



US Army Corps  
of Engineers  
St. Paul District

---

# **OPERATION AND MAINTENANCE MANUAL**

**ENVIRONMENTAL MANAGEMENT PROGRAM (HREP)**

**FINGER LAKES**

**WABASHA COUNTY, MINNESOTA**

**DECEMBER 1994**

## PREFACE

The Finger Lakes Habitat Rehabilitation and Enhancement Project, constructed by the Corps of Engineers, was completed in July, 1994. In accordance with Section 906(e) of the Water Resources Development Act of 1986 and the policies set forth in the Fourth and Fifth Annual Addendums, the U.S. Fish and Wildlife Service has the responsibility for operation and maintenance. The Corps of Engineers has prepared this manual to assist in fulfilling the operation and maintenance tasks.

The manual and appendices contain the latest approved agreements, maps, drawings, tables, and references pertinent to operation and maintenance of this project. The project as designed and constructed will improve fish habitat in the Finger Lakes, located immediately below the L/D 4 dike. However, continued successful functioning of the project will depend upon the manner in which the project is maintained. Careful inspection and proper maintenance can help accomplish that goal.

The planning, design, and construction of the project was the result of an extensive cooperative effort on the part of the involved Federal and State agencies and the public. The continuation of this cooperation and coordination as part of the operation and maintenance of the project will be important to the success of the project and is strongly recommended.

DEPARTMENT OF THE ARMY  
St. Paul District, Corps of Engineers  
Army Corps of Engineers Centre, 190 Fifth Street East  
St. Paul, Minnesota 55101-1638

UPPER MISSISSIPPI RIVER SYSTEM  
ENVIRONMENTAL MANAGEMENT PROGRAM

FINGER LAKES  
POOL 5, UPPER MISSISSIPPI RIVER  
WABASHA COUNTY, MINNESOTA

OPERATION AND MAINTENANCE MANUAL

TABLE OF CONTENTS

<u>ITEM</u>	<u>PAGE</u>
PREFACE	
INTRODUCTION	1
PART I - PROJECT FEATURES AND CONSTRUCTION HISTORY	2
AUTHORIZATION AND LOCATION	2
DESCRIPTION OF PROJECT	2
General	2
Design Considerations	3
CONSTRUCTION HISTORY	4

ITEM CONT'D

PAGE

PART II - OPERATION AND MAINTENANCE	5
GENERAL RESPONSIBILITIES AND PROCEDURES	5
Approved Responsibilities	5
District Manager	5
Improvements or Alterations	6
Procedure for Reviewing Operation and Maintenance Responsibilities	6
Annual Report	6
OPERATION	7
MAINTENANCE	9
General Inspection and Maintenance	9
Repair Materials	10
INSPECTIONS, TESTS, AND OPERATIONS FOLLOWING MAJOR STORMS OR FLOODS	10
General	10
Project Rehabilitation/Abandonment	10
Project Monitoring and Evaluation	11

APPENDICES

A	PROJECT DRAWINGS
B	MEMORANDUM OF AGREEMENT
C	CHECKLIST FORM COVERING INSPECTIONS
D	GATE MANUFACTURER'S MAINTENANCE INSTRUCTIONS AND PARTS LIST
E	GATE OPERATING CURVES
F	CONSTRUCTION SPECIFICATION SECTIONS FOR REPAIR MATERIAL

## INTRODUCTION

This manual has been prepared to serve as a guide for the operation and maintenance of the Finger Lakes Habitat Rehabilitation and Enhancement Project in Wabasha County, Minnesota. Operation and maintenance instructions for the major features of the project are presented. These instructions are consistent with the general procedures found in the Finger Lakes Definite Project Report dated May 1990. This manual has been written for project and management personnel familiar with the project. It does not contain detailed information which is common knowledge to personnel or which is presented in other existing manuals or regulations.

The intent of the maintenance instructions is to present preventive maintenance information consisting of systematic inspections and subsequent corrective actions which should ensure long-term use of project features. A timely maintenance program prevents major damage to constructed features by early corrective action.

For ease in use, this manual is divided into two sections.

Part I. This section describes the project features and provides historical information on the project.

Part II. This section gives details on the operation and maintenance of the project.

## PART I - PROJECT FEATURES AND CONSTRUCTION HISTORY

### AUTHORIZATION AND LOCATION

The Finger Lakes project was authorized under the provisions of the 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99- 662). The Finger Lakes project area is located in pool 5 of the Upper Mississippi River, approximately 7 miles below Wabasha, Minnesota, and across the river from Alma, Wisconsin. The Finger Lakes lie immediately below the earthen dike at lock and dam 4 (L/D 4). The project lies within the Upper Mississippi River National Wildlife and Fish Refuge. Project drawings (appendix A) show the location of the Finger Lakes and project features.

Because the Finger Lakes project is located on Federal lands managed as a National Wildlife Refuge, operation and maintenance are to be carried out in compliance with Section 906(e) of the 1986 Water Resources Development Act and policies set forth in the Fourth and Fifth Annual Addendums.

### DESCRIPTION OF PROJECT

#### General

Prior to construction of the lock and dam system, what are now known as the Finger Lakes were a series of backwater sloughs. Construction of the L/D 4 dike in the 1930's resulted in the cutting off of these sloughs from the area above the dike. Impoundment of pool 5 increased water levels such that these sloughs became shallow backwater lakes. Five lakes make up the Finger Lakes. Beginning in order from the Minnesota mainland they

are Clear Lake, Lower Peterson Lake, Third Lake, Second Lake, and First Lake. In the 1960's, the Corps of Engineers installed a 48-inch culvert through the L/D 4 dike to provide fresh water flows to Lower Peterson Lake. The District has recently installed a slide gate control structure on this culvert.

The Finger Lakes Habitat Rehabilitation and Enhancement Project was designed to provide fresh water flows to First, Second, Third, and Clear Lakes to alleviate dissolved oxygen depletion problems in these lakes to improve fish habitat. The project consists of gated culverts installed in the L/D 4 dike to provide these flows. The Definite Project Report/Environmental Assessment (SP-7), Finger Lakes Habitat Rehabilitation and Enhancement Project, May 1990, provides details on the overall project.

## Design Considerations

The gated culverts (36-inch) for supplying water to Clear and Third Lakes were designed to provide a maximum of 50 cfs to each of these lakes. The gated culvert supplying water to First and Second Lakes was also designed to supply a maximum of 50 cfs to each lake. Because this structure has to provide this flow for both lakes, the culvert was sized at 48 inches. A junction box located below the dike allows for the splitting of the flows to the two lakes. The gates in the culverts are sluice gates with mechanical lifters powered by a portable electric operator. The gates in the junction box are slide gates, also to be lifted using the portable electric operator.

Each structure has stoplogs to allow the closing off of flow for gate maintenance. To control debris, each structure has wooden pilings placed a short distance above the inlets to catch larger wooden debris, and a trash rack designed to catch smaller debris.

## **CONSTRUCTION HISTORY**

A contract was awarded to ABE Construction Co., 2525 Nevada Avenue North, Golden Valley, Minnesota 55427 in September, 1992. Construction began in November 1992 with clearing and grubbing and other earthwork. The summer flood of 1993 delayed construction on the structures until late July 1993. The construction of the structures was essentially completed in November, 1993, allowing operation of the project during the winter of 1993-94. Miscellaneous work and project cleanup was completed in July 1994.

## PART II - OPERATION AND MAINTENANCE

### GENERAL RESPONSIBILITIES AND PROCEDURES

#### Approved Responsibilities

Operation and maintenance responsibilities for the Finger Lakes habitat project were originally outlined in the Definite Project Report. The acceptance of these responsibilities was formally recognized by an agreement signed by the U.S. Fish and Wildlife Service (USFWS) and the St. Paul District, Corps of Engineers. This agreement, dated January 3, 1992, is contained in appendix B. The capability of the USFWS to carry out the maintenance responsibilities described below will be contingent upon the passage of sufficient appropriations by Congress.

Annual operation and maintenance costs estimated during the preparation of the Definite Project Report were \$10,500 for the First/Second Lake and Clear Lake structures. With the addition of the responsibility for the Third Lake structure, annual operation and maintenance costs are expected to be approximately \$15,000.

#### District Manager

Typically, the USFWS operation and maintenance responsibility for habitat projects is given to the district manager in charge of that portion of the appropriate National Wildlife Refuge. For the Finger Lakes project, the current address for the district manager is District Manager, U.S. Fish and Wildlife Service, 51 East 4th Street, Winona, Minnesota 55987. Hereafter, for the purposes of this manual, when describing responsibilities, etc., the term "District Manager" will be used.

### Improvements or Alterations

It is understood that improvements and alterations to any portion of the habitat project that would affect the ability of that element to function as intended to meet the project's habitat goals and objectives would be coordinated with other involved agencies.

### Procedure for Reviewing Operation and Maintenance Responsibilities

The District Engineer or his representative will be kept informed on operation and maintenance activities for the Finger Lakes habitat project through a periodic inspection of the project by the Corps and through analysis of an annual inspection checklist submitted by the USFWS. The Corps will inspect the project with a USFWS representative at least every other year and at other times as may be required. The Corps should contact the District Manager so that a mutually convenient date can be set up for the joint inspection. The findings of these inspections will be transmitted to the USFWS and could include recommendations for any remedial work considered necessary to maintain the habitat project in a satisfactory operating condition. Any agreed upon remedial work should be completed as soon as possible by the USFWS as provided in the Memorandum of Agreement between the USFWS and the Corps.

### Annual Report

A checklist report covering inspection, operation, and maintenance of the habitat project shall be submitted each year to the District Engineer. The USFWS may send the Finger Lakes report in conjunction with reports on other habitat projects for which it has responsibility. If so desired, these reports can be sent to the Corps with the annual Cooperative Agreement Report which is done every April by the USFWS. A sample copy of the checklist can

be found in appendix C. Besides completion of the inspection checklist, each individual report should briefly summarize the condition of the entire system, including any maintenance work done during the past 1-year period.

## **OPERATION**

The structures are to be operated by the USFWS to provide flow to First, Second, Third, and Clear Lakes to improve fish habitat conditions. The basic purpose of the project is to alleviate dissolved oxygen depletion problems in the lakes during the winter (ice-cover) period. Late summer dissolved oxygen depletion has also been identified as a problem in these lakes. No predetermined operating plan was developed during project planning. At the time it was believed that providing 10 cfs flow to each of the lakes should be sufficient to prevent the winter dissolved oxygen depletion problems. The structures were designed to provide up to 50 cfs flow to each lake to provide a margin of safety to meet unforeseeable habitat requirements.

The Finger Lakes are the subject of a biological response monitoring study currently scheduled to be completed in 1996. During the period of the study, the structures will be operated to provide flows suggested by preliminary study results and/or to assist in the study itself. Following completion of the study the USFWS, in cooperation with State resource management agencies, will use the study results to develop a long-term operating plan for the structures.

The gates should be operated in accordance with the manufacturer's instructions (appendix D). Appendix E contains information that can be used to in determining the proper gate settings to achieve desire flow rates.

Two gates were placed on the downstream junction box for First/Second Lakes to increase the flexibility of directing flows to the lakes. However, this configuration could create a potential dam safety problem if the conduit flows are controlled only the downstream gates. For this reason, one of the gates in the junction box has been locked in the open position. The key to the gate will be held by the dam operating personnel and a change in which gate is locked open must be coordinated with them.

The Corps of Engineers reserves the right to take over operation of the structures as needed during emergency conditions to protect the structural integrity of the L/D 4 dike. During those times, the Corps of Engineers would be fully responsible for the project.

## **MAINTENANCE**

### **General Inspection and Maintenance**

The established points and times at which the required inspections should be made were developed through coordination between the Corps of Engineers and the USFWS during the preparation of plans and specifications for this project. After the habitat project has been in operation for 5 years, the Corps and the USFWS will review these inspection activities for adequacy. The frequency and nature of the inspections may be modified by mutual written agreement.

#### **Inspection**

The inspection of the project should be made by the District Manager at a minimum frequency of once a year. The frequency for inspection will be subject to review by the USFWS and Corps and could change upon mutual agreement of both parties. The timing of the inspection can be made at the discretion of the District Manager. Inspections should also be made after any flood whose elevation exceeds 669.0 feet msl at the lock 4 headwater gage.

#### **Maintenance**

Maintenance of the structures will be accomplished on an as needed basis such that the structures are maintained in an operable condition. The manufacturer's maintenance instructions for the sluice and slide gates are contained in appendix D.

All exposed rock surfaces should be kept free of plant growth. Displaced or missing rock should be replaced as soon as possible to prevent erosion damage to protected areas.

Excavated channels should be kept free of plant growth (especially woody plants) as much as possible to reduce the accumulation of sediment and other debris in the channels.

### **Repair Materials**

The manufacturer's parts list for the sluice and slide gates are contained in appendix D. All other repairs on the structures should use comparable materials to those used in the original construction. Applicable sections of the construction specification are included in appendix F.

## **INSPECTIONS, TESTS, AND OPERATIONS FOLLOWING MAJOR STORMS OR FLOODS**

### **General**

As stated in the Memorandum of Agreement between the USFWS and the Corps, the Corps will be responsible for any mutually agreed upon repair and rehabilitation of the Finger Lakes project that exceeds the annual maintenance requirements and that may be needed as a result of a specific storm or flood. The project will be inspected as previously described, following flood events producing a water surface elevation greater than 669.0 feet msl at the lock 4 headwater gage.

### **Project Rehabilitation/Abandonment**

Should inspection of the project area following a major flood or natural disaster disclose substantial damage to the entire project that appears to exceed the annual operation and maintenance as specified in this manual and the Definite Project Report, the Corps and USFWS should meet and discuss the appropriate course of action in light of original project design. The inspections by the

District Manager and the joint inspections with the Corps will be the basis for determining maintenance responsibility by the U.S. Fish and Wildlife Service versus potential rehabilitation by the Corps of Engineers. Repair of damage attributable to lack of maintenance would be considered a U.S. Fish and Wildlife Service responsibility.

The options of rehabilitation or abandonment of the project may be considered at this time. Any decision would be carried forth only upon written mutual agreement of the USFWS and the Corps. Included within such agreement would be a description of the agreed upon course of action and funding responsibilities, if any. The Minnesota Department of Natural Resources will be consulted prior to coming to any final determination on a course of action.

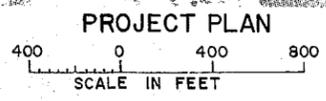
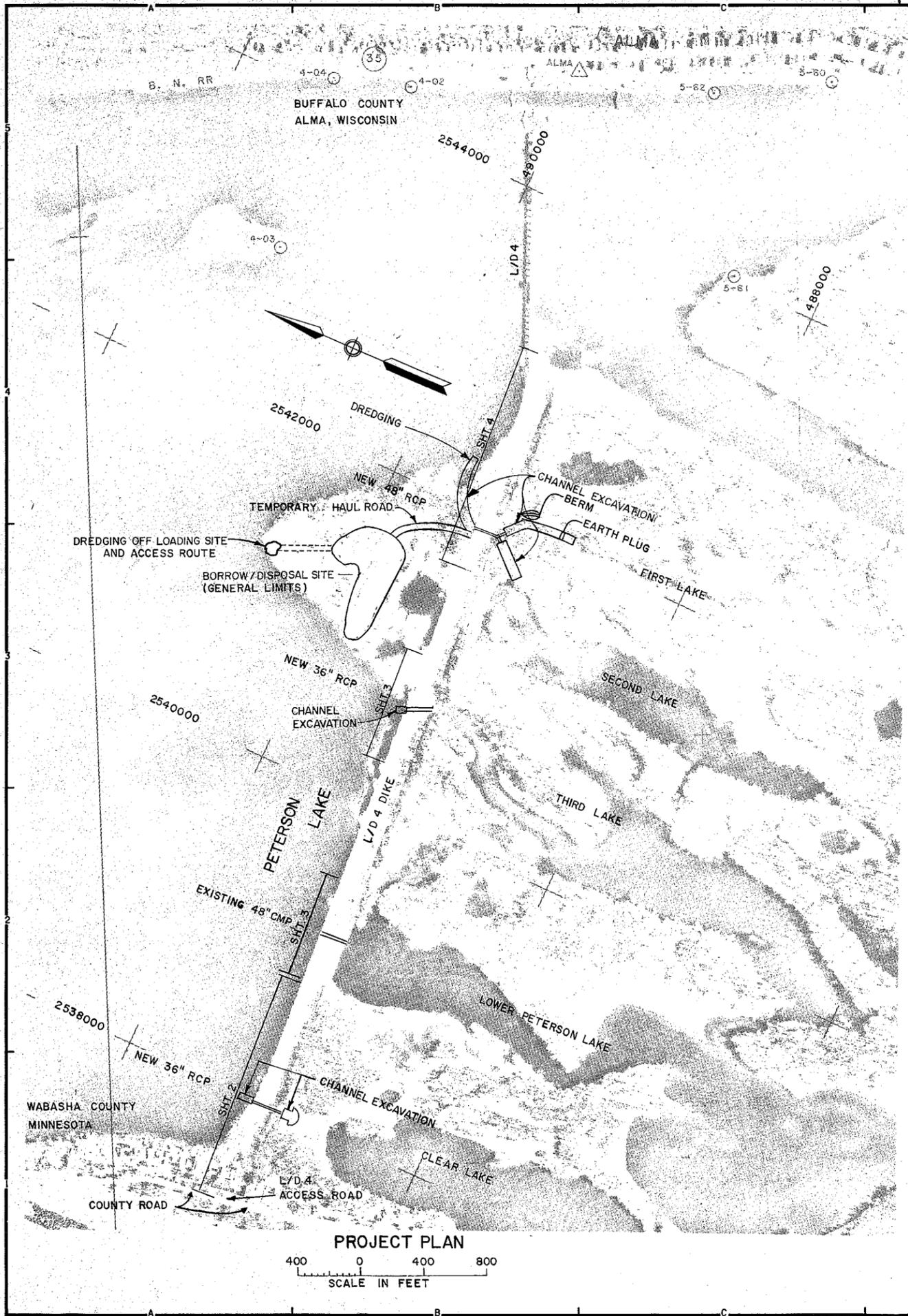
#### Project Monitoring and Evaluation

The Finger Lakes project is the subject of an extensive biological response monitoring effort. Pre-project monitoring of the project area was initiated in 1991, and involved extensive water quality monitoring, bathymetry measurements, hydrology studies, vegetation surveys, and macroinvertebrate and fisheries surveys. This monitoring program is an interagency effort involving the National Fisheries Research Center (La Crosse, Wisconsin), the Environmental Management Technical Center (Onalaska, Wisconsin), the Corps of Engineers Waterways Experiment Station (Vicksburg, Mississippi), and the Minnesota Department of Natural Resources.

The results of these extensive studies are presented in annual interim reports and a final report to be prepared at the end of the study. The National Fisheries Research Center and the Environmental Management Technical Center are responsible for the coordination of the preparation of these reports. The final report is scheduled for the spring of 1997.

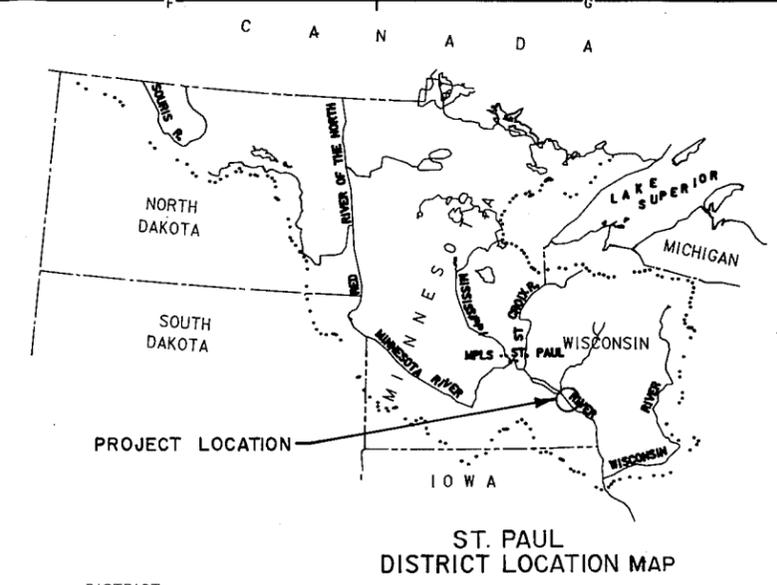
**APPENDIX A**

**PROJECT DRAWINGS**

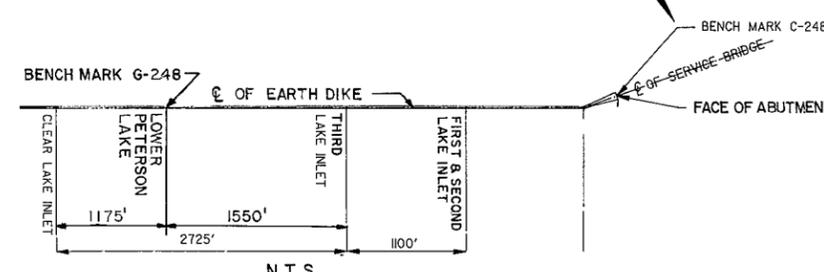


CONTRACT DRAWING INDEX		
DRAWING NO.	SHT.	DESCRIPTION
M-P4-10/4	1	LOCATION MAP, PROJECT PLAN & DRAWING INDEX
M-P4-64/1	2	CLEAR LAKE, SITE PLAN
M-P4-64/2	3	THIRD & LOWER PETERSON LAKE, SITE PLAN
M-P4-64/3	4	FIRST & SECOND LAKE, SITE PLAN
M-P4-64/4	5	CLEAR LAKE INLET, PLAN AND SECTIONS
M-P4-64/5	6	CLEAR LAKE OUTLET, PLAN AND SECTIONS
M-P4-64/6	7	THIRD LAKE INLET, PLAN AND SECTIONS
M-P4-64/7	8	THIRD LAKE OUTLET, PLAN AND SECTIONS
M-P4-64/8	9	FIRST/SECOND LAKE INLET, PLAN AND SECTIONS
M-P4-64/9	10	FIRST/SECOND LAKE OUTLET, PLAN AND SECTIONS
M-P4-64/10	11	CLEAR & THIRD LAKE CULVERTS, PROFILES
M-P4-64/11	12	FIRST/SECOND LAKE CULVERT, CULVERT & INLET EXCAVATION PROFILES
M-P4-64/12	13	FIRST & SECOND LAKE OUTLET CULVERTS/CHANNELS, PROFILES
M-P4-64/13	14	HEADWALL-PLAN SECTION, DETAILS AND TABLE
M-P4-64/14	15	HEADWALL REINFORCEMENT, PLAN SECTIONS & DETAILS
M-P4-64/15	16	HEADWALL GRATING, TRASH RACK & RAILING, PLAN, SECTIONS & DETAILS
M-P4-64/16	17	FIRST/SECOND LAKE JUNCTION BOX, PLAN & SECTIONS
M-P4-64/17	18	GRATING, LADDER & GRAB BAR, ELEVATIONS, SECTIONS & DETAILS
M-P4-64/18	19	FENCE-PLANS, SECTIONS & DETAILS
M-P4-64/19	20	STORAGE BUILDING, PLAN, SECTION & DETAILS
M-P4-64/20	21	PETERSON LAKE HEADWALL, PLAN & SECTIONS
M-P4-64/21	22	PETERSON LAKE HEADWALL, SECTIONS & DETAILS
M-P4-64/22	23	STORAGE BUILDING, LOCATION PLAN & ELEVATION

REFERENCE DRAWINGS		
DRAWING NO.	SHT.	DESCRIPTION
M-L4-52/1-FS	R1	EARTH DIKE-PLAN, DOWNSTREAM ELEVATION & TYPICAL SECTION
M-L4-10/14-FS	R2	DAM, BORINGS
M-L4-64/1	R3	CULVERT THRU DIKE @ STA. 58+53, PLANS, SECTIONS AND DETAILS
M-P4-67/1	R4	TRASH RACK FOR EXISTING HEADWALL @ STA. 58+53, PLAN, SECTIONS AND DETAILS
M-P4-14/1	R5	HYDROGRAPHS-POOL 4 (1981-1990)
M-P4-14/2	R6	HYDROGRAPHS-TAILWATER 4 (1981-1984)
M-P4-14/3	R7	HYDROGRAPHS-TAILWATER 4 (1985-1990)
M-P4-14/4	R8	ELEV DURATION CURVES-POOL 4 (JAN. TO AUG. OF 1971-90)
M-P4-14/5	R9	ELEV DURATION CURVES-POOL 4 (SEPT. TO DEC. OF 1971-90)
M-P4-14/6	R10	ELEV DURATION CURVES-TAILWATER (JAN. TO AUG. OF 1971-90)
M-P4-14/7	R11	ELEV DURATION CURVES-TAILWATER (SEPT. TO DEC. OF 1971-90)
M-P4-10/5	R12	BORING LOGS; 85-5M, 6M & 7M
M-P4-10/6	R13	BORING LOGS; 91-19M, 20M & 21M



- NOTES:**
- TO CONVERT 1929 ADJ NGVD BENCH MARKS C-248 OR G-248 TO 1912 ADJ NGVD (CONTRACT DRAWING ELEVATIONS) ADD 0.486 FEET.
  - C-248, EL. 676.488 IS SET IN THE TOP OF THE SOUTHWEST CONCRETE LAND WALL AND FOUNDATION FOR THE PIERS WHICH SUPPORT THE SERVICE BRIDGE FOR THE LOCK AND DAM AND 1.8 FEET NORTHWEST OF THE NORTHWEST FACE OF THE MOST SOUTHWESTERLY CONCRETE PIER.
  - G-248, EL. 688.932 IS SET IN THE TOP OF THE WEST END OF THE NORTH CONCRETE HEADWALL OF A 9 X 8 FOOT SLUICWAY GATE 43 FEET NORTH OF THE CENTER LINE OF THE LEVEE AND ABOUT 8 FEET BELOW THE LEVEL OF THE LEVEE.
  - SEE REF. DRAWING M-L4-52/1-FS FOR HORIZONTAL STATIONING.



5. VICINITY MAP IS FROM AN AERIAL TAKEN 11-8-81.  
 6. TOPOGRAPHY IS FROM AN AERIAL TAKEN 11-2-86.  
 A. VERTICAL CONTROL IS BASED ON N.G.V.D. ADJUSTMENT (1912)  
 B. HORIZONTAL CONTROL IS BASED ON THE STATE PLANE COORDINATE SYSTEM

SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET, AS INDEXED ON THIS SHEET.

APPROVAL RECOMMENDED BY:

CHIEF ED-DJ BRANCH  
 CHIEF ED-GH BRANCH  
 CHIEF ENGINEERING DIVISION

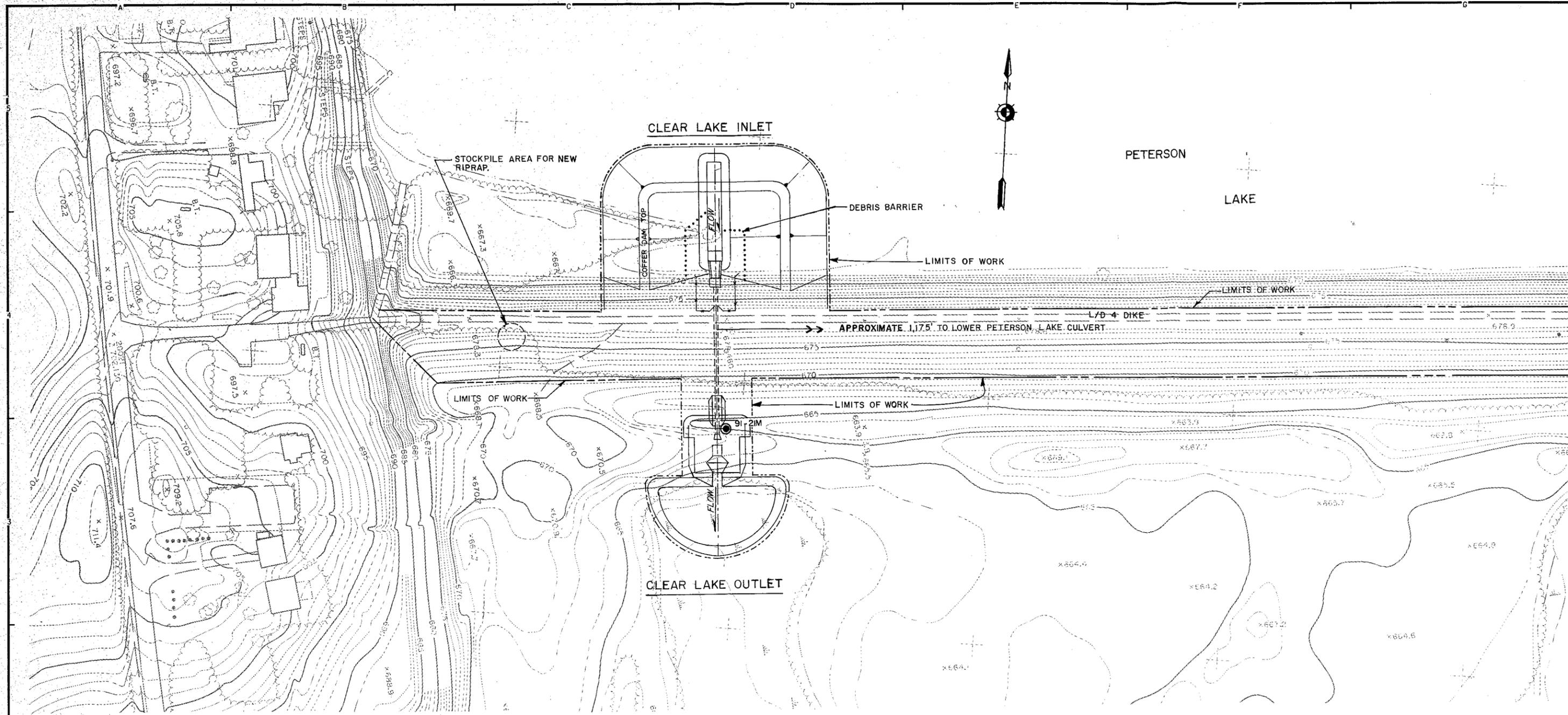
APPROVED BY:  
 COL., CORPS OF ENGINEERS



ENGINEER MANAGER  
 CHIEF SPECS. & TECH. SUPPORT SECTION  
 CHIEF GENERAL ENGINEERING SECTION  
 CHIEF STRUCTURAL SECTION  
 CHIEF MECH/ELEC/ARCH SECTION  
 CHIEF HYDRAULICS SECTION  
 CHIEF HYDROLOGY SECTION  
 CHIEF GEOTECHNICAL DESIGN SECTION

AS - BUILT AS OF COMPLETION DATE		11/94	A.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM FINGER LAKE AERATION CULVERTS	
CHECKED: JBM		MISSISSIPPI RIVER WARASHA CO., MN	
DRAWN: SKM/GRS		AERATION CULVERTS IN L/D 4 DIKE LOCATION MAP, PROJECT PLAN AND DRAWING INDEX	
DESIGNED:		CAD FILE NAME: MP4104.DGN	
CHECKED:		DRAWING NUMBER:	
DATE: APRIL 1992		SHT 1	
SPEC NO: DACW37-92-R-0004		OF 23	
M-P4-10/4			

AS - BUILT



CLEAR LAKE SITE PLAN

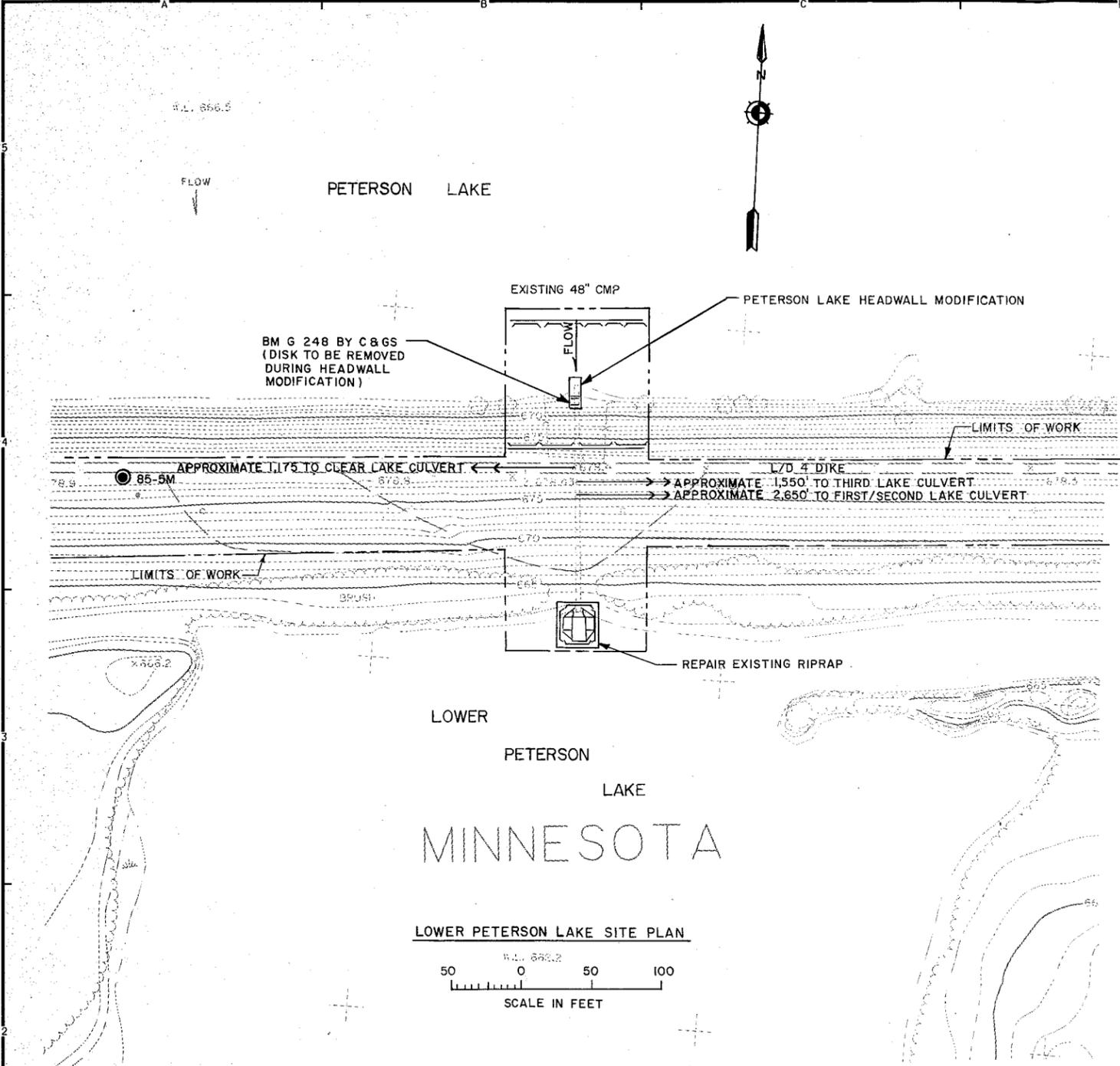


REFERENCES:  
 PLAN AND SECTIONS - INLET  
 - OUTLET  
 PROFILES - CULVERT

DWG. NO.  
 M-P4-64/4  
 M-P4-64/5  
 M-P4-64/10

- GEN ENG
- HYD
- HYDR
- GEOTECH
- S
- MEA

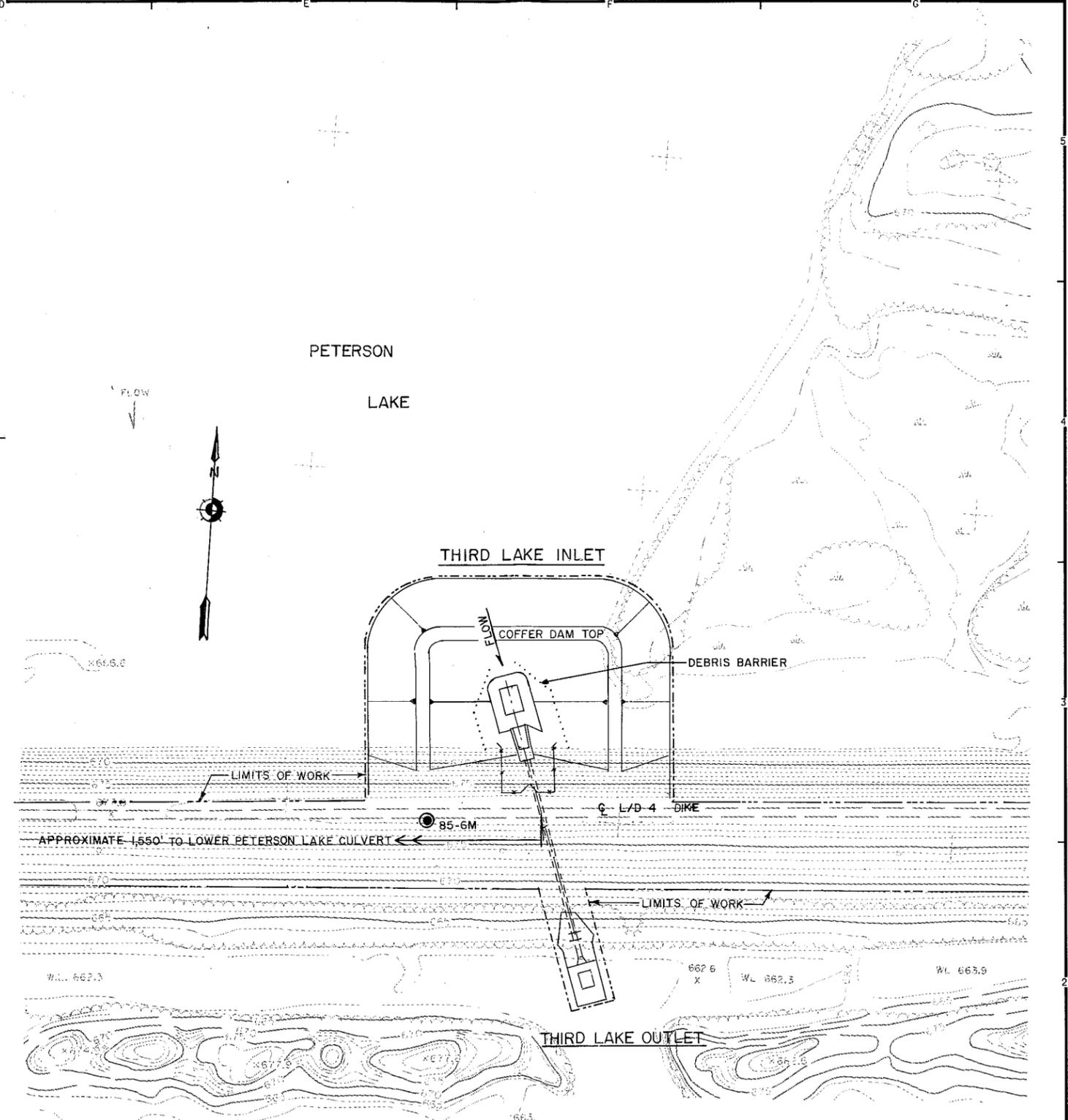
AS - BUILT AS OF COMPLETION DATE		11/94	<i>[Signature]</i>
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN CLEAR LAKE SITE PLAN	
DESIGNED: G.B.	CHECKED: JBM	CAD FILE NAME:	DRAWING NUMBER:
DESIGNED: <i>[Signature]</i>	CHECKED: <i>[Signature]</i>	DATE: 12-30-91	SPEC NO: DACW3792-R-0004
		M-P4-64/1	SHT 2 OF 23



**LOWER PETERSON LAKE SITE PLAN**  
 SCALE IN FEET  
 0 50 100

**REFERENCE DWG.**  
 CULVERT THRU DIKE AT STA. 58+53 M-L4-64/1  
 TRASH RACK FOR EXISTING HEADWALL AT STA. 58+53 M-P4-67/1

**REFERENCES:**  
 HEADWALL PLAN AND SECTIONS M-P4-64/20



**THIRD LAKE SITE PLAN**  
 SCALE IN FEET  
 0 50 100

**REFERENCES:**  
 PLAN AND SECTIONS-INLET M-P4-64/6  
 PROFILE-CULVERT M-P4-64/7  
 M-P4-64/10

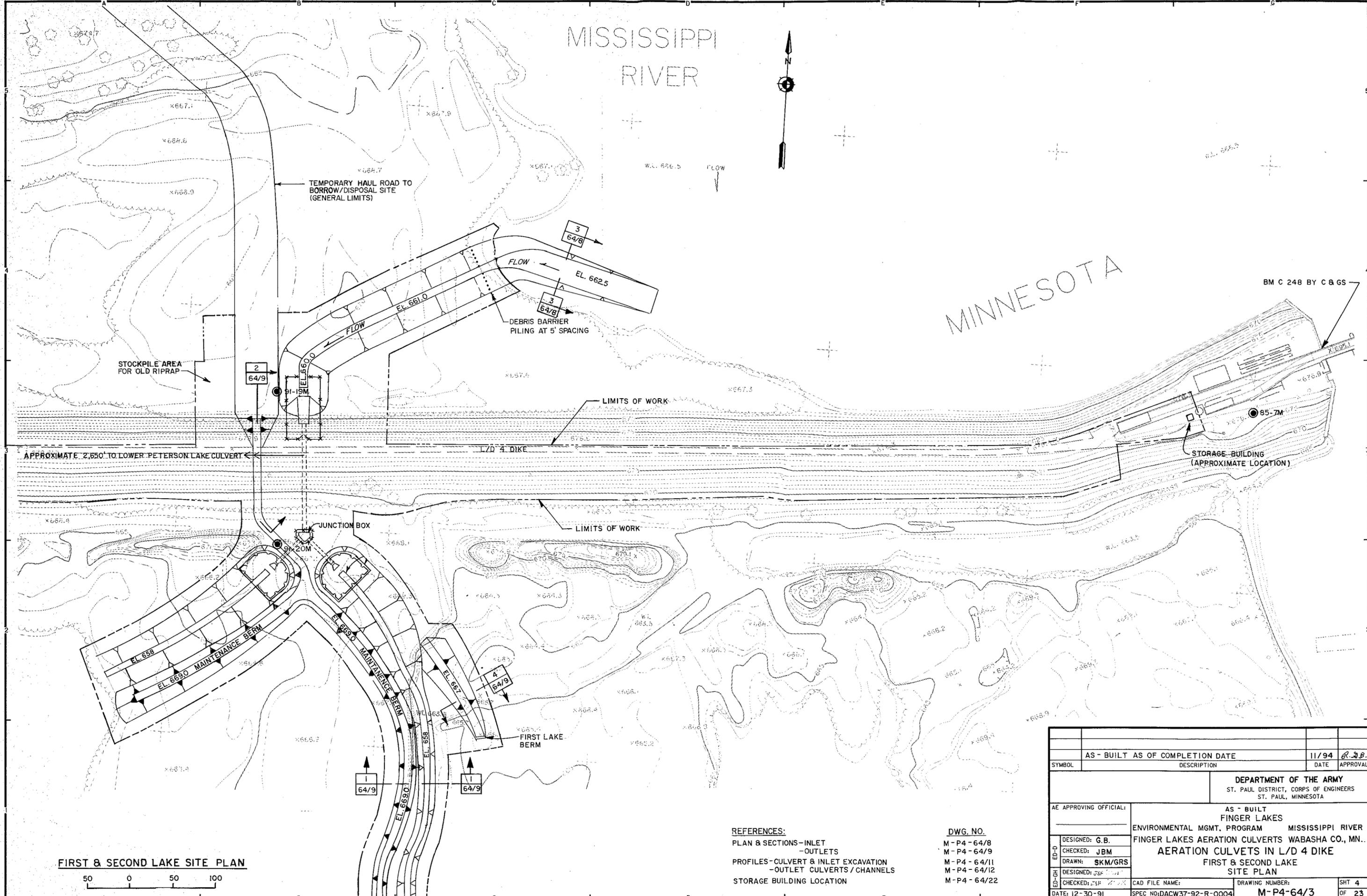
AS - BUILT AS OF COMPLETION DATE		11/94	R.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		<b>AS - BUILT</b> FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT, PROGRAM MISSISSIPPI RIVER	
CHECKED: JBM		FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
DRAWN: GRS/SKM		<b>AERATION CULVERTS IN L/D 4 DIKE</b>	
DESIGNED: JSH/MPW		<b>THIRD &amp; LOWER PETERSON LAKE</b>	
CHECKED: JSH/MPW		<b>SITE PLAN</b>	
DATE:	CAD FILE NAME:	DRAWING NUMBER:	SHT 3
	SPEC NO: DACW37-92-4-0004	<b>M-P4-64/2</b>	OF 23

- GEN ENG
- HYD
- HYDR
- GEOTECH
- ST
- MEA

# MISSISSIPPI RIVER

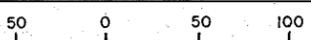


MINNESOTA



- GEN ENG
- HYD
- HYDR
- GEOTECH
- S
- MEA

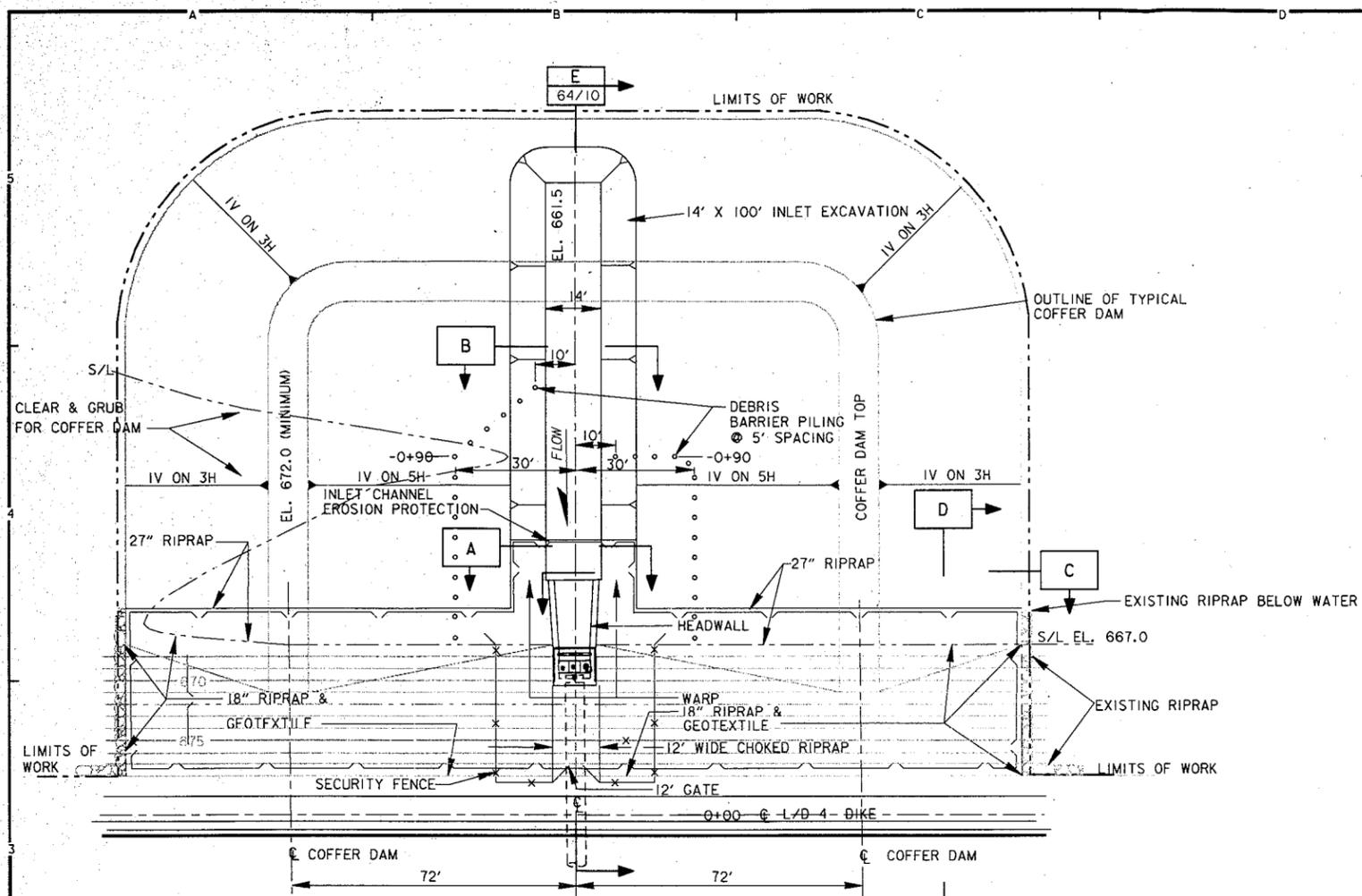
FIRST & SECOND LAKE SITE PLAN



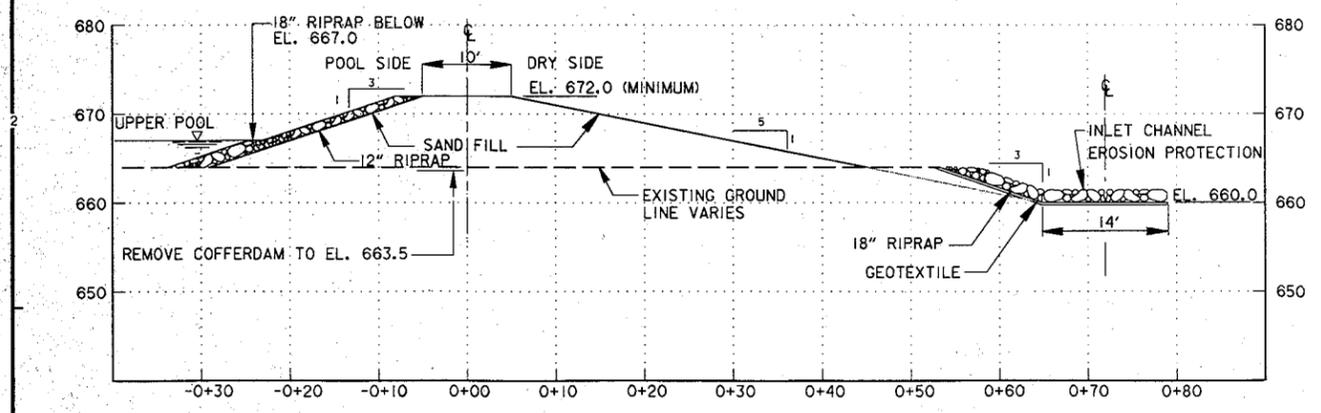
**REFERENCES:**  
 PLAN & SECTIONS—INLET  
 —OUTLETS  
 PROFILES—CULVERT & INLET EXCAVATION  
 —OUTLET CULVERTS / CHANNELS  
 STORAGE BUILDING LOCATION

**DWG. NO.**  
 M-P4-64/8  
 M-P4-64/9  
 M-P4-64/11  
 M-P4-64/12  
 M-P4-64/22

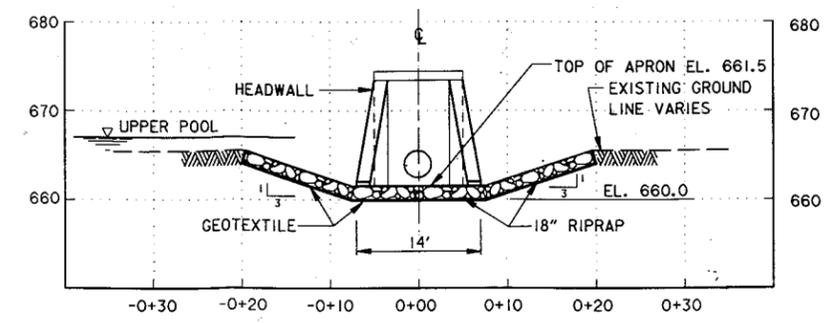
AS - BUILT AS OF COMPLETION DATE		11/94	R.J.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER	
CHECKED: JBM		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
DRAWN: SKM/GRS		AERATION CULVERTS IN L/D 4 DIKE	
DESIGNED: JSP		FIRST & SECOND LAKE	
CHECKED: JSP		SITE PLAN	
DATE: 12-30-91		CAD FILE NAME:	DRAWING NUMBER: M-P4-64/3
		SPEC NO: DACW37-92-R-0004	SHT 4 OF 23



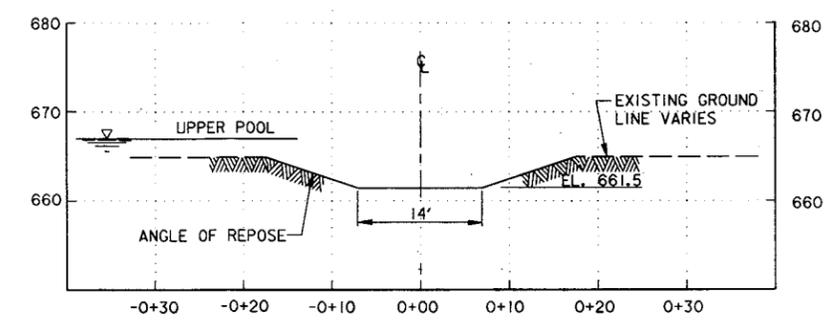
**CLEAR LAKE INLET PLAN**  
SCALE IN FEET



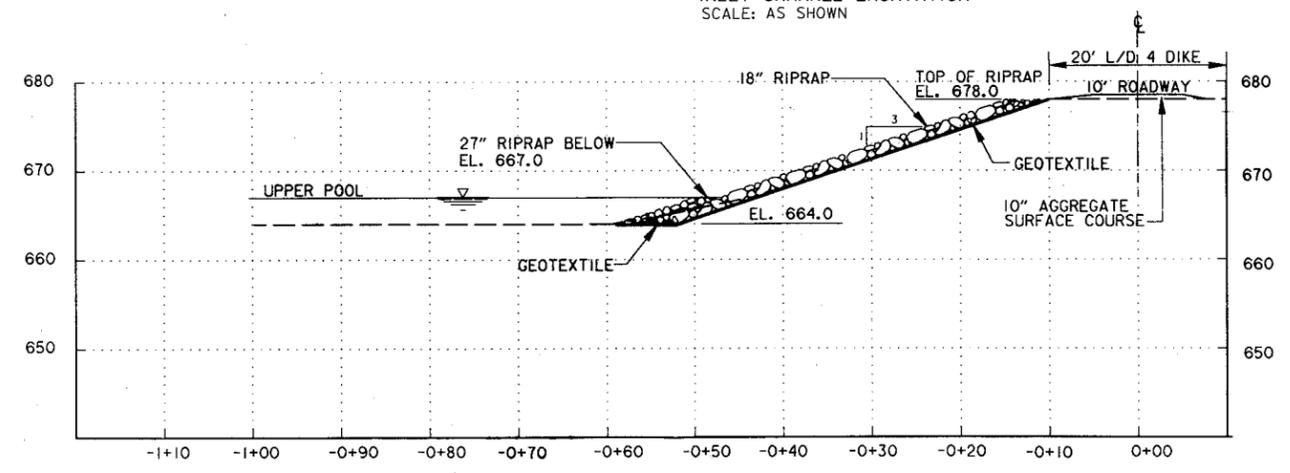
**SECTION C**  
TYPICAL COFFERDAM  
SCALE: AS SHOWN



**SECTION A**  
TYPICAL INLET CHANNEL EROSION PROTECTION  
SCALE: AS SHOWN



**SECTION B**  
TYPICAL INLET CHANNEL EXCAVATION  
SCALE: AS SHOWN



**SECTION D**  
TYPICAL DIKE PROTECTION  
SCALE: AS SHOWN

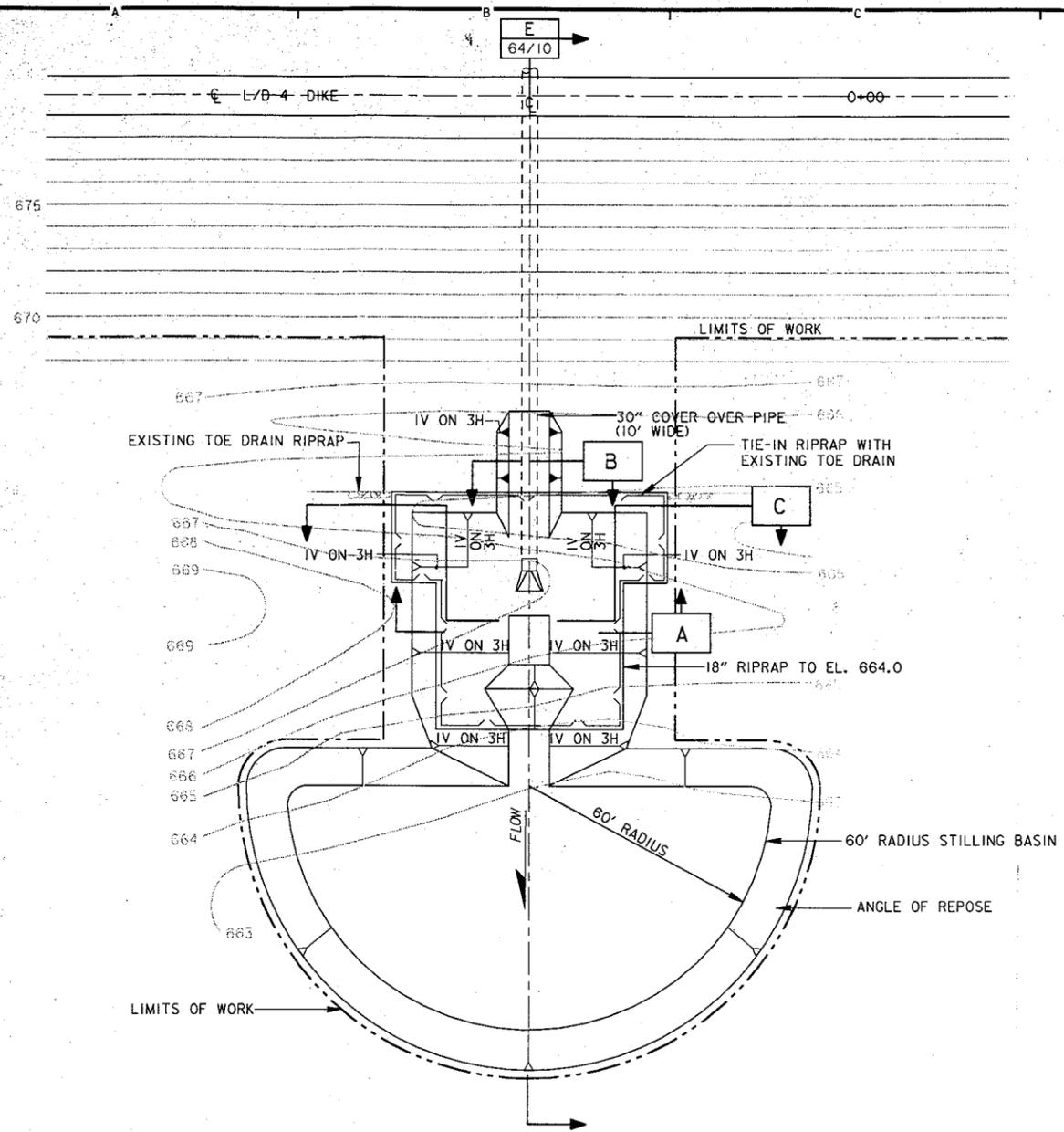
**REFERENCE DWG.**  
EARTH DIKE EMBANKMENT BORINGS

