WESTWEGO TO HARVEY CANAL, LA.
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

DEPARTMENT OF THE ARMY

NEW ORLEANS DISTRICT, CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

JULY 1989

SERIAL NO.26

US Army Corps of Engineers
New Orleans District

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 28 July 1989

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

SUBJECT: Westwego to Harvey Canal, Louisiana Hurricane Protection Project, General Design Memorandum No. 1 (Reduced Scope)

1. The subject General Design Memorandum (GDM) is submitted for review and approval. The GDM has been prepared generally in accordance with the guidance provided in the 31 March 1989 briefing held for ASA (CW) and the HQ U.S. Army Corps of Engineers, letter dated 10 May 1989. This letter provided clarifying comments for preparing the reduced scope GDM.

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

a. The work proposed in the subject GDM was addressed in the EIS for West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana, which was filed with EPA on 23 October 1987. The EIS did not include the Westside closure which was proposed subsequent to the original authorization. This will be addressed in an Environmental Assessment to be prepared upon final selection of the Westside closure alternate.

b. The construction of the project will not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species.

c. A detailed plan for a program of mitigative data recovery at the V-levee Archaeological Site is currently under review. Completing the required investigations at this site, which is eligible for National Register, should fully discharge all project cultural resource commitments.

3. The plan presented in the GDM generally follows the authorized plan, with the addition of a new levee/floodwall combination required to close the system and provide protection to the western portion of the project area.

CELMN-ED-SP
SUBJECT: Westwego to Harvey Canal, Louisiana Hurricane Protection Project, General Design Memorandum No. 1 (Reduced Scope)

4. As the final Design for the project work is not completed, the level of design detail for the GDM varies between traditional GDM and feasibility scope.

5. The subject GDM is being submitted on schedule.

6. As per LMVED-TS letter, dated 5 February 1981, this GDM has been reviewed by the District Security Office. There were no comments to be incorporated in the GDM.

7. Approval of the GDM is recommended.

FOR THE COMMANDER:

Encl (16 copies fwd sep)

FREDERIC M. CHATRY
Chief, Engineering Division

WESTWEGO TO HARVEY CANAL, LA.
HURRICANE PROTECTION PROJECT
DESIGN MEMORANDUM NO. 1 GENERAL DESIGN

STATUS OF DESIGN MEMORANDUMS

Design Memo	Title	Actual or Scheduled Submission Date
1.	ADVANCE SUPPLEMENT-HARVEY CANAL FLOODWALL	28 October 1988
1.	GENERAL DESIGN MEMORANDUM (REDUCED SCOPE)	28 July 1989
1.	SUPPLEMENT NO. 2	29 February 1990

WESTWEGO TO HARVEY CANAL, LA.
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1 (REDUCED SCOPE)

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EXECUTIVE SUMMARY

This General Design Memorandum (Reduced Scope) presents the design, cost estimates, and updated economic analysis for the remainder of the protective works for the Westwego to Harvey Canal, Louisiana Hurricane Protection Project. The designs for the Harvey Canal Floodwall portion of the project were presented in General Design Memorandum No. 1, Advance Supplement, Harvey Canal Floodwall, which was approved 20 December 1988. As the final design for all the project works is not complete, the level of detail for this reduced scope GDM varies between traditional GDM and Feasibility Scope.

This document was prepared in an effort to decrease the time and effort between the feasibility report and the start of construction in answer to CEEC-EP guidance which states that the Local Cooperation Agreement (LCA) for the project cannot be executed until the GDM for the entire project is approved. This GDM will be used as the basis for negotiation and execution of the LCA.

The authorized plan provides Standard Project Hurricane (SPH) protection to the urban area between Westwego to the Harvey Canal on the west bank of the Mississippi River. The plan consists of new and enlarged levees and floodwalls along the permitted alignment from Westwego to the V-levee then along the existing V-levee alignment to the vicinity of Estelle Pumping Station. From the existing Estelle Pumping Station at the V-levee, the levee alignment follows the existing Harvey Canal - Bayou Barataria Levee to the Harvey Pumping Station. From this point, a floodwall will parallel the Harvey Canal along Destrehan Avenue and tie back into the Harvey Lock. The elevation of the SPH levees and floodwalls varies by reach from 9.0 feet NGVD to 16.0 feet NGVD.

The plan presented in this document generally follows the authorized plan with the addition of a new levee/floodwall combination required to close the system and provide protection to the western portion of the project area.

The final EIS for the project was filed with EPA in October 1987. The EIS did not include the westside closure. This closure will be addressed in an Environmental Assessment to be prepared at a later date. According to the EIS a total of 814 acres will be directly impacted by construction of the project. Losses of bottomland hardwoods due to the westside closure would be 7.9 acres.

The recommended mitigation plan involves construction of a stone dike at the mouth of Baie du Cabanage within the state-owned Salvador Wildlife Management Area and acquisition

of 1,024 acres of wooded wetlands in the Bayou Piquant finger ridge area. The west side closure would require additional mitigation of 5.0 acres of bottomland hardwoods.

The first cost of the project is $78,000,000. This compares to the latest PB-3 estimate of $77,700,000. The section 902 limit for the project is $90,600,000. The average annual project cost is $13,854,000 which includes annual O&M cost of $76,000. Average annual benefits are $35,480,000 and the B/C ratio is 2.56 to 1.

It is recommended that the plan presented in this Design Memorandum be approved as a basis for negotiation and execution of the LCA for this project.

PERTINENT DATA

Location of Project: Urban area within Jefferson Parish between Westwego to Harvey Canal, on the west bank of the Mississippi River in the vicinity of New Orleans, Louisiana.

Datum Plane: National Geodetic Vertical Datum (NGVD)

Hydrologic Data:

Temperature (°F)	
Maximum monthly	90.6
Minimum monthly	45.3
Average	69.5
Annual Precipitation (inches)	
Maximum	83.5
Minimum	40.1
Average	61.6

Hydraulic Design Criteria:

Design Hurricane: Standard Project Hurricane	
Frequency	500 years
Central Pressure Index (CPI)	27.6 inches of mercury
Maximum Wind Speed	100 MPH

Proposed Protection: (Including Harvey Canal Floodwall)

Levee:	Top Elev. 9.0 to 12.0 N.G.V.D.
Flood Wall	
I-Type	Top Elev. 9.5 to 16.0 N.G.V.D.
T-Type	Top Elev. 9.0 to 15.5 N.G.V.D.

Right of Way:

Potential Commercial/Residential	34.28	Acres
Potential Commercial/Industrial	4.6	Acres
Potential Residential	467.59	Acres
Potential Commercial	21.84	Acres
Marsh/Wetlandilroad	568.08	Acres
Mitigation	1,024	Acres

PERTINENT DATA (Continued)

Estimated First Cost:

Federal	$50,700,000
Non-Federal	$27,300,000
Total	$78,000,000

Justification:

Average Annual Cost	$13,854,000
Average Annual Benefits	$35,480,000
Benefits-to-cost Ratio @ 8-7/8%	2.56 to 1

GENERAL

1. Project Authorization. Public Law 99-662, The Water Resources Development Act of 1986, authorized the project subject to the conditions recommended in the report approved by the Secretary of the Army. The report was approved by the ASA(CW) on 28 March 1989, in accordance with the plan recommended by the Chief of Engineers in his report dated 9 August 1988.

2. Project Location and Description. The project is located in southeastern Louisiana within the urban area of Jefferson Parish on the west bank of the Mississippi River. The area is generally bounded by the Harvey Canal to the east, Lakes Cataouatche and Salvador to the west, the Mississippi River to the north and Barataria Bay to the south as shown on Plate 1. The project will protect the urbanized areas within Jefferson Parish between Westwego and Harvey Canal. The plan of improvement will consist of new and enlarged levees and floodwalls along the permitted alignment from the vicinity of Westwego to the V-levee, along the existing V-levee alignment to the vicinity of Estelle Pumping Station, and along the existing Harvey Canal-Bayou Barataria Levee to Harvey Pumping Station. From this point, a floodwall will parallel Harvey Canal along Destrehan Avenue, tying into Harvey Lock (see Plates 2 through 5).

3. Purpose and Scope. The General Design Memorandum (Reduced Scope) presents the essential data, assumptions and criteria for developing plans, designs and cost estimates for protective works from Westwego to Harvey Canal, Louisiana. The design and cost estimate for the Harvey Canal Floodwall, (a feature of the Westwego to Harvey Canal project which extends from the Harvey Lock to the Harvey Pumping Station) was presented in General Design Memorandum No. 1, Advanced Supplement, approved 20 December 1988. Construction plans and specifications for the Harvey Canal Floodwall feature of the project are currently under preparation. This GDM contains the design for the remaining portion of the project (from the vicinity of Westwego to the Harvey Canal Pumping Station) and the cost estimate and the updated economic analysis for the total project.

As the final design is not complete at this time for all the project reaches, the level of detail in this reduced scope GDM varies between traditional GDM and the Feasibility Report. As a parallel effort, a supplement to the GDM based on detailed designs and cost estimates is also being prepared and is scheduled for submittal to LMVD in February 1990.

In an effort to decrease the time and effort between the approved project Feasibility Report and the start of construction, this General Design Memorandum (Reduced Scope) will (1) reaffirm the project scope, (2) present evidence to support a firm project cost estimate, and (3) verify the economic soundness of the

project. This design memorandum will be the basis for negotiation and execution of the Local Cooperation Agreement (LCA).

BACKGROUND

4. Inclusion of Harvey Canal Floodwall in Louisiana State Flood Control Program. Construction of the Harvey Canal Floodwall was included in the Louisiana Statewide Flood Control Program, and received authorization for initial funding by the 1985 Regular Session of the Louisiana Legislature. Construction of the floodwall was to be accomplished by the West Jefferson Levee District - the local sponsor for the authorized hurricane protection project. Under regulations governing the Statewide Flood Control Program, the State funds remain dedicated for four years from the date of notification to the levee district (March 1986). Thus, the contract for construction of the floodwall must be awarded by March 1990. (Relative correspondence is included as Appendix C to this design memorandum.)

Based on preconstruction engineering and design progress by the New Orleans District, Corps of Engineers, the levee district requested that we prepare the plans and specifications and award the contract for the Harvey Canal Floodwall.

5. Original Plan of Action to Effect Floodwall Contract Award by March 1990. In order to initiate Federal construction by March 1990, assuming approval of an FY 1990 new construction start, the Advance Supplement was prepared for the design of the floodwall, and an LCA for the entire project was scheduled for execution by October 1989. The original plan of action called for execution of the LCA based upon the Advanced Supplement for the Floodwall. The GDM for the remaining portion of the Westwego to Harvey Canal Project was scheduled for completion by February 1990. CEEC-EP guidance however, states that the LCA for the project can not be executed until the general design memorandum covering the entire project is approved.

6. Current Plan of Action and Milestones. Consequently, as shown in the chain of correspondence presented in Appendix C, a new plan of action resulted. Specifically, the following milestones represent the plan which will result in award of the construction contract for construction of the Harvey Canal Floodwall by March 1990.

a. Submittal of the project General Design Memorandum (Reduced Scope) by 31 July 1989.

b. Approval of General Design Memorandum (Reduced Scope) by 29 September 1989.

c. Submission by the New Orleans District of the draft LCA package in July 1989.

d. Execution of LCA in October 1989.

e. Award construction contract, assuming an FY 1990 new construction start, in December 1989.

LOCAL COOPERATION

7. Requirements of Local Cooperation. Prior to construction, local interest must give assurance satisfactory to the Secretary of the Army that they will:

a. Provide without cost to the United States all necessary lands, easements, and rights-of-way, including borrow and excavated material disposal areas necessary for construction, operation, and maintenance of the project;

b. Accomplish, without cost to the United States, all necessary alterations and relocations to roads, railroads, pipeline, cables, and other facilities, including interior drainage, required by the construction of the the project, excluding facilities necessary to maintain the existing interception and disposal of interior drainage at the line of protection;

c. Hold and save the United States free from damages due to the construction, operation, and maintenance of the project, except where such damages are due to the fault or negligence of the United States or its Contractors;

d. Bear 35 percent of the first cost of construction. If the value of contribution required under Paragraphs 7a and 7b above is less than 35% of the cost of the project, the local sponsor shall provide, during the period of construction, an additional cash contribution, or approved equivalent work necessary to make its total contribution equal to 35 percent of the total project cost.

e. Maintain and operate all features of the project in accordance with regulations prescribed by the Secretary of the Army, including levees, floodwalls, floodgates, approach channels, and all interior drainage features, including but not limited to drainage structures, drainage ditches, canals, and stoglop structures;

f. Prior to initiation of construction, prescribe and enforce regulations or other management techniques to prevent encroachment on floodplain area, channels, rights-of-way, and levee, along with interior drainage, ponding, and sump areas, necessary for proper functioning of the project;

g. Publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regula-

tions as may be necessary to ensure compatibility between future development and protection levels provided by the projects;

h. Provide a cash or in-kind contribution for fish and wildlife mitigation features of the project in an amount equal to the same percentage as the non-Federal share of the basic project;

i. Comply with the applicable provisions of the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970 (PL 91-646);

j. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, Approved December 31, 1970; and

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

8. Current Status of Assurances. By letter dated 2 December 1986, the Board of Commissioners of the West Jefferson Levee District advised the Corps of Engineers that they intend to serve as local sponsor for the plan of improvement recommended in the feasibility report. Further, by letter dated 3 June 1988, the Board also advised the Corps that they will enter into an LCA for the V-Levee North Plan - an alternative alignment which avoids any 404(c) and Jean Lafitte National Park lands. The West Jefferson Levee District also stated in their 2 December 1986 letter that by law they are empowered to provide all non-Federal cooperation required for the project, and intend to enter into a binding agreement with the Corps of Engineers at the appropriate time.

9. Credit for Compatible Work by Local Sponsor. Pursuant to Section 104 of the Water Resources Development Act of 1986, a credit to the project sponsor for certain compatible work accomplished by local interests prior to 17 November 1986 was approved by the Assistant Secretary of the Army (Civil Works) in a memorandum to the Director of Civil Works dated 13 May 1988. The approved credit is for work external to the works incorporated in the project, as authorized. Hence, the value of that work, currently estimated as $6.7 million, was added to the estimate of project costs. The actual amount of credit will be determined following a final audit of expenditures.

In addition to above, $21.4 million in additional credit has been identified by the local sponsor for work accomplished or to be accomplished subsequent to 17 November 1986. We will audit these items of credit as the local sponsor submits documentation in support of each work item.

10. Local Cooperation Agreement. A draft LCA was furnished to the local sponsor in April 1989. We have subsequently met with

the sponsor, and reviewed the draft document. The draft LCA and financing plan will be submitted in July 1989. Approval of the General Design Memorandum (Reduced Scope) in September 1989 along with execution of the LCA in October 1989, will complete the requirements for award of the first construction contract in December 1989.

PROJECT PLAN

11. Authorized Plan: The authorized plan provides Standard Project Hurricane (SPH) Protection to the urban area between Westwego and the Harvey Canal on the west bank of the Mississippi River in the vicinity of New Orleans, Louisiana. The plan consists of new and enlarged levees and floodwalls along the permitted alignment from Westwego to the V-levee then along the existing V-levee alignment to the vicinity of Estelle Pumping Station. From the existing Estelle Pumping Station at the V-levee, the levee alignment follows the existing Harvey Canal-Bayou Barataria Levee to the Harvey Pumping Station. From this point a floodwall is proposed to parallel the Harvey Canal along Destrehan Avenue and tie back into the Harvey Lock.

12. Protective Works. The plan presented in this GDM covers the portion of the authorized plan beginning at Westwego, traversing along the permitted alignment, and terminating at the Harvey Pumping Station.The portion of the project between the Harvey Pumping Station and the Harvey Lock was covered in the Advance Supplement for the Harvey Canal Floodwall. Paragraphs 24 through 26 provide description of the proposed levees, floodwalls and other structural improvements.

DEPARTURE FROM PROJECT DOCUMENT PLAN

13. Westside Closure. The proposed levee system as described in the Feasibility Report and authorized, ties into the existing Lake Cataouatche levee system at Bayou Segnette Pumping Station. As the Lake Cataouatche levee does not conform to SPH grade or section, the western part of the project area remains unprotected from SPH flooding.

The following alternative alignments were investigated as a means for closing the system. These alignments are shown on Plate 5A.

a. Alternative No. 1. An earthen levee to commence in the vicinity of Bayou Segnette State Park, traverse west along the south shoulder of West Bank Expressway, turn in a northerly direction east of LP&L No. 1 canal, and tie into the existing railroad embankment. Under this alternate, Whiskey Bayou and Railroad Canal drainage will be diverted in a westerly direction

into LP&L No. 1 Canal. A ramp will be provided at Bayou Segnette Park entrance road and West Bank Expressway.

b. Alternate No. 2. This alternate is similar to Alternate 1 above except the proposed alignment will turn north along the east bank of Railroad Canal (east of trailer park) in the form of a floodwall and tie into the existing railroad embankment.

c. Alternate No. 3. This alternate is essentially the same as alternate no. 2 above, except along the south shoulder of West Bank Expressway a floodwall will be built in lieu of a levee.

d. Recommended Westside Closure Plan. West Jefferson Levee District has expressed desires to upgrade the existing Lake Cataouatche Levee to provide SPH protection to the Westside area. Reconnaissance Report for Hurricane Protection of the Louisiana Coastal Area indicated that this plan is not cost effective. The survey scope cost estimate of the three alternatives discussed above indicates that alternative no. 2 is the least cost alternative and is selected as the recommended plan pending GDM scope design and cost estimates. Of the three alternatives investigated the West Jefferson Levee District has indicated their preference for alternative no. 1. The economic feasibility of this alternative will be reassessed during the preparation of the supplement to the GDM.

HYDROLOGY AND HYDRAULICS

14. General. The hydrology and hydraulic analyses and design for the proposed works are presented in Appendix A of this memorandum. The appendix contains detailed descriptions of the hydraulic analyses, methods and procedures used in the design of the protection features of the proposed plan.

15. Design Elevations. Due to the urban nature of the project area, the standard project hurricane (SPH) was selected as the design hurricane. Due to the transposition of the regional SPH to the smaller study area, the recurrence interval of this hurricane is about 500 years. Characteristics of this hurricane are: central pressure index (CPI) 27.6 inches of mercury; maximum wind velocity 100 mph; radius of maximum winds 30 miles from the center; and forward speed 11 knots.

Protective works exposed to wave runup will be constructed to an elevation and cross section sufficient to prevent all the overtopping from significant wave and waves smaller than the significant wave accompanying the SPH. Waves larger than the significant wave will be allowed to overtop the protective structures; however such overtopping will not endanger the security or cause material flooding.

Heights of the proposed protective work along Bayou Segnette and east of Highway 3134, which are subject to only minor wave activity generated by boat traffic or winds across a limited fetch during several hours of super elevated wind tide levels, were designed to include a freeboard allowance of 2 feet above the still water level. The height of the remaining levee from Bayou Segnette to Highway 3134 was designed to prevent overtopping from waves generated in Lakes Salvador and Catouatche which propagate across the marsh to this reach of levee. Table 1 gives the height of protection required in the project area.

TABLE 1

REQUIRED ELEVATION OF PROTECTIVE WORKS

Reach	Elevation of Protective Structure (Ft. NGVD)
Bayou Segnette	9.0
Bayou Segnette to Dugues Canal	10.0
Dugues Canal to Estelle Canal	11.0
Estelle Canal to Bayou Des Familles	12.0
Bayou Des Familles to Highway 3134	12.0
Highway 3134 to Apex of "V" Levee	12.0
Apex of "V" Levee to Harvey Canal	9.5

GEOLOGY AND SOILS

16. Physiography. The project site is located on the Deltaic Plain portion of the Mississippi River Alluvial Plain. Specifically, the project is located on the northern edge of the Barataria Basin on the western side of the Mississippi River. The Barataria Basin is an interdistributary basin dominated by features which include natural levee ridges, crevasse-splay deposits, marsh, lakes, and swamps. The eastern and northern edge of the basin is defined by the natural levee ridge of the Mississippi River and the western edge of the basin is defined by the Bayou Lafourche natural levee ridge. The Gulf of Mexico constitutes the southern boundary. Elevations vary from approximately +10 to +15 feet NGVD along the natural levee of the Mississippi River to 0 feet NGVD in the back swamp and lake areas.

17. General Geology. Only the geologic history since the end of the Pleistocene Epoch is pertinent to the project. At the close of the Pleistocene, sea level was approximately 360 to 400 feet below present sea level and the Mississippi River was entrenched into the older Pleistocene sediments to the west of the project. As sea level rose to its present stand, the entrenched valley was filled with sediment by the Mississippi River, resulting in an increase in meandering and channel migration. This meandering and channel migration has resulted in a series of deltas extending into the Gulf of Mexico. Seven Holocene deltas are recognized in

the lower Mississippi River Valley; however, only four are relevant to the project area. The oldest of the four deltas in the vicinity of the project was the Cocadrie Delta whose distal edges extended across the New Orleans area from west to east. Following the Cocadrie Delta into the vicinity of the project was the St. Bernard Delta which followed the same general course as the Cocadrie Delta but extended further to the east. It was during this period that maximum sedimentation into the project area occurred via the Bayou Barataria and des Familles distributaries. A shifting of the river course upstream in response to a shorter route to the Gulf resulted in the formation of the LaFourche Delta southwest of the project. A final shift of the river brought the flow into its present course forming the Plaquemine Delta just south of New Orleans, and the present Balize Delta below the Plaquemine Delta. Development of the deltas below New Orleans coupled with the restrictions of floodwaters has resulted in the gradual degradation of the study area through subsidence and shoreline retreat.

FOUNDATION INVESTIGATION AND DESIGN

18. General. The project alignment has been divided into five design areas due to a variation in soil strength, stratification and required protection elevations. Many of these design areas were divided into reaches because of varying ground elevations, levee crown transitions and soil strength variation. Areas and reaches are as follows:

Harvey Canal Levee:	2 Reaches
V-Line Levee:	3 Reaches
Hwy. 45 Levee:	1 Reach
Oak Cove Levee:	3 Reaches
Westwego Levee:	5 Reaches

19. Field Exploration. One hundred and fifteen (115) borings were made along the proposed alignment. Of the 115 borings, 102 were obtained by Eustis Engineering of Metairie, La. at the request and authorization of the West Jefferson Levee District, the local project sponsor. The rest of the borings (13), the majority of which were check borings, were obtained by the Corps of Engineers. All Eustis borings were undisturbed (5" or 3" I.D.). Eight C.E. borings were 5" undisturbed borings and 5 were general type borings.

20. Laboratory Tests. Visual classifications were made on all samples and water content determinations were made on cohesive samples from all the borings. Unconfined compression solidated tests (UCT's) were run on typical clay samples. Unconsolidated undrained (Q) triaxial test were performed on selected samples. Atterberg limit determinations were performed on each test sample. Consolidation test was performed on selected clay samples.

21. Foundation Condition. The foundation soils are predominantly fat clays (CH) varying in consistency from very soft to stiff. In many areas, organic clays (OH) and peat (PT) may be found in the top 20 feet and have a very soft to soft consistency. The V-Line and Hwy. 45 levees are underlain by large layers of sand (SM, SP) and silt (ML) 10 to 15 feet below the surface. Thin strata of silt and sand are encountered at various other locations in the foundation.

22. Shear Stabilities.

a. Levee Stability. Stability sections for each design area were determined by use of the "Methods of Planes." A "Factor of Safety" (F.S.) of 1.3 was required for the levee stability and a F.S. of 1.5 was the minimum required for failures into borrow pits and canals.

b. Cantilever I-Wall. I-wall stability and required penetration were determined by the "Method of Planes." A "Factor of Safety" was applied to the soil parameters. For the friction angle, the F.S. was applied as follows:

$$\phi d = \tan^{-1} \frac{\tan \phi a}{\text{Factor of Safety}}$$

re: ϕa = available friction angle
ϕd = developed friction angle

The developed friction angle was used in determining lateral earth pressure coefficients.

Using the resulting shear strengths, net horizontal water and earth pressure diagrams were determined for movement toward each side of the sheet pile. From the earth pressure diagrams, the summation of horizontal forces was equated to zero and the summation of overturning moments was determined for various tip penetrations. The depth of necessary penetration is the point of zero summation of moments.

The following design cases were analysed for determining required penetration:

Case I: No significant wave load on I-wall:

Q-Case
F.S. = 1.5 with static water at still water level (SWL)
F.S. = 1.0 with static water at SWL plus 2 feet

General: If the penetration to head ratio is less than 3:1, increase it to 3:1.

Case II: Significant wave load on I-wall:

Q-Case - Same as above

F.S. = 1.25 with water to SWL plus wave load.

S-Case

F.S. = 1.2 with water to flowline or SWL

General: If the penetration to head ratio is less than 3:1, increase it to 3:1 or to that required by the S-case, F.S. = 1.5, whichever results in the least penetration.

23. Pile Foundation. Pile capacity curves will be generated for various structures along the alignment (pumping stations, gates, T-walls, etc.). Lateral earth pressure coefficients (Kc) of 1.0 and (Kt) 0.7 were used to determine the pressure on the pile surface in both tension and compression.

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

24. Levees. The project levee will consist of enlargement of existing levee in some areas and construction of new levee in others. The levee work will, in general, extend from the Bayou Segnette Pumping Station to the Harvey Pumping Station (see Plates 2 through 5). Levee work will also include a western tie-in that extends from about half a mile North of Bayou Segnette Pumping Station in a North-Westerly direction to the vicinity of the Southern Pacific Railroad. From Bayou Segnette Pumping Station to the southern side of Oak Cove Subdivision, the proposed levee will be approximately parallel to and marshward of the existing levee protection (levee baseline). From the south side of the Oak Cove Subdivision to the V-Levee at Hwy 45, a new levee will be constructed approximately 500 feet parallel to and marshward of Hwy 45. Beginning at Hwy 45 and extending along the V-Levee to the Estelle Pumping Station, the proposed levee will be constructed on the protected side of the existing levee protection (levee baseline), so that construction will not impact the Jean Lafitte National Historic Park and the 404-C area. A shell road will be provided on the crown of the V-levee from approximate Station 572+17 to Station 804+33 for recreational walking, biking and observation of wildlife in the adjacent Jean Lafitte National Park. Details of this road will be included in the supplement to the GDM for this project. From Estelle Pumping Station to Harvey Pumping Station, construction will consist of a straddle enlargement of the existing levee. Typical levee design sections are shown on Plates 17 through 21.

25. Floodwalls and Gates. I-type and T-type floodwalls will be used to provide protection in congested areas, and to provide a transition between the pumping station fronting protection and the full earthen levee sections. Details of the I-walls and T-walls are shown on Plates 37 and 38. I-walls will be overbuilt by a mi-

nimum of 6 inches to account for long term settlement. However, long term settlement calculations will be presented in the supplement to the GDM and may reveal the need for higher I-wall grades. Aesthetic floodwall surface treatment will be provided in areas of high visibility. Details of this treatment will be included in the supplement to the GDM for this project. Swing gates and bottom roller gates will be located along the floodwall alignment to allow vehicular access to local roads and streets on both sides of the floodwall. Details of the swing gates are presented on Plates 31 through 33. Details of the bottom roller gates are presented on Plates 34 through 36. Utilities, including gas and water, crossing the floodwall alignment will be passed through a pipe sleeve as indicated on Plate 39.

26. Pumping Station Modifications. The fronting protection at each pumping station location will be raised to SPH levels by either replacement of the existing protection with pile supported T-walls, or by increasing the height of the existing fronting T-walls or sheet pile bulkheads. The structures deemed suitable for modification will require a full geotechnical and structural analysis. This analysis will be presented in the supplement to the GDM to verify the preliminary design assumptions. Shell and riprap will be provided to fill scour holes that have developed at the discharge outlets of the pumping stations. This is required to ensure the stability of the proposed fronting protection structures. In addition, butterfly valves will be incorporated into each of the pumping station steel discharge pipes to insure a positive cutoff from the back flow of hurricane level floodwaters through the discharge pipes. Two of the pumping stations, namely Ames and Cousins, contain square concrete discharge tubes which cannot be modified with butterfly valves. Positive cutoff at theselocations will be provided by constructing sluice-gated structures at the discharge tube outlets as shown on Plate 29.

The required levels of protection for the Standard Project Hurricane (SPH) for each structure location are presented in Table 2.

TABLE 2

LOCATION	WIND TIDE LEVEL (N.G.V.D.)	FLOODWALL GRADE (N.G.V.D.)	WAVE LOADING
Segnette Pumping Station (Vic. 2+00 B/L)	7.0	9.0	N/A
Old Westwego Pumping Station & Vicinity (Vic. 41+00 B/L)	7.0	9.0	N/A
Lapalco Bridge (Vic. 56+00 B/L)	7.0	9.0	N/A

TABLE 2 (Continued)

LOCATION	WIND TIDE LEVEL (N.G.V.D.)	FLOODWALL GRADE (N.G.V.D.)	WAVE LOADING
New Westwego Pumping Station (Vic. 68+00 B/L)	7.0	10.0	N/A
Westwego Airport (Vic. 129+00 B/L)	7.0	13.0	Yes
Ames Pumping Station (Vic. 325+00 B/L)	8.0	15.5	Yes
Mount Kennedy Pumping Station (Vic. 335+00 B/L)	8.0	14.5	Yes
Oak Cove Pumping Station (Vic. 377+00 B/L)	8.0	14.5	Yes
Ross Canal Drainage Structure (Vic. 478+00 B/L)	8.0	Levee to El. 12.0	Yes
Estelle Pumping Station & Vicinity (Vic. 803+00 B/L)	7.5	9.5	N/A
Floodwall in Vic. La. Power and Light Co. Power Lines (Vic. 959+00 B/L)	7.5	9.5	N/A
Cousins Pumping Station (Vic. 1020+00 B/L)	7.5	9.5	N/A
Harvey Pumping Station (Vic. 1070+00 B/L)	7.5	9.5	N/A

The following is a brief description of the proposed improvements at each structure location:

a. Bayou Segnette Pumping Station. The existing sheet pile bulkhead fronting protection will be replaced by a pile supported T-wall constructed on a shell embankment as shown on Plate 22. The discharge pipes will be extended through the proposed T-wall as shown on the plate. An I-wall over a levee section will tran-

sition from the T-wall to the full earthen levee section. A 24-foot wide swing gate will be provided for access to the pump station. The layout of the proposed floodwall is shown on Plate 6.

b. Old Westwego Pumping Station and Vicinity. The existing sheet pile bulkhead fronting protection will be modified by the addition of a concrete cap as shown on Plate 23. I-walls and T-walls will be constructed at the boat staging area around Company Canal at the locations shown on Plate 7. Swing gates, one on each side of Bayou Segnette, will allow access to the canal area.

c. Lapalco Bridge. The flood protection in this area will comprise an I-wall over an earthen levee section as shown on Plate 8. The proposed layout will cross two pipelines, a natural gas pipeline and a municipal waterline. An I-wall was chosen in this area since a full earthen levee section would add overburden to the bridge piers. This overburden could induce a settlement on the bridge piers.

d. New Westwego Pumping Station. The existing fronting T-wall will be extended to SPH levels as shown on Plate 24. The wall extension will require the addition of buttresses, concrete piles, and an extension to the base slab. The layout of the proposed floodwall is shown on Plate 9.

e. Westwego Airport. An I-wall on earthen levee section comprises the flood protection in this area as shown on Plate 10. A 36 foot wide swing gate will allow access through the floodwall to the airport and adjacent trailer park. Rights-of-Way constraints between Lapalco Blvd. and Dugues Canal justified the use of a floodwall in lieu of the full earthen section.

f. Ames Pumping Station. The layout of the proposed fronting floodwall is shown on Plate 11. The existing fronting T-wall will be extended to SPH levels as shown on Plate 24. The wall extension will require the addition of buttresses, concrete piles, and an extension to the base slab. SPH levels of protection will be provided by the addition of a concrete stub wall located on the top of the existing concrete discharge tube. A sluice-gated structure will be constructed at the outlet of the discharge tube to provide positive cutoff. A T-wall will provide flood protection between the Ames Pumping Station and the Mount Kennedy Pumping Station as shown on Plate 11.

g. Mount Kennedy and Oak Cove Pumping Stations. The existing earthen levees that serve as fronting protection at these pumping stations will be degraded and T-wall structures will be constructed as shown on Plate 25. The layout of the proposed floodwalls at Mount Kennedy and Oak Cove are shown on Plates 11 and 12 respectively.

h. Ross Canal Drainage Structure. A 60-inch diameter corrugated metal pipe drainage structure will be located through the proposed levee section to provide an outlet for water draining out through the Ross Canal as shown on Plate 3. A 60-inch x 60-inch sluice gate structure will be incorporated into the corrugated metal pipe to provide a positive cutoff from hurricane flood waters. Details of the proposed drainage structure are shown on Plate 30.

i. Estelle Pumping Station. The existing sheet pile bulkhead fronting protection will be modified by the addition of a concrete cap as shown on Plate 26. An elevated walkway attached to the concrete cap will provide access for operation and maintenance of the butterfly valves at each discharge pipe. The layout of the tie-in floodwalls and fronting floodwalls is shown on Plate 13.

j. Louisiana Power & Light Co. (L.P.& L.) Power Lines. The existing sheet pile wall located in the vicinity of the L.P.& L. power lines will be brought to SPH levels by the addition of a concrete cap. The layout of the floodwall is shown on Plate 14.

k. Cousins Pumping Station. The existing pumping station fronting protection will be modified as shown on Plate 15. The portion of the existing fronting protection provided by the pumping station building wall will be brought to SPH levels by raising a portion of the existing building structure floodwall as shown on Plate 27. Sluice-gated structures will be constructed at the outlets of the square concrete discharge tubes to provide positive cutoff. The remainder of the pumping station fronting protection comprised of a concrete-capped sheet pile wall, will be demolished and recapped to meet SPH levels. I-walls will join the areas adjacent to the pumping station and the area below the Lapalco Bridge to the full earthen sections as shown on Plate 15. A 44-foot wide bottom roller gate will be provided across Destrehan Ave., and a 24-foot wide swing gate will allow access across the shell road north of the station.

l. Harvey Pumping Station. The existing floodwall will be extended to SPH levels by the addition of stiffened steel plates anchored to the existing wall as shown on Plate 28. A 44-foot wide bottom roller gate will replace the existing stop log gate at Destrehan Ave. The location and alignment for the proposed flood protection is presented on Plate 16.

STRUCTURAL DESIGN

27. Criteria for Structural Design. The structural designs to be used in preparing the final plans for construction of the structural features presented herein will comply with standard engineering practice and criteria set forth in Engineering Manuals and Engineering Technical Letters for civil works construction pub-

lished by the Office, Chief of Engineers, subject to modifications indicated by engineering judgement and experience to meet local conditions.1/

28. Basic Data. Basic data relevant to the design of the protective works are described in Paragraphs 24 through 26 collectively titled "Description of Proposed Structures and Improvements".

29. Design Methods.

a. 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 17 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 328, "Standard Specifications for Steel Sheet Piling".

b. Reinforced Concrete. The design of reinforced concrete structures is in accordance with the requirements of the strength design method of the current ACI building Code, as modified by the guidelines of "Strength Design Criteria for Reinforced Concrete Hydraulic Structures", ETL 1110-2-312 dated 10 March 1988. The basic minimum 28-day compressive strength concrete will be 3,000 psi, except for prestressed concrete piling where the minimum will be 5,000 psi. For convenient reference, pertinent stresses are tabulated below:

TABLE 3

PERTINENT STRESSES FOR REINFORCED CONCRETE DESIGN

Reinforced Concrete	
f'c	3,000 psi
fy (Grade 60 Steel)	48,000 psi
Maximum Flexural Reinforcement	0.25 x Balance Ratio
Minimum Flexural Reinforcement	200/fy
f'c (For Prestressed Concrete Piles)	5,000 psi
fu (Prestressing Strands, Gr. 250)	250,000 psi
(Prestressing Strands, Gr. 270)	270,000 psi

30. I Type Floodwall.

a. General. The I-walls consist of steel sheet piling driven into the existing ground and, in some cases, into a new

1/ The floodwall design is similar to the design presented in the Lake Pontchartrain, La. & Vicinity, High Level Plan, Jefferson Parish Lakefront Levee, Design Memorandum No. 17, General Design, dated November 1987.

embankment. The upper portion of the sheet piling will be capped with concrete. The sheet piling will be driven to the required depth with 9 inches of the sheet piling extending above the finished ground elevation. The concrete portion of the floodwall will extend from 2 feet below the finished ground elevation to the required protection height.

b. Loading Cases. In the design of the I-walls, the loading case to be considered will be as follows:

Q-Case, F.S. = 1.5 with water to SWL
Q-Case, F.S. = 1.25 with water to freeboard or
with SWL plus waveload
Q-Case, F.S. = 1.0 with water to freeboard
S-Case, F.S. = 1.2 with water to SWL plus waveload
S-Case, F.S. = 1.0 with water to freeboard
No water, lateral soil pressure (where applicable)

c. Joints. Expansion joints in the I-wall will be spaced approximately 30 feet apart, adjusted to fall at sheet pile interlocks. To compensate for expansion, contraction, or displacement, three-bulb waterstops and premolded expansion joint fillers will be provided. Where the I-wall joins the T-wall, the deflection of the I-wall will produce a lateral displacement. To compensate for this displacement, a special sheet pile connection detail and a waterstop seal located in a notch in the I-wall have been designed to prevent water from flowing through this joint.

d. Tied-Back Sheet Pile Walls. The tied-back sheet pile walls will consist of steel sheet piling driven into existing ground and anchored with tie rods to a steel pipe, pile, or H-pile dead man. The upper portion of the sheet piling will be capped with concrete. The required sheet pile penetration and maximum bending moment will be determined by applying a factor-of-safety of 1.2 to the soil parameters. The required anchor force will be determined by applying a factor-of-safety of 1.0 to the soil parameters.

31. T-Type Floodwall.

a. General. The T-wall will consist of a reinforced concrete stem on a monolithic concrete base of varying width supported on precast, prestressed concrete piles or H-Piles. The base of the T-wall will be constructed on a four-inch concrete stabilization slab. A continuous steel sheet pile wall will be provided beneath the base for seepage cutoff purposes.

b. Loading Cases. These walls will be designed for the following load conditions:

Case I. Static water pressure with water to SWL, no wind, impervious sheet pile cutoff, no dynamic wave force.

Case II. Static water pressure with water to SWL, no wind, pervious sheet pile cutoff, no dynamic wave force.

Case III. Stillwater pressure with water 2 feet above SWL, dynamic wave force, impervious sheet pile cutoff (75% forces used).

Case IV. Stillwater pressure with water 2 feet above SWL, dynamic wave force, pervious sheet pile cutoff (75% forces used).

Case V. Static water pressure to SWL, dynamic waveforce, impervious sheet pile cutoff (75% forces used).

Case VI. Static water pressure to SWL, dynamic waveforce, pervious sheet pile cutoff (75% forces used).

Case VII. No water, no wind.

Case VIII. No water, wind from protected side (75% forces used).

Case IX. No water, wind from flood side (75% forces used).

c. Joints. Expansion joints in the T-wall will be spaced not more than forty feet apart except at gate monoliths. The joints will be adjusted to fall at sheet pile interlocks. To compensate for expansion, contraction, or displacement, three-bulb waterstops and premolded expansion joint fillers will be provided.

32. Gates and Gate Monoliths.

a. General. Gate monoliths will be constructed for street crossings in lieu of I-walls. Each gate monolith will include a steel gate which will be closed by local interests when a hurricane approaches. Two types of gates will be used as described below.

b. Swing Gates. The locations of the swing gates are described in Paragraph 26. To assure a proper seal, the gate will be constructed so that it can be adjusted in either the horizontal or vertical direction. The side and bottom seals can also be adjusted as alternate or supplemental means to assure that a proper seal is obtained.

c. Bottom Roller Gates. The locations of the bottom roller gates are described in Paragraph 26. These gates will be constructed so that they can be adjusted in the horizontal direction, perpendicular to the tracks. The side and bottom seals can be adjusted in either the horizontal or vertical direction to assure that a proper seal is obtained.

d. Loading Cases. The gate structures were designed for the following load conditions:

Case I. Gate closed, static water pressure to SWL, no wind, impervious sheet pile cutoff, no dynamic wave force.

Case II. Gate closed, static water pressure to SWL, no wind, pervious sheet pile cutoff, no dynamic wave force.

Case III. Gate closed, 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. 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 closed, static water pressure to SWL, dynamic wave force, impervious sheet pile cutoff (75% forces used).

Case VI. Gate closed, static water pressure to SWL, dynamic wave force, pervious sheet pile cutoff (75% forces used).

Case VII. Gate open, no wind, truck or train on protected edge of base slab.

Case VIII. Gate open, no wind, truck or train on flood side edge of base slab.

Case IX. Gate open, wind from protected side, truck or train on flood side edge of base slab (75% forces used).

Case X. Gate open, wind from flood side, truck or train on protected edge of base slab (75% forces used).

33. Cathodic Protection and Corrosion Control.

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

b. Corrosion Control. The steel gates, corner plates, and all ferrous metal components which are not galvanized or stainless steel will be coated with a 7-coat vinyl paint system as required for corrosion control.

34. Recommended Levee Construction. The proposed levees, with wave berms required for the reach between the New Westwego Pumping Station and the Lafitte-LaRose Highway (or Hwy 3134), will be constructed by uncompacted fill methods (see Plates 17 through 21). A three lift construction sequence will be required to reach the ultimate design grades, with 3 years between lifts to allow for settlement and consolidation of embankment and foundation. Uncompacted fill will be placed in horizontal layers not exceeding 3 feet in thickness. Where the levee crosses canals, shell cores will be constructed within the levee section.

Uncompacted fill will be excavated from adjacent borrow areas for most of the project, except for the levee reach between the Estelle Pumping Station and the Harvey Pumping Station, where uncompacted fill will be excavated from a 55-acre borrow area just west of this reach (see Plate 4). Shell and sand would be acquired from commercial sources.

ENVIRONMENTAL EVALUATION

35. Status of EIS. The final EIS for West Bank of the Mississippi River in the vicinity of New Orleans, La. (dated December 1986) was filed with EPA in October 1987. The EIS covered the area from Westwego to west of the Harvey Canal. It did not include the Westside closure north of Bayou Segnette. This section will be addressed in an Environmental Assessment to be prepared at a later date. The EIS addressed several alternatives including the selected V-levee North alignment at SPH, with mitigation for loss of marsh, swamp, and hardwood bottomland (BLH). According to the EIS, a total of 814 acres would be directly impacted by V-levee North construction, of which 72 acres would be BLH, 727 acres would be swamp, and 15 acres would be marsh. Losses of BLH due to the westside closure alignment would range from about 3 to 18 acres of BLH depending on the alternative. Mitigation for the V-levee North alignment was presented in the 1986 EIS as summarized below.

36. Mitigation. The recommended mitigation plan as shown in the 1986 EIS involves construction of a stone dike at the mouth of Baie du Cabanage within the state-owned Salvador Wildlife Management Area (WMA) and acquisition of 1,024 acres of wooded wetlands in the Bayou Piquant finger ridge area. The 1,024 acres of wooded wetland acquisition would prevent logging or development and would thereby preserve this area. The acquired land would be licensed to an appropriate agency such as the Louisiana Department of Wildlife and Fisheries for protection and management. The westside closure area north of Bayou Segnette would require additional mitigation of 1-9 acres for BLH depending on the alternative (Table 4). As with the 1986 EIS, Habitat Evaluation System Analysis (HES) was the primary tool used to evaluate habitat losses and compensation needs for the tie-in area.

TABLE 4

MITIGATION REQUIREMENTS FOR BLH LOSSES
ASSOCIATED WITH WESTSIDE CLOSURE

Alternative	Acres of HQI 0.8 BLH LOST	Remaining AAHU in Impact Area	Acres of HQI 0. BLH Mitigation Needed
No Action	0.0	9.8	0.0
1	17.6	0.4	9.0
2	7.9	5.2	5.0
3	4.1	8.3	2.0

The stone dike would maintain approximately 370 acres of aquatic bed and about 100 acres of fresh marsh habitat. The measure would mitigate marsh losses and all remaining woodland losses associated with the hurricane protection project. If at the time of mitigation implementation, conditions have changed within the Salvador WMA and the Louisiana Department of Wildlife and Fisheries can demonstrate that marsh management could be better implemented on other than Baie du Cabanage Lands, then comparable funding of structural measures elsewhere within Salvador WMA would be permissible.

CULTURAL RESOURCES

37. Cultural Resources. All required cultural resources investigations have been completed except for the V-Levee and the alternatives being considered for the westside closure. The V-levee (North alignment) has been surveyed, but test excavations defined an archeological site in the project impact area which appears to be eligible for the National Register of Historic Places (Register). The site, a prehistoric shell midden, will probably need to be studied further before construction proceeds. No cultural resource surveys have been conducted for the westside closure.

Preliminary data on the V-levee survey has been furnished to the Corps by the Contractor (R. Christopher Goodwin and Associates, Inc.). The final report on the work is due 28 August 1989.

If the V-levee site is found to be eligible to the Register, then, appropriate mitigation measures will be defined in consultation with the Advisory Council on Historic Preservation and the Louisiana State Historic Preservation Officer. Avoiding the site is the preferred mitigation, but may not be feasible. A preconstruction data recovery program will probably be needed. The field work that may be required will not take more than 8 weeks and should not delay construction.

The westside closure alternatives contain no known historic properties, but the surveys needed prior to construction have yet to be done. There is only a low probability that significant sites will be found, as the area has been disturbed by transmission lines, the Westbank Expressway, and several subdivisions. The woodlands east of the Bayou Segnette State Park entrance and along the south side of the expressway are the areas most likely to contain culturally significant sites. The selected alternative will need to be surveyed for cultural resources before construction.

REAL ESTATE REQUIREMENTS

38. General. All lands, easements, and rights-of-way required to construct the plan described in this GDM will be acquired by the local sponsor and furnished without cost to the United States. A detailed Real Estate estimate is presented in Appendix B.

PROJECT COST ESTIMATE

39. Costs. The estimated total first cost of the proposed works including the Harvey Canal Floodwall is $78,000,000. The Federal and non-Federal shares are $50,700,000 and $27,300,000 respectively. Table 5 shows the detailed estimate of first cost.

40. Basis of Cost Estimate and Level of Design Details: The design and cost estimate presented in this reduced scope GDM are based on currently available engineering data and past engineering experience on projects with similar conditions. The level of details for the design and cost estimate varies for different reaches of the project. The location and limits of the I-type and T-type floodwall may change based on final stability analysis of the earthen sections. The exact location and limits of the levees may vary based on final design considerations. Unknown site and foundation conditions may alter the final design and cost estimates.

41. Discussion of Level of Confidence in Design and Cost Estimate:

a. Unit Price. Unit prices for this project were derived through analysis of recent past bids for the type of work involved, judgementally adjusted based on extensive experience of qualified cost estimators.

b. Contingencies. The project cost estimate was subjected to risk analysis to determine the degree of uncertainty associated with each major cost item in the estimate. Special attention was given to cost items that are most sensitive to change. Range estimating procedure-risk analysis quantifying the uncertainties in estimating-was used on a typical levee reach and a typical

floodwall reach. The results of this analysis indicated that a contingency factor of 20% would yield a level of confidence which exceeds a 95% probability that the estimated cost would not be exceeded. It is our judgement that a 95% probability factor is an appropriate level.

The only exception to the above is the levee reach between Bayou Segnette Pumping Station and New Westwego Pumping Station. Due to rights-of-entry not being available in a segment of this reach, complete survey coverage has not been obtained. Consequently, evaluation of additional design alternatives may be required. In this reach, the contingencies have been raised to 25%. With the higher contingency allowance, we believe that the confidence level in costs with the segment is equivalent to that for the remainder of the job.

