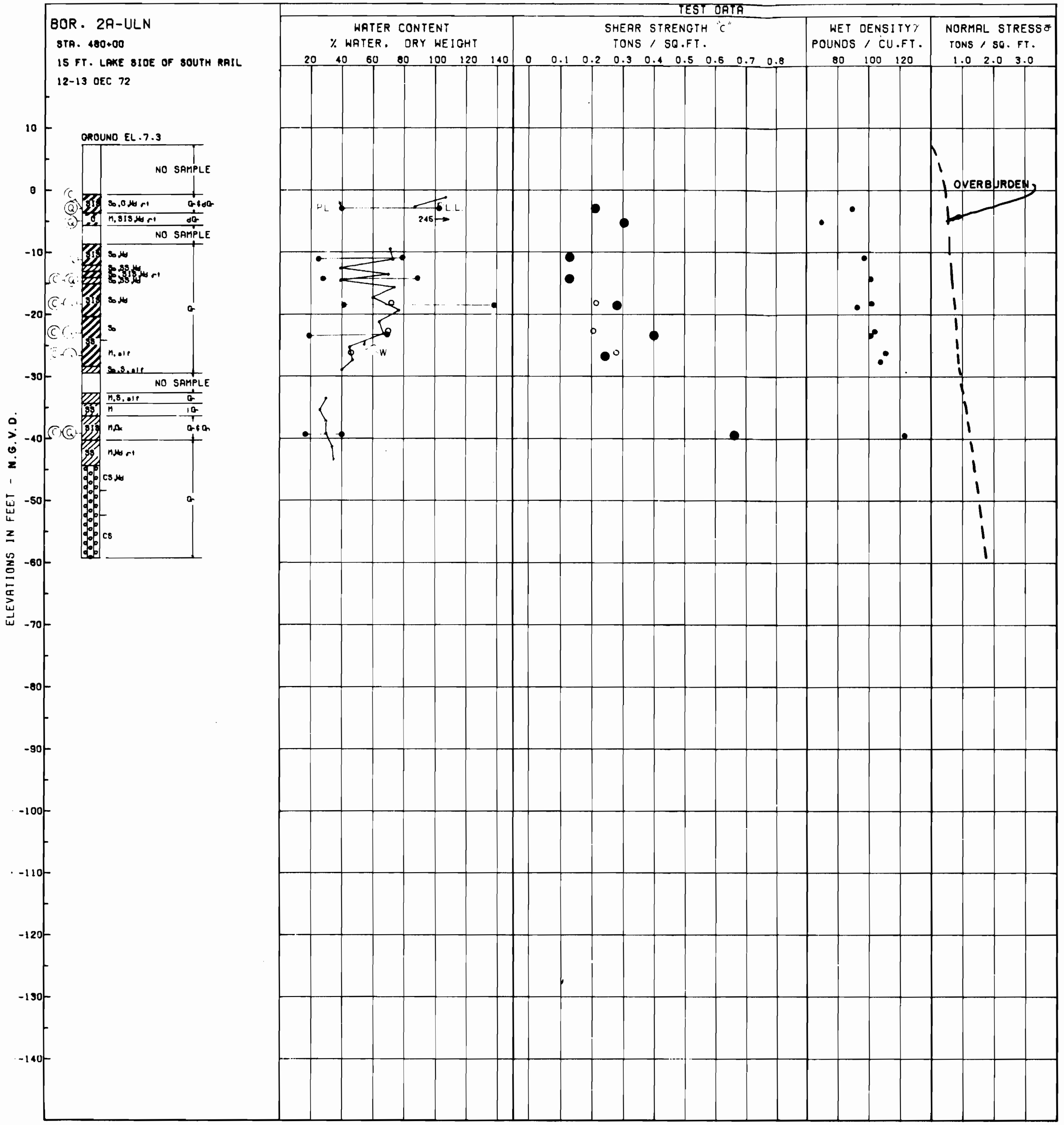
FOR LOCATION OF BORING SEE PLATE 7

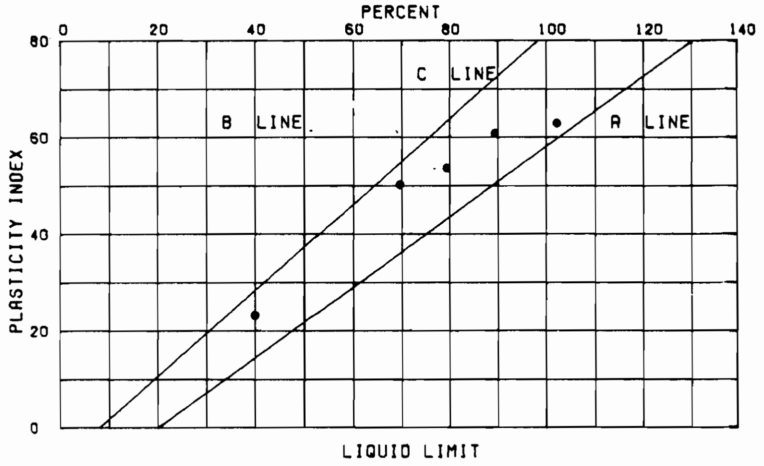
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

UNDISTURBED BORING
18-SPU

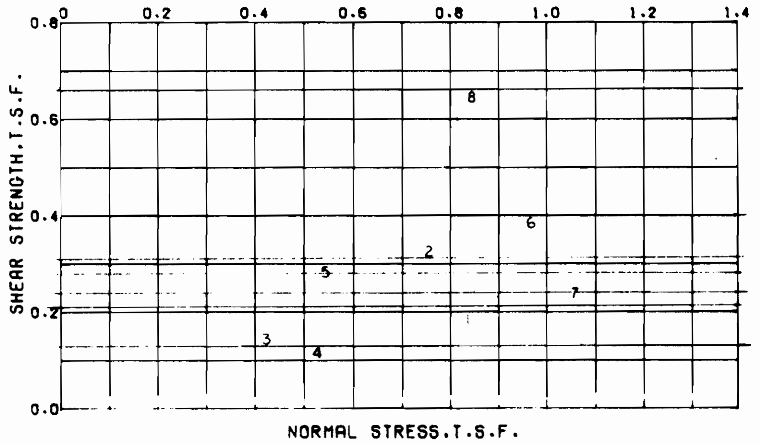
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



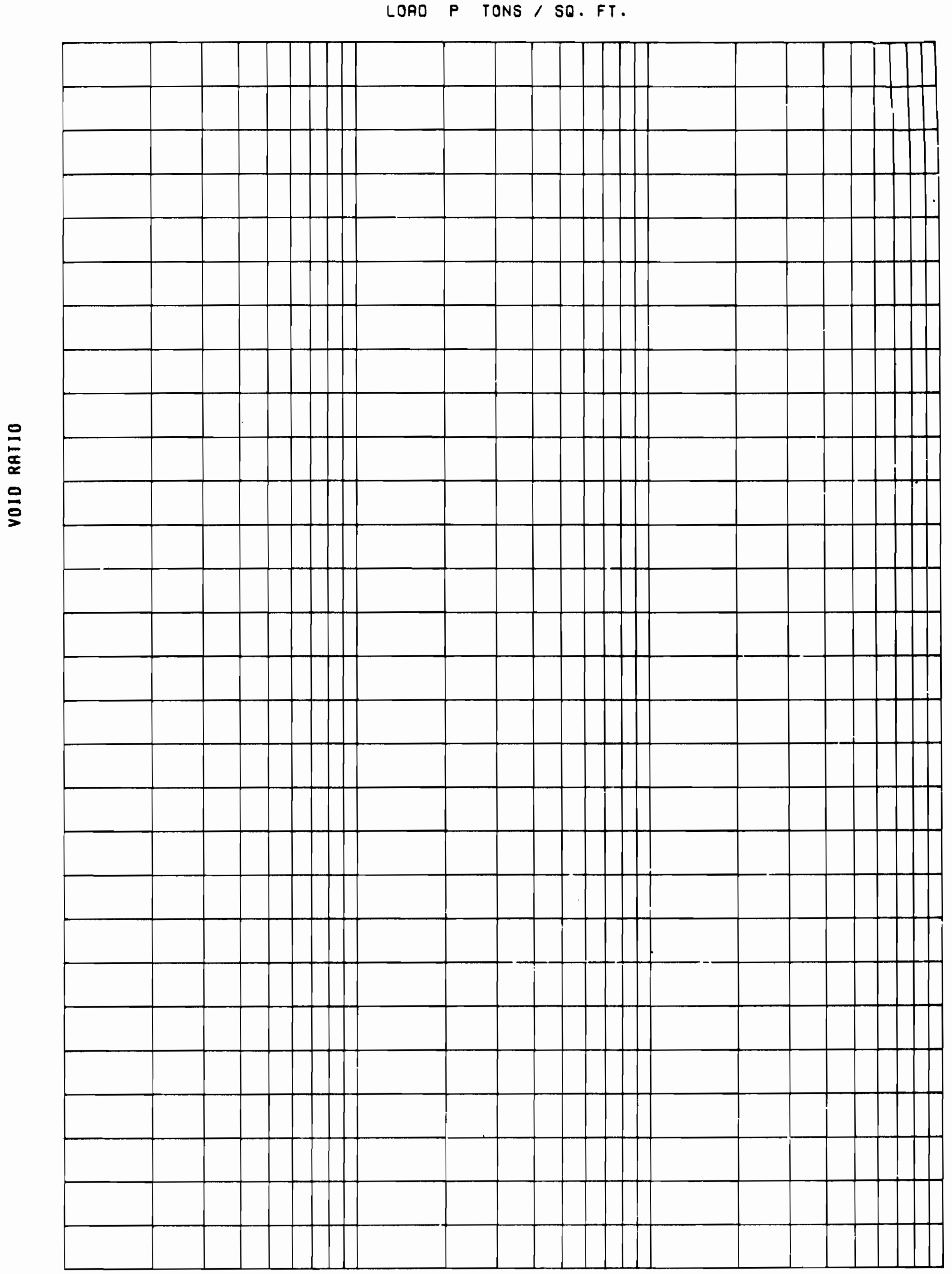


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-3.1	Q	0°	0.21	
2	-5.3		0°	0.31	
3	-10.9		0°	0.13	
4	-14.4		0°	0.13	
5	-18.[illegible]		0°	0.28	
6	-23.3		0°	0.40	
7	-26.7		0°	0.24	
8	-39.3		0°	0.66	



CONSOLIDATION DATA

- (UC) UNCONFINED COMPRESSION TEST
- (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
- (R) CONSOLIDATED - UNDRAINED SHEAR TEST
- (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORINGS SEE PLATE 4

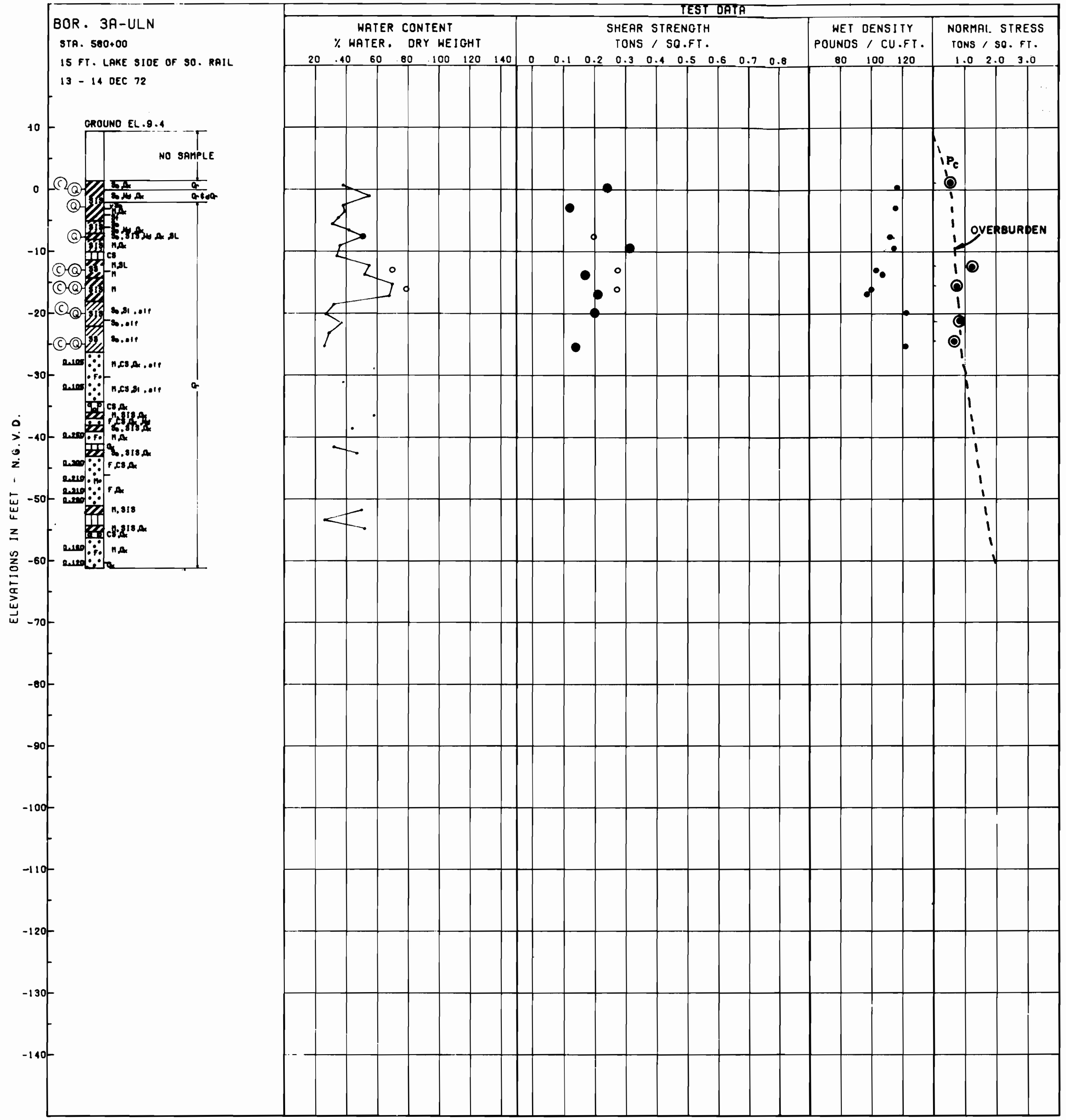
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

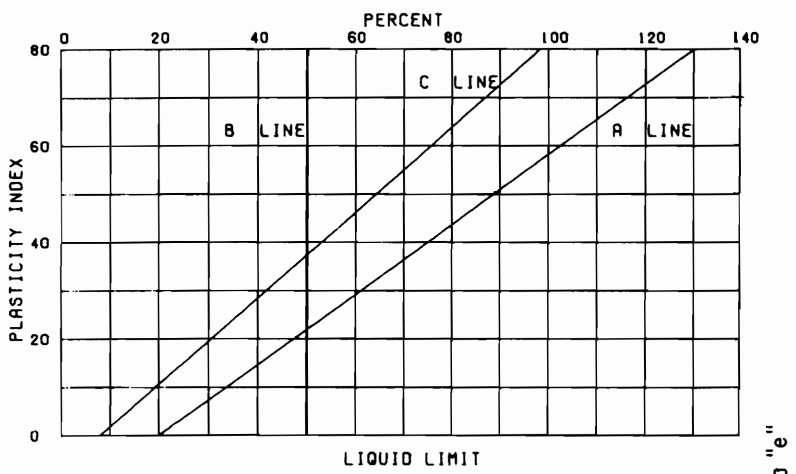
UNDISTURBED BORING

2A-ULN

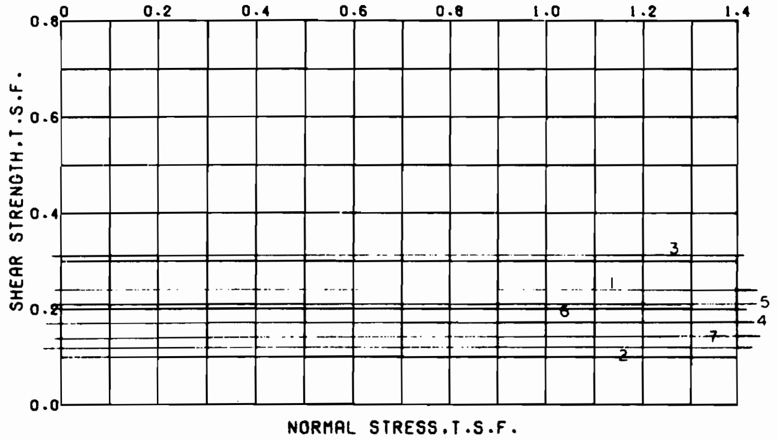
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820



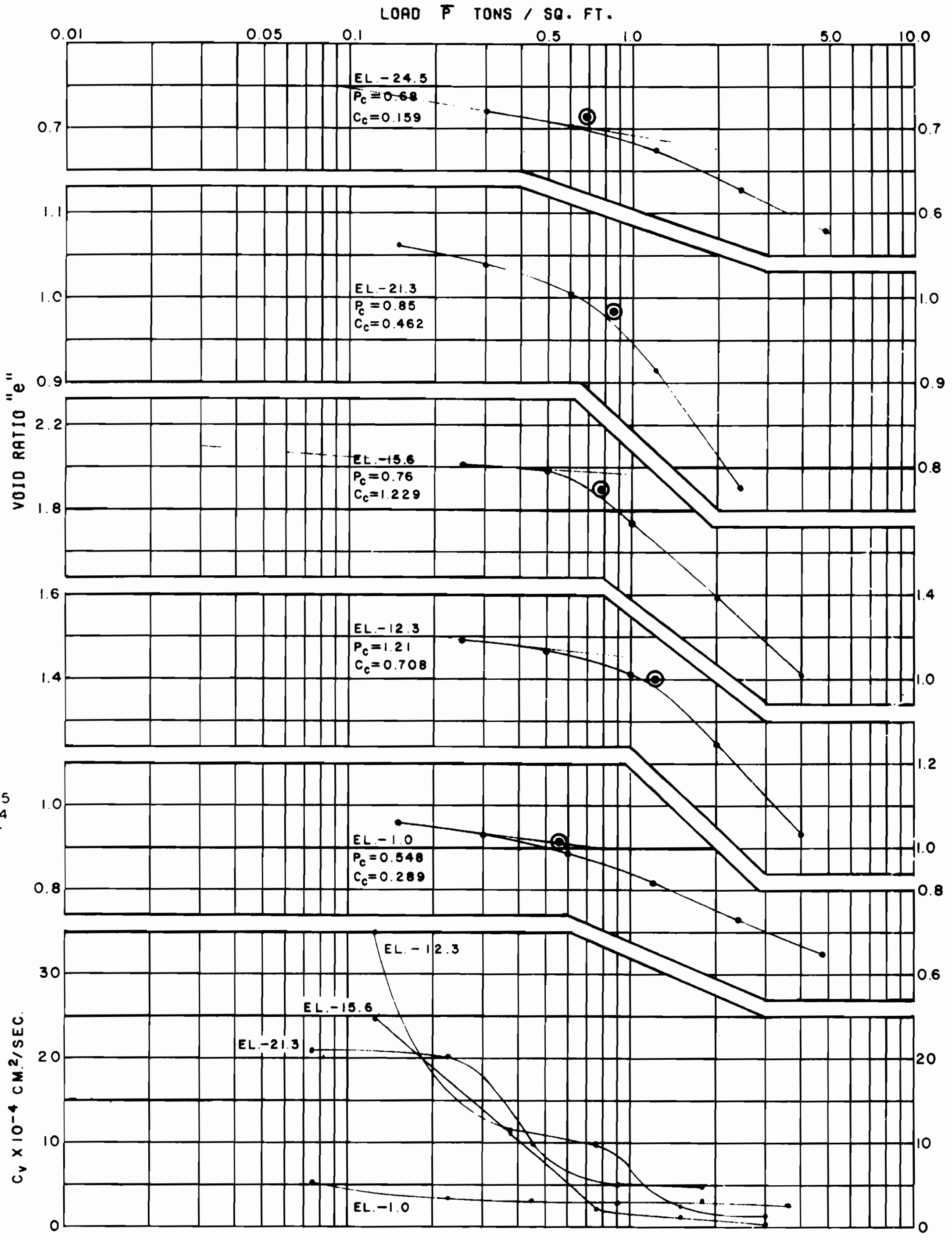


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	0.20	Q	0°	0.24	
2	-2.9		0°	0.12	
3	-9.4		0°	0.31	
4	-13.6		0°	0.17	
5	-16.9		0°	0.21	
6	-19.9		0°	0.20	
7	-25.5		0°	0.14	



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
◻ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORINGS SEE PLATE 6

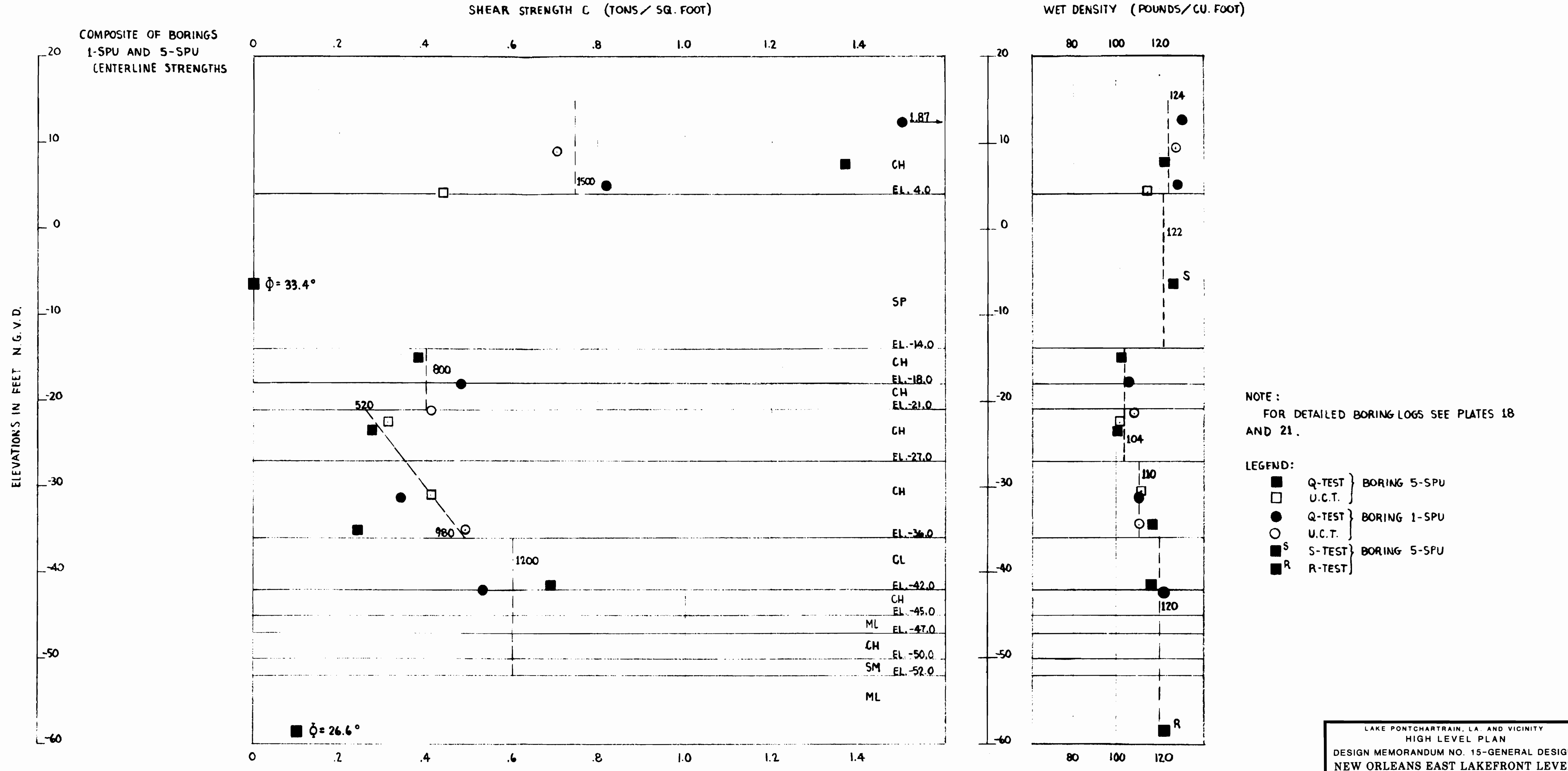
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

UNDISTURBED BORING

3A-ULN

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

DATE: FEB. 1985 FILE NO. H-2-29820

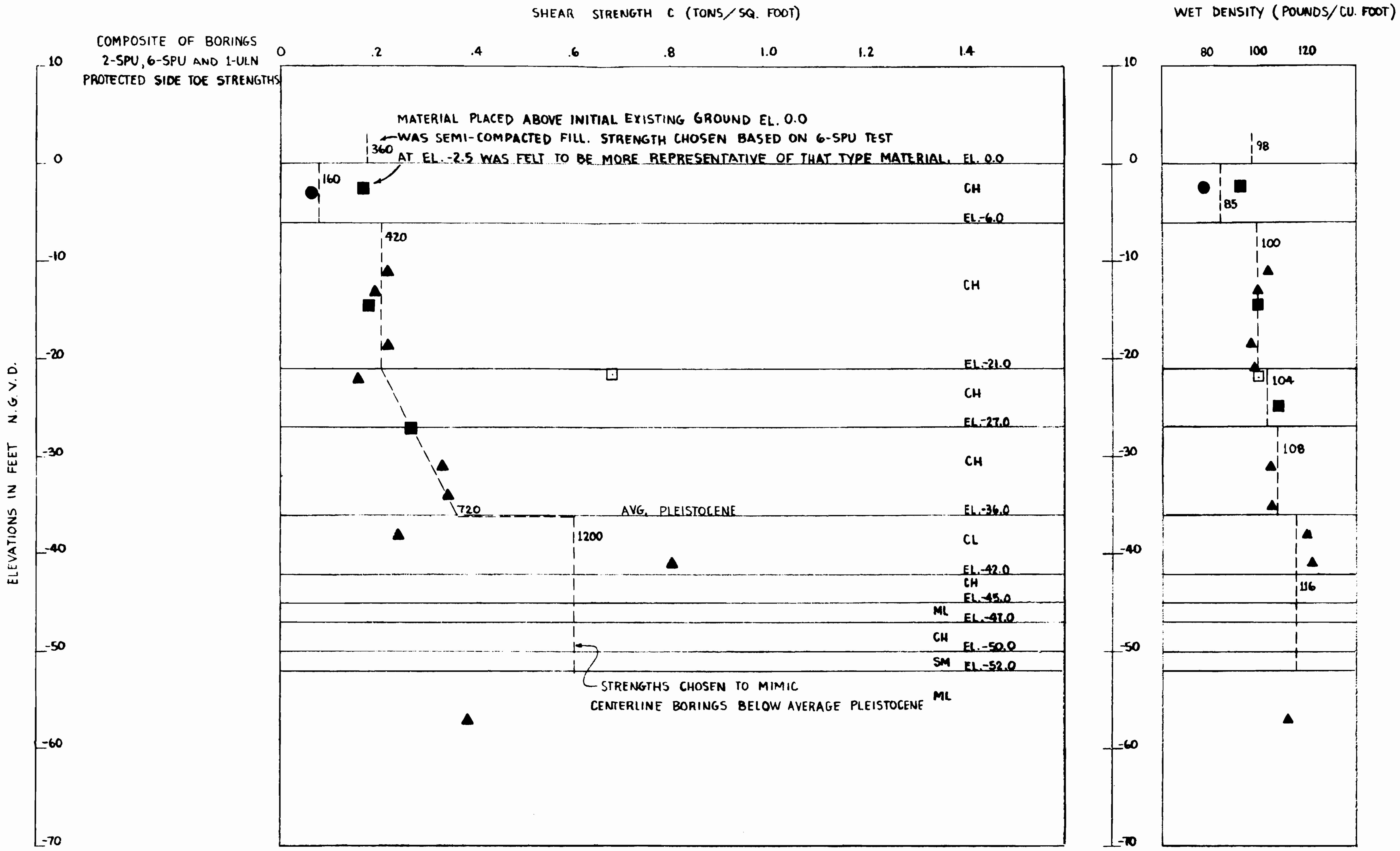


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

COMPOSITE OF UNDISTURBED BORINGS
1-SPU AND 5-SPU

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

DATE: FEB. 1985 FILE NO. H-2-29820



NOTES:

FOR DETAILED BORING LOGS OF 2-SPU AND 6 SPU SEE PLATES 19 AND 22. FOR A DETAILED LOG OF BORING 1-ULN SEE PLATE 11 OF DESIGN MEMORANDUM NO. 2, GENERAL DESIGN SUPPLEMENT NO. 5B. Lake Pontchartrain, La. and Vicinity Hurricane Protection Project.

PIPELINE CLOSURE BORING 2-SPU USED TO PROVIDE ADDITIONAL STRENGTH DATA IN TOP STRATUM ONLY.

LEGEND:

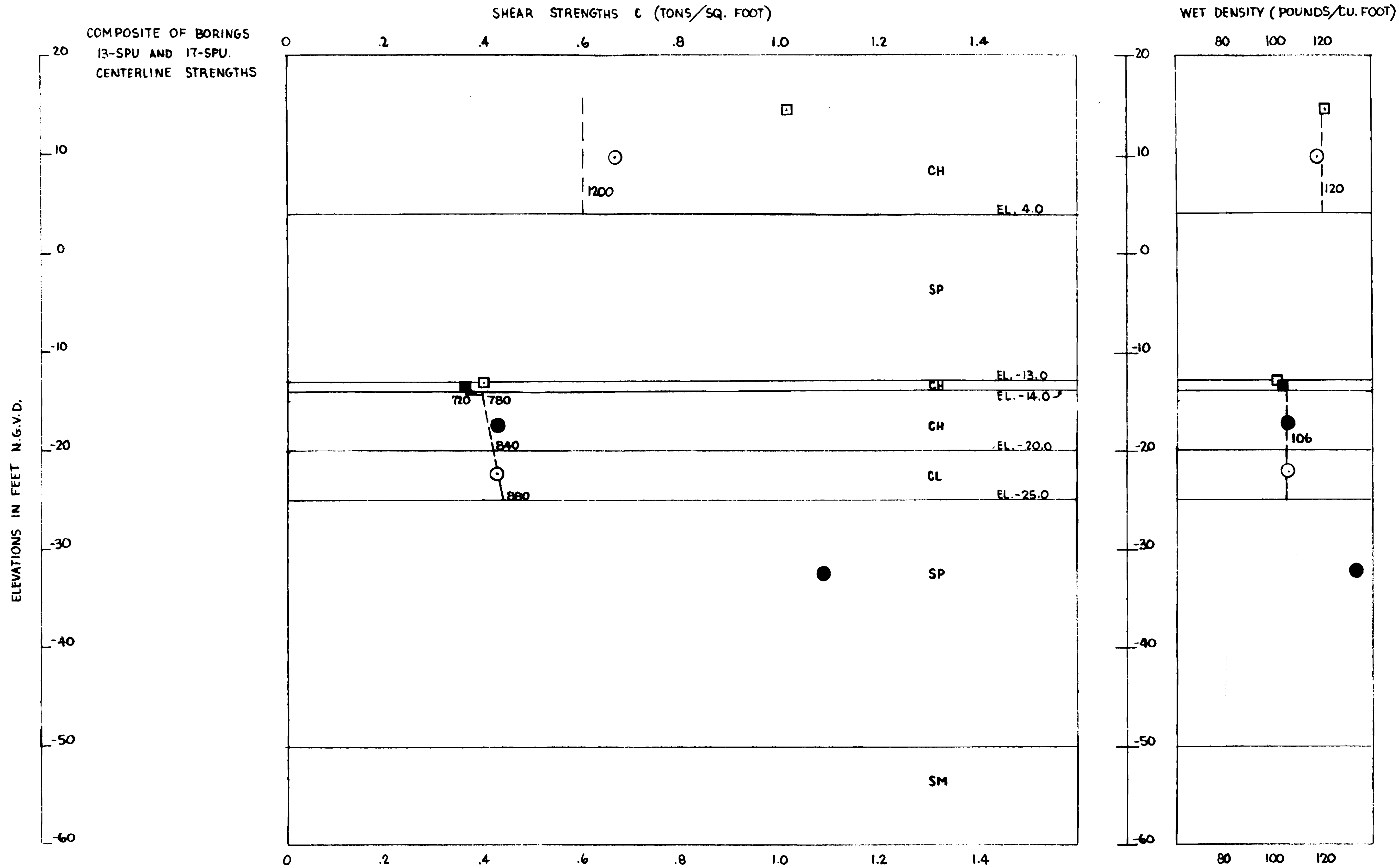
■ Q-TEST } BORING 6-SPU
□ U.C.T. }
● Q-TEST BORING 2-SPU

▲ Q-TEST } BORING 1-ULN
△ U.C.T. }

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
COMPOSITE OF UNDISTURBED BORINGS
2-SPU, 6-SPU, AND 1-ULN

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

DATE: FEB. 1985 FILE NO. H-2-29820



NOTES:

FOR DETAILED BORING LOGS OF 13-SPU AND 17-SPU SEE PLATES 28 AND 31.

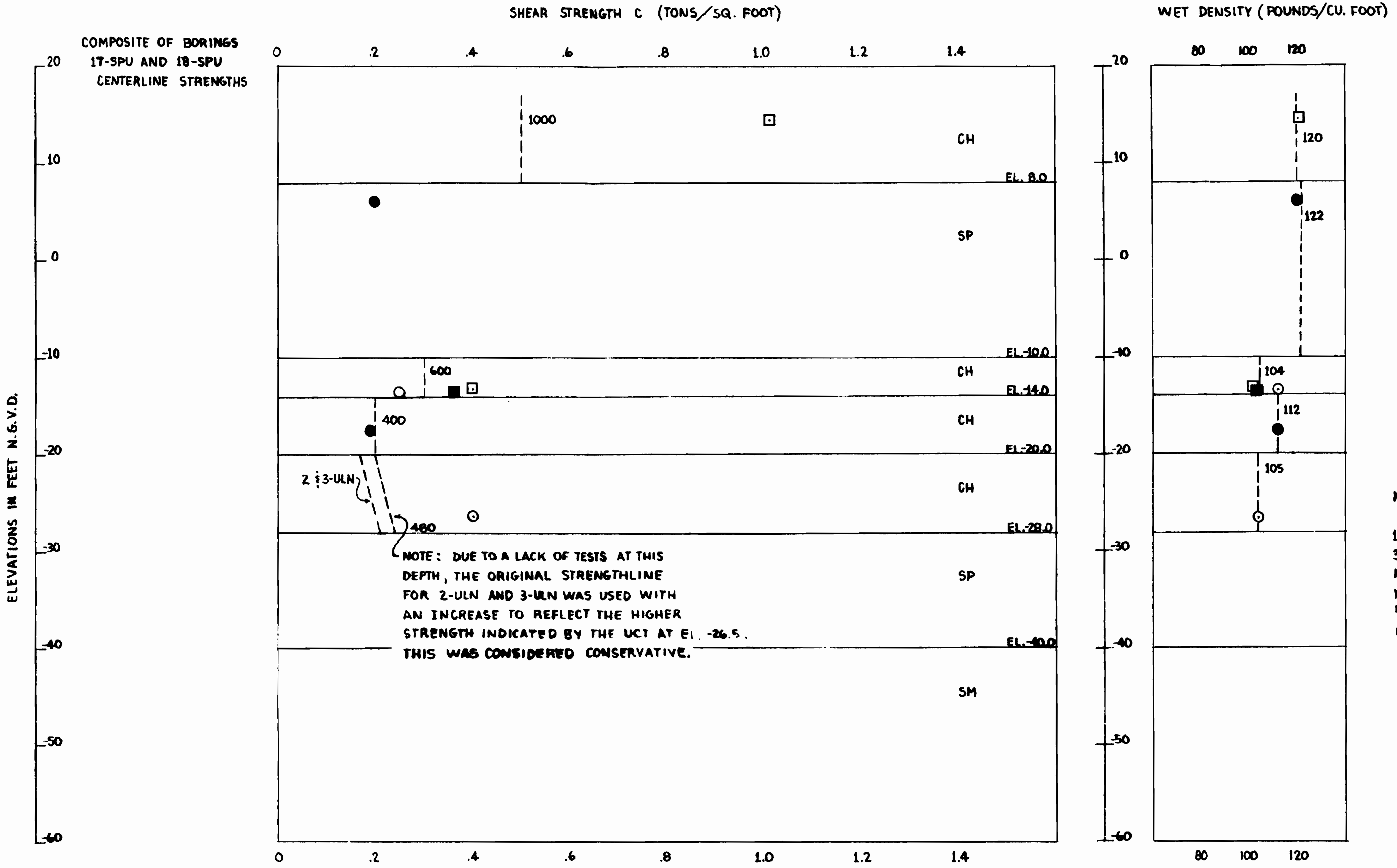
LEGEND:

- ● Q-TEST } BORING 13-SPU
- ⊙ U.C.T. } BORING 13-SPU
- ■ Q-TEST } BORING 17-SPU
- ⊡ U.C.T. } BORING 17-SPU

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
COMPOSITE OF UNDISTURBED BORINGS
13-SPU AND 17-SPU

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

DATE: FEB. 1985 FILE NO. H-2-29820



NOTES:

FOR DETAILED BORING LOGS OF 17-SPU AND 18-SPU SEE PLATES 31 AND 32. FOR 2-ULN AND 3-ULN COMBINED SEE PLATE 14 OF DESIGN MEMORANDUM NO. 2, GENERAL DESIGN SUPPLEMENT NO. 5B, Lake Pontchartrain, La. and Vicinity Hurricane Protection Project.

LEGEND:

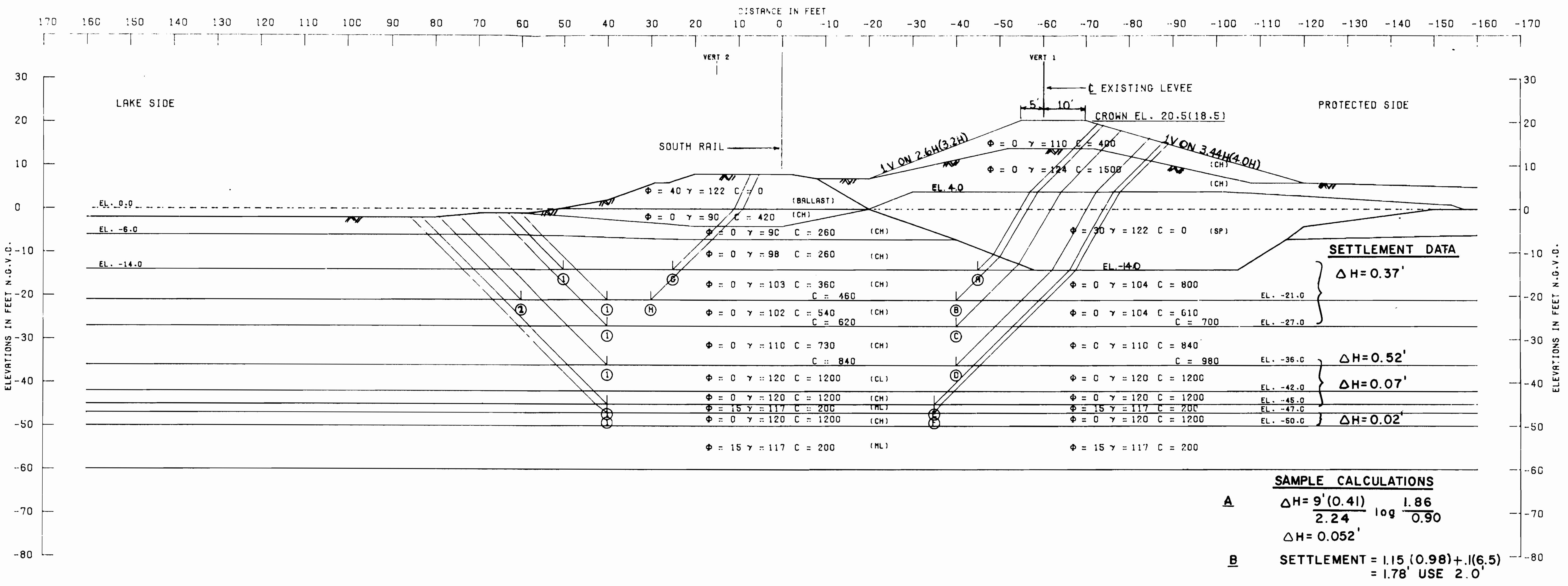
■ Q-TEST, ⊡ U.C.T. — BORING 17-SPU

● Q-TEST, ⊙ U.C.T. — BORING 18-SPU

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
COMPOSITE OF UNDISTURBED BORINGS
17-SPU AND 18-SPU

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

DATE: FEB. 1985 FILE NO. H-2-29820



SAMPLE CALCULATIONS

A $\Delta H = \frac{9'(0.41)}{2.24} \log \frac{1.86}{0.90}$

$\Delta H = 0.052'$

B SETTLEMENT = 1.15 (0.98) + .1(6.5)
= 1.78' USE 2.0'

CONSOLIDATION	0.98'
LATERAL SPREAD	0.15'
SHRINKAGE	0.65'

ANALYSIS COVERS STA. 331+50 TO 364+50.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 1-SPU AND 5-SPU. FOR TOE STRENGTHS SEE BORING 2A-ULN.

ANALYSIS WAS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC LEVELS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

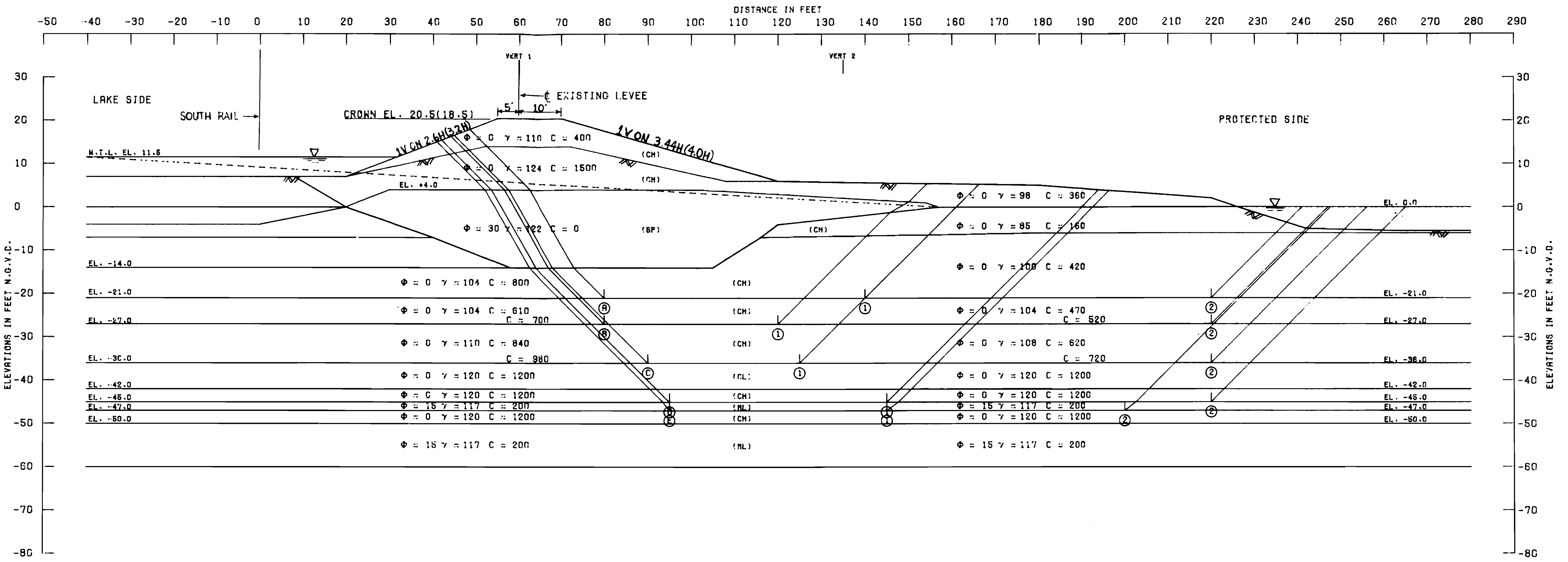
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-14.0	60325	24700	6760	67416	8311	91785	59105	1.550
B 1	-21.0	71121	43520	11800	95403	21670	126441	73733	1.710
C 1	-27.0	80237	51213	18280	125556	35233	149730	90323	1.660
D 1	-36.0	93113	70023	31160	176185	62655	194296	113530	1.710
E 1	-45.0	111988	71972	52500	231908	98852	236460	133056	1.780
F 1	-47.0	114402	74163	56587	245549	107943	245152	137606	1.780
G 1	-14.0	11615	6500	6760	26072	8311	24875	17761	1.400
H 2	-21.0	16655	13800	11323	43420	18568	41778	24852	1.080

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
VICINITY OF LITTLE WOODS
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 331+50 TO 364+50.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 1-SPU AND 5-SPU. FOR TOE STRENGTHS SEE COMPOSITE OF BORINGS 6-SPU AND 1-ULN. BORING 1-ULN TAKEN FROM DESIGN MEMORANDUM NO. 2, GENERAL DESIGN SUPPLEMENT NO. 5B.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

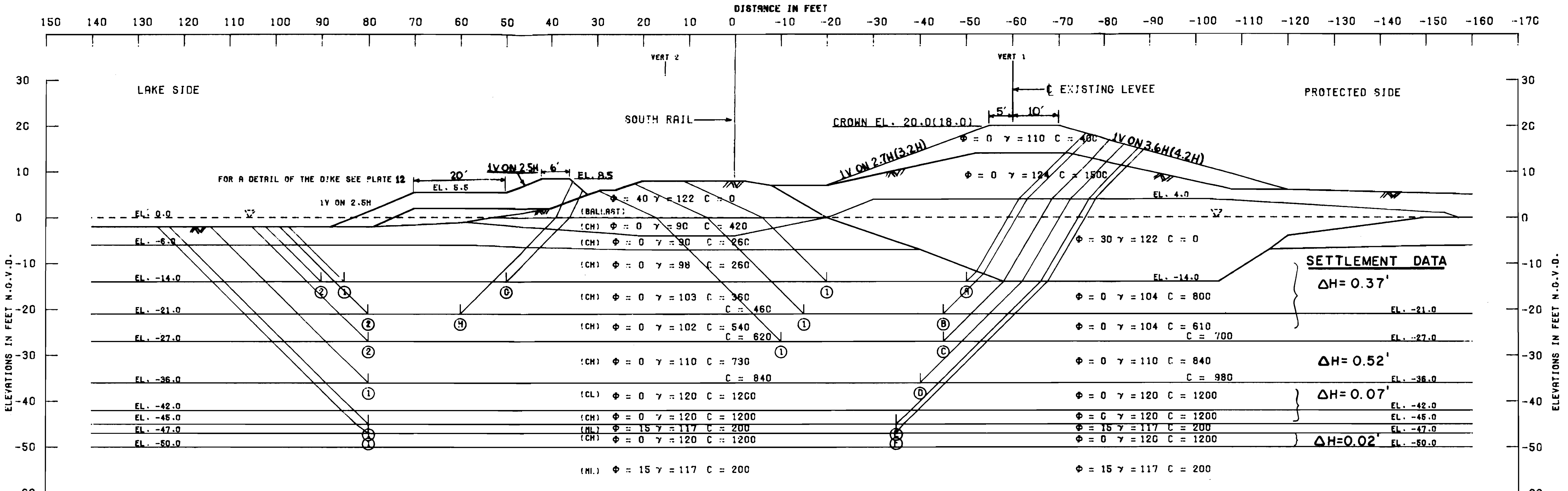
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-21.0	71741	32454	18079	98349	34064	122274	64285	1.900
A	2	-21.0	71741	66054	13377	98349	20411	151172	77938	1.940
B	1	-27.0	75801	24159	25010	127523	54990	125570	72533	1.730
B	2	-27.0	75801	76429	18560	127523	33761	170790	93762	1.820
C	1	-36.0	90100	28536	35169	175995	80800	153805	89195	1.720
C	2	-36.0	90100	97109	29656	175995	60803	216865	115192	1.880
D	1	-45.0	109713	47794	55766	232995	123708	213273	109287	1.950
D	2	-45.0	109713	109032	51192	232995	97038	269937	135957	1.990
E	1	-47.0	112388	49255	60174	246905	133928	221817	112977	1.960
E	2	-47.0	112388	96616	55517	246905	113874	264521	133031	1.990

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
VICINITY OF LITTLE WOODS
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



SAMPLE CALCULATIONS

A $\Delta H = \frac{9'(0.41)}{2.24} \log \frac{1.86}{0.90}$

$\Delta H = 0.052'$

B SETTLEMENT = 1.15(0.98)+.1(6.5)
= 1.78' USE 2.0'

CONSOLIDATION	0.98'
LATERAL SPREAD	0.15'
SHRINKAGE	0.65'

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 1-SPU AND 5-SPU. FOR TOE STRENGTHS SEE BORING 2A-ULN.

ANALYSIS WAS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

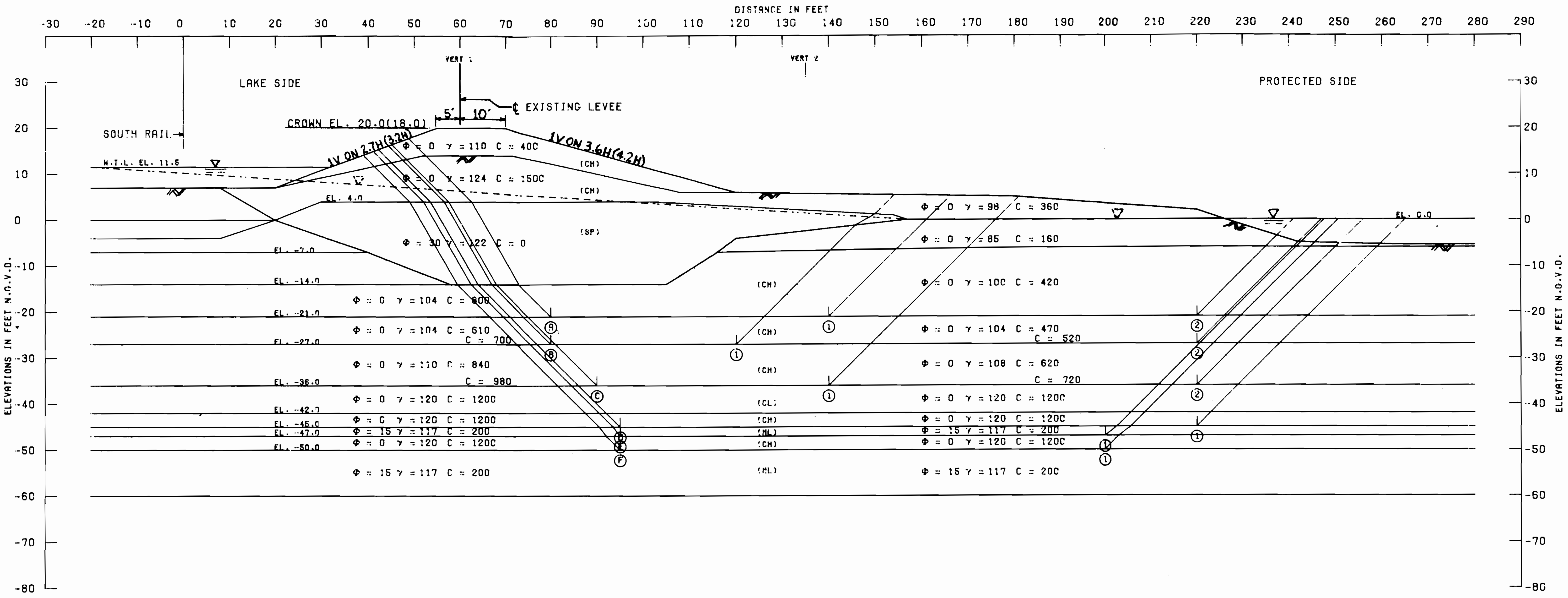
ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-14.0	61678	7800	21804	67377	24926	91282	42451	2.150
A 2	-14.0	61678	36400	6240	67377	6736	104318	60641	1.720
B 1	-21.0	72190	19587	29625	96143	43913	121402	52230	2.320
B 2	-21.0	72190	65327	11280	96143	19025	148797	77118	1.930
C 1	-27.0	79546	23286	31939	125309	63454	134771	61855	2.180
C 2	-27.0	79546	79420	17760	125309	32051	176726	93258	1.900
D 1	-36.0	92235	103623	30900	173614	58798	226758	114816	1.970
E 1	-45.0	111152	109441	52500	229097	94859	273093	134238	2.030
F 1	-47.0	113567	112800	56555	242694	103964	282922	138730	2.040
G 1	-14.0	10697	9100	6240	26178	6983	26037	19195	1.360
H 2	-21.0	16715	9200	11280	43218	19025	37195	24193	1.540

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
STA. 364+50 TO 390+00
AND 398+25 TO 436+50
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 1-SPU AND 5-SPU. FOR TOE STRENGTHS SEE COMPOSITE OF BORINGS G-SPU AND 1-ULN. BORING 1-ULN TAKEN FROM DESIGN MEMORANDUM NO. 2, GENERAL DESIGN SUPPLEMENT NO. 5B.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ASSUMED FAILURE NO.	SURFACE	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-21.0	70410	32454	18079	96301	34064	120943	62237	1.940
A	2	-21.0	70410	66054	13377	96301	20411	149841	75890	1.970
B	1	-27.0	74473	24159	25596	125293	54990	124228	70303	1.770
B	2	-27.0	74473	76429	18560	125293	33701	169462	91532	1.850
C	1	-36.0	88770	39509	34787	173408	83516	163066	89892	1.810
C	2	-36.0	88770	97109	29656	173408	60803	215535	112605	1.910
D	1	-45.0	108390	108728	51192	230153	97038	268310	133115	2.020
E	1	-47.0	111029	96312	55517	244017	113874	262858	130143	2.020
F	1	-50.0	116126	101127	62664	265524	128845	279917	136679	2.050

NOTES

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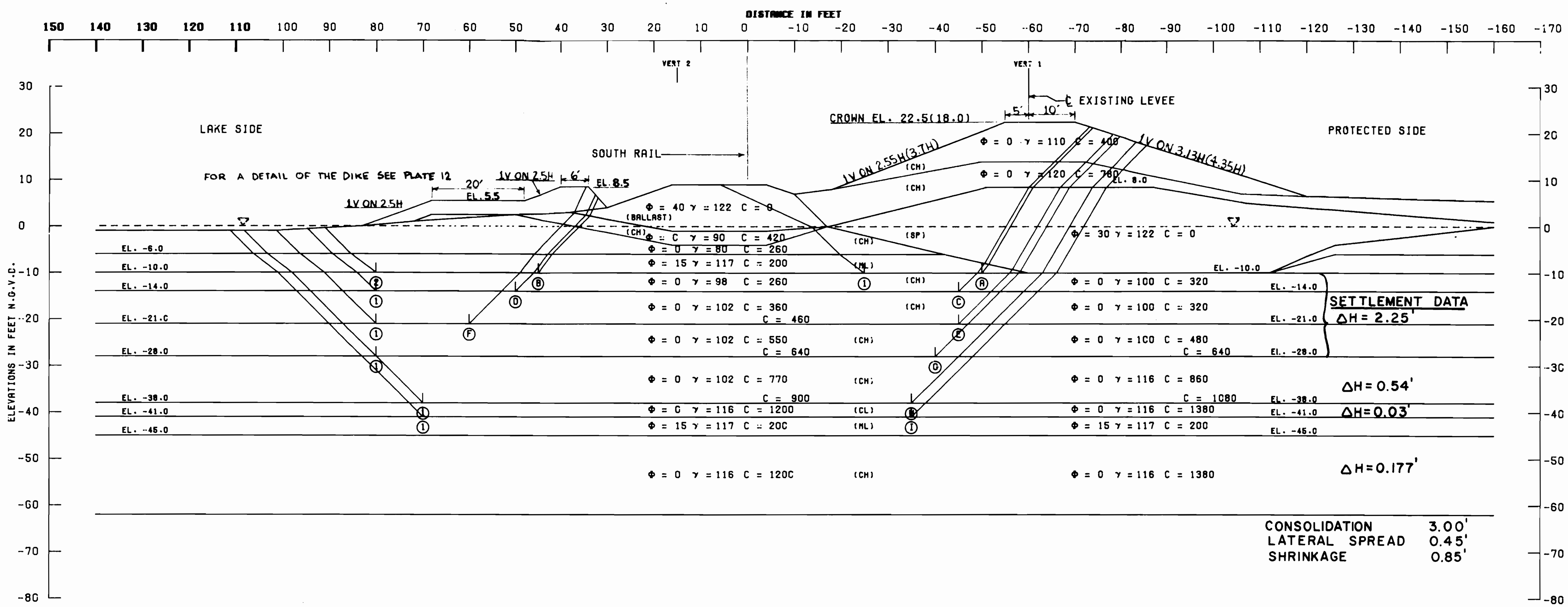
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
STA. 364+50 TO 390+00
AND 398+25 TO 436+50
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 3-SPU. FOR TOE STRENGTHDS SEE BORING 2A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ANALYSIS COVERS STA. 390+00 TO 392+36 AND 396+04 TO 398+25.

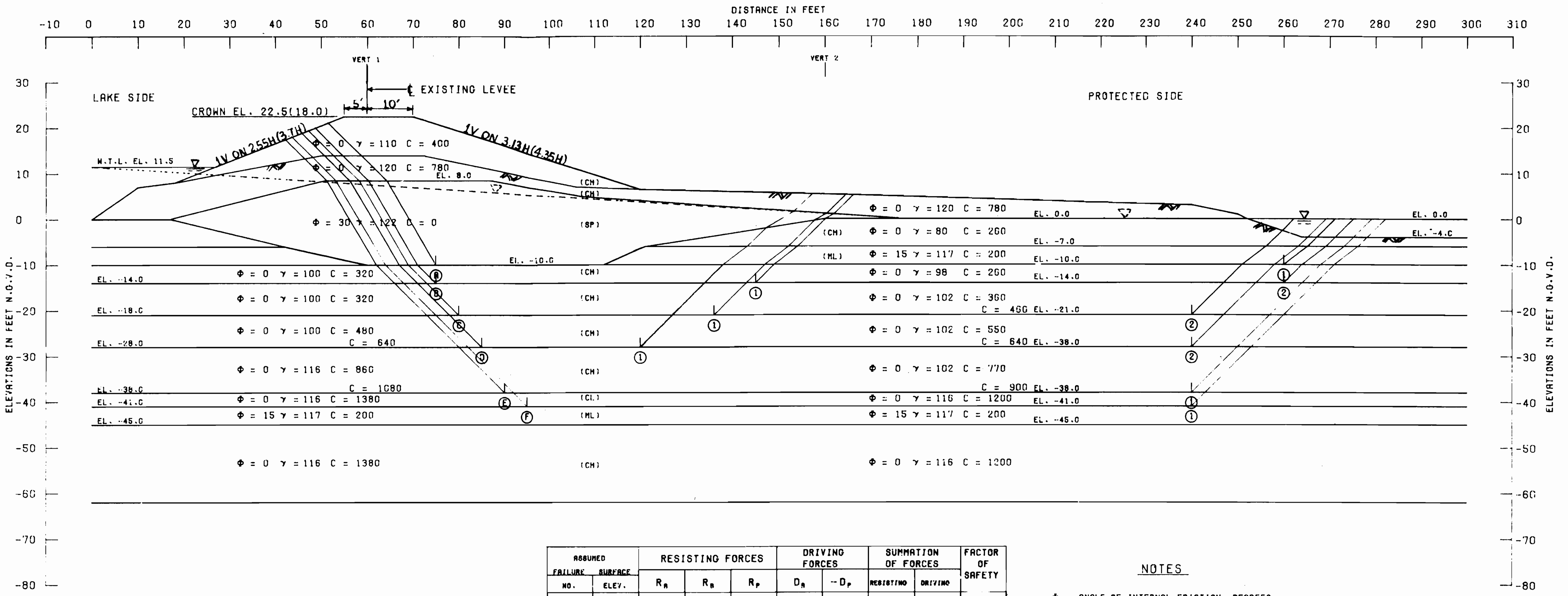
ASSUMED FAILURE	SURFACE	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-10.0	44490	7650	25246	60142	19164	77286	40978	1.890
Ⓐ ②	-10.0	44490	35490	5689	60142	4314	85669	55828	1.530
Ⓑ ②	-10.0	9161	9100	5689	17006	4314	23950	12692	1.890
Ⓒ ①	-14.0	46841	33940	7523	74618	8788	88304	65830	1.340
Ⓓ ①	-14.0	11544	7800	7523	24248	8788	26867	15460	1.740
Ⓔ ①	-21.0	51442	54140	12299	105861	20262	117881	85599	1.380
Ⓕ ①	-21.0	16741	9200	12299	39641	20262	38240	19379	1.970
Ⓖ ①	-28.0	57946	76800	19897	139477	36615	154643	102862	1.500
Ⓗ ①	-38.0	72913	97499	35297	195189	72882	205709	122307	1.680
Ⓘ ①	-41.0	79241	93076	42481	214059	84535	214798	129524	1.660

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
COLLINS MAIN LEVEE TIE-IN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 3-SPU. FOR TOE STRENGTHS SEE BORING 2-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ANALYSIS COVERS STA. 390+00 TO 392+36 AND 396+04 TO 398+25.

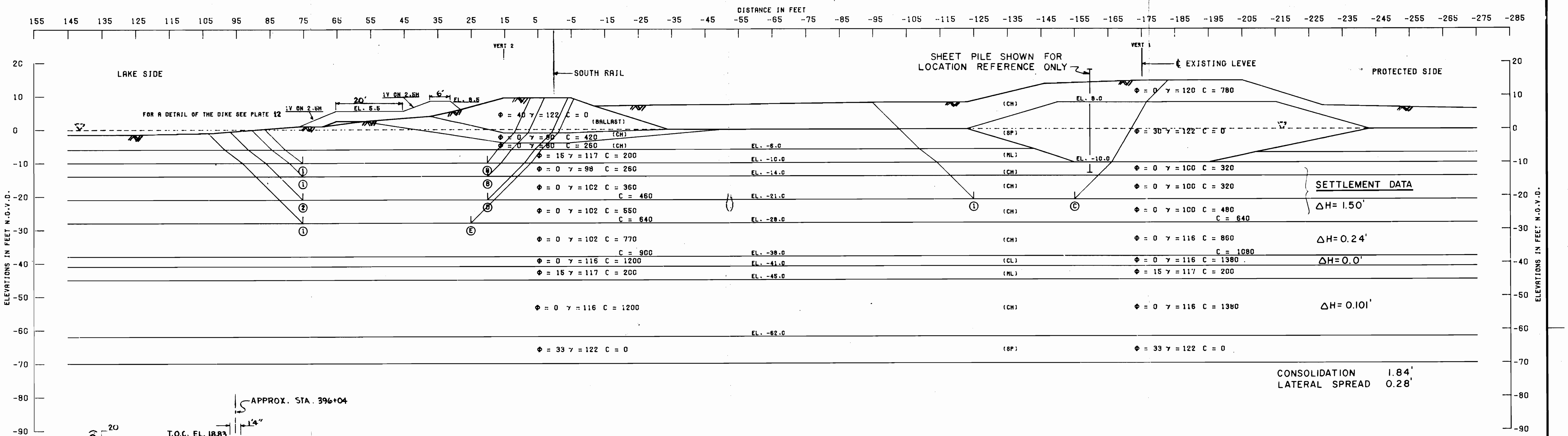
ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
A	1	-10.0	20801	39171	3551	26717	3769	63223	22948	1.660
B	1	-14.0	43320	20300	17355	75889	20705	80975	55184	1.470
B	2	-14.0	43320	50267	5606	75889	8074	99193	67815	1.460
C	1	-21.0	47377	21683	22555	106136	38913	91615	67225	1.360
C	2	-21.0	47377	69120	11583	106138	23042	128080	83096	1.540
D	1	-28.0	53761	22400	31352	140239	64805	107513	75434	1.430
D	2	-28.0	53761	99200	18402	140239	39555	171363	100684	1.700
E	1	-38.0	68253	139409	33746	196613	71654	241408	124959	1.930
F	1	-41.0	77210	117190	40946	214469	83329	235346	131140	1.790

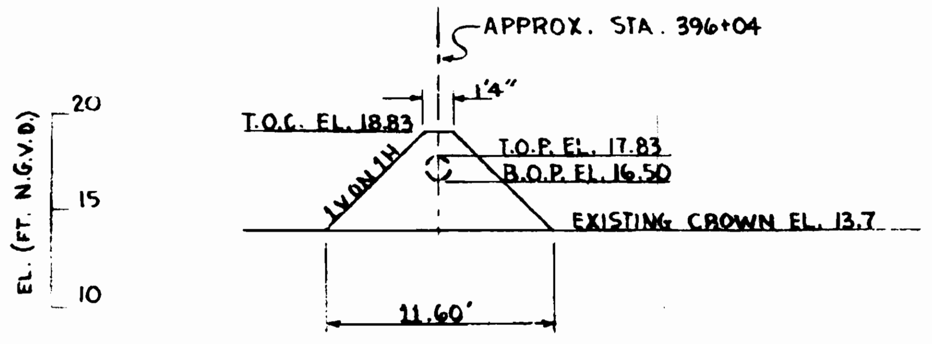
NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
COLLINS MAIN LEVEE TIE-IN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985
FILE NO. H-2-29820





EXISTING COVER - TO BE REPLACED FOLLOWING INSTALLATION OF THE SHEET PILE.

ANALYSIS COVERS STA. 393+51 TO 394+89

ANALYSIS RUN AS A MASS STABILITY TO INCLUDE THE EFFECTS OF THE EXISTING PIPELINE COVER.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING3-SPU. FOR TOE STRENGTHS SEE BORING 2A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

FROM STA. 393+51, TRANSITION INTO SECTION SHOWN ON PLATE 43 AT STA. 392+36. FROM STA. 394+89, TRANSITION INTO SECTION SHOWN ON PLATE 43 AT STA. 396+04.

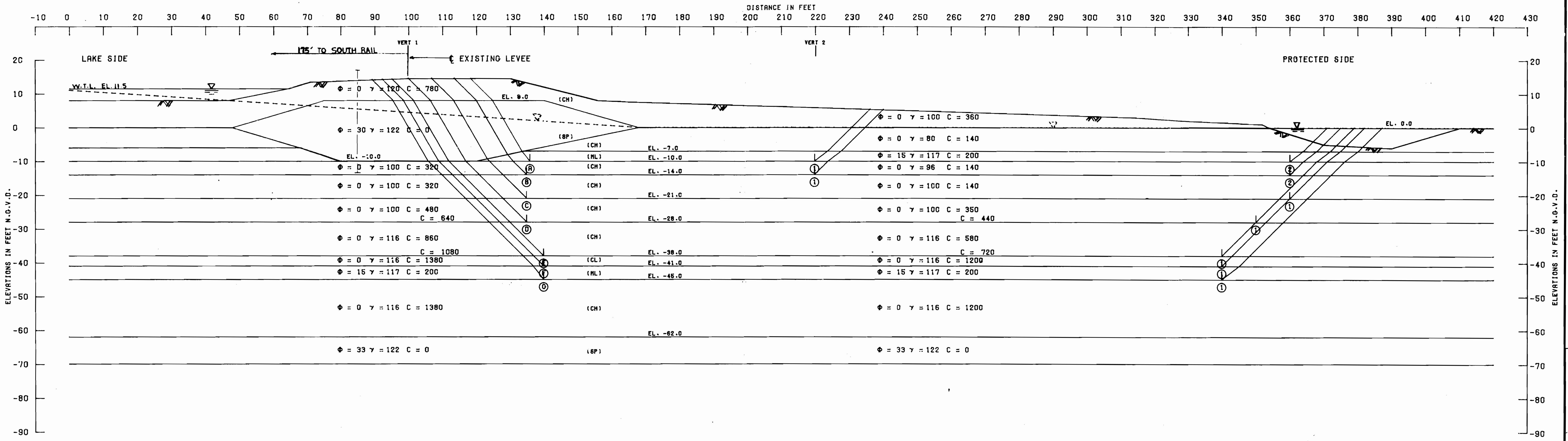
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-10.0	12163	14300	6115	21356	4810	32578	16546	1.970
B	1	-14.0	14469	14300	7965	30983	9439	36734	21544	1.710
C	1	-21.0	37427	10374	25137	74023	43512	72938	30511	2.390
C	2	-21.0	37427	95153	12624	74023	21181	145204	52842	2.750
D	2	-21.0	19532	25300	12624	51485	21181	57456	30304	1.900
E	1	-28.0	27207	32000	19976	75381	37644	79183	37737	2.100

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY OF THE EXISTING LEVEE
COLLINS PIPELINE CROSSING
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 393+51 TO 394+89.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 3-SPU. FOR TOE STRENGTHS SEE BORING 2-SPU.

ANALYSIS WAS RUN AS A MASS STABILITY TO INCLUDE THE EFFECTS OF THE EXISTING PIPELINE COVER.

SHEET PILE SHOWN FOR LOCATION REFERENCE ONLY.

FROM STA. 393+51, TRANSITION INTO SECTION SHOWN ON PLATE 44 AT STA. 392+36. FROM STA. 394+89, TRANSITION INTO SECTION SHOWN ON PLATE 44 AT STA. 396+04.

FOR DETAILS OF THE EXISTING PIPELINE COVER, SEE THE INSET, PLATE 45.

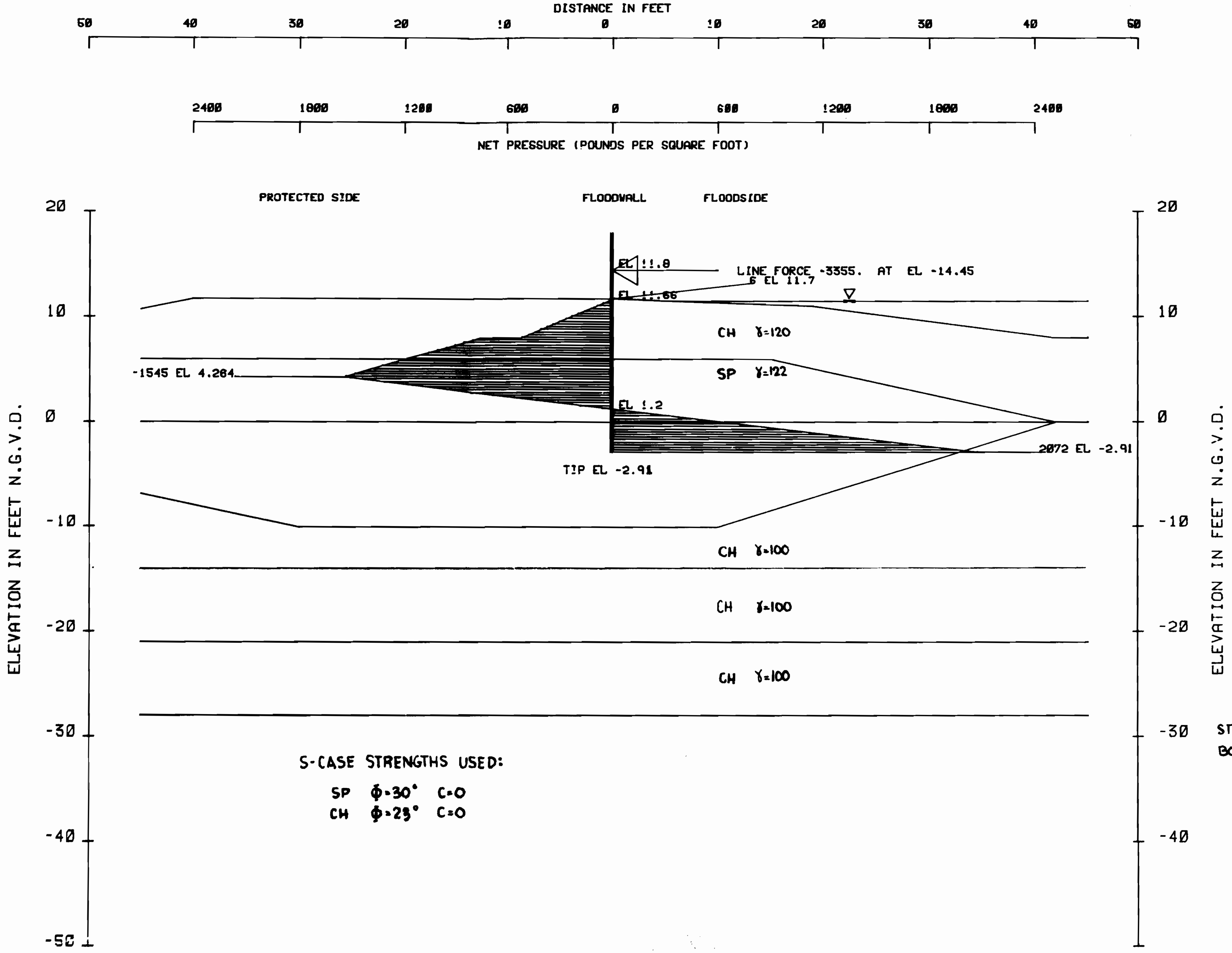
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-10.0	27014	17052	9059	34863	11385	53125	23478	2.260
A	2	-10.0	27014	36652	2733	34863	3706	66399	31157	2.130
B	1	-14.0	29902	17319	10067	47896	17942	57288	29954	1.910
B	2	-14.0	29902	36919	3540	47896	7821	70361	40075	1.760
C	1	-21.0	34262	36919	5350	73856	18722	76531	55134	1.390
D	1	-28.0	41056	100620	10300	104812	35618	151976	69194	2.200
E	1	-38.0	56636	153599	21900	156818	69683	232135	87135	2.660
F	1	-41.0	64615	158883	29050	175088	81496	252548	93592	2.700
G	1	-45.0	71418	170565	36341	200731	98575	278324	102156	2.720

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
OF THE EXISTING LEVEE
COLLINS PIPELINE CROSSING
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



NET DIAGRAM

(S) CASE F.S.=1.25

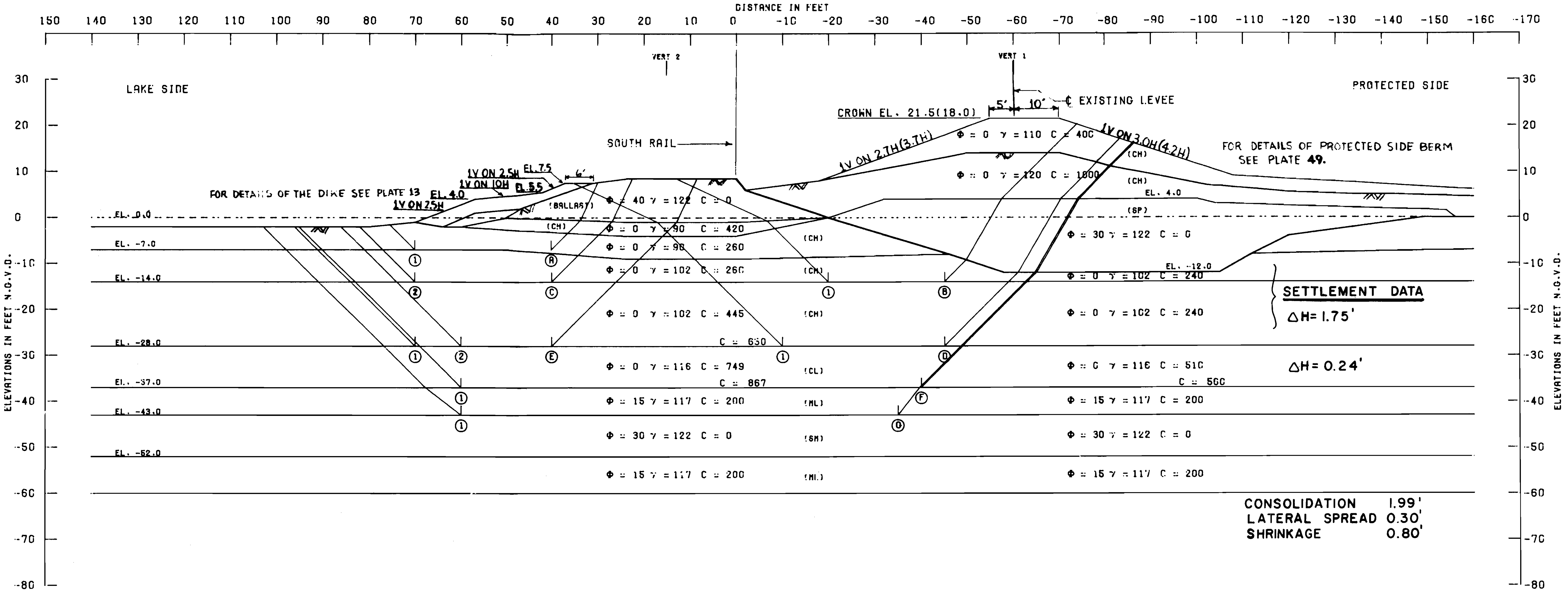
ELEVATION	PRESSURE
11.80	0.0
11.70	6.3
11.66	0.0
8.00	-519.0
8.00	-762.0
7.00	-965.6
4.26	-1544.7
1.20	0.0
-2.91	2072.4
-2.91	0.0

STRATIFICATION BASED ON BORING 3-SPU. SEE PLATE 20.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
CANTILEVER SHEET PILE ANALYSIS
COLLINS PIPELINE CROSSING

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

DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 7-SPU. FOR TOE STRENGTHS SEE BORING 2A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

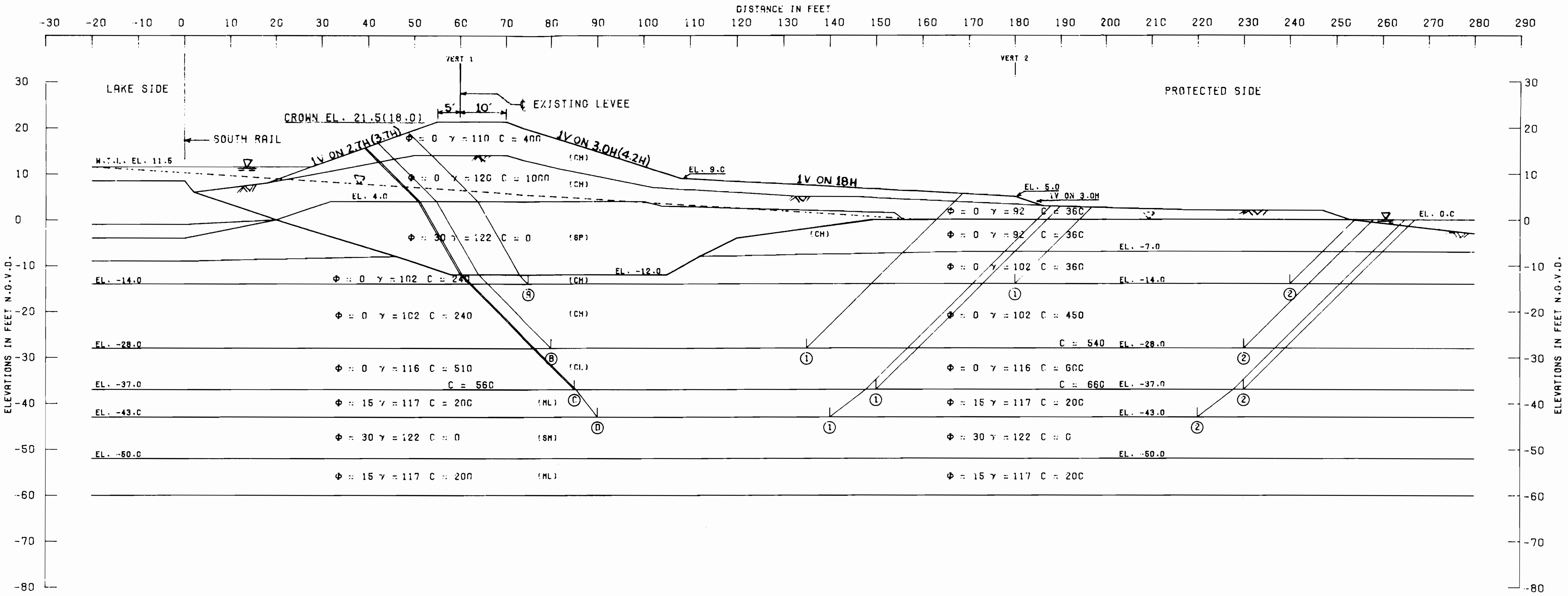
ASSUMED FAILURE SURFACE NO.		ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-7.0	7355	7800	2836	12087	1472	17991	10615	1.690
B	1	-14.0	49941	6183	23145	70485	25495	79269	44990	1.760
B	2	-14.0	49941	29420	6240	70485	7223	85601	63262	1.350
C	2	-14.0	11706	7800	6240	26421	7223	25746	19198	1.340
D	1	-28.0	57335	14316	36002	135058	68902	108253	66156	1.640
D	2	-28.0	57335	56791	18700	135058	37209	132826	97849	1.360
E	1	-28.0	24464	18900	18700	70040	33515	62064	36525	1.700
F	1	-37.0	64947	78291	32182	184578	65235	175420	119343	1.470
D	1	-43.0	75972	89944	43342	221169	88374	209258	132795	1.580

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
STA. 436+50 TO STA. 456+50
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 7-SPU. FOR TOE STRENGTHS SEE BORING 6-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

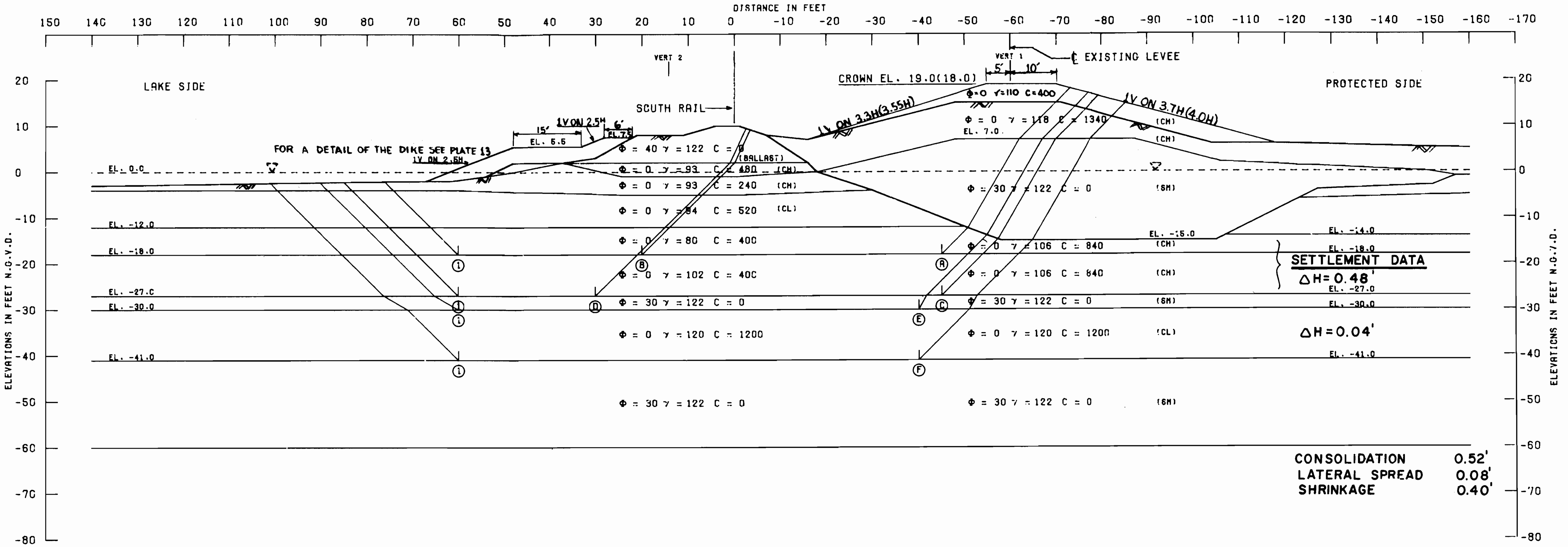
ASSUMED FAILURE NO.		ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
A	1	-14.0	49874	32288	12014	70704	14023	94176	56681	1.660
A	2	-14.0	49874	53888	10007	70704	11097	113769	59607	1.910
B	1	-28.0	54323	19732	25016	134150	60284	99071	73866	1.340
B	2	-28.0	54323	68501	22319	134150	41907	145143	92243	1.570
C	1	-37.0	61386	39515	34478	183978	88025	135379	95353	1.420
C	2	-37.0	61386	91888	32472	183978	71425	185746	112553	1.650
D	1	-43.0	72103	49141	47517	221664	119336	168761	102328	1.650
D	2	-43.0	72103	113901	43571	221664	98098	229035	123566	1.860

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
STA. 436+50 TO STA. 456+50
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 13-SPU. FOR TOE STRENGTHS SEE BORING 3A-ULN.

ANALYSIS WAS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-18.0	62167	52347	14022	76286	12963	128536	65323	1.970
B 1	-18.0	19715	16000	14022	38521	12963	49737	25558	1.950
C 1	-27.0	73930	52347	21163	120416	29703	147440	90713	1.630
D 1	-27.0	27047	12000	21163	64819	29703	60210	35116	1.710
E 1	-30.0	80797	108545	26918	133821	36626	216260	97195	2.230
F 1	-41.0	103231	119573	51833	200121	73728	274637	126393	2.170

NOTES

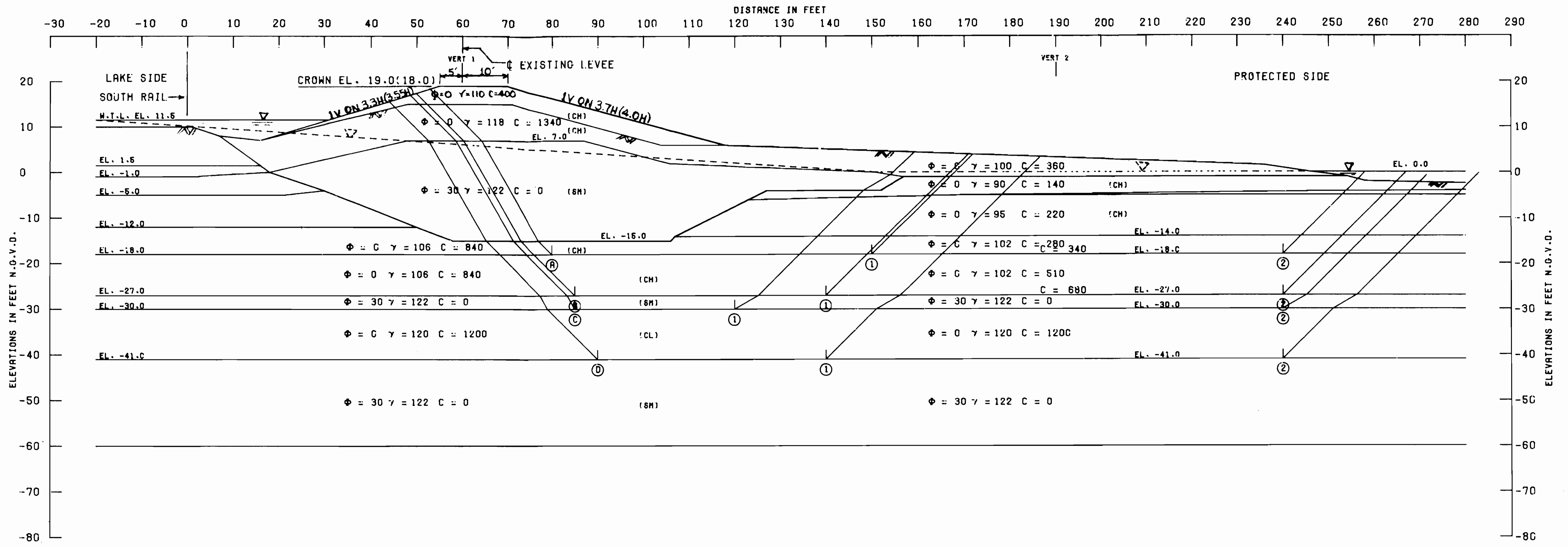
Φ --- ANGLE OF INTERNAL FRICTION, DEGREES
C --- UNIT COHESION, P.S.F.
∇ --- STATIC WATER SURFACE
D --- HORIZONTAL DRIVING FORCE IN POUNDS
R --- HORIZONTAL RESISTING FORCE IN POUNDS
A --- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B --- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P --- AS A SUBSCRIPT, REFERS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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
STA. 456+50 TO STA. 556+00

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

DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 13-SPU. FOR TOE STRENGTHS SEE BORING 12-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

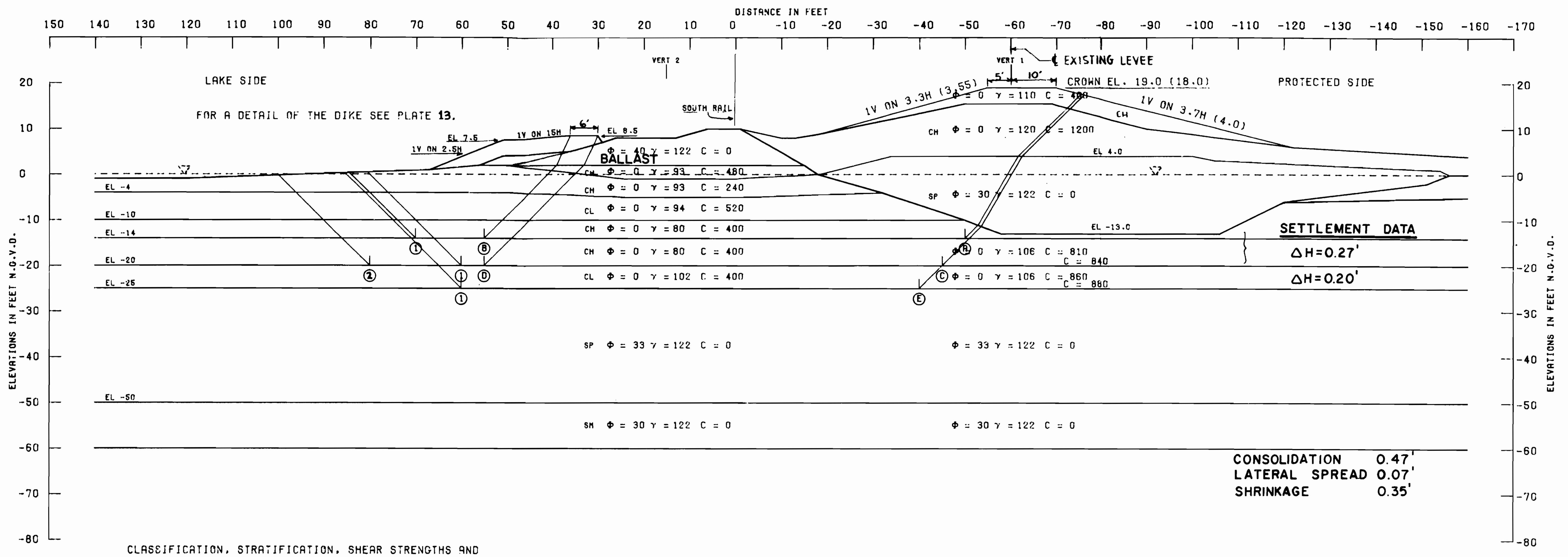
ASSUMED FAILURE NO.		ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-18.0	58926	43991	13854	78287	24993	116771	53294	2.190
A	2	-18.0	58926	77607	7731	78287	15233	144324	63054	2.290
B	1	-27.0	73040	42646	25263	119945	50817	140949	69128	2.040
B	2	-27.0	73040	111562	16818	119945	34308	201410	85637	2.350
C	1	-30.0	78865	41699	41402	135662	65322	161966	70340	2.300
C	2	-30.0	78865	148476	23399	135662	42311	250740	93351	2.690
D	1	-41.0	103231	60000	58407	201187	104711	221638	96476	2.300
D	2	-41.0	103231	177561	49271	201187	82015	330063	119172	2.770

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
STA. 456+50 TO STA. 556+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORING 13-SPU AND 17-SPU. FOR TOE STRENGTHS SEE BORING 3A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS (NET).

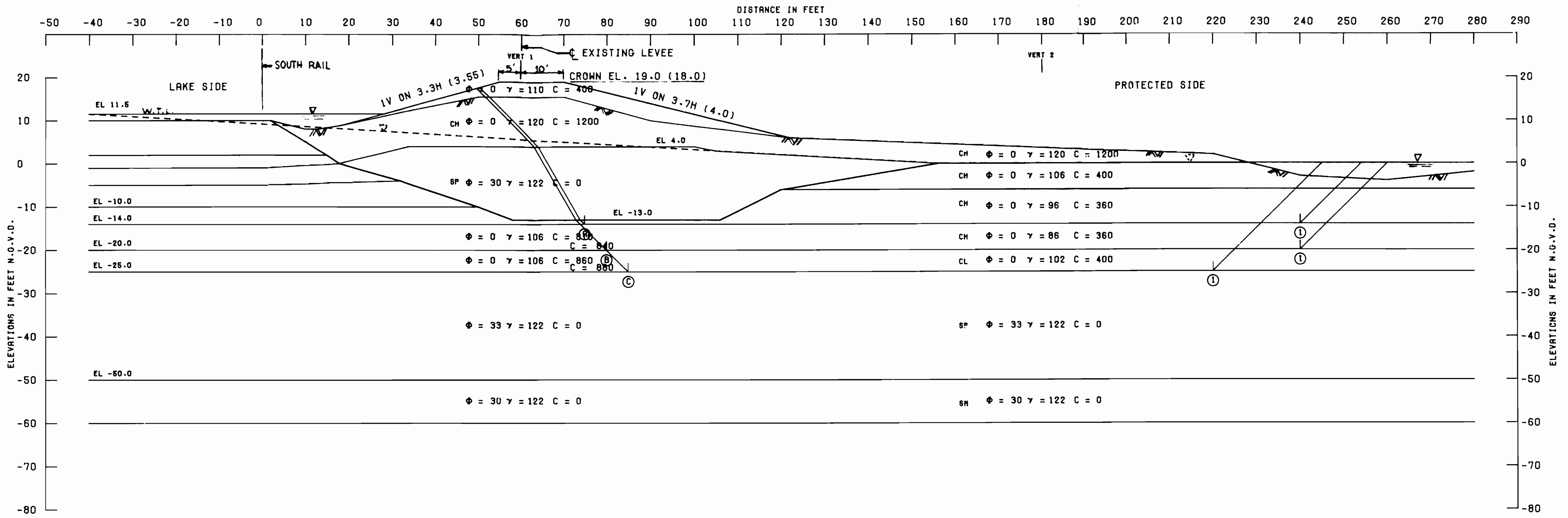
ASSUMED FAILURE NO.		SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-14.0	56327	57012	11531	63515	9877	124870	53638	2.330
B	1	-14.0	14863	6000	11531	25985	9877	32394	16108	2.010
C	1	-20.0	66046	52558	16400	87208	20834	134004	66374	2.020
D	2	-20.0	19863	10000	16057	41033	18305	45920	22728	2.020
E	1	-25.0	72573	49678	20314	108511	30980	142565	77531	1.840

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
STA. 556+00 TO 588+60
597+14 TO 636+70
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 13-SPU AND 17-SPU. FOR TOE STRENGTHS SEE BORING 14-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS (NET).