**DWG. NO.**  
M-L4-52/1-FS  
M-L4-10/14-FS

**REFERENCES:**  
SITE PLAN-CLEAR LAKE PROFILES-CLEAR & THIRD LAKE CULVERTS PLAN, SECTION, DETAILS & TABLE-HEADWALL PLAN, SECTIONS & DETAILS-FENCE

**DWG. NO.**  
M-P4-64/1  
M-P4-64/10  
M-P4-64/13  
M-P4-64/18

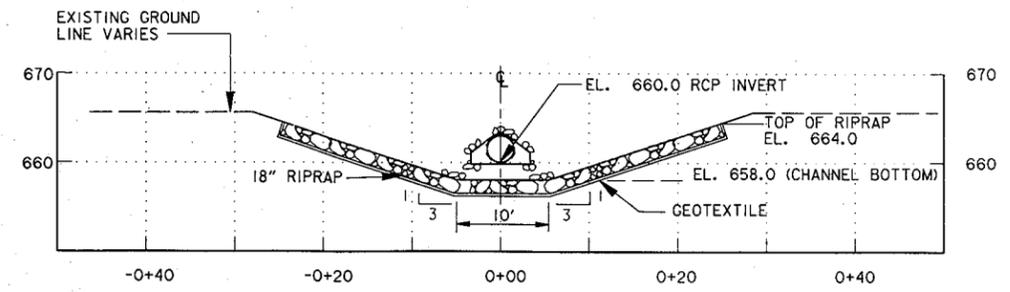
AS-BUILT AS OF COMPLETION DATE		11/94	APPROVAL
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER	
CHECKED: JBM		FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
DRAWN: T.J.		<b>AERATION CULVERTS IN L/D 4 DIKE</b>	
DESIGNED: JSH/AMK		CLEAR LAKE INLET	
CHECKED: JSH/AMK		PLAN AND SECTIONS	
DATE: APRIL, 1992	CAD FILE NAME: MFO4POOF.DGN	DRAWING NUMBER:	SHT 5
	SPEC NO: DACW37-92-R-0004	<b>M-P4-64/4</b>	OF 23



**PLAN**  
**CLEAR LAKE OUTLET**

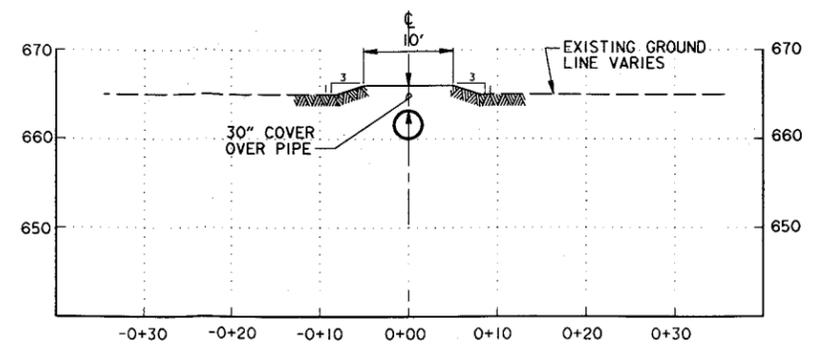
20 0 20 40

SCALE IN FEET



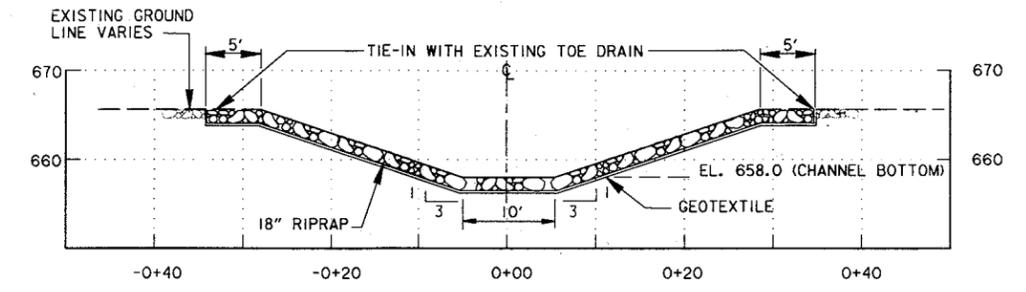
**SECTION**  
**TYPICAL**  
**OUTLET CULVERT PROTECTION**

SCALE: AS SHOWN



**SECTION**  
**TYPICAL**  
**OUTLET PIPE COVER**

SCALE: AS SHOWN



**SECTION**  
**TYPICAL**  
**OUTLET PROTECTION**

SCALE: AS SHOWN

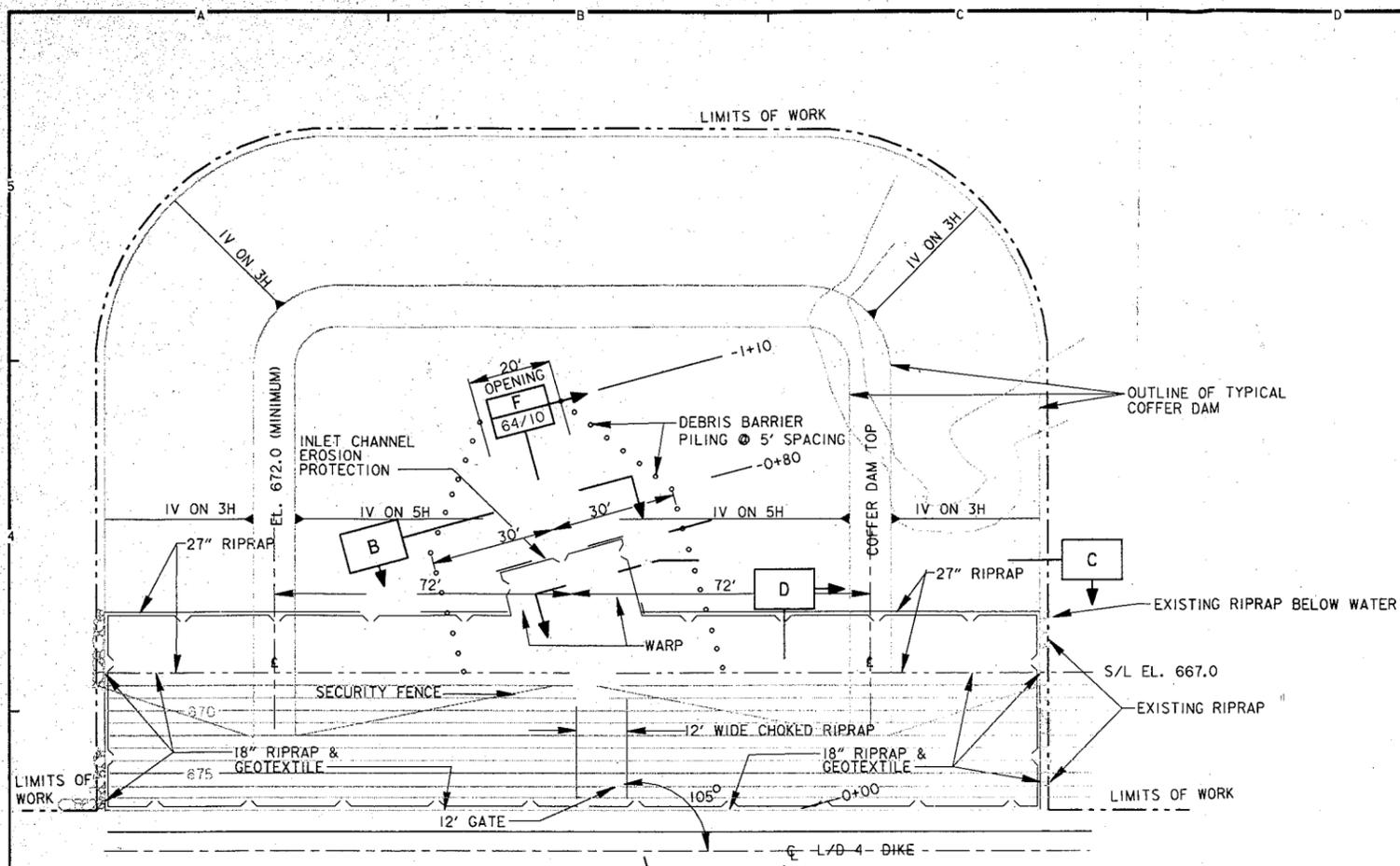
**REFERENCE DWG.**  
EARTH DIKE  
EMBANKMENT BORINGS

**DWG. NO.**  
M-L4-52/1-FS  
M-L4-10/14-FS

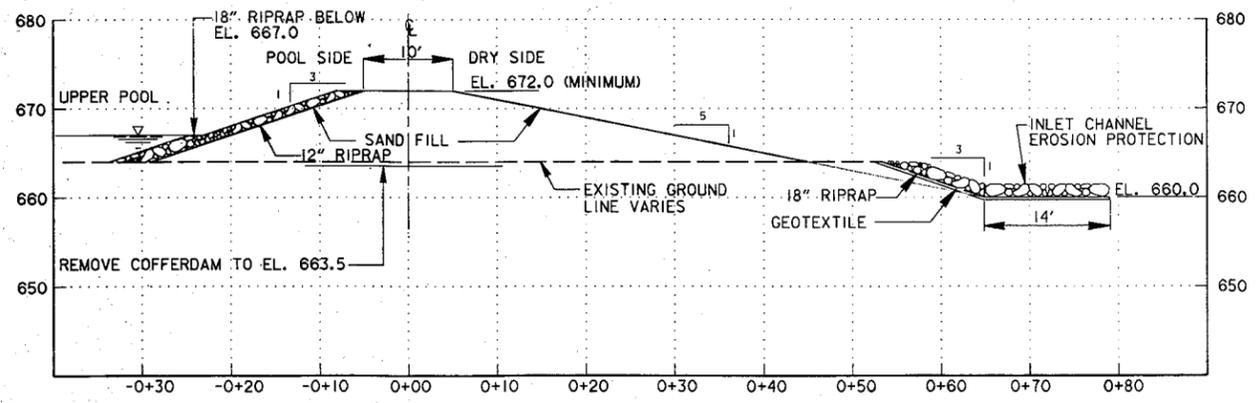
**REFERENCES:**  
SITE PLAN-CLEAR LAKE  
PROFILES-CLEAR & THIRD LAKE CULVERT

**DWG. NO.**  
M-P4-64/1  
M-P4-64/10

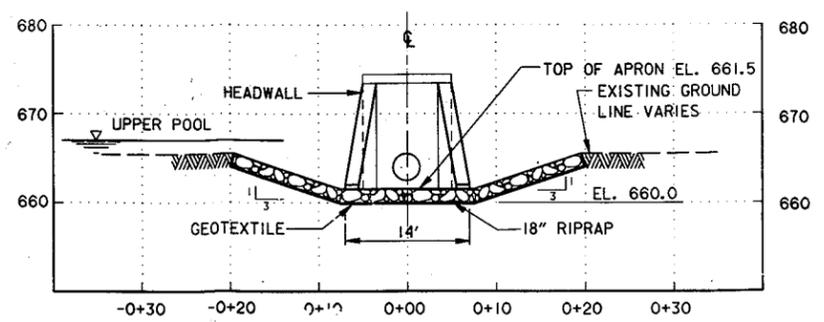
AS-BUILT AS OF COMPLETION DATE		11/94	JWB
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER	
CHECKED: JBM		FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
DRAWN: T.J.		<b>AERATION CULVERTS IN L/D 4 DIKE</b>	
DESIGNED: JSH/AMK		CLEAR LAKE OUTLET	
CHECKED: JSH/AMK		PLAN AND SECTIONS	
DATE: APRIL, 1992	SPEC NO: DACW37-92-R-0004	DRAWING NUMBER: M-P4-64/5	SHT 6 OF 23



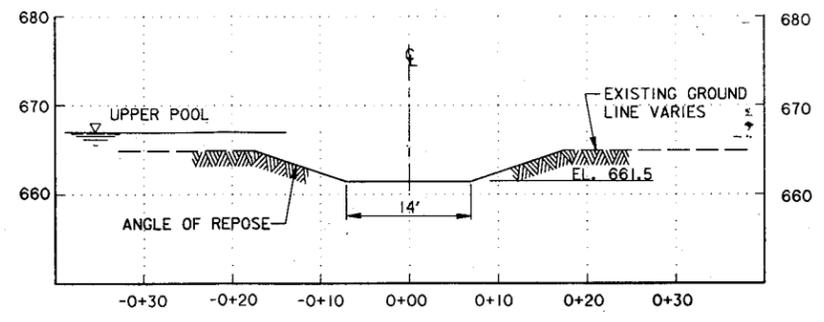
PLAN  
THIRD LAKE INLET  
SCALE IN FEET



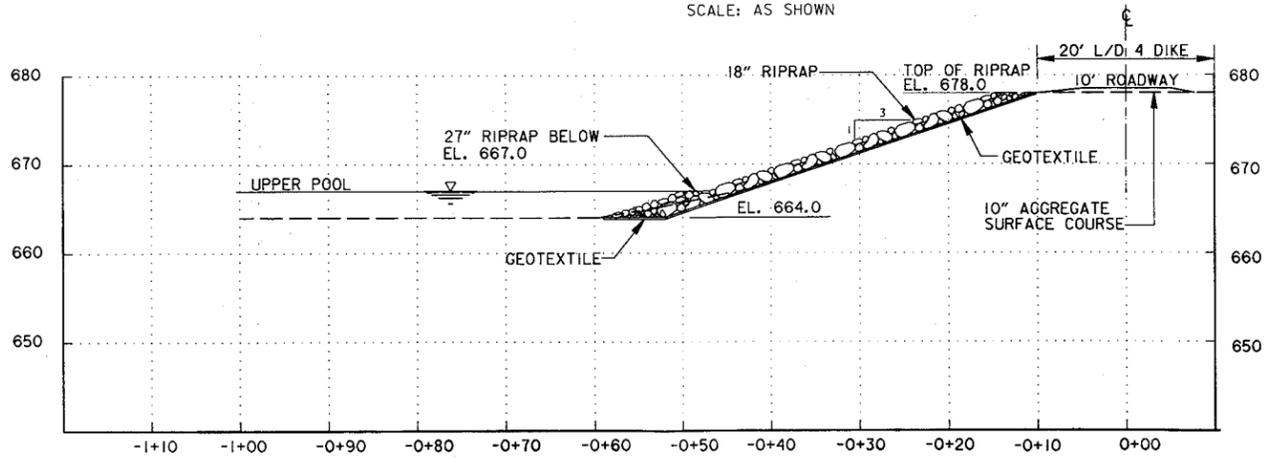
SECTION  
TYPICAL COFFERDAM  
SCALE: AS SHOWN



SECTION  
TYPICAL  
INLET CHANNEL EROSION PROTECTION  
SCALE: AS SHOWN



SECTION  
TYPICAL  
INLET CHANNEL EXCAVATION  
SCALE: AS SHOWN



SECTION  
TYPICAL  
DIKE PROTECTION  
SCALE: AS SHOWN

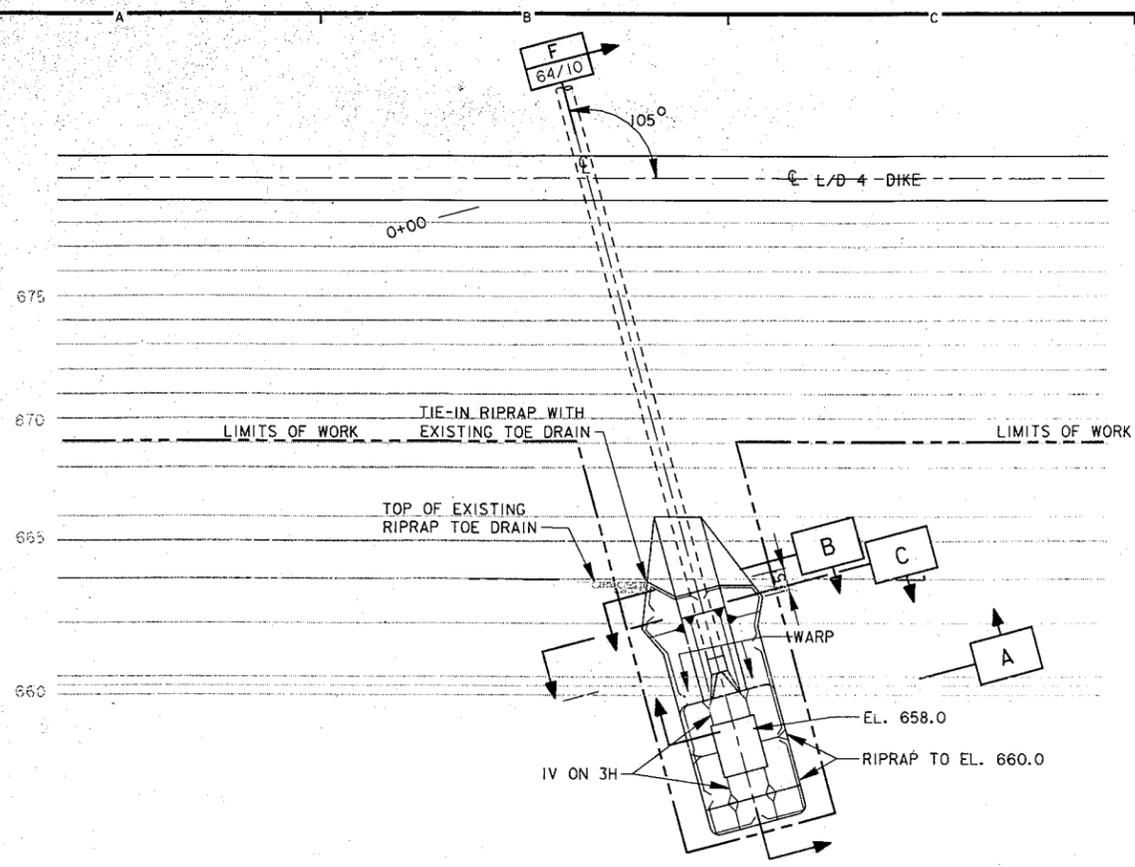
REFERENCE DWG.  
EARTH DIKE  
EMBANKMENT BORINGS

DWG. NO.  
M-L4-52/1-FS  
M-L4-10/14-FS

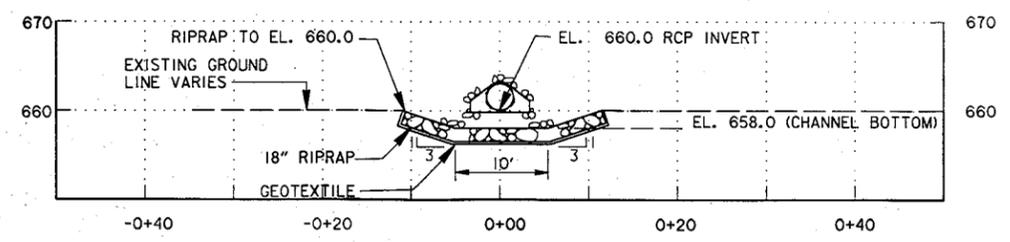
REFERENCES:  
SITE PLAN-THIRD & PETERSON LAKE  
PROFILES-CLEAR & THIRD LAKE CULVERT  
PLAN, SECTION, DETAILS & TABLE-HEADWALL  
PLAN, SECTIONS & DETAILS-FENCE

DWG. NO.  
M-P4-64/2  
M-P4-64/10  
M-P4-64/13  
M-P4-64/18

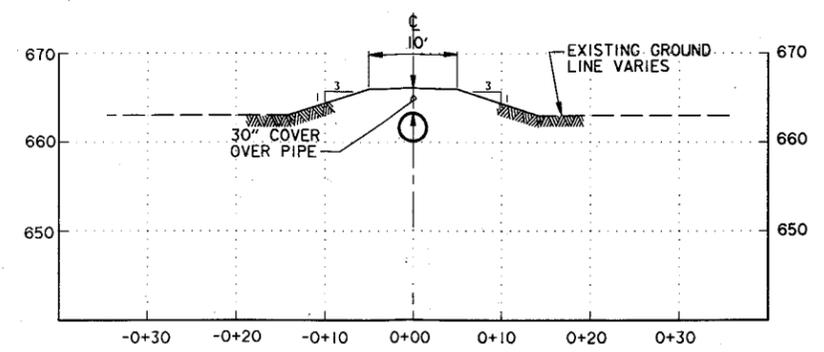
AS-BUILT AS OF COMPLETION DATE		11/94	J.H.E.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM	
CHECKED: JBM		MISSISSIPPI RIVER	
DRAWN: T.J.		FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
DESIGNED: JSH/AMK		THIRD LAKE INLET	
CHECKED: JSH/AMK		PLAN AND SECTIONS	
DATE: APRIL, 1992	CAD FILE NAME: MFO4POOH.DGN	DRAWING NUMBER:	SHT 7
	SPEC NO: DACW37-92-R-0004	M-P4-64/6	OF 23



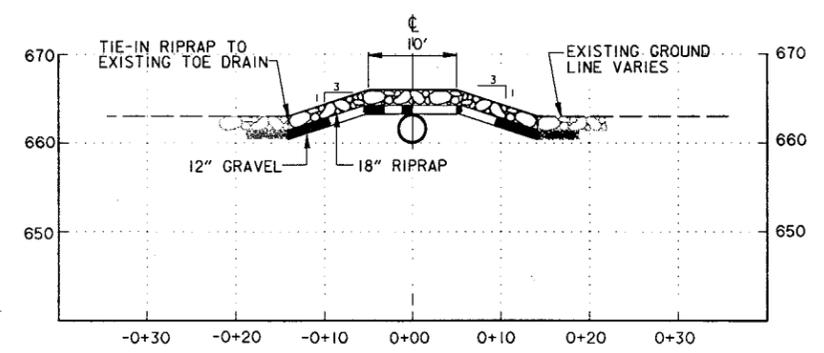
**PLAN**  
THIRD LAKE OUTLET  
SCALE IN FEET  
0 20 40



**SECTION**  
A  
TYPICAL  
OUTLET CULVERT/CHANNEL EROSION PROTECTION  
SCALE: AS SHOWN



**SECTION**  
B  
TYPICAL  
OUTLET CULVERT COVER  
SCALE: AS SHOWN



**SECTION**  
C  
TYPICAL  
OUTLET CULVERT PROTECTION  
SCALE: AS SHOWN

**REFERENCE DWG.**  
EARTH DIKE  
EMBANKMENT BORINGS

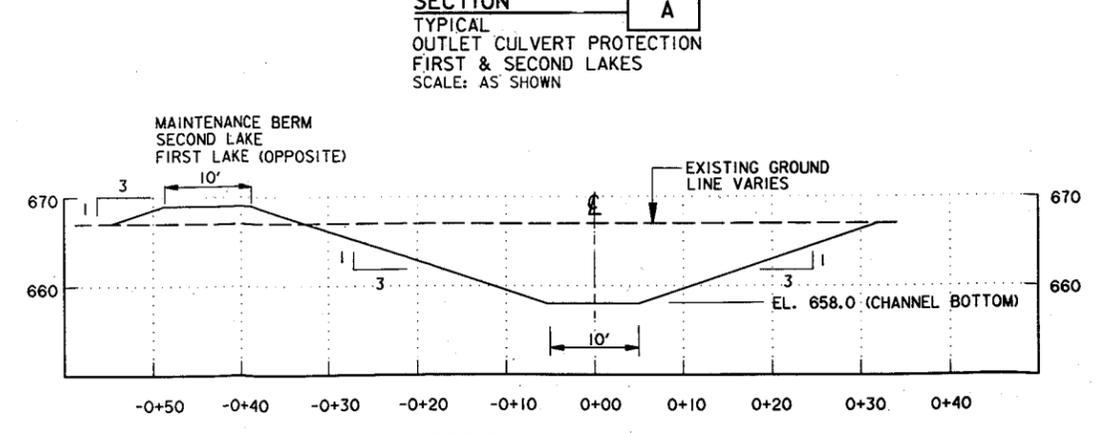
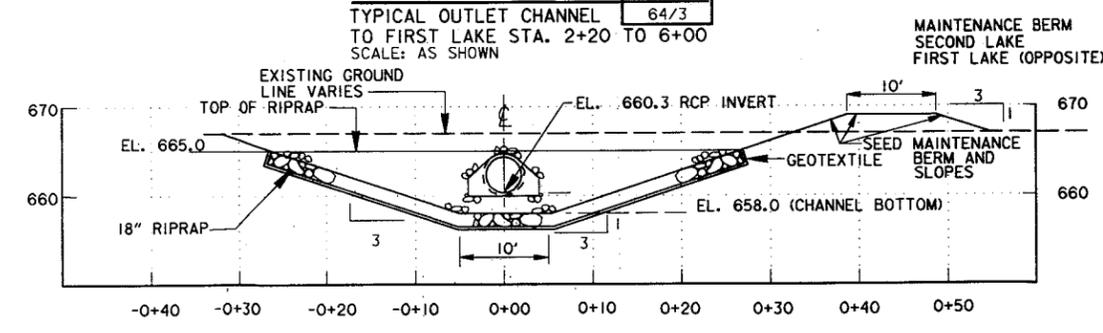
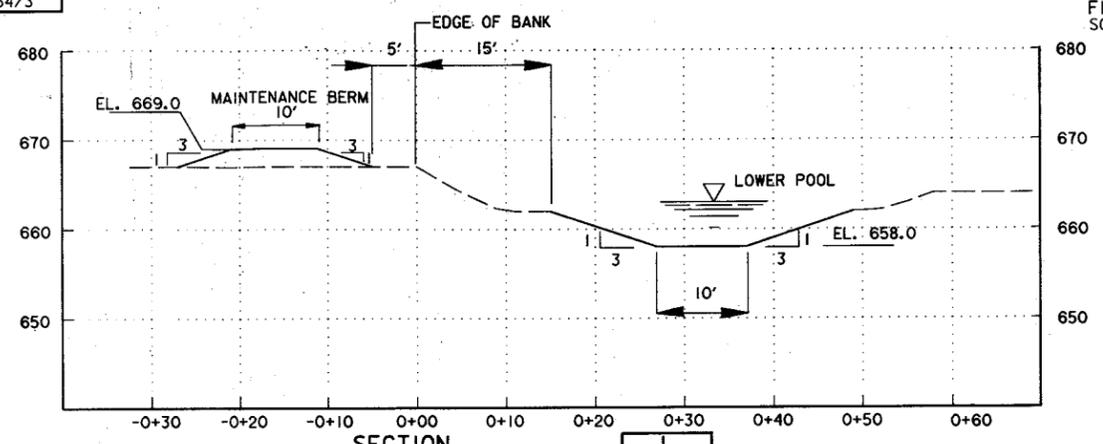
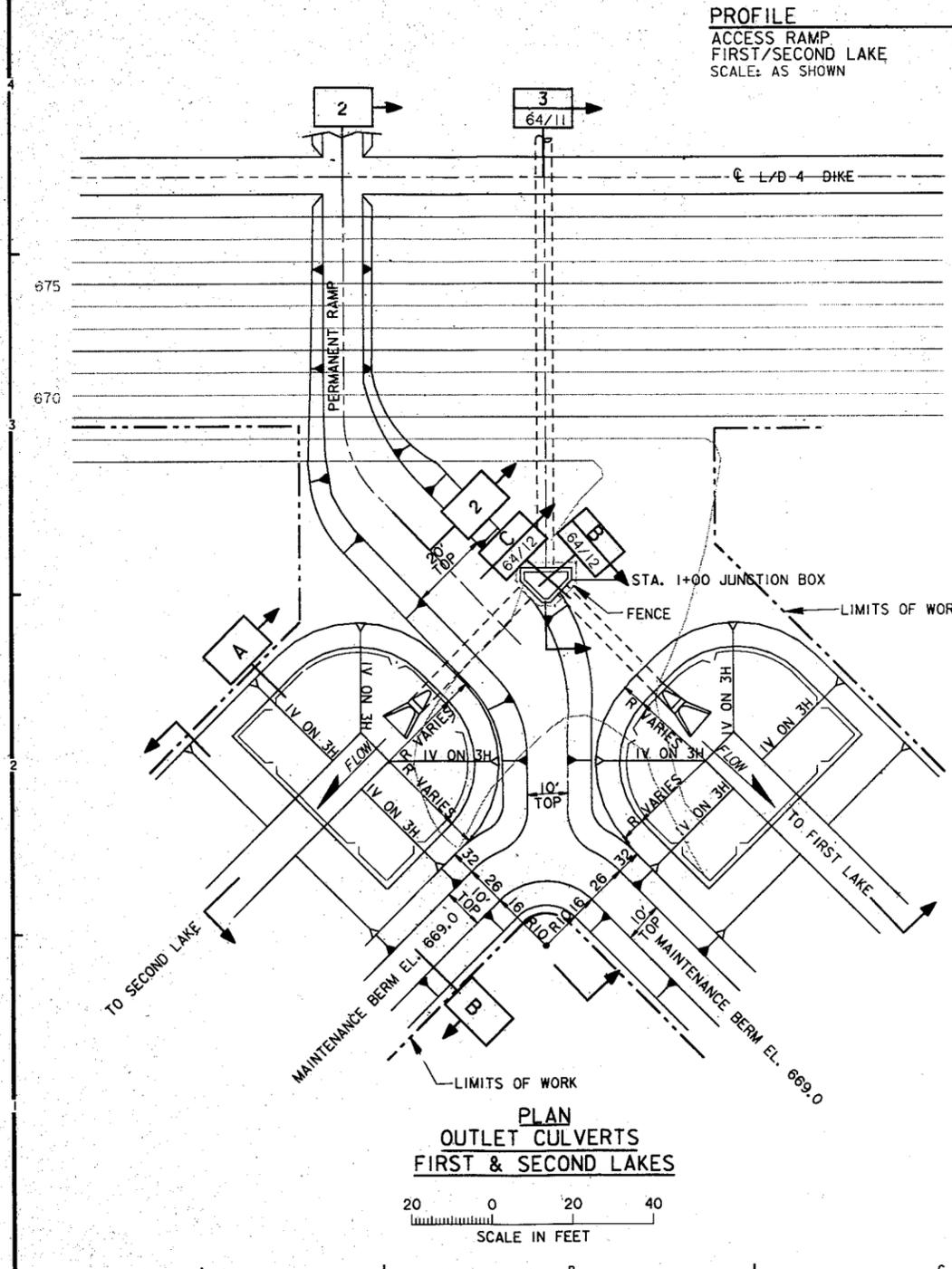
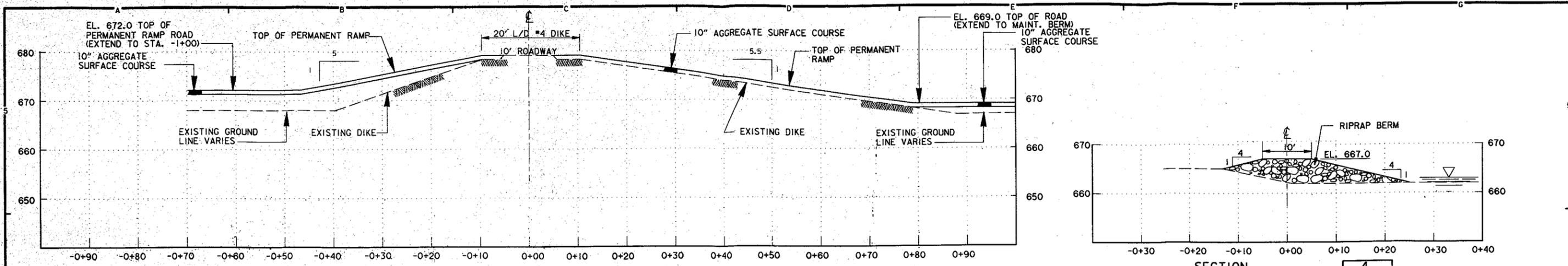
**DWG. NO.**  
M-L4-52/1-FS  
M-L4-10/14-FS

**REFERENCES:**  
SITE PLAN-THIRD & PETERSON LAKE  
PROFILES-CLEAR & THIRD LAKE CULVERT

**DWG. NO.**  
M-P4-64/2  
M-P4-64/10

AS - BUILT AS OF COMPLETION DATE		11/94	J.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM	
CHECKED: JBM		FINGER LAKES AERATION CULVERTS	
DRAWN: T.J.		MISSISSIPPI RIVER WABASHA CO., MN	
DESIGNED: JSH/AMK		<b>AERATION CULVERTS IN L/D 4 DIKE</b>	
CHECKED: JSH/AMK		THIRD LAKE OUTLET	
DATE: APRIL, 1992		PLAN AND SECTIONS	
CAD FILE NAME: MFO4POOJ.DGN	DRAWING NUMBER:	SHT 8	OF 23
SPEC NO: DACW37-92-R-0004	<b>M-P4-64/7</b>		





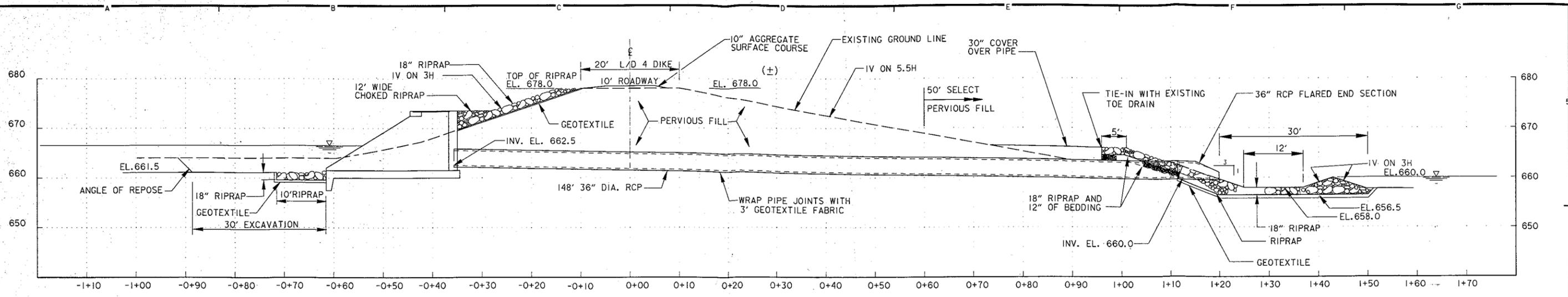
**REFERENCE DWG.**  
EARTH DIKE  
EMBANKMENT BORINGS

**DWG. NO.**  
M-L4-52/1-FS  
M-L4-10/14-FS

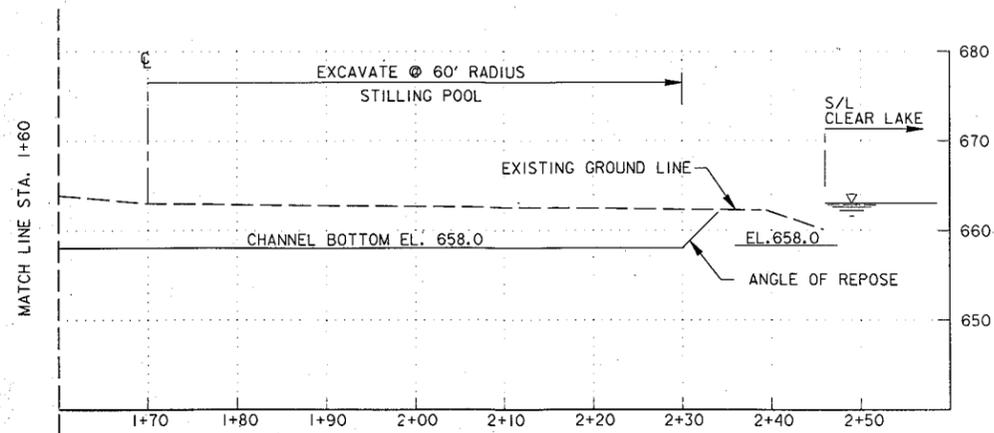
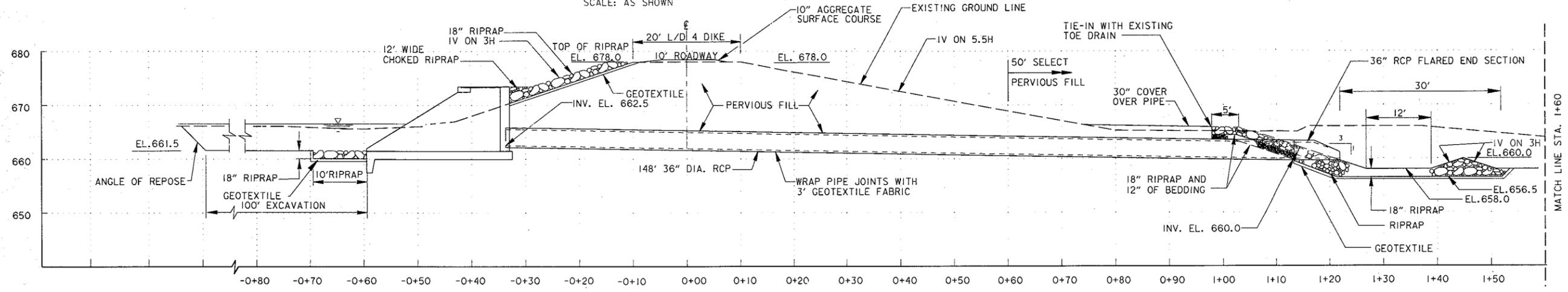
**REFERENCES:**  
SITE PLAN-FIRST & SECOND LAKE  
PROFILES-FIRST & SECOND LAKE OUTLET CULVERT/CHANNEL  
PLAN & SECTION-FIRST/SECOND LAKE JUNCTION BOX

**DWG. NO.**  
M-P4-64/3  
M-P4-64/12  
M-P4-64/16

AS-BUILT AS OF COMPLETION DATE		11/94	APPROVAL
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:	AS - BUILT FINGER LAKES		
DESIGNED: G.B.	ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER		
CHECKED: JBM	FINGER LAKES AERATION CULVERTS WABASHA CO., MN		
DRAWN: T.J.	AERATION CULVERTS IN L/D 4 DIKE		
DESIGNED: JSH/AMK	FIRST/SECOND LAKE OUTLET		
CHECKED: JSH/AMK	PLAN AND SECTIONS		
DATE: APRIL, 1992	CAD FILE NAME: MFO4P00m.DGN	DRAWING NUMBER:	SHT 10
SPEC NO: DACW37-92-R-0004	M-P4-64/9		OF 23



**PROFILE**  
 THIRD LAKE @ 105° TO E 64/6 | 64/7  
 SCALE: AS SHOWN



**PROFILE**  
 CLEAR LAKE  
 SCALE: AS SHOWN

**REFERENCE DWG.**

- EARTH DIKE
- EMBANKMENT BORINGS
- HYDROGRAPHS-POOL 4
- HYDROGRAPHS-TAILWATER
- HYDROGRAPHS-TAILWATER
- FLOW DURATION CURVES-POOL 4
- FLOW DURATION CURVES-POOL 4
- FLOW DURATION CURVES-TAILWATER
- FLOW DURATION CURVES-TAILWATER

**DWG. NO.**

- M-L4-52/1-FS
- M-L4-10/14-FS
- M-P4-14/1
- M-P4-14/2
- M-P4-14/3
- M-P4-14/4
- M-P4-14/5
- M-P4-14/6
- M-P4-14/7

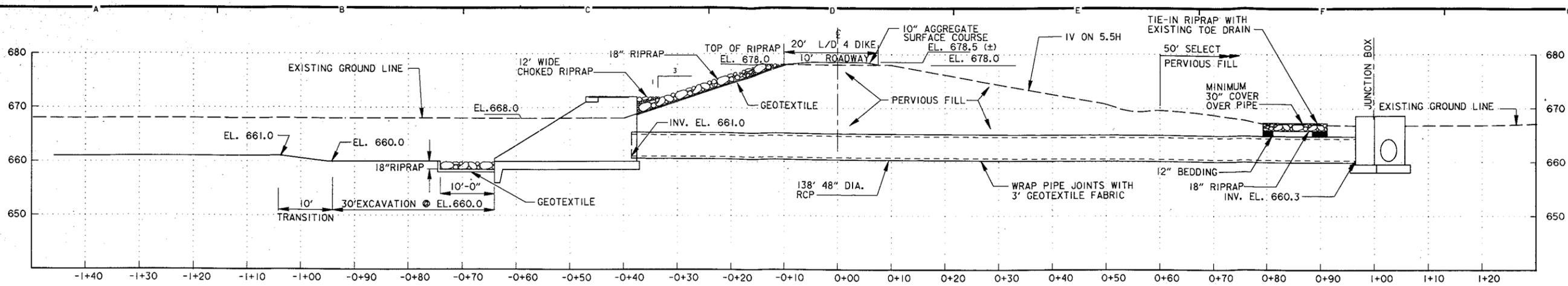
**REFERENCES:**

- CLEAR LAKE INLET
- CLEAR LAKE OUTLET
- THIRD LAKE INLET
- THIRD LAKE OUTLET

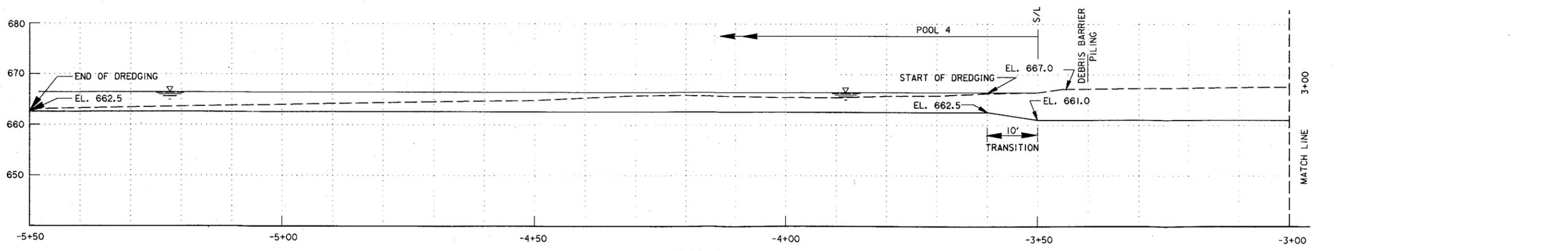
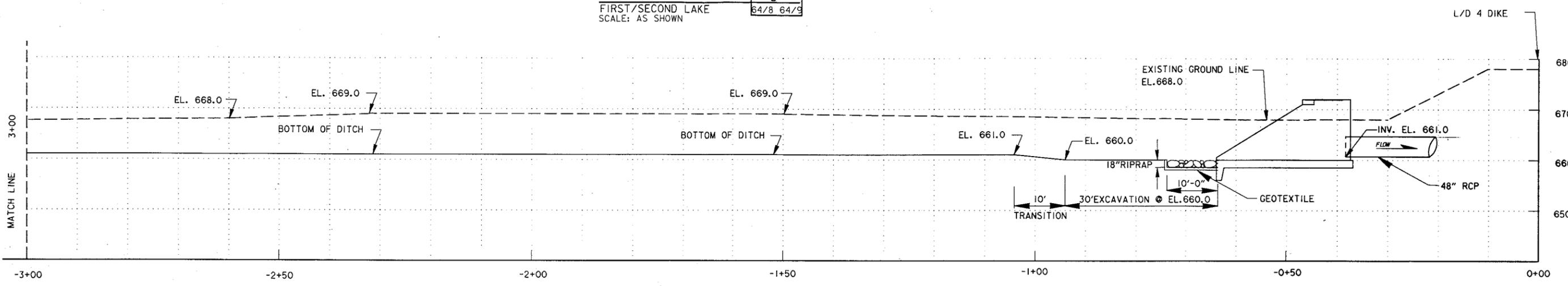
**DWG. NO.**

- M-P4-64/4
- M-P4-64/5
- M-P4-64/6
- M-P4-64/7

AS-BUILT AS OF COMPLETION DATE		11/94	APPROVAL
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT	
		FINGER LAKES	
		ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER	
		FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
		AERATION CULVERTS IN L/D 4 DIKE	
		CLEAR & THIRD LAKE CULVERTS	
		PROFILES	
DESIGNED: G.B.	CAD NAME: MFO4X00A.DGN	DRAWING NUMBER:	SHT 11
CHECKED: JBM	DATE: APRIL, 1992	SPEC NO: DACW37-92-R-0004	OF 23
DRAWN: T.J.		M-P4-64/10	



**PROFILE G**  
FIRST/SECOND LAKE  
SCALE: AS SHOWN



**PROFILE**  
FIRST/SECOND LAKE INLET EXCAVATION  
SCALE: AS SHOWN

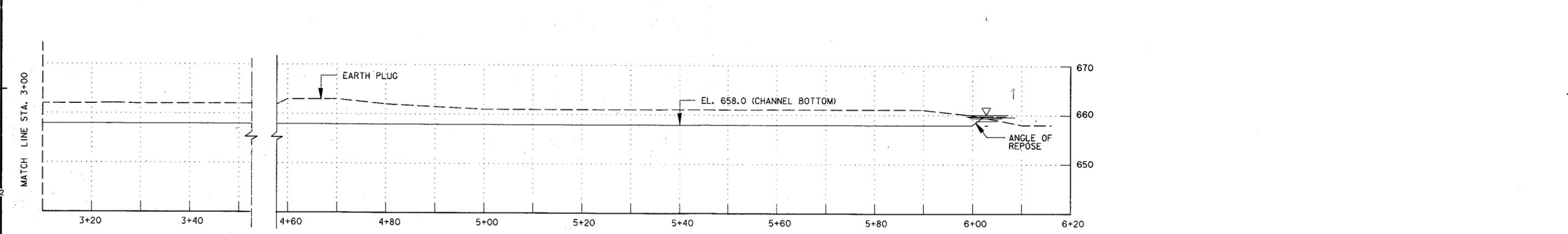
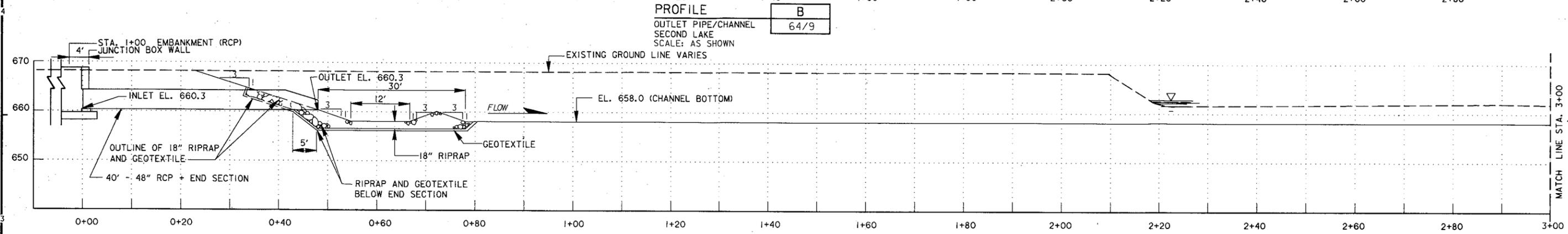
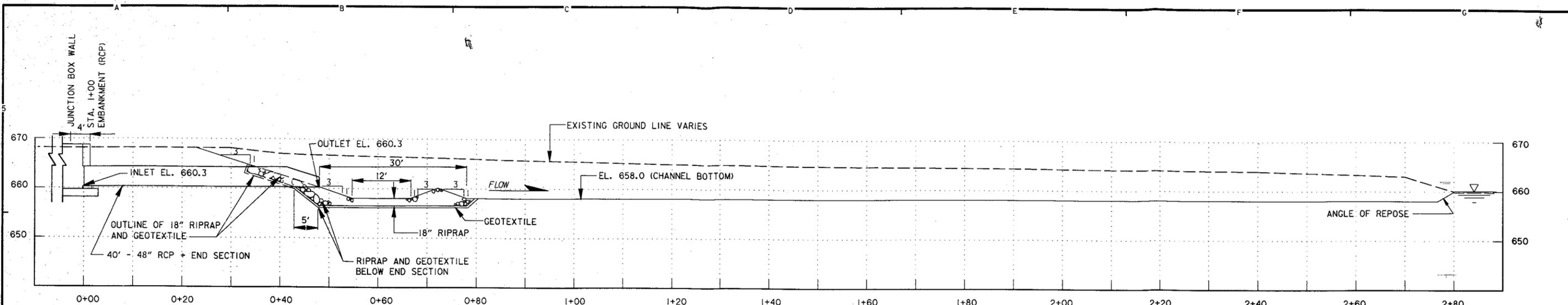
- REFERENCE DWG.**  
EARTH DIKE  
EMBANKMENT BORINGS  
HYDROGRAPHS-POOL 4  
FLOW DURATION CURVES-POOL 4  
FLOW DURATION CURVES-POOL 4

**REFERENCES:**  
FIRST/SECOND LAKE INLET

**DWG. NO.**  
M-L4-52/1-FS  
M-L4-10/14-FS  
M-P4-14/1  
M-P4-14/4  
M-P4-14/5

**DWG. NO.**  
M-P4-64/8

AS-BUILT AS OF COMPLETION DATE		11/94	JMB
SYMBOL	DESCRIPTION	DATE	APPROVAL
AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN		DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA	
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
DESIGNED: G.B.		AERATION CULVERTS IN L/D 4 DIKE	
CHECKED: JBM		FIRST/SECOND LAKE CULVERT	
DRAWN: T.J.		CULVERT & INLET EXCAVATION PROFILES	
DESIGNED: JSH/AMK		DRAWING NUMBER: M-P4-64/11	
CHECKED: JSH/AMK		SHT 12 OF 23	
DATE: APRIL, 1992		SPEC NO: DACW37-92-R-0004	



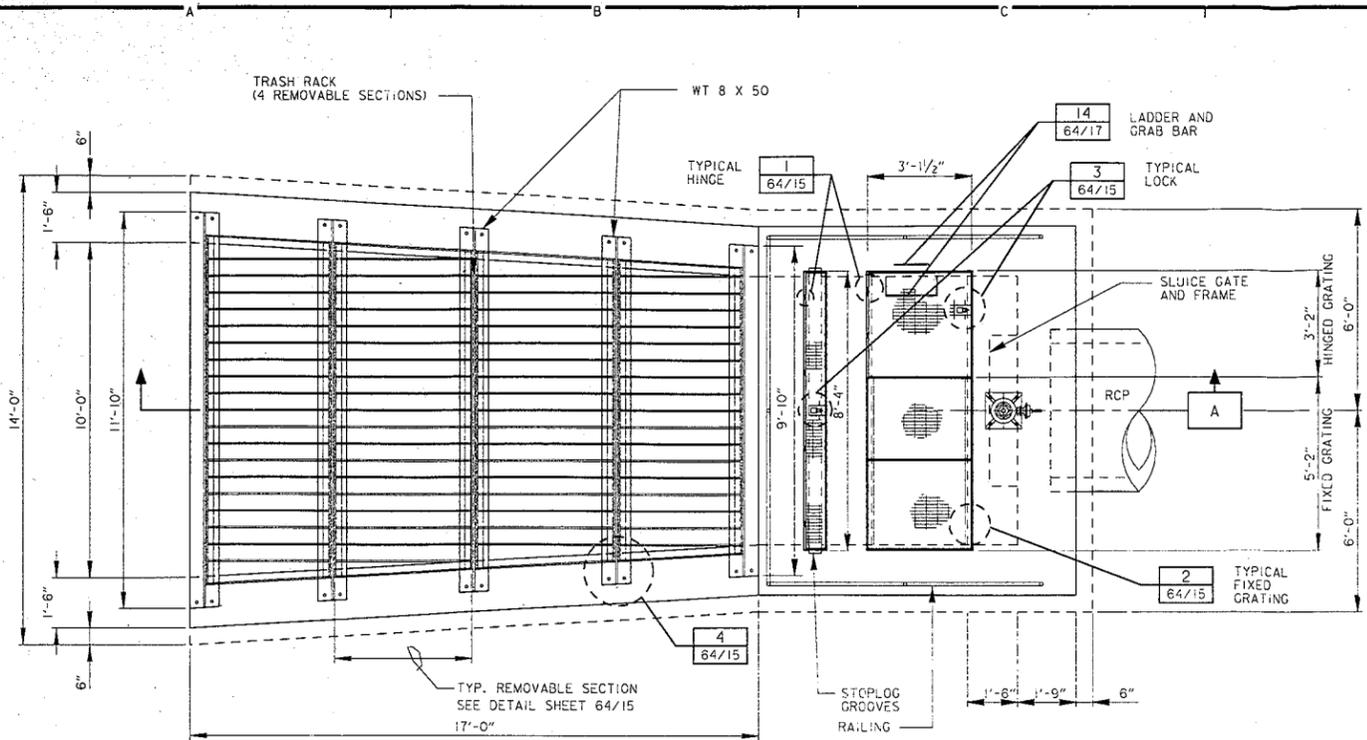
**REFERENCE DWG.**  
 EARTH DIKE  
 EMBANKMENT BORINGS  
 HYDROGRAPHS-TAILWATER  
 HYDROGRAPHS-TAILWATER  
 FLOW DURATION CURVES-TAILWATER  
 FLOW DURATION CURVES-TAILWATER

**DWG. NO.**  
 M-L4-52/1-FS  
 M-L4-10/14-FS  
 M-P4-14/2  
 M-P4-14/3  
 M-P4-14/6  
 M-P4-14/7

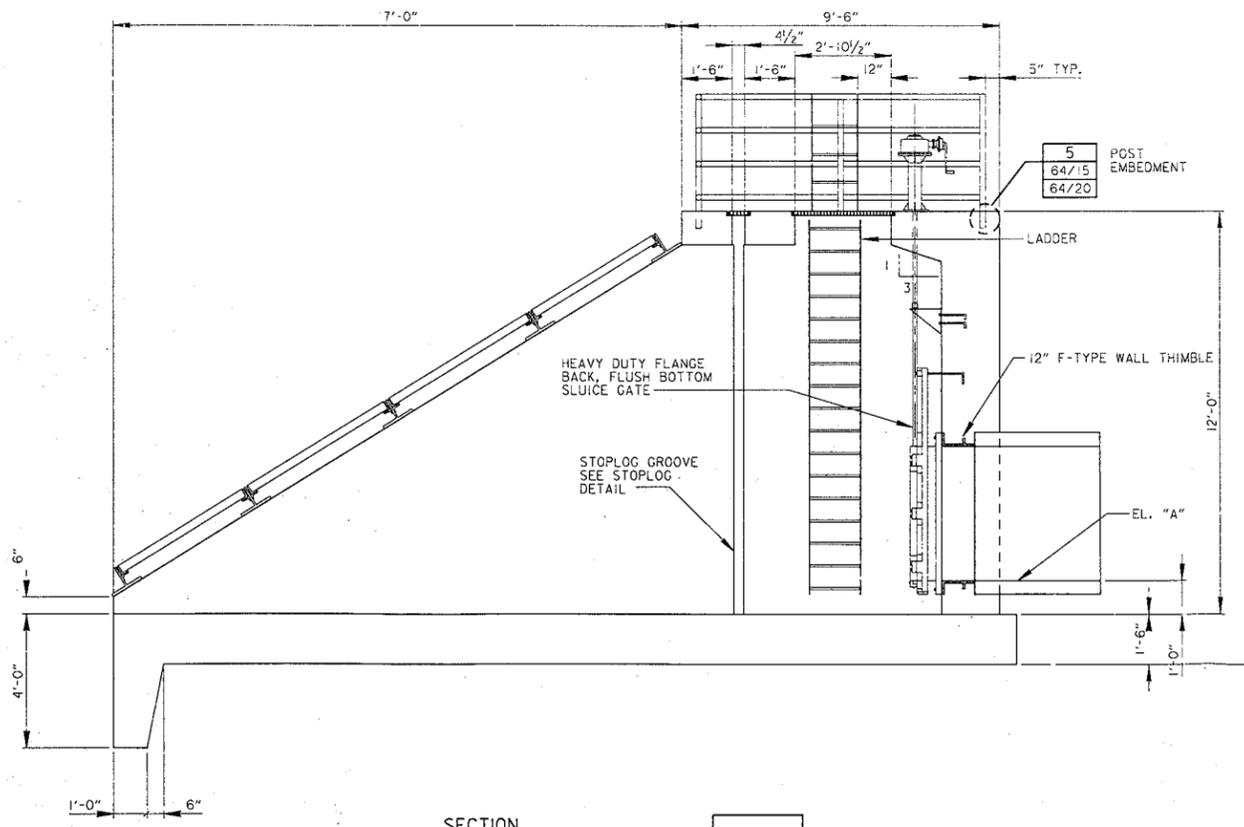
**REFERENCES:**  
 SITE PLAN, FIRST & SECOND LAKE  
 FIRST & SECOND LAKE OUTLETS

**DWG. NO.**  
 M-P4-64/3  
 M-P4-64/9

AS-BUILT AS OF COMPLETION DATE		11/94	J.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: G.B.		ENVIRONMENTAL MGMT. PROGRAM MISSISSIPPI RIVER	
CHECKED: JBM		FINGER LAKES AERATION CULVERTS WABASHA CO., MN	
DRAWN: T.J.		<b>AERATION CULVERTS IN L/D 4 DIKE</b>	
DESIGNED: JSH/AMK		FIRST & SECOND LAKE OUTLET CULVERTS/CHANNELS	
CHECKED: JSH/AMK		PROFILES	
DATE: APRIL, 1992	CAD FILE NAME: MFO4POOD.DGN	DRAWING NUMBER:	SHT 13
	SPEC NO: DACW37-92-R-0004	<b>M-P4-64/12</b>	OF 23



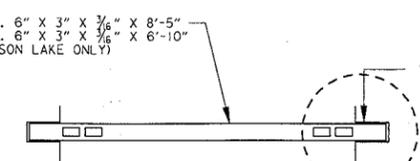
PLAN  
TYPICAL HEADWALL  
SCALE: 3/8" = 1'-0"



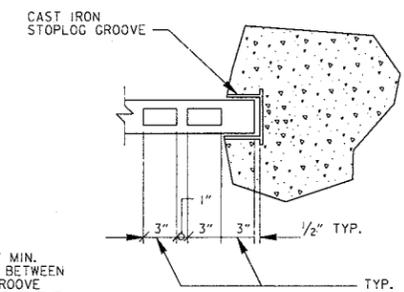
SECTION  
TYPICAL HEADWALL  
SCALE: 3/8" = 1'-0"

LAKE	EL. "A"	RCP DIA.	GATE
1ST/2ND	661.0	48"	48" X 48"
3RD	662.5	36"	36" X 36"
CLEAR	662.5	36"	36" X 36"

