US Army Corps
of Engineers
New Orleans District

NEW ORLEANS TO VENICE, LOUISIANA

HURRICANE PROTECTION

REACH B-1 TROPICAL BEND TO FORT JACKSON

EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 9

23 MARCH 1999

CEMVD-ET-EG (CEMVN-ED-GE/14 Dec 99) (1105-2-10c) 1st End
Stagg/ts/5644
SUBJECT: 1999 Periodic Inspection Report No. 9 for Empire Floodgate

CDR, Mississippi Valley Division, Vicksburg, MS 39180-0080
21 January 2000

FOR Commander, New Orleans District, ATTN: CEMVN-ED-GE

The following comments are provided on the subject inspection report:

a. The report should include comments made by the Independent Technical Review Committee.

b. New Orleans District should ensure that the stone breakwater is in fact restored to its design elevation, no later than the summer of 2000 as indicated in paragraph 6.02x, page VI-4 of the main inspection report. The structure should not be allowed to go through another hurricane season without the restored breakwater in place, as the design of all of the major features of the project assume that the breakwater is in place at its design elevation.

FOR THE COMMANDER:

3 Encls
wd all

J. R. MCCORMICK, JR., P. E.
Acting Chief, Engineering Division

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

REPLY TO
ATTENTION OF:

CEMVN-ED-GE

14 Dec 99

MEMORANDUM FOR Commander, Mississippi Valley Division,
ATTN: CEMVD-ET-EG

SUBJECT: 1999 Periodic Inspection Report No. 9 for Empire Floodgate

1. Subject report is submitted for your information and concurrence (Encl. 1).

2. The Technical Review was conducted as outlined in Encls. 2 and 3.

FOR THE COMMANDER:

Gerard S Satterlee

GERARD S. SATTERLEE JR., P.E.
Chief, Engineering Division

3 Encls.
1. Periodic Inspection
   Report No. 9 (4 cys)
2. Quality Control Plan
3. Design/Review Activities

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
QUALITY CONTROL PLAN
PERIODIC INSPECTION REPORT

Project Title: 1999 Periodic Inspection Report No. 9 for Empire Floodgate.

Authority: Authority to inspect the subject lock is provided by ER 1110-2-100, subject "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures", dated 15 February 1995. The Periodic Inspection was performed in accordance with the subject regulation.

Quality Control Plan: The Quality Control is the function whereby policies, standards, procedures, and format are used to control the quality of the work produced.

Preinspection Brochure. A preinspection brochure was prepared in advance of the project inspection in order to familiarize inspection team members with the control structure general features and project history. The brochure included a checklist that was used during the inspection to highlight areas of concern.

Periodic inspection Report. The Periodic Inspection Report presents the results and conclusions of the engineering inspection and data evaluation to evaluate the structural integrity and operational adequacy of the control structure. The report also presents recommended remedial actions to correct any noted deficiencies. The inspection and report were accomplished in accordance with the subject ER.

In-House Technical Review. The New Orleans District (NOD) performed an in-house review to achieve the desired quality control on various project tasks and to check for format, adequacy and accuracy of the report. A copy of the quality control plan is filed in Gen & Env Des Section. These reviews were conducted in-house because the necessary expertise was located within NOD. These reviews ensure the accuracy of the report and ensure the inspection and reporting were conducted in accordance with ER 1110-2-100. A copy of NOD's quality control plan with all endorsements to the report will be included with the file copy of the Periodic Inspection Report.

Periodic Inspection Team

Brown, Cunningham & Gannuch, Inc.

Name	Function	Registered
Silas Cunningham	Structural Engineer	Yes/Civil
Luther Newton	Project Engineer	Yes/Civil
Ken McLaughlin	Electrical Engineer	Yes/Elect
Mel Stegall	Geotechnical Engineer	Yes/Civil
Robert White	Mechanical Engineer	Yes/Mech

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
QUALITY CONTROL PLAN
PERIODIC INSPECTION REPORT

Corps of Engineers – New Orleans District

Name	Function	Office	Ext.	Registered
Joseph Chryssoverges	Inspection Coordinator/ Civil Engr	ED-GE	1009	No/EIT
Paul Salassi	Civil Engr Tech	ED-GE	2714	Certified ET
Greg Breerwood	Emergency Manager/Mech Engr	OD-R	2244	Yes/Mech
Brian Keller	Project Manager/ Civil Engr	OD-R	2344	No/EIT
Amy Powell	Civil Engr	OD-R	2241	No/EIT

Mississippi River Commission

Name	Function	Office	Registered
Frank Johnson	Structural Engineer	CEMVD-ET-ES	Yes/Civil

Louisiana Department of Transportation and Development

Ennis Johnson	District 02 Design
John Monzon	District 02 Design

Orleans Levee District

Steve Spencer	Chief, Engineering
C.A. Wethern	Engineering
Guy Dietsch	Electrical Maintenance

Corps of Engineers – New Orleans District - Technical Review Team

Name	Function	Office	Ext.	Registered
Walter Baumy	C/Gen & Env Des Sec	ED-GE	2656	Yes/Civil
Joseph Chow	Review Team Manager	ED-E	2722	No/EIT
Paul Salassi	Technical Reviewer/Civil Tech	ED-GE	2714	----------

DESIGN/REVIEW ACTIVITIES

TASK	DATE COMPLETED
Prepare preinspection brochure	03 Feb 99
Preinspection meeting and finalize schedule for inspection	18 Mar 99
Perform periodic inspection	23 Mar 99
Assemble draft report	21 May 99
Performed supplemental detailed inspection of pump platform	02 Sep 99
Assemble revised draft report (including pump platform inspection)	08 Oct 99
Perform in-house review, and resolve comments	08 Nov 99
Prepare final report	07 Dec 99
Submit report to MRC	14 Dec 99

Joseph Chryssoverges 13 Dec 99

Joseph Chryssoverges,
Inspection Coordinator Date

Joseph Chow 14 DEC 99

Joseph Chow,
Technical Review Manager Date

NEW ORLEANS TO VENICE, LOUISIANA

HURRICANE PROTECTION

REACH B-1 – TROPICAL BEND TO FORT JACKSON

EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 9

23 MARCH 1999

PREPARED BY:

BROWN, CUNNINGHAM & GANNUCH, INC.

FOR

U. S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

EMPIRE FLOODGATE

PHOTO TAKEN 22 JULY 86

EMPIRE FLOODGATE

SUMMARY

Periodic Inspection No. 9 of the Empire Floodgate was conducted on 23 March 1999 by the Brown, Cunningham & Gannuch, Inc. inspection team, a representative of the Mississippi River Commission and representatives of the New Orleans District (NOD), the Louisiana Department of Transportation and Development (LaDOTD), and the Plaquemines Parish Government. Observations made during the periodic inspection indicate that the structure is structurally sound and in operating condition. Even though some (four) of the eight 16-inch concrete piles supporting the pump platform were damaged, considering the magnitude of the vertical loads from the platform, they were considered adequate to provide the required support for the near future.

A supplemental detailed inspection of the upper and lower pump platform decks, upper deck support beams, and piling (including diver inspection of the piling down to the "mud line") was made on September 1, and 2, 1999. Results of this inspection, recommended remedial repairs, estimated costs of repairs, and recommended schedules of repairs are contained in Appendix B to this report.

Some remedial actions are required. The deficiencies are not critical at present, but recommended repairs to the pump platform support piling, upper deck and support beams should be accomplished expeditiously. Deficiencies will be corrected as discussed in Section VI and Appendix B.

EMPIRE FLOODGATE

PREVIOUS PERIODIC INSPECTION REPORTS

Report No	Inspection Date	Approval Date
1	4 SEP 75	7 APR 76
2	4 OCT 78	13 AUG 79
3	29 JUL 81	20 OCT 82
4	31 JAN 84	4 JAN 85
5	29 JAN 87	21 SEP 87
6	30 JAN 90	Not Available
7	28 JAN 93	No Report
8	17 JAN 96	23 SEP 96

EMPIRE FLOODGATE
PERIODIC INSPECTION REPORT NO. 9
TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

1-01. Authority. Authority is provided by ER 1110-2-100, subject "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures", dated 15 February 1995.

1-02. Purpose and Scope. The results and conclusions of the inspection and evaluation for assuring the structural integrity and operational adequacy of the floodgate are presented herein.

1-03. Datum. All elevations, unless otherwise indicated, are in feet and refer to the National Geodetic Vertical Datum (N.G.V.D.), formerly Mean Sea Level (M.S.L.).

SECTION II - PROJECT DESCRIPTION AND BACKGROUND

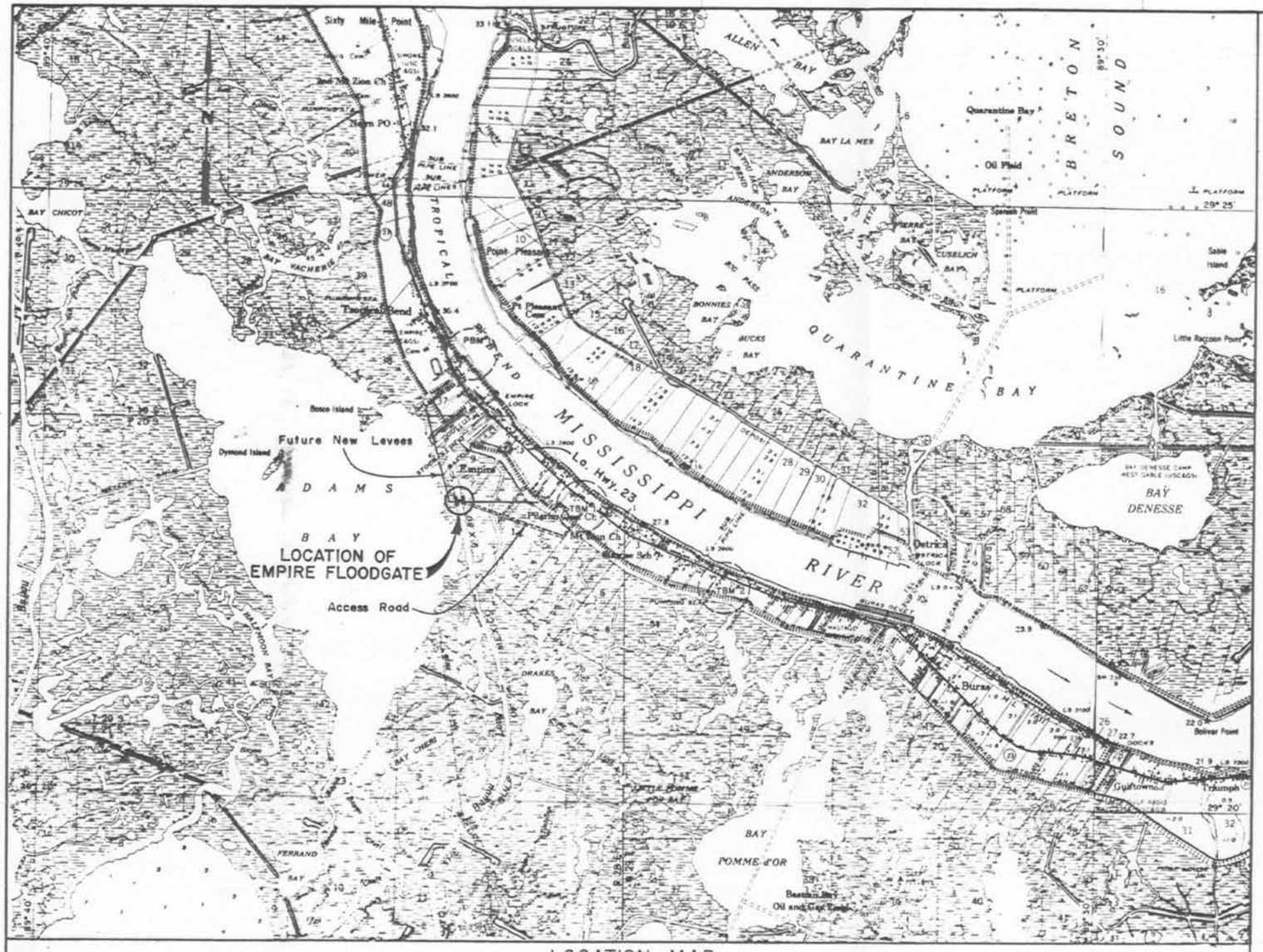
2-01. General. The Empire Floodgate is a feature of the hurricane protection project, "New Orleans to Venice, La", authorized by Public Law 874, 87th Congress, approved 23 October 1962, to provide hurricane protection in accordance with the recommendations of the Chief of Engineers in his report entitled "Mississippi River Delta at and below New Orleans, La.", and contained in House Document No. 550, 87th Congress, 2nd Session. With completion of the raising of the levees in Reach B-1, Tropical Bend to Fort Jackson, in the project "New Orleans to Venice, La.", the Empire Floodgate serves to protect the general area from hurricane tidal overflows and allows water traffic to proceed normally along the waterway from Empire to the Gulf of Mexico. The Empire Floodgate provides drainage for an area of about 365 acres enclosed by the hurricane protection levee, the levee along the Mississippi River, and the levees approximately parallel to the Mississippi River levee. The floodgate structure is part of the hurricane protection levee system and is located at the hurricane protection levee base line station 101+80.89 in Plaquemines Parish, Louisiana, near Empire at the river end of the Empire to Gulf Waterway. The site is accessible by a temporary road from Louisiana Highway No. 23.

The Empire Floodgate structure was turned over to the Plaquemines Parish Commission Council, Pointe-a-la-Hache, Louisiana on 11 May 1976, for maintenance and operation in accordance with the conditions of local cooperation, as specified by the authorizing law.

The Empire Floodgate structure consists of a reinforced concrete gate bay, supported on prestressed concrete piles, timber guide walls, pile supported inverted "T" reinforced concrete floodwalls and uncapped steel sheet piling connecting the "T" floodwalls to the earthen levee on each side. The gate bay is 109 feet in total width and has a channel width of 84 feet. The elevation of the tops of the gate bay and floodwalls is 15.0 and top of sill is at -14.0. The gate is a bottom hinged single-leaf flap gate which, in the open position, is stored in a recess in the base slab of the structure.

The floodgate was originally to be closed when rising tides, in advance of an approaching hurricane, exceeded elevation 5.0 on the protected side of the structure. Because of the construction of commercial enterprises at levels below elevation 5.0, the gate is now closed when rising tides exceed elevation 3.0. The floodgate is kept closed until such time that the hurricane tides have receded and the stage on the landside is equal to or higher than the stage on the gulfside.

A detailed description of the floodgate and historical and other general background information are included in Periodic Inspection Report No. 1, which also contains selected construction drawings illustrating typical sections and details. A vicinity map (Plate No. 1) is included in this report. This report is supplementary to previously numbered reports.



LOCATION MAP

SCALE 1" = 1,680

VICINITY MAP

SCALE IN MILES

INDEX TO DRAWINGS

DWG.	TITLE
	GENERAL DRAWINGS
1	LOCATION MAP, VICINITY MAP, AND INDEX
2	SITE PLAN
3	SOIL BORINGS
4	SOIL BORING LEGEND
5	COMPLETED PLAN
6	COMPLETED SECTION
7	TYPICAL SECTIONS
8	[illegible] EXCAVATION
9	[illegible] EXCAVATION
10	[illegible] EXCAVATION AND SECURITY FENCE
	FLOODGATE STRUCTURE
11	[illegible] AND FLOODWALL PILING LAYOUT
12	PLAN OF GATE BAY MONOLITH
13	SECTIONAL ELEVATION OF GATE BAY MONOLITH
14	TRANSVERSE SECTION OF GATE BAY MONOLITH
15	GATE BAY WALL REINFORCEMENT PLAN AT EL. 15.0
16	GATE BAY WALL REINFORCEMENT PLAN AND SECTIONS
16A	GATE BAY WALL REINFORCEMENT PLAN AND SECTIONS
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18	GATE BAY WALL REINFORCEMENT SECTIONS
19	GATE BAY SLAB REINFORCEMENT
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21	FLOODWALL MASONRY AND REINFORCEMENT
22	FLOODWALL TRANSITION SECTIONS
23	EXPANSION JOINT DETAILS
24	CONTROL HOUSE PLAN AND ELEVATIONS
25	CONTROL HOUSE ELEVATIONS AND DETAILS
26	CONTROL HOUSE REINFORCEMENT
27	CONTROL HOUSE REINFORCEMENT
28	PUMP PLATFORM
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29A	PUMP PLATFORM - MISCELLANEOUS DETAILS
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32	MISCELLANEOUS EMBEDDED METALS
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35	HANDRAILING LAYOUT - SECTIONS AND DETAILS
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53	PUMPING UNIT LAYOUT
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	ELECTRICAL
55	SCHEMATIC WIRING DIAGRAM
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59	CONDUIT LAYOUT
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Note:
See dwg. 2 for tabulation of bench marks.

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

NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION, REACH B-1
EMPIRE FLOODGATE
PLAQUEMINES PARISH, LA.
LOCATION MAP VICINITY MAP AND INDEX

William E. Simmons
Jerome B. Baehr
William E. Ringate
Jack L. Henderson, Jr.

D.A.M. R.G.S. F.N.J. FEB. 1973 DACW29-73-B-0111

H-4-26081
1 64

PLATE - 1

SECTION III - OPERATION AND MAINTENANCE DATA

3-01. Operation and Maintenance Problems. The structure was last dewatered in March 1991. No significant problems have occurred since the previous inspection.

3-02. Actions on Deficiencies From Last Inspection. The following remedial actions have been taken:

a. Spalls in the concrete surface have not been repaired.

b. Subsequent to the previous inspection (No. 8, 17 January 1996) NOD Hired Labor Forces remounted and adjusted the "L" shaped seal at the juncture of monolith T-4L and the west sheet pile wall to provide a proper seal.

c. Joints in the concrete floodwalls have not been sealed.

d. Corroded areas of embedded metals above the waterline have not been cleaned and painted.

e. Exterior miscellaneous metals were cleaned and painted by Plaquemines Parish in September 1997.

f. Handrails on the boat dock were repaired/replaced by Plaquemines Parish in February 1997.

g. A new boat dock deck has been built on top of the original deck. This deck is above the corroded bottom tread and bottom attachment plate. The stairway was cleaned and painted by Plaquemines Parish in February 1997.

h. The damage on the top of the gate has not been repaired because the gate bay has not been dewatered. This work is still scheduled to be done during the next dewatering.

i. Exposed surfaces of the gate operating machinery were cleaned and painted by Plaquemines Parish in September and October 1997.

j. No action has been taken relative to possible revision of the greasing schedule in the Empire Floodgate O&M manual. Plaquemines Parish personnel grease on a regular basis.

k. Copius and frequent application of chain lubricant is now applied to the hoist chains and sprockets prior to and during gate operation.

l. Hoist chains were replaced by Plaquemines Parish in February 1997.

m. In February 1997, electrical test instruments were used to determine the hoist motor electrical loads in order to determine the actual chain loads applied. An evaluation to determine the hoist chain loads has been made and results are discussed in 5-03e (7).

n. In February 1997 NOD personnel observed operation of the gate through a close/open cycle to determine whether repairs to the gate hoist wildcat sprockets are needed. They concluded that the machinery worked well and no repairs are needed.

o. The O&M manual was revised in March 1988 to change the required frequency of readiness check operations from monthly (with additional check items quarterly) to annually. The copy of the O&M manual furnished the inspection team had not been revised, thus the team's recommendation to evaluate the frequency of readiness checks.

p. Actions relative to the counterweight system are the same as those for the hoist system as noted in subparagraphs 3-02 k and 3-02 n. The ends (approximately 50-feet beginning at the gate attachment points) of the counterweight chains were replaced in February 1997.

q. In November 1997 Plaquemines Parish personnel installed new hydraulic lifts to suspend the counterweights.

r. The gate recess flushing system pump has not been removed and rehabilitated.

s. The inoperative hydraulic gate latch systems were restored to operative condition by Plaquemines Parish in February 1997. However, the hydraulic systems were modified for manual operation.

t. The emergency generator engine belts, water hoses, and fuel lines were replaced, the oil leak was repaired, and the generator room was cleaned. This work was done by Plaquemines Parish in February 1997.

u. Missing diffuser lenses on the east side area lights have been replaced, and at the missing area light location on the east side a metal cover box has been installed. Six floodlights were installed beneath the west side control house overhang.

v. Two of the removed area lights on the west side have been re-installed and a cover box installed at the area of the third removed light.

w. The open junction boxes (with wires hanging out) at the gate latching device on the east side were corrected by Plaquemines Parish in February 1997. The gate latching devices have been converted to manual hydraulic operation.

x. Non-destructive weld testing of fracture critical welds on the steel needle girders has not been performed. The timbers used as spacers between the stacked dewatering elements are adequate at present.

y. Guidewall timbers that needed replacing have not been replaced.

z. A new boat dock deck has been constructed on top of the original deck. This was done by Plaquemines Parish in 1997.

aa. NOD Engineering Division has not obtained a survey of the stone breakwater. Based on visual observations, the stone breakwater is still below the original grade.

bb. Receding bank lines along the approach channels continue to be monitored for encroachment that could endanger the stability of the levees. No potentially critical conditions have been reported.

cc. Subsequent to Periodic Inspection No. 8, 17 January 1996, NOD Hired Labor Forces raised the west sheet pile floodwall to El. 15.5. The deficient (low) elevations of the floodgate structure and adjacent T-walls were reported to the NOD project manager for future consideration.

dd. Exposed portions of the sheet piles were cleaned and painted with coal tar epoxy by Plaquemines Parish.

ee. Missing handrail chains and attachment eyes were replaced by Plaquemines Parish in February 1997.

ff. The access ladder on the east side of the pump platform was repaired by Plaquemines Parish in February 1997.

SECTION IV - REVIEW OF DESIGN AND ANALYSIS OF INSTRUMENTATION

4-01. Geotechnical Design Criteria

a. General. The geotechnical design for Empire Floodgate was presented in the design memorandum "New Orleans to Venice, La., Design Memorandum No. 1, General Design, Reach B-1, Tropical Bend to Fort Jackson" dated October 1970. The original geotechnical design was reviewed and presented in Periodic Inspection Report No. 1, dated September 1975. The evaluation of the design criteria revisions presented herein is based on the review presented in Periodic Inspection Report No. 1.

b. Revised Design Criteria. The following geotechnical design criteria have been revised since the original design.

(1) EM 1110-2-2906, "Design of Pile Foundations", dated 15 January 1991, updated the design requirements for pile foundations.

(2) EM 1110-2-2504, "Design of Sheet Pile Walls", 31 March 1994, updated the design requirements for sheet pile walls.

(3) DIVR 1110-1-400, Section 5 - Sliding Stability of Slopes and Structures, Part 4 - General Guidance on Investigation and Design, Item 1 - Channel Slopes, 19 March 1973.

(4) Letter CEMRC-ED-GS (1105-2-10c), 24 July 1989, Subject: Sheet Pile Wall Design Criteria, furnished guidance for determining sheet pile wall penetrating deflections, and moments, when founded in soft clays.

c. Impacts to Design Requirements. The impacts of revisions to the design requirements are as follows:

(1) Slope Stability. The slope stability analyses generally meet the requirements of the referenced DIVR for a Type A project, except that the long-term loading case was not considered in the analyses. However, because of the relatively flat slopes required to satisfy the end-of-construction loading case, the long-term loading case would not likely govern any of the design slopes. Therefore, the slopes appear to satisfy current criteria.

(2) Stability of Sheet Pile Wall. The sheet pile wall was designed considering a design loading due to a breaking wave. The analysis was performed using S strengths in both fine-grain and free-draining soils. A factor of safety of 1.25 was applied to the soil strength parameters used in developing both the active and passive pressures for a loading condition with water to the static water level and the dynamic wave forces added. The breaking wave is normally considered as an unusual loading condition in terms of defining the appropriate design factor of safety. For an unusual loading condition, a safety factor of 1.25 for the Q-case and 1.10 for the S-case is specified in the referenced EM for fine-grain soils and a factor of safety of 1.25 is specified for the S-case for free draining soils. The factors of safety are also applied to both the active and passive pressures in accordance with the MRC letter referenced in paragraph 4-01.b.(4). In comparison to the current criteria, the original design analyses were more conservative for the "S" case, and were the same as the current criteria for the "Q" case.

(3) Pile Foundation. The piling were designed using a factor of safety of 1.75 for compression and a factor of safety of 2.0 in tension. A total of four piles were load tested during construction in both compression and tension. Current criteria require a minimum factor of safety of 2.0 for normal loading conditions for both compression and tension when pile load tests are performed. Loading conditions that are classified as unusual require a factor of safety of 1.5 for both compression and tension, and loading conditions that are classified as extreme require a factor of safety of 1.15 for both compression and tension. Based on the performance of the structure to date, the original foundation design has proven to be adequate.

4-02. Structural Design Criteria.

a. A detailed comparison of the original design criteria to current structural design criteria was performed. The design of the concrete and structural steel portions of the structure was based on EM 1110-2-2101, "Working Stresses for Structural Design" dated 1 November 1963, which is still current, with minor revisions, for the structural steel flap gate. The following design criteria have been revised or developed since the structure was designed:

(1) The latest concrete design criteria is contained in EM 1110-2-2104, "Strength Design for Reinforced Concrete Hydraulic Structures," dated 30 June 1992. The latest design criteria for steel structures is contained in EM 1110-2-2703, "Lock Gates and Operating Equipment," dated 30 June 1994, and EM 1110-2-2105, "Design of Hydraulic Steel Structures," dated 31 March 1993. However, since no guidance is contained in these EMs for flap gate design, the design criteria in EM 1110-1-2101, "Working Stresses for Structural Design," dated 1 November 1963 is applicable for the design of the gate.

(2) New criteria for the design of piles and pile foundations is contained in EM 1110-2-2906, "Design of Pile Foundations," dated 15 January, 1991.

(3) Guidance has been received from MVD regarding lateral earth pressures and drag loading on structures.

(4) The seismic risk zones have changed since the original design.

b. A review of the original design utilizing this new criteria indicates the following:

(1) A comparison of the new concrete design criteria with that utilized in the original design indicates that the design of the floodgate structure is adequate in flexure. It is likely that the amount of temperature steel provided does not meet the current design standards which have been increased significantly. The latest ACI criteria for development and splice lengths have also increased significantly. A comparison with the code requirements in effect during the design of this structure indicates that the bar development and splice requirements do not meet current standards.

(2) The original design meets current standards for the design of steel elements.

(3) The pile foundation design meets current standards.

(4) The structure was not designed for seismic accelerations. The current earthquake design criteria is contained in ER 1110-2-1806 "Earthquake Design and Evaluation for Civil Works Projects," dated July 31, 1995. This document places this project in Earthquake Zone 0. Based on the ER, NOD Geotechnical Branch personnel consider the appropriate geotechnical design earthquake acceleration loading to be zero. Therefore the earthquake loading will not be critical.

(5) The design of the tie-in floodwalls does not meet the current criteria based on a detailed review of the floodwall monolith adjacent to the floodgate. Potential design deficiencies noted were:

(a) The base slab, using the design pile loads, is overstressed in shear and does not quite meet the criteria for flexure and axial load. It was recommended at Periodic Inspection No. 8 that the pile reactions be reevaluated since a cursory review performed for that inspection indicated that some of the loads may be in error.

(b) The wall stem is slightly overstressed in compression when considering the design wave loading which may be high using current hydraulic criteria.

(c) The structure has likely experienced stages close to those anticipated during the design. The design wave loading (both original and current) however, probably has not occurred since no major hurricanes have struck the area since 1975.

(d) Since the floodwall did not meet the current criteria, and because of uncertainties in both the hydraulic loading and the design pile reactions, it was recommended at Periodic Inspection No. 8 that the floodwall monolith design be reviewed in detail prior to the next hurricane season. Subsequent to Periodic Inspection No. 8, NOD Engineering Division personnel conducted a structural design analysis of Monolith T-1R (floodwall monolith) using current (revised) wave load data and EM 1110-2-2104, "Strength Design for Reinforced Concrete Hydraulic Structures," dated 30 June 1992. Design pile loadings and reactions were also reviewed. It was concluded that the design of Monolith T-1R meets the most current strength and load criteria established for design of hydraulic structures.

(e) While a review of current design standards indicates that the structure does not meet several current design requirements for concrete structures as stated

above, those deficiencies are not expected to be critical. In accordance with ER 1110-2-8157, "Responsibility for Hydraulic Steel Structures," dated 31 January 1997, the flap gate should be evaluated by NOD Engineering Division to determine fracture critical members, and field inspection and testing of the fracture critical members should be performed, as required.

4-03. Analysis of Instrumentation Data.

a. General. Instrumentation measurements at Empire Floodgate consist of elevations taken on the settlement reference marks on the floodgate structure, the east and west concrete "T" walls, the east and west sheet pile walls, concrete hubs in the earth fill adjacent to the north face of the sheet pile walls and scour surveys consisting of profiles and cross sections of the north and south approach channels. In addition, joint opening measurements are taken between reference marks on the "T" walls. Analyses of the engineering measurements are presented in the following paragraphs.

b. Settlement Reference Marks.

(1) General. The locations of the reference marks are shown on Instrumentation Plate No. EMP-1, and tabulations of the survey data are presented on Instrumentation Plate No. 2. Plots of the settlement versus time are presented on Instrumentation Plate Nos. 3 through EMP-6. The data presented include the initial survey in 1975, four sets of data from 1984 through 1992, and five sets of data since 1992. The design grade for the top of the floodgate structure and the walls is Elevation 15.0 and the design grade for the levee adjacent to the sheet pile wall is Elevation 15.5.

(2) Floodgate Structure and T-Walls. The survey data show that the floodgate structure was 0.24 to 0.32 feet below the design grade of 15.0 at the time of the initial set of readings taken in December 1975, the west T-wall was 0.21 to 0.41 feet below

grade, and the east T-wall was 0.33 to 0.43 feet below design grade. The latest reading, taken 31 March 1998, shows an apparent increase in the rate of settlement since the 1997 survey. The apparent increase in settlement between the 1997 and 1998 readings (approximately 14 months) shows an additional average settlement of 0.04 feet. The 1995 to 1997 surveys (approximate 22 months) show an average settlement of 0.02 feet. This sudden increased rate of settlement appears to be caused by erroneous data in the 31 March 1998 readings. Therefore, these latest readings were not used in this analysis. The plotted data on Instrumentation Plate Nos. 3 and 4 show this possible error by the sharp settlement increase in the latest readings. The plots of the data, shown on Instrumentation Plate Nos. 3 and 4, show continuing slow settlement since 1987. The average annual rate of settlement since 1987 has slowed considerably from the period 1975 to 1987. The monument (bench mark) used to perform the survey was examined during this inspection and was found in poor condition. Refer to Paragraph 5-03.o (1). The next set of data should be promptly reviewed to verify that the 1998 data are in error and do not represent a sufficient increase in the rate of settlement.

The differential settlements (vertical movements between monoliths) have been relatively small. The total differential settlements between the floodgate structure and the adjacent T-wall, or between adjacent T-wall monoliths, have been 0.02 feet or less.

(3) Sheet Pile Walls and Levees. The survey data indicate the east sheet pile wall was 0.87 to 1.24 feet below the design elevation of 15.0 at the time of the initial readings and the west sheet pile wall was 1.13 feet to 2.35 feet below design grade. By 1988, the east side had settled an additional 1.89 feet and the west side an additional 1.00 feet. The east sheet pile wall was raised to Elevation 15.5 in 1992. The west sheet pile wall was raised to Elevation 15.5 in 1997.

