US Army Corps
of Engineers
Great Lakes and Ohio River Division
LOUISVILLE DISTRICT / HUNTINGTON DISTRICT

Ohio River Mainstem Systems Study (ORMSS)

Interim Feasibility Report:

J.T. Myers and Greenup Locks Improvements

INDIANA, KENTUCKY and OHIO

Document ED-1:

J.T.Myers Engineering Site Appendix

April 2000

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

Interim Feasibility Report:

J.T. Myers and Greenup Locks Improvements

INDIANA, KENTUCKY and OHIO

Document ED-1:

J.T. Myers L&D Engineering Site Appendix

April 2000

Document ED-1:
J.T. Myers Engineering Site Appendix

Table of Contents

Item **Page**

SECTION 1 INTRODUCTION 1-1

1.1 PURPOSE AND SCOPE 1-1
1.2 STUDY AUTHORITY 1-1
1.3 DESIGN APPROACH 1-1
1.4 DESCRIPTION OF RECOMMENDED ALTERNATIVE 1-2
1.5 SUMMARY OF COST ESTIMATE AND LOCK CLOSURES 1-3

SECTION 2 HYDROLOGY AND HYDRAULICS 2-1

2.1 BASIC DATA 2-1
2.2 STAGE AND/OR DISCHARGE FREQUENCY RELATIONSHIPS 2-6
2.3 FLOOD FREQUENCIES (SMITHLAND, J.T. MYERS POOLS) 2-14
2.4 POOL HYDROGRAPHS 2-19
2.5 STAGE DURATION 2-45
2.6 LOCKSIM COMPUTER MODEL 2-54
2.7 FUTURE MODEL STUDIES 2-55
2.8 100-YR FLOODWAY 2-56
2.9 EXISTING AND POST-PROJECT SEDIMENTATION 2-56
2.10 ENVIRONMENTAL CONSIDERATIONS 2-57
2.11 WATER QUALITY 2-57

SECTION 3 SURVEYING AND MAPPING REQUIREMENTS 3-1

3.1 EXISTING SURVEY AND MAPPING 3-1
3.2 FUTURE SURVEY AND MAPPING 3-1

SECTION 4 GEOTECHNICAL ENGINEERING 4-1

4.1 SITE GEOLOGY 4-1
4.1.1 Physiography 4-1
4.1.2 Stratigraphy 4-1
4.1.3 Geologic Structure 4-2
4.2 SUBSURFACE EXPLORATIONS TO DATE 4-2
4.2.1 Boring Maps and Data 4-2
4.2.2 Test Sample Selection 4-4
4.2.3 Rock Mechanics Design Strengths 4-4
4.2.4 Soil Mechanics Design Strengths 4-6
4.3 FOUNDATION CONDITIONS 4-11
4.4 GROUNDWATER STUDIES 4-11

Table of Contents (continued)

Item **Page**

4.4.1 Dewatering 4-11
4.5 SEISMOLOGICAL STUDIES 4-12
4.6 FOUNDATION AND SLOPE ANALYSES 4-12
4.7 ANTICIPATED CONSTRUCTION TECHNIQUES 4-14
4.8 BORROW AND DISPOSAL SITES 4-14

SECTION 5 DESIGN CRITERIA 5-1

5.1 CIVIL CRITERIA 5-1
5.1.1 Existing Conditions 5-1
5.1.2 Design Guidance 5-2
5.1.3 Disposal 5-2
5.2 STRUCTURAL CRITERIA 5-3
5.2.1 General 5-3
5.2.2 Geotechnical Parameters 5-3
5.2.3 Navigation Conditions 5-5
5.2.4 Material Properties 5-6
5.2.4.1 Concrete 5-6
5.2.4.2 Reinforcement 5-6
5.2.4.3 Structural Steel 5-6
5.2.5 Loads and Load Combinations 5-7
5.2.5.1 Loads 5-7
5.2.5.2 Loading Conditions 5-10
5.2.5.3 Load Combinations 5-15
5.2.6 Stability and Sliding Criteria 5-18
5.2.7 References 5-19
5.2.7.1 Engineering Manuals 5-19
5.2.7.2 Engineering Circular & Engineering Technical Letters 5-20
5.2.7.3 Engineering Regulations 5-20
5.2.7.4 Technical Publications 5-20

SECTION 6 DESCRIPTION AND GENERAL LAYOUT 6-1

SECTION 7 7-1

7.1 DESIGN OF POSITIVE ENVIRONMENTAL ATTRIBUTES INTO THE PROJECT 7-1
7.2 INCLUSION OF ENVIRONMENTALLY BENEFICIAL OPERATIONS AND MANAGEMENT FOR THE PROJECT 7-1
7.3 BENEFICIAL USES OF SPOIL OR OTHER PROJECT REFUSE DURING CONSTRUCTION AND OPERATION 7-1
7.4 MAINTENANCE OF THE ECOLOGICAL CONTINUITY IN THE PROJECT WITH THE SURROUNDING AREA AND WITHIN THE REGION 7-2
7.5 CONSIDERATION OF INDIRECT ENVIRONMENTAL COSTS AND BENEFITS 7-2
7.6 INTEGRATION OF ENVIRONMENTAL SENSITIVITY INTO ALL ASPECTS OF THE PROJECT 7-2
7.7 INCORPORATION OF ENVIRONMENTAL COMPLIANCE MEASURES INTO THE PROJECT DESIGN 7-3

Table of Contents (continued)

Item **Page**

SECTION 8 CIVIL ENGINEERING....8-1

8.1 EARTHWORK AND BACKFILL....8-1
8.1.1 General Excavation....8-1
8.1.2 Dredging....8-2
8.1.3 Underwater Excavation of Limestone....8-3
8.1.4 Underwater Excavation of Shale....8-3
8.1.5 Instrumentation for Monitoring....8-3
8.1.6 Backfilling....8-3
8.2 FOUNDATION PREPARATION....8-4
8.3 DISPOSAL....8-5
8.4 BUILDINGS AND GROUNDS....8-5
8.4.1 Visitors Facilities....8-6
8.4.2 Public Use....8-6
8.4.3 Utility Relocations....8-7
8.4.4 Fencing and Signing....8-8
8.4.4.1 Fencing....8-8
8.4.4.2 Signing....8-8
8.4.5 Mooring Facility....8-8

SECTION 9 STRUCTURAL DESIGN....9-1

9.1 LOCATION AND SITE RESTRICTIONS....9-1
9.2 TYPE AND CONFIGURATION....9-2
9.2.1 New Land Wall Monoliths....9-2
9.2.2 Modified Middle Wall Monoliths....9-3
9.2.3 Lock Wall Accessories....9-4
9.2.4 Float-In Miter Gate Monoliths and Sill Structure (Miter Gate Bay)....9-4
9.2.5 Fill/Empty System....9-5
9.2.6 Culvert Valves....9-6
9.2.7 Approach Walls....9-7
9.3 SUBSTRUCTURE EVALUATION....9-8
9.4 CONSTRUCTION TECHNIQUES AND PROCEDURES....9-10
9.4.1 Wrap Around Culvert....9-10
9.4.1.1 Intake Structure and Wing Walls....9-10
9.4.1.2 Intake Culvert....9-11
9.4.1.3 Recommendation for Installation of Culvert Pipe....9-15
9.4.1.4 The 45° Elbow and Connection into the New Lock Wall....9-16
9.4.2 Float-In Wall Monolith....9-17
9.4.2.1 Design....9-17
9.4.2.2 Stability....9-17
9.4.3 Float-In Miter Gate Bay....9-18
9.4.3.1 Off-Site Construction....9-18
9.4.3.2 Transportation....9-19
9.4.3.3 Design....9-19
9.4.3.4 Temporary Support....9-21
9.4.3.5 Underbase Concrete Placement....9-22

Table of Contents (continued)

Item **Page**

9.4.3.6 Concrete Fill 9-23
9.4.4 Float-in Wall Diffuser Monolith 9-23
9.4.4.1 Design Considerations 9-23
9.4.4.2 Construction Method 9-24
9.4.5 Upper Middle Approach Wall Pylon 9-25
9.4.5.1 Pylon Protrusion Description 9-25
9.4.5.2 Fender Configuration 9-25
9.4.5.3 Construction Sequence 9-26
9.4.6 Lower Middle Approach Wall Pylon 9-26
9.4.6.1 Pylon Protrusion Description 9-26
9.4.6.2 Construction Sequence 9-27
9.4.7 Lower Landside Approach Wall Pylon 9-28
9.4.7.1 Pylon Protrusion Description 9-28
9.5 STABILITY ANALYSES 9-28
9.6 INITIAL STRESS ANALYSES 9-33
9.6.1 Intake Wingwalls 9-33
9.6.2 Float-in Land Wall 9-33
9.6.3 Approach Walls 9-35
9.6.4 Miter Gate Bay 9-35
9.7 INITIAL SEISMIC EVALUATION 9-36
9.8 INITIAL THERMAL STRESS ANALYSIS 9-36
9.9 ADDITIONAL STUDIES, TESTS AND 9-38
ANALYSES 9-38
9.9.1 Temperature Profiles 9-38

SECTION 10 MECHANICAL DESIGN 10-1

10.1 LOCK DEWATERING EQUIPMENT 10-1
10.1.1 Existing Maintenance Bulkheads 10-1
10.1.1.1 General 10-1
10.1.1.2 Condition of Existing Equipment 10-1
10.1.1.3 Proposed Rehabilitation 10-2
10.1.2 New Maintenance Bulkhead Slots 10-2
10.1.3 Existing Emergency Bulkheads 10-2
10.1.3.1 General 10-2
10.1.3.2 Condition of Existing Equipment 10-2
10.1.3.3 Proposed Rehabilitation 10-2
10.1.4 Existing Bulkhead Hoist and Crane 10-3
10.1.4.1 General 10-3
10.1.4.2 Condition of Existing Equipment 10-3
10.1.4.3 Proposed Rehabilitation 10-3
10.1.5 Existing Lock Dewatering Equipment 10-3
10.1.5.1 General 10-3

Table of Contents (continued)

Item **Page**

10.2 MITER GATES 10-4
10.2.1 Existing Miter Gates 10-4
10.2.1.1 General 10-4
10.2.1.2 Condition of Existing Equipment 10-4
10.2.1.3 Proposed Rehabilitation 10-4
10.2.2 New Miter Gates 10-4
10.2.3 Existing Gate Operating Machinery 10-5
10.2.3.1 General 10-5
10.2.3.2 Condition of Existing Equipment 10-5
10.2.3.3 Proposed Rehabilitation 10-5
10.2.3.4 New Miter Gate Operating Machinery 10-6
10.2.4 Existing Hydraulic Power System 10-7
10.2.4.1 General 10-7
10.2.4.2 Condition of Existing System 10-8
10.2.4.3 Proposed Modifications 10-8
10.2.5 New Hydraulic Power System 10-8
10.2.6 Existing Control Stations 10-10
10.2.7 New Control Stations 10-10
10.3 CULVERT VALVES AND BULKHEADS 10-11
10.3.1 Existing Culvert Valves 10-11
10.3.1.1 General 10-11
10.3.1.2 Condition of Existing Equipment 10-11
10.3.1.3 Rehabilitation of Existing Equipment 10-11
10.3.2 New Culvert Valves 10-11
10.3.3 Existing Culvert Valve Operating Machinery 10-14
10.3.3.1 General 10-14
10.3.3.2 Condition of Existing Equipment 10-14
10.3.3.3 Rehabilitation of Existing Operating Machinery 10-14
10.3.4 New Culvert Valve Operating Machinery 10-15
10.3.5 Existing Hydraulic Power System 10-16
10.3.5.1 General 10-16
10.3.5.2 Condition of Existing System 10-16
10.3.5.3 Proposed Modifications 10-17
10.3.6 New Hydraulic Power System 10-17
10.3.7 Existing Control Stations 10-17
10.3.8 New Control Stations 10-18
10.3.9 Existing Culvert Valve Bulkheads 10-18
10.3.9.1 General 10-18
10.3.9.2 Condition of Existing Bulkheads 10-18
10.3.9.3 Proposed Rehabilitation 10-18
10.3.10 New Culvert Valve Bulkheads 10-18

Table of Contents (continued)

Item **Page**

10.4 MISCELLANEOUS MECHANICAL SYSTEMS 10-19
10.4.1 Trashrake 10-19
10.4.2 Raw Water System 10-19
10.4.2.1 General 10-19
10.4.2.2 Condition of Existing System 10-19
10.4.2.3 Rehabilitation of Existing System 10-19
10.4.3 Compressed Air System 10-20
10.4.3.1 General 10-20
10.4.3.2 Condition of Existing System 10-20
10.4.3.3 Rehabilitation of Existing System 10-20
10.4.4 Potable Water System 10-20
10.4.5 Fuel Oil System 10-20
10.4.6 Sewage System 10-20

SECTION 11 ELECTRICAL DESIGN 11-1

11.1 GENERAL REQUIREMENTS 11-1
11.2 POWER SUPPLY AND DISTRIBUTION 11-1
11.3 STANDBY GENERATION 11-3
11.4 OPERATING AND CONTROL SYSTEM 11-4
11.5 GATE AND VALVE CONTROL 11-5
11.6 SIGNAL SYSTEM AND NAVIGATION LIGHTS 11-5

SECTION 12 HAZARDOUS AND TOXIC MATERIALS 12-1

SECTION 13 REAL ESTATE 13-1

SECTION 14 CONSTRUCTION PROCEDURES/WATER CONTROL PLAN 14-1

14.1 NEAR SITE WORK STATION 14-1
14.2 NEW MOORING FACILITY, INTAKE STRUCTURE, AND WRAP AROUND CULVERT 14-2
14.3 EXISTING LOWER LAND WALL END MONOLITHS - MODIFICATION AND DEMOLITION 14-3
14.4 EXISTING MIDDLE WALL MONOLITHS - MODIFICATION 14-4
14.5 FLOAT-IN LAND WALL MONOLITH 14-4
14.6 FLOAT-IN MITER GATE BAY AND CLOSURE POUR 14-5
14.7 LANDSIDE WALL DIFFUSER MONOLITH 14-6
14.8 MAINTENANCE BULKHEAD SILL, LATERALS AND MITER GATE 14-7
14.9 APPROACH WALLS 14-7
14.10 CONSTRUCTION REQUIREMENTS 14-8
14.10.1 Overall Site Plan - Construction Areas 14-8
14.10.2 Temporary Staging Area 14-8

SECTION 15 FLOOD EMERGENCY PLAN 15-1

SECTION 16 CONSTRUCTION MATERIALS 16-1

16.1 AGGREGATE SOURCES 16-1

Table of Contents (continued)

Item **Page**

SECTION 17 OPERATION AND MAINTENANCE 17-1

17.1 GENERAL 17-1
17.2 MOORING FACILITY 17-1
17.3 MITER GATE 17-1
17.4 LOCK WALLS 17-2
17.5 APPROACH WALLS 17-2
17.6 FILL/EMPTY SYSTEM 17-3
17.7 HELPER TUG 17-3
17.8 POOL MAINTENANCE AND DREDGING 17-3
17.9 O&M STAFFING AND COSTS 17-4

SECTION 18 ACCESS ROADS 18-1

SECTION 19 CORROSION MITIGATION 19-1

19.1 REFERENCE MATERIALS 19-1
19.2 GALVANIC CORROSION CONTROL MEASURES 19-2
19.3 CORROSION CONTROL MEASURES FOR SPECIFIC ELEMENTS 19-3
19.3.1 Approach Walls 19-3
19.3.2 Gates and Gate Guides 19-4
19.3.3 Monoliths 19-4
19.3.4 Filling/Empty System 19-4
19.3.5 Reinforcing Steel 19-5

SECTION 20 PROJECT SECURITY 20-1

SECTION 21 COST ESTIMATES 21-1

21.1 PLAN 1 21-1
21.1.1 Plan 1 Assumptions and Revisions 21-1
21.1.2 Plan 1 Cost Estimate 21-4
21.2 PLAN 1A 21-9
21.2.1 Plan 1A Assumptions and Revisions 21-9
21.2.2 Plan 1A Cost Estimate 21-12
21.3 PLAN 2 21-16
21.3.1 Plan 2 Assumptions and Revisions 21-16
21.3.2 Plan 2 Cost Estimate 21-18
21.4 PLAN 3 21-24
21.4.1 Plan 3 Assumptions and Revisions 21-24
21.4.2 Plan 3 Cost Estimate 21-28
21.5 PLAN 4 - PHASE 1 WORK 21-64
21.5.1 Plan 4 – Phase 1 Work, Assumptions and Revisions 21-64
21.5.2 Plan 4 – Phase 1 Work, Cost Estimate 21-66
21.6 PLAN 4 - PHASE 2 WORK 21-72
21.6.1 Plan 4 – Phase 2 Work, Assumptions and Revisions 21-72
21.6.2 Plan 4 – Phase 2 Work, Cost Estimate 21-74
21.7 COST COMPARISON 21-78
21.7.1 Comparison Between Plan 3 and Plan 4 Cost Estimates 21-78

Table of Contents (continued)

Item **Page**

SECTION 22 DESIGN AND CONSTRUCTION SCHEDULES 22-1

22.1 DESIGN SCHEDULE 22-1
22.1.1 Plan 3 Design Schedule 22-1
22.2 CONSTRUCTION SCHEDULE 22-5
22.2.1 Plan 3 –Construction Schedule 22-6
22.3 SCHEDULE OF APPROPRIATIONS 22-23

SECTION 23 SPECIAL STUDIES 23-1

23.1 WES MODEL STUDIES 23-1
23.1.1 Fill/Empty System Model 23-1
23.1.2 Navigation Model 23-1
23.1.3 Impact Loads 23-2
23.2 NONLINEAR INCREMENTAL STRUCTURAL ANALYSES (NISA) 23-2
23.3 SEISMIC ANALYSES 23-3
23.4 STUDIES TO MINIMIZE ZEBRA MUSSEL IMPACTS 23-4
23.5 FLOOD PLAIN ANALYSIS 23-4

List of Tables

Number	Title	Page
1.5A	Summary of Cost Estimates	1-4
2.1A	Ohio River Mainstem Hydraulic Characteristics of Locks	2-2
2.1B	Ohio River & Tributaries Drainage Areas	2-3
2.1C	Temperature Summary	2-4
2.1D	Precipitation Summary	2-5
2.4A	Ohio River at J.T. Myers (UPR) River Elevation Frequency Table For Period September 1975 - October 1998	2-20
2.5A	Ohio River at J.T. Myers (UPR) Elevation Duration Table for Period September 1975 - October 1998, Days	2-46
2.5B	Ohio River at J.T. Myers (UPR) Elevation Duration Table For Period October 1975 - September 1998, Percentage	2-47
2.5C	Ohio River at J.T. Myers (LWR) Elevation Duration Table For Period October 1975 - September 1998, Days	2-49
2.5D	Ohio River at J.T. Myers (LWR) Elevation Duration Table For Period October 1975 - September 1998, Percentage	2-50
4.2A	Rock Testing	4-4
4.2B	Rock Design Strengths	4-5
4.2C	Soil Design Strengths	4-6
4.4A	Permeabilities	4-12
4.6A	Slope Stability Analysis Summary	4-13
5.2.2A	Geotechnical Parameters	5-3
5.2.2B	Geotechnical Parameters	5-4
5.2.2C	Lateral Pressures	5-4
5.2.5.3A	Floating Approach Wall Pontoon Load Combinations	5-16
5.2.5.3B	Nose Pier, Pylon, and Lower Landside Approach Wall Load Combinations	5-17
5.2.6A	Stability and Sliding Criteria	5-18
9.5A	600' Lock Extension Stability Analysis Summary	9-30
10.2.3.4A	Advantages and Disadvantages of Miter Gate Operating Machinery	10-6
10.2.5A	Advantages and Disadvantages of Hydraulic Power Systems	10-8
10.3.2A	Advantages and Disadvantages of Culvert Valves	10-12
10.3.4A	Advantages and Disadvantages of Culvert Valve Operating Machinery	10-15
16.1A	Active Aggregate Sources	16-2
17.9A	Estimated Annual Cost of Operation and Ordinary Maintenance	17-4
22.2A	600' Lock Extension Construction Periods and Lock Closures	22-22
22.3A	J.T. Myers Auxiliary Lock Extension, Plan 4 Funding Stream	22-24

List of Figures

Number	Title	Page
1.5A	Summary of Lock Closures and Helper Tug Requirements	1-4
2.2A	Stage & Discharge Frequency Curves, Ohio River at Evansville, IN	2-8
2.2B	Stage & Discharge Frequency Curves, Ohio River at Lock & Dam 50	2-9
2.2C	Stage Frequency Curve, Ohio River at Evansville, IN	2-10
2.2D	Discharge Frequency Curve, Ohio River at Evansville, IN	2-11
2.2E	Stage Frequency Curve, Ohio River at J.T. Myers L&D - Upper Gage (Uniontown L&D)	2-12
2.2F	Stage Frequency Curve, Ohio River at J.T. Myers L&D - Lower Gage (Uniontown L&D)	2-13
2.3A	Ohio River Highwater Profiles Between River Miles 830 and 880	2-15
2.3B	Ohio River Highwater Profiles Between River Miles 790 and 830	2-16
2.3C	Ohio River Profiles Between River Miles 840 and 870	2-17
2.3D	Ohio River Profiles Between River Miles 810 and 840	2-18
2.4A	J.T. Myers L&D - Historical Water Elevations, Water Year 1975	2-21
2.4B	J.T. Myers L&D - Historical Water Elevations, Water Year 1976	2-22
2.4C	J.T. Myers L&D - Historical Water Elevations, Water Year 1977	2-23
2.4D	J.T. Myers L&D - Historical Water Elevations, Water Year 1978	2-24
2.4E	J.T. Myers L&D - Historical Water Elevations, Water Year 1979	2-25
2.4F	J.T. Myers L&D - Historical Water Elevations, Water Year 1980	2-26
2.4G	J.T. Myers L&D - Historical Water Elevations, Water Year 1981	2-27
2.4H	J.T. Myers L&D - Historical Water Elevations, Water Year 1982	2-28
2.4I	J.T. Myers L&D - Historical Water Elevations, Water Year 1983	2-29
2.4J	J.T. Myers L&D - Historical Water Elevations, Water Year 1984	2-30
2.4K	J.T. Myers L&D - Historical Water Elevations, Water Year 1985	2-31
2.4L	J.T. Myers L&D - Historical Water Elevations, Water Year 1986	2-32
2.4M	J.T. Myers L&D - Historical Water Elevations, Water Year 1987	2-33
2.4N	J.T. Myers L&D - Historical Water Elevations, Water Year 1988	2-34
2.4O	J.T. Myers L&D - Historical Water Elevations, Water Year 1989	2-35
2.4P	J.T. Myers L&D - Historical Water Elevations, Water Year 1990	2-36
2.4Q	J.T. Myers L&D - Historical Water Elevations, Water Year 1991	2-37
2.4R	J.T. Myers L&D - Historical Water Elevations, Water Year 1992	2-38
2.4S	J.T. Myers L&D - Historical Water Elevations, Water Year 1993	2-39
2.4T	J.T. Myers L&D - Historical Water Elevations, Water Year 1994	2-40
2.4U	J.T. Myers L&D - Historical Water Elevations, Water Year 1995	2-41
2.4V	J.T. Myers L&D - Historical Water Elevations, Water Year 1996	2-42
2.4W	J.T. Myers L&D - Historical Water Elevations, Water Year 1997	2-43
2.4X	J.T. Myers L&D - Historical Water Elevations, Water Year 1998	2-44
2.5A	Ohio River at J.T. Myers (Upper) For Year Elevation Duration Curve for Period October 1975 - September 1998)	2-48
2.5B	Ohio River at J.T. Myers (Lower) For Year Elevation Duration Curve for Period October 1975 - September 1998	2-51
2.5C	J.T. Myers L&D Upper Gage (January 1975 - December 1998)	2-52
2.5D	J.T. Myers L&D Lower Gage (January 1975 - December 1998)	2-53
4.1A	Generalized Geologic Section for Dam	4-3
4.2A	Shale, Peak Design Strength	4-7

List of Figures (continued)

Number	Title	Page
4.2B	Shale, Sliding Friction Design Strength	4-8
4.2C	Shale, Triaxial Strength	4-9
4.2D	Coal, Design Strengths	4-10

List of Drawings

Number	Title	Page
1.3A	600' Lock Ext. - Plan 1	1
1.3B	600' Lock Ext., Phase 2 of Plan 1 - Plan 1A	2
1.3C	600' Lock Ext. With Modifications - Plan 2	3
1.3D	600' Lock Ext. With Culverts - Plans 3	4
1.3E	600' Lock Ext., Phased Construction, Plan 4 – Phase 1	5
1.3F	600' Lock Ext., Phased Construction, Plan 4 – Phase 2	6
4.1A	Geologic Profile	7
4.2A	Boring Log Legend	8
4.2B	Boring Logs, ADC-521	9
4.2C	Boring Logs, ADC-521	10
4.2D	Boring Logs, ADC-522	11
4.2E	Boring Logs, ADC-523	12
4.2F	Boring Logs, ADC-524	13
4.2G	Boring Logs, ADC-525	14
4.2H	Boring Logs, ADC-526	15
4.2I	Boring Logs, ADC-527	16
4.2J	Boring Logs, ADC-528	17
4.2K	Boring Logs, ADC-529	18
4.2L	Boring Logs, ADC-530	19
4.2M	Boring Logs, ADC-531	20
4.2N	Boring Logs, ADC-532	21
4.2O	Boring Logs, ADC-533	22
4.2P	Boring Logs, ADC-533	23
4.6A	Historical Boring Locations	24
4.6B	Fall 1998 Boring Locations	25
4.6C	Slope Stability Analysis	26
4.6D	Slope Stability Analysis	27
6.0A	600' Lock Extension - Documented Design	28
6.0B	600' Lock Ext., F/E System - Plan & Profile, Drawing 1	29
6.0C	600' Lock Ext., F/E System - Plan & Profile, Drawing 2	30
6.0D	600' Lock Ext., Landside Wall Diffuser Details	31
6.0E	600' Lock Ext., Upper River Approach Wall	32
6.0F	600' Lock Ext., Upper Middle Approach Wall	33
6.0G	600' Lock Ext., Upper Middle & River Approach Wall Cross Sections	34
6.0H	600' Lock Ext., Lower Middle Approach Wall	35
6.0I	600' Lock Ext., Lower Land Approach Wall	36
6.0J	600' Lock Ext., Lower Middle & Land Approach Wall Cross Sections	37
6.0K	600' Lock Ext., Upper River Appr. Wall Nose Pier & Pylon Details	38
6.0L	600' Lock Ext., Upper Middle Appr. Wall Nose Pier & Pylon Details	39
6.0M	600' Lock Ext., Lower Middle Appr. Wall Nose Pier & Pylon Details	40
6.0N	600' Lock Ext., Lower Land Appr. Wall Nose Pier & Pylon Details	41
6.0O	600' Lock Ext., Nose Pier & Pylon Construction Sequence	42
8.1.1A	600' Lock Ext., Lower Approach Channel Improvement	43
8.3A	600' Lock Ext., Disposal Area General Plan	44
8.3B	600' Lock Ext., Disposal Cross Section	45
8.4.3A	600' Lock Ext., Utilities	46
9.4.1A	600' Lock Ext., Wrap Around Culv. Intake Structure & Wingwall	47
9.4.1B	600' Lock Ext., Wrap Around Culvert, Option "A", Drawing 1	48

List of Drawings (continued)

Number	Title	Page
9.4.1C	600' Lock Ext., Wrap Around Culvert, Option "A", Drawing 2	49
9.4.1D	600' Lock Ext., Wrap Around Culvert, Option "B", Drawing 1	50
9.4.1E	600' Lock Ext., Wrap Around Culvert, Option "B", Drawing 2	51
9.4.1F	600' Lock Ext., Wrap Around Culvert, Typical Section	52
9.4.2A	600' Lock Ext., Float-In Wall Monolith - Sections	53
9.4.2B	600' Lock Ext., Float-In Wall Monolith - Plan	54
9.4.3A	600' Lock Ext., Float-In Gate Bay, Drawing 1	55
9.4.3B	600' Lock Ext., Float-In Gate Bay, Drawing 2	56
9.4.3C	600' Lock Ext., Float-In Gate Bay-Steel Pipe Col. & Jackup Leg Details	57
9.4.4A	600' Lock Ext., Float-In Landside Wall Diffuser Constr., Drawing 1	58
9.4.4B	600' Lock Ext., Float-In Landside Wall Diffuser Constr., Drawing 2	59
9.6.2A	600' Lock Ext., Land Wall Lift-In Buttress Details, Drawing 1	60
9.6.2B	600' Lock Ext., Land Wall Lift-In Buttress Details, Drawing 2	61
10.0A	600' Lock Ext., Equipment Location, Drawing 1	62
10.0B	600' Lock Ext., Equipment Location, Drawing 2	63
10.0C	600' Lock Ext., Miter Gate Machinery General Arrangement	64
10.0D	600' Lock Ext., Culvert Valve General Arrangement	65
11.2A	600' Lock Ext., Existing & New Power Distrib., One Line Diagram	66
13.0A	Real Estate Map	67
13.0B	Real Estate Map	68
13.0C	In-Stream Mitigation Sites	69
14.9.2A	600' Lock Ext., Upstream Temporary Constr. Requirements	70
14.9.2B	600' Lock Ext., Downstream Temporary Constr. Requirements	71

Overall Report Structure

Document Code	Title
MR	**Main Report and EIS**
PF	**Plan Formulation Appendix**
EC	**Economics Appendix**
GE	**General Engineering Appendix**
ED-1	**J.T.Myers Engineering Site Appendix**
ED-2	**Greenup Engineering Site Appendix**
RE	**Real Estate Appendix**

THIS DOCUMENT

SECTION 1

INTRODUCTION & SUMMARY

1.1 PURPOSE AND SCOPE

The purpose of this appendix is to present the feasibility level design for large scale navigation improvements at the John T. Myers Locks & Dam site. The appendix includes preliminary engineering, design, schedules, and cost estimates. These elements formed the basis for the assessment of the costs and benefits associated with large scale navigation improvements presented in the Main Report of the Feasibility Study. The preliminary calculations and design, which are summarized in this appendix, were completed to the feasibility level of detail.

1.2 STUDY AUTHORITY

Authorization for the Ohio River Mainstem Systems Study was given in the resolution adopted by the Committee on Public Works of the U.S. Senate, dated 16 May 1955. Further authorization was given by a resolution adopted by the U.S. House of Representatives Committee on Public Works and Transportation on 11 March 1982.

On 29 September 1995, the Louisville District Corps of Engineers gave INCA Engineers, Inc. notice-to-proceed on work for Contract No. DACW27-95-C-0126 for Preparation of Engineering Appendices to the Ohio River Mainstem Systems Study Feasibility Report. This work was accomplished in conjunction with the Louisville District staff.

1.3 DESIGN APPROACH

Two prototype designs were developed for expanding lock capacity along the Ohio River Mainstem System. The first design was for an extension of the existing 110' x 600' lock downstream to form a 110' x 1200' lock. The second design was for a new 110' x 1200' lock immediately landward of the existing 110' x 600' lock. In addition, alternate configurations of lock components were explored, including alternate inlet and outlet layouts. After reviewing and evaluating all alternatives, innovative design layouts (which incorporated fast fill/empty systems and could be utilized at a number of sites along the Ohio River Mainstem) were chosen for the two prototype designs. In order to develop these prototype designs, the John T. Myers site was chosen as the prototype site.

Based on subsequent economic analyses, the John T. Myers and Greenup sites were selected for site specific improvements. Once these sites were selected, the prototype designs were further developed in order to provide feasibility level of detail. As a result of continued engineering and economic studies, it was determined that the design consisting of an extension of the existing 110' x 600' lock was a preferred alternative. Several different implementations of the 600' lock extension design were considered, including phased construction alternatives. The following 600' lock extension design plans were considered:

- Plan 1 – Auxiliary Lock Extension
- Plan 1A – Phase 2 of Plan 1, Construct Supplemental F/E System
- Plan 2 – Auxiliary Lock Extension with Modifications
- Plan 3 – Auxiliary Lock Extension with Culverts
- Plan 4 – Auxiliary Lock Extension, Phased Construction

Drawings 1.3A – 1.3F show the overall layouts of these five 600' lock extension plans. Cost estimates are also provided for the five plans. The engineering appendix describes Plan 3, which provides for the construction of a full 1200' (minimum) lock by the extension of the existing 600' lock and provides for full filling and emptying systems. Design and construction schedules are also provided for Plan 3.

Information that pertains to preliminary alternate configurations, as well as general information that pertains to the Ohio River Mainstem, can be found in the Main Report and the General Engineering volume.

1.4 DESCRIPTION OF RECOMMENDED ALTERNATIVE

In the process of selecting the recommended alternative, numerous plans and designs have been examined. Once it was determined that an extension of the auxiliary 600' lock chamber was preferred over a new landward 1200' lock chamber, the engineering team decided to concentrate their efforts on Plan 3. However, variations of the lock extension design were investigated in order to determine the preferred implementation of the auxiliary lock extension alternative. Plan 3 contains all of the design features that were under consideration for an extension of the 600' auxiliary lock with filling and emptying features. As described in the Main Report, Plan 3 was chosen as the recommended alternative. This plan calls for extension of the existing 600' lock to a minimum of 1200' lock length, with a supplemental fill/empty system.

Plan 3 provides for the extension of the existing 600' lock, downstream of the existing structures, to form a minimum of a 1200' lock. This extension is accomplished by demolishing existing land wall monolith L-1, extending the existing land wall with a 463-foot long float-in monolith, and adding a downstream float-in miter gate bay monolith. The existing 600' lock chamber fill/empty system will be augmented in order to maintain the approximate fill/empty time of the existing lock chambers. The supplemental fill/empty system consists of a culvert which wraps around the existing lock land wall, is incorporated into the new float-in land wall extension, splits into laterals, and empties into the lower approach using a landside wall diffuser

outlet. A culvert-type intake, which was developed and modeled for the Robert C. Byrd Locks & Dam, is used for the fill/empty culvert inlet. The culvert inlet and wrap around culvert construction requires relocation of the existing upstream mooring facility. The new inlet valve is also located along a portion of the wrap around culvert, in a stand-alone valve monolith. Four new approach walls are required for the 600' lock extension alternative design. The overall layout for Plan 3 is shown in ***Drawing 1.3D***.

1.5 SUMMARY OF COST ESTIMATE AND LOCK CLOSURES

The following table and figure summarize the feasibility level cost estimate and the required lock closures for the recommended design alternative.

TABLE 1.5A
Summary of Cost Estimate
(Cost in Millions)

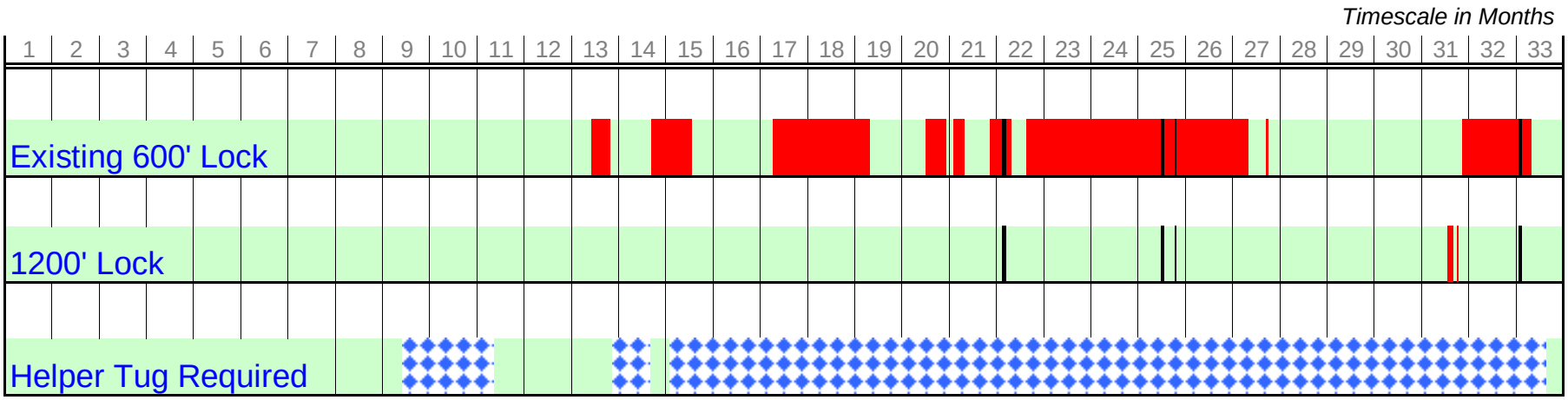
	Recommended Alternative Plan 3
Construction Cost Including Contingencies	$139.2
Fish & Wildlife	$4.6
PED (Preconstruction Eng. & Design)	$19.8
Construction Management	$9.5
Total	$173.1

This is a feasibility level cost estimate, which includes line item costs for PED, environmental mitigation for fish & wildlife, and construction management. Future studies will refine this cost estimate and reduce the associated contingencies. However, ***Table 1.5A*** provides feasibility level costs, for relative comparisons of this alternative with others that were considered, as well as a reasonable baseline for future design phases. See Section 21 for detailed MCACES cost estimate summaries.

Figure 1.5A provides a graphical overview of required lock closures and helper tug durations. More detailed information pertaining to lock closures and associated tasks is shown in the construction schedule and ***Table 22.2A***.

FIGURE 1.5A
Summary of Lock Closures and Helper Tug Requirements During Construction

Plan 3 - Recommended Alternative



Legend

- Chamber Open for Traffic
- Full Closure of Chamber
- Simultaneous Closure of Both Chambers
- Helper Tug Required

SECTION 2

HYDROLOGY AND HYDRAULICS

The General Engineering volume provided a number of general hydrology and hydraulics topics, which referred to the entire Ohio River basin. Some of these topics included drainage areas at gaging stations, tributaries, etc. and the location, area controlled and impounding dates of lake flood-control projects. Other data, such as temperature and precipitation, was provided at a sample station in each district. Likewise historical and frequency flood profiles were shown for a sample reach in each district. The sample data are replaced by site-specific data for the John T. Myers project in this Site Engineering Appendix. Additional pertinent hydrology and hydraulic data are included in order to aid in the scheduling of construction activities.

2.1 BASIC DATA

John T. Myers Lock and Dam (formerly known as Uniontown) is located on the Ohio River at Mile 846 which is about 2 miles upstream from where the states of Kentucky, Indiana, and Illinois meet. The drainage area at the damsite is 108,000 square miles. The Wabash River, having a drainage area of 33,100 square miles, forms the southernmost portion of the state line between Indiana and Illinois. J. T. Myers L&D is located between Newburgh L&D upstream and Smithland L&D downstream, and is part of the lower Ohio River navigation system. ***Table 2.1A*** provides basic and hydraulic characteristics of the locks in this reach of the Ohio River. ***Table 2.1B*** shows the drainage areas and location of tributaries and other features for the lower part of the Ohio River. The City of Evansville, Indiana is located about 30 miles northeast of the J. T. Myers dam site. ***Tables 2.1C*** and ***2.1D*** provide Evansville temperature and precipitation data respectively for the period 1961-1990 and extreme conditions for the period 1896-1996.

TABLE 2.1A
OHIO RIVER MAINSTEM HYDRAULIC CHARACTERISTICS OF LOCKS

	McALPINE	CANNELTON	NEWBURGH	J T MYERS	SMITHLAND	OLMSTED
GENERAL	(L/D 41)			(Uniontown)	(Dog Island)	(Under Construction)
River Mile	606.8	720.7	776.1	846	918.5	964.4
District	Louisville	Louisville	Louisville	Louisville	Louisville	Louisville
In-Service Date	1961-2003	1971	1975	1975	1979	2008 (Scheduled)
Upper Pool Elevation	420	383	358	342	324	295-301
Lower Pool Elevation	383	358	342	324	302	Uncontrolled
Lift (ft)	37	25	16	18	22	21 (Nominal)
Top/Lock Elevation	443	402	380	362	344	310
Lock/Out Elevation	440	399	377	359	341	295-301
LOCK SIZES						
Main Lock	1200' x 110'	1200' x 110'	1200' x 110'	1200' x 110'	1200' x 110'	1200' x 110'
Auxiliary Lock	1200' x110' (2003)	600' x 110'	600' x 110'	600' x 110'	1200' x 110'	1200' x 110'
FILLING/EMPTYING SYSTEM						
Main Lock Type	Split Lateral (Existing)	Side Port	Side Port	Side Port	Side Port	Side Port
Culvert Size	16' x 18'	16' x 18'	14' x 16'	14' x 16'	14' x 18'	14' x 18'
Operating Valves	Reverse Tainter	Reverse Tainter	Reverse Tainter	Reverse Tainter	Reverse Tainter	Reverse Tainter
Discharge Location	River - Direct	River - Direct	River - Direct	River - Direct	River - Direct	River - Direct
Depth Over Sill	18.0'U - 12.0'L	15.0'U - 15.0'L	18.0'U - 16.0'L	20.0'U - 16.0'L	34.0'U - 15.0'L	34' to 40'U - 18'L
Aux Lock Type	Central Culverts (UC)	Bottom Lateral	Bottom Lateral	Bottom Lateral	Side Port	Side Port
Culvert Size	16' x 18'	16' x 18'	14' x 16'	14' x 16'	14' x 18'	14' x 18'
Operating Valves	Reverse Tainter	Reverse Tainter	Reverse Tainter	Reverse Tainter	Reverse Tainter	Reverse Tainter
Discharge Location	Lower Approach	River - Direct	River - Direct	River - Direct	River - Direct	River - Direct
Depth Over Sill	18.0'U - 16.0'L	15.0'U - 15.0'L	18.0'U - 16.0'L	20.0'U - 16.0'L	34.0'U - 15.0'L	34' to 40'U - 18'L
APPROACH WALLS	(Upper Approach in Canal)					
Main Lock - Upper Wall						
Type	Guard (Ported)	Guard (Ported)	Guard (Ported)	Guard (Ported)	Guard (Ported)	Guard (Floating)
Length (Useable)	1010'	1188'	1190'	1198'	900'	900'
- Lower Wall						
Type	Guard (Ported)	Guard (Solid)	Guard (Solid)	Guard (Solid)	Guard (Solid)	Guard (Floating w/ Curtains)
Length (Useable)	1094'	1002'	1009'	998'	1050'	852'
Aux Lock - Upper Wall						
Type	Guide	Guide	Guide	Guide	Guard (Ported)	Guard (Floating)
Length (Useable)	390'	430'	310'	310'	600'	767'
- Lower Wall						
Type	Guide	Guide	Guard	Guard	Guide	Guide (Fixed)
Length (Useable)	600'	439'	426'	448'	450'	359'
NAVIGABLE WEIRS						
Type	None	None	1300'	2100'	1572'	1400'
Length	N/A	N/A	Fixed	Fixed	Fixed	Boat Operated Wickets
REMARKS						

NOTES: "Useable" Length of approach walls means that length of wall available to an approaching tow for landing.
"Depth over sill" means depth over highest feature in the approach, usually a bulkhead sill
"Aux Lock" refers to the landward 1200' lock at the McAlpine, Smithland and Olmsted projects.

TABLE 2.1B OHIO RIVER & TRIBUTARIES
DRAINAGE AREAS

RIVER MILE	LOCATION	TRIBUTARIES DRAINAGE AREA (S.M.)	OHIO RIVER DRAINAGE AREA (S.M.)
663.2	Dam 44		95,685
703.0	Dam 45		96,260
720.7	Cannelton Dam		96,700
727.8	Tell City		96,750
757.3	Dam 46		97,180
755-757	Owensboro, KY		97,200
776.1	Newburg Dam		97,690
777.7	Dam 47		97,690
784.2	Green River	9,230	
792.4	Evansville		107,000
803.9	Henderson, KY		107,600
809.6	Dam 48		107,600
829.2	Mt. Vernon, IN		107,700
845.0	Dam 49		107,965
846.0	J.T. Myers (formerly "Uniontown") Dam		108,000
848.0	Wabash River	33,100	
867.3	Saline River	1,170	
873.4	Tradewater River	1,000	
876.8	Dam 50		143,400
903.1	Dam 51 (Golconda, IL)		143,900
918.5	Smithland Dam		
920.4	Cumberland River	17,920	
934.5	Tennessee River	40,910	
938.9	Dam 52		202,830
943.6	Metropolis, IL		203,000
962.6	Dam 53		203,100
974.2	Mound City, IL		
981.0	Mouth of the Ohio River		203,943

TABLE 2.1C
TEMPERATURE SUMMARY

Station: (122738) EVANSVILLE_WSO_AP **Missing Data: 0%**

Averages: 1961-1990 Extremes: 1896-1996

	Averages			Daily Extremes				Mean Extremes				NCDC Averages			
												#Day-Max		#Day-Min	
	Max	Min	Mean	High	Date	Low	Date	High	Yr	Low	Yr	=> 90	<= 32	<= 32	<= 0
Jan.	38.9	21.2	30.1	76	24/1943	-21	17/1977	43.9	33	14.8	77	0	7.6	22	1.3
Feb.	43.7	25.0	34.4	79	13/1962	-23	02/1951	46.3	32	21.0	78	0	5.1	19	0.6
Mar.	55.9	35.7	45.8	87	24/1929	-9	06/1960	57.2	10	30.2	60	0	1.1	12	0
April	67.4	45.0	56.2	91	26/1989	23	03/1987	62.9	25	47.8	7	0	0	2.0	0
May	76.9	54.2	65.5	98	28/1911	28	01/1963	74.4	62	60.3	24	1.5	0	0	0
June	86.2	63.3	74.8	104	26/1954	41	02/1956	81.1	52	69.3	55	9.2	0	0	0
July	89.1	67.5	78.4	111	28/1930	47	16/1930	85.1	36	72.8	47	15	0	0	0
Aug.	87.2	64.9	76.1	105	08/1930	43	29/1986	84.1	36	70.1	67	12	0	0	0
Sep.	80.7	57.6	69.2	104	06/1925	31	28/1942	78.3	25	63.2	74	5.2	0	0	0
Oct.	69.6	44.7	57.2	94	02/1953	21	22/1952	66.2	0	51.2	87	0.3	0	1.7	0
Nov.	55.9	36.5	46.2	83	02/1961	-3	25/1950	55.7	31	38.7	76	0	0.6	11	0
Dec.	43.6	26.7	35.2	77	02/1982	-15	22/1989	46.7	23	23.0	89	0	4.9	20	0.4
Annual	66.3	45.2	55.8	111	07/28/30	-23	02/02/51	60.8	21	53.8	79	43	19	88	2.4
Winter	42.1	24.3	33.2	79	02/13/62	-23	02/02/51	45.1	32	25.1	78	0	17	61	2.3
Spring	66.7	45.0	55.8	98	05/28/11	-9	03/06/60	61.6	77	50.3	60	1.6	1.1	14	0
Summer	87.5	65.2	76.4	111	07/28/30	41	06/02/56	82.2	36	72.3	67	36	0	0	0
Fall	68.7	46.3	57.5	104	09/06/25	-3	11/25/50	65.1	31	52.7	76	5.5	0.6	13	0

TABLE 2.1D
PRECIPITATION SUMMARY

Station: (122738) EVANSVILLE_WSO_AP Missing Data: 0%
Averages: 1961-1990 Extremes: 1896-1996

	Total Precipitation							Snow			#Days Precip		
	Mean	High--Yr		Low--Yr		1-Day Max		Mean	High—Yr		=>.01	=>.50	=>1.
Jan.	2.66	14.78	37	0.51	81	3.72	22/1982	4.9	21.3	77	10.8	2.2	1.0
Feb.	3.12	7.25	56	0.27	47	3.00	13/1946	4.3	18.4	93	9.4	2.0	0.6
Mar.	4.71	12.84	64	0.01	10	4.25	9/1964	2.6	20.2	60	11.7	2.9	1.0
April	4.02	11.83	96	0.40	15	6.04	28/1996	0.5	8.6	71	11.6	2.7	1.0
May	4.75	13.51	95	0.59	13	4.92	17/1995	0.0	0.0	48	11.3	2.8	1.0
June	3.49	11.44	0	0.38	33	4.71	15/1900	0.0	0.0	48	9.8	2.5	0.9
July	4.04	10.32	10	0.18	1	4.75	1/1897	0.0	0.0	48	8.8	2.4	1.0
Aug.	3.11	8.43	77	0.13	43	3.77	10/1908	0.0	0.0	48	7.8	2.0	1.0
Sep.	2.97	9.89	45	0.25	28	4.39	20/1924	0.0	0.0	48	7.6	2.0	0.8
Oct.	2.87	11.19	10	0.01	64	6.50	5/1910	0.0	4.6	93	7.6	2.0	0.7
Nov.	3.73	9.24	21	0.20	4	3.52	18/1921	0.6	6.9	58	9.1	2.4	0.8
Dec.	3.67	8.23	82	0.56	76	4.87	30/1932	2.6	10.4	73	10.4	2.4	0.7
Annual	43.14	64.00	96	25.55	30	6.50	10/ 5/10	15.4	36.4	60	116.1	28.3	10.6
Winter	9.45	24.38	50	3.77	77	4.87	12/30/32	11.8	27.8	78	30.6	6.6	2.3
Spring	13.48	24.34	96	4.04	30	6.04	4/28/96	3.0	20.2	60	34.8	8.4	3.1
Summer	10.64	19.83	77	2.59	36	4.75	7/ 1/-3	0.0	0.0	48	26.5	6.9	2.9
Fall	9.57	17.64	96	2.95	63	6.50	10/ 5/10	0.6	6.9	58	24.2	6.4	2.3

2.2 STAGE AND/OR DISCHARGE FREQUENCY RELATIONSHIPS

The Corps of Engineers Lakes and Rivers Division (successor to the Ohio River Division (ORD)) periodically provided to each district bordering the Ohio River, natural and modified (reflecting reductions attributable to upstream lake projects) stage and discharge-frequency curves at a number of gage locations along the river. The updates resulted from additional lake projects being added. The last set provided were dated April 1976. Since projects added since that date have minimal effects on the data, these curves are considered current. Copies of these curves with stage and discharge values are shown for various frequency of occurrence at the Evansville gage (river mile 792.3) (***Figure 2.2A***) and at Lock & Dam 50 (river mile 876.6) (***Figure 2.2B***). These were the two closest gage locations to the J. T. Myers L&D at river mile 846. These curves were based on maximum annual peaks only and did not include partial, multiple yearly peaks in the statistical analysis.

The J. T. Myers L&D was authorized as a replacement for Locks and Dams 47, 48 and 49. Construction of the lock portion of the project started in June 1965 and was completed and placed in operation in December 1969. Construction on the dam started in May 1970, the pool raised to its final level in January 1975, and all construction was completed in 1977. During this same time period, Newburgh L&D was being constructed about 16 miles upstream of Evansville to replace Locks and Dams 46 and 47. Construction of the lock started in June 1966 and was completed and placed in operation in December 1969. Dam construction started in June 1970, the pool was raised to its final level in January 1975 and all construction was completed in 1975. Smithland L&D is located downstream from the J. T. Myers project on the Ohio River at stream mile 918.5. Lock construction was started in 1971 and completed in 1979. The dam construction was started in 1974 and completed in November 1980.

It was known that the April 1976 curves were basically correct for the 10% chance exceedence flood frequency (commonly known as the 10-year flood) and less frequent floods. Since there was not a gage at the location of the present Myers project before it was built, the period-of- record was not long enough at that time to properly analyze discharges and stages for more frequent flood events.

Within the last year, an analysis has been made to compare actual peaks that have occurred since the present pools were established and compare the results to the 1976 Ohio River curves developed in the Division Office. Of special concern was the plotting of the partial duration portion of the curve so that elevations of the more frequent occurrence floods could be better estimated. At the Evansville gage, the partial peaks for the 29-year period (1970-1998) were plotted versus the Ohio River Division curve data, as shown in ***Figure 2.2A***. The stage-frequency curve and discharge-frequency curve for the Evansville gage are shown as ***Figures 2.2C*** and ***2.2D*** respectively and includes the blending of the annual events with partial duration data. Partial duration stage data has been plotted with results from the HEC-2 model study for the Ohio River at J. T. Myers site since data has been collected. These results are shown for the upper gage and lower gage in ***Figures 2.2E*** and ***2.2F*** respectively.

The analyses that have been made within the last year have been forwarded to the Division Office for review and concurrence. Ohio River data developed by the Division Office

in 1976 generally provide smooth transitions when plotted with the partial duration data for locations above the Wabash River.

FIGURE 2.2A

LAKES AND RIVERS DIVISION (LRD)

STAGE & DISCHARGE FREQUENCY CURVES

OHIO RIVER AT EVANSVILLE, IN (1976 UPDATE)

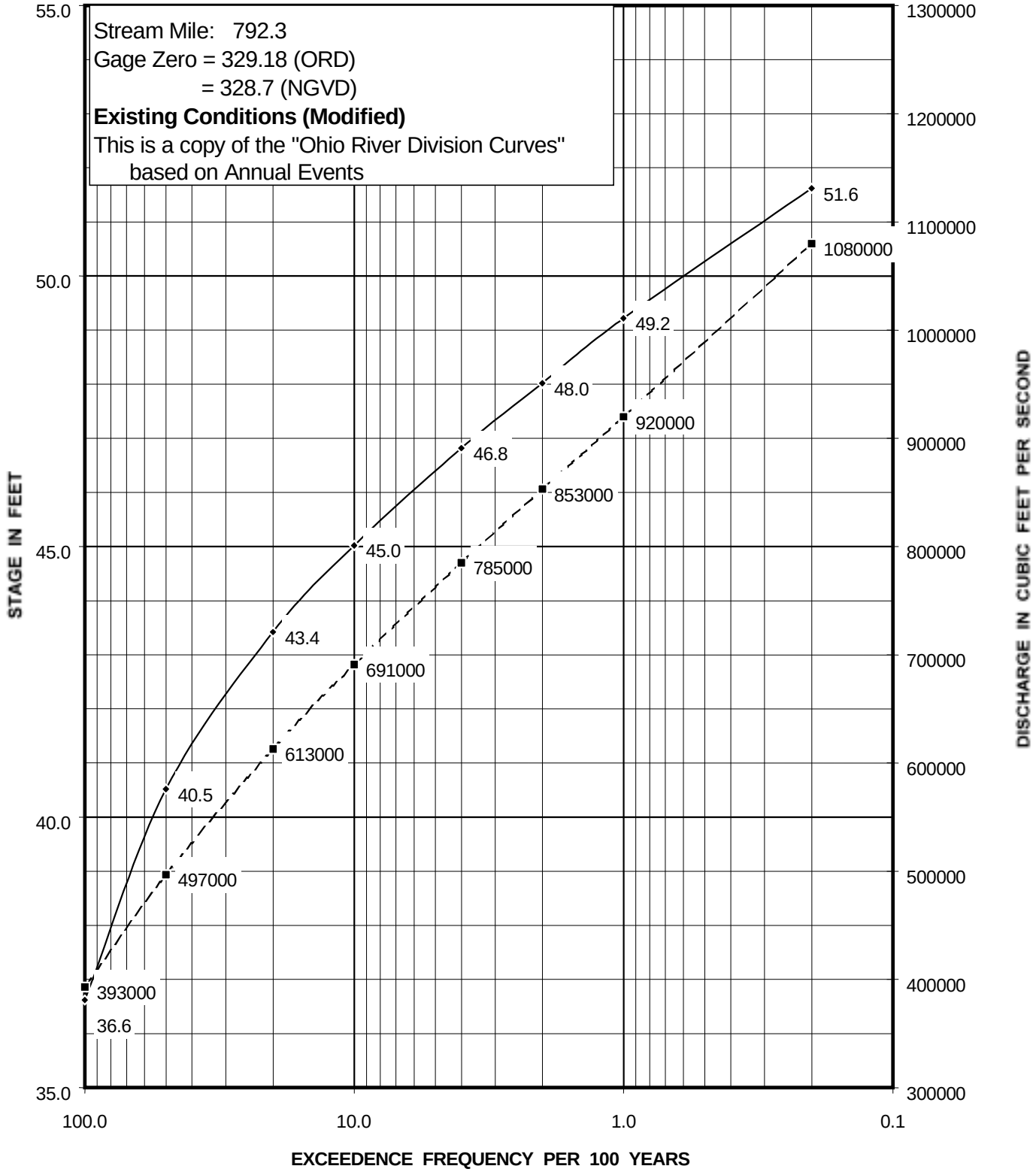


FIGURE 2.2B

LAKES AND RIVERS DIVISION (LRD)

STAGE & DISCHARGE FREQUENCY CURVES

OHIO RIVER AT LOCK & DAM 50 UPPER GAGE (1976 UPDATE)

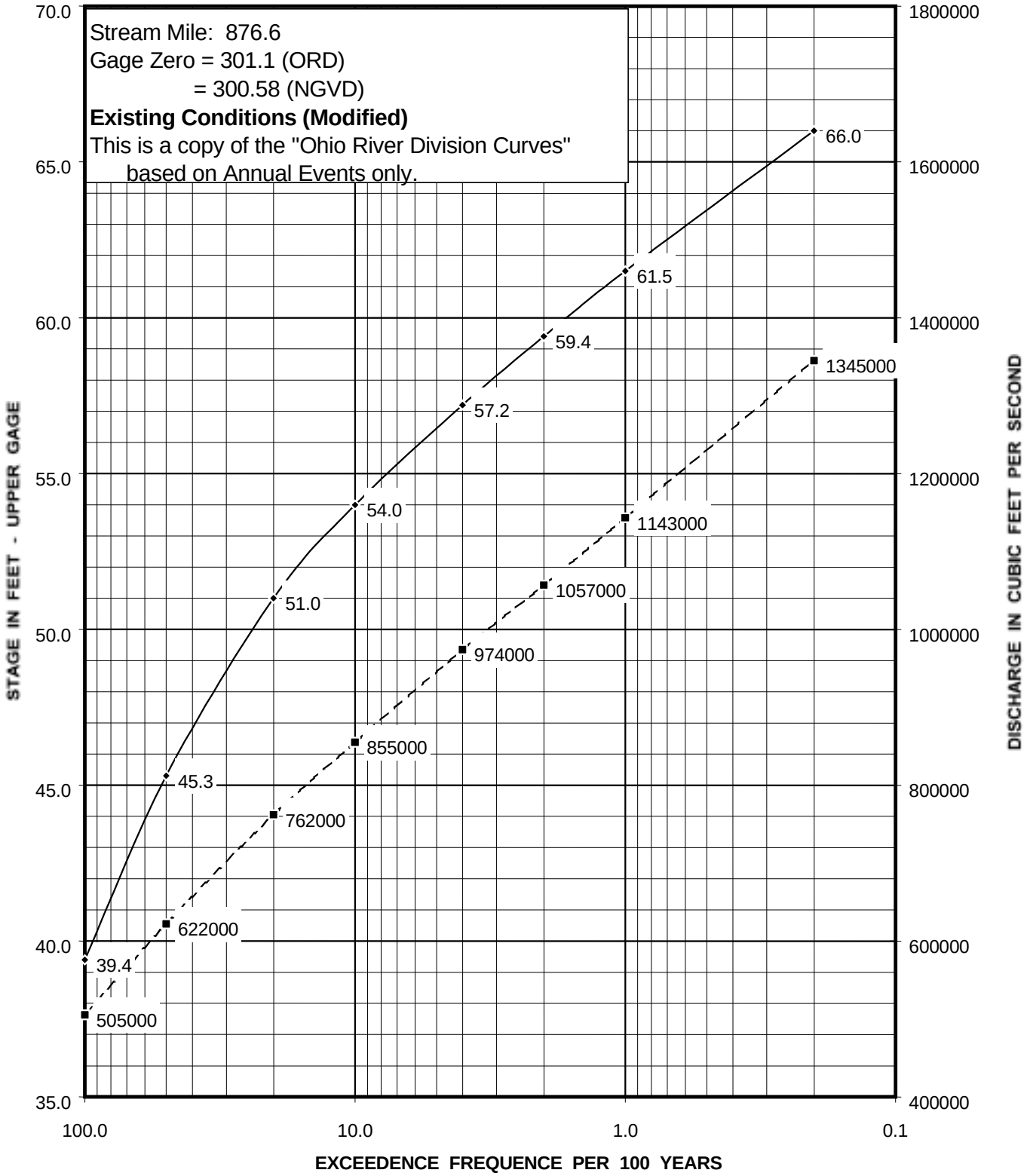


FIGURE 2.2C
STAGE FREQUENCY CURVE
OHIO RIVER AT EVANSVILLE, IND.
(Comparison of 1976 with 1998 Update)

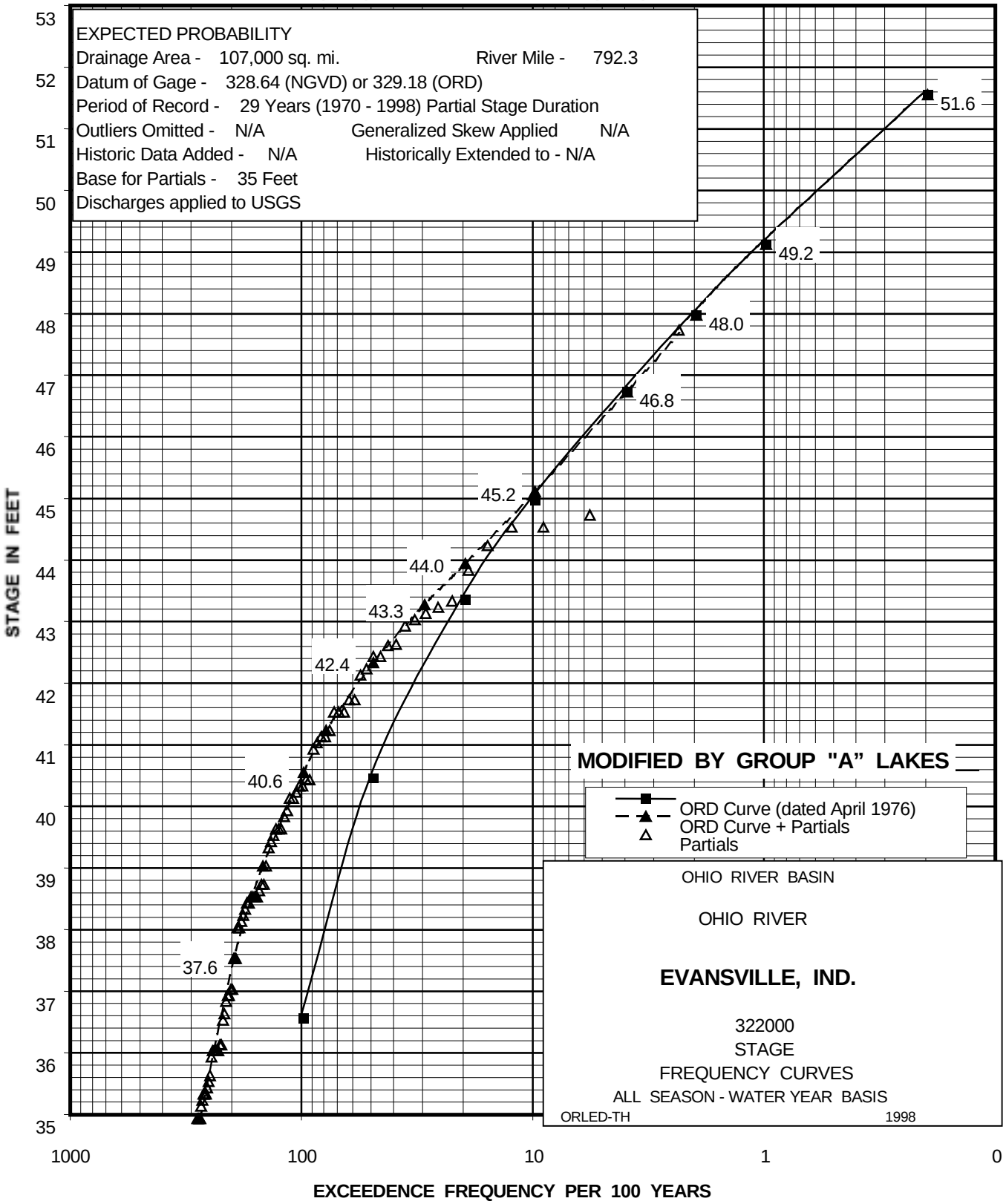


FIGURE 2.2D
DISCHARGE FREQUENCY CURVE
OHIO RIVER AT EVANSVILLE, IND.
(Comparison of 1976 with 1998 Update)

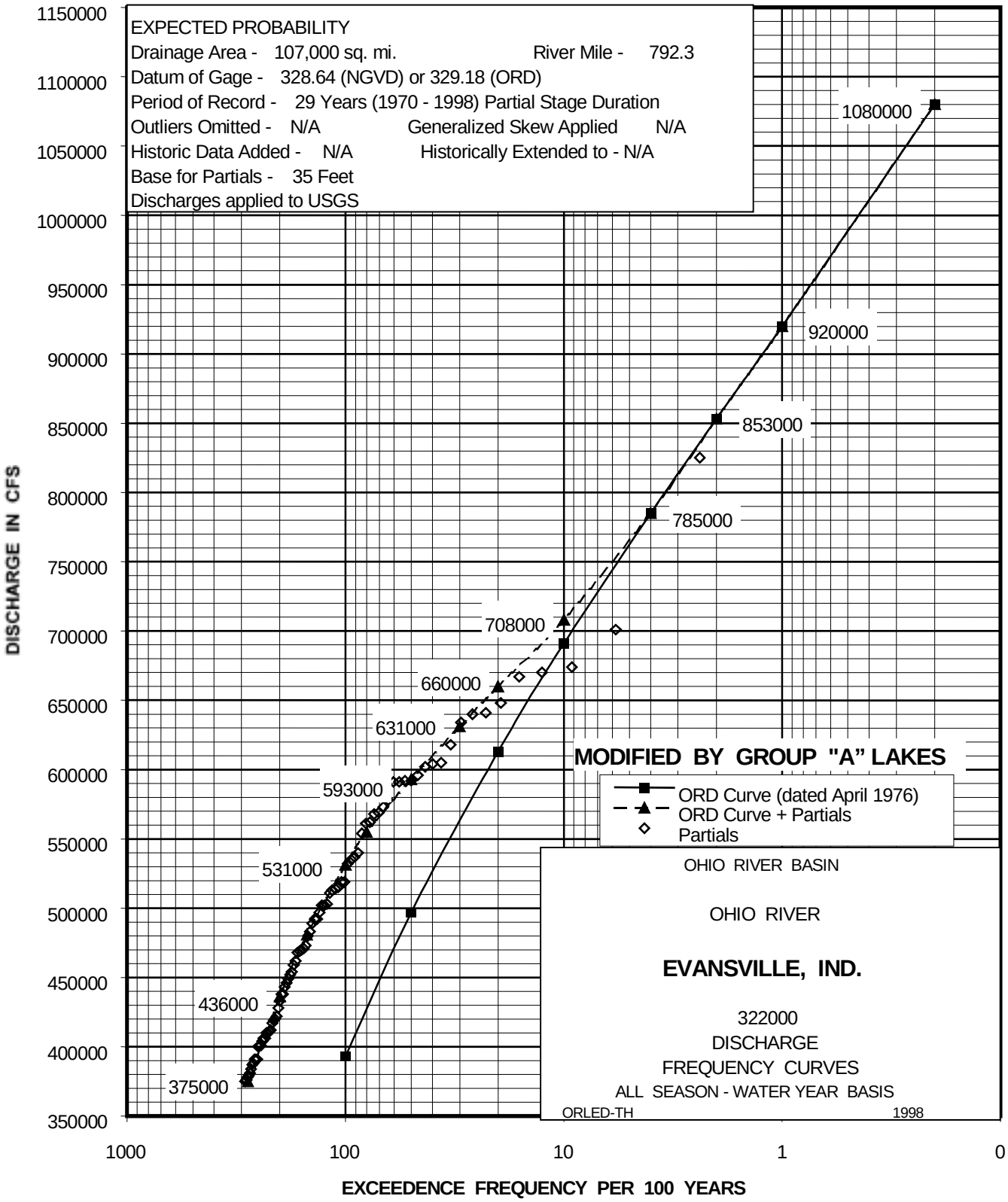


FIGURE 2.2E
STAGE FREQUENCY CURVE
OHIO RIVER AT T. J. MYERS L & D - UPPER GAGE
(UNIONTOWN L & D)

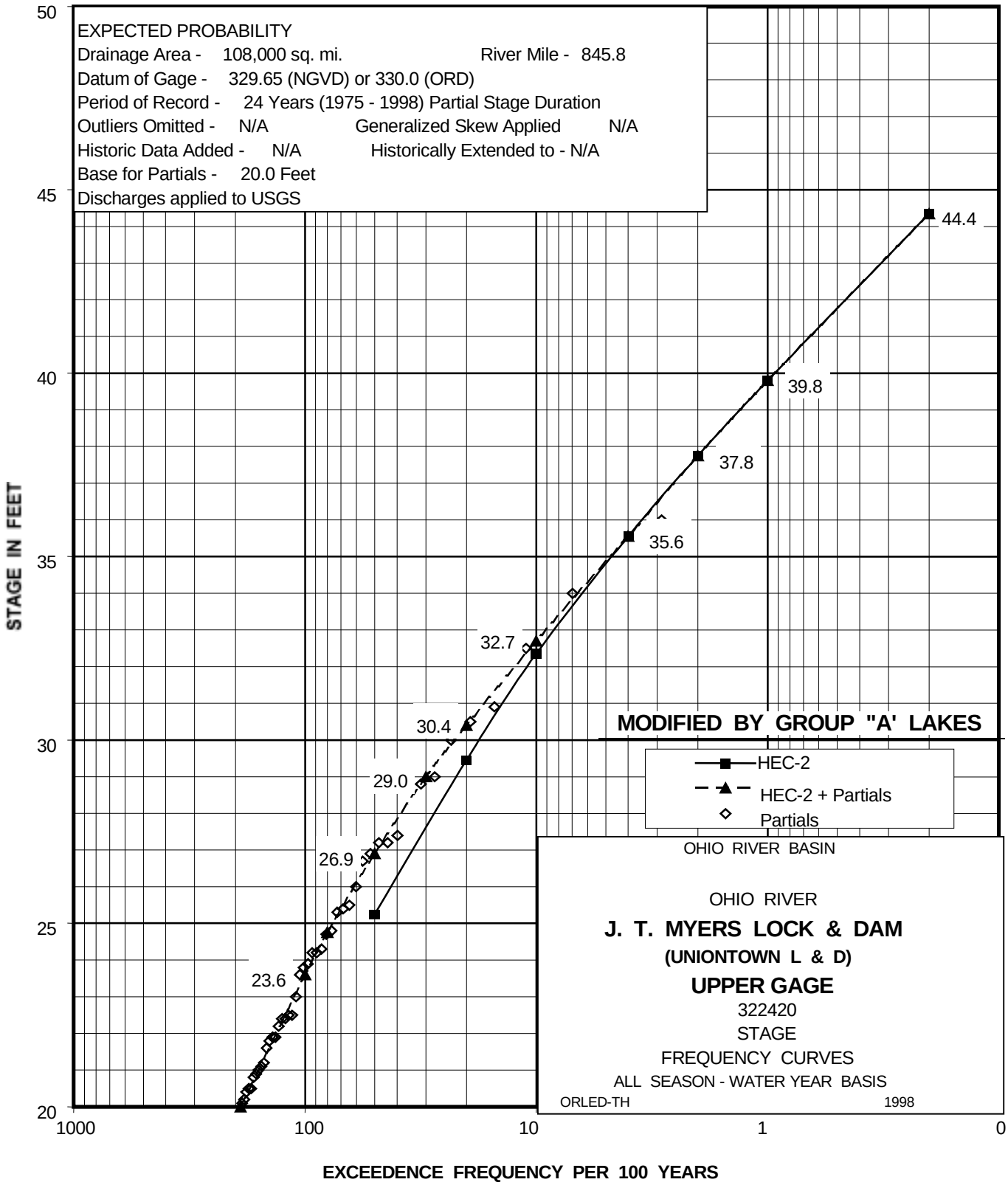
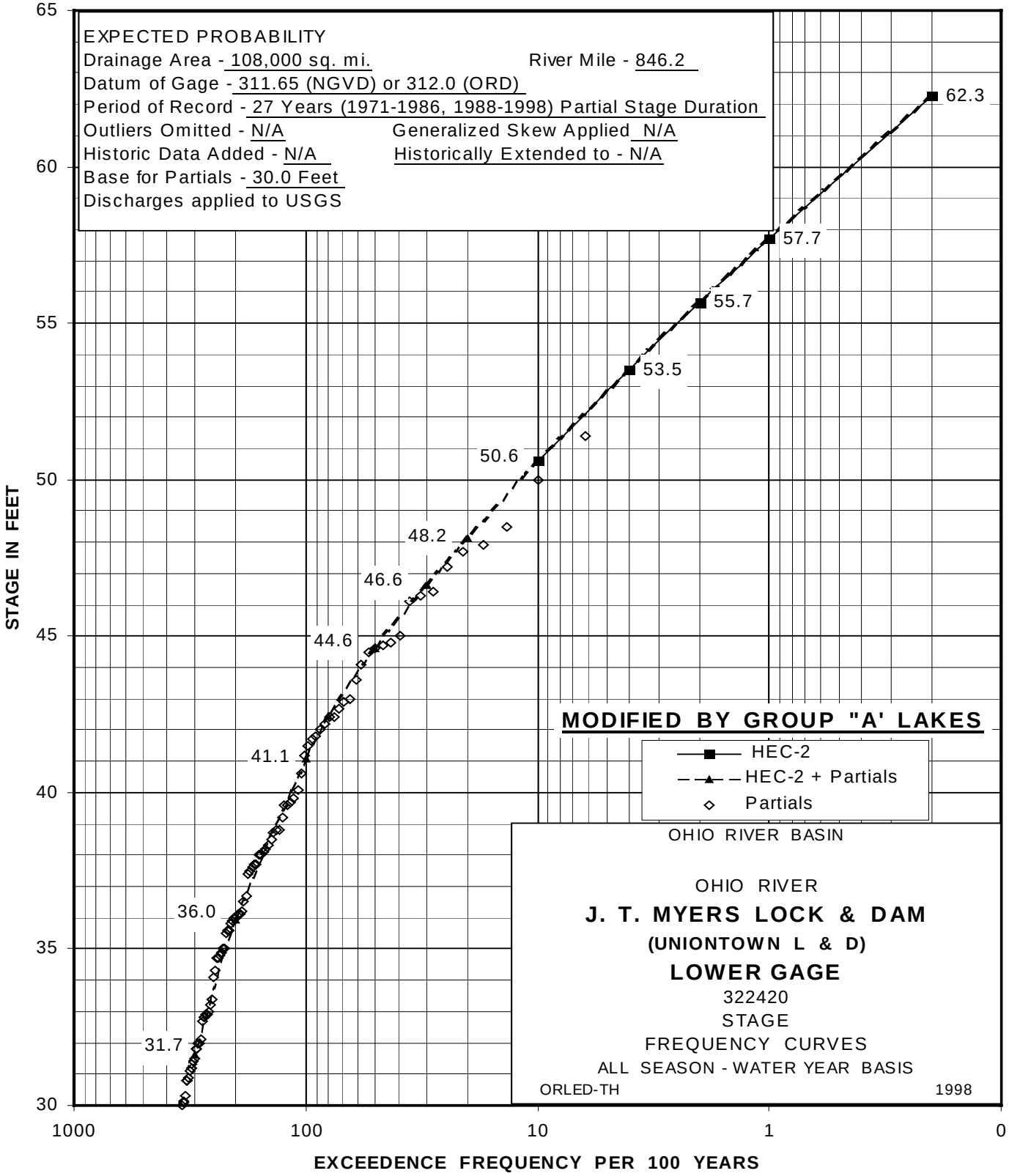


FIGURE 2.2F
STAGE FREQUENCY CURVE
OHIO RIVER AT T. J. MYERS L & D - LOWER GAGE
(UNIONTOWN L & D)



2.3 FLOOD FREQUENCIES (SMITHLAND, J.T. MYERS POOLS)

The April 1976 discharges for the Ohio River were the basis of the frequency profiles that were developed for the Ohio River. The factors used to develop the HEC-2 model were verified by the reproduction of historical flood profiles utilizing the April 1976 ORD stage and discharge frequency curves. ***Figures 2.3A*** and ***2.3B*** show six historical flood profiles in the reach covering J. T. Myers (labeled as Uniontown on the profile) Lock and Dam. ***Figures 2.3C*** and ***2.3D*** show eight frequency profiles, ranging from a 1-year to a 500-year flood compared to the 1937 flood in the reach of J.T. Myers Lock and Dam. Note that the two sets of plates are on different datums.