TABLE 5

DETAILED ESTIMATE OF FIRST COST
(Oct 89 Price Levels)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
01.-.-.-	Lands & Damages				
	a. Perpetual Levee, Floodwall & Borrow Easement				
	Marsh/Wetlands	586.66	ACRES	500	293,330
	Potential Commercial	1.8	ACRES	30,000	54,000
	Potential Commercial/ Industrial	3.3	ACRES	30,000	99,000
	Potential Commercial/ Industrial	1.3	ACRES	108,900	141,570
	Potential Commercial/ Residential	10.	ACRES	30,000	300,000
	Potential Residential	.7	ACRES	10,000	7,000
	Potential Residential	260.14	ACRES	5,000	1,300,700
	Potential Residential	21.88	ACRES	40,000	875,200
	b. Perpetual Levee & Floodwall Easement				
	Potential Commercial/ Residential	5.7	ACRES	15,000	85,500
	Potential Commercial	3.8	ACRES	130,680	496,584
	Potential Residential	2.3	ACRES	87,120	200,376

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	c. Perpetual Borrow Easement				
	Potential Residential	55	ACRES	5,000	275,000
	d. Existing Levee Right-of-Way				
	Harvey Canal	93.92	ACRES	35,000x.10	328,720
	V-Levee	50	ACRES	5,000x.10	25,000
	e. Mitigation (Fee Simple Excluding Mineral Rights)				
	Bottomland Hardwoods	54	ACRES	500	27,000
	Swamp	970	ACRES	500	485,000
	f. Improvements				0
	g. Severance Damage				0
	SUBTOTAL: LANDS & DAMAGES (Rounded)				4,994,000
	Contingencies (25%) (Rounded)				1,248,000
	h. Mitigation (Westside Closure)				4,300
	Acquisition Costs (Estimated 98 tracts)				
	Non-Federal 75 @ $2000 per tract				170,000
	Non-Federal 23 @ $3000 per tract				69,000
	Federal 75 @ $1000 per tract				85,000
	Federal 23 @ $2000 per tract				46,000
	PL-91-646				0
	TOTAL: LANDS & DAMAGES				6,616,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
02.-.-.-	Relocations				
	a. Levee-Bayou Segnette P.S. to New Westgo P.S. 2-L.G.S. Pipelines	Lump Sum	LS	236,000	236,000
	b. Levee-New Westwego P.S. to East-West H.V. Powerlines	Lump Sum	LS	270,000	270,000
	c. Levee-East West to Oak Cove 20" United H.P. Gasline	Lump Sum	LS	182,000	182,000
	d. Levee-Oak Cove to V-Levee (Vic Hwy 45) 22" Texaco Gasline 10" Shell Gasline 20" H.P. United Gasline	Lump Sum	LS	461,500	461,500
	e. V-Line Levee, West of Vertex 6" & 8" LP & L Lines	Lump Sum	LS	179,400	179,400
	Ramps - LA Hwy 3134 & LA Hwy 45	Lump Sum	LS	300,000	300,000
	f. V-Line Levee East of Vertex 6" Sng. Line	Lump Sum	LS	204,100	204,100
	g. Levee-Cousins P.S. to Harvey P.S. 22" Texaco H.P. Gas	Lump Sum	LS	209,000	209,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	h. Floodwall at New Westwego Pump Station & Lapalco Bridge Relocate 36" Dia. Watermain Thru Wall with Sleeve	Lump Sum	LS	30,000	30,000
	16" Dia HP - Gas	Lump Sum	LS	45,000	45,000
	i. Floodwall at Mt.Kennedy 20" H.P. United Gasline	Lump Sum	LS	55,000	55,000
	j. Westside Closure Relocate 48" Dia Pipe Thru Wall with Sleeve	3	EA	60,000	180,000
	Utility Pipe Crossings	3	EA	11,300	33,900
	Ramp Crossing (Asphalt)	2	EA	100,000	200,000
	SUBTOTAL: RELOCATIONS				2,585,900
	Contingencies: Item a. (25% ±)				59,000
	Contingencies: Item b., c., d., e., f., g., h., i., j. (20% ±)				470,100
	SUBTOTAL: RELOCATIONS				3,115,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
11.-.-.-	Levees & Floodwalls				
	a. Levee-Bayou Segnette P.S. to New Westwego P.S.				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	60,000	60,000
11.0.1.B	Clearing	41	AC	1,500	61,500
11.0.1.B	Uncompacted Fill	74,100	CY	2	148,200
11.0.1.B	Fert & Seeding	8	AC	500	4,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	8	AC	500	4,000
11.0.1.B	Uncompacted Fill	37,100	CY	1.60	59,360
11.0.1.B	Fert & Seeding	8	AC	500	4,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	8	AC	500	4,000
11.0.1.B	Uncompacted Fill	28,500	CY	1.60	45,600
11.0.1.B	Fert & Seeding	8	AC	500	4,000
	SUBTOTAL: Item a				494,660
11.0.Z.-	Contingencies (25% ±)				123,340
	SUBTOTAL: Item a				618,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	b. Levee-New Westwego P.S. to East-West Levee (Sta. 188+73.12)				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	60,000	60,000
11.0.1.B	Clearing	95	AC	1,500	142,500
11.0.1.B	Uncompacted Fill	257,200	CY	2.50	643,000
11.0.1.B	Fert & Seeding	28	AC	500	14,000
11.0.1.B	Plug	Lump Sum	LS	90,000	90,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	57	AC	500	28,500
11.0.1.B	Uncompacted Fill	136,600	CY	2	273,200
11.0.1.B	Fert & Seeding	40	AC	500	20,000
11.0.1.B	Pulling & Driving Plug Sheeting	Lump Sum	LS	40,000	40,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	40	AC	500	20,000
11.0.1.B	Uncompacted Fill	129,800	CY	1.60	207,680
11.0.1.B	Fert & Seeding	40	AC	500	20,000
11.0.1.B	Pulling & Driving Plug Sheeting	Lump Sum	LS	40,000	40,000
	SUBTOTAL: Item b				1,698,880
11.0.Z.-	Contingencies (20% ±)				339,120
	SUBTOTAL: Item b				2,038,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	c. Levee-East West Levee (Sta. 188+73.12) to Oak Cove Levee (Sta. 376+55.35)				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	60,000	60,000
11.0.1.B	Clearing	214	AC	1,500	321,000
11.0.1.B	Uncompacted Fill	615,100	CY	2.50	1,537,750
11.0.1.B	Fert & Seeding	65	AC	500	32,500
11.0.1.B	Shell Closure	10,000	CY	16	160,000
11.0.1.B	Plug	Lump Sum	LS	90,000	90,000
11.0.1.B	Flotation Access	Lump Sum	LS	30,000	30,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	65	AC	500	32,500
11.0.1.B	Uncompacted Fill	307,500	CY	2	615,000
11.0.1.B	Fert & Seeding	65	AC	500	32,500
11.0.1.B	Pulling & Driving				
11.0.1.B	Plug Sheeting	Lump Sum	LS	40,000	40,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	65	AC	500	32,500
11.0.1.B	Uncompacted Fill	236,200	CY	1.60	377,920
11.0.1.B	Fert & Seeding	65	AC	500	32,500
11.0.1.B	Pulling & Driving				
	Plug Sheeting	Lump Sum	LS	40,000	40,000
	SUBTOTAL: Item c				3,534,170
11.0.Z.-	Contingencies (20% ±)				706,830
	SUBTOTAL: Item c				4,241,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	d. Levee-Oak Cove Levee (Sta. 376+55.35) to V-Levee (Vic Hwy 45)				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	60,000	60,000
11.0.1.B	Clearing	210	AC	1,500	315,000
11.0.1.B	Uncompacted Fill	699,300	CY	2.50	1,748,250
11.0.1.B	Fert & Seeding	58	AC	500	29,000
11.0.1.B	Plug	Lump Sum	LS	90,000	90,000
11.0.1.B	Flotation Access	Lump Sum	LS	30,000	30,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	58	AC	500	29,000
11.0.1.B	Uncompacted Fill	349,600	CY	2	699,200
11.0.1.B	Fert & Seeding	58	AC	500	29,000
11.0.1.B	Pulling & Driving Plug Sheeting	Lump Sum	LS	40,000	40,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	58	AC	500	29,000
11.0.1.B	Uncompacted Fill	268,400	CY	1.60	429,440
11.0.1.B	Fert & Seeding	58	AC	500	29,000
11.0.1.B	Pulling & Driving Plug Sheeting	Lump Sum	LS	40,000	40,000
	SUBTOTAL: Item d				3,696,890
11.0.Z.-	Contingencies (20% ±)				739,110
	SUBTOTAL: Item d				4,436,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	e. V-Line Levee, West of Vertex				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	80,000	80,000
11.0.1.B	Clearing	138	AC	1,500	207,000
11.0.1.B	Uncompacted Fill	464,100	CY	3.25	1,508,325
11.0.1.B	Sand	142,400	CY	5	712,000
11.0.1.B	Sand, Bayou Des Familles	12,000	CY	5	60,000
11.0.1.B	Fert & Seeding	38	AC	500	19,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	38	AC	500	19,000
11.0.1.B	Uncompacted Fill	232,100	CY	2.50	580,250
11.0.1.B	Fert & Seeding	38	AC	500	19,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	38	AC	500	19,000
11.0.1.B	Uncompacted Fill	178,200	CY	1.60	285,120
11.0.1.B	Fert & Seeding	38	AC	500	19,000
	SUBTOTAL: Item e				3,627,695
11.0.Z.-	Contingencies (20% ±)				725,305
	SUBTOTAL: Item e				4,353,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	f. V-Line Levee, East of Vertex				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	80,000	80,000
11.0.1.B	Clearing	178	AC	1,500	267,000
11.0.1.B	Uncompacted Fill	519,300	CY	2.50	1,298,250
11.0.1.B	Stripping	143,000	CY	1.50	214,500
11.0.1.B	Sand	242,200	CY	5	1,211,000
11.0.1.B	Fert & Seeding	44	AC	500	22,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	44	AC	500	22,000
11.0.1.B	Uncompacted Fill	259,700	CY	1.60	415,520
11.0.1.B	Stripping	143,000	CY	1.50	214,500
11.0.1.B	Fert & Seeding	44	AC	500	19,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.1.B	Clearing	44	AC	500	22,000
11.0.1.B	Uncompacted Fill	199,400	CY	1.60	319,040
11.0.1.B	Fert & Seeding	44	AC	500	22,000
	SUBTOTAL: Item f				4,229,810
11.0.Z.-	Contingencies (20% ±)				845,190
	SUBTOTAL: Item f				5,075,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	g. Levee-Estelle P.S. to Cousions P.S.				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	25,000	25,000
11.0.1.B	Clearing	78	AC	1,500	117,000
11.0.1.B	Uncompacted Fill	248,800	CY	4.00	995,200
11.0.1.B	Fert & Seeding	46	AC	500	23,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	20,000	20,000
11.0.1.B	Clearing	46	AC	500	23,000
11.0.1.B	Uncompacted Fill	124,400	CY	4.00	497,600
11.0.1.B	Fert & Seeding	46	AC	500	23,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	25,000	25,000
11.0.1.B	Clearing	46	AC	500	23,000
11.0.1.B	Uncompacted Fill	95,600	CY	4.00	382,400
11.0.1.B	Fert & Seeding	46	AC	500	23,000
	SUBTOTAL: Item g				2,177,200
11.0.Z.-	Contingencies (20% ±)				435,800
	SUBTOTAL: Item g				2,613,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	h. Levee - Cousins P.S. to Harvey P.S.				
	1st Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	25,000	25,000
11.0.1.B	Clearing	16	AC	1,500	24,000
11.0.1.B	Uncompacted Fill	41,800	CY	4.00	167,200
11.0.1.B	Fert & Seeding	10	AC	500	5,000
	2nd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	20,000	20,000
11.0.1.B	Clearing	10	AC	500	5,000
11.0.1.B	Uncompacted Fill	20,900	CY	4.00	83,600
11.0.1.B	Fert & Seeding	10	AC	500	5,000
	3rd Lift				
11.0.A.-	Mob & Demob	Lump Sum	LS	20,000	20,000
11.0.1.B	Clearing	10	AC	500	5,000
11.0.1.B	Uncompacted Fill	16,100	CY	4.00	64,400
11.0.1.B	Fert & Seeding	10	AC	500	5,000
	SUBTOTAL: Item h				429,200
11.0.Z.-	Contingencies (20% ±)				85,800
	SUBTOTAL: Item h				515,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	i. Bayou Segnette Pump Station Floodwall				
11.0.A.-	Mob & Demob	Lump Sum	LS	100,000	100,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding)	Lump Sum	LS	10,000	10,000
11.0.2.B	Removal of Timber Pile Tie-Back (3 Piles/Tiebk)	27	EA	200	5,400
11.0.2.B	Embankment Semicompacted Fill (For I-Wall & Cofferdam)	600	CY	10	6,000
11.0.2.B	Shell Embankment for T-Wall	18,500	CY	20	370,000
11.0.2.B	Riprap	1,000	TONS	20	20,000
	Filter Fabric	450	SY	5	2,250
11.0.2.B	Steel Sheet Piling, PZ-22	6,520	SF	12	78,240
11.0.2.B	Steel Sheet Piling, PZ-27	3,500	SF	13	45,500
11.0.2.B	12 x 53 H-Piles	6,200	LF	24	148,800
11.0.2.C	Conc. In T-Wall Stab Slab	20	CY	70	1,400
11.0.2.C	Conc. In Base Slabs	148	CY	200	29,600
11.0.2.C	Conc. In T-Wall Stem	39	CY	330	12,870
11.0.2.C	Conc. In I-Wall	106	CY	330	34,980
11.0.2.-	24' x 6' Swing Gate (Incls Steel, Conc., Sht Pile & Piles)	1	EA	64,500	64,500
11.0.2.-	Discharge Pipe Extension				
	a. 54" Dia x 5/8"	Lump Sum	LS	145,000	145,000
	b. 54" Dia Butterfly Valves	6	EA	32,000	192,000
	c. Conc. Pile Bents	25	CY	250	6,250
	d. 12" x 12" PRSTD Conc Piles	1,824	LF	18	32,832
11.0.2.-	Cofferdam				
	a. PZ-22 Sheet Pile Cofferdam in Front of T-Wall	5,120	SF	12	61,440
	b. Embkmt Semicomp Fill	600	CY	10	6,000
	SUBTOTAL: Item 1				1,373,062
11.0.Z.-	Contingencies (20% ±)				272,938
	SUBTOTAL: Item 1				1,646,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	j. Old Westwego Pump Station Floodwall				
11.0.A.-	Mob & Demob	Lump Sum	LS	70,000	70,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding	Lump Sum	LS	25,000	25,000
11.0.2.B	Embankment, Semicompacted Fill	500	CY	10	5,000
11.0.2.B	Shell Backfill	1,300	CY	20	26,000
11.0.2.B	Riprap	300	TONS	20	6,000
11.0.2.B	Steel Sheet Piling, PZ-22	11,520	SF	12	138,240
11.0.2.B	Steel Sheet Piling, PZ-27	11,200	SF	13	145,600
11.0.2.C	Conc. In T-Wall Stab Slab	118	CY	70	8,260
11.0.2.C	Conc. In Base Slabs	870	CY	200	174,000
11.0.2.C	Conc. In T-Wall Stem	279	CY	330	92,070
11.0.2.C	Conc. In I-Wall	320	CY	330	105,600
11.0.2.C	12" x 12" Prestd Conc Piles	24,710	LF	18	444,780
11.0.2.B	Comp. Pile Test	1	EA	18,000	18,000
11.0.2.B	Additional Comp. Pile Test	1	EA	14,000	14,000
11.0.2.B	Tension Pile Test	1	EA	19,000	19,000
11.0.2.B	Additional Ten. Pile Test	1	EA	14,000	14,000
11.0.2.-	84" DIA Butterfly Valves	1	EA	142,000	142,000
11.0.2.-	54" DIA Butterfly Valves	1	EA	38,000	38,000
11.0.2.-	Swing Gate 26' x 6' (Incls Steel, Conc., Sht Pile & Piles)	2	EA	77,000	154,000
	SUBTOTAL: Item j				1,639,550
11.0.Z.-	Contingencies (20% ±)				325,450
	SUBTOTAL: Item j				1,965,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	k. Floodwall at New Westwego Pump Station & Lapalco Bridge				
11.0.A.-	Mob & Demob	Lump Sum	LS	100,000	100,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding	Lump Sum	LS	25,000	25,000
11.0.2.B	Embankment, Semicompacted Fill	2,520	CY	10	25,200
11.0.2.B	Demolition of Conc. Slabs	6	CY	130	780
11.0.2.B	Steel Sheet Piling, PZ-22	2,400	SF	12	28,800
11.0.2.B	Steel Sheet Piling, PZ-27	16,260	SF	13	211,380
11.0.2.C	Conc. in T-Wall Stab Slab	24	CY	70	1,680
11.0.2.C	Conc. In Base Slabs	220	CY	200	44,000
11.0.2.C	Conc. In T-Wall Stem & Butresses	100	CY	330	33,000
11.0.2.C	Conc. In I-Wall	410	CY	330	135,300
11.0.2.B	12" x 12" PRSTD Conc Piles	7,500	LF	18	135,000
11.0.2.-	84" DIA Butterfly Valves	3	EA	142,000	426,000
	SUBTOTAL: Item k				1,166,140
11.0.Z.-	Contingencies (20% ±)				230,860
	SUBTOTAL: Item k				1,397,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	1. Westwego Airport Floodwall				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding	Lump Sum	LS	20,000	20,000
11.0.2.B	Embankment, Semicompacted Fill	9,000	CY	10	90,000
11.0.2.B	Steel Sheet Piling, PZ-22	30,000	SF	13	390,000
11.0.2.C	Conc. In I-Wall	486	CY	330	160,000
11.0.2.-	36' x 10' Swing Gate (Incls Steel, Conc., Sht Pile & Prsted Piles)	1	EA	115,000	115,000
11.0.2.C	Conc. In T-Wall Stab Slab	11	CY	70	770
11.0.2.C	Conc. In T-Wall Base Slab	82	CY	200	16,400
11.0.2.C	Conc. In T-Wall Stem	45	CY	330	14,850
11.0.2.B	14" x 14" PRSTD Conc. Piles	2,320	LF	20	46,400
11.0.2.B	Steel Sheet Piling, PZ-22	800	SF	12	9,600
	SUBTOTAL: Item 1				913,400
11.0.Z.-	Contingencies (20% ±)				182,600
	SUBTOTAL: Item 1				1.096,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	m. Ames & Mt. Kennedy Pump Station Floodwalls				
11.0.A.-	Mob & Demob	Lump Sum	LS	100,000	100,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding	Lump Sum	LS	20,000	20,000
11.0.2.B	Embankment, Semicompacted Fill	1,066	CY	10	10,660
11.0.2.B	Steel Sheet Piling, PZ-23	10,730	SF	12	128,760
11.0.2.B	Steel Sheet Piling, PZ-27	2,800	SF	13	36,400
11.0.2.B	14" x 14" PRESTRSD Conc Piles	32,280	LF	20	645,600
11.0.2.B	12" UNTRTD Timber Piles	1,133	LF	10	11,330
11.0.2.B	Comp Pile Test	1	EA	18,000	18,000
11.0.2.B	Additional Comp. Pile Test	1	EA	14,000	14,000
11.0.2.B	Tension Pile Test	1	EA	19,000	19,000
11.0.2.B	Additional Tension Pile Test	1	EA	14,000	14,000
11.0.2.-	9' x 9' Sluice Gates & Machinery Incl Electrical	2	EA	110,000	220,000
11.0.2.-	8' x 9' Sluice Gates & Machinery Incl Electrical	1	EA	95,000	95,000
	84" Butterfly Valves	2	EA	142,000	284,000
	48" Butterfly Valves	2	EA	26,500	53,000
	30" Butterfly Valves	2	EA	16,000	32,000
11.0.2.C	Conc. In T-Wall Stab Slab	142	CY	70	9,940
11.0.2.C	Conc. In Base Slabs	1,110	CY	200	222,000
11.0.2.C	Conc. In T-Wall Stem	554	CY	330	182,820
11.0.2.C	Conc. In Sluice Gate Struc	120	CY	330	39,600
11.0.2.C	Conc. At Exist Fldwalls	38	CY	330	12,540
11.0.2.C	Conc. In I-Wall	40	CY	330	13,200
11.0.2.B	Demolition of Existing T-Wall	175	CY	130	22,750
11.0.2.-	Cofferdam For Sluice Gates Including Dewatering	Lump Sum	LS	88,000	88,000
	SUBTOTAL: Item m				2,292,600
11.0.Z.-	Contingencies (20% ±)				456,400
	SUBTOTAL: Item m				2,749,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	n. Oak Cove Pump Station Floodwall				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding)	Lump Sum	LS	10,000	10,000
11.0.2.B	Steel Sheet Piling, PZ-22	2,600	SF	12	31,200
11.0.2.B	Steel Sheet Piling, PZ-27	5,760	SF	13	74,880
11.0.2.C	Conc. In T-Wall Stab Slab	32	CY	70	2,240
11.0.2.C	Conc. In Base Slabs	237	CY	200	47,400
11.0.2.C	Conc. In T-Wall Stem	103	CY	330	33,990
11.0.2.C	Conc. In I-Wall	78	CY	330	25,740
11.0.2.B	14" x 14" PRSTD Conc Piles	9,984	LF	20	199,680
11.0.2.-	24" DIA Butterfly Valves	2	EA	13,000	26,000
	SUBTOTAL: Item n				501,130
11.0..Z.-	Contingencies (20% ±)				99,870
	SUBTOTAL: Item n				601,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	o. Sluice Gate Drainage Structure at Ross Canal				
11.0.A.-	Mob & Demob	Lump Sum	LS	60,000	60,000
11.0.G.B	Clearing & Grubbing	1	ACRE	1,500	1,500
11.0.G.B	Excavation At Structure	3,527	CY	2	7,054
11.0.G.B	Embankment Semicompacted Fill	3,220	CY	10	32,200
11.0.G.B	Geotextile Seperator Fabric	170	SY	2	340
	Concrete Sand	163	CY	20	3,260
11.0.G.B	Riprap	95	TONS	20	1,900
11.0.G.C	Concrete In Base Slab	8	CY	200	1,600
11.0.G.C	Concrete In Headwalls & Wingwalls	60	CY	330	19,800
11.0.G.C	Concrete In Sluice Gate Chamber	11	CY	330	3,630
11.0.G.B	Steel Sheet Pile, PZ-22	1,530	SF	12	18,360
11.0.G.B	Fertilizing & Seeding	1	ACRE	500	500
11.0.G.E	(5' x 5') Sluice Gates & Machinery Incl Electrical	1	EA	35,000	35,000
11.0.G.E	Misl. Metals (Hand Rails & Trash Rack)	Lump Sum	LS	7,000	7,000
11.0.G.B	60 - Inch Cmp Culverts	268	LF	200	53,600
11.0.G.B	Shell Bedding	3,890	CY	20	77,800
	SUBTOTAL: Item o				323,544
11.0.Z.-	Contingencies (20% ±)				64,456
	SUBTOTAL: Item o				388,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	p. Floodwalls @ Estelle Pump Station & LP&L Powerlines				
11.0.A.-	Mob & Demob	Lump Sum	LS	60,000	60,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding)	Lump Sum	LS	20,000	20,000
11.0.2.B	Embankment, Semicompacted Fill (5 - 10 ft Levee Setback)	2,175	CY	2.50	5,438
11.0.2.B	Steel Sheet Piling, PZ-22	400	SF	12	4,800
11.0.2.B	Steel Sheet Piling, PZ-27	7,520	SF	13	97,760
11.0.2.C	Conc. In T-Wall Stab Slab	8	CY	70	560
11.0.2.C	Conc. In Base Slabs	60	CY	200	12,000
11.0.2.C	Conc. In T-Wall Stem	18	CY	330	5,940
11.0.2.C	Conc. In I-Wall	296	CY	330	97,680
11.0.2.B	12" x 12" PRSTD Conc Piles	2,128	LF	18	38,304
11.0.2.-	Elevated Walkway	Lump Sum	LS	50,000	50,000
11.0.2.-	54" DIA Butterfly Valves	3	EA	38,000	114,000
	SUBTOTAl: Item p				506,482
11.0.Z.-	Contingencies (20% ±)				101,518
	SUBTOTAL: Item p				608,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	q. Cousins Pumping Station Floodwalls				
11.0.A.-	Mob & Demob	Lump Sum	LS	100,000	100,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding)	Lump Sum	LS	20,000	20,000
11.0.2.B	Steel Sheet Piling, PZ-27	25,800	SF	13	335,400
11.0.2.B	12" UNTRTD Timber Piles	3,000	LF	10	30,000
11.0.2.-	7' x 10' Sluice Gates & Machinery Incl Electrical	6	EA	95,000	570,000
11.0.2.-	72" DIA Butterfly Valves	3	EA	58,500	175,500
11.0.2.-	36" DIA Butterfly Valves	1	EA	14,000	14,000
11.0.2.B	Conc. Demolition	30	CY	130	3,900
11.0.2.C	Conc. In Base Slabs	34	CY	200	6,800
11.0.2.C	Conc. In Sluice Gate Struc	166	CY	330	54,780
11.0.2.C	Conc. Slabs & Beams	16	CY	330	5,280
11.0.2.C	Conc. In I-Walls	580	CY	330	191,400
11.0.2.-	Miscellaneous Metals	5,350	LDS	1.50	8,025
	24' x 5' Swing Gate (Incls Steel, Conc., Sht Pile & PRSTED Piles)	1	EA	52,000	52,000
11.0.2.-	44' x 8' Roller Gate (Incls Steel, Conc., Sht Pile & PRSTED Piles)	1	EA	125,000	125,000
11.0.2.-	Cofferdams for Sluice Gates (One Per Discharge Tube)				
	a. First Structure	Lump Sum	LS	156,000	156,000
	b. Second Structure	Lump Sum	LS	126,000	126,000
	SUBTOTAl: Item q				1,974,085
11.0.Z.-	Contingencies (20% ±)				392,915
	SUBTOTAL: Item q				2,367,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	r. Harvey Pump Station Floodwall				
11.0.A.-	Mob & Demob	Lump Sum	LS	50,000	50,000
11.0.2.B	Site Work (Clearing, Struc. Excavation & Bkfill, Fert & Seeding)	Lump Sum	LS	5,000	5,000
11.0.2.B	Embankment Semicompacted Fill	1,222	CY	10	12,220
11.0.2.B	Demolition of Conc. Walls & Base Slabs	42	CY	130	5,460
11.0.2.B	Steel Sheet Piling, PZ-27	4,400	SF	13	57,200
11.0.2.C	Conc. In Base Slabs	9	CY	200	1,800
11.0.2.C	Conc. In Wall Stem	6	CY	330	1,980
11.0.2.C	Conc. In I-Wall	104	CY	330	34,320
11.0.2.-	Floodwall Extension, 3/8" PL (Including Painting)	21,600	LBS	1.50	32,400
11.0.2.-	72" DIA Butterfly Valves	3	EA	58,500	175,500
11.0.2.-	44' x 10' Roller Gate (Incls Steel, Conc., Sht Pile & PRSTED Piles)	1	EA	135,000	135,000
	SUBTOTAL: Item r				510,880
11.0.Z.-	Contingencies (20% ±)				102,120
	SUBTOTAL: Item r				613,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
	s. Westside Closure				
11.0.A.-	Mob & Demob	Lump Sum	LS	80,000	80,000
11.0.2.B	Clearing & Grubbing	8	ACRE	1,500	12,000
11.0.2.B	Fertilizing & Seeding	8	ACRE	500	4,000
11.0.2.B	Degrading Existing Canal Bank	3,450	CY	2	6,900
11.0.2.B	Steel Sheet Piling, PZ-27	62,000	SF	13	806,000
11.0.2.C	Conc. In I-Walls	1,464	CY	330	483,120
11.0.2.B	Embankment, Uncompacted Fill	46,800	CY	3	140,400
	SUBTOTAl: Item s				1,532,420
11.0.Z.-	Contingencies (20% ±)				307,580
	SUBTOTAL: Item s				1,839,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
11.0.-.-	t. Mitigation Dike				
	Mob & Demob	Lump Sum	LS	15,000	15,000
	Flotation Channel	Lump Sum	LS	50,000	50,000
	Shell	525	CY	22	11,550
	Stone	3,500	TONS	18	63,000
	SUBTOTAL: Item t				139,550
11.0.Z.-	Contingencies (25% ±)				34,450
	SUBTOTAL: Item t				174,000
11.0.R.B	u. Other Mitigation Development Costs[1]/				53,000
	[1]/ Development costs are the initial costs for providing roads, fencing, etc. necessary for proper management.				
	SUBTOTAL: Item u				53,000
	TOTAL: Levees and Floodwalls				39,385,000
18.-.-.-	Cultural Resource Preservation				100,000
30.-.-.-	Engineering and Design				5,604,000
31.-.-.-	Construction Management (S&I)				7,269,000

TABLE 5 (Cont'd)

Cost Acct. No.	Description	Estimated Amount
	Harvey Canal Floodwall	
01.-.-.-	Lands & Damages	156,000
02.-.-.-	Relocations	1,299,000
11.-.-.-	Levees and Floodwalls	5,850,000
30.-.-.-	Engineering and Design	1,056,000
31.-.-.-	Construction Management (S&I)	850,000
	TOTAL: Harvey Canal Floodwall	9,211,000
	Credit For External Work	
11.-.-.-	Levees and Floodwalls	6,100,000
30.-.-.-	Engineering and Design	600,000
	TOTAL: Credit For External Work	6,700,000
	TOTAL PROJECT COST	78,000,000

The above cost estimate was prepared by Cost Engineering Branch.

CHARLES E. SETTOON
Chief, Cost Engineering Branch

DATE: 28 July 87

42. Project Cost Increase Limitation.

a. Section 902 of the Water Resources Development Act (WRDA) of 1986 (P.L. 99-662), as amended by Section 3(b) of the Water Resources Development Act of 1988 (P.L. 100-676), legislates the maximum total project cost. The maximum cost includes the cost cited in the authorizing legislation increased by:

(1) Appropriate indexing to account for prior increases.

(2) Additional costs required by the authorizing act or subsequent law.

(3) Not more than 20% of the authorized cost (without adjustment for inflation) for modifications which do not materially alter the scope or function of the project.

b. The section 902 limit for the Westwego to Harvey Canal, Louisiana project is $90,600,000. This figure is comprised of: (1) $61,500.000 - the project cost cited in the authorizing legislation; (2) $10,100,000 - the price level increases from the date of authorized cost; (3) $6,700,000 for the cost of credit under Section 104 of WRDA of 1986 for work accomplished by local interests for the 5 year period prior to project authorization; and (4) $12,300,000 - 20% of the authorized cost. The current fully funded project cost estimate based on the costs presented herein is $84,900,000.

c. The current project cost estimate includes about $1,100,000 for mitigation measures, and about $4,400,000 for the V-Levee north alignment as outlined in the August 9, 1988 Report of the Chief of Engineers to the Secretary of the Army.

d. Completion of this project within the Section 902 limit will be accomplished through appropriate management actions.

COMPARISON OF COST ESTIMATES

43. Breakdown Comparison of PB-3 and GDM No. 1 (Reduced Scope) Cost Estimates. The current total estimates of $78,000,000 for the protection works represents a increase of $300,000 over the corresponding costs shown in the PB-3 (effective Oct 1989). Table 6 shows a breakdown comparison of cost estimates of work items under each account for the PB-3 and the reduced scope GDM cost estimates.

TABLE 6

BREAKDOWN COMPARISON OF PB-3 AND GDM No. 1 (REDUCED SCOPE) COST ESTIMATES

Item	PB-3 (Effective Oct. 89)	GDM No.1 (Reduced Scope)	Difference
01 Lands and Damages	$6,083,000	$ 6,772,000	+689,000 1/
02 Relocations	1,291,000	4,414,000	+3,123,000 2/
11 Levees and Floodwalls	46,539,000>	51,335,000	-5,929,000 3/
13 Pumping Stations	10,725,000>		
18 Cultural Resource Preservation	--	100,000	+100,000 4/
30 E&D	6,892,000	7,260,000	+368,000 5/
31 Construction Mgmnt (S&I)		8,119,000	+1,949,000 6/
31 S&A	6,170,000		
TOTAL	$77,700,000	$78,000,000	+300,000

1/ This includes an increase for the westside closure; an increase for mitigation land, reevaluation of the type and value of land affected; and new ownership information.

2/ Relocations for floodwall items were included in the 11 Account in the PB-3 estimate. These items have been put under the 02 Account for the GDM. Additional relocations were also identified during the GDM designs.

3/ The GDM estimates for all work (excluding relocations) at the pumping stations have been included in the 11 Account. The difference in cost includes an increase in levees cost, an increase due to addition of the westside closure and a decrease in the remaining floodwall costs. The increase in levees cost was due to the addition of certain items of work such as stripping. The decrease in the floodwall estimate is due to placing the floodwall relocations in the 02 Account and elimination of 4 swing gates and the floodwall between the Mt. Kennedy and Oak Cove pumping stations; also, the PB-3 estimate was based on construction of a cellular cofferdam along with the dewatering and rerouting of the pumping station discharge pipes for the Bayou Segnette and Estelle pumping stations. A less costly method of construction was used in determining the estimates for work at these two pumping stations for the GDM.

TABLE 6 (CONT'D)

4/ This increase is due to the need for investigations and mitigation of an archeological site which may be eligible for the National Register of Historic Places.

5/ This increase is due to the more detailed estimate done for the GDM. Part of this increase is attributable to the fact that under the new code of accounts the 30 account now includes S&A on E&D. The remaining increase is due to the more detailed estimate done for the GDM.

6/ The PB-3 estimate includes S&A and S&I. The GDM estimate was prepared using the new cost account codes under which the 31 account includes S&I only. The increase over the PB-3 number is due to the more detailed estimate done for the GDM.

SCHEDULES FOR DESIGN AND CONSTRUCTION

44. Schedule for Design and Construction. The sequence of contracts and the schedules for design, construction, relocations, and land acquisition are shown in Table 7.

TABLE 7
SCHEDULE FOR DESIGN AND CONSTRUCTION

Contracts	P&S Start	P&S Complete	Construction Advertise	Construction Award	Construction Complete	Estimated Construction Cost 1/
1st Lift Hwy 45 Levee (420+96.34 to 472+00)	AUG 89	APR 90	JUN 90	JUL 90	JAN 91	1,061,000
Reach I Structures*	JAN 90	NOV 90	JUN 91	JUL 91	MAR 94	5,952,000
1st Lift Oak Cove to V-Levee (Not Cont.)	FEB 90	OCT 90	DEC 90	JAN 91	NOV 91	2,769,000
1st Lift V-Levee West of Vertex	AUG 90	APR 91	JUN 91	JUL 91	NOV 92	4,295,000
1st Lift V-Levee East of Vertex	FEB 91	OCT 91	DEC 91	JAN 92	MAY 93	4,618,000
Ross Canal Drainage Str.	APR 91	OCT 91	NOV 91	DEC 91	AUG 92	453,000
Reach III Structures*	JUN 91	MAR 92	OCT 92	NOV 92	JUL 95	3,988,000
1st Lift Levee-Estelle P.S. to Harvey P.S.	AUG 91	APR 92	JUN 92	JUL 92	SEP 93	2,227,000
1st Lift Levee-East West to Oak Cove	FEB 92	OCT 92	DEC 92	JAN 93	APR 94	3,381,000
1st Lift Levee-Bayou Segnette to East West	AUG 92	APR 93	JUN 93	JUL 93	SEP 94	2,852,000
2nd Lift Oak Cove to V-Levee (Hwy. 45)	AUG 92	AUG 94	OCT 94	NOV 94	SEP 95	1,187,000
Reach IV Structures*	JUL 93	MAR 94	APR 94	MAY 94	JAN 95	710,000
Westwego Air-port Floodwall	JAN 94	SEP 94	OCT 94	NOV 94	MAY 95	1,280,000
2nd Lift V-Levee, West of Vertex	AUG 93	AUG 95	OCT 95	NOV 95	JUN 96	936,000

TABLE 7 (CONT'D)

Contracts	P&S Start	P&S Complete	Construction Advertise	Construction Award	Construction Complete	Estimated Construction Cost [1/]
2nd Lift V-Levee, East of Vertex	MAR 94	MAR 96	MAY 96	JUN 96	MAY 97	1,015,000
Reach VI Structures*	MAY 94	APR 95	NOV 95	DEC 95	FEB 98	3,479,000
2nd Lift Estelle P.S. Harvey P.S.	JUL 94	JUL 96	SEP 96	OCT 96	JUL 97	949,000
2nd Lift East West to Oak Cove	JAN 95	JAN 97	MAR 97	APR 97	FEB 98	1,079,000
2nd Lift Bayou Segnette to East-West	JUL 95	JUL 97	SEP 97	OCT 97	AUG 98	741,000
West-Side Closure	JUN 96	FEB 97	OCT 97	NOV 97	SEP 98	2,817,000
3rd Lift Oak Cove to V-Levee	JUL 96	JUL 98	SEP 98	OCT 98	JUN 99	809,000
3rd Lift V-Levee	FEB 98	FEB 00	APR 00	MAY 00	MAY 01	1,039,000
3rd Lift Estelle P.S. Harvey P.S.	FEB 98	APR 00	JUN 00	JUL 00	FEB 01	767,000
3rd Lift Bayou Segnette to Oak Cove	MAY 99	MAY 01	JUL 01	AUG 01	DEC 02	1,365,000
					TOTAL	49,769,000

[1/] This cost includes contingencies, Federal and non-Federal construction costs, and Federal and non-Federal supervision and inspection (S&I) costs.

*Reach I - Bayou Segnette Pumping Station Floodwall
- Old Westwego Pumping Station Floodwall
- Lapalco Bridge Floodwall
- New Westwego Pumping Station Floodwall

*Reach III - Ames Pumping Station Floodwall
- Mt. Kennedy Pumping Station Floodwall
- Oak Cove Pumping Station Floodwall

*Reach IV - Estelle Pumping Station Floodwall
- Floodwall at La. Power & Light Powerlines

*Reach VI - Cousins Pumping Station Floodwall
- Harvey Pumping Station Floodwall

ECONOMIC ANALYSIS

45. General. The study area is located entirely within Jefferson Parish, which is part of the New Orleans Metropolitan Statistical area (MSA). The protected area encompasses a portion of Jefferson Parish on the West Bank of the Mississippi River. Both residential and commercial structures occupy the area, with an industrial band centered around the Harvey Canal. Single and two story residential structures comprise the bulk of protected properties in terms of total value and numbers of structures. Residential structural value exceeds $1 billion and commercial structures are valued at over $250 million in 1986 dollars. The area has been broken into seven reaches for analysis, based on hydrologic make-up. All reaches have both residential and commercial structures except Reach 3 which has only commerical properties.

46. Authorized Plan. The "V-levee north" alignment with SPH level of protection, which is the authorized plan, is the only plan being evaluated in this report. When the plan was originally selected the hurricane protection levee was designed to tie into an existing levee on the western end. Since this plan is no longer feasible, a new alignment has been chosen for the western end. The new alignment skirts Bayou Segnette State Park along the Westbank Expressway, then turns north to tie into an existing railroad embankment. It encompasses an additional area containing 515 trailers, an apartment complex with approximately 400 apartments, and two signle-family subdivisions consisting of 559 structures. Due to localized drainage conditions, a portion of these additional structures are expected to experience a minor degree of induced flooding as a result of the new alignment. Induced damages result from a 0.2' increase in the with-project condition for the 10-year through 100-year events in a portion of the newly included area. The expected annual value of these damages amounts to about $10,000. The additional costs and benefits for the redesigned closure are included in all computations.

47. Presentation of Average Annual Benefits and Costs.

a. Methodology. The economic justification of the plan is determined by comparing estimates of the average annual costs and average annual benefits which are expected to accrue over the life of the project. Participation in a project by the Federal Government normally requires that average annual benefits equal or exceed average annual costs.

The values estimated for benefits and costs at the time of accrual are made comparable by conversion to an equivalent time basis

using an interest rate of 8-7/8 percent. The period of analysis, or project life, which is utilized in the analysis is 100 years. The benefits and costs are expressed as the average annual value of the present worth of all expenditures and all plan outputs. These expenditures and outputs are measured at a specific point in time, the base year, which is the first year complete, permanent protection is achieved.

b. Benefit Analysis. Benefits from the project result from reduction in flooding and the costs related to flooding. Benefits in the following categories were quantified; inundation reduction to structures and vehicles, flood insurance costs saved, emergency operations costs saved, and inundation reduction benefits accrued during the installation period.

48. Installation Period Benefits.

a. Installation Period Benefits Accrual. Although construction of the project requires 14 1/2 years, some benefits accrue during the installation period. During the construction period 100 percent protection is obtained at the beginning of years six and ten. Due to settlement, protection is subsequently reduced to 50 percent at the end of year nine and 75 percent during year 14. since some level of protection is provided from the beginning of year six, average annual damages prevented during the installation period can be counted as NED benefits. In order to be able to compare them at the same point in time with average annual costs, benefits accrued during installation were compounded forward to the end of the installation period. Benefits were compounded from mid-year points in order to represent the average benefit for that year. The percentage of total average annual benefits that were used to comput benefits during installation ranged from 94 percent to 56 percent for the first lift, and from 97 percent to 80 percent for the second lift.

b. Summary of NED Benefits. A summary of all benefits (damages prevented) attributable to the plan is presented below.

Benefit Summary

Category	Average Annual Dollars (1,000)
Inundation Reduction	
Structures	$ 17,997
Vehicles	2,104
Benefits During Installation Period	14,961
FIA Costs Saved	342
Emergency Operations Costs Saved	76
Total Benefits	$ 35,480

49. Cost Analysis.

a. Installation Sequence. The proposed levee will be constructed in several sequences, or lifts. These lifts are required to bring the levee up to the approved project design level. The first lift will be complete after the fifth year of construction, and that lift settles to 50 percent of its original heights before construction of the second lift begins. By the end of the ninth year, the second lift is complete and the project is again at 100 percent of the approved protection level. The second lift then settles to 75 percent of its original height and construction of the third and final lift begins. Construction of the third lift is completed during the 14th year and the area is then fully protected. Yearly construction costs including cost spent on Preconstruction Engineering and Design have been compounded forward to the base year, the point where construction is complete and the life of the project begins. The mid-point of each year was chosen as the point from which yearly costs were compounded forward.

b. Annual Costs. Annual costs include interest and amortization of the initial investment, average annual maintenance and operation costs, and fish and wildlife mitigation. Summaries of the average annual charges for the plan are listed below.

Remaining Investment Cost and
Average Annual Charges
(October 1989 Price Levels)

Item	Dollars (1,000)
Remaining First Cost 1/	$ 70,314
Interest During Construction	84,823
Gross Investment Cost at End of Installation Period	$155,137
Annual Charges*	
Interest and Amortization	$ 13,778
Operation, Maintenance and Replacements	76
Total Average Annual Charges	$ 13,854

*includes all mitigation costs, 1/does not include $6.7m sunk cost spent by the local sponsor.

50. Benefit-Cost Ratio. Based on the benefit and cost data presented in the two previous tables, the benefit-cost ratio and net benefits for the V-Levee north plan with SPH level of protection is shown below.

V-Levee North Alignment
SPH
8-7/8 Percent

Average Annual Benefits ($1,000)	Average Annual Costs ($1,000)	Net Benefits ($1,000)	Benefit-Cost Ratio
$35,480	$13,854	21,626	2.56 to 1

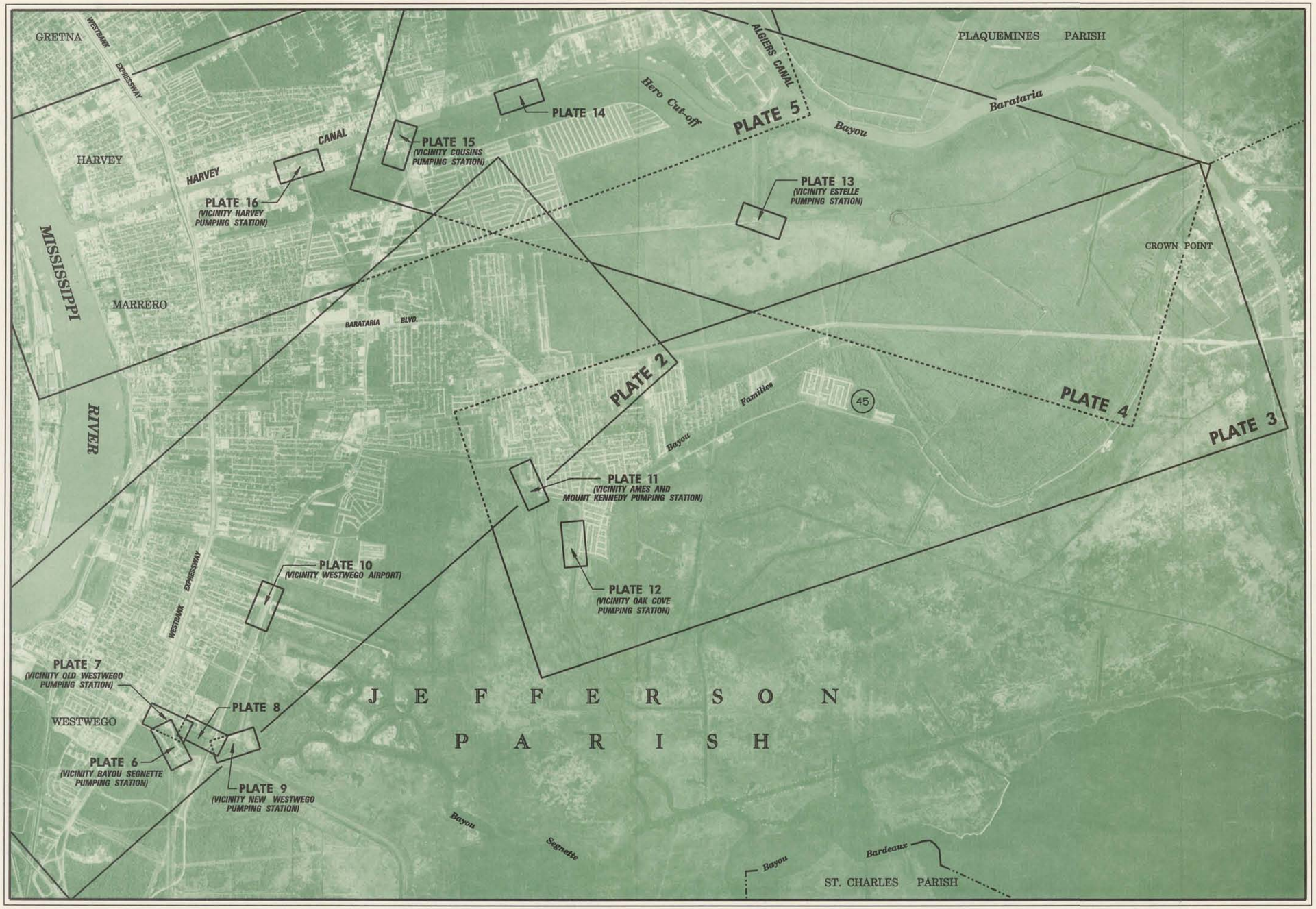
OPERATION AND MAINTENANCE

51. Annual Costs. The operation and maintenance of the proposed levee system, floodwalls, gates, etc. will be the responsibility of West Jefferson Levee District. The estimate of annual operations and maintenance costs are as follows:

a. Levee and Floodwall Maintenance (includes mowing approximately 325 acres of levee 12 times/year and minor floodwall maintenance 4 times/year).	$48,000/yr.
b. Floodgate Operations (Includes operating 5 swing gates and 2 roller gates 4 times/year).	$800/yr.
c. Floodgate Maintenance (Includes spot painting, miscellaneous routine maintenance, and complete repainting every 10 years of 7 floodgates).	$5,000/yr.
d. Sluice Gate Drainage Structure Maintenance (Includes periodic routine maintenance and complete repainting every 5 years of 10 gates).	$2,500/yr.
Subtotal	$56,300/yr.
10% - 12% contingency	6,700/yr.
Total	$63,000/yr.

RECOMMENDATIONS

52. Recommendations. The plans and cost estimates contained in this Design Memorandum are recommended for use as a basis for negotiation and execution of the LCA for this project.



VICINITY MAP

SCALE OF MILES

40 0 40 80 120 160 200

N

INDEX MAP

SCALE: 1" = 2000'

2000' 0 2000' 4000' 6000' 8000'

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

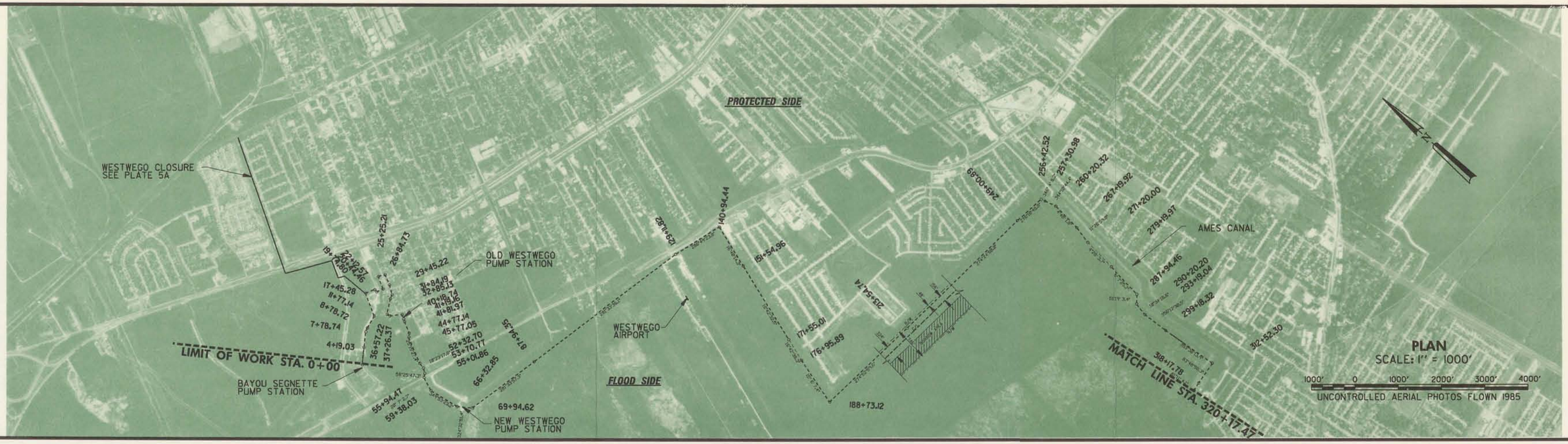
HURRICANE PROTECTION PROJECT

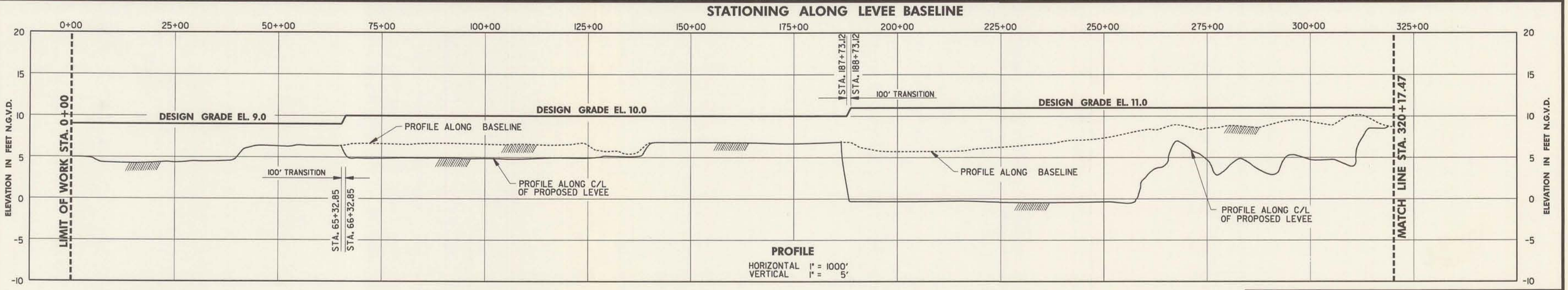
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

INDEX AND VICINITY MAP

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SAI8.DGN	1	H-2-30649





COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1

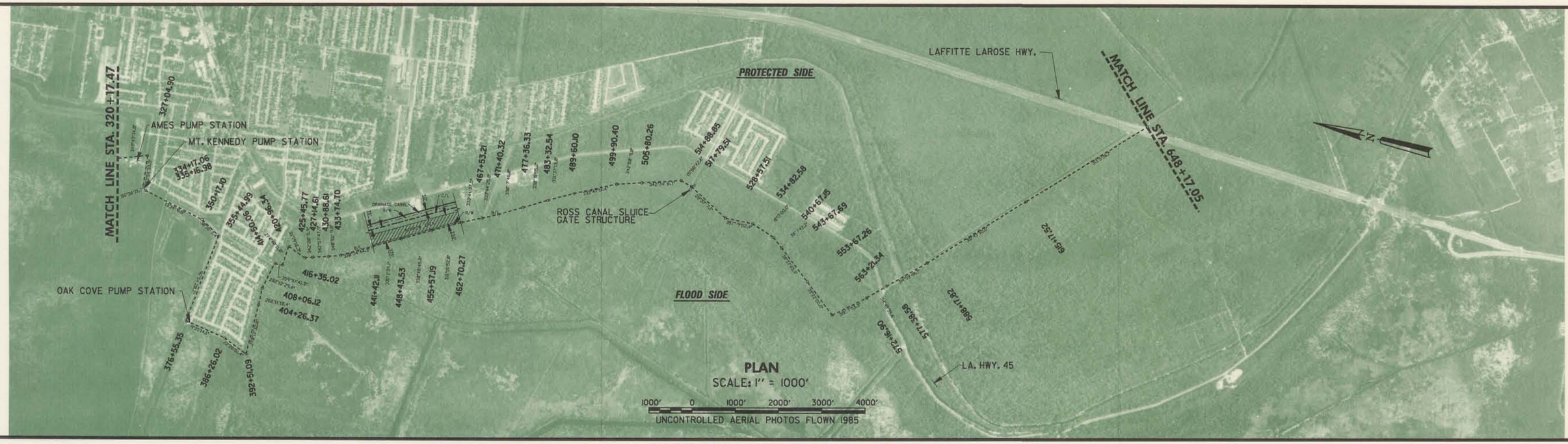
(REDUCED SCOPE)

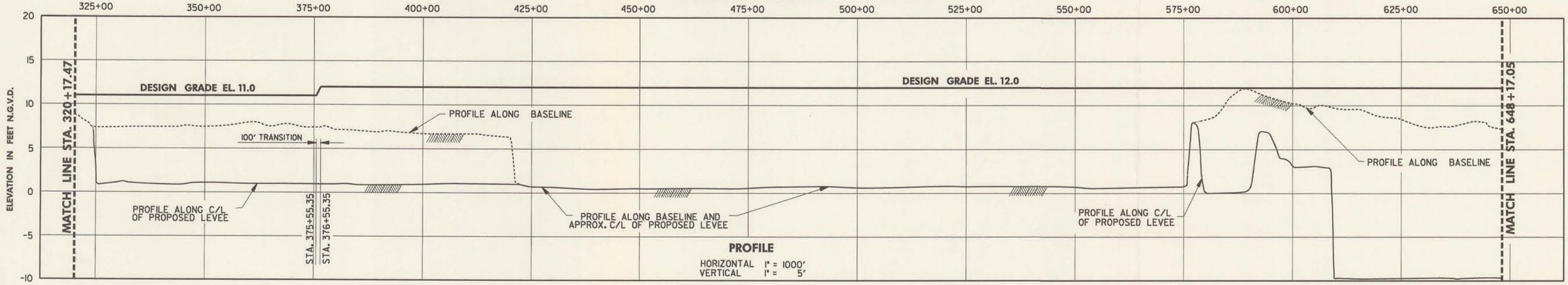
PLAN AND PROFILE
STA. 0+00 TO STA. 320+17.47

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBASEW	1000	H-2-30649

PLATE 2





COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1

(REDUCED SCOPE)

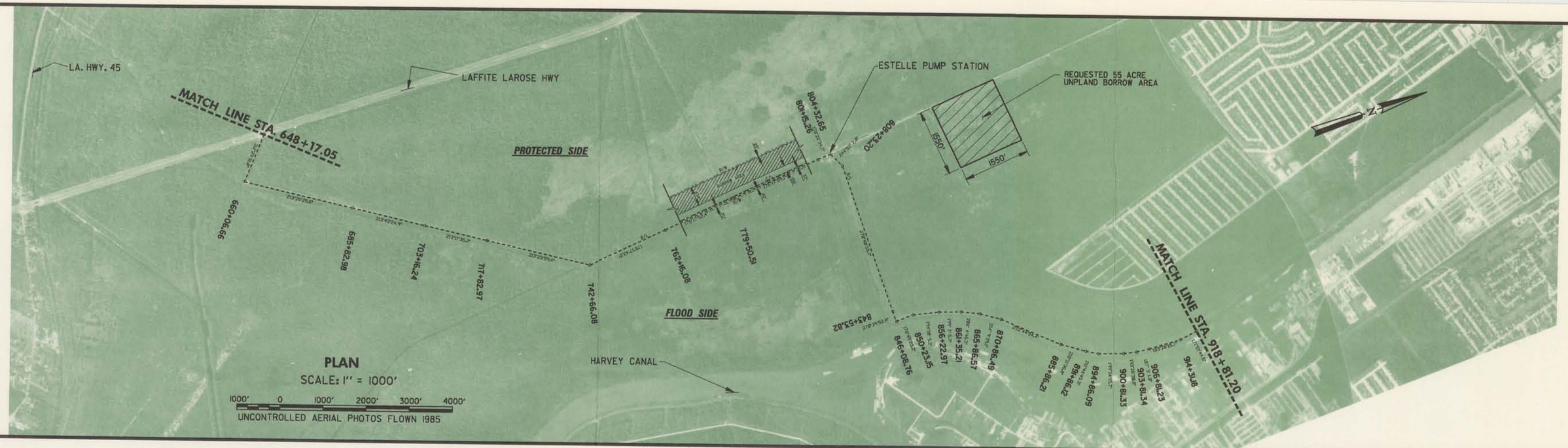
PLAN AND PROFILE

STA. 320+17.47 TO STA. 648+17.05

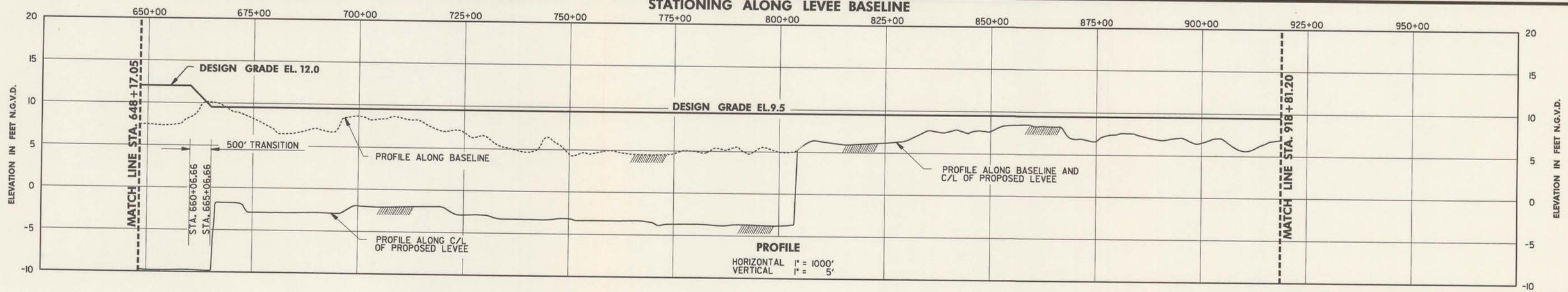
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBASEW	1000	H-2-30649

PLATE 3



STATIONING ALONG LEVEE BASELINE



PROFILE
HORIZONTAL 1" = 1000'
VERTICAL 1" = 5'

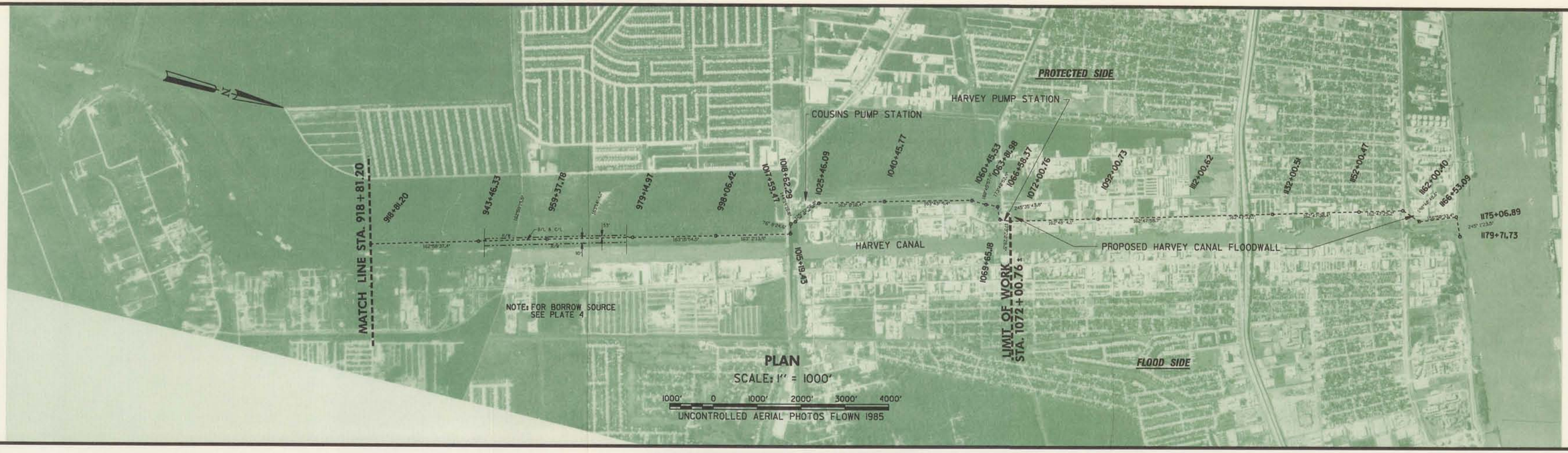
COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

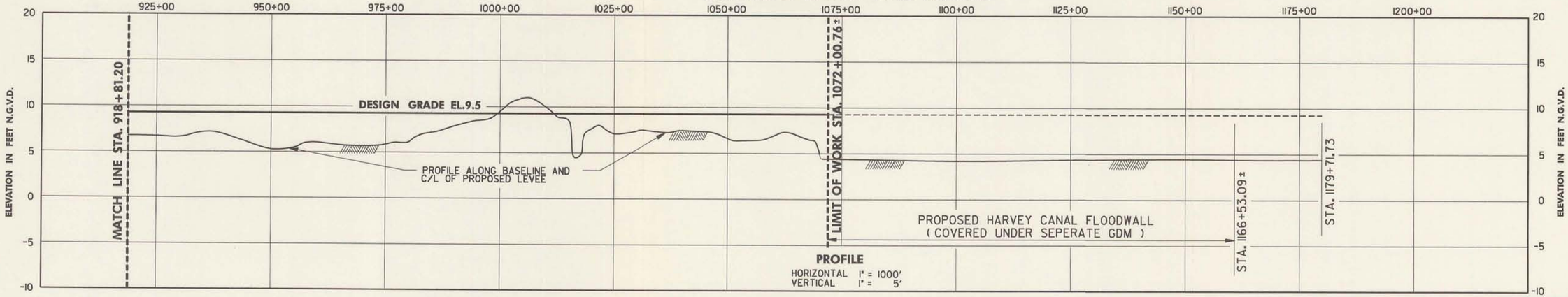
PLAN AND PROFILE
STA. 648+17.05 TO STA.918+81.20