The cumulative settlement of the east sheet pile wall has been 0.15 feet since it was raised in 1992. The east wall settled at an average rate of 0.145 feet per year from 1975 to 1988 and at an average rate of 0.03 feet per year from 1992 to 1997. Therefore, the rate of settlement has declined significantly in recent years. The rate of settlement on the west side is also declining; however, an adequate number of data points since the wall was raised are not available to develop an average rate of settlement. As noted previously, the March 1998 readings are apparently in error and, therefore, were not used in this analysis. The greater settlements recorded in both sheet pile walls have been at the ends where the walls meet the levee (earth embankment). This is graphically illustrated by the plots on Instrumentation Plate No. 5.

c. Joint Openings. Joint openings on the west T-wall vary from a total of + 0.50 inches on the western end to 0.00 inches near the structure. Joint openings on the east T-wall vary from a total of +0.75 inches on the eastern end to +0.31 inches at the structure. The joint openings are measured as the differential between the 1975 readings and the 1998 readings. The fact that the greater joint openings have occurred between the end monoliths and the adjacent monoliths is consistent with the higher total settlements in the end monoliths. The fact that the largest joint openings occurred before the 1988 readings is consistent with the indicated settlements with respect to magnitude and rate of settlement.

d. Conclusions. Considerable settlements and joint openings have occurred since the structure was constructed; however, the magnitude of the movements is fairly consistent with the subsurface soil conditions. The settlements to date indicate that the floodgate structure is 0.70 to 0.88 feet below the design grade of Elevation 15.0, the east T-wall is 0.90 to 1.48 feet below design grade, and the west T-wall is 0.67 to 0.98 feet below

design grade. The sheet piling walls were raised to El. 15.5 (0.5 feet above design grade) in 1992 (east wall) and 1997 (west wall). Although minor settlement has occurred, the sheet pile walls are still above the design grade of 15.0.

e. Scour Surveys. The scour surveys consist of a centerline profile and 20 cross-sections in the north and south approach channels and in the structure area. The location of the profile and cross sections are shown on Instrumentation Plate No. 6. The north centerline profile is shown on Instrumentation Plate No. 7, and the south centerline profile is shown on Instrumentation Plate No. 12. The north approach channel cross-sections are shown on Instrumentation Plate Nos. 8 through 11, and the south approach channel cross sections are shown on Instrumentation Plate Nos. 13 through 16. The plotted sections and profiles show the original 1976 scour survey and the 1993, 1995, 1997 and 1998 surveys. Comparison of the original 1976 scour survey and the more recent scour surveys show that, in general, a siltation of the channel to depths of 6 to 10 feet has occurred. The siltation is 2 to 5 feet deep along the channel banks. The amount of deposition varies from one survey to the next. A number of the cross sections show erosion of the banks at the waterline. Several sections show that the natural ground surface is only 1 to 2 feet higher than normal stage. The bank line has receded as much as 60 to 70 feet or more in some of these areas (stations 0+96N, 1+06N, 4+00N, 5+00N, 3+00S and 5+00S). Loss of stone from the breakwater was noted in the previous inspection and was closely observed and discussed during this inspection.

SECTION V – INSPECTION

5-01. Inspection Team. Periodic Inspection No. 9 of Empire Floodgate was conducted on 23 March 1999 by the following personnel:

MISSISSIPPI RIVER COMMISSION

Mr. Frank Johnson	Engineering & Technical Services Directorate

NEW ORLEANS DISTRICT

Mr. Paul Salassi	General Engineering Branch
Mr. Joseph Chryssoverges	General Engineering Branch
Mr. Brian Keller	Operations Division
Ms. Amy Powell	Operations Division
Mr. Greg Breerwood	Operations Division

BROWN, CUNNINGHAM & GANNUCH, INC.

Mr. Luther Newton	Project Engineer
Mr. Silas Cunningham	Structural Engineer
Mr. Mel Stegall	Geotechnical Engineer
Mr. Ken McLaughlin	Electrical Engineer
Mr. Bob White	Mechanical Engineer

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

Ms. Geneva Grille	District 02 Design
Mr. John Monzon	District 02 Design

PLAQUEMINES PARISH GOVERNMENT

Mr. Henry Urban	Heavy Equipment, Drainage Department
Mr. Ruben Victory	Heavy Equipment, Drainage Department
Mr. K.P. Madere	Heavy Equipment, Drainage Department

5-02. Orientation. A handout containing a condensed project description, team roster, and emphasized inspection items was provided by Mr. Luther Newton, Project Engineer, Brown, Cunningham & Gannuch, Inc. Mr. Newton then introduced the team members, and outlined the project features each Brown, Cunningham & Gannuch, Inc. team member would be inspecting and what they would be looking for. The plan for accomplishing the inspection was discussed and agreed upon.

5-03. Observations.

a. General. The floodgate was not dewatered and was fully operational. A detailed visual inspection was made of all features of the structure above the water level. At the time of inspection the water level was at El. 1.3. It was obvious that a considerable amount of maintenance and housekeeping activity has been performed since the last inspection. The overall appearance of the structure is greatly improved over that noted during the previous inspection. It is apparent that the Plaquemines Parish officials recognize the importance of this structure in their hurricane protection system and are trying to keep the floodgate in a state of readiness for operation on a short notice. They are to be commended for their efforts.

b. Concrete.

(1) In general the integrity of the gate structure and the floodwalls is good except for conditions noted in the following sub-paragraphs. Some minor cracking, spalls, and small popouts were noted, but these have no bearing on the function of the structure. The spalls should be repaired with epoxy as recommended in the previous report.

(2) The floodwall concrete was found to be in overall good condition. A concrete spall, on the protected side of the wall at the joint between Monoliths T-2R and T-3R and directly beneath the walkway, was noted. See Photo No. 1. The "L" type waterstops at

the juncture of the "T" wall monoliths and the sheet pile floodwalls were noted to be in good contact to seal the joints. At the joint between floodwall Monoliths T-3L and T-4L (west side) and T-3R and T-4R (east side) the torn waterstops noted in the previous inspection report have not been repaired. See Photo No. 2. These waterstops were torn as a result of differential settlements between the east and west ends of monoliths T-4L and T-4R. None of the floodwall monolith joints are sealed with joint sealer, and the joint filler material has deteriorated to such extent that almost all of it is completely gone. The joints between the concrete floodwall monoliths should be sealed with a joint sealer similar and equal to Sonne-Borne NP-2 or Sika 2-C, installed in accordance with the manufacturer's recommendations.

(3) The gatebay concrete was in good condition. No new cracks or spalls were observed. Minor spalls were noted at some handrail posts on the protected sides (east and west) of the structure. See Photo No. 3. On the east side of the structure, near the junction of the timber guidewall and the protected side of the structure, water was observed to be squirting and seeping from the concrete through and above the chamfered construction joint which was just above the water line. See Photo No. 4. The flow was attributed to water trapped in the adjacent counterweight recess however, the gate recess flushing system pump was running at the time the flow was observed. Plaquemines Parish personnel noted that when the pump is running with the counterweights raised (gate fully opened) there is no water leakage, but when the gate is closed (raised) and the counterweight lowers into the recess, and raises the water level in the recess, the leakage is noted. Therefore, it is concluded that the leakage is not from the operation of the gate recess flushing system. The leakage through the concrete is attributed to rock pockets above the construction joint which intersect honeycombed areas within the wall and transmit the flow of water from the counterweight

recess through the wall. During the next dewatering when equipment will be available, the counterweight should be removed, the area of honeycombed concrete determined, and the honeycombed concrete removed and the area repaired using an epoxy bonding agent, or if possible repaired by epoxy injection. Observations on the west side of the structure indicated that the drain for that counterweight recess was functioning properly and that no water was flowing from the concrete.

(4) The upper deck of the pump platform and the pump house appear to be in good condition. See Photo Nos. 5 and 6. A close visual inspection of the piles supporting the pump platform indicates that four of the eight concrete piles (Pile Nos. 2, 3, 5 and 7 as numbered on the sketch on the page following the photos at the end of this section) have significant vertical cracks at various locations, many of which extend below the water line. (See Photo Nos. 7 through 14). In addition, a crack in the upper deck perimeter support beam and the underside of the platform, at the southwest corner were also noted. (See Photo Nos. 15 and 16). No immediate explanation for the cracks was apparent during the inspection. A cursory review of the thrust loads imparted by the pump indicates, as expected, that this loading is very small. The possible cause of these cracks is discussed in Appendix B. Considering the magnitude of the vertical loads from the pump platform, the eight 16-inch concrete piles beneath the platform, even though some are damaged, are presently adequate to provide the required support. A supplemental detailed inspection of the upper and lower pump platform decks, upper deck support beams, and piling (including diver inspection of the piling down to the "mud line") was made on September 1 and 2, 1999. Results of this inspection, recommended remedial repairs, estimated costs of repairs, and recommended schedules of repairs are contained in Appendix B to this report.

c. Embedded Metals and Miscellaneous Metals.

(1) Corrosion of the embedded metals continues to worsen at the splash zone. See Photo 17. These items do not presently affect that integrity or the function of the structure and the structure is scheduled to be dewatered in the next two or three years. It is recommended that the corroded areas of embedded metals above the water be cleaned and painted. Any embedded metals below water level that are accessible during dewatering should be evaluated for the effects of corrosion and cleaned and painted accordingly during the dewatering.

(2) The exterior miscellaneous metals (stairs, ladders, handrails, safety chains, etc.) had been recently painted and were in good condition. See Photo Nos. 18 and 19.

d. Gate.

(1) The gate was fully raised and lowered and those portions of the gate above the water surface were inspected. The overall condition of the gate that was exposed to view was very good. The coating system and cathodic protection system have been very effective against corrosion. See Photo Nos. 20 and 21. As the gate was being raised a silt accumulation was noted on the top (skin plate) surface of the gate. The silt accumulations subsequently "slid off" the smooth skin plate surface as the gate continued to rise. See Photo Nos. 22, 23 and 24. The silt accumulation is a significant load to overcome by the hoist chain and operating machinery when the gate is being closed, but does not exceed the design load of four (4) feet of silt on the gate at initiation of closing. The siltation on the chamber floor and in the gate recess precludes the gate (when open) from fully seating in the gate recess, causing its surface to protrude above the level of the chamber floor. As a result, the top of the

gate has apparently been damaged by heavy laden vessels passing through the floodgate structure. (See Photo Nos. 20, 21 and 25). This damage has been observed at all inspections since 1990. Removal of silt from the gate recess is obviously a significant expense, and results in the structure being closed to navigation an appreciable length of time. Local interest operating personnel noted that each time the gate is closed (raised) and then opened (lowered) it lacks 6 to 12 inches of lowering to its previous elevation. At the time of this inspection the gate was approximately four (4) feet above its fully recessed position.

(2) During the inspection gate modifications which may minimize the exposure to damage were discussed. It was mentioned that modifications to the top of the gate which included a taper at the top of the gate could possibly lower the gate profile in the recessed position. This taper could possibly be attained by reducing the width of the channel at the top of the gate from 12-inches to 6-inches and sloping the upper part of the skin plate. This would also create a tapered surface for vessel props to "ride" over as opposed to the blunt end which presently exists and seems to be prone to damage. Any gate modification must retain the current top girder width as this surface is used by local maintenance personnel to access the hinge grease lines which are located along the axis of the gate. The top elevation of the gate when fully closed (raised) must also be retained.

(3) The gate shock absorbers were inoperative, being stuck in the fully recessed position. See Photo No. 26. Plaquemines Parish personnel at the inspection stated that the shock absorbers becoming stuck in the fully recessed position has been a constant problem since shortly after the structure was placed in operation. This is probably the result of the interior components corroding. The shock absorbers are intended to keep the gate from "slamming" against the vertical concrete surface it seals against should a wave hit the gate just

before it is fully closed. Considering that the gate is closed well before a hurricane arrives, large waves that would "slam" the gate against the concrete surface are unlikely. Additionally, when the gate is near full closure, the force of the counterweights is trying to open the gate. See Photo No. 25. This is a considerable force for dampening or restraining wave forces trying to close the gate. Accordingly, it is felt that the shock absorbers are not necessary.

(4) No signs of distress were noted on any of the visible welds when the gate was raised (closed). In accordance with ER-1110-2-8157, "Engineering and Design-Responsibility for Hydraulic Steel Structures," dated 31 January 1997, all fracture critical welds require non-destructive testing. This should be done during the next scheduled dewatering. Identification of fracture critical welds to be tested will be performed by NOD and furnished to Plaquemines Parish.

e. Gate Operating Machinery.

(1) The gate operating equipment package for each side of the structure consist of an "outdoor" type package consisting of a 7.5 horsepower electrical motor driving the main hoisting chain sprocket (called a "wildcat" sprocket) through a drive system consisting of several gear reducers, shaft couplings, etc., with auxiliary components such as brakes and synchronizing elements connected thereto. See Photo Nos. 17 and 18. Each package is mounted on a steel base unit partially embedded in the concrete gate bay structure. Weather protection for certain components is provided by a metal cover system bolted to the steel base unit. All operating components of the drive trains were in operating condition. All the anchor bolts were tight and no movement symptoms which could lead to misalignments were observed. The exterior surfaces of the gate operating machinery have been cleaned and painted since the last inspection and the paint system is in good condition.

(2) The hoist and counterweight chains create loud "snapping and popping" noises as the chain links engage and seat with their respective wildcat sheaves. Operating personnel reported that not infrequently, one or more of the chains will "slip a link." They stated that "slipping a link" usually occurs during a gate opening cycle when the gate is at or near the half open position. It appears that the chains "walk" out of the wildcat sheave recesses. During the opening (lowering) cycle a hoist chain passing over the wildcat sheave was closely observed. It was noted that as the horizontal chain link carrying the load moved through its chain link sheave load range, the horizontal link pivoted such that the unloaded end raised up an estimated 1/4 to 3/8-inch. As the load was transferred to the next horizontal link and sheave recess, the link is elevated above the bottom of its companion sheave recess. As this second link was observed through its travel, the friction holding it up out of the sheave recess was overcome, and with some noise, it seated. If the links do not overcome the friction keeping them from seating, they are increasingly raised above their seating position, and eventually "walk-out" and jump a link. The following factors have an influence on the chains "slipping a link."

(a) The wildcat sheaves have appreciable wear on the load side of the sheave recesses. This may contribute to the problem, but is probably not a major cause since the problem has existed since the equipment (sheaves) was new.

(b) There is not an appreciable amount of load (weight) on the unloaded side of the chain relative to a load required to make that side of the chain fully seat in the wildcat sheaves. As the gate is opened (lowered) and more chain passes over the sheaves, this weight becomes less, exacerbating the situation.

(c) Lubrication of the interfacing surfaces between the chains and the wildcat sheaves reduces the friction between the chain links and wildcat sheave recesses. This helps the chains to seat better, and should reduce the incidence of the chains "slipping a link."

(3) The hoist chains and the ends (approximately fifty (50) feet beginning at the gate attachment point) of the counterweight chains were replaced in February 1997 by Plaquemines Parish. The chains are in good condition but are showing some corrosion and barnacle collection at the splash zone and below water (with the gate in the open (lowered) position).

(4) There was a discussion on the possible conversion of the hoist and counterweight systems to utilize cables in lieu of the chains. It was noted that larger diameter, wider hoist sheaves and counterweight sheaves may be required. The hoist machinery will require revision, possibly complete replacement, and possibly structural concrete revisions to the gate bay may be required. A preliminary analysis of what would be required, and an estimate of costs could be made to determine if using cables in lieu of the chains is feasible. Operating personnel stated that the hoist support beams (trunnion) were cut in order to remove the hoist sprocket sheave. This procedure should not be repeated. The hoist sheave should be removed by first removing the gear box with sheave followed by removal of the sheave from the gear box.

(5) Plaquemines Parish personnel have installed hydraulic cylinders over the counterweight pits so that the counterweights can easily be raised and suspended during periods of gate inactivity.

(6) The gate operating machinery is always operated in a manual mode. This has been the practice for many years. Whenever one of the chains would "jump a link"

the system that synchronized the hoists had to be "shut out" and the gate operated manually to "level up" the gate. The synchronous system would then have to be adjusted accordingly. This also adversely affected the limit switches which stop the gate when fully closed (or open). Adjustments were frequent and very time consuming. Local interests have successfully operated the gate in the manual mode for many years and prefer this method. It was agreed that manual operation of the gates is satisfactorily, and that efforts to maintain the synchronizing systems and limit switches are not required.

(7) Volt-amp readings on the gate hoist motors during raising (closing) and lowering (opening) of the gate were taken on February 17 and 18, 1997, by Fluid Power (for Plaquemines Parish). These readings were analyzed by NOD Engineering Division to determine the load in the hoist chain. To do this, several assumptions were made. First it was assumed the drive train was operating efficiently and without binding. Secondly, it was assumed that the brake was not dragging and thirdly, the readings were taken correctly. The original specified chains had a design breaking strength of 548,000 lbs. The readings during the first 30 seconds of the lifting operation correlated to a calculated chain load of 320,000 lbs. and a SF=1.7. After this time frame, the readings correlate to a maximum load of 220,000 lbs. and a SF=2.5. The design maximum hoisting load was 161,000 lbs. (including silt loads) giving a design safety factor of 3.4. The probable 50% reduction in the factor of safety could be a primary consideration in evaluating the need for replacing the hoist chains. However, since the time duration is so short, the temporary increase in loading could be attributed to a loss of efficiency of the pump as explained in paragraph 5-03f. NOD Engineering Division recommends that a reduction of 1/8 inch in diameter of the hoist chain be used as a guide for replacing hoist chain links.

(8) There is no redundancy (backup) in the event of failure of any of the elements of the gate operating machinery used to close the gate when a hurricane is approaching. During early stages of the design of the project, it was assumed that if the gate could not be closed (raised) by the gate hoist equipment, a large crane or derrick barge would be brought in to lift the gate from the protected side. In reality, there would be little time to procure a rig large enough to lift the gate and its probable accumulated silt load. Lifting equipment of the needed capacity would probably have been secured in a safe harbor well in advance of the hurricane's approach, and the crew would also probably have left the area. It is also questionable if a rig of sufficient capacity could be mobilized through the relatively narrow Empire Lock (40'WX200'L chamber). Maintaining a spare parts inventory on site or at a reasonably close suitable storage site could alleviate some problems. As a minimum, spare parts such as several connecting links for both the hoist and counterweight chains and a spare hoist motor (or a known location where a replacement hoist motor could be procured within a few hours) should be maintained. An updated list of available (if any) barge mounted cranes with capacities sufficient to raise one side of the gate should be maintained. The sizes of the barges (to be used to determine if they can be mobilized and demobilized through Empire Lock from the Mississippi River, or will have to be mobilized from the Gulf of Mexico through the Empire Floodgate and have to remain in the Empire harbor until the hurricane threat is gone) and mobilization times should also be included in this list.

f. Gate Recess Flushing System. At the preceding inspection (Periodic Inspection No. 8, 17 January 1996), it was recommended that the pump be removed and refurbished as necessary. This recommendation was based on a probable loss of pump

efficiency based on visible amounts of flow disturbance and probable wear and corrosion of the vanes and diffuser bowl.

(1) Visual observations indicated the surface disturbances caused by operation of the system have decreased significantly from those observed at the preceding inspection, slightly more than three years ago. This indicates an additional loss of efficiency. The increase in the hoist load indicated by the electrical tests (See Par. 5-03 e (7)) may be at least partially attributable to the loss of efficiency of the system. The pump has not been removed, inspected and refurbished as recommended, nor has the inlet strainer been checked for clogging. This should be done.

(2) The hand operated pump lubricating unit mounted beside the right angle gear reducer was not operable. See Photo No. 6. This unit provides lubrication to the pump bearings which should be lubricated before each operation of the pump. The lubricating unit should be repaired/replaced as soon as possible.

(3) The discharge line from the pump is equipped with two air vent valves, a 24-inch check valve and an expansion coupling. See Photo Nos. 8, 11 and 44. Water leaks at both of the air vent valves from the ruptured 2-inch attachment pipes. This discharges a significant amount of water when the pump is operating. See Photo No. 8. The valves and attachment pipes should be repaired/replaced and the leaks stopped. The embedded attachment ring (embedded in the structure concrete) and the attachment bolts and nuts for both the 24-inch check valve and the expansion coupling are badly corroded. See Photo No. 44. Replacement of the embedded attachment ring and the corroded nuts and bolts is needed. At that time, the check valve and expansion coupling should be removed, examined externally and internally, and rehabilitated or replaced as indicated. NOD Engineering Division will

furnish technical assistance in developing methods of repair/rehabilitation. The work should be scheduled concurrently with the recommended removal and refurbishment of the pump which should be accomplished at the next dewatering which is currently scheduled for 2001.

(4) The condition of the pump engine appears normal for a unit of its age, a bit ragged in engine response, but with no indications of requiring an overhaul. See Photo No. 28. However, the muffler, located on top of the pump house, is badly corroded and leaking exhaust through the bottom. See Photo No. 29. The muffler needs replacing.

(5) There is no redundancy for the gate recess flushing system.

g. Hydraulic Systems. Hydraulic systems were originally provided to actuate the gate safety latch (used to provide a positive means of restraining the gate in the fully closed (raised) position). The hydraulic pumps (one on each side of the structure) were powered by electric motors. At the previous inspection the systems on both sides of the structure were inoperable and had been removed. It was recommended that the hydraulic systems be restored to operable condition to assure that the gate latches are operable. Since the last inspection, Plaquemines Parish personnel have installed manually operated hydraulic units to actuate the gate latches. See Photo No. 30. They work well and are much easier to maintain. Here again, the local interests are to be commended for their excellent solution to a problem.

h. Emergency Power Generator. The generator appeared to be in good condition. See Photo No. 31. It functioned properly when supplying power to the structure during a gate closure cycle. Since the last inspection belts and hoses have been replaced and fuel and oil leaks corrected and the generator room has been cleaned and straightened up. Two small leaks in the cooling system were noted, and these should be corrected.

i. Electrical.

(1) Visual inspection of the motors and controls during gate operation indicated they are in good condition considering the age of the structure.

(2) Gate operations are performed strictly in the manual mode, and the gate operating motors must be stopped by the operator since the limit switches associated with stopping travel of the gate are inoperable. This was discussed at length by the inspection team and operating personnel. It was agreed that due to the recurring slippages of the chains, restoration of the limit switches is not considered worth the effort and expense. Therefore gate operation in the manual mode will continue.

(3) There was a discussion on providing navigation signals to indicate to marine traffic if the gate is open or closed. There is a red light on top of the control house that is turned on when the gate is not in the "fully open" position (structure available for marine traffic passage). The navigation horn is programmed for a two second sounding and eight second silent cycle when the gate is not in the fully open position. NOD Operations Division considers the structure to have all the necessary signals and aids. Since there are no lights on the gate itself, operating personnel manually place a red light on the center of the gate when closed. To further enhance visibility of the black colored gate, Plaquemines Parish may wish to consider placing a large yellow iridescent stripe, or a series of smaller stripes on the upper portion of the gate (similar to markings on sheet pile dolphins at locks). This could be done with tape or paint, or reflectors could be installed.

(4) The obstruction lights for the guidewalls appeared to operate properly.

(5) The area lighting components have been renovated since the last inspection and are in good condition. Refractors for the two lights on the east side of the

structure have been recently broken, but the lights are still operable. The broken refractors should be replaced.

j. Dewatering Elements. Since the previous inspection the steel needle girders and steel needle girder supports have been cleaned and painted and re-stacked on the storage rack. See Photo No. 32. Defective treated timbers used as spacers between the stacked items have been replaced. The concrete storage rack was in good condition. In accordance with ER 1110-2-8157, "Engineering and Design Responsibility for Hydraulic Steel Structures," dated 31 January 1997, all fracture critical welds on the needle girders should be non-destructive tested. This should be done prior to their use for the next dewatering (tentatively scheduled for 2001).

k. Timber Guidewalls. The overall condition of the timber guidewalls, and dolphins was good. Caps were in place on the timber piles. See Photo No. 33. There are a number of deteriorated timbers that will require replacement in the near future. See Photo Nos. 34 and 35. Replacement of the deteriorated timbers should logically be scheduled for when the next dewatering occurs when equipment will be on site. Monitoring of the condition of the timbers, and absolutely necessary replacement, should be performed until that time.

l. Boat Dock. The boat dock deck has been rebuilt since the last inspection and was in good condition. See Photo No. 36.

m. Channels.

(1) At the time of this inspection the channel had silted in such that its thalweg was several feet higher than its originally constructed grade of el.-12.0. The channel thalweg was originally constructed to el-12.0 to accommodate for a 2-foot advance maintenance overexcavation and a one-foot allowable overdepth, both below the design

thalweg grade of el-9.0. Plaquemines Parish operating personnel asked if siltation within the limits of the structure could be removed as part of the Corps channel dredging. Plaquemines Parish personnel also noted that the floodgate sill elevation is -14.0, with the gate recess at -17.5 and the outer sill at -20.75, all lower than the channel design thalweg of -9.0. This, they believe contributes to the gate bay siltation problem. Plaquemines Parish operating personnel requested that NOD Operations Division personnel check to see if during the next channel cleanout (dredging) if the channel thalweg could be lowered such that it is several feet below the floodgate sill elevation. NOD Operations Division team members stated they will check to see if this can be done.

(2) At the previous inspection, it was visually noted that the stone breakwater dike at the southwest end of the channel appeared to have lost some stone on the lakeside (east) end over a distance of some 50 to 75 feet. Also, Plaquemines Parish personnel reported that erosion of the lake bottom beyond the breakwater was apparently occurring. It was recommended that a detailed survey be made of the stone breakwater and suspected area of the lake bottom, the results evaluated, and indicated remedial measures accomplished. To date no action has been taken. Visual observations at this inspection indicate that loss of stone from the breakwater is about the same as observed at the previous inspection. The breakwater appears to be about 1.7 feet deficient in elevation. See Photo Nos. 37 and 38. Other riprap areas appeared to be in good condition.

(3) Erosion of the protected side bank lines in the unprotected areas appears to have increased in some areas since the last inspection. See Photo No. 39. In one area, about 100' in length, located approximately 200 feet north of the end of the northwest guidewall, the erosion is approaching the toe of the levee. The receding bank lines along the

approach channels should continue to be monitored for any encroachment that would endanger the stability of the levees.

n. Sheet Pile Floodwalls.

(1) At the previous inspection the west side sheet pile floodwall was from 1.7 to 3.4 feet below design grade. The "L" type seal at the east end of the sheet pile wall did not seal against the west end of the "T" wall as it should. Subsequent to the previous inspection, NOD forces restored the sheet pile wall to design grade by "pulling up" the sheet piles and replaced and remounted the "L" type seal so that it now seals properly.

(2) The sheet pile floodwalls have been recently cleaned and painted with coal tar epoxy from slightly below ground line to the tops and are in very good condition. See Photo No. 40.

(3) There is a gap between the east levee embankment and the east end of the east sheet pile floodwall. See Photo No. 41. The levee embankment should be extended to tie in to the sheet pile wall such that the gap is properly closed.

o. Instrumentation Devices.

(1) The east bench mark, PBM-EFE, could not be located. Bench mark PBM-EFW was located but appears to be in poor condition. This bench mark consists of a very rusty 1-1/2-inch diameter galvanized steel pipe with a cap encased in an open 3-inch diameter pipe. See Photo No. 42. The bench mark is adjacent to, but not connected to a large concrete block. A witness post is located adjacent to the bench mark. See Photo No. 43. Bench mark PBM-EFW should be repaired or replaced. If PBM-EFE is required to provide adequate control for the surveys, it should also be replaced.

(2) All settlement marks on the gate bay structure and T-walls are in good condition and the markings are easily read. The sheet piles, however, have been re-coated with coal tar epoxy and the reference marks were obliterated. The reference marks on top of the sheet pile walls and the companion marks at ground level (adjacent to the sheet pile walls) should be reestablished.

PHOTO NO. 1 – SPALL ON PROTECTED SIDE OF EAST "T" WALL AT JOINT BETWEEN MONOLITHS T-2R AND T-3R.

PHOTO NO. 2 – FLOODSIDE VIEW OF WEST "T" WALL AT JOINT BETWEEN MONOLITHS T-3L AND T-4L. NOTE OPEN JOINT AND TORN WATER STOP.

PHOTO NO. 3 – SPALL ON GATE BAY DECK AT HANDRAIL ANCHORAGE. NOTE COVER OVER OUTLET FOR LIGHT POLE THAT HAS BEEN RELOCATED.

PHOTO NO. 4 – PROTECTED SIDE (NORTH FACE) OF EAST GATE BAY WALL OPPOSITE COUNTERWEIGHT RECESS WITH WATER SQUIRTING OUT.

PHOTO NO. 5 – PUMPHOUSE AND PUMP PLATFORM.

PHOTO NO. 6 – RIGHT ANGLE PUMP DRIVE.

PHOTO NO. 7– LOOKING ENE AT CRACK IN WEST FACE OF PUMP PLATFORM PILE NO. 3.

PHOTO NO. 8 – LOOKING WNW AT CRACKS IN SOUTH AND EAST FACES OF PUMP PLATFORM PILE NO. 3.

PHOTO NO. 9 – LOOKING SOUTH AT CRACKS IN NORTH FACES OF PUMP PLATFORM PILE NOS. 3 (BACKGROUND) AND 5 (FOREGROUND)

PHOTO NO. 10 – LOOKING ESE AT CRACK IN NORTH FACE OF PUMP PLATFORM PILE NO. 2.

PHOTO NO. 11 – LOOKING NW AT CRACKS IN SOUTH AND EAST FACES OF PUMP PLATFORM PILE NO. 5.

PHOTO NO. 12 – LOOKING SE AT CRACK IN NORTH FACE OF PUMP PLATFORM PILE NO 7.

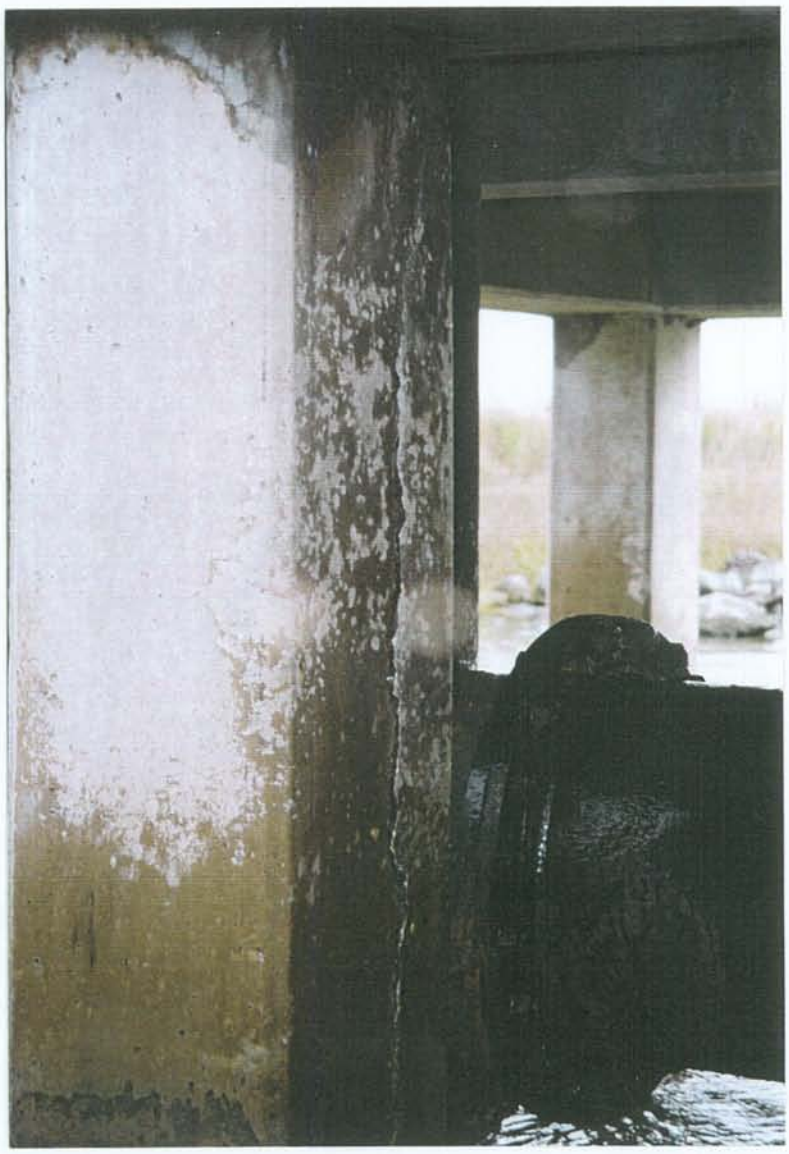


PHOTO NO. 13 – LOOKING ENE AT CRACK IN SOUTH FACE OF PUMP PLATFORM PILE NO. 5.