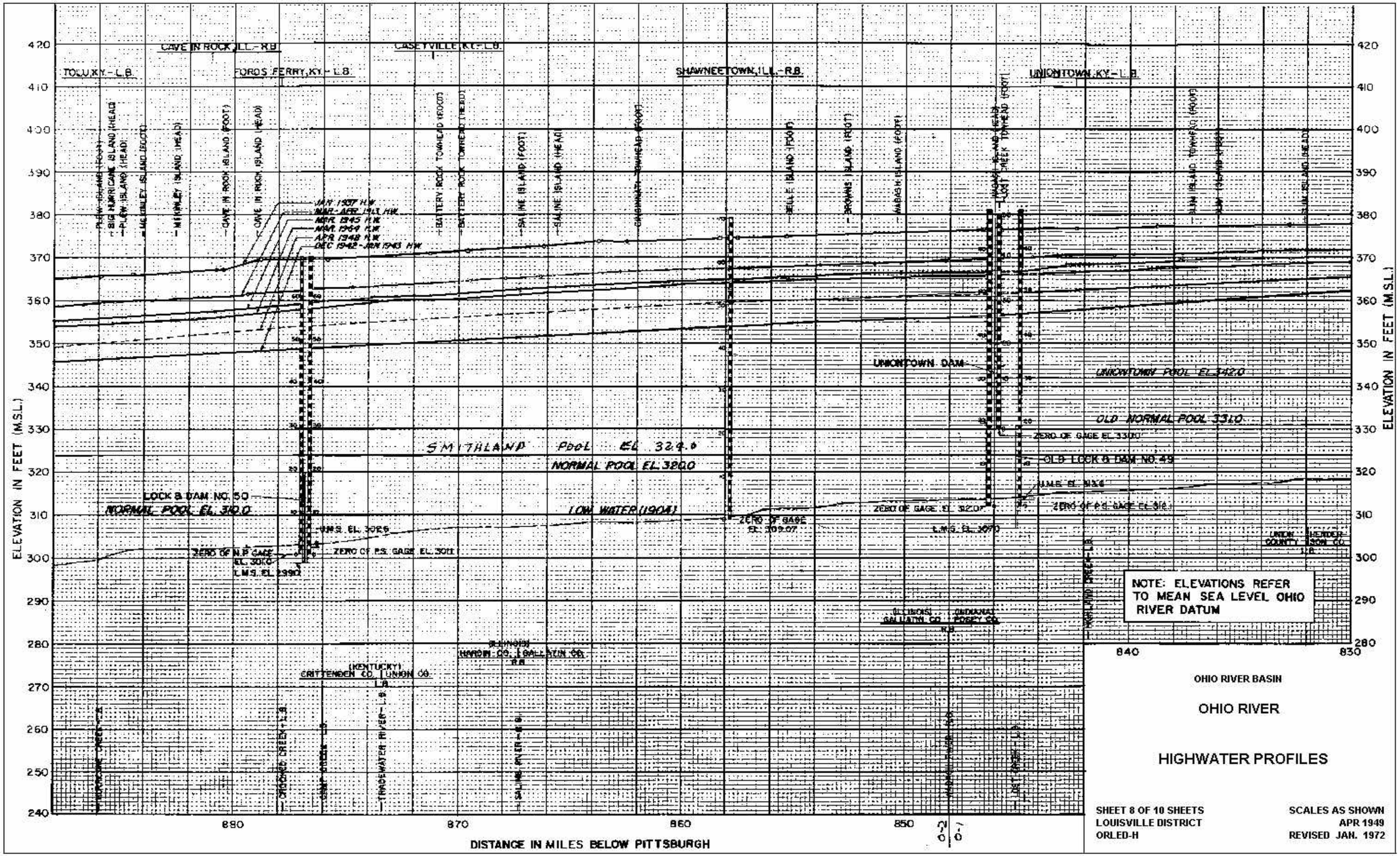

CAVE IN ROCK, ILL.-R.B.
CASEYVILLE, KY.-L.B.
TOLU, KY.-L.B.
FOROS FERRY, KY.-L.B.
SHAWNEETOWN, ILL.-R.B.
UNIONTOWN, KY.-L.B.
JAN 1937 H.W.
MAR-APR 1943 H.W.
APR 1945 H.W.
MAY 1964 H.W.
APR 1948 H.W.
DEC 1942-JAN 1943 H.W.
UNIONTOWN DAM
UNIONTOWN POOL EL 342.0
OLD NORMAL POOL 331.0
ZERO OF GAGE EL 330.0
OLD LOCK & DAM NO. 49
SMITHLAND POOL EL 324.0
NORMAL POOL EL 320.0
LOCK & DAM NO. 50
NORMAL POOL EL 310.0
LOW WATER (1904)
ZERO OF GAGE EL 309.07
ZERO OF GAGE EL 320.7
L.M.S. EL 307.0
ZERO OF N.P. GAGE EL 301.0
L.M.S. EL 299.0
ZERO OF P.S. GAGE EL 301
NOTE: ELEVATIONS REFER TO MEAN SEA LEVEL OHIO RIVER DATUM
(ILLINOIS) HARDIN CO., GALLATIN CO.
(KENTUCKY) CRITTENDEN CO., UNION CO.
(ILLINOIS) GALLATIN CO.
(INDIANA) POSEY CO.
ELEVATION IN FEET (M.S.L.)
DISTANCE IN MILES BELOW PITTSBURGH
OHIO RIVER BASIN
OHIO RIVER
HIGHWATER PROFILES
SHEET 8 OF 10 SHEETS
LOUISVILLE DISTRICT
ORLED-H
SCALES AS SHOWN
APR 1949
REVISED JAN. 1972

FIGURE 2.3A

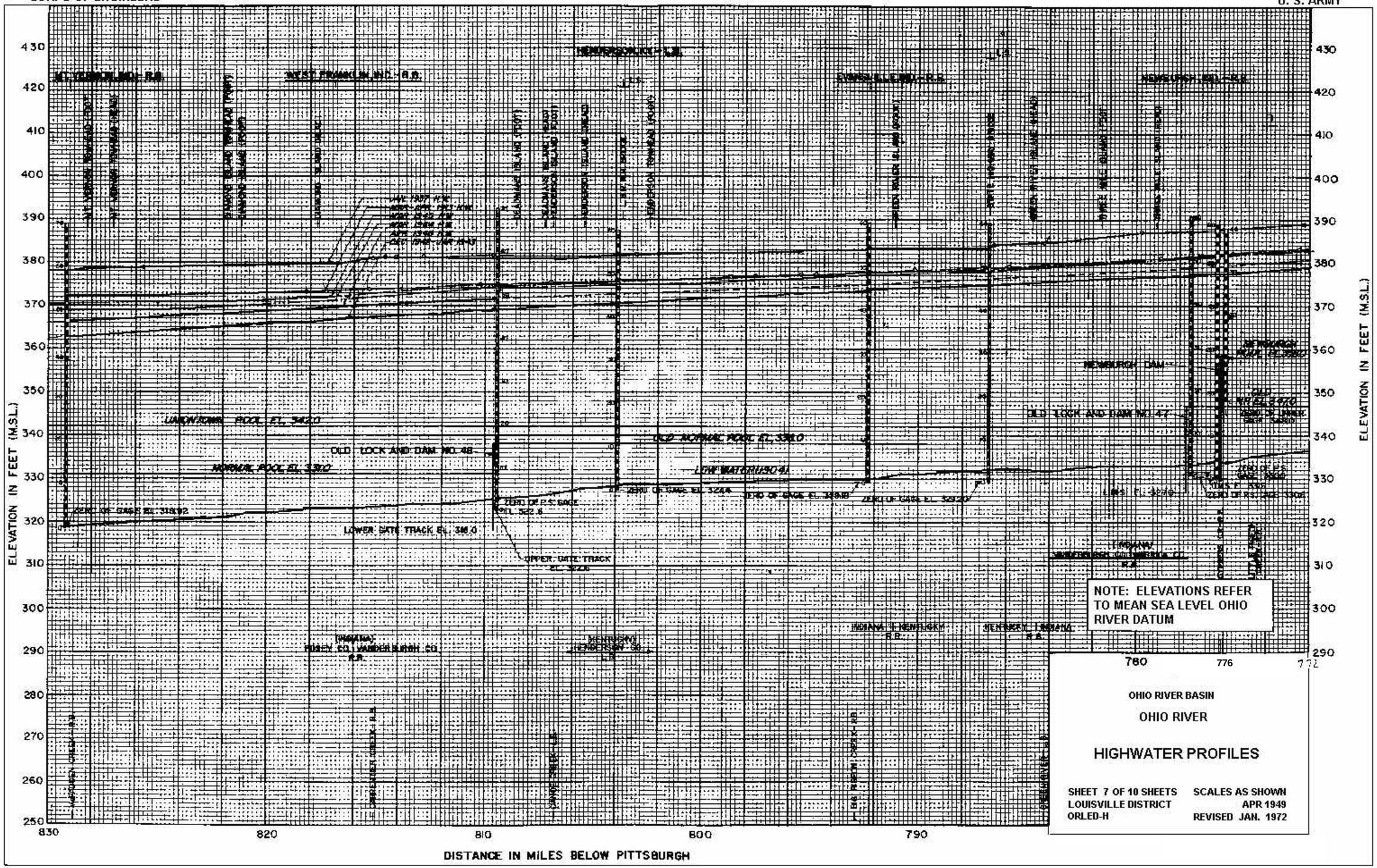

ELEVATION IN FEET (M.S.L.)
DISTANCE IN MILES BELOW PITTSBURGH
UNION DAM POOL EL. 342.0
NORMAL POOL EL. 339.0
OLD LOCK AND DAM NO. 48
OLD NORMAL POOL EL. 338.0
LOW WATER (1940)
OLD LOCK AND DAM NO. 47
HENDERSON DAM
LOWER GATE TRACK EL. 318.0
UPPER GATE TRACK EL. 322.6
NOTE: ELEVATIONS REFER TO MEAN SEA LEVEL OHIO RIVER DATUM
OHIO RIVER BASIN
OHIO RIVER
HIGHWATER PROFILES
SHEET 7 OF 10 SHEETS
LOUISVILLE DISTRICT
ORLED-H
SCALES AS SHOWN
APR 1949
REVISED JAN. 1972

FIGURE 2.3B

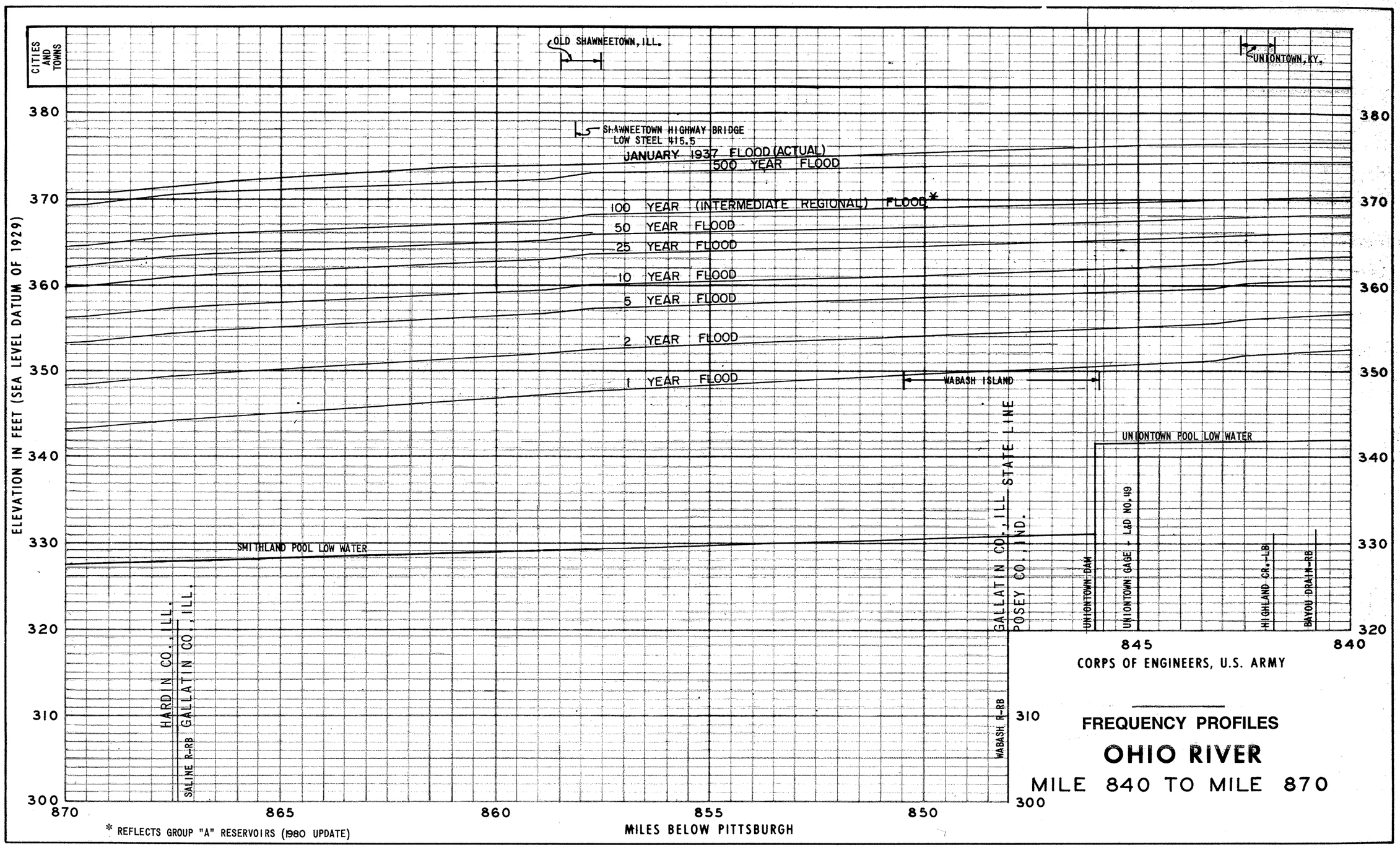
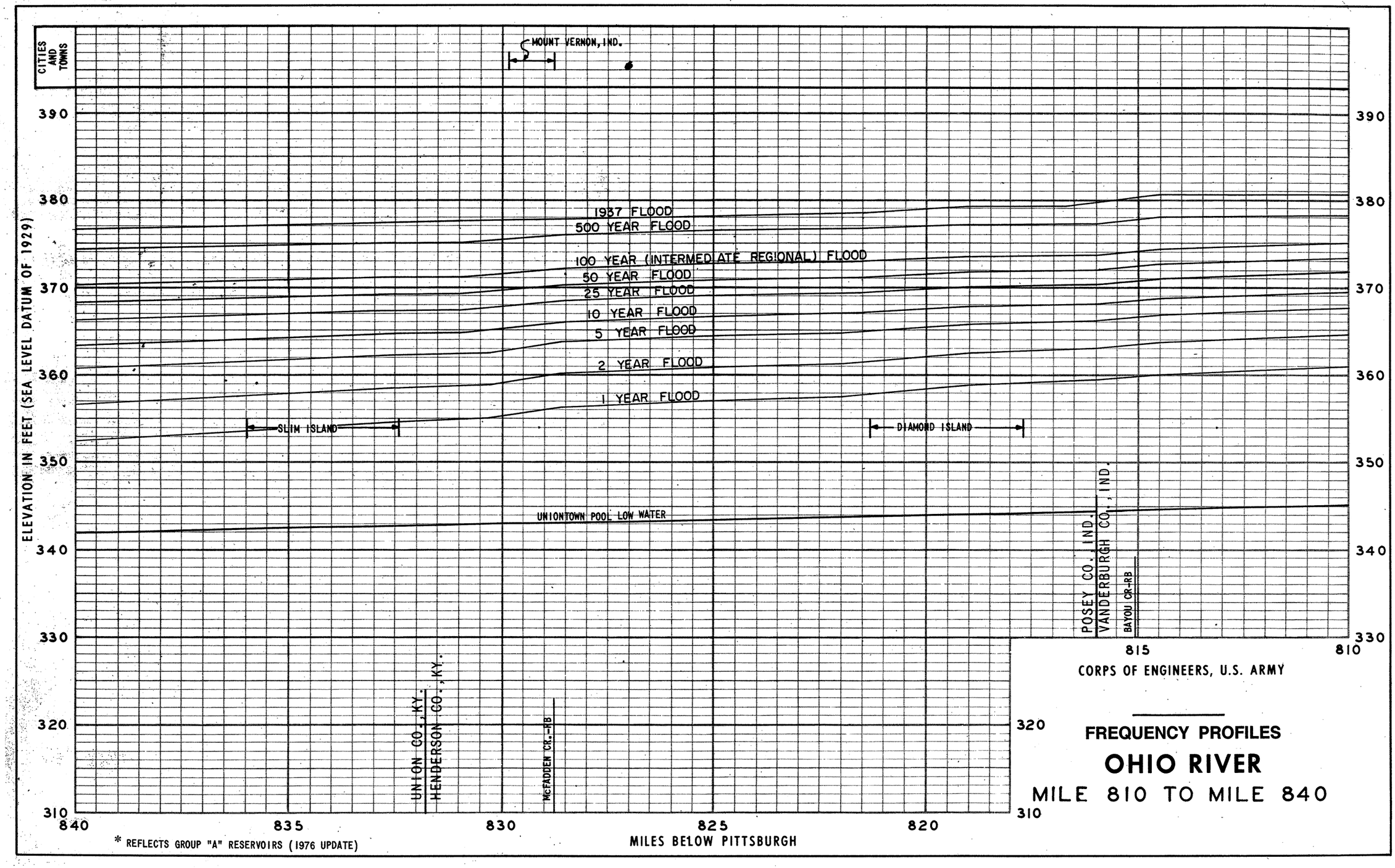

CITIES AND TOWNS
OLD SHAWNEETOWN, ILL.
UNIONTOWN, KY.
SHAWNEETOWN HIGHWAY BRIDGE
LOW STEEL 415.5
JANUARY 1937 FLOOD (ACTUAL)
500 YEAR FLOOD
100 YEAR (INTERMEDIATE REGIONAL) FLOOD*
50 YEAR FLOOD
25 YEAR FLOOD
10 YEAR FLOOD
5 YEAR FLOOD
2 YEAR FLOOD
1 YEAR FLOOD
WABASH ISLAND
UNIONTOWN POOL LOW WATER
SMITHLAND POOL LOW WATER
ELEVATION IN FEET (SEA LEVEL DATUM OF 1929)
380
370
360
350
340
330
320
310
300
HARDIN CO., ILL.
GALLATIN CO., ILL.
SALINE R-RB
GALLATIN CO., ILL.
POSEY CO., IND.
WABASH R-RB
UNIONTOWN DAM
UNIONTOWN GAGE - L&D NO. 49
HIGHLAND CR.-LB
BAYOU DRAIN-RB
870
865
860
855
850
845
840
MILES BELOW PITTSBURGH
* REFLECTS GROUP "A" RESERVOIRS (1980 UPDATE)
CORPS OF ENGINEERS, U.S. ARMY
FREQUENCY PROFILES
OHIO RIVER
MILE 840 TO MILE 870

FIGURE 2.3C



* REFLECTS GROUP "A" RESERVOIRS (1976 UPDATE)

FIGURE 2.3D

2.4 POOL HYDROGRAPHS

Water was stored above the newly constructed J. T. Myers Dam starting in December 1974 and the upper pool stage was reached in January 1975. ***Table 2.4A*** shows this filling period as well as daily elevations of the upper pool for water year 1975. ***Figures 2.4B*** through ***2.4X*** show the comparison of daily upper and lower pool levels for water years 1976 through 1998 based on daily 7 A.M. gage readings. The datum of the upper pool gage is elevation 330.0 Ohio River Datum and the lower pool gage is elevation 312.0 Ohio River Datum. The hydrographs have been summarized in ***Table 2.4A*** which provides the annual peak and all peaks above elevation 350.8 both chronologically and in order of magnitude for water years 1976 through 1998 at the upper gage at the J.T. Myers lock as indicated on the hydrographs. The lower pool elevation data would be slightly lower because of the channel slope in the stream between the two gages (located less than a mile apart) and the swellhead through the dam. Flood stage is considered to be at elevation 349. These plots show that there is much more variation in the lower pool at the dam than in the upper pool. Since the Smithland Dam was not completed until November 1980, there were J. T. Myers lower gage readings below elevation 324 until the Smithland upper pool was attained in late January 1981. This fact will be reflected in the lower pool stage duration data in Section 2.5. These pools provide critical information toward the constructability of the project because much of the work will be done in the lower pool for the lock extension. The hydrographs differ from the stage duration data, which is discussed in Section 2.5, because hydrographs indicate the number of times an elevation is attained during a certain period of time.

TABLE 2.4A

OHIO RIVER AT J.T.MYERS(UPR)
RIVER ELEVATION FREQUENCY TABLE
(FOR PERIOD SEP 1975 - OCT 1998)

ANNUAL PEAKS (BY WATER YEAR)

YEAR	PEAK	DATE
1976	355.30	27 FEB 1976
1977	351.60	13 APR 1977
1978	358.70	23 MAR 1978
1979	362.50	08 MAR 1979
1980	352.50	29 MAR 1980
1981	350.80	14 JUN 1981
1982	355.40	26 MAR 1982
1983	360.90	10 MAY 1983
1984	354.20	15 MAY 1984
1985	354.70	05 MAR 1985
1986	356.00	07 DEC 1985
1987	349.70	18 APR 1987
1988	350.90	10 FEB 1988
1989	357.40	24 FEB 1989
1990	356.90	20 FEB 1990
1991	364.00	09 JAN 1991
1992	346.80	09 DEC 1991
1993	353.60	13 MAR 1993
1994	357.20	23 APR 1994
1995	358.80	26 MAY 1995
1996	360.00	15 MAY 1996
1997	366.00	11 MAR 1997
1998	353.90	27 APR 1998

PEAKS IN PERIOD (BY ORDER OF OCCURANCE)

PEAK	DATE
351.10	9 JAN 1976
355.30	27 FEB 1976
351.60	13 APR 1977
351.00	3 FEB 1978
358.70	23 MAR 1978
359.00	18 DEC 1978
352.40	9 JAN 1979
352.50	29 JAN 1979
362.50	8 MAR 1979
354.20	18 APR 1979
352.50	29 MAR 1980
350.80	14 JUN 1981
351.20	29 JAN 1982
351.00	9 FEB 1982
355.40	26 MAR 1982
360.90	11 MAY 1983
353.40	23 MAY 1983
353.50	5 APR 1984
354.10	30 APR 1984
354.20	15 MAY 1984
354.70	5 MAR 1985
351.90	7 APR 1985
356.00	7 DEC 1985
353.00	14 FEB 1986
350.90	10 FEB 1988
357.40	24 FEB 1989
352.20	14 MAR 1989
355.50	9 APR 1989
356.90	21 FEB 1990
351.90	23 MAY 1990
351.00	3 JUN 1990
364.00	9 JAN 1991
354.30	31 MAR 1991
353.60	13 MAR 1993
352.40	4 APR 1993
356.70	6 FEB 1994
352.20	3 MAR 1994
354.10	18 MAR 1994
357.20	23 APR 1994
358.80	26 MAY 1995
357.20	31 JAN 1996
360.00	16 MAY 1996
366.00	13 MAR 1997
353.90	27 APR 1998
352.10	12 MAY 1998

PEAKS IN PERIOD (BY ORDER OF MAGNITUDE)

PEAK	DATE
366.00	13 MAR 1997
364.00	09 JAN 1991
362.50	08 MAR 1979
360.90	11 MAY 1983
360.00	16 MAY 1996
359.00	18 DEC 1978
358.80	26 MAY 1995
358.70	23 MAR 1978
357.40	24 FEB 1989
357.20	23 APR 1994
357.20	31 JAN 1996
356.90	21 FEB 1990
356.70	06 FEB 1994
356.00	07 DEC 1985
355.50	09 APR 1989
355.40	26 MAR 1982
355.30	27 FEB 1976
354.70	05 MAR 1985
354.30	31 MAR 1991
354.20	18 APR 1979
354.20	15 MAY 1984
354.10	30 APR 1984
354.10	18 MAR 1994
353.90	27 APR 1998
353.60	13 MAR 1993
353.50	05 APR 1984
353.40	23 MAY 1983
353.00	14 FEB 1986
352.50	29 JAN 1979
352.50	29 MAR 1980
352.40	09 JAN 1979
352.40	04 APR 1993
352.20	14 MAR 1989
352.20	03 MAR 1994
352.10	12 MAY 1998
351.90	07 APR 1985
351.90	23 MAY 1990
351.60	13 APR 1977
351.20	29 JAN 1982
351.10	09 JAN 1976
351.00	03 FEB 1978
351.00	09 FEB 1982
351.00	03 JUN 1990
350.90	10 FEB 1988
350.80	14 JUN 1981

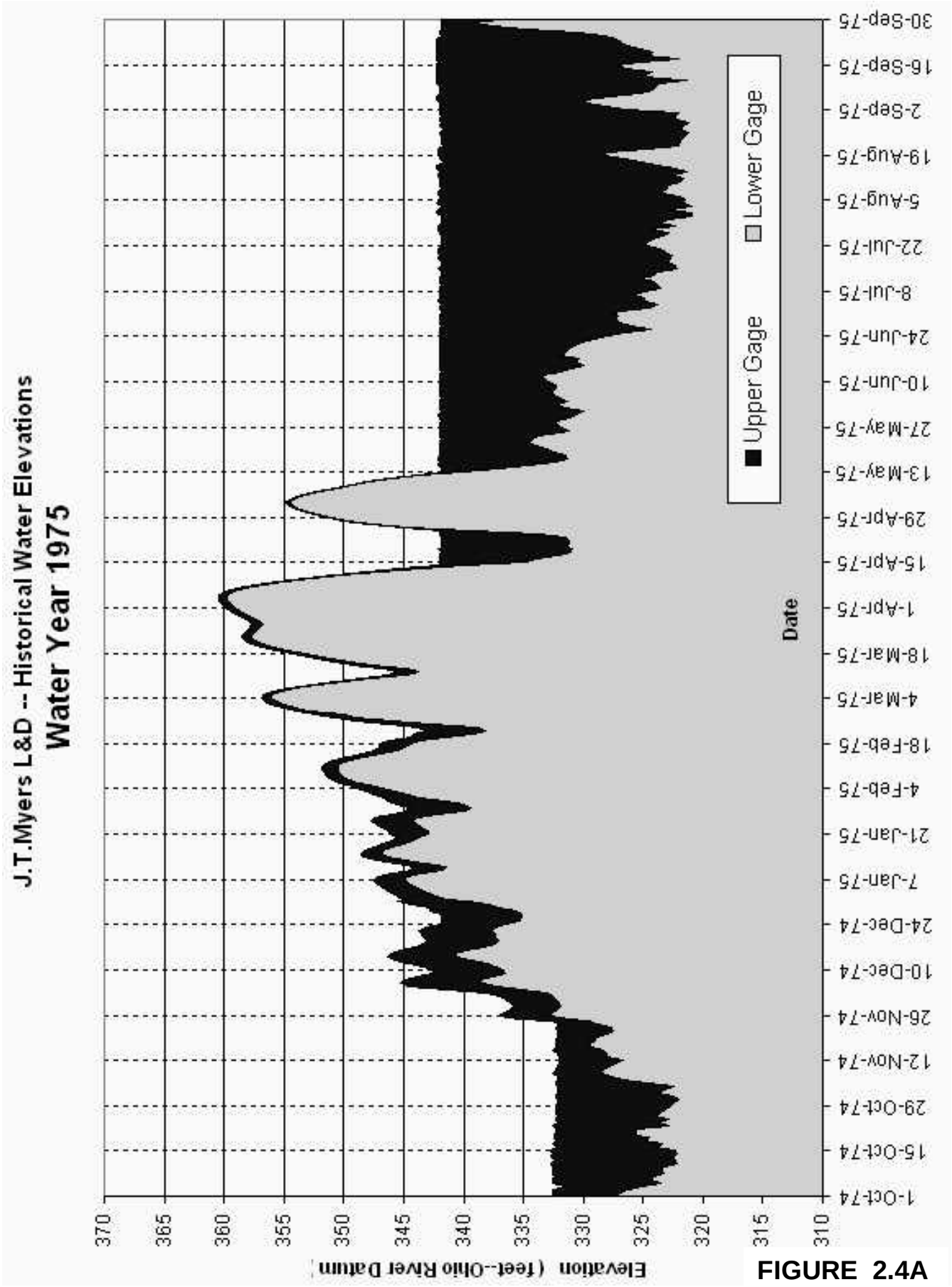

J.T.Myers L&D -- Historical Water Elevations
Water Year 1975
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-74
15-Oct-74
29-Oct-74
12-Nov-74
26-Nov-74
10-Dec-74
24-Dec-74
7-Jan-75
21-Jan-75
4-Feb-75
18-Feb-75
4-Mar-75
18-Mar-75
1-Apr-75
15-Apr-75
29-Apr-75
13-May-75
27-May-75
10-Jun-75
24-Jun-75
8-Jul-75
22-Jul-75
5-Aug-75
19-Aug-75
2-Sep-75
16-Sep-75
30-Sep-75

FIGURE 2.4A

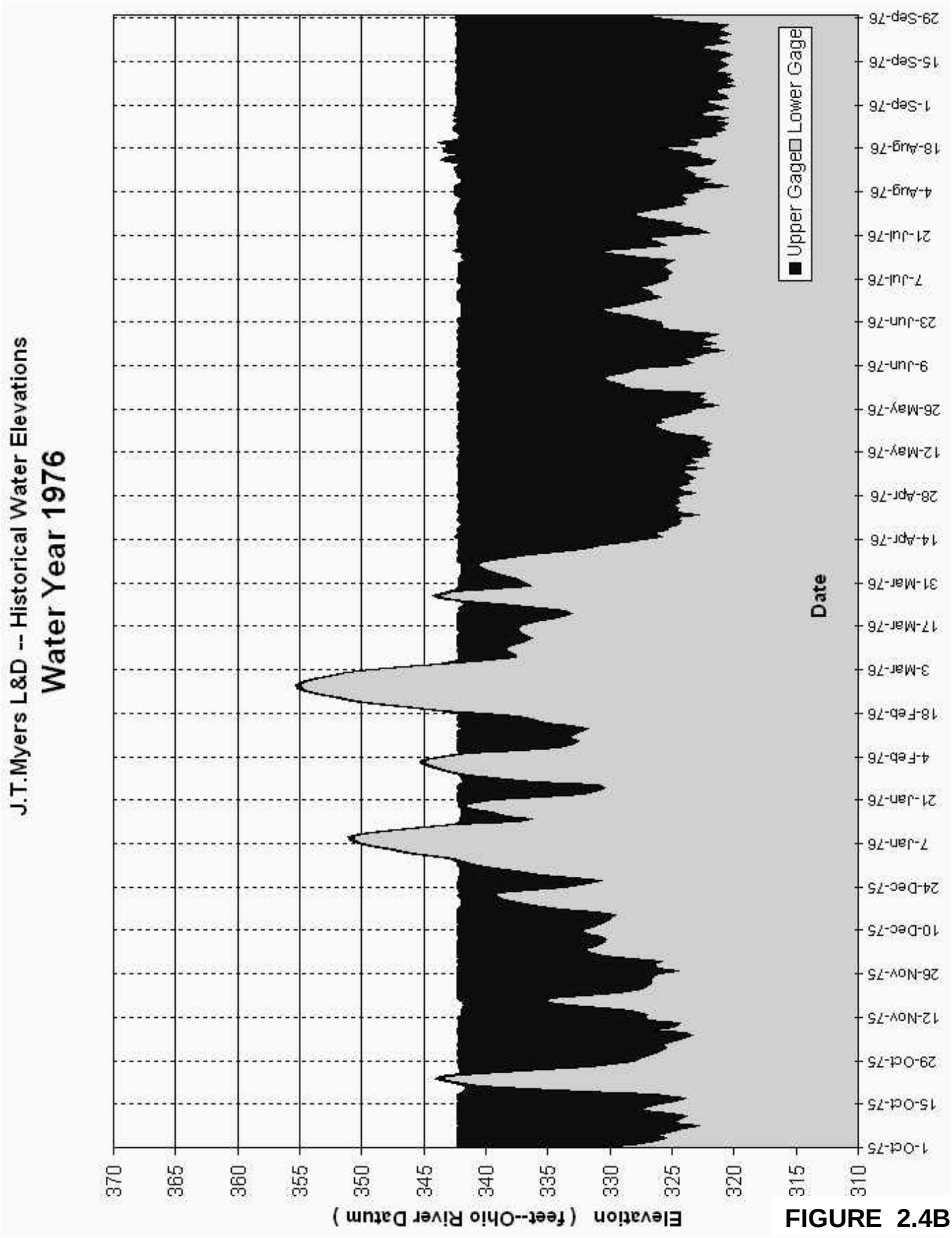

J.T.Myers L&D -- Historical Water Elevations
Water Year 1976
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-75
15-Oct-75
29-Oct-75
12-Nov-75
26-Nov-75
10-Dec-75
24-Dec-75
7-Jan-76
21-Jan-76
4-Feb-76
18-Feb-76
3-Mar-76
17-Mar-76
31-Mar-76
14-Apr-76
28-Apr-76
12-May-76
26-May-76
9-Jun-76
23-Jun-76
7-Jul-76
21-Jul-76
4-Aug-76
18-Aug-76
1-Sep-76
15-Sep-76
29-Sep-76
Upper Gage
Lower Gage

FIGURE 2.4B

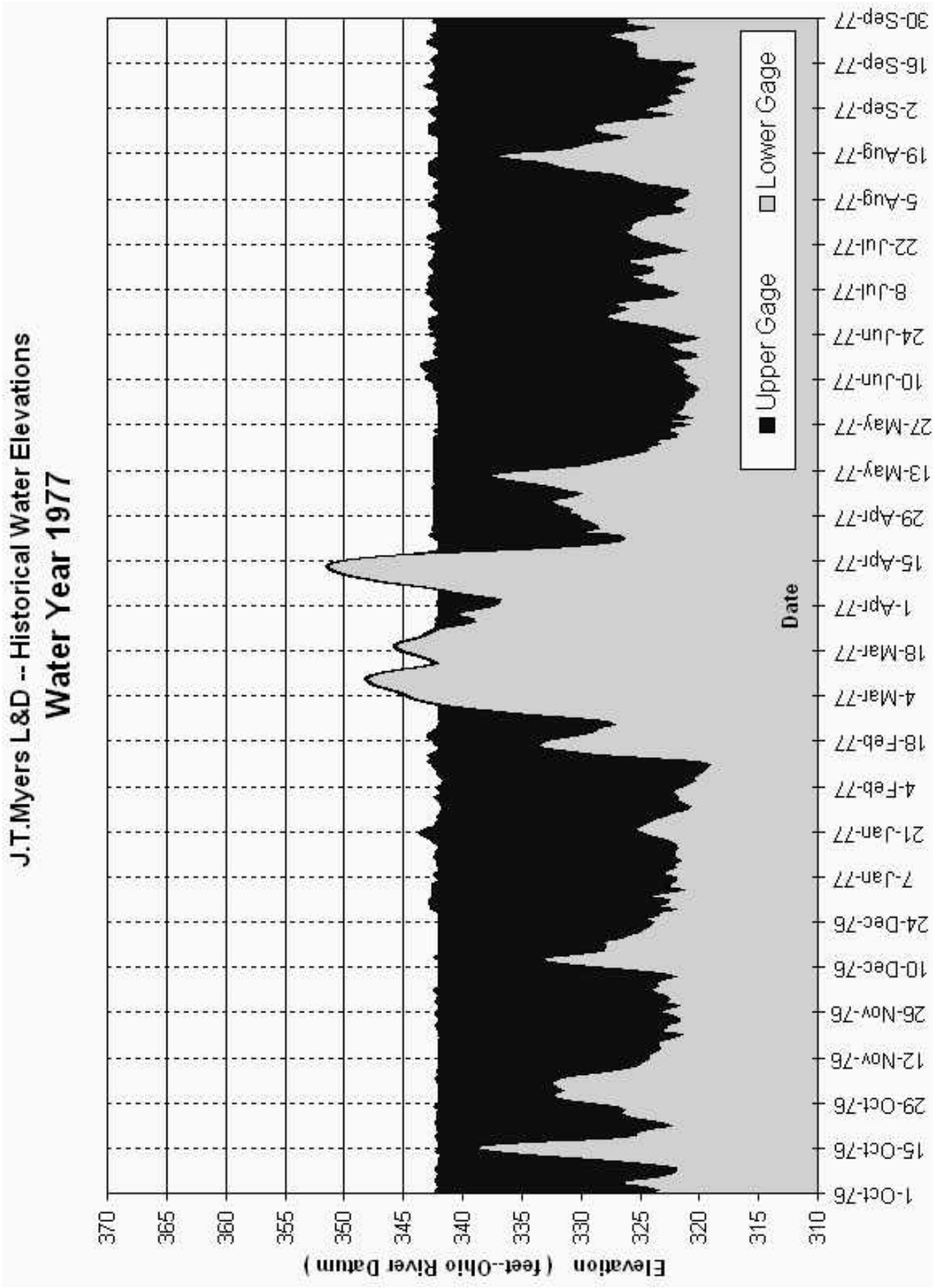

J.T.Myers L&D -- Historical Water Elevations
Water Year 1977
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-76
15-Oct-76
29-Oct-76
12-Nov-76
26-Nov-76
10-Dec-76
24-Dec-76
7-Jan-77
21-Jan-77
4-Feb-77
18-Feb-77
4-Mar-77
18-Mar-77
1-Apr-77
15-Apr-77
29-Apr-77
13-May-77
27-May-77
10-Jun-77
24-Jun-77
8-Jul-77
22-Jul-77
5-Aug-77
19-Aug-77
2-Sep-77
16-Sep-77
30-Sep-77
Upper Gage
Lower Gage

FIGURE 2.4C

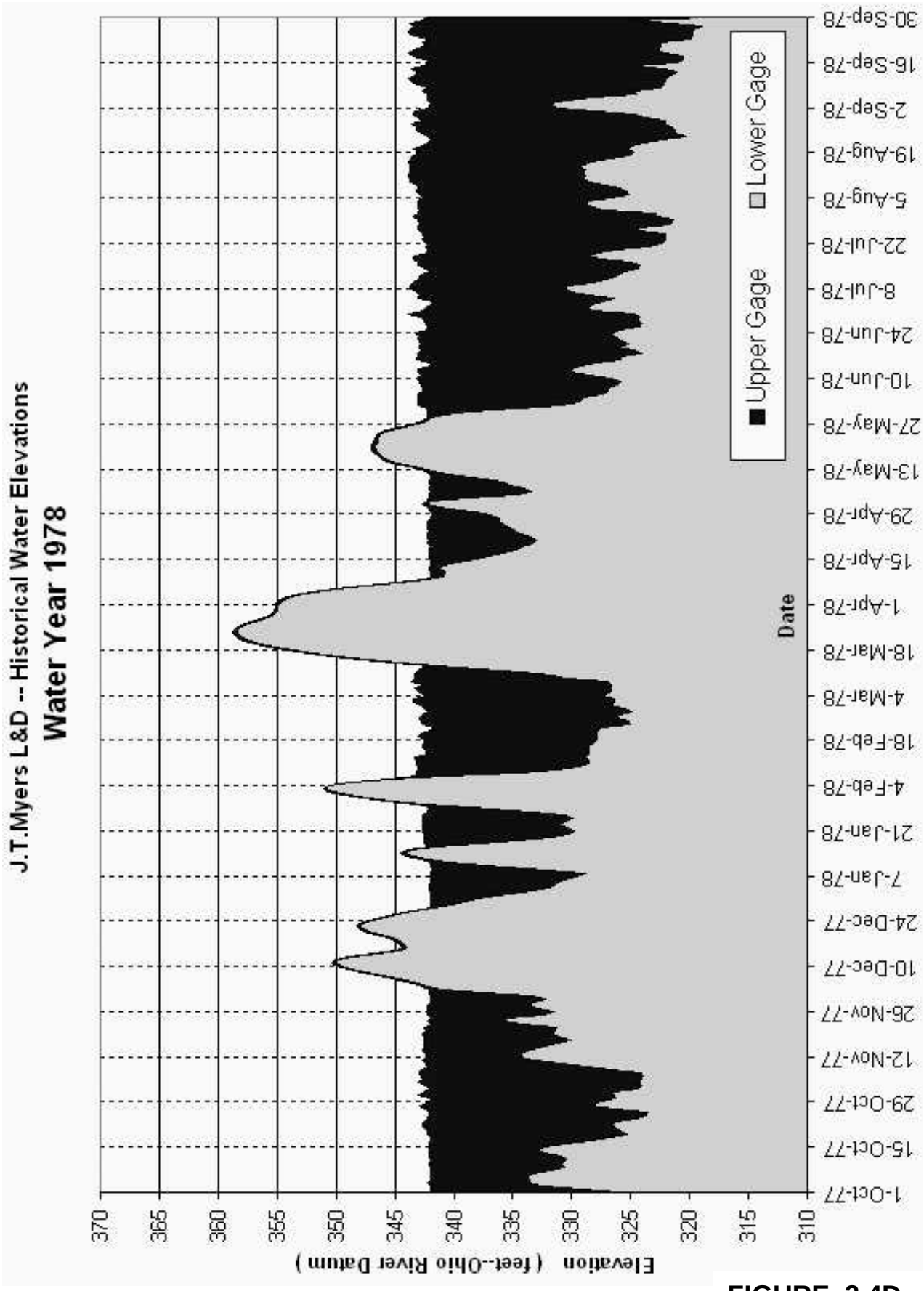

J.T.Myers L&D -- Historical Water Elevations
Water Year 1978
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-77
15-Oct-77
29-Oct-77
12-Nov-77
26-Nov-77
10-Dec-77
24-Dec-77
7-Jan-78
21-Jan-78
4-Feb-78
18-Feb-78
4-Mar-78
18-Mar-78
1-Apr-78
15-Apr-78
29-Apr-78
13-May-78
27-May-78
10-Jun-78
24-Jun-78
8-Jul-78
22-Jul-78
5-Aug-78
19-Aug-78
2-Sep-78
16-Sep-78
30-Sep-78
Upper Gage
Lower Gage

FIGURE 2.4D

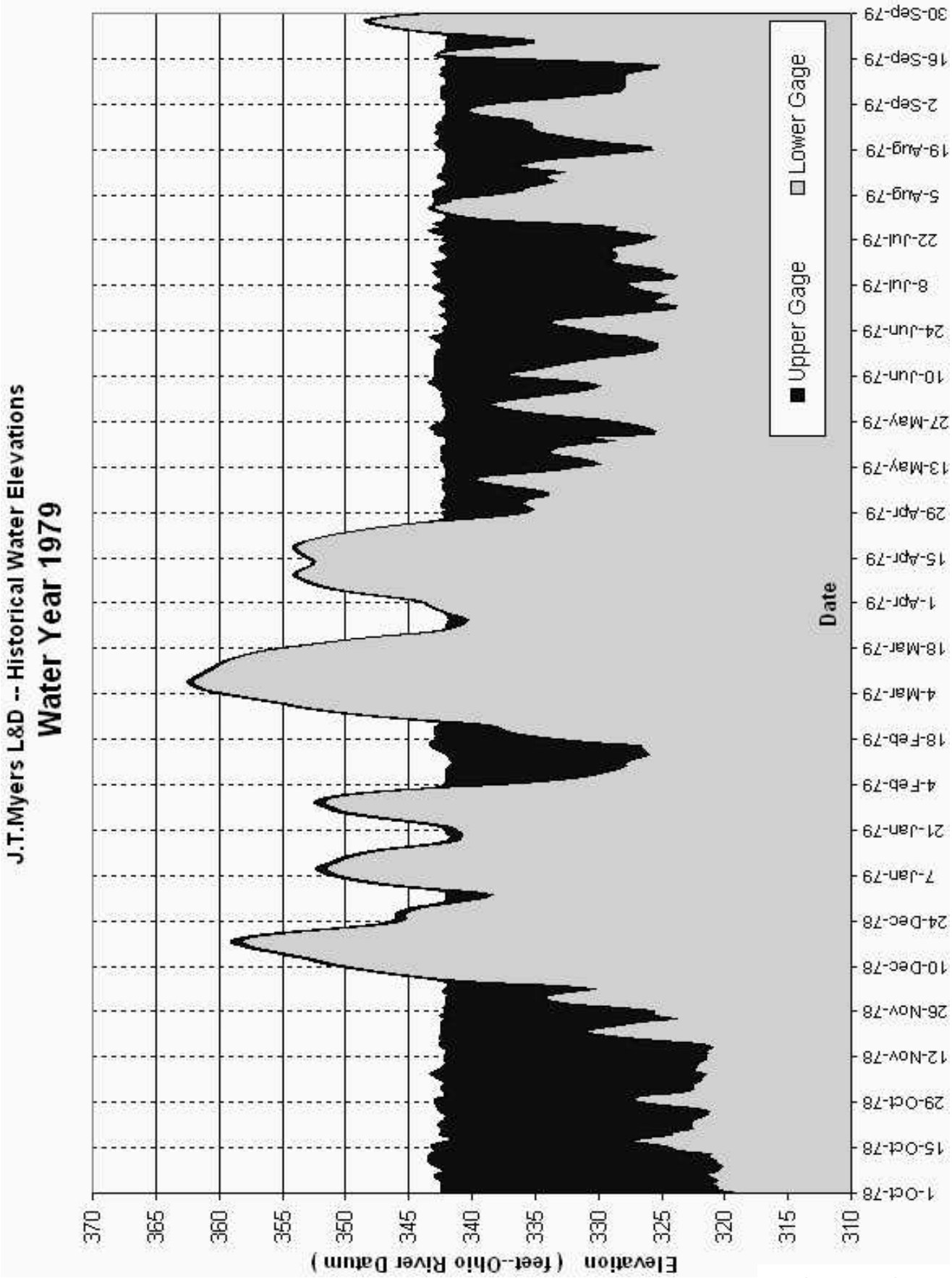

J.T.Myers L&D -- Historical Water Elevations
Water Year 1979
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-78
15-Oct-78
29-Oct-78
12-Nov-78
26-Nov-78
10-Dec-78
24-Dec-78
7-Jan-79
21-Jan-79
4-Feb-79
18-Feb-79
4-Mar-79
18-Mar-79
1-Apr-79
15-Apr-79
29-Apr-79
13-May-79
27-May-79
10-Jun-79
24-Jun-79
8-Jul-79
22-Jul-79
5-Aug-79
19-Aug-79
2-Sep-79
16-Sep-79
30-Sep-79
Upper Gage
Lower Gage

FIGURE 2.4E

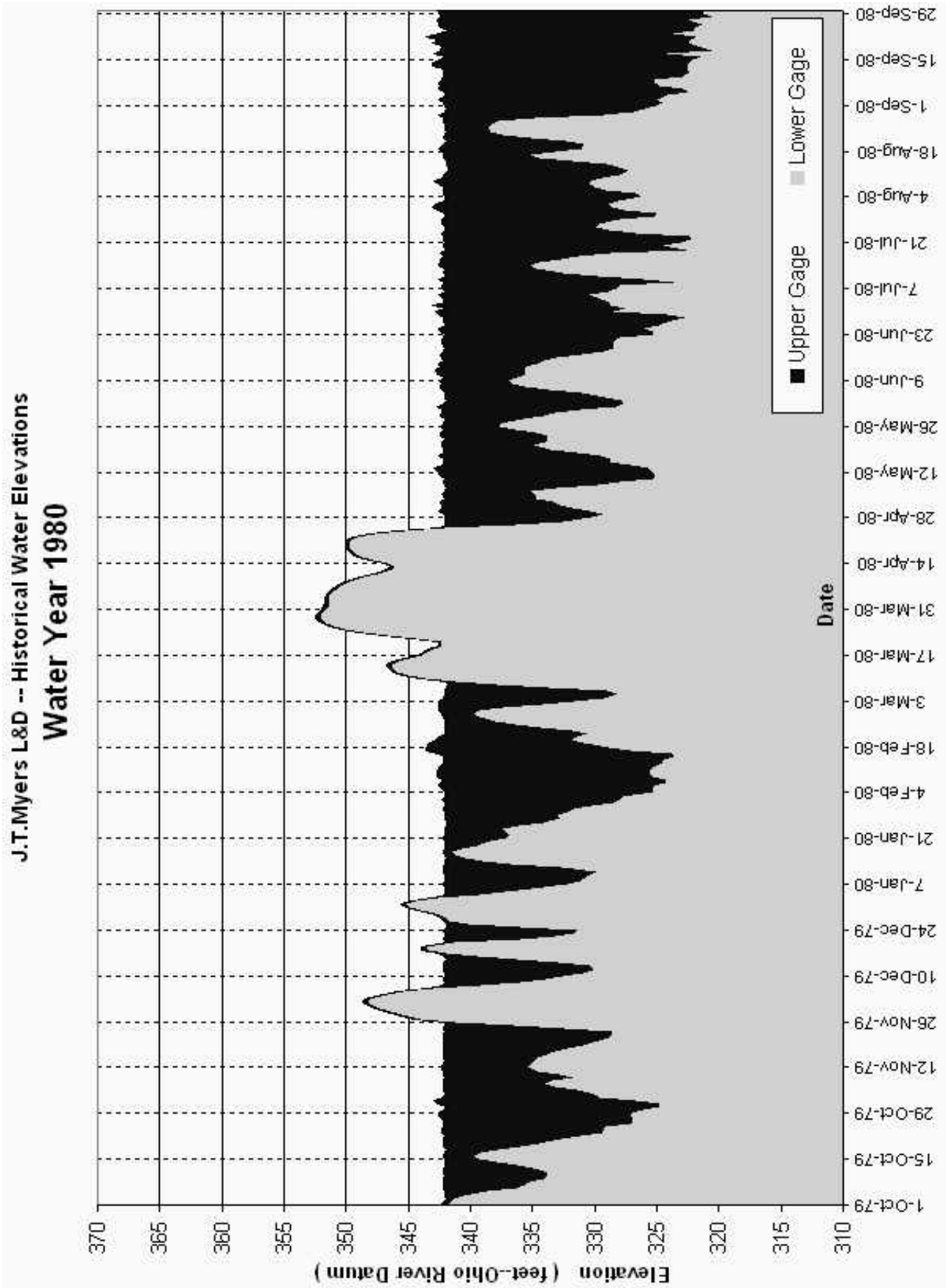

J.T.Myers L&D -- Historical Water Elevations
Water Year 1980
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-79
15-Oct-79
29-Oct-79
12-Nov-79
26-Nov-79
10-Dec-79
24-Dec-79
7-Jan-80
21-Jan-80
4-Feb-80
18-Feb-80
3-Mar-80
17-Mar-80
31-Mar-80
14-Apr-80
28-Apr-80
12-May-80
26-May-80
9-Jun-80
23-Jun-80
7-Jul-80
21-Jul-80
4-Aug-80
18-Aug-80
1-Sep-80
15-Sep-80
29-Sep-80

FIGURE 2.4F

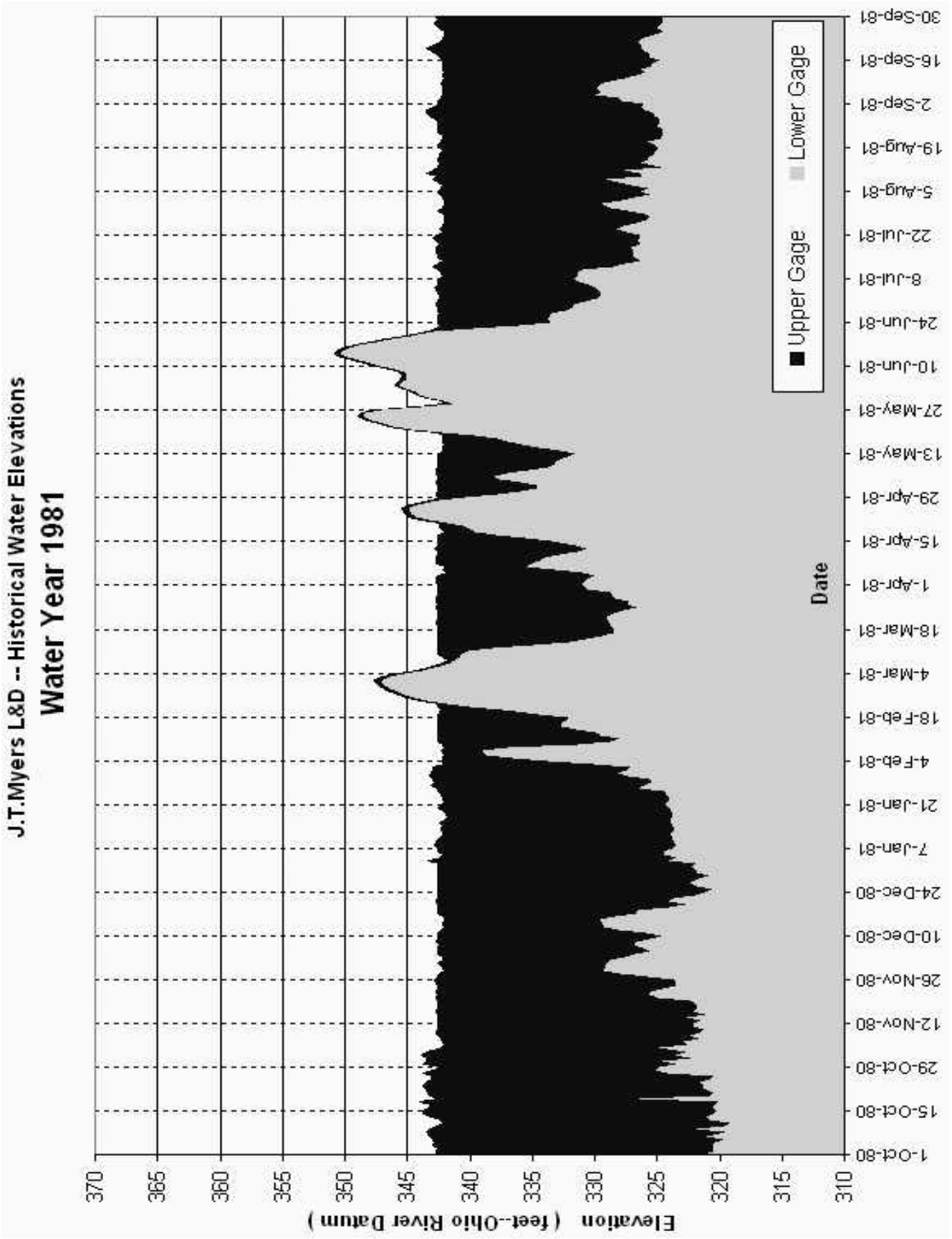

J.T.Myers L&D -- Historical Water Elevations
Water Year 1981
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-80
15-Oct-80
29-Oct-80
12-Nov-80
26-Nov-80
10-Dec-80
24-Dec-80
7-Jan-81
21-Jan-81
4-Feb-81
18-Feb-81
4-Mar-81
18-Mar-81
1-Apr-81
15-Apr-81
29-Apr-81
13-May-81
27-May-81
10-Jun-81
24-Jun-81
8-Jul-81
22-Jul-81
5-Aug-81
19-Aug-81
2-Sep-81
16-Sep-81
30-Sep-81
Upper Gage
Lower Gage

FIGURE 2.4G

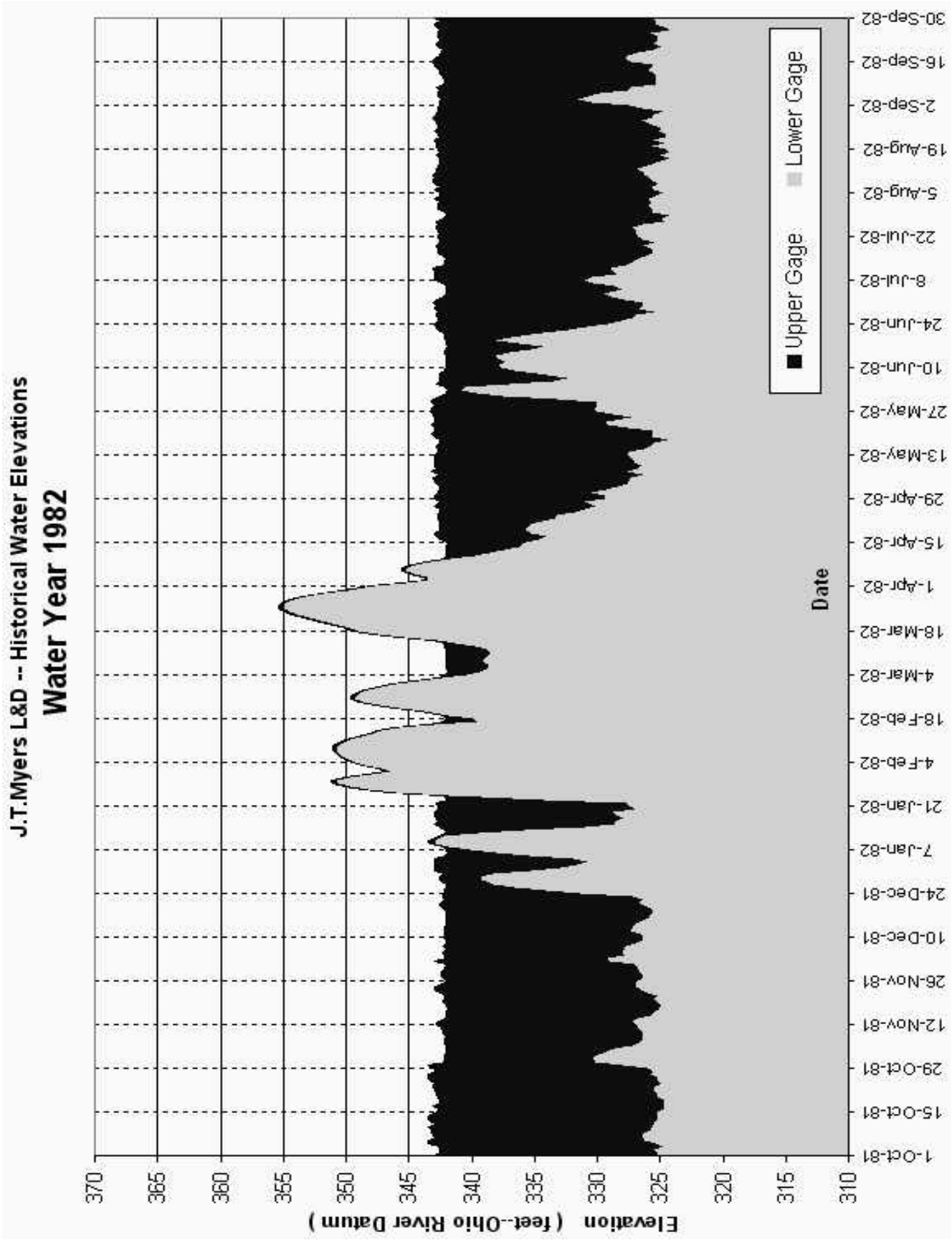

J.T.Myers L&D -- Historical Water Elevations
Water Year 1982
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-81
15-Oct-81
29-Oct-81
12-Nov-81
26-Nov-81
10-Dec-81
24-Dec-81
7-Jan-82
21-Jan-82
4-Feb-82
18-Feb-82
4-Mar-82
18-Mar-82
1-Apr-82
15-Apr-82
29-Apr-82
13-May-82
27-May-82
10-Jun-82
24-Jun-82
8-Jul-82
22-Jul-82
5-Aug-82
19-Aug-82
2-Sep-82
16-Sep-82
30-Sep-82
Date
Upper Gage
Lower Gage

FIGURE 2.4H

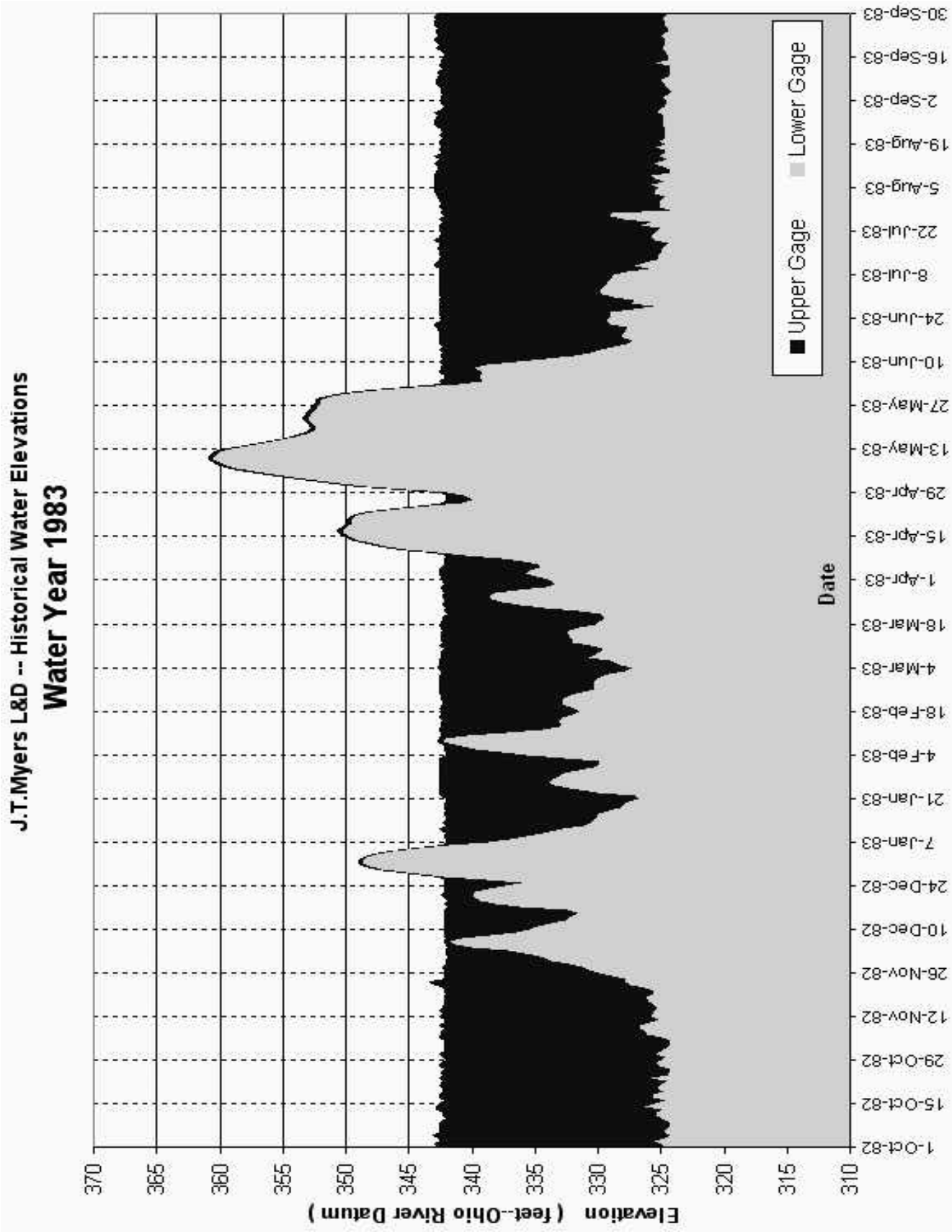

J.T.Myers L&D -- Historical Water Elevations
Water Year 1983
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-82
15-Oct-82
29-Oct-82
12-Nov-82
26-Nov-82
10-Dec-82
24-Dec-82
7-Jan-83
21-Jan-83
4-Feb-83
18-Feb-83
4-Mar-83
18-Mar-83
1-Apr-83
15-Apr-83
29-Apr-83
13-May-83
27-May-83
10-Jun-83
24-Jun-83
8-Jul-83
22-Jul-83
5-Aug-83
19-Aug-83
2-Sep-83
16-Sep-83
30-Sep-83
Date
Upper Gage
Lower Gage

FIGURE 2.4I

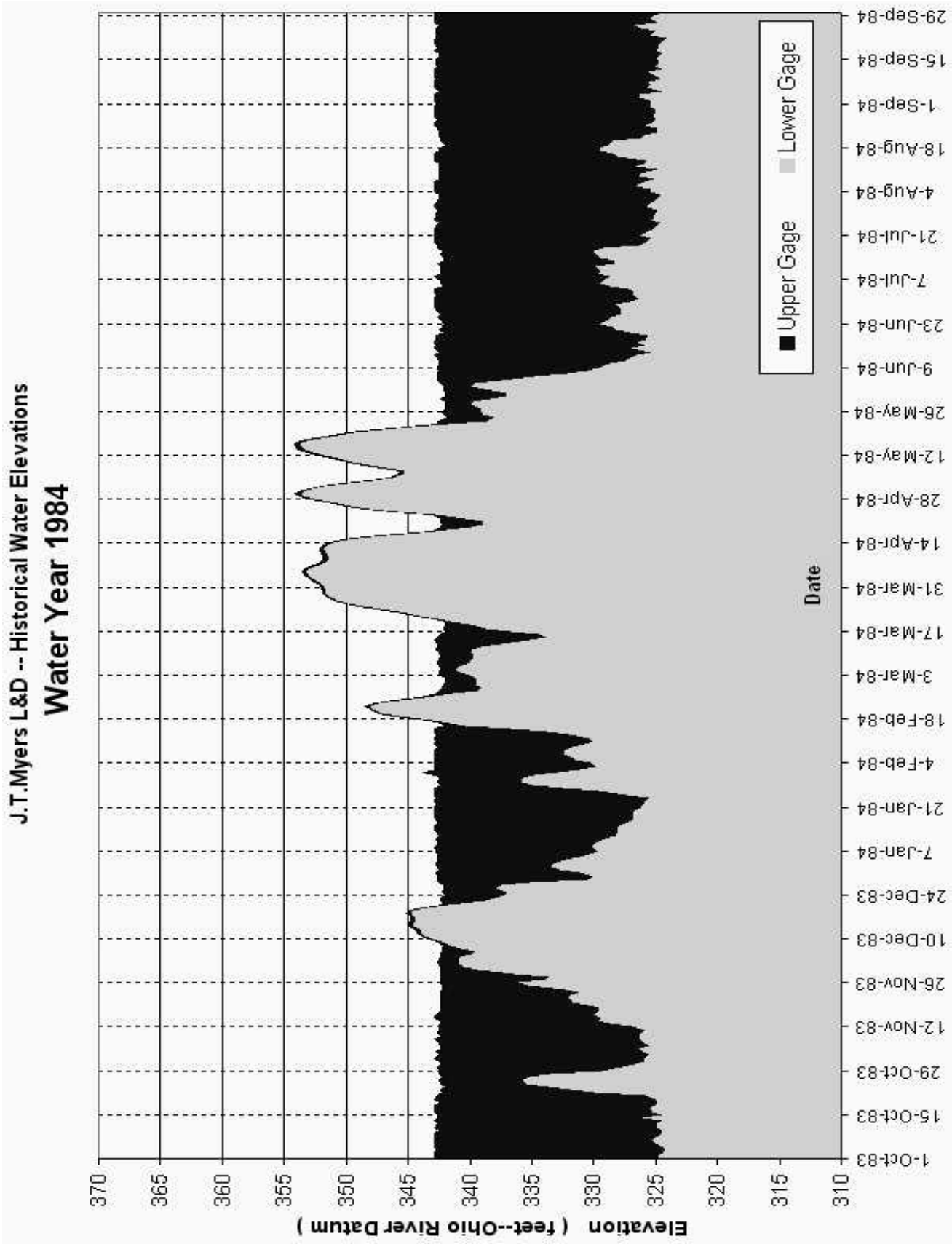

J.T.Myers L&D -- Historical Water Elevations
Water Year 1984
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-83
15-Oct-83
29-Oct-83
12-Nov-83
26-Nov-83
10-Dec-83
24-Dec-83
7-Jan-84
21-Jan-84
4-Feb-84
18-Feb-84
3-Mar-84
17-Mar-84
31-Mar-84
14-Apr-84
28-Apr-84
12-May-84
26-May-84
9-Jun-84
23-Jun-84
7-Jul-84
21-Jul-84
4-Aug-84
18-Aug-84
1-Sep-84
15-Sep-84
29-Sep-84
Date
Upper Gage
Lower Gage

FIGURE 2.4J

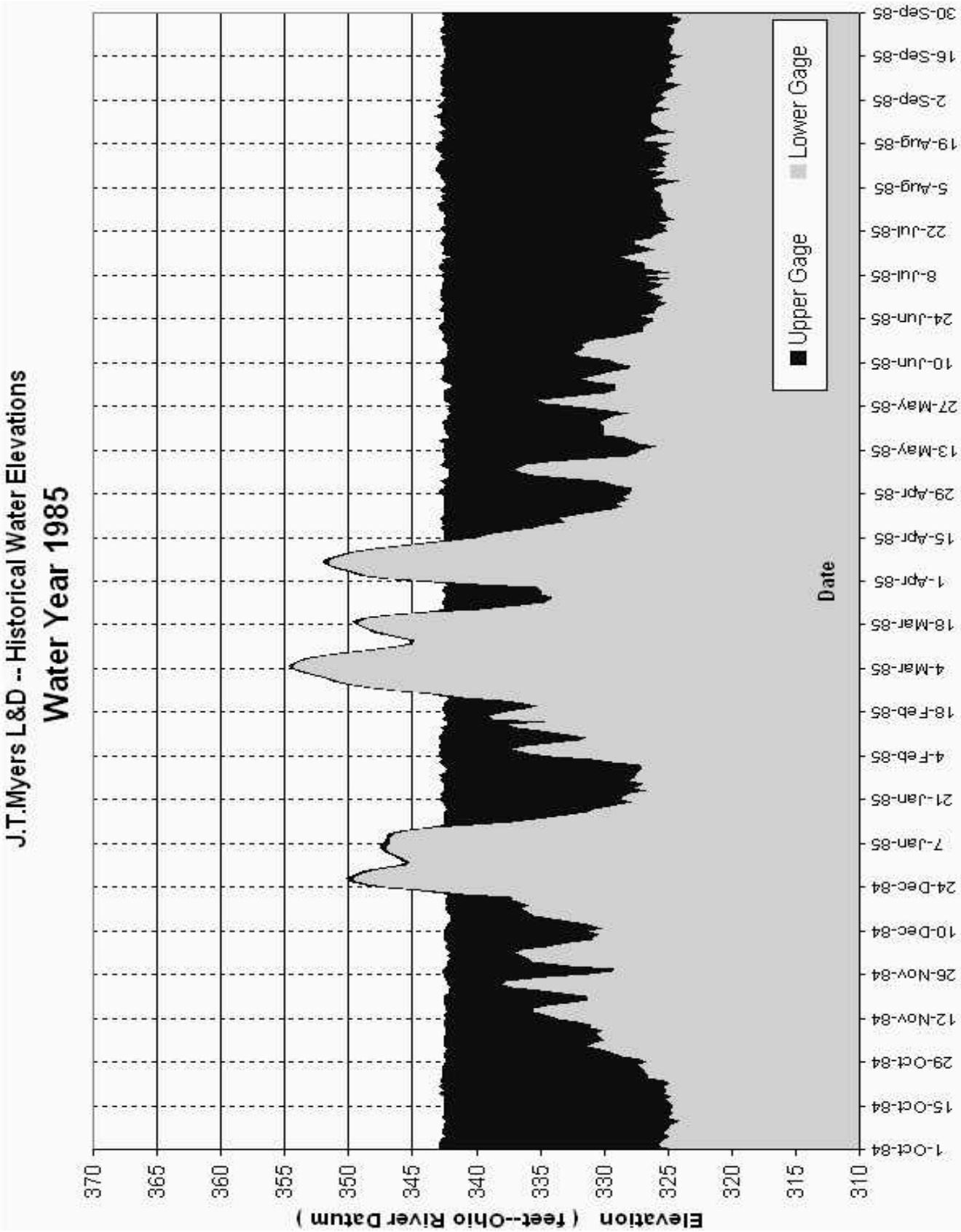

J.T.Myers L&D -- Historical Water Elevations
Water Year 1985
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-84
15-Oct-84
29-Oct-84
12-Nov-84
26-Nov-84
10-Dec-84
24-Dec-84
7-Jan-85
21-Jan-85
4-Feb-85
18-Feb-85
4-Mar-85
18-Mar-85
1-Apr-85
15-Apr-85
29-Apr-85
13-May-85
27-May-85
10-Jun-85
24-Jun-85
8-Jul-85
22-Jul-85
5-Aug-85
19-Aug-85
2-Sep-85
16-Sep-85
30-Sep-85
Date
Upper Gage
Lower Gage

FIGURE 2.4K

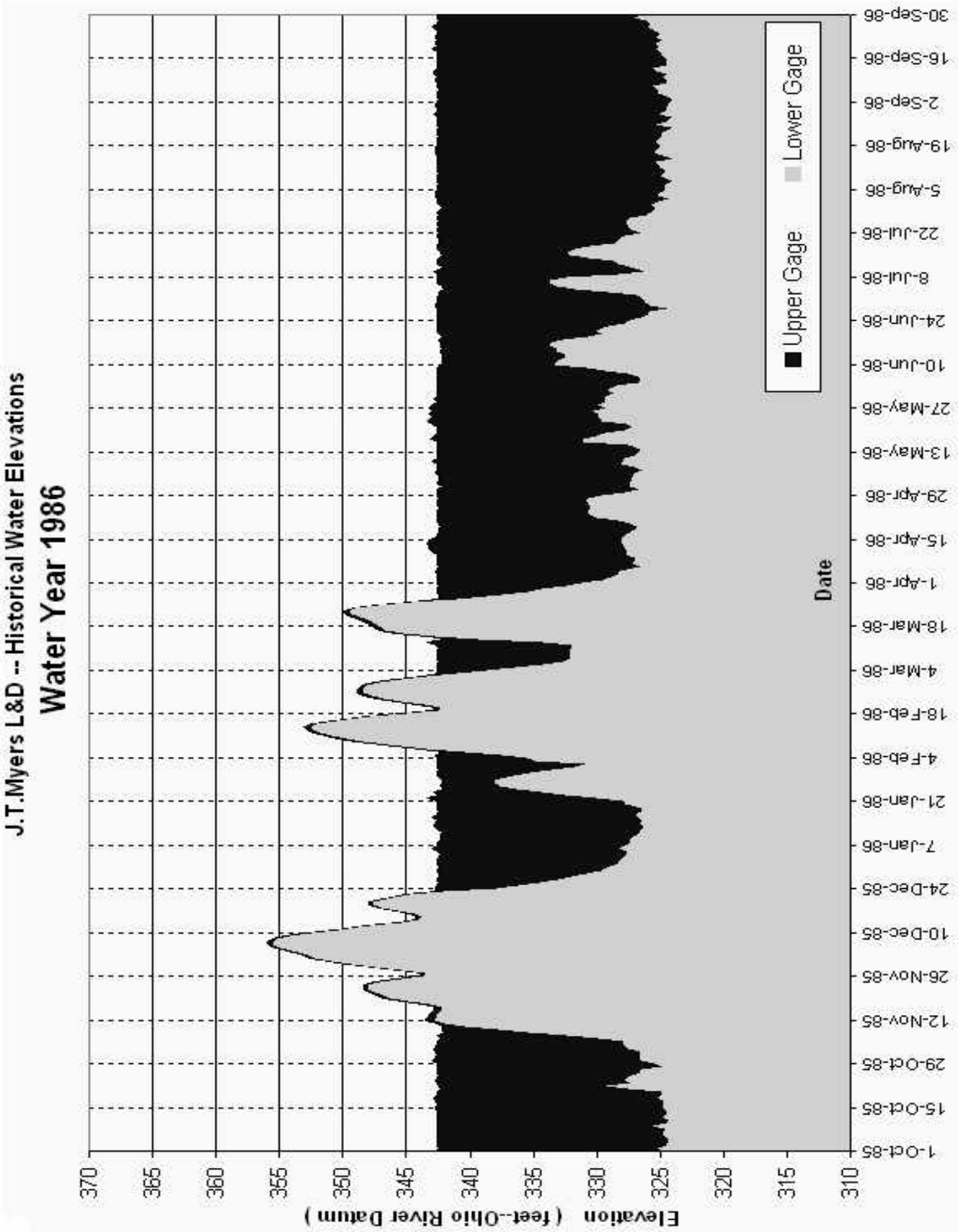

J.T.Myers L&D -- Historical Water Elevations
Water Year 1986
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-85
15-Oct-85
29-Oct-85
12-Nov-85
26-Nov-85
10-Dec-85
24-Dec-85
7-Jan-86
21-Jan-86
4-Feb-86
18-Feb-86
4-Mar-86
18-Mar-86
1-Apr-86
15-Apr-86
29-Apr-86
13-May-86
27-May-86
10-Jun-86
24-Jun-86
8-Jul-86
22-Jul-86
5-Aug-86
19-Aug-86
2-Sep-86
16-Sep-86
30-Sep-86
Upper Gage
Lower Gage