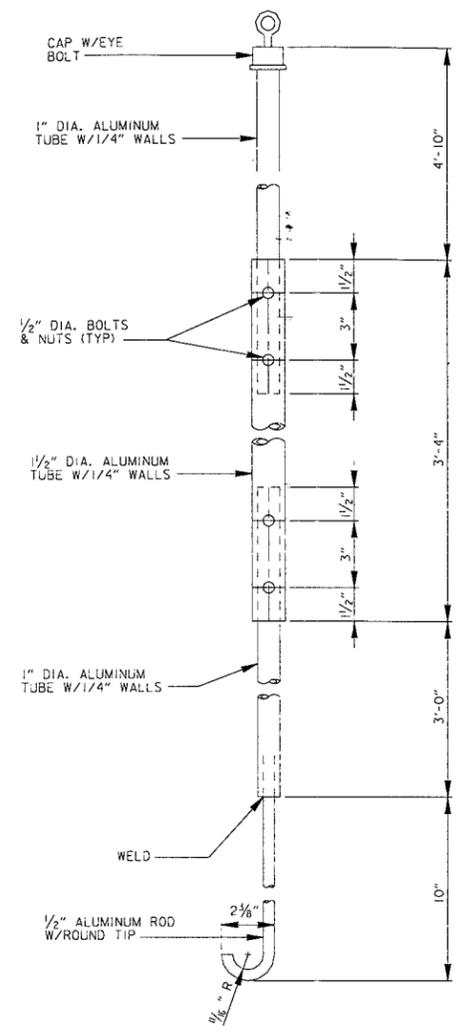
HEADWALL TABLE



DETAIL  
TYPICAL STOPLOG  
SCALE: 3/4" = 1'-0"



DETAIL  
STOPLOG GROOVE  
SCALE: NONE

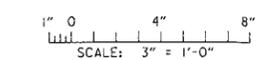
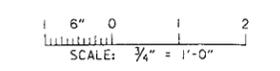
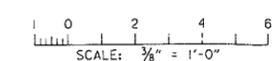


DETAIL  
STOPLOG HOOK  
SCALE: 3" = 1'-0"

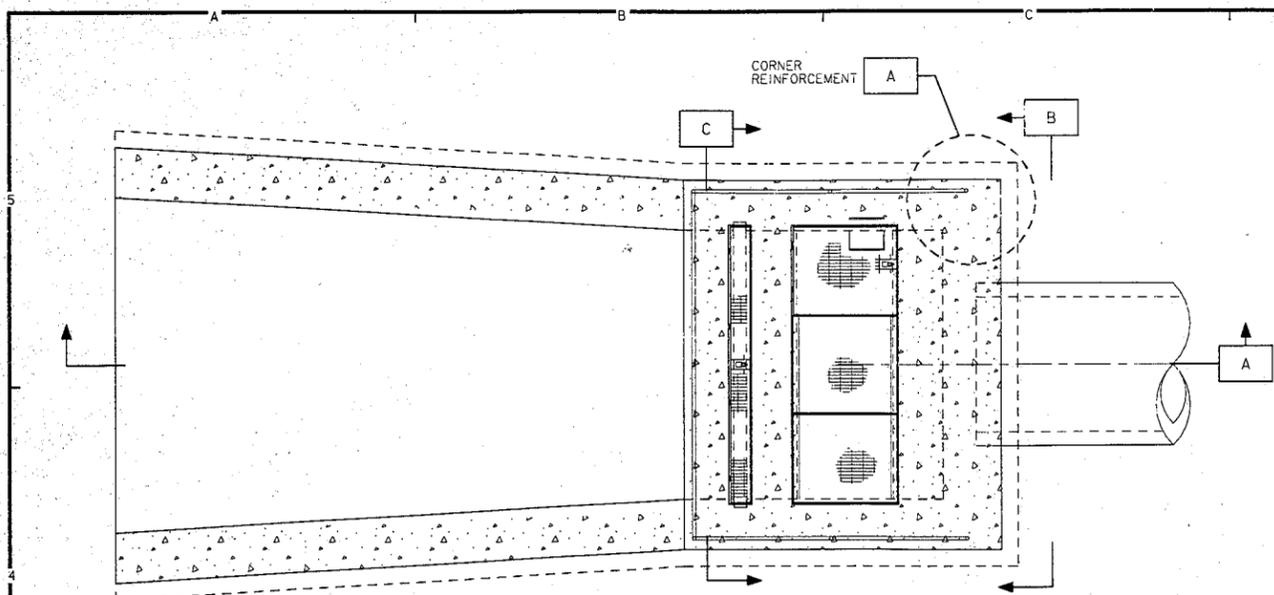
NOTE:  
PROVIDE 2" MIN. CLEARANCE BETWEEN STOPLOG GROOVE AND REINFORCEMENT

REFERENCES:  
TRASH RACK AND GRATING SECTIONS AND DETAILS

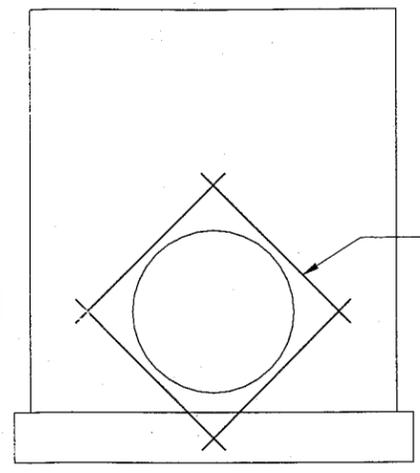
DWG. NO.  
M-P4-64/15



AS-BUILT AS OF COMPLETION DATE		11/94	<i>R.H.B.</i>
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:	AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN. AERATION CULVERTS IN L/D 4 DIKE HEADWALL PLAN, SECTION, DETAILS AND TABLE		
DESIGNED: PWS			
CHECKED: MGE			
DRAWN: JJZ/HPA			
DATE: APRIL 1992	CAD FILE NAME: M45PPOI3.DGN	DRAWING NUMBER: M-P4-64/13	SHT 14 OF 23

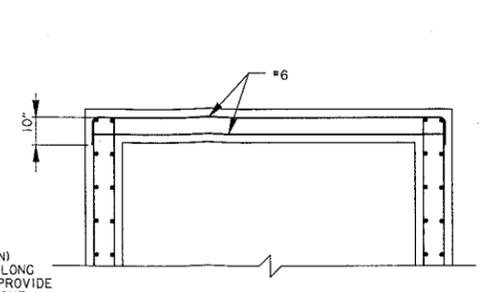


PLAN  
TYPICAL HEADWALL  
SCALE: 3/8" = 1'-0"

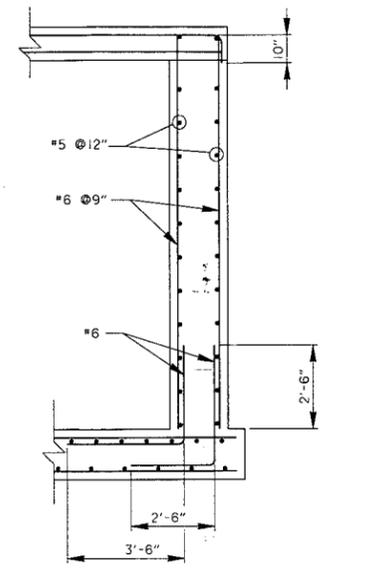


SECTION  
REINFORCEMENT AROUND OPENING  
SCALE: 3/8" = 1'-0"

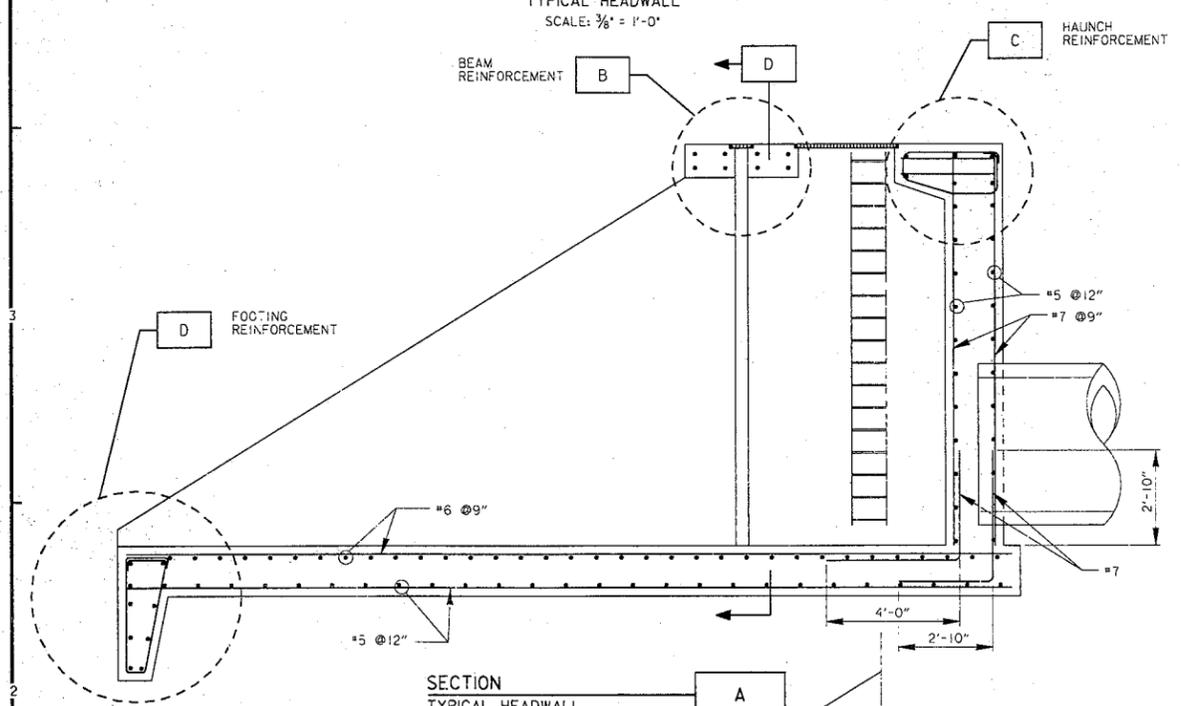
4 #8 E.F. 5'-2" LONG (MIN)  
FOR 36" DIA. PIPE 8'-4" LONG  
(MIN) FOR 48" DIA. PIPE PROVIDE  
MIN. 3" COVER FOR HORIZONTAL  
AND VERTICAL WALL REINFORCEMENT  
AROUND OPENING



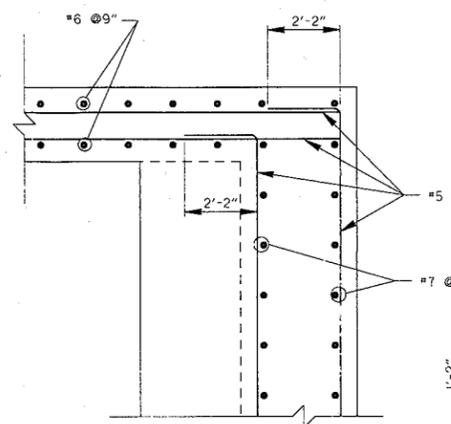
SECTION  
TYPICAL BEAM REINFORCING  
SCALE: 3/8" = 1'-0"



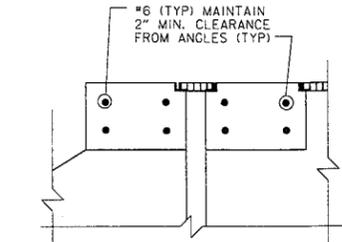
SECTION  
SIDE WALL  
SCALE: 3/8" = 1'-0"



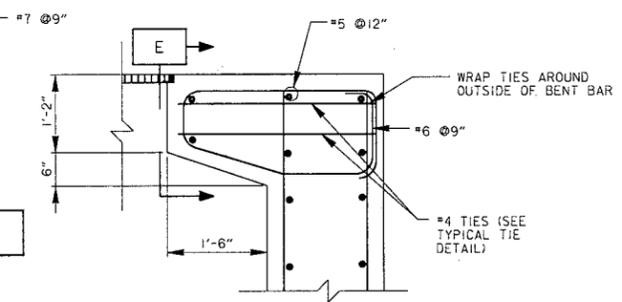
SECTION  
TYPICAL HEADWALL  
SCALE: 3/8" = 1'-0"



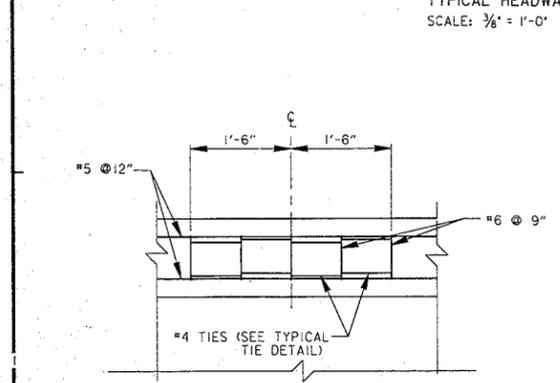
DETAIL  
BEAM REINFORCEMENT  
SCALE: 3/4" = 1'-0"



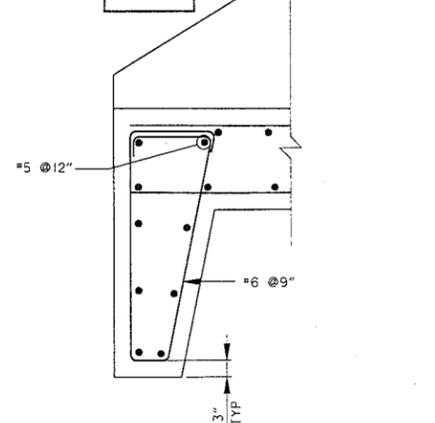
DETAIL  
CORNER REINFORCEMENT  
SCALE: 3/4" = 1'-0"



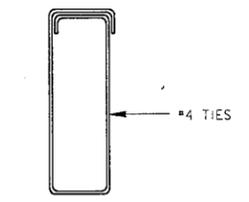
DETAIL  
HAUNCH REINFORCEMENT  
SCALE: 3/4" = 1'-0"



SECTION  
HAUNCH REINFORCEMENT TIES  
SCALE: 3/4" = 1'-0"

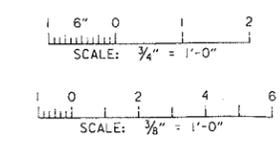


DETAIL  
FOOTING REINFORCEMENT  
SCALE: 3/4" = 1'-0"

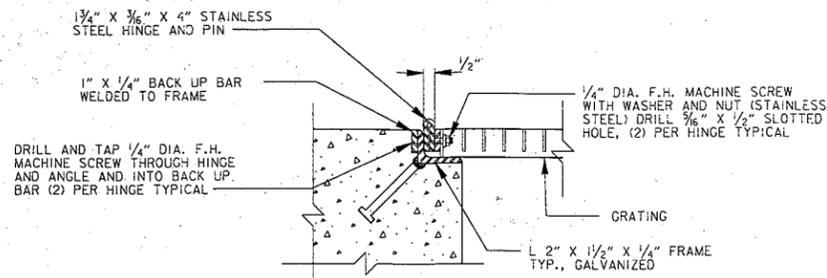


DETAIL  
TYPICAL TIE  
SCALE: NONE

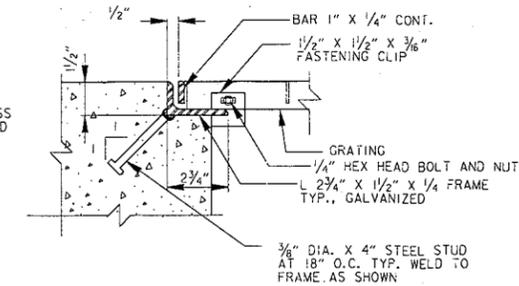
NOTES:  
1. 3" MIN. CONCRETE COVER UNLESS OTHERWISE SPECIFIED



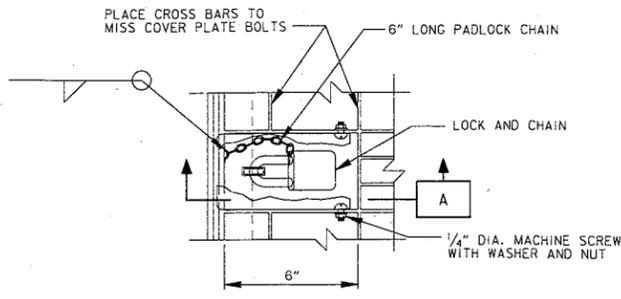
AS-BUILT AS OF COMPLETION DATE		11/94	J.J.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:	AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN. AERATION CULVERTS IN L/D 4 DIKE HEADWALL REINFORCEMENT PLAN, SECTIONS AND DETAILS		
DESIGNED: PWS			
CHECKED: MGE			
DRAWN: JJZ/HPA			
DESIGNED:			
CHECKED:	CAD FILE NAME: M4SPP014.DGN	DRAWING NUMBER:	SHT 15
DATE: APRIL 1992	SPEC NO: DACW37-92-R-0004	M-P4-64/14	OF 23



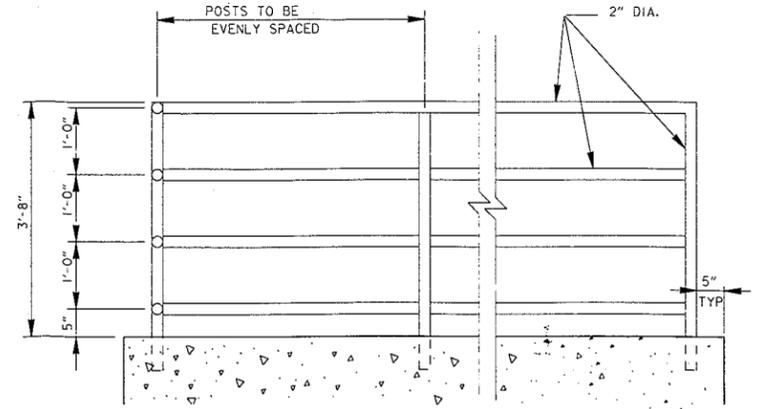
DETAIL 1  
TYPICAL HINGE DETAIL  
SCALE: 3" = 1'-0"



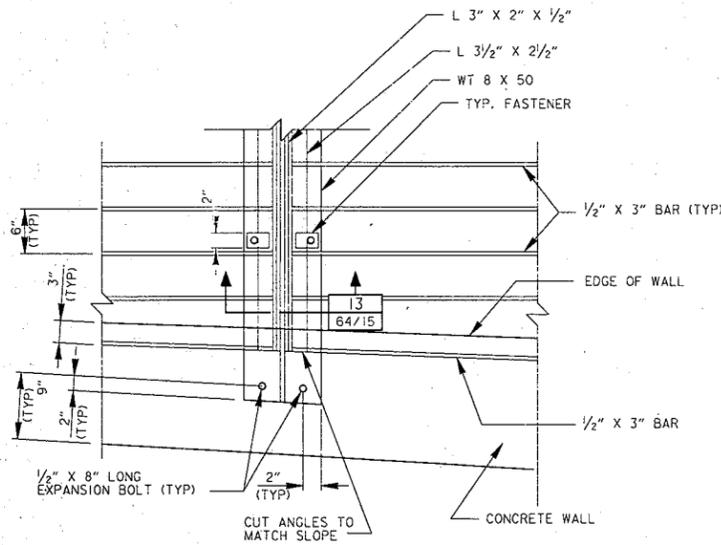
DETAIL 2  
TYPICAL FIXED GRATING  
SCALE: 3" = 1'-0"



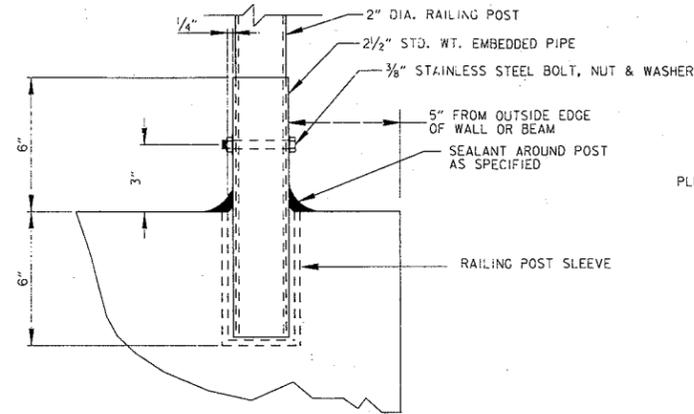
DETAIL 3  
TYPICAL LOCK DETAIL  
SCALE: 3" = 1'-0"



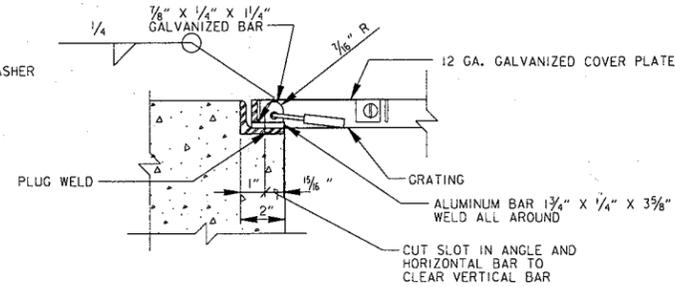
ELEVATION  
TYP. RAILING  
SCALE: 3/4\"/>



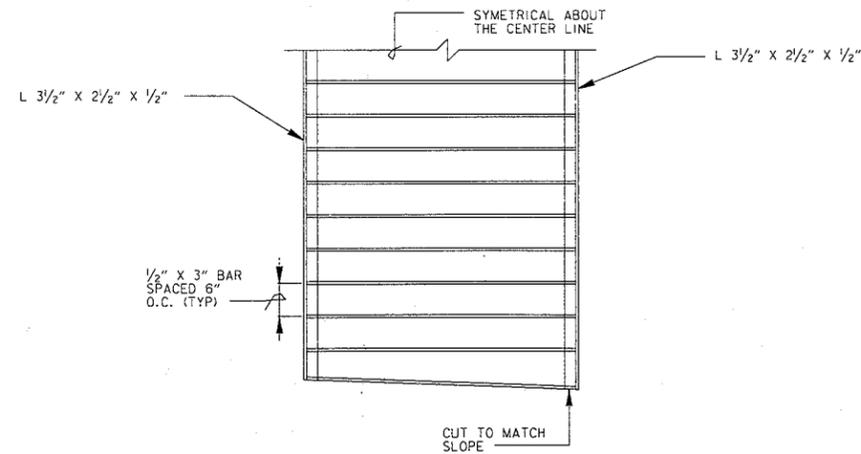
DETAIL 4  
TRASH RACK BAR INSTALLATION  
SCALE: 1\"/>



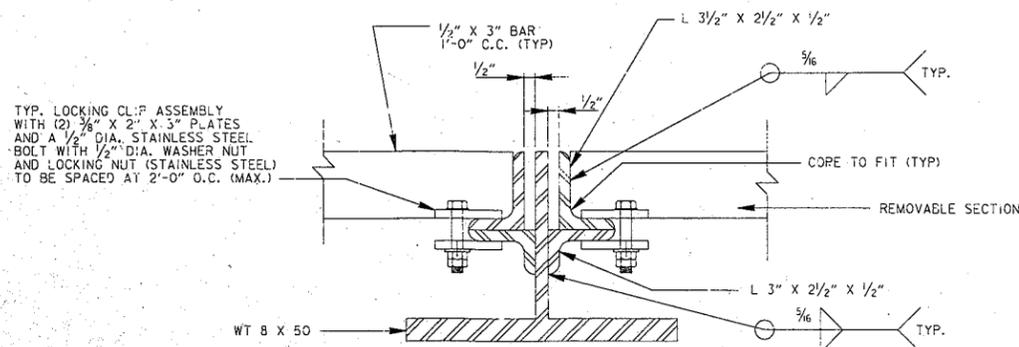
DETAIL 5  
RAILING POST EMBEDMENT  
SCALE: 3\"/>



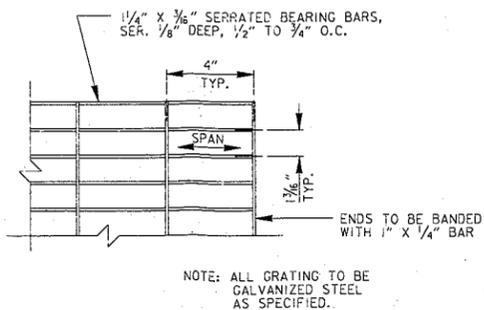
SECTION A  
TYPICAL LOCK DETAIL  
SCALE: 3\"/>



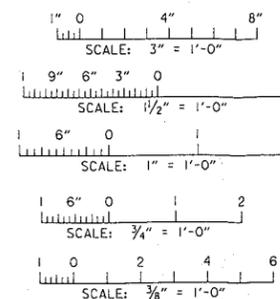
PLAN  
TYP. REMOVABLE TRASH RACK UNIT  
SCALE: 3/4\"/>



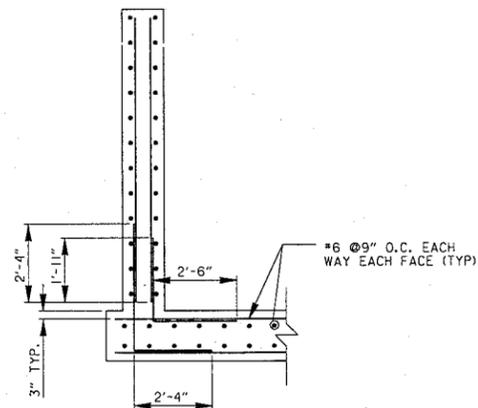
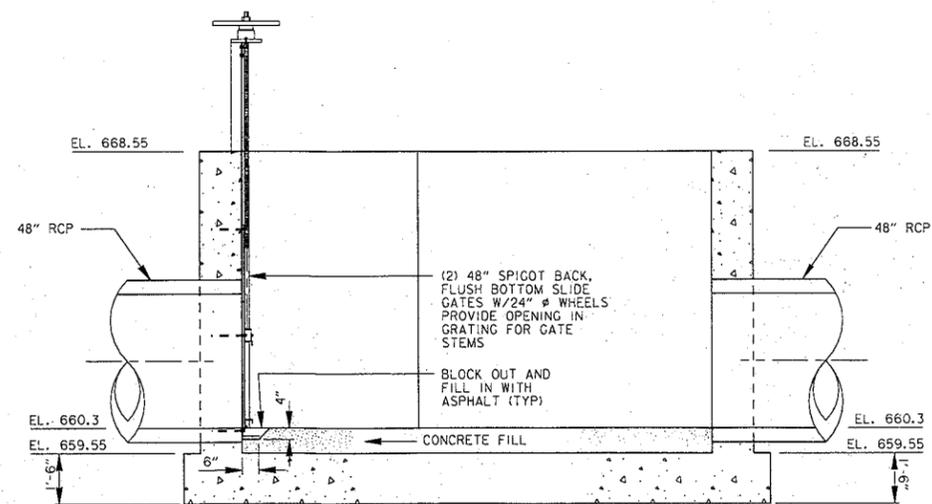
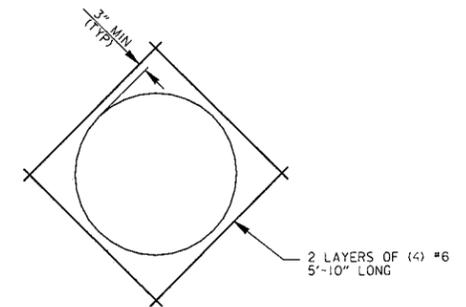
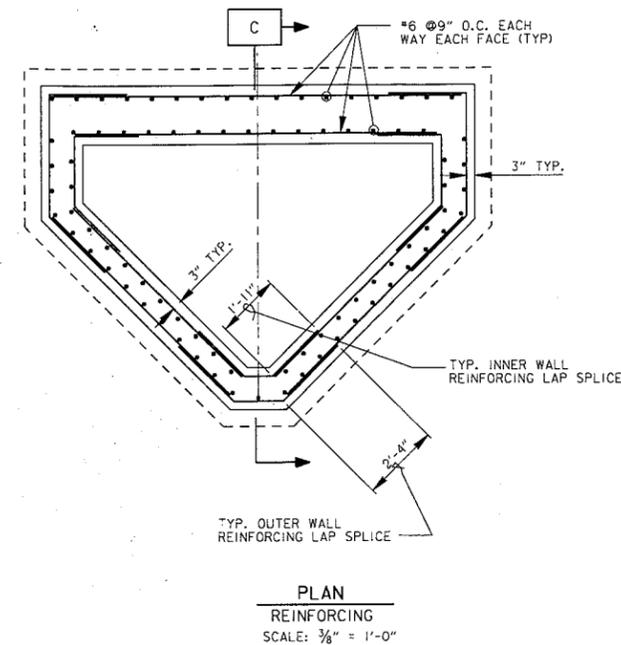
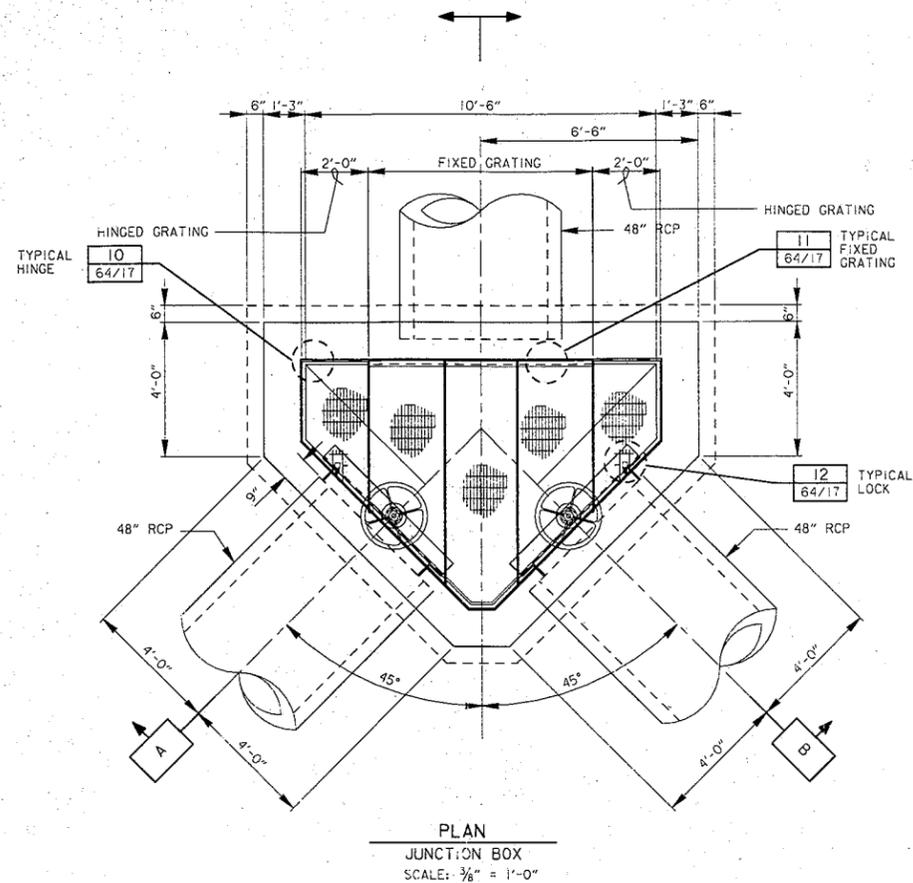
SECTION 13  
TRASH RACK BAR INSTALLATION  
SCALE: 3\"/>



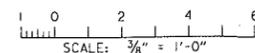
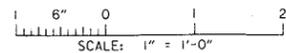
DETAIL  
TYPICAL GRATING  
SCALE: 3\"/>



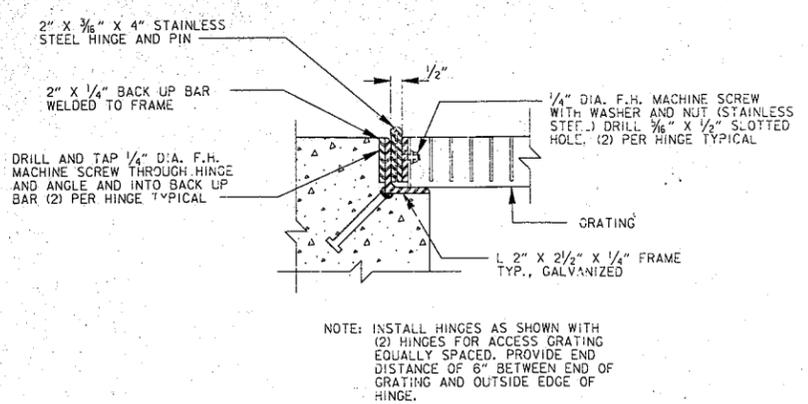
AS-BUILT AS OF COMPLETION DATE		11/94	R.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT	
		FINGER LAKES	
		ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER	
		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
		AERATION CULVERTS IN L/D 4 DIKE	
		HEADWALL GRATING, TRASH RACK AND RAILING	
		ELEVATION, PLAN, SECTIONS AND DETAILS	
DESIGNED: PWS			
CHECKED: MGE			
DRAWN: JJZ/HPA			
DATE: APRIL 1992	CAD FILE NAME: M4SPPO15.DGN	DRAWING NUMBER:	SHT 16
	SPEC NO: DACW37-92-R-0004	M-P4-64/15	OF 23



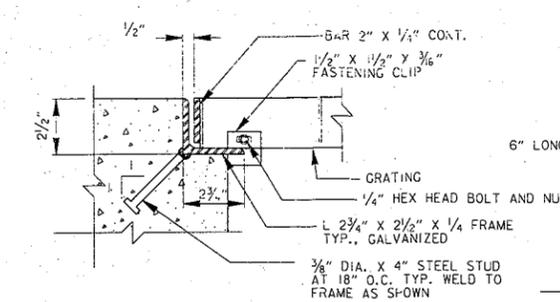
**NOTES:**  
 1. 3" MIN. CONCRETE COVER UNLESS OTHERWISE SPECIFIED.



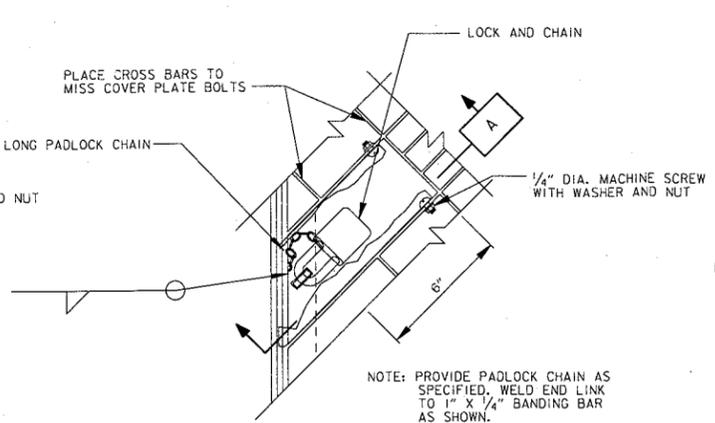
AS-BUILT AS OF COMPLETION DATE		11/94	A.S.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT	
DESIGNED: PWS		FINGER LAKES	
CHECKED: MGE		ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER	
DRAWN: JJZ/HPA		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
DESIGNED:		AERATION CULVERTS IN L/D 4 DIKE	
CHECKED:		FIRST/SECOND LAKE JUNCTION BOX	
DATE: APRIL 1992		CAD FILE NAME: M4SPPO16.DGN	DRAWING NUMBER: M-P4-64/16
		SHEET 17	OF 23



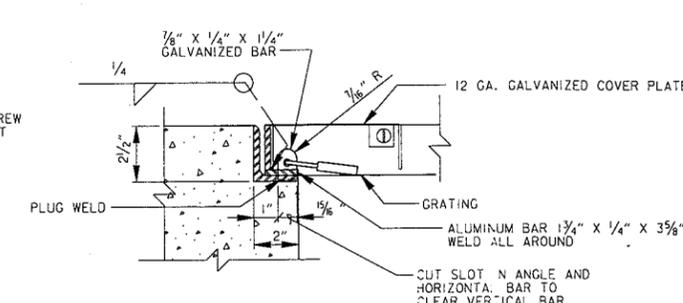
**DETAIL 10**  
TYPICAL HINGE DETAIL AT JUNCTION BOX  
SCALE: 3" = 1'-0"



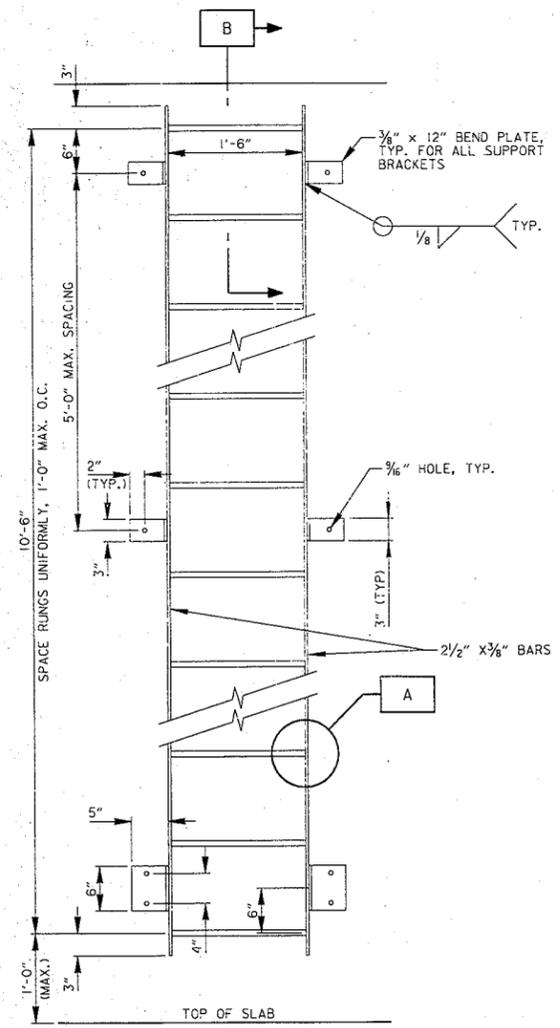
**DETAIL II**  
TYPICAL FIXED GRATING AT JUNCTION BOX  
SCALE: 3" = 1'-0"



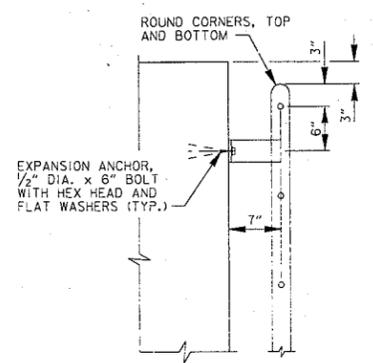
**DETAIL 12**  
TYPICAL LOCK DETAIL AT JUNCTION BOX  
SCALE: 3" = 1'-0"



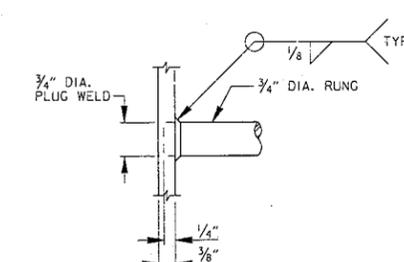
**SECTION A**  
TYPICAL LOCK DETAIL AT JUNCTION BOX  
SCALE: 3" = 1'-0"



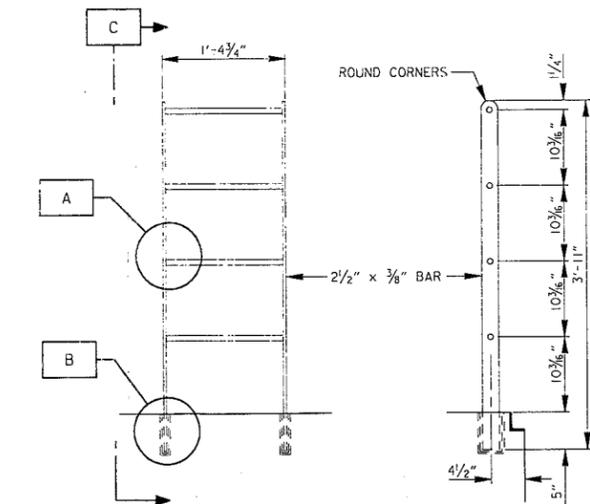
**ELEVATION LADDER**  
SCALE: 1" = 1'-0"



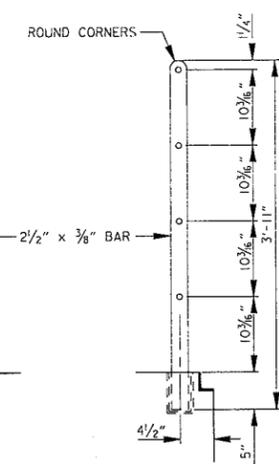
**SECTION B**  
LADDER  
SCALE: 1" = 1'-0"



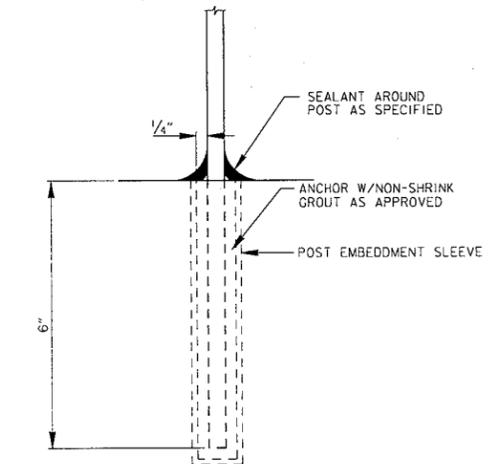
**DETAIL A**  
LADDER & GRAB BAR RUNG CONNECTION  
SCALE: 6" = 1'-0"



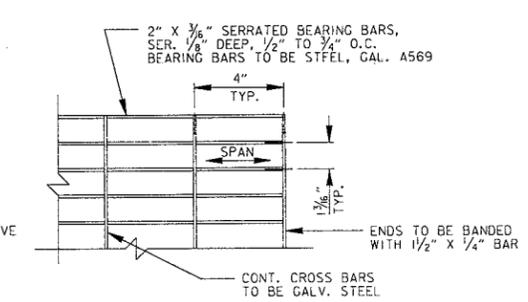
**ELEVATION GRAB BAR**  
SCALE: 1" = 1'-0"



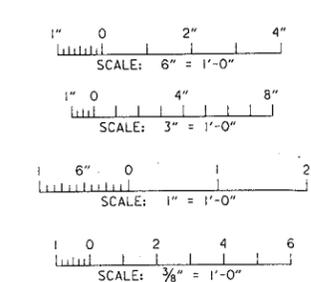
**SECTION C**  
GRAB BAR  
SCALE: 1" = 1'-0"



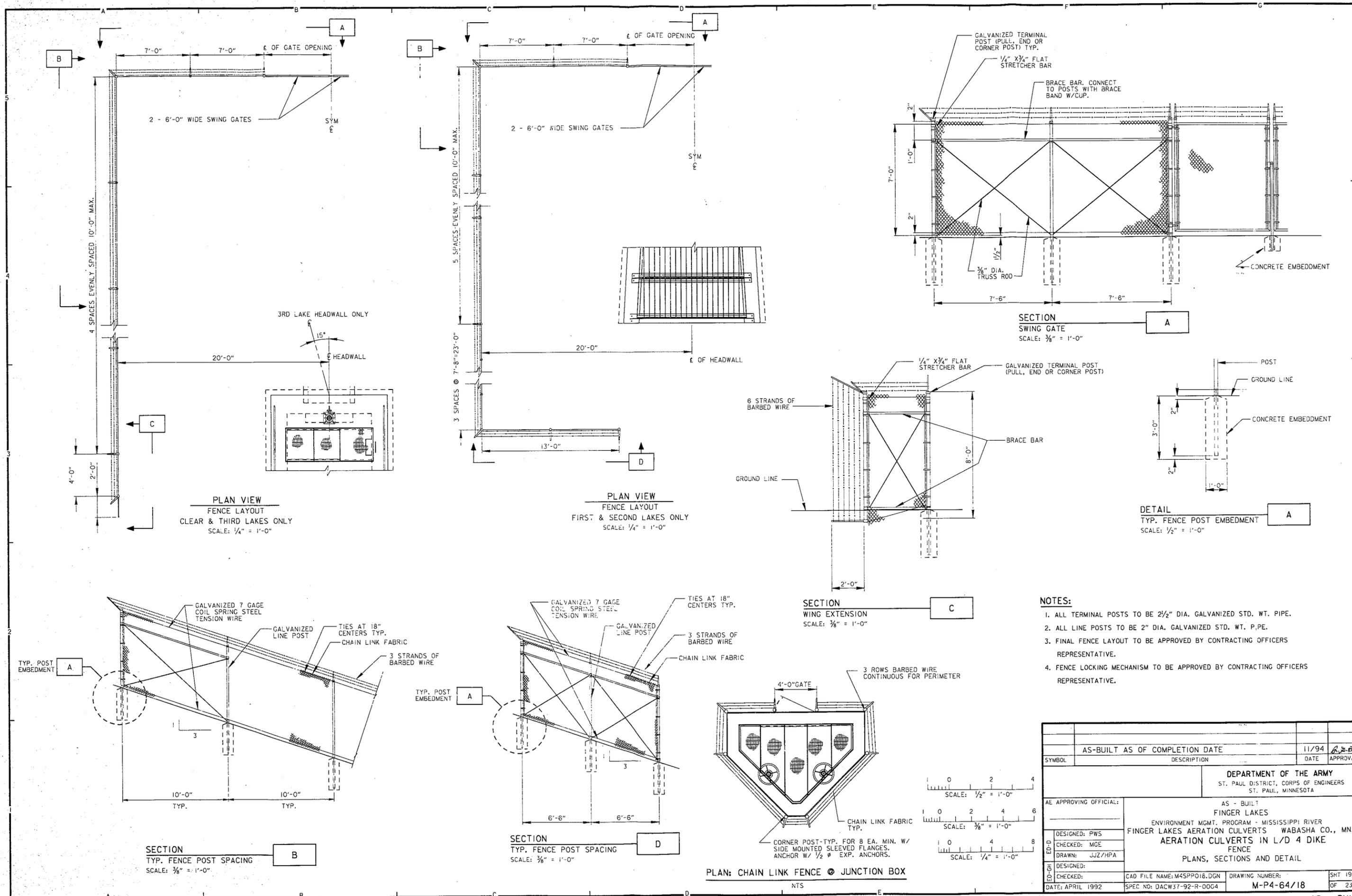
**DETAIL B**  
GRAB BAR ANCHORAGE  
SCALE: 6" = 1'-0"



**DETAIL**  
TYPICAL GRATING AT JUNCTION BOX  
SCALE: 3" = 1'-0"

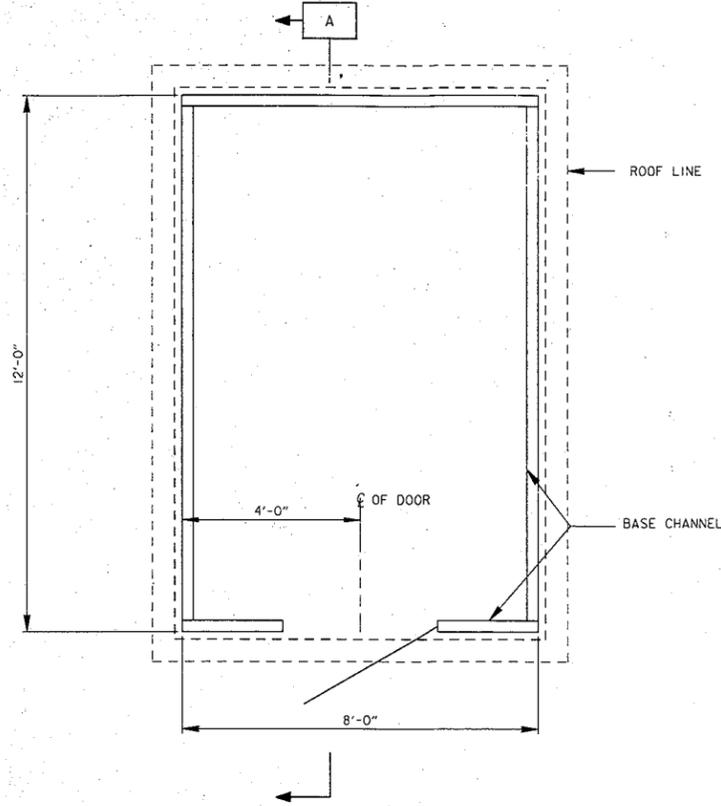


AS-BUILT AS OF COMPLETION DATE		11/94	AS-B
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN. GRATING, LADDER AND GRAB BAR ELEVATIONS, SECTIONS AND DETAILS	
DESIGNED: PWS	CAD FILE NAME: M45PPO17.DGN	DRAWING NUMBER:	SHT 18
CHECKED: MGE	DATE: APRIL 1992	DATE: APRIL 1992	OF 23
DRAWN: JJZ/HPA	SPEC NO: DACW37-92-R-0004	M-P4-64/17	

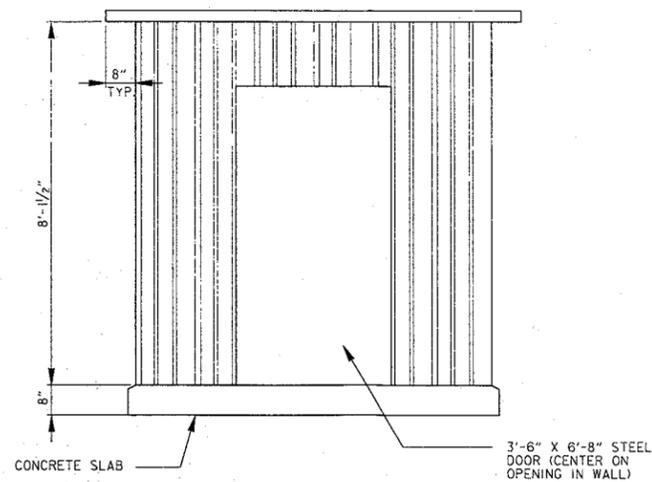


- NOTES:**
1. ALL TERMINAL POSTS TO BE 2 1/2" DIA. GALVANIZED STD. WT. PIPE.
  2. ALL LINE POSTS TO BE 2" DIA. GALVANIZED STD. WT. P.P.E.
  3. FINAL FENCE LAYOUT TO BE APPROVED BY CONTRACTING OFFICERS REPRESENTATIVE.
  4. FENCE LOCKING MECHANISM TO BE APPROVED BY CONTRACTING OFFICERS REPRESENTATIVE.

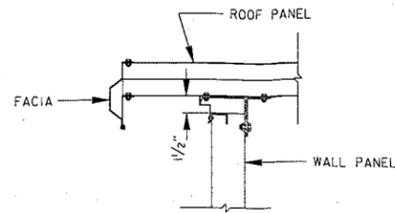
AS-BUILT AS OF COMPLETION DATE		11/94	J.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
<b>DEPARTMENT OF THE ARMY</b> ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT	
		FINGER LAKES	
		ENVIRONMENT MGMT. PROGRAM - MISSISSIPPI RIVER	
		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
		AERATION CULVERTS IN L/D 4 DIKE	
		FENCE	
		PLANS, SECTIONS AND DETAIL	
DESIGNED: PWS	CAD FILE NAME: M4SPP018.DGN	DRAWING NUMBER:	SHT 19
CHECKED: MGE	SPEC NO: DACW37-92-R-004	M-P4-64/18	OF 23
DRAWN: JJZ/HPA			
DATE: APRIL 1992			



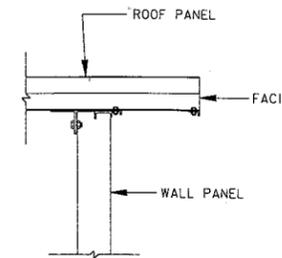
PLAN  
METAL STORAGE BUILDING  
SCALE: 1/2" = 1'-0"



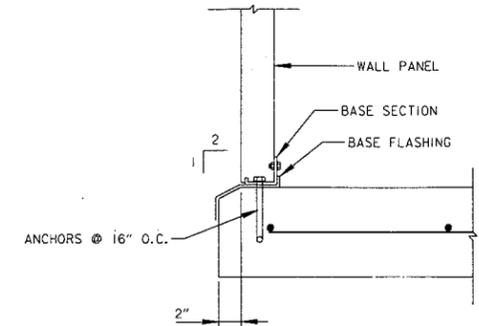
FRONT ELEVATION  
METAL STORAGE BUILDING  
SCALE: 1/2" = 1'-0"



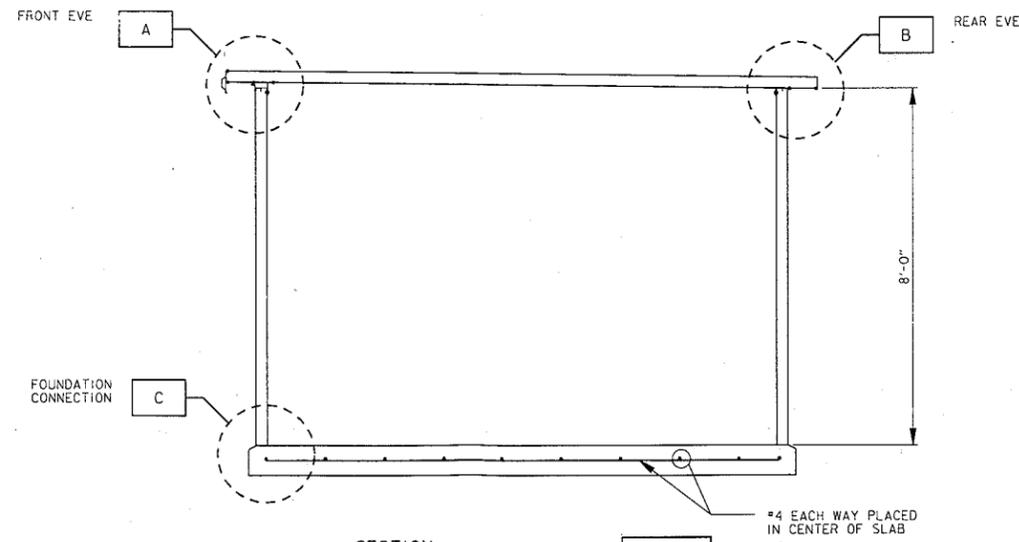
DETAIL  
FRONT EAVE CONNECTION  
SCALE: 1-1/2" = 1'-0"



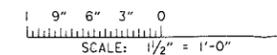
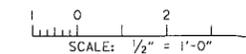
DETAIL  
REAR EAVE CONNECTION  
SCALE: 1-1/2" = 1'-0"



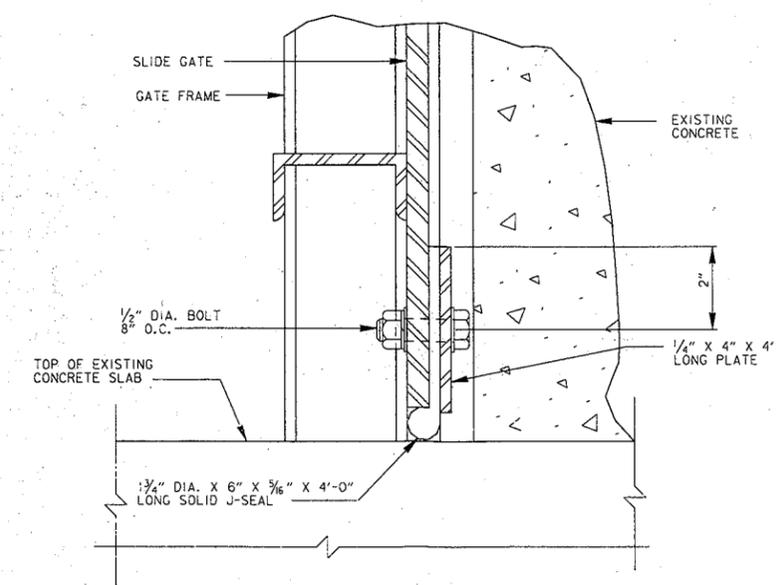
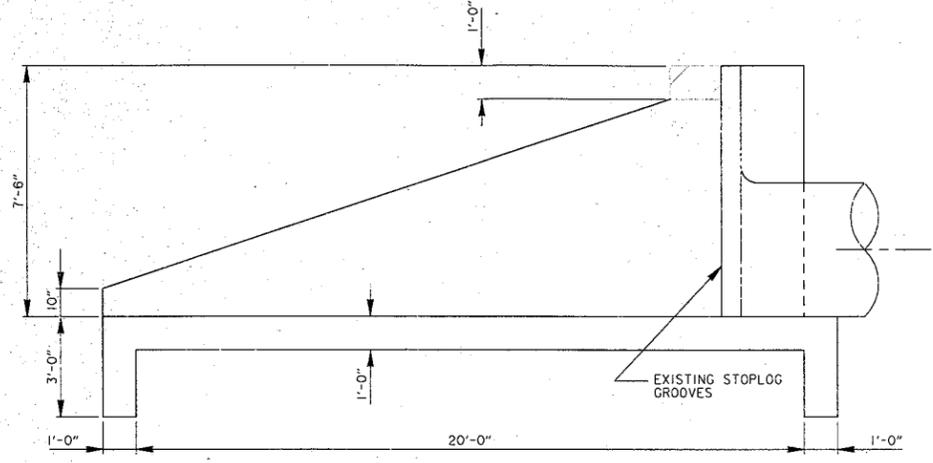
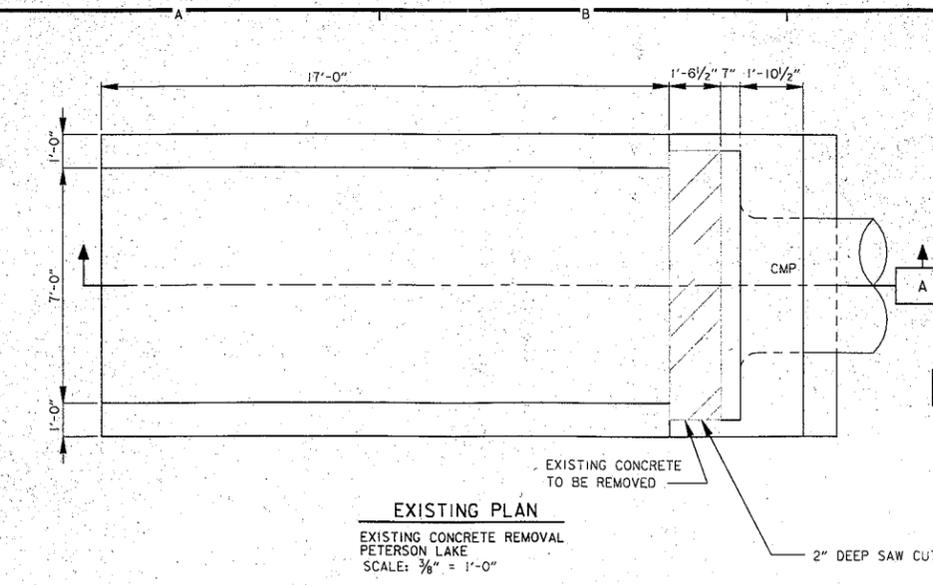
DETAIL  
FOUNDATION CONNECTION  
SCALE: 1-1/2" = 1'-0"