PHOTO NO. 14 – LOOKING NNW AT CRACK IN SOUTH FACE OF PUMP PLATFORM PILE NO. 7.

PHOTO NO. 15 – CRACK IN WEST FACE OF UPPER DECK PERIMETER SUPPORT BEAM AT SOUTH WEST CORNER OF PUMP PLATFORM.

PHOTO NO. 16 – CRACK IN BOTTOM OF PUMP PLATFORM DECK AT SOUTHWEST CORNER.

PHOTO NO. 17 – LOOKING WEST AT CHAMBER FACE OF WEST GATE BAY WALL. NOTE CORROSION ON EMBEDDED METAL AT SPLASH ZONE.

PHOTO NO. 18 – LOOKING NORTH ALONG TOP OF WEST SIDE GATE BAY WALL. NOTE GOOD CONDITION OF PAINT ON HANDRAILS.

PHOTO NO. 19 – VIEWS OF SAFETY CHAINS ACROSS HANDRAIL OPENINGS. SAFETY CHAINS PAINTED AND IN GOOD CONDITION.

PHOTO NO. 20 – GATE IN FULLY CLOSED POSITION. PAINT SYSTEM IN GOOD CONDITION. NOTE DAMAGE ALONG TOP OF GATE. DAMAGE APPEARS TO BE SAME AS NOTED AT LAST INSPECTION.

PHOTO NO. 21 – SKINPLATE SIDE OF GATE IN FULLY CLOSED POSITION. PAINT SYSTEM IN GOOD CONDITION. NOTE DAMAGE ON TOP OF GATE.

PHOTO NO. 22 – GATE BEING CLOSED (RAISED). NOTE SILT SLIDING OFF.

PHOTO NO. 23 – SILT SLIDING OFF GATE AS IT IS BEING CLOSED (RAISED).

PHOTO NO. 24 – SILT ACCUMULATION AS GATE IS BEING CLOSED (RAISED).

PHOTO NO. 25 – GATE APPROACHING CLOSED POSITION. NOTE COUNTERWEIGHT CHAIN IS PULLING AGAINST GATE CLOSING.

PHOTO NO. 26 – GATE SHOCK ABSORBER STUCK IN FULLY RECESSED POSITION.

PHOTO NO. 27 – VIEW SHOWING POSITION OF HOIST AND COUNTERWEIGHT CHAINS WITH GATE OPEN (LOWERED).

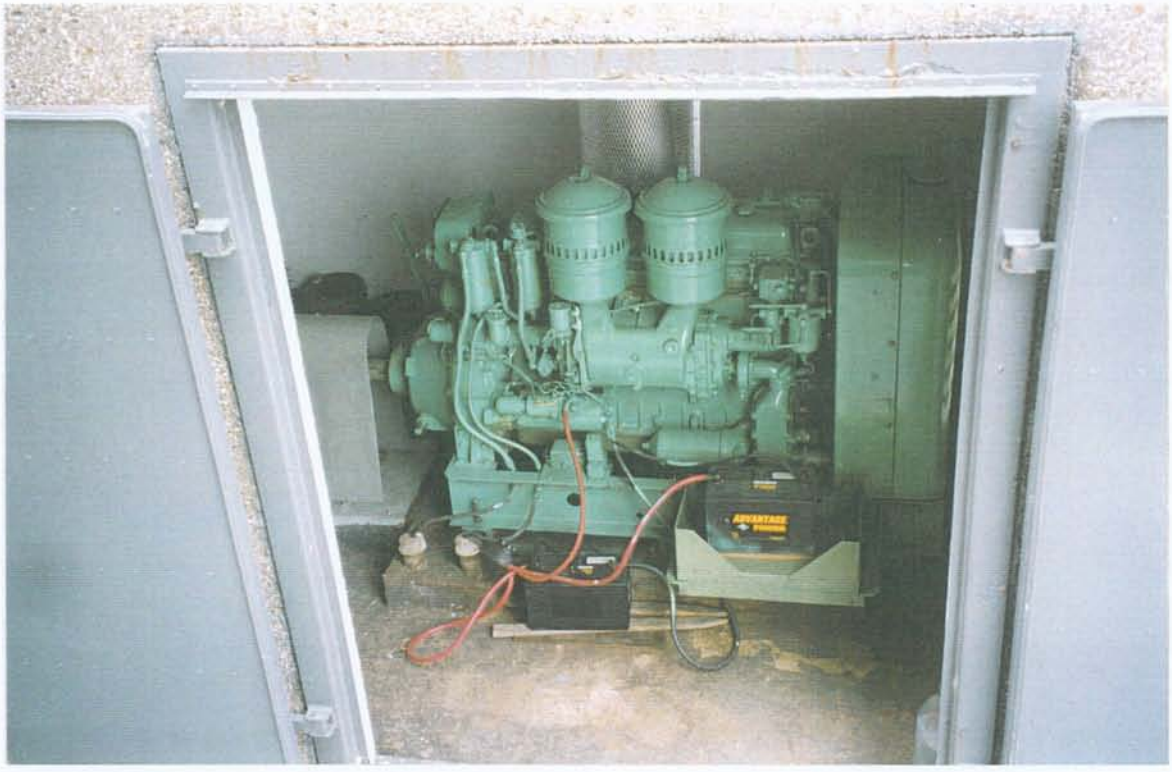


PHOTO NO. 28 – ENGINE FOR GATE RECESS FLUSHING SYSTEM PUMP.

PHOTO NO. 29 – PUMP ENGINE MUFFLER ON TOP OF PUMP HOUSE. MUFFLER BADLY CORRODED ON BOTTOM AND LEAKING EXHAUST.

PHOTO NO. 30 – MANUALLY OPERATED GATE LATCHING MECHANISM.

PHOTO NO. 31 – EMERGENCY POWER GENERATOR UNIT.

PHOTO NO. 32 – DEWATERING ELEMENTS STACKED ON STORAGE RACK.

PHOTO NO. 33 – NORTHWEST TIMBER GUIDEWALL. NOTE ALUMINUM CAPS ON TOP OF PILES AND VERTICAL TIMBERS.

PHOTO NO. 34 – BADLY DETERIORATED TOP FENDER TIMBER ON NORTHWEST GUIDEWALL.

PHOTO NO. 35 – DETERIORATED FENDER TIMBER AT SPLASH ZONE.

PHOTO NO. 36 – NEW BOAT DOCK DECK.

PHOTO NO. 37 – LOOKING SOUTHWEST AT EASTERN END OF STONE BREAKWATER. TOP OF BREAKWATER SHOULD BE ABOUT 1.7 FEET ABOVE WATER SURFACE.

PHOTO NO. 38 – LOOKING EAST ALONG CENTERLINE OF STONE BREAKWATER.

PHOTO NO. 39 – PROTECTED SIDE WEST CHANNEL BANK. NOTE EROSION POCKET APPROXIMATELY 200 FEET NORTH OF NORTH END OF GUIDEWALL.

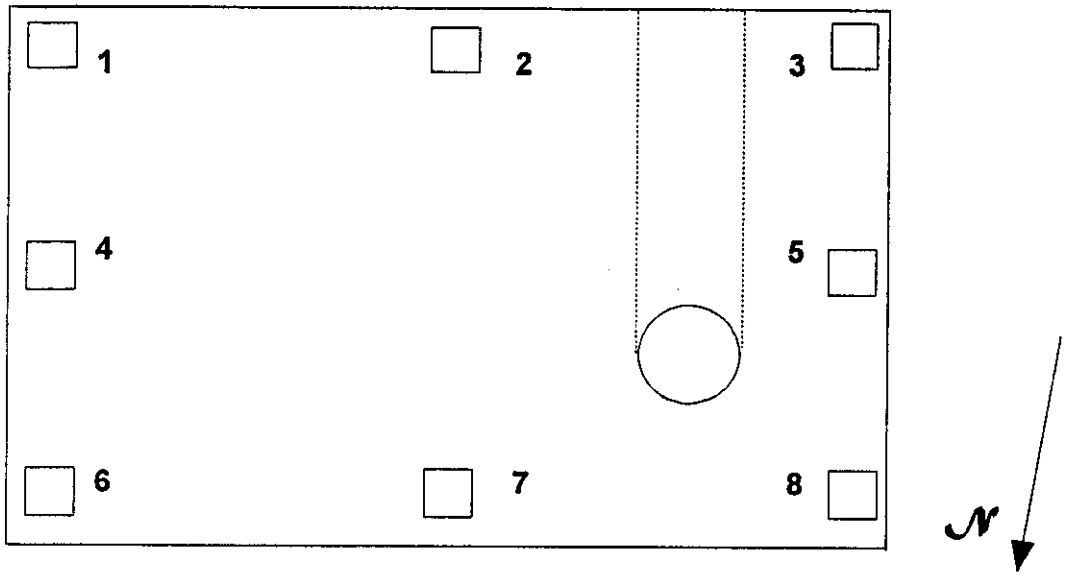
PHOTO NO. 40 – WEST SHEET PILE FLOODWALL.

PHOTO NO. 41 – EAST END OF EAST SIDE SHEET PILE FLOODWALL. NOTE LOW LEVEE EMBANKMENT AREA.

PHOTO NO. 42 – BENCH MARK PBM-EFW.

PHOTO NO. 43 – WITNESS POST FOR PBM-EFW.

PHOTO NO. 44 - VIEW OF BADLY CORRODED ATTACHMENT RING AND ATTACHMENT BOLTS AND NUTS FOR 24-INCH CHECK VALVE AND EXPANSION COUPLING.



PUMP PLATFORM - PILE NUMBERS

SECTION VI – CONCLUSIONS AND PROPOSED REMEDIAL ACTIONS

6-01. Conclusions. It is concluded from Periodic Inspection No. 9 that the Empire Floodgate is operationally and structurally adequate. Since Periodic Inspection No. 8, the Plaquemines Parish Government has expended large amounts of both manpower effort and funds in improving the overall condition of the project. The project now receives periodic maintenance and housekeeping, and diligent effort is being made to maintain the project in good state of readiness in case it is needed for hurricane protection.

6-02. Proposed Remedial Actions. To assure the continued structural integrity and operational adequacy of Empire Floodgate the following remedial measures will be performed by local interests prior to the next inspection, unless otherwise noted.

a. Spalls in the concrete surfaces will be repaired with epoxy by June 2000. The epoxy product should be similar or equal to Sika 32 High Mod or Pilgrim EM 52.

b. The spall on the protected side of the concrete "T" wall at the joint between monoliths T-2R and T-3R will be monitored quarterly.

c. The joints between the concrete floodwall ("T" wall) monoliths will be sealed with a joint sealer similar and equal to Sonne-Borne NP-2 or Sika 2-C by June 2000. Special emphasis will be given to joints with torn water stops.

d. The extent of the honeycombed concrete in the north wall of the east side counterweight recess will be determined and evaluated. The evaluation will determine if removal and replacement of the "honeycombed" concrete is required or if epoxy injection could be used. The area can then be repaired. This work will require removal of the counterweight and will therefore be scheduled to be accomplished during the next dewatering when a crane

will be on site. The counterweight drain hole is stopped up and should be opened to drain freely as soon as practical.

e. Recommended remedial measures for the cracked pump platform piles and deck are presented in Appendix B.

f. Corroded areas of embedded metals above normal water surfaces will be cleaned and painted by June 2000. Any embedded metals below water level that are accessible during the next dewatering will be evaluated for the effects of corrosion and cleaned and painted accordingly during the dewatering.

g. NOD will evaluate modifying the top of the gate in an effort to reduce damage to the top of the gate. This will be done in accordance with paragraph 6-03.

h. Fracture critical welds on the flap gate will be non-destructive tested during the next dewatering (presently scheduled for 2001). Fracture critical welds on the dewatering needle girders will be non-destructive tested prior to their use during the next dewatering.

i. The "wildcat" sheave contact surfaces will be maintained in a well lubricated condition. A lubricant that is environmentally safe will be used.

j. NOD Engineering Division will make a preliminary analysis of what would be required to convert the hoist and counterweight systems such that cables could be used in lieu of the chains. A rough estimate of costs will then be prepared and the practicality of such a conversion will be determined. This will be done in accordance with paragraph 6-03.

k. It was concluded that operation of the gate in the manual mode without benefit of limit switches and synchronizing systems is satisfactory.

l. An inventory of spare parts for the gate operating machinery will be maintained on site. These spare parts will consist of a minimum of 2 master links for the hoist chains and 2 master links for the counterweight chains and a spare hoist motor.

m. An updated list of possibly available barge mounted cranes with capacities sufficient to raise one side of the gate will be maintained. The list will also include sizes of the crane barges and probable mobilization time and routes. This will be done by June 2000.

n. The gate recess flushing system pump will be removed, inspected and refurbished as necessary to restore it to, or near, its original capacity. At this time the inlet strainer will be checked for clogging and cleaned if necessary. This will be done during the next dewatering, presently scheduled for 2001.

o. The hand operated lubricator mounted on the pump right angle gear reducer will be repaired/replaced by June 2000.

p. The two air vent valves on the pump discharge line will be repaired/replaced so that they operate properly and the leaks will be repaired. This will be done during the next dewatering, presently scheduled for 2001.

q. The muffler for the pump engine will be replaced by June 2000.

r. There is no redundancy provided for the gate recess flushing system. Providing redundancy would be very expensive (additional pump and engine and piping connections) and is considered impractical as a retrofit. Spare parts (belts, hoses and spare battery) will be obtained and maintained in the pump house. If the gate recess flushing system fails with a hurricane approaching, and cannot be quickly restored to operating condition, Plaquemines Parish Government will have no choice but to raise the gate without benefit of the system. Considering the suspected loss of efficiency of the flushing system, and the high

hoist loads indicated by the electrical tests (see paragraph 5-03.e.(7)), the higher loads are probably the result of the ineffiency of the gate recess flushing system.

s. The two small leaks in the emergency generator cooling system will be corrected by June 2000.

t. The broken refractors for the area lighting on the east side of the structure will be replaced by June 2000.

u. The condition of the deteriorating guidewall timbers will be monitored and timbers will be replaced as absolutely necessary until the next dewatering at which time deteriorated guidewall timbers will be replaced and any other required guidewall repairs accomplished.

v. During prior Corps dredging of the approach channels, dredging within the limits of the structure was also accomplished. This practice will be continued whenever possible.

w. NOD Operations Division has evaluated Plaquemines Parish Government's request that the approach channels thalweg be lowered such that it is several feet lower than the gate sill elevation and they have determined that the Corps does not have authority to lower the authorized navigation channel depth of elevation -9.0. However as before, when the Corps dredges the approach channels, they will be dredged to approximately el.-12.0 to accommodate for 2-feet of advance maintenance and 1-foot allowable overdepth. The siltation problem will be further investigated as noted in paragraph 6-03.

x. Plans and specifications are being developed for a project to increase protection of the levee system in the vicinity of the floodgate. The project will include repairing the foreshore dike in Bay Adams and repairing bank erosion on the protected side,

west channel bank along with a new foreshore dike. The existing alignment at the southern end of the foreshore dike will be modified such that it ties into the levee berm adjacent to the breakwater dike. The original breakwater dike has been reevaluated and found to be deficient for current conditions. The project will include construction of a new breakwater dike section at elevation +6.0, with an 8-foot wide crown, and IV and 2H side slopes. The breakwater dike will be constructed on a geofabric, followed by a one-foot thick layer of bedding material capped with armor stone. Construction is anticipated to begin in the summer of 2000.

y. The gap between the east levee embankment and the east end of the east sheet pile wall will be closed by June 2000.

z. NOD Engineering Division will install three (3) new benchmarks (two on the east side and one on the west side of the structure) by December 1999.

aa. NOD Engineering Division's contract instrumentation survey party will reestablish reference marks on top of the sheet pile floodwalls and the companion marks at the ground level during the next instrumentation readings (prior to the 2001 dewatering).

6-03. Further Investigation. Numerous operating issues have been mentioned during this inspection as well as past inspections: (1) siltation of the gate recess and approach channels, (2) slippage of chain links and (3) lack of redundancy for the gate operating machinery and pumping system. Various modifications and improvements were also mentioned at the inspection: (1) cable hoist system to replace chain hoist system, (2) taper top portion of gate (to minimize damage done by boats) and (3) the ability to dewater the entire structure. It has been brought to the attention of NOD that the nearby Empire Lock is used to divert fresh water and sediments from the Mississippi River into the protected area served by Empire floodgate. This practice could be contributing to the siltation problem at the

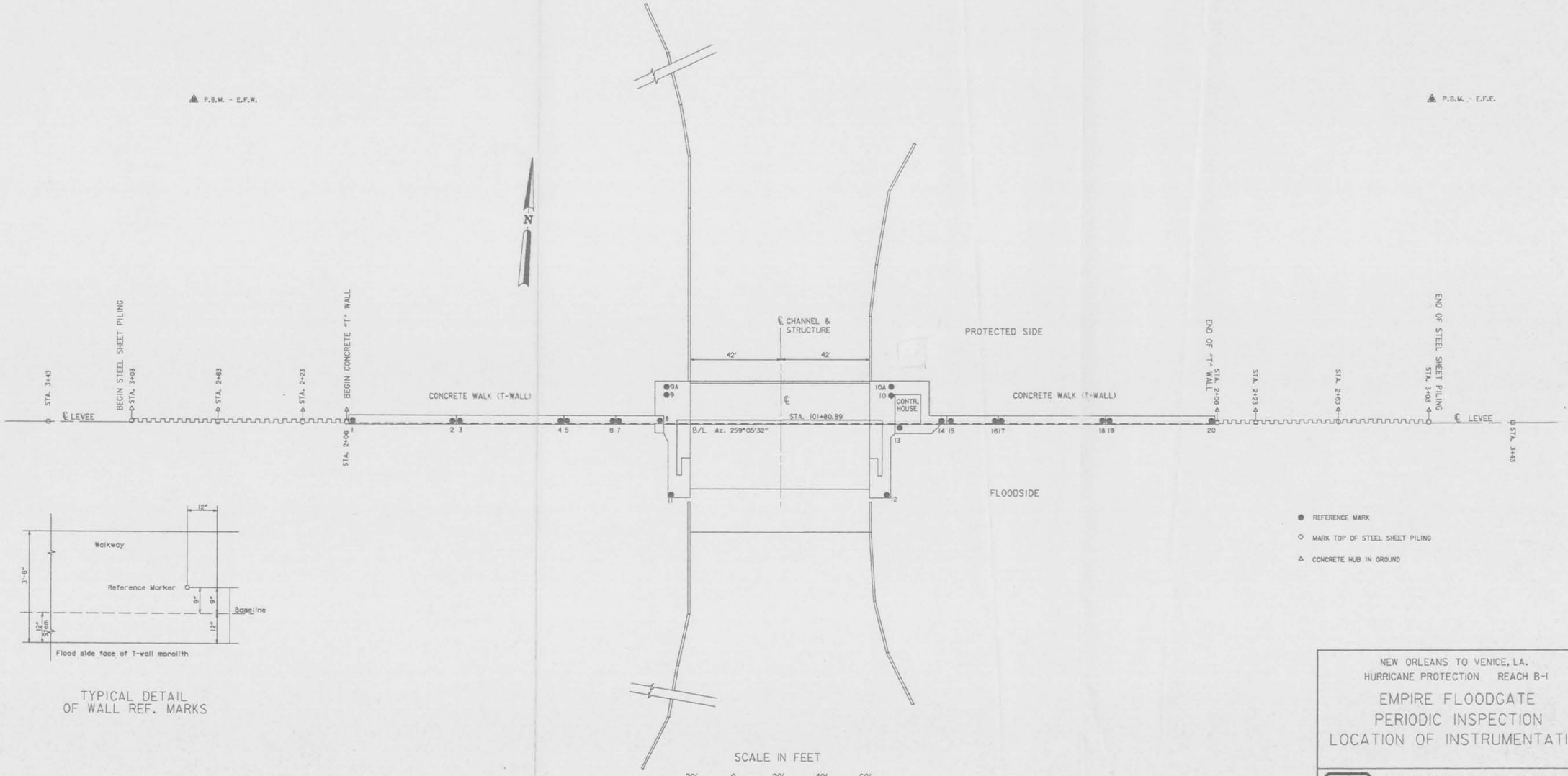
structure. The investigation of these items fall outside the funding realm of the Periodic Inspection Program. Engineering Division is coordinating with Planning, Programs & Project Management Division to obtain a funding source. Once funding has been obtained, Engineering Division will coordinate an investigation plan with Plaquemines Parish Government and the Louisiana Department of Transportation and Development.

6-04. Next Inspection. The next periodic inspection of Empire Floodgate is tentatively scheduled for the 2001 dewatering.

VICINITY MAP

INSTRUMENTATION PLATES

Plate No.	Title
EMP-1	Location of Instrumentation
2	Settlement Reference Marks - Tabulations
3	Settlement and Reference Marks - Differential Movement
4	Settlement and Reference Marks - Differential Movement
5	Reference Marks-Differential Chart
EMP-6	Baseline and Range Layout
7	Profile Survey (FY-98)
8	Scour Survey (FY-98)
9	Scour Survey (FY-98)
10	Scour Survey (FY-98)
11	Scour Survey (FY-98)
12	Profile Survey (FY-98)
13	Scour Survey (FY-98)
14	Scour Survey (FY-98)
15	Scour Survey (FY-98)
16	Scour Survey (FY-98)



NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-I

EMPIRE FLOODGATE
PERIODIC INSPECTION
LOCATION OF INSTRUMENTATION

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

PLATE EMP-1

SETTLEMENT REFERENCE MARK - STRUCTURE AND T-WALL

NO. OF REFERENCE MARK		RM 1	RM 2	RM 3	RM 4	RM 5	RM 6	RM 7	RM 8	RM 9	RM 9A	RM 10	RM 10A	RM 11	RM 12	RM 13	RM 14	RM 15	RM 16	RM 17	RM 18	RM 19	RM 20	TEM	GAGE1	GAGE2	REMARK	PBM E.F.E.	PBM E.F.W.	PBM H.W.H.
INITIAL DATE		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	49°	0.32			12-2-75		
ORIGINAL READINGS (FT)		14.59	14.72	14.73	14.78	14.76	14.77	14.79	14.74	14.76	14.77	14.71	14.70	14.74	14.73	14.75	14.68	14.67	14.67	14.66	14.61	14.61	14.57					3.122		
DATE OF OBSERVATION	9 NOV. 1984	14.18	14.38	14.39	14.44	14.42	14.42	14.42	14.36	14.39	14.38	14.30	14.30	14.37	14.33	14.34	14.27	14.26	14.25	14.24	14.14	14.13	13.93	70°	0.90	0.90		2.971	-	
	24 JUL. 1986	14.16	14.38	14.38	14.45	14.43	14.43	14.43	14.37	14.40	14.40	14.30	14.29	14.39	14.32	14.34	14.26	14.25	14.24	14.24	14.11	14.11	13.86	83°	1.20	1.20		2.971	4.200	
	8 DEC. 1988	14.14	14.37	14.37	14.44	14.42	14.44	14.43	14.36	14.40	14.39	14.29	14.28	14.38	14.33	14.33	14.25	14.24	14.22	14.21	14.07	14.07	13.79	60°	0.00	0.00		2.971	4.217	
	25 FEB. 1992	14.07	14.30	14.30①	14.37	14.35	14.36	14.36	14.30	14.33	14.33	14.23	14.22	④	14.27	14.27	14.18	14.17	14.15	14.14	13.97	13.97	13.67	72°	1.20	1.20		2.970	-	
	22 JAN. 1993	14.08	14.32	14.33	14.40	14.39	14.39	14.40	14.34	14.38	14.37	14.26	14.25	14.36	14.30	14.30	14.21	14.20	14.17	14.15	13.98	13.98	13.67	72°	0.9	0.4				
	20 MAR. 1995	14.05	14.29	14.30	14.38	14.36	14.39	14.39	14.32	14.35	14.35	14.26	14.23	14.34	14.27	14.26	14.17	14.16	14.13	14.11	13.93	13.93	13.61	80°	1.5	1.3		-	4.208	
	15 FEB 1996	14.03	14.27	14.28	14.36	14.35	14.36	14.37	14.31	14.34	14.35	14.22	14.22	14.33	14.26	14.27	14.16	14.15	14.11	14.11	13.91	13.90	13.58	67°	-	-		-	4.200	
	29 JAN. 1997	14.03	14.28	14.28	14.37	14.35	14.37	14.37	14.32	14.36	14.35	14.23	14.22	14.34	14.26	14.27	14.16	14.15	14.11	14.10	13.91	13.90	13.58	45°						2.669
	31 MARCH 1998	14.02	14.23	14.24	14.33	14.31	14.32	14.33	14.27	14.32	14.32	14.18	14.17	14.30	14.22	14.23	14.12	14.10	14.08	14.06	13.84	13.83	13.52	78°	2.5	2.5				2.669

DISTANCES TO REFERENCE MARKS

NO. OF REFERENCE MARKS		RM2-RM3	RM4-RM5	RM6-RM7	RM9A-RM10A	RM11-RM12	RM14-RM15	RM16-RM17	RM18-RM19	TEMP	REMARKS
INITIAL DATE		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75		
ORIGINAL READINGS (IN)		24.313	24.500	23.750	105.83 ①	103.96 ①	24.000	24.094	24.313		
DATE OF OBSERVATION	9 NOV. 1984	24.750	24.750	23.813	-	-	24.000	24.375	24.813	70°	
	24 JUL. 1986	24.843	24.750	23.718	-	-	24.000	24.406	25.000	83°	
	8 DEC. 1988	24.875	24.906	23.781	-	-	24.156	24.530	25.219	70°	
	25 FEB. 1992	24.875	24.906	23.750	-	-	24.063	24.469	25.156	72°	
	22 JAN. 1993	24.96	24.96	23.76	-	-	24.24	24.48	25.08	72°	
	20 MAR. 1995	24.77	24.80	23.68	-	-	24.20	24.38	25.06	80°	
	15 FEB 1996	24.77	24.88	23.68	-	-	24.18	24.38	25.02	67°	
	29 JAN. 1997	24.94	25.06	23.81	-	-	24.38	24.50	25.25	45°	
	31 MARCH 1998	24.81	24.88	23.75			24.31	24.38	25.06	78°	

SETTLEMENT REFERENCE MARK - SHEET PILING and LEVEE

REFERENCE MARK EAST or WEST		2+06E	2+06E	2+23E	2+23E	2+63E	2+63E	3+03E	3+03E	3+43E	E-W	2+06W	2+06W	2+23W	2+23W	2+63W	2+63W	3+03W	3+03W	3+43W
INITIAL DATE		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75
ORIGINAL READINGS (FT)		14.13	7.65	13.89	8.13	13.78	7.96	13.76	14.45	14.11		13.87	7.11	13.38	7.56	13.03	7.80	12.65	13.91	11.69
DATE OF OBSERVATION	9 NOV. 1984	13.21	6.29	12.75	②	12.32	6.22	12.07	11.88	12.03		13.37	②	12.78	②	12.26	②	11.71	12.42	10.11
	24 JUL. 1986	13.11	6.17	12.62	②	12.16	5.96	11.92	11.61	11.86		13.35	②	12.75	②	12.22	②	11.64	12.15	②
	8 DEC. 1988	13.00	6.02	12.49	②	12.01	5.77	11.74	11.40	15.74		13.33	②	12.72	②	12.18	②	11.58	12.05	②
	25 FEB. 1992 **	15.30	5.74	15.23	②	15.28	②	15.32	②	④		13.25	②	12.62	②	12.01	②	③	②	②
	22 JAN. 1993	15.31	5.73	15.23	②	15.27	②	15.32	②	④		13.28	②	12.65	②	12.03	②	③	②	④
	20 MAR. 1995	15.21	5.61	15.14	②	15.16	②	15.18	②	15.65		13.22	②	12.58	②	11.93	②	③	②	④
	15 FEB 1996	15.18	-	15.10	-	15.13	-	15.16	-	-		13.20	-	12.55	-	11.90	-	-	-	-
	29 JAN. 1997 ***	15.18	5.54	15.07		15.11	-	15.13	-	-		15.57	-	15.50	5.71	15.52	-	15.44	-	-
	31 MARCH 1998	15.12	5.49	15.02	5.73	15.04	6.87	15.07	10.02	15.11		15.53	4.48	15.46	5.67	15.46	7.30	15.38	14.85	16.53

NOTE:
THE DIFFERENTIAL GRAPHS (1975-DATE) ARE PLOTTED USING THE EQUATION (R-R)-.151'= DIFF. THE 0.151IS CAUSED BY THE FOLLOWING BENCH MARK (N.G.V.D.) CORRECTIONS; PBM E.F.E. (1975-76) ELEV. 3.122'-(1979) ELEV. 2.971' = 0.151'.