FIGURE 2.4L

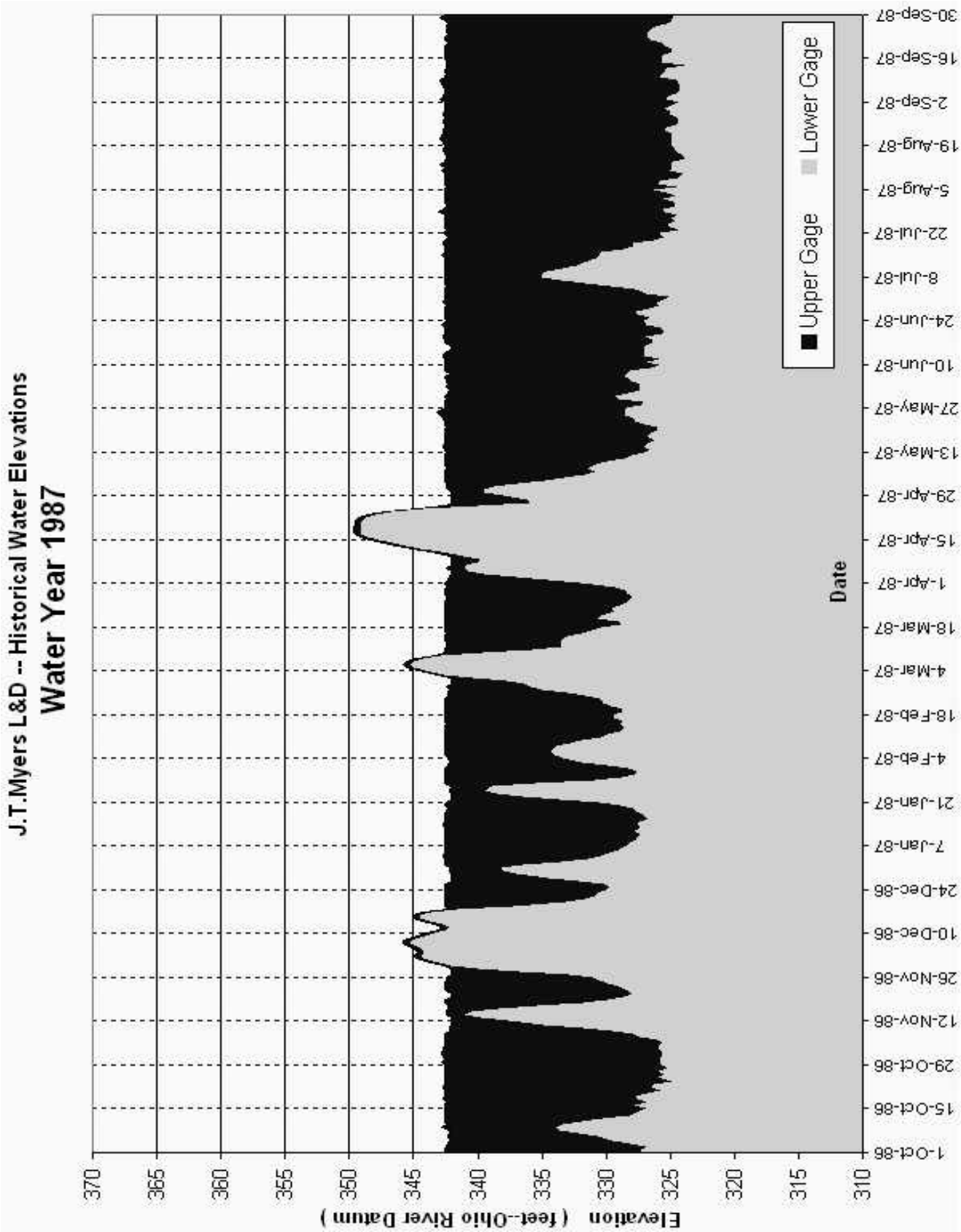

J.T.Myers L&D -- Historical Water Elevations
Water Year 1987
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-86
15-Oct-86
29-Oct-86
12-Nov-86
26-Nov-86
10-Dec-86
24-Dec-86
7-Jan-87
21-Jan-87
4-Feb-87
18-Feb-87
4-Mar-87
18-Mar-87
1-Apr-87
15-Apr-87
29-Apr-87
13-May-87
27-May-87
10-Jun-87
24-Jun-87
8-Jul-87
22-Jul-87
5-Aug-87
19-Aug-87
2-Sep-87
16-Sep-87
30-Sep-87

FIGURE 2.4M

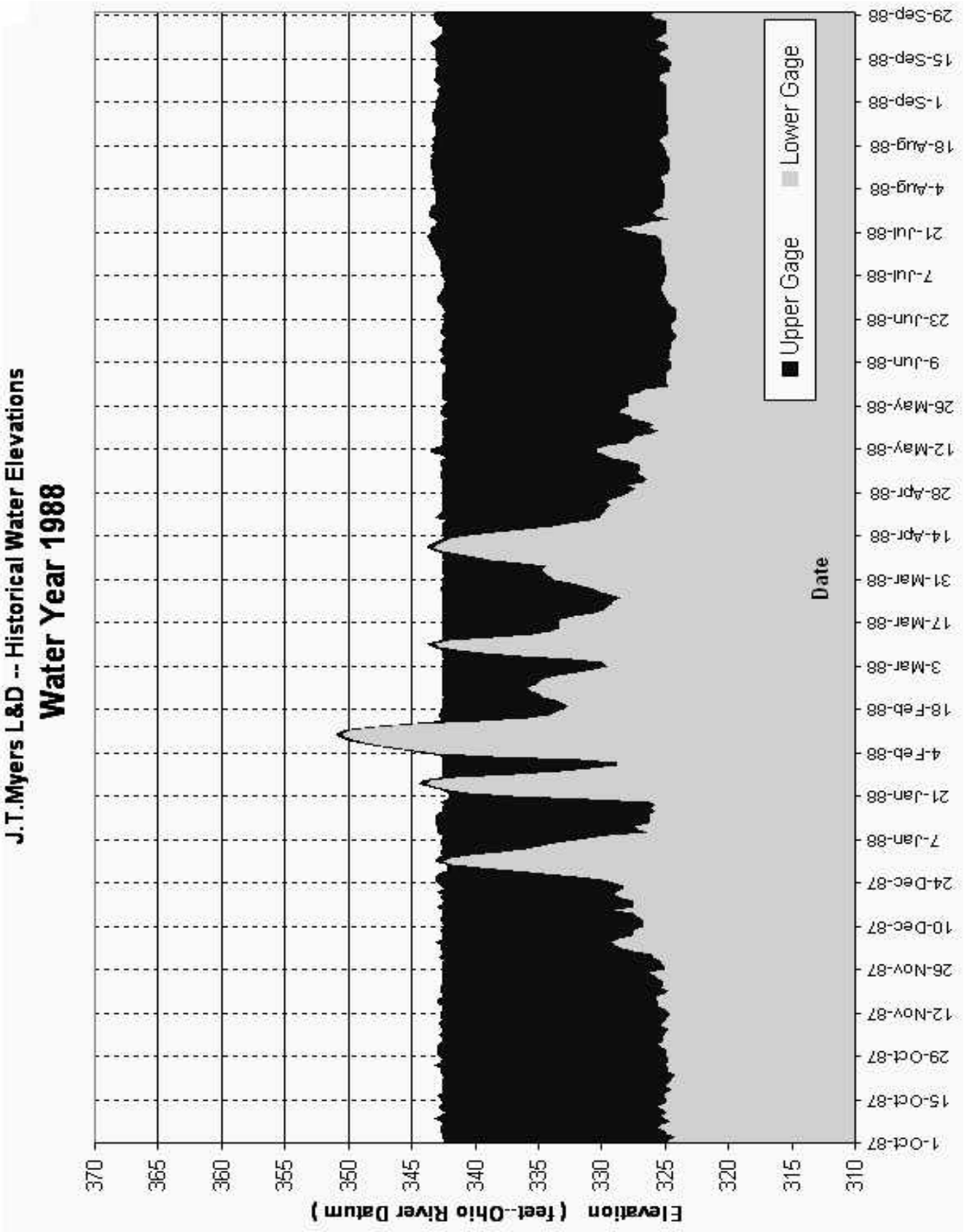

J.T.Myers L&D -- Historical Water Elevations
Water Year 1988
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-87
15-Oct-87
29-Oct-87
12-Nov-87
26-Nov-87
10-Dec-87
24-Dec-87
7-Jan-88
21-Jan-88
4-Feb-88
18-Feb-88
3-Mar-88
17-Mar-88
31-Mar-88
14-Apr-88
28-Apr-88
12-May-88
26-May-88
9-Jun-88
23-Jun-88
7-Jul-88
21-Jul-88
4-Aug-88
18-Aug-88
1-Sep-88
15-Sep-88
29-Sep-88
Date
Upper Gage
Lower Gage

FIGURE 2.4N

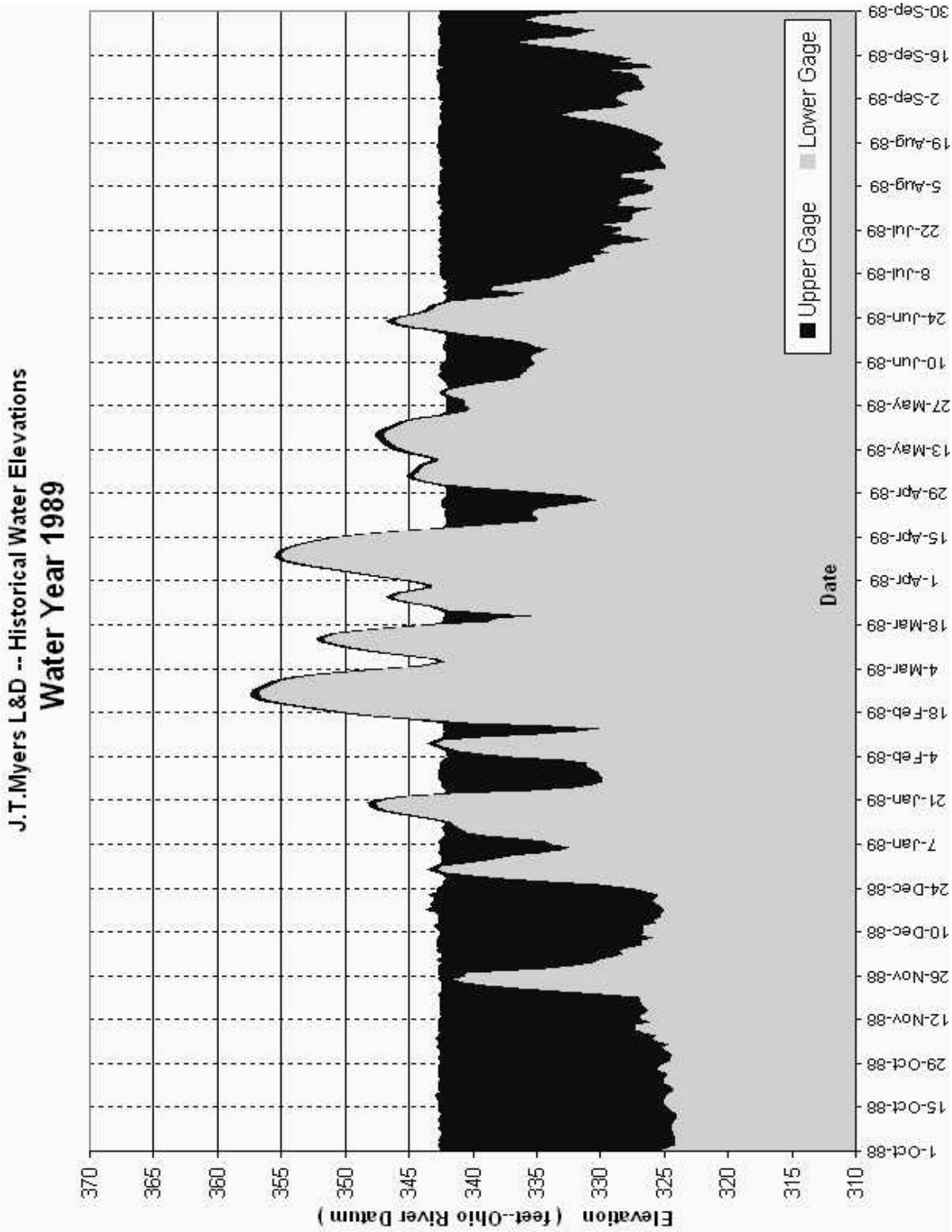

J.T.Myers L&D -- Historical Water Elevations
Water Year 1989
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-88
15-Oct-88
29-Oct-88
12-Nov-88
26-Nov-88
10-Dec-88
24-Dec-88
7-Jan-89
21-Jan-89
4-Feb-89
18-Feb-89
4-Mar-89
18-Mar-89
1-Apr-89
15-Apr-89
29-Apr-89
13-May-89
27-May-89
10-Jun-89
24-Jun-89
8-Jul-89
22-Jul-89
5-Aug-89
19-Aug-89
2-Sep-89
16-Sep-89
30-Sep-89

FIGURE 2.4O

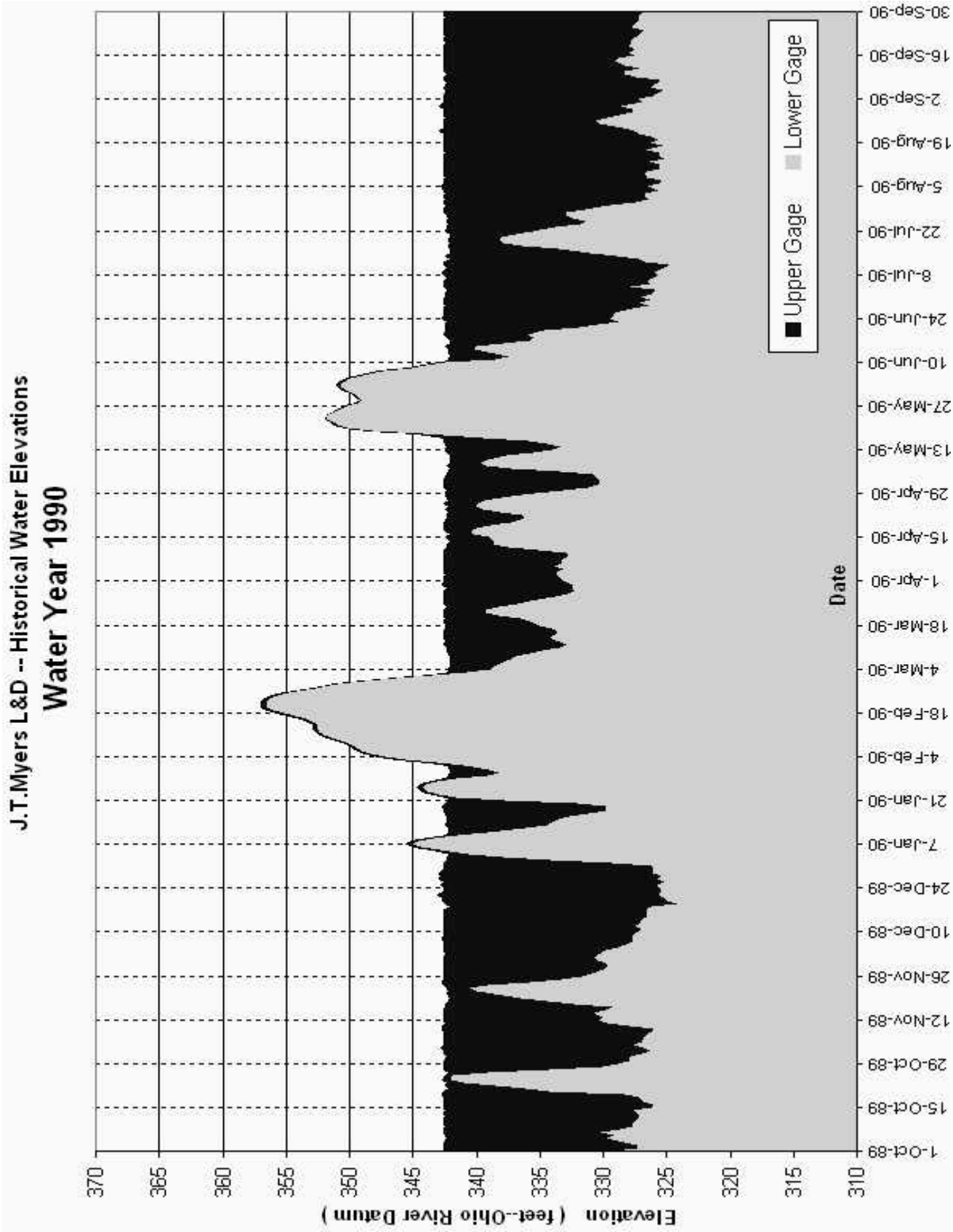

J.T.Myers L&D -- Historical Water Elevations
Water Year 1990
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-89
15-Oct-89
29-Oct-89
12-Nov-89
26-Nov-89
10-Dec-89
24-Dec-89
7-Jan-90
21-Jan-90
4-Feb-90
18-Feb-90
4-Mar-90
18-Mar-90
1-Apr-90
15-Apr-90
29-Apr-90
13-May-90
27-May-90
10-Jun-90
24-Jun-90
8-Jul-90
22-Jul-90
5-Aug-90
19-Aug-90
2-Sep-90
16-Sep-90
30-Sep-90
Upper Gage
Lower Gage

FIGURE 2.4P

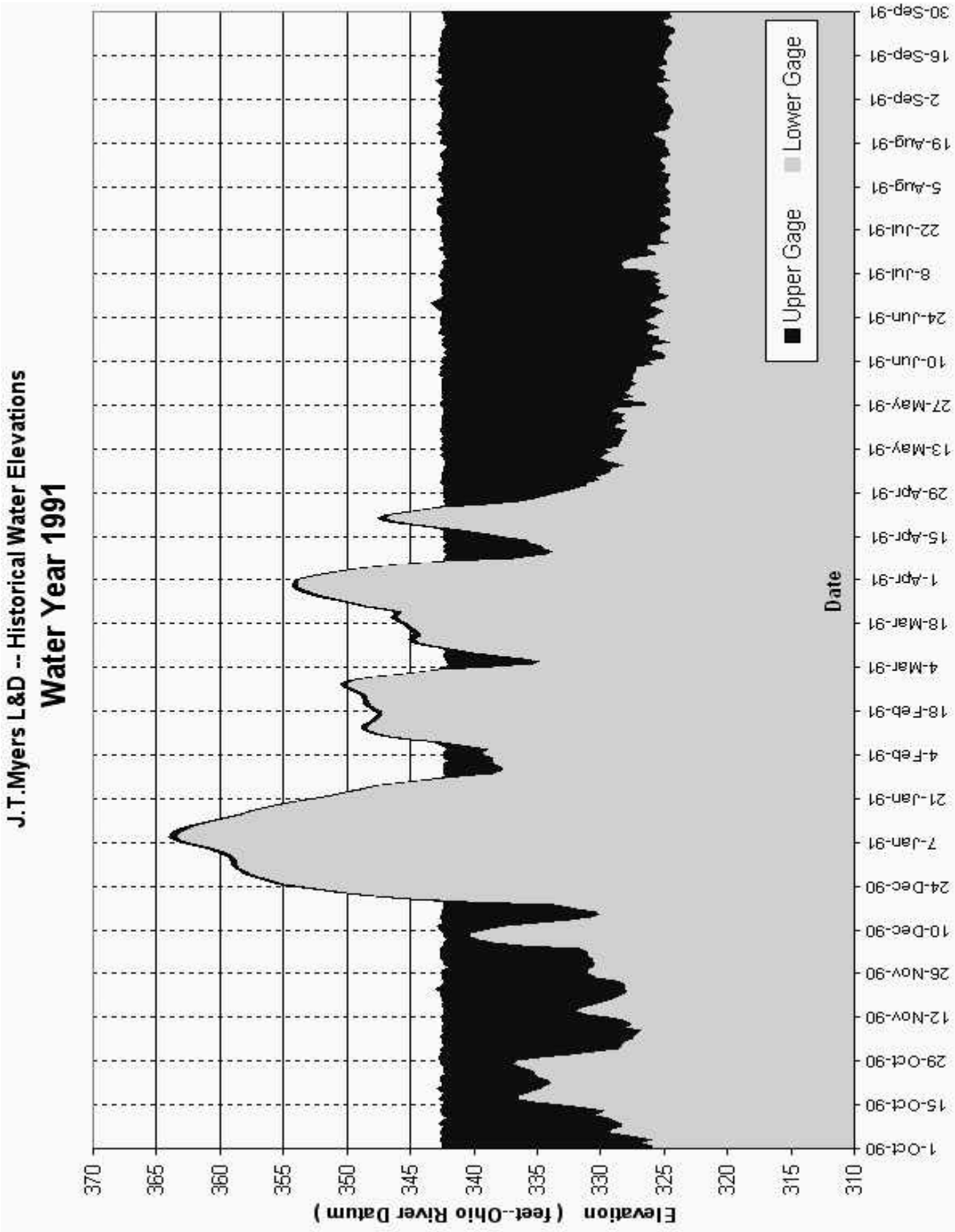

J.T.Myers L&D -- Historical Water Elevations
Water Year 1991
Upper Gage
Lower Gage
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-90
15-Oct-90
29-Oct-90
12-Nov-90
26-Nov-90
10-Dec-90
24-Dec-90
7-Jan-91
21-Jan-91
4-Feb-91
18-Feb-91
4-Mar-91
18-Mar-91
1-Apr-91
15-Apr-91
29-Apr-91
13-May-91
27-May-91
10-Jun-91
24-Jun-91
8-Jul-91
22-Jul-91
5-Aug-91
19-Aug-91
2-Sep-91
16-Sep-91
30-Sep-91

FIGURE 2.4Q

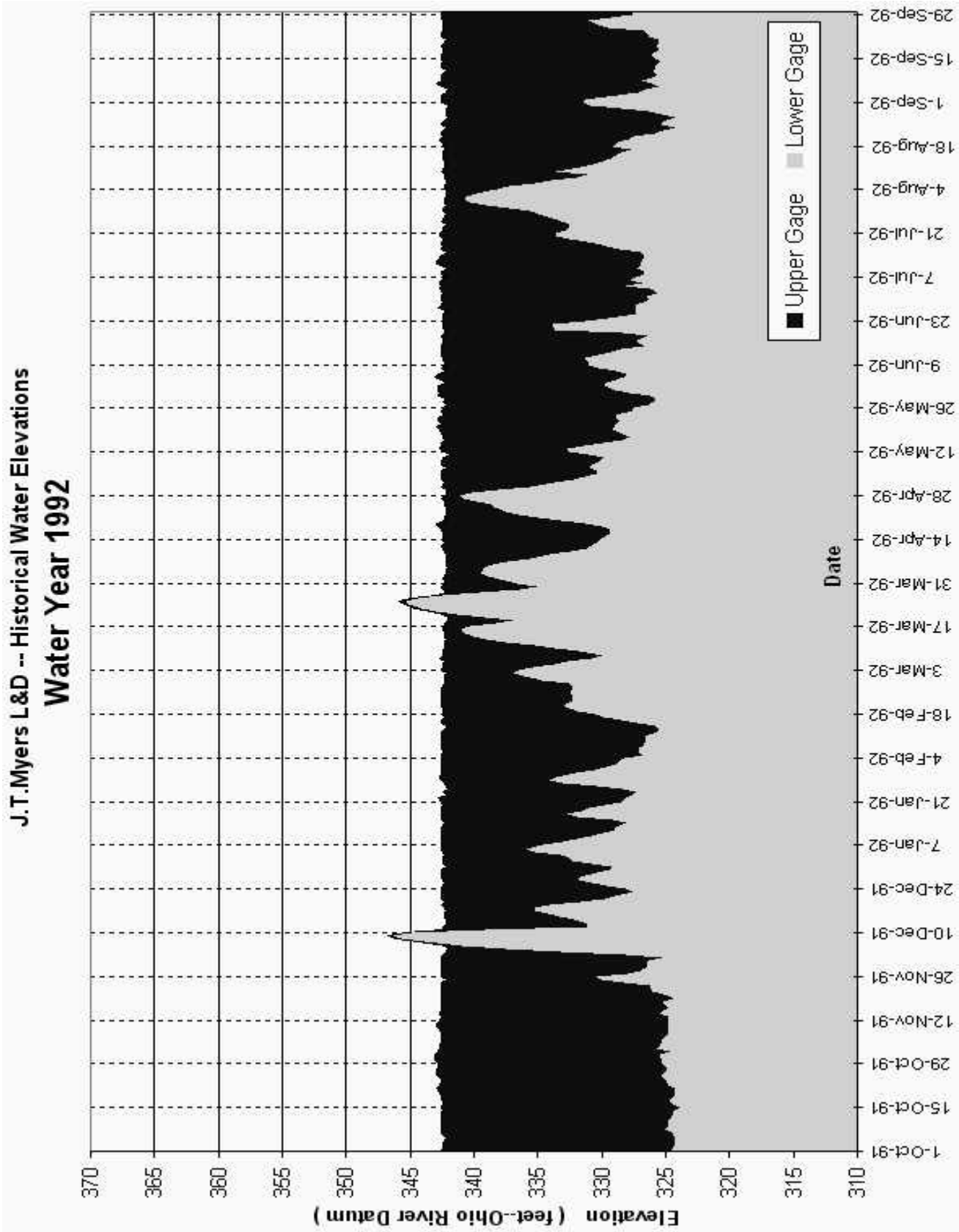

J.T.Myers L&D -- Historical Water Elevations
Water Year 1992
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-91
15-Oct-91
29-Oct-91
12-Nov-91
26-Nov-91
10-Dec-91
24-Dec-91
7-Jan-92
21-Jan-92
4-Feb-92
18-Feb-92
3-Mar-92
17-Mar-92
31-Mar-92
14-Apr-92
28-Apr-92
12-May-92
26-May-92
9-Jun-92
23-Jun-92
7-Jul-92
21-Jul-92
4-Aug-92
18-Aug-92
1-Sep-92
15-Sep-92
29-Sep-92

FIGURE 2.4R

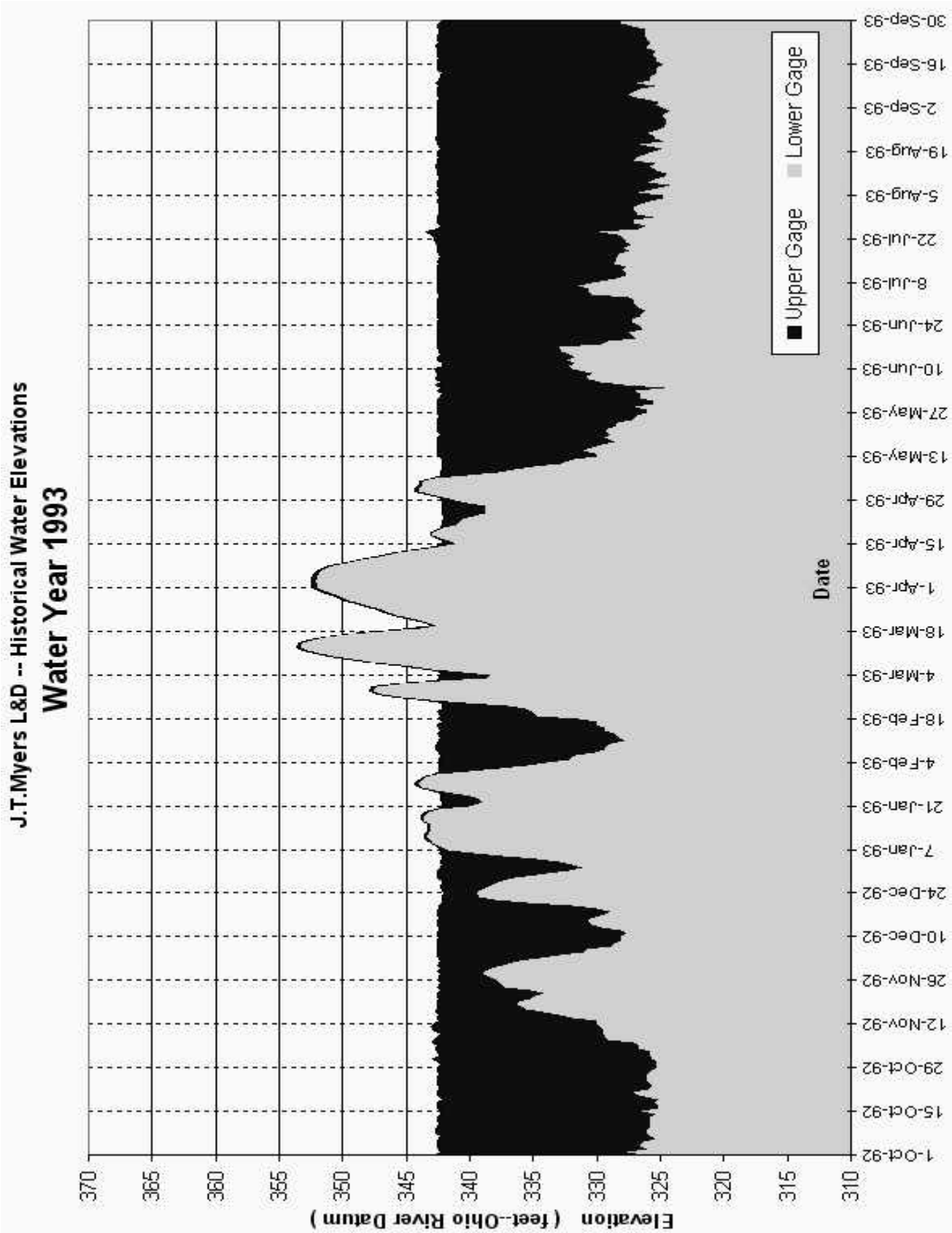

J.T.Myers L&D -- Historical Water Elevations
Water Year 1993
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-92
15-Oct-92
29-Oct-92
12-Nov-92
26-Nov-92
10-Dec-92
24-Dec-92
7-Jan-93
21-Jan-93
4-Feb-93
18-Feb-93
4-Mar-93
18-Mar-93
1-Apr-93
15-Apr-93
29-Apr-93
13-May-93
27-May-93
10-Jun-93
24-Jun-93
8-Jul-93
22-Jul-93
5-Aug-93
19-Aug-93
2-Sep-93
16-Sep-93
30-Sep-93
Date
Upper Gage
Lower Gage

FIGURE 2.4S

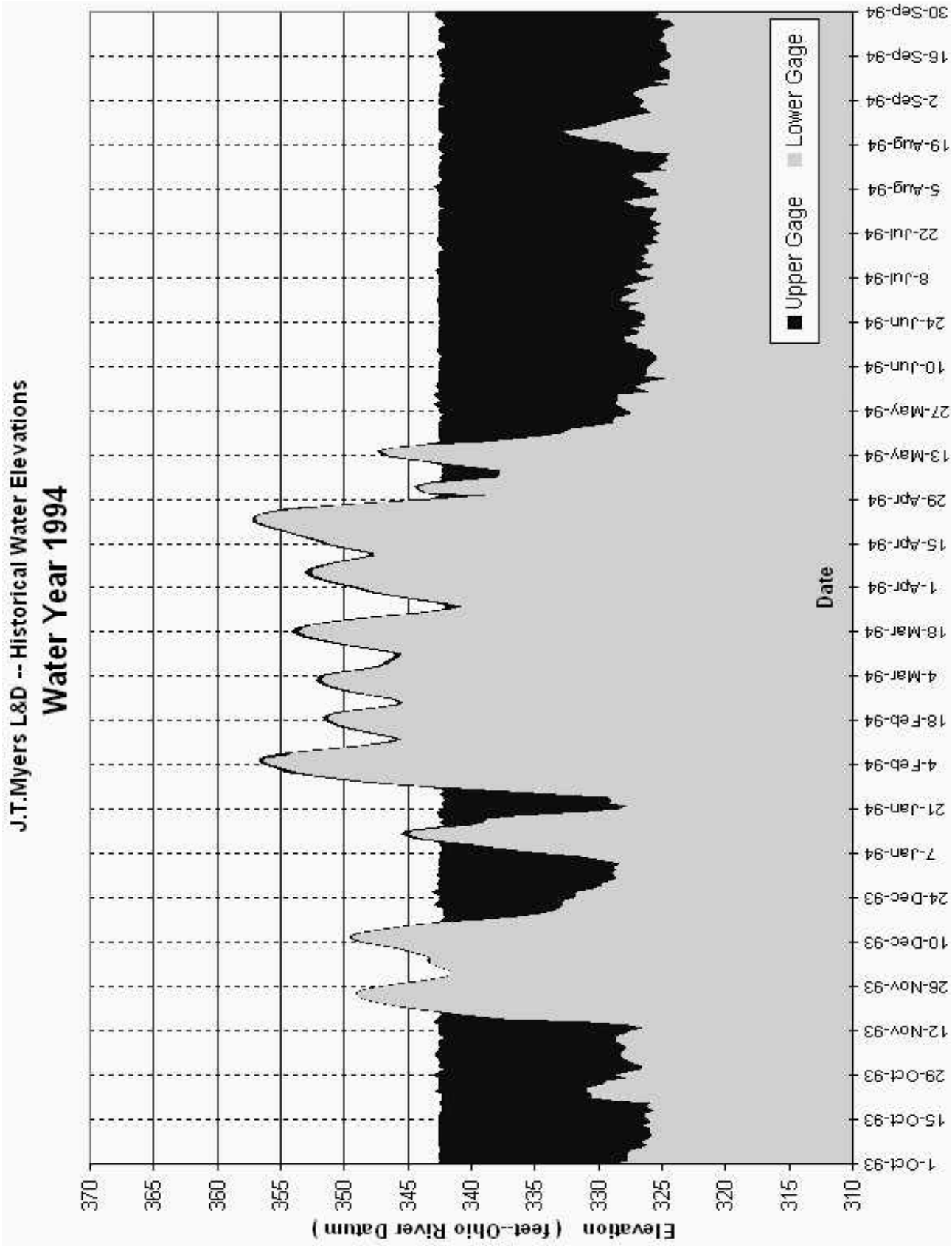

J.T.Myers L&D -- Historical Water Elevations
Water Year 1994
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-93
15-Oct-93
29-Oct-93
12-Nov-93
26-Nov-93
10-Dec-93
24-Dec-93
7-Jan-94
21-Jan-94
4-Feb-94
18-Feb-94
4-Mar-94
18-Mar-94
1-Apr-94
15-Apr-94
29-Apr-94
13-May-94
27-May-94
10-Jun-94
24-Jun-94
8-Jul-94
22-Jul-94
5-Aug-94
19-Aug-94
2-Sep-94
16-Sep-94
30-Sep-94

FIGURE 2.4T

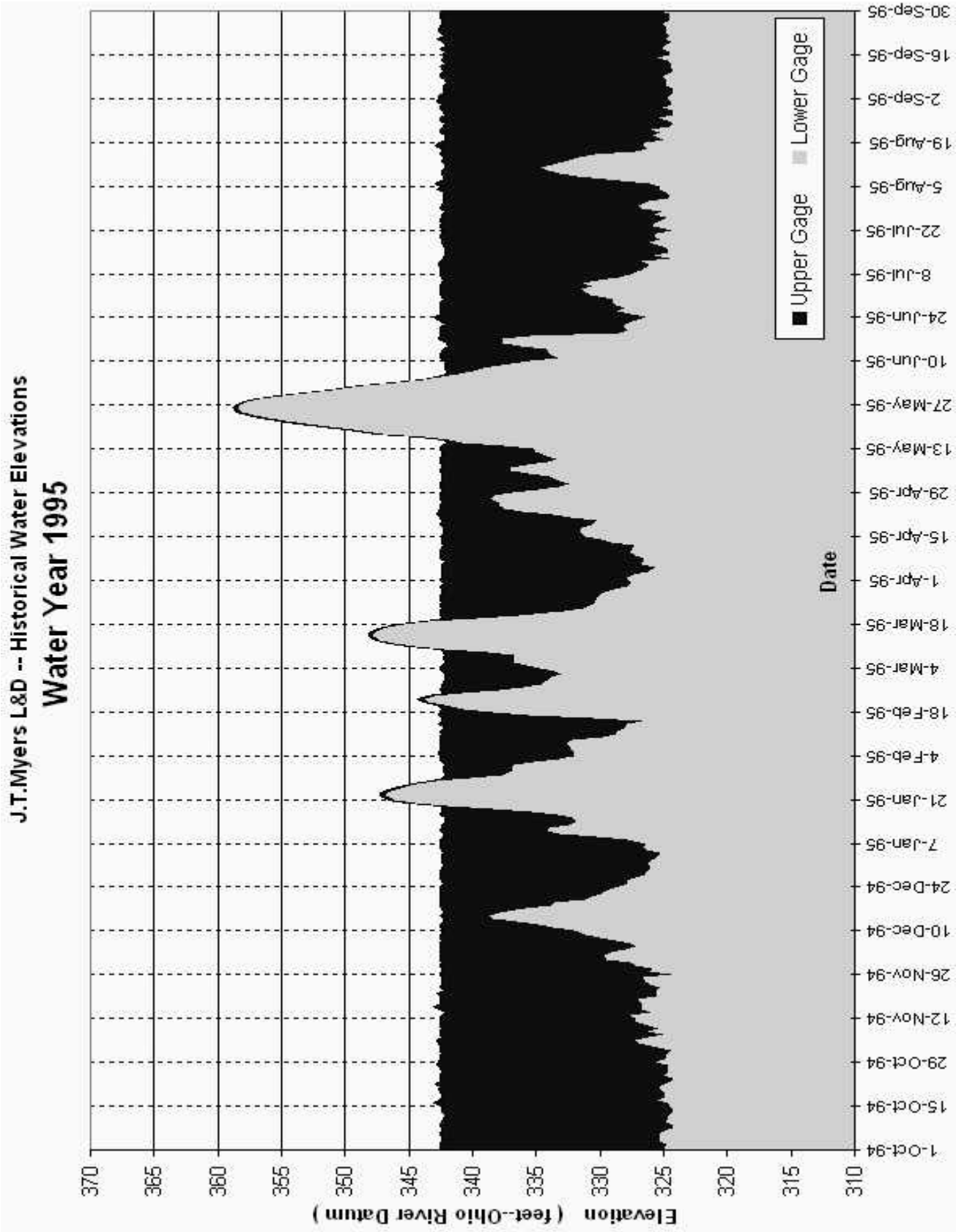

J.T.Myers L&D -- Historical Water Elevations
Water Year 1995
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-94
15-Oct-94
29-Oct-94
12-Nov-94
26-Nov-94
10-Dec-94
24-Dec-94
7-Jan-95
21-Jan-95
4-Feb-95
18-Feb-95
4-Mar-95
18-Mar-95
1-Apr-95
15-Apr-95
29-Apr-95
13-May-95
27-May-95
10-Jun-95
24-Jun-95
8-Jul-95
22-Jul-95
5-Aug-95
19-Aug-95
2-Sep-95
16-Sep-95
30-Sep-95
Upper Gage
Lower Gage

FIGURE 2.4U

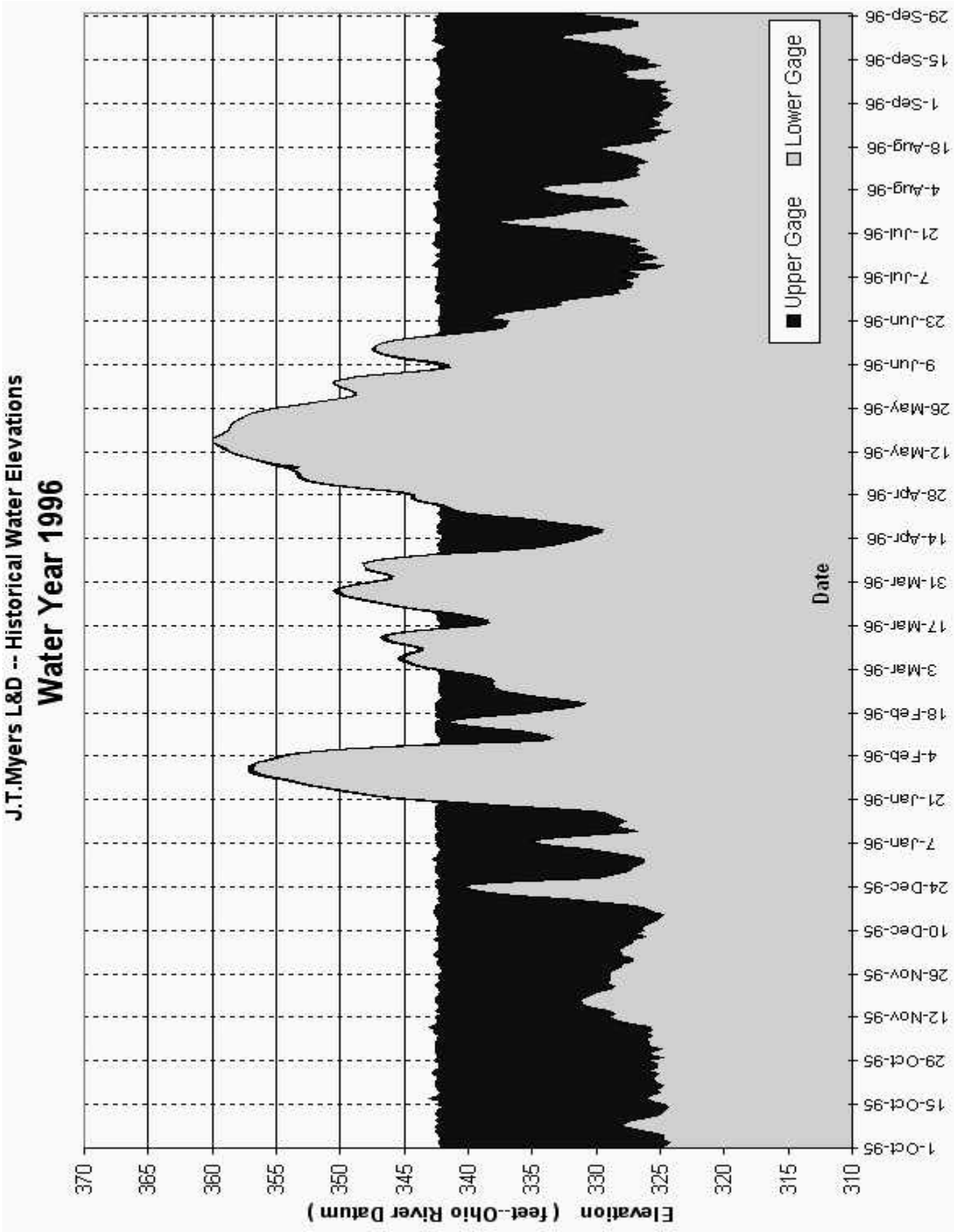

J.T.Myers L&D -- Historical Water Elevations
Water Year 1996
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-95
15-Oct-95
29-Oct-95
12-Nov-95
26-Nov-95
10-Dec-95
24-Dec-95
7-Jan-96
21-Jan-96
4-Feb-96
18-Feb-96
3-Mar-96
17-Mar-96
31-Mar-96
14-Apr-96
28-Apr-96
12-May-96
26-May-96
9-Jun-96
23-Jun-96
7-Jul-96
21-Jul-96
4-Aug-96
18-Aug-96
1-Sep-96
15-Sep-96
29-Sep-96
Date
Upper Gage
Lower Gage

FIGURE 2.4V

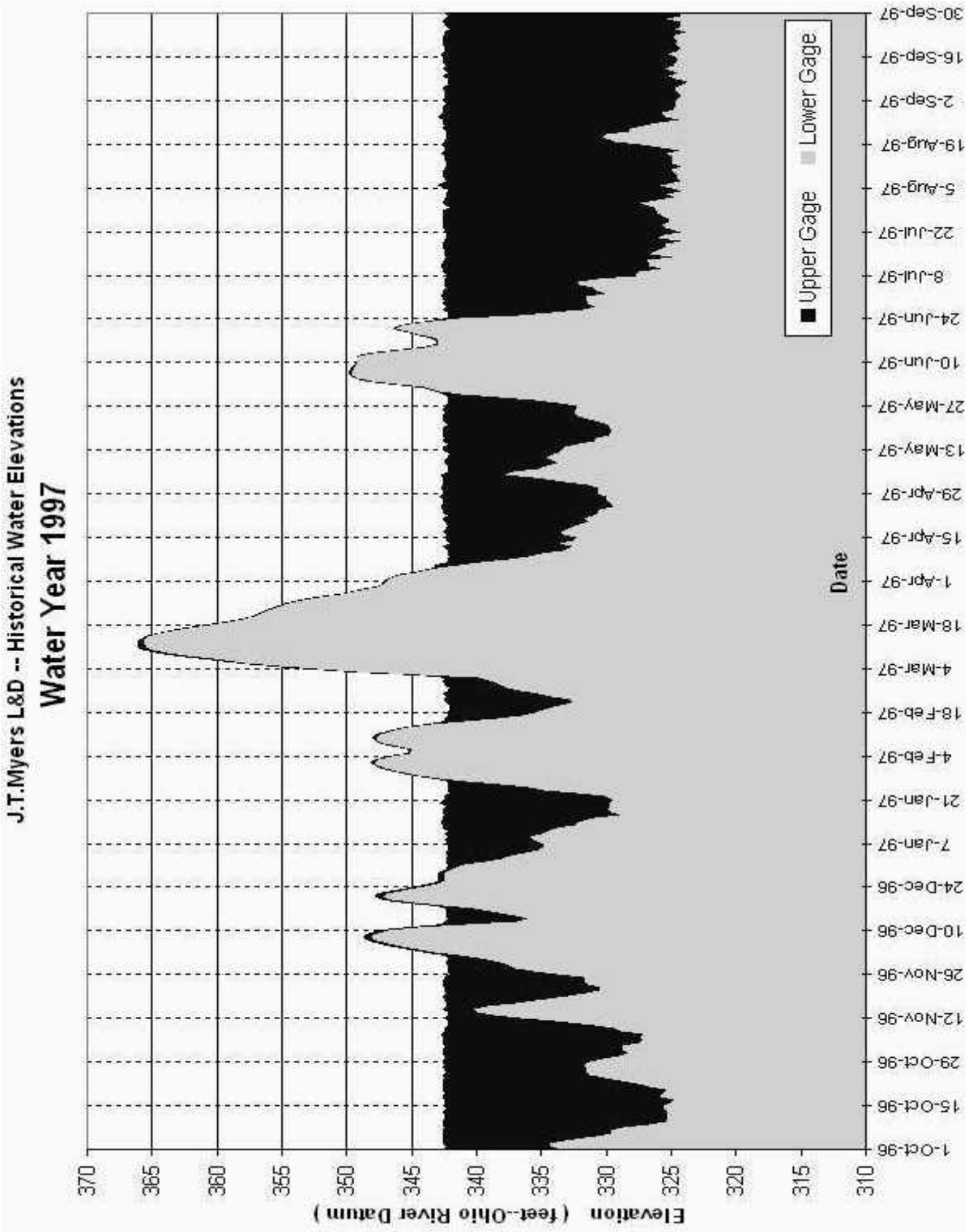

J.T.Myers L&D -- Historical Water Elevations
Water Year 1997
Upper Gage
Lower Gage
Date
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
1-Oct-96
15-Oct-96
29-Oct-96
12-Nov-96
26-Nov-96
10-Dec-96
24-Dec-96
7-Jan-97
21-Jan-97
4-Feb-97
18-Feb-97
4-Mar-97
18-Mar-97
1-Apr-97
15-Apr-97
29-Apr-97
13-May-97
27-May-97
10-Jun-97
24-Jun-97
8-Jul-97
22-Jul-97
5-Aug-97
19-Aug-97
2-Sep-97
16-Sep-97
30-Sep-97

FIGURE 2.4W

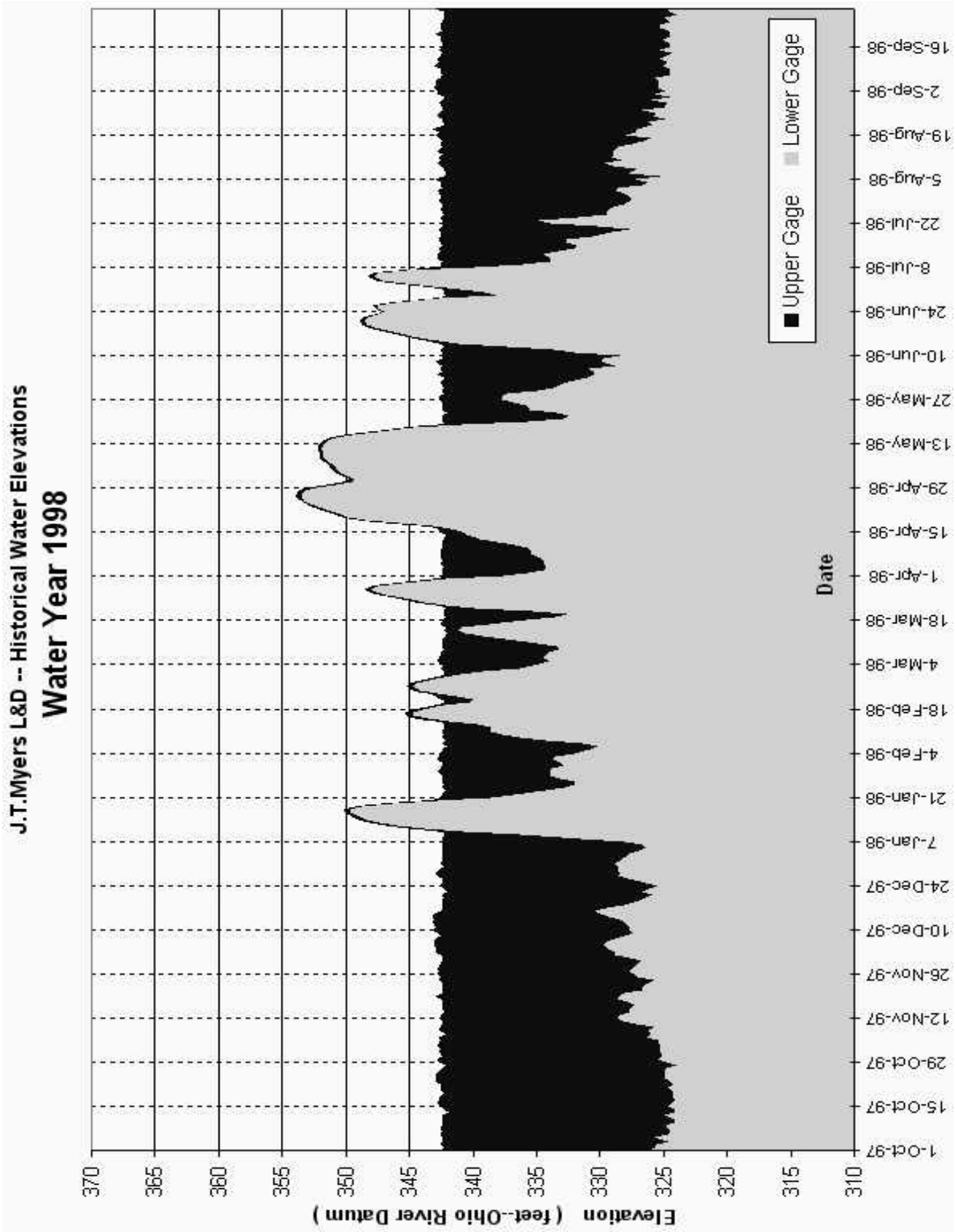

J.T.Myers L&D -- Historical Water Elevations
Water Year 1998
Elevation (feet--Ohio River Datum)
370
365
360
355
350
345
340
335
330
325
320
315
310
Date
1-Oct-97
15-Oct-97
29-Oct-97
12-Nov-97
26-Nov-97
10-Dec-97
24-Dec-97
7-Jan-98
21-Jan-98
4-Feb-98
18-Feb-98
4-Mar-98
18-Mar-98
1-Apr-98
15-Apr-98
29-Apr-98
13-May-98
27-May-98
10-Jun-98
24-Jun-98
8-Jul-98
22-Jul-98
5-Aug-98
19-Aug-98
2-Sep-98
16-Sep-98
Upper Gage
Lower Gage

FIGURE 2.4X

2.5 STAGE DURATION

Stage duration data provides information concerning the number of days or percent of time that a particular elevation is equaled or exceeded. This information is provided by a particular month or annually for the period of record shown. ***Tables 2.5A*** and ***2.5B*** show the number of days and percent of time a particular pool elevation is equaled or exceeded in J. T. Myers upper pool whereas ***Tables 2.5C*** and ***2.5D*** provides the same information for the lower pool. ***Figures 2.5A*** and ***2.5B*** shows the data in graphical form for the tabular data for the upper and lower pools respectively. Note that data are for water years 1976 through 1998. Data is not included for water year 1975 because the upper pool was in a transitional period. However, note that pool elevation 360 was exceeded in April 1975 (as shown in ***Figure 2.4A***), which has not happened again in that month through 1998.

To better pinpoint the time to accomplish certain construction activities, ***Figures 2.5C*** and ***2.5D*** show the maximum elevation, the average for the 24 years of data for calendar year 1975 through 1998, and the minimum elevation for each date in the calendar year.

TABLE 2.5A

OHIO RIVER AT J.T MYERS(UPR)
ELEVATION DURATION TABLE
FOR PERIOD (OCT 1975 - SEP 1998)

*** NUMBER OF DAYS WHEN ELEVATION IS >= CLASS ***

CLASSES (FEET)	FOR YEAR	FOR MONTHS OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
367.00	0	0	0	0	0	0	0	0	0	0	0	0	0
366.00	3	0	0	0	0	0	3	0	0	0	0	0	0
365.00	5	0	0	0	0	0	5	0	0	0	0	0	0
364.00	8	0	0	0	1	0	7	0	0	0	0	0	0
363.00	14	0	0	0	5	0	9	0	0	0	0	0	0
362.00	20	0	0	0	6	0	14	0	0	0	0	0	0
361.00	25	0	0	0	8	0	17	0	0	0	0	0	0
360.00	40	0	0	0	11	0	22	0	7	0	0	0	0
359.00	56	0	0	3	15	0	25	0	13	0	0	0	0
358.00	81	0	0	8	16	0	33	0	24	0	0	0	0
357.00	101	0	0	10	19	4	37	2	29	0	0	0	0
356.00	131	0	0	13	21	16	42	4	35	0	0	0	0
355.00	171	0	0	18	23	25	55	10	40	0	0	0	0
354.00	217	0	0	22	25	33	67	25	45	0	0	0	0
353.00	278	0	0	25	25	40	80	47	61	0	0	0	0
352.00	368	0	0	28	32	52	104	75	77	0	0	0	0
351.00	459	0	0	30	43	64	123	104	93	2	0	0	0
350.00	558	0	0	37	54	86	139	127	102	13	0	0	0
349.00	663	0	2	44	62	105	159	153	113	25	0	0	0
348.00	794	0	7	61	72	137	182	176	122	34	1	0	2
347.00	938	0	14	80	91	164	210	191	136	46	3	0	3
346.00	1074	0	18	93	106	184	243	210	151	61	3	0	5
345.00	1221	0	22	118	119	203	283	228	163	75	5	0	5
344.00	1359	2	25	148	142	215	314	240	178	85	5	0	5
343.00	1907	59	43	189	189	254	357	274	215	130	55	85	57
342.00	8284	703	684	700	697	639	701	680	708	680	700	705	687
341.00	8401	713	690	713	713	650	713	690	713	690	713	713	690

TABLE 2.5B

OHIO RIVER AT J.T.MYERS(UPR)
ELEVATION DURATION TABLE
FOR PERIOD (OCT 1975 - SEP 1998)

**** PERCENTAGE OF DAYS WHEN ELEVATION IS >= CLASS ****

CLASSES (FEET)	FOR YEAR	FOR MONTHS OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
367.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
366.00	.04	.00	.00	.00	.00	.00	.42	.00	.00	.00	.00	.00	.00
365.00	.06	.00	.00	.00	.00	.00	.70	.00	.00	.00	.00	.00	.00
364.00	.10	.00	.00	.00	.14	.00	.98	.00	.00	.00	.00	.00	.00
363.00	.17	.00	.00	.00	.70	.00	1.26	.00	.00	.00	.00	.00	.00
362.00	.24	.00	.00	.00	.84	.00	1.96	.00	.00	.00	.00	.00	.00
361.00	.30	.00	.00	.00	1.12	.00	2.38	.00	.00	.00	.00	.00	.00
360.00	.48	.00	.00	.00	1.54	.00	3.09	.00	.98	.00	.00	.00	.00
359.00	.67	.00	.00	.42	2.10	.00	3.51	.00	1.82	.00	.00	.00	.00
358.00	.96	.00	.00	1.12	2.24	.00	4.63	.00	3.37	.00	.00	.00	.00
357.00	1.20	.00	.00	1.40	2.66	.62	5.19	.29	4.07	.00	.00	.00	.00
356.00	1.56	.00	.00	1.82	2.95	2.46	5.89	.58	4.91	.00	.00	.00	.00
355.00	2.04	.00	.00	2.52	3.23	3.85	7.71	1.45	5.61	.00	.00	.00	.00
354.00	2.58	.00	.00	3.09	3.51	5.08	9.40	3.62	6.31	.00	.00	.00	.00
353.00	3.31	.00	.00	3.51	3.51	6.15	11.22	6.81	8.56	.00	.00	.00	.00
352.00	4.38	.00	.00	3.93	4.49	8.00	14.59	10.87	10.80	.00	.00	.00	.00
351.00	5.46	.00	.00	4.21	6.03	9.85	17.25	15.07	13.04	.29	.00	.00	.00
350.00	6.64	.00	.00	5.19	7.57	13.23	19.50	18.41	14.31	1.88	.00	.00	.00
349.00	7.89	.00	.29	6.17	8.70	16.15	22.30	22.17	15.85	3.62	.00	.00	.00
348.00	9.45	.00	1.01	8.56	10.10	21.08	25.53	25.51	17.11	4.93	.14	.00	.29
347.00	11.17	.00	2.03	11.22	12.76	25.23	29.45	27.68	19.07	6.67	.42	.00	.43
346.00	12.78	.00	2.61	13.04	14.87	28.31	34.08	30.43	21.18	8.84	.42	.00	.72
345.00	14.53	.00	3.19	16.55	16.69	31.23	39.69	33.04	22.86	10.87	.70	.00	.72
344.00	16.18	.28	3.62	20.76	19.92	33.08	44.04	34.78	24.96	12.32	.70	.00	.72
343.00	22.70	8.27	6.23	26.51	26.51	39.08	50.07	39.71	30.15	18.84	7.71	11.92	8.26
342.00	98.61	98.60	99.13	98.18	97.76	98.31	98.32	98.55	99.30	98.55	98.18	98.88	99.57
341.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FIGURE 2.5A OHIO RIVER AT J. T. MYERS (UPPER) FOR YEAR ELEVATION DURATION CURVE FOR PERIOD (OCT 1975 - SEP 1998)

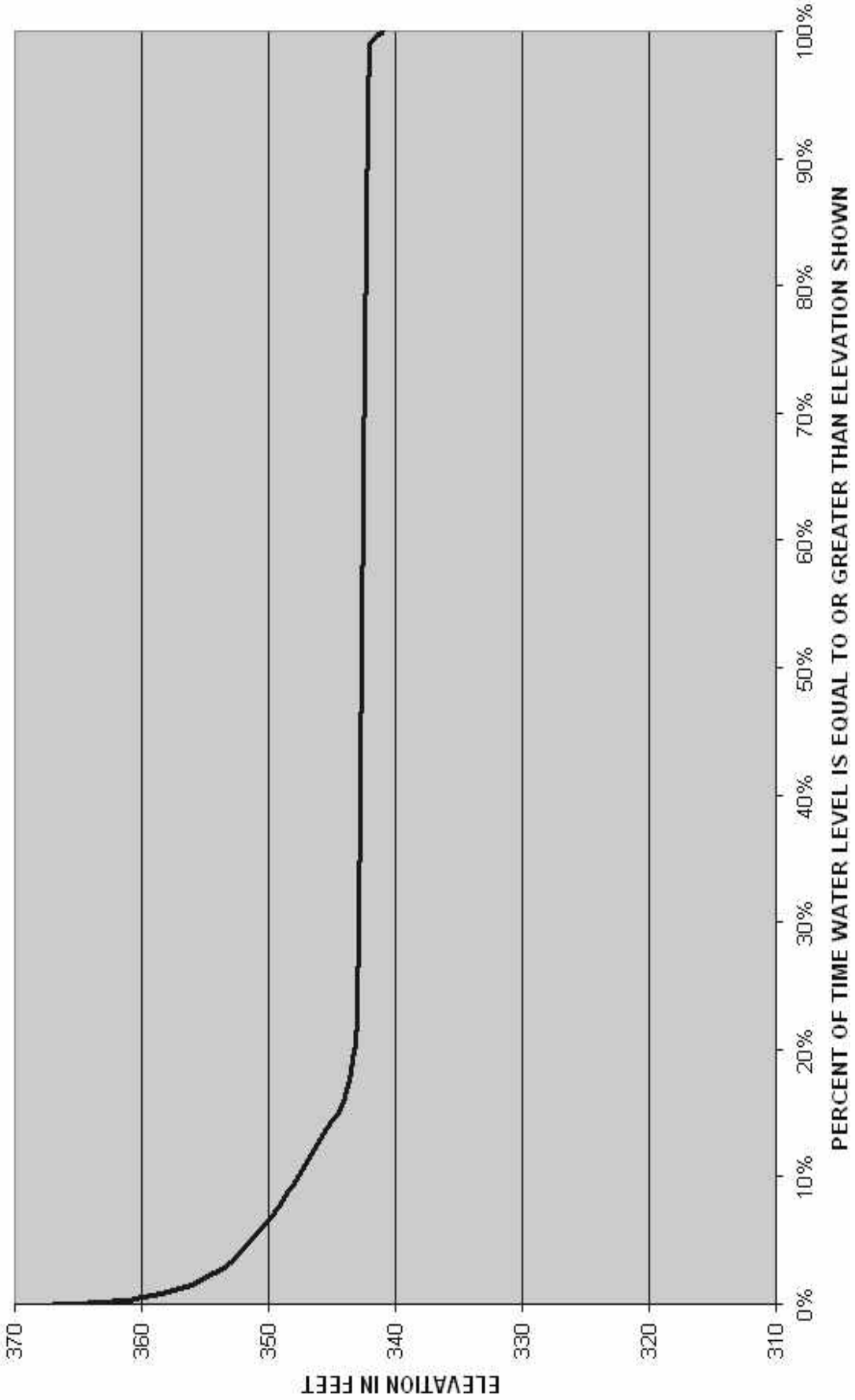


TABLE 2.5C

OHIO RIVER AT J.T.MYERS (LWR)
ELEVATION DURATION TABLE
FOR PERIOD (OCT 1975 - SEP 1998)

*** NUMBER OF DAYS WHEN ELEVATION IS >= CLASS ***

CLASSES (FEET)	FOR YEAR	FOR MONTHS OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
366.00	0	0	0	0	0	0	0	0	0	0	0	0	0
365.00	4	0	0	0	0	0	4	0	0	0	0	0	0
364.00	6	0	0	0	0	0	6	0	0	0	0	0	0
363.00	11	0	0	0	3	0	8	0	0	0	0	0	0
362.00	17	0	0	0	6	0	11	0	0	0	0	0	0
361.00	23	0	0	0	8	0	15	0	0	0	0	0	0
360.00	34	0	0	0	10	0	21	0	3	0	0	0	0
359.00	49	0	0	0	13	0	24	0	12	0	0	0	0
358.00	74	0	0	5	16	0	32	0	21	0	0	0	0
357.00	91	0	0	8	17	0	36	1	29	0	0	0	0
356.00	124	0	0	11	21	13	41	4	34	0	0	0	0
355.00	154	0	0	16	23	20	50	6	39	0	0	0	0
354.00	192	0	0	20	24	31	61	14	42	0	0	0	0
353.00	254	0	0	23	25	36	76	39	55	0	0	0	0
352.00	325	0	0	27	27	48	90	65	68	0	0	0	0
351.00	418	0	0	29	35	57	114	94	88	1	0	0	0
350.00	511	0	0	32	45	78	130	115	100	11	0	0	0
349.00	631	0	2	42	57	99	151	144	113	23	0	0	0
348.00	747	0	6	55	69	127	171	166	120	32	0	0	1
347.00	888	0	13	75	81	158	199	185	128	44	3	0	2
346.00	1025	0	17	85	103	176	231	203	147	56	3	0	4
345.00	1158	0	21	104	113	194	269	221	156	70	5	0	5
344.00	1308	0	24	137	132	207	304	240	171	83	5	0	5
343.00	1458	2	28	160	159	227	335	255	187	91	6	1	7
342.00	1608	4	36	182	185	241	366	278	198	100	7	2	9
341.00	1734	8	41	97	1	251	391	296	08	0	8	4	9
340.00	1885	12	49	216	231	268	417	328	219	116	11	7	11
339.00	2057	16	56	243	249	290	449	356	234	130	13	9	12
338.00	2229	20	66	265	271	310	482	383	245	142	17	15	13
337.00	2398	23	76	286	289	329	501	409	270	161	21	19	14
336.00	2568	33	86	309	311	346	526	428	282	179	28	23	17
335.00	2775	43	102	325	329	369	547	462	311	197	35	33	22
334.00	3011	57	123	342	359	400	572	496	336	214	44	44	24
333.00	3261	72	142	359	388	427	599	526	371	237	60	54	26
332.00	3517	81	167	382	424	471	623	544	391	258	81	63	32
331.00	3787	95	204	415	452	502	633	566	417	282	107	74	40
330.00	4138	113	242	456	488	531	653	599	461	311	141	91	52
329.00	4515	137	286	493	524	553	677	626	506	352	183	116	62
328.00	4998	157	337	545	566	584	697	642	560	403	254	168	85
327.00	5558	205	396	594	612	605	705	664	615	478	346	206	132
326.00	6245	281	490	642	648	618	713	674	653	557	471	297	201
325.00	7159	452	587	678	658	630	713	678	673	608	625	487	370
324.00	7967	653	633	688	672	636	713	688	681	652	684	668	599
323.00	8069	663	648	698	690	638	713	689	690	657	695	679	609
322.00	8202	672	670	705	703	640	713	690	706	667	709	692	635
321.00	8317	686	689	711	712	643	713	690	711	680	713	706	663
320.00	8386	708	690	713	713	647	713	690	713	690	713	713	683
319.00	8398	712	690	713	713	650	713	690	713	690	713	713	688
318.00	8401	713	690	713	713	650	713	690	713	690	713	713	690

TABLE 2.5D

OHIO RIVER AT J.T MYERS (LWR)
ELEVATION DURATION TABLE
FOR PERIOD (OCT 1975 - SEP 1998)

*** PERCENTAGE OF DAYS WHEN ELEVATION IS >= CLASS ***

CLASSES	FOR	FOR MONTHS											
(FEET)	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
366.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
365.00	.05	.00	.00	.00	.00	.00	.56	.00	.00	.00	.00	.00	.00
364.00	.07	.00	.00	.00	.00	.00	.84	.00	.00	.00	.00	.00	.00
363.00	.13	.00	.00	.00	.42	.00	1.12	.00	.00	.00	.00	.00	.00
362.00	.20	.00	.00	.00	.84	.00	1.54	.00	.00	.00	.00	.00	.00
361.00	.27	.00	.00	.00	1.12	.00	2.10	.00	.00	.00	.00	.00	.00
360.00	.40	.00	.00	.00	1.40	.00	2.95	.00	.42	.00	.00	.00	.00
359.00	.58	.00	.00	.00	1.82	.00	3.37	.00	1.68	.00	.00	.00	.00
358.00	.88	.00	.00	.70	2.24	.00	4.49	.00	2.95	.00	.00	.00	.00
357.00	1.08	.00	.00	1.12	2.38	.00	5.05	.14	4.07	.00	.00	.00	.00
356.00	1.48	.00	.00	1.54	2.95	2.00	5.75	.58	4.77	.00	.00	.00	.00
355.00	1.83	.00	.00	2.24	3.23	3.08	7.01	.87	5.47	.00	.00	.00	.00
354.00	2.29	.00	.00	2.81	3.37	4.77	8.56	2.03	5.89	.00	.00	.00	.00
353.00	3.02	.00	.00	3.23	3.51	5.54	10.66	5.65	7.71	.00	.00	.00	.00
352.00	3.87	.00	.00	3.79	3.79	7.38	12.62	9.42	9.54	.00	.00	.00	.00
351.00	4.98	.00	.00	4.07	4.91	8.77	15.99	13.62	12.34	.14	.00	.00	.00
350.00	6.08	.00	.00	4.49	6.31	12.00	18.23	16.67	14.03	1.59	.00	.00	.00
349.00	7.51	.00	.29	5.89	7.99	15.23	21.18	20.87	15.85	3.33	.00	.00	.00
348.00	8.89	.00	.87	7.71	9.68	19.54	23.98	24.06	16.83	4.64	.00	.00	.14
347.00	10.57	.00	1.88	10.52	11.36	24.31	27.91	26.81	17.95	6.38	.42	.00	.29
346.00	12.20	.00	2.46	11.92	14.45	27.08	32.40	29.42	20.62	8.12	.42	.00	.58
345.00	13.78	.00	3.04	14.59	15.85	29.85	37.73	32.03	21.88	10.14	.70	.00	.72
344.00	15.57	.00	3.48	19.21	18.51	31.85	42.64	34.78	23.98	12.03	.70	.00	.72
343.00	17.36	.28	4.06	22.44	22.30	34.92	46.98	36.96	26.23	13.19	.84	.14	1.01
342.00	19.14	.56	5.22	25.53	25.95	37.08	51.33	40.29	27.77	14.49	.98	.28	1.30
341.00	20.64	1.12	5.94	27.63	29.59	38.62	54.84	42.90	29.17	15.94	1.12	.56	1.30
340.00	22.44	1.68	7.10	30.29	32.40	41.23	58.49	47.54	30.72	16.81	1.54	.98	1.59
339.00	24.49	2.24	8.12	34.08	34.92	44.62	62.97	51.59	32.82	18.84	1.82	1.26	1.74
338.00	26.53	2.81	9.57	37.17	38.01	47.69	67.60	55.51	34.36	20.58	2.38	2.10	1.88
337.00	28.54	3.23	11.01	40.11	40.53	50.62	70.27	59.28	37.87	23.33	2.95	2.66	2.03
336.00	30.57	4.63	12.46	43.34	43.62	53.23	73.77	62.03	39.55	25.94	3.93	3.23	2.46
335.00	33.03	6.03	14.78	45.58	46.14	56.77	76.72	66.96	43.62	28.55	4.91	4.63	3.19
334.00	35.84	7.99	17.83	47.97	50.35	61.54	80.22	71.88	47.12	31.01	6.17	6.17	3.48
333.00	38.82	10.10	20.58	50.35	54.42	65.69	84.01	76.23	52.03	34.35	8.42	7.57	3.77
332.00	41.86	11.36	24.20	53.58	59.47	72.46	87.38	78.84	54.84	37.39	11.36	8.84	4.64
331.00	45.08	13.32	29.57	58.20	63.39	77.23	88.78	82.03	58.49	40.87	15.01	10.38	5.80
330.00	49.26	15.85	35.07	63.96	68.44	81.69	91.58	86.81	64.66	45.07	19.78	12.76	7.54
329.00	53.74	19.21	41.45	69.14	73.49	85.08	94.95	90.72	70.97	51.01	25.67	16.27	8.99
328.00	59.49	22.02	48.84	76.44	79.38	89.85	97.76	93.04	78.54	58.41	35.62	23.56	12.32
327.00	66.16	28.75	57.39	83.31	85.83	93.08	98.88	96.23	86.26	69.28	48.53	28.89	19.13
326.00	74.34	39.41	71.01	90.04	90.88	95.08	100.00	97.68	91.58	80.72	66.06	41.65	29.13
325.00	85.22	63.39	85.07	95.09	92.29	96.92	100.00	98.26	94.39	88.12	87.66	68.30	53.62
324.00	94.83	91.58	91.74	96.49	94.25	97.85	100.00	99.71	95.51	94.49	95.93	93.69	86.81
323.00	96.05	92.99	93.91	97.90	96.77	98.15	100.00	99.86	96.77	95.22	97.48	95.23	88.26
322.00	97.63	94.25	97.10	98.88	98.60	98.46	100.00	100.00	99.02	96.67	99.44	97.05	92.03
321.00	99.00	96.21	99.86	99.72	99.86	98.92	100.00	100.00	99.72	98.55	100.00	99.02	96.09
320.00	99.82	99.30	100.00	100.00	100.00	99.54	100.00	100.00	100.00	100.00	100.00	100.00	98.99
319.00	99.96	99.86	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.71
318.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FIGURE 2.5B OHIO RIVER AT J. T. MYERS (LOWER) FOR YEAR ELEVATION DURATION CURVE FOR PERIOD (OCT 1975 - SEP 1998)

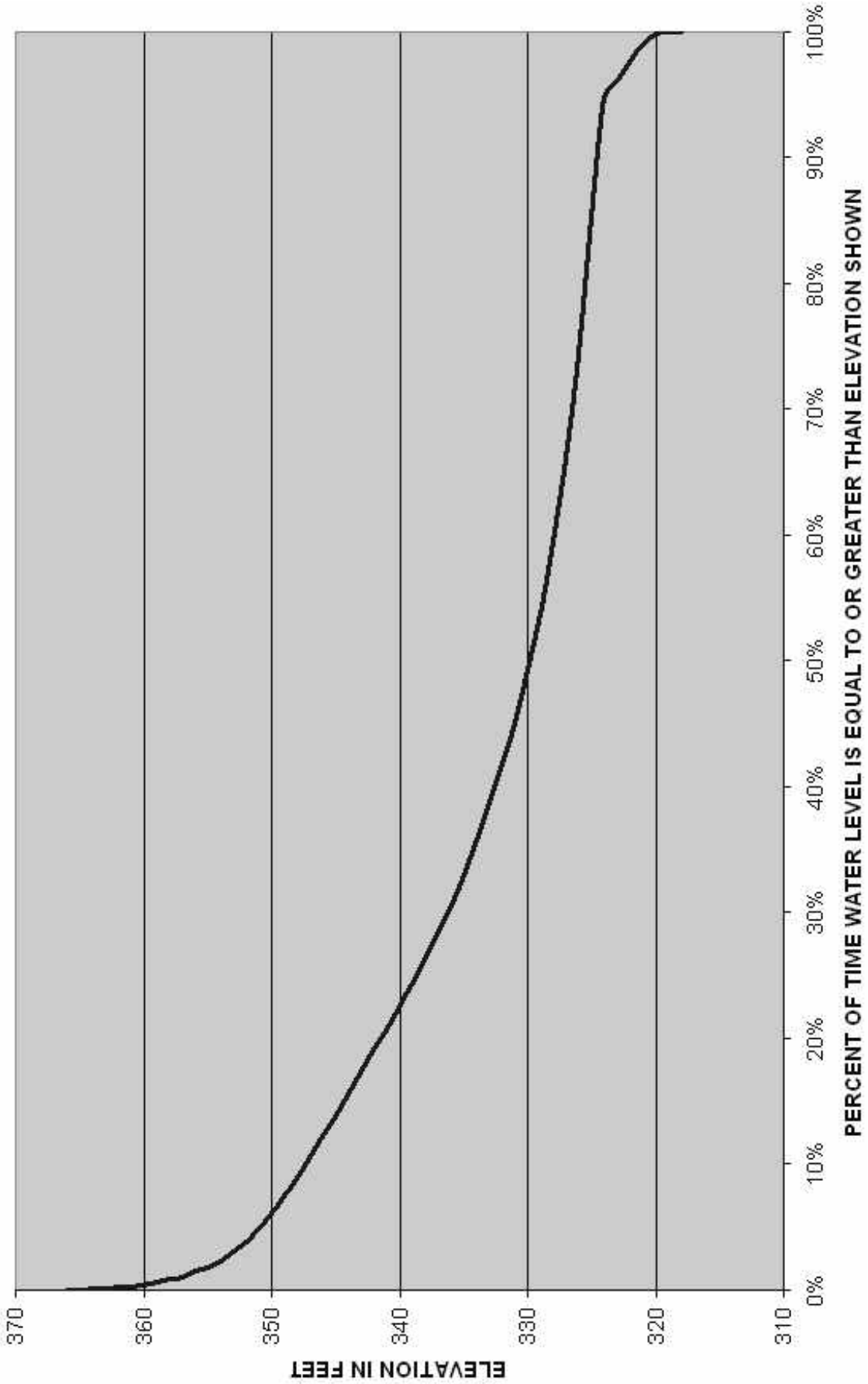


FIGURE 2.5C
J.T. Myers L&D Upper Gage (Jan75-Dec98)

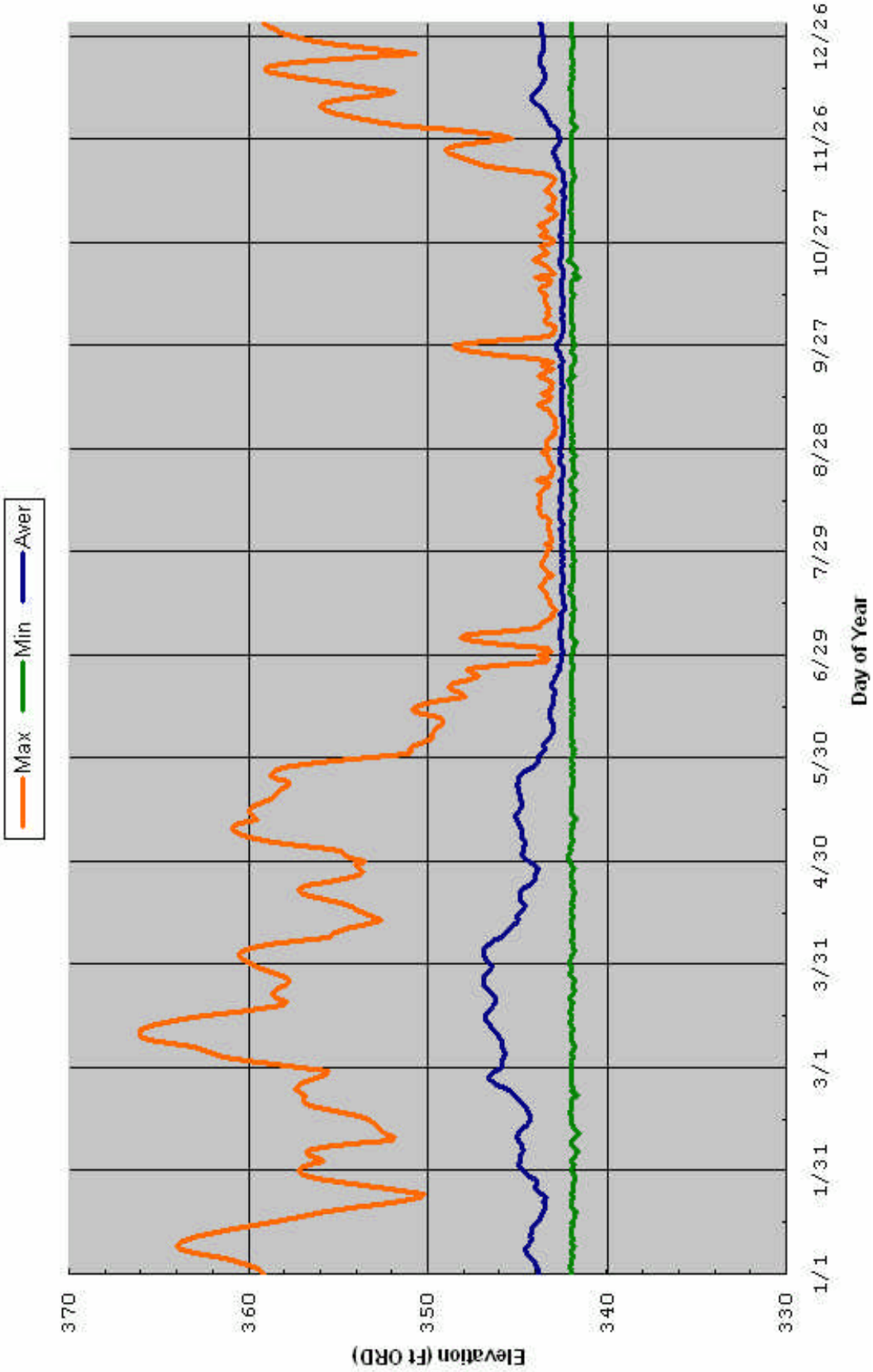
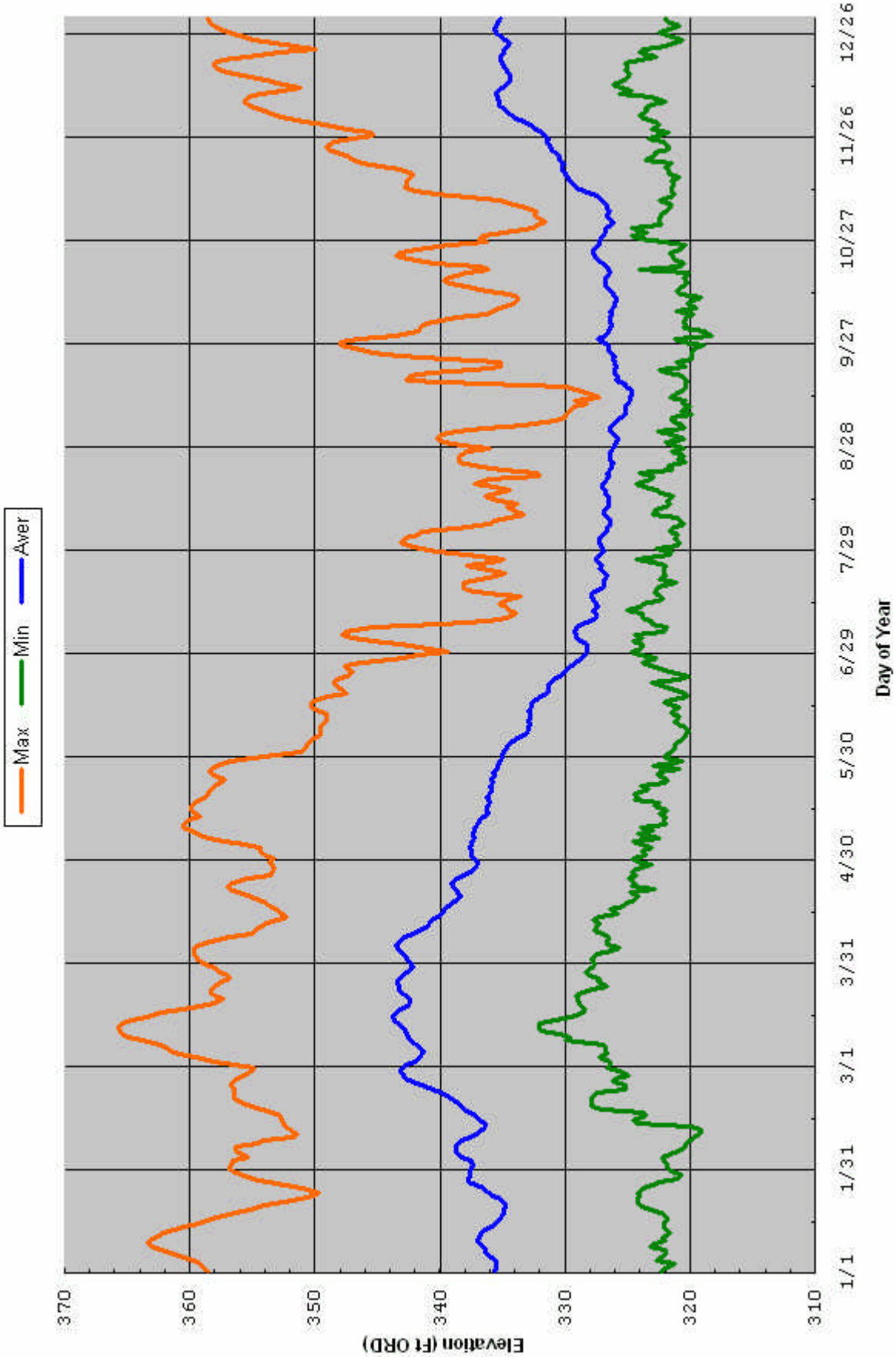


FIGURE 2.5D

J.T. Myers L&D Lower Gage (Jan75-Dec98)



2.6 LOCKSIM COMPUTER MODEL

The recently developed computer program LOCKSIM was used to evaluate the performance of different filling systems for considered improvements to the 670-foot chamber at J.T. Myers L&D. That program has the capacity to simulate flows, pressures and hydraulic gradients for all physical components of a filling/emptying system, including the water surface elevations at various points within the lock chamber itself. By evaluating the time-histories of the water surface elevations at various points within the chamber, it is possible to quantify the hydraulic driving forces which are the principal component of the stresses on hawsers for tows moored in the chamber.