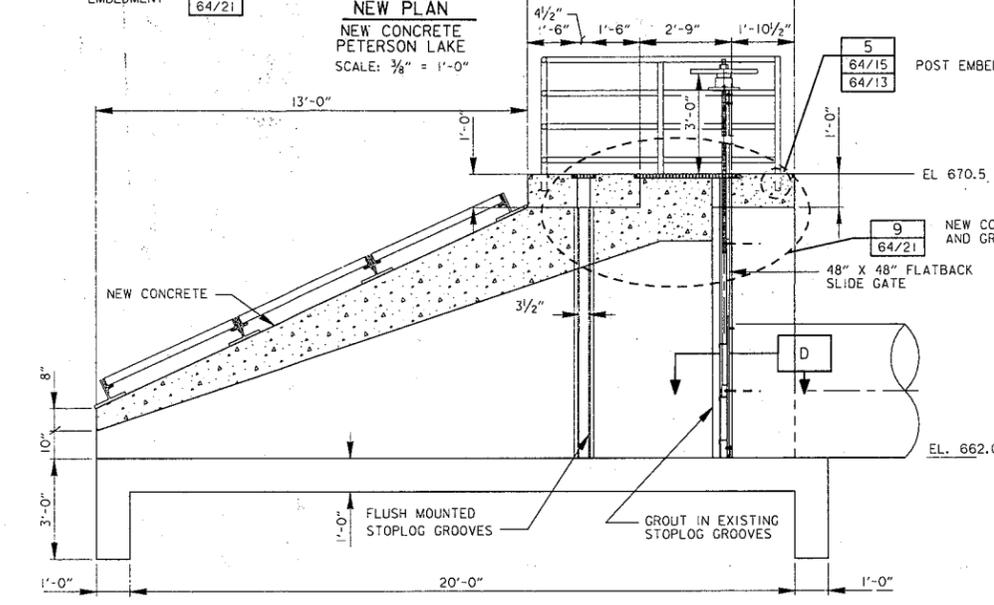
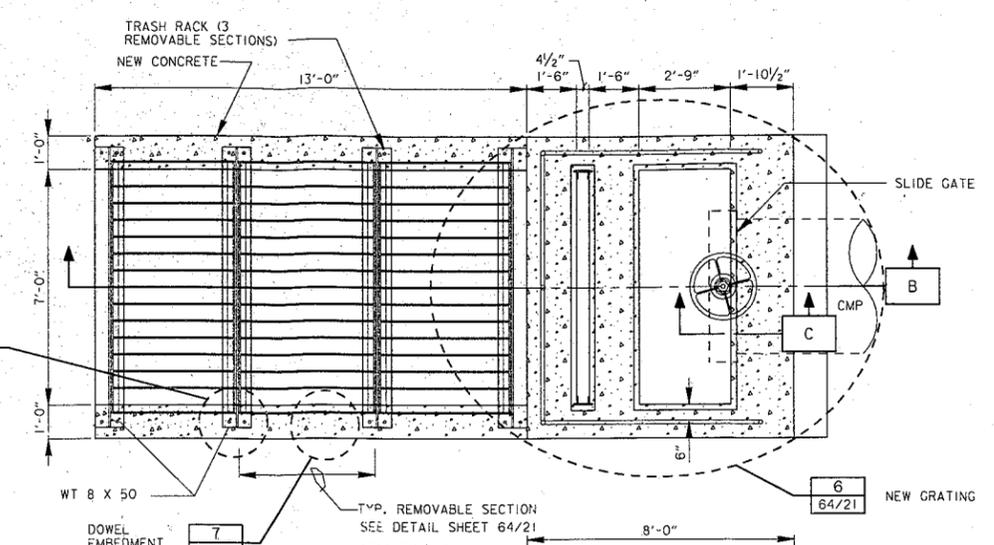
SECTION  
METAL STORAGE BUILDING  
SCALE: 1/2" = 1'-0"



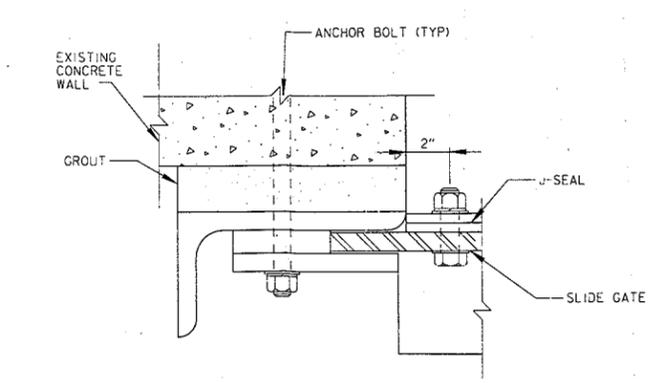
AS-BUILT AS OF COMPLETION DATE		11/94	<i>J.J.B.</i>
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT	
		FINGER LAKES	
		ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER	
		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
		AERATION CULVERTS IN L/D 4 DIKE	
		STORAGE BUILDING	
		PLAN, SECTION AND DETAILS	
DESIGNED: PWS	CAD FILE NAME: M4SPPO19.DGN	DRAWING NUMBER:	SHT 20
CHECKED: MGE	DATE: APRIL 1992	SPEC NO: DACW37-92-R-0004	OF 23
DRAWN: JJZ/HPA		M-P4-64/19	
DESIGNED:			
CHECKED:			



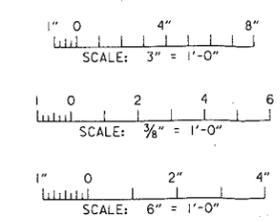
SECTION  
SLIDE GATE BOTTOM SEAL  
SCALE: 8" = 1'-0"



SECTION  
HEADWALL  
SCALE: 3/8" = 1'-0"



SECTION  
SLIDE GATE SIDE FRAME  
SCALE: 3" = 1'-0"

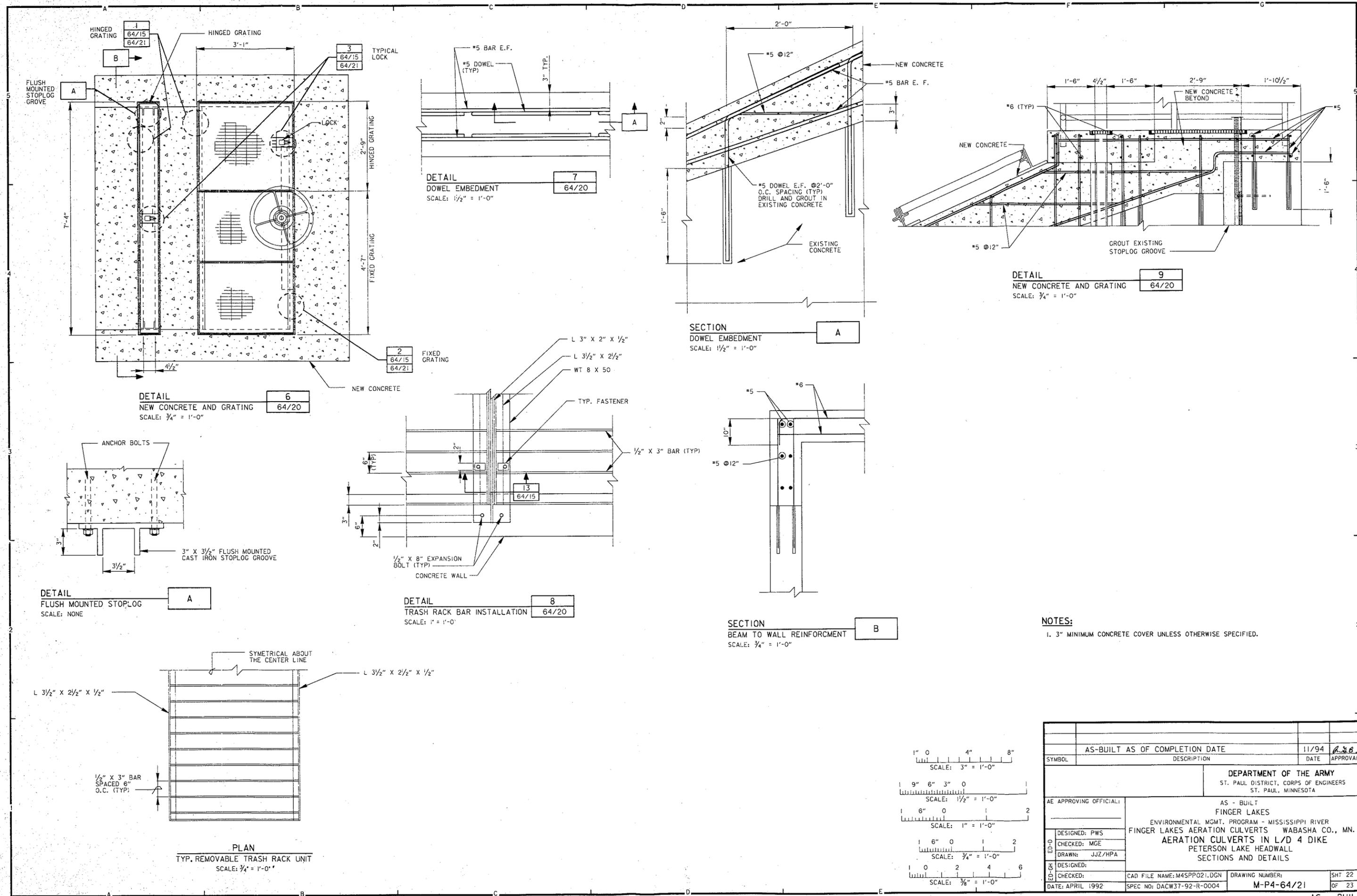


**NOTES:**  
1. REMOVE EXISTING RAILING, GRATING AND TRASH RACK.

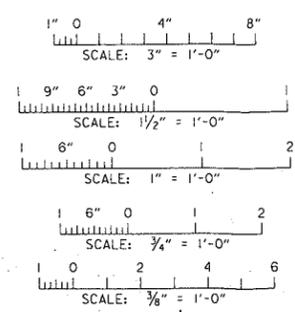
**REFERENCES:**  
CULVERT THRU DIKE  
TRASH RACK FOR EXISTING HEADWALL

**DWG NO.**  
M-L4-64/1  
M-P4-67/1

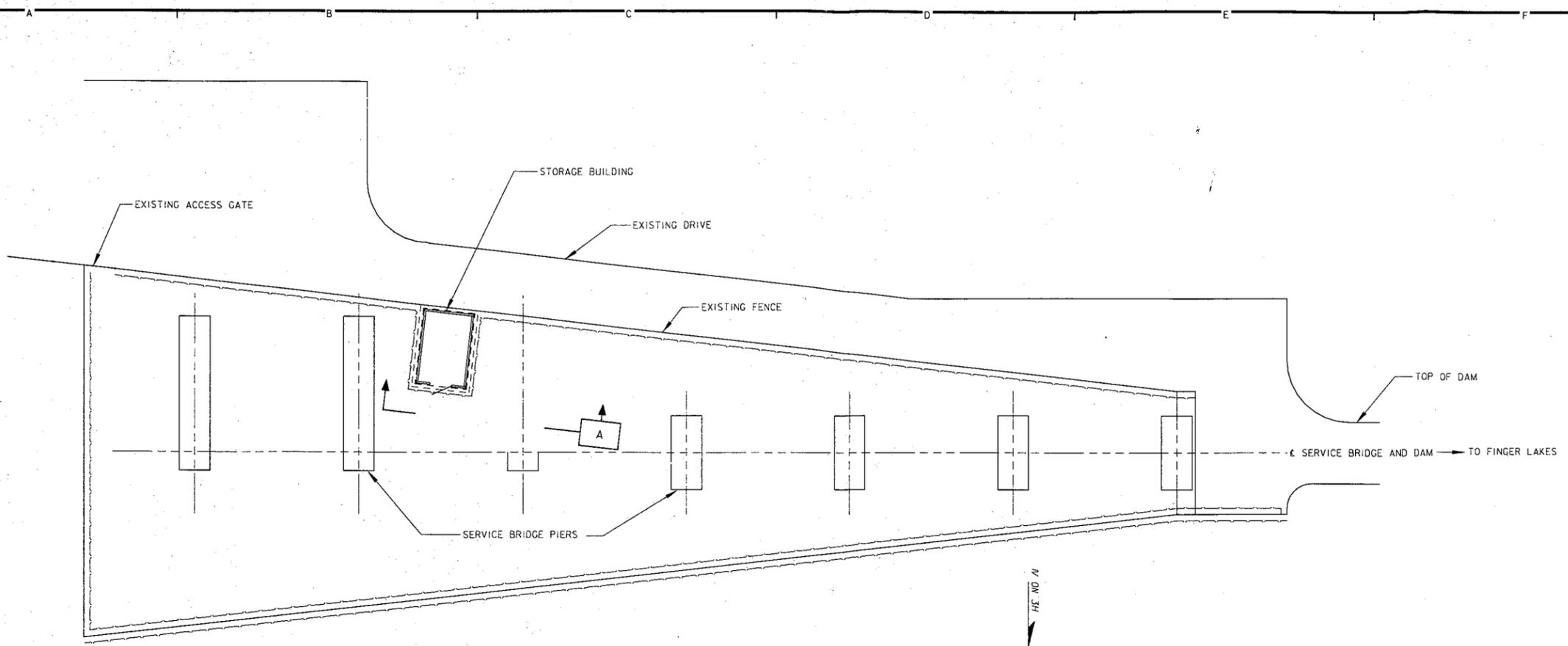
AS-BUILT AS OF COMPLETION DATE		11/94	<i>R.S.B.</i>
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT	
		FINGER LAKES	
		ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER	
		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
		AERATION CULVERTS IN L/D 4 DIKE	
		PETERSON LAKE HEADWALL	
		PLANS AND SECTIONS	
DESIGNED: PWS	CAD FILE NAME: M4SPPO20.DGN	DRAWING NUMBER:	SHT 21
CHECKED: MGE	SPEC NO: DACW37-92-R-0004	M-P4-64/20	OF 23
DRAWN: JJZ/HPA	DATE: APRIL 1992		



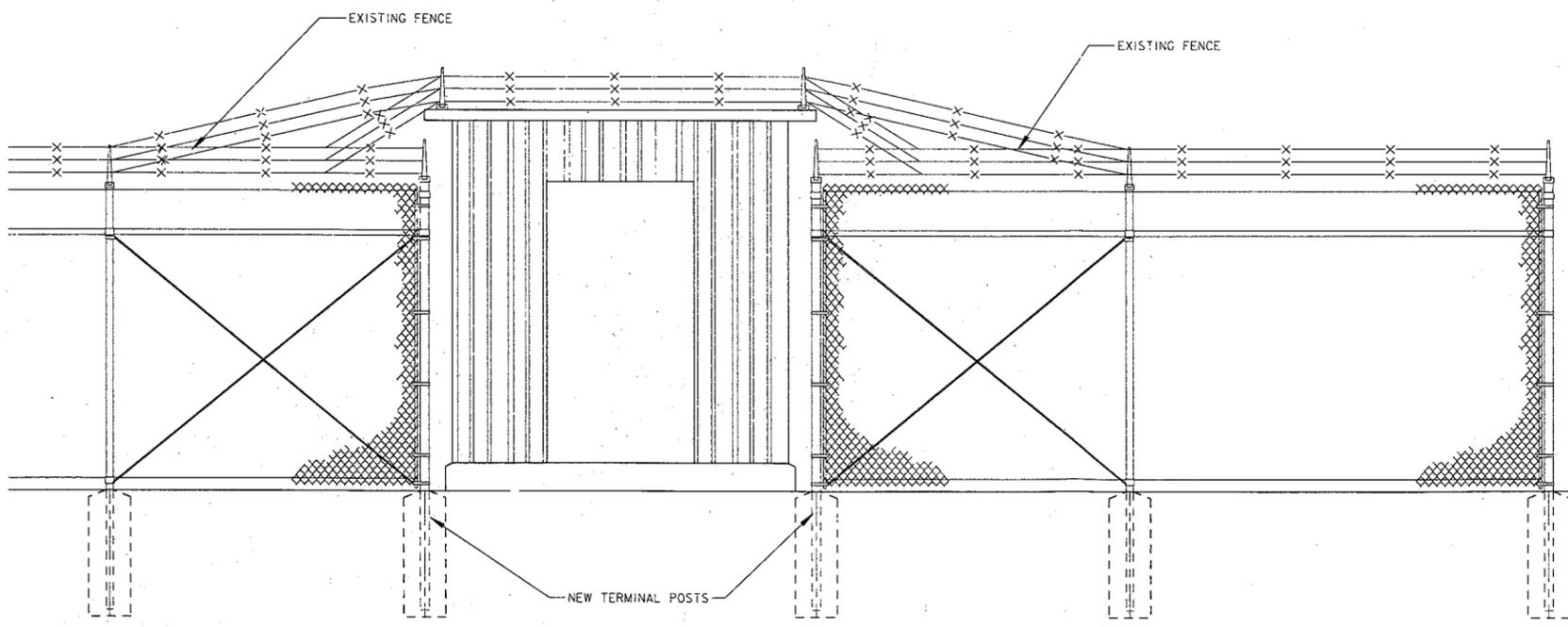
**NOTES:**  
1. 3" MINIMUM CONCRETE COVER UNLESS OTHERWISE SPECIFIED.



AS-BUILT AS OF COMPLETION DATE		11/94	ASB
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:		AS - BUILT FINGER LAKES	
DESIGNED: PWS		ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER	
CHECKED: MGE		FINGER LAKES AERATION CULVERTS WABASHA CO., MN.	
DRAWN: JJZ/HPA		AERATION CULVERTS IN L/D 4 DIKE	
DESIGNED:		PETERSON LAKE HEADWALL	
CHECKED:		SECTIONS AND DETAILS	
DATE: APRIL 1992	CAD FILE NAME: M4SPP021.DGN	DRAWING NUMBER:	SHT 22
	SPEC NO: DACW37-92-R-0004	M-P4-64/21	OF 23



PLAN  
L & D 4 STORAGE YARD  
STORAGE BUILDING LOCATION  
SCALE: 1/32" = 1'-0"

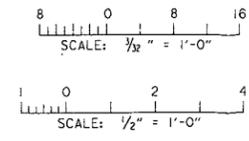


SECTION  
STORAGE BUILDING LOCATION  
SCALE: 1/2" = 1'-0"

- NOTES:**
1. REMOVE AND REPLACE EXISTING FENCE AS NECESSARY.
  2. FINAL LOCATION OF STORAGE BUILDING TO BE DETERMINED IN FIELD BY CONTRACTING OFFICERS REPRESENTATIVE.
  3. REMOVE EXISTING RIPRAP FOR PLACEMENT OF SLAB.
  4. NEW REPLACEMENT FENCE SHALL MATCH EXISTING FENCE IN SIZE AND TYPE OF COMPONENTS.

**REFERENCES:**  
FIRST AND SECOND LAKES SITE PLAN

**DWG NO.**  
M-P4-64/3



AS-BUILT AS OF COMPLETION DATE		11/94	A.B.
SYMBOL	DESCRIPTION	DATE	APPROVAL
DEPARTMENT OF THE ARMY ST. PAUL DISTRICT, CORPS OF ENGINEERS ST. PAUL, MINNESOTA			
AE APPROVING OFFICIAL:	AS - BUILT FINGER LAKES ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER FINGER LAKES AERATION CULVERTS WABASHA CO., MN. AERATION CULVERTS IN L/D 4 DIKE STORAGE BUILDING LOCATION PLAN & ELEVATION		
DESIGNED: PWS			
CHECKED: MGE			
DRAWN: JJZ			
DESIGNED:			
CHECKED:	CAD FILE NAME: M4SPPO22.DGN	DRAWING NUMBER:	SHT 23
DATE: APRIL 1992	SPEC NO: DACW37-92-R-0004	M-P4-64/22	OF 23

**APPENDIX B**

**MEMORANDUM OF AGREEMENT**

MEMORANDUM OF AGREEMENT  
BETWEEN  
THE UNITED STATES FISH AND WILDLIFE SERVICE  
AND  
THE DEPARTMENT OF THE ARMY  
FOR  
ENHANCING FISH AND WILDLIFE RESOURCES  
OF THE  
UPPER MISSISSIPPI RIVER SYSTEM  
AT  
FINGER LAKES  
WABASHA COUNTY, MINNESOTA

I. PURPOSE

The purpose of this Memorandum of Agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (FWS) and the Department of the Army (DOA) will operate in constructing, operating, maintaining, repairing, and rehabilitating the Finger Lakes separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features for the Finger Lakes project are 100 percent Federal, and all operation, maintenance, repair, and rehabilitation costs are to be cost shared 75 percent Federal and 25 percent non-Federal.

### III. GENERAL SCOPE

The Finger Lakes project provides for the construction of controlled culvert systems into First, Second, Third, and Clear Lakes. This would provide direct flows into these backwater lakes, thereby improving the dissolved oxygen in the Finger Lakes system. This should lead to increased use of the area by fish throughout the year.

### IV. RESPONSIBILITIES

#### A. DOA is responsible for:

1. Construction: Construction of the Project which consists of installing three controlled culvert systems into the Finger Lakes area.

2. Major Rehabilitation: Any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the Definite Project Report and that is needed as a result of specific storm or flood events.

3. Construction Management: Subject to and using funds appropriated by the Congress of the United States, DOA will construct the Finger Lakes project as described in the Definite Project Report, Finger Lakes, Habitat Rehabilitation and Enhancement, dated March 1990, and as amended by the Assistant Secretary of the Army (Civil Works) in July 1991, to include the Third Lake culvert system, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The FWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. If DOA encounters potential delays related to construction of the Project, DOA will promptly notify FWS of such delays.

4. Maintenance of Records: DOA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the Project to the extent and in such detail as will properly reflect total costs. DOA shall maintain such books, records, documents, and

other evidence for a minimum of three years after completion of construction of the Project and resolution of all relevant claims arising therefrom, and shall make available at its offices, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the FWS.

B. FWS is responsible for:

1. Operation, Maintenance, and Repair: Upon completion of construction as determined by the District Engineer, St. Paul, the FWS shall accept the Project and shall operate, maintain, and repair the Project as defined in the Definite Project Report entitled "Finger Lakes Habitat Rehabilitation and Enhancement," dated March 1990, and as amended by the Assistant Secretary of the Army (Civil Works) in July 1991, to include the Third Lake culvert system, in accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662.

2. Non-Federal Responsibilities: In accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662, the FWS shall obtain 25 percent of all costs associated with the operation, maintenance, and repair of the Project from the Minnesota Department of Natural Resources.

V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the Project.

VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties:

FWS: Regional Director  
U.S. Fish and Wildlife Service  
Federal Building, Fort Snelling  
Twin Cities, Minnesota 55111

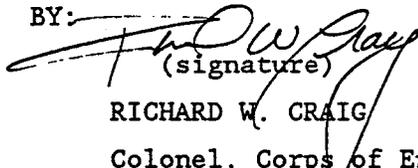
DOA: District Engineer  
U.S. Army Engineer District, St. Paul  
180 Kellogg Boulevard East, Room 1421  
St. Paul, Minnesota 55101-1479

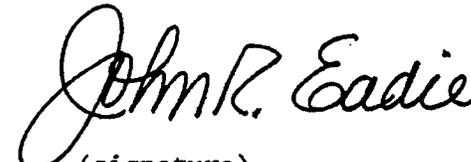
VII. EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF THE ARMY

THE U.S. FISH AND WILDLIFE SERVICE

BY:   
(signature)  
RICHARD W. CRAIG  
Colonel, Corps of Engineers  
St. Paul District

BY:   
(signature)  
Acting JAMES C. GRITMAN  
Regional Director  
U.S. Fish and Wildlife Service

Date: 3 January 1992

Date: December 12, 1991

**APPENDIX C**

**CHECKLIST FORM COVERING INSPECTIONS**

SUBJECT: Annual Inspection Report, Finger Lakes Habitat Rehabilitation and Enhancement Project  
 Pool 5, Upper Mississippi River, for the period \_\_\_\_\_ to \_\_\_\_\_.

TO: St. Paul District, Corps of Engineers  
 ATTN: CO-NR  
 190 Fifth Street  
 St. Paul, Minnesota 55101

Indicate deficiencies by noting location and condition. Indicate repairs made under the remarks section.

Item	Date of Inspection	Identified Deficiencies		Remarks
		Location	Condition (describe deficiency)	
1st/2nd Lake Channels				
1st/2nd Lake Structures				
3rd Lake Structure				
Clear Lake Structure				

**APPENDIX D**

**GATE MANUFACTURER'S MAINTENANCE INSTRUCTIONS  
AND PARTS LIST**

OPERATION AND MAINTENANCE MANUAL

FOR:  
SLUICE & SLIDE GATES, & PORTABLE OPERATOR

FOR:  
FINGER LAKES AERATION CULVERTS  
WABASHA COUNTY MN

FOR: ABE CONSTR  
2525 NEVADA AVE NORTH  
SUITE 307  
GOLDEN VALLEY MN 55427

JOB# B-3222

QUOTE# KQ92-D-2040

OPERATION AND MAINTENANCE MANUAL  
INDEX

INTRODUCTION

PAGE #

FORWARD	1.0
RECEIVING	1.1
HANDLING & STORAGE	1.2

INSTALLATION

PROCEDURE FOR INSTALLING FLATBACK OR FLANGEBACK GATE ON THIMBLE OR PIPE FLANGE	2.1
INSTALLATION OF SLIDE OR STOP GATE TO CONCRETE WALL	2.5
PROCEDURE FOR INSTALLING STEMS AND STEM GUIDES	3.0
PROCEDURE FOR INSTALLING MANUALLY OPERATED LIFT	3.2
INSTALLATION OF LIMIT NUTS	3.8
INITIAL OPERATION OF GATES	4.0 & 4.1
FIELD LEAKAGE TEST PROCEDURE/SLUICE GATES	4.2
OPERATION WITH PORTABLE OPERATOR (ELECTRIC)	4.5
PROCEDURE FOR ADJUSTING SIDE WEDGES ON S-4000 SLUICE GATES (15" & LARGER)	5.3
PROCEDURE FOR ADJUSTING TOP & BOTTOM WEDGES ON S-4000 SLUICE GATES	5.7
PROCEDURE FOR REPLACING AND ADJUSTING J-BULB SEAL ON FABRICATED SLIDE GATES	5.10
PROCEDURE FOR SETTING COUNTER POSITION INDICATORS (MANUAL LIFT)	5.14

TROUBLE SHOOTING GUIDE FOR

SLUICE GATE (3 PAGES)	5.20, 21 & 22
SLIDE GATE	5.23

MAINTENANCE

MAINTENANCE OF:SLUICE & SLIDE GATES, STEM GUIDES	6.0
MAINTENANCE OF OPERATING STEMS	6.0
MAINTENANCE OF MANUAL GATE OPERATORS	6.1
LUBRICATION CROSS REFERENCE CHART	6.10
SPECIAL TOOLS	7.0
SPARE PARTS	7.1
FIELD SERVICE & FIELD SERVICE CHARGES	8.0
LIMITED WARRANTY	9.0

SPECIAL EQUIPMENT

(SPECIAL MANUALS FOR EMOs, HYD, CYL, POWER SUPPLIES, ETC.)

MILWAUKEE HEAVY-DUTY, COMPACT & SUPER HOLE SHOOTERS	10.0
AMERICAN AUTOGUARD CORP(INSTALLATION AND MAINTENANCE MANUAL)	10.1

# Waterman INDUSTRIES SALES, INC.

## DETAIL DRAWINGS

DWG.#

PAGE #

### MODEL S-4000 SLUICE GATES (15" & UP)

SIDE WEDGE ASSEMBLY	102572	15.0.6
BOTTOM WEDGE ASSEMBLY	102984	15.0.8
TOP WEDGE ASSEMBLY	102983	15.0.9

### STEM GUIDES

K-2 STEM GUIDE	103251	15.1.1
K-2B STEM GUIDE	100885	15.1.2

### 3ESN AND 2:1 LIFTS

3ESN - 2:1C (W/COUNTER IND)		15.7.9
-----------------------------	--	--------

### 3EN = 2:1 LIFTS

3EN - 2:1C (W/COUNTER IND)		15.7.17
----------------------------	--	---------

### TYPE 3E 2:1 AND 6:1 LIFTS

3ED - 4:1 C		15.8.4.2
-------------	--	----------

## ENGINEERING DRAWINGS

(WATERMAN SUBMITTAL DRAWINGS)

RB-92-2005  
RB-92-2006  
RB-92-2007  
RB-92-2008  
RA-92-2009

FORWARD

The purpose of this manual is to provide information to the engineers, contractors, plant operators and associated personnel involved with installation, operation, and maintenance of equipment supplied by WATERMAN INDUSTRIES, INC. for this project. Although every care is taken in our factory to ensure top quality equipment, we cannot be responsible for damage caused by negligence after shipping. Therefore, described herein are WATERMAN'S recommended methods of handling, storage, installation, adjustment, and initial operation for standard situations to be used in conjunction with the approved installation drawings provided by WATERMAN INDUSTRIES, INC. If proper care and accuracy are exercised in the field when installing our gates; they will operate as designed at maximum efficiency.

WATERMAN INDUSTRIES, INC.

RECEIVING

CHECK COUNT all parts when you receive shipment. All individually shipped parts or assemblages are listed on packing list. Should a shortage exist, notify WATERMAN INDUSTRIES, INC. immediately. We cannot be responsible for any shortages reported more than 30 days after receipt of shipment. Special care should be taken in accounting for and safely storing all bolts, nuts, and small items which are often misplaced at jobsites.

Unless your contract with WATERMAN INDUSTRIES, INC. states otherwise, all equipment is shipped F.O.B. factory. If any equipment has been damaged in transit, the purchaser will be responsible for filing claim with the transportation company. For assistance in filing any claim and/or replacing equipment, please contact WATERMAN INDUSTRIES, INC., directly.

## PROCEDURE FOR INSTALLING A FLATBACK OR FLANGEBACK GATE ON A THIMBLE.

1. Place the thimble in correct position in the forms and secure in place. The top and bottom center line is marked on the flange face and should be aligned with a plumb. Thimble should be flush or projecting slightly from the headwall face.
2. As shown in Figure 1 below, use timbers or other bracing on the inside of the opening to support the thimble and prevent warpage during the pour. This is especially important on larger thimbles or when the concrete cover will be especially high.
3. Plug the tapped holes in the thimble with the studs provided or other removable plugs that will prevent concrete from entering the tapped holes.
4. Secure anchor bolts for guide rail extensions (or provide block out) in the proper position as given on our installation drawings, (your certified submittal drawing provided by the manufacturer). Check projection and perpendicular alignment of these anchors.
5. Pour concrete, using care not to tilt or move thimble from its original position in the forms.
6. Let concrete set, then remove forms and bracing. Remove any spackle from machined face of the thimble and place studs into tapped holes provided.
7. Clean the back of the gate frame and the mounting flange or thimble thoroughly. Apply a thin coat of mastic (such as butyl rubber compound or black asphaltic compound) to the contact surfaces and scrape off but do not wash.
8. Mount the COMPLETELY ASSEMBLED gate on the thimble of pipe flange. Place washers and nuts on studs and tighten uniformly to a near metal to metal contact.
9. Check clearance between surfaces, with a .004" feeler gauge. In the event that the gate is not seating properly, make wedge adjustments. (Another cause of improper seating is warpage of gate frame due to mounting on a thimble which has been warped during the pouring of the concrete. If steps one through five are strictly adhered to, this will be avoided and the mounting of the gate will be a simple procedure. Gate is now ready for initial operation.

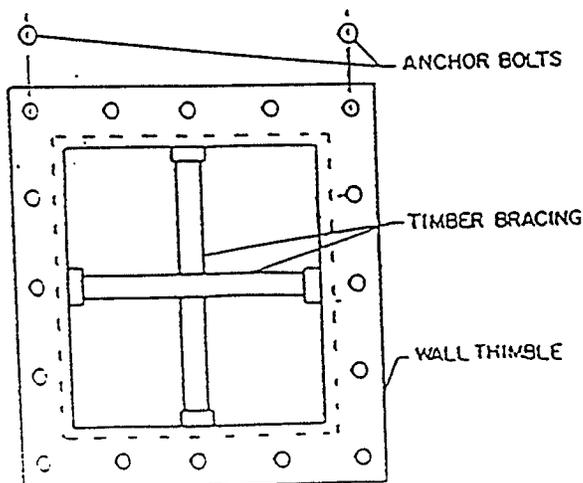


FIGURE 1

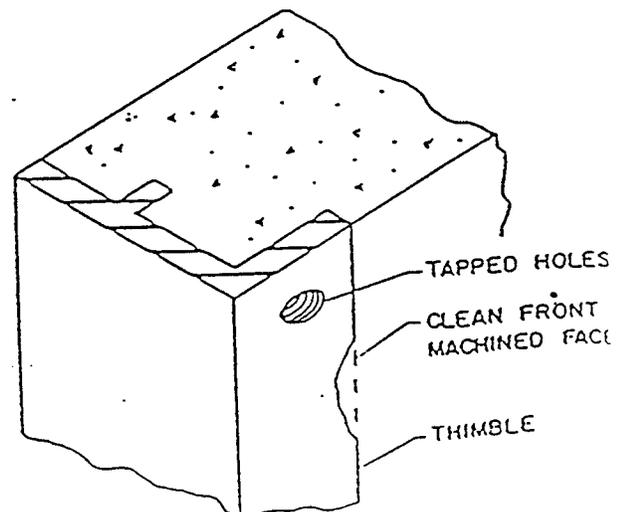


FIGURE 2

INSTALLATION OF SLIDE OR STOP GATE TO FACE OF CONCRETE WALL

1. The wall mounted guide frame must be set plumb and straight regardless of the condition of the vertical concrete wall on which it is to be mounted. The wall may need to be grout faced if it is unduly rough or badly out of plumb. Any small voids between the guide frame and the wall should be filled with a mastic sealant or with grout in an extreme case. The amount of sealing required will depend solely on the accuracy with which the wall is formed or faced. We emphasize that the guide frame is sufficiently flexible that it will follow the contour of the wall if all bolts are pulled tight. If grout is used in any of this sealing, it should be of non-shrink type so as to maintain its seal after curing.
  - 1a. Paragraph 1 above applies especially around gate sealing periphery.
2. Secure all anchor bolts in proper position in forms, checking carefully to see that size, projection, perpendicular, and horizontal alignments conform to requirements shown on our installation drawings. EXTREME CARE must be exercised in this initial procedure in that bolts which are improperly set will cause gate warpage and therefore excess leakage between the seating surfaces. DO NOT FORCE GATE ON TO MISALIGNED BOLTS.

Optional method of mounting could be with concrete anchors or studs. Install concrete anchor per manufacturer's recommended procedure, making sure that stud projections are as shown on drawing. Use guide rail as template.

3. The guide frame should be hung loosely on the mounting bolts, tightening each nut a small amount each time until the guide touches the wall initially. The guide should then be checked to ensure that both legs are parallel and plumb. After the wall has been dressed to provide a good mounting surface for the guide frame all bolts should be tightened and the guide frame again checked for straightness.
  - 3a. Paragraph above should apply to extension frame above opening.

PROCEDURE FOR INSTALLING STEMS & STEM GUIDES

1. Stems are shipped with thrust nuts and couplings attached; these must be removed prior to installation.
2. After the gate has been mounted and shipping stops have been removed, lower short-threaded end of stem through holes in upper ribs of cover into contact with the top of the thrust nut.
3. With thrust nut located in gate pocket, thread stem into thrust nut until stem is flush with bottom of nut.
4. Tighten set screws on thrust nut into indents in stem. (for rising stem only)
5. Mount stem guides in order from bottom up as stem is installed. Do not tighten stem guide assembly bolts, taking care to maintain proper plumb and horizontal orientation.
6. Install stem couplings as required, being sure to install keys. Tighten all set screws, or drive in pins as required.
7. Take care not to bend stems or damage threads during installation.\*
8. Thoroughly clean and grease stem threads with heavy duty grease, such as Mobilux grease #2EP or equal.
9. Check final alignment of stem to be sure it is plumb and does not bind. (This should be checked again after installation of lift mechanism. .

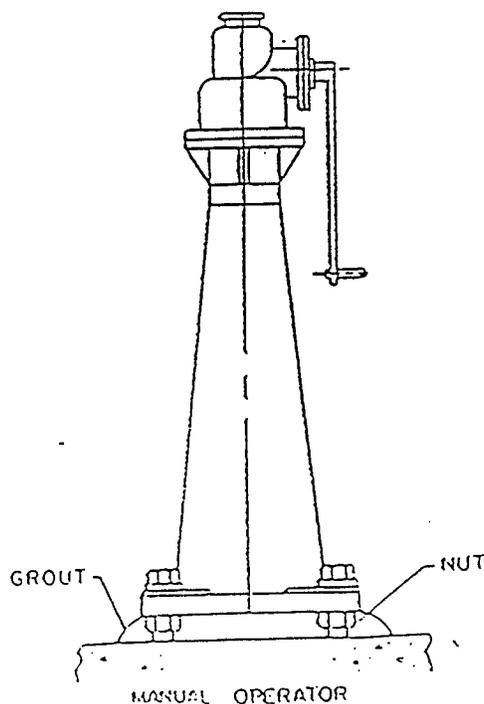
\*This is especially true on electric motor operated lifts. Extra care should be taken with stems for these operators.

PROCEDURE FOR INSTALLING MANUALLY OPERATED LIFT

1. Lifts are factory lubricated, and do not need lubrication at time of installation.

INSTALLATION OF MANUAL LIFT ON OPERATING FLOOR

1. Place one nut on each anchor bolt and run down against operating floor, as shown in Figure.
2. After assembling and installing stem, lower the lift over the upper threaded portion of stem carefully engaging threads of lift nut and stem.
3. By turning handwheel or crank, bring base of lift over anchor bolts to about 1" from floor and adjust lower nut by finger turning each nut until it touches pedestal base.
4. Tighten top nuts on anchor bolts and grout in place.
- 4a. Vertical alignment is now correct:
5. Once the lift is properly installed, apply tension to the stem with the lift and align the stem guide, tighten stem guide assembly bolts.



INSTALLATION OF LIMIT NUTS

1. After lift is installed with gate in fully closed position, screw limit nut down on stem until it just starts to bottom out on top of lift nut.\* Tighten set screws.
2. IMPORTANT: In those cases where a limit nut is used to stop upward gate travel, and a pedestal lift is also used, the limit nut must be installed on stem prior to installing lift.

\*If gates have wedges which require adjustment, final setting and tightening of nut will have to be done after gate wedges are adjusted.

INITIAL OPERATION OF GATES

1. After gate, stem guides, stem, lifting mechanism, and other necessary appurtenances have been installed, check the following prior to operation:
  - a. Check all assembly and mounting hardware for proper tightness.
  - b. Apply tension to stem and check for proper alignment.
  - c. Remove any shipping stops on gates.
  - d. Check gate guide grooves and seats for any foreign matter and clean as necessary.
2. If not done previously, or if gate stem has set some time after installation, thoroughly clean stem threads and lubricate in accordance with stem installation instruction.
3. Open gate slide to fully open position. All lifts are factory lubricated, so there is no need for additional lubrication.

- a. For manually operated lifts, turn handwheel or handcrank in direction noted on handwheel or lift housing.
- b. Electric operators should be initiated per the instructions in the operation manual for this item.
- c. Pressure must be applied to bottom side of cylinder pistons to get gate to rise. This should be done with manually actuated controls, rather than automatic controls, with pressure being applied very slowly and carefully.\*

\*On pneumatic operators gate will "jump" out of closed position then begin steady rising movement. There is no way to prevent this.

Regardless of operator, operation should be easy and unlabored. If not, check for binding or other causes by reviewing previously mentioned installation and start-up procedures. Do not apply any excess force to handwheel or handcranks on operators.

4. Clean all dirt, paint, concrete splatter, or other foreign material from seating surfaces, wedges, flushbottom seals, etc.

INITIAL OPERATION OF GATES (CONT'D.)

5. Grease any and all seating and wedging surfaces with water resistant grease as noted:
  - a. For machined iron or bronze seating or wedging surfaces, grease with Intertol Grease Coating, as manufactured by Koppers, Inc., or equal.\*  
  
\*See lubrication chart for equivalent lubricants.
  - b. Grease stainless steel seats and wedging surfaces with Never-Seez, manufactured by Never-Seez Corporation or equal.\* For best results mix Never-Seez with an equal portion of ten weight oil.  
  
\*See lubrication chart for equivalent lubricants.
  - c. Seating surfaces of aluminum or fiberglass slide gates, including gates with UHMW polyethylene bearing strips require no lubrication.

6. Close gate completely and check for proper closure. See CAUTION following:

- a. On all cast iron sliding gates(also applicable to flap gates and shear gates) check seat clearance with .004" feeler gauge. Best results can be obtained by checking seat faces from back side of gate when installation permits. Adjust any wedges as necessary per applicable wedge adjustment procedures following, until .004" feeler gauge cannot be inserted between seats.
- b. On fabricated slide gates, check to see that slide fits flat against seating surface. Check to be sure frame is not warped.

CAUTION: Be extremely careful when closing gate so as not to apply excessive compressive force on stem. The stem under a compressive load is the weakest link in the system and can buckle (bow) if excessive force is applied to operator. Limit nuts should be in place if applicable.

7. Set any limit nuts or position indicators as required per applicable instructions.
8. Cycle gates with operators to ensure proper installation, alignment, and operation.

FIELD LEAKAGE TEST PROCEDURE/SLUICE GATES

1. INSTALL SLUICE GATE ACCORDING TO THE INSTRUCTIONS GIVEN IN THIS OPERATION AND MAINTENANCE MANUAL.
2. CHECK SEAT CLEARANCE AND ADJUST WEDGES AS REQUIRED ACCORDING TO THE INSTRUCTIONS GIVEN IN THIS OPERATION AND MAINTENANCE MANUAL FOR THE GATE MODEL TO BE TESTED.
3. LUBRICATE OPERATOR AND STEM THREADS PRIOR TO OPERATION. NOTE: MOST OPERATORS ARE PRE-LUBRICATED AT THE FACTORY. ADDITIONAL LUBRICATION MAY BE REQUIRED IF THE OPERATORS HAVE BEEN STORED FOR A LONG PERIOD OF TIME.
4. REVIEW THE APPROPRIATE WATERMAN SUBMITTAL DRAWING TO DETERMINE THE AMOUNT OF SEATING / UNSEATING HEAD PRIOR TO TESTING. THIS IS LISTED IN THE "NOTES" SECTION UNDER "OPERATING HEADS".
5. FILL THE STRUCTURE WITH THE APPROPRIATE AMOUNT OF WATER TO TEST THE GATE (CAUTION: LEVEL MUST NOT EXCEED RATED GATE CAPACITY). AFTER THE WATER LEVEL HAS BEEN REACHED, MEASURE ANY GATE LEAKAGE BY USING A TROUGH OR SIMILAR DEVICE TO COLLECT THE WATER FOR A PERIOD OF ONE MINUTE. GATE LEAKAGE IS DETERMINED PER AWWA C501 SPECIFICATIONS. 0.1 GPM PER FOOT OF PERIPHERY SEATING/0.2 GPM PER FOOT OF PERIPHERY ON SEATING.  
FOR EXAMPLE: AN 84" X 84" SLUICE GATE HAS A SEATING PERIMETER OF 28 FEET. THE TOTAL LEAKAGE FOR THIS SIZE OF GATE WOULD BE  $0.10 \times 28 = 2.80$  GPM SEATING AND  $0.20 \times 28 = 5.6$  GPM UNSEATING.
6. IF EXCESSIVE LEAKAGE IS DETERMINED DURING THE TEST, REVIEW THE APPROPRIATE OPERATION AND MAINTENANCE MANUAL SECTION TO ADJUST WEDGES IF REQUIRED. IF EXCESS LEAKAGE IS NOTED BETWEEN THE GATE FLANGE/WALL THIMBLE, ADDITIONAL GASKET MATERIAL MAY BE REQUIRED. NOTE: A WARPED THIMBLE FLANGE MAY CAUSE EXCESSIVE LEAKAGE BETWEEN THE GATE SEATS. BE SURE THE THIMBLE HAS BEEN INSTALLED PROPERLY, & THAT NO DEBRIS IS CAUGHT BETWEEN THE GATE AND THIMBLE, OR BETWEEN THE GATE SEAT PACINGS OR GUIDE WAYS.
7. IF YOU ARE UNABLE TO MINIMIZE LEAKAGE TO WITHIN THE ALLOWABLE PARAMETERS, CALL YOUR NEAREST FACTORY REPRESENTATIVE FOR ASSISTANCE.
8. IF REQUIRED BY SPECIFICATIONS, CYCLE GATE OPEN & CLOSED AND RETEST.

WATERMAN INDUSTRIES, INC.

OPERATION WITH PORTABLE OPERATOR (ELECTRIC)

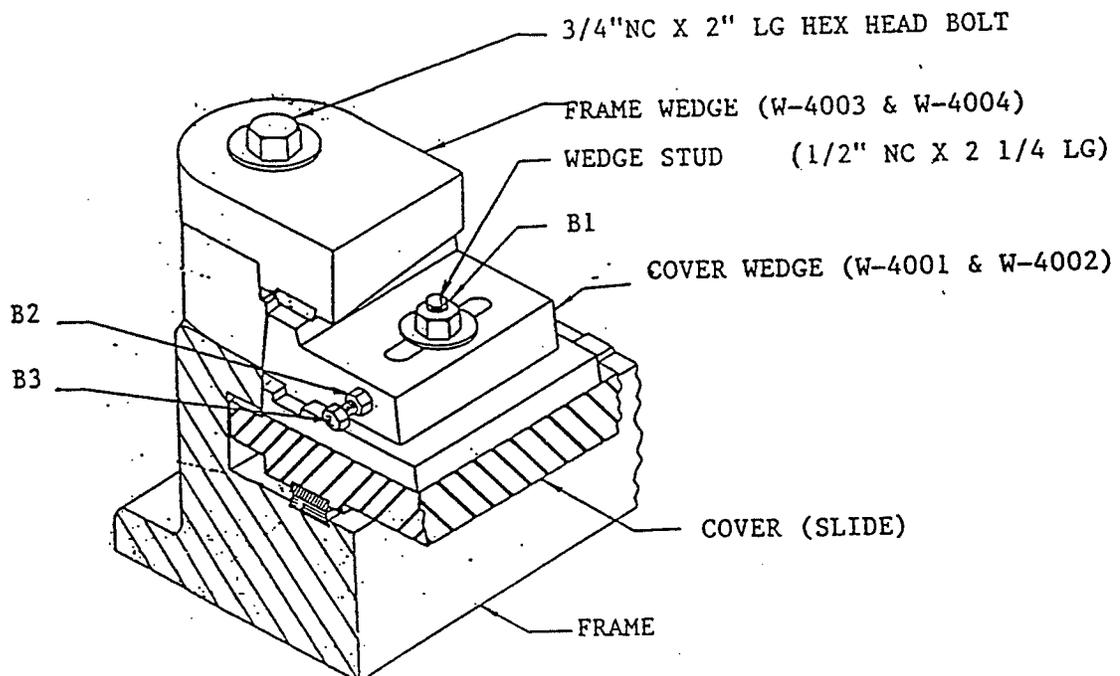
1. With handcrank, slightly open gate to "break" gate out of wedges.
2. Loosen set screw on handcrank and remove handcrank from lift.
3. Position portable operator to socket of portable operator lines up with input shaft. Adjust height as necessary.
4. Slip socket on input shaft until fully engaged (minimum 1 inch). Tighten set screw on socket.
5. Plug in operator to 115V-60HZ power source; be sure outlet is grounded type.
6. Set forward-reverse switch (forward is clockwise rotation as required for proper gate operation. Direction to open gate is shown on lift above input shaft.

PROCEDURE FOR ADJUSTING SIDE WEDGES ON SLUICE GATES

(S-4000)

SIDE WEDGES (ADJUSTABLE PORTION OF WEDGE ON SLIDE)

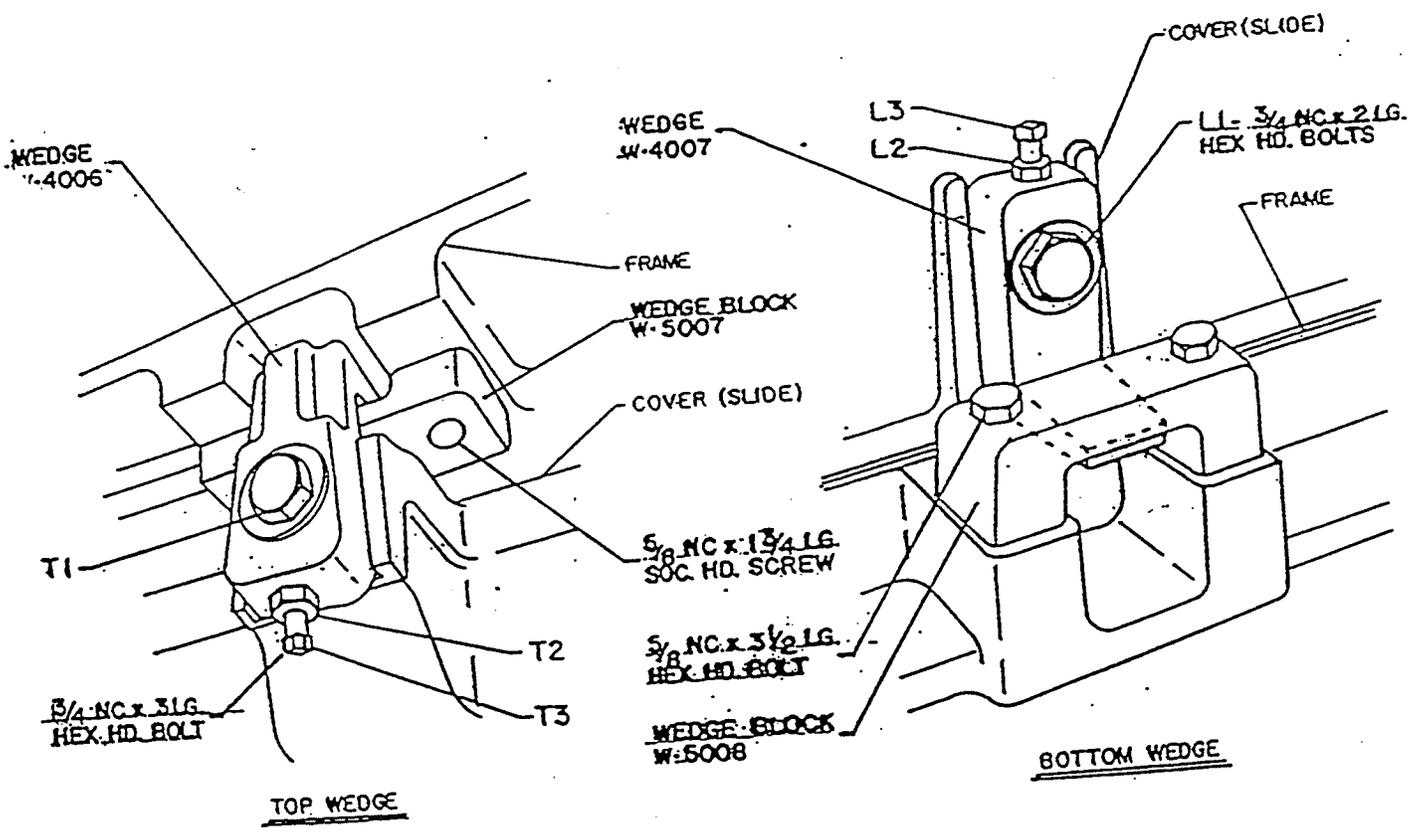
1. Open gate slightly.
2. Loosen locking nut (B1) [1/2NC HEX NUT]
3. Loosen adjusting screw lock nut. (B2) [3/8 NC HEX NUT].
4. Move wedge down into desired position by turning adjusting screw. (B3) [3/8NC X 1 3/4 LG HEX HD. BOLT].
5. Tighten locking bolts. (B1).
6. Tighten adjusting screw lock nut. (B2).
7. Close gate and check with .004" feeler gauge.
8. Repeat procedure as necessary until desired closing is attained.
9. Check to see that gate cover will repeat final closed position. If gate cover will not repeat - readjust.



PROCEDURE FOR ADJUSTING TOP AND BOTTOM WEDGES ON SLUICE

GATES (S-4000)

1. Loosen locking bolt slightly. (T1) (L1).
2. Loosen adjusting screw lock nut. (T2) (L2) [3/8NC HEX].
3. Tighten adjusting screw until proper seating is attained. (T3) (L3) [3/8NC x 1 3/4 LG. HEX HD. BOLT.
4. Tighten locking bolt. (T1) (L1)
5. Tighten adjusting screw lock nut. (T2) (L2).



PROCEDURE FOR REPLACING AND ADJUSTING J-BULB SEALS FOR FABRICATED SLIDE GATES

1. Adjustment on J-bulb seals are made at factory and should not need to be field adjusted, but if adjustment is necessary carefully note the following instructions:

- a. To adjust J-bulb seal, slide should be in the fully closed position. Begin by checking clearance between seals and slide with a .002 inch feeler gauge around entire perimeter, noting any points which allow passage of the gauge. Loosen hex head machine bolts adjacent to points requiring adjustment just enough to allow the seal to be moved. Push seal against the slide until feeler gauge will not enter, retighten bolts. Recheck entire perimeter and readjust if necessary.

Under full design head, slide is engineered not to deflect more than 1/360th of the width of the gate opening. The amount of deflection is dependent upon the amount of head, thus gates which are subject to constant maximum heads may need the top or bottom seals adjusted to compensate for the deflection, especially toward the center of the gate.

- b. To replace J-bulb seal, remove hex head machine bolt, nut plate seal retainer, and J-bulb seal, carefully noting the position of each. Remove old J-bulb seal and replace with new seal and assemble with seal retainer nut plate and hex head machine bolts being careful not to over-tighten bolts. To adjust new seal, follow instructions above.

PROCEDURE FOR SETTING COUNTER POSITION INDICATORS (MANUAL LIFTS)

1. When installing a manually operated lift with counter position indicator, remove the indicator prior to mounting. Indicator must be field set after gate is installed and adjusted.
2. After the lift has been properly installed, lower the gate until the bottom seating surface of the cover just meets the bottom seating surface of the frame. This is the point of zero opening.
3. Set the indicator to zero and replace it on the lift, making sure that as the gears are engaged the indicator does not move from zero.
4. Note that in the full wedging position, the indicator will read less than zero.

SLUICE GATE TROUBLE SHOOTING GUIDE

Despite their rugged appearance, sluice gates are precision equipment with carefully machined seating surfaces and accurate adjustability. Each sluice gate is checked at the factory and properly adjusted, but improper installation or maintenance can seriously affect its performance. If there appears to be a problem in the performance of the gate, the following trouble-shooting tips may help determine the cause and correct the problem.

SYMPTOM: LEAKAGE

1. CAUSE: Paint, mastic, concrete or other foreign material on seat facing.  
REMEDY: Carefully remove with solvent or fine emery cloth.
2. CAUSE: Concrete, asphalt or debris on stop bar under Q seal.  
REMEDY: Remove foreign material. Also check for permanent damage and possible replacement.
3. CAUSE: Loose or unevenly adjusted wedge.  
REMEDY: See pages 5.0 & 5.3 for wedge adjusting procedures.
4. CAUSE: Excessive hoist force.  
REMEDY: On gates under 24", excessive hoist thrust may distort the top of the gate allowing leakage. Reduce hoist thrust until leakage is at a minimum then reset stop collar to contact nut or hoist.

SYMPTOM: NOISE

1. Loud bang occurring at opening only:  
CAUSE: Withdrawal of disc from tightly wedged condition.  
REMEDY: Normal--no action necessary.

SLUICE GATE TROUBLE SHOOTING GUIDE      PAGE 2

2. A high pitched squeal or singing:

CAUSE: Generally confined to gates operated by electric motor driven hoists. The stem threads may be dry. The stem guides may be misaligned causing excessive rubbing as the stem passes through.

REMEDY: Check thread surface and remove any burrs or damaged areas. Clean and coat with an extreme pressure grease and check stem guides for correct alignment.

3. Chatter:

CAUSE: Generally occurs on partially open gates with a high discharge velocity through the gate.

REMEDY: As this is a function of many factors such as relationship of gate to walls and floor, heads, size of gate, etc., not much can be done except to raise or lower the disc to a new position.

CAUSE: Also may be heard on electric hoists with dry stems or grit laden grease on stems.

REMEDY: Clean and lubricate stems.

4. Slow rythmic bang during closing:

CAUSE: Generally occurs on electric hoist operated gates which during their closing stroke have the condition that the resistance to closing offered by water pressure and sliding friction is nearly equal to the dead weight of the disc. The disc then remains stationary while the thrust nut travels downward until it uses up the vertical clearance with the pocket at which time the disc will drop with a small bang to hang on the thrust nut. This repeats until the water pressure and friction is sufficient to need constant nut force to move.

REMEDY: If the noise is unacceptable shims may be secured in thrust nut pocket to nearly eliminate verticle clearance.

SYMPTOM: GATE WILL NOT OPEN

1. CAUSE: Shipping stops still in place.  
REMEDY: Remove shipping stops.

SLUICE GATE TROUBLE SHOOTING GUIDE PAGE 3

SYMPTOM: STEM TURNS ON RISING STEM GATE

1. CAUSE: Key not installed in stem coupling or thrust nut, allowing stem to thread itself out or set screws not properly tightened.  
REMEDY: Thread stem back into coupling or thrust nut and install key and/or set screw.

SYMPTOM: HYDRAULICALLY OPERATED GATE WILL NOT OPEN

1. CAUSE: The thrust nut may be adjusted so that the piston bottoms out in the cylinder, stopping the downward force at the same time that the disc is wedged sufficiently for water tightness. In the absence of a correctly adjusted pressure reducing valve in closing direction pressure line, there is generally more force available to seat the disc in the wedges than there is to unseat it.  
REMEDY: Adjust thrust nut and reduce closing line pressure below system pressure.

SYMPTOM: EXCESSIVE FORCE REQUIRED TO OPERATE

1. CAUSE: Dry stem threads or misaligned stem, stem guides and hoist.  
REMEDY: Clean and lubricate threads. Realign stem guides and hoist.

SYMPTOM: DISC WILL NOT COMPLETELY CLOSE

1. CAUSE: Wedges badly out of adjustment.  
REMEDY: See pages 5.0 & 5.3 for wedge adjusting procedure.

SYMPTOM: BOWING STEMS

1. CAUSE: Loose stem guides.  
REMEDY: Tighten stem guide anchor bolts and assembly bolts.
2. CAUSE: Stem guides not placed per manufacturers installation drawing.  
REMEDY: Install stem guides per drawing.
3. CAUSE: Excessive hoist output.  
REMEDY: Limit input to manual hoist crank or handwheel to 40#. If electric hoist is used, consult factory.

SLIDE GATE TROUBLE SHOOTING GUIDE

The installation of slide gates requires a great deal of care to prevent damage to the gates and distortion of the frame. Slide gates are an economical choice for open channel flow applications where tight sealing is not necessary. There is no standard allowable leakage specification for slide gates and some leakage is to be expected. However, the following trouble-shooting tips may help to reduce the leakage and improve the performance of the gate.