① APPEARS TO BE SURVEY ERROR.
② CAP DESTROYED; SHOT NATURAL GROUND.
③ NO PILE WALL (REMOVED)
④ NO READING

NOTE: FIRST STATIONINGS LISTED ARE ON STEEL SHEET PILINGS; ELEVATIONS FOR 3 + 43 E & W ARE ON CONCRETE MONUMENTS

** NOTE: EAST SHEET PILE I-WALL WAS RAISED TO ELEV. 15.5 IN 1992 UNDER CONTRACT NO. DACW29-90-C-0046

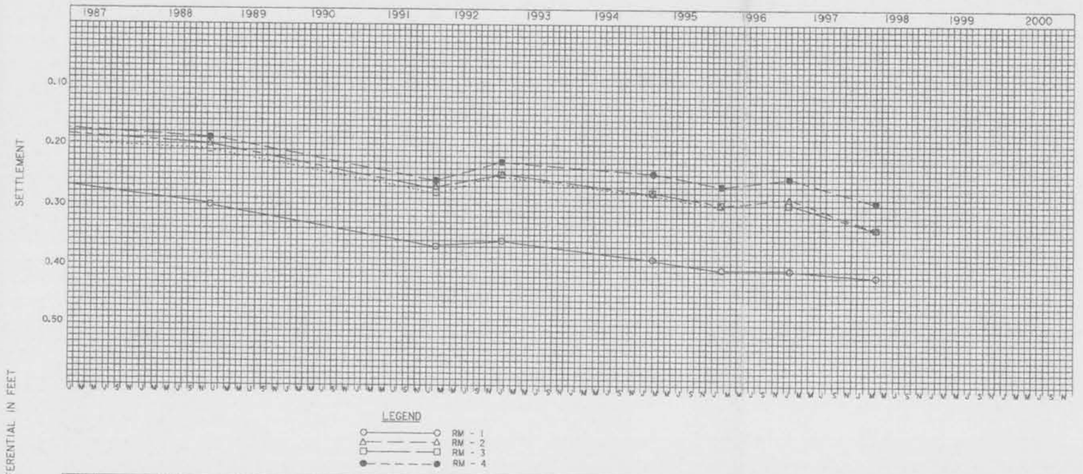
*** NOTE: WEST SHEET PILE I-WALL WAS RAISED TO ELEV. 15.5 IN 1997

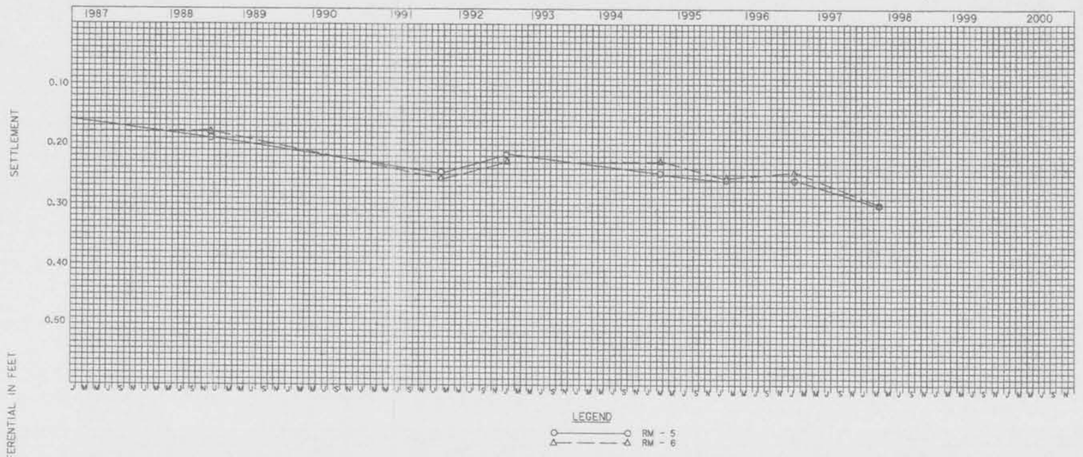
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-I
PERIODIC INSPECTION
EMPIRE FLOODGATE

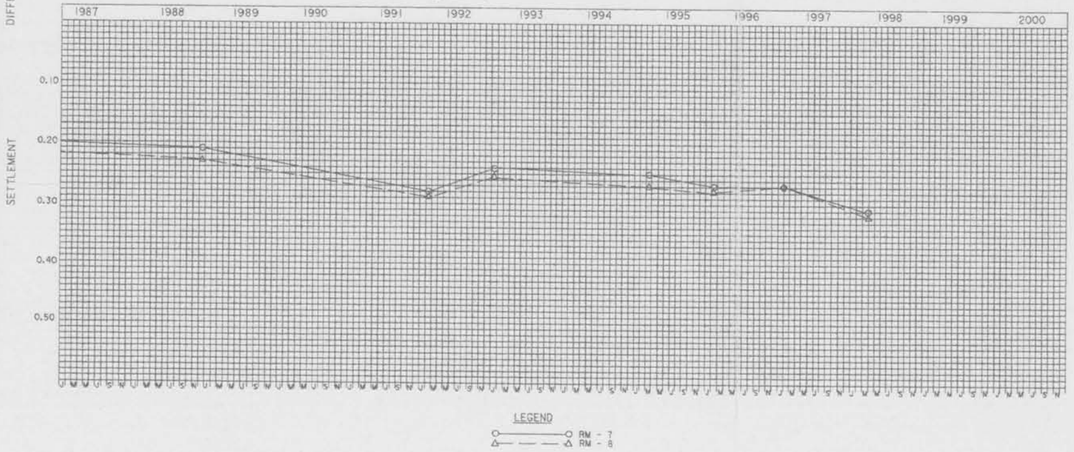
SETTLEMENT REFERENCE MARKS
TABULATIONS

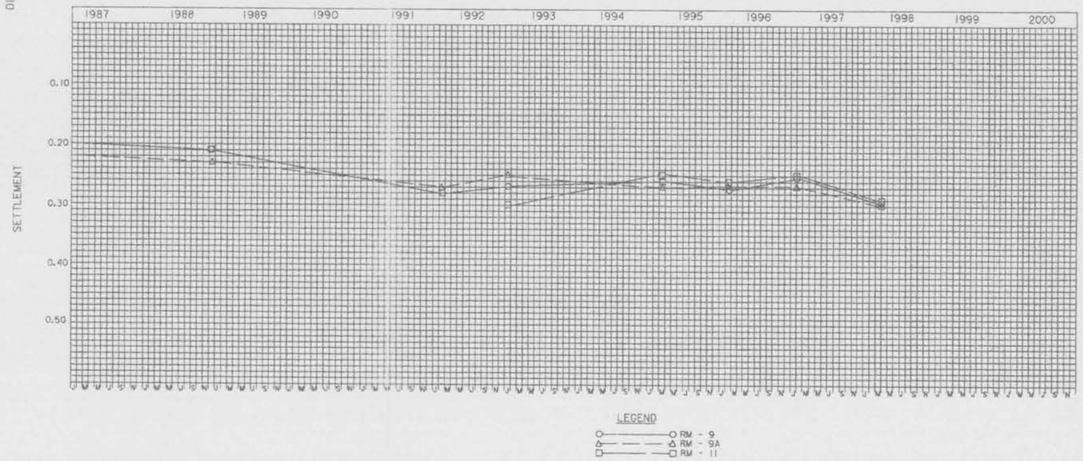
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PLATE 2









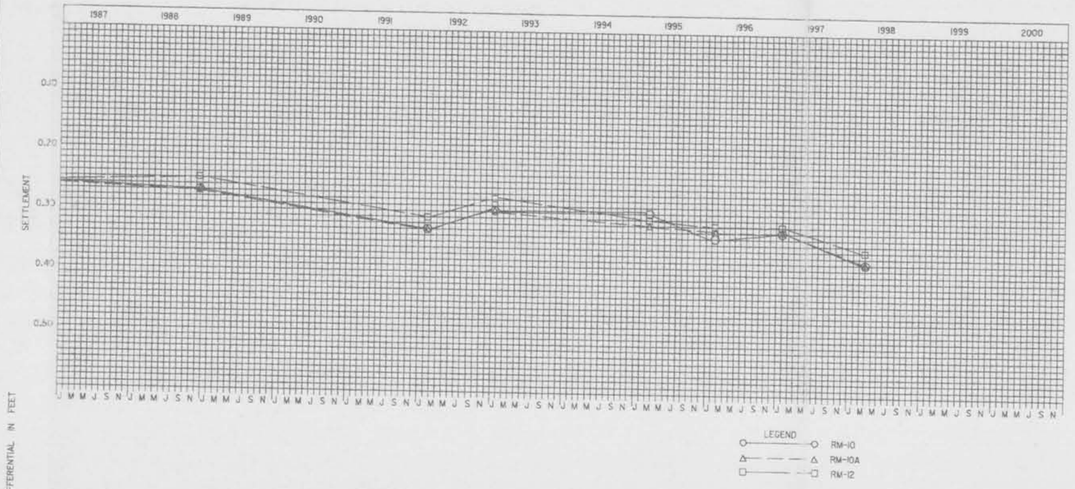
NOTE: ALL POINTS PLOTTED AFTER 1979 ARE USING THE EQUATION (R-R) -.151 = DIFF. SEE TABULATION CHART FOR FURTHER INFORMATION

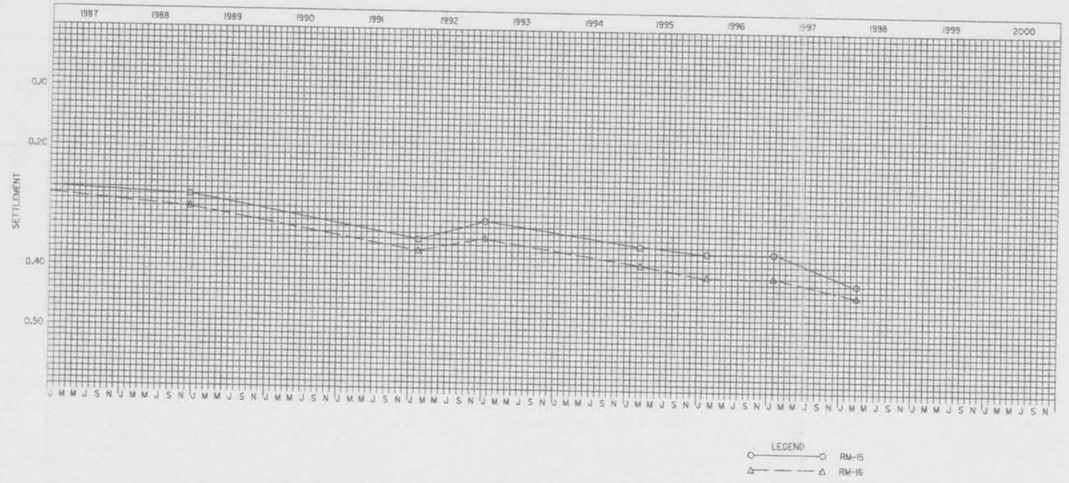
NEW ORLEANS TO VENICE, LA
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

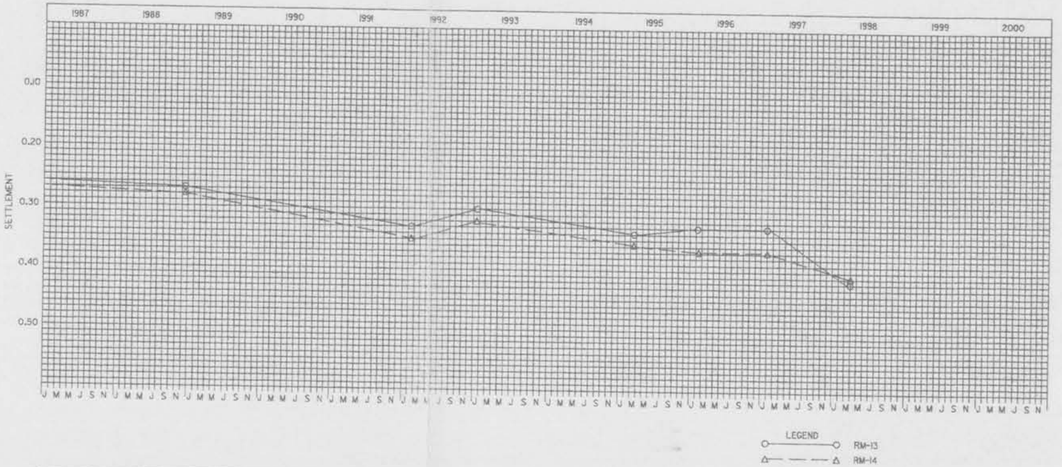
SETTLEMENT AND REFERENCE MARKS
DIFFERENTIAL'S MOVEMENT

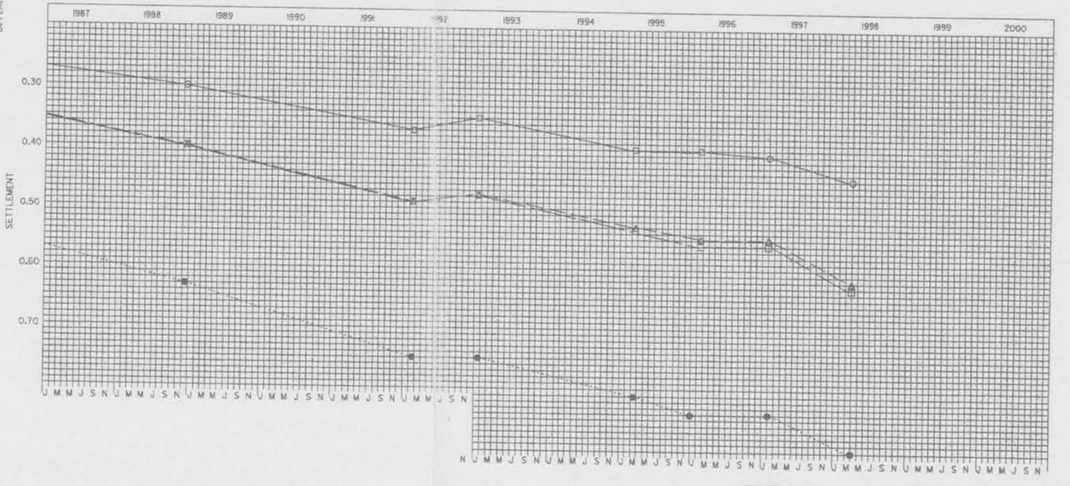
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PLATE 3









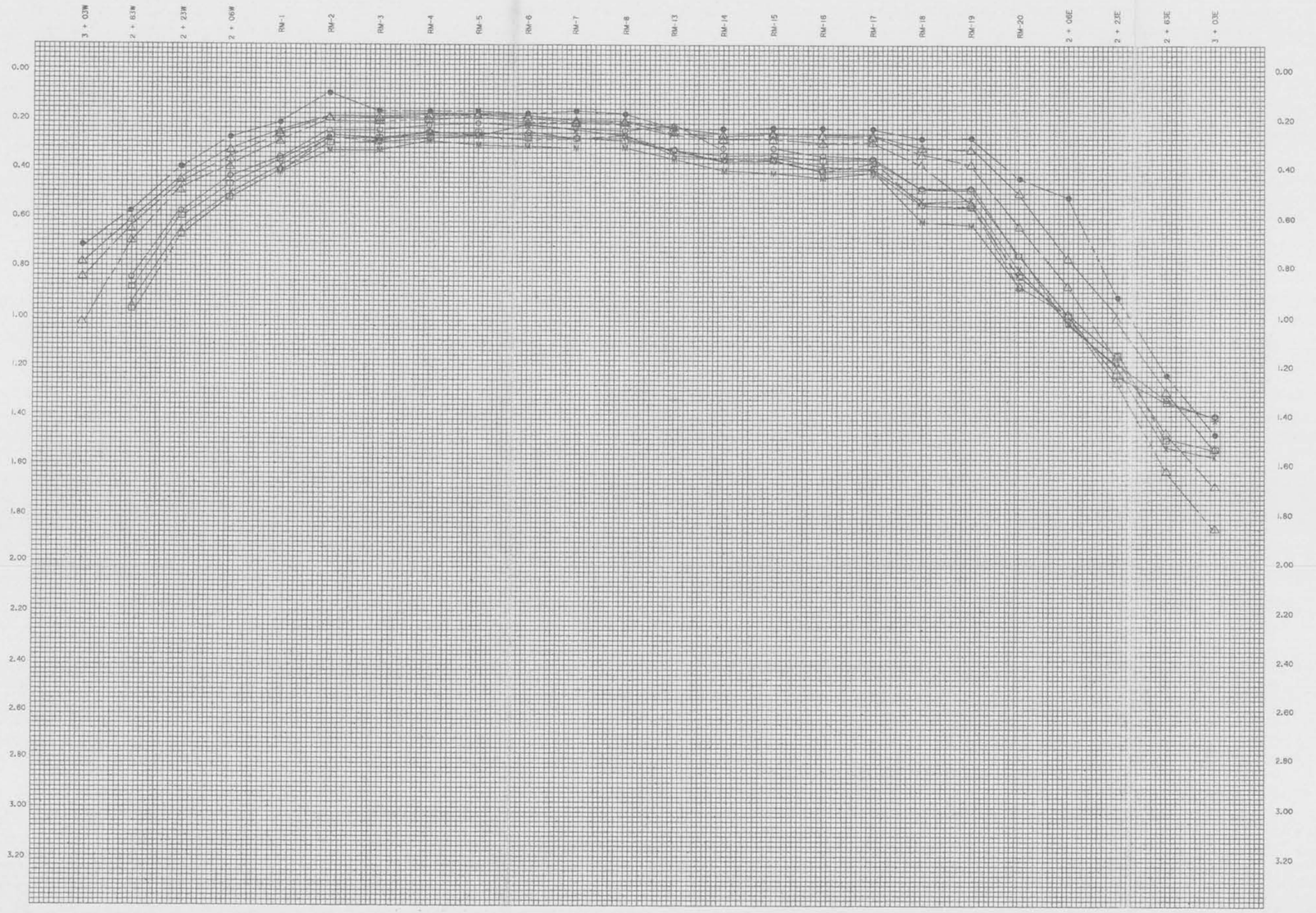
NOTE: ALL POINTS PLOTTED AFTER 1979 ARE USING THE EQUATION (R-R1-15) = DIFF.; SEE TABULATION CHART FOR FURTHER INFORMATION.

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

SETTLEMENT AND REFERENCE MARKS
DIFFERENTIAL'S MOVEMENT

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

PLATE 4



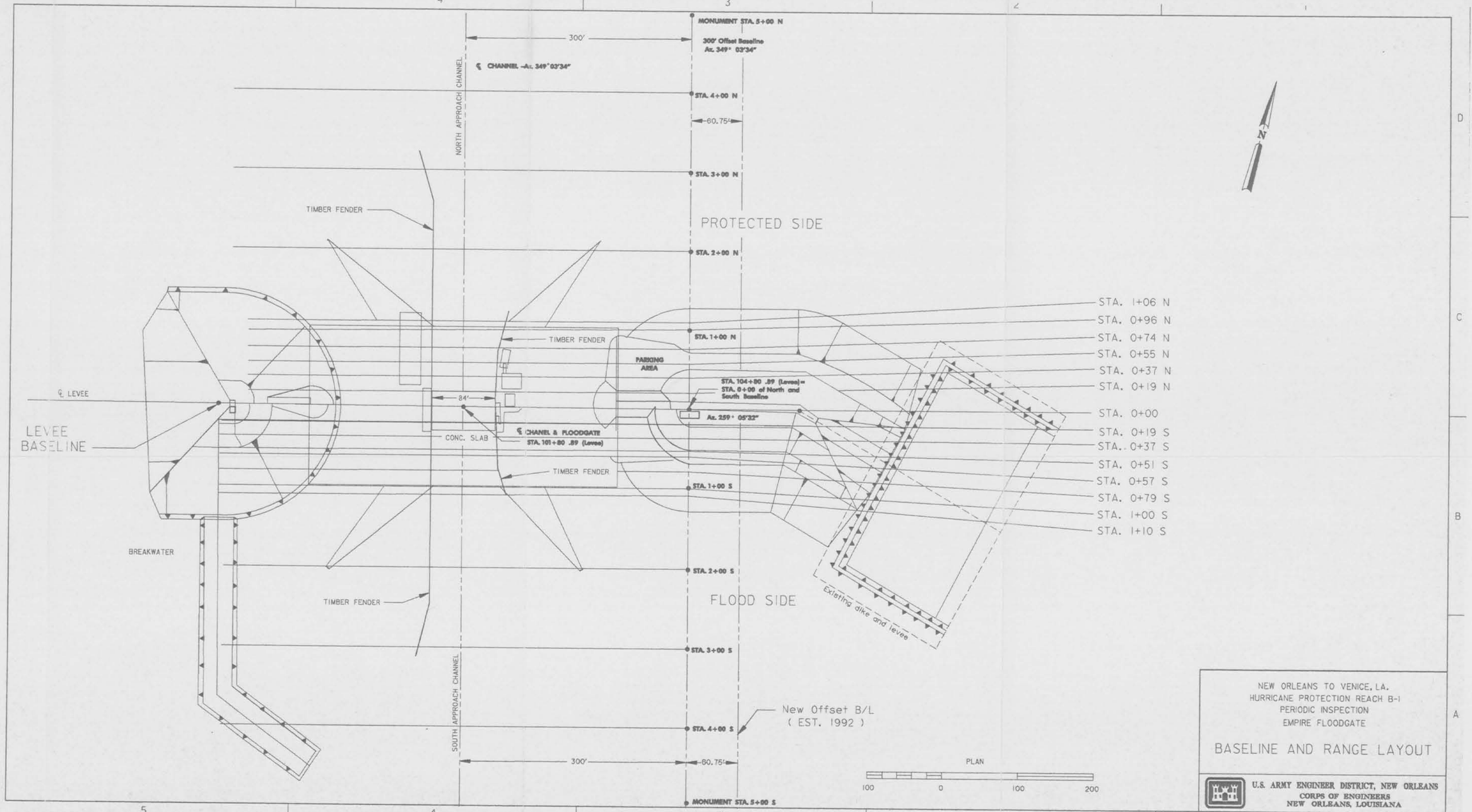
LEGEND

MAR 1984	●—●—●
NOV 1984	△—△—△
JUL 1986	△—△—△
DEC 1988	△—△—△
FEB 1992	□—□—□
JAN 1993	○—○—○
MAR 1995	×—×—×
FEB 1996	□—□—□
JAN 1997	○—○—○
MAR 1998	M—M—M

NEW ORLEANS TO VENICE, LA
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

REFERENCE MARKS DIFFERENTIAL CHART

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

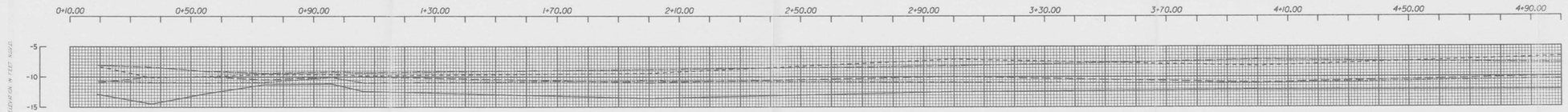


NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

BASELINE AND RANGE LAYOUT

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

PLATE EMP-6



NOTES:
SECTION PLOTTED LOOKING NORTH
PROFILE OFFSET 300'

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH 9-I
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
PROFILE SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 7

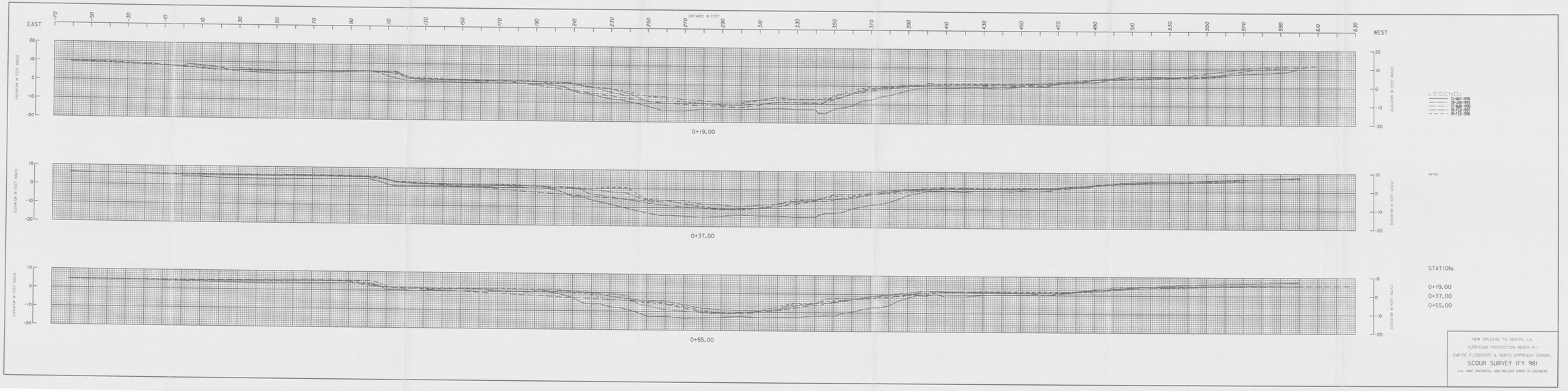

EAST
WEST
DISTANCE IN FEET
ELEVATION IN FEET NGVD
0+19.00
0+37.00
0+55.00
LEGEND:
21-MAY-1998
27-APR-1998
17-MAR-1998
05-FEB-1997
05-FEB-1996
NOTES:
STATIONS
0+19.00
0+37.00
0+55.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 8

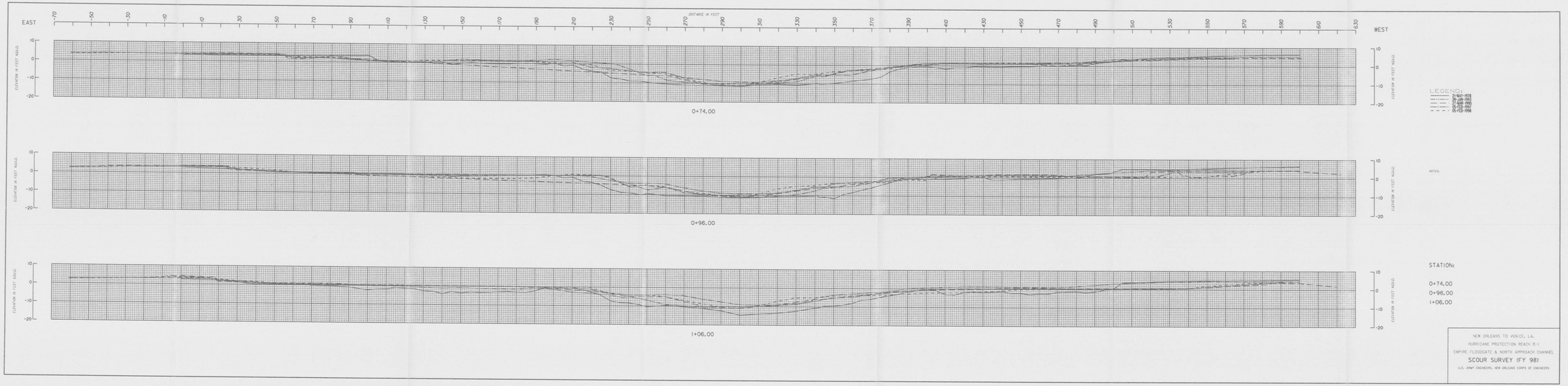

EAST
WEST
DISTANCE IN FEET
ELEVATION IN FEET NGVD
0+74.00
0+96.00
1+06.00
LEGEND:
21-NOV-1978
09-JAN-1985
17-MAR-1995
05-FEB-1997
20-FEB-1998
NOTES:
STATION:
0+74.00
0+96.00
1+06.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 9

LEGEND:

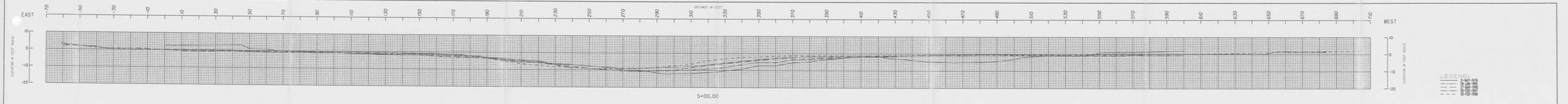
21-MAY-1976
26-JAN-1993
27-MAR-1995
05-FEB-1997
05-FEB-1998

NOTES:

STATION:

2+00.00
3+00.00
4+00.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS



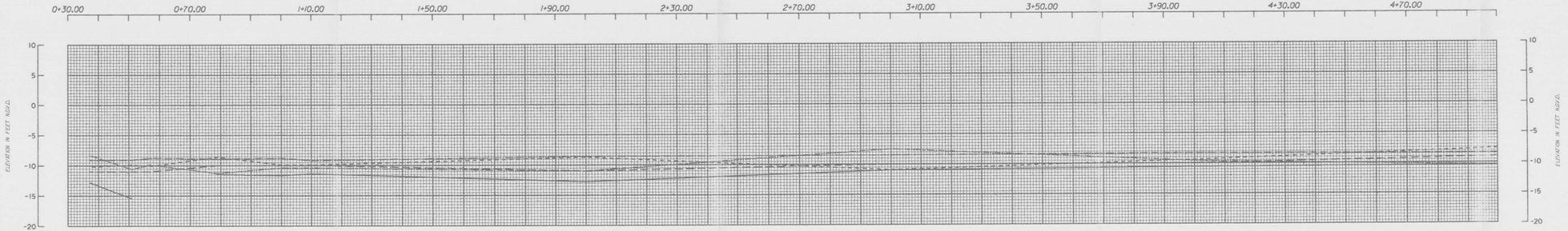
NOTES:

STATION:

5+00.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION (REACH B-1)
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 11



LEGEND:
- 21-MAY-1978
- 26-JAN-1993
- 27-MAR-1995
- 05-FEB-1997
- 19-MAY-1998

NOTES:
SECTIONS PLOTTED LOOKING SOUTH
PROFILE OFFSET 300'

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
PROFILE SURVEY (FY 98)
U.S ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 12

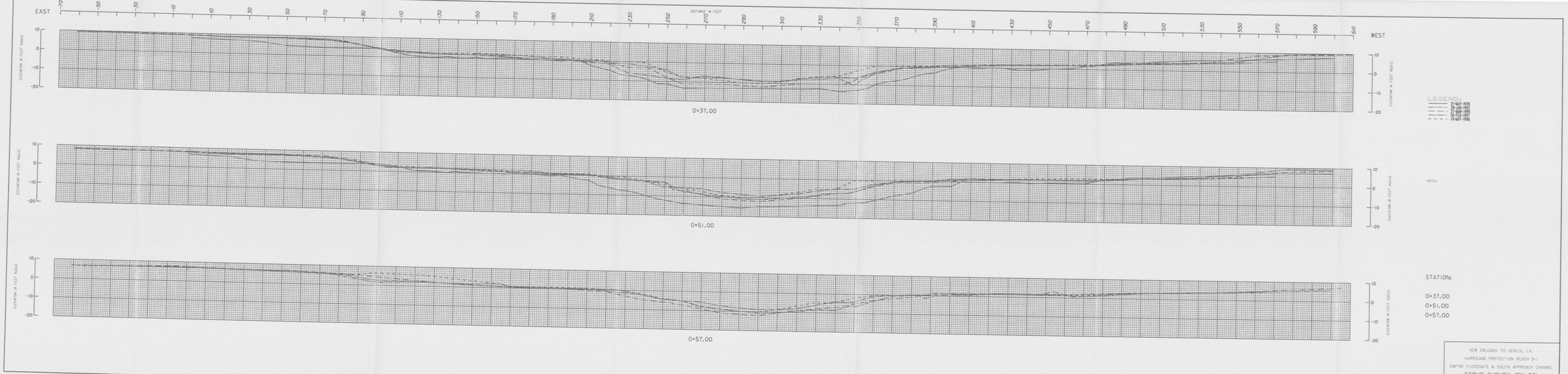

EAST
WEST
DISTANCE IN FEET
ELEVATION IN FEET NGVD
0+37.00
0+51.00
0+57.00
LEGEND
NOTES:
STATION:
0+37.00
0+51.00
0+57.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 13

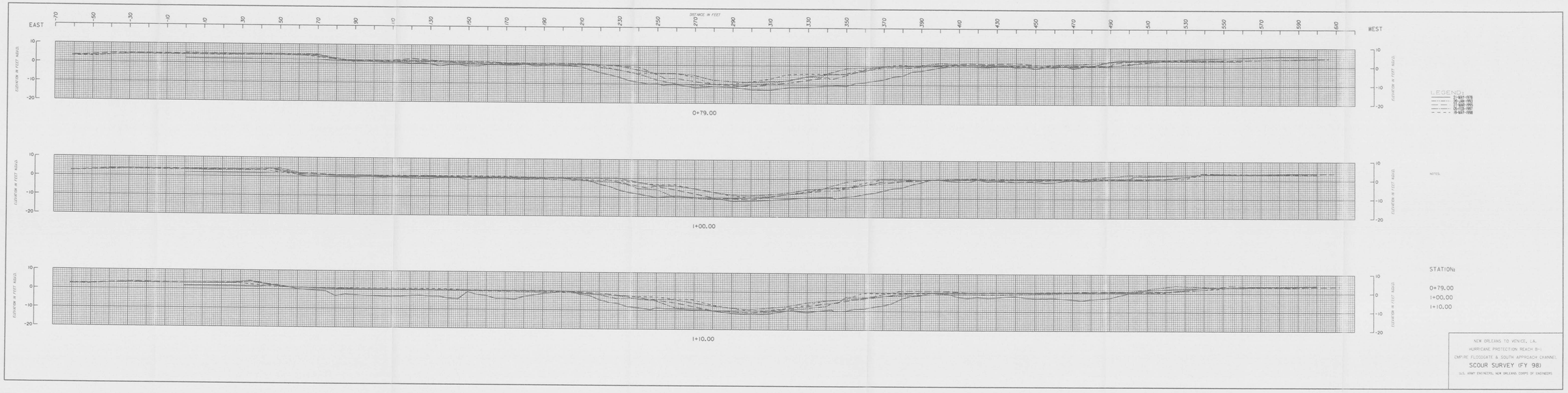

EAST
WEST
DISTANCE IN FEET
-70 -50 -30 -10 10 30 50 70 90 110 130 150 170 190 210 230 250 270 290 310 330 350 370 390 410 430 450 470 490 510 530 550 570 590 610
ELEVATION IN FEET NGVD
10
0
-10
-20
0+79.00
1+00.00
1+10.00
LEGEND:
7-MAY-1978
27-JAN-1993
12-MAR-1993
15-JUN-1993
29-SEP-1998
NOTES:
STATIONS
0+79.00
1+00.00
1+10.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS DISTRICT CORPS OF ENGINEERS

PLATE 14

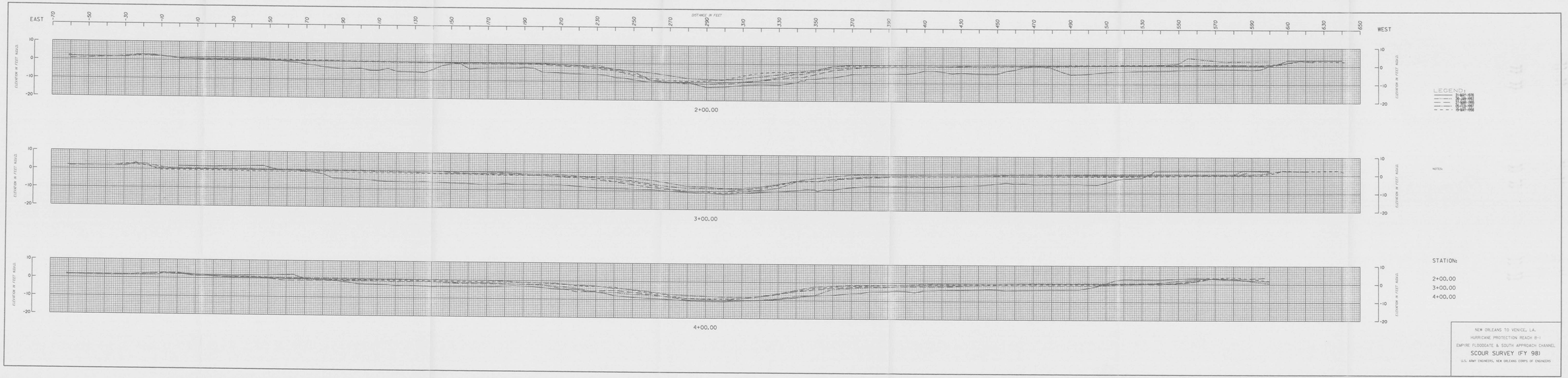
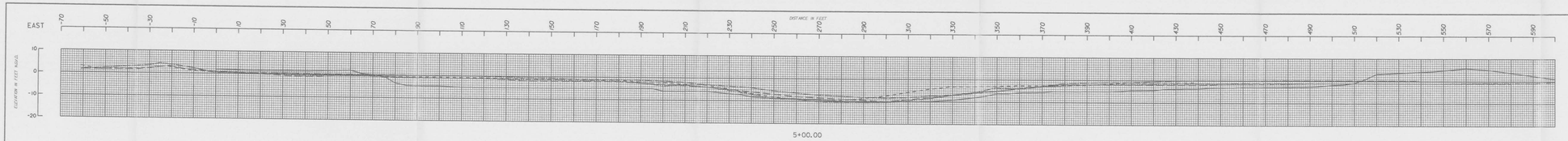

EAST
WEST
DISTANCE IN FEET
ELEVATION IN FEET NGVD
2+00.00
3+00.00
4+00.00
LEGEND:
NOTES:
STATION:
2+00.00
3+00.00
4+00.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 15



LEGEND:

- 21-MAY-1978
- 26-JAN-1981
- 21-MAR-1990
- 20-FEB-1992
- 19-MAY-1998

NOTES:

STATION:

5+00.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 98)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 16

APPENDIX A

MRC TRIP REPORT

CEMVD-ET-ES

8 April 1999

MEMORANDUM FOR RECORD

SUBJECT: Trip Report, Periodic Inspection No. 9, Empire Floodgate, Plaquemines Parish Louisiana, New Orleans District

1. On 23 March 1999, the undersigned participated in the ninth periodic inspection of the Empire Floodgate with representatives of the New Orleans District, the Plaquemines Parish Commission Council (local sponsor), the Louisiana Department of Transportation and Development (LDOTD), and the Architect-Engineer firm of Brown Cunningham & Gannuch which was contracted to conduct this inspection. Personnel participating in the inspection are listed in enclosure 1.