In July 1996, Louisville District personnel conducted field studies on the existing 670-foot chamber at J.T. Myers L&D. Measurements of valve operating times and time-histories of the lock water surface were taken for several filling and emptying cycles. The chamber was empty when these measurements were made. The valve operating time was 120 seconds, and both the filling and emptying times were seven minutes. Using this field data, it was possible to calibrate the various loss coefficients of the LOCKSIM model to closely reproduce the prototype data.

The considered improvements to the auxiliary chamber at J.T. Myers L&D consist of an extension of that chamber to a nominal 1200 feet. There are two general configurations of the filling/emptying system associated with this extended lock. They are 1) an unaugmented system, in which the extended chamber is operated using the existing system without modification, and 2) an augmented filling/emptying system in which a new lateral field is incorporated in the downstream portion of the extended chamber. Several different configurations of an augmented system were evaluated, and a system involving an auxiliary filling culvert was selected as the most practical. The physical configuration of the emptying components was not finalized at the time of modeling.

The calibrated J.T. Myers LOCKSIM model was modified to evaluate the filling system performance for an extended chamber using both an augmented and an unaugmented filling system. The model was configured to provide the fastest possible filling time (and fastest valve operating time) consistent with the accepted standard of a 5 ton maximum hawser stress. Because of the uncertainties about the physical nature of the emptying system, no LOCKSIM evaluations of the emptying cycle were conducted.

For an extended lock without an augmented filling/emptying system, the minimum valve time was found to be 4 minutes, and the lock chamber filled in 16 minutes. When the extended chamber was evaluated with a supplemental system, the valve time was reduced to 2 minutes, with a chamber filling time of 8 minutes, 20 seconds. Although the emptying cycles were not evaluated, experience indicates that for lock chambers in this lift range, the emptying times are very close to the filling times.

The LOCKSIM model for the extended lock was also used to evaluate minimum pressures in the proposed supplemental culvert during the lock filling cycle. This information was used to raise the profile grade of the supplemental culvert, thereby minimizing the required excavation for this structure.

2.7 FUTURE MODEL STUDIES

The Waterways Experiment Station (WES) has three ongoing research programs that are of special interest to the hydrology and hydraulics effort associated with the Ohio River Main Stem Study. These three studies all involve physical models. A meeting was held in July 1998 attended by WES, Lakes and Rivers Division and the three districts (Louisville, Huntington and Pittsburgh) involved in ORMSS at which the general configuration, status, and schedule for all three studies was discussed. These studies are:

Study 1) The extended auxiliary lock filling/emptying system. This is a model study by Jose Sanchez. Sanchez is using the Greenup auxiliary lock as his model template. The Greenup Lock and Dam feasibility study is being prepared concurrently with the John T. Myers study. Documentation of the hydraulic conditions with no supplemental culvert is underway and was scheduled to be completed by the end of fiscal year 1999. A technical note of these research results should be published by January 2000. Future research efforts will evaluate two supplemental culvert systems along the lines of those proposed by INCA Engineers, Inc. for the Corps of Engineers in this study. As constructed, the model should be able to supply data for locks with 25 to 35 foot lifts, and the model can be modified to provide data on locks with lifts in the 16 to 25 foot range. The lift at the John T. Myers Lock is 18 feet.

Study 2) The longitudinal in-chamber filling/emptying system. John Hite is the principal investigator for this model. Experiments are being conducted in this model with the purpose of developing general guidelines for this type of system. Various lifts and lock lengths together with such items as port locations, port spacings, extensions, etc. are being investigated. The model occupies the flume previously used for the McAlpine lock model. The experimental program will be completed by the end of fiscal year 2000.

Model results for both of these lock designs facilities will be used to determine filling time required with various head and submergence conditions. This would also provide verification of the LOCKSIM computer model and the actual tests made at projects made earlier in the ORMSS.

Study 3) Lock approach walls. The principal investigator for the research effort is Howard Park. The purpose of the research work unit is to investigate and determine the hydraulic characteristics of guard walls to locks. Model construction should be completed by October, 1999. Three common approach walls will be investigated. They are floating, multi-cell, and long-span. Consideration could also be given to investigating an extended type or combination wall similar to those proposed on the Ohio River Mainstem. Actual model testing will begin as soon as model construction is complete.

An evaluation will be made to determine which site specific models and testing for the John T. Myers project should be considered. Any of the above three models or some other physical model could be required depending on the design selected. It is likely that funding for a navigation model will be needed in the next phase of the study so that results can be used in the design. Another factor will be the lessons learned from construction of the Olmsted Locks and the placement of its floating approach walls which should be in progress. For additional descriptions of model studies required, see Section 23, Special Studies.

2.8 100-YR FLOODWAY

There has been no official Federal Emergency Management Administration (FEMA) floodway determination in the area just upstream and downstream of the J.T. Myers Lock and Dam area. The Louisville District of the Corps of Engineers (COE) made HEC-2 model runs for each of the six Ohio River pools in its district. In the late 1980's a Section 22 study was made to show the sensitivity of the floodway location for four levels of encroachments as requested by the State of Indiana. The study reach for each pool started just upstream of the project's lock and stopped just downstream of the next upstream project's lock. In the case of the Smithland pool study, it was stopped just downstream of the Wabash River. The State of Indiana has generally used the 0.1 foot encroachment floodway developed from this study to regulate any proposed changes. COE personnel met with the State personnel in mid-1995 to discuss this project and requested their position.

In an Indiana Department of Natural Resources (IDNR), Division of Water's 17 July 1995 letter, it was stated that a hydraulic assessment would be required only if the total floodplain cross sectional area obstructed by the project during a 100-year flood event is more than 5% of the pre-project area. In an area similar to the J. T. Myers area where the flood plain exceeds a mile width for this flood event, the IDNR position was that the model would not be required. However this office stated there is no language within the Flood Control Act or the Navigable Waterways Act which exempts the federal government from the State's permitting process.

The main concern for this project is the permanent placing of spoil excavation material. Temporary stockpiling of the material during construction should not be a problem. This has become a less critical item since a new 1200-foot lock is no longer being considered. The access road to the dam running basically perpendicular to the present project is considerably higher that the adjacent downstream land. Also there are two areas downstream of the road that are extremely elevated above the road's elevation. They are the area of the present project office and visitor area and the old field office. Any disposal area parallel to the Ohio River and in line with these elevated areas would not decrease the present flow condition.

2.9 EXISTING AND POST-PROJECT SEDIMENTATION

Under present conditions, yearly dredging of material occurs mainly in the area of the lower approach to the 600-foot lock. at the J. T. Myers project. Sedimentation results from the lack of use of the smaller lock and the small number of tows to move the sediment. It is expected in the post-project condition that yearly dredging may not be needed and, with two 1200-foot locks having nearly equal use, that the amount of dredging may be less. There is a possibility that some material may have to be removed initially from the Indiana bank downstream of the landwall. This results from longer tows using the landside lock with a need to provide towboat maneuverability for approaching and exiting this lock. The stability of this bank area will determine the magnitude of dredging in this area.

2.10 ENVIRONMENTAL CONSIDERATIONS

Environmental engineering concerns have been addressed mainly with regards to the placement of spoil material. These concerns were greatly diminished after consideration of a new landward 1200' lock was eliminated. Of the three sites being considered for deposition of spoil, the site given most consideration is adjacent to the proposed lock extension. Most of the spoil would be placed downstream of entrance road to J. T. Myers, which is basically perpendicular to the project and forms a weir (because of its high elevation). This area is shown on ***Drawing 8.3A***. Indiana Department of Natural Resources (IDNR) currently leases some of the land defined by this area.

Meetings have taken place where federal, state, and local officials have been made aware of proposed plans. During future design phases, more detailed information will be made available to continue IDNR's use of the land. Another area which has been addressed is land in the downstream approach area which may need reshaping if model studies in the future show that more area is needed for large tows entering the landward lock for which tow size was previously limited by a 600' lock. This area is shown in ***Drawing 8.1.1A***. More details on the Environmental Engineering plans are addressed in Sections 7 and 13.

2.11 WATER QUALITY

The Louisville District's Water Quality Team operates a continuous monitor at J.T. Myers Locks and Dam between the months of May through October consisting of temperature, dissolved oxygen, pH and specific conductance. Ohio River Sanitation Commission (ORSANCO) provides monthly sampling at J. T. Myers Locks and Dam, and provides data on certain chemical parameters including solids, nutrients, metals, mineral constituents, cyanide, and phenolics. These data are collected to support assessments of water quality conditions and trends.

Overall water quality conditions in this area of the Ohio River should not be affected by Lock improvements at J. T. Myers. Temporary changes in water quality caused by disturbance of sediments can be anticipated during the construction phase of the project; however, measures to minimize these effects are planned.

SECTION 3

SURVEYING AND MAPPING REQUIREMENTS

3.1 EXISTING SURVEY AND MAPPING

Original aerial photography of J.T. Myers site was taken in April 1993 to develop contour mapping. Two-foot contour maps were developed based upon the aerial photography. Additionally, mapping of the J.T. Myers riverbed in the immediate vicinity of the project was completed for Louisville District Operations Division in 1997. Then, bathymetry mapping was accomplished by merging soundings of the riverbed around J.T. Myers with the two-foot countour topographic maps already developed. A digital terrain model has been completed for the site.

3.2 FUTURE SURVEY AND MAPPING

The J.T. Myers site was again flown for aerial photography in early 1999 to develop 1-foot contours in the immediate vicinity of the project and its approaches. The contour map will be developed during fiscal year 2000. Additionally, a larger surrounding area was flown in anticipation of off-site mapping requirements for any potential disposal or environmental mitigation areas required during construction. Because the surrounding area was much larger, the aerial photography was flown at a higher elevation. Therefore, four-foot contours will be developed for the areas surrounding the site. These contour maps will be developed during fiscal year 2000. Additional funds will be allocated in future years for any necessary survey and mapping needs as the project develops.

SECTION 4

GEOTECHNICAL ENGINEERING

4.1 SITE GEOLOGY

4.1.1 Physiography

The project is located in the Western Kentucky Coal Field Physiographic Unit of Kentucky. The Western Kentucky Coal Fields form the southeastern portion of the Eastern Interior Coal Field, which includes parts of Indiana and Illinois. The topography adjacent to the Ohio River occurs as broad, flat lowlands where alluvial deposits overlay bedrock.

4.1.2 Stratigraphy

In the area of the dam, there are 8 to 35 feet of gravelly sand overlying bedrock. Top of bedrock varies from elevation 286± to 304±. Bedrock is comprised of the Pennsylvanian series Sturgis (Lisman) formation. A geologic column is presented in ***Figure 4.1A***. The Sturgis formation is approximately 2,000 feet thick overall (350 feet thick locally) and predominantly shale with thin coal beds, associated underclays, and occasional organic-rich shale. The shale is dark gray to black, thin to medium bedded with localized silty and sandy laminations and stringers. These light gray to white sandy laminations are occasionally very common and locally make up to 50% of the stone. The coal seams are less than a foot thick while the underclay ranges from 0 to 1.8 feet. Occasionally, the coal seams are overlain by an overclay or organic-rich shale up to 0.3' thick. Also, the Sturgis formation contains several members distributed throughout, including the Madisonville limestone. The Madisonville limestone is a light gray, crystalline, very hard, medium bedded limestone with occasional fossils. At the project area, the Madisonville limestone varies from 0 to 8 feet thick and is typically at the top of rock column when present. A typical geologic column of the project site is presented on ***Figure 4.1A***. Approximate thickness and general descriptions are given in the columnar section. A geologic profile along the centerline of the existing landwall is presented in ***Drawing 4.1A***.

4.1.3 Geologic Structure

The project is located in an area of considerable faulting. The Rough Creek fault complex is a major structural feature in Western Kentucky. It extends east-west from Illinois into Kentucky some eight miles south of the dam. The fault complex is a zone of intense faulting up to several miles in width. Both normal and high-angle reverse faults are common. Displacements of up to 2,000 feet are found in the complex. It is commonly believed that the Rough Creek fault zone resulted from compression and breaking of an anticline and that it was essentially a high-angle thrust fault accompanied by an echelon normal faulting. The Shawneetown-Uniontown faults are part of a system of sub-parallel normal faults closely related to and intersecting the Rough Creek fault zone. Maximum displacement of these faults are 400 feet. It has been noted in mines and exposures that there has been very little drag effect along the fault planes. One of the Shawneetown-Uniontown faults cuts across the upper end of Wabash Island, some 2,000 feet downstream from the dam axis. The fault strikes northeast and has a displacement of approximately 300 feet. The smaller faults located under the lock and dam trend to the north and have smaller faults which branch off at normal angles. The displacement of these project faults is approximately 20 feet at high angles, approximately 5-15° from normal. The borings that crossed one of the faults revealed high angled, slickensided, and occasional soft joints.

4.2 SUBSURFACE EXPLORATIONS TO DATE

Numerous borings have been drilled at the J. T. Myers lock and dam site, for the design and construction of the existing structures and for the proposed 600' lock extension. Borings previously presented in Design Memoranda and as-built drawings are shown on ***Drawing 4.6A***. Borings drilled in late 1998 are shown in plan view on ***Drawing 4.6B***, and the boring legend and logs are presented on ***Drawings 4.2A*** through ***4.2P***. Additional subsurface investigations will be required prior to detailed design.

4.2.1 Boring Maps and Data

A total of 13 borings (AC-521, ADC-522 through 533) were made in the fall of 1998 along the landward portion of the proposed 600-foot lock extension site. The holes were staggered along three lines of borings as shown on Sheet 4.6B. Eleven of the borings range in depth from 70 to 150 feet. One deep hole was drilled to 200 feet for stratigraphic information and one boring was drilled to approximately 196 feet at a 40° angle from normal. The angled boring was the only boring to intersect the fault zone located at station 2+10 U.S. along the landwall. ***Drawings 4.2B*** through ***4.2P*** are detailed logs of these borings. The locations of the borings are shown on ***Drawing 4.6B***.

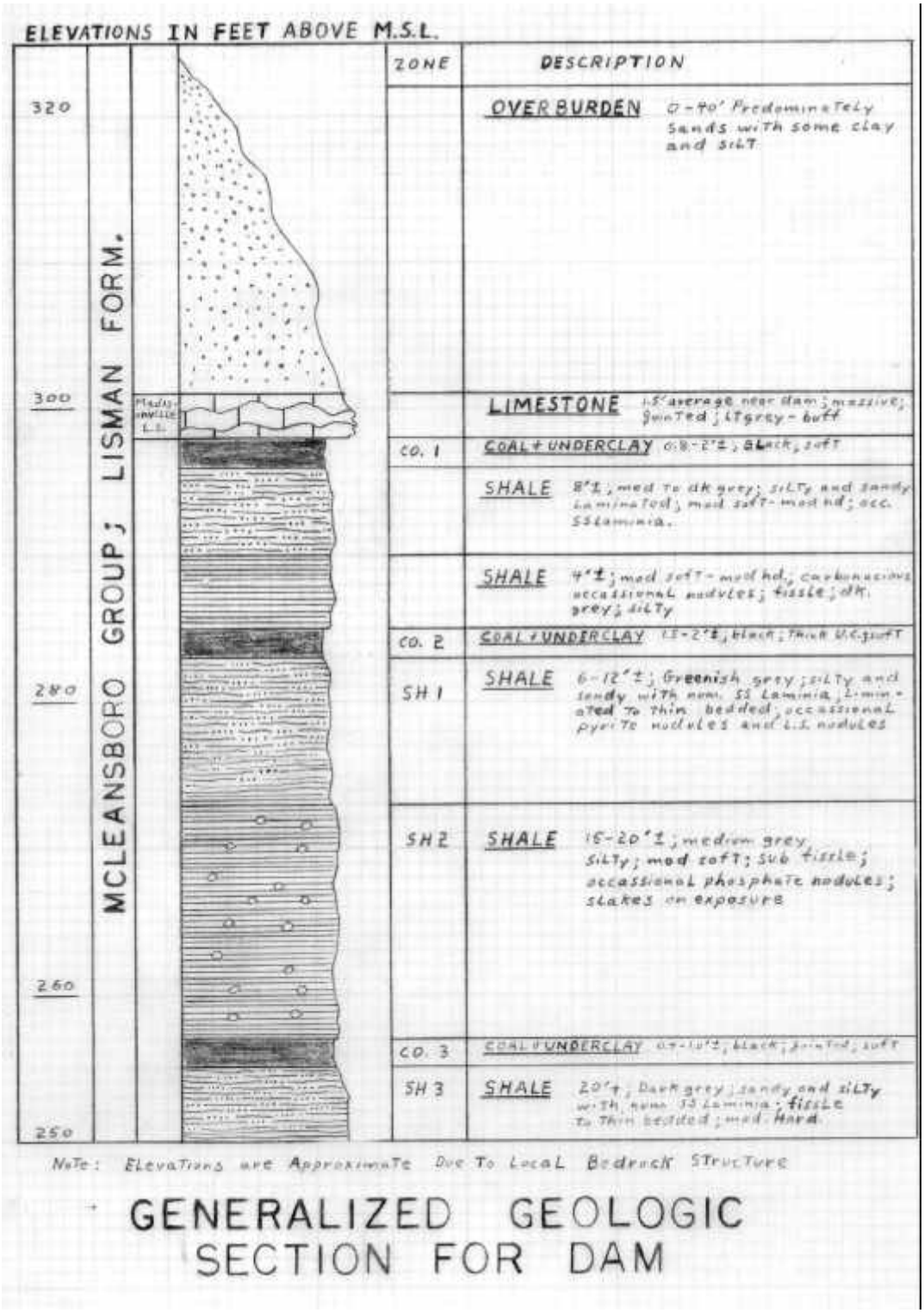

ELEVATIONS IN FEET ABOVE M.S.L.
ZONE
DESCRIPTION
320
300
280
260
250
MCLEANSBORO GROUP; LISMAN FORM.
OVERBURDEN 0-40' Predominately sands with some clay and silt
LIMESTONE 1.5' average near dam; massive; jointed; lt grey - buff
CO. 1
COAL + UNDERCLAY 0.8'-2'±; black, soft
SHALE 8'±; med to dk grey; silty and sandy laminated; mod soft - mod hd; occ. SS laminia.
SHALE 4'±; mod soft - mod hd; carbonaceous occassional nodules; fissle; dk. grey; silty
CO. 2
COAL + UNDERCLAY 1.5-2'±; black; Thick U.C. soft
SH 1
SHALE 6-12'±; Greenish grey; silty and sandy with nom. SS Laminia; Lamin-ated to thin bedded; occassional pyrite nodules and L.S. nodules
SH 2
SHALE 15-20'±; medium grey, silty; mod soft; sub fissle; occassional phosphate nodules; slakes on exposure
CO. 3
COAL + UNDERCLAY 0.7-1.0'±; black; jointed; soft
SH 3
SHALE 20'±; Dark grey; sandy and silty with nom. SS Laminia; fissle to thin bedded; med. Hard.
Note: Elevations are Approximate Due To Local Bedrock Structure
GENERALIZED GEOLOGIC SECTION FOR DAM

FIGURE 4.1A

4.2.2 Test Sample Selection

After each 3.3-inch diameter core sample was collected, selected portions of the rock core were wrapped in wax paper, cheese cloth, and waxed with paraffin to help the samples retain as close to natural moisture content as possible. These samples were then placed in the core boxes with the rest of the boring and stored in a warehouse until District geologists could re-examine each sample to determine testing suitability.

Once at the warehouse, each boring was laid out end to end to determine the basic rock type and depth. Each waxed portion was then cut open to determine if the sample would be representative of the three basic rock types (limestone, shale, and coal). If the sample was selected for rock testing, it was re-wrapped in double plastic sheathing, taped, and labeled. The Direct-shear samples were then placed in coolers with packing materials and chemically-based heat sources to keep the more delicate shale and coal samples from freezing during transport to the laboratory in Lakewood, Colorado. The triaxial and unconfined compression samples were loaded in core boxes with packing material and delivered to the University of Kentucky, Mining Engineering Lab, in Lexington, Kentucky.

4.2.3 Rock Mechanics Design Strengths

A total of 15 unconfined compression, 14 triaxial, and 19 direct shear specimens were tested. All specimens also had density testing conducted on them. The following table ***Table 4.2A*** shows each lithology and tests conducted:

TABLE 4.2A
Rock Testing

Lithological Types	# of Triaxial Compression Tests	# of Unconfined Compression Tests	# of Direct Shear Tests
Limestone	0	3	0
Shale	14	12	17
Coal	0	0	2

The distribution of confining pressures and normal loads were based on the depth of the engineering structures and lithological type and were determined to be a range of 30 psi to 90 psi. The lower limit of the confining pressures were set by the capability of the testing equipment

Unconfined Compression Testing - Unconfined compression testing was conducted as per the ASTM D 2938-86 (RTH 111-89) method. Each sample is trimmed to represent a 2:1 length:diameter ratio and run under a strain controlled load until failure. The peak load at failure is recorded and stress at failure is calculated. The limestone samples had an average peak strength of 16,560 psi. The shale had an average peak strength of 1580 psi.

Triaxial Compression Testing - Triaxial compression testing was conducted as per the ASTM D 2664-86 (RTH 202-89) method. Each sample was trimmed to represent a 2:1 length:diameter ratio. They were placed in a chamber to impose a predetermined confining force on the sample and run under strain controlled loading until failure. The peak load at failure was recorded. The data was analyzed using p-q analysis techniques and linear regression to determine the line of best fit for the p-q plot. The shale had an average phi of approximately 70° and a cohesion of 20 psi.

Direct Shear Testing - Direct shear testing was conducted according to the ASTM D 5607 (RTH 203-80) method. Each sample is trimmed to approximately a four-inch height and centered around the weakest plane found on the sample. The orientation of the sample was such that the failure would take place within a 1/16" shear plane and slide as unencumbered as possible. After shearing, the samples were then allowed to travel up to 0.5-inches on the shear plane in order to obtain a sliding friction value. These peak and sliding friction values are then plotted versus the normal load. The resultant best fit line determines a theoretical phi angle and cohesion strength of the material. These theoretical values were then adjusted based on experience and knowledge of the local geology to account for losses during drilling, scale effects, and testing procedures.

Past rock mechanic results were analyzed to determine the value of adding those to the most recent results. The test results from 1996 were determined to be of value due to the consistent manner of sampling and the test methods. However, the results obtained during the 1971 testing rounds were determined to be of little value, due to outdated test procedures. Also, the 1971 test specimens were divided into three shale types and three coal types. After analyzing the 1996 and 1998 data, there was no discernable difference between any of the shale results. Therefore, the current shale results were consolidated into one lithological group.

After interpreting the rock mechanics data results from current testing and correlating them with past testing data, design parameters were established. The following table, ***Table 4.2B***, contains the rock strength parameters for use in general design in the area of the existing and new lock structures for the J.T. Myers project. Rock strength interpretation charts are presented in ***Figures 4.2A*** through ***4.2D***.

TABLE 4.2B
Rock Design Strengths

Rock Unit	ϕ design	c design	Elevation
Shale	20°	5 psi	General Design
Underclay	10°	0 psi	Variable
Coal	20°	5 psi	Variable
Limestone	20°	5 psi	Top of Rock Intermittent
Cross-Bed Shear	40°	20 psi	More than 5' into rock

4.2.4 Soil Mechanics Design Strengths

Overburden materials found in the borings consisted of sands, clays, fill, and silts. The fill materials were generally consistent with natural soils of the site. For design purposes the silts were treated as clays at this level of design. Design values were based on judgement, experience, and the subsurface explorations performed to date. ***Table 4.2C*** depicts the soil parameters determined for analysis and design at this stage. These parameters will be refined as more explorations are completed and laboratory analyses are performed.

Table 4.2C
Soil Design Strengths

MATERIAL	DENSITY (pcf)	STRENGTHS (deg)	(psf)	WALL FRICTION	MODULUS
CLAY(drained)	121Mst, 125Sat	Phi=30	C=0	18	111-333 psi
CLAY(undrained)	125Sat	Phi=0	C=1000	18	111-333 psi
SAND	121Mst, 125Sat	Phi=30	C=0	21	2.4-7.4 pci

FIGURE 4.2A - SHALE, PEAK DESIGN STRENGTH

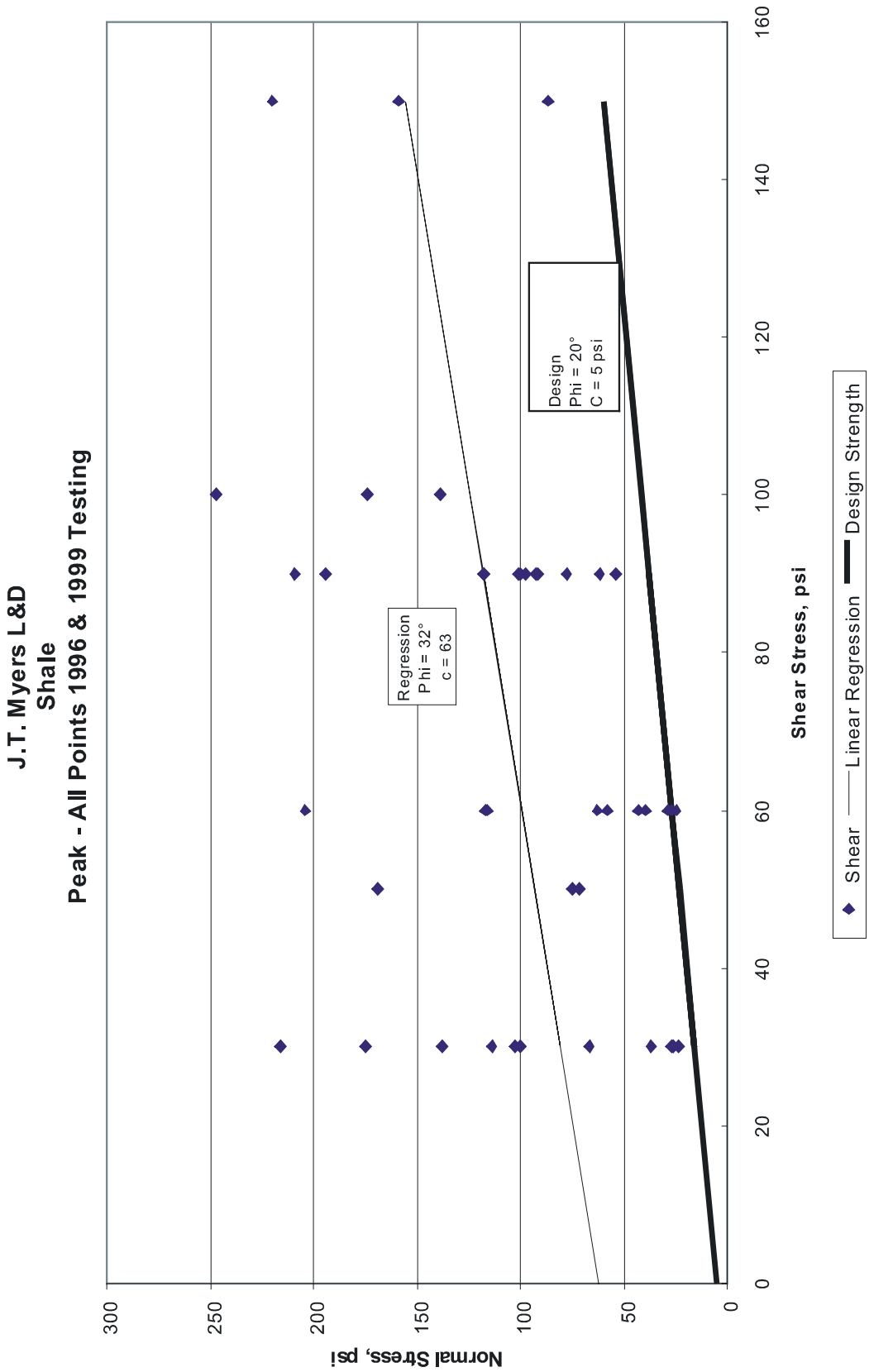


FIGURE 4.2B - SHALE, SLIDING FRICTION DESIGN STRENGTH

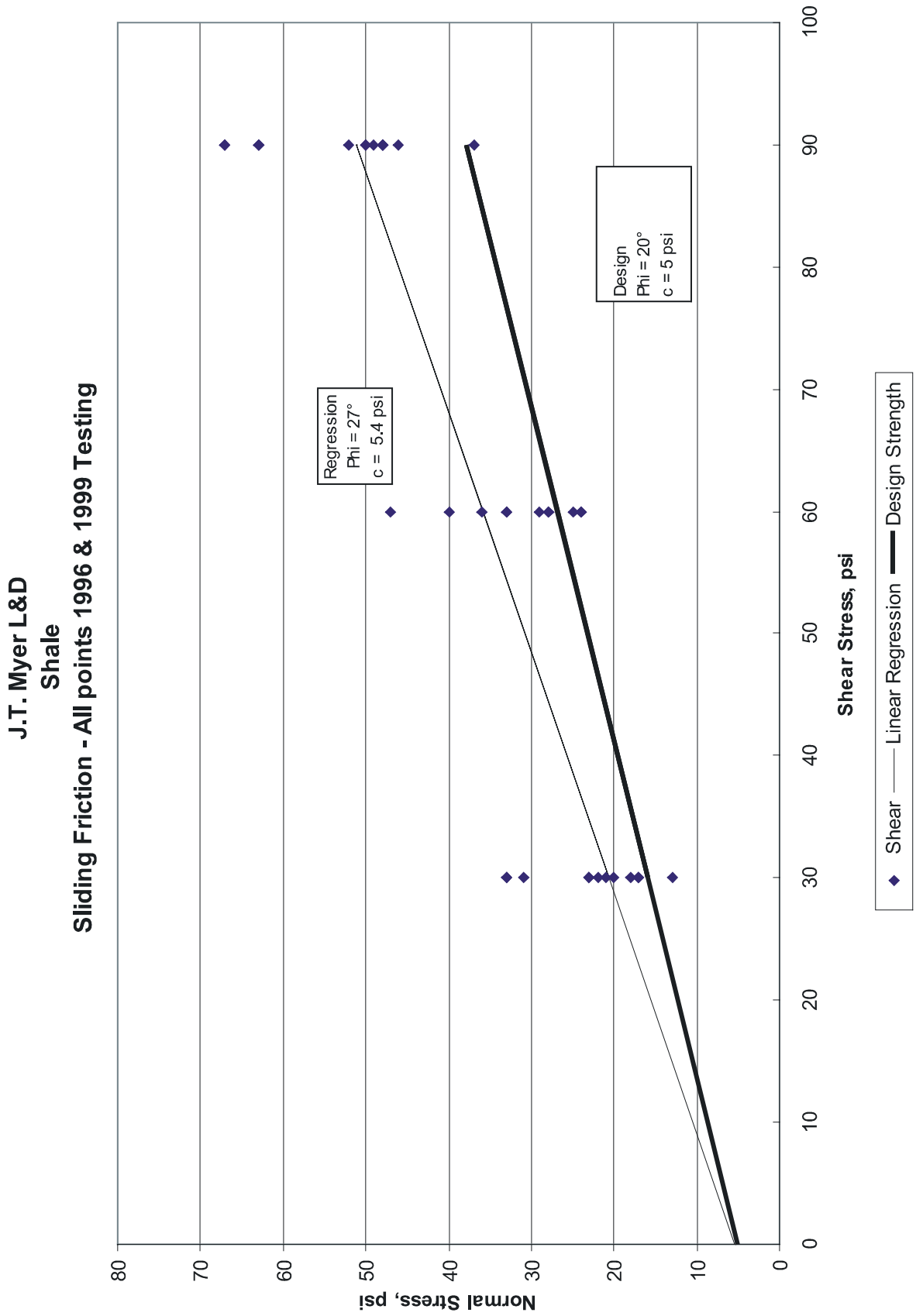


FIGURE 4.2C - SHALE, TRIAXIAL STRENGTH

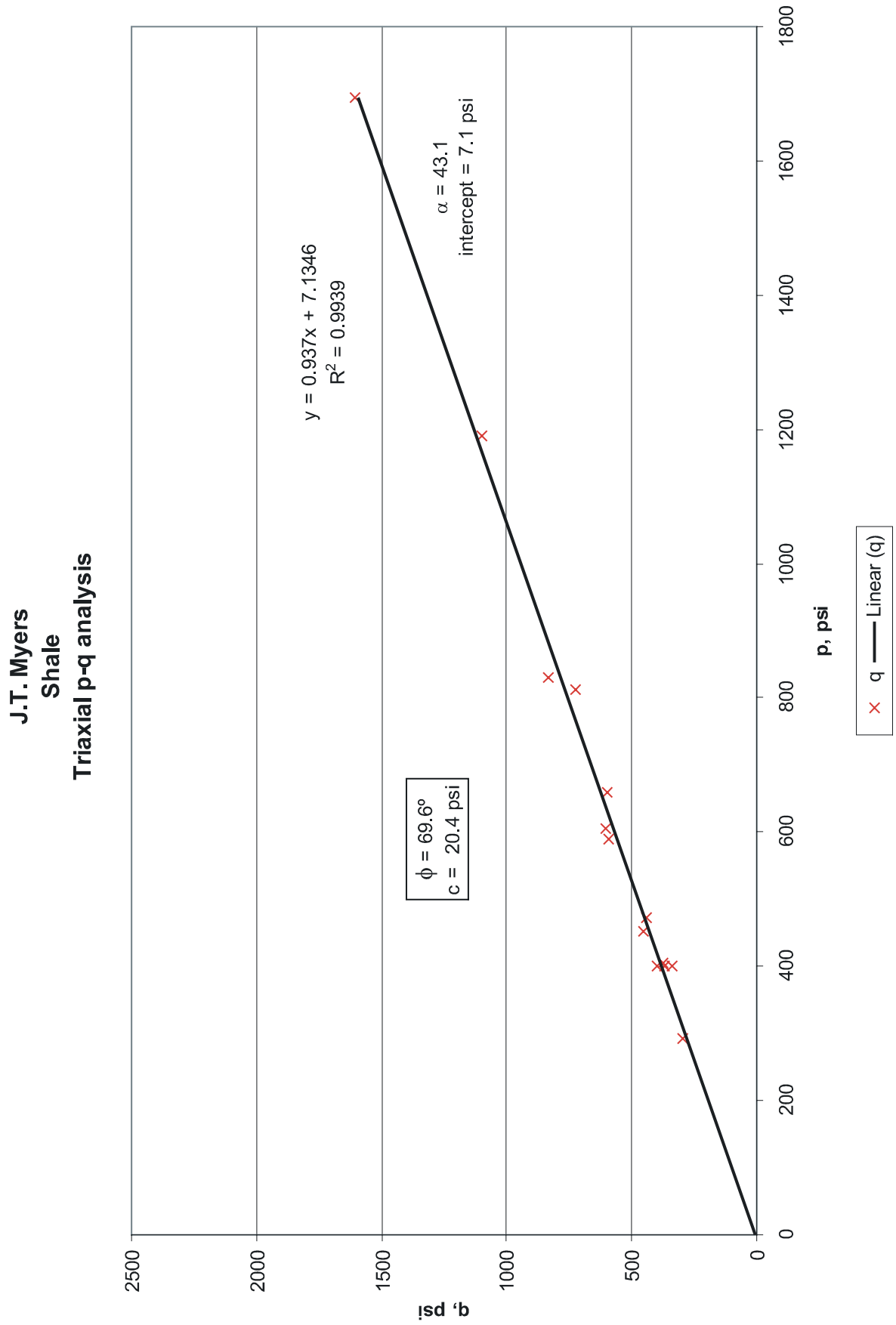
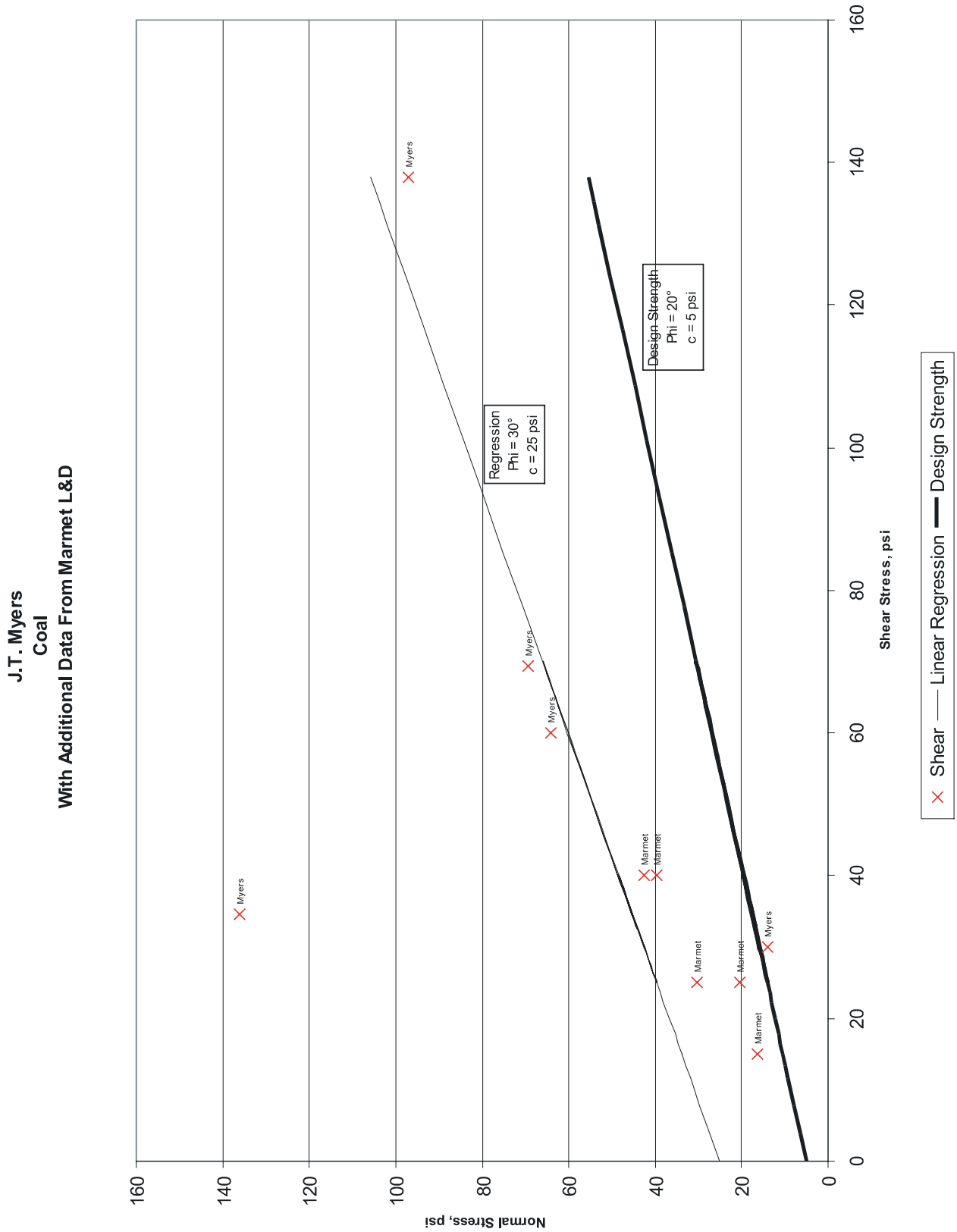


FIGURE 4.2D - COAL, DESIGN STRENGTHS



4.3 FOUNDATION CONDITIONS

The founding conditions for the extension of the locks at J.T. Myers are likely to be somewhat variable in that complete explorations were not possible at this stage of design. As more explorations are performed, more refined analyses of the specific foundations for each monolith can be performed. Currently, it is known that the foundation for the existing landwall has three faults passing through it and it is possible that additional faults may be identified in the area of the lock extension. Drilling to date has not identified any faults in the area of the lock extension so it is not likely that the properties of any faults discovered in the future would vary significantly from the properties of the known faults. The known faults are localized in nature and are oriented perpendicular to the centerline of the lockwall, and based on current knowledge of the faulting at the site, it is not expected that any faults discovered would present any problems which would endanger the viability of the project. Contingencies have been added to the cost estimate to account for the possible need to revise a few monoliths based on faults discovered during the next stage of design. Anchor bond strength tests were not conducted. A bond strength of 40 psi has been estimated and once bond strength tests are available, anchor spacing will be refined, and other routine design analyses will be conducted.

4.4 GROUNDWATER STUDIES

From data of the borings and piezometers along the existing landwall in the fall of 1998, the groundwater elevations were determined to be at approximate elevation 333.

4.4.1 Dewatering

Construction of the wraparound culvert will be in the dry. Temporary cofferdam berms will provide protection from floods up to the top of the lock wall at elevation 362. The culvert intake structure and the thrust block excavations will be open cut. The rest of the culvert will be a combination of the top 20 ft open excavation, and the remaining depth will be braced excavation.

Sheetpiles used for bracing the culvert also will be used to keep most of the water from the braced excavation. In addition, the three temporary cofferdam berms will require sheetpiles to either keep water out of excavations or maintain slope stability. A system of sheetpiles, driven to rock, will be required to completely surround the culvert excavations. Berm 1 is shown on ***Drawing 14.9.2A***. Berm 2 begins in the area of the sewage treatment plant and ties into existing monolith 3. Berm 3 also begins in the area of the sewage treatment plant , but it will tie into the float-in miter gate monolith.

Water not contained by the sheetpiles which could enter the excavations (seepage and internal drainage) has been calculated to total a maximum of 30,000,000 gal. Most of the water will be removed by sumps during the excavation cuts. The intake structure excavation could have up to 113,000 CY (20,000,000 gal) of water, 8305 CY (1,670,000 gal) in the excavated soil and the rest in surrounding soil within the sheetpiles. The thrust block excavation could have

3,586 CY (724,300 gal) of water. The rest of the culvert excavation could have 33,000 CY (6,665,100 gal) of water. Dredged materials used for the berms were assumed not to contribute water into the excavation.

Sumps will be needed for keeping water level at top of rock. Design permeabilities for the overburden and rock layers are shown in Table 4.4A, below. In addition, wells may be used to dewater excavated slopes for stability of the thrust block and/or intake structure excavations.

TABLE 4.4A
Permeabilities

OVERBURDEN	PERMEABILITY
Clay	10 e -7
Sand	10 e -5
Shale	10 e -5

4.5 SEISMOLOGICAL STUDIES

During the next stage of design a seismic study will be completed to determine the seismic loading parameters for the project. Due to the known faulting at the site and in the surrounding region the study is expected to be more involved than other sites where faulting is not known to exist. For the current stage of design, the Maximum Design Earthquake was set at 0.2 g, and the Operating Basis Earthquake was set at 0.1 g. These parameters are thought to be conservative, but contingencies have been added to the cost estimate to account for the possibility that the design parameters may be somewhat higher.

4.6 FOUNDATION AND SLOPE ANALYSES

A summary of the slope stability analysis is shown in ***Table 4.6A***. The criteria for the safety factor is a minimum of 1.3. Critical sections of the slope stability analyses of the temporary berms and excavations are provided on ***Drawings 4.6C*** and ***4.6D***. It was determined that sheetpiles were necessary for the stability of most of the excavation slopes. Sheetpiles also serve to hold most of the water out of the excavation area. Sheetpiles in the berms will be tied into the lock walls or culvert sheetpiles.

The temporary berms were determined to have 2:1 slopes, except for at the thrust block excavation, which must be on 2.5:1. The thrust block excavation will require a retaining wall or anchored bulkhead into the rock, retaining a load of soil from rock elevation and sloping up to elevation 362. This excavation may require wells to maintain stability of the slope. All of the berms, as well as the culvert open-to-braced excavation, will require sheetpiles down to rock.

This will help slope stability and also keep most of the water out of the excavations. In all cases, these minimum slopes are for both sides of the berm or all slopes in the excavations.

The culvert profiles show the transition from the culvert trench open-to-braced excavation as it descends to the thrust block open excavation. The inner and outer sheetpile slopes must be at least 2.5:1.

The excavation of the float-in monolith must be 2.5:1.

The approach channel will be designed at 3:1 slopes.

TABLE 4.6A
Slope Stability Analysis Summary

LOCATION	SAFETY FACTOR	SAFETY FACTOR MIN. CRITERIA	SLOPE
Berm 1 U/S Approach Channel	3.0	1.3	3.25:1
Berm 1 Culvert Intake Structure	1.3	1.3	2:1
Berm 2 Sewage Plant Area	1.3	1.3	2:1
Berms 2/3 Monoliths L6-10	1.3	1.3	2:1
Float-in Monolith (Berm N/A)	1.5	1.3	2.5:1
Berm 3 Monolith Final Backfill	3.9	1.5	3.5:1
Outer Sheetpile Wall (Berm N/A)	1.8	1.3	2.5:1
Inner Sheetpile Wall (Berm N/A)	1.4	1.3	2.5:1
Thrust Block	1.3	1.3	2.5:1
D/S Approach Channel	3.0	1.3	3:1

4.7 ANTICIPATED CONSTRUCTION TECHNIQUES

Temporary Berm 1 – The purpose of this berm is to construct the culvert intake structure and the upstream end of the culvert in the dry. The top elevation of the berm will be 362. Sheetpiling will be required down to rock at the centerline of Berm 1 for the open excavation of the intake structure (See ***Drawing 14.9.2A***). This sheetpiling will begin with a tie into the existing upstream lock wall and will end with a tie into the culvert bracing sheetpiles or the existing cut-off sheetpile wall at the dam axis. The existing sheetpiling within 100 foot of the lock wall must be used, as the rest does not go all the way down to rock.

Temporary Berm 2 - The purpose of this berm is the same as Berm 1, protecting the downstream end. Top of berm is elevation 362. Berm sheetpiling will tie into the culvert bracing sheetpiles and then into the downstream end of the existing landwall.

Temporary Berm 3 - The purpose of this berm is to construct the thrust block end of the culvert, and backfill the new float-in monoliths. Top elevation is designed at 362. This berm will contain the thrust block excavation, which will be done after the new wall extension has been floated in and backfilled. Sheetpiles will tie in at the centerline of the intact part of Berm 2 and also tie into the new lockwall.

4.8 BORROW AND DISPOSAL SITES

No borrow activity is anticipated, as fill is to be obtained from soil materials at the site for temporary cofferdam berms, spoil mounds, access roads, etc. It is anticipated that there will be sufficient quantities of acceptable materials. The clay and silt portions of the available fill materials on site are unusable for the berms or other fill at the water's edge. There is not sufficient testing of the soils at this time to determine the use of the dredge materials from either of the approach channels, but the borings indicate that at least 60% is sand.

Disposal will be required from excavating and dredging operations, and will be placed on site.

SECTION 5

DESIGN CRITERIA

5.1 CIVIL CRITERIA

The civil portion of the study consists of the design elements required to relocate and/or replace the existing utilities, roadways, parking areas, public areas and amenities affected by the proposed expansion of the locks. In addition, required dredging, excavation, access roads, haul roads and disposal areas necessary for the work will be studied.

5.1.1 Existing Conditions

The following utilities and improvements are found at the John T. Myers Locks and Dam site:

1. Power is provided by Southern Indiana Gas & Electric, with transformers located on the utility service mound.

2. Water is provided from a private well on the utility service mound.

3. Sanitary sewage for the site is treated on the utility service mound with a drain field located in the level grassy area between the service mound and the esplanade.

4. A 3,000 gallon fuel oil tank is currently located on the utility service mound.

5. No gas is used on site.

6. Public facilities with parking, picnic tables, and restrooms are located adjacent to the service mound and esplanade.

7. A small boat basin to provide safe moorage for COE work boats is located behind the upstream end of the land wall.

5.1.2 Design Guidance

Guidance having an impact on the civil design and operation of facilities are as follows:

1. ER 1110-2-400, Design of Recreation Sites, Areas and Facilities, May 1988. Covers requirements for public facilities and equipment to be provided, including comfort facilities, parking, picnic areas, play areas, and public viewing.

2. ORD/ED-T/ORDCO, Regulation No. 1110-2-16, Operations and Maintenance facilities at Civil Works Projects, August 1972. Regulations governing the maintenance shops, and support facilities to be provided on the utility mound.

3. CEORD-ED-T, Regulation No. 1110-2-38, Seismic Design, November 1987. Provides the requirements governing the seismic design of utility connections, above ground tanks, recreation facilities and other support and maintenance facilities.

4. ORDDE Regulation No. 1165-2-2, Resource Enhancement and Recreational Development on Navigation Projects, April 1979. Provides guidance and regulations regarding public facilities associated with any work along the river.

5. ER 1130-2-401, Planning, Development, Management and Operation Visitor Center Program, February 1991. This regulation establishes policy governing planning, development, management and operations of visitor center facilities at U.S. Army Corps of Engineers civil works water resource projects.

In addition, all local regulations of Posey County and the State of Indiana regarding water, sewer, storm drainage and other utilities shall be followed.

5.1.3 Disposal

Extent of property acquisition (if any) and improvements required on lands to enable the proper disposal of dredged or excavated material will need to be determined in accordance with EM 1110-2-5025. The backwater pool shall not be changed by construction disposal.

When storing and/or disposing dredged or excavated materials the following items need to be considered:

1. Location.
2. Capacity of available sites.
3. No change can be made to the river channel, i.e., during a flood the backwater pool cannot be changed by the proposed work.
4. Erosion control both during and after the work.
5. Landscaping, seeding and planting.

5.2 STRUCTURAL CRITERIA

5.2.1 General

This section presents the basic data, loads, assumptions, and methods that shall be used in design of the lock walls, sills, miter gates, guide and guard walls and appurtenant structures at the John T. Myers Locks and Dam site. Design criteria for a 600' lock extension is addressed. The project purpose is to provide capacity improvements for navigation at the John T. Myers site.

5.2.2 Geotechnical Parameters

General geology of the Lower Ohio River Valley, specific site geology and testing of foundation materials for existing structures are briefly outlined in "Information Brochure for Periodic Inspection, June 1974". Regional geotechnical data is provided in Section 3.2 of the General Engineering volume, and site specific geotechnical data is provided in Section 4.0 of the Engineering Appendix.

Tables 5.2.2A and ***5.2.2B*** characterize the soil and rock layers at the John T. Myers Locks and Dam site and summarize parameters which were provided by Louisville District geotechnical engineers. For drilled shaft design, the computer program LPILE was used. ***Table 5.2.2B*** specifies the LPILE input values which were used in the nose cell, pylon, and lower landside approach wall drilled shaft designs.

TABLE 5.2.2A

Soil/Rock Type	γ_m (pcf)	γ_s (pcf)	φ (deg)	c (psi)	Wall Friction, δ	Modulus***
Clay	118	121	30 (drained)	-	18	E_s=111 to 333 psi
Sand/Gravel	120	125	30	-	21	N_h=2.4 to 7.4 pci**
Limestone	165	165	20	5	35	E_s=2.45 to 4.9 x 10^6 psi
Shale	145	145	20	5	11	E_s=1.1 to 2.2 x 10^6 psi
Limestone/Shale (cross-bed)	see above	see above	40*	20*	see above	see above
Coal	100	100	20	5	N/A	N/A
Underclay	100	100	10	0	7	E_s=1.1 to 2.2 x 10^6 psi

Notes: * 1. Applicable for cross-bed failure planes (>5' deep) only.
** 2. $E_s = N_h * z$ where z = depth.
*** 3. $E_s = k_h * B$ where B = shaft diameter.

TABLE 5.2.2B			
Soil/Rock Type	**k_s (pci)**	**S_u (psi)**	**ε_{50}**
Clay	50	7	0.02
Sand/Gravel	200	5200	0
Limestone	29000	250	0.00005
Shale	12500	250	0.0005

Lateral Pressures:

Table 5.2.2C summarizes the equivalent fluid densities (determined in accordance with EC 1110-2-291, Stability Analysis of Concrete Structures) used to calculate lateral pressures for the feasibility design stage.

TABLE 5.2.2C		
Load Condition	**Clay Soil**	**Equivalent Fluid Density (pcf)**
Usual	Moist Earth	55.6
	Saturated Earth	90.0
Unusual	Moist Earth	49.9
	Saturated Earth	87.2
Extreme	Moist Earth	43.1
	Saturated Earth	83.8
Load Condition	**Sand/Gravel**	**Equivalent Fluid Density (pcf)**
Usual	Moist Earth	56.6
	Saturated Earth	91.9
Unusual	Moist Earth	50.7
	Saturated Earth	88.9
Extreme	Moist Earth	43.9
	Saturated Earth	85.3

As can be seen from ***Table 5.2.2C***, the design earth pressures are dependent on the load case under consideration. For the J. T. Myers site, where the level of knowledge is considered to be ordinary, the design earth pressures are approximately equal to “at-rest” pressures for the usual load condition and are approximately equal to “active” pressures for the extreme load condition.

Bearing:

Allowable bearing pressure (in rock layer) = 40 ksf.

Skin Friction:

Allowable skin friction (in rock layer) = 40 psi.

Settlement:

Assume no settlement (weak seams are small and will pinch out).

Rock Anchors and Tiebacks:

Rock Anchors

Allowable bond stress	=	40 psi
Ultimate bond stress	=	80 psi
Minimum bond length	=	10 feet
Maximum capacity (in shale)	=	1500 kips

Bonded length shall begin 15 feet below base of structure

Soil Anchors (Tiebacks)

Allowable bond strength in sand*	=	2 kips/ft
Ultimate bond strength in sand	=	5 kips/ft
Allowable bond strength in clay*	=	0.6 kips/ft
Ultimate bond strength in clay	=	1.65 kips/ft
Minimum bond length	=	15 feet
Minimum unbonded length	=	15 feet
Minimum hole diameter	=	4.5 inches (for 500 kip anchor max.)
Installation angle	=	10º to 30º from horizontal (45º max.)

*Note: Allowable strengths reduced to lower level in order to prevent creep.

5.2.3 Navigation Conditions

River navigation conditions are based on scale model test data contained in Technical Report H-75-9 “Navigation Conditions at Uniontown Locks and Dam, Ohio River” (May 1975). The anticipated design current has a maximum flow velocity of approximately 5 feet per second, and varies in direction from parallel to face of walls to an incident angle of approximately 15º. Additional test data is required to generate probability distributions for collision impact, angle and velocity of barge tows. Preliminary approach wall design was based on engineering judgment from data collected for the Olmsted Approach Walls.

5.2.4 Material Properties

A list of the preliminary material properties assumed follows:

5.2.4.1 Concrete

a) Cast-in-Place and Tremie.

Typical	f'c = 4,000 psi at 28 days
Pontoons	f'c = 6,000 psi at 28 days
Non-Shrink Grout	f'c = 6,000 psi at 28 days

b) Precast.

Typical	f'c = 4,000 psi at 28 days
Float-In Base Rafts	f'c = 6,000 psi at 28 days
Pontoons & Lower Landside Approach Wall	f'c = 6,000 psi at 28 days

5.2.4.2 Reinforcement

a) Mild Steel Reinforcing (Fy = 60 ksi).

Deformed Bars	ASTM A 615, Grade 60
Welded Bars	ASTM A 706, Grade 60

b) Post-tensioned/Prestressed.

Strands (fy = 270 ksi)	ASTM A 416, Grade 270, Low Relaxation
Threadbars (fy = 150 ksi)	ASTM A 722, Grade 150

5.2.4.3 Structural Steel

Maintenance Bulkhead	ASTM A 572, Grade 50
Miter Gates	ASTM A 36
Miter Gate Diagonals	ASTM A 514
Culvert Valves & Bulkheads	ASTM A36
Drilled Shaft Permanent Casing	ASTM A 572, Grade 50 and ASTM A 852, Grade 70
Nose Pier Embedded Steel	ASTM A 572, Grade 50
Other Embedded Steel	ASTM A 36

5.2.5 Loads and Load Combinations

5.2.5.1 Loads

Design lock loads are described in EM 1110-2-2602 and EC 1110-2-291.

Following is a list of design loads with pertinent design notes:

a) Dead Loads.

The following unit weights of materials shall be assumed (pcf):

Item	Unit Weight
Water	62.4
Concrete (Mass)	150.0
Concrete (Thin-walled)	157.0
Steel	490.0

An additional weight corresponding to a 4 inch layer of zebra mussels with a unit weight of 22 pcf shall be assumed on permanently floating structures. Also, for the analysis of draft and buoyant stability, a 2% increase of concrete weight shall be assumed to account for construction tolerances and swelling.

b) Hydrostatic (Including Uplift).

Normal Upper Pool:	El. 342
Normal Saturation Level at Cutoff Wall	El. 334
Normal Lower Pool:	El. 324

Uplift forces on floating pontoon base per ETL 1110-2-307.

Per the Information Brochure for Periodic Inspection (June 1974) and new design elevations:

- Maximum lower pool during maintenance and unwatering shall be assumed to be El. 338 (elevation of top of (5) 6-foot maintenance bulkheads on sill). This is an unusual load condition.

- Assume existing main lock chamber is pumped to El. 295.0 during maintenance (new 1200' lock chamber and extended 600' lock chamber are pumped to El. 291.0 and El. 296.5, respectively, during maintenance).

- Actual uplift is not precisely known. Uplift is assumed to vary in a straight line from 100% of hydrostatic head at one face to 100% of hydrostatic head at the other face, effective over the area of base in compression. Where loadings (other than seismic) produced resultants outside the kern, full headwater pressures are assumed under the inactive areas of the base.

It was determined that six maintenance bulkheads are often used for lock unwatering. However, these maintenance periods are scheduled during the dry summer months, and hydrologic information indicated that lower pool elevations greater than El. 338 are very unlikely. Therefore, an extreme load condition case was also considered in which the lower pool elevation was assumed to be El. 344 during maintenance and unwatering.

c) Earth Loads.

Per EC 1100-2-291 (which superseded EM 1110-2-2502 and 2602).

See ***Table 5.2.2C***.

d) Seismic.

Per ER 1110-2-1806 (Zones), EM 1110-2-2200 (Methodology), EM 1110-2-2502 (Forces) and TM 5-809-10.

- John T. Myers Lock is located in Posey County, Indiana - Seismic Zone 2.

- A Seismic Coefficient method of analysis (pseudostatic) shall be used at the feasibility project stage.

- The magnitude of the inertia forces is the product of the structural mass and seismic coefficient (a = 0.1g for OBE and 0.2g for MDE, based on preliminary seismological estimates).

- Additional horizontal loads due to inertia of water shall be considered per EM 1110-2-2200, Section 5-9b.(1).

According to the Information Brochure for Periodic Inspection (June 1974), existing structures were designed based on EM 1110-2-2200, using an acceleration coefficient of a = 0.05g.

Stability criteria for existing monoliths shall conform to ETL 1110-2-310 and Chapter 7 of EC 1110-2-291.

e) Impact.

Accidental barge impact forces shall be calculated in accordance with EM 1110-2-2602 and ETL 1110-2-338 at a future design stage.

In the design of the Olmsted approach walls, it was found that the impact wall thickness and pontoon width were governed by a usual load in the range of 300k to 400k. Impact loads greater than this, but less than 600k, did not govern the selection of the key dimensions of the pontoons. Based on the flow velocities and angles determined during the physical modeling at WES prior to the original construction, the impact loads at the John T. Myers prototype site are anticipated to fall within the range given above. Therefore, the engineering judgment gained from the design of the Olmsted approach walls will be used in the preliminary sizing of the prototype approach walls.

In the design of the Olmsted approach walls, barge impact was assumed to occur at any location along the entire length of the primary impact sides of the pontoon at elevations between 7 feet above and 2 feet below the waterline. The same impact height was assumed at the nose piers. In the determination of the Olmsted approach wall post-tensioning design, the following impact loads were assumed for the primary impact faces:

Upper River Wall

- Usual 600 k
- Unusual 900 k
- Extreme 1000 k

Upper Middle Wall

- Usual 300 k
- Unusual 600 k
- Extreme 800 k

Lower Land Wall and Lower Middle Wall

- Usual 300 k
- Unusual 450 k
- Extreme 500 k

The design extreme impact loading for the nose pier was 4000 k at the operating pool elevation range and 2500 k at elevations higher than that (due to the low probability of having a loaded barge in the vicinity of the locks during flood conditions when barges are diverted over the fixed weir section of the dam).

f) Hawser Pull.

Per EM 1110-2602 and ETL 1110-2-247.

- Checking hawser pull shall be assumed to be 160 kips at 30 degrees to lock wall, applied 5 feet above the water line, at line hooks, check posts and floating mooring bits. The perpendicular component is 80 kips.

- Lock fill and empty hawser pull shall be assumed to be 10 kips maximum.

g) Ice and Debris.

A maximum linear force of 5 kips/ft, acting at the water line, may be used in the design of upper approach walls if this potential ice load is supported by site data and CRREL (Cold Regions Research and Engineering Laboratory).

h) Wave Pressures.

Wave pressures on gates and appurtenances per Shore Protection Manual (1984).

i) Wind.

Wind loads usually are not included in the lock wall analysis (except where major portions are not backfilled). Where included, a pressure of 30 psf shall be used but, if critical, this assumption should be investigated further. See TM 5-809-1 for additional guidance.

j) Gate and Bulkhead Loads.

Per EM 1110-2-2602.

k) Construction.

During construction, some of the existing lock wall monoliths will be used as a portion of the construction cofferdam for construction of elements, including the wrap around culvert, laterals, and maintenance bulkhead sill. The loads transmitted to the lock walls under this temporary construction condition should be checked as an unusual load condition.

l) Temperature.

See ACI 224 R-80 and ETL 1110-2-365 for techniques to reduce temperature cracking in mass concrete.

The temperature design range is -13° F to 107° F. For floating structures, summer and winter differential temperatures of +40 °F and -60 °F are assumed between the top slab and submerged portions of the structure. These assumptions should be further investigated during future design phases.

m) Internal Hydrostatic Concrete Pore Pressure.

Per EM 1110-2-2602 Section 8-19 (September 1995).

n) Marine Growth.

Zebra mussel colonies exist at lock location. See Dead Load.

5.2.5.2 Loading Conditions

The following loading conditions are based on EM 1110-2-2602 Appendix B, EM 1110-2-2200 and John T. Myers site conditions:

a) General Design Loading Conditions.

1. Usual
2. Unusual
3. Extreme

b) General Design Loading Locations.

1. Lock Chamber Land Wall
2. Lock Chamber Intermediate Wall
3. Upper and Lower Gate Bays
4. Upper and Lower Approach Walls
5. Upper and Lower Sills

Specific Load Cases below follow this numbering system, e.g., Load Case 3B refers to Upper and Lower Gate Bays, etc.

c) Specific Loading Conditions.

Lock Chamber Land Wall (Cases 1A Through 1F)	
	600 Ft. Extension
Case 1A - Normal Operating Condition (Usual)	• Backfill or silt assumed to El. 362. • Saturation gradient assumed to vary as a straight line from El. 334 upstream at cutoff wall to El. 324 downstream. • Hawser Load - See Section 5.2.5.1f. • Water El. 324 inside lock chamber. • No silt inside lock. • 100% Uplift.
Case 1B - Earthquake Conditions (Unusual/Extreme)	• Same as Case 1A Plus OBE Earthquake (Unusual). • Same as Case 1A Plus MDE Earthquake (Extreme).
Case 1C - Construction Condition (Unusual)	• Moist earth on landside assume to El. 362. • No Water in Lock Chamber. • No Uplift. • No Earthquake. • For float-in construction, see normal operating condition.

Lock Chamber Land Wall (Cases 1A Through 1F)	
	600 Ft. Extension
Case 1D - Maintenance Condition (Unusual/ Extreme)	• Backfill or silt assumed to El. 362. • Lock Chamber pumped dry (El. 296.5). • No silt inside lock. • Saturation gradient assumed to vary as a straight line from El. 342 upstream to El. 338 downstream. (Unusual) • Saturation Level Assumed to be El. 344. (Extreme) • 100% Uplift. • Maintenance Bulkhead in place. • No Hawser Load.
Case 1E - Maintenance Condition (Unusual)	• Same as Case 1D without uplift (maximum bearing pressure).
Case 1F - Flood Condition - 10 Foot Quick Drawdown (Unusual)	• Water Inside Chamber at El. 352. • Saturated Backfill or Silt Assumed to El. 362. • No Silt Inside Lock. • 100% Uplift.

Lock Chamber Intermediate Wall (Cases 2A Through 2F) Check Renovated and Existing Monoliths for Intermediate Wall Conditions	
	600 Ft. Extension
Case 2A - Normal Operating Condition (Usual)	• Lower Pool in "New" Lock Chamber at El. 324. • Upper Pool in "Existing" Lock Chamber at El. 342. • Silt El. 296.5 in "New" Lock. • Silt El. 308 in "Existing" Lock. • 100% Uplift. • Hawser Load in "New" Lock - See Loads Section 5.2.5.1f. • Vessel Impact in "Existing" Lock.

Lock Chamber Intermediate Wall (Cases 2A Through 2F) Check Renovated and Existing Monoliths for Intermediate Wall Conditions	
	600 Ft. Extension
Case 2B - Normal Operating Condition (Usual)	• Upper Pool in “New” Lock Chamber at El. 342. • Lower Pool in “Existing” Lock Chamber at El. 324. • Silt El. 308 in “New” Lock. • Silt El. 296.5 in “Existing” Lock. • 100% Uplift. • Hawser Load in “Existing” Lock - See Loads Section 5.2.5.1f. Vessel Impact in “New” Lock.

Case 2C - Operating Condition With Drawdown (Unusual)	• Same as Cases 2A and 2B except for the following:
	  • Applicable Pool Drawdown.
	  • Extreme low-water stage (El. 324 for lower pool only).

Case 2D - Maintenance Condition (Unusual/ Extreme)	• “New” Lock Chamber Pumped to El. 296.5. • Upper Pool in “Existing” Lock Chamber at El. 342. (Unusual) • Upper Pool in "Existing" Lock Chamber at El. 344. (Extreme) • Silt El. 296.5 in “New” Lock. • Silt El. 308 in “Existing” Lock. • 100% Uplift.
Case 2E - Maintenance Condition (Unusual/ Extreme)	• Upper Pool in “New” Lock Chamber at El. 342. (Unusual) • Upper Pool in "Existing" Lock Chamber at El. 344. (Extreme) • “Existing” Lock Chamber Pumped to El. 296.5. • Silt El. 308 in “New” Lock. • Silt El. 296.5 in “Existing” Lock. • 100% Uplift.
Check Cases 2D & 2E also with no uplift for maximum bearing pressure.	
Case 2F - Earthquake Conditions (Unusual/Extreme)	• Same as Cases 2A and 2B plus OBE Earthquake (Unusual). • Same as Cases 2A and 2B plus MDE Earthquake (Extreme).

Miter Gate Bay (Cases 3A Through 3H)	
	600 Ft. - Extension (Lower Gate Bay Only)
Case 3A - Normal Operating Condition (Usual) - Gate Loaded	• Upper Pool Upstream of Gate El. 342. • Lower Pool Downstream of Gate El. 324. • Gates Mitered. • Gate Weight. • Gate Thrust. • 100% Uplift. • Wall Loadings.
Case 3B - Normal Operating Condition (Usual) - Gate Unloaded	• Lower Pool El. 324 in Gate Bay. • Gates Almost Mitered. • Gate Weight (Including Strut Normal Force) • 100% Uplift. • Wall Loadings.
Case 3C - Operating Conditions with Drawdown (Unusual)	• Same as Cases 3A and 3B Except Drawdown.
Case 3D - Operating Drains Ineffective Condition (Unusual)	• Same as Cases 3A and 3B Except Raised Saturation Level Due To Ineffective Drains.
Case 3E - Maintenance Condition (Unusual)	• Same as Condition 3B Except Lock Chamber Unwatered to El. 296.5.
Case 3F - Earthquake Conditions (Unusual/ Extreme)	• Same as Conditions 3A and 3B Plus OBE Earthquake (Unusual) • Same as Conditions 3A and 3B Plus MDE Earthquake (Extreme)
Case 3G - Construction Condition (Unusual)	• Float-in and Submerge Gate Bay Raft and Wall Shell.
Case 3H - Construction With Cofferdam Condition (Unusual)	• Not Applicable.

Upper and Lower Approach Walls

Refer to ***Tables 5.2.5.3A*** and ***5.2.5.3B*** (developed for Olmsted Locks & Dam Approach Walls).

5.2.5.3 Load Combinations

Tables 5.2.5.3A and ***5.2.5.3B*** present load combinations applicable to approach wall, nose pier, and pylon designs only. They were developed for the Olmsted Locks & Dam approach walls and can be used for the John T. Myers approach walls during future design stages, adjusting load magnitudes to reflect the John T. Myers site conditions. At the feasibility stage, however, preliminary approach wall design will be based primarily on engineering judgment from data collected for the Olmsted approach walls, supplemented by site specific calculations for governing load cases.

TABLE 5.2.5.3A

Floating Approach Wall Pontoon Load Combinations

Load Symbol	Load Description	Notes	Basic Ultimate Factor *	Construction Condition					Usual Condition							Unusual Condition						Extreme Condition				
				DCW	DPT	DPHT	DPHt	DPG	DPH	DPHV	DPHVS	DPHTBM	DPHW	DPHTW	DPHWB	DPHW	DPHTW	DPHTB	DPHWI	DPHWB	DPHE	DPHWB	DPHTB	DPHF	DPHE	DPG
				Hydraulic Factor, Hf																						
				1.00	1.00	1.00	1.00	1.00	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.00	1.00	1.00	1.00	1.00
				Demand Reduction Factor																						
				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00
				Load Combination Numbers																						
Constr. & Transp.				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
				Load Combination Coefficients																						
C	Construction Phase	7	1.4	1.00																						
P	Posttensioning	5	0.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
T	Deformation Loads (Dif'ntl. Temper., Shrinkage, & Friction)		1.70			1.00																				
L	Launching	8																								
t	Towing		1.70		1.00	1.00																				
G	Partial Grounding	1	Note 1					1.00																		
Dead Loads																										
D	Dead Load (solids)		1.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
D	Water Accumulation Allowance		1.40						1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
D	Zebra-Mussels Infestation Allowance		1.40						1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vehicle																										
V	Wheel Load (static load + 15% Lifting allowance)	2	1.70							1.00	1.00															
Collision																										
B	Barge Collision with Pontoon (Initial barge damage limit)	4	1.70									TBD			1.00			TBD					TBD			
B	Barge Collision with Pontoon (1% prob. of being exceeded)	4, 6	1.70									TBD						TBD		1.00			TBD			
B	Barge Collision with Pontoon (0.1% prob. of being exceeded)	4	1.00									TBD						TBD				1.00	TBD			
Hydraulic Forces																										
H	Hydrostatic Pressure		1.40		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
H	Water Current		1.70									1.00	0.50	1.00	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
H	Waves (horizontal forces)		1.70									1.00		1.00			1.00	1.00				1.00	1.00			
H	Waves (sag & hog)		1.70							1.00	1.00	1.00		1.00			1.00	1.00				1.00	1.00			1.00
I	Ice Floes pressure		1.70																1.00							
M	Barge Mooring Forces 160k mooring lift)		1.70									1.00														
Ambient Forces																										
S	Snow and Ice Accumulation	2	1.70								1.00															
T	Deformation Loads (Differential Temperature & Shrinkage)		1.70									1.00						1.00					1.00			
W	Wind Pressure		1.70	0.50									1.00	0.50	0.75	0.75	1.00		0.75	0.75		1.00				
G	Partial Grounding	1	1.00																							1.00
E	Operating Basis Earthquake (OBE)		*																		*					
E	Maximum Credible Earthquake (MCE)		*																						*	
F	Flooding of one (two) pontoon compartment(s) (global effects)	3	*																					*		

Notes:

1: Design accounts for partial grounding of the pontoon during launching and tow as well as during the design life. Critical low water levels with respect to the limiting design criteria shall be stated in the pertinent contract drawings.

2: Truck mounted crane for maintenance work. Lifting allowance to be applied only for the design of the top slab (local effect) and not simultaneously applied with snow and ice accumulation.

3: Different crack control limits apply to flooding of one compartment as opposed to flooding of two compartments.

4: No simultaneous application of impact with respect to pontoon and Nose pier.

