LAKE PONTCHARTRAIN, LA.
AND VICINITY
LAKE PONTCHARTRAIN
HIGH LEVEL PLAN

US-CE-C Property of the
United States Government

DESIGN MEMORANDUM NO. 19A
GENERAL DESIGN

LONDON AVENUE OUTFALL CANAL
ORLEANS PARISH

IN TWO VOLUMES
VOLUME I

US Army Corps
of Engineers
New Orleans District

DEPARTMENT OF THE ARMY

NEW ORLEANS DISTRICT, CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

JANUARY 1989

RESEARCH LIBRARY
US ARMY ENGINEER WATERWAYS
EXPERIMENT STATION
VICKSBURG, MISSISSIPPI

SERIAL NO. 59

264081J-0

TC 20 2
N46 L3P6
no. 19A
1989
V. 1

CELMV-ED-PG (CELMN-ED-SP/14 Feb 89) (1105-2-10c) 3d End Bardwell/ts/5925
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19A - General Design, London Avenue Outfall Canal

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080

18 AUG '89

FOR Commander, New Orleans District, ATTN: CELMN-ED-SP

The resolution of the 1st endorsement comments is satisfactory.

FOR THE COMMANDER:

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

2 Encls
1. nc
2. wd

CF:
CEEC-EB (with 9 cys of encl 2)

CELMV-ED-PG (CELMN-ED-SP/14 Feb 89) (1105-2-10c) 1st End Mr. Burttschell/jl/7246
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19A - General Design, London Avenue Outfall Canal

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080
13 APR '89
FOR Commander, New Orleans District, ATTN: CELMN-ED-SP

The subject GDM is approved subject to satisfactory resolution of the following comments:

a. Page 7, para following subpara m. The content of this paragraph differs from the last paragraph, page 16, 1 Jan 89 DTO which is quoted as follows:

"Draft mitigation report with corresponding EIS was prepared and distributed for public review on 16 Mar 88. The completion date for submittal of the final EIS is currently unscheduled pending legal opinion from counsel as to whether local assurers are legally bound to sponsor project mitigation."

You should clarify the requirements of local interests with respect to mitigation.

b. Pages 7 and 8, para 9. In this paragraph it is stated that local interests have had engineering work completed on the parallel protection plan and that supplemental GDM work would be required if the parallel protection plan is to be constructed. You should respond to the following:

(1) Views concerning credit to local interests for their engineering work on the parallel protection plan.

(2) Funding source (and who will do the work) for supplemental work on parallel protection plan.

c. Pages 33, 43, and 48, paras 31, 51h and 60a. Paragraph 31 indicates that wave loading was considered with the "Q-Case," requiring a factor of safety of 1.25; whereas, paragraphs 51h and 60a do not indicate this loading criterion. We understand that only the I-walls bordering the lake will be subject to wave loads and, in that case, wave loading was applied with the "S-Case." Therefore, the discrepancies regarding use of wave loading in paragraphs 31, 51h and 60a should be clarified.

d. Page 43, para 51h. You should assure that the design stages for the butterfly valve structure take into account wave loads or that wave loads (if applicable) are incorporated with other loadings.

e. Page 53, para 71. This paragraph should address the current status and furnish the basis for the exception to compliance with the National Historic Preservation Act.

f. Page 67, para 91. Economic information has not been updated to current price levels and interest rates as required by ER 1110-2-1150.

g. Page 68, para 93. Local interests must concur with the butterfly control valve plan before you proceed with the recommendations contained in this paragraph.

h. Plates 6,9 and 10. From the information on these plates, it appears that it will be difficult to install the butterfly valves into the structure due to limited access and the confined nature of the valve bays. Also, after the structure is in operation it appears that the valve cannot be removed due to the location of the needle girder recesses. There is not enough room between the needle girder locations and the machinery house overhang to allow the valves to be removed either from the lakeside or the pumping station side. While the likelihood that the valves will need to be removed is small, the possibility should be considered. The installation and removal of the butterfly valves should be discussed.

i. Plates 42-94. These I-wall analyses assume all sand levee and foundation soils. However, the borings through these reaches (see Plate 39) show silt and clay layers in the levee and foundation. In the DDM, these plates should be revised to utilize the most conservative stratification for the I-wall stability analyses.

j. Plates 66, 67, 68 and 70. These stability analyses plates show no clay layers above el-41. However, Borings 3-LUG and 4-LUG show very soft clay layers (and "no sample") in the vicinity of el-15; and Boring 32 very soft clay between elevations -18 and -20. If these very soft clays were included in the referenced stability analyses, lower than allowable factors of safety would result. Borings should be made during the DDM studies to better delineate these soft clay layers, and if present, they should be included in the appropriate DDM stability analyses.

k. Plate 94, et al. You should furnish a table which summarizes the critical bending moments and deflections (and identify corresponding case loading) along with the sheet pile section used for each stability section shown.

FOR THE COMMANDER:

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

Encl
wd

CF:
CEEC-EB (w/9 cys encl)

CELMN-ED-SP (CELMN-ED-SP/14 Feb 89) 2d End Mr. Stutts/saj/2614
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19A - General Design, London Avenue Outfall Canal

DA, New Orleans District, Corps of Engineers,
P.O. Box 60267, New Orleans, La. 70160-0267 30 Jun 89

FOR Commander, Lower Mississippi Valley Division
ATTN: CELMV-ED-PG

Responses in this subject 2d End are offered herein and are referenced by like paragraph designations to those comments contained in the 1st End.

a. Page 7, Para following subpara 4. A legal opinion has been issued by CELMN-RE indicating that local interests are obligated to cost-share the project mitigation feature. It is the District intent to obtain a signed Memorandum of Understanding with the assuring agencies for the project. That agreement will detail the apportionment of first cost for the mitigation feature to be borne by each assuring agency, along with identifying the agency or agencies responsible for O&M for the mitigation feature. A copy of this signed agreement will be furnished to LMVRE by a separate chain of correspondence when it is available.

b. Page 7 and 8, Para 9.

(1) Local engineering efforts used in preparing this GDM included borings, surveys, and soils design work relative to the evaluation of the parallel protection alternative. Credit for the value of these efforts will be given toward the local share of the cost for the selected plan.

(2) The selected plan will be constructed with Federal funds. The local credit balance currently is in excess of the share required for the selected plan. With respect to construction of parallel protection on the Orleans Avenue Canal, the matter is unresolved. A CEEC-EP letter dated February 9, 1989 is under review in this office. If it is assumed that no avenue exists for reimbursing the local sponsor for construction of the parallel protection plan, then it is likely that that plan would be constructed under Federal auspices to the limit that the Federal share of the butterfly valve plan would allow, with remaining construction to be accomplished

either by the local sponsor or by the Corps with local sponsor contribution, whichever is the more desirable on balance. Appropriate arrangements would be needed to ensure that the work beyond that done under Federal auspices would, in fact, be completed in a timely manner. The need for the unusual procedures described derives from the fact that the local sponsor has accumulated project credits which are likely to exceed the sponsor's total requirements, so that additional credits have no value to them.

c. Pages 33, 43, and 48, Paras 31, 51h and 60a.

(1) Para. 51h, page 43. Revise Case III to read "Case III: S-Case with water to stillwater level and wave load (where applicable) with factor of safety, FS = 1.2." Add "Case IV: Q-Case with water to stillwater level and wave load with a factor of safety, FS = 1.25."

(2) Para. 60a, page 48. Revise Case III to read "Case III: S-Case with water to stillwater level and wave load (where applicable) with factor of safety, FS = 1.2." Add "Case IV: Q-Case with water to stillwater level and wave load with a factor of safety, FS = 1.25."

d. Page 43, Para 51h. Wave loads were not applied to the Butterfly Valve structure because the CERC model study of wave conditions in the canal indicated that wave action from the lake would not reach the structure during the design storm (see CERC miscellaneous paper CERC 87-4, "Effects of Wave Action on Hurricane Protection Structure for London Avenue Outfall Canal in Lake Pontchartrain, New Orleans, Louisiana"). Where applicable, wave loading on the floodwalls nearer the Lakefront was employed.

e. Page 53, Para 71.

(1) No exception to the National Historic Preservation Act of 1966 (NHPA), as amended, is claimed for this project feature. The regulations implementing this act (36 CFR Part 800: Protection of Historic Properties) were followed during the cultural resources and environmental analysis of the project.

(2) A thorough review of the available information revealed that the possibility of significant cultural resources being affected by the proposed project was negligible. The Butterfly Valve alternative is located entirely within an

existing levee corridor on post-1930 reclaimed land. The London Avenue Canal is an artificial channel and, therefore, the potential for historic shipwrecks is precluded. The Parallel Protection alternative is located entirely within an existing levee corridor in a heavily built-up, post-1900 residential area. No cultural resources are recorded in the vicinity of either alternative. Therefore, it was our conclusion that no cultural survey was necessary.

(3) In keeping with section 800.4(a) of the above cited regulation, we coordinated this conclusion with the Louisiana State Historic Preservation Officer (SHPO) through public review of the Environmental Assessment in October 1988. No adverse comments were received from the SHPO. This coordination completed all procedural requirements under NHPA.

f. Page 67, Para 71. Concur. An update of the project's economics using the latest guidelines contained in EC 11-2-156 dated March 31, 1989 yields a Benefit-to-Cost ratio (B/C ratio) of 8.1 to 1 at the project interest rate (3.125 %) and 3.0 to 1 at the current Federal discount rate. Remaining benefits versus remaining costs are 5.0 to 1 for the project interest rate and 1.9 to 1 for the current Federal discount rate.

g. Page 68, Para 93. Concur.

h. Plates 6, 9 and 10. Although the London Avenue Outfall Canal is connected to Lake Pontchartrain, a bridge severely limits the size of waterborne traffic which can access the project site. With this in mind, the following responses are provided.

(1) Installation. It is anticipated that the gates will be moved by barge to the mouth of the canal in Lake Pontchartrain, and from there, over the short distance, truck-hauled to the site. The gates will be lowered into the forebay area and rolled into position under the machinery room floors. Once in position, each gate will be lowered onto its pintle and then have its upper pintle secured. DDM design will ensure there is sufficient clearance to raise the gates above the pintles, thereby allowing for the required lateral movement.

(2) Removal. We concur that there is not enough room between the needle girder recesses and the machinery room overhang to vertically lift and remove a gate with the dewatering

bulkheads in place. Should gate removal become necessary, it will be accomplished without dewatering the gatebay. Small barges or pontoons will be secured to the gate, which will then be floated off of its pintle and out from between the piers. The gates will be skin plated on both sides and sealed to facilitate this type of operation. Since we are also in agreement with LMVD that the potential need for gate removal is extremely small - there will be little or no marine traffic to cause damage by impacting the gates, a dampening system will prevent the gates from slamming shut and routine maintenance can be handled with the gates in place during normal dewatering - this method of removal is considered adequate.

i. Plates 42 - 94. (Should be plates 92 - 94). For plate 92, the only boring in that reach is boring 33 which consists of fine sands from the ground surface to EL - .3 (levee embankment), and a fat clay layer 4.5 ft. thick overlying 13 ft. of sands. Altering the stratification to include the fat clay will not change the I-Wall stability (tip EL +.7) Plate 93 is the start of the transition from the canal levee to the lakefront levee. Boring 34 is the nearest boring to the start of the transition. The stratification of boring 34 is clayey sand to EL -1.5 (levee embankment) overlying a 10 ft. thick layer of fat clay. Changing the stratification from (SM) to (SC) will not change the I-Wall stability (tip EL -.4). The foundation sands on both plates will be changed to clays, but the change will not affect either plate 92 or 93. For plate 94, we concur the stratification will be altered in the DDM to reflect the clays and silts shown in borings 1-ULP, 1-LP and 35. The stationing in the DDM for the geological profile and borings will also include the structure B/L.

j. Plates 66, 67, 68 and 70. We concur that if soft clay layers are present, they will be included in the appropriate stability analyses. Funds have been programmed for the DDM for two forty foot undisturbed borings at the structure site. The soft clay layer in boring 3-LUG consists of .2 ft. and .4 ft. clay (separated by a sand layer) at EL -14 to EL -15 in laboratory log sample 6A. The very soft clay layers in boring 4-LUG consist of .4 ft. at EL -13.2 to EL -14.2 in laboratory log sample 4A and .3 ft. at EL -16.8 to EL -17.8 in laboratory log sample 5A. The boring log program will not plot less than a 1 ft. layer of sample; therefore, sample sizes are increased to 1 ft. These borings are in an area of hydraulic fill and artificial fill. The soil layers are not continuous. The

CELMN-ED-SP
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19A - General Design, London Avenue Outfall Canal

non-continuity of the soils is especially seen by borings 2-LUG and 3-LUG which are centerline levee and toe borings fifty feet apart.

k. Plate 94, et al. Concur. The information requested is presented as enclosure 2. Please note that deflection was not used as a criterion for selection of sheet pile size; however, the deflections corresponding to the noted cases are presented as requested.

FREDERIC M. CHATRY
Chief, Engineering Division

2 Encls
added 1
2 as

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

REPLY TO
ATTENTION OF:

CELMN-ED-SP 14 February 1989

MEMORANDUM FOR COMMANDER, LOWER MISSISSIPPI VALLEY DIVISION,
ATTN: CELMV-ED-PG

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19A - General Design, London Avenue Outfall Canal

1. The subject design memorandum is submitted for review and approval, and has been prepared generally in accordance with the provisions of ER 1110-2-1150, dated November 1984.

2. A summary of the current status of the Clean Water Act, endangered species, Environmental Impact Statement (EIS), and cultural resources investigations is as follows:

a. Since the tentatively selected plan would require the deposition of dredged and fill material into waters of the U.S., a Section 404(b) (1) Evaluation will be prepared and application will be made for a State Water Quality Certificate.

b. Based on studies and investigations at this stage of design, the proposed action is not likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitats of such species.

c. A final EIS for the barrier plan for the subject project was filed with the Council on Environmental Quality (CEQ) on 17 January 1975. A final supplement to this EIS was filed with the Environmental Protection Agency (EPA) on 7 December 1984. An Environmental Assessment addressing both the butterfly valve and parallel protection alternatives was mailed to the public in October 1988.

d. The project area includes an existing levee corridor on Post-1930 reclaimed land, and the artificial channel of the London Avenue Canal. No cultural resources are recorded in the vicinity of the proposed work and no cultural resource surveys are warranted.

CELMN-ED-SP
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19A - General Design, London Avenue Outfall Canal

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

4. This report was scheduled to be submitted to LMVD by 31 Jan 1989. This delay will not cause a delay in the start of construction.

5. Approval of this report and project plan as a basis for preparation of the Detailed Design Memorandum is recommended.

FOR THE COMMANDER:

Encl (16 cys, fwd sep)

FREDERIC M. CHATRY
Chief, Engineering Division

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

TABLE OF CONTENTS VOLUME I

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLES

PLATES

PLATES

PLATES

PLATES

PLATES

PLATES

VOLUME II
APPENDICES

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

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."

c. BERH Recommendation. The report of the Chief of Engineers stated: "The Board (of Engineers of 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. General design of the Lake Pontchartrain High Level Plan, Orleans Parish Lakefront Levee, was presented in Design Memorandum (DM) No. 13. The plan, assumed no barriers in the Chef Menteur and Rigolets Passes, recommended the least costly method of modifying the existing lakefront levee so that a high level of protection can be achieved. DM No. 13 did not cover the lakefront protection at the junction of three Orleans Parish outfall canals.

This memorandum presents the essential data, assumptions, criteria and computations for developing project plan, design and cost estimate for protection of the London Avenue Outfall Canal. The protection of the Metairie Relief Canal will be addressed in future design memoranda. Detailed designs for the Orleans Avenue Outfall Canal were presented in Design Memorandum No. 19. Scope of this memorandum involves developing a project plan which cost-effectively protects the London Avenue Outfall Canal from a Standard Project Hurricane, SPH, as authorized under the Public Law discussed in Paragraph 1. In conjunction with hurricane protection, the plan must also provide optimum conditions for storm drainage through the outfall canal into the lake.

Hurricane Protection for the London Avenue Outfall Canal can be achieved by two alternative plan concepts. One plan concept is to provide fronting protection at/or near the lakefront end of the canal. The fronting protection structure would have specialized gates or valves that could be closed during a hurricane. A description of gate requirements is detailed in a subsequent paragraph. The structure and appurtenant floodwall would tie-in to the existing lakefront levee so that once closed, a continuous line of protection would be achieved. Design details for the fronting protection plan are contained herein. A second plan concept requires upgrading the height of the existing 2.4 miles of parallel levees along both sides of the canal. This plan concept would also require that the bridges at Leon C. Simon Boulevard, Robert E. Lee Boulevard, Filmore Street, Mirabeau Avenue, Gentilly Boulevard, Benefit Street, and The Southern Railroad be modified or floodproofed since their respective deck elevations are below the grades required to achieve project protection. Means to achieve positive closure at Pumping Station No. 3 and No. 4, located at the southern end of the canal and at approximate east W/L Station 101+50, respectively must also be incorporated into this plan. Sufficient plan details for the parallel protection plan are also presented herein. As will be demonstrated in this report, the fronting protection plan is the most cost effective way to provide hurricane protection; can be designed to fully accommodate existing and/or future interior drainage; and will be the least disruptive method (from the stand point of construction) to protect the developed areas behind the levees. The local sponsor, the Orleans Levee Board, OLB, as well as the Sewerage and Water Board of New Orleans, SWBNO, have gone on record in support of the parallel protection plan.

3. <u>Local Cooperation</u>.

a. <u>Flood Control Act of 1965 (Public Law 89-298)</u>. The conditions of local cooperation pertinent to this supplement 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 the Orleans Parish Lakefront Levee West of IHNC report and this report as part of the Lake Pontchartrain Hurricane Protection Project, 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 general and undisturbed type borings and associated laboratory investigations;

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

e. Tidal hydraulic studies required for establishing design grades for protective works based on the latest 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; and

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, an additional Detailed Design Memorandum (DDM) will be prepared to support construction of this project feature. Upon approval of the DDM, Engineering Plans and Specification will be prepared. The recommended plan for the London Avenue Outfall Canal hurricane protection is based on a 1:20 scale model study of the butterfly valve structure. Additionally, a 1:10 scale sectional model is planned to simulate and measure internal gate stresses and also to further refine the mechanical design for the hydraulic machinery for the gate.

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.

While the above requirements reflect the present agreements of local assurance as signed in June 85, they do not address the need for mitigation as required by the Fish and Wildlife Coordination Act of 1958, 16 U.S.C. 661 et seq. (PL 85-624, Aug 58).

8. Status of Local Cooperation. New agreements of assurances covering all local cooperation requirements and a deferred payment plan for the Barrier Plan as authorized by Public Law 93-251 were executed by the Orleans Levee District on 30 March 1976. These assurances were accepted on behalf of the United States on 7 December 1977. Amended assurances for the High Level Plan were executed by the local sponsor on 29 May 1985, and accepted by the United States on 21 June 1985.

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. The Levee District has gone on record as favoring the parallel protection plan over a fronting protection. In fact, OLD has entered into contracts with several local Architectural Engineering firms to design and initiate construction work on parallel protection for both Orleans Avenue and the 17th Street Outfall Canals. A draft General Design Memorandum dated April 1986 for London Avenue Outfall Canal was prepared by Burk and Associates, Inc. but was not finalized due to the projected high cost to achieve the parallel protection. Rather than finalizing their draft, the Levee District has decided to await the results of the Corps GDM study before taking a definitive stand on the London Avenue Canal plan selection.

The Levee District has indicated that they may wish to treat London Avenue Outfall Canal in the same manner as proposed for the Orleans Avenue Outfall Canal, i.e. employ the 70 percent Federal share for the fronting protection plan towards the construction cost for the parallel protection plan. Should this scenario develop, then it will be necessary to supplement this GDM to further expand on the designs for the alternative parallel protection plan. Specifically, the area of coverage for flood proofing of bridges presented in this GDM is sufficient for developing the cost estimates for the parallel plan but does not have the degree of structural design coverage required for the selected plan.

LOCATION OF PROJECT AND TRIBUTARY AREA

10. Project Location. The Orleans Parish Outfall canals segment of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project as shown on Plate 1 is located in southeastern Louisiana on the south side of Lake Pontchartrain in Orleans Parish. There are three outfall canals which transport storm water drainage from the major urbanized areas of Orleans Parish on the east bank of the Mississippi River. The London Avenue Outfall Canal lies to the east of the other two canals, 17th Street Canal and Orleans Avenue Canal. The three canals run parallel to each other and are oriented in the north-south direction. Plate 1 shows the location of all three outfall canals.

PROJECT PLAN

11. General.

The need for project work at the three outfall canals in Orleans Parish was identified subsequent to the authorization of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project. The adoption of more severe hurricane parameters by the U.S. Weather Bureau necessitated upward revisions to the levee grades under that project.

The canals provide the main pumped drainage outfalls for the City of New Orleans. As can be seen on Plate 1, the pumping stations located on each of these canals are situated interior to the city some 2.5 to 3.1 miles from the shoreline of Lake Pontchartrain. Protection from tidal inundation via the lake-canal connection is presently achieved by locally constructed lateral parallel levees along each side of the canals. The existing lateral levees along each of the outfall canals do not meet the design height or design sectional stability required for the Lake Pontchartrain project under either the previously authorized Barrier Plan or the currently approved High Level Plan. Much of the New Orleans Area served by the Outfall Canals is well below sea level. Average topographic elevations in the drainage area are -6.0 ft. NGVD 1/

1/ Elevations throughout this GDM are in feet referenced to National Geodetic Vertical Datum (NGVD) unless otherwise noted.

with some areas as low as -10.0 ft. NGVD. Although each of the outfall canals is similar in function and appearance, the hydrologic requirements for conveyance are quite different. This memorandum addresses the proposed hurricane plan of protection for the London Avenue Outfall Canal only.

12. London Avenue Outfall Canal.

The London Avenue Canal extends about 2.6 miles from Pumping Station No. 3 in the vicinity of Benefit Street to its mouth at Lake Pontchartrain. The canal has average bottom and top widths of 100 feet and 60 feet, respectively. The average invert elevation varies from -6 ft NGVD at the pumping station to approximately -10.0 ft NGVD at Lakeshore Drive. Pumping Station No. 3, located at the south end of the canal, receives storm drainage from approximately 3,080 acres of highly urbanized drainage area and discharges into the canal through three 14-foot pumps and two 12-foot horizontal pumps. The total existing nominal capacity of these pumps is 4300 cfs. Located approximately 1.9 miles north of Pumping Station No. 3 on the east bank is Station No. 4. Pumping Station No. 4 has a nominal capacity of 3,980 cfs and receives storm drainage from approximately 4,800 acres of highly developed urbanized land. The Sewerage and Water Board of New Orleans expects in the future to increase the total combined capacity in the canal to 9,280 cfs. This will be done with the addition of a 1,000 cfs pumping station located on the west bank of the canal in the vicinity of Pumping Station No. 4. The existing lateral parallel levees along London Outfall Canal do not have sufficient elevation to protect the city from the Standard Project Hurricane (SPH).

The project plan presented in this memorandum recommends the construction of a butterfly control valve type gated structure near the lake end of the outfall canal between Leon C. Simon Blvd. and Lakeshore Drive. The structure primarily consists of eight 28 ft x 16 ft gated bays. The eccentrically pinned, vertical "butterfly" gates are designed for flow-induced operation and will automatically open or close as the direction of flow changes. No mechanical controls are required to operate the structure although this capability had been incorporated into the structure's design. As long as the direction of flow in the canal is towards the lake, gates will remain open. During hurricane events, should the lake elevation rise enough to reverse the direction of flow in the canal, the gates will automatically close. Concrete capped steel sheet pile I-walls will tie into both sides of the butterfly valve structure and follow the alignment of the existing canal levee system to the lake front levee. Approximately 100 feet of uncapped steel sheet pile I-wall will tie into the lake front levee on both sides of the canal. The existing New Orleans Lake Front Levee crown is at El. 18.0 N.G.V.D. The I wall will be transitioned from net El. 18.0 to net En. 14.0 along the canal upstream of Lakeshore Drive.

13. Special Gate Requirements.

The fronting protection is the recommended Federal Plan, therefore the proposed structure must be designed so that it provides for maximum latitude or flexability to accommodate interior drainage. This can only be done if the gates on the structure are designed so that they can rapidly respond to the movement of water in the canal. Ideally, the gates should remain open as long as flow direction in the canal is from the pumping station to the lake. However if a condition should develop so that canal flow reverses and inflow from the lake occurs; then the gates should be equipped or specially designed to sense this condition and close. A capability to re-open when the lake stage drops below the canal stage is also an important priority for the gate system to have.

There are two separate approaches or ways that a gate system can be designed to achieve the above stated capability. A passive type of gate system using conventional gates i.e. vertical lift, sector or miter can be designed by equipping the gates with mechanical controls that are activated by a signal from gauges placed in the canal, is one way. A second design approach is to design an active type of gate system. An active gate system responds directly to the movement of water, much like the concept behind the conventional flap gated structure. In this GDM, the active gate system is called the vertically pinned butterfly valve. The butterfly valve also has a manual override which will allow the gates to be opened or closed simply by pushing a button. Volume III, DM 19, Orleans Avenue Outfall Canal contains the WES model study report on the vertically pinned butterfly valve which was conducted for the London Avenue Outfall Canal. For GDM scope designs the London Avenue model study adequately demonstrates that the valve concept is a functional alternative. However, a 1:10 scale sectional model is planned to investigate internal gate stress and also to refine the hydraulic machinery design contained in this GDM.

It should be noted that the fronting protection plan as conceived herein would be operated so that the gates or valves would remain locked in their open position all of the time except when a storm approaches the Louisiana coast. When a tropical storm or hurricane threatens, the gates would be placed in their active operational mode free to respond to the movement of water in the canal.

HYDROLOGY AND HYDRAULICS

14. General.

Design Memorandum No. 13, General Design Orleans Parish Lakefront Levee West of I.H.N.C. presents the essential data, assumptions, and computations for developing the plan design. Criteria applicable to the High Level Plan is provided in Appendix A.

Construction of the proposed levee/floodwall system and/or Butterfly Gates will not significantly affect existing surface drainage patterns. Minor modifications to existing area storm and sanitary utilities are required.

15. <u>Water Surface Elevations Using Nominal Pump Capacities</u>.

A hydraulic analysis was performed for the London Avenue Outfall Canal to determine the required levee/floodwall height for hurricane protection. Water surface profiles were computed using the HEC-2 Computer Program. For flow through the bridges, HEC-2's special bridge routine was implemented. The existing bridges crossing the canal are at elevations lower than the existing levee grades. Therefore, under existing conditions, pressure flow or both pressure and weir flow is a common occurrence. It was assumed that flow would be contained within the levee cross sections at the bridge sites.

Cross section information was taken from the Burk and Associates, Inc., Hydraulic Study, dated January 1986, prepared for the New Orleans Sewerage and Water Board. Values used for Manning's "n" range as follows:

main channel	n	=	.015 (for concrete slope) to .021
channel overbank	n	=	.015 (for concrete slope) to .027

Flow rates in the canal were initially based on nominal pump capacities. Sewerage and Water Board Pump Station No. 3, consisting of three 14-foot pumps and two 12-foot pumps, has a 4,300 cfs capacity. Pump Station No. 4 consists of 3 horizontal pumps and 2 centrifugal pumps. The combined discharge capacity under existing conditions is 8,280 cfs. A 1,000 cfs pump station is proposed for construction west of Pump Station No. 4. Therefore, a future capacity of 9,280 cfs is anticipated, so computer runs were made for 9,280 cfs (future flow) as well as 8,280 cfs (existing flow).

A starting water surface elevation of 11.5 ft. NGVD was used at the lake. This is the still water surface elevation of Lake Pontchartrain for the Standard Project Hurricane.

Various alternatives were developed to prevent the flow of water onto the bridge decks and into residential areas during periods of extreme high water. Raising bridges, floodproofing and butterfly gates were all considered. The following profiles show the water surface elevations for the various bridge conditions for both existing and future pump nominal capacities. The computed water surface elevations at the upstream side of the bridges and the respective bridge head losses are shown in Table 1.

The existing conditions flowline is shown on Plate 33 for both existing and future flow.

The optimum alternative for reductions in stage is the plan which raises all the bridges above the flowline, Plate 34. The resulting water surface elevations are shown in Table 1 and on Plate 34.

Our recommendation is to floodproof the bridges by extending solid guardrails to a height above the anticipated water surface elevation.

This modification prevents storm water from escaping into residential areas via the bridge and allows the passage of traffic in hurricane situations. Plates 35 and 36 show flowlines for two floodproofing alternatives. The flowline on Plate 35 was developed assuming that the Robert E. Lee and Gentilly bridges were floodproofed and that the remaining bridges are modeled as existing conditions. The flowline on Plate 36 assumes all bridges are floodproofed.

Floodproofing of a bridge causes all the flow to pass under the bridge deck, i.e., pressure flow. The inundation, as well as any entrapment of air under the deck, reduces the effective weight of the bridge. The horizontal forces due to unbalanced hydrostatic pressure, plus the energy from the moving mass of water increases the dynamic forces acting on the bridge deck. The likelihood of the structure being lifted or pushed off the abutments and piers is greatly increased. Therefore, any floodproofed bridge must be sufficiently anchored. Where channel velocities exceed the erodable velocity of the in situ material riprap will be placed on the embankment to maintain the design section.

16. Design Discharge and Watersurface Profile. Given the large pool to pool head that would exist across Pumping Stations Numbers 3 and 4 during the design hurricane, Burk and Associates, Inc., working under contract to the New Orleans Sewerage and Water Board, undertook an indepth review of the pump discharge curves for the various pumps at the two pumping stations. It was recognized that the additional height of floodwall necessary to provide protection for the total nominal pump capacity would represent a significant additional investment in project monies. The rational and recommendations for the selected design discharge capacity are contained in their January 1986 report entitled "Hydraulic Study of the London Avenue Outfall Canal." The findings of this report are briefly summarized as follows: At Pumping Station Number 3, the pump capacity curves for the 2-12 feet diameter pumps show that the shut off head level for these pumps is at about 13 feet pool to pool. The 3-14 feet diameter pumps can operate to about 16 feet differential head. This means that when the SPH design lake level occurs, Pumping Station No. 3 will have become in effect and essentially no discharge can be achieved. At Pumping Station No. 4, the two centrifugal pumps can not operate at heads of 16 feet pool to pool. The remaining 3-1000 cfs pumps have a total capacity of 2475 cfs at maximum head differential near 17 feet, pool to pool. The New Orleans Sewerage and Water Board has indicated that they have future plans to add an additional 1000 cfs capacity station opposite to Pumping Station Number 4. Because of this, it was assumed that the total design discharge capacity should be 3475 cfs. This discharge capacity is more realistic than using the total combined nominal capacities of the pumping stations. Plate 37A shows the recommended design watersurface profile generated by using the following boundary conditions:

a. Discharge at Lake Pontchartrain = 3475 cfs
b. Discharge South of Pump Station No. 4 = 0 cfs
c. Existing channel geometry

d. Bridges Floodproofed
   (1) Gentilly Blvd.
   (2) Mirabeau Ave.
   (3) Filmore Ave.
   (4) Robert E. Lee Blvd.
   (5) Leon C. Simon Blvd.
e. Road Gates at bridge approaches
   (1) Benefit St.
   (2) Southern Railroad Br.

Table 1 list the computed watersurface elevations at the bridge crossings and associated bridge head for the design discharge.

TABLE 1
LONDON AVENUE OUTFALL CANAL
DESIGN FLOWLINES AND BRIDGE HEAD LOSSES
FOR HIGH LAKE LEVEL (11.5 FT. NGVD)

	CANAL WATER SURFACE ELEVATION (FT. NGVD)									
BRIDGE CONDITION	Canal Flow (cfs)	Lake Pont	Leon C. Simon Blvd	Robt. E. Lee Blvd	Pump Sta 4	Filmore Avenue	Mirabeau Avenue	Gentilly Blvd	Benefit Street	Pump Sta 3
1) EXISTING										
	8280	11.5	11.96	12.35						
	4300				12.94	13.22	13.67	14.29	14.47	14.87
Bridge Head Loss			0.36	0.38	0.33*	0.17	0.17	0.32	0.18	
	9280	11.5	12.06	12.53						
	4300				13.26	13.57	14.01	14.62	14.81	15.19
Bridge Head Loss			0.43	0.45	0.42*	0.17	0.17	0.31	0.18	
2) ALL BRIDGES RAISED	8280	11.5	11.60	11.57						
	4300				11.99	12.11	12.30	12.44	12.44	12.66
Bridge Head Loss			0.01	0	0.32*	0	0	0	0	
	9280	11.5	11.63	11.59						
	4300				12.11	12.28	12.47	12.61	12.61	12.83
Bridge Head Loss			0.01	0.01	0.39*	0	0	0	0	
3) ROBT. E. LEE & GENTILLY FLOODPROOFED	8280	11.5	11.96	12.56						
	4300				13.15	13.42	13.87	15.28	15.46	15.83
Bridge Head Loss			0.36	0.59	0.33*	0.17	0.18	1.11	0.17	
	9280	11.5	12.06	12.81						
	4300				13.54	13.85	14.29	15.70	15.88	16.25
Bridge Head Loss			0.43	0.73	0.42*	0.17	0.18	1.11	0.17	
4) ALL BRIDGES FLOODPROOFED	8280	11.5	12.02	12.61						
	4300				13.20	13.62	14.15	15.57	16.00	16.63
Bridge Head Loss			0.42	0.58	0.33*	0.31	0.25	1.12	0.43	
	9280	11.5	12.15	12.90						
	4300				13.63	14.09	14.62	16.03	16.47	17.10
Bridge Head Loss			0.52	0.73	0.42*	0.32	0.26	1.11	0.43	
	3475	11.5	11.59	11.69						
	0				11.85	11.85	11.85	11.85	11.85	11.85
Bridge Head Loss			0.08	0.10	0.05*	0	0	0	0	

*Pump Station Head Loss in Canal from Downstream to Upstream Side.

Channel velocities would increase due to pressure flows. The velocities are presented in Table 2.

Table 2

BRIDGE VELOCITY (FT/SEC)				
	Present Pump Capacity		Future Pump Capacity	
BRIDGE	Non Floodproofed	Floodproofed	Non Floodproofed	Floodproofed
Leon C. Simon	2.71	4.70	3.01	5.27
Robt. E. Lee	2.67	5.25	2.96	5.89
Filmore	1.87	3.80	1.83	3.80
Mirabeau	1.90	3.16	1.87	3.16
Gentilly	2.57	6.96	2.52	6.96
Benefit	2.67	4.56	2.62	4.56

17. Structure Analysis.

The U. S. Army Engineer Waterways Experiment Station (WES) conducted a 1:20 scale model study on the use of a butterfly structure in the London Avenue. The model test results of head losses through the structure were very small and the hydraulic losses are considered insignificant. The primary purpose of the model was to establish the feasibility of the valve concept and to determine the most appropriate location and structure orientation in the canal. Inlet and exit conditions to the structure were found to be critical in proper operations of the butterfly valves. The proposed 1:10 scale sectional model will be designed to, among other things, provide data about internal stresses to the butterfly valves. This information will be used in the DDM to complete structural designs on the valves.

GEOLOGY

18. General.

a. Scope. The geology presented herein is based on regional and local surface and subsurface information. It is intended to present a general project overview of the pertinent geologic data and interpretation.

b. Physiography and Topography. The project site is located within the Central Gulf Coastal Plain region on the flanks of the Mississippi River Deltaic Plain and normal to the Lake Pontchartrain shoreline in northern Orleans Parish. Pronounced physiography features of the area are lakes, shorelines, canals, an abandoned Mississippi River delta, the Mississippi River, beach ridges, marshes, and swamps. Elevations in the vicinity vary from -15.0 feet NGVD in Lake Pontchartrain to +20.0 feet NGVD along the crown of the mainline Mississippi River levees.

c. Surface Investigation. Aerial photographs, topographic maps, and geologic maps were used in conjunction with published literature to define the geologic setting of the project area.

d. Subsurface Investigation. Four Two 1-7/8 inch I.D. general type borings and eleven 5-inch undisturbed borings were drilled by Corps of Engineers personnel for this project. In addition a total of seventy-one 3-inch and 5-inch A-E contract undisturbed borings were reviewed for additional geologic classification by Corps of Engineer personnel. All borings are included on the geologic profiles (Plates 37 through 44) in order to present the most geologically complete interpretation. The A-E contract boring symbols were modified to accommodate the Unified Soil Classification system. All borings encountered artificial fill and Holocene soils. Those borings exceeding 70 feet generally encountered the Pleistocene horizon. The boring data, used in conjunction with other available data, was the primary source for site specific geologic foundation interpretations. (Refer to Table 3 for additional boring information).

e. Geophysical Investigation. No geophysical methods were used at the project site. Present refractive methods would not have delineated the various Holocene environments.

19. Regional Geology.

a. Geologic Structure. The project site is located within the Gulf Coastal Plain province. The province extends east to west from Georgia to Texas and north to south from southern Illinois to the Gulf of Mexico continental shelf. The central portion of the province and area of project location is the Mississippi Embayment. The embayment is structurally oriented in a north-south direction with its axis passing locally through a point east of Houma, Louisiana.

TABLE 3
LONDON AVENUE BORING DATA

BORING NO.	DRILLING AGENCY	LEVEE	PROJECT BASELINE STATION	OFFSET
1-LUW	COE	WEST	0+50	TOE
2-LUE	COE	EAST	1+88	C/L
6-LUG	*	WEST	27+77	C/L
3-LUW	COE	WEST	50+00	36'LS
4-LUE	COE	EAST	49+75	TOE
5-LUG	*	EAST	87+70	C/L
5-LUW	COE	WEST	112+16	C/L
2-LG	COE	C/L CANAL	139+68	---
4-LUG	COE	C/L CANAL	141+68	---
1-LG	COE	C/L CANAL	143+68	---
3-LUG	COE	WEST	144+20	50 'LS
2-LUG	COE	WEST	144+20	C/L
1-LUG	COE	EAST	151+00	C/L
6-LUE	COE	EAST	154+68	TOE
1-ULP	COE	WEST	156+58	TOE
1-LP	COE	WEST	157+90	150 'LS
2-LP	COE	EAST	159+41	50 'LS
B-1	AE	WEST	0+85	TOE
B-2	AE	WEST	7+60	C/L
B-3	AE	WEST	11+60	C/L
B-4	AE	WEST	14+70	C/L
B-5	AE	WEST	19+60	C/L
B-6	AE	WEST	24+60	C/L
B-7	AE	WEST	29+60	C/L
B-8	AE	WEST	34+60	C/L
B-9	AE	WEST	39+60	C/L
B-10	AE	WEST	44+60	C/L
B-11	AE	WEST	50+35	C/L
B-12	AE	WEST	55+00	C/L
B-13	AE	WEST	60+00	C/L
B-14	AE	WEST	65+00	C/L
B-15	AE	WEST	69+85	C/L
B-16	AE	WEST	74+75	C/L
B-17	AE	WEST	79+75	C/L
B-18	AE	WEST	84+75	C/L
B-19	AE	WEST	86+35	C/L
B-20	AE	WEST	89+75	C/L
B-21	AE	WEST	94+75	C/L
B-22	AE	WEST	99+75	C/L
B-23	AE	WEST	101+20	C/L
B-24	AE	WEST	104+75	C/L
B-25	AE	WEST	109+75	C/L
B-26	AE	WEST	114+75	C/L
B-27	AE	WEST	121+35	TOE

TABLE 3 (cont'd)
LONDON AVENUE BORING DATA

BORING NO.	DRILLING AGENCY	LEVEE	STATION	OFFSET
B-28	AE	WEST	124+75	TOE
B-29	AE	WEST	127+50	TOE
B-30	AE	WEST	134+00	TOE
B-31	AE	WEST	139+00	TOE
B-32	AE	WEST	143+00	TOE
B-33	AE	WEST	149+00	TOE
B-34	AE	WEST	154+00	TOE
B-35	AE	WEST	159+00	TOE
B-36	AE	EAST	1+95	C/L
B-37	AE	EAST	7+10	C/L
B-38	AE	EAST	11+60	C/L
B-39	AE	EAST	13+70	C/L
B-40	AE	EAST	21+40	C/L
B-41	AE	EAST	24+60	C/L
B-42	AE	EAST	29+60	C/L
B-43	AE	EAST	34+60	C/L
B-44	AE	EAST	39+60	C/L
B-45	AE	EAST	44+60	C/L
B-46	AE	EAST	50+65	C/L
B-47	AE	EAST	55+00	C/L
B-48	AE	EAST	60+00	C/L
B-49	AE	EAST	65+00	C/L
B-50	AE	EAST	69+85	C/L
B-51	AE	EAST	74+75	C/L
B-52	AE	EAST	79+75	C/L
B-53	AE	EAST	84+75	C/L
B-54	AE	EAST	89+75	C/L
B-55	AE	EAST	94+75	C/L
B-56	AE	EAST	99+75	C/L
B-57	AE	EAST	102+95	C/L
B-58	AE	EAST	104+75	C/L
B-59	AE	EAST	109+75	C/L
B-60	AE	EAST	114+75	C/L
B-61	AE	EAST	119+75	C/L
B-62	AE	EAST	124+75	TOE
B-63	AE	EAST	128+60	C/L
B-64	AE	EAST	134+00	TOE
B-65	AE	EAST	139+00	TOE
B-66	AE	EAST	143+00	TOE
B-67	AE	EAST	149+00	TOE
B-68	AE	EAST	154+00	TOE
B-69	AE	EAST	159+00	TOE

* BORINGS 5-LUG AND 6-LUG WERE DRILLED BY AE CONTRACTOR AND CLASSIFIED BY CORPS OF ENGINEER PERSONNEL

The development of the embayment, an approximate 60 million year process, is continuous with the influx of additional sediment. Tertiary and Quaternary sediment thicknesses presently exceed 40,000 feet near the gulf coastline. This tremendous accumulation of sediments has caused a downwarping of the underlying basement rock resulting in the deformation such as folds. Salt domes, diapiric formations of deeply seated Triassic-Jurassic evaporitic deposits, have also produced a locally faulted and massively deformed subsurface. These surficial extrusions or near surficial intrusions usually result in large easily mined halite and gypsum deposits. Diapiric movement appears to be pre-Quaternary in age.

b. Faulting. A series of subsurface normal faults trending NE and SW and NW to SE are common in the area, but lack surface expression in the immediate project area. Most of these faults, classic down to the basin normal faults, are associated with the structural deformation of the sedimentary deposits, resulting from differential settlement of the subsiding sediments. Local faulting is somewhat responsible for the orientation of the north shoreline of Lake Pontchartrain. As previously stated, diapiric salt movement has caused local, generally radial type normal faulting.

c. General Historical Geology and Geomorphology. The Holocene Geologic History of the project area is directly related to the developing Mississippi River. The Mississippi River was formed during the Nebraskan stage, the first glacial advance of the Pleistocene Epoch. Sea level at that time was approximately 450 feet below present level due to the massive continental accumulations of ice. Subsequent to this first glacial period, three other major cycles of continental glacial advancement and recession occurred. These advances (waxing glaciation) and retreats (waning glaciation) have respectively resulted in periods of Mississippi River degradation (erosion or stream entrenchment) and aggradation (sediment deposition or channel filling).

During the last glacial cycle (Wisconsin), the lower Mississippi Embayment experienced a major Mississippi River entrenchment and stratigraphic incision of older Pleistocene and Tertiary deposits. The axis of this ancestral trench runs southeast to northwest between Baton Rouge and Lafayette and southward through a point near Houma, Louisiana. This orientation and location approximates the present central portion of the alluvial valley. During this period, the various tributaries of the Mississippi River also experienced entrenchment.

As glacial meltwaters returned to the oceanic basins, sea level rose and eventually stream gradients decreased. Decreased Mississippi River gradients and associated energy losses resulted in a massive coarse grained alluviation of the entrenched valley. A braided river system resulted from these factors. Continued deposition of coarse grained material within the valley directly above the incised and formerly exposed Pleistocene surface resulted in a massive coarse grain blanket that is now referred to as the Holocene substratum.

As stream gradients stabilized, grain size and sediment load decreased to such an extent that a single meandering channel, forerunner of the modern Mississippi, formed and the braiding characteristic ceased. A top stratum comprised of the finer grain size sediment and representing the various deltaic and fluvial environments developed within the Mississippi River floodplain.

Lateral and southern deltaic progradation resulted from a meandering Mississippi River. As a result of continued meandering, channel shifts, and massive deposition, a series of seven delta lobes were built gulfward. The seven major courses and associated delta lobes are presently identifiable in the region. The oldest course that can be detected is the Sale'-Cypremort (Maringouin), which is located along the present western boundary of the Mississippi River Deltaic Plain. The Sale'-Cypremort was active approximately 5,500 to 4,400 years before present. Concurrent with the abandonment of that course, the Mississippi River shifted eastward and occupied the Cocodrie course. It was during this period, approximately 4,600-3,500 years before present that the first Holocene sediments of any significance were introduced into the study area. However, when the Mississippi River again shifted, this time to the west to occupy the Teche course (3,800 to 2,700 years before present), most of the residual Cocodrie Delta began to subside and was eventually destroyed by advancing gulf waters. Continuing to seek a shorter route to the gulf because of decreased channel gradient, the Mississippi River again shifted eastward to occupy the St. Bernard course. It was during this period, 2,800 to 1,700 years before present, that maximum Holocene deposition occurred in the study area, Lake Pontchartrain was encapsulated in its present form, and major physiographic features of the New Orleans area were developed. The Mississippi River, shifting briefly to the west once again, occupied the Lafourche Course from 1,900 to 1,300 years before present, and then finally shifted eastward to occupy the Plaquemine course (1200 to 450 years before present) and the Balize or Modern course (450 to years before present). (Refer to Figure 1, <u>Deltaic Plain of the Mississippi River</u>.)

When course abandonment occurs, deltaic accretion and sedimentation ceases. These processes are then replaced by the effects of subsidence and coastal erosion. This destructive phase is characterized by a series of environmental changes that includes landform deformation and shoreline retreat.

At present, the Mississippi River is discharging most sediments near or at the edge of the continental shelf and into deep gulfwaters. Thus, dissipation of sediment occurs over a relatively large geographical area. Construction of flood protection levees and major flood control projects restrains the river from migrating laterally and prevents the replenishment of much needed sediment in southeastern Louisiana.

d. <u>Regional Subsidence and Land Loss</u>. The project area lies in a region of active subsidence. Regional subsidence rates vary from less than 0.5 foot to greater than 5.0 feet per century. Estimated project

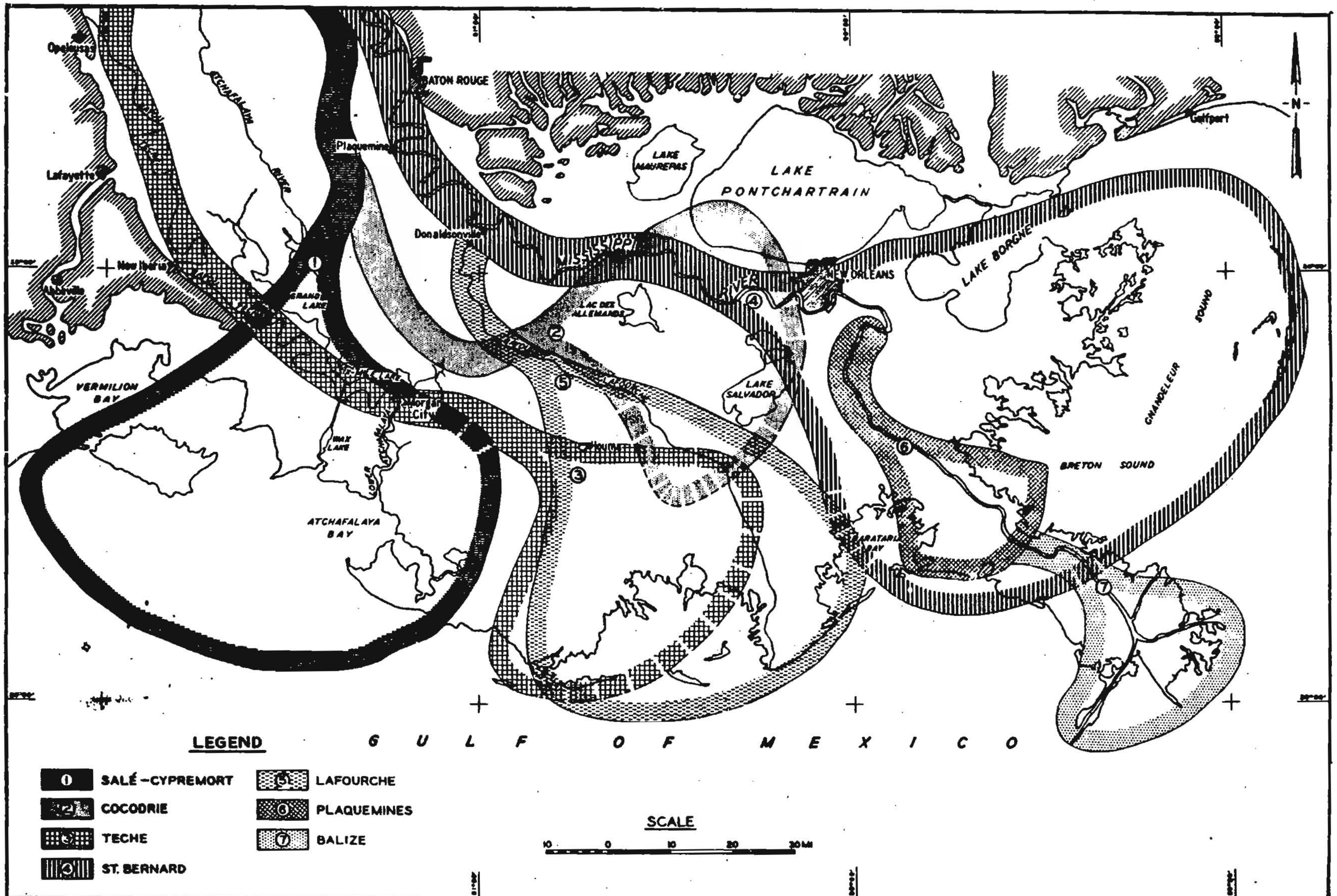


Fig. 1. Mississippi River deltas

site rates average 0.46 foot per century (McFarlan, 1961 and Frazier, 1967). Rates of 5.00 or more feet per century are found in the active delta to the south. The high subsidence and land loss rates result from five major processes. They are:

(1) Tectonic

(a) Sea level rise

(b) Basement sinking

(c) Faulting

(2) Consolidation or sediment compaction

(3) Human influences

(a) Water and hydrocarbon withdrawal

(b) Commercial activities

(c) Construction

(4) Vegetative modifications

(5) Erosion

Subsidence within the deltaic plain is a natural process and is expected to continue. The effects may be mitigated by controlled sediment replenishment within marsh environments and areas of prior marsh existence by such methods as breached levees, strategically placed drainage structures, and pumping stations.

The Pontchartrain Basin is experiencing serious shoreline retreat and land loss. Saucier (1963) estimated shoreline retreat at 2 feet per year along Lake Maurepas and 5.4 feet per year along Lake Pontchartrain. Land losses ins the immediate project area of the Pontchartrain Basin average 8-10 acres per year.

e. Earthquake History. The region is located in a stable area of low seismicity. The Mississippi River Deltaic Plain is encompassed by "Zone 1" on the Seismic Zone Map of the United States (Figure 2). This indicates that earthquake activity is a relatively rare event and usually less severe than average. Resulting damage to structures or levees in the immediate area can be expected to be minimal.

The only events that are known to have produced motion in the region were a series of New Madrid, Missouri, earthquakes dated 1811 to 1812. These earthquakes were felt in the New Orleans area. However, no direct report or geologic evidence suggests that the zone of damage extended to the study site. A few minor quakes, having occurred in south Louisiana

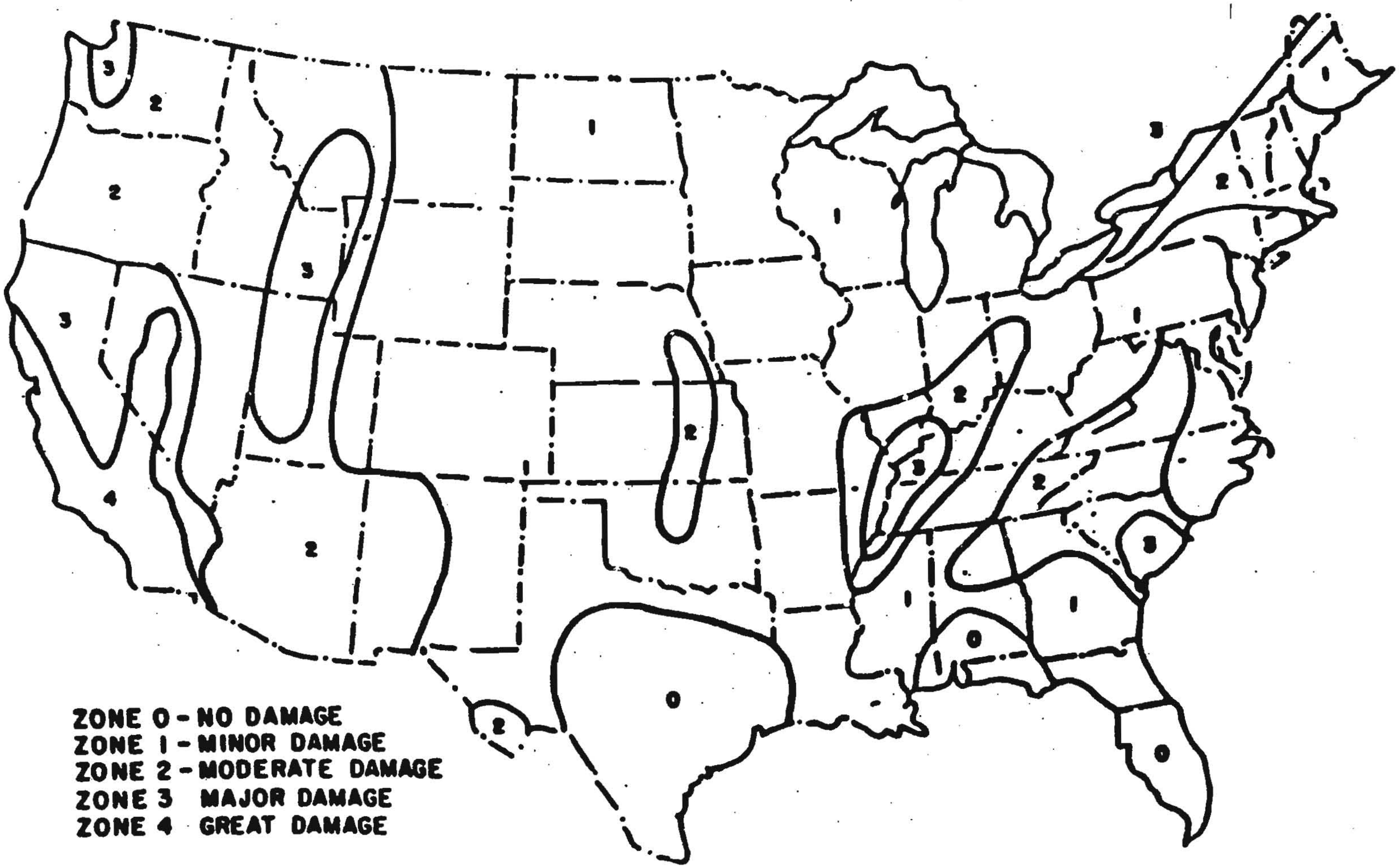


FIG. 2 Seismic Zone Map of the United States

and southwest Texas, may have transmitted vibrations to the area. Calculated ground accelerations show that the greatest ground motions would likely occur from a major earthquake in the New Madrid Zone of the northern Mississippi Embayment. However, none of the calculated motions would exceed 0.05 g.

f. Groundwater. The shallow aquifers of the New Orleans area consist of discontinuous near-surface sands, such as former and present Mississippi River accretionary and distributary-channel deposits. These sands, because of quality and quantity constraints, are of little importance as aquifers. Where present, they are capable of supplying only small quantities of water (less than 50 gal/min).

Four deep freshwater aquifers in close proximity to the project area are: the Gramercy (historically referred to as the 200-foot sand), Norco (400-foot sand), Gonzales-New Orleans (700-foot sand), and the "1,200-foot" sand. The Gonzales-New Orleans aquifer, as determined by the Louisiana Geological Survey, is a good source of potable water within the New Orleans area and is presently being used in various cooling systems in the New Orleans Metropolitan Area. Stratigraphically equivalent sands upriver from New Orleans are without similar nomenclature and are historically referred to simply as older deltaic or pre-Holocene deposits. The project effect on the water quality or volume per local aquifer will be minimal.

g. Mineral Resources. Several hydrocarbon reservoirs are located in the region; however, none are presently in close proximity to the project area.

Any future levee construction will not preclude future oil and gas production or exploration, since directional drilling methods can be utilized.

Shell dredging within the confines of Lake Pontchartrain would not be effected unless an offshore borrow site is selected. Constraints on shell dredging may be inacted to prevent any activity near such a borrow site. Measures may then become necessary to mitigate possible loss of resource at this site.

No other major mineral resources are presently being developed in the area.

20. Site Geology.

a. Site Location and Description. The project is confined to northern Orleans Parish and that portion of the levee that parallels the London Avenue Outfall Canal. This represents approximately 6 miles of levee improvement. The project alignment is nearly normal to the regional geologic strike and traverses hydraulic fill, Holocene surficial marsh and subsurface beach, intradelta, abandoned distributary, lacustrine, prodelta, and marine deposits. A review of geologic profiles A-A' thru F-F' (Plates 37 through 42) details geologic structure parallel to levee centerline. Profile AA-A'A' (Plate 43) details geologic stratigraphy parallel to the valve strucutre axis. Profile 1A-1A' (Plate 44) details the stratigraphy perpendicular to the valve structure axis within the canal. Subsurface elevations at the top of Pleistocene average a -60 feet, but vary from approximately -55 to -70 feet. Depth to top of the Pleistocene increases as we move southward from the lakeshore to the pump plant.

Historically, the site stratigraphic sequence indicates a period of aerially exposed Pleistocene prior to an early Holocene marine transgression. Evidence of a gulfwater transgression and the subsequent development of the Pontchartrain Embayment is present as a locally extensive basal bay-sound deposit. The clayey bay-sound deposit averages 20 feet in thickness and provides parenting material for the overlying Pine Island Beach trend. Estimated ages of the beach and bay-sound deposits are respectively 5,000 and 7,000 years.

Isolation of the embayment by the eastward prograding Cocodrie Delta (4,600 to 3,500 years before present) marked the end of marine conditions and the subsequent development of a lacustrine (lake) environment that is apparent from approximate station 140+00 northward. Cocodrie aged deposits appear to be absent or obscured in the immediate area. This is possibly a result of two factors: (1) the deltaic material was eroded after abandonment and (2) the remaining material closely resembles the overlying lacustrine and further testing would be necessary to differentiate.

The later prograding St. Bernard Delta, 2,800-1,700 years ago, represented the last major period of active deltaic sedimentation within the area. The surficial marsh deposit and the southern wedge of prodelta clays were deposited during this period of time. The abandoned distributary located at the southern terminus of the project is a remnant of past St. Bernard deltaic activities. West of the project, marsh type deposits are found within the confines of Lake Pontchartrain. This may be evidence of an expanding lake resulting from shoreline retreat.

The surficial marsh veneer, 5 to 15 feet thick throughout most of the project, represents the last stage of sedimentation in the area. Marsh type sediments are a result of annual Mississippi River overbank flooding and subsequent deposition of clay and silt size particles landward of the natural levees.

A review of borings in the vicinity of the artificial levee indicates that the additional overburden acts as a surcharge, in some instances consolidating the underlying marsh deposit to less than half the original thickness. Along the centerline of the artificial levee, the additional loading of soil has, to a lesser extent, similarly affected the underlying lacustrine deposit.

Borings north of Leon C. Simon Blvd. reveal a 10 to 20 feet thick surficial blanket of hydraulic fill. This fill was placed behind the seawall during the later portion of the 1920's and the early 1930's. The fill is an excellent base for founding structures.

Borings within the confines of the lake reveal a slightly elevated Pleistocene surface and Holocene stratigraphic thinning. This may be indicative of one or a combination of the following: southern stratigraphic dip, deltaic loading, lower subsidence rates, and/or possible normal faulting. Lake Pontchartrain bay-sound deposits are thinner than the onshore equivalent.

b. Detailed Holocene Environmental Descriptions.

(1) Bay-sound deposits are fine to coarse grain sediments bottoming bays and sounds. Average thicknesses are 20 feet in the project area. Reworking of the bottom portion by burrowing marine organisms produces a mottled appearance and inclusions of materials that are distinct from the surrounding sediment. Colors are typically light gray to gray.

(2) Beach deposits are typically fine sands with large quantities of shells and shell fragments. The sands, generally well sorted with few clay lenses, are well suited for founding projects. Subsidence due to soil compaction is relatively minimal. The wedge shaped beach deposit, found throughout most of the project, thins from 40 feet near station 40+00 to 5 feet near Lake Pontchartrain. The base elevation of the deposit remains a relatively constant -50 feet NGVD. This deposit is the remnant Pine Island Beach trend.

(3) An intradelta deposit located at the southern end of the project (station 0+00 to 10+00) flanks the abandoned distributary. It is a relatively coarse grained deposit averaging 10 feet in thickness from approximate elevation -15 to -25 feet NGVD.

(4) Area lacustrine deposits are generally fine grained, thinly stratified, and average 15 feet in thickness. These characteristics are indicative of periodic deposition within a quiescent environment. Organic remains are more prominant in the upper 5 feet. The bottom one-third is characteristized by relatively massive clays and an absence of organics.

(5) Approximately ten feet of prodelta clays are found at the southern end of the project overlying the beach deposit. The clays are homogeneous and generally more consolidated than the overlying marsh clays. Moistures contents range from approximately 30 to 40 percent.

(6) The marsh deposits are highly compressible organic soils that typically cover 95 percent of area. They grade vertically downward from peat to organic clays and silts. Generally, soil moistures exceed 100 percent, color varies from light grey to black, and consistences vary from very soft to medium.

(7) A 10 feet thick surficial natural levee deposit flanks the abandoned distributary from station 0+00 to 40+00. The deposit is a predominantly fat clay. Generally the deposit exhibits low moisture contents, oxidized zones, medium to stiff consistencies.

(8) An abandoned distributary (Metairie) traverses the southern end of the project area from approximate station 10+00 to 22+00. The channel is a remnant of the St. Bernard deltaic complex. The channel depth in the project vicinity is approximately 70 feet. Silt is the predominant soil type within the channel confines.

c. Detailed Pleistocene Soil Descriptions. The Pleistocene soils are a result of both deltaic and marine deposition. They represent both the regressive and transgressive phases and associated environments of an earlier Mississippi River deltaic system. The soils are, therefore, similar to the overlying Holocene. However, due to dessication, Pleistocene deposits are distinguished by a decrease in moisture contents, a stiffening of consistencies, a decrease in sampling penetration rates, an increase in oxidized sediments, and the presence of calcareous concretions.

d. Foundation Conditions. Representative geologic site conditions are displayed on cross-sections A-A' thru F-F' (Plates 37 thru 42). The massive beach deposit has greatly influenced the stratigraphic geometry of the area. The wedge shaped subsurface beach has prevented an accumulation of deltaic type deposits at the southern end of the project; thus, this area is well suited for project improvement. However, as the beach thins northward, the foundation stability suffers due to a thickening surficial marsh and the development of an underlying lacustrine deposit. However, northward of Leon C. Simon Blvd. the foundation is relatively stable due to an absence of marsh deposits and the placement of hydraulic fill. Potential for additional differential settlement, structural uplift, or need of construction dewatering and its effect of foundation conditions must be addressed.

e. Future Investigations. Subsurface field investigations have been completed, and only occasional future investigations are anticipated if it becomes necessary to verify anomalous subsurface conditions.

21. Conclusion. Current geologic information indicates generally favorable foundation conditions with regard to future construction. Further addition of fill, may result in increased settlement rates, due to lacustrine and marsh soil compaction. Differential settlement may result in areas where organic contents are extremely high and relatively thick. Should future construction in the immediate project vicinity require dewatering local settlement may occur due to oxidation of organics and consolidation of sediment.

FOUNDATION INVESTIGATION AND DESIGN

22. General. This section includes the soils investigations and foundation design for both the valve structure plan and the parallel protection plan. Both plans consist of I-walls, levees, and pile supported structures.

23. Field Exploration. A total of thirteen continuous undisturbed 5 inch diameter soil borings were made in the project area. Borings 1-LUW,

2-LUE, 6-LUG, 3-LUW, 4-LUE, 5-LUW and 5-LUG were made at the levee C/L and protected side levee toe for the parallel protection plan south of Leon C. Simon Blvd. Borings 1-LUG, 2-LUG, centerline of levee; 3-LUG, 6-LUE, protected side toe and 1-ULP, flood side toe; were made north of Leon C. Simon Blvd for the parallel protection plan and the valve structure plan. Boring 4-LUG was made in the C/L of the existing canal for the valve structure plan. The individual logs of these 13 undisturbed borings are shown on plates 45 through 57. A total of 4 general type borings (1-LP, 2-LP, 1-LG, 2-LG) was taken using a 1 7/8 inch ID core barrel or a 1 3/8 inch split spoon sampler. Borings 1-LG and 2-LG were made in the C/L of the existing canal. Borings 1-LP and 2-LP were made at the protected side and flood side of the existing levee. The locations of the undisturbed and general type borings are shown on plate 14 through 16. The boring logs are shown in profile on plates 58 and 59. Sixty nine borings taken by an A-E for the Orleans Levee Board were used in conjunction with the COE borings in the foundation design. Three of the borings were made with a 5 inch diameter Shelby Tube sampling barrel and sixty six of the borings were made with a 3 inch diameter Shelby Tube sampling barrel. The locations of borings taken by the A-E are shown on Sheets 1 through 3 of Appendix A, Volume II, and the boring logs are also contained in Appendix A, Volume II.

24. Laboratory Tests.

a. COE. All samples obtained from the borings were visually classified. Water content determinations were made on all cohesive soil samples. Unconfined Compression (UC) Shear Tests, Atterberg and grain size analysis were made on selected samples of cohesive and granular soils respectively. Water content determinations, (UC) test results and the D_{10} determined from grain size analysis are shown adjacent to the logs on the boring profiles presented on plates 45 through 57. Unconsolidated-Undrained (Q), Consolidated-Undrained (R), and Consolidated Drained (S) shear tests and Consolidation (C) tests were made on represenative soil samples obtained from the undisturbed samples. These tests are summarized on the boring logs shown on plates 45 through 57. The individual shear strength data sheets are shown in Appendix A, Volume II.

b. A-E. Laboratory tests consisting of natural water content, unit weight, and either Unconfined Compression (UC), or Unconsolidated-Undrained (Q) one point or 3 point shear tests were performed by the A-E on samples obtained from the A-E borings. Liquid and plastic limit tests were made on selected samples. Laboratory test results are shown in Appendix A, Volume II. (UC) tests, one point and three point (Q) tests in silts and sands were not plotted on the design shear strength profiles.

c. Design Shear Strength. Design shear strength parameters are shown on plates 60 and 61.

25. Design Problems

a. Structural excavation slopes, cantilever and braced sheetpile.

b. Dewatering and hydrostatic pressure relief required to construct the structure in the dry.

c. The stabilities of the final slopes of the closure levees and approach levees.

d. Bearing pile lengths and subgrade reaction data for the valve structure and retaining walls.

e. Bearing capacity and drainage blanket requirements for the valve structure.

26. Lateral Earth Pressure. Backfill adjacent to the structure and retaining walls will consist of a sand wedge to minimize lateral earth pressure. At rest coefficients (k_o) for the backfill materials were used to determine the lateral earth pressure against the structure and retaining walls. For sand backfill, a lateral earth pressure coefficient of 0.5 was used for design and for clay backfill, a lateral earth pressure coefficient of 0.8 was used. Total unit weights were used above water, and submerged unit weights below the water. The lateral earth pressure diagrams for the construction, operating, and dewatering cases are shown in cross sections on Plate 62.

27. Construction Dewatering and Hydrostatic Pressure Relief. To build the structure in the dry and insure stability of the structure excavation during construction, hydrostatic pressure relief will be provided in the pervious layers in the structure excavation area. Temporary piezometers will be installed in the pervious layers to monitor the pressure during dewatering and pressure relief period. The method of lowering the groundwater is to be left to the construction contractor with performance specifications being prepared on an "end-result" basis. The specifications will allow the use of wells, sumps, pumps, etc., as well as well points. The theoretical radius of influence of 1,167 ft. estimated for dewatering the excavation will include residential homes and buildings on the University of New Orleans campus. The buildings on the UNO campus will be investigated for the type of foundation. If the buildings are on piles no monitoring will be necessary. The many residential homes on the west side of the canal may preclude determination of the foundation type; however, the area where the homes are located consists primarily of silts and sands. The contractor's dewatering proposal should provide for surface control points to measure settlements adjacent to existing structures. Final approval of the proposed system should include provisions for installation of recharge wells if the radius of influence, magnitude of drawdown and soil stratification indicates that settlement will occur. The dewatering system presented on plate 63 is for cost estimating

purposes and for use in evaluating the adequacy of the contractor's proposed hydrostatic pressure relief system.

28. Underseepage and Hydrostatic Pressure Relief

a. Underseepage

(1) Valve Structure. A steel sheet pile cutoff wall will be used beneath the structure to provide protection against detrimental seepage. The location and penetration depth of the sheet pile cutoff wall are shown on Plate 6. Analyses were performed by using a flow net determined with an electric analog. The flow net and calculations are shown in Appendix B.

(2) Apron and Retaining Walls. The sheet pile walls below the apron are for erosion and were not considered in the flow net analysis. The sheet pile walls below the retaining walls are also for erosion protection.

(3) East and West Levee Closure Walls. The sheet pile cutoff wall to EL-33.0 NGVD under the structure, was extended into the east and west levee closure as recommended by EM-1110-2-1913.

b. Hydrostatic Pressure Relief Approach Levees-Valve Structure to Lakefront Levee. Two piezometers were installed by the Orleans Levee Board's A-E in 1985 at Sta 149+00 A-E B/L, west levee toe and 100 ft west of the west levee toe. No top of pipe elevation or ground elevation was taken and only one observation was made. A piezometric headline based on the piezometric data at Orleans Ave Outfall Canal (GDM19) was used. The geological profile for London Ave Outfall Canal displays a more clean sand than at Orleans Ave Outfall Canal; therefore, the pervious strata is probably connected to London Ave Outfall Canal. The above assumptions will be verified after the Orleans Levee Board collects readings on the piezometers. The design piezometric headline was used in the stability analysis and uplift analysis. The stability analysis and uplift analysis indicated that a hydrostatic pressure relief system would not be required. Sheet pile tip elevations for the approach levees were extended based on flow net analysis shown in Appendix B, Volume II.

29. Pile Foundations

a. Ultimate compression and tension pile capacities versus tip elevations developed for 12" square prestressed concrete piles and HP 14x73 steel H piles, are shown on plates 64 and 65. Overburden stresses were limited to D/B=15. Soil design parameters are shown on Plate 61. Values of soil to pile frictional resistance, lateral earth pressure coefficients for compression and tension, and bearing capacity factors used to compute pile capacities are shown in Tables 4 and 5. The results of design pile loads versus tip elevations for cost estimating purposes are based on applying factors-of-safety shown in Table 6.

b. During construction, test piles will be driven and load tested in the project area. The results of pile load tests will be used to determine the length of the service piles.

c. The settlement of the valve structure is estimated to be 0.2' from consolidation below the pile tips in the first pleistocene horizon.

d. Subgrade moduli curves for estimating lateral resistance of the soil beneath the structure and pile supported retaining walls are shown on Plate 64.

TABLE 4

Concrete and Timber Piles

	Q-CASE						S-CASE					
	0	K_c	K+	N_c	N_q		0	K_c	K_t	N_c	N_q	
Clay	0°	1	0.7	9	1.0	0°	23°	1.0	0.7	0	10.5	23°
Silt	15°	1	0.5	12.9	4.4	15°	30°	1.0	0.5	0	22.5	30°
Sand	30°	1.25	0.75	0	22.5	30°	30°	1.25	0.75	0	22.5	30°

TABLE 5

Steel H- Piles

Q-CASE

	0	K_c	K+	N_c	N_q	
Clay	0°	1.0	0.7	9	1.0	0°
Silt	15°	1.0	0.5	12.9	4.4	7.5
Sand	30°	1.25	0.75	0	22.5	20°

TABLE 6

RECOMMENDED FACTORS OF SAFETY
FOR PILE CAPACITY CURVES

WITH PILE LOAD TEST*	W/O PILE LOAD TEST
2.0	3.0

* A pile load test will be conducted and F.S. = 2.0 will be used for both the Q and S Cases.

30. Shear Stability

a. Construction Slopes - Valve Structure. All stability analysis into the excavation utilized piezometric headlines three feet below the ground surface. The excavation plan is shown on Plate 5. Stability was determined by the LMVD Method of Planes analysis for a minimum factor of safety of 1.3 with respect to the design shear strength. The borings used to develop a design shear strength profile for the valve structure and for the approach levees COE B/L Sta 0+00 to Sta 31+51 are shown on Plate 61. The stability analysis relative to the excavation for the braced wall is shown on Plate 66. Plate 67 shows the stability analysis from the area of Pratt Dr. into the excavation. A circular wedge stability analysis utilizing Spencer's Method from the UTEX A52 slope stability computer program is also shown for comparison. Plate 68 shows the stability analysis. The height of protection is based on the higher of the maximum experienced wind tide level of 6.5 NGVD with two feet of freeboard or the height of the existing protection (El.10.0). Plate 69 shows the stability of the existing east levee into the dredged bypass channel. A low water elevation of -2.0 NGVD was used during construction. A mass stability analysis was made for the centerline of the west levee into the excavation as shown on Plate 70. Plate 71 shows the stability of the existing east levee into the retaining wall excavation for phase II construction.

b. Final Slopes Structure and Vicinity. The stability of the approach levees, east closure levee and west closure levee was determined by the method of planes analysis. These sections are shown in plan on plate 4. The method of planes analysis was based on a minimum factor of safety of either 1.3 or 1.5 with respect to the (Q) design shear strengths. The factor of safety of 1.5 applies to the protection levees into the valve structure channel. The stability of the east closure levee into the south approach channel is shown on plate 72 for a Lake Stage at EL. 11.5 NGVD and interior Canal Stage at EL. 2.0 NGVD. Plate 73 shows the stability analysis for the east closure levee into the south approach channel for the lake stage at EL. 11.5 NGVD and the interior canal stage tailwater at EL. -5.0 NGVD. No stability analysis were shown for the west closure since (1) the west section is similar to the east closure and (2) the soil shear strengths for the west closure are the same or better than the east closure. The stability analysis for the spur levee and protection levee into the valve structure channel is shown on Plate 74. Plates 75 and 76 are floodside and protected side analyses for the east approach levee into the dredged channel of El.-12.5 NGVD. Plates 77 and 78 show protected and floodside analyses from E. W/L Sta 6+70 to Sta 18+60 where the existing channel begins. Floodside and protected side analyses for Sta 0+73 to Sta 8+53 W. W/L for the new realigned levee are shown on Plates 79 and 80. From W. W/L Sta 8+53 to Sta 21+00.06, the stratification changes with a deposit of clay, and the realigned levee ties into the existing levee. Plates 81 and 82 show floodside and protected side analyses for the existing levee.

31. I-Walls. The required penetration of the steel sheet piling below ground surface was determined by the method of planes using an "S" shear strength of c=0 and 0=23° for the clay strata, and 0=30° and c=0 for silts. "Q" case design strengths are based on data shown on plate 61. The factors of safety were applied to the design shear strengths as follows: 0 developed = arctan 0 (tan 0 available/factor of safety) and c/factor of safety. Using the resulting shear strengths, net lateral

soil and water pressure diagrams were developed for movement toward each side of the sheet pile. With these pressure distributions, the summation of horizontal forces was equated to zero for various tip penetrations and the overturning moments about the tip of the sheet pile were determined. The required depth of penetration to satisfy the stability criteria was determined where the summation of moments was equal to zero. Following is sheet pile wall design criteria for hurricane protection levees:

TIP PENETRATIONS

Q-CASE

F.S. = 1.5 With water to SWL
F.S. = 1.25 With water to SWL and waveload
F.S. = 1.0 With water to SWL + 2ft freeboard

S-CASE

F.S. = 1.2 With water to SWL and waveload (if applicable)

DEFLECTIONS

Q-CASE F.S.= 1.0 With water to SWL + 2 ft freeboard

BENDING MOMENTS

Governing Tip Penetration Case

If the penetration to head ratio is less than about 3:1, it is increased to 3:1 or to that required by the S-case, F.S. = 1.5, whichever results in the least penetration. The SWL is used to calculate head for penetration to head ratio.

a. Construction Floodwalls. A cantilever floodwall, Plate 83, will be used to transition from the braced wall to the existing levee embankment for the cofferdam of the valve structure excavation. The sheet pile tip was checked for seepage. The analysis is shown in Appendix B, Volume II.

b. Closure Walls and Approach Walls. Stability analysis for the east and west closure walls for the valve structure are shown on Plates 84 thru 86. Plates 87 through 94 show I-wall analyses for flood protection from the valve structure to the Lakefront Levees on both the east and west sides.

c. Braced Walls. A sheet pile braced wall with HP14X73 steel H-pile anchorage will provide flood protection for the excavation during construction of the structure (see Plate 95). The sheet pile tip was extended based on seepage. A seepage analysis is shown in Appendix B, Volume II.

32. Retaining Walls. A deep seated analysis utilizing a 1.3 factor of safety incorporated into the soil properties was performed for various

potential failure surfaces beneath the retaining walls. The analyses are shown on plates 96 and 97. The summation of horizontal driving and resisting forces results in a value that is positive at the base and negative as the elevation of the failure surface is lowered. Since the net driving forces are less than the net at-rest force the structure is assumed to be stable and all loads (vertical and horizontal) must be developed in pile capacity below the slip plane. The difference between the net driving forces at the base and below the base is negative as shown on Plate 96 therefore no load is required to be transferred between the slip plane and the structure. For Plate 97 the difference between the net driving forces at the base El. -17.0 and at the critical slip plane El. -19.0 is positive and this load will be transferred to the structure by the sheet pile cutoff wall.

33. Levee Settlements. The following settlement estimates were based on empirical data and theoretical analysis. No consolidation is expected at the interface of the valve structure and east or west levee closure; however, shrinkage of the fully compacted fill will result in 0.25 ft of settlement. The settlement of the east levee closure is estimated at 1.5 ft based on theoretical analysis. The estimated settlement of the northwest approach levee at the valve structure is 1.5 ft which is shrinkage of the levee fill. The southwest approach levee at the valve structure has an estimated settlement of 1 ft based on a net levee crown of 10.0 NGVD.

34. Bearing Capacity & Drainage Blanket. The valve structure apron will be founded on a sand strata extending from El.-17.0 NGVD to El.-41.0 NGVD. Plate 98 shows the equations used in the bearing capacity analysis. The equations are based on a conservative relation developed by Terazaghi and Peck (1948) between standard penetration tests, loads and settlements. Based on the graph of SPT versus depth for Bor 4-LUG and 0=30° for the sand, a value of N=10 was utilized in the bearing capacity equations. No consolidation settlements are expected since the weight being removed is greater than the weight of the apron. A drainage blanket is provided under the apron to dissipate excess pressures when the low water case of El.-5.0 NGVD occurs. Calculations are shown on Plate 98.

PARALLEL PROTECTION PLAN

35. Design Problems

a. Stability of the floodwall to the protected side because of limited rights of way with property lines at the toe or on the slope of the levees.

b. The stability of the floodwalls into the canal for the low water case El.-5.0 NGVD.

c. Six highway bridges and one railroad bridge over the canal with Gentilly Blvd bridge slab 8 ft below the design SWL.

d. Two pumping stations and a syphon structure along the canal which require fronting protection and reverse flow protection for the discharge tube.

e. The buried beach sand and its connection to the canal.

f. Past and possible future scour problems along the canal.

g. Pile capacities of the existing bridges for floodproofing.

h. Pile driving near existing structures.

36. Underseepage. The existing bridge cutoff sheet pile walls will be utilized at Mirabeau Ave, Robert E. Lee Blvd, and Leon C. Simon Blvd. At the Benefit St. and the Southern Railroad bridges, floodgates will be installed with sheet pile cutoff walls. At Gentilly Blvd a new sheet pile cutoff wall will be installed. At Filmore Ave a new sheet pile cutoff wall will be installed unless the existing sheet pile cutoff wall can be verified.

37. Hydrostatic Pressure Relief. Two piezometers were installed in 1985 by the Orleans Levee Board's A-E at Sta 101+00 A-E B/L west levee toe and 75 ft. west of the west levee toe. No top of pipe elevation or ground elevation was taken, and only one observation was made. Twelve COE piezometers were installed in 1970 at the Mirabeau Ave Bridge at A-E B/L Sta 69+40. Locations are shown in Table 7. Piezometric readings for the COE piezometers were taken in 1970 and 1971. The readings are shown in Appendix B, Volume II. A piezometric headline based on the ground surface and the past piezometric readings was used. The above assumptions will be verified after the Orleans Levee Board collects readings on their piezometers. The design piezometric headline was used in the stability analyses and uplift analyses.

TABLE 7

COE PIEZOMETERS

PIEZOMETERS	A-E B/L STATION		LOCATION
1-E	69+40	EAST	Floodside edge of floodwall
2-E	69+40	EAST	12.5 ft protected side centerline of floodwall
3-E	69+40	EAST	39.2 ft protected side centerline of floodwall
4-E	69+40	EAST	114.2 ft protected side centerline of floodwall
5-E	69+40	EAST	271.7 ft protected side centerline of floodwall
1-W	69+40	WEST	Floodside edge of floodwall
2-W	69+40	WEST	15 ft protected side centerline of floodwall

TABLE 7 (con't)

COE PIEZOMETERS

PIEZOMETERS	A-E B/L STATION		LOCATION
3-W	69+40	WEST	7.3 ft west bottom concrete step
4-W	69+40	WEST	75 ft west piezometer 3-W
5-W	69+40	WEST	225 ft west piezometer 3-W

38. Pile Foundations.

a. Ultimate compression and tension pile capacities versus tip elevations were developed for 12" square prestressed concrete piles, timber piles and 12" diameter steel pipe piles. Overburden stresses were limited to D/B=15 in the sands or a maximum limiting resistance of less than 2.0 ksf in S-case clays. Soil design parameters are shown on plate 60. Values used in pile capacity calculations are shown in Tables 4 and 5. Pile capacities were estimated for the existing bridge piles which are primarily 12" diameter steel pipe piles in the canal and timber piles in the abutments. The results of design pile loads versus tip elevations for cost estimating purposes are based on applying factors-of-safety shown in Table 6.

b. During construction, test piles will be driven and load tested for the floodgates or for the bridge floodproofing plan of protection, whichever plan is selected. The results of the pile load tests will be used to determine the length of the service piles.

c. No settlement is expected for the bridge flood proofing since primarily tension piles will be required.

d. Subgrade moduli curves for estimating lateral resistance of the soil beneath the floodgates and pile supported T-walls were developed.

39. Shear Stability. Plates 99 and 100 show typical design sections for the parallel protection plan from A-E B/L Sta 0+00 (pumping station at end of canal) to A-E B/L Sta 152+50. From A-E B/L Sta 152+50 to the Lakefront Levee the design section is the same for both the Valve Structure Plan and the Lateral Protection Plan. Stability was determined by the LMVD Method of Planes analysis based on a minimum factor of safety of 1.3 with respect to the design shear strength. The borings used to develop a design shear strength profile for the parallel protection plan are shown on Plates 60 and 61. Since the valve structure plan is the approved plan only a few stability analyses are presented. Plates 101 and 102 are floodside and protected side analyses for a section of floodwall in Soils Reach 1 with very limited protected side rights of way. Plates 103 and 104 are floodside and protected side analysis for an I-wall in levee section where there is sufficient area to increase the protected side embankment and reduce the head to penetration ratio.

40. I-wall. The required penetration of the steel sheet piling below ground surface was determined by the Method of Planes using an "S" or "Q" shear strengths. An "S" shear strength of C=0 and 0=23° for the clay strata, and 0=30° and C=0 for silts was used. The "Q" case design strengths are based on data shown on Plates 60 and 61. The pile tip determinations were discussed previously for the valve structure. Plates 105 thru 106 are I-wall analyses for the same reaches as the levee stability analysis presented previously.

41. Levee Settlements. Theoretical analyses were used to compute settlement estimates for levee enlargements. Settlements of 0.5' to 1' are estimated.

42. T-Walls. Between Pumping Sta No. 4 and B/L Station 120+10 east, the floodwall failed in 1980 due to erosion along the canal side. Unsuccessful attempts were made by the OLB to stabilize the floodwall by placing riprap on the canal side. The existing floodwall was removed and a uncapped sheet pile wall was constructed. A deep seated analysis utilizing a 1.3 factor of safety incorporated into the soil properties was performed for various potential failure surfaces beneath the T-wall for B/L Sta. 59+00 to B/L Sta. 120+10 east. The analysis is shown on plate 107. The summation of horizontal driving and resisting forces results in a value that is positive at the base and equal to the value at the critical slip plane. Since the net driving forces are less than the net at-rest force the structure is assumed to be stable and all loads (vertical and horizontal) must be developed in pile capacity below the slip plane. The difference between the net driving forces at the base and below the base is zero therefore no load is required to be transferred between the slip plane and the structure.