2. Purpose. This inspection was made in accordance with the provisions of ER 1110-2-100, Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures, 15 February 1995. The structure was not dewatered for the inspection.

3. Description of Project. The Empire Floodgate is part of the New Orleans to Venice, LA, Hurricane Protection levee system, which serves to protect the general area from hurricane tidal overflows. During times of hurricanes, the floodgate is raised to provide a closure across the waterway from Empire, LA, to the Gulf of Mexico. It also provides an avenue of drainage to the Gulf, for an area of about 365 acres inclosed by hurricane protection levees and Mississippi River Levees, and allows water traffic to proceed normally along the waterway from Empire, LA, to the Gulf of Mexico.

4. Description of Structure. The Empire Floodgate structure consists of a reinforced concrete gate bay, supported on prestressed concrete piles, timber guide walls, pile supported inverted "T" type reinforced concrete flood walls, and an uncapped cantilevered steel sheet pile wall, connecting the "T" type flood walls to the earthen levee on each side. The gate bay is 109 ft in length and has a channel width of 84 ft. The floodgate is a bottom hinged single-leaf flap gate, which in the open position, rests in a recess in the base slab of the structure. For a more detailed description of the various components of the project, you are referred to the preinspection brochure.

5. Observations and Recommendations. Due to the large number of discrepancies found at the last inspection (January 1996), many of the following comments are in a "before and after" format in order to demonstrate the improvements made at this structure in the last three years. At the last periodic inspection in January of 1996, it was observed that although the floodgate was operable, there appeared to be a general lack of day to day "housekeeping" which is necessary for the overall upkeep of the structure. This was noted in the trip report for that inspection and documented in the inspection report. At this inspection it was obvious that a considerable amount of maintenance work had been done since the last inspection. It is apparent that the officials of Plaquemine Parish are aware of the importance of this structure in their hurricane protection system and are willing to do whatever is necessary to keep this facility in a high state of readiness. They are to be commended for their efforts.

a. Flood Walls. The exposed steel sheet pile wall has been painted with coal tar epoxy and the rubber waterstops at the connection between the sheet pile wall and the concrete "T" Wall has

been replaced and realigned with no visible gaps. The sheetpile wall is now considered to be in excellent condition. No major discrepancies were noted on any of the floodwalls.

b. Bottom Hinged Flap Gate.

(1) Condition of Flap Gate. At the last inspection, the flood gate was not operated throughout it's full closing and opening cycle. In fact, the gate never broke the surface of the water, and was not inspected. During this inspection the gate was raised to the fully closed position and maintenance personnel walked out on the upright gate along the main plate girder and pumped grease through the grease fittings located on top of the girder, to the hinges at the bottom of the gate. The flap gate appeared to be in satisfactory condition, except for the very top of the gate which had extensive localized damage to the structural channel member at the top. The structural channel is the part of the gate that gets hit by deep draft vessels as they come through the gate monolith. This member has been damaged and repaired, many times in the past. The damage does not affect the overall structural integrity of the flap gate, or it's operation, and will be repaired when the structure is dewatered, which is scheduled for 2001.

(2) Hoist and Counterweight Chains. In the past, it has been reported that when lifting the gate, both hoist chains will sometimes slip one, or sometimes two links at a time, on the hoist wildcat. We did not observe any links of the hoist chain slipping during this inspection. During the lifting of the gate at the last inspection, both the hoist chain links, and the counterweight links made very loud popping sounds during the short lifting operation that was conducted. It was concluded at that time that this was a result of the total absence of lubrication on the chains, i.e., all of the chains were extremely rusty. Since that time, the chains have apparently been periodically lubricated, judging from their black color, and there were only a few minor popping sounds from the chains as the gate was lifted. Operating personnel should continue to lubricate the chains on a regular basis.

(3) Counterweights. At the last inspection the counterweights were observed to be hanging free in the counterweight wells, rather that attached to the ratchet jacks located over the counterweight wells. The original design of the length of the counterweight chains allowed the counterweights to rise to the top of the well when the gate was fully lowered, thereby positioning the counterweights within easy reach of the ratchet jacks. Over the years, the length of the counterweight chains has been altered as a result of other operational problems. Consequently, the counterweight is now several feet below the ratchet jacks. Site personnel informed us that due to the approximate 40 kip weight of each counterweight, and the stiffness of the ratchet screw, it was extremely difficult to ratchet the counterweights up a sufficient amount to assure a slack-chain condition. Consequently, the counterweights were always left in the free-hanging position. Since the last inspection, the local sponsor has installed a powered, hydraulic jack device at each counterweight well, for use in raising the counterweights up for attachment to the ratchet jacks. This new hardware will assure that the counterweights are properly secured during periods of gate inactivity.

(4) Gate-Stop Devices. At the last inspection, the gate stop on the east side of the structure was found to be inoperable due to lack of maintenance, and the entire gate stop assembly (ram and electric motor) on the west side of the structure was missing. The function of the two gate stops is to provide a positive means of holding the gate in the closed position while the structure is unmanned during passage of a hurricane. Since the last inspection, both gate stops have been rehabilitated, and are now in good working order.

c. Pump House Platform. The underside of the pump house platform was inspected from a boat. The platform is generally in good condition. However, a detailed inspection of the 16"x16" prestressed concrete support piles revealed vertical cracks near the corners of several of the piles. The cracks were typically about four inches from the corner of the piles, and running vertically up the pile. A crack was also observed in one of the canal side, horizontal beams (see enclosure 2 for locations of typical cracks). Most of the cracks were about equal to the thickness of the blade of a pocket knife, however the opening of one of the cracks was approximately 1/8 inch wide. The cracks did not appear to be fresh, although considering exposure to the elements, along with barnacles, moss, etc., a fairly recent crack of a few months in age, could look virtually the same as a crack several years old. The cracks did not appear to have caused any structural distress to the platform and there did not appear to be an obvious explanation for the cause of the cracks. The pump platform is not heavily loaded, vibrations from the pump engine are minor and the pump is operated only occasionally, for short periods of time. The cracks should be cleaned and repaired to prevent corrosion of the reinforcing steel and possible spalls. Recommendations for a method of performing the repair will be included in the inspection report.

d. Structure Lighting. It was noted at the last inspection that the original flood side light poles on the east and west side of the structure were missing, and the two "add-on" light poles on each side of the structure in the vicinity of the hoist machinery area, appeared to be somewhat unstable. Since that inspection the light poles on both sides of the structure have been rehabilitated. As a result of operational experience at the structure, the Gulf Side poles on each side of the structure have been repositioned to a location near the gate hoist machinery so that they will give more light in that area, and will also be less susceptible to damage by overhanging equipment on marine vessels. The protective glass globes for the two lights on the east side of the structure were broken recently, however, the light bulbs still work. The globes will be replaced by operating personnel.

e. Embedded Metals. Wall armor and corner protection plates in the splash zone was observed to be severely corroded at the last inspection. Since then, these items have been sandblasted and painted, and appear to be in good condition.

f. Needle Girder Storage Rack.

(1) The concrete storage rack for the needle girders, concrete needles, and related hardware are still in satisfactory condition, and it appeared that most, if not all of the 12" x 12" treated timbers used as spacers between the stacked items on the rack have been replaced.

(2) The paint job on the steel needle girders and steel needle girder supports is considered satisfactory. The former accumulation of soil and other debris that had collected on the top surface of the steel members has been removed.

(3) The underside of the concrete storage rack was inspected by boat. No discrepancies in the concrete were found.

g. Riprap. In general the riprap protection appeared satisfactory, however, one area that is still deficient is the southeast leg of the breakwater dike, on the flood side of the structure. The design elevation of the top of the dike is 3.0 ft. NGVD. The stage reading at the time of the inspection was 1.3 NGVD. The top of the breakwater appeared to be just underwater. This would be a deficiency of approximately 1.7 feet of riprap. The District should ensure the breakwater is restored to grade, since it's function is to reduce the intensity of the design hurricane wave on the floodgate by causing it to break on the breakwater. This hydraulic effect is dependant on the full length and height of the breakwater being in place as originally designed. The breakwater is also intended to produce a somewhat quietened area in the vicinity of the floodgate during hurricane closing operations, thereby reducing the possibility of gate slamming caused by hurricane waves, which would cause undue stress on the gate operating machinery. Repair of this item could easily be performed at any time by contract or hired labor forces, and does not have to wait for dewatering of the structure.

h. Landside Boat Dock. The boat dock has been completely repaired since the last inspection and appeared to be in excellent condition.

i. Miscellaneous.

(1) The access ladder on the east side of the pump platform has been repaired.

(2) All of the required hand railing safety chains were in place and were painted yellow for visibility.

6. General Comments. Some of the participants at the subject inspection were first time visitors to the site, and had never seen the gate operate, nor did they have the benefit of knowing some of the operational history of the structure and the original assumptions that were made in the planning and design of the project, some 30+ years ago. Consequently, the concept of the bottom hinged flap gate and the decision to use that type gate, along with the somewhat cramped layout of the equipment on the main deck, was the subject of considerable discussion during the inspection. The following are some of the observations that were made during the inspection, along with an explanation as to why some of these apparent "discrepancies" exist. These comments are included for informational purposes only.

a. It was pointed out by some of the visiting members of the inspection party, that there does not appear to be any backup plan for lifting the gate, in the event it cannot be raised as

designed, when a hurricane is approaching. This is a valid concern, however, during the early stages of the design of the project, it was assumed that if the gate could not be raised in the conventional manner, that a large crane or derrick barge would be brought in to lift the gate from the land side. In reality, this approach would leave very little time to procure a rig large enough to lift the 100 ton gate (80+ tons fully submerged), with the accumulated layer of silt (about 190 tons). Lifting equipment of this capacity would probably have long since been docked and battened down for the storm. Needless to say the operating crew for that type equipment would also have left the area. It is further unlikely that such a rig could be brought in to the area at all, since the Empire Lock is very narrow, and a rig of the capacity needed, may not be able to pass through the lock. Consequently, there is still no backup plan for emergency lifting of the gate.

b. It was also, observed that there is no backup for the pumping system used to break the suction that may be present under the gate, just before lifting begins. Although the hoist machinery is designed to lift the gate, plus the full load of silt, the design assumes the suction forces would have been dissipated by the pumping action. It probably would not be advisable to attempt to lift the gate without first breaking the suction, especially as the facility increases in age. Of course in an extreme emergency, i.e., no backup system available, the gate operator would have no choice but to proceed with the lifting operation. If a feasible backup system is eventually devised, e.g., a barge mounted facility of some sort, it would require that prior alterations to the structure be made to readily accept the connection to the backup system. When the tide is rising, there is no time to design a retrofit system of hoses, pipes, etc.

c. Another observation by one of the visiting members of the inspection party was that there is no way to dewater the structure with the flap gate in the down position. The existing needle girder slots are located, such that the gate must be in the fully raised position in order for dewatering to proceed. This fact was known during the detailed design phase of the project, and the problem was given some study at that time. However, since several other significant design changes had already been made, which resulted in increased costs, and delays in the schedule, the structural changes necessary to accomplish dewatering in the desired manner were not pursued further. Those changes would have effectively required that the project go "back to the drawing board." The decision by those in charge at that time was to proceed with the project as it was.

d. The three items discussed above are considered valid issues, and since it is reasonable to expect that the bottom hinged flapgate currently in place will likely remain there for the foreseeable future, these issues will have to eventually be addressed. As a point of interest, the National Weather Service has already predicted that the coming hurricane season for 1999 is expected to be at least as active as the 1998 season was (that season, as you will recall, set a record for the number of hurricanes in one season).

7. Action. No immediate action required by the Division Commander at this time. Those deficiencies requiring action should be corrected as described above. CEMVN will document the

CEMVD-ET-ES 8 April 1999
SUBJECT: Trip Report, Periodic Inspection No. 9, Empire Floodgate, Plaquemines Parish Louisiana, New Orleans District

findings of this inspection in a report, for submission to this office. A copy of the report will be furnished to Plaquemine Parish and the State of Louisiana (LDOTD), with a letter recommending action be taken to correct those deficiencies for which they are responsible.

8. Next Inspection. The next periodic inspection of this structure will be in March of 2002.

2 Encls
as

Frank N. Johnson
Structural Engineer

ROUTING:

CEMVD-ET-ES
CEMVD-ET-ET (Mr. Madison)
CEMVD-ET-ET (Mr. Rush)
CEMVD-ET-EG
CEMVD-ET-EW
CEMVD-ET-C
CEMVD-ET-E
CEMVD-ET-EG (Mr. Stagg)

CF w/encl
CEMVN-ED-GE (Mr. Chryssoverges)

List of Attendees

Empire Floodgate
Periodic Inspection No. 9

23 March 1999

Mississippi Valley Division Office

Frank N. Johnson	Structures Branch, Engineering Division

New Orleans District

Paul Salassi	General Engineering Branch
Joseph Chryssoverges	General Engineering Branch
Greg Breerwood	Operations Division
Brian Keller	Operations Division
Amy Powell	Operations Division

Brown Cunningham & Gannuch, Inc.

Luther Newton	Project Engineer
Robert White	Mechanical Engineer
Robert Yokum	Structural Engineer
Mel Stegall	Geotechnical Engineer
Kenneth McLaughlin	Electrical Engineer

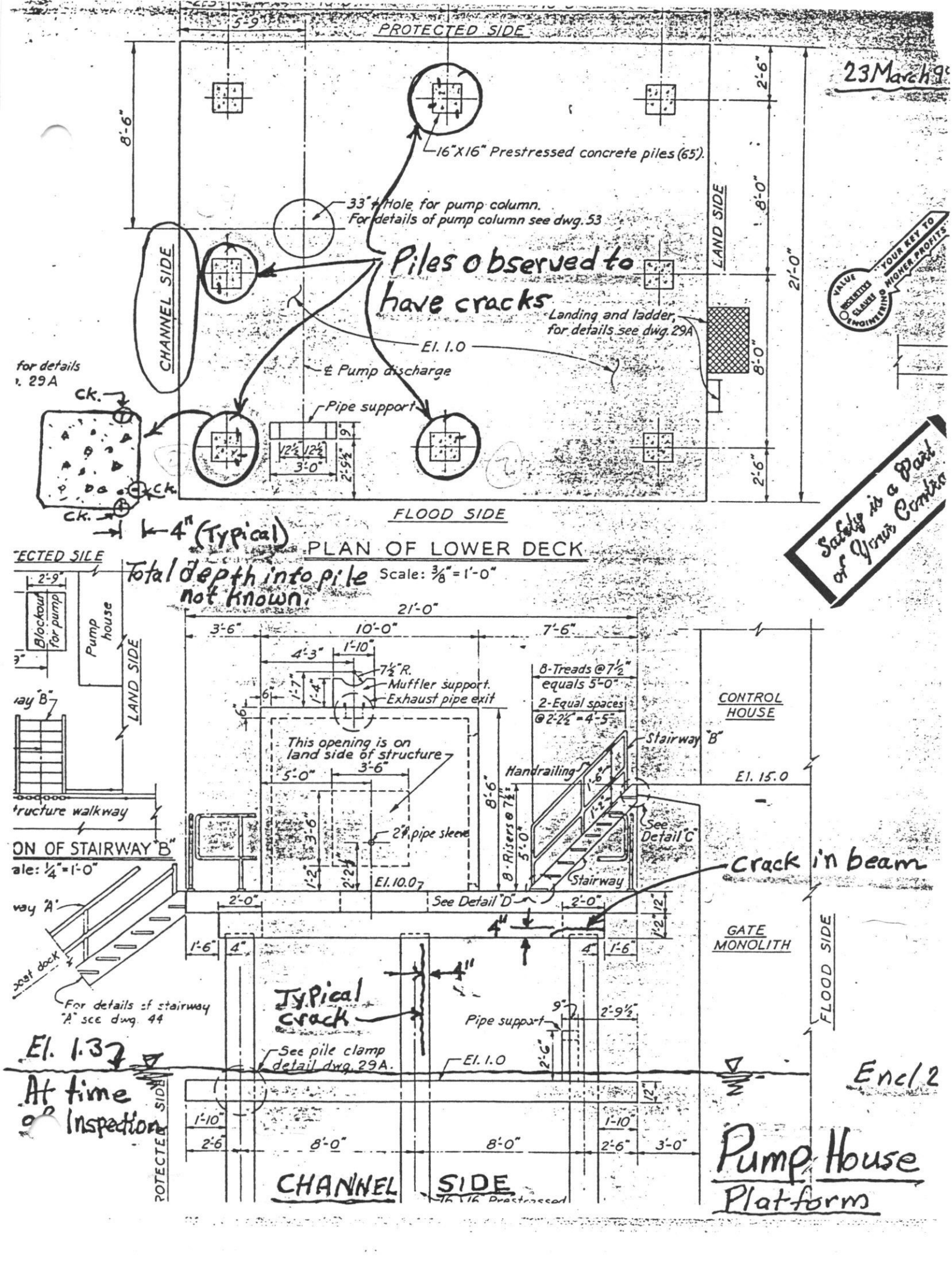
Plaquemines Parish

Henry Urban	Field Foreman
Ruben Victory	Floodgate Operator
K.P. Madere	Plaquemines Parish Heavy Equipment Operator

State of Louisiana (LDOTD)

Geneva Grille	District 02 Design Engineer
John Monzon	District 02 Design Engineer

Encl 1


23 March 9
PROTECTED SIDE
5'-9"
8'-6"
16"X16" Prestressed concrete piles (65').
33" ϕ Hole for pump column.
For details of pump column see dwg. 53
Piles observed to have cracks
CHANNEL SIDE
LAND SIDE
2'-6"
8'-0"
21'-0"
Landing and ladder, for details see dwg. 29A
El. 1.0
℄ Pump discharge
Pipe support
3'-0"
2'-9½"
Ck.
4" (Typical)
FLOOD SIDE
PLAN OF LOWER DECK
Scale: 3/8" = 1'-0"
Total depth into pile not known.
2'-9"
Blockout for pump
Pump house
21'-0"
3'-6"
10'-0"
7'-6"
4'-3"
1'-10"
7½" R.
Muffler support.
Exhaust pipe exit
8-Treads @ 7½" equals 5'-0"
2-Equal spaces @ 2'-2½" = 4'-5"
CONTROL HOUSE
This opening is on land side of structure
5'-0"
3'-6"
Stairway "B"
Handrailing
El. 15.0
8'-6"
8-Risers @ 7½"
5'-0"
See Detail "C"
2" ϕ pipe sleeve
El. 10.07
Stairway
See Detail "D"
2'-0"
Crack in beam
4"
GATE MONOLITH
FLOOD SIDE
1'-6"
Typical crack
Pipe support
9"
2'-9½"
2'-6"
See pile clamp detail dwg. 29A.
El. 1.0
El. 1.37
At time of Inspection
Encl 2
1'-10"
2'-6"
8'-0"
8'-0"
3'-0"
CHANNEL SIDE
Pump House Platform
Safety is a Part of Your Contract
VALUE ENGINEERING CLAUSE
YOUR KEY TO HIGHER PROFITS
for details see 29A
Ck.
Ck.
Ck.
Ck.
PROTECTED SIDE
Total depth into pile not known.
Pump house
Blockout for pump
LAND SIDE
way "B"
structure walkway
ON OF STAIRWAY "B"
ale: ¼" = 1'-0"
way "A"
coast dock
For details of stairway "A" see dwg. 44

APPENDIX B

REPORT OF SUPPLEMENTAL INSPECTION
OF
PUMP PLATFORM
30 AUGUST 1999 THRU 2 SEPTEMBER 1999

APPENDIX B
TO
EMPIRE FLOODGATE
PERIODIC INSPECTION REPORT NO. 9
TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

1-01. Background. During Empire Floodgate Periodic Inspection No. 9, 23 March 1999, significant structural cracking was noted in the visible (above water) portions of four of the eight pump platform support piles, and structural cracks in the western north/south upper deck perimeter support beam. As a result, Modification No. 1 to Task Order No.6, Contract DACW29-97-D-0021, was issued to Brown, Cunningham & Gannuch, Inc. (BCG) to:

a. Perform a detailed inspection of all eight piles, upper and lower deck (portion adjacent to piles), and the lower deck pile clamp assemblies to determine the extent of damage to the pump platform.

b. Document and evaluate the inspection findings for inclusion as an appendix to Periodic Inspection Report No. 9.

c. Recommend repair methods to permanently restore the damaged piles and beams and decks. Prepare estimates of costs and schedules of repairs. These are also to be included in the appendix to Periodic Inspection Report No. 9.

SECTION II - INSPECTION

2-01. Inspection Team. The inspection team consisted of Mr. Luther Newton, Project Engineer and Mr. Robert Yokum, Structural Engineer, of Brown, Cunningham & Gannuch, Inc. (BCG). A Corps of Engineers dive team from Vicksburg District, headed by Mr. Jimmy Coldiron, performed pressure washer cleaning of areas to be inspected, and performed the underwater video inspection of the underwater portions of the piles and the upper surface of the lower deck adjacent to the piles. Plaquemines Parish furnished water (using a tanker truck) for both cleaning and the "clear-box" utilized for the underwater inspection, and personnel to control the speed of marine traffic through the floodgate during diving operations, and personnel for site security.

2-02. Inspection Sequence. The Corps diving team mobilized on Monday, 30 August 1999. On 31 August 1999, Corps diving team personnel cleaned areas above water to be inspected, the top of the lower deck (underwater) and the portions of the piles above the lower deck that were underwater, and began cleaning piles (underwater) from the bottom of the lower deck to the mud line. Pressure washer cleaning of the underwater areas was supplemented with cleaning using a pneumatic grinder as necessary. On 1 September 1999, Messrs. Newton and Yokum, BCG, arrived on site and performed a "crack survey" and noted any other damage to the piling (above water), the upper deck support beams and underside of the upper deck. The Corps diving team completed cleaning of the piling from the underside of the lower deck to the mud line. On 2 September 1999, video inspection of underwater portions of the piling and the top side of the upper deck was performed. The lower deck pile clamp connections could not be seen. A "clear box" video camera (furnished by Speciality Diving, Inc. of Hammond, LA) was utilized for the underwater video inspection.

Specialty Diving also furnished one of their employees to assist in coaching the Corps diving team in the use of the "clear box" video camera, and assist Messrs. Newton and Coldiron in interpreting views shown on the video monitor. The video monitor was constantly observed by Mr. Newton during the video inspection of the various structural elements. The inspection was concluded on 2 September 1999, and the diving team de-mobilized on 3 September 1999.

SECTION III - FINDINGS

3-01. General. The findings are divided in subsequent paragraphs by structural features, i.e., top deck bottom side, lower deck top side, top deck support beams, and piling. For orientation the piling are numbered and areas A and B denoted on the Crack Survey plan sheet at the beginning of SECTION IV - CRACK SURVEYS, which contains plots of damages noted. SECTION V - PHOTOGRAPHS pictorially depicts damages noted.

3-02. Top Deck Bottom Side.

a. Overhangs.

(1) West Overhang. On the west overhang, generally north/south cracks were noted at both ends, in the area of the drip strip. Exposed reinforcing supports (chairs) were noted along these cracks. A spall was noted at the south end of the drip strip. See Photo Nos. 39 and 40 and page 4-1.

(2) South Overhang. There is a crack extending northerly across the overhang from the outside corner of the north/south and east/west deck support beams. See Photo No. 41. There is also a small spall opposite the middle north/south beam and an exposed reinforcing bar about 4 feet east of the west edge of the deck west overhang. See page 4-1.

(3) North Overhang. There is a long (3-foot ±) narrow spall at the drip strip, and throughout the western half scattered exposed reinforcing supports. See Photo No. 42 and page 4-1.

(4) East Overhang. No defects were noted in the east overhang. See page 4-1.

b. Area A. Only two exposed reinforcing supports (chairs) and a drilled hole through the deck slab were noted. See page 4-1.

c. Area B. There is a crack and an exposed reinforcement bar adjacent to the western edge of the pump column blockout. See Photo No. 45. Exposed reinforcing, with shallow spalling contiguous thereto and small cracks were noted in the area north of the pump recess. See Photo Nos. 44 and 46. South of the pump recess a small crack, a spall adjacent to a reinforcing bar (barely visible), an exposed reinforcing bar with a spalling area at its south end, and immediately south of that a patch over the reinforcing bar, and several scattered exposed reinforcing supports were noted. See Photo Nos. 47 and 48. Also see page 4-1.

3-03. Top Deck Support Beams.

a. North/South Beam, West. On the south end of the beam the bottom/west corner of the beam is cracked and spalled. During this inspection a part of the spalled area was easily removed by prying with a scraping hoe. In this area a reinforcing bar is exposed. See Photo No. 40. On the bottom face, a "forked" crack extends south about 2-feet from the south face of pile no. 5, and north of the north face of pile no. 5 are some exposed corroded metals, which appear to be nails, or wire. No other defects were noted. See page 4-3.

b. North/South Beam, East. On the bottom face there is a small crack around the perimeter of small patch at the southeast corner of pile no. 4, and a small popout and an exposed corroded piece of nail or wire, both north of the north face of pile no. 4, and an exposed corroded piece of nail wire north of pile no. 1. No defects were noted on the east and west faces. See page 4-4.

c. North/South Beam, Middle. No defects were noted on this beam. See page 4-5.

d. East/West Beam, North. On the bottom face, a small crack was noted running generally northeast from the northeast corner of pile no. 8, an exposed reinforcement support chair was noted about 4-feet west of pile no. 7, a popout (about 1" in diameter) about 2.5-feet east of pile no. 7, and an exposed nail (or wire) was noted adjacent to the south face of pile no. 6. No defects were noted on the north or south faces. See page 4-6.

e. East/West Beam, South. On the bottom face, there are a number of exposed reinforcement chairs and a nail beginning about a foot east of pile no. 3, two small cracks adjacent to the west face of pile no. 3, a hairline crack opposite the south end of the north/south middle beam, and an exposed nail adjacent to the north face of pile no. 1. On the south face two (one forked) cracks were noted on the west end. No cracks were noted on the north face. See page 4-7.

3-04. Lower Deck Top Side. Only one small (hairline) crack was noted. The crack is located on the top surface adjacent to the north face of Pile No. 4. See page 4-2. The lower deck pile clamp assemblies could not be observed. It appears that they were encapsulated in the lower deck concrete placement.

3-05. Piling.

a. Portion of piling from top deck to lower deck.

(1) Pile No. 1. A small (hairline) crack 9-inches $\pm$ in length was noted at the top of the north face, and a small (hairline) crack 8-inches $\pm$ in length was noted at the top of the east face. See Photo Nos. 1 and 2 and page 4-8. Patches at the top of the pile on the west, north and east faces were also noted. The patches were tightly adhered to the underlaying concrete and appeared in good condition. See page 4-8.

(2) Pile No. 2. A structurally significant vertical crack was noted on the west face near the southwest corner. See Photo No. 6 and page 4-9. The crack at its maximum width is open from 1/8 to 1/4 inch. On the south face three vertical cracks were noted. See Photo Nos. 3 and 4 and page 4-9. The longer of the cracks is slightly open at its maximum width (1/64 to 1/32 inch), the shorter cracks are hairline. Tightly adhering patches on the top of the pile were noted on all four faces. No cracks were noted on the east and north faces. See page 4-9.

(3) Pile No. 3. There are significant, open cracks on all faces. See Photo Nos. 9 through 19. The cracks are identified on the crack survey drawing for this pile. Patches on the top of the pile were noted on all four faces. The patches were tightly adhered to the underlaying concrete and appeared in good condition.

(4) Pile No. 4. No defects were noted on this pile.

(5) Pile No. 5. There were no cracks noted on the west face of the pile. See Photo No . 24. The cracks noted on the upper portion of the north face are hairline. See Photo No. 21. The crack in the lower portion close to the eastern side of the north face (northeast corner of pile) is wider than hairline and is a continuation of a crack on the east face. See Photo No. 22. On the east face, the crack near the north edge (northeast corner) of the pile at its maximum width is open 1/16-inch $\pm$. The crack which starts near the top of the pile toward the northeast corner of the pile, crosses diagonally to just south of the center of the pile and then runs vertically is hairline in width. The vertical crack near and generally parallel to the southeast corner of the pile at its maximum opening is 1/4$\pm$-inch in width. See Photo No. 28. Along this crack the southeast corner of the pile is displaced 1/4-inch out (east). On the south face, the crack generally parallel to and about 6-inches west of the

southeast corner of the pile is tight but has shallow spalling along its edge. The crack that starts at the southeast corner of the pile near the top of the pile and moves out to about 2-inches west of the southeast corner of the pile and then goes back to the southeastern corner is "tight" but near its midpoint is displaced out (south) ½-inch±. See Photos 25, 26, and 27.

(6) Pile No. 6. There were no cracks noted on this pile. Two patches at the top of the pile (one on the west face and one on the north face) were in good condition. See Photo No. 30.