5: Prestressing force not applicable with the Basic Ultimate Factor.

6: 100 year event barge impact shall is the applied for the design of the pontoon side walls designated 'Secondary Impact Walls' in the performance category 'Unusual.'

7: This construction phase load yields the maximum tolerable vertical load (e.g., weight of the fresh concrete of the top slab and its forms) imposed on the cantilevering side walls and bulkheads during the construction of the top slab.

8: Force magnitude, flooding rate, etc. still to be defined or verified, respectively.

*: Basic ultimate factor of 0.90 applies when pertinent loads (either dead or live) have a relieving effect on the factored load. For example, bottom slab and water content in the flooded compartment will counteract hydrostatic pressure only at 90% of their nominal weight.

*: Basic ultimate factors of unity applies to MCE, compartment(s) flooding, and part. grounding loads (perf. categ. 'extreme'), i.e., Uh = 1.0 D + 1.0 L + 1.0 (E or F or G). For OBE (perf. categ. 'Unusual') Uh = 1.4 D + 1.4 L + 1.5 E.

TABLE 5.2.5.3B

Nose Pier and Pylon Load Combinations

Load Type				Constr'n		Usual						Unusual						Extreme		
Load Symbol	**Load Description**			D P H	D P H T	D P H	D P H S	D P H T	D P H W	D P H W	D P H W B	D P H W M	D P H W	D P H W I	D P H W R	D P H W B	D P H W E	D P H W B	D P H	D P H E
				Hydraulic Factor, H_f																
				1.00	1.00	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.00	1.00	1.00
				Demand Reduction Factor																
				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00
			Basic	**Load Combination Numbers**																
		Notes	**Ultimate**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Dead Loads			**Factor**	**Load Combination Coefficients**																
D	Dead Load		1.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Collision																				
B	Barge Collision with Pontoon (Initial barge damage limit)		1.70								1.00									
B	Barge Collision with Pontoon (100 year event)		1.70													1.00				
B	Barge Collision with Pontoon (1000 year event)		1.00															1.00		
B	Head on Impact		1.00															1.00		
Hydraulic Forces																				
H	Hydrostatic Pressure		1.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
H	Water Current		1.70					1.00	0.75		0.75	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	0.50
H	Waves (horizontal forces)		1.70		1.00			1.00	0.75											
I	Ice Floes pressure		1.70											1.00						
M	Mooring		1.70									1.00								
R	Salvage Rating (Applied to upper river nose pier only)		1.70												1.00					
Ambient Forces																				
S	Snow and Ice Accumulation		1.70				1.00													
T	Deformation Loads on Pontoon (Differential Temp. & Shrink.)		1.70					1.00												
W	Wind Pressure		1.70						1.00	0.50	0.75	0.75	1.00	0.75	0.50	0.75	0.50	1.00		
E	Operating Basis Earthquake (OBE)		1.00														0.50			
E	Maximum Design Earthquake (MDE)		1.00																	1.00

5.2.6 Stability and Sliding Criteria

The following criteria, shown in ***Table 5.2.6A***, are in accordance with EC 1110-2-291 (which supersedes EM 1110-2-2200):

TABLE 5.2.6A

Load Condition	Resultant Location Requirements	Minimum Sliding Factor of Safety	Foundation Bearing Pressure
Usual	Middle 1/3 (100% comp.)	1.5	1.0* Allowable
Unusual	Middle 1/2 (75% comp.)	1.3	1.14* Allowable
Extreme	Within Base	1.1	1.50* Allowable

Note: The lock structure category was considered to be "normal" (not critical) and the availability of site information was considered to be "ordinary" (not limited nor very well defined).

Based on preliminary stability analyses of lock monoliths at the John T. Myers site, using current guidelines and geotechnical parameters described in Section 5.2.2, it was found that a typical existing land wall monolith did not meet current stability criteria. Existing river wall monolith stabilities were not investigated.

In the development of the expanded lock design for this engineering appendix, monolith stabilization is addressed in a limited manner, analyzing only those monoliths which are significantly affected by the lock expansion. The extended 600' lock design will include stabilization of only those existing monoliths which will have:

- a significant increase in the magnitude of loading or
- a significant change in the direction of loading

when compared with the existing conditions. Of the existing middle wall monoliths which will form a portion of the extended chamber, a few typical monoliths were investigated to see if stability requirements were met.

Although the existing lock wall monoliths have performed satisfactorily for many years, it may be decided to improve the stability of selected existing monoliths before a new or extended lock is constructed. In this case, we recommend that:

- in the stabilization design, consideration be given to the loading condition for the monolith if it is incorporated into a new or extended lock
- the stabilization method does not interfere with a new or extended lock chamber

New monoliths in the extended 600' lock design must meet current stability criteria.

5.2.7 References

The structures shall be designed in accordance with the criteria and guidance furnished in Corps of Engineers manuals for engineering and design, industry standards and other technical references as follows:

5.2.7.1 Engineering Manuals

- EM 385-1-1 Safety and Health Requirements Manual, October 1987
- EM 1110-1-1804 Geotechnical Investigations, February 1984
- EM 1110-1-1904 Settlement Analysis, September 1990
- EM 1110-1-1905 Bearing Capacity of Soil, October 1992
- EM 1110-1-2908 Rock Foundations, November 1994
- EM 1110-2-1301 Cost Estimates - Planning and Design Styles
- EM 1110-2-1604 Hydraulic Design of Navigation Locks, June 1995
- EM 1110-2-1610 Hydraulic Design of Lock Culvert Valves, August 1975
- EM 1110-2-2000 Standard Practice for Concrete for Civil works Structures, February 1994
- EM 1110-2-2102 Waterstops and Other Joint Materials, May 1983
- EM 1110-2-2104 Strength Design of Reinforced Concrete Hydraulic Structures, 30 June 1992
- EM 1110-2-2105 Design of Hydraulic Steel Structures, March 1993
- EM 1110-2-2200 Gravity Dam Design, June 1995
- EM 1110-2-2302 Construction with Large Stone, October 1990
- EM 1110-2-2502 Retaining and Flood Walls, September 1989
- EM 1110-2-2503 Design of Sheet Pile Cellular Structures, September 1989
- EM 1110-2-2504 Design of Sheet Pile Walls
- EM 1110-2-2602 Planning and Design of Navigation Locks, September 1995
- EM 1110-2-2608 Navigation Locks-Fire Protection Provisions
- EM 1110-2-2703 Lock Gates and Operating Equipment
- EM 1110-2-2902 Conduits, Culverts and Pipes
- EM 1110-2-2906 Design of Pile Foundations
- EM 1110-2-3400 Painting: New Construction and Maintenance, April 1995
- EM 1110-2-3504 Chemical Grouting
- EM 1110-2-4300 Instrumentation for Concrete Structures
- EM 1110-2-5025 Dredging and Dredged Material Disposal

5.2.7.2 Engineering Circular & Engineering Technical Letters

- EC 1110-2-291 Stability Analysis of Concrete Structures, October 1997
- ETL 1110-1-127 Use of Fly Ash in Concrete, August 1984
- ETL 1110-2-216 Energy Conservation for Civil Works, June 1976
- ETL 1110-2-223 Navigation Lock Sill Depths and Hydraulic Loads on Gates, June 1977
- ETL 1110-2-254 Finite Element Analysis Interpretation and Documentation Guidelines, December 1980
- ETL 1110-2-256 Sliding Stability for Concrete Structures, June 1981
- ETL 1110-2-307 Flotation Stability Criteria for Concrete Hydraulic Structures, August 1987
- ETL 1110-2-310 Stability Criteria for Existing Concrete Navigation Structures on Rock Foundations
- ETL 1110-2-321 Reliability Assessment of Navigation Structures, Stability of Existing Gravity Structures
- ETL 1110-2-338 Barge Impact Analysis, April 1993
- ETL 1110-2-355 Structural Analysis and Design of U-Frame Lock Monoliths
- ETL 1110-2-365 Nonlinear Incremental Structural Analysis of Massive Concrete Structures
- ETL 110-2-366 Seismic Design for Civil Works Buildings
- ETL 1110-2-532 Reliability Assessment of Navigation Structures
- ETL 1110-8-2 (FR) Anchor Embedment in Hardened Concrete
- ETL 1110-8-13 (FR) Structural Engineering Responsibilities for Civil Works Projects

5.2.7.3 Engineering Regulations

- ER 1110-2-1150 Engineering and Design for Civil Works Projects, March 1994
- ER 1110-2-1200 Engineering and Design Plans and Specifications, June 1972
- ER 1110-2-1302 Civil Works Cost Engineering
- ER 1110-2-1404 Hydraulic Design of Deep Draft Navigation Projects
- ER 1110-2-1458 Hydraulic Design of Shallow Draft Navigation Projects, August 1985
- ER 1110-2-8152 Planning and Design of Temporary Cofferdams and Braced Excavations
- ER 1110-2-1806 Earthquake Design and Analysis for Corps of Engineers Projects

5.2.7.4 Technical Publications

- American Concrete Institute, “Building Code Requirements for Reinforced Concrete”, ACI-318-95
- American Concrete Institute, “Manual of Concrete Practice”

- American Concrete Institute, “Guide for the Design and Construction of Fixed Offshore Concrete Structures”, ACI-351-R-84
- American Concrete Institute, “Control of Cracking in Concrete Structures”, ACI 224R-80
- American Institute of Steel Construction, “Manual of Steel Construction, Allowable Stress Design”, AISC, 9th Edition, 1989
- American Institute of Steel Construction, “Manual of Steel Construction, Load and Resistance Factor Design”, AISC, 1st Edition, 1986
- American Welding Society, “Structural Welding Code”, AWS D1.1
- American Association of State Highway and Transportation Officials, “Standard Specifications for Highway Bridges”
- American Society of Civil Engineers, “Minimum Design Loads for Buildings and Other Structures”, ASCE 7-88
- Portland Cement Association, “Design and Control of Concrete Mixtures”
- Post-Tensioning Institute, Recommendations for Prestressed Rock and Soil Anchors

SECTION 6

DESCRIPTION AND GENERAL LAYOUT

In the selected design alternative, shown in ***Drawing 6.0A***, the existing 110' x 600' lock is extended downstream to form a 110' x 1200' lock, as a minimum. At the John T. Myers site, the extended lock will have a 110' x 1313' chamber due to existing conditions which restrict the placement of the new miter gate recess. This extension is accomplished by demolishing existing monolith L-1, extending the existing land wall with a 463' long float-in monolith, and adding a downstream float-in miter gate bay monolith. Due to the increased lock size, the existing fill/empty system must be augmented in order to approximately maintain the existing fill/empty time. The supplemental fill/empty system consists of a culvert which wraps around the existing lock land wall, is incorporated into the new float-in land wall extension, splits into laterals, and empties into the lower approach using a landside wall diffuser outlet. A culvert-type intake, which was developed and modeled for the Robert C. Byrd Locks & Dam, is used for the fill/empty culvert inlet. The fill/empty system layout is shown in ***Drawings 6.0B*** and ***6.0C***, and details of the landside wall diffuser outlet are shown in ***Drawing 6.0.D***.

Four new approach walls are required for the 600' lock extension alternative design. Approach wall pontoon, nose pier, and pylon details are shown in ***Drawings 6.0E*** through ***6.0O***. Final required approach wall lengths will be determined during site specific model testing. For feasibility study purposes, the following preliminary approach wall lengths were included in this design:

- 900' Floating Upper Middle Approach Wall
- 960' Floating Upper Riverside Approach Wall
- 700' Floating Lower Landside Approach Wall
- 100' Floating Lower Middle Approach Wall

These approach wall lengths provide 1270' from the landside miter gate pintle to the end of the upper middle approach wall, 1200' from the end of the upper middle approach wall to the end of the upper riverside approach wall, and 700' minimum from the miter gate bay to the end of the lower landside approach wall. (Prior to final design refinements, the lower landside approach wall connected to the wall diffuser, as shown in the referenced drawings.) The 100' floating pontoon is required as a very short lower middle approach wall in order to prevent lower miter gate damage due to accidental barge impact.

SECTION 7

ENVIRONMENTAL ENGINEERING

7.1 DESIGN OF POSITIVE ENVIRONMENTAL ATTRIBUTES INTO THE PROJECT

Generally, areas disturbed by construction and disposal will be returned to their pre-project vegetative cover. Frequently mowed open areas will be re-vegetated in grasses similar to their current condition. Prairie lands will be restored to prairie. Scrub shrub areas will be replanted in bottomland hardwoods. Agricultural fields will either be returned to agriculture or restored in bottomland hardwoods or as moist soil management units (wetlands).

7.2 INCLUSION OF ENVIRONMENTALLY BENEFICIAL OPERATIONS AND MANAGEMENT FOR THE PROJECT

It is proposed that all on-site areas that are not needed as reserve for future needs be leased to the state of Indiana for management. This would amount to about 300+ of the 400+ total project acres.

7.3 BENEFICIAL USES OF SPOIL OR OTHER PROJECT REFUSE DURING CONSTRUCTION AND OPERATION

It is proposed to aggressively seek environmentally beneficial opportunities for use of all spoil, concrete rubble and rock.

7.4 MAINTENANCE OF THE ECOLOGICAL CONTINUITY IN THE PROJECT WITH THE SURROUNDING AREA AND WITHIN THE REGION

Areas disturbed by construction and disposal will generally be returned to their pre-project vegetative cover. Frequently mowed open areas will be re-vegetated in grasses similar to their current condition. Prairie lands will be restored to prairie. Scrub shrub areas will be replanted in bottomland hardwoods. Agricultural fields will either be returned to agriculture or restored in bottomland hardwoods or as moist soil management units (wetlands).

7.5 CONSIDERATION OF INDIRECT ENVIRONMENTAL COSTS AND BENEFITS

Indirectly, extension of the auxiliary chamber will be beneficial to aquatic and riparian resources through reduction of traffic queues and, therefore, fewer boats sitting at idle and/or nosed up into the bank.

7.6 INTEGRATION OF ENVIRONMENTAL SENSITIVITY INTO ALL ASPECTS OF THE PROJECT

Areas disturbed by construction and disposal, generally, will be returned to their pre-project vegetative cover. Frequently mowed open areas will be re-vegetated in grasses similar to their current condition. Prairie lands will be restored to prairie. Scrub shrub areas will be replanted in bottomland hardwoods. Agricultural fields will either be returned to agriculture or restored in bottomland hardwoods or as moist soil management units (wetlands).

7.7 INCORPORATION OF ENVIRONMENTAL COMPLIANCE MEASURES INTO THE PROJECT DESIGN

Environmental impacts will be avoided, minimized, or mitigated fully.

SECTION 8

CIVIL ENGINEERING

8.1 EARTHWORK AND BACKFILL

8.1.1 General Excavation

The six elements which will require major excavation are the wrap around culvert, the wall monoliths, the miter gate monoliths and sill structure, the temporary construction moorage for float-in structures, the small boat basin, and the improvement of the downstream approach.

The majority of the excavation required for the wrap around culvert takes place in-the-dry and can be accomplished by conventional means. For those materials with moisture contents suitable for supporting the movement of construction equipment, conventional excavation may be performed, using equipment such as self-loading scraper pans, backhoes, trucks, and dozers. Excavation, in materials with moisture contents which are not suitable for conventional equipment, will require excavation with draglines or other suitable equipment.

Excavation for the near site work station (temporary construction moorage area), approach areas, wall monoliths, and miter gate monoliths and sill structure, will, where feasible, be performed from the shoreline, using draglines or other suitable equipment.

Excavation of the riverbank, in order to improve the downstream approach, which is shown in ***Drawing 8.1.1A***, will be performed from the shoreline using draglines or other suitable equipment.

With the availability of a disposal site adjacent to the excavation, stockpiling and/or long haul routes are not necessary at this site. Excavation materials that are suitable for backfilling (i.e., material excavated for the wrap around culvert) may be stockpiled, temporarily, on the site just upstream of the existing locks.

Construction of the 600' lock extension will require significant amounts of excavation, some of which will be performed "in-the-wet." Generally speaking, there are three different types of material to be excavated:

- Sands (alluvial deposits)
- Shale
- Limestone

A 5 cy heavy duty clamshell is proposed for the work although a hydraulic excavator (backhoe) mounted on a barge would be even more effective in removing limestone. However, this latter equipment is not normally used for relatively small jobs such as this.

The clamshell production rate is normally determined by an analysis of cycle times, including dropping of bucket, closing time, lifting time (limited by speed of hoist line), swing time, open bucket, swing back. However in the case of concrete and limestone excavation, which have to be blasted, the rate is considerably slowed because of integration of sequential activities. Thus in the case of concrete demolition, only 250 to 500 cy will be removed per shift, whereas in silts and sands, the rate will be determined by the depth of water. In the case of shale, the rate will be limited by the amount ("bite") that the bucket, with teeth, can get, and by the need to use an underwater hydraulic breaker ram or chisel.

Excavated material will be loaded onto scows (with sides) for transport to the stockpile or disposal area. At the unloading site, a shore-based clamshell will unload, although an alternative is a scoop loader on the scow and a conveyor belt.

The material will then be stockpiled, if necessary, separating it as reasonably practicable and allowing it to drain. This will be done with a scoop loader, which will also load to trucks for hauling to the disposal area.

Concrete will be crushed and separately stockpiled.

8.1.2 Dredging

Excavation of materials in the water, outside the reach of conventional shore-based equipment, will require dredging. Due to the added costs and disposal considerations required when dredging, dredging will be minimized, and conventional excavation will be utilized to the maximum practical extent.

Most dredging can be carried out independently of other operations, in which case the rate of production will be relatively high. The largest quantities of dredging will be required for the construction moorage area and the downstream approach channel improvement. In both of these cases, either hydraulic suction dredging or clamshell dredging could be used. It is anticipated that hydraulic suction dredging would be more cost effective unless environmental considerations are too prohibitive. Therefore, it is recommended that the contractor be allowed to use the most economical method.

In the cases where dredging of overburden material is required in addition to drilling and shooting limestone (e.g., for the float-in land wall monolith construction), clamshell dredging is preferable. Drilling is most effectively carried out with some or all the overburden left in place, since the casing can be seated. Also the blasting will be more effective, with greater fragmentation. Using this approach, much of the silt and sand will necessarily be dredged with the broken limestone, and a clamshell dredge is required. The clamshell buckets should be without teeth and tight fitting so as to prevent loss of material.

Typical cycle times will be 1 min. 20 sec., and each bucket should be full. There will be a 25% swell however, so net bank yards will be 4 cy. Production rate, (4 cy/bucket) (1 bucket/1.333 min.) (50 min/hr) (7 hrs/shift) = 1,050 cy/shift.

8.1.3 Underwater Excavation of Limestone

This will be required for the construction of the new float-in wall diffuser, land wall and miter gate bay.

The limestone will be drilled and shot underwater, using the OD method of casing. Holes will be loaded as they are drilled. Holes will be on 7-foot centers, both directions. One or two lines will be shot at a time, so as to limit the amount of powder and to keep an open face.

The drill barge will drill and shoot 14 – 16 holes/shift. Then the clamshell crane barge, with heavy duty bucket and teeth, will excavate the limestone and the accompanying sand and silt.

8.1.4 Underwater Excavation of Shale

As indicated, a 5 cy heavy duty rock bucket with teeth will be used. A hydraulic ram (chisel) will be available to use to increase production where indicated. It is not believed that drilling and blasting will be needed.

Excavation will be by clamshell bucket augmented by the hydraulic ram as needed. Buckets will be 1/2 full on average. Swell is anticipated to be approximately 25%.

8.1.5 Instrumentation for Monitoring Blasting

Instrumentation for control of blasting vibrations and overpressures is anticipated. The blasting plan is based on an assumed limitation of peak particle velocity to 4.0 in/sec, at the face of the structure, and a peak water overpressure measured 5 ft. in front of the existing structures to 50 psi, or less.

8.1.6 Backfilling

Lock wall monolith foundations will be backfilled with tremie concrete, up to the existing top of rock elevation, in order to provide adequate resistance against sliding. Thus, excavated rock in these areas will be replaced with tremie concrete. In order to achieve a good bond with the existing rock, the surface should be vacuumed clean prior to concrete placement. When the

extended lock chamber is dewatered for interior construction and miter gate installation, grout may be injected at locations where leakage is noted through the underbase and backfill concrete.

For the overburden material, backfilling will be performed with conventional earth moving equipment, using suitable materials stockpiled during excavation. It is anticipated that a sufficient quantity of stockpiled excavated materials will be available at the site. If additional backfill is required, materials obtained from regional commercial quarry sites will be used.

8.2 FOUNDATION PREPARATION

The new float-in concrete monoliths for the 600' lock extension will be founded 10 to 20 feet into the existing bedrock at the site. The culvert laterals and maintenance bulkhead sill will also be founded on bedrock at the site.

The foundations for these structures should be excavated to the dimensions and grades indicated, without excessive loose material in the excavation, and free of large protrusions into the foundation excavation. Rock excavation should be done in a manner which minimizes damage and cracking to the remaining adjacent bedrock. The cast-in-place concrete laterals and maintenance bulkhead sill should be cast in-the-dry on a sound bedrock surface without loose material. Therefore, care should be taken, during this in-the-dry excavation work, to avoid overexcavation and the need for additional foundation concrete.

For the float-in monoliths, the rock excavation in the areas where the concrete pedestals will be located should be fairly level (approximately ±1 to 2 inches) in order to provide the required seating elevation. All other areas of foundation rock excavation may have a higher roughness and elevation tolerance. Allowing a higher tolerance will reduce the excavation cost. In this case, a roughness and elevation tolerance of up to approximately ±12 inches can be allowed without adversely affecting the structural foundation. This tolerance level should provide adequate space for good quality underbase grouting without significantly increasing the construction cost.

The excavation surface may be mapped, using one of the following two techniques investigated, in order to verify that it is within allowable tolerances. The first method considered is acoustic imaging, which uses sonar technology, and the second method considered is based on pressure sensitive transducers, which use precision quartz crystal oscillations. The sonar system requires the use of triangulation, using sound waves to determine the precise location of an object. The scanning sonar will be able to map the bottom of the excavation and determine the surface geometry to within ±12 inches. The pressure-based system uses pressure sensitive transducers, which are capable of determining the elevation of an object to within ±0.01 percent accuracy. For the anticipated maximum 50-foot depth of water during placement of the float-in monolith structures, this translates to approximately 1/16-inch accuracy. The transducers are small in size and can be placed, by a diver, on an object to determine it's elevation. The sensors are connected to the surface via an air pipe, and the equipment on the surface monitors the barometric pressure and the water temperature to provide precise information for use in calculating the elevation of the object. It is anticipated that the transducers would be particularly useful at the concrete pedestal locations.

Also, for the float-in monoliths, the rock should be overexcavated by approximately 2 feet on each side, at the base of the excavation, extending the foundation footprint for a total of 4 feet along its length and width. All loose and fractured rock should be removed. As the visibility is very poor at the site, the rock evaluation will not be straightforward. One potential fractured rock determination and removal method would include hammering the area with a specified force prior to final removal and vacuuming of the excavation debris. In order to improve the bond between the underbase grout and the existing rock, the foundation area should be vacuumed immediately prior to placement of the float-in monoliths and associated grouting.

8.3 DISPOSAL

Expansion of the 600' lock will require disposal of approximately 864,000 cubic yards of common excavation. Excavation of 49,000 cubic yards of rock and demolition of 6,000 cubic yards of concrete will also be required. However, it is assumed that these materials will be recycled or reused by the contractor and will, therefore, not require disposal. At the John T. Myers site, approximately 46.7 acres of land is available just downstream and north of the existing lock and service mound. By filling to a final grade of El. 367, approximately 895,000 cubic yards of material can be disposed of on site. See ***Drawings 8.3A*** and ***8.3B*** for the disposal plan and cross section, respectively.

However, stretching the proposed area to the size of 94 acres (as shown in ***Drawing 13.0A***) still does not impact existing wetlands. Therefore, in order to reduce the top of disposal mound elevation, the disposal area will be expanded. It will fit within the 94 acres that have been identified, and the top of disposal mound elevation will be reduced from what is currently shown. The top of disposal mound elevation shall be held at or below El. 358, which is below the existing road at the site.

All excavated material except suitable backfill, rock, and demolition debris, will be spoiled in the disposal areas. In addition to the materials to be spoiled, material removed for the installation of the wrap around culvert or lower approach channel improvements will need to be temporarily stockpiled before backfilling the culvert and other structures. Some of the stockpiled material may be used to construct temporary dewatering berms and elevated construction staging and lay down areas. See ***Drawings 14.9.2A*** and ***14.9.2B*** for some temporary construction requirements.

8.4 BUILDINGS AND GROUNDS

Existing project operations facilities at the site include an operations building located on the middle wall, a maintenance building located on the service mound, a garage/storage building located on the service mound, and a public restroom facility located adjacent to the service mound. Except for the public restroom, the facilities are located inside a security fence and accessed by a paved access road. The non-public facilities will remain accessible and operational during expansion of the lock. The maintenance building and garage/storage building will be accessed by the existing paved roadway. A temporary gravel access roadway to the land wall, and, therefore, to the middle wall and operations building, will be maintained at all times.

The temporary gravel access roadway will need to be shifted from time to time as work on the wrap around culvert progresses.

A new, centralized control room, sized to accommodate future automatic controls for both locks, is proposed. It is anticipated that it will be located on top of the existing operations building and will be similar to the control room constructed at Newburgh Locks & Dam.

Parking along the esplanade will be temporarily eliminated during construction of the wrap around culvert. There is ample parking available in the existing public parking lot and service mound to accommodate employee and service vehicle parking during construction. Also, see the Visitors Facilities section below.

8.4.1 Visitors Facilities

Existing visitors facilities consist of a 77-car parking lot adjacent to the service mound, connected to the esplanade by a 6-foot wide concrete fenced walkway. From the esplanade, a painted crosswalk directs the visitor to fenced viewing areas on the existing land wall and middle wall. Access from the land wall to the middle wall is provided over the existing upstream miter gates.

Construction of the wrap around culvert will temporarily cut off access to the visitors' facilities making it necessary to close the facilities during construction. An added benefit of temporarily closing the visitors' facilities is that the existing visitor parking lot is then fully available for employee parking and construction activities.

8.4.2 Public Use

In addition to the visitors facilities, a public restroom, picnic tables, and other public facilities are located along the esplanade at the base of the service mound. Construction of the wrap around culvert and other heavy construction activities in the vicinity of the public facilities will require their closure for the anticipated two-year construction period. The facilities will be reestablished and landscaped to create a more pleasing atmosphere as well as provide visual relief at the end of the project.

It is anticipated that the public restroom will also be shut down during this period. The contractor will be required to provide and maintain temporary sanitary facilities for his personnel.

Water activities, such as fishing and motor boating, will also be limited by construction activities. Safety zones will be established around blasting and dredging activities to ensure the safety of the public and a safe working environment for the contractor.

8.4.3 Utility Relocations

No off-site or public utilities are impacted by the proposed lock construction. The following on-site utilities run between the service mound and the existing land wall:

Sta. 1+98 D.S.
- 2-500 MCM Bare Copper Ground

Sta. 6+66 D.S.
- 1-1/2" Fuel Oil Line - sch 40 steel pipe
- 1-1/2" Potable Water Line - copper pipe
- 1-1/2" Hydraulic Oil Fill Line - sch 40 steel pipe
- 4" Raw Water Line - mechanical joint cast iron pipe

Sta. 7+23 D.S.
- 4" Sanitary Sewer Force Main - mechanical joint cast iron pipe
- 2-500 MCM Bare Copper Ground
- 2-3/C-500 MCM Direct Buried Power
- 2/C #12 Direct Buried Control Cables for fuel oil transfer pump
- 3/C #12 Direct Buried Control Cables for hydraulic oil transfer pump
- Telephone Cable

Sta. 7+40 D.S.
- 6" V.C.P. Sanitary Sewer

See ***Drawing 8.4.3A*** for the utility plan. The existing utilities will need to be relocated and supported by a structural bridge over the wrap around culvert excavation. All utilities must remain operational with only short scheduled outages. If desired, this bridge could also be designed to provide pedestrian access.

The raw water system, used for fire protection, will need to be replaced with a new system located outside the limits of the culvert excavation. The new system must be installed and operational before the existing system is shut down and removed. The new system will also be extended to provide service to the relocated mooring facility and the lock wall extension.

The sewage drain field is located in the grass area between the service mound and the esplanade. The drain field will need to be relocated to allow for excavation of the wrap around culvert.

In addition to the utilities serving the existing lock, there are buried power, water and sewer lines between the service mound and the public restroom facilities. It is anticipated that these utilities will not be impacted by construction. Care shall be taken when working near these utilities to prevent damage caused by construction activities.

Overhead power is provided to the existing moorage facility by Southern Indiana Gas and Electric (SIGECO). The overhead power lines and poles will be removed from the existing moorage basin. Electrical service for the new mooring basin will be provided, by buried cable

from the main power service in the operations building. This will enable the mooring facility to be serviced by the emergency generator, in the event of an SIGECO power outage.

8.4.4 Fencing and Signing

New and/or relocated fencing and signing will be required to secure restricted areas, and protect the public from hazardous conditions.

8.4.4.1 Fencing

Temporary fencing will be required to limit access to the work area and to provide protection at the top of deep cuts and excavations. Construction fencing will be required around the disposal area to define the limits of work and to keep out the public.

New fencing will be designed to match existing in type and appearance in accordance with EM 1110-1-400 and ER 1130-2-400.

8.4.4.2 Signing

Signs will be provided where needed to regulate traffic, warn of hazardous conditions, establish restrictions and restricted areas and to direct and inform the public. All traffic and warning signs shall be placed and installed in accordance with the current "Manual on Uniform Traffic Control Devices for Streets and Highways" and Chapter 4 of EP 310-1-C. Informational signs and bulletin board will be provided in public use and observation areas containing project maps, emergency numbers, Title 36 rules and regulations, safety tips and general information on the history, purpose and operation of the facility.

8.4.5 Mooring Facility

A mooring facility for storing and securing a workboat and work barge to be used for maintenance and operational requirements is located at the upstream end of the locks behind the landwall. Construction of the fill/empty intake structure will require relocation of the mooring facility.

The relocated mooring facility will be of similar size and configuration as the existing facility. Additionally, to the extent feasible, the relocated facility shall use components taken from the existing facility such as the floating dock, access stairs, handrail, fencing and gates, and electrical service panel.

The following issues were considered in locating a new site:

- The site needed to provide protection during high water.
- An upstream site was preferred, although not required. This allows the workboat to be used for emergency situations that occur above the dam.
- The facility needs to be located such that a truck with equipment can be pulled along side and equipment off loaded using the workboat crane.

The proposed location for the relocated mooring facility is approximately 500 feet upstream of the existing facility. A new access roadway from the entry roadway, in the vicinity of the visitor parking to the mooring facility, will be constructed. The alignment of the roadway was chosen to provide quick access from both the service mound and the esplanade in cases of emergency. A parking, loading, and turnaround area will be constructed adjacent to the mooring basin to accommodate loading and servicing of the boats. Approximately 14,900 cubic yards of excavation are required to construct the mooring basin.

In order to construct the dewatering berm and temporary spoil and construction lay down area, a temporary access road to the mooring facility will be required (see ***Drawing 14.9.2A***). Upon completion of the lock work, the temporary access roadway will be removed and the permanent road, discussed above, will be installed. Although it would be possible to use the temporary access road as a permanent road, its entrance location, length, and added time of travel make the alignment at the temporary access roadway less desirable. The proposed permanent roadway alignment will allow for quicker access from both the service mound and the esplanade.

Electrical power and raw water will be supplied to the relocated mooring facility as noted in Section 8.4.3.

SECTION 9

STRUCTURAL DESIGN

9.1 LOCATION AND SITE RESTRICTIONS

In the Interim Reconnaissance Report for the Ohio River Mainstem Study (June 1991), an extension of the existing 110’ x 600’ lock to a 110’ x 1200’ lock was evaluated. The current general configuration for the 600’ lock extension alternative is very similar to the one which was presented in this reconnaissance level report. In both cases, the lock chamber is extended downstream, utilizing as many of the existing lock wall monoliths as possible. In this way, excavation and new construction are minimized. The lock extension is accomplished by demolishing existing monolith L-1, extending the existing land wall with a 463’ long float-in monolith, and adding a downstream float-in miter gate bay monolith.

At the John T. Myers site, the extended lock will actually have a 110’ x 1313’ chamber, due to existing conditions which restrict the placement of the new miter gate recess. A 110’ x 1200’ extended lock chamber could be achieved by cutting a recess for the new miter gate into the existing middle wall monoliths M-1, M-2, and M-3. However, this design was investigated in earlier reports, and it has several difficulties. One difficulty is cutting into the existing middle wall monoliths very close to the existing culvert location. If the middle wall culvert placement was not constructed accurately, or if the recess is overcut, then the existing culvert wall could be compromised. For this reason, cutting a miter gate recess would necessitate shutdown of the downstream end of the existing middle wall culvert and emptying the existing 1200’ lock using only one culvert (the riverside culvert). Thus, the emptying time for the existing 1200’ lock would be greatly increased at the same time as the existing 600’ lock would be closed to navigation, during the period of time required for this construction step. As a result, significant “disbenefits” costs would be incurred. Another difficulty is ensuring that the bull nosed middle wall end monolith can resist the large thrust of the new miter gate. Additionally, locating a new miter gate machinery pit, and relocating a culvert bulkhead slot would be difficult in this congested area of the end wall monoliths. For these reasons, this miter gate location was not pursued further. Instead, a stand alone miter gate and sill structure, which could be floated into place, was chosen. This structure was located downstream of existing end monolith M-1, forming a 110’ x 1313’ extended lock chamber.

At the John T. Myers site, there are very few other site restrictions which affect the 600' lock extension alternative. A large area is available for disposal. The disposal area capacity is limited by neighboring wetlands and floodway considerations, however. The actual amount of

excavation, disposal, and utility disturbances is dependent on the type of construction method chosen for the new wrap around culvert. At the proposed location, there are no highways or railroads that would constrain the placement of the wrap around culvert.

9.2 TYPE AND CONFIGURATION

The extension of the existing 110' x 600' lock to a minimum of a 110' x 1200' lock is accomplished by demolishing existing monolith L-1, modifying existing monoliths L-2 to L-5, and adding a 463-foot float-in land wall monolith, a downstream float-in miter gate bay monolith, a supplemental fill/empty system, and four new approach walls. The type and configuration of these new lock structure components are described in the following section.

9.2.1 New Land Wall Monoliths

New and modified land wall monoliths proposed for the 600' lock extension alternative include the following:

- CIP concrete anchored to existing monoliths L-2 to L-5
- 463-foot long float-in land wall monolith upstream of the new miter gate
- 111-foot long float-in landside wall diffuser monolith downstream of the new miter gate

The existing monolith L-1 at the end of the lower guide wall has a V-shaped wall return. Therefore, it either needs to be demolished or modified in order to form a smooth and even extended lock wall face. In earlier designs, the inlet valve was incorporated into the 463-foot long floating land wall monolith. In order to provide adequate space between the inlet valve seat and the first lateral in these designs, it was decided that the existing land wall monolith L-1 should be demolished. As the inlet valve has been relocated to a stand alone valve monolith, this decision should be reevaluated in future design phases.

In order to stabilize monoliths L-2 to L-5 for their new loading conditions, they will be modified by anchoring cast-in-place concrete to the landward side of these existing monoliths from approximately El. 310.0 to El. 362.0 to form 39-foot wide wall monoliths, as shown in ***Drawing 9.4.1C***. In addition, a 7.5-foot wide heel will be anchored to the landward side of these monoliths from their foundation elevation to El. 300.0. This heel construction may be accomplished during construction of the wrap around culvert in this vicinity. In order to maintain stability during this construction, the upper concrete work must be completed before excavating for the heel construction, and this excavation must be limited to periods when the water level in the lower pool is at El. 340 or below. Alternatively, temporary bracing may be used during this construction to ensure monolith stability.

One new float-in land wall monolith will be located between wall monolith L-2 and the new float-in miter gate bay, as shown in ***Drawing 6.0A***. It will be founded on rock at El. 284.0. The length of this new land wall monolith will be approximately 463 feet, and the width will be 55 feet at its base, including a 13-foot wide toe and a 6-foot wide heel. Below El. 334.0, it will

be composed of a post-tensioned precast concrete float-in shell structure which is filled with tremie concrete. The monolith will step in to a narrower width of 36 feet from El. 305.0 to El. 334.0. Above El. 334.0, the wall will be composed of lift-in precast concrete buttresses which vary in width from 36 feet at its base to 14 feet wide at its top, El 362.0. These lift-in buttresses have been preliminarily designed for this feasiblity report. Backfill will be placed to El. 362.0 landward of the monolith in order to provide access to the new miter gate. Backfill between the lift-in buttresses will also increase the vertical load on the float-in land wall monolith, improving the stability of this monolith.

This monolith will incorporate a 14-foot wide by 16-foot high longitudinal culvert at the center of the 36-foot wide wall as well as six connections to new laterals located in the extended lock chamber. The invert of the culvert and lateral connections will be at El 297.0. One culvert valve pit and two bulkhead slots will be located at the downstream end of the monolith in order to house the outlet valve which will control the supplemental lock emptying system. At the upstream end of the wall monolith, the culvert will tie in to the wrap around culvert, and at the downstream end of the wall monolith, the culvert will transition into a 16.5-foot diameter pipe culvert and tie in to the culvert of this size and shape in the wall of the miter gate bay monolith. Construction techniques and construction sequences for this float-in land wall monolith are discussed in Section 9.4.2, and preliminary designs are discussed in Section 9.6.2.

The new float-in landside wall diffuser monolith will be located downstream of the new float-in miter gate bay, will connect to the fill/empty culvert, and will be founded on rock at El. 287.0. It will empty the lower half of the lock chamber landside, and riprap will be placed along the bank to provide slope protection. Its cross section and construction techniques will be very similar to those described above for the float-in land wall monolith upstream of the new miter gate, except that it will be 111 feet in length and will be composed of solid concrete from El. 334.0 to El. 362.0 instead of precast concrete buttresses. (In final design and cost estimate refinements, the top of diffuser monolith elevation was reduced to El. 311, below the lower approach wall pontoons. However, the drawings were not revised to reflect this change.) Also, stability analyses indicate that no toe or heel will be required for this monolith. Further discussion of construction procedures and sequences for this monolith are provided in Section 9.4.4.

9.2.2 Modified Middle Wall Monoliths

Modified middle wall monoliths proposed for the 600’ lock extension alternative include the following:

- CIP concrete anchored to existing monolith M-1 in order to “square off” this existing bull nosed monolith
- Pylon protrusion anchored to existing monolith M-38 in order to provide lateral support for new upper middle approach wall
- Vertical rock anchors installed through existing monoliths M1-M4 and M6-M14 so that they meet stability requirements for their new loading conditions

The pylon protrusion is anticipated to be 9 feet wide, 8.5 feet long, and 40 feet tall. It has been preliminarily designed as a precast concrete and CIP concrete structure, and its top of pylon

elevation was set at El. 382. Geometry, design, and construction of this pylon protrusion is further described in Section 9.4.5.

Middle wall monolith stabilization will require two rows of vertical rock anchors, one row near each face of the monolith. Monoliths M1-M4 require significantly more anchorage force than monoliths M6-M14 as monoliths M1-M4 (which are located downstream of the existing 1200' lock miter gate) will see a more drastic change in loading conditions and have a narrower base than monoliths M6-M14. Additional descriptions of stabilization requirements are described in Section 9.5.

9.2.3 Lock Wall Accessories

Lock wall accessories will consist of floating mooring bits, line hooks, check posts, wall armor, ring bolts, mooring rings, ladders, gages, and pedestrian railing. The floating mooring bits will have detachable floating tanks and will be interchangeable with other bits at the existing site and other sites on the Ohio River. If not already provided on site, a spare floating mooring bitt will be allocated. Standard line hooks, check posts, pedestrian railing and recessed ladders will be provided along the length of the approach walls and lock walls. In order to provide for easier maintenance and replacement, the pedestrian railing will be removable. Standard wall armor will also be provided along the inside face of the walls to protect this concrete face from barge tows which scrape and rub up against it. The standard armor consists of horizontal strips of steel T-section along the face and preformed steel plates and corner cap castings at all exposed edges and corners. In order to monitor lower pool elevation, one new recessed steel staff gage will be provided.

9.2.4 Float-In Miter Gate Monoliths and Sill Structure (Miter Gate Bay)

The float-in miter gate bay consists of a sill section and wall monoliths on each side, forming a U-shaped structure. The 182’ x 100’ long structure, of which 110’ x 100’ forms the new sill, will be founded in rock at El. 284.0. The walls monoliths on each side of this structure will be 36' wide x 100' long. The new top of miter gate sill elevations will match the existing miter gate sills elevation, and the new and existing miter gates will be interchangeable. The preliminary miter gate bay details are shown in ***Drawings 9.4.3A*** and ***9.4.3B.***. At the John T. Myers site, the top of miter gate and bulkhead sill elevations will be set at El. 308.0, which provides 16-foot submergence below the normal lower pool elevation. This submergence is equal to 1.8d, where d is the authorized draft of 9 feet. In between the miter gate sill and the upstream bulkhead sill, the top of concrete will be set at El. 305.0, yielding a minimum sill thickness of 21 feet. Uplift pressures were investigated at the lock sills for normal and maintenance conditions, and it was determined that pressure relief drains will not be required at the John T. Myers site which has a normal lift of 18 feet. A detailed discussion of the construction procedure and construction sequence for the float-in miter gate bay is presented in Section 9.4.3.

9.2.5 Fill/Empty System

Due to the increased lock size, the existing fill/empty system must be augmented in order to approximately maintain the existing fill/empty time. The supplemental fill/empty system consisting of an intake, a culvert which wraps around the existing land wall, is incorporated into the new float-in land wall extension, splits into laterals, and empties into the lower approach using a landside wall diffuser outlet. The fill/empty system layout is shown in ***Drawings 6.0B*** and ***6.0C***, and details of the wall diffuser are shown in ***Drawing 6.0D***. Anticipated construction procedures for the wall diffuser are shown in ***Drawing 9.4.4A.***

The following list describes pertinent geometric information for the fill/empty system:

- Culvert size is 16'-6" diameter wrap around culvert, 14' H x 16' V at the inlet valve 14' H x 16' V in lower land wall, and 16'-6" diameter in the miter gate bay
- Min. submergence over top of culvert at intake = 7'-6"
- Min. submergence over top of ports at outlet = 21'-0"
- Culvert bends form 45º angle
- Minimum horizontal curve radius is 1.5 x culvert width = 24'-0"
- Minimum vertical curve radius is 1.5 x culvert height = 24'-0"
- Maximum culvert slope is 3.4H:1V
- Number and spacing of new laterals match existing laterals
- New laterals and existing laterals are symmetric about lock hydraulic centerline
- Distance between inlet valve seat and first lateral centerline is 206'-0"
- Distance between last lateral centerline and outlet valve seat is 118'-6"
- One short lateral due to interference with existing middle wall gate monolith toe
- Port size increased in short lateral to match total port area of adjacent lateral

A culvert-type intake, which was developed and modeled for the Robert C. Byrd Locks & Dam, will be used for the fill/empty culvert inlet. This type of intake has been modeled, but has not yet been utilized at an existing lock and dam site. The hydraulic design for this intake should be adapted to the specific design site. Two intake wingwalls at both sides of intake will consist of reinforced concrete drilled shafts, precast concrete facing panels, and a cap beam. The top of cap beam will be at El. 362.0 near the intake and will slope to El. 352.0 at the end of the wingwall furthest from the intake. The ground will slope from El. 324.0 to El. 318.0 in front of the intake in order to improve flow conditions there.

The wrap around culvert will be a precast concrete pipe and will have a 16.5-foot inside diameter and a wall thickness of approximately 20 inches. The invert elevation of the pipe will vary from El. 318.0 at its intake to El. 297.0 at the inlet valve monolith and new float-in land wall monolith. A transition between the circular and rectangular culvert sections is required at the upstream end of the stand-alone inlet valve monolith. A concrete thrust block will be located immediately downstream of the valve monolith, at the 45º bend, in order to resist loads resulting from the redirection of flow. The culvert shape will continue as a 14’-0” wide by 16’-0” high rectangular culvert between the valve monolith and the new float-in land wall monolith. In the wall monolith, the culvert will split into laterals. In locating the downstream laterals, in earlier designs the trade off in hydraulic benefits was considered with respect to either increasing the distance between the inlet valve seat and the first lateral or placing the downstream laterals closer to the inlet valve seat so that they will be symmetric with the existing upstream laterals.

This tradeoff was originally balanced by locating the new downstream laterals so that they would be approximately 60 feet downstream of the point of symmetry and were approximately 74 feet from the original inlet valve seat location. In the current design, the inlet valve is located in a stand-alone monolith, sufficiently upstream of the laterals. Therefore, the location of the laterals was reevaluated and revised. In the current design, the downstream laterals are located so that they are symmetric with the upstream laterals about the hydraulic centerline of the lock chamber. Center to center spacing of the laterals is 36 feet. The new laterals were sized to match the size and spacing of the existing laterals. One of the laterals will be significantly shorter than the remaining laterals due to interference with the existing middle wall gate monolith toe.

The longitudinal culvert will transition back into a 16.5-foot diameter pipe culvert immediately prior to entering the downstream miter gate monolith. After continuing through the miter gate monolith and the new float-in lower land wall monolith, the culvert connects to a float-in landside wall diffuser, which dissipates some of the energy in the flow and directs it toward the riprap-protected riverbank. Prior to entering the wall diffuser, the culvert expands from a circular to elliptical shape. At the entrance to the wall diffuser, the culvert transitions from this elliptical shape to a rectangular one in order to simplify the remainder of the forming for the wall diffuser. The wall diffuser is described in Section 9.4.4 and shown in ***Drawings 6.0D*** and ***9.4.4A***. As this outlet is not riverside, it is expected to worsen the lower approach conditions for upbound tows.

9.2.6 Culvert Valves

In order to match the existing culvert valves and provide superior hydraulic characteristics, traditional reverse tainter gate valves were chosen for the valving in the new fill/empty system culverts. See Section 10 and the General Engineering Appendix for culvert valve descriptions, advantages, and disadvantages. For preliminary layout purposes, the existing culvert valve dimensions at the site were matched. The inlet culvert valve will be located in a stand-alone valve pit monolith in a section of the wraparound intake culvert. This location was chosen in order to meet hydraulic spacing requirements between the intake valve seat and the first lateral while minimizing the amount of concrete demolition required at the existing lower land wall monoliths. The culvert should be rectangular at the valve locations, but the wraparound culvert is circular, so a transition between circular and rectangular culvert sections is required at the upstream end of the valve pit monolith. The number of spare culvert valves required at the site will need to be determined, but it is currently assumed that the current number of spare valves will be adequate.

For preliminary design purposes, the inlet valve monolith was initially sized to match the existing valve monolith dimensions. However, during the final design iteration, these dimensions were refined. By decreasing the distance between the upstream bulkhead slot and the upstream face of the valve pit, it was possible to reduce the length of the monolith by approximately 6 feet. Stability analyses also showed that it was possible to raise the foundation elevation to El. 292. These refinements yielded significant cost reductions and were reflected in the Plan 3 cost estimate included in Section 21. However, since the other plans had been screened out from further consideration prior to these changes, their costs were not revised. Also, due to the late timing of these final changes, they are not reflected in the set of drawings included in this appendix.

9.2.7 Approach Walls

Four new approach walls are required for the 600' lock extension alternative design. Final required approach wall lengths will be determined during site specific model testing. For feasibility study purposes, the following preliminary approach wall lengths were included in this design:

- 900' Floating Upper Middle Approach Wall
- 960' Floating Upper Riverside Guard Wall
- 700' Floating Lower Landside Approach Wall
- 100' Floating Lower Middle Approach Wall

The upper middle approach wall length provides 1270 feet from the landside miter gate pintle to the end of the upper middle approach wall. The upper riverside guard wall length provides 1200 feet from the end of the upper middle approach wall nose cell to the end of the upper riverside approach wall. The lower landside approach wall length provides 700 feet minimum from the end of the wall diffuser monolith to the end of the lower landside approach wall. In addition, a 100-foot long floating lower middle approach wall is required to protect the lower miter gate.

In this design, all of the approach walls are floating. The major components of a floating approach wall are constructed off-site, producing high quality precast concrete pontoons while reducing construction interference. For locations with large operating pool variations, the construction cost of a floating approach wall can be much lower than the construction cost of a fixed approach wall. In addition, while a floating wall may require periodic under wall dredging, a fixed wall may have additional maintenance costs associated with debris removal if monoliths are overtopped during a flood. On the other hand, fixed walls may be desirable at sites/locations which have a significant siltation problem, such as at the lower landside location at the Olmsted Locks & Dam site. The J. T. Myers Locks & Dam site has a moderate siltation problem, but it is anticipated that this siltation problem will be reduced as a result of outflow from the landside wall diffuser. Outflow from this diffuser is expected to flush silt and debris from this lower landside location, which would otherwise be a slack water area. For this reason, a floating approach wall was chosen for the lower landside location, and significant cost savings were realized.

The floating approach walls consist of floating, precast, longitudinally post-tensioned, concrete box structures, called pontoons. These pontoons typically include intermediate transverse bulkheads and span between a supporting pylon or pylon protrusion at one end and a notched nose pier at the other end. The pylon and nose pier notch also act as guides for the pontoons as they float up and down with the rising and falling pools. Marine fenders provide a flexible linkage between the pontoons and the pylon/nose pier guides. This flexible linkage is required in order to isolate the pontoons and supporting structures from applied forces such as waves, earthquakes, and barge impacts. At each guide, there are two transverse fenders and one longitudinal fender. A group of three drilled shafts will form a nose pier at the exposed end of each approach wall in order to protect the pontoons from head-on barge impacts. The pontoon depth is sized to provide a minimum of 2 feet of impact/rubbing surface below the waterline and 7 feet above the waterline. The preliminary pontoon depth is 15'-0" at the crown and 14'-6" at the impact face plus a 3'-6" high parapet wall.

If required, skirting panels may be suspended from the floating pontoons in order to improve navigation conditions. Final skirting panel requirements will be determined during site specific model testing. The upper middle approach wall may not require skirting panels but will require armor and rubbing surfaces on both faces of the floating pontoons. The upper riverside guard wall will require armor and a rubbing surface on its landside face. The lower middle approach wall will require armor and rubbing surfaces on both faces of the pontoon. The lower landside approach wall will require armor and a rubbing surface on its riverward face.

All of the on-site construction of the approach walls is completed in-the-wet. Approach wall plan views, elevations, and sections are shown in ***Drawings 6.0E*** through ***6.0J***, and nose pier and pylon details are shown in ***Drawings 6.0K*** through ***6.0O***.

9.3 SUBSTRUCTURE EVALUATION

The rock foundation at the John T. Myers site is composed primarily of shale layers which are interlaced with a few deep weak coal and underclay seams. This rock has numerous vertical and angled fractures and faults. During the original construction of the existing dam at the John T. Myers site, a cofferdam failure occurred in 1971. It was caused by deep seated sliding on one of the weak seams

For the 600' lock extension design, the float-in lock wall monoliths will be founded in rock at approximately El. 285. This elevation is approximately 10 feet below the top of rock elevation and satisfies geotechnical, hydraulic, and structural requirements.

For the new monoliths, overturning stability can be satisfied and bearing pressures kept below allowable levels by adjusting toe and heel dimensions and, if necessary, increasing the monolith width. However, meeting the sliding stability requirements, using initial estimates of rock parameters, was more difficult. The following three substructure types were evaluated in order to address sliding instabilities:

- Drilled Shafts
- Rock Anchors
- Floor Compression Struts

Using initial estimates of rock parameters, it was found that neither drilled shafts nor rock anchors were feasible due to the unreasonably long lengths of shafts/anchors required before an adequate factor of safety was developed against deep seated sliding failures. These long lengths were required because the failure surface at which an adequate factor of safety was reached was very deep. Because the assumed water pressure (differential head) does not vary with depth below the top of rock and the initial assumed rock strength was very low and also did not vary with depth, the governing failure surface was very deep (the unbalanced horizontal load increased with depth until enough very weak rock was mobilized). Therefore, concrete floor compression struts were chosen and designed to resist the unbalanced load on the wall monoliths, using a similar approach to that used for a portion of the original design at the Cannelton Locks and Dam site. At Cannelton, the struts were designed to have a capacity

sufficient to take the unbalanced load on the lock wall monolith minus the horizontal resistance along the potential failure plane underneath the lock wall monolith.

The unbalanced load would be transferred through the compression struts to the existing middle wall monoliths, thereby mobilizing both the land and middle wall monoliths to act as a unit against the imposed horizontal loads. As two lock chambers are never dewatered simultaneously, the hydrostatic pressure inside the main lock chamber would oppose the load transferred through the compression struts. The difference between these two loads would be the imposed unbalanced load on the existing middle wall monoliths. This unbalanced load was compared to the original unbalanced design load for the existing middle wall monoliths and found to be below these design values. Because these existing middle wall monoliths had performed satisfactorily since the locks were placed in operation in 1972, and the load transferred through the proposed floor compression struts did not exceed the original design loads for these monoliths, the addition of floor compression struts in the extended 600' lock chamber was not expected to adversely affect the existing middle wall monoliths.

The 600' lock extension design included a supplemental fill/empty system, which included a new set of laterals inside the new land wall monoliths of the extended lock chamber. In this portion of the design, the new laterals were preliminarily designed to act as compression struts. The new laterals were sized to match the size and spacing of the existing laterals. Outside of this region, 5-foot square reinforced concrete compression struts, spaced at 24 feet on center, were preliminarily designed. However, when seismic coefficients were provided, it was found that most of the monoliths could not meet required stability requirements, and it was felt that compression struts were not the optimum solution for high seismic loading conditions. (Please see September 1998 letter report entitled "Criteria Evaluation and Increased Seismic Loading Report" for further discussions of preliminary seismic analyses, completed using initial rock parameter values.) In addition, it was found that a typical existing land wall monolith, which has performed well under dewatered conditions, could not meet stability requirements during maintenance loading when the initially assumed rock parameters were used. Therefore, it was decided that refined rock parameters would be required. Additional drilling and rock sample testing were completed, and the initially provided rock parameters were reevaluated.

Simultaneously, the stability analyses were also refined from a modified single wedge to a multiple wedge analysis. Between the two refinements, it was possible to meet all stability requirements without the aid of compression struts.

It was found, however, that rock anchors will be required to stabilize existing middle wall monoliths M1-M4 and M6-M14 in order to resist new loading conditions which will exist when these monoliths form part of the extended lock chamber. Rock anchor requirements are further explained in Section 9.5, Stability Analyses.

9.4 CONSTRUCTION TECHNIQUES AND PROCEDURES

This section describes the more unusual and difficult construction elements required for the 600' lock extension alternative. In this alternative, the wrap around culvert, float-in miter gate bay, float-in lock wall monolith, and wall diffuser are critical elements, and the techniques and procedures proposed for their construction are discussed in the following subsections.

9.4.1 Wrap Around Culvert

One of the key elements in extending the existing 600' lock to a 1200' lock is bringing in additional water to retain the design filling rate for a lock that is twice as long. As the existing land and middle walls for the 600' lock are occupied with existing culverts and valves, it is necessary to route the second intake culvert outside the land wall. This concept is called the "wrap around culvert". The standard culvert section is rectangular, but a 16.5-foot diameter conventional reinforced concrete round section is proposed, with flush bell and spigot joints and O-ring gaskets.

The proposed wrap around culvert consists of three components:

1. An upstream intake structure with wing walls, which direct the water into the culvert and retain the land on the upstream end of the culvert system.

2. Approximately 1200 linear feet of 16.5-foot diameter heavy-wall reinforced concrete pipe installed on the land side of the existing land wall, with invert elevation sloping 0.58% from El. 318 to El. 312 for approximately 1000 feet, then dipping over the final length to invert El. 297.

3. A 45° elbow and short section which connects through the side of the new lock wall monolith to the culvert manifold contained therein.

Recommended concepts for these three components are described below:

9.4.1.1 Intake Structure and Wing Walls

In order to construct the intake structure and wrap around culvert in the dry by utilizing the existing sheet pile for installation, the new intake structure is positioned to the land side of land wall monolith L31 (see ***Drawing 9.4.1A***). It is founded on prepared rock at approximate El. 285 and extends up to El. 362 to match the top of existing lock walls.

The new intake structure is approximately 40' x 40' x 75' high. It contains a horizontal water conduit through the structure with a 4-foot long 16.5-foot diameter pipe section cast into the downstream face to serve as a starter point for the concrete pipe culvert. At the upstream face of the intake structure, the conduit flares to an oval that is 24' H x 17' V. This flared

entrance is designed to facilitate water flow into the culvert. The upstream end is fitted with a steel trash rack grating. A horizontal concrete beam bisects the opening and serves as mid-span support for the trash rack. A 24' x 15' notch is cast in the top of the intake structure, from the top down to El. 338. Preliminary hydraulic model tests for the Robert C. Byrd site showed this notch to be beneficial for the water flow into the conduit entrance. Final hydraulic model testing is required for final design of this notch and of the flared entrance to the culvert.

The intake structure and the intake wing wall will be built in-the-dry. The location of the new intake structure is behind existing land wall monoliths L-29 to L-31 and approximately 135 feet downstream of the existing mooring facility tieback sheetpile wall. The top of sheetpile is EL 357.0 at land wall and slopes down to EL 348.5 at the end. In order to construct the intake structure, soil must be added upstream of this sheetpiling in order to form a berm (with a line of sheetpiling along the centerline of the berm). The top of berm elevation should be high enough for a six month construction duration during the drier part of the year. The sheetpile and soil berm cofferdam will allow faster and cheaper cast-in-place construction than would a cellular cofferdam. For dewatering purposes, preliminary designs indicate that it will be necessary to extend the sheetpiling down to the top of rock, which is approximately El. 295.

The intake structure has a footprint of 40' x 40' and height of 75'. Concrete wingwalls frame into the intake structure. A short wall (approximately 40 feet long) connects the intake structure to the back face of monolith L31. A vertical recess cast into the intake structure supports the downstream edge of the wall panel. Heavy steel corbels can be bolted to the wall on L31 to support the upstream edge of the short wing wall.

A wing wall, which is approximately 300 feet long, angles upstream from the intake structure to the reshaped river bank. Its top is at El. 362 near the intake structure and slopes to El. 352 at the far end. This wing wall will be designed as a cantilever wall to support the earth embankment. The structural concept incorporates drilled shafts which are drilled into the base rock in order to provide adequate fixity. These shafts may require the steel casing to be left in place (as preliminary designs indicate) plus substantial rebar for the final design moment. Precast concrete walls are installed as facing panels. These are connected to the shafts by means of U-shaped precast shells which encapsulate the drilled shafts and provide space for rebar anchors and tremie concrete which integrates the facing panel, the U-panel, and the vertical shaft. (See detail on ***Drawing 9.4.1A***). The tops of the drilled shafts are connected by a cap beam comprising precast trough sections filled with reinforced concrete. A similar design was developed for the lower landside approach wall at Olmsted Locks & Dam.

9.4.1.2 Intake Culvert

It is recommended that a 1200-foot long culvert be constructed with conventional reinforced concrete pipe cast in 8-foot to 12-foot lengths to act as an intake culvert. With an assumed 24" wall thickness, the pipe sections will range from 70 tons to 105 tons. The “Earth Pressure Balance” tunneling system, described below, would use tunnel lining segments in smaller sizes. Flush bell and spigot joints with O-ring seals are proposed.

Because of their diameter and weight, the pipe sections would generally be delivered by barge or cast by the supplier at the lock site on land provided by the general contractor. However, the “Earth Pressure Balance” tunneling system would use concrete segment sizes that

could be carried by truck over the highways. Even with high mobilization costs for only 1200 feet of pipe, we believe that precasting and installing the large diameter pipe will be substantially less costly than constructing a cast-in-place concrete rectangular culvert which is typically used at lock sites along the Ohio River. However, the principal advantage in using precast pipe is that it speeds the installation, permitting the construction of the pipe and the downstream connection to the lock wall in a single season, having installed the intake structure and wing walls in the previous season.

Several construction methods have been studied for installing the 1200 feet of pipe up to the 45° elbow. The first 1000 feet are installed with the bottom of the pipe about 45 feet below grade in soil. The last section dips deeper and will involve a few feet of rock excavation for the final length. Because of the deeper trench and possible rock excavation, this final length plus the 45° elbow and transition into the new lock wall monolith will have to be constructed in a fully excavated zone which must be dewatered. Six construction methods were examined:

1. *Conventional Pipe Jacking*. This method was considered for the approximately 1000-foot length of straight pipe. Conventional pipe jacking is generally used for pipes which are in the range of 70" to 130" diameter in clays or silty soils, sometimes crushing cobbles and other obstructions. Boring attachments are available with carbide teeth for drilling ahead through material with very high blow counts (on the order of 100 to 200). In the case of conventional pipe jacking, dewatering is often required when jacking below the water table, unless the jacking is done in clays or other "gooey" materials with a closed face head where some seepage can be tolerated. A well-point dewatering system is often used when jacking through sands, but sheetpiling cutoff walls are not usually required.

2. *"Microtunneling" Pipe Jacking*. This method was considered for the approximately 1000-foot length of straight pipe. Microtunneling is generally used for pipes which are in the range of 40" to 80" diameter in gravel or sandy soils, possibly below the water table, and a minimum of two pipe diameters below grade (in order to prevent a "geyser" from forming). The soil is excavated and carried out of the tunnel in slurry pipes. Microtunneling can also be performed through some clay areas, although the production rate is slower. The typical production rate for microtunneling is approximately 30 feet/day although rates of 80 feet/day can be achieved. The largest diameter pipe that we are aware of that has been placed using microtunneling was 144" in diameter. The typical spacing of jacking pit stations is 400' and the maximum spacing is approximately 700'. Microtunneling can be used with either steel or concrete pipes, but, for the same inside diameter, concrete pipe jacking is more expensive because a bigger jacking head is required.

3. *"Earth Pressure Balance" soil tunneling method*. For the 1150 feet of straight pipe, employing a large "mole" boring machine complete with soil removal carts and tunnel liners. Earth pressure balance is generally used for pipes which are larger than 144" diameter. The earth pressure balance system consists of tunneling equipment with a sealed pressure plenum in the front 6 to 10 feet of the rotor cutter boring machine. Panels in the cutterhead open when the cutterhead is in operation and these panels close when excavation

stops and there is minimal pressure, preventing significant water flow through the excavation tunnel. A screw conveyor moves the excavated material from the cutter head through the pressure plenum to the remainder of the tunnel where the excavation material is carried off by carts or other conventional means. A major advantage of this system is that dewatering is not required. The tunnel is usually lined with precast concrete segments installed behind the advancing cutterhead. Typically gaskets separate each concrete segment.

4. *In-the-wet construction*. At the downstream end of the pipeline, excavate and flood the full length behind the existing land wall and install the pipe using floating equipment similar to that used in laying offshore outfall pipe. To provide upstream access for the floating excavating and pipe laying equipment, the intake structure and wing walls, described earlier, could not be constructed until after installing the culvert pipe. In order to maintain the pool, a temporary structure must be constructed between the landside face of the existing land wall and the existing bank of soil. The section of culvert required at this location must be constructed after this temporary structure is removed.

5. *Excavate a slope*. Excavate a slope sided trench to permit setting the pipe sections by conventional methods and equipment. The excavation can be performed using large scrapers and bull dozers. At the bottom of the first stage trench, two rows of sheetpiles support a 15-foot deep ditch excavated to the final bedded location of the pipe. This shallow sheetpile trench will reduce the amount of sloped excavation and minimize the quantity of sheet piling required.

6. *Use a braced excavation*. Use a braced excavation 24 feet wide by 50 feet deep, to limit excavation, ensure existing monolith stability, and to provide protection for labor and equipment setting the pipe sections. The braced excavation could be constructed using sheetpiling, walers, and struts.

Methods 1, and 2 were rejected for the following reasons:

Jacking 16.5-foot diameter concrete pipe by conventional methods or microtunneling methods is substantially beyond the size of concrete pipe currently installed by state-of-the-art jacking techniques. Based on conversations with a tunneling consultant, a pipe-jacking contractor, and a pipe jacking equipment supplier, the largest concrete and steel pipes which have been jacked are 96" diameter and 144" diameter, respectively. Two considerations were cited:

- The number of jacks, size of the jacking ring, and the reaction block would be well beyond current practice and would be very costly. Also jacking pit stations would be required at approximately every 400 feet.

- Cutting and removing the soil at the advancing face would require special equipment to be developed and large removal effort to slurry the soil and pump it out of the pipe. Dewatering the site by a well-point system may also be required.

Method 4 is rejected for the following reasons:

Flooding the rear side of the land wall and using floating equipment to excavate and set the pipe sections was rejected because:

- Excavating a trench underwater, or flooding a partially excavated trench, would result in very flat soil slopes which would affect the ground for considerable distances back from the Land Wall and undermine the service buildings and landscaping.

- The cost of mobilizing floating equipment for this work would be extremely high for the relatively small amount of pipe line to be laid.

- Underwater pipe laying is beyond the experience of the vast majority of contractors that would otherwise be interested in bidding for this project.

That leaves Methods 3, 5, and 6 which are most probably the pipe installation methods that would be employed by the contractor. Methods 5 and 6 are illustrated in ***Drawings 9.4.1B*** and ***9.4.1C*** for OPTION "A" (sloped trench excavation) and ***Drawings 9.4.1D*** and ***9.4.1E*** for OPTION "B" (using deep, braced excavation). The "Earth Pressure Balance" soil tunneling method is OPTION "C" and was described in Method 3.

OPTION "A"

Option "A" shows an excavation with sloped sides to an elevation about 10 feet above the invert of the culvert. Then, a 14-foot deep narrow trench is excavated using unbraced sheet piles to contain the bedding gravel and set the pipe (See ***Drawings 9.4.1B*** and ***9.4.1C***). Laying the pipe starts at the intake structure and moves downstream to culvert Sta. 15 + 50 where the slope steepens. A modified precast pipe section is used to change the vertical slope from 0.4% to approximately 30% for the last 50 feet. A thrust block or inclined rock anchors may be required to handle the longitudinal reaction on the pipe arising from the vertical slope change.

It is expected that rock will be encountered as the pipe trench dips during the final 50 feet of culvert prior to the 45° elbow. When this occurs, the use of the shallow trench is abandoned and sloped excavation all the way to the rock line will be required (See culvert Sta. 16 + 00 on ***Drawing 9.4.1C***). An access road will be required to permit access for equipment operating on the floor of the excavation and for heavy trucks carrying the precast pipe sections.

It is anticipated that a well-point system will be necessary to keep the excavation and trench dry and safe for installation of the pipe.

From approximate culvert Sta. 12 + 40 to Sta. 11 + 70, special slope protection may be required to prevent undermining the sewage treatment plant located on top of the service berm. If final geotechnical analysis shows that a 2:1 excavated slope has marginal stability, special protection of the service buildings will be necessary. ***Drawing 9.4.1C*** shows a short section of sheet pile between the building and the excavation. Other options can be evaluated for protecting these buildings.

OPTION "B"

Option "B" employs a 24-foot wide vertical trench with braced sheetpiling, which reduces the cost and problems of a sloped excavation. Offsetting these savings, of course, is the cost and risk associated with a 50-foot deep braced excavation.

Drawings 9.4.1D and ***9.4.1E*** show two rows of Z-sheetpiles forming the trench, braced with two sets of heavy waler beams and compression struts. With the 20-foot O.D. concrete pipe, the lowest row of struts may be a minimum of 23 feet above the floor of the trench. With rock in the region of El. 290, there may not be sufficient penetration at the bottom of the trench to restrain the tips of the sheetpiles. If restraint is required below the lowest row of compression struts, it may have to be provided by drilled in anchors which are expensive, lengthen construction time, and complicate the pulling and re-use of the sheetpiles. Alternatively, it may be possible to place a row of struts at the bottom of the trench, abandoning them in place beneath the bedding gravel.

As with Option "A," it is anticipated that a well-point system will be necessary to draw down the water table and keep the excavated trench dry.

OPTION "C"

The “Earth Pressure Balance” method of construction for OPTION "C" is considered technically feasible and, based on preliminary data, is anticipated to be economically competitive with OPTION "A" and OPTION "B."

This option has the advantage of not requiring large amounts of open trench excavation. Existing operations at the Lock would be less disrupted by this construction method. Lowering the local water table level with a well-point system would not be required.

Soils data is one of the most important pieces of information needed in order to determine the cost of OPTION "C," which is more sensitive to the soil type than the other two options. A recent bid for a project in Oregon was approximately $27 million for 7000 linear feet of a 16-foot diameter tunnel. This equates to $3850/ft, using the earth pressure balance method. For projects with a shorter length of pipe, such as the John T. Myers wraparound culvert which is approximately 1200 feet long, the cost per foot would be significantly higher.

9.4.1.3 Recommendation for Installation of Culvert Pipe

Based on preliminary information, Options "A," "B," and "C" are all technically feasible and economically comparable, but each option has its own set of risks. For further refinement, more detailed geotechnical information, design of the sheetpile trenches, and development of detailed cost analyses is required. It is recommended that each of these options for the construction of the wrap around culvert be carried forward to the DM phase. Ultimately, unless one of the options is rejected for technical reasons or risks unacceptable to the Corps, the contractor should be permitted to select a preferred option. For purposes of schedules and cost estimates, an intermediate option between Options "A" and "B" (see ***Drawing 9.4.1F***) was assumed. It was assumed that a bench cut was made by making a 20-foot deep open excavation

and the remaining excavation was accomplished by braced excavation, using sheet piling and struts. It was further assumed that the wrap around culvert construction would be broken up into approximately four segments, backfilling one segment before proceeding to the next one. In this way, the quantity of sheetpiling and bracing required could be reduced.

9.4.1.4 The 45° Elbow and Connection into the New Lock Wall

At the end of the straight run of culvert, there is a 45° elbow followed by a short tangent run of culvert and the final connection to the new lock wall.

As this work is close to the downstream end of the new lock extension, it is anticipated that a cut-off structure and full dewatering will be required. A sheetpile cut-off wall braced with fore and aft berms should be sufficient to cut off water flow back into the existing river bank. As there is 500 feet of new lock wall structure, previously installed by float-in and set-down techniques, there is ample room for this sheetpile / berm cut-off wall downstream of the entry of the wrap-around culvert into the new lock wall. A vertical section of a sheetpile knuckle could be cast into the landside face of the new wall to serve as the starter for the sheetpile wall. The continuation of dewatering well points in this excavated area is anticipated. The section at L3 on ***Drawing 9.4.1C*** shows this construction.

The final length of wrap around culvert can be considered in three sections:

1. The 45° elbow is located in a region of the culvert profile where there are both horizontal and vertical curves. If both these horizontal and vertical curves occur together at the elbow, then the elbow should be cast-in-place. However, it is possible to take the vertical change out in one precast section and construct the 45° horizontal bend in a subsequent precast section. This detail can be evaluated during the DM phase. At the culvert bends, large forces are generated due to the change in water flow direction. These forces must be taken into the rock foundation by means of large thrust blocks which are built on the outside of the curves and anchored into the bedrock.

2. Between the 45° elbow and the transition into the lock wall, there is approximately 30 feet of tangent culvert. Sections of conventional 16.5-foot diameter reinforced concrete pipe can be used here.

3. Finally, there is the transition into the wall of the new lock wall, which should be cast-in-place. This section of the culvert provides the opportunity to convert the circular cross section to a rectangular section which serves as the manifold for the laterals as they exit into the floor of the extended lock.

See Section 22.2 for the recommended construction schedule for the wrap around culvert.

9.4.2 Float-In Wall Monolith

9.4.2.1 Design

The float-in wall monolith will be constructed in a manner similar to that described in the following section for the float-in gate bay monolith. Many of the same construction methods will apply. The various phases of construction are shown on ***Drawings 9.4.2A*** and ***9.4.2B***.

The wall monolith is 463 feet long and 55 feet wide at the base, including the monolith toe and heel. The wall monolith steps to a narrower width of 36 feet above elevation 305. The monolith incorporates a culvert within the structure as well as six connections to the laterals located in the new portion of the lock.

Its length is a critical parameter in selection of the construction method for the float-in portion of the work. If it proves too costly to find a site to construct the 463-foot length, it is possible to construct the monolith in two sections and connect them at the site before completing construction and placing the monolith.

9.4.2.2 Stability

Due to its narrow width, its stability will be an important issue in the design. The stability during the float-in operation is less critical, but as the height of the structure is increased, the stability decreases. The situation is made worse as the base portion of the structure is submerged and the width at the waterline decreases to 36 feet. The location of ballast, at this phase of construction, is critical to maintain stability. At this time, a two dimensional analysis of the structure has been completed and stability appears adequate. This will need to be monitored as design continues. If necessary, the stability may be controlled with the aid of guide dolphins and/or supplemental buoyancy tanks.

The invert of the culvert and lateral connections is at El. 297. During the transportation phase of construction, the water surface is only about 2 feet below this invert. These openings will need to be bulkheaded. As construction proceeds and the culvert is completed, it is necessary to keep water out of the culvert. This will require full bulkheads over all eight openings. When the structure reaches El. 334, the volume of the culvert can be flooded without unduly affecting the stability of the structure. At this time, the bulkheads could be removed by divers.

9.4.3 Float-In Miter Gate Bay

9.4.3.1 Off-Site Construction

The design of a float-in monolith for the miter gate bay must satisfy several constraints. It must have:

1. Minimum draft for transportation.
2. Strength for transportation and placement
3. Means to provide location and support during placement
4. Means for placement of concrete fill.

The Gate Bay Monolith (GBM) is shown on ***Drawings 9.4.3A*** through ***9.4.3C***.

The first step in constructing this U-shaped monolith, is to construct a base raft which is capable of floating and supporting wall construction above while afloat. We have identified two methods for construction of the float-in base raft module which satisfy the system constraints. They are construction in a dry dock, or construction on a submersible barge. In the first case, the location of the facility is not defined at this feasibility level stage although the decommissioned Gallipolis lock has been considered. The Gallipolis site can be retrofitted for fabrication of the entire raft in one piece or submersible barges can be leased for fabrication of the raft structure in two shorter pieces.

Gallipolis site would require adjustment by the Government to make it immediately useable by the raft fabrication contractor. The work to the existing Gallipolis lock includes filling the lock with crushed stone capped by a concrete slab to elevation 520 (approximately 24 feet of fill), and installing a gate upstream of the upstream miter gate sill. We have assumed a submersible gate would be used for this purpose.

The Gallipolis site is potentially an excellent site for fabrication of the raft structure. This site also has the possibility of being a permanent asset to the Corps for future float-in construction at other sites on the river system. With a one-time investment, the Corps could eliminate or substantially reduce dry dock and/or submersible barge costs on future projects.

Use of commercially-available barges requires the contractor to identify and secure a lease on an appropriately-sized barge for the approximate one-year duration of the raft fabrication and off-loading. In addition, the contractor will need a location with sufficient water depth to begin fabrication of the two pieces of the raft structure. Either a commercially-available barge could be retrofitted for this submersion operation or submersible barges could be leased.

We estimate that the cost of retrofitting the Gallipolis site is between $2.5 and $3 million, and the cost of leasing and adapting a submersible barge for a 12-month period is approximately $2.0 to $2.5 million. Subsequent to the Olmsted floating approach wall construction, other dry docks may also be available.

In order to transport the module from the construction site to the lock, the draft must be limited. For this feasibility effort, the draft has been limited to approximately 11 feet. Since the

minimum guaranteed channel depth is 9 feet, some restrictions must be placed on what time of year the module can be transported if it is constructed in a dry dock. However, if the module is constructed on a submersible barge, it may be possible to increase the float-in structure depth somewhat and eliminate the delivery restrictions.

The float in module would be constructed of reinforced concrete. Prestressing of components subjected to high stresses during transportation and placement may also be necessary. As design progresses, the use of precast elements may provide some cost and weight savings, although their use would require post-tensioning.

The base of the GBM will be founded at El. 284. The top of the sill between the side walls will be El. 305. This difference yields a possible module height of 21 feet. A portion of the sill downstream of the miter gates extends 3 feet higher to El. 308.

9.4.3.2 Transportation

If the float-in base raft includes a top slab, then the draft of this 21-foot high module will be significantly greater that 11 feet. Because of this, the float-in module will be constructed without the top slab, reducing the draft to an acceptable 11-foot amount, and floated to the site. At the site, the sill slab will be completed. The freeboard available during transportation of the module is approximately 9 feet.

The structure is constructed with interior walls, which provide structural integrity. They also divide the interior into separate compartments, which will limit flooding if the structure is damaged during shipment. The issue of safety during transportation will be addressed as the design proceeds. A drain system will be provided in the base module, which will allow water to be pumped from the bottom of the structure. The pumps for this drain system should be sized to protect the structure in the event of structural damage.

The transportation of the base module without the top slab has several advantages. The elimination of the sill floor slab eliminates the need for supplemental flotation. This should reduce costs and simplify transportation. Also, maintaining vertical access from the top of the structure at the side wall areas will facilitate placement of fill concrete.

9.4.3.3 Design

The current design utilizes the following sizes for structural elements. The base slab is 18 inches thick. The interior walls, which supply support for this slab, are located at a maximum spacing of 18 feet. These dimensions yield a bending stress in the bottom slab of about 600 psi during transportation of the module. This stress is counteracted by stressing the module to an average prestress of 600 psi. This would meet a zero tension design criteria, if required for temporary construction loading. This design criteria is conservative. It may be possible to reduce the weight of components if a design allowing tension in the concrete is allowed. This tension criteria should be considered since the stresses in the concrete are low after it is filled with concrete and watertight construction is not an issue as the GBM, in its final condition, is a gravity monolith; not a permanently floating structure.