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBASEE	1000	H-2-30649



STATIONING ALONG LEVEE BASELINE



PROFILE
HORIZONTAL 1" = 1000'
VERTICAL 1" = 5'

COMPUTER AIDED DESIGN DRAFTING

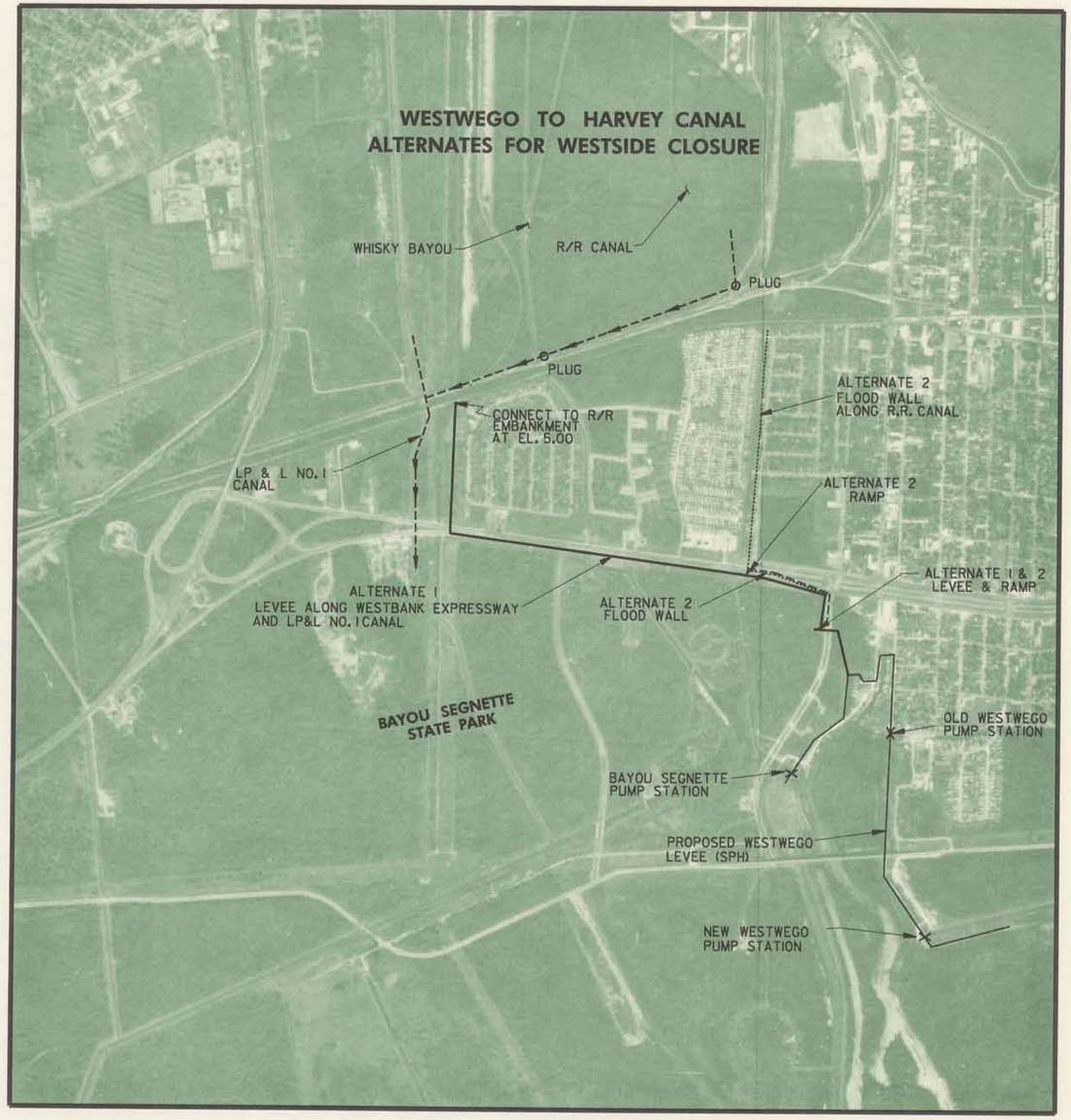
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

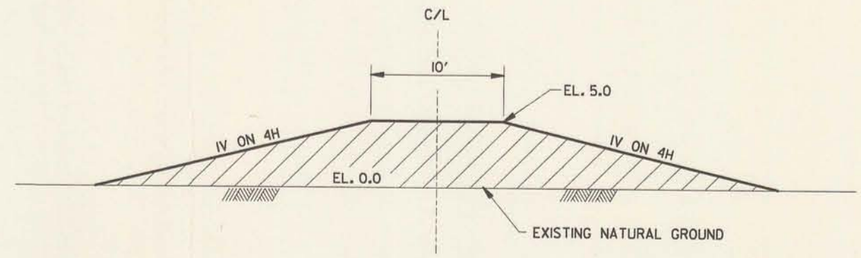
PLAN AND PROFILE
STA. 918+81.20 TO STA.1179+71.73

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

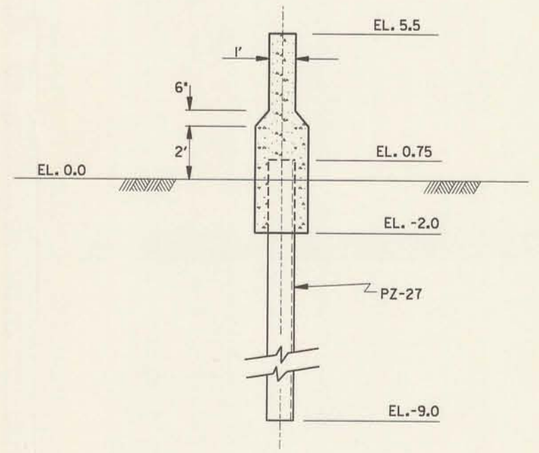
DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBASEE	1000	H-2-30649

PLATE 5





LEVEE DESIGN SECTION
NOT TO SCALE



FLOODWALL DESIGN SECTION
NOT TO SCALE

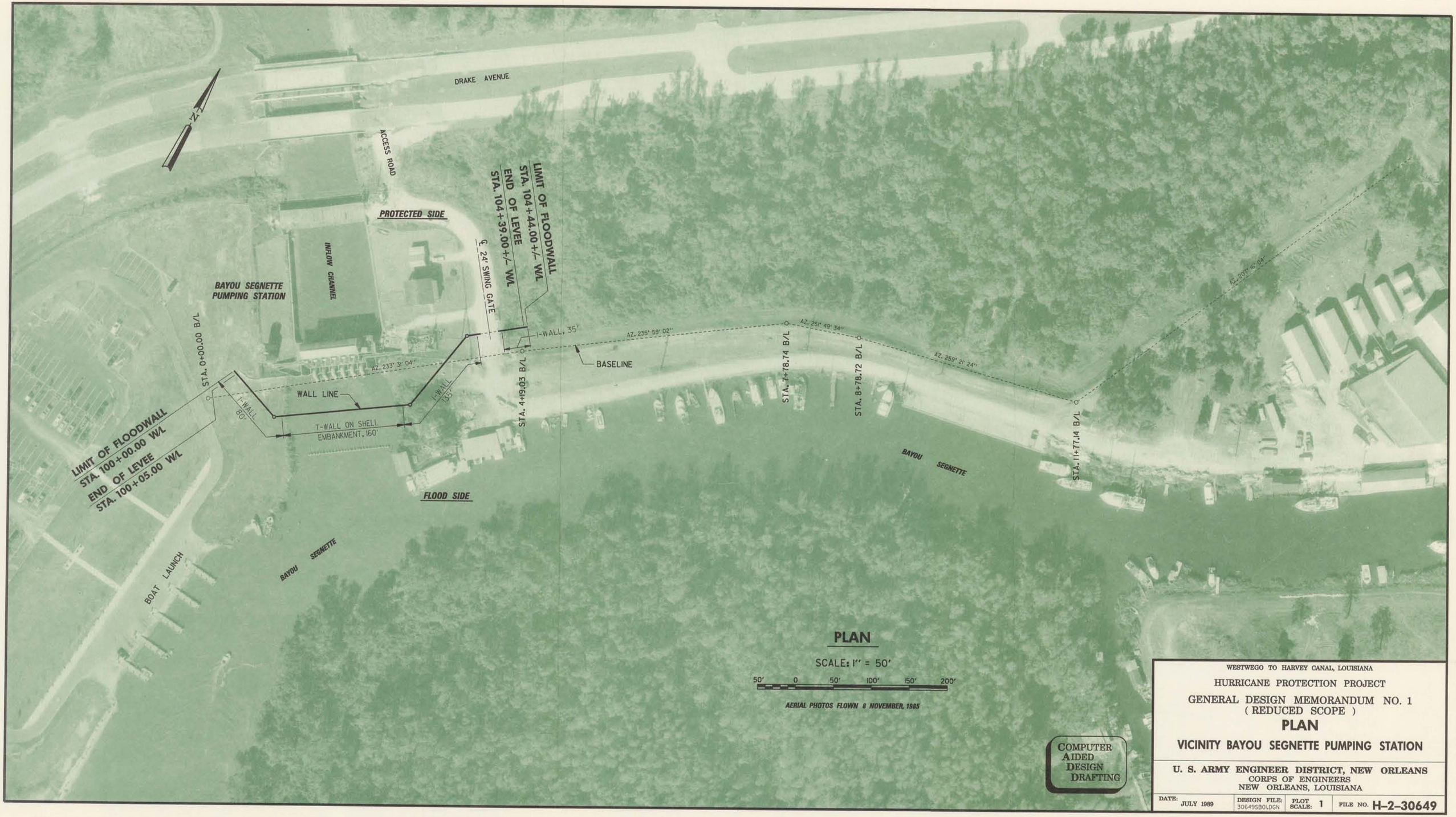
COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

ALTERNATES FOR WESTSIDE CLOSURE

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBASEW	1000	H-2-30649



PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN

VICINITY BAYOU SEGNETTE PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SB01.DGN	1	H-2-30649

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY
OLD WESTWEGO PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SA09.DGN	1	H-2-30649

PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
UNDER LAPALCO BLVD. BRIDGE
VIC. NEW WESTWEGO PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SAI6.DGN	1	H-2-30649

STA. 55+94.47 B/L

LAPALCO BLVD.

AZ. 20° 07' 05"

STA. 59+38.03 B/L

BASELINE

AZ. 349° 53' 23"

PROTECTED SIDE

DRAINAGE CANAL

FLOOD SIDE

BAYOU

SEGNETTE

END OF LEVEE
STA. 400+05.00 W/L

STA. 66+32.85 B/L

AZ. 324° 32' 51"

LIMIT OF FLOODWALL
STA. 400+00.00 W/L

I-WALL
50'

T-WALL
120'

NEW WESTWEGO
PUMPING STATION

MODIFY EXISTING
FLOODWALL, 126'

MAYRONNE CANAL

STA. 69+94.62 B/L

AZ. 28° 33' 57"

BASELINE

END OF LEVEE
STA. 405+71.00 +/- W/L

WALL LINE

T-WALL
120'

I-WALL
160'

LIMIT OF FLOODWALL
STA. 405+76.00 +/- W/L

PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

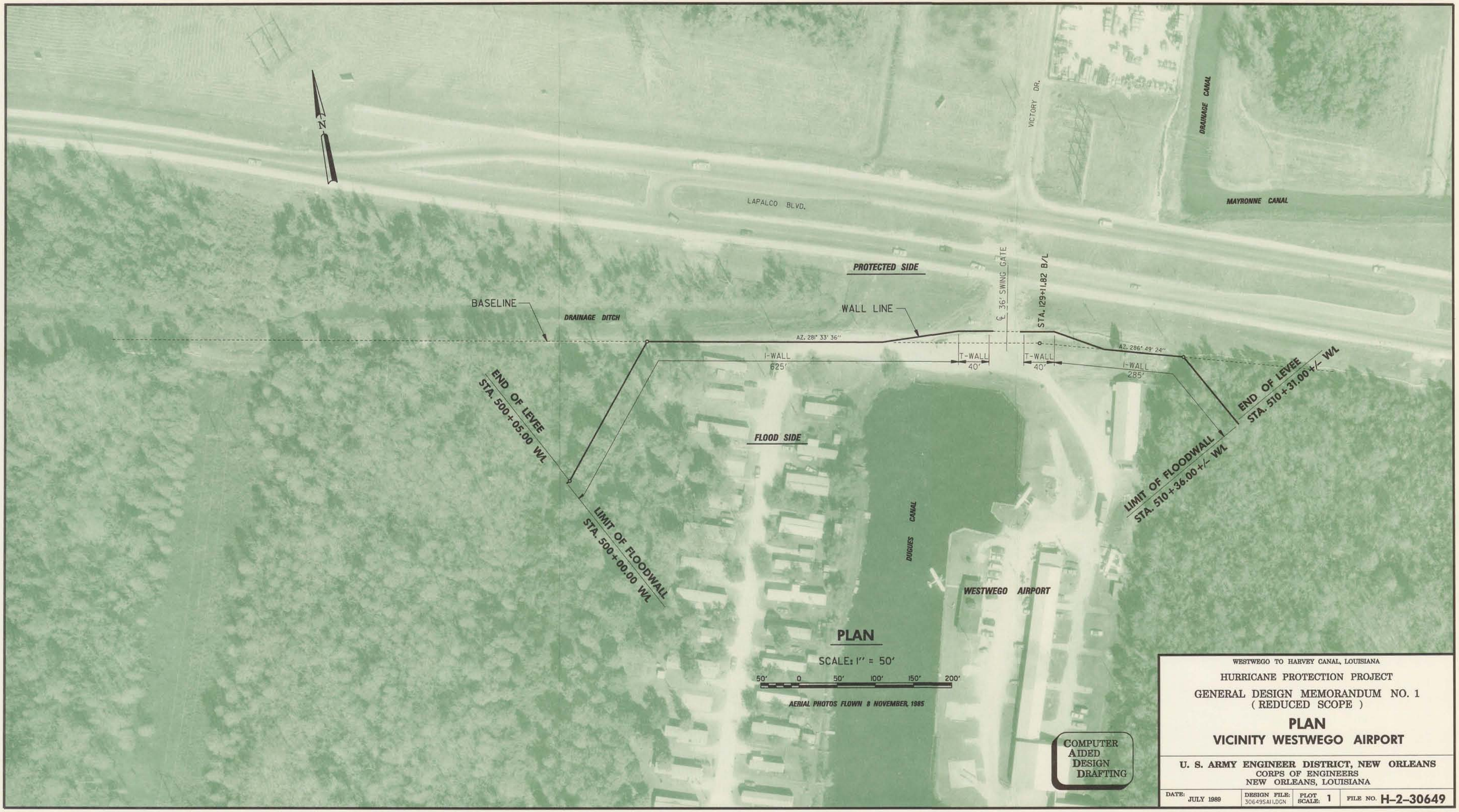
COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY
NEW WESTWEGO PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SA08.DGN	1	H-2-30649



PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY WESTWEGO AIRPORT

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SAI.DGN	1	H-2-30649

PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

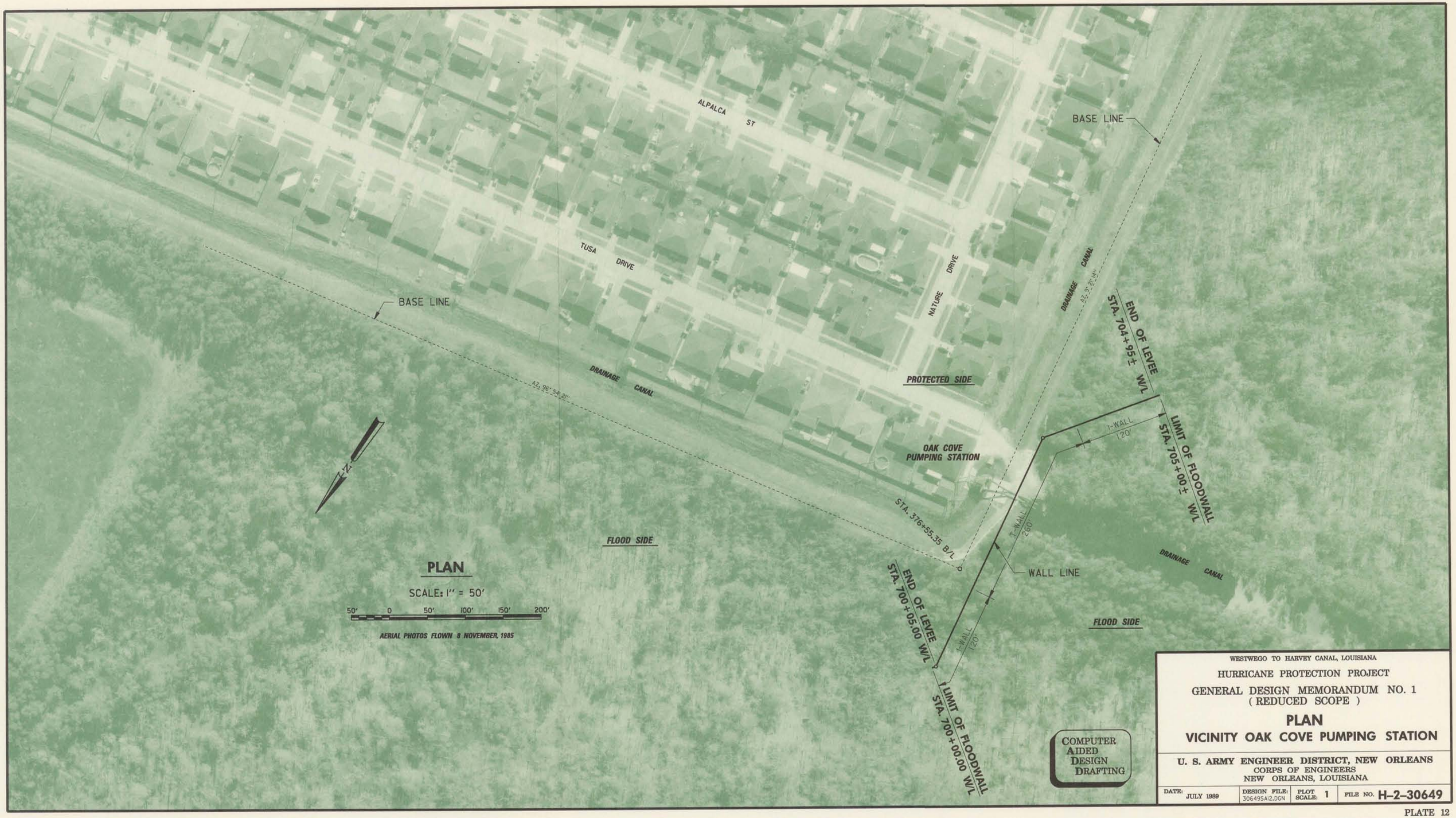
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY AMES PUMPING STATION AND MT. KENNEDY PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA10.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY OAK COVE PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SAI2.DGN	1	H-2-30649

PLATE 12

PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY ESTELLE PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SAI3.DGN	1	H-2-30649

PROTECTED SIDE

END OF LEVEE
STA. 1100+05 W/L

WALL LINE

STA. 959+37.78 B/L

END OF LEVEE
STA. 1102+13± W/L

BASE LINE

AZ. 163° 14' 04"

AZ. 162° 58' 20"

LIMIT OF FLOODWALL
STA. 1100+00 W/L

LIMIT OF FLOODWALL
STA. 1102+18± W/L

FLOOD SIDE

HARVEY CANAL

PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN

VIC. LA. POWER AND LIGHT POWER LINES SOUTH OF COUSINS PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA17.DGN	PLOT SCALE: 1	FILE NO. H-2-30649

N

DESTREHAN AVE.

PROTECTED SIDE

BASELINE

STA. 1017+59.47 B/L

AZ. 103° 02' 10"

END OF LEVEE
STA. 1000+05.00 W/L

AZ. 149° 19' 17"

AZ. 76° 08' 25"

LIMIT OF FLOODWALL
STA. 1000+00.00 W/L

STA. 1018+62.29 B/L

L-WALL
55'

℄ 44' BOTTOM ROLLER GATE

AZ. 125° 32' 56"

STA. 1015+19.43 B/L

WALL LINE

FLOOD SIDE

HARVEY CANAL

L-WALL
346'

WALL LINE

MODIFY EXISTING FLOODWALL
EXISTING FLOODWALL
NO CHANGE

55'±
MODIFY EXIST. FLDW.

29' 2"±

29' 35"±

SLUICE GATE STRUCTURE
3 - 7 X 10 SLUICE GATES

SLUICE GATE STRUCTURE
3 - 7 X 10 SLUICE GATES

MODIFY EXIST. FLDW.

T-WALL
178'

L-WALL
109'

MODIFY EXISTING DISCHARGE TUBES ANG FLOODWALL

℄ 24' SWING GATE

I-WALL
128'

STA. 1025+46.09 B/L

END OF LEVEE
STA. 1014+99.00± W/L

LIMIT OF FLOODWALL
STA. 1015+04.00± W/L

AZ. 163° 00' 00"

BASELINE

COUSINS CANAL

COUSINS
PUMPING STATION

PROTECTED SIDE

15TH AVE. CANAL

FLOOD SIDE

DESTREHAN AVE.

PLAN

SCALE: 1" = 50'

50' 0 50' 100' 150' 200'

AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

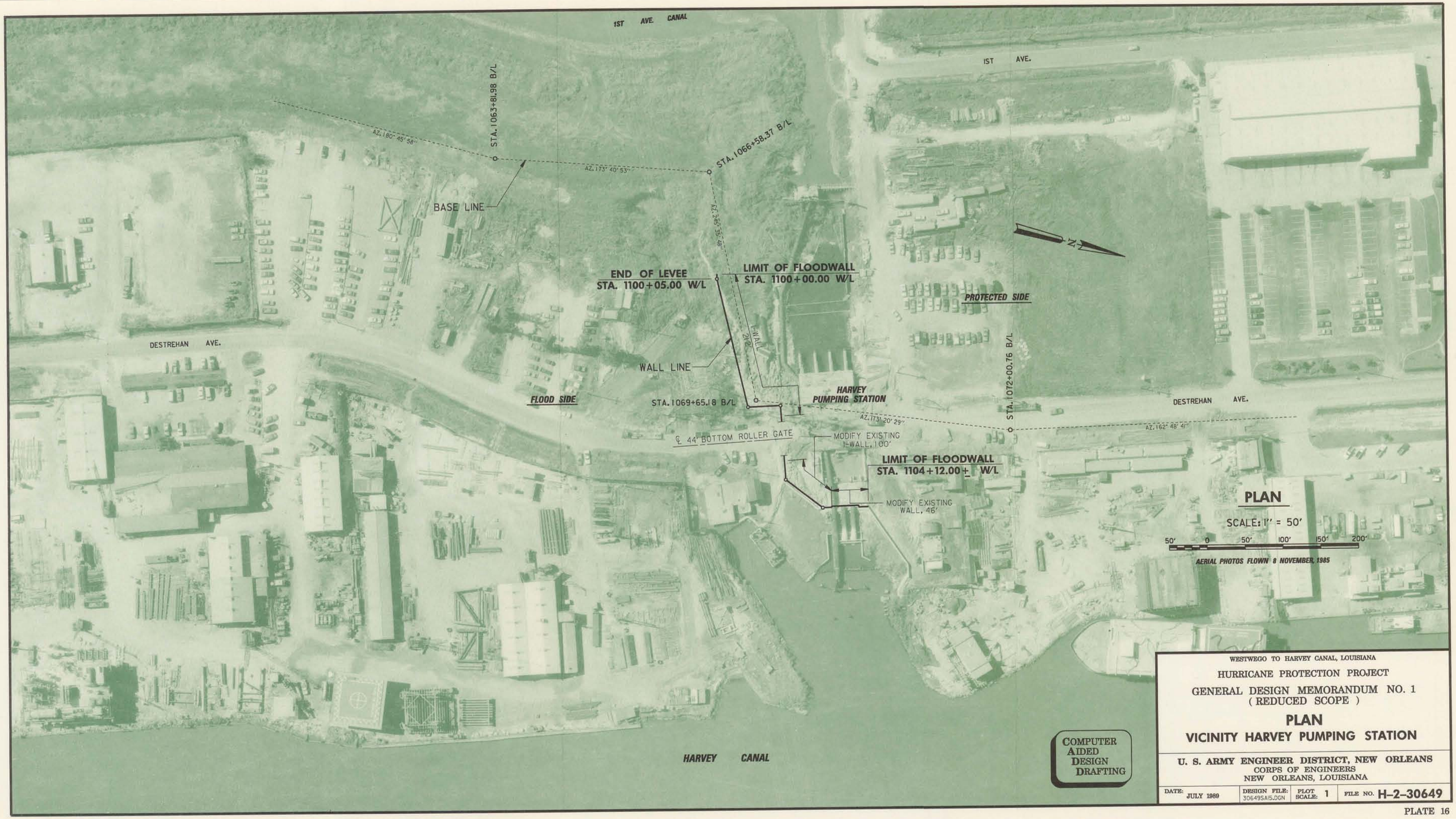
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY COUSINS PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA14.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



WESTWEGO TO HARVEY CANAL, LOUISIANA

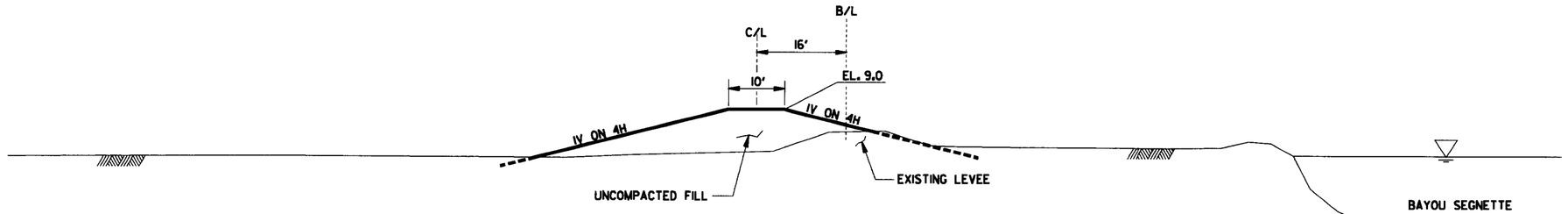
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

PLAN
VICINITY HARVEY PUMPING STATION

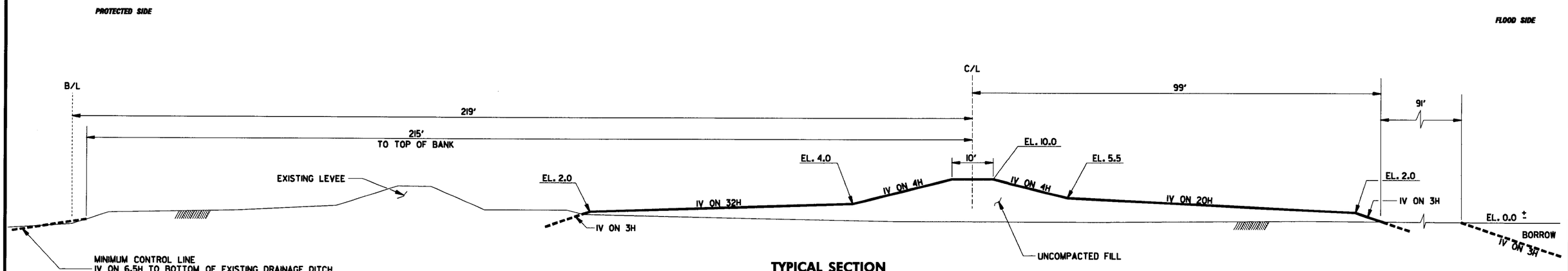
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SA15.DGN	1	H-2-30649



TYPICAL SECTION

AROUND BAYOU SEGNETTE
STA. 0+00 TO STA. 65+32.85
NOT TO SCALE



TYPICAL SECTION

WESTWEGO
STA. 66+32.85 TO WALL IN VICINITY OF AIRPORT
NOT TO SCALE

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

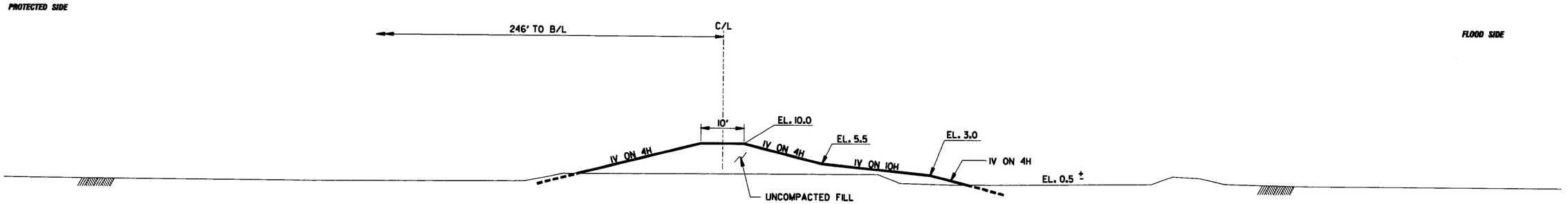
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

TYPICAL SECTIONS

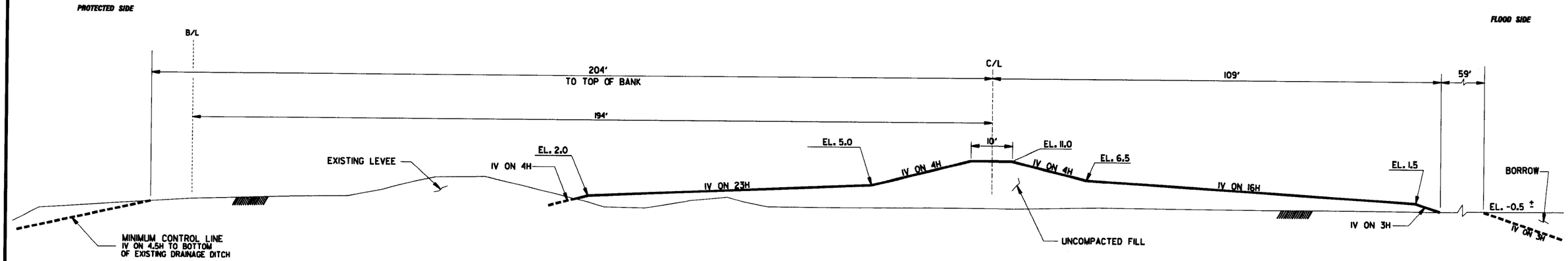
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBSUPP	1:10	H-2-30649



TYPICAL SECTION

WESTWEGO
FROM WALL IN VICINITY OF AIRPORT TO STA. 187+73.12
NOT TO SCALE



TYPICAL SECTION

WESTMINISTER – LINCOLNSHIRE
STA. 188+73.12 TO STA. 257+30.98
NOT TO SCALE

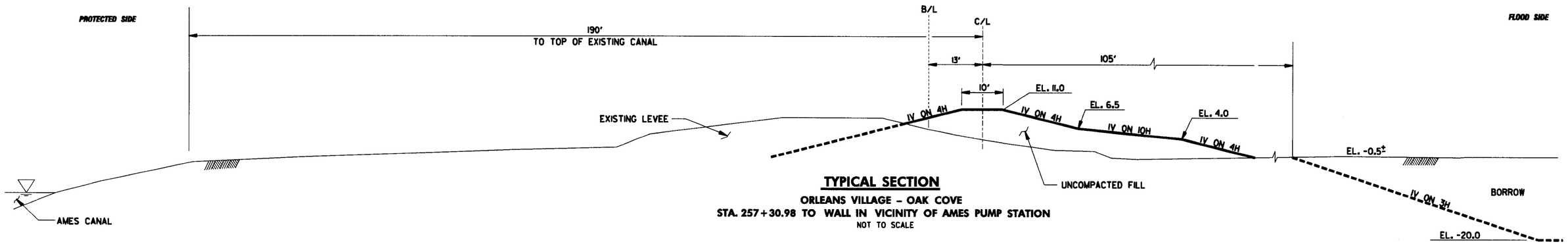
COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

TYPICAL SECTIONS

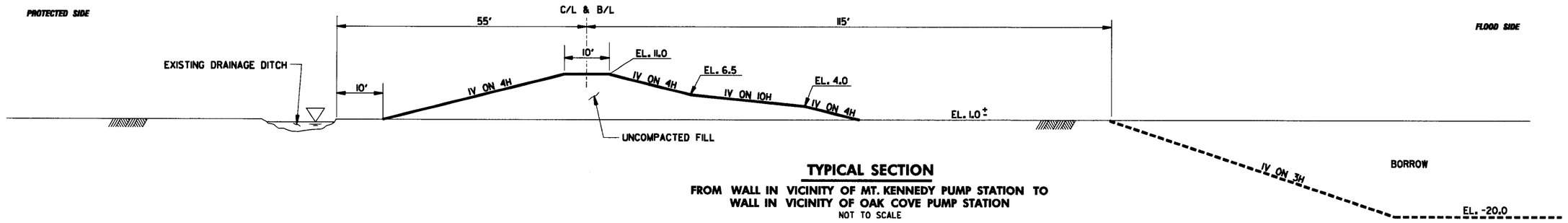
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE: JULY 1989	DESIGN FILE: WBSUPP	PLOT SCALE: 1:10	FILE NO. H-2-30649



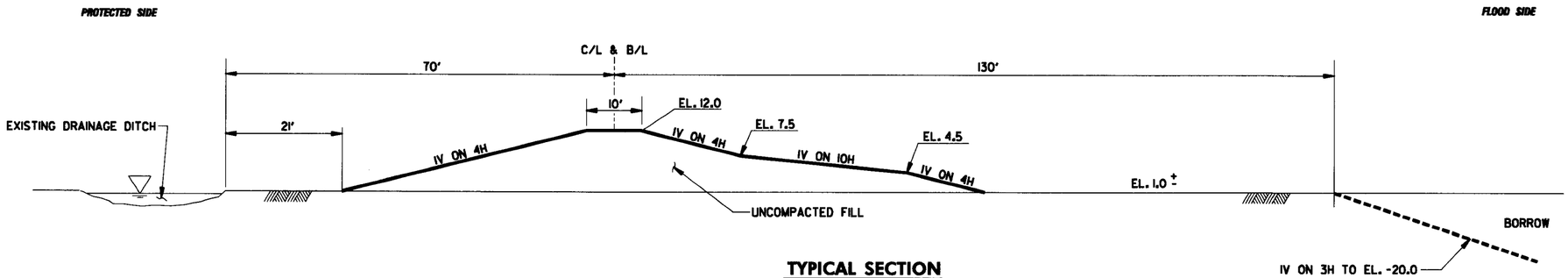
TYPICAL SECTION

ORLEANS VILLAGE – OAK COVE
STA. 257+30.98 TO WALL IN VICINITY OF AMES PUMP STATION
NOT TO SCALE



TYPICAL SECTION

FROM WALL IN VICINITY OF MT. KENNEDY PUMP STATION TO
WALL IN VICINITY OF OAK COVE PUMP STATION
NOT TO SCALE



TYPICAL SECTION

FROM WALL IN VICINITY OF OAK COVE PUMP STATION TO STA. 420+96.34
NOT TO SCALE

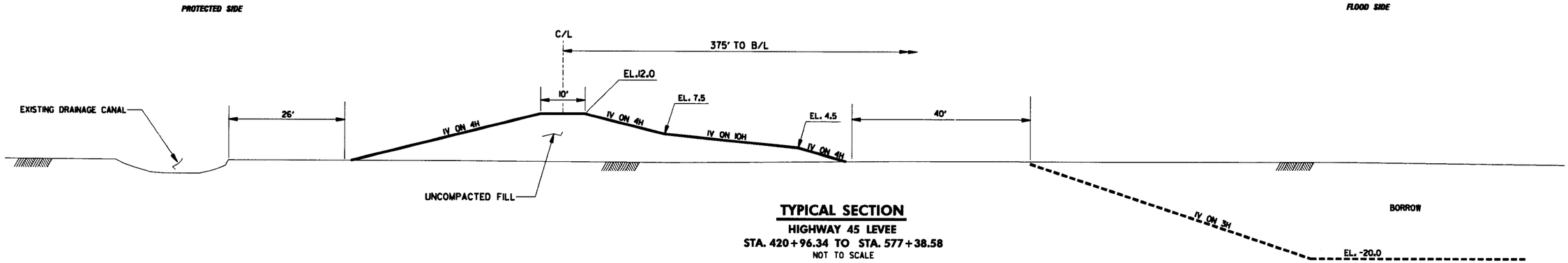
COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

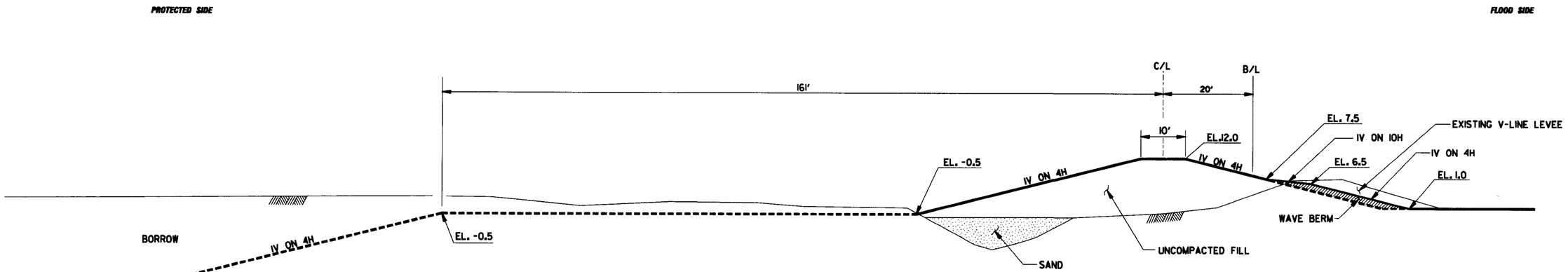
TYPICAL SECTIONS

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBSUPP	1:10	H-2-30649



TYPICAL SECTION
HIGHWAY 45 LEVEE
STA. 420+96.34 TO STA. 577+38.58
NOT TO SCALE



TYPICAL SECTION
V-LINE LEVEE
STA. 577+38.58 TO STA. 588+17.82
NOT TO SCALE

COMPUTER AIDED DESIGN DRAFTING

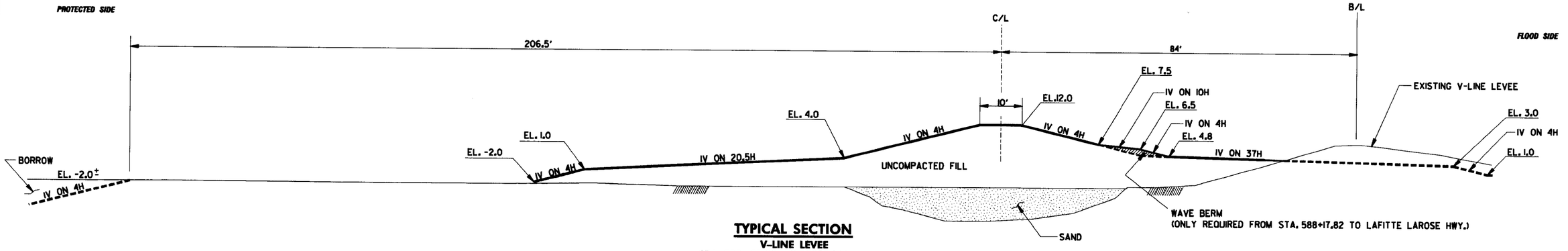
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

TYPICAL SECTIONS

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBSUPP	1:10	H-2-30649

PLATE 19 A



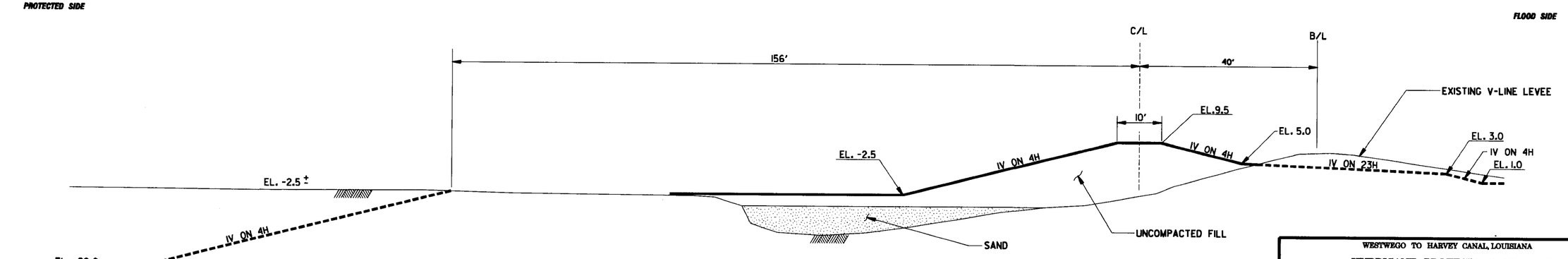
TYPICAL SECTION

V-LINE LEVEE

STA. 588+17.82 TO STA. 660+06.66

(SLOPE TRANSITION)

NOT TO SCALE



TYPICAL SECTION

V-LINE LEVEE

STA. 655+06.66 TO WALL IN VICINITY OF ESTELLE PUMP STATION

NOT TO SCALE

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

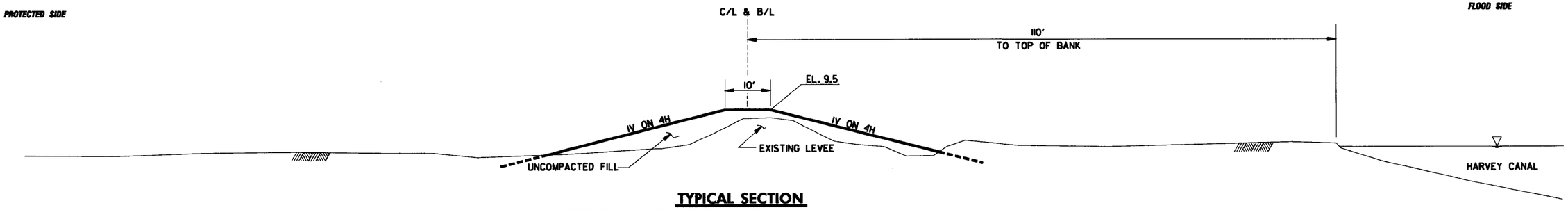
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

TYPICAL SECTIONS

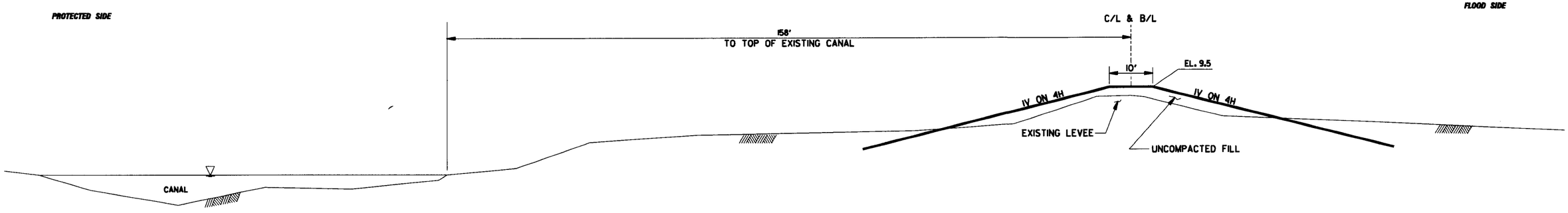
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	WBSUPP	1:10	H-2-30649



TYPICAL SECTION

ESTELLE PUMP STATION TO COUSINS PUMP STATION LEVEE
STA. 808+23.20 TO STA. 1015+19.43
NOT TO SCALE



TYPICAL SECTION

COUSINS PUMP STATION TO HARVEY PUMP STATION LEVEE
STA. 1025+46.09 TO STA. 1069+65.18
NOT TO SCALE

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

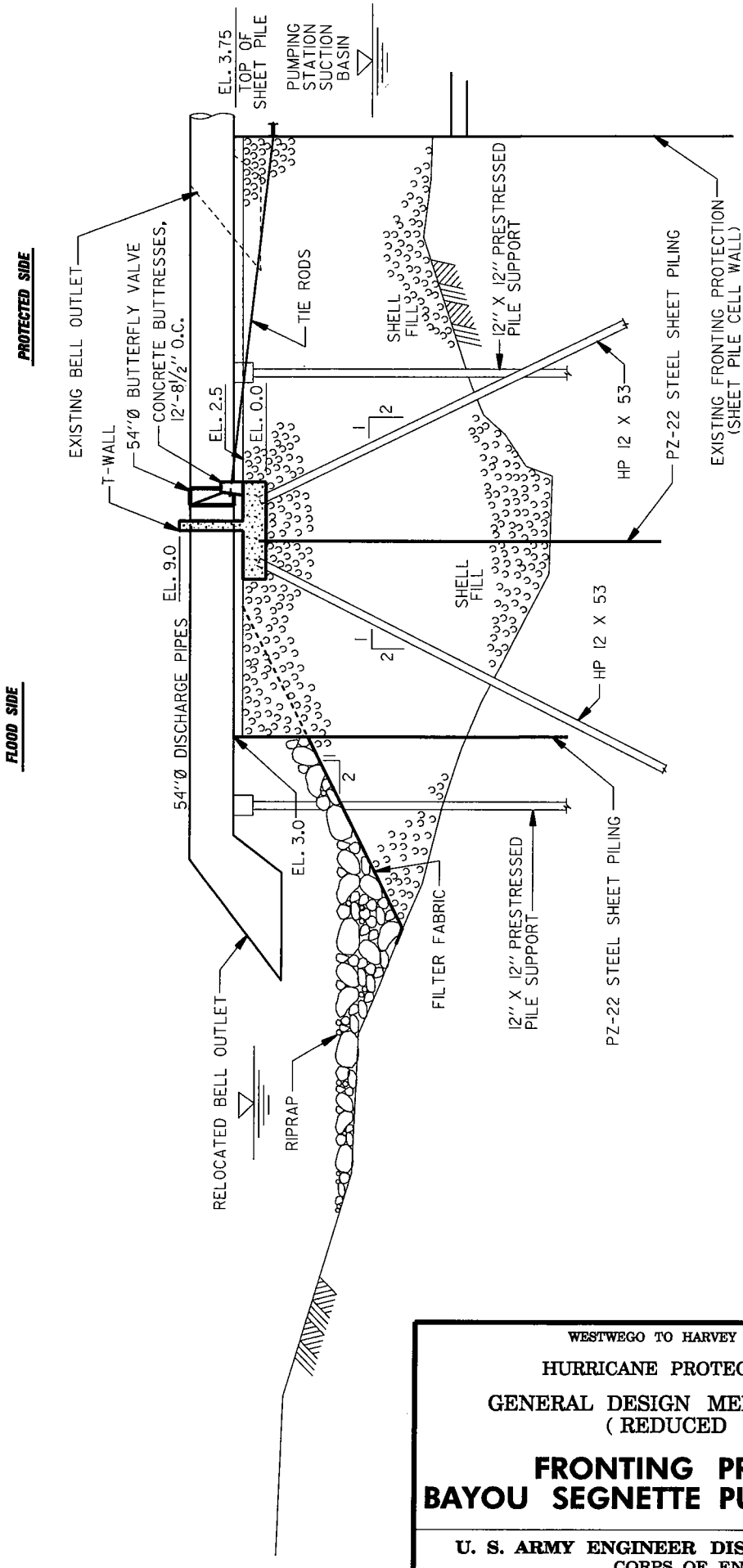
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

TYPICAL SECTIONS

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

DATE: JULY 1989	DESIGN FILE: WBSUPP	PLOT SCALE: 1:10	FILE NO. H-2-30649



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

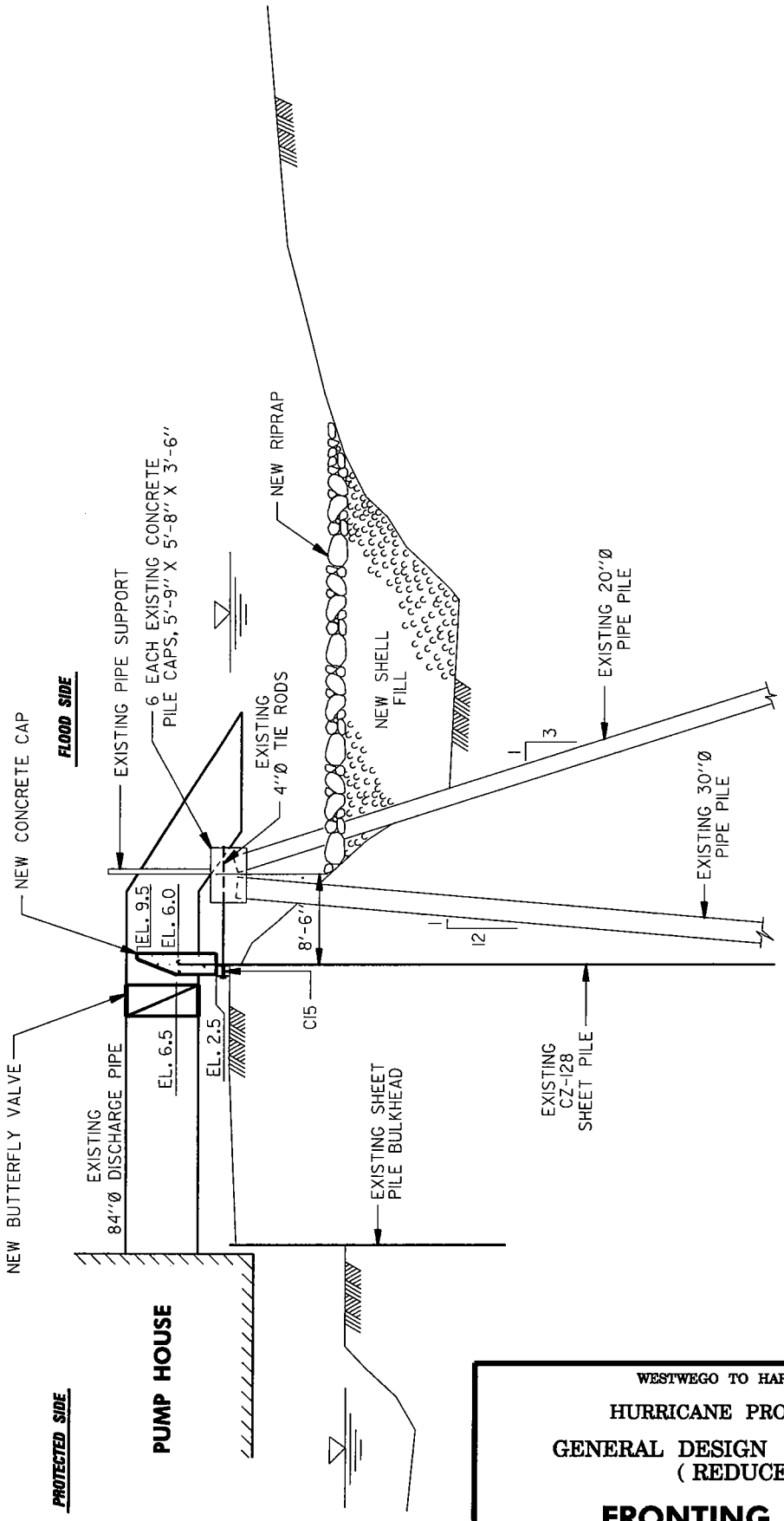
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION
BAYOU SEGNETTE PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA20.DGN	PLOT SCALE: 1	FILE NO. H-2-30649

PLATE 22



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

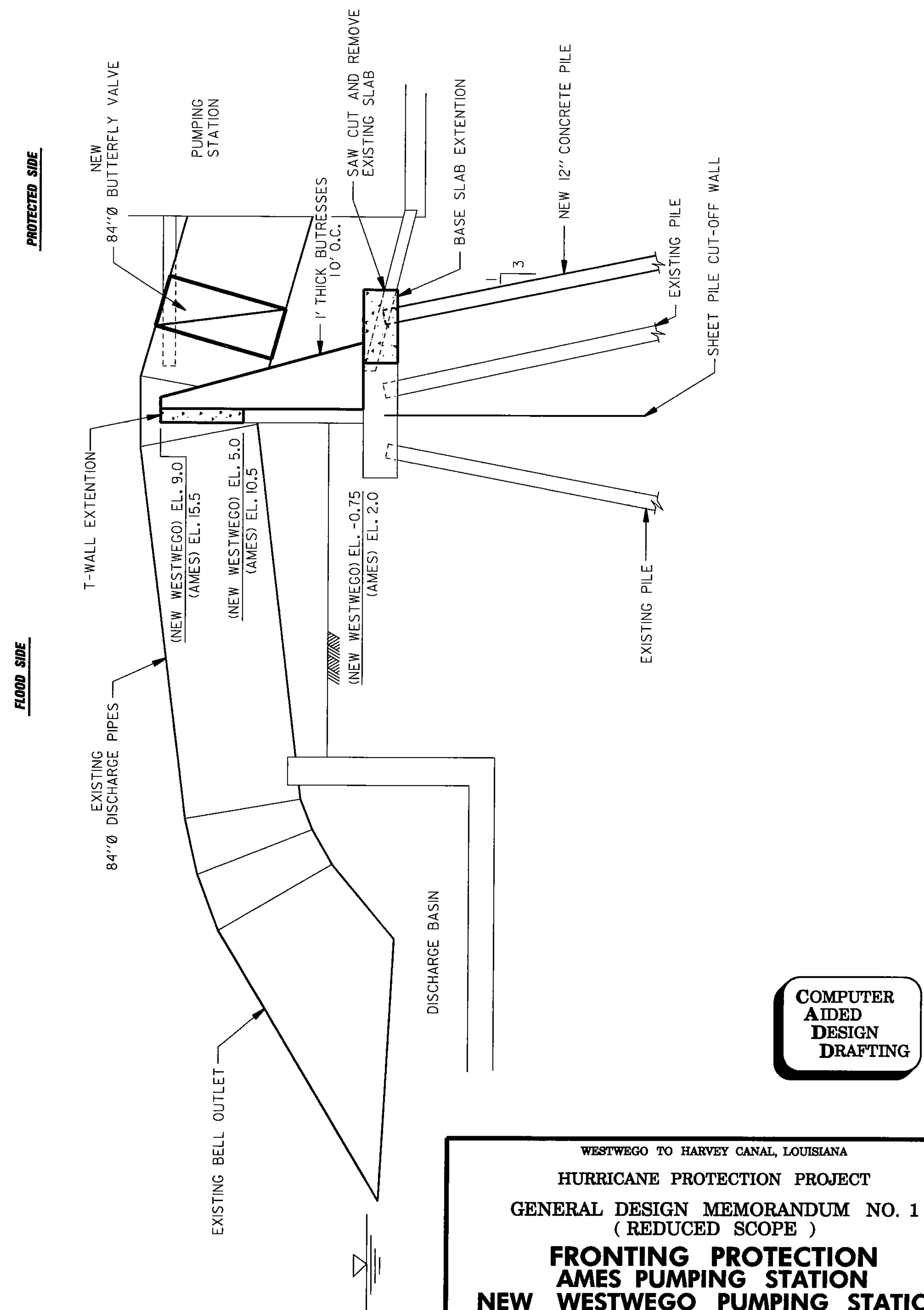
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION
OLD WESTWEGO PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA2I.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