(7) Pile No. 7. On the north face a slightly larger than hairline crack was noted near and generally parallel to the northwest corner of the pile. See Photo No. 31. On the west face there is a crack near and generally parallel to the southwest corner of the pile, which at its maximum width is open 3/8-inch ±. See Photo Nos. 32 and 33. On the south face, a crack originates at the southwest corner of the pile about 13-inches below the top of the pile, runs diagonally to about 3-inches east of the southwest corner of the pile, and then runs near vertically about 9-inches to its intersection with a second crack. This second crack begins at the southeast corner of the pile and runs irregularly horizontally and diagonally about 9-inches eastward and then generally vertically to about 12-inches above the lower deck. Two shorter cracks branch off this crack about half-way up the pile. Another crack, about 33-inches long runs generally parallel to and about 2 ½" from the southwest corner of the pile to about 12-inches above the lower deck. See Photo Nos. 34 and 35. On the east face there is a crack which begins about half-way down the pile and runs parallel to, and about 2-inches from the southeast corner of the pile to about 15-inches above the lower deck. See Photo No. 37. The patch at the top of the pile is in good condition.

(8) Pile No. 8. There are patches at the top of the pile on all four faces, and two small cracks at the top of the pile on the south and west faces. See Photo No. 38.

b. Portion of piling from lower deck to mudline.

(1) Pile Nos. 2, 3, 5, 7 and 8. These piles were inspected utilizing an underwater video camera. No damage was noted between the lower deck and the mudline, a distance of approximately 5 feet at Pile Nos. 3, 5, and 8 (closest to the channel) and 3 feet or less at piles 2 and 7.

(2) Pile Nos. 1, 4, and 6. Because of the configuration of the underwater camera, these piling could not be inspected with the underwater camera. The Corps dive team used the pressure washer to wash out small conical shaped holes in the silted material around the piles, but this did not provide enough horizontal clearance for the underwater video camera. Corps diving team personnel estimated an additional one or two days would be required to move enough of the silt to be able to video the top 1-1/2 to 2-feet of these piles immediately below the lower deck. Since only one of these piles has any cracks (Pile No. 1 has two very small cracks at its top), and none were within 6 feet of the lower deck, it was not considered economically justified to expend the extra effort required. The divers carefully inspected the areas accessibly to them by touch and reported no indication of any damage.

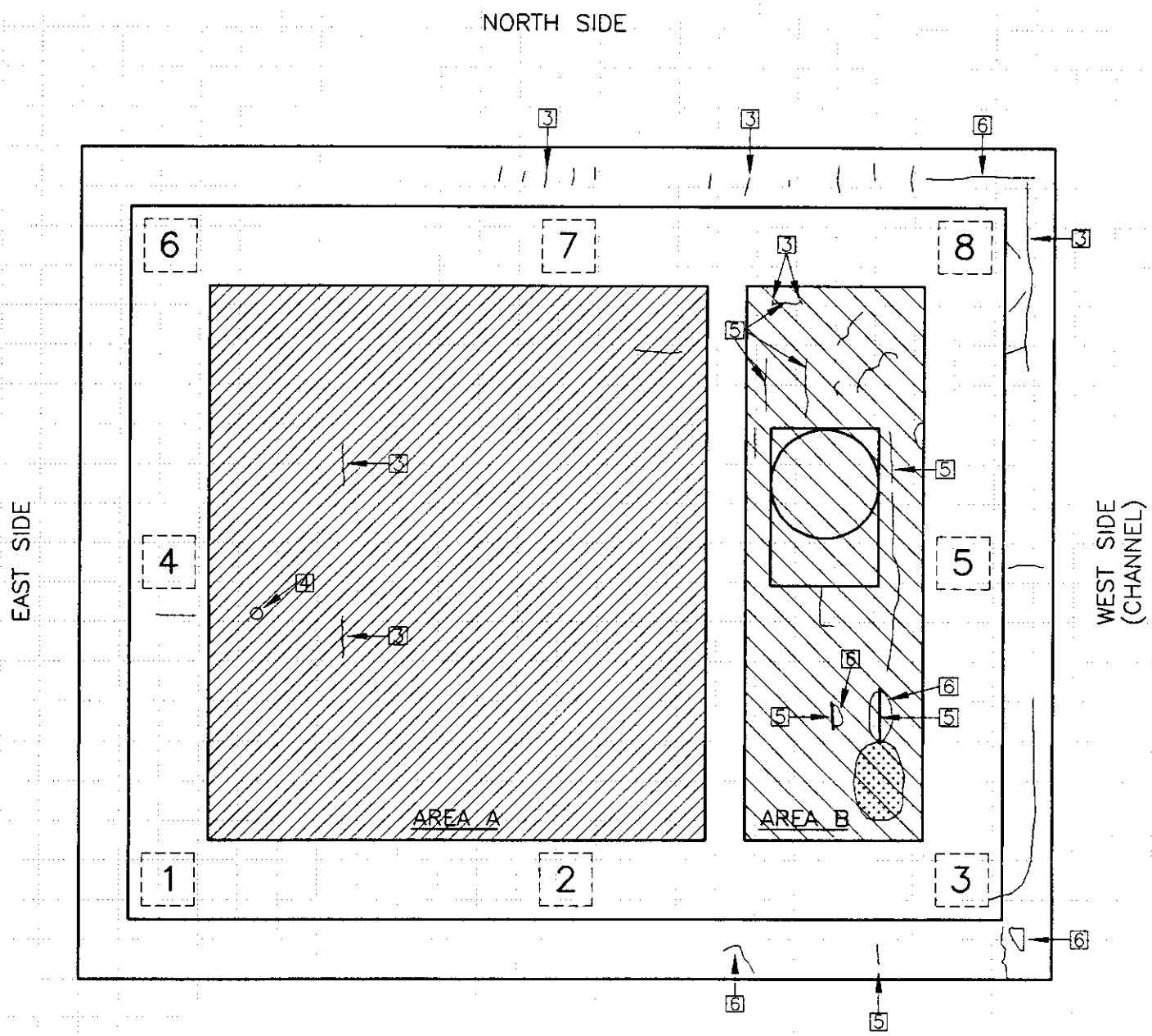
SECTION IV - CRACK SURVEY

INDEX

EMPIRE FLOODGATE PUMP PLATFORM

TOP DECK PLAN
BOTTOM SIDE

(VIEW LOOKING UP)



AREA "A"
AREA "B"
PATCH
CRACK

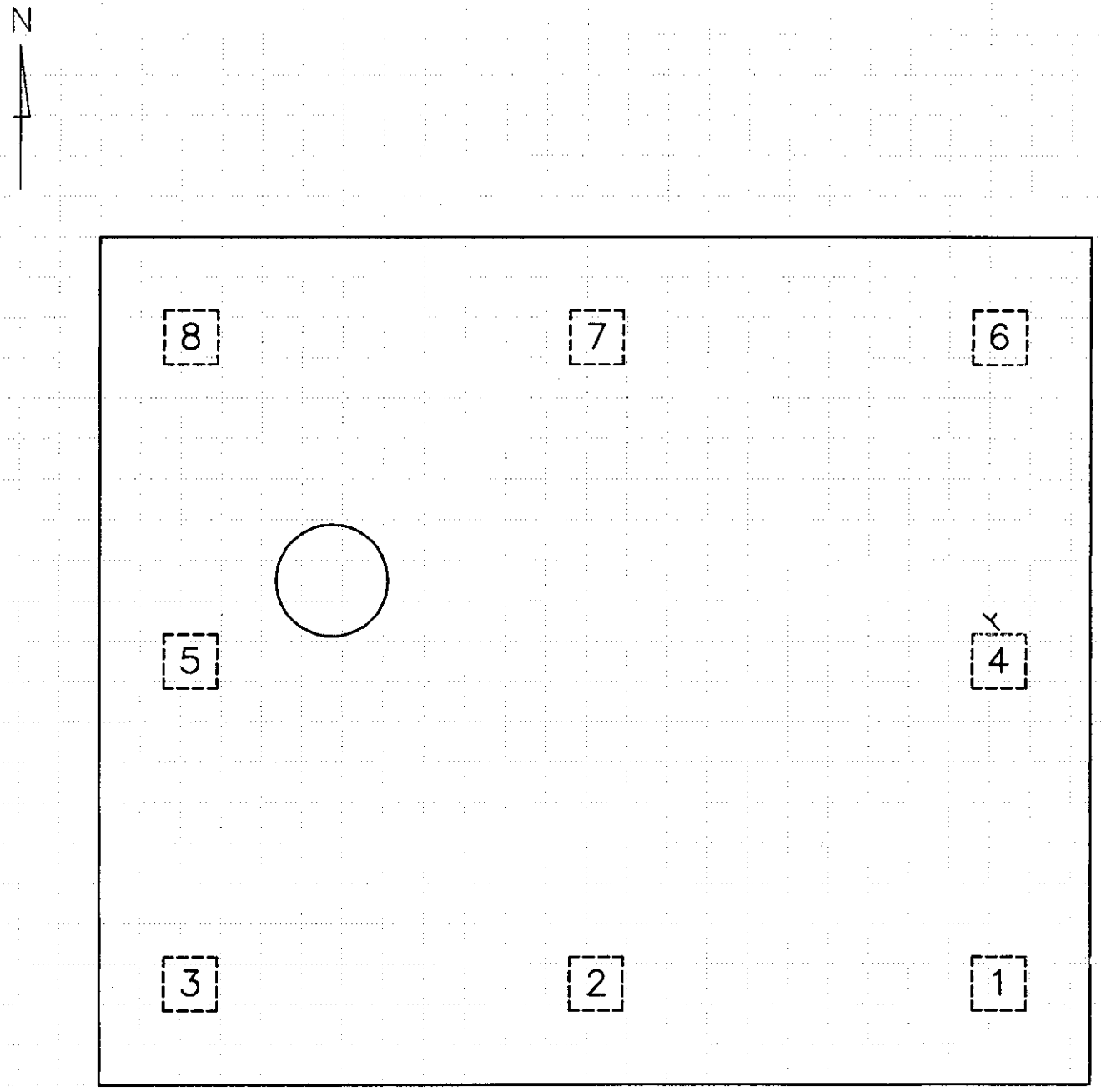
- [1] NAIL(NONE NOTED)
- [2] WIRE(NONE NOTED)
- [3] CHAIRS
- [4] DRILLED HOLE
- [5] EXPOSED BAR
- [6] SPALL

SCALE: 1"=4'

EMPIRE FLOODGATE PUMP PLATFORM

LOWER DECK PLAN
TOP SIDE

(VIEW LOOKING DOWN)

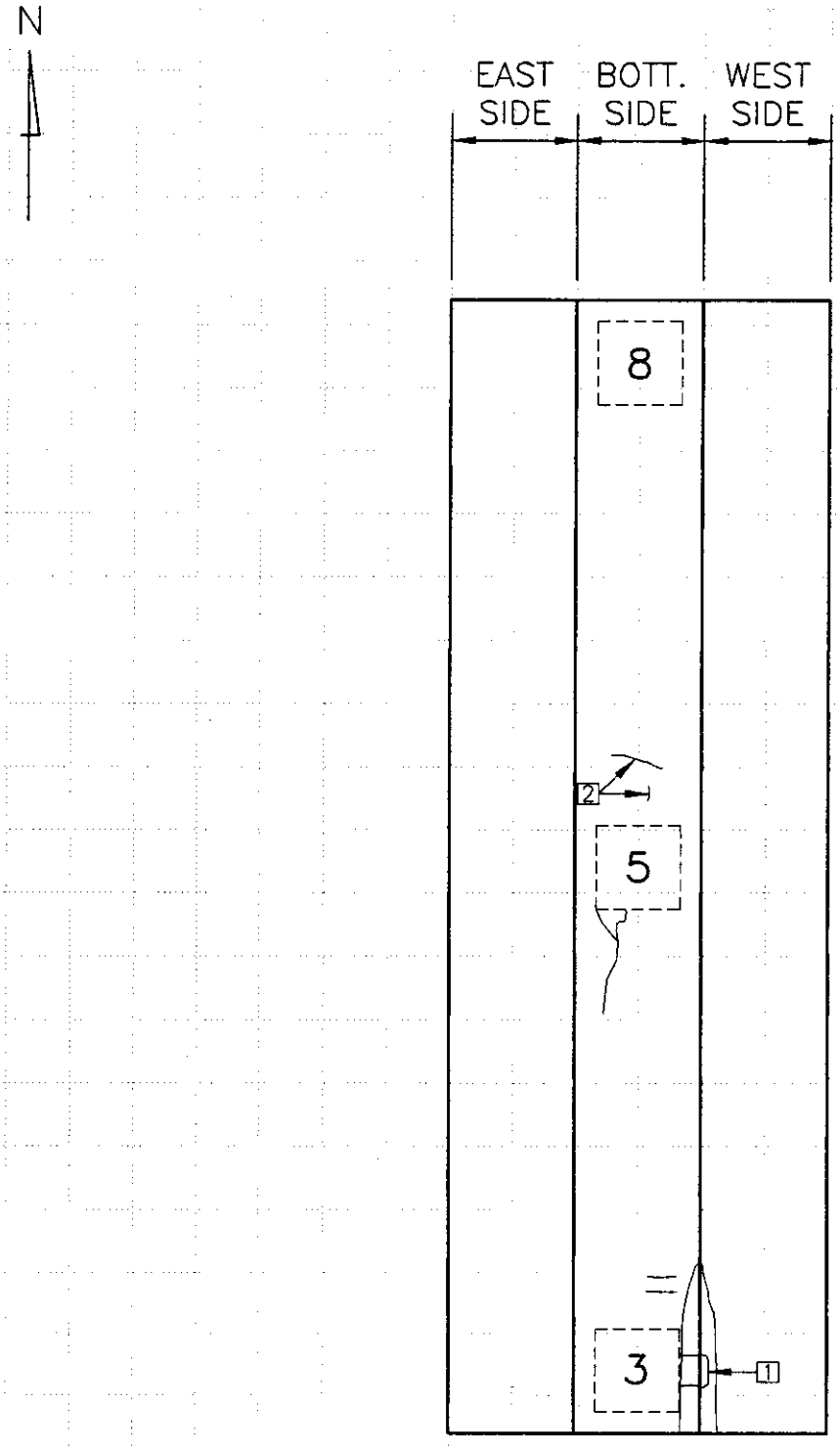


SCALE: 1"=4'

EMPIRE FLOODGATE PUMP PLATFORM

NORTH/SOUTH BEAM

(VIEW LOOKING UP)



NORTH/SOUTH BEAM WEST

CRACK

1 SPALL WITH EXPOSED REINFORCING

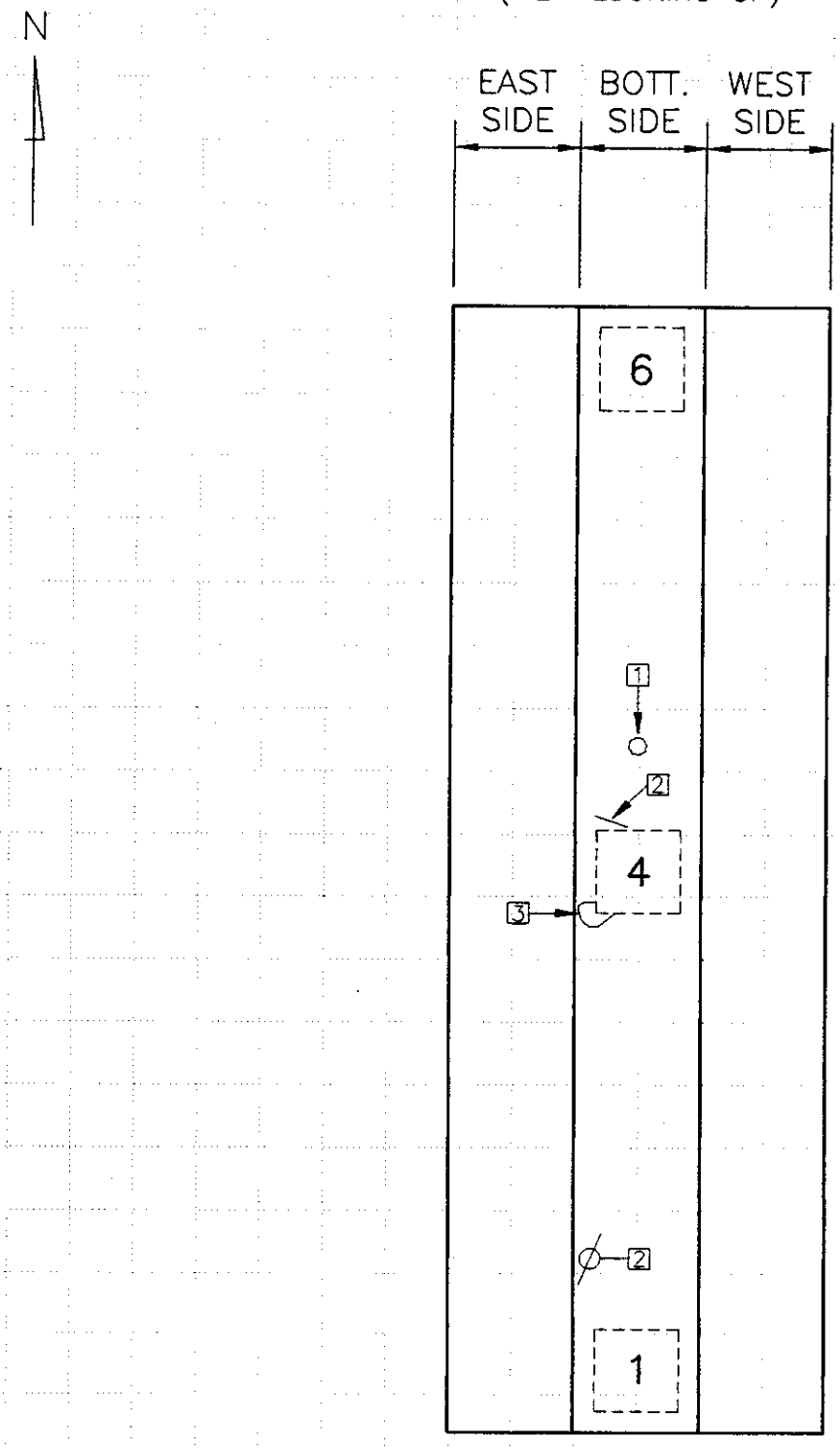
2 EXPOSED METAL(NAILS OR WIRE)

SCALE: 1"=3'

EMPIRE FLOODGATE PUMP PLATFORM

NORTH/SOUTH BEAM

(VIEW LOOKING UP)



NORTH/SOUTH BEAM EAST

CRACK

←[1] SMALL "POPOUT"

←[2] EXPOSED CORRODED NAIL OR SCRAP PIECE OF WIRE

←[3] CRACK ON PERIMETER OF PATCH

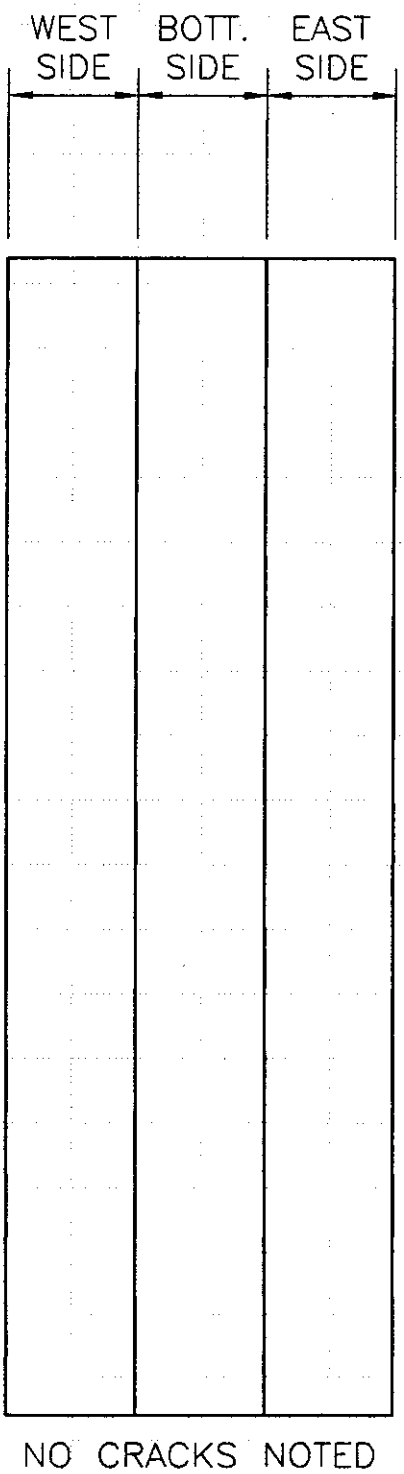
SCALE: 1"=3'

EMPIRE FLOODGATE PUMP PLATFORM

NORTH/SOUTH BEAM

(VIEW LOOKING UP)

N



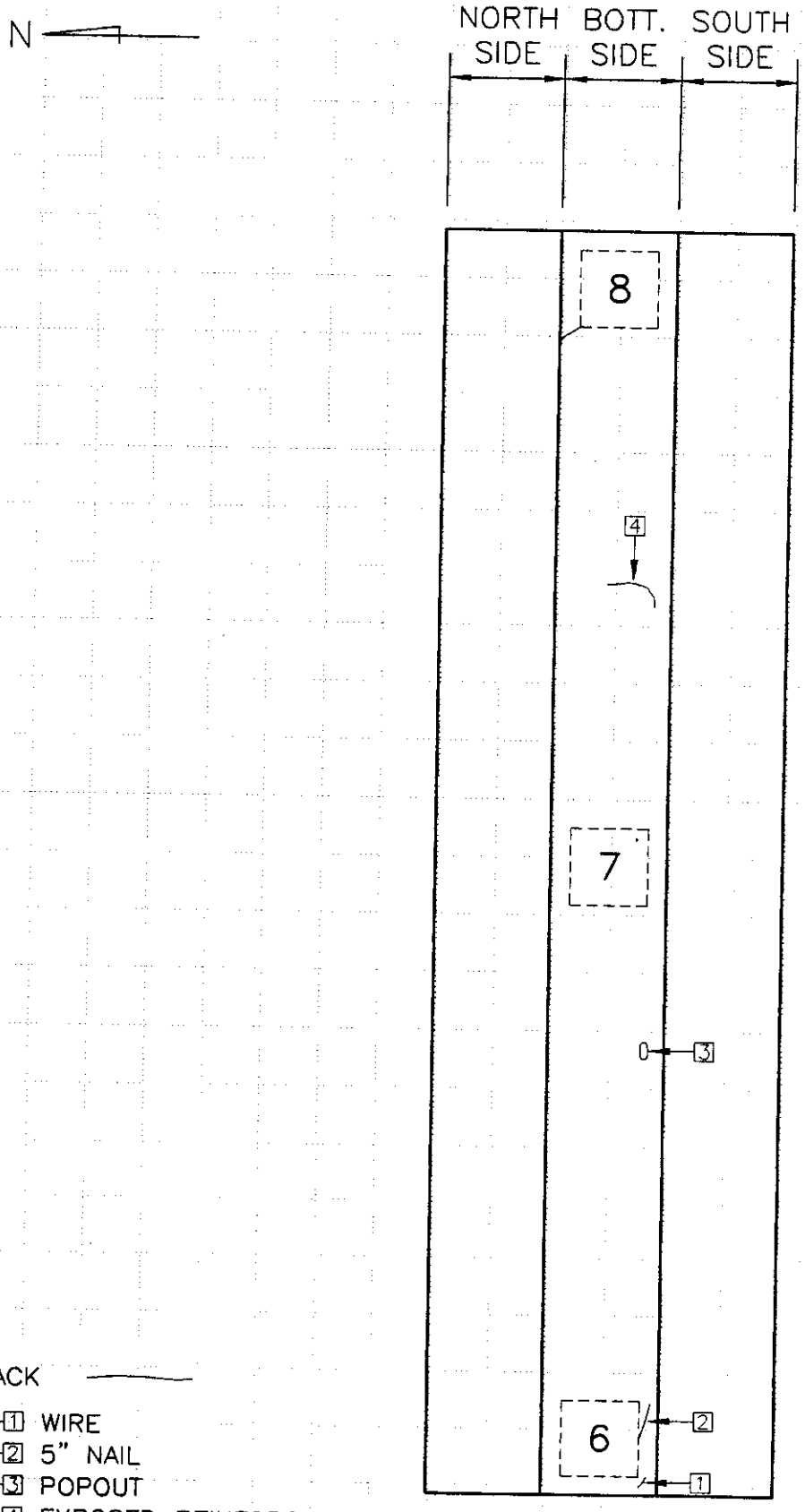
NORTH/SOUTH BEAM MIDDLE

SCALE: 1"=3'

EMPIRE FLOODGATE PUMP PLATFORM

EAST/WEST BEAM

(VIEW LOOKING UP)



CRACK

- 1 WIRE
- 2 5" NAIL
- 3 POPOUT
- 4 EXPOSED REINFORCEMENT SUPPORT

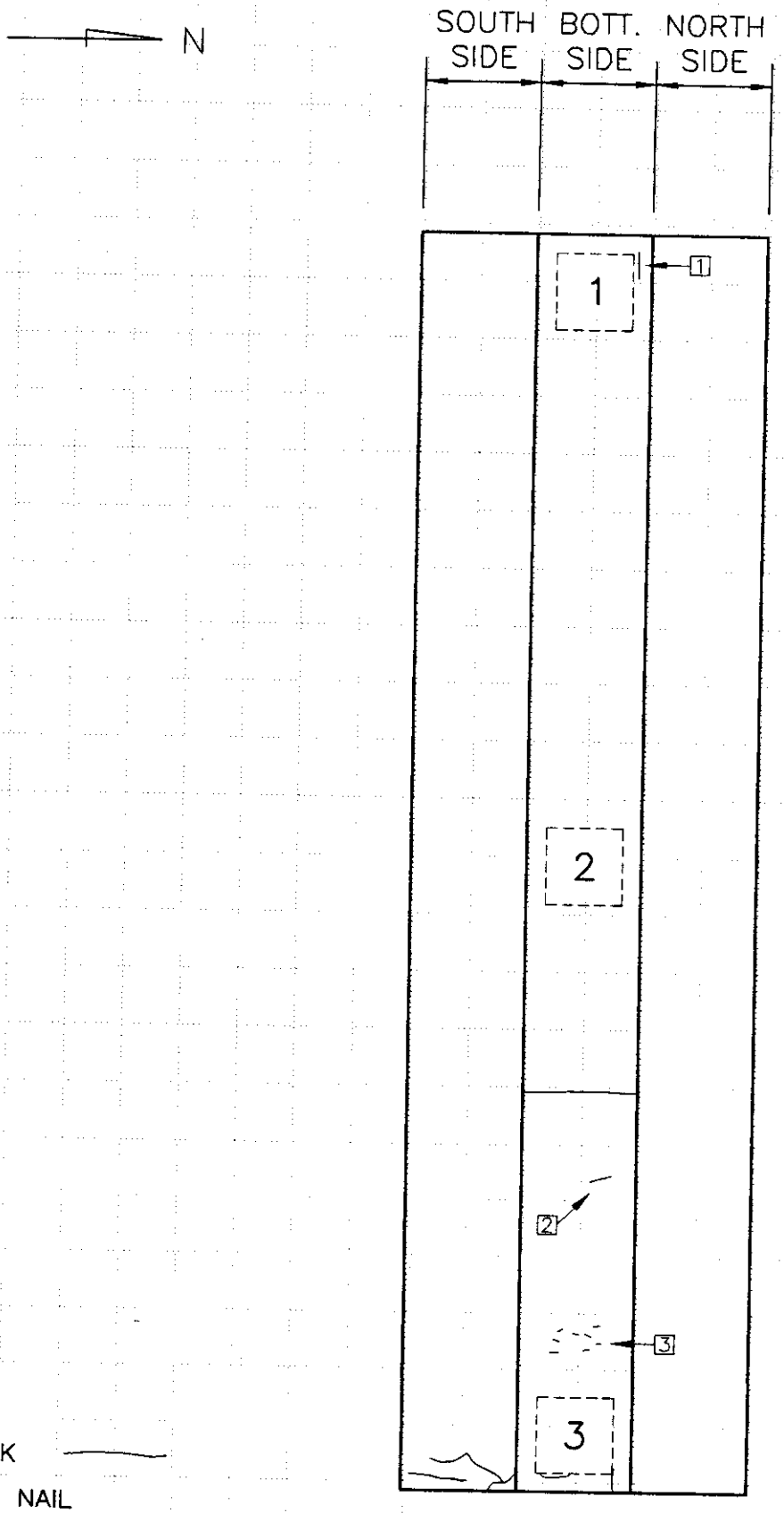
EAST/WEST BEAM NORTH

SCALE: 1"=3'

EMPIRE FLOODGATE PUMP PLATFORM

EAST/WEST BEAM

(VIEW LOOKING UP)