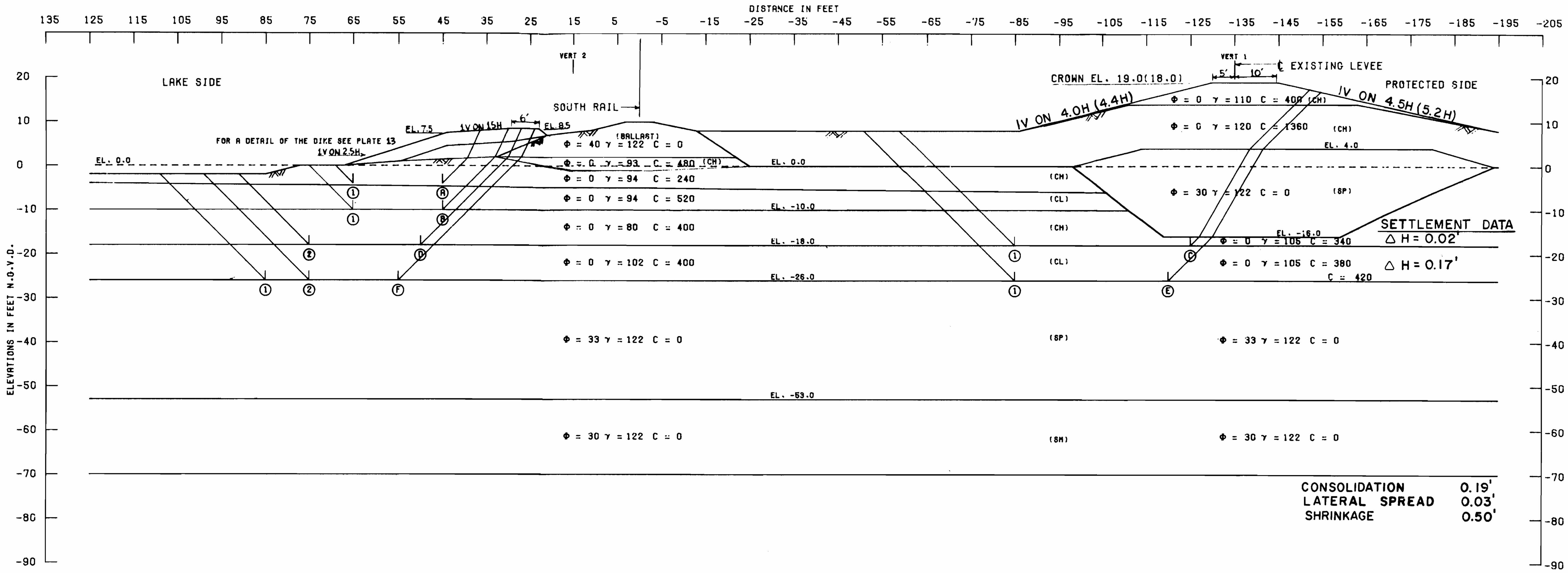
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-14.0	55417	75936	7741	63596	8307	139094	55289	2.520
B 1	-20.0	64285	77598	11833	87894	17320	153716	70574	2.180
C 1	-25.0	72023	72048	16404	110092	30625	160475	79467	2.020

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
STA. 556+00 TO 588+60
597+14 TO 636+70
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 589+35 TO 594+75.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 15-SPU. FOR TOE STRENGTHS SEE BORING 3A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

FROM STA. 589+35, TRANSITION INTO SECTION SHOWN ON PLATE 52 AT STA. 588+60. FROM STA. 594+75, TRANSITION INTO SECTION SHOWN ON PLATE 58 AT STA.595+50.

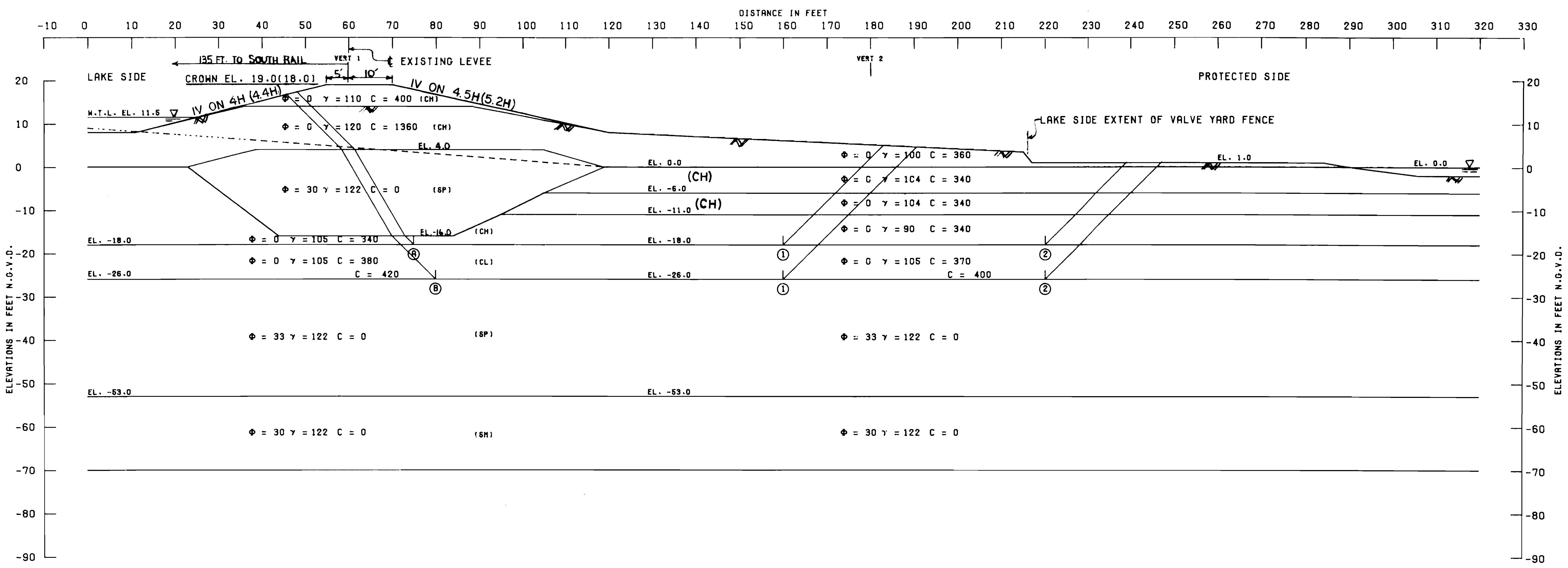
ASSUMED FAILURE NO.		SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-4.0	4687	4800	1920	8314	832	11407	7482	1.520
B	1	-10.0	10715	8000	7882	18335	4779	26597	13556	1.960
C	1	-18.0	65421	14080	27087	79615	34971	106588	44644	2.390
C	2	-18.0	65421	76080	13415	79615	12710	154916	66905	2.320
D	2	-18.0	17403	10000	13415	35354	12710	40818	22644	1.800
E	1	-26.0	71273	14548	32523	116549	58949	118344	57600	2.050
E	2	-26.0	71273	79215	19856	116549	27110	170344	89439	1.900
F	1	-26.0	23984	11985	19907	57151	25983	55876	31168	1.790

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
SO. NATURAL GAS PIPELINE CROSSING
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 589+35 TO 594+75.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 15-SPU. FOR TOE STRENGTHS SEE BORING 14-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

FROM STA. 589+35, TRANSITION INTO SECTION SHOWN ON PLATE 53 AT STA. 588+60. FROM STA. 594+75, TRANSITION INTO SECTION SHOWN ON PLATE 59 AT STA. 595+50.

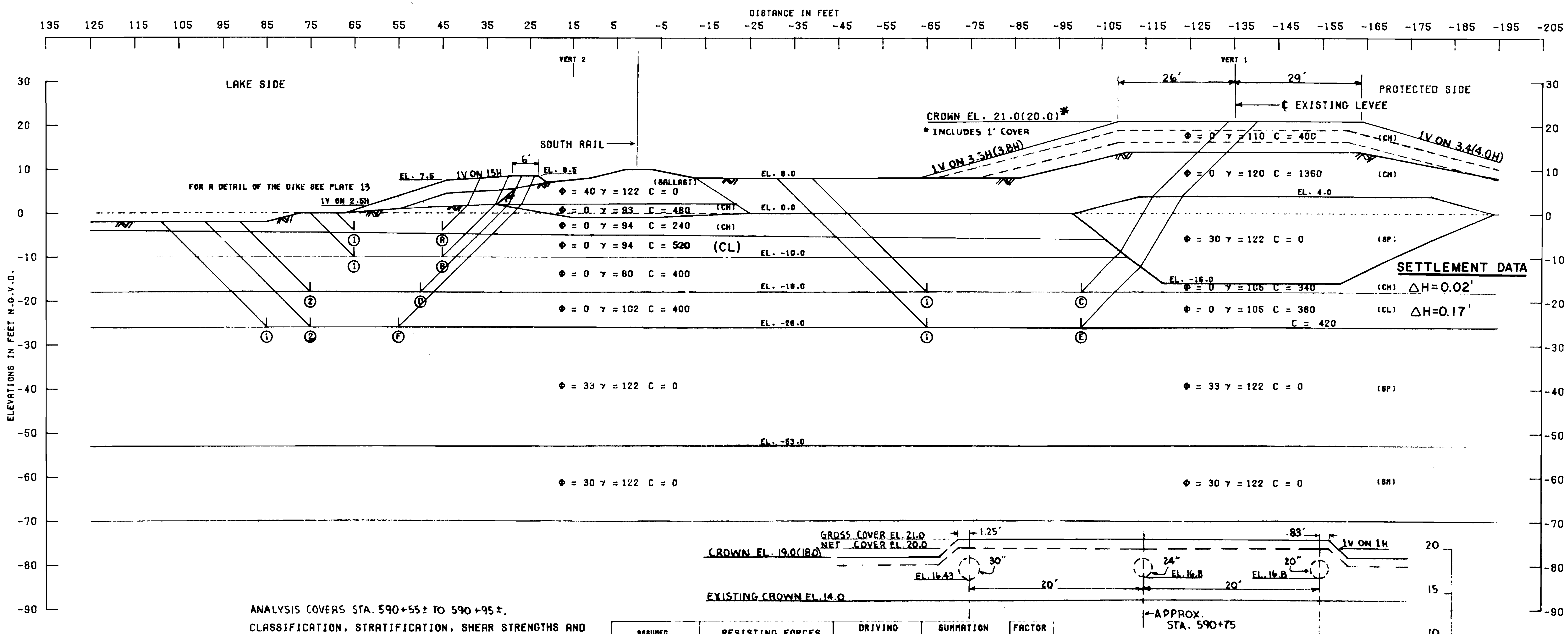
ASSUMED FAILURE NO.		ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
A	1	-18.0	62240	28900	15850	79383	28284	106890	51099	2.090
A	2	-18.0	62240	49300	12960	79383	18354	124500	61029	2.040
B	1	-26.0	67824	32800	21529	116316	49790	122153	66526	1.840
B	2	-26.0	67824	56833	18880	116316	36705	143537	79611	1.800

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
SO. NATURAL GAS PIPELINE CROSSING
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 590+55± TO 590+95±.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 15-SPU. FOR TOE STRENGTHS SEE BORING 3A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

SEE INSET FOR DETAILS OF THE PIPELINE COVER

ASSUMED FAILURE NO.		SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-4.0	4687	4800	1920	8314	832	11407	7482	1.520
B	1	-10.0	10715	8000	7882	18336	4779	26597	13556	1.960
C	1	-18.0	58370	12635	25190	84928	34457	97195	50471	1.930
C	2	-18.0	59370	67355	13415	84928	12710	140140	72218	1.940
D	2	-18.0	17403	10000	13415	35354	12710	40818	22644	1.800
E	1	-26.0	70615	14455	30669	124104	58037	115739	66067	1.750
E	2	-26.0	70615	70882	19856	124104	27110	161353	96994	1.660
F	1	-26.0	23984	11985	19907	57151	25983	55876	31168	1.790

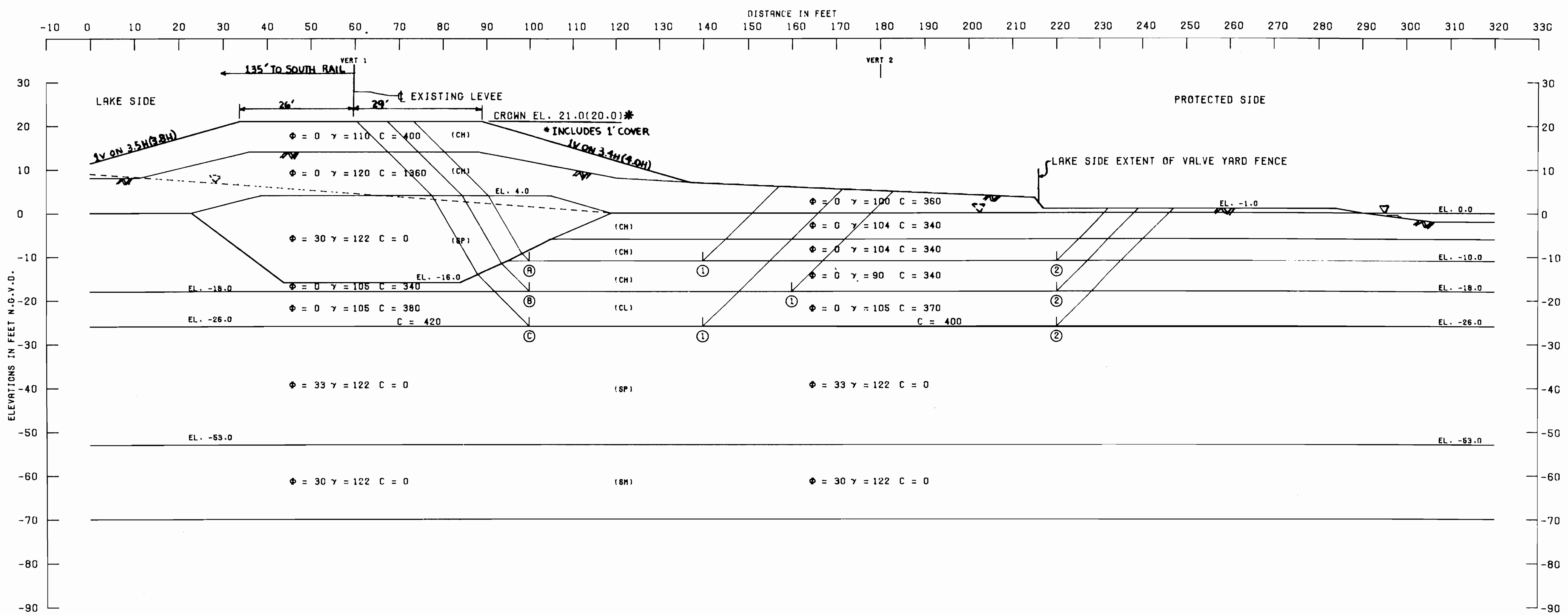
NOTES

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

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

CONSOLIDATION	0.19'
LATERAL SPREAD	0.03'
SHRINKAGE	0.50'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
WITH PIPELINE COVER
SO. NATURAL GAS PIPELINE CROSSING
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE FEB 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 590+55± TO 590+95±.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 15-SPU. FOR TOE STRENGTHS SEE BORING 14-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

FOR DETAILS OF THE PIPELINE AND COVER SEE PLATE 56.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-11.0	49695	13600	14515	55532	16031	77810	39501	1.970
A 2	-11.0	49695	40800	8200	55532	7442	98695	48090	2.050
B 1	-18.0	59397	20400	15798	85061	28042	95595	57019	1.680
B 2	-18.0	59397	40800	12960	85061	18354	113157	66707	1.700
C 1	-26.0	70152	16400	23163	124884	53078	109715	71806	1.530
C 2	-26.0	70152	48533	18880	124884	36705	137565	88179	1.560

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
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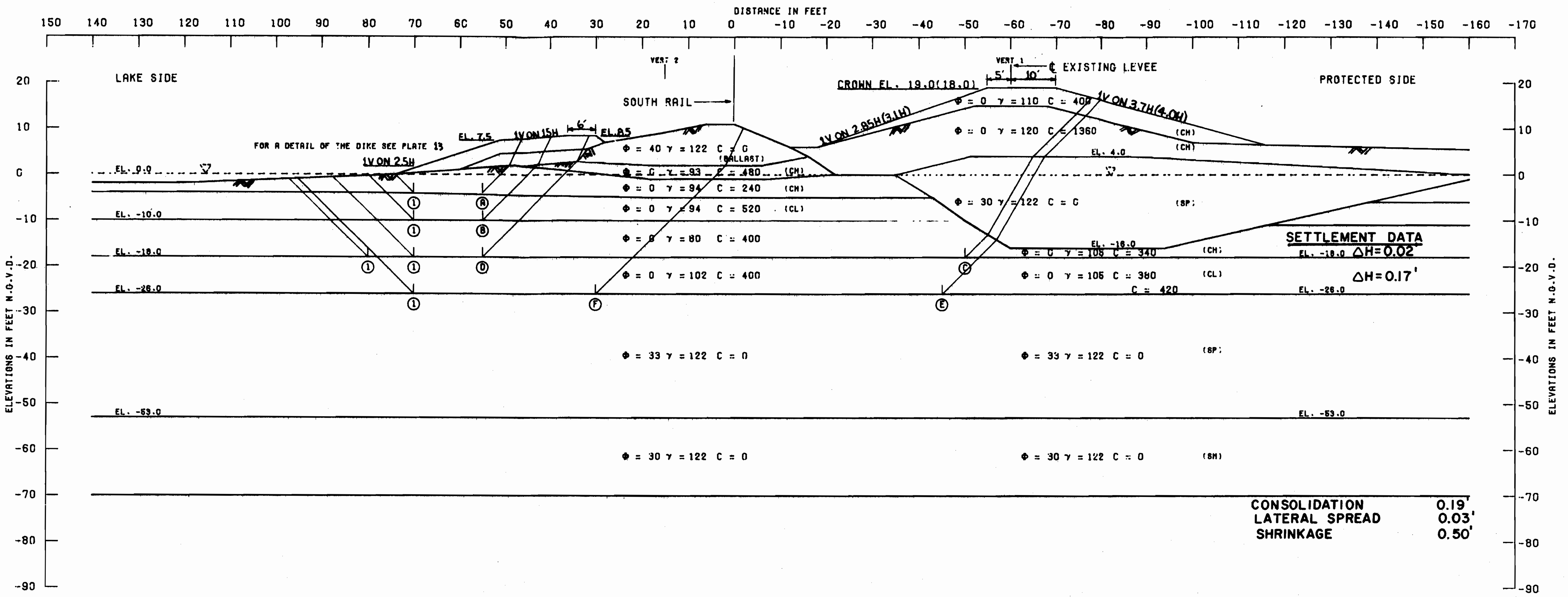
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

PROTECTED SIDE STABILITY WITH PIPELINE COVER SO. NATURAL GAS PIPELINE CROSSING

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

DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 595+50 TO 597+14.

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 15-SPU. FOR TOE STRENGTHS SEE BORING 3A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ASSUMED FAILURE NO.		ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-4.0	4550	3600	1920	7779	1074	10070	6705	1.500
B	1	-10.0	11151	6000	8003	17600	4951	25154	12649	1.990
C	1	-18.0	60074	46310	14280	79033	14718	120664	64315	1.880
D	1	-18.0	18197	10000	14080	35675	13725	42277	21950	1.930
E	1	-26.0	66301	46480	20520	114159	30057	133301	84102	1.580
F	1	-26.0	26494	16000	20520	64654	30057	63014	34597	1.820

NOTES

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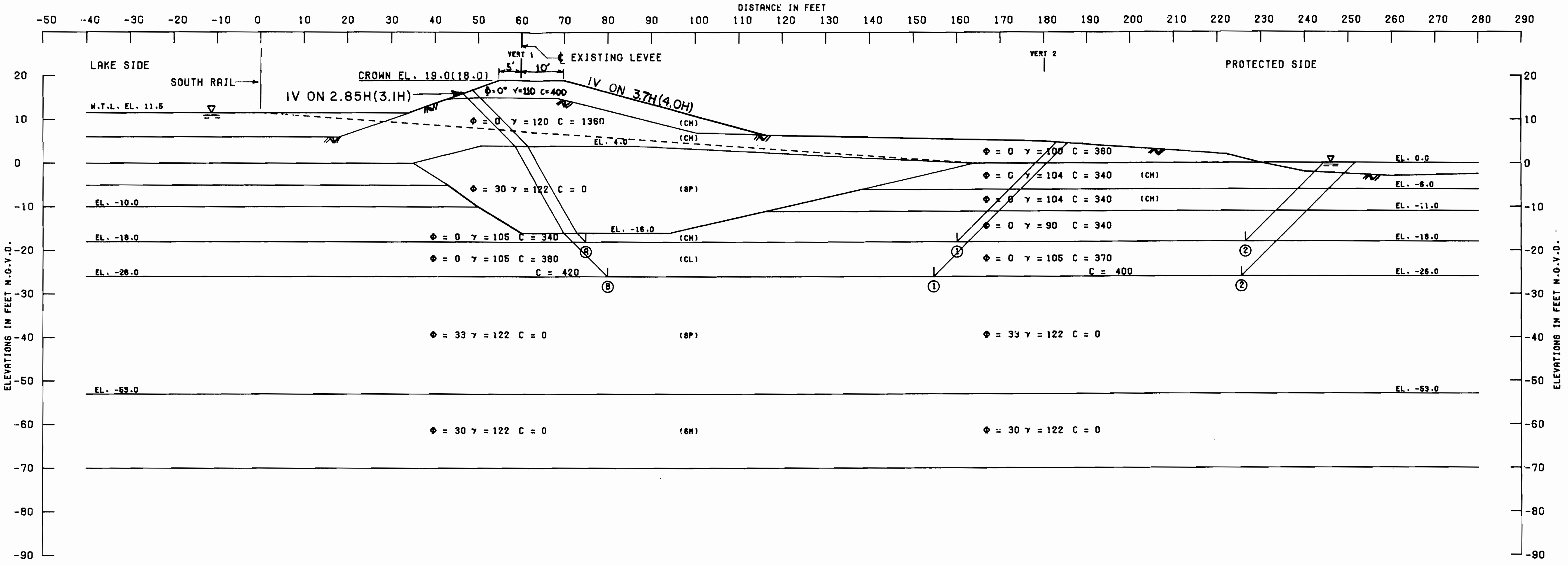
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
SO. NATURAL GAS MAIN LEVEE TIE-IN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



ANALYSIS COVERS STA. 595+50 TO 597+14

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE BORING 15-SPU. FOR TOE STRENGTHS SEE BORING 14-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-18.0	61395	28900	15696	79267	27459	105991	51808	2.050
A	2	-18.0	61395	51492	10801	79267	15953	123688	63314	1.950
B	1	-26.0	66713	30634	21518	115798	49657	118865	66141	1.800
B	2	-26.0	66713	59021	16493	115798	32936	142227	82862	1.720

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
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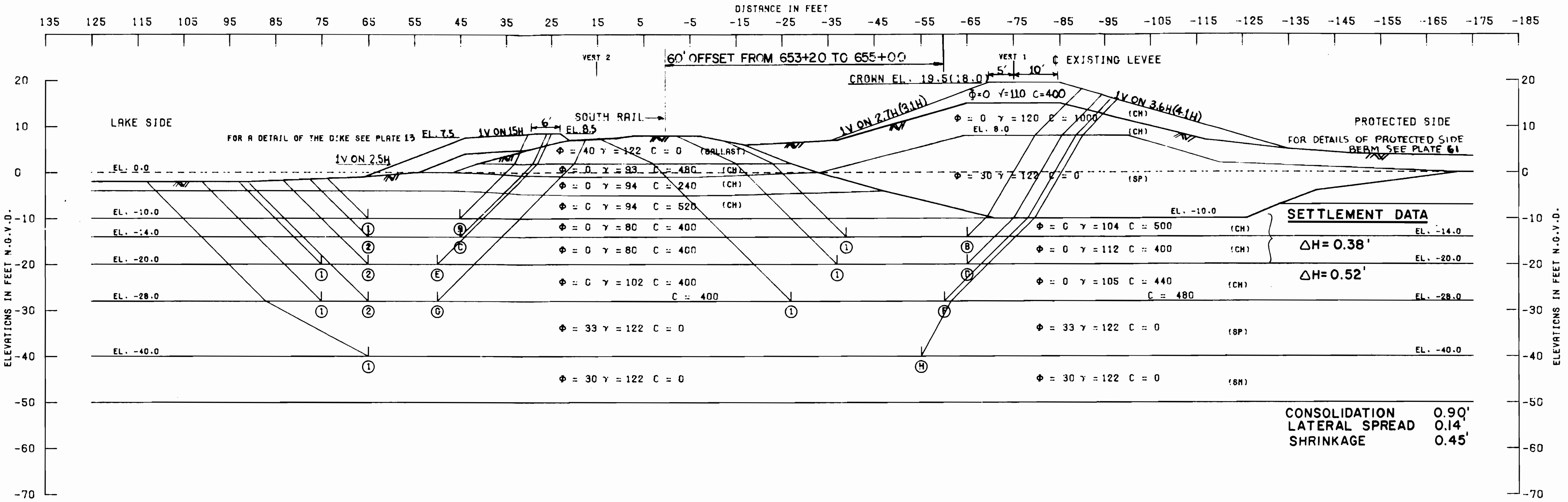
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
SO. NATURAL GAS MAIN LEVEE TIE-IN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 17-SPU AD 18-SPU. FOR TOE STRENGTHS SEE BORING 3A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC HEADS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

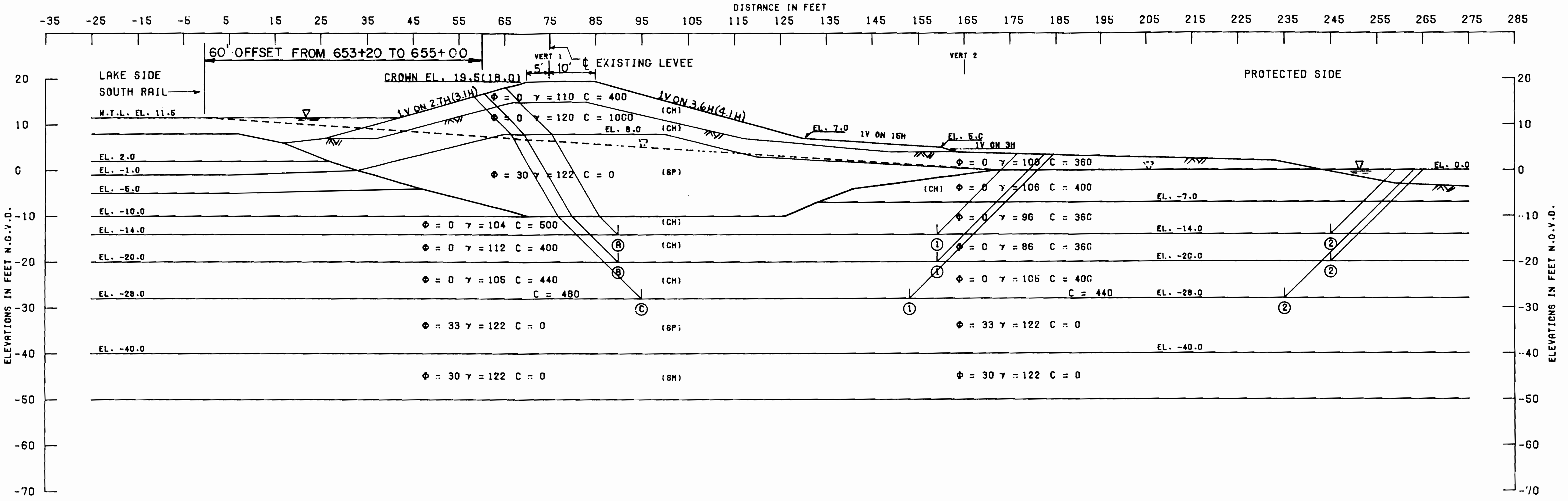
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-10.0	12166	8000	7532	18363	3715	27698	14648	1.890
B 1	-14.0	46810	10400	17558	65165	22986	74768	42179	1.770
B 2	-14.0	46810	52000	10658	65165	7594	109468	57571	1.900
C 1	-14.0	15452	8000	10658	26872	7594	34110	19278	1.770
D 1	-20.0	49580	11200	24994	89432	36945	85774	52487	1.630
D 2	-20.0	49580	52000	15348	89432	15704	116928	73728	1.590
E 1	-20.0	20243	10000	15200	40780	15009	45443	25771	1.760
F 1	-28.0	55075	14916	32088	126447	62690	102079	63751	1.600
F 2	-28.0	55075	52500	21600	126447	31500	129175	94947	1.360
G 1	-28.0	25738	10000	21600	64446	30688	57338	33758	1.700
H 1	-40.0	83150	170325	51227	192978	68120	304702	124858	2.440

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
STA. 636+70 TO STA. 655+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 17-SPU AND 18-SPU. FOR TOE STRENGTHS SEE BORING 14-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-14.0	44075	26082	13294	65146	16835	83451	48311	1.730
A 2	-14.0	44075	57050	8619	65146	9277	109744	55869	1.960
B 1	-20.0	46569	26082	17456	89541	29004	90107	60537	1.490
B 2	-20.0	46569	57050	12459	89541	18547	116078	70994	1.640
C 1	-28.0	51910	26577	23862	127091	52175	102349	74916	1.370
C 2	-28.0	51910	62689	18926	127091	38238	133525	88853	1.500

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES

C -- UNIT COHESION, P.S.F.

∇ -- STATIC WATER SURFACE

D -- HORIZONTAL DRIVING FORCE IN POUNDS

R -- HORIZONTAL RESISTING FORCE IN POUNDS

A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE

B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK

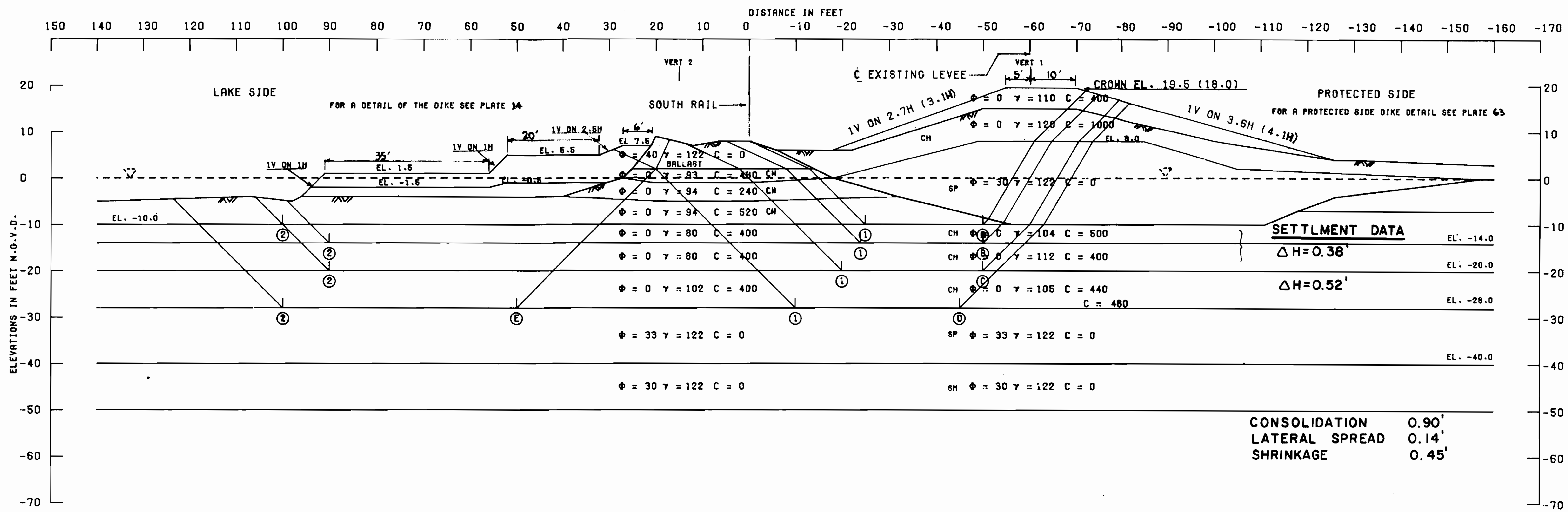
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
STA. 636+70 TO STA. 655+00

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

DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 17-SPU AND 18-SPU. FOR TOE STRENGTH SEE BORING 3A-ULN.

ANALYSIS RUN WITH LAKE LEVELS DRAWN DOWN TO THE LAKE BOTTOM. PIEZOMETRIC LEVELS REFLECT NORMAL LAKE LEVELS.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS (NET).

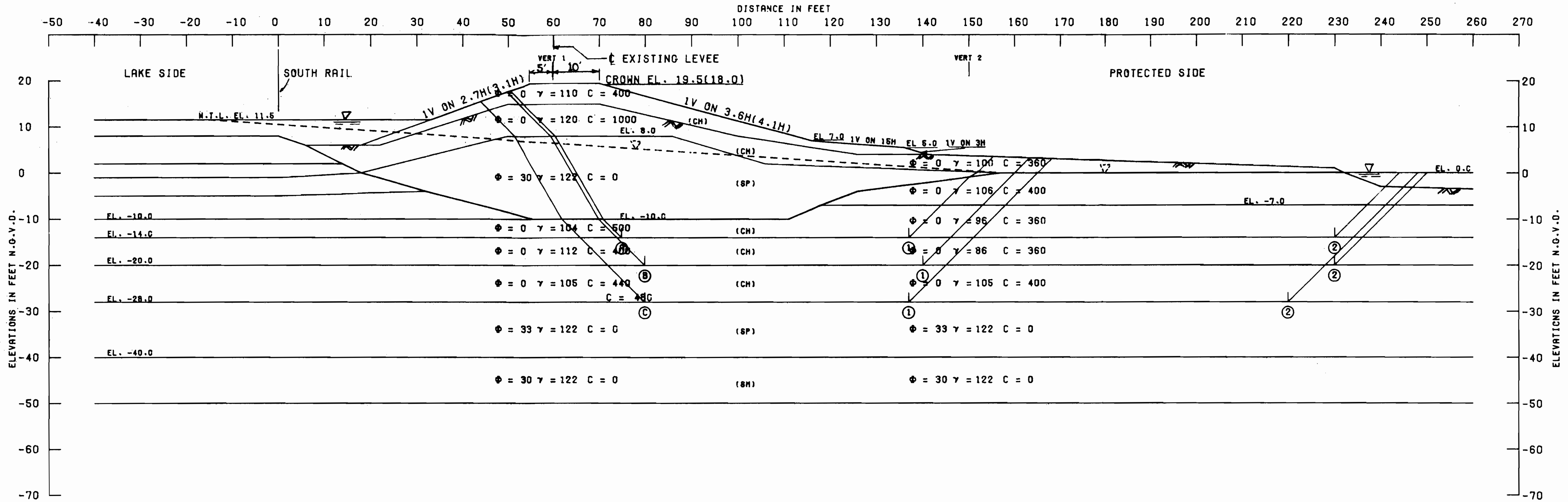
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-10.0	42910	11750	13708	50501	15244	68368	35257	1.940
A 2	-10.0	42910	62816	6110	50501	1442	111836	49059	2.280
B 1	-14.0	46855	10400	19425	65182	22620	76680	42562	1.800
B 2	-14.0	46855	56000	8531	65182	6562	111386	58620	1.900
C 1	-20.0	49749	12000	25298	89483	36680	87047	52803	1.650
C 2	-20.0	49749	56000	14110	89483	13024	119859	76459	1.570
D 1	-28.0	55301	15587	30303	126500	63002	101191	63498	1.590
D 2	-28.0	55301	59174	20120	126500	24852	134595	101648	1.320
E 2	-28.0	26494	19255	20120	61615	24852	65869	36763	1.790

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
LAKE SIDE STABILITY
STA. 655+00 TO STA. 661+70
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 17-SPU AND 18-SPU. FOR TOE STRENGTH SEE BORING 14-SPU.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS (NET).

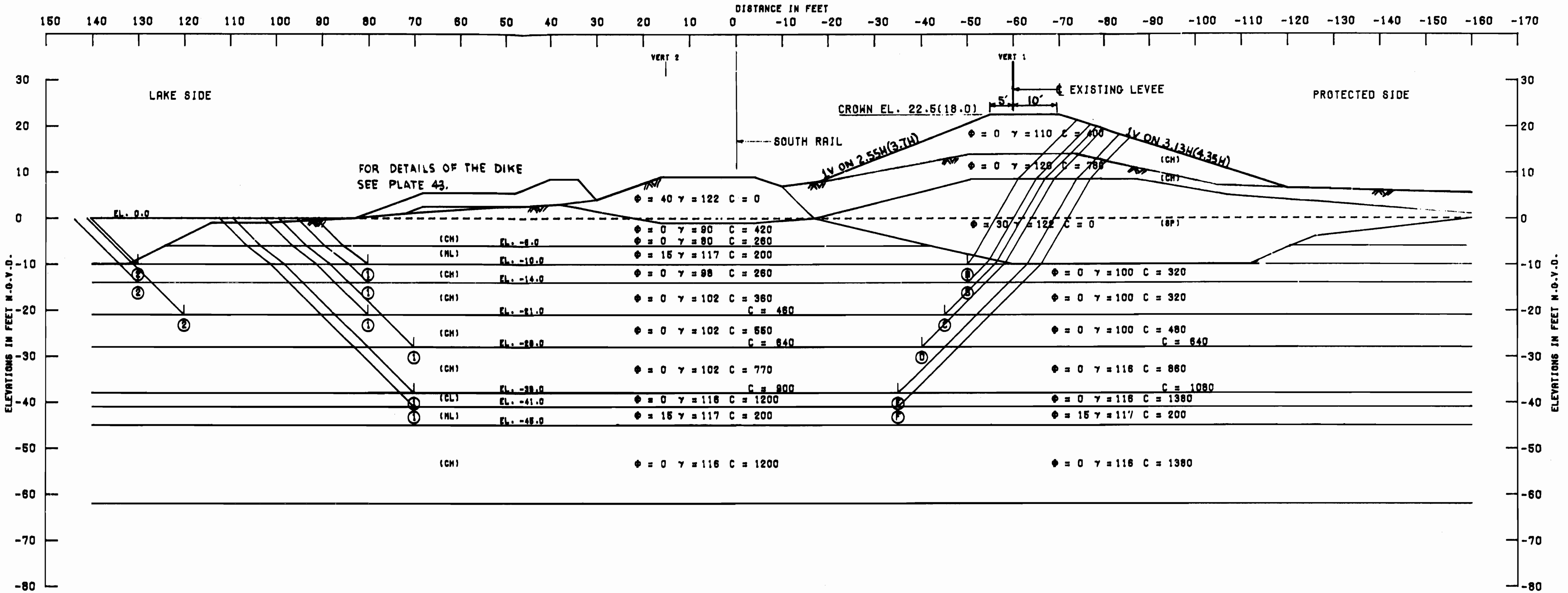
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-14.0	43870	23532	13259	65094	17037	80661	48057	1.680
A 2	-14.0	43870	57050	8220	65094	9391	109140	55703	1.960
B 1	-20.0	48369	22667	17348	89191	28616	88384	60575	1.460
B 2	-20.0	48369	55089	12423	89191	18612	115881	70579	1.640
C 1	-28.0	51605	26131	23657	126592	50736	101393	75856	1.340
C 2	-28.0	51605	62689	18862	126592	38850	133156	87742	1.520

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
PROTECTED SIDE STABILITY
STA. 655+00 TO STA. 661+70
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE 3-SPU. FOR TOE STRENGTHS SEE BORING 2A-ULN.

LEVEE ELEVATION LISTED AS GROSS(NET).

REQUIRED DISTANCE FROM 654+50 TO 661+70 INCREASES TO 130 FT. AS SHOWN ON PLATE 65. TRANSITION AS NECESSARY.

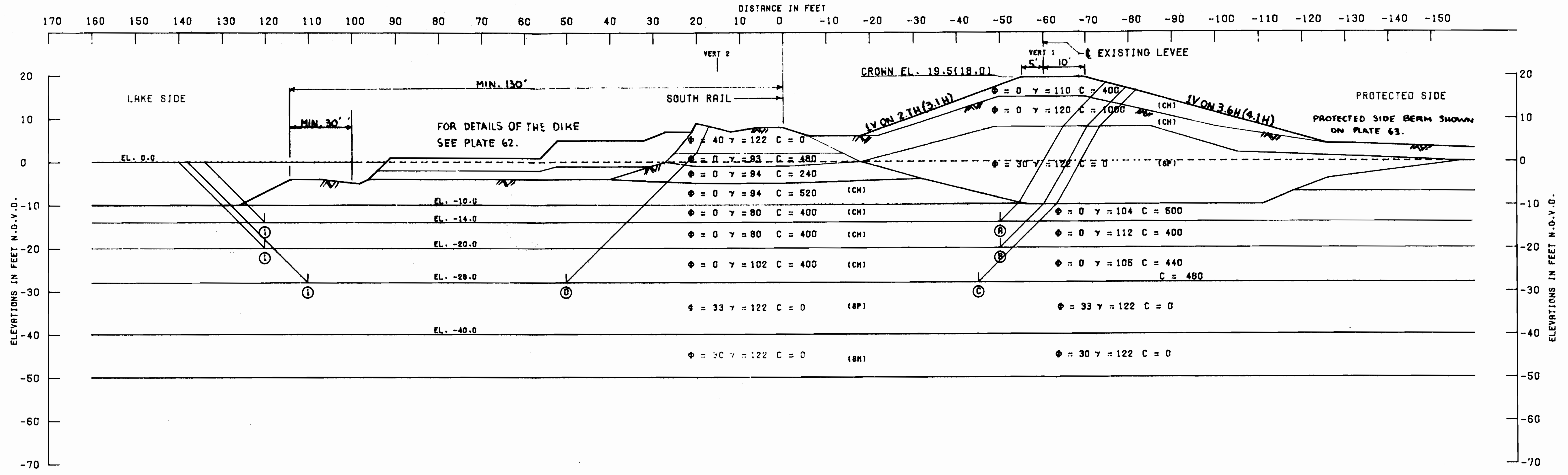
ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
A	1	-10.0	44490	35490	5693	60142	4417	85673	55725	1.540
A	2	-10.0	44490	48347	327	60142	3136	93164	57006	1.630
B	1	-14.0	47075	35490	7556	75878	9006	90121	66872	1.350
B	2	-14.0	47075	48490	2080	75878	6412	97645	69466	1.410
C	1	-21.0	51442	54140	12396	105861	20796	117978	85065	1.390
C	2	-21.0	51442	72540	7280	105861	17813	131262	88048	1.490
D	1	-28.0	57946	70400	20182	139477	41203	148528	98274	1.510
E	1	-38.0	72913	97499	35457	195189	73824	205869	121365	1.700
F	1	-41.0	79241	93076	42652	214059	85658	214969	128401	1.670

NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
FLOTATION CHANNEL STABILITY
STA. 364+50 TO STA. 654+50
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. FOR CENTERLINE STRENGTHS SEE COMPOSITE OF BORINGS 17-SPU AND 18-SPU. FOR TOE STRENGTHS BORING 3A-ULN.

LEVEE SLOPES AND ELEVATIONS LISTED AS GROSS(NET).

SECTION RUN USING SUGGESTED BARRIER PLAN DISTANCE OF 114 FEET FROM THE SOUTH RAIL. MINIMUM DISTANCE OF 130 FEET IS SUGGESTED HERE TO ASSURE THE INTEGRITY OF THE LARGER DIKE SECTION.

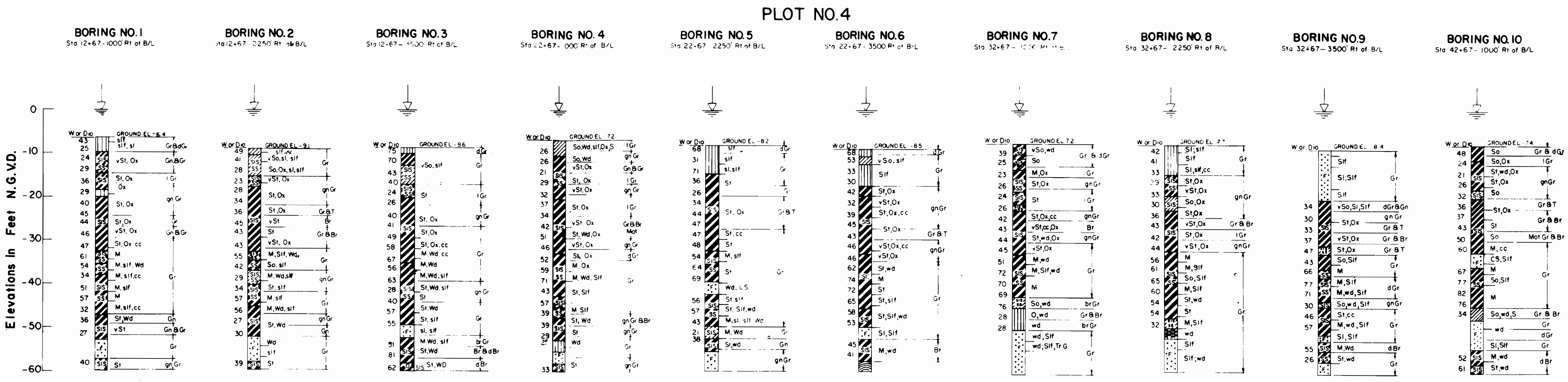
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-14.0	46855	68000	3893	65182	6519	118748	58663	2.020
B 1	-20.0	49749	68000	8000	89483	13644	125749	75839	1.660
C 1	-28.0	55301	63920	14400	126500	29910	133621	96590	1.380
D 1	-28.0	26494	24000	14400	61615	29910	64894	31705	2.050

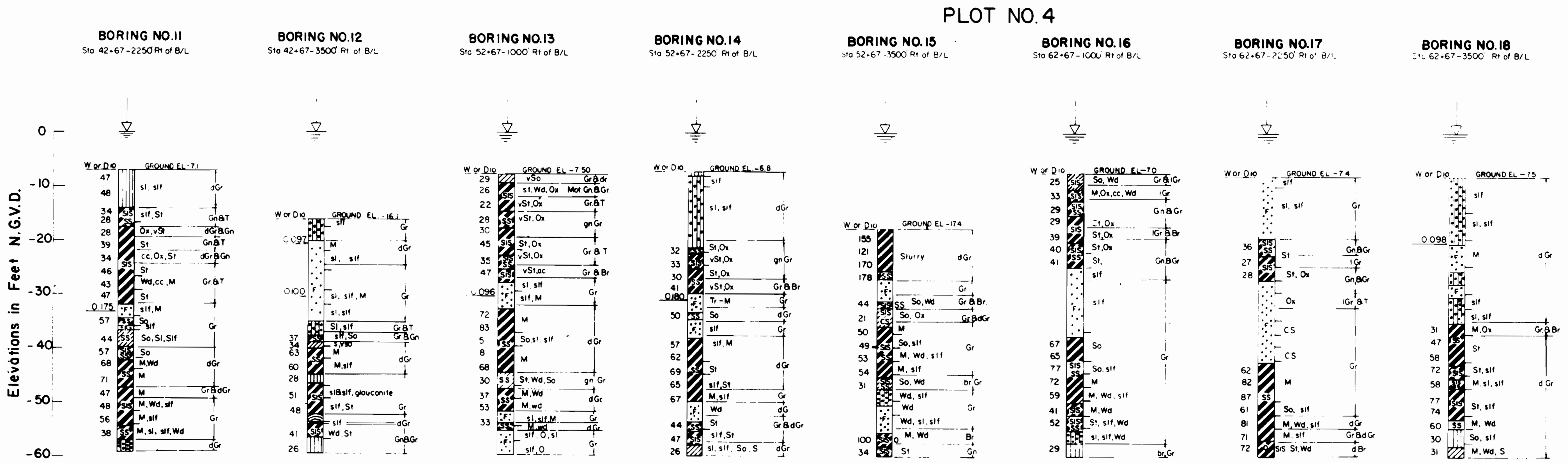
NOTES

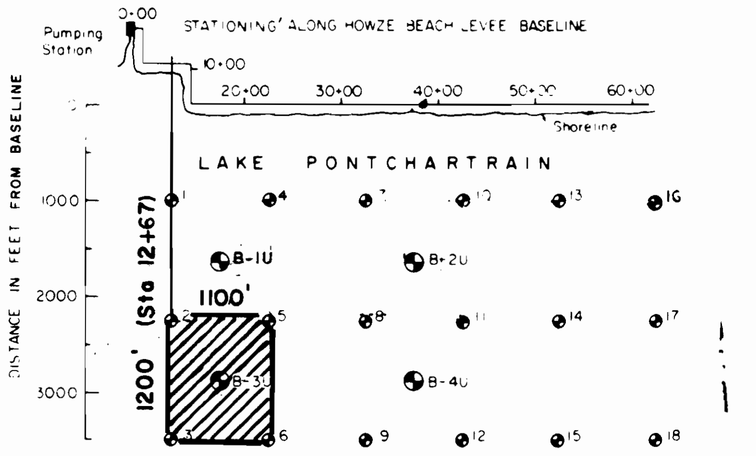
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
FLOTATION CHANNEL STABILITY
STA. 654+50 TO STA. 661+70
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



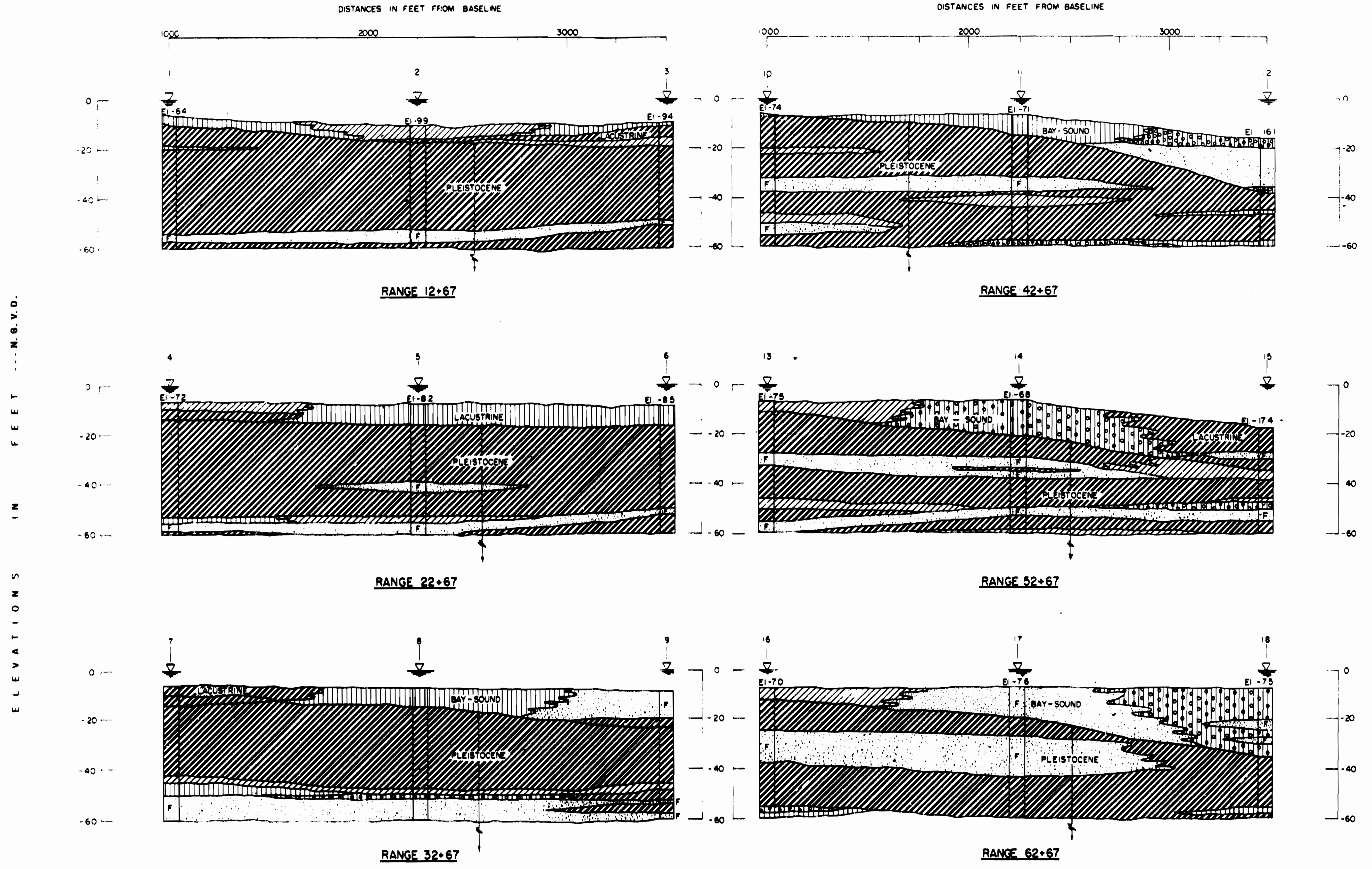




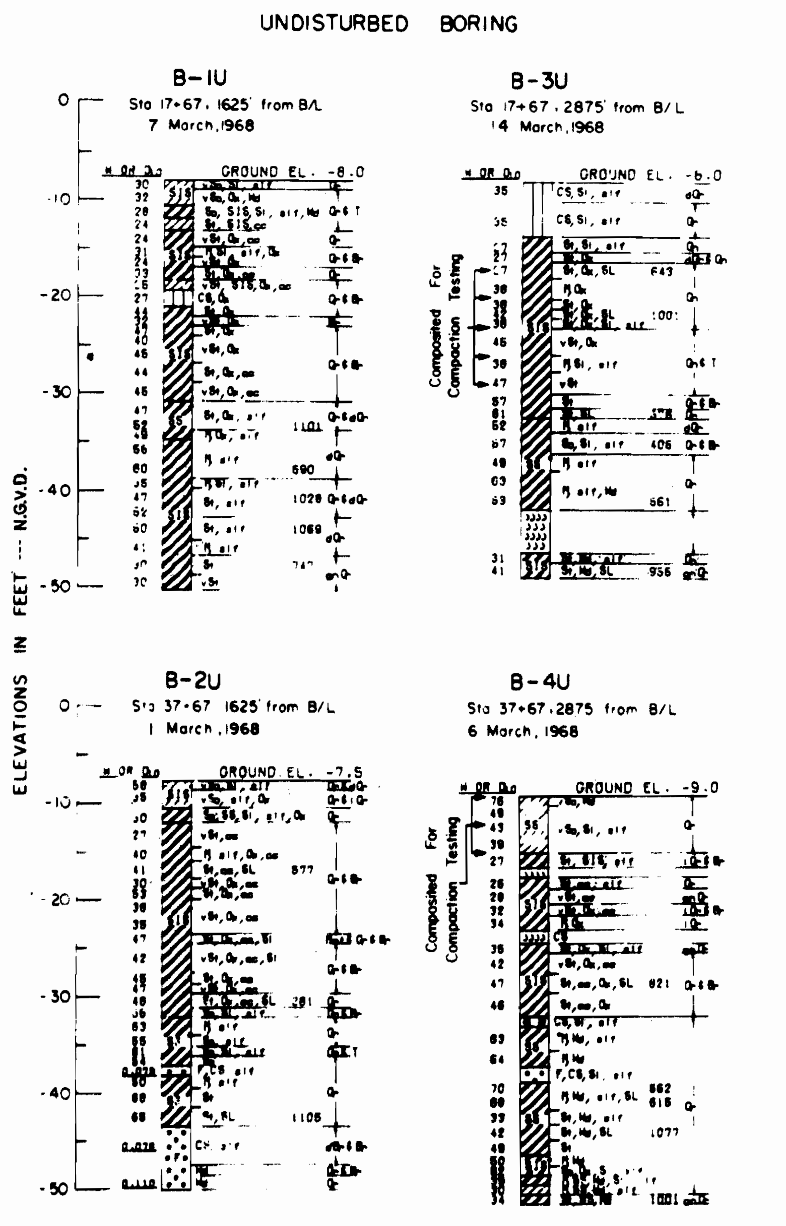
PROSPECTIVE BORROW AREA
LAKE PONTCHARTRAIN ALONG NORTH SHORE
⊕ INDICATES BORING LOCATIONS

GENERAL NOTES
FOR SOIL BORING LEGEND SEE PLATE A.
SOIL SAMPLES TAKEN WITH 1 7/8" I.D. CORE BARREL SAMPLER (BORINGS 1 THRU 18)
BORINGS B-1 THRU B-4U WERE TAKEN WITH A 5" DIAMETER STEEL TUBE PISTON TYPE SAMPLER.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
BORROW DATA
HOWZE BEACH BORROW AREA
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: FEB. 1985 FILE NO. H-2-29820



SOIL BORING SECTIONS



LEGEND (Soil Boring Sections)

CH - Fat Clay
CL - Lean Clay
ML - Silt
SM - Silty Sand
SP - Fine Sand

RECENT
- Lacustrine - soft to very soft lean clay and fat clay with silty sand and sand, and with shell and shell fragments
- Bay-Sound - silt, silty sand and sand with shell and shell fragments

PLEISTOCENE — stiff to very stiff clays with layers and lenses silt and sand

Soil samples taken with 1 7/8 inch I.D. core barrel.
See PLATE A for soil boring legend
See PLATE 66 for location of borings

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15-GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
BORROW DATA
HOWZE BEACH BORROW AREA
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1985 FILE NO. H-2-29820

LAKE PONTCHARTRAIN, LOUISIANA & VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

APPENDIX A

HYDROLOGY AND HYDRAULICS

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15 - GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
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APPENDIX A
HYDROLOGY AND HYDRAULICS

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PARIS ROAD TO SOUTH POINT

APPENDIX A
HYDROLOGY AND HYDRAULICS

SECTION I - ANALYSIS

1. General. This appendix presents all hydrologic and hydraulic design criteria and analyses associated with the New Orleans East Lakefront levee. The overall plan of improvement is described in detail in the main body of this memorandum and references to the main text are cited where appropriate.

2. Description. The project area is located in southeastern Louisiana within the limits of New Orleans. The dominant topographic feature is Lake Pontchartrain, a shallow tidal basin approximately 640 square miles in area and 12 feet in depth. Lake Pontchartrain is connected to the Gulf of Mexico through the Rigolets and Chef Menteur Passes, Lake Borgne, and Mississippi and Chandeleur Sounds, and is connected with Lake Maurepas to the west by Pass Manchac.

The area fronted by the New Orleans East Lakefront Levee is bounded on the other three sides by the South Point to GIWW Levee, the New Orleans East Back Levee and the Michoud Canal - Village D'Lest - Paris Road Levee. This area is predominantly undeveloped marshland. The land south of and adjacent to U.S. Highway 90 is developed mostly with large industrial complexes. The area is relatively flat with an elevation of approximately 0.0 feet National Geodetic Vertical Datum of 1929 (N.G.V.D.). Tidal exchange and drainage is afforded the area via a flap gated structure at South Point; sluice gates at this site provide positive cutoff, preventing hurricane surges from entering through the drainage structure. Drainage is also provided by a 750 cfs pumping station located in the New Orleans East Back Levee at the Maxent Canal.

The new hurricane protection levee will not interfere with the operation of these drainage facilities. The study area is depicted on Plate A-1.

3. Climatology.

a. Climate. The project area is located in a subtropical latitude having mild winters and hot, humid summers. During the summer, prevailing southerly winds produce conditions favorable for convective thundershowers. In the colder seasons, the area experiences frontal passages which produce squalls and sudden temperature drops. River fogs are prevalent in the winter and spring when the temperature of the Mississippi River is somewhat colder than the air temperature. Climatological data for the area are contained in monthly and annual publications by the U.S. Department of Commerce, Weather Bureau, titled, "Climatological Data for Louisiana," and "Local Climatological Data, New Orleans, La." Table A-1 lists active meteorological stations in and adjacent to the study area. These stations are also shown on the map on Plate A-2.

TABLE A-1
METEOROLOGIC STATIONS

Map Index No. (Plate A-2)	Length of Record (Yrs) Precipitation & Temperature Stations	Precipitation	Temperature
1	New Orleans - Audubon Park	92	92
2	New Orleans - Moisant Airport	28	92
3	Reserve (NR)	80	80
4	Slidell	25	25
5	Donaldsonville (NR)	92	93
6	Louisiana Nature Center	2	2
7	Paradis (NR)	67	27
OMS	Hammond (NR)	85	86
OMS	St. Bernard (NR)	16	16
OMS	Covington	88	88
OMS	Carville (NR)	43	42
OMS	Baton Rouge Airport	113	93
	Recording Precipitation Stations		
8	New Orleans Algiers	82	-
9	New Orleans DPS 14 - Citrus	27	-
10	New Orleans Water Plant - Dublin	88	-
11	New Orleans DPS 5 - Jourdan	48	-
12	New Orleans DPS 3 - London	88	-
13	New Orleans DPS 6 - Metairie	33	-
14	Gonzales	4	-
	Non-Recording Precipitation Stations		
15	New Orleans City Hall	4	-
OMS	Baton Rouge Central	3	-
OMS	Abita Springs Fire Tower	9	-

LEGEND: NR - Non-Recording
OMS - Off Map Station

b. Temperature. New Orleans has temperature records extending as far back as 1871. From temperature averages over the period 1951-1980, the mean annual temperature is 69.5°F. Extremes over the period of record are 7°F and 102°F. The average temperature in summer is

82.4°F and in the winter is 55.3°F. Temperature averages (1951-1980) for the New Orleans gage at Audubon Park Station are shown in Table A-2. Station locations are provided on the map on Plate A-2.

TABLE A-2
MONTHLY TEMPERATURES (°F)
NEW ORLEANS AT AUDUBON PARK
30-YEAR AVERAGES (1951-1980)

Month	Mean	Maximum	Minimum
Jan	53.6	61.8	45.3
Feb	56.1	64.6	47.6
Mar	62.6	71.0	54.1
Apr	69.8	78.3	61.2
May	76.0	84.2	67.7
Jun	81.3	89.4	73.2
Jul	83.0	90.6	75.3
Aug	82.8	90.3	75.3
Sep	79.8	87.0	72.6
Oct	70.8	79.5	62.1
Nov	61.6	70.1	53.1
Dec	56.2	64.5	47.8
Annual	69.5		

Extreme Minimum: 7°F(13 February 1899)
Extreme Maximum: 102°F(30 June 1954 as well as other dates)

c. Rainfall. Precipitation is generally heavy in two fairly definite rainy periods. Summer showers occur from about mid-June to mid-September, and heavy winter rains generally occur from mid-December to mid-March. The drainage area tributary to Lake Pontchartrain is served by 34 precipitation stations of the National Weather Service, with periods of record ranging from 2 to 113 years. Based on the 30-year averages for the period 1951-1980 and from the National Weather Service station New Orleans at Audubon, the annual average precipitation is 61.6 inches per year, with variations of plus or minus 50 percent. Extreme monthly rainfalls exceeding 12 inches are not uncommon, and as much as 25 inches have been recorded in a single month. Average monthly rainfalls range from an average of 7.2 inches in July to an average of 2.52 inches in October. Several stations have experienced calendar months in which no rainfall was recorded. Snow occurs infrequently in the area. An 8.2-inch snowfall occurred in New Orleans on 14-15 February 1895. The last measurable snowfall occurred on 31 December 1963, when 4.5 inches fell in New Orleans. Table A-3 shows the 30-year averages for the New Orleans at Audubon station along with the monthly maximum and minimum totals during the average period. Location of the precipitation stations are shown on Plate A-2.

TABLE A-3
MONTHLY RAINFALL (Inches)
NEW ORLEANS AT AUDUBON PARK
30-YEAR AVERAGES (1951-1980)

Month	Mean	Maximum	Minimum
Jan	4.9	12.69	0.99
Feb	5.19	12.44	0.54
Mar	4.68	10.17	T
Apr	4.68	20.24	0.58
May	5.06	12.61	0.62
Jun	5.39	16.98	0.39
Jul	7.17	20.30 a/	2.37
Aug	6.67	17.82	2.67
Sep	5.98	16.91	0.80
Oct	2.52	8.18	0.00 b/
Nov	4.01	10.15	0.49
Dec	5.30	8.93	1.40
Annual	61.55	83.54 c/	40.11 d/

LEGEND:
- T - Trace
- a/ - Jul 1959
- b/ - Oct 1952, Oct 1963
- c/ - 1961
- d/ - 1968

d. Wind. The National Weather Service anemometer coverage at Moisant Airport in Kenner, Louisiana, was installed in 1949. This anemometer provides the longest record available adjacent to the lake. Table A-4 shows the average monthly wind speeds and their resultant directions for the years 1966-1982. The average wind velocity over this period is 7.8 mph, but winds over 100 mph are experienced occasionally in hurricanes. The predominant wind directions are north-northeast from September through February and south-southeast from March through June. Plate A-3 is a wind rose for New Orleans at Moisant based on the period of record of 1949-1978. The frequency of wind speeds and direction from this wind rose are summarized in Table A-5.

4. Hydrologic Regimen

a. General. The water level in Lake Pontchartrain is subject to variations from direct rainfall, tributary inflow, wind-driven water movements, and flow through the Rigolets and Chef Menteur passes and the Inner Harbor Navigation Canal caused by tides. Infrequently, lake level is influenced by diversion of Mississippi River floodflow through Bonnet Carre

Spillway. Combinations of these factors determine the salinity regimen in the lake. Locations and periods of record of hydrologic stations are shown in Table A-6.

b. <u>Runoff and Streamflow</u>. Runoff from the 4,700 square miles north and west of Lakes Pontchartrain and Maurepas, estimated to average five million acre-feet annually, drains into the lakes via the Amite, Tickfaw, Natalbany, Tangipahoa, and Tchefuncta Rivers, and Bayous Lacombe, Bonfouca, and Liberty. Streamflow records are available at six locations on these streams and four locations on Pearl River for the periods of record listed in Table A-7. New Orleans and adjacent parishes are drained by outfall canals that discharge directly into Lake Pontchartrain. Yearly fresh water inflow records show considerable variation, as shown in Table A-7.

TABLE A-4
WIND SUMMARIES, NEW ORLEANS AT MOISANT AIRPORT (1966-1982)
AVERAGE WIND SPEED

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ANNUAL
1966	9.6	10.5	9.7	10.7	8.7	7.3	6.2	6.4	5.7	7.6	7.4	8.6	8.2
1967	8.3	9.5	9.0	9.3	9.1	6.8	6.2	5.9	7.0	7.4	8.0	9.8	8.0
1968	9.2	10.0	9.3	9.1	8.4	5.6	5.7	5.2	6.4	6.8	8.9	9.3	7.8
1969	9.7	9.8	10.0	8.6	7.3	7.2	6.5	6.8	6.8	9.7	8.0	9.1	8.3
1970	9.5	9.2	9.8	9.9	8.5	6.8	5.4	6.0	6.7	7.7	8.0	7.4	7.9
1971	8.4	9.8	9.8	8.5	7.9	5.3	5.7	5.0	6.5	4.8	8.0	8.7	7.4
1972	8.9	8.6	9.1	10.2	7.3	9.3	7.5	6.4	7.0	8.3	9.9	9.4	8.5
1973	9.6	10.2	12.0	11.5	10.0	6.7	6.7	6.3	7.9	7.0	9.6	11.4	9.1
1974	9.2	11.0	10.8	10.7	8.2	7.4	5.0	5.2	8.6	7.4	8.5	8.5	8.4
1975	9.4	8.6	11.0	10.0	7.4	6.5	6.5	4.9	6.3	6.4	8.0	7.8	7.7
1976	9.6	8.8	10.5	7.6	8.4	6.9	5.4	5.7	6.0	8.5	7.9	8.2	7.8
1977	9.8	8.5	8.5	7.3	5.7	5.3	4.4	5.5	5.4	6.6	8.1	8.8	7.0
1978	9.1	8.9	8.5	8.6	7.9	5.9	5.5	5.3	6.3	6.1	6.7	10.0	7.4
1979	10.5	9.0	9.3	8.0	7.2	6.5	6.7	4.4	8.0	6.7	8.1	6.3	7.6
1980	7.6	8.0	9.8	8.8	7.5	7.4	5.6	5.7	5.3	5.9	6.4	5.9	7.0
1981	7.6	8.3	7.7	7.3	7.8	6.9	5.7	4.8	5.7	7.0	7.3	8.6	7.1
1982	9.8	8.3	8.9	9.4	6.5	6.2	4.6	4.4	7.1	7.5	7.6	10.0	7.5
Average	9.2	9.2	9.6	9.1	7.9	6.7	5.8	5.5	6.6	7.1	8.0	8.7	7.8

TABLE 4 (Continued)
WIND SUMMARIES, NEW ORLEANS AT MOISANT AIRPORT (1966-1982)
RESULTANT DIRECTION*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ANNUAL
1966	02	04	07	16	07	07	23	15	02	03	03	05	05
1967	03	02	13	15	16	11	21	02	05	06	05	08	09
1968	03	35	12	16	15	19	12	05	06	04	04	06	07
1969	07	02	02	13	09	18	24	09	04	05	36	01	05
1970	03	03	08	17	10	21	20	12	08	03	32	06	09
1971	02	12	13	15	13	23	20	01	07	04	04	12	09
1972	07	07	12	15	04	20	14	34	12	06	02	06	08
1973	02	36	16	16	20	18	24	04	10	07	13	20	12
1974	12	24	16	13	16	16	25	13	05	06	06	16	12
1975	09	21	14	11	15	18	25	17	03	05	08	04	10
1976	04	19	15	15	15	13	25	01	04	02	02	02	07
1977	01	09	13	14	13	21	20	12	15	03	10	13	11
1978	01	01	28	15	16	12	19	11	08	03	08	07	07
1979	01	04	15	14	13	15	17	13	04	11	03	03	08
1980	06	06	09	20	1	22	27	13	09	04	02	02	08
1981	02	02	21	15	13	16	22	11	05	06	10	04	09
1982	11	01	12	10	13	22	21	21	06	06	06	10	NA

* Wind Direction - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm, 09 east, 18 south, 27 west, 36 north. Resultant wind is the vector sum of wind directions and speed divided by number of observations.

NA - Not available

TABLE A-5
WINDSPEED
NEW ORLEANS AT MOISANT AIRPORT
PERCENTAGE FREQUENCY (1949-1978)

SPEED GROUPS (mph)

Direction	03	4-13	14-19	20-25	26-32	32+	TOTAL
N	0.0	4.9	2.1	0.3	0.1	0.0	7.4
NNE	0.0	4.0	1.5	0.2	0.0	0.0	5.7
NE	0.0	5.0	1.6	0.2	0.0	0.0	6.8
ENE	0.0	4.9	1.4	0.1	0.0	0.0	6.4
E	0.0	4.3	1.0	0.1	0.0	0.0	5.4
ESE	0.0	3.6	0.7	0.1	0.0	0.0	4.4
SE	0.0	4.0	0.9	0.1	0.0	0.0	5.0
SSE	0.0	4.5	1.6	0.2	0.0	0.0	6.3
S	0.0	6.2	2.1	0.3	0.1	0.0	8.7
SSW	0.0	4.0	0.8	0.2	0.0	0.0	5.0
SW	0.0	3.0	0.4	0.0	0.0	0.0	3.4
WSW	0.0	2.1	0.4	0.0	0.0	0.0	2.5
W	0.0	2.4	0.5	0.1	0.0	0.0	3.0
WNW	0.0	2.0	0.5	0.1	0.0	0.0	2.6
NW	0.0	2.0	0.8	0.2	0.1	0.0	3.1
NNW	0.0	2.7	1.4	0.3	0.1	0.0	4.5
Calm	20.0	-	-	-	-	-	20.00
Total	20.0	59.6	17.7	2.5	0.4	0.0	100.00

TABLE A-6
HYDROLOGIC STATIONS

Map Index No. (Plate A-2)	Periods of Record			Stage Extremes (ft. NGVD)			
	Station	Types of Water Level Gage	Records Available Through 1982	Maximum	Date	Minimum	Date
16	Amite River at Port Vincent	Auto Recorder & Staff	Gage Heights, Dec 54 to Jun 74 and Jun 75 to date. Discharge, last observation - Apr 80	12.87	Apr 77	-0.93	Mar 81
17	Amite River at French Settlement	Auto Recorder & Staff	Gage Heights, intermittent 1947-51 and daily. Dec 54 to date. Discharge last observation - 8 in 1977	7.4	Apr 78	-1.5	Dec 54
18	Petite Amite River near St. Paul	Auto Recorder & Staff	Gage Heights, intermittent Mar 50 to May 51 and daily Oct 51 to date	4.72	Apr 73	-1.6	Dec 56
19	Reserve Canal near Lake Maurepas	Auto Recorder & Staff	Gage Heights, Jan 79 to date.	3.21	Sep 79	-1.14	Mar 81
20	Tickfaw River near Springfield	Auto Recorder & Staff	Gage Heights, May 47 to date. Discharge, last observation-7 in 1977	5.57	Apr 79	-1.43	Dec 54
21	Pass Manchac near Ponchatoula	Staff	Gage Heights, July 55 to date.	4.80	Apr 79	-2.0	Jan 61
22	Bayou Bonfouca at Slidell	Staff	Gage Heights, Aug 62 to date.	6.8 (affected by Hurricane)	Aug 69	-0.6	Feb 63
23	Lake Pontchartrain at Frenier	Auto Recorder & Staff	Gage Heights, Sep 31 to Sep 65 and Jan 69 to date	12.09* (watermark)	Sep 65	-2.1	Jan 38
24	Lake Pontchartrain at Mandeville	Auto Recorder & Wire Weights	Gage Heights, Sep 31 to date	6.95*	Sep 74	-2.25	Jan 38

* Caused by hurricane

TABLE A-6
HYDROLOGIC STATIONS
(Continued)

Map Index No. (Plate A-2)	Periods of Record: Station	Periods of Record: Types of Water Level Gage	Records Available Through 1982	Stage Extremes (ft. NGVD): Maximum	Date	Minimum	Date
25	Lake Pontchartrain at Midlake near New Orleans	Auto Recorder & Wire Weights	Gage Heights, Aug 57 to date	5.53*	Sep 65	-1.28	Mar 65
26	Lake Pontchartrain at West End	Auto Recorder & Staff	Gage Heights, Sep 31 to Nov 46 and Mar 49 to date	5.37*	Sep 65	-2.2	Jan 38
27	Lake Pontchartrain (Irish Bayou) near South Shore	Auto Recorder & Staff	Gage Heights, May 49 to date	7.16*	Aug 69	-1.30	Jul 54
28	Rigolets near Lake Pontchartrain	Auto Recorder & Staff	Gage Heights, Sep 31 to date	9.0*	Aug 69	-1.90	Jan 38
29	Lake Borgne at Rigolet	Auto Recorder & Staff	Gage Heights, Dec 57 to Sep 65 and Jul 67 to date	12.25* (watermark)	Aug 69	-2.04	Feb 78
30	Chef Menteur Pass near Lake Borgne	Auto Recorder & Staff	Gage Heights, Apr-Jun 45, Feb-Mar 50, Jul 57-Sep 65 and Oct 67 to date. Discharge 1937 and 1945	9.07*	Sep 65	-1.69	Feb 78
31	Mississippi River Gulf Outlet at Shell Beach	Auto Record & Staff	Gage Heights, Jun 61 to date	11.06*	Aug 69	-2.7	Mar 65
32	Bayou Dupre at Floodgate (west)	Auto Recorder & Staff	Gage Heights, Aug 75 to date	3.14	Apr 79	-1.94	Jan 79

* Caused by hurricane

TABLE A-6
HYDROLOGIC STATIONS
(Continued)

Map Index No. (Plate A-2)	Periods of Record			Stage Extremes (ft. NGVD)			
	Station	Types of Water Level Gage	Records Available Through 1982	Maximum	Date	Minimum	Date
33	Bayou Dupre at Floodgate (east)	Auto Recorder & Staff	Gage Heights, Aug 75 to date	4.51	Jul 79**	-1.78	Feb 78
34	Bayou Bienvenue at Paris Road	Auto Recorder & Staff	Gage Heights, Dec 74 to date	4.82	May 78	-1.78	Jan 77
35	Bayou Bienvenue at Floodgate (west)	Auto Recorder & Staff	Gage Heights, May 75 to date	3.55*	Sep 77	-2.03*	May 78
36	Bayou Bienenue at Floodgate (east)	Auto Recorder & Staff	Gage Heights, Dec 74 to date	4.62	Jul 79	-1.89	Jan 79
37	Intracoastal Waterway near Paris Road Bridge	Auto Recorder & Staff	Gage Heights, Apr 48 to date	10.04*	Sep 65	-2.19	Mar 65
38	Inner Harbor Navigation Canal near Seabrook Bridge	Auto Recorder & Staff	Gage Heights, daily, Aug 62 to date	6.47*	Aug 69	-1.53	Mar 65
39	Inner Harbor Navigation Canal (IWW) at Florida Ave. Bridge	Auto Recorder & Wire Weight	Gage Heights, Jul 44 to date	9.82*	Aug 69	-1.45	Jan 81
40	Inner Harbor Navigation Canal (IWW) at New Orleans	Staff	Gage Heights, May 22 to date	10.61*	Sep 65	-1.85	Jan 75
41	Intracoastal Waterway at Harvey Lock	Wire Weight	Gage Heights, Jan 25 to date	4.21	Apr 73	-1.28	Jan 40
42	Intracoastal Waterway at Algier's Lock	Auto Recorder	Gage Heights, May 56 to date	4.31	Apr 73	-1.64*	Sep 65

* Caused by hurricane
** From incomplete record

TABLE A-7
PERTINENT STREAMFLOW DATA (1938-1983)

Inflow Point	Total Drainage Area(Mi2)	Gaged* Location	Gaged Drainage Area(Mi2)	Period of Record	Average Discharge(cfs)	Maximum Discharge Rate (cfs)	Maximum Discharge Date	Minimum Discharge Rate (cfs)	Minimum Discharge Date
Amite River	2,373	near Denham Springs	1,280	9/38 to date	1,966	120,000	4/8/83 10/18/56	271	10/17/56
Tickfaw River	735	at Holden	247	10/40 to date	366	22,400	4/8/83	65	10/1-4/69
		Natalbany River at Baptist	79.5	8/43 to date	114	9,640	4/7/83	1.8	11/2-5/63
Tangipahoa River	885	at Robert	646	10/38 to date	1,129	86,000	4/8/83	245	10/30/68 Through 11/3/68
Tchefuncta River	459	near Folsom	95.5	1/43 to date	159	33,000	4/6/83	26	9/4/68 & 9/15/68
		Bogue Falaya at Covington	88.2	1964 to date	-	12,700**	4/8/83	-	-
Pearl River	8,689	at Bogalusa	6,573	10/38 to date	9,599	129,000	4/24/79	1,020	10/29/63 Through 11/1/63
		Bogue Chitto near Bush	1,213	10/37 to date	1,916	131,700	4/8/83	366	10/22,23, 26,29/68
		at Pearl River	3,494	10/63-9/70 10/75 to date	9,470 (1964-70)	230,000	4/9/83	1,580	10/24/63 & 11/10/63
		Bogue Luse Creek at Bogalusa	72.7	10/63 to date	116	15,000	4/7/83	5	10/27-28/67

* U.S. Geological Survey Gage Stations
** Previous Flood Discharge - 8,610 cfs 4/27/64

c. Stages, Salinities, Waves, and Tides.

(1) Lake stages.

(a) The Bonnet Carre Spillway is operated as required during major high water seasons on the Mississippi River to divert flows through Lake Pontchartrain in order to insure that a discharge of 1.25 mcfs is not exceeded at New Orleans. Studies indicate that the operations of the spillway produced maximum increases in lake level of about 0.8 feet in 1937, 1.5 feet in 1945, 1.0 feet in 1950, and 0.7 feet in 1973 and again in 1979. The effects of the Bonnet Carre operation on stages in Lake Pontchartrain were evaluated as part of a physical model study made by the U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi, in 1963(1). The report indicates that for the passage of flows at or near the design discharge of 250,000 cfs, the operation of the spillway would increase stages in Lake Pontchartrain by about 0.7 foot for average high water stages in Lake Borgne. An analysis of the effects of Bonnet Carre on lake stages during the 1973 and 1979 operations indicates that these model results are generally valid.

(b) The maximum recorded stage in Lake Pontchartrain of 13.0 feet N.G.V.D. occurred at Frenier on 29 September 1915. The minimum of minus 2.2 feet N.G.V.D. occurred at New Orleans (West End) on 26-27 January, 1938. The mean lake stage for the period from 1953 to 1971 was 1.2 feet N.G.V.D.

(c) Maximum stages occur in Lake Pontchartrain during hurricane activity in the vicinity. A list of high stages recorded during hurricanes is presented in Table A-8.

TABLE A-8
MAXIMUM STAGES - LAKE PONTCHARTRAIN

Location	Date	Stage - Ft. N.G.V.D.	
Mandeville	20 Sep 1909	8.0	
West End	20 Sep 1909	6.2	
Frenier	29 Sep 1915	13.0	
West End	29 Sep 1915	6.0	
West End	19 Sep 1947	5.4	
Mandeville	19 Sep 1947	6.8	
New Orleans	4 Sep 1948	4.9	
Frenier	24 Sep 1956	6.8	"Flossy"
Little Woods	24 Sep 1956	7.0	"Flossy"
West End	24 Sep 1956	5.3	"Flossy"
Mandeville	27 Jun 1957	4.1*	"Audrey"
Frenier	9 Aug 1957	3.3	"Bertha"
Frenier	18 Sep 1957	4.5	"Esther"
Mandeville	10 Sep 1961	5.5	"Carla"
Frenier	17 Sep 1963	4.0	"Cindy"

TABLE A-8 (Continued)
MAXIMUM STAGES - LAKE PONTCHARTRAIN

Location	Date	Stage - Ft. N.G.V.D.	
Mandeville	4 Oct 1964	6.4	"Hilda"
Frenier	10 Sep 1965	12.1	"Betsy"
Frenier	Aug 1969(watermark)	4.6	"Camille"
Mandeville	18 Aug 1969	4.6	
West End	17 Aug 1969	5.2	
Irish Bayou	18 Aug 1969	7.2**	
Rigolets	18 Aug 1969	9.0**	
Shell Beach	17 Aug 1969	11.1**	
Mandeville	8 Sep 1974	5.0	"Carmen"
Frenier	8 Sep 1974	4.5	
West End	8 Sep 1974	5.2	
Frenier	5 Sep 1977	4.2	"Babe"
Little Woods	4 Sep 1977	4.5	

* Possibly higher, gage failed during storm
** New record established

(2) Salinities. Diluted saline gulf waters enter Lake Pontchartrain from Lake Borgne via the Rigolets and Chef Menteur Pass and the Mississippi River - Gulf Outlet and Inner Harbor Navigation Canal in large quantities and mixes with the fresh water inflow. The salinity in the eastern portion of Lake Pontchartrain averages about 4.5 parts per thousand with a low of 1.1 parts per thousand, and a high of 16.5 parts per thousand. The salinity in the western portion of the lake averages about 1.5 parts per thousand with a low of 0.05 parts per thousand, and a high of 8.0 parts per thousand. Salinity is subject to considerable variation with respect to location, seasonal trends, and short-term fluctuations. More intensive data on salinities, tides, and currents in Lake Pontchartrain and vicinity are shown in a U.S. Army Waterways Experiment Station Report of January 1982 entitled, "Lake Pontchartrain and Vicinity Hurricane Protection Plan - Prototype Data Acquisition and Analysis."(2)

(3) Waves. In August 1957, two wave gages were installed on the east side of the Greater New Orleans Expressway Bridge, Station Ten at the north end, and Station Four on the south end. Both are approximately one-quarter mile from shore. In 1958, Station Nine was established at Frenier, with the gage on a tower approximately 1,200 feet from shore. Locations are shown on Plate A-2. Pertinent observed data are listed in Table A-9.

TABLE A-9
WAVE DATA

	Significant Waves		Maximum Waves	
Station	Range (ft)	Wind (mph)	Height (ft)	Date
4	0.1 to 4.9	30	8.3	9 October 1958
9	0.1 to 4.9	29	7.8	9 October 1958
10	0.1 to 5.3	40	9.0	10 May 1959

(4) Tides. The normal tide has a general range of one-half foot in Lake Pontchartrain and is diurnal in nature. However, wind effects usually mask the daily ebb and flood fluctuations. Because of the annual volume of freshwater inflow (estimated to average 5 million acre-feet), tides and storm surges, enormous volumes of water pass in both directions through the Rigolets, Chef Menteur Pass, Lake Borgne, Mississippi Sound, Inner Harbor Navigation canal, and Mississippi River-Gulf Outlet.

5. Description and Verification of Procedures.

a. Hurricane Memorandums. The Hydrometeorological Section (HMS), National Weather Service, cooperated in the development of hurricane criteria for experienced and potential hurricanes in the study area. The HMS memorandums provided frequency data, isovel and rainfall patterns, pressure profiles, hurricane paths, and other parameters required for the hydraulic computations. Those relative to experienced hurricanes are based on reevaluation of historic meteorologic and hydrologic data. Those relative to potential hurricanes contain generalized estimates of hurricane parameters that are based on the latest research and concept of hurricane theory. Memorandums pertinent to the study area are listed in Section III - Bibliography.

b. Historical Storms used for Verification. Three observed storms, with known parameters and effects, were used to establish and verify procedures and relationships for determining surge heights, wind tide levels (WTL's), inflow into Lake Pontchartrain, overtopping flows, and ultimately, flooding elevations that would result from synthetic hurricanes. These three storms occurred in September of 1915 (4) and September 1947 (5) and are shown on Plates A-4 and A-5.

(1) The hurricane of 29 September 1915 had a central pressure index (CPI) of 27.87 inches, an average forward speed of 10 knots, and a maximum wind speed of 99 mph at a radius of 29 nautical miles. This hurricane approached the mainland from the south. At the Lake Borgne entrance to the Rigolets, a highwater elevation of about 10 feet N.G.V.D. was experienced and the average elevation in Lake Pontchartrain rose to 6 feet N.G.V.D. This storm was not used for verification of levee overtopping because the present lakefront levee system was not in existence in 1915.

(2) The 19 September 1947 hurricane had a CPI of 28.57 inches, an average forward speed of 16 knots, and a maximum windspeed of 72 mph at a radius of 33 nautical miles. The direction of approach of this hurricane was approximately from the east. In Lake Borgne, at the entrance to the Rigolets, the maximum water surface elevation was 10 feet N.G.V.D. and in Lake Pontchartrain, the maximum elevation was 5 feet N.G.V.D. However, because of the rapid forward speed of this storm, the average water elevation in Lake Pontchartrain did not reach its maximum at the time that the winds were critical to the south

shore. The step-type seawall was in place along the New Orleans lakefront during this storm, and a fairly reliable flood line of overtopping flows was available for verification.

(3) Tropical storm ESTHER occurred on 16 September 1957, and the resultant elevations were accurately registered by stage recording gages at many locations within the study area. These records were available for verification of routing procedures. This storm was not severe enough to cause flooding.

c. Synthetic storms. Computed flood elevations, resulting from synthetic storms, are necessary for frequency and design computations. Parameters for certain synthetic storms and methods for derivation of others were furnished by the National Weather Service. The standard project hurricane (SPH) for the entire Louisiana coast was used for all locations in the study area with changes only in path and forward speed.

(1) SPH for the Louisiana coast was derived by the National Weather Service from a study of 42 hurricanes that occurred in the region over a period of 57 years (6). SPH paths critical to different locations in the study area and isovel patterns at critical hours are shown on Plates A-6 and A-7. Based on subsequent studies of more recent hurricanes, the National Weather Service has revised the SPH wind field patterns and other characteristics over the years. Wind field patterns were revised after HURRICANE BETSY in 1965 to reflect the intensified wind speeds (7), (8), (9). After HURRICANE CAMILLE in 1969, the National Weather Service completely revised hurricane characteristics for the SPH, including the wind speeds, central pressure indexes, and radii (10). In their latest publication (11), NOAA has expanded and generalized the latest SPH characteristics. For design of the Lake Pontchartrain and Vicinity Hurricane Protection Project High Level Plan, the SPH, as defined after HURRICANE BETSY, was used. To assure that all the segments of the project would be compatible, SPH parameters have not been changed since construction began. Modifications and adjustments of these parameters subsequent to HURRICANE BETSY have not significantly changed the characteristics of the SPH.

(a) The SPH for the Louisiana coastal region has a frequency of once in 100 years. The CPI that corresponds to this frequency is 27.6 inches. CPI probabilities are based on the following relationship (12):

$$P = \frac{100\ (M-0.5)}{Y}$$

Where P = percent chance of occurrence per year
M = number of event (ranking)
Y = number of years of record

(b) Radius of maximum winds is an index of hurricane size. The average radius of 12 hurricanes occurring in the New Orleans area is 36 nautical miles. From relationships of CPI and radius of maximum winds of gulf coast hurricanes (12), a radius of 30 nautical miles is considered representative for an SPH having a CPI of 27.6 inches.

(c) Different forward speeds are necessary to produce SPH effects at various locations within the study area. In Lake Pontchartrain, the forward speed is a particularly critical factor and may be as important as the track itself. Sufficient time must elapse between the time of maximum elevation at the entrances to Chef Menteur Pass and the Rigolets and the time of maximum critical winds at the Lake Pontchartrain shore in question to allow for maximum inflow into the lake. The SPH for the south shore, patterned after the September 1915 hurricane, has an average forward speed of 6 knots. An average forward speed of 11 knots was used for the SPH along the west shore of Lake Borgne at the entrance to the passes into Lake Pontchartrain.

(d) Maximum theoretical gradient wind (12) is expressed as:

$$V_{gx} = 73\ (P_n - P_o)^{1/2} - R\ (0.575\ \ f)$$

Where V_{gx} = maximum gradient wind speed in miles per hour
P_n = asymptotic pressure in inches
P_o = central pressure in inches
R = radius of maximum winds in nautical miles
f = coriolis parameter in units of hour

The estimated wind speed (30 feet above ground level) (V_x) (13) in the region of highest speeds is obtained as follows:

$$V_x = 0.885\ V_{gx}\ +\ 0.5T$$

Where T = forward speed in miles per hour.

From these relationships, a wind speed of approximately 100 mph was obtained.

(2) Other synthetic storms of different frequency and CPI are derived from SPH. Other CPI's for desired frequencies are obtained from the graph shown on Plate A-8. V_{gx}'s corresponding to any other CPI are determined similarly by use of the method described for the SPH. Variations in CPI's of historic storms were accomplished by the same procedure (12). Characteristics of synthetic storms and some historic storms are listed in Table A-10.

TABLE A-10
HURRICANE CHARACTERISTICS

Hurricane*	CPI (inches)	Radius of max. winds (nautical miles)	Forward Speed (knots)	V_x (m.p.h.)
Sep 1915	27.87	29	10	99
Sep 1947	28.57	33	16	72
Sep 1956	28.76	30	10	80
Sep 1965	27.79	32	20	122
Track A PMH	26.90	30	6	114
Track A SPH	27.60	30	6	100
Track A Mod H	28.30	30	6	83
Track F PMH	26.90	30	11	114
Track F SPH	27.60	30	11	100
Track F Mod H	28.36	30	10	80

* Tracks are shown on Plate A-9.

d. Surges. Maximum hurricane surge heights along the western shores of Lake Borgne at the entrances to Lake Pontchartrain were computed by use of a one-dimensional steady-state wind tide formula. A detailed description of the formula and its verification is contained in Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I - Chalmette (14).

e. Routing. Since the major hurricane damage in the study area results from storm induced effects on Lake Pontchartrain, it was necessary to establish a method to determine the hydraulic regimen in the lake at any time during the hurricane occurrence. This procedure involves the construction of a stage hydrograph for Lake Borgne, and the simultaneous hourly calculations of flows through Lake Pontchartrain's natural inlet and outlet passes, tilt and stage-volume relationships in Lake Pontchartrain and Lake Maurepas, accumulated rainfall, and overflow from the lake to the land areas.

(1) Prerequisite to any routing is the choice of an actual or hypothetical hurricane of known or designated characteristics. It is then possible to develop surge heights for any point in Lake Borgne for selected storms. For routing purposes, Long Point, which is east of the mouth of the Rigolets, was selected as the critical point for the hydrograph. The hydrograph for Long Point reflects stages at the mouths of both the Rigolets and Chef Menteur Pass. Construction of such a hydrograph of hourly stages at the mouth of the two passes was based on a method developed by R. O. Reid (15) that was modified by using the maximum surge elevation computed by the incremental setup method as the peak of the hydrograph for the critical period. A comparison of the rising portion of the hydrograph thus derived, with one obtained by computing surge elevations at hourly intervals, indicated agreement between the two methods. Final stages for the recession portion of the hydrograph could not be computed by the incremental

setup method because of the offshore wind directions prevailing after the peak stage. The recession produced by Reid's method (15), obtained by rotating the hydrograph about the peak ordinate, indicated stages considerably lower than corresponding stages for the 1947 hurricane surge. The observed stages of the 1957 storm surge also indicated that the recession was somewhat slower at intermediate stages in Lake Borgne. It was therefore necessary to estimate the recession portion of the hydrograph to verify routing procedures. Storm surge hydrographs for Long Point for each storm investigated, were determined by identical procedures.

(2) Storm tides flow in and out of Lake Pontchartrain through three major natural passes and an artificial canal. Rating tables, derived by reverse routing of observed storms, were developed for use in routing through the passes and canal. The elevation of Lake Borgne at Long Point was determined from the average of records obtained from automatic tide gage recorders, located at the mouths of the passes and at Shell Beach. Elevations of Lake Pontchartrain were determined from records of the automatic tide gages located in Lake Pontchartrain at U.S. Highway 11 and at West End. Although there was a fairly consistent relationship between head and flow, there was no consistency when a parameter of stage was introduced.

(a) The combined rating of the Rigolets, Chef Menteur Pass, flow over U.S. Highway 90 in vicinity of the passes, and Inner Harbor Navigation Canal, was based on the period 25 July to 11 August 1957, during which time a minor storm accompanied by moderate stages was experienced. The empirical relationship, $Q = 560\ H^{0.935}$, was derived from plots of the data, and used to compute a rating table.

(3) Storage tables for the range of stages were made for Lake Pontchartrain. The storage amounts included the volumes contained in the adjacent marsh areas when the stages exceeded the surface elevations of these marshes.

(4) Cumulative amount of rainfall that is coincident with the storm significantly affects the lake elevations and, hence, the routing procedure. The amount of this rainfall was calculated by the methods described in National Weather Service memorandums (16), (17), using a moderate rainfall that would be coincident with a tropical storm. For routing purposes, rainfall was considered as additional inflow into Lake Pontchartrain. The effect of cumulative rainfall is to raise the lake level.

(5) Stages, wind tide elevations, and waves induce flow over the shore protective structures. Adjustments were made in the routing procedure to account for the quantities that overtopped these structures.

(6) With the above-mentioned items resolved, the routing procedure was reduced to the successive approximation type problem in

which the variable factors were manipulated until a condition of balance between flows and storages was obtained for the incremental time intervals. A typical routing computation is illustrated on Plate A-10. The 1915 and 1947 hurricanes were routed by this procedure. Routed average stages for Lake Pontchartrain were found to be in reasonable agreement with the observed average stages for the two hurricanes. The degree of agreement between the observed and computed stages that were obtained by use of the routing procedure verifies the methods and rating tables used. Observed and computed average stages for the 1947 and 1957 hurricanes are shown on Plates A-11 and A-12. All other hurricanes studied were routed using similar procedures. The resultant stage hydrograph for the SPH critical to the south shore of Lake Pontchartrain is shown on Plate A-13.

f. Wind tides. The storms under consideration are accompanied by strong winds. The effect of strong winds blowing over a shallow enclosed body of water, such as Lake Pontchartrain, is to drive large quantities of water ahead of the winds. It was necessary, for purposes of routing and overflow computations, to determine the wind tide levels for Lake Pontchartrain. This was accomplished by dividing the lake into four or five segments that are roughly parallel to the wind directions, and by calculating setup and setdown for each of the segments. The average windspeed and average depth in each segment were determined from isovel and hydrographic charts for each wind tide computation. The storm isovel patterns were furnished by the National Weather Service (18), (19). The computation of wind along each zone was based on the segmental integration method (20) and was calculated by use of the step-method formulas (21) that were modified as follows:

$$\text{Setup} = d_t \left(-1 + \sqrt{\frac{0.00266\ u^2FN + 1}{d_t^2}} \right)$$

$$\text{Setdown} = d_t \left(1 - \sqrt{\frac{1 - 0.00266u^2\ \ FN}{d_t^2}} \right)$$

Where: Setup or setdown in feet is measured above or below mean water level (m.w.l.) of the surge in the lake.

d_t = average depth of fetch in feet below m.w.l.
u = windspeed in m.p.h. over fetch
F = fetch length in miles, node to shoreline
N = planform factor, equal generally to unity

(1) Graphs were constructed from the above formulas to determine setup and setdown quickly about any nodal elevation (see Plate A-15). Volumes of water along the zones, represented by the setup and setdown with respect to a nodal elevation, were determined and the water surface profiles adjusted until the setup and setdown

volumes balanced within 5 percent. Water surface contours were then drawn for several even-foot nodal elevations, and the tilt and WTL's were determined from the contour sketch. In the routing of surges, pertinent wind tides and tilts for other model elevations were interpolated from the contour sketches for the even-foot nodes. Typical wind tide computations are illustrated on Plate A-15.