<u>SYMPTOM</u>	<u>CAUSE</u>	<u>REMEDY</u>
LEAKAGE At bottom of gate.	Concrete, asphalt or debris under Q-seal on stop bar or in sill slot of a standard invert gate.	Remove foreign material. Check seal for permanent damage and possible replacement.
At sides of gate.	Concrete or debris wedged between disc and guide.	Remove foreign material.
At sides or bottom of gate.	Generally occurs on gates distorted by bolting to uneven concrete walls without the use of grout.	Loosen anchor bolt nuts, shim gate to true plane and fill void between guide and wall with grout.
At top of gate.	Excessive hoist effort at closed position deflecting the top of disc outward.	Limit hoist input to 40% pull Set stop collar on stem as described on Page 3.6.
At invert of gate used as downward opening weir	"J" seal may be out of adjustment across invert.	Loosen seal retainer bolts and force seal out into contact with disc. Tighten bolts.
Excessive effort to operate	Dry stem threads or grit laden grease in threads.	Clean threads and grease with with extreme pressure lubricant
Excessive effort to operate	May occur on long weirs with multistep application pulling the disc unevenly.	Disconnect couplings in inter-connecting shafts. Rotate individual hoist head pinion shafts until disc top is level then reassemble shaft couplings

MAINTENANCE OF GATES OR VALVES

Other than periodic cleaning as required to maintain smooth operation or painting to maintain appearance, no maintenance is required on the following listed equipment.

SLUICE, SLIDE GATES & STEM GUIDES

MAINTENANCE OF OPERATING STEMS

1. It is critical that operating stems be periodically cleaned and greased. Even though some environmental conditions are harsher than others and the use of pipe covers will protect stems, they still need to be cleaned and greased with Mobilux grease #2EP or equal\* at least once every six (6) months. More often if the grease becomes dirty.

\*See lubrication chart for equivalent lubricants. Pg. 6.10

2. WARNING!!! Non-rising stem gates generally require a special maintenance program. If the level of the fluid rises above the top of the opening, the threads on the stem may become coated with grit. Under this condition, frequent use of the gate will wear the threads in the thrust nut creating a dangerous and possible damaging position. Therefore the following maintenance procedure should be followed:
  - a. If practical, the stem should be kept clean and greased.
  - b. If the gate is cycled on the average of once a week, the thrust nut should be removed every year and inspected for wear. (More frequently after the first signs of wear or if the frequency of operation is greater or the conditions are severe.)

MAINTENANCE OF MANUAL GATE OPERATORS

1. At least three (3) times a year, all grease fittings on manual floor stands should be lubricated with a small amount of heavy duty grease, such as Zenaplex II manufactured by Pennwalt Keystone Company, or equal.\*

Handcrank or handwheel should be turning when grease is pumped into the fitting. 4 or 5 pumps of the grease gun handle should be adequate each time the grease gun is used.

\*See lubrication chart for equivalent lubricants.

2. CAUTION: DO NOT OVERFILL, when filling pinion shafts on manual 3EP series lifts.
3. For electric motor operated or cylinder lifts see separate manufacturers O & M manuals.

LUBRICATION CROSS REFERENCE CHART

STEMS

LUBRICANT

Molykote Type G  
Valvoline Wal-Lith #2EP  
No. 52 Grease  
Dura Lith #2  
Lubriplate #630-2  
Gulf Crown EP2  
Mobilux Grease #2EP  
Mobil Grease #4  
Alvania #AEP  
MultiFak #2EP  
Tycol Azepro #11

MANUFACTURER

Alpha Molykote Co.  
Ashland Oil & Refining Co.  
Atlantic Richfield(ARCO)  
Chevron Oil Co.  
Fiske Bros. Refining Co.  
Gulf Oil Co.  
Mobil Oil Co.  
Mobil Oil Co.  
Shell Oil Co.  
Texaco Oil Co.  
Tidewater Oil Co.

Lifts (also Aux. Gearboxes and Universal Couplings)

LUBRICANT

Lubriplate Type 630-AA  
Mobilplex #45  
Mobil Grease Special  
Zenaplex II

MANUFACTURER

Fiske Brothers Refining Co.  
Mobil Oil Co.  
Mobil Oil Co.  
Penwalt Keystone Co.

MACHINED IRON AND BRONZE SURFACES SEATS AND WEDGES

LUBRICANT

NO-OX-ID  
  
Intertol Grease Coating

MANUFACTURER

W.R. Grace, Inc. (Dearborn  
Chemical Division  
Koppers, Inc.

STAINLESS STEEL SURFACES (Seats and Wedges)

Never-Seez

Never-Seez Corp.

**WATERMAN INDUSTRIES, INC.**

SPECIAL TOOLS

The installation and adjustments of Waterman gates and equipment requires no special tools and can be accomplished using a minimum of the follow standard tools:

10" or 12" Crescent Wrench (2 required)

1/2" or 5/8" Allen Wrench

.004" Feeler Gauge

While these are the minimum tools required, installation time can be greatly decreased with such standard tools as socket wrenches and box wrenches.

If electric motor operated lifts, or cylinder operators supplied, see separate manufacturer's O & M Manual for special tools.

## **WATERMAN INDUSTRIES, INC.**

### SPARE PARTS & PARTS REPLACEMENT

All products supplied by Waterman Industries, Inc. are designed to last indefinitely if properly maintained and operated, therefore, no spare parts are recommended.

Should it become necessary to replace a part, refer to the enclosed installation or detail drawings for the appropriate part number or size. Replacements may be ordered direct from the factory or through your local representative. Always be prepared to give the Waterman Job number and installation drawing number. (see "Field Service", Pg. 8.0).

(If certain spare parts were required by project specifications, they will be listed on sheet 7.1, under "Spare Parts Addendum").

Replacement parts for "vendor supplied" products, i.e. motorized operators, hydraulic cylinders, etc. should be ordered as recommended in separate manufacturers O & M data located elsewhere in this manual.

# Waterman INDUSTRIES, INC.

## FIELD SERVICE

When trouble develops either in the installation, operation, or performance of the equipment, the installation manual and drawings should be checked to determine if the equipment has been installed properly. If proper performance and operation cannot be obtained, and assistance from the factory is desired, please contact the factory and REFERENCE THE JOB NUMBER B-3222, so that we may locate the project records and better assist you. Our company may be contacted at:

WATERMAN INDUSTRIES, INC.  
P.O. BOX 458  
EXETER, CALIFORNIA 93221

PHONE: (209) 562-4000  
FAX: (209) 562-2277

Arrangements may be made to send a representative to the jobsite if this is required. If the equipment is faulty in workmanship or material, the necessary repairs or adjustments will be made by the factory at no cost to the purchaser. If, however, the problem is due to faulty installation or adjustment, the cost of the field service will be charged to the purchaser.

If repairs are made in the field by the purchaser or authorized by the purchaser, backcharges for these repairs will NOT be accepted by the company unless the company has been notified prior to the incurring of these costs and has accepted the responsibility for these repairs. ANY UNAUTHORIZED REPAIRS OR CHANGES TO EQUIPMENT WILL AUTOMATICALLY VOID WARRANTY.

The company will not be liable for contingent costs or costs of delay due to the faulty equipment and the repairs thereof.

## FIELD SERVICE CHARGES

Field service charges begin from the time of departure until the return of the service man and include a daily rate plus travel and subsistence expenses. Premium day and hourly rates will be charged on Saturdays, Sundays, and Holidays and for time spent before 6 a.m. or after 5 p.m. or over eight hours per day. A schedule of Field Service charges can be obtained by calling Waterman Industries, Inc.

If service personnel are required for equipment produced by another manufacturer (i.e. for electric motor operator), that manufacturer's standard service charges will prevail.

## WATERMAN INDUSTRIES, INC.

### LIMITED WARRANTY

Every effort is made to assure the highest quality merchandise, free of any defects, which is warranted against defects in material and workmanship when used in accordance with the standards and/or instructions recommended by this catalog or other written quotation of this firm, but no warranty, expressed or implied, is made other than as follows:

Products manufactured by Waterman Industries, Inc. are warranted against defects in materials and workmanship for (18) eighteen months after shipment or (12) twelve months after installation, whichever occurs first and such warranty can only be enforced by the original consumer purchaser. During the warranty period, the product will be repaired or replaced at Waterman Industries, Inc.'s option at no cost to the purchaser.

Measure of damage is the price of defective material only. No charges for labor or expense required to remove or replace defective material or for any consequential damages will be allowed. Warranty excludes damage due to misuse, neglect or misapplication.

Any implied warranty of merchantability of fitness is limited to the duration of this written warranty. To the extent allowed by law, neither Waterman Industries, Inc. nor its selling dealer or agent shall have any responsibility for loss of use of the product, loss of time, commercial loss or consequential damages.

In the event a warranted product is believed defective, notify your Waterman Sales Office and furnish date purchased, copy of invoice or shipping documents. DO NOT attempt repairs or returns without authorization from Waterman Industries, Inc. Unauthorized repairs may void warranty, and costs for unauthorized repairs performed or replacement parts purchased within the warranty period will not be reimbursed. A return authorization number must be obtained from Waterman Industries, Inc. prior to returning any merchandise.

Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of consequential damages, therefore the above limitation may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

It is the policy of this company to encourage the settlement of disputes in an informal manner, and if such disputes arise over a warranty claim an informal dispute settlement mechanism can be agreed upon at that time.



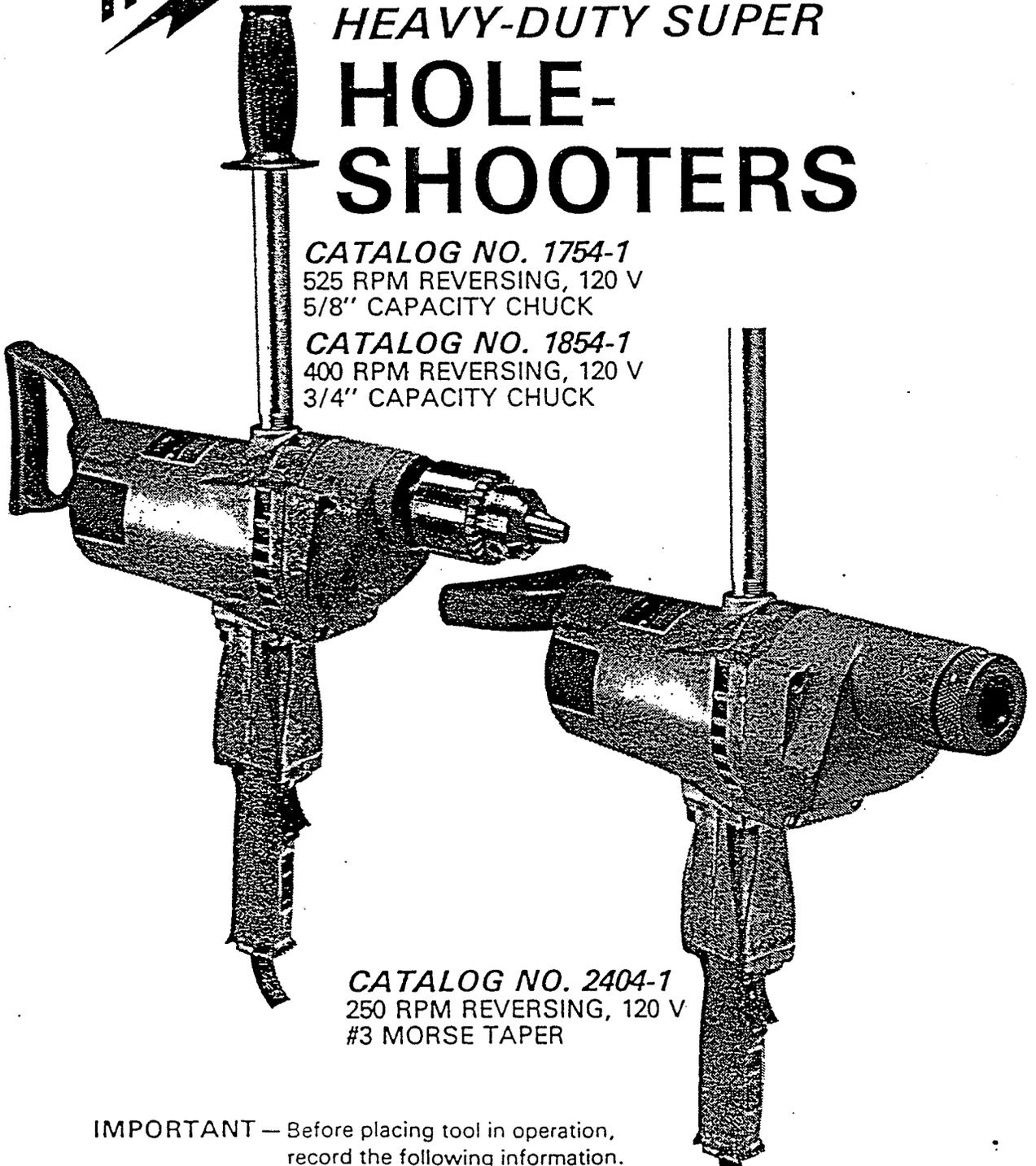
Amstar

# OPERATOR'S USE AND CARE MANUAL

## HEAVY-DUTY SUPER HOLE- SHOOTERS

**CATALOG NO. 1754-1**  
525 RPM REVERSING, 120 V  
5/8" CAPACITY CHUCK

**CATALOG NO. 1854-1**  
400 RPM REVERSING, 120 V  
3/4" CAPACITY CHUCK



**CATALOG NO. 2404-1**  
250 RPM REVERSING, 120 V  
#3 MORSE TAPER

**IMPORTANT** — Before placing tool in operation,  
record the following information.

Catalog No. \_\_\_\_\_ Serial Number \_\_\_\_\_ Date of Purchase \_\_\_\_\_

BE SURE THAT PERSONS OPERATING THIS EQUIPMENT, READ AND  
UNDERSTAND THESE INSTRUCTIONS BEFORE USE.

READ AND KEEP THIS FOR FUTURE REFERENCE.

THIS SYMBOL... *Milwaukee* ...IS YOUR ASSURANCE

Every tool manufactured by MILWAUKEE is fully inspected and produced in accordance with applicable standards for safety: O.S.H.A., Underwriters' Laboratories, Inc., Canadian Standards Association and American National Standards Institute (ANSI). MILWAUKEE Heavy-Duty Tools bearing the monograms of Underwriters' Laboratories, Inc. or Canadian Standards Association are listed by their testing laboratories as having complied with their standards for safety. Compliance is assured by continuing, independent inspections by both agencies.

## **SAFETY INSTRUCTIONS FOR ALL POWER TOOLS**

**WARNING:** When using electric tools, basic safety precautions should always be followed to reduce the risk of fire, electric shock and personal injury including the following items:

Read all instructions and save them for future reference.

1. **KNOW YOUR POWER TOOL.** Read owner's manual carefully. Learn its applications and limitations as well as the specific potential hazards peculiar to this tool.
2. **GROUND ALL TOOLS — UNLESS DOUBLE-INSULATED.** If the tool is equipped with a three prong plug, it should be plugged into a three hole electrical receptacle. If an adapter is used to accommodate a two hole receptacle, the grounding ear must be attached to a known ground. Never remove the third prong.
3. **KEEP GUARDS IN PLACE.** Tools, provided with or required by instruction to use a guard, must have it in place and in working order.
4. **KEEP WORK AREA CLEAN.** Cluttered areas and benches invite accidents.
5. **AVOID DANGEROUS ENVIRONMENTS.** Don't expose power tools to rain or use in damp or wet locations. Do not use tool in presence of flammable liquids or gases. Keep the work area well lit.
6. **KEEP CHILDREN AWAY.** All visitors should be kept a safe distance from the work area. Do not let visitors contact tool or extension cords.
7. **STORE IDLE TOOLS.** When not in use, tools should be stored in a dry, high or locked up place — out of reach of children.
8. **DON'T FORCE TOOL.** It will do the job better and safer at the rate for which it was designed.
9. **USE RIGHT TOOL.** Don't force a small tool or attachment to do the job of a heavy-duty tool. Don't use a tool for a purpose for which it was not designed, such as using a circular saw for cutting tree limbs or logs.
10. **WEAR PROPER APPAREL.** No loose clothing or jewelry to get caught in moving parts. Rubber gloves and insulated non-skid footwear are recommended when working outdoors. Wear protective covering to contain long hair.
11. **USE SAFETY GLASSES** at all times. Also, use a face or dust mask if cutting operation is dusty.
12. **DON'T ABUSE CORD.** Never carry the tool by its cord or yank it to disconnect from the receptacle. Keep cord from heat, oil and sharp edges.
13. **SECURE WORK.** Use clamps or a vise to hold work. It's safer than using your hand and it frees both hands to operate tool.
14. **DON'T OVERREACH.** Keep proper footing and balance at all times.

15. **DISCONNECT TOOLS.** When not in use; before servicing; when changing accessories such as blades, bits, cutters, etc.
16. **GUARD AGAINST ELECTRIC SHOCK.** Prevent body contact with grounded surfaces such as pipes, radiators, ranges and refrigerator enclosures.
17. **REMOVE ADJUSTING KEYS AND WRENCHES.** Form a habit of checking to see that keys and adjusting wrenches are removed from tool before turning it on.
18. **MAINTAIN TOOLS WITH CARE.** Keep tools sharp and clean at all times for best and safest performance. Follow instructions for lubricating and changing accessories. Keep handles dry, clean and free of oil or grease. Inspect switches, tool cords and extension cords periodically and have them repaired or replaced by an authorized service facility if damaged. Check moving parts for alignment and binding as well as for breakage and improper mounting. Damaged parts should be repaired or replaced by an authorized service facility unless otherwise indicated in this instruction book. **CAUTION:** Do not use carbon tetrachloride.
19. **AVOID ACCIDENTAL STARTING.** Don't carry a plugged-in tool with your finger on the switch. Be sure the switch is turned off before plugging in a tool. Do not use a tool if the switch does not turn it on or off.
20. **WEAR EAR PROTECTORS** when using for extended periods.
21. **ACCESSORIES.** The use of any accessories other than what is listed or recommended for this particular tool may be hazardous.
22. **KEEP HANDS AWAY FROM CUTTING EDGES AND ALL MOVING PARTS.**
23. **USE INSULATED SURFACES.** A double-insulated or grounded tool may be made live if the blade or bit comes in contact with live wiring in a wall, floor, ceiling, etc. Always check the work area for live wires and hold the tool by the insulated surfaces when making "blind" or plunge cuts.
24. **BRACE PIPE HANDLE AGAINST A FIXED OBJECT** to control high twisting force of drill.
25. **USE SIDE HANDLES** when supplied with tool for control and safety. Hold and brace tool securely at all times to reduce risk of personal injury. See pages 6 and 7.
26. **STAY ALERT.** Watch what you are doing and use common sense. Do not operate tool when you are tired.

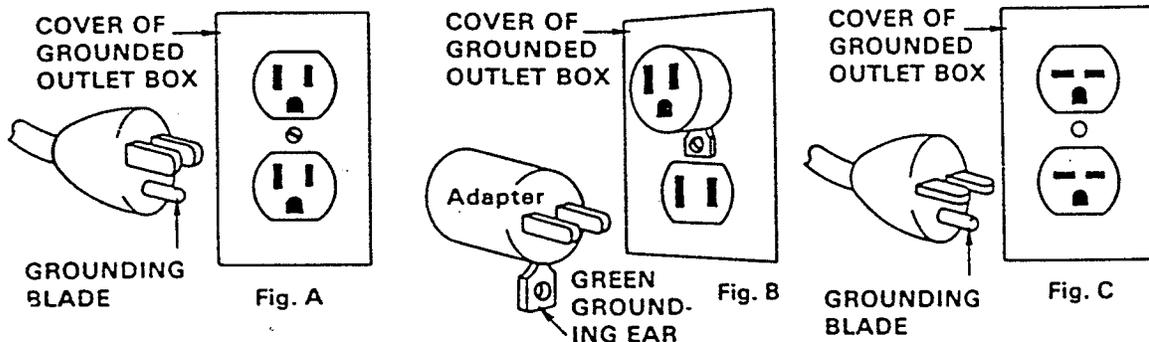
## GROUNDING INSTRUCTIONS

### Double Insulated—Tools with Two Prong Plugs.

Tools marked with the words "Double Insulated" are equipped with a two prong plug. These tools have a special insulation system that complies with applicable standards of both Underwriters' Laboratories, Inc. and Canadian Standard Association. They do not require grounding.

### Grounded—Tools with Three Prong Plugs.

These tools must be grounded while in use to protect the user from electric shock. The tool is equipped with an approved, three conductor cord and three prong grounding type plug to fit the proper grounding-type receptacle. The green conductor in the cord is the grounding wire. Never connect a green wire to a live terminal. If your unit is nameplate rated for use on less than 150 volts, it has a plug that looks like figure "A". If it is nameplate rated for use on 150 to 250 volts, it has a plug that looks like "figure "C".



An adapter, figure "B", is available for connecting, grounded, figure "A" type plugs to two prong receptacles. The green-colored rigid ear, lug, or the like, extending from the adapter must be connected to a permanent ground such as a properly grounded outlet box or receptacle; if in doubt, call a qualified electrician and have the receptacle checked for proper grounding. The use of adapters (figure "B") in Canada is prohibited by the Canadian Electrical Code. No adapter is available for figure "C" type plugs.

## EXTENSION CORDS

Grounded tools have three prong grounding-type plugs, and require a properly wired three prong grounding type extension cord. Double insulated tools have two prong cords, and can use either a two or three prong extension cord. As the distance from the supply outlet increases, however, heavier gauge extension cords are required. The use of extension cords of inadequate size wire causes a serious drop in voltage, loss of power and possible motor damage. This table is based on limiting the line voltage drop to five volts at 150% of the rated amperes. Protect the cord from damage. Keep cords away from excessive heat, sharp edges and damp or wet areas. Repair or replace damaged extension cords before using.

Ampere (on Nameplate)	0- 2.0	2.1- 3.4	3.5- 5.0	5.1- 7.0	7.1- 12.0	12.1- 16.0	16.1- 20.0	
Ext. Cord Length	Wire Size							
25 Ft.	18	18	18	18	16	14	12	Not normally available as flexible extension cord.
50 Ft.	18	18	18	16	14	12	10	
75 Ft.	18	18	16	14	12	10	8	
100 Ft.	18	16	14	12	10	8	8	
150 Ft.	16	14	12	12	8	8	6	
200 Ft.	16	14	12	10	8	6	4	
300 Ft.	14	12	10	8	6	4	4	
400 Ft.	12	10	8	6	4	4	2	
500 Ft.	12	10	8	6	4	2	2	
600 Ft.	10	8	6	4	2	2	1	
800 Ft.	10	8	6	4	2	1	0	
1000 Ft.	8	6	4	2	1	0	0	

IF USING AN EXTENSION CORD OUTDOORS, BE SURE IT IS MARKED WITH THE SUFFIX "W-A" ("W" IN CANADA) TO INDICATE THAT IT IS ACCEPTABLE FOR OUTDOOR USE.

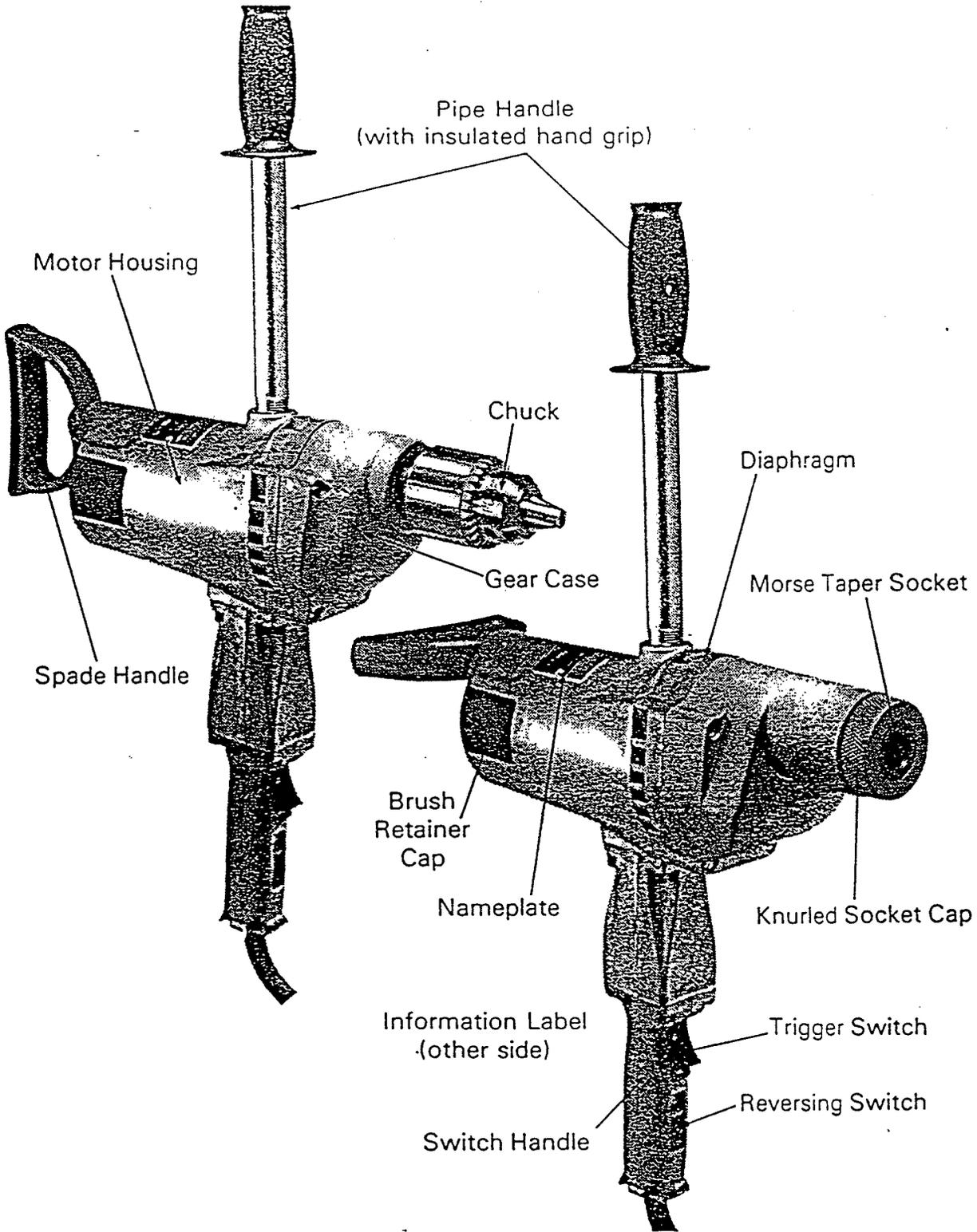
**WARNING:** Check the outlet voltage to be sure it matches the nameplate voltage. Applications which could cause this tool to be driven at speeds more than 25% in excess of its rated speed are potentially dangerous and constitute misuse. This includes the use of voltage boosters. To prevent personal injury or damage to the tool, do not use this tool to start or drive small engines or other rotating machinery.

Milwaukee Electric Tool Corporation assumes no responsibility for damage or accidents resulting from the misuse of this tool, its misapplication or nonadherence to precautionary safety measures.

Use only enough pressure to produce efficient drilling. The pressure used in drilling should not cause operator fatigue or reduce your balance and control of the tool.

**WARNING:** A high rotational force is developed when the bit binds. This reaction will cause the tool to rotate in a direction opposite to the bit rotation. Situations which cause bit binding should be avoided. Bit binding occurs most often with a misaligned bit or a bit breaking through a hole. Wood boring bits can also bind if they run into obstructions such as nail or knots. **HOLD AND BRACE THE TOOL SECURELY AT ALL TIMES TO REDUCE THE RISK OF PERSONAL INJURY OR DAMAGE TO THE TOOL** (see page 7).

Read all instructions and save them for future reference.



**ACCESSORY CAPACITY CHART**

Catalog Number	Volts	RPM	WOOD					STEEL	MASONRY
			Flat Boring	Hole Saw	Auger Bit	Ship Auger	Self Feed	Steel Bit	Carbide Tip Bit
1754-1	120	525	1-1/2"	6"	1-1/2"	1-1/2"	3-5/8"	5/8"	1-1/2"
1854-1	120	400	1-1/2"	6"	1-1/2"	1-1/2"	4-5/8"	3/4"	1-1/2"
2404-1▲	120	250	1-1/2"	6"	1-1/2"	1-1/2"	4-5/8"	1-1/4"	1-1/2"

▲ To adapt a 3/4" capacity chuck to 2404-1 Drill with No. 3 Internal Morse Taper Socket specify Chuck Kit No. 49-22-1550. Kit consists of Chuck No. 48-66-2000 and Arbor No. 48-07-0100.

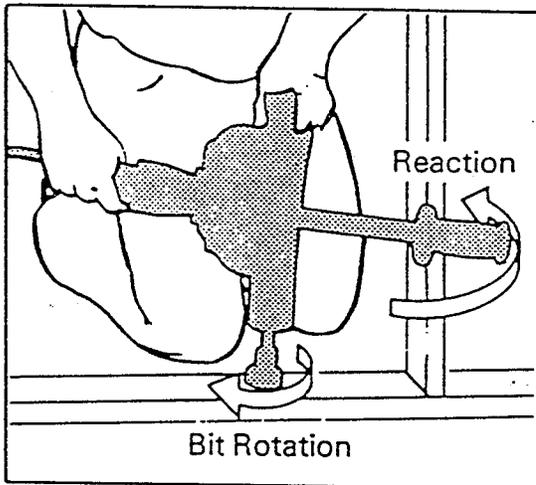
## OPERATION

**WARNING:** Always **UNPLUG TOOL** before attaching or removing accessories. The use of any accessory other than those specifically recommended for use with this tool may be hazardous.

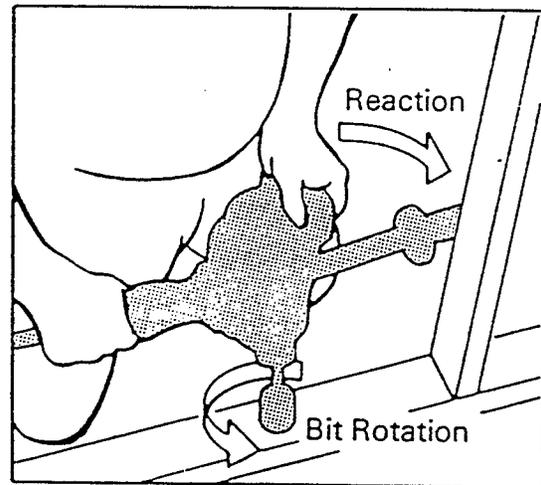
### PIPE HANDLE

To install the pipe handle, unplug the tool and screw the threaded end of the pipe securely into the top of the motor housing.

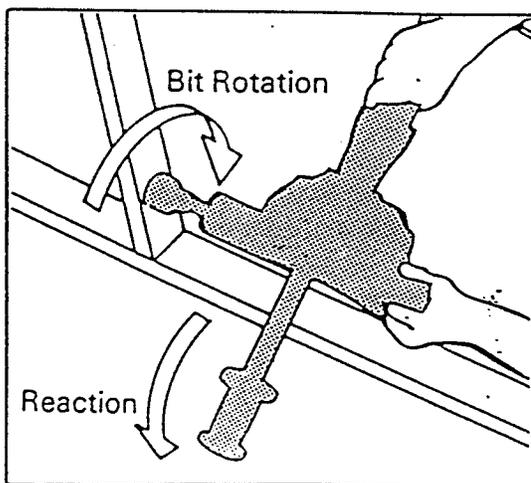
The pipe handle must be used as a brace to maintain safe control of the drill. Hold the pipe handle only by its insulated hand grip, and brace the handle against a stationary fixture such as a beam, stud or floor. When drilling in a forward (clockwise) direction, brace the tool to prevent counterclockwise reaction. When drilling in reverse (counterclockwise), brace the tool to prevent a clockwise reaction. The illustrations below show typical bracing methods for drilling applications.



**BRACING AGAINST STUD**  
(Forward, clockwise rotation)



**BRACING AGAINST STUD**  
(Reverse, counterclockwise rotation)



**BRACING AGAINST FLOOR**  
(Forward, clockwise rotation)

**WARNING:**  
WHEN DRILL CAN NOT BE  
BRACED AS SHOWN, AN ALTERNATE  
RIGID BRACING MUST BE  
PROVIDED BEFORE OPERATION.

### MORSE TAPER SOCKETS

A No. 3 Morse Taper Socket is furnished as standard equipment on Super Hole-Shooter No. 2404-1. Before inserting the drill bit, be sure that its taper matches the socket taper. To insert drill bit, simply push the shank of the bit firmly into the socket. This is all that is necessary to properly seat the bit for drilling. Always keep the taper shanks clean, free of nicks and coated with a film of oil.

To remove the bit from the socket, unscrew the knurled taper socket cap and pull out the bit and the socket. Once removed, the bit can be knocked free with a hammer. Replace the socket and the knurled cap.

### INSERTING BITS

The 1754-1 and 1854-1 Hole-Shooters are furnished with a industrial, key type, geared chuck. To insert a bit, open the chuck jaws wide enough to allow the bit to touch the bottom of the chuck. Be sure that the shank of the bit and the chuck jaws are clean. Dirt particles may cause the bit to line up improperly. When using drill bits with flattened shanks, the flat surfaces must rest squarely on the chuck jaws to prevent slippage. Tighten the chuck by hand to align the bit before tightening with the chuck key. Tighten the chuck by turning the key in each of the three holes for best grip. Never use a wrench or means other than a chuck key to tighten or loosen a chuck. Do not use bits which are larger than the rated capacity of the drill or personal injury, gear damage and motor overload may result (see capacity chart on page 6). For maximum drilling performance, be sure the bits are properly sharpened before using. Be sure to remove the chuck key before turning the drill on.

### REVERSING SWITCH

A reversing switch is located beneath the trigger switch for ease of removal of bits from holes. Permit the motor to come to a complete stop before reversing. Reversing the tool with the gears in motion may cause serious damage. When removing Selfeed bits from partially drilled holes, a flick of the trigger switch will free the threaded pilot screw. When the threads are loose, allow the motor to come to a complete stop and lift the bit from the work. See "PIPE HANDLE" on page 7 for proper bracing procedure.

### TYPICAL APPLICATIONS

#### KEEP HANDS AND CORD AWAY FROM BIT AND MOVING PARTS

Before drilling, clamp the material down securely. A poorly secured piece of material may result in inaccurate drilling or personal injury if the bit should bind. Brace the tool securely. See page 7 for typical bracing methods for drilling applications. When drilling holes in light gauge metal or thin pieces of wood, back the material with a wooden block to prevent bending, distorting or splintering. Mark the center of the hole to be drilled with a center punch to help start the bit and to prevent the bit from wandering. Place the drill on the center mark while it is in the "off" position. Holding the drill firmly at a 90° angle to the workpiece, start the motor and apply steady pressure. Lubricate the bit with cutting oil when drilling iron or steel. Use an appropriate coolant when drilling non-ferrous metals such as copper, brass or aluminum.

## MAINTENANCE

**WARNING:** Always UNPLUG TOOL before performing any maintenance. All servicing other than that recommended in this operator's manual must be performed by a MILWAUKEE Service Center or Authorized Service Station.

### Cleaning

Use only mild soap and a damp cloth to clean this tool. Do not use household cleaning agents that may contain chemicals harmful to plastics or other insulated parts. Do not use turpentine, lacquer or paint thinner or other solvents. Never immerse the tool in a liquid or allow a liquid to flow inside the tool.

### Brush Life and Lubrication

Proper care and lubrication are important factors in prolonging the useful life of this tool. It has been lubricated at the factory and this lubrication should be sufficient for six months to one year, depending upon the amount of use the tool receives. Tools used constantly on heavy-duty production jobs require lubrication more often. Tools which have not been used for extended periods should be relubricated before being put back in service. Under normal conditions, relubrication is not necessary until brush replacement. The need for brush replacement is indicated by one or more of the following:

- Excessive arcing between brushes and commutator
- Inefficient or interrupted operation
- Failure of the tool to start

Should any of these conditions exist, send or bring your tool to the nearest MILWAUKEE facility for the following:

- Replacement of brushes
- Inspection and testing
- Cleaning and lubrication
- Necessary repairs

**WHEN SERVICING, USE ONLY IDENTICAL REPLACEMENT PARTS**

Parts List Available On Request

When ordering, include Catalog Number and Serial No. of Tool.

Write: MILWAUKEE ELECTRIC TOOL CORP. SERVICE DEPT.

13135 W. Lisbon Rd.

Brookfield, WI. 53005



**AMERICAN AUTOGARD CORP.**

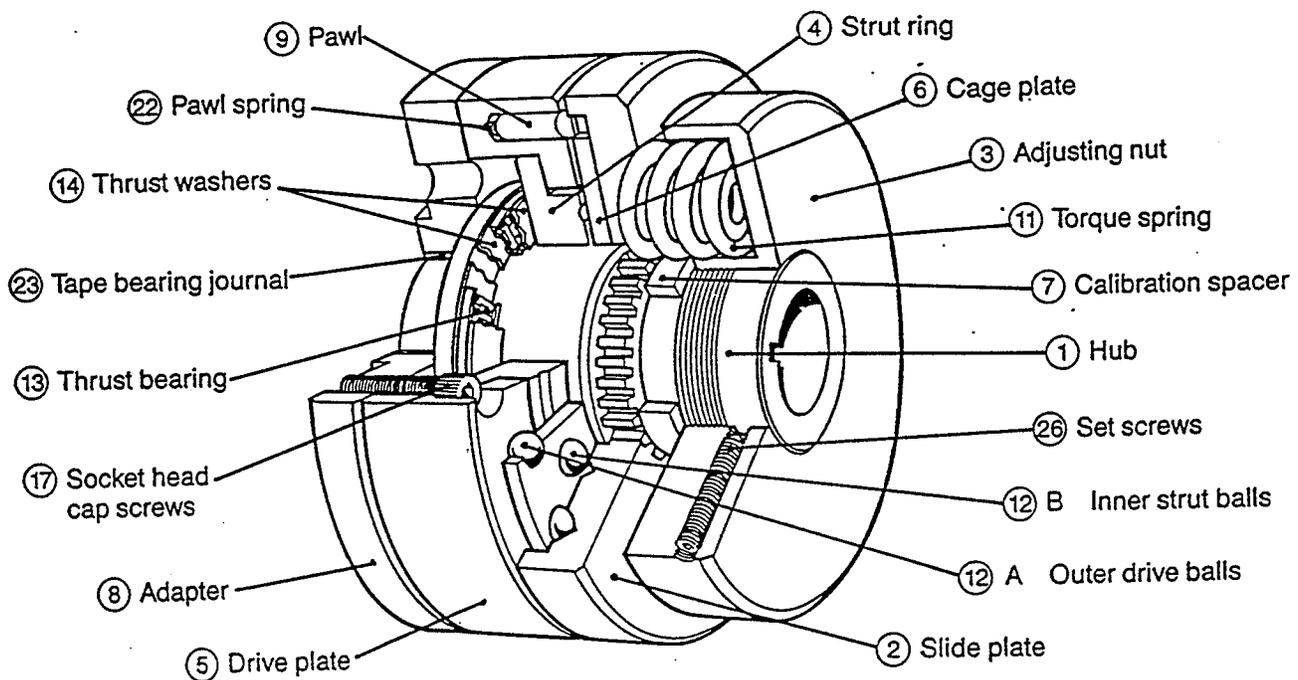
P.O. BOX 2116 • ROCKFORD, ILLINOIS 61130

PHONE: (815) 633-1441

## INSTALLATION AND MAINTENANCE MANUAL

### AUTOGARD TORQUE LIMITER

#### 400 SERIES



#### OPERATION:

The Autogard 400 Series torque limiters disengage the drive completely on overload in both directions of rotation.

After disengagement the drive is running free, which permits high speed operation (at or above normal electric motor speeds) and running for brief periods of time in the tripped condition without damage.

#### PRIOR TO INSTALLATION

~~Mounting Sprocket or Sheave on Model 401 (see Fig. 9)~~  
A. Mounting with tapered bushing. (Taper lock, Q.B. etc.)  
A sprocket, sheave, or timing belt pulley may be mounted directly on Model 401 by using a tapered bushing. Select a sprocket or sheave to fit "M" dia. of the Autogard (Table 1). No key is used with the bushing when mounting on the torque limiter. Thoroughly clean all grease and oil from "M" dia. with solvent prior to mounting the bushing. Be certain that the bushing is properly mounted and tightened according to the instructions accompanying each bushing.

**CAUTION:** It is possible to overtighten the bushing cap screws to an extent that will deform the adapter (8) and prevent its free rotation on the hub (1). Make sure that the adapter and bushing assembly is free to rotate on the hub after the bushing is fully tightened. To check this, the adjusting nut (3) must be backed off to release all pressure from the spring (11). Re-tighten adjusting nut to original position after free-rotation check is completed.

(continued on page 2)

**MANUAL 4020**

# MOUNTING TORQUE LIMITER ON SHAFT

## ~~Models 401, 402 & 409~~

~~See Figs. 3, 4, 5A, 5B page 2~~

~~With the torque limiter completely assembled, carefully engage hub (1) on shaft. The standard clearance-fit bore in the hub should permit the hub to be pushed or lightly tapped in place on the shaft. DO NOT STRIKE HEAVY HAMMER BLOWS ON THE HUB AS THIS COULD DAMAGE THE TORQUE LIMITER.~~

~~The torque limiter may be moved axially on the shaft to some degree to obtain proper alignment of the sprocket or sheave with the chain or belt.~~

shafts together and align the coupling carefully, checking with a dial indicator. For optimum life, maintain alignment within the limits shown in Table 3.

Table 3

Model	Size	Allowable Angular Misalignment	Allowable Parallel Misalignment	Gap between hub and adapter	
				Min.	Max.
<del>401</del>	<del>1-5</del>	<del>0</del>	<del>0</del>		
404	1-5	0	0		
<del>402</del>	<del>1-5</del>	<del>.5 deg.</del>	<del>0</del>		
<del>406</del>	<del>1</del>		<del>.005"</del>	<del>.08"</del>	<del>.16"</del>
	2		.008"	.08"	.16"
	3		.010"	.08"	.25"
	4	.10 deg.	.013"	.08"	.25"
	5		.017"	.12"	.31"
	6		.020"	.12"	.31"
	7		.028"	.20"	.36"

## Models 403\*, 404, 405, & 406

See Figs. 6, 7, 8, 9 below

Mount the torque limiter hubs on the shafts in the same manner as described for Models 401, 402, and 409 on this page. For coupling units, Models 404, 405, and 406, mount the torque limiter assembly on one of the shafts and the coupling hub, part 28, 29 or 30 on the other shaft. Bring the

~~\*For Model 403, the driven member is supplied by customer. If used for offset drive, the sheave, gear, etc., must be mounted on its own bearing.~~

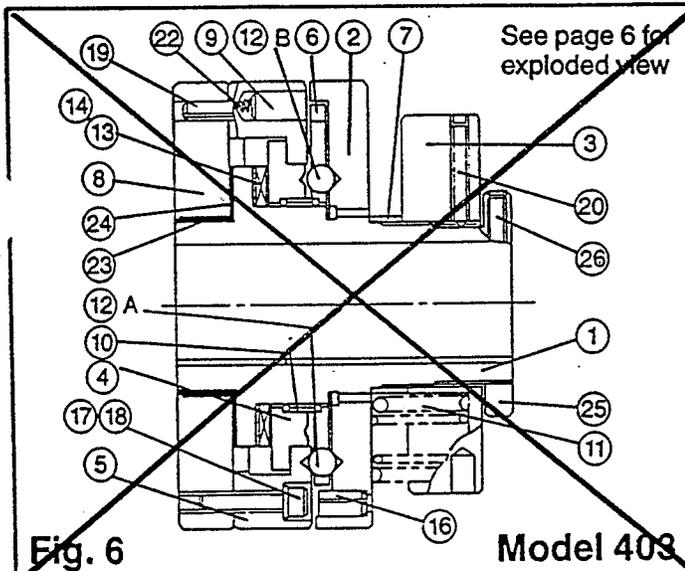


Fig. 6

Model 403

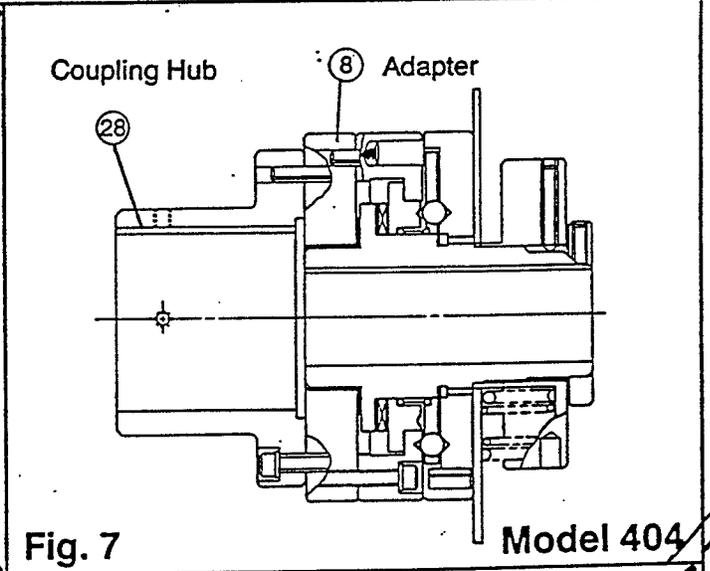


Fig. 7

Model 404

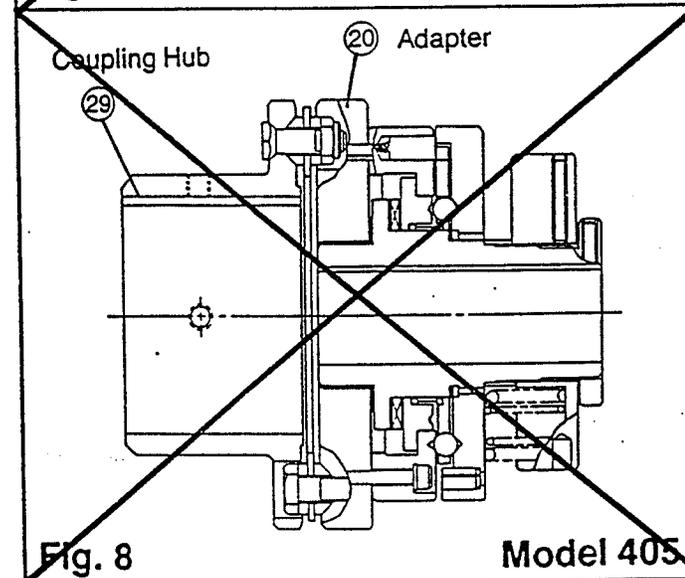


Fig. 8

Model 405

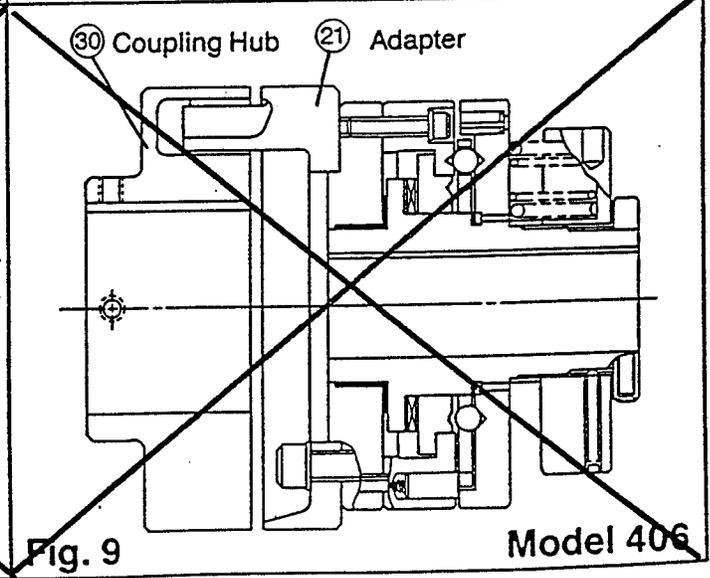


Fig. 9

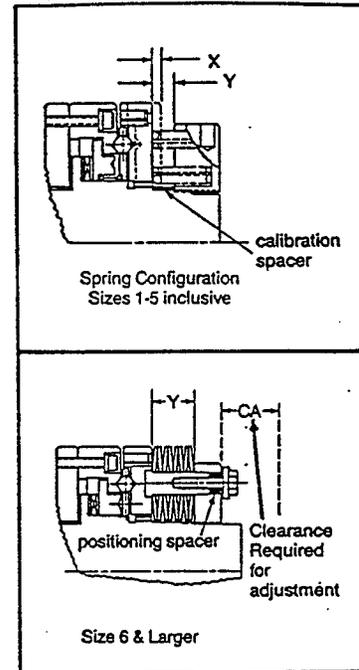
Model 406

Part numbers not shown in Fig. 7, 8 & 9 are the same as those shown in Fig. 6.

# TORQUE ADJUSTMENT DATA

## TABLE 4

Size	Standard Torque Adjustment Springs			Y-Inches		Clearance CA		Movement to disengage X
	Spring Assembly		Torque Range Lb. In.	Max. Torque	Min. Torque	In.	mm.	
	Quan.	Positions						
1	8	Outer	100-250	.075	.11	None Required		.059
	6	Outer	75-188	.075	.11			
	4	Outer	50-125	.075	.11			
	2	Outer	25-63	.075	.11			
2	8	Outer	400-2,000	.20	.4	None Required		.112
	6	Outer	300-1,500	.20	.4			
	4	Outer	200-1,000	.20	.4			
3	6	Inner & Outer	1,700-6,000	.20	.4	None Required		.137
	6	Outer	1,200-3,200	.20	.4			
	4	Outer	800-2,100	.20	.4			
	3	Outer	600-1,600	.20	.4			
4	8	Inner & Outer	2,500-10,000	.20	.4	None Required		.137
	8	Outer	2,000-6,800	.20	.4			
	6	Outer	1,500-5,100	.20	.4			
	4	Outer	1,000-3,400	.20	.4			
5	8	Inner & Outer	8,000-22,500	.40	.6	None Required		.173
	8	Outer	6,000-17,000	.40	.6			
	6	Outer	4,500-12,750	.40	.6			
	4	Outer	3,000-8,500	.40	.6			
6	8	Spring Stacks	12,000-50,000	1.22	1.5	1.00	25.4	.210
	6	Spring Stacks	9,000-37,500	1.22	1.5			
	4	Spring Stacks	6,000-25,000	1.22	1.5			



## CALIBRATION SPACERS

The torque limiter is shipped from the factory either (A) with the torque setting pre-adjusted as specified at the time of the order, or (B) furnished unset for adjustment at the time of installation.

- A. If the torque limiter has been furnished with a factory adjusted torque setting, calibration spacers of the proper total length will be in place on the hub to provide a stop for the adjusting nut at the specified torque setting.
- B. If the torque limiter has been furnished for adjustment at the time of installation, a complete stack of calibration

spacers of different widths will be in place on the hub. These will provide a stop for the adjusting nut at minimum torque setting. It will be necessary to remove one or more spacers to permit tightening of the adjusting nut to achieve higher torque settings.

**NOTE:** On all coupling models (i.e. Models 404, 405 and 406), as well as on other models where through shaft application is specified, calibration spacers will be furnished split axially to permit removal without removing the torque limiter from the shaft.

## INITIAL STARTUP

Prior to startup, examine torque limiter to make sure it is fully engaged with the balls seated correctly in both plates.

Obtain initial torque setting by one of the following methods:

### A. Torque limiter set at factory.

The setting as furnished will be within  $\pm 10\%$  of the torque value specified on the order. If the factory adjustment has been altered during assembly procedure, be sure to reposition the adjusting nut in its original location as measured during the first step of the disassembly procedure. Secure nut in place with setscrews.

If an increased torque setting is desired, the adjusting nut must first be backed off and calibration spacer(s) removed, then the nut re-tightened to the desired setting.

### B. Torque limiter to be set at job site, Sizes 1 thru 5.

#### 1. Setting by trial adjustments:

Remove spacer(s) if operational torque is higher than the minimum shown in Table 4, above. (See descrip-

tion of calibration spacers above.) Start up the drive at minimum torque setting. (See Dim. Y, Table 4.) If the torque limiter disengages before normal operating load level is reached, progressively tighten the adjusting nut until the drive will start and operate under normal load without tripping.

Starting torque is usually the highest torque that the torque limiter must transmit, but occasionally the torque limiter must be set to accommodate higher peak operating torques.

After desired torque setting is obtained, secure adjusting nut with setscrews.

#### 2. Setting to an established specified torque:

An approximate setting can be made from a Torque Adjustment Chart furnished with the torque limiter or from information in Autogard Catalog 1000.

# TORQUE ADJUSTMENT

## Size 6 and Larger

To facilitate adjustment under the high loads, these larger units use a number of adjusting bolts. See Fig. 14, pg. 7.

When building, assemble all components as Fig. 14, but omit the adjustment spacer. Be careful to stack the disc springs correctly. This is generally as shown in Fig. 14, but reference should be made to the assembly drawing as the number and method of stacking can vary.

Assemble the pillars (31), springs (31), washers (33) and adjustment bolts (32) into the adjusting nut (3), and lightly tighten the bolts, so that the springs are just nipped. Screw the complete assembly onto the hub.

Note that the flanges of the spring guide pillars are hexagonal. Each pillar must be positioned so that as the adjusting nut is tightened the hexagon engages with the groove in the slide plate (Item 2).

Tighten the adjusting nut as far as possible, using the bolts to equalize the length of each spring stack, so that all pillars are engaged with the groove on the slide plate.

To increase the torque tighten each bolt by an equal amount, but not enough to disengage the hexagons from the slide plate. One or two turns of the bolt is normally a convenient amount. Then tighten the adjusting nut without using excessive force. Shortening of the spring stack is by means of the bolts, not by the nut. Continue with this procedure of alternately tightening bolts and adjusting nut until the correct spring length is achieved, then slacken the bolts.

**THE UNIT WILL NOT OPERATE CORRECTLY UNTIL THIS IS DONE.**

When the correct torque setting is achieved, remove the pillar bolts completely, replace the adjustment spacer, and retighten the bolts. There must be a gap between the thick washer and the adjusting nut. Lock the adjusting nut with the setscrews.

### NOTE (ALL SIZES)

IT IS ESSENTIAL THAT ANY SET OF SPRINGS IS NOT USED ABOVE ITS CORRECT RANGE. IF THE SPRINGS ARE OVERTIGHTENED, THE BALLS WILL BE PREVENTED FROM ROLLING FROM THE SEATINGS. IF SLACKENED TOO FAR, SO THAT A POSITIVE LOAD IS NOT APPLIED TO THE BALLS AT ALL TIMES, IT IS POSSIBLE THAT ONE OR MORE BALLS MAY REMAIN IN THEIR SEATINGS DURING TRIPPING. IN BOTH CASES IT IS PROBABLE THAT DAMAGE WILL OCCUR TO THE MACHINERY OR TO THE AUTOGARD TORQUE LIMITER.

## RESETTING PROCEDURE

1. Shut down the drive.
2. Investigate and remove cause of overload or jam.
3. Reset.

This is achieved either by reversing the driving side of the drive or by taking the driven side forward.

Note that these units will trip at an accurate torque setting in both directions. Re-engaging must, therefore, be carried out at a speed slow enough to allow the unit to fully re-engage and then accelerate the mass of the driven machine.

If this is attempted at too high a speed (e.g. by direct-on-line starting) the set torque of the unit can be exceeded, causing tripping in the opposite direction.

The limiting re-engaging speed depends on factors such as the inertia of the driven plant, elasticity of the drive, and the torque setting of the Autogard, so it is not possible to give exact limiting re-engaging speeds. However, as a guide for most applications it should be under rather than over 100 RPM. Many drives incorporate a jogging facility which can be used for re-engaging.

## DISASSEMBLY PROCEDURE

1. Measure and make note of the position of the adjusting nut on the hub before proceeding with disassembly.
2. With spring end up, loosen the setscrews and remove adjusting nut, spring, spacers, limit switch plate, slide plate and drive balls.
- ~~3. On Model 401, remove sprocket or cheave from adapter.~~
4. On Models ~~401 and 404~~:
  - a): Tap drive pins free of drive plate.
  - b): Remove capscrews which join drive plate to adapter or to coupling hub.
5. Carefully work drive plate ~~(or drive plate together with sprocket or cheave on Models 402 and 400)~~ over spline so as not to damage bearing material on I.D. of drive plate.
6. ~~On Model 401, slide adapter off of hub carefully so as not to damage bearing material on I.D.~~
7. Clean all parts thoroughly, and inspect the bearing surfaces. Carefully blend out any scratches.
8. For reassembly, see page 6 and 7.

## MAINTENANCE

With the initial factory lubrication, the torque limiter may, under reasonably clean operating conditions, be considered to be lubricated for life. Frequent servicing should be unnecessary.

It is a good practice when other equipment in the drive train is down for service to make a general inspection of the torque limiter. Check for tightness of the torque limiter on its shaft, tightness of the sprocket, etc. and check for appearance of adequate lubrication. This may be done by backing off the adjusting nut and separating the plate set to permit viewing the interior components. If there is any indication that further servicing may be desirable the torque limiter should be disassembled and inspected as described above under DISASSEMBLY PROCEDURE.

For unusual conditions such as very high RPM, high ambient temperatures, high vibration or dirty environment, more frequent or special maintenance may be required.

**NOTE:** If, after the drive has been in operation for some time and the torque limiter suddenly starts disengaging for no apparent reason, check to see whether something in the drive train or driven machine, such as normal wear, a bad bearing, damaged sprocket, misalignment, change in machine duty, etc., may be the cause of the problem.

A visual inspection of the drive and slide plate is then recommended. Follow disassembly procedure above. Note that although a ball path between the ball seats should normally be visible, excessive wear on the seats themselves may require replacement of the drive plate.

Reassemble and follow INITIAL STARTUP procedure on page 4.

# BUILDING PROCEDURE

... the components being used are not new they should be inspected for accidental damage or wear. Particular attention should be paid to bearing surfaces. Any slight damage marks should be carefully blended out.

Any components showing substantial damage or wear should be replaced.

**GREASE.** Use a good quality grease such as Shell Alvania R3 or BP Energrease LS3. Units operating in conditions of high or low temperatures may require the appropriate special grease. Size 4 and larger use HCF grease.

REFER TO FIGS. 6, 10 & 11 TO ASSIST THE FOLLOWING PROCEDURE:

- a. Check the hub thread by running the adjusting nut (item 3) down its full length on the hub.
- b. Grease the needle bearing (item 13) and assemble onto the hub in this order:
  1. Thrust washer (item 14).
  2. Needle bearing (item 13).
  3. The second thrust washer (item 14).
- c. Assemble the strut ring (item 4) onto the hub, with the flat face against the thrust bearing. Check that it can rotate freely.
- d. Drive plate/pawl sub-assembly. Lightly oil the pawls and pawl springs (items 9 and 22) and assemble into the drive plate (item 5).

Check that the pawls can move freely. It must be possible to push them into the drive plate flush with the surface, and they must move easily from that position due to the spring pressure.

If the pawl locating pins (item 27) are not already in place they should now be carefully fitted after removal of the pawls and springs. Note, the pins must be positioned with the seam away from the pawl, see Fig. 10, item 27. Re-assemble pawls and springs and check that they still have free movement.