SOURCES OF CONSTRUCTION MATERIALS
BUTTERFLY VALVE

43. Sources of Construction Materials.

a. Concrete.

(1) Quantities and Qualities.

	Structural Feature	Concrete Quantity	28 Day* Compressive Strength (psi)
Cast-in-Place	Stab Slabs	375 CY	2,500
	Other Items	8,546 CY	3,000
Precast Concrete	Piles, 12"x12"	67,045 LF	5,000

*90 days if Pozzolan is used.

(2) Environmental Conditions. The concrete will not be subjected to any critical environmental or functional conditions.

(3) Specification Requirements. Concrete construction will be specified using CW-03301, entitled "Cast-In-Place Structural Concrete" as a guide. Because of the nature of local aggregates, low alkali cementitious materials will be specified.

(4) Commercial Ready Mix. Ready mix concrete meeting the requirements of this project and produced from batch plants meeting the guidelines of Cast-in-Place Structural Concrete (CW-03301) is available from several area ready mix companies.

(5) Sand and Gravel. For this project, 3/4" and either 1 1/2" or 1" nominal maximum size coarse aggregate will be used. Several area sources are capable of furnishing sand and/or gravel meeting ASTM quality and ASTM or Louisiana State Department of Transportation and Development gradation requirements.

b. Other Materials.

(1) Rip-Rap. Stone is available from Corps approved sources in Arkansas, Missouri, Kentucky and Illinois for the 3,100 tons of riprap needed.

(2) Shell. The 975 cubic yards of clam shell required can be obtained from adjacent Lake Pontchartrain.

(3) Soil. The levee fill material will be hauled clay which will be obtained from a borrow area in the Bonnet Carre' Spillway. The material will be transported by dump trucks. Soil borings of the borrow material are to be obtained during preparation of plans and specifications for construction. Because of the high percentage of fines in the existing levee it was assumed that only 50 percent of the existing levee material could be reused in the construction of the new realigned levee.

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS
RECOMMENDED PLAN - BUTTERFLY VALVE STRUCTURE

44. Butterfly Valve Structure. The proposed structure will consist of reinforced concrete components and steel butterfly valves (gates). Operation of the structure is based on the theory of vertical, self operating, eccentrically pinned, butterfly valves. Under normal circumstances, the valves will be maintained in a passive, open position to allow pumping of interior drainage into Lake Pontchartrain. When a hurricane approaches, the valves would be placed in the active (automatic) mode. In this case, the valves will remain open when the water level in the outfall canal exceeds that on the lake side of the structure but would close when the water level on the lake side of the structure is greater than that in the outfall canal. Closure of this type would normally be in response to the lake side water level rising due to a hurricane driven surge. In the open (trimmed) position, the axis of each valve will be rotated 12 degrees from the center line of

it's gate bay. During a surge flow, the eccentricity of the pin and the 12 degree offset (trim) will induce closure. This self-operating feature will permit continuous operation of the pumping station during a hurricane. This will be possible because the valves will prevent surge flows from entering the outfall canal and will automatically reopen when the water level on the lakeside of the control structure receeds to a level below that in the outfall canal. When the threat of further hurricane induce surges has passed, the valves will be returned to their passive, open condition. Along with the above described self-operating feature, machinery will be provided to permit manual operation of the valves. This would only be required in the event of a malfunction of the proposed automatic operating system.

The butterfly valve structure will contain the following features:

a. Gate Bays. The structure will have eight gate bays. They will be constructed in three monoliths - two abutment and one interior - and will be found on 12" x 12" prestressed concrete piles. Each gate bay will provide a 28' x 16' opening with a sill elevation of -10.0 N.G.V.D. One set of steel sheet pile dewatering bulkheads and structural steel needle girders shall be provided and each gate bay will have recesses for their installation to allow dewatering for maintenance and/or repairs. Protection against seepage under the structure will be provided by a steel sheet pile cutoff extending to elevation -33.0. For details, see plates 6, 9, and 10.

b. Approach Aprons. The approach aprons shall be reinforced concrete monoliths extending 25 feet on either side of the gate bay monoliths. The interior monoliths shall be soil founded slabs with underslab drainage blankets. The drainage blankets shall consist of a perforated pipe and layers of gravel and sand that are designed to relieve and protect against the build-up of excess uplift pressure under the soil founded slabs. The exterior monoliths shall be inverted T-type walls founded 12" x 12" prestressed concrete piles. Protection against erosion under the aprons shall be provided by steel sheet pile cutoffs extending to elevation -25.0. For details, see plate 6.

c. Retaining Walls. Four reinforced concrete retaining walls shall be incorporated into the structure - one at each corner. Each of the retaining walls shall be an inverted T-type wall founded on 12" x 12" prestressed concrete piles. Drainage of the backfill behind each of these walls shall be provided to protected against ponding water and the build up of excess pressures against the walls. The walls will have a top elevation of 6.0 and will extend out from the structure at approximately 45 degrees angles except for the southwest wall which will be constructed in a 60-foot radius to help ensure proper flow patterns of water through the structure. For details, see plate 12.

d. Valves. The butterfly valves shall be double skin plated structural steel gates with vertical and horizontal ribs. These valves will be supported in the structure by a vertically pinned shaft. The bottom pintle will be a spherical bearing. The ball will be stainless steel and the bearing will be a high lead bronze such as ASTM B 584-932. The top hinge will be a commercially available spherical roller bearing. The valves will be completely sealed and equipped with a ballasting system which will permit them to be floated to and from the structure and sunk into their final position. For details of the valves and the design of the hinge and pintle, see plates 11 and 13.

e. Machinery House. A machinery house spanning the length of the structure shall be located over the valves. This reinforced concrete house will protect the mechanical equipment associated with the gates as well as provided flood protection above elevation 8.5. For details, see plates 6, 9 and 10.

f. Dewatering Bulkheads and Needle Girders. these items shall be provided as stated in paragraph 44a above. The bulkheads shall be PZ 27 steel sheet piling framed with structural steel members to form a single diaphram which can be placed in a gate bay to allow dewatering. The needle girders shall be standard rolled structural steel members (W 16 x 67 and W 24 X 131) against which the bulkheads will bear when installed.

45. Floodwalls. I-type floodwalls consisting of steel sheet piling capped with reinforced concrete shall be provided as stated below. The reinforced concrete caps shall be architecturally treated with a fractured-fin finish on both sides for improved aesthetic quality.

a. Sta. 0+00 West W/L to Sta. 21+00.60 West W/L. This floodwall is on the west bank of the London Avenue Canal. At Sta. 0+00 West W/L it will tie into the Butterfly Valve Structure and at Sta. 21+00.60 West W/L it will be tied into the existing Lakefront Levee system. The top elevation of this wall shall be 14.0 (gross) and it will transition up to elevation 18.5 (gross) at the Lakefront levee. See plates 3 and 4.

b. Sta. 1+84 East W/L to Sta. 18+60.00 East W/L. This floodwall follows the east bank of the London Avenue Canal. At Sta. 1+84 East W/L it will tie into the channel closure I-wall and at Sta. 18+60.00 East W/L it will be tied into the existing Lakefront Levee System. The top elevation of this wall shall be 14.5 (gross) and it will transition up to elevation 18.0 (gross) at the Lakefront levee. See plates 3 and 4.

46. Levees.

a. Channel Closure. A combination earth embankment and I-wall will close the bypass channel after completion of the structure. The embankment will have a 10-foot wide crown at elevation 8.5 (gross) N.G.V.D. and the I-wall will be constructed in the embankment crown to elevation 14.5 (gross). (See Plates 4 and 8).

b. Spur Dike. An earthen spur dike will be constructed on the pumping station side of the structure adjacent to the east levee. The purpose of this dike is to train flow through the structure in such a way as not to cause turbulent and debilitating flow patterns. The dike will be constructed as a 50-foot wide berm off of the east levee at elevation 6.5 (gross). From that point, the dike will slope 1V on 3H down to the canal bottom. For details, see Plates 4 and 8.

c. West Levee Realignment. The existing levee on the west side of the canal shall be realigned to allow for proper placement of the new structure. The realigned portion shall be constructed of compacted clay material in a single lift and shall have a 10-foot wide crown at elevation 8.6 (gross). The floodwall described in paragraph 44a above will subsequently be built on the crown of this new levee. For details and alignment of the new portion of levee, see Plates 2, 4, and 8.

47. Operating Machinery. The machinery is designed for both automatic and manual gate operation. In the automatic mode, gate movement is generated by hydraulic forces acting on the gate due to variations in water levels on either side of the control structure. In this mode the machinery acts as a dampener and shock absorber. Damping time will be field adjustable and accomplished using two hydraulic cylinders and a set of parallel, adjustable flow control valves. One of these valves will be nonpressure compensated and will provide for low pressure, below 200 psi, damping. The other valve will be pressure compensating and will provide for damping when the system pressure exceeds 200 psi. Manual operation of the gate is accomplished by powering the damping cylinders with a hydraulic power unit consisting of a hydraulic pump driven by an electric motor. In this manner, approximately 417 to 513 Kip-Ft of torque can be applied at a gate's hinge to swing it in either direction. A diesel powered generator will be installed to provide on site backup emergency electrical power.

Also incorporated into the machinery is a spring. It is designed to assist in closing a gate when the system is in the automatic mode, i.e., when closing forces are generated by higher water levels in the lake than in the canal. The spring aids closing by providing a preliminary closing torque of approximately 10 Kip-Ft when the gate is fully open and lesser torques as the gate moves towards the closed position. Since the opening forces due to drainage pumping create torques of approximately 20 to 25 Kip-Ft, the spring loading will not increase the head across the structure under normal operating conditions.

48. Gate Bearings. The pintle will be a spherical bearing. The ball will be stainless steel and the bearing will be a high lead bronze such as ASTM B 584-932. The top bearing or hinge will be a commercially available spherical roller bearing. Plate 13 illustrates the machinery layout and the design of the hinge and pintle.

49. Drainage Facilities and Utility Lines. There are no known drainage facilities or utility lines which will be impacted by this project.

50. Cathodic Protection and Corrosion Control.

a. Cathodic Protection for Sheet Piling. Steel sheet piling will be bonded together to obtain electrical continuity and no additional corrosion protection measures will be provided. The bond will be formed by welding a continuous No. 6 reinforcing bar to the top of the piles. At monolith joints, where reinforcing is discontinuous, flexible jumpers, insulated with cross-linked polyethylene, will be welded or brazed to the adjacent piles, 3 inches below the bottom of the concrete. Cathodic protection can be installed in the future if the need arises.

b. Corrosion Control. The steel butterfly gates, corner plates and all other ferrous metal components shall be stainless steel, galvanized or coated with a vinyl paint system, as appropriate, for corrosion control.

BUTTERFLY VALVE STRUCTURE
STRUCTURAL DESIGN

51. Design Cases. The following load cases were used for the preliminary design of the structural components of the butterfly valve structure. Additional loading cases will be considered in the final design as necessary.

a. Construction Case. This case considers the structural components during construction with backfill in place prior to watering of the structure.

b. Maximum Water Level. This case corresponds to the maximum water level under normal operating conditions. Under this condition the pumping station will be discharging maximum flow, the structure gates will be open and both sides of the structure will be subject to the same maximum water elevation of 11.5 NGVD.

c. Minimum Water Level. This case represents the lowest water level that the structure is anticipated to experience (i.e., the operating case that most closely reflects the construction case) under normal operating conditions. In this case, the pumping station will be discharging minimum flow, the lake will be at its lowest anticipated level, the structure gates will remain open and both sides of the structure will be subject to the same minimum water elevation of -5.0.

d. Maximum Stage with Project Hurricane. This condition combines a normal canal stage with the maximum hurricane driven surge from the lake against the structure. In this case, the structure gates will be closed creating the maximum differential head across the structure.

e. Minimum Stage with Project Hurricane. This condition combines the lowest anticipated canal stage with the maximum hurricane driven surge from the lake against the structure. In this case, the structure gates will be closed creating the maximum differential head across the structure. The water elevations used for this case were 7.0 on the lake side of the structure and -5.0 on the canal side.

f. One Bay Dewatered. This case is a maintenance condition which considered maximum normal water levels with one bay dewatered.

g. Earthquake. Structural components were checked for earthquake forces due to the dynamic actions of the structural mass, the adjacent water and the adjacent earth. Earthquake loadings were combined with normal operating condition water levels in the direction resulting in the most severe combined loading.

h. I-Walls. The structural design of the steel sheet pile and reinforced concrete for the I-type floodwalls was based on the following cases:

Case I :Q-Case with water to still water level and a factor of safety, FS = 1.5

Case II :Q-Case with water to still water level plus 2' of freeboard (top of wall) and a factor of safety, FS=1.0

CASE III :S-Case with water to still water level and a factor of safety, FS=1.2

52. Design Criteria.

a. General. The structural designs presented herein for the butterfly valve structure plan comply with standard engineering practice and criteria set forth in Engineering Manuals and Engineering Technical Letters for civil works construction published by the Office, Chief of Engineers.

b. Structural Steel. The design of steel structures is in accordance with the requirements of the allowable working stresses recommended in "Working Stresses for Structural Design", EM 1110-1-2101 dated 1 November 1963 and amendment No. 2 dated 7 January 1972. The basic working stress for ASTM, A-36 steel is 18,000 psi. Steel for steel sheet piling will meet the requirements of ASTM A328, "Standard Specification for Steel Sheet Piling".

c. 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 for "Strength Design Criteria for Reinforced Concrete Hydraulic Structures", ETL 1110-2-312 dated 10 March 1988, which supersedes ETL 1110-2-265 dated 15 September 1981. Pertinent stresses are tabulated below:

f'c	3,000 psi
fy (grade 60 steel)	48,000 psi (flexure)
	60,000 psi (embedment)
Maximum flexural reinforcement	0.25 x balance ratio
Minimum flexural reinforcement	200 / fy
f'c (prestressed concrete piles)	5,000 psi
fu (prestressed strands, GR. 270)	270,000 psi

d. Unit Weights. The following unit weights were used in design calculations:

Item	Lbs. per cubic foot
Water	62.5
Concrete	150.0
Steel	490.0
Gravel	110.0
Riprap	132.0
Saturated Sand	122.0
Saturated Clay	110.0
Saturated Shell	117.0
Saturated Silt	117.0

e. Uniform Live Loads. The following values for uniform live loads were used for design:

Item	Lbs. per square foot
Machinery Room	
- Floors	100
- Roofs	20

ALTERNATE PLAN - PARALLEL PROTECTION

53. General. An alternative means of providing hurricane protection of the project area, in lieu of the butterfly valve structure, would be to construct floodwalls along both banks of the London Ave Outfall Canal. This alternative would require demolition of the deficient existing floodwall, providing access at two bridge locations, water-proofing five bridges, providing pedestrian bridge access at the Gregory Junior High School, removing 3 pedestrian bridges constructing fronting protection systems at the New Orleans Sewerage and Water Board Drainage Pumping Station Numbers 3 and 4, and the modification of existing utilities.

A description of the above required work is as follows:

54. Floodwalls.

a. General. The existing flood protection system along both sides of the London Avenue Outfall Canal consists of earthen levees and concrete-capped M-115 steel sheet pile I-walls. The M-115 steel sheet pile between Prentiss Avenue (Sta. 103+00) and Robert E. Lee Blvd. (Sta. 120+10), on the east side of the canal, was replaced with uncapped PZ-27 steel sheet piles by the Orleans Levee Board in 1982.

M-115 sheet piling is a narrow corrugation, low section modulus sheet pile. The existing piling is badly corroded in many places thereby making it unfeasible for it to be used to upgrade the existing flood protection system. Therefore, the existing system must be removed and replaced, except for the PZ-27 steel sheet pile which will be incorporated into the new flood protection system. The new floodwalls will tie into the existing lakefront levee at the northern end, and into the proposed frontal protection system for Sewerage and Water Board's Pumping Station No. 3 at the southern end of the canal. Plates 14 through 19 depict the new flood protection system.

b. T-Walls. An inverted T-Type floodwall founded on HP 12 x 53 steel H-piles with a steel sheet pile seepage cut-off will be constructed between Sta. 59+00 and Sta. 120+10 on the east side of the canal. The use of steel H-piles in this reach is necessary due to the close proximity of residential houses which would be subject to excessive vibrations if prestressed concrete piles were used. The top of the T-Wall slab will be embedded 2 feet below the levee crown. The existing PZ-27, between Sta. 103+00 and Sta. 120+10 on the east side of the canal, will be driven to the required tip elevation for seepage cut-off. Expansion joints in the floodwall will be spaced approximately 30 feet apart, adjust to fall at the steel sheet pile interlocks. Both sides of the new T-wall will be artchitecturally treated with a fractured fin finish for improved aesthetic quality. For typical T-Wall monolith, see Plate 20A.

c. I-Walls. An I-type floodwall consisting of steel sheet piling capped with reinforced concrete shall be constructed at all other areas on both sides of the canal. The concrete portion of the floodwall will extend from 2 feet below the canal side finished levee crown elevation to the required protection height. Expansion joints in the floodwall will be spaced approximately 30 feet apart, adjusted to fall at the steel sheet pile interlocks. Both sides of the new I-wall will be architecturally treated with a fractured fin finish for improved aesthetic quality. For typical I-wall sections, see Plate 20.

55. Bridges. There are nine bridges crossing the London Avenue Outfall Canal. They are as follows:

1. Southern Railroad Bridge
2. Benefit St. Bridge
3. Interstate 610 Bridge, East Bound
4. Interstate 610 Bridge, West Bound
5. Gentilly Blvd. Bridge
6. Mirabeau Ave. Bridge
7. Filmore Ave. Bridge
8. Robert E. Lee Blvd. Bridge
9. Leon C. Simon Blvd. Bridge

Seven of the above bridges are below the level of protection required under this plan. During the approach of a hurricane, these bridges function as primary evacuation routes for residents of this area. Therefore, it is necessary to maintain these bridges open to traffic during the approach of a major storm. Information regarding the bridge cross sections were taken from available as-built plans. The following modifications are proposed:

a. Southern Railroad Bridge: Steel swing gates will be constructed at both bridte approaches where the railroad crosses the floodwalls. A steel sheetpile cutoff will be provided for underseepage at each gate monolith. Each gate monolith will have a 31' -3" opening. For typical sections and details, see Plates 22 through 24.

b. Benefit St. Bridge: This two lane bridge handles only localized traffic, and is in close proximity to the Gentilly Blvd. Bridge, for which vehicular access will be maintained. Therefore, we will construct bottom roller gates at both bridge approaches. A steel sheet pile cutoff will be provided for underseepage at each gate monolith. Each gate monolith will have a 30' -0" opening. For typical sections and details, see Plates 25 through 27.

c. Interstate 610 Bridges: These two elevated structures, both east bound and west bound, provide adequate vertical clearance above the proposed floodwall height needed for flood protection. The lowest elevation of the bottom of the steel girders is elevation 15.0 NGVD. Construction of new floodwalls under these existing structures will pose some problems, but modification to the bridge structures will not be necessary.

d. Gentilly Blvd. Bridge: Modification to this bridge entails the removal of the existing deck; installing precast, prestressed concrete piles at each bent to resist uplift; and installing a new concrete watertight deck and parapet walls. See Plates 30, 31 and 32 for details.

e. Mirabeau Avenue and Filmore Avenue Bridges: Modification to these bridges entail the removal of the existing decks; installing new steel girders along the exterior faces of the existing pile caps; installing tension connectors to the steel girders, piles and caps; and installing new concrete watertight decks, parapet walls and pedestrian sidewalks. See Plates 30 and 31 for details.

f. Robert E. Lee Blvd. Bridge: Modification to this bridge entails the removal of the existing deck; installing new steel girders along the exterior faces of the existing pile caps; installing precast, prestressed concrete piles at each bent to resist uplift; and installing a new concrete watertight deck, parapet walls and pedestrian sidewalks. See Plates 30, 31 and 32 for details.

g. Leon C. Simon Blvd. Bridge: The existing bridge deck is watertight and replacement is not necessary. Modification to this bridge entails installing tension connectors to the steel girders, concrete caps and piles; and constructing new watertight parapet walls. See Plates 30 and 31 for details.

All of the existing bridges except Gentilly Blvd. and Filmore Ave. have adequate seepage cutoff sheetpiling at the end abutments. The proposed floodwalls will tie into the existing seepage cutoff and parapet walls for continuity of flood protection.

56. Pedestrian Bridges. There are a total of four pedestrian bridges that cross the London Avenue Outfall Canal. The pedestrian bridge

located at approximate Sta. 49+88 that serves the Gregory Junior High School will be retained and have pedestrian gate openings provided where the bridge crosses the proposed floodwalls on both sides of the canal. All other remaining pedestrian bridges shall be removed and pedestrian sidewalks incorporated into the adjacent vehicular bridges. For typical sections and details of Pedestrian Gate Monolith, see Plates 28 and 29.

57. New Orleans Sewerage and Water Board Drainage Pumping Station No. 3. This pumping station is located just north of the intersection of N. Broad Avenue and London Avenue and marks the beginning of the London Avenue Outfall Canal. Being situated across the south end of the canal, the current level of flood protection is provided by the structure of the station itself. The walls of the discharge basin are then integrated with the earthen levee and floodwall system of the canal on the east and west sides to complete the system of flood protection. Increased flood protection across the front of the station will be provided by constructing a new concrete T-Wall with sluice gates immediately in front of the existing discharge basin. This new wall shall extend laterally between the discharge basin walls on either side and will be supported on 14" x 14" prestressed concrete piles. The discharge piles will be extended and tied into the sluice gates. Sluice gates shall also be provided in front of the existing flow diversion flood gate on the east side of the station which permits certain pumps within the station to pump either directly to Lake Pontchartrain or to divert discharge to N.O.S. & W.B. Pumping Station No. 5. The existing discharge basin walls, from the new fronting protection system to the proposed new swing gate monolith at the Southern Railroad bridge crossing, will be raised to the required elevation of 14.4 N.G.V.D.

Selection of the parallel protection plan alternative would require the preparation of a separate Detailed Design Memorandum, (DDM), for the fronting protection system of this drainage structure.

58. New Orleans Sewerage and Water Board Drainage Pumping Station No. 4. This pumping station is located on the east bank of London Avenue Outfall Canal at Prentiss Avenue. Being situated parallel with the flow of the canal, existing flood protection is provided by the earthen levee and floodwall system of the canal being linked with the foundation and building structure of the station.

Increased flood protection will be provided by constructing a new concrete T-wall with sluice gates, supported by 14" x 14" prestressed concrete piles, immediately in front of the existing discharge basin culverts. The existing discharge culverts will be extended to this new frontal protection system. The centrifugal pump discharge bay at the south end of the structure is to receive a new concrete wall facing against the existing building. This wall is to extend laterally between the walls of the discharge basin and vertically from the top of the existing discharge tubes up to the required elevation of 14.4 NGVD. A frontal protection system will also be provided with sluice gates immediately in front of this discharge basin.

Selection of the parallel protection plan alternative would require the preparation of a separate Detailed Design Memorandum, DDM, for the fronting protection system of this drainage structure.

59. Structural Design. The structural designs presented herein for the parallel protection plan comply with standard engineering practice and criteria set forth in Engineering Manuals and Engineering Technical Letters for civil works construction published by the Office, Chief of Engineers.

a. Structural Steel. The design of steel structures is in accordance with paragraph 52b above.

b. Reinforced Concrete. The design of reinforced concrete structures in in accordance with paragraph 52c above.

60. Design Criteria. The design grade elevations, tabulated below, are based on the still water level (SWL), plus 2 feet of freeboard and 6 inches of projected settlement.

Station Limits		Design Grade
0+00 to 120+08		EL. 14.4
120+42 to 127+15		EL. 14.1
127+85 to 152+50		EL. 14.0
152+50 to 158+50,	Transition from	EL. 14.0 to EL. 18.5, West Side
	Transition from	EL. 14.0 to EL. 18.0, East Side
158+50 to 159+70		EL. 18.5, West Side
		EL. 18.0, East Side

a. I-Wall Steel Sheet Piling. The structure of all steel sheet pile and reinforced concrete for the I-type floodwalls was based on the following cases:

CASE I: Q-Case with water to still water level and a factor of safety, FS = 1.5

CASE II: Q-Case with water to still water level plus 2' of freeboard (top of wall) and a factor of safety, FS=1.0

CASE III: S-Case with water to still water level and a factor of safety, FS=1.2

CASE IV: Water at low pool level with lateral earth pressure, where applicable.

b. T-Wall Monoliths: The pile designs presented herein are based on the use of a pile test and are designed with a factor of safety = 2.0 The following loading conditions were anazlyzed:

CASE I: Static water pressure to SWL, no wind, impervious sheet pile cut-off, no dynamic wave force (100% forces used).

CASE II: Static water pressure to SWL, no wind, pervious sheet pile cut-off, no dynamic wave force (100% forces used).

CASE III: Static water pressure with water level 2 feet above SWL, no wind, impervious sheet pile cutoff, no dynamic wave force (75% forces used)

CASE IV: Static water pressure with water level 2 feet above SWL, no wind, pervious sheet pile cutoff, no dynamic wave force (75% forces used).

CASE V: No water, no wind (100% forces used).

CASE VI: No water, wind from land side (75% forces used).

CASE VII: No water, wind from canal side (75% forces used).

c. Steel Gate Monoliths: The pile designs presented herein are based on the use of a pile test and are designed with a factor of safety = 2.0. The following loading conditions were analyzed:

CASE I: Gate closed, static water pressure to SWL, no wind, impervious sheet pile cutoff, no dynamic wave force (100% forces used).

CASE II: Gate closed, static water pressure to SWL, no wind, pervious sheet pile cutoff, no dynamic wave force (100% forces used).

CASE III: Gate closed, static water pressure with water level 2 feet above SWL, no wind, impervious sheet pile cut-off, no dynamic wave force (75% forces used).

CASE IV: Gate closed, static water pressure with water level 2 feet above SWL, no wind, pervious sheet pile cutoff, no dynamic wave force (75% forces used).

CASE V: Gate open, no wind, truck or train on land side edge of base slab (100% forces used).

CASE VI: Gate open, no wind, truck or train on canal side edge of base slab (100% forces used).

CASE VII: Gate open, wind from land side, truck or train on canal side edge of base slab (75% forces used).

CASE VIII: Gate open, wind from canal side, truck or train on land side edge of base slab (75% forces used).

61. Cathodic Protection and Corrosion Control. Cathodic protection and corrosion control for steel sheet piling, steel gates, corner plates and all other ferrous metal components of the parallel protection plan shall be provided as stated in paragraph 50.

ACCESS ROADS

62. Access Roads Butterfly Valve.

Vehicular access to the project site is available via many public roads. Major thoroughfares which provide access are Lakeshore Drive and Leon C. Simon Blvd. and Pratt Drive traverses the western side of the area. A new access road will be constructed from Pratt Drive to a parking area on the west side of the structure.

METHOD OF CONSTRUCTION
BUTTERFLY VALVE PLAN

63. General. Construction will begin with installation of the cantilever and H-pile braced cofferdams and excavation of the bypass channel. Water within the cofferdam will be pumped out, a dewatering system installed and excavation will proceed to elevation -17.0 NGVD. When the structure and the northwest, southwest and southeast retaining walls are completed, the spur dike, the west closure area, the realigned levee on the west side of the site and the west I-wall will be constructed. The cofferdams will then be removed and the structure flooded. The east closure will then be built up to grade and the east I-wall constructed. A second set of cofferdams and dewatering system will be installed to permit construction of the northeast retaining wall. Finally, the approach channels will be dredged to their final elevations.

RELOCATIONS

64. 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 ...". There are no relocation requirements for the recommended butterfly valve plan.

65. Utility Relocation and Parallel Protection Plan. Included in the plan for the floodwall improvements is the relocation work at certain existing utility crossings along the existing floodwall. Where new steel sheetpiling is to be driven at these utility crossings, the normal procedure is to build a temporary bypass line to maintain the necessary services. After installation of the temporary bypass, the new steel sheetpiling is driven at the proper location and a steel sleeve is installed to allow the permanent utility line to pass through the floodwall. Once the permanent utility pipe is passed through the floodwall, a water tight seal is placed around the pipe and then the temporary bypass pipe line can be disassembled. At less critical utility crossings, the bypass line can be deleted if the existing utility line can be disconnected long enough to allow construction of the new sheet pile floodwall and reconnection of the utility pipeline.

In addition to water mains, sewer force mains and gas transmission trunklines crossing this floodwall, the Sewerage and Water Board's primary electric power transmission cable will require relocation at certain areas. This power cable provides electric power to Drainage Pumping Station Nos. 3 & 4 and must be maintained operable at all times to allow the drainage pump stations to operate. Therefore, before construction commences, a relocated power cable must be installed.

Another major utility line which will be affected is the 10 foot diameter siphon pipeline from Prentiss Avenue west of London Avenue Canal to Pumping Station No. 4 on the east side of the canal. Constructing the new frontal protection system will have to be coordinated closely with the New Orleans Sewerage and Water Board so the siphon tube can be disconnected while the steel sheet piles are driven. Then the tube must be replaced immediately, keeping the shut down time to a minimum. The construction must also take place at a time of the year when the weather conditions will permit. Installing a bypass siphon tube would not be economically feasible.

A summary of the existing utilities requiring relocation is shown in Table 8.

TABLE 8
UTILITY RELOCATION SCHEDULE

Station	Description	Disposition
1+23	48" Dia. Drainage Force Main	Pass Through Floodwall
6+55	Overhead Power Lines	Remain
10+59	Overhead Power Lines	Remain
13+08	12" Dia. Gas Main	Install Temporary Bypass
14+18	12" Dia. Water Main	Install Temporary Bypass
49+88	Pedestrian Foot Bridge	Remains, Construct Pedestrian Gate
69+35	Pedestrian Foot Bridge	Replaced with Sidewalk on Adjacent Bridge
69+44	10" Dia. Gas Main	Install Temporary Bypass
69+46	6" Dia. Gas Main	Install Temporary Bypass
70+40	12" Dia. Water Main	Install Temporary Bypass
84+91	5" Dia. Gas Main	Install Temporary Bypass

TABLE 8
UTILITY RELOCATION SCHEDULE

Station	Description	Disposition
85+00	50" Dia. Water Main	Install Temporary Bypass
85+13	Pedestrian Foot Bridge	Replaced with Sidewalk on Adjacent Bridge
100+60	Overhead Power Lines	Remain
100+66	18-5" Dia. Telephone Conduits	Pass Through Floodwall Sleeve in Sheet piling
101+55	10' Dia. Steel Siphon Tube	Temporary Removal During Sheet pile Installation
101+64	52" Dia. Steel Discharge Tube	Temporary Removal During Sheet pile Installation
119+87	Pedestrian Foot Bridge	Replaced with Sidewalk on Adjacent Bridge
120+49	12" Dia. Water Main	Install Temporary Bypass
121+10	Overhead Power Lines	Remain
0+00 to 100+00	S & WB Primary 25 Cycle Power Cable	Relocate Where Necessary

REAL ESTATE REQUIREMENTS

66. General. All rights-of-way needed to construct the recommended project plan (fronting protection) are currently within the existing Orleans Levee Board right-of-way and/or canal bottoms. However, all of the required right-of-way is not currently being utilized for flood protection. While the acquisition of additional rights-of-way outside of the existing Orleans Levee Board right-of-way will not be required for construction of the recommended plan, 1.0 additional acres of the existing right-of-way must be dedicated for flood protection use. For the parallel protection plan an additional 3.5 acres of Orleans Levee Board property will have to be dedicated to flood protection. For both plans the lands in question are located north of Leon C. Simon Blvd.

AFFECTED ENVIRONMENT

67. Biological. Vegetation on the flood side of the protection consists of shrub habitat with baccharis, giant ragweed, mulberry and elderberry predominating. The levee is kept mowed and is covered with annual and perennial grasses and weeds. Because of high incidence of human disturbance, the area provides marginal habitat for rabbits, small

rodents, and birds. Some use of shrubs and trees by squirrels and songbirds occurs. Least terns and seagulls are commonly seen feeding on the canal.

Water quality in the London Avenue Outfall Canal is generally poor; therefore, the canal has minimal value as habitat for fishery resources. Contaminants frequently found in the stormwater effluent are organic chemical and heavy metals, both of which accumulate in the sediments, and through bioaccumulation cause varying degrees of toxcity or sublethal effects to the organisms. Environmental Protection Agency criteria for propogation of fish and wildlife were consistently exceeded for dissolved oxygen, copper, iron, barium, zinc, cadmium, and phenol. Nickel, mercury, cyanide, arsenic, lead, PH, suspended solids, and oil and grease concentrations also frequently exceeded recommended levels (England et al. 1979). Some fishery use of the canal exists, mainly mullet and gar. Due to the poor water quality, the benthos of the canal is limited to worms, blue crabs, clams, and gatropods. The benthic community is more diverse near the lake. Most benthic species in the area are tolerant of prolonged periods of low dissolved oxygen and are not the benthics primarily utilized as fish food organisms by economic and commercially important fish species.

68. Endangered Species. No threatened or endangered species or their critical habitat are found in the project area.

69. Recreation. Some recreational opportunities exist in the vicinity. The levee is used by joggers, walkers, bird watchers, and fishermen, especially north of Robert E. Lee Blvd. Very little bank fishing occurs along the canal south of Robert E. Lee Blvd. due to the location of floodwalls that restrict pedestrian access. Some limited fishing, crabbing, and pleasure-boating takes place between Robert E. Lee Blvd. and the lake. The New Orleans Recreation Department operates the adjacent Pratt Park on the west side of the canal which provides areas for field sports, picnicking and similar activities. A park like area adjacent to the University of New Orleans on the east side is utilized by students and public alike for walking, relaxation and studying.

70. Esthetics. Within the project reach between Robert E. Lee Blvd. and Pumping Station No. 3 positive esthetic conditions are limited. A parallel floodwall in need of painting and refurbishment currently exists in this area. This area is not regularly maintained and voluntary growth of various vegetation is evident. However, positive esthetic conditions exist on both sides of the canal north of Robert E. Lee Blvd. This open grass west of the canal has scattered oaks and oleanders and is well maintained, contributing to positive esthetic conditions experienced by students of the university and visiting general public.

71. Cultural. The project area includes an existing levee corridor on post-1930 reclaimed land and the artificial channel of the London Avenue Outfall Canal. No cultural resources are recorded in the vicinity of the work.

72. Noise. Background noise levels for the project area are approximated to range from 70 dBA in the project reaches, located in residential areas south of Robert E. Lee Blvd., to 50 dBA in the quieter park-like residential areas north of Robert E. Lee Blvd. to the lakefront.

73. Community Cohesion. The residents of Orleans Parish are in favor of protection provided by the hurricane protection project and have voted for a bond issue that assists in funding the work.

ENVIRONMENTAL EFFECTS

74. Biological Impacts.

a. Butterfly Valve Alternative. Placement of this structure and associated abutment work would result in the loss of 2.2 acres of marginal benthic habitat associated with the canal bottom. An additional 1.4 acres of benthic habitat would be temporarily removed from production due to excavation associated with the fore and aft bay areas on either side of the structure.

Turbidities associated with the fill placement would result in temporary reductions in primary production. Water quality within the project area would be adversely affected due to increase in turbidity, reductions in dissolved oxygen, and resuspension of contaminated sediments in the water column. There would be only minimal temporary interference with normal canal/lake interchange during the period of construction. Various estuarine fish species inhabiting this aquatic environment have the mobility to avoid the direct adverse impacts; however, the localized benthic and planktonic food supplies would be temporarily reduced.

Secondary, indirect impacts may result near the canal mouth and adjacent nearshore waters of Lake Pontchartrain.

Terrestrial impacts associated with the alternative would involve the temporary disturbance of six acres of existing levee. The fringe of roseau cane would also be impacted but would probably revegetate once construction is complete. The impacted area provides low wildlife usage. Five small oaks and six oleander shrubs would be removed which would have minimal impact on wildlife until their replacement plants mature. Oaks would be replaced three for one and oleanders one for one.

Placement and handling of any contaminated dredged material from the canal bottom could cause potential sources of pollution if not contained in a properly secured site.

b. Parallel Protection Alternative. All work south of Leon C. Simon Blvd. would be within existing rights-of-way. Approximately 29 acres of low value wildlife habitat would be temporarily impacted by degrading, earth moving, and shaping operations. If an earthen levee is chosen north of Leon C. Simon Blvd., 16 young oaks and 26 oleanders would be removed. Replacement would be as described above. If a floodwall is built, no trees or shrubs would be impacted, only existing right-of-way would be affected.

Temporary displacement of habitat for songbirds and tree-dwelling animals would occur in association with tree removal. Habitat in the immature trees would be of moderate value only for some species. This impact would be short term and would be minor due to the small numbers of trees impacted. In the long term, habitat for tree dwellers would be increased.

In addition, some of the stands of roseau cane and the associated fishery habitat would be affected by degrading and upgrading the existing levee. Runoff during construction would slightly increase turbidity in the canal as well as the amount of airborne dust in the project area. Once the levee became vegetated, this impact would be eliminated.

75. Endangered Species. There would no impact on endangered species under either alternative.

76. Recreation.

a. Butterfly Valve Alternative. Construction of the cofferdam and the structure would interrupt the fishing and crabbing activities that occur at the mouth of the canal. Noise during construction would temporarily disrupt the minimal bird-watching activities that occur at present. With the butterfly valve in place, boat access within the canal south of the structure would be blocked. This is not considered detrimental due to minimal use of the canal for boating. Essentially, the completed structure would have no overall impact on recreation use in the canal. However, floodwalls placed within the center at the existing levees (east and west) will restrict both visual and physical access to the water's edge from the structure to the lake. Activities dependent upon water access will be eliminated in this area.

b. Parallel Protection Alternative. During construction all recreation in the work area will cease. Minimal impacts would occur within the reach between Robert E. Lee Blvd. and Pumping Station No. 3 due to limited use. Impacts north of Robert E. Lee Blvd. would be more severe because of heavier use. However, once built, the levee would then support recreational activities similar to those occurring now, although on a levee 3 to 4 feet higher than the present levee. If a floodwall is built in the crown of the existing levee, no additional right-of-way would be needed; therefore, no tree loss would occur. However, placement of a floodwall in the levee would restrict pedestrian access to the water's edge and impact recreational crabbing and fishing activities. No impact would occur to Pratt Park.

77. Esthetics.

a. Butterfly Valve Alternative. Initial construction would result in increasing levels of noise and dust in the area of work. It is anticipated that less than 20 trees and shrubs will be removed as a result of the base levee re-shaping. Vegetation lost during construction will be replaced upon completion of earth work. The visual environment north of Robert E. Lee Blvd. will experience negative impacts due to the placement of a floodwall within the center of the existing levee. The open park-like atmosphere in this area, having long undisturbed vistas and access to the water's edge will be negatively impacted. Development of a floodwall will restrict pedestrian use of the shoreline in an area where neighborhood use is high. Recreationalist such as bikers, joggers, and casual walkers will experience blocked views toward the water on both the east and west side of the canal.

This wall could be esthetically unattractive if measures are not implemented to soften visual impacts. Surface treatment, such as exposed aggregate, textures and/or earth tone paint should be used to minimized and partially mitigate adverse visual impacts.

b. Parallel Protection Alternative Impacts. Increasing the height of protection would cause impacts to the esthetic environment. If an earthen levee is built, 16 oaks and 26 oleander shrubs would be removed but, these trees will be replaced upon completion of the earth work. If a new floodwall is constructed within the levee crown north of Robert E. Lee Blvd., a visual and physical barrier would be created in an area that traditionally has been a green space. This wall is esthetically unattractive if measures are not implemented to soften visual impacts. Surface treatment, such as exposed aggregate, three dimensional features, and earth-tone paint, could be implemented to minimize and partially mitigate adverse visual impacts. No trees would be impacted if a floodwall is built in this area.

78. Cultural.

a. Butterfly Valve Alternative Impacts. No impacts to significant cultural resources are anticipated, and no cultural surveys are warranted.

b. Parallel Protection Alternative Impacts. No impacts on significant cultural resources are anticipated and no cultural resource surveys are warranted.

79. Noise.

a. Butterfly Valve Alternative. Pile driving would create the largest source of noise during construction. The exposure levels would range from 95-105 dBA in the areas immediately adjacent to the construction site. This level of noise would be noncontinuous for approximately 108, 10-hour days. This level of noise intrusion would interfere with passive recreation such as pleasure walking, picnicking, bird watching, etc. In addition, some interference with oral communication could be expected near the construction site.

There are no residences within the primary noise impact zone, extending up to 400 feet from the construction site of the butterfly valve structure. Approximately 23 homes are located within 200-400 feet of the floodwall construction and adjoining levees. The homes could experience 77-83 dBA noise exposure levels for approximately 42 days. These would be exterior noise levels. Interior noise exposure should be less. Vibrations resulting from the pile driving operation that would affect approximately 20 residences located 200-400 feet from the source, should be minimal. While these vibrations could be annoying to inhabitants of these residences, the potential for vibration-induced structural damage should be minimal.

b. Parallel Protection. This method of construction would result in increases in noise levels produced from degrading and upgrading existing levees and floodwalls. The noise levels expected would range from 95-105 dBA when measured 50 feet from the center of the noise source. Approximately 66 residences would be exposed to this level of noise. Another 225 homes would be exposed to 77-89 decibels. In addition, 166 residences would be exposed to 77-95 dBA, while 483 homes would be exposed to 77-83 dBA noise levels. Ambient noise level for the area is 50-70 dBA.

Construction workers would have to use protective hearing devices. Since construction would take place during daylight hours, sleep interference should occur only for napping children and day sleepers. Noise mainly affects bodily functions (hearing rate, respiratory volume, digestive secretions, hormonal secretions, etc.). If prolonged, the construction noise levels could produce significant physiological damage; however, the relatively short duration of the noise should prevent such problems from occurring. The noise above 63 dBA could be annoying to inhabitants of the 457 residences within 200 feet of the actual work site. During the time the noise was higher than 85 dBA, it would be difficult to hold a conversation within the impacted house and recreational areas.

During construction, the noise levels would increase a maximum of 35-45 dBA above ambient levels. This level of increase is not expected to significantly interfere with residential activity since most of the work would be done during daylight hours and exposure levels inside the homes would be further reduced.

80. Community Cohesion

a. Butterfly Valve Alternative Impacts. This alternative would provide the necessary flood protection. Disruption in localized traffic patterns would be sporadic and of fairly short duration. Initial movement of equipment onto and off the site would account for the major portion of the traffic increase. Some occasional heavy traffic would be encountered when fill material is truck-transported to the site and when dredged material is being transported off site. Since fill requirements are minimal, traffic patterns should be normal during the majority of the construction.

b. Parallel Protection Alternative Impacts. This alternative would provide the necessary flood protection. Disruption in traffic patterns and increase in truck traffic on residential streets would be much greater with this alternative due to the fill requirements and widespread use of pile-driving equipment. Increased levels of noise would be expected during the entire 2-year construction period at varying points along the canal from the lakefront to Interstate 610. This construction method is not localized to a specific area like the construction methods associated with the butterfly valve.

COMPLIANCE WITH ENVIRONMENTAL LAWS

81. Compliance with Environmental Laws. An Environmental Assessment and signed Finding of No Significant Impacts, FONSI, has been prepared and circulated for public comment. Compliance with the Endangered Species Act has been achieved. Cultural compliance has been achieved. A Section 404(b)(1) evaluation and a CZM Consistency Determination will be required. These documents will be prepared and coordinated during preparation of the Detailed Design Memorandum for the Butterfly Value Plan.

COORDINATION WITH OTHER AGENCIES

82. 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 Board has provided the local cooperation for this feature of the hurricane protection project. The project plan has been explained to the engineering staff and representatives of the Levee Board. 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 coordination required for input to the Draft Supplemental Environmental Impact Statement (DSEIS) of the Lake Pontchartrain project as a whole. The Environmental Assessment (EA) for work on the London Avenue Outfall Canal was provided to the Public in Oct 1988. A copy of the EA and the finding of no significant impacts (FONSI) is contained in Appendix C, Volume 2 of this report. Also contained in Appendix C, Volume 2 is a copy of the Fish and Wildlife Coordinations Act Report Supplement.

ALTERNATIVE PLAN CONSIDERED

83. General. The two major alternatives that exist for London Avenue Canal are Fronting Protection and the Parallel Protection. Both plans have previously been described in detail in earlier sections of this report.

a. Parallel Protection: The parallel protection plan includes floodwall along each bank of the London Avenue Canal from the Lakefront to Pumping Station No. 3. For the seven bridges with road approaches and decks below the design grades, five of the bridges for this plan would be flood proofed. The remaining two would be designed to have road gates at each side of the bridge approach. Fronting protection and/or modification to Pumping Station No. 3 and Pumping Station No. 4 is also necessary for the parallel protection plan. Table 9 gives a summary of estimated cost for the parallel protection plan.

b. Fronting Protection. DM No. 19, Orleans Avenue Outfall Canal Discuss in some detail the full range of other gates i.e. vertical lift, sector, etc. that could be used in lieu of the butterfly valve type of gate. Each of these gates types have unacceptable operational requirements that make their use undesirable for the outfall Canals. Specifically the lead time necessary to safely operate the more conventional gates would necessitate stoppage of the pumping stations pumps to close the gates well in advance of the hurricane highest winds. This is unacceptable to the New Orleans Sewerage and Water Board, the agency responsible for operating the pumping stations.

c. Other Plans. Other plans that would satisfy project objective included: gravity drainage structures with supplemental pumping at lakefront; U-shaped reinforced concrete channel; and total replacement of existing pumping stations and construction of a new station near the lakefront. All of the plans were dropped because of excessive costs.

TABLE 9
LONDON AVENUE CANAL
SUMMARY OF ESTIMATED COST
PARALLEL PROTECTION PLAN
(Oct 88 Price Levels)

Cost Acct. No.	Item	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
					$	$
11	1	Mob & Demob	Lump Sum	L.S.		150,000
	2	Reinforced Concrete I-Wall	15,440	C.Y.	350.00	5,404,000
	3	Reinforced Concrete T-Wall				
		a. Stem	2,916	C.Y.	350.00	1,020,600
		b. Slab	4,356	C.Y.	200.00	871,200
	4	Steel Sheet Piling				
		a. PZ-22	473,111	S.F.	12.00	5,677,332
		b. Drive Existing PZ-27	47,250	S.F.		25,000
	5	12" x 53 Steel H-Piles	188,160	L.F.	21.00	3,951,360
	6	Benefit Street Gate (2 Req'd)	2	EA.	90,000.00	180,000
	7	Southern R/R Gate (2 Req'd)	2	EA.	77,500.00	155,000
	8	Railroad Falsework (2 Req'd)	2	EA.	25,000.00	50,000
	9	Pedestrian Gate (2 Req'd)	2	EA.	10,000.00	20,000
	10	N. O. S&WB D.P.S. #3	Lump Sum	L.S.		2,300,000
	11	N. O. S&WB D.P.S. #4	Lump Sum	L.S.		1,500,000
	12	Bridge Modifications				
		a. Gentilly Blvd.	Lump Sum	L.S.		950,000
		b. Mirabeau Ave.	Lump Sum	L.S.		600,000
		c. Filmore Ave.	Lump Sum	L.S.		575,000
		d. Robert E. Lee Blvd.	Lump Sum	L.S.		800,000
		e. Leon C. Simon Blvd.	Lump Sum	L.S.		675,000
	13	Inspection Trench	25,100	L.F.	8.00	200,800
	14	Pedestrian Bridge Demolition	3	L.S.	30,000.00	90,000
	15	Existing Floodwall Demolition	Lump Sum	L.S.		575,000
	16	Structural Excavation	25,580	C.Y.	2.50	63,958
	17	Structural Backfill	15,785	C.Y.	5.00	78,925
	18	Riprap	6,169	Tons	20.00	123,380
	19	Filter Fabric	15,006	S.Y.	4.00	60,024
	20	Semi-Compacted Clay Fill	40,128	C.Y.	10.00	401,280
02	21	Utility Modifications	Lump Sum	L.S.		325,000
			SUBTOTAL			$26,822,859
			25% CONTINGENCIES			6,705,715
			TOTAL, CONSTRUCTION (R)			$33,529,000
01	22	Lands & Damages I.D. Number 80915				2,861,000
30		Engineering & Design (12%±)				4,023,000
31		Supervision and Administration (10%±)				3,353,000
			TOTAL COST (R)			$43,800,000

84. Plan Selection. The task of providing hurricane protection for the outfall canals present some unique problems. On the one hand, the highly urbanized area to be protected is low-lying and must depend on the pumping stations for storm drainage for all rainfall events. On the other hand, hurricane protection demands full closure of the lakefront side of the canal during the standard project hurricane event. In the process of plan formulation, practically all conceivable alternatives were considered. Fronting protection which is designed to accommodate interior drainage, fully meets the mandate of the Project Authorization. With the line of hurricane protection established at or near the lakefront, the levees on the protected side of the structure are considered to be interior drainage features. Any existing limitations which the interior drainage system currently has will not be affected with construction of the proposed fronting protection. The limitations referred to here concern the capability of the Pumping Stations numbers 3 and 4 to pump against high lake stages, i.e. reduce pump efficiency, and inadequate freeboard of the existing lateral levees. Sewerage and Water Board of New Orleans has indicated to the New Orleans District that one of their long range goals is to achieve a pumping capacity, capable of evacuating a 5 inch - 5 hour rainfall. This approximates a 3 year rainfall event for the New Orleans area. Also, this pumping objective is for a normal lake stage and not for a SPH event which has a recurrence interval of about once in 300 years. The management of storm drainage is entirely SWBNO's responsibility. Consequently the focus of plan formulation process was centered around alternatives which appear cost-effective from a hurricane protection standpoint while offering optimum physical conditions for an efficient operation of the existing pumping station during hurricane event. Development of such an alternative became more desirable when SWBNO expressed its strong opposition to any plan which calls for establishing a pre-agreed set of conditions for gate closure.

Based on the given set of constraints and associated costs, all alternatives involving channel or pumping station improvements become relatively less feasible. The project plan detailed in Section 44 best meets the objectives of flood protection for the Orleans Avenue Outfall Canal.

85. Need for Further Investigations. The concept of the butterfly control valve-type gated structure, as recommended in the project plan, was model-tested at the Waterways Experiment Station at Vicksburg, Mississippi. A 1:20 scale physical model of the London Avenue Outfall Canal was built and channel geometry modified to achieve acceptable hydraulic performance. It was observed that a uniform approach flow was necessary for the flow-induced opening and closing of the gates. The designed gates performed satisfactory under the anticipated flow conditions. A 1:10 Sectional model is necessary to validate the torque forces required for the detailed design in sizing various components of the structure, as well as to ascertain the reliability of the flow-induced opening and closing operations under a wide range of hydraulic conditions.

ESTIMATE OF COST

86. General. Based on October 1988 price levels, the estimate first cost for constructing the London Avenue Outfall Canal Butterfly Valve Control Structure plan is $15,100,000. A cost of $10,600,000 is for the levees and floodwalls feature lands and damages are estimated to be $1,243,000. Engineering and Design and Supervisions and Administration are estimated to be $1,560,000 and $1,680,000. These costs also include such cost for inhouse work to prepare this report and prior reports. Table 10 presents the itemized first cost for the butterfly control valve plan.

TABLE 10
LONDON AVENUE CANAL
ESTIMATED COST
BUTTERFLY VALVE PLAN
(Oct 88 Price Levels)

Cost Acct. No.	Item	Description	Estimated Quantity	Unit	Unit Price $	Estimated Amount $
11	1	STEEL BUTTERFLY GATES				
		a. Structure Steel	313,600	LB.	2.00	627,200.00
		b. Miscellaneous Metal	32,000	LB.	1.50	48,000.00
		c. Mechanical	Lump Sum	L.S.	500,000.00	500,000.00
		d. Electrical	Lump Sum	L.S.	400,000.00	400,000.00
	2	COFFERDAM 1				
		a. Sheetpiling - PZ-27	32,830	S.F.	12.50	410,375.00
		b. Piling - HP 14 x 73	23,750	L.F.	24.00	570,000.00
		c. Waler - W 10 x 22	550	L.F.	33.00	18,150.00
		d. Removal	Lump Sum	L.S.	85,000.00	85,000.00
	3	COFFERDAM 2				
		a. Sheetpiling - PZ-27	7,110	S.F.	12.50	88,875.00
		b. Piling - HP 14 x 73	6,650	L.F.	24.00	159,600.00
		c. Waler W 10 x 22	150	L.F.	33.00	4,950.00
		d. Removal	Lump Sum	L.S.	21,600.00	21,600.00
	4	APPROACH APRONS				
		a. Sheetpiling - PMA 22	6,500	S.F.	11.50	74,750.00
		b. Reinforced Concrete Slab	1,500	C.Y.	200.00	300,000.00
		c. Reinforced Concrete Wall	160	C.Y.	350.00	56,000.00
		d. Stabilization Slab	165	C.Y.	70.00	11,550.00
		e. Concrete Piles - 12" x 12"	4,500	L.F.	16.00	72,000.00
		f. Drainage System - Sand	240	C.Y.	16.00	3,840.00
		g. Drainage System - Filter B	700	C.Y.	8.00	5,600.00
		h. Drainage System - 6" D.I. Pipe	525	L.F.	20.00	10,500.00
	5	EROSION PROTECTION				
		a. Riprap	3,100	TON	20.00	62,000.00
		b. Shell Bedding	750	C.Y.	20.00	15,000.00
	6	CHANNEL EXCAVATION				
		a. Main Channel	60,000	C.Y.	1.75	105,000.00
		b. Bypass Channel	6,250	C.Y.	1.75	10,937.50
	7	RETAINING WALLS				
		a. Concrete Piles - 12" x 12"	20,545	L.F.	16.00	328,720.00
		b. Reinforced Concrete - Walls	635	C.Y.	350.00	222,250.00
		c. Reinforced Concrete - Slab	650	C.Y.	200.00	130,000.00
		d. Stabilization Slab	75	C.Y.	70.00	5,250.00
		e. Sheetpiling - PMA 22	5,500	S.F.	11.50	63,250.00

TABLE 10(cont'd)
LONDON AVENUE CANAL
ESTIMATED COST
BUTTERFLY VALVE PLAN

Cost Acct. No.	Item	Description	Estimated Quantity	Unit	Unit Price $	Estimated Amount $
11	8	PILE TEST	2	EA.	16,000.00	32,000.00
	9	DEWATERING 1	Lump Sum	L.S.	400,000.00	400,000.00
	10	DEWATERING 2	Lump Sum	L.S.	80,000.00	80,000.00
	11	MOBILIZATION AND DEMOBILIZATION	Lump Sum	L.S.	70,000.00	70,000.00
	12	EAST FLOODWALL				
		a. Sheetpiling - PZ 22	18,000	S.F.	11.50	207,000.00
		b. Sheetpiling - PZ 35	6,500	S.F.	18.00	117,000.00
		c. Reinforced Concrete	1,250	C.Y.	350.00	437,500.00
	13	WEST FLOODWALL				
		a. Sheetpiling - PZ 22	38,000	S.F.	11.50	437,000.00
		b. Sheetpiling - PZ 35	2,500	S.F.	18.00	45,000.00
		c. Reinforced Concrete	1,300	C.Y.	350.00	455,000.00
	14	EARTHWORK				
		a. Degrade Levee	10,000	C.Y.	1.25	12,500.00
		b. New Realined Levee	4,300	C.Y.	2.00	8,600.00
		c. Spur Dike	7,000	C.Y.	11.00	77,000.00
		d. Structure Excavation	28,000	C.Y.	2.25	63,000.00
		e. Backfill - Sand	1,850	C.Y.	16.00	29,600.00
		f. Backfill - Compacted Clay	2,252	C.Y.	11.00	24,772.00
		g. Clear & Grubb	3	ACRE	1,500.00	4,500.00
		h. Fertilize & Seed	3	ACRE	500.00	1,500.00
		i. Degrade East Levee	3,000	C.Y.	1.25	3,750.00
		j. Degrade West Levee	1,700	C.Y.	1.25	2,125.00
	15	CONTROL STRUCTURE				
		a. Reinforced Concrete Slab	1,421	C.Y.	200.00	284,200.00
		b. Reinforced Concrete Wall	880	C.Y.	350.00	308,000.00
		c. Machinery Room	600	C.Y.	300.00	180,000.00
		d. Concrete Piles 12" x 12"	42,000	L.F.	16.00	672,000.00
		e. Sheetpiling - PMA 22	4,920	S.F.	11.50	56,580.00
		f. Stabilization Slab	135	C.Y.	70.00	9,450.00
		g. Dewatering Bulkheads Sheetpiling PZ 27	1,050	S.F.	12.50	13,125.00
		h. Needle Girders - W 24 x 131	62	L.F.	40.00	2,480.00
		i. Needle Girders - W 16 x 67	62	L.F.	24.00	1,488.00

TABLE 10(cont'd)
LONDON AVENUE CANAL
ESTIMATED COST
BUTTERFLY VALVE PLAN

Cost Acct. No.	Item	Description	Estimated Quantity	Unit	Unit Price $	Estimated Amount $
11	16	ACCESS ROAD AND PARKING				
		a. Concrete	150	C.Y.	200.00	30,000.00
		b. Shell	225	C.Y.	20.00	4,500.00
			SUBTOTAL			$8,480,000.00
			25% CONTINGENCIES			$2,120,000.00
			SUBTOTAL, CONSTRUCTION			$10,600,000.00
01	17	LAND & DAMAGES I.D. #81104	1.52	ACRE		1,243,000.00
30		ENGINEERING & DESIGN (12%±)				1,310,000.00
		WES MODEL STUDY				250,000.00
		TOTAL				1,560,000.00
31		SUPERVISION AND ADMINISTRATION (10%±)				1,680,000.00
			TOTAL COST (R)			$15,100,000.00

87. Schedule for Design and Construction. The sequence for design and construction contract are listed as follows:

TABLE 11

SCHEDULE FOR DESIGN AND CONSTRUCTION

ACTIVITY	DESIGN START	DESIGN COMPLETE	CONSTRUCTION ADVER.	CONSTRUCTION AWARD	CONSTRUCTION COMPLETE	ESTIMATED COSTS $
WES TEST	Feb 89	June 89	----	----	-----	270,000
DDM	June 89	Jan 91	----	----	-----	500,000
P&S	Aug 90	Sep 91	----	----	-----	350,000
CONSTRUCTION CONTRACT			Nov 91	Jan 92	Jan 95	12,100,000 1/

1/ This cost includes contingencies, Federal and Non-Federal Construction Costs, Federal and Non-Federal Supervision and Inspection (S&I) Costs. (S&I Costs constitute 90% of the Supervision and administration Costs).

88. Comparison of Estimates. The current estimate of $15,100,000 for the high level plan London Avenue Outfall Canal represents a decrease of $21,600,000 when compared to the current PB-3 estimate. The largest part of the decrease in cost is in the estimated cost for levees and floodwalls. This reduction in cost is primarily due to a refinement of the designs from a survey scope to a GDM scope which includes cost savings achieved by changing from a cellular type cofferdam to a braced-wall type cofferdam. The PB-3 plan was based on fronting protection using a more conventional gate design and higher contingencies. The estimated cost for engineering and design contained in this GDM is based on estimates of cost needed to complete designs for the butterfly valve plan. It includes sunk cost; cost for model test; DDM cost; and P&S preparation costs. The estimate for supervision and administration cost is also based on the estimated cost to accomplish supervision and inspection during construction with an additional 10 percent added for district overhead support plus prior sunk cost.

TABLE 12
COMPARISON OF ESTIMATES
(Incremental Costs)

Feature Feature	PB-3 (Eff. Oct 88)	GDM	Difference GDM & PB-3
	($)	($)	($)
11 Levees & Floodwalls	30,112,000	10,600,000	-19,512,000
30 Engineering & Design	3,610,000	1,560,000	- 2,050,000
31 Supervision & Administration	3,010,000	1,680,000	- 1,350,000
01 Lands & Damages	---	1,243,000	+ 1,243,000
TOTAL PROJECT COST (R)	$36,700,000	15,100,000	-21,600,000

89. Federal and Non-Federal Cost Breakdown. The breakdown of Federal and non-Federal costs needed to construct the butterfly valve plan described in the GDM is shown in Table 13 below:

TABLE 13
FEDERAL AND NON-FEDERAL COST BREAKDOWN
OCT 88 PRICE LEVELS

Item	Federal	Non-Federal	Total
	($)	($)	($)
Fronting Protection & Levees	10,570,000	4,530,000	15,100,000

OPERATION AND MAINTENANCE

90. General. The London Avenue Outfall Canal butterfly control valve plan would be operated at the expense of the local interests. The estimate of the annual operation and maintenance costs for the control structure and appurtenant levees and floodwalls which are detailed in the GDM are as follows:

Maintenance & replacement of machinery	$ 9,600
Three-time major replacement of gates @ 30 year interval	$10,800
TOTAL ANNUALIZED COST	$20,400

ECONOMICS

91. 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 1981 price levels, and the project interest rate of 3 1/8 percent, the benefit-cost ratio for the project as a whole was 4.2 to 1. The project is currently under construction and a remaining benefit-remaining cost ratio at the project interest rate is 9.9 to 1 and at the current Federal discount rate is 5.0 to 1. The Reevaluation Study also broke out separable project areas (SPA) for incremental justification. The London Avenue Outfall Canal reach is a part of the New Orleans-Jefferson SPA. The computed benefit-cost ratio for the New Orleans-Jefferson area was 5.0 to 1 in the 1984 Reevaluation Study. Updating this SPA for price levels and interest rates produced a remaining benefit to remaining cost ratio of 6.0 to 1 at the project interest rate and 1.6 to 1 at the current Federal interest rate.

92. Funds Required by Fiscal Year. To maintain the schedule for design and construction of the London Avenue Butterfly control valve plan total Federal and non-Federal funding required by fiscal year are tabulated as follows:

TABLE 14

TOTAL FEDERAL AND NON-FEDERAL 1/
FUNDING BY FISCAL YEAR

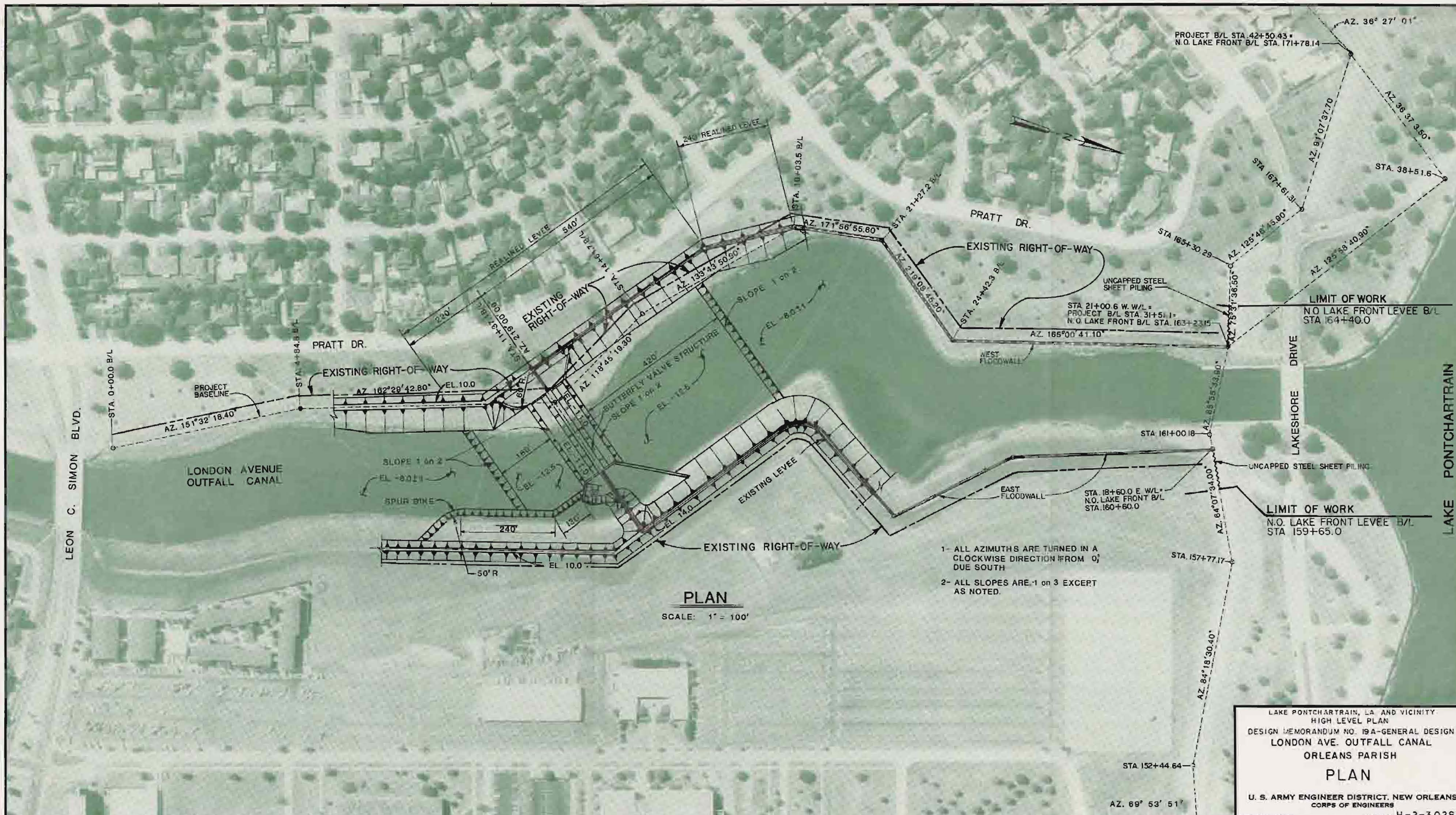
Sunk Funds Thru	FY 88	$ 574,000
	FY 89	$ 385,000
	FY 90	$ 425,000
	FY 91	$ 250,000
	FY 92	$5,523,000
	FY 93	$4,489,000
	FY 94	$2,194,000

1/ Does not include estimate cost for real estate acquisitions (1,243,000)

RECOMMENDATIONS

93. Recommendations. The plan of improvement recommended herein calls for fronting protection employing the butterfly control valve type of gate. This plan fully satisfies the projects mandate to provide protection against hurricane generated tidal surges and yet provides the maximum latitude for operation of local interest interior drainage. The butterfly control valve plan has been shown to be the least costly fully responsive plan. When compared to the parallel protection plan it is approximately three times less costly. From the design details and cost information presented herein, it is recommended that this GDM be approved as the basis for preparing a Detailed Design Memorandum, DDM, for the butterfly control valve structure in the London Avenue Outfall Canal.


LAKE PONTCHARTRAIN
LAKESHORE DR.
ROBERT E. LEE BLVD.
UNIVERSITY OF NEW ORLEANS
PLATE 2
BONNABEL BLVD.
METAIRIE RELIEF OUTFALL CANAL
PONTCHARTRAIN BLVD.
WEST END BLVD.
FILMORE AVE.
CANAL BLVD.
HARRISON AVE.
ORLEANS AVE. OUTFALL CANAL
MARCONI DR.
CITY PARK
BAYOU ST. JOHN
WISNER BLVD.
LONDON AVE. OUTFALL CANAL
ELYSIAN FIELDS AVE.
FRANKLIN AVE.
VETERANS MEMORIAL HWY.
10
610
90
JEFFERSON PARISH
ORLEANS PARISH
METAIRIE RD.
New Orleans
DILLARD UNIVERSITY
ARKANSAS
LOUISIANA
MISSISSIPPI
TEXAS
LOCATION OF WORK
GULF OF MEXICO
VICINITY MAP
N
INDEX MAP
SCALE IN FEET
4000 0 4000 8000 12000
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A
GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
INDEX AND VICINITY MAP
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989
FILE NO. H-2-30288

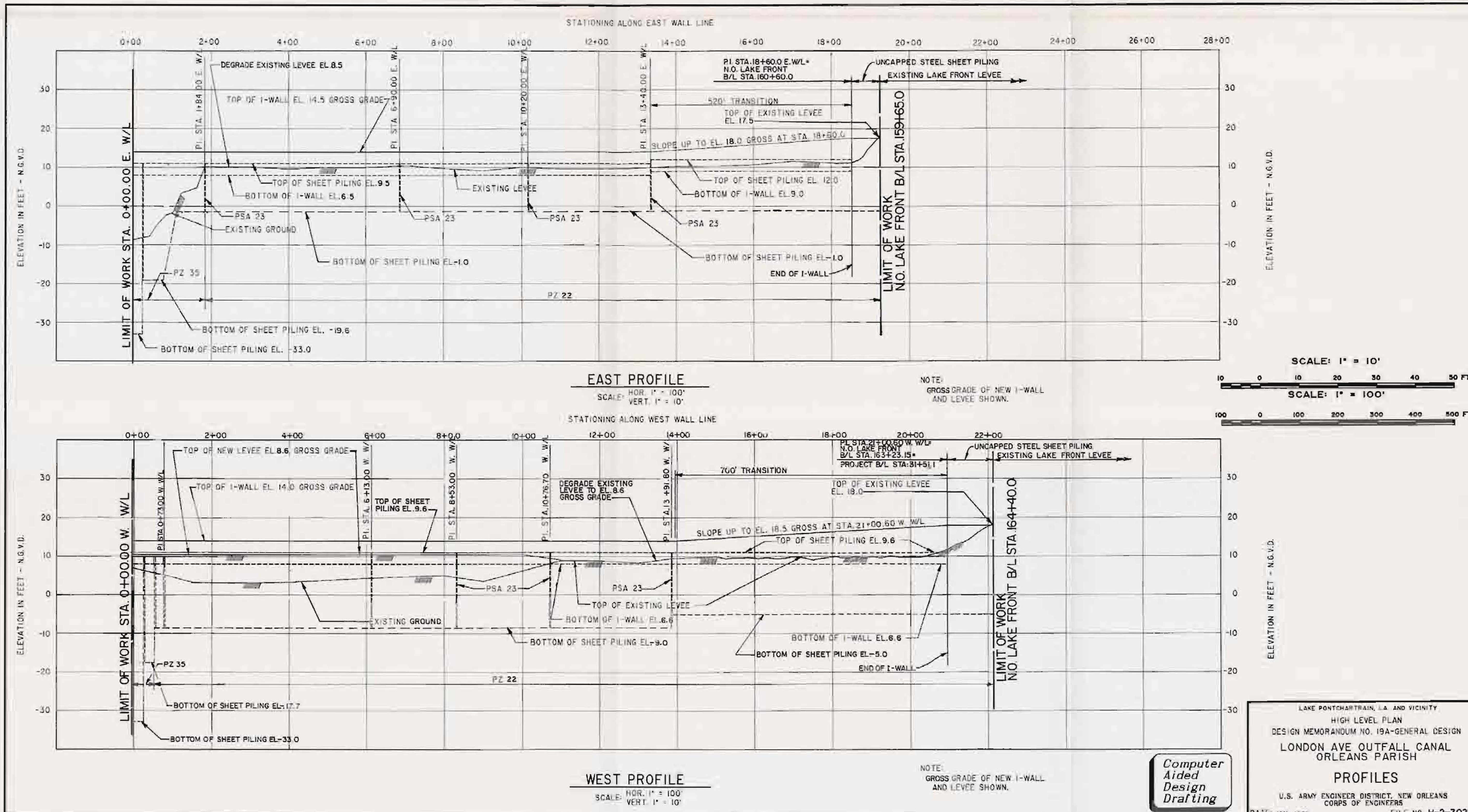


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PLAN

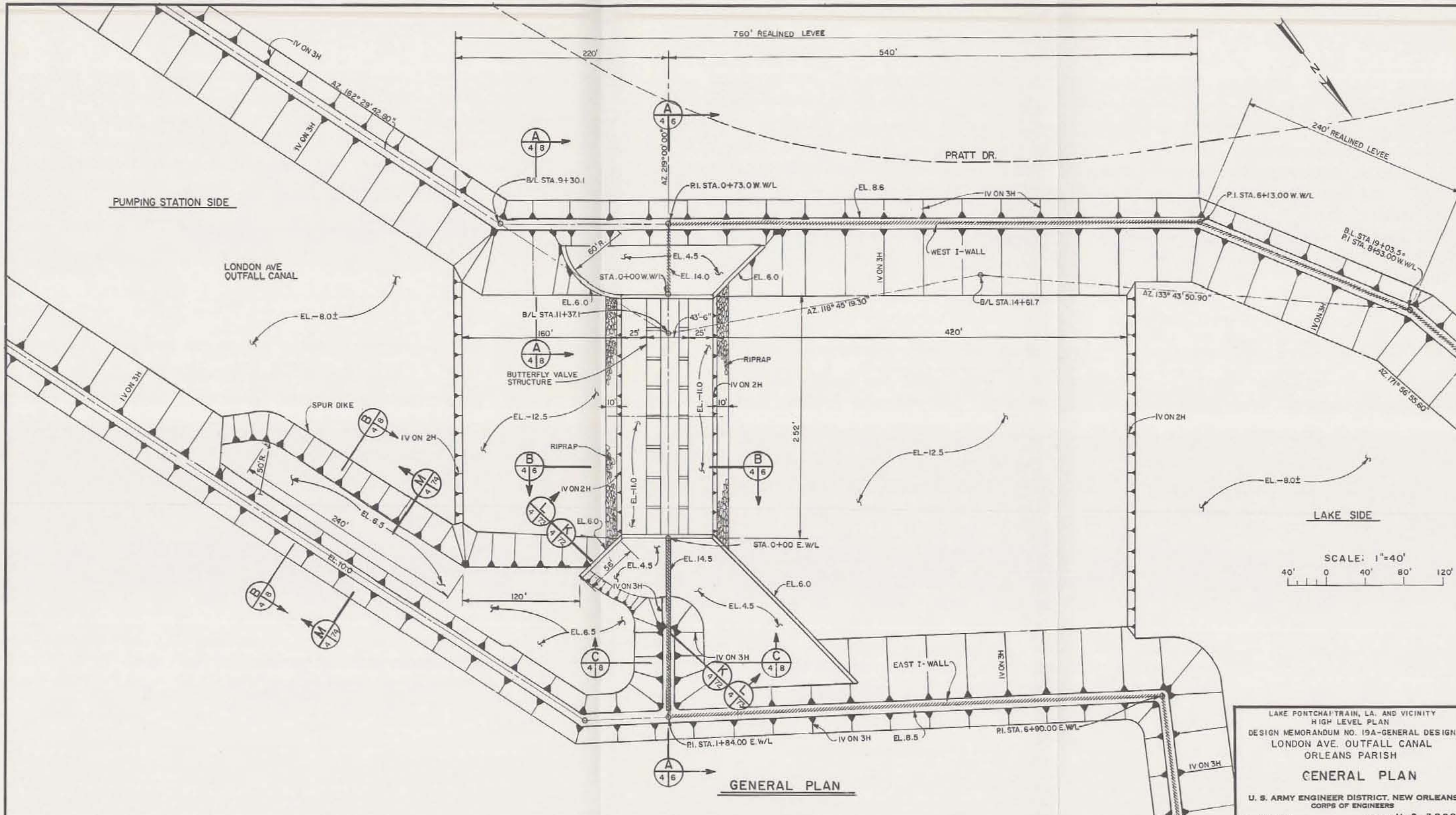
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE JAN. 1989 FILE NO. H-2-30268



STATIONING ALONG EAST WALL LINE
EAST PROFILE
SCALE: HOR. 1" = 100' VERT. 1" = 10'
LIMIT OF WORK STA. 0+00.00 E. W/L
DEGRADE EXISTING LEVEE EL 8.5
TOP OF I-WALL EL. 14.5 GROSS GRADE
TOP OF SHEET PILING EL.9.5
BOTTOM OF I-WALL EL.6.5
PSA 23
EXISTING GROUND
EXISTING LEVEE
BOTTOM OF SHEET PILING EL-1.0
PZ 35
PZ 22
BOTTOM OF SHEET PILING EL. -19.6
BOTTOM OF SHEET PILING EL. -33.0
P.I. STA.18+60.0 E.W/L= N.O. LAKE FRONT B/L STA.160+60.0
UNCAPPED STEEL SHEET PILING
EXISTING LAKE FRONT LEVEE
520' TRANSITION
TOP OF EXISTING LEVEE EL. 17.5
SLOPE UP TO EL. 18.0 GROSS AT STA. 18+60.0
TOP OF SHEET PILING EL. 12.0
BOTTOM OF I-WALL EL.9.0
END OF I-WALL
LIMIT OF WORK N.O. LAKE FRONT B/L STA.159+65.0
NOTE: GROSS GRADE OF NEW I-WALL AND LEVEE SHOWN.
SCALE: 1" = 10'
SCALE: 1" = 100'
STATIONING ALONG WEST WALL LINE
WEST PROFILE
SCALE: HOR. 1" = 100' VERT. 1" = 10'
LIMIT OF WORK STA. 0+00.00 W. W/L
TOP OF NEW LEVEE EL.8.6, GROSS GRADE
TOP OF I-WALL EL. 14.0 GROSS GRADE
TOP OF SHEET PILING EL.9.6
DEGRADE EXISTING LEVEE TO EL.8.6 GROSS GRADE
EXISTING GROUND
PSA 23
TOP OF EXISTING LEVEE
BOTTOM OF I-WALL EL.6.6
BOTTOM OF SHEET PILING EL-9.0
PZ 35
PZ 22
BOTTOM OF SHEET PILING EL-17.7
BOTTOM OF SHEET PILING EL-33.0
P.I. STA.21+00.60 W. W/L= N.O. LAKE FRONT B/L STA.163+23.15= PROJECT B/L STA.31+51.1
UNCAPPED STEEL SHEET PILING
EXISTING LAKE FRONT LEVEE
700' TRANSITION
TOP OF EXISTING LEVEE EL. 18.0
SLOPE UP TO EL. 18.5 GROSS AT STA. 21+00.60 W. W/L
BOTTOM OF SHEET PILING EL-5.0
END OF I-WALL
LIMIT OF WORK N.O. LAKE FRONT B/L STA.164+40.0
NOTE: GROSS GRADE OF NEW I-WALL AND LEVEE SHOWN.
ELEVATION IN FEET - N.G.V.D.
Computer Aided Design Drafting
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH
PROFILES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
DATE: JAN. 1989
FILE NO. H-2-30288