Exterior walls of the base raft are 18 inches thick, minimum, while the interior walls are 10 inches thick. Upper exterior walls are 1'-4" thick. This interior wall thickness allows them to be constructed as cast-in-place with two layers of reinforcement. A thinner wall could be utilized if precast elements were used. The upper slabs are 18 inches thick. These only withstand loads during transportation and construction.

Construction of a rectangular culvert within the monolith requires extra thickness in walls and floor elements. This leads to an increase in the required draft of the structure. The effect is more pronounced since the extra weight is highly eccentric. To counteract the additional weight, external flotation may be required.

In order to simplify the design and avoid the high bending moments, the culvert design was changed to a round conduit, 16.5 feet in diameter. The conduit is constructed using a steel liner. The liner functions as an interior form. It is supported at the interior walls of the structure. It is located so that the minimum concrete cover surrounding it is 3.5 feet. The steel form liner serves no permanent structural purpose, and does not need to be painted or maintained. Reinforcement will be installed around the liner during initial construction. When the space is filled with concrete it will reinforce the conduit structurally.

After the module is transported to the site, additional construction would take place at a temporary, deep draft, moorage facility near the final location. The first step is to construct the sill slab. After completion of the sill slab, the walls on either side of the GBM will be raised. These can be slipformed; however their limited elevation would probably make conventional forming systems more cost effective.

Construction of the gate bay will require large amounts of structural and fill concrete. A batch plant on site will be required for efficiency. Efficient crane access to the module will also be required. This could be supplied by either barge-mounted cranes or tower cranes located on the module.

The wall structures of the gate bay can be constructed of either cast-in-place concrete or precast concrete elements. It may be most practical to use a combination of these techniques.

As the wall structures are completed, the structure will float deeper in the water. As the draft increases, the stresses on the bottom of the structure will increase. Several methods are available to resist these forces. The first is to add additional structure to provide support for the bottom slab. These walls could be in the form of partial height walls in the lower level. They would decrease the span in the bottom slab. They could be constructed as soon as the module was delivered to the site and additional draft is acceptable.

A second method to control the bottom slab stresses is to place concrete ballast in the lowest level of the module compartments. The weight of this concrete fill will act to resist the hydraulic forces. The fill concrete could also be detailed with reinforcement to add to the strength of the floor slab. Reinforcement used for this purpose could be installed as part of the original construction effort so that only concrete placement would be required at the site.

A third alternative is to place structural columns between the upper and lower slabs. As the sill structure submerges, hydraulic forces will increase on both the upper and lower surfaces. Columns between the two can resist these forces. One possibility is to utilize steel pipes for

these columns. They could be detailed so that they would penetrate the upper and lower slabs, which would provide access to the area below the sill for the underbase concrete placement. When is completed, the pipe sleeves would be filled with concrete. Details of this arrangement are shown in ***Drawings 9.4.3C***.

When concrete wall construction is completed to a height of greater than 40 feet (which will correspond to the low pool elevation of 324.0), the GBM can be permanently placed. A top of outermost exterior wall elevation of 362.0 was used for this study in order to minimize closure of the existing 1200' lock. The exterior walls which will form the extended 600' lock chamber walls will be constructed to El. 338 in order to accelerate bulkhead placement and to provide 14 feet of freeboard over low pool when the unit is installed. This will provide sufficient freeboard for continuation of construction after the gate bay is in place. In order to provide support for the outermost exterior walls, the transverse interior walls will be constructed to El. 355 at the intersection with these outermost walls and will step down at El. 338. Construction of the unit to a greater height would reduce the chance of the structure being flooded and the associated schedule delays but would require deeper dredging of the channel.

9.4.3.4 Temporary Support

The GBM must be supported in its final location before it can be concreted in place. Its longitudinal restraint can be provided by adjacent structures since it is one of the last major structures to be placed. Provisions are easily constructed on the wall monolith for an adjustable guide to locate the gate bay.

The vertical support of the gate bay can be provided by several methods. The most straight forward is to construct pedestals on the bottom of the excavation. This surface is excavated rock and is expected to have reasonable bearing capacity. The entire weight of the GBM does not need to be supported, since adjustment of its ballast can make it negatively buoyant to any desired amount. The structure should be grounded using ballast with sufficient load to resist movement from currents and forces associated with the underbase concrete placement procedure. After the gate bay is in place, the flat jacks on the pedestals could be adjusted to the desired elevation and filled with grout to provide permanent support while the space under the structure is filled with concrete.

It is recommended the flat jacks be set into a recess in a thickened area of the keel slab during gate bay construction at the dry dock. This will protect them from damage during the placement of the structure. The piping to the flat jacks can be cast into the concrete. Connections would be located at the base of the structure perimeter where they can be easily reached by divers. Due to the range of adjustment required, multiple flat jacks will be used. They will be free to expand downward from their keel slab recess when pressure is applied. After the structure is in its final position, grout will be pumped into the jacks to finalize the structure's position.

An alternative to the pedestal support system is to provide jackup legs within the structure. Although the required sizes would be determined at the later design phases, the legs are anticipated to be 16-inch diameter pipes and would extend from an elevation at the top of the structure at the time of positioning through the bottom to the rock surface (see ***Drawing 9.4.3C***). The legs would be located in wells provided by an 18-inch diameter pipe. These wells would be

incorporated into the concrete structure. At the top of the well, a hydraulic jack would provide force to raise the structure on the jacking leg. An adjustable yoke would extend over the jack to facilitate the positioning of the legs. The legs would be located within the wall sections of the GBM. Tremie concrete pads would be placed in the support locations over the excavated rock. The surface should be reasonably level, but the elevation is not critical.

No support is provided for the gate bay sill between the two walls. To avoid overstressing the sill, it is necessary to ballast the floor section so that it is nearly neutrally buoyant when it is submerged. The bottom slab is designed to withstand the local effects of bending between the supports, but additional stress due to global bending of the structure may be detrimental. This issue needs further review as design continues. The ballast necessary to meet this criterion should be placed before the floor structure is submerged.

If jacking legs are used, than the structure will be ballasted to a position slightly lower than its final elevation. The jacking legs will then be lowered into position and extended by the jacks to pick up some initial load. At this point, the jacks could be adjusted to level the structure. After the structure is in place, the jacking locations could be shimmed. Additional ballast can be added to the structure to provide the required downward force. If any adjustments need to be made at this time, the jacks could be unshimmed and adjusted as necessary. The capacity of the jacks and legs should be sufficient for support in the final condition before the under-base concrete placement takes place.

9.4.3.5 Underbase Concrete Placement

The underbase concrete placement must fulfill two requirements. First, it must provide adequate support for vertical and lateral loads imposed by the gate bay. Second, it must provide a seal with minimal leakage beneath the structure. Since the concrete is significantly stronger than the rock below it, the critical issue is to provide continuous support for the bottom of the slab. Large voids below the structure may result in excessive stresses on the structure. If interconnected, these voids have the potential to allow inflow of water when the lock is dewatered.

To facilitate underbase concrete placement, the pipe column penetrations at the sill could provide access to the space below the structure. These pipes will be about 18 inches in diameter and will be left open at both ends. A concrete pipe will be used to place the concrete through the pipe column. In this manner, the concrete placement operation could be moved to another location by moving the concrete pipe and placing it in another pipe column. Riser tubes should be provided in the wall areas of the GBM to facilitate grouting beneath those areas.

A flowable concrete mix would be used for the underbase concrete. This mix could have a large slump and contain additives, to minimize the tendency for cement to wash out. Water reduction agents could be used which would act as a plasticizer. A retarding mixture to increase setting time for the mix could also be used. The concrete could be placed from the center of the structure and allowed to flow to the perimeter. At the perimeter, the concrete will be contained by the sides of the rock excavation. It will flow up the sides of the structure for a minimum distance. This concrete at the side would help resist lateral movement of the structure.

9.4.3.6 Concrete Fill

After underbase concrete placement of the GBM is finished, placement of the interior concrete must be completed. Access to the compartments in the sill is difficult. Pipes for pumping and venting concrete in these spaces should be installed during initial construction of the float-in structure. Since access to the bottom level of the wall portions of the monoliths can be maintained, these pumping and venting pipes can be routed directly to the sides. This will eliminate bends which increase the likelihood of concrete blockage. The concrete supply pipes will be located at the bottom of the compartments while vent pipes will be located at the top. Extra pipes should be provided in case the placement of concrete fill is interrupted and the pipe is blocked. It may be necessary to place the concrete in lifts to minimize heat and shrinkage problems. Before the concrete is placed, ballast water can be pumped from a number of compartments at one time through the concrete placement piping.

To reduce voids, it may be advantageous to fill the majority of the compartment with concrete while maintaining a void at the top. This void could then be filled with a grout mixture, which could be injected under a higher pressure and vented from the opposite side of the compartment.

Placement of fill concrete in the wall areas of the GBM can be easily completed from the top of the structure. Since vertical access is maintained, precast blocks of concrete could also be used in order to reduce heat and shrinkage of the placed fill concrete.

Above El. 334, the walls can be either cast-in-place or precast concrete (in which case, they would be lifted into place). These additional walls above El. 334 would be cast before the concrete fill operation was completed. This cast-in-place or precast structural concrete would provide the required machinery and access spaces in the monolith.

9.4.4 Float-in Wall Diffuser Monolith

This section describes the design and construction methods developed for the wall diffuser. This structure is located downstream of the lower miter gate. It is used to discharge water from the culvert system into the area landside of the lock land wall and dissipate energy from this outlet flow. In order to minimize navigation disruption downstream of the locks, the wall diffuser should provide a uniform distribution of flow as it mixes with water in the downstream approach.

9.4.4.1 Design Considerations

The diffuser used for this design uses the hydraulic design of previous wall diffusers, similar to standard discharge manifolds. The wall diffuser is 111 feet long and 42.5 feet wide. The water enters from a culvert at one end. The culvert is ellipsoid-shaped, approximately 18 feet wide by 16.5 feet high at the entrance to the outlet. This culvert transitions to a rectangular section, 20 feet wide by 15 feet high through a transition zone which is approximately 10 feet long. Through another transition zone that is approximately 34 feet long, the culvert then decreases in height to 13 feet high at the first port. The invert elevation is level at El. 291

throughout its length. (Prior to final design refinements, the invert elevation was El. 296, as shown in the referenced drawings.)

Flow is distributed from the outlet structure culvert to eight ports on the landside. Each port is 4.5 feet wide by 7 feet high. These ports discharge the flow directly to the landside. Riprap will be placed on the riverbed and riverbank in the vicinity of the outlet in order to provide scour and slope protection.

9.4.4.2 Construction Method

The float-in wall diffuser will be constructed in a manner similar to that described in the previous sections for the float-in wall monolith and float-in gate bay monolith. Many of the same construction methods will apply. The various phases of construction are shown on ***Drawings 9.4.4A*** and ***9.4.4B***. (In final design refinements that are not reflected in these drawings, the top of monolith elevation was reduced to El. 311. This change resulted in significant cost savings. However, the associated changes in construction method have not been addressed. As the top of monolith will no longer extend above the waterline, revised construction procedures will be necessary. The revised construction approach will be investigated and finalized in future design phases.)

As can be seen from these drawings, the base raft is constructed without a top slab in order to minimize its draft during transportation from the graving dock to the construction moorage area at the site. Its draft is approximately 11 feet at this stage, which is only 2 feet greater than the minimum navigable channel depth of 9 feet. Therefore, it may be easily towed to the site during the high water periods of winter and spring.

At the construction moorage area, construction of the exterior sidewalls and supporting interior walls continue. At this area, the structure will have a maximum draft of 21 feet. The construction moorage area and connecting channel to the diffuser's final location will be dredged to El. 300, which should be adequate to allow this draft for transport over a short distance for a brief period of time.

Due to the wall diffuser's narrow width, its stability will be an important issue in the design. The stability during the float-in operation is less critical, but as the height of the structure is increased, the stability decreases. The situation is most critical when the structure is still in the temporary moorage area and ready to tow to its final location. The location of the ballast, at this phase of construction, is critical to maintain stability. Preliminary buoyancy and stability calculations have been completed and, based on the structure's metacentric height, stability appears adequate. This will need to be monitored as design continues.

The invert of the culvert and diffuser ports is at El. 291. (Prior to final design refinements, the invert elevation was El. 296, as shown in the referenced drawings.) There are eight openings for the ports and one opening for the culvert. As construction proceeds, and the culvert is completed and submerged, it is necessary to keep water out of the culvert. This will require full bulkheads over all nine openings. When the shell structure reaches El. 334 and is towed to its final location, the shell structure compartments will be ballasted to lower the structure to El. 287. At this point, the bulkheads may be removed by divers.

9.4.5 Upper Middle Approach Wall Pylon Protrusion

9.4.5.1 Pylon Protrusion Description

A pylon protrusion will be attached to the upstream end of existing monolith M38 in order to provide lateral support for the new upper middle approach wall pontoon. The existing monolith M38 nose radius is 15'-6", and the entire nose concrete is protected by a steel plate from approximately El. 342 to El. 362 with corner armor at the top (reference drawing OU 200.1/48). The steel plate is 3/4" thick and anchored to the nose concrete with 3/8" x 2" x 18" steel plate straps spaced at 1'-6", horizontally and vertically.

The pylon protrusion size has been determined by the following water pool elevations:

- Max. Operating Pool Elevation = El. 359
- Min. Operating Pool Elevation = El. 342
- Max. Flood of Record Elevation = El. 377
- Top of Existing Monolith M38 Elevation = El. 362

Preliminarily, the pylon was sized to be 9' wide x 8.5' long x 43' tall, extending from El. 339 to El. 382. Upper middle pylon protrusion details are shown on ***Drawing 6.0L***.

Precast concrete shells will be used for the pylon protrusion, and these shells will also be used as concrete forms for the concrete placement inside the shell. The pylon protrusion consists of two shells, forming the bottom and top portions. The bottom portion is 28-feet tall, and this structure will be supported and restrained on the top of monolith during construction. The top portion is 15-feet tall, and it will be place on the bottom portion after the completion of bottom shell construction. The bottom shell weight is approximately 180 kips and the top shell weight is approximately 85 kips. Therefore, the crane lifts should be reasonable, and construction handling should not be difficult.

The bottom portion of the structure will be anchored to the existing monolith using 1-3/8" diameter high-tensile bar rock anchors ("Willams" super-high tensile 'Spin-Lock' rock anchors or equal), requiring 2-1/4" diameter horizontal holes through the existing monolith steel plate armor and vertical holes at the top of monolith. The anchors will be attached to the existing monolith structure and post-tensioned. The barge impact force (shear) will be resisted by 7/8" diameter headed studs welded to the existing nose steel plate armor.

9.4.5.2 Fender Configuration

Transverse fenders are anticipated to be Bridgestone SM800 (or equal) with 3000 mm (118") tall contact surfaces, the longitudinal fender is SM1000 with 1000 mm (39") tall contact surface. All fenders are installed on the end of the pontoon.

Stainless steel plates will be attached to the fender contact surfaces and bear on UHMW plastic pads attached to the pylon protrusion. Assumed UHMW pad width is 6 feet, based on an assumed 18" maximum pontoon displacement in any direction due to barge impact.

9.4.5.3 Construction Sequence

The anticipated steps required for the pylon protrusion construction are given below:

1. Drill vertical holes at the top of the existing monolith for reinforcing bars. Install bars and fill void with non-shrink grout.

2. Install panel restrainers at the top of existing monolith. The anchor bolts shall be finger tight.

3. Install precast concrete pylon protrusion bottom shell against the existing monolith and the restrainers. Place the restrainer against the shell and tighten the anchor bolts.

4. Dewater inside the shell and weld the headed studs on the existing steel armor plate. Weld struts inside, between the shell walls.

5. Using horizontal pile sleeves in the shell as guides, drill horizontal holes through the existing steel armor plate for the anchor bars, alternating 10-foot and 6-foot embedment lengths.

6. Stress the anchor bars, and grout according to the manufacturer's directions. Weld corner plates to cover the anchor heads of the anchor bars. Fill the corner cavities with sand/cement grout pumped in from the bottom.

7. Install reinforcing bars, and place concrete inside the shell to El. 364.

8. After concrete has reached a minimum strength of 2,000 psi, install precast concrete pylon protrusion top shell on top of the bottom shell.

9. Install reinforcing bars, and place concrete inside the shell to the top of pylon, El.382. Place grout around vertical reinforcing steel bars.

9.4.6 Lower Middle Approach Wall Pylon Protrusion

9.4.6.1 Pylon Protrusion Description

A pylon protrusion will be attached to the downstream end of the new float-in miter gate bay structure to provide lateral support for the new lower middle approach wall pontoon. The pylon protrusion will be constructed after the completion of the miter gate bay construction. The structure above elevation 362 will be a mushroom-shaped shield structure that will be anchored

to the top of the miter gate bay structure. It protects the pontoon from debris and runaway barges during flood conditions.

The pylon protrusion size has been determined by the following water pool elevations:

- Max. Operating Pool Elevation = El. 359
- Min. Operating Pool Elevation = El. 324
- Max. Flood of Record = El. 377
- Top of New Miter Gate Monolith Elevation = El. 362

Preliminarily, the pylon was sized to be 9' wide x 11.5' long x 66' tall, extending from El. 316 to El. 382. Lower middle pylon protrusion details are shown on ***Drawing 6.0M***.

One precast concrete shell will be used for the pylon protrusion, and this shell will also be used as the concrete form for the concrete placement inside the shell. The shell will be vertically supported on a corbel at El. 316 of the miter gate bay structure and laterally restrained on the top of this structure during construction. The shell weight is approximately 340 kips. Alternatively, if this lift is too heavy, the shell may be constructed in two 170k pieces.

The gate bay structure has a shear key at the pylon location to resist the lateral force on the pylon, and reinforcing steel bar dowels extend from this structure in order to splice with the reinforcing bars in the pylon protrusion. The structure below El. 362 will be anchored to the miter gate bay structure, and the structure above El. 362 will be anchored to the shield structure.

The fender configuration will be similar to that described in Section 9.4.5.2 for the upper pylon protrusion.

9.4.6.2 Construction Sequence

The anticipated steps required for the pylon protrusion construction are given below:

1. Install the panel lateral restrainers at the top of the miter gate bay structure.

2. Lift the precast concrete pylon protrusion, and place it on the corbel built into the miter gate bay structure. The entire shell weight will be supported by the corbel. Anchor the shell to the lateral restrainer at the top of gate bay structure.

3. Dewater inside the shell and place reinforcing bars inside it.

4. Place a 10 to 12-foot lift of concrete and wait until the concrete has reached a strength of 2,000 psi minimum. Repeat this step, as required, to fill the concrete inside the shell to El. 362.

5. Construct the mushroom-shaped shield structure on top of the miter gate bay structure, providing reinforcing bar dowels which will splice to the reinforcing bars in the pylon protrusion.

6. Place reinforcing bars and concrete inside the shell to El. 372. After the concrete has reached a minimum strength of 2,000 psi, place concrete inside the shell to elevation 382.

9.4.7 Lower Landside Approach Wall Pylon Protrusion

9.4.7.1 Pylon Protrusion Description

A pylon protrusion will be attached to the downstream end of the new float-in miter gate bay monolith (prior to final design refinements, the pylon protrusion was attached to the landside wall diffuser, as shown in the referenced drawing) in order to provide lateral support for the new lower landside approach wall pontoon. The landside pylon protrusion will be constructed very similarly to the lower middle pylon protrusion and will have a very similar geometry. Lower landside pylon protrusion details are shown on ***Drawing 6.0N***.

9.5 STABILITY ANALYSES

A three dimensional stability analysis was carried out for the new float-in miter gate bay. Two dimensional stability analyses were performed for the new float-in land wall monolith and landside wall diffuser. Stability analyses were also performed for existing middle wall monoliths M-2, M-3, and M-9, as well as modified existing land wall monolith L-3. The middle wall monoliths investigated were assumed to be typical for monoliths M-1 to M-4 and M-6 to M-14, and the land wall monolith investigated was assumed to be typical for monoliths L-2 to L-5. In addition, the construction condition was checked for existing monolith L-7 to ensure that stability requirements were met during wrap around culvert construction. Allowable bearing pressures, overturning stability, and sliding stability were investigated for each monolith.

The stability analyses followed the criteria presented in the design basis in Section 5.2. The results of the stability analyses are presented in ***Table 9.5A***. For the new monoliths and existing land wall monoliths, overturning stability was satisfied and bearing pressures kept below allowable levels by adjusting toe and heel dimensions. However, as can be seen from ***Table 9.5A***, the existing middle wall monoliths did not meet stability requirements under their new loading conditions. Furthermore, modifying their heels and/or toes would either require undesirable closures of the existing 1200' lock or interfere with the new laterals. Therefore, rock anchors are recommended for stabilization of monoliths M-1 to M-4 and M-6 to M-14. The preliminary analyses and designs indicate that monoliths M-6 to M-14 will require approximately 80, 27-strand anchors (or 58, 37-strand anchors), in total, for this 400-foot length of existing middle wall. These anchors will be divided into two rows, with one row at each face of the monolith. Typical anchor spacings would be 11'-6" for 27-strand anchors (or 16' for 37-strand anchors). Typical anchor lengths would be 76 feet through the existing concrete monolith, 15 feet unbonded in the rock, and 79 feet of embedment length (91 feet of embedment length for

37-strand anchors), for a total anchor length of 170 feet for 27-strand anchors (total anchor length of 182 feet for 37-strand anchors).

Monoliths M-1 to M-4 are more difficult to stabilize as one of them has a big opening for a culvert valve pit, and none of them have heels or toes. For this 163-foot length of existing middle wall, it is estimated that a maximum total of approximately 48, 37-strand rock anchors will be required. The minimum required spacing of 7 feet for these anchors is anticipated. Again, a total anchor length of 182 feet is estimated for the 37-strand anchors.

The governing load condition for these middle wall monoliths was the OBE seismic load case. With the use of vertical, tensioned rock anchors, it was possible to meet overturning stability and bearing pressure requirements. The OBE seismic load case also governed the stabilization requirements for the existing land wall monoliths L-1 to L-4. Additional discussion of the seismic analyses is provided in Section 9.7.

Without modification, existing monoliths L-2 through L-5 did not meet stability requirements for their new normal, maintenance, and OBE seismic loading conditions. These monoliths were stabilized by anchoring CIP concrete to their sloped back faces and by forming a 7'-6" wide CIP concrete heel from their foundation elevations to El. 300. Depending on the timing of the heel construction, temporary bracing may or may not be required to ensure stability during this temporary construction stage. After anchoring concrete on the sloped back face, if the existing 600' lock is closed and dewatering is completed on both sides of these monoliths (in the lock chamber and on the landside), then excavation and heel construction may proceed without temporary bracing. If the construction is scheduled differently and the existing 600' lock is open to traffic during construction of the new heels, then these monoliths will require temporary bracing (as the maximum water elevation allowable in the lock chamber during heel excavation and construction is El. 340).

Existing monolith L-7 was evaluated for the construction condition in which it forms a portion of a temporary cofferdam for the wrap around culvert construction. This monolith was considered to be typical of existing land wall monoliths. Also, the excavation depth required for the wrap around culvert is deeper near this monolith than it is near the intake structure. Open cut excavation for the wrap around culvert will not extend below El. 342. Below that, the excavation for the wrap around culvert will be braced and dewatered. Therefore, this excavation will reduce the loading on the land wall monoliths for the dewatered chamber and seismic load conditions. For the temporary construction condition, however, the loading on the land wall monoliths may change directions when the lock chamber is flooded. As wrap around culvert construction will continue through the rainy winter and spring seasons and the existing land wall monoliths will form a portion of a construction cofferdam, they must be evaluated for a flooded lock chamber (pool at top of cofferdam El. 362) with a dewatered culvert excavation. It was found that all stability requirements were met under this temporary load condition.

TABLE 9.5A
600' Lock Extension Stability Analysis Summary

Description	Run I.D.	Type	Overturning Eccentricity		Sliding F.S.		Bearing Pressure	
			Actual (ft)	Allowable (ft)	Actual	Allowable	Actual (ksf)	Allowable (ksf)
Alt 600 New Float-in Land Wall: 463' Long, 36' Wall + 13' Toe + 6' Heel (Fdn El. 284)								
Shear @ Base EL. 284, Normal Condition	MWLW1A1	Usual	7.12	9.17	1.72	1.50	15.31	40.00
Shear @ Underclay EL. 271, Normal Condition	MWLW1A2	Usual			2.61	1.50		
Shear @ Base EL. 284, Maintenance Condition w/ Saturated Level at EL. 339.5	MWLW1D1	Unusual	10.39	13.75	1.42	1.30	17.87	45.60
Shear @ Underclay EL. 271, Maintenance Condition w/ Saturated Level at EL. 339.5	MWLW1D2	Unusual			1.79	1.30		
Shear @ Base EL. 284, Maintenance Condition w/ Saturated Level at EL. 344	MWLW1D3	Extreme	10.69	27.50	1.35	1.10	18.19	60.00
Shear @ Underclay EL. 271, Maintenance Condition w/ Saturated Level at EL. 344	MWLW1D4	Extreme			1.71	1.10		
Shear @ Base EL. 284, Emergency Condition (OBE, 0.1g)	MWLW1B1	Unusual	11.94	13.75	1.42	1.30	20.31	45.60
Shear @ Weak Seam EL. 271, Emergency Condition (OBE, 0.1g)	MWLW1B2	Unusual			1.81	1.30		
Shear @ Base EL. 284, Emergency Condition (MDE, 0.2g)	MWLW1B3	Extreme	19.57	27.50	1.15	1.10	39.86	60.00
Shear @ Weak Seam EL. 271, Emergency Condition (MDE, 0.2g)	MWLW1B4	Extreme			1.41	1.10		
Existing Monolith L-3, 39' Wall + 7.5' Toe +0' Heel (Fdn El. 282)								
Shear @ Base EL. 282, Normal Condition	MWL31A1	Usual	***8.77****	7.75	1.77	1.50	23.00	40.00
Shear @ Weak Seam EL. 267, Normal Condition	MWL31A2	Usual			2.86	1.50		
Shear @ Base EL. 282, Maintenance Condition w/ Saturated Level at EL. 339.5	MWL31D1	Unusual	***12.22****	11.63	1.32	1.30	29.51	45.60
Shear @ Weak Seam EL. 267, Maintenance Condition w/ Saturated Level at EL. 339.5	MWL31D2	Unusual			1.89	1.30		
Shear @ Base EL. 282, Maintenance Condition w/ Saturated Level at EL. 344	MWL31D3	Extreme	12.38	23.25	1.26	1.10	29.95	60.00
Shear @ Weak Seam EL. 267, Maintenance Condition w/ Saturated Level at EL. 344	MWL31D4	Extreme			1.81	1.10		
Shear @ Base EL. 282, Emergency Condition (OBE, 0.1g)	MWL31B1	Unusual	***13.64****	11.63	1.34	1.30	34.64	45.60
Shear @ Weak Seam EL. 267, Emergency Condition (OBE, 0.1g)	MWL31B2	Unusual			1.94	1.30		
Shear @ Base EL. 282, Emergency Condition (MDE, 0.2g)	MWL31B3	Extreme	21.34	23.25	1.11	1.10	***174.27****	60.00
Shear @ Weak Seam EL. 267, Emergency Condition (MDE, 0.2g)	MWL31B4	Extreme			1.51	1.10		
Shear @ Base EL. 282, Construction Condition After Fill CIP, Driving Water EL 324	MWL31C1	Unusual	5.44	11.63	2.91	1.30	18.28	45.60
Shear @ Weak Seam EL. 267, Construction Condition After Fill CIP, Driving Water EL 324	MWL31C2	Unusual			2.90	1.30		
Shear @ Base EL. 282, Construction Condition After Fill CIP, Driving Water EL 340	MWL31C3	Unusual	8.93	11.63	1.44	1.30	23.60	45.60
Shear @ Weak Seam EL. 267, Construction Condition After Fill CIP, Driving Water EL 340	MWL31C4	Unusual			1.81	1.30		
Shear @ Base EL. 282, Construction Condition Before Fill CIP, Driving Water EL 324	MWL31C5	Unusual	2.75	11.63	1.90	1.30	10.17	45.60
Shear @ Weak Seam EL. 267, Construction Condition Before Fill CIP, Driving Water EL 324	MWL31C6	Unusual			2.65	1.30		
Shear @ Base EL. 282, Construction Condition Before Fill CIP, Driving Water EL 330	MWL31C7	Unusual	4.20	11.63	1.43	1.30	11.67	45.60
Shear @ Weak Seam EL. 267, Construction Condition Before Fill CIP, Driving Water EL 330	MWL31C8	Unusual			2.18	1.30		
Existing Monolith L-3, 39' Wall + 7.5' Toe +7.5' Heel (Fdn El. 282)								
Shear @ Base EL. 282, Normal Condition	MWL31A1	Usual	7.87	9.00	1.86	1.50	19.99	40.00
Shear @ Weak Seam EL. 267, Normal Condition	MWL31A2	Usual			2.68	1.50		
Shear @ Base EL. 282, Maintenance Condition w/ Saturated Level at EL. 339.5	MWL31D1	Unusual	10.85	13.50	1.44	1.30	23.26	45.60
Shear @ Weak Seam EL. 267, Maintenance Condition w/ Saturated Level at EL. 339.5	MWL31D2	Unusual			1.93	1.30		
Shear @ Base EL. 282, Maintenance Condition w/ Saturated Level at EL. 344	MWL31D3	Extreme	11.01	27.00	1.37	1.10	23.49	60.00
Shear @ Weak Seam EL. 267, Maintenance Condition w/ Saturated Level at EL. 344	MWL31D4	Extreme			1.85	1.10		
Shear @ Base EL. 282, Emergency Condition (OBE, 0.1g)	MWL31B1	Unusual	12.92	13.50	1.37	1.30	27.21	45.60
Shear @ Weak Seam EL. 267, Emergency Condition (OBE, 0.1g)	MWL31B2	Unusual			1.92	1.30		
Shear @ Base EL. 282, Emergency Condition (MDE, 0.2g)	MWL31B3	Extreme	20.30	27.00	1.12	1.10	57.21	60.00
Shear @ Weak Seam EL. 267, Emergency Condition (MDE, 0.2g)	MWL31B4	Extreme			1.47	1.10		
Existing Monolith M-2, 36' Wall + 0' Toe +0' Heel (Fdn El. 275)								
Shear @ Base EL. 275, Normal Condition	MWM22B1	Usual	***7.69****	6.00	7.65	1.50	29.38	40.00
Shear @ Base EL. 275, Maintenance Condition with EL 338 Lower Pool	MWM22D1	Unusual	***9.24****	9.00	3.90	1.30	34.61	45.60
Shear @ Base EL. 275, Maintenance Condition with EL 344 Lower Pool	MWM22D2	Extreme	12.74	18.00	3.05	1.10	57.65	60.00
Shear @ Base EL. 275, Emergency Condition (OBE, 0.1g)	MWM22F1	Unusual	***15.10****	9.00	3.41	1.30	***104.67****	45.60
Shear @ Base EL. 275, Emergency Condition (MDE, 0.2g)	MWM22F3	Extreme	***22.66****	18.00	2.30	1.10	***64.97****	60.00

TABLE 9.5A
600' Lock Extension Stability Analysis Summary

Description	Run I.D.	Type	Overturning Eccentricity		Sliding F.S.		Bearing Pressure	
			Actual (ft)	Allowable (ft)	Actual	Allowable	Actual (ksf)	Allowable (ksf)
Existing Monolith M-3, 36' Wall + 0' Toe +0' Heel (Fdn El. 275)								
Shear @ Base EL. 275, Normal Condition	MWM32B1	Usual	***9.67****	6.00	6.15	1.50	30.91	40.00
Shear @ Base EL. 275, Maintenance Condition with EL 338 Lower Pool	MWM32D1	Unusual	***9.71****	9.00	3.43	1.30	31.06	45.60
Shear @ Base EL. 275, Maintenance Condition with EL 344 Lower Pool	MWM32D3	Extreme	13.90	18.00	2.69	1.10	***62.85****	60.00
Shear @ Base EL. 275, Emergency Condition (OBE, 0.1g)	MWM32F1	Unusual	***16.91****	9.00	3.09	1.30	***235.12****	45.60
Shear @ Base EL. 275, Emergency Condition (MDE, 0.2g)	MWM32F3	Extreme	***24.47****	18.00	2.15	1.10	***	60.00
Existing Monolith M-9, 36' Wall +1.5' Toe +0' Heel (Fdn El. 286)								
Shear @ Base EL. 286, Normal with New Lock at EL 324 Pool and Existing Lock at EL 342 Pool	MWM92A1	Usual	4.84	6.25	3.40	1.50	17.77	40.00
Shear @ Base EL. 286, Normal with New Lock at EL 342 Pool and Existing Lock at EL 324 Pool	MWM92B1	Usual	5.53	6.25	3.43	1.50	19.02	40.00
Shear @ Base EL. 286, Maintenance with Dewatered New Lock and Existing Lock at EL 342 Pool	MWM92D1	Unusual	6.87	9.38	2.09	1.30	20.92	45.60
Shear @ Base EL. 286, Maintenance Dewatered Existing Lock and New Lock at EL 342 Pool	MWM92E1	Unusual	7.72	9.38	2.09	1.30	22.87	45.60
Shear @ Base EL. 286, Maintenance with Dewatered New Lock and Existing Lock at EL 344 Pool	MWM92D2	Extreme	7.85	18.75	1.93	1.10	22.80	60.00
Shear @ Base EL. 286, Maintenance Dewatered Existing Lock and New Lock at EL 344 Pool	MWM92E2	Extreme	8.67	18.75	1.94	1.10	25.04	60.00
Shear @ Base EL. 286, Emergency w/ New Lock at EL 324 and Existing Lock at EL 342 Pools (OBE,0.1g)	MWM92F1	Unusual	***10.98****	9.38	1.89	1.30	31.74	45.60
Shear @ Base EL. 286, Emergency w/ New Lock at EL 342 and Existing Lock at EL 324 Pools (OBE,0.1g)	MWM92F2	Unusual	***11.65****	9.38	1.90	1.30	35.52	45.60
Shear @ Base EL. 286, Emergency w/ New Lock at EL 324 and Existing Lock at EL 342 Pools (MDE,0.2g)	MWM92F3	Extreme	17.15	18.75	1.36	1.10	***156.07****	60.00
Shear @ Base EL. 286, Emergency w/ New Lock at EL 342 and Existing Lock at EL 324 Pools (MDE,0.2g)	MWM92F4	Extreme	17.78	18.75	1.36	1.10	***261.04****	60.00
Shear @ Base EL.286, Emergency w/ New Lock at EL 324 and Existing Lock at EL 342 Pools (MDE,.17g)	MWM92F9	Extreme	15.30	18.75	1.48	1.10	***72.52****	60.00
Shear @ Base EL.286, Emergency w/ New Lock at EL 342 and Existing Lock at EL 324 Pools (MDE,.17g)	MWM92F10	Extreme	15.94	18.75	1.48	1.10	***89.89****	60.00
Float-in Landside Diffuser Monolith: Outside Lock Chamber, 42.5' Wall + 0' Toe + 0' Heel (Fdn El. 28								
Shear @ Base EL. 287, Normal Condition with EL 324 Lower Pool	MWLWO1A1	Usual	0.83	7.10	45.10	1.50	11.50	40.00
Shear @ Base EL. 287, Emergency Condition with EL 324 Lower Pool (OBE)	MWLWO1B1	Unusual	4.70	10.60	2.39	1.30	17.10	45.60
Shear @ Weak Seam EL. 271, Emergency Condition with EL 324 Lower Pool (OBE)	MWLWO1B2	Unusual			5.14	1.30		
Shear @ Base EL. 287, Emergency Condition with EL 324 Lower Pool (MDE)	MWLWO1B3	Extreme	10.16	21.25	1.21	1.10	26.29	60.00
Shear @ Weak Seam EL. 271, Emergency Condition with EL 324 Lower Pool (MDE)	MWLWO1B4	Extreme			1.61	1.10		
Float-In Gate Bay, 100' Long and 182' Wide								
Transverse Direction Stability Analysi								
Shear @ Base EL. 284, Inside EL. 342 and Outside EL.324 Pools, Normal Condition	MWGB3A1T	Unual	7.32	30.33	3.34	1.50	9.08	40.00
Shear @ Weak Seam EL. 270, Inside EL. 342 and Outside EL.324 Pools, Normal Condition	MWGB3A2T	Unual			4.35	1.50		
Shear @ Base EL. 284, Inside EL. 324 and Outside EL.324 Pools, Normal Condition	MWGB3B1T	Unual	8.08	30.33	3.19	1.50	8.69	40.00
Shear @ Weak Seam EL. 270, Inside EL. 324 and Outside EL.324 Pools, Normal Condition	MWGB3B2T	Unual			4.27	1.50		
Shear @ Base EL. 284, Maintenance Condition with EL 338 Lower Pool	MWGB3E1T	Unusual	9.67	45.50	3.09	1.30	8.70	45.60
Shear @ Weak Seam EL. 270, Maintenance Condition with EL 338 Lower Pool	MWGB3E2T	Unusual			4.63	1.30		
Shear @ Base EL. 284, Maintenance Condition with EL 344 Lower Pool	MWGB3E3T	Extreme	9.47	91.00	3.18	1.10	8.78	60.00
Shear @ Weak Seam EL. 270, Maintenance Condition with EL 344 Lower Pool	MWGB3E4T	Extreme			4.99	1.10		
Shear @ Base EL. 284, Emergency Condition (OBE) w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F1T	Unusual	12.04	45.50	2.30	1.30	10.22	45.60
Shear @ Weak Seam EL.270, Emergency Condition (OBE), w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F2T	Unusual			2.02	1.30		
Shear @ Base EL. 284, Emergency Condition (MDE), w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F3T	Extreme	17.77	91.00	1.60	1.10	11.60	60.00
Shear @ Weak Seam EL.270, Emergency Condition (MDE), w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F4T	Extreme			1.33	1.10		
Shear @ Base EL. 284, Emergency Condition (OBE) w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F5T	Unusual	12.77	45.50	2.27	1.30	9.76	45.60
Shear @ Weak Seam EL.270, Emergency Condition (OBE), w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F6T	Unusual			2.03	1.30		
Shear @ Base EL. 284, Emergency Condition (MDE), w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F7T	Extreme	18.59	91.00	1.59	1.10	11.07	60.00
Shear @ Weak Seam EL.270, Emergency Condition (MDE), w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F8T	Extreme			1.35	1.10		
Longitudinal Direction Stability Analys								
Shear @ Base EL. 284, Inside EL. 342 and Outside EL.324 Pools, Normal Condition	MWGB3A1L	Unual	3.83	16.67	14.14	1.50	8.98	40.00

TABLE 9.5A
600' Lock Extension Stability Analysis Summary

Description	Run I.D.	Type	Overturning Eccentricity		Sliding F.S.		Bearing Pressure	
			Actual (ft)	Allowable (ft)	Actual	Allowable	Actual (ksf)	Allowable (ksf)
Shear @ Weak Seam EL. 270, Inside EL. 342 and Outside EL.324 Pools, Normal Condition	MWGB3A2L	Unual			50.44	1.50		
Shear @ Base EL. 284, Inside EL. 324 and Outside EL.324 Pools, Normal Condition	MWGB3B1L	Unual	1.77	16.67	***N/A***	1.50	7.58	40.00
Shear @ Weak Seam EL. 270, Inside EL. 324 and Outside EL.324 Pools, Normal Condition	MWGB3B2L	Unual			***N/A***	1.50		
Shear @ Base EL. 284, Maintenance Condition with EL 338 Lower Pool	MWGB3E1L	Unusual	3.38	25.00	4.84	1.30	7.59	45.60
Shear @ Weak Seam EL. 270, Maintenance Condition with EL 338 Lower Pool	MWGB3E2L	Unusual			5.31	1.30		
Shear @ Base EL. 284, Maintenance Condition with EL 344 Lower Pool	MWGB3E3L	Extreme	5.21	50.00	3.71	1.10	8.28	60.00
Shear @ Weak Seam EL. 270, Maintenance Condition with EL 344 Lower Pool	MWGB3E4L	Extreme			3.99	1.10		
Shear @ Base EL. 284, Emergency Condition (OBE) w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F1L	Unusual	9.49	25.00	2.39	1.30	11.46	45.60
Shear @ Weak Seam EL.270, Emergency Condition (OBE), w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F2L	Unusual			2.73	1.30		
Shear @ Base EL. 284, Emergency Condition (MDE), w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F3L	Extreme	15.16	50.00	1.41	1.10	13.95	60.00
Shear @ Weak Seam EL.270, Emergency Condition (MDE), w/ Inside EL.342 and Outside EL.324 Pools	MWGB3F4L	Extreme			1.53	1.10		
Shear @ Base EL. 284, Emergency Condition (OBE) w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F5L	Unusual	6.61	25.00	3.96	1.30	9.57	45.60
Shear @ Weak Seam EL.270, Emergency Condition (OBE), w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F6L	Unusual			4.20	1.30		
Shear @ Base EL. 284, Emergency Condition (MDE), w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F7L	Extreme	11.45	50.00	1.86	1.10	11.56	60.00
Shear @ Weak Seam EL.270, Emergency Condition (MDE), w/ Inside EL.324 and Outside EL.324 Pools	MWGB3F8L	Extreme			1.86	1.10		

*Note:

Existing land wall monoliths L-2 to L-5 will be stabilized with the addition of a 7.5' wide heel.

Existing middle wall monoliths M-1 to M-4 and M-6 to M-14 will be stabilized with two rows of rock anchors.

9.6 INITIAL STRESS ANALYSES

Initial analyses and designs were completed in order to determine key dimensions of the structural elements described in the following subsections.

9.6.1 Intake Wingwalls

Preliminary analyses were completed for the intake wingwalls. These walls consist of 6-foot diameter drilled shafts and precast concrete facing panels. Because no seepage control is required, the facing panels will be terminated 2 feet below the riverbed. The top of cap beam will be at El. 362.0 near the intake structure and will slope down to El. 352.0 at the end of the wingwall furthest from the intake.

The analyses were performed for usual and unusual load conditions, in accordance with EM1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures. For the unusual seismic load condition which governed the preliminary design, nonsite-specific ground motions, with ground accelerations of 0.1g, were used. The shaft spacing was preliminarily determined to vary from 12 to 15 feet, on center, for exposed wall heights which varied from 44 feet to 28 feet or less, respectively. The reinforced concrete shafts required an embedment of approximately 30 feet into the rock. It was found that permanent steel casing was required in order to develop the needed moment capacity. In order to install the permanent casing, an oversized hole must be drilled in the rock. The preliminary design calls for a 7-foot hole and a 6-foot permanent steel casing. The void in between shall be pressure grouted.

If larger diameter drilled shafts are utilized, then the shaft spacing can be reduced. However, the difficulty of drilling increases. Based on limestone and shale rock strengths and discussions with drilling contractors, a maximum drilled hole diameter of 8 feet was determined, and a 6-foot diameter shaft with a 7-foot diameter drilled hole was recommended.

9.6.2 Float-in Land Wall

The new float-in land wall monolith will be constructed in several stages as described in Section 9.4.2. This structure will be composed of a post-tensioned base raft, side wall shell, culvert, and either mass concrete or a combination of precast concrete blocks and CIP concrete. In the early stages of construction, the majority of the shell structure will not have a top slab in order to facilitate interior concrete placement.

The preliminary dimensions were sized based on the applied hydrostatic pressure. The base slab, culvert walls, longitudinal walls, and portions of base raft which have a top slab will be 12 inches thick. All internal transverse bulkheads will be 10 inches thick. Due to higher hydrostatic pressure on the base slab and lower part of the exterior side walls, the spacing of the transverse bulkheads will be 9 feet below El. 313.0 and 18 feet above El. 313.0.

Buoyancy calculations were completed, and floatation stability was checked for each construction stage. The preliminary design was refined until the section maintained sufficient

freeboard, minimized draft to within feasible navigation limits, and had adequate capacity to resist the applied hydrostatic loads. The amount and placement of concrete and water ballast was calculated to keep the structure level and stable during construction. See Section 9.4.2 for pertinent freeboard and draft values at each construction stage.

The precast concrete lift-in buttress walls will be installed after the lower portions of the float-in land wall have been constructed. To accommodate the typical spacings for the floating mooring bitts and line hooks, the precast concrete wall segments are typically 54 feet long, which provides a reasonably standard distance between monolith joints. Buttress walls are spaced at 27 feet on center to support the lock wall face. These 9-foot module spacings work well with the 9-foot and 18-foot wall spacings of the supporting float-in land wall structure below. ***Drawings 9.6.2A*** and ***9.6.2B*** show the preliminary design of the lift-in buttress walls which form the top 28 feet of the lock land wall. The interface between the lock buttress walls and the float-in monolith below is the full 36-foot width of the monolith at that elevation.

The lock buttress wall segments are precast concrete and each 54-foot segment weighs 360 tons without the optional horizontal epoxy construction joint. Construction cranes are readily available to lift loads in this range. However, if it is determined that this lift is too heavy, then this structure can be constructed using the optional construction joint. In that case, the lower piece will weigh approximately 220 tons and the upper piece will weigh approximately 140 tons. The lock wall face is required to be 2'-0" thick to support the impact loads (250 kips unsymmetric impact is specified in EM-1110-2-2105 and 300 kips impact is the minimum for the approach walls). Since there is soil and not concrete fill behind the lock wall face, the entire punching shear load must be resisted in the wall slab itself. The transverse buttress walls are 1'-0" thick with stiffened edges to accommodate the anchorages for the threadbars. Vertical post-tensioned threadbar anchors are installed to resist the horizontal shear and overturning forces while keeping the concrete and its construction joints in compression for *all usual and unusual* loading conditions to minimize corrosion potential. Horizontally, the lock face walls and buttress walls are reinforced with mild reinforcement to carry the loads.

For the lock buttress wall design, the controlling ***usual*** load case is for the normal operating loads with 80-kip perpendicular Hawser loads (3.0 kips per foot). The controlling ***unusual*** load case is for OBE seismic loading. The controlling ***extreme*** load case is for MDE seismic loading.

Connections to the float-in monolith below the lock buttress wall are accomplished through mechanical couplings to the vertical threadbars with shear lugs keys at the bottom of the buttress walls. The 3-foot vertical lift where the shear lugs and couplers are located is filled with structural concrete after the connections are made. Connections between lock buttress wall segments are accomplished with vertical wall joints with grouted keys in pipe embedment keyways. These vertical joints transfer shear forces from one precast segment to another for sharing of impact and other horizontal loads.

On top of each lock buttress wall, there is a 14-foot-wide cast-in-place concrete slab designed to support the equivalent of an AASHTO HS-20 truck loading. These slabs are designed to span 27 feet between buttress walls, in case the supporting soil between buttresses subsides. Special precast lift-in buttress sections, as detailed on ***Drawing 9.6.2B*** accommodate the valve pit and bulkhead recess areas.

9.6.3 Approach Walls

Preliminary key dimensions of the approach walls were also evaluated. In the design of the Olmsted approach walls, it was found that the impact wall thickness and pontoon width were governed by a usual load in the range of 300k to 380k. Impact loads greater than this, but less than 600k, did not govern the selection of the key dimensions of the pontoons. Based on the flow velocities and angles determined during the physical modeling at WES prior to the original construction, the impact loads at the John T. Myers site are anticipated to fall within the range given above. Therefore, the engineering judgment gained from the design of the Olmsted approach walls was used in the preliminary sizing of the approach walls.

Due to its unusually short length and small width, the buoyancy of the lower middle wall was also investigated. Using the wall thicknesses and heights that were determined for middle walls in the Olmsted design, a resulting freeboard of 5 feet was calculated, whereas the general criteria for impact face freeboard is 7 feet. Currently, the impact loads are under review and may be reduced significantly. As a result, it may be possible to reduce the thickness of the pontoon impact walls. If both the pontoon walls and parapets are also increased in height by approximately 1 foot, then a 7-foot freeboard can be achieved. However, the final cross sectional dimensions can not be determined until the impact loads are finalized during future design phases.

Also during future design phases, the required length of this middle wall structure should be determined based on model testing at WES. For the determined length, a cost comparison should be completed to determine whether a floating approach wall, a float-in monolith, or other structural type is most cost effective at this location. As this short end of the wall length spectrum, the analysis is likely to be very sensitive to the length of the structure. Due to this sensitivity, it is not useful to complete this cost comparison until the final wall length has been determined in future design phases.

9.6.4 Miter Gate Bay

The new float-in miter gate bay will be constructed in several stages, as described in Section 9.4.3. The miter gate bay consists of a base raft section (which includes the sill), and wall monoliths on each side of the sill, forming a U-shaped structure. The base raft section will be 182 feet wide,100 feet long, and 21 feet high. The wall monoliths on each side of the miter gate bay will be 36 feet wide. The top of the wall elevation will be El. 362.0. Preliminary calculations were completed for the base raft in order to preliminarily design it to resist hydraulic pressures during the delivery voyage, set down, and in place condition during construction. The topslab, base slab, and exterior walls were preliminarily sized to be 18 inches thick. The base raft structure will be separated into compartments by 10" thick interior bulkhead walls. The transverse bulkheads will be spaced at an approximate spacing of 17 feet, and the longitudinal bulkheads will be spaced at an approximate spacing of 20 feet. The maximum base slab bending stress was found to be approximately 600 psi, which occurs when the gate bay structure is set down to EL 284.0. In order to meet a zero tension design criteria, post-tensioning the base raft module to an average compressive stress of 600 psi is recommended.

9.7 INITIAL SEISMIC EVALUATION

Preliminary seismic analyses were performed for the same typical monoliths which were analyzed for overturning and sliding stability. The OBE seismic loading was added to the normal operating load for the unusual emergency condition, as listed in EM 1110-2-2602, Planning and Design of Navigation Locks. The MDE seismic loading was added to the normal operating load for an extreme emergency condition. The combination of construction and seismic loading is not listed in the aforementioned EM, and the probability of an earthquake occurring during the unusual flood condition of the temporary construction phase was considered to be very low and was not evaluated.

The John T. Myers site is located in Seismic Zone 2 per ER 1110-2-1806, Earthquake Design and Analysis for Corps of Engineers Projects. A psuedostatic, seismic coefficient, method of analysis was used for this feasibility study, using an acceleration coefficient of a = 0.1g for the OBE case and a = 0.2g for the MDE case. The existing monoliths were designed using an acceleration coefficient of a = 0.05g but were not reanalyzed for this higher seismic loading unless the new lock construction increased or changed the direction of loading on these monoliths. The seismic analyses were completed in accordance with EC 1110-2-291, Stability Analysis of Concrete Structures and EM 1110-2-2200, Gravity Dam Design.

The emergency condition of normal operating loads plus seismic loads governed for the overturning stability and sliding stability of the new float-in land wall monolith and the sliding stability of the float-in miter gate bay. The new 36-foot wide monolith will require a 13-foot toe and a 6-foot heel to resist the overturning forces. The emergency OBE seismic load also governed the stabilization requirements for the existing land wall monoliths L-2 to L-5 and existing middle wall monoliths M-1 to M-4 and M-6 to M-14.

In addition, preliminary seismic analyses were performed for the strength design of the intake wingwalls which will be composed of drilled shafts and precast concrete fascia panels. Calculations were completed in accordance with EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures, using the load combination for nonsite-specific ground motions. This load combination governed the strength design of the intake wingwalls.

9.8 INITIAL THERMAL STRESS ANALYSIS

A preliminary thermal analysis was prepared to study the need for postcooling the concrete to be placed in the compartments of the new land wall monolith. It was determined that careful mix design and standard precooling of the aggregate and water could adequately manage the temperature of the mass concrete.

The initial analysis was prepared for concrete mix. It was concluded that postcooling of the mass concrete could be avoided by: minimizing the volume of cement used; using cements with low or delayed heat of hyduration, replacing a portion of the portland cement with pozzolan; and controlling the placing sequence of the concrete.

An independent check of the initial analysis was performed using a typical mass concrete mix design. This mix is not commonly available from local suppliers. An on-site concrete batch plant probably will be required, with the capability of producing concrete with the materials and proportions common to mass concrete operations for the construction effort. This is a common occurrence for large civil/structural projects such as this one. In this analysis, a preliminary mix design was developed based on Type II cement, 6-inch maximum aggregate size and a design compressive strength at 28 days of 3500 psi. The remaining elements of the preliminary mix were designed to produce a placement and curing sequence that avoided the use of postcooling.

Adiabatic temperature rise and the heat dissipation was calculated for the 1, 28, 90, 180, and 365-day post-placement conditions. The temperature rise and the rate of heat dissipation were compared and it was determined that the dissipation rate was great enough to keep up with the heat generation, after the first 28 days. This analysis was used to determine the initial temperature of the concrete at placement, which should be approximately 50°F or lower. This can be accomplished by cooling the fine aggregate, coarse aggregate, and/or the mix water.

The compressive stresses due to the expansion of the concrete as it generates heat and the tensile stresses generated in the concrete as it cools were calculated and compared to the compressive and tensile capacity of the concrete. This comparison was made at various concrete ages since both the demand and the capacity are a function of time. The result of this analysis determined the relative composition of the cementitious materials.

Additional work was done to develop a mass concrete mix design with a water to cementitious material ratio (w/c ratio) of approximately 0.50. This w/c ratio was selected because it matched the w/c ratio of the 3500-psi concrete previously analyzed. Replacing the mix water with ice controlled the temperature of the concrete at placement. The final preliminary mix design is comprised of 250 lb/cy Type II cement, 76 lb/cy pozzolon, 40 lb/cy water, 2800 lb/cy 6-inch maximum size aggregate, 700 lb/cy fine aggregate, and 125 lb/cy ice. This mix design should result in concrete with a temperature at placement of 52°F, a 28-day compressive strength of 3500 psi, no tensile or compressive cracks due to heat generated during hydration, and no need for postcooling. A refrigeration plant with a capacity of 107 tons per day can supply the volume of ice needed.

The actual required 28-day compressive strength of the concrete will be determined during future design phases. It is anticipated that this strength will be considerably lower than 3500 psi. In that case, the amount of cement and ice can be decreased.

The stresses induced in the precast land wall monolith due to the heat of hydration of the in-fill concrete in the compartments of the monolith are considered to be insignificant, based on preliminary evaluation. As discussed in ACI 207.2R, “The initial hydration temperature rise produces little, if any, stress in the concrete. At this early age, the modulus of elasticity of concrete is so small that compressive stresses induced by the rise in temperature are insignificant even in zones of full restraint, and in addition, are relaxed by a high rate of early creep. By assuming a condition of no initial stress, a slightly conservative and realistic analysis results.”

Furthermore, the temperature rise in the infill concrete will be minimized through the use of low cement content, the use of pozzolans to replace a portion of the portland cement, the use of cements with low or delayed heats of hydration, low initial concrete placement temperature

(approximately 50° F). If further reductions in the infill concrete temperature rise are required, then concrete placement sequencing can be controlled by using checkerboard placement or reducing lift heights. The walls of the precast monolith structure should be capable of supporting the form loads imposed by the liquid concrete during placement, but no significant additional loading due to initial hydration temperature rise will occur for the mass concrete mix designs that will be used.

Temperature effects on the final monolith structure are considered to be negligible, in general. However, an evaluation of the need for crack control joints should be completed during future design phases.

9.9 ADDITIONAL STUDIES, TESTS AND ANALYSES

9.9.1 Temperature Profiles

During the design of the Olmsted Lock approach walls, two site-specific temperature profiles were developed for the design of the pontoons. One temperature profile was associated with the 'summer gradients,' the other with the 'winter gradients.'

The Olmsted, Illinois site-specific temperature range was -14 to +108 degrees Fahrenheit for the air and +37 to +87 degrees Fahrenheit for the river water. Approach wall pontoon design is dependent on extreme temperature gradients on the concrete walls of the pontoon rather than on the maximum ambient temperatures. Therefore, the temperature records measured during several seasons were scrutinized for the maximum relative difference between the temperature of the river water and the air temperature. The evaluation brought to light significant seasonal temperature variations. The findings were as follows:

- During the winter period, the water was warmer than the air by 60 degrees Fahrenheit or less.
- During the summer season, the air was warmer than the water by 40 degrees Fahrenheit or less.

These data series were processed to develop the design temperature gradients. In order to process the data, the temperature distribution study of the (guide wall) pontoons at the John Day Locks and Dam site, in Oregon, was essential.

The varying temperature of the concrete walls and slabs, in the existing approach wall pontoon at John Day Locks and Dam, was surveyed at a multitude of locations of the pontoon and over an extended period of time, capturing both typical summer and typical winter temperatures. The temperature profiles were developed from the empirical data that had been obtained. The temperature profiles of the pontoon at John Day brought to light the relationship between the temperature of the water and air surrounding the pontoon and the temperature distribution over the pontoon cross section. The findings concluded that:

- The temperature gradient (over the pontoon height) is extremely non-uniform,
- The highest temperature gradient should be anticipated within the top 2.5 feet of the pontoon.

Subsequently, the temperature gradient profiles for the John Day pontoon were calibrated for the design of the Olmsted pontoons accounting for several parameters including:

- The difference in the geometry of pontoons.
- The difference in freeboard and draft.
- Water and air temperature at the Olmsted site.

It must be determined, during future design phases, whether the temperatures at Myers are similar enough to the temperatures at Olmsted to reuse these study results instead of requiring a new, site-specific temperature profile study.

SECTION 10

MECHANICAL DESIGN

Mechanical equipment locations are shown on ***Drawings 10.0A*** and ***10.0B***. General arrangement drawings for the miter gate machinery and the culvert valves are shown on ***Drawings 10.0C*** and ***10.0D***, respectively.

10.1 LOCK DEWATERING EQUIPMENT

10.1.1 Existing Maintenance Bulkheads

10.1.1.1 General

Maintenance bulkhead units are installed upstream and downstream of each set of lock miter gates to facilitate dewatering, maintenance, and repair of the gates. The maintenance bulkhead units are also used as temporary cofferdams for raising the main lock upstream emergency sills. No permanent maintenance bulkhead handling facilities exist at the lock. The bulkheads are handled using a work barge-mounted crane. The Operations and Maintenance Branch manage the maintenance bulkheads, the work barge, and the crane.

It should be noted that there are no recesses in the lock walls and no bulkhead sill to accommodate installation of maintenance bulkheads upstream at the upper set of miter gates in the auxiliary lock at Control Stations (CS) 2L and 3M. This portion of the lock chamber can be dewatered by installing the emergency bulkheads.

10.1.1.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing bulkheads are in satisfactory condition.

10.1.1.3 Proposed Rehabilitation

No modifications or replacements of the existing maintenance bulkheads are envisioned for the prototype alternative. A nominal budget amount will be included in the estimate (for the site-specific adaptations) for basic repair/refurbishment of the bulkheads, such as replacing rubber seals, that may be necessary to improve the condition of the bulkheads prior to their use during the lock extension work.

10.1.2 New Maintenance Bulkhead Slots

For the lower set of miter gates in the auxiliary lock extension, a new set of bulkhead slots with embedded parts will be provided. The embedded parts will be weldments of structural shapes and plate of similar design to the existing parts. Existing maintenance bulkheads will be installed in these slots for miter gate dewatering. Installation aspects of the embedded parts will be added for the 90 percent submittal.

10.1.3 Existing Emergency Bulkheads

10.1.3.1 General

Emergency bulkheads are installed to provide upstream closure of the main and auxiliary locks. The bulkheads are also used to provide upstream closure of the dam crest gates. The bulkheads are handled by means of an existing bulkhead hoist and crane located on the service bridge.

10.1.3.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing bulkheads are in satisfactory condition.

10.1.3.3 Proposed Rehabilitation

No modifications or replacements of the existing emergency bulkheads are envisioned for the prototype alternative. A nominal budget amount will be included in the estimate (for the 90 percent submittal) for basic repair/refurbishment of the bulkheads, such as painting and replacing rubber seals, which may be necessary to improve the condition of the bulkheads prior to their use during the lock extension work.

10.1.4 Existing Bulkhead Hoist and Crane

10.1.4.1 General

An existing wire rope bulkhead hoist and crane is used for emergency bulkhead handling. The crane is capable of traveling across the dam and over the lock chambers on rails mounted on the top of the service bridges. The crane is designed to pick and transport one bulkhead at a time from its dogged position in the dam gate bays and lower two bulkheads latched together in the lock chambers during still or flowing water conditions.

10.1.4.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing bulkhead hoist and crane is in satisfactory condition.

10.1.4.3 Proposed Rehabilitation

No modifications or replacements of the existing crane are envisioned for the prototype alternative, only standard part replacement and maintenance. A nominal budget amount will be included in the estimate for basic repair/refurbishment of the crane, including crane inspection/testing, wire rope replacement, hoist seals and rubber goods replacement, oil and lubricating grease replacement, minor electrical work, etc.

10.1.5 Existing Lock Dewatering Equipment

10.1.5.1 General

The existing lock has no permanent dewatering equipment for pumping down the lock chamber for inspection and maintenance. Complete dewatering of the lock is achieved by portable dewatering pumps brought into the lock on a barge managed by the Operations and Maintenance Branch.

10.2 MITER GATES

10.2.1 Existing Miter Gates

10.2.1.1 General

The existing miter gates are horizontally-framed weldments of plate and structural shapes. The gates are fairly simple in construction and operation. The gates operate under essentially balanced head conditions. They cannot operate or close under appreciable unbalanced head or flowing water conditions. The miter gates fit into recesses in the lock walls. For the existing main and auxiliary chambers, the upper and lower sets of miter gates are the same height.

10.2.1.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing miter gates are in satisfactory condition. According to other inspection reports, the Corps is considering the option of a gate change-out or exchange program whereby most gates in the Ohio River System will be modified to be interchangeable. The gates will be replaced with newly refurbished/modified gates on a periodic basis.

10.2.1.3 Proposed Rehabilitation

For the 600-ft lock extension alternative, it is assumed that the existing lower set of miter gates and operating machinery will be removed and the gate recesses filled in. The gates will be turned over to the District. It is anticipated that the gates, once removed, will be used in the proposed gate exchange program. Depending on the proposed schedule for gate exchange, cost savings may be realized by refurbishing and reusing the existing downstream miter gates at the new miter gate bay location. In this case, purchase of new miter gates could be delayed until they are needed for a scheduled gate exchange. If applicable, this option should be evaluated in future design phases.

No modifications or replacements of the existing upper set of miter gates are envisioned for the prototype alternative. At this time, no budget has been included in the estimate for basic repair/refurbishment of the existing gates.

10.2.2 New Miter Gates

One set of new, lower miter gates is proposed for the 600-ft lock extension. The new gates will be downstream of the existing miter gates in the auxiliary lock chamber, as shown on ***Drawing 10.0B***. The new gates will be similar in size, design, and construction as the existing

gates. Each miter gate will include a walkway similar to that used at Smithland Lock and Dam. The new gates will be interchangeable with the existing gates; provisions will include two strut pin boxes on the top girder for use with either sector gear or direct connected cylinder operators. Each gate leaf will be a weldment of plate and structural shapes, horizontally-framed, and fabricated into a single piece. The estimated weight of each gate leaf is 400,000 lb.

The gate embedded parts will be installed in blockouts provided in the concrete structure after maintenance bulkheads have been installed for dewatering. After the embedded parts have been installed and concreted, each gate leaf will be installed and aligned in the dry.

As noted in Section 10.2.1.3, depending on the proposed schedule for gate exchange, consideration of reuse of the existing miter gates may yield cost savings. This option should be investigated further in future design phases.

10.2.3 Existing Gate Operating Machinery

10.2.3.1 General

The operating machinery for the miter gates is hydraulically operated from a constant pressure system. The existing operating machinery is of the Ohio River linkage type, consisting of hydraulic cylinder, toothed rack meshed with a sector gear assembly, sector arm, and strut. The rack includes support/alignment features. The sector gear assembly includes a custom sector base subassembly, sector base support, and sector base support anchorage.

10.2.3.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing miter gate operating machinery is in satisfactory condition.

10.2.3.3 Proposed Rehabilitation

No major modifications or replacements of the existing miter gate operating machinery are envisioned for the prototype alternative. Minor retrofits to the existing operating machinery (i.e., the existing, upstream set of miter gates) will be made, including the addition of sensors and other devices to provide remote operation/indication of the existing gates that is similar to the new, downstream gates. In other respects the existing, upstream gate operating machinery will remain as-is due to its condition and operating history. As a side note, the Panama Canal Commission is beginning work to retrofit all existing lock miter gates (over 80 gates total) with direct-connected hydraulic cylinders. The width of the Panama Canal locks is 110 feet, like the prototype project. A nominal budget amount will also be included in the estimate for basic repair/refurbishment of the machinery, including inspection/testing, seals and rubber goods replacement, oil and lubricating grease replacement, minor electrical work, etc.

10.2.3.4 New Miter Gate Operating Machinery

Ohio River linkage and direct-connected type of operating machinery were considered for the new lower set of miter gates in the prototype project. The Ohio River linkage type of operating machinery consists of a hydraulic cylinder, toothed rack meshed with a sector gear assembly, sector arm, and strut, as described previously. The direct-connect type of operating machinery consists of a mill-type hydraulic cylinder mounted in a gimbal bracket, with the cylinder rod directly attached to the gate leaf.

The following advantages and disadvantages, shown in ***Table 10.2.3.4A***, were considered to compare the two types of operating machinery.

TABLE 10.2.3.4A
Advantages and Disadvantages of Miter Gate Operating Machinery

Machinery Type	Advantages	Disadvantages
Ohio River Linkage (existing)	1. Inherent acceleration/ deceleration characteristics.	1. Wear, bearing forces, and mechanical inefficiencies.
	2. Requires less complex hydraulic/control system.	2. More complex operating machinery.
	3. Good/proven reliability.	3. More labor/maintenance intensive; more components to maintain and keep in adjustment or alignment.
	4. Used throughout the Ohio River System.	4. Strut exposed to lock traffic.
		5. More significant installation/ alignment issues or difficulties.
		6. Some major components require special/custom designs. Spare parts may difficult to obtain.
		7. More components requiring grease or lubrication.
Direct-Connected Hydraulic Cylinder	1. More accurate/flexible control of speed and position of gate.	1. Oil containment over waterway, although biodegradable, fish-friendly fluids will be considered. Also, modern cylinder and piping designs have virtually eliminated the possibility of leakage.
	2. Inherent spring/shock absorbing characteristics.	2. Cylinder rod exposed to lock traffic, water, and weather.

TABLE 10.2.3.4A Advantages and Disadvantages of Miter Gate Operating Machinery		
Machinery Type	**Advantages**	**Disadvantages**
	3. Smooth operation, minimal backlash or slop in system.	3. Piston rod used as a strut, resulting in a larger piston rod diameter and increasing the ratio of time-of-opening to time-of-closing. Although modern hydraulic controls can compensate for this situation.
	4. Good maintainability, fewer components to maintain and keep in adjustment or alignment.	4. Requires a more complex pumping/control system necessary to control gate acceleration/de-acceleration and compensate for opening/closing time differential.
	5. Good availability of spare parts. Most parts are commercially available.	
	6. Fewer installation/alignment issues or difficulties.	
	7. Fewer components requiring grease or lubrication. Bushings can utilize self-lubricating materials.	

Considering the above issues, operating conditions at the prototype site, and trends in the industry, direct-connected hydraulic cylinder operating machinery was selected for the new miter gates for the 600-ft lock extension alternative. Direct cost for each type of machinery incrementally favors direct-connected hydraulic cylinders. Factoring in life-cycle costs, the direct-connected machinery would also be less costly, particularly with regard to labor and material maintenance costs.

10.2.4 Existing Hydraulic Power System

10.2.4.1 General

The existing hydraulic system is a central-type pumping system, where the pumps are all located in one central location at the operations building with supply and return lines extending to and from the gate operating machinery. Separate piping systems are provided for each lock with interconnection at the pumps in the operations building. The arrangement provides the flexibility for taking either or both of the systems (main or auxiliary lock systems) out of service for repair or maintenance. This arrangement will facilitate modifications considered for the 600' lock extension alternative, because work on the auxiliary lock can proceed without interfering with operations at the main lock.

10.2.4.2 Condition of Existing System

According to Periodic Maintenance Report No. 8 dated June 1996, the existing hydraulic system is in satisfactory condition, although some piping has been replaced due to excessive corrosion in some locations.

10.2.4.3 Proposed Modifications

Hydraulic piping, control valves, and other devices in the existing hydraulic power system in connection with the 600' lock will be abandoned in favor of new hydraulic power units for each new and existing miter gate.

10.2.5 New Hydraulic Power System

Central and local pumping systems were considered for the prototype project. Central pumping systems are characterized by centrally located pumps, as noted in Section 10.2.4.1. Local pumping systems are stand alone pumping or power units located at each individual operating cylinder or several "local" cylinders.

The main issue to consider in selecting a system is whether to extend the existing system of hydraulic piping and controls to the new miter gates, and possibly the new culvert valves, or whether it is more appropriate to leave the existing system intact, to the extent possible, and add stand alone, local pumping systems for the new gates. The following advantages and disadvantages, shown in ***Table 10.2.5A*** were considered.

TABLE 10.2.5A
Advantages and Disadvantages of Hydraulic Power Systems

System Type	Advantages	Disadvantages
Central Pumping System (existing)	1. Minor increase in O&M costs, mainly for additional piping runs and control stations.	1. Size of cylinder constrained due to 800 psi working pressure limitation.
	2. Cost to retrofit existing system probably less than providing local pumping units.	2. Abandonment of existing miter gate operating machinery may be required to minimize the net impact on system modifications, but not necessarily a requirement.
Local Pumping System	1. Creates an opportunity to increase working pressure to reduce the size and cost of cylinders and power unit equipment.	1. Requires a watertight or elevated structure for housing the power unit.

TABLE 10.2.5A Advantages and Disadvantages of Hydraulic Power Systems		
System Type	**Advantages**	**Disadvantages**
	2. Eliminates the need to modify the existing hydraulic system.	2. Requires the existing standby generator to be replaced with a larger capacity unit. Accumulators could also be used to provide stored energy to operate the gates, depending on specific requirements.
	3. Reduces the amount of field piping and galleries or trenches.	3. Increases O&M due to introducing new equipment.
	4. Reduces the amount of system headloss to improve energy conservation.	

Each of the two types of hydraulic systems has advantages and disadvantages. In light of recent trends at other lock projects and considering the above issues, we believe it would be appropriate to provide local hydraulic power units (HPUs) with associated piping systems for operating the new and existing miter gates in the auxiliary lock. Each HPU will be interchangeable between upstream and downstream (i.e., existing and new) miter gates.

Given the arrangement and relative location of miter gates and culvert valves throughout the auxiliary lock, three installation scenarios for the HPUs are appropriate for the project:

1. Provide an HPU for each miter gate and culvert valve.
2. Provide an HPU for a single miter gate.
3. Provide an HPU for a single culvert valve.

A combination of all the above installation scenarios are planned, for a total of six HPUs.

1. The HPUs near C.S. 1L and 3L will operate the adjacent miter gate leaf and culvert valve (Items 6, 8, 12 and 15 on Drawings 10.0A and B).

2. The HPUs near C.S. 2M and 5M will operate the adjacent miter gate leaf only (Items 6 and 8 on Drawings 10.0A and B) as the adjacent culvert valves are connected with the main lock and existing hydraulic systems.

3. The HPUs for the existing auxiliary lock emptying valve (Item 13 on Drawing 10.0A and the new auxiliary lock filling valve (Item 14 on Drawing 10.0A) will operate the adjacent culvert valve only.

Installation of each miter gate HPU will depend on its location. The following installation alternatives are possible.

1. A semi-permanent installation where the power units are installed in enclosures on top of the lock walls with the power unit designed for temporary removal in case of flooding.

2. A permanent installation where the power units are installed in watertight enclosures on top of the lock walls with the enclosure designed to withstand the forces of flooding and the impact load of floating debris.

3. A permanent installation where the power units are installed in watertight enclosures on top of the lock walls with the power units elevated above flood stage. This approach would be similar to the existing HPU installation on the second floor of the Operations Building.

4. A permanent installation where the power units are installed in a watertight cavity in the lock walls. Although the power units would be installed below flood stage, a watertight hatch would be provided to prevent flooding of the cavity.

Installation of the power units for the upper or upstream set of existing miter gates could follow Alternatives 1 – 3. It would not be practicable to install the power units for the upper existing miter gates according to Alternative 4 because of the significant lock wall modifications that would be required. Installation of the lower or downstream set of miter gates could follow Alternatives 1 – 4. Alternative 4 is shown for the power unit installation at the lower set of miter gates in ***Drawing 10.0C***.

Trenches for the new hydraulic system will be used instead of galleries for routing piping and conduit.

10.2.6 Existing Control Stations

The existing control stations will be modified to provide manual override/backup control of the gates.

In the auxiliary lock, the lower control stations (C.S. 3M and 2L on Drawing 10.0B) will be removed, as the miter gates and operating machinery will also be removed from service. The control station concrete structures will remain intact.

10.2.7 New Control Stations

The new control stations will be designed to provide manual override/backup control of the gates. New stations C.S. 3L and 5M are shown on ***Drawing 10.0B***.

10.3 CULVERT VALVES AND BULKHEADS

10.3.1 Existing Culvert Valves

10.3.1.1 General

The existing culvert valves are vertically-framed, reverse tainter type. The valves consist of a skin plate, concentrically curved ribs, struts, and trunnions. The valves are weldments of plate and structural shapes.

10.3.1.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing culvert valves are in satisfactory condition.

10.3.1.3 Rehabilitation of Existing Equipment

No modifications or replacements of the existing culvert valves are envisioned for the prototype alternative. Only standard part replacement and maintenance on an as-needed basis has been considered at this time. A nominal budget amount will be included in the estimate (for site-specific adaptations) for basic repair/refurbishment of the valves, including inspection/ testing, hoist seals/pads and rubber goods replacement, oil and lubricating grease replacement, minor mechanical/electrical work, etc.

10.3.2 New Culvert Valves

New filling and emptying culvert valves will be required for the prototype 600' lock extension. Reverse tainter valves and vertical-lift gate valves were considered for the prototype project. Reverse tainter valves are similar to the existing valves described in Section 10.3.1.1. Vertical-lift gates consist of a simple flat, structural-steel gate leaf with rollers or wheels which create rolling friction, instead of sliding friction, to reduce valve operating loads. Two variations of vertical-lift gates were considered, fixed-wheel gates and Stoney gates. The following advantages and disadvantages were considered to compare these types of culvert valves.

TABLE 10.3.2A Advantages and Disadvantages of Culvert Valves		
Valve Type	**Advantages**	**Disadvantages**
Reverse Tainter Gate (existing)	1. Vast experience and similar to most other culvert valves in use at similar lock facilities.	1. Generally a more complicated gate structure.
	2. Proven design, good reliability.	2. Requires larger "footprint" and larger chamber to retract gate than vertical-lift gates.
	3. Good discharge characteristics.	3. More complicated and relatively large monolith; monolith more expensive.
	4. Smooth channel or conduit walls, absent of gate slots.	4. High concentrated loads at trunnions.
	5. Generally lower hoist loads than vertical-lift gates.	5. Aside from Stoney gate, the operating machinery for reverse tainter gates can be more complex than vertical-lift gates, although this can depend on the chosen arrangement. Using direct connect hydraulic cylinders simplifies the installation.
	6. Generally less maintenance, particularly when compared to Stoney gates.	6. Difficult to pull gate for major maintenance, although most work can be done with the valve in-place.
	7. Less complicated valve mechanical design, requires no load rollers or wheels.	
	8. Less complicated hoist design than Stoney gates, particularly when direct connect hydraulic cylinders are used.	
Vertical-Lift Gate, including Stoney Gates	1. Can be fitted into a relatively narrow slot with small "footprint."	1. Gate guides/slots required, creating flow disturbances.
	2. Proven design. Simple to fabricate and install.	2. Gate can jam due to silt or debris build-up in slots.
	3. Less expensive to fabricate than tainter gate.	3. Stoney gates require higher maintenance due to the design and arrangement of the load rollers and treads.
	4. Easier to remove gate from gate slot for maintenance.	
	5. Simple and relatively small monolith; monolith less expensive.	

Culvert valve selection for the prototype project was driven on the basis of four main issues, which are listed below in descending order of precedence.

1. Experience.

2. Reliability.

3. Maintenance.

4. Performance

Other issues, such as the cost or the complexities in civil construction were taken into account but considered to be less of a factor in culvert valve selection.

In terms of experience, the vast majority of lock facilities, particularly facilities built in the last 40-years, use reverse tainter gates. During this period a tremendous amount of test data and experience has been gained regarding reverse tainter gates. This experience far outweighs that of vertical lift and Stoney gates for culvert valve applications. In addition, the lock staff is accustomed to operating reverse tainter valves, as reverse tainter valves are located in six other areas at the existing site.

As far as reliability issues are concerned, reverse tainter gates represent a proven design with excellent reliability. By contrast, the reliability of Stoney gates is considered to be less than reverse tainter gates, primarily due to the Stoney gate's more complicated mechanical design. On account of the frequency of operation, the Stoney gate load rollers and treads typically wear rapidly and involve more complicated and expensive maintenance than reverse tainter gates. Also, the hoist design of Stoney gates is more complicated than gates operated with direct connect hydraulic cylinders because of the need to operate the gate slide and roller train at different speeds.