CRACK

1 NAIL

2 WIRE

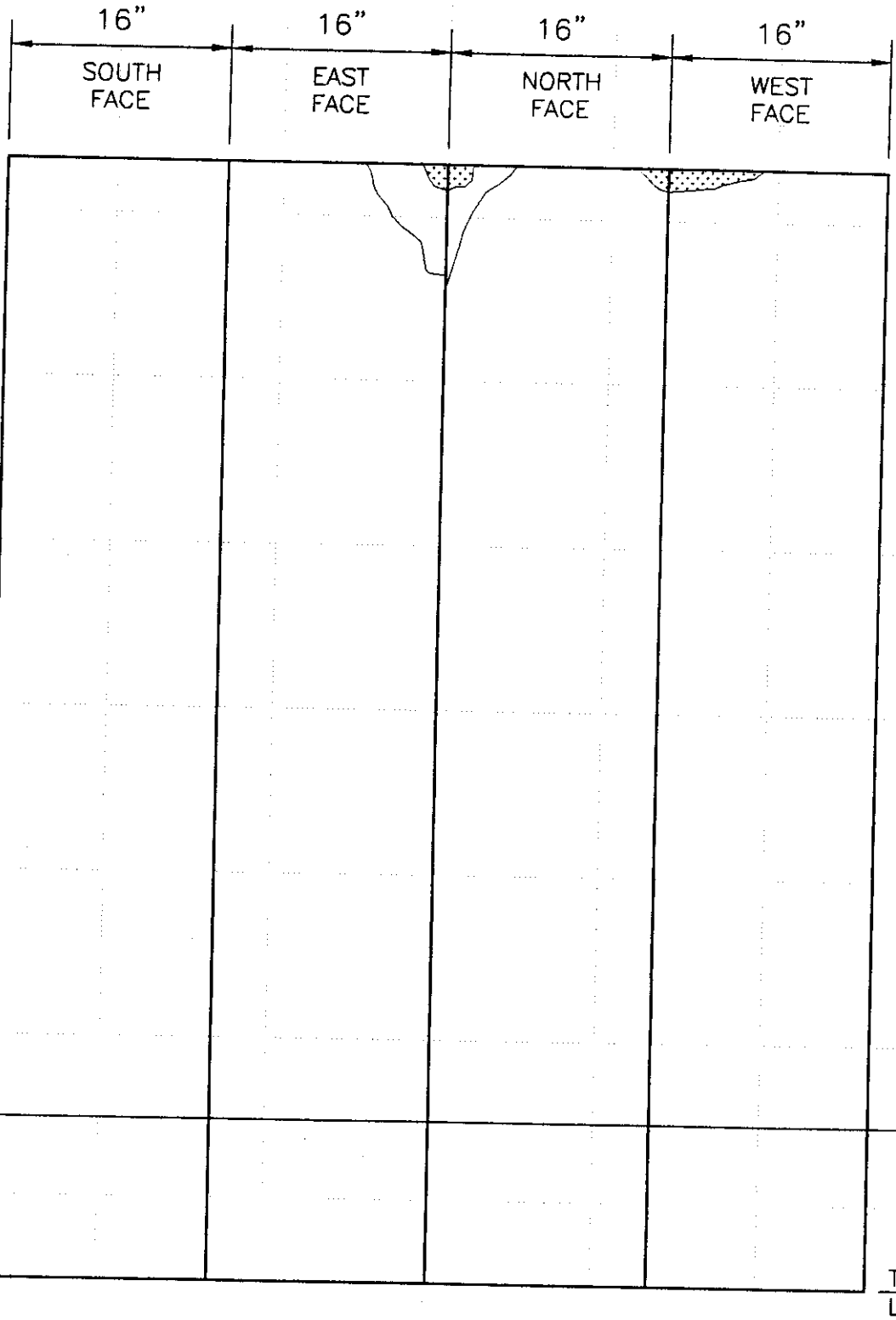
3 CHAIRS

EAST/WEST BEAM SOUTH

SCALE: 1"=3'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



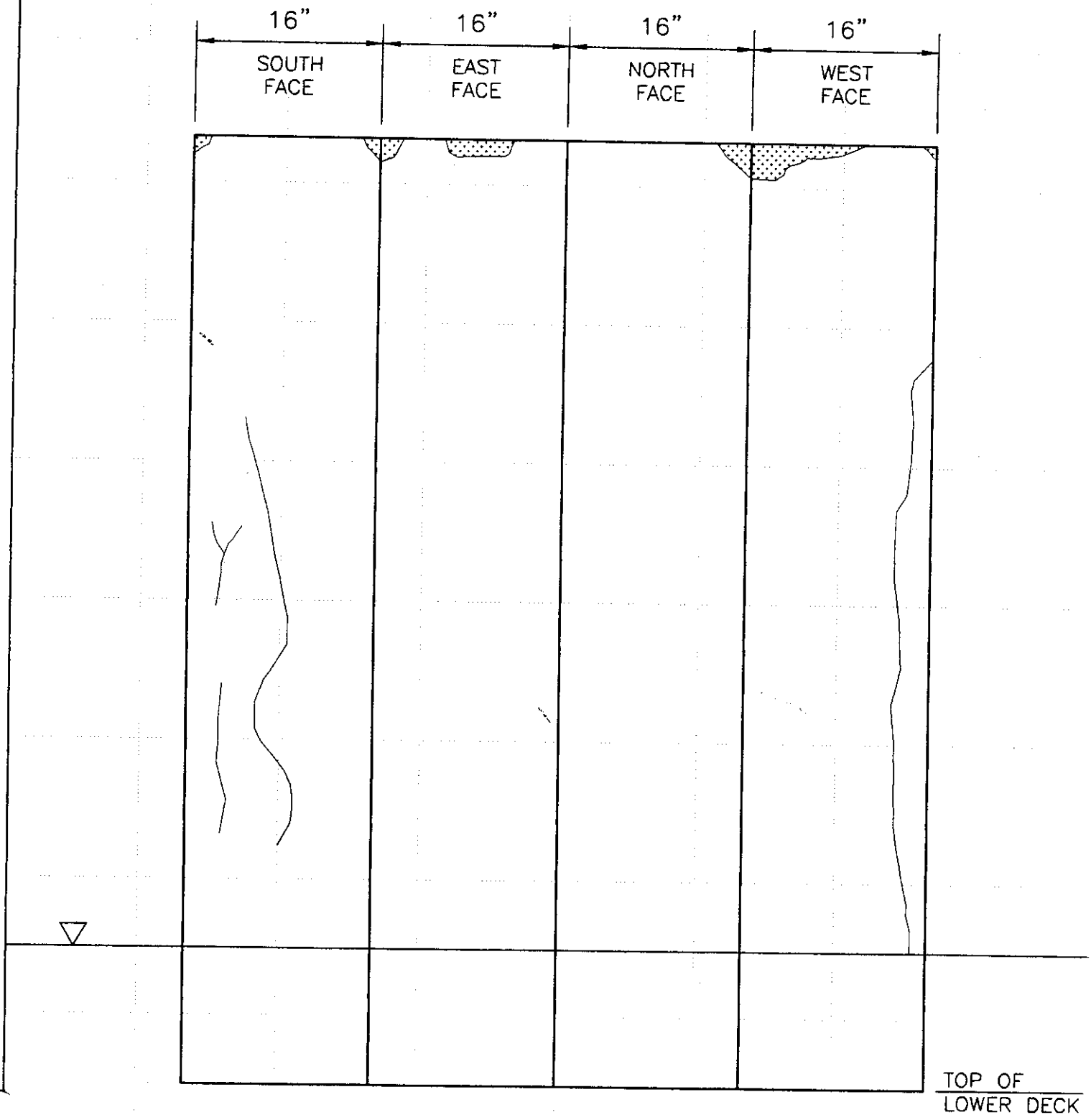
PATCH
CRACK

PILE NO. 1

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



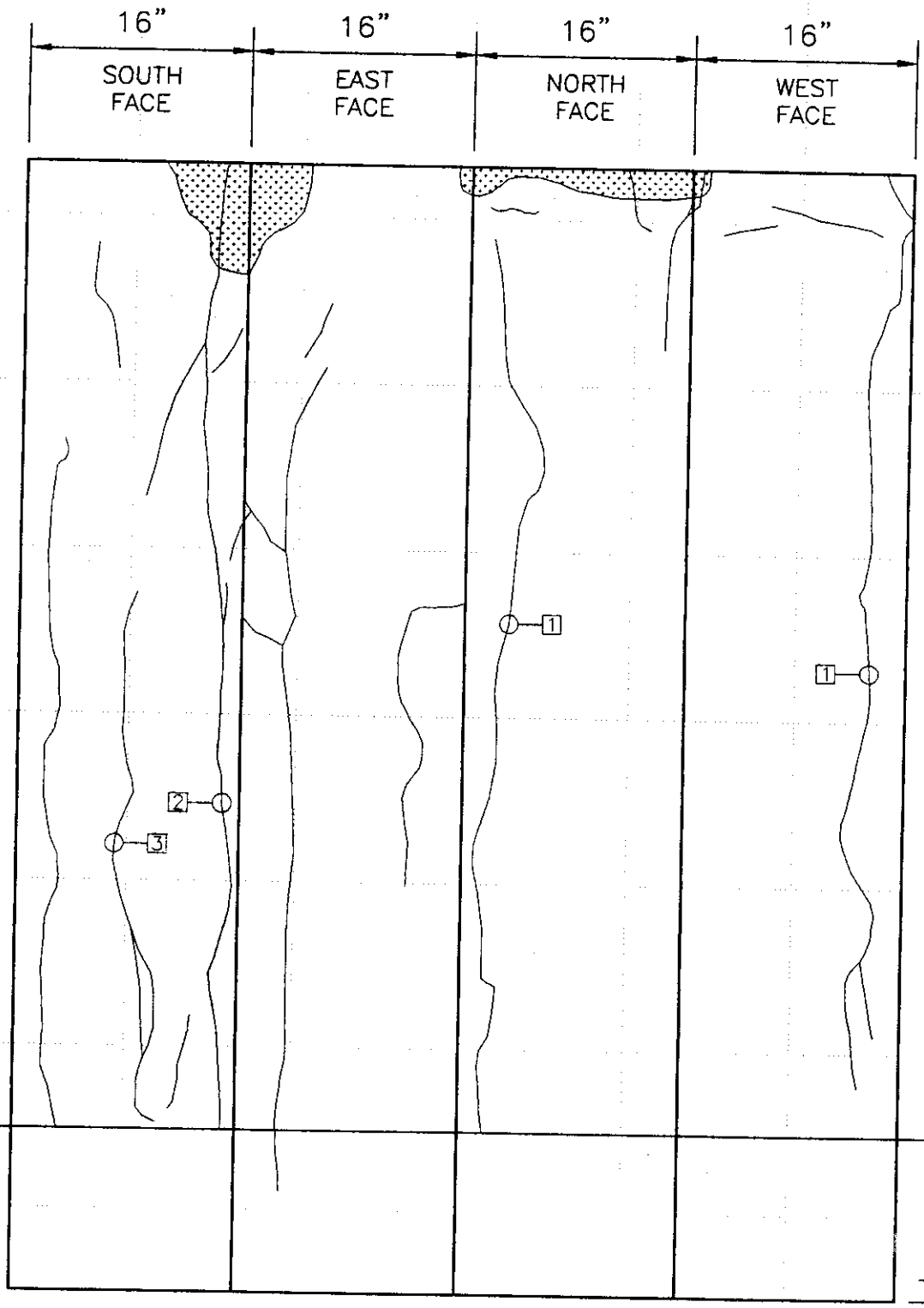
PATCH
CRACK

PILE NO. 2

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



PATCH

CRACK

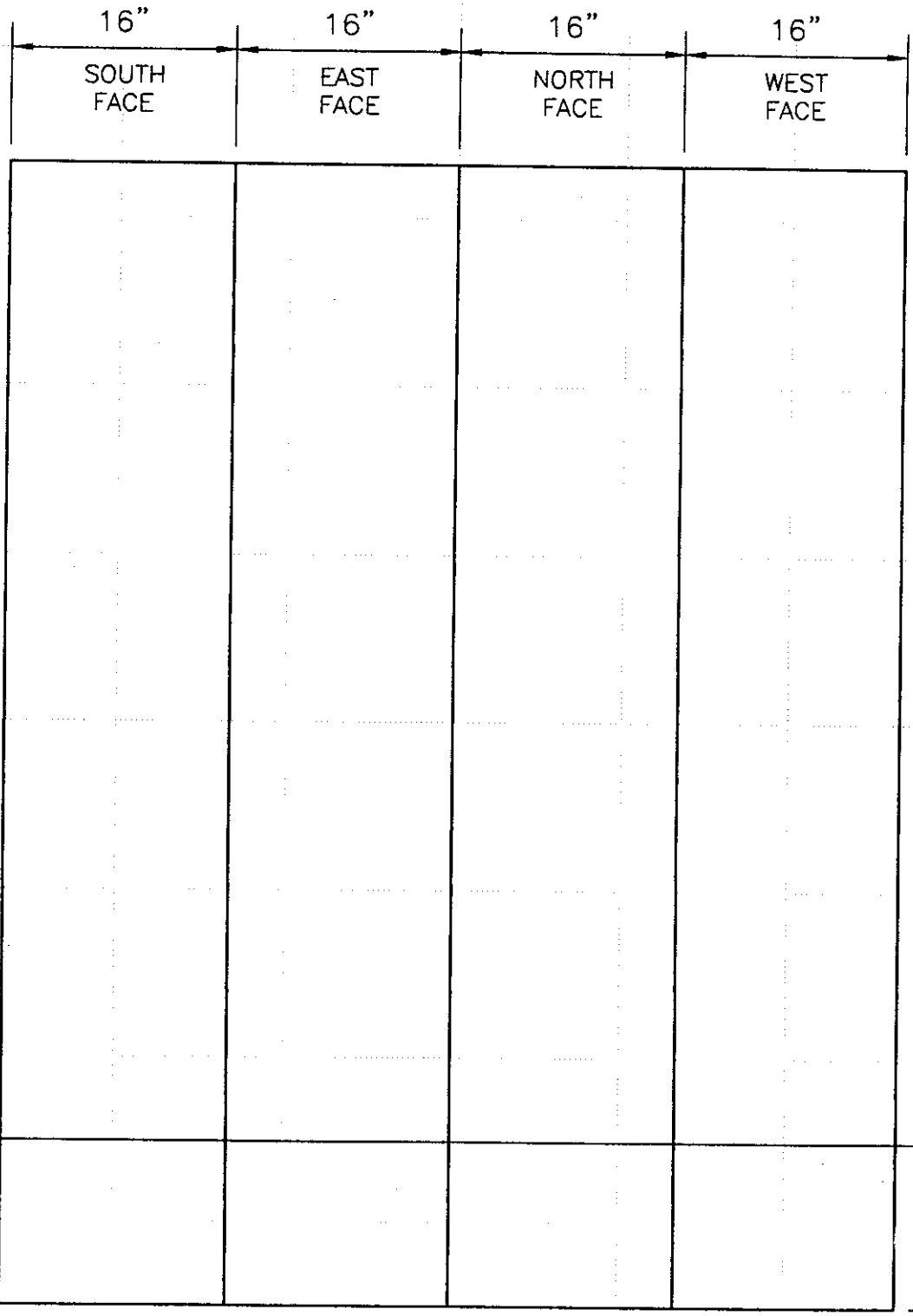
PILE NO. 3

○—1 OPEN CRACK, 1/8"±
○—2 OPEN CRACK, 1/4"±
○—3 OPEN CRACK, 1/16"±

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



* NO CRACKS NOTED

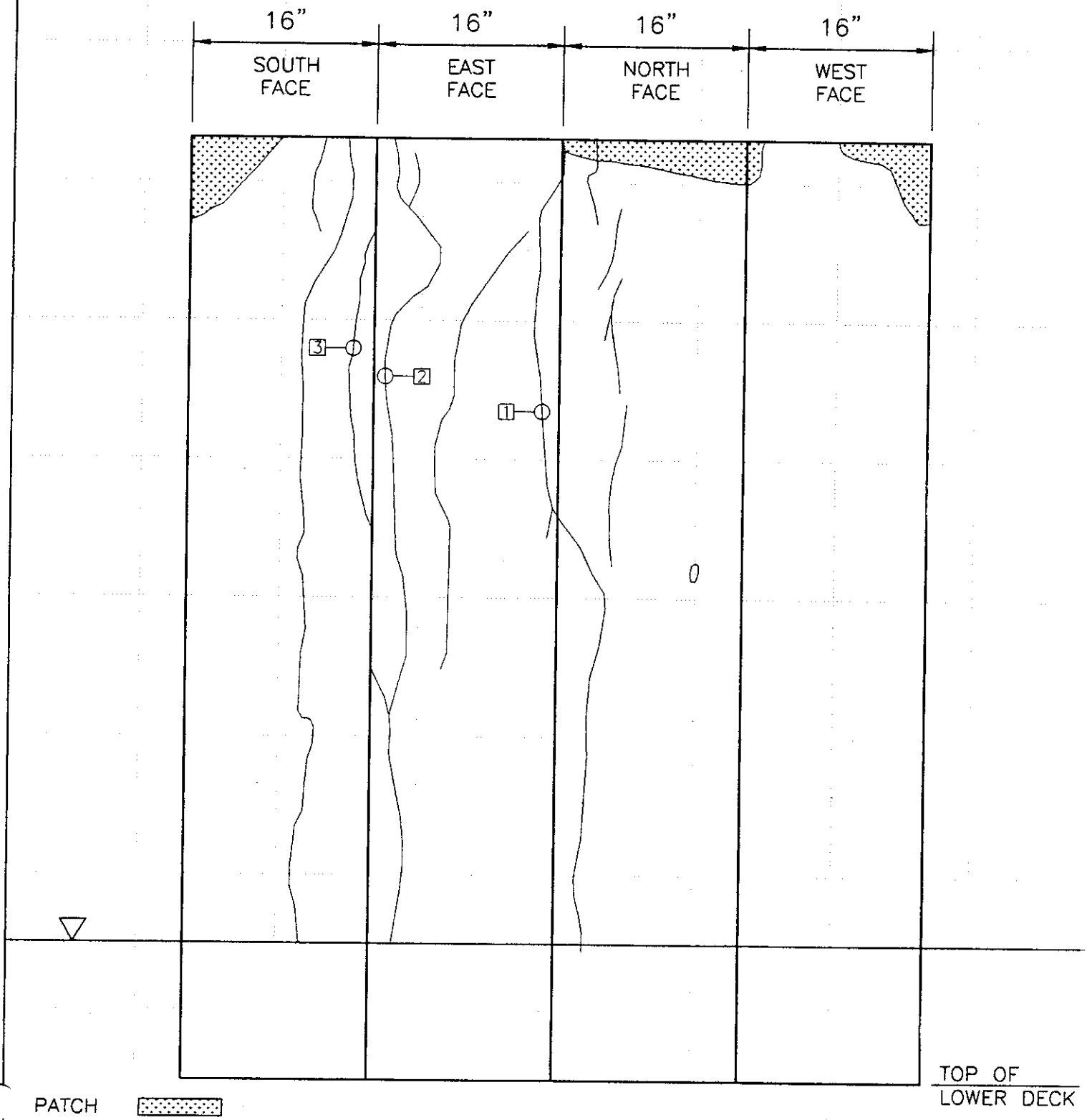
PATCH
CRACK

PILE NO. 4

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



PATCH

CRACK

PILE NO. 5

○—1 OPEN CRACK, 1/16"±

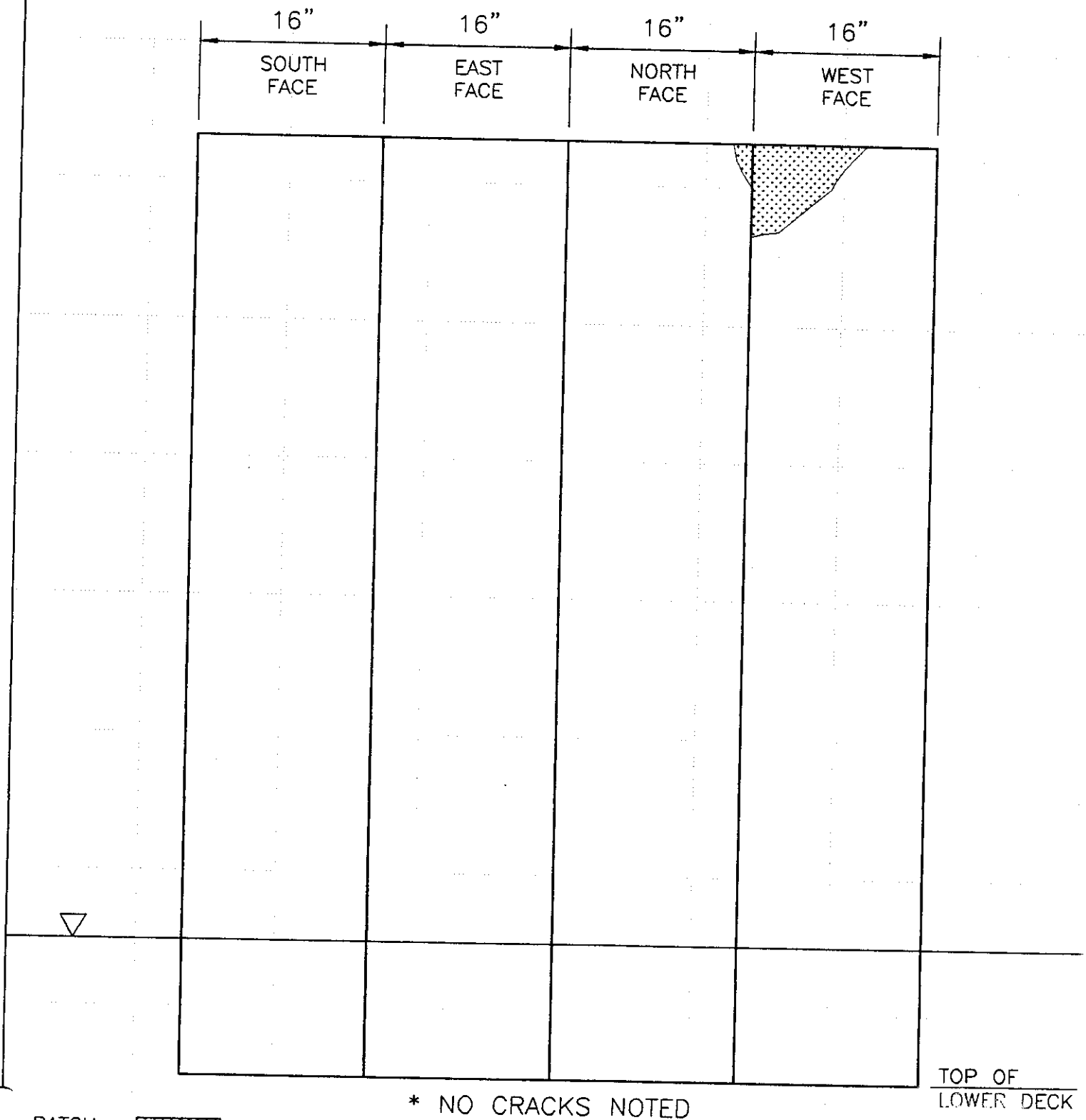
○—2 OPEN CRACK 1/4"±, CORNER DISPLACEMENT 1/4" OUT(EAST)

○—3 CORNER DISPLACEMENT 1/2"± OUT(SOUTH)

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



* NO CRACKS NOTED

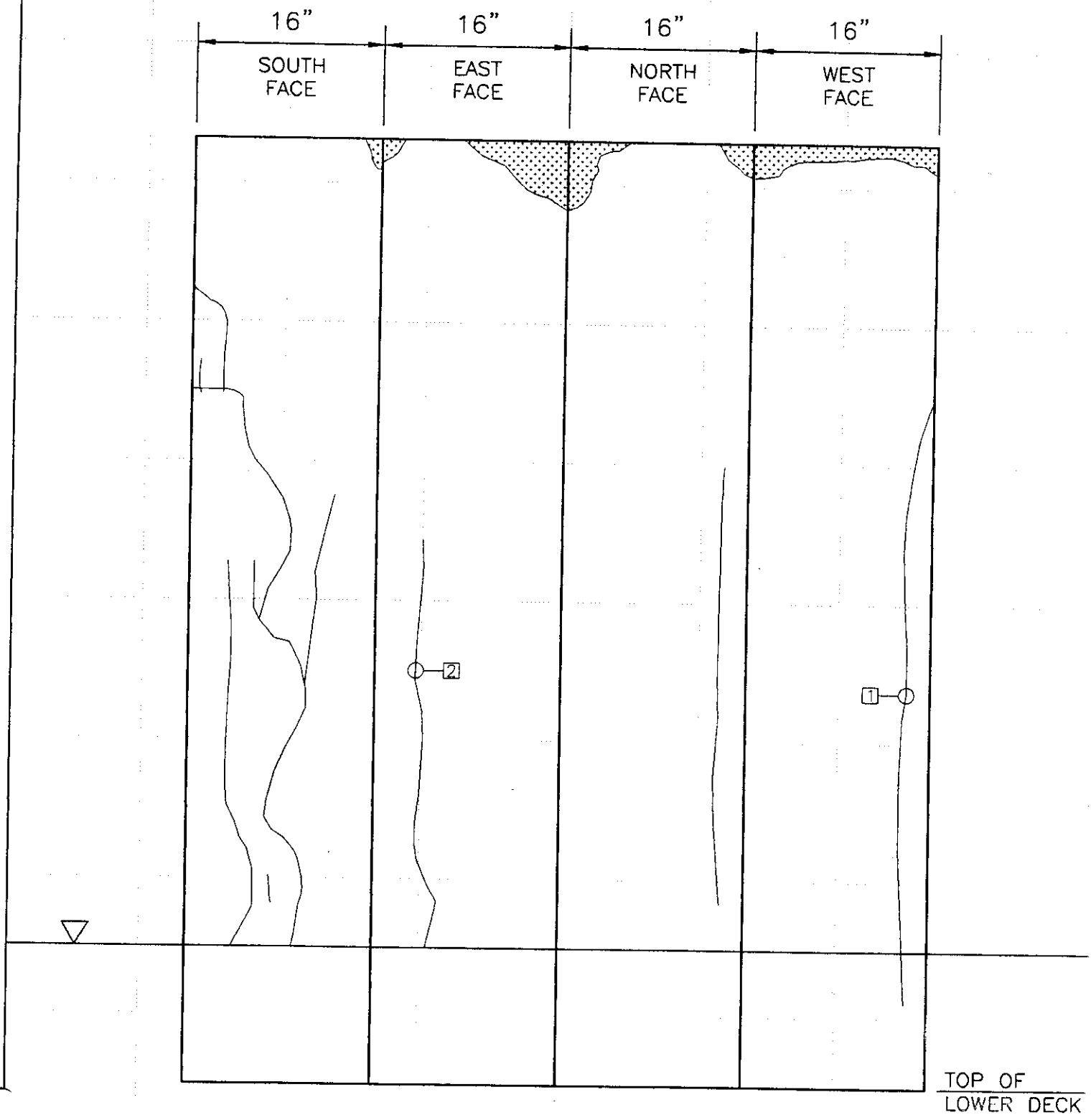
PATCH
CRACK

PILE NO. 6

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



PATCH

CRACK

PILE NO. 7

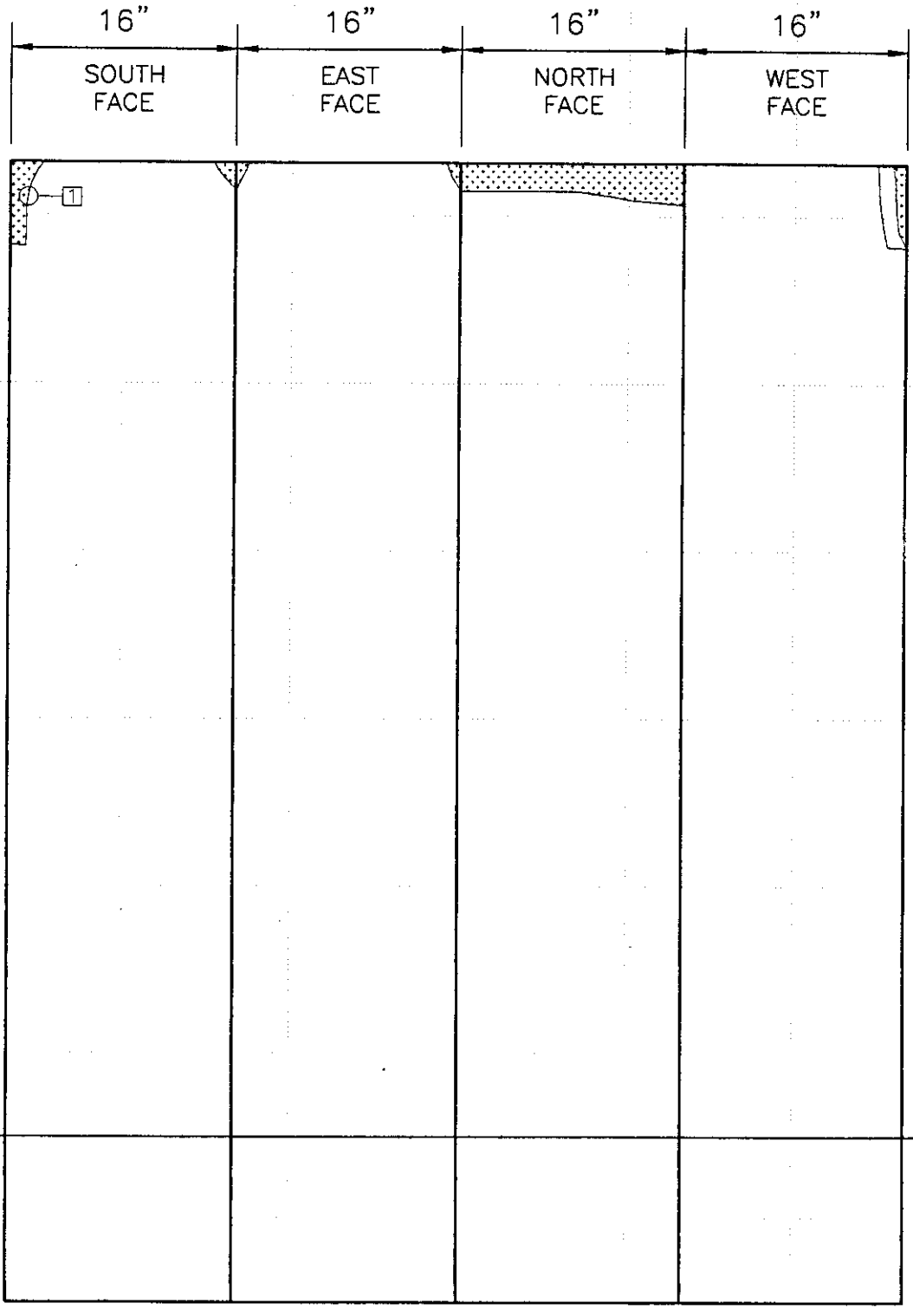
○—1 OPEN CRACK, 3/8"±

○—2 OPEN CRACK, 1/8"± MAX.

SCALE: 1"=1'

EMPIRE FLOODGATE PUMP PLATFORM

PILE ABOVE LOWER DECK



PATCH

CRACK

PILE NO. 8

○—1 SMALL CRACK ALONG EDGE OF PATCH.

SCALE: 1"=1'

SECTION V - PHOTOGRAPHS

Photo Nos. 1 through 48

PHOTO NO. 1 - PILE NO. 1, NORTH FACE. NOTE SMALL CRACK (MARKED WITH LUMBER CRAYON) AND PATCH (UPPER LEFT CORNER).

PHOTO NO. 2 - PILE NO. 1, EAST FACE. NOTE SMALL CRACK (MARKED WITH LUMBER CRAYON) AND PATCH (ALONG TOP AND UPPER RIGHT CORNER).

PHOTO NO. 3 - PILE NO. 2, SOUTH FACE. NOTE CRACK.

PHOTO NO. 4 - PILE NO. 2, SOUTH FACE. CONTINUATION OF CRACK SHOWN IN PHOTO NO. 3 AND ADDITIONAL CRACK.

PHOTO NO. 5 - PILE NO. 2, EAST FACE. NO CRACKS. WHAT APPEARS TO BE CRACKS (ARROW) IS STAINS.

PHOTO NO. 6 - PILE NO. 2, WEST FACE. CRACKS NEAR SOUTHWEST CORNER OF PILE.

PHOTO NO. 7 - PILE NO. 2, NORTH FACE, UPPER PART OF PILE. NO CRACKS.

PHOTO NO 8 - PILE NO. 2, NORTH FACE ON LEFT, WEST FACE ON RIGHT. NO CRACKS NOTED IN NORTH FACE. CRACKS IN WEST FACE ALSO SHOWN IN PHOTO NO. 6.

PHOTO NO. 9 - PILE NO. 3, WEST FACE. TOP PORTION OF PILE. SMALL DIAGONAL CRACK AT TOP (MARKED WITH LUMBER CRAYON) AND OPEN VERTICAL CRACK NEAR SOUTHWEST CORNER OF PILE.

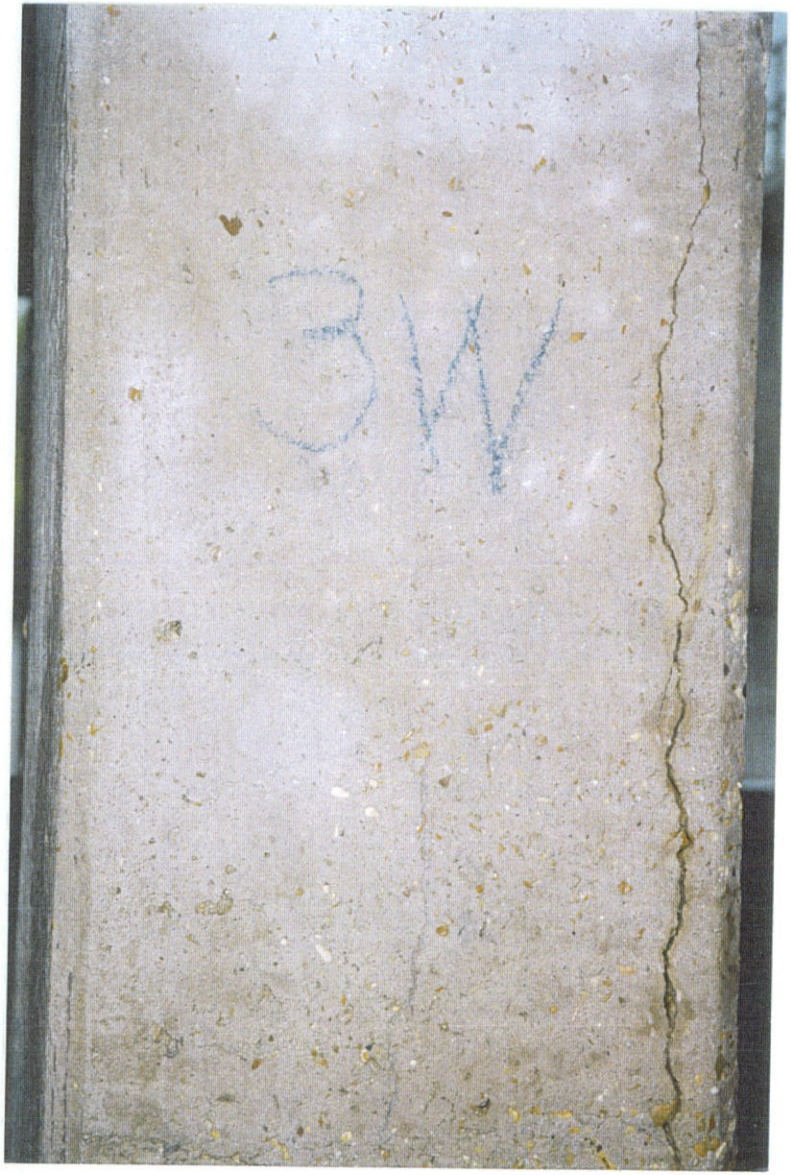


PHOTO NO. 10 - PILE NO. 3, WEST FACE. MIDDLE PORTION OF PILE. CONTINUATION OF OPEN CRACK SHOWN IN PHOTO NO. 9.