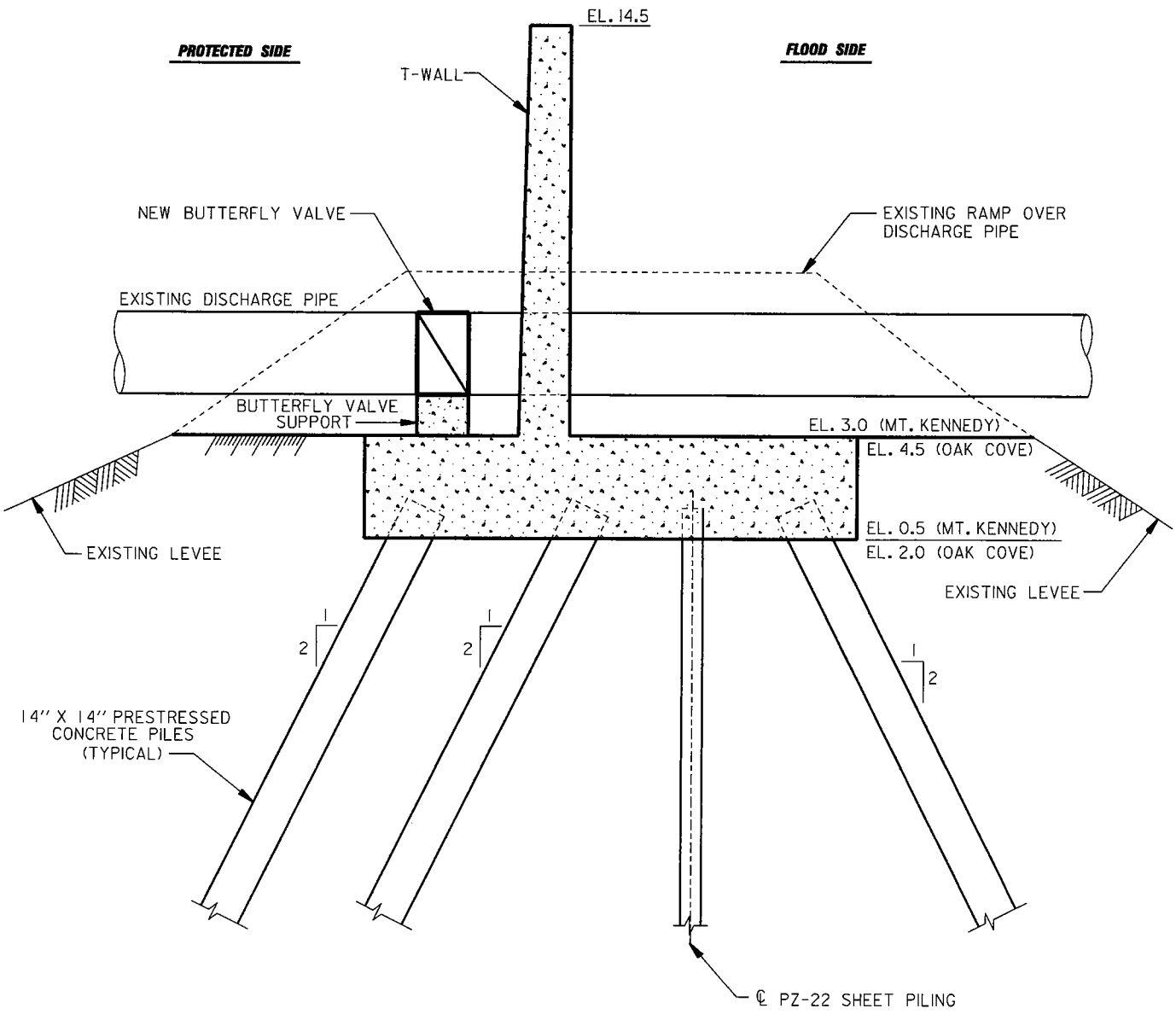
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION
AMES PUMPING STATION
NEW WESTWEGO PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA23.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

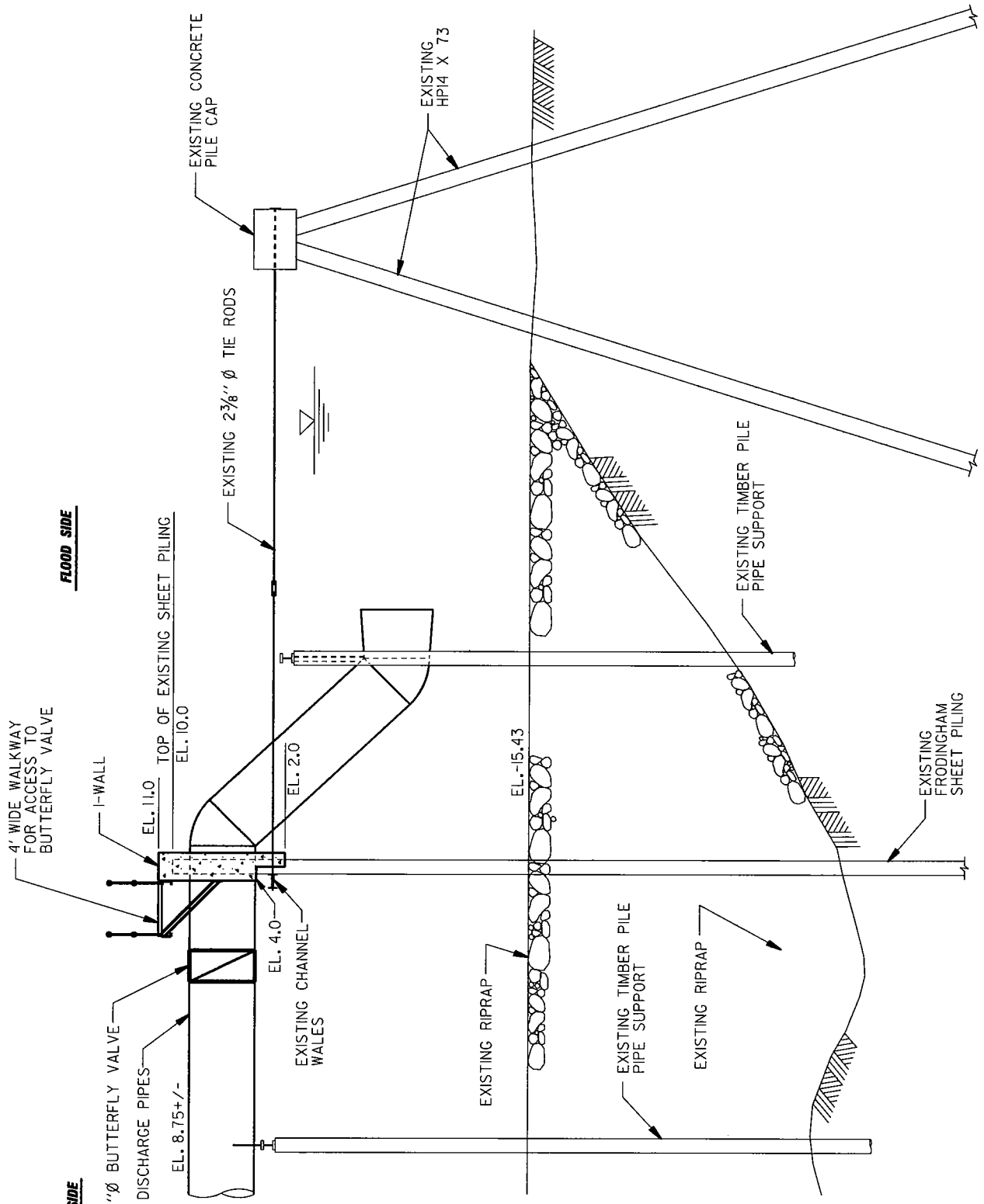
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION
MOUNT KENNEDY PUMPING STATION
OAK COVE PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA24.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

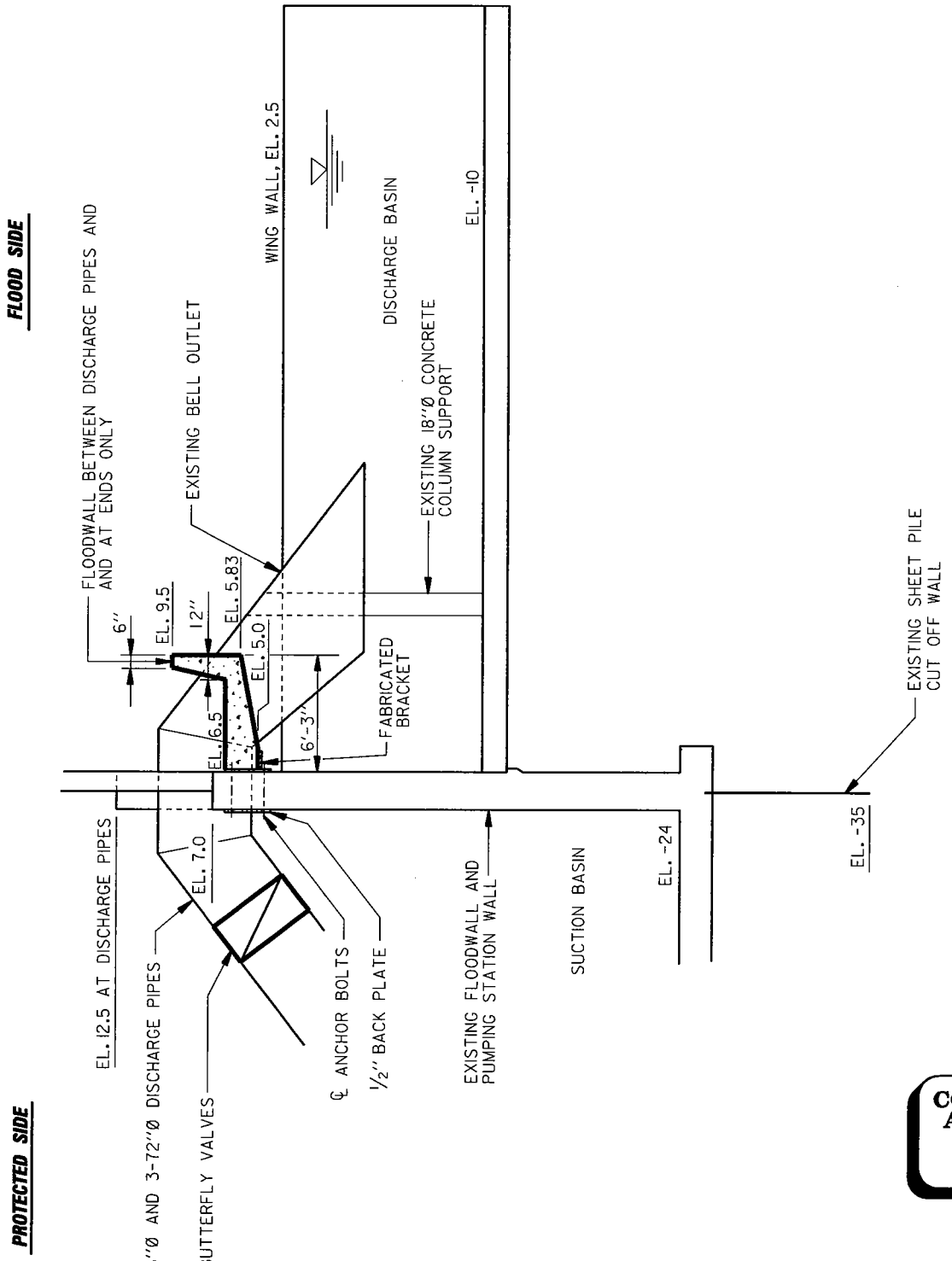
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION ESTELLE PUMPING STATION

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SB03.DGN	1	H-2-30649

PLATE 26



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

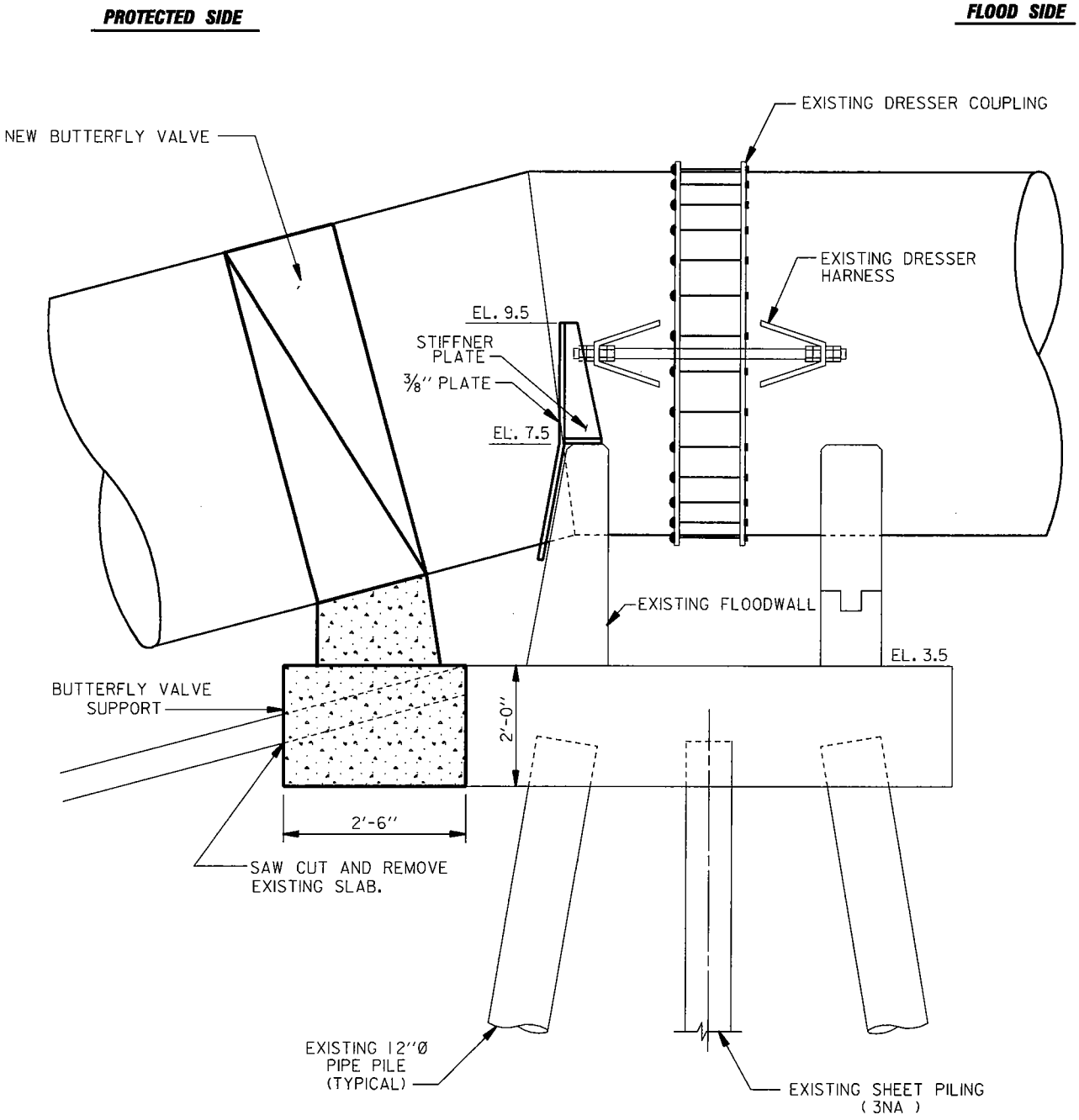
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION
COUSINS PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA22.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

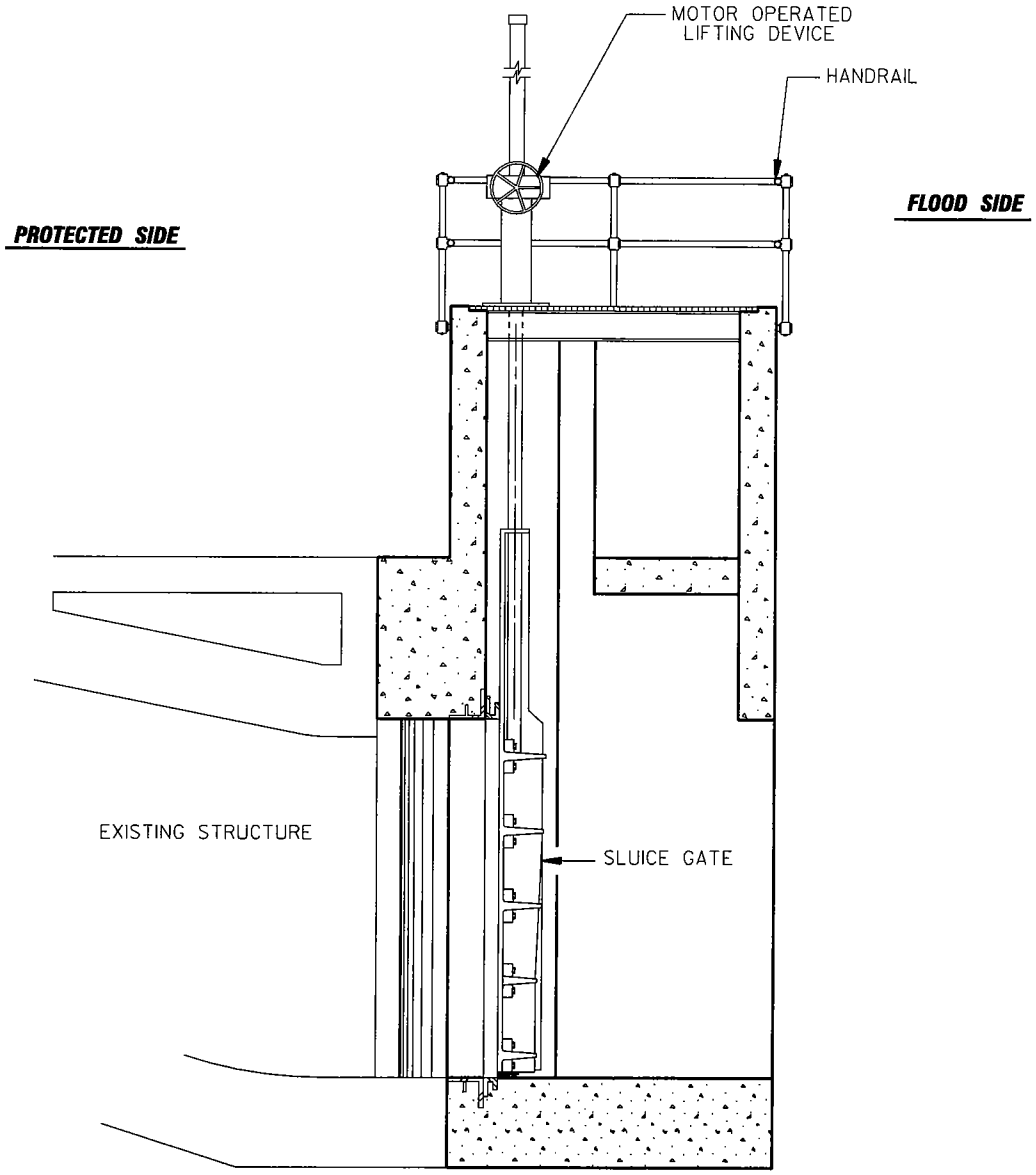
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

FRONTING PROTECTION HARVEY PUMPING STATION

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

DATE: JULY 1989	DESIGN FILE: 30649SA25.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



TYPICAL SECTION

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

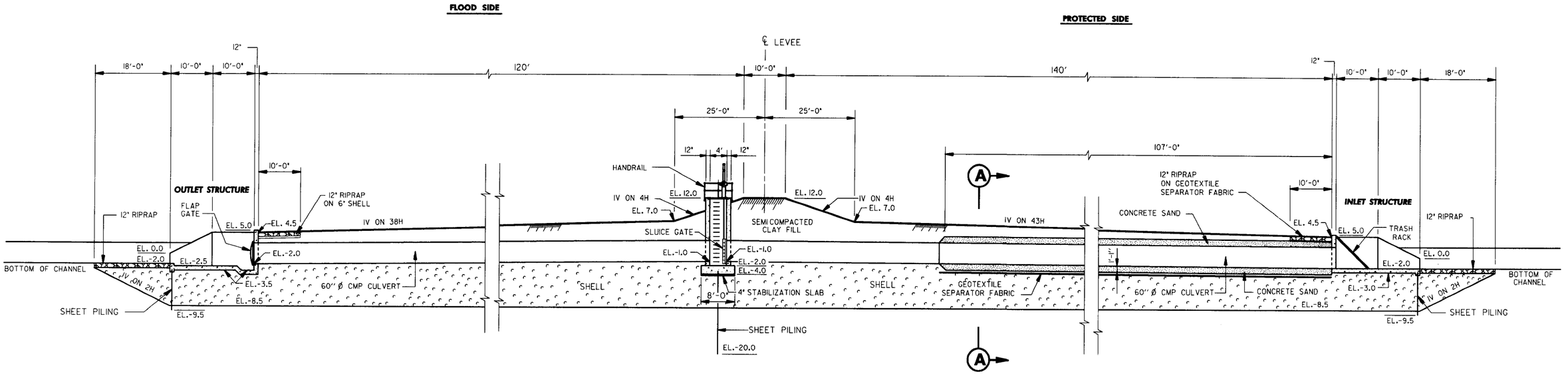
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

SLUICE GATE STRUCTURE
AT DISCHARGE CULVERT
AMES AND COUSINS PUMPING STATIONS

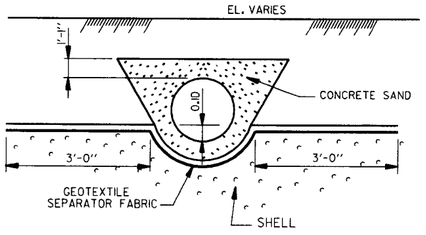
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE: JULY 1989	DESIGN FILE: 30649SAI9.DGN	PLOT SCALE: 32	FILE NO. H-2-30649



TYPICAL SECTION

SCALE: 1" = 10'



SECTION A

A
45 46

SCALE: 1" = 5'

SCALE: 1" = 5'

5' 0 5' 10' 15' 20'

SCALE: 1" = 10'

10' 0 10' 20' 30' 40'

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

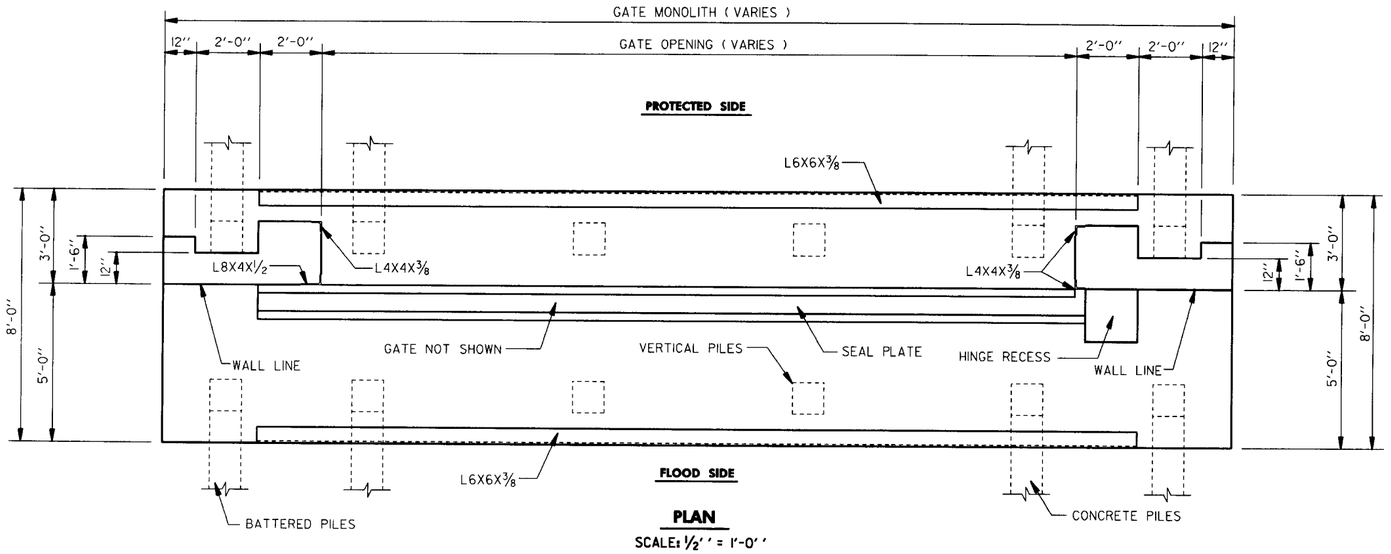
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

ROSS CANAL DRAINAGE STRUCTURE

TYPICAL SECTION

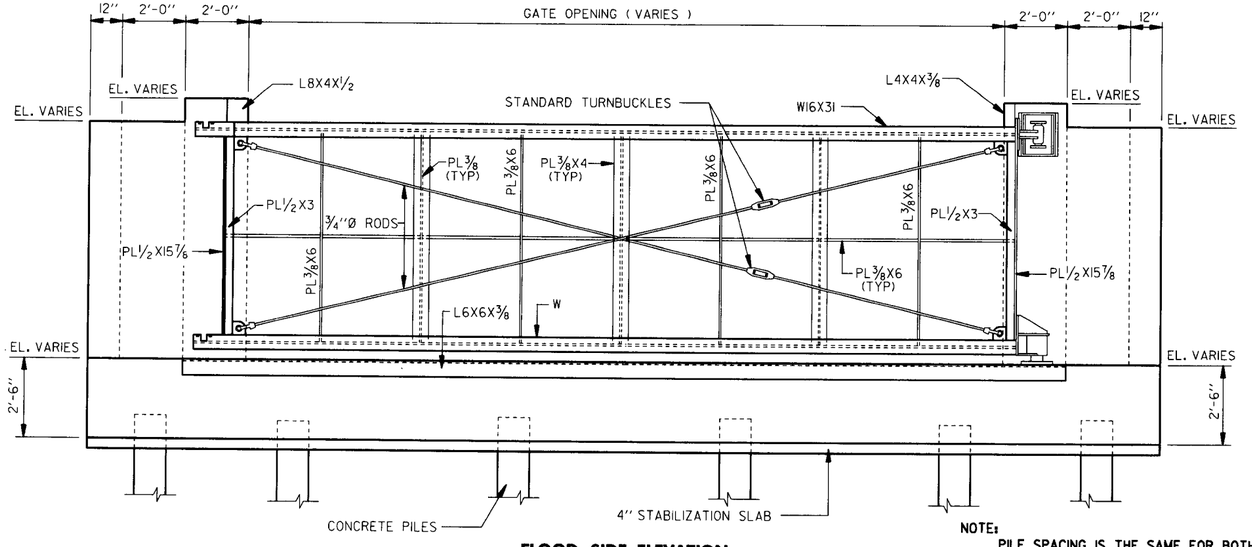
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SB02.DGN	120	H-2-30649



PLAN

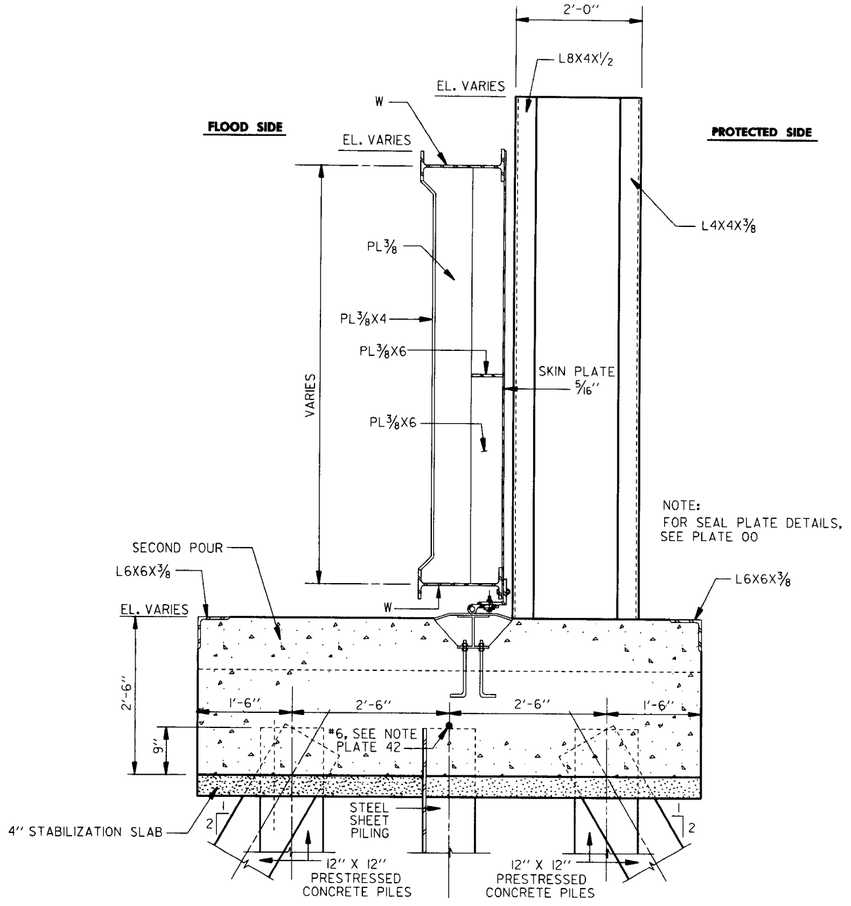
SCALE: 1/2'' = 1'-0''



FLOOD SIDE ELEVATION

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

NOTE:
PILE SPACING IS THE SAME FOR BOTH THE FLOOD SIDE AND THE PROTECTED SIDE AND IS SYMETRICAL ABOUT C/L GATE MONOLITH.



TYPICAL SECTION

SCALE: 1'' = 1'-0''

COMPUTER AIDED DESIGN DRAFTING

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

2' 0 2' 4' 6' 8'

SCALE: 1'' = 1'-0''

1' 0 1' 2' 3' 4'

WESTWEGO TO HARVEY CANAL, LOUISIANA

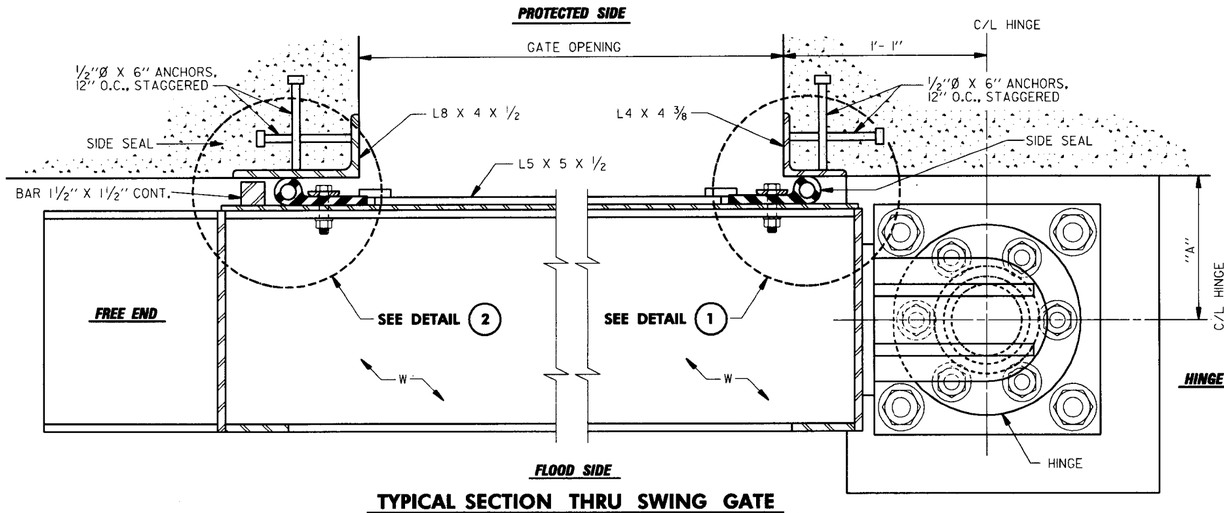
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

SWING GATE DETAILS

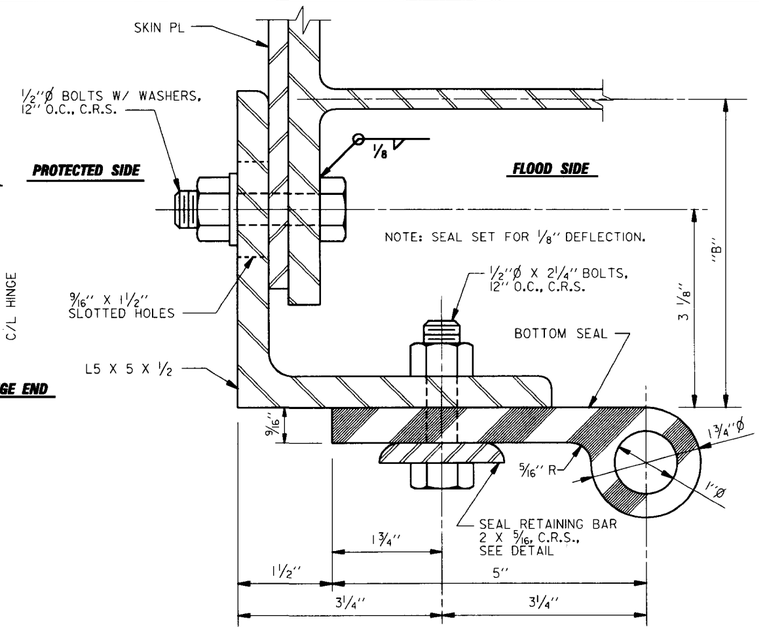
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1969	306495A04.DGN	24	H-2-30649



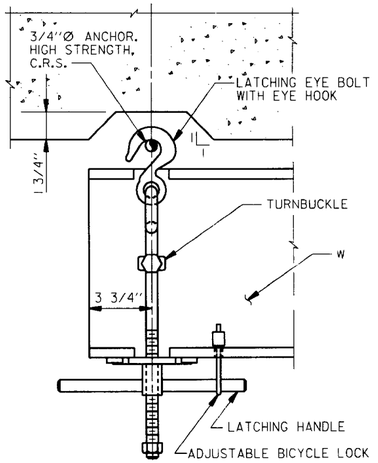
TYPICAL SECTION THRU SWING GATE

SCALE: 3" = 1" - 0"

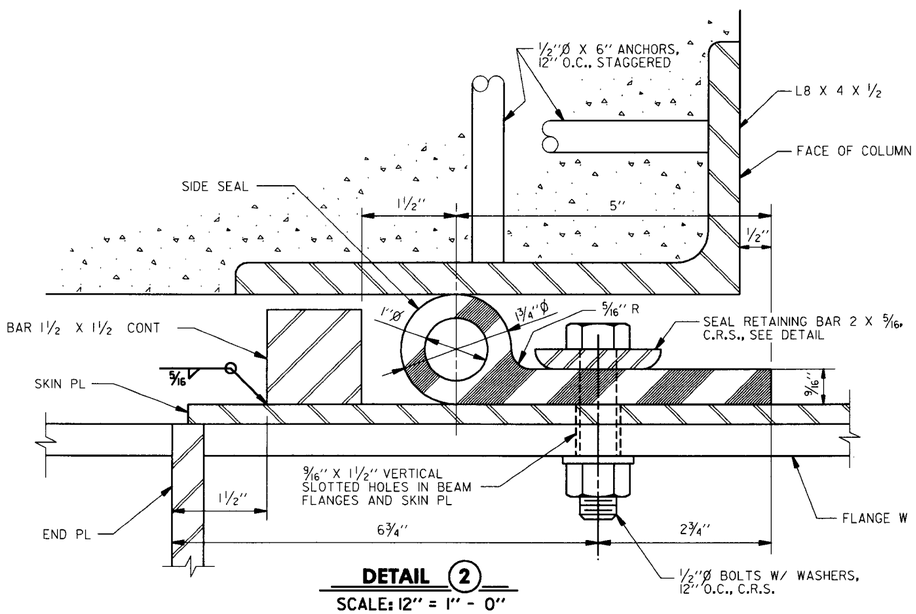


SECTION THRU BOTTOM SEAL

SCALE: 12" = 1" - 0"

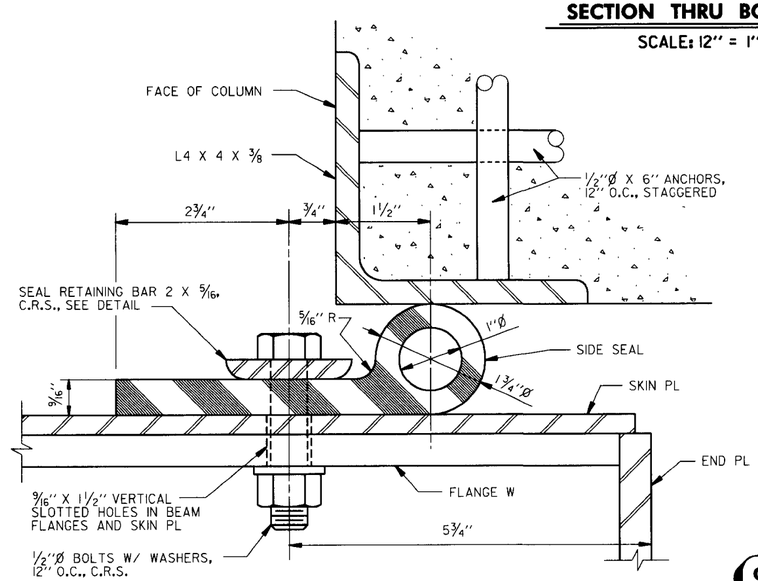


PLAN



DETAIL (2)

SCALE: 12" = 1" - 0"



DETAIL (1)

SCALE: 12" = 1" - 0"

SCALE: 3" = 1" - 0"

12" 0 1'

SCALE: 12" = 1" - 0"

6" 3" 0

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

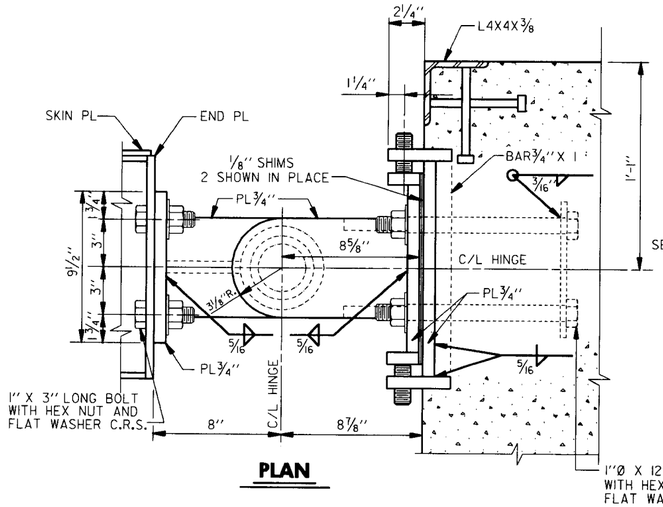
GENERAL DESIGN MEMORANDUM NO. 1 (REDUCED SCOPE)

SWING GATE SEAL DETAILS AND LATCHING DEVICE

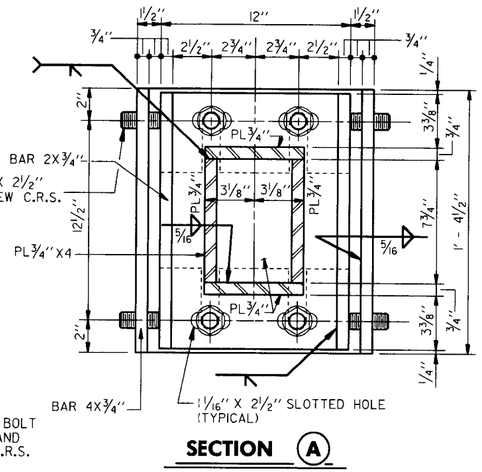
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SA02.DGN	1	H-2-30649

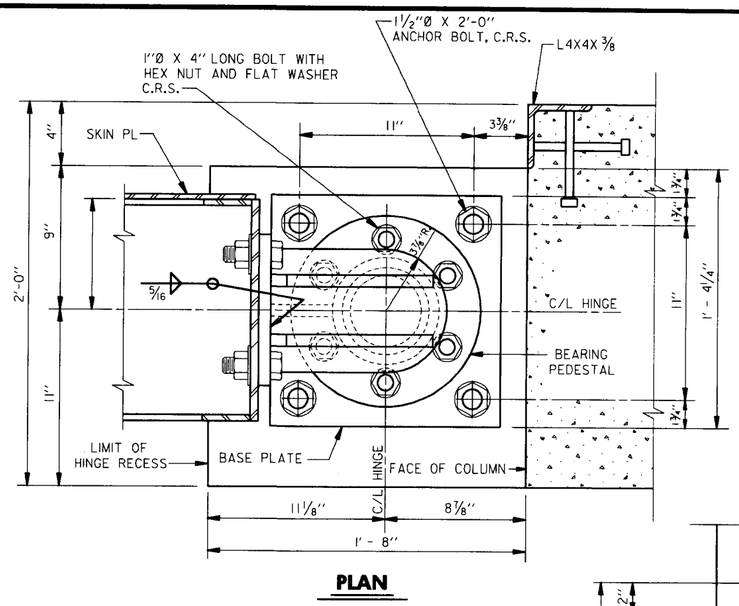
PLATE 32



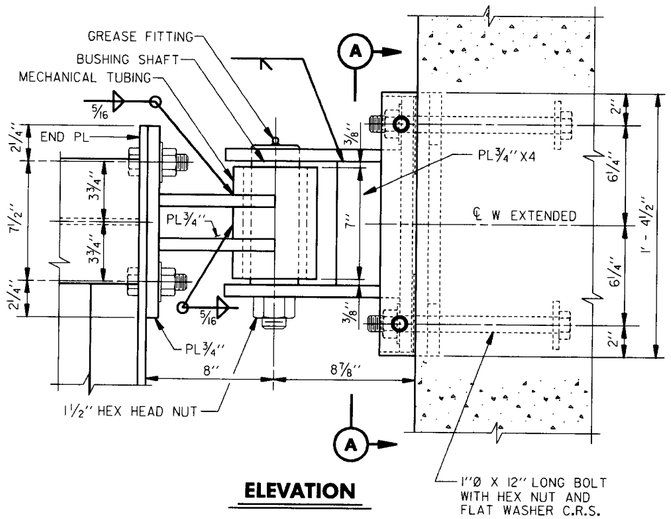
PLAN



SECTION (A)



PLAN

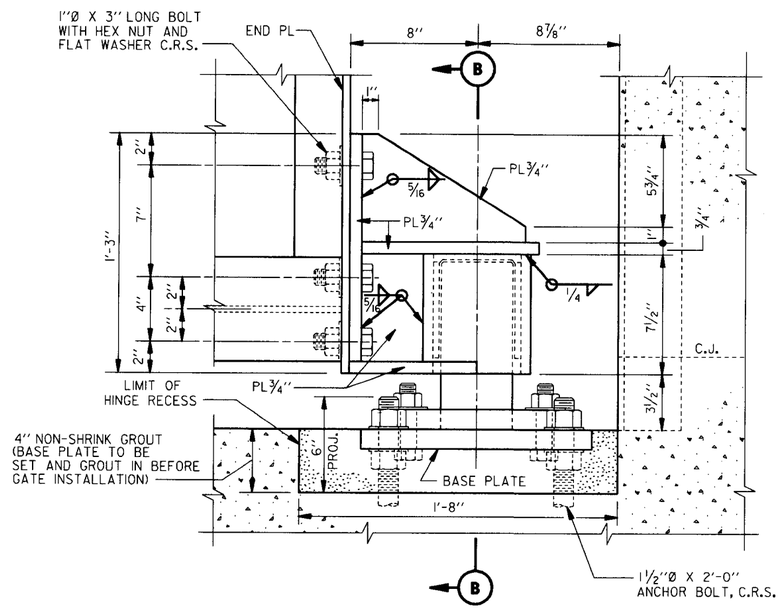


ELEVATION

UPPER HINGE

SCALE: 3" = 1'-0"

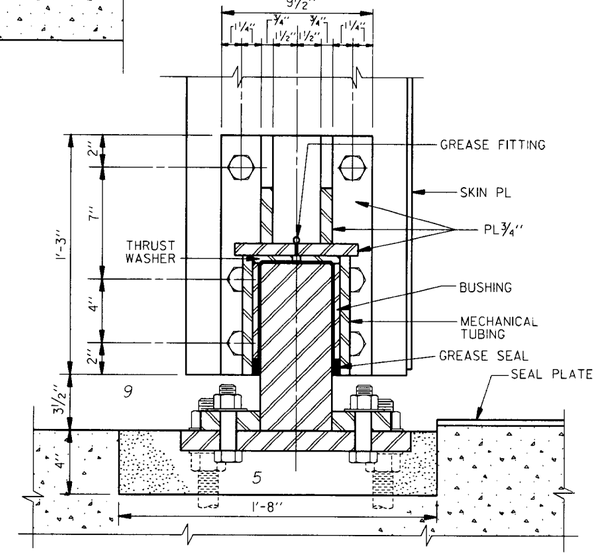
NOTE:
WELDS SHOWN ARE TYPICAL FOR SIMILAR JOINTS WHERE NOT SHOWN.



ELEVATION

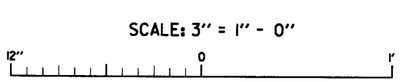
LOWER HINGE

SCALE: 3" = 1'-0"



SECTION (B)

SCALE: 3" = 1'-0"



COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

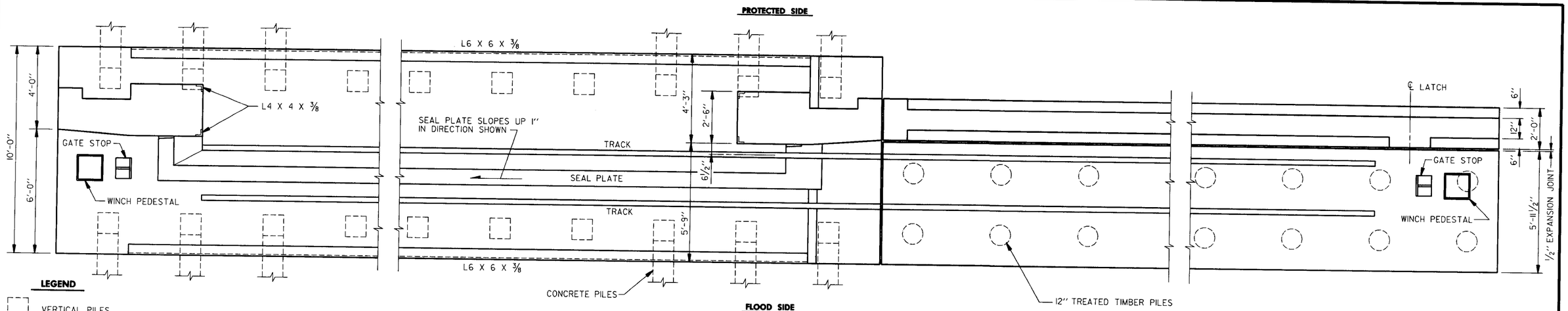
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

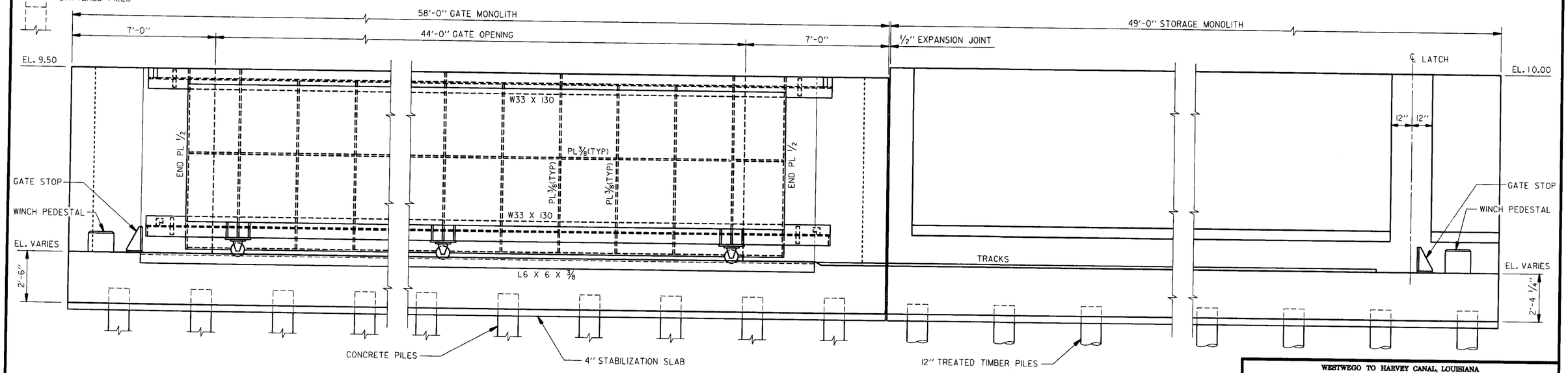
SWING GATE HINGE DETAILS

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

DATE:	DESIGN FILE:	PLOT SCALE:	FILE NO.
JULY 1989	30649SA01.DGN	4	H-2-30649



PLAN AT TOP OF WALL



FLOOD SIDE ELEVATION

COMPUTER AIDED DESIGN DRAFTING

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

12" 0 2' 4' 6' 8'

WESTWEGO TO HARVEY CANAL, LOUISIANA

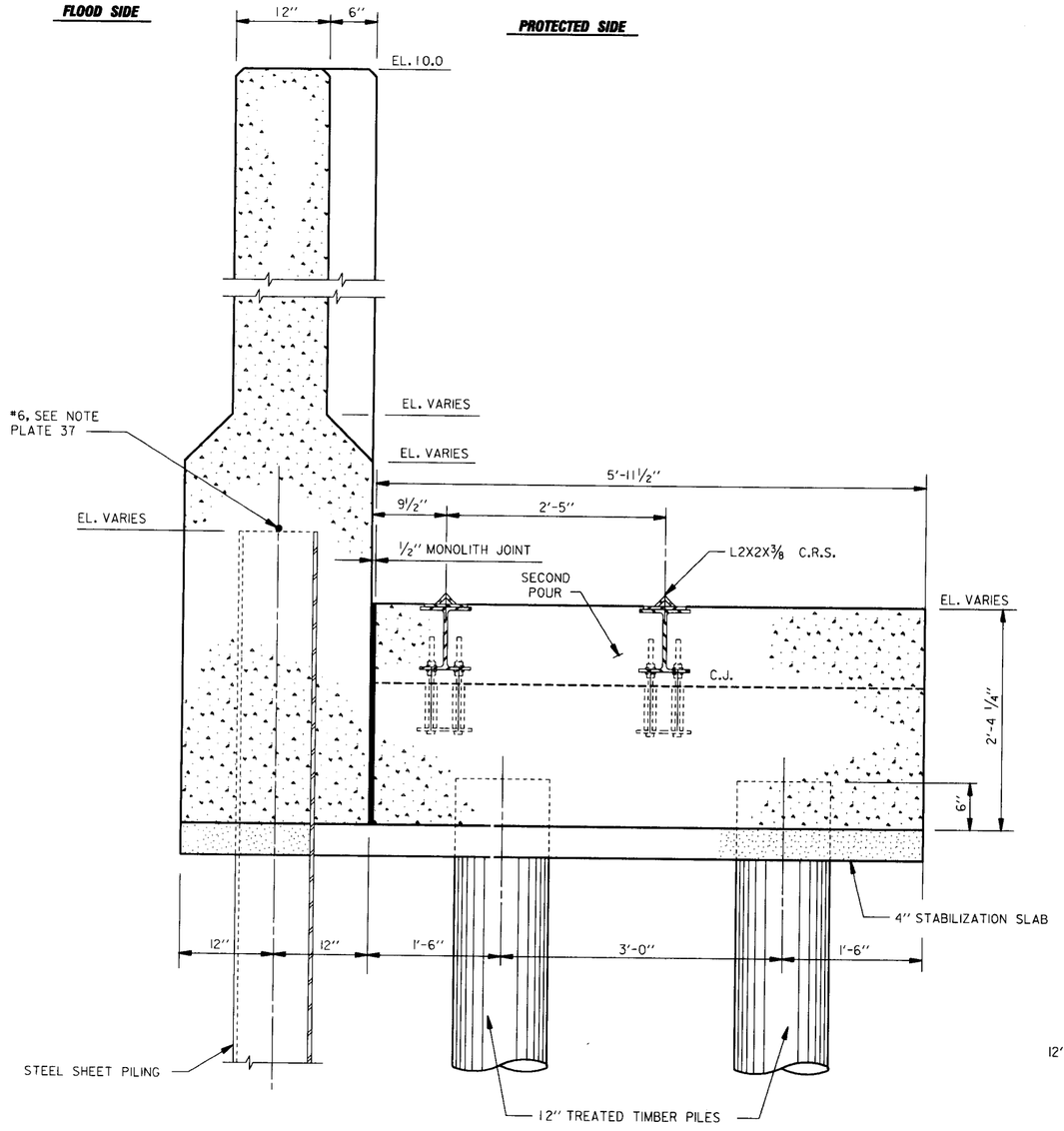
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

BOTTOM ROLLER GATE

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

DATE: JULY 1989	DESIGN FILE: 30649SB04.DGN	PLOT SCALE: 24	FILE NO. H-2-30649

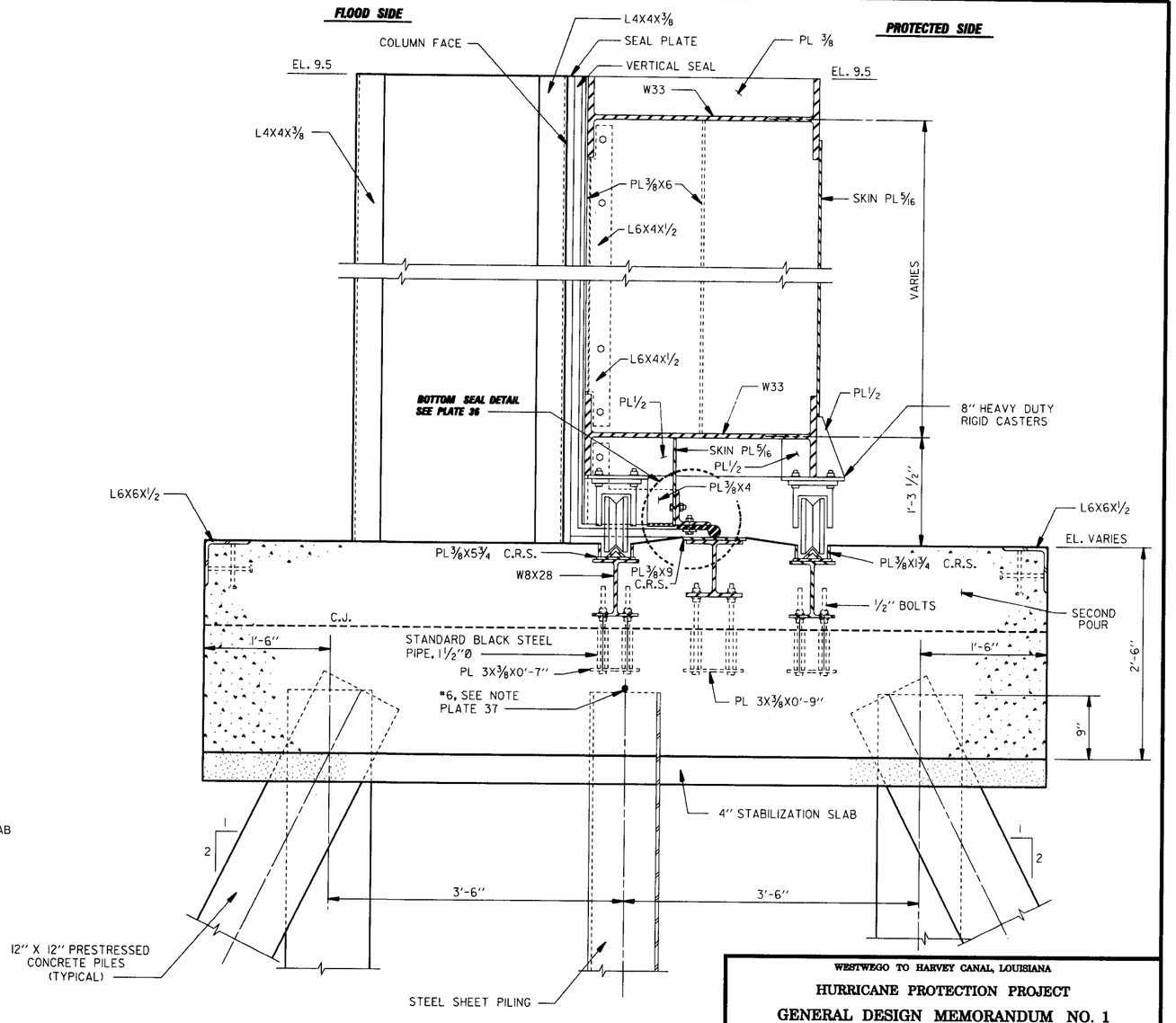


STORAGE MONOLITH

SCALE: 1½" = 1'-0"