PLATE 3



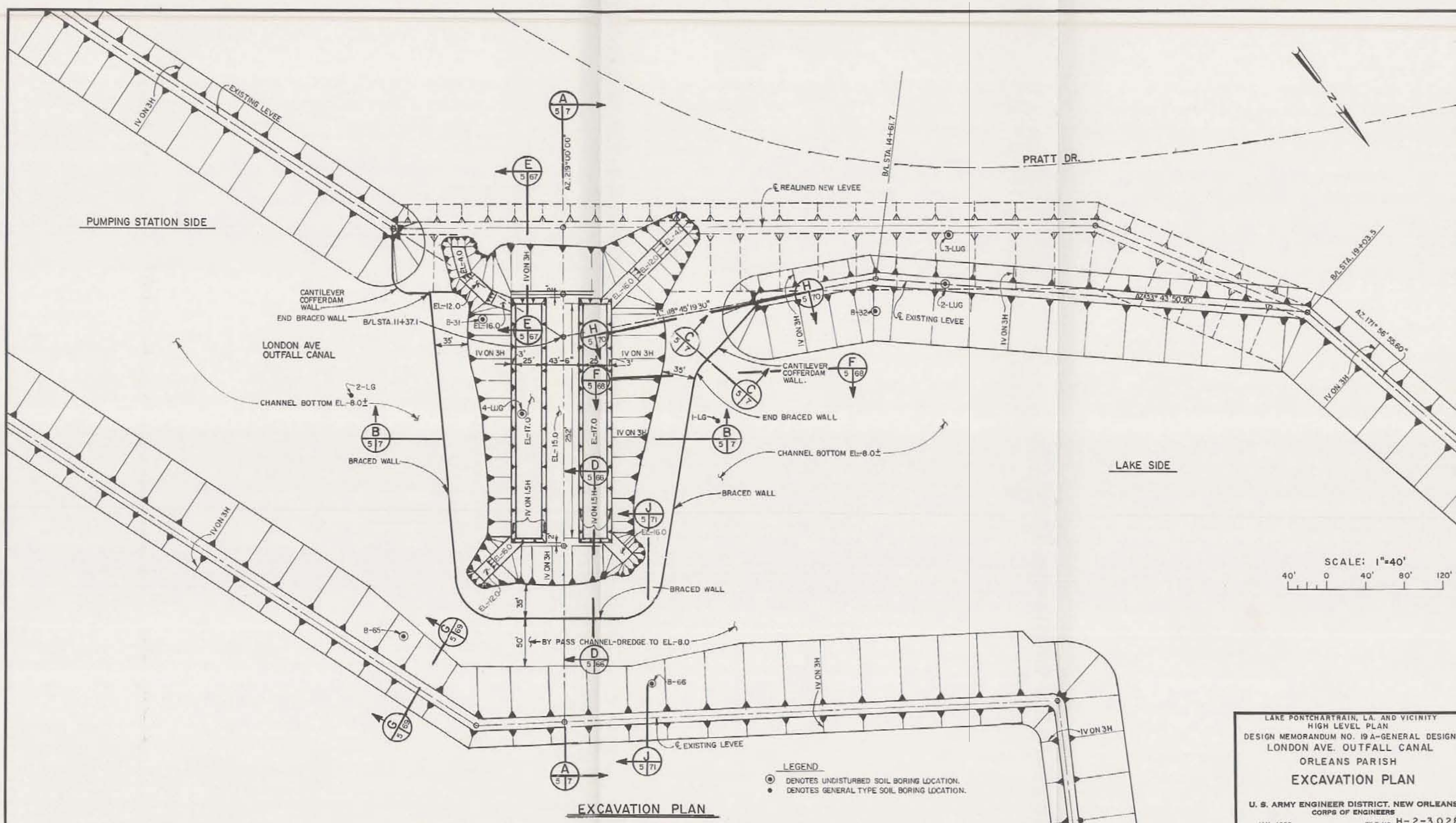
GENERAL PLAN

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

GENERAL PLAN

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

DATE JAN. 1989 FILE NO. H-2-30288

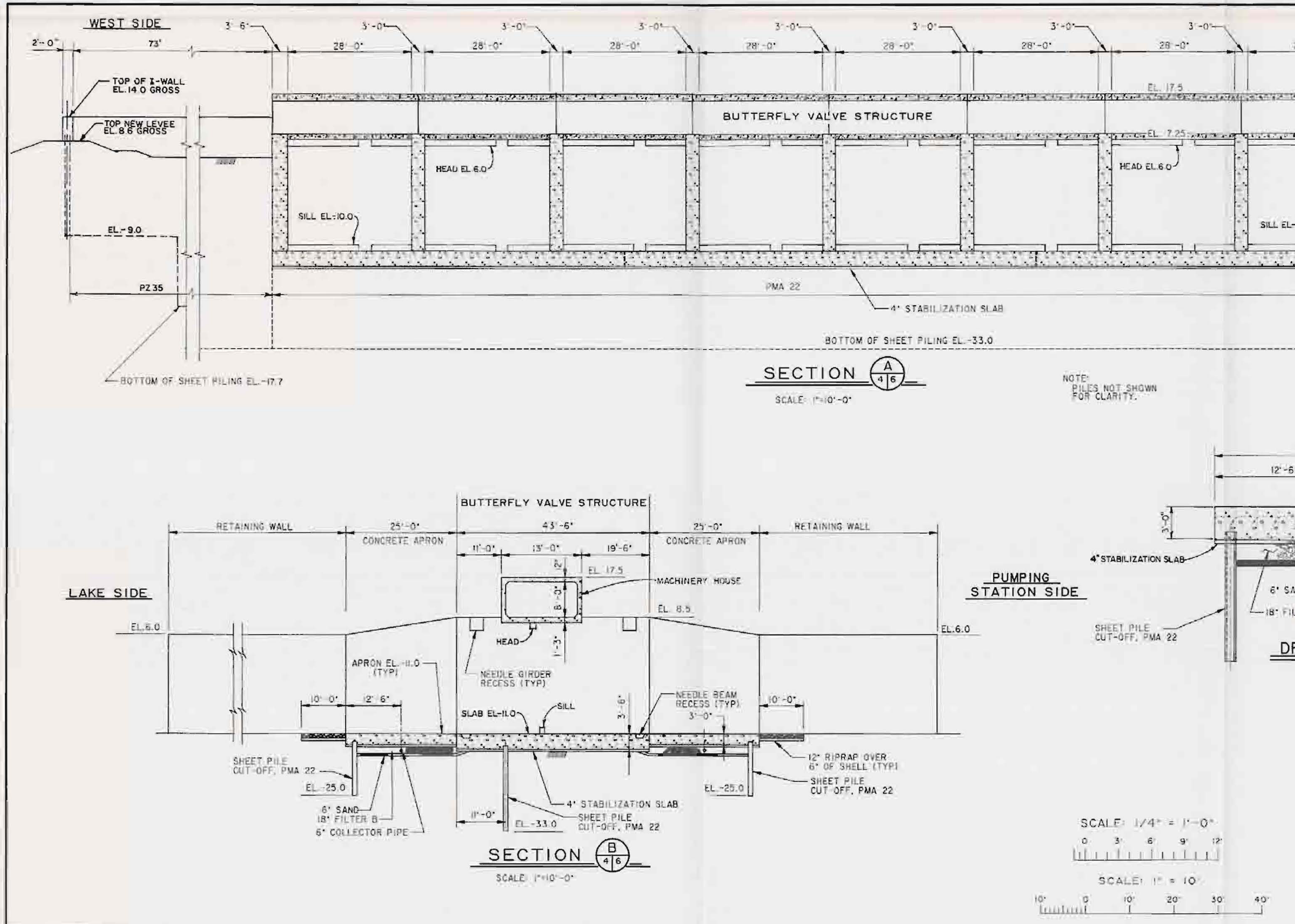


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

EXCAVATION PLAN

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

DATE: JAN. 1989 FILE NO. H-2-30288



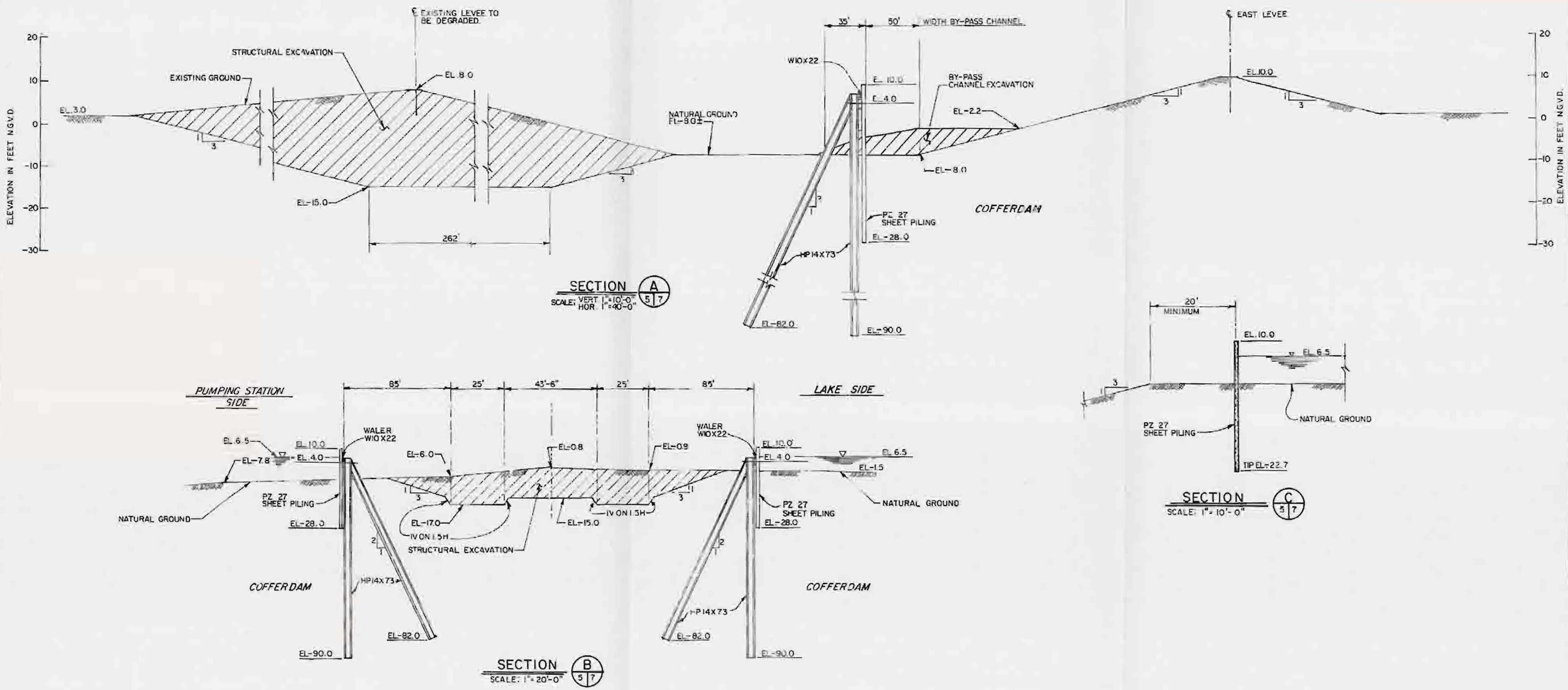
Computer Aided Design Drafting

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

BUTTERFLY VALVE STRUCTURE
TYPICAL SECTIONS

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

DATE: JAN. 1989 FILE NO. H-2-30288

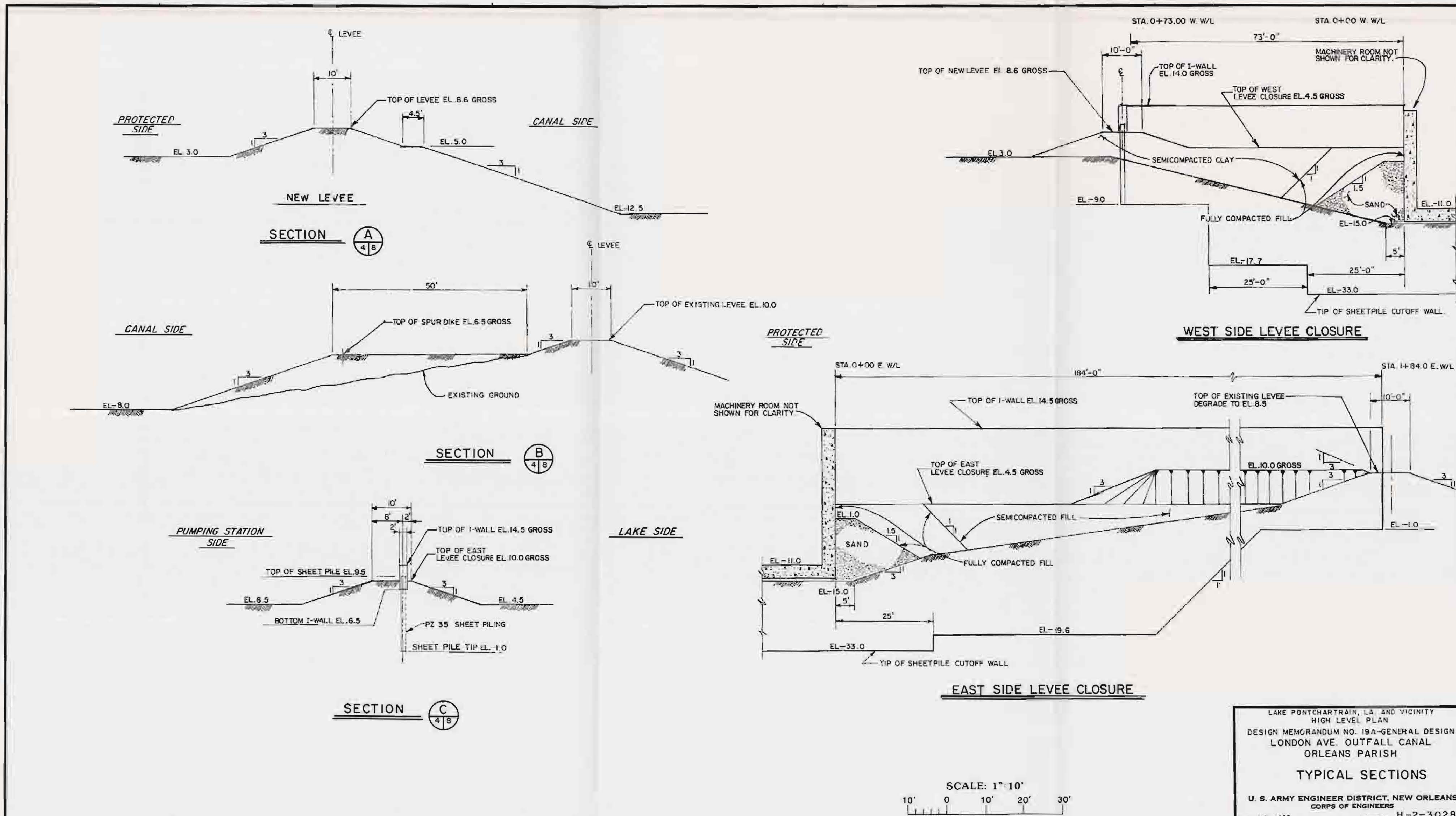


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

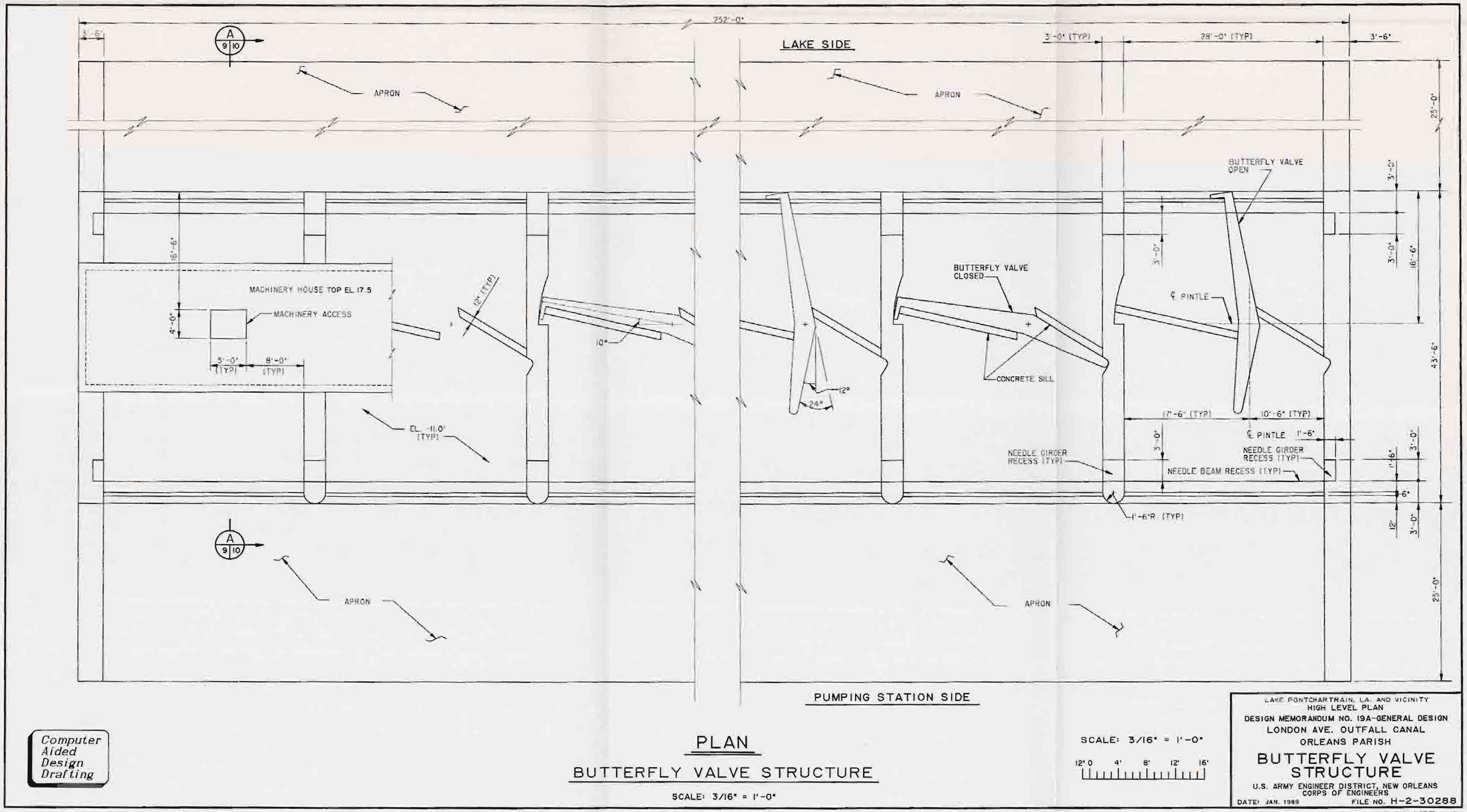
TYPICAL EXCAVATION SECTIONS

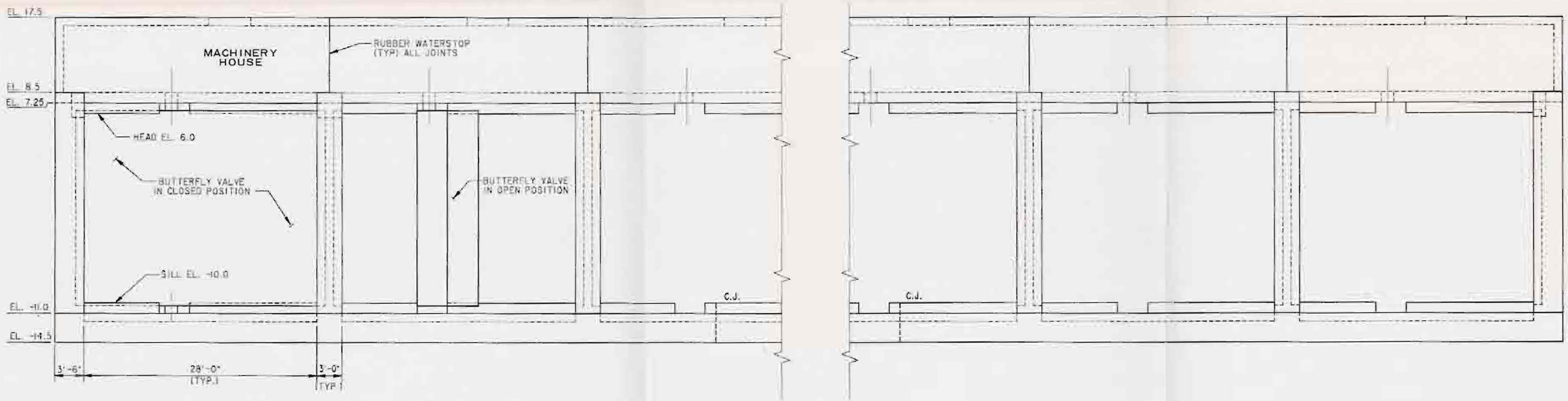
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE JAN. 1988 FILE NO. H-2-30288



℄ LEVEE
10'
TOP OF LEVEE EL. 8.6 GROSS
4.5'
PROTECTED SIDE
CANAL SIDE
EL. 3.0
EL. 5.0
EL. -12.5
NEW LEVEE
SECTION A 4/8
℄ LEVEE
50'
10'
TOP OF EXISTING LEVEE EL. 10.0
TOP OF SPUR DIKE EL. 6.5 GROSS
CANAL SIDE
EL. -8.0
EXISTING GROUND
SECTION B 4/8
10'
8'
2'
TOP OF I-WALL EL. 14.5 GROSS
TOP OF EAST LEVEE CLOSURE EL. 10.0 GROSS
PUMPING STATION SIDE
LAKE SIDE
TOP OF SHEET PILE EL. 9.5
EL. 6.5
EL. 4.5
BOTTOM I-WALL EL. 6.5
PZ 35 SHEET PILING
SHEET PILE TIP EL. -1.0
SECTION C 4/8
STA. 0+73.00 W. W/L
STA. 0+00 W. W/L
73'-0"
10'-0"
TOP OF NEW LEVEE EL. 8.6 GROSS
TOP OF I-WALL EL. 14.0 GROSS
MACHINERY ROOM NOT SHOWN FOR CLARITY.
TOP OF WEST LEVEE CLOSURE EL. 4.5 GROSS
EL. 3.0
SEMICOMPACTED CLAY
1.5
SAND
EL. -9.0
EL. -11.0
FULLY COMPACTED FILL
EL. -15.0
5'
EL. -17.7
25'-0"
25'-0"
EL. -33.0
TIP OF SHEETPILE CUTOFF WALL
WEST SIDE LEVEE CLOSURE
PROTECTED SIDE
STA. 0+00 E. W/L
184'-0"
STA. 1+84.0 E. W/L
MACHINERY ROOM NOT SHOWN FOR CLARITY.
TOP OF I-WALL EL. 14.5 GROSS
TOP OF EXISTING LEVEE DEGRADE TO EL. 8.5
10'-0"
TOP OF EAST LEVEE CLOSURE EL. 4.5 GROSS
EL. 10.0 GROSS
EL. 1.0
SEMICOMPACTED FILL
1.5
SAND
EL. -11.0
FULLY COMPACTED FILL
EL. -1.0
EL. -15.0
5'
25'
EL. -19.6
EL. -33.0
TIP OF SHEETPILE CUTOFF WALL
EAST SIDE LEVEE CLOSURE
SCALE: 1" = 10'
10' 0 10' 20' 30'
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
TYPICAL SECTIONS
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989
FILE NO. H-2-30288

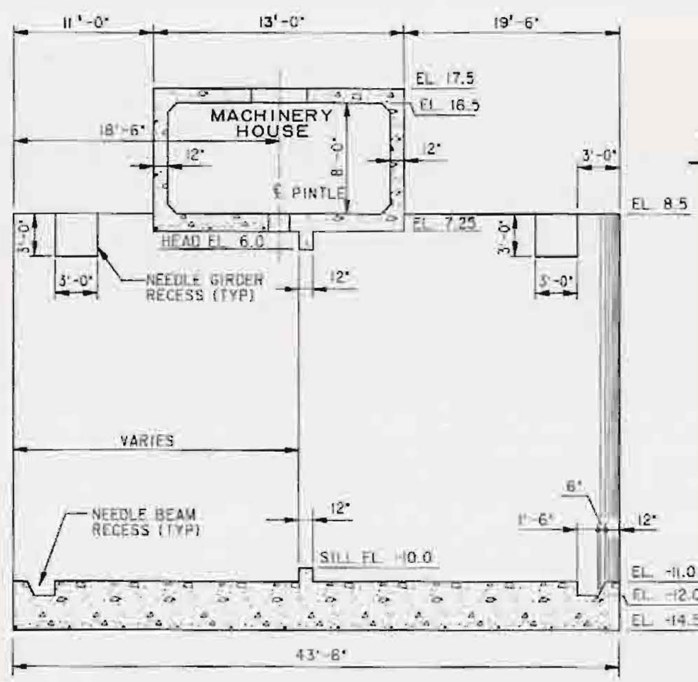

252'-0"
LAKE SIDE
3'-0" (TYP)
28'-0" (TYP)
3'-6"
APRON
APRON
25'-0"
BUTTERFLY VALVE OPEN
3'-0"
3'-0"
18'-6"
43'-6"
16'-6"
MACHINERY HOUSE TOP EL 17.5
MACHINERY ACCESS
4'-0"
5'-0" (TYP)
8'-0" (TYP)
12" (TYP)
10°
12°
24°
BUTTERFLY VALVE CLOSED
CONCRETE SILL
℄ PINTLE
EL. -11.0' (TYP)
17'-6" (TYP)
10'-6" (TYP)
℄ PINTLE
1'-6"
NEEDLE GIRDER RECESS (TYP)
NEEDLE GIRDER RECESS (TYP)
NEEDLE BEAM RECESS (TYP)
1'-6"R (TYP)
6"
12"
3'-0"
APRON
APRON
25'-0"
PUMPING STATION SIDE
Computer Aided Design Drafting
PLAN
BUTTERFLY VALVE STRUCTURE
SCALE: 3/16" = 1'-0"
SCALE: 3/16" = 1'-0"
12' 0 4' 8' 12' 16'
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
BUTTERFLY VALVE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JAN. 1989
FILE NO. H-2-30288



LAKE SIDE ELEVATION

NOTE:
PILES NOT SHOWN FOR CLARITY.

BUTTERFLY VALVE STRUCTURE



SECTION A 9|10

Computer Aided Design Drafting

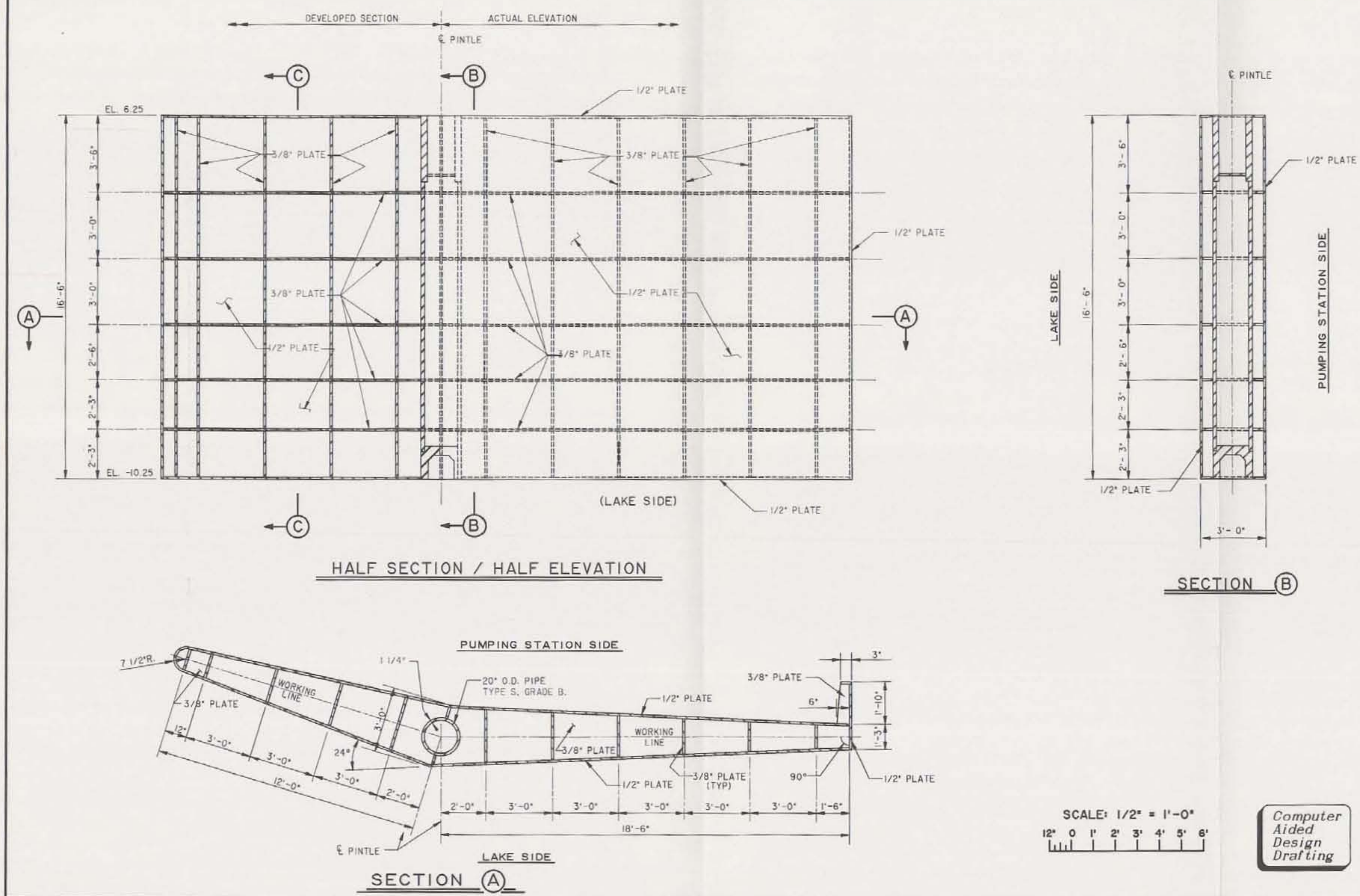
SCALE: 3/16" = 1'-0"

12' 0 4' 8' 12' 16'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

BUTTERFLY VALVE STRUCTURE
ELEVATION AND SECTION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JAN. 1989 FILE NO. H-2-30288



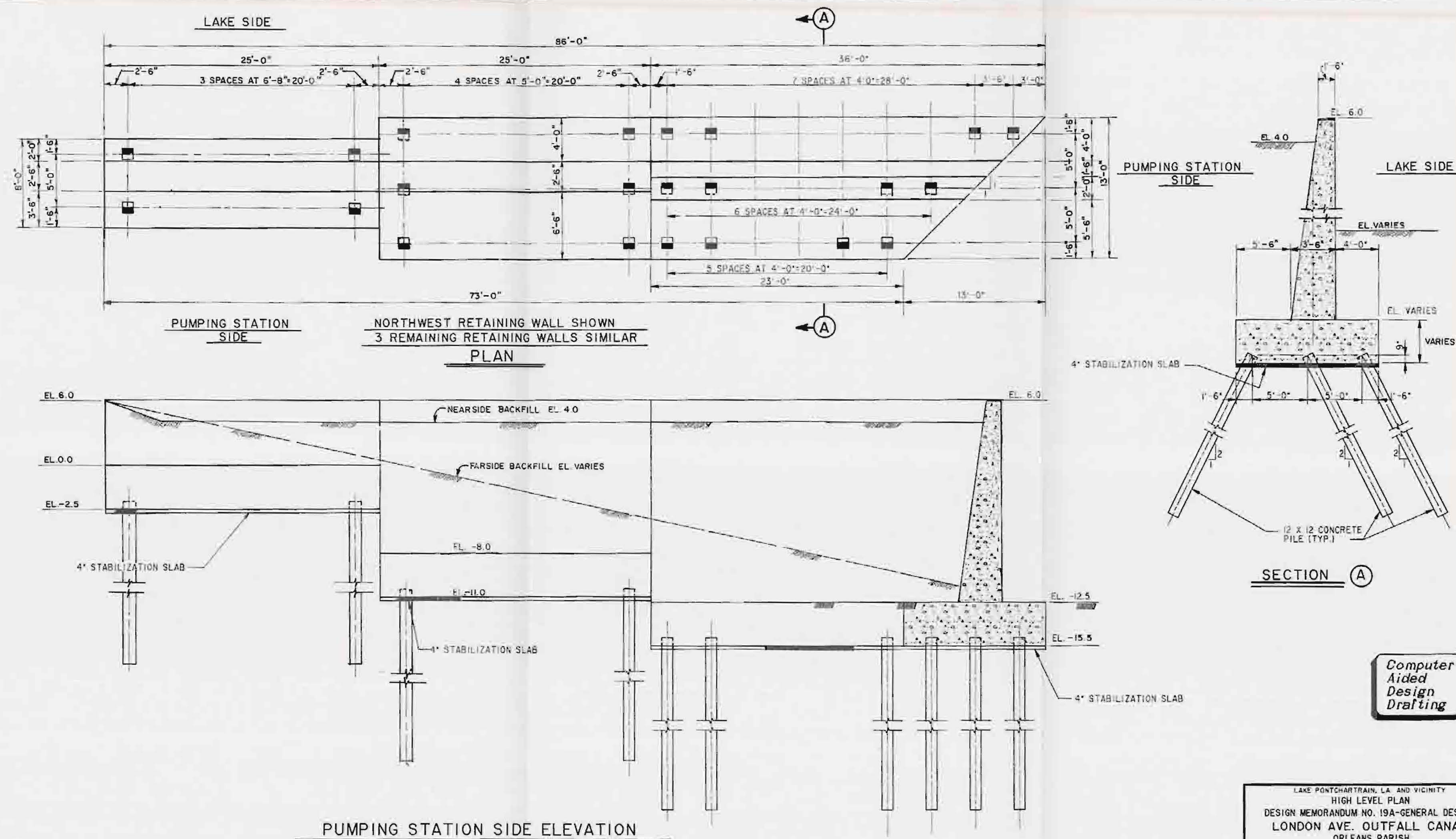
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

BUTTERFLY VALVE

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

DATE: JAN. 1989 FILE NO. H-2-30288

PLATE 11



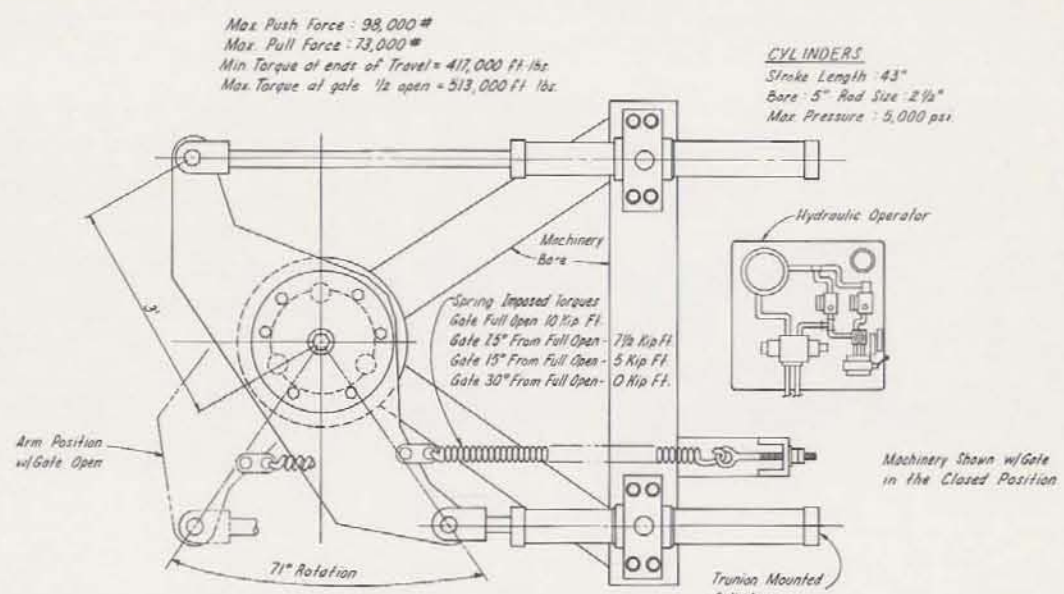
SCALE: 1/4" = 1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

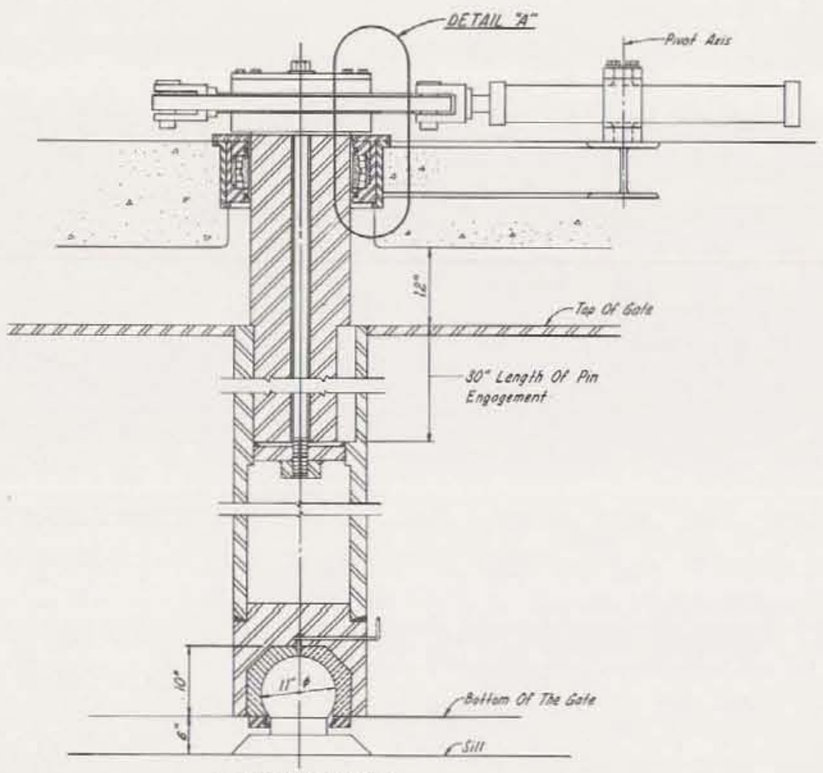
RETAINING WALLS

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

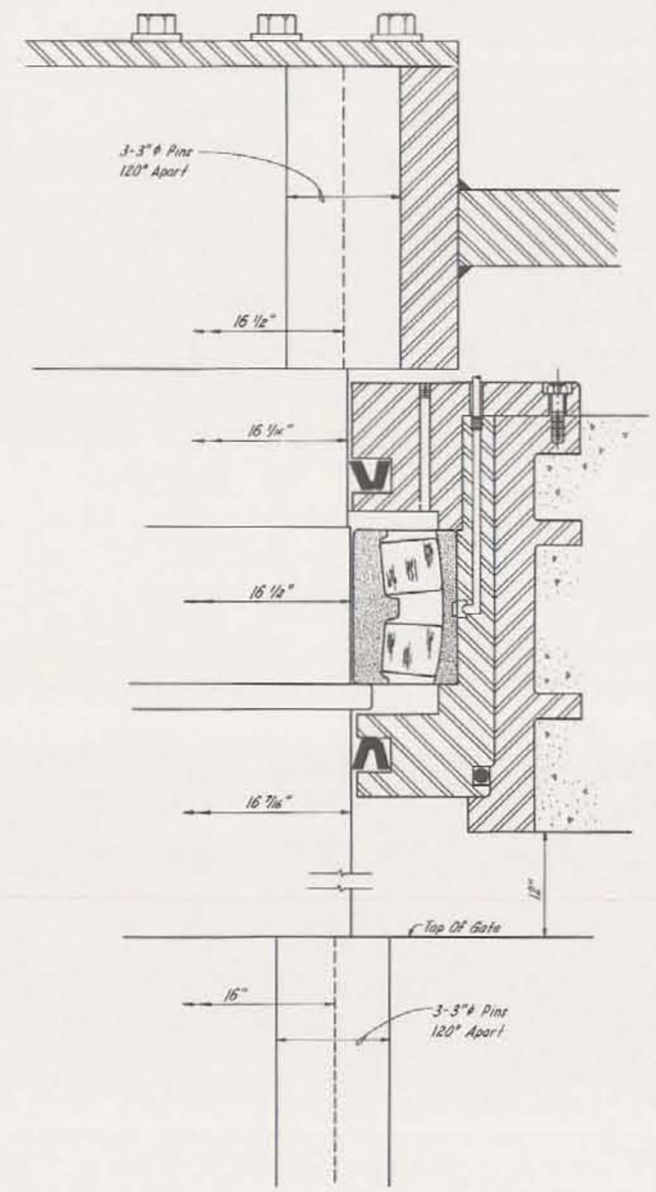
DATE: JAN. 1980 FILE NO. H-2-30288



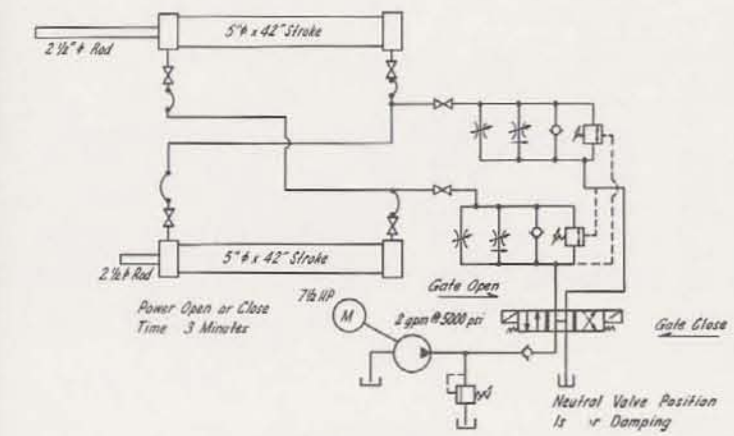
PLAN VIEW



SECTION ELEVATION



DETAIL "A"
UPPER BRG. ASSEMBLY



HYDRAULIC SCHEMATIC

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

MACHINERY LAYOUT

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

DATE JAN. 1989 FILE NO. H-2-30288

PLAN

1 - SOUTHERN RAILROAD BRIDGE
Approx Sta. 2+00

Flood Protection Provided By Steel Swing Gates At Both Bridge Approaches. Each Gate Monolith Will Have A 31'-3" Opening With Steel Sheet Pile Cut-Off For Underseepage.

2 - BENEFIT ST BRIDGE.
Approx. Sta 6+60

Flood Protection Provided By Bottom Roller Gates At Both Bridge Approaches. Each Gate Monolith Will Have A 30'-0" Opening, With Steel Sheet Pile Cut-Off For Underseepage.

3 - INTERSTATE 610 BRIDGES

These Bridges Have Adequate Vertical Clearance For Construction Of The Required Height Floodwall, And Modification To The Bridge Structures Will Not Be Necessary. Steel Sheet Pile Cut-Off For The Proposed Floodwall Will Be Driven In Sections.

4 - GENTILLY BLVD. BRIDGE
Approx. Sta 14+00

Remove Existing Deck; Drive Tension Piles At Each Bent; And Construct A New Concrete Watertight Deck And Parapet Walls.

5 - PEDESTRIAN WALKWAY BRIDGE
Approx. Sta. 49+88

Flood Protection Provieded By A 5'-0" Pedestrian Gate Opening On Each Side Of The Canal.

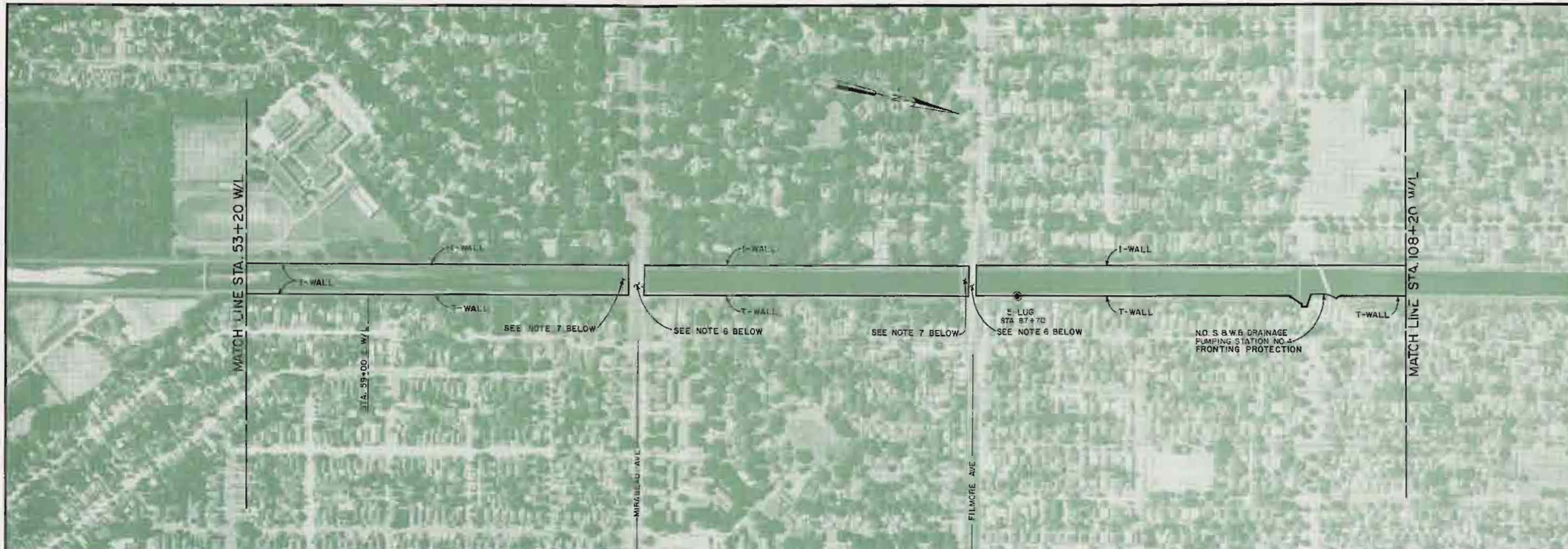
LEGEND:

◉ DENOTES UNDISTURBED SOIL BORING LOCATION.
• DENOTES GENERAL TYPE SOIL BORING LOCATION.

SCALE: 1" = 200'

200 0 200 400 600 800 1000 FT

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
PLAN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989 FILE NO. H-2-30288



PLAN

6 – MIRABEAU AVE. AND FILMORE AVE. BRIDGES:
Approx. Sta. 70+00 AND STA. 85+50 Respectively

Remove Existing Decks; Install New Steel Girders Along Exterior Faces Of The Existing Pile Caps; Install Tension Connectors To The Steel Girders, Piles And Pile Caps; And Construct New Watertight Decks And Parapet Walls. Pedestrian Sidewalks Will Be Provided To Replace The Adjacent Pedestrian Bridges.

7 – PEDESTRIAN WALKWAY BRIDGES:
Approx. Sta. 69+35 And Sta. 85+13

These Bridges Shall Be Removed And Pedestrian Access Incorporated Into Adjacent Vehicular Bridges.

LEGEND:

◉ DENOTES UNDISTURBED SOIL BORING LOCATION.
• DENOTES GENERAL TYPE SOIL BORING LOCATION.

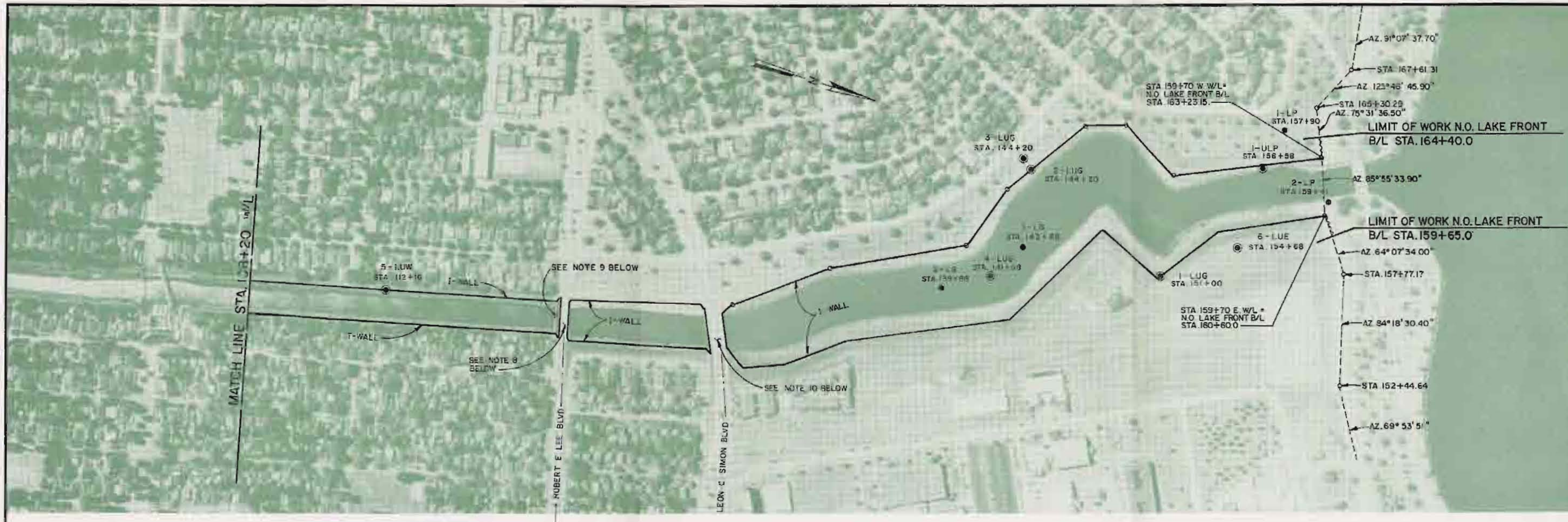
SCALE: 1" = 200'

200 0 200 400 600 800 1000 FT

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A–GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PLAN

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989 FILE NO. H-2-30288



PLAN

8 – ROBERT E. LEE BLVD. BRIDGE
Approx. Sta. 120 + 25

Remove Existing Deck; Install New Steel Girders Along The Exterior Faces Of The Existing Pile Caps; Drive Tension Piles At Each Bent; Install Tension Connectors To The Steel Girders, Piles And Pile Caps; And Construct A New Watertight Deck And Parapet Walls. Pedestrian Sidewalks Will Be Incorporated To Replace The Adjacent Pedestrian Bridge.

9 – PEDESTRIAN WALKWAY BRIDGES
Approx. Sta. 119 + 87

This Bridge Shall Be Removed And Pedestrian Access Incorporated Into Adjacent Vehicular Bridge.

10 – LEON C. SIMON BLVD. BRIDGE
Approx. Sta. 127 + 50

Existing Bridge Deck Is Watertight And Replacement Is Not Necessary. Modification Entails Installing Tension Connectors To The Steel Girders, Concrete Caps And Piles, And Constructing New Watertight Parapet Walls.

LEGEND:

- ◉ DENOTES UNDISTURBED SOIL BORING LOCATION.
- • DENOTES GENERAL TYPE SOIL BORING LOCATION.

SCALE: 1" = 200'

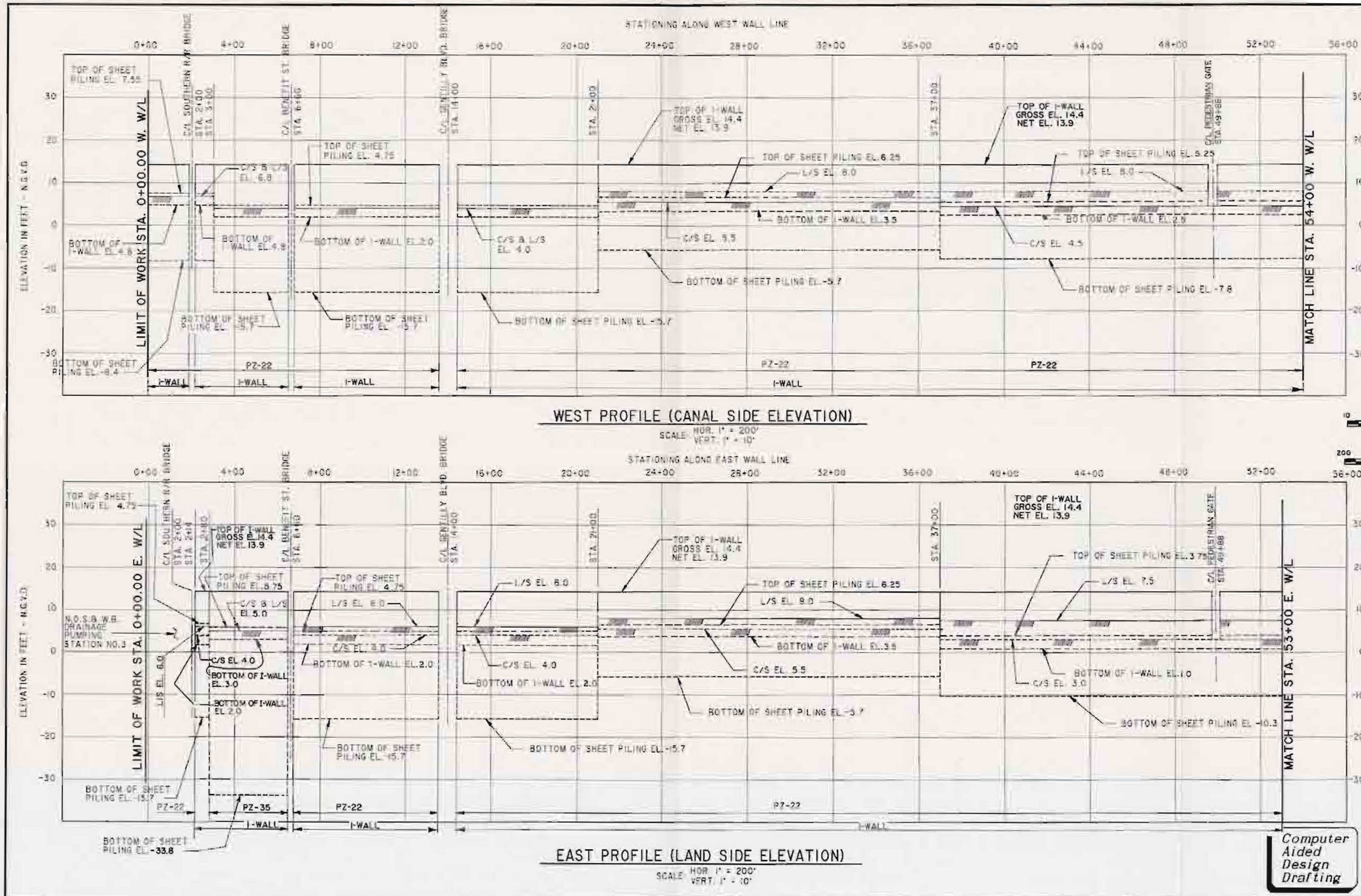
200 0 200 400 600 800 1000 FT

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A – GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PLAN

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

DATE JAN. 1989 FILE NO. H-2-30288



LEGEND

C/S —— CANAL SIDE
L/S —— LAND SIDE
W/L —— WALL LINE
C/L ---- CENTER LINE

SCALE: 1" = 10'

10 0 10 20 30 40 50 FT.

SCALE: 1" = 200'

200 0 200 400 600 800 1000 FT.

NOTE:
1. ALL GROUND ELEVATION TRANSITIONS ARE 1V ON 3H
2. EXISTING LEVEE PROFILE NOT SHOWN FOR CLARITY.

Computer Aided Design Drafting

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

PROFILES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JAN. 1989 FILE NO. H-2-30288

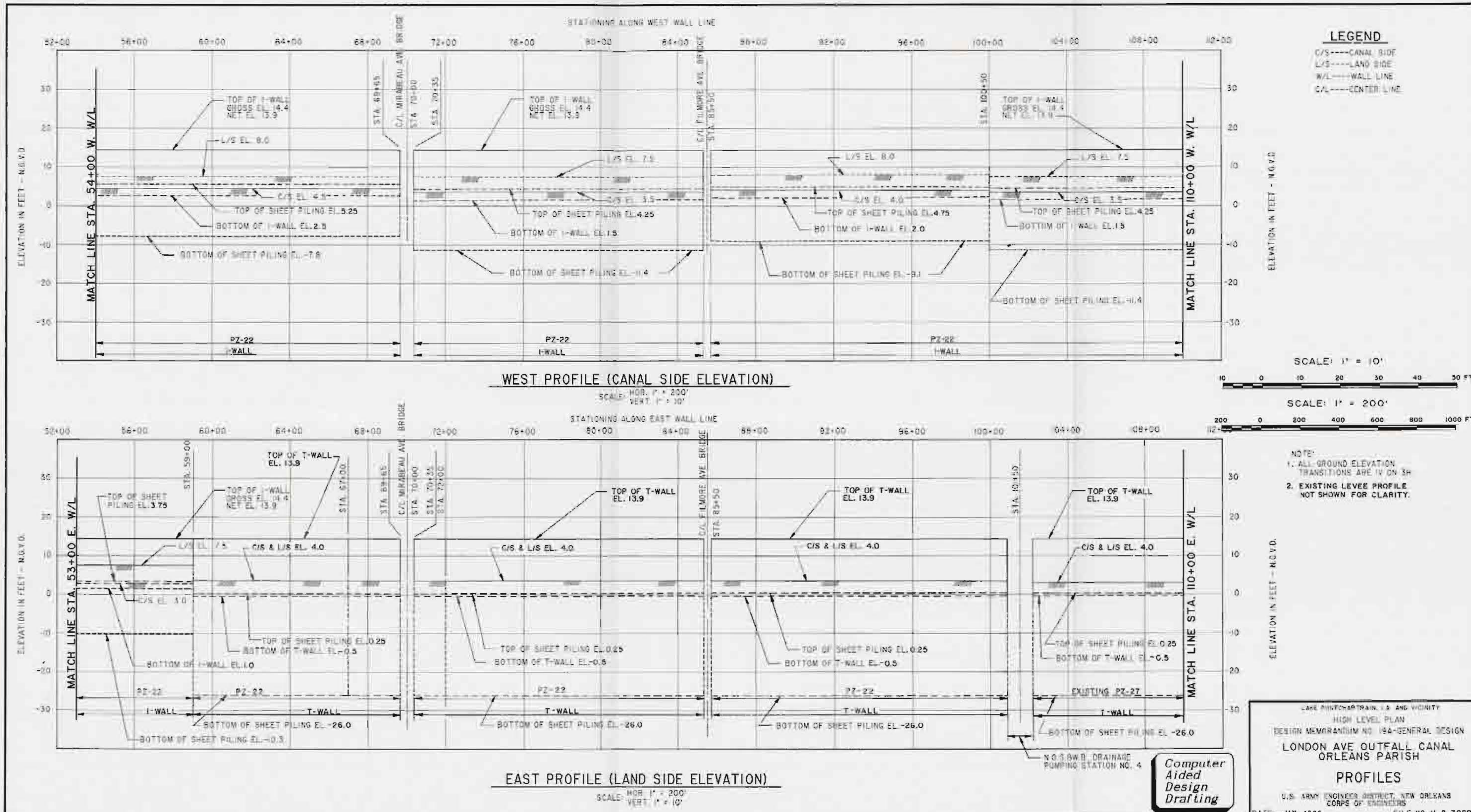
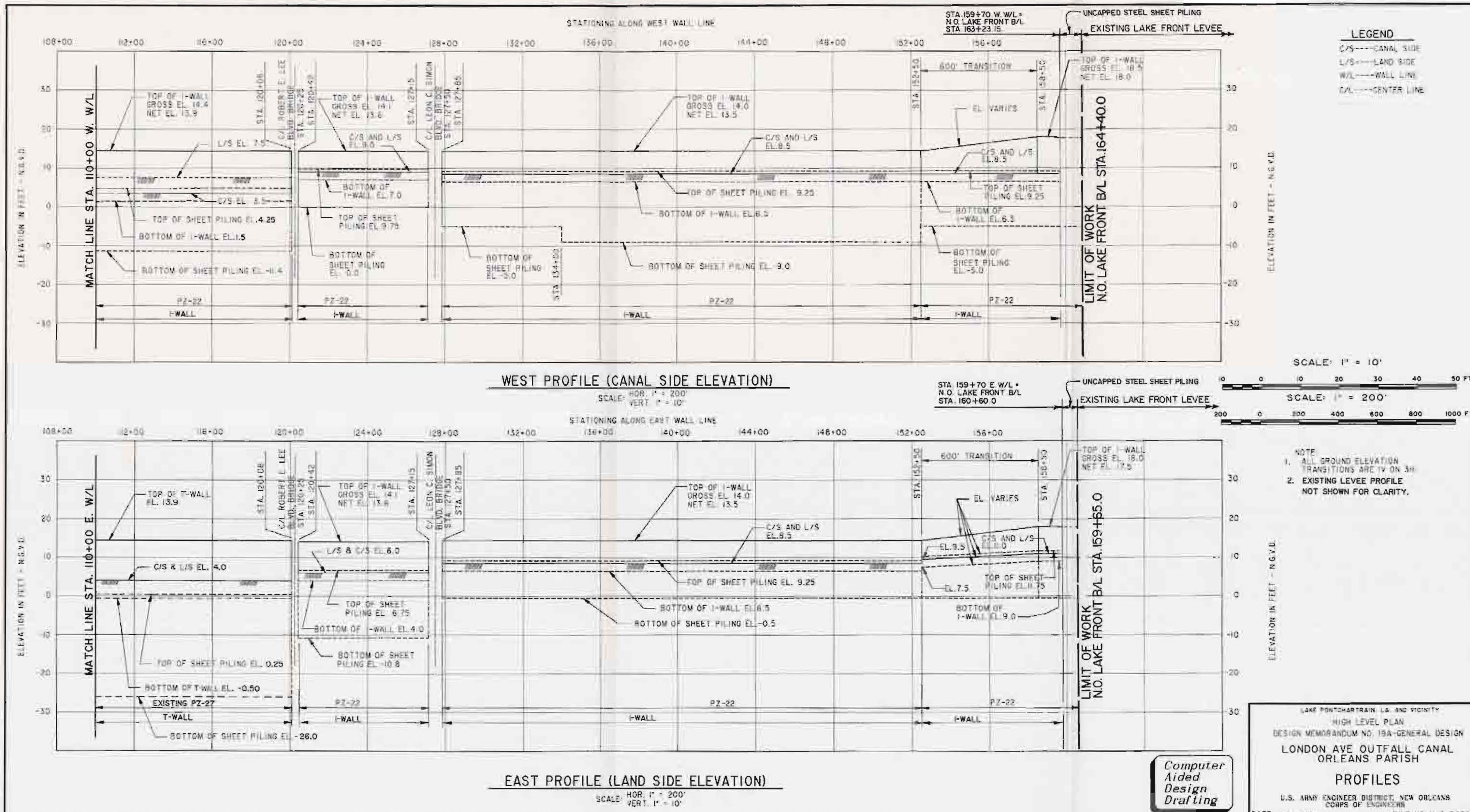
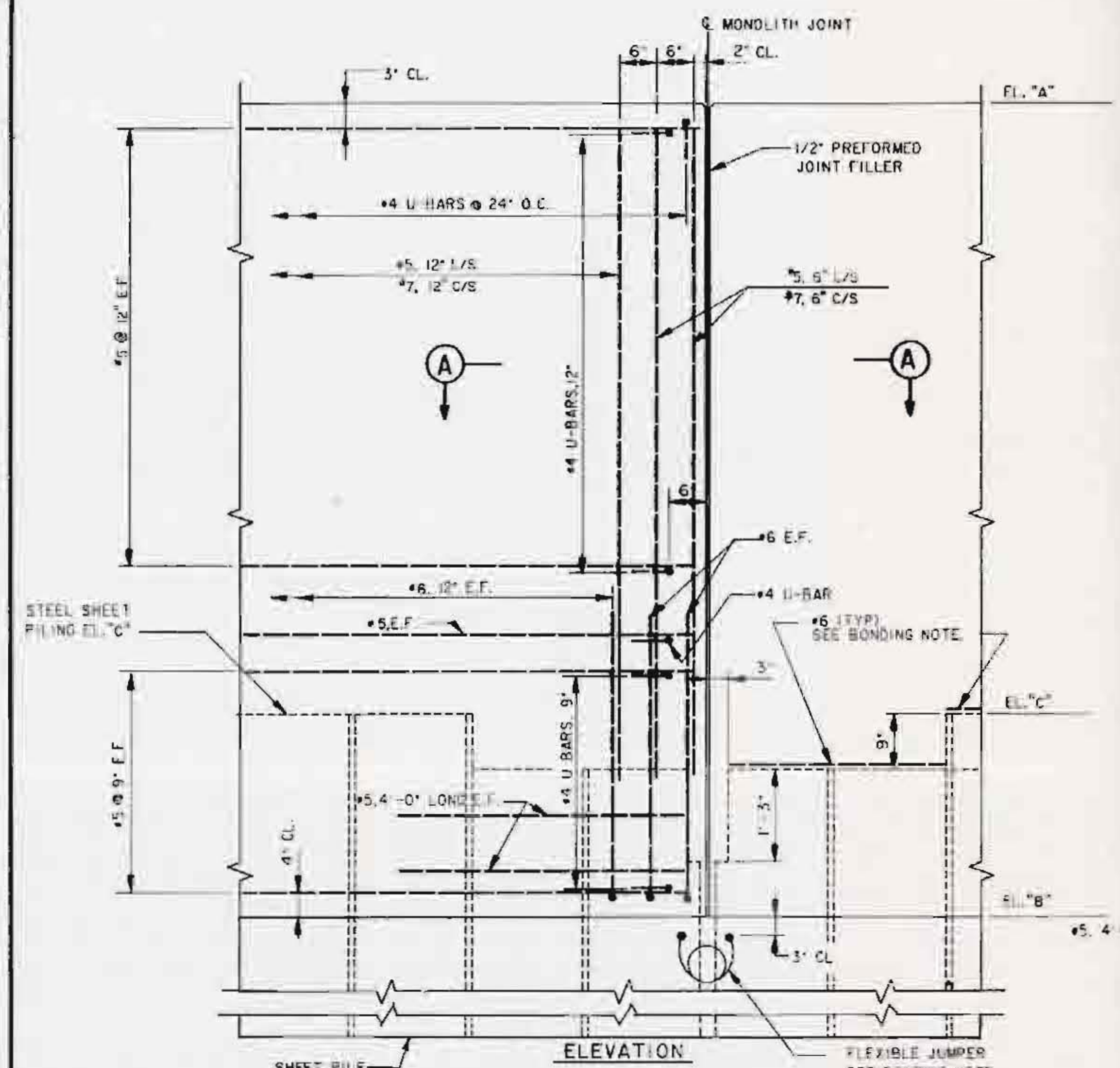

STATIONING ALONG WEST WALL LINE
MATCH LINE STA. 54+00 W. W/L
MATCH LINE STA. 110+00 W. W/L
ELEVATION IN FEET - N.G.V.D.
C/L MIRABEAU AVE. BRIDGE
C/L FILMORE AVE. BRIDGE
TOP OF I-WALL GROSS EL. 14.4 NET EL. 13.9
L/S EL. 8.0
C/S EL. 4.5
TOP OF SHEET PILING EL. 5.25
BOTTOM OF I-WALL EL. 2.5
BOTTOM OF SHEET PILING EL. -7.8
L/S EL. 7.5
C/S EL. 3.5
TOP OF SHEET PILING EL. 4.25
BOTTOM OF I-WALL EL. 1.5
BOTTOM OF SHEET PILING EL. -11.4
L/S EL. 8.0
L/S EL. 4.0
TOP OF SHEET PILING EL. 4.75
BOTTOM OF I-WALL EL. 2.0
BOTTOM OF SHEET PILING EL. -9.1
PZ-22
I-WALL
WEST PROFILE (CANAL SIDE ELEVATION)
SCALE: HOR. 1" = 200' VERT. 1" = 10'
STATIONING ALONG EAST WALL LINE
MATCH LINE STA. 53+00 E. W/L
MATCH LINE STA. 110+00 E. W/L
TOP OF SHEET PILING EL. 3.75
TOP OF I-WALL GROSS EL. 14.4 NET EL. 13.9
TOP OF T-WALL EL. 13.9
L/S EL. 7.5
C/S & L/S EL. 4.0
C/S EL. 4.0
TOP OF SHEET PILING EL. 0.25
BOTTOM OF T-WALL EL. -0.5
BOTTOM OF I-WALL EL. 1.0
BOTTOM OF SHEET PILING EL. -10.3
BOTTOM OF SHEET PILING EL. -26.0
EXISTING PZ-27
T-WALL
N.O.S.&W.B. DRAINAGE PUMPING STATION NO. 4
EAST PROFILE (LAND SIDE ELEVATION)
SCALE: HOR. 1" = 200' VERT. 1" = 10'
LEGEND
C/S----CANAL SIDE
L/S----LAND SIDE
W/L----WALL LINE
C/L----CENTER LINE
SCALE: 1" = 10'
SCALE: 1" = 200'
NOTE:
1. ALL GROUND ELEVATION TRANSITIONS ARE 1V ON 3H
2. EXISTING LEVEE PROFILE NOT SHOWN FOR CLARITY.
Computer Aided Design Drafting
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH
PROFILES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JAN. 1989
FILE NO. H-2-30288

PLATE 18

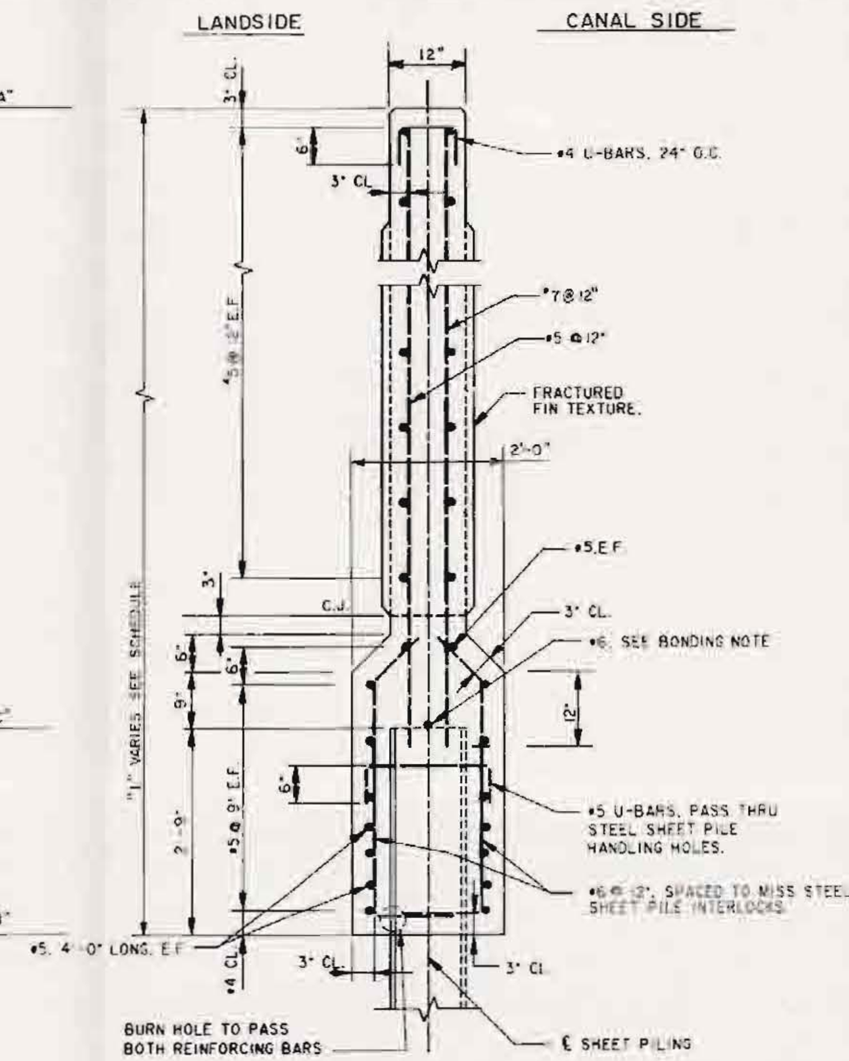


STATIONING ALONG WEST WALL LINE
STA.159+70 W. W/L = N.O. LAKE FRONT B/L STA.163+23.15
UNCAPPED STEEL SHEET PILING
EXISTING LAKE FRONT LEVEE
LEGEND
C/S----CANAL SIDE
L/S----LAND SIDE
W/L----WALL LINE
C/L----CENTER LINE
MATCH LINE STA. 110+00 W. W/L
TOP OF I-WALL GROSS EL. 14.4 NET EL. 13.9
L/S EL. 7.5
C/S EL. 5.5
TOP OF SHEET PILING EL.4.25
BOTTOM OF I-WALL EL.1.5
BOTTOM OF SHEET PILING EL. -11.4
STA. 120+06
C/L ROBERT E. LEE BLVD. BRIDGE
STA. 120+25
STA. 120+49
TOP OF I-WALL GROSS EL. 14.1 NET EL. 13.6
C/S AND L/S EL. 9.0
BOTTOM OF I-WALL EL. 7.0
TOP OF SHEET PILING EL. 9.75
BOTTOM OF SHEET PILING EL. 0.0
STA. 127+15
C/L LEON C. SIMON BLVD. BRIDGE
STA. 127+50
STA. 127+85
BOTTOM OF SHEET PILING EL. -5.0
STA. 134+00
TOP OF I-WALL GROSS EL. 14.0 NET EL. 13.5
C/S AND L/S EL. 8.5
TOP OF SHEET PILING EL. 9.25
BOTTOM OF I-WALL EL. 6.5
BOTTOM OF SHEET PILING EL. -9.0
STA. 152+50
600' TRANSITION
STA. 158+50
TOP OF I-WALL GROSS EL. 18.5 NET EL. 18.0
EL. VARIES
C/S AND L/S EL. 8.5
TOP OF SHEET PILING EL. 9.25
BOTTOM OF I-WALL EL. 6.5
BOTTOM OF SHEET PILING EL. -5.0
LIMIT OF WORK N.O. LAKE FRONT B/L STA.164+40.0
PZ-22
I-WALL
ELEVATION IN FEET - N.G.V.D.
WEST PROFILE (CANAL SIDE ELEVATION)
SCALE: HOR. 1" = 200' VERT. 1" = 10'
SCALE: 1" = 10'
SCALE: 1" = 200'
STA 159+70 E W/L = N.O. LAKE FRONT B/L STA. 160+60.0
UNCAPPED STEEL SHEET PILING
EXISTING LAKE FRONT LEVEE
STATIONING ALONG EAST WALL LINE
NOTE
1. ALL GROUND ELEVATION TRANSITIONS ARE 1V ON 3H
2. EXISTING LEVEE PROFILE NOT SHOWN FOR CLARITY.
MATCH LINE STA. 110+00 E. W/L
TOP OF T-WALL EL. 13.9
C/S & L/S EL. 4.0
TOP OF SHEET PILING EL. 0.25
BOTTOM OF T-WALL EL. -0.50
EXISTING PZ-27
T-WALL
BOTTOM OF SHEET PILING EL. -26.0
STA. 120+08
C/L ROBERT E. LEE BLVD. BRIDGE
STA. 120+25
STA. 120+42
TOP OF I-WALL GROSS EL. 14.1 NET EL. 13.6
L/S & C/S EL. 6.0
TOP OF SHEET PILING EL. 6.75
BOTTOM OF I-WALL EL. 4.0
BOTTOM OF SHEET PILING EL. -10.8
STA. 127+15
C/L LEON C. SIMON BLVD. BRIDGE
STA. 127+50
STA. 127+85
TOP OF I-WALL GROSS EL. 14.0 NET EL. 13.5
C/S AND L/S EL. 8.5
TOP OF SHEET PILING EL. 9.25
BOTTOM OF I-WALL EL. 6.5
BOTTOM OF SHEET PILING EL. -0.5
STA. 152+50
600' TRANSITION
STA. 158+50
TOP OF I-WALL GROSS EL. 18.0 NET EL. 17.5
EL. VARIES
EL. 9.5
C/S AND L/S EL. 11.0
TOP OF SHEET PILING EL. 11.75
EL. 7.5
BOTTOM OF I-WALL EL. 9.0
LIMIT OF WORK N.O. LAKE FRONT B/L STA. 159+65.0
PZ-22
I-WALL
EAST PROFILE (LAND SIDE ELEVATION)
SCALE: HOR. 1" = 200' VERT. 1" = 10'
Computer Aided Design Drafting
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH
PROFILES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JAN. 1989
FILE NO. H-2-30288



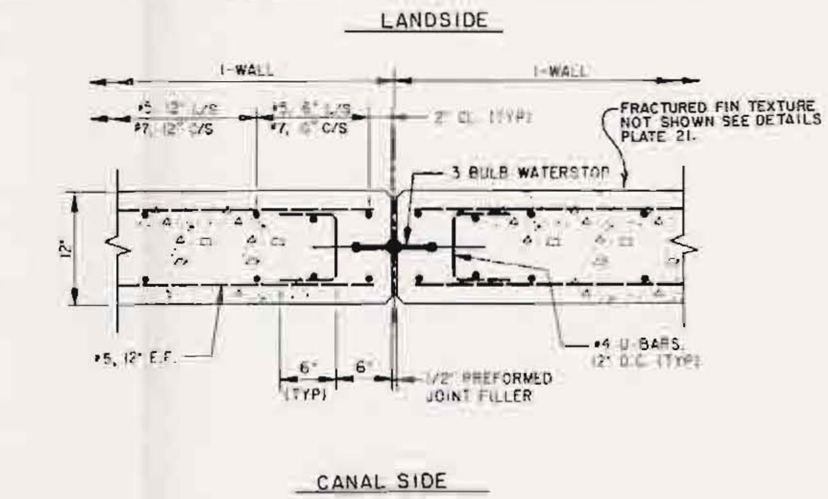
DETAIL OF I-WALL MONOLITH JOINTS

SCALE: 1" = 1'-0"



TYPICAL SECTION THROUGH I-WALL

SCALE: 1" = 1'-0"



SECTION (A)

SCALE: 1 1/2" = 1'-0"

TYPICAL REINF. AT MONOLITH JOINTS

WEST I-WALL SCHEDULE

APPROX. STATION LIMITS	"L"	"A"	"B"	"C"	"D"	"E"	"F"
0+00 — 3+00	9.6'	14.4	4.8	7.55	-8.4	6.8	6.0
3+00 — 21+00	12.4'	14.4	2.0	4.75	-15.7	4.0	4.0
21+00 — 37+00	10.9	14.4	3.5	6.25	-5.7	5.5	8.0
37+00 — 69+65	11.0	14.4	2.5	5.25	-7.8	4.5	8.0
70+35 — 85+31	12.9	14.4	1.5	4.25	-11.4	3.5	7.5
85+69 — 100+50	12.4	14.4	2.0	4.75	-9.1	4.0	8.0
100+50 — 120+08	12.9	14.4	1.5	4.25	-11.4	3.5	7.5
120+42 — 127+15	7.1'	14.1	7.0	9.75	0.0	9.0	9.0
127+85 — 134+00	7.5'	14.0	6.5	9.25	-5.0	8.5	8.5
134+00 — 149+00	7.5'	14.0	6.5	9.25	-9.0	8.5	8.5
149+00 — 152+50	7.5'	14.0	6.5	9.25	-5.0	8.5	8.5
*152+50 — 158+50	7.5 / 12.0'	14.0 / 18.5	6.5	9.25	-5.0	8.5	8.5
158+50 — 159+70	12.0	18.5	6.5	9.25	-5.0	8.5	8.5

EAST I-WALL SCHEDULE

APPROX. STATION LIMITS	"L"	"A"	"B"	"C"	"D"	"E"	"F"
2+14 — 2+80	12.4'	14.4	2.0	4.75	-15.7	4.0	6.0
2+80 — 6+38	11.4	14.4	3.0	5.75	-33.8	5.0	5.0
6+82 — 21+00	12.4'	14.4	2.0	4.75	-15.7	4.0	6.0
21+00 — 37+00	10.9	14.4	3.5	6.25	-5.7	5.5	8.0
37+00 — 59+00	13.4	14.4	1.0	3.75	-10.3	3.0	7.5
120+42 — 127+15	10.1'	14.1	4.0	6.75	-10.8	6.0	6.0
127+85 — 152+50	7.5'	14.0	6.5	9.25	-0.5	8.5	8.5
* 152+50 — 158+50	6.5 / 9.0	14.0 / 18.0	7.5 / 9.0	10.25 / 11.75	-0.5	9.5 / 11.0	9.5 / 11.0
158+50 — 159+70	9.0	18.0	9.0	11.75	-0.5	11.0	11.0

* 600' TRANSITION AREA

BONDING NOTE:

#6 REINFORCING BAR SHALL BE WELDED ACROSS THE TOP OF EACH SHEET PILE. #6 REINFORCING BAR SHALL NOT EXTEND ACROSS THE MONOLITH JOINT. INSTALL FLEXIBLE JUMPER AT ALL MONOLITH JOINTS. JUMPERS SHALL BE INSULATED NO. 1/0 AWG COPPER TYPE USE INSULATED WITH A MINIMUM OF 95 MILS OF CROSS LINKED POLYETHYLENE IN A 8" DIA. LOOP. JUMPERS SHALL BE WELDED AS SPECIFIED TO ADJACENT STEEL SHEET PILES 3" BELOW THE BOTTOM OF THE CONCRETE CAP. WELDED CONNECTIONS SHALL BE COATED WITH SPLICING EPOXY TO OBTAIN MOISTURE PROOF JOINTS.

#6 REINFORCING BARS SHALL BE WELDED TO THE LAST THREE SHEET PILINGS AT EACH END OF THE MONOLITH AS SHOWN FOR CONTINUITY.

SPLICING OF #6 REINFORCING BAR, EXCEPT THAT SHOWN, WILL NOT BE ALLOWED.

LEGEND

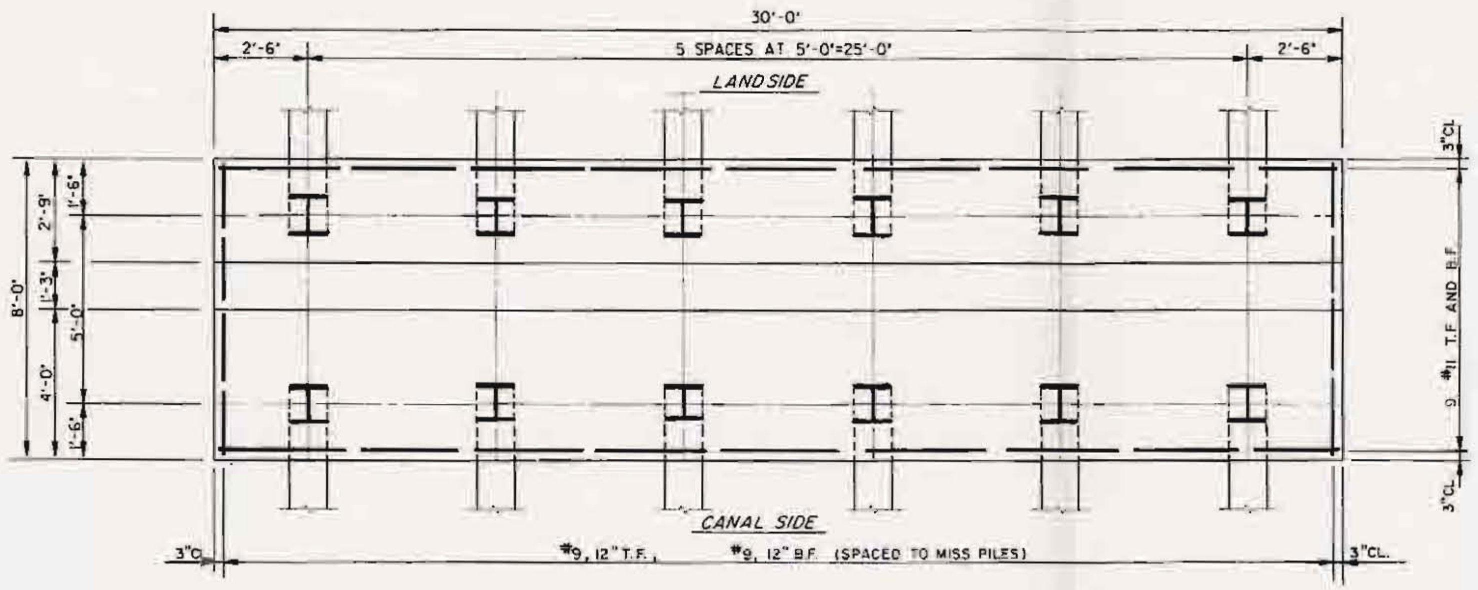
C/S ------ CANAL SIDE
L/S ------ LAND SIDE
E/F ------ EACH FACE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

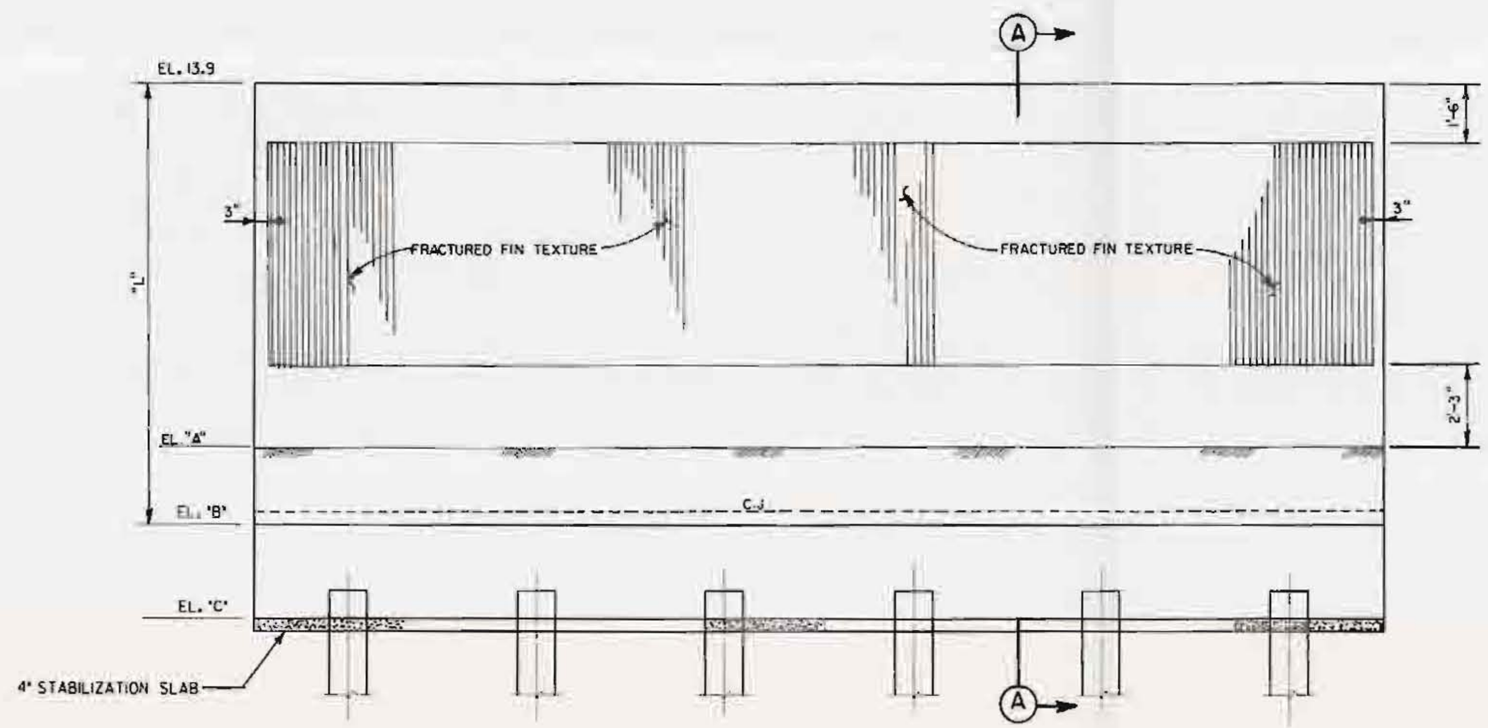
TYPICAL I-WALL SECTION

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

DATE JAN. 1989 FILE NO. H-2-30288

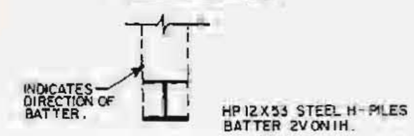


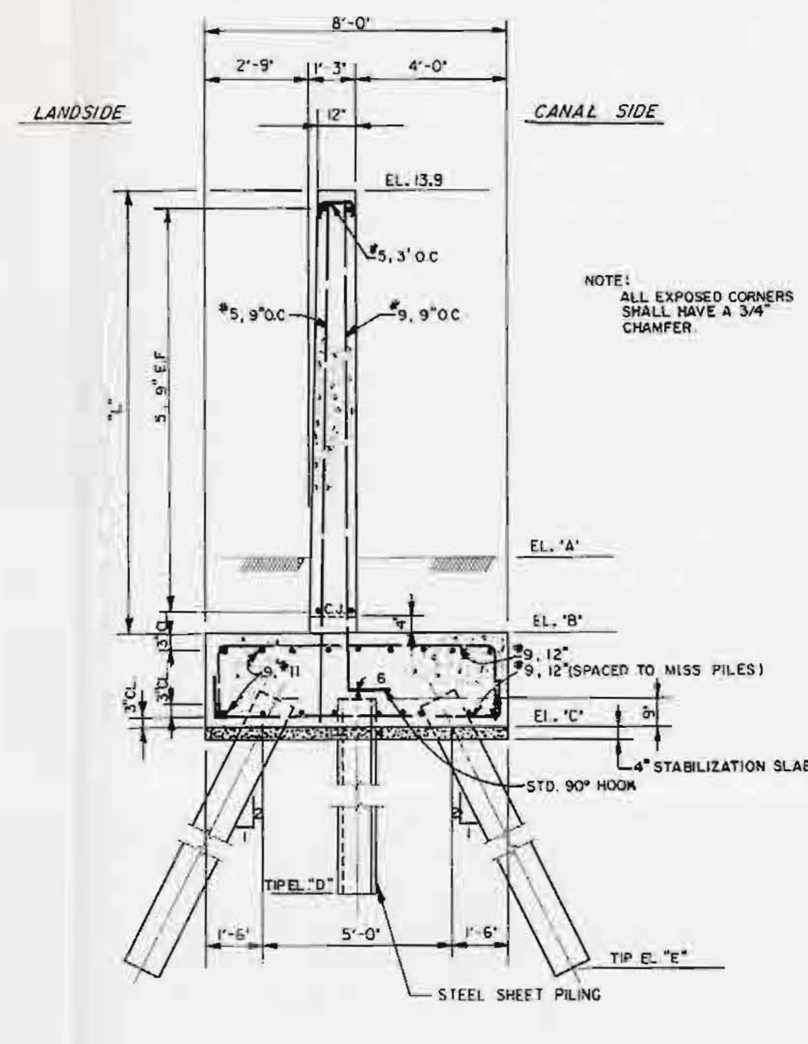
PLAN



CANAL SIDE ELEVATION

LEGEND





NOTE:
ALL EXPOSED CORNERS SHALL HAVE A 3/4" CHAMFER.