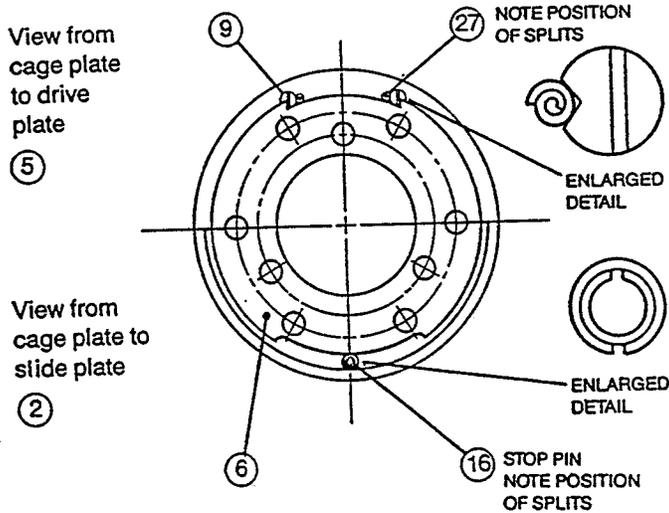


Fig. 10

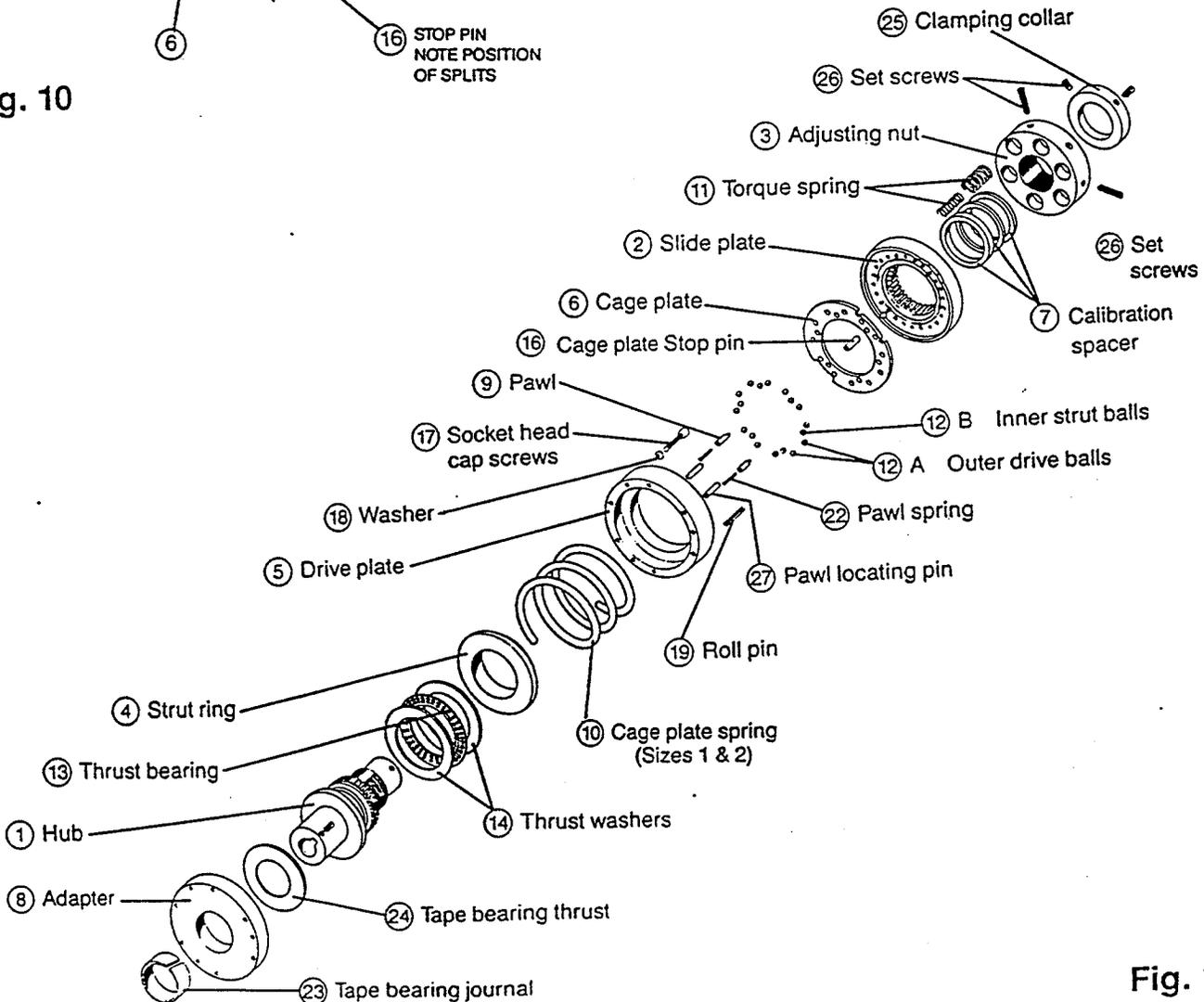


Fig. 11

- e. Assemble the drive plate onto the strut ring.
- f. Lightly grease the bearing surface of the hub, and assemble the tape thrust bearing (item 24) against the flange. Carefully position the tape journal bearing (item 23) in the bore of the adapter (item 8), and assemble onto the hub. Make sure the tape bearing stays in position during this assembly, and check that the adapter can then turn freely on the hub.

Connect the adapter to the drive plate with capscrews (item 17) and roll pins (item 19).

Check that the drive plate/adapter assembly can rotate freely on the hub.

- g. On size 1 and 2, assemble the cage plate spring (item 10) onto the hub, ensuring that it is housed in the counterbore in the strut ring, and that the coils are not intertwined. On size 3 and larger, a bayonet type of cage plate retention is used. The cage plate is placed in the slide plate with the stop pin notch 90° to the proper location. The stop pin (item 16) should now be installed per Fig. 10. (Note position of splits in rollpins).

- h. Check that the stop pin (item 16) is correctly positioned in the slide plate (item 2) and is not loose or damaged. It should lie flush with the top of the flange of the slide plate.

Size 1 uses a single pin, all other sizes use double pins, see Fig. 10.

Place the slide plate (item 2) on the bench with the flange and ball seat face upwards. Lightly grease the cage plate (item 6) and place it on the slide plate with the shallow recess in the bore upwards.

**NOTE**

The correct angular positioning of this plate relative to the ball seats and pins is most important, see Fig. 10. The cage plate holes must be directly over the ball seatings, and the stop pin (item 16) in the slide plate must be central in the cage plate cut-out. Ensure that the plate is not 180 degrees out of position—the stop pin must be centrally positioned in the wider slot.

- j. Insert some grease into each of the cage plate holes, and place drive balls 12a and strut balls 12b in these holes. There should be sufficient grease to hold these balls in position when the assembly is inverted.
- k. Insert springs (item 11) into the adjusting nut (item 3). Some grease in the holes will help hold these in position for the next stages of assembly.
- l. Carefully holding the cage plate in position, invert the slide plate, and pass it over the hub thread to engage with the splines on the hub. As soon as the splines are engaged, rotate the drive plate until the pawls are symmetrically facing the cutout in the slide plate flange. Then push the slide plate fully home, holding the cage plate until the last possible moment.

The drive balls should now be engaged with the seatings in the drive plate, and the pawls pushed almost completely into the drive plate by the flange on the slide plate.

There should be a small gap, about 0.010 inches (0.25mm) between the slide plate flange and the drive plate.

- m. Hold the slide plate in this position against the cage plate spring pressure, and screw the nut/spring assembly onto the hub until the springs are against the slide plate with a positive pressure—more than the cage plate spring load so that the slide plate is held in position.

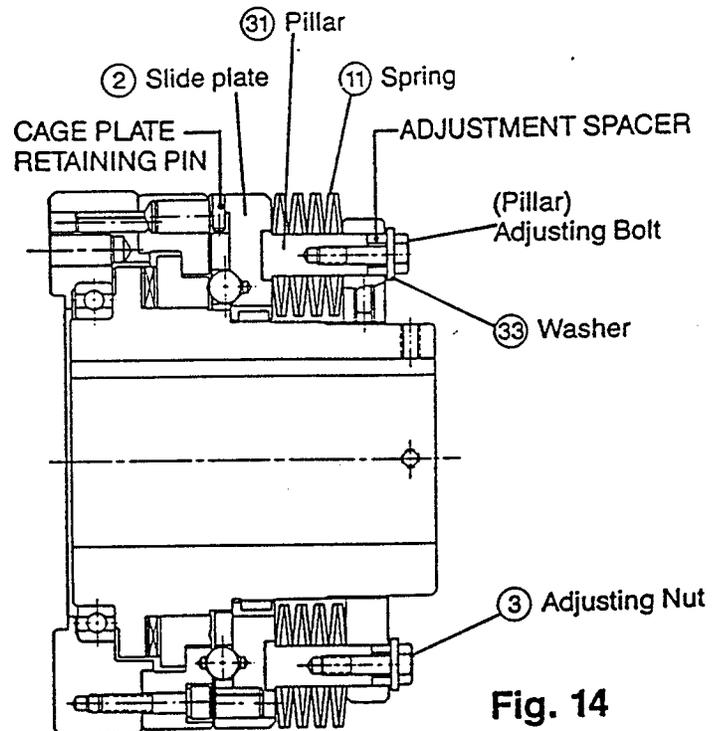
**SIZE 6 AND LARGER.** (See Fig. 14).

These units differ from the smaller sizes in three respects, and the assembly procedure is as for the smaller units apart from these features.

1. The tape bearings in the adapter are replaced by a ball bearing.
2. The cage plate spring is omitted, and the cage plate retained in the slide plate by tension pins.
3. The torque springs are guided on pillars instead of being housed in the adjusting nut. Disc springs are normally used on these sizes.

The cage plate retaining pins should be inserted at stage h. Ensure that the cage plate is free to rotate relative to the slide plate after inserting these pins.

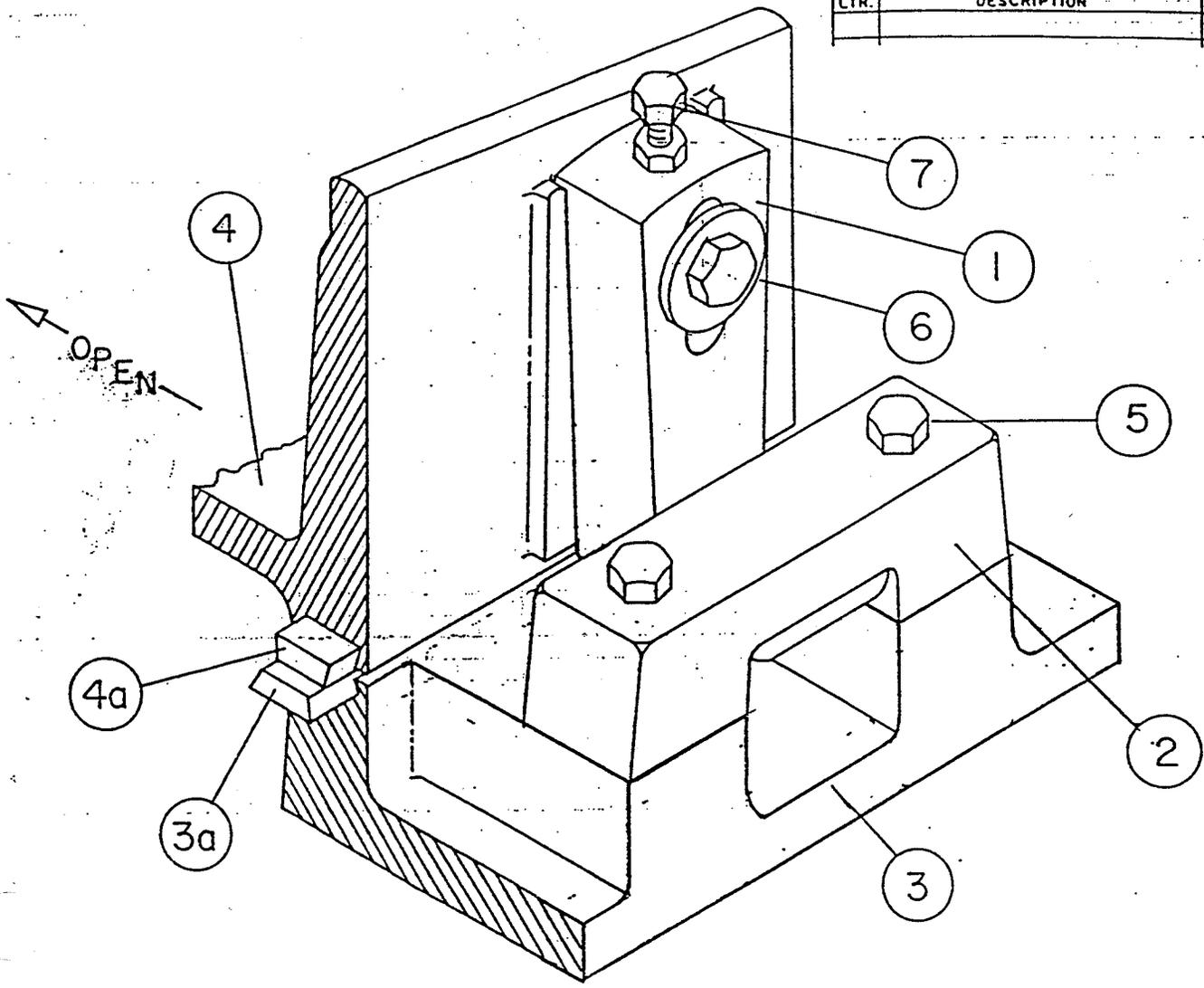
See notes on Torque Adjustment regarding assembly of the spring system on these larger units.



**Fig. 14**



REVISIONS			
LTR.	DESCRIPTION	DATE	APPR'D



⑦	ADJUST'G SCREW W/NUT	-	3/8 NC x 1-3/4 LG. HEX HD	1 ea
⑥	WEDGE BOLT W/WASHER	-	3/4 NC x 2 LG. CAP SCREW	1 ea
⑤	WEDGE BLOCK BOLT	-	5/8 NC x 3-1/2 LG. HEX HD	2
④a	DOVETAIL SEAT	100076	3/4" EXTRUSION	1
④	COVER	-	-	1
③a	DOVETAIL SEAT	100076	3/4" EXTRUSION	1
③	FRAME	-	-	1
②	WEDGE BLOCK BRKT	100071	W-5008	1
①	WEDGE	102980	W-4007	1

NOMENCLATURE      DETAIL DWG.#      DESCRIPTION      QTY/ASSY

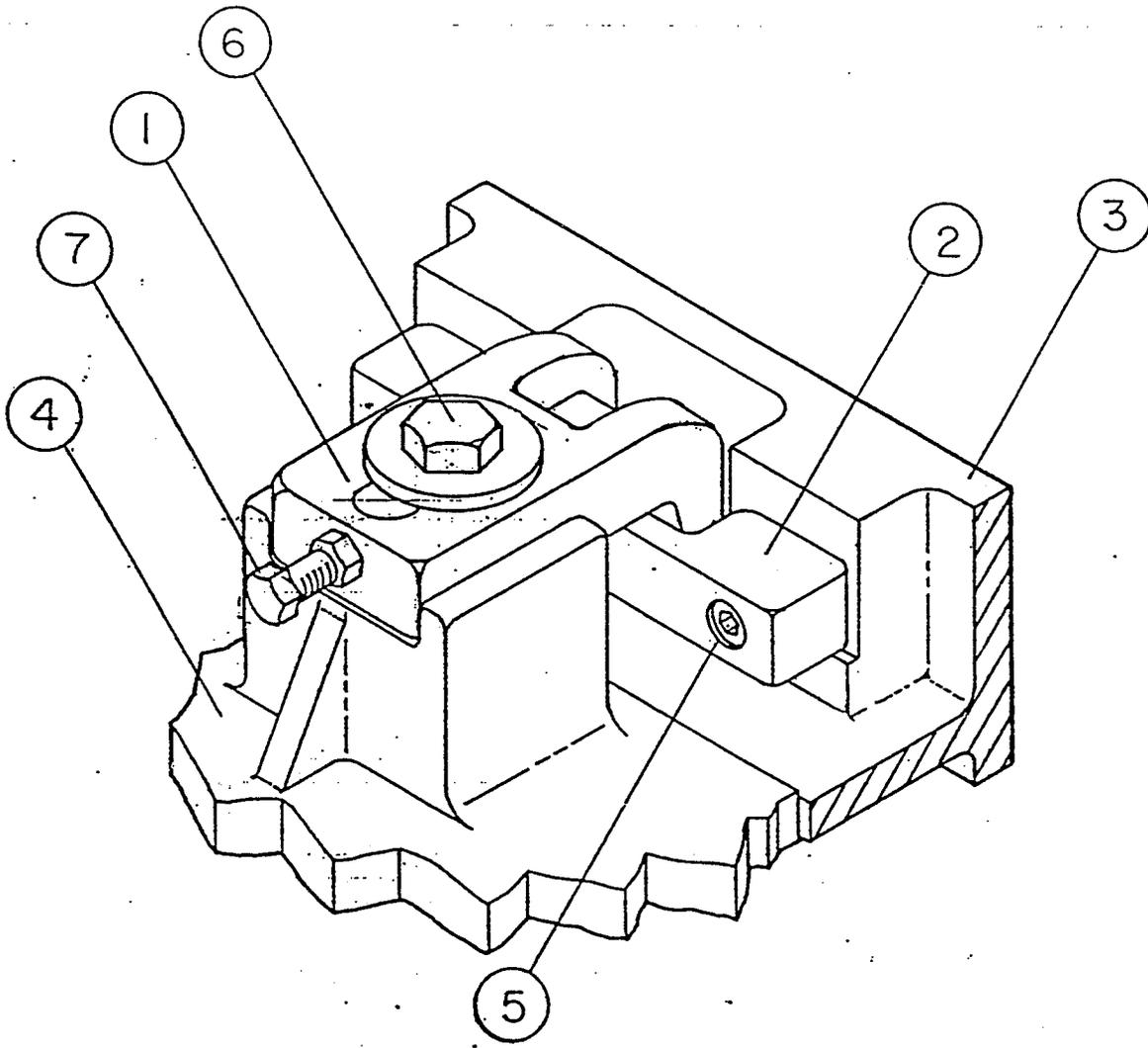
RED TOP **WATERMAN** WATERMAN IND. INC  
EXETER, CALIFORNIA

CAST NO. W-	SCALE: N.T.S.	MACHINED SURFACES: 125/ OR BETTER	GENERAL	S-4000
DIMENSIONS ARE IN INCHES	ARE	IN	INCHES	
DECIMALS .XX ± .03	FRACTIONS ± 1/32	ANGLES ± 2°	DRAWN MITCH KING	7-84
.XXX ± .010	EXCEPT AS NOTED		CHECKED	7-16-84

BOTTOM WEDGE ASSY  
SERIES S-4000 SLUICE GATE

SIZE A      102984      P.15.0.8

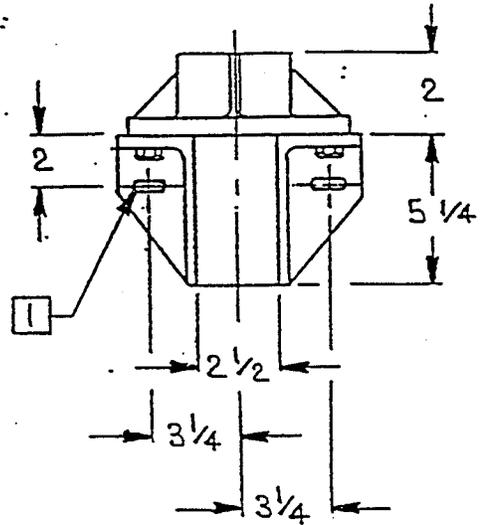
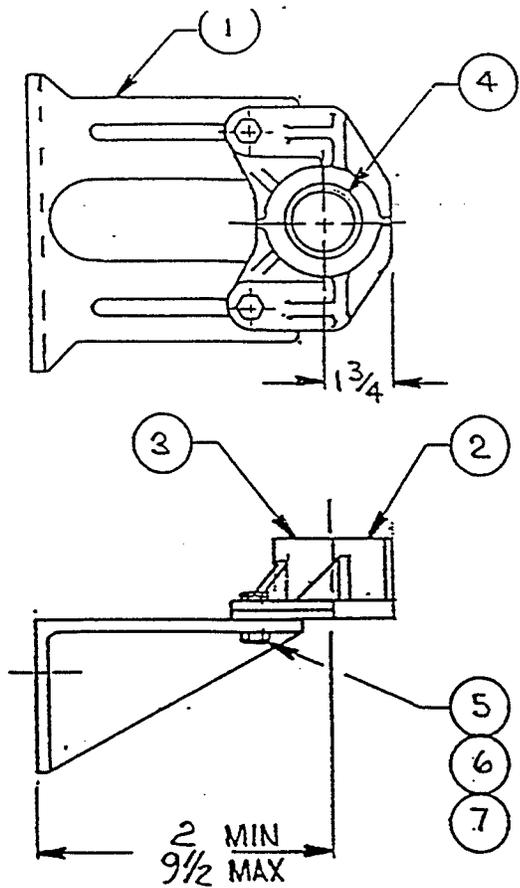
REVISIONS			
LTR.	DESCRIPTION	DATE	APPRV'D



7	ADJUST'G SCREW W/NUT	-	3/8" NC x 1-3/4 LG. HEX HD.	1ea
6	WEDGE BOLT W/WASHER	-	3/4" NC x 3 LG. HEX HD. CAP SCREW	1ea
5	WEDGE BLOCK BOLT	-	5/8" NC x 1-3/4 LG. SOC. HD SCREW	2
4	COVER	-	-	1
3	FRAME	-	-	1
2	WEDGE BLOCK BRKT	100070	W-5007	1
1	WEDGE	102980	W-4006	1
NOMENCLATURE		DETAIL DWG.#	DESCRIPTION	QTY/ASSY

CAST NO.:		RED TOP		 <b>WATERMAN</b> IND., INC. EXETER, CALIFORNIA	
W-					
MACHINED SURFACES:		GENERAL		TOP WEDGE ASSY ; SERIES S-4000 SLUICE GATE	
125/ OR BETTER		S-4000			
NEXT ASSY		USED ON			
DIMENSIONS ARE IN INCHES		DRAWN		SIZE	
		MITCH KING		A	
		CHECKED		102983	
DECIMALS .XX ± .03		FRACTIONS ± 1/32		ANGLES ± 2°	
XXX ± .010		— EXCEPT AS NOTED —			

REVISIONS			
LTR.	DESCRIPTION	DATE	APPR'D
A	E.O. # 0593	10-23-86	PA



ITEM NO.	DESCRIPTION	PART NO. OR SIZE	DETAIL DRAWING	QTY	MATERIAL
1	BRACKET	W-837	100880	1	CAST IRON : ASTM A-126 CL. B
2	GUIDE (FRONT)	W-1829	103243	1	CAST IRON : ASTM A-126 CL. B
3	GUIDE (BACK)	W-1830	103244	1	CAST IRON : ASTM A-126 CL. B.
4	GUIDE SLEEVE	-	103245	2	PHOSPHOR BRONZE : ASTM B-439 : [2] ALLOY 510
5	BOLT-HEX HD.	1/2 NC X 2-1/2 LG	---	2	STAINLESS STEEL : TYPE 304
6	NUT-HEX.	1/2 NC	---	2	STAINLESS STEEL : TYPE 304
7	WASHER	1/2 DIA	---	2	STAINLESS STEEL : TYPE 304

[2] OPTIONAL MAT'L: STAINLESS STEEL (TYPE 316) / CARTRIDGE BRASS - ALLOY 260.

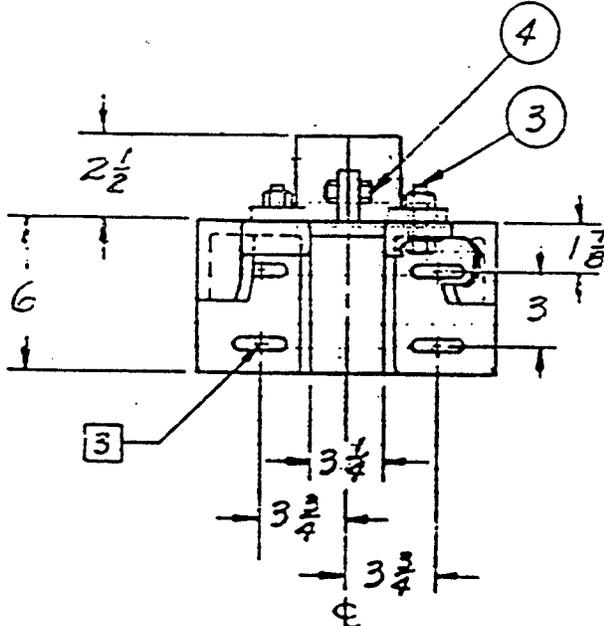
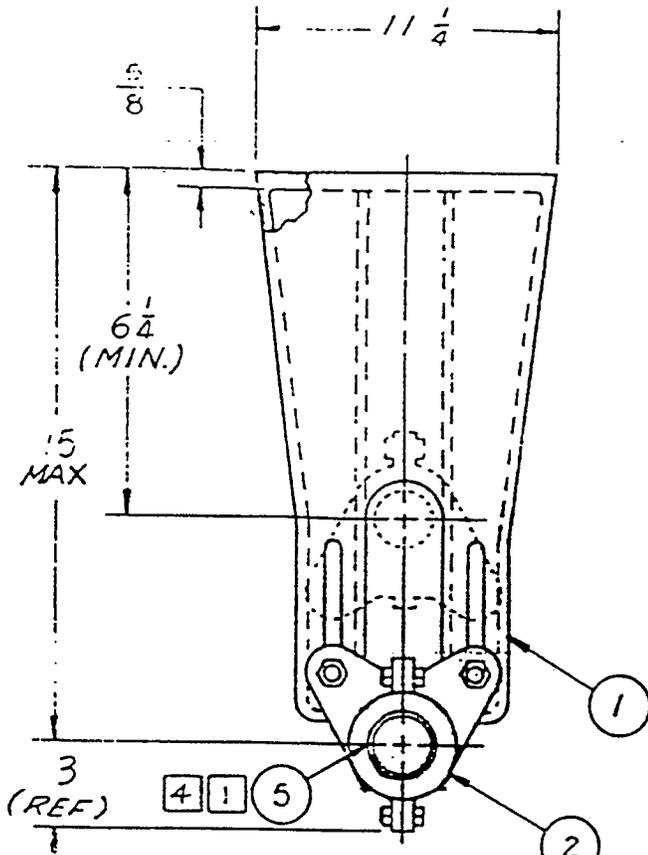
[1] USE 5/8 DIA ANCHOR BOLTS: PROJ. -2": 2 REQ'D, 1-5/16 ADJUSTMENT AVAILABLE.

NOTES: UNLESS OTHERWISE SPECIFIED.

CAST NO.: W-		RED TOP WATERMAN WATERMAN IND., INC. EXETER, CALIFORNIA	
SCALE: NONE		K-2 STEM GUIDE (NEW STYLE-SPLIT)	
MACHINED SURFACES: 125% OR BETTER		GENERAL	
DIMENSIONS ARE IN INCHES		NEXT ASSY USED ON	
DECIMALS .xx ± .03	FRACTIONS ± 1/32	ANGLES ± 2°	DRAWN M. KING 1030-44
.xxx ± .010 —EXCEPT AS NOTED—			CHECKED [Signature] 11-6-87
		SIZE A	103251 P.15.1.1

REVISIONS:

LTR	DESCRIPTION	DATE	APPRV'D
A	REV'D. WAS: A-7088; A-7247; A-72158 1B.	8-10-78	/
B	E.O. #0262	12-13-82	C. Starn
C	E.O. #0603	1-23-87	22
D	E.O. #0717	11-4-88	M



- ① BRACKET-(100884); W-848. CAST IRON PER ASTM A-126, CLASS B.
- ② GUIDE-(100878); W-849 L&R. CAST IRON PER ASTM A-126, CLASS B.
- ③ ASSY HDW= 1/2 NC x 1 1/2 LG. HEX HD BOLT AND NUT; 2 REQ'D, 304 STN. STL. STD
- ④ ASSY HDW= 3/8 NC x 1 1/4 LG. HEX BOLT AND NUT; 2 REQ'D, PLATED STEEL.
- ⑤ BUSHING-PHOSPHER BRONZE; ASTM B-139 ALLOY 510; STANDARD BRONZE; STN. STL. TY. 316 (OPTIONAL)  
(103245) 7/8 DIA THRU. 2" DIA.  
(103730) 2 1/2 DIA THRU. 3" DIA.

NOTES:

- ① BUSHING I.D., STEM SIZE + 3/32 INCH.
- 2
- ③ USE 5/8" DIA ANCHOR BOLTS; PROJ=2"; 4 REQ'D. 1 1/4" ADJUSTMENT AVAILABLE.
- ④ FOR STEM SIZE 7/8 DIA THRU 3" DIA. MAY BE USED W/PIPE OR SMALLER STEM SIZES W/SPECIAL MACHINED.

WATERMAN MODEL K-2B  
FULLY ADJUSTABLE  
WALL MOUNTED  
STEM GUIDE

FOR:

STANDARD

JOB NO

QUOTE NO.

DRAWN BY  
J. BRAVO

CHECKED BY

SCALE  
NONE

DATE  
10 AUG. 1978

RED TOP



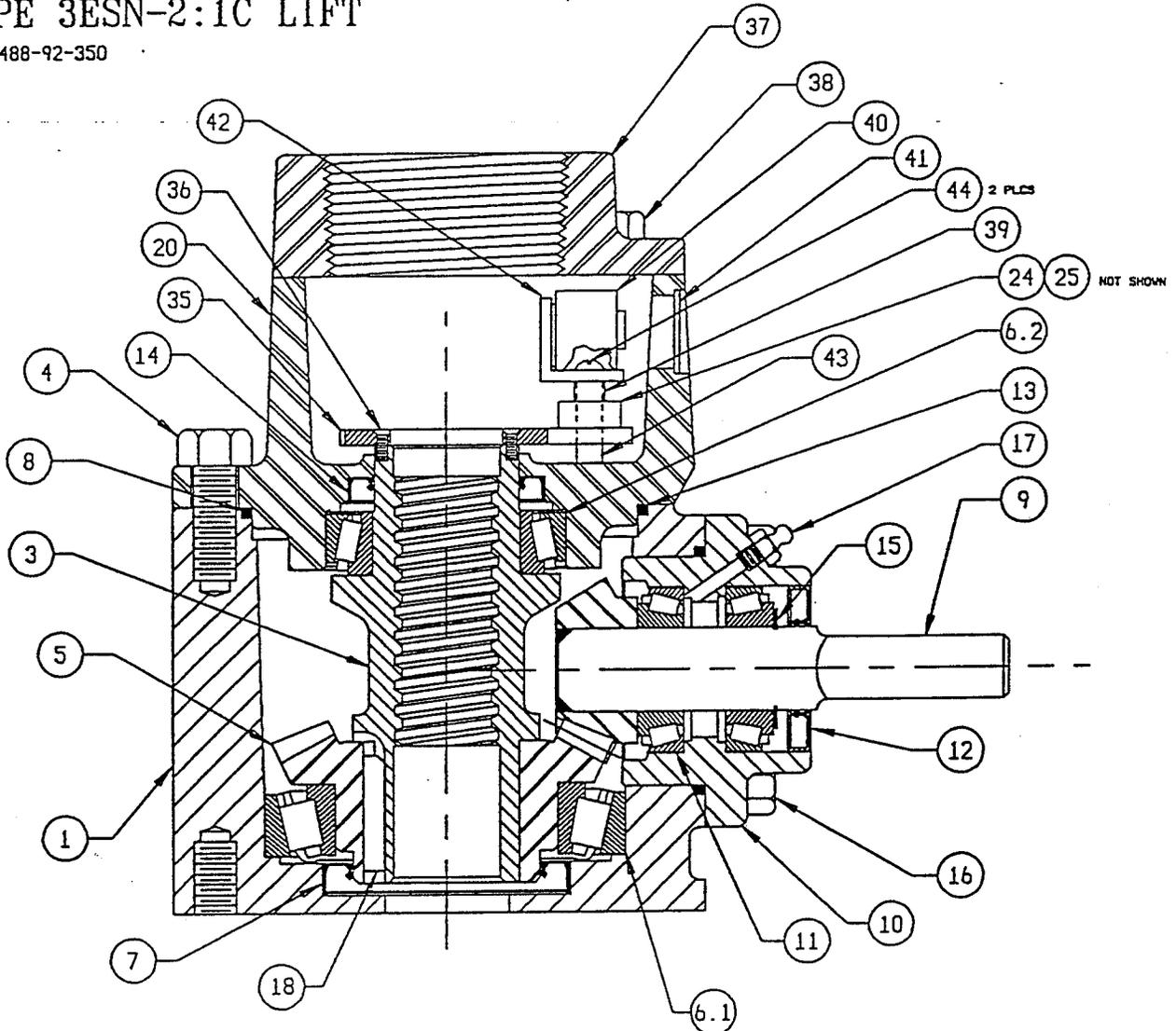
WATERMAN INDUSTRIES, INC.  
EXETER, CALIFORNIA 93221

DR NO

100885

# TYPE 3ESN-2:1C LIFT

P/N 488-92-350



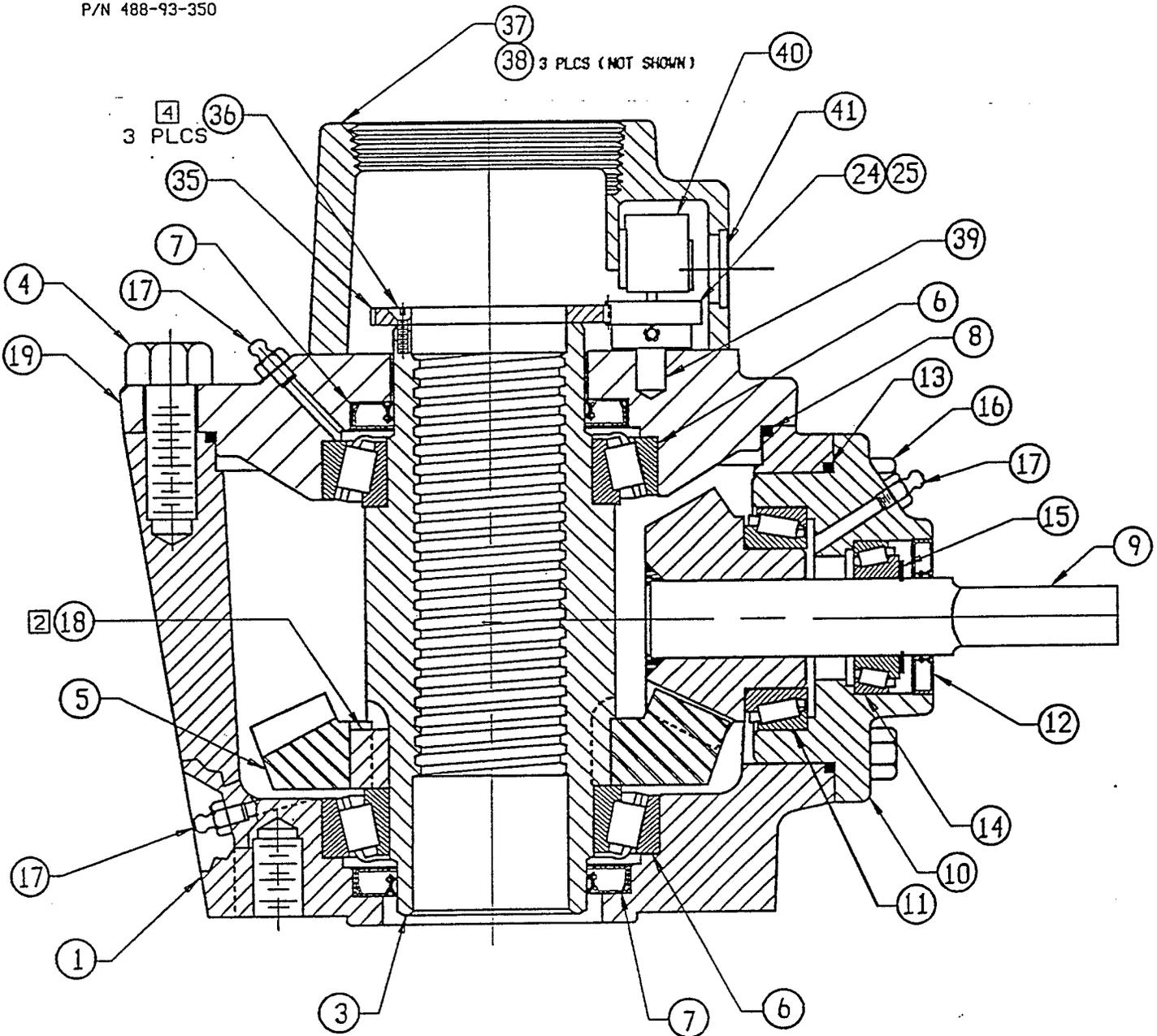
## PARTS LIST

NO. ITEM	REQ'D QTY	DESCRIPTION	PART NO.	NO. ITEM	REQ'D QTY	DESCRIPTION	PART NO.
1	1	HOUSING	407-04-950	20	1	COVER -COUNTER INDICATOR	410-04-992
3	1	LIFT NUT (R.S.)	484-04-954	24	1	SMALL COUNTER GEAR	451-02-769
4	4	BOLT - HEX BOLT	808-05-125	25	2	SET SCREW	221-06-187
5	1	BEVEL GEAR	451-04-956				
6.1	1	BEARING	845-30-399	35	1	LARGE COUNTER GEAR	451-05-146
6.2	1	BEARING	845-02-949	36	2	FLAT HEAD PHILLIPS, TYPE F BLIND HEAD, J.C. SCREW	814-06-037
7	1	OIL SEAL	655-71-272	37	1	STEM COVER ADAPTER	553-02-674
8	1	O-RING	432-00-247	38	3	BOLT - HEX HEAD	808-04-100
9	1	GEAR/SHAFT ASSY	524-04-957	39	1	SHAFT	525-02-766
10	1	THRUST CAP	612-04-961	40	1	COUNTER	547-45-815
11	2	BEARING	845-30-643	41	1	WINDOW	695-06-101
12	1	OIL SEAL	655-71-760	42	1	COUNTER BRACKET	546-27-651
13	1	O-RING	432-00-232	43	2	STAND OFF	672-32-100
14	1	OIL SEAL	655-73-237	44	2	SCREW: ROUND HEAD	816-10-138
15	1	SNAP RING	584-31-101				
16	4	BOLT - HEX HEAD	808-04-100				
17	3	GREASE FITTING	848-02-028				
18	2	KEY	638-01-138				

FORM : 3ESN21C.20

# TYPE 3EN-2:1C LIFT

P/N 488-93-350



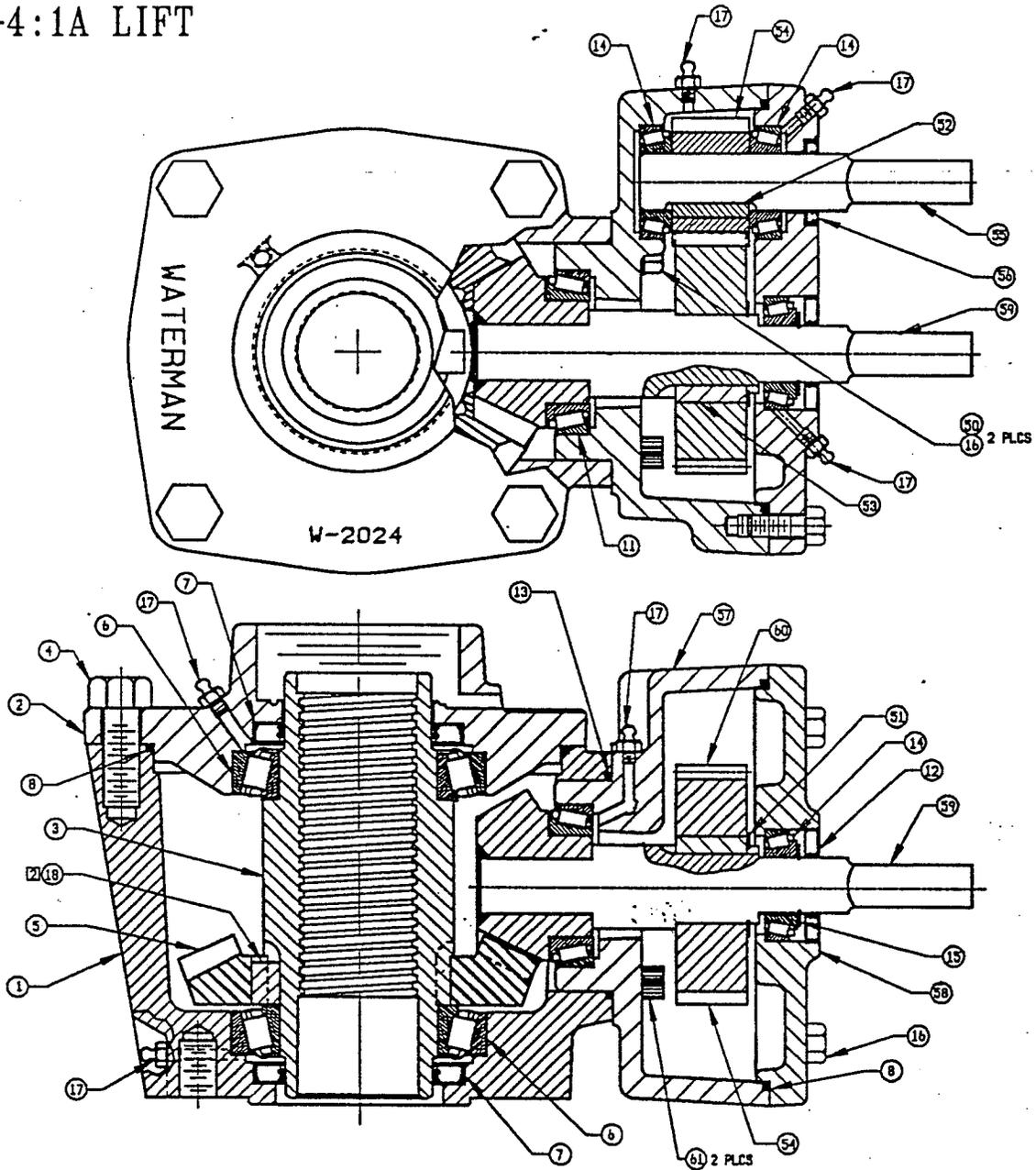
## PARTS LIST

NO. ITEM	REQ'D QTY	DESCRIPTION	PART NO.	NO. ITEM	REQ'D QTY	DESCRIPTION	PART NO.
1	1	HOUSING	407-04-806	16	4	BOLT - HEX HEAD	808-04-100
3	1	LIFT NUT	484-04-883	17	3	GREASE FITTING	848-02-028
4	4	BOLT -HEX HEAD	808-06-150	18	2	KEY	638-07-075
5	1	BEVEL GEAR	451-04-885	19	1	COVER - DIAL INDICATOR	410-04-917
6	2	BEARING	845-30-399	24	2	SMALL COUNTER GEAR	451-01-661
7	2	OIL SEAL	655-16-273	25	2	SET SCREW	821-02-025
8	1	O-RING	432-00-262	35	1	LARGE COUNTER GEAR	451-05-143
9	1	GEAR SHAFT ASSY	524-04-886	36	3	FLAT HEAD PHILLIPS, TYPE F BLUNT HEAD, T.C. SCREW	814-06-050
10	1	THRUST CAP	612-04-805	37	1	COUNTER HOUSING	407-00-334
11	1	BEARING	845-02-949	38	3	HEX HEAD BOLT	808-04-100
12	1	OIL SEAL	655-71-760	39	1	SHAFT	525-02-766
13	1	O-RING	432-00-240	40	1	COUNTER	547-45-815
14	1	BEARING	845-30-643	41	1	WINDOW	695-06-101
15	1	SNAP RING	584-31-101				

FORM : 3EN21C.20

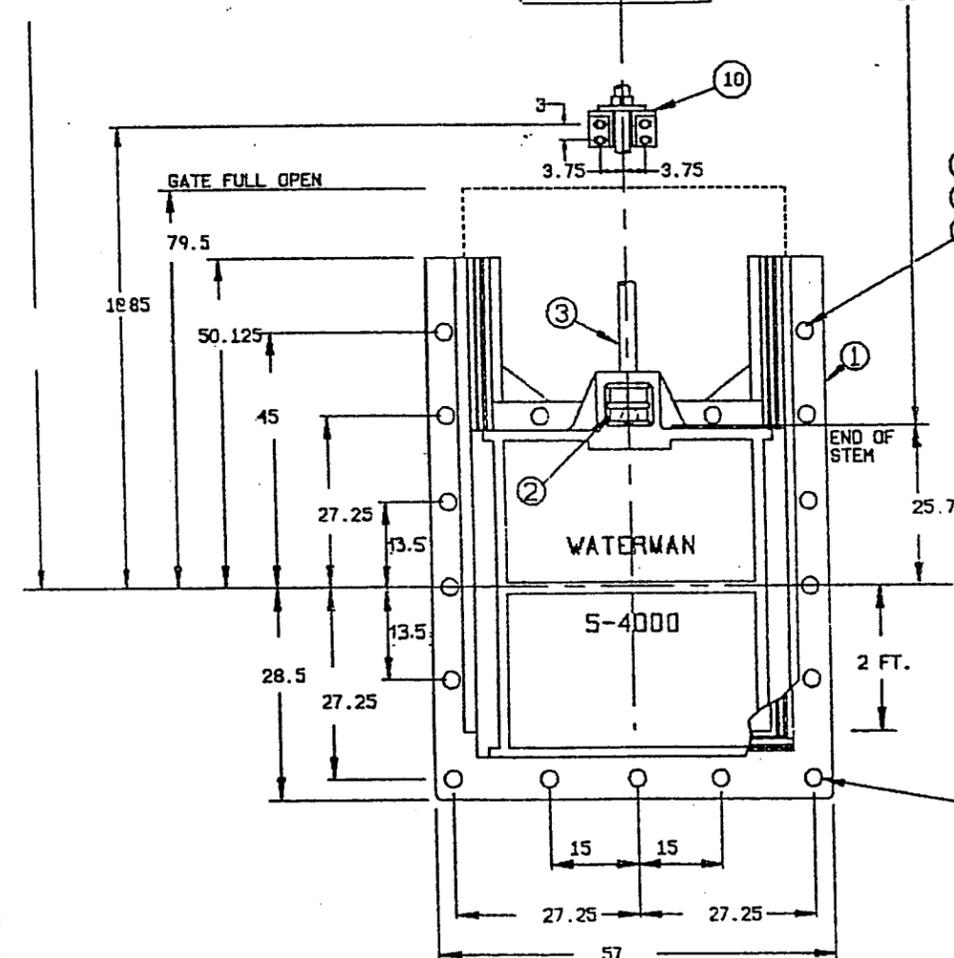
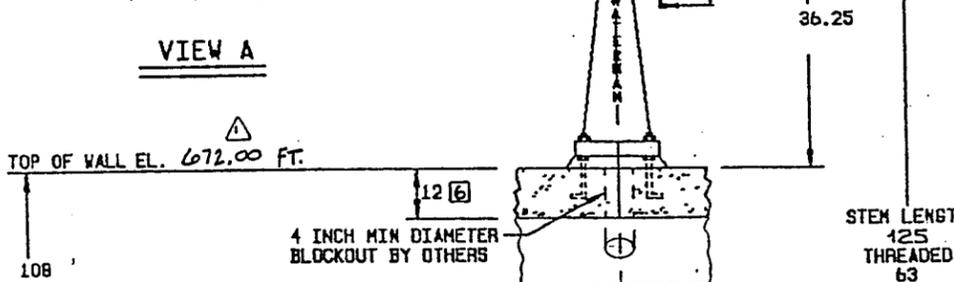
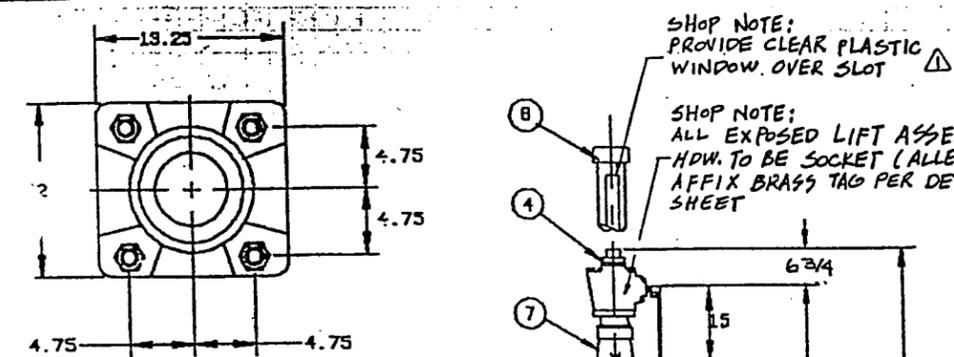
# TYPE 3ED-4:1A LIFT

P/N 488-93-730



## PARTS LIST

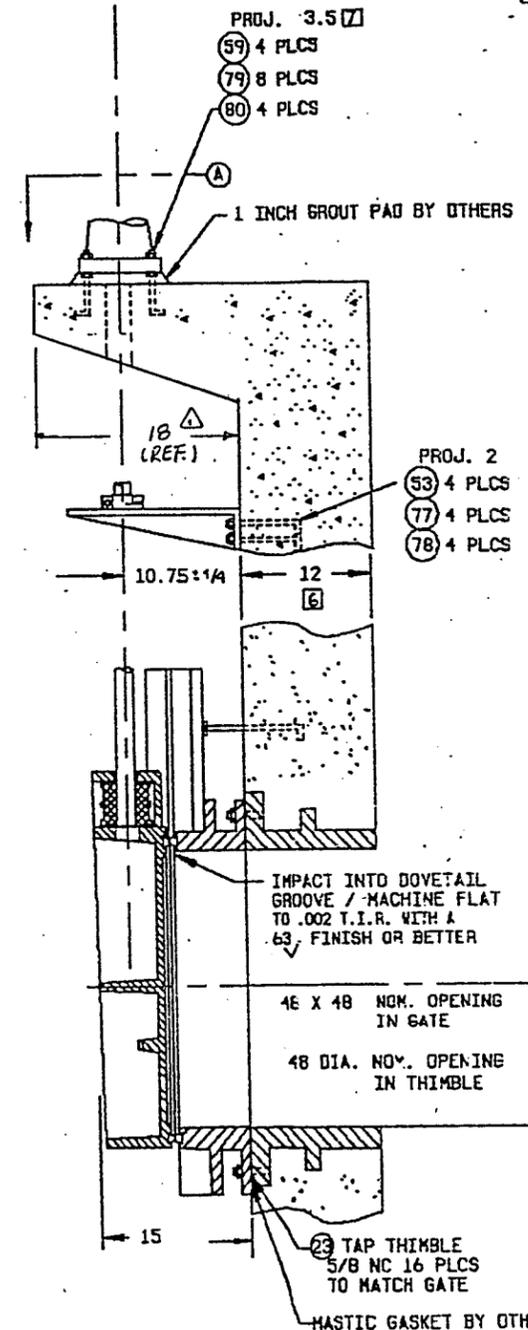
NO. ITEM	REQ'D QTY	DESCRIPTION	PART NO.	NO. ITEM	REQ'D QTY	DESCRIPTION	PART NO.
1	1	HOUSING	407-04-806	17	6	GREASE FITTING	848-02-028
2	1	COVER - STANDARD	410-04-807	18	1	KEY	638-07-075
3	1	LIFT NUT	484-04-883				
4	4	BOLT - HEX HEAD	808-06-150	50	4	SEALING WASHER	818-04-052
5	1	BEVEL GEAR	451-04-885	51	1	SNAP RING	584-31-102
6	2	BEARING	845-30-399	52	1	KEY	639-02-159
7	2	OIL SEAL	655-71-760	53	1	KEY	639-02-160
8	1	O-RING	432-00-240	54	1	SPUR GEAR	451-04-798
				55	1	INPUT SHAFT	525-05-002
11	2	BEARING	845-02-949	56	1	SEAL	651-71-224
12	2	OIL SEAL	655-71-760	57	1	HOUSING	407-04-941
13	3	O-RING	432-00-240	58	1	COVER	411-04-940
14	2	BEARING	845-30-643	59	1	GEAR SHAFT / ASSEMBLY	524-04-942
15	2	SNAP RING	584-31-101	60	1	SPUR GEAR	451-04-799
16	6	BOLT - HEX HEAD	808-04-100	61	1	SCREW-HEX SOC. HD. CAP	810-04-100



NOTE: DIRECTIONAL ARROW AND WORD OPEN CAST IN LIFT HOUSING.

COUNTER READING  
 ○ CLOSED;  
 ○ OPEN;

NOTE: CONTRACTOR TO FIELD STAMP COUNTER READINGS AFTER INSTALLATION & VERIFICATION TAG DETAIL



ITEM DESCRIPTION	MATERIAL KEY	FIN KEY	PART NO. OR SIZE (FOR WATERMAN USE ONLY)	QTY/ GATE	TOTAL QTY
1. SLUICE GATE ASSEMBLY					
a) FRAME	1	6C	W-4042-1	1	1
b) COVER	1	6C	W-4041	1	1
c) SEAT	5	3			
d) GUIDE RAIL	1	6C	CAST INTEGRAL WITH FRAME		
e) SIDE WEDGE ASSEMBLY R & L				4 EA	
f) WEDGES	1, 4, 5	1, 3	W-4001 THRU W-4004		
g) ASSEMBLY / ADJUSTING HARDWARE	15A, 27	2			
h) TOP WEDGE ASSEMBLY				2	
i) WEDGES & BRACKETS	4	1, 3	W-4006 & W-5007		
j) ASSEMBLY / ADJUSTING HARDWARE	15A, 27	2			
k) BOTTOM WEDGE ASSEMBLY				2	
l) WEDGES & BRACKETS	4	1, 3	W-4007 & W-5008		
m) ASSEMBLY / ADJUSTING HARDWARE	15A, 27	2			
2. THRUST NUT	12	2, 3	3 CUBIC 1.5 DIA. 4TPI, RH)	1	1
3. STEM	9A	2, 3	1.5 DIA. 4TPI, LH STD	1	1
4. LIMIT NUT	1	5	1.5 DIA. 4TPI, LH STD	2	2
7. LIFT ASSEMBLY					
a) HANDCRANK	1, 4	6D	TYPE 3EN-2-LAC	1	1
b) PEDESTAL	1, 12	6D	101653	1	1
c) POSITION INDICATOR	1	6D	W-2041	1	1
d) COUNTER TYPE			COUNTER TYPE	1	1
8. STEM COVER (SLOTTED)	19	2	REF 102790 (3) 5/2 LG. W/104964	1	1
10. STEM GUIDE (LZ BRONZE BUSHED)	1, 26, 9A, 27	6C	TYPE K-28	1	1
23. THIMBLE (PAINT INSIDE ONLY)	1	6C	48 TYPE F-5C X 12 LG.	1	1
24. DOUBLE ENDED STUD	9A	2, 3	5/8 NC X 3-1/2 LG.	16	16
57. ANCHOR BOLT	9A	2, 3	5/8 NC X 18 LG	2	2
59. ANCHOR BOLT	9A	2, 3	3/4 NC X 12 LG.	4	4
77. HEX NUT	27	2	5/8 NC	24	24
78. WASHER	15A	2	5/8 DIA	24	24
79. HEX NUT	27	2	3/4 NC	8	8
80. WASHER	15A	2	3/4 DIA.	8	8

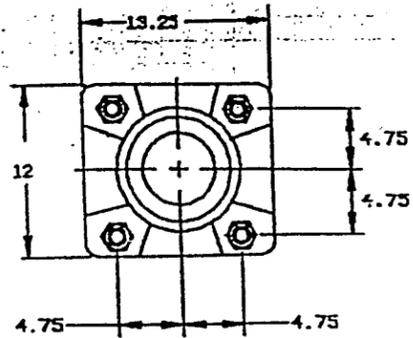
NOTES:  
 1. (GATE CAPACITY) MAX. SEATING HD. = 30 FT.; MAX UNSEATING HD. = 20 FT.  
 2. OPERATING HEAD FROM E: SEATING = 9 FT.; UNSEATING = 9 FT. (6)  
 3. LIFT CAPACITY @ 40 LBS. PULL = 7520-LBS.  
 4. TURN HANDCRANK CCW TO OPEN (RAISE) GATE.  
 5. 29° MODIFIED STUD ACME THREADS.  
 6. CONTRACTOR TO VERIFY OR SUPPLY.  
 7. DIMENSION INCLUDES 1 INCH FOR GROUT PAD.  
 8. ALL NUTS TO BE SILICON BRONZE PER MAT'L KEY 27

REF: FINGER LAKE AERATION CULVERTS  
 WABASHA COUNTY, MINNESOTA

48 X 48 WATERMAN MODEL  
 S-4000-FF  
 SLUICE GATE

FOR: ABE CONSTRUCTION  
 2525 NEVADA AVE NORTH, SUITE 307  
 GOLDEN VALLEY, MN 55427  
 P.O. 9204-3402

REV. NO.	DATE	BY	JOB NO.	PROJECT MANAGER
			B-3222-1	LES
			QUOTE NO. KQ92-0-2040	QUOTE ITEM NO. 1
			DRAWN BY JM	CHECKED BY SH
			SCALE NONE	DATE 12-01-1992
			DRAWING NO. RB-92-2005	



SHOP NOTE:  
PROVIDE CLEAR PLASTIC  
WINDOW OVER SLOT

SHOP NOTE:  
ALL EXPOSED LIFT ASSEMBLY BOLT  
HDW. TO BE SOCKET (ALLEN) HEAD  
AFFIX BRASS TAG PER DETAIL THIS  
SHEET

NOTE:  
DIRECTIONAL ARROW AND WORD  
OPEN CAST IN LIFT HOUSING.

COUNTER READING  
O CLOSED:  
O OPEN:

NOTE: CONTRACTOR TO FIELD STAMP  
COUNTER READINGS AFTER  
INSTALLATION & VERIFICATION.

TAG DETAIL

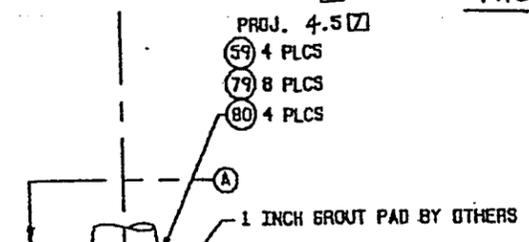
TOP OF WALL EL. 673.50 FT.

4 INCH MIN DIAMETER  
BLOCKOUT BY OTHERS

STEM LENGTH  
135  
THREADED  
51

PROJ. 9.25  
56 2 PLCS  
77 4 PLCS  
78 4 PLCS

105 14 PLCS  
77 14 PLCS  
78 14 PLCS



PROJ. 2  
53 2 PLCS  
77 2 PLCS  
78 2 PLCS PER GUIDE

IMPACT INTO DOVETAIL  
GROOVE / MACHINE FLAT  
TO .002 T.I.R. WITH A  
63 FINISH OR BETTER

EL. 664.0 FT.