In addition to experience and reliability, valve selection is also driven by maintenance considerations. As noted previously, the Stoney gate design involves a fairly complicated load roller and hoist design. The load rollers have numerous links, bushings, and rollers. These items wear and must be replaced periodically. In contrast to the Stoney gate, the reverse tainter gates have significantly fewer moving and wearing parts and the degree of maintenance is much less. Another maintenance-related issue worth noting relative to valve selection is interchangeability, in the same manner as the miter gate exchange program mentioned previously. Reverse tainter gates are already in use at the prototype site and at most other projects upstream and downstream of the site. So an opportunity exists to exchange in-service gates with newly refurbished gates, to reduce the amount of maintenance downtime. As a final note regarding maintenance, the lock staff is accustomed to maintaining similar valves.

The last main issue considered with respect to valve selection pertains to performance, which can relate to hydraulic, mechanical, and other performance issues. Reverse tainter gates offer good discharge characteristics, as do vertical lift gates. For culvert valve applications, however, extensive hydraulic data is available for reverse tainter valves and presumably less up front effort is required to produce a final valve design. In addition, reverse tainter valves do not require guide or bearing slots in the culvert walls and provide a smooth surface with fewer hydraulic disturbances. From a mechanical perspective, reverse tainter gates typically require

lower hoist loads than vertical lift gates, making the hoists incrementally smaller and less expensive.

Most of the noted disadvantages of reverse tainter gates relate primarily to concrete work. We believe the concrete-related issues are less of a factor, however, and carry less weight than the experience, reliability, maintenance, and performance issues described above. It is for these reasons that reverse tainter gates were selected as the culvert valves in the 600-ft. lock extension alternative.

As indicated above the valves will be vertically framed. It is worth mentioning that two other types of reverse tainter gates are in use at various projects, horizontally framed and double skinplate. From a structural point of view, horizontally framed valves are more desirable, however, these valves do not perform hydraulically as well as vertically framed or double skinplate valves. Due to their weight, double skinplate valves perform better than vertically framed valves. For low-head applications like the prototype site, vertically framed valves are more economical than double skinplate valves and perform as well hydraulically. A conceptual arrangement of the prototype culvert valve is shown on ***Drawing 10.0D***.

10.3.3 Existing Culvert Valve Operating Machinery

10.3.3.1 General

The existing culvert valve operating machinery consists of a horizontal rocking type cylinder, with the piston rod directly connected to one end of a vertical bell crank. A pipe strut, with helical spring shock absorber, connects the other end of the bell crank to the culvert valve. The operating machinery for the culvert valves is hydraulically operated from the existing central, constant pressure power system.

10.3.3.2 Condition of Existing Equipment

According to Periodic Maintenance Report No. 8 dated June 1996, the existing culvert valve operating machinery is in satisfactory condition.

10.3.3.3 Rehabilitation of Existing Operating Machinery

No major rehabilitation is envisioned at this time; only standard part replacement and maintenance on an as-needed basis.

10.3.4 New Culvert Valve Operating Machinery

Wire rope and hydraulic cylinder type operating machinery were considered for the prototype project, based on using reverse tainter valves. Wire-rope type operating machinery is an electro-mechanical drive and consists of electric motors driving hoisting drums through shafting and multi-stage reduction gear boxes. The valves are raised by wire ropes and close by gravity. Hydraulic cylinder type operating machinery consists of a hydraulic cylinder operating the valves. The valves open and close by stroking the cylinder. Gravity closure can be more easily achieved using hydraulic cylinders than with wire rope hoists, due to self-braking characteristics.

In some lock applications involving hydraulic cylinders, the cylinders are mounted horizontally, with the piston rod directly connected to one end of a wire rope. The rope travels over and around a sheave and extends vertically down to the gate leaf. This arrangement reduces the risk of oil leaks and increases the accessibility of the cylinder. The arrangement also simplifies removal of the gate without disturbing the cylinder. For the 600-ft lock extension alternative, however, the culvert dewatering bulkheads might be located too close to the culvert valves. Therefore, little or no room may be available to horizontally mount the cylinder. Other arrangements include vertically and diagonally mounted cylinders. Final selection of cylinder mounting orientation will be determined later, as layouts of the valve monoliths become more defined. For the time being ***Drawing 10.0D*** shows a diagonally mounted cylinder.

The following advantages and disadvantages were considered in the selection of operating machinery for the culvert valves.

TABLE 10.3.4A
Advantages and Disadvantages of Culvert Valve Operating Machinery

Machinery Type	Advantages	Disadvantages
Wire Rope	1. Good/proven reliability.	1. Wear and mechanical inefficiencies.
		2. Relatively more complex operating machinery.
		3. Requires a dedicated hoist for each gate.
		4. Requires back-up power supply to operate gate.
		6. Some components may require custom designs. Spare parts may be not as obtainable as hydraulic components.
		7. More components requiring grease or lubrication.

TABLE 10.3.4A Advantages and Disadvantages of Culvert Valve Operating Machinery		
Machinery Type	**Advantages**	**Disadvantages**
Hydraulic Cylinder	1. More flexible control of gate speed.	1. Oil containment in water conduit, although biodegradable, fish-friendly fluids will be considered. Also, modern cylinder and piping designs have virtually eliminated oil leakage.
	2. Inherent spring/shock absorbing characteristics.	2. May be expensive to adapt Stoney gates for 2:1 reeving.
	3. Smooth operation, minimal backlash or slop in system.	
	4. Good maintainability.	
	5. Good availability of spare parts. Most parts are commercially available.	
	6. Fewer components requiring grease or lubrication. Bushings can utilize self-lubricating materials.	
	7. Inherent braking for gravity closure.	

Considering the above issues, operating conditions at the prototype site, and selection of culvert valves, hydraulic cylinder type operating machinery was selected for the new culvert valves for the 600-ft lock extension alternative.

10.3.5 Existing Hydraulic Power System

10.3.5.1 General

The existing hydraulic system is a central-type pumping system, refer to Section 10.2.4 for a more complete description of the system.

10.3.5.2 Condition of Existing System

According to Periodic Maintenance Report No. 8 dated June 1996, the existing hydraulic system is in satisfactory condition, although some piping has been replaced due to excessive corrosion in some locations.

10.3.5.3 Proposed Modifications

Hydraulic piping, control valves, and other devices in the existing hydraulic power system in connection with the 600' lock will be abandoned in favor of new hydraulic power units for each new and existing culvert valve.

10.3.6 New Hydraulic Power System

Refer to Section 10.2.5 for an evaluation of hydraulic power systems. Local HPUs will be provided.

Installation of each culvert valve HPU will depend on its location. The following installation alternatives are possible.

1. A semi-permanent installation where the power units are installed in enclosures on top of the lock walls with the power unit designed for temporary removal in case of flooding.

2. A permanent installation where the power units are installed in watertight enclosures on top of the lock walls with the enclosure designed to withstand the forces of flooding and the impact load of floating debris.

3. A permanent installation where the power units are installed in watertight enclosures on top of the lock walls with the power units elevated above flood stage. This approach would be similar to the existing HPU installation on the second floor of the Operations Building.

4. A permanent installation where the power units are installed in a watertight cavity in the lock walls. Although the power units would be installed below flood stage, a watertight hatch would be provided to prevent flooding of the cavity.

Installation of the power units for the existing culvert valves could follow Alternatives 1 - 3. It would not be practicable to install the power units for the existing culvert valves according to Alternative 4 because of the significant lock wall modifications that would be required. Installation of the new culvert valve HPUs could follow Alternatives 1 – 4.

Trenches for the new hydraulic system will be used instead of galleries for routing piping and conduit.

10.3.7 Existing Control Stations

The existing control stations will be modified to provide manual override/backup control of the valves.

10.3.8 New Control Stations

The new control stations will be designed to provide manual override/backup control of the valves.

10.3.9 Existing Culvert Valve Bulkheads

10.3.9.1 General

The existing culvert valve bulkheads consist of a flat, structural-steel gate leaf that has a skin plate, beams, and girders. The bulkheads are installed to provide upstream and downstream closure for maintenance dewatering of the culvert valves.

10.3.9.2 Condition of Existing Bulkheads

According to Periodic Maintenance Report No. 8 dated June 1996, the existing culvert valve bulkheads are in satisfactory condition.

10.3.9.3 Proposed Rehabilitation

Proposed modifications to the existing equipment will be developed after a condition assessment has been obtained from the District.

10.3.10 New Culvert Valve Bulkheads

Two new culvert valve bulkheads and four sets of bulkhead slots are proposed for the 600-ft lock extension. The new bulkheads will be installed upstream and downstream of the new culvert valves in the 600-ft lock extension alternative. The new bulkheads will be similar in size, design, and construction as the existing bulkheads. Each bulkhead will be a weldment of plate and structural shapes, horizontally-framed, and fabricated into a single piece. The estimated weight of each bulkhead is 50,000 lb. The estimated weight of bulkhead embedded parts is 25,000 lb.

10.4 MISCELLANEOUS MECHANICAL SYSTEMS

10.4.1 Trashrake

The new filling conduit intake will be equipped with a trashrake for removing and keeping the intake racks clean of floating and submerged trash, such as grass, weeds, tree branches, plastic rubbish, etc., collected on the rack bars. The rake will be hydraulically operated and complete with superstructure, telescoping or cable operated boom with raking head, service platform, debris spillway and ramp, and controls to provide an automated system. The raking device could be either stationary, raking the entire rack width in one cycle, or moveable, raking the rack in two or more cycles.

10.4.2 Raw Water System

10.4.2.1 General

The existing raw water system is used for general clean-up and washdown purposes and for fire protection at the lock. Water is provided by a vertical deep well pump that is located in a sump beneath the operations building. Raw water lines extend from the pump to the pipe galleries and lock wall deck areas.

10.4.2.2 Condition of Existing System

Available inspection reports did not have information pertaining to this equipment.

10.4.2.3 Rehabilitation of Existing System

The existing raw water system will be modified by extending piping runs on both sides of the lock chamber to the end of the new auxiliary lock in the same manner as the main lock. The rehabilitation needs of the existing system will be determined after a condition assessment has been obtained from the District.

10.4.3 Compressed Air System

10.4.3.1 General

The existing compressed air system is provided for general service throughout the lock and for supplying air jets for the bubbler system at each miter gate recess to eject ice and debris. Air is provided by an electric motor-driven vertical two-stage compressor unit that is installed on the second floor of the operations building. Compressed air lines extend from the compressor/ receiver tank to the pipe galleries and lock wall deck areas.

10.4.3.2 Condition of Existing System

Available inspection reports did not have information pertaining to this equipment.

10.4.3.3 Rehabilitation of Existing System

The existing compressed air system will be modified by extending piping runs on both sides of the lock chamber to the end of the new auxiliary lock in the same manner as the main lock. The extension will provide air service along the new section of the auxiliary lock and supply air for the bubbler system at each new miter gate recess. The rehabilitation needs of the existing system will be determined after a condition assessment has been obtained from the District.

10.4.4 Potable Water System

At the present time no refurbishment or modifications are envisioned for the existing potable water system. The existing system will remain intact unless it is determined that the lock extension will require modifications.

10.4.5 Fuel Oil System

At the present time no refurbishment or modifications are envisioned for the existing fuel oil system. The existing system will remain intact unless it is determined that the lock extension will require modifications.

10.4.6 Sewage System

At the present time no refurbishment or modifications are envisioned for the existing sewage system. The existing system will remain intact unless it is determined that the lock extension will require modifications.

SECTION 11

ELECTRICAL DESIGN

11.1 GENERAL REQUIREMENTS

For the 600' lock extension, new miter gates operated with direct connected cylinders will be provided downstream. The existing upstream gates, as well as the new downstream gates, will each be equipped with new hydraulic power units. The upstream gates' operating machinery will be retained, but retrofitted with sensors and other devices to facilitate remote operation/indication. The existing and new culvert valves will each be equipped with new hydraulic power units.
It is anticipated that the added electrical loads of the new hydraulic power units will exceed the spare capacity of the existing electrical power supply system.

11.2 POWER SUPPLY AND DISTRIBUTION

The existing power distribution system consists of a 12.5 kV overhead distribution circuit from SIGECO; three single-phase, step-down transformers (each 333 kVA) located at the Service Mound; a main motor control center (MCC), located on the second floor of the Operations Building; and a 150-kW diesel engine generator, also located in the Operations Building. Two 3-conductor, direct buried, 500 kcmil copper cables connect the step-down transformer on the Service Mound to the MCC in the Operations Building. The electrical equipment appears to be about 30 years old, with no reported modifications or additions since its installation in the mid 1960s.

Several alternatives have been considered for providing service to the new electrical loads:

1. Use the existing distribution system to the extent possible with the addition of new circuit breakers, as required for new feeder circuits, in the existing MCC.

2. Install a new MCC for the new loads only.

3. Install a new MCC in a location different from the existing MCC, for feeding the new loads, but with added capacity for feeding all existing loads.

4. Install a new MCC in the same location as the existing MCC, for feeding the new loads, but with added capacity for feeding all existing loads.

The thought process for selecting an alternative for the prototype site is included herein in order to facilitate the decision making process when the prototype design is adapted to other sites.

Alternative 1, install new circuit breakers as required in the existing MCC, is considered to be the least cost option, and would be selected if sufficient spare capacity exists to serving the new loads. For the 600' lock extension alternative, the new electrical loads were estimated to be 180 kVA (160 kVA for the new hydraulic power units and 20 kVA for new lighting circuits and miscellaneous small loads). The spare capacity of the existing system (excluding the emergency generator) appears to be in the order of 100 - 125 kVA. This estimate is based on information in the original lock Design Memorandum No. 3, which states that the power distribution system was sized for a future load addition of 225 kVA for tow haulage units. The current inventory list of electrical equipment shows only one 40 Hp motor for tow haulage units, which, if no other loads have been added, would imply a design spare capacity of about 185 kVA. The calculated initial full load current shown in Design Memorandum No. 3 is 406 A, which, when added to the 40 Hp tow haulage motor, becomes about 455 A. It appears that the MCC main circuit breaker, rated at 600 A according to the One Line Diagram, is the limiting component in the power distribution system, since it would have a design spare capacity of about 145 A, equating to about 120 kVA. Therefore, it appears that for the J.T. Myers site, there is marginal to insufficient spare capacity in the existing power supply system and Alternative 1 is consequently discarded.

Alternative 2, install new MCC for new loads only, would be considered only if Alternative 1 were not feasible and the existing MCC were considered to be in good condition with a reasonable amount of remaining service life.

Alternatives 3 and 4, replace the existing MCC, would be considered only if the existing MCC were considered to be close to or at the end of its useful life, and had unacceptably high maintenance costs. The Louisville District reports that a survey of electrical systems on the locks was carried out in 1997, and no significant deficiencies were reported for the electrical systems of the J.T. Myers lock. Based on this information, Alternatives 3 and 4 would normally be rejected. However, because project implementation is expected to occur around 2010, the existing equipment will, at that time, be approaching the end of its useful life and should be replaced. Of the two approaches, Alternative 3 would normally be the preferred, provided that suitable physical space is available for a new MCC, since Alternative 4 would entail significant outage time and interruption of electrical service during construction. Alternative 4 would require removal of the existing MCC prior to installation of the new MCC, which would imply interruption of electrical service. At the J.T. Myers site, Alternative 3 will be selected. It is anticipated that the new equipment will be located in the new control room structure to be constructed on top of the existing Operations Building.

Drawing 11.0A shows a One Line Diagram that depicts the proposed power distribution system.

This arrangement includes two transformer taps from the utility distribution feeder. Each transformer and its feeder to the MCC would be sized for the entire lock load such that full redundancy is achieved. This system will simplify maintenance operation and also facilitate easy cut-over of loads from the existing to the new MCC.

Cable routing will be using existing raceways to the extent possible in the existing locks and will be in trenches on top of the lock walls for the lock extension. The existing cables are mainly run in cable trays in the lock wall galleries. These raceways will be reused to the extent possible for new cables. Transitions will be provided from the gallery to a utility trench located in the top surface of the lock wall at the ends of the existing galleries. The final interface configurations will be determined during future design phases.

11.3 STANDBY GENERATION

Locks supplied by a single, radial utility distribution line need a backup source of power supply, due to the inherently insufficient reliability of radial distribution systems. Backup power supply is normally provided by a standby, on-site engine-generator set, sized to provide sufficient power for lock operation during utility power outages. Two main options exist for selection of standby generator voltage:

1. Low voltage to match the lock main distribution system, normally 480 V.

2. Medium voltage to match the utility voltage level, normally 12.5 kV or 13.8 kV.

Economics will normally dictate that the low voltage option is selected, since both the generator and associated automatic transfer equipment rated for low voltage is less costly than equipment rated for medium voltage.

The existing standby generator is rated at 150 kW, 0.8 power factor, and is sized to operate the following, according to the original lock Design Memorandum No. 3:

1. Hydraulic pump motor: 75 Hp.

2. Dam tainter gate hoist: 30 Hp.

3. Pressure holding oil pump motor: 15 Hp.

4. Partial lock wall lighting: 20 kW.

5. Operation building lighting: 6 kW.

6. Miscellaneous power and lighting: 8 kW.

The new, added critical load would result primarily from the new hydraulic power units and some lighting loads. The generator is located in the Operations Building in the vicinity of the MCC and there appears to be little or no spare capacity for even lighting loads. Furthermore, space is limited for installation of a larger engine-generator. Therefore, if it is decided to install

a new and larger engine-generator set, it should be located at the Service Mound. The existing standby generator will be at the end of its useful life at the time of project implementation (~2010) and is not considered suitable for further service as part of the new lock electrical service system.

The new standby generation system could consist of one large generator sized to supply all critical loads, or it could consist of two smaller generators, each sized for approximately half of the total lock critical loads. Given the double-ended MCC configuration with dual transformers, two equally sized standby generators, each connected to one of the transformer taps though an automatic transfer switch, is considered the preferred system. This system is shown in ***Drawing 11.0A***. The generator set will include the necessary automatic transfer equipment.

Using two generators, each sized for the entire critical load, is considered unnecessary, since lock loads would not be interrupted for any single contingency failure, when using the concept of the two smaller generators.

Locating the standby generator at the Service Mound would remove the existing fuel line from the fuel tank to the Operations Building, and free up space in the Operations Building. This location could reduce the reliability of the standby generation system marginally, since a failure of the 480 V power cable between the Service Mound and the MCC in the Operations Building would disconnect the standby generator from the lock. This risk is considered to be acceptable, since an underground low voltage power cable is normally very reliable, and there are dual power cable feeders to the MCC. As an alternative to replacing the standby generator, future work should review the possibility of using accumulators connected to the new hydraulic power units to provide backup "power" for gate and valve operation in the case of utility power outages.

11.4 OPERATING AND CONTROL SYSTEM

Most existing locks have conventional hard-wired control systems, except locks that have been constructed or refurbished in recent years, which may have modern, digital controls based on programmable logic controllers (PLCs). The existing locks are controlled from local control stations only, each located at the respective gate position, with no centralized control room. Even if the existing hard-wired controls operate satisfactorily, it is recommended that the extended lock be operated from a new central control room. The new central control room will be located on top of the existing Operation Building and will be sized to also accommodate future remote control of the existing 1200' lock. Fiber optics will be used for the remote control systems. The new centralized controls will provide benefits in terms of enhanced lock operation safety and reduced labor costs. Local, manual controls will also be provided for each gate and valve for emergency operation and back-up to the centralized control systems. Sensitive electrical equipment in the local control stations will be designed to be unplugged and removed during periods of flooding.

11.5 GATE AND VALVE CONTROL

Centralized control from a new control room will be provided for the new and existing miter gates of the extended lock. CCTV systems will provide visual inspection of lock areas that can not be seen easily from the Operations Building. The automated system will include safety interlocks to minimize the risk of operator mistakes and have extensive data logging capabilities.

The new emptying and filling culvert valves will be controlled from the central control room. Local, back-up controls will also be provided.

11.6 SIGNAL SYSTEM AND NAVIGATION LIGHTS

The existing horn signal circuits and the navigation traffic light circuits will be extended to cover the 600' extended lock.

Traffic lights will be relocated on the upstream end of the 1200' lock to the end of the new guard wall.

New lighting of conventional design will be provided for the 600' extension. The existing lighting systems are reported to be at the end of their useful life, and plans for replacement are underway. High mast type lighting will not be used.

11.7 MOORING FACILITY POWER SUPPLY

Power supply to the new mooring facility will be provided from the new MCC in the Operations Building, thus facilitating backup from the standby generator. Voltage drop considerations dictate the use of 480 V supply cable to the mooring facility with a small step-down transformer for 120 V service at the facility.

SECTION 12

HAZARDOUS AND TOXIC MATERIALS

A Phase I HTRW assessment for the J.T. Myers site has been completed. The Phase I assessment revealed the potential to encounter contaminated sediments from wet excavation operations associated with construction activities. Further investigation was recommended. Using Louisville District maintenance dredging sampling data from recent work near the J.T. Myers site, analysis results indicated that there should be no significant contamination associated with these sediments. However, the laboratory quality control parameters associated with the analysis did not meet current Indiana Department of Environmental Management (IDEM) criteria. Therefore, the Louisville District is preparing a quality assurance project plan (QAPP) and field sampling plan (FSP) to meet current IDEM criteria. Coordination with IDEM is ongoing, and positive feedback, regarding the approach the District is taking, has been received. The plan is to have IDEM approve both plans in time for the Interim Report. Depending upon funding, sampling and analysis will, hopefully, occur during fiscal year 2000.

SECTION 13

REAL ESTATE

As currently planned, new real estate acquisition will be minimal for this project. In the proposed design, all new construction, approach channel improvement, disposal areas, and mitigation sites fall within existing United States government property. Refer to ***Drawings 13.0A***, ***13.0B***, and ***13.0C***. Construction activities include extending the existing 600' lock chamber, constructing new approach walls, improving the downstream approach channel for navigation concerns, building a new work-fleet mooring area, and constructing a temporary mooring facility for construction staging. In addition, there are seven in-stream mitigation site locations that are under consideration. Further detail can be found in the Real Estate Appendix.

Total disposal requirements are discussed in Section 8.3. Approximately 870,000 cubic yards of disposal material is anticipated for this project. As planned, approximately 46.7 acres immediately downstream and north of the J. T. Meyers project site have been identified for the disposal area, which is shown in ***Drawing 8.3A***. With a final top of disposal mound El. 367, as shown on the disposal cross section in ***Drawing 8.3B,*** the entire disposal amount can be accounted for within this area. However, stretching the proposed area to the size of 94 acres (as shown in ***Drawing 13.0A***) still does not impact existing wetlands. Therefore, in order to reduce the top of disposal mound elevation, the disposal area will be expanded. It will fit within the 94 acres that have been identified, and the top of disposal mound elevation will be reduced from what is currently shown. The top of disposal mound elevation shall be held at or below El. 358, which is below the existing road at the site.

In order to have available options in case of changes in spoil and mitigation plans during future design phases, two additional disposal site alternatives have been identified. Therefore, there are a total of three alternative locations for disposal and/or mitigation sites.

Alternative No. 1 – (Current Plan) All mitigation and spoil material will be placed on government land on the existing project site, including adjacent government land that is currently leased to the Indiana Department of Natural Resources for habitat restoration.

Alternative No. 2 – (First Option) Some disposal will be placed within the property limits of the existing project site. All additional mitigation and disposal will be placed on land at Hovey Lake on government, which is presently under lease to the State of Indiana. In the Hovey Lake area, there are 143 acres, at various locations, that could use some improvement and, therefore, would be good candidates for spoil and mitigation sites.

Alternative No. 3 – (Second Option) Some disposal will be placed within the property limits of the existing project site. All additional mitigation and disposal will be placed on private

land that is immediately adjacent to the existing project site on the east side. There are approximately 467 acres on this private land to work with.

In Alternatives No.2 and No. 3 above, haul roads will be required for movement of material and equipment. As shown in ***Drawing 13.0B***, existing county roads can be used for these purposes.

The seven proposed in-stream mitigation plans are provided as additional, desirable mitigation site designs that could be used instead of or in addition to the primary alternatives for excavated material placement, which are described above. All lie below the ordinary high water mark and are all located within existing navigation servitude. They are located at the following approximate river mile locations: ORM 846, ORM 908, ORM 837, ORM 833, ORM 912, ORM 807, and ORM 846. More detail on these options can be found in the Environmental Impact Statement (EIS).

SECTION 14

CONSTRUCTION PROCEDURES/ WATER CONTROL PLAN

This section briefly describes an overview of the construction procedures and the water control plan for each construction stage of the prototype design for the 600' lock extension shown in ***Drawing 6.0A***. Many of the construction techniques and procedures are described in greater detail in other sections of this appendix, including Section 9.4. The following construction procedures are listed in their recommended order of completion.

14.1 NEAR SITE WORK STATION

A near site work station must be constructed in order to provide temporary construction moorage for the deep draft construction stages of the float-in structures. First, a construction access road will be constructed to connect the existing road to the near site work station for delivery of materials and equipment during construction. The near site work station will most likely be composed of a dredged area and channel, a work trestle platform, and mooring dolphins. The affected area should be dredged to an elevation of El. 300±. It is anticipated that the work station will be constructed on the riverbank approximately 350 feet from the end of the existing downstream middle wall end monolith and will be large enough so that three structures (the float-in wall monolith, the wall diffuser, and the miter gate bay) may be moored there simultaneously. As the footprints of these float-in structures will be 55' x 463' for the land wall monolith, 100' x 182' for the miter gate bay, and 42'-6" x 111' for the landside wall diffuser monolith, it was determined that the dredged area should be approximately 200' x 900'. This location should place the work station out of the way of barge traffic, and the dredged area should provide a wide channel for transport of the deep draft float-in shell structures to their final design locations.

The working platform, adjacent to the river bank, could be composed of a trestle which is approximately 40 feet wide and is U-shaped in plan view. The portion of the trestle which will be parallel to the riverbank is anticipated to be approximately 250 feet long. Approximately ten temporary dolphins, each composed of three steel pipe piles and rock anchors, will be required along the riverbank and work platform to provide moorage for the float-in structures while work is performed on them.

No closures of the existing locks are anticipated for this work as it does not obstruct the barge traffic. However, as wind often pushes barges toward this area, either helper tugs or a temporarily anchored section of approach wall will be required while this area is in use, in order to prevent accidental impact.

14.2 NEW MOORING FACILITY, INTAKE STRUCTURE, AND WRAP AROUND CULVERT

Prior to construction of the wrap around culvert intake structure, a new upstream mooring facility must be constructed, and salvageable portions of the existing mooring facility must be relocated. This work can be completed very early in the construction schedule, and it is expected to take approximately 2 months. As the work is outside of the normal approach path, it is anticipated that most of the work may be completed without helper tugs or lock closures. However, it is possible that construction of the sheetpile cell may require either a short lock closure or helper tug assistance.

Depending on the desired permanent location of the mooring facility access road, it may be necessary to construct a temporary access road during construction of the intake structure and then construct a permanent access road after the upstream dewatering berm is removed.

A berm with sheetpiling, which extends down to rock, will be utilized in order to construct the intake structure and wrap around culvert in-the-dry. The existing mooring facility tieback sheetpile wall will be left intact during construction, forming a portion of the berm. It will be removed during berm removal. The new intake structure will be positioned downstream of this mooring facility wall and landside of existing land wall monolith L-29. It will have two wingwalls which will be composed of drilled shafts and precast concrete panels. See ***Drawing 9.4.1A*** for the intake structure location and wingwall details.

After the drilled shafts are constructed, the area must be dewatered before the intake structure is constructed in-the-dry. The intake area may then be excavated for the precast concrete facing panels, which may be placed in-the-wet. This work should be performed with minimal, if any, impact on the existing lock traffic.

It is anticipated that the wrap around culvert will be constructed using a combination of open cut and braced excavation. The depth of excavation required varies from approximately 45 feet to 65 feet. It is recommended that the majority of the culvert be composed of 16.5-foot diameter precast concrete pipe. The 45° elbow, and the thrust block at this bend, will be constructed of CIP concrete. In order to perform this construction in-the-dry, the new float-in land wall monolith will be partially backfilled after it is in position, forming a large berm, and the area will be dewatered. As this work occurs behind the existing and new land wall monoliths, it should be completed with minimal, if any, impact on the existing lock traffic.

14.3 EXISTING LOWER LAND WALL END MONOLITHS - MODIFICATION AND DEMOLITION

The existing land wall end monolith L-1 must be demolished, and monoliths L-2 to L-5 must be stabilized, for their new loading conditions, by anchoring CIP concrete at their currently sloped back face from approximately El.310.0 to El.362.0, as well as at their heel from their foundation elevation to El. 300.0.

There are several methods available for demolishing and removing monolith L-1. Ultimately, the selected demolition method must permit continued lock operations during construction with only minor disruption. When possible, the contractor's equipment should be set up landside of the existing land wall so that the operation of the 600' lock can be maintained with minimal interruptions. Although the limited use of the wire saw-cut method has been considered, the exclusive use of wire saw-cutting has been found to be prohibitively expensive and has been deleted from consideration for this project.

It is proposed to remove the existing above water concrete down to an elevation three feet above the pool levels. The vertical line between the concrete to remain and that to be removed will be cut by a diamond wire saw, working through a pilot hole drilled just above water and operated from the top. Then the remaining concrete demolition above water will be performed by hydraulic chipping rams. Both barge-mounted and on-top equipment will be used.

The first task is to isolate the underwater concrete to be removed from that to remain, forming an isolation joint. Cutting with diamond wire saw has been used successfully on a number of other Corps projects, but here it requires a 47-foot long pilot hole to be drilled through the base of the monolith, at El. 284, 58 feet below water and 40 feet below the present mud line, although much of the mud could be dredged beforehand. The alternative method is vertical line drilling, carried out from El. 327±. If a smoother surface than that provided by line drilling is required in this area, then we would propose the use of a chipper mounted on a backhoe/excavator arm to finish this area underwater.

Because of the sloping back wall, we believe a 12" down-the-hole rock drill should be used, with a cantilevered structural template to ensure verticality and positioning. The 12" holes would be drilled so as to overlap.

We believe this latter method is more practicable and less costly.

Next, drilling and blasting of the underwater concrete will take place, starting at the exposed end of the wall (moving the structural template from the isolation joint to the exposed end) and working towards the isolation joint. Holes will be drilled on seven foot centers, each direction, using the same template to ensure verticality and position on the sloping concrete surface, as was used in producing the line drilling of the isolation joint.

Two lines will be drilled and loaded. The template will be moved. Blasting mats will be placed over the top. The lines will be fired using delays on the second line. The clamshell

dredge will remove the rubble and adjoining mud. Powder charge will be as light as practicable, about 1-1/2 to 2 lbs./cy, so as to produce rubble about 2 feet in diameter, on average.

Thus, all blasting will be working against an open face, enabling lighter charges to be used, and blasting away from the operating locks. Drilling and blasting operations are proposed to be conducted during the day, with removal of the debris during a second shift at night. Using this approach, it is anticipated that the 600' lock will be closed for only 4 days of double shift work.

The best time of year to do this demolition work, from a low river standpoint, is during the summer and early fall. From the river level data since 1976, it can be seen that, during the summer and early fall, the maximum river level is typically less than El. 332 (which is 30' below the top of the monoliths). If it is not possible to schedule this work during a low pool period, it is feasible to complete this demolition under less favorable conditions.

The monolith modification work can be accomplished working from the landside. It may be possible to schedule this work so that it is completed, in-the-dry, simultaneously with the nearby CIP concrete work on the wrap around culvert elbow and thrust block. However, it must be completed before the extended lock chamber is dewatered for installation of the miter gate and construction of the laterals and maintenance bulkhead sill so that the existing monoliths will be stable for this dewatered load condition. In any case, this monolith modification work should not require any closures of the existing lock chambers.

14.4 EXISTING MIDDLE WALL MONOLITHS - MODIFICATION

The existing middle wall monoliths M-1 to M-4 and M-6 to M-14 must be stabilized, for their new loading conditions, by installing rock anchors. Two rows of rock anchors will be required. This stabilization must be completed prior to dewatering the lower portion of the extended 600' lock. It is anticipated that this work will be accomplished from the top of the monolith or from the 600' lock channel so that no closure of the existing 1200' lock will be required.

14.5 FLOAT-IN LAND WALL MONOLITH

After some in-water excavation and bedding is done, a float-in monolith, approximately 463 feet long, will be placed in line with the existing land wall monoliths, starting in the former location of demolished monolith L-1. This float-in monolith will incorporate a culvert for the supplemental fill/empty system.

During the transportation of this monolith from the drydock location to the near site work station, an approximate draft of 10 feet is anticipated. As the minimum navigable channel depth is 9 feet during low pool, a water level of only 1 foot above low pool is required for transportation to the near site work station. Based on the requirements for the following

construction step, it may be desirable to transport the base structure during the spring. After forming the side walls for this structure up to El. 334.0, which is anticipated to take approximately 2 months, the shell structure should be lowered into position. The shell structure should be lowered into position during the dry, low pool summer and fall months so that the side walls can be shorter and the channel between the near site workstation and the final design location can be shallower.

The in-water dredging and excavation work for all of the float-in monoliths will require approximately 14 weeks of existing 600' lock closure. Seven-day work weeks and double shifting (20 hour work days) will be required. Positioning and lowering the float-in monolith should take approximately 1 day, requiring closure of the existing 600' lock. Until the monolith is grouted securely into place, the existing 600' lock will also be fully closed for approximately 7 double shift days. In addition, a helper tug will be required during the majority of the float-in construction work in order to guide the barges through the lock while keeping them away from the unfinished structure.

14.6 FLOAT-IN MITER GATE BAY AND CLOSURE POUR

Construction procedures, which are similar to those used for the float-in land wall monolith, can be used for constructing the float-in miter gate bay. This U-shaped structure is 182' x 100' long. During the transportation of the base of this structure from the drydock location to the near site work station, an approximate draft of 11 feet is anticipated. As the minimum navigable channel depth is 9 feet during low pool, a water level of only 2 foot above low pool is required for transportation to the near site work station. This water level is common throughout the year. Based on the requirements for the following construction step, it may be desirable to transport the base structure during the late spring. After forming the interior side walls for this structure up to El. 334.0, which is anticipated to take approximately 8 weeks, the shell structure should be lowered into position. This step should be performed during the dry, low pool summer and fall months so that the side walls can be shorter and the channel between the near site work station and the final design location can be shallower.

In order to correctly align the miter gate bay when it is floated into place, horizontal jacks will be placed at the bull nosed middle wall end monolith, M-1, of the existing lock. Placing these jacks, positioning the float-in monolith, and ballasting it down to its foundation elevation should take approximately 10 days, requiring closure of the existing 600' lock. Until the monolith is grouted securely into place, the existing 600' lock will also be fully closed for approximately 2 weeks. During this time, and until the structure is not in a vulnerable condition, a helper tug will be required for traffic through the existing 1200' lock.

After the miter gate bay underbase grouting is completed, the gap between the miter gate bay and the middle wall end monolith, M-1, may be filled. The construction of this closure pour is anticipated to follow these steps:

1. Place precast concrete stay-in-place form panels (with grout bags attached to bottom of panel).
2. Install high strength tie rods, with the aid of divers, to hold form panels in place.
3. Inflate the grout bags at the bottom of the form panels.
4. Pour a tremie seal and dewater the area between the forms.
5. Place reinforcing anchors and cages.
6. Place closure pour concrete.

It is anticipated that this work will take approximately 9 days and will be completed during a period when the 600' lock is closed. Barge traffic may be stopped during placement of the precast concrete stay-in-place form panels. However, it is anticipated that the impact on the existing 1200' lock traffic will be minimal.

14.7 LANDSIDE WALL DIFFUSER MONOLITH

Again, the construction procedures for the landside wall diffuser monolith will be similar to those used for the new float-in land wall monolith and the new float-in miter gate bay. The landside wall diffuser wall monolith will be 111 feet long.

During the transportation of the base of this structure from the drydock location to the near site work station, an approximate draft of 11 feet is anticipated. As the minimum guaranteed navigable channel depth is 9 feet during low pool, a water level of only 2 feet above low pool is required for transportation to the near site work station. This water level is common throughout the year. Based on the requirements for the following construction step, it may be desirable to transport the base structure during the spring. After forming the side walls for this structure up to El. 334.0, the shell structure should be ballasted down into position. The shell structure should be lowered into position during the dry, low pool summer and fall months so that the side walls can be shorter and the channel between the near site workstation and the final design location can be shallower. (In final design refinements that are not reflected in the appendix drawings, the top of monolith elevation was reduced to El. 311. This change resulted in significant cost savings. However, the associated changes in construction method have not been addressed. As the top of monolith will no longer extend above the waterline, revised construction procedures will be necessary. The revised construction approach will be investigated and finalized in future design phases.)

See the following paragraphs for the construction timing anticipated for this monolith.

14.8 MAINTENANCE BULKHEAD SILL, LATERALS AND MITER GATE

Once the miter gate bay is completed (including the closure pour between it and the middle wall end monolith, M-1), the bulkhead which will be downstream of the new miter gate will be installed and the lower portion of the extended lock chamber will be dewatered. During this dewatered period, the existing 600’ lock will be closed for approximately 13 weeks, and several construction tasks should be completed simultaneously. By completing tasks simultaneously, the required lock closure period will be minimized. During this period, the new miter gate and operating machinery will be installed, and excavation will be completed for the laterals and the maintenance bulkhead sill upstream of the new miter gate. These elements will then be constructed, and the miter gate operation will be tested and adjusted. In addition, the landside wall diffuser monolith will be constructed while the lock is dewatered. By constructing this monolith simultaneously with these other tasks, closure of the existing 600' lock is minimized.

14.9 APPROACH WALLS

Approach walls will be constructed at four locations: upper riverside, upper middle, lower middle, and lower landside. All four approach walls will consist of floating, longitudinally post-tensioned, precast concrete boxes called pontoons which will be anchored to nose piers and pylon protrusions or a stand alone pylon. These approach walls will be bounded by the lock structure at one end and a nose pier at the other end. The nose piers will be composed of three drilled shafts, a steel shell structure, and concrete infill. Skirting panels may be attached to the pontoons, as required, in order to adjust the flow. These approach walls will be very similar to the approach walls being designed for Olmsted Locks & Dam and will be constructed similarly.

A helper tug will be required during the approach wall construction. In addition, the following existing lock closures are anticipated:

- 7-week closure of the 600’ lock during upper middle wall dredging and drilled shaft excavation.
- 4-day simultaneous closures of both the 600’ and 1200’ locks during nose pier completion and approach wall positioning for the upper middle approach wall.
- 4-day closure of the 1200’ lock during nose pier completion and approach wall positioning for the upper riverside approach wall.
- 6-week closure of the 600' lock during lower middle wall drilled shaft excavation and nose pier/pylon construction.
- 4-day simultaneous closure of both the 600' and 1200' locks during nose pier completion and approach wall positioning for the lower middle approach wall.

- 7-week closure of the 600' lock during drilled shaft excavation and nose pier/pylon construction for the lower landside approach wall.

It is important to follow nose pier construction closely with approach wall pontoon placement so that the nose pier does not become an obstacle to navigation, for a long period of time, before being incorporated into an approach wall system. In addition, the upper riverside approach wall will be constructed prior to the upper middle approach wall. In this way, the tows will be able to land against the extended guard wall while construction of the middle wall is in progress.

14.10 CONSTRUCTION REQUIREMENTS

14.10.1 Overall Site Plan - Construction Areas

The overall site plan and areas potentially impacted by construction are shown on ***Drawings 13.0A***, ***13.0B***, and ***13.0C***. These drawings indicate areas which are anticipated to be required for or are affected by construction activities, including potential disposal sites and potential mitigation sites. However, exact implications will be dependent on construction techniques and procedures chosen by the contractor.

14.10.2 Temporary Staging Area

Temporary construction staging areas are shown in ***Drawings 14.9.2A*** and ***14.9.2B***, which show the upstream and downstream areas, respectively. Areas for temporary spoil, lay down, and concrete batch plant are indicated. It is anticipated that the lay down area will also be used for parking and site offices for the contractor. Again, these drawings indicate anticipated contractor needs. Actual needs will be dependent on chosen construction techniques and procedures.

SECTION 15

FLOOD EMERGENCY PLAN

There is no loss of life, outside the project area, associated with the unlikely event of a sudden failure of the John T. Myers Dam. Therefore, an emergency warning/notification plan is not required for this project. Flood emergency plans for temporary safety, during construction, will be developed during future design phases.

SECTION 16

CONSTRUCTION MATERIALS

16.1 AGGREGATE SOURCES

Within the vicinity of the J.T. Meyers L&D site near Uniontown, there are seventeen active aggregate sources within a 50-mile radius of the project site. Of these seventeen, ten are sand and gravel quarries and seven are limestone quarries. The closest sand and gravel source to the site is Delta Materials Co. in Shawneetown, Illinois, which is approximately 13 miles from the site. Another sand and gravel quarry in close proximity is another Delta Materials co. quarry in Henderson, Kentucky. The nearest limestone sources are located in Cave-In-Rock, Illinois, approximately 22 miles from the site. These include Denny-Simpson Co., Rigsby-Barnard Quarry, and Dravo Corporation. A listing of the active aggregate sources is shown on ***Table 16.1A*** denoting the type of aggregate, company name, and location.

A Construction Materials Design Memorandum will be prepared for future design phases and will address the design, as well as the sources and suitability of the various types and quantities of materials, required for constructing the new lock. The acceptability of these materials from various project-area sources will be determined. Sources will be evaluated based on their quality, availability, production capacity, and economics. A summary of test results, cost comparisons, and detailed laboratory test results will be provided. Additional aggregate testing will be necessary at the quarries to determine approval of the source. During that stage of design, additional quarries will be added to the list for evaluation. The list of quarries contained in ***Table 16.1A*** is only intended to demonstrate that materials are available in sufficient quantities and at competitive prices so that availability of materials does not unduly influence the cost of the project.

TABLE 16.1A Active Aggregate Sources J.T. Myers Lock & Dam			
Type	**Name**	**Town**	**State**
LIMESTONE	Brown, P.R., Stone Co.	Shetlerville	IL
	Cape Sandy Quarry - Mulzer Stone Co.	Alton	IN
	Cedar Bluff Stone Co.	Princetown	KY
	Denny-Simpson Co.	Cave-In-Rock	IL
	Derby Quarry - Mulzer Stone Co.	Derby	IN
	Dravo Corp. - Cave-In-Rock Quarry	Cave-In-Rock	IL
	Kentucky Stone Co.	Marion	KY
	Rigsby-Barnard Quarry	Cave-In-Rock	IL
	Riverside Stone Co.	Battletown	KY
	State Contracting & Stone Co.	Hartford	KY
	White Stone Co.	Hardinsburg	KY
	Williams Stone Co.	Rosiclare	IL
SAND & GRAVEL	Cloverport Sand & Gravel Co.	Cloverport	KY
	Daviess County Sand & Gravel Co.	Owensboro	KY
	Delta Materials Co.	Henderson	KY
	Delta Materials Co.	Sturgis	KY
	Delta Materials Co.	Shawneetown	IL
	Evansville Materials	Evansville	IN
	Gibson County Sand & Gravel Co.	Owensville	IN
	Hardy Sand Co.	Sandridge	IN
	Mt. Carmel Sand & Gravel Co.	Vincennes	IN
	Owensboro River Sand & Gravel Co.	Owensboro	KY
	Uniontown Sand & Gravel Co.	Caseyville	IL

SECTION 17

OPERATION AND MAINTENANCE

17.1 GENERAL

After completion of the 600' lock extension, operation and maintenance of the J. T. Myers L&D site and environmental mitigation areas will continue to follow current policy and guidance. Additional information and recommendations are provided below for specific new structures. These recommendations are dependent on the overall layout, design, and operating experience and are, therefore, subject to revision during final design.

17.2 MOORING FACILITY

The existing mooring facility behind the upper lock land wall will be relocated into a new harbor immediately upstream of the new inlet area. Salvageable materials, such as the existing floating dock, will be reused at the new mooring facility. As the new mooring facility will be similar to the existing facility, operation and maintenance of the new mooring facility will be comparable to the existing, with the exception of a new concrete-filled sheetpile cell, which will require periodic inspection and maintenance.

17.3 MITER GATE

Periodic maintenance such as resealing and repainting will need to be performed in accordance with current guidelines. It is anticipated that passive cathodic protection (sacrificial magnesium marine anodes) will be included in the design of the miter gates. The magnesium anodes should be periodically inspected (approximately once a year) and replaced (approximately once every ten years). For ease of replacement, it is recommended that these anodes be mounted on threaded studs which are welded to the gate. Inspection and replacement procedures and schedules should be included in the Operations and Maintenance Manual.

Bulkhead slots will be fabricated from carbon steel and painted to control corrosion. Periodic maintenance, such as repainting, will need to be performed. Repainting will be limited

to the portions of these slots which are above low water. Periodic repainting should follow procedures and schedules set forth in the current Operations and Maintenance Manual.

17.4 LOCK WALLS

Maintenance of the new lock walls will be comparable to maintenance of the existing lock walls. Periodic painting of wall armor and other lock wall appurtenances will be required. Inspection and maintenance should follow procedures and schedules set forth in the current Operations and Maintenance Manual.

17.5 APPROACH WALLS

All four proposed new approach walls will be composed of long floating pontoons, bounded by a fixed nose pier and a fixed pylon. Some of the approach walls may have collapsible skirting panels hung from the pontoons in order to provide flow control. As the existing approach walls are not floating walls, it is important to address the maintenance requirements that are specific to this wall type in more detail.

It is anticipated that water flow patterns in the vicinity of these floating approach walls will naturally flush away silt accumulating below these walls. This natural flushing will prevent the pontoons from bottoming out on the riverbed. WES modeling, to be completed during future design phases, will provide valuable insight in assessing this silt flushing assumption. Occasionally, root balls or other very large and substantial debris may sink to the riverbed below a pontoon. In order to avoid pontoon damage, local soundings may be required quarterly, and large debris removal (with the aid of draglines) may be required occasionally. Frequency of soundings may be revised after sufficient operating experience has been gained.

A cursory, overall visual inspection of the pontoon horizontal and vertical alignment should occur naturally, on a daily basis, as a result of normal lock operation. If misalignment is noted during this visual inspection, lock personnel should investigate the cause promptly. If leakage is suspected, compartments should be inspected and repaired, as necessary. If lodged debris is suspected, inspection and debris removal should be performed.

Pontoon fenders should be inspected in place every year, unless this frequency is found to be unwarranted based on initial experience. Fender replacement will be required approximately every ten to fifteen years. Occasionally, a minor amount of debris removal may also be required from this area between the pontoon and the fixed nose pier and pylon structures.

Every two years, a thorough inspection of the pontoon compartments is recommended. All compartments should be visually checked for water leakage, without entering them, by looking through the access ports and hatches. Also, at this time, the seals in the access openings should be cleaned and coated with silicone, if needed. Five percent to ten percent of all compartments, fifty percent of all segment joint compartments, and all compartments suspected of leakage should be entered, thoroughly inspected, and repaired as necessary. Again, inspection frequency may be revised based on experience gained by lock personnel.

The pontoon wall armor, line hooks, timber heads, and ladder recess armor will require periodic painting, comparable to the painting requirements for the existing approach walls.

Very infrequent reattachment or replacement of skirting panels may be required. Periodic indirect inspection of the skirting panels may be accomplished by measuring the variation of flow velocity (using a vane anemometer or other measuring device) along the length of the approach walls. A sudden change in velocity may indicate a damaged or missing skirting panel. If further inspection is warranted, a diver or remote camera may then be required.

17.6 FILL/EMPTY SYSTEM

Periodic repainting of the exposed portion of the embedded metal parts and carbon steel portions of the equipment will be required. Inspection and repainting should follow procedures and schedules set forth in the current Operations and Maintenance Manual.

17.7 HELPER TUG

During construction, a helper tug will be provided by the government in order to prevent barges from impacting incomplete structures, while maintaining lock operations. In general, the criteria used to determine the necessity of the helper tug will be as follows:

- When construction activity is in or is very close to the navigation channel.
- When structural elements could be damaged by scraping or minor impacts from the tows.

It is anticipated that a helper tug will be needed on site for approximately 630 calendar days. The tug will be at least 1800 HP, and it will be capable of turning within the lock approach area.

17.8 POOL MAINTENANCE AND DREDGING

The completed 600’ lock extension will increase the footprint of the lock structure and may change the existing flow patterns somewhat, but it will not change the existing permanent pool. During future design phases, WES studies will be performed to examine flow patterns and also to evaluate the need for excavation of the downstream bank in order to improve the lower approach channel. If it is found that bank excavation is required, then maintenance dredging of this area may be required. Requirements specific to the new approach walls were addressed in Section 17.5. The new intake structure (for the new wrap around culvert) will require periodic debris removal. All other dredging and debris requirements are anticipated to be comparable to those set forth in the current Operations and Maintenance Manual.

17.9 O&M STAFFING AND COSTS

The staff required to operate and perform routine maintenance at the expanded lock and dam site will consist of 17 permanent and 2 intermittently needed employees. Employee duties will remain similar to their current ones, and the Lockmaster will be in charge of the entire operation. The average annual cost of operation and maintenance of the existing and new project areas is estimated to total $2,370,000. An estimated cost breakdown summary is shown in ***Table 17.9A***.

TABLE 17.9A
Estimated Annual Cost of Operation and Ordinary Maintenance
J. T. Myers Locks & Dam

Item	Cost
Permanent Staff, 17 employees	$1,000,000
Intermittently Needed Staff, 2 employees	$50,000
Utilities	$30,000
On-Site Equipment Maintenance	$50,000
Visitor's Area	$20,000
Supplies	$60,000
Pool Maintenance and Dredging	$160,000
General Site Maintenance/Minor Contracts	$250,000
LRL Repair Fleet and Large Scale Maintenance Contracts	$500,000
Subtotal	$2,120,000
Supervision and Administration	$250,000
TOTAL	$2,370,000

SECTION 18

ACCESS ROADS

A 20-foot wide, two lane, bituminous concrete entry roadway provides access to the existing esplanade, service mound, visitor, and public use facilities. Since this is an operating project, entry to the existing nonpublic facilities must be maintained at all times. The existing roadway will continue to provide access to the service mound and public parking lot (to be used by construction personnel and employees).

Excavation for the wrap-around culvert will require temporary removal of the esplanade. Therefore, a temporary gravel access roadway will be required between the entry road and the lock wall. By staging the construction of the wrap-around culvert and moving the temporary access roadway as needed, access to the existing lock land wall will be maintained at all times.

A temporary access road will be required east of the entry road to service the relocated upstream mooring basin and temporary spoil and construction lay down area. See ***Drawing 14.9.2.A***. In order to construct the dewatering berm and temporary spoil and construction lay down area, it is not possible to construct this road at its preferred permanent location. Upon completion of the lock work, this temporary road will be replaced with a permanent bituminous concrete road to the relocated mooring basin. Although it would be possible to use the temporary access road as a permanent road, its entrance location, length, and added time of travel make the alignment at the temporary access roadway less desirable. The proposed permanent roadway alignment will allow for quicker access from both the service mound and the esplanade.

A 24-foot gravel access roadway will be constructed and maintained from the existing bituminous concrete entry road to the proposed work trestle and adjacent concrete batch plant and construction lay down area. See ***Drawing 14.9.2B***. A second gravel access road will then branch off of this road in the vicinity of the trestle and extend downstream to access the downstream approach channel improvement work area.

The second gravel access road is temporary and will be removed after the downstream bank work is complete. The first road, between the entry road and the trestle, may be removed or may remain as permanent access, depending on what is done with the trestle.

Additionally, the contractor may construct temporary access roads through the disposal area as needed for circulation and operation of construction equipment.

SECTION 19

CORROSION MITIGATION

19.1 REFERENCE MATERIALS

In the preparation of the *Design Report for the Olmsted Locks and Dams, Upper and Lower Approach Walls* (INCA, et. al.), extensive research was conducted in the selection of appropriate construction materials and corrosion protection measures for construction in the Ohio River environment. While the Olmsted Locks and Dams project is 118.4 river miles downstream of the John T. Myers Locks and Dams project, it was decided that the data available from the Olmsted project was sufficiently representative to be of value for this study. The selection of materials and corrosion protection measures was guided by:

- Corrosion protection strategies followed in the design of the Olmsted replacement lock structure presently under construction.
- Experience with lock facilities exposed to similar environmental conditions.
- Documentation of Corps research on the performance of different materials at existing lock facilities.

Corps-provided documents regarding water and air quality at the site, measured corrosion rates, material performance, and material recommendations included:

- *Materials Testing Program for Blocks and Wedges of the Ohio River Gate Changeout Project* prepared by James Wert and Associates under DACW62-96-D-0002, delivery order No. 0003.
- Memorandum for Commander, dated 13 December 1994, on the subject *Corrosion Study of Locks and Dams 52 and 53*.
- Memorandum for Chief, Engineering Division, dated 24 August 1994, on the subject *Listing of Material Requirements for Steel Components on Lock Structure at Olmsted L & D*.
- *Quality of the Ohio River and Atmospheric Deposition and its Relation to Corrosion of Lock and Dam Facilities in the Lower Ohio River Basin near*

Paducah, Kentucky, Water Resources Investigations Report 91-4050, prepared by the U.S. Geological Survey.

This document concluded that the "Ohio River water quality does not seem to be particularly corrosive, on the basis of the pH, alkalinity, and major ion determinations made during this study and on the basis of historical data." (p. 60) However, it was noted that "…abnormally rapid corrosion of the steel and galvanized steel components of Dam 53 was occurring (Myers and Riggs, 1984)." (p. 2)

- Corrosion rate determination based on the REMR Technical Note D2, *Optimal NDE Selection for Sheet Piling at Ohio River Lock & Dam 53.*

This document stated that, for the cellular sheetpile structures, "the corrosion at Lock 53 was subjectively estimated to be 8% to 10% of steel thickness (0.375"). Assuming a steel loss of 9%, gives an estimated corrosion of 0.0337". For the six years since construction, this translates to an annual rate of 0.00562" in one year. Projecting this rate over a standard 50 year design life, expected corrosion is computed as 0.28 inches."

19.2 GALVANIC CORROSION CONTROL MEASURES

Corrosion control measures for galvanic cells are generally classified as one of two types. The first type consists of breaking the electrical circuit. This can be accomplished by eliminating the anode, the cathode, the electrolyte, or the conductor. The primary example of this measure is painting exposed steel, which isolates the anode from the circuit. Modifying the electrolyte is common for buried pipe installations, and is usually accomplished by control of the trench backfill material. Modifying the electrolyte for this project is not feasible as the most likely electrolyte is the Ohio River water. Eliminating the conductor is also not feasible in this installation since elements of the installation are the conductor. In the example of a stainless steel embedded part, the conductor is the embedded part and the reinforcing steel. For this installation, breaking the electrical circuit will be accomplished by protective coatings.

The second type of corrosion control for galvanic corrosion is modifying the current flow. The current flow can be modified by reducing the electrical potential between the cathode and the anode, offsetting the electrical potential between the cathode and the anode, or by providing a sacrificial anode. Reducing the electrical potential between the cathode and the anode can be accomplished by selecting construction materials which are close in the galvanic series. While this is possible, it is not always feasible in structural designs. Material selection is governed primarily by a structural demand and capacity analysis that routinely investigates a small number of metals, usually limited to carbon steel, stainless steel, and aluminum.

The electrical potential in a galvanic cell can be offset by impressing an electrical current on the element of the construction which you desire to protect. The result of this measure is to stop the flow of ions from the anode to the cathode, thereby stopping the corrosion. This is generally called active corrosion protection. Active corrosion measures are used most frequently for ferrous items buried in corrosive soils.

During design for the Olmsted Locks and Dam upper and lower approach walls, active corrosion protection measures were considered. It was determined through contact with operators of similar facilities and the designers of the replacement lock structure, currently under construction, that impressed current corrosion protection measures were not necessary. At present, there is no foreseeable need for an active system at the J. T. Myers Locks & Dam site.

Provision of a sacrificial anode is the third method of modifying the current flow. This method consists of providing an anode that creates a greater electrical potential between itself and the cathode than the element you wish to protect. In the *Galvanic Series of Metals and Alloys*, zinc is second only to magnesium and magnesium alloys in anodic activity. The inclusion of a sacrificial zinc or magnesium anode in the galvanic cell creates a circuit that develops a greater electrical potential between the sacrificial anode and the cathode than between the anode you wish to protect and the cathode. This potential creates current flow and, hence, ion flow from the sacrificial zinc or magnesium, and subsequent corrosion of the sacrificial anode rather than the protected anode. The sacrificial anode can be provided as a discreet element, such as a brick, or distributed over the surface as galvanizing. Sacrificial zinc anodes are commonly bolted to hulls of metal boats and to outboard motors. While impressed current anodes are considered active corrosion control measures, sacrificial anodes are called passive corrosion control measures. It is anticipated that the new miter gate will utilize a passive cathodic protection system by installing sacrificial anodes. Other special conditions will be evaluated individually as they arise during final design.

Cathodic protection is the general term for corrosion control measures that include either an impressed current or a sacrificial anode.

19.3 CORROSION CONTROL MEASURES FOR SPECIFIC ELEMENTS

19.3.1 Approach Walls

The pontoon wall armor, line hooks, timber heads, and ladder recess armor will be fabricated using appropriate grades of carbon steel material. They will be painted for corrosion protection, and repainted as part of the planned maintenance.

Ladders in the pontoon chambers, ladders attached to the end walls of the pontoons, stairs above the pontoon deck, guard rails, sway bridges, hatch frames, interior bearing plates for segment joint bolts, and the anchorage chain will be fabricated from carbon steel materials and hot-dipped galvanized.

The restrainer brackets and impact shields, embedded girders, embedded plates, embedded ferrules and pipe sleeves (except those grouted inside) receiving bolts, embedded

pipes accepting the skirt wire rope, gudgeon and pintle, wire ropes holding the skirts, skirt panels, redundant anchorage system, anchor bolts for high mast light poles, temporary supports for precast bulkheads, headed studs and bolts (in contact with stainless steel materials) debris fender brackets, etc. will be made of a variety of stainless steel grades.

19.3.2 Gates and Gate Guides

Gates and gate guides will be fabricated from carbon steel and painted to control corrosion. Periodic maintenance such as re-sealing and repainting will need to be accomplished. Repainting the gate guides will be limited to the portions above low water. The Maintenance and Emergency Bulkheads, and the embedded items in the bulkhead slots will also be fabricated from carbon steel and painted. Periodic repainting of the bulkheads and the upper portions of the embedded parts should be included in the Operations and Maintenance Manual for the lock during final design.

It is anticipated that passive cathodic protection (sacrificial magnesium marine anodes) will be included in the design of the miter gates. The magnesium anodes should be located in each compartment below the waterline on each side of the gate and at both quoin and miter ends. These anodes will need to be periodically inspected (usually, once a year) and replaced (usually, once every ten years). For ease of replacement, it is recommended that these anodes be mounted on threaded studs which are welded to the gate. Inspection and replacement procedures and schedules should be included in the Operations and Maintenance Manual during final design.

Gate operating machinery and bulkhead hoists will generally be fabricated out of carbon steel and painted. Special items, such as the piston on the gate operators, will be stainless steel or chrome plated.

19.3.3 Monoliths

Metallic components of the monoliths will have corrosion control measures similar to the approach walls. That is, the exterior armor elements will be painted carbon steel, the above deck and interior items will be galvanized carbon steel, and the exterior embedded items will be stainless steel. The painting schedule should be included in the Operations and Maintenance Manual during final design.

19.3.4 Filling/Empty System

The exposed metallic items of the fill/empty (F/E) system will be galvanized carbon steel. The principal example of an exposed item is the trashrack. The embedded metal parts will be carbon steel, painted for corrosion control. The equipment will be a combination of painted carbon steel and specialty metals. The equipment includes the culvert valves, culvert bulkheads, valve and bulkhead guide slots, hoists, and cranes. As before, special items such as the piston on the gate operators, will be stainless steel or chrome plated. Bushings for the culvert valves will be bronze.

Periodic painting of the exposed portion of the embedded metal parts and carbon steel portions of the equipment will be required. Inspection and repainting procedures and schedules should be included in the Operations and Maintenance Manual during final design.

19.3.5 Reinforcing Steel

Corrosion control for the reinforcing steel in the concrete portions of the structure is accomplished during the design of the structural elements. For reinforced concrete, corrosion control is accomplished primarily through crack control and concrete cover requirements. The Corps Engineer Manual, EM-1110-2-2104, *Strength Design for Reinforced Concrete Hydraulic Structures* provides design guidelines for crack control in reinforced concrete structures. The EM requires that the factored load combinations are multiplied by a hydraulic factor, H_f. Increasing the required ultimate strength capacity results in the structural element "working" in a stress range which is well below its cracking capacity. The EM also states that the inclusion of the hydraulic factor precludes the usual checks on the crack control parameter, z, used by the American Concrete Institute (ACI). While this is true in general, z may be investigated for some particular designs as an additional serviceability check.

For buildings (per ACI), z is limited to 175 kips/in for interior exposure and 145 kips/inch for exterior exposure. For environmental concrete structures (or hydraulic structures) z is limited to 115 kips/inch. This provides for crack widths which are applicable to environmental engineering concrete structures. For severe conditions, z should be limited to 95 kips/inch. Immersion in the Ohio River is not considered a severe condition. Therefore, during design, z will be limited to 115 kips/inch.

Corrosion protection for the floating portions of the lock is aided by longitudinally post-tensioning the pontoons. The presence of a post-tensioning force has several desirable affects relative to crack and corrosion control. The primary effect is that precompression of the section eliminates tension cracks. A secondary effect is decreased permeability of the concrete. This is a by product of the concrete mix design. Concrete for post-tensioned sections usually has higher compressive strength, lower water/cement ratio, and lower permeability than concrete for mild reinforced sections.

SECTION 20

PROJECT SECURITY

A Project Physical Security Plan is in place for the John T. Myers Locks & Dam project, and it is in accordance with Security Engineering Manuals TM 5-853-1, -2, -3, and -4. This plan outlines in-place site precautions as well as responses to be taken as a result of threats to the facility.

The locks and dam are manned 24 hours a day, seven days a week at this site. Limited applications of fencing and area lighting have been used. With the 600' lock extension, this approach will be continued and closed-circuit television (CCTV), intended for the purpose of lock operations, will also be available for limited assessment use. As stated in Volume 3 of the Security Engineering Manual, "although the use of CCTV for surveillance purposes is not recommended, it is recommended as an assessment tool." (p. 2-18)

Adequate lighting is required for the CCTV and for general area lighting. Per Volume 3, "Although lighting itself does not provide security, it helps to assess aggressor activities. The primary purpose of lighting is to illuminate an area so that visual assessment of that area can be made either by a guard or by CCTV. Security lighting also acts as a psychological deterrent to potential aggressors." (p. 2-16)

In addition, there is limited fencing at the site, including some fencing with barbed wire outriggers. Again, as described in Volume 3 of the Security Engineering Manual, fences "… are used as protective measures against project-specific threats. Fencing is not a reliable security barrier because it provides little delay and can be breached in seconds. Fences are most appropriately used to define boundaries and to deter the casual intruder from penetrating a secure area (by mistake or intentionally). A fence will assist in controlling and screening authorized access into a secure area." (p. 2-7) Fences used at the project site were placed and will be continued to be used in this manner, in order to achieve the boundary and screening goals described in the manual. During construction, additional fencing will be required to control and restrict access to construction areas, including those areas which are normally open to the public.

SECTION 21

COST ESTIMATES

Cost estimates are provided for the following five alternatives (although the cost estimate for Plan 3 is the most detailed):

- Plan 1 – Auxiliary Lock Extension
- Plan 1A – Phase 2 of Plan 1, Construct Supplemental F/E System
- Plan 2 – Auxiliary Lock Extension with Modifications
- Plan 3 – Auxiliary Lock Extension with Culverts
- Plan 4 – Auxiliary Lock Extension, Phased Construction

Drawings 1.3A – 1.3F show the overall layouts of the five 600' lock extension alternatives.

The Plan 3 cost estimate has been reviewed and revised, incorporating information from recently received bids for similar projects. However, since the other plans were screened out from further consideration, their cost estimates were not revised. Therefore, while the Plan 1, 2, and 4 cost estimates may be compared with each other, it is not appropriate to compare them with Plan 3.

21.1 PLAN 1

21.1.1 Plan 1 Assumptions and Revisions

The current feasibility cost estimate is a continuing effort to refine previous submittals. It is a refinement of the construction approach and includes some changes in scope. Plan 1 includes construction of the 600' lock extension without the wrap around culvert or any other aspect of the fast fill-empty system of Plan 3. The discussion and analysis here concern changes to the estimate and project from Plan 3. Plan 3 is the "Master Plan", since it contains the complete scope of work that was in previous submittals.

The strategy of using either the decommissioned lock at Gallipolis or submersible barges for construction of float-in monoliths and the floating approach walls is unchanged. Mobilization, demobilization and preparation costs are slightly less than for Plan 3. The duration of time that the contractor's equipment and batch plant is needed at the site is the same as in Plan 3.

Some quantity takeoffs from the Plan 3 estimate, especially site work, have been divided, separating out work for the lock extension without the wrap around culvert. The work associated with the wrap around culvert construction was moved to the Plan 1A estimate.

As in previous estimates, it is assumed that there are no contaminated or hazardous materials on the site. It is anticipated that the on-site excavated material will be used as backfill for the entire project, with no significant quantities of imported borrow required. The primary components requiring backfill are the float-in land wall monolith and the float-in miter gate bay monolith.

The following major changes from Plan 3, resulting from deletion of the wrap around culvert, are:

- The esplanade remains intact.
- The upstream Operations Moorage Facility is not relocated.
- The existing utilities between the service mound and the locks do not need to be temporarily relocated.

The contingencies averaged approximately 22% and were assigned based on the level of knowledge available for each element.

During the final preparation of this report, bids for similar work in the Ohio River System, at Olmsted Lock and Dam and Braddock Lock and Dam, were opened. Bid prices for several similar items of work in the current estimate were higher. As a result, analysis of the costs and prices for these work items will continue, and it may result in higher estimated costs in future submittals.

The major work breakdown structure (WBS) elements that were revised significantly from the Plan 3 estimate are discussed below. Costs include contingencies, unless otherwise noted.

Distributed Items

Distributed items for the "LP" contractor at the Uniontown site and the "GP" contractor at Gallipolis are the same as for Plan 3. However, at the lock site, the direct costs of the lock extension, without the wraparound culvert, are considerably smaller. This results in a higher field office overhead rate of 8.19%, up from 6.60% in Plan 3. This is reflected in all of the WBS elements. Therefore, even those elements unchanged in scope or quantities by deletion of the wrap around culvert show a higher contract amount in the respective summaries.

Helper tugs and marine insurance are unchanged from the Plan 3 estimate.

Feature 0500: Locks

Element:

01 Mobilization and Preparatory Work: The site work has been reduced from 29 acres to 22 acres, due to elimination of the wrap around culvert excavation/fill and elimination of the upstream mooring facility relocation, when compared with Plan 3.

02 Drainage: There were no changes to quantities or scope. The additional cost was due to the effects of the increased field office overhead, as discussed above.

03 Care and Diversion of Water: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

04 Permanent Access Roads and Parking: The quantity has been reduced to 1445 SY from 33667 SY. The esplanade reconstruction will not have to be done in this phase.

09 Buildings, Project Operations: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

10 Earthwork for Structures: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

11 Foundation Work: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

57 Lock Gates and Operating Machinery: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

62 Approach Walls, Upper and Lower: A very large cost increase over Plan 3 stems from deleting the floating lower land guide wall and substituting a fixed guide wall with a drilled pier foundation at this location. A fixed approach wall is required in Plan 1 due to Operations maintenance dredging concerns. These concerns are alleviated in Plan 3 by the "flushing action" provided by the landside diffuser. This component alone has a contract price of approximately $15.4 million. The remaining floating walls, in this plan, amount to a $22.1 million contract price. There were no other changes to quantities or scope. The increase in field office overhead was also included, as discussed above.

63 Lock Structure: Additional mass concrete is required for the lock wall. Therefore, the direct costs increase by approximately $1.9 million. This results in a $2.2 million increase after contingencies. There are also additional costs due to the increase in field office overhead, as discussed above.

64 Fill/Empty System: Deleted; there is no part of the fast F/E system in this plan.

65 Piping System: There was a decrease due to elimination of the piping system for the culvert valves.

66 Power and Lighting System: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

Feature 1900: Buildings, Grounds, and Utilities

Element:

04 Construction Moorage Area and Service Roads: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

06 Day Use Area, next to Esplanade: Deleted, as there will be no removal and restoration needed since the wrap around culvert is not constructed in Plan 1.

08 Operations Mooring Facility Relocation: Deleted, since this will not be required in Plan 1.

09 Miscellaneous Site Work: Site grading and landscaping has a little reduction in scope due to elimination of wrap around culvert and operations moorage facility construction in Plan 1. The cost is a little higher, nevertheless, due to the field office overhead increase discussed above.

21.1.2 Plan 1 Cost Estimate

The cost estimate summary for Plan 1 – Auxiliary Lock Extension is provided on the following pages.

** PROJECT OWNER SUMMARY - Element (Rounded to 1000's) **

		QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500	LOCKS						
0500.01	Mob, Demob & Preparatory Work		5,652,000	1,300,000	6,952,000		
0500.02	Drainage		146,000	35,000	181,000		
0500.03	Care and Diversion of Water		279,000	56,000	335,000		
0500.04	Permanent Access Roads & Parking	1445.00 SY	30,000	5,000	35,000	24.24	
0500.09	Buildings, Project Operations	1584.00 SF	134,000	33,000	167,000	105.60	
0500.10	Earthwork for Structures		7,011,000	1,683,000	8,694,000		
0500.11	Foundation Work	6500.00 CY	1,895,000	379,000	2,274,000	349.90	
0500.57	Lock Gates & Operate Machine U/L		4,787,000	718,000	5,505,000		57
0500.62	Approach Walls, Upper and Lower		37,519,000	7,504,000	45,023,000		
0500.63	Lock Structure		25,981,000	6,495,000	32,477,000		
0500.65	Piping system		326,000	62,000	388,000		
0500.66	Power and Lighting System		2,130,000	383,000	2,513,000		
	TOTAL LOCKS		85,891,000	18,654,000	104,545,000		
1900	BUILDINGS, GROUNDS & UTILITIES						
1900.04	Construction Moorage & Svc Roads		1,743,000	436,000	2,179,000		
1900.09	Misc Sitework		3,497,000	699,000	4,197,000		
	TOTAL BUILDINGS, GROUNDS & UTILITIES		5,240,000	1,135,000	6,376,000		
	TOTAL 600 Ft Lock Extension Plan 1		91,132,000	19,789,000	110,921,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500 LOCKS							
0500.01 Mob, Demob & Preparatory Work							
0500.01.01 Mobilization & Demob of Equipmnt			962,000	221,000	1,183,000		
0500.01.02 Preparatory Work	22.50	ACR	1,301,000	299,000	1,600,000	71098	
0500.01.03 Dry Dock			3,390,000	780,000	4,170,000		
TOTAL Mob, Demob & Preparatory Work			5,652,000	1,300,000	6,952,000		
0500.02 Drainage							
0500.02.01 Catch Basins			12,000	3,000	15,000		
0500.02.03 Drainage Pipe, Size 12"-18"	3980.00	LF	134,000	32,000	166,000	41.70	
TOTAL Drainage			146,000	35,000	181,000		
0500.03 Care and Diversion of Water							
0500.03.05 Dewater Lock Chamber	3.00	MO	279,000	56,000	335,000	111772	
TOTAL Care and Diversion of Water			279,000	56,000	335,000		
0500.04 Permanent Access Roads & Parking							
0500.04.03 Upgrade Existing Roads	1445.00	SY	30,000	5,000	35,000	24.24	
TOTAL Permanent Access Roads & Parking	1445.00	SY	30,000	5,000	35,000	24.24	
0500.09 Buildings, Project Operations							
0500.09.02 Control Stations	1584.00	SY	134,000	33,000	167,000	105.60	
TOTAL Buildings, Project Operations	1584.00	SF	134,000	33,000	167,000	105.60	
0500.10 Earthwork for Structures							
0500.10.02 Common Excavation	92195	CY	704,000	169,000	873,000	9.47	
0500.10.03 Rock Excavation	3591.00	BCY	85,000	20,000	106,000	29.39	
0500.10.05 Backfill	170950	CY	746,000	179,000	925,000	5.41	
0500.10.07 Demolition	4870.00	CY	766,000	184,000	949,000	194.93	
0500.10.08 Dredging	417644	CY	4,708,000	1,130,000	5,837,000	13.98	
0500.10.09 Stone Slope Protection	100.00	CY	3,000	1,000	4,000	42.76	
TOTAL Earthwork for Structures			7,011,000	1,683,000	8,694,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.11 Foundation Work							
0500.11.05 Site Work	6500.00	CY	1,895,000	379,000	2,274,000	349.90	
TOTAL Foundation Work	6500.00	CY	1,895,000	379,000	2,274,000	349.90	
0500.12 Seepage Control							
0500.12.01 Drilling and Grouting							
0500.57 Lock Gates & Operate Machine U/L							
0500.57.01 Miter Gates & Embedded Metals	820000	LB	3,434,000	515,000	3,949,000	4.82	
0500.57.02 Embedded Metals, Maint Bulkhead	208000	LB	804,000	121,000	925,000	4.45	
0500.57.04 Miter Gate Operating Machinery	2.00	EA	338,000	51,000	388,000	194194	
0500.57.05 Existing Miter Gate Removal	656000	LB	211,000	32,000	242,000	0.37	
TOTAL Lock Gates & Operate Machine U/L			4,787,000	718,000	5,505,000		57
0500.62 Approach Walls, Upper and Lower							
0500.62.34 JT Myers Nose Piers, Upper Walls	2.00	EA	5,186,000	1,037,000	6,223,000	3111642	
0500.62.35 JT Myers Nose Piers, Lower Walls	1.00	EA	3,089,000	618,000	3,707,000	3707100	
0500.62.36 Pylon, Stand Alone, U/S River	1.00	EA	597,000	119,000	716,000	716317	
0500.62.37 Pylon, Attached, DS Guide Wall	1.00	EA	252,000	50,000	302,000	302090	
0500.62.38 Pylon, Attached, US Middle Wall	1.00	EA	87,000	17,000	105,000	104911	
0500.62.40 Upper & Lower Float Guide Walls	1960.00	LF	12,937,000	2,587,000	15,524,000	7920.32	
0500.62.50 JT Myers CIP Lower Land Wall	700.00	LF	15,371,000	3,074,000	18,445,000	26351	
TOTAL Approach Walls, Upper and Lower			37,519,000	7,504,000	45,023,000		
0500.63 Lock Structure							
0500.63.01 Concrete, Float-In, Stage I	6476.00	CY	3,047,000	762,000	3,809,000	588.20	
0500.63.04 Concrete, Precast, Stage 2 3 & 4	5567.00	CY	4,098,000	1,024,000	5,122,000	920.11	
0500.63.05 Concrete, Mass, Stage 4	56568	CY	6,869,000	1,717,000	8,586,000	151.79	
0500.63.06 Concrete, CIP, Miter Gate Recess	2058.00	CY	529,000	132,000	661,000	321.12	
0500.63.07 Concrete, CIP, Wall Mono's L2-L5	2431.00	CY	2,479,000	620,000	3,098,000	1274.58	
0500.63.08 Reinforcing Steel	1836.00	TON	3,320,000	830,000	4,151,000	2260.65	
0500.63.09 Anchor Existing Monolith Walls	106.00	EA	1,901,000	475,000	2,377,000	22421	
0500.63.10 Floating Mooring Bitt	10.00	EA	615,000	154,000	768,000	76836	
0500.63.12 Steel Ladders	1900.00	VLF	155,000	39,000	193,000	101.67	
0500.63.22 Line Hooks			160,000	40,000	201,000		
0500.63.23 Check Posts			160,000	40,000	201,000		
0500.63.24 Wall Armor	80.00	TON	287,000	72,000	358,000	4481.23	
0500.63.40 Embedded Piping			1,306,000	327,000	1,633,000		
0500.63.70 Maintenance Bulkhead Sill	2900.00	CY	806,000	202,000	1,008,000	347.46	
0500.63.85 Metals	85.00	TON	249,000	62,000	311,000	3658.61	

	QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
TOTAL Lock Structure		25,981,000	6,495,000	32,477,000		
0500.65 Piping system						
0500.65.01 Hydraulic System	1.00 EA	230,000	44,000	273,000	273335	
0500.65.02 Compressed Air Piping System		48,000	9,000	57,000		
0500.65.03 Raw Water Piping System		48,000	9,000	57,000		
TOTAL Piping system		326,000	62,000	388,000		
0500.66 Power and Lighting System						
0500.66.01 Electrical Work		621,000	112,000	733,000		
0500.66.02 Control & Signal Systems		1,509,000	272,000	1,781,000		
TOTAL Power and Lighting System		2,130,000	383,000	2,513,000		
TOTAL LOCKS		85,891,000	18,654,000	104,545,000		
1900 BUILDINGS, GROUNDS & UTILITIES						
1900.04 Construction Moorage & Svc Roads						
1900.04.20 Temporary Construction Moorage		1,743,000	436,000	2,179,000		
TOTAL Construction Moorage & Svc Roads		1,743,000	436,000	2,179,000		
1900.09 Misc Sitework						
1900.09.04 Downstream Channel Approach	318916 CY	2,946,000	589,000	3,536,000	11.09	
1900.09.10 Excavation and Grading	256000 SY	256,000	51,000	308,000	1.20	
1900.09.15 Landscaping	53.03 ACR	295,000	59,000	354,000	6666.58	
TOTAL Misc Sitework		3,497,000	699,000	4,197,000		
TOTAL BUILDINGS, GROUNDS & UTILITIES		5,240,000	1,135,000	6,376,000		
TOTAL 600 Ft Lock Extension Plan 1		91,132,000	19,789,000	110,921,000		

21.2 PLAN 1A

21.2.1 Plan 1A Assumptions and Revisions

The current feasibility cost estimate is a continuing effort to refine previous submittals. It is a refinement of the construction approach and includes some changes in scope. Plan 1A includes construction of the wrap around culvert and a fast fill-empty system, which is substantially different from Plan 3. It assumes that Plan 1 was constructed at an earlier date, and lock improvements to provide a fast fill/empty system are desired at a later date. The discussion and analysis here concern changes to the estimate and project from Plan 3. Plan 3 is the "Master Plan", since it contains the complete scope of work that was in previous submittals.