(2) Maximum computed and observed setup elevations, for the 1947 hurricane, were 4.9 feet and 5.4 feet, respectively at West End. Computed stages for the 1915 hurricane compared favorably with observed high water marks. Wind tide levels for all hurricanes studied were computed by applying the same methods and procedures described above. Maximum surge height contours in the Lake Borgne area and maximum WTL contours in the Lake Pontchartrain area were developed for the SPH. These contours are shown on Plate A-16. The contours represent the maximum elevations that would be experienced for the occurrence of a hurricane in the SPH category for the most critical storm path.

6. Frequency estimates.

a. Procedures.

(1) The area along the south shore of Lake Pontchartrain was used in developing a procedure for making frequency estimates since more historical hurricane data were available for this area than for any other location. The maximum WTL or stage for a specific area is a measure of the character of storm that produces it. In order to use data from early hurricanes, which caused high wind tides along the south shore of Lake Pontchartrain, it was necessary to analyze meteorologic factors and to adjust the observed data to represent stages that would have occurred had presently existing protective works been in place at that time. It was found that adjustments were required for the 1893 and 1901 hurricanes. Along the south shore of Lake Pontchartrain, determinations of maximum WTL's were from the adjusted historical data from the locus of points through which a representative WTL-frequency curve would pass in the low-stage, high-frequency region. Probabilities for historical data on the curve shown on Plate A-17 were calculated by means of the following formula:

$$P = \frac{100 \quad (M-0.5)}{Y}$$

The WTL for the Probable Maximum Hurricane (PMH), which has an infinite return period, establishes another limit for the frequency curve in the high-stage, low-frequency region. However, because of the lack of historical data for the region of the curve between these two extremes, the synthetic WTL-frequency relationships were developed to show the shape of the curve in this region. In the process of formulating such relationships, it was necessary to correlate the following hurricane parameters: central pressure index, paths of approach, wind velocities, radii to maximum winds, and forward speeds of translation.

(2) Prior to 1900, information of record dealt primarily with loss of life and damage in the more densely populated areas, with practically no reference to water surface elevations caused by hurricanes. Only since 1900 has detailed information been available on flooding in coastal Louisiana and adjacent areas. Subsequent to the widely destructive September 1915 hurricane, Charles W. Oakey, Senior Drainage Engineer, Office of Public Roads and Rural Engineering, U.S. Department of Agriculture, made a thorough survey of the coastal areas between Biloxi, Mississippi and Palacios, Texas. The 1915 investigation is the only known area-wide study containing reliable stages until the investigation of Hurricane FLOSSY, September 1956, was completed. The data indicate that there is no locality along the Louisiana coast which is more prone to hurricane attack than other localities.

(3) The first requirement in the development of synthetic frequency relationships for localities within the study area was to select representative critical hurricane paths of approach for the particular locale in question. For the passes into Lake Pontchartrain, track F is the critical path for the design hurricane. For the south shore of Lake Pontchartrain, track A was selected to represent the hurricane situation that would produce critical conditions. These tracks are shown on Plate A-9.

(4) After hurricane paths were selected, surge heights and wind tides were developed, as described previously, for at least three storms of different CPI values for each track. Each hurricane selected for the representative paths were assumed to have the same radius of maximum winds, the same forward speed of translation, and the same adjustment for any land effects. Only CPI's and wind velocities were adjusted to develop these three storms. Results of these computations for the New Orleans reach of Lake Pontchartrain are shown in Table A-11. Wind tide elevations for storms with other CPI values were obtained graphically by plotting the above data and reading from the resulting curves.

TABLE A-11
CENTRAL PRESSURE INDEX VS. WIND TIDE LEVELS
LAKE PONTCHARTRAIN - NEW ORLEANS REACH

PATH A		PATH F	
Central Pressure Index (CPI)(inches)	Max Wind Tide Level(Ft.NGVD)	Central Pressure Index (CPI)(inches)	Max. Wind Tide Level(Ft.NGVD)
26.9	12.7	27.6	7.7
27.6	11.2	27.87	6.6
28.5	8.2	28.57	4.8

(5) Hurricane characteristics of area-representative storms were developed in cooperation with the National Weather Service. This agency has made a generalized study of hurricane frequencies for a

400-mile zone along the central gulf coast, Zone B, from Cameron, Louisiana, to Pensacola, Florida, and has presented the results in a memorandum (12). Frequencies for hurricane central pressure indexes that were represented in the report, as shown on Plate A-8, reflect the probability of hurricane recurrences from any direction in the midgulf coastal area. In order to establish frequencies for the localities under study, it was assumed that a hurricane whose track is perpendicular to the coast will ordinarily cause high tides and inundation for a distance of about 50 miles along the coast. Thus, the number of occurrences in the 50-mile subzone would be 12.5 percent of the number of occurrences in the 400-mile zone, provided that all hurricanes traveled in a direction normal to the coast. However, the usual hurricane track is oblique to the shoreline as shown in Table 2 of the HMS memorandum (12). The average projection along the coast of this 50-mile swath for the azimuths of 42 Zone B hurricanes is 80 miles. Since this is 1.6 times the width of the normal 50-mile strip affected by a hurricane, the probability of occurrence of any hurricane in the 50-mile subzone would be 1.6 times 12.5 percent, or 20 percent of the probability for the entire midgulf Zone B. Thus, 20 percent of the Zone B frequencies shown on Plate A-8 were used to represent the CPI-frequencies in the 50-mile subzone that is critical for each study locality.

(6) The azimuths of track observed in the vicinity of landfall were divided into quadrants corresponding to the four cardinal points. In Zone B, 24 tracks were from the south, 14 from the east, 3 from the west, and 1 from the north. Hurricanes with tracks having major components from the south and east are more critical to the WTL's within the study area than hurricanes from other directions. Approximately two-thirds of all experienced hurricanes have come from a southerly direction, whereas about one-third have come from the east. The average azimuth of tracks from the south are 180°. Tracks from the east had an average azimuth of 115°. These azimuths were used in approximately computing WTL's. Further adjustment of the probability of occurrence was made by using two-thirds of the probability for WTL's computed for hurricanes approaching from the south and one-third of the probability for WTL's computed for hurricanes approaching from the east. The probabilities of equal stages for both groups of tracks were then added arithmetically to develop a curve representing a synthetic probability of recurrence of maximum wind tide levels for hurricanes from all directions. Table A-12 presents the results of these computations and those of the previous paragraph for the New Orleans reach.

TABLE A-12
STAGE-FREQUENCY - SOUTH SHORE
LAKE PONTCHARTRAIN

	New Orleans Reach			Path A Freq.*		Path F Freq.*
	ZONE B	80-mi subzone	WTL	(67% Col 3)	WTL	(33% Col 3)
CPI	2	3	4	5	6	7
1 in.	occ/100 yrs		ft NGVD	occ/100 yrs	ft NGVD	occ/100 yrs
27.6	1	0.2	11.5	0.13	8.0	0.07
27.8	2	0.4	10.9	0.27	7.0	0.13
28.1	5	1.0	9.8	0.67	6.1	0.33
28.3	10	2.0	9.1	1.34	5.6	0.66
28.6	20	4.0	8.0	2.68	4.9	1.32
29.0	40	8.0	6.5	5.36	4.1	2.64

$$* \text{ Freq.} = \frac{100}{\text{Return period years}}$$

(7) Using the shape of the synthetic stage-frequency curve as a guide, it was then possible to complete a final curve for the New Orleans reach between the predetermined limits mentioned previously.

(8) Lack of historical data prevented the similar development of WTL-frequency relationships for other localities within the study area. For the remaining reaches, wind tide levels were calculated for Zone B hurricanes of different frequencies by using different combinations of critical paths and distribution of azimuths of incidence. It follows that a Zone B hurricane of a particular frequency would have the same recurrence period for any locale in the study area since all are within the same subzone. Therefore, the final stage - frequency curves for the remaining areas were developed by plotting the computed stages for several different Zone B hurricanes at the corresponding frequencies indicated for the south shore of Lake Pontchartrain. Only two-thirds of the hurricanes from the south or east are most critical relative to WTL's along the south shore of Lake Pontchartrain, while all of the hurricanes from the south or east are equally critical to the area affected by Lake Borgne. Therefore, the most critical WTL along the south shore of Lake Pontchartrain for a Zone B hurricane of given frequency occurs only two-thirds as often as the most critical WTL along the shores of Lake Borgne for the same hurricane.

b. Relationships. Based on the above described procedures, stage-frequency relationships were established for the south shore of Lake Pontchartrain and the passes into Lake Pontchartrain from Lake Borgne. Stage-frequency curves are shown on Plate A-18.

7. Design Hurricane.

a. Selection of the design hurricane. The standard project hurricane was selected as the design hurricane (Des H) due to the urban nature of the study area. A design hurricane of lesser intensity which would indicate a lower levee grade and an increased frequency would expose the protected areas to hazards to life and property that would be disastrous in the event of the occurrence of a hurricane of the intensity and destructive capability of the standard project hurricane.

b. Characteristics. The characteristics of the Des H for the proposed plan of protection are identical to the standard project hurricane described in detail in paragraph 5. However, due to transposition of the regional SPH to the smaller study area, the design hurricane would have a probability of recurrence of only once in about 300 years in the study area. The path of the Des H was located successively to produce maximum hurricane tides along the entire length of the proposed structure. The Des H is a theoretical hurricane but ones of similar intensity have been experienced in the area. Table A-13 is a summary of the Des H characteristics.

TABLE A-13
DESIGN HURRICANE CHARACTERISTICS

Location	CPI (Inches)	Max Winds (m.p.h.)	Radius of max winds (miles)	Forward Speed (knots)	Direction of Approach	Track (Plate A-7)
Lake Pontchartrain South Shore	27.6	100	30	6	South	A

c. Normal predicted tides. The average tidal range in Lake Pontchartrain is 0.5 feet. Lake Pontchartrain has an average elevation of about 1.0 feet. In determining the elevation of design surges and wind tide levels, the mean normal predicted tide was assumed to occur at the critical period.

d. Design tide. The hurricane tide is the maximum stillwater surface elevation experienced at a given location during the passage of a hurricane. It reflects the combined effects of the hurricane surge and wind tide. Design hurricane tides were computed for conditions reflecting the proposed protective works. The resulting elevations, which are identical to those for an SPH, are the same for existing or project conditions.

TABLE A-14
DATA USED TO DETERMINE WAVE CHARACTERISTICS
DESIGN HURRICANE

F	Length of fetch, miles	5
U	Windspeed, mph	83
SWL	Stillwater elevation, feet NGVD	11.5
d	Average depth of fetch, feet	24.4
d_t	Depth at toe of structure, feet	10.5

e. Wave characteristics. Using the design hurricane characteristics given above and the charts and nomographs published by CERC in Technical Report No. 4 (22), wave heights and periods and their associated characteristics were developed. To determine the wave characteristics for the design hurricane, Technical Report No. 4 (22) was selected, since it was the state-of-the-art technical aid at the time the hurricane parameters were developed. Wave characteristics thus determined are compatible with the SPH hurricane characteristics. Table A-15 lists some of the wave characteristics associated with the design hurricane.

TABLE A-15
WAVE CHARACTERISTICS - DESIGN HURRICANE

H_s	Significant wave height, feet	7.8
T	Wave Period, seconds	7.3
Lo	Deepwater wave length, feet	273
d/Lo	Relative depth	.0894
H_s/H_0'	Shoaling coefficient	.9426
H_0'	Deepwater wave height, feet	8.2
H_0'/T^2	Wave Steepness	.154

f. Maximum runup and overflow.

(1) Hurricanes approaching on paths critical to the south shore of Lake Pontchartrain create conditions whereby shore protective structures are overtopped. It was necessary to calculate the magnitude of the heights of wave runup and quantities of the overflow by use of established procedures in order to develop improved protective structure designs and to determine damages. This determination was divided into two significant parts for convenience of calculation, namely maximum runup and wave overtopping. Common factors which must be resolved in all types of calculations are the WTL, and the geometry and crown elevation of the protective structure.

(2) Wave runup on a protective structure depends upon the physical characteristics (i.e., configuration and surface roughness), the depth of water at the structure, and the wave characteristics. Computation of maximum runup was necessary in order to determine the heights to which existing shore protective structures would have to be raised to prevent all overflow for the significant wave accompanying the SPH. Wave runup was considered to be the ultimate height to which water in a wave ascended on the proposed slope of a protective structure. This condition occurred when the WTL was at a maximum, and was calculated by the interpolation of model study data developed by Saville (23), (24), (25), which relates runup (R/H_0'), wave steepness (H_0'/T^2), relative depth (d/H_0'), and structure slope. The technique for computing wave runup is explained in detail in the Shore Protection Manual (SPM) (26).

(3) Protective structures exposed to wave runup will be constructed to an elevation and cross-section that is sufficient to prevent all overtopping from the significant wave and waves smaller than the significant wave accompanying the SPH. Waves larger than the significant wave will be allowed to overtop the protective structures; however, such overtopping will not endanger the security of the structure or cause material flooding. In the case of New Orleans East Lakefront levee, runup was computed for waves breaking on each berm to determine the required levee elevation. Wave data, runup elevation, and required elevation of the protective structure are shown in Table A-16.

TABLE A-16
WAVE RUNUP AND PROPOSED ELEVATION OF PROTECTIVE STRUCTURE
STANDARD PROJECT HURRICANE ALONG
NEW ORLEANS EAST LAKEFRONT

Location Stations (ft)	Avg Depth (ft)	H (ft)	T (secs)	WTL Elevation (ft NGVD)	Elevation of Levee (ft NGVD)
331+50 to 364+50	24.4	7.8	7.3	11.5	18.5
364+50 to 661+70	24.4	7.8	7.3	11.5	18.0

g. Residual flooding. The procedures described in the SPM (26) are used to determine wave runup and wave overtopping for the significant wave that would be experienced during hurricane occurrences. However, 14 percent of the waves in a spectrum are higher than the significant wave and the maximum wave heights to be expected are about 1.87 times the significant wave height. Thus a structure designed to prevent all overtopping by a significant wave would be overtopped by that portion of the spectrum that is higher than the significant wave. It was therefore necessary to assure that this residual overtopping would not produce flooding and subsequent damage to the extent that only partial protection was afforded to an area for the design hurricane. A determination of the residual overtopping was made for the New Orleans East area and it was concluded that no material flooding results if the design cross-section is overtopped by waves higher than the significant wave. It was therefore concluded that the use of the significant wave runup would result in design grades for protective structures that would permit residual flooding only to a negligible degree.

8. Embankment design.

a. General. The design cross-section presented on Plate A-19 was selected as the best choice for protection of the New Orleans East area. It consists of a levee with foreshore protective rock at the toe. The foreshore rock serves to reduce normal wave activity and thus impede erosion of the levee and railroad embankment. In the reach where the levee is afforded adequate erosion protection by existing camps and land area (Sta 331+50 to Sta 364+50), the foreshore rock is not required.

b. Foreshore rock. The foreshore rock consists of a 3-foot layer of graded rock over a 12-inch layer of a smaller gradation. Rock sizes were determined using a wave height that could reasonably be expected to occur annually. Using the cumulative frequency of observations from the wave hindcast study for Seabrook Lock (27), a 3-foot to 4-foot wave has been observed 3 to 4 days annually. Using a 4-foot wave, rock sizes were determined from the following formula:

$$W_{50} = \frac{w_r H^3}{K_{rr} \ (S_r - 1)^3 \cot 0}$$

W_{50} is the weight in lbs of an individual stone
w_r is the unit weight of stone (in this case 155 lbs/ft^3)
H is the design wave height at the structure (H=4.0)
S_r is the specific gravity of the stone relative to water (S_r=Wr/Ww)
W_w is the net weight of water (64 lbs/ft^3)
0 is the angle of the structure slope from the horizontal in degrees
K_{rr} is the stability coefficient (K_{rr} = 2.2)

This formula, known as Hudson's formula, and values for K_{rr} are explained in detail in the SPM (26). Gradations were determined from a set of standard gradations provided by LMV Division in a November 1981 letter report (28), by selecting the gradation which most closely fit the stone weight determined from Hudson's formula. Design stone sizes are large enough to insure that the stone will not be displaced during the occurrence of a 4-foot or lesser wave. Rock gradations required for the foreshore protection along the New Orleans East Lakefront are given in Table A-17.

TABLE A-17
NEW ORLEANS EAST LAKEFRONT FORESHORE PROTECTION
ROCK GRADATIONS

Percent Lighter by Weight(SSD)		Limits of Stone Weight(lbs.)
	Graded Stone No. 1	
100		2200-900
50		930-400
15		460-130
	Graded Stone No. 2	
100		25-10
50		10-5
15		5-2

Typical foreshore dike cross-sections are shown in the main body of the report.

SECTION II - INTERIOR DRAINAGE

9. Intercepted drainage. With construction of the new levee, no additional runoff will be intercepted. The runoff between the levee and railroad embankment is collected in a ditch that runs between the two and is discharged into the lake via drainage culverts through the railroad and rock embankments. Catch basins collect the flow from each culvert. Extension of the drainage culverts will be required with the foreshore work. A description of this drainage plan and techniques used to design it are contained in the Barrier Plan General Design Memorandum for New Orleans East Lakefront Levee (29).

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UNIFIED SOIL CLASSIFICATION

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

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

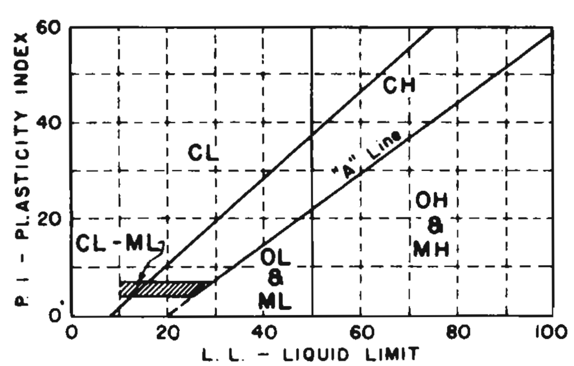
DESCRIPTIVE SYMBOLS

COLOR

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

CONSISTENCY FOR COHESIVE SOILS

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



PLASTICITY CHART

For classification of fine - grained soils

MODIFICATIONS

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

NOTES:

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

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm *

FIGURES TO LEFT OF BORING UNDER COLUMNS "LL" AND "PL"

Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

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

FIGURES TO RIGHT OF BORING

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

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

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

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

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

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

GENERAL NOTES:

While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of clause 4 of the contract.

Ground-water elevations shown on the boring logs represent ground-water surfaces encountered in such borings on the dates shown. Absence of water surface data on certain borings indicates that no ground-water data are available from the boring, but does not necessarily mean that ground water will not be encountered at the locations or within the vertical reaches of such borings.

Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

REVISION	DATE	DESCRIPTION	BY
4	2-10-84	2nd Para. General Notes Revised	LMNED-GS Let. dated 12 Dec. 83
3	5-3-71	ADDED UPPER LIMIT LINE (PI = 0.9 (LL - 8)) ON PLASTICITY CHART	LMVED-G LETTER DTD 29 APRIL 1971
2	6-8-64	SYMBOL FW, NOTE REVISED	ORAL FROM LMVGG 5 JUNE 1964
1	9-17-63	1ST PAR OF GENERAL NOTES REVISED	LMVD MULTIPLE LETTER, DATED 5 SEPT. 1963

SOIL BORING LEGEND

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO H-2-21800

CORPS OF ENGINEERS

U.S. ARMY

PLATE A-1

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

METEOROLOGIC AND HYDROLOGIC STATIONS

SCALES AS SHOWN

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEBRUARY 1985

FILE NO H-2-29820

PLATE A-2

WIND ROSE

Percentage Frequency
Annual

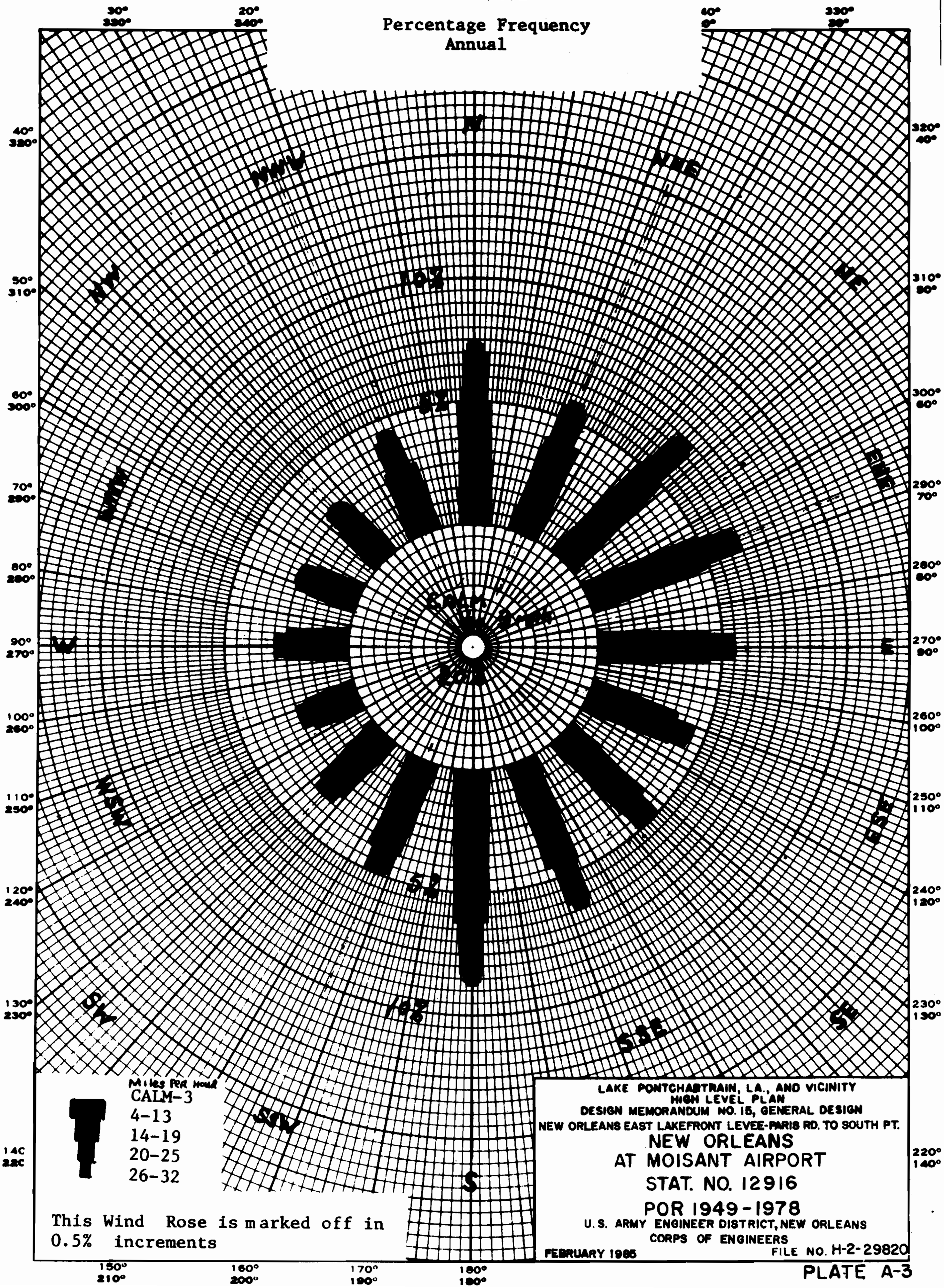
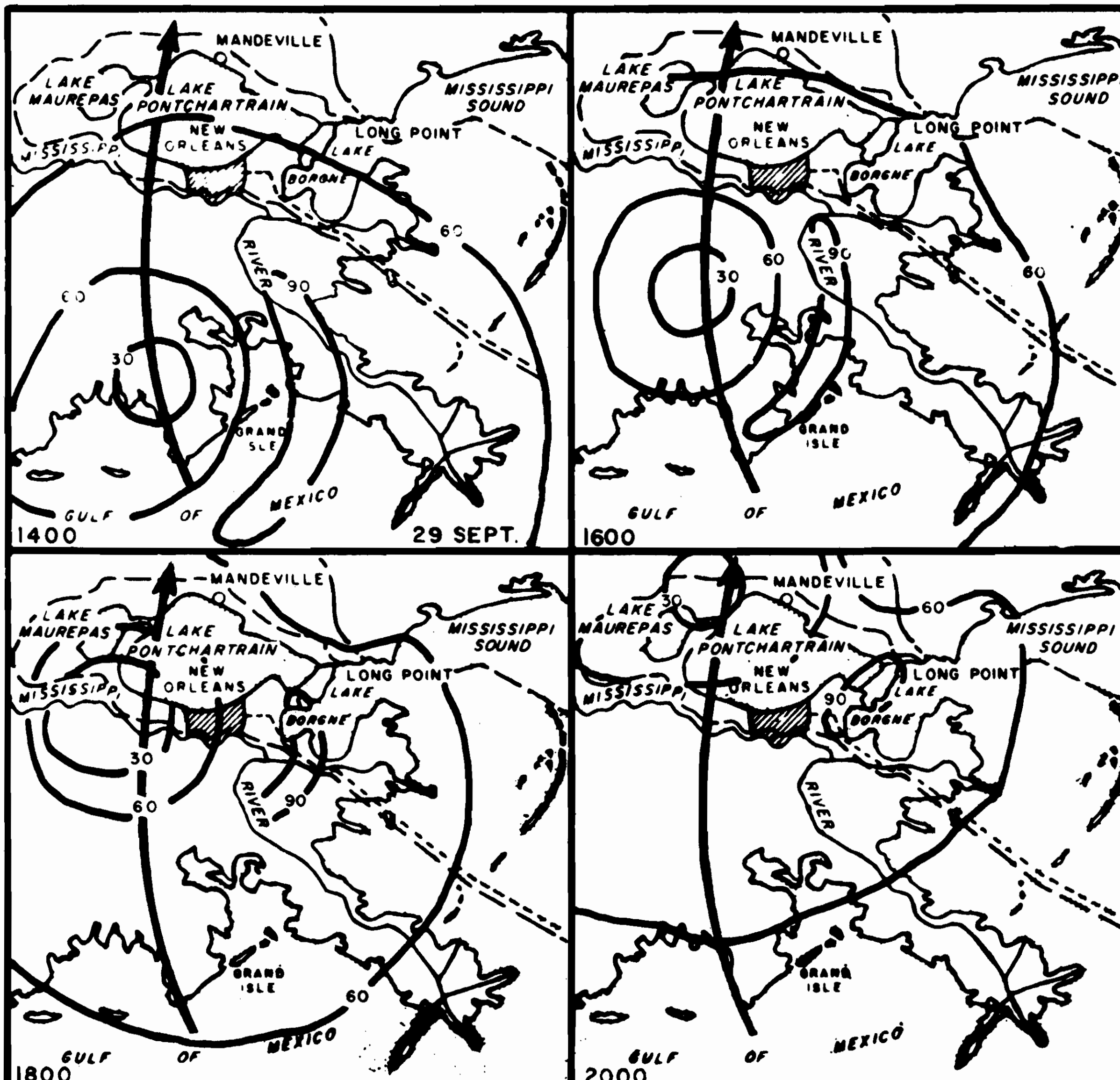
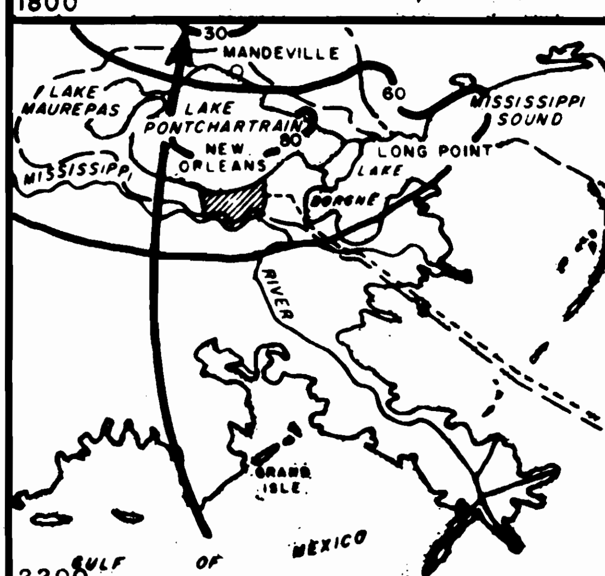


PLATE A-3





LEGEND

Study area

30 Average wind velocity

Hurricane path

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE-PARIS RD. TO SOUTH POINT

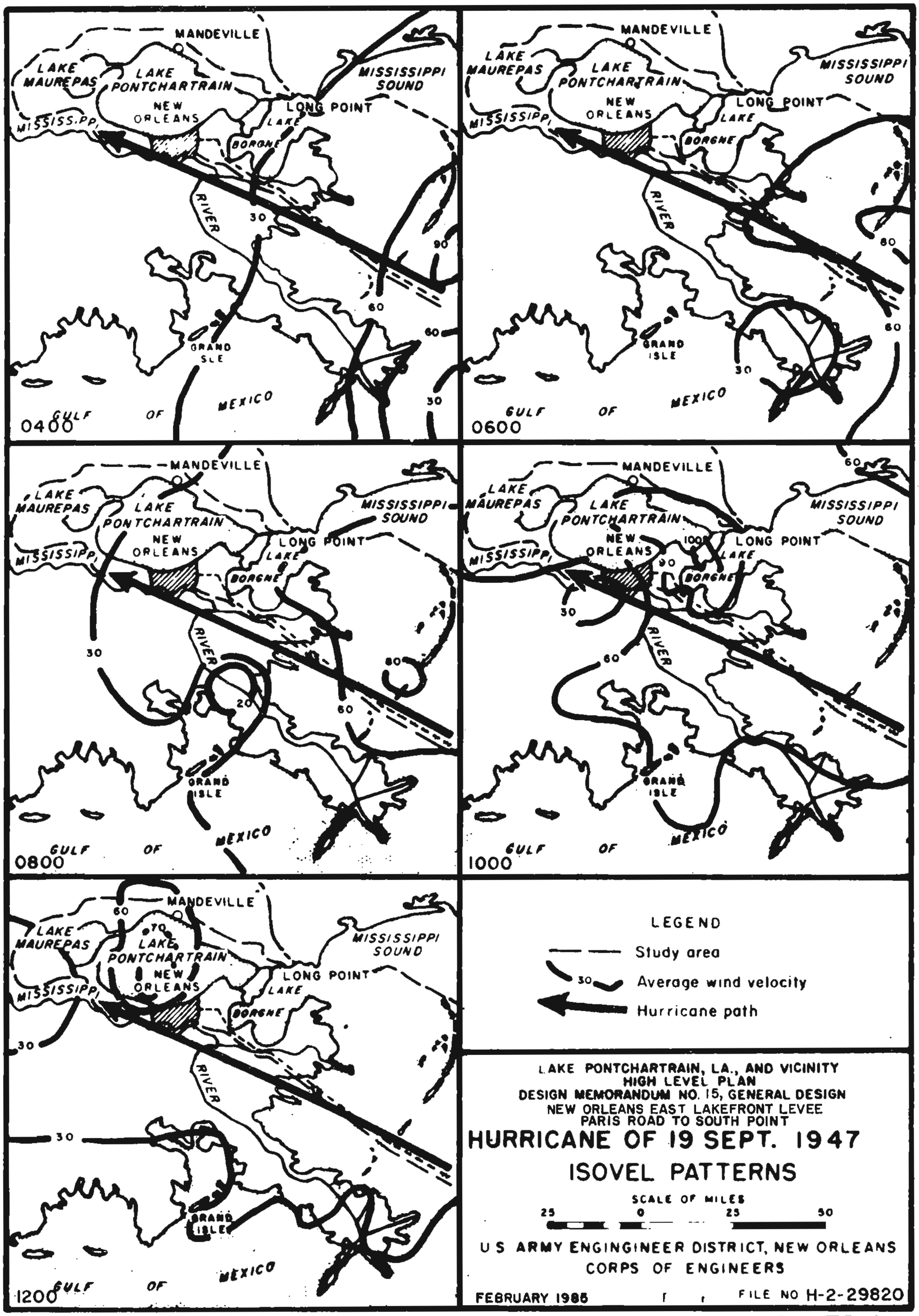
HURRICANE OF 28 SEPT. TO 1 OCT. 1915 ISOVEL PATTERNS

SCALE OF MILES
25 0 25 50

U S ARMY ENGINGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEBRUARY 1985 FILE NO H-2-29820

PLATE A-4



LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

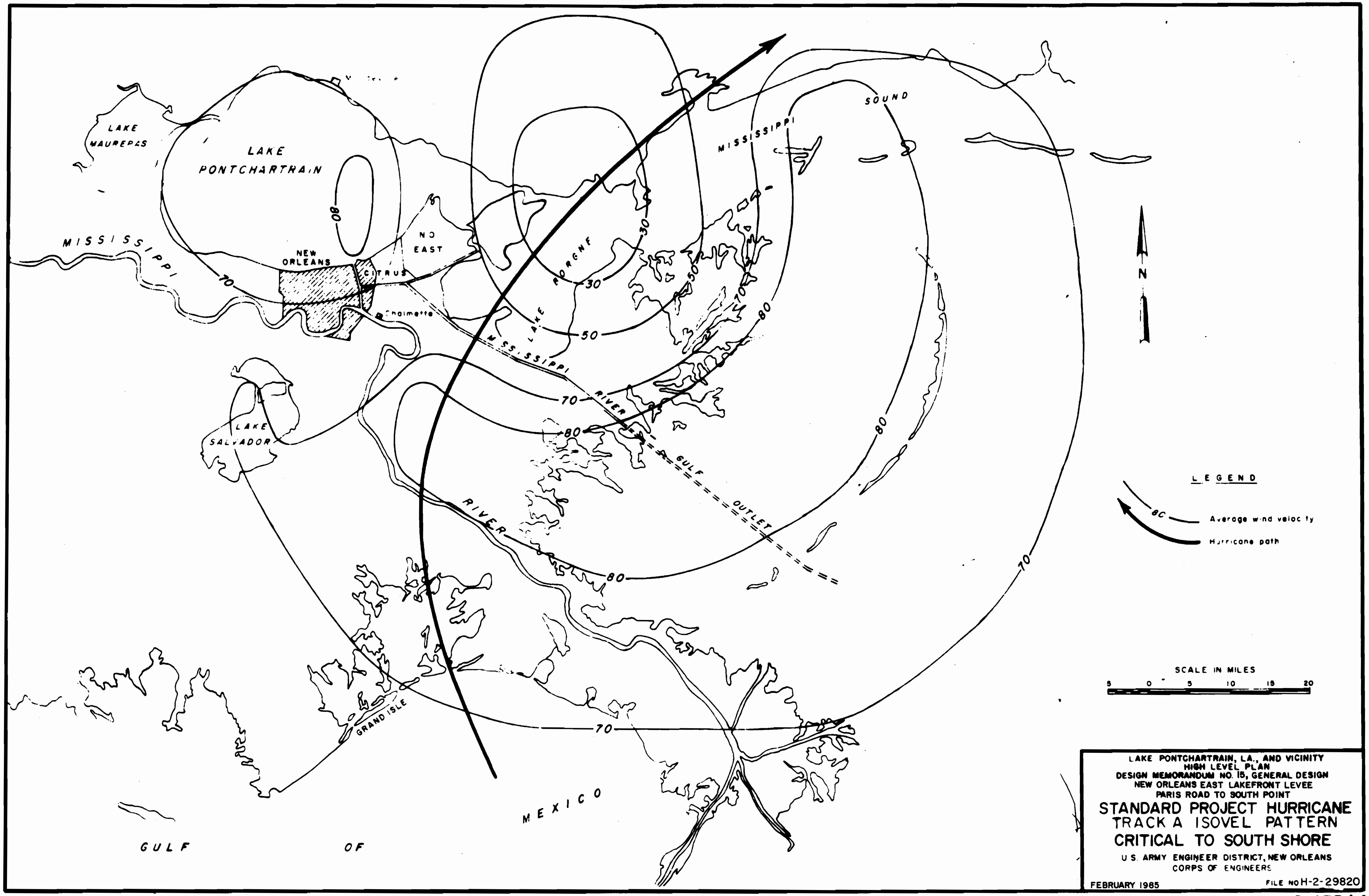
HURRICANE OF 19 SEPT. 1947
ISOVEL PATTERNS

SCALE OF MILES
25 0 25 50

U S ARMY ENGINGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEBRUARY 1985 FILE NO H-2-29820

PLATE A- 5



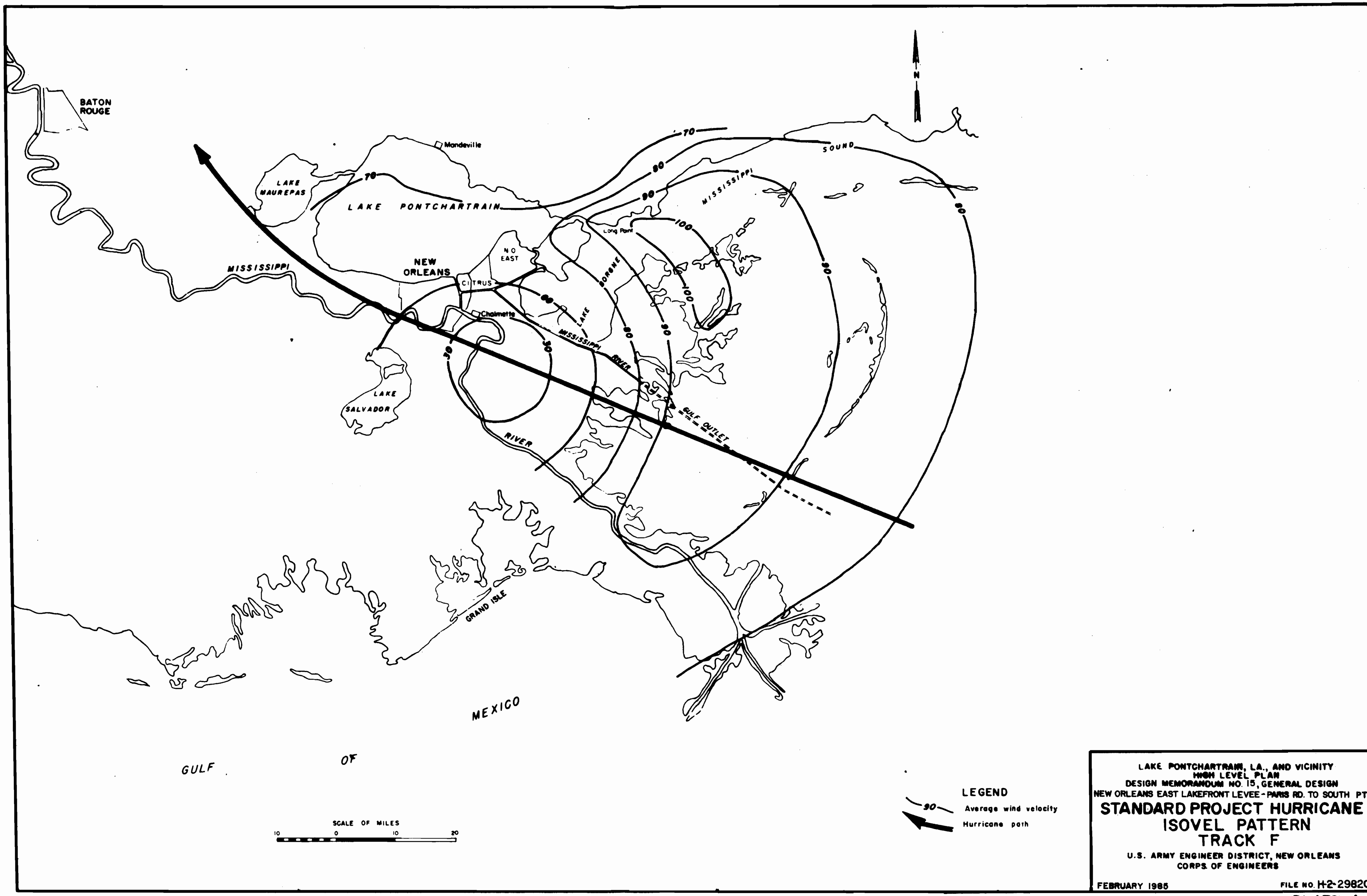
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

STANDARD PROJECT HURRICANE
TRACK A ISOVEL PATTERN
CRITICAL TO SOUTH SHORE

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

FEBRUARY 1985 FILE NO H-2-29820

PLATE A-6

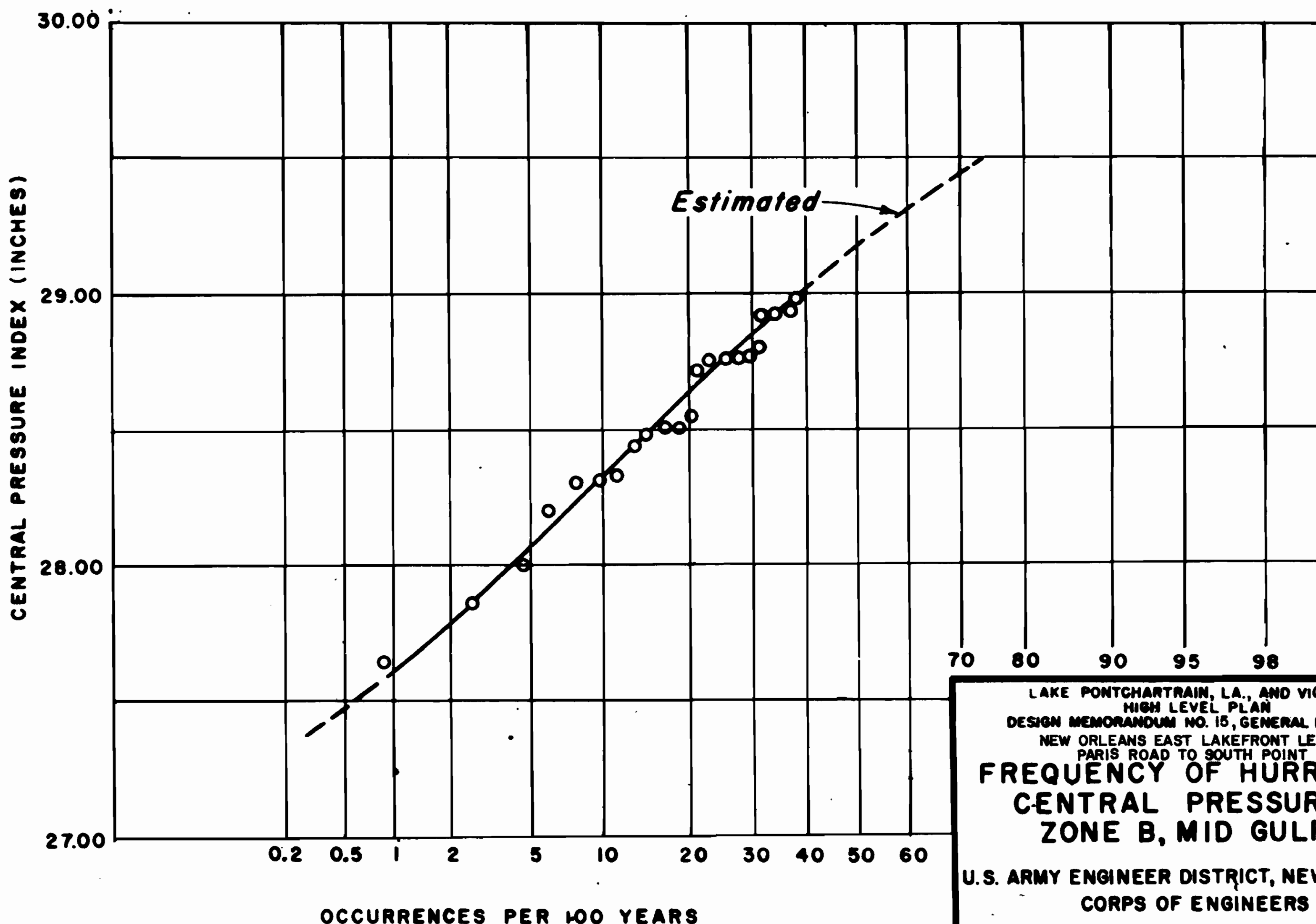


LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE - PARIS RD. TO SOUTH PT.

STANDARD PROJECT HURRICANE
ISOVEL PATTERN
TRACK F

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

FEBRUARY 1985 FILE NO. H-2-29820



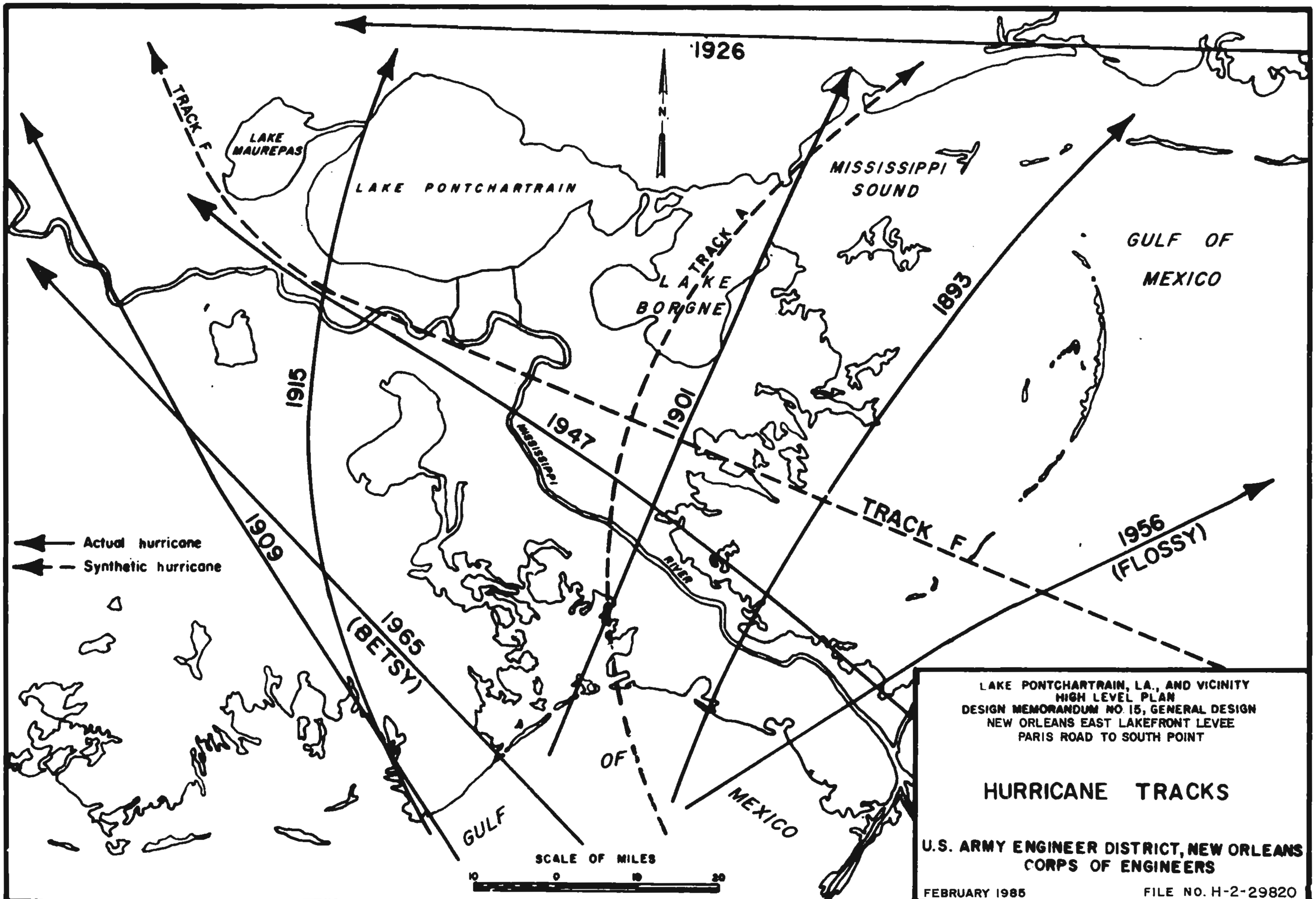
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

FREQUENCY OF HURRICANE CENTRAL PRESSURES ZONE B, MID GULF

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-8



LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

HURRICANE TRACKS

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-9

PLATE A-9

Hours referenced to landfall	El. in Lake Borgne: El. in L. Borgne	El. in Lake Borgne: Av. of (2)	El. in Lake Pontchartrain: Av. El. in L. Pont.	El. in Lake Pontchartrain: El. at Hwy. 11	El. in Lake Pontchartrain: Av. of (5)	Flow into Lake Pontchartrain: Head between L. Borgne & L. Pont.	Flow into Lake Pontchartrain: Flow into L. Pont.	Flow into Lake Pontchartrain: Volume of flow for 2 hours	Flow into Lake Pontchartrain: Rain in L. Pont.	Flow into Lake Pontchartrain: Volume of rain for 2 hours	Flow into Lake Pontchartrain: Total inflow into L. Pont.	L. Pont. Storage: Storage in L. Pont. for El. in (4)	L. Pont. Storage: Δ Storage in L. Pont.	Overflow: Flow over L. Pont. levees for 2 hour	Flow into L. Maurepas: (12)-(14)-(15)	El. in Lake Maurepas: Storage in L. Maurepas	El. in Lake Maurepas: Av. El. in L. Maurepas	Verification — Stages in Pass Manchac, L. Pont. side: El. in Pass Manchac	Verification — Stages in Pass Manchac, L. Pont. side: Av. of (19)	Verification — Stages in Pass Manchac, Lake Maurepas side: Tilt in L. Pont.	Verification — Stages in Pass Manchac, Lake Maurepas side: Tilt in L. Maurepas	Verification — Stages in Pass Manchac, Lake Maurepas side: El. in Pass Manchac	Verification — Stages in Pass Manchac, Lake Maurepas side: Av. of (23)	Verification — Flow into Lake Maurepas: Head between L. Pont. & L. Maurepas	Verification — Flow into Lake Maurepas: Flow into L. Maurepas	Verification — Flow into Lake Maurepas: Volume of flow for 2 hours	Verification — Stage in Lake Maurepas: Storage in L. Maurepas	Verification — Stage in Lake Maurepas: El. in L. Maurepas
(1)	(2) Feet N.G.V.D.	(3) Feet N.G.V.D.	(4) Feet N.G.V.D.	(5) Feet N.G.V.D.	(6) Feet N.G.V.D.	(7) Feet	(8) 1000 C.F.S.	(9) 1000 D.S.F.	(10) Feet	(11) 1000 D.S.F.	(12) 1000 D.S.F.	(13) 1000 D.S.F.	(14) 1000 D.S.F.	(15) 1000 D.S.F.	(16) 1000 D.S.F.	(17) 1000 D.S.F.	(18) Feet N.G.V.D.	(19) Feet N.G.V.D.	(20) Feet N.G.V.D.	(21) Feet	(22) Feet	(23) Feet N.G.V.D.	(24) Feet N.G.V.D.	(25) Feet	(26) 1000 C.F.S.	(27) 1000 D.S.F.	(28) 1000 D.S.F.	(29) Feet N.G.V.D.
2	9 46		3.94	2.33					0.115			1970.6				225.1	1.12	3.54		1.21	0.24	1.00					226.2	1.13
		9.86			1.21	8.65	4214.0	351.2		13.7	364.9		346.5	2.3	16.1				4.52				0.86	3.66	165.8	13.8		
4	10.25		5.26	0.09					0.052			2317.1				241.2	1 27	5.50		5.41	1.08	0.73					240.0	1.26
		9.91			1.62	8.29	4043.2	336.9		42.0	378.9		351.7	11.6	15.6				6.02				0.90	5.18	181.6	15.4		
6	9.56		6.55	3.14					0.165			2668.8				256.8	1.41	6.55		3.41	0.68	1.07					256.4	1.40
		9.11			4.55	4.56	2310.6	192.6		49.6	242.2		202.5	25.8	13.9				6.08				1.32	4.76	180.5	15.0		
8	8 66		7.28	5.96					0.180			2871.8				270.7	1 58	5.61		-0.35	-0.07	1.57					270.4	1.53
		7.43			7.43	0.00	0.0	0.0		21.0	21.0		-47.7	54.9	13.8				5.11				1.82	3.29	160.2	13.4		
10	6.19		7.11	8.90					0.075			2823.6				284.5	1 65	4.61		-4.29	-0.86	2.08					283.8	1.64

SAMPLE ROUTING

EXPLANATION:

COLUMN (2) FROM LAKE BORGNE HYDROGRAPH DERIVED BY THE METHOD DESCRIBED IN PARAGRAPH 1-5 (1) AND SHOWN ON PLATE A-13

(4) ASSUMED

(5) OBTAINED FROM WATER SURFACE CONTOURS DERIVED FROM WIND SETUP COMPUTATIONS FOR LAKE PONT., SAMPLE SHOWN ON PLATE A-15

(7) (3) - (6)

(8) FROM CHEF MENTEUR PASS AND RIGOLETS RATING CURVE SHOWN BELOW

(10) FROM RAINFALL ESTIMATES DESCRIBED IN PARAGRAPH 1-5E(A)

(12) (9) + (11)

(13) FROM LAKE PONT. STORAGE CURVE SHOWN BELOW FOR THE ELEVATION IN (4)

COLUMN (14) (13) - (13)

(15) BY THE PROCEDURES DESCRIBED IN PARAGRAPH 1-7E

(17) (16) + (17)

(18) CORRESPONDING ELEVATION FOR VOLUME IN (17) FROM LAKE MAUREPAS STORAGE CURVE SHOWN BELOW

(19) SAME AS EXPLANATION FOR (5)

(21) (19) - (5)

(22) 1/5 OF (21), ESTIMATED AS 1/5 OF THE TILT OF LAKE PONTCHARTRAIN SINCE LAKE MAUREPAS IS 1/5 AS WIDE.

(23) (19) - $\frac{(22)}{2}$

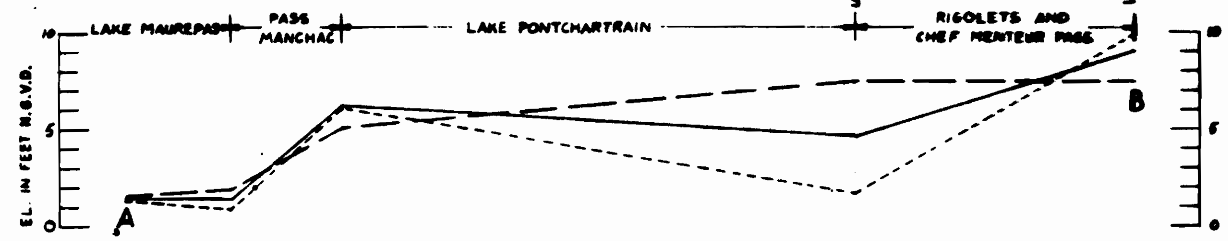
(25) (20) - (24)

(26) FROM PASS MANCHAC RATING CURVE SHOWN BELOW

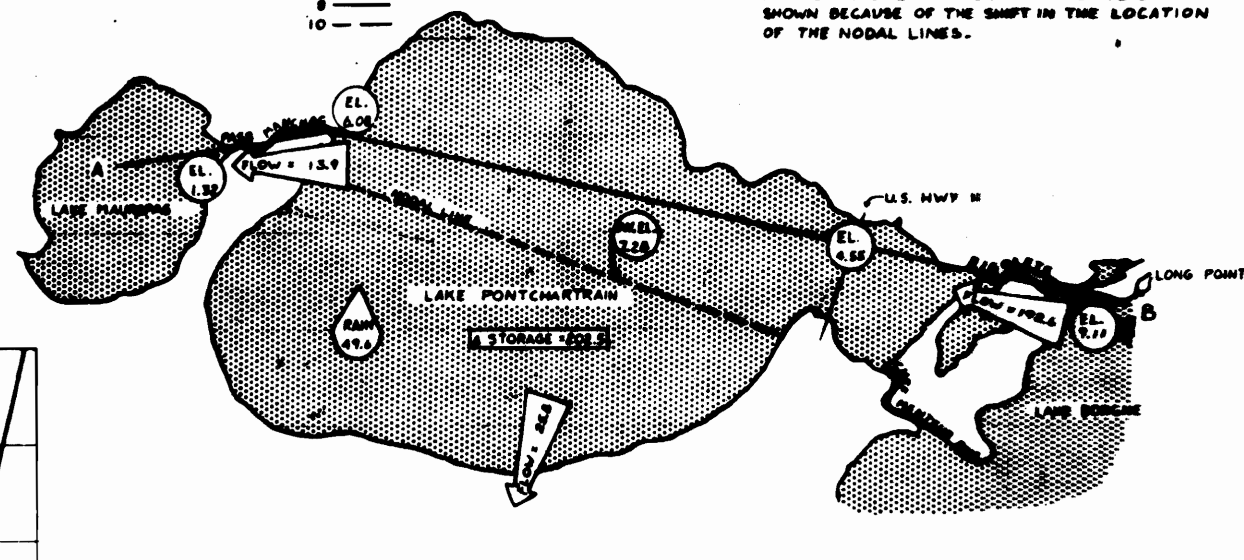
(28) (17) + (27)

(29) CORRESPONDING ELEVATION FOR VOLUME IN (28) FROM LAKE MAUREPAS STORAGE CURVE SHOWN BELOW

WATER SURFACE PROFILES

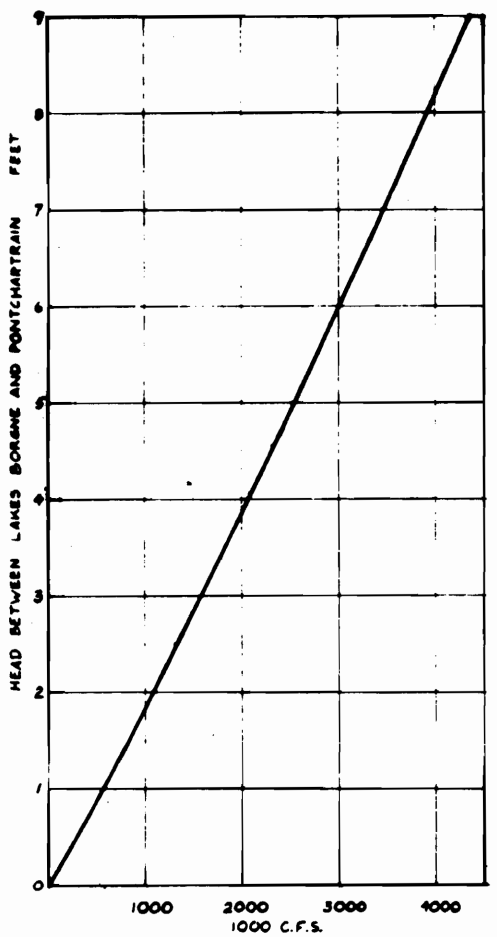


NOTE:
THE LAKE PONTCHARTRAIN PROFILES DO NOT REFLECT THE AVERAGE LAKE ELEVATIONS FOR THE HOURS SHOWN BECAUSE OF THE SHIFT IN THE LOCATION OF THE NODAL LINES.

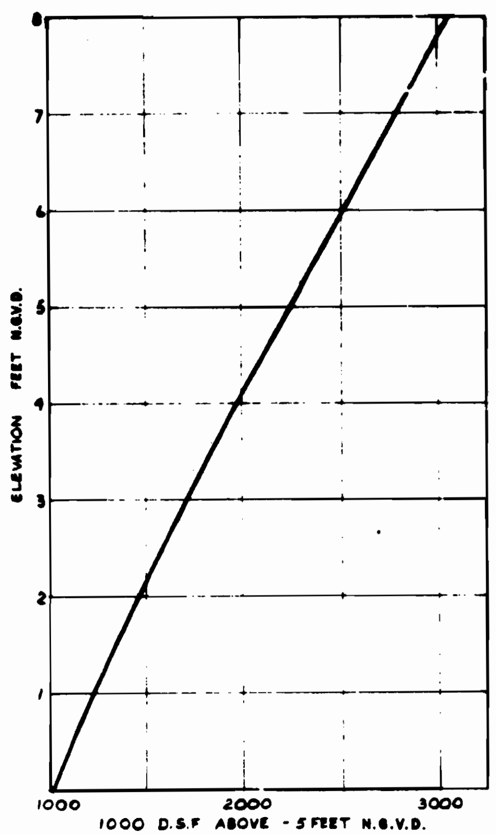


ROUTING DIAGRAM
6 TO 8 HOURS AFTER LANDFALL

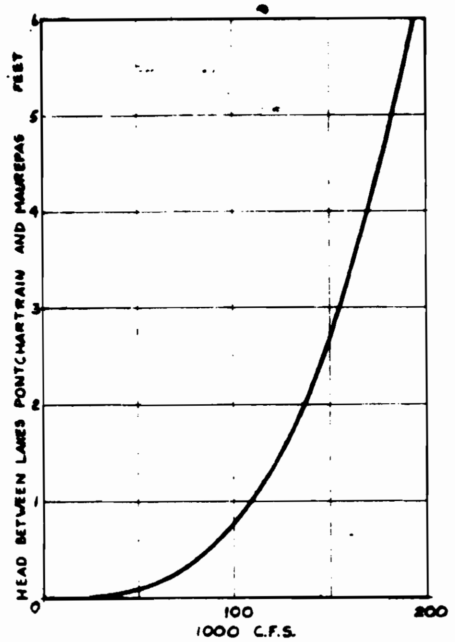
NOTE:
FLOW AND RAIN IN 1000 D.S.F.
ELEVATIONS IN FEET N.G.V.D



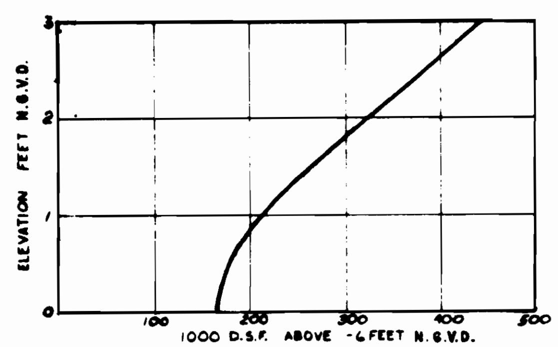
CHEF MENTEUR PASS & RIGOLETS FLOW



LAKE PONTCHARTRAIN STORAGE



PASS MANCHAC FLOW



LAKE MAUREPAS STORAGE

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

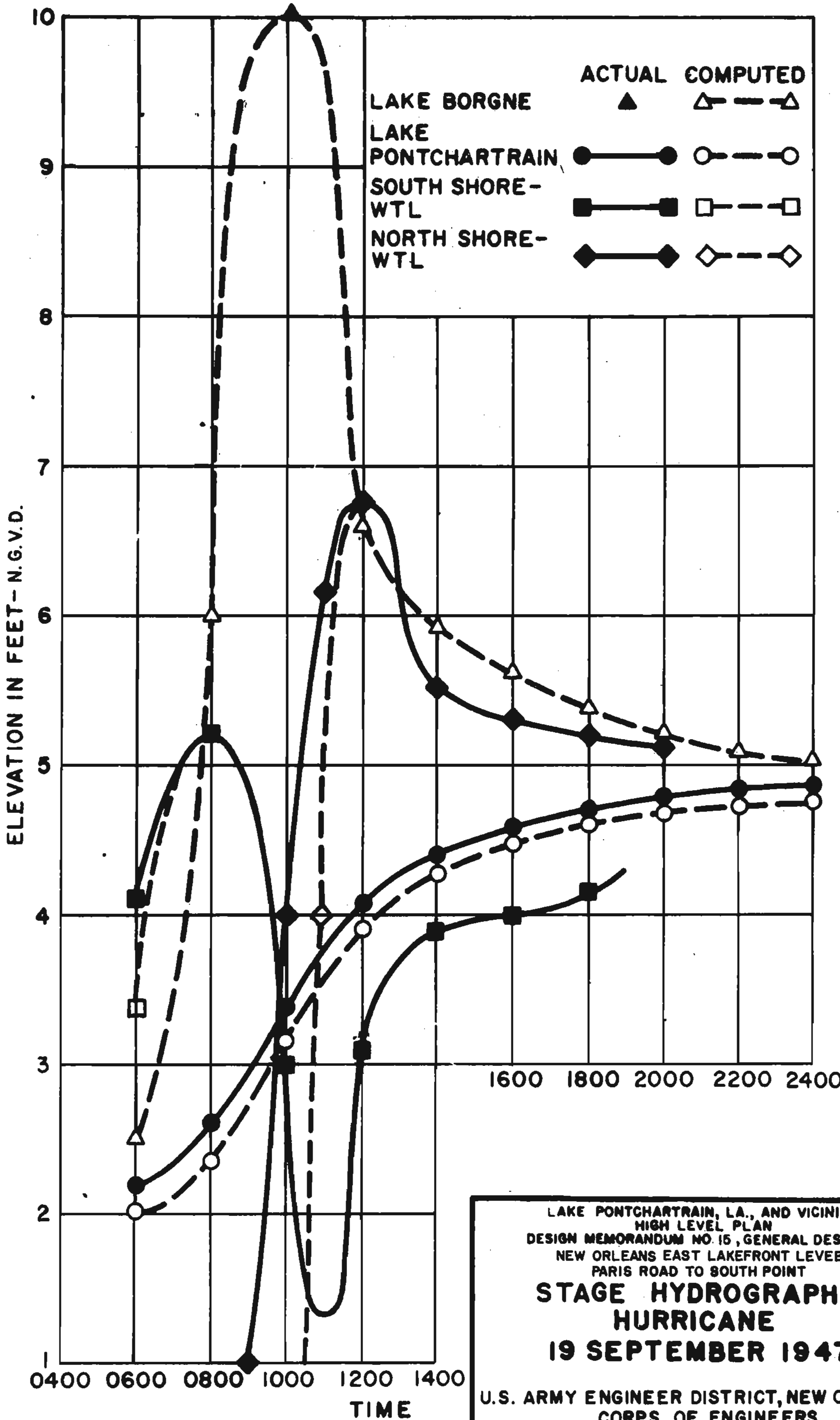
LAKE PONTCHARTRAIN ROUTING

SCALE AS SHOWN

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-10



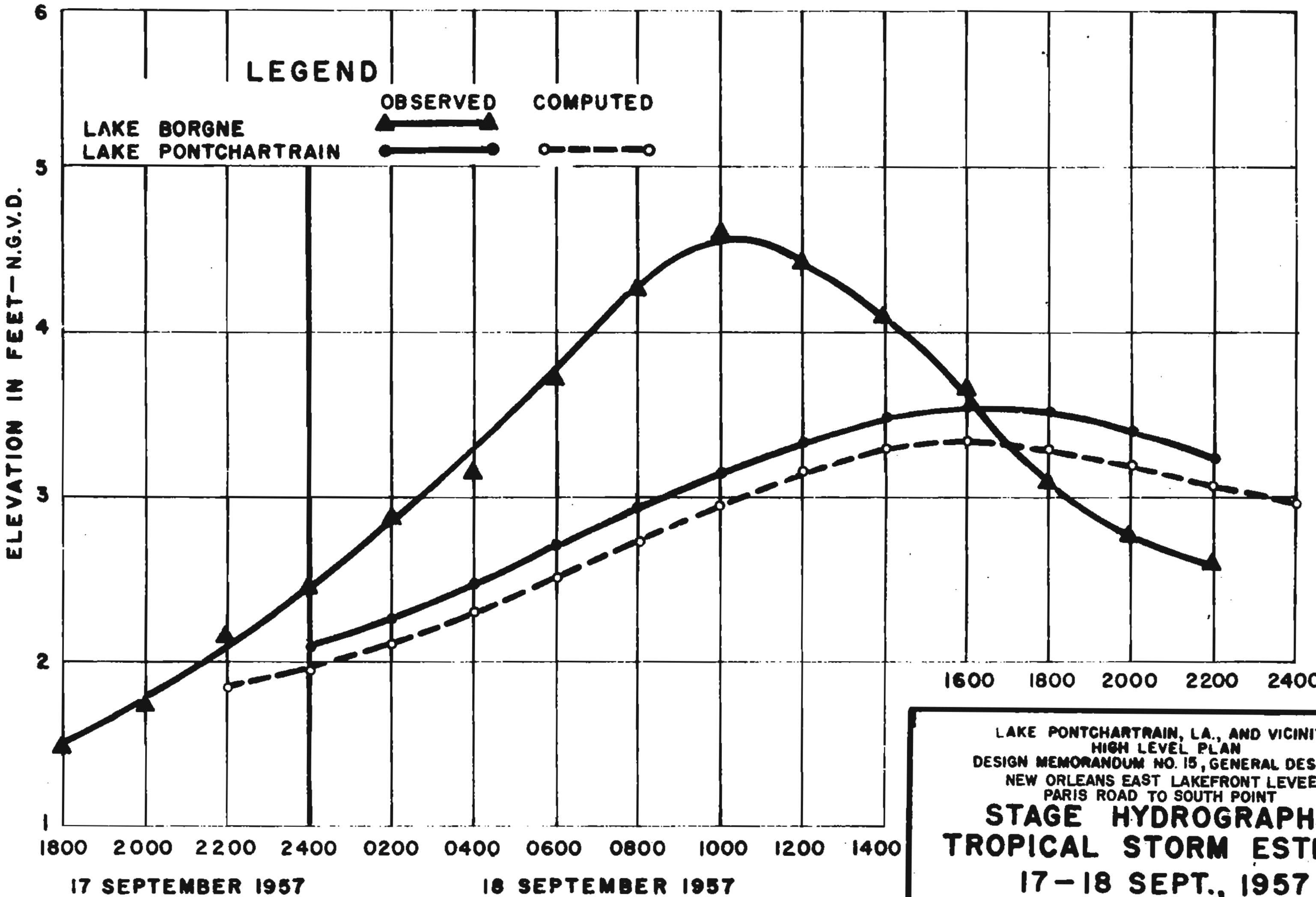
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

STAGE HYDROGRAPHS HURRICANE 19 SEPTEMBER 1947

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-11



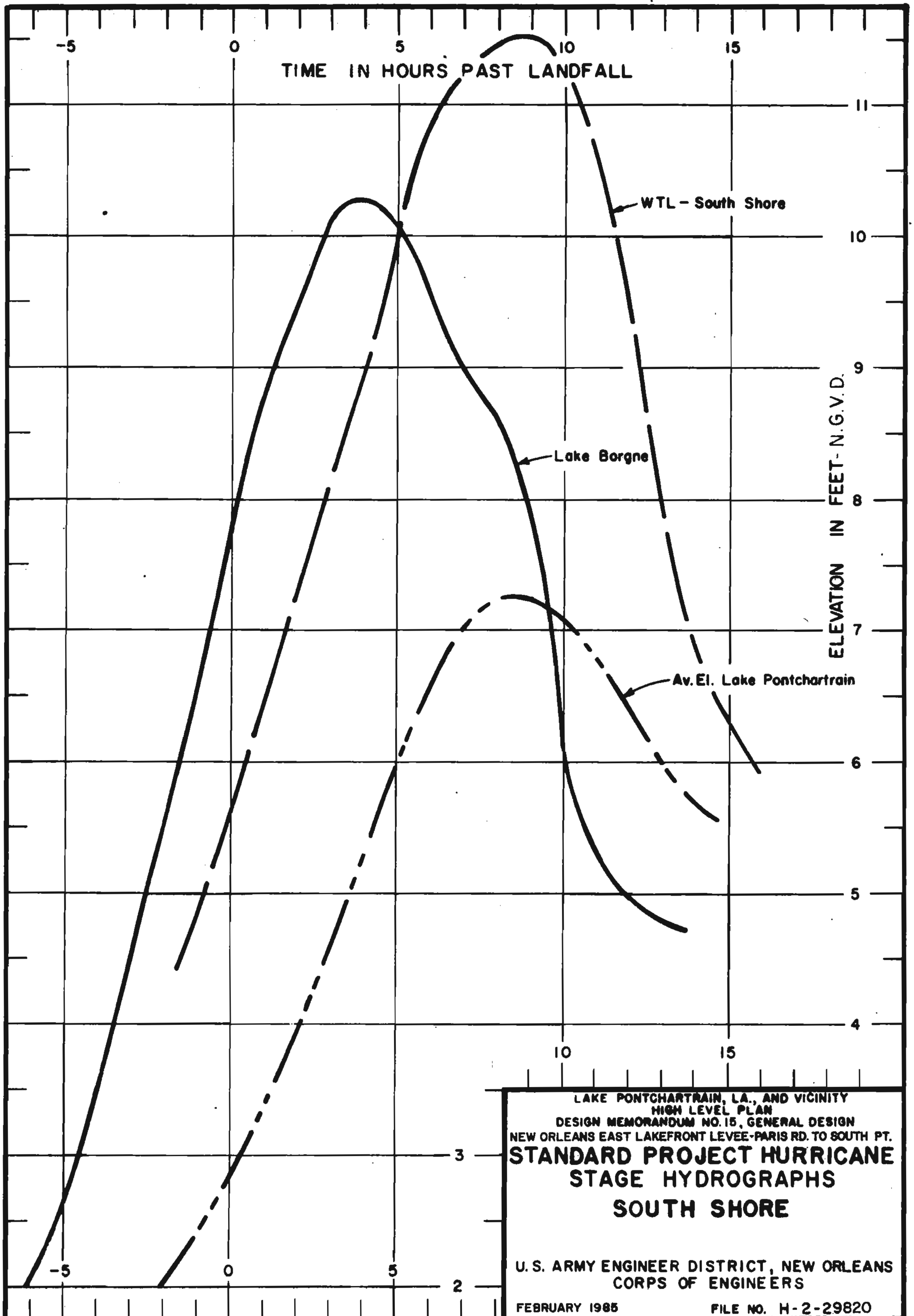
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

STAGE HYDROGRAPHS
TROPICAL STORM ESTHER
17 – 18 SEPT., 1957

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-12



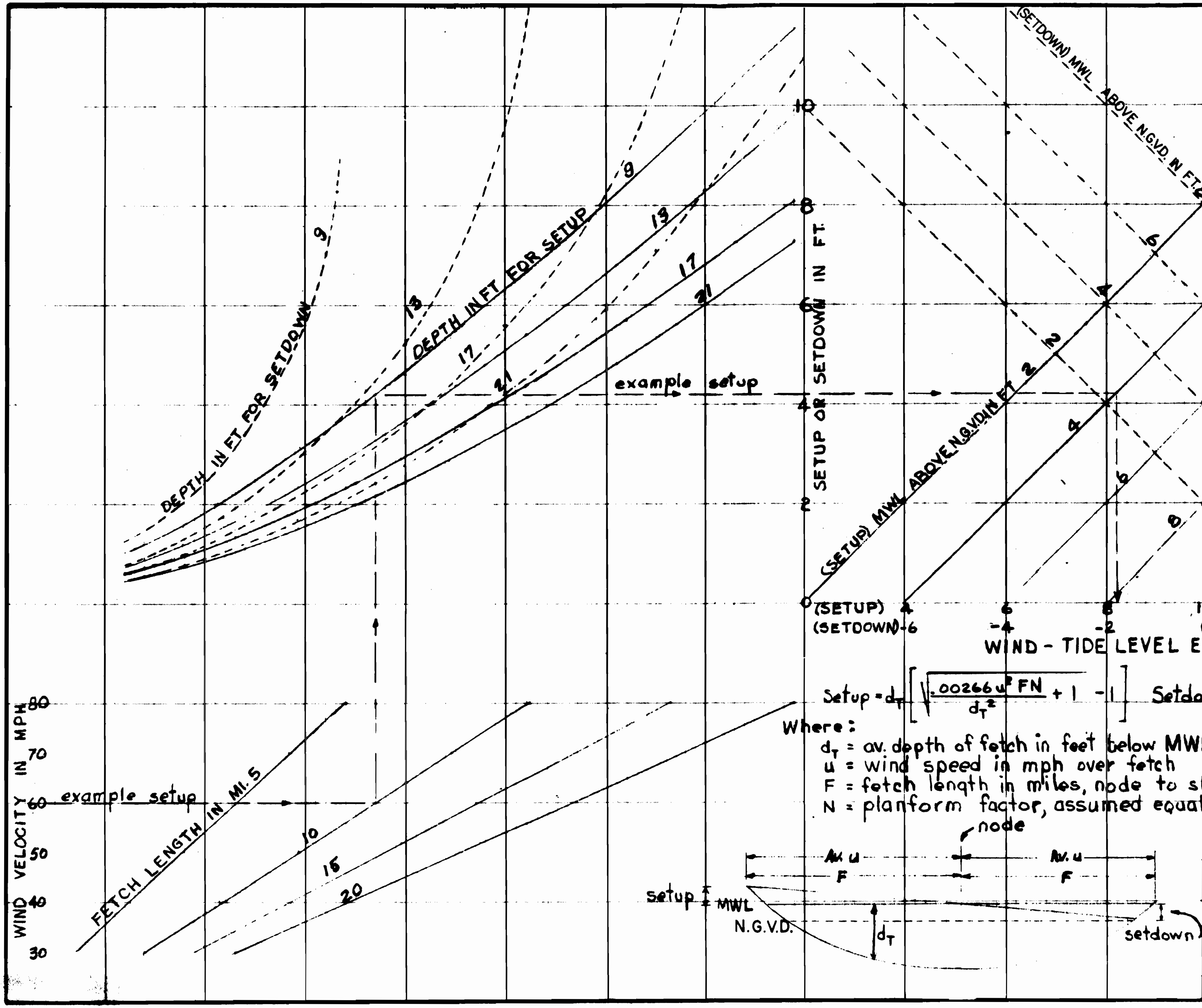
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE-PARIS RD. TO SOUTH PT.

STANDARD PROJECT HURRICANE
STAGE HYDROGRAPHS
SOUTH SHORE

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-13



$$\text{Setup} = d_T\left[\sqrt{\frac{.00266\,u^2 FN}{d_T^2}+1}-1\right] \qquad \text{Setdown} = d_T\left[1-\sqrt{1-\frac{.00266\,u^2 FN}{d_T^2}}\right]$$

Where:

d_T = av. depth of fetch in feet below MWL (Mean Water Level)

u = wind speed in mph over fetch

F = fetch length in miles, node to shoreline

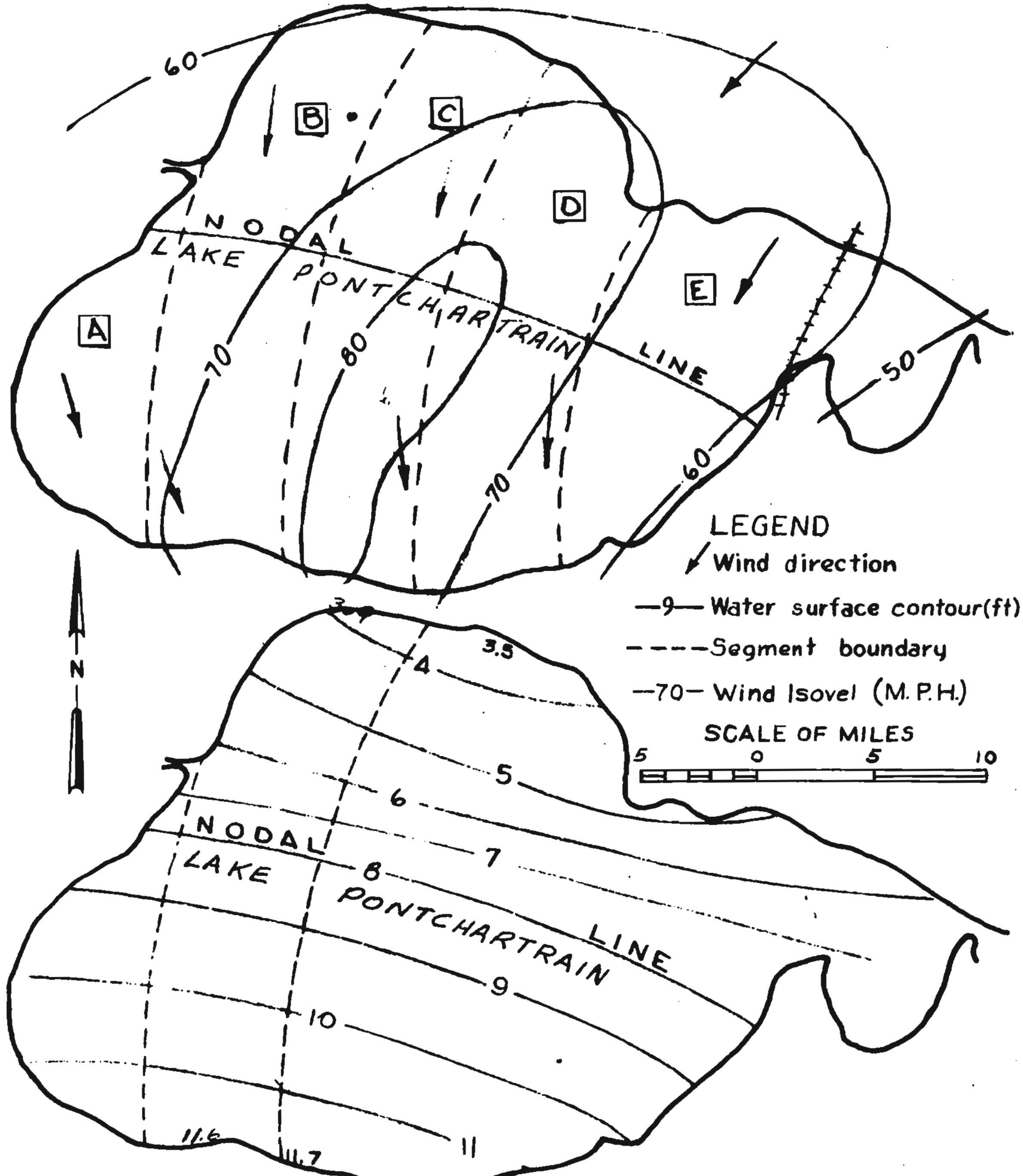
N = planform factor, assumed equal to unity

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

WIND TIDE LEVEL FORECAST CURVES

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

FEBRUARY 1985 FILE NO. H-2-29820



Sample: 8 hours after landfall - Track A-SPH

Setdown:

$$S = 19.2\left[1-\sqrt{1-\frac{0.00266(66)^2(12.5)(1.0)}{(19.2)^2}}\right] = \begin{array}{r} +8.0\text{-MWL} \\ -4.1 \\ \hline +3.9 = \text{WTL} \end{array}$$

Setup:

$$S = 20.5\left[\left(\sqrt{\frac{0.00266(70)^2(12.5)(1.0)}{(20.5)^2}+1}\right)-1\right] = \begin{array}{r} +3.6' \\ 8.0\text{-MWL} \\ \hline +11.6\text{-WTL} \end{array}$$

Interpolate with data for MWL=+6.0' to obtain WTL's for routed MWL=+7.28'.

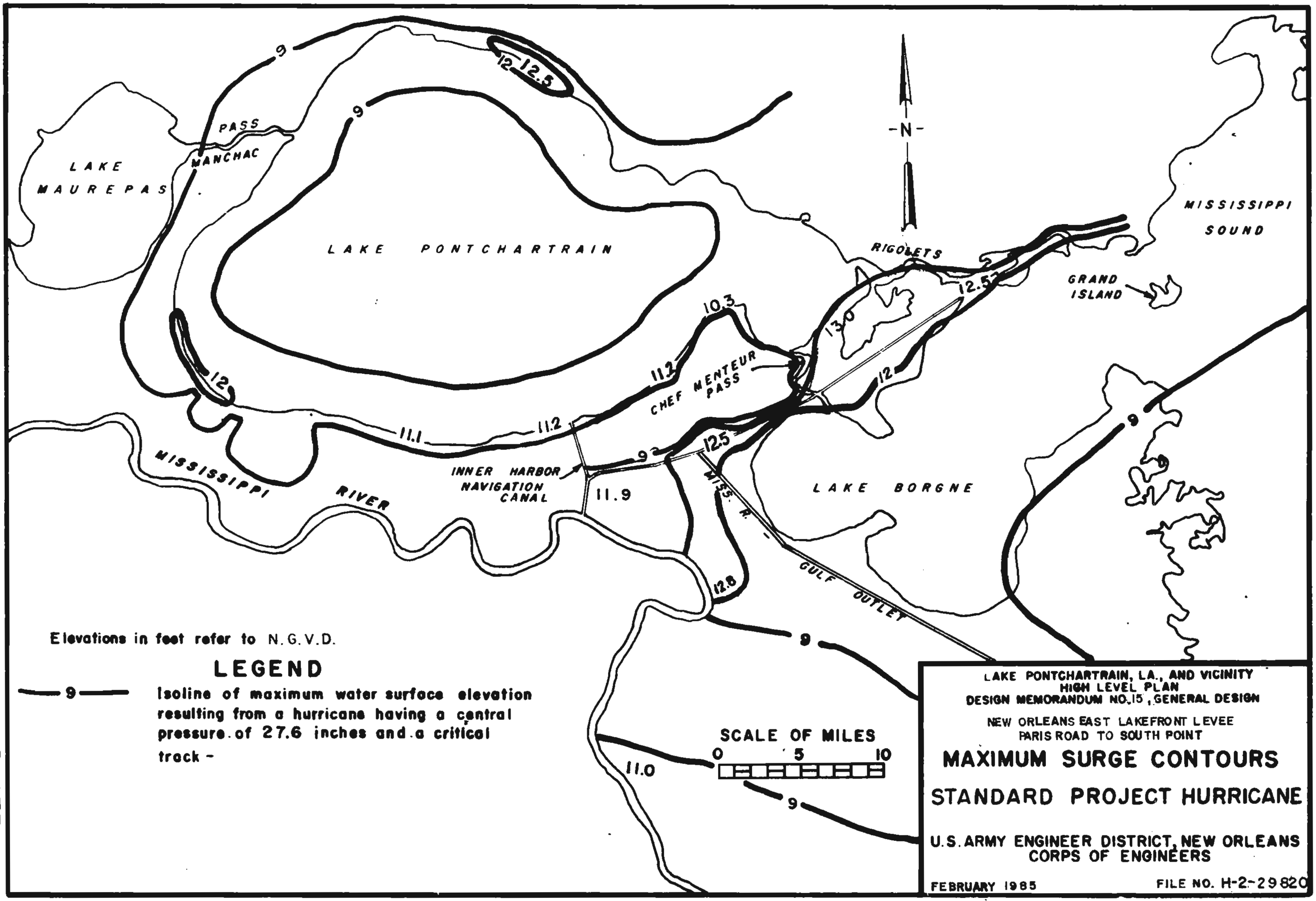
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE - PARIS RD. TO SOUTH PT.

LAKE PONTCHARTRAIN
TYPICAL
WIND TIDE CONTOURS

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-15



Elevations in feet refer to N.G.V.D.

LEGEND

—9— Isoline of maximum water surface elevation resulting from a hurricane having a central pressure of 27.6 inches and a critical track -

LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN

NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

MAXIMUM SURGE CONTOURS
STANDARD PROJECT HURRICANE

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-16

PLATE A-16

LEGEND

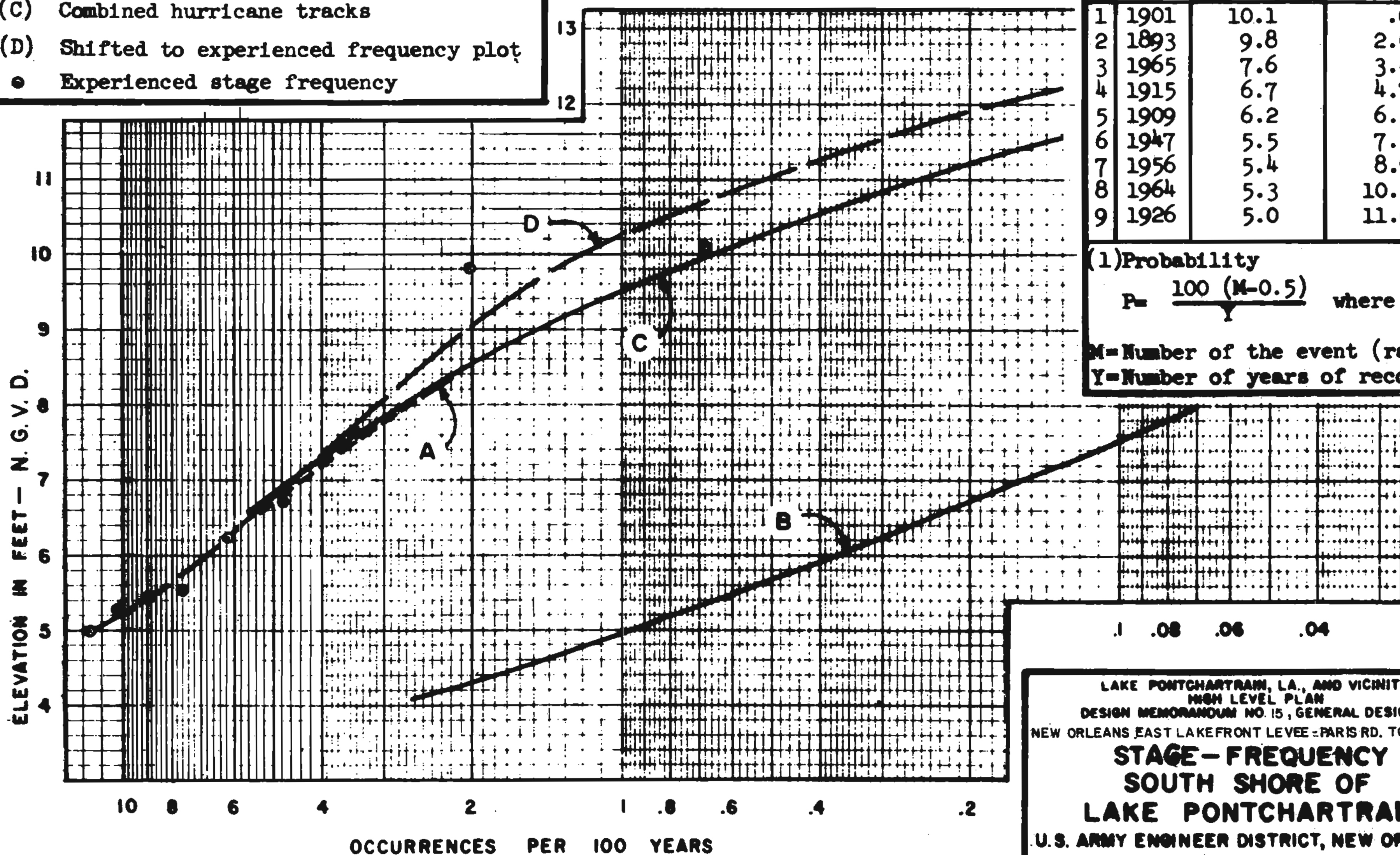
(A) Hurricane tracks from the south

(B) Hurricane tracks from the east

(C) Combined hurricane tracks

(D) Shifted to experienced frequency plot

• Experienced stage frequency



FREQUENCY ANALYSIS

M	Years	Wind tide level (ft.)	(1) Probability
1	1901	10.1	.685
2	1893	9.8	2.05
3	1965	7.6	3.42
4	1915	6.7	4.79
5	1909	6.2	6.16
6	1947	5.5	7.53
7	1956	5.4	8.90
8	1964	5.3	10.27
9	1926	5.0	11.64

(1) Probability

$P = \frac{100\ (M-0.5)}{Y}$ where

M = Number of the event (rank)
Y = Number of years of record (73)

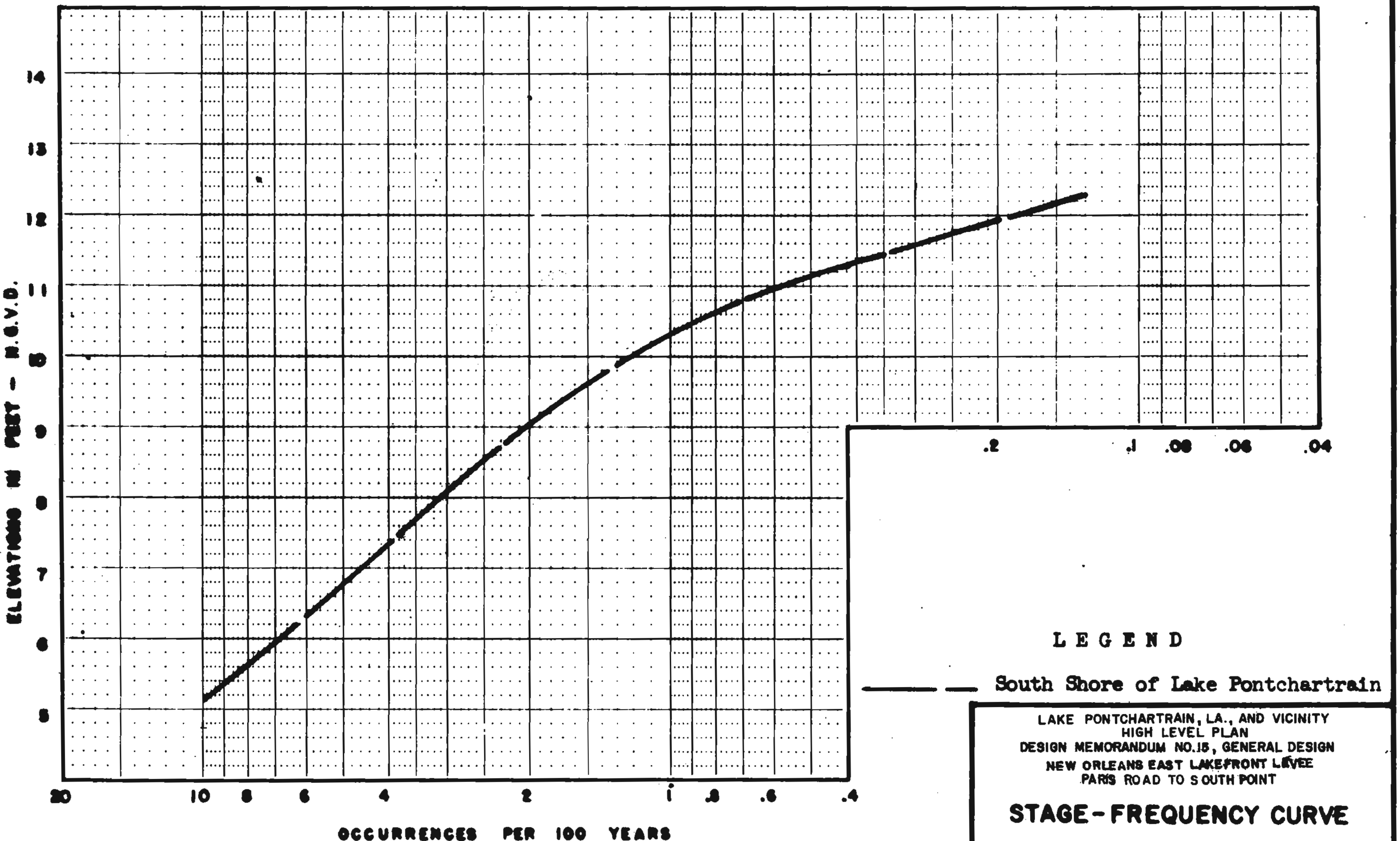
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE – PARIS RD. TO SOUTH PT.