INT. EL. 662.50 FT.

12.75  
TAP THIMBLE  
5/8 NC 14 PLCS  
TO MATCH GATE  
MASTIC GASKET BY OTHERS

1. CAST IRON: ASTM A-126 CL. B
4. HANG. BRZ.: ASTM B-584 AL. C85200
5. NAVAL BRZ.: ASTM B-21 AL. C48200
- 9A. STN. STEEL: ASTM A-276 TY-304
12. COMMERCIAL BRONZE
- 15A. STN. STL. HDW.: ASTM F-593 & 594 TYPE 304 (GRADE 8 & 88)
19. ALUMINUM PIPE: ASTM B-221 AL. 6061-T6
26. PHOSPHOR BRZ.: ASTM B-139 AL. 510
27. SILICON BRONZE: ASTM B-98 AL. 651 OR 655

1. AS CAST
2. MILL
3. MACHINED
4. GALVANIZE-ASTM A-123
5. GALVANIZE-ASTM A-153
6. SEE PAINT KEY

(1) CTS. - (1.5 MILS) E-303d  
EPOXY ZINC-RICH PRIMER  
(2) CTS. - (8.0 MILS) C-2009  
COAL TAR EPOXY TDF-19 MILS.  
COLOR: BLACK  
60. (2) CTS. - 50 MILS (CT. AMERLOCK  
400, 4 (1) CT. - (2.0 MILS) CT.)  
AMERCOAT 450 H.S. TDF-12  
MIL MINIMUM: COLOR: LT. GRAY

ITEM DESCRIPTION	MATERIAL KEY	FIN KEY	PART NO. OR SIZE (FOR WATERMAN USE ONLY)	QTY/ GATE	TOTAL QTY
1. SLUICE GATE ASSEMBLY	-	-	W-4057-1	1	2
a) FRAME	1	6C	W-4056	1	1
b) COVER	1	6C		1	1
c) SEAT	5	3		-	-
d) GUIDE RAIL	1	6C	CAST INTEGRAL WITH FRAME	-	-
e) SIDE WEDGE ASSEMBLY R & L	-	-		3	3
WEDGES	1,4,5	1,3	W-4001 THRU W-4004	-	-
ASSEMBLY / ADJUSTING HARDWARE	15A, 27	2		-	-
f) TOP WEDGE ASSEMBLY	-	-		2	2
WEDGES & BRACKETS	4	1,3	W-4006 & W-5007	-	-
ASSEMBLY / ADJUSTING HARDWARE	15A, 27	2		-	-
g) BOTTOM WEDGE ASSEMBLY	-	-		2	2
WEDGES & BRACKETS	4	1,3	W-4007 & W-5008	-	-
ASSEMBLY / ADJUSTING HARDWARE	15A, 27	2		-	-
2. THRUST NUT	4	1,3	W-5072 NB ( 1.125 DIA., 4PI. LH)	1	2
3. STEW	9A	2,3	1.125 DIA., 4PI. LH STD	1	2
4. LIMIT NUT	1	5	1.125 DIA., 4PI. LH STD	2	4
7. LIFT ASSEMBLY	1,4	6D	TYPE 3ESH-2:1AC	1	2
a) HANDCRANK	1,12	6D	102671	1	1
b) PEDESTAL	1	6D	W-375	1	1
c) POSITION INDICATOR	1	-	COUNTER TYPE	1	1
8. STEM COVER (SLOTTED PER 100252)	14	2	REF 102790 (3) 45 LG.	1	2
9. STEM GUIDE (LZ BRONZE BUSHED)	1,26,27	6C	TYPE K-2	1	2
10. STEM GUIDE (LZ BRONZE BUSHED)	1,26	6C	TYPE KSG-2	1	2
23. THIMBLE (PAINT INSIDE ONLY)	1	6C	36 TYPE: F-5C X 12 LG.	1	2
105. DOUBLE ENDED STUD	9A	2,3	5/8 NC X 2 3/4 LG.	14	28
53. ANCHOR BOLT	9A	2,3	5/8 NC X 10 LG.	2	4
56. ANCHOR BOLT	9A	2,3	5/8 NC X 16 LG.	4	8
59. ANCHOR BOLT	9A	2,3	3/4 NC X 12 LG.	20	40
77. HEX NUT	2,7	2	5/8 NC	20	40
78. WASHER	15A	2	5/8 DIA	8	16
79. HEX NUT	2,7	2	3/4 NC	4	8
80. WASHER	15A	2	3/4 DIA.	4	8

- NOTES:
1. (GATE CAPACITY) MAX. SEATING HD. = 30 FT.; MAX UNSEATING HD. = 20 FT.
  2. OPERATING HEAD FROM C: SEATING= 10.75 FT.; UNSEATING= 10.75 FT. [6]
  3. LIFT CAPACITY @ 40 LBS. PULL = 4000 LBS.
  4. TURN HANDCRANK CCW TO OPEN (RAISE) GATE.
  5. 29° MODIFIED STUD ACME THREADS.
  6. CONTRACTOR TO VERIFY OR SUPPLY.
  7. DIMENSION INCLUDES 1 INCH FOR GROUT PAD.
  8. ALL NUTS TO BE SILICON BRONZE PER MAT'L KEY 27

( 2 ) GATES REQ'D @ 3RD LAKE AND CLEAR LAKE

REF. FINGER LAKE AERATION CULVERTS  
WABASHA COUNTY, MINNESOTA

36 X 36 WATERMAN MODEL  
S-4000-FF  
SLUICE GATE

FOR: ABE CONSTRUCTION  
2525 NEVADA AVE NORTH, SUITE 307  
GOLDEN VALLEY, MN 55427

P.O. 9204-3402

REV. NO.	DATE	BY	JOB NO.	PROJECT MANAGER
REV. NO.	DATE	BY	B-3222-1	LES
REV. NO.	DATE	BY	QUOTE NO. KJ92-D-2040	QUOTE ITEM NO. 2
REV. NO.	DATE	BY	DRAWN BY JM	CHECKED BY SH
REV. NO.	DATE	BY	SCALE NONE	DATE 12-01-1992
REV. NO.	DATE FEB. 6, '93	BY SH	DRAWING NO. RB-92-2006	

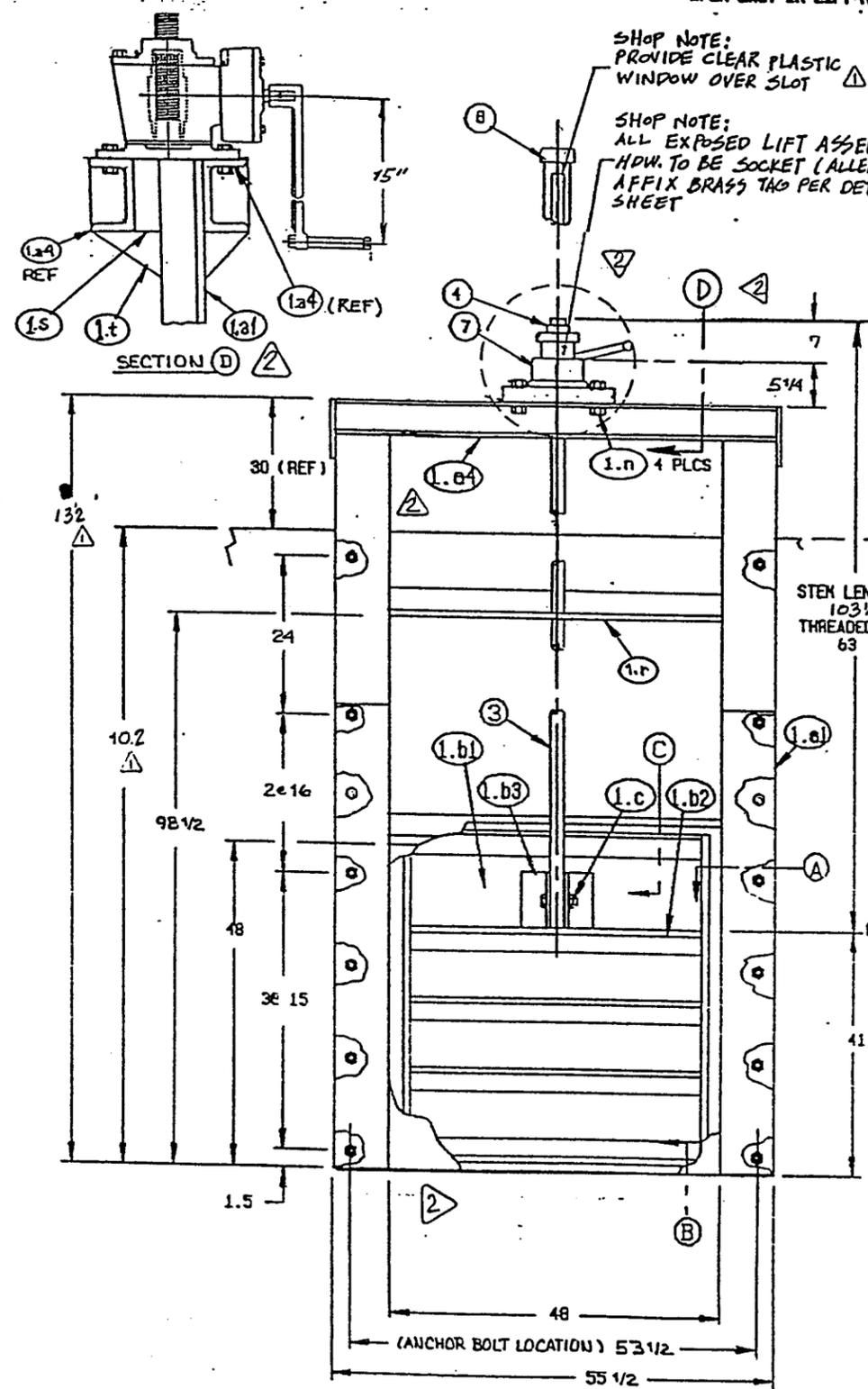


INDUSTRIES INC. EXETER, CALIFORNIA 93221



CONTRACTOR TO PROVIDE REQUIRED OPENINGS

DIRECTIONAL ARROW AND WORD OPEN CAST IN LIFT HOUSING

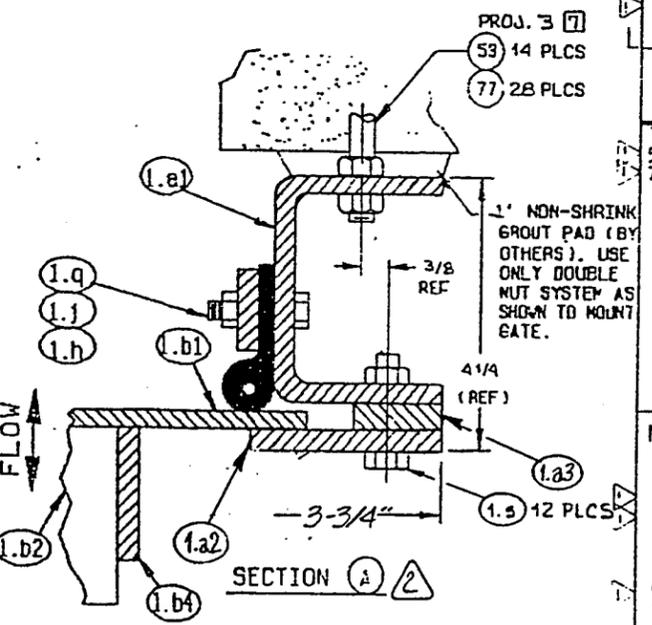
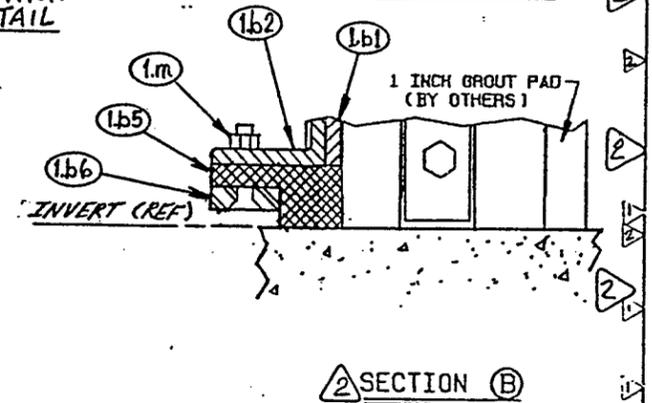
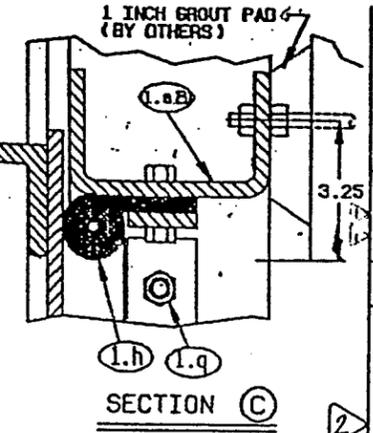


COUNTER READING  
 O CLOSED;  
 O OPEN:

NOTE: CONTRACTOR TO FIELD STAMP COUNTER READINGS AFTER INSTALLATION & VERIFICATION TAG DETAIL

NOTE: TOP STRONGRIB TO OVERLAP TOP J-BULB SEAL WHEN GATE IS CLOSED

SHOP NOTE:  
 PROVIDE CLEAR PLASTIC WINDOW OVER SLOT  
 SHOP NOTE:  
 ALL EXPOSED LIFT ASSEMBLY BOLT HDW. TO BE SOCKET (ALLEN) HEAD AFFIX BRASS TAG PER DETAIL THIS SHEET



MATERIAL KEY	FINISH KEY	PAINT KEY
1. CAST IRON: ASTM A-126 CL. B	1. AS CAST	60-BLAST CLEAN PER SSPC-SP10 (2)TS
2. STRUCTURAL STEEL: ASTM A-36	2. MILL	(1.5 MILS/ST) E-2034 EPDXY ZINC RICH PRIMER (2)TS (6 MILS/ST) E-2039 EQUAL TAR EPDXY TDFT-19 MILS COLOR-BLACK (2)
3. STN. STEEL: ASTM A-276 TY. 304	3. MACHINED	60. (2) CT. - 5.0 MILS/CT. AMERLOCK 400, 4 (1) CT. - (2.0 MILS/CT.) AMERCOAT 450 H.S. TDFT-12 MIL MINIMUM; COLOR: LT. GRAY (2)
12. COMMERCIAL BRONZE	4. GALVANIZE-ASTM A-123	
15A. STN. STL. HDW.: ASTM F-593 & 594 TYPE 304 (GRADE B & B8)	5. GALVANIZE-ASTM A-153	
4. MANG. BRZ.: ASTM B-584 AL. 865	6. SEE PAINT KEY	
13. NEOPRENE RUBBER: ASTM D-2000		
19. ALUMINUM PIPE: ASTM B-221 AL. 6061-T6		
27. SILICON BRZ.: ASTM B-98, AL. 651 OR 655		

ITEM DESCRIPTION	MATERIAL KEY	FIN KEY	PART NO. OR SIZE (FOR WATERMAN USE ONLY)	QTY/ GATE	TOTAL QTY
1. SLIDE GATE ASSEMBLY	-	-		1	1
a) FRAME WELDMENT	-	-		1	1
1) GUIDE RAIL	6	4	FORMED CHANNEL 104102	2	2
2) COVER GUIDE	6	4	3/8 X 3 BAR	2	2
3) FILLER BAR	6	4	3/8 X 1-1/2 BAR	2	2
4) HEADRAIL	6	4	C7 X 12.25 CHANNEL	2	2
8) CROSS RAIL	6	4	FORMED CHANNEL 104102	2	2
b) SLIDE WELDMENT	-	-		1	1
1) SLIDE PLATE	6	4	52.50 X 49 1/2 X .25 PLATE	1	1
2) STRONG RIB	6	4	5 X 3 X 1/4 ANGLE	5	5
3) STEM BRACKET	6	4	REF. 102523	1	1
4) VERTICAL RIB	6	4	1/4 X 1-3/4 BAR	2	2
5) SEAL	13	2	STANDARD EXTRUSION	1	1
6) SEAL RETAINER	6	4	1/4 X 1 BAR	1	1
c) HEX HEAD BOLT & NUT	15A/27 B	2	3/4 NC X 3	1	1
n) J BULB SEAL	13	2	REF. 100159	3	3
j) SEAL RETAINER	6	4	1/4 X 1-1/4 BAR	3	3
m) FLAT HEAD SCREW & NUT	75A/27	2	3/8 NC X 1-1/4 LG.	A/R	A/R
n) HEX HEAD BOLT & NUT	15A/27 B	2	1/2 NC X 2 LG.	4	4
q) HEX HEAD BOLT	15A	2	1/4 NC X 1-1/4 LG.	A/R	A/R
r) STEM BRACE	6	4	3 X 2 X 1/4 ANGLE	1	1
s) HEX HD BOLT & NUT	15A/27 B	2	5/8 NC X 2 LG.	12	12
t) SPACER	6	4	FORMED CHANNEL 104102	2	2
3. STEM	9A	2,3	1.5 DIA., 4TPI, LH STD	1	1
4. LIMIT NUT	1	5	1.5 DIA., 4TPI, LH STD	1	1
7. LIFT ASSEMBLY	1,4	6D	TYPE 3ED-4:1AC	1	1
a) HANDCRANK	1,12	6D	101653-1	1	1
b) BASEPLATE	1	6D	REF. 105115	1	1
c) SYSTEM COVER	19	-	REF. 102190 (3) 52 LB. W/104964	1	1
53 CONC. ANCHOR	STN. STL.	2,3	REDHEAD WW-5084	14	14
77. HEX NUT	27	2	5/8 NC	28	28

NOTES:  
 1. (GATE CAPACITY) MAX. SEATING HD. = 10 FT.; MAX UNSEATING HD. = 10 FT.  
 2. OPERATING HEAD FROM C: SEATING = 7 FT.; UNSEATING = 7 FT. (E)  
 3. LIFT CAPACITY @ 40 LBS. PULL = 11,800 LBS.  
 4. TURN HANDCRANK CCW TO OPEN (RAISE) GATE. (2:1 RATIO)  
 5. 29" MODIFIED STUB ACME THREADS.  
 6. CONTRACTOR TO VERIFY OF SUPPLY.  
 7. DIMENSION INCLUDES 1 INCH FOR GROUT PAD.  
 8. ALL NUTS TO BE SILICON BRONZE PER MAT'L KEY 27

(1) GATE REQ'D @ PETERSON LAKE HEADWALL

REV. NO.	DATE	BY	JOB NO.	PROJECT MANAGER
			B-3222-2	LES
REV. NO.	DATE	BY	QUOTE NO.	QUOTE ITEM NO.
			KQ92-D-2040	4
REV. NO.	DATE	BY	DRAWN BY	CHECKED BY
3	MAY 10, '93	SH	LES	JM
REV. NO.	DATE	BY	SCALE	DATE
2	3-30-93	NE	LES	NONE
REV. NO.	DATE	BY	DRAWING NO.	DATE
1	FEB. 8, '93	SH	LES	NONE
			RB-92-2008	12-01-1992

REF: FINGER LAKE AERATION CULVERTS  
 WABASHA COUNTY, MINNESOTA

**WATERMAN** INDUSTRIES INC.

48 X 48 WATERMAN MODEL  
 QSR-10FFJ-Y  
 SLIDE GATE

FOR: ABE CONSTRUCTION  
 2525 NEVADA AVE NORTH, SUITE 307  
 GOLDEN VALLEY, MN 55427

P.O. 9204-3402

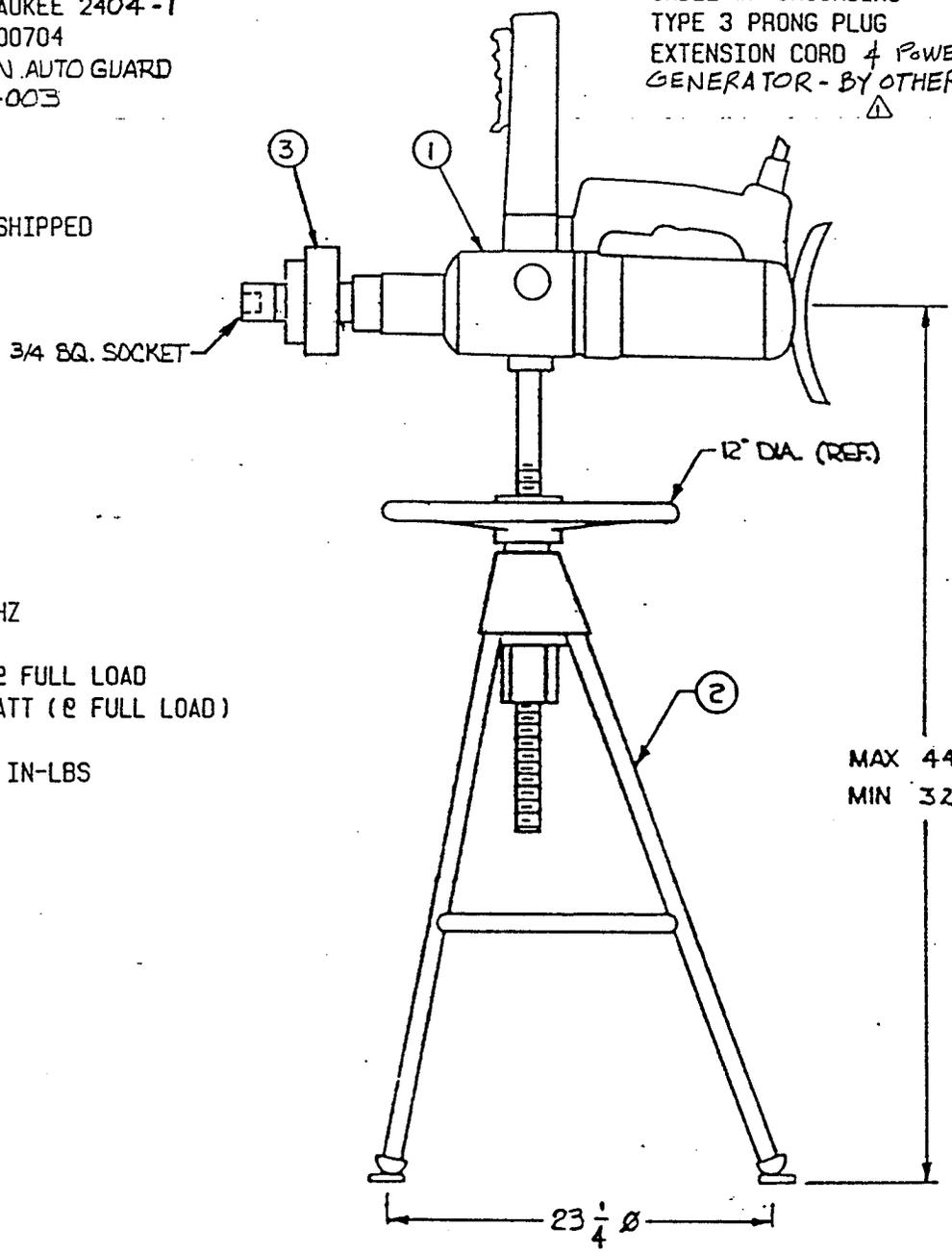
EXETER, CALIFORNIA 93221

ITEMS

- ① ELECTRIC OPERATOR - MILWAUKEE 2404-1
- ② ALUMINUM TRIPOD - REF. 100704
- ③ OVERLOAD RELEASE AMERICAN AUTO GUARD (3/4 SQ. MODEL NO. 101456-003

8.0 FT. 3 COND., 16 GA. CABLE W/ GROUNDING  
 TYPE 3 PRONG PLUG  
 EXTENSION CORD & POWER GENERATOR - BY OTHERS  
 ⚠

- ⑤ TORQUE HANDLE (REMOVED) SHIPPED LOOSE WITH TRIPOD



NOTES:

- 1.
- 2. 2404-1 SPECIFICATIONS :  
 MAXIMUM TORQUE - 4  
 SPEED - 250 MAXIMUM RPM  
 OPERATION - REVERSIBLE  
 POWER - 115 VOLTS AC 60HZ  
 OVERALL LENGTH - 18.75"  
 CURRENT DRAW - 10 AMPS @ FULL LOAD  
 POWER REQUIRED - 1200 WATT (@ FULL LOAD)
- 3. WEIGHT - 70 LBS.
- 4. CLUTCH RATING 300 - 1000 IN-LBS  
 SHOP SET AT 50 FT.-LBS  
 ⚠

(1) REQ'D

JOB REF.  
 FINGER LAKE AERATION CULVERTS  
 WABASHA COUNTY, MINNESOTA

ALUMINUM TRIPOD MOUNTED PORTABLE  
 ELECTRIC OPERATOR (250 RPM)

FOR:  
 ABE CONSTRUCTION  
 2525 NEVADA AVE NORTH, SUITE 307  
 GOLDEN VALLEY, MN 55427

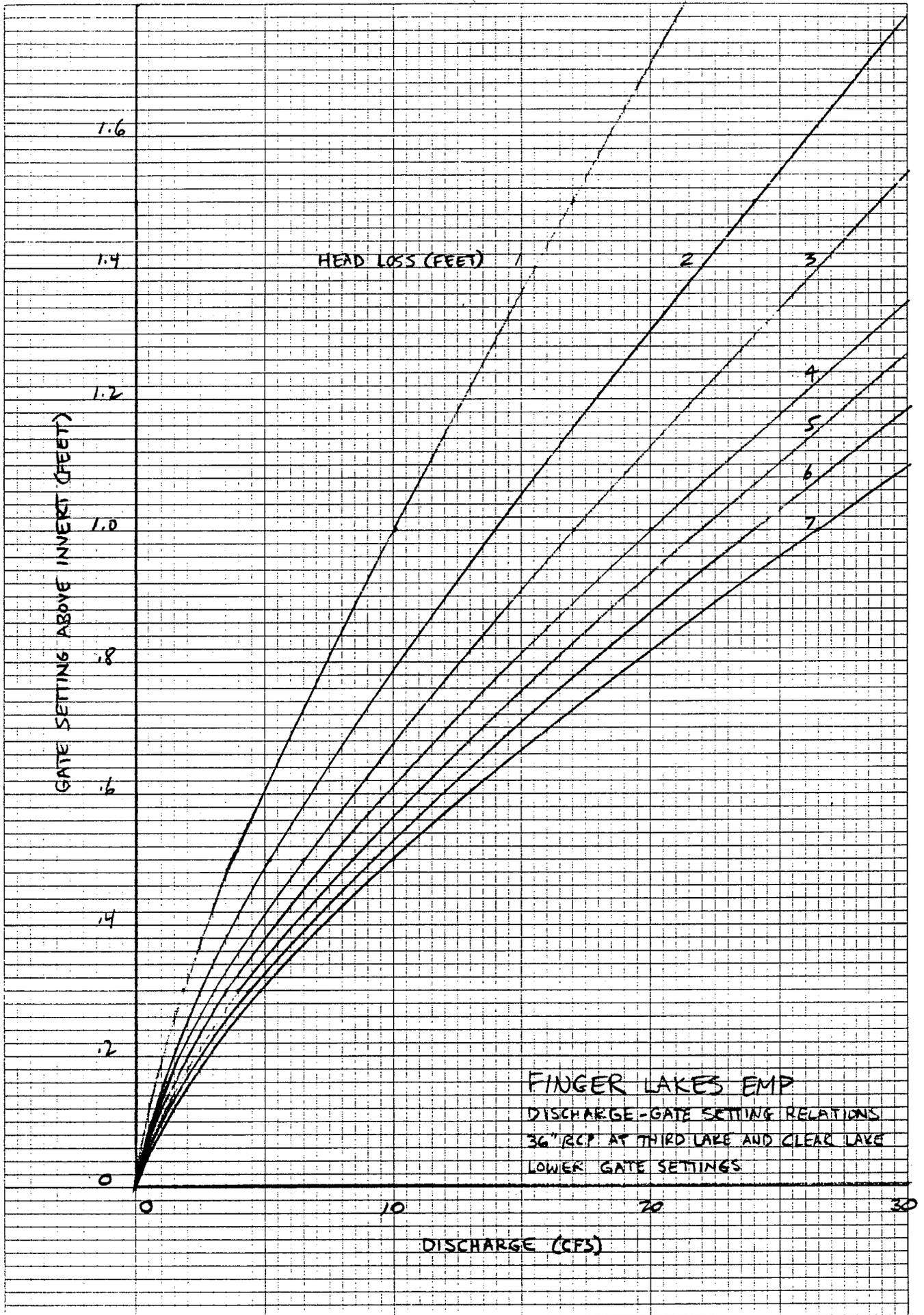
P.O. NO. 9204-3402

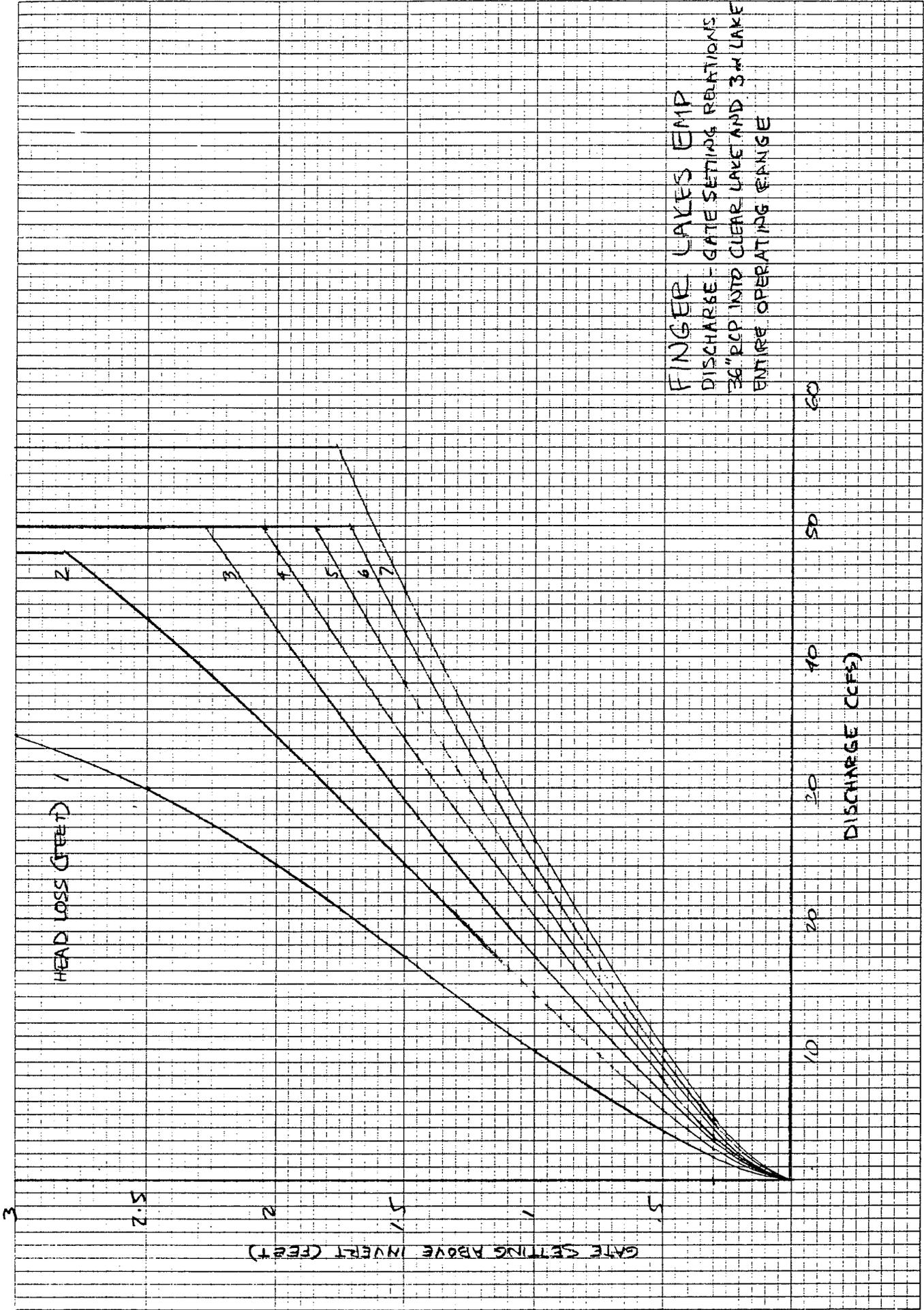
FEB. 8, 1993		SH	LES
JOB NO. B-3222-8	PROJECT MANAGER LES		
QUOTE NO. KQ92-D-2040	QUOTE ITEM 5		
DRAWN BY JM	CHECKED BY SH		
SCALE NONE	DATE 12-1-92		
DRAWING NO. RA-92-2009			

WATERMAN INDUSTRIES INC. EXETER, CA. 93221

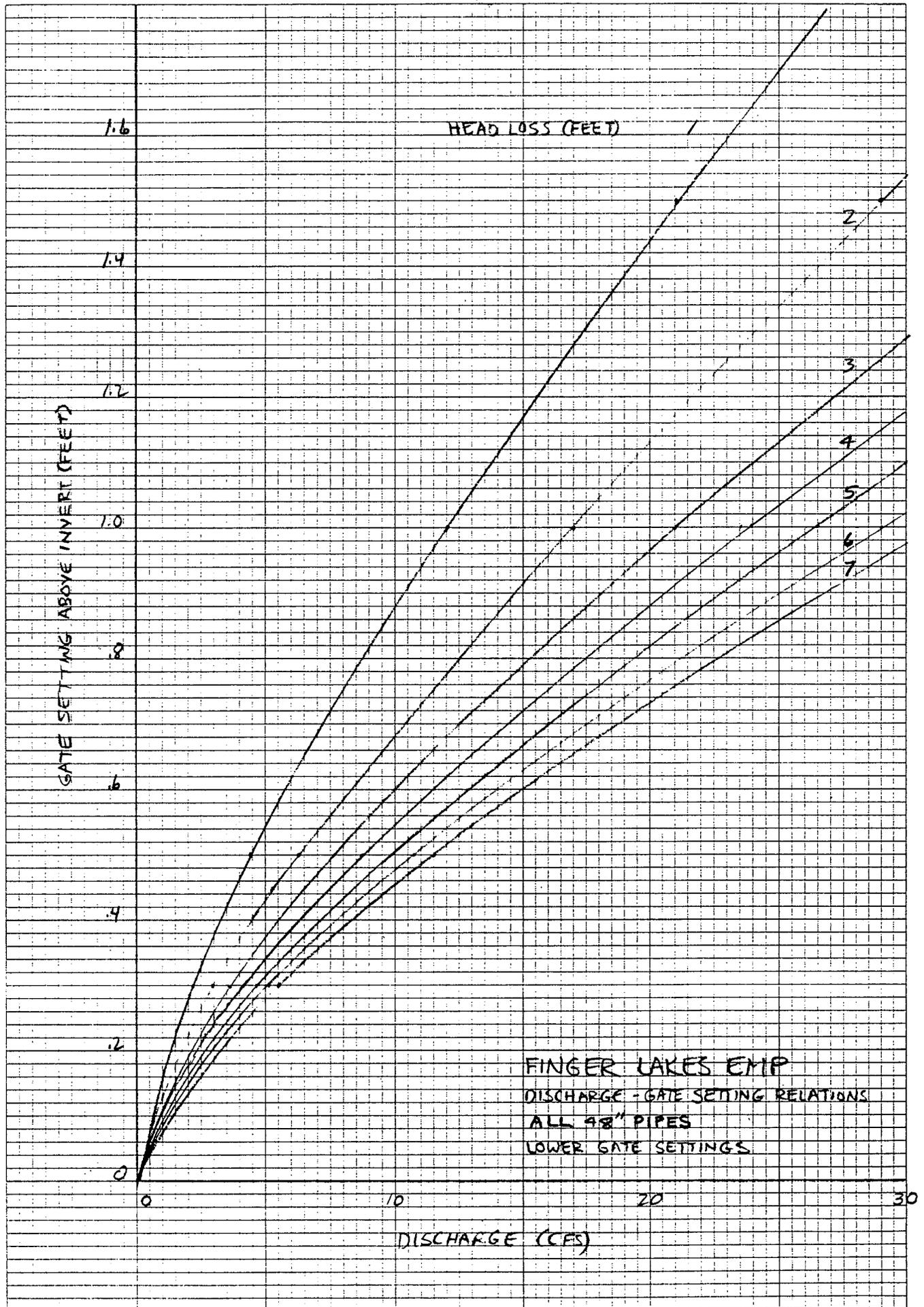
**APPENDIX E**

**GATE OPERATING CURVES**



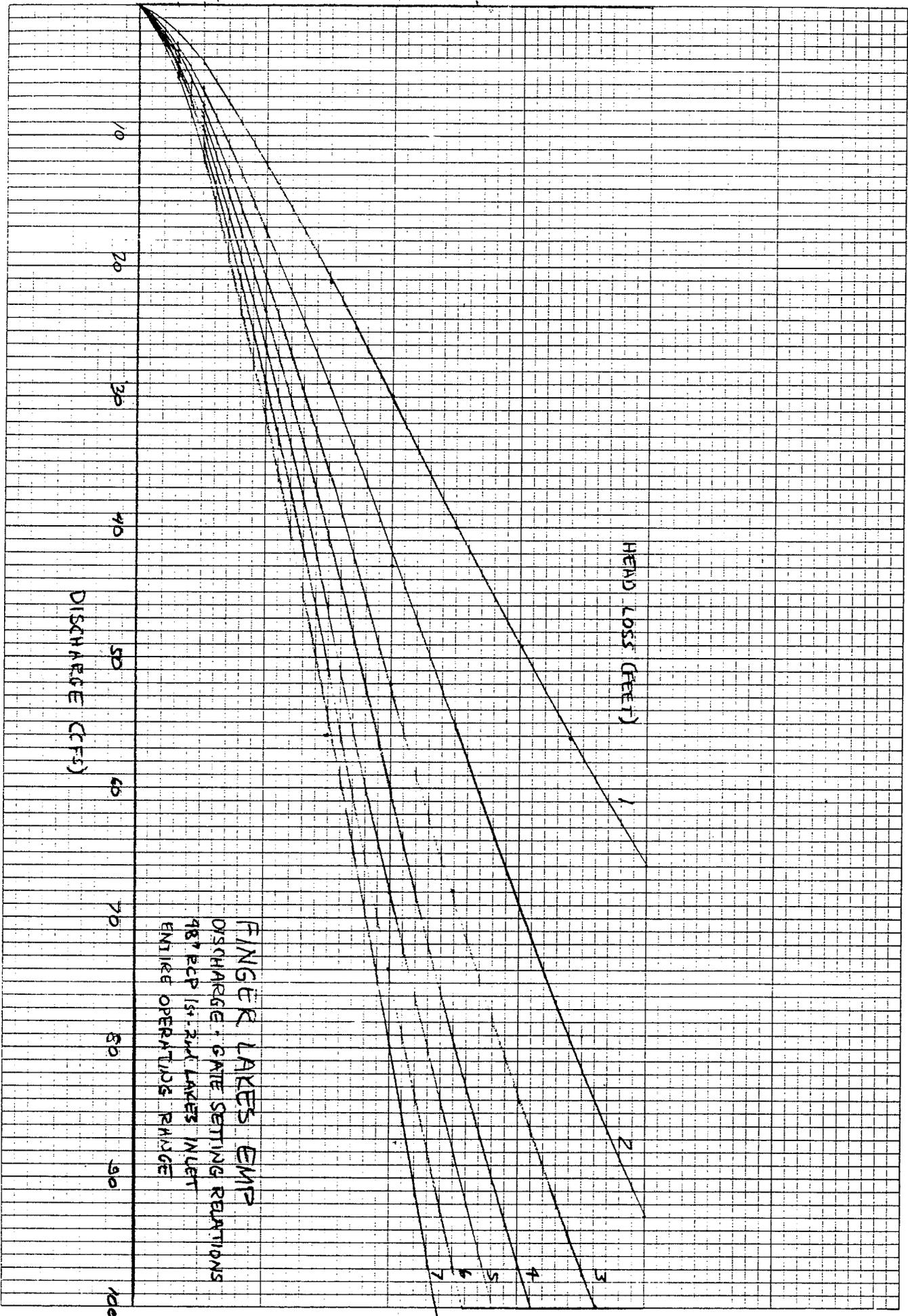


FINGER LAKES EMP  
DISCHARGE - GATE SETTING RELATIONS  
36" RCP INTO CLEAR LAKE AND 3" LAKE  
ENTIRE OPERATING RANGE



GATE SETTING ABOVE INVERT (FEET)

5  
1  
2  
3  
4



DISCHARGE (CCFS)

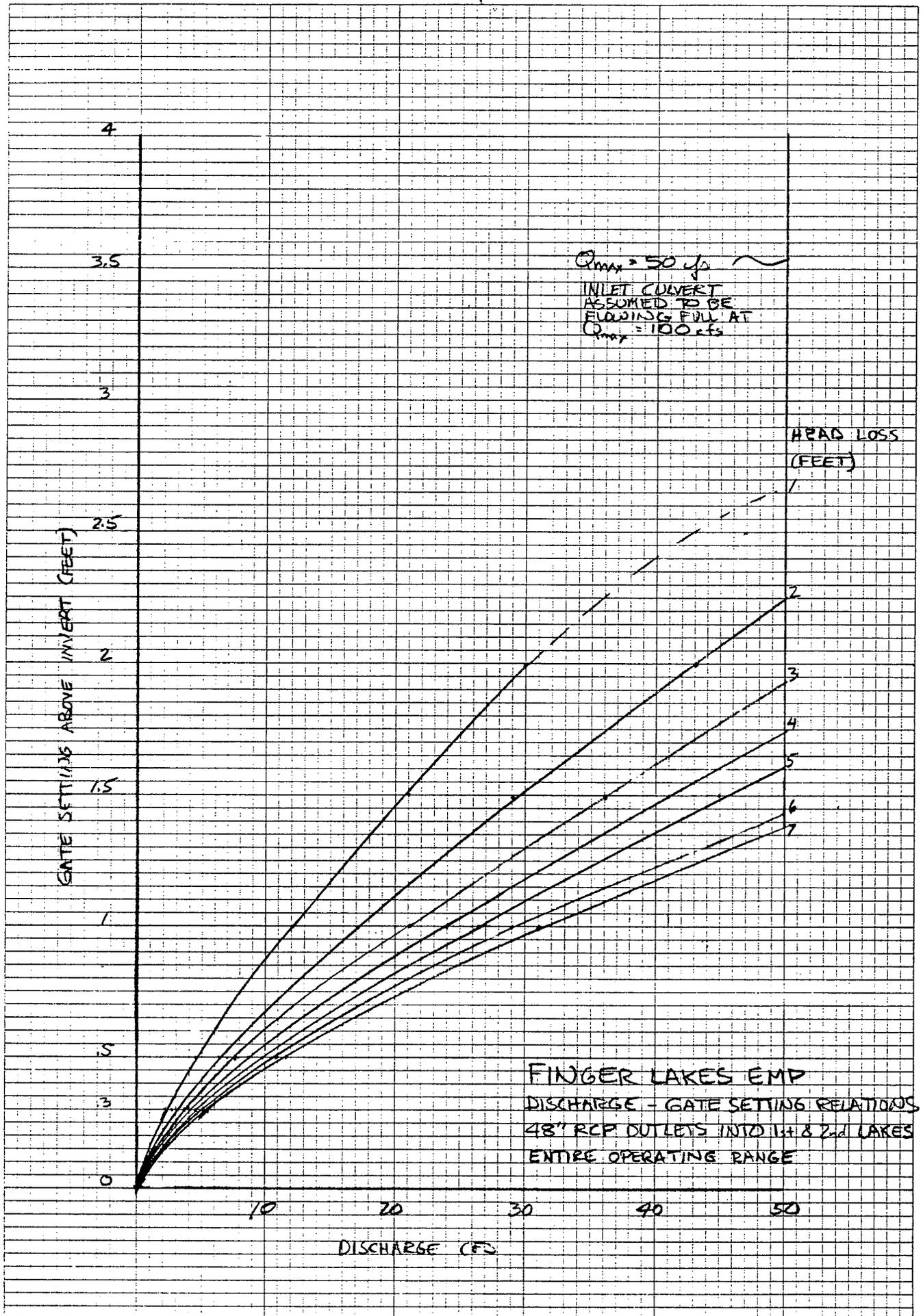
HEAD LOSS (FEET)

FINGER LAYERS EMP  
DISCHARGE - GATE SETTING RELATIONS  
987 ECP 15" FINGER LAYERS INLET  
ENGINE OPERATING RANGE

46 0700

10 X 10 TO THE INCH 7 X 10 INCHES  
NEUFEL & ESSER CO. MADE IN U.S.A.





**APPENDIX F**

**CONSTRUCTION SPECIFICATION SECTIONS  
FOR REPAIR MATERIAL**

PART I  
SECTION C  
DIVISION 2  
SECTION 2M

CHAIN LINK FENCING

<u>Para. No.</u>	INDEX <u>Description</u>	<u>Page No.</u>
1	SCOPE	2M-1
2	RELATED WORK OF OTHER SECTIONS	2M-1
3	APPLICABLE PUBLICATIONS	2M-1
4	NOT USED	2M-1
5	SUBMITTALS	2M-1
6	MATERIALS	2M-2
7	INSTALLATION	2M-3
8	QUALITY CONTROL	2M-3
9	MEASUREMENT AND PAYMENT	2M-3
10	BIDDING SCHEDULE ITEMS	2M-4

## SECTION 2M - CHAIN LINK FENCING

1. SCOPE. This section covers chain link fencing and accessories.
2. RELATED WORK OF OTHER SECTIONS. The following items of related work are covered under other sections:

2.1 Concrete: SECTION 3A: CONCRETE.

3. APPLICABLE PUBLICATIONS. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

3.1 American Society for Testing and Materials (ASTM).

A 121-86	Zinc-Coated (Galvanized) Steel Barbed Wire
A 123-89a	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 392-91	Zinc-Coated Steel Chain-Link Fence Fabric
A 824-91	Metallic-Coated Steel Marcellled Tension Wire for Use With Chain-Link Fence
F 567-84	Installation of Chain-Link Fence
F 669-91	Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence
F 900-84	Industrial and Commercial Swing Gates
F 1083-90	Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

4. NOT USED.

5. SUBMITTALS. The following shall be submitted in accordance with SECTION L.

5.1 Shop Drawings. Shop drawings shall show post sizes and sections; post setting and bracing, gate details, barbed wire support arms; details of attachment of fabric and barbed wire to support members; gate locking mechanisms; and any other details required to erect the fence along the lines indicated.

## 6. MATERIALS.

### 6.1 Chain Link Fence.

6.1.1 Fabric. Fabric shall be in accordance with ASTM A 392. Fabric shall be minimum 9-gage and shall be Class 2. Fabric shall be woven in 2-inch mesh and selvage shall be knuckled. Fabric height shall be 7 feet.

6.1.2 Gates. Gates shall be in accordance with ASTM F 900. Gates shall be of the type and swing shown. Gate fabric shall be as specified for chain link fabric. Each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Truss rods shall be attached to the gate as shown. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Gates shall be equipped with a double gate latch that has the provision for locking the gate with the specified padlock without the use of chain.

6.1.3 Posts. Posts shall be in accordance with ASTM F 669, Heavy Industrial Fence. Gate posts shall be in accordance with ASTM F 900. Posts shall be made of round steel pipe galvanized in accordance with ASTM F 1083. The term "terminal posts" shall apply to end, corner, and pull posts. The term "line posts" shall apply to the vertical posts installed between terminal posts. "Gate posts" are posts to which gates are either attached or latched.

6.1.4 Brace bars. Braces shall be in accordance with ASTM F 669, Heavy Industrial Fence, and shall be galvanized in accordance with ASTM F 1083.

6.1.5 Tension Wire. Tension wire shall be in accordance with ASTM A 824 and shall be Type II, Class 3.

6.1.6 Truss Rods. Truss rods shall be of the minimum diameter as shown and shall be installed on at each terminal post, gate post, and on gates. Truss rods shall be galvanized and shall be provided with galvanized turnbuckles for adjustment.

6.1.7 Barbed Wire. Barbed wire shall be zinc-coated steel wire in accordance with ASTM A 121. Barbed wire shall be chain link fence grade. The barbed wire shall be minimum 12-1/2 gage. The barbs shall be made of minimum 14 gage wire, shall have 4 points, shall have maximum spacing of 5 inches, and shall be round or half-round.

6.1.8 Accessories. Ferrous accessories shall be provided as shown and shall be galvanized. Tie wire for attaching fabric to rails and posts shall be 9 gage galvanized steel wire. Stretcher bars shall be of the size shown and shall be galvanized in accordance with ASTM A 123.

6.2 Concrete. Concrete shall be a mix containing 3/4-inch maximum size aggregate in accordance with SECTION 3A: CONCRETE. The concrete shall have a minimum compressive strength of 2000 psi at 28 days. Testing of Concrete shall be in accordance with SECTION 3A: CONCRETE.

6.3 Padlocks. Padlocks shall be provided for each installed gate and for the existing gate at Peterson Lake. Padlocks shall be Master No. 160-D or approved equal. The padlocks shall have a case hardened steel shackle with solid brass bodies and cylinders. All padlocks shall be keyed alike and each lock shall be furnished with a key.

7. INSTALLATION. Fences shall be installed to the lines indicated in accordance with ASTM F 567.

7.1 Posts shall be set plumb and in alignment. Posts shall be set in concrete as shown. Concrete shall be thoroughly consolidated around each post so as to be free of voids and finished to form a dome. Concrete shall be allowed to cure a minimum of 72 hours prior to attachment of any item to the posts.

7.4 Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in such a manner to prevent easy removal with hand tools. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

7.5 Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates after gate installation is completed.

7.6 The fencing and gate at Peterson Lake shall be removed as necessary to perform the required work on the headwall. The fence shall be reinstalled to preconstruction condition after completion of the work at Peterson Lake.

8. QUALITY CONTROL. The Contractor shall establish and maintain quality control for work under this section to assure compliance with the contract requirements and maintain records of his quality control for all construction operations. Quality control shall be in accordance with SECTION E. A copy of the records of inspections and tests, as well as the records of corrective action taken, shall be furnished to the Government.

9. MEASUREMENT AND PAYMENT.

9.1 Fencing will be measured for payment by the lineal foot. Payment shall include all labor and materials associated with furnishing and installing the fencing.

9.2 Gates will be measured for payment by the unit, in place, complete and fully operable. Payment will include all costs for padlocks, and other accessories.

9.3 Removal and reinstallation of the fence and gate and lock at Peterson Lake will not be measured for payment and costs, therefore, should be included in the item to which the work pertains.

10. BIDDING SCHEDULE ITEMS applicable to the work of this section are as follows:

<u>Item</u>	<u>Unit</u>
Chain Link Fencing	LF
Gates	EA

\* \* \* \*

PART I  
SECTION C  
DIVISION 2  
SECTION 2T

GEOTEXTILE USED AS FILTER

<u>Par. No.</u>	<u>INDEX Description</u>	<u>Page No.</u>
1	SCOPE	2T-1
2	NOT USED	2T-1
3	APPLICABLE PUBLICATIONS	2T-1
4	NOT USED	2T-1
5	SUBMITTALS	2T-1
6	MATERIALS	2T-1
7	SHIPMENT AND STORAGE	2T-2
8	INSTALLATION	2T-2
9	QUALITY CONTROL	2T-3
10	MEASUREMENT AND PAYMENT	2T-3
11	BIDDING SCHEDULE ITEMS	2T-4
	ATTACHMENT Table No. 1	

## SECTION 2T - GEOTEXTILE USED AS FILTER

1. SCOPE: The work provided for herein consists of furnishing all plant, labor, material, and equipment and performing all operations required for furnishing, hauling, and placing the geotextile, complete, as specified and shown, and maintaining the geotextile until placement of the stone protection cover is completed and accepted.

2. NOT USED.

3. APPLICABLE PUBLICATIONS: The current issues of the publications listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

3.1 American Society for Testing and Materials (ASTM):

D 123-89C. Standard Terminology Relating to Textiles.

D 1683-81. Failure in Sewn Seams of Woven Fabrics.

D 3787-80A. Bursting Strength of Knitted Goods: Constant-Rate-of-  
Traverse (CRT), Ball Burst Test.

D 3884-80. Abrasion Resistance of Textile Fabrics (Rotary  
Platform, Double-Head Method).

D 4533-85. Trapezoid Tearing Strength of Geotextiles.

D 4632-86. Breaking Load and Elongation of Geotextiles (Grab  
Method).

D 4751-87. Determining Apparent Opening Size of a Geotextile.

4. NOT USED.

5. SUBMITTALS. The following items shall be submitted in accordance with SECTION L.

5.1 Certificates of compliance as specified in PARAGRAPH: MATERIALS.

5.2 Samples as specified in PARAGRAPH: MATERIALS.

6. MATERIALS:

6.1 Geotextile: The geotextile shall be a woven or non-woven pervious sheet of plastic yarn as defined by ASTM D-123. The geotextile shall meet the physical requirements specified in Table No. 1. The geotextile fiber shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amide, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration

due to ultra-violet and heat exposure. The edges of the geotextile shall be finished to prevent the outer fibers from pulling away from the geotextile.

6.2 Seams: The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary, to form sections not less than 36 feet wide. Seams shall be tested in accordance with method ASTM D 1683, using 1-inch square jaws and 12 inches per minute constant rate of traverse. The strengths shall be not less than 90 percent of the required tensile strength (Table No. 1) of the unaged geotextile in all principal directions.

6.3 Acceptance Requirements: All geotextile to be used shall be accepted on the following basis. The Contractor shall furnish the Contracting Officer, in duplicate, a certificate of compliance (mill certificate or affidavit) signed by a legally authorized official from the company manufacturing the geotextile. The certificate of compliance shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification. If requested by the Contracting Officer, the Contractor shall provide to the Contracting Officer geotextile samples for testing to determine compliance with any or all of the requirements in this specification. When samples are to be provided, they shall be submitted a minimum of 60 calendar days prior to the beginning of installation of the same geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation.

7. SHIPMENT AND STORAGE: During all periods of shipment and storage, the geotextile shall be protected from direct sunlight, ultra-violet rays, temperatures greater than 140 degrees Fahrenheit, mud, dirt, dust and debris. To the extent possible, the fabric shall be maintained wrapped in a heavy duty protective covering.

8. INSTALLATION: The geotextile shall be placed in the manner and at the locations shown. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation, or storage. The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris and soft or low density pockets of material. Erosion features such as rills, gullies, etc. must be graded out of the surface before geotextile placement. If erosion features should develop after placement of the geotextile and prior to placement of stone protection, the geotextile shall be removed, the surface regraded and the geotextile replaced by the Contractor at no additional cost to the Government. The geotextile shall be laid smooth and free of folds, wrinkles, or creases, but also free of tensile stress. Sections of geotextile shall be placed to provide a minimum width of 36 inches of overlap for each joint. The placement procedure below water shall avoid water entrapment under the geotextile during the stone placement and

subsequent reduction of overlap at geotextile joints. For joints that run parallel to the shoreline, the upslope strips shall overlap the downslope strips. Temporary pinning of the textile to help hold it in place until the riprap is placed will be allowed. The temporary pins shall be removed as stone protection is placed to relieve high tensile stress which may occur during placement of stone protection on the geotextile. The placement procedure requires that the length of the geotextile be approximately 15 percent greater than the slope length. The Contractor shall adjust the actual length of the geotextile used based on initial installation experience. The geotextile shall be protected at all times during construction from contamination by surface run-off and any geotextile so contaminated shall be washed clean with water or replaced with uncontaminated geotextile. Geotextile damaged during its installation or during placement of stone protection shall be replaced by the Contractor at no cost to the Government. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile: failure to comply with this requirement will require replacement of geotextile. The geotextile shall be protected from damage during the placement of stone protection. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the stone protection, or other methods approved by the Contracting Officer. Before placing the stone protection or other materials, the Contractor shall demonstrate that the placement technique will prevent damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

9. QUALITY CONTROL: The Contractor shall establish and maintain quality control for all operations to assure compliance with the contract requirements and maintain records of his quality control for all construction operations, including but not limited to, the following:

- (1) Materials. Suitability, type and strength.
- (2) Construction. Layout, materials, handling, maintaining drainage, line and grade, installation, fabrication.
- (3) Testing for connection strength and long term allowable design load.
- (4) Certificate of Compliance.
- (5) Storing and Handling.

A copy of the records of inspections and test, as well as corrective actions taken, shall be furnished to the Government as directed by the Contracting Officer.

10. MEASUREMENT AND PAYMENT: For purposes of payment, the installed geotextile will be measured in place to the nearest square yard of protected area as delineated on the drawings. Payment will be made at the contract unit price and will constitute full compensation to the Contractor for providing all plant, labor, material, and equipment and performing all operations necessary for the complete and satisfactory

installation of the geotextile. Payment for the following items shall be included in the contract unit price for geotextile and shall not be counted a second time in the process of determining the extent of geotextile placed:

- a. Material and associated equipment and operation used in laps, seams, or extra length;
- b. Securing pins and associated material, equipment, and operations;
- c. Material and associated equipment and operations used to provide cushioning layer of sand or gravel or both to permit increase in allowable drop height of stone materials.

No payment shall be made for geotextiles replaced because of contamination or damage due to Contractor fault or negligence.

11. BIDDING SCHEDULE ITEMS applicable to the work of this section are as follows:

<u>Item</u>	<u>Unit</u>
Geotextile	S.Y.

\* \* \* \*

TABLE NO. 1 - PHYSICAL REQUIREMENTS

<u>Physical Property</u>	<u>Test Procedure</u>	<u>Acceptable Values</u>
Tensile Strength (unaged geotextile) <sup>+</sup>	ASTM D 4632 grab method using 1 inch by 2 inch jaws and a 12 inches per minute constant rate of traverse.	200 pound minimum in all principal directions.
Breaking Elongation (unaged geotextile) <sup>+</sup>	ASTM D 4632 determine apparent breaking elongation.	15 percent minimum in all principal directions.
Puncture Strength (unaged geotextile) <sup>+</sup>	ASTM D 3787 except polished steel ball replaced with a 5/16-inch diameter solid steel cylinder with a hemispherical tip centered within the ring clamp.	80 pound minimum.
Abrasion Resistance	ASTM D 3884 Rubber-base abrasive wheels equal to CS-17 "Calibrase" by Taber Instrument Co; 1 kilogram load per wheel; 1000 revolutions, determine residual breaking load.	55 pound minimum residual breaking load in all principal directions.
Apparent Opening Size (AOS)	ASTM D-4751 determine apparent opening size.	No finer than U.S. Standard Sieve No. 120 and no coarser than U.S. Standard Sieve No. 30.
Tear Strength	ASTM D 4533 trapezoid tearing strength.	30 pounds minimum in all principal directions.

+Unaged geotextile is defined as geotextile in the condition received from the manufacturer or distributor.

++All numerical values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the minimum in the table).