SECTION (A)

EAST T-WALL SCHEDULE							
APPROX STATION LIMITS	"L"	"A"	"B"	"C"	"D"	"E"	
59+00 — 120+10	11.9	4.0	2.0	-0.5	-26.0	-71.8	

COMPUTER AIDED DESIGN DRAFTING

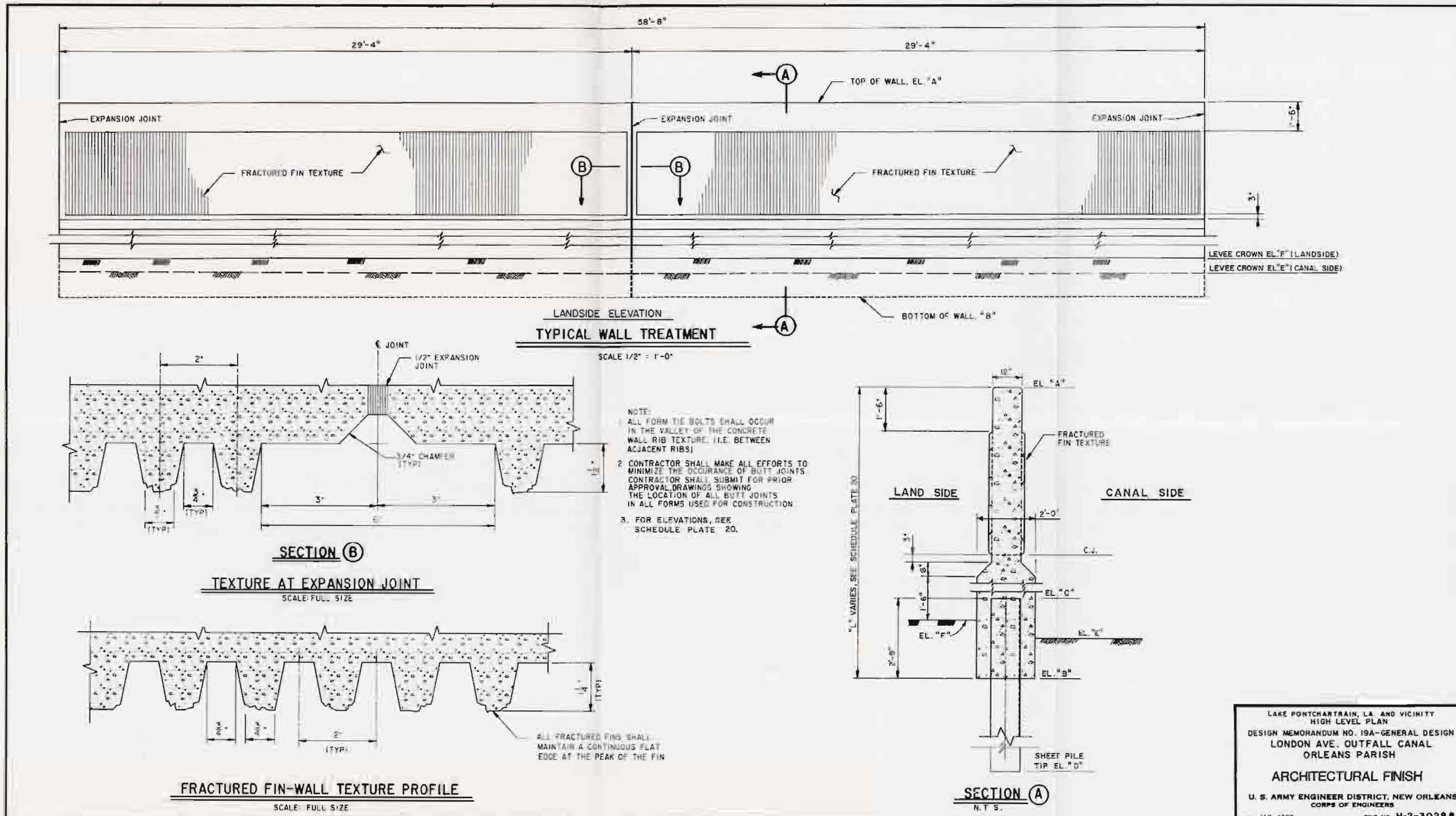
SCALE: 1/2"=1'-0"
12" 0 1' 2' 3' 4' 5' 6'

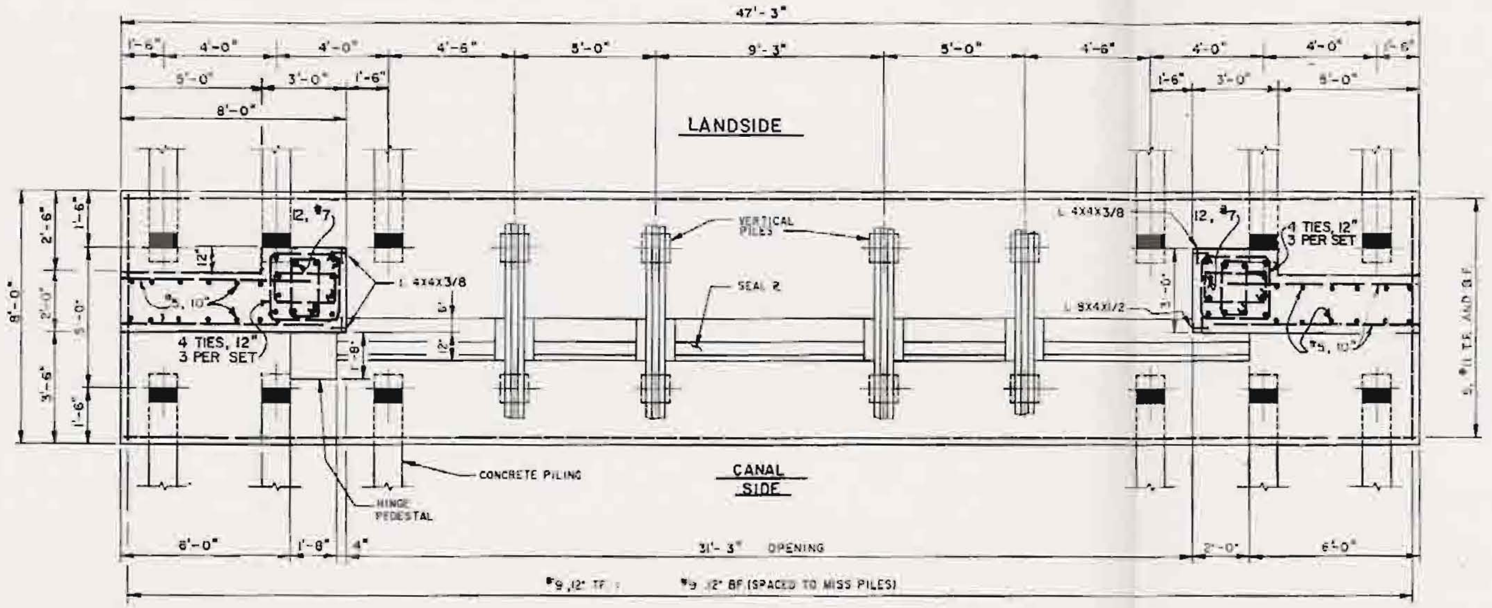
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

TYPICAL T-WALL

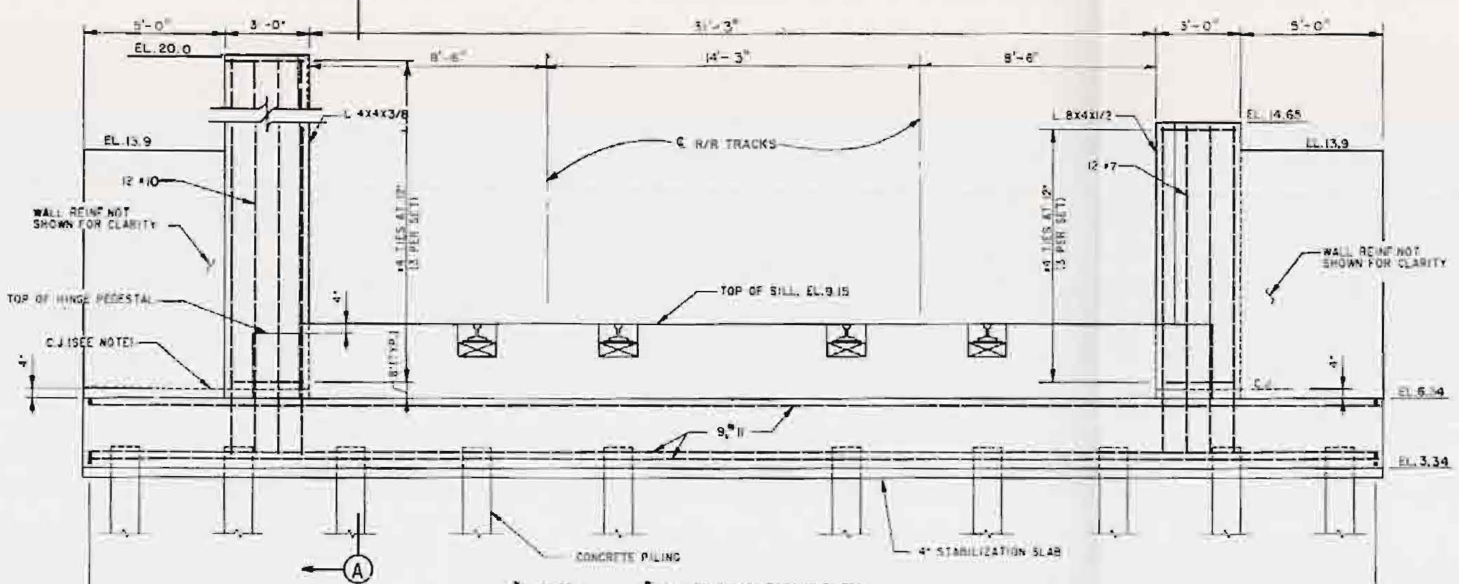
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989 FILE NO. H-2-30288

PLATE 20A


58'-8"
29'-4"
29'-4"
TOP OF WALL, EL "A"
EXPANSION JOINT
EXPANSION JOINT
EXPANSION JOINT
FRACTURED FIN TEXTURE
FRACTURED FIN TEXTURE
1'-6"
3'
LEVEE CROWN EL"F" (LANDSIDE)
LEVEE CROWN EL"E" (CANAL SIDE)
BOTTOM OF WALL "B"
LANDSIDE ELEVATION
TYPICAL WALL TREATMENT
SCALE 1/2" = 1'-0"
℄ JOINT
1/2" EXPANSION JOINT
3/4" CHAMFER (TYP)
2"
3"
3"
6"
(TYP)
SECTION (B)
TEXTURE AT EXPANSION JOINT
SCALE: FULL SIZE
NOTE:
1. ALL FORM TIE BOLTS SHALL OCCUR IN THE VALLEY OF THE CONCRETE WALL RIB TEXTURE. (I.E. BETWEEN ACJACENT RIBS)
2. CONTRACTOR SHALL MAKE ALL EFFORTS TO MINIMIZE THE OCCURANCE OF BUTT JOINTS CONTRACTOR SHALL SUBMIT FOR PRIOR APPROVAL,DRAWINGS SHOWING THE LOCATION OF ALL BUTT JOINTS IN ALL FORMS USED FOR CONSTRUCTION
3. FOR ELEVATIONS, SEE SCHEDULE PLATE 20.
ALL FRACTURED FINS SHALL MAINTAIN A CONTINUOUS FLAT EDGE AT THE PEAK OF THE FIN
FRACTURED FIN-WALL TEXTURE PROFILE
SCALE: FULL SIZE
12"
EL "A"
FRACTURED FIN TEXTURE
LAND SIDE
CANAL SIDE
2'-0"
C.J.
EL "C"
EL "E"
EL "F"
EL "B"
1'-6"
2'-9"
"L" VARIES, SEE SCHEDULE PLATE 20
SHEET PILE TIP EL "D"
SECTION (A)
N.T.S.
LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
ARCHITECTURAL FINISH
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989
FILE NO. H-2-30288

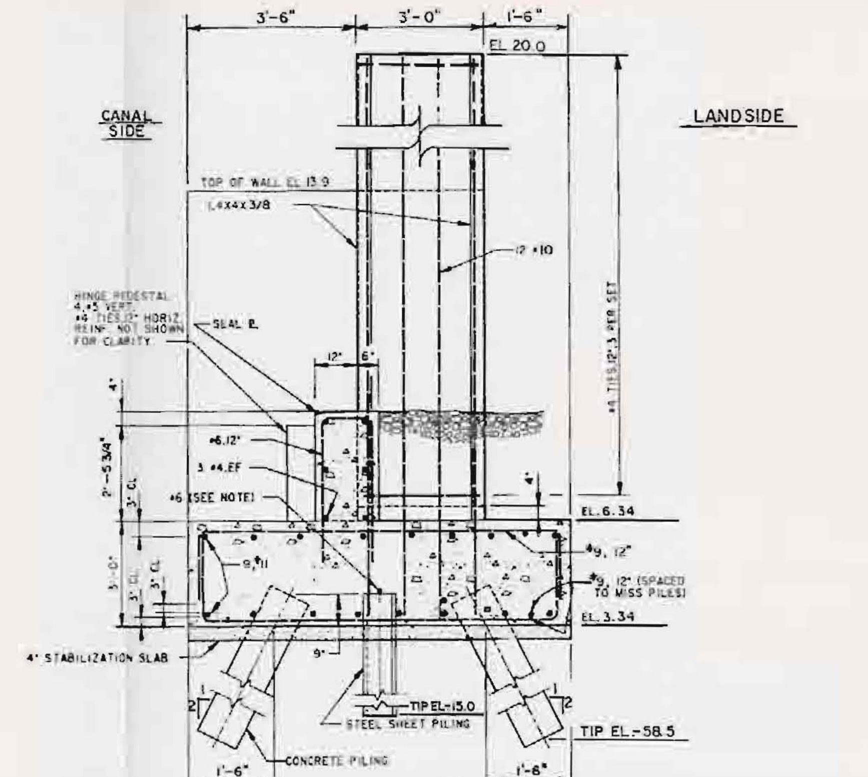


PLAN
N.T.S.



CANAL SIDE ELEVATION
N.T.S.

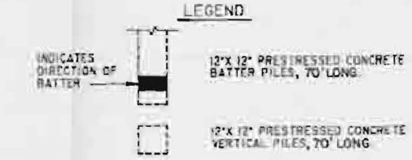
NOTE:
CONSTRUCTION JOINT APPLIES TO WALLS AND COLUMNS ONLY.



SECTION A
N.T.S.

BONDING NOTE:
#6 REINFORCING BAR SHALL BE WELDED ACROSS THE TOP OF EACH SHEET PILE. #6 REINFORCING BAR SHALL NOT EXTEND ACROSS THE MONOLITH JOINT. INSTALL FLEXIBLE JUMPER AT ALL MONOLITH JOINTS IN ACCORDANCE WITH THE SPECIFICATIONS.

LEGEND

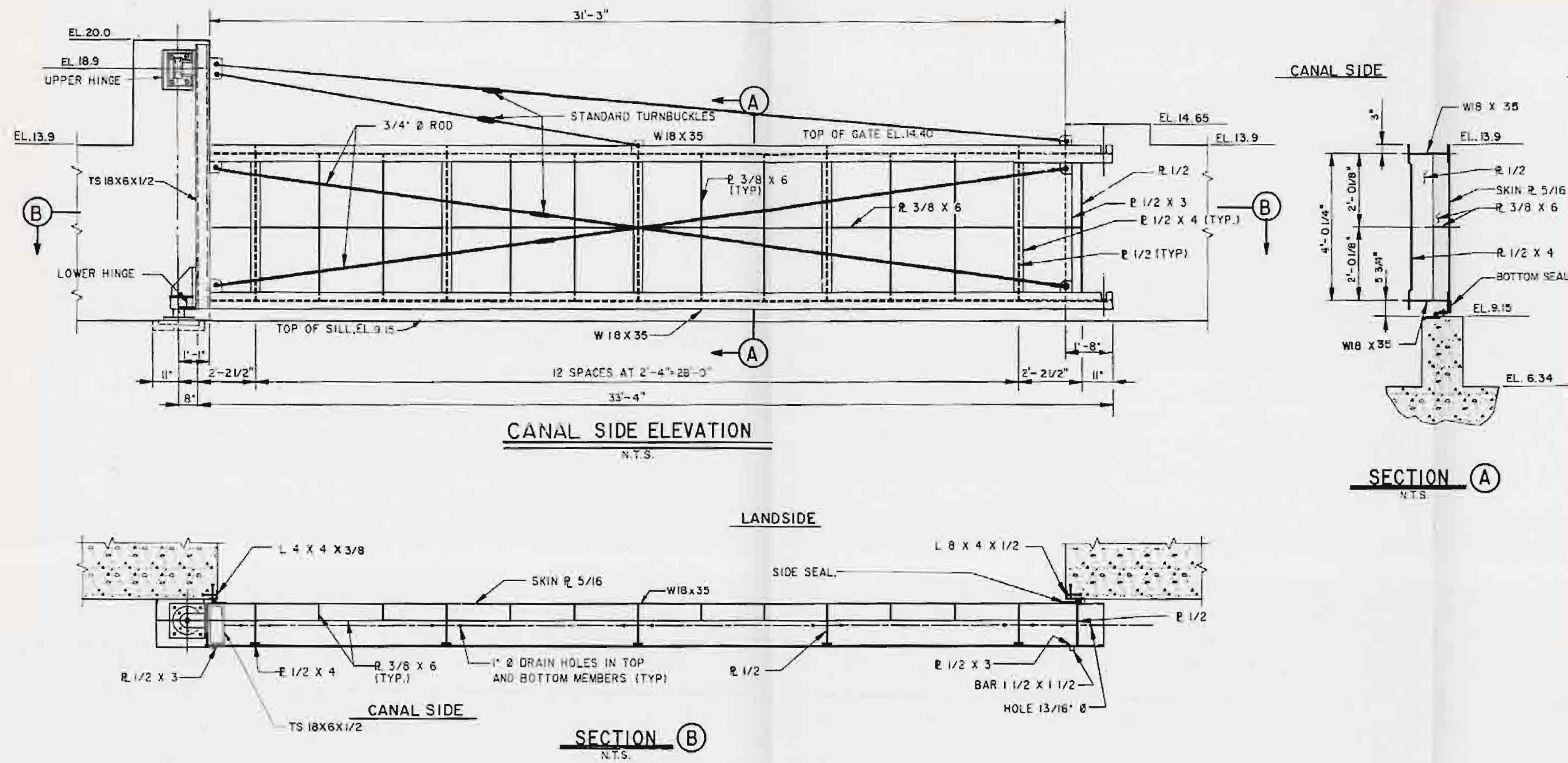


NOTE:
EAST SIDE GATE MONOLITH SHOWN, WEST SIDE OPPOSITE HAND.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
SOUTHERN RAILROAD
SWING GATE MONOLITH

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

DATE: JAN. 1989 FILE NO. H-2-30288

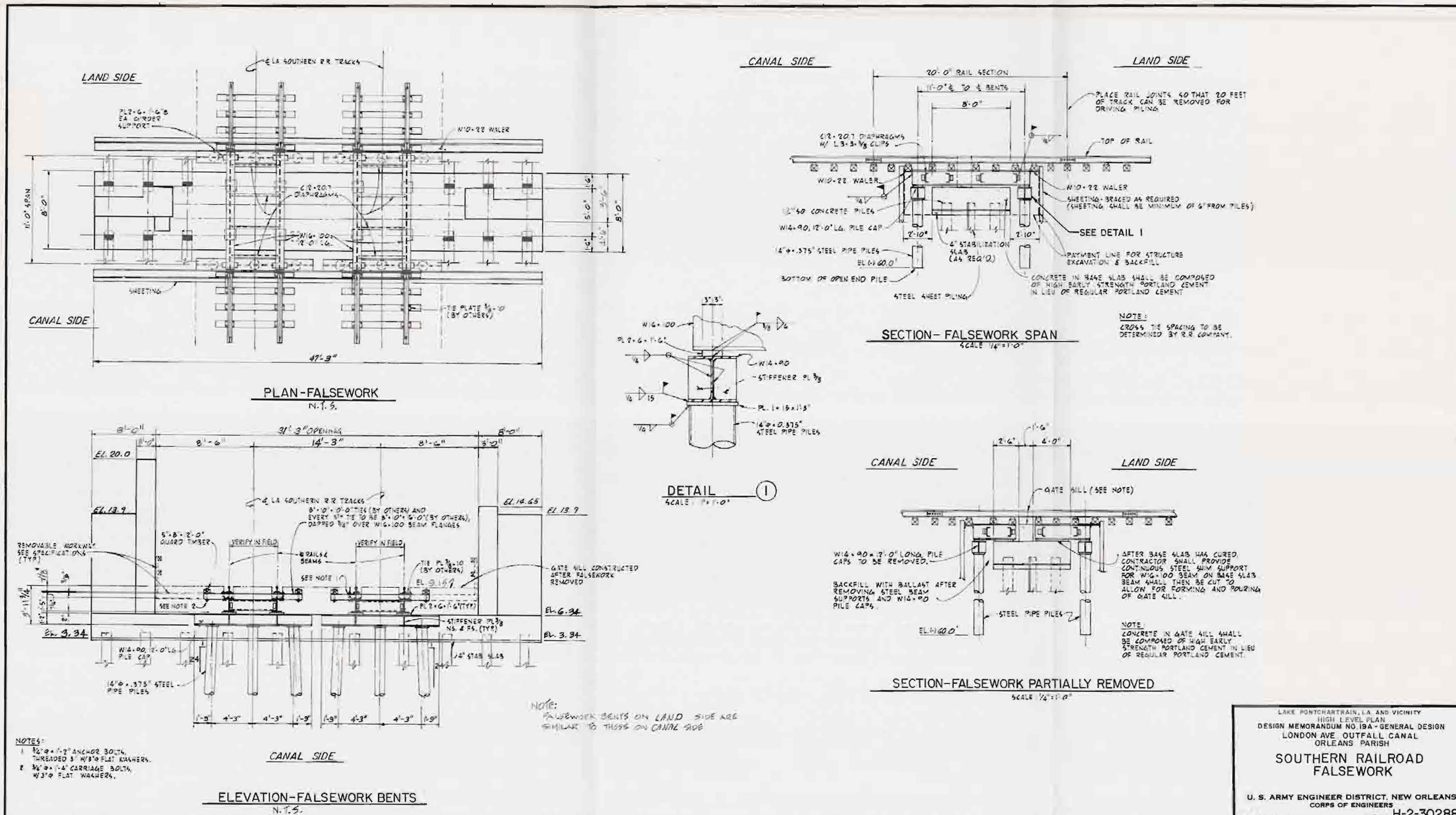


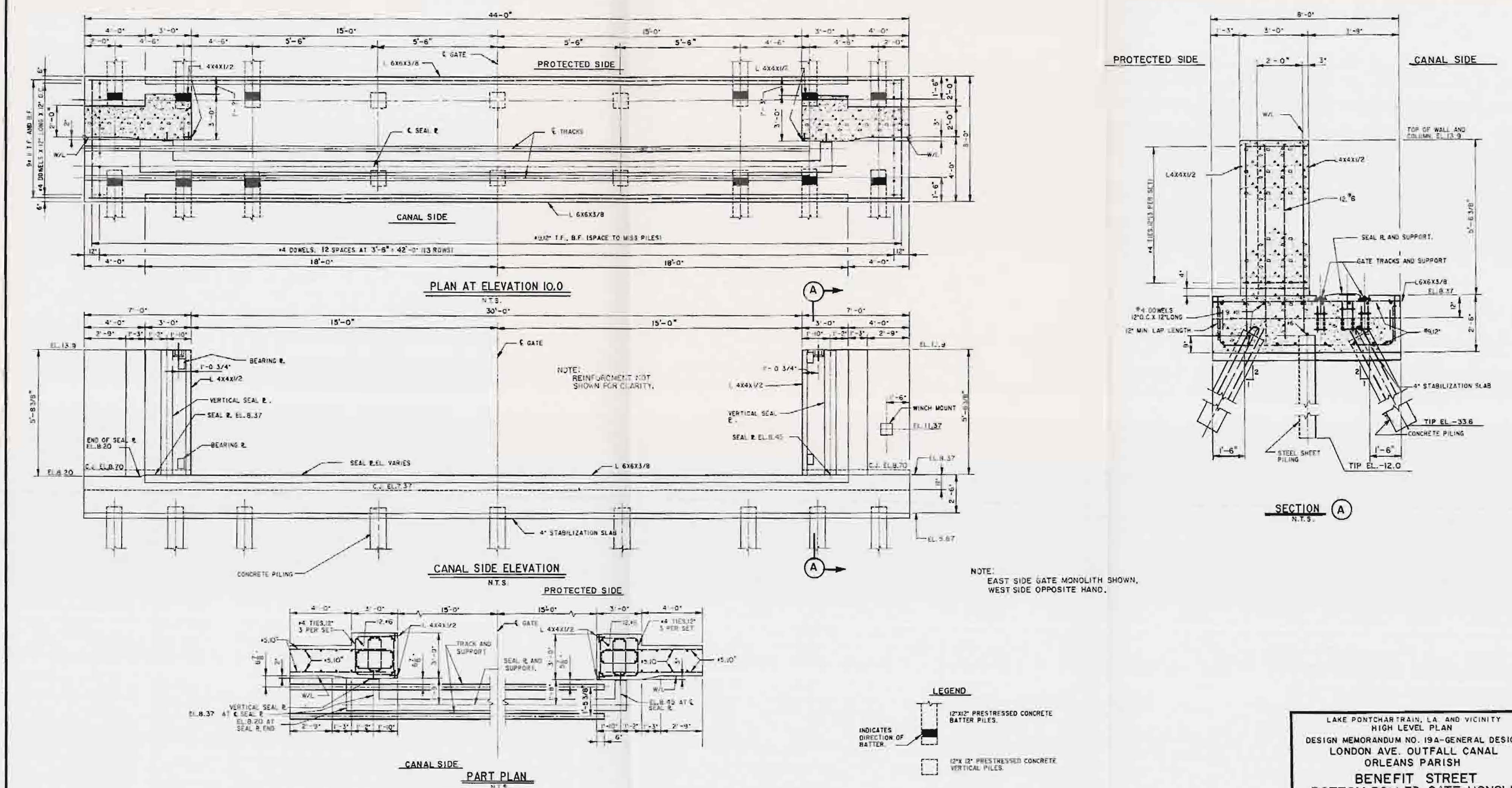
NOTE:
EAST SIDE GATE SHOWN,
WEST SIDE OPPOSITE HAND.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOUTHERN RAILROAD
SWING GATE

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989 FILE NO. H-2-30288


PLAN-FALSEWORK
N.T.S.
LAND SIDE
CANAL SIDE
℄ LA SOUTHERN R.R. TRACKS
W10×22 WALER
SHEETING
47'-3"
ELEVATION-FALSEWORK BENTS
N.T.S.
31'-3" OPENING
EL. 20.0
EL. 13.9
EL. 14.65
EL. 6.34
EL. 3.34
CANAL SIDE
NOTES:
DETAIL 1
SECTION- FALSEWORK SPAN
SCALE 1/4"=1'-0"
CANAL SIDE
LAND SIDE
20'-0" RAIL SECTION
TOP OF RAIL
SEE DETAIL 1
NOTE: CROSS TIE SPACING TO BE DETERMINED BY R.R. COMPANY.
SECTION-FALSEWORK PARTIALLY REMOVED
SCALE 1/4"=1'-0"
CANAL SIDE
LAND SIDE
GATE SILL (SEE NOTE)
NOTE: CONCRETE IN GATE SILL SHALL BE COMPOSED OF HIGH EARLY STRENGTH PORTLAND CEMENT IN LIEU OF REGULAR PORTLAND CEMENT.
NOTE: FALSEWORK BENTS ON LAND SIDE ARE SIMILAR TO THOSE ON CANAL SIDE
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
SOUTHERN RAILROAD
FALSEWORK
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989
FILE NO. H-2-30288

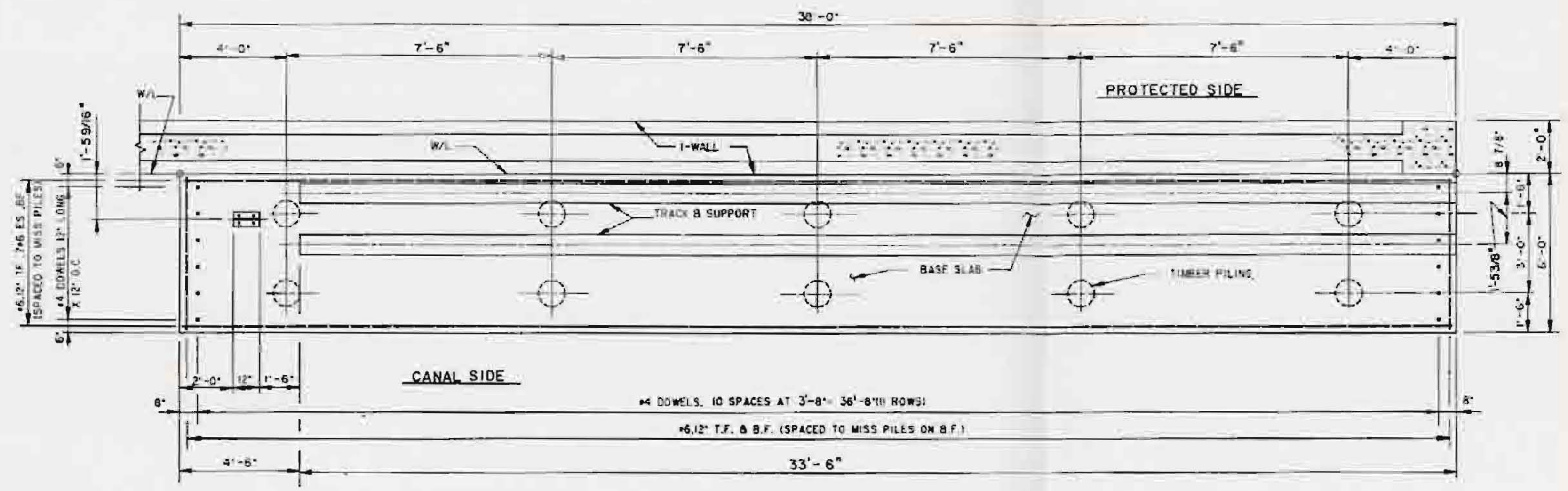


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

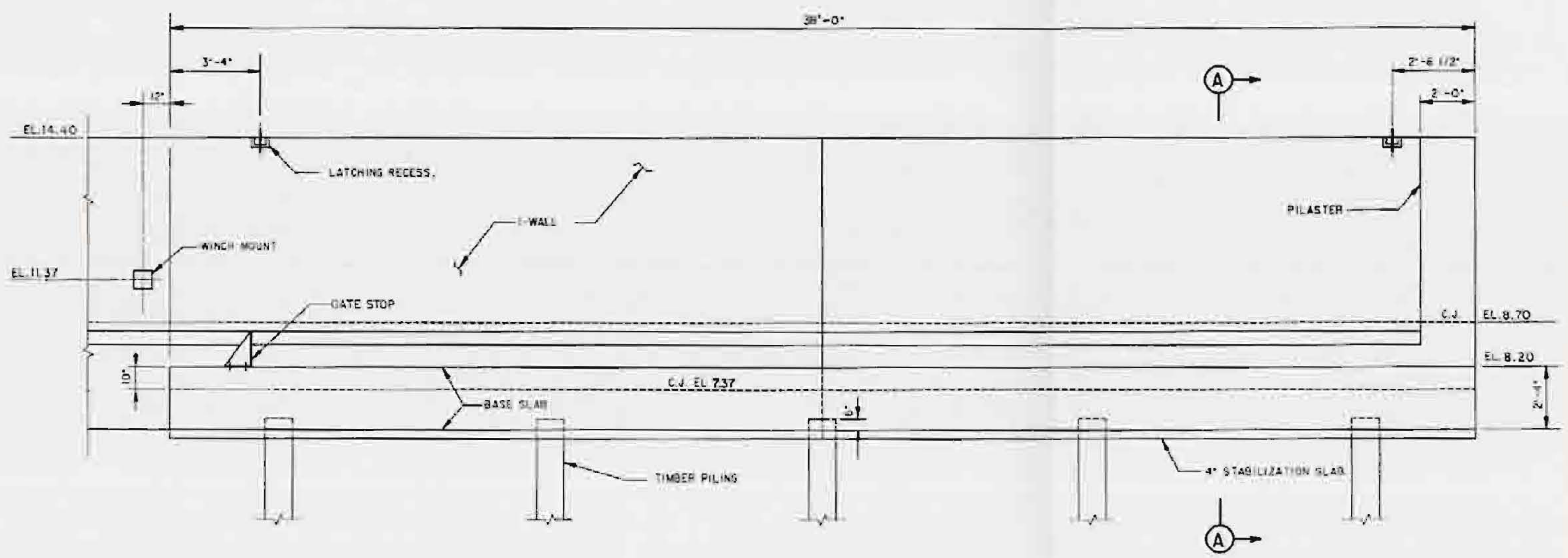
BENEFIT STREET
BOTTOM ROLLER GATE MONOLITH

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

DATE JAN. 1989 FILE NO. H-2-30288



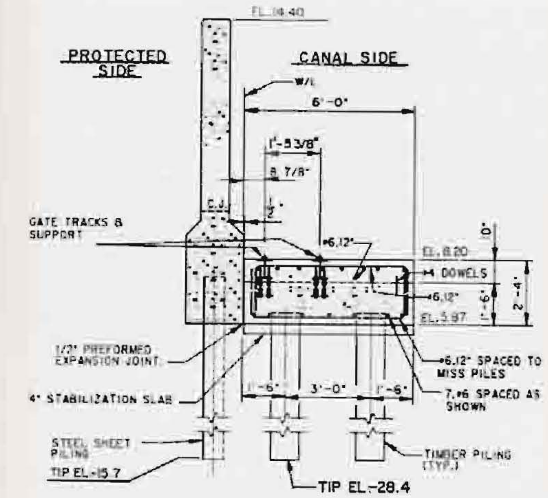
PLAN AT ELEVATION 10.00
N.T.S.



CANAL SIDE ELEVATION
N.T.S.

NOTE:
EAST SIDE GATE STORAGE MONOLITH SHOWN, WEST SIDE OPPOSITE HAND.

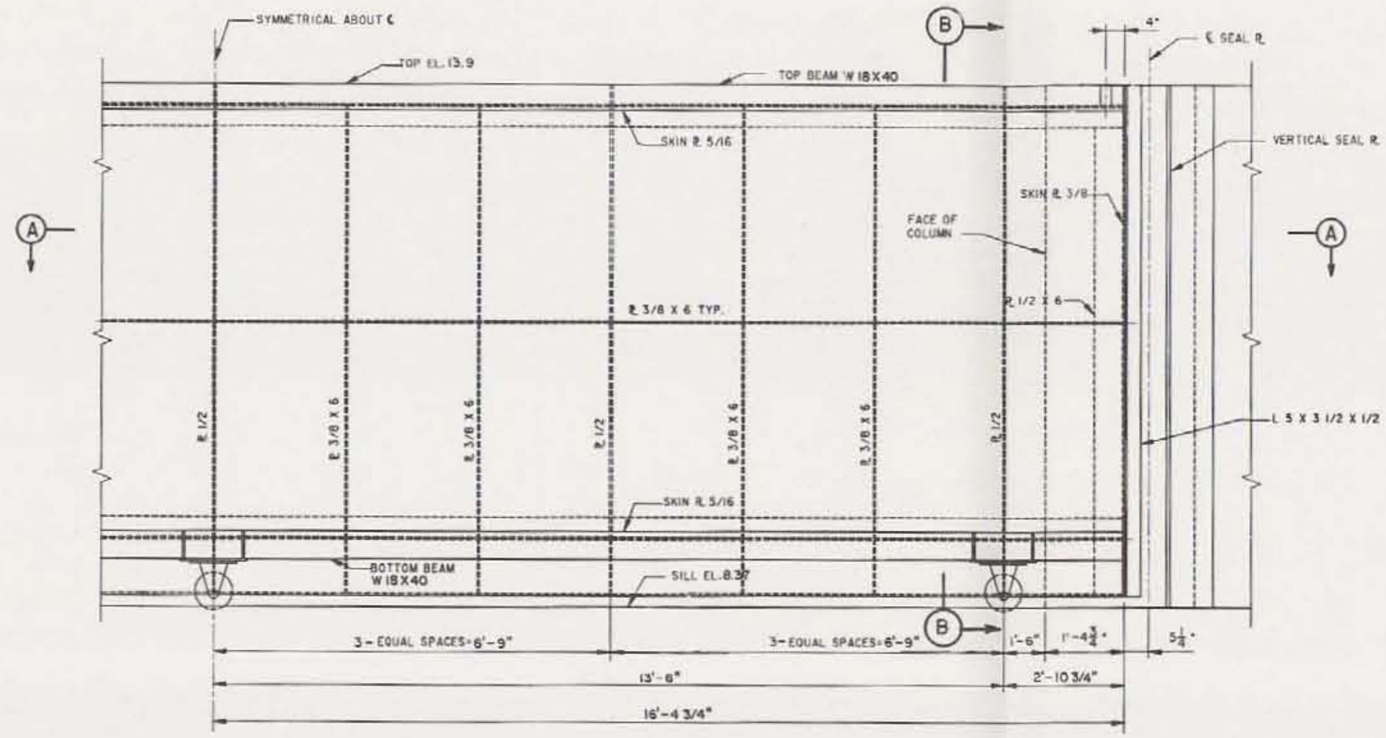
LEGEND
◯ 12"Ø TIMBER PILES



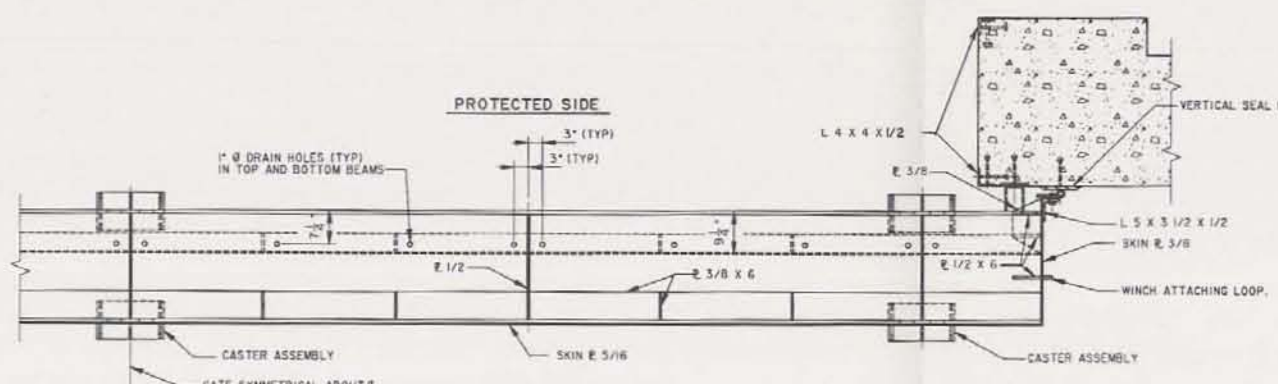
SECTION (A)
N.T.S.

NOTE:
I-WALL SHOWN FOR ILLUSTRATIVE PURPOSES ONLY, ELEVATIONS VARY, SEE EAST AND WEST PROFILE, PLATE 17.

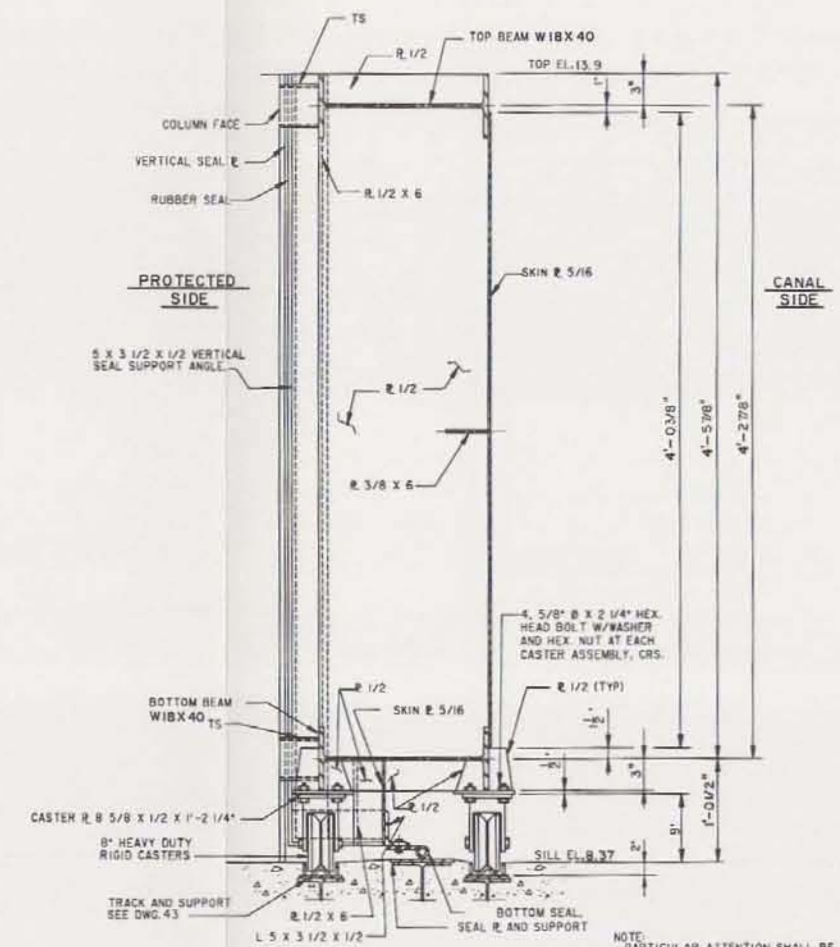
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
BENEFIT STREET
BOTTOM ROLLER GATE
STORAGE MONOLITH
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989 FILE NO. H-2-30288



CANAL SIDE ELEVATION
N.T.S.



SECTION (A)
N.T.S.



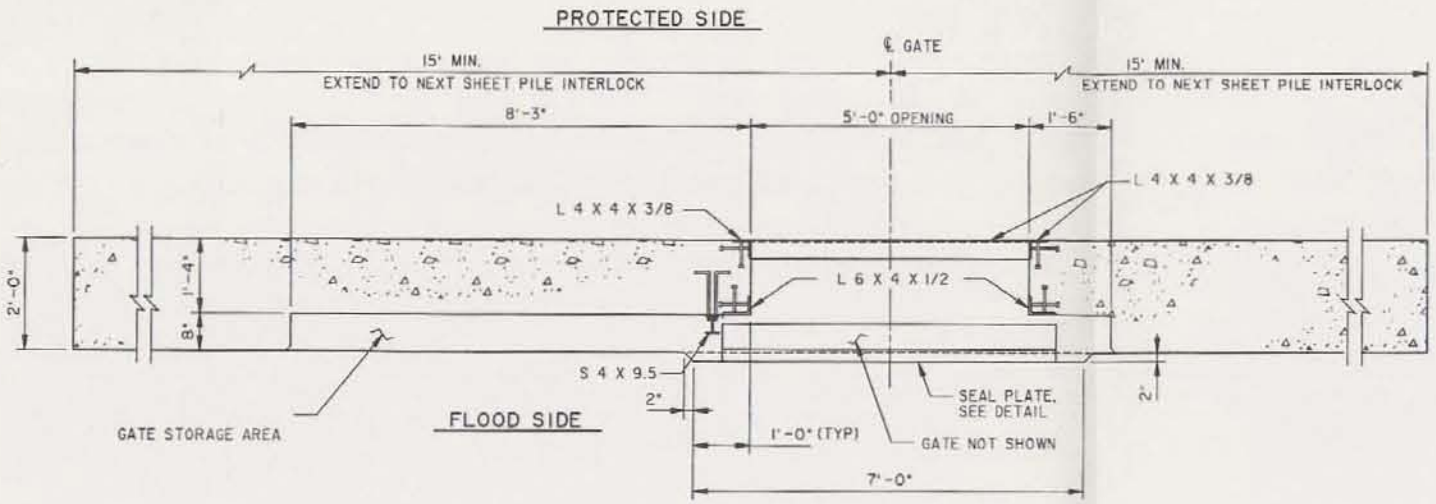
SECTION (B)
N.T.S.

NOTE:
PARTICULAR ATTENTION SHALL BE GIVEN TO FIELD ADJUSTMENT OF BOTTOM SEAL IN ORDER TO OBTAIN A PERFECT SEAL WITH SEAL ℞

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
BENEFIT STREET
BOTTOM ROLLER GATE

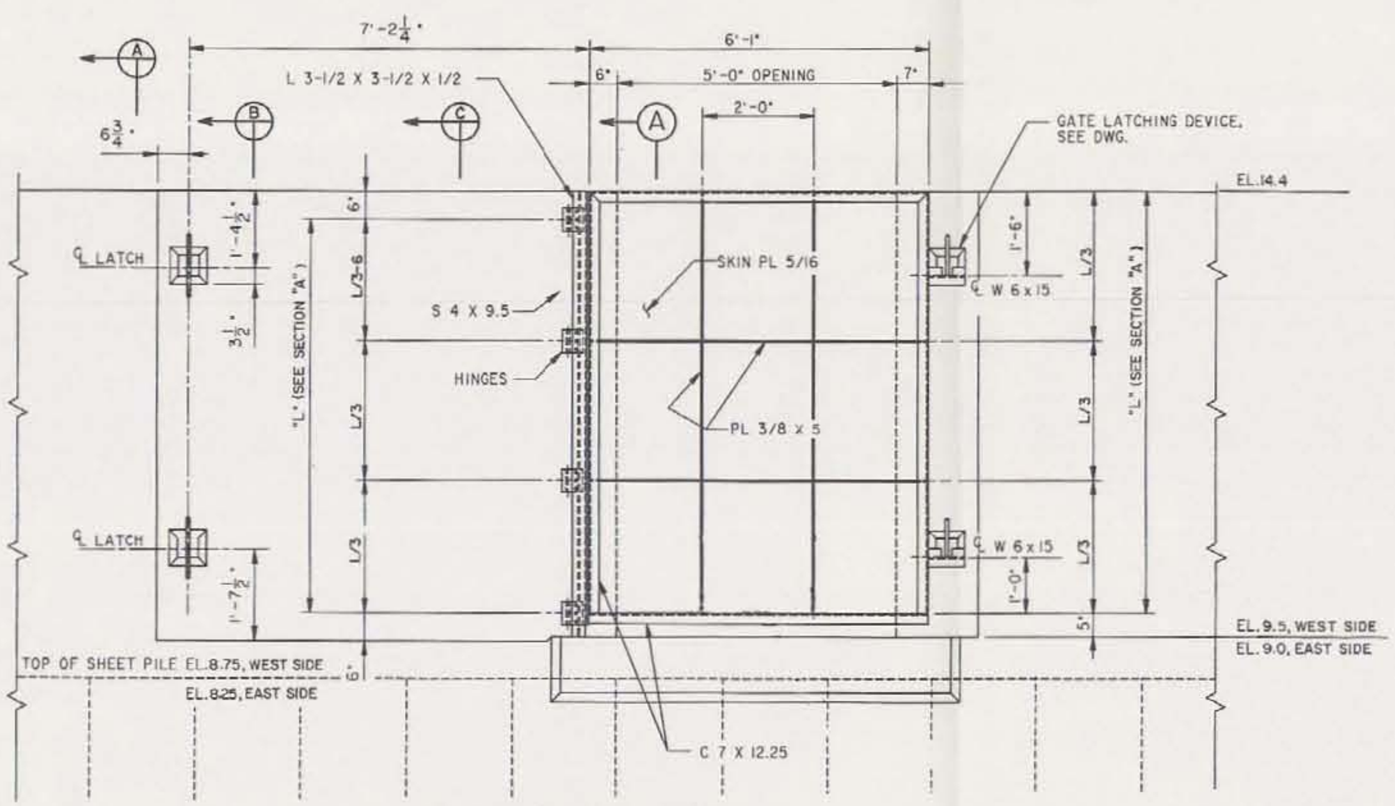
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE JAN. 1989 FILE NO. H-2-30288



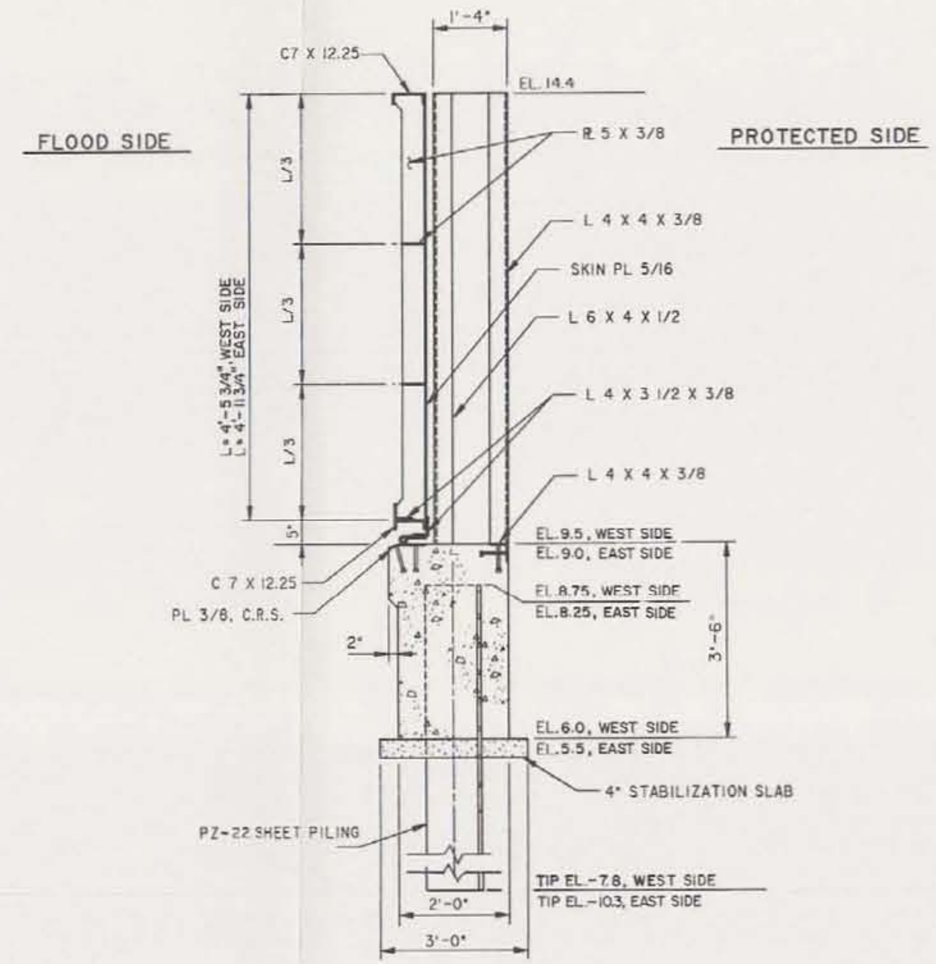
PLAN AT ELEVATION 13.0

N.T.S.



FLOOD SIDE ELEVATION

N.T.S.



SECTION (A)

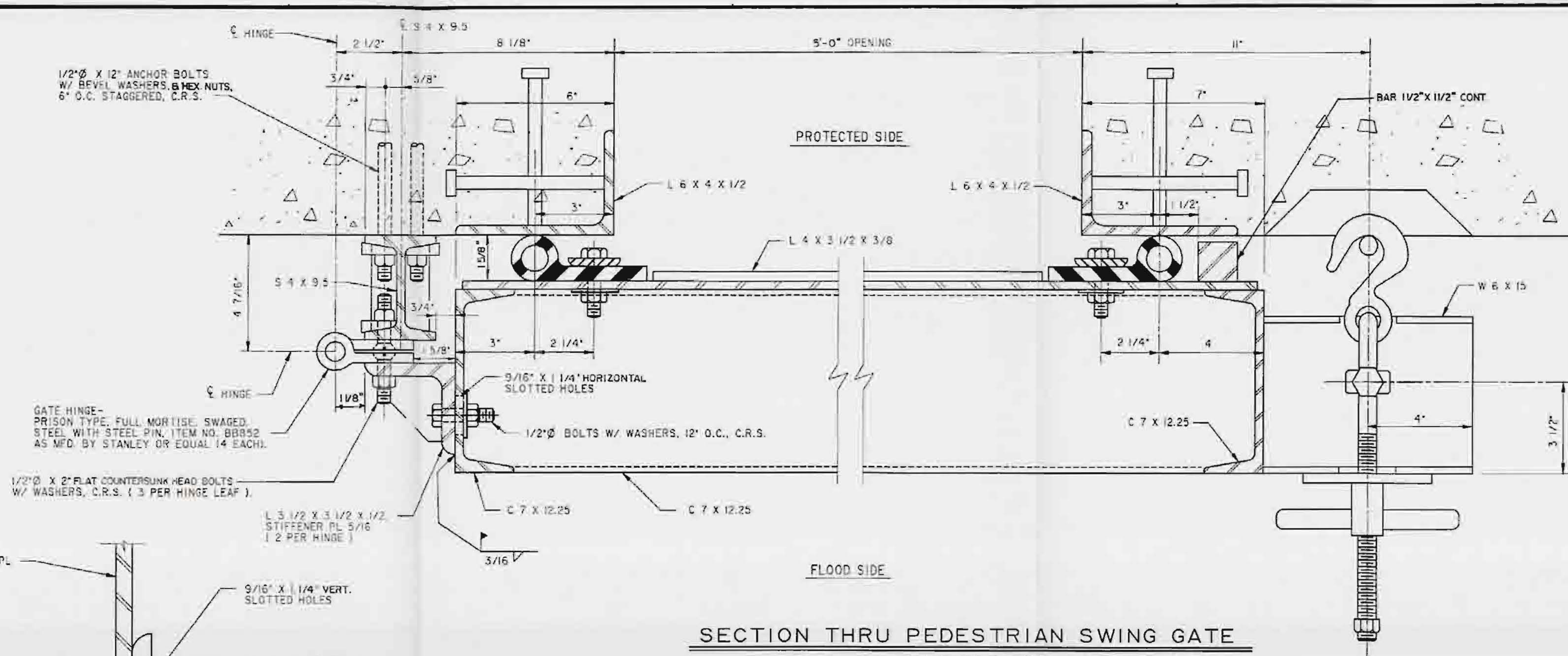
N.T.S.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PEDESTRIAN GATE MONOLITH

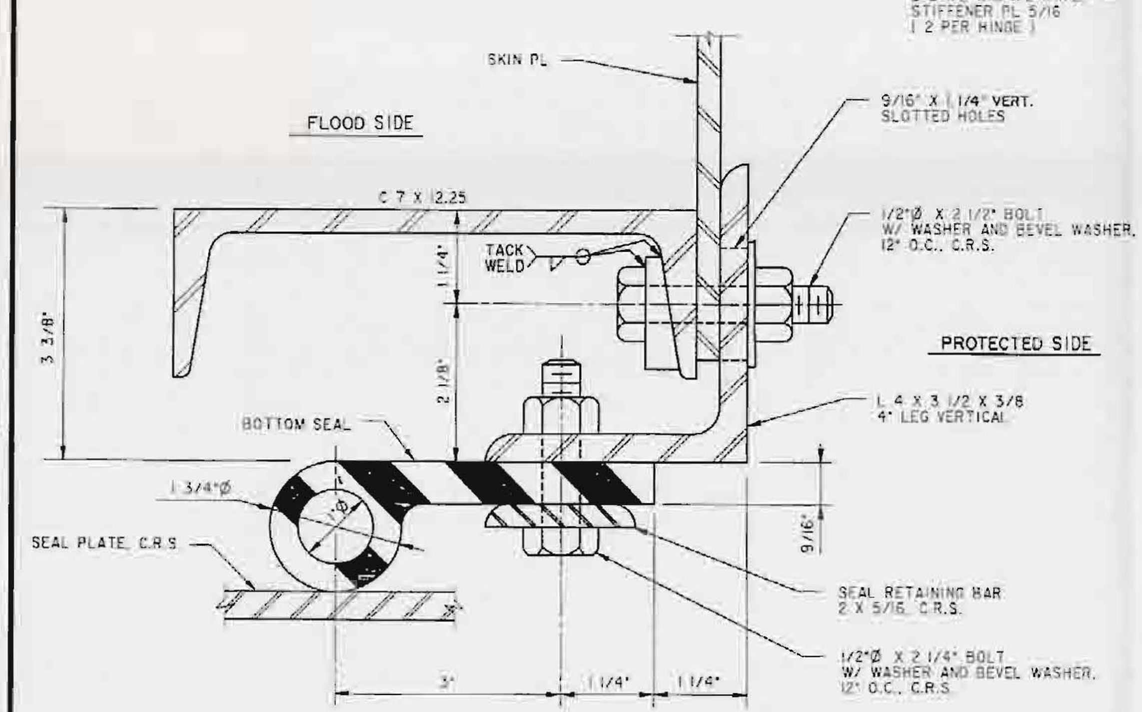
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE JAN. 1989 FILE NO. H-2-30288



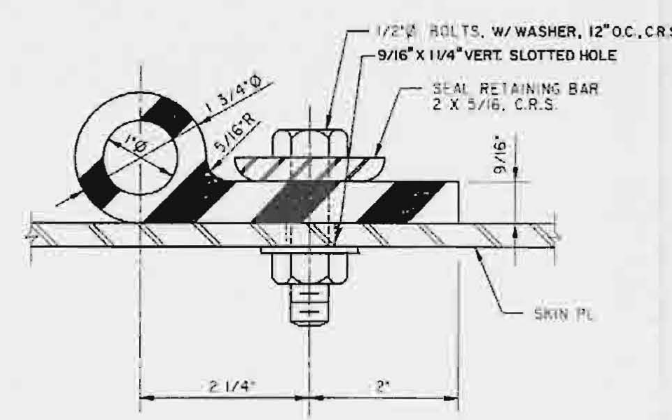
SECTION THRU PEDESTRIAN SWING GATE

SCALE: 6" = 1'-0"



SECTION THRU BOTTOM SEAL

SCALE: 12" = 1'-0"



VERTICAL SEAL DETAIL

SCALE: 12" = 1'-0"

SCALE: 6" = 1'-0"

12" 6" 0

SCALE: 12" = 1'-0"

6" 3" 0

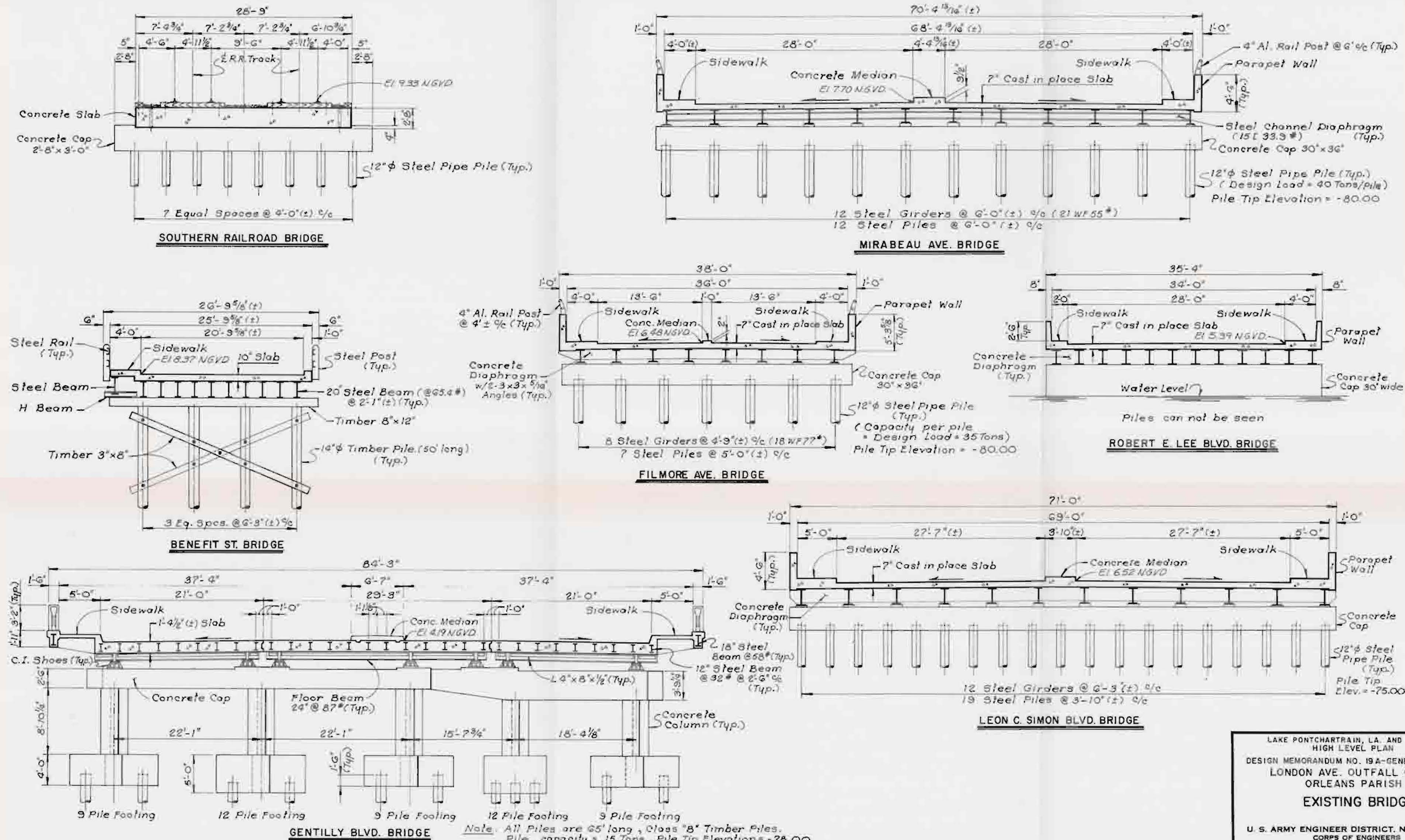
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PEDESTRIAN SWING GATE

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

DATE JAN. 1989 FILE NO. H-2-30288

PLATE 29

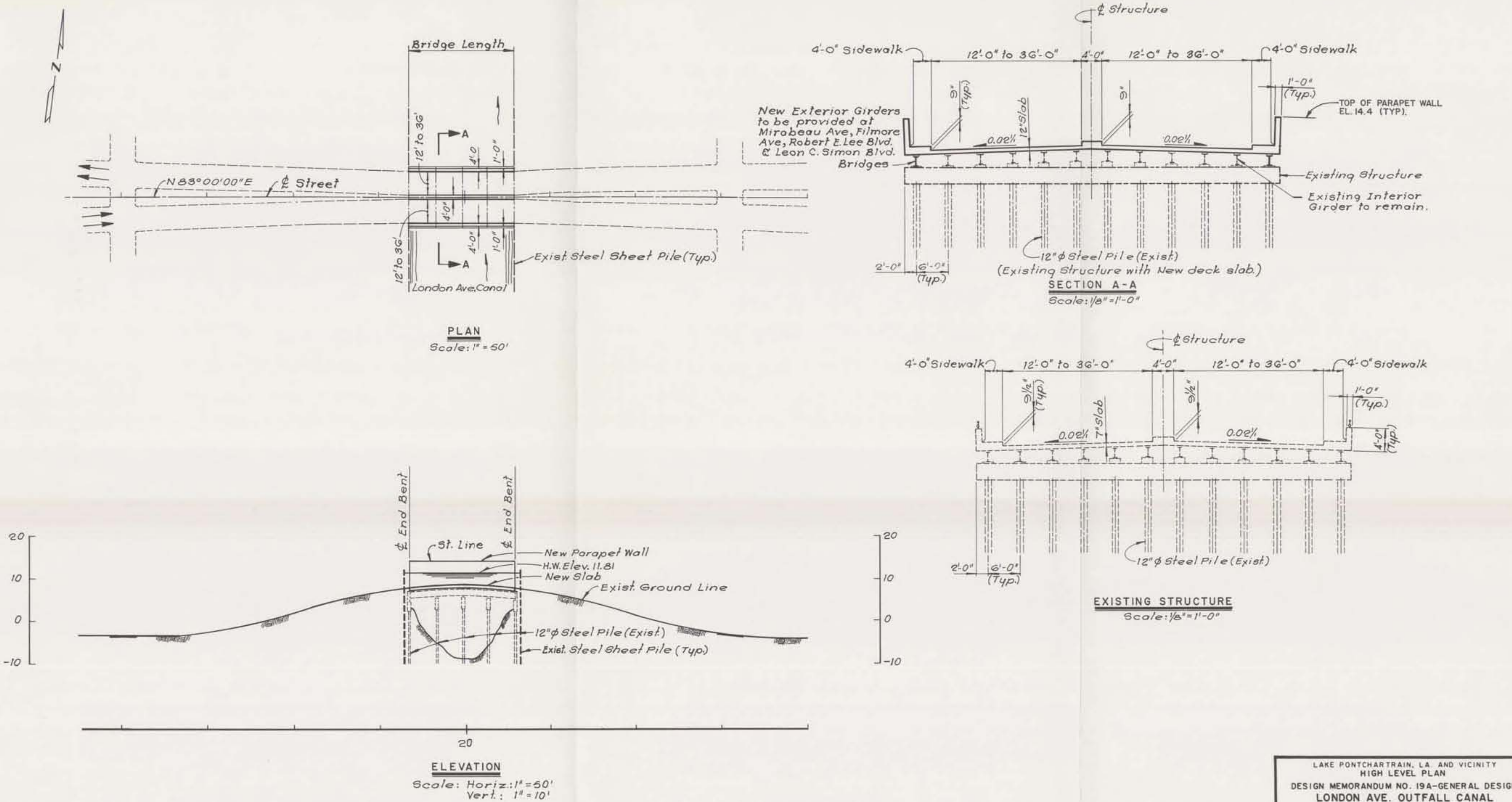


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

EXISTING BRIDGES

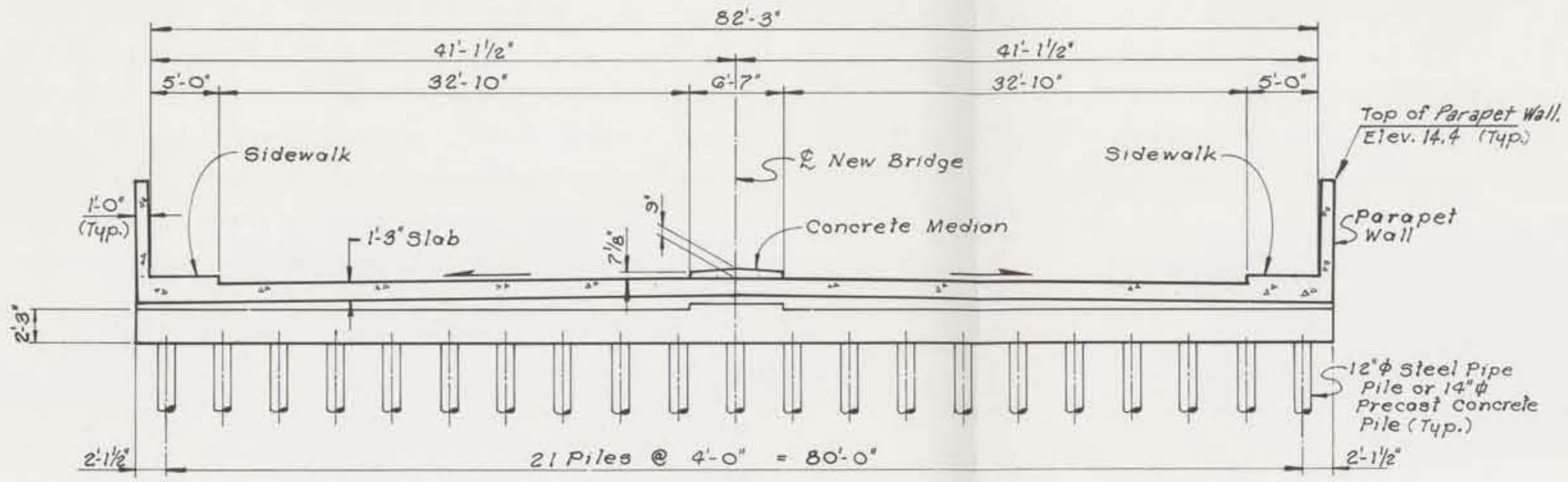
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE JAN. 1989 FILE NO. H-2-30288



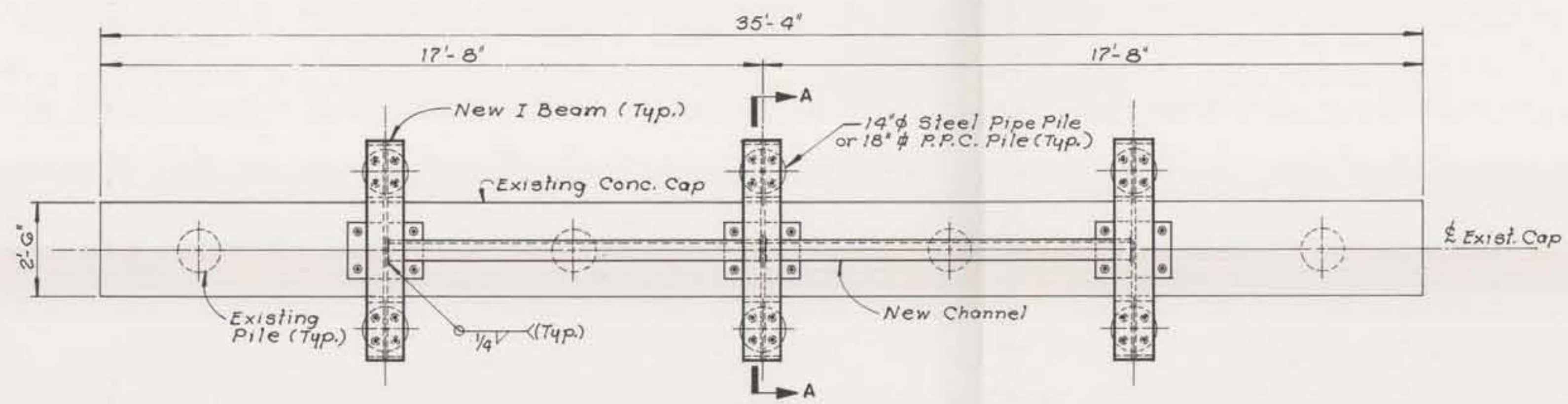
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
BRIDGE DECK REPLACEMENTS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JAN. 1989 FILE NO. H-2-30288

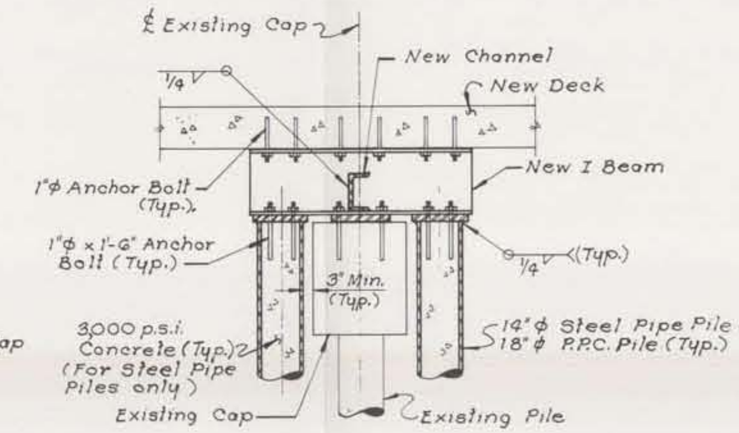


SECTION
(Scale: 3/16" = 1'-0")

PROPOSED NEW BRIDGE @ GENTILLY BLVD.



PLAN
(Scale: ½" = 1'-0")



SECTION A-A
(Scale: ½" = 1'-0")

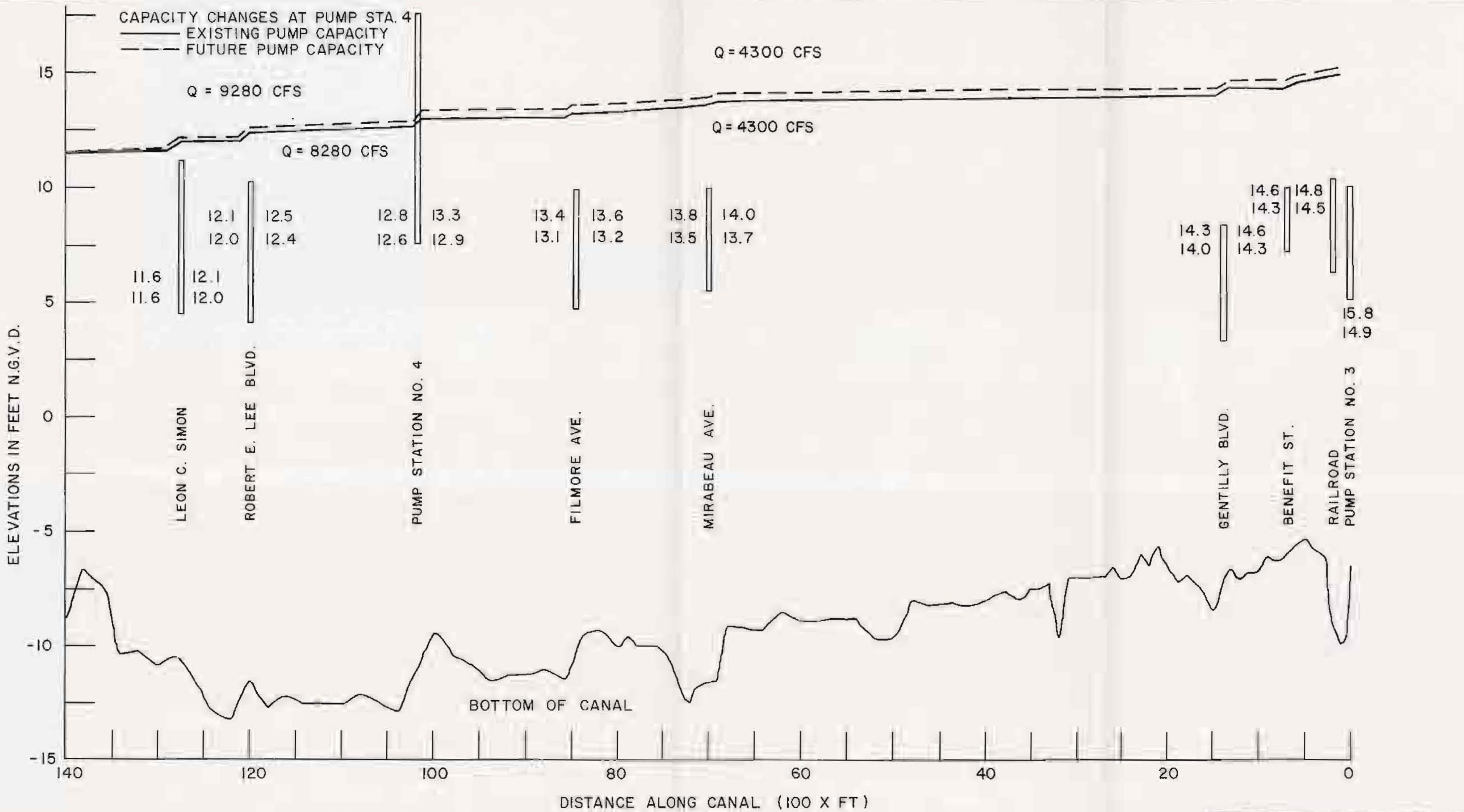
PROPOSED TENSION PILES @ ROBERT E. LEE BLVD. BRIDGE
(SIMILAR DETAIL FOR GENTILLY BLVD. BRIDGE)

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

GENTILLY BLVD. BRIDGE AND ROBERT E. LEE BLVD. BRIDGE TENSION PILES

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

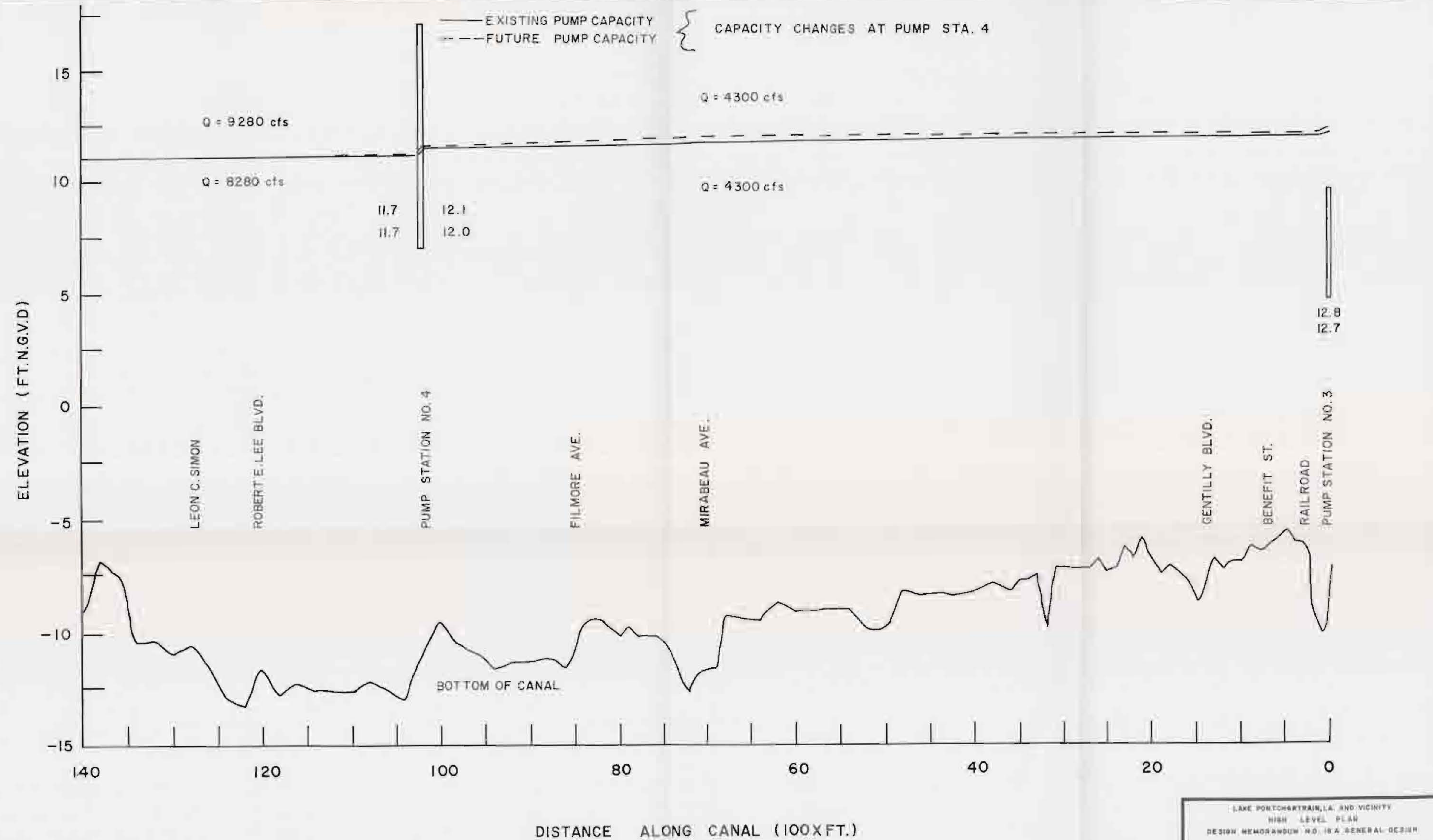
DATE JAN. 1989 FILE NO. H-2-30288



LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

EXISTING CHANNEL
EXISTING BRIDGE CONFIGURATION
WITHOUT BUTTERFLY VALVES

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288

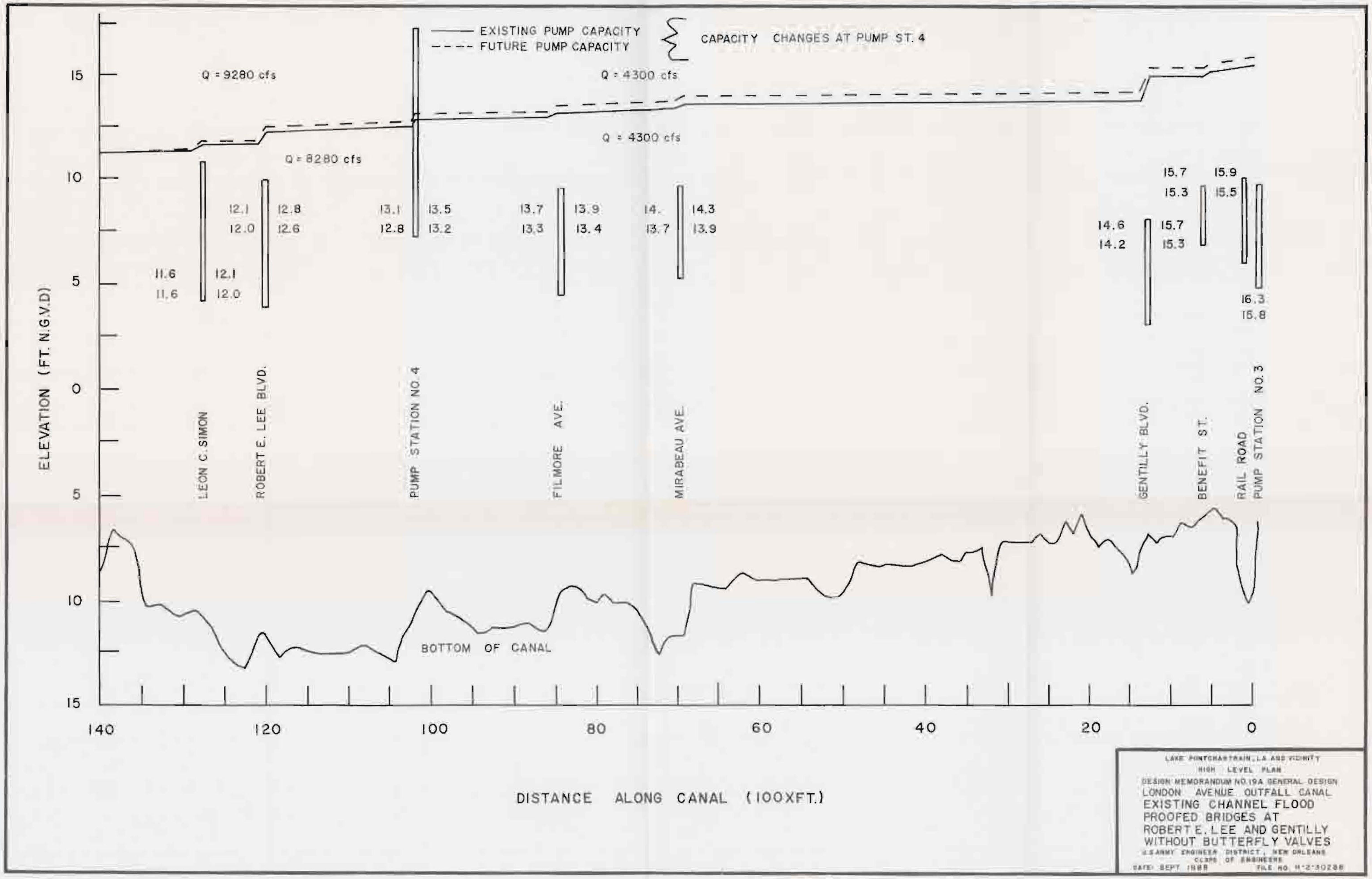


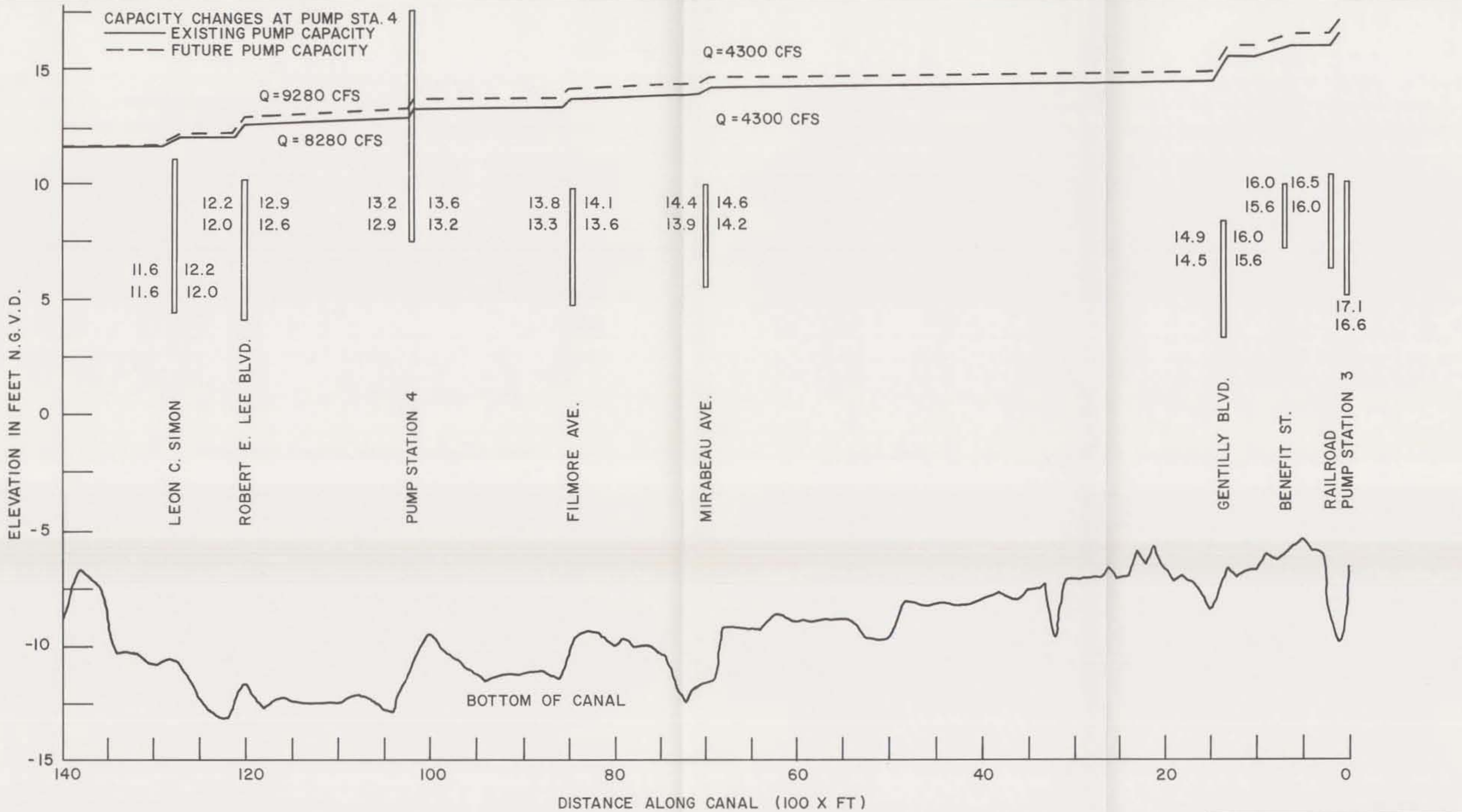
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