STAGE–FREQUENCY SOUTH SHORE OF LAKE PONTCHARTRAIN

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-17



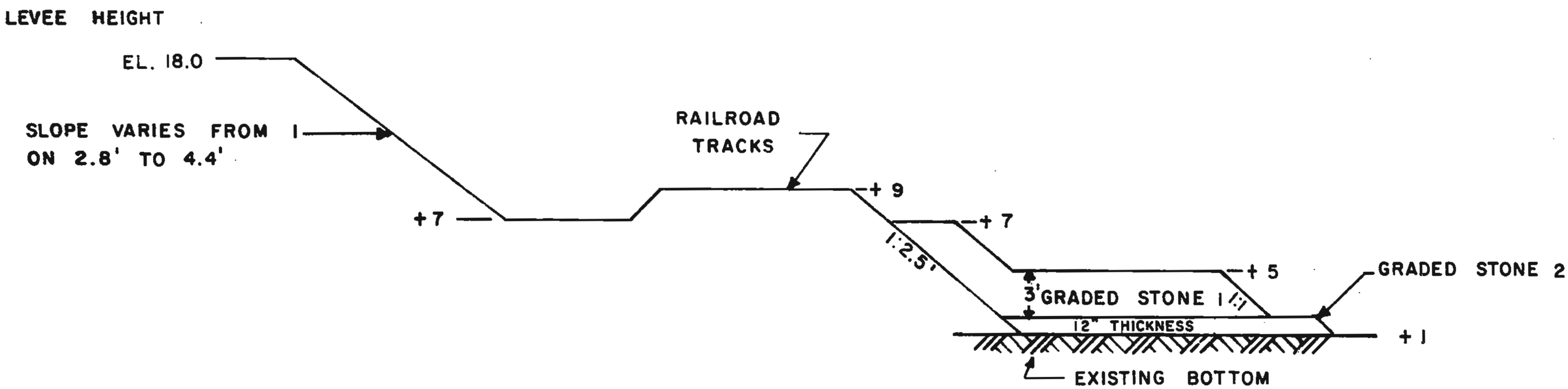
LAKE PONTCHARTRAIN, LA., AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

STAGE-FREQUENCY CURVE

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

FEBRUARY 1985 FILE NO. H-2-29820

PLATE A-18



NOT TO SCALE

NOTE:
All elevations shown on this plate are in feet N.G.V.D.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT
NEW ORLEANS EAST LAKEFRONT LEVEE
AND FORESHORE PROTECTION

TYPICAL CROSS SECTION

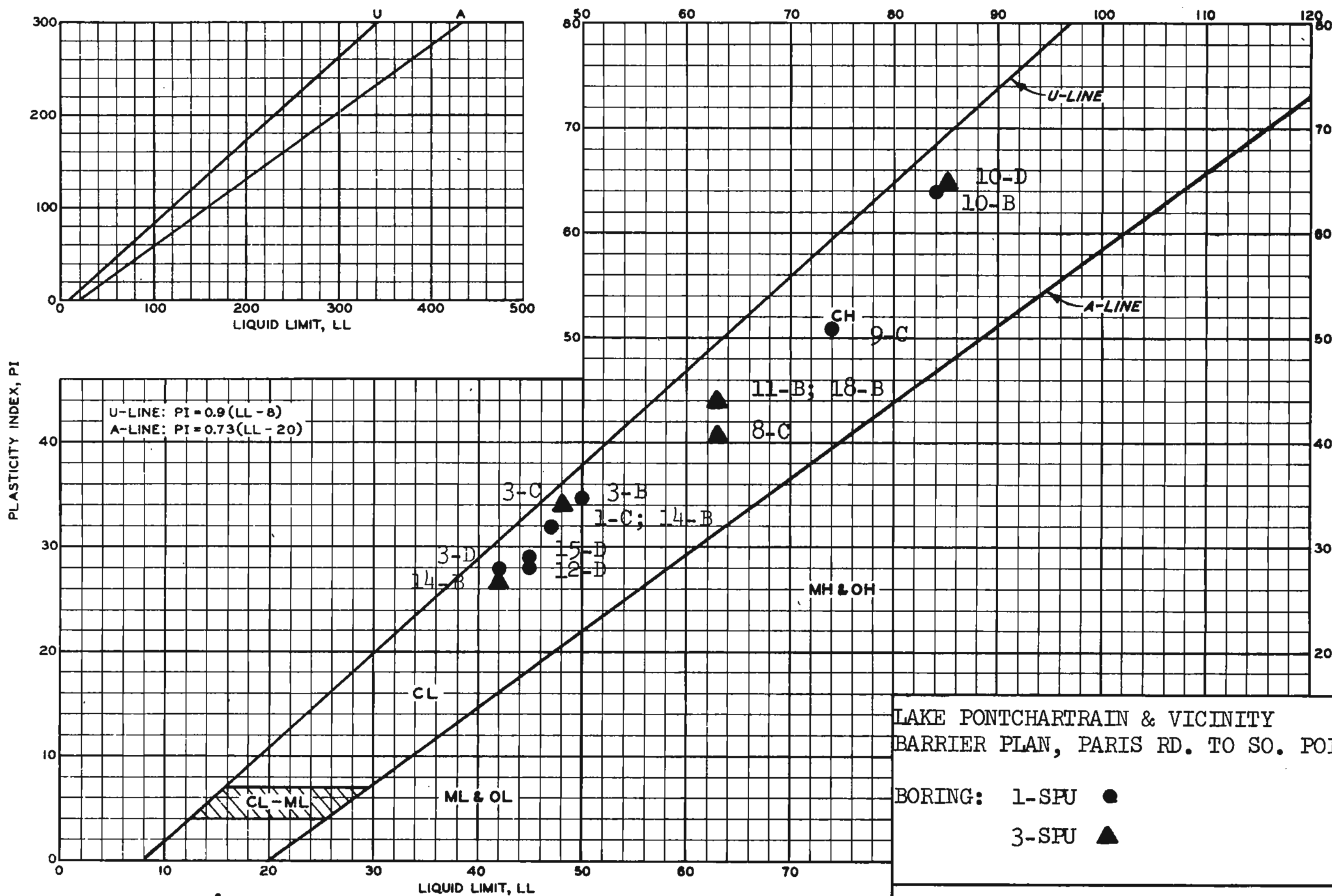
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
CORPS OF ENGINEERS
FEBRUARY 1985 FILE NO H-2-29820

PLATE A-19

LAKE PONTCHARTRAIN, LOUISIANA & VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

APPENDIX B

LABORATORY TEST DATA SHEETS (SOIL SAMPLES)



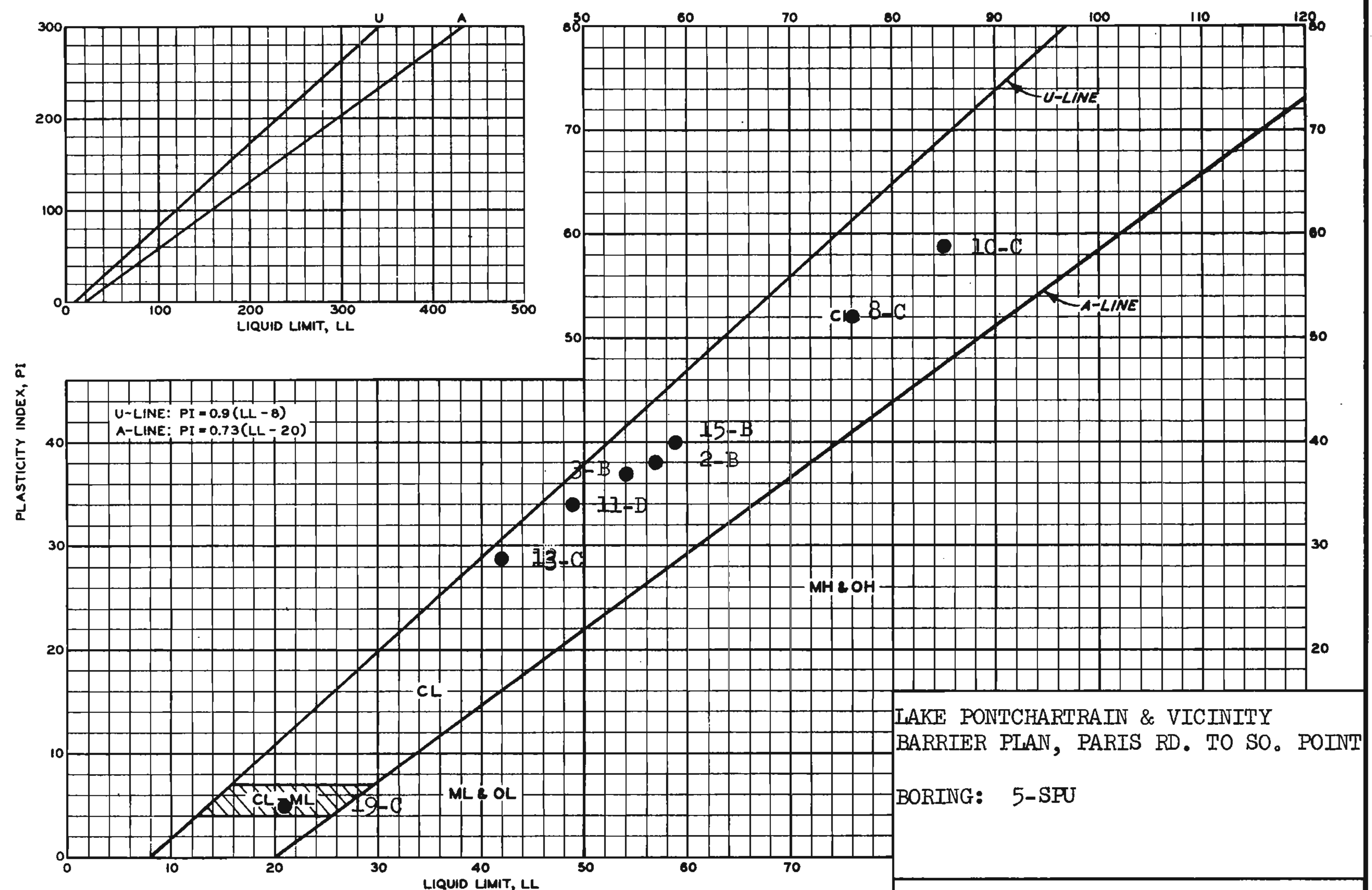
LAKE PONTCHARTRAIN & VICINITY
BARRIER PLAN, PARIS RD. TO SO. POINT

BORING: 1-SPU ●

3-SPU ▲

PLASTICITY CHART

ENG FORM JUN 70 **4334** (E M 1110-2-1906) TRANSLUCENT

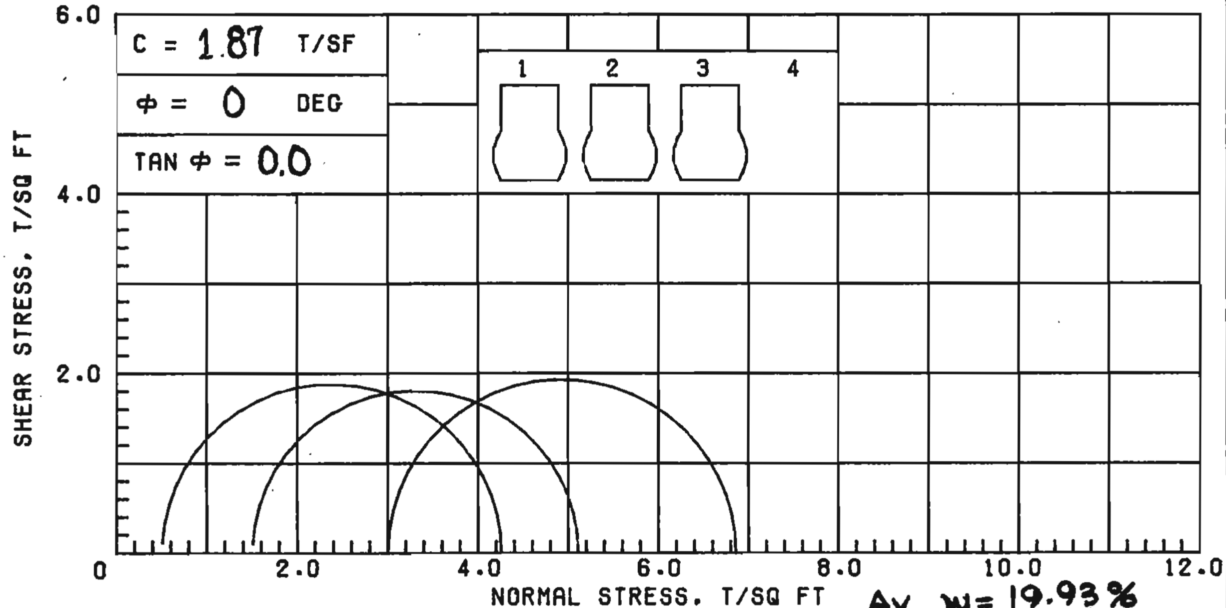


LAKE PONTCHARTRAIN & VICINITY
BARRIER PLAN, PARIS RD. TO SO. POINT

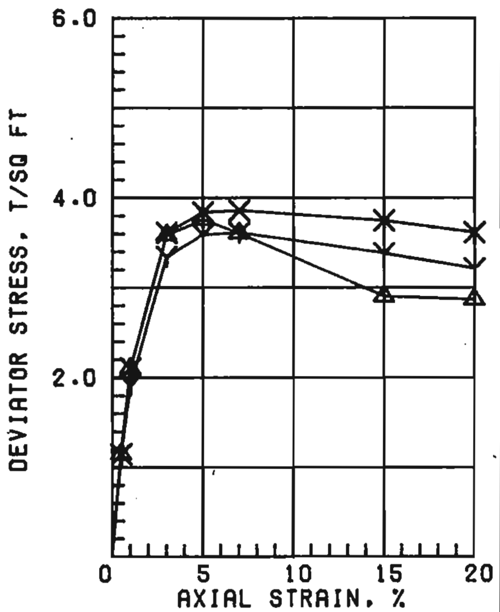
BORING: 5-SPU

PLASTICITY CHART

ENG FORM 4334 (E M 1110-2-1906) TRANSLUCENT
JUN 70



Av. w = 19.93 %
γ_{SAT} = 129.4 pcf



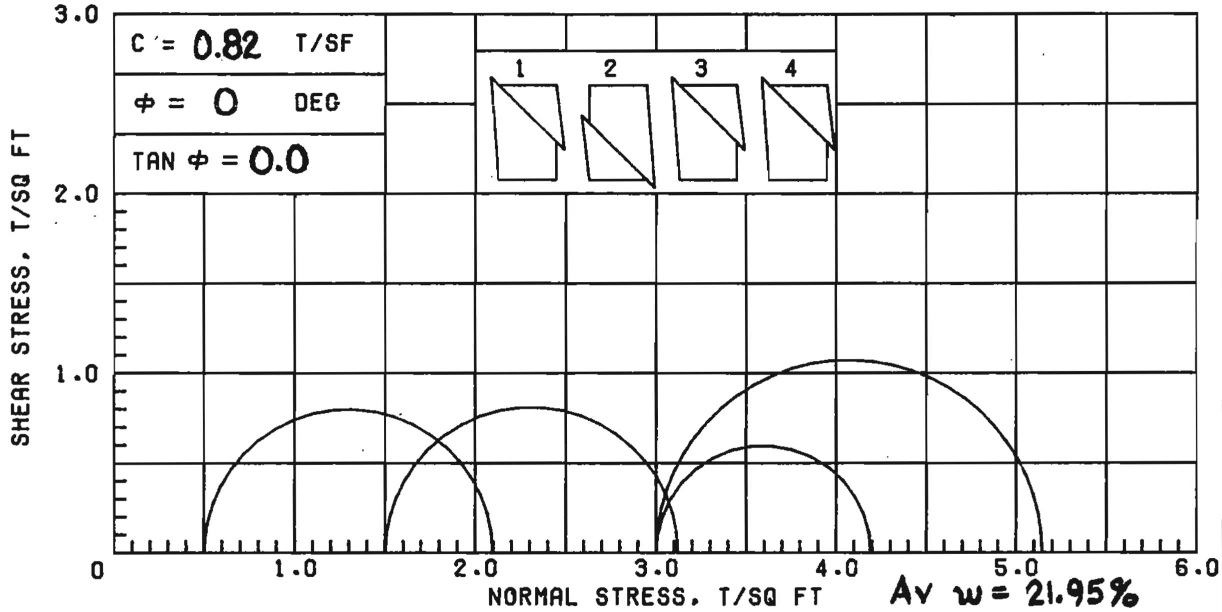
	SPECIMEN NO.	Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	19.2	21.2	19.4	
INITIAL	DRY DENSITY, PCF	107.9	104.2	107.1	
INITIAL	SATURATION, %	92.3	92.8	91.2	
INITIAL	VOID RATIO	0.562	0.617	0.574	
BEFORE SHEAR	WATER CONTENT, %				
BEFORE SHEAR	DRY DENSITY, PCF				
BEFORE SHEAR	SATURATION, %				
BEFORE SHEAR	VOID RATIO				
BEFORE SHEAR	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	3.76	3.61	3.86	
	TIME TO FAILURE, MIN.	10	15	14	
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.43	1.43	1.43	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

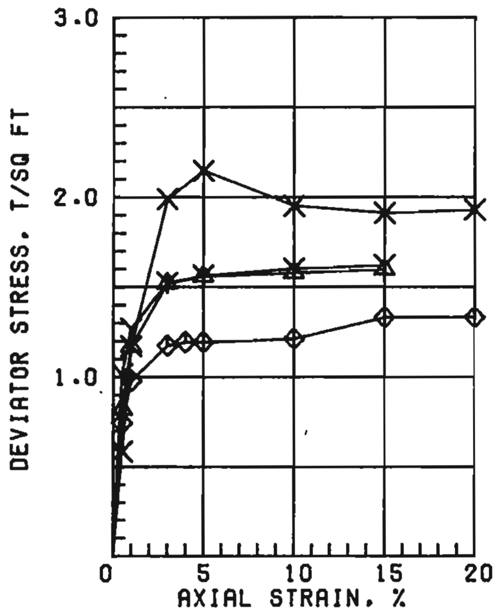
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY & BROWN MOTTLED

LL 47	PL 15	PI 32	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 1-SPU	SAMPLE NO. 1-C
	DEPTH/ELEV 2.2/12.5	TECH. KOC
	LABORATORY USAE WES	DATE 27 JAN 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av w = 21.95%
γSAT = 128.1 pcf



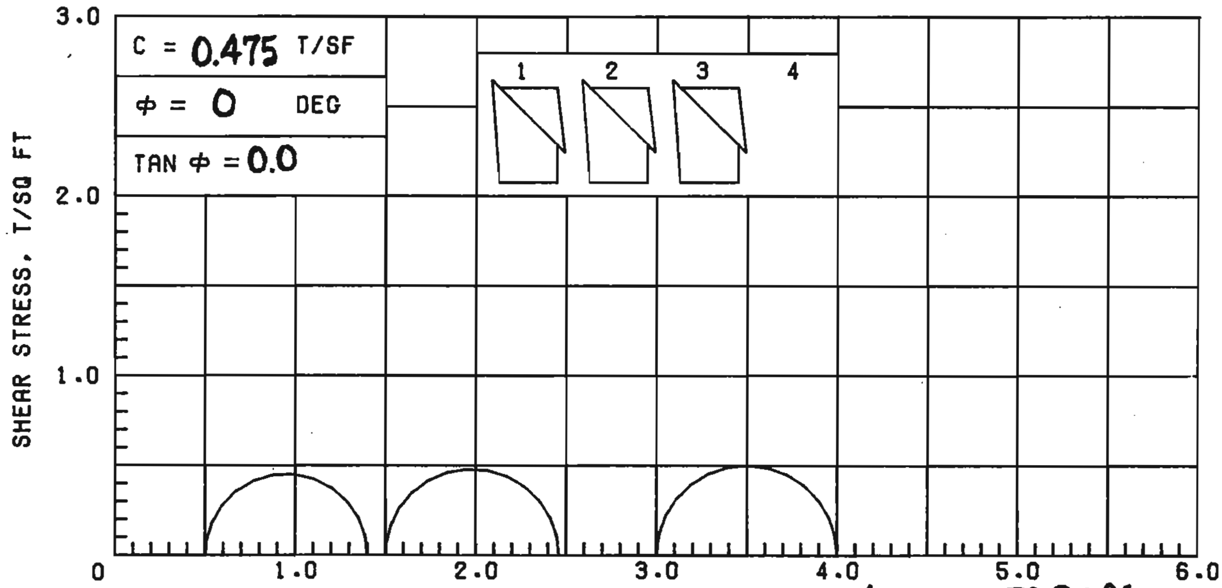
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	20.5	22.7	21.4	23.2
	DRY DENSITY, PCF	107.1	103.1	105.3	101.5
	SATURATION, %	96.5	96.6	96.1	94.8
	VOID RATIO	0.574	0.634	0.601	0.661
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	3.0
	MAX. DEV. STRESS, TSF	1.60	1.62	2.14	1.19
	TIME TO FAILURE, MIN.	30	30	10	8
	RATE OF STRAIN INCR,%				
	INITIAL DIAMETER, IN.	1.42	1.42	1.42	1.42
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

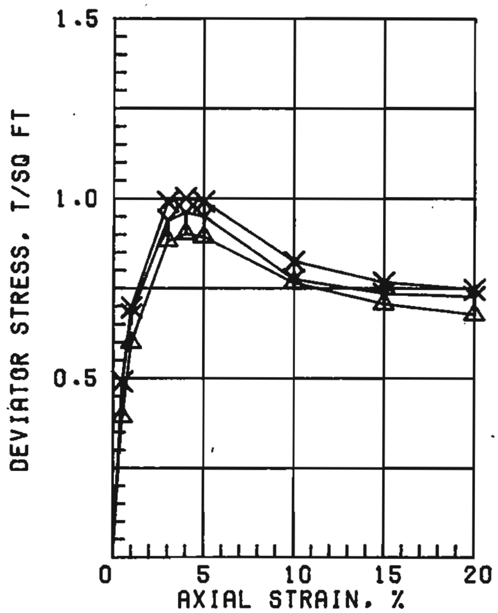
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SILT POCKETS

LL 42	PL 14	PI 28	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY	
	BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 1-SPU	SAMPLE NO. 3-D
	DEPTH/ELEV 9.7/5.0	TECH. KOC
	LABORATORY USAE WES	DATE 30 JAN 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 52.97 %
γ_{SAT} = 105.8 pcf



	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	50.9	53.5	54.5	
	DRY DENSITY, PCF	70.3	68.2	68.0	
	SATURATION, %	98.3	98.3	99.4	
	VOID RATIO	1.399	1.470	1.480	
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	0.90	0.96	1.00	
	TIME TO FAILURE, MIN.	8	8	8	
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.42	1.42	1.41	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

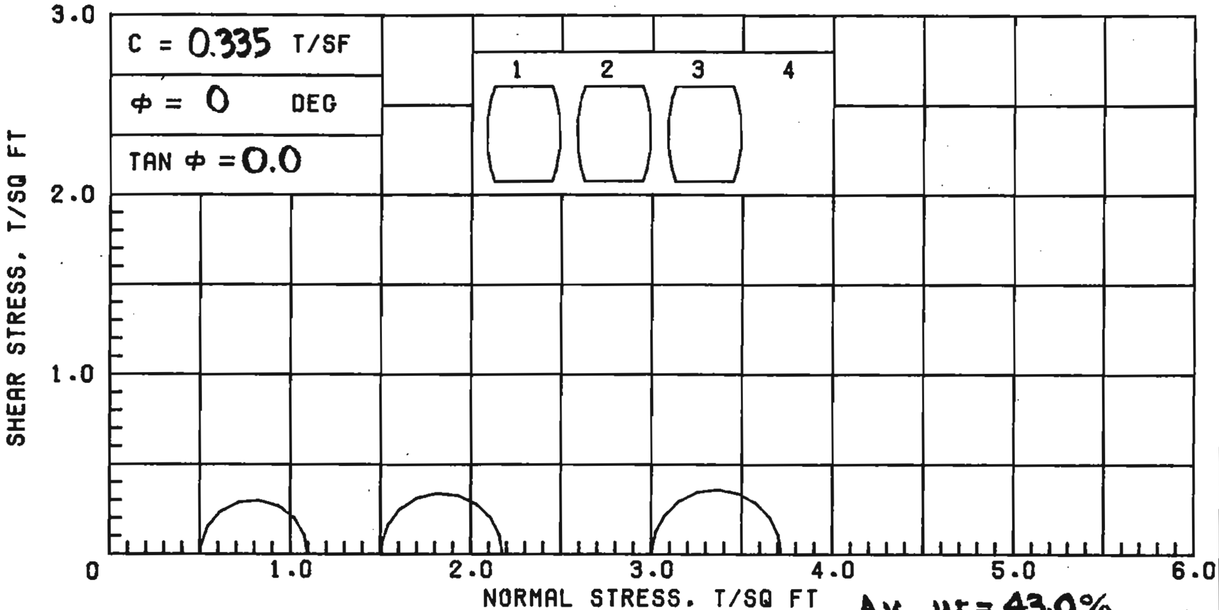
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 74	PL 23	PI 51	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

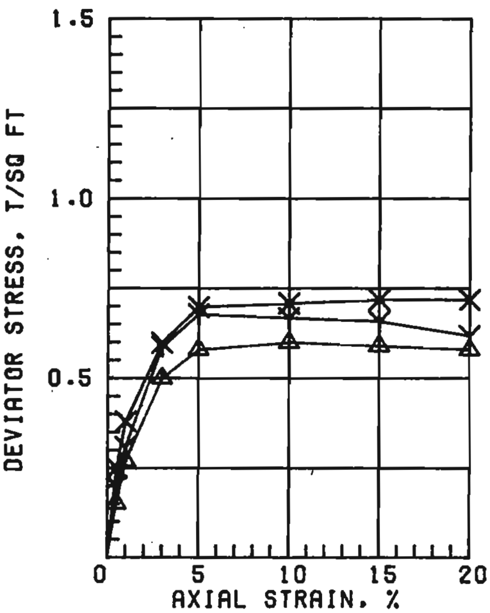
REMARKS:

PROJECT	LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT
BORING NO. 1-SPU	SAMPLE NO. 9-C
DEPTH/ELEV 32.5/-17.8	TECH. KOC
LABORATORY USAE WES	DATE 30 JAN 84

TRIAXIAL COMPRESSION TEST REPORT



Av. w = 43.0%
γ SAT = 110.6 pcf



SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	45.0	40.8	43.2	
	DRY DENSITY, PCF	75.2	78.1	76.1	
	SATURATION, %	97.9	95.1	96.1	
	VOID RATIO	1.241	1.158	1.214	
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		0.60	0.68	0.72	
TIME TO FAILURE, MIN.		20	10	30	
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

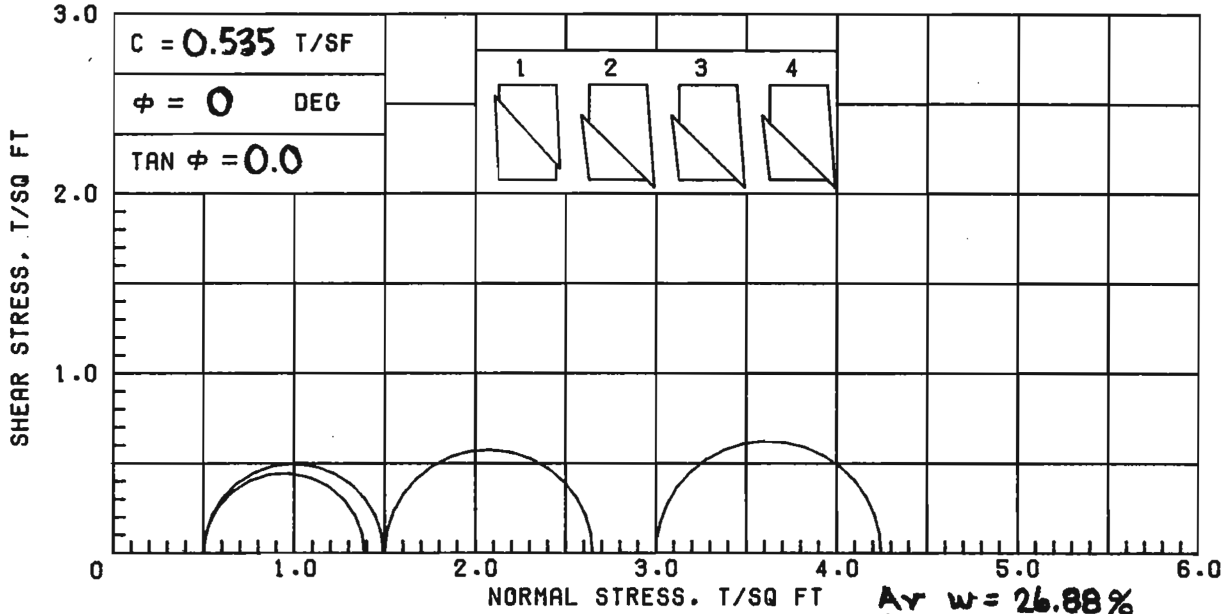
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SILT POCKETS

LL 45	PL 17	PI 28	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

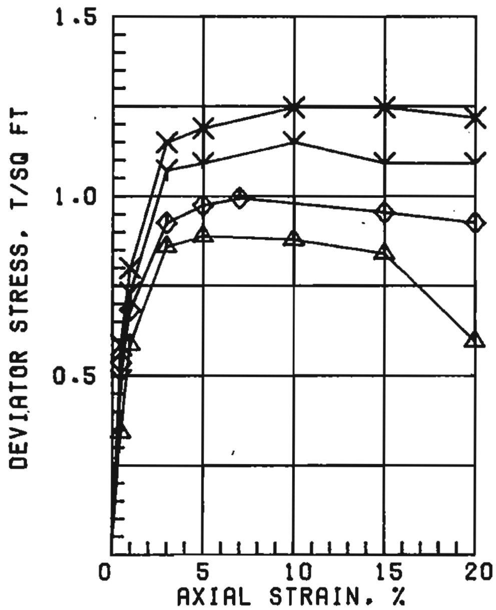
REMARKS:

PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
BORING NO. 1-SPU	SAMPLE NO. 12-D
DEPTH/ELEV 46.0/-31.3	TECH. KOC
LABORATORY USAE WES	DATE 31 JAN 84

TRIAXIAL COMPRESSION TEST REPORT



Av w = 26.88 %
γ_{SAT} = 122.4 pcf



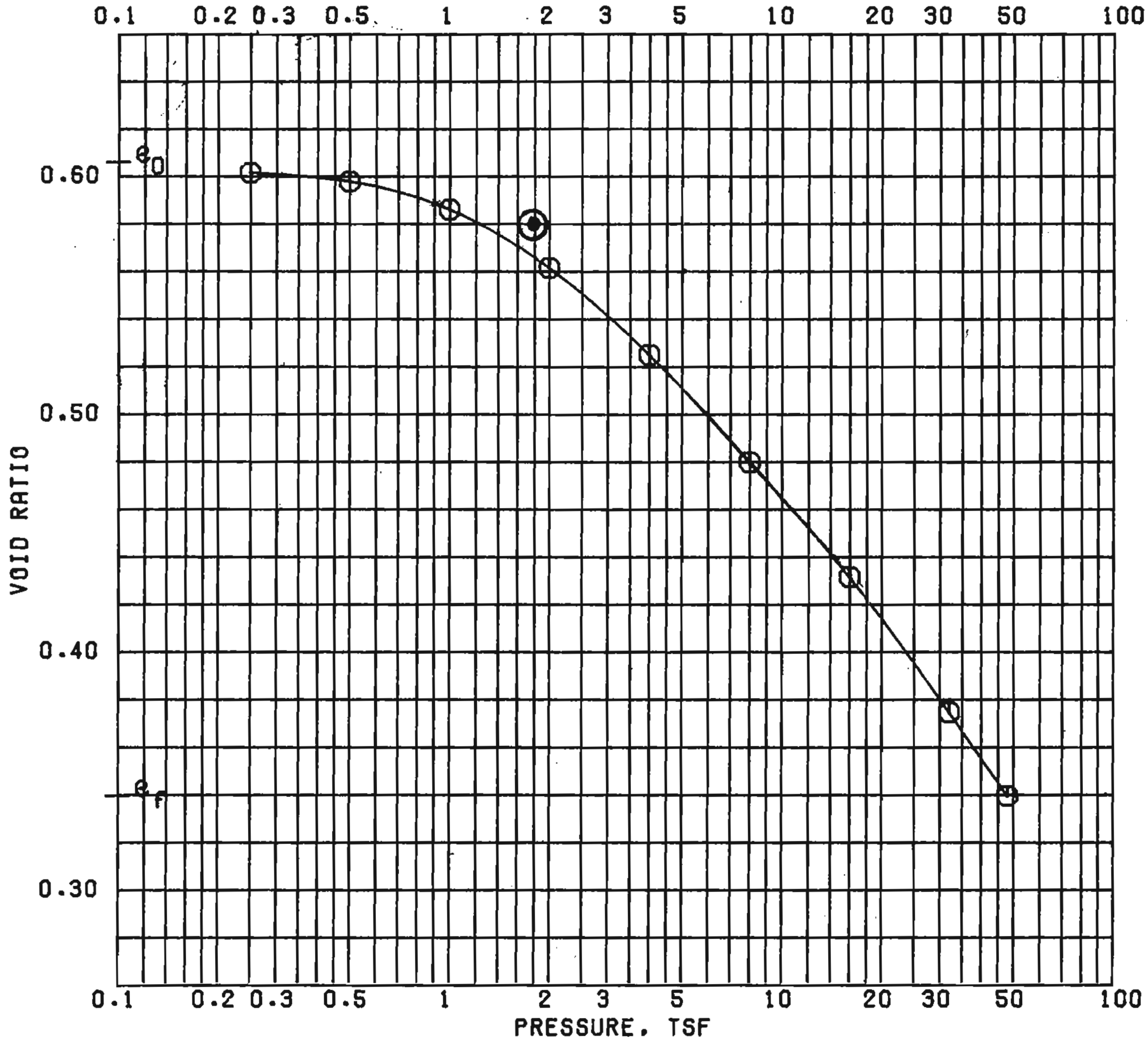
	SPECIMEN NO.	Δ1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	28.7	27.0	25.7	26.1
	DRY DENSITY, PCF	92.3	95.7	97.0	96.0
	SATURATION, %	93.8	95.7	94.1	93.2
	VOID RATIO	0.826	0.761	0.738	0.756
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.89	1.15	1.25	0.99
TIME TO FAILURE, MIN.		10	20	20	14
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.42	1.42	1.42	1.42
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

LL 45	PL 16	PI 29	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 1-SPU	SAMPLE NO. 15-C
	DEPTH/ELEV 57.0/-42.3	TECH. KOC
	LABORATORY USAE WES	DATE 01 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	

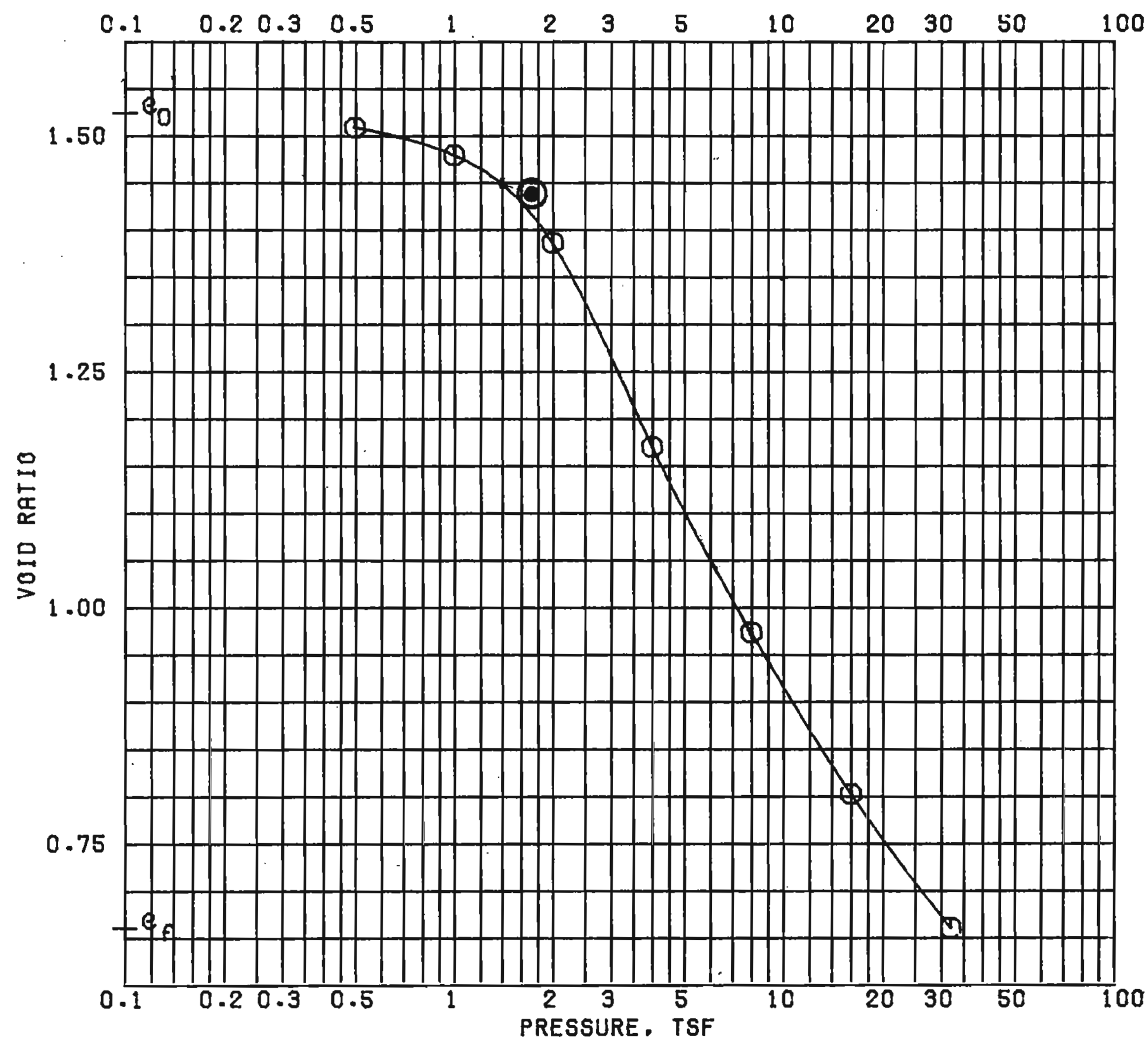


γ_{SAT} = 128.6 pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.5	WATER CONTENT, %	20.9	14.1
PRECONSOL. PRESSURE, TSF	1.8	DRY DENSITY, PCF	105.0	125.9
COMPRESSION INDEX	0.154	SATURATION, %	93.0	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.605	0.339
DIA. IN 4.44	HT. IN 1.122	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY		
LL 50 · PL 15 · PI 35	PROJECT LAKE PONTCHARTRAIN & VICINITY	
GS 2.70 (EST) · D_{10}	BARRIER PLAN, PARIS RD. TO SO. POINT	
REMARKS	BORING NO. 1-SPU	SAMPLE NO. 3-B
	DEPTH/ELEV 8.4/6.3	DATE 05 JAN 84

CONSOLIDATION TEST REPORT



γ_{SAT} = 104.5 pcf

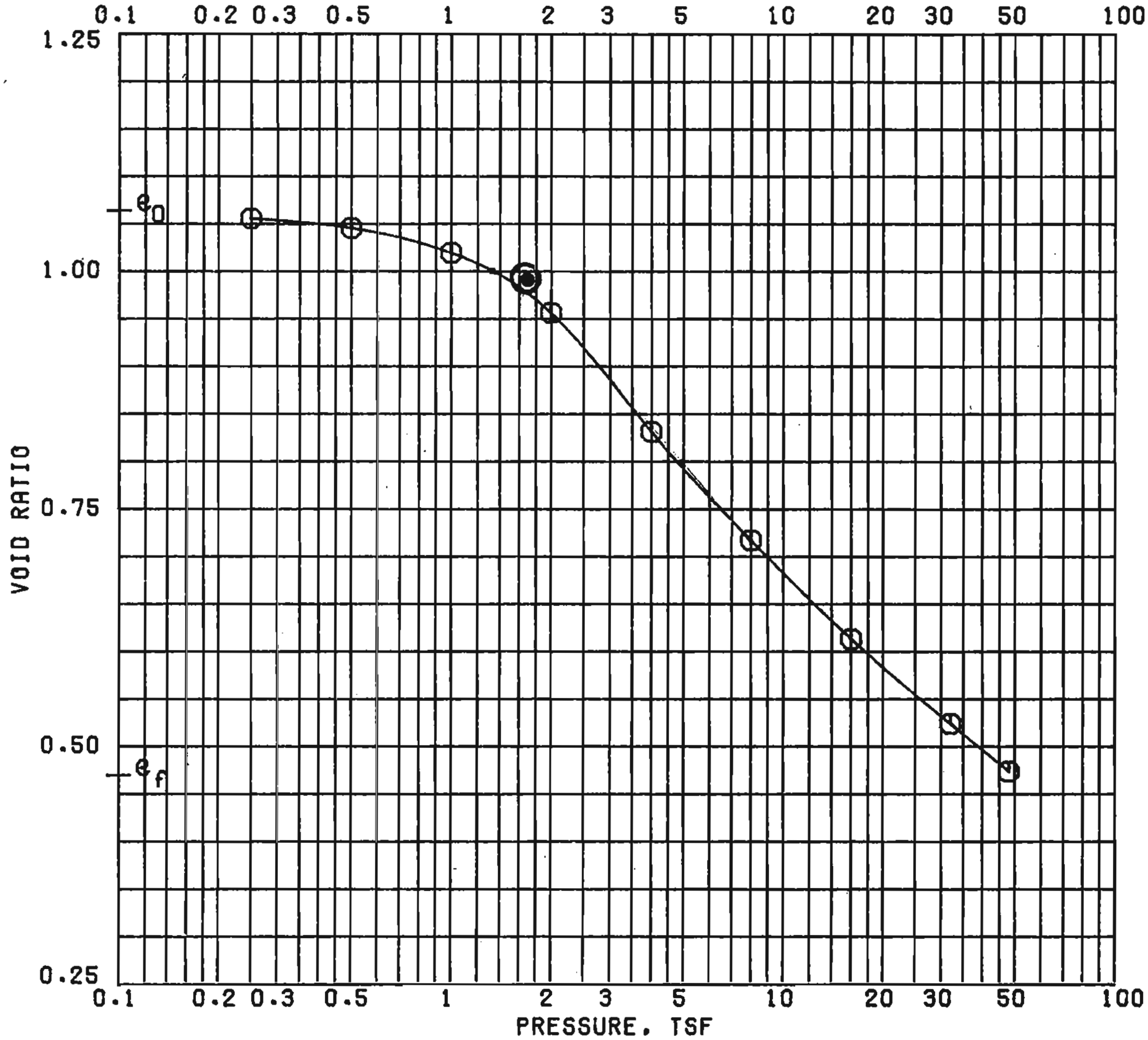
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.60	WATER CONTENT, %	54.9	26.4
PRECONSOL. PRESSURE, TSF	1.75	DRY DENSITY, PCF	66.8	101.6
COMPRESSION INDEX	0.693	SATURATION, %	97.3	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.524	0.660
DIA. IN 4.44	HT. IN 1.123	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS

LL 84	PL 20	PI 64	PROJECT LAKE PONTCHARTRAIN & VICINITY	
GS 2.70 (EST)	D_{10}		BARRIER PLAN, PARIS RD. TO SO. POINT	
REMARKS			BORING NO. 1-SPU	SAMPLE NO. 10-B
			DEPTH/ELEV 36.0/-21.3	DATE 10 JAN 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 9



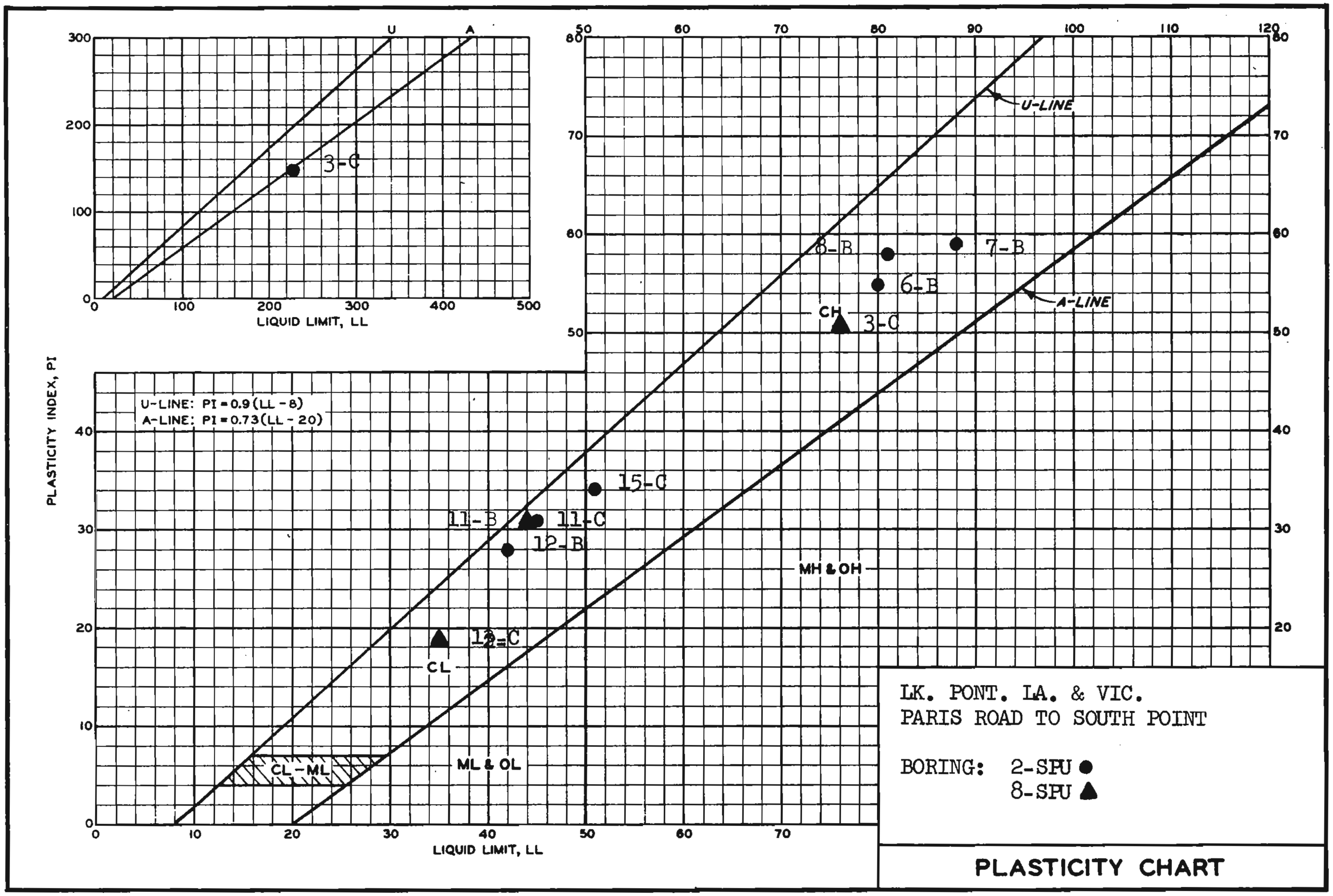
γ_{SAT} = 113.8 pcf

				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		1.85	WATER CONTENT, %	36.7	17.6
PRECONSOL. PRESSURE, TSF		1.70	DRY DENSITY, PCF	81.7	114.8
COMPRESSION INDEX		0.404	SATURATION, %	93.3	100 +
TYPE SPECIMEN	UNDISTURBED		VOID RATIO	1.062	0.468
DIA. IN 4.44	HT. IN 1.148		BACK PRESSURE, TSF		

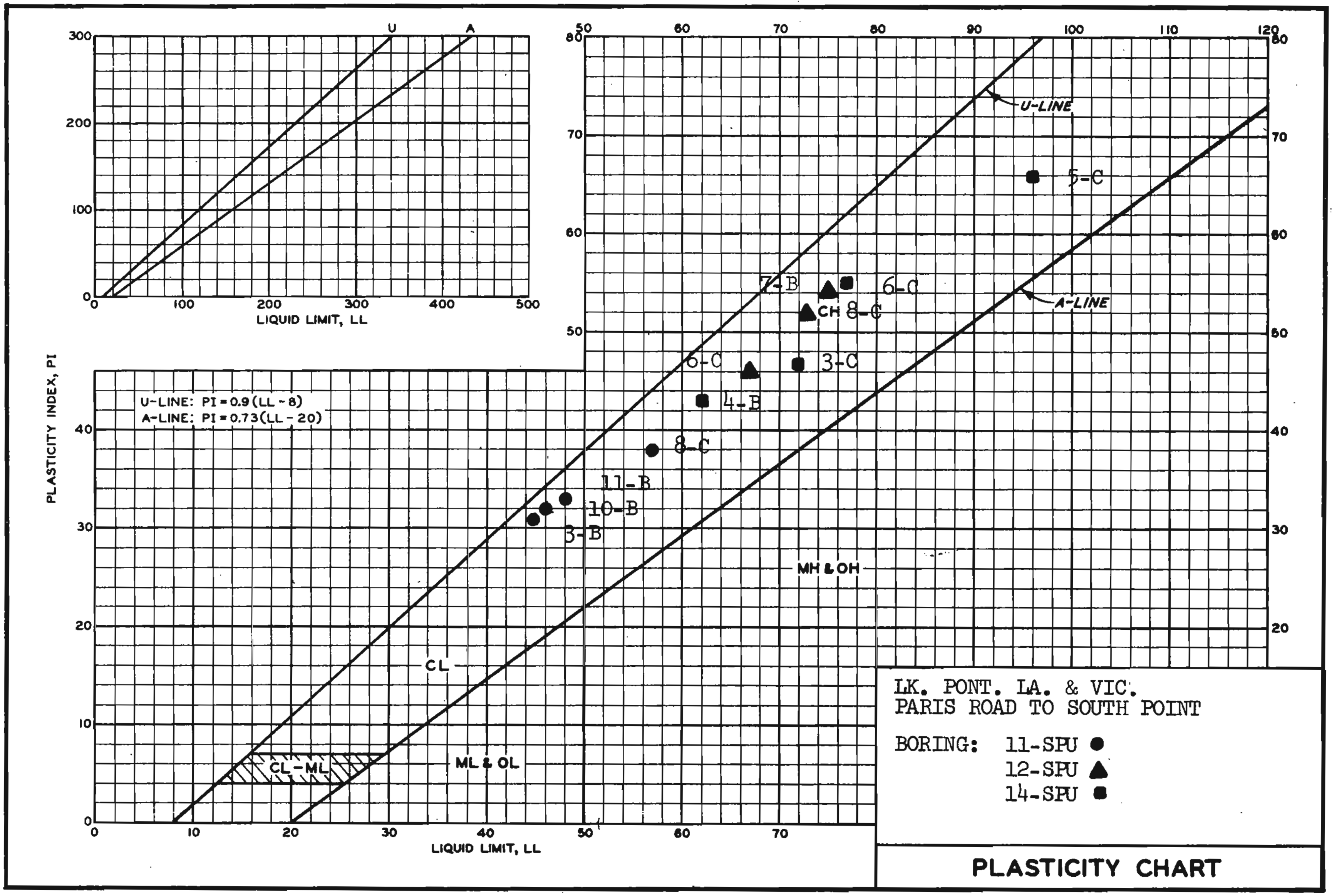
CLASSIFICATION PLASTIC CLAY (CH), GRAY			
LL 50 / PL 15 / PI 35	PROJECT LAKE PONTCHARTRAIN & VICINITY		
GS 2.70 (EST) / D_{10}	BARRIER PLAN, PARIS RD TO SO. POINT		
REMARKS	BORING NO. 1-SPU	SAMPLE NO. 14-B	
	DEPTH/ELEV 52.0/-37.3	DATE 10 JAN 84	

CONSOLIDATION TEST REPORT

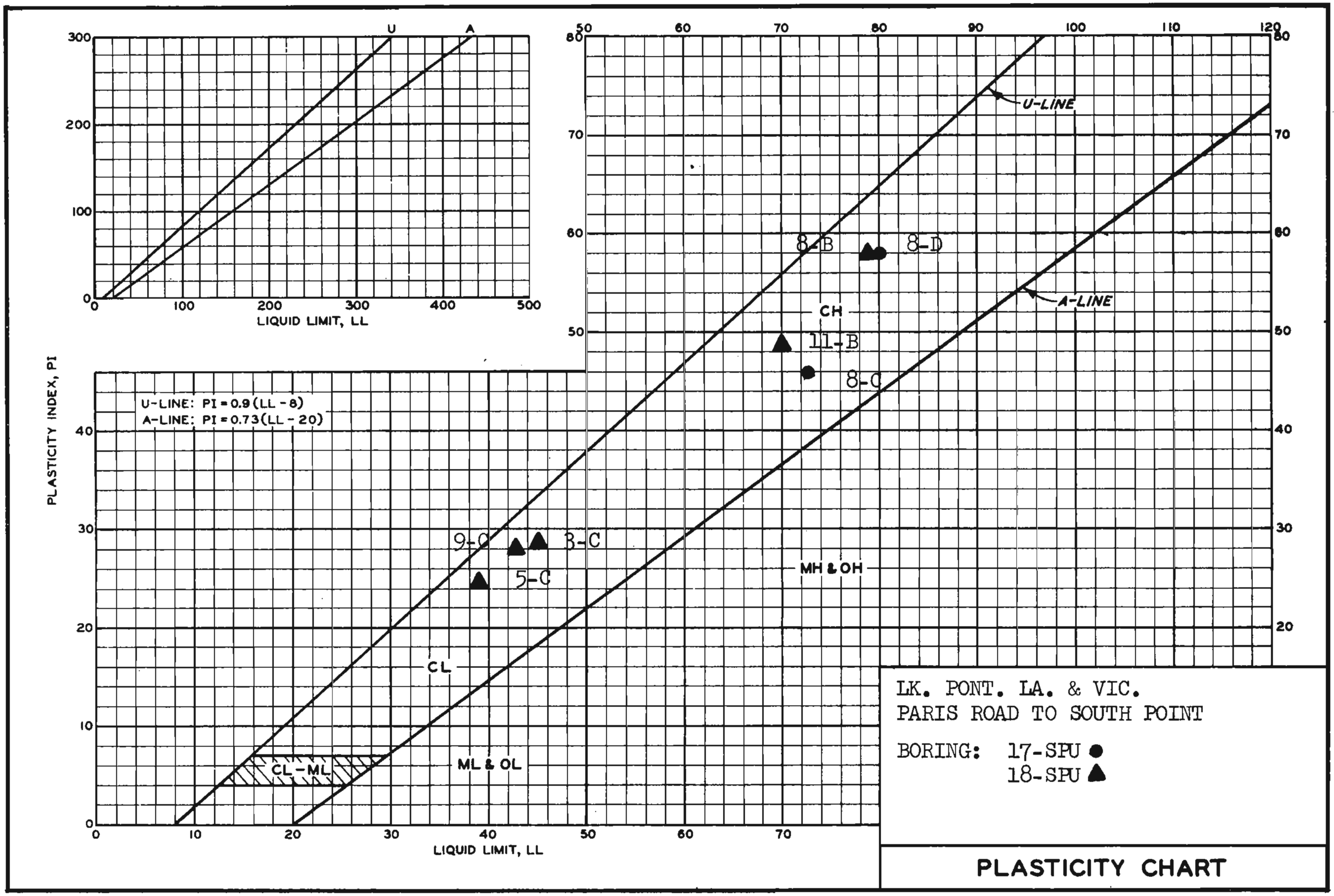
SHEET 1 OF 11



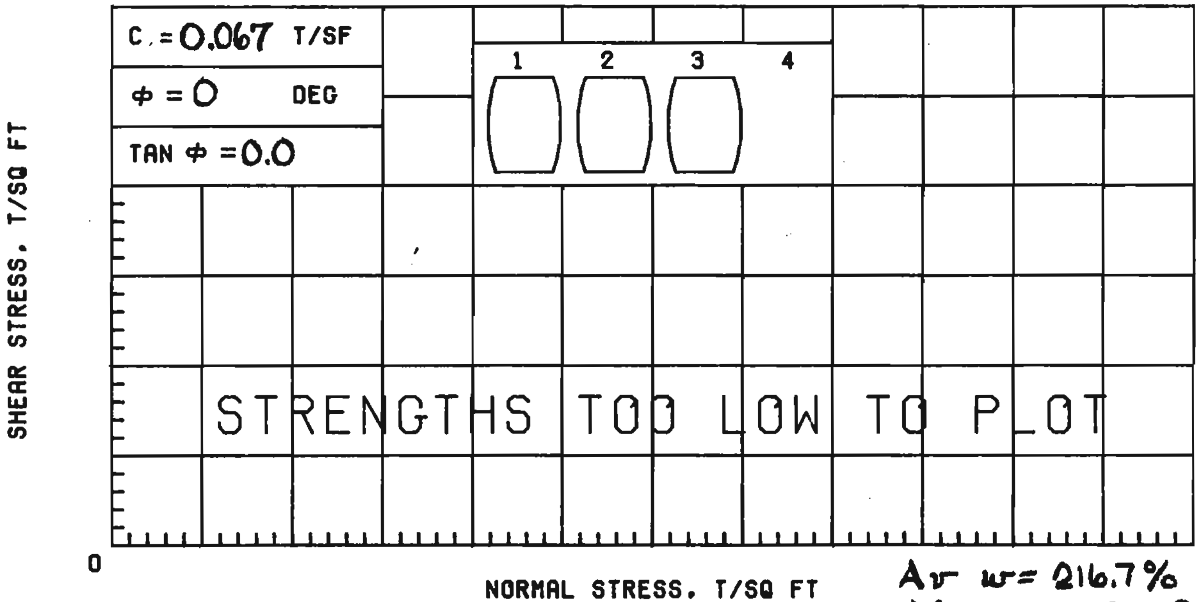
ENG FORM JUN 70 **4334** (E M 1110-2-1906) TRANSLUCENT



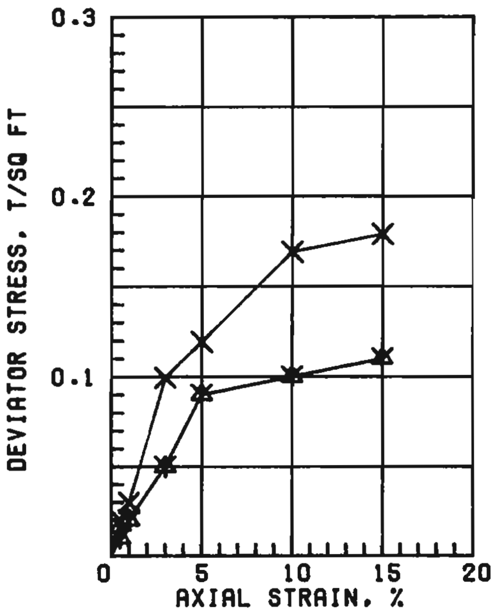
ENG FORM JUN 70 **4334** (E M 1110-2-1906) TRANSLUCENT



ENG FORM JUN 70 **4334** (E M 1110-2-1906) TRANSLUCENT



Av w = 216.7%
γ_{SAT} = 77.9 pcf



SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	227.7	241.6	180.8	
	DRY DENSITY, PCF	21.3	20.5	27.4	
	SATURATION, %	89.2	90.7	95.5	
	VOID RATIO	6.635	6.924	4.921	
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		0.11	0.11	0.18	
TIME TO FAILURE, MIN.		30	30	30	
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: ORGANIC CLAY (OH), DARK BROWN; DECAYED WOOD; ROOTS TO 1/2"

LL 229	PL 82	PI 147	GS 2.60 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

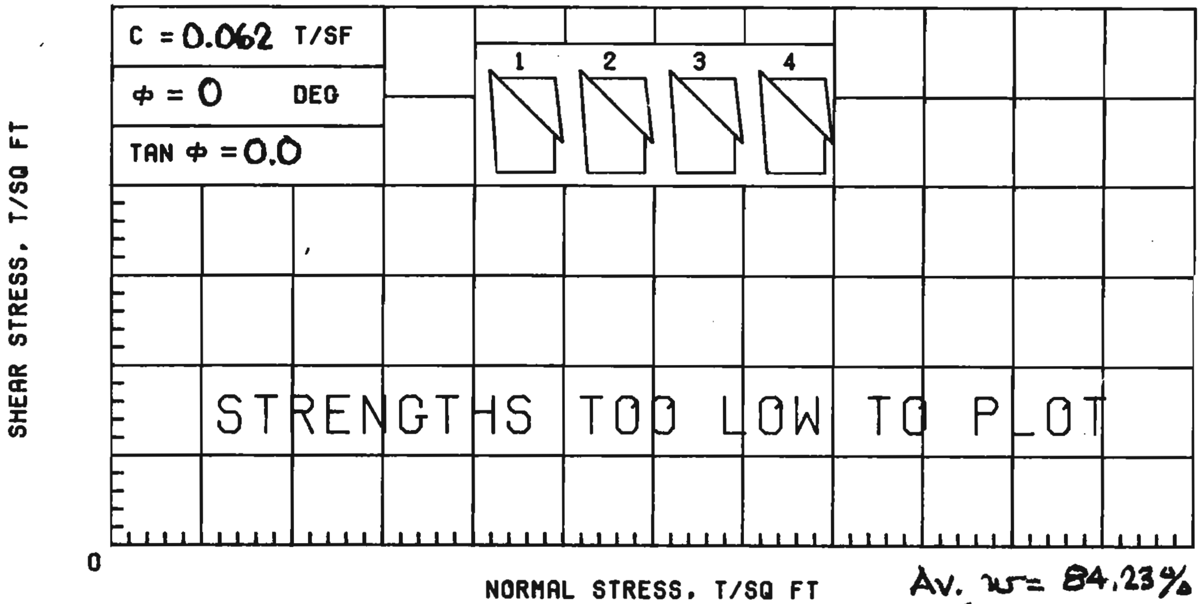
PROJECT LAKE PONT., LA. & VIC. PARIS ROAD TO SOUTH POINT	
BORING NO. 2-SPU	SAMPLE NO. 3-C
DEPTH/ELEV 9.2	TECH. KOC
LABORATORY USAE WES	DATE 25 APR 84

TRIAXIAL COMPRESSION TEST REPORT

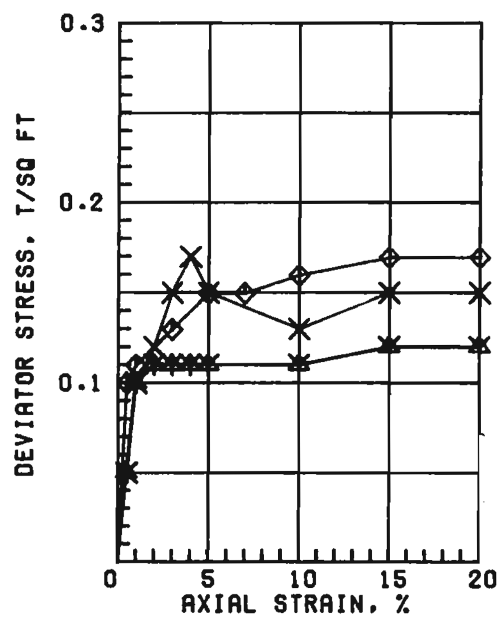
C = 0.062 T/SF

ϕ = 0 DEG

TAN ϕ = 0.0



Av. w = 84.23%
γ_{SAT} = 95.04 pcf



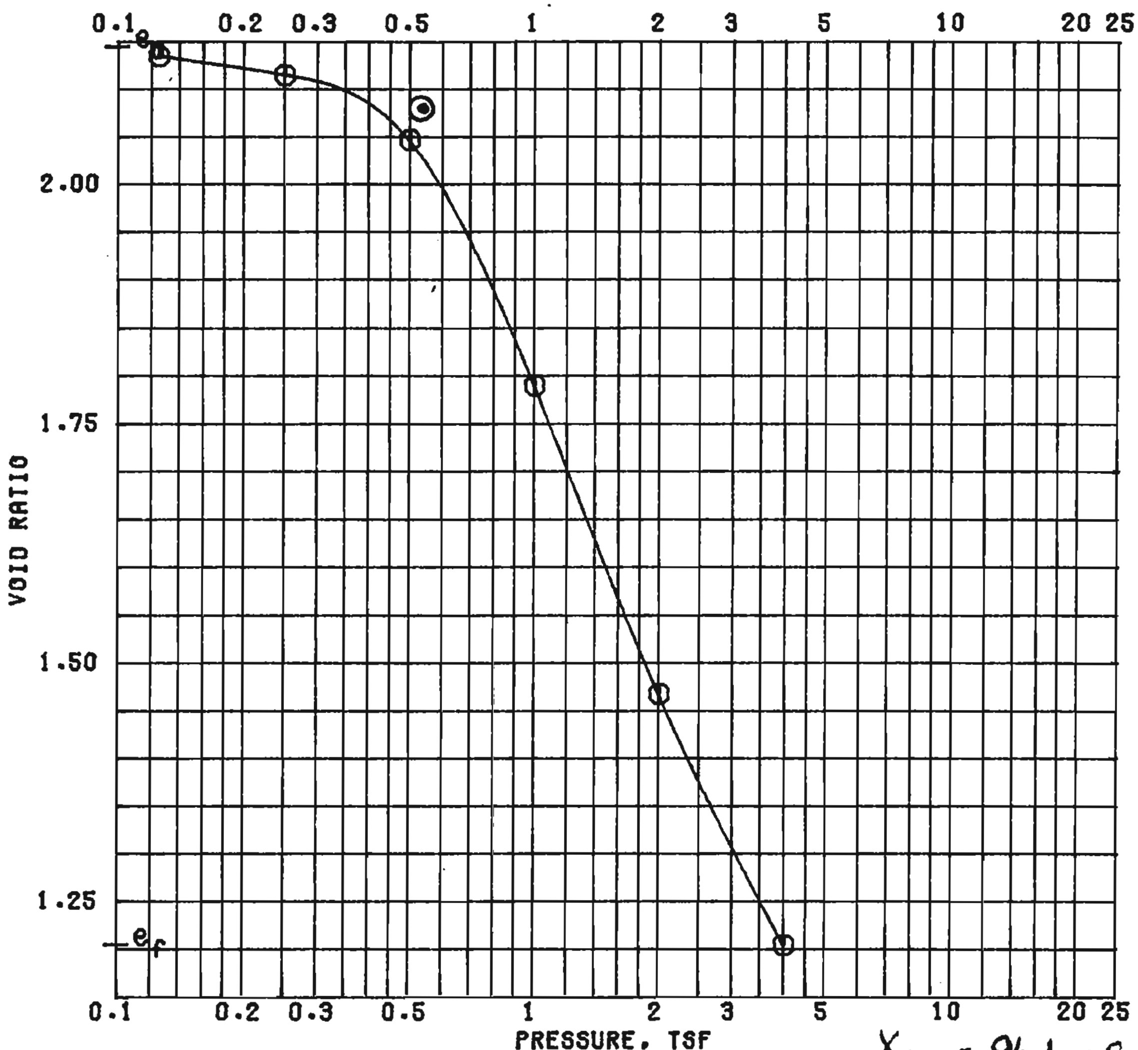
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	87.8	85.5	88.2	79.4
	DRY DENSITY, PCF	50.2	50.9	50.1	53.6
	SATURATION, %	100+	99.9	100+	99.9
	VOID RATIO	2.360	2.312	2.367	2.147
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	3.0
MAX. DEV. STRESS, TSF		0.11	0.11	0.17	0.15
TIME TO FAILURE, MIN.		4	4	8	10
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: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 80	PL 25	PI 55	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 2-SPU	SAMPLE NO. 6-B
	DEPTH/ELEV 20.1	TECH. KOC
	LABORATORY USAE WES	DATE 25 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



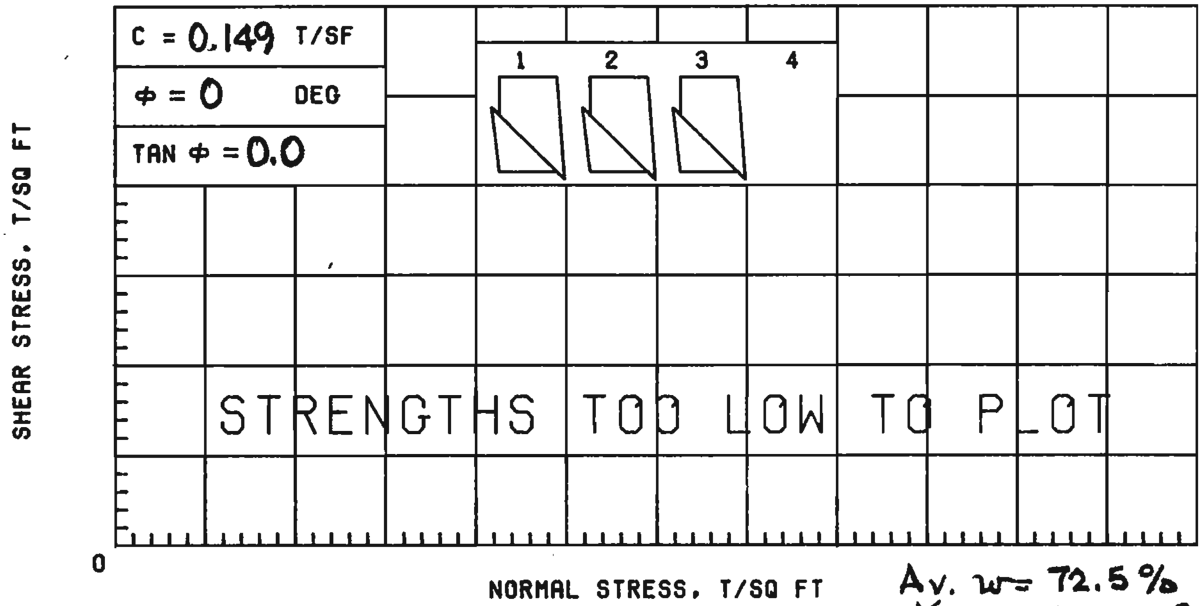
$\gamma_{SAT} = 96.1$ pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.53	WATER CONTENT, %	78.2	45.0
PRECONSOL. PRESSURE, TSF	0.53	DRY DENSITY, PCF	53.6	76.5
COMPRESSION INDEX	1.62	SATURATION, %	98.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.143	1.203
DIA. IN 4.44	HT. IN 1.128	BACK PRESSURE, TSF		

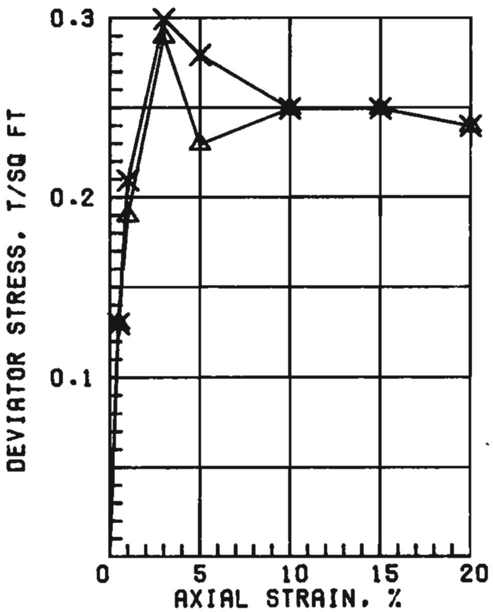
CLASSIFICATION PLASTIC CLAY (CH), GRAY		
LL 88	PL 29	PI 59

GS 2.70 (EST)	D_{10}	PROJECT LK. PONT. LA. & VIC PARIS ROAD TO SOUTH POINT
REMARKS		BORING NO. 2-SPU / SAMPLE NO. 7-B
		DEPTH/ELEV 24.2 / DATE 13 JUN 84

CONSOLIDATION TEST REPORT



Av. w = 72.5 %
γ_{SAT} = 98.4 pcf



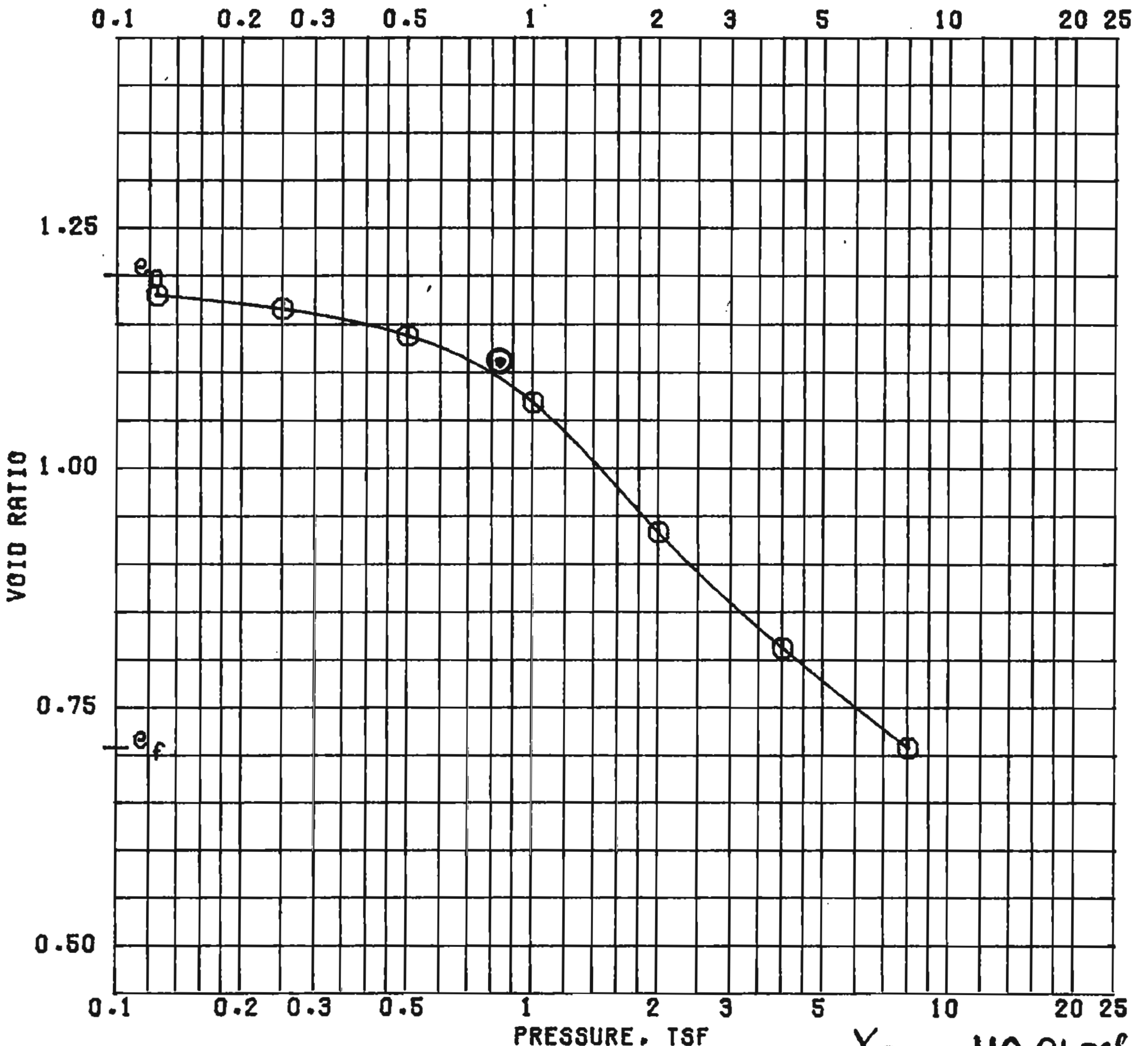
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	73.0	71.9	72.6	
	DRY DENSITY, PCF	56.8	57.2	57.1	
	SATURATION, %	100+	99.8	100+	
	VOID RATIO	1.967	1.945	1.953	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.29	0.30	0.30	
	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

LL 81	PL 23	PI 58	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

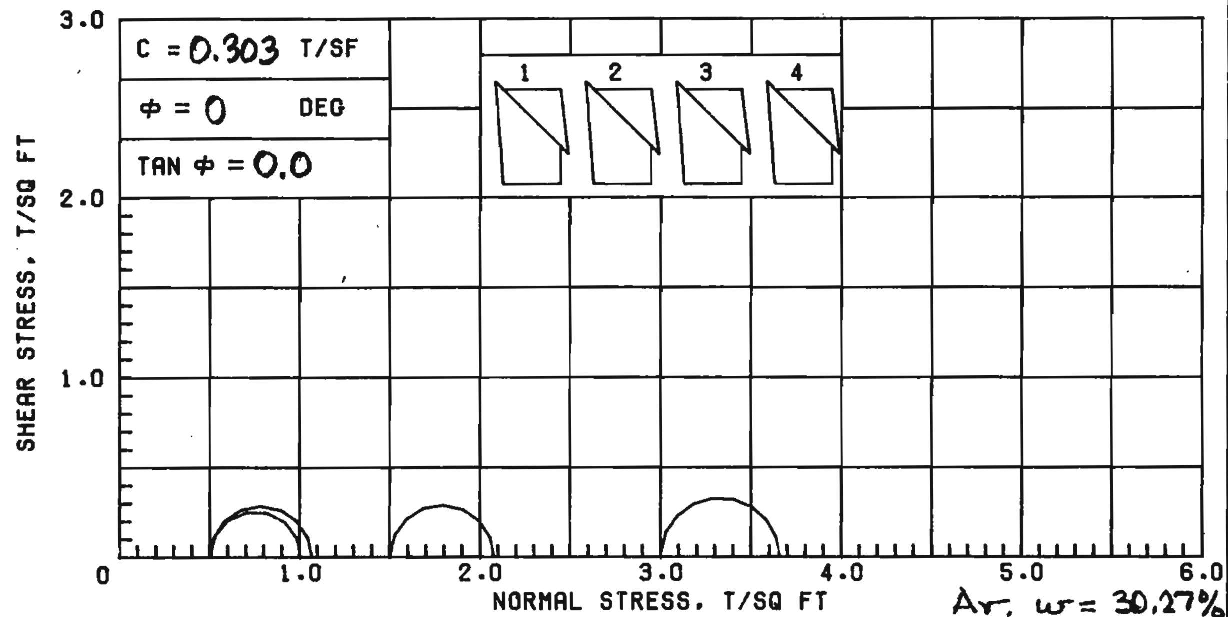
REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 2-SPU	SAMPLE NO. 8-B
	DEPTH/ELEV 28.1	TECH. KOC
	LABORATORY USAE WES	DATE 26 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



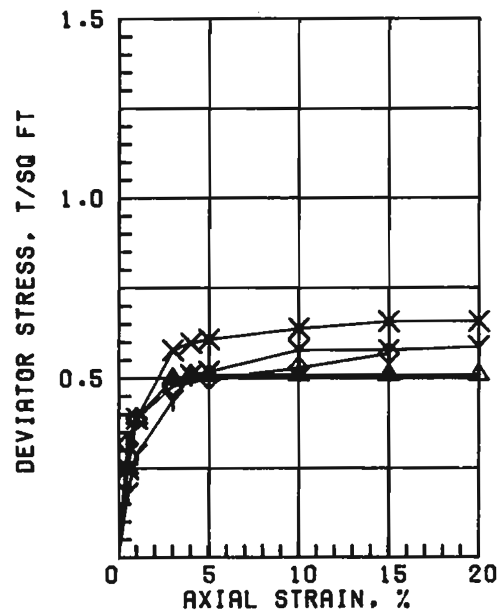
γ_{SAT} = 110.01 pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.82	WATER CONTENT, %	41.0	25.9
PRECONSOL. PRESSURE, TSF	0.82	DRY DENSITY, PCF	76.7	98.8
COMPRESSION INDEX	0.455	SATURATION, %	94.4	99.2
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.198	0.705
DIA. IN 4.44	HT. IN 1.116	BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CL), GRAY				
LL 45 / PL 14 / PI 31		PROJECT LK. PONT. LA. & VIC		
GS 2.70 (EST)	D_{10}	PARIS ROAD TO SOUTH POINT		
REMARKS		BORING NO. 2-SPU		SAMPLE NO. 11-C
		DEPTH/ELEV 41.4		DATE 14 JUN 84
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 9



Av. w = 30.27%
γSAT = 119.7pcf



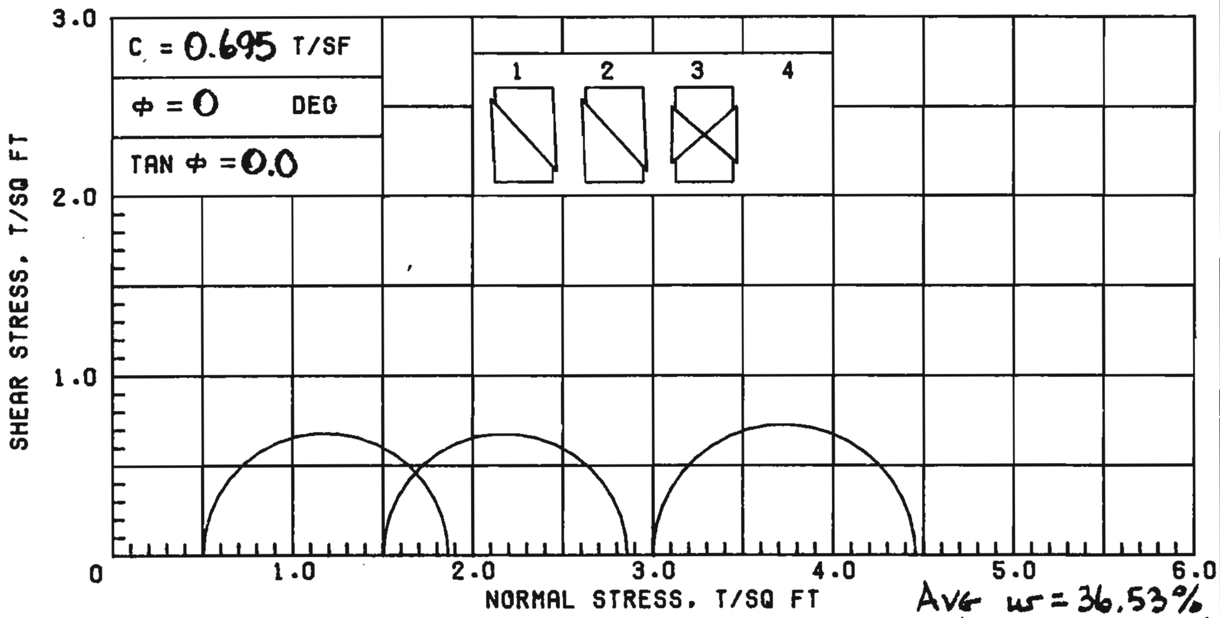
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	30.4	29.5	30.1	31.2
	DRY DENSITY, PCF	91.7	91.6	91.2	90.1
	SATURATION, %	97.9	94.8	95.8	96.7
	VOID RATIO	0.838	0.840	0.848	0.871
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.51	0.58	0.66	0.57
TIME TO FAILURE, MIN.		8	20	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

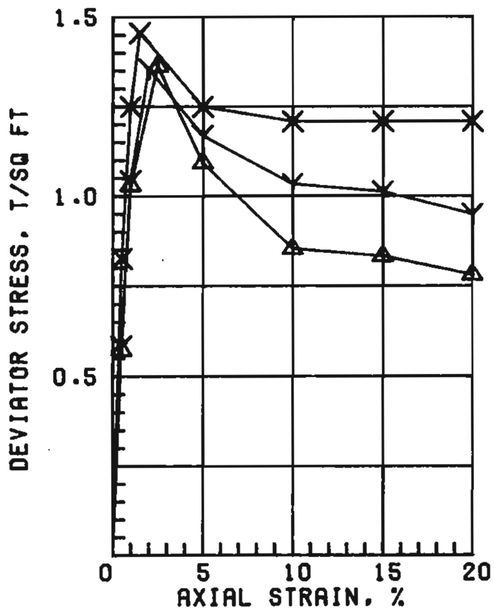
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY

LL 42	PL 14	PI 28	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 2-SPU	SAMPLE NO. 12-B
	DEPTH/ELEV 44.5	TECH. KOC
	LABORATORY USAE WES	DATE 26 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



Avg w = 36.53%
γsat = 115.8 pcf



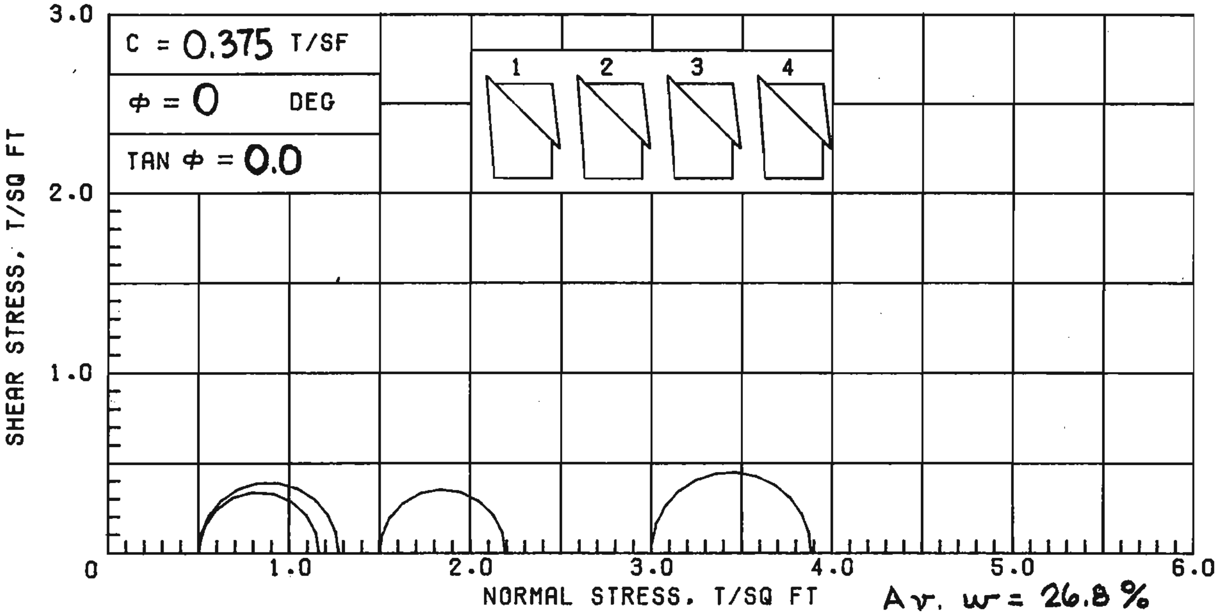
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	36.4	36.0	37.2	
	DRY DENSITY, PCF	85.2	85.6	83.2	
	SATURATION, %	100+	100+	97.9	
	VOID RATIO	0.977	0.970	1.026	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		1.36	1.36	1.46	
TIME TO FAILURE, MIN.		5	5	6	
RATE OF STRAIN INCR.,%			16	8	
INITIAL DIAMETER, IN.		1.37	1.37	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

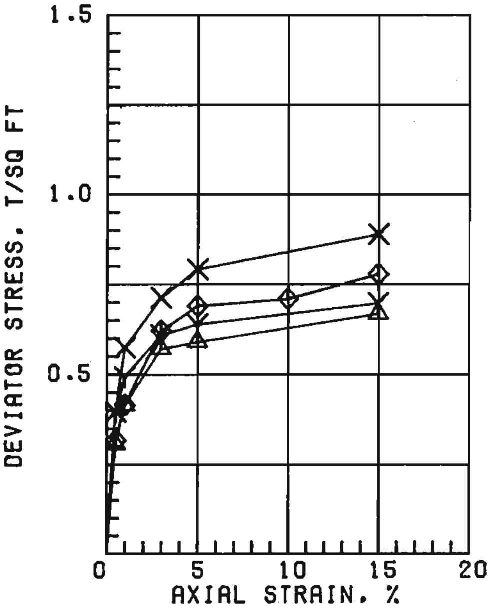
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES; FINE SAND POCKETS

LL 51	PL 17	PI 34	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC. PARIS ROAD TO SOUTH POINT	
	BORING NO. 2-SPU	SAMPLE NO. 15-C
	DEPTH/ELEV 57.1	TECH. WJH
	LABORATORY USAE WES	DATE 26 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 26.8 %
γ_{SAT} = 122.4 pcf



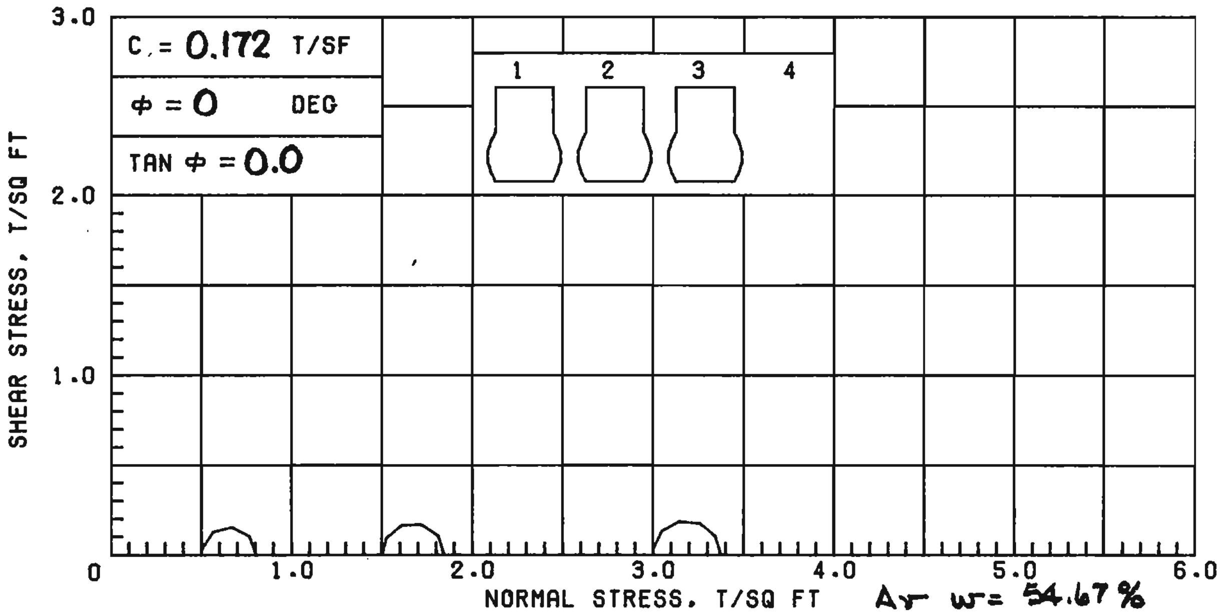
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	24.1	26.0	28.3	28.8
	DRY DENSITY, PCF	98.3	95.9	93.3	93.2
	SATURATION, %	90.9	92.7	94.8	96.1
	VOID RATIO	0.716	0.757	0.806	0.809
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	0.5
	MAX. DEV. STRESS, TSF	0.66	0.69	0.88	0.77
	TIME TO FAILURE, MIN.	30	30	30	30
	RATE OF STRAIN INCR.,%				
	INITIAL DIAMETER, IN.	1.42	1.42	1.41	1.42
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

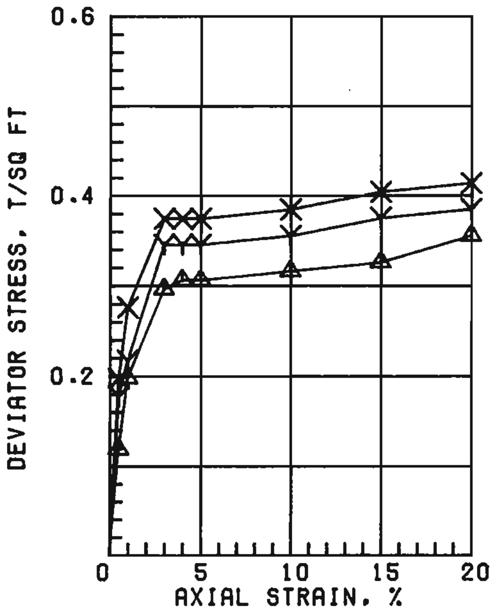
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY & BROWN MOTTLED; SILT POCKETS

LL 48	PL 14	PI 34	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;	PROJECT LAKE PONTCHARTRAIN & VICINITY	
LIMITS ON MIXTURE OF MATERIAL.	BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 3-SPU	SAMPLE NO. 3-C
	DEPTH/ELEV 8.6/10.4	TECH. KOC
	LABORATORY USAE WES	DATE 02 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av w = 54.67 %
γ SAT = 104.9 pcf



	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	54.3	55.4	54.3	
INITIAL	DRY DENSITY, PCF	67.5	66.8	68.0	
INITIAL	SATURATION, %	97.9	98.3	99.0	
INITIAL	VOID RATIO	1.497	1.522	1.480	
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	0.31	0.35	0.37	
	TIME TO FAILURE, MIN.	8	6	6	
	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; SILT LENSES

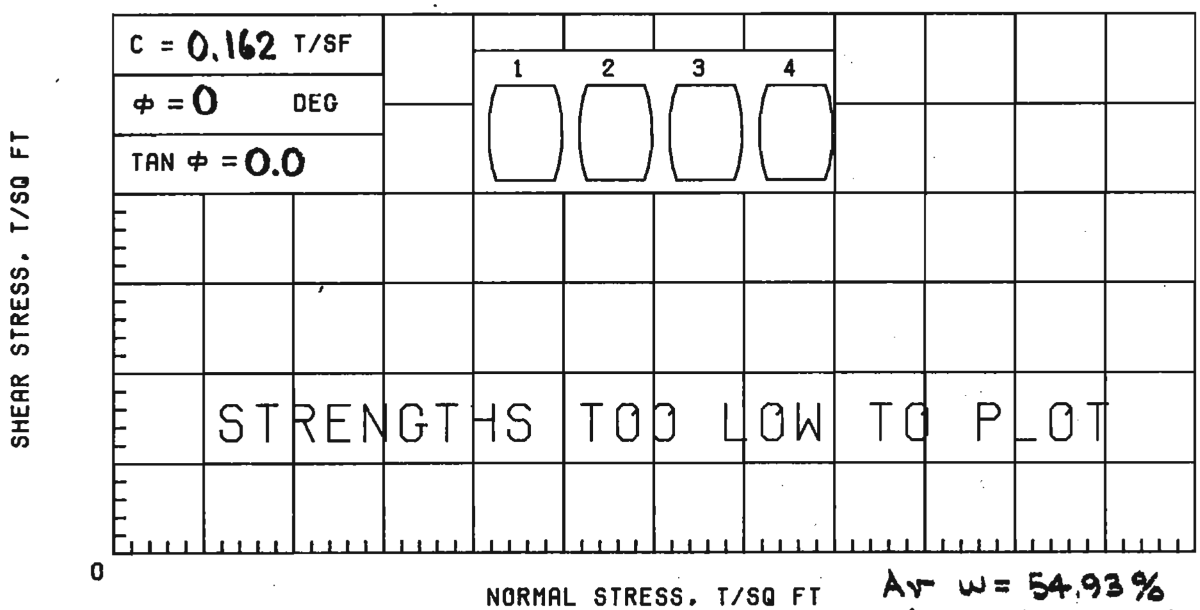
LL 63	PL 22	PI 41	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