SCALE: 1½" = 1' - 0"

12" 0 1' 2' 3'



GATE MONOLITH

SCALE: 1½" = 1'-0"

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

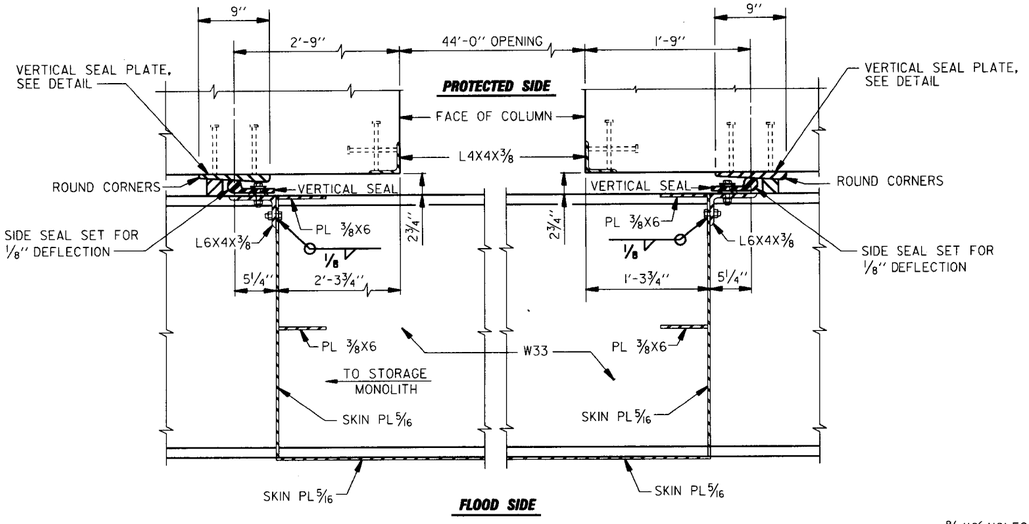
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

BOTTOM ROLLER GATE DETAILS

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

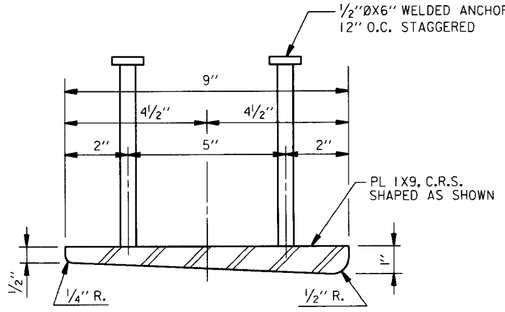
DATE: JULY 1980	DESIGN FILE: 30649SA30.DGN	PLOT SCALE: 8	FILE NO. H-2-30649

PLATE 35



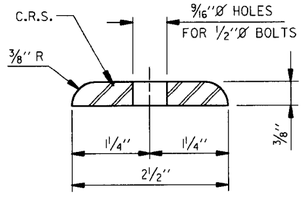
SECTION THRU ROLLER GATE

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



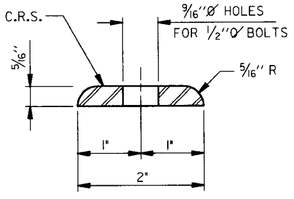
VERTICAL SEAL PLATE DETAIL

SCALE: 6'' = 1'' - 0''



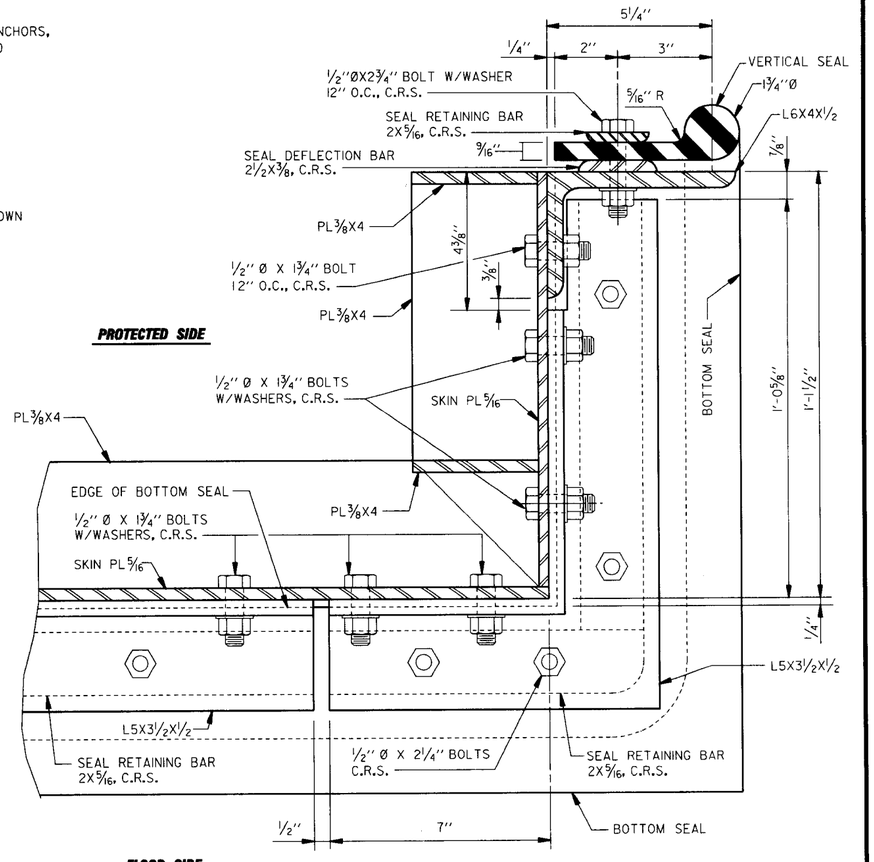
SEAL DEFLECTION BAR

SCALE: 12'' = 1'' - 0''



SEAL RETAINING BAR

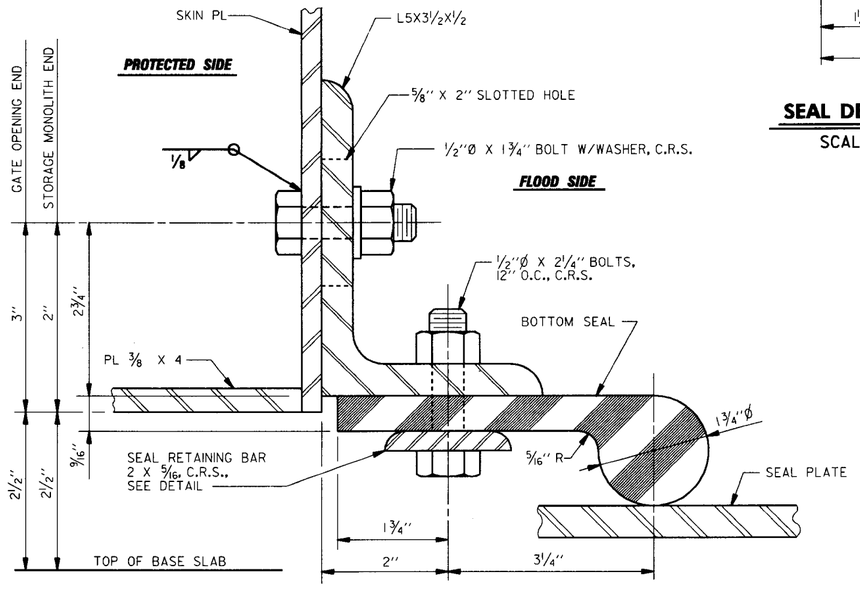
SCALE: 12'' = 1'' - 0''



VERTICAL SEAL

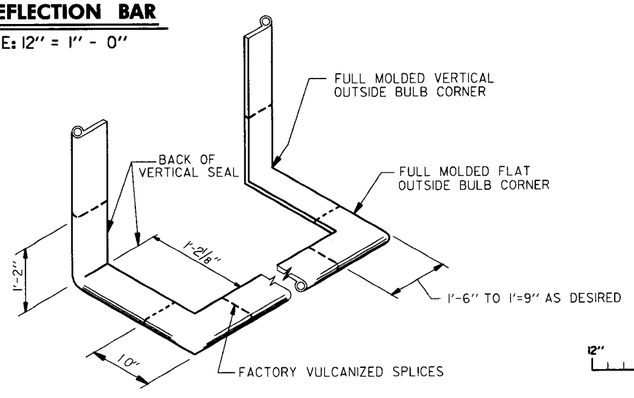
PLAN AT END OF GATE BELOW W

SCALE: 6'' = 1'' - 0''



TYPICAL SECTION THRU BOTTOM SEAL

SCALE: 12'' = 1'' - 0''



CORNER DETAIL, TYPICAL EACH SIDE

TYPICAL GATE SEAL

NOT TO SCALE

SCALE: 3'' = 1'' - 0''

12'' 0 1'

SCALE: 6'' = 1'' - 0''

12'' 6'' 0

SCALE: 12'' = 1'' - 0''

6'' 3'' 0

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

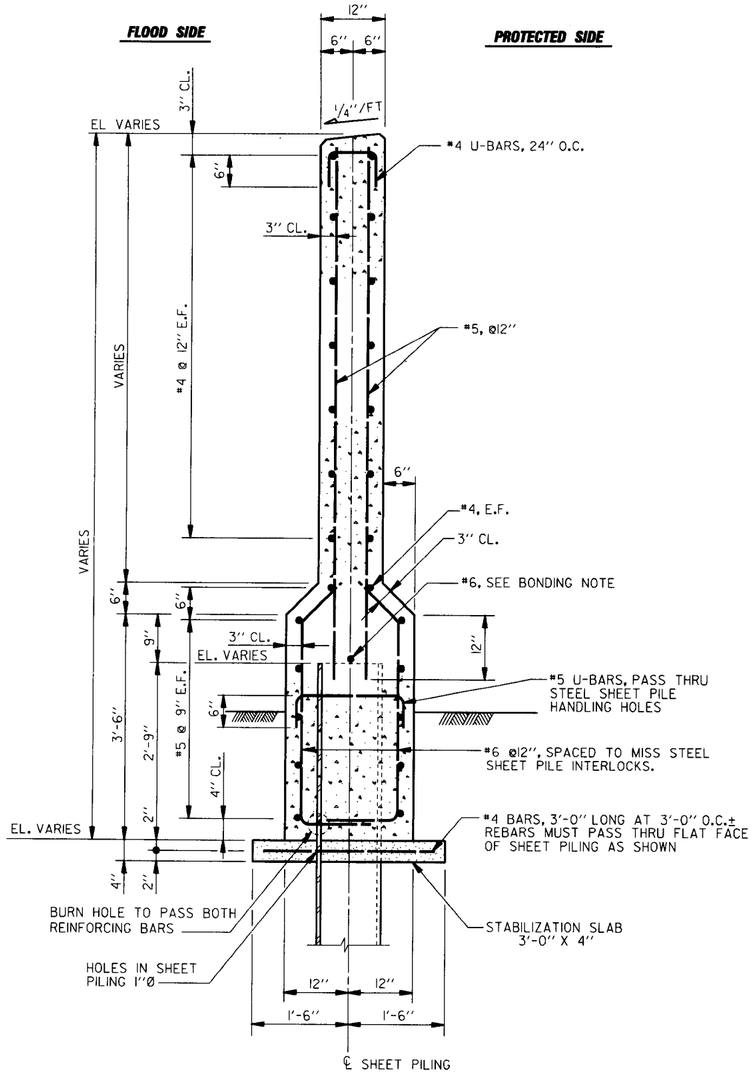
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

BOTTOM ROLLER GATE SEAL DETAILS

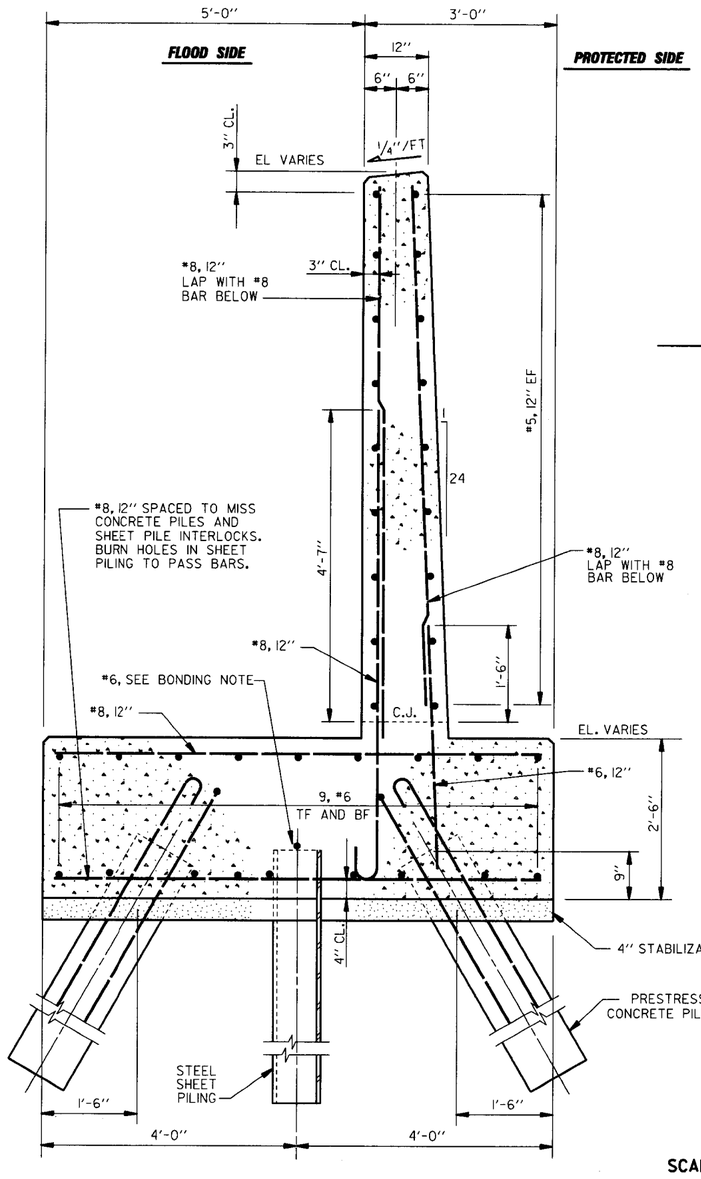
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE: JULY 1989	DESIGN FILE: 30649SA29.DGN	PLOT SCALE: 2	FILE NO. H-2-30649



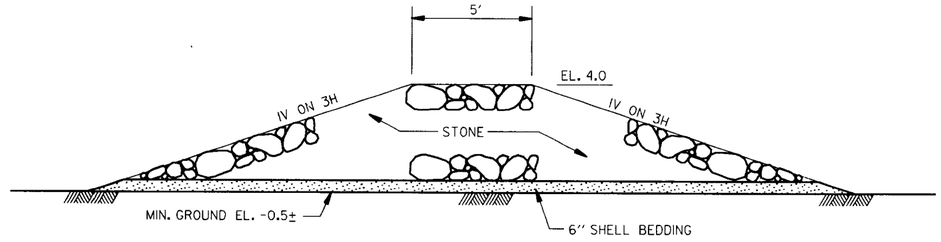
TYPICAL I-WALL SECTION

SCALE: 1'' = 1'-0''



TYPICAL T-WALL SECTION

SCALE: 1'' = 1'-0''



TYPICAL SECTION

BAIE DU CABANAGE MITIGATION DIKE

SCALE: 3/8'' = 1'- 0''

BONDING NOTE:

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

SCALE: 3/8'' = 1'- 0''

12'' 0 2' 4' 6' 8' 10'

SCALE: 1'' = 1'- 0''

12'' 0 1' 2' 3' 4' 5'

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

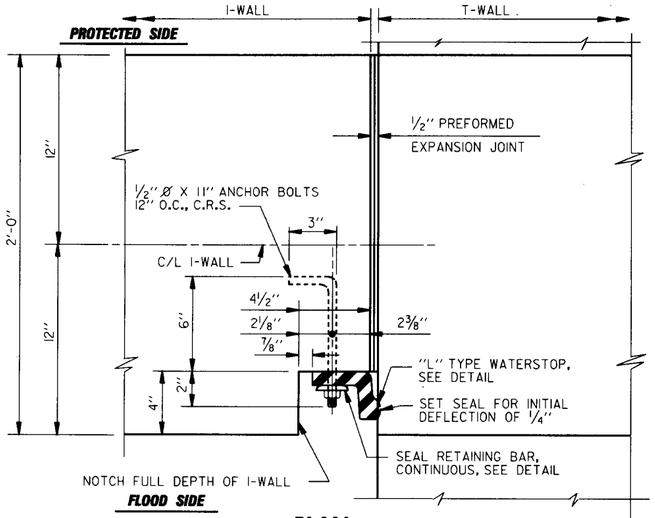
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1 (REDUCED SCOPE)

TYPICAL WALL SECTIONS AND BAIE DU CABANAGE DIKE

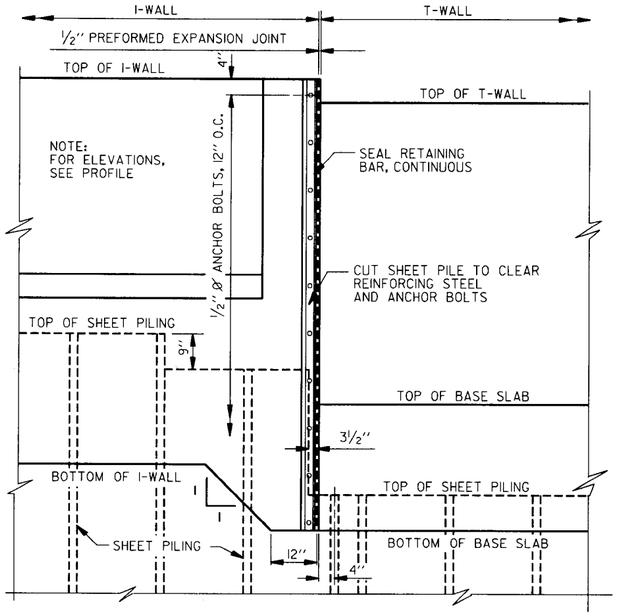
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DATE: JULY 1989	DESIGN FILE: 30649SA06.DGN	PLOT SCALE: 12	FILE NO. H-2-30649



PLAN

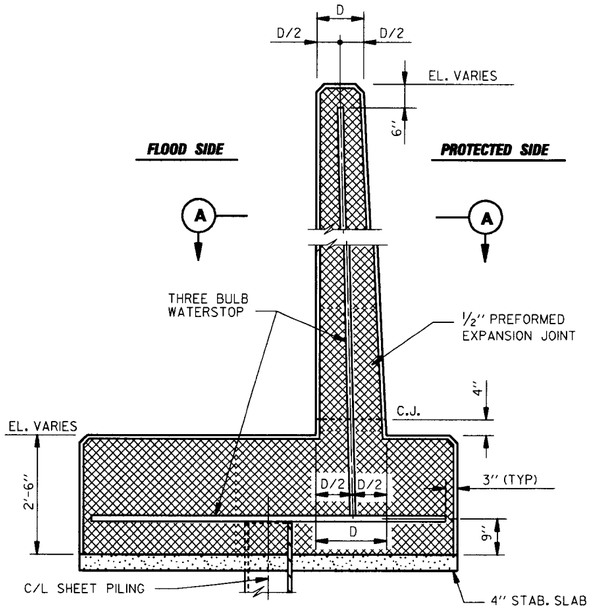
SCALE: 3" = 1'-0"



FLOOD SIDE ELEVATION

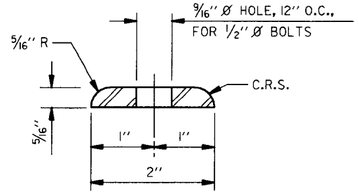
TYPICAL JOINT BETWEEN I-WALL AND T-WALL

SCALE: 3/4" = 1'-0"



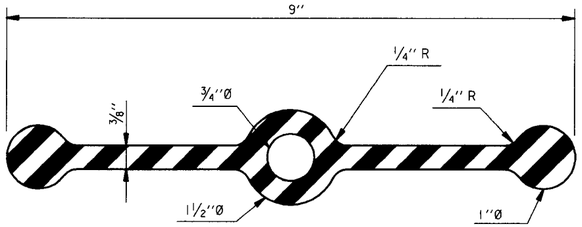
TYPICAL T-WALL JOINT

SCALE: 3/4" = 1'-0"



SEAL RETAINING BAR

SCALE: 12" = 1'-0"



THREE BULB WATERSTOP

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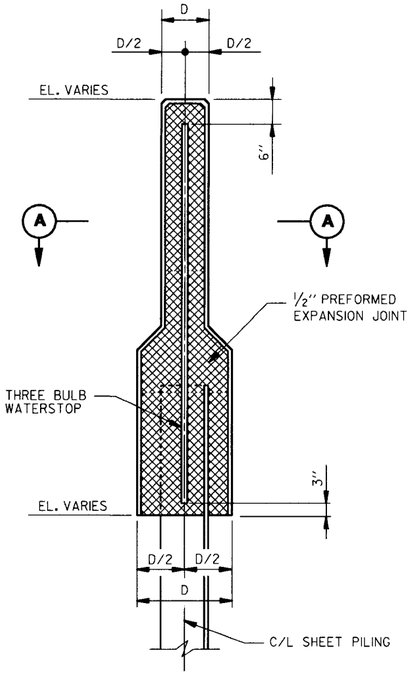

TYPICAL I-WALL JOINT

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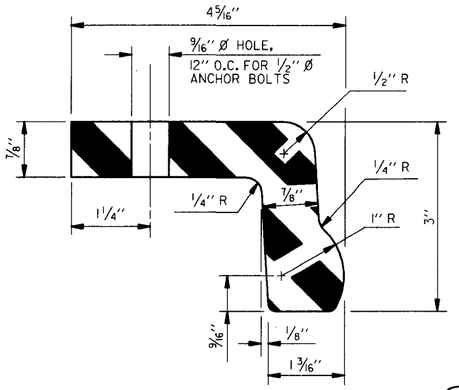

"L"-TYPE WATERSTOP

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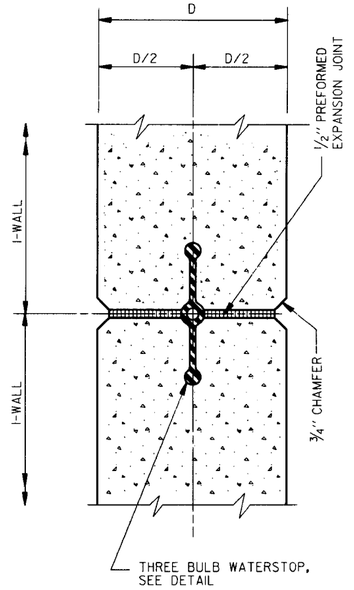

SECTION (A)

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SCALE: 3/4" = 1'-0"

12" 0 1' 2' 3' 4'

SCALE: 3" = 1'-0"

12" 0 1'

SCALE: 12" = 1'-0"

6" 3" 0

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

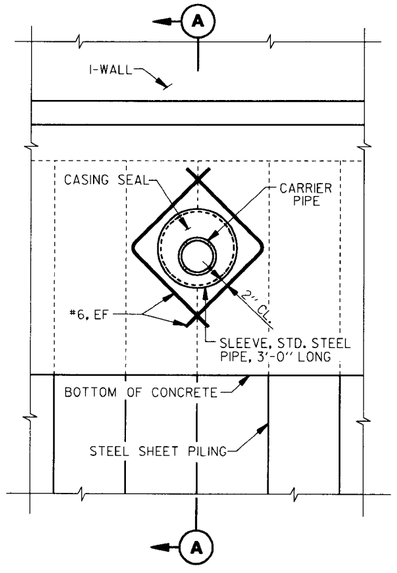
HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

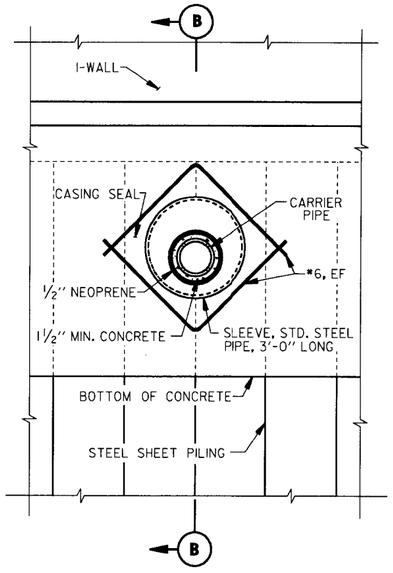
TYPICAL JOINT DETAILS

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

DATE: JULY 1989	DESIGN FILE: 30649SA03.DGN	PLOT SCALE: 1	FILE NO. H-2-30649



ELEVATION



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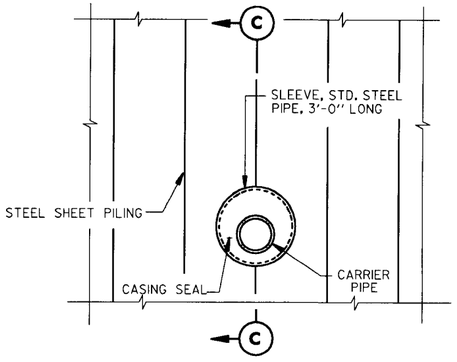

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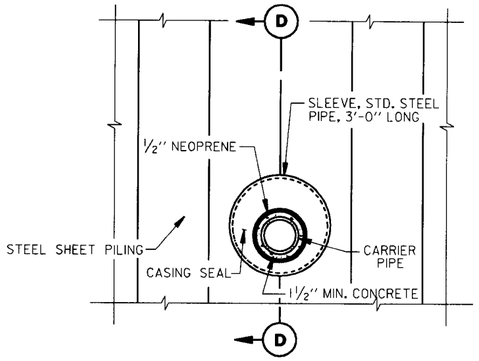
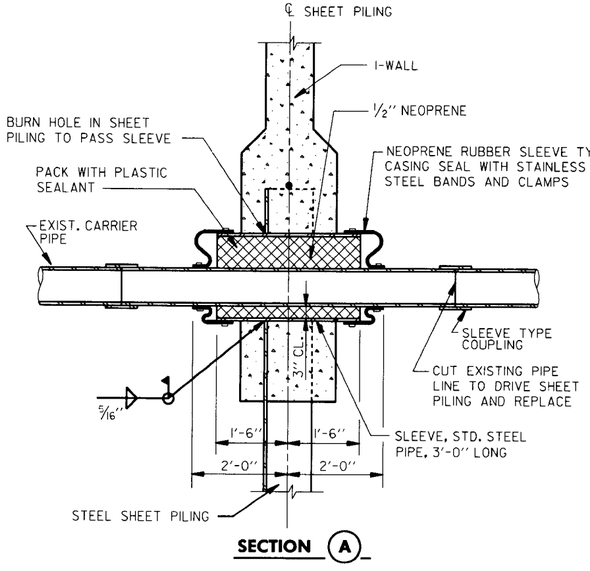


ELEVATION



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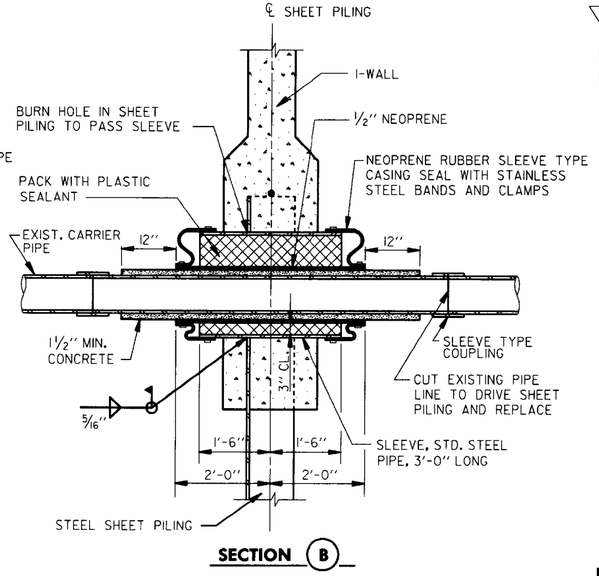
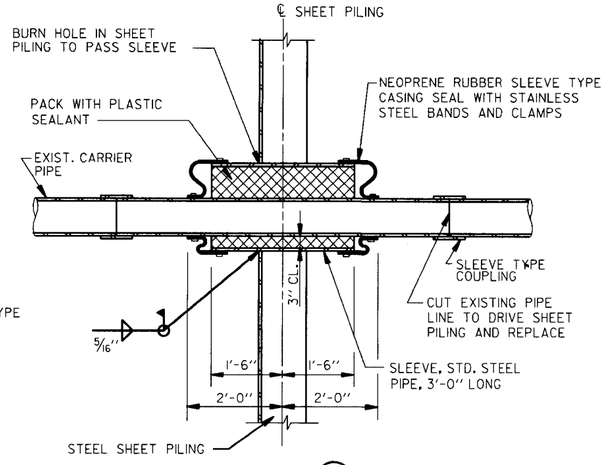
TYPICAL PIPE THRU I-WALL



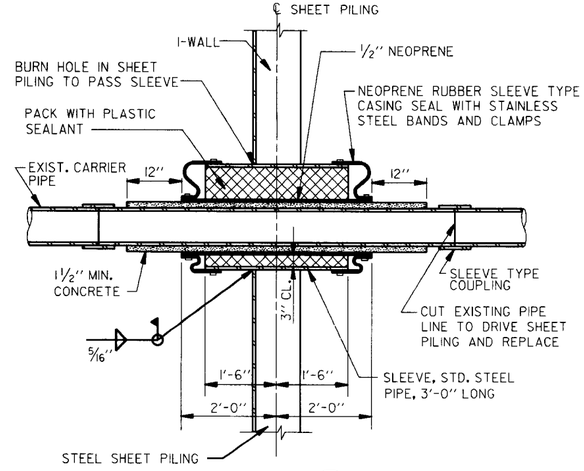
SECTION (B)

TYPICAL GAS PIPE THRU I-WALL



SECTION (C)

TYPICAL PIPE THRU STEEL SHEET PILING



SECTION (D)

TYPICAL GAS PIPE THRU STEEL SHEET PILING

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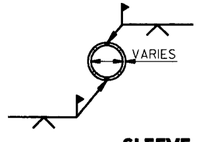

IF CONDITIONS PERMIT, AN ALTERNATE METHOD OF PASSING A UTILITY LINE THROUGH SHEET PILE CAN BE ACCOMPLISHED WITHOUT CUTTING THE UTILITY LINE. THIS METHOD CONSIST OF LATERALLY DISPLACING THE UTILITY LINE, DRIVING THE SHEET PILING, NOTCHING THE SHEET PILE AND INSTALLING SLEEVES IN HALVES.

SLEEVE INSTALLATION IN HALVES

COMPUTER AIDED DESIGN DRAFTING

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1 (REDUCED SCOPE)

UTILITY CROSSING DETAILS

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

DATE: JULY 1989	DESIGN FILE: 30649SA05.DGN	PLOT SCALE: 16	FILE NO. H-2-30649

WESTWEGO TO HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1 (REDUCED SCOPE)

APPENDIX A

HYDROLOGY AND HYDRAULICS

WESTWEGO TO HARVEY CANAL, LOUISIANA
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
Appendix A

Hydrology and Hydraulics

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SECTION I - ANALYSIS

A-1. General.

This appendix presents detailed descriptions of the climatology and hydrologic regimen of the area and detailed descriptions of hydraulic analysis methods and procedures used in the design of the protection features of the plan. The overall plan of improvement is described in detail in the main body of this memorandum and reference to the main text is cited where appropriate.

A-2. Description.

The study area, located in Southeastern Louisiana, lies within Jefferson Parish on the west bank of the Mississippi River. The area is bounded by the Harvey Canal to the east, Lakes Cataouatche and Salvador to the west, the Mississippi River to the north and Barataria Bay to the south. Lakes Salvador and Cataouatche are estuary areas which connect to the Gulf of Mexico through Barataria Bay. Tidal waters can be carried into the study area through these lakes and Bayou Barataria into Bayou Segnette and the Harvey Canal. Freshwater is introduced into the study area from the Mississippi River via the Harvey and Algiers Locks, direct rainfall and pumpage from leveed areas.

The project area, is of mostly low relief and characteristic of an alluvial plain. Situated on the western bank of the Mississippi River near New Orleans, land elevations slope gently from an average elevation of about 12 feet NGVD along the natural banks of the Mississippi River to several feet below sea level in portions of the leveed areas. Natural ground elevations in the unleveed marsh areas in the southern part of the study area average 0.5 to 1.0 ft NGVD. Although leveed marshland will subside when pumped, unleveed areas are subject to natural subsidence and in the future will become increasingly vulnerable to flooding from the combined effects of this subsidence and global sea level rise. During the next 100 years subsidence in the project area will vary from as much as 1 to 2 feet in the leveed areas to 0.65 feet in the surrounding marsh. Global sea level rise is expected to be 0.5 feet within the next century.

All of the area is protected from Mississippi River overflows by the mainline levee system. Storm surge originating in the Gulf of Mexico can travel across the marsh and through the many natural and man-made channels to threaten the project area from the south and west. Storm winds blowing across Lakes Salvador and Cataouatche further raise the height of flood waters outside the leveed areas and add to required levee heights. To protect the area from this tidal and storm surge flooding, local interests have constructed a network of levees that nearly encompass the area. Along the unleveed reach, the area is afforded protection by the Bayou Des Familles Ridge, a ridge at an elevation of approximately 4.5 feet NGVD, which generally runs perpendicular to the Mississippi River in a north-south direction.

Several pumping stations drain the study area. Two stations, the Harvey and Cousins Stations discharge directly into the Harvey Canal. The Estelle Pumping Station discharges into Bayou Barataria. An additional Estelle

Pumping Station will be constructed near the existing station; it will also discharge into Bayou Barataria. On the western side of the study area six pumping stations, the new Westwego, Bayou Estates, Orleans Village, the new Ames, Mt. Kennedy and Oak Cove, drain rainfall-runoff water into the marsh. The Bayou Estates pump, will be replaced by the new Westminster/Lincolnshire Pumping Station.

The new hurricane protection levee will not interfere with the operation of these pumping stations and will protect this portion of Jefferson Parish from the standard project and lesser intensity hurricane surges emanating from Lakes Salvador and Cataouatche; the area will still be subject to periodic inundation caused by excessive rainfall. The study area is depicted on Plate A-1.

A-3. Climatology.

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

TABLE A-1
METEOROLOGIC STATIONS

LENGTH OF RECORDS (YRS.) TO 1985

PRECIPITATION & TEMPERATURE STATIONS	Precipitation	Temperature
NEW ORLEANS - AUDUBON PARK	97	97
NEW ORLEANS - MOISANT AIRPORT	33	33
RESERVE (NR)	85	85
SLIDELL	30	30
DONALDSONVILLE (NR)	97	98
LOUISIANA NATURE CENTER	7	7
PARADIS (NR)	72	32
HAMMOND (NR)	90	91
ST. BERNARD (NR)	21	21
COVINGTON	93	93
CARVILLE (NR)	48	47
BATON ROUGE AIRPORT	118	98

TABLE A-1 (cont'd)
METEOROLOGIC STATIONS

LENGTH OF RECORDS (YRS.) TO 1985
PRECIPITATION & TEMPERATURE STATIONS

	Precipitation	Temperature
RECORDING PRECIPITATION STATIONS		
NEW ORLEANS ALGIERS	87	-
NEW ORLEANS DPS 14 - CITRUS	32	-
NEW ORLEANS WATER PLANT DUBLIN	93	-
NEW ORLEANS DPS 5 - JOURDAN	53	-
NEW ORLEANS DPS 3 - LONDON	93	-
NEW ORLEANS DPS 6 - METAIRIE	38	-
GONZALES	9	-
NON-RECORDING PRECIPITATION STATIONS		
NEW ORLEANS CITY HALL	9	-
BATON ROUGE CENTRAL	8	-
ABITA SPRINGS FIRE TOWER	14	-

LEGEND: NR Non-Recording

b. Precipitation. Precipitation generally is heavy in two fairly definite rainy periods. Summer showers last from mid-June to mid-September, and heavy winter rains generally occur from mid-December to mid-March. The annual normal precipitation for New Orleans at Audubon Park is 61.6 inches, with annual variations of plus or minus 50 percent. Extreme monthly rainfalls exceeding 12 inches are not uncommon, and as much as 20 inches have been recorded in a single month. The greatest 24-hour amount of precipitation at this station since 1871 was 14.01 inches on 15 and 16 April 1927. At Belle Chase, 15.4 inches of rain fell on 2 October 1937. Table A-2 gives the 30-year normals for the New Orleans at Audubon Park station along with the monthly maximum and minimum totals during the 1951-1980 period. Snowfall amounts are generally insignificant, and hail of a damaging nature seldom occurs.

TABLE A-2
MONTHLY RAINFALL (INCHES)
NEW ORLEANS AT AUDUBON PARK
30-YEAR NORMALS (1951-1980)

Month	Normal	Maximum	Minimum	Month	Normal	Maximum[a]	Minimum
Jan	4.9	12.69	0.99	Jul	7.17	20.39	2.37
Feb	5.19	12.44	0.54	Aug	6.67	17.82	2.67
Mar	4.68	10.17	T	Sep	5.98	16.91	0.80

TABLE A-2 (Cont'd)
MONTHLY RAINFALL (INCHES)
NEW ORLEANS AT AUDUBON PARK
30-YEAR NORMALS (1951-1980)

Month	Normal	Maximum	Minimum	Month	Normal	Maximum[a]	Minimum
Apr	4.68	20.24	0.58	Oct	2.52	8.18	0.0[b]
May	5.06	12.61	0.62	Nov	4.01	10.15	0.49
Jun	5.39	16.98	0.39	Dec	5.30	8.93	1.40
				ANNUAL	61.55	83.54[c]	40.11[d]

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

c. Temperature. Temperature records at New Orleans Audubon Park show the normal annual temperature is 69.5°F. The monthly mean temperatures vary from 54°F to 83°F. Record high temperatures of 102°F occurred on 30 June 1954 and 22 August 1980. The record low temperature of 7°F occurred on 13 February 1899. Temperature normals (1951-1980) for New Orleans at Audubon Park station are shown in Table A-3.

TABLE A-3
MONTHLY TEMPERATURE (°F)
NEW ORLEANS AT AUDUBON PARK
30-YEAR NORMALS (1951-1980)

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

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

d. Wind. Average wind velocity is 7.8 mph, based on anemometer records at New Orleans Moisant Airport over the period 1966-1983. The predominant wind directions are north-northeast from September through February and south-southeast from March through June. Table A-4 shows the average monthly wind speed and its resultant direction for this period.

TABLE A-4

WIND SUMMARIES, NEW ORLEANS AT MOISANT AIRPORT (1966-1983)

AVERAGE WIND SPEED (MPH)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ANN
1966	9.6	10.5	9.5	10.7	8.7	7.3	6.2	6.4	5.7	7.6	7.4	8.6	8.2
1967	8.3	9.5	9.0	9.3	9.1	6.8	6.2	5.9	7.0	7.4	8.0	9.8	8.0
1968	9.2	10.0	9.3	9.1	8.4	5.6	5.7	5.2	6.4	6.8	8.9	9.3	7.8
1969	9.7	9.8	10.0	8.6	7.3	7.2	6.5	6.8	6.7	9.7	8.0	9.1	8.3
1970	9.5	9.2	9.8	9.9	8.5	6.8	5.4	6.0	6.7	7.7	8.0	7.4	7.9
1971	8.4	9.8	9.8	8.5	7.9	5.3	5.7	5.0	6.5	4.8	8.0	8.7	7.4
1972	8.9	8.6	9.1	10.2	7.3	9.3	7.5	6.4	7.0	8.3	9.9	9.4	8.5
1973	9.6	10.2	12.0	11.5	10.0	6.7	6.7	6.3	7.9	7.0	9.6	11.4	9.1
1974	9.2	11.0	10.8	10.7	8.2	7.4	5.0	5.2	8.6	7.4	8.5	8.5	8.4
1975	9.4	8.6	11.0	10.0	7.4	6.5	6.5	4.9	6.3	6.4	8.0	7.8	7.7
1976	9.6	8.8	10.5	7.6	8.4	6.9	5.4	5.7	6.0	8.5	7.9	8.2	7.8
1977	9.8	8.5	8.5	7.3	5.7	5.3	4.4	5.5	5.4	6.6	8.1	8.8	7.0
1978	9.1	8.9	8.5	8.6	7.9	5.9	5.5	5.3	6.3	6.1	6.7	10.0	7.4
1979	10.5	9.0	9.3	8.0	7.2	6.5	6.7	4.4	8.0	6.7	8.1	6.3	7.6
1980	7.6	8.0	9.8	8.8	7.5	7.4	5.6	5.7	5.3	5.9	6.4	5.9	7.0
1981	7.6	8.3	7.7	7.3	7.8	6.9	5.7	4.8	5.7	7.0	7.3	8.6	7.1
1982	9.8	8.3	8.9	9.4	6.5	6.2	4.6	4.4	7.1	7.5	7.6	10.0	7.5
1983	8.0	10.0	8.8	10.4	7.8	6.3	5.8	5.3	6.0	6.8	8.3	10.0	7.8
AVG	9.1	9.2	9.6	9.2	7.9	6.7	5.8	5.5	6.6	7.1	8.0	8.8	7.8

WIND SUMMARIES, NEW ORLEANS AT MOISANT AIRPORT (1966-1983)

RESULTANT DIRECTION*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ANN
1966	02	04	07	16	07	07	23	15	02	03	03	05	05
1967	03	02	13	15	16	11	21	02	05	06	05	08	09
1968	03	35	12	16	15	19	12	05	06	04	04	06	07
1969	07	02	02	13	09	18	24	09	04	05	36	01	05
1970	03	03	08	17	19	21	29	12	08	03	32	06	09
1971	02	12	13	15	13	23	20	01	07	04	04	12	09
1972	07	07	12	15	04	20	14	34	12	06	02	06	08
1973	02	36	16	16	20	18	24	04	10	07	13	20	12
1974	12	24	16	13	16	16	25	13	05	06	06	16	12
1975	09	21	14	11	15	18	25	17	03	05	08	04	10
1976	04	19	15	15	15	13	25	01	04	02	02	02	07
1977	01	09	13	14	13	21	20	12	15	03	10	13	11
1978	01	01	28	15	16	12	19	11	08	03	08	07	07
1979	01	04	15	14	14	15	17	13	04	11	03	03	08
1980	06	06	09	20	15	22	27	13	09	04	02	02	08
1981	02	02	21	15	13	16	22	11	05	06	10	04	09
1982	11	01	12	10	13	22	21	21	06	06	06	10	09
1983	04	05	29	18	15	12	10	11	07	05	10	03	08

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

e. Streamflow. Stage records are available at four locations within the study area. Hurricane Juan set new record highs at three of these gages. Table A-5 gives the period of record and extremes of these stations. Discharge data is not taken due to tidal influence.

TABLE A-5
GAGE DATA

Station	Period of Record	Stage Extremes (ft NGVD) Maximum	Date	Minimum	Date
Mississippi River @ Harvey Lock	Jan 1924 - to date	19.42	24 Apr 1927	-0.68	17, 18 Dec 1953
IWW @ Harvey Lock	Jan 1925 - to date	4.74[a]	29 Oct 1985	-1.28	26, 27 Jan 1940
Bayou Barataria @ Barataria	Jan-Sep 1950 and Nov 1951 - to date	4.25[a]	29 Oct 1985	-0.58	9 Sep 1965
Bayou Barataria @ Lafitte	Oct 1955 to Dec 1960 and May 1963 - to date	5.05[a]	29 Oct 1985	-0.60	12, 13 Jan 1956

[a]Caused by Hurricane Juan

f. Tropical Storms and Hurricanes. Several hurricanes and tropical storms have passed through or near the study area. Some of the major storms include the 1915 hurricane, the 1947 hurricane, Hurricanes Flossy, Hilda, Betsy, Carmen, Babe, Bob, Danny, and Juan. Some major characteristics of these storms are summarized in Table A-6. Hurricane tracks are illustrated on Plate A-3.

TABLE A-6
EXPERIENCED HURRICANES

STORM	DATE	CENTRAL PRESSURE (inches mercury)	FORWARD SPEED (Knots)	MAXIMUM RECORDED WINDSPEED (M.P.H.)
1915	22 Sep - 2 Oct	27.87	10	106
1947	4 - 21 Sep	28.57	16	98
FLOSSY	21 - 30 Sep 1956	28.76	10	90
HILDA	28 Sep - 5 Oct 1964	28.40	7	98
BETSY	27 Aug - 10 Sep 1965	28.0	20	105
CARMEN	29 Aug - 10 Sep 1974	27.84	9	86
BABE	3 - 8 Sep 1977	29.85	--	46+
BOB	9 - 16 Jul 1979	29.58	15	58
DANNY	12 - 20 Aug 1985	29.61	13	--
JUAN	26 - 31 Oct 1985	29.13	13*	74

* Maximum reported forward speed. Several times during its traversal, the storm stalled while changing direction.

Hurricane Flossy brought torrential rains and tidal flooding to the study area. Golden Meadow, which is below the area, received 16.7 inches of rain in a 24 hour period. Hurricane Hilda raised water levels at Barataria and Lafitte to 3.6 and 4.0 feet NGVD, respectively. Hurricanes Betsy and Carmen also caused flooding to some parts of the study area. Hurricane Juan broke high water records throughout the area (see Table A-5, Gage Data). On the west bank, three local levees were breached and several subdivisions were flooded by tidal inundation and the long duration of high stages. The total storm precipitation for Juan ranged from 8 to 12 inches over the area.

A-4. Stages, Tides and Salinities.

a. Stages. High stages usually result from the occurrence of a tropical storm or hurricane. However, high stages can also be caused by long duration southerly winds or westerly winds across Lakes Cataouatche and Salvador. Highest stages at the Harvey Lock at IWW and at both Barataria and Lafitte on Bayou Barataria were caused by Hurricane Juan in Oct 1985, see table A-5.

b. Tides. The normal tide has a general range of 0.35 foot in the Harvey Canal and the surrounding marsh and is diurnal in nature. However, wind effects usually mask the daily ebb and flood variations. The mean high and low tide in the area is approximately 1.6 and 1.3, respectively. The average annual high stages vary from 3.0 to 3.5 in the study area.

c. Salinities. The Barataria Bay Waterway transmits water of elevated salinity from Barataria Bay into the project area. This water is distributed throughout the area via Bayou Barataria, Bayou Segnette, Bayou Des Familles, and vaious other smaller waterways in the area. These waterbodies also provide drainage for freshwater runoff in the project area. This, results in variable salinity levels depending upon climate and weather conditions. Long-term data from Bayou Segnette indicate that salinities in the southern part of the project area are slightly higher than in the northern part. Salinity concentrations in Bayou Segnette near Lake Cataouatche averaged 1.6 parts per thousand (PPT) and ranged from 0.2 to 4.5 PPT. Further north on Bayou Segnette, near the Churchill Farms Canal, salinities were lower with an average of 1.4 PPT and a range of 0.4 to 3.1 (PPT). Chloride measurements made by the United States Geological Survey (USGS) during 1981 and 1982 indicate that salinities are lower in the wetlands and canals of the interior of the drainage area. In the urbanized areas that are surrounded by levees the water is fresh. The levees act as barriers to flow from outside which may contain elevated salinity levels. Interior freshwater runoff is pumped out of the leveed areas.

A-5. Description and Verification of Procedures.

a. Hurricane Memorandums. The Hydrometeorological Section (HMS), U.S. Weather Bureau, has cooperated in the development of hurricane criteria for experienced and potential hurricanes in the study area. The HMS memorandums provided isovel patterns, hurricane paths, pressure profiles, rainfall estimates, frequency data, and various other parameters required for the hydraulic computations. A reevaluation of historic meteorologic and hydrologic data was the basis for memorandums relative to experienced hurricanes. Those relative to potential hurricanes were developed through the

use of generalized estimates of hurricane parameters based on the most recent research and concepts of hurricane theory. Memorandums applicable to the study area are listed in the attached bibliography.

b. Historical Storms used for Verifications. Three observed storms, with known parameters and effects, were used to establish and verify procedures and relationships for determining surge heights, wind tide levels (WTL's), inflow into Lakes Salvador and Cataouatche and ultimately, flood elevations that result from hurricanes. The three storms used for verification occurred in September of 1915 (1)*, September of 1947 (2) and September 1956 (3). Isovel patterns for these storms are shown on Plates A-4, A-5, and A-6, respectively.

(1) The hurricane of 29 September 1915 had a central pressure index (CPI) of 27.87 inches, an average forward speed of 10 knots, and a maximum sustained wind speed of 99 mph at a radius of 29 nautical miles. This hurricane approached the mainland from the south. At Grand Isle a high water elevation of 9 feet was experienced and near Manila Village at the rear of Barataria Bay a stage of 8.0 feet was reported. Destruction was extensive. At Leesville, Louisiana, approximately 13 miles west of Grand Isle only 1 of 100 houses remained standing.

(2) The 19 September 1947 hurricane had a CPI of 28.57 inches, an average forward speed of 16 knots, and a maximum sustained windspeed of 72 mph at a radius of 33 nautical miles. The direction of approach of this hurricane was approximately from the east. A stage of 4.0 was observed at Grand Isle. The Gulf Coast from Florida to Louisiana experienced a tidal surge from the hurricane with the western end of the Mississippi Sound receiving the greatest buildup.

(3) Hurricane Flossy, which occurred on 24 September 1956, had a CPI of 28.76 inches, an average forward speed of 10 knots, and a maximum wind speed of 80 mph at a radius of 30 nautical miles. This hurricane approached the Louisiana coastline from the southwest, crossing the Mississippi River delta and reentering the Gulf of Mexico. The tide rose to 8.0 feet at Grand Isle. Tides were unusually high from 20 miles west of Grand Isle to western Florida.

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

(1) SPH for the Louisiana coast was derived by the National Weather Service from a study of 42 hurricanes that occurred in the region over a period of 57 years (4). The SPH path critical to the project location and isovel patterns at critical hour are shown on Plate A-4. Based on subsequent studies of more recent hurricanes, the National Weather Service has revised

* Numbers in parenthesis indicate reference in bibliography

the SPH wind field patterns and other characteristics over the years. Wind field patterns were revised after Hurricane Betsy in 1965 to reflect the intensified wind speeds (5), (6), (7). After Hurricane Camille in 1969, the Weather Service completely revised hurricane characteristics for the SPH, including the wind speeds, central pressure and radii (8). In their latest publication (9) NOAA has expanded and generalized the latest SPH characteristics, previous SPH characteristics fit within the new generalized parameters.

(a) The SPH for the Louisiana coastal region has a frequency of once in 100 years. The CPI that corresponds to this frequency of once in 100 years is 27.6 inches. CPI probabilities are based on the following relationship (10):

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

Where P = percent change of occurrence per year
M = number of the event (rank)
Y = number of years of record

(b) Radius of maximum winds is an index of hurricane size. The radius of 12 hurricanes occurring in the New Orleans area is 36 nautical miles. From relationships of CPI and radius of maximum winds of gulf coast hurricanes (10), a radius of 30 nautical miles is considered representative for an SPH having a CPI of 27.6 inches.

(c) Different forward speeds are necessary to produce SPH effects at various locations within the study area. In Lake Salvador, the forward speed is a critical factor and may be as important as the track itself. Sufficient time must elapse to allow for maximum inflow into the lake. The SPH for the east shore, has an average forward speed of 11 knots.

(d) Maximum theoretical gradient wind (10) is expressed as:

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

where V_{gx} = maximum gradient wind speed in miles per hour
P_n = asymptotic pressure in inches
P_o = central pressure in inches
R = radius of maximum winds in nautical miles
f = coriolis parameter in units of hour $^{-1}$

The estimated wind speed (30 feet above ground level) (V_x) (11) in the region of highest speeds is obtained as follows:

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

where T = forward speed in miles per hour.

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

(2) Other synthetic storms of different frequency and CPI are derived from SPH. Other CPI's for desired frequencies are obtained from the graph shown on Plate A-8. V_{gx}'s corresponding to any other CPI are determined similarly by use of the method described for the SPH. Variations in CPI's of historic storms were accomplished by the same procedure (10). Characteristics of synthetic storms and some historic storms are listed in Table A-7.

TABLE A-7
HURRICANE CHARACTERISTICS

Hurricane*	CPI inches	Radius of Max. Winds nautical miles	Forward Speed knots	Vx m.p.h.
Sep 1915	27.87	29	10	99
Sep 1947	28.57	33	16	72
Sep 1956	28.76	30	10	80
Sep 1965	27.79	32	20	122
SPH	27.60	30	11	100
Mod H	28.30	30	11	83

* Tracks are shown on Plate A-9.

d. Surges.

(1) Maximum hurricane surge heights along the gulf shores were determined from computations made for ranges extending from the shores out to the continental shelf by use of a general wind tide formula based on the steady state conception of water superelevation (12) (13) (14). The average windspeed and average depth in each range were determining from isovel and hydrographic charts for each computation. The storm isovel patterns were furnished by U.S. Weather Bureau. In order to reach agreement between the computed maximum surge heights and the observed high water marks, it was necessary to introduce a surge adjustment factor or calibration coefficient into the general equation, which in its modified form, was as follows:

$$S = 1.165 \times 10^{-3} \frac{V^2 F N Z}{D} \cos \theta$$

where S = wind setup in feet
V = windspeed in m.p.h.
F = fetch length in statute miles
D = average depth of fetch in feet
θ = angle between direction of wind and the fetch
N = planform factor, assumed equal to unity
Z = surge adjustment factor

(2) Hurricane surges at the shore were determined by summation of incremental wind setups along a range above the water surface elevation at the the gulf end of the range. A combination of the setup due to atmospheric pressure anomaly and the predicted normal tide was used to determine the

initial elevation at the gulf end of the range. Due to the variation in pressure setup between the shoreward end and gulfward end of the range, an adjustment was made at the former to compensate for the difference. This procedure for determining surge heights at the coastline was developed for the Mississippi gulf coast, where reliable data were available at several locations for more than one severe hurricane, and is used for the entire coastal Louisiana region. Due to dissimilar shoreline configurations different factors were required at different locations, but identical factors were used at each location for every hurricane. The value of the factor is apparently a function of the distance from the shoreline to deep water and varies inversely with this distance. Comparative computed surge heights and observed high water marks for the 1915 and 1947 hurricanes at the locations used to verify the respective procedures are shown in table A-8. All elevations in this appendix are in feet and are referred to National Geodetic Vertical Datum of 1929 (ngvd).