2T-5

PART I  
SECTION C  
DIVISION 2  
SECTION 2S

STONE

<u>Par. No.</u>	<u>Description</u>	<u>Page No.</u>
1	SCOPE	2S-1
2	RELATED WORK OF OTHER SECTIONS	2S-1
3	APPLICABLE PUBLICATIONS	2S-1
4	GENERAL	2S-1
5	SUBMITTALS	2S-1
6	MATERIALS	2S-1
7	SOURCES AND EVALUATION	2S-2
8	TESTS FOR GRADATION AND SHAPE	2S-2
9	FOUNDATION PREPARATION	2S-3
10	PLACEMENT	2S-4
11	QUALITY CONTROL	2S-5
12	MEASUREMENT	2S-5
13	PAYMENT	2S-6
14	BIDDING SCHEDULE ITEMS	2S-6

ATTACHMENTS:

RIPRAP GRADATION CURVES  
ENG FORM 4055  
GRADATION ANALYSIS WORKSHEET

## SECTION 2S - STONE

1. SCOPE. This section covers riprap and bedding materials.
2. RELATED WORK OF OTHER SECTIONS. The following items of related work are covered under other sections:
  - 2.1 Geotextiles: SECTION 2T: GEOTEXTILE USED AS FILTER.
3. APPLICABLE PUBLICATIONS. The current issues of the publications listed below, but referenced to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:
  - 3.1 U. S. Army Corps of Engineers, Engineer Manual (EM).  
EM 1110-2-1906 Laboratory Soils Testing (Nov 70) change 1  
(May 80) and change 2 (Aug 86).
4. GENERAL.
  - 4.1 Tolerances. Where tolerances are shown or specified, plus shall be above lines and grades, and minus shall be below lines and grades.
5. SUBMITTALS. The following items shall be submitted in accordance with SECTION L.
  - 5.1 Gradation and testing procedures as specified in PARAGRAPH: TESTS FOR GRADATION AND SHAPE.
  - 5.2 Material Sources as specified in PARAGRAPH: SOURCES AND EVALUATION.
  - 5.3 Test Results as specified in PARAGRAPH: TESTS FOR GRADATION AND SHAPE.
  - 5.4 Weighing operations plans and results as specified in PARAGRAPH: MEASUREMENT.
6. MATERIALS.
  - 6.1 Bedding material shall consist of gravel or crushed stone, and sand, and shall be reasonably well graded within the limits specified herein. The material shall be composed of tough, durable particles; shall be free of thin, flat, and elongated pieces; and shall contain no organic matter or soft, friable particles in quantities considered objectionable by the Contracting Officer. The gradation for the bedding material shall be as specified below.

## BEDDING GRADATION

<u>Sieve Designation</u>	<u>Percent Passing By Weight</u>
2 in.	100
1 in.	70 - 100
1/2 in.	43 - 85
No. 4	15 - 37
No. 10	0 - 15
No. 20	0 - 5

6.2 Riprap shall be a durable, quarried stone of a quality suitable to ensure permanence of the structure in the climate in which it is used. The stone shall be well graded within the limits specified and shall be free from cracks, seams, and other defects that would unduly increase its deterioration from natural causes. Neither the breadth nor thickness of any piece of stone shall be less than one-third of its length. Occasional pieces of stone slightly larger than the maximum weight will be permitted, provided the gradation and voids are not unduly affected and that surface tolerances are met. In order to meet the structural design requirements for weight, gradation, and layer thickness, stone for riprap shall have a specific gravity between 2.60 and 2.70. Riprap gradation curves are attached at the end of this section.

6.3 Geotextiles shall be in accordance with SECTION 2T: GEOTEXTILE USED AS FILTER.

6.4 Choking Stone. Choking stone materials shall consist of stones reasonably well graded between the limits specified. Maximum stone size shall be 4 inches in any dimension and the minimum size stone shall be no less than 1 inch in any dimension. The material shall be composed of tough, durable stone of a quality to ensure permanence in the climate in which it is used and shall not contain quantities of dirt, sand, clay or rock fines.

7. SOURCES AND EVALUATION. Stone materials shall be produced from the sources listed in the SECTION H. If the Contractor proposes to furnish materials from a source not listed, the Government Geologist will make such investigations and evaluations as necessary to determine whether or not materials meeting the requirements of this project can be produced from the proposed source. Sources from which the Contractor proposes to obtain the materials shall be selected and submitted for approval at least 30 days in advance of the time when the material will be required in the work.

## 8. TESTS FOR GRADATION AND SHAPE.

8.1 Riprap. Tests shall be performed by and at the expense of the Contractor. Testing shall be under the direction of the Contracting Officer, unless waived. Gradation test results shall be submitted on ENG Form 4055 provided at the end of this section and on the Gradation Analysis Worksheet provided at the end of this section. One sample for each type of material shall be taken from stockpiled materials and the

remaining samples shall be taken from loads prior to dumping or from in-place material, when and where directed. Prior to placing materials, the Contractor shall submit for approval proposed testing and procedures. The Contractor shall state, in writing, methods of processing and handling samples and shall notify the Contracting Officer immediately when production methods are changed. A minimum of 5 weight classes shall be used in the gradation testing. The Contractor shall select weight classes to yield approximately 75, 50 and 30 percent finer by weight gradation points. The Contractor shall weigh that portion smaller than 4 inches in each sample of riprap and indicate that weight in the total weight of the gradation test sample. Determination of the gradation of riprap material smaller than 4 inches is not required.

8.2 Bedding and choking stone gradations shall be determined in accordance with the requirements for sieve analysis in EM 1110-2-1906.

8.3 Testing results shall be submitted to the Contracting Officer immediately after testing completion. The minimum sample size for tests shall be as follows:

<u>Material</u>	<u>Minimum Sample Size</u>
Bedding	150 pounds
Riprap	4 cubic yards
Choking Stone	600 pounds

8.4 Frequency. The minimum gradation tests shall be performed as follows. The Contractor shall take as many additional tests under the Contractor's quality control program as is needed to ensure that the gradation is being met. Tests performed on materials that do not meet requirements will not be counted as part of the minimum required.

<u>Material</u>	<u>Minimum Number of Tests</u>
Riprap	1 test per 2,000 C.Y. per each type (or fraction thereof)
Bedding	1 test per 1,000 C.Y. per each type (or fraction thereof)
Choking Stone	1 test

8.5 Corrective Action. If materials fail to meet gradation or shape requirements, the Contractor shall adjust his operations and verify with necessary tests that acceptable materials are being produced, or he shall propose another source and verify, with necessary tests, that acceptable material can be produced from that source. Failure to meet requirements may result in removal of material already in place that the failed test represents.

9. FOUNDATION PREPARATION. Foundation areas shall be excavated or filled to the lines and grades shown, or otherwise established, within a tolerance of plus or minus 2 inches for areas above and 3 inches plus or minus for areas below the water line. Filling shall be with earth similar to the adjacent material or with bedding material each well compacted. When overexcavation occurs the filling shall be at no additional expense to the Government. Immediately prior to placing bedding or riprap, the prepared subgrade will be inspected by the Contracting Officer and no material shall be placed thereon until that area has been approved.

## 10. PLACEMENT

10.1 Riprap and bedding thicknesses shall be measured perpendicular to the slope.

### 10.2 Bedding.

10.2.1 Bedding materials shall be spread uniformly to the lines and grades shown. Placing of material by methods which could segregate particle sizes will not be permitted. Any damage to the surface of the subgrade shall be repaired before proceeding with the work. Except where bedding is used to repair damage to the subgrade, compaction will not be required but bedding shall be finished to a uniform surface, free from mounds and windrows.

10.2.2 Bedding materials placed under water shall be discharged from a bucket or other suitable container, resting on the subgrade, as close to its final position as practicable so as to avoid segregation. Materials shall not be cast across, or dumped through the water. Materials shall be spread to a uniform thickness by dragging a bucket or other suitable device over the surface of the material.

### 10.3 Riprap.

10.3.1 Riprap shall be constructed to the lines and grades shown or established within a tolerance of 6 inches above and 3 inches below the prescribed grade, except either extreme shall not be continuous over an area greater than 200 square feet. Riprap shall be placed to the full surface course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing riprap in layers shall not be permitted. All riprap shall be placed in such a manner as to produce a mass of unsegregated stone with maximum interlocking and stone to stone contact and a minimum of voids. The finished mass shall be free from pockets of small stones, clusters of larger stones and excessive voids. Placing riprap by dumping into chutes or by similar methods likely to cause segregation shall not be permitted. Distribution of various sizes of stones shall be obtained during final placing, or by other methods which will produce the specified results. Rearranging of individual riprap stones by mechanical equipment or by hand may be required to obtain a reasonably well graded distribution of stone sizes. The Contractor shall maintain the riprap protection until accepted, and displaced material must be replaced by the Contractor at no additional cost to the Government.

10.3.2 New riprap used on the cofferdams may be used as riprap for the permanent work. Care shall be taken when removing the riprap from the cofferdams so as not to include sand fill or riprap from the existing dike in the riprap placed in the permanent work. The Contractor shall process the riprap as necessary to remove cofferdam fill and to obtain the specified well graded distribution of stone sizes.

10.3.3 Riprap to be placed under water shall meet gradation requirements in the bucket or container used for placing, and shall be placed in a systematic manner directly on the bedding so as to ensure a continuous uniform layer of well-graded stone of the required thickness. Stone to be placed under water shall not be cast across the surface of the water.

10.4 Placement of Stone Protection on Geotextile. In areas where geotextile is shown to be placed, the geotextile shall be in place prior to placement of the stone thereon. Placement of the geotextile is specified under SECTION: GEOTEXTILE USED AS FILTER. The stone shall be placed on the geotextile with care so as not to rupture the geotextile and shall not be dropped from a height greater than one (1) foot. During placement of stone, any damage to the geotextile must be repaired by the Contractor at no additional expense to the Government.

10.5 Choking stone shall be placed in the areas shown after riprap placement is completed. Choking stone shall be placed in the voids in the riprap and then in a layer to 2 inches above the neat line for riprap.

10.6 Existing riprap shall be removed in areas where the cofferdams tie into the existing dike. Existing riprap may also be removed within the work limits as necessary for construction. The existing riprap may be used for stone protection on the cofferdams. Upon removal from the cofferdams or from the existing dike the existing riprap shall be stockpiled in areas shown. Fifty (50) cubic yards of the removed riprap shall be placed at the culvert outlet at Lower Peterson Lake as directed by the Contracting Officer.

11. QUALITY CONTROL. The Contractor shall establish and maintain quality control for work under this section to ensure compliance with contract requirements and maintain records of his quality control for all construction including, but not limited to, the following:

- (1) Gradation.
- (2) Uniformity of in place materials.
- (3) Elevations of all underlying materials.
- (4) Finished elevations of all materials.

A copy of the records of inspections and tests, as well as corrective actions taken, shall be furnished to the Government as directed by the Contracting Officer.

## 12. MEASUREMENT.

12.1 Riprap, choking stone and bedding placed in the permanent work shall be weighed on accurate, approved scales furnished or made available by the Contractor. Before being approved for use, the scales shall have

been tested by the Department of Weights and Measures or by a reliable scale servicing company so as to operate within a degree of error not greater than 1 percent and to be sensitive to a change in load of 1/5 of 1 percent, both percentages being based on the total required weight of material normally weighed as a unit on the scale. Scales shall be spot checked for accuracy and sensitivity at least once a week as the work progresses. When materials are weighed in hauling vehicles, gross weights shall be checked and the vehicle tare weight determined as often as the Contracting Officer directs. The Contractor shall furnish such weights, accessories, and assistance as the Contracting Officer may require for making weighing equipment tests.

12.1.1 Weighing operations shall be performed offsite, as approved, in the presence of a representative of the Contracting Officer, unless waived. Each load shall be accompanied by duplicate copies of delivery tickets certified by the weighmaster. As a minimum, each ticket shall contain the following information:

- (1) Date and time.
- (2) Vehicle number.
- (3) Gross weight.
- (4) Vehicle tare weight.
- (5) Net weight.
- (6) Material weighed.
- (7) Signature of weighmaster.

Delivery tickets shall be collected by the Contractor, and one copy thereof shall be furnished to the Contracting Officer at the close of each day's operations.

12.1.2 A plan indicating the location and proposed schedule of weighing operations shall be submitted for approval at least 15 days prior to delivery of stone to the site.

12.2 Riprap placed at the outlet to Lower Peterson Lake will not be measured for payment and will be paid for on a job basis, complete.

### 13. PAYMENT.

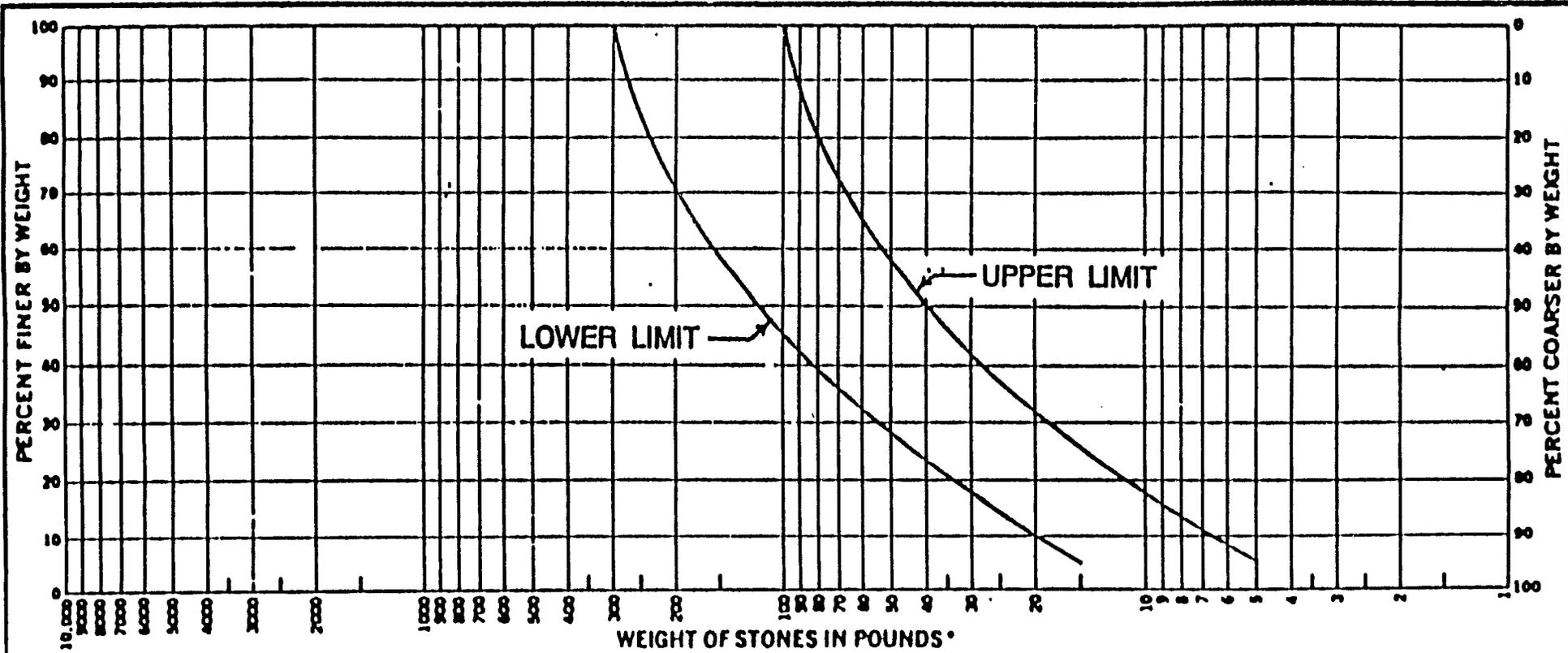
13.1 Riprap, choking stone and bedding. Payment shall be by ton (2,000 pounds avoirdupois) of material acceptably placed in the permanent work within the tolerances specified. Payment shall constitute full payment for all work associated with placement as shown and specified.

13.1.1 Deductions. All stone permitted by the Contracting Officer to remain outside the tolerances specified will be deducted from the quantity to be paid for. Volume of excess stone will be computed, using the average-end-area of excess above the tolerance line. The excess volume will be deducted for the payment quantity at a rate of 100 pounds per cubic foot, regardless of actual weight per cubic foot.

14. BIDDING SCHEDULE ITEMS. Bidding schedule items applicable to the work of this section are as follows:

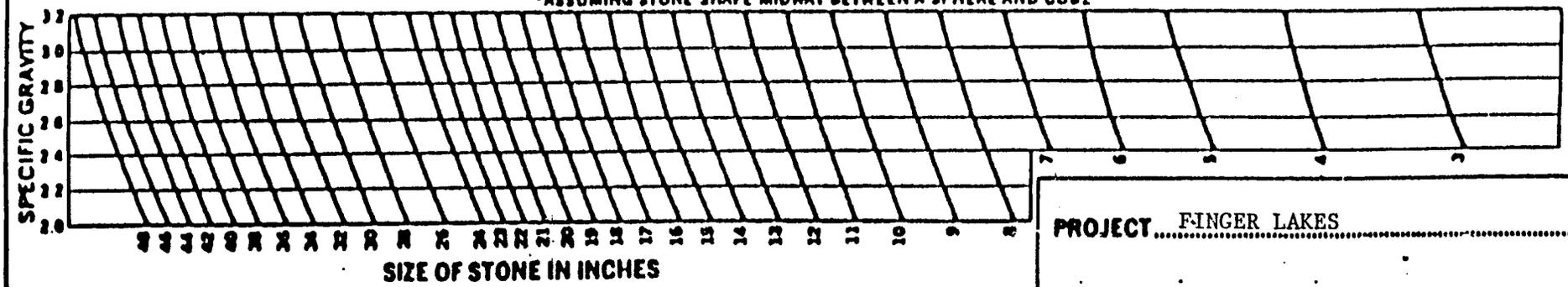
<u>Item</u>	<u>Unit</u>
Bedding	Ton
Riprap	Ton
Choking Stone	Ton
Riprap at Lower Peterson Outlet	Job

\* \* \* \*



WEIGHT OF STONES IN POUNDS\*  
 SPECIFIC GRAVITY OF ROCK.....

\*ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE AND CUBE

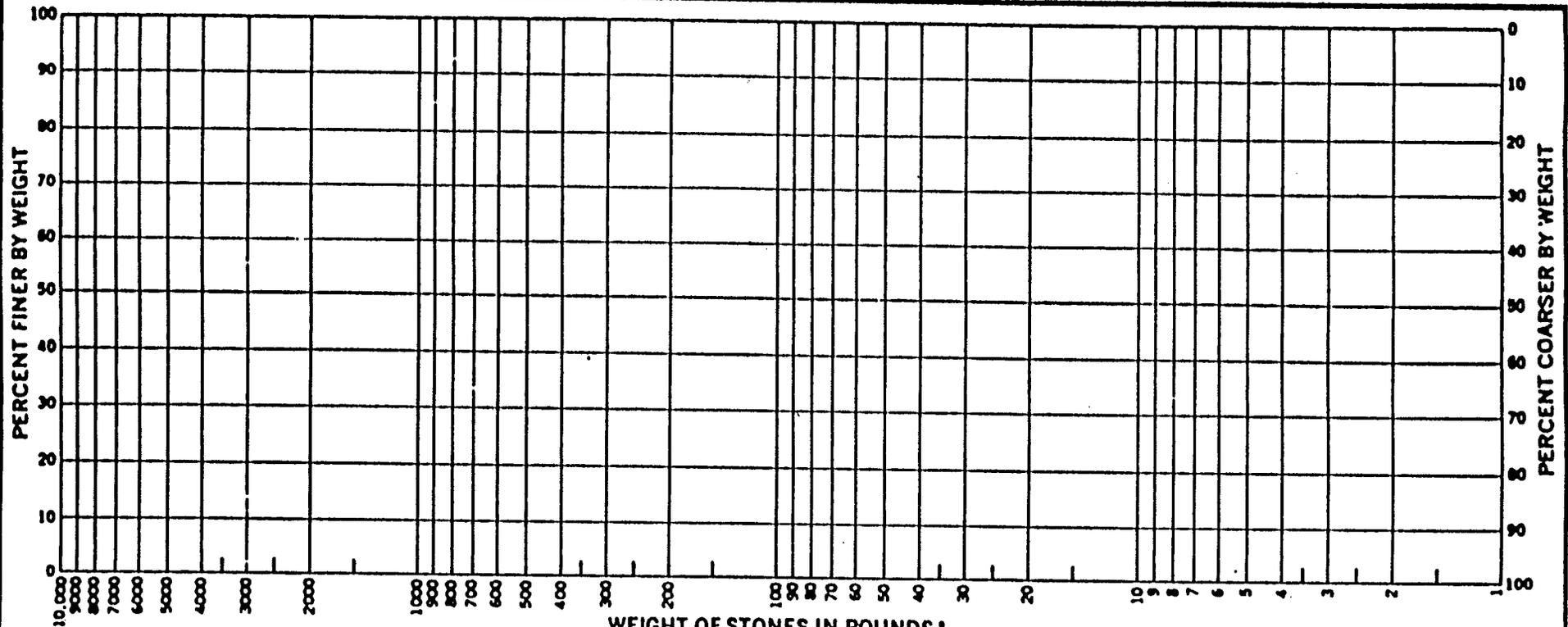


PROJECT FINGER LAKES

DATE

**RIPRAP GRADATION CURVES**

25-9





PART I  
SECTION C  
DIVISION 2  
SECTION 2Z

STOP LOG STORAGE BUILDING

<u>Para. No.</u>	<u>INDEX</u> <u>Description</u>	<u>Page No.</u>
1	SCOPE	2Z-1
2	RELATED WORK OF OTHER SECTIONS	2Z-1
3	APPLICABLE PUBLICATIONS	2Z-1
4	NOT USED	2Z-1
5	SUBMITTALS	2Z-1
6	MATERIALS	2Z-1
7	PAINTING	2Z-2
8	INSTALLATION	2Z-2
9	QUALITY CONTROL	2Z-2
10	MEASUREMENT AND PAYMENT	2Z-2
11	BIDDING SCHEDULE ITEMS	2Z-3

## SECTION 2Z - STOP LOG STORAGE BUILDING

1. SCOPE. This section covers the stop log storage building.
2. RELATED WORK OF OTHER SECTIONS. The following items of related work are covered under other sections:

2.1 Concrete: SECTION 3A: CONCRETE.

3. APPLICABLE PUBLICATIONS. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

3.1 American Society for Testing and Materials (ASTM).

A 463-88	Steel Sheet, Cold-Rolled, Aluminum-Coated, Type 1 and Type 2
A 525-91a	General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
A 792-89	Steel Sheet, Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements

4. NOT USED.

5. SUBMITTALS. The following items shall be submitted in accordance with SECTION L.

5.1 Shop Drawings. Shop drawings shall show construction details, weld procedures if needed, and any other details required to erect the building in the location indicated.

5.2 Certificates of Compliance for all building materials shall be submitted.

6. MATERIALS.

6.1 The storage building shall be Armco Tec-Line 1 or approved equal. The provided building shall meet the following criteria.

6.1.1 Framing members, fascia, and flashing shall be made of galvanized steel. Galvanizing shall be done in accordance with ASTM A 525, coating designation G-90. Roof panels and wall panels shall be made of aluminized steel or of galvalume coated steel. Aluminizing shall be in accordance with ASTM A 463, Type 2. Galvalume steel shall be in accordance with ASTM A 792.

6.1.2 The walls shall be made of panels a minimum of 24-gage thick with ribs for attaching adjacent panels. The walls shall be shop painted Armco Village Green or equivalent in accordance with PARAGRAPH: PAINTING.

6.1.3 Roofs shall be made of interlocking steel panels a minimum of 22-gage thick. The roof shall have a single slope as shown.

6.1.4 Framing Members. Base channel shall be minimum 14-gage steel. Eave plates shall be minimum 16-gage steel.

6.1.5 Flashing shall be minimum 22-gage except that base channel flashing shall be minimum 26 gage.

6.1.6 Fascia shall be minimum 24 gage steel. Fascia shall be factory painted white in accordance with PARAGRAPH: PAINTING.

6.1.7 Fasteners shall be zinc-coated steel, stainless steel, corrosion resisting steel or nylon capped steel, type and size as applicable. Exposed fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material shall be compatible with the items being connected. Washers for waterproofing shall be neoprene or other durable elastomeric material approximately 1/8 inch thick.

6.1.8 Steel door shall be as recommended by the building manufacturer with swing as shown. The door shall be equipped with a door knob with a passage lock. Two keys shall be supplied for the door lock. The door shall not have a window. Both sides of the door shall be painted white in accordance with PARAGRAPH: PAINTING.

6.2 Concrete shall be in accordance with SECTION 3A: CONCRETE. Tests shall be performed on the concrete by the Contractor in accordance with SECTION 3A: CONCRETE.

7. PAINTING. Specified building components shall have a factory applied baked on enamel color finish. As a minimum, wall panels and fascia shall be painted on the exterior side. The steel door shall be painted on both sides.

## 8. INSTALLATION.

8.1 The building and foundation shall be constructed as indicated on the drawings and in accordance with manufacturers written recommendations.

9. QUALITY CONTROL. The Contractor shall establish and maintain quality control for work under this section to assure compliance with the contract requirements and maintain records of his quality control for all construction operations. Quality control shall be in accordance with SECTION E. A copy of the records of inspections and tests, as well as the records of corrective action taken, shall be furnished to the Government.

10. MEASUREMENT AND PAYMENT. The stop log storage building will not be measured for payment, and shall be paid for on a job basis, complete.

11. BIDDING SCHEDULE ITEMS applicable to the work of this section are as follows:

<u>Item</u>	<u>Unit</u>
Stop Log Storage Building	Job

\* \* \* \*

PART I  
SECTION C  
DIVISION 5  
SECTION 5A

MISCELLANEOUS METALS, STANDARD ARTICLES,  
SHOP FABRICATED ITEMS AND METALWORK FABRICATION

<u>Para. No.</u>	INDEX <u>Description</u>	<u>Page No.</u>
1	SCOPE	5A-1
2	RELATED WORK OF OTHER SECTIONS	5A-1
3	APPLICABLE PUBLICATIONS	5A-1
4	GENERAL	5A-3
5	SUBMITTALS	5A-3
6	MATERIALS	5A-3
7	SHOP FABRICATED METAL ITEMS	5A-4
8	WORKMANSHIP	5A-5
9	STRUCTURAL FABRICATION	5A-6
10	WELDING	5A-6
11	INSTALLATION	5A-7
12	QUALITY CONTROL	5A-8
13	MEASUREMENT AND PAYMENT	5A-8
14	BIDDING SCHEDULE ITEMS	5A-8

SECTION 5A - MISCELLANEOUS METALS, STANDARD ARTICLES, SHOP  
FABRICATED ITEMS AND METALWORK FABRICATION

1. SCOPE. The work covered by this section consists of providing all equipment, materials, and labor for fabricating, furnishing, and installing metal handrailing, metal grating, aluminum stop logs and metal items not specified elsewhere.

2. RELATED WORK OF OTHER SECTIONS. The following items of related work are covered under other sections:

2.1 Sluice Gates: Section 15A: VERTICAL LIFT GATES

2.2 Slide Gate: Section 15A: VERTICAL LIFT GATES.

2.3 Painting: Section 9P: PAINTING HYDRAULIC STRUCTURES AND APPURTENANT WORKS.

3. APPLICABLE PUBLICATIONS. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

3.1 American Institute of Steel Construction (AISC) Publication.

Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Nov. 1989 with Commentary).

3.2 American Welding Society (AWS).

D1.1-90 Structural Welding Code

3.3 American Society for Testing and Materials (ASTM).

A 36-90 Structural Steel

A 53-90 Rev. B Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A 108-90 Rev. A Steel Bars, Carbon, Cold-Finished, Standard Quality

A 123-89a Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A 276 Rev A-90 Stainless and Heat-Resisting Steel Bars and Shapes

A 325-88 High-Strength Bolts for Structural Steel Joints

A 385-80 Providing High-Quality Zinc Coatings (Hot Dip)

A 307-90 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

A 153-82	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 563-90	Carbon and Alloy Steel Nuts
A 444-89	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Storm Sewer and Drainage Pipe
A 446-89	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
A 525-90	General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
B 209-90	Aluminum and Aluminum-Alloy Sheet and Plate
B 211-90	Aluminum and Aluminum-Alloy Bar, Rod, and Wire
B 241-89	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

### 3.4 Federal Specifications (Fed. Spec.).

FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
RR-G-661E (as amended)	Grating, Metal, Bar Type

### 3.5 American Society of Mechanical Engineers Boiler and Pressure Vessel Code

Section IX            Welding and Brazing Qualifications

### 3.6 Military Specifications (Mil. Spec.).

DOD-P-21035A	Paint, High Zinc Dust Content, Galvanizing Repair
--------------	---

### 3.7 American National Standards Institute (ANSI).

B 18.22.1 (R 1990)	Plain Washers
B 18.21.1 (R 1983)	Lock Washers

#### 4. GENERAL.

4.1 The AISC Specification for Design, Fabrication and Erection of Structural Steel Buildings shall govern the work. Welding shall be in accordance with AWS code D1.1.

4.2 The Contractor shall verify dimensions and shall take field measurements necessary before fabrication. Exposed accessories shall be compatible, and shall match in color and finish with the material to which the accessories are being applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Miscellaneous supports, braces and connections necessary for completion of the metal-work shall be provided. Fastenings shall be concealed where practicable. Joints shall be formed to exclude water.

5. SUBMITTALS. Contractor submittals shall be in accordance with the requirements of the particular sections of these specifications for the respective items and as herein specified. Submittals shall be submitted in accordance with Section L.

5.1 Shop Drawings shall be submitted for approval. Drawings shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of materials as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the shop drawings. Shop drawings shall be submitted for the following items:

- (1) Handrailing and post embedment sleeves
- (2) Grating and details of hinges and locks
- (3) Stoplogs, Stoplog hooks, Stoplog grooves and anchor bolts
- (4) Structural steel
- (5) Trash racks
- (6) Expansion anchors and anchor bolt anchorage details
- (7) Ladders, grab bars and post embedment sleeves

5.2 Certificates of Compliance stating that materials provided and work performed meet the requirements specified.

5.3 Welding procedures, welding operator qualifications and weld schedule shall be submitted for approval.

#### 6. MATERIALS.

6.1 Handrailing. ASTM A 53, Type E or S, Grade A or B, standard strength pipe, galvanized after fabrication in accordance with ASTM A 123 and ASTM A 385. Size and class shall be as shown on the drawings. All fastening hardware shall be stainless steel.

6.2 Grating. Fed. Spec. RR-G-661E, Type I, Class 1 or 2, Material S. The surface of the bearing bars shall be serrated. Edges of gratings which require the cutting of more than one bearing bar shall be banded. Grating shall be galvanized after fabrication in accordance with ASTM A

123 and ASTM A 385. Grating shall be able to support a minimum of 85 psf with a maximum of 0.25 inches deflection. Grating shall be fastened as indicated on the drawings.

6.3 Structural steel shall be in accordance with ASTM A 36. Steel items indicated to be galvanized shall be galvanized in accordance with ASTM A 123 and ASTM A 385.

6.5 Steel studs shall be of length and diameter as shown and shall be in accordance with ASTM A 307 Grade A.

6.6 Steel bars and rods for trash racks, ladders and grab bars. ASTM A 108, Grades 1010 through 1020.

#### 6.7 Aluminum

6.7.1 Tubes and Pipe. ASTM B 241, Alloy 6061, Temper T6.

6.7.2 Bars and Rods. ASTM B 211-90, Alloy 6061, Temper T6.

6.8 Expansion anchors. Fed. Spec. FF-S-325, group and type as required, except that nail driven types will not be accepted. Anchors shall be galvanized unless otherwise indicated. Expansion anchors shall be proof load tested in accordance with FF-S-325.

6.9 Bolts, nuts, washers and other fasteners shall be of the material, grade, type, class, style, and finish indicated; or best suited for the intended use as determined by the Contracting Officer.

6.9.1 High-strength bolts, nuts, and washers. ASTM A 325.

6.9.2 Bolts, nuts, and washers (other than high-strength).

6.9.2.1 Bolts and nuts. ASTM A 307, Grade A.

6.9.2.2 Washers.

6.9.2.2.1 Plain. ANSI B18.22.1, Type B.

6.9.2.2.2 Lock. ANSI B18.21.1.

6.10 Grating hinges shall be of the size as shown and shall be full surface, not swagged, with fixed pin. Hinges and pins shall be made of ASTM A 276, Type 316 stainless steel.

7. SHOP FABRICATED METAL ITEMS. Shop fabricated metal items shall conform to the requirements and details as specified or shown on the drawings and to the workmanship provisions and other applicable fabrication requirements as specified herein.

7.1 Handrailing shall be steel pipe as specified herein, size as shown on the drawings and shall be furnished and installed complete with all fittings, rail post anchorage, hardware, sleeves and other appurtenances as shown and required for proper installation.

7.1.1 Steel pipe handrailing shall be fabricated from pipe sections by mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight-fitting interior sleeve. Railings shall be free of burrs, sharp corners, and sharp edges.

7.2 Grating shall be of the material specified herein, and shall be fabricated in sectional panels of the width and length as necessary to accurately fit on the supporting frame.

7.3 Ladders shall be fixed-rail metal ladders as shown. Ladders, grab bars and accessories shall be fabricated with steel, galvanized after fabrication in accordance with ASTM A 123. Fabrication of ladders shall be as indicated on the drawings. Splices in side bars shall be made using full penetration welds and shall be a smooth transition between connecting ends without sharp or extensive projections. All welds shall be ground smooth. Ladders and grab bars shall be anchored to supporting structure as indicated.

7.4 Trash Racks shall be steel as specified herein and fabricated as shown on the drawings. All welds shall be ground smooth. Trash racks, including locking clip plates, structural angles and structural tee-sections, shall be galvanized after fabrication in accordance with ASTM A 123.

7.5 Stop Logs and stoplog hook shall be made of aluminum as indicated and specified herein and shall be fabricated as shown on the drawings. Stoplogs and stoplog hooks shall be placed in the stoplog storage building by the Contractor.

7.6 Padlocks for hinged grating shall be Master No. 160-D or approved equal. Padlocks shall have case hardened steel shackles and solid brass bodies and cylinders. Padlocks shall be keyed alike and shall be keyed the same as the padlocks on the fence gates and each lock shall be furnished with at least one key.

7.7 Chain for grating shall be Mc Master Case Hardened Security Chain or approved equal. The chain shall be 5/16" nominal size. The chain shall be made of case hardened steel, shall be electric welded and shall have a zinc-coated finish. Chain shall be attached to grating as shown.

7.8 Stoplog grooves shall be Neenah R-7500, Type A or equal, except that stoplog grooves at Peterson Lake headwall shall be Neenah R-7500, Type L or equal. Stoplog grooves shall be cast iron, mounted as indicated on the drawings. Size shall be as shown and strength shall be in accordance with stoplog groove manufacturer's written recommendations.

8. **WORKMANSHIP.** Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications and approved shop drawings for the item of work being furnished. Metalwork shall be well formed to shape and size, with

sharp lines and angles and true curves. Drilling and punching shall produce clean, true lines and surfaces. Welding shall be continuous along the entire area of contact, except where tack welding is permitted. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, unless otherwise specified.

## 9. STRUCTURAL FABRICATION.

9.1 General. Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated on the drawings or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on shop drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown on the drawings. Re-entrant cuts shall be filleted to a minimum radius of 3/4-inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

9.2 Dimensional Tolerances for Structural Work. Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured at the time of measurement. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown on the drawings an allowable variation of 1/32-inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown on the drawings by more than 1/16-inch for members 30 feet or less in length and by more than 1/8-inch for members 30 feet in length.

9.3 Structural Steel Fabrication. Structural steel may be cut by mechanically guided or hand guides or hand guided torches provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1, Subsection 3.2. Where structural steel is not to be welded chipping or grinding will not be required except as necessary to removed slag and sharp edges of mechanically guided or hand guided cuts not exposed to view. Hand guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

## 10. WELDING.

10.1 Welding Process. Welding, unless otherwise specified, shall meet the applicable requirements of AWS D1.1.

10.2 Qualifications of Welders and Welding Operators. Welders and welding operators shall pass successfully the qualification tests as prescribed by Section 5 of AWS D1.1, or Section IX or ASME Boiler and Pressure Vessel Code, before being assigned to production work. The Contractor shall certify by name the welders and welding operators so qualified, the date of qualification and code and procedures under which qualified. Prior qualification will be accepted if welders have performed satisfactory work under the codes for which qualified within the preceding three months. The Contractor shall require welders and welding operators to repeat the qualifying tests when in the opinion of the Contracting Officer their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests shall be recertified. Those not passing shall be disqualified until passing. All expenses in connection with qualification and requalification shall be borne by the Contractor.

## 11. INSTALLATION.

11.1 General. All parts to be installed shall be thoroughly cleaned; all packing compounds, rust, dirt, grit and other foreign matter removed; and all enclosed chambers or passages examined to make sure that they are free from injurious materials. When units or items are shipped as assemblies, they will be inspected by the Contracting Officer prior to installation. Disassembly, cleaning and lubrication will not be required, except where there is indication that such work is necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause injury to the surfaces of rods, nuts or other parts shall not be used for the work of assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly, but care shall be taken not to overstress the threads. When a half nut is placed for the purpose of locking a full nut, the half nut shall be placed first and followed by the full nut. Threads of all nuts, screws, bolts, except for high-strength bolts, shall be lubricated by graphite and oil before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with a suitable anti-galling compound. Driving and drifting bolts or keys will not be permitted.

11.2 Alignment and Setting. Each unit shall be accurately aligned by the use of steel shims or other approved methods, such that binding or distortion of any member will not occur before it is finally fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. The units shall be set true to the elevations shown on the drawings.

11.3 Handrailing shall be installed as indicated with all posts vertical.

11.4 Grating shall be installed in accordance with manufacturer's written recommendations and as indicated.

11.5 Anchor bolts and expansion anchors shall be installed in locations shown in accordance with manufacturer's written recommendations and as approved by the Contracting Officer.

12. **QUALITY CONTROL.** The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements, and maintain records of his quality control for all construction operations. Quality Control shall be in accordance with Section E. Copies of quality control reports shall be furnished to the Government.

13. **MEASUREMENT AND PAYMENT.**

13.1 Stop logs and stop log hooks will be measured by the unit, in place, complete.

13.2 The remaining work of this section will not be measured for separate payment and costs therefore shall be included in the price bid for the feature to which the work pertains.

14. **BIDDING SCHEDULE ITEMS** applicable to the work of this section are as follows:

<u>Item</u>	<u>Unit</u>
Stop Logs	
8'-5" Long	EA
6'-11" Long	EA
Stop Log Hooks	EA

\* \* \* \*

PART I  
SECTION C  
DIVISION 15  
SECTION 15A

VERTICAL LIFT GATES

<u>Para. No.</u>	<u>INDEX Description</u>	<u>Page No.</u>
1	SCOPE	15A-1
2	RELATED WORK OF OTHER SECTIONS	15A-1
3	APPLICABLE PUBLICATIONS	15A-1
4	GENERAL	15A-2
5	SUBMITTALS	15A-2
6	MATERIALS	15A-3
7	DESIGN DATA	15A-4
8	GENERAL DESIGN	15A-4
9	GATES	15A-4
10	OPERATING HOISTS	15A-6
11	INSTALLATION	15A-7
12	PORTABLE POWER OPERATOR	15A-8
13	PAINTING	15A-9
14	MAINTENANCE AND OPERATING MANUALS	15A-9
15	TOOLS	15A-10
16	WARRANTY	15A-10
17	QUALITY CONTROL	15A-10
18	MEASUREMENT AND PAYMENT	15A-10
19	BIDDING SCHEDULE ITEMS	15A-11



A 320-90	Alloy-Steel Bolting Materials for Low Temperature Service.
A 582-88	Free-Matching Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished.
B 21-E1-90	Naval Brass Rod, Bar and Shapes.
B 98-84	Copper-Silicon Alloy Rod, Bar and Shapes.
B 584 Rev A-90	Copper Alloy Sand Castings for General Applications.
D 2000-90	Rubber Products in Automotive Applications.

3.4 American Association of State Highway and Transportation Officials (AASHTO).

M 82-75	Cut-Back Asphalt
M 29-88	Fine Aggregate Bituminous Paving Mixtures

3.5 National Electric Manufacturers Association (NEMA).

MG 1-87	Motors and Generators
---------	-----------------------

3.6 Underwriters' Laboratory, Incorporated (UL).

UL 508-89	Industrial Control Equipment
-----------	------------------------------

4. GENERAL. Slide gates shall be the standard product of a reputable manufacturer having had at least 5 years of successful experience in the design and manufacture of such items. Gates and accessories shall be of the following design:

- (1) Slide and sluice gates shall be rising stem.
- (2) Sluice gate shall be flange back type as shown.
- (3) Junction box slide gates shall be spigot back type as shown. Peterson Lake slide gates shall be flatback type as shown.
- (4) Thimbles shall be sufficiently rigid to preclude distortion during installation.
- (5) Gates shall be flush bottom as shown.

5. SUBMITTALS. The following items shall be submitted in accordance with SECTION L.

5.1 Shop drawings shall be submitted for slide and sluice gates showing details for mounting, materials, construction and installation

procedures. Catalog data, including specifications and full descriptive data, shall be submitted for all materials and equipment furnished.

5.2 Design information as specified in PARAGRAPH: DESIGN DATA.

5.3 Maintenance data and operating instructions as specified in PARAGRAPH: MAINTENANCE AND OPERATING MANUALS.

5.4 Warranty for items as specified in PARAGRAPH: WARRANTY.

5.5 Erecting engineer qualifications: as specified in PARAGRAPH: GATE VENDOR'S ERECTING ENGINEER.

6. MATERIALS. Materials shall meet the requirements of the following referenced publications. Use of other grades or alloys shall be requested in writing and will be subject to approval.

6.1 Structural steel: ASTM A 36.

6.2 Naval brass: ASTM B 21, copper alloy No. 464 or 482; temper, optional.

6.2.1 Iron castings - ASTM A 126.

6.2.2 Steel castings - ASTM A 148.

6.3 Manganese bronze: ASTM B 584, high-strength yellow brass, copper alloy No. 932.

6.4 Cold rolled steel: ASTM A 108, Grades 1010 through 1020.

6.5 Stainless Steel.

6.5.1 ASTM A 276, Type 304, Condition A (annealed) or B (cold worked, high tensile), type of finish optional.

6.5.2 ASTM A 582, Type 303, Condition A (annealed), type of finish optional.

6.6 Bolting Materials.

6.6.1 Bolts - ASTM A 582 - Type 303 or 416.

6.6.2 Nuts - ASTM B 98 - Alloy 655.

6.7 Seals: ASTM D 2000 - Grade 4AA 625A13.

6.8 Asphalt.

6.8.1 Asphalt liquid: AASHTO M 82, medium core liquid asphalt type, Grade MC-30 or MC-70.

6.8.2 Sand: AASHTO M 29.

7. DESIGN DATA. Design computations and technical data showing factors of safety, calculations of stresses, and other information necessary to assure compliance with the drawings and specifications shall be submitted to the Contracting Officer.

7.1 Hoist Design Criteria. The Contractor shall submit calculations which clearly show how the size of the operator was chosen. For the slide and sluice gate lifts, a friction factor of 0.6 shall be used, and the gate size and the heads shall be those specified below.

8. GENERAL DESIGN. Component parts shall be designed for the seating and unseating heads shown in TABLE 1 using a minimum safety factor of 5 and be sized and guided so that, unless otherwise shown on the drawings, the slenderness ratio (L/R) shall not exceed 200. The opening and closing forces for design of the stem and stem block anchorage shall include friction load based on the operating pressure shown in TABLE 1, with coefficient of friction of not less than 0.6 for slide and sluice gates in addition to the weight of the gate and stem. Stem design shall include a factor of safety of 5 against failure in addition to the column buckling strength reduction effects as given by the Euler formula.

9. GATES.

9.1 General. The gate installation shall be furnished complete with frames, leaves, stems, adjustable stem guides, and bolts, complete and operable in all respects described herein and as indicated on the drawings. The gates shall be of the pressure seating type, and shall be designed for the face pressures and back pressures indicated in TABLE 1 with a minimum factor of safety of five. The capacities of the operating stands shall be based upon the pressure exerted on the entire area enclosed by the gate sealing surfaces (seating faces). As used herein operating pressure head is defined as the distance from the center of the slide, in its closed position, to the maximum water surface elevation. Sluice gates shall be sufficiently rugged to withstand operation by means of electric lifts.

TABLE 1

LOCATION GATE	GATE TYPE	GATE SIZE	NO. OF GATES	MAX. FACE PRESSURE (HEAD-FT)	OPERATING PRESSURE (HEAD-FT)
1st/2nd Lake	Sluice	48"x48"	1	7	7
3rd Lake	Sluice	36"x36"	1	7	7
Clear Lake	Sluice	36"x36"	1	7	7
Junction Box	Slide	48"x48"	2	7	7
Peterson Lake	Slide	48"x48"	1	7	7

## 9.2 Sluice Gates.

### 9.2.1 Component.

9.2.1.1 Frames. The frames shall be cast iron of ample section to prevent distortion. Seat facings shall be naval brass and shall be machined to a smooth finish for making a tight seal meeting the requirements of AWWA C 501. The frame guides shall be of cast iron. The frame guides shall be equipped with adjustable side wedges, and the guides shall be of sufficient length so that not less than one-half of the gate is within the guides when the gate is wide open. The side wedges shall be faced with manganese bronze. Wedges shall be designed in such a manner that the wedge fastening bolts may be replaced without the removal of the gate frame from the masonry or other setting, and their attachments adequate to resist tight closures of the gates. Gates shall be provided with top wedges.

9.2.1.2 Wall Thimbles. Wall thimbles shall be of the F type as shown on the drawings. The thimbles shall be of cast iron with the front flange machined to a plane to provide a true seating surface for the sluice gate frame. Holes shall be drilled and tapped in the thimble to match the mounting hole pattern of the sluice gate frame. The gate frames shall be attached to the thimble by studs of the material specified in PARAGRAPH: BOLTS AND NUTS. The wall thimble shall be internally braced during concrete placement. Thimble shall be plumb in both planes within  $\pm 1/16$  inch.

9.2.1.3 Gate leaves shall be of cast iron, consisting of flat castings with horizontal and vertical ribs of ample section to withstand all of the specified conditions of operation with limited distortion to prevent leakage. The seating surfaces shall be of naval brass not less than 3/4-inch wide and shall be machined to a 63 micro-inch finish or better and attached by dovetail notching to make a watertight seal. The gate shall be guided in the frame with a tongue and groove construction. The tongue and grooves shall be machined full length with a 1/8-inch overall clearance in the frame guide groove. Slide wedges shall be faced with manganese bronze and mounted and secured to prevent rotation that would interfere with their proper action or cause the gate to bind, in addition to meeting the requirements of AWWA C 501.

### 9.3 Slide Gates.

9.3.1 The gate, gate frame, and gate slide shall be made of carbon steel.

9.4 Stems. Stems for slide and sluice gates shall be of stainless steel conforming to Fed. Spec. QQ-S-763E, Type 304 with a 63 micro-inch finish if machine cut or 32 micro-inch if rolled threads, and shall be of the sizes recommended by the manufacturer. No detectable flaws or surface imperfections will be permitted. The stems shall be provided with thrust nuts of corrosion-resisting metal and shall have adjustable stop nuts to limit the upward and downward travel of the stems. The stems shall be of a size to withstand the axial compressive and tensile forces created during gate operation under the specified unbalanced

heads and to transmit in compression at least two times the rated output of the lift with a 25 pound effort on the handwheel. Threads on stems shall be machine cut or rolled with single or double lead threads of the Acme type. The exterior corners of the threads shall be given slight radius of approximately 0.015-inch in order to prevent them from acting as cutting edges as the stem passes through the left nut.

9.5 Stem guides shall be a manufacturer's standard product, except as specified herein, and shall be adjustable in two directions to provide full adjustment for proper alignment of the stem. The stem bearing, in the stem guides, shall be brass or bronze brushed. The guides shall be anchored in an approved manner with not less than two bolts.

## 10. OPERATING HOISTS.

10.1 Hoists. The hoisting units shall be made of cast iron or cast steel. Exposed fastening of 1-1/2 inch diameter and less shall have American Standard hexagon-socket (Allen) type wrench heads. The hoist shall have a cast bronze lift nut, threaded to match and engage with the stem threads. The lift nut shall be provided with ball or roller bearings both above and below a flange on the lift nut, to accommodate the opening and closing thrusts. Each hoist shall be provided with an integral position indicator. A brass plate shall be attached to the lift housing to show counter reading with gate in fully closed and fully open position. Each hoist shall be designed to unseat the slide from its wedging device at the maximum head with a maximum force of 40 pounds at a 15-inch radius. Means for lubrication of the hoist shall be provided. No more than 16 turns of the handwheel shall be required to move the gate 1 inch.

### 10.2 Slide Gates.

10.2.1 Hoisting units shall be of the handwheel operated type. The handwheel shall be in accordance with manufacturer's recommendations except that the handwheel shall be a minimum of 24" diameter and shall be removable.

### 10.3 Sluice Gates.

10.3.1 Hoisting units shall be of the hand crank operated, enclosed, pedestal type, equipped with machine cut gears, having gear ratios recommended by the hoist manufacturer. All hoists shall be capable of being driven by the portable operator.

10.4 Position Indicators. Weathertight and dust-tight stem position indicators shall be provided for all gate stands. The indicators shall be of the dial or counter type, mounted in a cast housing on top of the lift, and with the face of the counter showing through a recessed window in the housing and easily read from the crank location.

10.5 Stem Covers. Weathertight and dust-tight stem covers shall be provided to enclose and protect the threaded portion of the gate stem. Slotted aluminum stem covers shall be provided. The top of the stem shall be visible through the slot throughout its distance of travel during opening and closing operations. The slot shall be covered with

a vandal resistant clear plastic material as recommended by the stem manufacturer and as approved. The above plastic material shall be installed as recommended by the stem manufacturer.

10.6 Bolts and Nuts. All anchor bolts for the rising stem type slide gate frames and guided, stem guides, hoists and floor stands, and all bolts and studs used in the slide gate leaves, frames and guides, and stem guides shall conform to the requirements of Fed. Spec. QQ-S-763E, Class 302. All nuts used on the above bolts shall conform to Fed. Spec. QQ-C-591E, Alloy 655.

## 11. INSTALLATION.

11.1 Services of Gate Manufacturer Erecting Engineer. The setting, installation, assembly, lubrication, and testing of the slide gate and hoisting unit shall be in accordance with gate manufacturer as approved by the Contracting Officer. These instructions shall be submitted for approval prior to any gate installation work. An erecting engineer, as specified in PARAGRAPH: GATE VENDOR'S ERECTING ENGINEER, shall inspect and determine the adherence to the specifications for the setting of the gate frame, rail assemblies, the stem guide anchor bolts, and the hoisting unit anchor bolts; the alignment and assembly of the stem to the sluice gate, stem guides, and hoisting unit; and observe the initial gate operations using the hoist. The Contractor shall make all arrangements for the presence of the erecting engineer for this inspection. The presence of the erecting engineer, however, will not relieve the Contractor of full responsibility. The erecting engineer shall be present not less than 3 days and not more than 5 days.

11.2 Gate Vendor's Erecting Engineer. The erecting engineer shall be experienced in the specific installation of slide and sluice gates as a complete system. The erecting engineer must be knowledgeable in the interface between the gate and frame. Installation experience shall include as a minimum three successful installations of which at least one must have been in the last two years and at least one must have been a gate of at least the size of the gate required for this contract. The Gate Vendor shall coordinate with the Contractor on the most advantageous times and durations necessary for his erecting engineer to be at the construction site and be confident of the proper installation and operational function of their product. The Vendor's erecting engineer shall initiate instructions for all actions necessary for the proper receipt, inspection, handling, assembly, installation, operation, and testing of the gate system furnished by his company under this contract to the Contractor's erecting engineer for compliance. Discrepancies shall be reported to the Contracting Officer. The Vendor's erecting engineer shall also keep records of measurements and actions taken during his visits and shall furnish a copy to the Contracting Officer on request or at the completion of each visit. One of the visits shall be during final preparation and performance of the installed acceptance test. The erecting engineer shall instruct the Contracting Officer in the operation and maintenance features of his company's installed slide gate product. The following information shall be submitted with the submittal package to verify the qualifications of the engineer:

- (1) Experience, years of service, etc., as an erecting engineer.
- (2) List of successful gate installations with owner's address and phone number.
- (3) Size and type control of the installed gates.

11.3 Assembly. Prior to assembly, the gate stems shall be thoroughly cleaned, for inspection by the Contracting Officer or his representative. All parts of the gates and operating mechanisms shall be installed and fitted together so that after final assembly there will be no interference through bad alignment, or any warping or twisting of the members that would in any way interfere with operation. All finished contact or bearing surfaces shall be true and exact to insure full and complete contact. Provisions for lubrication of the operating mechanisms shall be made and the lubrication systems shall be properly filled with suitable lubricant as recommended by the manufacturer of the hoists. When the sluice gate slide is in the fully closed position and wedged in position against the frame, maximum clearance between mating faces shall not exceed 0.004 inch.

11.4 Tests and Trials. After final assembly, the gate shall be tested in the presence of the manufacturer's erecting engineer and the Contracting Officer or his representative by raising and lowering it throughout its complete travel by means of its operating mechanism to demonstrate that it complies with the specifications. Any defective part or error in the construction or alignment of the complete gate discovered during the tests and trials shall be immediately corrected by the Contractor without cost to the Government.

## 12. PORTABLE POWER OPERATOR.

12.1 General. One power operating device shall be provided. The operator shall be capable of opening and closing the sluice gates at the speed and torque requirements herein. The operator shall be portable, consisting of an electric motor operated wrench.

12.2 The power operator, portable cable, and accessories shall be in accordance with the requirements of NEMA MG 1 and UL 508.

12.3 Electric Motor-Operated Wrench. The wrench shall have a reversing unit as part of the assembly. The dimensions of the coupling for connecting the wrench to the sluice gate shaft shall be determined by the Contractor after selection of the sluice gate. The wrench shall be suitable for all weather service and designed for operation on 120 volt, single phase, 60 hertz service. The wrench shall be capable of providing a minimum of 30 foot-pounds of torque for continuous duty while operating at a speed of not less than 140 rpm, and shall develop a stall torque of 250 foot-pounds. The wrench shall be equipped with a reversing switch and not less than 15 feet of three conductor heavy duty cable, complete with a 3 wire, 3 pole plug that is compatible with the power generator and portable cable.

12.3.1 Electrically Operated Torque Limiting Device. The wrench shall include a built-in, electrically operated torque limiting device that shall be an integral part of the complete wrench. The limiting device shall permit the operator to deliver a minimum torque of 30 foot-pounds but shall turn the unit off before a torque in excess of 50 foot-pounds is reached.

12.3.2 Portable Cable. One 50-foot length of approved three conductor, No. 12 AWG, 600 volt heavy duty type S0 portable cable shall be furnished for extension cord purposes. The cable shall be equipped with a 3 wire, 3 pole, weather-proof, grounding type plug rated 15 amperes, 120 volts. The plug shall be for use with the receptacles furnished on the generator and power operator.

12.3.3 Mechanical Torque Limiting Device. A detachable overload release clutch, "Center Type C", without limit switch pin, as manufactured by Centric Clutch Co., Woodbridge, NJ, 07095, or approved equal, shall be furnished that will cause the wrench to run free if the turning torque at the gate hoist exceeds 600 inch-pounds. Integral drive adaptations shall be made so that it can be inserted between the wrench socket and the gate hoist shaft.

12.3.4 Operating Stand. An operating stand that is compatible with the power operator shall be provided. The stand shall be stable up to the stall torque of the power operator. The stand shall be aluminum or steel and its height shall be adjustable. If a steel stand is supplied, the stand shall be painted in accordance with SECTION 9A: PAINTING, HYDRAULIC STRUCTURES AND APPURTENANT WORKS.

12.4 Power Generator. A generator shall be provided that is compatible with the power operator. The generator shall be a manufacturer's standard product. The generator shall have a 5 horsepower, 4 stroke, single cylinder, air cooled, gas fueled engine with recoil starting system and a minimum 2.5 gallon gas tank. The generator shall be 120 volts, and shall produce a minimum of 2000 watts and a maximum of 3000 watts. The generator shall have suitable carrying handles to accommodate carrying by 2 persons.

12.5 The power generator, operating stand, portable cable, torque limiting device and electric motor-operated wrench shall be placed in the stop log storage building after its completion.

13. PAINTING. Painting shall be in accordance with SECTION 9P: PAINTING HYDRAULIC STRUCTURES AND APPURTENANT WORKS.

14. MAINTENANCE AND OPERATING MANUALS. The Contractor shall furnish three sets of maintenance data and operating instructions, including parts list, for the slide and sluice gate equipment. The data and instructions shall cover servicing and dismantling of the respective items. The manuals shall be furnished to the Contracting Officer not later than the date the equipment is shipped from the manufacturer's plant. Each set shall be permanently bound and shall have on the cover the following: (1) the words "OPERATING AND MAINTENANCE INSTRUCTIONS",

(2) the name and location of the project, (3) the Contractor's name, (4) invitation number, and (5) the contract number. Flysheets shall be placed before instructions covering the subject. The sheets shall be 8-1/2 by 11 inches, with large sheets of drawings folded in. Each set shall include, but not be limited to, the following:

- (1) Operating and maintenance instructions for each piece of equipment including lubrication instructions.
- (2) Manufacturer's bulletins, cuts, and descriptive data.
- (3) Parts lists and recommended spare parts.

15. TOOLS. One set of wrenches and special tools required for the operation and maintenance of the slide gates installed under this contract shall be furnished at the time of the trial operation specified in PARAGRAPH: TESTS AND TRIALS.

16. WARRANTY. The Government shall receive the standard warranty for the gates, including operating stand and stem provided under this section of the specifications. The period of warranty shall begin on the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier, against defective materials, design, and workmanship. Upon receipt of notice from the Government of failure of any part of the guaranteed equipment during the guarantee period, the affected parts shall be replaced promptly with new parts by the Contractor and at no additional cost to the Government.

17. QUALITY CONTROL. The Contractor shall establish and maintain quality control for work under this section to assure compliance with contract requirements, and maintain records of his quality control for all construction operations. Quality control shall be in accordance with SECTION E. Copies of quality control reports shall be furnished to the Government.

18. MEASUREMENT AND PAYMENT.

18.1 Slide and sluice gates will be measured for payment by the unit, in place, complete and fully operable. Tools, wrenches, maintenance and operating manuals, and other appurtenances are considered incidental to the slide gates and will not be measured for separate payment. Payment will include all costs for stems, thimbles, operators, and accessories, complete.

18.2 Portable electric operator will not be measured for payment and shall be paid for on a job basis, complete. Payment will include all costs for tripod, portable cable, generator, and accessories.

19. BIDDING SCHEDULE ITEMS applicable to the work of this section are as follows:

<u>Item</u>	<u>Unit</u>
48" x 48" Sluice Gates	EA
36" x 36" Sluice Gates	EA
Junction Box Slide Gates	EA
Peterson Lake Slide Gate	EA
Portable Electric Operator	JOB

\* \* \* \* \*