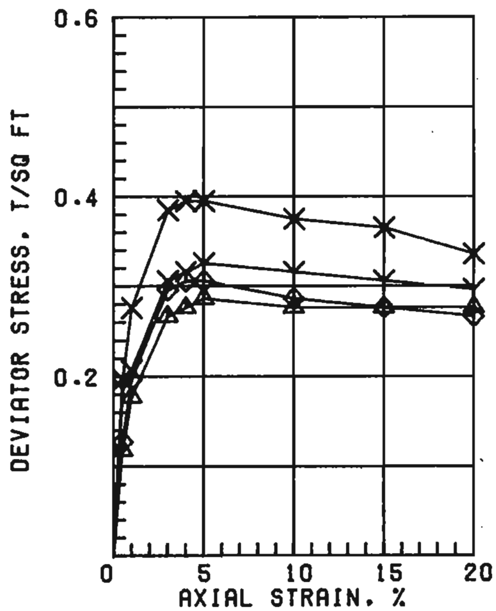
PROJECT LAKE PONTCHARTRAIN & VICINITY
BARRIER PLAN, PARIS RD. TO SO. POINT

BORING NO. 3-SPU	SAMPLE NO. 8-C
DEPTH/ELEV 28.8/-9.8	TECH. KOC
LABORATORY USAE WES	DATE 02 FEB 84

TRIAXIAL COMPRESSION TEST REPORT



Av w = 54.93%
γ sat = 104.8 pcf



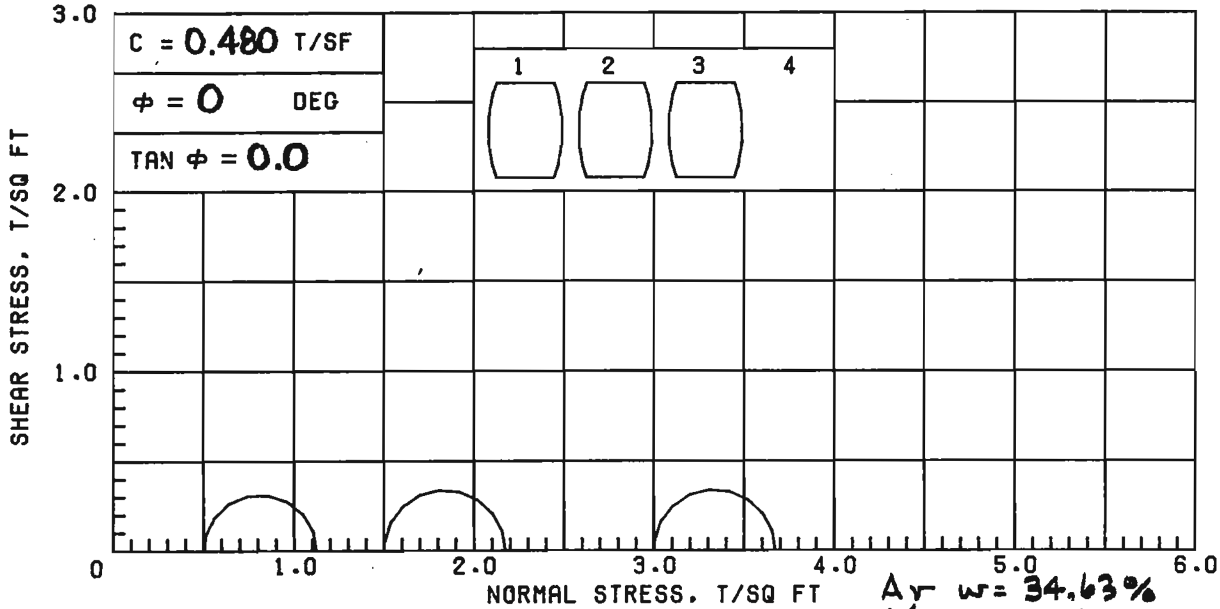
		△1	Y2	X3	◇4
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	49.4	58.2	56.3	55.8
	DRY DENSITY, PCF	70.9	64.8	66.6	66.6
	SATURATION, %	96.8	98.0	99.4	98.5
	VOID RATIO	1.378	1.603	1.529	1.529
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.29	0.33	0.40	0.31
TIME TO FAILURE, MIN.		10	10	8	8
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.41	1.41	1.41	1.41
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

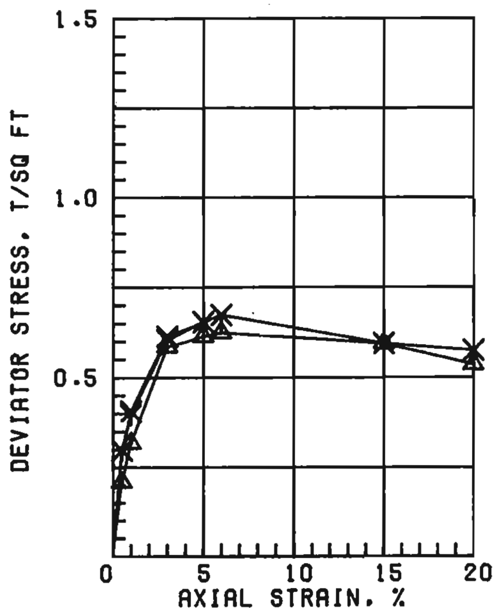
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT POCKETS

LL 63	PL 19	PI 44	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 3-SPU	SAMPLE NO. 11-B
	DEPTH/ELEV 40.0/-21.0	TECH. KOC
	LABORATORY USAE WES	DATE 03 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av w = 34.63%
γ_{SAT} = 116.6 pcf



SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	33.7	34.9	35.3	
	DRY DENSITY, PCF	87.3	85.0	85.6	
	SATURATION, %	97.8	95.9	98.3	
	VOID RATIO	0.931	0.983	0.970	
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	0.67	0.67	
TIME TO FAILURE, MIN.		12	12	12	
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: CLAY (CL), GRAY; SILT POCKETS

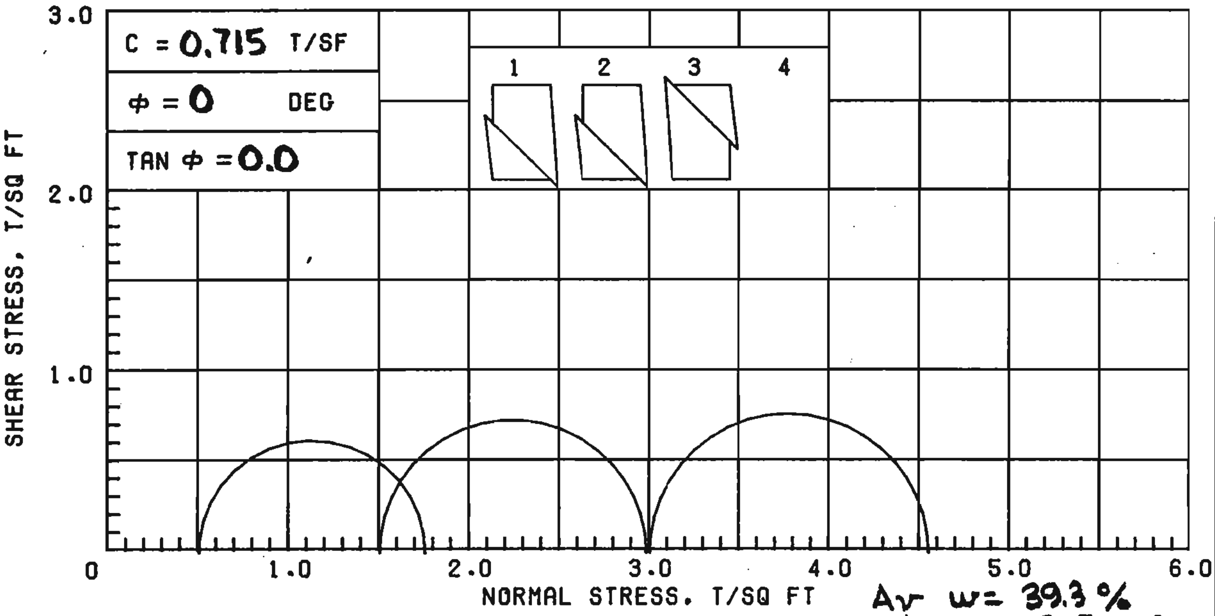
LL 42	PL 15	PI 27	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

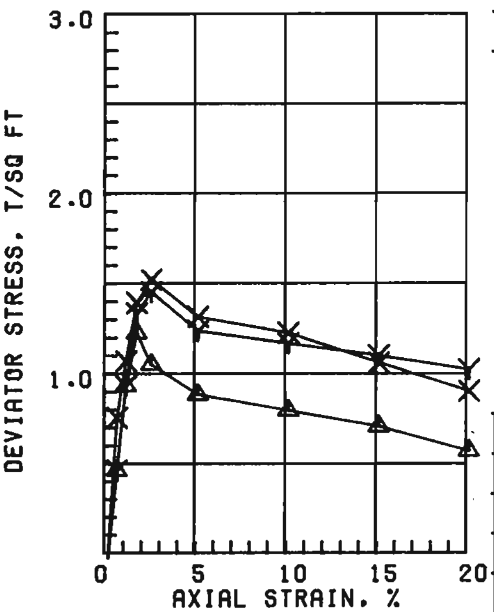
PROJECT LAKE PONTCHARTRAIN & VICINITY
BARRIER PLAN, PARIS RD. TO SO. POINT

BORING NO. 3-SPU	SAMPLE NO. 14-B
DEPTH/ELEV 51.9/-32.9	TECH. KOC
LABORATORY USAE WES	DATE 06 FEB 84

TRIAXIAL COMPRESSION TEST REPORT



Av w= 39.3 %
γ SAT= 113.5 pcf



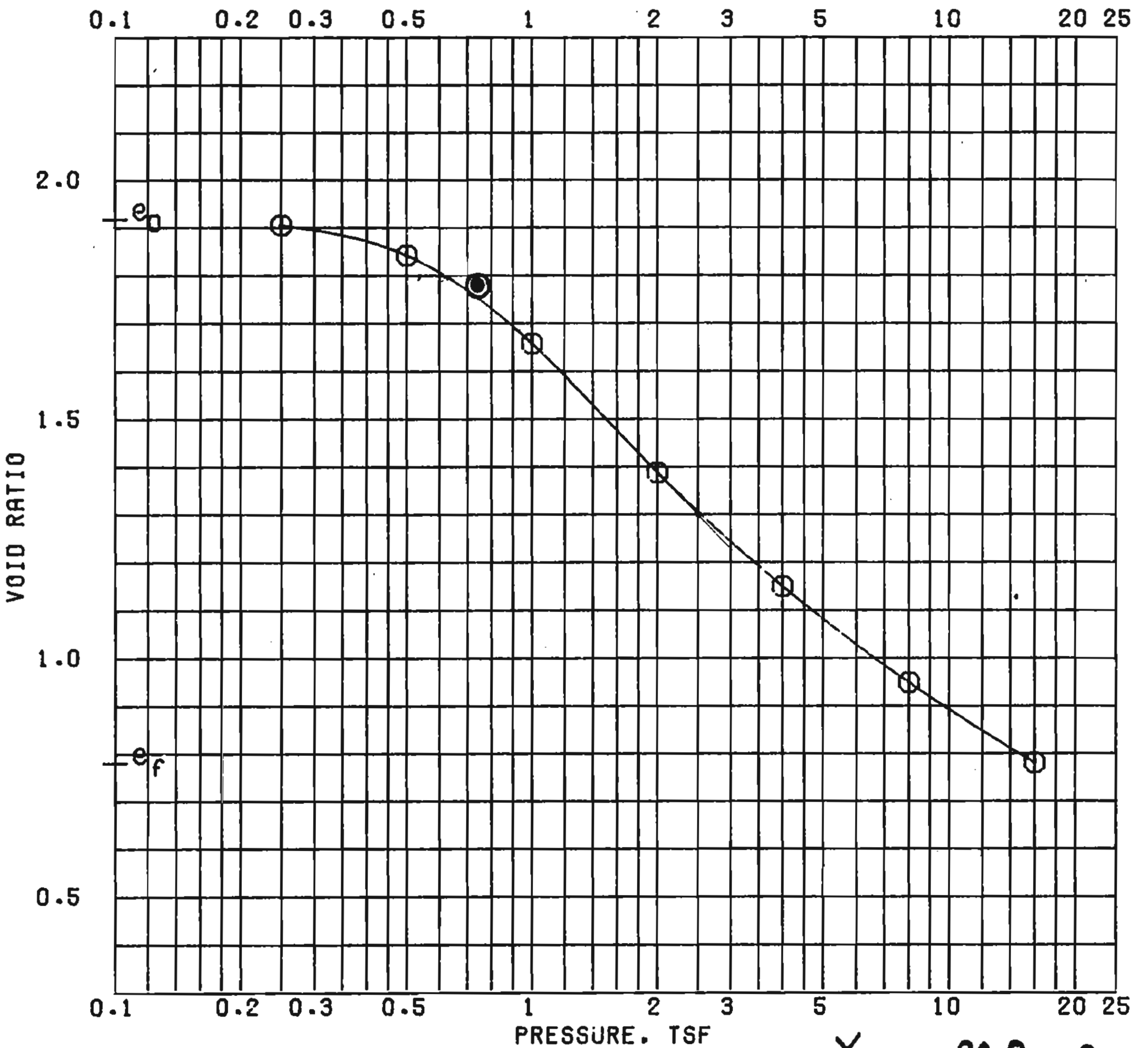
		SPECIMEN NO.	△1	Y2	X3	4
INITIAL		WATER CONTENT, %	39.8	38.4	39.6	
		DRY DENSITY, PCF	81.2	81.1	80.6	
		SATURATION, %	99.9	96.1	97.9	
		VOID RATIO	1.076	1.079	1.092	
BEFORE SHEAR		WATER CONTENT, %				
		DRY DENSITY, PCF				
		SATURATION, %				
		VOID RATIO				
		BACK PRESS., TSF				
		MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
		MAX. DEV. STRESS, TSF	1.25	1.48	1.55	
		TIME TO FAILURE, MIN.	3	14	14	
		RATE OF STRAIN INCR.%		6	6	
		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 & BROWN MOTTLED;
SILT POCKETS & LENSES

LL 63	PL 19	PI 44	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 3-SPU	SAMPLE NO. 18-B
	DEPTH/ELEV 68.1/-49.1	TECH. KOC
	LABORATORY USAE WES	DATE 06 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	

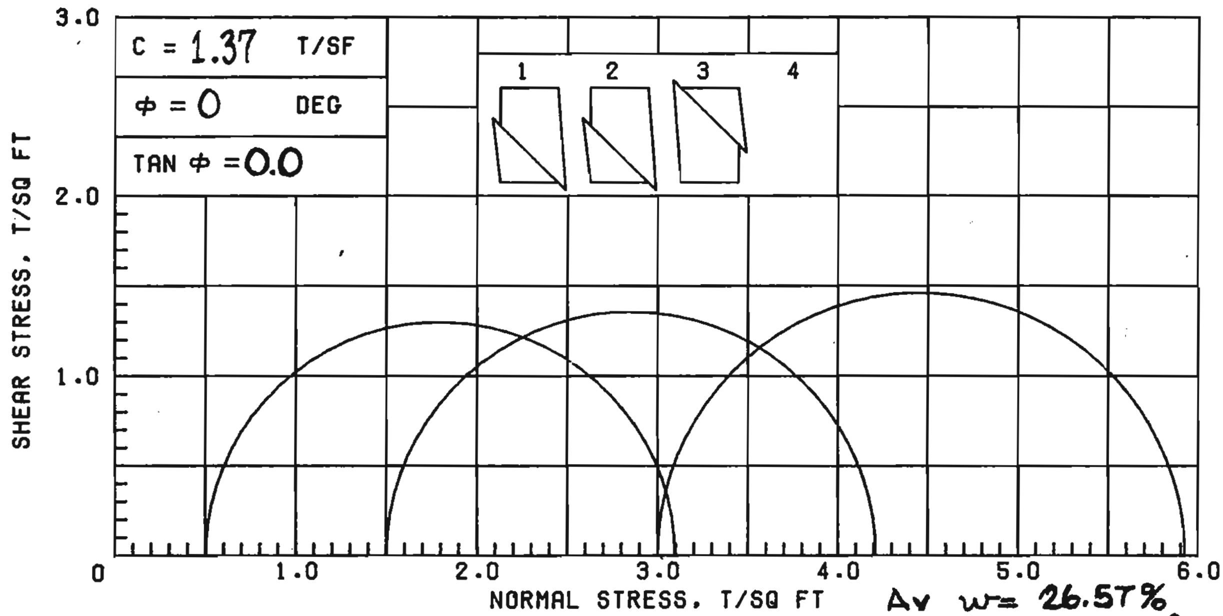


γ_{SAT} = 98.8 pcf

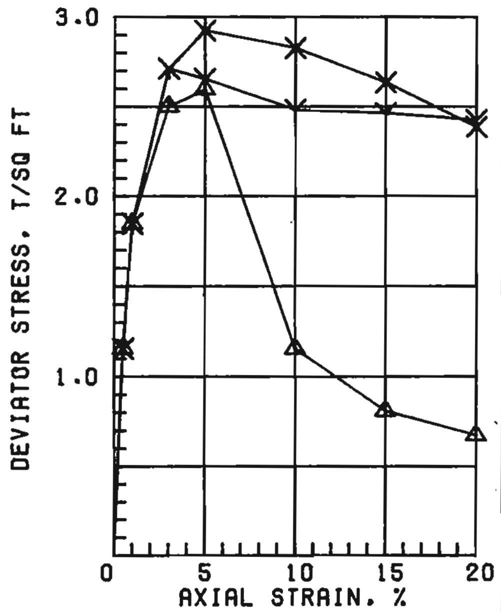
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.60	WATER CONTENT, %	69.5	30.8
PRECONSOL. PRESSURE, TSF	0.75	DRY DENSITY, PCF	57.8	94.9
COMPRESSION INDEX	0.912	SATURATION, %	98.0	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.915	0.777
DIA. IN 4.44	HT. IN 1.114	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY			
LL 85	PL 20	PI 65	PROJECT LAKE PONTCHARTRAIN & VICINITY
GS 2.70 (EST)	D_{10}		BARRIER PLAN, PARIS RD. TO SO. POINT
REMARKS		BORING NO. 3-SPU	SAMPLE NO. 10-D
		DEPTH/ELEV 37.8/-18.8	DATE 11 JAN 84

CONSOLIDATION TEST REPORT



Av w= 26.57%
γ_{SAT} = 123.4 pcf



	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	28.1	25.9	25.7	
	DRY DENSITY, PCF	94.6	97.9	98.1	
	SATURATION, %	97.1	97.0	96.5	
	VOID RATIO	0.782	0.721	0.719	
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	2.60	2.71	2.92	
	TIME TO FAILURE, MIN.	10	18	10	
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.43	1.43	1.43	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

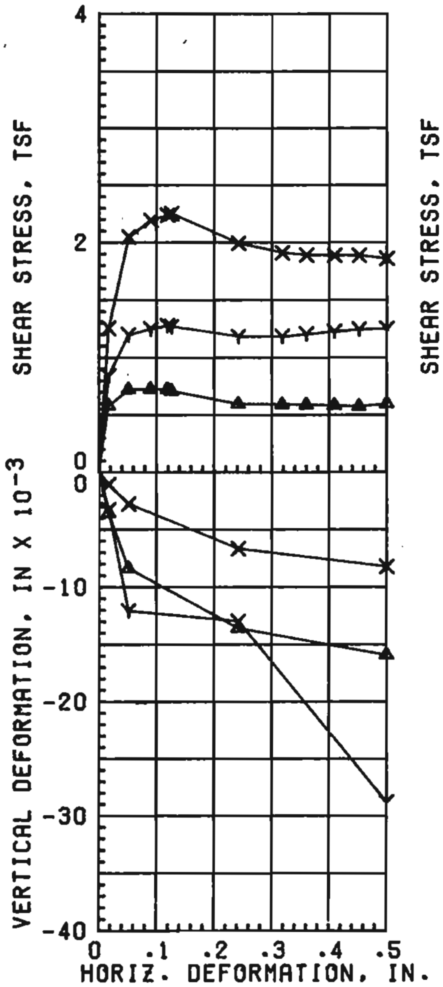
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY & BROWN MOTTLED; SILT POCKETS

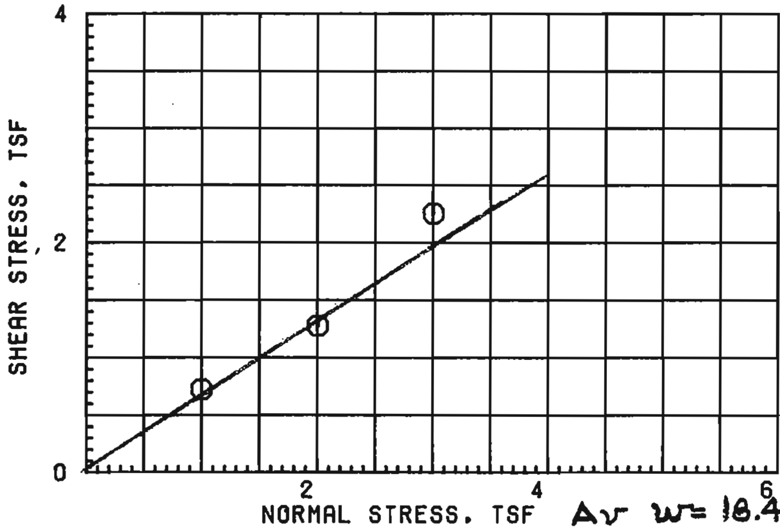
LL 57	PL 19	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
BORING NO. 5-SPU	SAMPLE NO. 2-B
DEPTH/ELEV 6.1/7.9	TECH. KOC
LABORATORY USAE WES	DATE 07 FEB 84

TRIAXIAL COMPRESSION TEST REPORT





Av w= 18.47%
γ_{SAT} = 127.5 pcf

ϕ = 33.4

TAN ϕ = 0.66

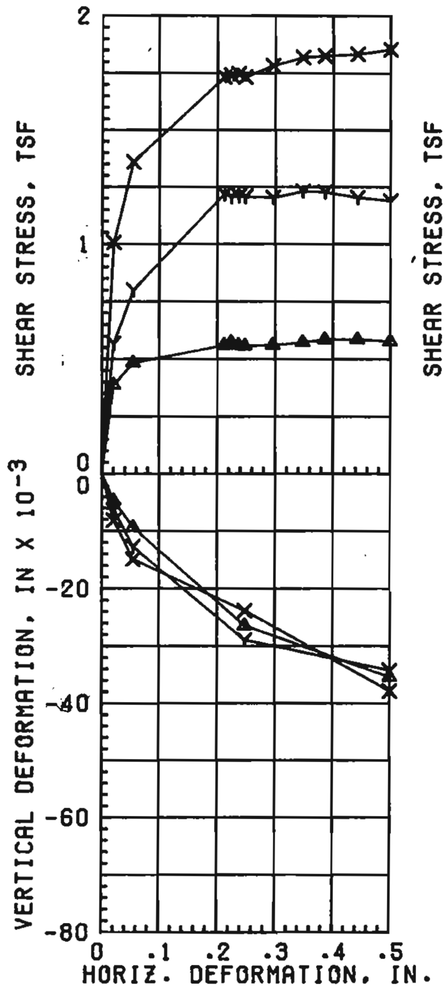
C = 0.0

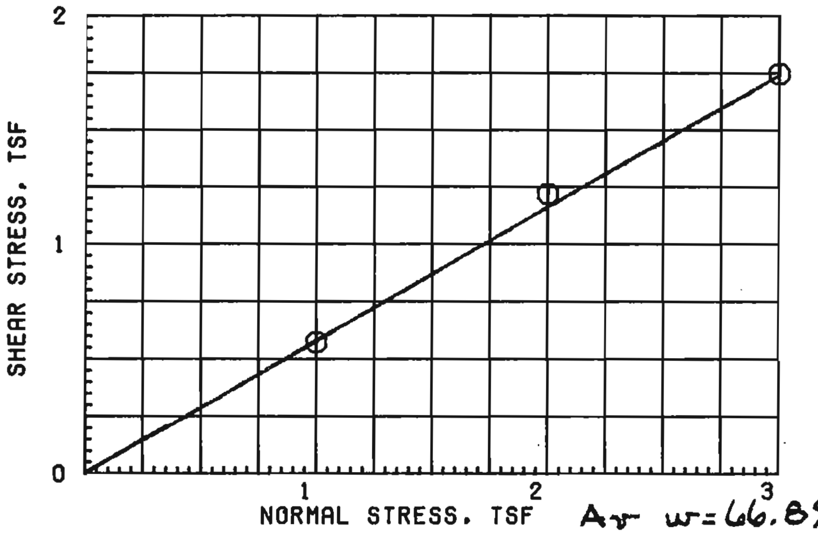
		TEST NO.	1 ▲	2 Y	3 X	
INITAL		WATER CONTENT, %	18.1	18.7	18.6	
		VOID RATIO	0.604	0.577	0.572	
		SATURATION, %	79.3	85.7	86.2	
		DRY DENSITY, PCF	103.1	104.9	105.2	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	16.2	15.8	14.2	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.72	1.27	2.25	
TIME TO FAILURE, MIN			494	653	691	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF						

TYPE SPECIMEN UNDISTURBED			3.00 IN. SQUARE	0.553 IN. THICK
CLASSIFICATION SAND (SP); LIGHT BROWN				
LL	PL	PI		GS 2.65 (EST)

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY	
	BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 5-SPU	SAMPLE 6-B
	DEPTH/ELEV 20.0/-6.0	DATE 15 FEB 84

DIRECT SHEAR TEST REPORT





Av w = 66.8%
γ_{sat} = 95.8pcf

		TEST NO.	1 ▲	2 Y	3 X	
INITAL		WATER CONTENT, %	72.1	66.9	61.4	
		VOID RATIO	2.339	2.224	2.036	
		SATURATION, %	83.2	81.2	81.5	
		DRY DENSITY, PCF	50.5	52.3	55.5	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			3	4	2	
FINAL		WATER CONTENT, %	135.1	125.0	46.0	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.57	1.22	1.75	
TIME TO FAILURE, MIN			1229	1163	1300	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF						

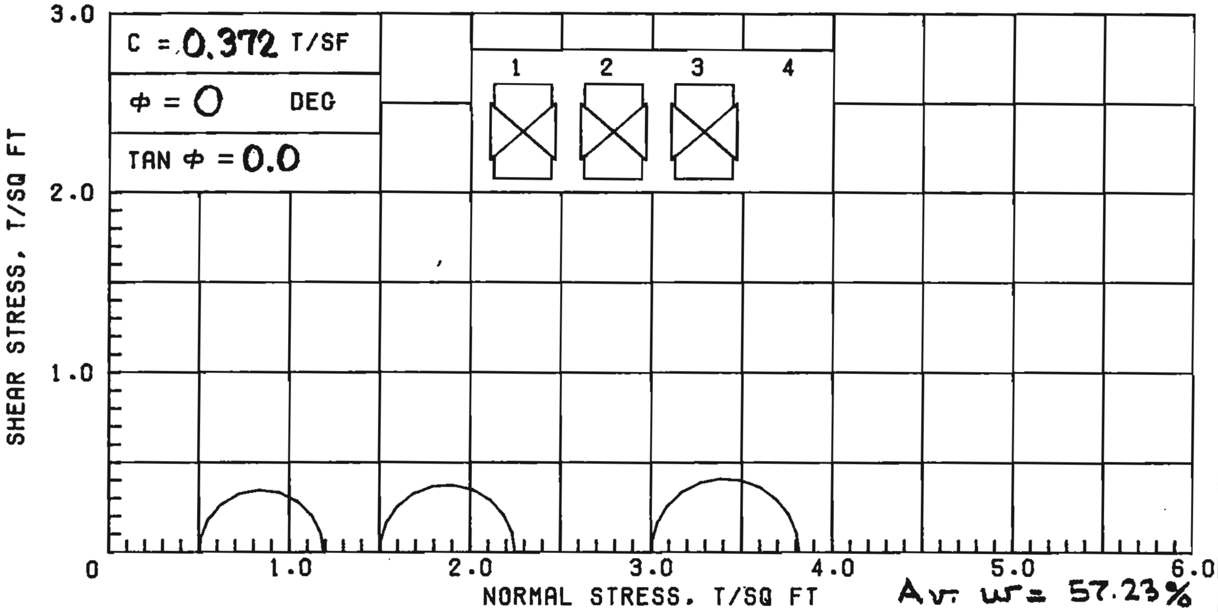
ϕ = 29.7°

TAN ϕ = 0.5

C = 0.0

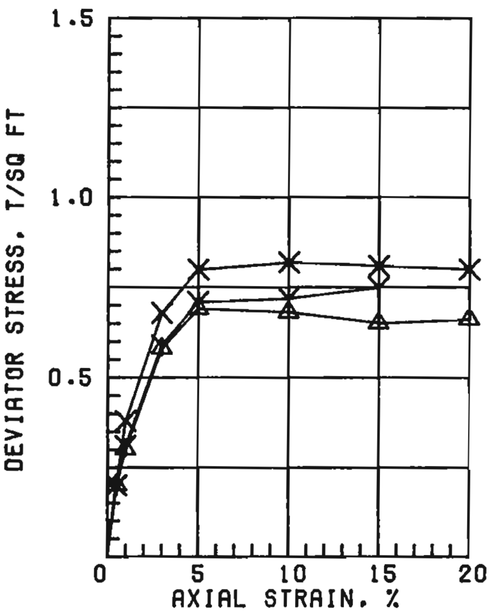
TYPE SPECIMEN UNDISTURBED			3.00 IN. SQUARE	0.553 IN. THICK
CLASSIFICATION ORGANIC CLAY (OH), DARK BROWN				
LL	PL	PI		GS 2.70 (EST)

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY	
	BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 5-SPU	SAMPLE 8-B
	DEPTH/ELEV 38.0/-14.0 (-26)	DATE 21 FEB 84
	DIRECT SHEAR TEST REPORT	



Av. w = 57.23%

γ SAT = 102.7 pcf



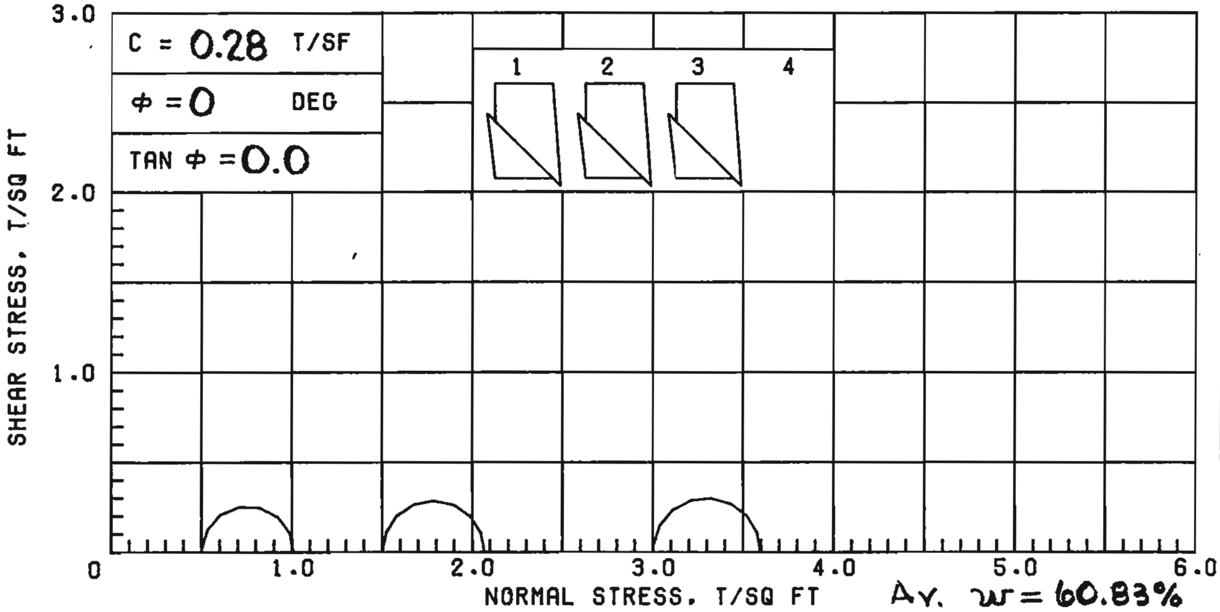
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	58.7	56.6	56.4	
	DRY DENSITY, PCF	63.1	64.4	64.3	
	SATURATION, %	94.7	94.6	94.0	
	VOID RATIO	1.673	1.616	1.621	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.69	0.75	0.82	
TIME TO FAILURE, MIN.		10	30	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

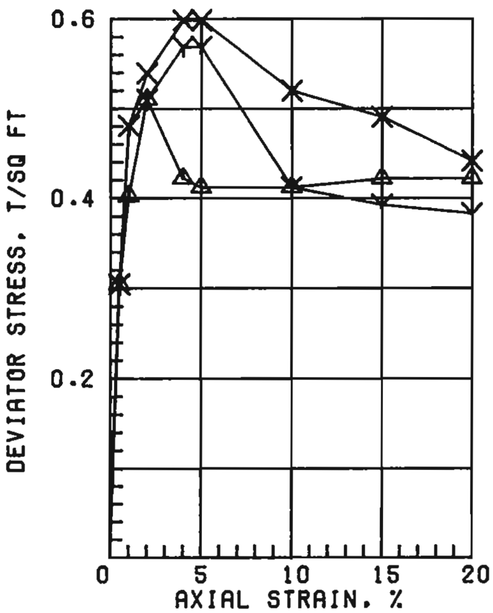
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES; ORGANIC MATERIAL

LL 76	PL 24	PI 52	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 5-SPU	SAMPLE NO. 8-C
	DEPTH/ELEV 29.0/-15.0	TECH. KOC
	LABORATORY USAE WES	DATE 07 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 60.83%
γ_{SAT} = 102.4 pcf



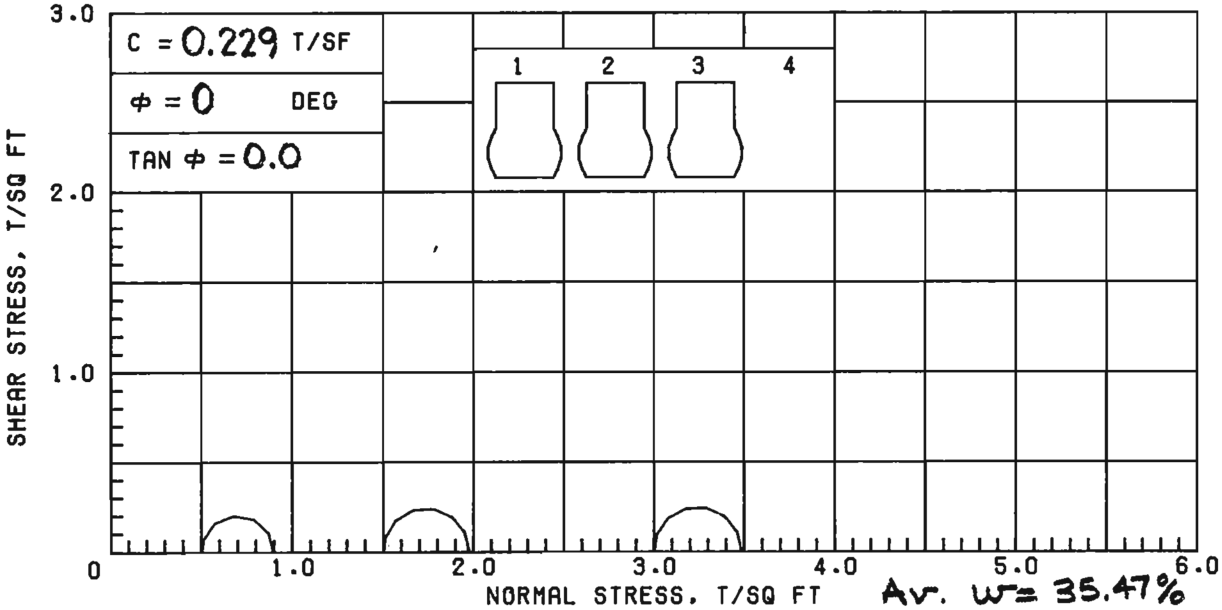
		SPECIMEN NO.	△1	Y2	X3	4
INITIAL		WATER CONTENT, %	61.3	61.0	60.2	
		DRY DENSITY, PCF	63.2	63.5	63.8	
		SATURATION, %	99.4	99.5	99.1	
		VOID RATIO	1.665	1.655	1.641	
BEFORE SHEAR		WATER CONTENT, %				
		DRY DENSITY, PCF				
		SATURATION, %				
		VOID RATIO				
		BACK PRESS., TSF				
		MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
		MAX. DEV. STRESS, TSF	0.51	0.57	0.60	
		TIME TO FAILURE, MIN.	4	8	8	
		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

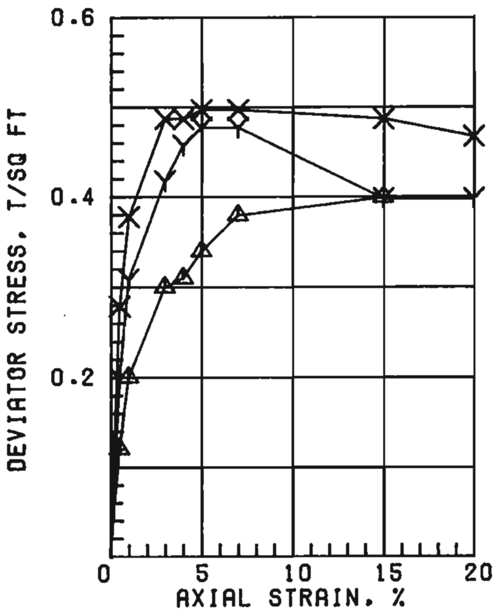
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 84	PL 25	PI 59	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY	
	BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 5-SPU	SAMPLE NO. 10-C
	DEPTH/ELEV 37.1/-23.1	TECH. KOC
	LABORATORY USAE WES	DATE 08 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 35.47%
γ_{SAT} = 115.6 pcf



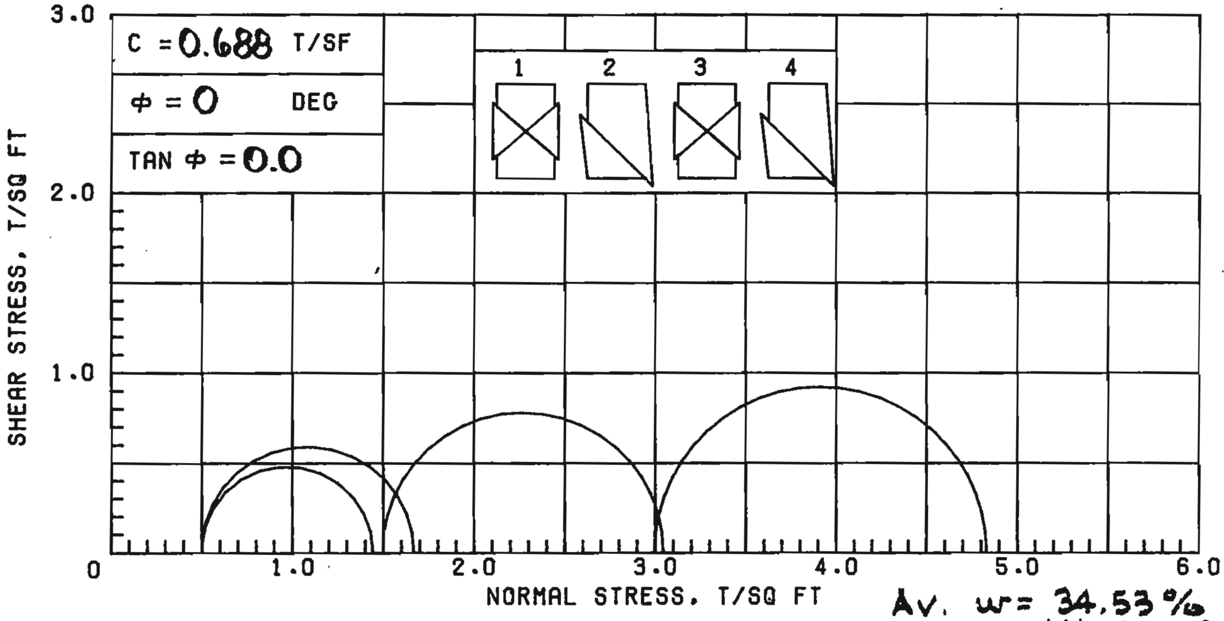
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	34.6	36.9	34.9	
	DRY DENSITY, PCF	83.8	84.3	85.3	
	SATURATION, %	92.4	99.7	96.6	
	VOID RATIO	1.011	0.999	0.975	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.40	0.48	0.49	
TIME TO FAILURE, MIN.		30	10	6	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.40	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

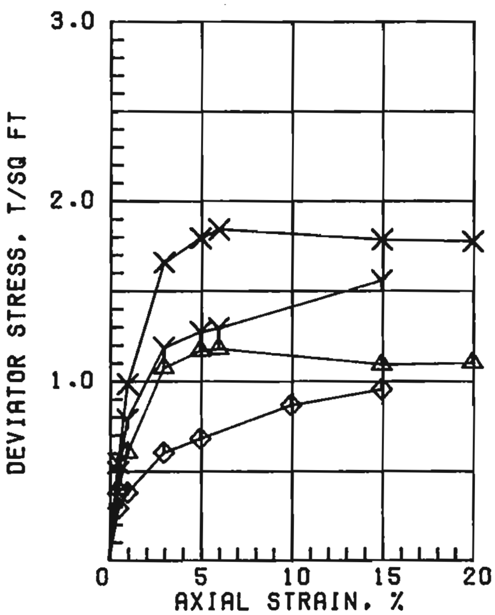
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SILT POCKETS; SHELL PARTICLES

LL 42	PL 13	PI 29	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT	
	BORING NO. 5-SPU	SAMPLE NO. 13-C
	DEPTH/ELEV 48.8/-34.8	TECH. KOC
	LABORATORY USAE WES	DATE 08 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 34.53 %
γSAT = 116.4 pcf



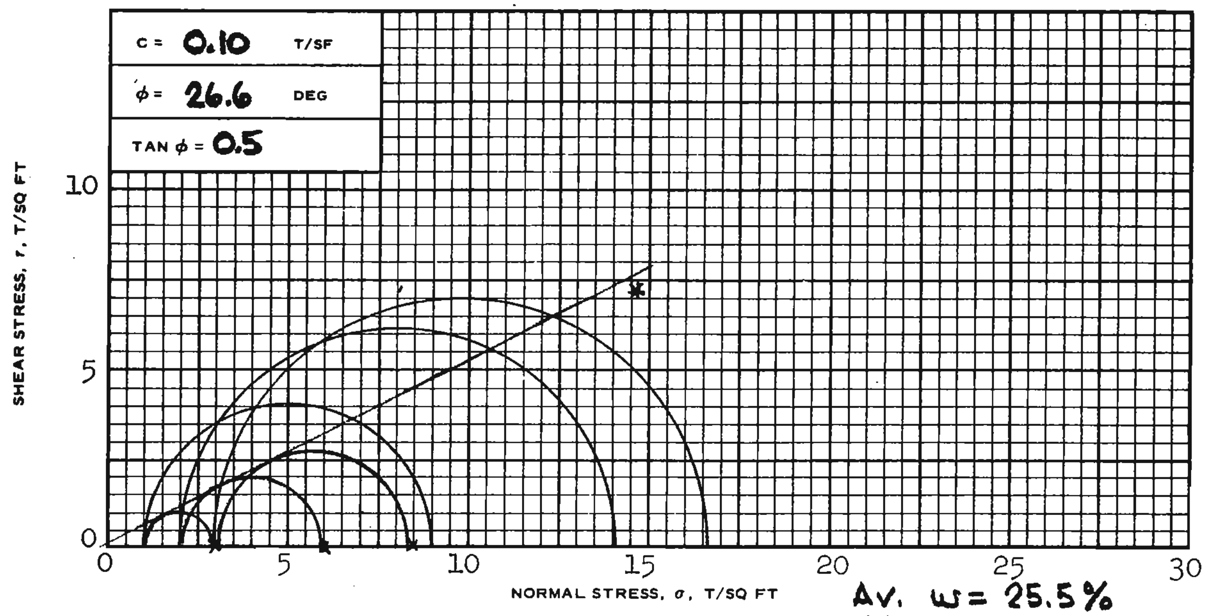
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	35.0	32.9	34.6	35.6
	DRY DENSITY, PCF	85.3	87.5	84.6	85.3
	SATURATION, %	96.9	95.8	94.1	98.4
	VOID RATIO	0.975	0.927	0.993	0.977
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	0.5
	MAX. DEV. STRESS, TSF	1.17	1.55	1.83	0.95
	TIME TO FAILURE, MIN.	12	30	12	30
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.42	1.42	1.42	1.42
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

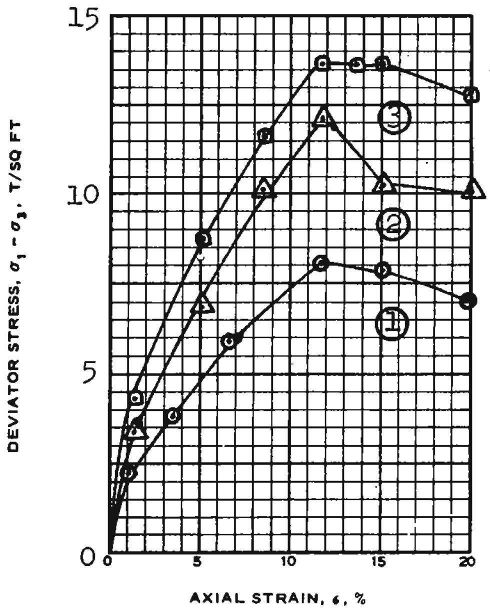
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 59	PL 19	PI 40	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VICINITY	
CHECK TEST SPECIMEN TAKEN	BARRIER PLAN, PARIS RD. TO SO. POINT	
FROM DIFFERENT LIFT.	BORING NO. 5-SPU	SAMPLE NO. 15-B
	DEPTH/ELEV 55.9/-41.9	TECH. KOC
	LABORATORY USAE WES	DATE 09 FEB 84
	TRIAXIAL COMPRESSION TEST REPORT	



AV. w = 25.5%
γ_{SAT} = 123.8 pcf



SPECIMEN NO.			1	2	3
INITIAL	WATER CONTENT, %	w_o	23.9	27.2	25.3
	DRY DENSITY LB/CU FT	γd_o	99.2	96.0	98.7
	SATURATION, %	S_o	93.8	98.6	98.7
	VOID RATIO	e_o	0.680	0.737	0.688
BEFORE SHEAR	WATER CONTENT, %	w_c	27.6	26.9	26.5
	DRY DENSITY LB/CU FT	γd_c	102.4	97.6	101.2
	SATURATION, %	S_c	100+	100+	100+
	VOID RATIO	e_c	0.628	0.708	0.647
	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		$(\sigma_1 - \sigma_3)_{MAX}$	8.02	12.05	13.65
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	1072	1072	1072
DEVIATOR STRESS AT MAX. PORE PRESS.		$\sigma_1 - \sigma_3$ *	2.0	4.0	5.5
INITIAL DIAMETER, IN.		D_o	1.37	1.38	1.37
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS CLAYEY SILT (CL-ML), GRAY; WITH SAND

LL 21 | PL 16 | PI 5 | Gs 2.67(EST) | TYPE OF SPECIMEN UNDISTURBED | TYPE OF TEST $\overline{R}$

REMARKS:

PROJECT LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT

BORING NO. 5-SPU | SAMPLE NO. 19-C

DEPTH/ELEV 72.5/-58.5

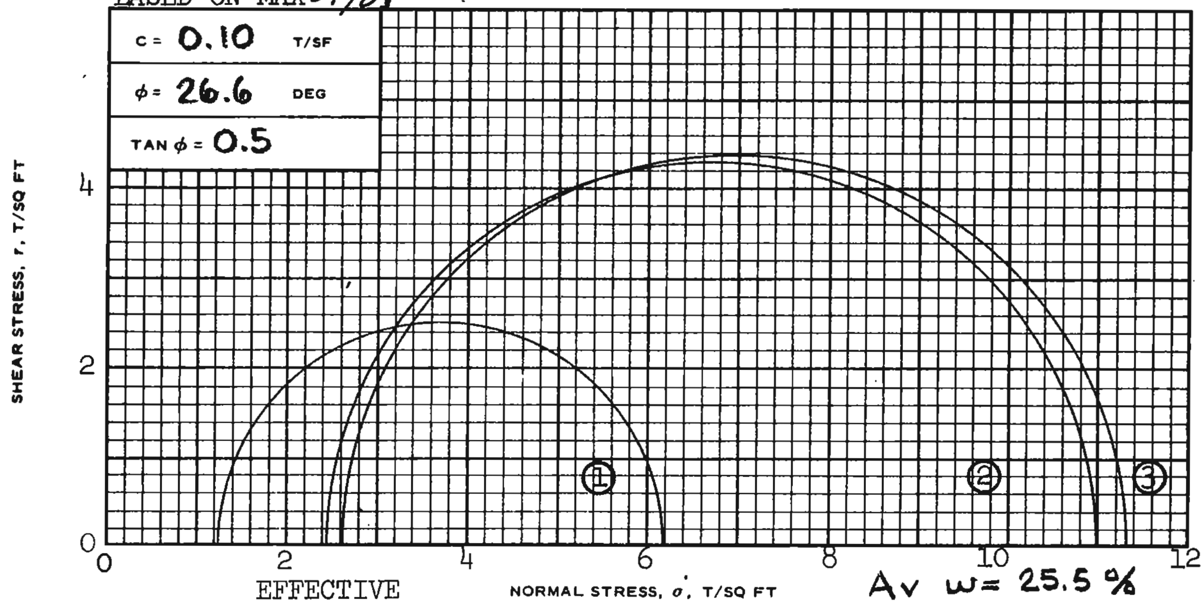
LABORATORY USAEWES | DATE 7 FEB 1984

SHEET 1 OF 2 | JMS **TRIAXIAL COMPRESSION TEST REPORT**

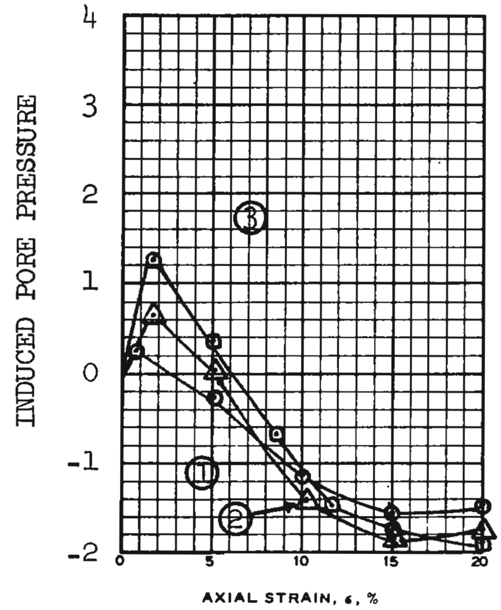
ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE

BASED ON MAX σ_1'/σ_3'

c =	0.10 T/SF
ϕ =	26.6 DEG
TAN ϕ =	0.5



Av w= 25.5 %
γ_{SAT} = 123.8 pcf



			1	2	3	
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	1.26	2.44	2.61	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	4.92	8.56	8.71	
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 LAKE PONTCHARTRAIN & VICINITY BARRIER PLAN, PARIS RD. TO SO. POINT

BORING NO. 5-SPU | SAMPLE NO. 19-C

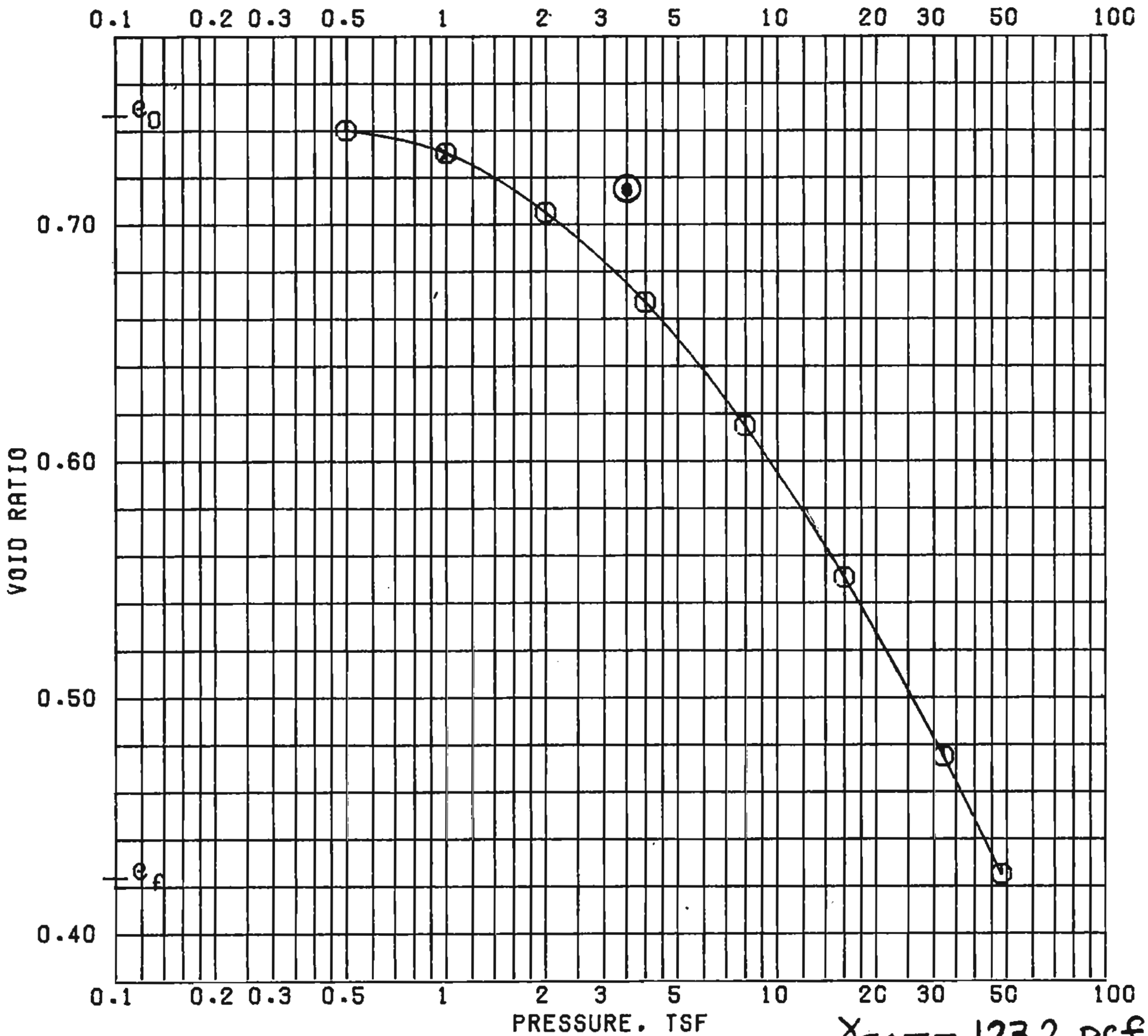
DEPTH/ELEV 72.5/-58.5

LABORATORY USAEWES | DATE 7 FEB 1984

SHEET 2 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE



γ_{SAT} = 123.2 pcf

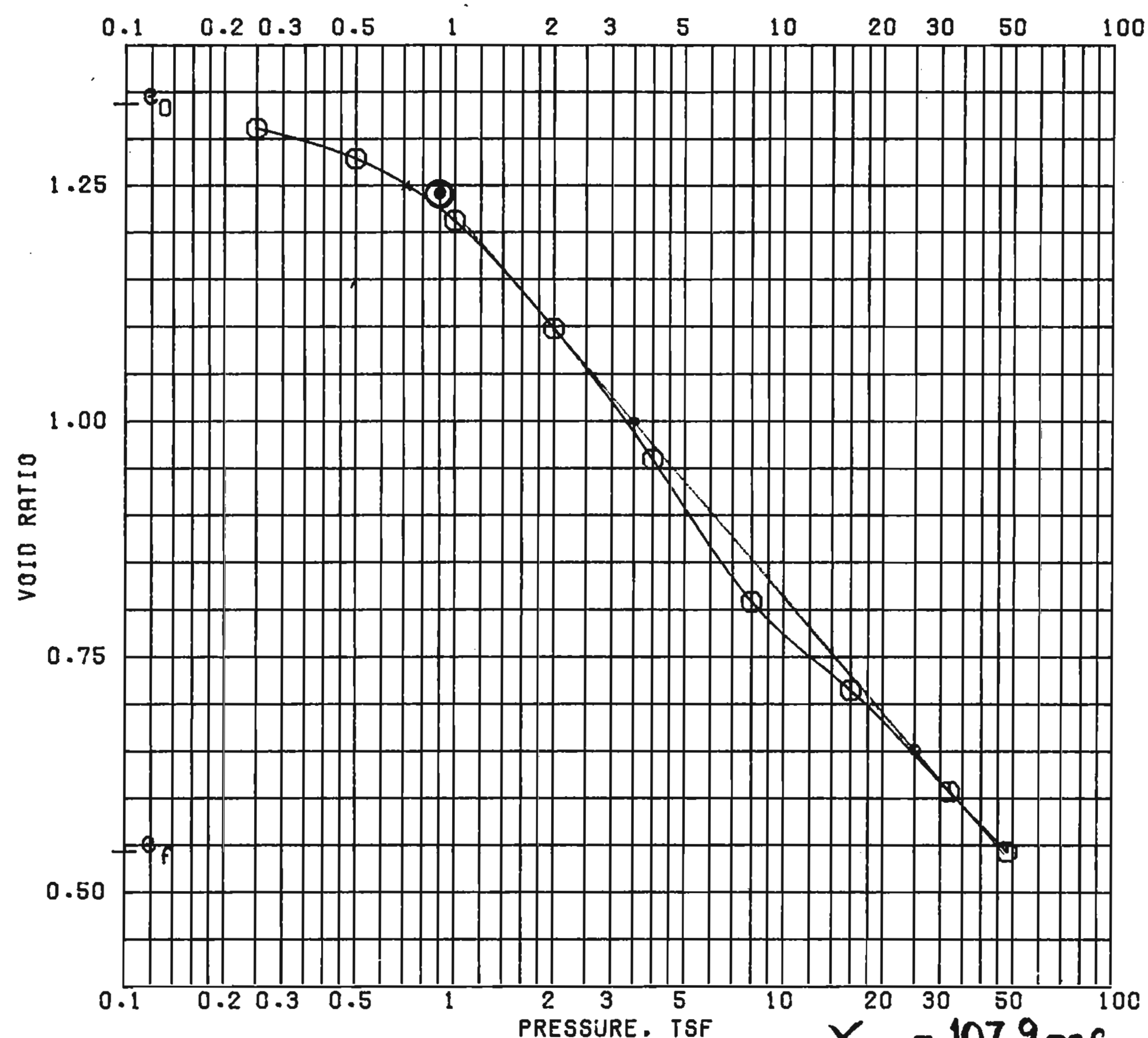
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.25	WATER CONTENT, %	26.4	17.3
PRECONSOL. PRESSURE, TSF	3.5	DRY DENSITY, PCF	96.6	118.4
COMPRESSION INDEX	0.247	SATURATION, %	95.7	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.746	0.423
DIA. IN 4.44	HT. IN 1.121	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), LIGHT GRAY

LL 54	PL 17	PI 37	PROJECT LAKE PONTCHARTRAIN & VICINITY
GS 2.70 (EST)	D_{10}		BARRIER PLAN, PARIS RD. TO SO. POINT

REMARKS	BORING NO. 5-SPU	SAMPLE NO. 3-B
	DEPTH/ELEV 8.5/+5.5	DATE 11 JAN 84

CONSOLIDATION TEST REPORT

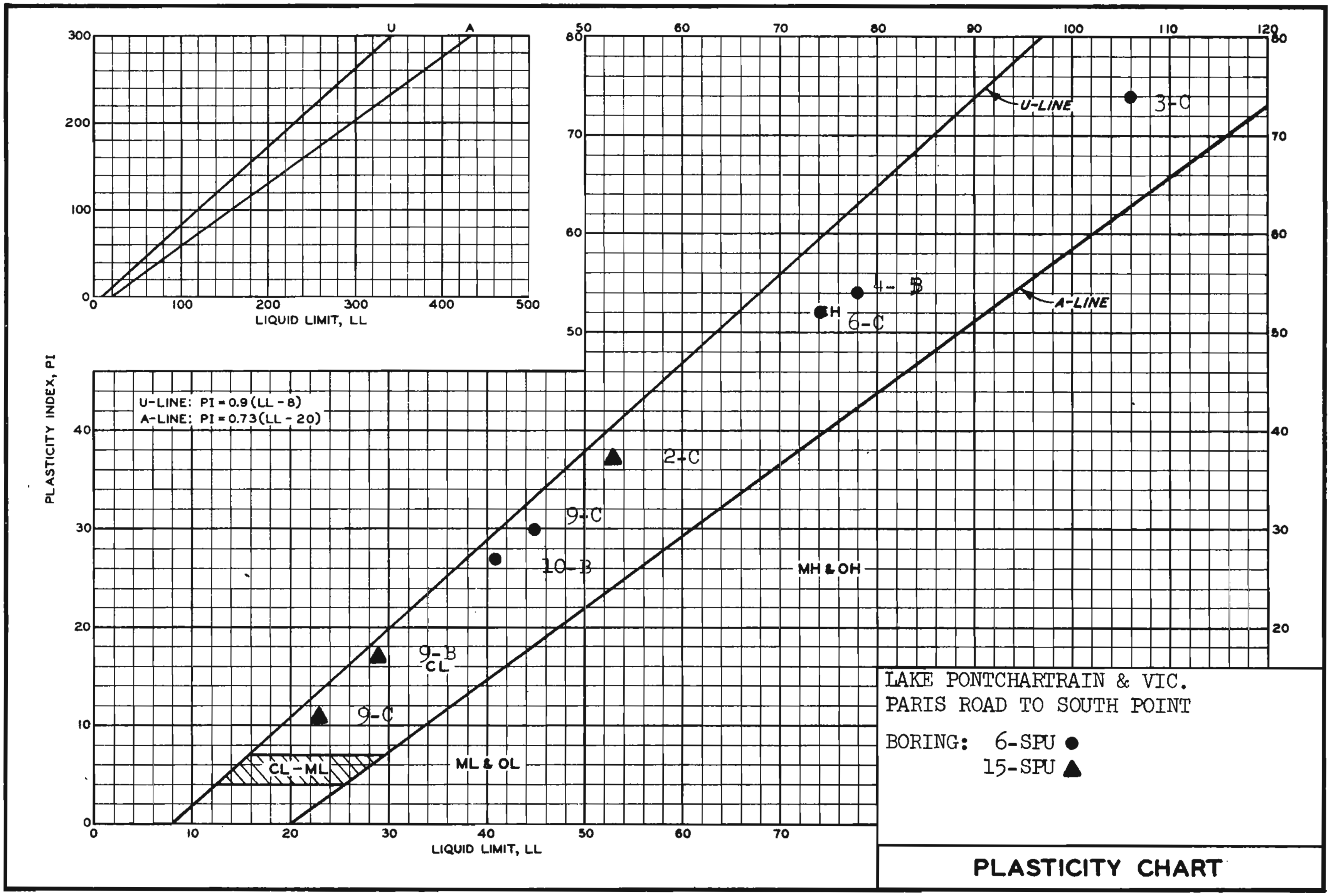


$\gamma_{SAT} = 107.9$ pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	46.3	20.3
PRECONSOL. PRESSURE, TSF	0.90	DRY DENSITY, PCF	72.2	109.4
COMPRESSION INDEX	0.410	SATURATION, %	93.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.336	0.541
DIA. IN 4.44	HT. IN 1.134	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; FINE SAND POCKETS				
LL 49	PL 15	PI 34	PROJECT LAKR PONTCHARTRAIN & VICINITY	
GS 2.70 (EST)	D_{10}		BARRIER PLAN, PARIS RD. TO SO. POINT	
REMARKS			BORING NO. 5-SPU	SAMPLE NO. 11-D
			DEPTH/ELEV 42.0/-28.0	DATE 16 JAN 84
			CONSOLIDATION TEST REPORT	

SHEET 1 OF 11

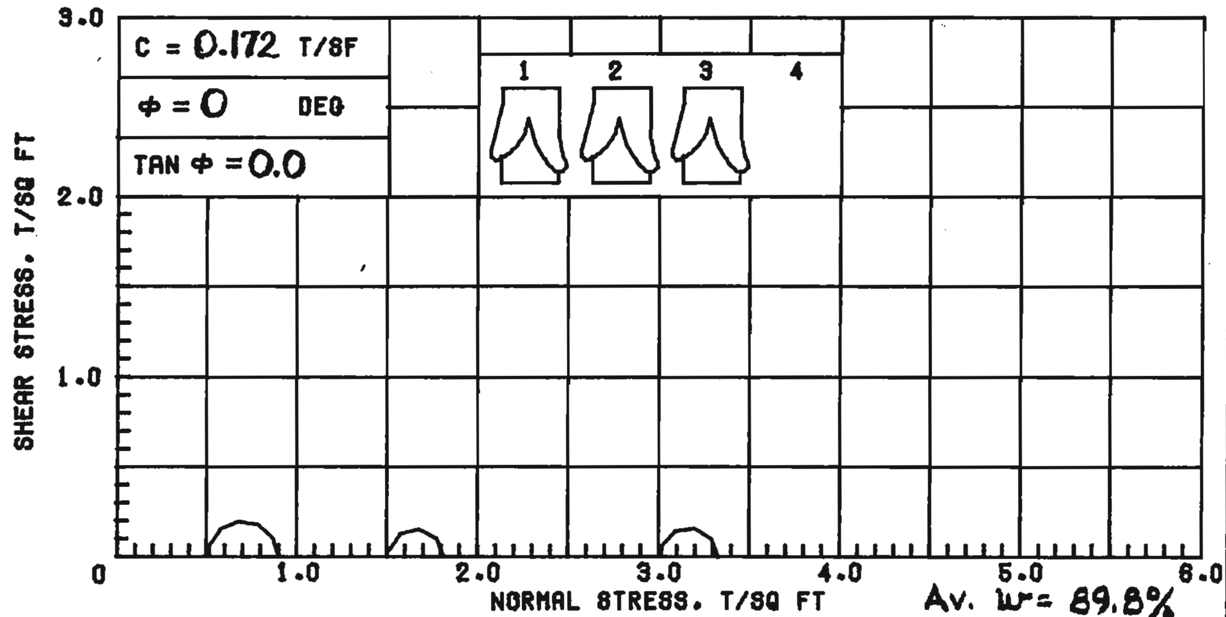


LAKE PONTCHARTRAIN & VIC.
PARIS ROAD TO SOUTH POINT

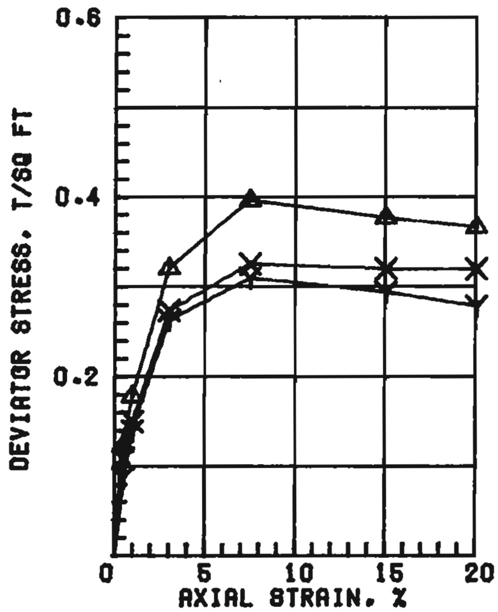
BORING: 6-SPU ●
15-SPU ▲

PLASTICITY CHART

ENG FORM JUN 70 4334 (E M 1110-2-1906) TRANSLUCENT



Av. w = 89.8%
γ_{SAT} = 93.3 pcf



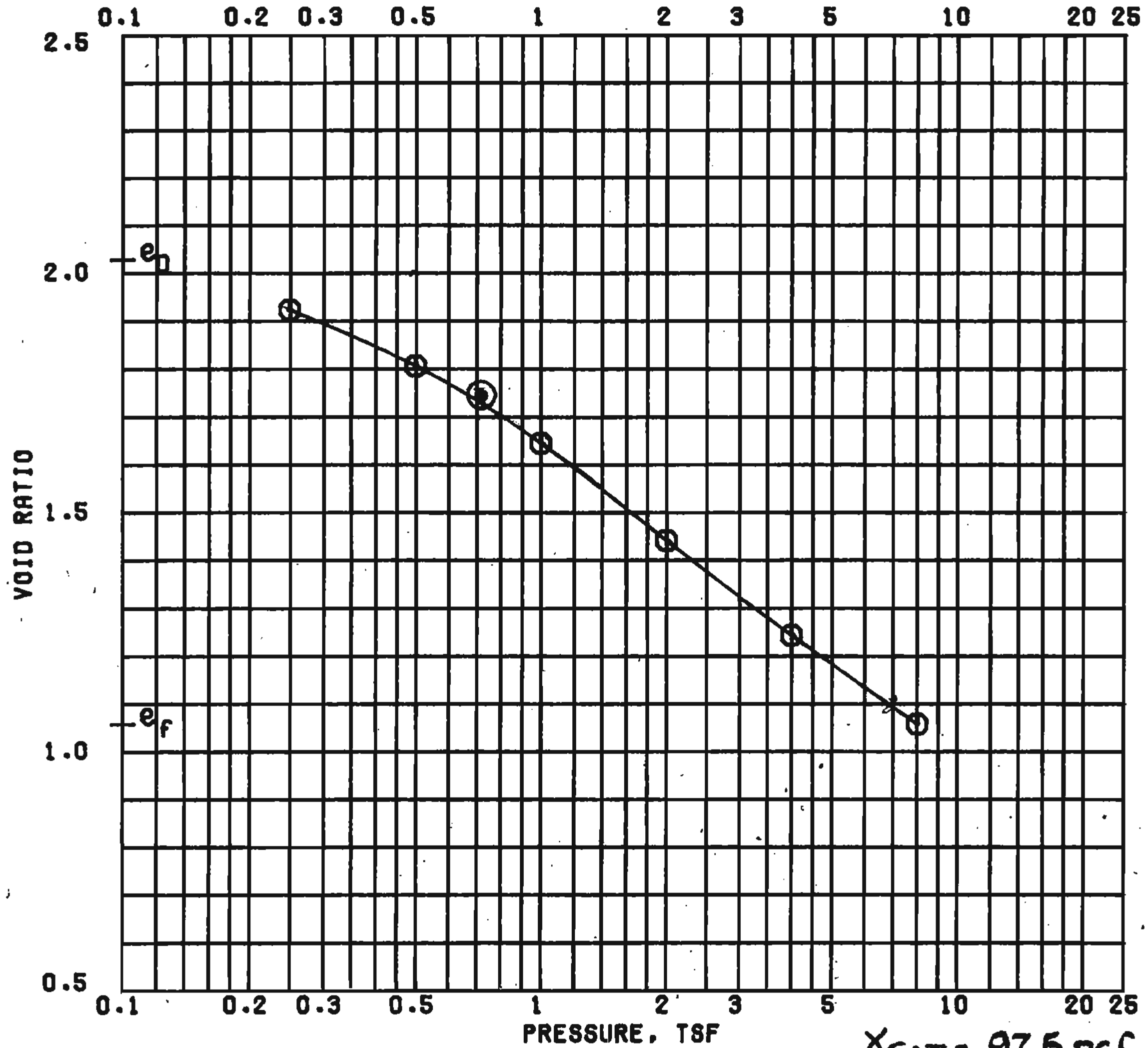
	SPECIMEN NO.	Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	76.9	96.5	96.0	
	DRY DENSITY, PCF	53.8	45.8	45.9	
	SATURATION, %	97.2	97.2	96.9	
	VOID RATIO	2.135	2.680	2.674	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.40	0.31	0.32	
	TIME TO FAILURE, MIN.	15	17	30	
	RATE OF STRAIN INCR.,%				
	INITIAL DIAMETER, IN.	1.39	1.38	1.38	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), DARK GRAY

LL 106	PL 32	PI 74	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 6-SPU	SAMPLE NO. 3-C
	DEPTH/ELEV 8.6	TECH. PJR
	LABORATORY USAE WES	DATE 15 MAY 84
	TRIAXIAL COMPRESSION TEST REPORT	



γ_{SAT} = 97.5 pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.50	WATER CONTENT, %	71.2	39.4
PRECONSOL. PRESSURE, TSF	0.71	DRY DENSITY, PCF	55.7	82.1
COMPRESSION INDEX	0.656	SATURATION, %	94.9	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.024	1.054
DIA. IN 4.44	HT. IN 1.129	BACK PRESSURE, TSF		

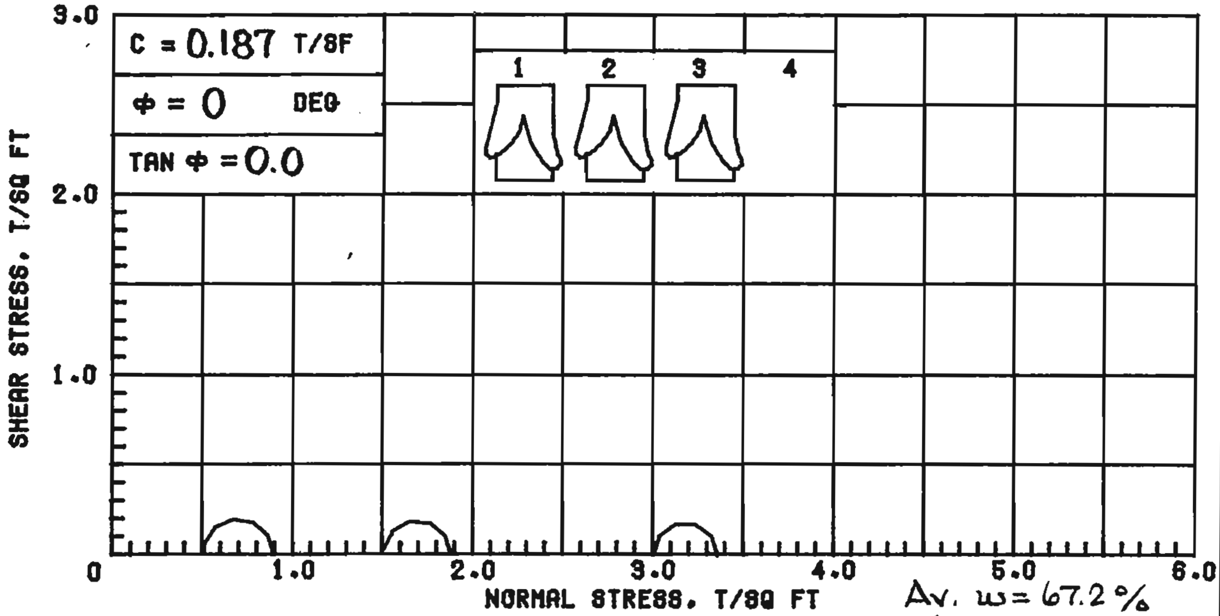
CLASSIFICATION PLASTIC CLAY (CH), GRAY; DECAYED WOOD		
LL 78	PL 24	PI 54
GS 2.70 (EST)	D_{10}	
REMARKS		

PROJECT LAKE PONTCHARTRAIN & VIC

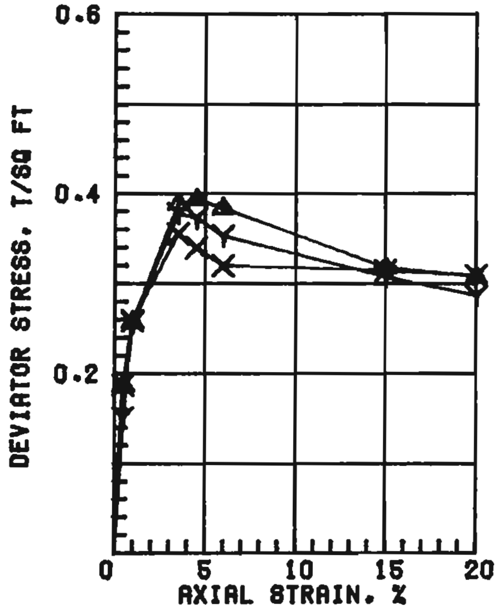
PARIS ROAD TO SOUTH POINT

BORING NO. 6-SPU	SAMPLE NO. 4-B
DEPTH/ELEV 11.9	DATE 10 JUL 84

CONSOLIDATION TEST REPORT



Av. w = 67.2 %
γ_{SAT} = 100.6 pcf



	SPECIMEN NO.	Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	66.9	66.7	68.0	
INITIAL	DRY DENSITY, PCF	60.3	60.4	59.8	
INITIAL	SATURATION, %	100+	100+	100+	
INITIAL	VOID RATIO	1.795	1.790	1.817	
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	0.39	0.38	0.35	
	TIME TO FAILURE, MIN.	11	16	18	
	RATE OF STRAIN INCR.%			6	
	INITIAL DIAMETER, IN.	1.39	1.40	1.39	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

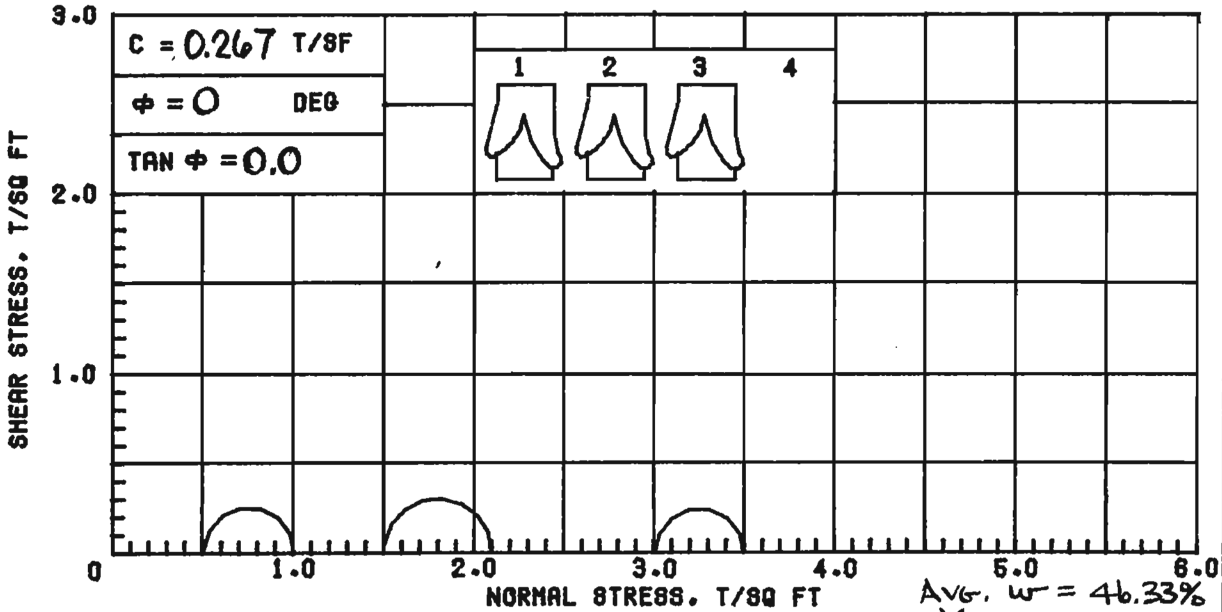
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 74	PL 22	PI 52	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

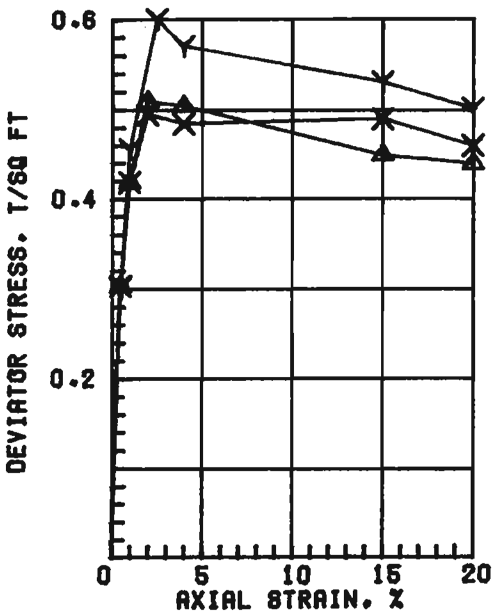
REMARKS:

PROJECT LAKE PONTCHARTRAIN & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 6-SPU	SAMPLE NO. 6-C
DEPTH/ELEV 21.0	TECH. PJR
LABORATORY USAE WES	DATE 15 MAY 84

TRIAXIAL COMPRESSION TEST REPORT



AVG. w = 46.33%
γ_{SAT} = 109.2 pcf



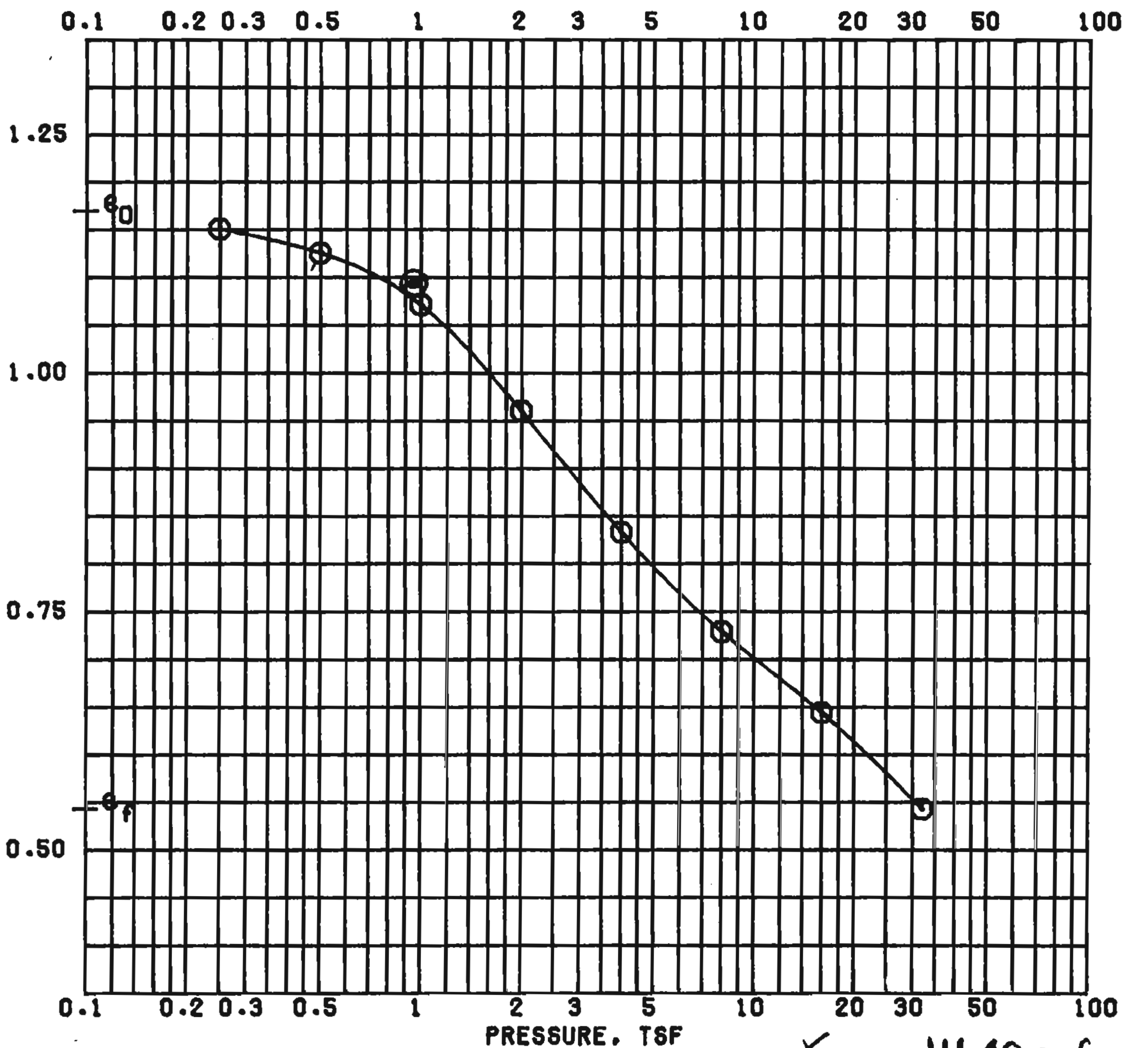
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	47.7	44.8	46.5	
	DRY DENSITY, PCF	73.4	75.6	73.9	
	SATURATION, %	99.4	98.4	98.0	
	VOID RATIO	1.296	1.230	1.281	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.51	0.60	0.49	
	TIME TO FAILURE, MIN.	4	17	20	
	RATE OF STRAIN INCR.%		6	4	
	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; FINE SAND POCKETS

LL 45	PL 15	PI 30	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 6-SPU	SAMPLE NO. 9-C
	DEPTH/ELEV 33.2	TECH. PJR
	LABORATORY USAE WES	DATE 16 MAY 84
	TRIAXIAL COMPRESSION TEST REPORT	



γ_{SAT} = 111.40 pcf

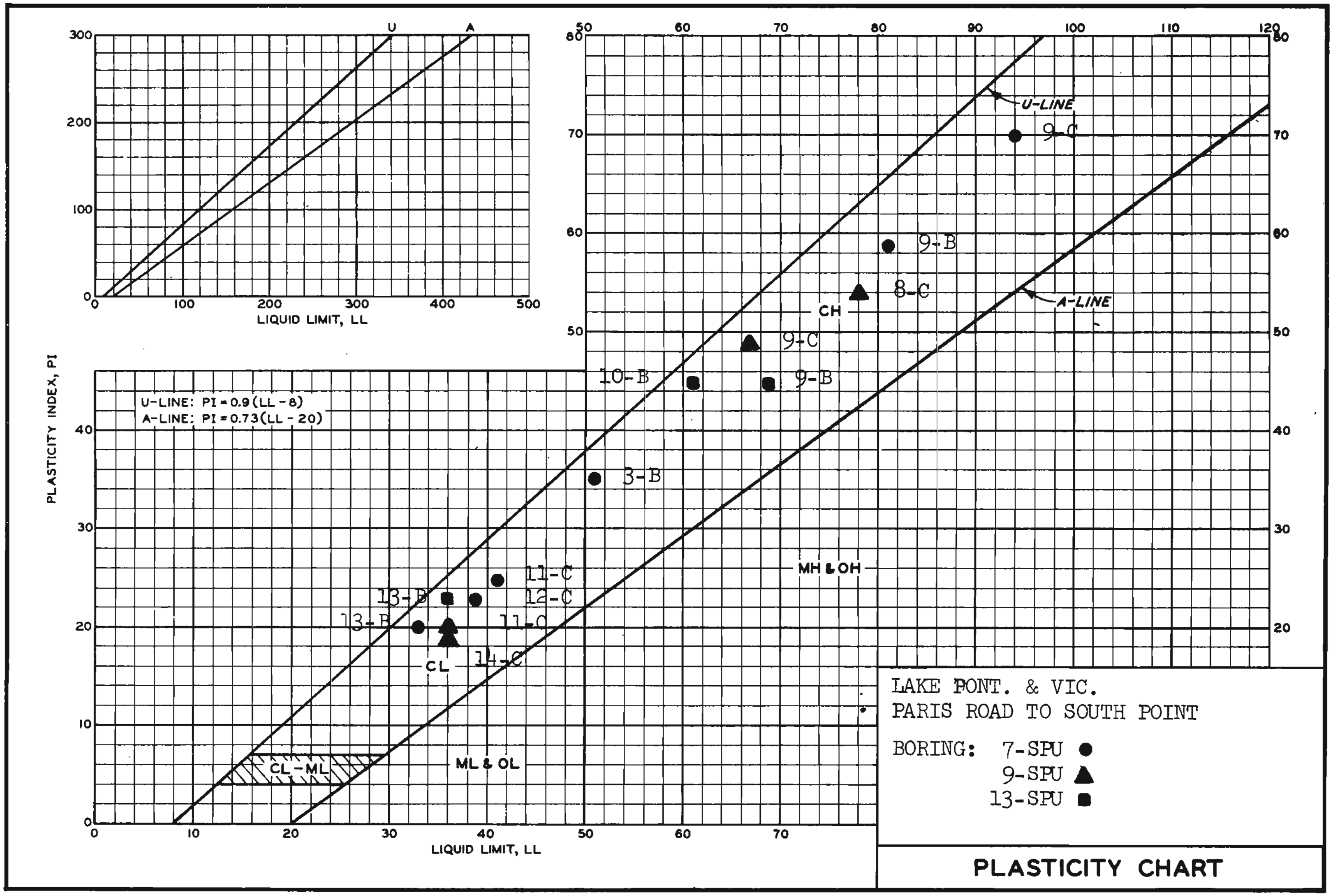
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.95	WATER CONTENT, %	40.9	20.9
PRECONSOL. PRESSURE, TSF	0.95	DRY DENSITY, PCF	77.8	109.4
COMPRESSION INDEX	0.394	SATURATION, %	94.7	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.168	0.541
DIA. IN 4.44	HT. IN 1.145	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), GRAY; SILT POCKETS

LL 41	PL 14	PI 27	PROJECT LAKE PONTCHARTRAIN & VIC
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT
REMARKS		BORING NO. 6-SPU	SAMPLE NO. 10-B
		DEPTH/ELEV 36.4	DATE 07 JUL 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 10



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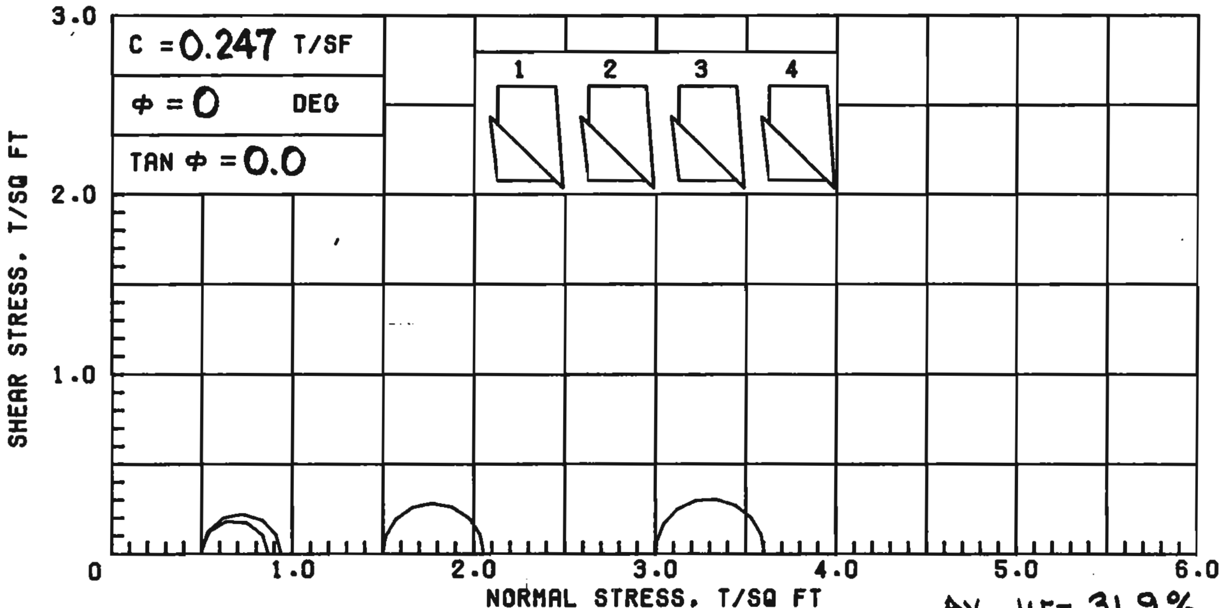
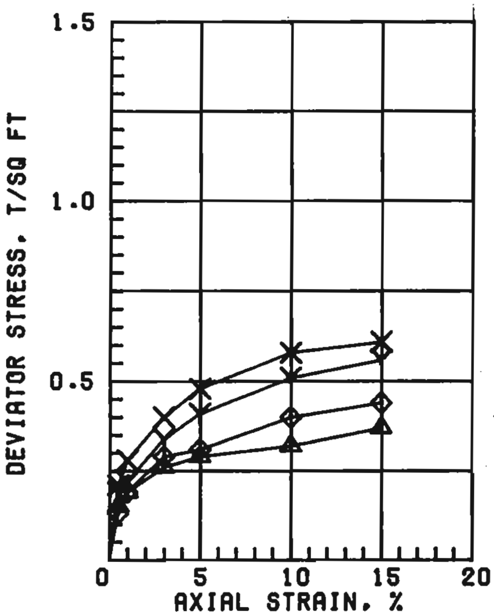


Av. w = 31.9%
γ sat = 118.8 pcf



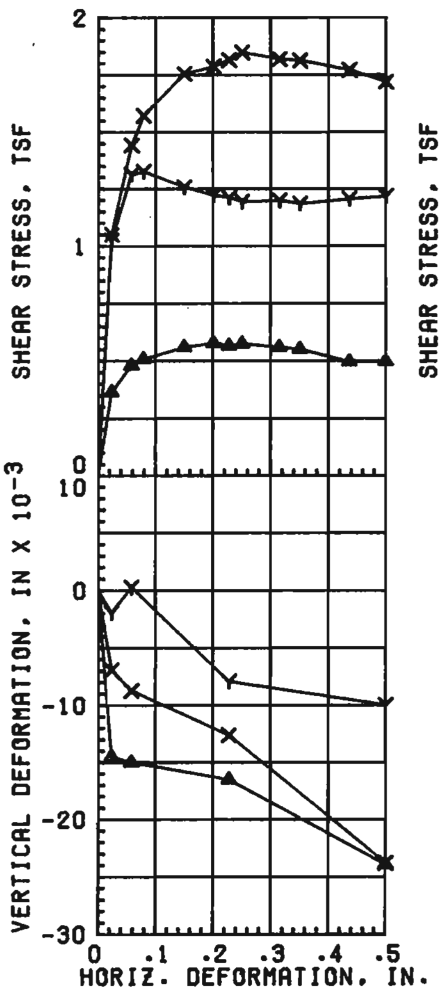
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	31.2	31.5	33.1	31.8
	DRY DENSITY, PCF	90.6	89.8	88.0	89.5
	SATURATION, %	98.0	97.1	97.7	97.1
	VOID RATIO	0.860	0.876	0.915	0.884
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	0.5
	MAX. DEV. STRESS, TSF	0.37	0.56	0.61	0.44
	TIME TO FAILURE, MIN.	30	30	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

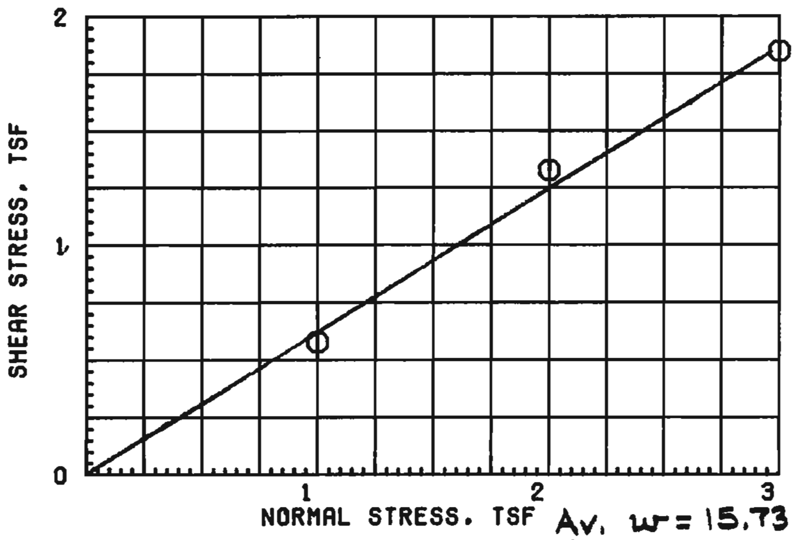
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY & BROWN MOTTLED; SILT POCKETS