EXISTING CHANNEL
ALL BRIDGES RAISED

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288

PLATE 34


EXISTING PUMP CAPACITY
FUTURE PUMP CAPACITY
CAPACITY CHANGES AT PUMP ST. 4
Q = 9280 cfs
Q = 4300 cfs
Q = 8280 cfs
Q = 4300 cfs
ELEVATION (FT. N.G.V.D)
15
10
5
0
5
10
15
11.6
11.6
12.1
12.0
12.1
12.0
12.8
12.6
13.1
12.8
13.5
13.2
13.7
13.3
13.9
13.4
14.
13.7
14.3
13.9
14.6
14.2
15.7
15.3
15.7
15.3
15.9
15.5
16.3
15.8
LEON C. SIMON
ROBERT E. LEE BLVD.
PUMP STATION NO. 4
FILMORE AVE.
MIRABEAU AVE.
GENTILLY BLVD.
BENEFIT ST.
RAIL ROAD
PUMP STATION NO. 3
BOTTOM OF CANAL
140
120
100
80
60
40
20
0
DISTANCE ALONG CANAL (100XFT.)
LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL
EXISTING CHANNEL FLOOD
PROOFED BRIDGES AT
ROBERT E. LEE AND GENTILLY
WITHOUT BUTTERFLY VALVES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

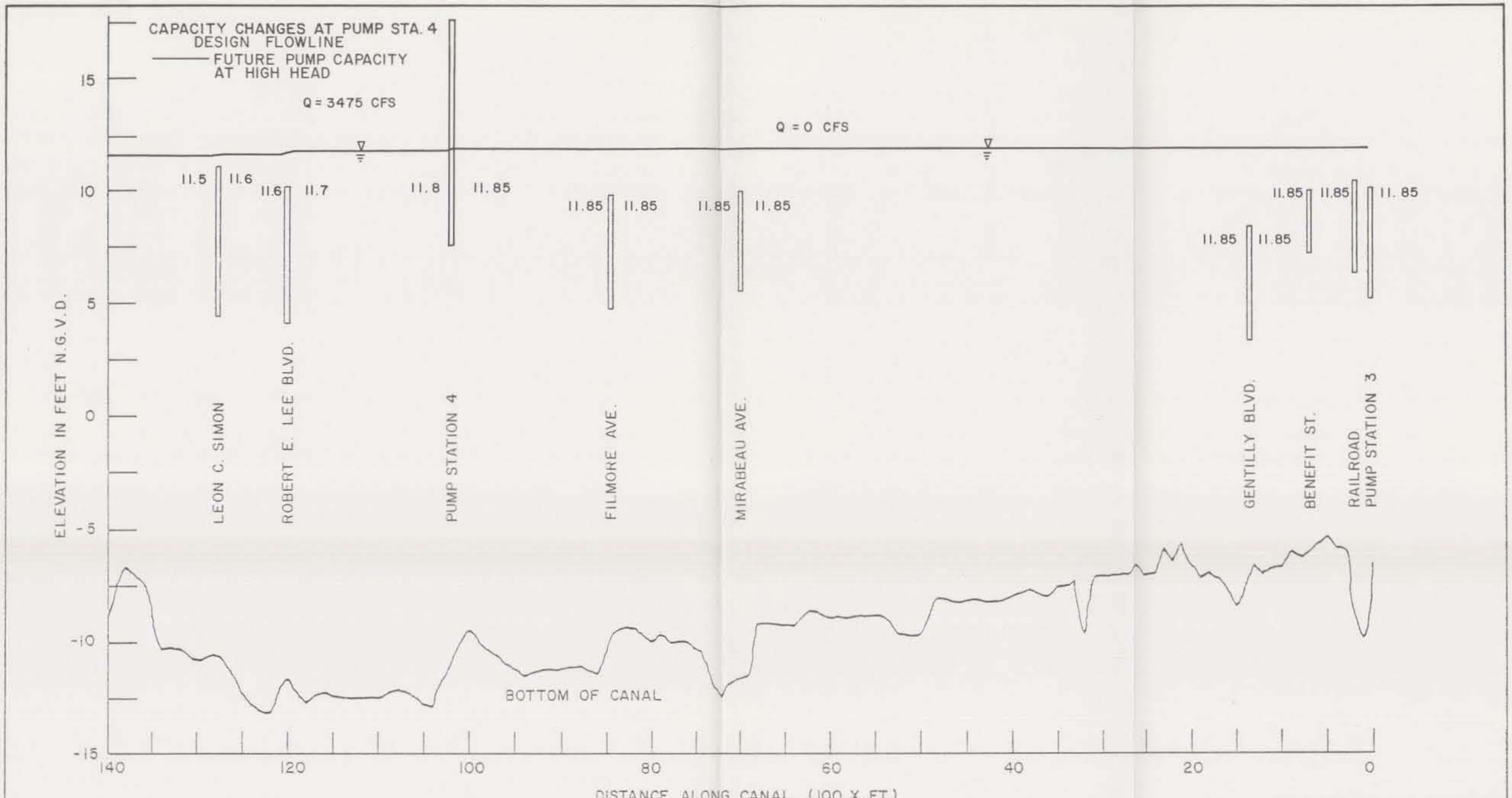


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

EXISTING CHANNEL
ALL BRIDGES FLOOD PROOFED
WITHOUT BUTTERFLY VALVES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288

PLATE 36

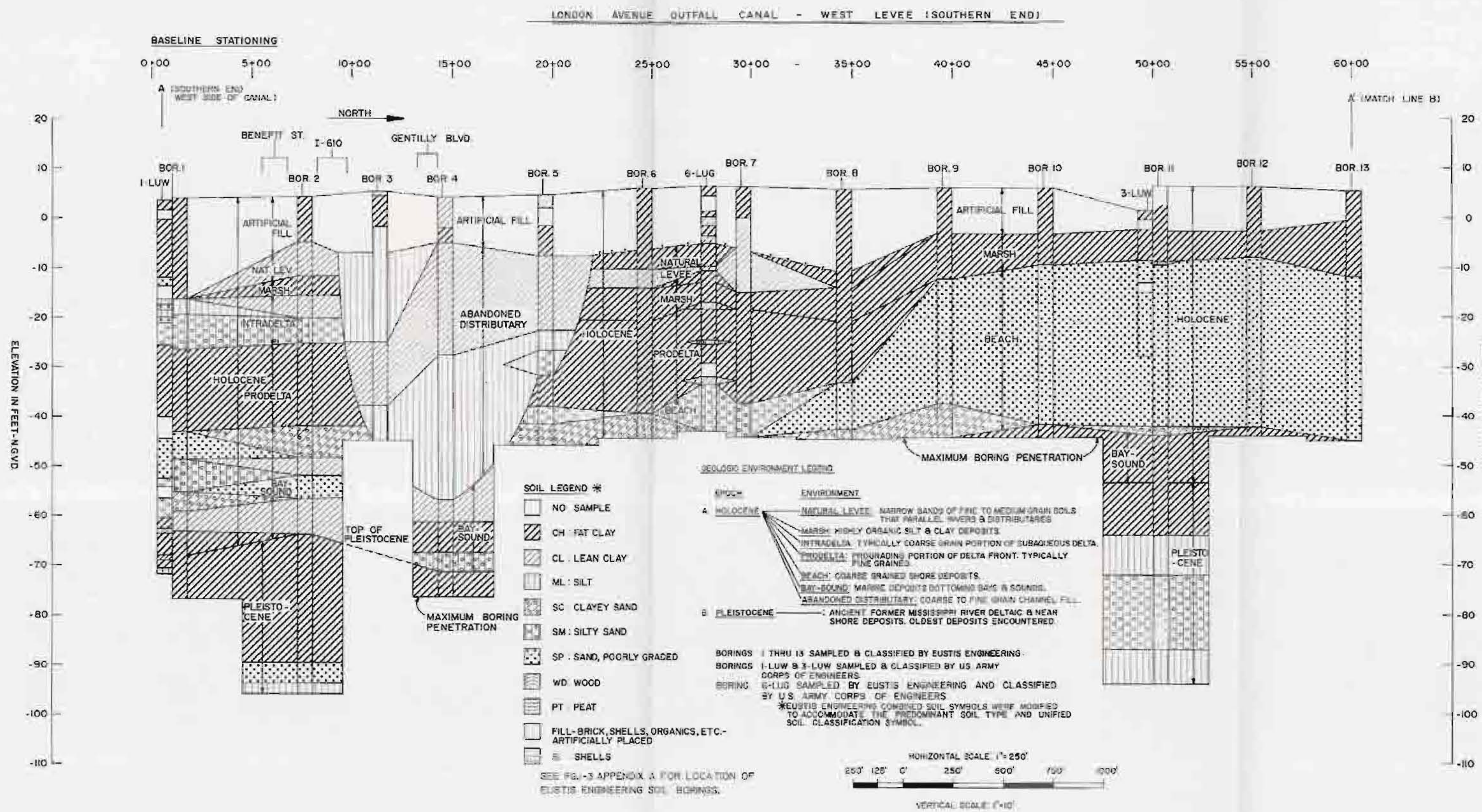


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

DESIGN FLOWLINE
EXISTING CHANNEL
ALL BRIDGES FLOOD PROOFED
WITHOUT BUTTERFLY VALVES

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

DATE: SEPT. 1988 FILE NO. H-2-30288



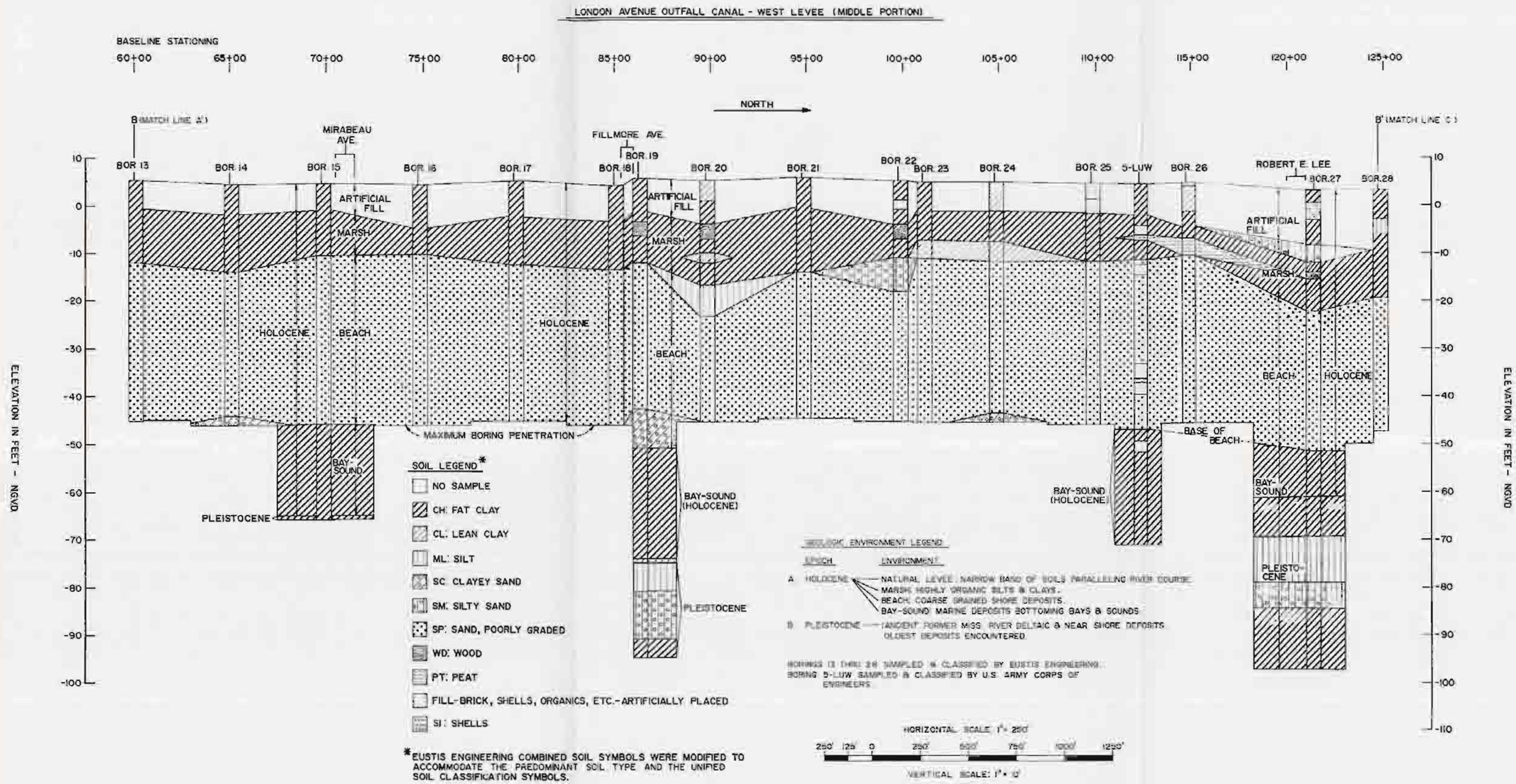
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

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

DATE: SEPT 1988 FILE NO. H-2-20288

PLATE 37



SEE APPENDIX A FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS.

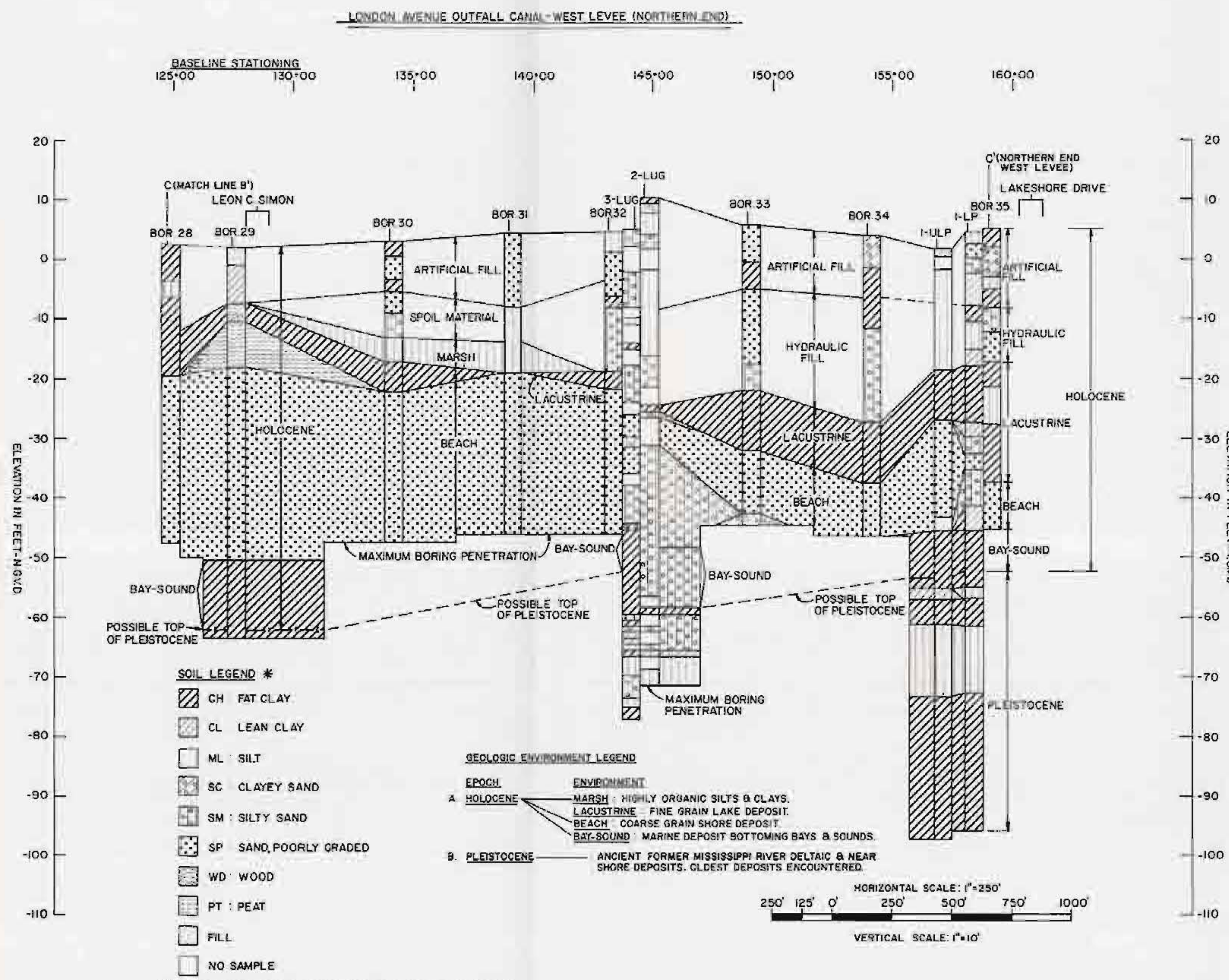
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN

LONDON AVE. OUTFALL CANAL

ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS



* EUSTIS ENGINEERING COMBINED SOIL SYMBOLS WERE MODIFIED TO ACCOMMODATE THE PREDOMINANT SOIL TYPE AND THE UNIFIED SOIL CLASSIFICATION SYMBOLS.

BORINGS 29 THRU 35 WERE SAMPLED & CLASSIFIED BY EUSTIS ENGINEERING. BORINGS 2-LUG, 3-LUG, 1-ULP, AND 1-LP SAMPLED & CLASSIFIED BY U.S. ARMY CORPS OF ENGINEERS PERSONNEL.

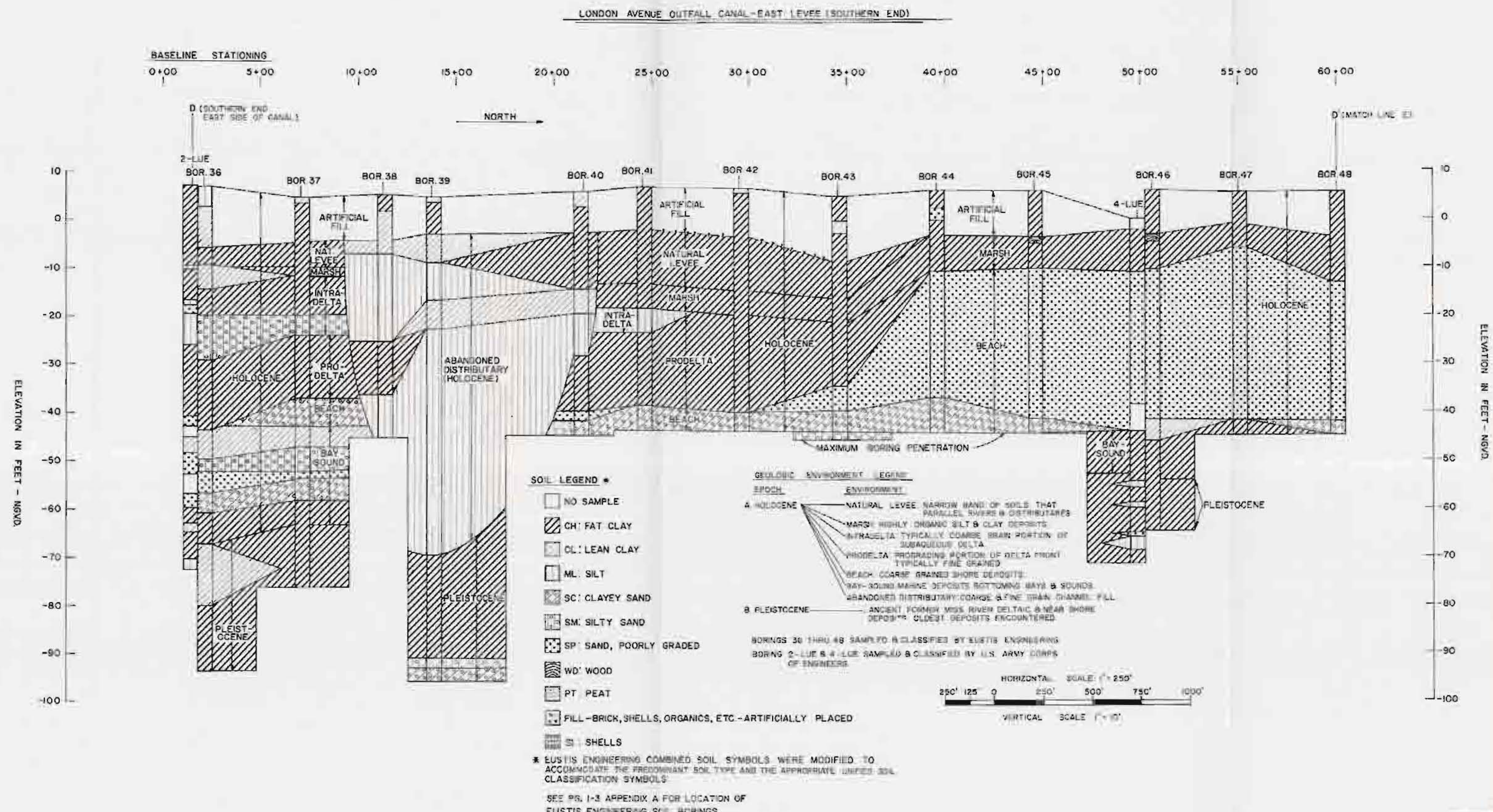
SEE PG. 1-3 APPENDIX A FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS.

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

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

DATE SEPT 1988 FILE NO. H-2-30288

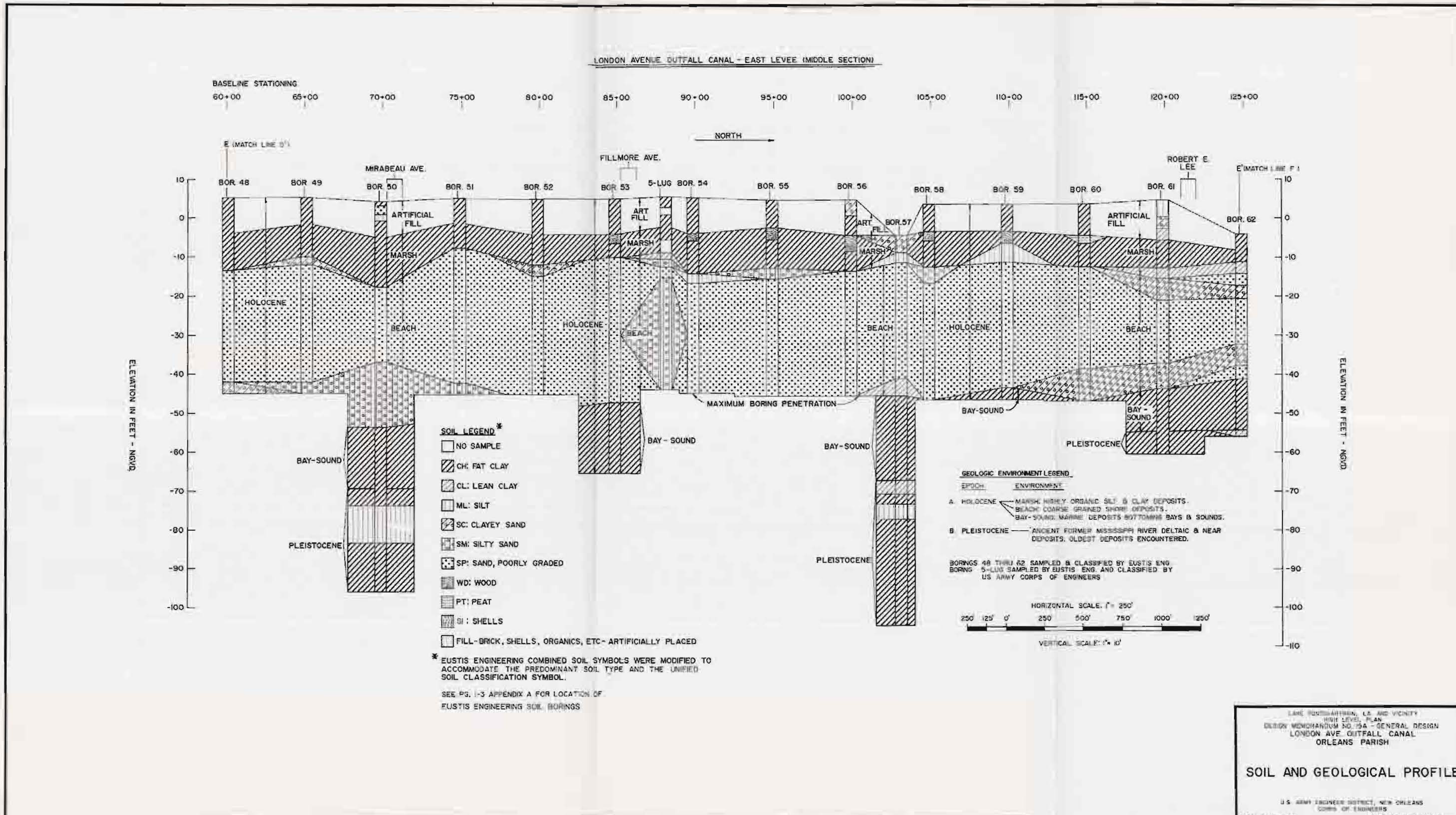


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

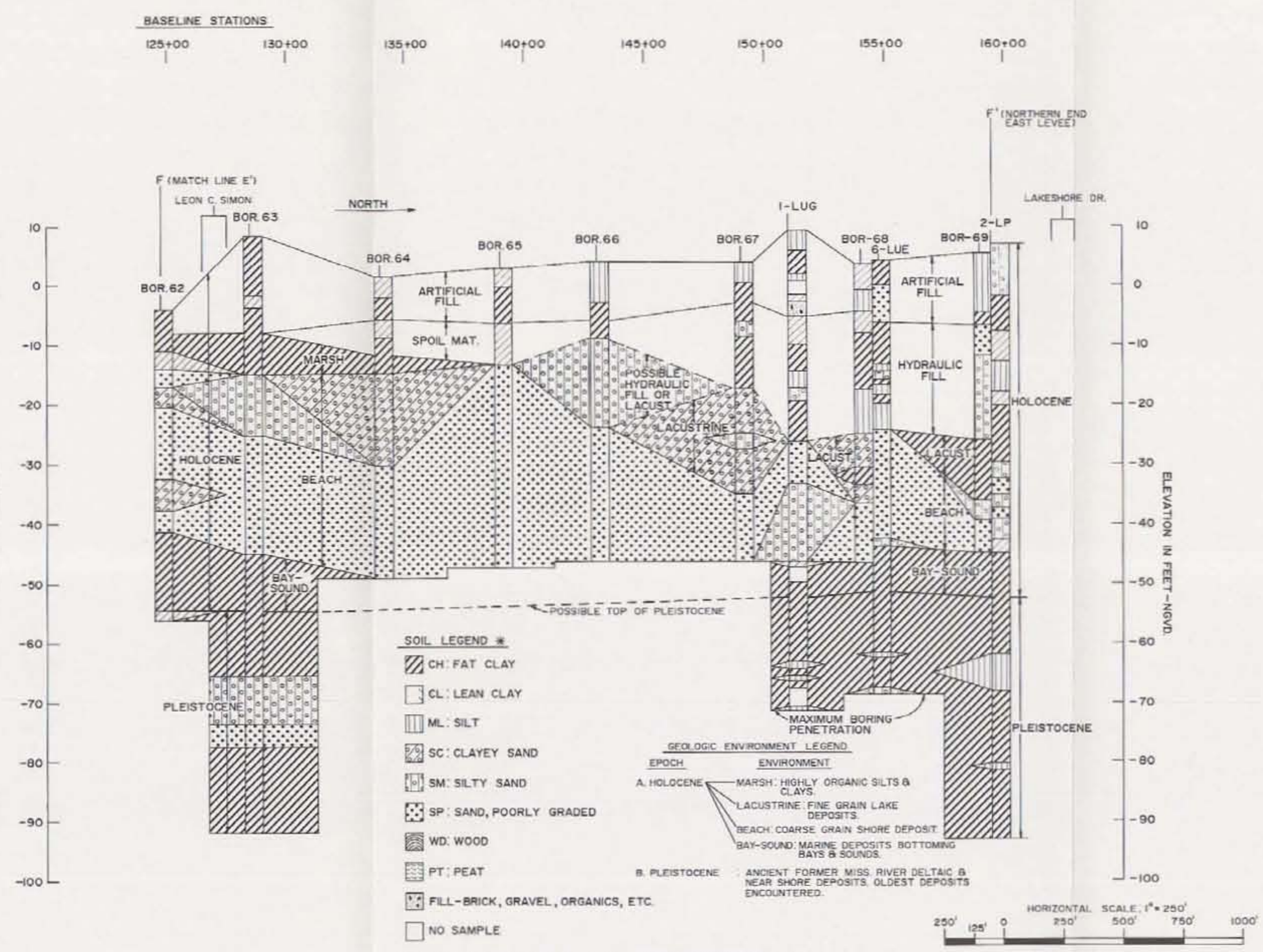
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT. 19[illegible]   FILE NO. H-2-30288



LONDON AVENUE OUTFALL CANAL - EAST LEVEE (MIDDLE SECTION)
BASELINE STATIONING
60+00
65+00
70+00
75+00
80+00
85+00
90+00
95+00
100+00
105+00
110+00
115+00
120+00
125+00
NORTH
E (MATCH LINE D')
MIRABEAU AVE.
FILLMORE AVE.
ROBERT E. LEE
E'(MATCH LINE F)
BOR. 48
BOR. 49
BOR. 50
BOR. 51
BOR. 52
BOR. 53
5-LUG
BOR. 54
BOR. 55
BOR. 56
BOR.57
BOR. 58
BOR. 59
BOR. 60
BOR. 61
BOR. 62
ARTIFICIAL FILL
ART FILL
MARSH
HOLOCENE
BEACH
BAY-SOUND
PLEISTOCENE
MAXIMUM BORING PENETRATION
ELEVATION IN FEET - NGVD
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
SOIL LEGEND*
NO SAMPLE
CH: FAT CLAY
CL: LEAN CLAY
ML: SILT
SC: CLAYEY SAND
SM: SILTY SAND
SP: SAND, POORLY GRADED
WD: WOOD
PT: PEAT
SI: SHELLS
FILL-BRICK, SHELLS, ORGANICS, ETC- ARTIFICIALLY PLACED
* EUSTIS ENGINEERING COMBINED SOIL SYMBOLS WERE MODIFIED TO ACCOMMODATE THE PREDOMINANT SOIL TYPE AND THE UNIFIED SOIL CLASSIFICATION SYMBOL.
SEE PG. I-3 APPENDIX A FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS
GEOLOGIC ENVIRONMENT LEGEND
EPOCH
ENVIRONMENT
A. HOLOCENE
MARSH: HIGHLY ORGANIC SILT & CLAY DEPOSITS.
BEACH: COARSE GRAINED SHORE DEPOSITS.
BAY-SOUND: MARINE DEPOSITS BOTTOMING BAYS & SOUNDS.
B. PLEISTOCENE
ANCIENT FORMER MISSISSIPPI RIVER DELTAIC & NEAR DEPOSITS. OLDEST DEPOSITS ENCOUNTERED.
BORINGS 48 THRU 62 SAMPLED & CLASSIFIED BY EUSTIS ENG
BORING 5-LUG SAMPLED BY EUSTIS ENG. AND CLASSIFIED BY US ARMY CORPS OF ENGINEERS
HORIZONTAL SCALE: 1" = 250'
250' 125' 0' 250 500' 750' 1000' 1250'
VERTICAL SCALE: 1" = 10'
LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
SOIL AND GEOLOGICAL PROFILE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT 1988
FILE NO. H-2-30288

LONDON AVENUE OUTFALL CANAL - EAST LEVEE (NORTH END)



✱ EUSTIS ENGINEERING COMBINED SOIL SYMBOLS WERE MODIFIED TO ACCOMMODATE THE PREDOMINANT SOIL TYPE AND THE UNIFIED SOIL CLASSIFICATION SYMBOLS.

BORINGS 62 THRU 69 WERE SAMPLED & CLASSIFIED BY EUSTIS ENGINEERING.

BORING I-LUG, 6-LUE AND 2-LP SAMPLED & CLASSIFIED BY U.S. ARMY CORPS OF ENGINEERING PERSONNEL.

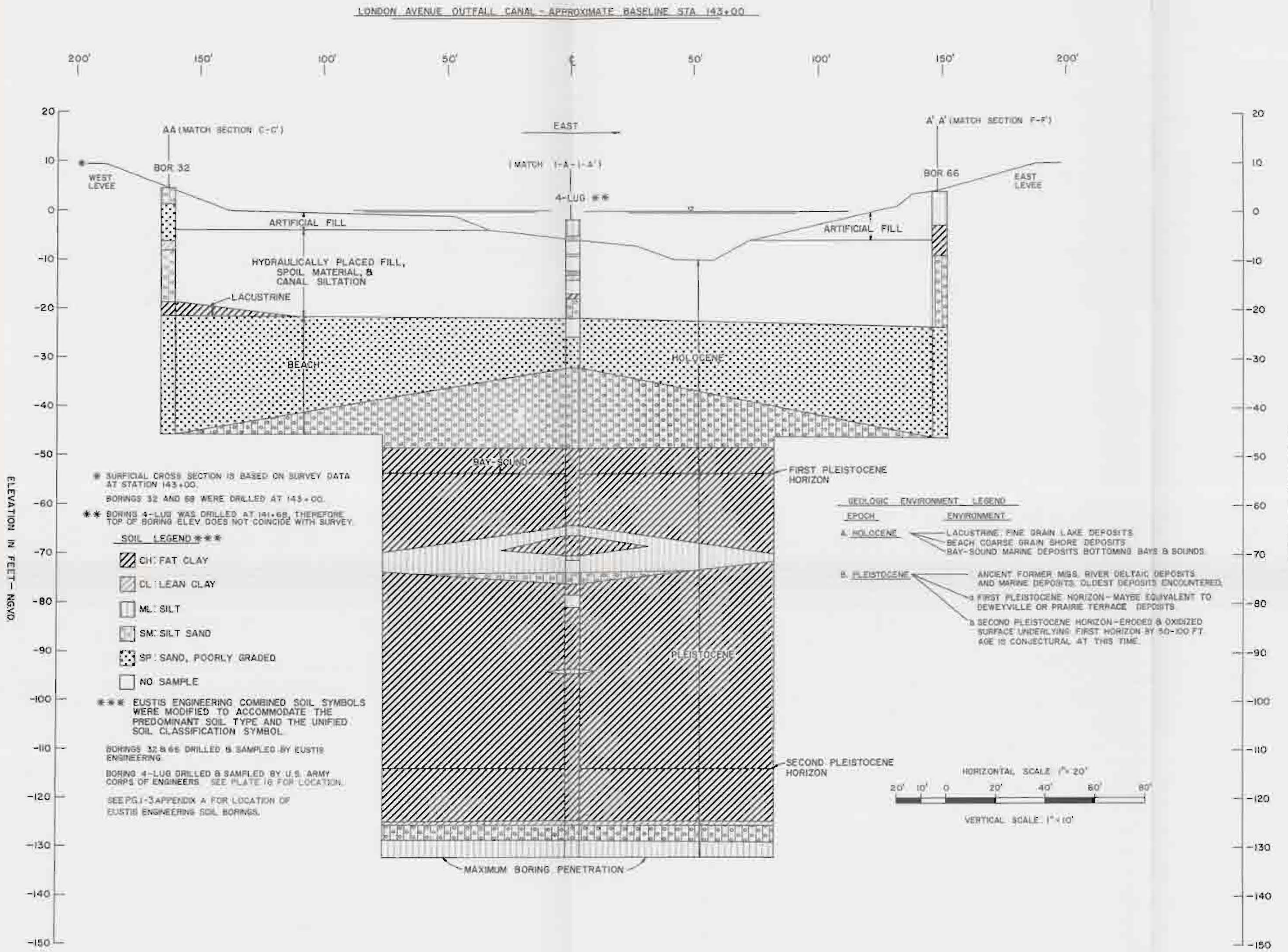
SEE PS. I-3 APPENDIX A FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

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

DATE: SEPT. 1988 | FILE NO. H-2-30288

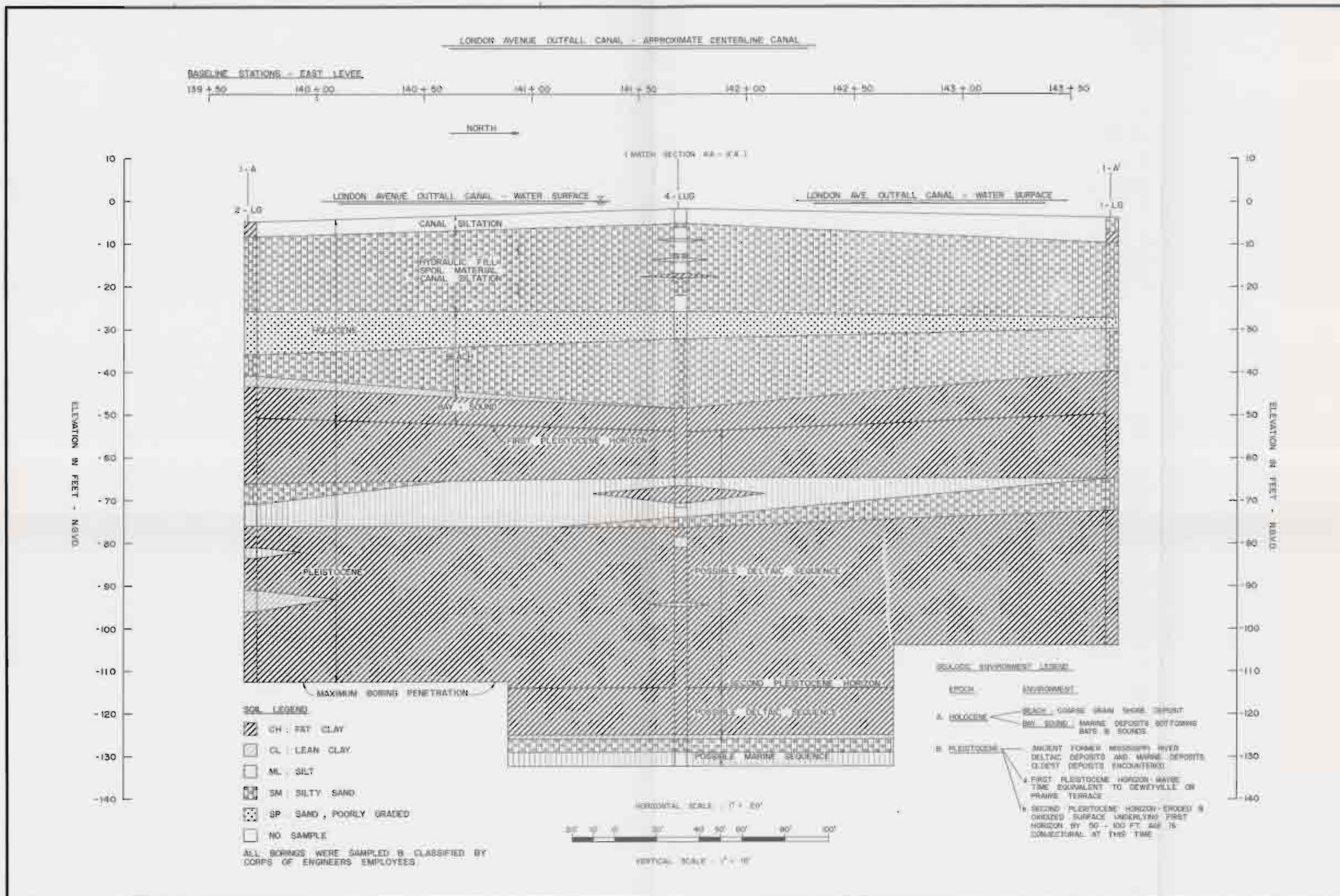


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

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

DATE: SEPT. 1988 FILE NO. H-2-30288

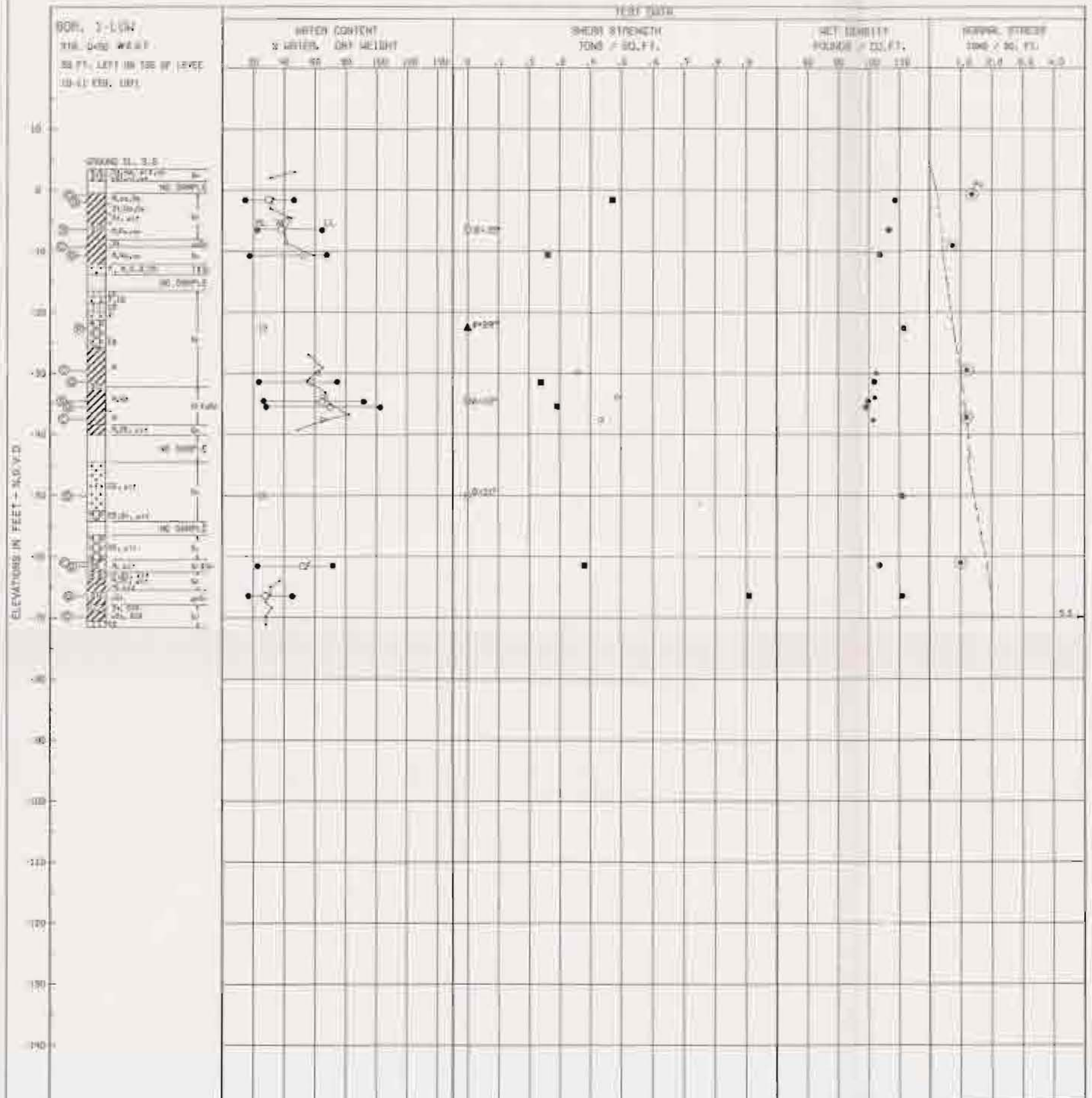


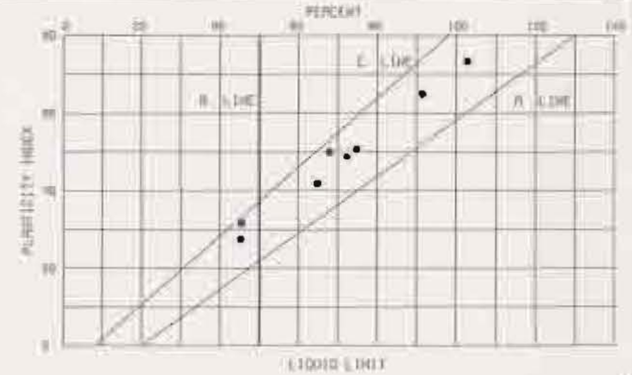
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOIL AND GEOLOGICAL PROFILE

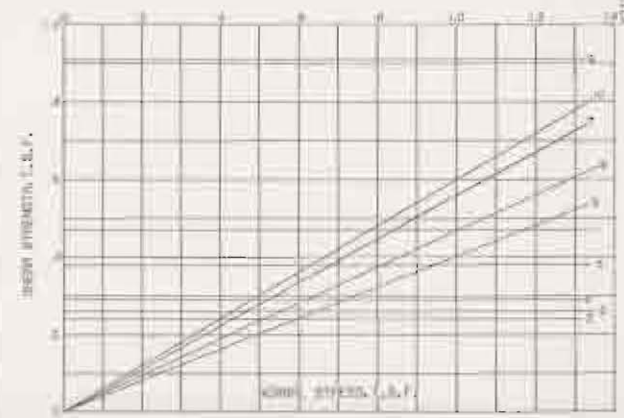
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT 1988 FILE NO. H-2-30288



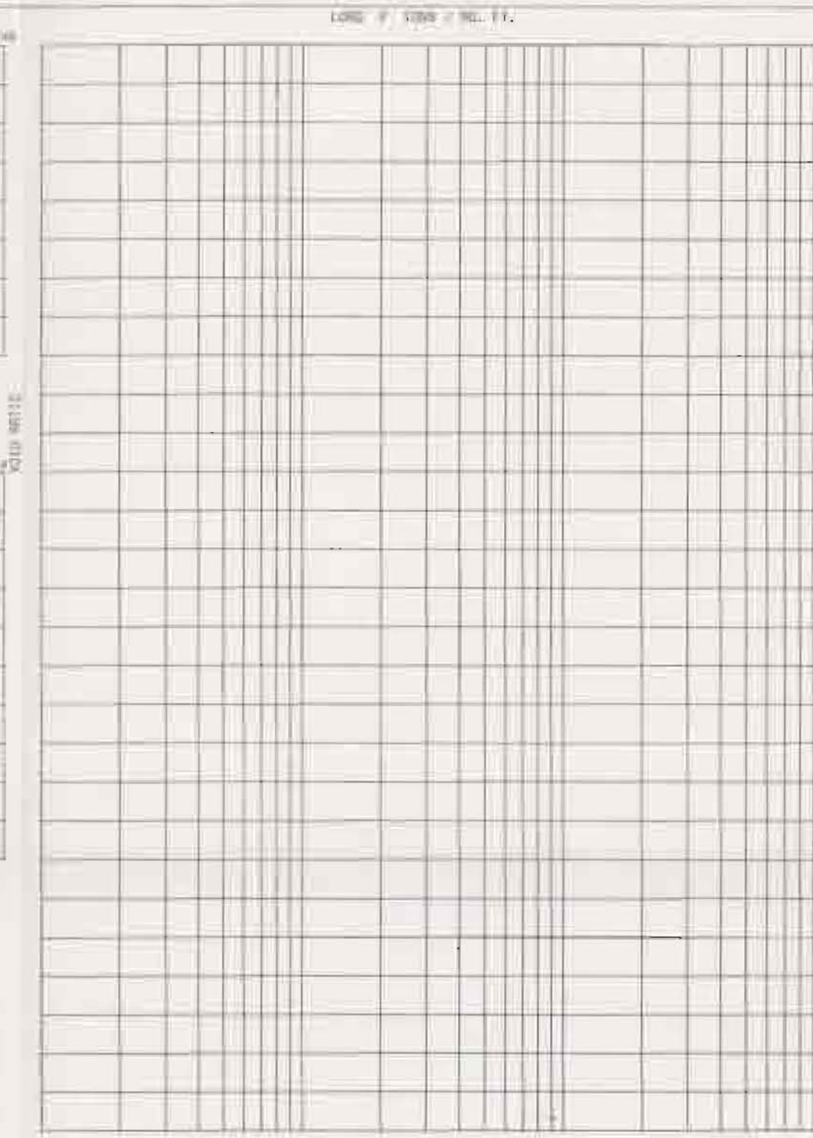


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	SAMPLE NO.	SAMPLE EL.	TYPE	STRENGTH Ø°	STRENGTH C - TSF	CLASS
	1	-1.7	Q	0	0.47	CL
	2	-10.6		0	0.36	CH
	3	-31.8		0	0.34	CH
	4	-35.4		0	0.29	CH
	5	-51.5		0	0.36	CH
	6	-65.4		0	0.91	CL
	7	-32.6	R	29	0.0	SM
	8	-6.6	S	35	0	CH
	9	-34.5		22	0	CH
	10	-60.1		31	0	SM



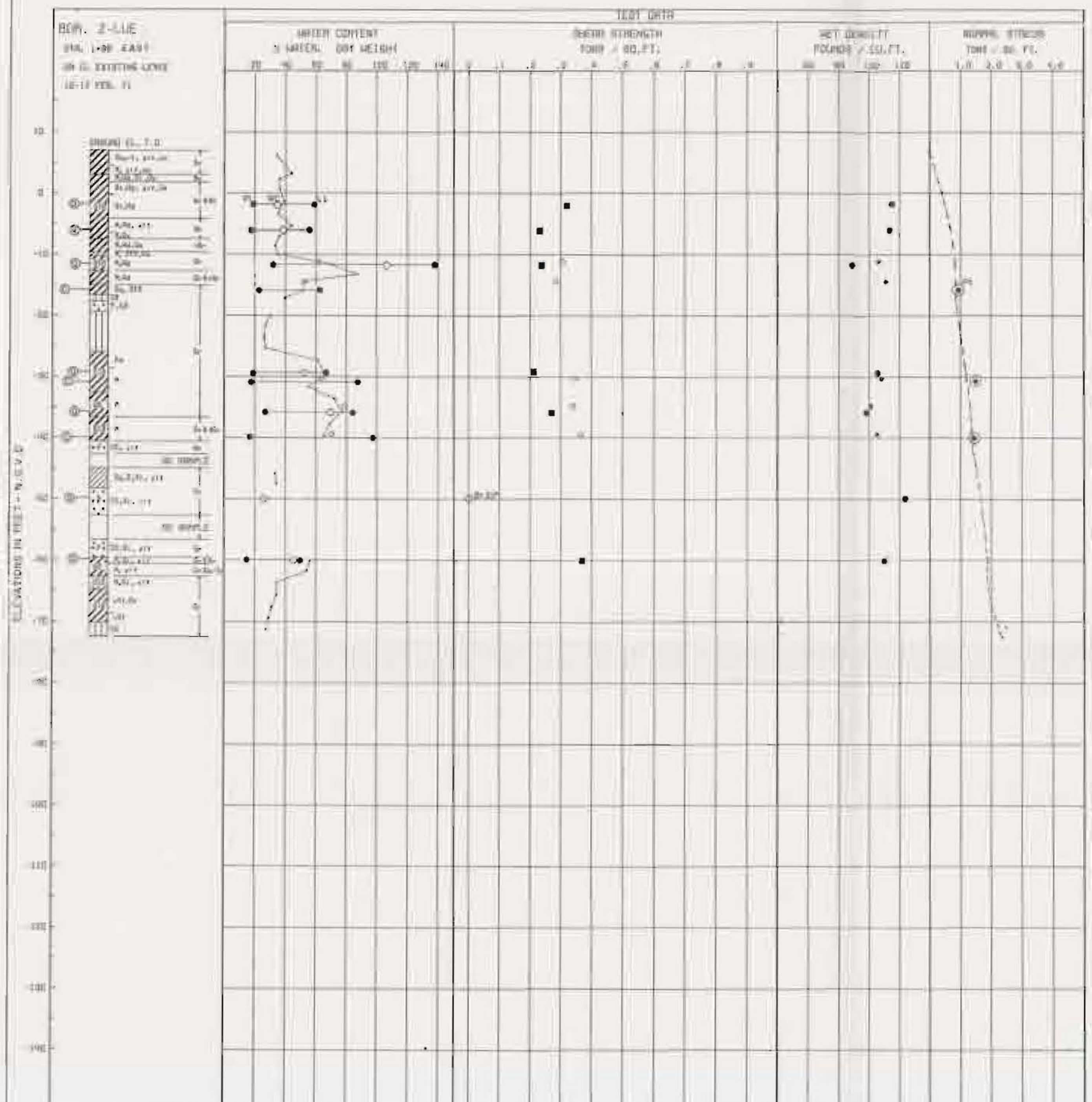
CONSOLIDATION DATA

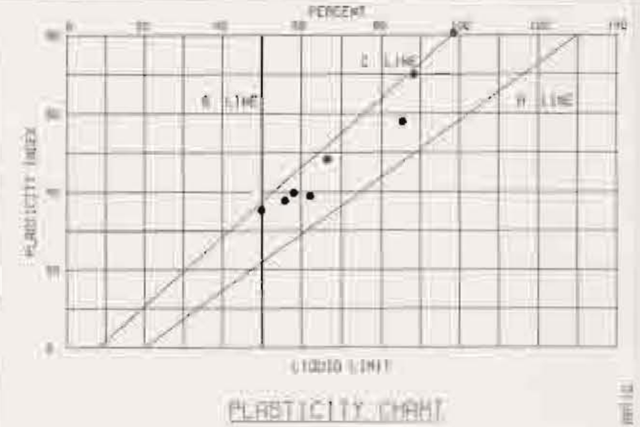
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
◎ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATES 14-16

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

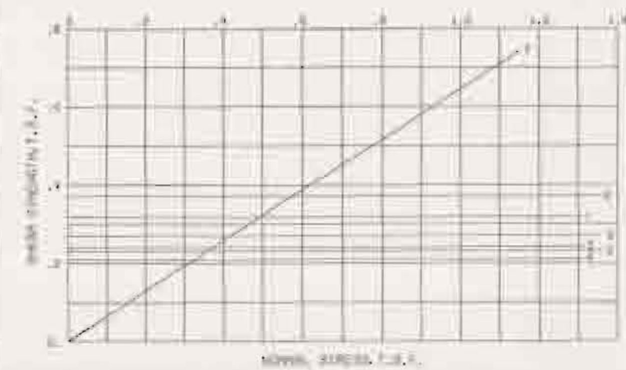
UNDISTURBED BORING NO. 1-LUW

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288



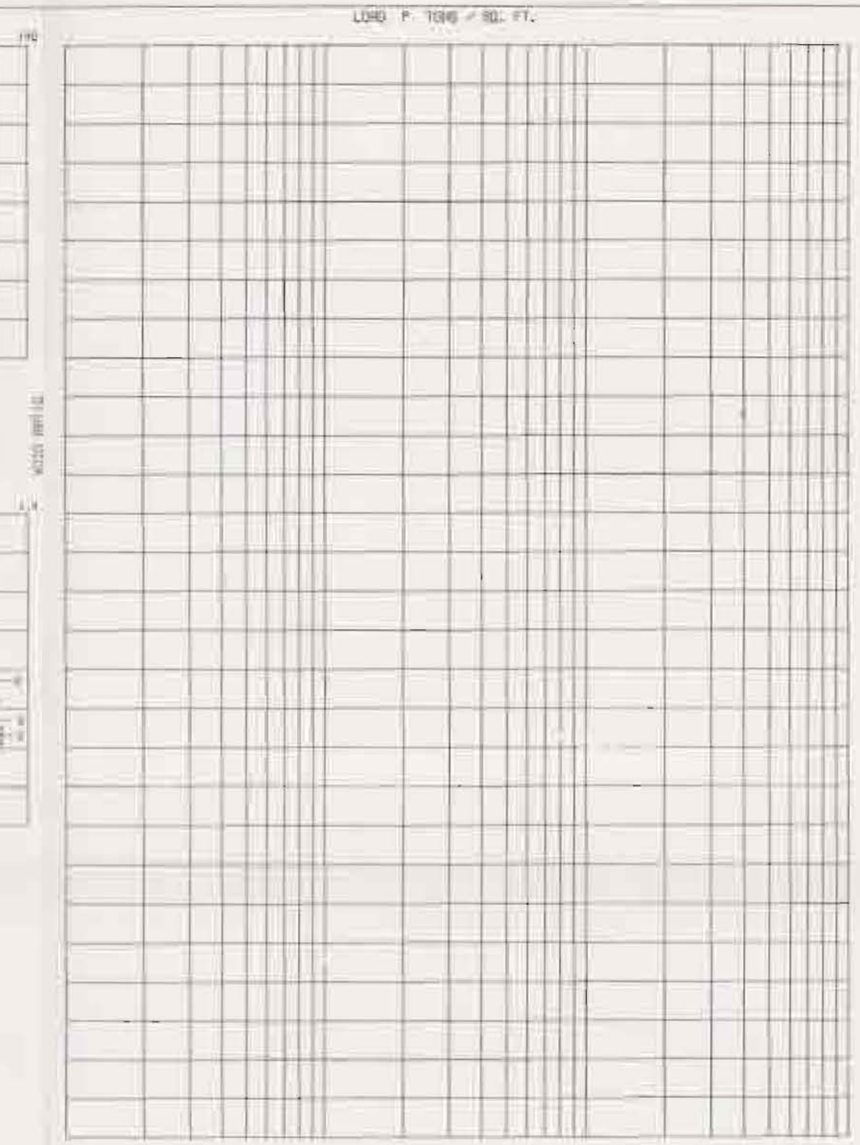


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	SAMPLE NO.	EL. FT.	TYPE	STRENGTH φ°	STRENGTH C, TSF	CLASS.
	1	-1.6	Q	0	0.32	CH
	2	-6.0		0	0.25	CH
	3	-11.7		0	0.34	CH
	4	-29.5		0	0.31	CH
	5	-35.5		0	0.27	CH
	6	-50.0		0	0.37	CH
	7	-60.0	S	33	0	SM



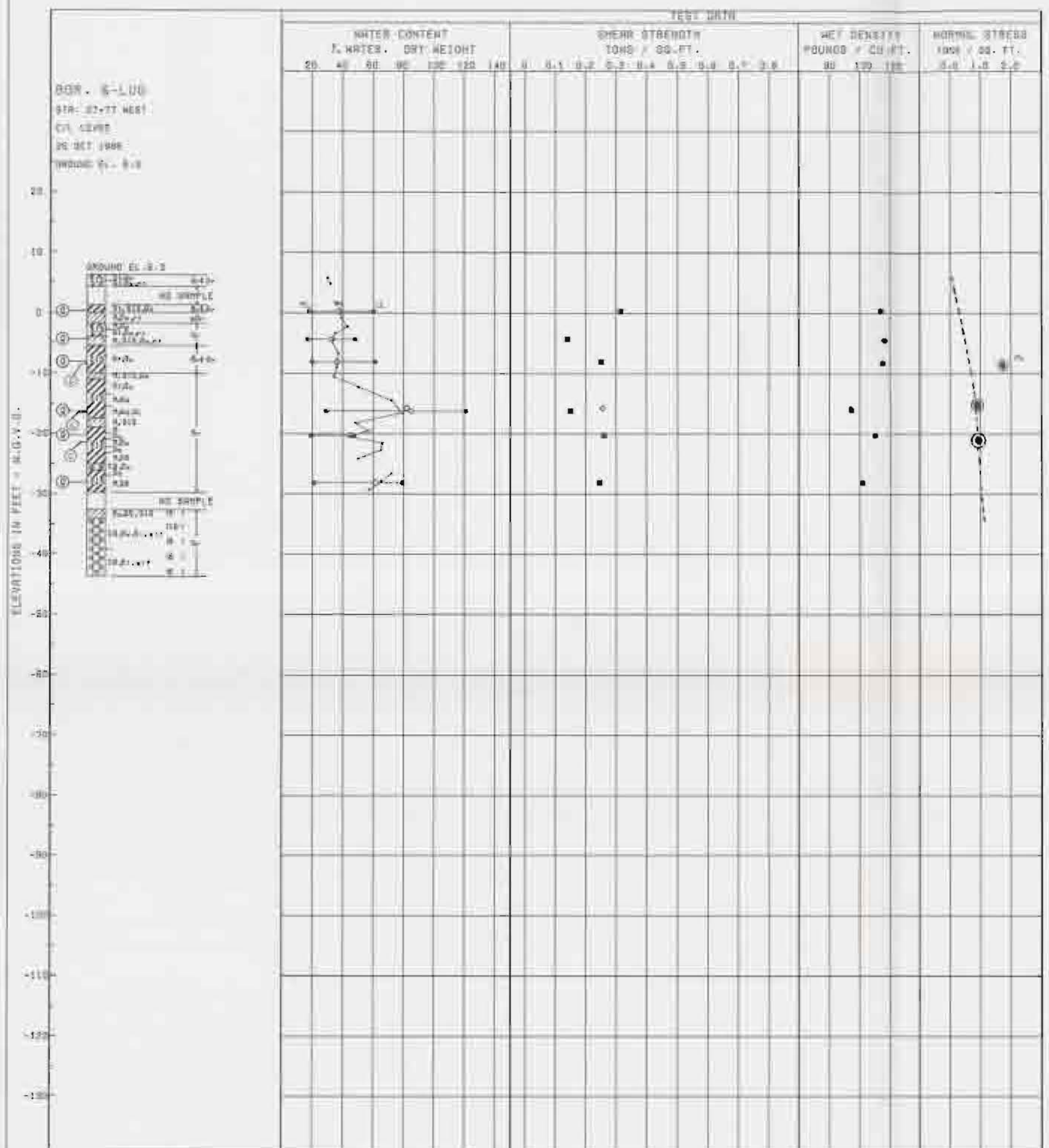
CONSOLIDATION DATA

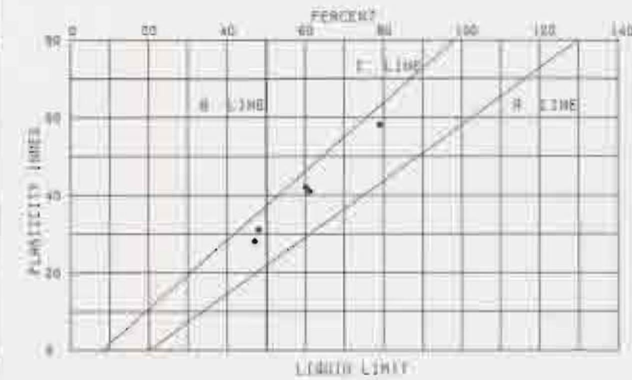
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
◻ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 3 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATES 14-18

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

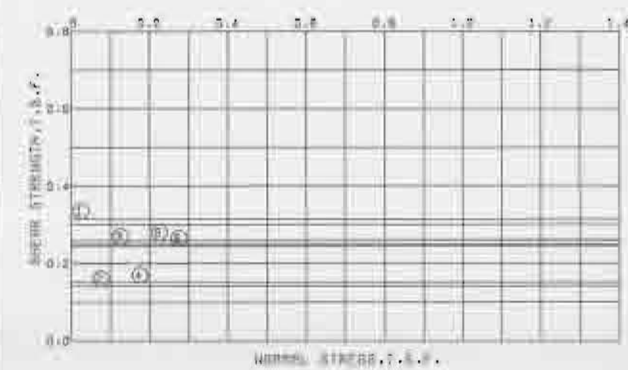
UNDISTURBED BORING NO. 2-LUE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT 1988 FILE NO. H-2-30088



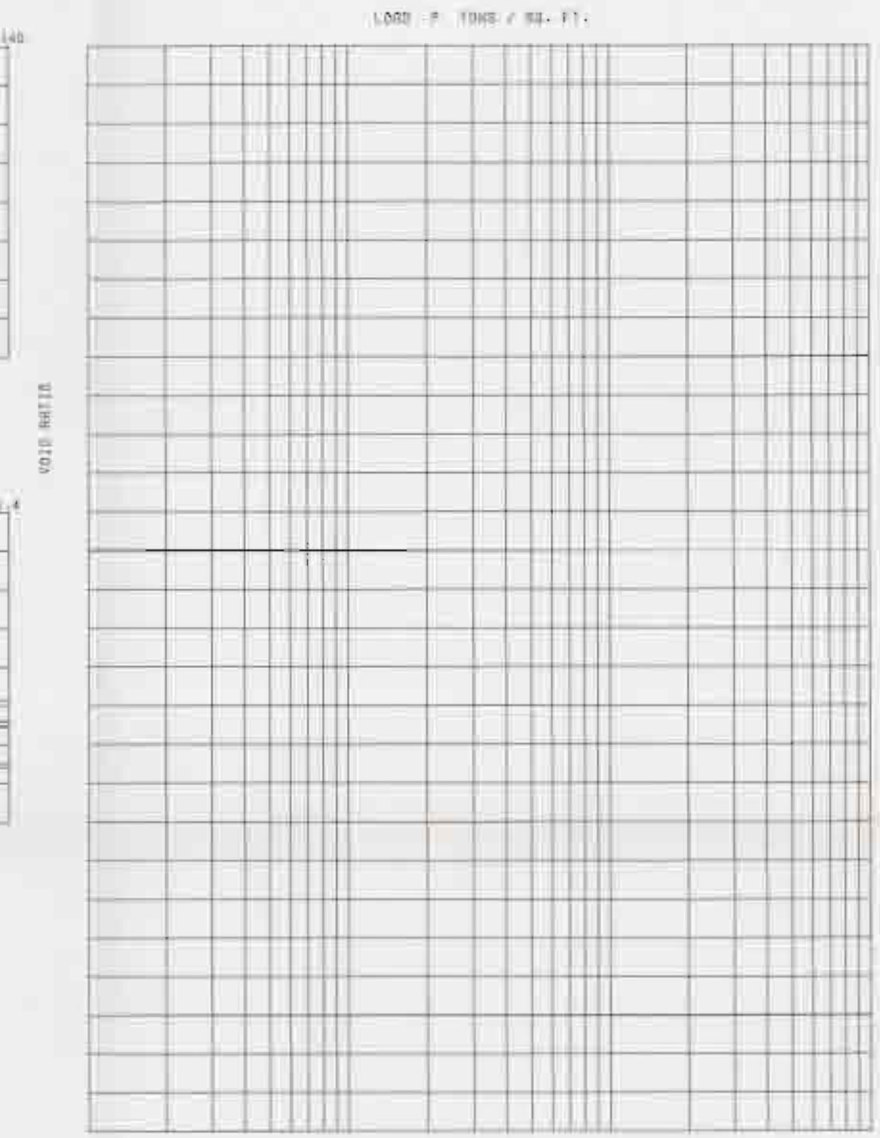


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	0.30	Q	0.0	0.310	CH
2	-4.30	Q	0.0	0.140	CH
3	-8.10	Q	0.0	0.250	CH
4	-16.00	Q	0.0	0.180	CH
5	-20.30	Q	0.0	0.260	CH
6	-28.10	Q	0.0	0.148	CH



CONSOLIDATION DATA

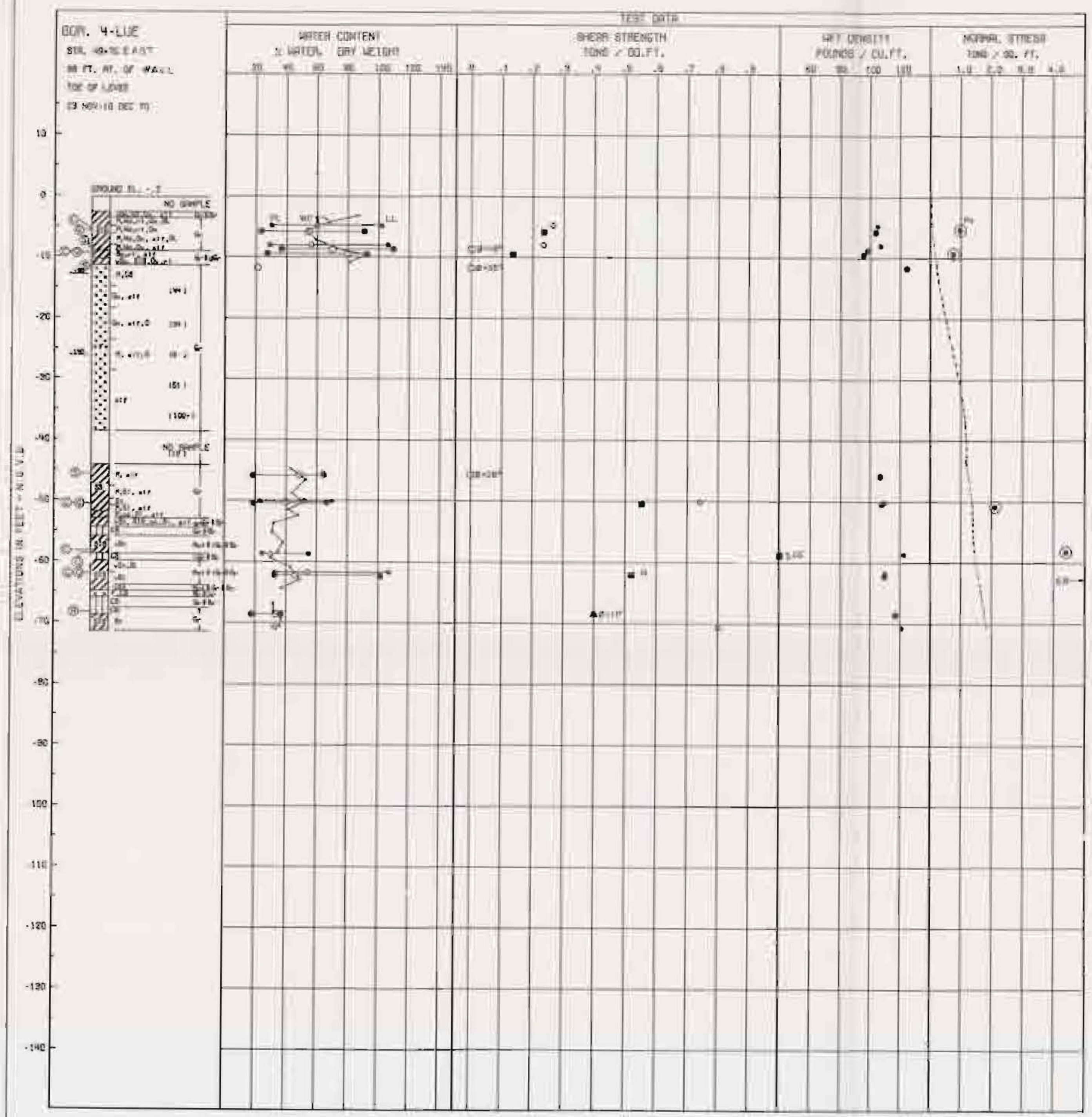
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
▤ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH 5.0 INCH-DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATES

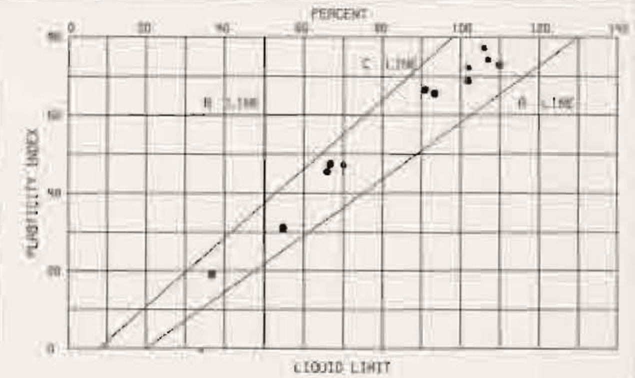
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 6-LUG

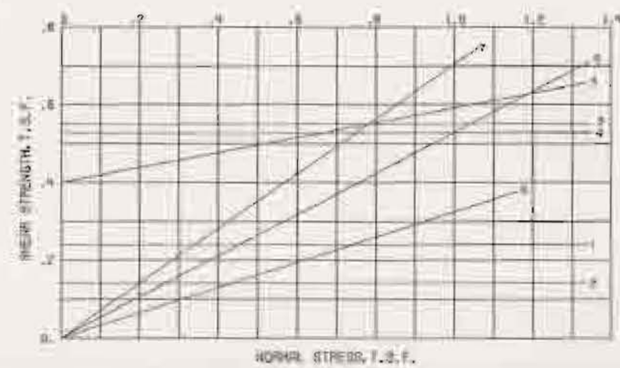
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT. 1988 FILE NO. H-2-30080



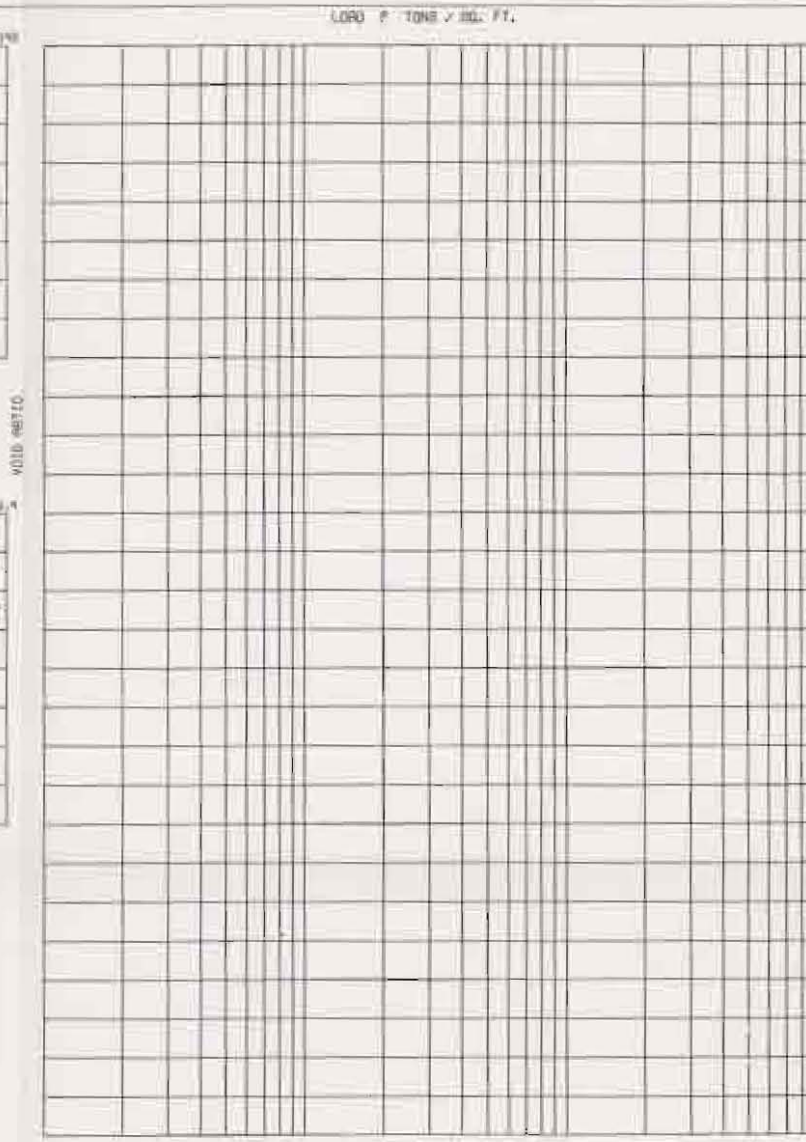


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ°	STRENGTH C : TSF	CLASS
	1	-5.4	Q	0	0.24	CH
	2	-9.5		0	0.14	CH
	3	-50.3		0	0.55	CH
	4	-62.3		0	0.52	CH
	5	-66.4	R	11	0.40	ML
	6	-8.0	S	18	0	CH
	7	-11.7		35	0	SM
	8	-45.8		28	0	CH
	9	-58.3	Q	0	1.05	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 [illegible]

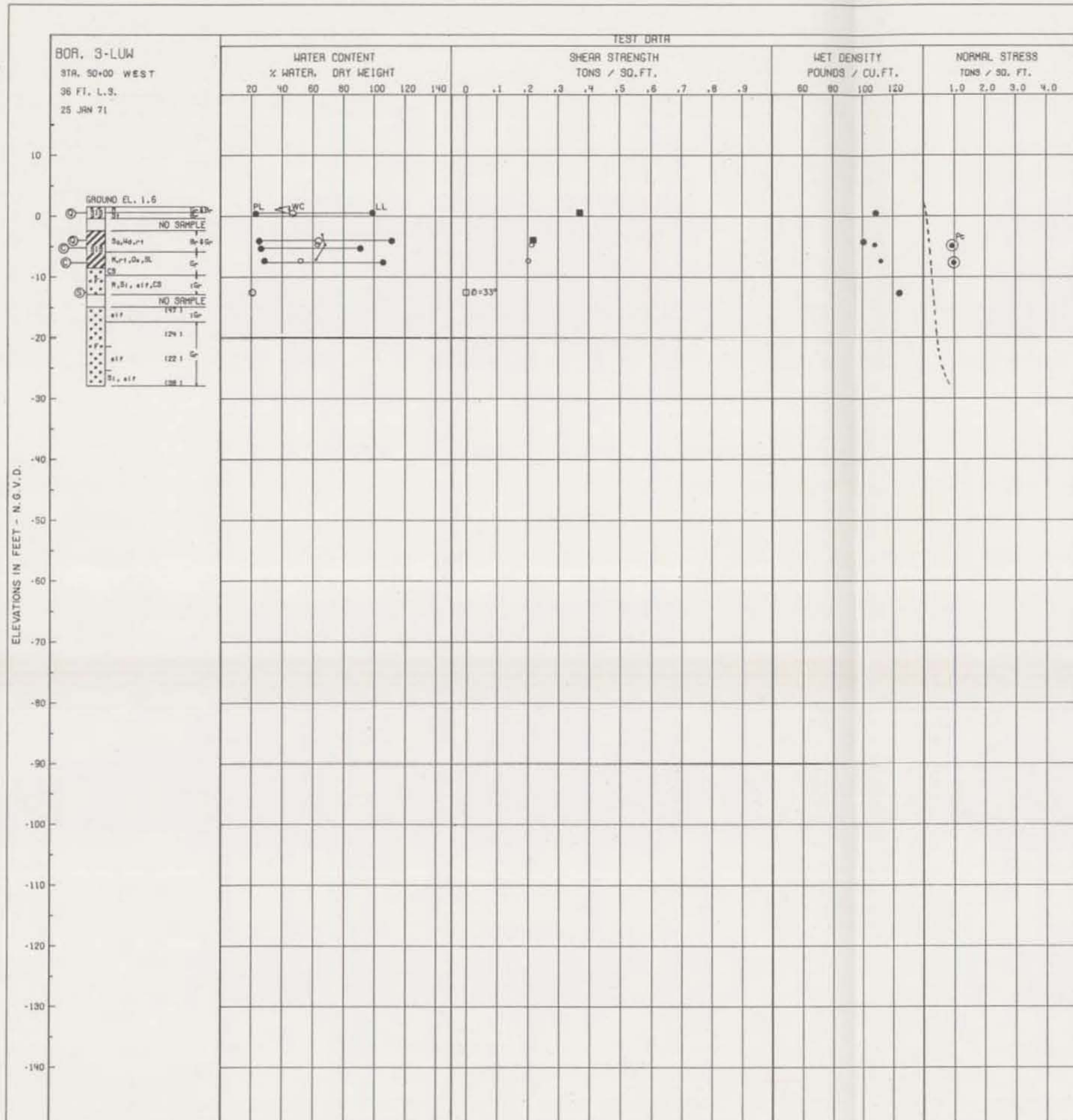
FOR LOCATION OF BORINGS SEE PLATES [illegible]

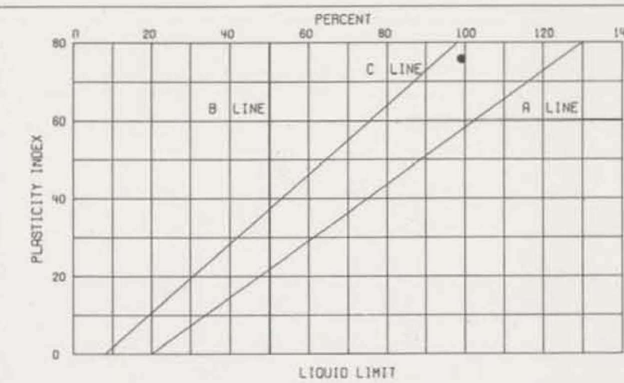
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 4-LUE

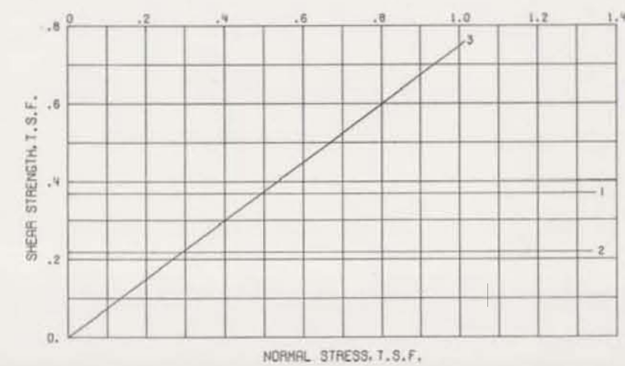
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE SEPT. 1988 FILE NO. H-2-30288



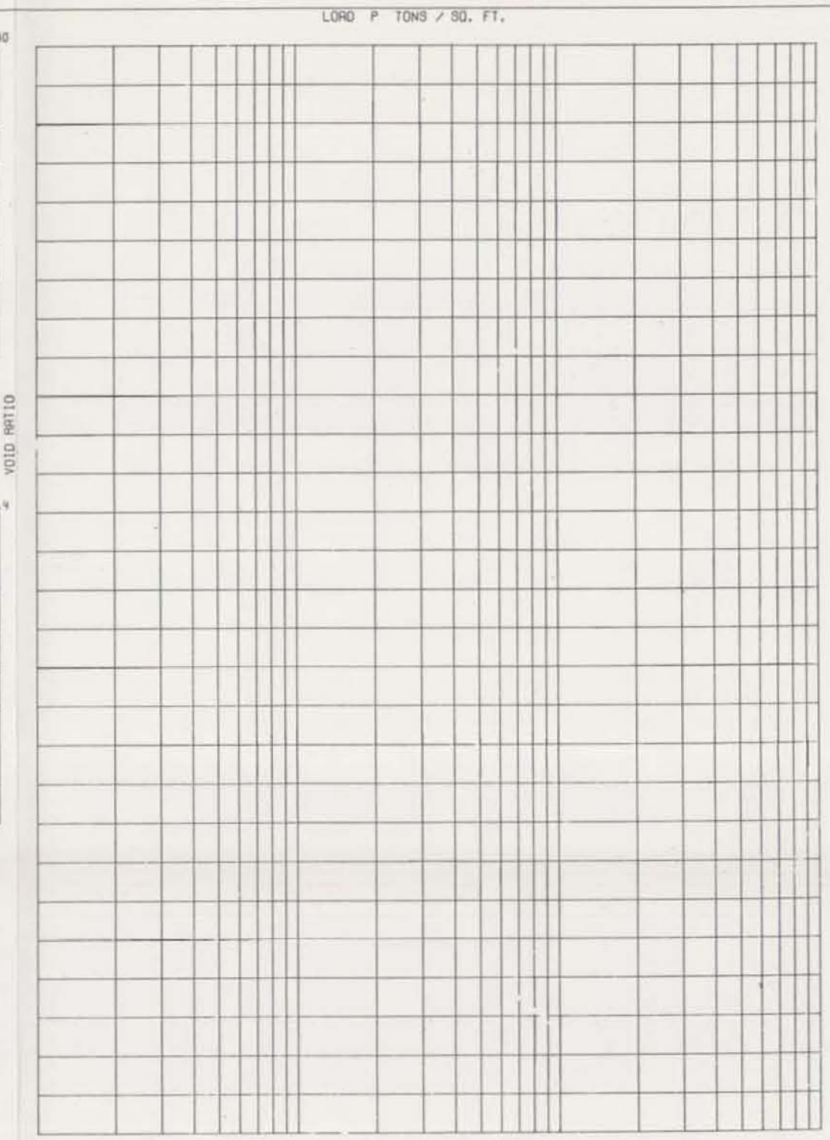


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH $\Phi°$	STRENGTH C - TSF	CLASS
	1	0.4	Q	0	0.37	CH
	2	-4.0		0	0.22	CH
	3	-12.5	S	33	0	SP