TABLE A-8

HURRICANE SURGE HEIGHTS

Location	Surge adjustment factor (Z)	1915		1947	
		Observed	Computed	Observed	Computed
		feet ngvd		feet ngvd	
Long Point, La.	0.21	9.8	9.6	10.0	10.1
Bay St. Louis, Ms.	0.46	11.8	11.8	15.2	15.1
Gulfport, Ms.	0.60	10.2(a)	9.9	14.1	14.3
Biloxi, Ms.	0.65	10.1(a)	9.8	12.2(a)	12.6

(a) Average of several high water marks.

(3) In those areas where the coastline is characterized by a coastal bay separated from the gulf by an offshore barrier island, such as Grand Isle, or by a shoal, it is necessary to inject an additional step in the normal procedure to verify experienced hurricane tides. The incremental step computation was completed to the gulf shore of the island and the water surface elevation transposed to the inland bay side of the island from whence the incremental computations were continued using a new surge adjustment factor which was considered representative of the shallower depths within the bay. This procedure resulted in a satisfactory verification of hurricane tides along other portions of the Louisiana coast.

(4) The incremental step computation was used to check elevations experienced during the hurricane of 22 September - 2 October 1915 and hurricane Flossy 21-30 September 1956. Verification of surge heights and surge adjustment factors for these hurricanes are shown in table A-9. Surge adjustment factors of 0.80 in open water and 0.48 in Barataria Bay were used for the Manila Village area.

TABLE A-9

VERIFICATION OF HURRICANE SURGE HEIGHTS

Location	Sep. 1915 Observed	Sep. 1915 Computed	Sep. 1956 (Flossy) Observed	Sep. 1956 (Flossy) Computed	Surge adjustment factor(Z)
	feet ngvd		feet ngvd		
Grand Isle					
Flooding from front	9.0	8.8	3.9	4.1	0.80(a)
Flooding from rear	-	-	8.0	7.8	0.80(a) 0.48(b)
Manila	8.0	8.5	-	5.1	0.48(b)

(a) In Gulf of Mexico
(b) In Barataria Bay

e. Routing. Since the major hurricane damage in the study area would result from storm induced effects on Lake Salvador, it was necessary to establish a method to determine the stage in the lake at any time during the hurricane occurrence. This procedure involves the construction of a stage hydrograph for Barataria Bay by calculating simultaneously, the hourly flows and rainfall through Lake Salvador's natural inlet channels (assumed in this case to be one large channel as shown on plate A-9).

(1) Prerequisite to any routing is the choice of an actual or hypothetical hurricane of known or designated characteristics. It is then possible to develop surge heights for any point in Barataria Bay for the selected hurricane. For routing purposes, the old fishing settlement of Manila Village which is about 20 miles southeast of Lake Salvador, was selected as the critical point for a hydrograph. It would reflect stages at the mouth of the schematized inlet channel. Such a hydrograph of hourly stages was constructed by computing the incremental setup for each hour and using the maximum surge elevation as the peak of the hydrograph for the critical period. Storm surge hydrographs at Manila Village for other frequencies were determined by identical procedures.

(2) A stage-area curve was made for the schematized conveyance channel between Manila Village and the entrance to the Lake Salvador Basin which consists of Lake Salvador, Lake Cataouatche, and the adjacent marsh area. Since the width of the channel is very large, the depth of water was used as the hydraulic radius.

(3) The cumulative amount of rainfall coincident with the storm significantly affects the lake elevation and hence the routing procedure. The amount of this rainfall was calculated by the methods described in U.S. Weather Bureau memorandums (15) (16), using a moderate rainfall that would be coincident with a tropical storm. For routing purposes, a moderate rainfall of 8.50 inches in 24 hours was considered as additional inflow into the Lake

Salvador Basin. The effect of cumulative rainfall is to raise the average lake level.

(4) With the above mentioned items resolved, the routing procedure was reduced to the successive approximation type problem in which the variable factors were manipulated until a correlation between flows from the gulf through the inlet channel and the rise in the mean elevation of the Lake Salvador Basin was obtained for the incremental time intervals. The use of this method has been illustrated by Bretschneider and Collins (17). A typical routing computation is illustrated on plate A-10. For verification of the method the surge caused by Hurricane Betsy, September 1965, was routed by this procedure. The routed stage for Bayou Barataria at Lafitte (assumed to be the representative stage of the Lake Salvador Basin), was found to be in reasonable agreement with the observed stage for the hurricane. The observed and computed peak stages for Hurricane Betsy are 3.35 and 3.05 ft., respectively. If the average stage between the Lafitte and Barataria, Louisiana, gages was used as the representative stage, the computed and observed stages would be in very close agreement. The computed Lake Salvador Basin average water surface hydrograph for the Standard Project Hurricane and the SPH surge hydrograph at Manila Village are shown on plate A-11.

f. Wind Tides. When strong hurricane winds blow over inclosed bodies of shallow water, they tend to drive large quantities of water ahead of them; therefore, wind tide levels (WTL's) in Lakes Salvador and Cataouatche, respectively are needed to determine stage-damage curves and to design protective levee heights.

(1) Lakes Salvador and Cataouatche are located in a marsh south and west of the study area and are so situated that the volume of incoming flow from the gulf cannot be measured because the water flows over broad areas of ungaged marshland. Therefore, the extensive marshlands which surround both lakes results in an almost unlimited storage area when lake waters overflow their banks. Hourly lake elevations for the various frequencies used in computing wind tide levels for Lakes Salvador and Cataouatche were obtained from the routed hydrographs which reflect the average lake level.

(2) To compute wind tide, the lake is divided into three zones that are roughly parallel to wind directions. A nodal line is designated perpendicular to the zones and setup is calculated for the leeward segment and setdown for the windward segment. The average windspeed and average depth in each segment were determined from isovel and hydrographic charts for each computation. The storm isovel patterns were furnished by the U.S. Weather Bureau (ESSA) (5). The computation of setup or setdown along each segment was based on the segmental integration method (14) and was calculated by the use of the step method formulas (18) that were modified as follows:

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

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

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

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

Graphs were constructed from the above formulas to determine setup and setdown quickly about the nodal elevation for storms of varied frequencies. Volumes of water along the zones, represented by the setup and setdown with respect to a nodal elevation, were determined and the water surface profiles adjusted until setup and setdown volumes for the lake balanced within 5 percent. Then setup elevations were added to the still water level to yield the WTL. The time dependent SPH wind tide hydrograph computed for the eastern shore of Lake Salvador is shown on plate A-12.

(3) Observed wind tide elevations at the shorelines of Lakes Salvador and Cataouatche are not available. Therefore, the method of wind tide level computation could not be verified by comparing observed and computed data. However, the above described method has been used successfully for the south shore of Lake Pontchartrain at New Orleans, Louisiana. Observed data were available for this lake and the method verified. (See the series of reports on Lake Pontchartrain and Vicinity, Louisiana, Hurricane Protection Project.)

(4) In order to obtain wind tide levels at the existing back levees of Westwego, and Marrero, as well as along State of Louisiana Highway #45, it was necessary to use the relationship between the maximum wind tide level and the distance inland from the shoreline.

(5) Marshlands that fringe the shoreline in certain locations are inundated for considerable distances inland by hurricane wind tides that approach the shores. The limit of overland surge penetration is dependent upon the height of the wind tides and the duration of high stages at the lakeshore. The study of available observed high water marks at the coastline and inland indicates a fairly consistent simple relationship between the maximum surge height and the distance inland from the coast, as shown on plate A-13. This relationship exists independently of the speed of hurricane translation, wind speeds, or directions. The data indicate that the weighted mean decrease in surge heights inland is at the rate of 1.0 foot per 2.75 miles. This relationship remains true even in the western portion of Louisiana where relatively high chenieres, or wooded ridges, parallel the coast. Efforts to establish time lags between peak wind tide heights at the shoreline and at inland locations were unsuccessful because of inadequate basic data.

(6) For the purpose of surge routing procedures, the shoreline is defined as the locus of points where the maximum WTL's would be observed along fetches normal to the general shore. This synthetic shoreline is assumed to be near the extreme western tip of the proposed Lake Salvador levee as shown on plate A-2. In order to determine the maximum water surface elevations at

inland locations, it was necessary to compute maximum WTL's at the designated points mentioned above. These computed wind tide levels were then adjusted by application of the average slope of maximum surge height inland (1 foot/2.75 miles, plate A-13) to the location of interest. Hurricane stages were not available for positive verification of the procedure within the area. However, the procedure has given satisfactory results in this area and has verified the observed data in other areas of study, including the Lake Pontchartrain Basin.

A-6 Frequency Estimates.

a. Procedure.

(1) Accounts of inundation by hurricane surges do not appear in the earliest records of the study area. Information on stages is available only for the larger towns or more thickly populated locations. After about 1900 when systematic records of hurricane damages were assembled by the U.S. Weather Bureau, more details relative to flooding along the isolated coastline and vicinity are available. However, until recent years, no attempt had been made to determine accurately the maximum height of stages experienced during hurricanes. The only exception is that after the September 1915 hurricane, a thorough survey was made by Charles W. Okey, Senior Drainage Engineer, Office of Public Roads and Rural Engineering, U.S. Department of Agriculture. In this survey, he covered the affected coastal areas which were between central Mississippi and central Texas. His report (19) is the only comprehensive record of reliable stages in the study area prior to hurricane "Audrey" of June 1957.

(2) The lack of additional data has made the establishment of dependable stage-frequency relationships impracticable. Records indicate that there is no locality along the Louisiana coast which is more prone to hurricane attack than other localities. The U.S. Weather Bureau has made a generalized study of hurricane frequencies and presented the results in a memorandum (10) (20). In a 400-mile zone along the central gulf coast from Cameron, Louisiana, to Pensacola, Florida, (Zone B), frequencies for hurricane central pressure indexes (CPI) presented in the report, shown on plate A-8, reflect the probability of hurricane recurrence in the mid-gulf coastal area. Hurricane characteristics with critical tracks and CPI's representative of the SPH and Moderate Hurricane, were then developed in cooperation with the U.S. Weather Bureau. The CPI's used were 27.6 and 28.3 inches for these two hurricanes, respectively. The SPH described in NHRP Report No. 33 (21) was the basis of development of the Design and the Moderate Hurricane used in the study. The representative hurricane path and wind pattern for the SPH critical to the study area is shown on plate A-7.

(3) Conversion of the SPH wind fields for use as the Mod-H was accomplished in the following manner. A Mod-H was assumed to have a CPI with a Zone B probability of 10 percent. Maximum gradient winds (V_{gx}) were derived for the SPH and Mod-H CPI's in accordance with procedure recommended by the U.S. Weather Bureau (10) (22). An adjustment coefficient equal to the ratio of V_{gx} of the Mod-H to V_{gx} of the SPH was then used to convert SPH wind velocities to Mod-H velocities. Thus, Mod-H winds were 83 percent of SPH winds for any given hurricane path. It was necessary to use additional

synthetic hurricanes of moderate intensity to define in more detail the stage-frequency relationship. When this was required, moderate hurricanes having CPI's of 27.8 and 29.0 inches were used. These hurricanes were of 2 and 40 percent probability, and wind speeds were 96.6 and 59.8 percent of SPH winds, respectively.

(4) Hurricane WTL's were then computed for the theoretical hurricanes in accordance with procedures described in paragraph A-5f. Isovels were rotated and the path transposed within allowable limits as necessary to produce maximum surge elevations at the proposed levee near Lake Salvador. Contours of maximum water surface elevations for the SPH that would be experienced in the study area are shown on plate A-14.

(5) A synthetic stage-frequency curve was developed by correlating stages and frequencies for corresponding CPI's, using a procedure developed for the Lake Pontchartrain study area (23). Stages for pertinent locations in the area that would accompany the SPH, and Mod H are shown in table A-10.

TABLE A-10

COMPARATIVE SURGE HEIGHTS

Location	SPH	Mod H
Bayou Des Familles Ridge to Estelle Canal	9.0	3.7
Estelle Canal to Dugues Canal	8.0	2.9
Dugues Canal to Bayou Segnette	7.0	2.4

The probability value used for a given CPI represents frequency of occurrence from any direction in a 400-miles zone along the central gulf coast. In order to establish frequencies for the locality under study, it was assumed that hurricanes critical to the locality would pass through a 50-mile subzone along the coast. Thus, the number of occurrences in the 50-mile subzone would be 12.5 percent of the number of occurrences in the 400-mile zone, provided that all hurricanes travel in a direction normal to the coast. A hurricane whose track is perpendicular to the coast ordinarily will cause extremely high tides and inundation for a distance of about 50 miles along the coast. However, the usual hurricane track is oblique to the shoreline, as shown in table 2 of HMS memorandum (10). The average projection along the coast of this 50-mile swath for the azimuth of 48 Zone B hurricanes is 80 miles. Since this is 1.6 times the width of the normal 50-mile strip affected by a hurricane, the probability of occurrence of any hurricane in the 50-mile subzone would be 1.6 times the 12.5 percent, or 20 percent of the probabilities for the entire midgulf Zone B. Therefore, 20 percent of the frequencies for hurricanes for Zone B, midgulf, shown in figure 4 of HMS memorandum HUR 2-4 (10), was used to represent the frequencies of hurricanes in the critical 50-mile subzone for each study locality.

(6) Since tracks having major components from the southeast create the most critical stages in the Grand Isle area, maximum hurricane surge heights were computed for synthetic hurricanes approaching the area on a track from that direction. Four-fifths (4/5) of all tracks that approached the Grand Isle area were from the southeast. Therefore, a stage-frequency curve was derived using four-fifths of the 50 mile subzone probability for all tracks. Frequencies for observed hurricane stages were then computed on the same basis as the CPI frequencies (10), and a curve plotted. the synthetic frequency curve was then adjusted to the plotted Grand Isle observed data. A frequency curve for Manila Village was then obtained by adding the additional wind tide setup across Barataria Bay to the appropriate stage-frequency value on the adjusted Grand Isle curve. A graphical presentation of this procedure is shown on Plate A-15.

(7) There is a direct relationship between the stage-frequency at Manila Village and the average lake stage-frequency in Lakes Salvador and Cataouatche. However, the critical stage-frequency at the shoreline is considerably diminished because the hurricane track required to cause critical stages at the eastern shore of Lake Salvador is unique. Only 6.4 percent of all hurricane tracks observed have followed a track similar to the unique hypothetical track used in this study. Stage-frequencies were also developed based on the remaining 93.6 percent observed hurricane tracks as described in paragraph A-6, a.(8).

(8) The azimuths of tracks observed in the vicinity of the study area were divided into quadrants corresponding to the four cardinal points. Since 1900, 73 storms have affected the Louisiana Coast; 46 had tracks from the south, 18 from the east, 8 from the west, and 1 from the north. Hurricanes with tracks having major components from the south and east generate WTL's that are near critical relative to the study area, while those tracks from the west generate WTL's most critical to the study area. The average azimuth of tracks from the south is 180°. Tracks from the east had an average azimuth of 117°. These azimuths along with the critical track from the west, were used in computing WTL's for Lake Salvador. Of all experienced tracks since 1900 affecting the Louisiana Coast, approximately 63 percent have come from a southerly direction, 24.6 percent from the east, and 11 percent have come from the west. The probabilities of equal stages for the three groups of tracks were then added arithmetically to develop a curve representing a synthetic probability of recurrence of maximum wind tide levels for hurricanes from all directions.

(9) Table A-11 illustrates the synthetic frequency computation for WTL's at the east shore of Lake Salvador.

TABLE A-11

STAGE-FREQUENCY COMPUTATION
LAKE SALVADOR

Zone B				50-MILE SUBZONE					
				Tracks from West		Tracks from South		Tracks from East	
CPI	Probability		Probability All Tracks	Stage	Probability	Stage	Probability	Stage	Probability
		occ/100	occ/100	feet	occ/100	feet	occ/100	feet	occ/100
in.	years	years	years	ngvd	years	ngvd	years	ngvd	years
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
29.0	2.5	40	8.0	2.78	0.88	4.59	5.04	4.37	1.97
28.3	10.0	10	2.0	7.08	0.22	6.47	1.26	6.04	0.49
27.8	50.0	2	0.4	8.56	0.04	7.60	0.25	7.18	0.10
27.6	100.0	1	0.2	9.04	0.02	7.93	0.13	7.48	0.05

Col. 4 20 Percent of Col. 3
Col. 6 11.0 Percent of Col. 4
Col. 8 63.0 Percent of Col. 4
Col. 10 24.6 Percent of Col. 4

b. Relationships. Based on the above described procedures, stage-frequency relationships were established under existing conditions for flooding by surges from Lake Salvador for the rear areas of Westwego, and Marrero; and west of Highway #45 to the "V" Levee. The stage-frequency curve for the Lake Salvador basin was compared with those developed for the Lake Pontchartrain basin, where stage data for a partially levee rimmed lake basin is more extensive. The Lake Pontchartrain frequency relationship for the south shore was developed from analysis of available stage data and model study results (24) (25). Comparison of the two frequency curves indicates that for the south shore of Lake Pontchartrain the frequency curve is straighter in the less frequent region of the curve, i.e. between the 100-year and SPH frequencies, than the curves for Lake Salvador. Because of the similarity in the topography between the two basins and the large data base available in the Pontchartrain basin, the upper part of the Salvador frequency curve was adjusted to agree with the slope of the curve developed for the South Shore of Lake Pontchartrain. Stage-frequency curve for the east shore of Lake Salvador is shown on plate A-16.

A-7. Design Hurricane.

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

b. Characteristics. The characteristics of the Des H for the proposed plan of protection are identical to the standard project hurricane described in detail in paragraph A-5. However, due to transposition of the regional SPH to the smaller study area the design hurricane would have a probability of recurrence of only once in about 500 years in the study area. The path of the Des H's was located to produce maximum hurricane tides along the entire length of the proposed structures. The Des H is a theoretical hurricane but ones of similar intensity have been experienced in the area. Table A-12 is a summary of the Des H characteristics. Plate A-7 illustrates the critical track.

TABLE A-12
DESIGN HURRICANE CHARACTERISTICS

Location	CPI (inches)	Max. winds (mph)	Radius of max. winds (miles)	Forward speed (knot)	Direction of approach
Lake Salvador East Shore	27.6	100	30	11	South-Southwest

c. Normal Predicted Tides. The mean tide in the study area is estimated to be approximately 0.2 foot n.g.v.d. the mean tidal range is about 0.35 foot. The difference in height of hurricane tides for occurrence of the Des H at high or low tide was only a few tenths of a foot. In determining the elevation of design surges, it was assumed that mean normal predicted tide occurs at the critical period of surges.

d. Design Rainfall. Hurricanes usually are accompanied by intense rainfalls. The mean 24-hour maximum point precipitation depth is 9.4 inches, based on data available on over 50 gulf region hurricanes (15) (16). Complete precipitation records, including but not limited to hurricane induced rainfall, indicate maximum 24-hour point depths of 21 inches for a standard project rainfall and 40 inches for the probable maximum rainfall. Estimates of point precipitation depths likely to be experienced with a standard project hurricane are 14 inches for moderately high and between 8.6 and 9.8 inches for moderate rainfalls. A moderate hurricane rainfall of 8.5 inches in 24-hours, based on observed average volume was used in the determination of residual damages for hurricanes, both under present conditions and after construction of the project.

e. Design Tide. The hurricane tide is the maximum still water surface elevation experienced at a given location during the passage of a hurricane. It reflects the combined effects of the hurricane surge, and where applicable, the overland flow of the surge, and wind tide. Design hurricane tides were computed to reflect conditions with authorized protective works or improvements in place, using the procedures described in paragraph A-5. Hurricane surges and tides usually are accompanied by violent wave action at the coastline, in unprotected bays, and in inland lakes close to the hurricane path. As the surge moves inland over marshlands and natural ridges, the waves deteriorate rapidly, and wave heights are attenuated by marsh grasses and woodland. To reach the protective works to the east of the apex of the "V" levee, the hurricane surge must traverse the heavily wooded Bayou Des Familles Ridge and the surrounding marsh, resulting in a much reduced wave climate and lower stages. Stages were reduced, as described in paragraph A-5 f., using the dropoff rate of 1 foot per 2.75 miles. These hurricane stages were incorporated into the experienced stage frequency curve at the gage on the Harvey Canal at the Harvey Lock to arrive at the combined stage frequency curve used in design of these protective works. Table A-13 gives a comparison of stages at the surge reference line on eastern side of Lake Salvador and in the Harvey Canal for the SPH and 100-year frequency Storms.

TABLE A-13
STAGE COMPARISON

Frequency In Years	Stage East Side Lake Salvador feet ngvd	Stage Harvey Canal feet ngvd
SPH	9.0	7.5
100	7.0	5.5

The levee reach from the lower levee edge at Bayou Segnette to Highway 3134 near the apex of the "V" levee is subject to waves generated in Lakes Salvador and Cataouatche. This reach is further divided into subreaches delinated by the surge elevation within the subreach. Surge elevations at the levee will vary depending upon the distance to the surge reference line. These design storm elevations at the levee alignment are the same for existing or project conditions. Pertinent data for the design hurricane used to determine wave characteristics is given in Table A-14.

TABLE A-14

DATA USED TO DETERMINE WAVE CHARACTERISTICS - DESIGN HURRICANE

Characteristics	Bayou Segnette to Dugues Canal	Dugues Canal to Estelle Canal	Estelle Canal to Bayou Des Familles	Bayou Des Familles to Highway 3134
F- fetch length (miles)	5	5	5	5
U- wind speed (mph)	78	78	78	78
SWL- still water level (ft ngvd)	7.0	8.0	9.0	9.0
D- average fetch depth (ft)	5.5	6.5	7.5	2.5

f. Wave characteristics. Using the design hurricane characteristics given above and the charts and nomographs published in the Shore Protection Manual (26), wave heights and periods and their associated characteristics were developed at the surge reference line. Using techniques described in the Shore Protection Manual these waves were propagated across the marsh to the location of the actual levee location. Table A-15 lists wave characteristics for the design hurricane at the levee in each subreach.

TABLE A-15
WAVE CHARACTERISTICS - DESIGN HURRICANE

	Bayou Segnette to Dugues Canal	Dugues Canal to Estelle Canal	Estelle Canal to Bayou Des Familles	Bayou Des Familles to Highway 3134
H_S - Significant wave height, feet	3.0	3.3	3.7	2.1
T - Wave period, seconds	4.0	4.0	4.1	4.1
Lo - Deep water wave length, feet	82	82	86	86
d/L_0 - Relative depth	.067	.079	.087	.029
H_S/H_0 - Shoaling Coefficient	.977	.956	.946	1.13
H_0' - Deepwater wave height, feet	3.1	3.5	3.9	1.9
H_0'/T - Wave Steepness	.192	.216	.233	.113

g. Maximum runup and overflow.

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

(2) Wave runup on a protective structure depends upon the physical characteristics (i.e., configuration and surface roughness), the depth of water at the structure, and the wave characteristics. Computation of maximum runup was necessary in order to determine the heights to which existing shore protective structures would have to be raised to prevent all overflow for the significant wave accompanying the SPH. Wave runup was considered to be the ultimate height to which water in a wave ascended on the proposed slope of a

protective structure. This condition occurred when the WTL was at a maximum, and was calculated by the interpolation of model study data presented in the 1984 Shore Protection Manual (26), which relates runup (R/H_0'), wave steepness (H_0'/T^2), relative depth (d/H_0'), and structure slope.

(3) Protective structures exposed to wave runup will be constructed to an elevation and cross-section that is sufficient to prevent all overtopping from the significant wave and waves smaller than the significant wave accompanying the SPH. Waves larger than the significant wave will be allowed to overtop the protective structures; however, such overtopping will not endanger the security of the structure of cause material flooding. In the case of the levee reach from Bayou Segnette to Highway 3134, runup was computed for waves breaking on each berm to determine the required levee elevation. Wave data, runup elevation, and required elevation of the protective structures are shown in Table A-16.

Table A-16
WAVE RUNUP AND PROPOSED ELEVATION OF PROTECTIVE STRUCTURES
STANDARD PROJECT HURRICANE

Location	H (ft)	T (sec)	WTL Elevation (ft ngvd)	Elevation of Levee (ft ngvd)
Bayou Segnette to Dugues Canal	3.0	4.0	7.0	10.0
Dugues Canal to Estelle Canal	3.3	4.0	8.0	11.0
Estelle Canal to Bayou Des Familles	3.7	4.1	9.0	12.0
Bayou Des Familles to Highway 3134	2.1	4.1	9.0	12.0

h. Residual flooding. The procedures described in the SPM (26) are used to determine wave runup and wave overtopping for the significant wave that would be experienced during hurricane occurrences. However, 14 percent of the waves in a spectrum are higher than the significant wave and the maximum wave heights to be expected are about 1.87 times the significant wave height. Thus, a structure designed to prevent all overtopping by a significant wave would be overtopped by the portion of the spectrum that is higher than the significant wave. It was, therefore, necessary to assure that this residual overtopping would not produce flooding and subsequent damage to the extent that only partial protection was afforded to an area for the design hurricane. A determination of the residual overtopping was made for the area

and it was concluded that no material flooding results if the designed cross-section is overtopped by waves higher than the significant wave. It was, therefore, concluded that the use of the significant wave runup would result in design grades for protective structures that would permit residual flooding only to a negligible degree.

A-8. Embankment Design.

a. General. The design cross-sections presented on Plate A-17 were selected as the best choice for the project area, Bayou Segnette to the Harvey Lock. This design is an all-earthen levee with reinforcing geotechnical fabric. Foreshore protection is not required along the toe of the levee, since presently there will not be daily exposure of the new levee to wave action and along the older reaches of levee the existing toe, which has reached equilibrium with the daily wave environment, will not be disturbed.

b. Levee heights. Heights of the proposed protective work along Bayou Segnette and east of Highway 3134, which are subject to only minor wave activity generated by boat traffic or winds across a limited fetch during several hours of superelevated wind tide levels, were designed to include a freeboard allowance of 2 feet above the still water level. The height of the remaining levee from Bayou Segnette to Highway 3134 was designed to prevent overtopping from waves generated in Lakes Salvador and Cataouatche which propagate across the marsh to this reach of levee. Table A-17 gives the height of protection required in the project area.

TABLE A-17
SPH HURRICANE WINDTIDE LEVELS AND
ELEVATION OF PROTECTIVE STRUCTURES

Reach	Windtide Levels (ft. ngvd)	Composite Structure Slope	Elevation of Protective Structure (ft. ngvd)
Bayou Segnette	7.0	3	9.0
Bayou Segnette to Dugues Canal	7.0	6.0	10.0
Dugues Canal to Estelle Canal	8.0	6.1	11.0
Estelle Canal to Bayou Des Familles	9.0	6.3	12.0
Bayou Des Familles to Highway 3134	9.0	5.1	12.0
Highway 3134 to Apex of "V" Levee	9.0	3	12.0
Apex of "V" Levee to Harvey Canal	7.5	3	9.5

SECTION II - INTERIOR DRAINAGE

a. Description of Drainage Area. The only drainage area affected by the proposed hurricane protection system is the approximately 315 acres which is presently unleveed and drains naturally from the Bayou Des Familles ridge into the marsh to the west. This area will be bounded by the proposed project levee on the North, South and East and the existing high ground, Bayou Des Familles (HWY 45), on the west. The confined area is approximately 1000 ft. wide and 14000 ft. in length.

b. Proposed Drainage Improvements. The entire area will be drained into the Ross Canal via a 60 inch C.M.P. culvert 270 ft. in length with it's invert at -2.0 ft. ngvd beneath the proposed levee. A mitered entrance which conforms to the slope of the proposed drainage channel will be provided with a positive closure or flapgated exit.

A drainage channel with a 5 ft. bottom width, 4.5 ft. depth (at the culvert) and 1V on 3H side slopes will be constructed to convey rainfall runoff from the area to the culvert. The channel bottom will remain 5 ft. in width and slope upward at 0.0003 ft/ft both north & south of the structure.

c. Hydraulic Computations. The culvert size was estimated based on the orifice equation with an inflow of Q = CIA. Culvert dimensions were verified later by use of a HEC-1 model. The discharge rating curve for the culvert used in the model was prepared using the Manning Equation with a roughness coefficient of 0.024. The mean daily high outside (floodside) stage used was 1.6 ft. ngvd. Rainfall runoff was calculated by the model using a 10 yr-24 hour rainfall event and a unit hydrograph developed using the inverted "V" method.

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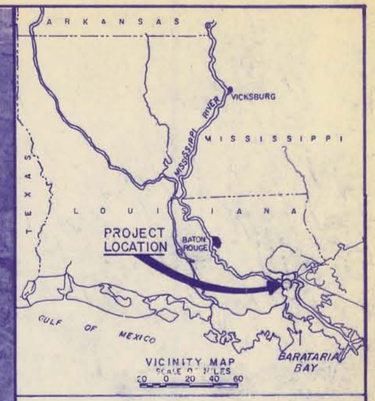


LEGEND

SCALE IN FEET

2000 0 2000 4000 6000

WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

STUDY AREA

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-- 1

LAKE PONTCHARTRAIN
NEW ORLEANS
G I W W
LAKE BORGNE
MISSISSIPPI
LOUISIANA
ALA
MOBILE
GULFPORT
BILOXI
BAY ST LOUIS
LONG POINT
ORLEANS
RIVER
BRETON SOUND
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
0 50 100
VIOLET
46 VERRET
SHELL BEACH
YSCLOSKEY
BAYOU
LA LOUTRE
S R L
LAKE LERY
OAKVILLE
BERTRANDVILLE
BELAIR
LAKE SALVADOR
LA REUSSITE
PHOENIX
IRONTON
39
23
BAYOU
LOCKPORT
LAFOURCHE
WATERWAY
HOLIMA
GULF
INTRACOASTAL
LAROSE
POINTE A LA HACHE
BOHEMIA
CITY PRICE
PORT SULPHUR
MISSISSIPPI RIVER-GULF OUTLET
BRETON SOUND
CHANDELEUR ISLANDS
MANILA
BARATARIA BAY
GOLDEN MEADOW
OSTRICA
BURAS
FORT LIVINGSTON
GRAND TERRE ISLANDS
LEEVILLE
VENICE
CHENIERE CAMINADA
GRAND ISLE
1
TIMBALIER BAY
TERREBONE BAY
GULF OF MEXICO
BURRWOOD

LEGEND

RECORDING	NON-RECORDING	
●	○	PRECIPITATION STATION
●—○	○—○	PRECIPITATION AND TEMPERATURE
⊕	⊕	COMPLETE MET. STATION
■	□	RIVER GAGE, STAGE ONLY
	◪	HIGH WATER PIPE
		SURGE REFERENCE LINE

SCALE OF MILES
10 0 10

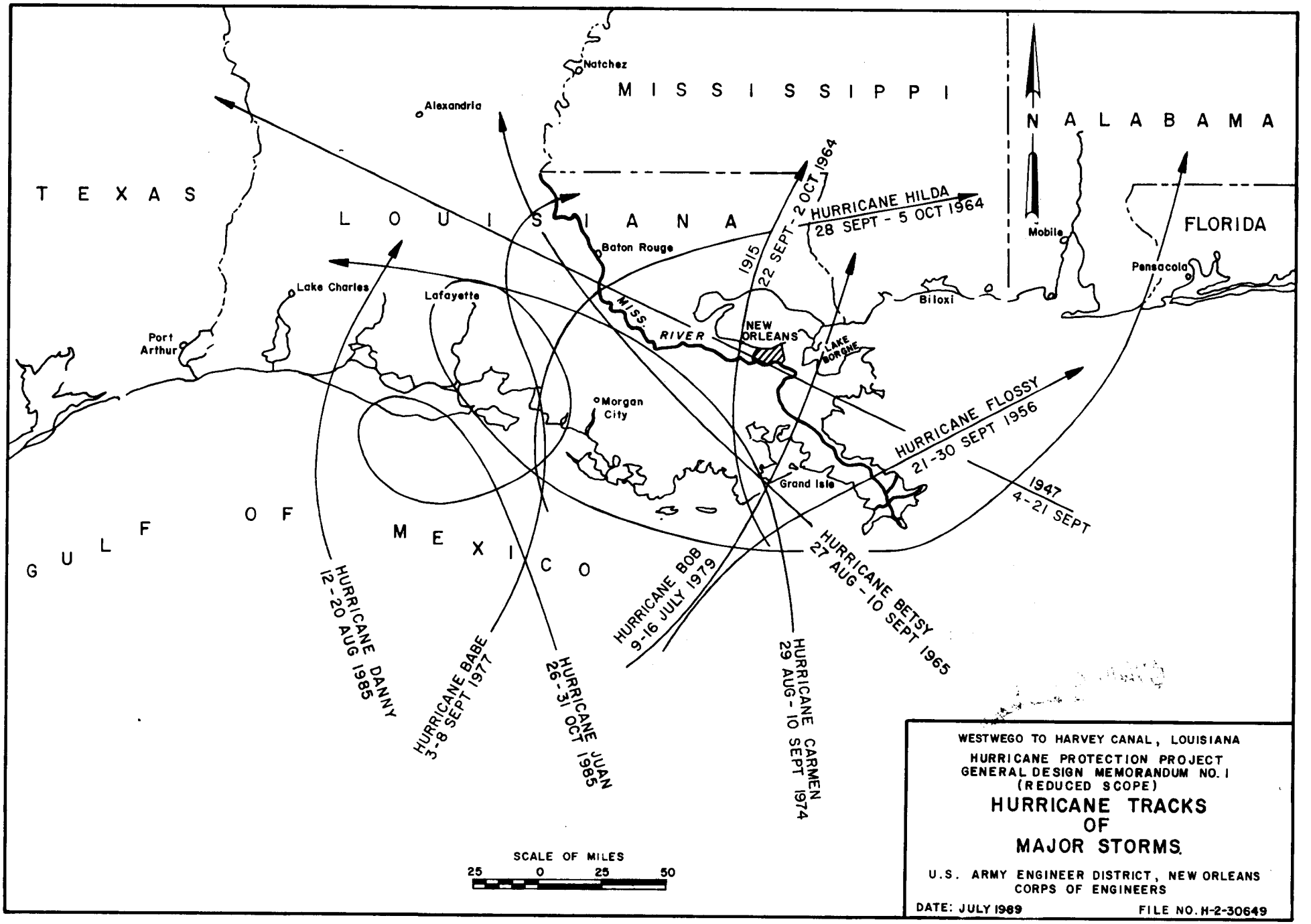
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

METEOROLOGICAL STATIONS AND SURGE REFERENCE LINE

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-2



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HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

HURRICANE TRACKS OF MAJOR STORMS

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-3

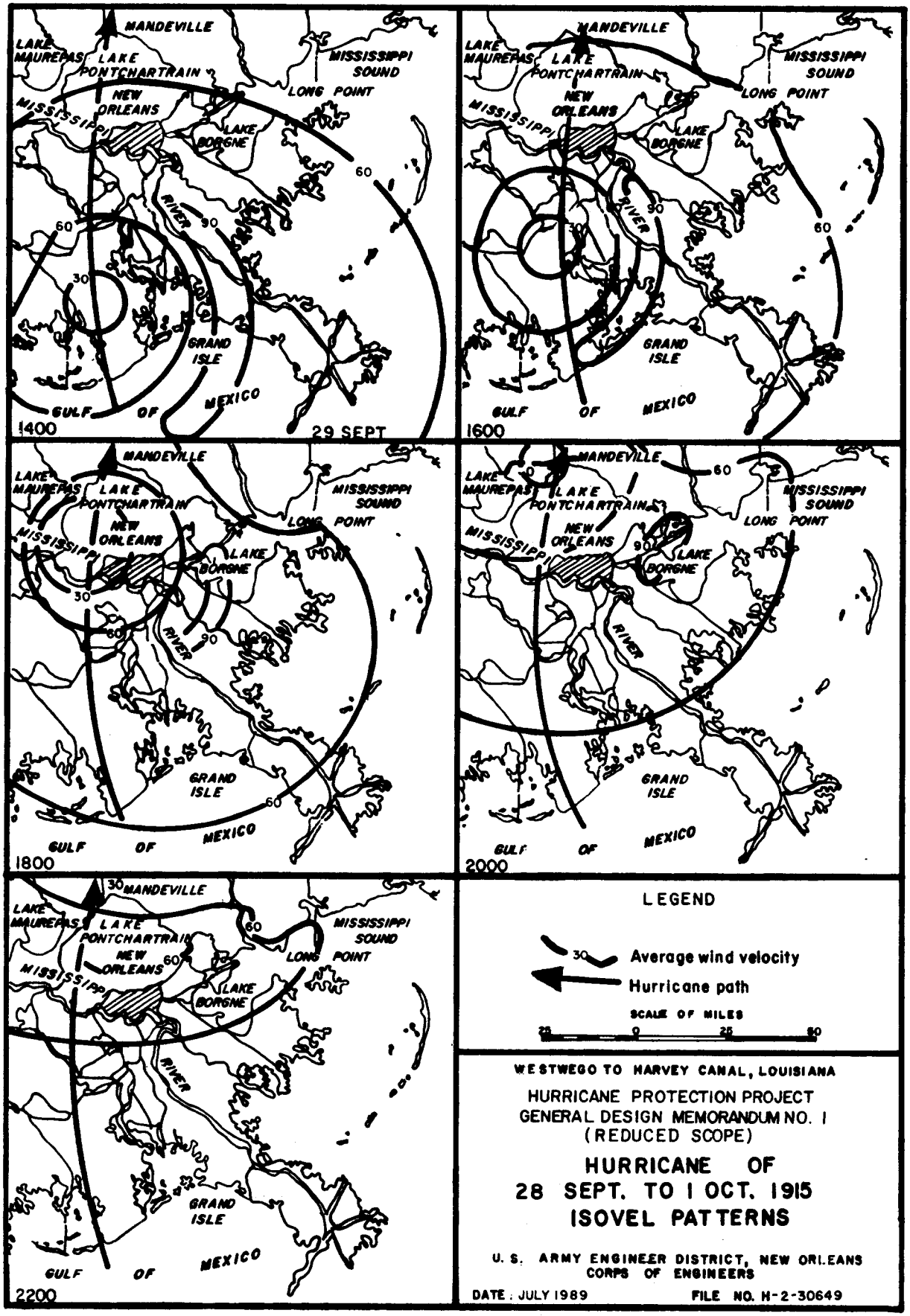
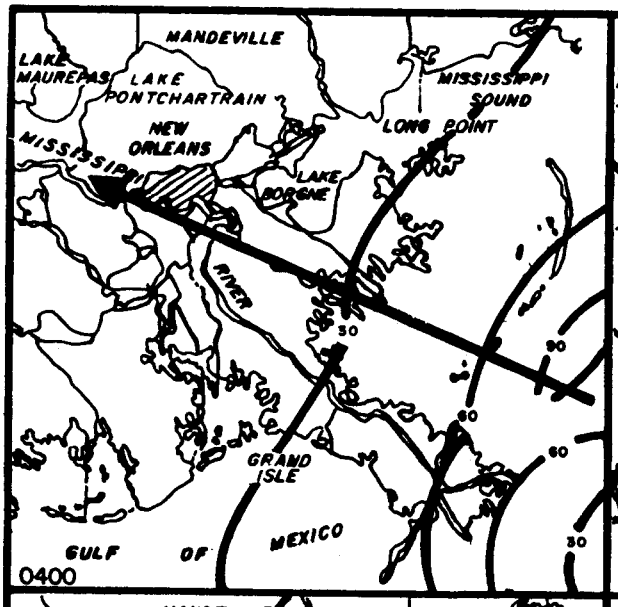
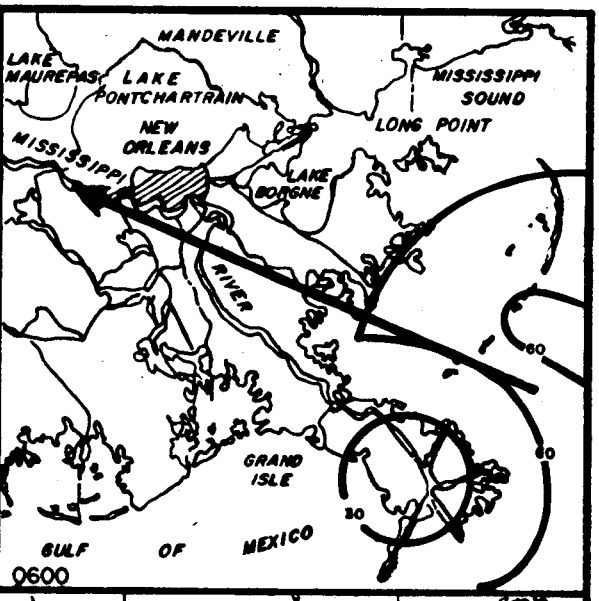
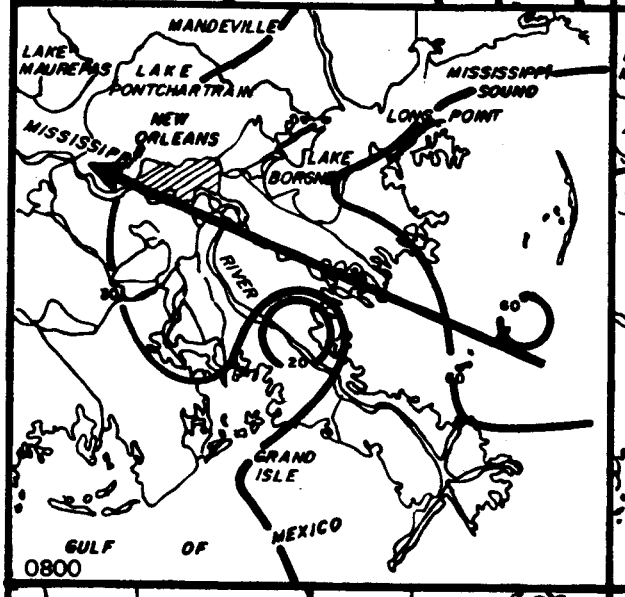
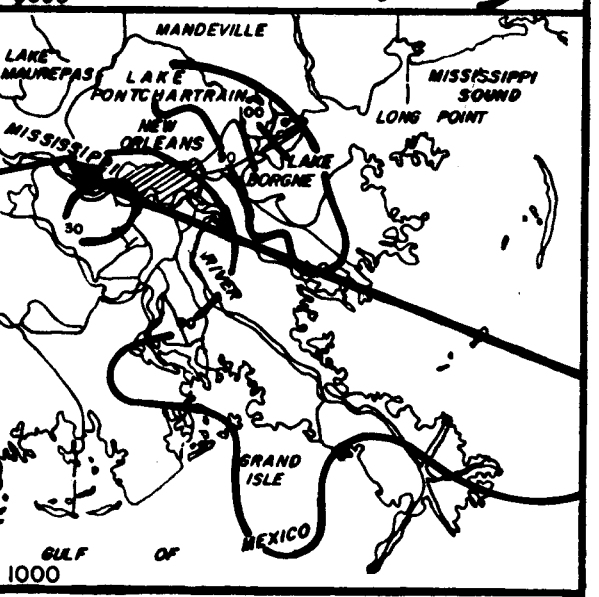

MANDEVILLE
LAKE MAUREPAS
LAKE PONTCHARTRAIN
MISSISSIPPI SOUND
LONG POINT
NEW ORLEANS
MISSISSIPPI
LAKE BORGNE
RIVER
GRAND ISLE
GULF OF MEXICO
30
60
90
1400
29 SEPT
1600
1800
2000
2200
LEGEND
Average wind velocity
Hurricane path
SCALE OF MILES
25 0 25 50
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)
HURRICANE OF
28 SEPT. TO 1 OCT. 1915
ISOVEL PATTERNS
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE : JULY 1989
FILE NO. H-2-30649

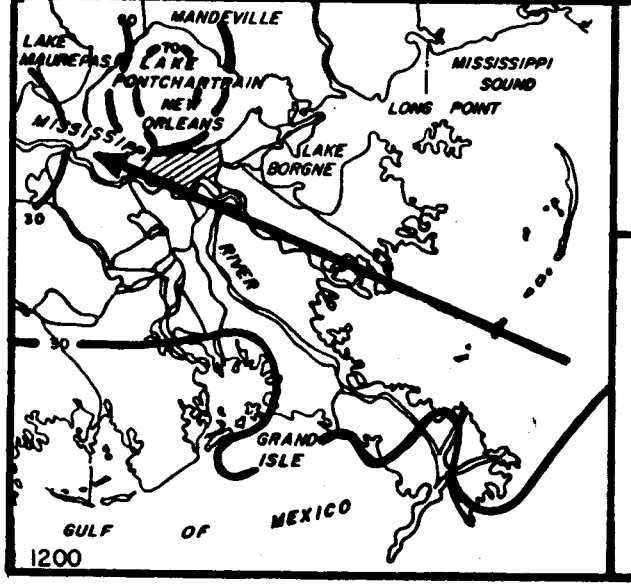
PLATE A-4











LEGEND

30 Average wind velocity

Hurricane path

SCALE OF MILES

25 0 25 50

WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SCOPE)

HURRICANE OF 19 SEPT. 1947
ISOVEL PATTERNS

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

DATE: JULY 1969 FILE NO. H-2-30649

PLATE A-5

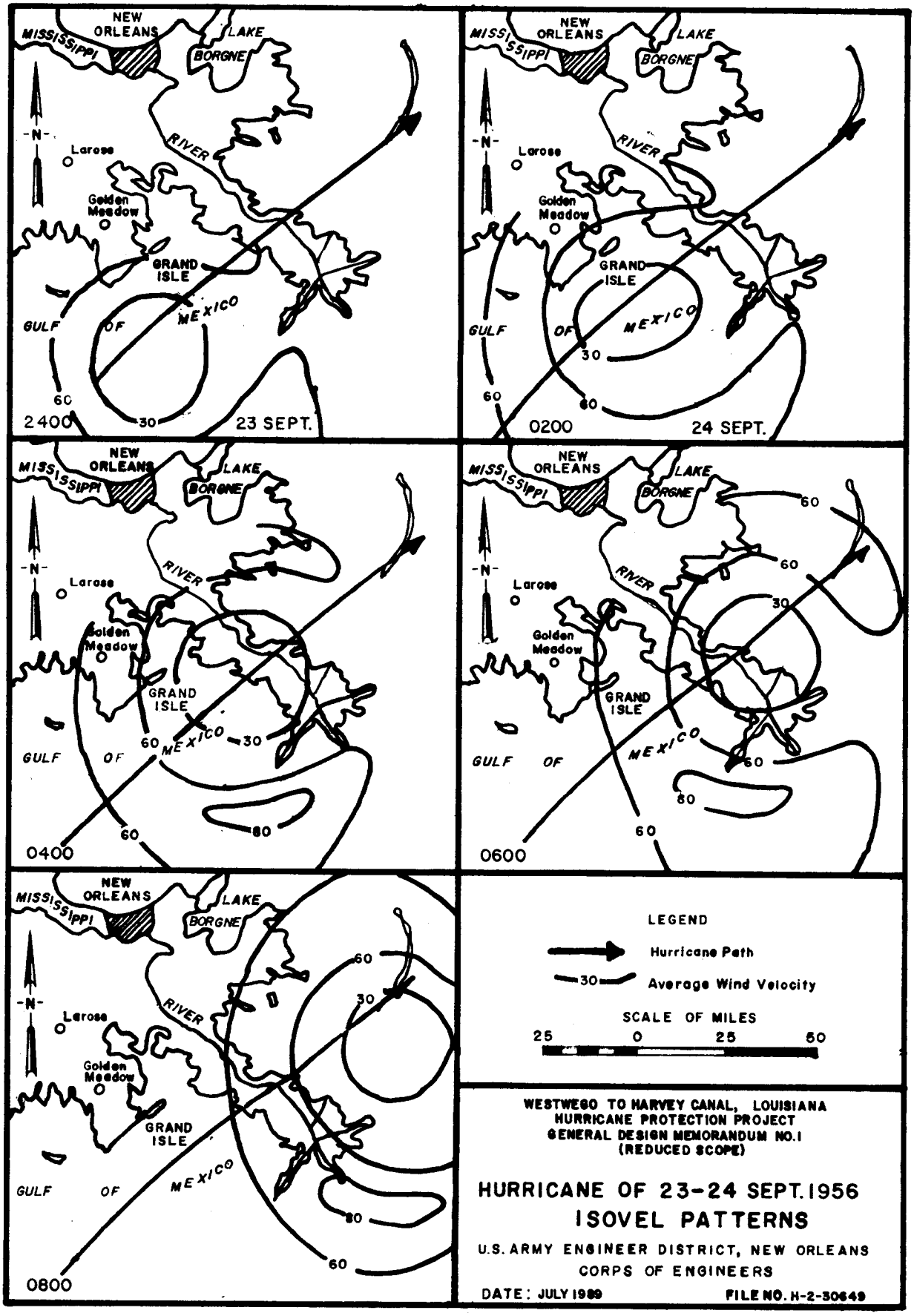
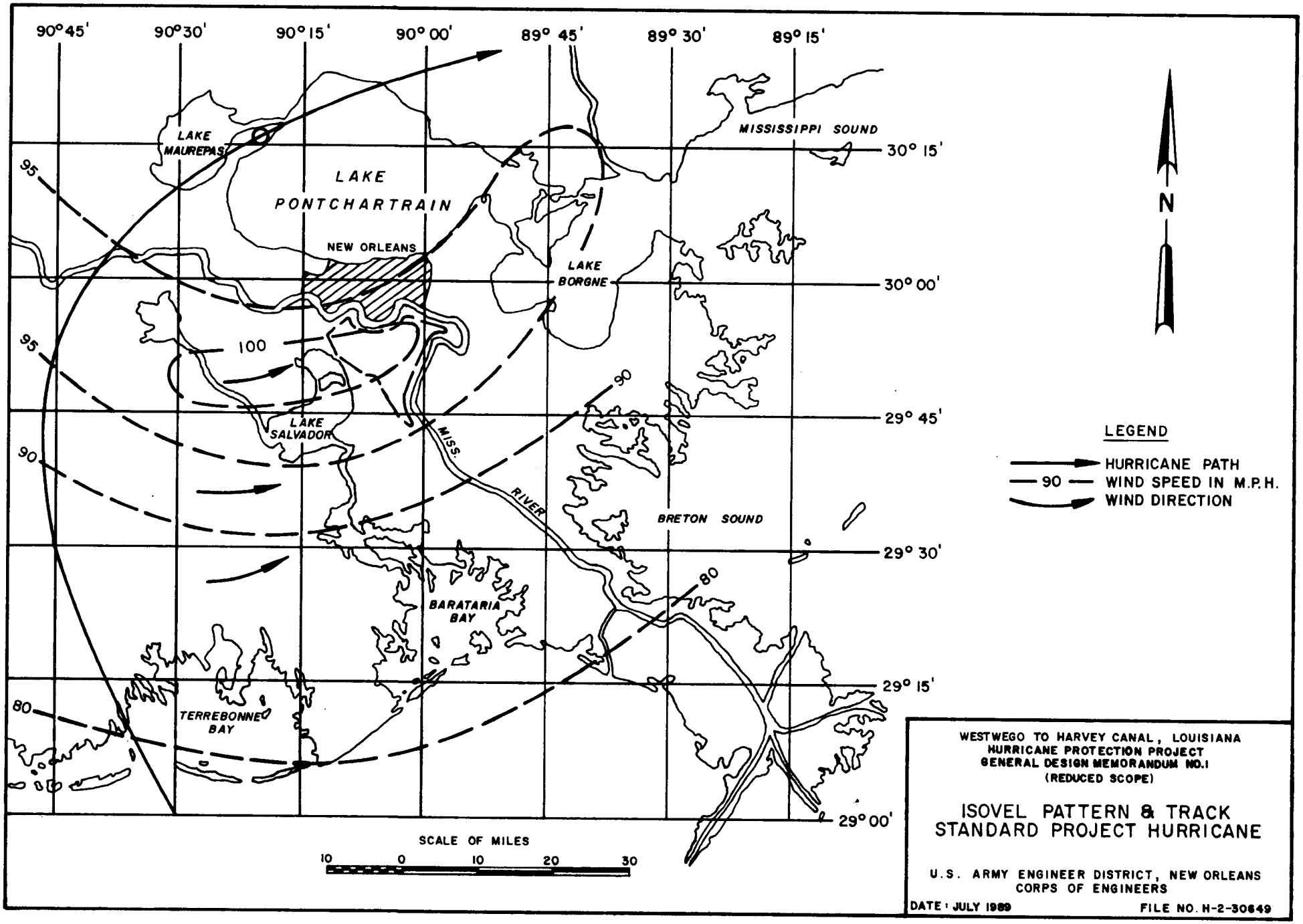

NEW ORLEANS
MISSISSIPPI
LAKE BORGNE
RIVER
N
Larose
Golden Meadow
GRAND ISLE
GULF OF MEXICO
60
30
2400
23 SEPT.
0200
24 SEPT.
80
0400
0600
0800
LEGEND
Hurricane Path
30
Average Wind Velocity
SCALE OF MILES
25 0 25 50
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SCOPE)
HURRICANE OF 23-24 SEPT. 1956
ISOVEL PATTERNS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JULY 1959
FILE NO. H-2-30649

PLATE A-6



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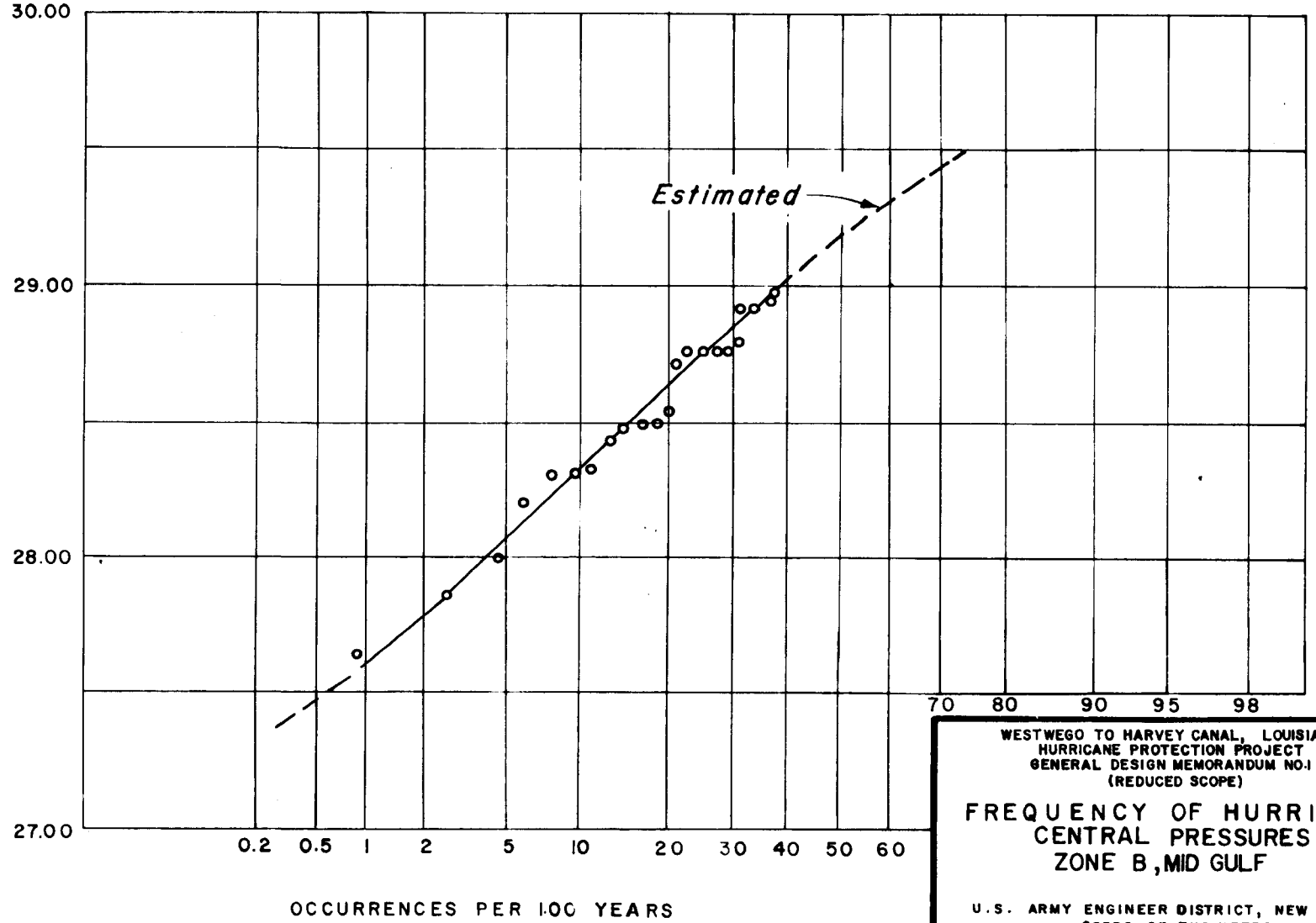
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SCOPE)