LL 51	PL 16	PI 35	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., & VIC.	
LIMITS ON MIXTURE OF MATERIAL.	PARIS ROAD TO SOUTH POINT	
	BORING NO. 7-SPU	SAMPLE NO. 3-B
	DEPTH/ELEV 7.6/7.72	TECH. KGC
	LABORATORY USAE WES	DATE 24 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	





Av. w = 15.73 %
γ_{SAT} = 129.22 pcf

ϕ = 31.8°

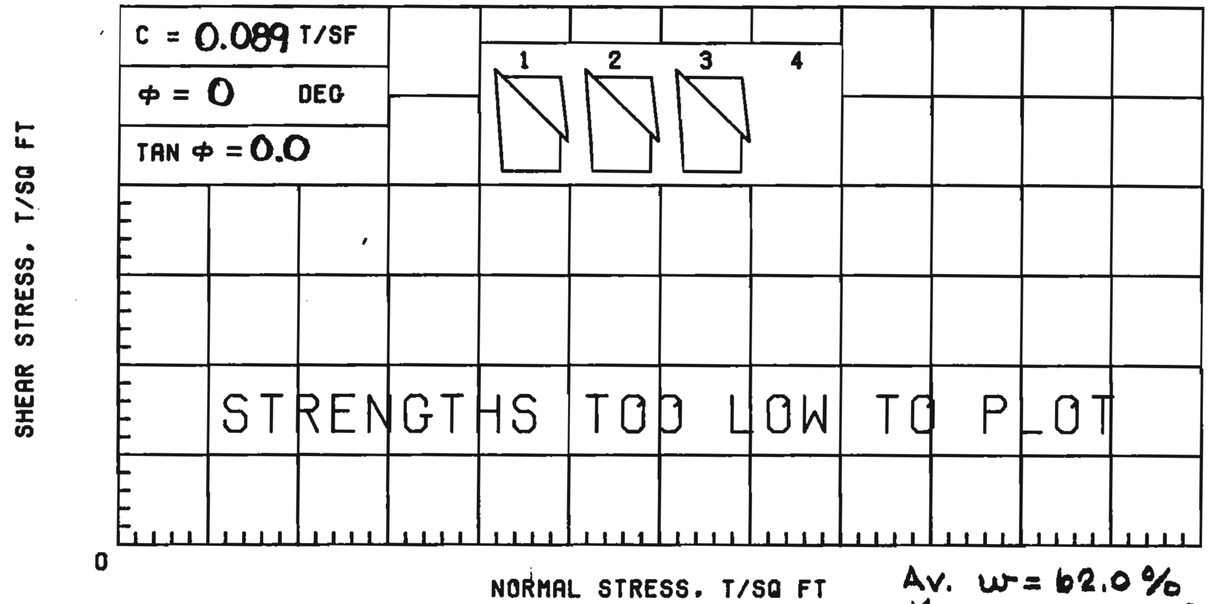
TAN ϕ = 0.619

C = 0

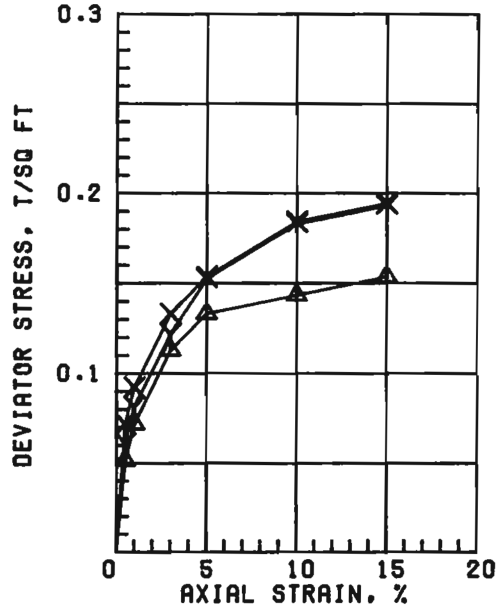
		1 ▲	2 Y	3 X	
	TEST NO.	1 ▲	2 Y	3 X	
INITAL	WATER CONTENT, %	15.5	15.1	16.6	
INITAL	VOID RATIO	0.566	0.550	0.566	
INITAL	SATURATION, %	73.1	73.2	78.2	
INITAL	DRY DENSITY, PCF	106.4	107.5	106.4	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	21.8	15.2	9.2	
FINAL	VOID RATIO				
FINAL	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.58	1.33	1.85	
TIME TO FAILURE, MIN		1103	433	1375	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

TYPE SPECIMEN UNDISTURBED			3.00 IN. SQUARE	0.553 IN. THICK
CLASSIFICATION SILTY SAND (SM), BROWN				
LL	PL	PI		GS 2.67 (EST)

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 7-SPU	SAMPLE 5-C
	DEPTH/ELEV 17.0/-1.68	DATE 25 APR 84
	DIRECT SHEAR TEST REPORT	



Av. w = 62.0 %
γSAT = 102.1 pcf



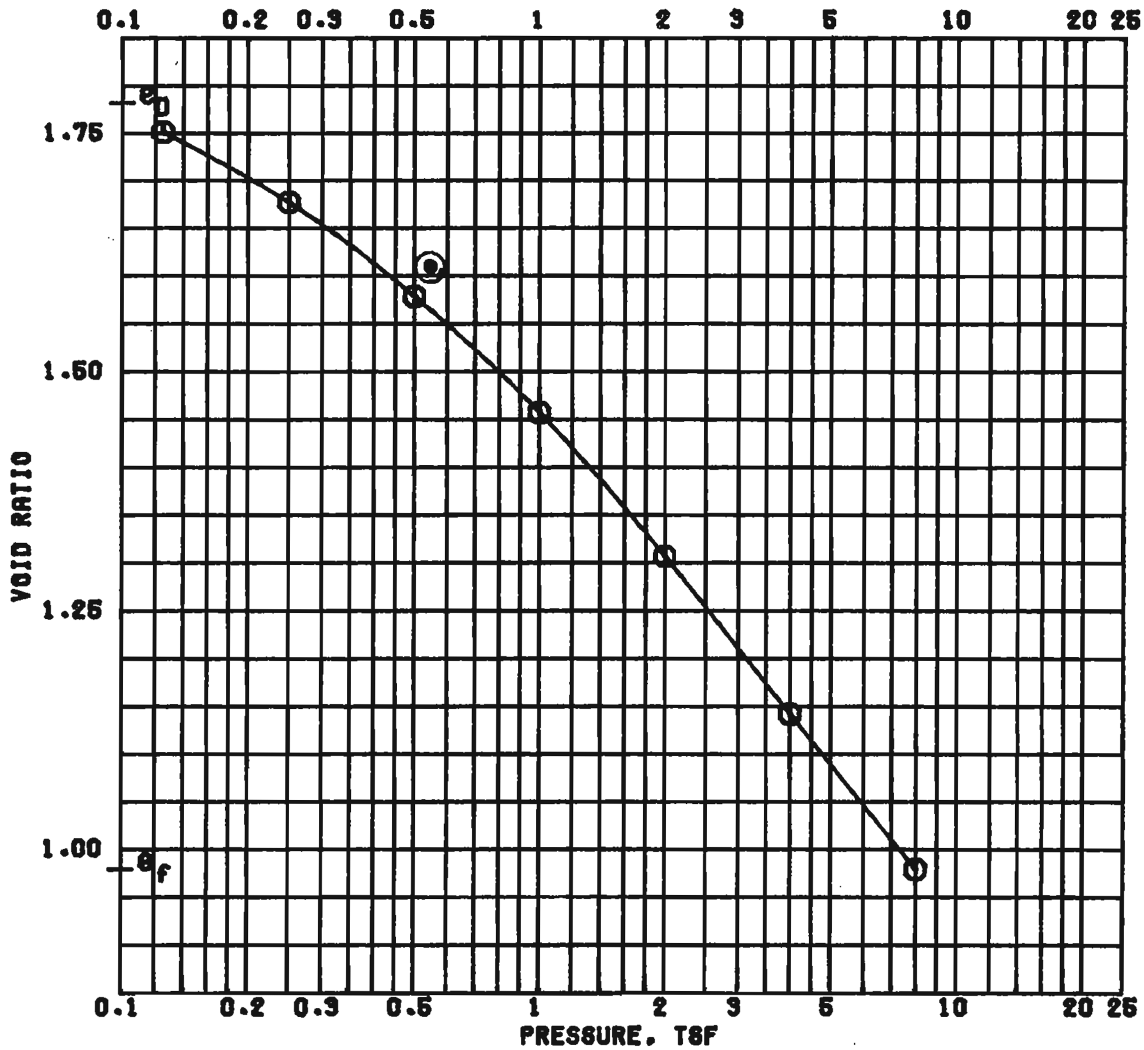
		△1	Y2	X3	4
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	63.5	61.0	61.4	
INITIAL	DRY DENSITY, PCF	62.0	63.8	63.0	
INITIAL	SATURATION, %	99.9	100+	98.8	
INITIAL	VOID RATIO	1.717	1.641	1.677	
BEFORE SHEAR	WATER CONTENT, %				
BEFORE SHEAR	DRY DENSITY, PCF				
BEFORE SHEAR	SATURATION, %				
BEFORE SHEAR	VOID RATIO				
BEFORE SHEAR	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.15	0.19	0.19	
TIME TO FAILURE, MIN.		30	30	30	
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

LL 81	PL 22	PI 59	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 7-SPU	SAMPLE NO. 9-B
	DEPTH/ELEV 31.9/-16.58	TECH. KOC
	LABORATORY USAE WES	DATE 24 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



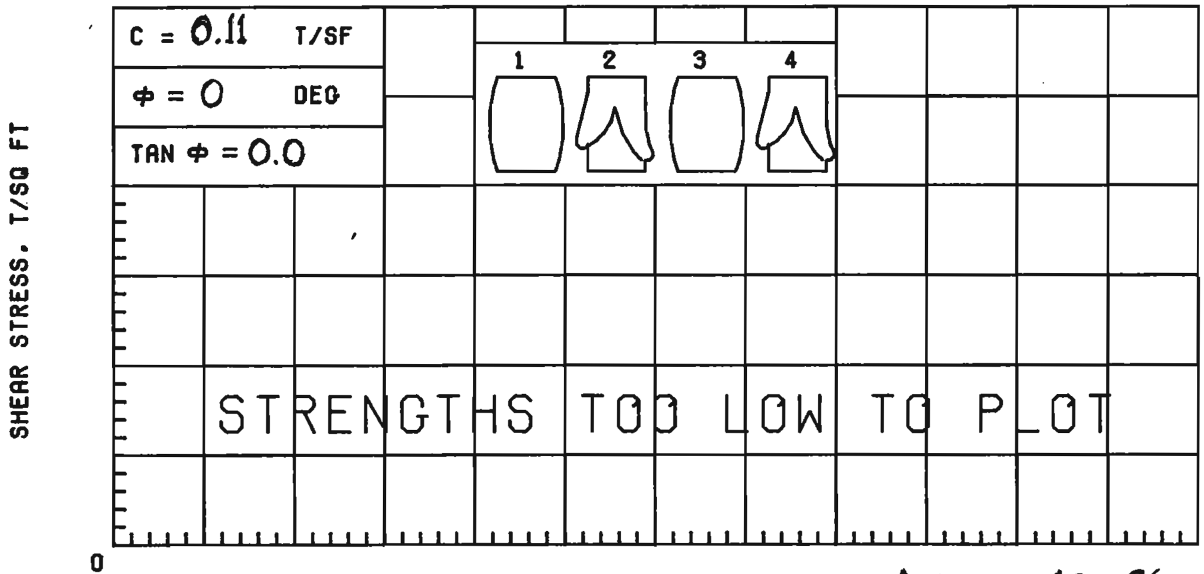
$\gamma_{SAT} = 100.6$ pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.40	WATER CONTENT, %	64.2	36.5
PRECONSOL. PRESSURE, TSF	0.55	DRY DENSITY, PCF	60.6	85.2
COMPRESSION INDEX	0.536	SATURATION, %	97.3	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.781	0.977
DIA. IN 4.44	HT. IN 1.119	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY				
LL 94 / PL 24	PI 70	PROJECT LAKE PONT. 4 VIC		
GS 2.70 (EST)	D_{10}	PARIS ROAD TO SOUTH POINT		
REMARKS		BORING NO. 7-SPU	SAMPLE NO. 9-C	
		DEPTH/ELEV 33.0/-17.68	DATE 09 JUN 84	
		CONSOLIDATION TEST REPORT		

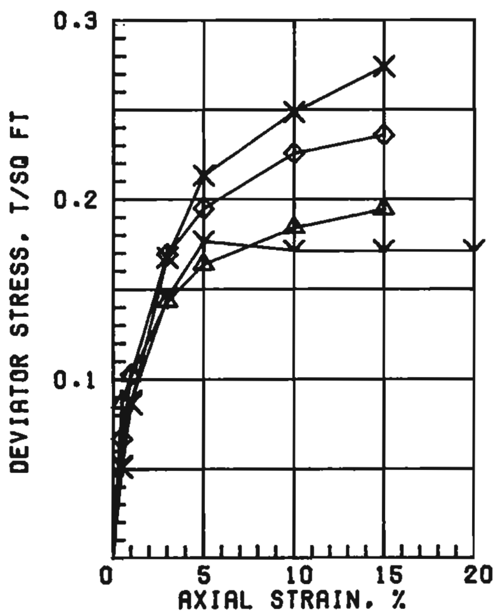
c = 0.11 T/SF

ϕ = 0 DEG

TAN ϕ = 0.0



Av. w = 40.0%
γ_{SAT} = 114.3 pcf



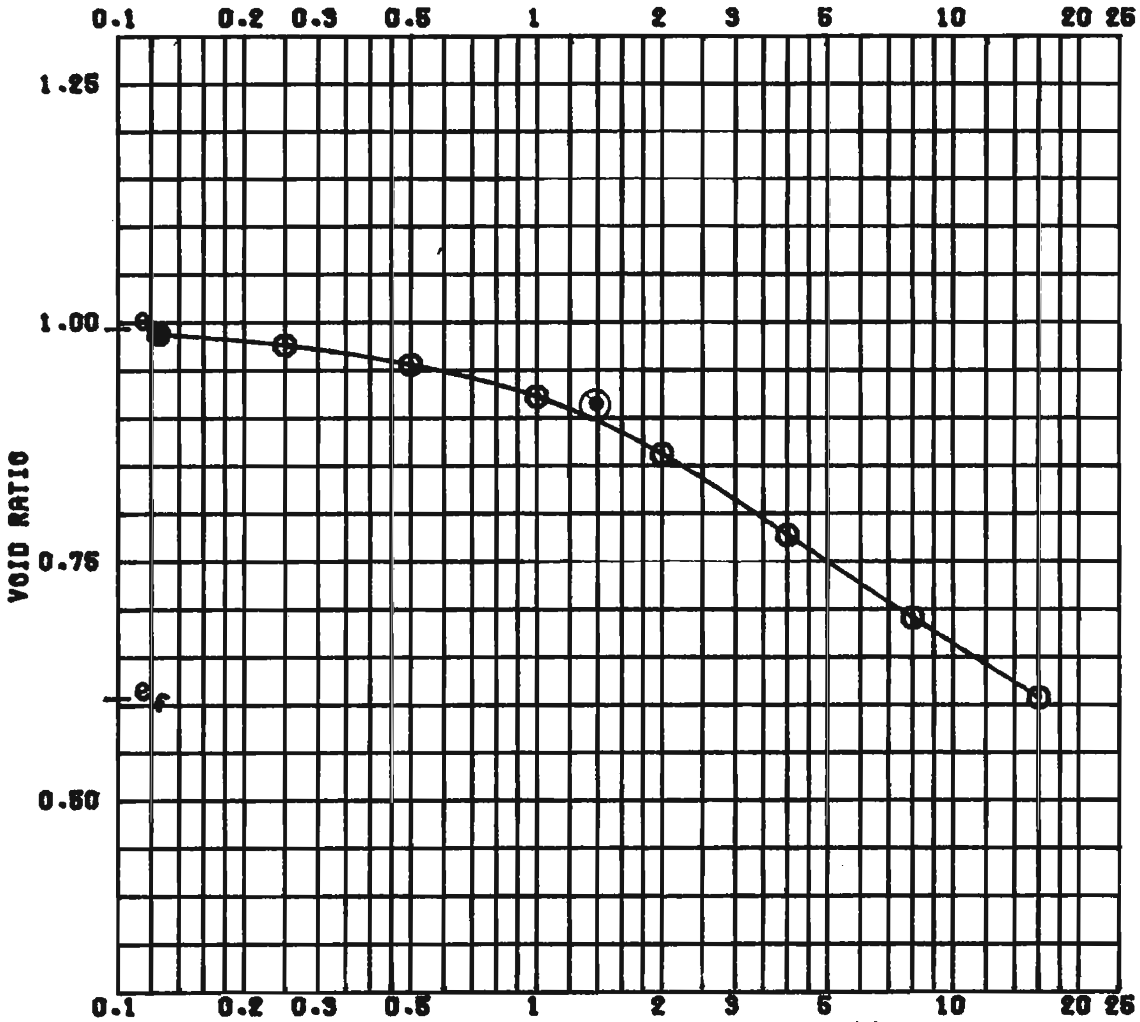
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	39.5	42.5	37.7	40.3
	DRY DENSITY, PCF	81.9	79.9	83.0	81.6
	SATURATION, %	100+	100+	98.8	100+
	VOID RATIO	1.059	1.111	1.030	1.067
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	3.0
MAX. DEV. STRESS, TSF		0.19	0.18	0.27	0.24
TIME TO FAILURE, MIN.		34	13	34	38
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.39	1.37	1.39	1.38
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SHELL PARTICLES

LL 41	PL 16	PI 25	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 7-SPU	SAMPLE NO. 11-C
	DEPTH/ELEV 41.4/-26.1	TECH. PJR
	LABORATORY USAE WES	DATE 24 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	

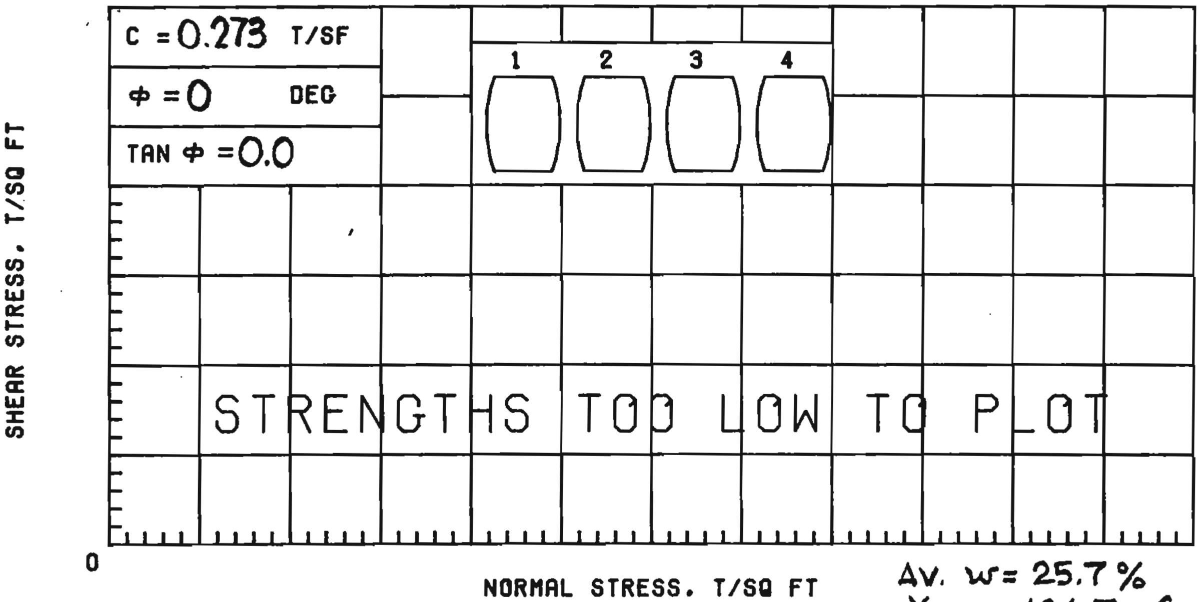


$\gamma_{SAT} = 115.7$ pcf

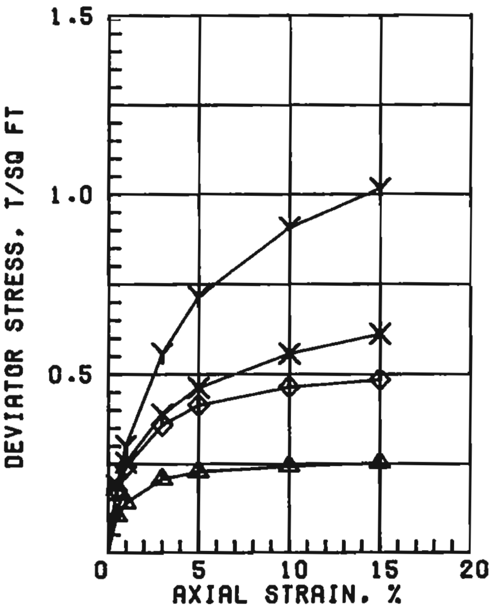
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.60	WATER CONTENT, %	34.4	22.3
PRECONSOL. PRESSURE, TSF	1.40	DRY DENSITY, PCF	84.6	105.0
COMPRESSION INDEX	0.303	SATURATION, %	93.6	99.6
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	0.992	0.606
DIA. IN 4.44	HT. IN 1.119	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), GRAY; FINE SAND LENSES			
LL 39	PL 16	PI 23	PROJECT LAKE PONT. & VIC
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT
REMARKS		BORING NO. 7-SPU	SAMPLE NO. 12-C
		DEPTH/ELEV 45.2/-29.9	DATE 12 JUN 84
		CONSOLIDATION TEST REPORT	

SHEET 1 OF 10



AV. w = 25.7 %
γ SAT = 124.7 pcf



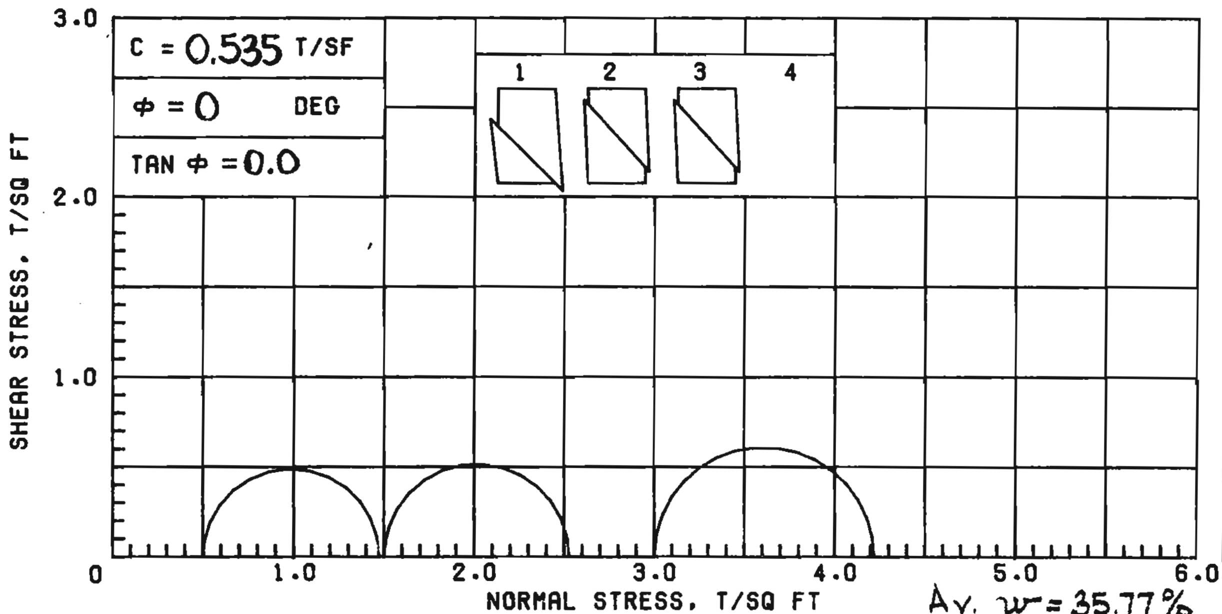
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	30.6	21.9	24.3	25.8
	DRY DENSITY, PCF	91.9	102.9	100.9	98.7
	SATURATION, %	99.1	92.6	97.8	98.3
	VOID RATIO	0.834	0.639	0.671	0.709
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.25	1.02	0.61	0.48
TIME TO FAILURE, MIN.		40	23	35	35
RATE OF STRAIN INCR.,%					
INITIAL DIAMETER, IN.		1.38	1.41	1.40	1.39
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

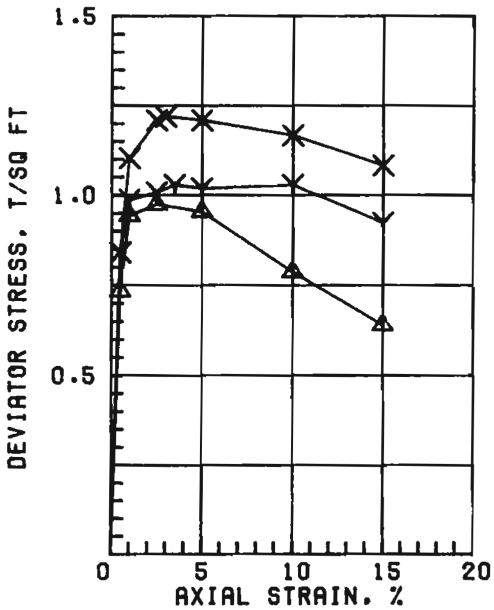
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SHELL PARTICLES

LL 33	PL 13	PI 20	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 7-SPU	SAMPLE NO. 13-B
	DEPTH/ELEV 48.0/-32.7	TECH. PJR
	LABORATORY USAE WES	DATE 24 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 35.77%
γ_{SAT} = 117.4 pcf



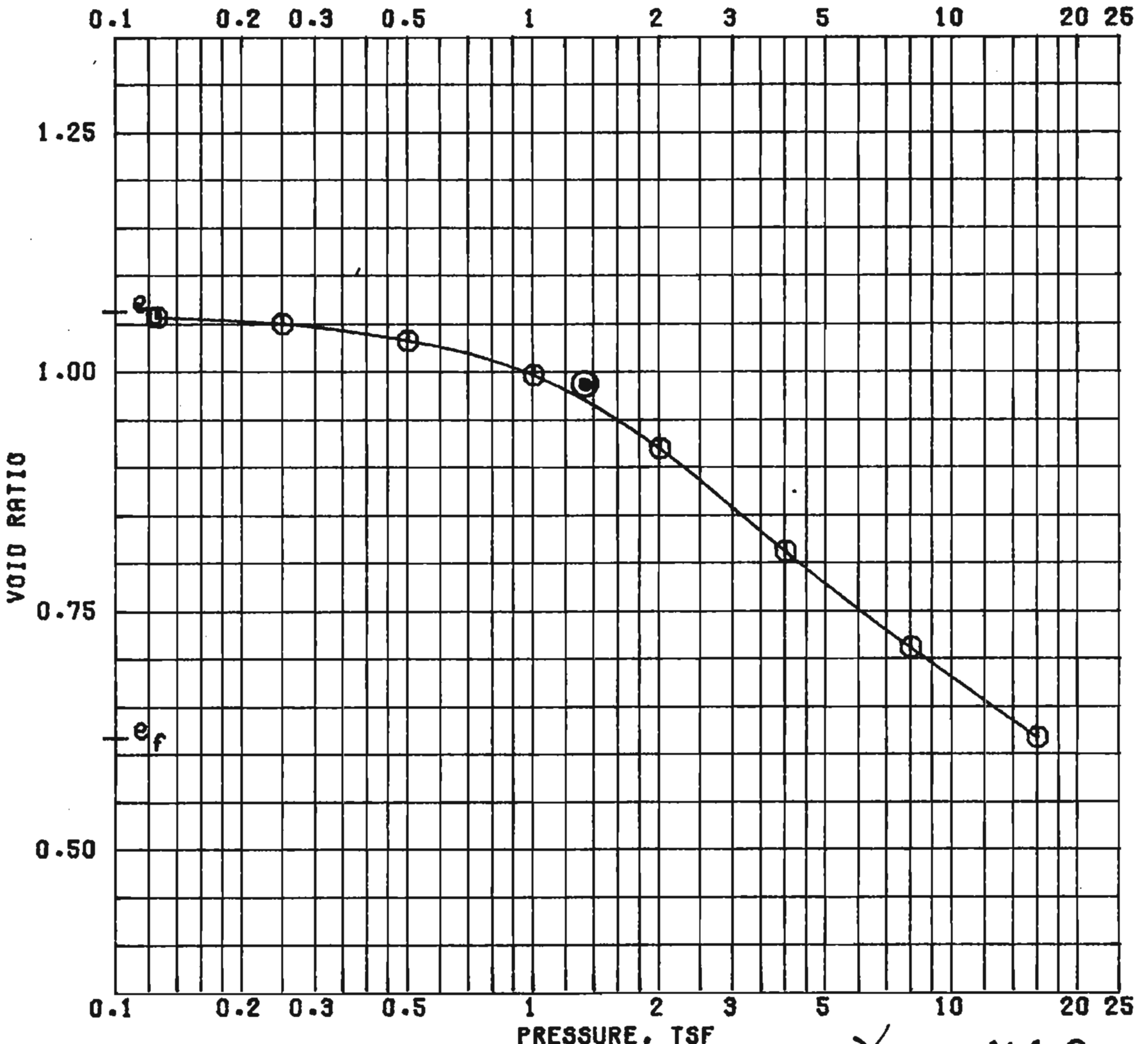
SPECIMEN NO.		Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	35.9	35.1	36.3	
	DRY DENSITY, PCF	86.5	87.2	85.7	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	0.948	0.934	0.967	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.97	1.03	1.22	
TIME TO FAILURE, MIN.		6	9	13	
RATE OF STRAIN INCR.,%			7	5	
INITIAL DIAMETER, IN.		1.37	1.37	1.37	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), BROWN & GRAY

LL 76	PL 25	PI 51	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 8-SPU	SAMPLE NO. 3-C
	DEPTH/ELEV 9.1/-3.9	TECH. WJH
	LABORATORY USAE WES	DATE 26 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



$\gamma_{SAT} = 114.0$ pcf

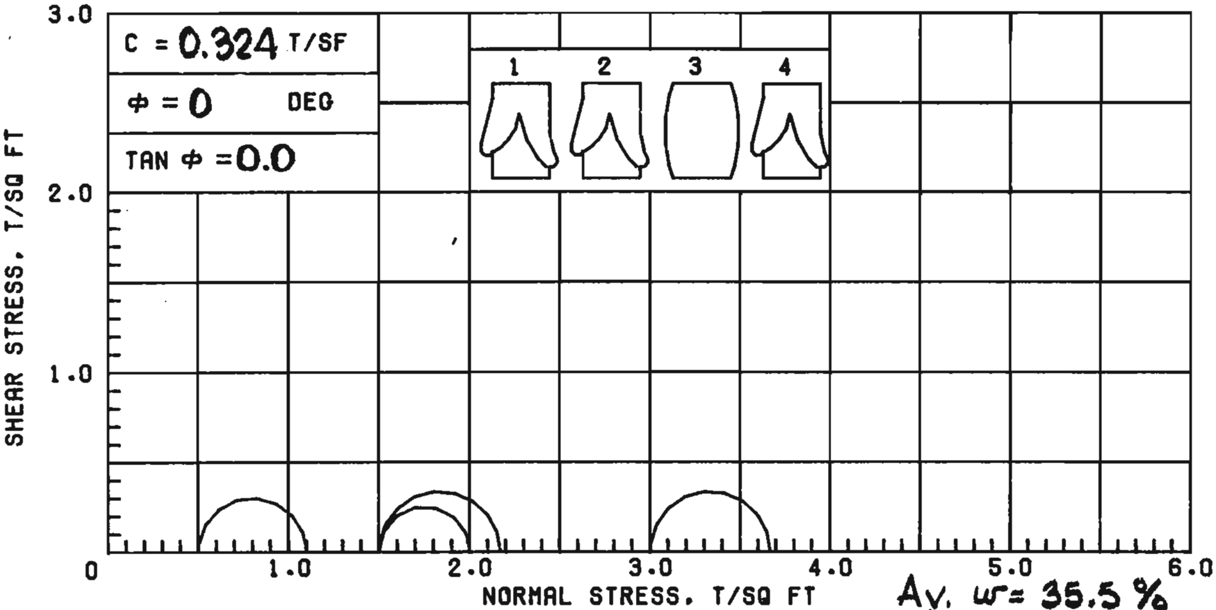
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.65	WATER CONTENT, %	36.8	23.2
PRECONSOL. PRESSURE, TSF	1.35	DRY DENSITY, PCF	81.8	104.3
COMPRESSION INDEX	0.36	SATURATION, %	93.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.061	0.615
DIA. IN 4.44	HT. IN 1.149	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), GRAY

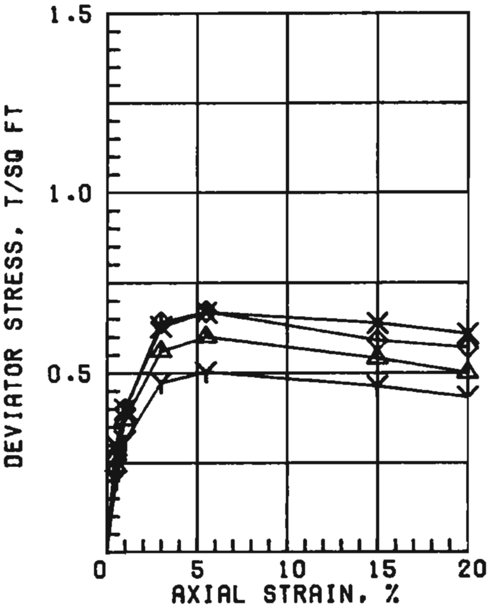
LL 44	PL 13	PI 31	PROJECT LK. PONT. LA. & VIC	
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT	
REMARKS			BORING NO. 8-SPU	SAMPLE NO. 11-B
			DEPTH/ELEV 40.0/-24.8	DATE 14 JUN 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 10



Av. w = 35.5 %
γ_{SAT} = 115.8 pcf



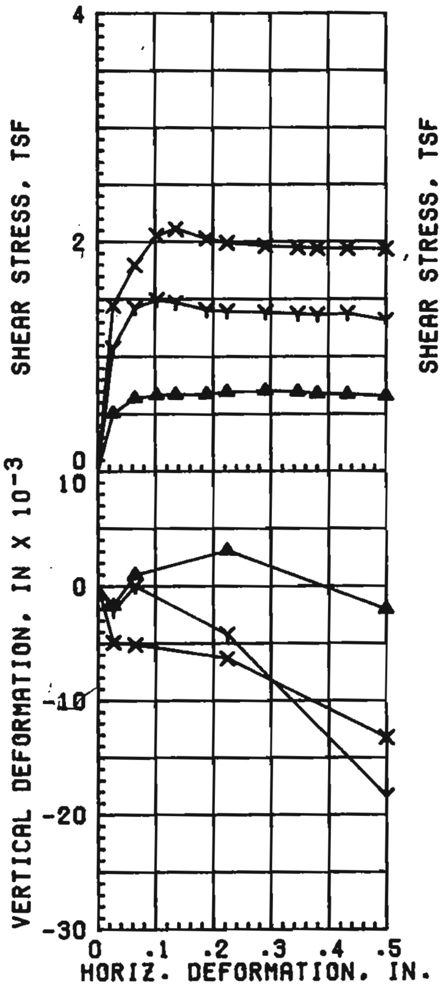
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	36.2	37.0	34.4	35.9
	DRY DENSITY, PCF	84.2	83.6	85.9	84.4
	SATURATION, %	98.0	98.7	96.9	97.7
	VOID RATIO	0.994	1.008	0.955	0.989
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	1.5
MAX. DEV. STRESS, TSF		0.60	0.50	0.67	0.67
TIME TO FAILURE, MIN.		11	17	30	19
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

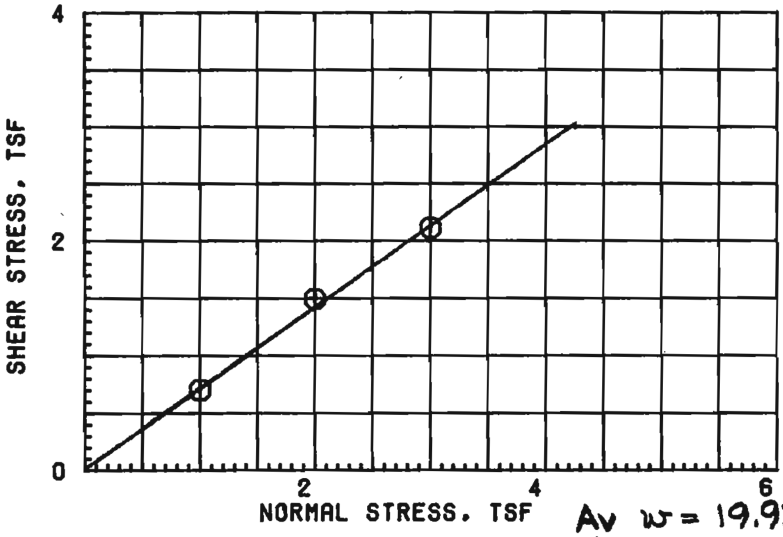
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), GRAY

LL 35	PL 16	PI 19	GS 2.69 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 8-SPU	SAMPLE NO. 12-C
	DEPTH/ELEV 45.3/-40.1	TECH. PJR
	LABORATORY USAE WES	DATE 26 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	





Av w = 19.93%
γ_{SAT} = 129.02 pcf

ϕ = 31.22°

TAN ϕ = 0.606

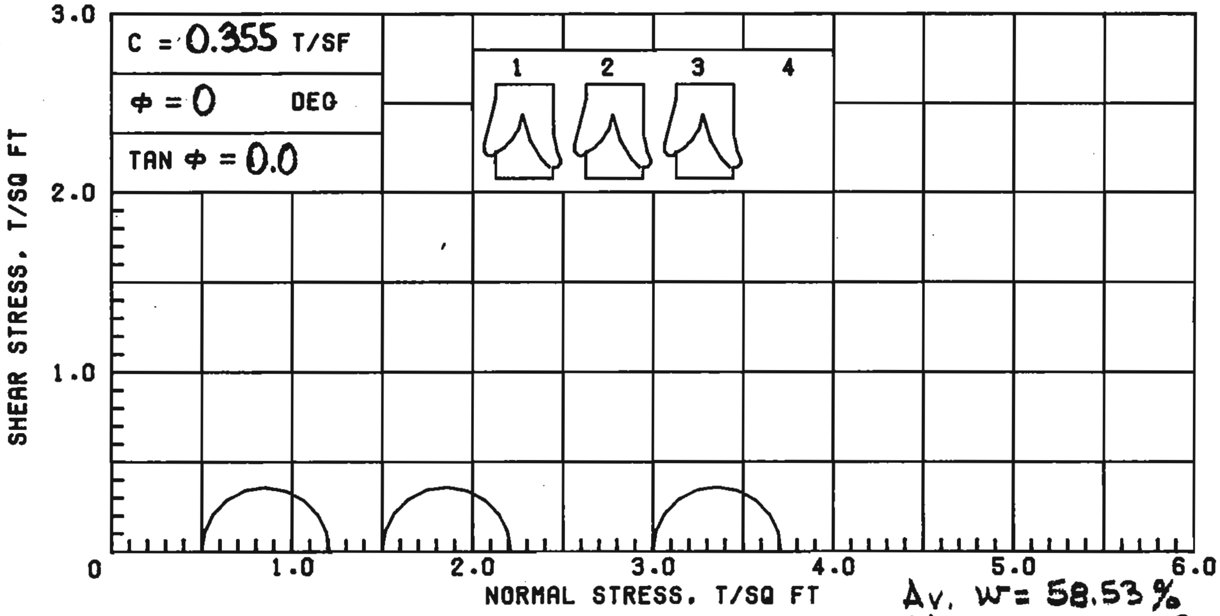
C = 0

	TEST NO.	1 ▲	2 Y	3 X	
INITAL	WATER CONTENT, %	20.3	20.0	19.5	
	VOID RATIO	0.576	0.558	0.557	
	SATURATION, %	93.9	95.9	93.4	
	DRY DENSITY, PCF	105.7	106.9	107.0	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	19.1	16.8	17.2	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.70	1.49	2.11	
TIME TO FAILURE, MIN		1600	566	748	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

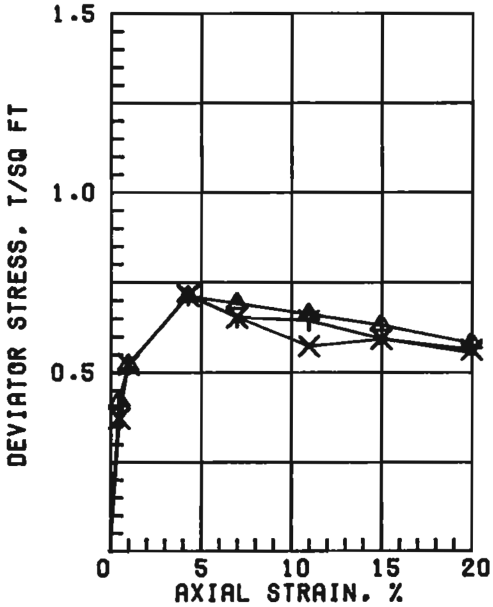
TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.553 IN. THICK
CLASSIFICATION SILTY SAND (SM), GRAY		

LL	PL	PI		GS 2.67 (EST)

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 9-SPU	SAMPLE 7-C
	DEPTH/ELEV 24.7/-9.5	DATE 30 APR 84
	DIRECT SHEAR TEST REPORT	



Av. w = 58.53 %
γ_{sat} = 104.7 pcf



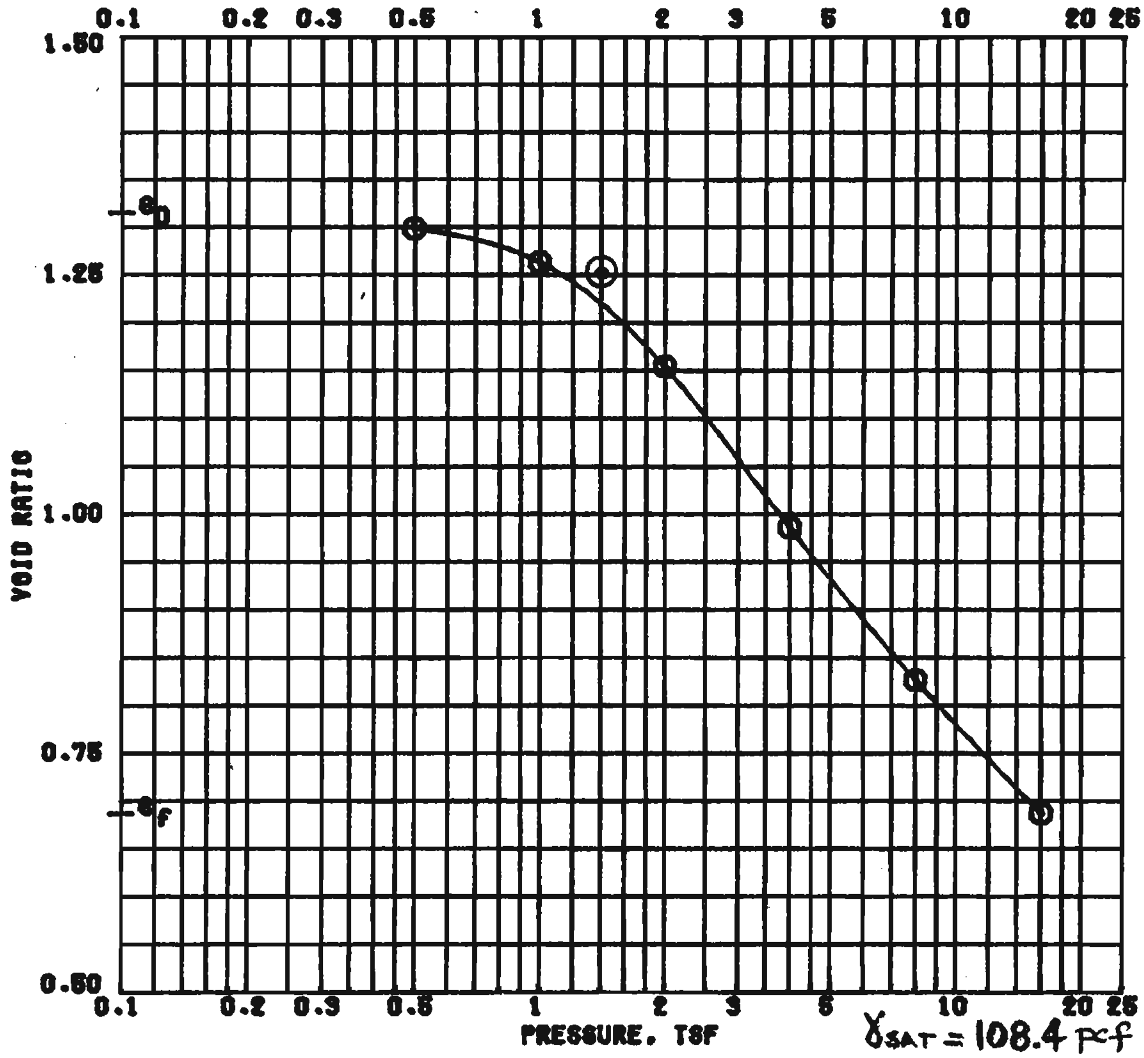
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	58.3	58.6	58.7	
INITIAL	DRY DENSITY, PCF	66.2	66.0	66.0	
INITIAL	SATURATION, %	100+	100+	100+	
INITIAL	VOID RATIO	1.545	1.553	1.555	
BEFORE SHEAR	WATER CONTENT, %				
BEFORE SHEAR	DRY DENSITY, PCF				
BEFORE SHEAR	SATURATION, %				
BEFORE SHEAR	VOID RATIO				
BEFORE SHEAR	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.71	0.71	0.71	
	TIME TO FAILURE, MIN.	9	18	22	
	RATE OF STRAIN INCR.%		7	11	
	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 78	PL 24	PI 54	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:		
	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 9-SPU	SAMPLE NO. 8-C
	DEPTH/ELEV 29.2/-14.0	TECH. PJR
	LABORATORY USAE WES	DATE 25 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



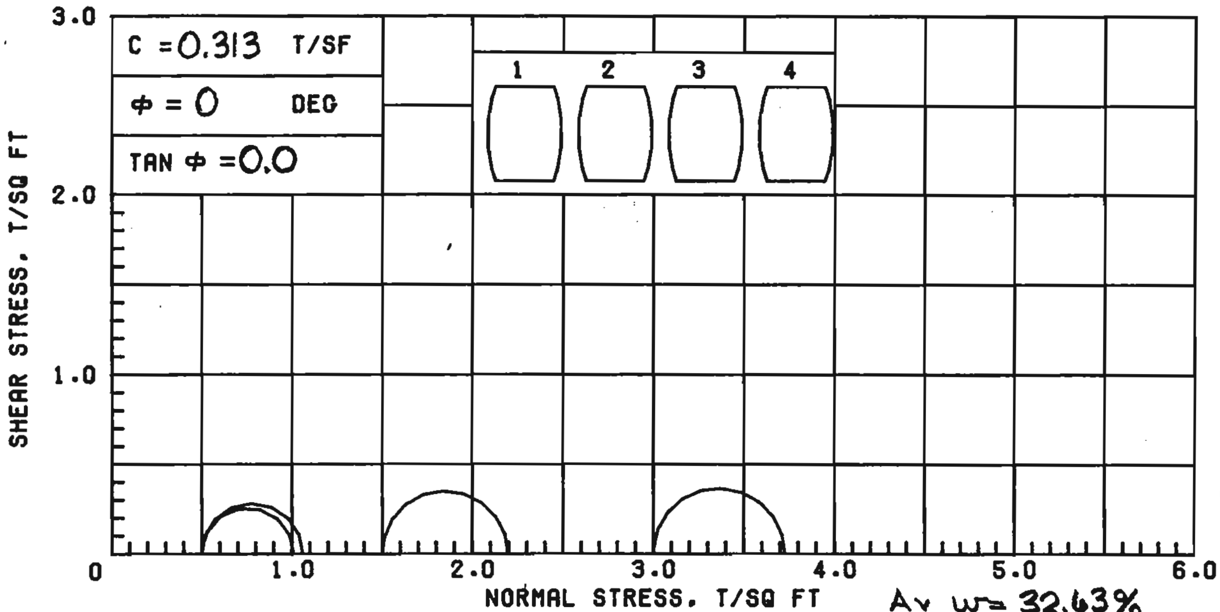
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.40	WATER CONTENT, %	46.7	25.6
PRECONSOL. PRESSURE, TSF	1.40	DRY DENSITY, PCF	72.9	100.0
COMPRESSION INDEX	0.59%	SATURATION, %	96.0	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.313	0.685
DIA. IN 4.44	HT. IN 1.126	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SHELL PARTICLES

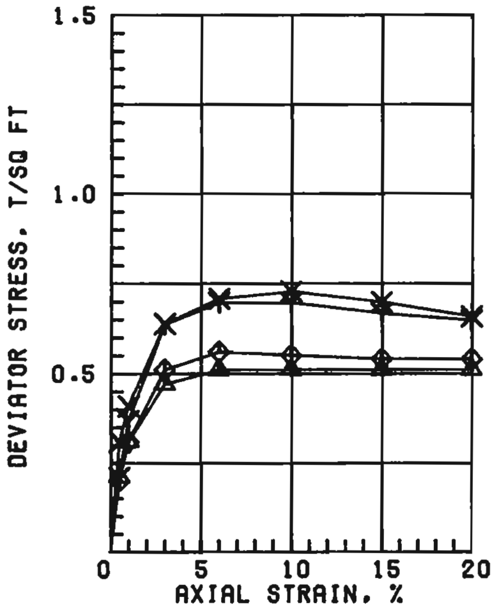
LL 67	PL 18	PI 49	PROJECT LAKE PONT. & VIC
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT
REMARKS			BORING NO. 9-SPU / SAMPLE NO. 9-C
			DEPTH/ELEV 32.5/-17.3 / DATE 12 JUN 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 8



Av w = 32.63%
γSAT = 118.25 PCF



SPECIMEN NO.		Δ1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	33.2	32.0	32.0	33.3
	DRY DENSITY, PCF	88.4	89.1	89.1	88.1
	SATURATION, %	98.9	97.0	97.0	98.5
	VOID RATIO	0.906	0.891	0.891	0.912
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		0.51	0.70	0.73	0.56
TIME TO FAILURE, MIN.		15	21	25	18
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

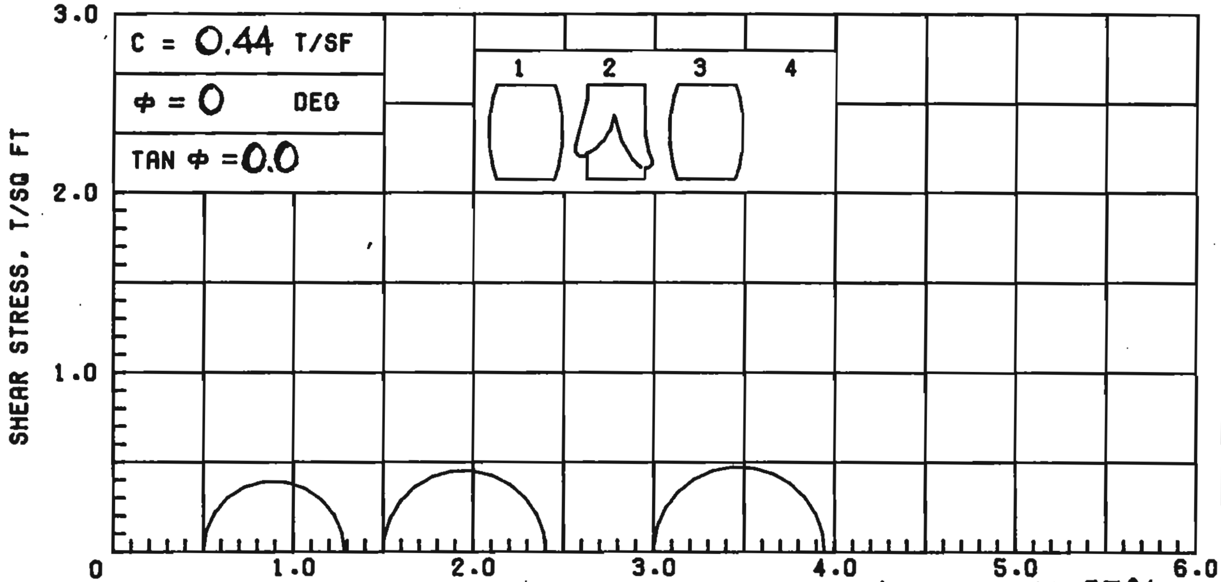
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SHELL PARTICLES

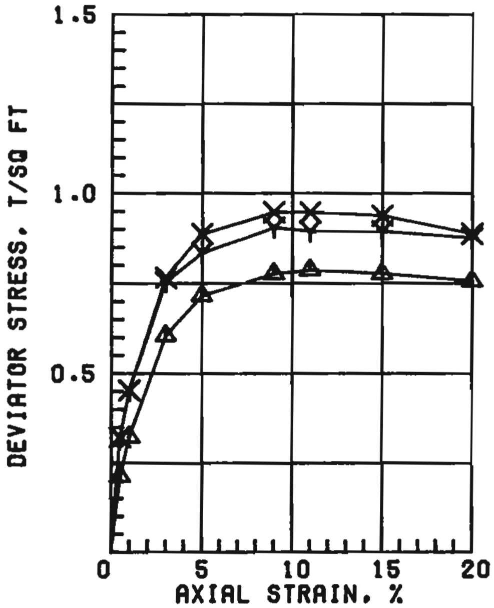
LL 36	PL 16	PI 20	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 9-SPU	SAMPLE NO. 11-C
	DEPTH/ELEV 41.3/-26.1	TECH. PJR
	LABORATORY USAE WES	DATE 02 MAY 84
	TRIAXIAL COMPRESSION TEST REPORT	

ms



Av. w = 33.57%
γ_{SAT} = 117.7 pcf



	SPECIMEN NO.	Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	34.4	33.4	32.9	
	DRY DENSITY, PCF	87.4	87.9	88.2	
	SATURATION, %	100+	98.4	97.6	
	VOID RATIO	0.929	0.917	0.911	
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	0.79	0.90	0.95	
	TIME TO FAILURE, MIN.	22	20	20	
	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

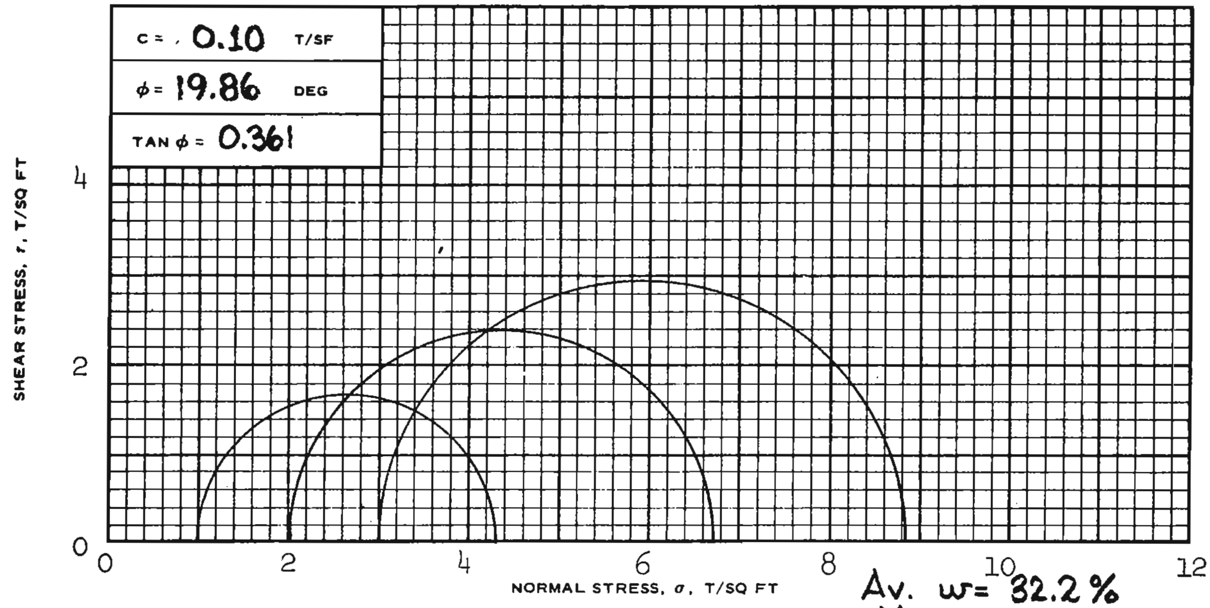
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; SILT LENSES; ROOTLETS

LL 36	PL 17	PI 19	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

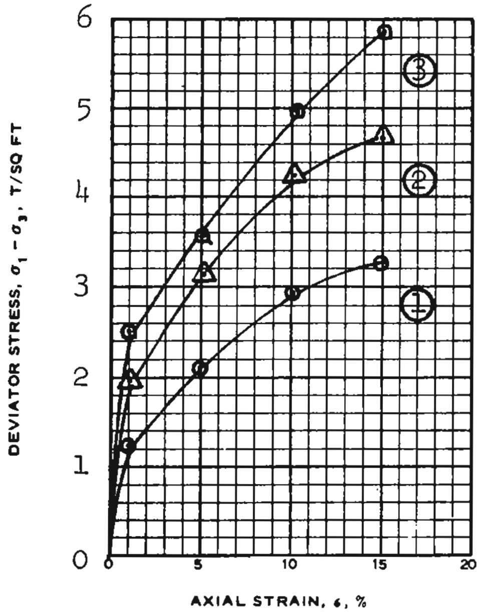
REMARKS:

PROJECT LAKE PONT., & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 9-SPU	SAMPLE NO. 14-C
DEPTH/ELEV 52.8/-37.6	TECH. PJR
LABORATORY USAE WES	DATE 25 APR 84

TRIAXIAL COMPRESSION TEST REPORT



Av. w = 32.2 %
γ_{SAT} = 120.0 pcf



SPECIMEN NO.			1	2	3
INITIAL	WATER CONTENT, %	w_o	33.1	31.6	31.9
	DRY DENSITY LB/CU FT	γ_{d_o}	91.1	90.6	90.6
	SATURATION, %	S_o	100+	100+	100+
	VOID RATIO	e_o	0.831	0.839	0.839
BEFORE SHEAR	WATER CONTENT, %	w_c	32.0	31.0	30.6
	DRY DENSITY LB/CU FT	γ_{d_c}	92.4	94.1	93.5
	SATURATION, %	S_c	100+	100+	100+
	VOID RATIO	e_c	0.804	0.771	0.784
	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		$(\sigma_1 - \sigma_3)_{MAX}$	3.26	4.68	5.86
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	1.35	1.37	1.38
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS SANDY SILT (ML), GRAY

LL	PL	PI	Gs 2.67 (EST)	TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST $\bar{R}$

REMARKS:

PROJECT LAKE PONT., & VIC.
PARIS ROAD TO SOUTH POINT

BORING NO. 9-SPU SAMPLE NO. 15-C

DEPTH/ELEV 57.0/-41.8

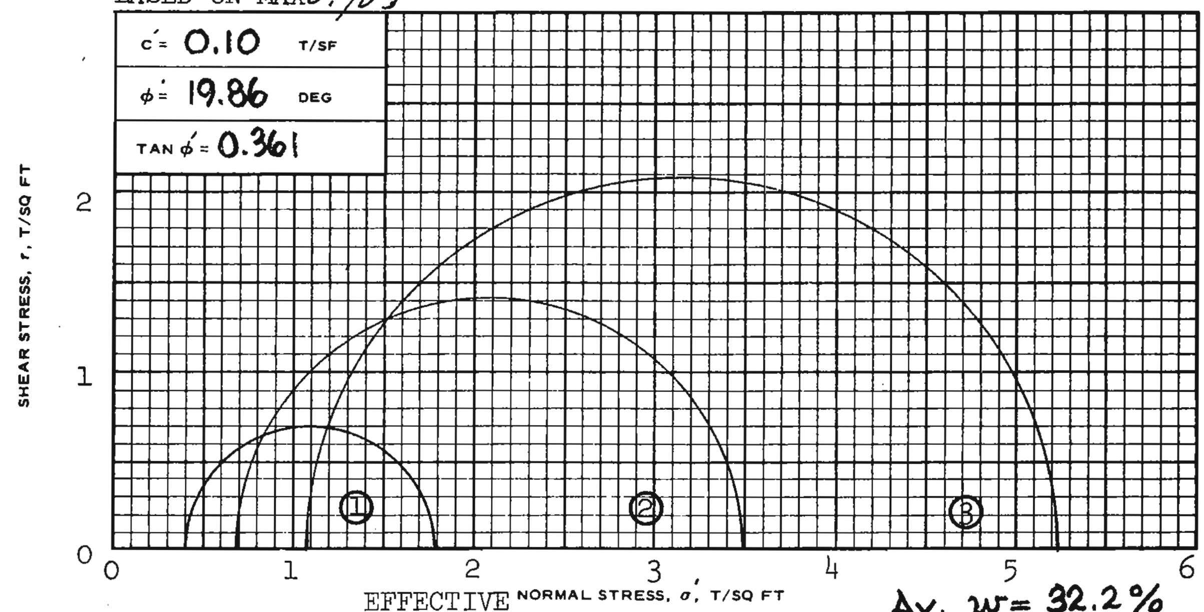
LABORATORY USAEWES DATE 19 APRIL 1984

SHEET 1 OF 2

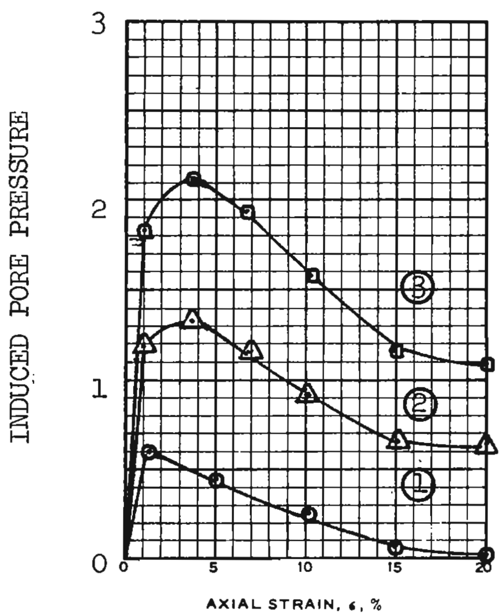
JMS **TRIAXIAL COMPRESSION TEST REPORT**

BASED ON MAX σ_1'/σ_3'

c' = 0.10	T/SF
φ' = 19.86	DEG
TAN φ' = 0.361	



Av. w = 32.2 %
γSAT = 120.0 pcf



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	0.40	0.68	1.07	
MAXIMUM DEVIATOR STRESS, T/SQ FT	$(\sigma_1 - \sigma_3)_{MAX}$		1.37	2.81	4.16	
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 LAKE PONT., & VIC.
PARIS ROAD TO SOUTH POINT

BORING NO. 9-SPU | SAMPLE NO. 15-C

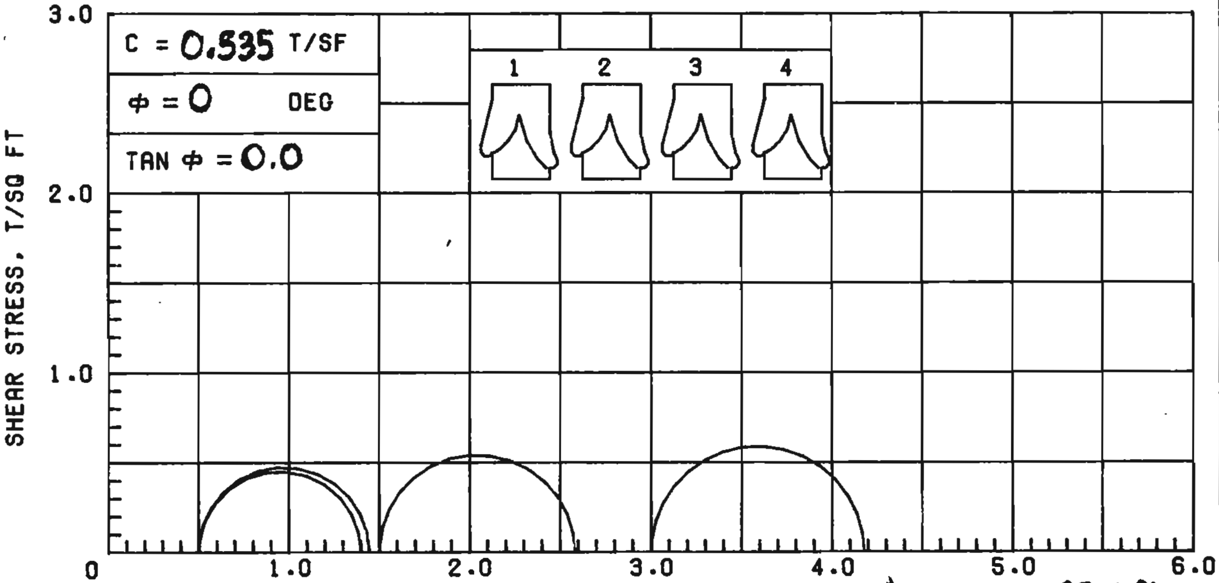
DEPTH/ELEV 57.0/-41.8

LABORATORY USAEWES | DATE 19 APRIL 1984

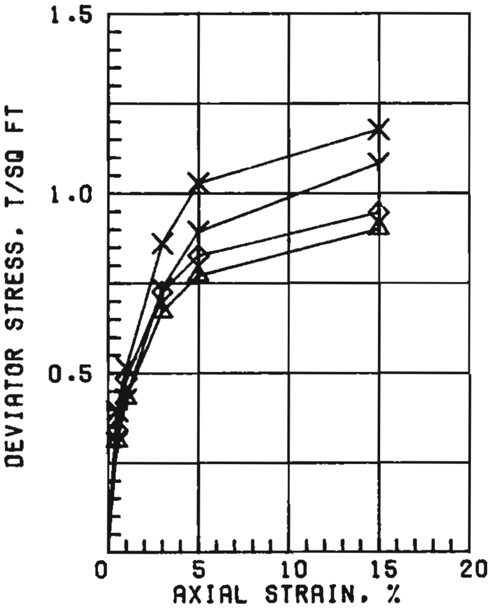
SHEET 2 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE



Avg. w = 23.8%
γ_{SAT} = 125.7 pcf



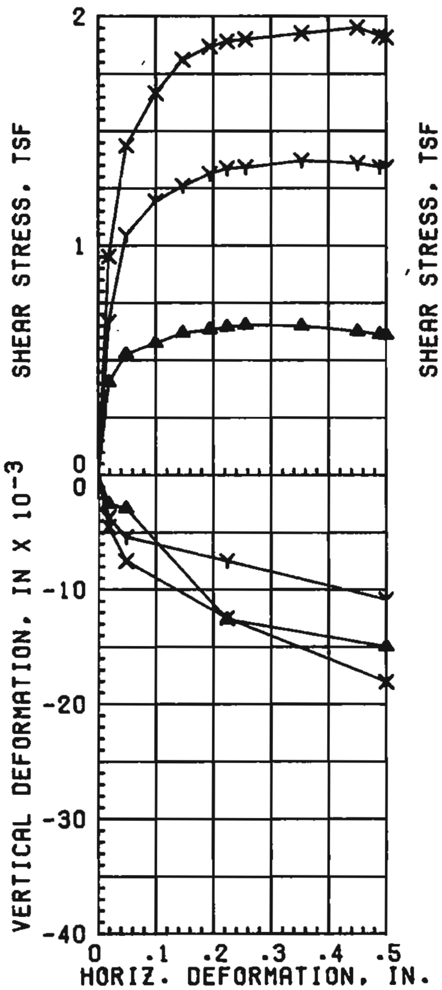
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	25.6	24.5	22.7	24.2
	DRY DENSITY, PCF	99.0	99.7	101.7	100.0
	SATURATION, %	98.4	95.8	93.2	95.3
	VOID RATIO	0.703	0.691	0.658	0.685
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	0.5
MAX. DEV. STRESS, TSF		0.90	1.08	1.18	0.95
TIME TO FAILURE, MIN.		49	30	30	30
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.40	1.40	1.41	1.39
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

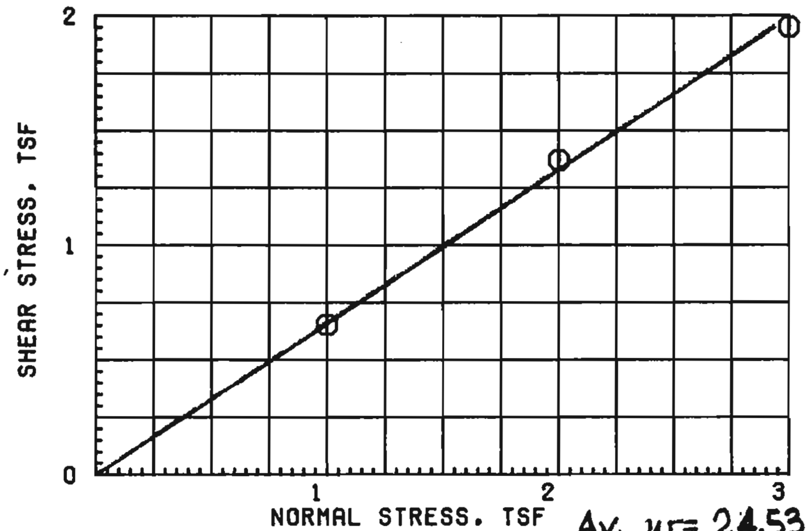
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), LIGHT GRAY

LL 45	PL 14	PI 31	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 11-SPU	SAMPLE NO. 3-B
	DEPTH/ELEV 8.6/7.0	TECH. PJR
	LABORATORY USAE WES	DATE 26 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	





Av. w= 24.53 %
γ_{SAT} = 123.5 pcf

Φ = 33.7°

TAN Φ = 0.667

C = 0

		TEST NO.	1 ▲	2 Y	3 X	
INITAL		WATER CONTENT, %	24.6	24.3	24.7	
		VOID RATIO	0.699	0.711	0.705	
		SATURATION, %	94.0	91.1	93.6	
		DRY DENSITY, PCF	98.0	97.4	97.7	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	19.5	18.8	18.9	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.65	1.37	1.95	
TIME TO FAILURE, MIN			1407	1941	2474	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF						

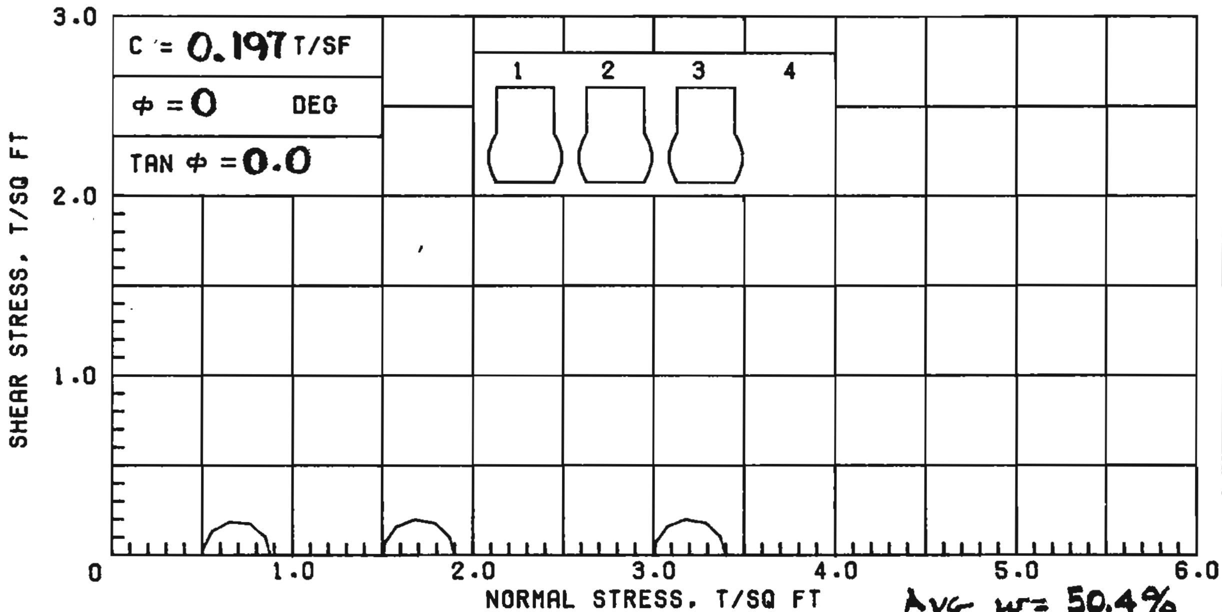
TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.553 IN. THICK

CLASSIFICATION SILTY SAND (SM), GRAY

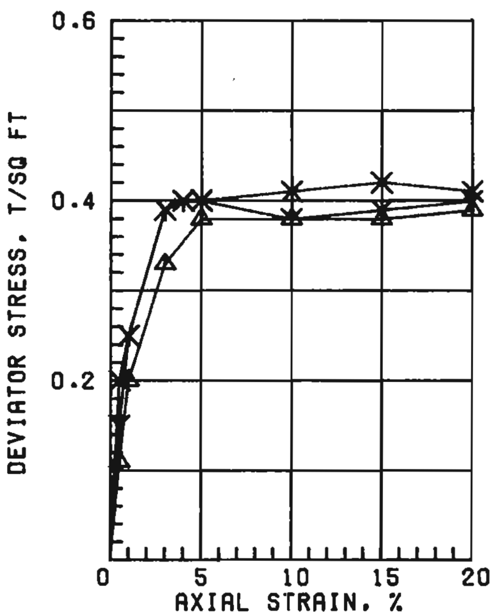
LL	PL	PI		GS 2.67 (EST)

REMARKS:	PROJECT LAKE PONT., LA. & VIC.
	PARIS ROAD TO SOUTH POINT
	BORING NO. 11-SPU — SAMPLE 6-B
	DEPTH/ELEV 20.2/-4.6 — DATE 01 MAY 84

DIRECT SHEAR TEST REPORT



Avg w = 50.4%
γ_{SAT} = 107.2 pcf



	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	51.2	49.9	50.1	
INITIAL	DRY DENSITY, PCF	70.6	71.8	71.0	
INITIAL	SATURATION, %	99.7	100+	98.5	
INITIAL	VOID RATIO	1.387	1.347	1.373	
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	0.38	0.40	0.40	
	TIME TO FAILURE, MIN.	13	8	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

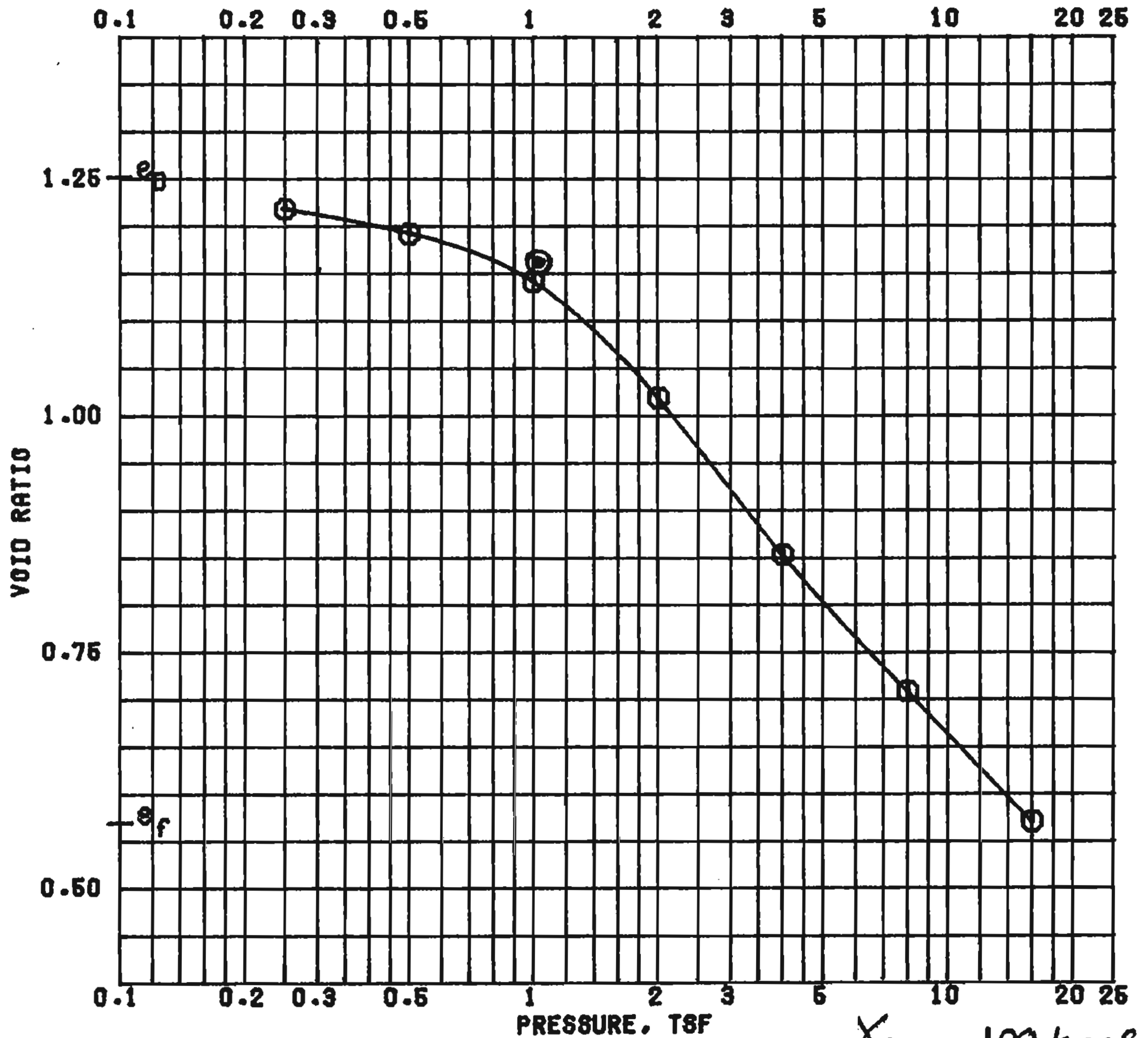
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 57	PL 19	PI 38	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LAKE PONT., LA. & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 11-SPU	SAMPLE NO. 8-C
DEPTH/ELEV 28.9/-13.3	TECH. KOC
LABORATORY USAE WES	DATE 27 APR 84

TRIAXIAL COMPRESSION TEST REPORT



γ_{SAT}= 109.6 pcf

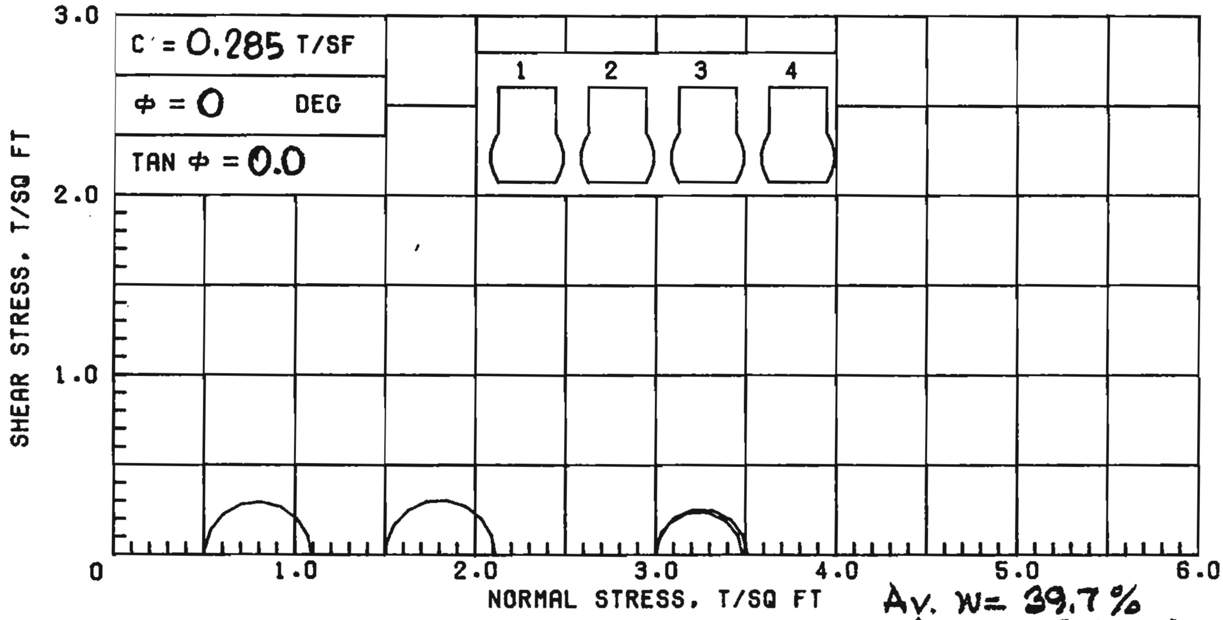
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.40	WATER CONTENT, %	44.6	25.2
PRECONSOL. PRESSURE, TSF	1.05	DRY DENSITY, PCF	74.9	107.5
COMPRESSION INDEX	0.572	SATURATION, %	96.4	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.250	0.568
DIA. IN 4.44	HT. IN 1.134	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CL), GRAY; SHELL PARTICLES

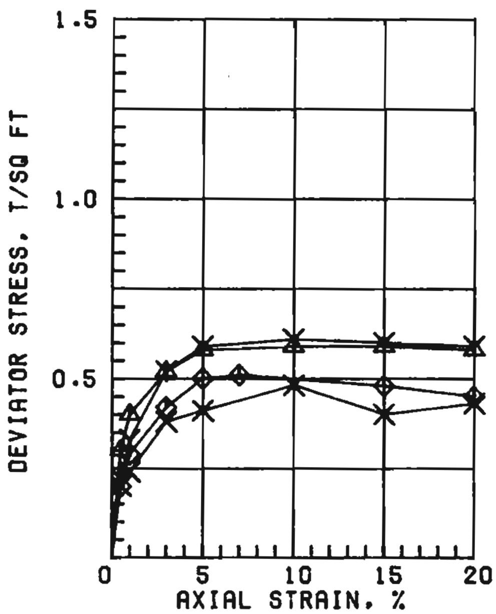
LL 46	PL 14	PI 32	PROJECT LK. PONT. LA. & VIC.	
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT	
REMARKS			BORING NO. 11-SPU	SAMPLE NO. 10-B
			DEPTH/ELEV 36.4/-20.8	DATE 02 AUG 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 9



Av. w = 39.7%
γ_{SAT} = 113.2 pcf



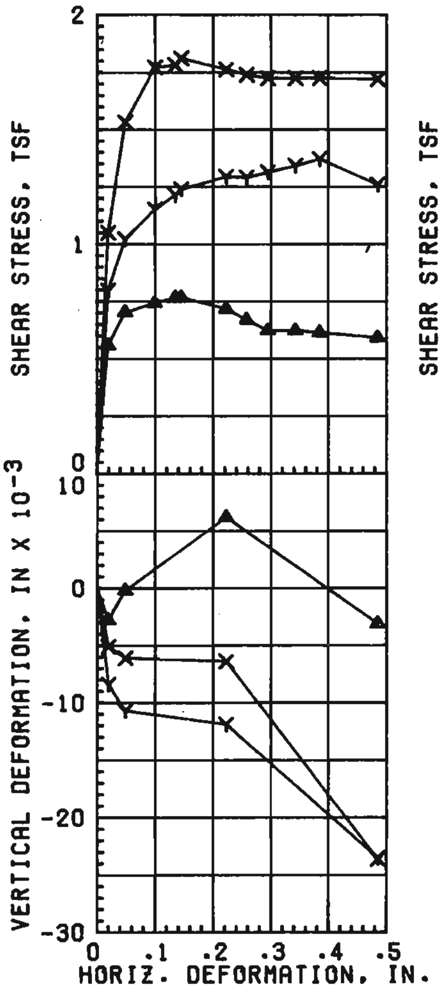
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	36.5	38.4	45.2	44.2
	DRY DENSITY, PCF	83.0	81.5	75.6	76.9
	SATURATION, %	95.6	97.1	99.3	100+
	VOID RATIO	1.031	1.067	1.229	1.192
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	3.0
MAX. DEV. STRESS, TSF		0.59	0.61	0.48	0.51
TIME TO FAILURE, MIN.		20	20	20	14
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

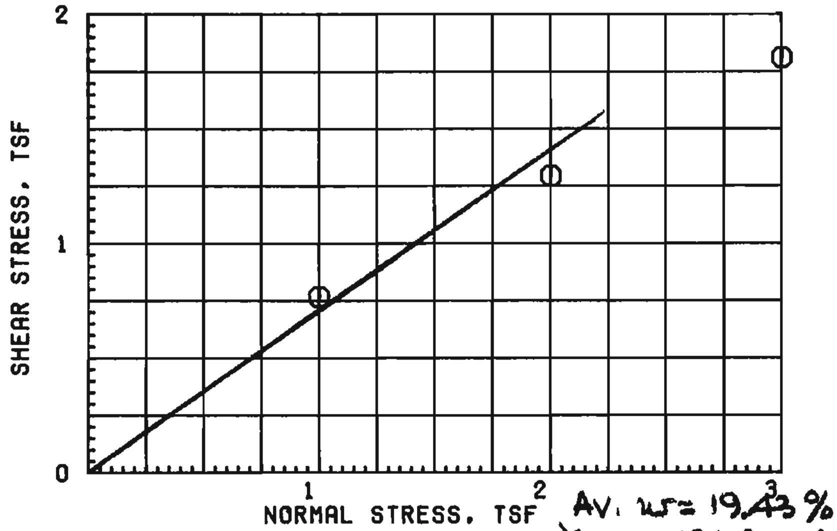
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT POCKETS

LL 48	PL 15	PI 33	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
LIMITS ON MIXTURE OF MATERIAL.	PARIS ROAD TO SOUTH POINT	
	BORING NO. 11-SPU	SAMPLE NO. 11-8
	DEPTH/ELEV 40.3/-24.7	TECH. KOC
	LABORATORY USAE WES	DATE 27 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	





AV. w = 19.43 %
γ_{SAT} = 131.2 pcf

		TEST NO.	1 ▲	2 Y	3 X	
INITAL		WATER CONTENT, %	19.2	19.0	20.1	
		VOID RATIO	0.519	0.515	0.524	
		SATURATION, %	98.5	98.4	100 +	
		DRY DENSITY, PCF	109.7	110.0	109.3	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	20.0	20.3	20.1	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.77	1.29	1.81	
TIME TO FAILURE, MIN			768	1266	825	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF						

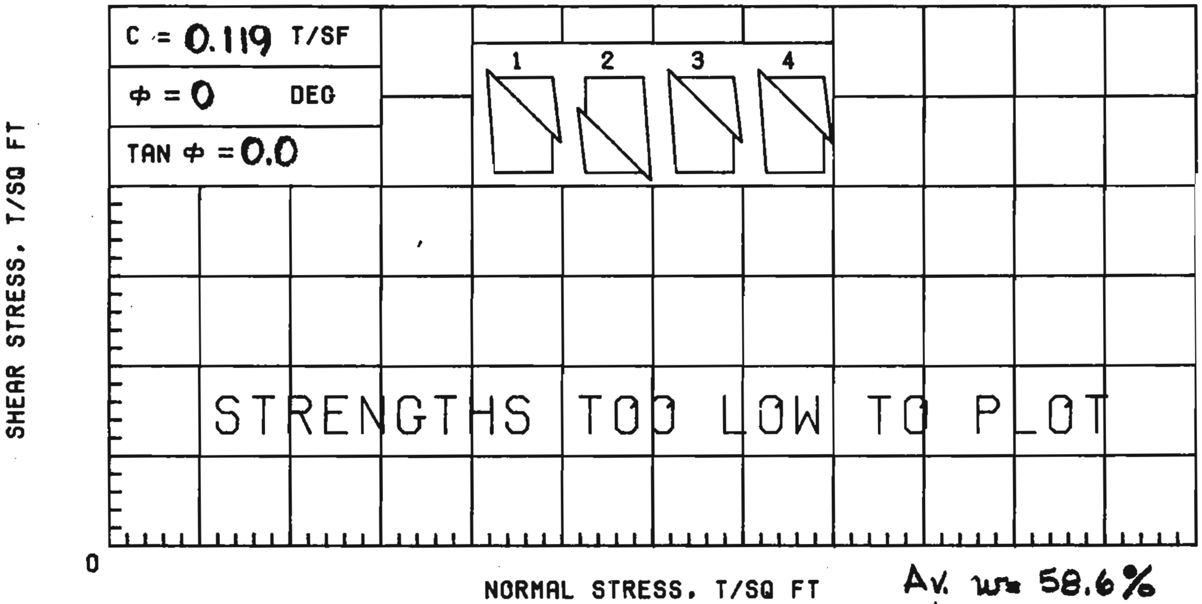
ϕ = 35.5°

TAN ϕ = 0.7143

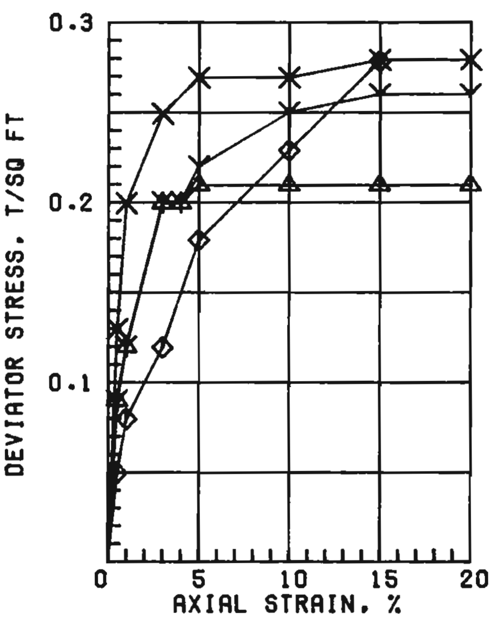
C = 0

TYPE SPECIMEN UNDISTURBED			3.00 IN. SQUARE	0.744 IN. THICK
CLASSIFICATION SILTY SAND (SM), GRAY				
LL	PL	PI		GS 2.67 (EST)

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 12-SPU	SAMPLE 3-C
	DEPTH/ELEV 9.0/-2.5	DATE 01 MAY 84
	DIRECT SHEAR TEST REPORT	



Av. w = 58.6%
γ_{sat} = 103.6 pcf



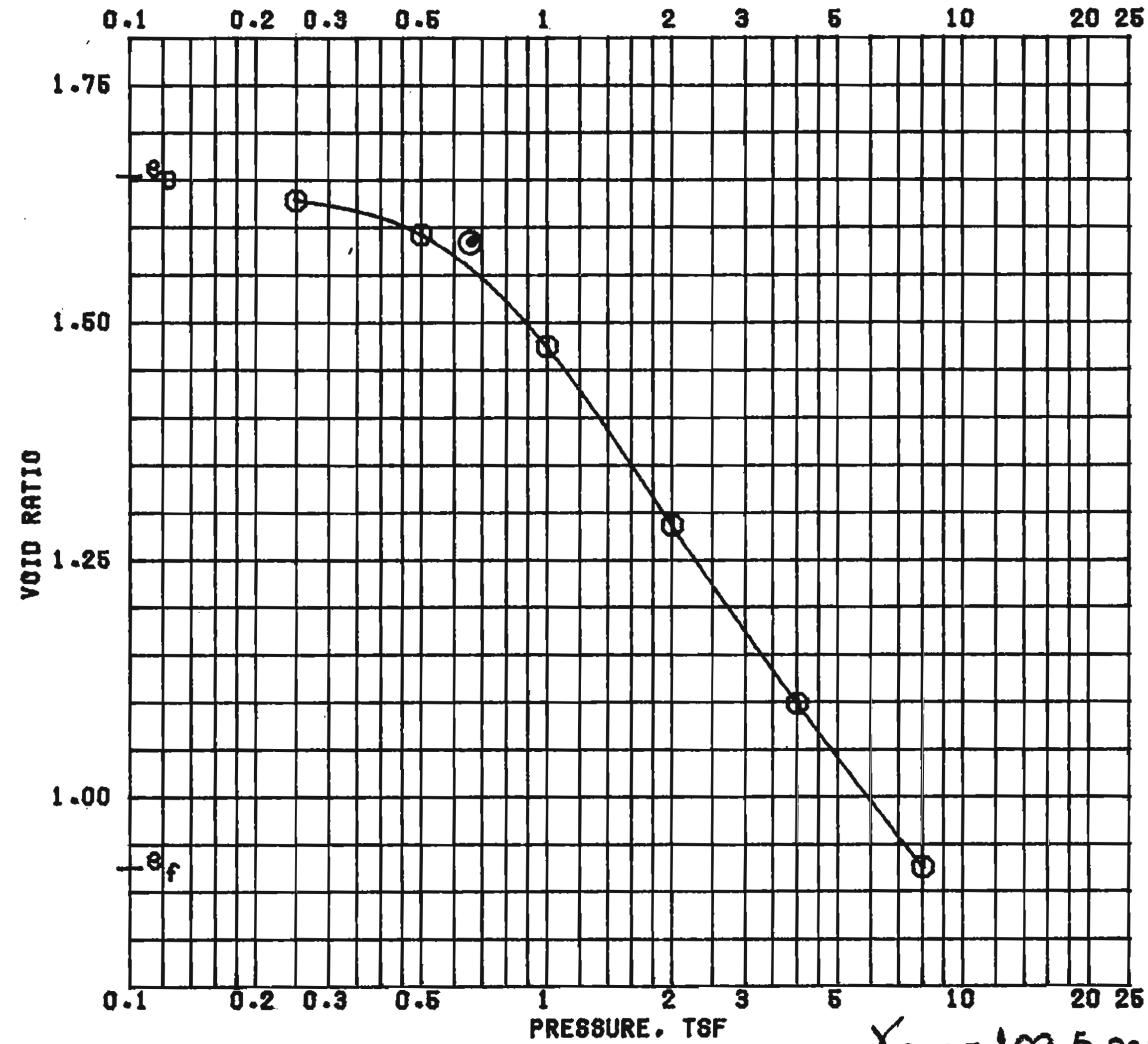
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	59.0	67.9	58.8	48.6
	DRY DENSITY, PCF	64.8	59.1	64.2	71.7
	SATURATION, %	99.5	99.0	97.7	97.0
	VOID RATIO	1.601	1.852	1.626	1.352
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	3.0
	MAX. DEV. STRESS, TSF	0.20	0.20	0.27	0.28
	TIME TO FAILURE, MIN.	6	6	10	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: PLASTIC CLAY (CH), GRAY; ORGANIC MATERIAL

LL 67	PL 21	PI 46	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
CHECK TEST SPECIMEN TAKEN	PARIS ROAD TO SOUTH POINT	
FROM DIFFERENT LIFT.	BORING NO. 12-SPU	SAMPLE NO. 6-C
	DEPTH/ELEV 21.3/-14.8	TECH. KOC
	LABORATORY USAE WES	DATE 30 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	