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

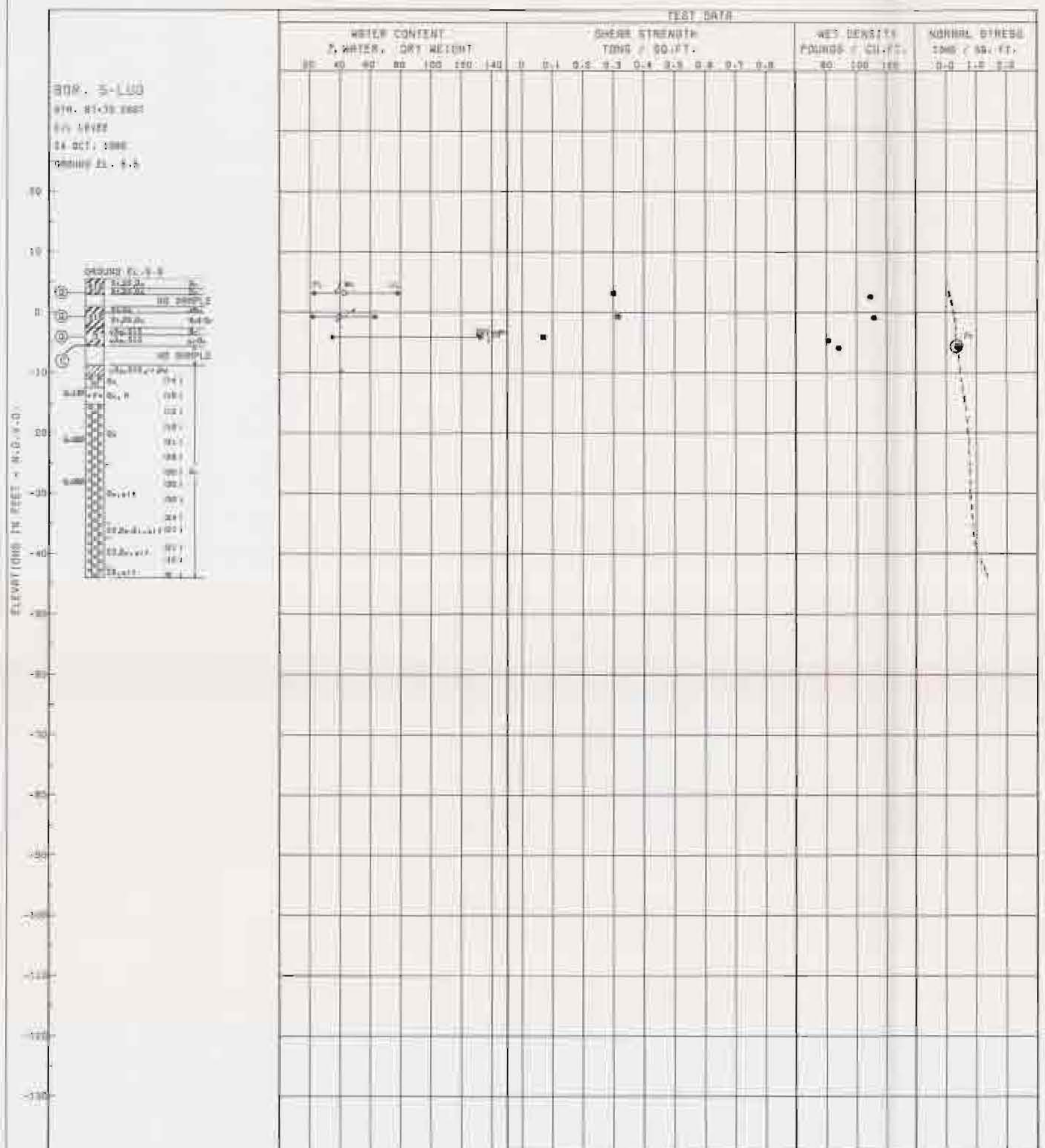
FOR LOCATION OF BORINGS SEE PLATES 14-16

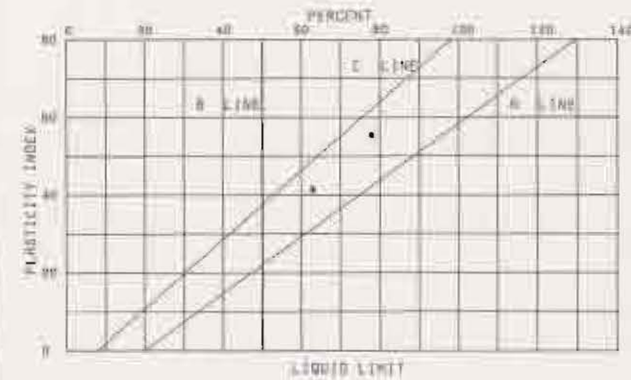
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 3-LUW

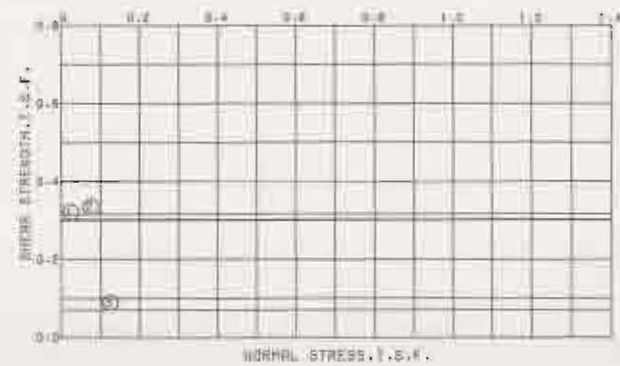
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT. 1988 FILE NO. H-2-30288



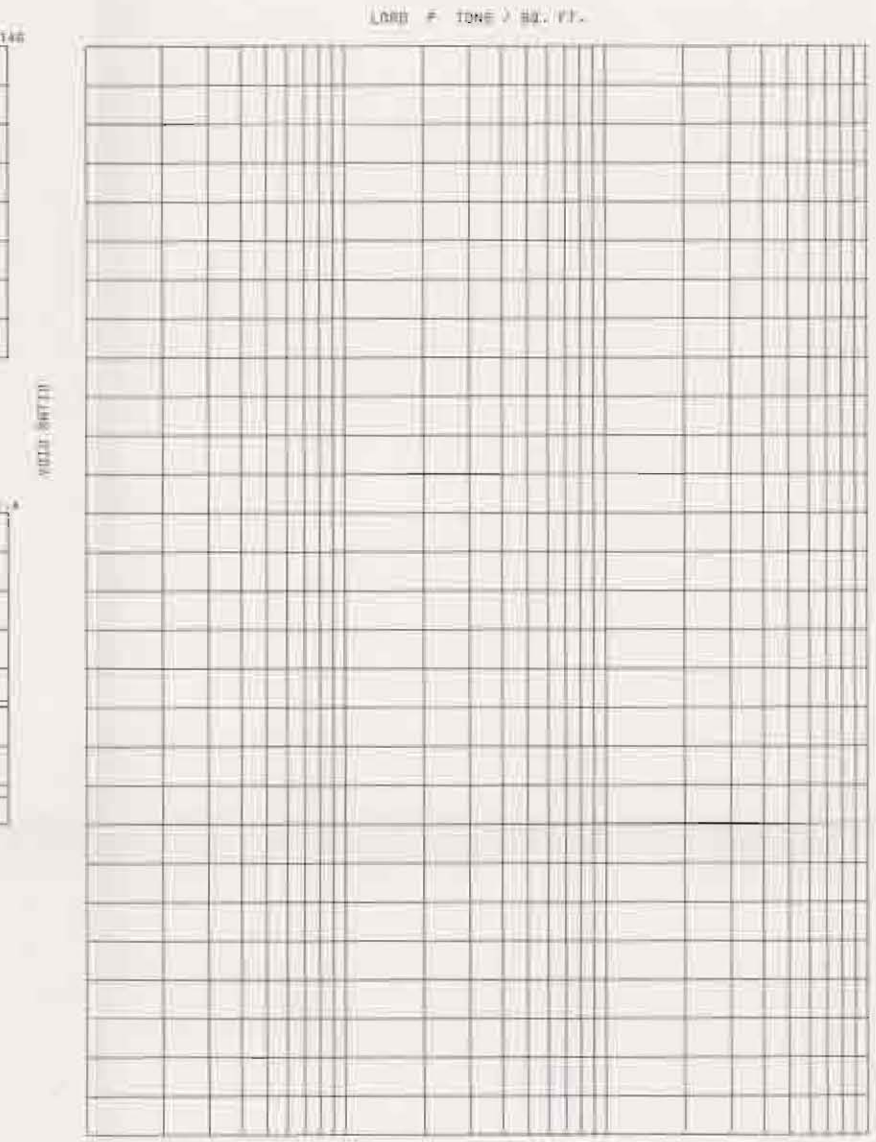


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	3.20	Q	0.0	0.300	CH
2	-0.70	Q	0.0	0.315	CH
3	-4.10	Q	0.0	0.070	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 8

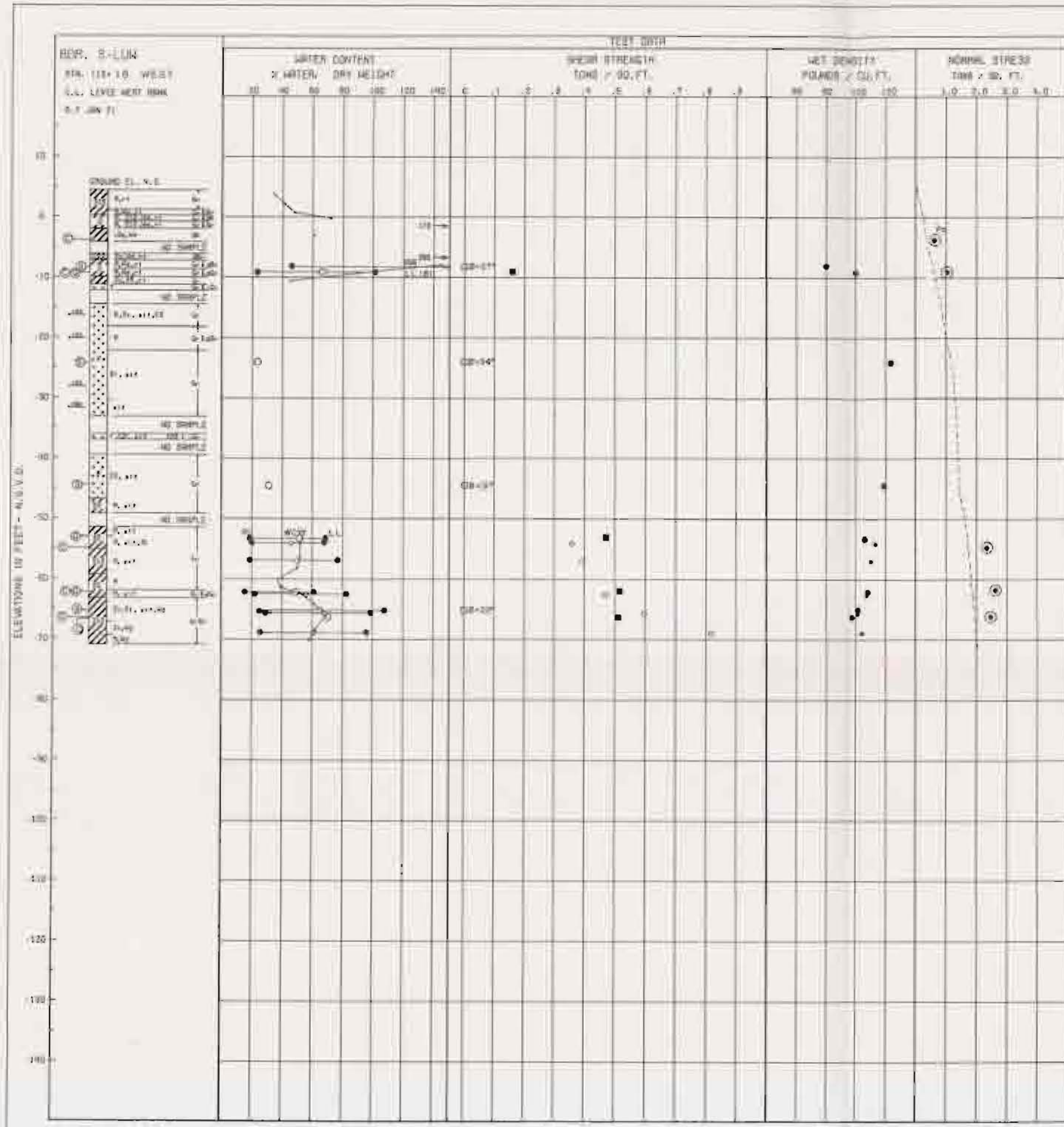
FOR LOCATION OF BORING SEE PLATES 14-16

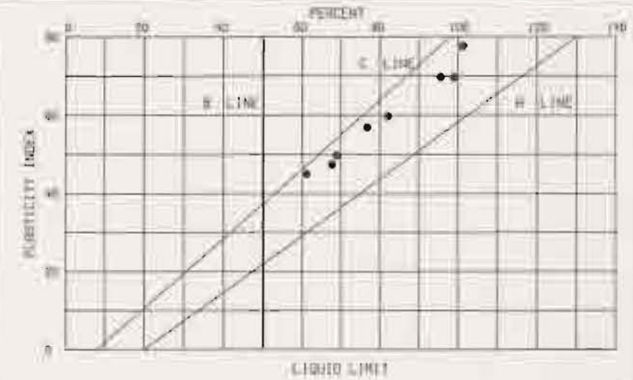
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 A — GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 5-LUG

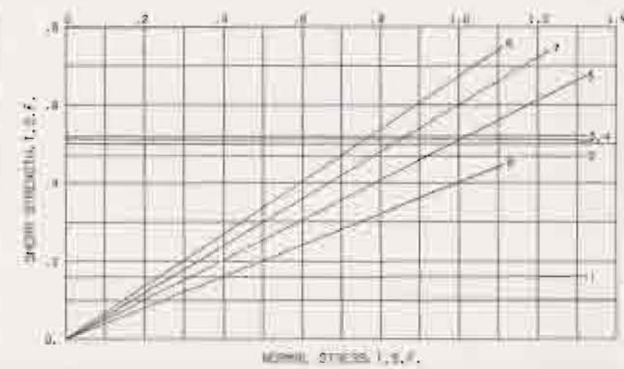
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT 1988 FILE NO. H-2-30288



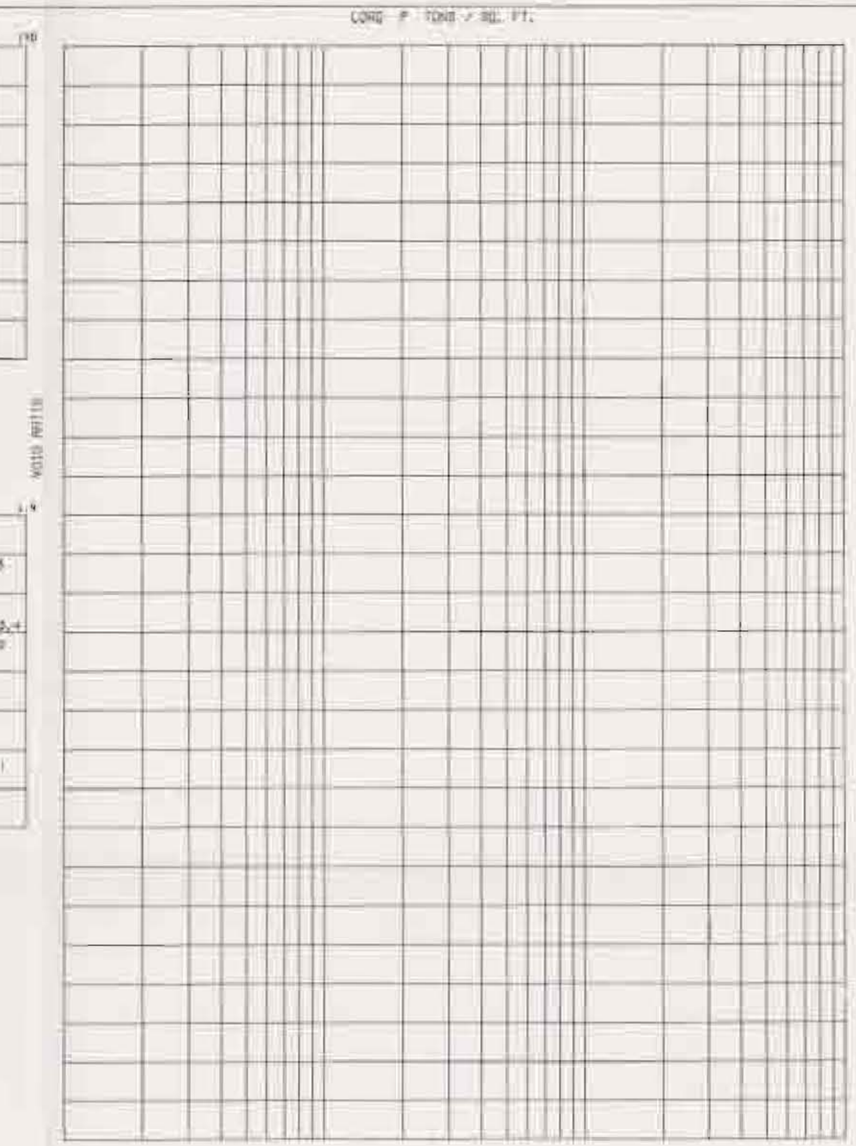


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH $\phi°$	STRENGTH C TSF	CLASS
	1	-8.1	Q	0	0.18	CH
	2	-53.4		0	0.41	CH
	3	-62.1		0	0.53	CH
	4	-66.3		0	0.51	CH
	5	-8.2	S	27	0	CH
	6	-24.1		34	0	SM
	7	-44.6		31	0	SM
	8	-65.2		22	0	CH



CONSOLIDATION DATA

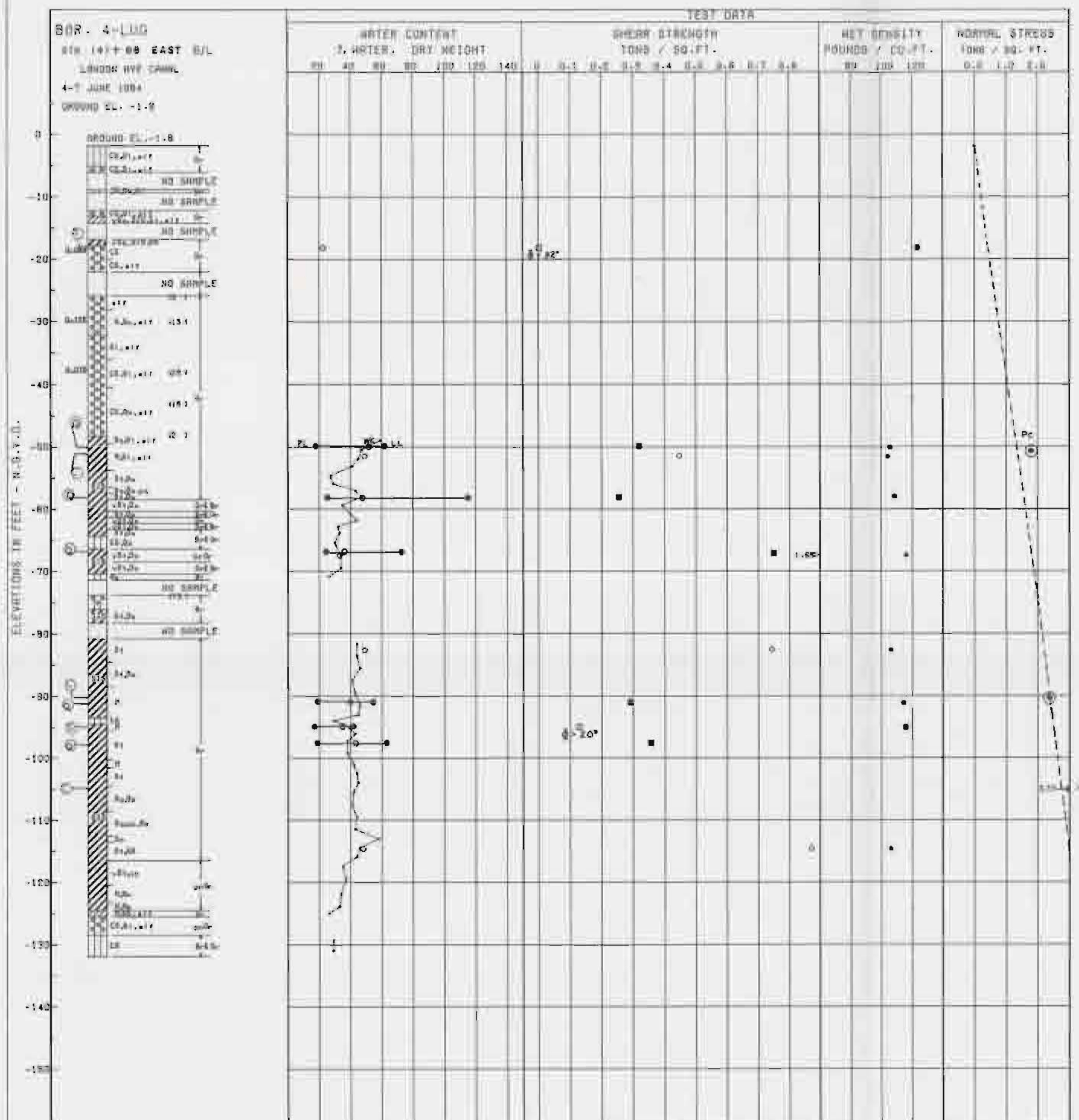
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATES 14-16

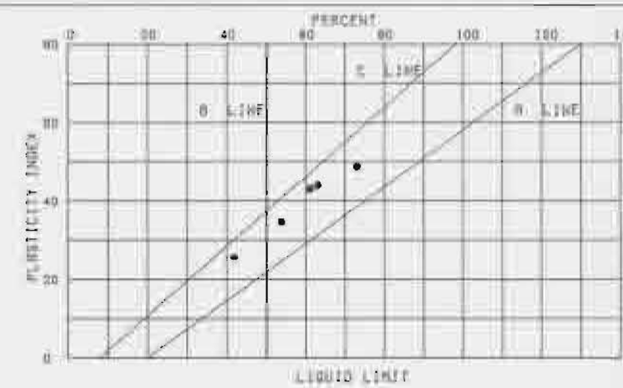
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 5-LUW

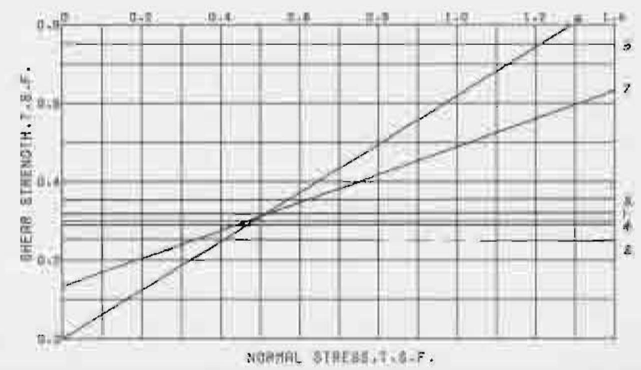
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT 1968 FILE NO. H-2-30288



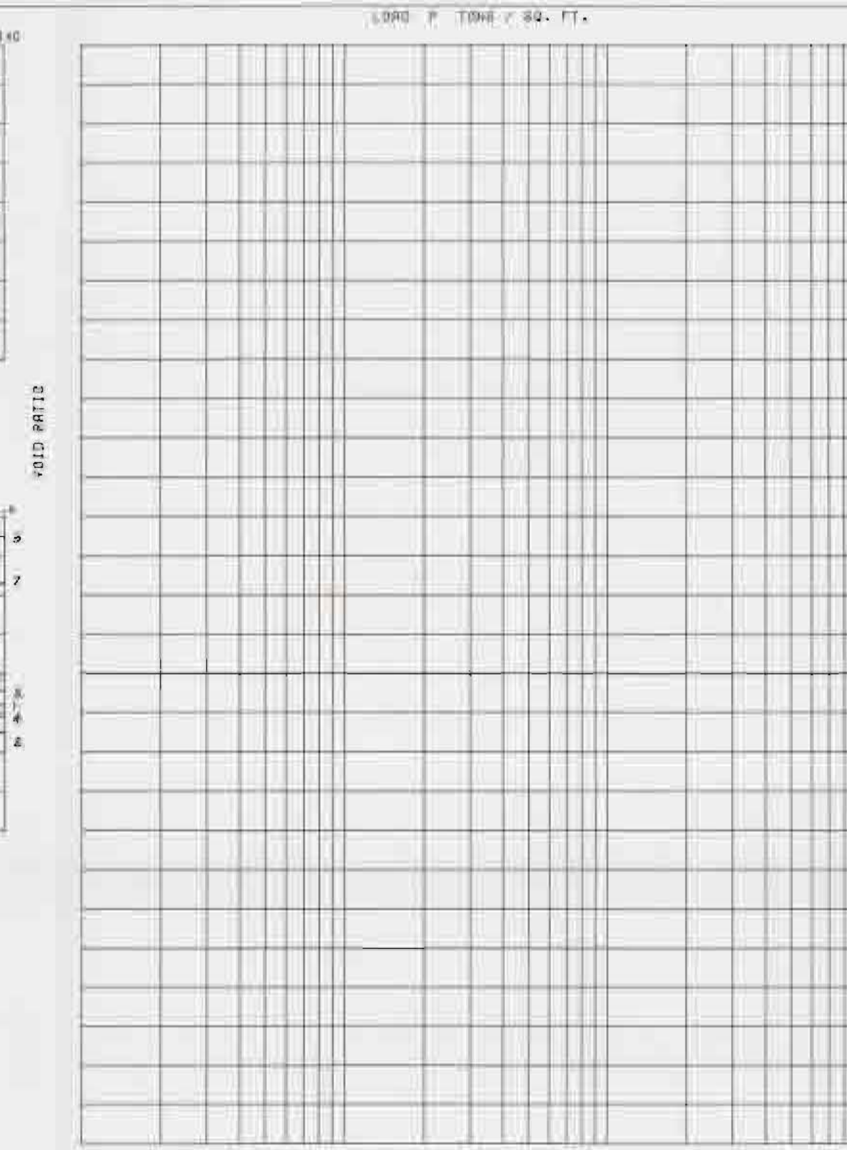


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-50.0	Q	0°	0.32	CH
2	-58.1	Q	0°	0.224	CH
3	-67.0	Q	0°	0.75	CH
4	-91.0	Q	0°	0.29	CH
5	-97.5	Q	0°	0.355	CH
6	[illegible]	S	32°	0.0	SM
7	-95.0	S	20°	0.15	CL



CONSOLIDATION DATA

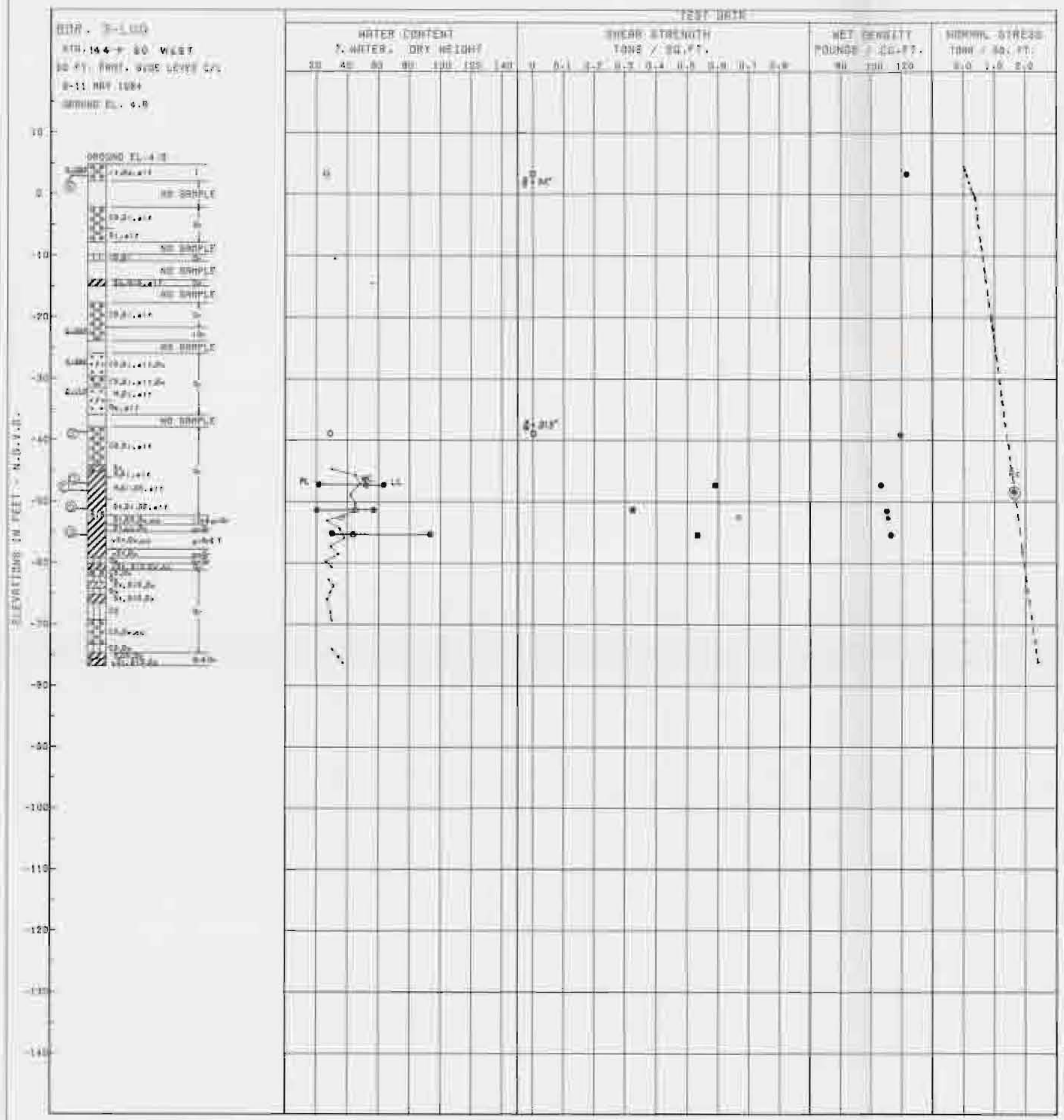
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
◻ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORING SEE PLATES 4-10

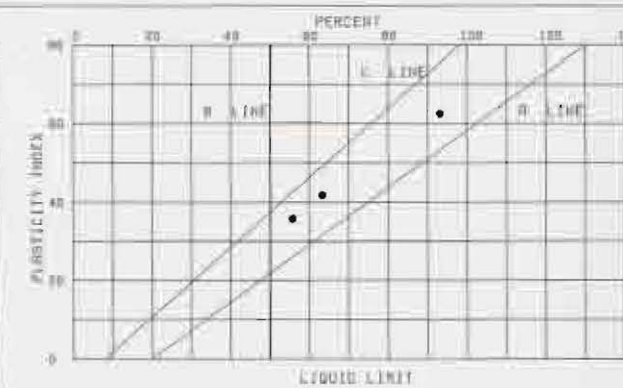
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 4-LUG

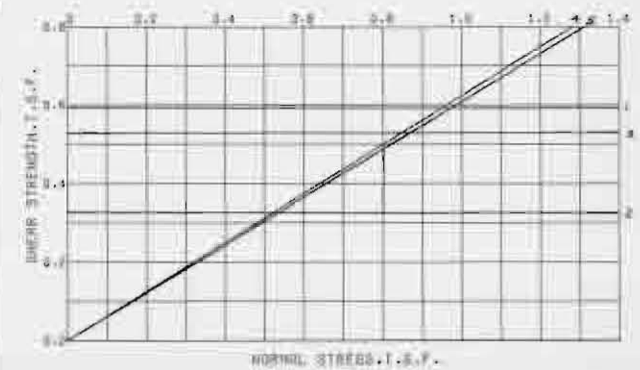
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT. 1988 FILE NO. H-2-30288



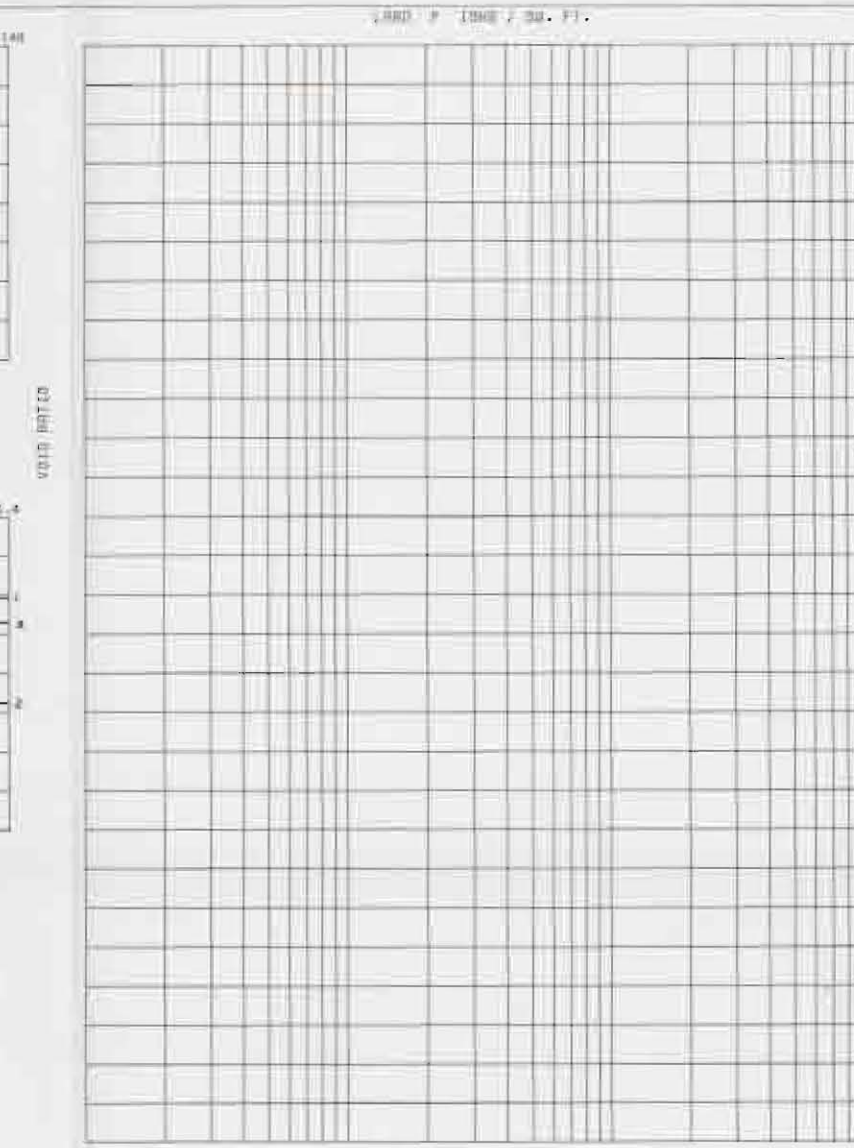


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-47.2	Q	0°	0.59	CH
2	-51.4	Q	0°	0.385	CH
3	-55.6	Q	0°	0.57	CH
4	+3.2	S	32°	0.0	SM
5	-39.2	S	31.2°	0.0	SM



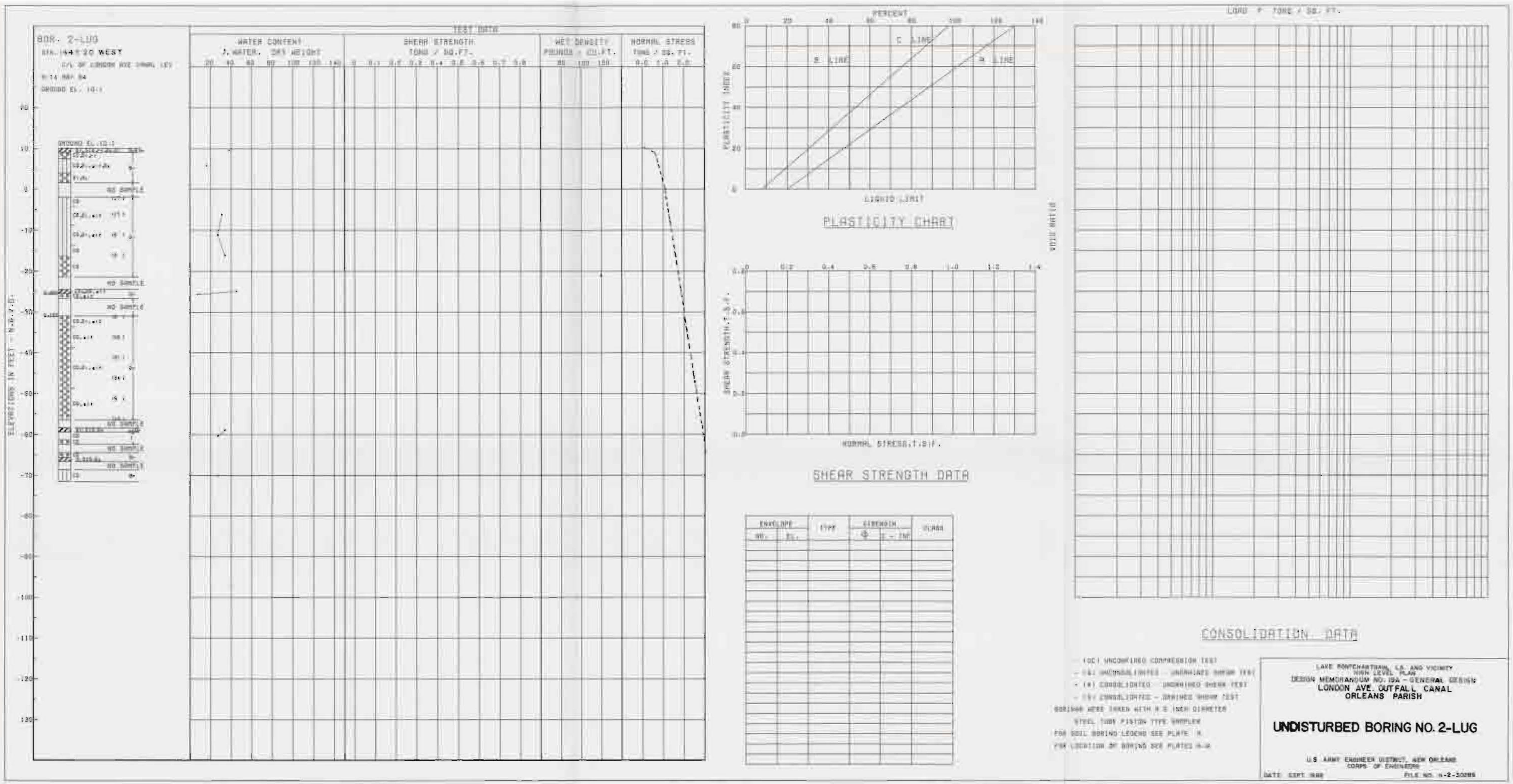
CONSOLIDATION DATA

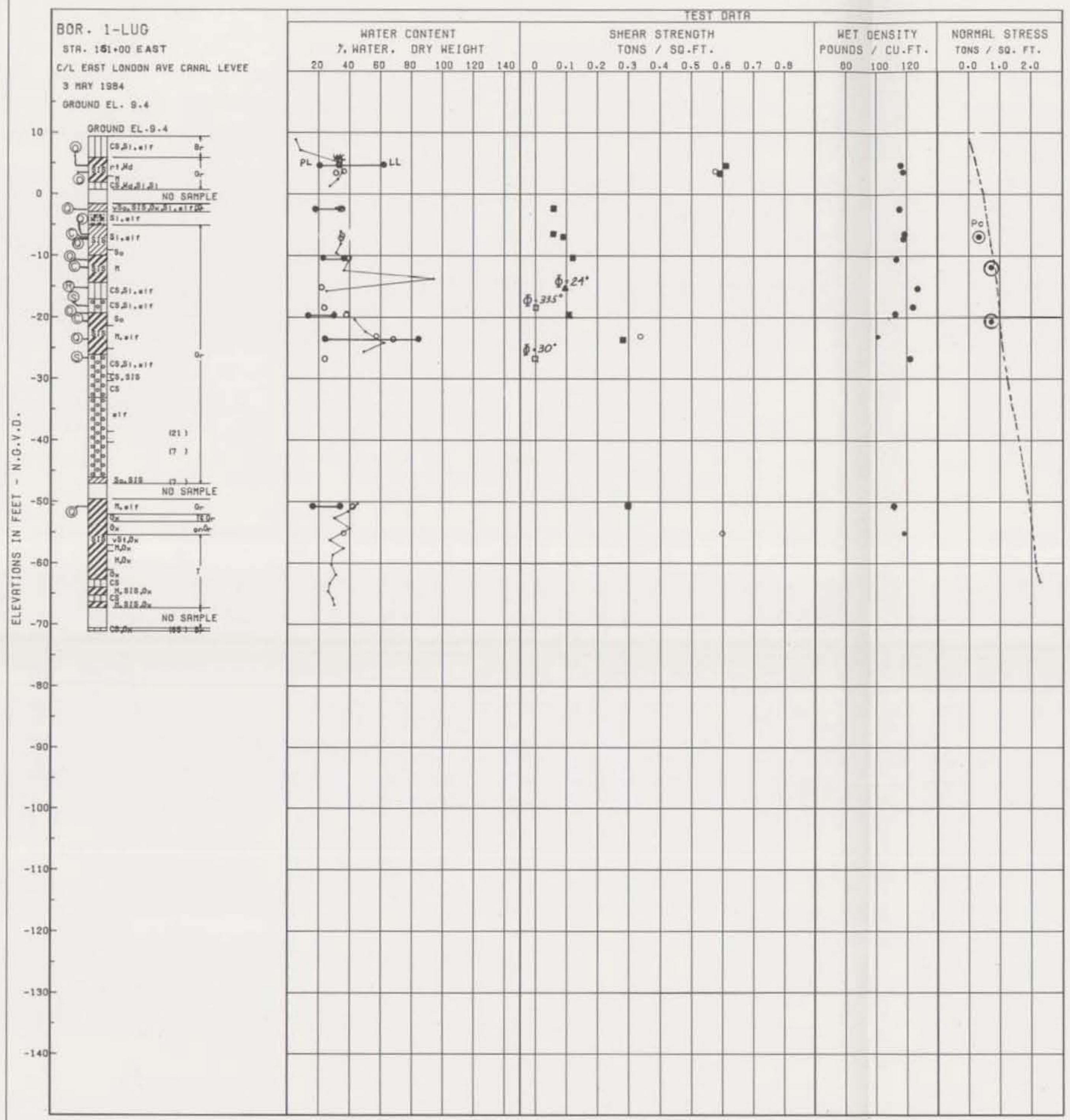
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORING SEE PLATES 14-16

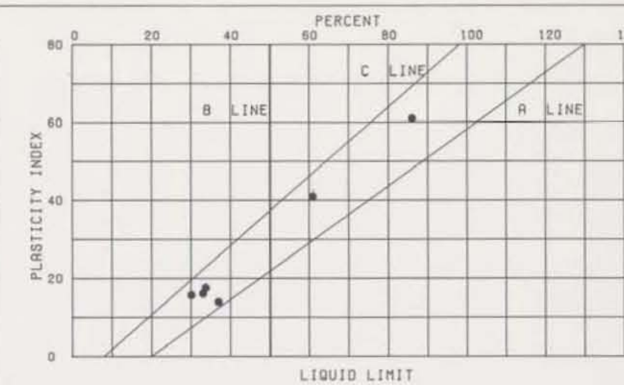
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 3-LUG

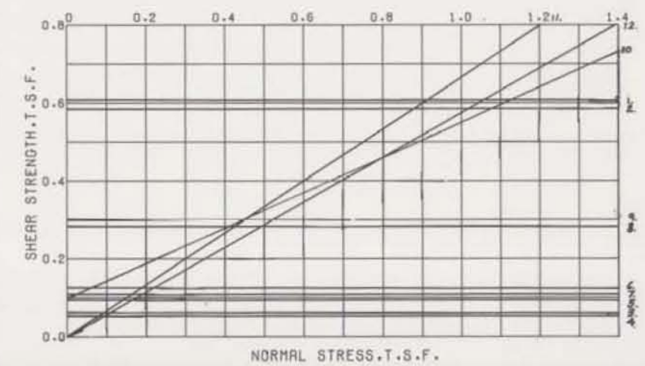
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30888


BOR. 2-LUG
TEST DATA
WATER CONTENT
% WATER, DRY WEIGHT
SHEAR STRENGTH
TONS / SQ.FT.
WET DENSITY
POUNDS / CU.FT.
NORMAL STRESS
TONS / SQ. FT.
NO SAMPLE
ELEVATIONS IN FEET
PERCENT
C LINE
B LINE
A LINE
PLASTICITY INDEX
LIQUID LIMIT
PLASTICITY CHART
SHEAR STRENGTH, T.S.F.
NORMAL STRESS, T.S.F.
SHEAR STRENGTH DATA
ENVELOPE
NO.
EL.
TYPE
STRENGTH
CLASS
LOAD P TONS / SQ. FT.
VOID RATIO
CONSOLIDATION DATA
(UC) UNCONFINED COMPRESSION TEST
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
UNDISTURBED BORING NO. 2-LUG
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS



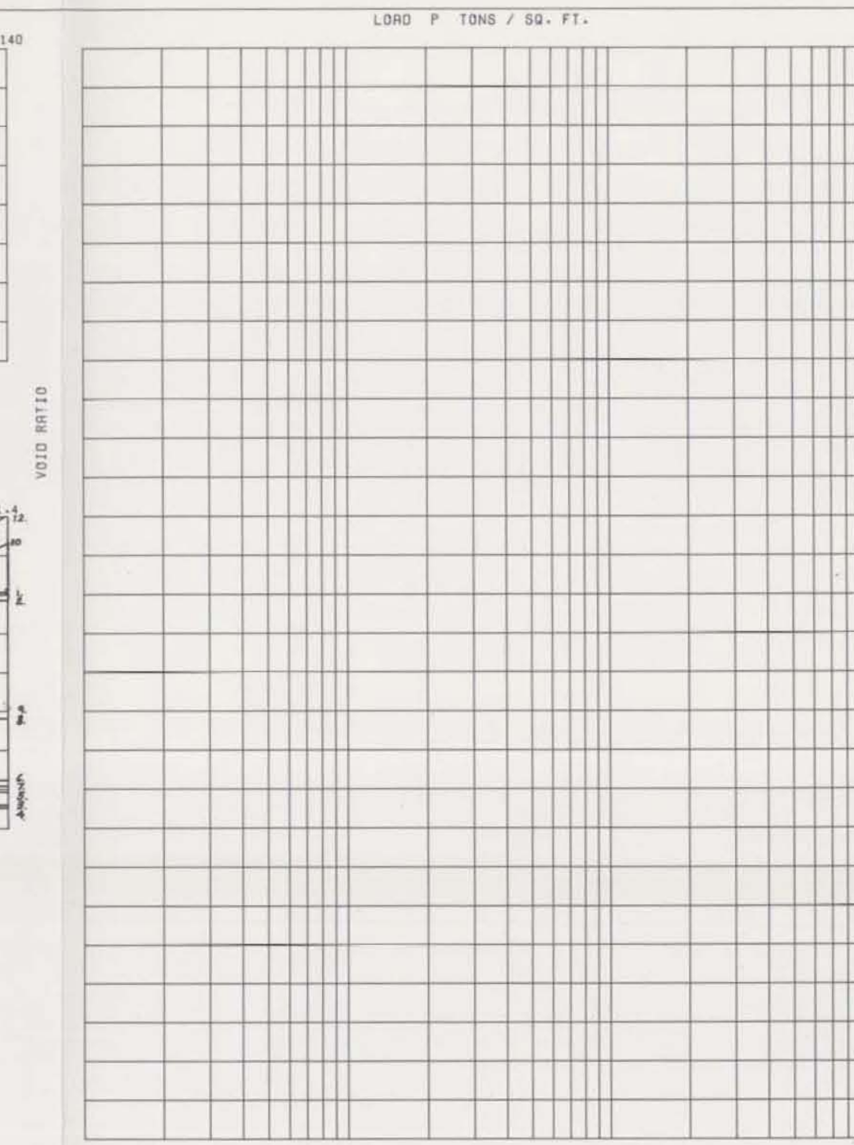


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1.	4.7	Q	0°	0.61	CH
2.	3.6	Q	0°	0.59	CH
3.	-2.4	Q	0°	0.06	CL
4.	-6.4	Q	0°	0.055	ML
5.	-7.1	Q	0°	0.095	ML
6.	-10.2	Q	0°	0.125	CL
7.	-19.9	Q	0°	0.105	CL
8.	-23.7	Q	0°	0.285	CH
9.	-50.6	Q	0°	0.30	CL
10.	-15.1	R	24°	0.1	ML
11.	-18.8	S	33.5°	0.0	ML
12.	-26.9	S	30°	0.0	SM



CONSOLIDATION DATA

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

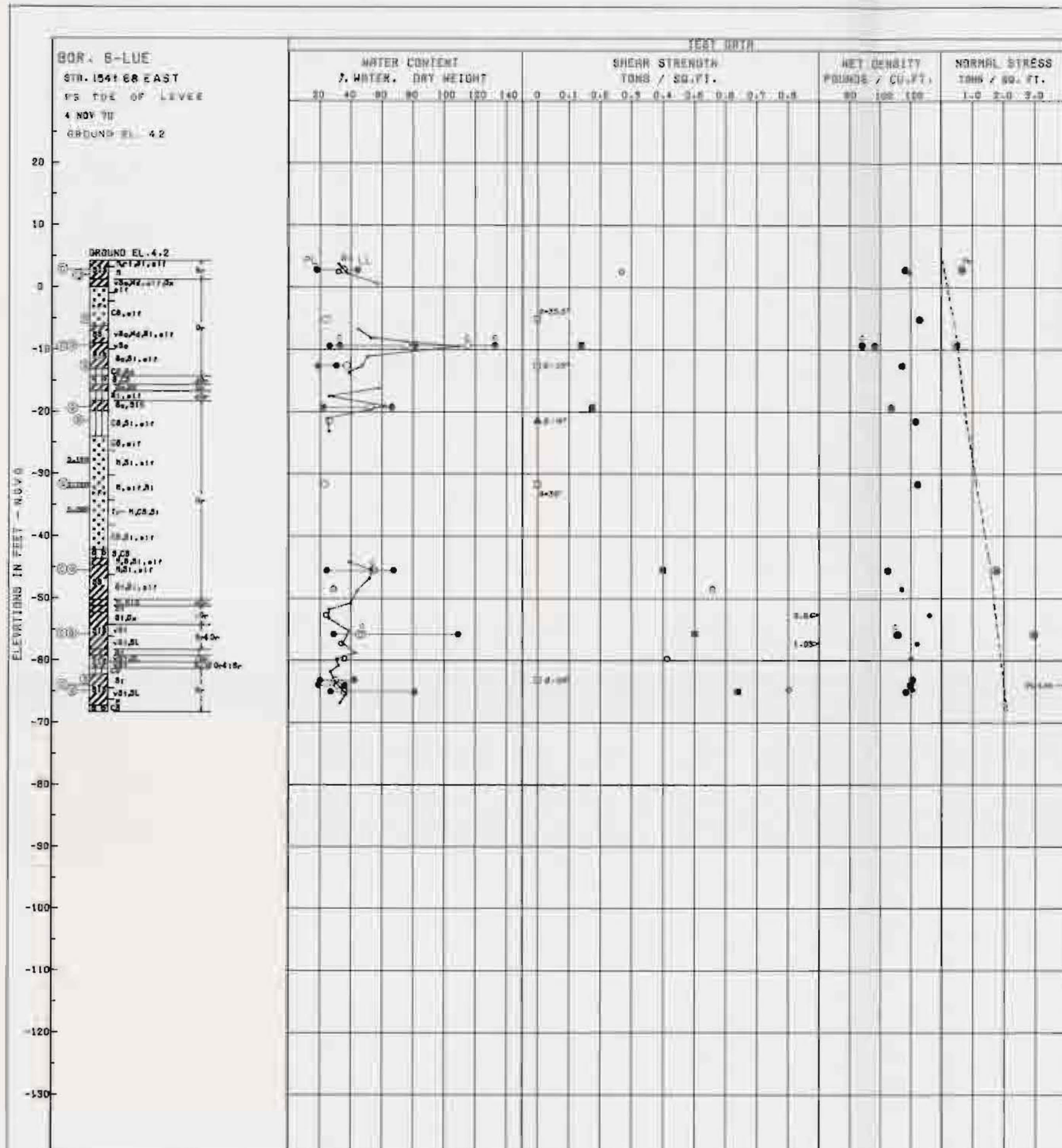
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATES 14-16

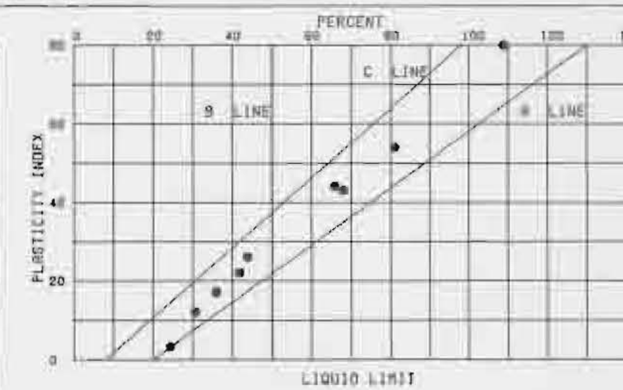
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 1-LUG

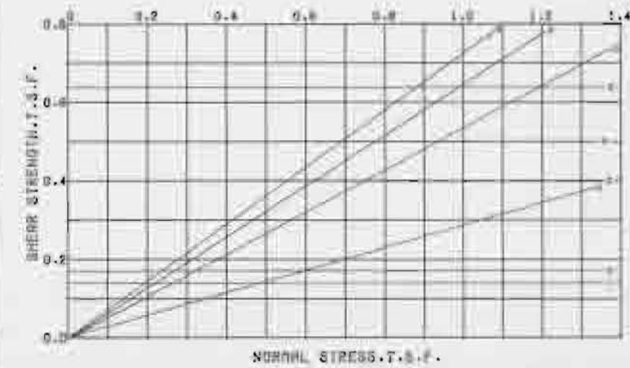
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT. 1988 FILE NO. H-2-30288



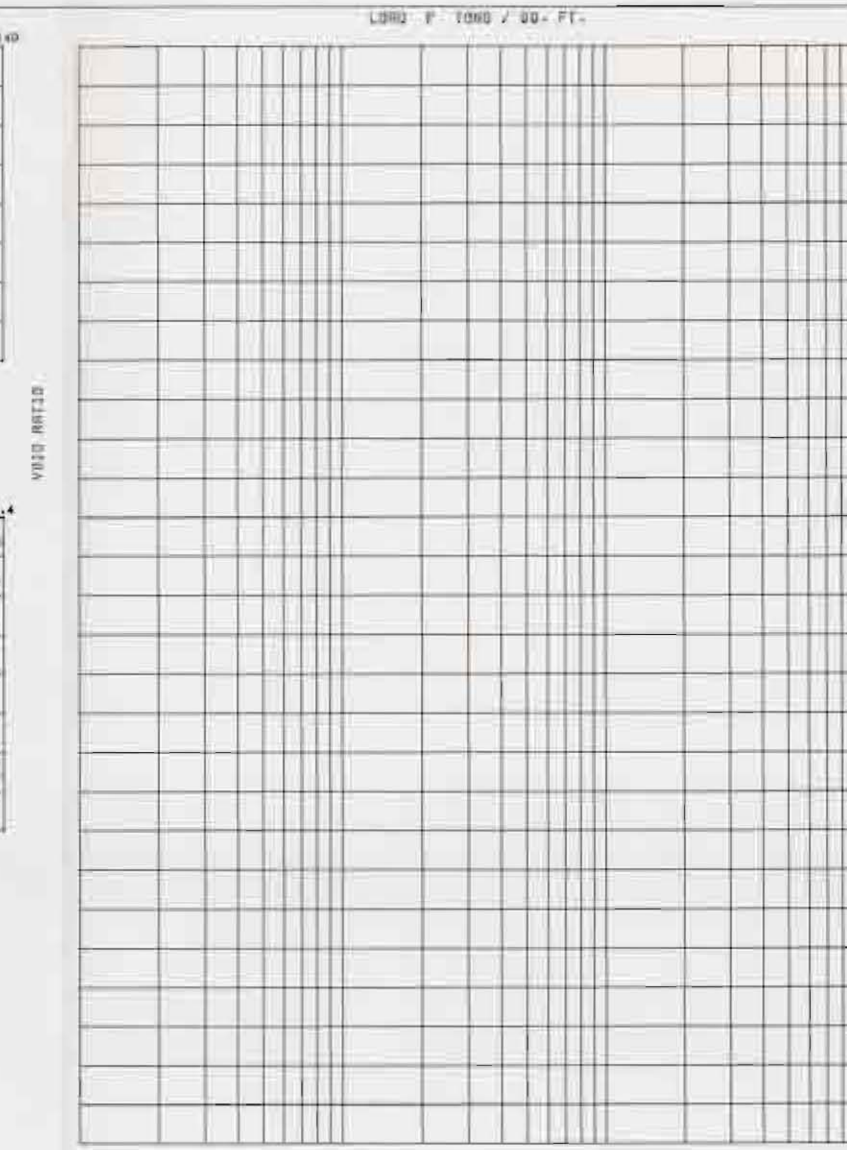


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	-3.4			0.14	
2	[illegible]			0.17	
3	-43.3	Q	0	0.40	CH
4	-58.8			0.50	
5	-65.0			0.66	
6	-31.4	[illegible]	18°		SP
7	-5.0		35.0°		SM
8	-12.8	[illegible]	17°	0	CL
9	-31.8		34°		SM
10	-63.2		[illegible]		CL
11	3.1	Q	0	0.08	ML



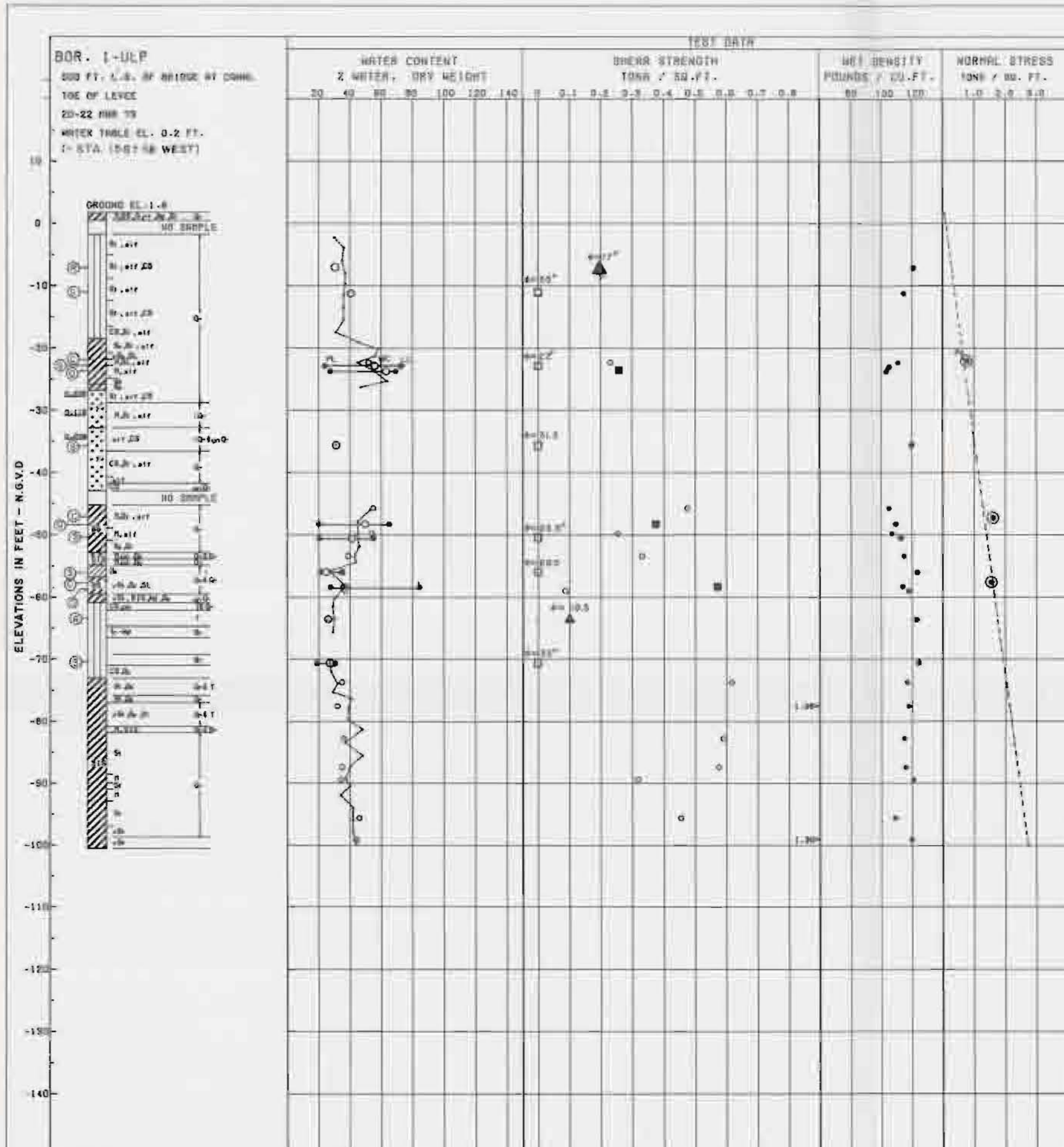
CONSOLIDATION DATA

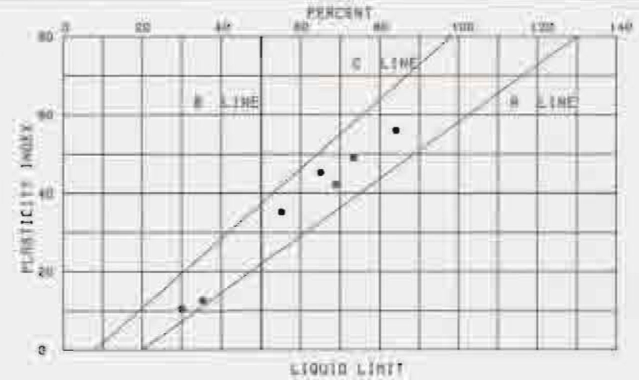
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER
STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATES 14-16

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

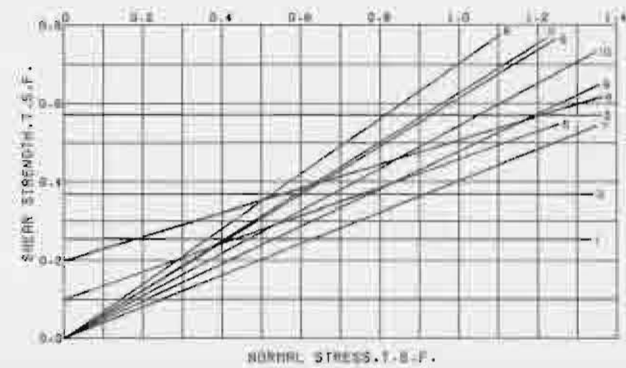
UNDISTURBED BORING NO. 6-LUE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288



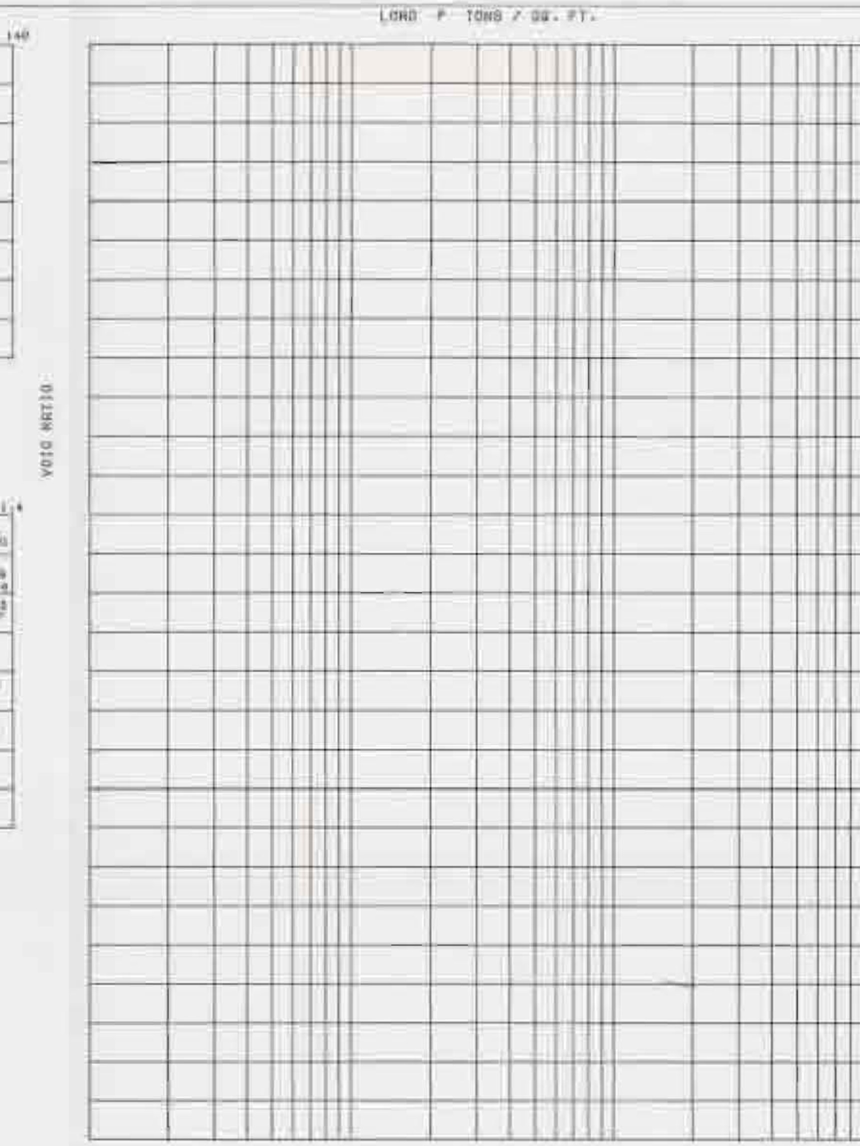


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH ϕ°	STRENGTH C - TSF	CLASS
1	-23.9	Q	0	0.26	CH
2	-48.3		0	0.37	CH
3	-58.4		0	0.37	CH
4	-7.0	R	17	0.20	ML
5	-63.6		19.5	0.10	ML
6	-11.2	S	35	0.0	ML
7	-23.0		22	0.0	CH
8	-35.4		31.5	0.0	SM
9	-50.5		25.5	0.0	CH
10	-55.9		28.5	0.0	CL
11	-70.8		32	0.0	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

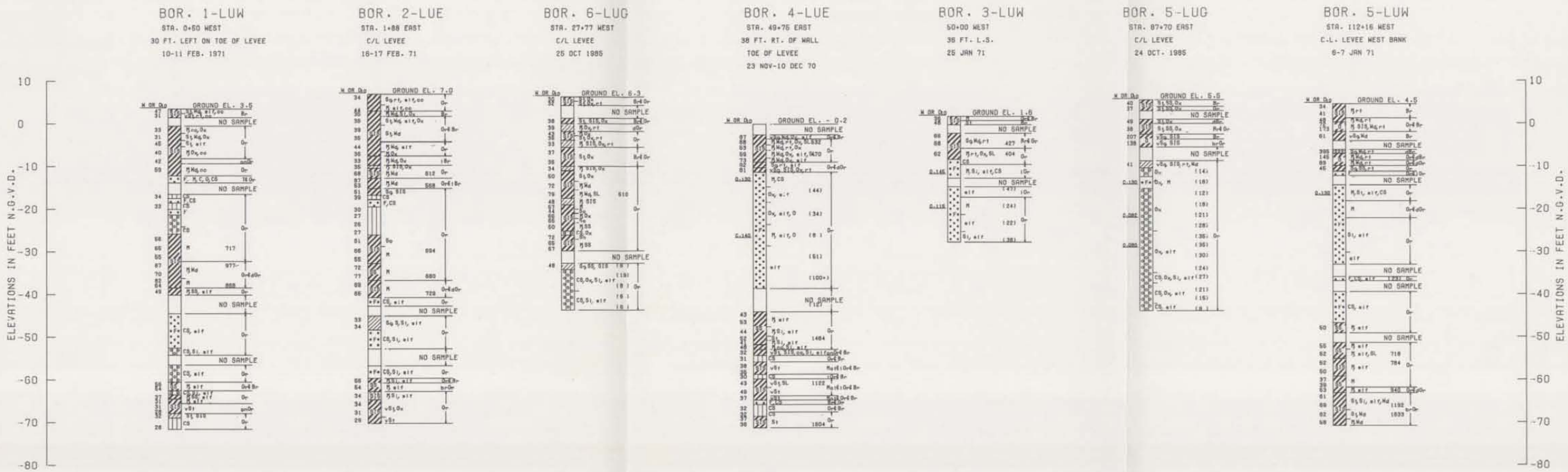
FOR LOCATION OF BORINGS SEE PLATES 14-16

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING NO. 1-ULP

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

DATE: SEPT 1988 FILE NO. H-2-



NOTES:
GENERAL TYPE BORINGS OBTAINED WITH 1-7/8 IN. I.D. X 29 INCH SAMPLER. UNDISTURBED BORINGS INDICATED BY THE LETTER "U" TAKEN WITH 5 IN. I.D. X 4 FOOT PISTON TYPE SAMPLER.

FOR BORING LOCATIONS SEE PLATES 14-16

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

UNDISTURBED BORING LOGS 1-LUW, 2-LUE, 6-LUG, 4-LUE, 3-LUW, 5-LUG, 5-LUW

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

DATE: SEPT. 1988 FILE NO. H-2-30288

NOTES:
GENERAL TYPE BORINGS OBTAINED WITH 1-7/8 IN. I.D. X 20 INCH SAMPLER. UNDISTURBED BORINGS INDICATED BY THE LETTER "U" TAKEN WITH 5 IN. I.D. X 4 FOOT PISTON TYPE SAMPLER.

FOR BORING LOCATIONS SEE PLATES 14-16

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

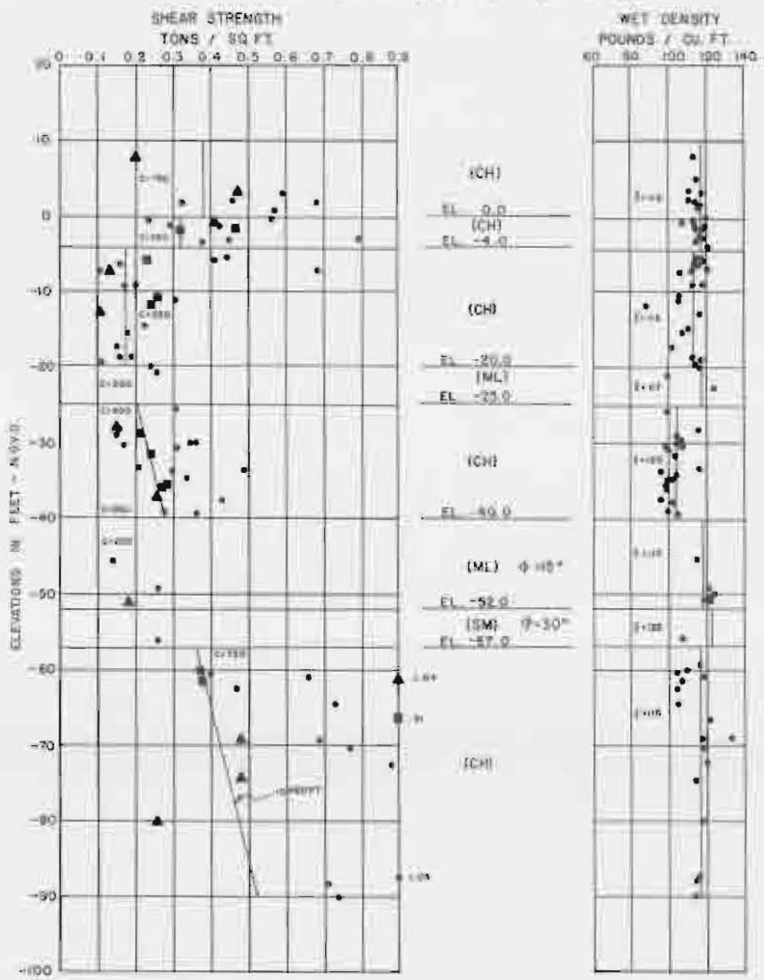
GENERAL TYPE & UNDISTURBED BORING LOGS 2-LG, 4-LUG, 1-LG, 3-LUG, 2-LUG, 1-LUG, 6-LUE, 1-ULP, 1-LP, 2-LP

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

DATE: SEPT 1988 FILE NO. H-2-30288

PARALLEL PROTECTION PLAN

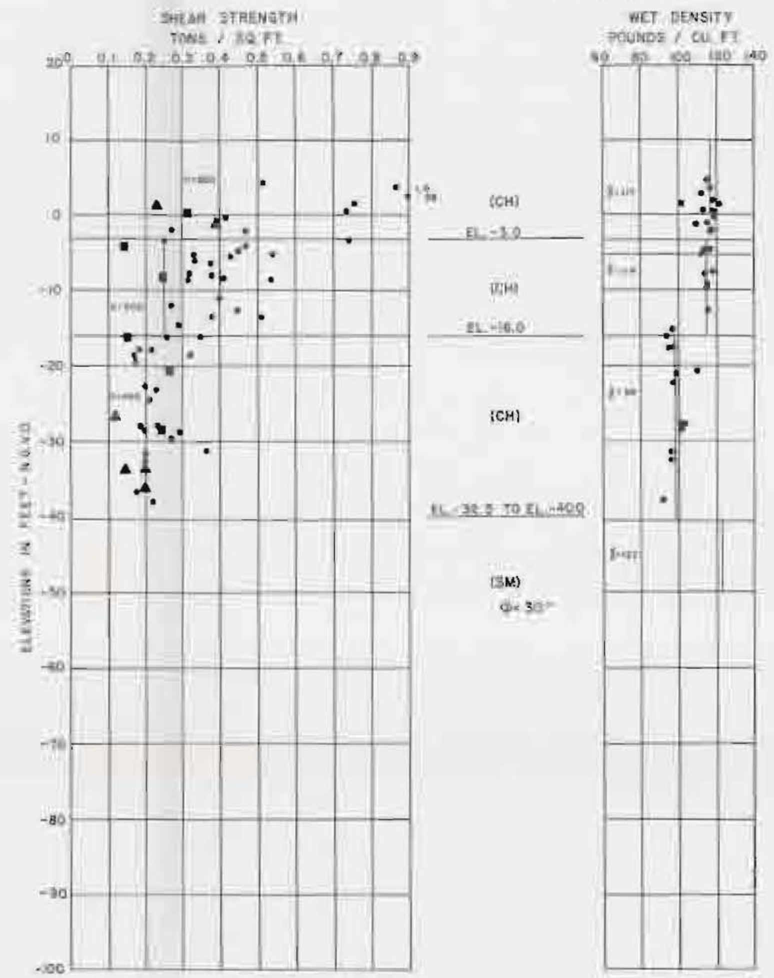
STA. 0+00 TO STA. 21+00



BORING LEGEND:
SHEAR STRENGTHS
• ■ 1-LUW, 2-LUE PLATES 45, 46
• ▲ B-1 THRU B-5, B-36 THRU B-39 APPENDIX A

PARALLEL PROTECTION PLAN

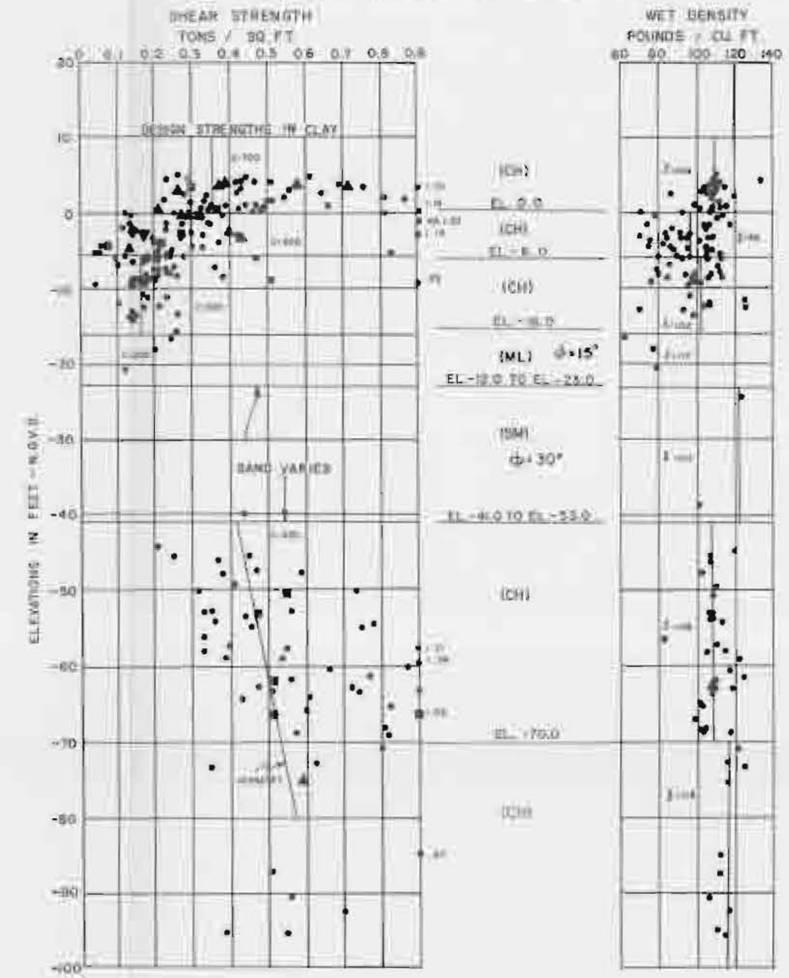
STA. 21+00 TO STA. 37+00



BORING LEGEND:
SHEAR STRENGTHS
• ■ 6-LUG PLATE 47
• ▲ B-6 THRU B-9, B-40 THRU B-43 APPENDIX A

PARALLEL PROTECTION PLAN

STA. 37+00 TO STA. 127+50



BORING LEGEND:
• ■ 3-LUW, 4-LUE, 5-LUG, 5-LUW PLATES 48, 49, 50, 51
• ▲ B-9 THRU B-29, B-44, B-46 THRU B-62 APPENDIX A
• ▼ B-45 APPENDIX A

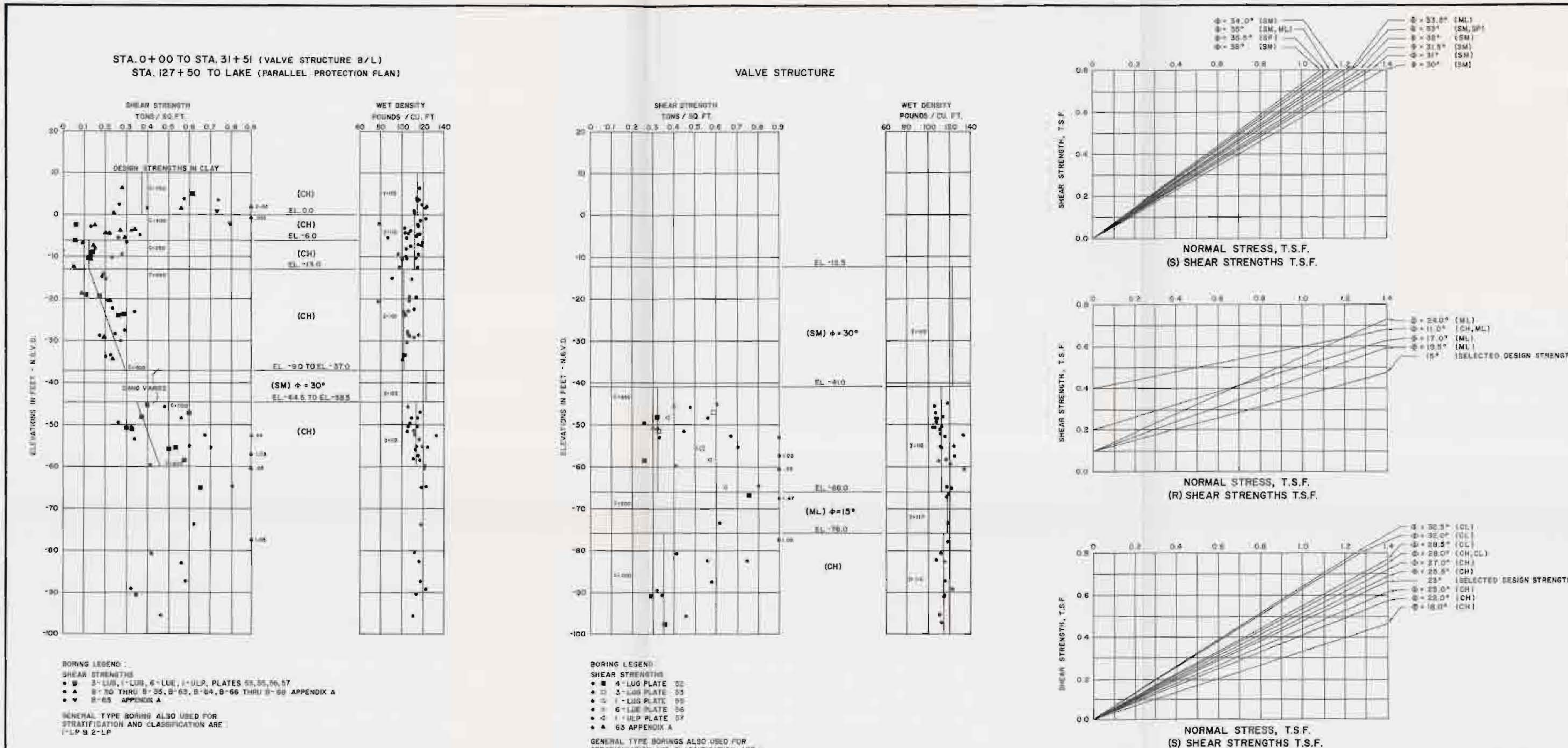
• UNCONFINED COMPRESSION TEST
■ UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
▲ " " " " " (FT. EUSTIS ENGINEERING 3" I.D. BORING
▼ " " " " " 5" I.D. BORING
SEE APPENDIX A FOR EUSTIS ENGINEERING BORINGS AND LABORATORY TESTS

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOIL DESIGN PARAMETERS

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

DATE: SEPT. 1988 FILE NO. H-2-30288



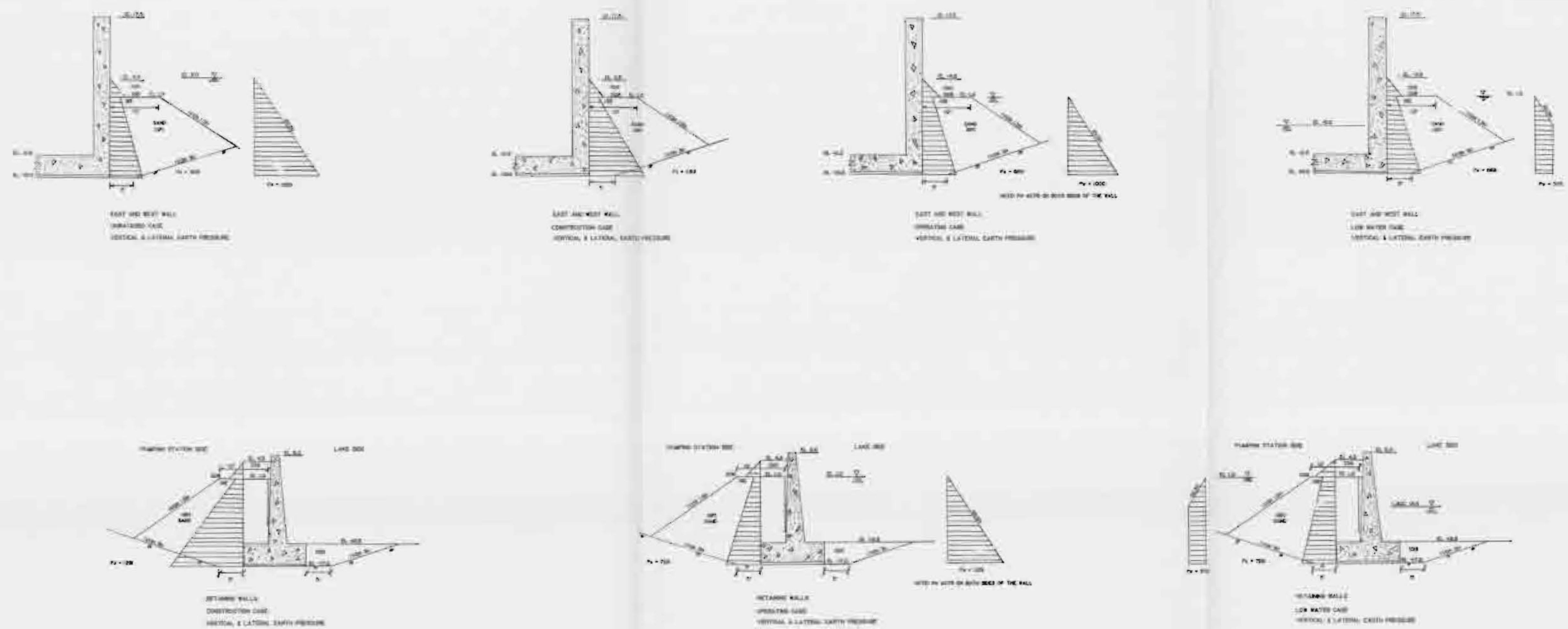
• UNCONFINED COMPRESSION TESTS
◁ ◇ △ ○ ■ UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS
▼ " " " " " 3 PT. EUSTIS ENGINEERING 5" I.D. BORING
▲ " " " " " 1 PT. " " 5" " "
SEE APPENDIX A FOR EUSTIS ENGINEERING BORING AND LABORATORY TESTS

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

SOIL DESIGN PARAMETERS

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

DATE: SEPT. 1988 FILE NO. H-2-33288



	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

NOTE:
ALL PRESSURES ARE GIVEN IN UNITS OF P.S.F.
LOW WATER OPERATING CONDITION IS EL. -5.0
UNWATERED CONDITION IS EL. [illegible]

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A — GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

LATERAL PRESSURES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30289

Assumption: Line Source, Gravity Flow Partially Penetrating Infinite Line of Wells.