PHOTO NO. 11 - PILE NO. 3, WEST FACE. LOWER PORTION OF PILE. CONTINUATION OF OPEN CRACK SHOWN IN PHOTO NOS. 9 AND 10.

PHOTO NO. 12 - PILE NO. 3, NORTH FACE, TOP PORTION OF PILE. PATCH AT TOP OF PILE. CRACKS NEAR TOP OF PILE. VERTICAL CRACK ON RIGHT, AND UPPER PORTION OF VERTICAL CRACK ON LEFT MARKED WITH LUMBER CRAYON. CRACK ON LEFT IS OPEN EXCEPT UPPER PORTION.

PHOTO NO. 13 - PILE NO. 3, NORTH FACE, MIDDLE PORTION OF PILE. CONTINUATION OF OPEN CRACK SHOWN IN PHOTO NO. 12.

PHOTO NO. 14 - PILE NO. 3, NORTH FACE, LOWER PORTION OF PILE. CONTINUATION OF CRACK SHOWN IN PHOTO NOS. 12 AND 13.

PHOTO NO. 15 - PILE NO. 3, EAST FACE, UPPER PORTION OF PILE. CRACK INCREASES IN SIZE (WIDTH) TOWARD BOTTOM OF PILE.

PHOTO NO. 16 - PILE NO. 3, EAST FACE, LOWER PORTION OF PILE. CONTINUATION OF CRACK SHOWN IN PHOTO NO. 15.

PHOTO NO. 17 - PILE NO. 3, SOUTH FACE, UPPER PORTION OF PILE. PATCH AT TOP OF PILE ON SOUTHEAST CORNER OF PILE. LARGER CRACK IS OPEN.

PHOTO NO. 18 - PILE NO. 3, SOUTH FACE, MIDDLE PORTION OF PILE. CONTINUATION OF CRACKS SHOWN IN PHOTO NO. 17.

PHOTO NO. 19 - PILE NO. 3, SOUTH FACE, CONTINUATION OF CRACKS SHOWN IN PHOTO NO. 18.

PHOTO NO. 20 - PILE NO. 4, SOUTH FACE, GOOD VISUAL CONDITION . NO CRACKS NOTED ON PILE NO. 4

PHOTO NO. 21 - PILE NO. 5, NORTH FACE, UPPER PORTION OF PILE. PATCH AT TOP OF PILE. VERTICAL CRACKS ON LEFT SIDE.

PHOTO NO. 22 - PILE NO. 5 NORTH FACE, LOWER PORTION OF PILE. CONTINUATION OF CRACK SHOWN IN PHOTO NO. 21 AND CRACK AT NORTHEAST CORNER OF PILE.

PHOTO NO. 23 - PILE NO. 5, WEST FACE, UPPER PORTION OF PILE. PATCHES AT TOP OF PILE AT BOTH CORNERS. NO CRACKS OBSERVED.

PHOTO NO. 24 - PILE NO. 5, WEST FACE, LOWER PORTION OF PILE. NO CRACKS OBSERVED.

PHOTO NO. 25 - PILE NO. 5, SOUTH FACE, UPPER PORTION OF PILE. LARGE PATCH AT TOP, VERTICAL CRACKS ON RIGHT.

PHOTO NO. 26 - PILE NO. 5, SOUTH FACE, MIDDLE PORTION OF PILE. CONTINUATION OF CRACKS SHOWN IN PHOTO NO. 25.

PHOTO NO. 27 - PILE NO. 5, SOUTH FACE, LOWER PORTION OF PILE. CONTINUATION OF CRACKS SHOWN IN PHOTO NO. 26.

PHOTO NO. 28 - PILE NO. 5, EAST FACE, UPPER PORTION OF PILE. CRACK AT SOUTHEAST CORNER OPEN 1/4 INCH ±.

PHOTO NO. 29 - PILE NO. 5, EAST FACE, LOWER PORTION OF PILE. CONTINUATION OF CRACK AT SOUTHEAST CORNER (PHOTO NO. 28) TO WATER SURFACE DOES NOT SHOW EXCEPT NEAR WATER SURFACE DUE TO POOR QUALITY OF PHOTO.

PHOTO NO. 30 - PILE NO. 6, WEST FACE. PATCH AT TOP AT NORTHWEST CORNER OF PILE. NO CRACKS OBSERVED ON PILE NO. 6.

PHOTO NO. 31 - PILE NO. 7, NORTH FACE. VERTICAL CRACK NEAR NORTHWEST CORNER OF PILE.

PHOTO NO. 32 - PILE NO. 7, WEST FACE, UPPER PORTION OF PILE. PATCH AT TOP OF PILE. OPEN CRACK AT SOUTHWEST CORNER OF PILE.

PHOTO NO. 33 - PILE NO. 7, WEST FACE, LOWER PORTION OF PILE. CONTINUATION OF OPEN CRACK SHOWN IN PHOTO NO. 32.

PHOTO NO. 34 - PILE NO. 7, SOUTH FACE, UPPER PORTION OF PILE. PATCHES AT TOP OF PILE. CRACK NEAR SOUTHWEST CORNER AND LEFT OF LOWER "7S."

PHOTO NO. 35 - PILE NO. 7, SOUTH FACE, LOWER PORTION OF PILE. CONTINUATION OF CRACK NEAR SOUTHWEST CORNER OF PILE SHOWN IN PHOTO NO. 34 AND CRACK WEST OF CENTER OF PILE.

PHOTO NO. 36 - PILE NO. 7, EAST FACE. TOP PORTION OF PILE. PATCHES AT TOP OF PILE.

PHOTO NO. 37 - PILE NO. 7, EAST FACE. LOWER PORTION OF PILE. CRACK NEAR AND GENERALLY PARALLEL TO SOUTHEAST CORNER OF PILE.

PHOTO NO. 38 - PILE NO. 8, WEST FACE. UPPER PORTION OF PILE. HAIRLINE CRACK AT TOP OF PILE (ARROW). NO OTHER CRACKS OBSERVED ON THIS PILE.

PHOTO NO. 39 - WEST UPPER DECK OVERHANG UNDERSIDE. NOTE CRACK ALONG DRIP STRIP.

PHOTO NO. 40 – SOUTH END OF WEST NORTH/SOUTH BEAM AND UNDERSIDE OF TOP DECK OVERHANG. NOTE CRACKED AND SPALLED AREA ON BEAM WITH EXPOSED REINFORCEMENT AND SPALL AND CRACK IN DECK OVERHANG.

PHOTO NO. 41 – UNDERSIDE OF UPPER DECK SOUTH OVERHANG, PHOTO LOOKING WEST. NOTE SPALL AT DRIP STRIP (SHOWS IN PHOTO NO. 40) AND CRACKS IN UNDERSIDE OF DECK.

PHOTO NO. 42 - LOOKING WEST AT UNDERSIDE OF UPPER DECK NORTH OVERHANG. NOTE SHALLOW SPALLS WITH WHAT APPEARS TO BE EXPOSED REINFORCEMENT CHAIRS THAT ARE CORRODED.

PHOTO NO. 43 - LOOKING WEST AT UNDERSIDE OF UPPER DECK (AREA A AS DENOTED ON CRACK SURVEY PLAN SHEET). NO CRACKS NOTED.

PHOTO NO. 44 - UNDERSIDE OF UPPER DECK, NORTHEAST CORNER OF AREA B (DENOTED ON CRACK SURVEY PLAN SHEET) LOOKING EAST.

PHOTO NO. 45 - UNDERSIDE OF UPPER DECK, AREA B, JUST WEST OF PUMP COLUMN BLOCKOUT, LOOKING NORTH. PUMP COLUMN ON RIGHT.

PHOTO NO. 46 - UNDERSIDE OF UPPER DECK, AREA B, LOOKING SOUTH. PUMP COLUMN RECESS (AT BOTTOM OF PHOTO) JUST SOUTH OF EXPOSED REINFORCEMENT.

PHOTO NO. 47 - UNDERSIDE OF UPPER DECK, AREA B, LOOKING WEST AT AREA JUST SOUTH OF PUMP COLUMN RECESS. NOTE SPALL AND CRACK FROM PUMP COLUMN RECESS.

PHOTO NO. 48 - UNDERSIDE OF UPPER DECK, LOOKING WEST AT SOUTHWEST PART OF AREA B, WEST NORTH/SOUTH BEAM IN BACKGROUND. NOTE PATCH AT SOUTH (LEFT) END OF EXPOSED CORRODED REINFORCEMENT.

SECTION VI - REMEDIAL MEASURES

6-01. General. The defects noted were evaluated and it was determined that pile nos. 2, 3, 5, and 7 should be encapsulated with some type of system that will reduce the rate of corrosion of the pile reinforcement and enhance the structural capacity of the restored piling. Three manufacturers representing two types of encapsulation were contacted and their product information, recommendations and estimated system costs obtained. Recommended remedial measures for each manufacturer's system, with BCG input, are presented in the following paragraphs.

6-02. System No. 1. This system, by Master Builders, Inc., uses their Advanced Pile Encapsulation (APE) Process which consists of a fiber-reinforced polymer encapsulation jacket with the annular space between the jacket and pile surfaces filled with an epoxy grout, for repairs to pile nos. 2, 3, 5 and 7. Per the system manufacturer, the only repairs required for piles to be encapsulated would be removal and restoration of the spalled offset (displaced) southeast corner of pile no. 5.

a. Repairs to piling.

(1) Pile No. 1. Clean and epoxy seal one hairline crack on the east and north faces (8" and 9" respectively; total 17-inches) with Masterseal GP epoxy sealer, installed per manufacturers instructions.

(2) Pile No. 2. Encapsulate with APE system, 36 SF, per Masterbuilders recommendation. No other repairs required.

(3) Pile No. 3. Encapsulate with APE system, 36 SF. Install per manufacturers recommendation.

(4) Pile No. 4. No repairs required.

(5) Pile No. 5. Remove spalled offset southeast corner and restore to section with Masterbuilders Emaco S 71C1, shrinkage compensated structural repair mortar with corrosion inhibitor, 0.5 CF. Encapsulate with APE system, 36 SF. Install products per manufacturers recommendations.

(6) Pile No. 6. No repairs required.

(7) Pile No. 7. Encapsulate with APE system, 36 SF. Install per manufacturers recommendation.

(8) Pile No. 8. Epoxy seal a hairline crack 6"± long on the south face and a hairline crack 6"± long on the west face, 1 LF. Use Masterseal GP, installed per manufacturers recommendation.

b. Repairs to Top Deck, Bottom Side.

(1) West Overhang. Chip out at exposed reinforcing supports along cracks in drip strips, epoxy inject cracks and patch at exposed reinforcing supports, 85-inches epoxy inject, 0.6 SF patch. Patch spall at the south end of the drip strip, 0.25 SF. Epoxy inject other cracks, 50-inches. Epoxy inject cracks with SCB Concresive 1380, and patch with Emaco P-24 bonding agent and Concresive 1490 patching material, installed per manufacturers instructions.

(2) South Overhang. Epoxy inject cracks, 18-inches. Chip and patch at exposed reinforcing bar and reinforcing support, 0.1 SF. Epoxy inject cracks with SCB Concresive 1380, and patch with Emaco P-24 bonding agent and Concresive 1490 patching material, installed per manufacturers instructions.

(3) North Overhang. Clean, chip and patch exposed chairs and accompanying spalls, 2.0 SF, and chip off, clean and patch spall at drip strip, approximately

3 SF. Use Emaco P-24, rebar coating and bonding agent (epoxy based) and Concresive 1490, patching material (epoxy based), both installed per manufacturers instructions.

(4) East Overhang. No repairs required.

(5) Area A. Chip and patch spalled areas at exposed reinforcing supports, 1 SF. Use Emaco P-24 bonding agent and Concresive 1490 patching material.

(6) Area B. Chip and patch spalled areas (including areas at exposed reinforcing bars and reinforcing supports), 30 SF and epoxy inject cracks, 2 LF. Epoxy inject cracks with SCB Concresive 1380 and patch with Emaco P-24 bonding agent and Concresive 1490 patching material installed per manufacturers instructions.

c. Lower Deck, Top Side. Epoxy inject crack adjacent to north face of pile no. 4, 1 LF. Use SCB Concresive 1380 per manufacturers instructions.

d. Repairs to Top Deck Support Beams.

(1) North/South Beam, West. Remove and replace spalled area on south end, 1 CF. Use Concresive Liquid LPL bonding agent with Emaco S77C1 patching material. Epoxy inject cracks, 3 LF. Use SCB Concresive 1380. Apply 5-part M Brace (wrap) system to south 5 feet, bottom and west side, 16 SF. On the bottom of face chip and patch two exposed pieces of nails or wire. Use Emaco P-24 bonding agent and Concresive 1490 patching material installed per manufacturers instructions.

(2) North/South Beam, East. On the bottom face chip and patch the exposed piece of nail or wire, and patch the small popout, 0.1 SF. Use Emaco P-24 bonding agent and Concresive 1490 patching material installed per manufacturers instructions. Epoxy seal the crack around the perimeter of the patch at the southeast corner of pile no. 4, 0.5 LF, with Masterseal GP. No repairs required on side faces.

(3) North/South Beam, Middle. No repairs required.

(4) East/West Beam, North. On the bottom face, epoxy inject crack at northeast corner of pile no. 8, 0.4 LF, with SCB Concresive 1380. Chip and patch exposed nail and reinforcing support, and patch the small popout, 0.1 SF, using Emaco P-24 bonding agent and Concresive 1490 patching material. No repairs on side faces.

(5) East/West Beam, South. On the bottom face epoxy inject transverse crack near midway between pile nos. 2 and 3 and 2 cracks west of pile no. 3, 3.0 LF, using SCB Concresive 1380. Chip and patch exposed reinforcing supports and nails (or wire), 4 SF, using Emaco P-24 bonding agent and Concresive 1490 patching material. On the south face, at the west end, epoxy inject 2 cracks, 1 LF, using Masterseal GP.

6-03. System No. 2. This system by Fyfe Co., Inc. uses their Tyfo Fiberwrap system (SEH-51, or SEH-51W under water, 3 layer) to wrap pile nos. 2, 3, 5, and 7. Fyfe Co., Inc. recommends that cracks 1/64-inch or greater in width in piles to be wrapped be epoxy injected. Other repairs will be the same as for system, 1 (Par 6-02.) except for the use of Tyfo materials.

a. Repairs to Piling.

(1) Pile No. 1. Clean and epoxy seal one hairline crack on the east and north faces (8" and 9" respectively, total of 17-inches) with Masterseal GP epoxy sealer or equal (Fyfe Co. does not have an epoxy sealer).

(2) Pile No. 2. Epoxy inject cracks on the south and west faces, 10 LF, with TYFO-111 low viscosity injection epoxy installed per manufactures instructions. Coat with TYFO CIS (corrosion inhibitor) 36 SF and 3 layer TYFO SEH-51 and SEH-51W system, 36 SF.

(3) Pile No. 3. Epoxy inject cracks on all faces with TYFO 111, 40 LF. Coat with TYFO C1S, 36 SF and wrap with 3 layer TYFO SEH-51 and SEH-51W system, 36 SF.

(4) Pile No. 4. No repairs required.

(5) Pile No. 5. Remove spalled offset southeast corner and restore to section with TYFO P self bonding patching material. Epoxy inject cracks in the north, south and east faces with TYFO-111, 13 LF coat with TYFO CIS, 36 SF, and wrap with 3 layer TYFO SEH-51 and SEH-51W System, 36 SF.

(6) Pile No. 6. No repairs required.

(7) Pile No. 7. Epoxy inject cracks in all faces with TYFO-111, 21 LF, Coat with TYFO CIS, 36 SF, and wrap with 3 layer TYFO SEH-51 and SEH-51W System, 36 SF.

(8) Pile No. 8. Epoxy seal hairline cracks, one on the south face and one on the west face, with Masterseal GP or equal, 1 LF.

b. Repairs to Top Deck, Bottom Side.

(1) North Overhang. Clean, chip and patch exposed chairs and accompanying spalls (approximately 2 square feet) and chip off, clean and patch spall at drip strip (approximately 3 square feet). Use TYFO P, self bonding patch material installed per manufacturers instructions.

(2) West Overhang. Chip out at exposed reinforcing supports along cracks in drip strips, epoxy inject cracks and patch at exposed reinforcing supports, 85-inches epoxy inject, 0.6 SF patch. Patch spall at the south end of the drip strip, 0.25 SF. Epoxy inject

other cracks, 50-inches. Epoxy inject cracks with TYFO 111, and patch with TYFO P, both installed per manufacturers instructions.

(3) South Overhang. Epoxy inject cracks, 18-inches. Chip and patch at exposed reinforcing bar and reinforcing support, 0.1 SF. Epoxy inject cracks with TYFO 111, and patch with TYFO P, both installed per manufacturers instructions.

(4) East Overhang. No repairs required.

(5) Area A. Chip and patch spalled areas at exposed reinforcing supports, 1 SF. Use TYFO P patching material.

(6) Area B. Chip and patch spalled areas (including areas at exposed reinforcing bars and reinforcing supports), 30 SF and epoxy inject cracks, 2 LF. Epoxy inject cracks with TYFO 111 and patch with TYFO P patching material, installed per manufacturers instructions.

c. Lower Deck, Top Side. Epoxy inject crack adjacent to north face of pile no. 4, 1 LF. Use TYFO 111 per manufacturers instructions.

d. Repairs to Support Beams.

(1) North/South Beam, West. Remove and replace spalled area in south end, 1 CF. Use TYFO P patching material. Epoxy inject cracks, 3 LF. Use TYFO 111. Apply 3 layer TYFO SEH-51 system to south 5 feet, bottom and west side, 16 SF.

(2) North/South Beam, East. On the bottom face chip and patch the exposed piece of nail or wire, and patch the small popout, 0.1 SF. Use TYFO P installed per manufacturers instructions. Epoxy seal the crack around the perimeter of the patch at the southeast concrete of pile no. 4, 0.5 LF. Use Masterbuilders Master Seal GP Epoxy sealer, or equal. No repairs required on side faces.

(3) North/South Beam, Middle. No repairs required.

(4) East/West Beam, North. On the bottom face, epoxy inject crack at northeast corner of pile no. 8, 0.4 LF, with TYFO 111. Chip and patch exposed nail and reinforcing support, and patch the small popout, 0.1 SF, using TYFO P patching material. No repairs on side faces.

(5) East/West Beam, South. On the bottom face epoxy inject transverse crack near midway between pile nos. 2 and 3, and 2 cracks west of pile no. 3, 3.0 LF, using TYFO 111. Chip and patch exposed reinforcing supports and nails (or wire), 4 SF, using TYFO P patching material. On the south face, at the west end, epoxy inject 2 cracks, 1 LF, using TYFO 111.

6-04. System No. 3. This system by Zinc Products Company uses their Altrista Lifejacket system to provide a galvanic corrosion protection system for the piling reinforcement. It consists of a fiberglass jacket lined with an expanded zinc mesh which during installation is connected to a pile reinforcement strand. The annular space between the jacket and the pile is filled with a sand-cement grout. Accordingly, repairs will be the same as presented for System No. 1 (paragraph 6-02) except pile nos. 2, 3, 5, and 7 will be encapsulated in the Lifejacket system instead of being encapsulated in the Masterbuilders APE system, and the spalled and offset (displaced) southeast corner of pile no. 5 would only require removal, no restoration. This system provides essentially no increase in the encapsulated pile's structural strength. The manufacturer recommends that repairs to piles to be encapsulated, such as those required for System No. 2 (paragraph 6-03), **not** be performed as they will have an adverse effect on the corrosion resistance provided by System No. 3.

6-05. System 3A. This system is the same as System 3 except that a larger (thicker) annular space is provided so that a cage of reinforcement can be placed therein, and a concrete grout (with aggregate, but no fly ash) is used to fill the annular space. This will provide additional structural strength for the encapsulated piles. The manufacturer will design the reinforcement and determine the thickness of the annular space (or have it done under his supervision).

SECTION VII - COST ESTIMATES

7-01. General. The following cost estimates are based on estimated costs provided by the manufacturers of the repair system products, supplemented by BCG estimates for work items the manufacturers had no data on, or declined to provide.

7-02. System No. 1. Master Builders, Inc. products. With this system, per Master Builders, Inc. recommendations, no repairs are to be made on pile nos. 2, 3, 5 and 7 except encapsulation with their APE process and restoration of the displaced southeast corner of pile no. 5. Estimated repair costs for this system are:

ITEM	QUANTITY	UNIT COST	TOTAL COST
1. Mob & Demob	Job	$3,000.00	$3,000.00
2. Epoxy Seal Cracks	3 LF	$4.00	$12.00
3. Epoxy Inject Cracks	23 LF	$31.00	$713.00
4. Epoxy Patching	41 SF	$82.00	$3,362.00
5. Restore Corner, Pile No. 5	1 CF	$344.00	$344.00
6. M Brace on N/S Beam, West	16 SF	$50.00	$800.00
7. Restore Corner, N/S Beam, West	1 CF	$344.00	$344.00
8. Encapsulate Pile Nos. 2, 3, 5 & 7	4 EA	$1,650.00	$6,600.00
9. Clean and Chip	Job	$5,500.00	$5,500.00
		Subtotal	$20,675.00
	Contingencies, 10% +/-		2,325.00
		TOTAL	**$23,000.00**

7-03. System No. 2. FYFE Co., Inc. products. Per recommendations of FYFE Co., pile nos. 2, 3, 5 and 7 will be repaired prior to wrapping them with the TYFO SEH-51 and SEH-51W systems. Estimated repair costs for this system are:

ITEM	QUANTITY	UNIT COST	TOTAL COST
1. Mob & Demob	Job	$2,000.00	$2,000.00
2. Epoxy Seal Cracks	3 LF	$5.00	$15.00
3. Epoxy Inject Cracks	107 LF	$25.00	$2,675.00
4. Epoxy Patching	41 SF	$15.00	$615.00
5. Restore Corner Pile No. 5	Job	$1,000.00	$1,000.00
6. SEH-51 on N/S Beam, West	16 SF	$35.00	$560.00
7. Restore Corner, N/S Beam, West	Job	$1,000.00	$1,000.00
8. Wrap Pile Nos. 2, 3, 5 & 7	146 SF	$35.00	$5,110.00

9.	Corrosion Inhibitor, Pile Nos. 2, 3, 5 & 7	146 SF	$3.00	$438.00
10.	Clean and Chip	Job	$5,500.00	$5,500.00
			Subtotal	$18,913.00
		Contingencies, 10% +/-		2,087.00
			TOTAL	**$21,000.00**

7-04. System No. 3. Zine Products Co. Lifejacket for encapsulating piles. This company does not manufacture any of the other products required for repairs. Other than using the Lifejacket for encapsulating pile nos. 2, 3, 5 and 7, repairs are the same as for System No. 1, except only removal of the spalled displaced southeast corner of pile no. 5 is required, no restoration. Estimated repair costs for this system are:

ITEM		QUANTITY	UNIT COST	TOTAL COST
1.	Mob & Demob	Job	$3,000.00	$3,000.00
2.	Epoxy Seal Cracks	3 LF	$4.00	$12.00
3.	Epoxy Inject Cracks	23 LF	$31.00	$713.00
4.	Epoxy Patching	41 SF	$82.00	$3,362.00
5.	Remove Corner, Pile No. 5	Job	$100.00	$100.00
6.	M Brace on N/S Beam, West	16 SF	$50.00	$800.00
7.	Restore Corner, N/S Beam, West	1 CF	$344.00	$344.00
8.	Encapsulate Pile Nos. 2, 3, 5 & 7	27.33 LF	$250.00	$6,832.50
9.	Clean and Chip	Job	$5,500.00	$5,500.00
			Subtotal	$20,663.50
		Contingencies, 10% +/-		2,336.50
			TOTAL	**$23,000.00**

7-05. System No. 3A. Same as System No. 3, except a larger (thicker) annular space with a reinforcing cage therein, and concrete grout, is provided. Estimated repair costs for this system are:

ITEM		QUANTITY	UNIT COST	TOTAL COST
1.	Mob & Demob	Job	$3,000.00	$3,000.00
2.	Epoxy Seal Cracks	3 LF	$4.00	$12.00
3.	Epoxy Inject Cracks	23 LF	$31.00	$713.00
4.	Epoxy Patching	41 SF	$82.00	$3,362.00
5.	Remove Corner, Pile No. 5	Job	$100.00	$100.00
6.	M Brace on N/S Beam, West	16 SF	$50.00	$800.00
7.	Restore Corner, N/S Beam, West	1 CF	$344.00	$344.00
8.	Encapsulate Pile Nos. 2, 3, 5 & 7*	27.33 LF	$375.00	$10,248.75
9.	Clean and Chip	Job	$5,500.00	$5,500.00
			Subtotal	$24,079.75
		Contingencies, 10% +/-		1,920.25
			TOTAL	**$26,000.00**

*** Includes resteel cage.**

7-06. Summary. Costs of repairs vary from an estimated low of $21,000 for System No. 2 to an estimated high of $26,000 for System No. 3A. Any of the four systems should provide adequate repairs, however, System No. 3 is less desirable since it will not enhance the strength of the encapsulated piles.

SECTION VIII - CONCLUSIONS AND RECOMMENDATIONS

8-01. Conclusions. The exposed reinforcing bars and corroded reinforcing supports noted on the underside of the top deck slab are the results of construction practices. The cracked and spalled area on the north/south west beam has probably existed since construction, having been exacerbated by the salt water environment causing corrosion of the reinforcement, via entrance through what was originally hairline, or slightly larger, cracks. The cracks in the piles have also probably existed since construction. At the time of construction the cracks were probably hairline or slightly larger in width. The cracks could have resulted from their manufacture, poor handling, either in the casting yard or on the job site, or driving problems. Patches on the tops of the piles indicate that the heads were spalled during driving. Corrosion of the pile reinforcement over the years has caused the reinforcement to expand in diameter, thus expanding the cracks. There is nothing to indicate that any of the defects could have been caused by improper operation or lack of maintenance on the part of the local interest, Plaquemines Parish.

8-02. Recommendations.

a. Contracting Procedures. It is recommended that repairs be accomplished using simplified acquisition procedures wherein the bidders will be required to visit the job site where Corps representatives will discuss the required work. In their bids, bidders shall be required to specify their proposed repair methods, including manufacturers data on all products to be used (crack sealers, epoxy injection material and installation methods, patching materials and installation, and methods and materials for encapsulating pile nos. 2, 3, 5 and 7). Where the manufacturer of an encapsulation system requires installation by an installer certified by the manufacturer, the bidders shall include the manufacturers certification in their

bid. Where system manufacturers of an encapsulation system do not require installation by an installer certified by the manufacturer, the bidder shall furnish information sufficient to establish satisfactory proficiency in installing required repair materials, and shall provide a letter from the encapsulation system manufacturer stating the manufacturer is satisfied that the bidder can satisfactorily install the manufacturer's system. The bids will then be evaluated, any changes to the technical part of the bids made, and best and final bids requested (if needed). The government will select the "best value" bid, not necessarily the "low bid." When evaluating the bids, those proposed systems that enhance the encapsulated pile's structural strength should be considered more desirable than those that do not. Any system proposed should be supported by a listing of projects where the system has been successfully used, including the owner's representatives phone number and address.

8-03. Suggested Specifications Language.

a. Scope of Work.

(1) Site Visit. Prospective bidders must visit the work site between the hours of _____ to _____, on _____. A roster of prospective bidders attending the site visit will be signed by a representative of each bidder. Attendance at the specified site visit is mandatory, and failure to do so shall result in the rejection of the bid of any prospective bidder who does not attend.

(2) Required Repairs.

(a) General. No work is required below the lower deck, however some work under water, and in damp and wet conditions will be required on the top surface of the lower deck and portions of the piling immediately above the lower deck.

(b) Pile nos. 2, 3, 5 and 7. These piles shall be encapsulated with a system that will enhance the structural strength of the piles and reduce the rate of corrosion of the pile reinforcement. The extent of repairs to these piles shall be as recommended by the manufacturer, subject to concurrence by the Contracting Officer. These piles shall encapsulated from the top surface of the lower deck to the bottom face of the upper deck support beams.

(c) Other Areas. On pile nos. 1, 4, 6 and 8, all cracks 1/64-inch or greater in width shall be epoxy injected and all other cracks shall be epoxy sealed. On the north/south, west, upper deck support beam, the entire spalled area on the south end of the beam (at the bottom/west corner of the beam) shall be removed to sound concrete and restored to its original section using an epoxy bonding agent and epoxy based patching material, or a self bonding epoxy based patching material, or approved equal. The west and bottom face of the beam through the length of the restored area shall, after restoration to section, be covered with a composite strengthening system such as those used for wrapping piles. On the top surface of the lower deck, the crack adjacent to the north face of pile no. 4 shall be sealed with an epoxy sealer suitable for underwater application. On the upper deck support beams and the underside of the top deck, at all areas of exposed ferrous metals the areas adjacent to the exposed metal shall be chipped to sound concrete. If more than ½-the diameter of the metal is exposed, the concrete around the exposed metal shall be removed such that a minimum of ½-inch clearance around the metal is provided for encapsulation with the patching material. The minimum depth of chipping required shall be that required to provide the minimum depth of patching material specified by the patching material manufacturer. All areas of loose and/or spalled concrete shall be chipped to sound concrete

and repaired as specified for areas of exposed metals. All cracks shall be repaired as specified for pile nos. 1, 4, 6 and 8.

b. Proposed Repair Method. Bidders, as part of their bid, shall specify the complete system they propose to utilize to accomplish all the required work. Bidders, at their option may submit multiple bids utilizing different systems, but each system must be proposed in a separate, independent, complete bid package. Bidders shall provide their methods, including types and capacities (size) of equipment to be used for cleaning and concrete removal, and epoxy injection of cracks.

c. System Acceptability. In order to demonstrate acceptability of a proposed system, the bidder shall as part of his bid package submit the following information.

(1) System manufacturer's company name, address, telephone number, and name of company representative who can answer questions about the system.

(2) Complete manufacturer's data on installation procedures and all materials to be used in the required work, whether provided by the system manufacturer or not.

(3) A listing of projects where the system has been utilized. This listing shall include the project owners name, address and telephone number, type of project, type of repairs, and date of installation of the system. If available, a point of contact for the owner shall also be included.

d. Contractor Qualifications. For systems where the system manufacturer utilizes certified contractors to accomplish the work, the bidder shall submit with his bid package a letter from the system manufacturer, signed by a responsible officer of the firm, stating that the contractor is qualified to perform all the required work. If the system manufacturer does not utilize certified contractors, the contractor (bidder) shall submit

written evidence to establish that he has the necessary equipment and qualified personnel to accomplish the required work.

8-04. Recommended Construction Schedules.

a. Required Construction Time. Based on conversations with system manufacturers it is estimated that a maximum of 3 to 4 weeks will be required to accomplish the required work. This includes time for mobilization and demobilization.

b. Recommended Calendar Time Periods for Construction. Because of the potential effects of temperatures on some epoxy compounds, and the fact that some of the work will require the workers to work in shallow water, the work should be scheduled when air and water temperatures at the work site are moderate. Also the work should not be scheduled during the hurricane season because of the possibility of a required evacuation. The recommended "window" for accomplishing the work is between 1 March and 1 June.

c. Urgency of Accomplishing Repairs. Subject to availability of funding, it is recommended that the repairs be accomplished during calendar year 2000. The repairs should not be delayed beyond calendar year 2001 because of continued deterioration of the damaged features of the structure and increased costs due to cost escalations of labor, materials, and equipment.