ISOVEL PATTERN & TRACK STANDARD PROJECT HURRICANE

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

DATE: JULY 1969 FILE NO. H-2-30649

PLATE A-7



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HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SCOPE)

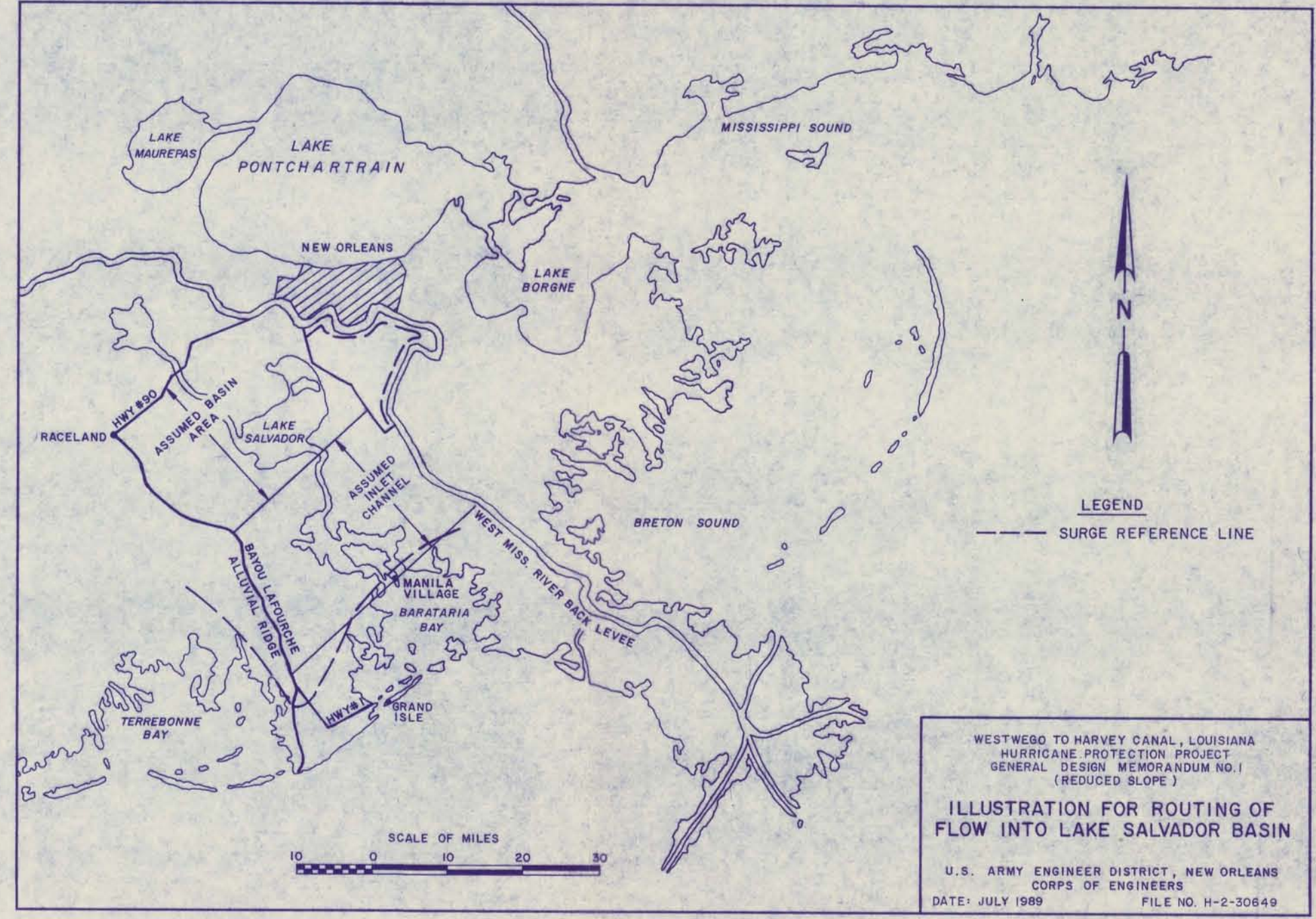
FREQUENCY OF HURRICANE CENTRAL PRESSURES ZONE B, MID GULF

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-8

PLATE A-8



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HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SLOPE)

ILLUSTRATION FOR ROUTING OF FLOW INTO LAKE SALVADOR BASIN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JULY 1989 FILE NO. H-2-30649

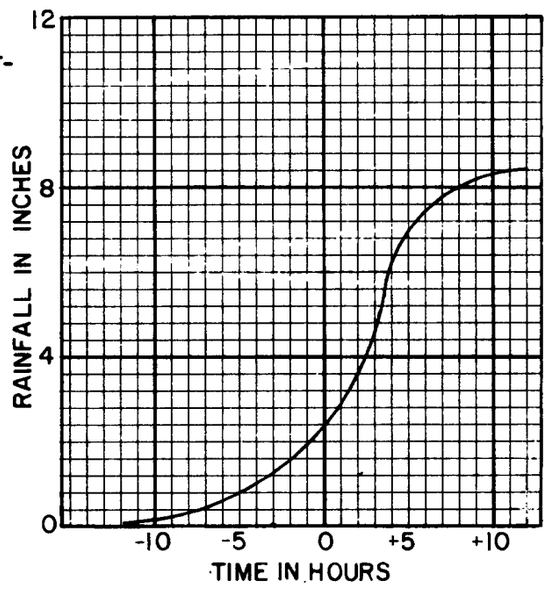
PLATE A-9

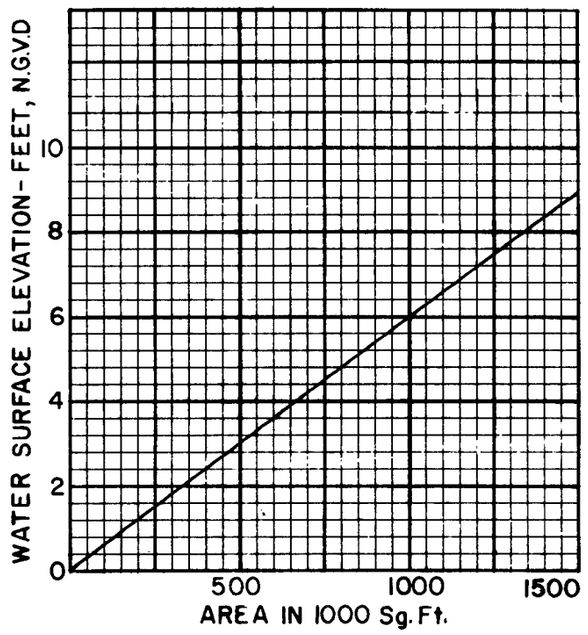
HOURS REFERENCE TO LANDFALL	AVERAGE GULF ELEVATION	AVG. LAKE SALVADOR BASIN ELEVATION	AVG. WATER SURFACE ELEVATION IN CHANNEL	Δz	$\frac{1.49}{n}$	CHANNEL AREA	R	$R^{2/3}$	ΔH	$\sqrt{\Delta H}$	Δt	$(Q\Delta t)$ FLOW INTO LAKE SALVADOR BASIN	Δz^*	Δ RAINFALL	MEAN BASIN ELEVATION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	FT. N.G.V.D	FT. N.G.V.D	FT. N.G.V.D	FEET		1000 Sq. Ft.	FEET	FEET	FEET	FEET	SECONDS	C.F.S.	FEET	FEET	FT N.G.V.D
0															1.78
	11.18	1.91	6.54	0.26	0.076	1105	6.54	3.497	9.27	3.045	3600	3,219,300	0.25	0.05	-
+1															2.08
	11.02	*2.20	6.61	0.24	"	1120	6.61	3.522	8.82	2.970	3600	3,205,400	0.25	0.05	
+2															2.38
	10.24	2.59	6.42	0.42	"	1080	6.42	3.451	7.65	2.766	7200	5,641,100	0.43	0.19	
+4															3.00
	8.52	3.15	5.84	0.30	"	985	5.84	3.243	5.37	2.317	7200	4,050,000	0.31	0.16	
+6															3.47
	6.30	3.56	4.93	0.17	"	830	4.93	2.877	2.74	1.655	7200	2,177,600	0.17	0.04	
+8															3.68
	3.98	3.70	3.84	0.04	"	645	3.84	2.452	0.28	0.529	7200	457,800	0.04	0.02	
+10															3.74
	1.98	3.72	2.85	(-) 0.05	0.076	480	2.85	2.010	1.74	1.319	7200	696,400	(-) 0.05	0.02	
+12															3.71

COLUMN

(4) AVERAGE WATER SURFACE ELEVATION BETWEEN LAKE SALVADOR BASIN & MANILA VILLAGE.
(5) ASSUMED INCREMENTAL CHANGE IN LAKE LEVEL
(6) FROM MANNING'S FORMULA (n=0.06, L=105,600 or 20 MI.)
(8) HYDRAULIC RADIUS - SAME AS CHANNEL ELEVATION.
(10) DIFFERENCE BETWEEN LAKE SALVADOR BASIN & MANILA VILLAGE WATER SURFACE.
(13) Q=6x7x9x11x12
(14) COMPUTED

$$\Delta z^* = \frac{Q}{13,034 \times 10^6 \left(\text{BASIN SURFACE AREA}\right)}$$



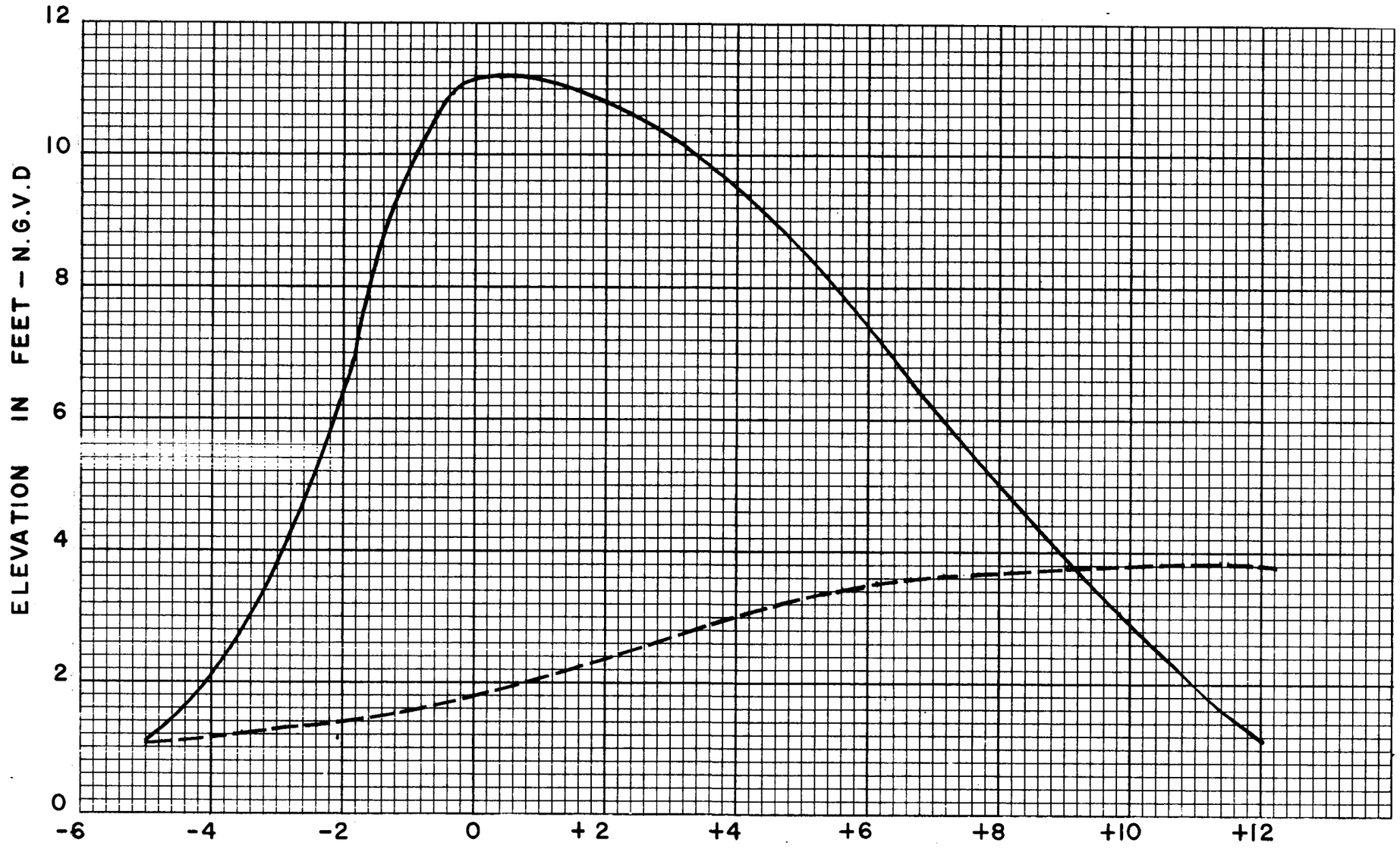


WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SLOPE)

ROUTING INTO LAKE SALVADOR BASIN

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-10



LEGEND

——— MANILA VILLAGE

– – – LAKE SALVADOR BASIN

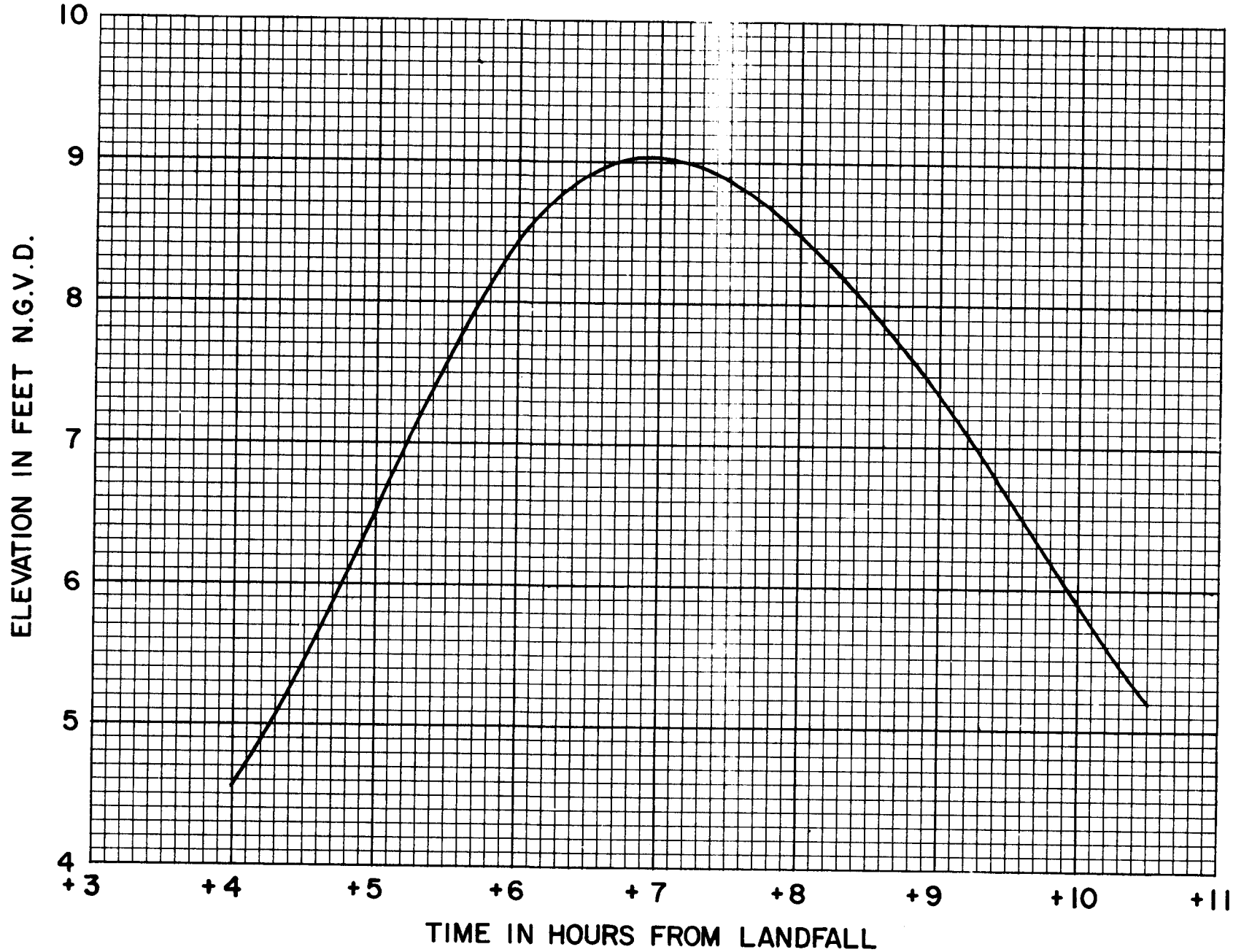
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SLOPE)

AVERAGE LAKE SALVADOR AND
MANILA VILLAGE SPH HYDROGRAPHS

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-11



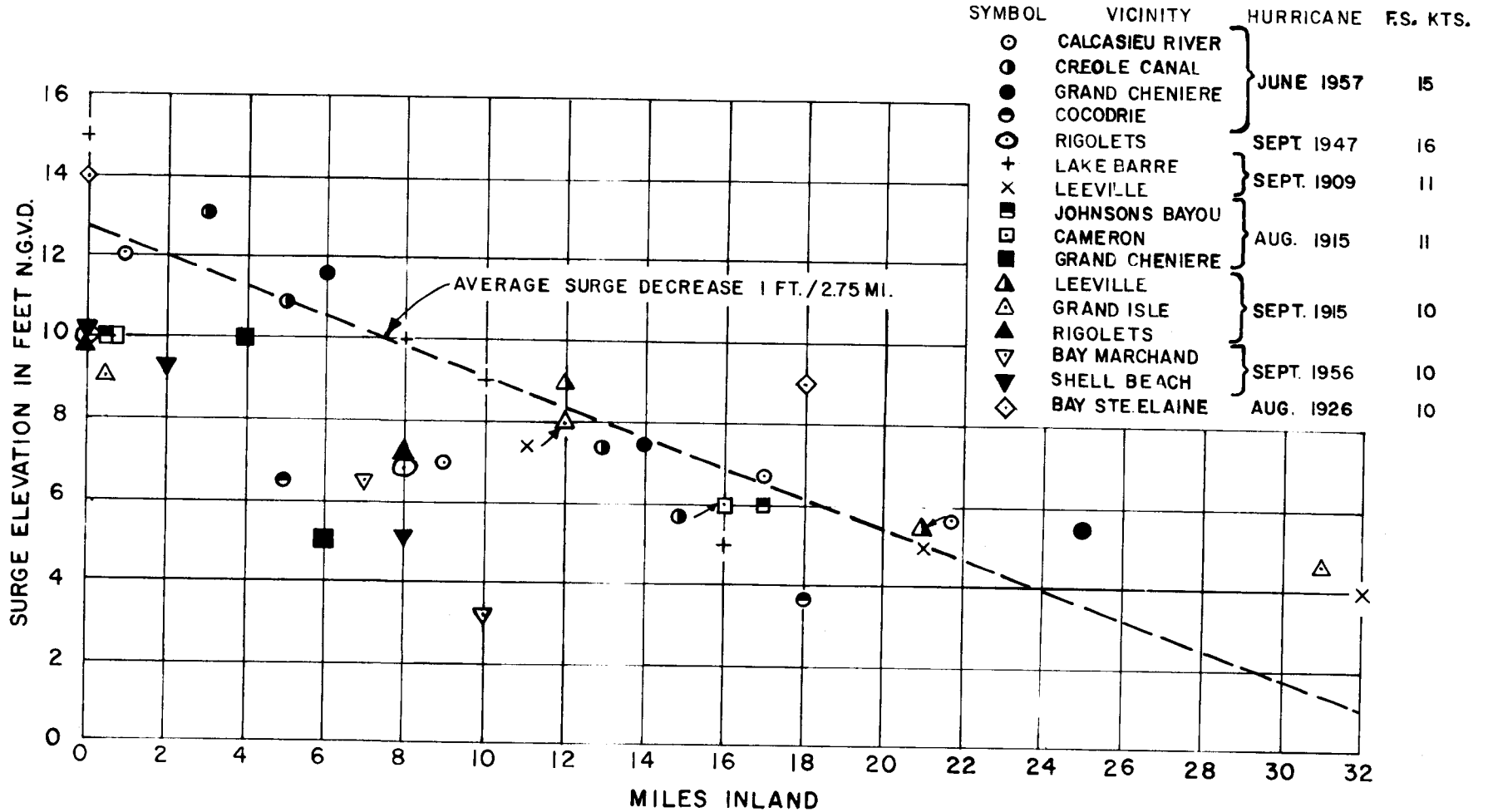
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. I
(REDUCED SLOPE)

LAKE SALVADOR STAGE HYDROGRAPH
EAST SHORE
DESIGN HURRICANE

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-12



WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

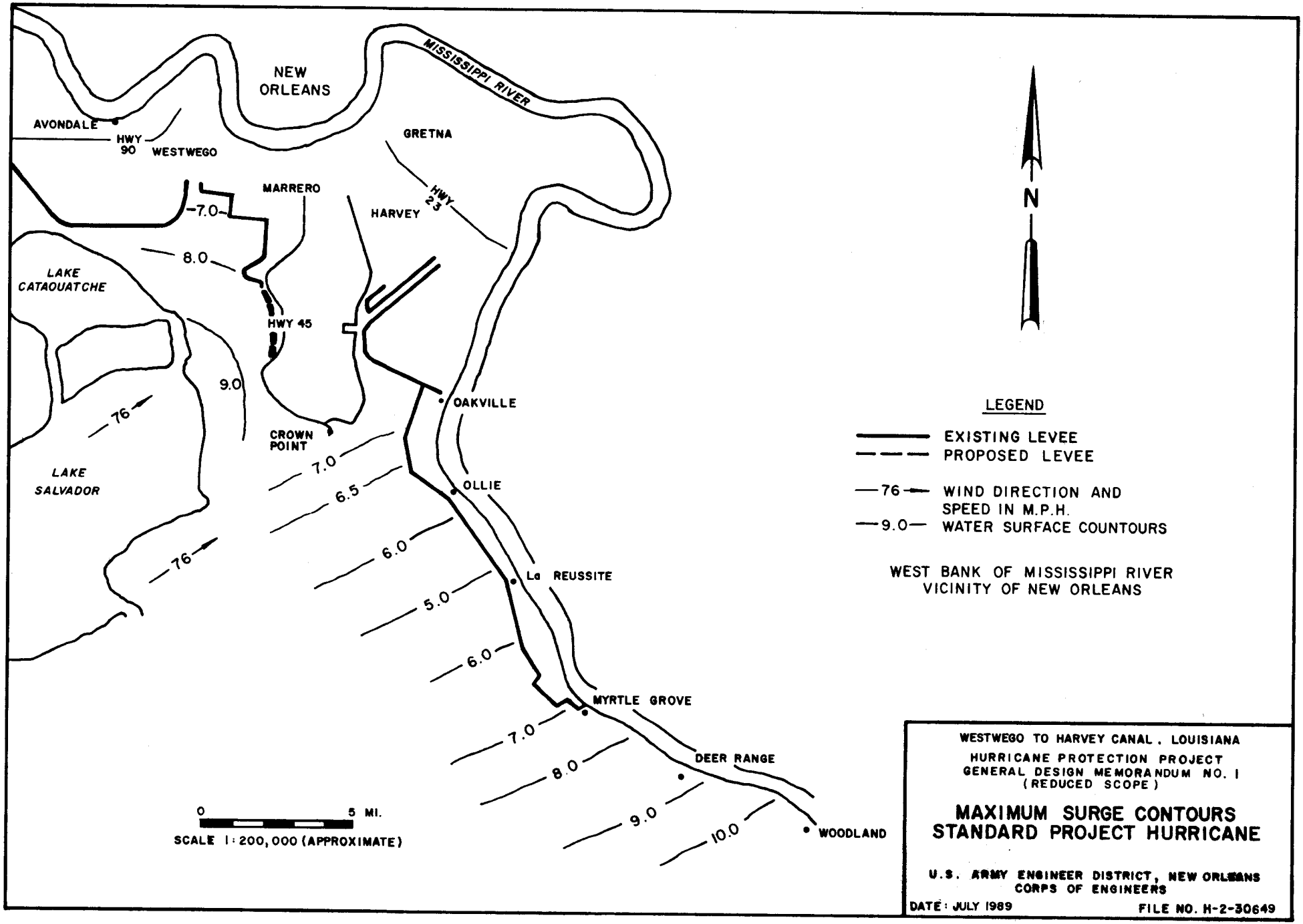
OVERLAND SURGE ELEVATIONS COASTAL LOUISIANA

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-13

PLATE A-13



WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

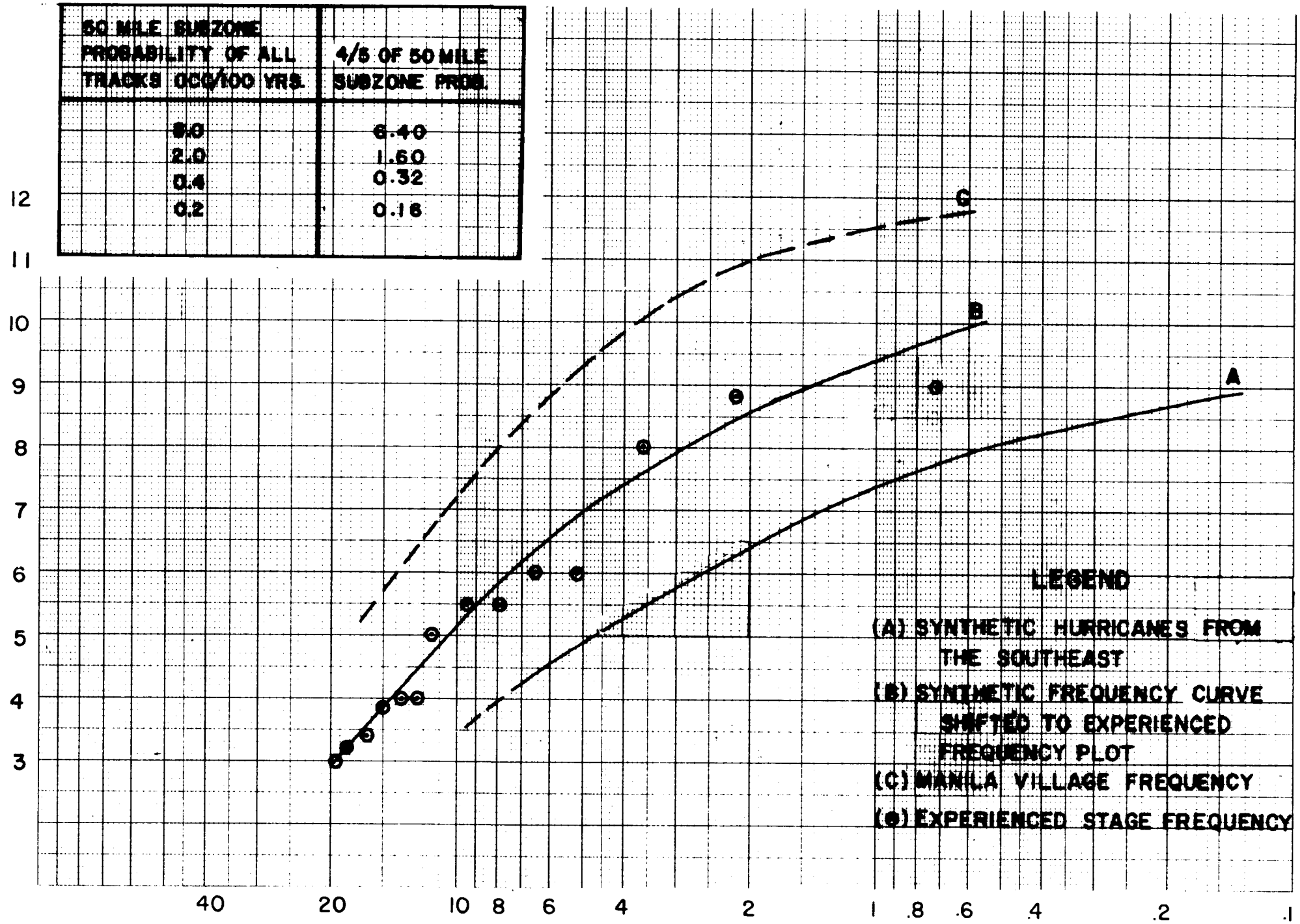
MAXIMUM SURGE CONTOURS STANDARD PROJECT HURRICANE

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-14

50 MILE SUBZONE PROBABILITY OF ALL TRACKS OCC/100 YRS.	4/5 OF 50 MILE SUBZONE PROB.
8.0	6.40
2.0	1.60
0.4	0.32
0.2	0.16



WESTWEGO TO HARVEY CANAL, LOUISIANA

HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SCOPE)

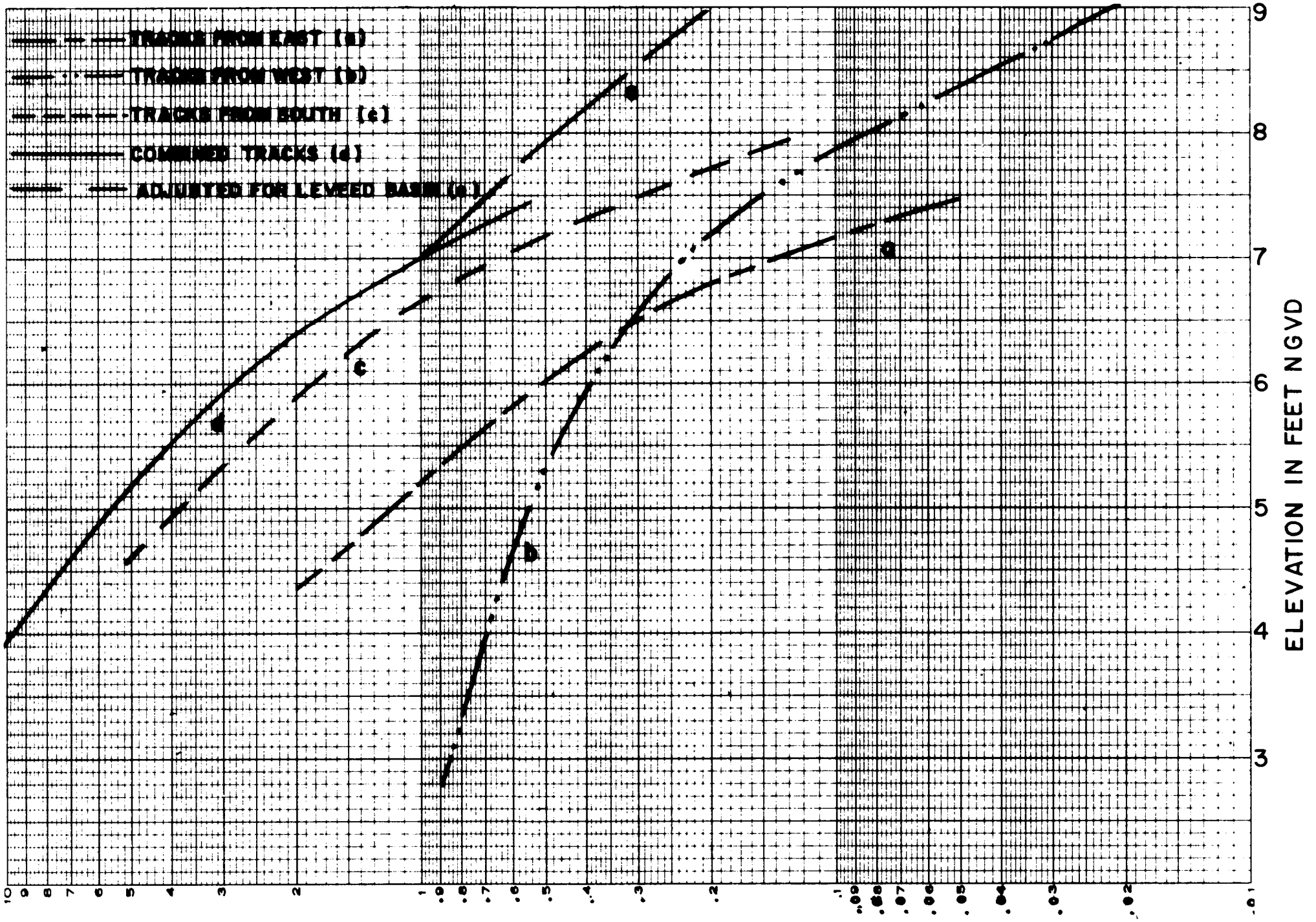
STAGE-FREQUENCY
MANILA VILLAGE

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

DATE JULY 1989 FILE NO. H-2-30649

PLATE A-15

OCCURRENCES PER 100 YEARS



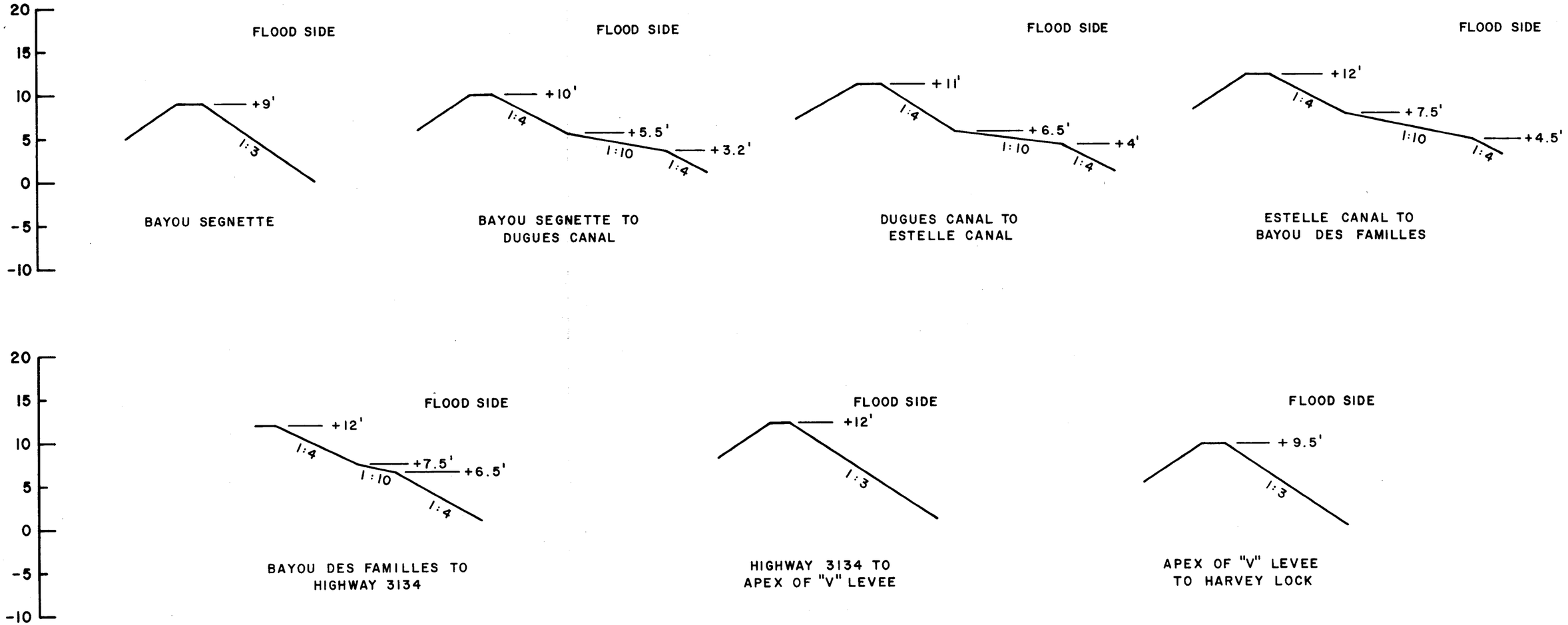
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1
(REDUCED SCOPE)

LAKE SALVADOR
STAGE-FREQUENCY
EAST SHORE

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-16



WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO. 1
(REDUCED SCOPE)

TYPICAL CROSS SECTION
EARTHEN LEVEE

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

DATE: JULY 1989 FILE NO. H-2-30649

PLATE A-17

WESTWEGO TO HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1 (REDUCED SCOPE)

APPENDIX B

REAL ESTATE COST ESTIMATE

IDENTIFICATION
NUMBER 90721

REAL ESTATE COST ESTIMATE
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GDM No. 1 (Reduced Scope)
JEFFERSON PARISH, LOUISIANA

Standard Protection Hurricane (SPH) Plan - Bayou Segnette Pumping Station to the Harvey Canal Pumping Station

ESTIMATE OF COSTS (Date of Value - June 1989)

(a) Lands and Damages	Acres	Unit Value	Total Value
Perpetual Levee, Floodwall and Borrow Easement			
Marsh/Wetlands	579.06	$ 500	$ 289,530
Potential Commercial/Residential	10.00	30,000	300,000
Potential Residential	260.14	5,000	1,300,700
**Existing Levee Right-of-Way (V-Levee)	50.00	5,000 x .10	25,000
Potential Commercial/Residential	21.88	40,000	875,200
**Existing Levee Right-of-Way (Harvey Canal)	93.92	35,000 x .10	328,720
Perpetual Borrow Easement			
Potential Residential	55	5,000	275,000
Improvements			0
Severance Damage			0
Total (R)			$ 3,394,000
(b) Contingencies 25% (R)			849,000
(c) Acquisition Costs (Estimated 75 tracts)			
Non-Federal	75 tracts @ $2,000 per tract		150,000
Federal	75 tracts @ $1,000 per tract		75,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 4,468,000

**Cost estimates provided for existing right-of-way areas to coincide with the acquisition policy of the local sponsor (West Jefferson Levee District) on this project.

This appraisal is a revision to Real Estate Cost Estimate Identification Numbers 61119, 90613 and 90712.

This estimate is based on mapping, acreage calculations and levee rights-of-way as provided by CEMN-ED-DL. Almost all of the land included in this appraisal report from the Bayou Segnette Pumping Station to the "V-Levee" alignment of Highway 45, is in an area designated as marsh/wetlands. As such, because the appraiser was unable to obtain a yes or no answer to whether future development would be permitted in the marsh/wetland areas, the appraiser has made the estimates based on the premise no future development will be allowed. If it can be demonstrated that this premise is incorrect, this report will be modified to reflect the change in "Highest and Best Use."

Severance Damage not estimated as maps furnished do not show the exact right-of-way lines. Sound acquisition policy should eliminate severance damages.

The tract/ownership count is subject to revision once specific property maps are provided.

NOTE: Part of the right-of-way to be used for construction of this new levee reportedly was acquired for the Harvey Canal-Barataria Levee project in the 1960s.

Barnie L. McDonald

BARNIE L. McDONALD
Appraiser
21 July 1989

Approved By:

Joseph G. Kopec

JOSEPH G. KOPEC
Review Appraiser
21 July 1989

IDENTIFICATION
NUMBER 90613

REAL ESTATE COST ESTIMATE
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GDM No. 1 (Reduced Scope)
JEFFERSON PARISH, LOUISIANA

Flood Protection Levee (West Side) Closure

Alternative 1 - Bayou Segnette Pumping Station to Park Entrance, then along South Side of West Bank Expressway, then North along LP&L Canal to the Southern Pacific Railroad Track

ESTIMATE OF COSTS (Date of Value - June 1989)

	Acres	Unit Value	Total Value
(a) Lands and Damages			
Perpetual Levee and Floodwall Easement			
Potential Commercial/Residential	4.5	$ 15,000	$ 67,500
Potential Commercial	17.0	130,680	2,221,560
Potential Residential	5.5	87,120	479,160
Improvements			0
Severance Damage			0
Total (R)			$2,768,000
(b) Contingencies 25% (R)			692,000
(c) Acquisition Costs (Estimated 10 tracts)			
Non-Federal	10 tracts @ $2,000 per tract		20,000
Federal	10 tracts @ $1,000 per tract		10,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$3,490,000

Flood Protection Levee (West Side) Closure

Alternative 2 - Bayou Segnette Pumping Station to the Southern Pacific Railroad Track North of Circle West Mobile Home Estates

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee and Floodwall Easement			
	Potential Commercial/Residential	4.5	$ 15,000	$ 67,500
	Potential Commercial	3.8	130,680	496,584
	Potential Residential	2.3	87,120	200,376
	Improvements			0
	Severance Damage			0
	Total (R)			$ 764,000
(b)	Contingencies 25% (R)			191,000
(c)	Acquisition Costs (Estimated 10 tracts)			
	Non-Federal	10 tracts @ $2,000 per tract		20,000
	Federal	10 tracts @ $1,000 per tract		10,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 985,000

Flood Protection Levee (West Side) Closure

Alternative 3 - Bayou Segnette Pumping Station to the Southern Pacific Railroad Track North of Circle West Mobile Home Estates

ESTIMATE OF COSTS (Date of Value - June 1989)

	Acres	Unit Value	Total Value
(a) Lands and Damages			
Perpetual Levee and Floodwall Easement			
Potential Commercial/Residential	4.5	$ 15,000	$ 67,500
Potential Commercial	.8	130,680	104,544
Potential Residential	2.3	87,120	200,376
Improvements			0
Severance Damage			0
Total (R)			$ 372,000
(b) Contingencies 25% (R)			93,000
(c) Acquisition Costs (Estimated 10 tracts)			
Non-Federal	10 tracts @ $2,000 per tract		20,000
Federal	10 tracts @ $1,000 per tract		10,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 495,000

Flood Protection Levee (West Side) Closure

Alternative 4 - Bayou Segnette Pumping Station to Park Entrance, Cross the West Bank Expressway, then North Along Canal to the Southern Pacific Railroad Track

ESTIMATE OF COSTS (Date of Value - June 1989)

	Acres	Unit Value	Total Value
(a) Lands and Damages			
Perpetual Levee and Floodwall Easement			
Potential Commercial/Residential	4.5	$ 15,000	$ 67,500
Potential Commercial	4.2	130,680	548,856
Potential Residential	2.3	87,120	200,376
Improvements			200,000
Severance Damage			0
Total (R)			$1,017,000
(b) Contingencies 25% (R)			254,000
(c) Acquisition Costs (Estimated 10 tracts)			
Non-Federal	10 tracts @ $2,000 per tract		20,000
Federal	10 tracts @ $1,000 per tract		10,000
(d) PL 91-646			50,000
(e) Total Estimated Real Estate Cost			$1,351,000

This estimate is based on mapping acreage calculations and levee rights-of-way as provided by CELMN-ED-SP.

Severance Damage not estimated as maps furnished do not show the exact right-of-way lines. Sound acquisition policy should eliminate severance damages.

The tract/ownership count is subject to revision once specific property maps are provided.

BARNIE L. McDONALD
Appraiser
13 June 1989

Approved By:

JOSEPH G. KOPEC
Review Appraiser
13 June 1989

IDENTIFICATION
NUMBER 90613

REAL ESTATE COST ESTIMATE
WESTWEGO TO HARVEY CANAL, LOUISIANA
HURRICANE PROTECTION PROJECT
GDM No. 1 (Reduced Scope)
JEFFERSON PARISH, LOUISIANA

Real Estate Requirements for Modifications to the Bayou Segnette Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee, Floodwall and Borrow Easement Potential Commercial/Residential	1.2	$ 15,000	$ 18,000
	Improvements			0
	Severance Damage			0
	Total (R)			$ 18,000
(b)	Contingencies 25% (R)			5,000
(c)	Acquisition Costs (Estimated 1 tract)			
	Non-Federal	1 tract @ $3,000 per tract		3,000
	Federal	1 tract @ $2,000 per tract		2,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 28,000

Real Estate Requirements for Modifications to the Old Westwego Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee, Floodwall and Borrow Easement Potential Commercial/Industrial	3.3	$ 30,000	$ 99,000
	Improvements			0
	Severance Damage			0
	Total (R)			$ 99,000
(b)	Contingencies 25% (R)			25,000
(c)	Acquisition Costs (Estimated 4 tracts)			
	Non-Federal	4 tracts @ $3,000 per tract		12,000
	Federal	4 tracts @ $2,000 per tract		8,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 144,000

Real Estate Requirements for Construction of an I-Wall at the Lapalco Bridge

ESTIMATE OF COSTS (Date of Value - June 1989)

	Acres	Unit Value	Total Value
(a) Lands and Damages			
Perpetual Levee, Floodwall and Borrow Easement Marsh/Wetland	.9	$ 500	$ 450
Improvements			0
Severance Damage			0
Total (R)			$ 1,000
(b) Contingencies 25% (R)			1,000
(c) Acquisition Costs (Estimated 1 tract)			
Non-Federal	1 tract @ $3,000 per tract		3,000
Federal	1 tract @ $2,000 per tract		2,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 7,000

Real Estate Requirements for Modifications to the New Westwego Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

(a) Lands and Damages	Acres	Unit Value	Total Value
Perpetual Levee, Floodwall and Borrow Easement Marsh/Wetland	1.0	$ 500	$ 500
Improvements			0
Severance Damage			0
Total (R)			$ 1,000
(b) Contingencies 25% (R)			1,000
(c) Acquisition Costs (Estimated 1 tract)			
Non-Federal	1 tract @ $3,000 per tract		3,000
Federal	1 tract @ $2,000 per tract		2,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 7,000

Real Estate Requirements for Construction of a Floodwall Across the Driveway at the Westwego Airport

ESTIMATE OF COSTS (Date of Value - June 1989)

	Acres	Unit Value	Total Value
(a) Lands and Damages			
Perpetual Levee, Floodwall and Borrow Easement			
Marsh/Wetland	.5	$ 500	$ 250
Potential Commercial	1.8	30,000	54,000
Improvements			0
Severance Damage			0
Total (R)			$ 54,000
(b) Contingencies 25% (R)			14,000
(c) Acquisition Costs (Estimated 3 tracts)			
Non-Federal	3 tracts @ $3,000 per tract		9,000
Federal	3 tracts @ $2,000 per tract		6,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 83,000

Real Estate Requirements for Modifications to the Ames and Mt. Kennedy Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee, Floodwall and Borrow Easement Marsh/Wetland	2.6	$ 500	$ 1,300
	Improvements			0
	Severance Damage			0
	Total (R)			$ 1,000
(b)	Contingencies 25% (R)			1,000
(c)	Acquisition Costs (Estimated 1 tract)			
	Non-Federal	1 tract @ $3,000 per tract		3,000
	Federal	1 tract @ $2,000 per tract		2,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 7,000

Real Estate Requirements for Modifications to the Oak Cove Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee, Floodwall and Borrow Easement Marsh/Wetland	.9	$ 500	$ 450
	Improvements			0
	Severance Damage			0
	Total (R)			$ 1,000
(b)	Contingencies 25% (R)			1,000
(c)	Acquisition Costs (Estimated 1 tract)			
	Non-Federal	1 tract @ $3,000 per tract		3,000
	Federal	1 tract @ $2,000 per tract		2,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 7,000

Real Estate Requirements for Modifications to the Ross Canal Drainage Structure

ESTIMATE OF COSTS (Date of Value - June 1989)

	Acres	Unit Value	Total Value
(a) Lands and Damages			
Perpetual Levee, Floodwall and Borrow Easement Marsh/Wetland	1.0	$ 500	$ 500
Improvements			0
Severance Damage			0
Total (R)			$ 1,000
(b) Contingencies 25% (R)			1,000
(c) Acquisition Costs (Estimated 1 tract)			
Non-Federal	1 tract @ $3,000 per tract		3,000
Federal	1 tract @ $2,000 per tract		2,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 7,000

Real Estate Requirements for Modifications to the Estelle Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

(a) Lands and Damages	Acres	Unit Value	Total Value
Perpetual Levee, Floodwall and Borrow Easement			
Marsh/Wetland	.7	$ 500	$ 350
Potential Residential	.7	10,000	7,000
Improvements			0
Severance Damage			0
Total (R)			$ 7,000
(b) Contingencies 25% (R)			2,000
(c) Acquisition Costs (Estimated 1 tract)			
Non-Federal	1 tract @ $3,000 per tract		3,000
Federal	1 tract @ $2,000 per tract		2,000
(d) PL 91-646			0
(e) Total Estimated Real Estate Cost			$ 14,000

Real Estate Requirements for Modifications to the Cousins Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee, Floodwall and Borrow Easement Potential Commerical/Industrial	.8	$108,900	$ 87,120
	Improvements			0
	Severance Damage			0
	Total (R)			$ 87,000
(b)	Contingencies 25% (R)			22,000
(c)	Acquisition Costs (Estimated 5 tracts)			
	Non-Federal	5 tracts @ $3,000 per tract		15,000
	Federal	5 tracts @ $2,000 per tract		10,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 134,000

Real Estate Requirements for Modifications to the Harvey Pump Station

ESTIMATE OF COSTS (Date of Value - June 1989)

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Perpetual Levee, Floodwall and Borrow Easement Potential Commerical/Industrial	.5	$108,900	$ 54,450
	Improvements			0
	Severance Damage			0
	Total (R)			$ 54,000
(b)	Contingencies 25% (R)			14,000
(c)	Acquisition Costs (Estimated 4 tracts)			
	Non-Federal	4 tracts @ $3,000 per tract		12,000
	Federal	4 tracts @ $2,000 per tract		8,000
(d)	PL 91-646			0
(e)	Total Estimated Real Estate Cost			$ 88,000

This estimate is based on mapping, acreage calculations and levee rights-of-way as provided by CELMN-ED-DL. Almost all of the land included in this appraisal report from the Bayou Segnette Pumping Station to the "V-Levee" alignment of Highway 45, is in an area designated as marsh/wetlands. As such, because the appraiser was unable to obtain a yes or no answer to whether future development would be permitted in the marsh/wetland areas, the appraiser has made the estimates based on the premise no future development will be allowed. If it can be demonstrated that this premise is incorrect, this report will be modified to reflect the change in "Highest and Best Use."

Severance Damage not estimated as maps furnished do not show the exact right-of-way lines. Sound acquisition policy should eliminate severance damages.

The tract/ownership count is subject to revision once specific property maps are provided.

BARNIE L. McDONALD
Appraiser
13 June 1989

Approved By:

JOSEPH G. KOPEC
Review Appraiser
13 June 1989

WESTWEGO TO HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO 1 (REDUCED SCOPE)

APPENDIX C

CORRESPONDENCE

CELMV-ED-PG (CELMN-ED-SP/20 Oct 88) (1105-2-10c) 5th End Mr. Bardwell/jm
601-634-5925
SUBJECT: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project - General Design Conference

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

19 MAY '89

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

Referred for action.

FOR THE COMMANDER:

William R. Hill

FRED H. BAYLEY III
Chief, Engineering Division

3 Encls
nc

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

20 Oct 88

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

SUBJECT: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project - General Design Conference

1. Reference ER 1110-2-1150, para. 8.b. concerning the requirements for the General Design Conference (GDC). In accordance with the above referenced ER, the enclosed MFR is furnished for your review and approval to complete the requirements for the GDC for the subject project.

2. Approval is recommended.

Encl

FREDERIC M. CHATRY
Chief, Engineering Division

CELMV-ED-PG (CELMN-ED-SP/20 Oct 88) (1105-2-10c) 1st End . Mr. Bardwell/caf/5925
SUBJECT: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project - General Design Conference

DA, Lower Mississippi Valley Division, CE, Vicksburg, MS 39181-0080

30 DEC 88

FOR: CDR USACE (CEEC-EB) WASH DC 20314-1000

The Memorandum for Record for the subject General Design Conference is forwarded for your review. Approval is recommended subject to the satisfactory resolution of the following comments:

a. Paragraph B, page 1. The local interests' deadline of March 1990 for a construction start to avoid forfeiture of the State-provided funds requires deviating from our current procedure of having an approved General Design Memorandum (GDM) as the basis for the Local Cooperation Agreement (LCA). My staff discussed this problem with Messrs. Ed Nutter and Rob Vining of your office and the following was agreed to:

(1) The LCA will reflect the project features presented in the Feasibility Report, including the V-Levee North alternative. An additional change in the recommended plan will be an extension of the west side levee from the Bayou Segnette pumping station northwesterly to high ground to complete the required protection.

(2) The LCA will be based on the current available information and will include data from the feasibility report, the advance GDM supplement for the Harvey Canal Floodwall and the GDM currently under development.

b. Paragraph B, page 2. In the third sentence of the penultimate paragraph, the word "freeboard" should be replaced with the word "height" since the levee crest elevation will be established based on wave runup computations. Freeboard is selected so that it includes factors which cannot be accurately calculated.

FOR THE COMMANDER:

FRED H. BAYLEY III
Chief, Engineering Division

Encl (quad)
nc

CF:
CELMN-ED-SP (wo/encl)
CELMN-DD-P (wo/encl)

CEEC-EP (CELMV-ED-PG/20 Oct 88) (335-2-5c) 2nd End WALLACE/272-8890
SUBJECT: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project - General Design Conference

HQ, U.S. Army Corps of Engineers, Washington, DC 20314-1000 9 March 1989

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

1. Reference CECW-RN Memorandum dated 23 November 1987, Subject: Guidance Letter No. 4, New Start Construction Projects--Draft LCA Submission Requirements and Status of General Design Memorandum (GDM).

2. The Memorandum for Record (MFR) for the subject design conference accurately reflects the conclusions reached at the conference. However, there are several issues raised in the MFR and the 1st Endorsement that need clarification.

3. Based on conversations between our staffs, we understand that an LCA package which reflects GDM scope costs will be available by October 1989. The LCA package should be consistent with EC 1165-2-144 and submitted to CECW-RN for review and approval. In accordance with the referenced memorandum, the LCA will not be executed until the GDM is approved and funds have been appropriated for the project. At the time the GDM is submitted to your office for approval, information copies should be provided concurrently to CEEC-EP for review. It is imperative that the October 1989 submission date be met in order to be in a position to initiate construction by March 1990.

4. The position that the project plan signed by the Secretary of the Army should serve as the basis for Section 902 cost computations is incorrect. The baseline project cost is the cost contained in the authorizing language for the project ($61,500,000). Section 104 credit approved for external but compatible work is additive to the total project costs but is not counted against the 20% limit. If it is determined that the project costs will exceed the Section 902 limit, a post-authorization change report should be prepared and submitted to CECW-P. ER 1105-2-10 and EC 1105-2-176 (draft) should be reviewed in consultation with CECW-PS staff in this regard.