Aquifer 1 ML/SM Ground Surface to EL. -19.0
Aquifer 2 SM EL. -19.0 to EL. -48.0

Transformation:

$Kh/Kv = 4$

Assume Aquifer 1 = Aquifer 2

$K = \sqrt{Kh\,Kv} = \sqrt{(400\times10^{-4})(100\times10^{-4})} = .020$ cm/sec = .0394 ft/min

Wellpoints Drawdown to EL -20.0, Lake Stage +6.5
Assuming an equivalent continuous slot.

$H = 54.5'$ $V = 15'$ $ho = 27'$

$R = C(H - hw)\sqrt{K} = 3(54.5' - 27')\sqrt{200} = 1167'$ Fig 4-23 Eq.1
$K = .0394$ fpm $a = 15'$

Assuming 15 ft spacing between wellpoints

Where $L \geq 3H$

$Qp = (0.73 + 0.27\frac{H - ho}{H})\frac{Kx}{2L}(H^2 - ho^2)$ Fig 4-3 Eq.3 $L = 1167 > 3(54.5) = 163.5'$

$Qp = (0.73 + 0.27\frac{54.5 - 27}{54.5})\frac{0.0394(15')}{2(1167')}[(54.5')^2 - (27')^2] = .806$

$h_D = ho\,[\frac{1.48}{L}(H - ho) + 1]$ Fig 4-3 Eq.4

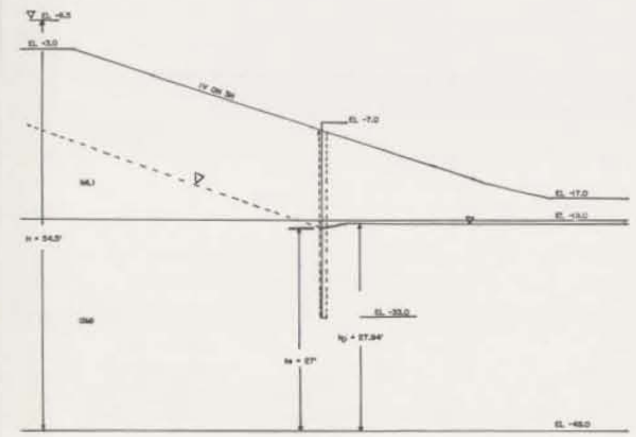
$h_D = 27'\,[\frac{1.48}{1167}(54.5 - 27) + 1]$

$h_D = 27.94$ or EL $-20.06 \leq -20.0$ (OK)

Head loss in wellpoints

$Hw = He + Hs + Hf + Hv$ Fig 4-25
Assuming 3ft Screen
$Hw \approx 0$ Due to Low Flow

$M = v + he - \Delta Hw - Hw$
$M = 15' + 27' - .94' - 0 = 41.06'$ Set header no higher than EL -6.94'



Sec A-A

SUMMARY

Use F.S. = 1.25 Then $\frac{15'}{1.25} = 12'$, Use 12' Spacing Between Wellpoints

Headers Elevation: EL -7.0
Tip Elevation: EL -33.0
3 ft screen with 5" filter from EL -8.0 to EL -33.0
1.5" wellpoint

(1) Drive Sheetpile
(2) Degrade Existing Levee to +3
(3) Sump pump out to existing ground
(4) Excavate to EL -8.0
(5) Place wellpoints
(6) Excavate to EL -17.0

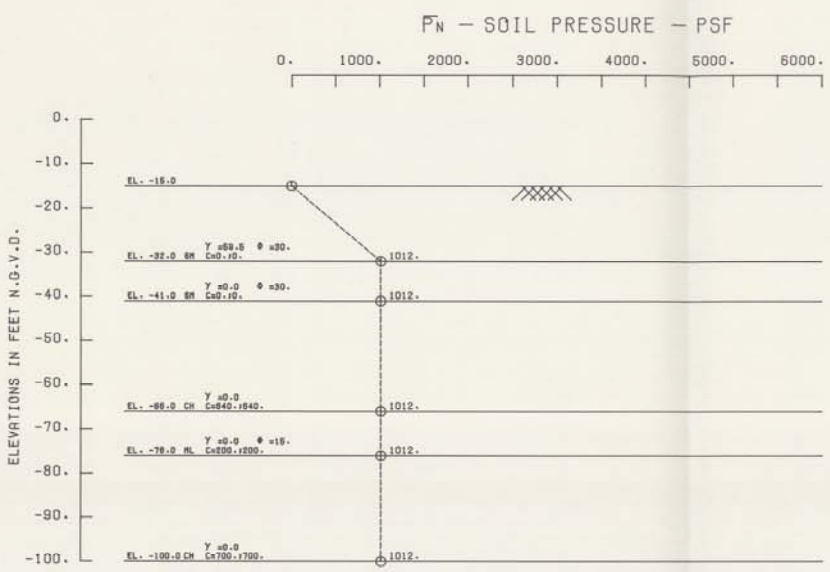
Reference TM-5-818-5 Nov 1983
* K_H Based on D_{10} from Graph Plate 98

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 - GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

DEWATERING SYSTEM

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

DATE SEPT. 1988 FILE NO. H-2-30288

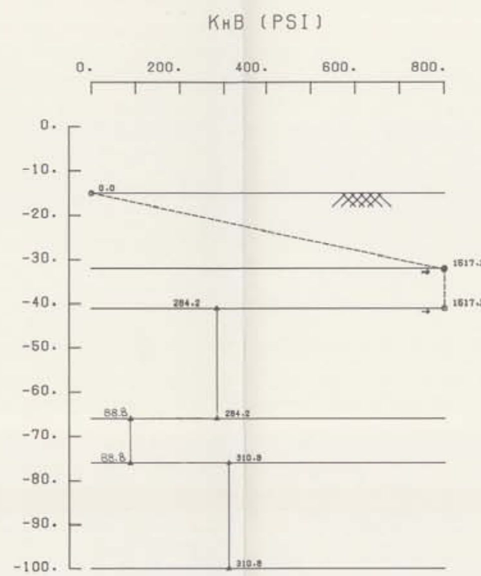


TYPICAL SOIL PROFILE

SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE

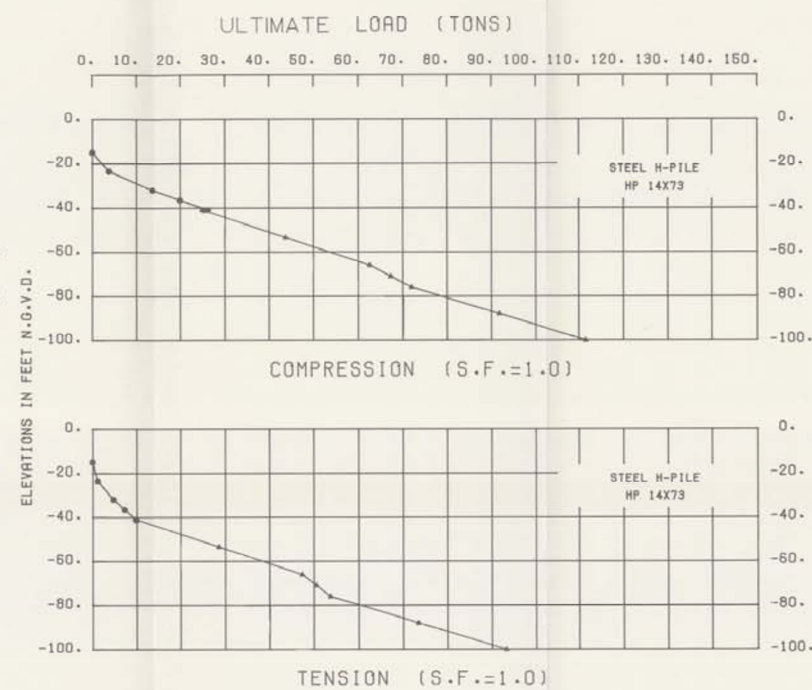
SHEAR STRENGTH AND WET DENSITIES SEE PLATE 61

D	PILE SPACING IN DIRECTION OF LOADING
1.00	8B
0.85	7B
0.70	6B
0.55	5B
0.40	4B
0.25	3B
C	**LOADING CONDITION**
1.00	INITIAL LOADING
0.30	CYCLIC LOADING



NOTES: $K_H = \alpha K_1/B = (0.2222\,qu/B)(C)(D)$ COHESIVE

- α = 0.4 = Factor of material properties of soil and pile
- k_1 = Modulus of subgrade reaction for test plate (pci)
- B_1 = Width or diameter of test plate (in)
- $K_1 = k_1 B_1$ = 80 qu (psf) = 0.5556 qu (psi)
- qu = 2·c = Unconfined compressive strength (psf)
- C = Reduction for cyclic loading-not applicable
- D = Group effect reduction factor
- B = Width of pile measured at right angles to the direction of displacement (in)
- K_H = (nh)(Z/B)(C)(D) COHESIONLESS
- nh = Coefficient of horizontal subgrade reaction (pci)
- Z = Depth below equivalent ground surface (in)



THE FACTOR SHOWN, (MODULUS OF HORIZONTAL SUBGRADE K_h, TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_h = \frac{0.2222\,qu\,(C)(D)}{(B)}$

——— Q-CASE

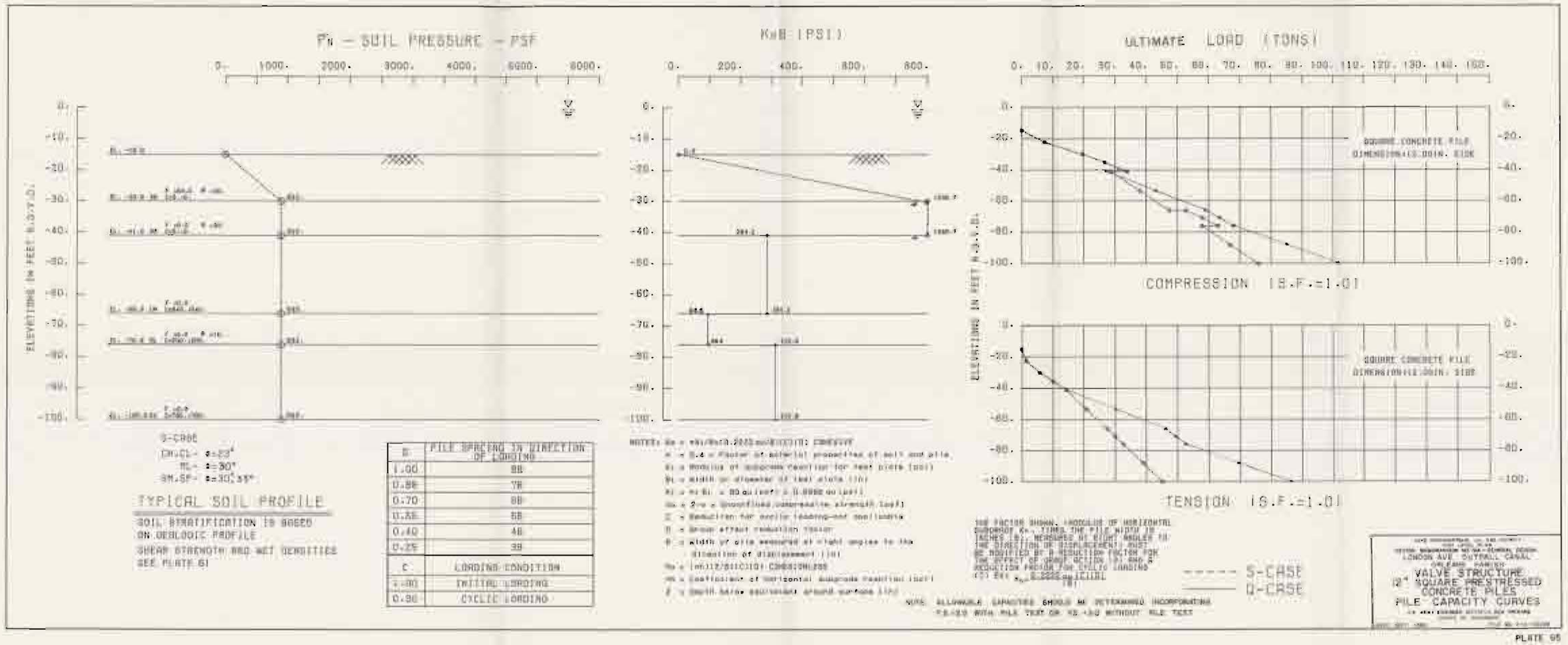
NOTE: ALLOWABLE CAPACITIES SHOULD BE DETERMINED INCORPORATING F.S.=2.0 WITH PILE TEST OR F.S.=3.0 WITHOUT PILE TEST.

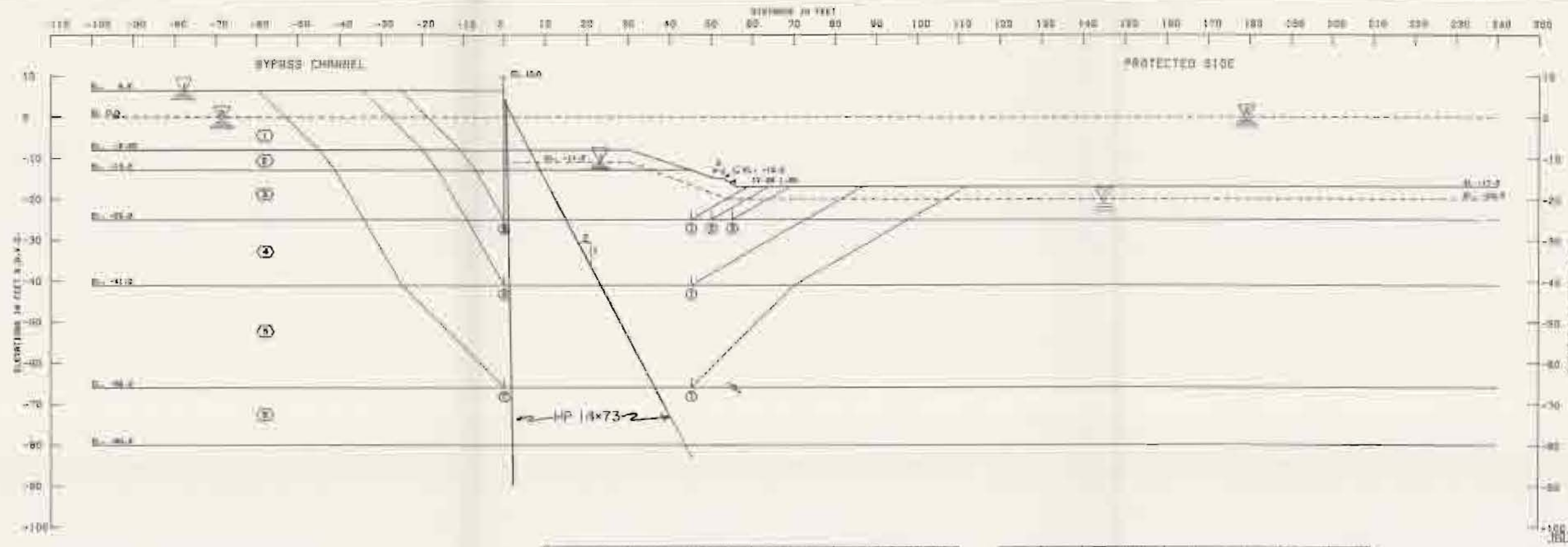
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A–GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

VALVE STRUCTURE EXCAVATION
14 X 73 STEEL H-PILES
PILE CAPACITY CURVES

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

DATE: SEPT. 1988 — FILE NO. H-2-30888


Pн — SOIL PRESSURE — PSF
KнB (PSI)
ULTIMATE LOAD (TONS)
ELEVATIONS IN FEET N.G.V.D.
COMPRESSION (S.F.=1.0)
TENSION (S.F.=1.0)
SQUARE CONCRETE PILE DIMENSION=12.00IN. SIDE
S-CASE
CH,CL- ∅=23°
ML- ∅=30°
SM,SP- ∅=30°,35°
TYPICAL SOIL PROFILE
SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE
SHEAR STRENGTH AND WET DENSITIES SEE PLATE 61
R | PILE SPACING IN DIRECTION OF LOADING
1.00 | 8B
0.85 | 7B
0.70 | 6B
0.55 | 5B
0.40 | 4B
0.25 | 3B
C | LOADING CONDITION
1.00 | INITIAL LOADING
0.90 | CYCLIC LOADING
S-CASE
Q-CASE
LONDON AVE. OUTFALL CANAL
VALVE STRUCTURE
12" SQUARE PRESTRESSED CONCRETE PILES
PILE CAPACITY CURVES
PLATE 95



∇—∇ PH LINE IN STRATA 2,3,&4

∇—∇ PH LINE IN STRATA 6

WEDGE FAILURE NO.	WEDGE 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
⑤ ①	-22.0	8842	33564	9758	36619	6657	45156	33551	1.56
⑤ ②	-22.0	9842	32110	7888	36615	4838	48974	34871	1.58
⑥ ③	-25.0	8842	34588	9292	38519	8827	47730	38338	1.36
⑥ ①	-41.0	23439	39882	10882	102110	78854	84085	55617	1.44
⑦ ①	-66.0	34441	33852	74708	256798	149778	137847	175457	1.56

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	CENTER OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(ML)	117.0	117.0	300.0	300.0	300.0	300.0	15.0
③	(SP)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
④	(SP)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
⑤	(CH)	112.0	112.0	640.0	640.0	640.0	640.0	0.0
⑥	(ML)	117.0	117.0	300.0	300.0	300.0	300.0	15.0

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

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

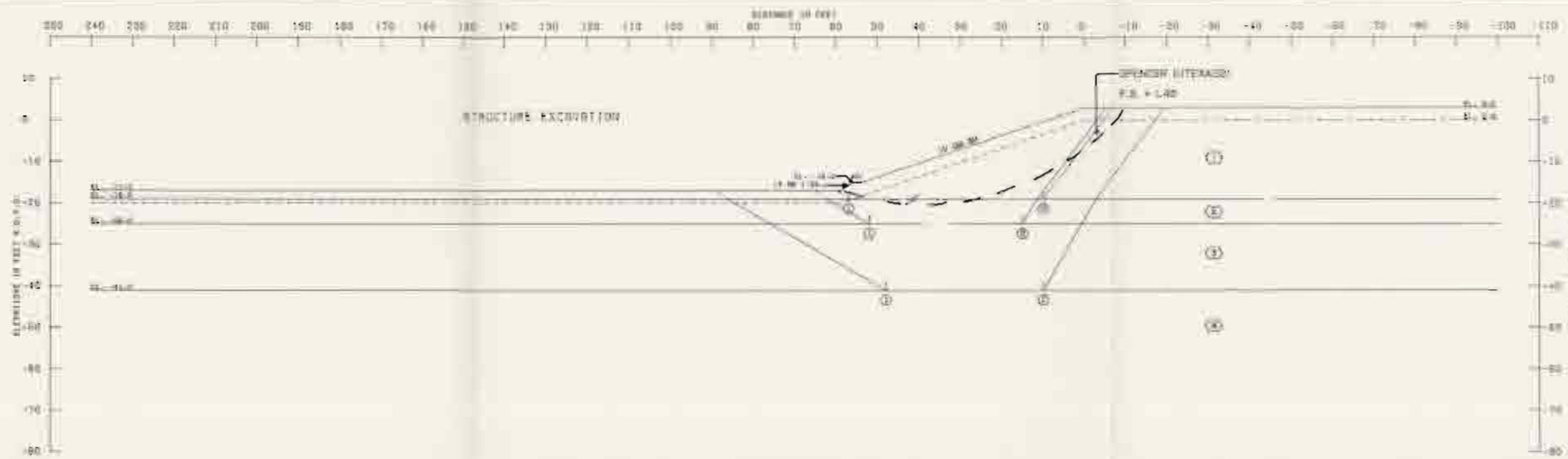
GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

STABILITY ANALYSIS D-D

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: OCT. 1989 FILE NO. H-2-[illegible]



WEDGES 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
(8) (1)	-18.0	15550	19700	1255	28704	383	35889	29411	1.25
(9) (1)	-25.0	10831	24144	7077	46497	4551	38580	34948	1.48
(10) (1)	-41.0	42848	24022	72884	111071	98880	139683	14478	1.47

STRATUM NO.	REL. ELEV.	EFFECTIVE UNIT WT. P.C.F. SAT.	SUB.	C = UNIT COHESION (P.S.F.) CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)		117.0	0.0	200.0	0.0	200.0	0.0	10.0
(2)		122.4	0.0	0.0	0.0	0.0	0.0	30.0
(3)		120.0	0.0	0.0	0.0	0.0	0.0	35.0
(4)		112.0	0.0	540.0	0.0	540.0	0.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 6.

NOTES

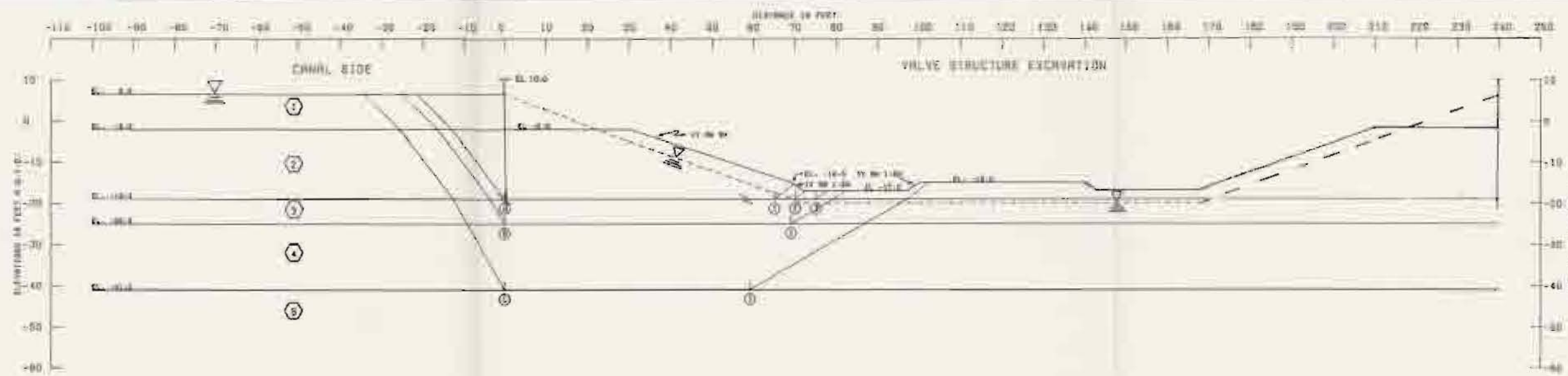
φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
SWS -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 19A GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

STABILITY ANALYSIS E-E

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: [illegible] FILE NO. H-2-[illegible]



MODE OF 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
(5)	(1)	-18.0	8481	20488	2026	35176	1146	30577	27030	[illegible]
(6)	(2)	-18.0	8481	20888	1986	35176	883	30626	27859	[illegible]
(4)	(3)	-18.0	8481	21803	1827	35176	226	27711	23944	1.34
(5)	(1)	-25.0	10897	40888	8618	45481	4077	64838	41464	[illegible]
(2)	(1)	-41.0	21806	37780	88064	115194	38037	144480	76857	[illegible]

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C = UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)	[illegible]	92.8	92.8	0.0	0.0	0.0	0.0	0.0
(2)	CH	117.0	117.0	200.0	200.0	205.0	205.0	15.0
(3)	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
(4)	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
(5)	CH	110.0	110.0	840.0	840.0	840.0	840.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

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

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

[illegible]

DESIGN MEMORANDUM [illegible] GENERAL DESIGN

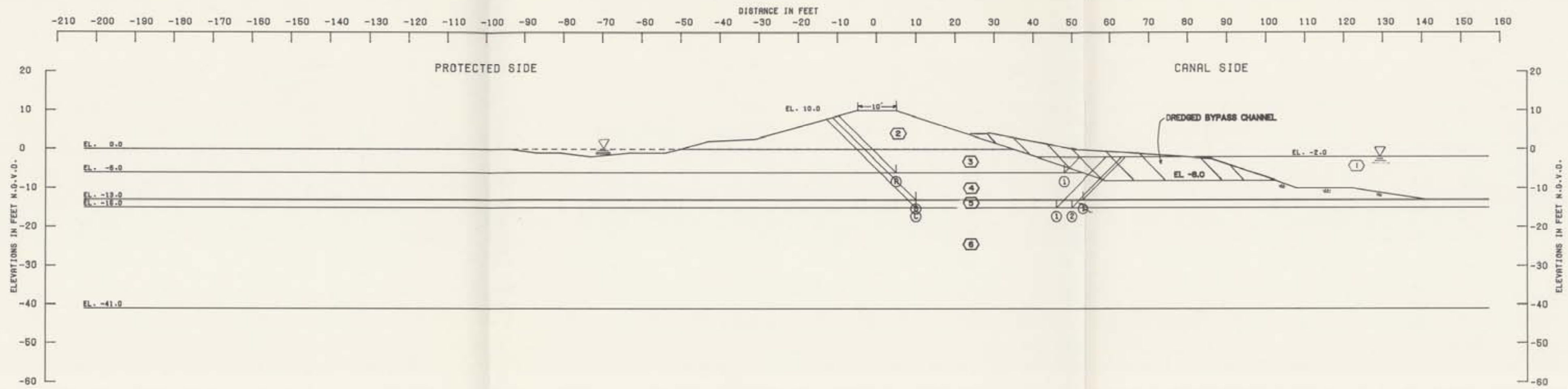
LONDON AVE. OUTFALL CANAL

ORLEANS PARISH

STABILITY ANALYSIS F-F

[illegible]

PLATE 60



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
Ⓐ	①	-6.0	17807	10750	998	14206	551	29555	13655	2.16
Ⓑ	①	-13.0	20642	10750	2625	28866	4690	34017	24176	1.41
Ⓒ	①	-15.0	21038	10080	4309	33821	7642	35427	26179	1.35
Ⓒ	②	-15.0	21038	11200	3810	33821	7114	36048	26707	1.35

Stratum No.	Soil Type	Effective Unit Wt. P.C.F. Vert. 1	Effective Unit Wt. P.C.F. Vert. 2	C - Unit Cohesion - P.S.F. Center of Stratum Vert. 1	C - Unit Cohesion - P.S.F. Center of Stratum Vert. 2	C - Unit Cohesion - P.S.F. Bottom of Stratum Vert. 1	C - Unit Cohesion - P.S.F. Bottom of Stratum Vert. 2	Friction Angle Degrees
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	115.0	115.0	750.0	750.0	750.0	750.0	0.0
3	(CH)	112.0	112.0	400.0	400.0	400.0	400.0	0.0
4	(CH)	112.0	112.0	250.0	250.0	250.0	250.0	0.0
5	(CH)	101.0	101.0	205.0	265.0	280.0	280.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

NOTES

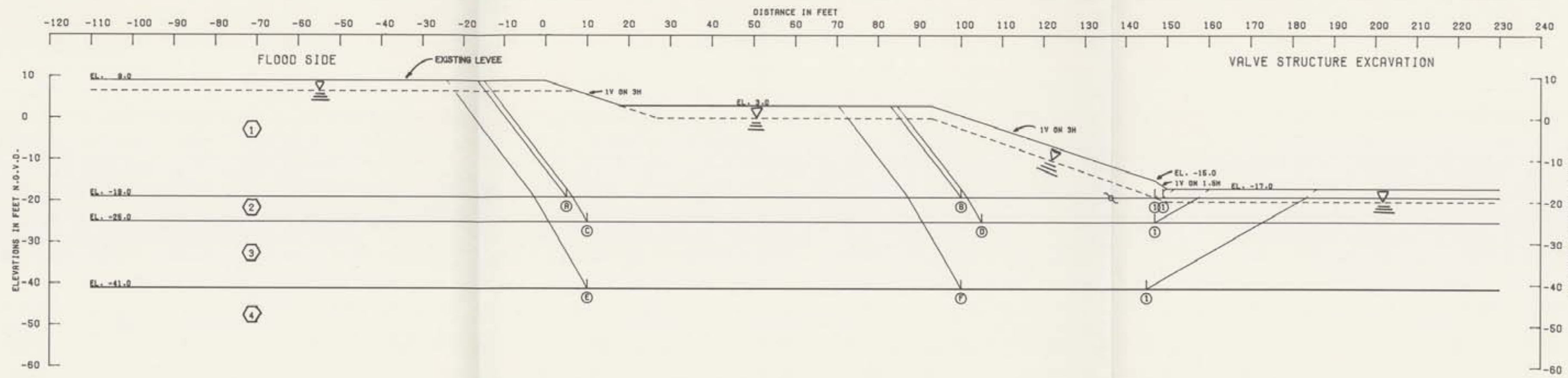
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

STABILITY ANALYSIS G-G

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288



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)	-19.0	18834	74172	1227	45223	264	94233	44959	2.10
(B) (1)	-19.0	13841	19997	1465	27061	500	35303	26561	1.33
(C) (1)	-25.0	24905	122498	6919	64687	4036	154322	60651	2.54
(D) (1)	-25.0	19281	28606	6919	41689	4036	54806	37653	1.46
(E) (1)	-41.0	51389	86400	42266	144070	35421	180055	108649	1.66
(F) (1)	-41.0	43398	28800	42266	112795	35421	114464	77374	1.48

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)	(ML)	117.0	117.0	200.0	200.0	200.0	200.0	15.0
(2)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
(3)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
(4)	(CH)	112.0	112.0	640.0	640.0	640.0	640.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

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

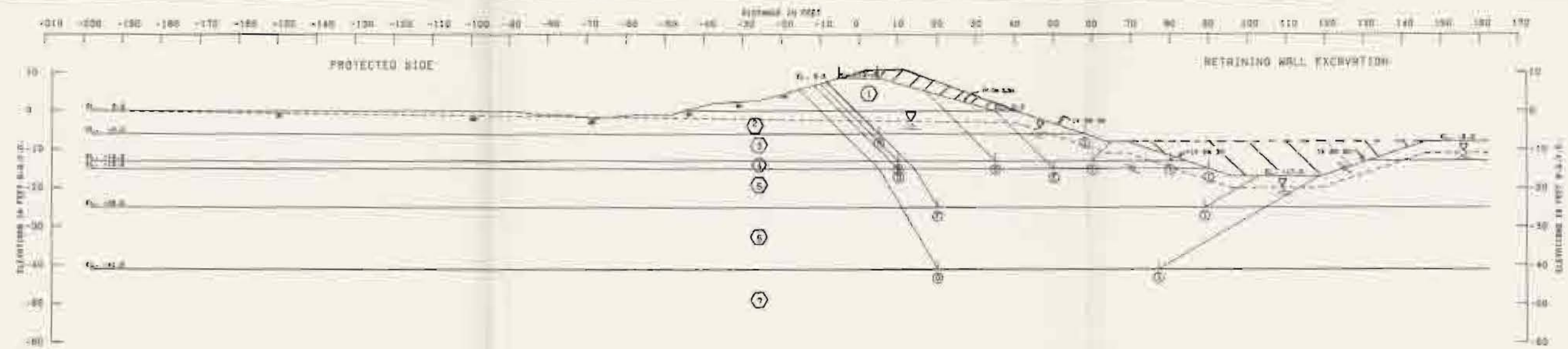
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
ORLEANS AVE. OUTFALL CANAL
ORLEANS PARISH

STABILITY ANALYSIS H-H

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

DATE: SEPT. 1988 FILE NO. H-2-30288



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
Ⓐ	①	-8.0	10970	13250	-0	11778	0	23938	11779	2.45
Ⓑ	①	-13.0	18810	13550	3551	25993	1996	33842	23885	1.43
Ⓒ	①	-13.0	16000	11550	400	13304	74	27799	13000	2.10
Ⓓ	①	-18.0	19510	16440	-1	30073	0	36000	30075	1.31
Ⓔ	①	-18.0	5960	8746	-2	10707	0	15107	10707	1.38
Ⓕ	①	-25.0	20559	61094	8895	50573	4470	90731	35000	1.80
Ⓖ	①	-41.5	29140	[illegible]	44070	132493	39093	130884	93412	1.00

Stratum No.	Soil Type	Effective Unit Wt. P.C.F. Part 1	Part 2	C = Unit Cohesion - P.S.F. Center of Stratum Part 1	Part 2	Bottom of Stratum Part 1	Part 2	Friction Angle Degrees
①	[illegible]	115.0	115.0	750.0	750.0	750.0	750.0	0.0
②	(CH)	112.0	110.0	430.0	400.0	400.0	400.0	0.0
③	(CH)	112.0	112.0	350.0	350.0	350.0	350.0	0.0
④	(CH)	101.0	101.0	280.0	280.0	280.0	280.0	0.0
⑤	(SP)	122.0	105.0	0.0	0.0	0.0	0.0	30.0
⑥	(SP)	120.0	100.0	0.0	0.0	0.0	0.0	30.0
⑦	(CH)	110.0	110.0	840.0	840.0	840.0	840.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES

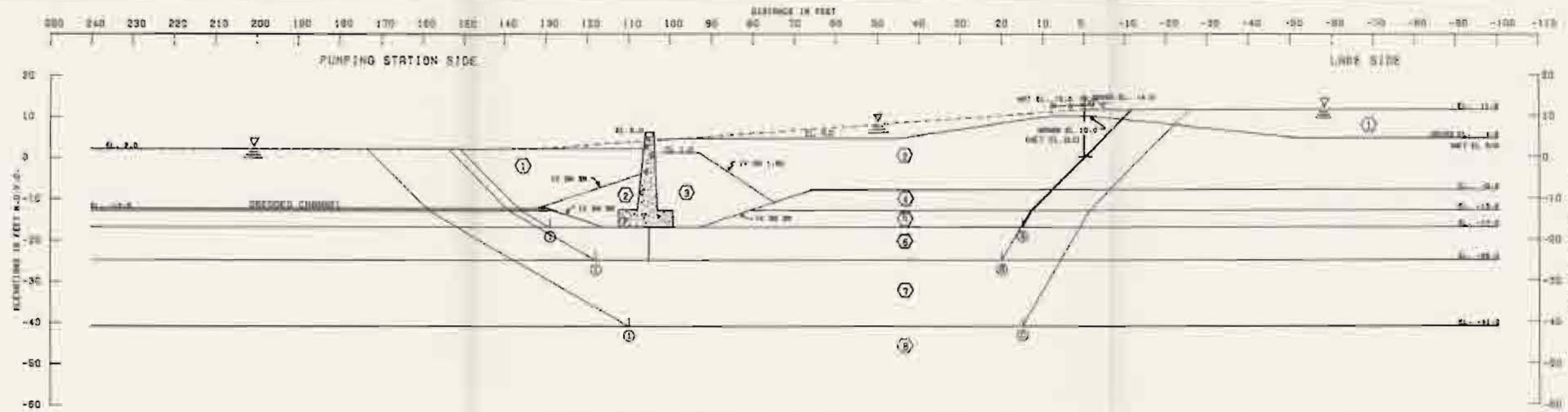
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. [illegible] GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
STABILITY ANALYSIS J-J

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE [illegible] FILE [illegible]

PLATE 71



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
(2) (1)	-17.0	18180	[illegible]	1400	[illegible]	[illegible]	78047	[illegible]	[illegible]
(3) (1)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	59148	[illegible]
(4) (1)	-41.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	151140	[illegible]	[illegible]

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				[illegible]		[illegible]		
(1)	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	[illegible]	[illegible]	[illegible]	400.0	400.0	400.0	400.0	0.0
(3)	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	0.0	30.0
(4)	[illegible]	[illegible]	112.0	[illegible]	[illegible]	[illegible]	[illegible]	0.0
(5)	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	[illegible]	30.0
(6)	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	[illegible]	30.0
(7)	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	0.0	30.0
(8)	[illegible]	[illegible]	[illegible]	840.0	840.0	840.0	840.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES

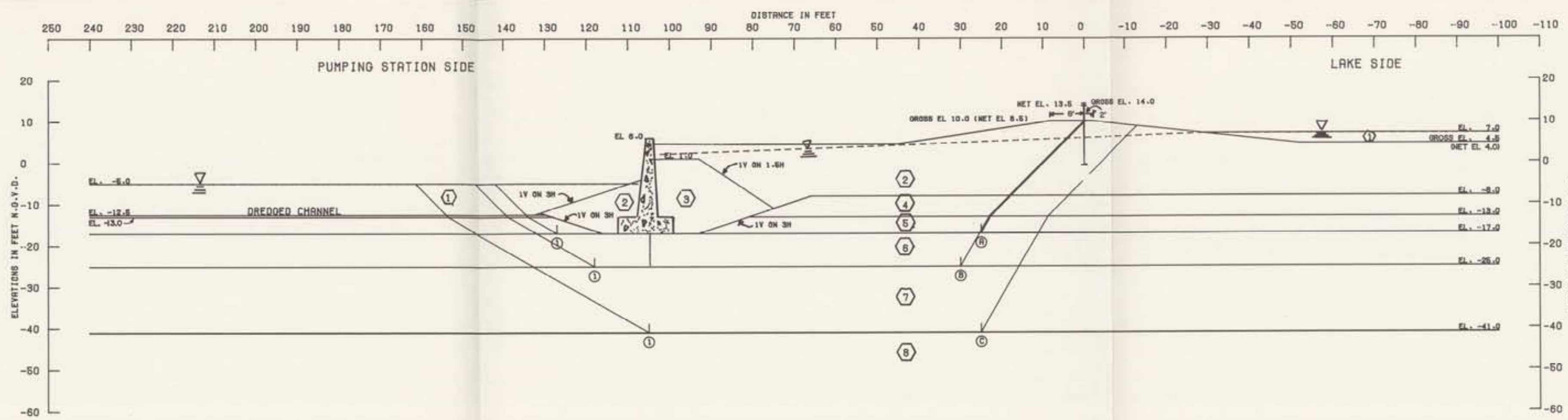
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE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

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

NEW ORLEANS, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

STABILITY ANALYSIS K-K

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



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
Ⓐ ①	-17.0	20295	62582	1679	37451	5221	84556	32230	2.62
Ⓑ ①	-25.0	28686	80841	11069	62885	17916	120596	44969	2.68
Ⓒ ①	-41.0	54829	51200	47458	143154	67610	153487	75544	2.03

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	CENTER OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(SP)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
4	(CH)	112.0	112.0	250.0	250.0	250.0	250.0	0.0
5	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
7	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
8	(CH)	112.0	112.0	640.0	640.0	640.0	640.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

NOTES

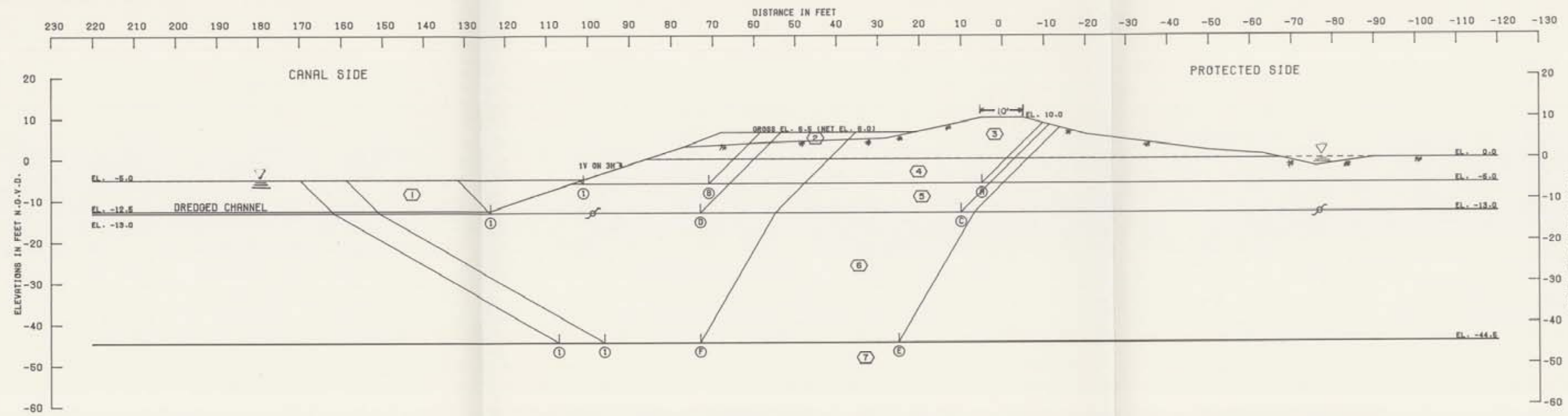
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 19A GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

STABILITY ANALYSIS L-L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30268



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)	-6.0	17906	24000	598	14229	50	42504	14179	3.00
(B)	(1)	-6.0	12652	7500	598	8573	50	20750	8523	2.43
(C)	(1)	-13.0	20775	25458	250	29072	2006	46483	27066	1.72
(D)	(1)	-13.0	16325	9708	250	20813	2006	26283	18807	1.40
(E)	(1)	-44.5	71569	49700	65070	162907	82811	186339	80096	2.33
(F)	(1)	-44.5	64747	23800	63435	149969	80356	151982	69613	2.18

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(CH)	115.0	115.0	750.0	750.0	750.0	750.0	0.0
4	(CH)	112.0	112.0	400.0	400.0	400.0	400.0	0.0
5	(CH)	112.0	112.0	250.0	250.0	250.0	250.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
7	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

NOTES

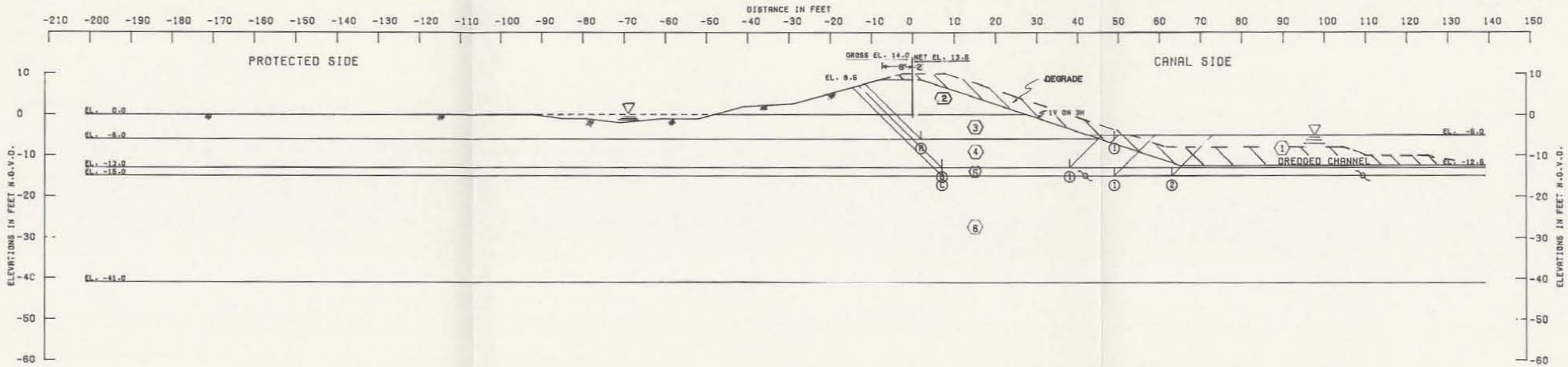
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE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

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

LAKE PONTCHATRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

STABILITY ANALYSIS M-M

US ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT 1988 FILE: NO H-2-30288



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	-6.0	16070	12275	-702	11779	57	27643	11722	2.36
Ⓑ ①	-13.0	18912	7750	3599	25311	3885	30261	21426	1.41
Ⓒ ①	-15.0	19315	11581	2997	30002	4241	33893	25761	1.32
Ⓒ ②	-15.0	19315	14229	1310	30002	3291	34854	26711	1.30

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM		FRICTION ANGLE DEGREES
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	115.0	115.0	750.0	750.0	750.0	750.0	0.0
3	(CH)	112.0	112.0	400.0	400.0	400.0	400.0	0.0
4	(CH)	112.0	112.0	250.0	250.0	250.0	250.0	0.0
5	(CH)	101.0	101.0	265.0	265.0	280.0	280.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION. STRATIFICATION. SHEAR STRENGTH. AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

NOTES

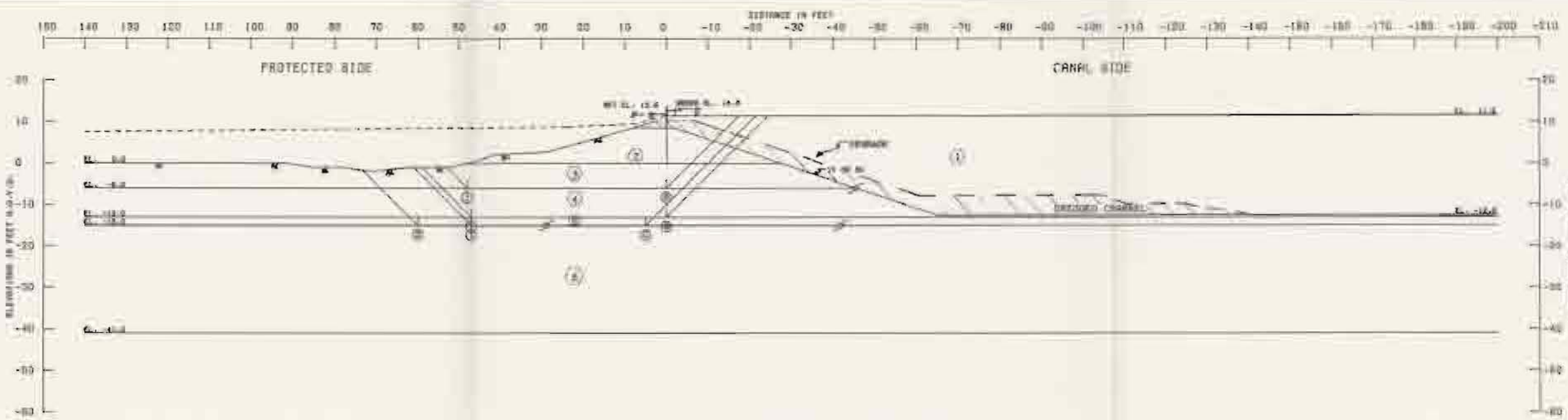
ϕ -- ANGLE OF INTERNAL FRICTION. DEGREES
C -- UNIT COHESION. P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT. REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT. REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT. REFERS TO PASSIVE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

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

LAKE PONTCHARTRAIN, LA, AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

FLOODSIDE LEVEE
STABILITY ANALYSIS
STA. 1+84 TO STA. 6+70 E. W/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT 1988 FILE NO. H-2-30288



WEDGES			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
ACTIVE NO.	SURFACE NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
B	1	-5.0	12804	12000	4002	14009	1833	28984	12296	2.38
B	1	-10.0	13740	11700	7465	29141	5415	30880	18726	1.87
C	1	-15.0	15824	10800	8680	29904	11830	35410	22085	1.61
C	2	-15.0	15824	11199	7868	29904	10140	35891	22315	1.84

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	HORZ. 1	VERT. 2	DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	110.0	110.0	700.0	700.0	700.0	700.0	0.0
3	CH	112.0	110.0	400.0	400.0	400.0	400.0	0.0
4	CH	112.0	110.0	280.0	280.0	280.0	280.0	0.0
5	CH	101.0	101.0	280.0	280.0	280.0	280.0	0.0
6	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 5.

NOTES

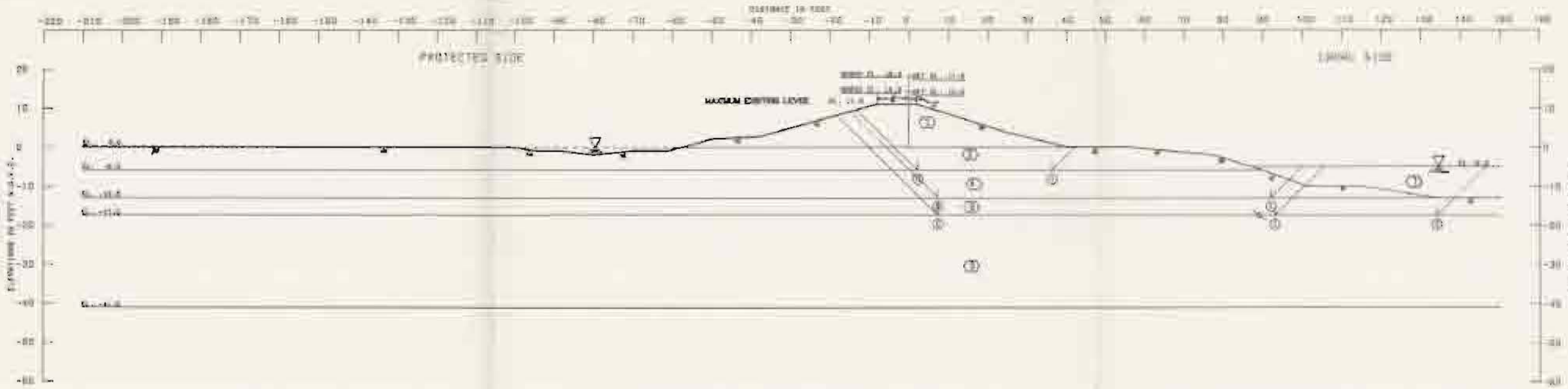
Φ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
▽ — STATIC WATER SURFACE
D — HORIZONTAL DRIVING FORCE IN POUNDS
R — HORIZONTAL RESISTING FORCE IN POUNDS
A — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B — AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P — AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
STA. 1+84 TO STA. 6+70 E. W/L

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



WEDGE NO.		ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
B	1	0.0	19034	8850	4800	15340	2546	32024	12886	[illegible]
B	1	-14.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	1	-17.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	3	-17.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STRATUM NO.	SOIL TYPE	SATURATED UNIT WT. P.C.F. WEDGE 1	WEDGE 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM WEDGE 1	WEDGE 2	BOTTOM OF STRATUM WEDGE 1	WEDGE 2	FRICTION ANGLE DEGREES
1	[illegible]	95.0	95.0	0.0	0.0	0.0	0.0	0.0
2	[illegible]	110.0	110.0	300.0	300.0	300.0	300.0	0.0
3	[illegible]	110.0	110.0	400.0	400.0	400.0	400.0	0.0
4	[illegible]	112.0	112.0	250.0	250.0	250.0	250.0	0.0
5	[illegible]	102.0	102.0	285.0	285.0	310.0	310.0	0.0
6	[illegible]	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES

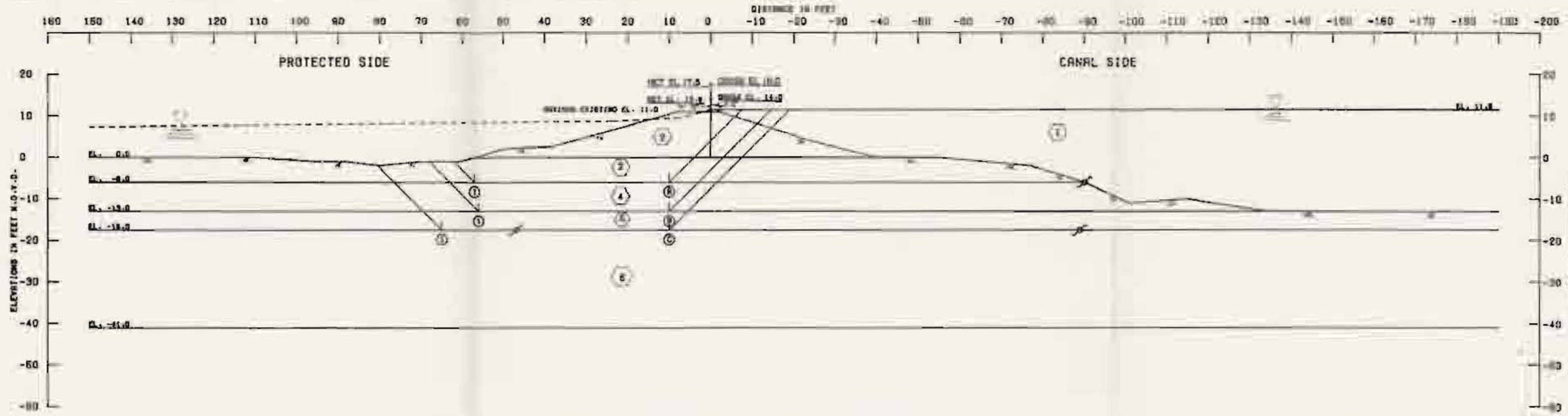
- φ — ANGLE OF INTERNAL FRICTION, DEGREES
- C — UNIT COHESION, P.S.F.
- ▽ — STATIC WATER SURFACE
- D — HORIZONTAL DRIVING FORCE IN POUNDS
- R — HORIZONTAL RESISTING FORCE IN POUNDS
- A — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
- B — AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
- P — AS A SUBSCRIPT, REFERS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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEE PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

FLOODSIDE LEVEE
STABILITY ANALYSIS
STA. 6+70 TO 18+60 E. W/L

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



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)	-6.0	19480	11755	4000	16900	1623	35240	14943	2.36
(B) (1)	-13.0	23407	11800	7468	25330	6418	35480	23078	1.65
(C) (1)	-17.0	21546	16888	6676	44800	14484	45888	36488	1.50

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C = UNIT COHESION - P.S.F. TOP OF STRATUM VERT. 1	TOP OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
(1)	[illegible]	90.0	90.0	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	115.0	115.0	700.0	700.0	700.0	700.0	0.0
(3)	(CH)	112.0	112.0	400.0	400.0	400.0	400.0	0.0
(4)	(CH)	117.0	117.0	280.0	280.0	280.0	280.0	0.0
(5)	(CH)	101.0	101.0	280.0	280.0	310.0	310.0	0.0
(6)	(SP)	125.0	125.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES

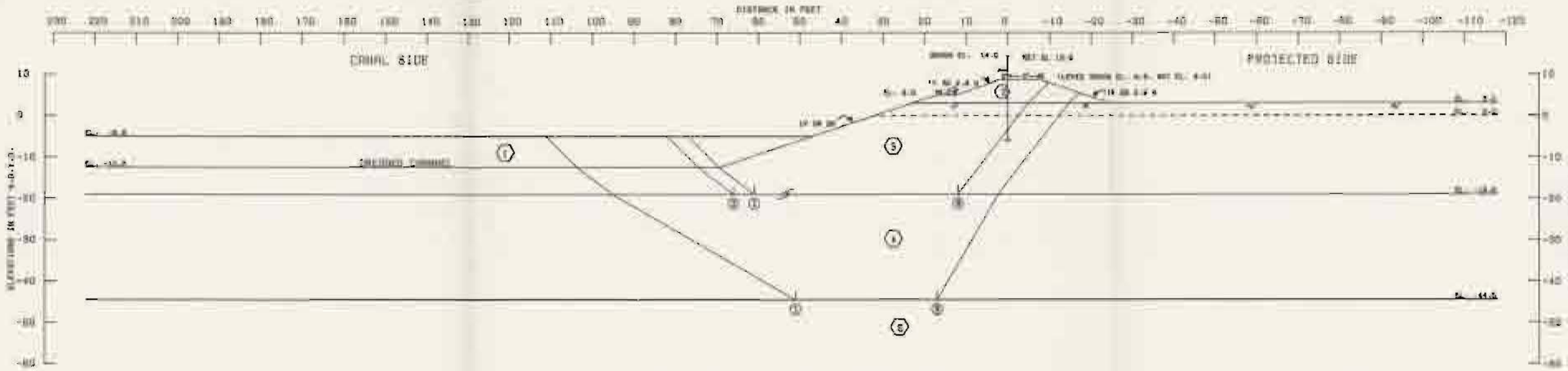
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE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

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
STA. 6+70 TO 18+60 E. W/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE [illegible] FILE NO. [illegible]



WEDGES 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
2	1	-10.0	22294	16110	4547	41042	7778	46980	48863	1.05
3	2	-19.0	22294	24480	4292	41042	7561	50066	50901	1.01
3	1	-44.5	95978	20860	64539	188595	82079	181729	78594	0.41

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	[illegible]	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	[illegible]	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	[illegible]	117.0	117.0	200.0	200.0	200.0	200.0	10.0
4	[illegible]	122.0	122.0	0.0	0.0	0.0	0.0	30.0
5	[illegible]	112.0	112.0	700.0	700.0	700.0	700.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

NOTES

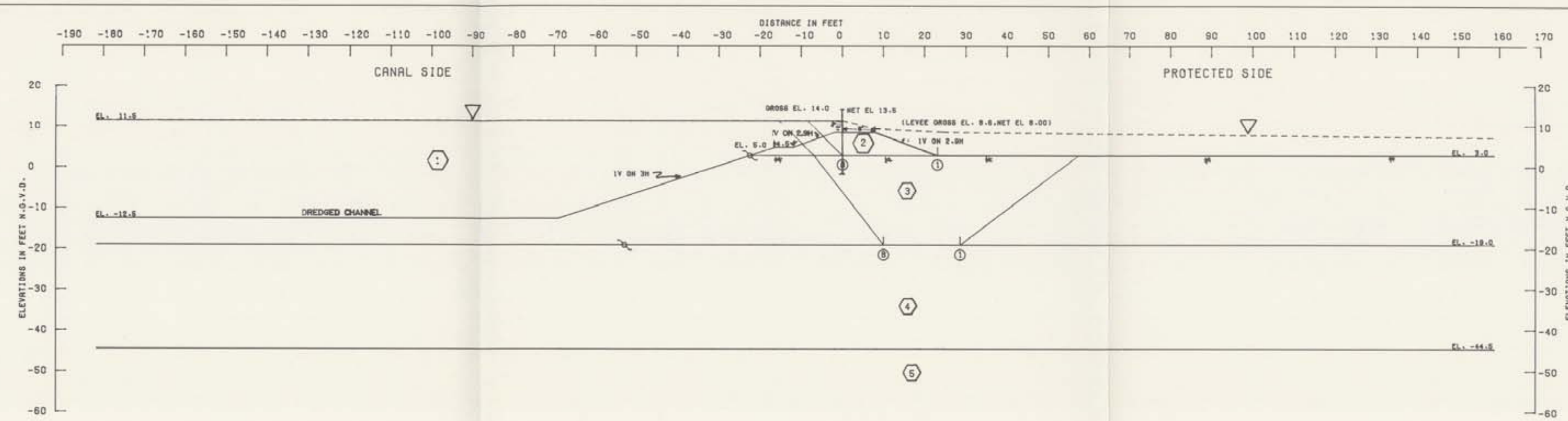
ϕ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
▽ — STATIC WATER SURFACE
D — HORIZONTAL DRIVING FORCE IN POUNDS
R — HORIZONTAL RESISTING FORCE IN POUNDS
A — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B — AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P — AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

FLOODSIDE LEVEE
STABILITY ANALYSIS
STA 0+73 TO 8+53 W. W/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
[illegible] FILE NO. [illegible]



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)	3.0	3718	5212	0	2905	0	8930	2905	3.07
(B)	(1)	-19.0	16307	8722	15389	45620	28313	40418	17307	2.34

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	CENTER OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(ML)	117.0	117.0	200.0	200.0	200.0	200.0	15.0
4	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
5	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61

NOTES

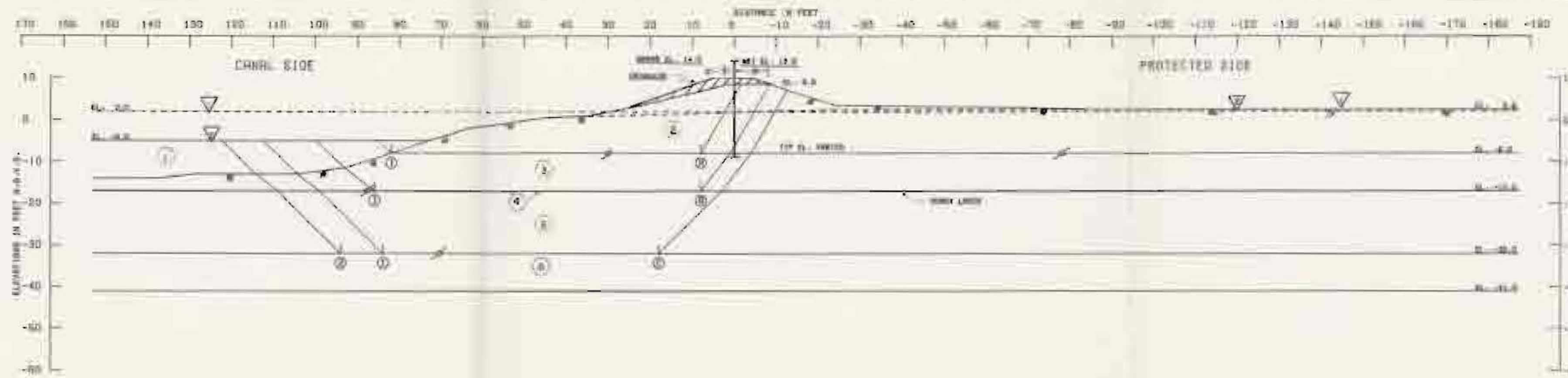
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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.19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
STA.0+73 TO 8+53 W. W/L

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288



PH LINE IN STRATUM 6

PH LINE IN STRATA 2 & 3

TOP OF WALL ELEVATION VARIES

WEDGE FAILURE NO.		WEDGE 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)	-8.0	[illegible]	21347	0	[illegible]	291	15430	[illegible]	[illegible]
(B)	(1)	-11.0	17560	[illegible]	3089	[illegible]	[illegible]	[illegible]	[illegible]	1.27
(C)	(1)	-22.0	29130	22070	14718	[illegible]	[illegible]	[illegible]	[illegible]	1.30
(D)	(2)	-32.0	[illegible]	[illegible]	14899	[illegible]	[illegible]	[illegible]	[illegible]	1.36

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C = UNIT COHESION P.S.F. CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE (DEGREES)
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	(CL)	117.0	117.0	300.0	300.0	300.0	300.0	10.0
4	(CH)	101.0	101.0	300.0	300.0	300.0	300.0	0.0
5	(CH)	101.0	101.0	410.0	410.0	320.0	320.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

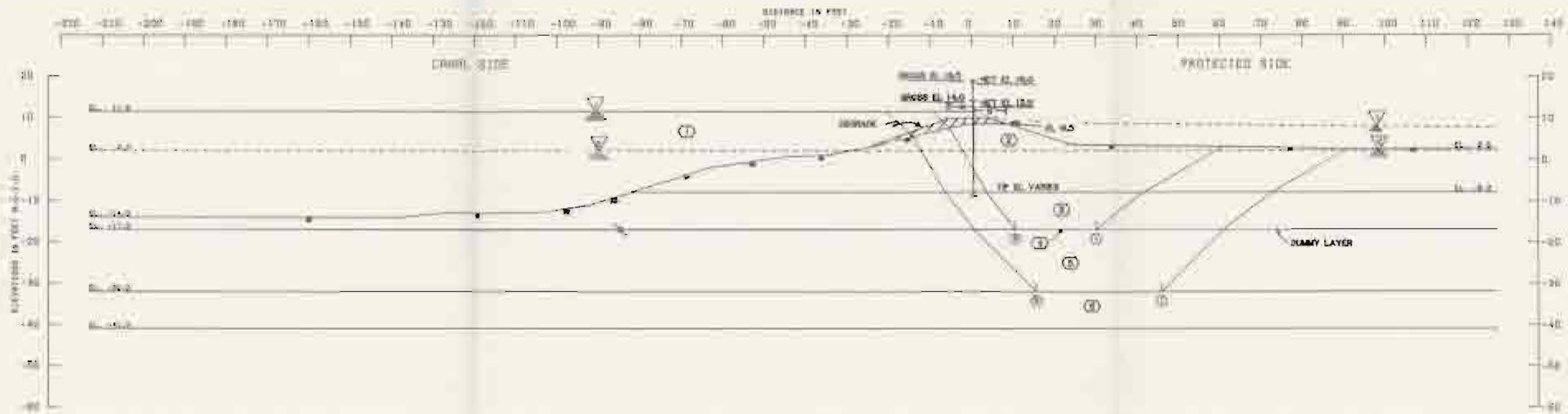
NOTES

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. [illegible] GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH
FLOODSIDE LEVEE
STABILITY ANALYSIS
STA 8+53 TO 21+00.06 W. W/L
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: [illegible] FILE NO. [illegible]

PLATE 81



▽ — ▽ PH LINE IN STRATA 2 & 3

▽ — ▽ PH LINE IN STRATUM 6

WEDGE 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)	-17.0	11768	8848	8848	41033	24384	19381	16799	1.01
(B) (1)	-30.0	28891	13884	20148	[illegible]	11306	[illegible]	17864	[illegible]

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	SM	117.0	117.0	200.0	200.0	200.0	200.0	15.0
4	CH	101.0	101.0	300.0	300.0	300.0	300.0	0.0
5	CH	101.0	101.0	410.0	410.0	550.0	550.0	0.0
6	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 61.

NOTES

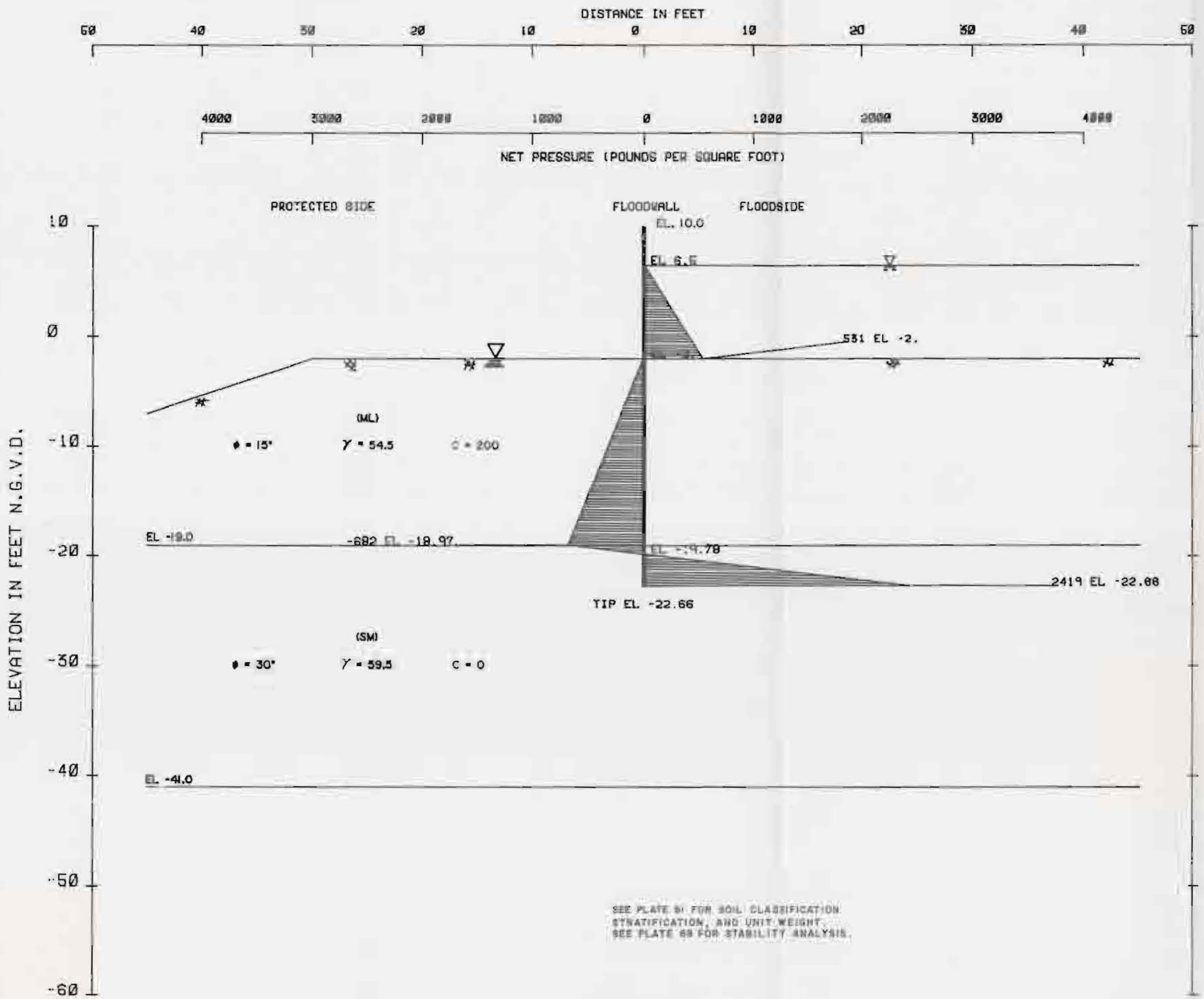
φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 19A, GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PROTECTED SIDE LEVEE STABILITY ANALYSIS STA 8+53.00 TO STA 21+00.06

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



NET DIAGRAM

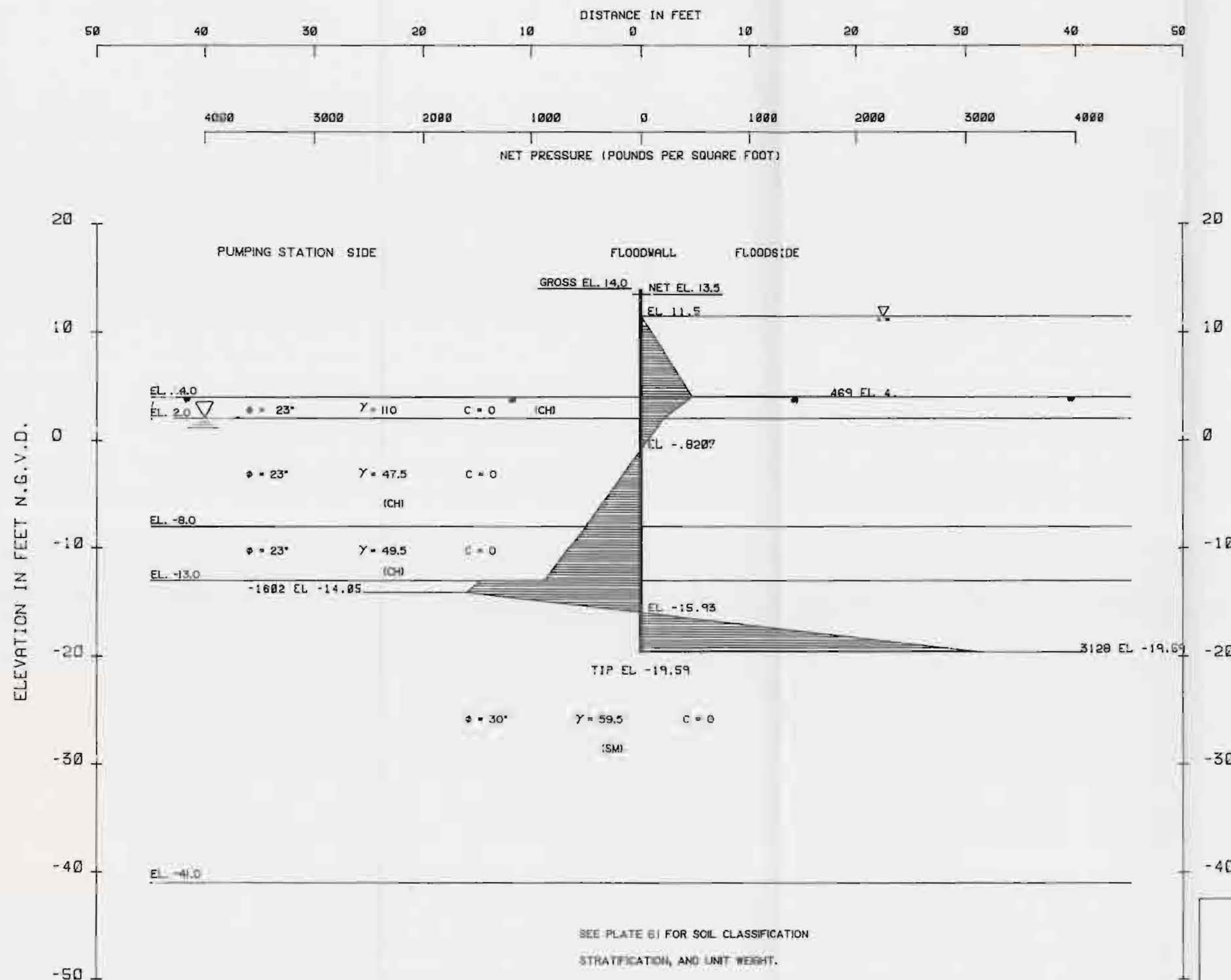
(Q) CASE F.S.=1.5

ELEVATION	PRESSURE
6.50	0.0
-2.00	631.2
-2.00	0.0
-2.00	-10.5
-18.97	-681.6
-19.78	0.0
-22.66	2418.6
-22.66	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I - WALL ANALYSIS
VALVE STRUCTURE EXCAVATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE : SEPT 1988 FILE NO. H-2-30288



SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT.

NET DIAGRAM

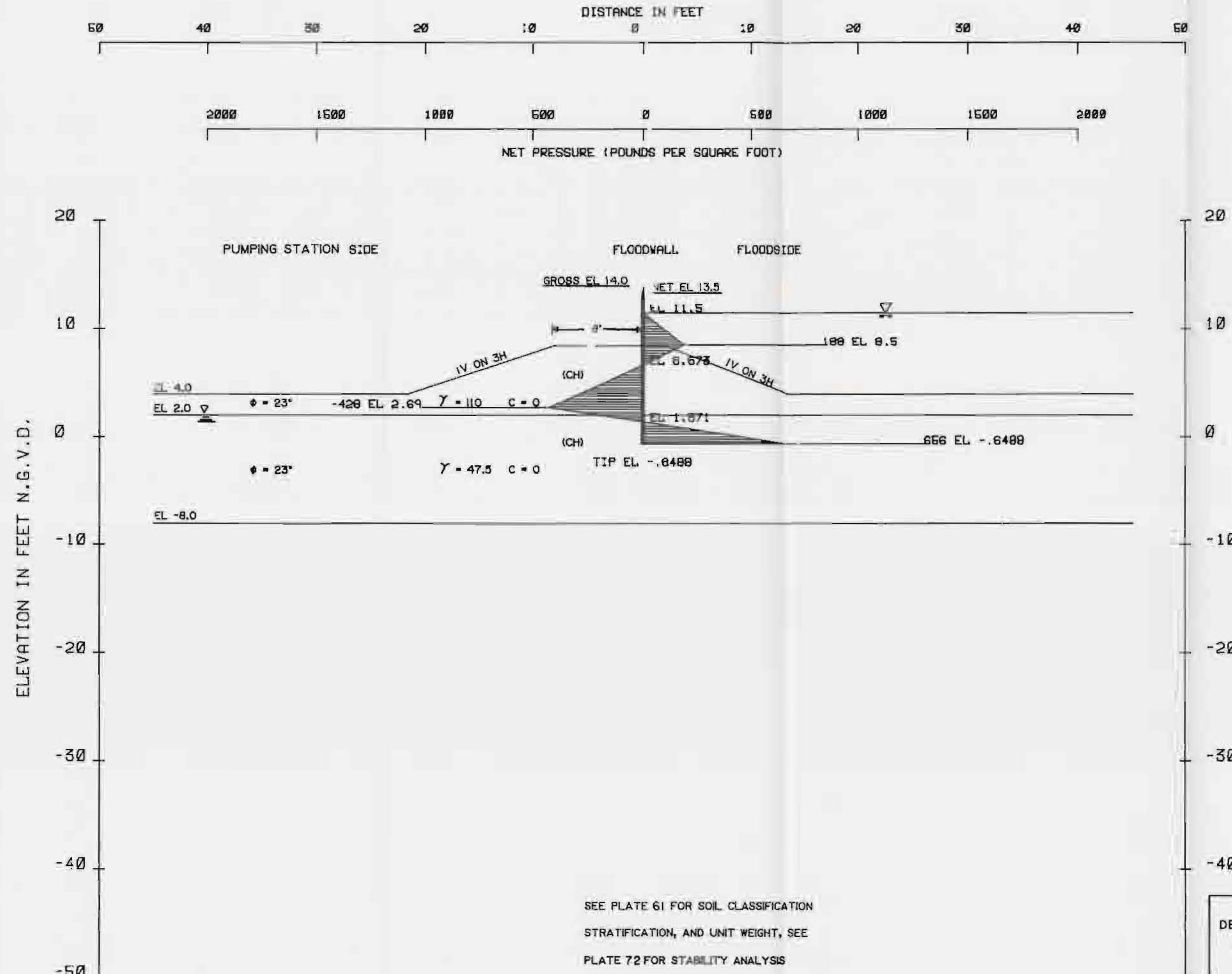
(S) CASE F.S.=1.2

ELEVATION	PRESSURE
11.50	0.0
4.00	469.8
2.00	201.1
-0.82	0.0
-8.00	-611.8
-13.00	-883.3
-13.00	-1468.5
-14.05	-1602.1
-15.93	0.0
-19.59	3128.0
-19.59	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A – GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I-WALL ANALYSIS
VALVE STRUCTURE EAST CLOSURE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT [illegible] FILE NO. H-2-[illegible]



ELEVATION	PRESSURE
11.50	0.0
8.50	187.5
6.67	0.0
5.50	-122.7
2.69	-428.5
1.37	0.0
-0.65	656.4
-0.65	0.0

SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 72 FOR STABILITY ANALYSIS

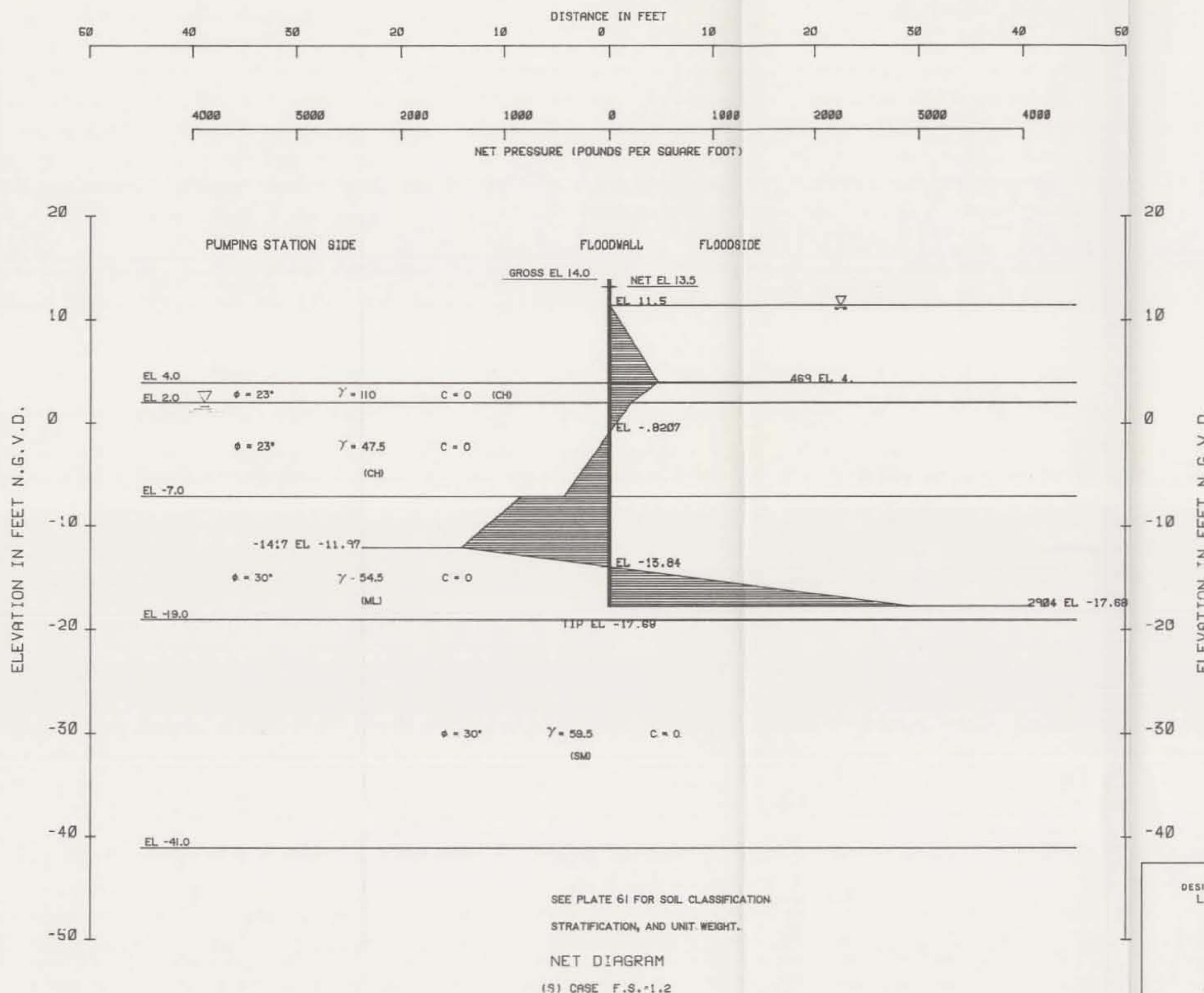
NET DIAGRAM

(S) CASE F.S.=1.5

LAKE PONTCHATRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 - GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

I - WALL ANALYSIS
VALVE STRUCTURE EAST CLOSURE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT 1988 FILE NO. H-2-30288



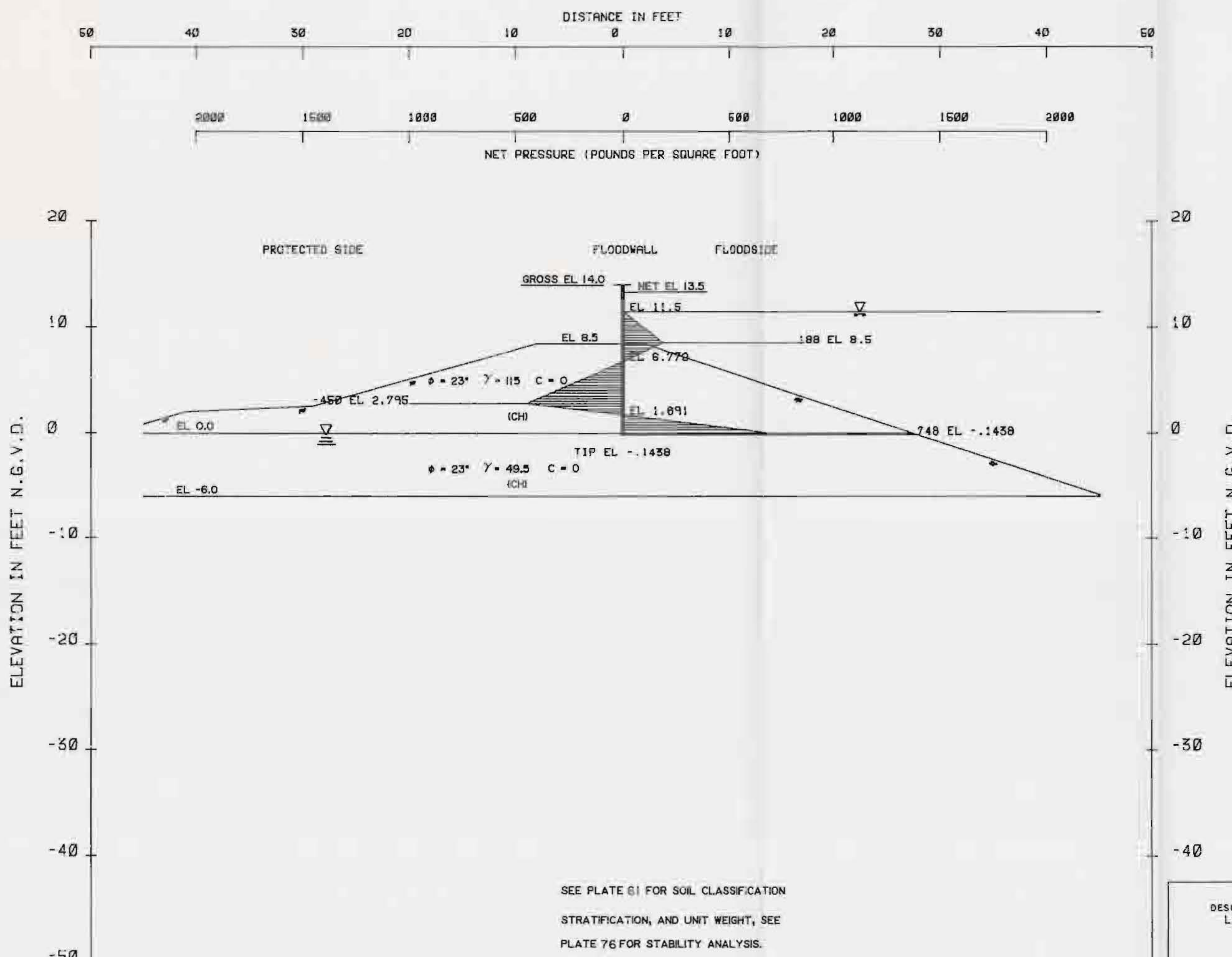
ELEVATION	PRESSURE
11.50	0.0
4.00	469.8
2.00	201.1
-0.82	0.0
-7.00	-440.5
-7.00	-838.5
-11.97	-1416.6
-13.84	0.0
-17.68	2903.6
-17.68	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A–GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I-WALL ANALYSIS
VALVE STRUCTURE
WEST CLOSURE

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

DATE: SEPT. 1988 FILE NO. H-2-30288



ELEVATION	PRESSURE
11.50	0.0
8.50	187.5
6.77	0.0
5.50	-140.2
2.80	-450.2
1.69	0.0
-0.14	748.0
-0.14	0.0

SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 76 FOR STABILITY ANALYSIS.