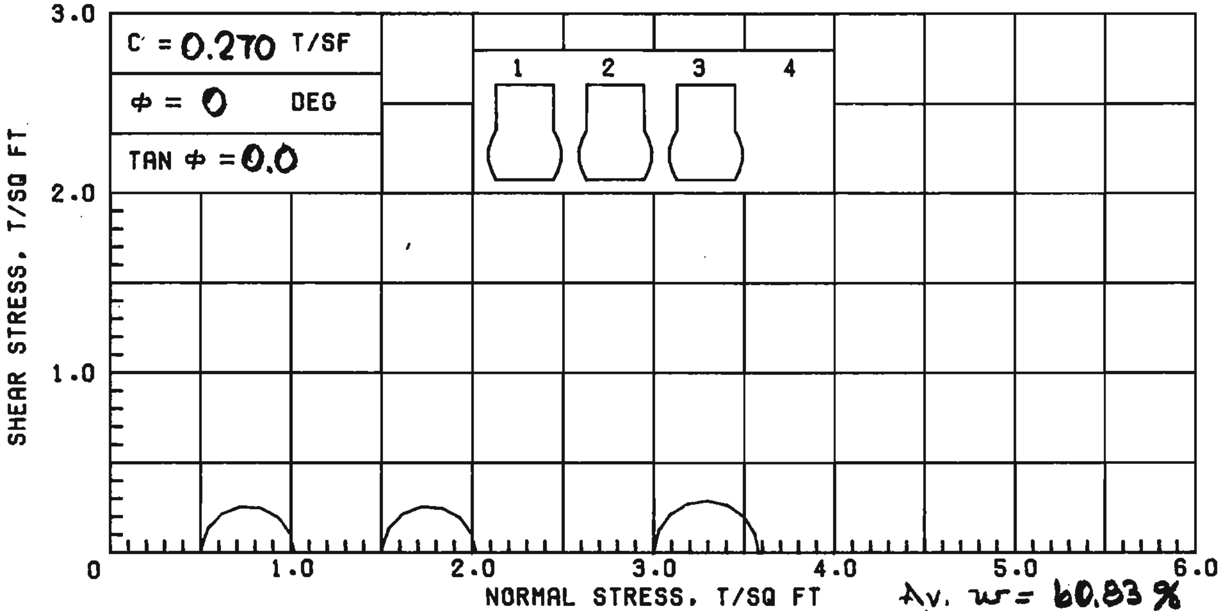


$\gamma_{SAT} = 102.5$ pcf

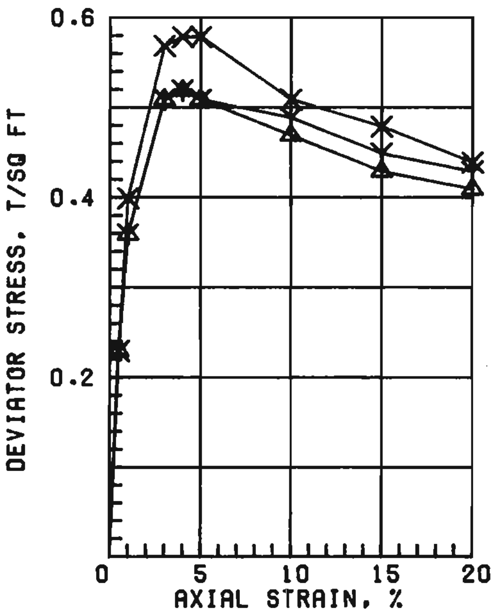
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.80	WATER CONTENT, %	58.7	35.2
PRECONSOL. PRESSURE, TSF	0.65	DRY DENSITY, PCF	63.6	87.6
COMPRESSION INDEX	0.628	SATURATION, %	95.9	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.652	0.923
DIA. IN 4.44	HT. IN 1.130	BACK PRESSURE, TSF		
CLASSIFICATION PLASTIC CLAY (CH), GRAY				
LL 75 / PL 21	PI 54	PROJECT LK. PONT. LA. & VIC.		
GS 2.70 (EST)	D_{10}	PARIS ROAD TO SOUTH POINT		
REMARKS		BORING NO. 12-SPU	SAMPLE NO. 7-B	
		DEPTH/ELEV 24.4/-17.9	DATE 01 AUG 84	

CONSOLIDATION TEST REPORT

SHEET 1 OF 8



Av. w = 60.83 %
γSAT = 102.2 pcf



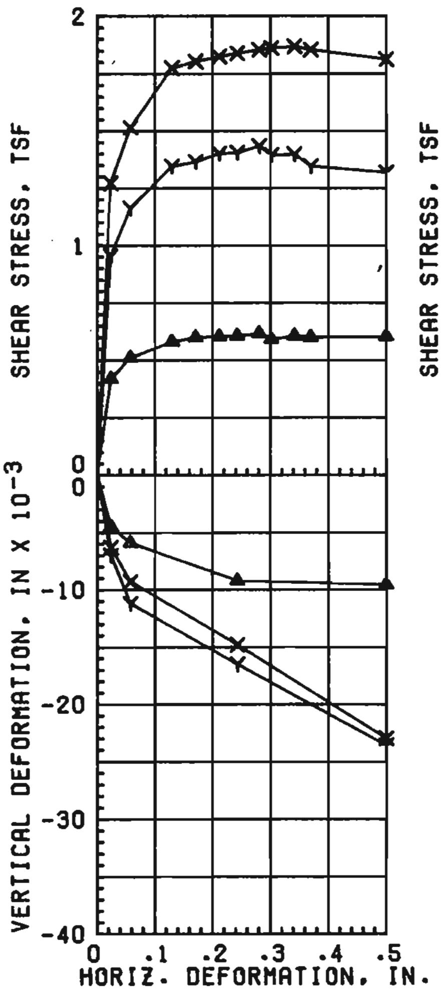
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	63.2	59.3	60.0	
	DRY DENSITY, PCF	62.0	63.8	63.7	
	SATURATION, %	99.4	97.5	98.3	
	VOID RATIO	1.717	1.642	1.647	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.52	0.52	0.58	
	TIME TO FAILURE, MIN.	8	8	8	
	RATE OF STRAIN INCR.,%				
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

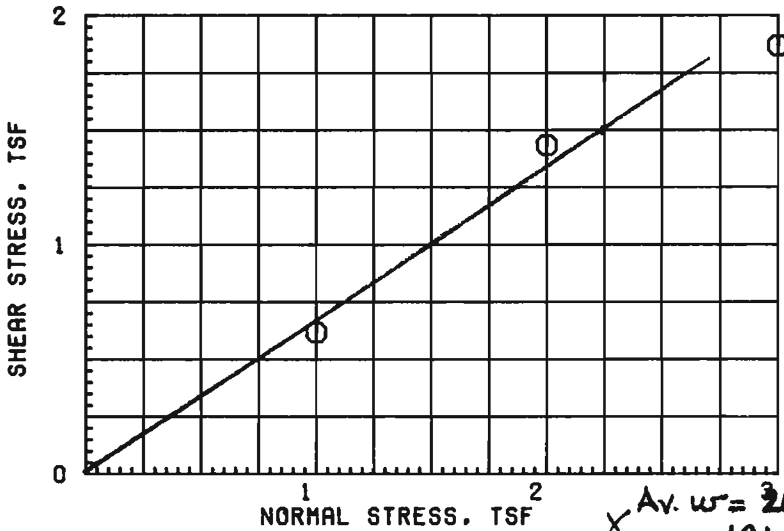
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY

LL 73	PL 21	PI 52	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:		
	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 12-SPU	SAMPLE NO. 8-C
	DEPTH/ELEV 29.2/-22.7	TECH. KOC
	LABORATORY USAE WES	DATE 30 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	





Av. w = 26.87%
γ_{SAT} = 121.7 pcf

ϕ = 33.7°

TAN ϕ = 0.666

C = 0

		1 ▲	2 Y	3 X	
	TEST NO.	1 ▲	2 Y	3 X	
INITAL	WATER CONTENT, %	26.8	26.5	27.3	
INITAL	VOID RATIO	0.754	0.761	0.757	
INITAL	SATURATION, %	94.8	92.9	96.1	
INITAL	DRY DENSITY, PCF	95.0	94.6	94.8	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	22.2	21.3	20.5	
FINAL	VOID RATIO				
FINAL	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.62	1.43	1.87	
TIME TO FAILURE, MIN		1542	1542	1877	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

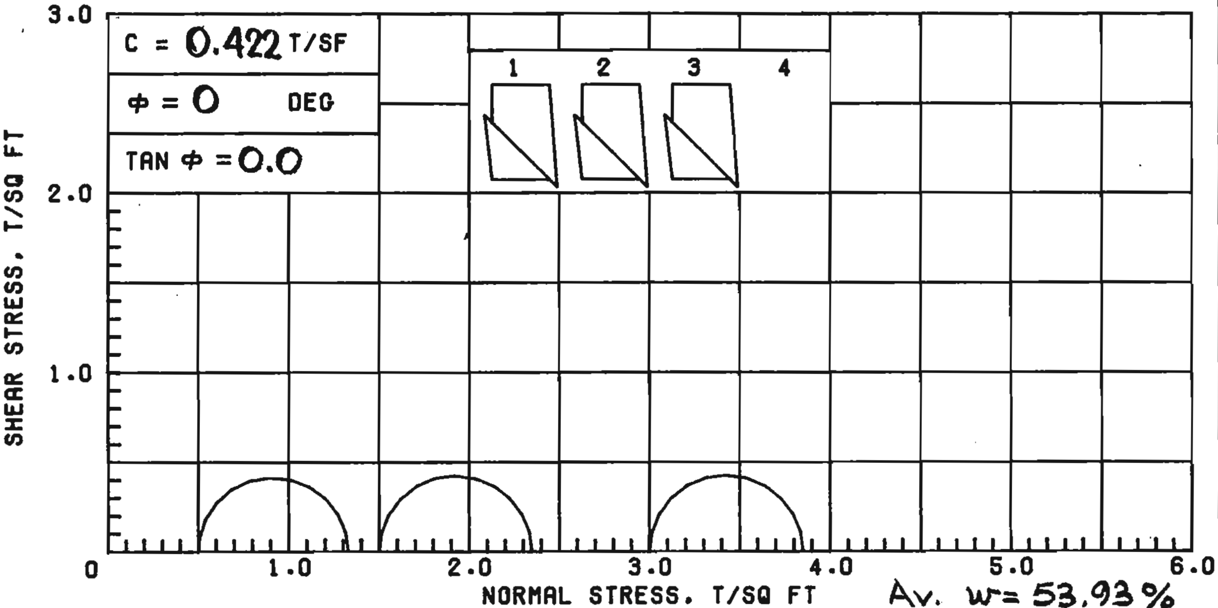
TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.553 IN. THICK

CLASSIFICATION SILTY SAND (SM), GRAY

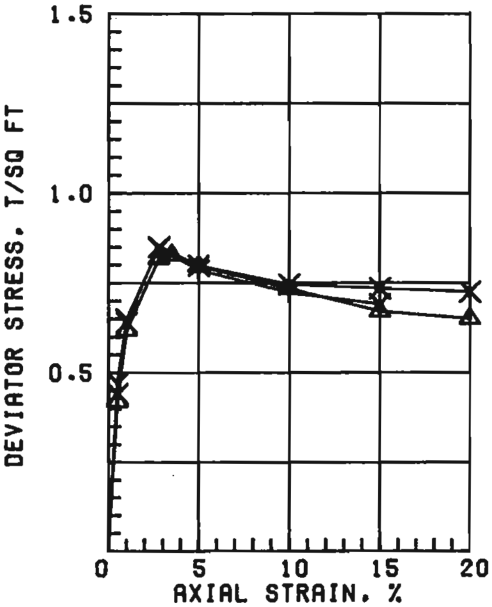
LL	PL	PI		GS 2.67 (EST)

REMARKS:	PROJECT LAKE PONT., LA. & VIC. PARIS ROAD TO SOUTH POINT	
	BORING NO. 12-SPU	SAMPLE 9-C
	DEPTH/ELEV 33.0/-26.5	DATE 09 MAY 84

DIRECT SHEAR TEST REPORT



Av. w= 53.93%
γ_{SAT} = 106.2 pcf



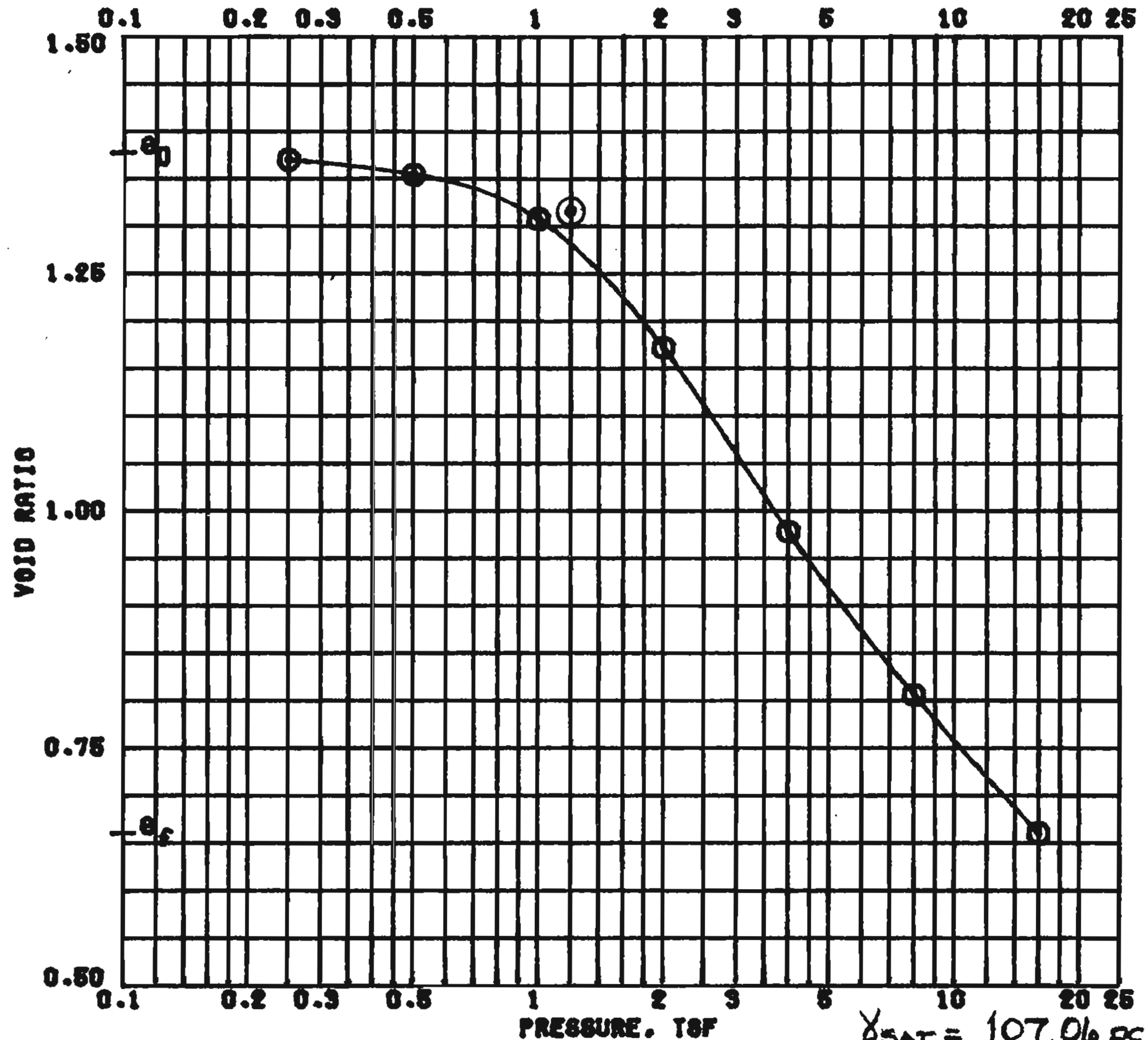
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	54.4	53.8	53.6	
	DRY DENSITY, PCF	68.7	69.1	69.2	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	1.453	1.440	1.437	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.83	0.85	0.85	
	TIME TO FAILURE, MIN.	7	7	10	
	RATE OF STRAIN INCR.%	7	8	10	
	INITIAL DIAMETER, IN.	1.37	1.37	1.37	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 69	PL 24	PI 45	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 13-SPU	SAMPLE NO. 9-B
	DEPTH/ELEV 32.6/-17.4	TECH. WJH
	LABORATORY USAE WES	DATE 24 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



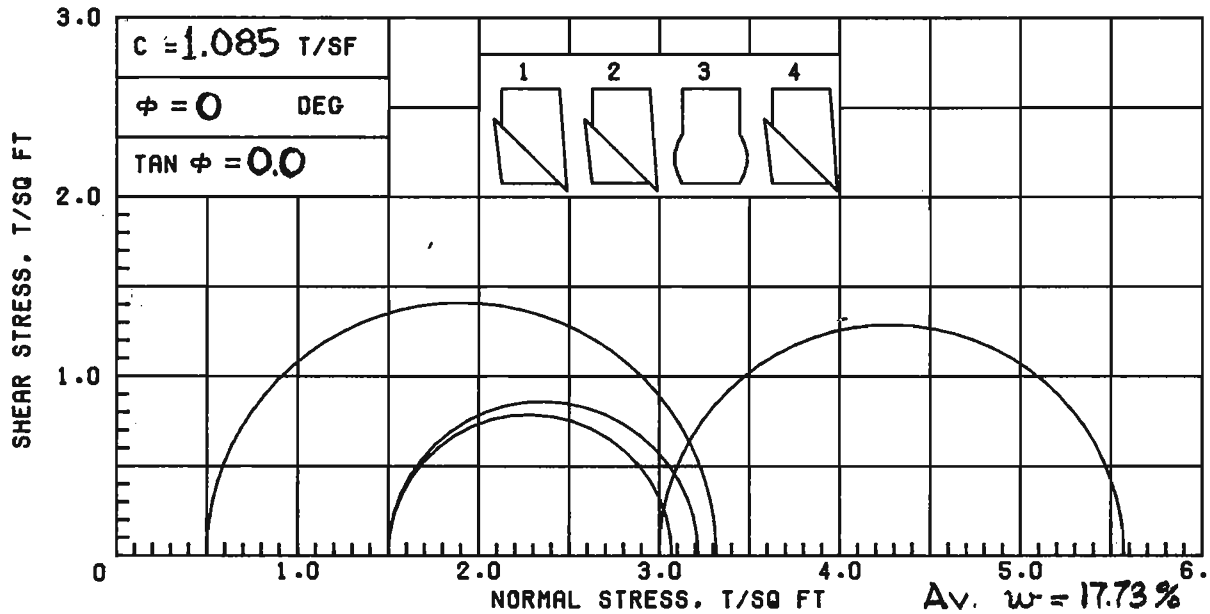
γ_{SAT} = 107.06 pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.50	WATER CONTENT, %	48.6	25.5
PRECONSOL. PRESSURE, TSF	1.22	DRY DENSITY, PCF	70.9	101.6
COMPRESSION INDEX	0.643	SATURATION, %	95.3	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.377	0.658
DIA. IN 4.44	HT. IN 1.115	BACK PRESSURE, TSF		

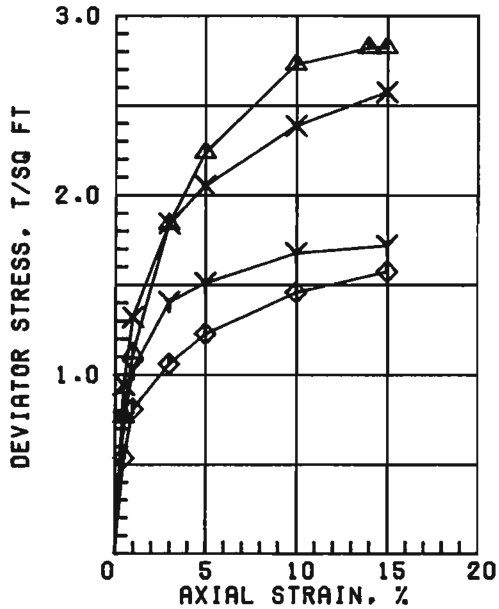
CLASSIFICATION PLASTIC CLAY (CH), GRAY; SHELL PARTICLES		
LL 61	PL 16	PI 45
GS 2.70 (EST)	D_{10}	
REMARKS		

PROJECT LAKE PONT. & VIC	
PARIS ROAD TO SOUTH POINT	
BORING NO. 13-SPU	SAMPLE NO. 10-B
DEPTH/ELEV 38.6/-21.4	DATE 13 JUN 84

CONSOLIDATION TEST REPORT



Av. w = 17.73%
γSAT = 133.1 pcf



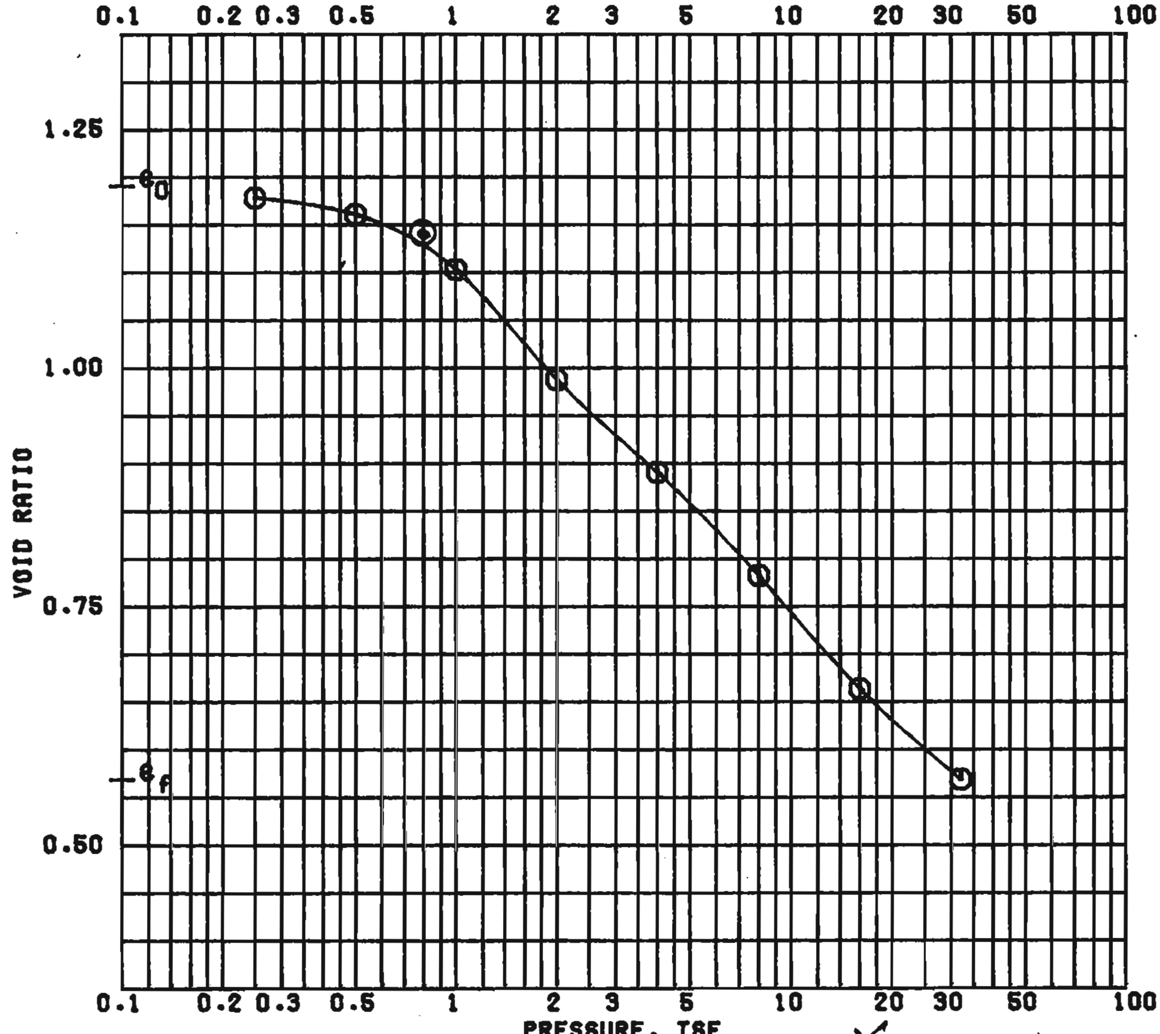
SPECIMEN NO.		△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	14.7	21.4	19.8	15,0
	DRY DENSITY, PCF	117.4	104.9	107.7	117.3
	SATURATION, %	91.9	95.7	95.3	93.3
	VOID RATIO	0.430	0.601	0.559	0.432
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	1.5
MAX. DEV. STRESS, TSF		2.82	1.72	2.57	1.57
TIME TO FAILURE, MIN.		32	34	34	30
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.37	1.37	1.37	1.37
INITIAL HEIGHT, IN.		3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), GRAY; FINE SAND POCKETS

LL 36	PL 13	PI 23	GS 2.69 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:		
	PROJECT LAKE PONT., & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 13-SPU	SAMPLE NO. 13-B
	DEPTH/ELEV 47.6/-32.4	TECH. WJH
	LABORATORY USAE WES	DATE 25 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



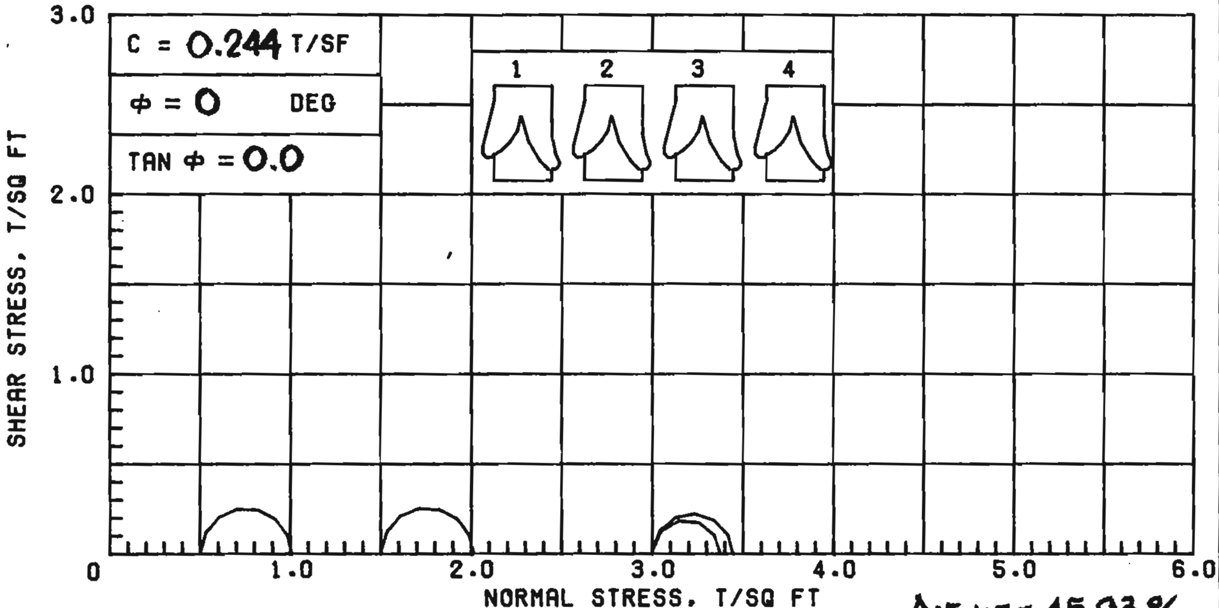
γ_{SAT} = 112.6 pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.40	WATER CONTENT, %	46.2	33.4
PRECONSOL. PRESSURE, TSF	0.80	DRY DENSITY, PCF	77.0	107.6
COMPRESSION INDEX	0.362	SATURATION, %	100 +	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.189	0.567
DIA. IN 4.44	HT. IN 1.123	BACK PRESSURE, TSF		

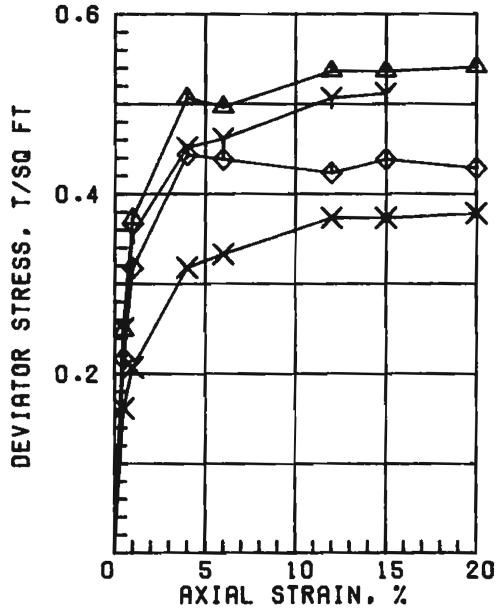
CLASSIFICATION PLASTIC CLAY (CH), GRAY

LL 72	PL 25	PI 47	PROJECT LK. PONT. LA. & VIC.	
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT	
REMARKS			BORING NO. 14-SPU	SAMPLE NO. 3-C
			DEPTH/ELEV 8.6/-2.4	DATE 16 AUG 84

CONSOLIDATION TEST REPORT



Av w = 45.93 %
γ_{SAT} = 110.3 pcf



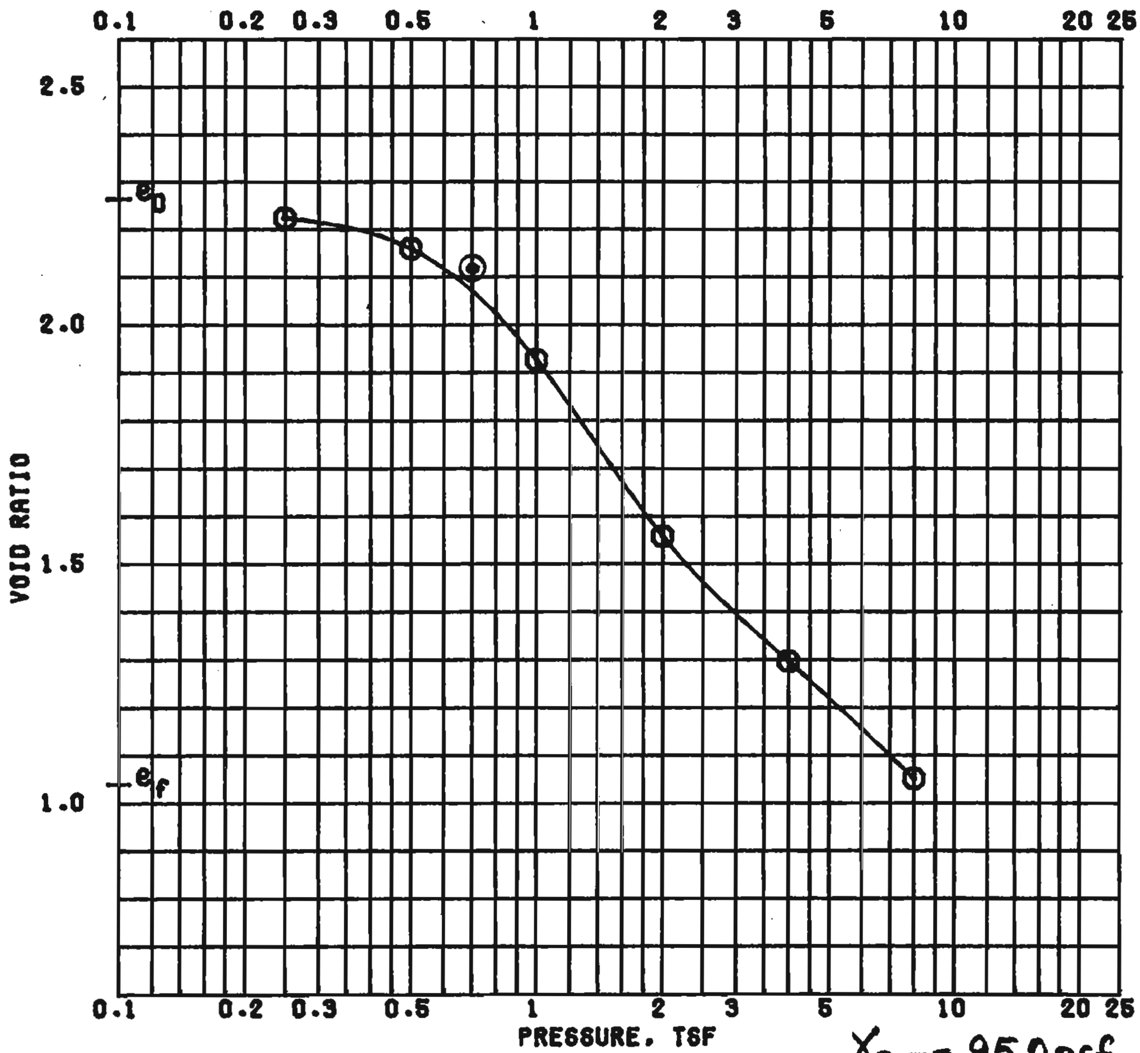
		△1	Y2	X3	◇4
	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	44.5	46.3	46.6	47.0
INITIAL	DRY DENSITY, PCF	76.4	75.4	75.2	74.8
INITIAL	SATURATION, %	99.6	100+	100+	100+
INITIAL	VOID RATIO	1.207	1.236	1.242	1.255
BEFORE SHEAR	WATER CONTENT, %				
BEFORE SHEAR	DRY DENSITY, PCF				
BEFORE SHEAR	SATURATION, %				
BEFORE SHEAR	VOID RATIO				
BEFORE SHEAR	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	3.0
	MAX. DEV. STRESS, TSF	0.51	0.51	0.37	0.44
	TIME TO FAILURE, MIN.	8	45	42	15
	RATE OF STRAIN INCR.,%				
	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; SILT LENSES

LL 62	PL 19	PI 43	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 14-SPU	SAMPLE NO. 4-B
	DEPTH/ELEV 11.9/-5.7	TECH. PJR
	LABORATORY USAE WES	DATE 30 APR 84
	TRIAXIAL COMPRESSION TEST REPORT	



$\gamma_{SAT} = 95.0$ pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	0.55	WATER CONTENT, %	83.8	41.3
PRECONSOL. PRESSURE, TSF	0.70	DRY DENSITY, PCF	51.7	82.8
COMPRESSION INDEX	1.06	SATURATION, %	100 +	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.260	1.037
DIA. IN 4.44	HT. IN 1.129	BACK PRESSURE, TSF		

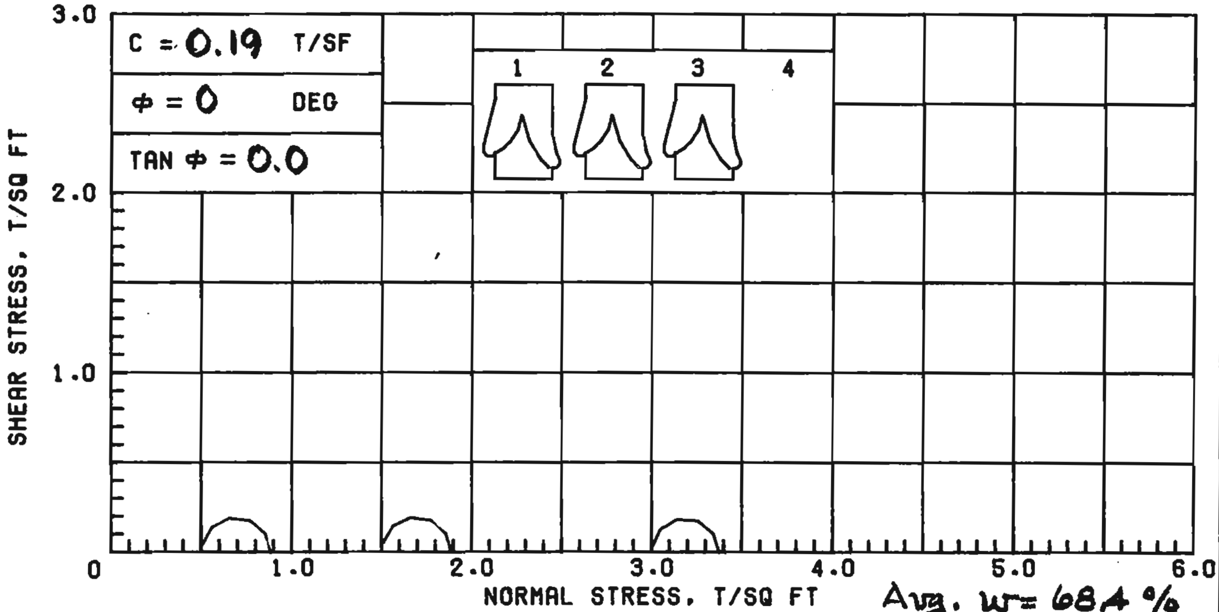
CLASSIFICATION PLASTIC CLAY (CH), GRAY		
LL 96	PL 30	PI 66
GS 2.70 (EST)	D_{10}	

PROJECT LK. PONT. LA. & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 14-SPU	SAMPLE NO. 5-C
DEPTH/ELEV 17.3/-11.1	DATE 10 AUG 84

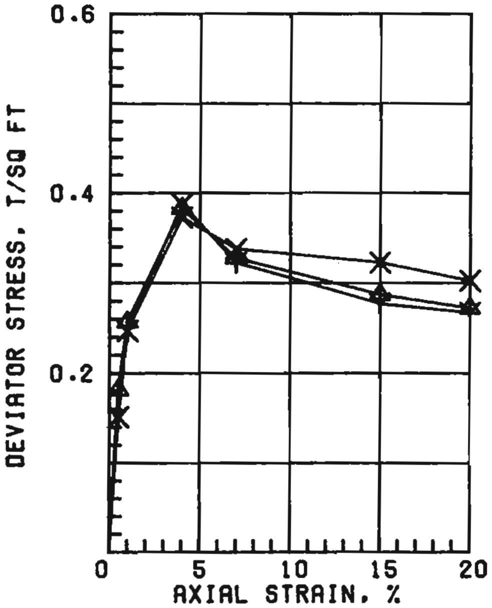
REMARKS

CONSOLIDATION TEST REPORT

SHEET 1 OF 8



Avg. w = 68.4 %
γ_{SAT} = 86.76 pcf



SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	68.3	68.7	68.1	
	DRY DENSITY, PCF	59.5	59.3	59.5	
	SATURATION, %	100+	100+	100+	
	VOID RATIO	1.833	1.843	1.831	
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	0.39	0.37	
TIME TO FAILURE, MIN.		9	16	26	
RATE OF STRAIN INCR.%				7	
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

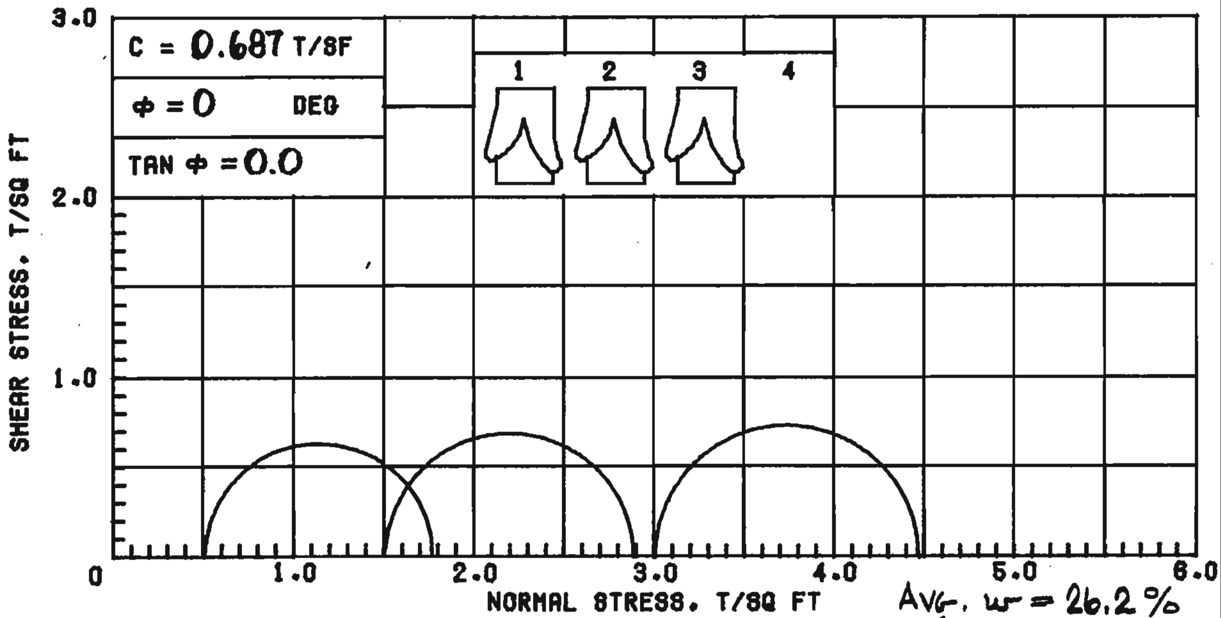
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 77	PL 22	PI 55	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

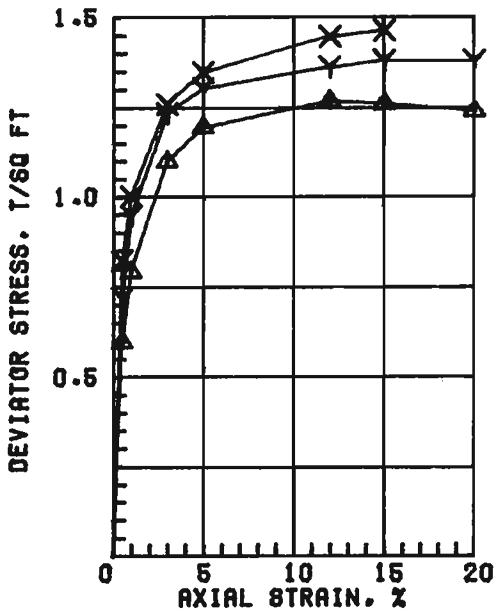
REMARKS:

PROJECT LAKE PONT., LA. & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 14-SPU	SAMPLE NO. 6-C
DEPTH/ELEV 21.2/-15.0	TECH. PJR
LABORATORY USAE WES	DATE 01 MAY 84

TRIAXIAL COMPRESSION TEST REPORT



Avg. w = 26.2 %
γ_{SAT} = 123.9 pcf



SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	26.4	25.8	26.4	
	DRY DENSITY, PCF	97.4	98.1	97.5	
	SATURATION, %	97.8	97.0	97.8	
	VOID RATIO	0.730	0.718	0.729	
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		1.27	1.38	1.47	
TIME TO FAILURE, MIN.		30	53	30	
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.40	1.41	1.41	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

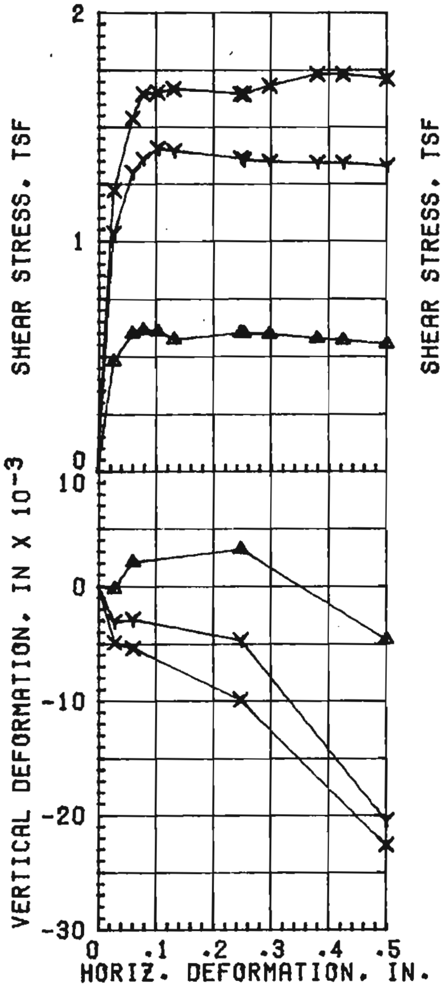
CONTROLLED-STRAIN TEST

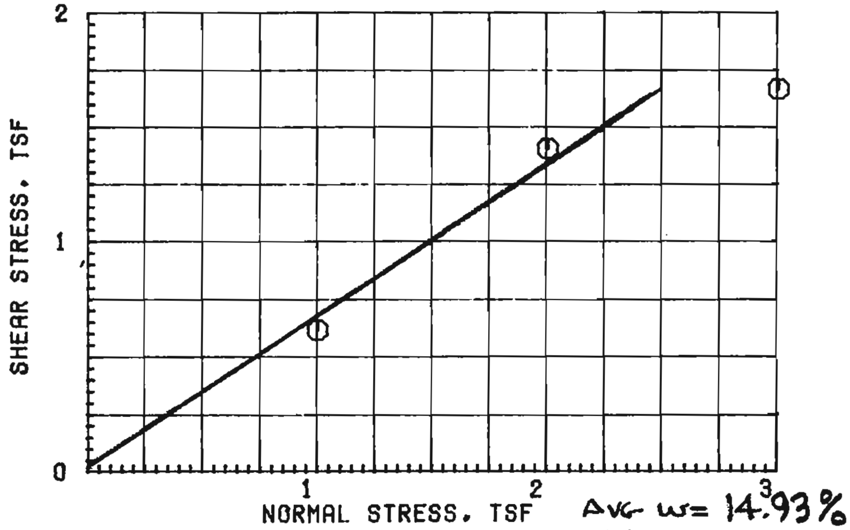
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), LIGHT GRAY

LL 53	PL 16	PI 37	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VIC. PARIS ROAD TO SOUTH POINT	
	BORING NO. 15-SPU	SAMPLE NO. 2-C
	DEPTH/ELEV 5.8	TECH. PJR
	LABORATORY USAE WES	DATE 18 MAY 84

TRIAXIAL COMPRESSION TEST REPORT





AVG w = 14.93%
γ_{SAT} = 129.7 pcf

φ = 33.7°

TAN φ = 0.6666

C = 0

	TEST NO.	1 ▲	2 Y	3 X	
INITAL	WATER CONTENT, %	15.6	15.2	14.0	
	VOID RATIO	0.559	0.573	0.571	
	SATURATION, %	75.1	71.2	65.9	
	DRY DENSITY, PCF	107.7	106.7	106.8	
VOID RATIO AFTER CONSOL					
FIFTY PERCENT CONSOL, MIN		< 1	< 1	< 1	
FINAL	WATER CONTENT, %	15.2	15.8	14.3	
	VOID RATIO				
	SATURATION, %				
NORMAL STRESS, TSF		1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF		0.61	1.41	1.67	
TIME TO FAILURE, MIN		434	572	726	
RATE OF STRAIN, IN/MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF					

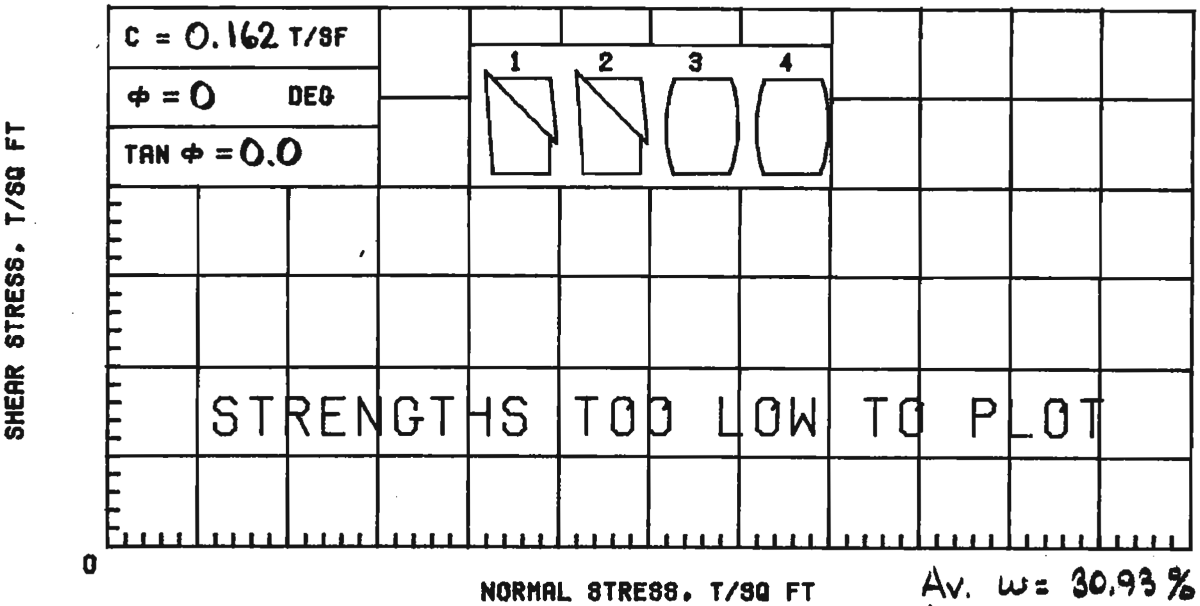
TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.553 IN. THICK

CLASSIFICATION CLAYEY SAND (SC), GRAY

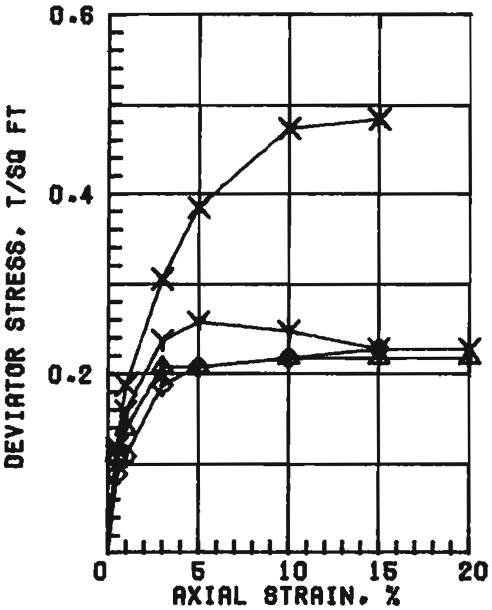
LL	PL	PI		GS 2.69 (EST)

REMARKS:	PROJECT LAKE PONTCHARTRAIN & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 15-SPU	SAMPLE 6-C
	DEPTH/ELEV 21.0	DATE 30 MAY 84

DIRECT SHEAR TEST REPORT



Av. w = 30.93 %
γsat = 119.3 pcf



	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	32.5	34.1	25.5	33.2
INITIAL	DRY DENSITY, PCF	87.4	86.4	97.3	86.3
INITIAL	SATURATION, %	94.9	97.2	94.5	94.4
INITIAL	VOID RATIO	0.921	0.944	0.726	0.946
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	0.5
	MAX. DEV. STRESS, TSF	0.21	0.26	0.48	0.23
	TIME TO FAILURE, MIN.	6	10	30	30
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.41	1.41	1.41	1.41
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: SANDY CLAY (CL), GRAY; SILT LENSES & POCKETS

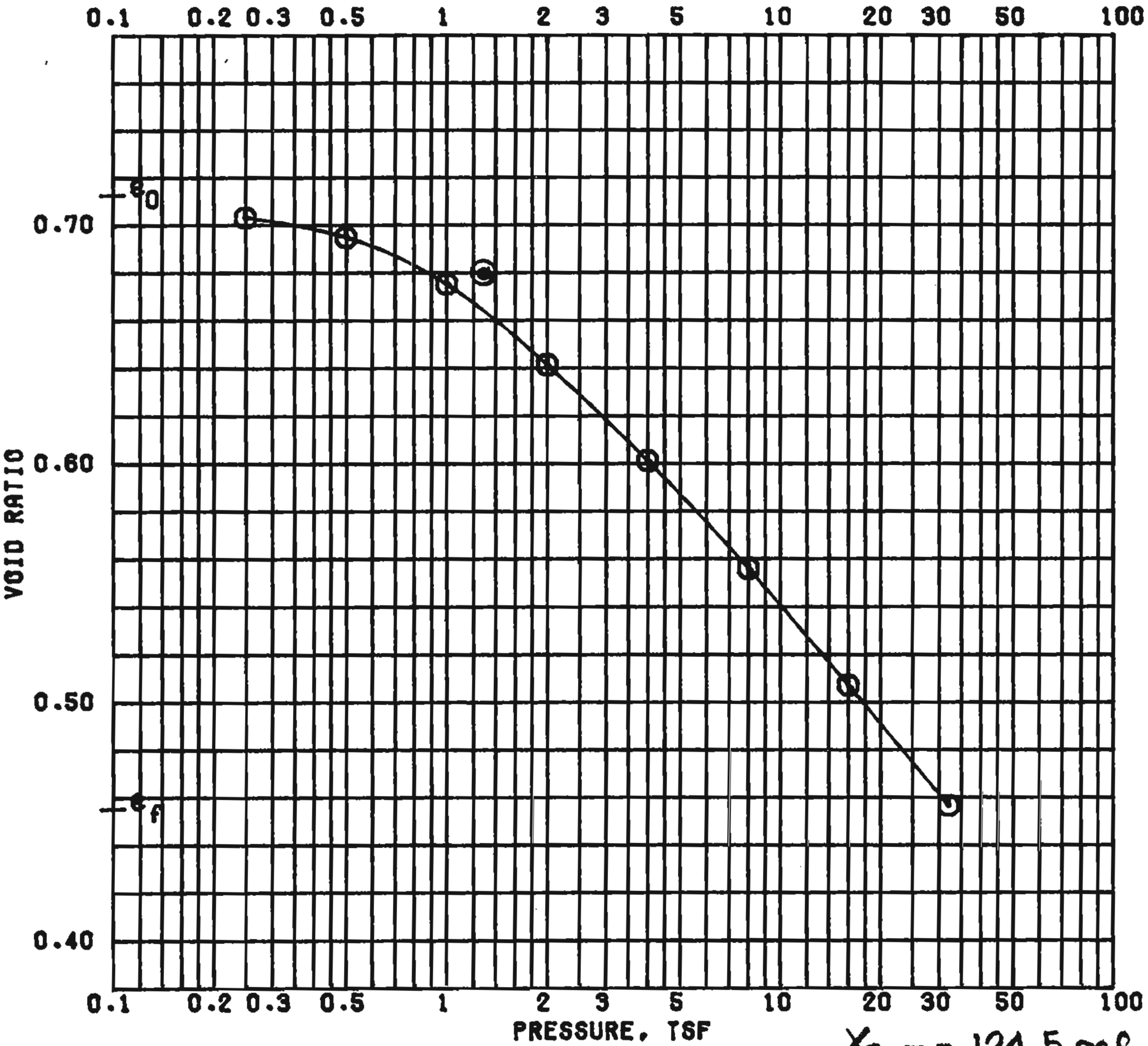
LL 29	PL 12	PI 17	GS 2.69 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

LIMITS ON MIXTURE OF MATERIAL.

PROJECT LAKE PONTCHARTRAIN & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 15-SPU	SAMPLE NO. 9-B
DEPTH/ELEV 32.3	TECH. KOC
LABORATORY USAE WES	DATE 16 MAY 84

TRIAXIAL COMPRESSION TEST REPORT



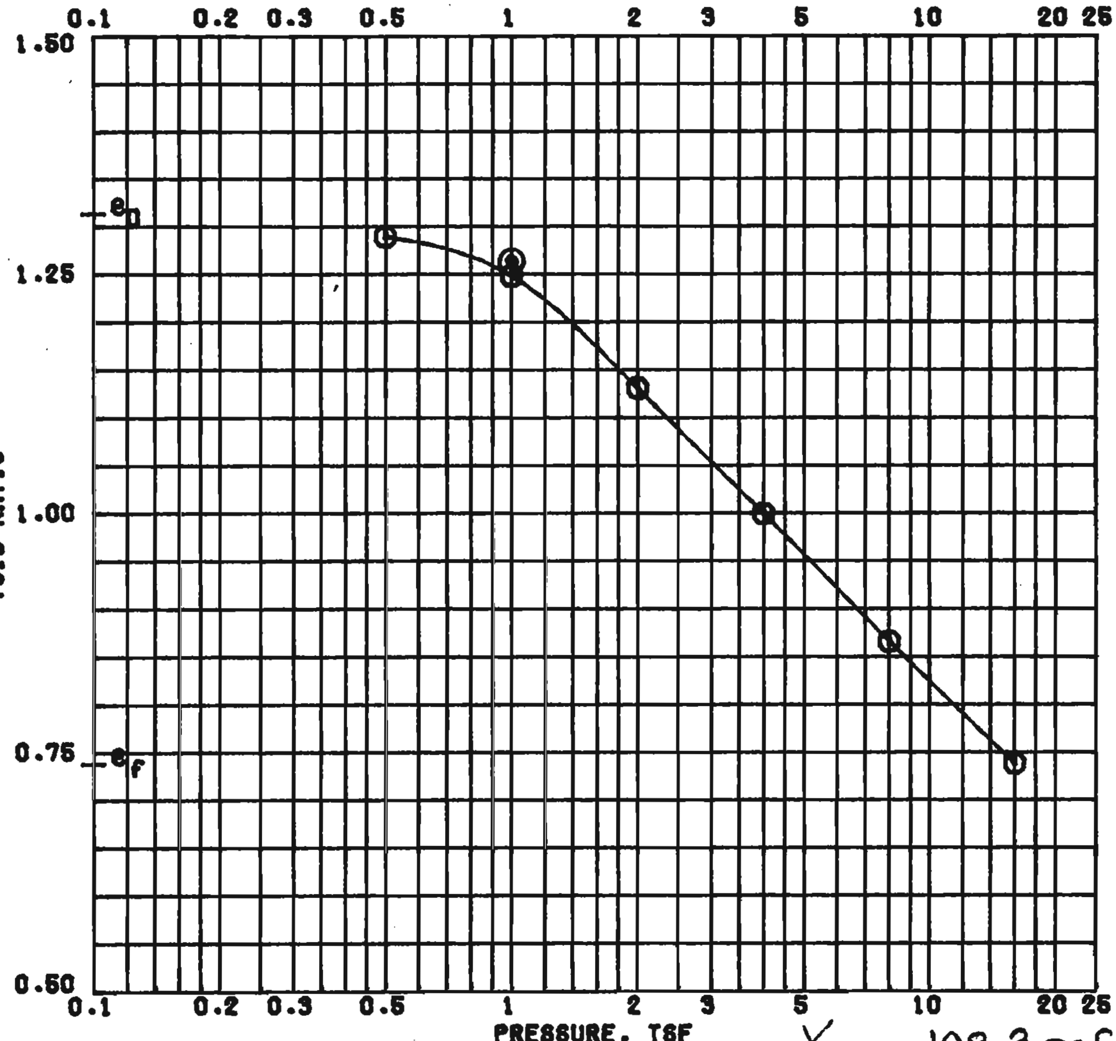
$\gamma_{SAT} = 124.5$ pcf

				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		1.45	WATER CONTENT, %	24.0	16.1
PRECONSOL. PRESSURE, TSF		1.30	DRY DENSITY, PCF	98.5	115.9
COMPRESSION INDEX		0.162	SATURATION, %	90.9	95.9
TYPE SPECIMEN	UNDISTURBED		VOID RATIO	0.712	0.454
DIA. IN 4.44	HT. IN 1.153		BACK PRESSURE, TSF		

CLASSIFICATION SANDY CLAY (CL), GRAY			
LL 23	PL 12	PI 11	PROJECT LAKE PONTCHARTRAIN & VIC
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT
REMARKS			BORING NO. 15-SPU / SAMPLE NO. 9-C
			DEPTH/ELEV 32.8 / DATE 10 JUL 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 10



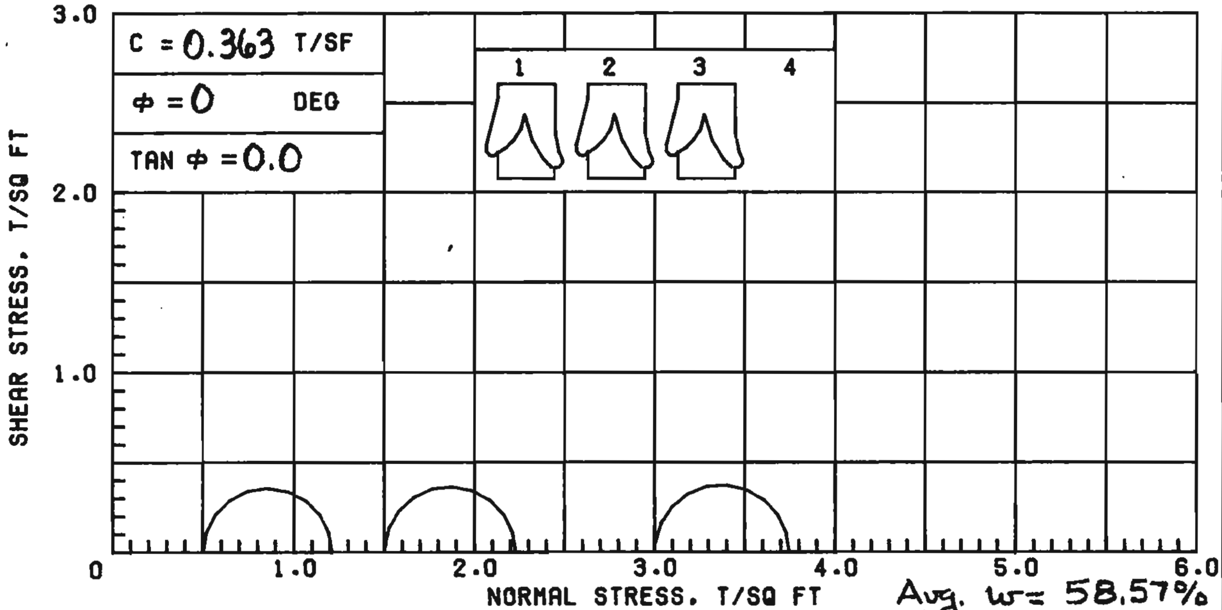
$\gamma_{SAT} = 108.3$ pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.35	WATER CONTENT, %	46.5	30.4
PRECONSOL. PRESSURE, TSF	1.00	DRY DENSITY, PCF	72.9	97.1
COMPRESSION INDEX	0.439	SATURATION, %	95.8	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.312	0.736
DIA. IN 4.44	HT. IN 1.126	BACK PRESSURE, TSF		

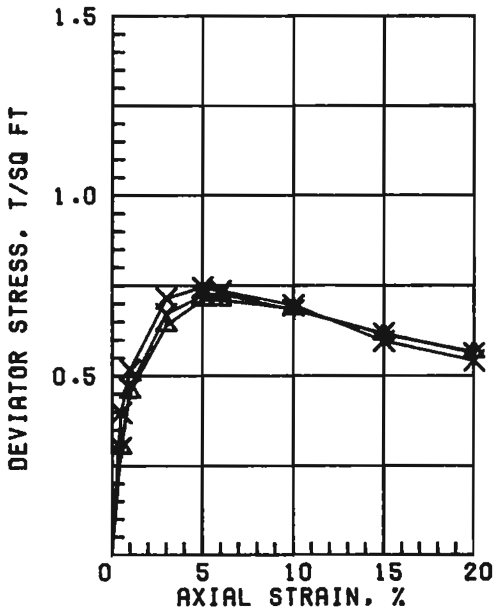
CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 73	PL 27	PI 46	PROJECT LK. PONT. LA. & VIC.	
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT	
REMARKS			BORING NO. 17-SPU	SAMPLE NO. 8-C
			DEPTH/ELEV 29.1/-13.0	DATE 09 AUG 84

CONSOLIDATION TEST REPORT



Avg. w = 58.57%
γ_{SAT} = 103.4 pcf



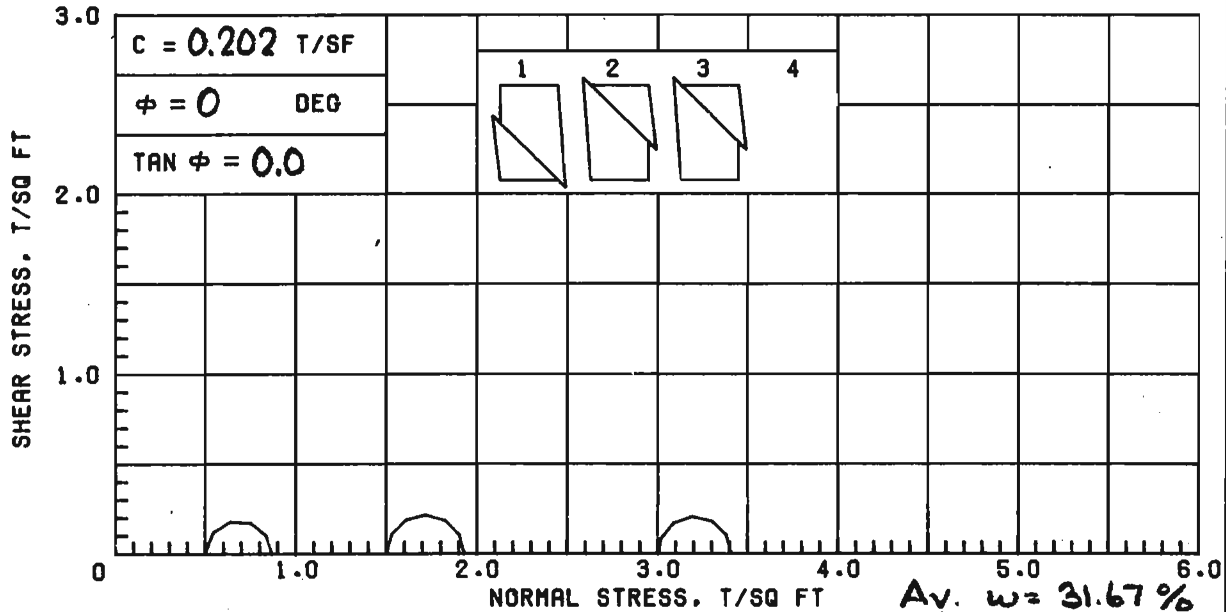
SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	59.2	58.4	58.1	
	DRY DENSITY, PCF	64.8	65.1	65.2	
	SATURATION, %	99.8	99.1	99.0	
	VOID RATIO	1.602	1.591	1.584	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.71	0.73	0.74	
TIME TO FAILURE, MIN.		12	17	19	
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

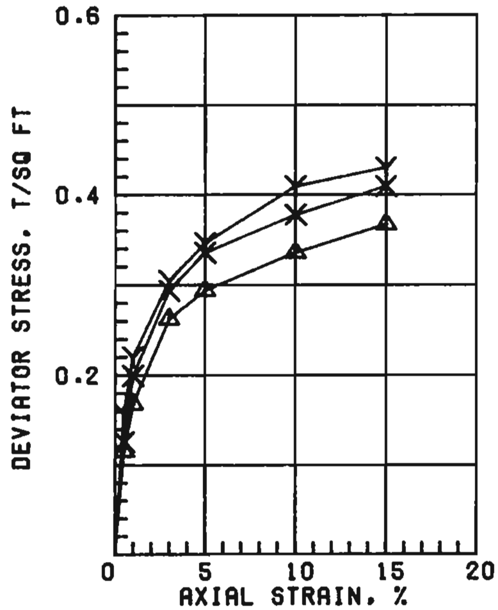
DESCRIPTION OF SPECIMENS: PLASTIC CLAY (CH), GRAY; ROOTLETS

LL 80	PL 22	PI 58	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 17-SPU	SAMPLE NO. 8-D
	DEPTH/ELEV 30.0/-13.9	TECH. PJR
	LABORATORY USAE WES	DATE 02 MAY 84
	TRIAXIAL COMPRESSION TEST REPORT	



Av. w = 31.67 %
γ_{SAT} = 119.12 pcf



		△1	Y2	X3	4
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	31.8	32.3	30.9	
INITIAL	DRY DENSITY, PCF	90.3	89.1	90.7	
INITIAL	SATURATION, %	99.2	97.7	97.2	
INITIAL	VOID RATIO	0.866	0.893	0.858	
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	0.37	0.43	0.41	
	TIME TO FAILURE, MIN.	31	29	31	
	RATE OF STRAIN INCR.,%				
	INITIAL DIAMETER, IN.	1.37	1.37	1.37	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

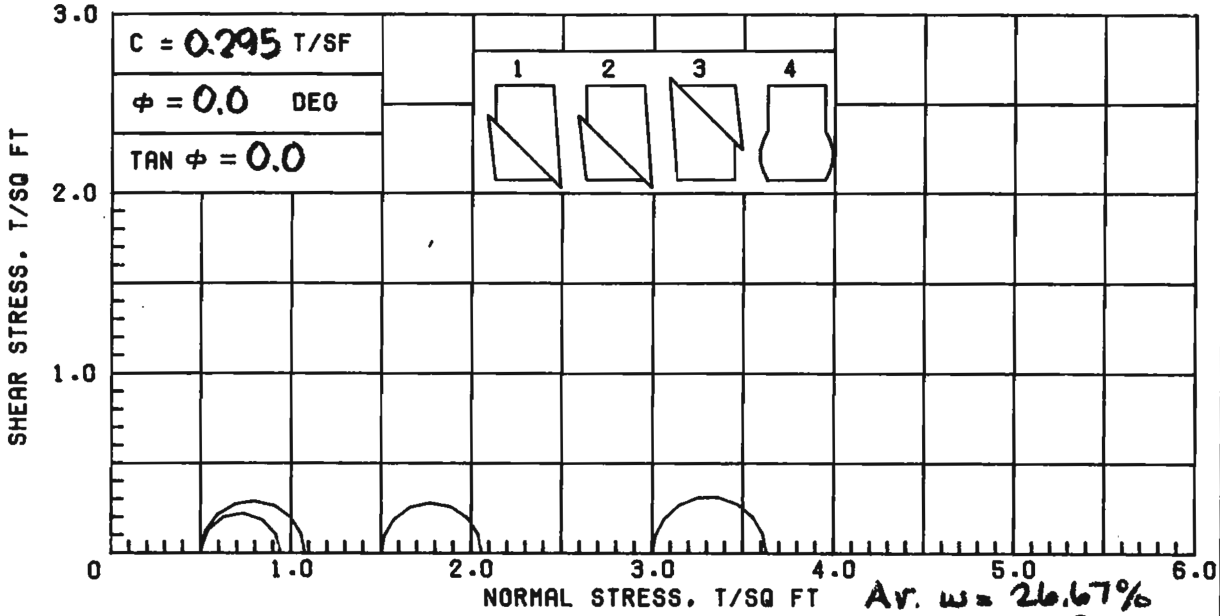
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; CLAY (CL), DARK GRAY; ROOTLETS;
SHELL PARTICLES

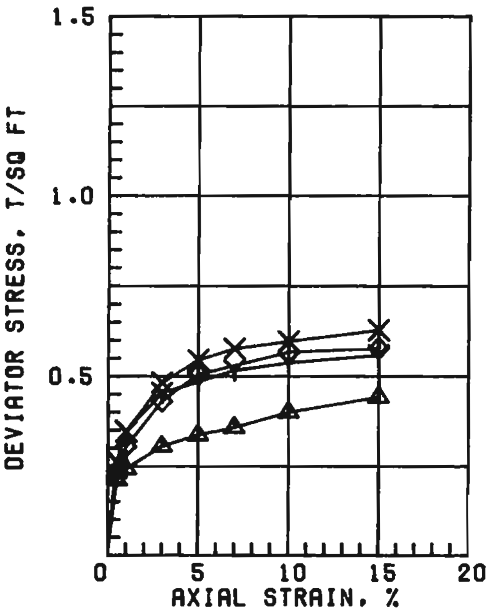
LL 45	PL 16	PI 29	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS;	PROJECT LAKE PONT., LA. & VIC.
	PARIS ROAD TO SOUTH POINT
BORING NO. 18-SPU	SAMPLE NO. 3-C
DEPTH/ELEV 9.2/6.3	TECH. WJH
LABORATORY USAE WES	DATE 30 APR 84

TRIAXIAL COMPRESSION TEST REPORT



Av. w = 26.67%
γSAT = 123.80



	SPECIMEN NO.	△1	Y2	X3	◇4
INITIAL	WATER CONTENT, %	27.5	25.6	27.7	26.7
	DRY DENSITY, PCF	96.7	98.0	96.6	97.5
	SATURATION, %	99.8	95.9	100+	98.8
	VOID RATIO	0.744	0.720	0.745	0.730
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	0.44	0.56	0.63	0.58
	TIME TO FAILURE, MIN.	30	30	30	32
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.36	1.36	1.37	1.37
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	3.00

CONTROLLED-STRAIN TEST

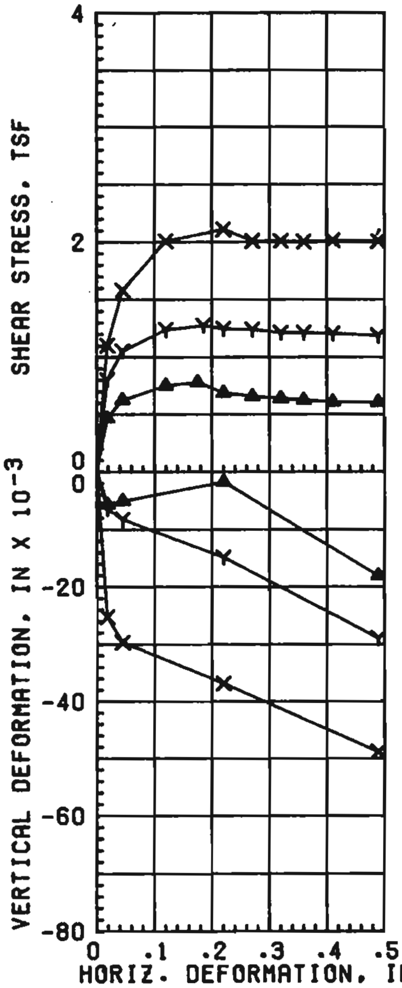
DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; FINE SAND POCKETS

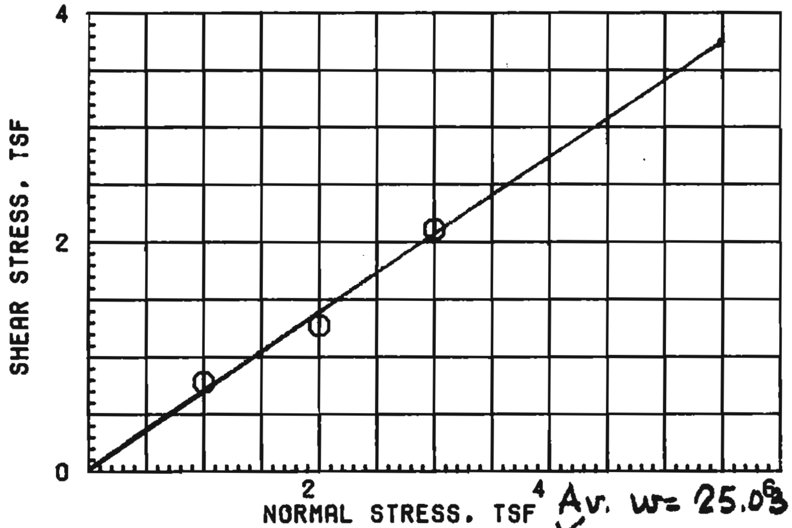
LL 39	PL 14	PI 25	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT LAKE PONT., LA. & VIC.	
PARIS ROAD TO SOUTH POINT	
BORING NO. 18-SPU	SAMPLE NO. 5-C
DEPTH/ELEV 16.8/-1.3	TECH. WJH
LABORATORY USAE WES	DATE 01 MAR 84

TRIAXIAL COMPRESSION TEST REPORT





Av. w= 25.03 %
γ_{SAT}= 127.3pcf

ϕ = 34.28°

TAN ϕ = 0.6818

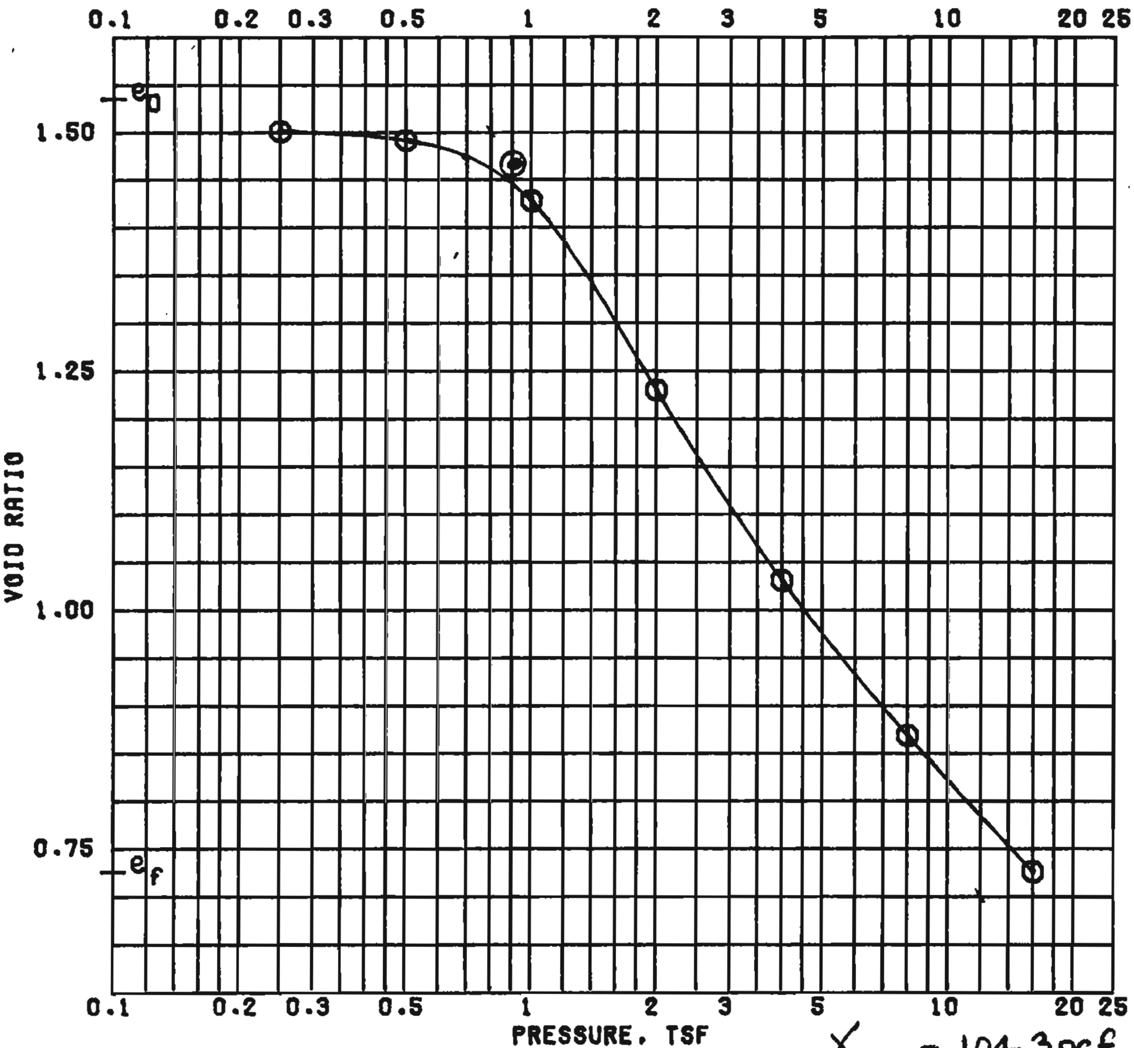
C = 0

		TEST NO.	1 ▲	2 Y	3 X	
INITAL		WATER CONTENT, %	25.7	24.5	24.9	
		VOID RATIO	0.649	0.642	0.638	
		SATURATION, %	100 +	100 +	100 +	
		DRY DENSITY, PCF	101.4	101.9	102.1	
VOID RATIO AFTER CONSOL						
FIFTY PERCENT CONSOL, MIN			< 1	< 1	< 1	
FINAL		WATER CONTENT, %	23.1	23.2	22.0	
		VOID RATIO				
		SATURATION, %				
NORMAL STRESS, TSF			1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, TSF			0.78	1.27	2.11	
TIME TO FAILURE, MIN			987	1044	1241	
RATE OF STRAIN, IN/MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, TSF						

TYPE SPECIMEN UNDISTURBED	3.00 IN. SQUARE	0.744 IN. THICK
CLASSIFICATION SILT (ML), GRAY; TRACE OF FINE SAND		

LL	PL	PI		GS 2.68 (EST)

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 18-SPU	SAMPLE 6-C
	DEPTH/ELEV 21.2/-5.7	DATE 04 MAY 84
	DIRECT SHEAR TEST REPORT	



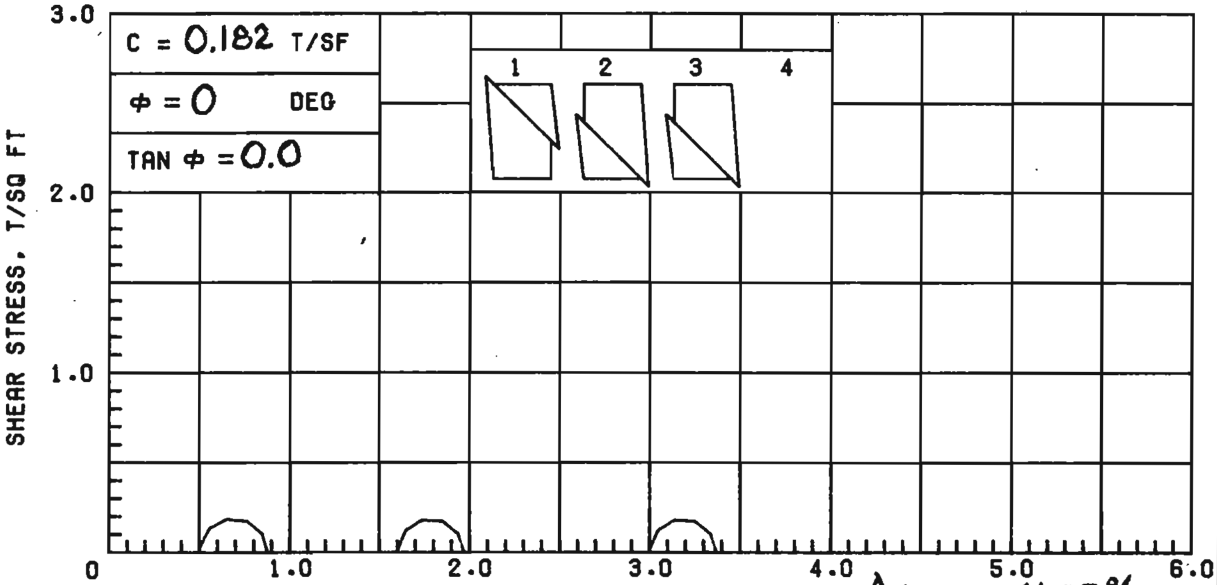
$\gamma_{SAT} = 104.3$ pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.25	WATER CONTENT, %	54.7	30.4
PRECONSOL. PRESSURE, TSF	0.90	DRY DENSITY, PCF	66.5	97.6
COMPRESSION INDEX	0.680	SATURATION, %	96.3	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.534	0.724
DIA. IN 4.44	HT. IN 1.126	BACK PRESSURE, TSF		

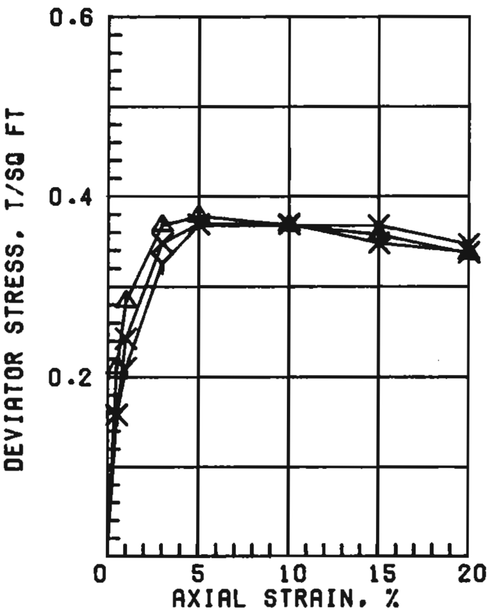
CLASSIFICATION	PLASTIC CLAY (CH), GRAY; SILT LENSES	
LL 79 | PL 21 | PI 58	PROJECT LK. PONT. LA. & VIC.	
GS 2.70 (EST) | D_{10}	PARIS ROAD TO SOUTH POINT	
REMARKS	BORING NO. 16-SPU	SAMPLE NO. 6-B
	DEPTH/ELEV 26.4/-12.9	DATE 11 AUG 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 9



Av. w = 41.07%
γ_{SAT} = 112.6 pcf



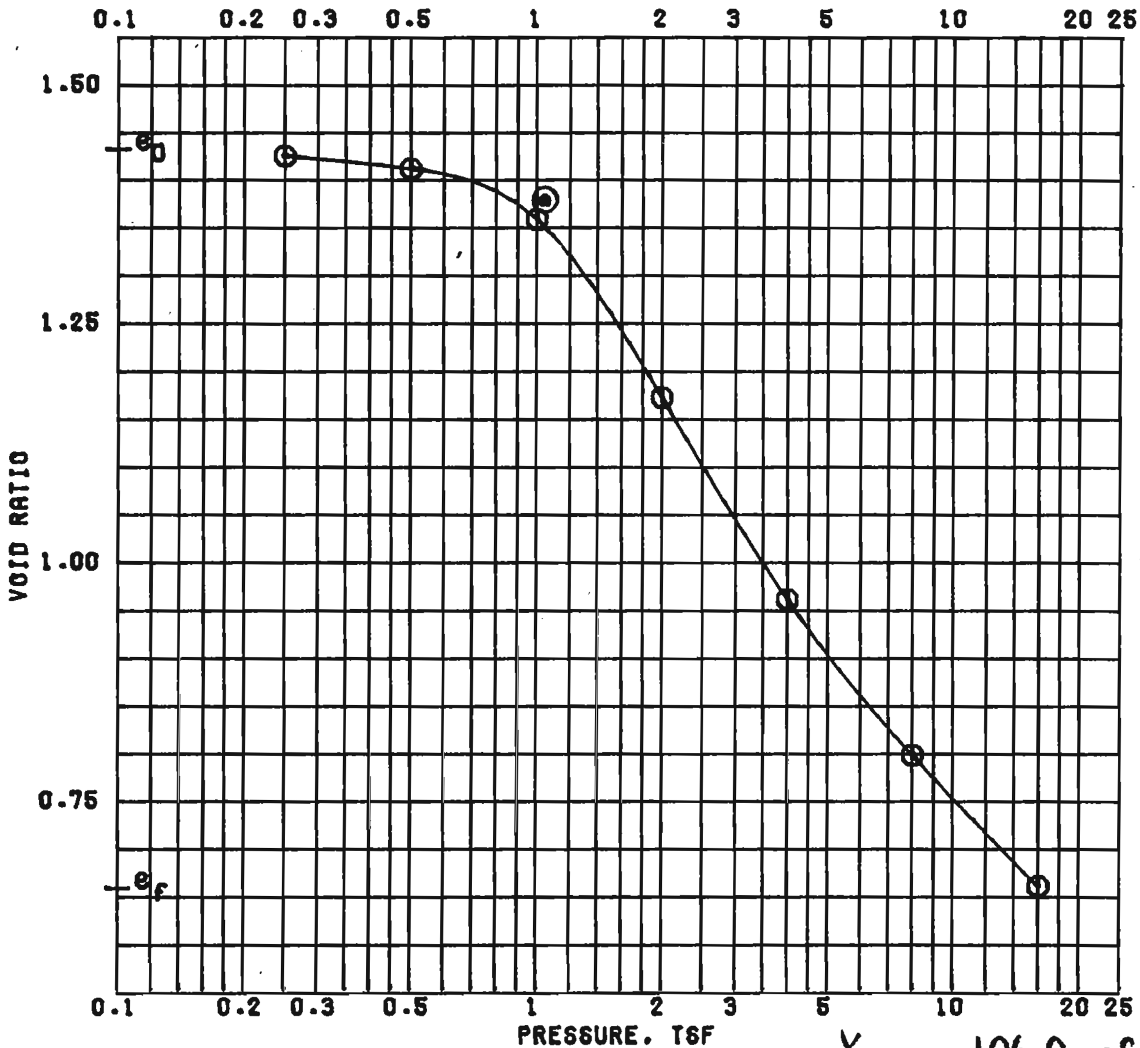
	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	43.8	36.6	42.8	
	DRY DENSITY, PCF	76.8	83.9	77.7	
	SATURATION, %	98.9	97.9	98.8	
	VOID RATIO	1.195	1.010	1.170	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.6	3.0	
	MAX. DEV. STRESS, TSF	0.38	0.37	0.37	
	TIME TO FAILURE, MIN.	10	11	11	
	RATE OF STRAIN INCR.,%				
	INITIAL DIAMETER, IN.	1.37	1.37	1.36	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS; CLAY (CL), GRAY; SHELL PARTICLES

LL 43	PL 15	PI 28	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT LAKE PONT., LA. & VIC.	
	PARIS ROAD TO SOUTH POINT	
	BORING NO. 18-SPU	SAMPLE NO. 9-C
	DEPTH/ELEV 33.0/-17.5	TECH. WJH
	LABORATORY USAE WES	DATE 01 MAR 84
	TRIAXIAL COMPRESSION TEST REPORT	



γ_{SAT} = 106.0 pcf

			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF	1.55	WATER CONTENT, %	50.6	25.3
PRECONSOL. PRESSURE, TSF	1.05	DRY DENSITY, PCF	69.3	101.7
COMPRESSION INDEX	0.721	SATURATION, %	95.5	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.431	0.657
DIA. IN 4.44	HT. IN 1.144	BACK PRESSURE, TSF		

CLASSIFICATION PLASTIC CLAY (CH), GRAY; SILT LENSES

LL 70	PL 21	PI 49	PROJECT LK. PONT. LA. & VIC.
GS 2.70 (EST)	D_{10}		PARIS ROAD TO SOUTH POINT
REMARKS			BORING NO. 18-SPU / SAMPLE NO. 11-B
			DEPTH/ELEV 40.0/-24.5 / DATE 11 AUG 84

CONSOLIDATION TEST REPORT

SHEET 1 OF 9

LAKE PONTCHARTRAIN, LOUISIANA & VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 15, GENERAL DESIGN
NEW ORLEANS EAST LAKEFRONT LEVEE
PARIS ROAD TO SOUTH POINT

APPENDIX C

PUBLIC COMMENTS AND RESPONSES

LAKE PONTCHARTRAIN, LA. & VICINITY
HURRICANE PROTECTION PROJECT
COMMENTS IN REEVALUATION STUDY FOR NEW ORLEANS EAST

AGENCY	COMMENT #	PAGE #
U.S. Dept of Commerce	1.3	D-2
National Oceanic and Atmospheric Administration	2.2, 2.3	D-7
National Marine Fisheries Service		
U.S. Dept. of Interior	7.2	D-14
Office of the Secretary	7.20	D-17
Office of Environmental Project Review	7.41, 7.44	D-20
State of Louisiana	13.1	D-29
Dept. of Natural Resources	13.5 through 13.11	D-31,D-32,D-33
	13.28	D-38,D-39
The Board of Levee Commissioners Orleans Levee District	15.5	D-42
City of New Orleans	-	D-44
	16.1	D-45
Environmental Defense Fund	-	D-51
	19.2, 19.3	D-52
League of Women Voters of La.	20.1, 20.3	D-57
Louisiana Wildlife Federation, Inc.	21.4	D-58,D-59
Orleans Audubon Society	22.1	D-60
Private letter from Moira Ford	24.1 through 24.3	D-62,D-63
	24.6, 24.7	D-64
Private letter from Michael Halle	26.1, 26.4	D-67

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, Florida 33702

February 16, 1984

F/SER11/PK
813-893-3503

Colonel Robert C. Lee
District Engineer, New Orleans District
Department of the Army, Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160

1

Dear Colonel Lee:

The National Marine Fisheries Service (NMFS) has received the Draft Supplement to the Environmental Impact Statement (DSEIS) Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project dated December 1983. We have reviewed this DSEIS and offer the following General and Specific Comments for your consideration. Our review concentrated on those parts of the project likely to have greatest impacts on marine fishery resources and their habitats.

General Comments

In general, we feel that the DSEIS adequately addresses the numerous alternatives to future work for the ongoing hurricane protection project for New Orleans metropolitan area. Of the two plans considered in detail, the NMFS had expressed opposition to the Barrier Plan in our comments dated March 21, 1975, May 18, 1978, and June 27, 1978, and in meetings with the Corps of Engineers and other federal and state agencies. The High Level Plan, designated as the Tentatively Selected Plan in the DSEIS, is the least environmentally damaging construction plan and the one that will be least detrimental to marine fisheries and their habitats.

1.1 One topic important to continued production of marine fisheries that was mentioned, but not thoroughly discussed or resolved, was mitigation for the loss of wetlands. We feel that mitigation, necessary to fully offset lost fishery habitat values upon completion of the selected plan, should be proposed, researched and conducted simultaneously with construction of the hurricane protection project. Although the management areas in St. Bernard Parish (already permitted) and/or stabilizing the shoreline of Lake Pontchartrain in St. Charles Parish (partially permitted) are excellent projects, without more detailed plans it is not possible to determine the adequacy of these projects as mitigation for either the High Level Plan or the Barrier Plan. No mitigation has been proposed to offset the impacts of deepening to -60 feet approximately 5 miles x 500 feet of Lake Pontchartrain.

RESPONSE 1.1: Further formulation and coordination of the mitigation plan is underway; the report and EIS are scheduled for completion in 1986. A number of alternative plans to fully offset losses due to direct construction impacts are being considered. These plans will be discussed and reviewed in scoping meetings and workshops to which the interested public, private organizations, and government agencies will be invited. The mitigation features will be implemented concurrently with construction of project features. Some environmental restoration and mitigation has already been implemented concurrently with construction (see paragraph 4.4.2.6.).

1.2 The value of commercial fisheries catch reported for the present, and the predicted fishery losses for future "with and without additional federal action", should be clarified and expanded. Also, at least an estimate of project impacts on sport fishing should be provided.

Specific Comments

4. ALTERNATIVES

4.2. PLANS ELIMINATED FROM FURTHER STUDY

4.2.5. PLAN 5

1.3 Page EIS-22-24, paragraphs 4.2.5.-4.2.11. This section discusses the reasons the Maxent Canal alignment was rejected in favor of the existing alignment (New Orleans East). Paragraph 4.2.10. should note that NMFS is an agency that recommends that tidal exchange be reestablished to increase the productivity of 13,000 acres of wetlands for estuarine fish and shellfish. Even though there is a proposal to develop 9,800 of the 13,000 acres, this section should be expanded to include the benefits to estuarine-dependent fishery resources with the additional habitat if the Maxent Canal alignment were selected.

1.4 4.3. FUTURE WITHOUT ADDITIONAL FEDERAL ACTION

Page EIS-25, paragraph 4.3.2. The approximate acres of marsh that will be converted to water, scrub/shrub, or upland developed habitat should be listed. Table 4.3. should be referenced and the impacts listed in order of decreasing amounts.

4.4. PLANS CONSIDERED IN DETAIL

4.4.2. HIGH LEVEL PLAN DESCRIPTION

1.5 Page EIS-30, paragraph 4.4.2.1. Possible alternatives to the borrow site in Lake Pontchartrain, such as use of maintenance dredged material from the Mississippi River or hauled fill, should be included either in this section or elsewhere (perhaps paragraph 1.4.4.) in the FEIS.

4.4.2.3. MITIGATION.

1.6 Pages EIS-31-32, paragraph 4.4.2.4., lines 12-15. The approximately 300 acres of Lake Pontchartrain that will be deepened to -60 feet should be included in the construction impacts for mitigation needs.