5. We are also uncertain as to the significance of the statement in the MFR that if the project is not under construction by March 1990, the State of Louisiana will withdraw its financial support for the project. Therefore, please furnish written documentation on the conditions surrounding the State's level of financial commitment to the project.

FOR THE DIRECTOR OF ENGINEERING AND CONSTRUCTION:

Encl
nc

HERBERT H. KENNON
Chief, Engineering Division
Directorate of Engineering
and Construction

CELMV-ED-PG (CELMN-ED-SP/20 Oct 88) (1105-2-10c) 3d End Mr. Miskelley/ts/5922
SUBJECT: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project - General Design Conference

DA, Lower Mississippi Valley Division, CE, Vicksburg, MS 39181-0080

24 APR '89

FOR CDR USACE (CEEC-EP), WASH DC 20314-1000

1. As discussed informally on several occasions with members of the HQUSACE staff the plan of action outlined in the enclosed CELMN-LC memorandum, 13 Apr 89, subject: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project, (encl 2), is proposed. Basically the plan includes submission of an Engineering Supplement to the Feasibility Report. The cost estimates will be prepared using detailed estimating procedures similar to procedures used in preparation of Fair and Reasonable estimates used in evaluating bids on construction contracts. The recently formulated code of accounts, required by EC 1110-2-538, will be used to identify cost items.

2. The documentation requested in paragraph 5 of your 2d Endorsement is enclosed (encl 3).

3. Expeditious approval of the proposed plan of action and outline for the Engineering Supplement is recommended.

FOR THE COMMANDER:

FRED H. BAYLEY III
Chief, Engineering Division

3 Encls
1. nc
added 2 encls
2-3. as

CF:
CELMN-LC
CELMN-ED-SP

CEEC-EP (CELMN-ED-SP/20 Oct 88) (1105-2-10c) 4th End
KAMIEN/vs/272-8894
SUBJECT: West Bank of the Mississippi River in the Vicinity of New Orleans, LA. (Westwego to Harvey Canal, Louisiana Hurricane Protection Project)

HQ, U.S. Army Corps of Engineers, Washington, DC 20314-1000
10 May 1989

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

1. Background.

a. On 31 March 1989, a briefing was held for ASA(CW) concerning the status of the Westwego to Harvey Canal, LA Hurricane Protection Project. Participating in the briefing were the New Orleans Deputy District Engineer for Project Management and the Life Cycle Project Manager for the Westwego to Harvey Canal Project. The purpose of the briefing was to evaluate options available for initiating Federal construction on the project by March 1990, as desired by the local sponsor.

b. Because of the uncertainty of funding, it is necessary to have a GDM suitable as a decision document for two potential funding scenarios:

1) Qualifying the project as an FY91 New Construction Start. The decision document will be needed by July-August 1989.

2) If Congress adds construction funds in FY90, a decision document is needed by October 1989 to allow for initiation of construction by March 1990.

c. It is understood that engineering and design through Plans and Specifications is underway for the Harvey Canal Floodwall feature of the project, which will be the first feature under construction.

2. In order to accelerate the schedule, the GDM must be of a reduced scope and detail compared with the GDM presently scheduled for approval in February 1990. However, it must be of sufficient scope to determine a firm forecast final cost estimate that would serve as the basis to execute the LCA. This concept was endorsed by ASA(CW).

3. The proposed plan of action and outline is approved subject to the following clarifying comments:

a. Affirm the authorized plan.

b. Contain a discussion of cost sharing (including the appropriate sections of the law) and Section 104 credits.

c. Include a draft LCA (See ER 1165-2-131) and a FEIS and if necessary, an SEIS.

d. Discuss the similarities and contrasts between the current plan and the authorized plan (i.e., to insure that the plan we build is still the authorized plan). This presentation will include a comparison of the estimated total project costs to the Section 902 cost limit.

e. If applicable, discuss induced damage mitigation costs.

f. Discuss real estate requirements and OMRR&R costs.

4. The cost estimate display and discussion should include the following:

a. Cost estimates in a Reduced Scope GDM must be the traditional GDM scope cost estimate using the new code of accounts.

b. Display first costs for construction and LERRD's for each project purpose (e.g. recreation structural flood control and nonstructural flood control).

c. Display environmental mitigation and environmental enhancement costs.

d. Display and discuss cost sharing separately for construction and LERRD's. If land enhancement benefits occur (unless incidental), display, the land enhancement cost sharing as a separate line item according to the applicable policy.

e. The costs of the Lands, Easements, Rights-of-Way, Relocations, and Dredged Material Disposal Areas will be displayed individually (e.g., utilities).

f. Operation, Maintenance, Repair, Replacement, and Rehabilitation will be displayed individually for each project purpose and environmental enhancement, if included.

5. EC 1105-2-176 (31 March 1989) provides guidance on computing the Section 902 limit for a project.

6. Your document should more appropriately be titled General Design Memorandum (Reduced Scope).

7. Please provide milestone schedule based on the above guidance.

CEEC-EP
SUBJECT: West Bank of the Mississippi River in the Vicinity of New Orleans, L.A. (Westwego to Harvey Canal, Louisiana Hurricane Protection Project)

8. Questions can be directed to Douglas J. Kamien, (202) 272-8894.

FOR THE DIRECTOR OF ENGINEERING AND CONSTRUCTION:

HERBERT H. KENNON
Chief, Engineering Division
Directorate of Engineering
and Construction

3 Encls
nc

CF: CECW-RN
CECW-BC

CELMN-ED-SP 15 Sep 88

MEMORANDUM FOR RECORD

SUBJECT: Westwego to Harvey, LA - General Design Conference

Dates of Conference: 13 & 14 September 1988

Place of Conference: New Orleans District Office
New Orleans, LA

Attendance: List of attendants is enclosed (Encl 1)

Conference Purpose: The purpose of the General Design Conference was to discuss the current project plan, background, objectives, schedules, costs, design options, major issues or problem areas and types of documents to be submitted.

Conference Summary

A. Field Trip

On 13 Sep 1988, a field trip was arranged for the conference participants. The existing conditions, the work currently being done by the local sponsor and the salient features to be proposed in the GDM, were described at key locations along the project alignment.

B. Design Conference

The design conference was held on 14 Sep 88. Participation generally followed the agenda shown on Encl 2 with attendants participating in the form of comments or questions invited at anytime during the course of the presentations and discussions. A brief history of the project including the status of local cooperation was given. The reasoning behind preparing the design of floodwall along Harvey Canal in the form of an advance supplement was discussed at length. The local sponsor of the project has already had funds appropriated by the State of Louisiana and has to start construction by March 1990 to avoid forfeiture of these funds. Mention was made of the fact that $4.5 million in state funds and $1.2 million in levee district funds are available for the construction of the floodwall along Harvey Canal. It was also mentioned that the local sponsor has submitted a letter indicating their willingness to enter into an LCA for the V-levee north plan. Regarding the current status of the project, the participants were advised that the advance supplement is scheduled to be submitted to LMVD on 31 Oct 88 and is currently on schedule. A draft LCA will not be sent with the supplement.

CELMN-ED-SP
SUBJECT: Westwego to Harvey, LA - General Design Conference

The LCA is scheduled to be completed and signed prior to the start of construction of the floodwall along Harvey Canal. It was mentioned by LMVD that approval of the Advance Supplement will be subject to signing of the Record of Decision. A new construction start will be needed for FY 90 but no federal funds will be needed for the first year of construction as local contributions will be used. The GDM is scheduled for submission to LMVD in Feb 1990. Some delay is being experienced in obtaining the right of entry for the field surveys, which in turn, may affect the GDM completion schedule.

The current project plan as contained in the Feasibility Report of Dec 1986 does not tie the proposed levee at Bayou Segnette Pumping Station to SPH protection. Alternatives to provide SPH protection in this area were discussed. The participants were advised that further investigations of these alternatives will be done to select the proposed plan and the result of these investigations presented in the GDM. Detailed designs for this area will be included in a supplement to the GDM.

The 20 percent project cost exceedence limit referred in the Water Resources Development Act of 1986 (PL99-662) section 902, was discussed in light of additional work. New Orleans District position is that the project plan signed by the Secretary of Army, should become the basic project to which the 20% exceedence limit will be applicable. (For further discussion, please refer to Encl 3)

Status of the study for hurricane protection for areas east of Harvey Canal and feasibility of a floodgate at Harvey Canal was given. The preliminary report is scheduled for completion in Feb 1989.

Discussion was held on H&H considerations for the project design. It was explained that the finished grade of the levee reach on the western side of the "V" levee is 3 feet above the still water level. This freeboard is based on existence of wave runup. Two feet of freeboard was used on the east side because no significant wave activity is expected on that side of the project. It was agreed that a discussion of the effect of relative sea level change on the project should be included in the GDM.

Status of the F&M designs for the project was provided. Some confusion over the relationship of the work the locals are doing now and our designs was evident. It was explained that the work the locals are doing, is generally for interim protection and the extent of any credit due for their work

will depend on the compatibility of the work with the Corps recommended Plan. It was clarified that the selection of the recommended plan presented in the GDM will be based upon the cost-effectiveness evaluations of various alternative plans. The recommended plan will be used as a basis to determine the credit due to the local sponsor for their design and construction effort.

Status of structural design for the project was discussed. It was agreed that the possibility of higher uplift pressures on the pumping stations as a result of higher head on the pump station walls will be investigated in the GDM. Architectural treatment for the floodwalls was also discussed. Areas to be considered for treatment are around Bayou Segnette in the vicinity of Westbank Expressway, the floodwall along Harvey Canal, the Ames pumping station, and the Harvey pumping station.

It was agreed that safety issues for the area around the airport should be coordinated with the FAA. The possibility of a folding floodwall will be investigated.

Status of the levee designs was provided. Alternatives being considered were discussed. It was stated, that the levees adjacent to Jean Lafitte National Historic Park area and the EPA designated 404 (c) area will be designed to conform to V-Levee North Plan as recommended in the Chief of Engineers report.

A handout providing the status of the mitigation plan for the project was provided. A short discussion of the mitigation plan followed. It was suggested and agreed that there should be coordination with the National Park Service during the GDM process.

Summary of Recommendations by OCE and LMVD Participants:

The following is a summary of concerns and suggestions expressed during the GDC.

a. The following design documents will be submitted for this project.

REPORT	SCHEDULED SUBMITTAL
Advance Supplement	OCT 88
GDM	FEB 90
Supplement #1 (SPH protection for the Western side of Project)	To be determined
REDM (Mitigation)	To be determined

b. A new construction start will be needed in FY 90 for the floodwall along Harvey Canal but no federal funds for construction work will be needed in that year.

c. The completed LCA will be forwarded to LMVD no later than Oct 89. The LCA will include provisions for creditable items.

d. Further research is needed to determine whether the 20% exceedence for project cost, (PL99-662, section 902), refers to the cost given in the WRDA or the cost of the project plan as approved by the Secretary of the Army. (Refer to Encl 3).

e. Discussion of the effect of relative sea level change on the project will be included in the GDM.

f. The possibility of higher uplift pressure on the pumping stations as a result of higher head on the walls will be investigated in the GDM.

g. Architectural treatment for the floodwalls will be considered for areas around Bayou Segnette, Harvey Canal floodwall, the Ames pumping station and the Harvey Pumping stations.

h. A folding floodwall will be investigated for the area around the airport.

i. There will be coordination with National Park Service during the GDM process.

j. The advance supplement, GDM and other reports will be reviewed by the cost-effectiveness review team.

PAM DELOACH
Project Engineering Section
Design Services Branch

ATTENDANCE RECORD

DATE(S)	SPONSORING ORGANIZATION	LOCATION
14 Sept, 88	New Orleans District. Corps of Engineers.	New Orleans Dist. office.

PURPOSE General Design Conference Westwego to Harvey canal, Louisiana

PARTICIPANT REGISTER *

NAME	ORGANIZATION	TELEPHONE NUMBER
Victor M. Agostinelli	CELMV-ED-TS	601-634-5932
Jim Mitchelley	CELMV-ED-PG	601-634-5922
Fred Caver	CELMV-ED-P	601-634-5904
J.H. Lockhart, Jr.	CEEC-EH-D	202-272-8553
Bruce Wallace	CEEC-EB (General Engr)	202-254-3757
Ron BURKHARD	CELMV-ED-TC	601-634-5930
JOE McCORMICK	CELMV-ED-WH	601-634-5914
Frank J. Heaver	CELMV-ED-G	601-634-5896
[illegible]	CELMV-BC-D	601-634-5800
Pamela A. DeLoach	CELMN-ED-SP	504-862-2621
RAUL VELEZ	CELMN-ED-DC	504-562-1944
Larry L. Weed	CELMN-ED-DD	504-862-2664
Jack Bardwell	CELMV-ED-PG	601-631-5925
ERNEST BARTON	CELMN-ED-SP	504-862-2608
Harry Walton	CELMV-PD-F	601-634-5833
Tom Pullen	CELMV-PD-R	601-634-5857
LESLIE S. WAGUESPACK	CELMN PD-FG	504-862-2503
Steve Finnegan	CELMN PD-RA	504 862-2553
Ed Nutter	CECW-PS	202 272-1974
Rich Jackson	CELMV-ED-G	601 634-5818
John Grieshaber	CELMN-ED-FS	
Ted Rossier	CELMV-VE	601 634 5936
Dan Marsalek	CELMNED-D	504 862 2260

LMV FORM 583-R (replaces LMN 906)

* If you wish to be furnished a copy of the attendance record, please indicate so next to your name.

Encl 1

PARTICIPANT REGISTER (CONTINUED)

NAME	ORGANIZATION	TELEPHONE NUMBER
JANIS HOTE	CELMNED-HC	5048622489
Jay Combs	CE-LMNED-HC	504-862-2480
LAWRENCE H. CAVE JR	CELMV-ED-GS	601-634-5897
LARRY COOK	" " -WW	" " 5915
Carl E Anderson	CELMNED-SP	504/862-2610
Mohammad Tufail	CELMVED-SP	504-862-2613
TERRAL BLOUNT	CELMN-LC	(504) 862-2597

LMV FORM 583-R

Westwego to Harvey Canal, Louisiana
Hurricane Protection Project
General Design Conference
13 - 14 September 1988

New Orleans District, Corps of Engineers

AGENDA

13 September 1988

0900 - 1500 Field Trip

14 September 1988

Welcome - Introduction	Mr. Tufail
Project History/Current Status Existing Conditions/Local Cooperation	Mr. Broussard
Status of GDM Alternative Plans/Schedule Heights of Protection Westside Closure	Mr. Tufail
Floodgate Considerations for Harvey Canal	Mr. Wagaspack

Break

H&H Considerations

Development of SPH Stages
Hydraulic Sections (With/Without Wave Berm)
Interior Drainage

Lunch

Foundation Design

Investigations (Borings/Testing)
Soil Conditions
Alternatives Considered

Break

Structural Design

Flood Wall
Levees
Alternative Plans

Break

Recommendations by OCE/LMVD participants
Wrap-up Discussions
End of Conference

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

13 April 1989

REPLY TO
ATTENTION OF:
Executive Office

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

SUBJECT: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project

1. References:

a. CELMN-ED-SP memorandum dated 20 October 1988 and endorsements 1 and 2, subject: Westwego to Harvey Canal, Louisiana, Hurricane Protection Project - General Design Conference.

b. Briefing, 31 March 1989, by Mr. Bory Steinberg (CECW-R) for Mr. Robert Page, ASA(CW), concerning the subject project.

c. Draft ER 1110-2-XXXX, dated 31 March 1989, Engineering and Design for Civil Works Projects.

2. In accordance with reference 1a, 2nd endorsement, paragraph 3, the LCA for the subject project will not be executed until the GDM is approved. The GDM is scheduled for completion in February 1990. However, in order to initiate Federal construction by March 1990, assuming approval of an FY90 new construction start, the LCA must be executed by October 1989.

3. In an effort to decrease the time and effort between the approved project feasibility report and the start of construction, we propose to submit a report in accordance with the enclosed outline which will: (1) reaffirm the project scope, (2) present evidence to support a firm project cost estimate, and (3) verify the economic soundness of the project. This report will be the basis for negotiation and execution of the LCA. We will submit the report within 60 days of approval of the enclosed outline.

4. Recommend approval of the enclosed outline.

Enclosures

CLETIS R. WAGAHOFF
Deputy District Engineer
for Project Management

Encl 7

WESTWEGO TO HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
ENGINEERING SUPPLEMENT TO
FEASIBILITY REPORT-OUTLINE

I. Executive Summary.

II. Project Authorization, Status and Description.

III. Purpose and Scope.

- A. Present project alignment and general project parameters based on current data.
- B. Present current project cost estimate.
- C. Present updated economic analysis.

IV. Background.

- A. General.
- B. Inclusion of Harvey Canal Floodwall in Louisiana State Flood Control Program.
- C. Original Plan of Action and Milestones to effect Floodwall contract award by March 1990.
- D. Current Plan of Action and Milestones to effect Floodwall contract award by March 1990.

V. Discussion of Design Data Currently Available.

VI. Presentation of Designs based on Current Data.

- A. Design criteria, methods and assumptions.
- B. Plan and Profile sheets.
- C. Typical design sections (see attachments numbered 1 and 2 for examples of level of detail).

VII. Project Cost Estimate.

A. Estimates for contract items shown on attachment numbered 3.

B. Discussion of level of confidence in design and cost estimates for each project Reach.

C. Discussion of 20% cost increase limitation (Section 902, P.L. 99-662).

VIII. Schedule for Design and Construction.

IX. Update of Project Benefits.

A. Project benefits.

B. Benefit - cost ratio based on updated benefits and current project cost estimate.

X. Environmental Information.

A. Status of EIS.

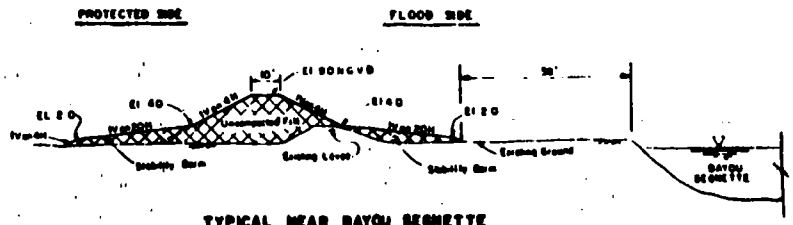
B. Mitigation.

XI. Views of Local Cost Sharing Sponsor.

XII. Recommendation.

A. Based on Engineering Supplement to Feasibility Report, proceed with execution of LCA in October 1989.

ATTACH 1



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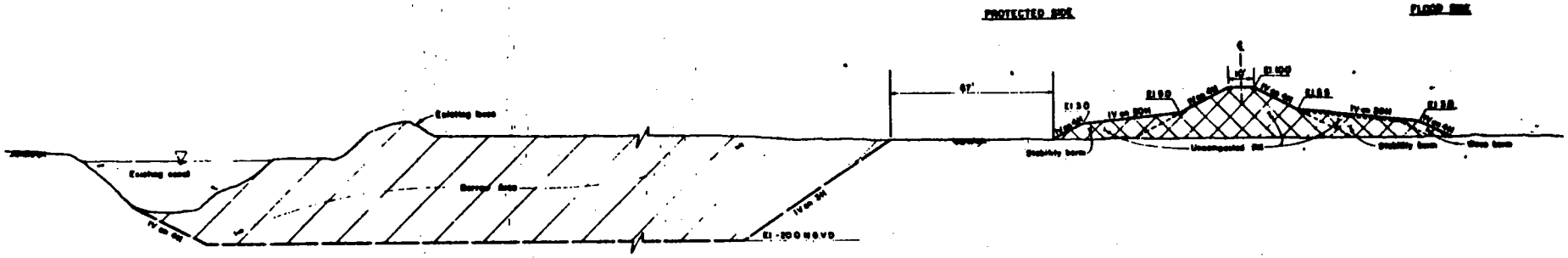

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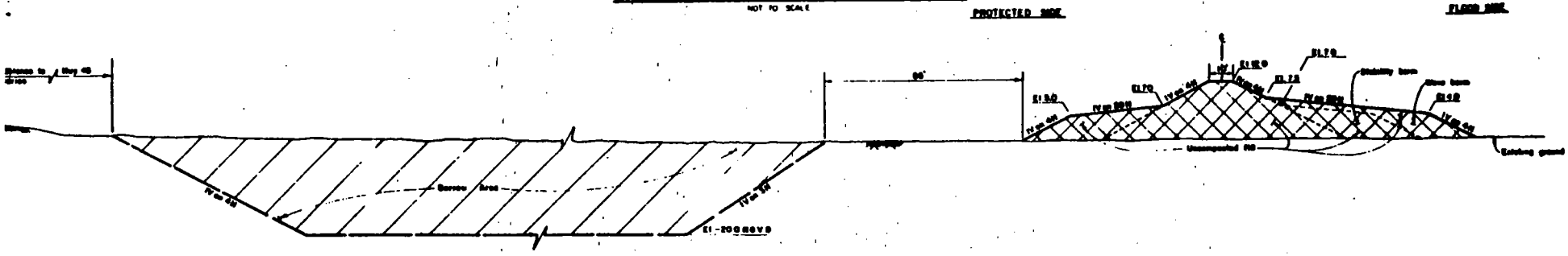

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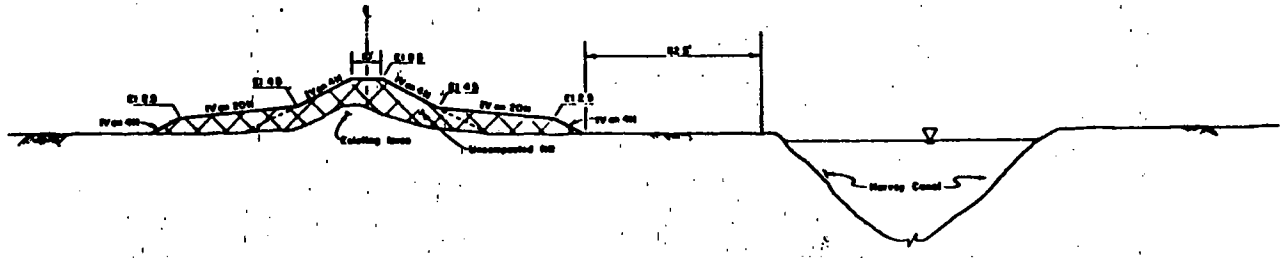

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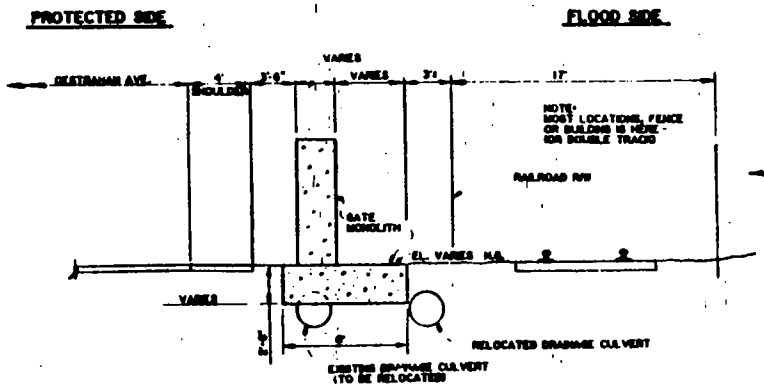
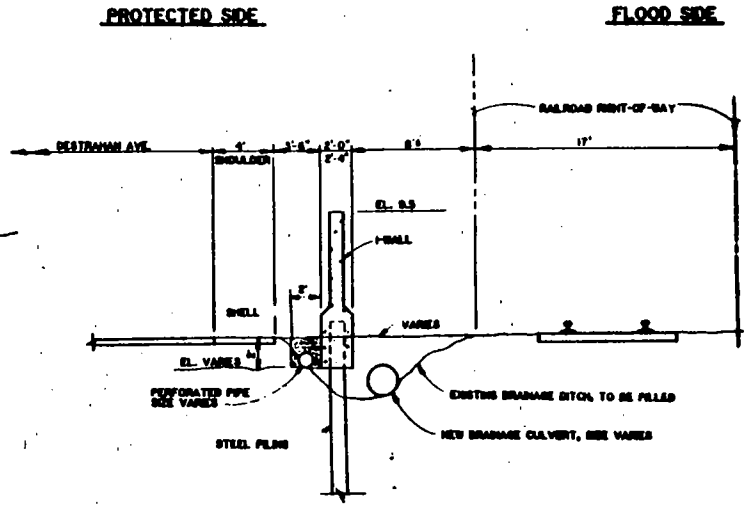
HTRH 2



TYPICAL SECTION AT GATE

SCALE: 1" = 4'-0"



TYPICAL SECTION -I WALL

SCALE: 1" = 4'-0"

WESTWEGO TO HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
CONTRACT ITEMS

(1ST LIFT)
BAYOU SEGNETTE P.S. TO OAK COVE
OAK COVE TO HWY 45
HWY 45 TO ESTELLE P.S.
ESTELLE P.S. TO HARVEY P.S.

(2ND LIFT)
BAYOU SEGNETTE P.S. TO OAK COVE
OAK COVE TO HWY 45
HWY 45 TO ESTELLE P.S.
ESTELLE P.S. TO HARVEY P.S.

(3RD LIFT)
BAYOU SEGNETTE TO HWY 45
HWY 45 TO HARVEY P.S.

(STRUCTURES/FLOODWALLS)
OAK COVE TO HWY 45-DRAIN STRUCT
HARVEY LOCK TO HARVEY P.S.-FLDWL
WESTWEGO P.S. FLDWL
ESTELLE P.S. FLDWL
HARVEY P.S. FLDWL
BAYOU SEGNETTE P.S. FLDWL
WESTWEGO AIRPORT FLDWL
AMES MT. KENNEDY-OAK COVE FLDWL
COUSINS P.S. FLDWL
HWY 45 & LAFITTE HWY-GATES
WEST SIDE TIE-IN WALL
EAST SIDE TIE-IN WALL

(PUMPING STATIONS)
WESTWEGO P.S.
ESTELLE P.S.
HARVEY P.S.
BAYOU SEGNETTE P.S.
AMES MT. KENNEDY & OAK COVE P.S.
COUSINS P.S.

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
P.O. Box 94245, Baton Rouge, Louisiana 70804-9245

NEIL L. WAGONER, P.E.
SECRETARY

BUDDY ROEMER
GOVERNOR

FAX Ph. 379-1393

Office Ph. 379- 1473

FAX LETTER

TO: CELMN-LC-Terral Broussard

FROM: Dot McConnell

DATE: 01-30-89

Total of pages including cover sheet 9

MESSAGE: _____

E1

Department of Transportation and Development

P. O. BOX 94245
BATON ROUGE, LA. 70804-9245

Robert G. Graves
Secretary

Edwin W. Edwards
Governor

March 5, 1986

Mr. Ernest J. Tassin, Exec. Director
West Jefferson Levee District
403 Barataria Blvd.
Marrero, Louisiana 70072

Dear Mr. Tassin:

The 1985 Regular Session of the Louisiana Legislature has provided funding for the Statewide Flood Control Program in accordance with the prioritized list of projects presented by the Joint Legislative Committee on Transportation, Highways, and Public Works. The authorized level of funding is sufficient to allow for the construction of the Destrehan Ave./Harvey Canal project. Funding scheduled is as follows:

Sponsor	Project Name	S.P. No.	Estimated Const. Cost	LA Funding Share
West Jefferson Levee District	Destrehan Ave. Floodgate/Harvey Canal Floodwall	576-26-02	$ 6,493,018	$ 2,457,807

The amount indicated as Louisiana's Funding Share does not reflect adjustments which may be made pursuant to RS38:90.12(c).

Please note the state project number that has been assigned to your project and use it for reference in all future correspondence.

Before we can proceed with the project, you will be required to enter into an agreement with DOTD. We are currently preparing an agreement for your signature and will forward it to you as soon as possible. In accordance with this agreement, the Office of Public Works will develop plans and specifications, prepare rights-of-way drawings, assist you in obtaining permits and assist you in developing any utility relocation information. Specific instructions for advertising, bidding, awarding of the contract, administration of the contract and payment release will be defined in the "Statewide Flood Control Procedural Manual". A copy of this manual will be forwarded to you at a later date.

(1)

We are looking forward to working with you toward reduction of flood damages in your area. If we can provide you with additional information, members of my staff can be reached at (504) 379-1473.

Yours very truly,

Arthur R. Theis

ARTHUR R. THEIS, CHAIRMAN
FLOOD CONTROL EVALUATION COMMITTEE

ART/DMc:clw

Enclosure

cc: Ms. Mona George
Ms. Delmar Fulmer
Dr. Charles Groat
Mr. Glen Daigre
Mr. J. C. McGrew
Attn: Geneva Grille
Senator Elwyn Nicholson
Senator Fritz Windhorst
Representative N. J. Damico
Representative J. Chris Ullo

Robert G. Graves
Secretary

Department of Transportation and Development

P. O. BOX 94245
BATON ROUGE, LA. 70804-9245
(504) 379-1473

Edwin W. Edwards
Governor

August 29, 1986

Mr. Ernest J. Tassin, Executive Director
West Jefferson Levee District
403 Barataria Blvd.
Marrero, LA 70072

Dear Mr. Tassin:

The 1986 Regular Session of the Louisiana Legislature has provided funding for the Statewide Flood Control Program in accordance with the prioritized list of projects presented by the Joint Legislative Committee on Transportation, Highways and Public Works. The authorized level of funding is sufficient to allow committment of the balance necessary to complete the State's 70% share for the Destrehan Ave. Floodgate/Harvey Canal Floodwall project.

Our letter of March 5, 1986 indicated that $2,457,807 was being made available from Fiscal Year 85-86 funds. At this time we are able to supplement that amount by an additional $2,087,306. Therefore the total state funding made available to the project is $4,545,113. In accordance with the Statewide Flood Control Program's guidelines, this represents 70% of the project's estimated construction cost. Funding scheduled is as follows:

Sponsor	Project	State Project No.	Estimated Const.Cost	LA Funding Share
West Jefferson Levee District	Destrehan Ave. Floodgate/ Harvey Canal Floodwall	576-26-02	$6,493,018	$4,545,113

Please do not hesitate to contact this office if you require additional information.

Yours very truly,

Arthur R. Theis

ARTHUR R. THEIS, CHAIRMAN
FLOOD CONTROL EVALUATION COMMITTEE

ART/DMc:bl

(3)

cc: Senator Elwyn Nicholson
Senator Fritz Windhorst
Representative N. J. Damico
Representative J. Chris Ullo
Ms. Mona George
Ms. Delmar Fulmer
Dr. Charles Groat
Mr. Glen Daigre
Mr. John Evanco
Attn: Ms. Geneva Grille

Department of Transportation and Development

Robert G. Graves
Secretary

P. O. BOX 94245
BATON ROUGE, LA. 70804-9245

(504) 379-1473

Edwin W. Edwards
Governor

September 16, 1986

Mr. Ronald R. Besson
President
West Jefferson Levee District
403 Barataria Blvd.
Marrero, LA 70072

Dear Mr. Besson:

I have received your letter concerning the Destrehan Avenue Floodgate/Harvey Canal Floodwall project (State Project Number 576-26-02). This project was approved and funded through the Statewide Flood Control Program. You received notification of that funding in our letter of March 5, 1986. Under the regulations governing the Statewide Flood Control Program at the time your project was funded, the money will remain dedicated for four (4) years from the date of that letter. Funding will not be jeopardized as long as a construction contract is awarded within that time period.

The project addresses a serious flooding problem and I understand your concern that it be accomplished in a timely manner. Since DOTD is handling all engineering aspects of the project on your behalf, I can assure you they will be completed within the time frame required by the Statewide Flood Control Program.

Thank you for your inquiry and do not hesitate to call if I can be of further assistance.

Sincerely,

ROBERT G. GRAVES
SECRETARY

RGG/DMc:bl

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
P.O. Box 94245, Baton Rouge, Louisiana 70804-9245

NEIL L. WAGONER, P.E.
SECRETARY

BUDDY ROEMER
GOVERNOR

(504) 379-1435

October 24, 1988

STATE PROJECT NO. 576-26-02
FLOOD CONTROL IMPROVEMENTS TO
HARVEY CANAL (WEST BANK) FLOODWALL
JEFFERSON PARISH

Mr. Ronald R. Besson, President
West Jefferson Levee District
403 Barataria Boulevard
Marrero, LA 70072

Dear Mr. Besson:

We have received your letter, dated October 13, 1988, requesting the U. S. Army, Corps of Engineers provide engineering services for the captioned project.

The Department has no objections to the Corps providing engineering services provided the project is developed in accordance with the Statewide Flood Control Program "Procedural Manual for Funded Projects" and a construction contract is awarded prior to March 5, 1990.

We will supplement our agreement so that DOTD will not provide the engineering services, but West Jefferson Levee District will be responsible for engineering services, so that you may contract with the Corps.

If we may be of additional service, please advise.

Sincerely,

D. J. Hebre, Jr., P. E.
Project Support Chief

DJW/jfh
cc: Mr. Dempsey D. White
Mr. Ed Breckwoldt
Mr. Curtis G. Patterson
Mr. Fred Chatry, Corps of Engineers

STATE PROJECT NO. 576-26-02
FLOOD CONTROL IMPROVEMENTS TO
HARVEY CANAL (WEST BANK) FLOODWALL
JEFFERSON PARISH

THIS AGREEMENT, made and executed in three (3) original copies on this 1 day of [illegible], 19[illegible], by and between the Department of Transportation and Development, Office of Public Works, hereinafter referred to as "DOTD", and the West Jefferson Levee District, a political subdivision of the State of Louisiana, hereinafter referred to as "Sponsor";

WITNESSETH: That;

WHEREAS, under the provisions of Title 38, Louisiana Revised Statutes, "Public Contracts, Works and Improvements", as amended, funds have been appropriated to finance improvement projects on the approved Statewide Flood Control Construction Program under the direct administration of the DOTD; and

WHEREAS, the Sponsor has requested and has received an appropriation of State funds to finance a portion of the flood control project as described herein; and

WHEREAS, the Sponsor has self-generated funds available for its share of participation in the flood control project; and

WHEREAS, the Sponsor agrees to furnish all lands, easements, rights-of-way and spoil disposal areas necessary to construct and maintain the project without cost to the State; and

WHEREAS, the Sponsor agrees to operate and maintain the project in accordance with the "Operation and Maintenance Manual" approved by the DOTD; and

WHEREAS, the Sponsor agrees to assume all maintenance and operation costs for the project and all future alterations as may be required without cost to the State; and

WHEREAS, the Sponsor agrees to accomplish all necessary utility and any other facility relocations, alterations and maintenance without cost to the State; and

WHEREAS, the Sponsor agrees to provide at least thirty percent (30%) local participation for cost of constructing the project; and

WHEREAS, the DOTD agrees to provide no more than seventy percent (70%) participation for the cost of constructing the project or as modified by RS 38:90.12(c);

NOW, THEREFORE, in consideration of the premises and mutual dependent covenants herein contained, the parties hereto agree as follows:

WESTWEGO TO HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
GENERAL DESIGN MEMORANDUM NO.1 (REDUCED SCOPE)

APPENDIX D

DRAFT (CURRENT)

LOCAL COOPERATION AGREEMENT

LOCAL COOPERATION AGREEMENT

BETWEEN

THE DEPARTMENT OF THE ARMY

AND

WEST JEFFERSON LEVEE DISTRICT

FOR CONSTRUCTION OF THE

WEST BANK HURRICANE PROTECTION LEVEE

(Westwego to the Harvey Canal)

JEFFERSON PARISH, LOUISIANA

THIS AGREEMENT, entered into this _____ day of _____ 1989, by and between the DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government"), acting by and through the Assistant Secretary of the Army (Civil Works), and the WEST JEFFERSON LEVEE DISTRICT (hereinafter referred to as the "Local Sponsor"), acting by and through _____

WITNESSETH, THAT:

WHEREAS, construction of the West Bank Hurricane Protection Levee at Westwego to the Harvey Canal, Jefferson Parish, Louisiana (hereinafter referred to as the "Project", as defined in Article I.a. of this Agreement), was authorized by Section 401 of the Water Resource Development Act of 1986, Public Law 99-662; and,

WHEREAS, Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, specifies the cost-sharing requirements applicable to the Project; and,

WHEREAS, Section 221 of the Flood Control Act of 1970, Public Law 91-611, as amended, provides that the construction of any water resource project by the Secretary of the Army shall not be commenced until non-Federal interest has entered into a written agreement to furnish its required cooperation for the project; and,

WHEREAS, on 13 May 1988, the Assistant Secretary of the Army, Civil Works, approved a credit, subject to audit, with an estimated value of $6,700,000 for West Jefferson Levee District towards West Jefferson District's share of the project cost for external work done during the 5-year period prior to enactment of the Water Resources Development Act of 1986. Hence, the value of this work is additive to the reporting officer's estimate of the

project cost. Furthermore, on 28 March 1989 the Assistant Secretary of the Army, Civil Works, approved a credit subject to audit, with an estimated value of $21,400,000 for West Jefferson Levee District towards West Jefferson Levee District's share of the project cost for work accomplished or to be accomplished subsequent to enactment of the Water Resources Development Act of 1986, 17 November 1986. This credit is in accordance with Section 104 of this Act;

WHEREAS, the Local Sponsor does not qualify for a reduction of the maximum non-Federal cost share pursuant to the guidelines which implement Section 103(m) of the Water Resources Development Act of 1986, Public Law 99-662, published in 33 C.F.R., sections 241.1 - 6, entitled "Flood Control Cost-Sharing Requirements Under the Ability to Pay Provision"; and

WHEREAS, the Local Sponsor has the authority and capability to furnish the cooperation hereinafter set forth and is willing to participate in cost-sharing and financing in accordance with the terms of this Agreement;

NOW, THEREFORE, the parties agree as follows:

ARTICLE I - DEFINITIONS AND GENERAL PROVISIONS

For purposes of this Agreement:

a. The term "Project" shall mean the provision of standard project hurricane protection to the areas between Westwego and the Harvey Canal on the west bank of the Mississippi River in the vicinity of New Orleans, Louisiana and consisting of approximately 22 miles of Levee and 2 miles of floodwalls in accordance with the plan delineated in the reduced scope General Design Memorandum.

b. The term "total project costs" shall mean all costs incurred by the Local Sponsor and the Government directly related to construction of the Project. Such costs shall include, but not necessarily be limited to, continuing planning and engineering costs incurred after October 1, 1985, costs of applicable engineering and design; actual construction costs; supervision and administration costs; costs of contract dispute settlements or awards, mitigation and the value of lands, easements, rights-of-way, utility and facility alterations or relocations, and dredged material disposal areas provided for the Project by the Local Sponsor, but shall not include any costs for betterments, operation, repair, maintenance, replacement, or rehabilitation.

c. The term "period of construction" shall mean the time from the advertisement of the first construction contract to the time of acceptance of the Project by the Contracting Officer.

d. The term "Contracting Officer" shall mean the U.S. Army Engineer for the New Orleans District, or his designee.

e. The term "highway" shall mean any highway, thoroughfare, roadway, street, or other public or private road or way.

f. The term "relocations" shall mean alterations, modifications, lowering or raised in place, and/or new construction related to, but not limited to, existing: railroads, highways, bridges, railroad bridges and approaches thereto, buildings, pipelines, public utilities (such as municipal water and sanitary sewer lines, telephone lines, and storm drains), aerial utilities, cemeteries, and other facilities, structures, and improvements determined by the Government to be necessary for the construction, operation and maintenance of the Project.

g. The term "fiscal year" shall mean one fiscal year of the United States Government unless otherwise specifically indicated. The Government fiscal year begins on October 1 and ends on September 30.

h. The term "involuntary acquisitions" shall mean the acquisition of lands, easements and rights-of-way by eminent domain.

i. The term "functional portion of the Project" shall mean a completed portion of the Project as determined by the Contracting Officer to be suitable for tender to the Local Sponsor to operate and maintain in advance of completion of construction of the entire Project.

ARTICLE II - OBLIGATIONS OF THE PARTIES

a. The Government, subject to and using funds provided by the Local Sponsor and appropriated by the Congress of the United States, shall expeditiously construct the Project (including relocations of railroad bridges and approaches thereto), applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations and policies. The Local Sponsor shall be afforded the opportunity to review and comment on all contracts, including relevant plans and specifications, prior to the issuance of invitations for bid. The Local Sponsor will will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. The Government will consider the comments of the Local Sponsor, but award of contracts, modifications or change orders, and performance of all work on the Project (whether the work is performed under contract or by Government personnel), shall be exclusively within the control of the Government. In those cases

where notification of the Local Sponsor of a required contract modification or change order is not practicable prior to the issuance of Notice to Proceed such modification will be provided at the earliest day possible.

b. When the Government determines that the Project, or a functional portion of the Project is complete, the Government shall turn the completed Project or functional portion over to the Local Sponsor, which shall accept the Project or functional portion and be solely responsible for operating, repairing, maintaining, replacing, and rehabilitating the Project, or functional portion in accordance with Article VIII hereof.

c. As further specified in Article III hereof, the Local Sponsor shall provide all lands, easements, rights-of-way, to include any separable fish and wildlife mitigation lands, and dredged material disposal areas, and perform all relocations (excluding railroad bridges and approaches thereto) determined by the Government to be necessary for construction of the Project. At its sole discretion, the Government may perform relocations in cases where it appears that the Local Sponsor's contributions will exceed the maximum non-Federal cost share set out in Article VI.f.

d. If the value of the contributions provided under paragraph c. of this Article and the referenced credits approved by the Assistant Secretary of the Army (Civil Works) and verified by audit represent less than 35 percent of total project costs, the Local Sponsor shall provide, during the period of construction, an additional cash contribution in the amount necessary to make its total contribution equal to 35 percent of total project costs.

e. The government shall apply credit, as verified by audit, for external compatible work performed prior to enactment of the Water Resources Development Act of 1986, 17 November 1986, by the Local Sponsor and work performed or to be performed subsequent to enactment of the Act in accordance with Section 104 of the Act. The credit shall be applied against the Local Sponsor's cost-sharing requirements for the project. The Local Sponsor's total cost-sharing requirements are presently estimated to be $30,000,000.

f. No Federal funds may be used to meet the Local Sponsor share of project costs under this Agreement unless the expenditure of such funds is expressly authorized by statute as verified in writing by the granting agency.

g. The Local Sponsor agrees to participate in and comply with applicable Federal flood plain management and flood insurance programs.

h. No less than once each year the Local Sponsor shall inform affected interests of the limitations of the protection afforded by the Project.

i. The Local Sponsor shall publicize flood plain information in the area concerned and shall provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the Project.

ARTICLE III - LANDS, FACILITIES, AND PUBLIC LAW 91-646 RELOCATION ASSISTANCE

a. Prior to the advertisement for any construction contract, the Local Sponsor shall furnish without cost to the Government all lands, easements, and rights-of-way, including suitable borrow and dredged material disposal areas, as may be determined by the Government to be necessary for construction, operation and maintenance of the Project, and shall furnish to the Government evidence supporting the Local Sponsor's legal authority to grant rights-of-entry to such lands.

b. The Local Sponsor shall provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged material disposal areas necessary for construction of the Project.

c. Upon notification from the Government, the Local Sponsor shall accomplish or arrange for accomplishment at no cost to the Government all relocations (excluding railroad bridges and approaches thereto) determined by the Government to be necessary for construction of the Project.

d. The Local Sponsor shall comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way for construction and subsequent operation and maintenance of the Project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - VALUE OF LANDS AND FACILITIES

a. The value of the lands, easements, and rights-of-way to be included in total project costs and credited towards the Local Sponsor's share of total project costs will be determined in accordance with the following procedures:

INDENT

1. If the lands, easements or rights-of-way are owned by the Local Sponsor as of the date the first construction contract for the Project is awarded, the credit shall be the fair market value of the interest provided to the Government by the Local Sponsor at the time of such award. The fair market value shall be determined by an appraisal, to be obtained by the Local Sponsor, which has been prepared by a qualified appraiser who is acceptable to both the Local Sponsor and the Government. The appraisal shall be reviewed and approved by the Government.

2. If the lands, easements, or rights-of-way are to be acquired by the Local Sponsor after the date of award of the first construction contract for the Project, the credit shall be the fair market value of the interest at the time such interest is acquired. The fair market value shall be determined as specified in Article IV.a.1. of this Agreement. If the Local Sponsor pays an amount in excess of the appraised fair market value, it may be entitled to a credit for the excess if the Local Sponsor has secured prior written approval from the Government of its offer to purchase such interest.

3. If the Local Sponsor acquires more lands, easements, or rights-of-way than are necessary for project purposes, as determined by the Government, then only the value of such portions of those acquisitions as are necessary for project purposes shall be included in total project costs and credited towards the Local Sponsor's share.

4. Credit for lands, easements and rights-of-way in the case of involuntary acquisitions which occur within a one-year period preceding the date this Agreement is signed or which occur after the date this Agreement is signed will be based on court awards, or on stipulated settlements that have received prior Government approval.

5. Credit for lands, easements, or rights-of-way acquired by the Local Sponsor within a five-year period preceding the date this Agreement is signed, or at any time after this Agreement is signed, will also include the actual incidental costs of acquiring the interest, e.g., closing and title costs, appraisal costs, survey costs, attorney's fees, plat maps, and mapping costs, as well as the actual amounts expended for payment of any Public LAw 91-646 relocation assistance benefits provided in accordance with the obligations under this Agreement.

b. The costs of relocations which will be included in total project costs and credited towards the Local Sponsor's share of total project costs shall be that portion of the actual costs as set forth below, and approved by the Government:

INDENT

1. Highways and Highway Bridges: Only that portion of the cost as would be necessary to construct substitute bridges and highways to the design standard that the State of Louisiana would use in constructing a new bridge or highway under similar conditions of geography and traffic loads.

2. Utilities and Facilities (including railroads): Actual relocation costs, less depreciation, less salvage value, plus the cost of removal, less the cost of betterments. With respect to betterments, new materials shall not be used in any alteration or relocation if materials of value and usability equal to those in the existing facility are available or can be obtained as salvage from the existing facility or otherwise, unless the provision of new material is more economical. If, despite the availability of used material, new material is used, where the use of such new material represents an additional cost, such cost will not be included in total project costs.

ARTICLE V - CONSTRUCTION PHASING AND MANAGEMENT

a. To provide for consistent and effective communication between the Local Sponsor and the Government during the period of construction, the Local Sponsor and the Government shall appoint representatives to coordinate on scheduling, plans, specifications, modifications, contract costs, and other matters relating to construction of the Project. The Local Sponsor will be informed of any changes in cost estimates.

b. The representatives appointed above shall meet as necessary during the period of construction and shall make such recommendations as they deem warranted to the Contracting Officer.

c. The Contracting Officer shall consider the recommendations of the representatives in all matters relating to construction of the Project, but the Contracting Officer, having ultimate responsibility for construction of the Project, has complete discretion to accept, reject, or modify the recommendations.

ARTICLE VI - METHOD OF PAYMENT

a. The Local Sponsor shall provide, during the period of construction, its required share of total project costs as stated under Article II of this Agreement. Total project costs are presently estimated to be $85,800,000. In order to meet its share, the Local Sponsor must provide a total contribution presently estimated to be $30,000,000. The dollar amounts set forth in this Article are based upon the Government's best estimates which will reflect projection of costs, price level changes, and anticipated inflation and credits provided by the Local Sponsor. Such cost estimates are subject to adjustments based upon cost actually incurred and are not to be construed as the total financial responsibilities of the Government and the Local Sponsor.

b. The Local Sponsor shall provide its required contribution in proportion to the rate of Federal expenditures during the period of construction in accordance with the following provisions:

INDENT

1. For purposes of budget planning, the Government shall notify the Local Sponsor by 31 July of each year of the estimated funds that will be required from the Local Sponsor to meet its share of total project costs for the upcoming fiscal year.

2. No later than 60 calendar days prior to the award of the first construction contract, the Government shall notify the Local Sponsor of the Local Sponsor's share of total project costs, including its share of costs attributable to the Project incurred prior to the initiation of construction, for the first fiscal year of construction. No later than 30 calendar days thereafter, the Local Sponsor shall verify to the satisfaction of the Government that it has deposited the requisite amount in an escrow account acceptable to the Government, with interest accruing to the Local Sponsor.

3. For the second and subsequent fiscal years of project construction, the Government shall, no later than 60 calendar days prior to the beginning of the fiscal year, notify the Local Sponsor of the Local Sponsor's share of total project costs for that fiscal year. No later than 30 calendar days prior to the beginning of the fiscal year, the Local Sponsor shall make the necessary funds available to the Government through the funding mechanism specified in Article VI. b.2. of this Agreement. As construction of the project proceeds, the Government shall adjust the amounts required to be provided under this paragraph to reflect actual costs.

4. If at any time during the period of construction the Government determines that additional funds will be needed from the Local Sponsor, the Government shall so notify the Local Sponsor, and the Local Sponsor, no later than 45 calendar days from receipt of such notice, shall make the necessary funds available through the funding mechanism specified in Article VI.b.2. of this Agreement.

c. The Government will draw on the escrow account provided by the Local Sponsor such sums as the Government deems necessary to cover contractual and in-house fiscal obligations attributable to the Project as they are incurred, as well as incurred by the Government prior to the initiation of construction.

d. Upon completion of the Project and resolution of all relevant contract claims and appeals, the Government shall compute the total project costs and tender to the Local Sponsor a final accounting of the Local Sponsor's share of total project costs. In the event the total contribution by the Local Sponsor is less than its minimum required share of total project costs, the Local Sponsor shall, no later than 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet its minimum required share of total project costs.

e. If the Local Sponsor's total contribution under this Agreement including lands, easements, rights-of-way, and relocations, and dredged material disposal areas provided by the Local Sponsor exceeds 50 percent of total project costs, the Government shall, subject to the availability of appropriations for that purpose, refund the excess to the Local Sponsor no later than 90 calendar days after the final accounting is complete.

ARTICLE VII - DISPUTES

Before any party to this Agreement may bring suit in any court concerning an issue relating to this Agreement, such party must first seek in good faith to resolve the issue through negotiation or other forms of nonbinding alternative dispute resolution mutually acceptable to the parties.

ARTICLE VIII - OPERATION AND MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION.

a. After the Government has turned the completed Project, or functional portion of the Project, over to the Local Sponsor, the Local Sponsor shall operate, maintain, repair, replace, and rehabilitate the completed Project, or functional portion of the Project, in accordance with regulations or directions prescribed by the Government.

b. The Local Sponsor hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land which it owns or controls for access to the Project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. If an inspection shows that the Local Sponsor for any reason is failing to fulfill its obligations under this Agreement without receiving prior written approval from the Government, the Government will send a written notice to the Local Sponsor. If the Local Sponsor persists in such failure for 30 calendar days after receipt of the notice, then the Government shall have a right to enter, at reasonable times and in a reasonable manner, upon lands the Local Sponsor owns or controls for access to the Project for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Government shall operate to relieve the Local Sponsor of responsibility to meet its obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to assure faithful performance pursuant to this Agreement.

ARTICLE IX - RELEASE OF CLAIMS

The Local Sponsor shall hold and save the Government free from all damages arising from the construction, operation, and maintenance of the Project, except for damages due to the fault or negligence of the Government or its contractors.

ARTICLE X - MAINTENANCE OF RECORDS

The Government and the Local Sponsor shall keep books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement to the extent and in such detail as will properly reflect total project costs. The Government and the Local Sponsor shall maintain such books, records, documents, and other evidence for a minimum of three years after completion of construction of the Project and resolution of all relevant claims arising therefrom, and shall make available at their offices at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the parties to this Agreement.

ARTICLE XI - GOVERNMENT AUDIT

The Government shall conduct an audit when appropriate of the Local Sponsor's records for the Project to ascertain the allowability, reasonableness, and allocability of its costs for inclusion as credit against the non-Federal share of project costs.

ARTICLE XII - FEDERAL AND STATE LAWS

In acting under its rights and obligations hereunder, the Local Sponsor agrees to comply with all applicable Federal and State laws and regulations, including section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.II issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

ARTICLE XIII - RELATIONSHIP OF PARTIES

The parties to this Agreement act in an independent capacity in the performance of their respective functions under this Agreement, and neither party is to be considered the officer, agent, or employee of the other.

ARTICLE XIV - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, or resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XV - COVENANT AGAINST CONTINGENT FEES

The Local Sponsor warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Local Sponsor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Agreement without liability, or, in its discretion, to add to the Agreement or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XVI - TERMINATION OR SUSPENSION

a. If at any time the Local Sponsor fails to make the payments required under this Agreement, the Secretary of the Army shall terminate or suspend work on the Project until the Local Sponsor is no longer in arrears, unless the Secretary of the Army determines that continuation of work on the Project is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with the Project. Any delinquent payment shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent

rate of the 13-week Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3-month period if the period of delinquency exceeds 3 months.

b. If the Government fails to receive annual appropriations for the Project in the amounts sufficient to meet project expenditures for the then-current or upcoming fiscal year, the Government shall so notify the Local Sponsor. After 60 calendar days either party may elect without penalty to terminate this Agreement pursuant to that Article or to defer future performance hereunder; however, deferral of future performance under this Agreement shall not affect existing obligations or relieve the parties of liability for any obligation previously incurred. In the event that either party elects to terminate this Agreement pursuant to this Article, both parties shall conclude their activities relating to the Project and proceed to a final accounting in accordance with Article VI. of this Agreement. In the event that either party elects to defer future performance under this Agreement pursuant to this Article, such deferral shall remain in effect until such time as the Government receives sufficient appropriations or until either party elects to terminate this Agreement.

ARTICLE XVII - NOTICES

a. All notices, requests, demands, and other communications required or permitted to be given this Agreement shall be deemed to have been duly given if in writing and delivered personally, given by prepaid telegram, or mailed by first-class (postage pre-paid), registered, or certified mail, as follows:

If to the local sponsor: West Jefferson Levee District
403 Barataria Boulevard
Marrero, Louisiana 70072

If to the Government: Department of the Army
U.S. Army Engineer District,
New Orleans
Corps of Engineers
ATTN: CELMN-DD-P
P.O. Box 60267
New Orleans, Louisiana 70160

b. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

c. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at such time as it is personally delivered or seven calendar days after it is mailed, as the case may be.

ARTICLE XVIII - CONFIDENTIALITY

To the extent permitted by the law governing each party, the parties agree to maintain the confidentiality of exchanged information when requested to do so by the providing party.

ARTICLE XIX - SECTION 902 PROJECT COST LIMITS

The _____ has reviewed the provisions set forth in Section 902 of P.L. 99-662, as amended, and understands that Section 902 establishes a maximum construction cost for the project. For purposes of this Agreement, the Section 902 cost limit is $_____ as calculated on _____ , _____.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the Assistant Secretary of the Army (Civil Works).

THE DEPARTMENT OF THE ARMY

BY: _____
ROBERT W. PAGE
Assistant Secretary
of the Army (Civil Works)

DATE: _____

WEST JEFFERSON LEVEE DISTRICT

BY: _____
RONALD R. BESSON
President
Board of Commissioners
West Jefferson Levee
District

DATE: _____

CERTIFICATE OF AUTHORITY

I, _____, do hereby certify that I am the principal legal officer of the _____, that the _____ is a legally constitued public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the _____ in connection with the Project, and to pay damages, if necessary, in the event of the failure to perform, in accordance with Section 221 of Public Law 91-611, and that the persons who have executed this Agreement on behalf of the _____ have acted within their statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this _____ day of _____ 19___.

_____
Title

CERTIFICATION OF LEGAL REVIEW

The draft Local Cooperation Agreement for _____ has been fully reviewed by this Office of Chief, Counsel, USAED, _____.

_____
District Counsel