NET DIAGRAM

(S) CASE F.S.=1.5

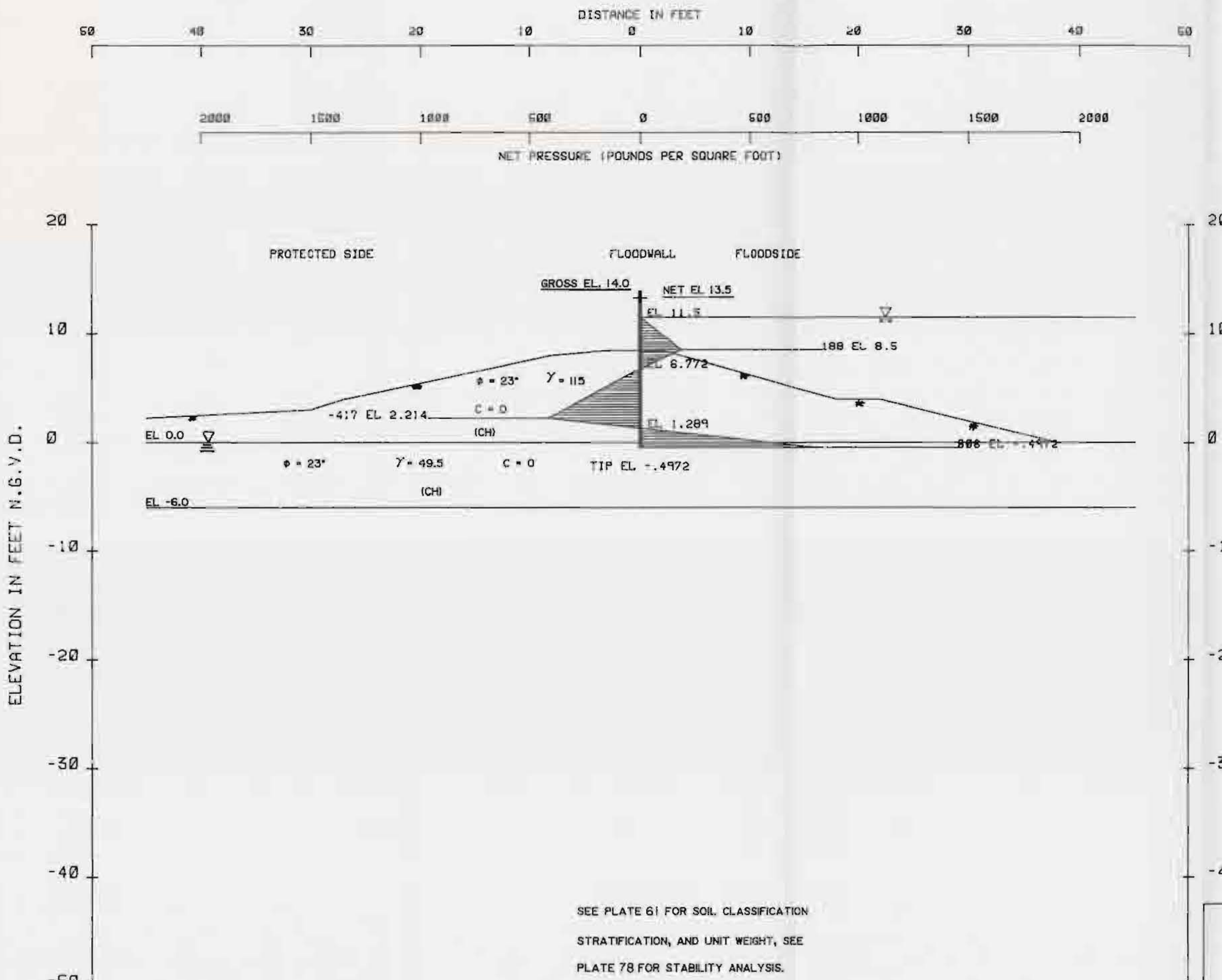
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A–GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I-WALL ANALYSIS

STA. 1+84 TO STA. 6+70 EAST W/L

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

DATE SEPT. 1988 FILE NO. H-2-30288



ELEVATION	PRESSURE
11.50	0.0
8.50	187.5
6.77	0.0
6.50	-29.6
2.50	-393.8
2.21	-417.0
1.29	0.0
-0.50	805.0
-0.50	0.0

SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 78 FOR STABILITY ANALYSIS.

NET DIAGRAM

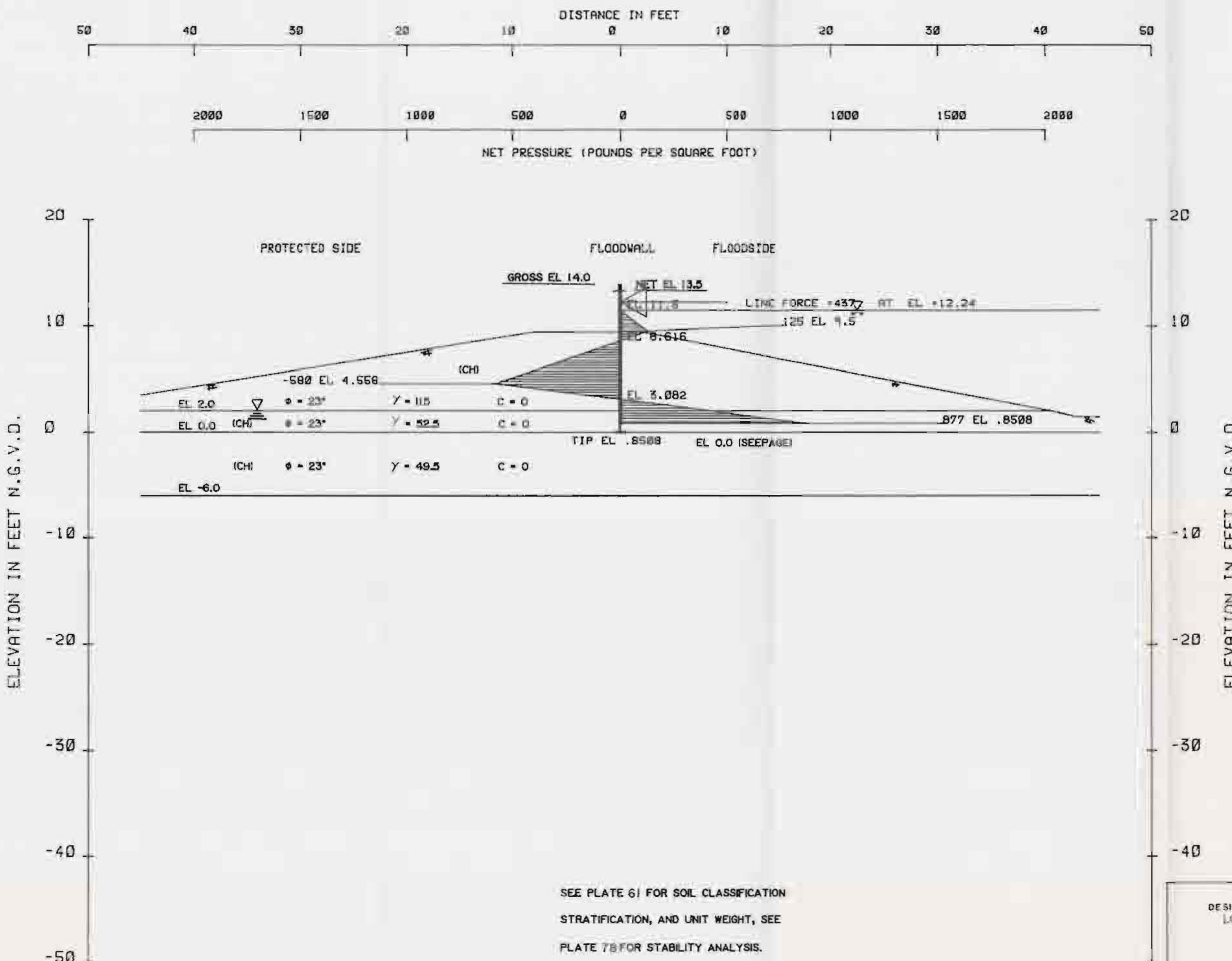
(S) CASE F.S.=1.5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A—GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I - WALL ANALYSIS
STA. 6+70 TO 13+40 EAST W/L

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

DATE SEPT. 1988 FILE NO. H-2-30288



ELEVATION	PRESSURE
11.50	0.0
9.50	125.0
8.62	0.0
4.56	-500.2
3.08	0.0
0.85	876.8
0.85	0.0

SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 78 FOR STABILITY ANALYSIS.

NET DIAGRAM

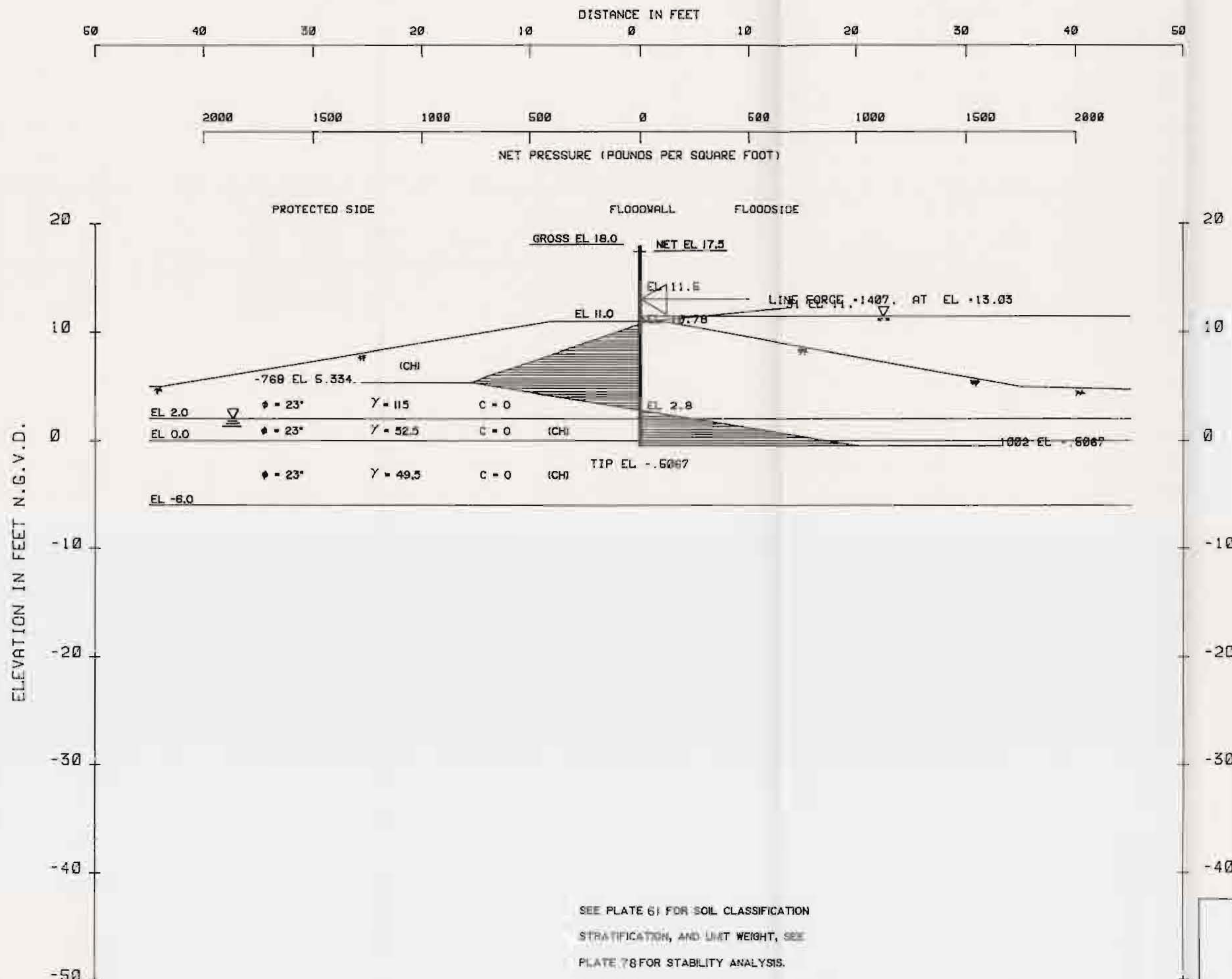
(S) CASE F.S.=1.2

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

I-WALL ANALYSIS
STA. 13+40 EAST W/L

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

DATE: SEPT. 1988 FILE NO. H-2-30[illegible]



ELEVATION	PRESSURE
11.50	0.0
11.00	31.3
10.78	0.0
6.00	-681.9
5.33	-767.9
2.80	0.0
-0.51	1002.2
-0.51	0.0

SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 78 FOR STABILITY ANALYSIS.

NET DIAGRAM

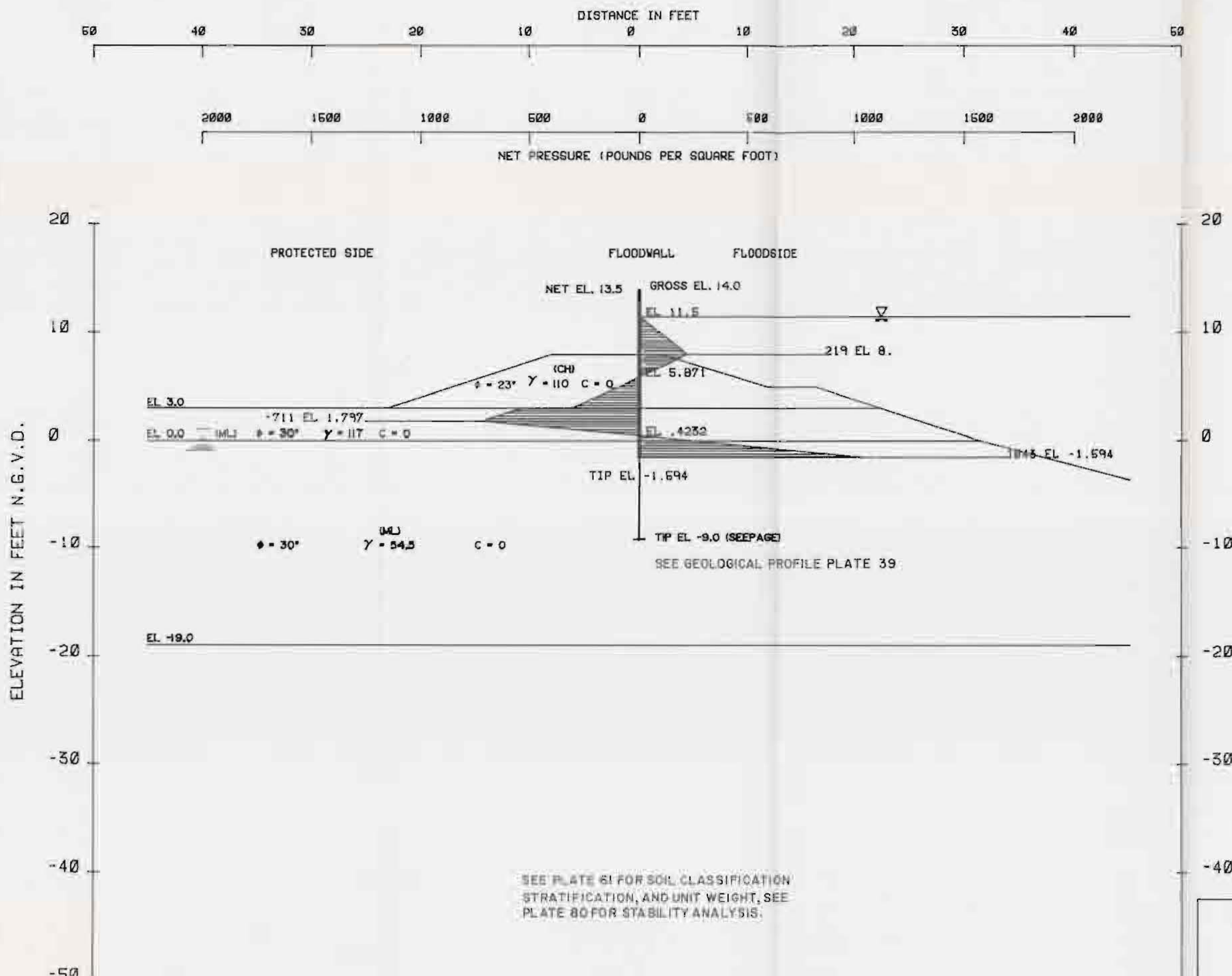
(S) CASE F.S.=1.2

LAKE PONTCHARTRAIN LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL

I- WALL ANALYSIS
STA 18+60 EAST W/L

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

DATE: SEPT 1988 FILE NO. H-2-30088



NET DIAGRAM

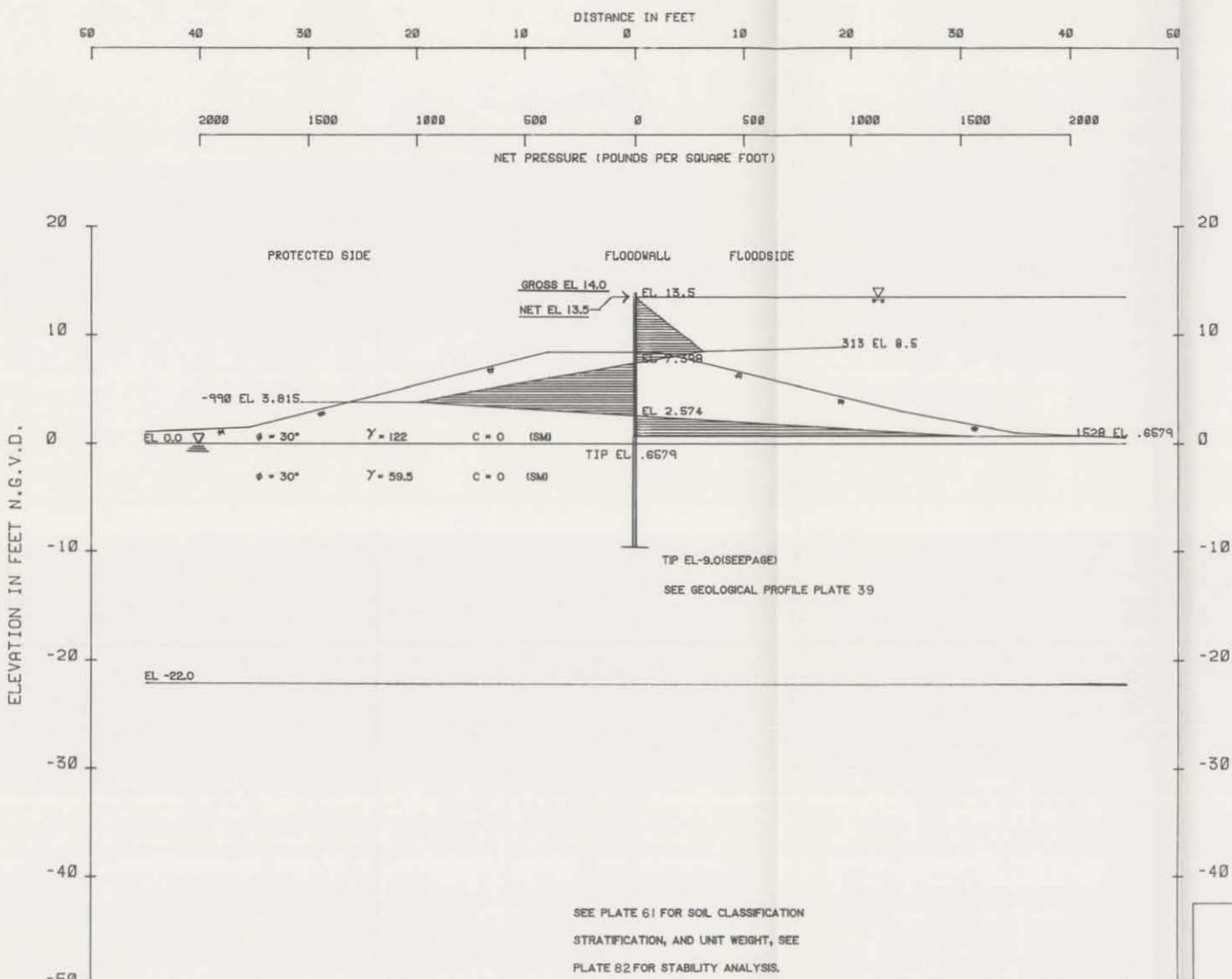
(S) CASE F.S.=1.5

ELEVATION	PRESSURE
11.50	0.0
8.00	219.0
5.87	0.0
5.00	-91.0
3.00	-306.3
3.00	-533.2
2.00	-693.3
1.80	-710.6
0.42	0.0
-1.59	1043.3
-1.59	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A–GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I - WALL ANALYSIS
STA. 0+73 TO 8+53 W. W/L

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



NET DIAGRAM

(Q) CASE F.S.=1.0

ELEVATION	PRESSURE
13.60	0.0
8.50	312.5
7.40	0.0
4.50	-823.5
3.82	-990.2
2.57	0.0
0.66	1528.5
0.66	0.0

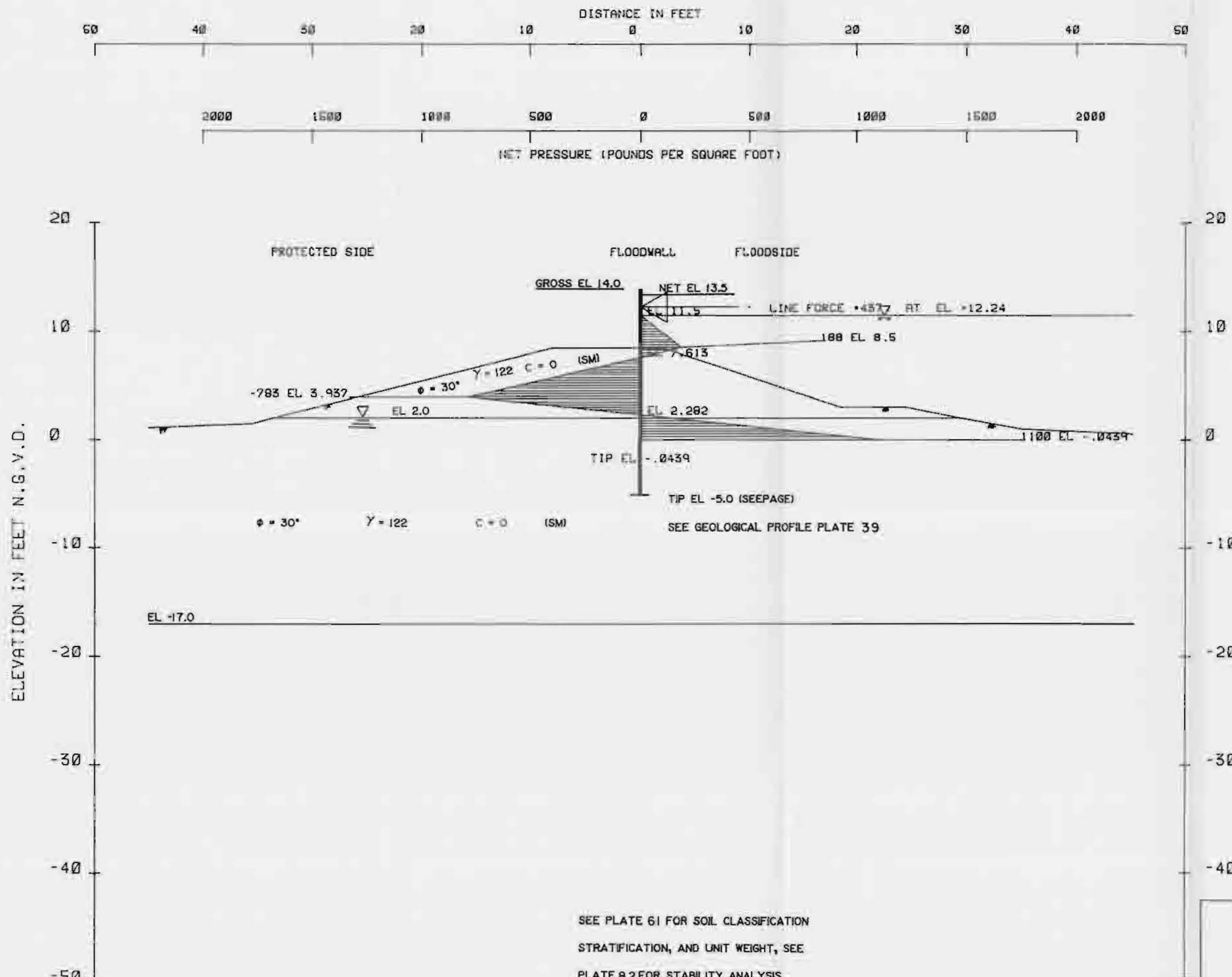
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A- GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I - WALL ANALYSIS

STA. 8+53 TO STA. 13+91.8 WEST W/L

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

DATE: SEPT. 1988 FILE NO. H-2-30288



ELEVATION	PRESSURE
11.50	0.0
8.50	187.5
7.61	0.0
5.50	-446.5
3.94	-783.0
2.28	0.0
-0.04	1100.1
-0.04	0.0

SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 82 FOR STABILITY ANALYSIS.

NET DIAGRAM

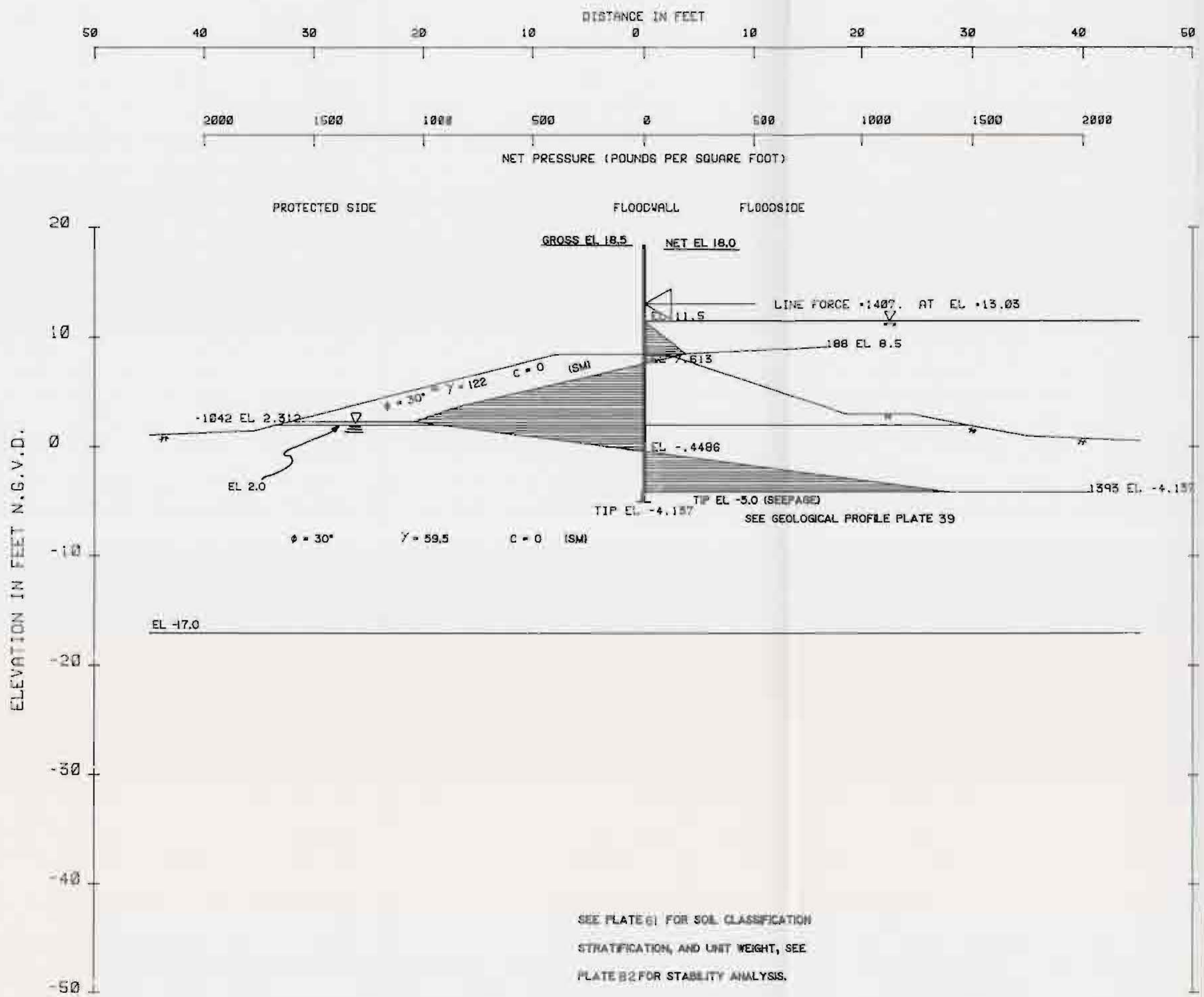
(Q) CASE F.S. = 1.25

LAKE PONTCHARTRAIN LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I - WALL ANALYSIS
STA. 13+91.8 WEST W/L

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

DATE SEPT 1988 FILE NO. H-2-30



SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 82 FOR STABILITY ANALYSIS.

NET DIAGRAM

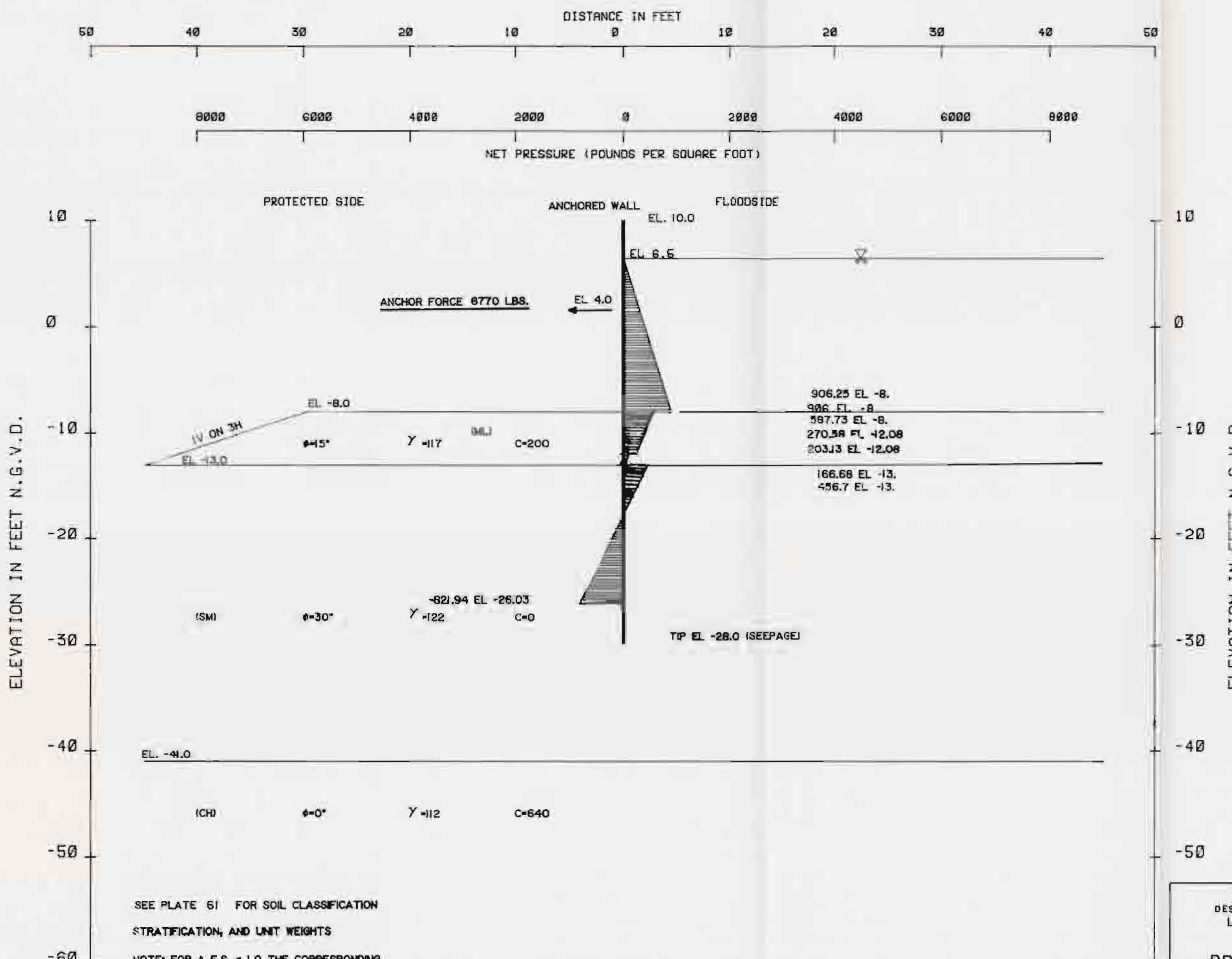
(Q) CASE F.S.=1.25

ELEVATION	PRESSURE
11.50	0.0
8.50	187.5
7.61	0.0
5.50	-446.5
3.50	-877.3
2.50	-1017.9
2.31	-1042.4
-0.45	0.0
-4.14	1392.8
-4.14	0.0

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

I - WALL ANALYSIS
STA. 21+00.6 WEST W/L

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



SEE PLATE 61 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHTS

NOTE: FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 6,770 LBS/LF

SEE PLATE 66 FOR STABILITY ANALYSIS

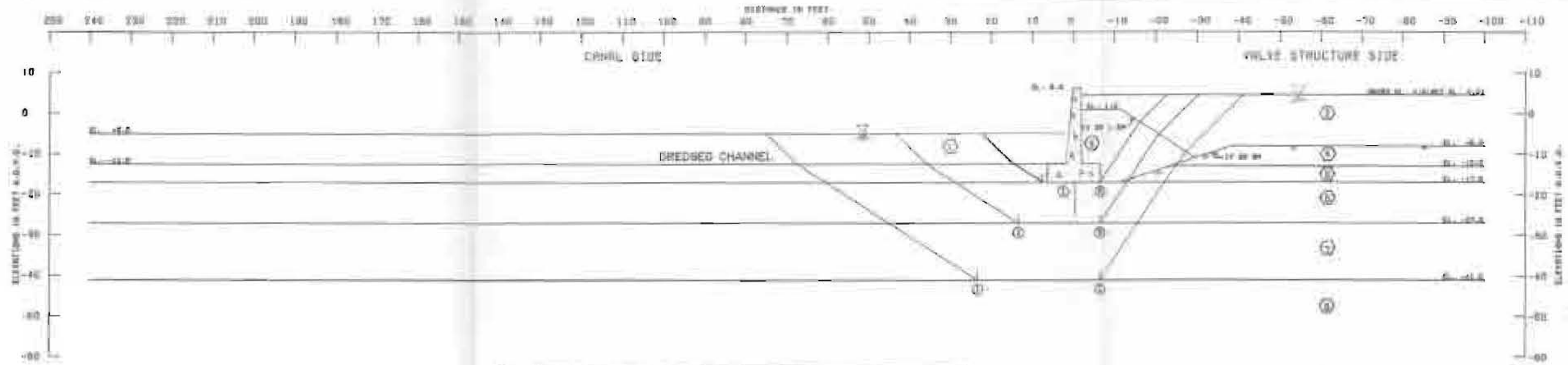
NET DIAGRAM

(Q) CASE F.S.= 1.5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

BRACED WALL ANALYSIS VALVE STRUCTURE EXCAVATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. [illegible] FILE NO. H-2-30288



NOTE: ANALYSIS WAS PERFORMED WITH A FACTOR OF SAFETY OF 1.3 INCORPORATED INTO THE SOIL PARAMETERS.

NO.	ELEV.	D_A	R_A	R_B	R_C	R_P	D_A	D_P	$D_A - D_P$
BASE	-17.0	27172	10834	4004	826	5032	10346	10482	5659
1	-27.0	58028	20072	10288	6570	22378	37956	40023	-2067
2	-41.0	102303	39660	14700	20830	64883	35646	102465	-69554

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. SECT. 1	EFFECTIVE UNIT WT. P.C.F. SECT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM SECT. 1	CENTER OF STRATUM SECT. 2	BOTTOM OF STRATUM SECT. 1	BOTTOM OF STRATUM SECT. 2	FRICTION ANGLE DEGREES
1	[illegible]	85.0	85.0	0.0	0.0	0.0	0.0	0.0
2	[illegible]	110.0	110.0	300.0	300.0	300.0	300.0	0.0
3	[illegible]	122.5	122.5	0.0	0.0	0.0	0.0	24.0
4	[illegible]	115.0	115.0	180.0	180.0	180.0	180.0	0.0
5	[illegible]	122.5	122.5	0.0	0.0	0.0	0.0	24.0
6	[illegible]	122.5	122.5	0.0	0.0	0.0	0.0	24.0
7	[illegible]	122.5	122.5	0.0	0.0	0.0	0.0	24.0
8	[illegible]	115.0	115.0	480.0	480.0	480.0	480.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES

ϕ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
SWS — 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

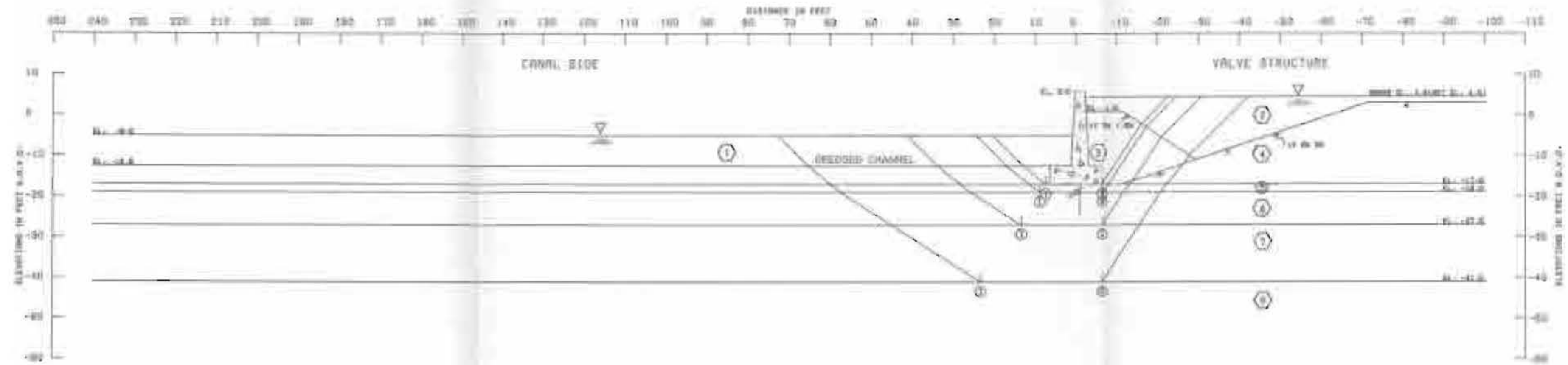
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

DEEP SEATED STABILITY ANALYSIS RETAINING WALLS
EASTSIDE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. [illegible] FILE NO. [illegible]

PLATE 95



NOTE: ANALYSIS WAS PERFORMED WITH A FACTOR OF SAFETY OF 1.3 INCORPORATED INTO THE SOIL PARAMETERS.

TOTAL UNBALANCED LOAD 300 #/lineal ft. SHOULD BE APPLIED AT THE BASE OF THE STRUCTURE.

UNBALANCED LOAD DIAGRAM

NO.	ELEV.	D_A	R_1	R_P	R_P	D_P	U_A	U_P	$U_A - U_P$
BASE	-11.0	37173	11856	4046	1885	5050	8549	1330	3050
1	-15.0	32404	12456	-4325	3040	7275	[illegible]	[illegible]	5564
2	-27.0	58386	2040	1040	8530	2054	57075	4096	-1988
3	-41.0	101696	39001	14700	33467	65045	22763	110006	-88929

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE DEGREES
1	(BERM)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	110.0	110.0	200.0	200.0	300.0	300.0	0.0
3	(SM)	120.0	122.0	0.0	0.0	0.0	0.0	24.0
4	(ML)	117.0	117.0	150.0	150.0	150.0	150.0	11.5
5	(ML)	117.0	117.0	150.0	150.0	150.0	150.0	11.5
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	33.0
7	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	24.0
8	(CH)	112.0	112.0	400.0	400.0	400.0	400.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 91

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

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

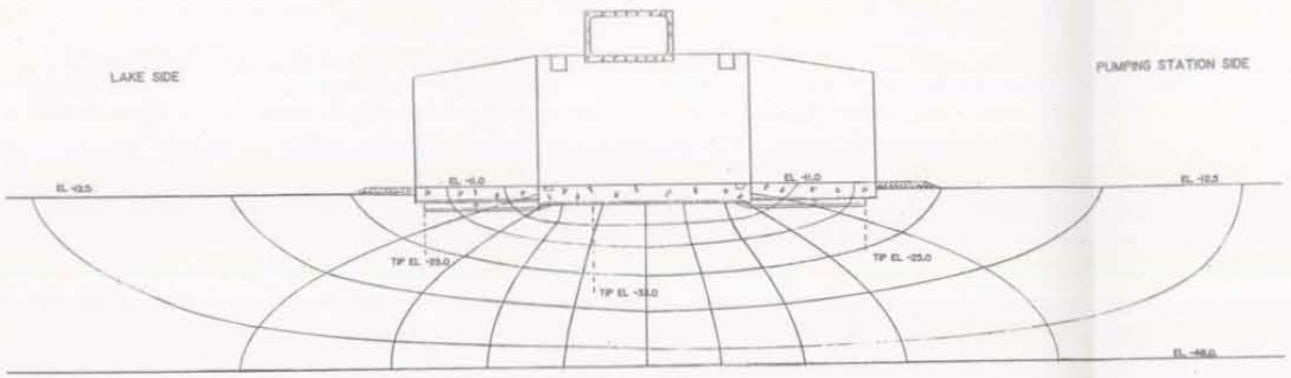
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

DEEP SEATED STABILITY ANALYSIS RETAINING WALL

WESTSIDE

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

PLATE 97



NOTE: SHEET PILE AND CONCRETE APRON CONSIDERED INEFFECTIVE FOR MAXIMUM FLOW.

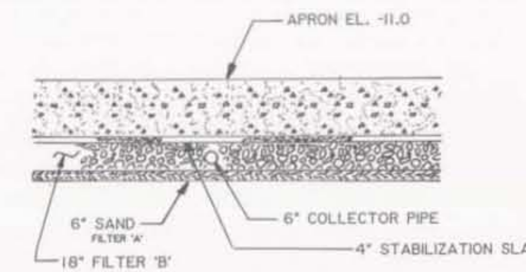
FILTER MATERIAL FOR DRAINAGE BLANKET

DESIGN CRITERIA:

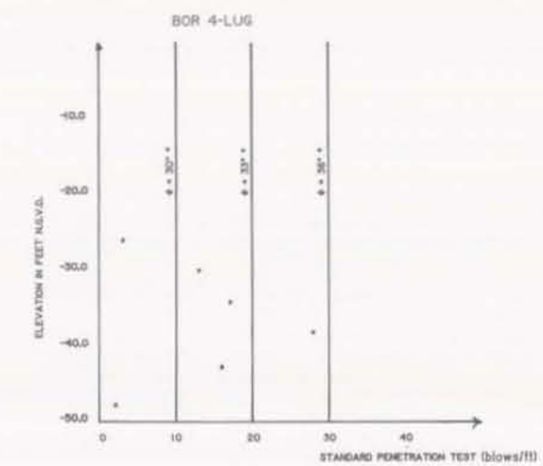
MIGRATION: $\frac{\text{MAX. FILTER } D_{15}}{\text{MIN. BASE } D_{85}} \leq 5$

$\frac{\text{MAX. FILTER } D_{50}}{\text{MIN. BASE } D_{50}} \leq 25$

FLOW: $\frac{\text{MIN. FILTER } D_{15}}{\text{MAX. BASE } D_{15}} \leq 5$



DRAINAGE BLANKET



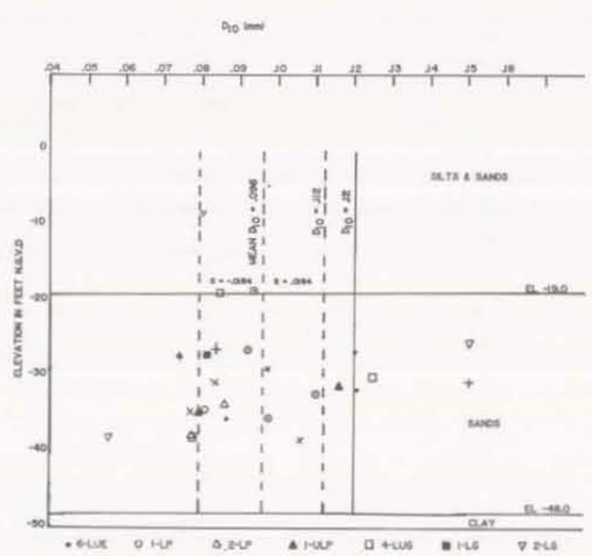
RAFTS ON SAND

* q_a (tons/ft^2) = .22 N_c (5 ≤ N ≤ 50) ⟹ 2" settlement with 3/4" differential settlement

* $C_w = 0.5 + 0.5 \frac{D_w}{D_f + B}$

CONSTRUCTION CASE	NORMAL CASE
$= 0.5 + \frac{0.5(3')}{1.5 + 25'} = .56$	$C_w = 0.5 + \frac{0.5(0)}{1.5 + 25'} = 0.5$
$N_c = (10)(.56) = 5.6$	$N_c = (10)(.5) = 5$
$q_a = 0.22(5.6) = 1.2$ TONS/FT^2	$q_a = 0.22(5) = 1.1$ TONS/FT^2

* FOUNDATION ENGINEERING, PECK, HANSON, AND, THORNBURN, 1974



ASSUMPTION AND FORMULAS

DETERMINATION OF PERMEABILITY

SANDS EL 0.0 TO -48.0

MEAN D_{10} = 0.096 mm

= STANDARD DEVIATION = .0164 mm

FROM McCLELLAND's CORRELATION CURVE

MEAN D_{10} = 0.096 $\Rightarrow K_H = 234 \times 10^{-4}$ cm/sec

MEAN $D_{10} + \sigma = 0.112$ Say $D_{10} = 0.12$ $K_H = 400 \times 10^{-4}$ cm/sec

F.S. $= \frac{400}{234} = 1.7$

$K = \sqrt{K_H K_v} = \sqrt{(400 \times 10^{-4})(100 \times 10^{-4})} = 200 \times 10^{-4}$ cm/sec

FLOW INTO DRAINAGE BLANKET

FLOW: $q = K h \frac{N_f}{N_d}$

$= 200 \times 10^{-4}$ cm/sec (12') $(\frac{5.4}{10})$ $(\frac{60 \text{ sec}}{30.5 \text{ cm}})$ (7.5 gal/ft^3) = 1.91 gpm/ft STRUCTURE

TOTAL FLOW:

Q = qL × SAFETY FACTOR

= 1.91 gpm/ft (252')(1.5*) = 722 GPM

DRAINAGE DESIGN - (1-6" PIPE)

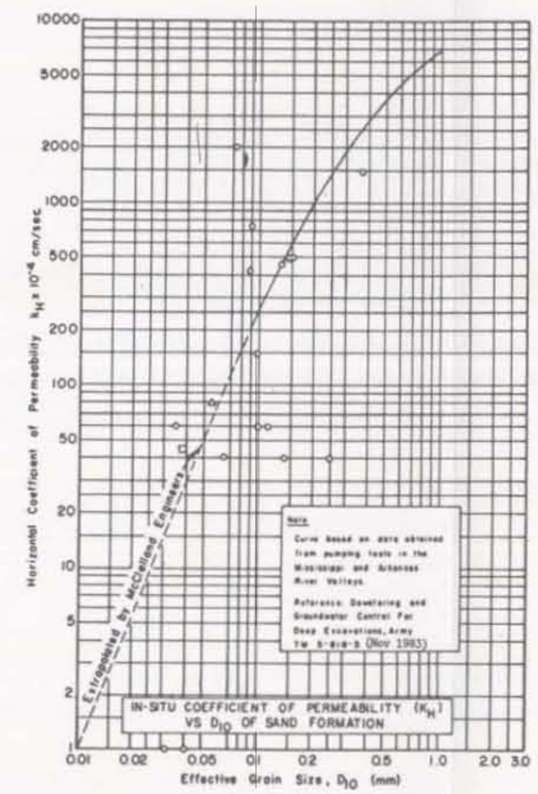
CHECK VELOCITY:

$V = Q/A = (\frac{722 \text{ GPM}}{1} \frac{1}{(7.5 \text{ gal/ft}^3)(60 \text{ sec})}) / \pi(.5')^2 = 2.04$ FPS ∠ 10 (OK)

CHECK HEADLOSS:

$\Delta H_F = f \frac{L}{D} \frac{V^2}{2g} = (0.054)(\frac{126'}{.5'})(\frac{(2.04 \text{ fps})}{2 (32.2 \text{ fps}^2)}) = .43'$

* GROUNDWATER AND WELLS, FLETCHER G. DRISCOLL, 2ED., 1986



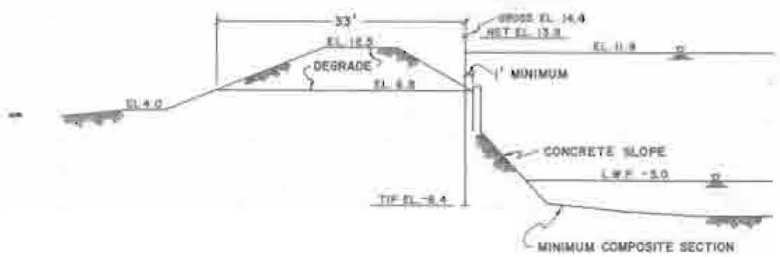
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19 - GENERAL DESIGN
LONDON AVENUE OUTFALL CANAL

VALUE STRUCTURE APRON BEARING CAPACITY AND DRAINAGE BLANKET ANALYSES

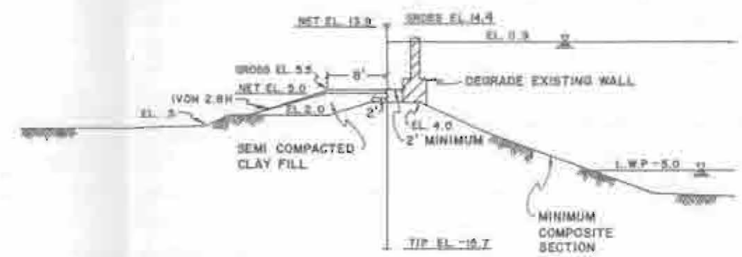
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE SEPT. 1988 FILE NO. H-2-30288

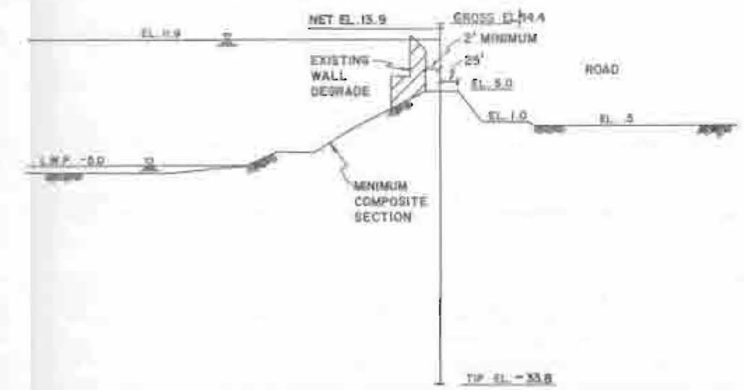
STA. 0+00 TO 3+00 WESTSIDE



STA. 3+00 TO 21+00 WESTSIDE; STA. 1+95 TO 2+80 & 7+00 TO 21+00 EASTSIDE

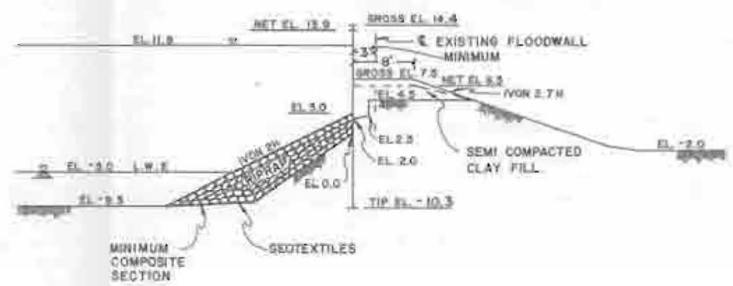


STA. 3+00 TO 7+00 EASTSIDE

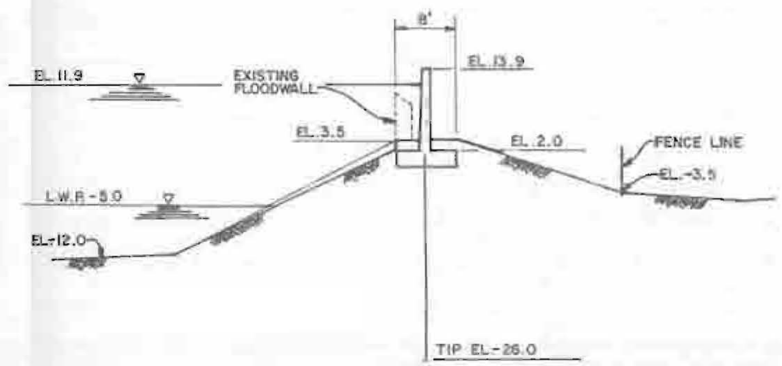


STA. 21+00 TO 37+00 EASTSIDE & WESTSIDE

STA. 37+00 TO 59+00 EASTSIDE



STA. 59+00 TO STA. 120+10 EASTSIDE



SCALE: 1"=10'

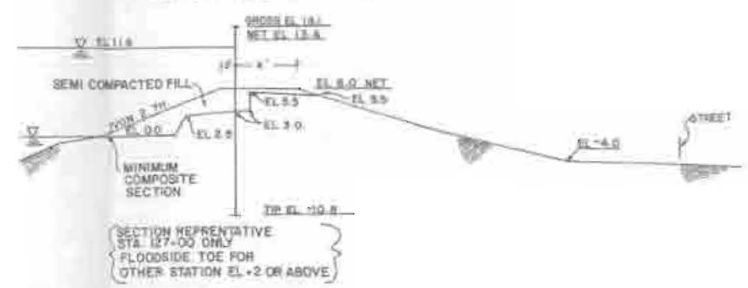
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEAN PARISH

TYPICAL SECTIONS
PARALLEL PROTECTION PLAN

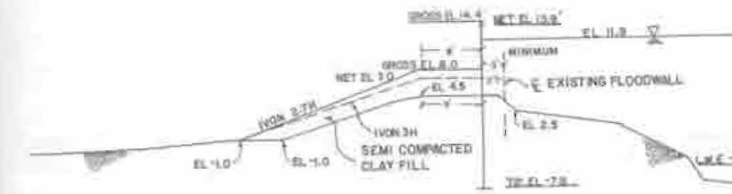
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT 1988 FILE NO. H-2-30288

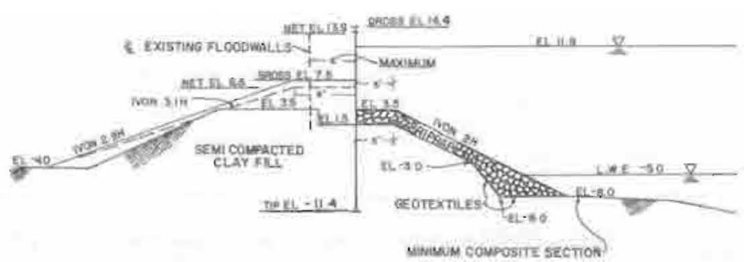
STA. 120+80 TO 127+50 EASTSIDE



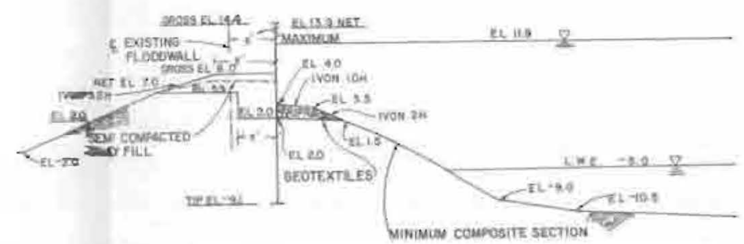
STA. 37+00 TO 70+00 WESTSIDE



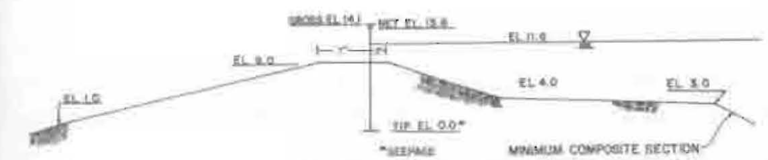
STA. 70+00 TO 86+50 AND STA. 100+00 TO 120+10 WESTSIDE



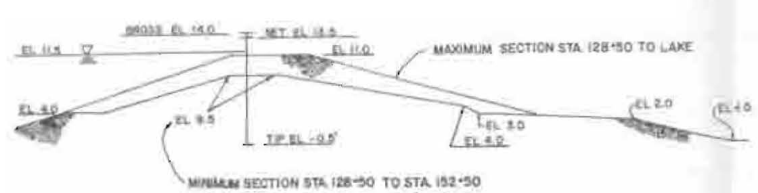
STA. 86+50 TO STA. 100+00 WESTSIDE



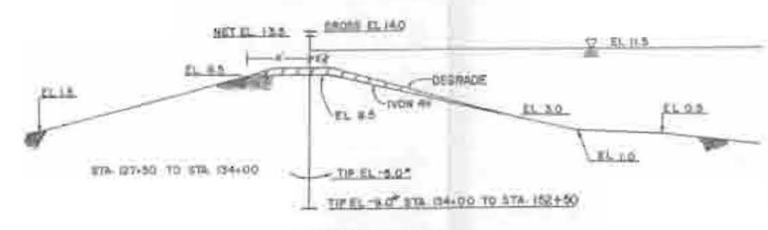
STA. 120+80 TO STA. 127+50 WESTSIDE



STA. 127+50 TO STA. 152+50 EASTSIDE



STA. 127+50 TO 152+50 WESTSIDE



SCALE 1" = 10'

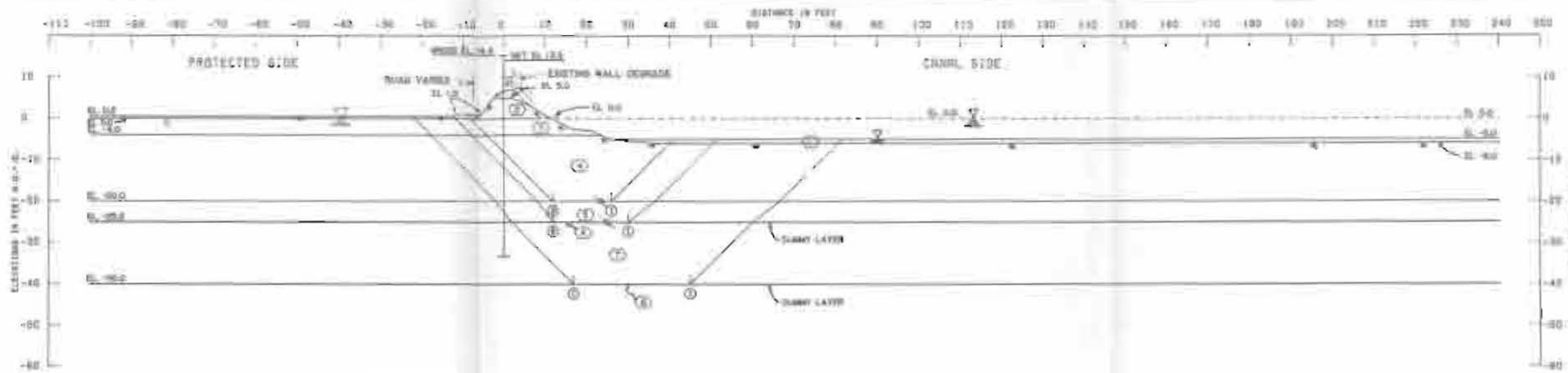
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

TYPICAL SECTIONS
PARALLEL PROTECTION PLAN

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

DATE: SEPT. 1988 FILE NO. H-8-30288

PLATE. 100



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)	-20.0	17868	4852	6802	29780	12274	30301	17382	1.88
(B) (1)	-25.0	21300	7181	11316	42119	21738	40819	21277	2.05
(C) (7)	-40.0	38484	12495	19446	67837	36087	70064	31144	2.08

STRATUM NO.	SOIL TYPE	SATURATED UNIT WT. P.C.F. VERT. 1	VERT. 2	C = UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	118.0	118.0	700.0	700.0	700.0	700.0	0.0
3	CH	118.0	118.0	400.0	400.0	500.0	400.0	0.0
4	CH	117.0	117.0	300.0	300.0	300.0	300.0	0.0
5	SM	117.0	117.0	500.0	500.0	500.0	500.0	18.0
6	CH	105.0	105.0	400.0	400.0	440.0	460.0	0.0
7	CH	105.0	105.0	475.0	475.0	600.0	600.0	0.0
8	CH	105.0	105.0	600.0	650.0	700.0	800.0	0.0

GENERAL NOTES:
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES:

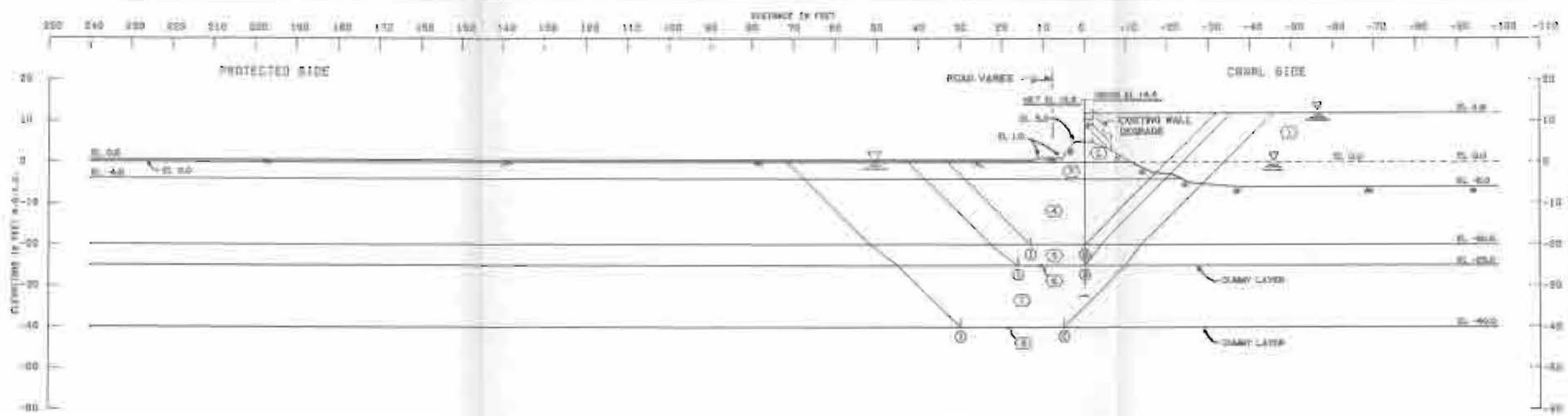
ϕ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
[illegible] — STATIC WATER SURFACE
D — HORIZONTAL DRIVING FORCE IN POUNDS
R — HORIZONTAL RESISTING FORCE IN POUNDS
A — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B — AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P — AS A SUBSCRIPT, REFERS TO PASSIVE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

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

[illegible]
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

FLOODSIDE LEVEE
STABILITY ANALYSIS
STA. 3+00 TO STA. 7+00 EAST

[illegible]



FAILURE NO.	SURFACE ELEV.	R_A	R_B	R_P	D_A	$-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
(A) (1)	-20.0	13080	4880	17302	43977	29086	64798	16897	1.79
(B) (1)	-25.0	18053	2483	24202	53848	31109	48000	56847	3.11
(C) (1)	-40.0	60868	13312	38959	127062	32434	91610	38896	2.45

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	CENTER OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	115.0	110.0	750.0	750.0	750.0	750.0	0.0
3	(CH)	116.0	116.0	850.0	850.0	850.0	850.0	0.0
4	(CH)	115.0	115.0	560.0	560.0	560.0	550.0	0.0
5	(ML)	117.0	117.0	200.0	200.0	250.0	200.0	10.0
6	(CH)	105.0	115.0	400.0	400.0	400.0	400.0	0.0
7	(CH)	103.0	108.0	475.0	475.0	550.0	550.0	0.0
8	(CH)	102.0	103.0	380.0	380.0	380.0	380.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 80.

NOTES

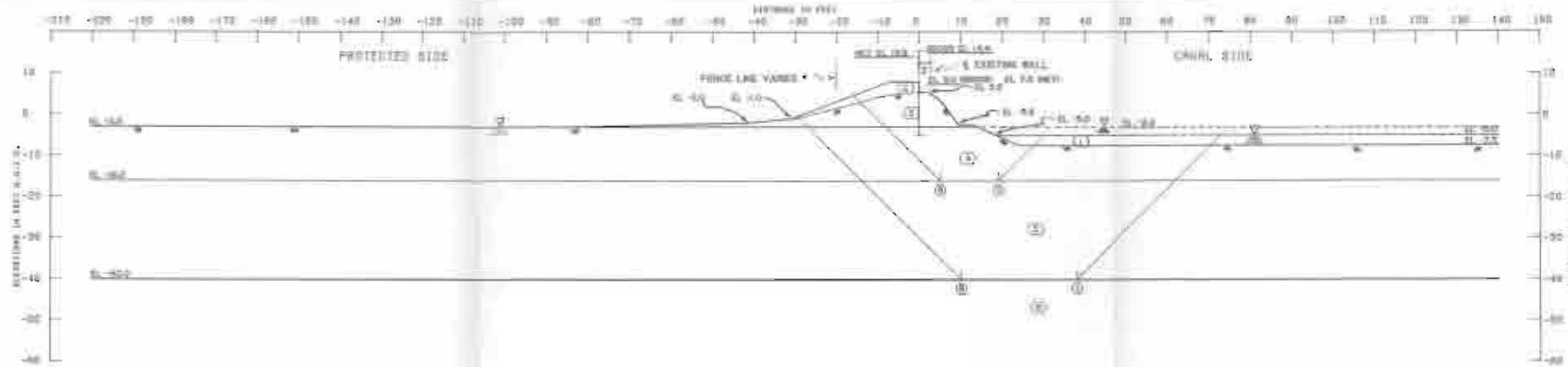
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PROTECTED SIDE LEVEE STABILITY ANALYSIS STA 3+00 TO STA 7+00 EAST

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



[illegible]		RESISTING FORCES			DRIVING FORCES		[illegible]		FACTOR OF SAFETY
[illegible]	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	[illegible]	[illegible]	
⑥ ①	-19.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑧ ⑦	-40.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STRATUM NO.	SOIL TYPE	[illegible]		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
①	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
②	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
③	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
④	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑤	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑦	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* NOTE: NO FILL NEEDED IN SECTIONS OUTSIDE OF FENCE LINE.

GENERAL NOTE:
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE [illegible]

NOTES

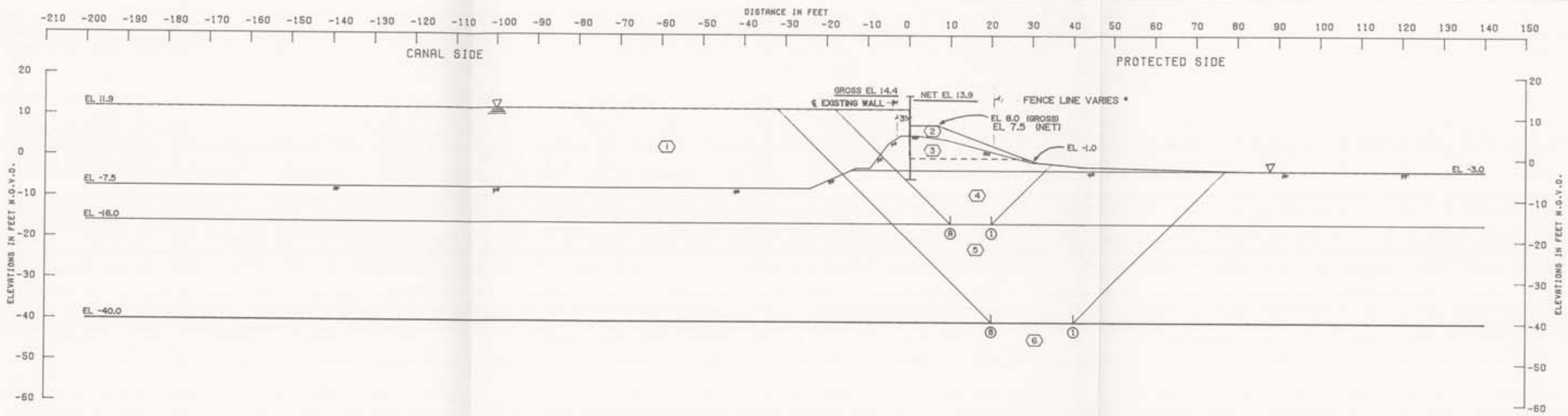
[illegible]

FACTOR OF SAFETY = [illegible]

[illegible]
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

FLOODSIDE LEVEE
STABILITY ANALYSIS
STA. 21+00 TO STA. 37+00

[illegible]



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)	-16.0	17719	4000	14999	34124	15414	36718	18710	1.96
(B) (1)	-40.0	31273	8000	32371	120934	76026	71644	44908	1.60

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
4	(CH)	114.0	114.0	500.0	500.0	500.0	500.0	0.0
5	(CH)	98.0	98.0	400.0	400.0	400.0	400.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

* NOTE: NO FILL NEEDED IN SECTIONS OUTSIDE OF FENCE LINE.

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 60

NOTES

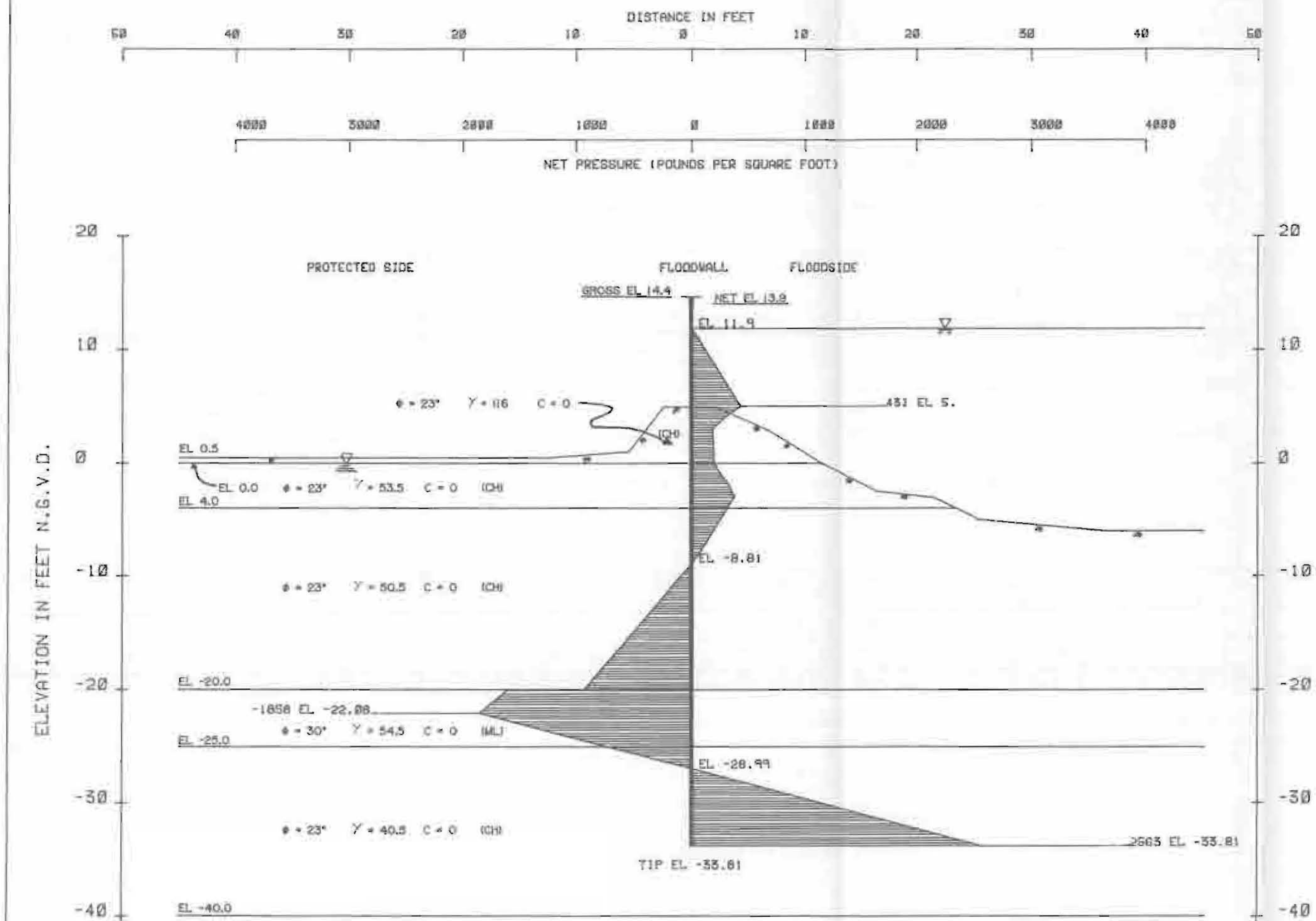
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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.19A-GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

PROTECTED SIDE LEVEE STABILITY ANALYSIS
STA. 21 + 00 TO STA. 37 + 00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288



SEE PLATE 60 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 102 FOR STABILITY ANALYSIS.

NET DIAGRAM

(S) CASE F.S.=1.2

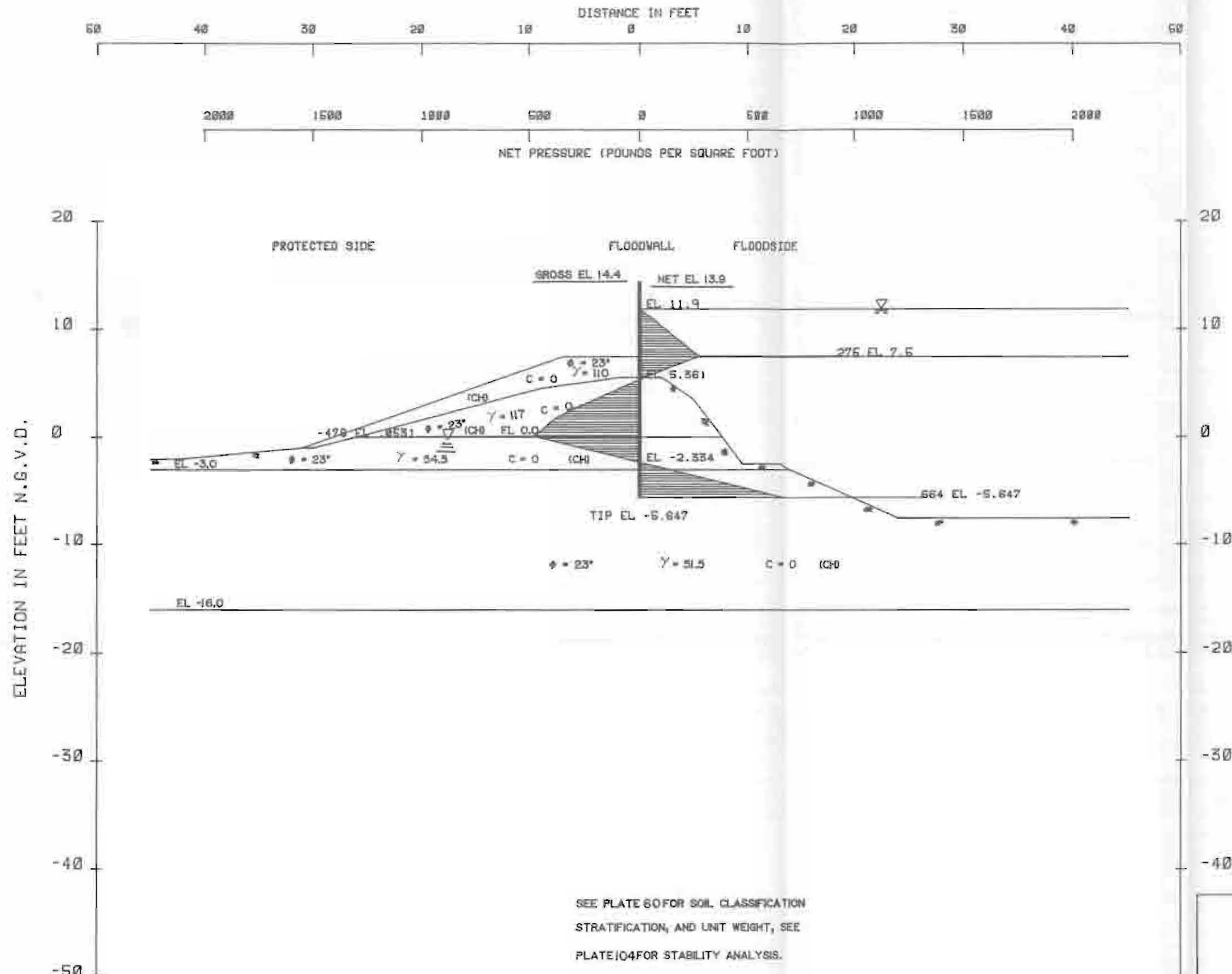
ELEVATION	PRESSURE
11.90	0.0
5.00	431.3
4.00	288.4
3.00	180.8
2.00	180.6
0.00	193.4
-2.00	323.4
-3.00	373.8
-4.00	308.4
-8.00	62.0
-8.81	0.0
-9.00	-14.6
-20.00	-932.2
-20.00	-1606.3
-22.08	-1855.7
-26.99	0.0
-33.81	2563.0
-33.81	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 19A - GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

I-WALL ANALYSIS
STA. 3+00 TO STA. 7+00 EAST

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

DATE SEPT 1988 FILE NO. H-2-30388



ELEVATION	PRESSURE
11.90	0.0
7.60	275.0
5.50	15.4
5.30	0.0
2.60	-318.1
1.50	-394.2
0.05	-478.2
-2.33	0.0
-5.65	663.8
-5.65	0.0

SEE PLATE 60 FOR SOIL CLASSIFICATION STRATIFICATION, AND UNIT WEIGHT, SEE PLATE 104 FOR STABILITY ANALYSIS.

NET DIAGRAM

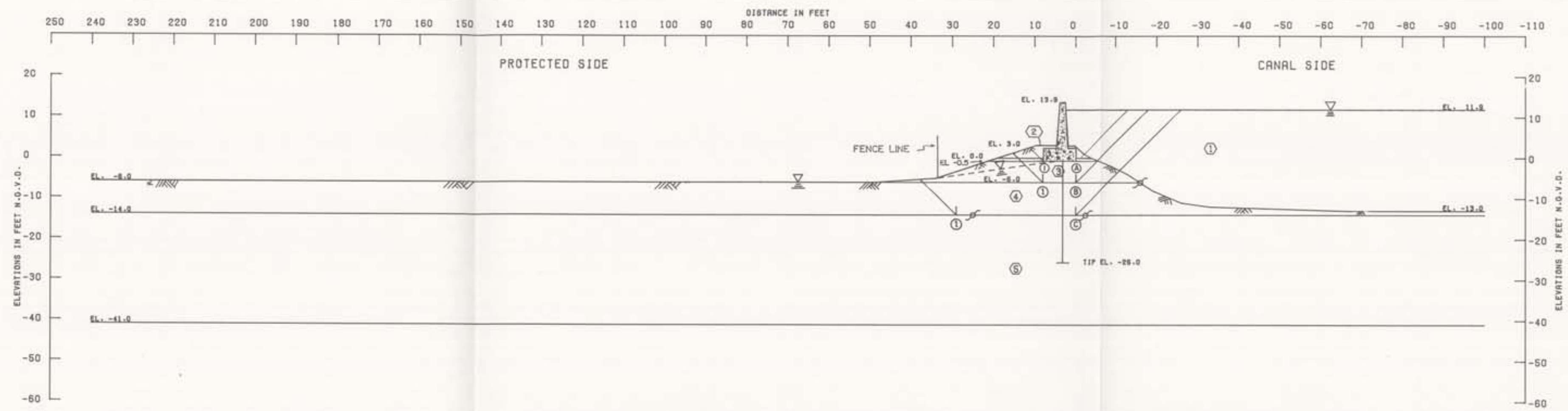
(S) CASE F.S.=1.5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.19A – GENERAL DESIGN
LONDON AVE OUTFALL CANAL
ORLEANS PARISH

I-WALL ANALYSIS
STA. 21+00 TO STA. 37+00

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

DATE SEPT 1988 FILE NO H-2-30298



NO.	ELEV.	$U_A = D_A - R_A$		$U_P = R_B + R_P + D_P$					
		D_A	R_A	R_B	R_P	D_P	U_A	U_P	$U_A - U_P$
BASE	-0.5	4805	0	2464	0	0	4805	2464	2341
1	-6.0	10780	3346	1968	5039	3511	7434	10518	-3084
2	-14.0	24135	5786	7052	4441	4503	18349	15881	2353

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	109.0	109.0	538.0	538.0	538.0	538.0	0.0
3	(CH)	96.0	96.0	308.0	308.0	308.0	308.0	0.0
4	(CH)	102.0	102.0	246.0	246.0	246.0	246.0	0.0
5	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	23.9

NOTE: ANALYSIS WAS PERFORMED WITH A FACTOR OF SAFETY OF 1.3 INCORPORATED INTO THE SOIL PARAMETERS.

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATE 60

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.19A - GENERAL DESIGN
LONDON AVE. OUTFALL CANAL
ORLEANS PARISH

DEEP SEATED STABILITY ANALYSIS
STA. 100+00 TO STA. 120+10 EAST

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1988 FILE NO. H-2-30288

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			Sl		SHELLS
NO SAMPLE					

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

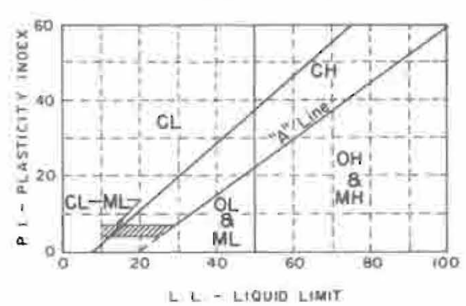
DESCRIPTIVE SYMBOLS

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	gy Br
GREENISH - GRAY	gn Gr
GRAYISH - GREEN	gy Gn
GREEN	Gn
BLUE	Bl
BLUE - GREEN	Bl Gn
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

Ⓒ Denotes location of consolidation test**

Ⓢ Denotes location of consolidated - drained direct shear test**

Ⓡ Denotes location of consolidated - undrained triaxial compression test**

Ⓠ Denotes location of unconsolidated - undrained triaxial compression test**

Ⓣ 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 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

TYPICAL 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 the contract clause entitled "Differing Site Conditions".

Ground - water elevations shown on the boring logs represents 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.

SOIL BORING LEGEND

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

1 JUNE 1987 FILE NO. H-2-21800

PLATE A