1.7 Page EIS-32, paragraph 4.4.2.4. The FEIS should note that implementation of any or all of the five permitted plans for St. Bernard Parish marsh management should enhance large areas of marsh, slow saltwater intrusion, and support

RESPONSE 1.2: Project impacts on sport fishing have been included by reference to the USFWS Coordination Act Report. An explanatory statement has been added to paragraph 6.1.5.2 to clarify how the fishing losses and monetary values were determined.

RESPONSE 1.3: Paragraph 4.2.10 has been modified accordingly. Selection of the Maxent Canal levee would not necessarily benefit fishery resources. The local sponsor could choose to continue to maintain the existing levee and drainage structures. Paragraph 4.2.10 already mentions the benefits to fishery resources if the tidal interchange were restored.

RESPONSE 1.4: Paragraph 4.3.2 has been modified accordingly.

RESPONSE 1.5: Paragraph 1.4.4 has been modified accordingly.

RESPONSE 1.6: Paragraph 4.4.2.4 has been modified accordingly.

RESPONSE 1.7: While it is true that implementation of any or all of the St. Bernard Parish marsh management plans would improve the marsh, our major task in formulating a mitigation plan is to compensate for the losses incurred. Also see response 1.1.

6.1.7. WATER QUALITY

1.19 Pages EIS-70-72, paragraphs 6.1.7.1.-6.1.7.7. This section should include approximate area and percent of Lake Pontchartrain impacted by deep borrow pits and the increase in such deep areas by either the High Level or Barrier Plans. Also, the relocation, if any, of deep borrow pits and "dead zones" in Lake Pontchartrain should be discussed.

6.1.9 FISHERIES

1.20 Pages EIS-73-78, paragraphs 6.1.9.1.-6.1.9.11. See above comments on FISHERIES, page EIS-48 in estimating the losses of fishery values in both plans discussed. The loss to the sport fishery at least should be roughly estimated for both plans, either as discussed in Appendix C - Environmental Resources, Section XIV, U.S. Fish and Wildlife Service Final Coordination Act Report, Appendix C - Monetary Evaluation of Fish and Wildlife Resources in the Area of Direct Project Impacts, or by some other method.

6.1.9.8. BARRIER PLAN

1.21 Page EIS-76, paragraph 6.1.9.9. The FEIS should fully explain why this paragraph states that the Barrier Plan would reduce the estimated commercial catch for the year 2100 by 265,869 pounds and $68,284 when the Fish and Wildlife Coordination Report (Appendix C, Section XIV) states on page 29 (last paragraph) that the total annual estuarine-dependent commercial fish and shellfish catch is expected to be reduced by over 388,800 pounds valued at almost $100,000.

Sincerely yours,

Richard J. Hoogland
Chief, Environmental Assessment
Branch

RESPONSE 1.19: The information requested in the first sentence of the comment is included in paragraphs 5.2.5.2, 6.1.4.1, and 6.1.4.2. There will be no known "relocation" of deep borrow pits or dead zones.

RESPONSE 1.20: Paragraph 6.1.5.7 and 6.1.5.10 have been modified accordingly.

RESPONSE 1.21: The FEIS has been revised to be consistent with the Fish and Wildlife Coordination Act report.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

February 24, 1984 F/SER112/JL:gog
409/766-3699

2

Colonel Robert C. Lee
District Engineer, New Orleans District
Department of the Army, Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

Dear Colonel Lee:

This is in response to your December 16, 1983 request for our views and comments on the December 1983 Draft Main Report (DMR) and Draft Supplemental Environmental Impact Statement (DSEIS) Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The National Marine Fisheries Service (NMFS) comments on the DSEIS have been forwarded for inclusion in the Department of Commerce's comments being submitted under provisions of the National Environmental Policy Act of 1969. This letter is to inform you of our views on the plans presented in the DMR.

The purpose of the proposed and partly completed project is to provide protection from hurricane-induced tidal surges flooding the New Orleans metropolitan area along the southern shore of Lake Pontchartrain and for repair for protection at Mandeville on the northern shore. Proposed repair of the Mandeville Wall is in abeyance.

There are two hurricane protection plans presented in the DMR, as stated in the Syllabus (page 1), (a) the use of barrier structures across tidal openings (Barrier Plan) and (b) raising the height of existing levees (High Level Plan). The High Level Plan, determined by the Corps as the most feasible one, would involve topping of existing levees and construction of a portion of new levee in the St. Charles Parish area. The Barrier Plan, which we commented on previously, (March 21, 1975, May 18, 1978, and June 27, 1978) is considered by the NMFS as being much more detrimental to marine fishery resources and their habitats than the tentatively selected (TS) High Level Plan. The Barrier Plan would have destroyed 28 acres of lake bottom, 2,363 acres of marsh and caused extensive adverse impacts to the estuarine-dependent living marine resources that utilize Lake Pontchartrain.

While the TS High Level Plan would be less damaging than the Barrier Plan, it would still adversely impact an estimated 54 acres of saline/brackish marsh and 984 acres of lake bottom. Filling some of the open water in Lake Pontchartrain and the adjacent marsh would eliminate some nursery habitat and contributions of detritus and nutrients to the marine food web. These losses are a great concern to the NMFS. Also, the degradation through deepening of several hundred acres of the lake bottom with the TS plan is of extreme concern to us since that plan calls for extensive deep dredging for borrow material along the lakefront. The predicted resulting anoxic conditions of the more than 300 acres of deep borrow area in the lake along with subsequent accumulation of industrial and residential effluents could further degrade the previously shallow productive benthic habitat. Indicative of the Corps' recognition of the value of this existing lake bottom near the shore is the fact that the Corps has not permitted shell dredging within one mile of the shoreline.

2.1 Alternative sources that are environmentally preferable exist for needed fill material which would reduce or eliminate any need for dredging material from the lake. Some suggested sources for levee material are the Bonnet Carre' Spillway area, the freshwater diversion channel adjacent to the north side of the Bonnet Carre' Spillway proposed in the TS plan for the Mississippi and Louisiana Estuarine Areas feasibility study, the Mississippi River bottom and upland/fastland sites. Obtaining the needed borrow material without dredging the lake bottom could greatly reduce adverse impacts. Reduction of adverse impacts would, in turn, reduce the amount of offsetting mitigation needed.

2.2 Mitigative projects, such as the St. Bernard Parish Marsh Management Plan for enhancement of those wetlands, should be implemented. Another project to be considered for mitigation to offset the adverse impacts to marine fishery resources would be restoring, to the greatest extent possible, marsh and water circulation where the channel was dredged for the Gulf Intracoastal Waterway to by-pass the tidal barrier that would have been constructed at Chef Menteur Pass under the Barrier Plan. Also, should the Corps finally decide not to issue the permit requested by New Orleans East, Inc. (NOE), the Maxent Canal alignment shown on Plate 6 could be used instead of the proposed east levee and reestablishment of tidal exchange to that undeveloped 13,000 acres of wetland habitat in the NOE area could then be considered as mitigation to benefit estuarine fisheries in the High Level Plan. 2.3 The Maxent Canal alignment was rejected by the Corps in favor of the present levee alignment due in part to the existing levee and a request by NOE to develop 9,800 acres of those wetlands. Pending the final decision on the NOE permit request, the Maxent Canal alignment should remain a viable alternative in the High Level Plan.

It is stated on page 52 of the DMR that "As far as practical, plans should be formulated to maximize the beneficial effects and minimize the adverse effects of the considered improvements." The DMR also states the plan should be environmentally acceptable. The NMFS feels that selection of the High Level Plan, with the levees being built out of hauled fill so that there would be little or no dredging in Lake Pontchartrain and with sufficient offsetting mitigation constructed concurrently with the hurricane protection project, would be environmentally acceptable.

2.4 In view of the above, we concur with tentative selection of the High Level Plan, rather than the Barrier Plan as the least damaging construction alternative. However, we recommend that detailed plans be developed to mitigate remaining adverse impacts that cannot be reduced through alternate borrow sources and/or levee alignments as suggested above. The mitigative work should be done simultaneously with project construction of the High Level Plan. As mitigation is an integral part of the plan and the DMR (page 52) states that "Federal participation in developments also should ensure that any plan is complete within itself, ...", the completed plans for the offsetting mitigation should be presented in the Final Main Report.

RESPONSE 2.1: The use of hauled material from upland sites is discussed on pages 90 through 92.

RESPONSE 2.2: The St. Bernard Marsh Management Plan, restoration of the Chef Menteur By-Pass Channel, and restoration of tidal exchange in New Orleans East will all be considered in the mitigation study. Already completed restoration near the By-Pass Channel is discussed in paragraph 4.4.2.6.

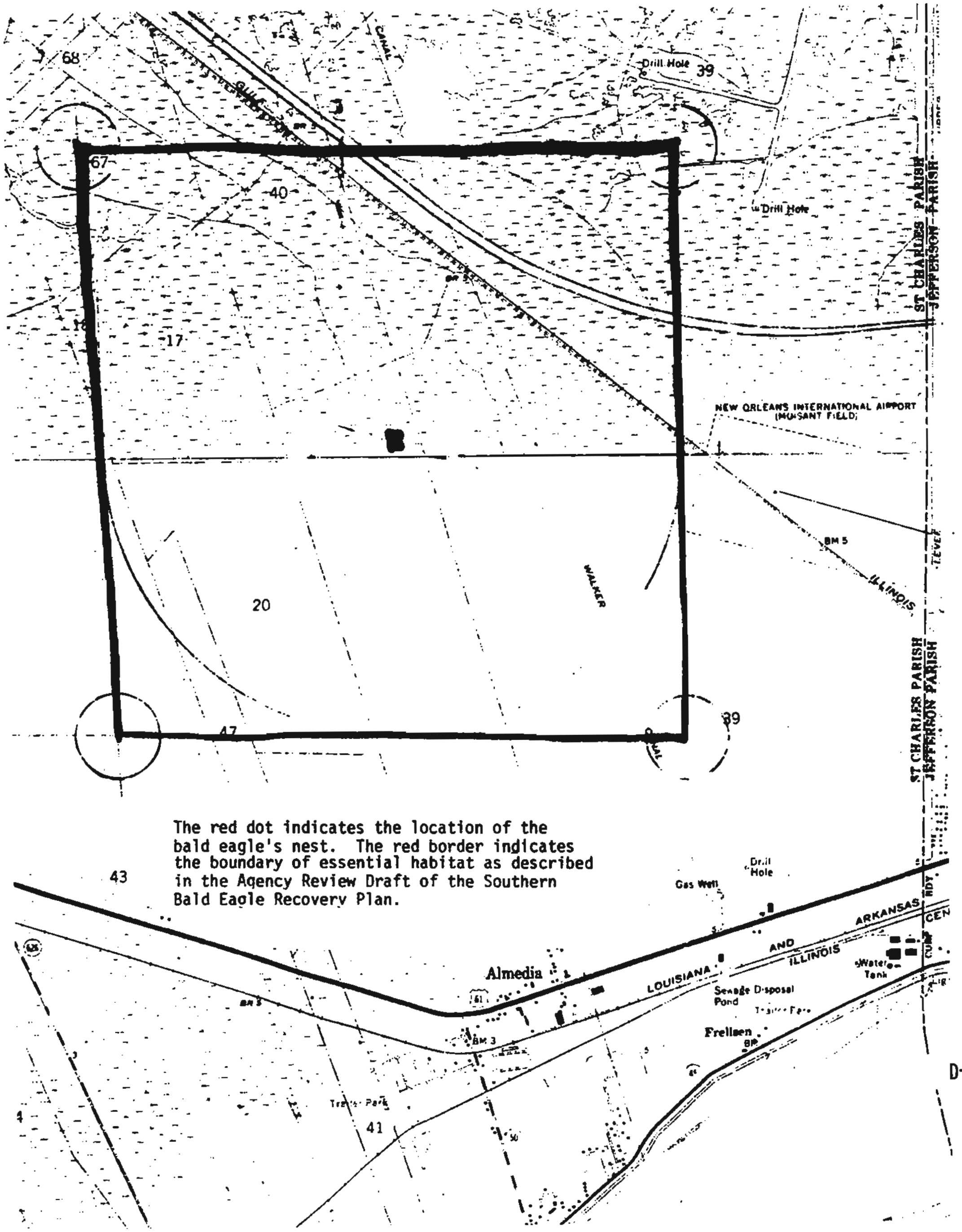
RESPONSE 2.3: As stated in paragraph 4.2.7, no benefits for development in the wetland areas of New Orleans East were included in the analysis. The New Orleans East alinement is justified without the proposed development. Due to the greater cost of the Maxent Canal alinement, it is not a viable alternative.

RESPONSE 2.4: See response to comment 1.1.

The NMFS would be pleased to coordinate with the Corps in development of the plans for mitigation. Thank you for this opportunity to review and comment on this proposed project.

Sincerely yours,

Richard J. Hoogland
Chief, Environmental Assessment
Branch



The red dot indicates the location of the bald eagle's nest. The red border indicates the boundary of essential habitat as described in the Agency Review Draft of the Southern Bald Eagle Recovery Plan.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Project Review
Post Office Box 2088
ALBUQUERQUE, NEW MEXICO 87103

ER 84/21 FEB 29 1984

Colonel Robert C. Lee
Commander and District Engineer
U.S. Army Engineer District, New Orleans
Post Office Box 60267
New Orleans, Louisiana 70160

7

Dear Colonel Lee:

We have reviewed the Draft Main Report and Draft Supplement to the Environmental Impact Statement, Lake Pontchartrain and Vicinity Hurricane Protection, Louisiana, and have the following comments.

General Comments

Fish and Wildlife Resources

7.1 The draft main report and draft supplement to the environmental impact statement (EIS) are generally well written and comprehensive. However, delineation of a specific levee alignment in St. Charles Parish and identification of a mitigation plan to fully compensate for project-related damages to fish and wildlife resources are necessary before the assessment of project impacts on those resources can be considered adequate.

7.2 The documents, in our opinion, fail to demonstrate compliance with Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands). Executive Order 11988 directs Federal agencies to avoid inducing development in floodplains unless there is no practicable alternative. Executive Order 11990 directs Federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The draft main report (page 44) implies that the likelihood for development of the wetland portion of New Orleans East will be enhanced once adequate hurricane protection is provided. Two alternatives to the proposed New Orleans East levee exist, i.e., use of the Maxent Canal alignment and modification of existing water-control structures along the South Point Gulf Intracoastal Waterway levee. The latter alternative has been suggested by the Fish and Wildlife Service (FWS) on numerous occasions and would reopen the 9,700 wetland acres of New Orleans East to estuarine fish and shellfish usage, and would facilitate detritus export of the Lake Pontchartrain-Lake Borne estuarine system. The former alternative would avoid provision of hurricane protection to the referenced 9,700 acres of undeveloped wetlands. Continued use of the proposed New Orleans East alignment without tidal-restoration modifications is considered to be clearly contrary to the intent and spirit of the aforementioned Executive Orders.

RESPONSE 7.1: **The levee in St. Charles Parish will be north of and generally parallel to Airline Highway at a distance of probably no more than 1,500 feet. The specific alinement will be determined in the design phase. See also response to comment 1.1.**

RESPONSE 7.2: **Discussion of compliance with Executive Orders 11990 and 11988 is contained in paragraphs 1.2.5 - 1.2.8 of the EIS. The Maxent Canal alinement is not a practicable alternative. It would cost an additional $70 million, and the benefits attributable to the wetland area are not sufficient to justify this expenditure. Restoration of tidal exchange will be considered as a mitigation measure during the separate mitigation study.**

7.14 final report also indicate the location, type, and objectives of all proposed mitigation measures. It is further recommended that the mitigation plan be designed, in cooperation with the FWS and other appropriate agencies, to fully compensate for quantifiable project-related losses in fish and wildlife productivity.

Draft Supplement to the Environmental Impact Statement (EIS)

7.15 Abstract - The estimate of the acreage of marsh to be impacted by implementation of the High-Level Plan was changed from 142 acres to 54 acres prior to release of the draft EIS. This change was apparently overlooked in the abstract and page EIS-76.

7.16 Page EIS-4, paragraph 1.2.2. - The construction method for the Jefferson Parish Lakefront levee will entail the dredging of a hole as much as 60 feet below the existing lake bottom and encompassing 573 acres. The hole is expected to become anoxic and severly reduce the value of the affected area of fish and wildlife resources. A statement to this effect should be included in this paragraph.

7.17 Page EIS-5, paragraph 1.2.3.- It would be helpful if this section identified the "existing linear recreational areas" to be destroyed and the "large, recently developed recreational complexes" which would be preserved by levee design.

7.18 Page EIS-7, paragraph 1.2.6.- The proposed North of Airline Highway levee alignment will not reduce existing water exchange with the 4,000 acres of wetlands located south of Airline Highway (U.S. Highway 61), particularly if the levee is placed immediately adjacent to the right-of-way for Airline Highway. Therefore, this alignment is not expected to encourage wetland development or adversely impact these wetlands. This paragraph should be revised to include this information.

7.19 Page EIS-9, paragraph 1.4.4.- As stated in our comments on the draft main report, the dredge hole should be reported as extending 9 miles, not 5 miles. A similar revision should also be made on page EIS-30, paragraph 4.4.2.1.

7.20 Page EIS-23, paragraph 4.2.10. - It should be noted that restoring tidal exchange between the New Orleans East wetlands and Lake Pontchartrain would primarily benefit estuarine commercial fishery resources. Applicable laws and regulations allow 100 percent Federal funding of the first costs of commercial fishery enhancement projects if operation, maintenance, and replacement costs are assumed by non-Federal interests or a Federal fisheries agency. Thus, renewal of tidal exchange to the New Orleans East wetlands would not necessarily increase the financial burden of the local levee board.

7.21 Page EIS-28, paragraph 4.4.1.9.- Implementation of the listed action has undoubtedly reduced project impacts on fish and wildlife resources. However, complete mitigation for unavoidable impacts to those resources can only be attained through habitat enhancement and preservation measures. A statement to this effect should be included in this paragraph.

RESPONSE 7.14: See response to comment 1.1.

RESPONSE 7.15: The abstract and the EIS have been corrected.

RESPONSE 7.16: Paragraph 1.2.2 has been modified accordingly.

RESPONSE 7.17: Paragraph 1.2.3. has been modified accordingly.

RESPONSE 7.18: Paragraph 1.2.6 has been modified accordingly.

RESPONSE 7.19: Paragraphs 1.4.4 and 4.4.2.1 have been modified accordingly.

RESPONSE 7.20: Paragraph 4.2.10 has been modified accordingly.

RESPONSE 7.21: Paragraph 4.4.1.9 has been modified accordingly.

7.22 Page EIS-30, paragraph 4.4.2.1. - Despite the orientation of the proposed borrow pit, physical and chemical stratification will probably prevent its flushing except possibly during extreme storm events such as hurricanes.

7.23 Page EIS-31, paragraph 4.4.2.4. - The final statement should indicate the extent to which mitigation needs were determined using a habitat-based assessment methodology, such as the FWS's Habitat Evaluation Procedures. It should also be noted that an average annual loss of 32, not 82, acres of brackish/saline marsh is expected to occur with completion of the High-Level Plan.

7.24 The present marsh deterioration rate being experienced in the wetlands to be affected by the mitigation features considered would be greatly reduced by implementation of the authorized Caernarvon Freshwater Diversion Structure. Therefore, it is expected that implementation of marsh management features proposed to date would only partially fulfill mitigation needs for unavoidable project losses to fish and wildlife resources.

7.25 Page EIS-32, paragraph 4.4.2.5. - The last two sentences of this paragraph are confusing and should be changed to read "...protection of marsh immediately adjacent to Lake Pontchartrain through shoreline stabilization. This would be limited to that portion of the Lake Pontchartrain shoreline in St. Charles Parish."

7.26 Page EIS-33, Table 4.3. (Water Quality) - The FWS believes that water quality in the proposed borrow pit adjacent to the Jefferson Parish levee will be extremely poor, possibly throughout the year. Should large volumes of anoxic water be displaced from this deep hole, biological productivity in adjoining areas would probably be reduced.

7.27 Page EIS-33, Table 4.3. (Fisheries) - The FWS believes that the reduction in gross exvessel value of fish and shellfish harvest is a more valid economic measure of adverse project-related impacts on estuarine-dependent commercial fisheries. This value should be used in lieu of the net profit to the fisherman, which is calculated by subtracting the cost of harvest from exvessel fish and shellfish prices. The latter measure was used in this table and throughout the draft supplement.

7.28 Page EIS-34, Table 4.3. - Impacts of the High-Level Plan on recreation indicated the loss of a total 318,147 user-days. However, design modifications would save 201,873 user-days. The chart and text should agree.

7.29 Page EIS-39, paragraph 5.2.2. - As noted previously, an estimated 268 acres, rather than 105 acres, of cypress-tupelo habitat are in the area of potential construction impacts. The total acreage impacts for this habitat type should be changed throughout the statement, including pages EIS-33, EIS-65, EIS-66, EIS-68, and EIS-78.

7.30 Page EIS-80, paragraph 6.1.13.1. - This section refers to the possible loss of boat launch complexes at Williams and Bonnabel Boulevards. However, Table 2, Appendix C, Section XI, indicates that design modifications will protect the 16 boat lanes at these sites; this discrepancy should be corrected.

RESPONSE 7.22: Concur

RESPONSE 7.23: Paragraph 4.4.2.4 has been modified accordingly and a new paragraph 4.4.2.7 has been added to further discuss the schedule for mitigation.

RESPONSE 7.24: Paragraph 4.4.2.4 has been modified accordingly.

RESPONSE 7.25: Paragraph 4.4.2.5 has been modified accordingly.

RESPONSE 7.26: Table 4.3 and paragraph 6.1.4.5 have been revised in accordance with a recent literature survey and field sampling.

RESPONSE 7.27: Gross exvessel values of fish and shellfish harvest are used in the EIS because the data came from the National Marine Fisheries Commission and the Coordination Act Report. The net profit to the fisherman is used in the economic section of the report as required by Principles and Guidelines.

RESPONSE 7.28: Report has been modified accordingly.

RESPONSE 7.29: See response 7.12. The appropriate pages have been modified accordingly.

RESPONSE 7.30: Paragraph 6.1.9.1 has been modified accordingly.

7.31 Reference is made to Jefferson Downs Race Track. We assume that this is Kenner Race Track and recommend the use of only one name throughout the documents.

7.32 Page EIS-81, paragraph 6.1.13.3. - This paragraph refers to the future of a covered picnic shelter and states that design modification might be necessary. Table 2, Appendix C, Section XI, shows that design modification will protect one covered picnic shelter. This discrepancy should be corrected.

7.33 This paragraph also states that the 18 boat lanes at Seabrook Bridge probably will not be impacted. The document should state conclusively if these facilities will be impacted.

7.34 This paragraph further discusses recreation potential of the levee crown and barge berms, but goes on to state that no new facilities have been recommended. Because of the significance of project-related impacts on recreation, we recommend that recreation development be investigated as part of the project and reported in the final statement.

7.35 Page EIS-82, paragraph 6.1.13.7. - This paragraph should state conclusively if design modifications will be incorporated in project plans.

7.36 Page C-VIII-29, Section III.f(3)(c). - This section states that no long-term adverse effects would occur to water-related recreation. If short-term effects are anticipated, they should be described and mitigated.

7.37 Page C-IX-33, Section III.f(3)(c). - "Disruption of use" appears to be the only effect on Kenner launch and Williams and Bonnabel Boulevard launches. It should be stated that the two boat lanes at Kenner launch will be destroyed and that the 16 boat lanes at Williams and Bonnabel Boulevards will be protected with the proposed design modifications.

7.38 Page C-IX-35, Section III.f(3)(e). - This section, or Section III.f(3)(c), should include discussions of impacts on the three children's play areas (Orleans Parish lakefront), the 330-foot fishing pier (Bonnabel Boulevard), and one covered picnic shelter (Orleans Parish). These are listed on Table 3, Appendix C, Section XI, as areas that would be impacted without design modification.

7.39 Page C-X-9, Guideline 1.7(q). - This discussion should include all impacted recreation areas and, again, refers to "ancillary facilities" near two newly constructed boat launch complexes. Clarification is needed.

Summary Comments

This Department recognizes the urgent need to provide hurricane protection to the project area. However, based on our analysis of environmental impacts, we believe the High-Level Plan, rather than the Barrier Plan, as the Tentatively Selected Plan would be more environmentally acceptable. In the October 13, 1983, draft Fish and Wildlife Coordination Report on this project, the FWS made the following recommendations to reduce adverse project impacts to fish and wildlife resources:

RESPONSE 7.31: Paragraph 6.1.9.1 has been modified accordingly.

RESPONSE 7.32: Paragraph 6.1.9.3 has been modified accordingly.

RESPONSE 7.33: Paragraph 6.1.9.3 has been modified accordingly.

RESPONSE 7.34: Paragraph 6.1.9.3 has been modified accordingly.

RESPONSE 7.35: Paragraph 6.1.9.7 has been modified accordingly.

RESPONSE 7.36: Section III.f(3)(c) has been modified accordingly.

RESPONSE 7.37: Section III.f(3)(c) has been modified accordingly.

RESPONSE 7.38: Section III.f(3)(e) has been modified accordingly.

RESPONSE 7.39: Guideline 1.7(q) has been modified accordingly.

7.40 1. Eliminate the St. Charles Parish alignment, or, if this levee segment is built, operate the proposed water-control structures to assure water circulation and estuarine organism movement through the levee;

7.41 2. Purchase non-development easements over the 9,700-acre wetland area in New Orleans East and modify the water-control structure along the South Point to Gulf Intracoastal Waterway levee segment to allow water and estuarine organism movement through the levee, between the enclosed wetland area and the adjacent estuary;

7.42 3. Eliminate or reduce impacts associated with the proposed borrow holes in Lake Pontchartrain adjacent to the Jefferson Parish Lakefront levee by either hauling levee material from another area or developing a dredge method that will alleviate water quality and biological productivity problems caused by these holes; and

7.43 4. Develop a mitigation plan that will fully compensate for all quantifiable project impacts to biological productivity resulting from past and future project work and that will be implemented simultaneously with construction of all project features.

7.44 This Department recommends that the final main report and impact statement include a detailed plan that prevents project-induced development of wetlands in the New Orleans East area and which fully compensates for unavoidable project-induced habitat losses. Adequate mitigation measures should be implemented simultaneously with the hurricane protection features of the project. We do acknowledge that progress has been made toward this goal. However, because of these remaining concerns, we may, depending on the proposal included in the final main report and statement, refer this project to the Council on Environmental Quality under Section 1504 for the Council's Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. We do, however, wish to coordinate in reaching a solution to our concerns to assure implementation of the project with a minimum of delay. Further coordination can be initiated by contacting the Field Supervisor, Division of Ecological Services, U.S. Fish and Wildlife Service, P.O. Box 4305, Lafayette, Louisiana 70502, (318/264-6630).

Sincerely,

Raymond P. Churan

Raymond P. Churan
Regional Environmental Officer

RESPONSE 7.40: The structures will remain open, except during threat of high water. See page 132 for proposed operation of structures.

RESPONSE 7.41: This will be considered in the mitigation study.

RESPONSE 7.42: Methods of reducing impacts associated with the borrow holes are still being investigated and those found to be economically feasible will be implemented.

RESPONSE 7.43: See response to comment 1.1.

RESPONSE 7.44: See response to comment 1.1.

DAVID C. TREEN
GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

FRANK P. SIMONEAUX
SECRETARY

13

February 28, 1984

Colonel Robert C. Lee
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

RE: C840069 Federal Consistency with the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Dear Colonel Lee:

Thank you for coordinating the reevaluation of this project with the Coastal Management Division (CMD) of the Department of Natural Resources (DNR). Certainly the City of New Orleans Metropolitan area is in need of improved Hurricane Protection.

Certain aspects of the tentatively selected plan (TSP), however, may not be consistent with the Federally approved Louisiana Coastal Resources Program, (LCRP) to the maximum extent practicable. The main aspects of the TSP which may be inconsistent are summarized below, and the specific guidelines that do not appear to be met by various aspects are appended. Please note that these comments pertain only to the TSP, for which the consistency determination was prepared. If any plan other than the TSP is proposed at a future time, then it would have to be evaluated for consistency.

13.1 1. New Orleans East Alignment: Basically the proposed alignment traverses through a wetland area instead of along the wetland/non-wetland interface. An alternative (Maxant canal alignment) exists, and the future development of this be tract of wetlands has not been determined. If the tract is not developed the wetlands would serve as valuable non-structural flood protection. If the New Orleans East area is determined to be a fastland, this proposed alignment may be consistent. More information should be provided by your office in order to substantiate this area as a fastland.

13.2 2. St. Charles Parish north of Airline Highway: DNR questions how this alignment will affect the 3000 acre area South of Airline Highway. There is also not enough information concerning the exact location of the proposed levee.

RESPONSE 13.1: It is our position that the area is a fastland. We are in the process of documenting this fact with DNR.

RESPONSE 13.2: The wetland area south of Airline Highway will not be affected by the levee because existing hydrology will be maintained by culverts in the levee.

P.O. BOX 44396 . BATON ROUGE, LA. 70804 . PHONE 342-4500
NATURAL RESOURCES BUILDING

13.3 3. Jefferson Parish Lakefront alignment: The basic issue here is the proposed dredge borrow area (-77; NGVD) in Lake Pontchartrain. The borrow hole would cause adverse environmental effects, and alternative sources of clay are available. More information is needed on the necessity to dredge such a deep hole as opposed to a shallower one.

13.4 4. Jefferson Parish and St. Charles Parishes line alignment: There is not enough information to determine the exact location of the levee.

We would like to work with your office to resolve these issues and collaborate on a plan that provides hurricane protection and achieves the goals of balancing conservation and development of coastal uses. Please contact me if you have any questions.

Sincerely,

Frank P. Simoneaux
SECRETARY

Dr. Charles G. Groat

cc: Kelley Taggart
Ann Berger-Blundon

RESPONSE 13.3: See response 13.19 for information about the necessity to dredge a deep hole as opposed to a shallower one.

RESPONSE 13.4: The return levee on the Jefferson/St. Charles Parish line will straddle the existing levee at this location.

New Orleans East Levee Alignment

The alignment of the New Orleans East Levee may be inconsistent with the goals and policies of the Louisiana Coastal Resources Program, and may not be in compliance with the following Coastal Use Guidelines:

13.5 Guideline 1.7 (e): More information is required concerning plans for the 13,000 acres of wetlands to be impacted by the proposed New Orleans East Levee. Information concerning the size, number, and placement of water control structures is needed, as well as a plan of operation for these structures.

13.6 Guideline 1.7 (0): The alignment of the New Orleans East levee may foster secondary impacts by encouraging further future development of wetland areas surrounded by the levee. The decision to place this levee in the proposed location will certainly influence how these areas will be regarded in terms of development and 404 permitting. The alternate Maxent Canal alignment would reduce these impacts to the maximum extent practicable.

13.7 Guideline 2.3: Although constructed for the purpose of floods associated with hurricanes, this present alignment will have a significant role in encouraging development of a large tract (approximately 9,773 acres) of a total of 13,000 acres of undeveloped wetlands.

It may be inconsistent to protect undeveloped wetlands from floods associated with hurricanes unless the levees are constructed for the purpose of developing or otherwise changing the use of the wetland. In order to avoid to the maximum extent practicable levee construction for the purpose of developing or changing the use of a wetland area, the alternate Maxent Canal alignment should be used.

13.8 Guideline 2.4: The alignment of the New Orleans East hurricane protection levee surrounds an area of wetlands approximately 9,773 acres in size. More information concerning the alignment of this levee is needed before compliance with this guideline can be determined. This guideline requires that hurricane and flood protection levees shall be located at the non-wetland/wetland interface or landward to the maximum extent practicable.

Again the Maxent Canal alignment is viewed as satisfying this guideline to the maximum extent practicable by being closer to the non-wetland/wetland interface by the elimination of the 13,000 acres of wetlands encircled by this levee.

13.9 Guideline 2.6: More information concerning the management of the wetlands to be leveed is needed before a proper evaluation can be made concerning the disruption of hydrology, and the ingress and egress of beneficial nutrients and aquatic organisms. Is there significant interchange of water under present conditions and will the proposed levee alter existing flow patterns?

13.10 Guideline 5.8: No permits have been issued for surface alterations of the New Orleans East area encompassed by the hurricane protection levee. However, the improvement of this levee system may encourage and act as a catalyst for future development. Is the existing levee a validly constructed, and maintained levee?

13.11 Guideline 6.1: No evidence is presented that suggests that the existing alignment of the New Orleans East levee fits the criteria listed in this guideline, i.e. a.) on lands five feet or more above sea level, or within fastlands; or b.) on lands which have foundation conditions sufficiently stable to support the use ... More information is required concerning how this area fits the following criteria outlined in the LCRP FEIS Appendix P (p.42) concerning fastland determinations:

1. Guideline 2.6 clearly states that any future development of hurricane protection levees shall be developed in such a way as to minimize disruption of water flow, beneficial nutrients or aquatic organisms between enclosed wetlands and coastal waters. The enclosed area including wetlands will not be considered a fastland and all activities proposed for such areas shall be subject to all rules, regulations and guidelines of the LCRP to the same extent as required elsewhere in the coastal zone.

   If the pre-existing validly constructed hurricane protection levees prevent a significant interchange of water between the enclosed area and coastal waters, the enclosed area would be considered a "fastland". This "fastland" would not be subject to the permitting procedure of the LCRP, but would still be subject to any other federal, state or parish governmental authority.

2. As noted above, action proposed for wetland areas enclosed by hurricane protection levees are subject to the coastal use permit program. Wetlands behind such levees may be drained and filled when such activities are consistent with all relevant guidelines.

3. Wetlands enclosed by hurricane/flood protection levees permitted under the LCRP in conformance with guideline 2.6 will continue to be biologically productive because they shall be built and maintained to minimize disruptions in the interchange of water, beneficial nutrients and aquatic organisms between the enclosed wetlands and those outside the levee system. The biological productivity of wetlands which are enclosed by existing hurricane and flood protection levees will be judged on a case by case system.

4. Wetlands enclosed by development levees would be eligible for designation as "fastlands" if the enclosed areas meet all the criteria included in the fastland definition provided by Act 361. Many types of activities could require a development levee; these include but are not limited to urban development and agricultural development.

St. Charles Parish Levee Alignment

The proposed St. Charles Parish hurricane protection levee alignment north of Airline Highway (U.S.61) may be inconsistent with the goals and policies of the Louisiana Coastal Resources Program, and may not comply with the following Coastal Use Guidelines:

RESPONSE 13.5: The area has been enclosed by a system of railroad embankments and levees since 1958, prior to authorization of the hurricane protection project. Four gravity drainage structures equipped with flapgates were included in the levee system and provided for flow out of the area only. There is no significant interchange between the leveed area and the surrounding marshes. The structures have been lengthened as the levees were enlarged under the Barrier Plan and positive closures were added to ensure closure during a hurricane event. Under the High Level Plan, the improved levee would have identical drainage structures to maintain the existing pattern of outflow only. The 13,000 acres of wetlands enclosed by this alinement have been cut from tidal exchange for over two decades. The items of local cooperation would require the Orleans Levee Board, as the local sponsor, to maintain and operate all features of the project in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates and approach channels, drainage structures, drainage ditches or canals, floodwalls, and stoplog structures.

RESPONSE 13.6: We concur that future development could occur but no economic benefits for this potential development have been credited in association with this plan. In addition, any development involving wetlands would be subject to the Section 404 permit process and any impacts incurred would be mitigated if necessary. The New Orleans East lakefront alinement was the preferred alternative because it would provide the same amount of hurricane protection to the developed areas at a lower cost due to better foundation conditions.

RESPONSE 13.7: The levee is not built for the purpose of developing a wetland area. See Response 13.6. In addition, this alinement would provide flood protection for the lower portions of I-10 crossing the eastern New Orleans area. This could be of great importance since this would become the major eastern hurricane evacuation route.

RESPONSE 13.8: While we recognize that the Maxent Canal alinement is at the true wetland/non-wetland interface, we do not consider the alinement practicable since it costs $59 million more than raising the levee along the existing alinement.

RESPONSE 13.9: There are no plans to manage the wetlands in question. There is no significant interchange under present conditions because locally constructed levees enclosed the wetlands over 20 years ago. Increasing the height of these existing levees would not alter the present conditions.

RESPONSE 13.10: The existing levee system is a validly constructed levee built and maintained by the Orleans Levee District. The levee was built in the 1950's prior to passage of the National Environmental Policy Act, Section 404 of the Clean Water Act, and the Louisiana Coastal Resource Program. While large scale permitting has not occurred in the area, several permits have been issued within the levee system and several permit applications are presently being reviewed.

13.12 Guideline 1.7(e): More information is required concerning the management of the wetlands to be impacted by the St. Charles Parish hurricane levee paralleling Airline Highway. A marsh management plan indicating the size, number, and placement of water control structures is needed, as well as a plan of operation for these structures in order to assess any adverse alterations of hydrology.

13.13 Guideline 1.7(L): Cumulative impacts and habitat destruction may increase as a result of the construction of this levee in St. Charles Parish. Therefore, more information concerning the exact placement of the levee in relation to its proximity to Airline Highway is required in order to determine how many acres of wetlands will actually be impacted.

13.14 Guideline 1.7(0): The construction of this levee north of Airline Highway may foster secondary impacts in adjacent wetlands and estuarine areas by encouraging future development of wetlands habitats to the south. The decision to place thse levees in the proposed locations will certainly influence how these areas will be regarded in terms of development and coastal use permitting.

13.15 Guideline 2.3: Although constructed for the purpose of floods associated with hurricanes, this present alignment may have a significant role in encouraging development of approximately 3000 acres of undeveloped wetlands south of Airline Highway. More information concerning the use and placement of water control structures, and a detailed marsh management plan for the impounded area are needed before a consistency determination can be made.

13.16 Guideline 2.4: More information concerning the proximity of the St. Charles levee to Airline Highway is needed in order to evaluate its location with regard to the non-wetland/wetland interface or landward to the maximum extent pracitcable.

13.17 Guideline 2.6: More information concerning the management of the wetlands to be leveed is needed before a proper evaluation can be made concerning the disruption of hydrology and ingress and egress of beneficial nutrients and aquatic organisms. Also, see LCPP FEIS Appendix P (p.42) as previously quoted for the New Orleans East levee alignment with regards to the definition of a hurricane protection levee as opposed to a development levee.

13.18 Guideline 7.6: More information concerning the management and use of the water control structures to be installed are necessary before a proper evaluation can be completed for the St. Charles Parish levee north of Airline Highway. Jefferson Parish Lakefront Reach (High leve Plan)

Jefferson Parish Lakefront Alignment.

The proposed and tentatively selected paln for construction of this reach may be inconsistent, to the maximum extent practicable, with the following Coastal Use Guidelines.

13.19 Guidelines 1.7(d): Construction of a dredge hole 65' deep (see plate A-I-36), or approximately - 77' NGVD, approximately 450' wide at the natural lake bottom, and approximately 5 miles long will significantly alter the natural oxygen concentrations of the waters in that area of the lake. The

Permits for fill and construction along the northern side of the GIWW have been granted in the Almonaster-Michoud area. In addition to this activity, permits for ditching associated with mosquito control have also been issued. Permit applications are presently pending for two large scale projects--New Orleans East Development and the City of New Orleans' "Recovery I" land fill. While we agree that raising the South Point to GIWW levee to high level specifications would increase the potential for development of the inclosed wetlands, these wetlands have been inclosed for approximately 20 years and any filling operations would be regulated under the permit authority of Section 404.

RESPONSE 13.11: It is the position of the New Orleans District that the enclosed wetlands would be considered "fastlands" by the definition you have provided in this guideline. It is preexisting, validly constructed hurricane levee which prevents significant interchange of water between the inclosed wetlands and adjacent coastal waters.

RESPONSE 13.12: It is not our intention to manage the swamp inclosed by the north of Airline alinement. We would retain the existing hydrology by placing in the levee structures of a size equal to the existing culverts under the highway. The exact size of such structures would be designed at a later stage in our planning process. Preliminary design indicates that there would be two structures with eight 60-inch diameter culverts, one structure with five 60-inch diameter culverts, and one structure with two 54-inch diameter culverts. All culverts would be closed during a hurricane, but would remain open at other times.

RESPONSE 13.13: The St. Charles Parish north of Airline Highway alinement would parallel Airline Highway at a distance of probably no more than 1,500 feet from the roadway embankment. I-wall construction is planned along the alinement to the maximum extent practicable, thus reaching levee width. The specific alinement and levee widths will be determined in the design phase.

RESPONSE 13.14: The north of Airline Highway alinement should not alter the wetlands south of the highway since existing water exchange would be maintained through operable culverts in the levee. Operating procedures would be established for the culverts which would have provisions for closing the culverts only during times of approaching hurricanes. During the remainder of the time, the culverts would be maintained in an open position to convey natural existing flow and exchange. With the incorporation of these design considerations, the wetlands south of Airline Highway will be maintained as they exist and would be governed by the Corps' wetland permit process.

RESPONSE 13.15: See response to 13.12 and 13.14.

RESPONSE 13.16: See response to 13.13.

RESPONSE 13.17: No management of the wetlands south of Airline Highway is presently planned other than to insure that the existing hydrologic character and water exchange as it exists will not be altered by the project. This would be accomplished by establishing operating procedures for the culverts through the north of Airline Highway levee as described in response 13.14.

RESPONSE 13.18: See response to 13.12.

RESPONSE 13.19: We concur that salt water could be trapped in the holes and may in turn produce anoxic conditions in portions of the hole. Based on limited field data obtained from an existing 65-foot borrow site in Lake Pontchartrain, it appears that low dissolved oxygen would possibly occur at depths below 20 feet. Hydraulic analyses of water movements in Lake Pontchartrain, as related to horizontal and vertical displacements in shallow and deep water for typical and extreme tidal occurrences, indicate that there is a greater opportunity for circulation at 20 feet than at 60 feet. In addition, even during extreme conditions (hurricanes), the bottom waters of the 60-foot borrow pit would not mix with adjacent Lake Pontchartrain water due to density gradient difference. The water quality at 20 feet should therefore be similar to that of ambient lake water, while the water quality at 60 feet would be different from ambient lake conditions. The use of shallower borrow pits was also investigated. The most recent soils information indicated that the upper 40 feet of material was not well suited to economical levee building. If

13.26 (cont.) or it can be substantially reduced by dredging a shallower hole.

Jefferson Parish and St. Charles Parish line alignment:

13.27 More information is needed on the exact location where the proposed levee will diverge from the existing levee to join the Airline Highway alignment. Would this alignment enclose wetlands and if so how many acres? Also, more information is needed concerning the relationship between the proposed levee alignment and the proposed extention of New Orleans International Airport Runway 10 extension.

RESPONSE 13.25: The cost effectiveness of obtaining upland based material was analyzed as noted in response 13.20. The rationale for the resultant deep borrow site rather than a shallow, more extensive site is to reduce the amount of benthic habitat impacted as noted in response 13.19. These impacts may be further reduced as final design of levee sections are formulated. For the purpose of the EIS, these impacts can be considered "worst case" impacts.

RESPONSE 13.26: We concur that the immediate loss of benthic production from the proposed borrow site would cause a reduction in biological activity due to loss or displacement of the resident benthic community. However, the proposed borrow site has only a moderate benthic community and represents only 0.2% of the offshore habitat and 0.1% of the total benthic habitat available in Lake Pontchartrain. Approximately 12% of the fish species in Lake Pontchartrain are benthic feeders; therefore, it appears that the impact on this habitat would not create a significant reduction in biological activity. See EIS para. 6.1.5.5 for further detail.

RESPONSE 13.27: The proposed St. Charles Parish levee alinement utilizes the existing Jefferson-St. Charles Parish line levee to a point approximately 0.5 miles north of the intersection of the parish line and Airline Highway (US Highway 61). From this point, the alinement diverges from the parish line levee and follows a line to encompass only existing development and joins the north of Airline Highway alinement approximately 0.2 miles north of Airline Highway near Almedia. Approval of the runway extension for New Orleans International Airport could result in an adjustment in the proposed alinement to the extent necessary to protect the runway. Therefore, specific details of levee alinement concerning these points would be addressed in the final design, and additional impacts would be addressed at this time.

State of Louisiana

DEPARTMENT OF NATURAL RESOURCES

EDWIN W. EDWARDS
GOVERNOR
WILLIAM C. HULS
SECRETARY

MICHAEL BOURGEOIS
DEPUTY SECRETARY

June 19, 1984

Colonel Robert C. Lee
U.S. Army Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

RE: C840069, Consistency Determination for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project

Dear Colonel Lee:

This is in response to your letter of May 7, 1984 concerning the consistency determination for the Lake Pontchartrain Hurricane Protection project. Based on the information presented, certain aspects of the tentatively selected plan (TSP) remain inconsistent with the Federally approved Louisiana Coastal Resources Program (LCRP), to the maximum extent practicable according to Section 307 (c) (3) (A) of the Coastal Zone Management Act of 1972, as amended. Basically, more information is required before a proper evaluation can be made concerning the New Orleans East alignment and the wetlands enclosed by this levee system.

1. NEW ORLEANS EAST ALIGNMENT

13.28 According to the information in your letter, the New Orleans East area has been enclosed since 1958; four gravity drainage structures with flap-gates drain the area but do not allow flow into the area; and no significant interchange between the leveed area and surrounding marshes is presently occurring. A recent field investigation by our staff in conjunction with the USFWS to an area north of the New Orleans Sewage and Waterboard Pumping Station #15 on the Maxent Canal revealed an open culvert approximately 36" in diameter draining the area east of the canal. This raises the possibility of other open culverts in the levee system, and will therefore require further investigation. Perhaps a joint field investigation between members of the Coastal Management staff and the Corp's Planning Division could resolve this matter.

In addition, we feel that in order for this part of the project to be consistent with the LCRP, three possible avenues exist by which consistency could be achieved.

First, sufficient quantitative documentation should be provided in order to substantiate that: 1) no significant interchange is occurring between the leveed area and the surrounding marshes, and 2) that no ingress and egress of marine organisms is presently occurring. In this manner, Coastal Use Guidelines 6.1 would be satisfied concerning the question of fastlands.

13.28 (cont.) Another alternative for the New Orleans East area would be to install drop gated culverts in place of the existing flap gated culverts as part of the TSP, thereby reinstating interchange of water, nutrients and organisms to the area. In this way, Coastal Use Guideline 2.6 would be satisfied concerning the design and operation of hurricane and flood protection levee systems to minimize disruptions of hydrology and water interchange.

A third choice, which was discussed in our meeting on March 23, 1984, and was determined to be the most costly, would require using the alternate Maxent Canal alignment. This would satisfy Coastal Use Guideline 2.4 which states that hurricane and flood protection levees shall be located at the non-wetland/wetland interface, or landward to the maximum extent practicable.

2. ST. CHARLES PARISH ALIGNMENT

13.29 The alignment of the St. Charles Parish levee north of Airline highway as described in the TSP is consistent with the LCRP to the maximum extent practical at this time. The Coastal Management Division of the Louisiana Department of Natural Resources (CMD/DNR) reserves the right to review the alignment before actual implementation to insure minimal wetland loss and that the existing hydrology is maintained. Any changes or re-alignment of this levee or of the north-south St. Charles-Jefferson Parish alignment would require a re-evaluation by CMD/DNR for consistency.

3. JEFFERSON PARISH LAKEFRONT ALIGNMENT

13.30 Based on the discussions held at your office on March 23, 1984 the design of the borrow pits will be such that adverse environmental impacts will be minimized to the maximum extent practicable by continued design improvement. We wish to encourage this effort and look forward to continued coordination and evaluation for consistency of any changes or solutions which your agency may suggest. Certainly experts in Gulf and estuarine cirulation should be consulted before the design is finalized.

Colonel Robert C. Lee
C840069, Page Three

We look forward to your response and to working with your office in resolving these issues. If you have any questions please do not hesitate to call me.

Sincerely,

WILLIAM C. HULS

By: Dr. C. G. Groat
Assistant to the Secretary

WCH:CGG/se

cc: Ms. Ann Berger-Blundon
Office of Coastal Resources Management, NOAA

Mr. Paul Wolff
U. S. Dept. of Commerce

Mr. Richard J. Hoogland, USNMFS

Mr. Dave Fruge, USFWS

Mr. Andy Mager, NMFS

RESPONSE 13.28: As noted in previous responses (13.8 and 13.9) it is the New Orleans District's opinion that no tidal exchange exists between the wetlands within the existing levee system and the Lake Pontchartrain system. A joint field investigation between members of the Coastal Management and the Corps' Planning Division verified to the satisfaction of the Corps that there is no significant interchange of water and ingress or egress of marine organisms.

RESPONSE 13.29: Noted.

RESPONSE 13.30: We assume that the CMD/DNR considers this feature consistent and we will continue to try to minimize the adverse impacts of the Jefferson Parish borrow pits by design improvement and consultation with experts in circulation.

Department of Transportation and Development
OFFICE OF PUBLIC WORKS
P.O. BOX 44155 CAPITOL STATION
BATON ROUGE, LA. 70804

Robert Graves
SECRETARY

Edwin W. Edwards
GOVERNOR

March 22, 1984

14

Colonel Robert C. Lee
U.S. Army, Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

This office has reviewed the Draft Main Report and Draft Supplement to the Environmental Impact Statement (DSEIS) for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, Reevaluation Study, and offers no objections to the recommended plan.

14.1 The Reevaluation Study document indicates that the recommended plan (high level plan) is more cost effective than the barrier plan and that the barrier plan is no longer being given consideration. The high level plan provides hurricane protection for the currently improved and heavily populated areas but it provides no protection for the Lake Maurepas and north shore areas which gives us some cause for concern. Other efforts should continue in search of feasible means for providing similar protection to these areas.

14.2 Although we have no objections to the high level plan, we do have some concern regarding the many engineering details yet to be resolved especially in the area of recent development along Airline Highway near the proposed runway extension to New Orleans International Airport. As always, this office would like to participate in the planning effort in these areas at such time as planning proceeds.

14.3 Previous efforts by the Pontchartrain Levee District to acquire rights-of-way along the lakefront in St. Charles Parish should be credited towards the local cost sharing in the project. These rights-of-way were acquired by the Levee Board at the request of the U.S. Army, Corps of Engineers, but will not be utilized. It will now be necessary to acquire additional rights-of-way at additional local expense for the new alignment along Airline Highway.

Your consideration of these views will be appreciated.

Yours truly,
Arthur R. Theis

ARTHUR R. THEIS
Chief Engineer

ART:dmr--cb

RESPONSE 14.1: A feasibility study of hurricane protection for the west shore of Lake Pontchartrain is underway.

RESPONSE 14.2: The specific alinement in St. Charles Parish will be determined in the design phase. We will continue to coordinate with your office.

RESPONSE 14.3: Concur

246-4000

The Board of Levee Commissioners

of the

Orleans Levee District

Suite 202 — Administration Building
New Orleans Lakefront Airport

New Orleans, La.

70126

15

PROTECTING YOU
AND YOUR FAMILY

February 21, 1984

Colonel Robert C. Lee
District Engineer
Department of the Army
New Orleans District
Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Attention: Planning Division
Environmental Quality Section

Dear Colonel Lee:

Reference is made to your letter dated December 16, 1983, enclosing the Draft Main Report and Draft Supplement to the Environmental Impact Statement (DSEIS) for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, Reevaluation Study. Also enclosed were the appendixes for the Draft Main Report and the DSEIS.

We have reviewed the above mentioned documents and agree with your recommendation that the Tentatively Selected Plan provides for the modification of the Lake Pontchartrain, Louisiana, and Vicinity project by eliminating the barrier design concept of the authorized plan and applying the high level design concept.

While we agree with the concept of the high level protection we wish to comment on some of the specifics presented in the reports.

Volume 1

15.1 page 37; last paragraph - "Municipal Yacht Harbor" should be "Orleans Marina"

15.2 page 106; last paragraph - "Municipal Yacht Harbor" should be "Orleans Marina"

RESPONSE 15.1: The paragraph has been modified accordingly.

RESPONSE 15.2: The paragraph has been modified accordingly.

FORM C38

Board of Levee Commissioners
Orleans Levee District

February 21, 1984
Page 2

Volume 1 (continued)

15.3 page 125; NEW ORLEANS AREA - The Tentatively Selected Plan between Jefferson Parish Lakefront and the west bank of the Inner Harbor Navigation Canal provides for an earthen levees topped by a floodwall. This is not an acceptable solution since this type of construction would be in conflict with the intended use of the lakefront park areas. We understand, however, that more detailed engineering analysis has proved that an all earthen levee and berm can and will be constructed in this reach.

15.4 It is recommended that the seepage criteria used in developing the berm size be adjusted to consider the actual estimated time that hurricane tides can reasonably be expected to cause a seepage problem. Extensive berms will cause excessive damage to the existing trees in the park areas, however if the berms are needed it is requested that tree replacement in the parks be a project cost.

15.5 page 126; CITRUS - NEW ORLEANS EAST AREA - The Tentatively Selected Plan for the Citrus Lakefront provides for an earthen levee topped by a floodwall with a large berm. We understand, however, that more detailed engineeering analysis has proved that an all earthen levee, even though steeper than normally acceptable, will be considered in this reach.

We are pleased to have been given an opportunity to review these documents and provide our comments.

15.6 As you are aware the Orleans Levee Board commenced interim protection construction along the lakefront in 1979 and we continue at this time to provide interim or permanent protection at specific locations. We, therefore, hereby request that any and all work accomplished by this Board to provide interim or permanent protection be considered as a credit to our share of the Lake Pontchartrain Louisiana and Vicinity Hurricane Protection Project.

It is further recommended that upon approval of the Tentatively Selected Plan, construction by the U.S. Army Corps of Engineers be accelerated and accomplished in the most expeditious manner.

You can be assured that the Orleans Levee Board will do everything in its power to provide adequate supplements to the current assurances as you require in your recommendations.

Yours very truly,

William A. Slatten

William A. Slatten
President

WAS:EJM:gmb

RESPONSE 15.3: Current in-house high level plan GDM design work supports an all earthen levee design for most of the reach in question. At this time, floodwalls or a combination floodwall/earthen levee, are required only at West End Boulevard, Pontchartrain Beach, American Standard, and Seabrook.

RESPONSE 15.4: The design of the berms presented in the reevaluation report was controlled by stability requirements. During future detailed studies of this area, using additional engineering data, the berms will be designed using stability and seepage analyses considering the hurricane loading time.

RESPONSE 15.5: The existing levee will be enlarged to SPH design standards. Floodwalls will be used only in the reaches where levee construction is impractical.

RESPONSE 15.6: Credit will be given for flood protection work which can be incorporated into the project that was accomplished by the local sponsor after project authorization.

CITY OF NEW ORLEANS

16

February 22, 1984

Colonel Robert C. Lee
U. S. Army Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

In reference to Draft Main Report and Draft Re-evaluation Study, I am transmitting minutes from the City Planning Commission meeting of February 15, 1984. As you can see, a number of concerns are raised, including attention to landscaping, impact on recreational sites, minimization of floodwalls in favor of earthen levees; importance of outfall canals, particularly the IHNC, and a need for City involvement at a sufficiently early stage in design formulation in order to achieve the most benefit with the least adverse impact. In particular, the City would like to participate in reviewing plans for the section along Pontchartrain Beach prior to final design memorandum.

We have found your staff most cooperative in their efforts to update us on this project, and look for a continued positive rapport as the program moves ahead.

Sincerely,

Robert W. Becker

Robert W. Becker
Executive Director

RWB:HS:br

cc: John Hammond
Gino Carlucci

LOUISIANA WORLD EXPOSITION 84 MAY 12 - NOV 11, 1984

Semi-Monthly Planning Meeting
Wednesday, February 15, 1984

CONSIDERATION - LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT.

Introduction:

In December of 1983, the U.S. Army Corps of Engineers published and distributed the documents entitled "Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project---Reevaluation Study". They have announced February 28, 1984 as the final date to receive comments. The City Planning Commission invited Corps representatives to its February 1, 1984 meeting in order to have a first-hand explanation of the project and its anticipated impacts.

In 1977, the Hurricane Barrier aspect of the project was held up by Judge Charles Schwartz. An environmental analysis was undertaken and the subject documents were the result of that work, spanning six years.

An economic analysis of various options ranging from the barrier plan to the high-level (levee) plan to "no action" was carried out. The high level plan, with levees raised to protect against the Standard Project Hurricane was tentatively selected as the most cost-effective alternative.

A number of parishes in the region share a common interest in the project. The modified portion of the plan consists of seven levee segments, five of which affect the City. To avoid confusion each segment is discussed individually in this report.

Aspects of the Project beyond Orleans Parish Boundaries

For St. Charles Parish, an earth levee at elevation +13.5' to 14' located on the north side of Airline Highway is proposed. It would have no effect on the City and extend from the Bonnet Carre' Spillway to the Jefferson Parish line.

The next levee improvement would consist of raising the existing levee along the Jefferson-St. Charles Parish boundary to an elevation of from 14' at the Lake to 13.5' at the St. Charles Parish levee. Presently, this levee is close to the end of the east-west runway at N.O. International Airport. Extension of the runway westward would require shifting a portion of this levee into St. Charles Parish. If the east/west runway is extended, a ring levee would have to be built to enclose the runway and a portion of the existing levee removed.

The next segment, along the Jefferson Parish lakefront would be substantially widened using hydraulic fill from the Lake. Floodgates would be built across the Causeway lanes.

The Project within Orleans Parish

Along the N. O. Lakefront between Jefferson Parish and the IHNC the existing levee at +16' would be elevated to a final elevation near 18.5 feet at Pontchartrain Boulevard, 18.0 feet at Orleans Outfall Canal and approximately 17.5 feet on most of the remaining length. This would be an all-earthen levee and requires no floodwall atop the levee, based upon soil borings and design criteria. A seepage berm on one side or the other would extend approximately 45 feet from the toe of the levee. The seawall at the marina may have to be raised from its present elevation of 10.5 feet to 11.5 feet for still water, or, ultimately 13.5 feet for final design specifications.

This segment would also call for floodwalls at the American Standard Plan (19.5 feet) and Pontchartrain Beach (14.5 feet) and existing floodwalls at Seabrook (presently measuring from 10.5 to 15.5 feet). Floodgates at Marconi and Pontchartrain Beach allow access to the lakeshore side of the levee system.

East of the Seabrook site, the Corps proposes to raise earthen levees up to 15 feet. A floodwall similar to the access provided for Pontchartrain Beach is being examined for Lincoln Beach. Approximately 1200 feet of I-wall, rising 2.5 feet above the levee to reach a final elevation of 15 feet are required in the vicinity of the Lakefront Airport. A barge berm or other foreshore protection will be required in this segment. A rock dike, for foreshore protection, is planned along the lake side of the remaining Citrus levee. Its final design height of 14 feet is to provide a break against waves.

The next segment is the N.O. East Lakefront segment which is east of Paris Road. The existing +14' earth levee will be widened and increased to +16.5'. Impounded marsh will be removed from the system.

Finally, the earthen levee from SouthPoint to the GIWW will be increased from its current height of +12.5' -14' to +13.5' - 15' and widened.

Levee protection along outfall canals along Lake Pontchartrain is a continuing problem which the Corps has acknowledged. Configuration of these vulnerable sites is still under study. One option being considered for the outfall canals is to shut down the pumps during high lake levels since they are not designed to handle a large volume against such a gradient. Designs of future drainage improvements may incorporate the capacity to continue pumping during hurricane tides.

D-44

EVALUATION

In consideration of the propsed project as a viable alternative for flood protection, the City Planning Commission may wish to endorse the high-level plan as presently interpreted. Provided that the City is involved in technical discussions prior to final design memoranda, the staff believes that concerns of Orleans Parish should be adequately considered.

16.1 It is the staff's contention that such major improvements, costing vast sums should be capable of addressing a multiplicity of needs, and not be limited to the single (albeit overwhelming) priority which is flood protection. The lack of pre-design communication has allowed the Citrus foreshore protection aspect of this project to move beyond further modification; we believe that a more mutually acceptable design, allowing for greater recreational access, for instance, could have been incorprated had the City been consulted in a timely manner. The City Planning Commission should insist on greater involvement during planning of the remainder of New Orleans East reaches.

16.2 The Corps has recommended "butterfly valves" for combined access to waterways and flood protection at the outlets of outfall canals. Once again, consultation with the City should preclude one-dimensional thinking and maximize the benefits of these essential components. In reference to the IHNC, the effect of saltwater intrusion and the linkage to "dead zones" and oxygen-poor stratification at the lake bottom require serious attention to a lock system for the Seabrook area.

16.3 Wherever feasible, it is the staff's opinion that I-walls should not be constructed, in part due to esthetics. Where they may be shown to be essential, funding and design should be included to reduce their visual impact by providing plant screening and surface treatment, texturing, etc. to discourage defacing. The City Parkway and Parks Commission will assist the Corps and/or the Levee Board in recommendations of appropriate plant material. The same esthetic concern is raised for floodgates and floodwalls, such as at Marconi Drive and Pontchartrain Beach respectively. Sufficient setback should be provided such that landscaping or other treatment will be accommodated, reducing their visual impact; also, adequate provision of ingress and egress to the beach area should be provided.

16.4 In reference to the New Orleans Lakefront stretch between Jefferson Parish and the IHNC, the Corps proposes to remove a large though unspecified number of trees to allow for widening of the levee base. This will result in a reduction of recreational access and could affect the area's appearance significantly even if mitigated. Every effort should be made to preserve as many mature trees and as much recreational space as possible. In sections where a significant number of trees would be removed by berm construction, alternatives to a seepage berm (such as a ditch or trench) should be considered seriously in order to preserve existing trees. In the event trees must be removed, the City Planning Commission may wish to recommend mitigation measures such as a tree-replanting ratio and/or a Corps evaluation of the recreational uses acceptable along the

RESPONSE 16.1: We concur that major projects such as this should be closely coordinated with local interests to maximize the benefits to a multiplicity of needs. In the future, coordination with the City Planning Commission through the local sponsor, the Orleans Levee Board, can and will be improved.

RESPONSE 16.2: The High Level plan does not require a lock at Seabrook. The feasibility of the Seabrook lock will have to be reanalyzed solely as a feature of the Mississippi River - Gulf Outlet navigation project.

RESPONSE 16.3: Floodwalls will be used only in the areas where levee construction is impractical. The floodwall exposed surfaces will be given an architectural finish; however, planting will not be allowed within the levee/floodwall rights-of-way because of seepage cut-off requirements. The design of the Pontchartrain Beach Floodwall has been coordinated with the developer and with the Orleans Levee District to provide the necessary number of gated openings.

RESPONSE 16.4: Design alternatives will be investigated during the preparation of detailed designs to minimize the removal of trees and to preserve the existing recreational areas. The removal and replanting of trees will be coordinated with the Orleans Levee District.

levee. These aspects should be a funded part of the entire project due to the intensity of recreational use of this portion of the lakefront.

The City Planning Commission may wish to develop its position and submit recommendations to the Corps prior to the February 28 deadline for comments.

DISCUSSION:

The Associate Planner presented the foregoing report, emphasizing staff's recommendation that recreational/aesthetic concerns be given serious consideration by the Corps in their location and design of Floodwalls, berms and levees. He further emphasized the need for city involvement in technical discussions prior to final design memoranda.

15.5 Mr. Caplinger expressed interest in exploring alternatives to a floodwall along the Pontchartrain Beach section, and suggested that an earthen levee along the south side of Lakeshore Drive may be more aesthetically desirable.

16.6 Mrs. Smith expressed concern about floodwall defacement, (e.g. graffiti) citing the existing condition of the Lincoln Beach Floodwall. Dr. Laska responded that the staff in their report recommended that floodwalls be texturized and/or screened with hardy shrubbery, (eg. Pyracantha, ligustrum) to discourage defacement.

After the discussion the following motion was made by Mr. Ledet and seconded by Mr. Favrot.

MOTION:

Be it moved that the City Planning Commission comments and recommendations in the foregoing report and during the foregoing discussion be approved and forwarded to the Corps for their consideration.

YEAS:	Caplinger, Chatelain, Colbert, Favrot, Ledet, Montelepre, Saputo, Smith
NAYS:	None
ABSTENTIONS:	None
RECUSALS:	None
ABSENT:	Dyer

RESPONSE 16.5: The alternative for providing an earthen levee on the south side of Lakeshore Drive in the Pontchartrain Beach area was investigated. The sand strata in this area would make large seepage berms or other means of seepage cut-off necessary.

RESPONSE 16.6: The floodwalls will have an architectural finish similar to that of the Orleans Marina Floodwall. Planting, however, cannot be allowed too close to the floodwalls because of seepage cut-off requirements. Planting would also impede proper inspection of the walls.

NOW, THEREFORE, BE IT RESOLVED, THAT THE ST. CHARLES PARISH COUNCIL hereby give there support to the tentatively selected plan as proposed.

18.1 BE IT FURTHER RESOLVED that the Corps include the proposed mitigation plan as a part of the main report and consider funding for implementation of management recommendation for the LaBranche Wetlands, North of the proposed levee alignment

The foregoing resolution having been submitted to a vote, the vote thereon was as follows:

YEAS: CHAISSON, HOGAN, TREGRE, FAUCHEUX, DUFRENE, CORTEZ, CLEMENT, RODRIGUE, GRIMES

NAYS: NONE

ABSENT: NONE

And the Resolution was declared adopted this 20th day of February, 1984, to become effective five (5) days after publication in the official Journal.

COUNCIL CHAIRMAN

SECRETARY

DELIVERED TO PARISH PRESIDENT

APPROVED:

DISAPPROVED:

PARISH PRESIDENT

RETURNED TO SECRETARY ON

AT ______ AM/PM

RECEIVED BY

RESPONSE 18.1: Management of the LaBranche wetlands will be considered in the mitigation study.

ENVIRONMENTAL DEFENSE FUND

March 6, 1984

Colonel Robert C. Lee
District Engineer
U.S. Army Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, LA 70160

RE: Draft Main Report and Draft Supplement to the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project Environmental Impact Statement

Dear Colonel Lee:

We have received and reviewed the Draft Main Report and Draft Supplement to the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project Environmental Impact Statement. We will provide some general comments on the impact of the proposed project on the resources of the Louisiana Coastal Zone and Lake Pontchartrain followed by a more detailed assessment of the adquacy of the Draft Main Report and Draft Supplement.

1. The Louisiana Coastal Zone --

The Louisiana Coastal Zone is a very productive and unique natural resource which contains an estimated 40% of the nation's coastal wetlands. The region's extensive coastal marshes, wooded swamps, bottomland hardwood forests and barrier islands support an economically valuable fishery and provide critical habitat for numerous species of furbearers, wintering waterfowl and other non-game wildlife species. In recent decades, however, the Louisiana Coastal Zone has experienced an alarming and accelerating rate of land loss due primarily to human activities. Collectively, these activities (i.e., (1) construction of canals and channels; (2) leveeing and jettying of the Mississippi and its tributaries; and (3) land reclamation) have contributed to land loss rates which now exceed 40 square miles per year.

In this context, we therefore strongly oppose any additional Corps projects which will substantially alter or degrade the already severely impacted resources of the Louisiana Coastal Zone. Instead, we believe the Corps, along with other involved state and federal agencies, should implement a well integrated and comprehensive land loss abatement program which will not only control existing coastal

. . . /

444 Park Avenue South New York, New York 10016 212 686-4191
OFFICES IN: NEW YORK, NY (NATIONAL HEADQUARTERS); WASHINGTON, DC; BERKELEY, CA; BOULDER, CO
RICHMOND, VA.

uses damaging to the region's resources but will also contribute to the restoration of already deteriorated wetlands. This, in effect, would require that Corps' projects currently under construction or in planning be significantly altered or abandoned altogether, whereas others such as the Lake Pontchartrain Basin Freshwater Diversion Project and regulatory programs designed to control sources of water pollution would need to be expanded. First and foremost, we therefore recommend that the Corps reassess the role of this project as well as others proposed for the region in terms of their overall contribution to such a land loss abatement program. It seems clear, for example, that the water quality and wetland impacts associated with this project are in many respects in direct conflict with the overall intent of the Lake Pontchartrain Basin Freshwater Diversion Project.

2. Lake Pontchartrain --

The proposed Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project located in Southeastern Louisiana is primarily intended to improve the existing hurricane protection levee network for the following parishes: Jefferson, Orleans, St. Bernard, St. Charles and St. Tammany. Two major alternative conceptual designs are evaluated in the main report and supplemental EIS. The first would entail the construction of three barrier complexes at the Rigolets, Chef Monteur Pass and Seabrook tidal entrances to Lake Pontchartrain coupled with the creation of an extensive series of new levees. The second major conceptual design would not include barrier complexes but to achieve the same level of hurricane protection (SPH) would require an even larger levee/floodwall construction program.

Either alternative will have substantial and largely unmitigated impacts on the natural resources in and around Lake Pontchartrain. This low salinity estuary serves a vital function as a nursery and feeding ground for marine fish, such as menhaden, while directly supporting an extensive and economically valuable sport and commercial fishery. Commercial fishery yields in 1981, for example, for both Lake Pontchartrain and Borgne totaled 3,351,621 pounds with a dockside value of $3,271,372. This accounts for an estimated 16% of the state's economic returns from commercial fishing. (EIS - 49)

The diverse terrestrial and wetland vegetation communities found within the project area include marshlands, cypress-tupelo swamps, bottomland hardwood forests and submerged grass beds. This is invaluable habitat for furbearers, as well as for large numbers of migratory waterfowl including approximately 500,000 lesser scaup. Moreover, the region supports extensive populations of seabirds, wading birds, and common game birds. (EIA - 49)

The Environmental Defense Fund, while recognizing the need for adequate hurricane-induced flood protection for New Orleans and surrounding environs, will only support a plan which also protects and preserves the unique, extremely diverse and, in many respects, invaluable natural resources of the Lake Pontchartrain region. Such an approach is in everyone's best interest.

. . . /

3. Draft Main Report and Draft Supplement --

Although our review of the Main Report and Draft Supplement did indicate that the Corps had substantially improved their environmental impact analysis, severe deficiencies still remain in the following area: (a) assessment of alternative levee alignments; (b) water quality impact analysis; and (c) mitigation of unavoidable adverse impacts on fisheries and wildlife.

a. Assessment of Alternative Levee Alignments

(1) Barrier v. High Level Plan

The assessment of alternative levee alignments occurred within the framework of one of two major conceptual designs, as discussed earlier. We would like to first and foremost commend the Corps for its decision to select a non-barrier approach as the tentatively selected plan. The use of barriers in the Rigolets, Chef Monteur and the Seabrook tidal entrances to Lake Pontchartrain would severely disrupt the natural hydrologic regime of Lake Pontchartrain. This would have long-term adverse impacts on salinity, populations of most fish species, and the nursery/feeding values of the lake for estuarine dependent marine fish. Specifically, migration or passive transport of fish eggs, larvae and juveniles as well as crabs, shrimp and other macro-organisms would be reduced, thereby diminishing the natural productivity and associated economic value of sport and commercial fisheries throughout the Louisiana Coastal Zone.

In addition, the passes at the Rigolets and Chef Monteur would have significant direct impact on wetlands, channel bottoms, fish and wildlife habitat and water quality as a result of dredging, construction and fill activities. Dr. Cronin, in his report to the Corps of Engineers entitled, "Effects of Flood Control Barriers in Passes of Lake Pontchartrain, Louisiana" estimated that dredging for this component of the project alone would destroy 118 acres of marsh, 68 acres of wetlands and the biota of more than 300 acres of channel bottom. Placement of dredge material on marshland would only further degrade and destroy additional habitat, radically altering the existing environment and burying entire populations of benthic organisms. Lastly, construction activities would significantly degrade water quality by interfering with water circulation, increasing turbidity and releasing chemicals.

(2) Maxent Canal Alignment

The Main Report and Draft Supplement to the Lake Pontchartrain Louisiana and Vicinity Hurricane Protection Project considered two vastly different levee alignments for the portion of the project directly affecting the Citrus-New Orleans East area. The first alignment would follow the existing alignment around New Orleans East which would incorporate approximately 13,000 acres of sparsely developed wetlands in the SPH levee system. In comparison, the second alternative is the maxent canal alignment which would exclude these wetlands but provide comparable hurricane-induced flood protection for already developed areas.

. . . . /

RESPONSE 19.1: It is unclear how impacts associated with the Hurricane Protection Project are in conflict with the Freshwater Diversion Project. The Diversion Project would enhance the 26,000 acres of unprotected wetlands in St. Charles Parish between the lake and Airline Highway. The New Orleans East wetland area is not presently subject to tidal interchange; thus, the Freshwater Diversion Project would have no impact on it. Furthermore, post-1984 construction of the Hurricane Protection Project would only impact on additional 54 acres of marsh.

The Corps' analysis of the alternative levee alignments for the Citrus-New Orleans East area is totally inadequate for several reasons. First, during the December 1977 trial in federal district court contesting the adequacy of the Final Environmental Impact Statement, we presented evidence of some continued tidal exchange between Lake Pontchartrain and/or Lake Borgne and the wetlands of New Orleans East. Second, rehabilitation of the approximately 13,000 acres of wetlands which would be included within the existing alignment is possible such that these wetlands could regain much of their prior value and hence again benefit the Lake Pontchartrain ecosystem and New Orleans metropolitan area. Third, the cost-benefit analysis appears to disregard the lost value for the 13,000-acre wetland which will almost certainly be developed if the existing levee alignment is completed. The Corps asserts that this increased potential for development is of no concern in the evaluation of this porject as it is regulated under the permit authority of Section 404 of the Clean Water Act. Furthermore, the Corps considers the existing levee alignment preferable, in large part, because it does not preclude the use of these wetlands for future development.

We categorically reject this analysis and its underlying assumptions. As the U.S. Fish and Wildlife Coordinate Act Report submitted to the Corps by the Fish and Wildlife Service (Section XIV of Appendix C) correctly points out, this rationale is "subject to considerable question ..." The report, in fact, concludes that completion of the proposed project along the existing levee alignment as opposed to the Maxent canal would increase the probability that a 404 permit would be issued and the increased security afforded by the levee would likewise offer additional development incentive.

In conclusion, we strongly believe that the loss of this wetland system is, in large measure, attributable to the completion of the existing levee alignment as compared to the Maxent canal. This loss must be incorporated into the project's decision-making process, rather than, as the Corps suggests, evaluated in the context of the 404 permit process. We strongly believe that the Corps should select a non-barrier alternative which includes both the Maxent canal alignment (alternatives 13-16) and a well conceived and designed management plan to restore this once pristine and invaluable wetland resource. Such an approach would be far more consistent than the TSP with the overall objectives of a well designed land loss abatement program. Furthermore, any efforts to restore this once pristine wetland would improve Lake Pontchartrain water quality thereby contributing to important recreational uses for the residents of New Orleans and surrounding areas.

(3) St. Charles Parish Segment of the Hurricane Protection System

The final major cross-roads in the alternative analysis process is the selection of a levee alignment in the vicinity of St. Charles Parish. EDF is not categorically opposed to a high level plan which incorporates

. . . . /

RESPONSE 19.2: **Flap gates on the existing drainage structures prevent tidal exchange between the lakes and the wetlands. Rehabilitation of the wetlands could increase their value. It is not appropriate to consider the "lost value" of these wetlands, since we are not taking benefits for their development. In addition, the value of the wetland area is not sufficient to justify the additional expense of constructing the Maxent Canal alinement. We will look at the feasibility of restoring tidal exchange to New Orleans East in developing our mitigation plan.**

RESPONSE 19.3: **The Hurricane Protection Project does not directly impact the wetland area. Development in the area will be controlled through the Section 404 permit process, and the cost of mitigation for adverse impacts to the wetlands will be more properly assumed by the developer, not the Federal Government.**

League of Women Voters of Louisiana

850 North 5th Street • Apt. 103 • Baton Rouge, Louisiana 70802 • (504) 344-3326

February 27, 1984

20

To: Colonel Robert C. Lee, Corps of Engineers
District Engineer
P. O. Box 60267
New Orleans, LA 70160

From: League of Women Voters of Louisiana
Bette Bornside, President
Charlotte Fremaux, Natural Resources Chair

Re: Draft Main Report and Draft Supplement to the Environmental Impact Statement (DSEIS) for the Lake Pontchartrain, Lousiana, and Vicinity Hurricane Protection Project, Reevaluation Study.

Attention Planning Division
Environmental Quality Section

Dear Colonel Lee:

The League of Women Voters of Louisiana appreciates this opportunity to review the Draft Main Report , the DSEIS and related appendixes, for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, Reevaluation Study as titled above.

There are a number of questions concerning the project which have been raised. Of particular significance are the following items:

20.1 • the loss of productive marsh areas in eastern New Orleans and St. Charles Parish

20.2 • the dredging of borrow sites opposite Jefferson Parish in Lake Pontchartrain

20.3 • construction problems affecting water quality in all areas of the project

20.4 • possible encouragement of development on unsuitable soils

Undoubtedly the whole issue of flood protection is one of deep concern in this area. We believe that it would be in the best interest of many who raise such questions as we have to be addressed at a public review. At a public hearing there is opportunity for ~~for~~ clarification and examination of data that is important in decision making.

Thank you for your consideration.

Sincerely,

Charlotte Fremaux

Charlotte Fremaux, Natural Resources Chair

RESPONSE 20.1: Very little loss of productive marsh areas in New Orleans East and St. Charles Parish is attributable to this project. Only 54 acres of marsh and 213 acres of swamp would be lost in these areas due to implementation of the High Level Plan. Past construction has destroyed approximately 1,400 acres of marsh. Mitigation for these losses will be studied in the Mitigation Plan. As described in paragraphs 4.2.3 and 4.2.8, the High Level Plan would not impact the enclosed wetlands in New Orleans East or St. Charles Parish.

RESPONSE 20.2: See response to comment 7.41.

RESPONSE 20.3: As discussed in paragraphs 6.1.4.4 to 6.1.4.8, water quality impacts of the high level plan are not significant except for the anoxic conditions in the borrow holes in the lake. As discussed above, we are investigating methods of reducing such impacts.

RESPONSE 20.4: No development was assumed to occur in wetland areas. Future development will be regulated in wetland areas by the Corps' Section 404 permit process and in all areas by local zoning regulations and building codes.

NATIONAL WILDLIFE FEDERATION
CONSERVE OUR NATURAL RESOURCES

Louisiana Wildlife Federation, Inc.

P O BOX 16089 LSU
BATON ROUGE, LOUISIANA 70893
504 355-1871

21

March 1, 1984

Colonel Robert C. Lee
District Engineer
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project

Dear Colonel Lee:

Thank you for granting our request for a public hearing on the Draft Main Report and Supplement to the Environmental Impact Statement for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. We feel it was a wise decision. Please indulge us another request by accepting for the record the Federation's comments on the Tentatively Selected Plan (TSP) for the hurricane protection project. They are several days late due to severe demands on time required by planning efforts for the Federation's 45th annual convention to be held March 9-11 in Monroe, Louisiana.

The Louisiana Wildlife Federation is the largest citizen conservation organization in the state with approximately 80 affiliate sportsmens clubs and 7,000 members throughout Louisiana. Over 3,000 of these members and 25 affiliates are domiciled within or immediately adjacent to the project area. The Federation has had a long-standing interest in the fish and wildlife resources of the Pontchartrain Basin. The proposed hurricane protection project has the potential to cause substantial degradation to the Lake's ecosystem if ample consideration is not given to resource protection in project design and construction.

We believe the Corps has made the correct decision in opting for the High Level Plan over the barrier plan. The Barrier Plan was much too risky, in our opinion, in terms of engineering feasibility, safety and ecosystem preservation. We feel that the High Level Plan, though also damaging to the environment, is more predictable in its effects and therefore, measures to lessen the adverse impacts can be more precisely determined.

Our comments in response to the previous solicitation of public comment on this project by your agency in October of 1981 emphasized our concern over the potential for the project to mislead citizens into the belief that, once constructed, the project will sufficiently protect them from any hurricane that would hit the

21.1 area. As we stressed then, and reiterate now, the only way to be safe from a hurricane is to get out of its way. We urge the Corps to include and emphasize development restrictions in high risk areas and evacuation contingencies as an integral part of this hurricane protection plan. Anything less is irresponsible and an invitation to disaster.

21.2 After thoroughly reviewing the Draft Supplement to the EIS for the TSP, we are concerned primarily with 3 issues. First of all, the levee proposed for St. Charles Parish will encourage development of several thousand acres of wetlands. If the citizens of St. Charles Parish wish that such a levee be constructed, it is our recommendation that the levee be aligned immediately adjacent to Airline Highway (U.S. 61) and that culverts or other kinds of water exchange devices be built into the levee to insure adequate drainage and nutrient transport through the levee.

21.3 The TSP calls for pumping fill from the bottom of Lake Pontchartrain to build the Jefferson Parish levee. Implementation of this plan would create several miles of deep trenches offshore from Jefferson Parish. Lake Pontchartrain, as you know, is already beleaguered by pollution and other degradations and abuses. These trenches would further degrade the Lake at a time when efforts are finally beginning to improve the Lake. We recommend that the Corps select an alternative that will avoid the creation of deep trenches in Lake Pontchartrain. Perhaps levee design might be streamlined to require less fill while still providing adequate protection, and a combination of hauled and pumped fill could be used so as to minimize disruption and degradation of lake bottom. If no alternatives to the proposed trenches can be found, a thorough evaluation of the impact that the holes will have on fisheries habitat should be made so that adequate mitigation can be proposed to offset the damages.

21.4 On page 31 of the EIS mitigation is discussed, however no specific mitigation plan is offered even though a cost figure for mitigation is given on page 124 of the Main Report. We object to the implementation of this project unless a fully defined and adequate mitigation plan is developed and simultaneously funded and implemented. You may want to consider the reestablishment of tidal exchange to the wetlands of New Orleans East and the preservation of the wetlands in that area as potential mitigation for this project.

That concludes the Federation's comments on the hurricane levee project proposal. Thank you for the opportunity to participate in the development of the final report.

Sincerely,

Randy P. Lanctot

Randy P. Lanctot
Executive Director

cc: Senator Russell Long
Senator J. Bennett Johnston
Representative Lindy Boggs
Representative W.J. "Billy" Tauzin
Representative Bob Livingston

RESPONSE 21.1: Development restrictions are imposed through the Federal Flood Insurance Program. The area has designated hurricane evacuation routes.

RESPONSE 21.2: The levee will be north of Airline Highway with culverts as described.

RESPONSE 21.3: See response 7.41. Once the size of the trenches is finalized and impacts evaluated, mitigation will be studied.

RESPONSE 21.4: See response 1.1. Restoration of tidal exchange in New Orleans East is one of the mitigation features which will be considered.

Orleans Audubon Society

A CHAPTER OF THE NATIONAL AUDUBON SOCIETY

February 28, 1984

22

Colonel Robert C. Lee,
District Engineer
Corps of Engineers, New Orleans District
P.O. Box 60267
New Orleans, LA 70160

Attention: Planning Division
Environmental Quality Section

Dear Colonel Lee:

The Orleans Audubon Society notes the receipt of a copy of the Draft Main Report and Draft Supplement to the Environmental Impact Statement (DSEIS) for the Lake Pontchartrain, Louisiana, and the Vicinity Hurricane Protection Project, Reevaluation Study, Vols. 1 and 11.

These documents have been under review by the Conservation Committee. It has been agreed that a number of questions have been raised that are of sufficient complexity and importance to warrant review at a public hearing at which time exchange of information can be of benefit to various interests involved.

22.1 The Orleans Audubon Society is deeply concerned about the effects of this project on the water quality of Lake Pontchartrain, the levees in the eastern part of New Orelans and the continued reduction of marsh acreage. We believe that the opportunity to review these aspects of the project as well as others in an open meeting will be most beneficial.

Sincerely,
Vivian Newman
Vivian Newman, President
Orleans Audubon Society

2418 Magazine Street
Apt C
New Orleans, LA 70130

RESPONSE 22.1: See responses 20.1 and 20.3.

February 25, 1984

Col. Robert E. Lee
District Engineer
Corps of Engineers
New Orleans District

23

Dear Col. Lee

23.1 I fully Support the new hurricane protection alignment along US 61 in St.Charles Parish. I do feel that the part of the levee that parallel's US 61 should begin immediately North of the canal along the highway. The state already owns the canal and some land North of it. This also is the alignment selected by the St. Charles Parish Council. Please carefully consider the costs on this project as there seems to be opportunities for cost savings that will greatly benefit local government.

23.2 A public hearing should be held on this project because of its impact on Lakes Pontchartrain & Borne. This will help people understand the project and give the opportunity for grass root support of the project. People need to feel that this alignment is for legitimate storm protection.

23.3 I feel that any mitigation involved with this project should be directed to St. Charles Parish. The problems with shoreline erosion strongly support & warrant it. There does not seem to be as much ~~m//~~ mitigation involved with this project as needed. The wetlands North of this alignment have been under severe stress for many years because of the many projects that have impacted on them. Landfills have been a constant problem and no amount of protection directed at wetlands have remedied this problem.

23.4 It would seem to be in the best interests of St. Charles Parish residents that this project move along as rapidly as possible. I would also ask that careful consideration be given to all development of all land South of this alignment as soon as possible. The Corps can assist the Parish by carefully balancing this as a growth line with lands North of the levee being preserved and land South of the levee slated for development. This would seem consistant with the goal of the coastal zone program in our state that offers a balance between conservation & development. ~~ifxixean~~

Yours truly,

M L Cambre

M.L. Cambre

RESPONSE 23.1: During the preparation of the General Design Memorandum, a levee alinement as close as practicable to the canal on the north side of Airline Highway will be selected.

RESPONSE 23.2: A public meeting was held on April 12, 1984.

RESPONSE 23.3: During plan formulation for mitigation, we will consider shoreline protection in St. Charles Parish. However, it should be noted that only 13% of the wetland damages occurred in St. Charles Parish, 20% in St. Bernard Parish, and 67% in Orleans Parish. Thus, it is unlikely that all mitigation would occur in St. Charles Parish.

RESPONSE 23.4: Development in the area south of Airline Highway requires a Section 404 permit from the Corps of Engineers. Decisions on these permits are made on a case by case basis and are based on the overall public interest.

February 27, 1984

24

Col. Robert Lee, District Engineer
U.S. Army Corps of Engineer
P. O. Box 60267
New Orleans, LA 70160

In Re: Lake Ponchartrain Hurricane Protection Project

Dear Col. Lee:

I am submitting the enclosed comments on the draft main report and draft supplement to the environmental impact statement on the Lake Ponchartrain Hurricane Protection Project. I am currently a second year law student at Tulane University and am involved in research on this proposal. On the basis of this research I concur with and commend the Corps' tentative selection of the High Level Plan; by comparison it appears to be much less costly and significantly less damaging to the environment than the Barrier Plan. This said, however, under current federal law and policy the selected plan continues to present serious environmental and legal problems.

1. New Orleans East

24.1 Over objections of environmental groups and resource-oriented state and federal agencies, the Corps plans to enclose a 13,000 acre wetland area in New Orleans East within the hurricane protection system. This plan will open up a vast area of marshland to potential urbanization. The Corps' analysis of benefits attributable to the National Economic Development (NED) Account asserts on the one hand that the development pattern of the New Orleans metropolitan area "suggests little evidence" of either intensification or location benefits associated with the hurricane protection project. The statement also indicates that the New Orleans East area wetlands are not needed to absorb the growth of New Orleans within the next 50 years. On the other hand, the statment admits in other parts that--given the selected levee location--urban development of the enclosed area is inevitable, and perhaps even desirable. The Corps can not have it both ways.

24.2 The contention that development of this area is contingent upon §404 permit issuance and not subject to the hurricane protection system analysis is flawed. The Fish and Wildlife Service points out that current state and federal regulatory definitions and policies may exempt this area from the need for a permit. Further if a permit is required, the completion of the proposed levee would greatly increase the likelihood of the issuance of such a permit and provide much incentive for development. Indeed, the development could not conceivably take

RESPONSE 24.1: No benefits for future development in the New Orleans East wetland areas were included in the analysis. Sufficient acreage exists to absorb projected development without the use of these area. Development in the wetland area would be regulated by the Section 404 permit program administered by the U. S. Army Corps of Engineers.

RESPONSE 24.2: We are not aware of any pending legislation that would exempt this area from the Section 404 permit process. The leveed area may be exempt from the state coastal permit process; however, it will be subject to the Section 404 permit process as long as it remains wetlands.

place without the levee. In short, the levee and the permitted development within it go hand in hand. As a matter of logic, and law, they should be considered together in the same statement.

24.3 Compliance with Executive Order 11990, Protection of Wetlands, requires federal agencies to avoid construction in wetlands unless 1) there is no practicable alternative, and 2) the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. The Maxent Canal Levee appears to be an acceptable, practicable alternative. By adopting this less damaging alignment, or by purchasing real estate easments in the expanded area, the Corps could avoid faciliting development of these wetlands pursuant to this national policy. The cost differential cited as the decisive reason for discarding the Maxent Canal alternative should be re-evaluated. Possible reductions in cost could be achieved by re-routing the northern end of the aligment. In any event, the additional costs of construction must be balanced against the costs of developing this wetland area, a qualification which does not appear in the EIS. Instead, the EIS states that "failure to provide adequate hurricane protection could discourage further economic growth in some of the undeveloped areas (EIS-44), and that "if hurricane protection is not provided, land use densities will probably increase in the more protected areas of the project." (EIS-47) In essence, both statements admit that if protection is not provided development will be discouraged. Conversely, if the protection is provided development will be encouraged. The report also states that the Maxent Canal alternative would preclude development of the area, but that "future national or local policies may make such development desirable." (EIS-24) A more appropriate statement would be that the Executive Order dictates the opposite choice.

2. St. Charles Parish

24.4 The Corps has selected the north of Airline Highway alignment. The discarded south of Airline Highway alternative would avoid enclosing 3,000 acres of wetlands in the protected area. The report assures that culverts in the proposed north levee, analogous to the existing culverts in Airline Highway, would maintain the existing hydrology of the area. However, inclusion of this area within protection could eventually lead to development, as discussed above regarding New Orleans East. Indeed, it is hard to think of another rationale for not selcting the south-of-the-highway alternative. If costs are the concern, these costs must again be balanced against the requirements of the relevant Executive Orders.

3. Jefferson Parish

The proposal to dredge material from Lake Ponchartrain to build the Jefferson Parish lakefornt levee would result in a

RESPONSE 24.3: The Maxent Canal alinement is neither acceptable nor practicable from an economic standpoint. The value of the wetlands is not sufficient to economically justify construction of the Maxent Canal alinement. The costs of developing the wetlands is not considered, because no benefits are taken for such development.

RESPONSE 24.4: The higher cost of the south alinement, with no additional benefits, provides sufficient rationale for selecting the north alinement. The additional expenditure of funds is not justified because the selected alinement will not reduce the environmental value of the wetland area. Therefore, there are no benefits to be gained.

24.5 substantial and unquantifiable adverse environmental impact. The weight of information concerning the biological implications of dredge holes indicates that an accumulation of pollutants and an eventual anoxic dead zone will result. Aquatic production surrounding the area will decrease significantly. These impacts can be significantly reduced by bringing in levee material from an upland area such as the Bonnet Carre Spillway, as proposed for other levee features. This alternative needs fuller exploration.

4. Mitigation

24.6 The requirements of the Fish and Wildlife Coordination Act, 16 U.S.C. ss 661-666c, and NEPA are that the planning goal of a federal project should go beyond the stated project purpose to include mititgation measures that will offset project-induced losses to fish and wildlife resources. A detailed mitigation plan should be completed, concurrently with a recommended plan, to compensate for all past and future project damages, and should be implemented simultaneously with construction of all proposed project fetaures. Mitigation is only briefly mentioned in the Corps' report; essentially the subject is deferred. A specific and complete mitigation plan must become a feature of the final EIS on the Hurricane Protection Project. The plan should be in accord with the FWS Habitat Evaluation Procedure, and should include, among others, the following measures:

24.7 a) Adoption of the Maxent Canal alternative or the acquisition of assessments to prevent development in the New Orleans East area, as, for example, in the Atchafalaya Floodway;

24.8 b) Modification of existing water control structures along the South Point to the GIWW levee segment. This would allow water and estuarine organism movement through the levee system, thereby revitalizing the marsh and restoring nursery use by estuarine dependent fish and shellfish.

24.9 c) Specific measures to restore and replace the loss of Jefferson Parish's 10.5 mile National Recreation Trail. The report states in this regard that "the Lake Ponchartrain shoreline is unique in itself and the activities which are intensely pursued in its vicinity are indicative of the current demand for water oriented outdoor recreation in highly urbanized areas."

24.10 d) Assurance that the St. Bernard Parish facet of the originally proposed mitigation plan will be implemented by state and/or private interests and development of substitute federal mitigation features at the earliest possible date for concurrent implementation with other project features.

24.11 e) Details of the plan proposing shoreline protection and improved management for erosion of the 1,600 acres of marsh and shallow open water habitat in St. Charles Parish.

RESPONSE 24.5: See response to comments 2.1 and 7.41. Also, the impacts are neither substantial nor unquantifiable. As discussed in para 6.1.4.1, the dredge holes would impact less than 0.1 percent of the lake bottoms. Aquatic production surrounding the holes should not decrease as discussed in paragraph 6.1.4.5.

RESPONSE 24.6: See response to comment 1.1.

RESPONSE 24.7: Selection of the Maxent Canal alinement has been shown to be unjustified. Acquisition of easements can be considered in the mitigation plan study.

RESPONSE 24.8: See discussion of restoration of tidal exchange in paragraph 4.2.10 and response to comment 24.7.

RESPONSE 24.9: Report has been modified accordingly.

RESPONSE 24.10: See response to comment 1.1.

RESPONSE 24.11: See response to comment 24.10.

2 3 FEB 1983

Colonel Robert Lee, District Engineer
US Army Corps of Engineers
POB 60267
New Orleans, La. 70160

26

Dear Colonel Lee;

February 22, 1984

Re: Lake Pontchartrain, La. and Vicinity Hurricane Protection Project

I'd like to see the Corps have a public hearing on this project. Some of the alignment plans for this levee system around the lake are questionable:

26.1 1) In N.O. East, a 13,000 acre tract of wetlands will be lost when an alternative alignment is available.

26.2 2) In St. Charles Parish, care should be taken not to lose the wetlands south of Airline Highway.

26.3 3) The Corps' dredging proposal along the Jefferson Parish Shoreline will create deep dead holes in the lake bottom. Clay could be hauled in instead.

26.4 4) The plan does not contain specific mitigation proposals.

26.5 5) A public hearing to examine these possibilities is highly desirable. The lake is in a deplorable state largely be cause of past work by the US Army Corps of Engineers of which you are presently District Engineer (MRGO, Intracoastal Canal, flood projects on all sides of the lake, permits to development on all sides of the lake).

Sincerely,
Michael Halle
Michael Halle
520 Esplanade Avenue
New Orleans, La. 70116

cc: Lindy Boggs

RESPONSE 26.1: The 13,000 acres of wetlands have been leveed since the mid-1950's. Any possible development will be considered via the Section 404 permit process.

RESPONSE 26.2: See responses 19.4 and 19.5.

RESPONSE 26.3: See responses 2.1 and 7.41.

RESPONSE 26.4: See response 1.1.

RESPONSE 26.5: A public hearing was held on April 12, 1984.

GEODATA INC.

27

February 27, 1984

United States Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Chief Engineer:

27.1 I urgently request a public hearing be held on the proposed "Hurricane Protection Project" for Lake Pontchartrain and vacinity.

Sincerely,

A. H. Rack

AHR/ep

A. H. RACK
16 MARINERS COVE, NORTH
NEW ORLEANS, LA 70124

MAILING ADDRESS: P.O. BOX 19102 • NEW ORLEANS, LA. 70119
OFFICE: 4330 DUMAINE ST.• NEW ORLEANS, LOUISIANA 70119 • *PHONE:* 504 488-2611

RESPONSE 27.1: A public hearing was held on April 12, 1984.