Mobilization, demobilization and preparation costs are incurred again, since the assumption is that Plan 1A construction will commence some time after Plan 1 construction is complete, and the extended lock is in operation. The duration of time that the contractor's equipment and batch plant is needed at the site is reduced slightly from Plan 3.

Some quantity takeoffs from the Plan 3 estimate, especially site work, have been divided, separating out work for the wrap around culvert without the lock extension. The work associated with the lock extension construction was included in the Plan 1 estimate.

As in previous estimates, it is assumed that there are no contaminated or hazardous materials on the site. It is anticipated that the on-site excavated material will be used as backfill for the entire project, with no significant quantities of imported borrow required. The primary components requiring backfill are the wrap around culvert and valve monoliths.

The following major changes from Plan 3, resulting from construction of the fast fill/empty system, are:

- Approximately 20-foot diameter openings must be mined through the lock wall monoliths in order to connect the wrap around culvert to the central culvert in the lock chamber.
- A central culvert and laterals must be constructed inside the lock chamber.
- Both an outlet valve monolith and an inlet valve monolith must be constructed.

The contingencies averaged approximately 22% and were assigned based on the level of knowledge available for each element.

During the final preparation of this report, bids for similar work in the Ohio River System, at Olmsted Lock and Dam and Braddock Lock and Dam, were opened. Bid prices for several similar items of work in the current estimate were higher. As a result, analysis of the costs and prices for these work items will continue, and it may result in higher estimated costs in future submittals.

The major work breakdown structure (WBS) elements that were revised significantly from the Plan 3 estimate are discussed below. Costs include contingencies, unless otherwise noted.

Distributed items

Distributed items from the "GP" contractor at Gallipolis are deleted. Although construction of the float-in wall diffuser monolith is required, it is expected there will be commercial graving docks available for the stage 1, base raft work, for this structure. Mobilizing the Gallipolis site is not cost effective. Distributed items for the "LP" contractor at the Uniontown site are reduced nominally from 24 months to 20 months This results in a field office overhead rate of 11.71%, which is higher than the Plan 3 rate of 6.60% and the Plan 1 rate of 8.19%. This is reflected in all of the WBS elements. Therefore, even those elements unchanged in scope or quantities by deletion of the wrap around culvert show a higher contract amount in the respective summaries.

Helper tug daily cost is unchanged from the Plan 3 estimate.

Feature 0500: Locks

Element:

01 Mobilization and Preparatory Work: The site work has been reduced to approximately 19 acres in Plan 1A, due to elimination of the downstream channel improvements from this plan, when compared with Plan 3. Work for the temporary construction moorage area, needed for the deep draft construction stages of the wall diffuser, is included in Feature 1900. Also, it is assumed there are no graving dock preparation costs, as discussed above.

02 Drainage: Deleted; no work in this phase.

03 Care and Diversion of Water: Need to dewater the lock chamber for rock excavation and construction of the F/E culvert and laterals. There are also additional costs due to the increase in field office overhead, as discussed above.

04 Permanent Access Roads and Parking: There were no changes to quanitites or scope. The additional cost was due to the increase in field office overhead, as discussed above. The esplanade and the project access road are rebuilt after the wrap around culvert construction is completed.

09 Buildings, Project Operations: Deleted; no work this phase.

10 Earthwork for Structures: Deleted; no work this phase. Excavation for the F/E system is included in Element 64.

11 Foundation Work: Deleted; no work this phase.

57 Lock Gates and Operating Machinery: Deleted; no work this phase.

62 Approach Walls, Upper and Lower: Deleted; no work this phase.

63 Lock Structure: Deleted; no work this phase.

64 Fill/Empty System: This cost increased approximately $10 million from the Plan 3 estimate. The chief reasons for this increase are:

- Boring 20-foot diameter openings through approximately 40-foot thick concrete monolith walls.
- Rock excavation inside the lock chamber for the central culvert.
- Installation of an additional 400 feet of precast concrete culvert.
- A second concrete culvert valve monolith is required.
- Increased shoring and dewatering effort.
- Other items unchanged in size, design and quantity have increased costs due to the increase in field office overhead effects discussed above.

65 Piping System: There were no changes to quanitites or scope. The additional cost was due to the increase in field office overhead, as discussed above.

66 Power and Lighting System: Deleted; no work this phase.

Feature 1900: Buildings, Grounds, and Utilities

Element:

04 Construction Moorage Area and Service Roads: 75% of the work and costs to construct the temporary moorage facility have been added here. It is needed for the deep draft stages of construction of the float-in wall diffuser. If this structure was retained from Plan 1 construction, it will have to be dredged and substantially renovated for Plan 1A construction. Also, $1.6 million in Mobilization & Preparatory work and Earthwork for Structures (Construction Moorage facility) quantities were moved here from Elements 01 and 10, respectively, in order to consolidate the effort for the construction moorage area.

06 Day Use Area, next to Esplanade: Same as Plan 3. There were no changes to quanitites or scope. The additional cost was due to the increase in field office overhead, as discussed above.

08 Operations Mooring Facility Relocation: Required in Plan 1A due to construction of the intake monolith and wrap around culvert.

09 Miscellaneous Site Work: Site grading and landscaping has a substantial reduction in scope, when compared with Plan 3, as downstream channel improvements are not required in this phase.

21.2.2 Plan 1A Cost Estimate

The cost estimate summary for Plan 1A – Phase 2 of Plan 1, Construct Supplemental F/E System is provided on the following pages.

** PROJECT OWNER SUMMARY - Element (Rounded to 1000's) **

		QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500	LOCKS							
0500.01	Mob, Demob & Preparatory Work			2,381,000	548,000	2,929,000		
0500.03	Care and Diversion of Water			288,000	58,000	346,000		
0500.04	Permanent Access Roads & Parking	33667	SY	828,000	141,000	968,000	28.76	
0500.64	Filling and Emptying System			35,841,000	7,885,000	43,726,000		
0500.65	Piping system			237,000	45,000	282,000		
	TOTAL LOCKS			39,575,000	8,676,000	48,251,000		
1900	BUILDINGS, GROUNDS & UTILITIES							
1900.04	Construction Moorage & Svc Roads			3,332,000	833,000	4,165,000		
1900.06	Day Use Area, next to Esplanade			149,000	37,000	186,000		
1900.08	Mooring Facility Relocation			2,957,000	739,000	3,697,000		
1900.09	Misc Sitework			203,000	41,000	243,000		
	TOTAL BUILDINGS, GROUNDS & UTILITIES			6,641,000	1,650,000	8,291,000		
	TOTAL 600 Ft Lock Extension Plan 1A			46,216,000	10,326,000	56,542,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500 LOCKS							
0500.01 Mob, Demob & Preparatory Work							
0500.01.01 Mobilization & Demob of Equipmnt			992,000	228,000	1,220,000		
0500.01.02 Preparatory Work	143000	SY	1,389,000	319,000	1,708,000	11.95	
TOTAL Mob, Demob & Preparatory Work			2,381,000	548,000	2,929,000		
0500.03 Care and Diversion of Water							
0500.03.05 Dewater Lock Chamber	3.00	MO	288,000	58,000	346,000	115314	
TOTAL Care and Diversion of Water			288,000	58,000	346,000		
0500.04 Permanent Access Roads & Parking							
0500.04.02 Esplanade	32222	SY	797,000	135,000	932,000	28.93	
0500.04.03 Upgrade Existing Roads	1445.00	SY	31,000	5,000	36,000	25.01	
TOTAL Permanent Access Roads & Parking	33667	SY	828,000	141,000	968,000	28.76	
0500.64 Filling and Emptying System							
0500.64.01 Shoring, Type 27	3124.00	TON	6,082,000	1,338,000	7,420,000	2375.09	
0500.64.02 Unwatering			1,128,000	248,000	1,376,000		
0500.64.03 Excavation, Common, Wet & Dry	659488	CY	3,086,000	679,000	3,765,000	5.71	
0500.64.04 Excavation, Rock, Wet & Dry	16478	CY	873,000	192,000	1,065,000	64.62	
0500.64.05 Backfill	266670	CY	2,355,000	518,000	2,873,000	10.77	
0500.64.06 Screens & Nose Plates at Intake	1.00	EA	217,000	48,000	265,000	264742	
0500.64.07 Concrete, C.I.P. Intake Monolith	4000.00	CY	1,124,000	247,000	1,371,000	342.70	
0500.64.08 Concrete, Thrust Block	9100.00	CY	2,737,000	602,000	3,340,000	367.00	
0500.64.09 Concrete Culvert, 16.5 Ft dia	9051.00	CY	6,639,000	1,461,000	8,100,000	894.94	
0500.64.10 Ice & Debris Boom	230.00	LF	278,000	61,000	339,000	1473.58	
0500.64.11 Culvert Valve & Embedded Metals	88000	LB	444,000	98,000	542,000	6.16	
0500.64.12 Culvert Valve Operating Machin-	2.00	EA	161,000	35,000	197,000	98333	
0500.64.13 Culvert Valve Bulkheads and	136000	LB	612,000	135,000	747,000	5.49	
0500.64.15 Float-in Diffuser Monolith	12427	CY	4,153,000	914,000	5,067,000	407.73	
0500.64.16 Valve Structure	2.00	EA	4,070,000	896,000	4,966,000	2482995	
0500.64.22 Drilled Shaft Wing Wall	340.00	LF	1,569,000	345,000	1,915,000	5631.06	
0500.64.90 Miscellaneous Mechanical Work			126,000	28,000	154,000		
0500.64.93 Relocate Existing Utilities			186,000	41,000	227,000		
TOTAL Filling and Emptying System			35,841,000	7,885,000	43,726,000		
0500.65 Piping system							

	QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.65.01 Hydraulic System	1.00 EA	237,000	45,000	282,000	281996	
TOTAL Piping system		237,000	45,000	282,000		
TOTAL LOCKS		39,575,000	8,676,000	48,251,000		
1900 BUILDINGS, GROUNDS & UTILITIES						
1900.04 Construction Moorage & Svc Roads						
1900.04.05 Mob, Demob & Preparatory Work		60,000	15,000	75,000		
1900.04.10 Earthwork for Structures		1,924,000	481,000	2,406,000		
1900.04.20 Temporary Construction Moorage		1,347,000	337,000	1,684,000		
TOTAL Construction Moorage & Svc Roads		3,332,000	833,000	4,165,000		
1900.06 Day Use Area, next to Esplanade		149,000	37,000	186,000		
1900.08 Mooring Facility Relocation						
1900.08.05 Remove Existing Boat Ramp		3,000	1,000	3,000		
1900.08.10 Remove Wharf Turn Around Area		6,000	2,000	8,000		
1900.08.15 Remove Boat Ramp Electrical		7,000	2,000	9,000		
1900.08.20 Construct New Boat Moorage		2,941,000	735,000	3,677,000		
TOTAL Mooring Facility Relocation		2,957,000	739,000	3,697,000		
1900.09 Misc Sitework						
1900.09.10 Excavation and Grading	81800 SY	97,000	19,000	116,000	1.42	
1900.09.15 Landscaping	18.53 ACR	106,000	21,000	128,000	6884.54	
TOTAL Misc Sitework		203,000	41,000	243,000		
TOTAL BUILDINGS, GROUNDS & UTILITIES		6,641,000	1,650,000	8,291,000		
TOTAL 600 Ft Lock Extension Plan 1A		46,216,000	10,326,000	56,542,000		

21.3 PLAN 2

21.3.1 Plan 2 Assumptions and Revisions

The current feasibility cost estimate is a continuing effort to refine previous submittals. It is a refinement of the construction approach and includes some changes in scope. Plan 2 includes construction of the 600' lock extension without the wrap around culvert. The fill/empty system laterals, outlet valve, and landside wall diffuser are constructed in this plan. The discussion and analysis here concern changes to the estimate and project from Plan 3. Plan 3 is the "Master Plan", since it contains the complete scope of work that was in previous submittals.

The strategy of using either the decommissioned lock at Gallipolis or submersible barges for construction of float-in monoliths and the floating approach walls is unchanged. Mobilization, demobilization and preparation costs are approximately the same as for Plan 3. The duration of time that the contractor's equipment and batch plant is needed at the site is the same as in Plan 3.

Some quantity takeoffs from the Plan 3 estimate, especially site work, have been divided, separating out work for the lock extension without the wrap around culvert. The work associated with the wrap around culvert construction is not included in Plan 2.

As in previous estimates, it is assumed that there are no contaminated or hazardous materials on the site. It is anticipated that the on-site excavated material will be used as backfill for the entire project, with no significant quantities of imported borrow required. The primary components requiring backfill are the float-in land wall monolith and the float-in miter gate bay monolith.

The following major changes from Plan 3, resulting from deletion of the wrap around culvert, are:

- The esplanade remains intact.
- The upstream Operations Moorage Facility is not relocated.
- The existing utilities between the service mound and the locks do not need to be temporarily relocated.

The contingencies averaged approximately 22% and were assigned based on the level of knowledge available for each element.

During the final preparation of this report, bids for similar work in the Ohio River System, at Olmsted Lock and Dam and Braddock Lock and Dam, were opened. Bid prices for several similar items of work in the current estimate were higher. As a result, analysis of the costs and prices for these work items will continue, and it may result in higher estimated costs in future submittals.

The major work breakdown structure (WBS) elements that were revised significantly from the Plan 3 estimate are discussed below. Costs include contingencies, unless otherwise noted.

Distributed Items

Distributed items for the "LP" contractor at the Uniontown site and the "GP" contractor at Gallipolis are the same as for Plan 3. However, at the lock site, the direct costs of the lock extension, without the wraparound culvert, is considerably smaller. This results in a higher overhead rate of 9.11%, up from 6.60% in Plan 3. This is reflected in all of the WBS elements. Therefore, even those elements unchanged in scope or quantities by deletion of the wrap around culvert show a higher contract amount in the respective summaries.

Helper tugs and marine insurance are unchanged from the Plan 3 estimate.

Feature 0500: Locks

Element:

01 Mobilization and Preparatory Work: The site work has been reduced from 29 acres to 22 acres, due to elimination of the wrap around culvert excavation/fill and elimination of the upstream mooring facility relocation, when compared with Plan 3.

02 Drainage: There were no changes to quantities or scope. The additional cost was due to the effects of the increased field office overhead, as discussed above.

03 Care and Diversion of Water: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

04 Permanent Access Roads and Parking: The quantity has been reduced to 1445 SY from 33667 SY. The esplanade reconstruction will not have to be done in this phase.

09 Buildings, Project Operations: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

10 Earthwork for Structures: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

11 Foundation Work: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

57 Lock Gates and Operating Machinery: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

62 Approach Walls, Upper and Lower: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

63 Lock Structure: There was a very small change in this element due to the addition of a knockout panel at the upstream end of the culvert in the lock wall extension. Mainly, the additional cost was due to the increase in field office overhead, as discussed above.

64 Fill/Empty System: This element includes construction of the laterals, outlet culvert valve and operating machinery, and landside wall diffuser. Direct costs of these structures are unchanged from the Plan 3 estimate. However, there was additional cost due to the increase in field office overhead, as discussed above. The wrap around culvert, utilities relocations, intake structure, and inlet valve monolith are not required for Plan 2.

65 Piping System: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

66 Power and Lighting System: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

Feature 1900: Buildings, Grounds, and Utilities

Element:

04 Construction Moorage Area and Service Roads: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

06 Day Use Area, next to Esplanade: Deleted, as there will be no removal and restoration needed since the wrap around culvert is not constructed in Plan 2.

08 Operations Mooring Facility Relocation: Deleted, since this will not be required in Plan 2.

09 Miscellaneous Site Work: Site grading and landscaping has a little reduction in scope due to elimination of wrap around culvert and operations moorage facility construction in Plan 2. The cost is a little higher, nevertheless, due to the field office overhead increase discussed above. The downstream approach channel improvements is the largest cost item in the sub-element, and it remains unchanged.

21.3.2 Plan 2 Cost Estimate

The cost estimate summary for Plan 2 – Auxiliary Lock Extension with Modifications is provided on the following pages.

		QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500	LOCKS						
0500.01	Mob, Demob & Preparatory Work		5,896,000	1,356,000	7,252,000		
0500.02	Drainage		153,000	37,000	190,000		
0500.03	Care and Diversion of Water		293,000	59,000	352,000		
0500.04	Permanent Access Roads & Parking	1445.00 SY	31,000	5,000	37,000	25.48	
0500.09	Buildings, Project Operations	1584.00 SF	141,000	35,000	176,000	111.09	
0500.10	Earthwork for Structures		7,363,000	1,767,000	9,130,000		
0500.11	Foundation Work	6500.00 CY	1,992,000	398,000	2,390,000	367.72	
0500.57	Lock Gates & Operate Machine U/L		5,036,000	755,000	5,791,000		57
0500.62	Approach Walls, Upper and Lower		31,458,000	6,292,000	37,749,000		
0500.63	Lock Structure		26,976,000	6,744,000	33,720,000		
0500.64	Filling and Emptying System		6,562,000	1,444,000	8,006,000		
0500.65	Piping system		584,000	111,000	695,000		
0500.66	Power and Lighting System		2,240,000	403,000	2,643,000		
	TOTAL LOCKS		88,726,000	19,406,000	108,132,000		
1900	BUILDINGS, GROUNDS & UTILITIES						
1900.04	Construction Moorage & Svc Roads		1,831,000	458,000	2,289,000		
1900.09	Misc Sitework		3,673,000	735,000	4,407,000		
	TOTAL BUILDINGS, GROUNDS & UTILITIES		5,504,000	1,192,000	6,696,000		
	TOTAL 600 Ft Lock Extension Plan 2		94,229,000	20,599,000	114,828,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500 LOCKS							
0500.01 Mob, Demob & Preparatory Work							
0500.01.01 Mobilization & Demob of Equipmnt			1,011,000	232,000	1,243,000		
0500.01.02 Preparatory Work	22.50	ACR	1,366,000	314,000	1,681,000	74696	
0500.01.03 Dry Dock			3,519,000	809,000	4,328,000		
TOTAL Mob, Demob & Preparatory Work			5,896,000	1,356,000	7,252,000		
0500.02 Drainage							
0500.02.01 Catch Basins			13,000	3,000	16,000		
0500.02.03 Drainage Pipe, Size 12"-18"	3980.00	LF	141,000	34,000	174,000	43.84	
TOTAL Drainage			153,000	37,000	190,000		
0500.03 Care and Diversion of Water							
0500.03.05 Dewater Lock Chamber	3.00	MO	293,000	59,000	352,000	117358	
TOTAL Care and Diversion of Water			293,000	59,000	352,000		
0500.04 Permanent Access Roads & Parking							
0500.04.03 Upgrade Existing Roads	1445.00	SY	31,000	5,000	37,000	25.48	
TOTAL Permanent Access Roads & Parking	1445.00	SY	31,000	5,000	37,000	25.48	
0500.09 Buildings, Project Operations							
0500.09.02 Control Stations	1584.00	SY	141,000	35,000	176,000	111.09	
TOTAL Buildings, Project Operations	1584.00	SF	141,000	35,000	176,000	111.09	
0500.10 Earthwork for Structures							
0500.10.02 Common Excavation	92195	CY	739,000	177,000	916,000	9.94	
0500.10.03 Rock Excavation	3591.00	BCY	89,000	21,000	111,000	30.86	
0500.10.05 Backfill	170950	CY	783,000	188,000	971,000	5.68	
0500.10.07 Demolition	4870.00	CY	805,000	193,000	998,000	204.89	
0500.10.08 Dredging	417644	CY	4,943,000	1,186,000	6,129,000	14.68	
0500.10.09 Stone Slope Protection	100.00	CY	4,000	1,000	4,000	44.97	
TOTAL Earthwork for Structures			7,363,000	1,767,000	9,130,000		

		QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.11	Foundation Work							
0500.11.05	Site Work	6500.00	CY	1,992,000	398,000	2,390,000	367.72	
	TOTAL Foundation Work	6500.00	CY	1,992,000	398,000	2,390,000	367.72	
0500.12	Seepage Control							
0500.12.01	Drilling and Grouting							
0500.57	Lock Gates & Operate Machine U/L							
0500.57.01	Miter Gates & Embedded Metals	820000	LB	3,613,000	542,000	4,155,000	5.07	
0500.57.02	Embedded Metals, Maint Bulkhead	208000	LB	846,000	127,000	973,000	4.68	
0500.57.04	Miter Gate Operating Machinery	2.00	EA	355,000	53,000	408,000	204218	
0500.57.05	Existing Miter Gate Removal	656000	LB	222,000	33,000	255,000	0.39	
	TOTAL Lock Gates & Operate Machine U/L			5,036,000	755,000	5,791,000		57
0500.62	Approach Walls, Upper and Lower							
0500.62.34	JT Myers Nose Piers, Upper Walls	2.00	EA	5,449,000	1,090,000	6,539,000	3269633	
0500.62.35	JT Myers Nose Piers, Lower Walls	2.00	EA	6,604,000	1,321,000	7,925,000	3962657	
0500.62.36	Pylon, Stand Alone, U/S River	1.00	EA	627,000	125,000	753,000	752958	
0500.62.37	Pylon, Attached, DS Guide Walls	2.00	EA	529,000	106,000	635,000	317626	
0500.62.38	Pylon, Attached, US Middle Wall	1.00	EA	92,000	18,000	110,000	110268	
0500.62.40	Upper & Lower Float Guide Walls	2660.00	LF	18,155,000	3,631,000	21,786,000	8190.38	
	TOTAL Approach Walls, Upper and Lower			31,458,000	6,292,000	37,749,000		
0500.63	Lock Structure							
0500.63.01	Concrete, Float-In, Stage I	6476.00	CY	3,162,000	790,000	3,952,000	610.28	
0500.63.04	Concrete, Precast, Stage 2 3 & 4	5567.00	CY	4,529,000	1,132,000	5,661,000	1016.91	
0500.63.05	Concrete, Mass, Stage 4	52731	CY	6,746,000	1,687,000	8,433,000	159.92	
0500.63.06	Concrete, CIP, Miter Gate Recess	2058.00	CY	556,000	139,000	694,000	337.42	
0500.63.07	Concrete, CIP, Wall Mono's L2-L5	2431.00	CY	2,605,000	651,000	3,256,000	1339.40	
0500.63.08	Reinforcing Steel	1836.00	TON	3,452,000	863,000	4,315,000	2350.18	
0500.63.09	Anchor Existing Monolith Walls	106.00	EA	1,999,000	500,000	2,499,000	23573	
0500.63.10	Floating Mooring Bitt	10.00	EA	646,000	161,000	807,000	80728	
0500.63.12	Steel Ladders	1900.00	VLF	162,000	41,000	203,000	106.89	
0500.63.22	Line Hooks			169,000	42,000	211,000		
0500.63.23	Check Posts			169,000	42,000	211,000		
0500.63.24	Wall Armor	80.00	TON	301,000	75,000	377,000	4708.22	
0500.63.40	Embedded Piping			1,372,000	343,000	1,715,000		
0500.63.70	Maintenance Bulkhead Sill	2900.00	CY	847,000	212,000	1,059,000	365.09	
0500.63.85	Metals	85.00	TON	262,000	65,000	327,000	3846.51	
	TOTAL Lock Structure			26,976,000	6,744,000	33,720,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.64 Filling and Emptying System							
0500.64.05 Backfill	266670	CY	471,000	104,000	575,000	2.16	
0500.64.09 Laterals, in New Lock Chamber	2600.00	CY	1,208,000	266,000	1,473,000	566.68	
0500.64.11 Culvert Valve & Embedded Metals	44000	LB	226,000	50,000	276,000	6.28	
0500.64.12 Culvert Valve Operating Machin-	2.00	EA	82,000	18,000	100,000	50116	
0500.64.13 Culvert Valve Bulkheads and	68000	LB	312,000	69,000	381,000	5.60	
0500.64.15 Float-in Diffuser Monolith	12427	CY	4,134,000	910,000	5,044,000	405.89	
0500.64.90 Miscellaneous Mechanical Work			128,000	28,000	156,000		
TOTAL Filling and Emptying System			6,562,000	1,444,000	8,006,000		
0500.65 Piping system							
0500.65.01 Hydraulic System	2.00	EA	483,000	92,000	575,000	287406	
0500.65.02 Compressed Air Piping System			50,000	10,000	60,000		
0500.65.03 Raw Water Piping System			50,000	10,000	60,000		
TOTAL Piping system			584,000	111,000	695,000		
0500.66 Power and Lighting System							
0500.66.01 Electrical Work			653,000	118,000	770,000		
0500.66.02 Control & Signal Systems			1,587,000	286,000	1,873,000		
TOTAL Power and Lighting System			2,240,000	403,000	2,643,000		
TOTAL LOCKS			88,726,000	19,406,000	108,132,000		
1900 BUILDINGS, GROUNDS & UTILITIES							
1900.04 Construction Moorage & Svc Roads							
1900.04.20 Temporary Construction Moorage			1,831,000	458,000	2,289,000		
TOTAL Construction Moorage & Svc Roads			1,831,000	458,000	2,289,000		
1900.09 Misc Sitework							
1900.09.04 Downstream Channel Approach	318916	CY	3,094,000	619,000	3,712,000	11.64	
1900.09.10 Excavation and Grading	256000	SY	269,000	54,000	323,000	1.26	
1900.09.15 Landscaping	53.03	ACR	310,000	62,000	372,000	7007.86	
TOTAL Misc Sitework			3,673,000	735,000	4,407,000		
TOTAL BUILDINGS, GROUNDS & UTILITIES			5,504,000	1,192,000	6,696,000		

	QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
TOTAL 600 Ft Lock Extension Plan 2		94,229,000	20,599,000	114,828,000		

21.4 PLAN 3

21.4.1 Plan 3 Assumptions and Revisions

The current feasibility cost estimate is a continuing effort to refine previous submittals. It is a refinement of the construction approach and includes some changes in scope. The discussion and analysis here concern changes to the estimate and project since the Interim Submittal of December 1999, which was based on the Alternative Formulation Briefing (AFB) pricing levels. This estimate also contains the latest changes resulting from additional site information and design refinements, completed subsequent to the original AFB submittal. Plan 3 is the "Master Plan", since it contains the complete scope of work from previous submittals and is the recommended lock expansion plan.

The strategy of using either the decommissioned lock at Gallipolis or submersible barges for construction of float-in monoliths and the floating approach walls is unchanged. Mobilization, demobilization, and preparation costs are estimated to be approximately $2.3 million in direct costs and approximately $3.3 million after markups and contingencies. The total for all float-in component project work at Gallipolis is approximately $32.6 million, after contingencies. Other costs for the float-in structures, such as grouting and ballast piping, have not changed appreciably.

As in previous estimates, it is assumed that there are no contaminated or hazardous materials on the site. It is anticipated that the on-site excavated material will be used as backfill for the entire project, with no significant quantities of imported borrow required. The primary components requiring backfill are the wrap around culvert and the float-in land wall monolith.

Changes since the December 1999 Interim submittal were made as a result of final quality control checks and review decisions reached at the cost coordination meeting held at the Louisville District Corps of Engineers office in Louisville, Kentucky on 19 and 20 January 2000. This meeting was held in order to review and revise the Plan 3 estimate, incorporating information from recently received bids for similar projects, addressing comments provided at the meeting, and ensuring consistency between the Greenup L&D and Myers L&D estimates. The following items were changed in the estimate:

- General refinements from the AFB costs levels to the 100% Final Feasibility Costs
- Increased lock structure direct costs for float-in base raft concrete
- Decreased wrap around culvert thrust block concrete quantities and associated cost
- Decreased unit costs for the fill/empty system excavation and backfill
- Decreased wrap around culvert shoring quantities and associated cost
- Decreased foundation preparation, underbase grouting direct costs
- Increased approach wall pontoon direct cost, including costs for straight run wall armor
- Decreased the inlet valve structure concrete quantities and associated cost
- Increased the intake monolith concrete quantities and associated cost
- Decreased total reinforcing and post-tensioning quantities and associated cost for the float-in monoliths

- Decreased the landside wall diffuser concrete quantities and associated cost

Overall, the Plan 3 construction costs, including contingencies, have increased from $131.9 to $139.2 million since the December 1999 Interim submittal.

The contingencies ranged from 15% to 25% and averaged approximately 20.8%. They were chosen by the design and cost engineers, based on the level of knowledge available for each element. The contingency for Element 63, Lock Structure, was reduced from 25% to 20%. This reduction was agreed upon at the January 2000 cost coordination meeting as a result of the increased knowledge gained from recent price quotes and construction bids from local contractors. During final preparation of this report, these construction bids were received for similar work in the Ohio River vicinity, including projects at Olmsted L&D and Braddock L&D.

The major work breakdown structure (WBS) elements that were revised significantly from the previous estimate are discussed below. Costs include contingencies, unless otherwise noted.

Distributed Items:

Distributed items have been left unchanged from the December 1999 submittal. However, they are no longer used for computing the field office overhead and distributing this amount throughout the estimate. At the January 1999 cost coordination meeting, it was decided that the field office overhead rate should be increased to 9% of the direct costs. These distributed items remain in the electronic MCACES files but are not used in the determination of the total construction cost.

Overhead and Profit:

Field Office overhead was increased from 5.3% (distributed) to 9%.

Home Office overhead was increased from 1% to 4%.

Profit was increased from 6% to 8.5%.

Bond requirements remained essentially the same.

The foregoing markups were for work done by the prime contractor. For subcontractor work, the prime's mark ups were revised to total 5%. These overhead and profit rates were reviewed and finalized at the January 2000 cost coordination meeting.

1997 labor and equipment rates were used to prepare the current estimate. To bring the price levels to an effective pricing date of 1 October 1999, MCACES global adjustment factors of 5.2% for labor and 5% for equipment were used.

Marine Insurance: This continues to be treated as in the previous December 1999 submittal. Marine insurance is a labor burden on the trades that work over water. Rates run from 15% to 50%, depending on the contractor's safety experience. A 35% rate was used in this estimate, increasing the burden for selected trades to 71% overall (up from 36%).

Feature 0500: Locks

Element:

01 Mobilization and Preparatory Work: The dry dock work was moved to a new line item, Element 99, Associated General Items.

02 Drainage: There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

03 Care & Diversion of Water: In the current estimate, dewatering of the lock chamber for construction of the maintenance bulkhead sill and laterals, as well as inspection/improvement of the underbase grouting, was included in this element. All other dewatering is for the wrap around culvert and is in Element 64, Fill/Empty System. The increase is due to higher overheads and profit being applied, as discussed above.

04 Permanent Access Roads and Parking: There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

09 Buildings, Project Operations: There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

10 Earthwork for Structures: The cost for this element increased. The increase was due to design refinements, which led to more accurate quantity calculations. Also, increases are due to higher overheads and profit being applied, as discussed above.

11 Foundation Work: There were no changes to quantities or scope. The reduction was due to increases in the productivity for underbase grouting, offset somewhat by higher overheads and profit being applied, as discussed above.

57 Lock Gates and Operating Machinery: There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

62 Approach Walls, Upper and Lower: The cost for this element increased. The increase was due to including the cost of straight run wall armor and application of higher overheads and profit, as discussed above. The resulting costs were comparable to the recent bids received for the Olmsted Approach Walls project.

63 Lock Structure: There were no changes to quantities or scope. The increase is due to raising the direct unit costs of the Stage I base raft concrete by $340 per cubic yard. Also, the increase is due to higher overheads and profit being applied, as discussed above.

64 Fill-Empty System: This element decreased by approximately $3.9 million due to:

- Decreasing the wrap around culvert thrust block concrete quantity
- Decreasing the shoring quantity

- Decreasing the excavation and backfill direct costs
- Decreasing the inlet valve structure concrete quantity
- Increasing the intake monolith concrete quantity
- Decreasing total reinforcing and post-tensioning quantities for the float-in monoliths
- Decreasing the landside wall diffuser concrete quantities

The foregoing changes were discussed and recommended at the January 2000 cost coordination meeting.

65 Piping System: There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

66 Power and Lighting System: There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

99 Associated General Items: This Element was added in order to have a work breakdown structure that was more consistent with the one used for the Greenup L&D cost estimate. It now includes:

Dry Dock work moved from Element 01, Mobilization and Preparatory Work

Temporary Construction Moorage, moved from Feature 1900, Buildings, Grounds, and Utilities.

Feature 1900: Buildings, Grounds, and Utilities

Element:

04 Construction Moorage Area and Service Roads: This has been moved to new Element 99, Associated General Items. There are no costs now in this element.

06 Day Use Area, next to Esplanade: There were no changes to quantities or scope. The reduction was due to changes in distributed items, as discussed above.

08 Relocate Operations Boat Mooring Facility: The name of this element was changed. There were no changes to quantities or scope. The increase is due to higher overheads and profit being applied, as discussed above.

09 Miscellaneous Site Work: The quantity of dredging required for the improvement of the downstream approach channel remained unchanged. Productivity was refined and slightly decreased, resulting in a slightly higher direct cost. Also, the increase is due to higher overheads and profit being applied, as discussed above.

21.4.2 Plan 3 Cost Estimate

The cost estimate summary for Plan 3 – Auxiliary Lock Extension with Culverts is provided on the following pages.

600 Ft Lock Extension Plan 3
Construction
John T. Myers Locks and Dam
Ohio River Mainstem Systems
Study, 100% Feasibility

Designed By: INCA Engineers, Inc.
Estimated By: Constructioneering, Inc.

Prepared By: S. Pierce, G. Griewe, P. Rem
Checked By: Martin Lockard

Preparation Date: 01/28/00
Effective Date of Pricing: 10/01/99
Est Construction Time: 790 Days

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

M C A C E S G O L D E D I T I O N
Composer GOLD Software Copyright (c) 1985-1994
by Building Systems Design, Inc.
Release 5.30A

57. 15% agreed at 5/19/99 joint review meeting among INCA, LRH & LRL reps. Basis for lower value is RW Beck's Cost per lb is current as-built data.

63a. Reduced from 25% to 20%, at Cost Coordination Meeting, Louisville Dist, C o E, 19 -20 January 2000. Element cost estimate reflect recent price quotes.

SUMMARY REPORTS SUMMARY PAGE

PROJECT OWNER SUMMARY - FeatSubF.....1
PROJECT OWNER SUMMARY - Element.....2
PROJECT OWNER SUMMARY - Cmponent.....4

THIS SHEET PURPOSELY BLANK

		QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0100	LANDS AND DAMAGES		42,000	8,000	50,000		
0500	LOCKS		108,475,000	22,434,000	130,908,000		
0600	FISH & WILDLIFE FACILITIES		3,538,000	1,061,000	4,600,000		
1900	BUILDINGS, GROUNDS & UTILITIES		6,796,000	1,515,000	8,312,000		
3000	PLANNING, ENGINEERING & DESIGN		16,500,000	3,300,000	19,800,000		
3100	CONSTRUCTION MANAGEMENT		8,640,000	864,000	9,504,000		
	TOTAL 600 Ft Lock Extension Plan 3		143,991,000	29,183,000	173,174,000		

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0100 LANDS AND DAMAGES						
0100.00 LANDS AND DAMAGES		42,000	8,000	50,000		
TOTAL LANDS AND DAMAGES		42,000	8,000	50,000		
0500 LOCKS						
0500.01 Mob, Demob & Preparatory Work		2,972,000	684,000	3,655,000		
0500.02 Drainage		152,000	36,000	188,000		
0500.03 Care and Diversion of Water		291,000	58,000	349,000		
0500.04 Permanent Access Roads & Parking		834,000	142,000	975,000		
0500.09 Buildings, Project Operations		139,000	35,000	174,000		
0500.10 Earthwork for Structures		7,291,000	1,750,000	9,041,000		
0500.11 Foundation Work		1,338,000	268,000	1,606,000		
0500.57 Lock Gates & Operate Machine U/L		4,280,000	642,000	4,922,000		57
0500.62 Approach Walls, Upper and Lower		32,470,000	6,494,000	38,964,000		
0500.63 Lock Structure		27,644,000	5,529,000	33,173,000		63a
0500.64 Filling and Emptying System		23,043,000	5,069,000	28,113,000		
0500.65 Piping system		577,000	110,000	687,000		
0500.66 Power and Lighting System		1,891,000	340,000	2,231,000		
0500.99 Associated General Items		5,554,000	1,277,000	6,831,000		
TOTAL LOCKS		108,475,000	22,434,000	130,908,000		
0600 FISH & WILDLIFE FACILITIES						
0600.03 Wildlife Facilities & Sanctuary		3,538,000	1,061,000	4,600,000		
TOTAL FISH & WILDLIFE FACILITIES		3,538,000	1,061,000	4,600,000		
1900 BUILDINGS, GROUNDS & UTILITIES						
1900.06 Day Use Area, next to Esplanade		150,000	37,000	187,000		
1900.08 Relocate Opns Boat Mooring Fac'y		2,972,000	743,000	3,715,000		
1900.09 Misc Sitework		3,675,000	735,000	4,410,000		
TOTAL BUILDINGS, GROUNDS & UTILITIES		6,796,000	1,515,000	8,312,000		
3000 PLANNING, ENGINEERING & DESIGN						
3000.00 Planning, Engineering & Design		16,500,000	3,300,000	19,800,000		
TOTAL PLANNING, ENGINEERING & DESIGN		16,500,000	3,300,000	19,800,000		

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
3100 CONSTRUCTION MANAGEMENT						
3100.00 CONSTRUCTION MANAGEMENT		8,640,000	864,000	9,504,000		
TOTAL CONSTRUCTION MANAGEMENT		8,640,000	864,000	9,504,000		
TOTAL 600 Ft Lock Extension Plan 3		143,991,000	29,183,000	173,174,000		

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0100 LANDS AND DAMAGES							
0100.00 LANDS AND DAMAGES							
0100.00.00 Real Estate Costs			42,000	8,000	50,000		
TOTAL LANDS AND DAMAGES			42,000	8,000	50,000		
TOTAL LANDS AND DAMAGES			42,000	8,000	50,000		
0500 LOCKS							
0500.01 Mob, Demob & Preparatory Work							
0500.01.01 Mobilization & Demob of Equipmnt							
0500.01.01.01 Equipment			999,000	230,000	1,229,000		
TOTAL Mobilization & Demob of Equipmnt			999,000	230,000	1,229,000		
0500.01.02 Preparatory Work							
0500.01.02.01 Sitework	143000	SY	1,972,000	454,000	2,426,000	16.97	
TOTAL Preparatory Work	143000	SY	1,972,000	454,000	2,426,000	16.97	
TOTAL Mob, Demob & Preparatory Work			2,972,000	684,000	3,655,000		
0500.02 Drainage							
0500.02.01 Catch Basins							
0500.02.01.01 Catch Basins 4' Depth	24.00	EA	12,000	3,000	15,000	640.08	
TOTAL Catch Basins			12,000	3,000	15,000		
0500.02.03 Drainage Pipe, Size 12"-18"							
0500.02.03.05 15"Perf. Pipe Underdrain	3750.00	LF	119,000	29,000	148,000	39.35	
0500.02.03.10 Maint. Disposal Basin Drain	230.00	LF	20,000	5,000	25,000	108.38	
TOTAL Drainage Pipe, Size 12"-18"	3980.00	LF	139,000	33,000	173,000	43.34	
TOTAL Drainage			152,000	36,000	188,000		

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.03 Care and Diversion of Water							
0500.03.05 Dewater Lock Chamber	3.00	MO	291,000	58,000	349,000	116240	
TOTAL Care and Diversion of Water			291,000	58,000	349,000		
0500.04 Permanent Access Roads & Parking							
0500.04.02 Esplanade							
0500.04.02.01 Esplanade and Parking Area	32222	SY	803,000	136,000	939,000	29.14	
TOTAL Esplanade	32222	SY	803,000	136,000	939,000	29.14	
0500.04.03 Upgrade Existing Roads							
0500.04.03.05 Misc Road Restoration	1445.00	SY	31,000	5,000	36,000	25.20	
TOTAL Upgrade Existing Roads	1445.00	SY	31,000	5,000	36,000	25.20	
TOTAL Permanent Access Roads & Parking			834,000	142,000	975,000		
0500.09 Buildings, Project Operations							
0500.09.02 Control Stations							
0500.09.02.05 Control Room	1584.00	SF	139,000	35,000	174,000	109.70	
TOTAL Control Stations	1584.00	SY	139,000	35,000	174,000	109.70	
TOTAL Buildings, Project Operations			139,000	35,000	174,000		
0500.10 Earthwork for Structures							
0500.10.02 Common Excavation							
0500.10.02.03 Structures	92195	CY	732,000	176,000	908,000	9.84	
TOTAL Common Excavation	92195	CY	732,000	176,000	908,000	9.84	
0500.10.03 Rock Excavation							
0500.10.03.03 Structures	3591.00	BCY	88,000	21,000	110,000	30.56	
TOTAL Rock Excavation	3591.00	BCY	88,000	21,000	110,000	30.56	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.10.05 Backfill							
0500.10.05.10 Backfill Structures	172600	CY	776,000	186,000	962,000	5.57	
TOTAL Backfill	172600	CY	776,000	186,000	962,000	5.57	
0500.10.07 Demolition							
0500.10.07.15 Concrete Demolition Monolith L1	4870.00	CY	796,000	191,000	987,000	202.61	
TOTAL Demolition	4870.00	CY	796,000	191,000	987,000	202.61	
0500.10.08 Dredging							
0500.10.08.03 Structures	417644	CY	4,896,000	1,175,000	6,071,000	14.54	
TOTAL Dredging	417644	CY	4,896,000	1,175,000	6,071,000	14.54	
0500.10.09 Stone Slope Protection							
0500.10.09.10 Lock Structure	100.00	CY	4,000	1,000	4,000	44.43	
TOTAL Stone Slope Protection	100.00	CY	4,000	1,000	4,000	44.43	
TOTAL Earthwork for Structures			7,291,000	1,750,000	9,041,000		
0500.11 Foundation Work							
0500.11.05 Site Work							
0500.11.05.05 Foundation Preparation	6500.00	CY	1,338,000	268,000	1,606,000	247.08	
TOTAL Site Work	6500.00	CY	1,338,000	268,000	1,606,000	247.08	
TOTAL Foundation Work			1,338,000	268,000	1,606,000		
0500.12 Seepage Control							
0500.12.01 Drilling and Grouting							
0500.57 Lock Gates & Operate Machine U/L							
0500.57.01 Miter Gates & Embedded Metals							
0500.57.01.01 Miter Gates	656000	LB	2,528,000	379,000	2,907,000	4.43	
0500.57.01.02 Miter Gates embedded parts	164000	LB	519,000	78,000	597,000	3.64	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
TOTAL Miter Gates & Embedded Metals	820000	LB	3,048,000	457,000	3,505,000	4.27	
0500.57.02 Embedded Metals, Maint Bulkhead							
0500.57.02.01 Maintenance Bulkheads Embed Part	208000	LB	714,000	107,000	821,000	3.95	
TOTAL Embedded Metals, Maint Bulkhead	208000	LB	714,000	107,000	821,000	3.95	
0500.57.04 Miter Gate Operating Machinery							
0500.57.04.01 Gate Operating Machinery	2.00	EA	300,000	45,000	345,000	172371	
TOTAL Miter Gate Operating Machinery	2.00	EA	300,000	45,000	345,000	172371	
0500.57.05 Existing Miter Gate Removal	656000	LB	219,000	33,000	252,000	0.38	
TOTAL Lock Gates & Operate Machine U/L			4,280,000	642,000	4,922,000		57
0500.62 Approach Walls, Upper and Lower							
0500.62.34 JT Myers Nose Piers, Upper Walls							
0500.62.34. 1 Dredging Excavation - Nose Piers	4320.00	CY	84,000	17,000	101,000	23.38	
0500.62.34. 2 Shaft Excavation - Nose Piers	1360.00	CY	1,064,000	213,000	1,277,000	938.80	
0500.62.34. 3 Nose Pier Debris Shield	2.00	EA	51,000	10,000	61,000	30593	
0500.62.34. 4 Permanent Steel Casing -Nose P	728.00	LF	823,000	165,000	988,000	1356.46	
0500.62.34. 5 Grout Casing in Rock	14000	CF	121,000	24,000	145,000	10.38	
0500.62.34. 6 Reinforcing Steel - Nose Piers	312000	LB	270,000	54,000	324,000	1.04	
0500.62.34. 7 Tremie Concr Cl 5000 - Shafts,	1920.00	CY	364,000	73,000	437,000	227.47	
0500.62.34. 8 CIP Concrete Class 4000 - Shell	1165.00	CY	174,000	35,000	209,000	179.30	
0500.62.34.10 Precast Concrete, U/S Nose Piers	530.00	CY	520,000	104,000	624,000	1177.14	
0500.62.34.15 Nose Pier Shell Steel	979520	LBS	1,596,000	319,000	1,915,000	1.95	
0500.62.34.20 Miscellaneous Metals	18190	LBS	40,000	8,000	49,000	2.67	
0500.62.34.25 Nose Pier Painting	61550	SF	100,000	20,000	120,000	1.95	
0500.62.34.30 Nose Pier Seals	220.00	LF	2,000	0	2,000	9.55	
0500.62.34.35 Nose Pier UHMW	4450.00	SF	58,000	12,000	69,000	15.57	
TOTAL JT Myers Nose Piers, Upper Walls	2.00	EA	5,267,000	1,053,000	6,320,000	3160009	
0500.62.35 JT Myers Nose Piers, Lower Walls							
0500.62.35. 1 Dredging Excavation - Nose Piers	4320.00	CY	84,000	17,000	101,000	23.38	
0500.62.35. 2 Shaft Excavation - Nose Piers	1360.00	CY	1,064,000	213,000	1,277,000	938.80	
0500.62.35. 3 Nose Pier Debris Shield	2.00	EA	51,000	10,000	61,000	30593	
0500.62.35. 4 Permanent Steel Casing -Nose P	728.00	LF	823,000	165,000	988,000	1356.46	
0500.62.35. 5 Grout Casing in Rock	14000	CF	121,000	24,000	145,000	10.38	
0500.62.35. 6 Reinforcing Steel - Nose Piers	312000	LB	270,000	54,000	324,000	1.04	

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.62.35. 7	Tremie Concr Cl 5000 - Shafts,	1920.00	CY	364,000	73,000	437,000	227.47	
0500.62.35. 8	CIP Concrete Class 4000 - Shell	1820.00	CY	268,000	54,000	322,000	177.03	
0500.62.35.10	Precast Concrete D/S Nose Piers	600.00	CY	589,000	118,000	706,000	1177.14	
0500.62.35.15	Nose Pier Shell Steel	1530500	LBS	2,493,000	499,000	2,992,000	1.95	
0500.62.35.20	Miscellaneous Metals	28420	LBS	63,000	13,000	76,000	2.67	
0500.62.35.25	Nose Pier Painting	28420	SF	126,000	25,000	151,000	5.33	
0500.62.35.30	Nose Pier Seals	345.00	LF	3,000	1,000	3,000	9.55	
0500.62.35.35	Nose Pier UHMW	6950.00	SF	90,000	18,000	108,000	15.57	
TOTAL	JT Myers Nose Piers, Lower Walls	2.00	EA	6,410,000	1,282,000	7,691,000	3845735	
0500.62.36	Pylon, Stand Alone, U/S River							
0500.62.36. 1	Dredging Excavation, River Pylon	650.00	CY	13,000	3,000	15,000	23.38	
0500.62.36. 2	Shaft Excavation, River Pylon	207.00	CY	162,000	32,000	194,000	938.80	
0500.62.36. 3	Permanent Steel Casing, R. Pylon	105.00	LF	115,000	23,000	138,000	1312.98	
0500.62.36. 4	Grout Pylon Casing in Rock	2050.00	CF	18,000	4,000	21,000	10.38	
0500.62.36. 5	Reinforcing Steel - Pylons	68000	LB	38,000	8,000	46,000	0.67	
0500.62.36. 6	Tremie Conc Cl. 5000 for Shaft-	420.00	CY	69,000	14,000	83,000	196.89	
0500.62.36. 7	CIP Concrete Class 4000 for Fill	35.00	CY	5,000	1,000	6,000	184.29	
0500.62.36. 8	Precast Conc for Base & Cap	160.00	CY	178,000	36,000	214,000	1336.48	
0500.62.36. 9	Structural Steel At Pylons	5425.00	LB	6,000	1,000	7,000	1.37	
0500.62.36.10	Miscellaneous Metals	250.00	LB	3,000	1,000	4,000	16.50	
0500.62.36.11	Pylon Seals			0	0	1,000		
0500.62.36.12	Pylon UHMW	600.00	SF	12,000	2,000	15,000	24.85	
TOTAL	Pylon, Stand Alone, U/S River	1.00	EA	620,000	124,000	745,000	744519	
0500.62.37	Pylon, Attached, DS Guide Walls							
0500.62.37. 5	Reinforcing Steel - Pylons	119000	LB	85,000	17,000	102,000	0.86	
0500.62.37. 7	CIP Concrete Class 4000 for Fill	1190.00	CY	183,000	37,000	219,000	184.29	
0500.62.37. 8	Precast Conc for Base & Cap	166.00	CY	185,000	37,000	222,000	1336.48	
0500.62.37. 9	Structural Steel At Pylons	21660	LB	25,000	5,000	30,000	1.37	
0500.62.37.10	Miscellaneous Metals	500.00	LB	7,000	1,000	8,000	16.50	
0500.62.37.11	Pylon Seals	2.00	SET	1,000	0	1,000	543.42	
0500.62.37.12	Pylon UHMW	1848.00	SF	38,000	8,000	46,000	24.85	
TOTAL	Pylon, Attached, DS Guide Walls	2.00	EA	523,000	105,000	628,000	313941	
0500.62.38	Pylon, Attached, US Middle Wall							
0500.62.38. 5	Reinforcing Steel - Pylons	24000	LB	25,000	5,000	30,000	1.26	
0500.62.38. 7	CIP Concrete Class 4000 for Fill	225.00	CY	35,000	7,000	41,000	184.29	
0500.62.38. 8	Precast Conc for Base & Cap	32.00	CY	36,000	7,000	43,000	1336.48	
0500.62.38. 9	Structural Steel At Pylons	10830	LB	12,000	2,000	15,000	1.37	
0500.62.38.10	Miscellaneous Metals	250.00	LB	3,000	1,000	4,000	16.50	
0500.62.38.11	Pylon Seals			0	0	1,000		

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.62.38.12 Pylon UHMW	720.00	SF	15,000	3,000	18,000	24.85	
TOTAL Pylon, Attached, US Middle Wall	1.00	EA	127,000	25,000	152,000	151814	
0500.62.40 Upper & Lower Float Guide Walls							
0500.62.40. 1 Pontoons	2660.00	LF	19,523,000	3,905,000	23,428,000	8807.56	
TOTAL Upper & Lower Float Guide Walls	2660.00	LF	19,523,000	3,905,000	23,428,000	8807.56	
TOTAL Approach Walls, Upper and Lower			32,470,000	6,494,000	38,964,000		
0500.63 Lock Structure							
0500.63.01 Concrete, Float-In, Stage I							
0500.63.01.20 Gate Bay	2740.00	CY	2,545,000	509,000	3,054,000	1114.52	
0500.63.01.25 Land Wall Monolith	3736.00	CY	3,468,000	694,000	4,161,000	1113.84	
TOTAL Concrete, Float-In, Stage I	6476.00	CY	6,013,000	1,203,000	7,215,000	1114.13	
0500.63.04 Concrete, Precast, Stage 2 3 & 4							
0500.63.04.05 Gate Bay	1469.00	CY	1,280,000	256,000	1,536,000	1045.91	
0500.63.04.10 Land Wall Monolith	4071.00	CY	3,192,000	638,000	3,831,000	941.04	
TOTAL Concrete, Precast, Stage 2 3 & 4	5567.00	CY	4,473,000	895,000	5,367,000	964.15	
0500.63.05 Concrete, Mass, Stage 4							
0500.63.05.05 Gate Bay	24538	CY	3,107,000	621,000	3,729,000	151.96	
0500.63.05.10 Land Wall Monolith	28193	CY	3,563,000	713,000	4,275,000	151.64	
TOTAL Concrete, Mass, Stage 4	52731	CY	6,670,000	1,334,000	8,004,000	151.79	
0500.63.06 Concrete, CIP, Miter Gate Recess							
0500.63.06.04 CIP Concrete, Miter Gate Recess	2058.00	CY	550,000	110,000	660,000	320.48	
TOTAL Concrete, CIP, Miter Gate Recess	2058.00	CY	550,000	110,000	660,000	320.48	
0500.63.07 Concrete, CIP, Wall Mono's L2-L5							
0500.63.07.04 CIP Concrete, el 310 - 362	3890.00	CY	1,039,000	208,000	1,247,000	320.55	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.63.07.11 CIP Concrete, Heel El 286 - 300	625.00	CY	167,000	33,000	201,000	321.48	
TOTAL Concrete, CIP, Wall Mono's L2-L5	2431.00	CY	1,207,000	241,000	1,448,000	595.59	
0500.63.08 Reinforcing Steel							
0500.63.08.05 Float-In Gate Bay	1300000	LB	885,000	177,000	1,061,000	0.82	
0500.63.08.10 Float-In Land Wall Monolith	2350000	LB	1,577,000	315,000	1,892,000	0.81	
0500.63.08.30 Modifying Exist Monoliths L2-L5	128.00	TON	258,000	52,000	309,000	2416.87	
0500.63.08.35 Fill Exist. Miter Gate Recesses	58.00	TON	152,000	30,000	182,000	3142.68	
TOTAL Reinforcing Steel	1836.00	TON	2,871,000	574,000	3,445,000	1876.32	
0500.63.09 Anchor Existing Monolith Walls							
0500.63.09.05 Drill Anchor holes	106.00	EA	768,000	154,000	921,000	8693.10	
0500.63.09.10 Install and Stress Rock Anchors	106.00	EA	708,000	142,000	849,000	8011.12	
0500.63.09.15 Grout Rock Anchors	106.00	EA	500,000	100,000	600,000	5664.49	
TOTAL Anchor Existing Monolith Walls	106.00	EA	1,976,000	395,000	2,371,000	22369	
0500.63.10 Floating Mooring Bitt							
0500.63.10.01 Floating Mooring Bits	10.00	EA	639,000	128,000	767,000	76685	
TOTAL Floating Mooring Bitt	10.00	EA	639,000	128,000	767,000	76685	
0500.63.12 Steel Ladders							
0500.63.12.01 Ladders	1900.00	VLF	161,000	32,000	193,000	101.43	
TOTAL Steel Ladders	1900.00	VLF	161,000	32,000	193,000	101.43	
0500.63.22 Line Hooks							
0500.63.22.01 Line Hooks			167,000	33,000	200,000		
TOTAL Line Hooks			167,000	33,000	200,000		
0500.63.23 Check Posts							
0500.63.23.01 Check Posts			167,000	33,000	200,000		
TOTAL Check Posts			167,000	33,000	200,000		

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.63.24 Wall Armor							
0500.63.24.01 Fabricate and Place Wall Armor	80.00	TON	298,000	60,000	358,000	4472.44	
TOTAL Wall Armor	80.00	TON	298,000	60,000	358,000	4472.44	
0500.63.40 Embedded Piping							
0500.63.40.05 Ballast Piping			821,000	164,000	985,000		
0500.63.40.10 Grout Piping			243,000	49,000	292,000		
0500.63.40.15 Jacking Legs	10.00	EA	256,000	51,000	307,000	30673	
0500.63.40.20 Water Stops	1000.00	LF	38,000	8,000	46,000	45.92	
TOTAL Embedded Piping			1,358,000	272,000	1,629,000		
0500.63.70 Maintenance Bulkhead Sill							
0500.63.70.05 Concrete, In Place	2900.00	CY	776,000	155,000	931,000	320.93	
0500.63.70.20 Reinforcing Steel	50.00	TON	62,000	12,000	75,000	1498.08	
TOTAL Maintenance Bulkhead Sill	2900.00	CY	838,000	168,000	1,006,000	346.76	
0500.63.85 Metals							
0500.63.85.20 Misc Metals	85.00	TOS	259,000	52,000	310,000	3650.18	
TOTAL Metals	85.00	TON	259,000	52,000	310,000	3650.18	
TOTAL Lock Structure			27,644,000	5,529,000	33,173,000		63a
0500.64 Filling and Emptying System							
0500.64.01 Shoring, Type 27							
0500.64.01.02 Sheet Piling Cut-off Walls	1964.00	TON	4,792,000	1,054,000	5,846,000	2976.75	
TOTAL Shoring, Type 27	1964.00	TON	4,792,000	1,054,000	5,846,000	2976.75	
0500.64.02 Unwatering							
0500.64.02.01 Wellpoints			801,000	176,000	977,000		
0500.64.02.05 Earthwork for Dewatering Berms	25100	CY	113,000	25,000	138,000	5.48	
TOTAL Unwatering			914,000	201,000	1,115,000		

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.64.03 Excavation, Common, Wet & Dry							
0500.64.03.01 Wrap Around Culvert	303106	CY	1,615,000	355,000	1,971,000	6.50	
TOTAL Excavation, Common, Wet & Dry	303106	CY	1,615,000	355,000	1,971,000	6.50	
0500.64.04 Excavation, Rock, Wet & Dry							
0500.64.04.01 Wrap Around Culvert	9848.00	CY	549,000	121,000	669,000	67.96	
TOTAL Excavation, Rock, Wet & Dry	9848.00	CY	549,000	121,000	669,000	67.96	
0500.64.05 Backfill							
0500.64.05.15 Wrap Around Culvert	253670	CY	1,907,000	420,000	2,327,000	9.17	
0500.64.05.20 Downstream Diffuser Lagoon Stone	13000	CY	466,000	102,000	568,000	43.71	
TOTAL Backfill	266670	CY	2,373,000	522,000	2,895,000	10.86	
0500.64.06 Screens & Nose Plates at Intake							
0500.64.06.01 Trashrack	1.00	EA	187,000	41,000	228,000	227774	
TOTAL Screens & Nose Plates at Intake	1.00	EA	187,000	41,000	228,000	227774	
0500.64.07 Concrete, C.I.P. Intake Monolith							
0500.64.07.02 Concrete, C.I.P.	4600.00	CY	1,230,000	271,000	1,501,000	326.28	
0500.64.07.20 Reinforcing Steel	57.50	TON	72,000	16,000	88,000	1523.04	
TOTAL Concrete, C.I.P. Intake Monolith	4600.00	CY	1,302,000	286,000	1,588,000	345.32	
0500.64.08 Concrete, Thrust Block							
0500.64.08.01 Thrust Block	1200.00	CY	364,000	80,000	444,000	369.82	
TOTAL Concrete, Thrust Block	1200.00	CY	364,000	80,000	444,000	369.82	
0500.64.09 Concrete Culvert, 16.5 Ft dia							
0500.64.09.05 Modify Existing Cutoff Wall			128,000	28,000	156,000		
0500.64.09.10 Wrap Around Culvert PCC Sections	1110.00	LF	3,108,000	684,000	3,791,000	3415.74	
0500.64.09.15 Wrap Around Culvert CIP Sections	75.00	LF	210,000	46,000	257,000	3423.09	
0500.64.09.20 Laterals	2600.00	CY	1,195,000	263,000	1,458,000	560.60	

	QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
TOTAL Concrete Culvert, 16.5 Ft dia	6830.00	CY	4,641,000	1,021,000	5,662,000	828.93	
0500.64.10 Ice & Debris Boom							
0500.64.10.01 Floating Boom	230.00	LF	280,000	62,000	341,000	1484.41	
TOTAL Ice & Debris Boom	230.00	LF	280,000	62,000	341,000	1484.41	
0500.64.11 Culvert Valve & Embedded Metals							
0500.64.11.01 Culvert Valves, 2 sets	66000	LB	307,000	67,000	374,000	5.67	
0500.64.11.02 Culvert Valves embedded parts	22000	LB	75,000	17,000	92,000	4.19	
TOTAL Culvert Valve & Embedded Metals	88000	LB	382,000	84,000	466,000	5.30	
0500.64.12 Culvert Valve Operating Machin-							
0500.64.12.01 Culvert Valve Operating Machiner	2.00	EA	139,000	31,000	169,000	84602	
TOTAL Culvert Valve Operating Machin-	2.00	EA	139,000	31,000	169,000	84602	
0500.64.13 Culvert Valve Bulkheads and							
0500.64.13.01 Culvert Valve Bulkheads	100000	LB	401,000	88,000	490,000	4.90	
0500.64.13.02 Culvert Valve Bulkheads Embedded	36000	LB	125,000	28,000	153,000	4.25	
TOTAL Culvert Valve Bulkheads and	136000	LB	527,000	116,000	643,000	4.72	
0500.64.15 Float-in Diffuser Monolith							
0500.64.15.05 Monolith Float-in Concr Stage 1	726.00	CY	477,000	105,000	582,000	801.09	
0500.64.15.10 Monolith Precast Concr, Stage 2,	224.00	CY	157,000	35,000	192,000	855.73	
0500.64.15.15 Monolith Mass Concrete Stage 4	3049.00	CY	432,000	95,000	528,000	173.01	
0500.64.15.20 Reinforcing Steel Diffuser Mono	260.00	TON	383,000	84,000	467,000	1797.44	
0500.64.15.25 Ballast Piping			236,000	52,000	288,000		
0500.64.15.35 Grout Piping-FI Diffuser			55,000	12,000	67,000		
TOTAL Float-in Diffuser Monolith	12427	CY	1,740,000	383,000	2,123,000	170.83	
0500.64.16 Valve Structure							
0500.64.16.01 Concrete, cast in place	4500.00	CY	1,028,000	226,000	1,254,000	278.71	
0500.64.16.02 Reinforcing Steel	105.00	TON	95,000	21,000	116,000	1102.67	
0500.64.16.04 Foundation Excavation	3000.00	CY	20,000	4,000	25,000	8.27	

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.64.16.07 Miscellaneous		111,000	24,000	135,000		
TOTAL Valve Structure	4500.00 CY	1,254,000	276,000	1,530,000	340.04	
0500.64.22 Drilled Shaft Wing Wall	340.00 LF	1,581,000	348,000	1,929,000	5674.38	
0500.64.90 Miscellaneous Mechanical Work		217,000	48,000	264,000		
0500.64.93 Relocate Existing Utilities						
0500.64.93.05 Relocate Mechanical, Civil Util		106,000	23,000	129,000		
0500.64.93.10 Relocate Elect, Comm. Utilities		82,000	18,000	100,000		
TOTAL Relocate Existing Utilities		187,000	41,000	229,000		
TOTAL Filling and Emptying System		23,043,000	5,069,000	28,113,000		
0500.65 Piping system						
0500.65.01 Hydraulic System	2.00 EA	477,000	91,000	568,000	284051	
0500.65.02 Compressed Air Piping System		50,000	9,000	59,000		
0500.65.03 Raw Water Piping System		50,000	9,000	59,000		
TOTAL Piping system		577,000	110,000	687,000		
0500.66 Power and Lighting System						
0500.66.01 Electrical Work						
0500.66.01.01 Motor Control Center and Wiring		284,000	51,000	336,000		
0500.66.01.02 Standby Generator	1.00 EA	130,000	23,000	154,000	153624	
0500.66.01.03 High Mast Light 12 x 400W HPS	30.00 EA	70,000	13,000	82,000	2742.30	
0500.66.01.04 Miscellaneous Electrical Work		67,000	12,000	79,000		
TOTAL Electrical Work		551,000	99,000	650,000		
0500.66.02 Control & Signal Systems						
0500.66.02.01 Misc Lighting and Signal Circuit		98,000	18,000	116,000		
0500.66.02.02 Control Systems, CCTV and wiring		1,241,000	223,000	1,465,000		
TOTAL Control & Signal Systems		1,339,000	241,000	1,581,000		
TOTAL Power and Lighting System		1,891,000	340,000	2,231,000		
0500.99 Associated General Items						
0500.99.03 Dry Dock						

	QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.99.03. 1 Prepare Graving Dock		3,742,000	861,000	4,602,000		
TOTAL Dry Dock		3,742,000	861,000	4,602,000		
0500.99.04 Construction Moorage & Svc Roads						
0500.99.04.20 Temporary Construction Moorage		1,812,000	417,000	2,229,000		
TOTAL Construction Moorage & Svc Roads		1,812,000	417,000	2,229,000		
TOTAL Associated General Items		5,554,000	1,277,000	6,831,000		
TOTAL LOCKS		108,475,000	22,434,000	130,908,000		
0600 FISH & WILDLIFE FACILITIES						
0600.03 Wildlife Facilities & Sanctuary						
0600.03.73 Habitat & Feeding Facilities						
0600.03.73. 1 Project #1		1,438,000	431,000	1,870,000		
0600.03.73. 2 Project #2		18,000	5,000	23,000		
0600.03.73. 3 Project #3		124,000	37,000	161,000		
0600.03.73. 4 Project #4		261,000	78,000	340,000		
0600.03.73. 5 Project #5		326,000	98,000	424,000		
0600.03.73. 6 Project #6		209,000	63,000	272,000		
0600.03.73. 7 Project #7		1,161,000	348,000	1,510,000		
TOTAL Habitat & Feeding Facilities		3,538,000	1,061,000	4,600,000		
TOTAL Wildlife Facilities & Sanctuary		3,538,000	1,061,000	4,600,000		
TOTAL FISH & WILDLIFE FACILITIES		3,538,000	1,061,000	4,600,000		
1900 BUILDINGS, GROUNDS & UTILITIES						
1900.06 Day Use Area, next to Esplanade		150,000	37,000	187,000		
TOTAL Day Use Area, next to Esplanade		150,000	37,000	187,000		
1900.08 Relocate Opns Boat Mooring Fac'y						
1900.08.05 Remove Existing Boat Ramp		2,000	1,000	3,000		
1900.08.10 Remove Wharf Turn Around Area		6,000	1,000	7,000		
1900.08.15 Remove Boat Ramp Electrical		6,000	2,000	8,000		
1900.08.20 Construct New Boat Moorage						

		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
1900.08.20.05	Earthwork	15000	CY	135,000	34,000	169,000	11.28	
1900.08.20.10	Sheetpile Mooring Cell			1,827,000	457,000	2,284,000		
1900.08.20.15	Tied-Back Sheetpile Wall	345.00	TON	669,000	167,000	836,000	2423.43	
1900.08.20.17	Permanent Access Road	2185.00	SY	190,000	47,000	237,000	108.51	
1900.08.20.20	Install Floating Dock & Access-			12,000	3,000	15,000		
1900.08.20.25	Parking Area 35' x 350'	1360.00	SY	35,000	9,000	43,000	31.94	
1900.08.20.27	Moorage Facility Mechanical Util			58,000	14,000	72,000		
1900.08.20.30	Moorage Facility Electrical			31,000	8,000	39,000		
TOTAL	Construct New Boat Moorage			2,957,000	739,000	3,696,000		
TOTAL	Relocate Opns Boat Mooring Fac'y			2,972,000	743,000	3,715,000		
1900.09	Misc Sitework							
1900.09.04	Downstream Channel Approach							
1900.09.04.05	Dredging, El 310 - 325	248094	CY	2,545,000	509,000	3,054,000	12.31	
1900.09.04.10	Unclassified, Dry, El 325 - 350	70822	CY	519,000	104,000	623,000	8.80	
TOTAL	Downstream Channel Approach	318916	CY	3,064,000	613,000	3,677,000	11.53	
1900.09.10	Excavation and Grading							
1900.09.10.10	Grading	256000	SY	305,000	61,000	366,000	1.43	
TOTAL	Excavation and Grading	256000	SY	305,000	61,000	366,000	1.43	
1900.09.15	Landscaping							
1900.09.15.10	Landscaping	53.03	ACR	306,000	61,000	367,000	6928.91	
TOTAL	Landscaping	53.03	ACR	306,000	61,000	367,000	6928.91	
TOTAL	Misc Sitework			3,675,000	735,000	4,410,000		
TOTAL	BUILDINGS, GROUNDS & UTILITIES			6,796,000	1,515,000	8,312,000		
3000	PLANNING, ENGINEERING & DESIGN							
3000.00	Planning, Engineering & Design							
3000.00.00	FY00							
3000.00.00.01	Value Engineering Study			88,000	18,000	105,000		
3000.00.00.02	Initiate Seismic Ground Motion			146,000	29,000	175,000		
3000.00.00.03	ITR of Seismic Ground Motions			42,000	8,000	50,000		

		QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
3000.00.00.04	Initial Design Conference(s)		42,000	8,000	50,000		
3000.00.00.05	JT Myers Survey and Mapping		50,000	10,000	60,000		
3000.00.00.06	Initiate DDR#1 (Initial Design)		63,000	13,000	75,000		
3000.00.00.07	Environmental, Ecomomics, PM		125,000	25,000	150,000		
TOTAL FY00			554,000	111,000	665,000		
3000.00.01 FY01							
3000.00.01.01	Construct WES Navigation Model		313,000	63,000	375,000		
3000.00.01.02	Test Navigation Model		83,000	17,000	100,000		
3000.00.01.03	Complete Seismic Ground Motions		63,000	13,000	75,000		
3000.00.01.04	Complete DDR#1 (Initial Design)		208,000	42,000	250,000		
3000.00.01.05	ITR of DDR#1 (Initial Design)		40,000	8,000	48,000		
3000.00.01.06	Phase 1 Geotech Drilling		229,000	46,000	275,000		
3000.00.01.07	HTRW Field Sampling/Testing Appx		125,000	25,000	150,000		
3000.00.01.08	Phase 1 Dynamic Analysis		229,000	46,000	275,000		
3000.00.01.09	Initiate NISA Study Appendix		208,000	42,000	250,000		
3000.00.01.10	Initiate DDR#2 (Lock Chamber)		517,000	103,000	620,000		
3000.00.01.11	Initiate DDR#3 (Approach Walls)		292,000	58,000	350,000		
3000.00.01.12	Environmental, Economics, PM		833,000	167,000	1,000,000		
TOTAL FY01			3,140,000	628,000	3,768,000		
3000.00.02 FY02							
3000.00.02.01	Test Navigation Model		188,000	38,000	225,000		
3000.00.02.02	Hydraulic Model Studies Appendix		83,000	17,000	100,000		
3000.00.02.03	Phase 2 Geotech Drilling		188,000	38,000	225,000		
3000.00.02.04	Foundations Appendix (incl. ITR)		233,000	47,000	280,000		
3000.00.02.05	Phase 2 Dynamic Analysis		125,000	25,000	150,000		
3000.00.02.06	Materials Appendix (incl. ITR)		245,000	49,000	294,000		
3000.00.02.07	Complete NISA Appendix		167,000	33,000	200,000		
3000.00.02.08	Continue DDR#2 (Lock Chamber)		583,000	117,000	700,000		
3000.00.02.09	Complete DDR#3 (Approach Walls)		458,000	92,000	550,000		
3000.00.02.10	Initiate DDR#4 (Miter Gates)		292,000	58,000	350,000		
3000.00.02.11	Environmental, Economics, PM		833,000	167,000	1,000,000		
TOTAL FY02			3,395,000	679,000	4,074,000		
3000.00.03 FY03							
3000.00.03.01	Final Navigation Model Testing		42,000	8,000	50,000		
3000.00.03.02	ITR of DDR#3 (Approach Walls)		83,000	17,000	100,000		
3000.00.03.03	Complete DDR#4 (Miter Gates)		250,000	50,000	300,000		
3000.00.03.04	ITR of DDR#4 (Miter Gates)		42,000	8,000	50,000		
3000.00.03.05	Plans/Specs - Miter Gates to 75%		250,000	50,000	300,000		
3000.00.03.06	Complete DDR#2 (Lock Chamber)		292,000	58,000	350,000		

		QUANTY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
3000.00.03.07	ITR of DDR#2 (Lock Chamber)		167,000	33,000	200,000		
3000.00.03.08	Plans/Specs - Lock Chamber 75%		625,000	125,000	750,000		
3000.00.03.09	Plans/Specs - Approach Walls 75%		625,000	125,000	750,000		
3000.00.03.10	Environmental, Economics, PM		833,000	167,000	1,000,000		
	TOTAL FY03		3,208,000	642,000	3,850,000		
3000.00.04	FY04						
3000.00.04.01	Draft Plans/Specs - Miter Gates		375,000	75,000	450,000		
3000.00.04.02	Draft Plans/Specs - Lock Chamber		875,000	175,000	1,050,000		
3000.00.04.03	Draft Plans/Specs - Appr Walls		583,000	117,000	700,000		
3000.00.04.04	Miscellaneous Design Work		417,000	83,000	500,000		
3000.00.04.05	Environmental, Economics, PM		833,000	167,000	1,000,000		
	TOTAL FY04		3,083,000	617,000	3,700,000		
3000.00.05	FY05						
3000.00.05.01	Final Plans/Specs Miter Gates		104,000	21,000	125,000		
3000.00.05.02	Final Plans/Specs Lock Chamber		333,000	67,000	400,000		
3000.00.05.03	Final Plans/Specs Approach Walls		417,000	83,000	500,000		
3000.00.05.04	Final Design Work		250,000	50,000	300,000		
3000.00.05.05	Environmental, Economics, PM		346,000	69,000	415,000		
	TOTAL FY05		1,450,000	290,000	1,740,000		
3000.00.06	Engineering During Construction						
3000.00.06.01	Engineering During Construction		1,670,000	334,000	2,004,000		
	TOTAL Engineering During Construction		1,670,000	334,000	2,004,000		
	TOTAL Planning, Engineering & Design		16,500,000	3,300,000	19,800,000		
	TOTAL PLANNING, ENGINEERING & DESIGN		16,500,000	3,300,000	19,800,000		
3100	CONSTRUCTION MANAGEMENT						
3100.00	CONSTRUCTION MANAGEMENT		8,640,000	864,000	9,504,000		
	TOTAL CONSTRUCTION MANAGEMENT		8,640,000	864,000	9,504,000		
	TOTAL 600 Ft Lock Extension Plan 3		143,991,000	29,183,000	173,174,000		

Pages 21-51 to 21-63 are NOT used in this printing (April 2000)

The back of this sheet should continue as Page 21-64

21.5 PLAN 4 - PHASE 1 WORK

21.5.1 Plan 4 – Phase 1 Work, Assumptions and Revisions

The current feasibility cost estimate is a continuing effort to refine previous submittals. It is a refinement of the construction approach and includes some changes in scope. Plan 4 – Phase 1 includes construction of the 600' lock extension without the wrap around culvert. The fill/empty system laterals, outlet valve, and landside wall diffuser are constructed in this plan. The discussion and analysis here concern changes to the estimate and project from Plan 3. Plan 3 is the "Master Plan", since it contains the complete scope of work that was in previous submittals.

The strategy of using either the decommissioned lock at Gallipolis or submersible barges for construction of float-in monoliths and the floating approach walls is unchanged. Mobilization, demobilization and preparation costs are approximately the same as for Plan 3. The duration of time that the contractor's equipment and batch plant is needed at the site is the same as in Plan 3.

Some quantity takeoffs from the Plan 3 estimate, especially site work, have been divided, separating out work for the lock extension without the wrap around culvert. The work associated with the wrap around culvert construction was moved to the Plan 4 – Phase 2 estimate.

As in previous estimates, it is assumed that there are no contaminated or hazardous materials on the site. It is anticipated that the on-site excavated material will be used as backfill for the entire project, with no significant quantities of imported borrow required. The primary components requiring backfill are the float-in land wall monolith and the float-in miter gate bay monolith.

The following major changes from Plan 3, resulting from deletion of the wrap around culvert, are:

- The esplanade remains intact.
- The upstream Operations Moorage Facility is not relocated.
- The existing utilities between the service mound and the locks do not need to be temporarily relocated.

The contingencies averaged approximately 22% and were assigned based on the level of knowledge available for each element.

During the final preparation of this report, bids for similar work in the Ohio River System, at Olmsted Lock and Dam and Braddock Lock and Dam, were opened. Bid prices for several similar items of work in the current estimate were higher. As a result, analysis of the costs and prices for these work items will continue, and it may result in higher estimated costs in future submittals.

The major work breakdown structure (WBS) elements that were revised significantly from the Plan 3 estimate are discussed below. Costs include contingencies, unless otherwise noted.

Distributed Items

Distributed items for the "LP" contractor at the Uniontown site and the "GP" contractor at Gallipolis are the same as for Plan 3. However, at the lock site, the direct costs of the lock extension, without the wraparound culvert, is considerably smaller. This results in a higher field office overhead rate of 9.11%, up from 6.60% in Plan 3. This is reflected in all of the WBS elements. Therefore, even those elements unchanged in scope or quantities by deletion of the wrap around culvert show a higher contract amount in the respective summaries.

Helper tugs and marine insurance are unchanged from the Plan 3 estimate.

Feature 0500: Locks

Element:

01 Mobilization and Preparatory Work: The site work has been reduced from 29 acres to 22 acres, due to elimination of the wrap around culvert excavation/fill and elimination of the upstream mooring facility relocation, when compared with Plan 3.

02 Drainage: There were no changes to quantities or scope. The additional cost was due to the effects of the increased field office overhead, as discussed above.

03 Care and Diversion of Water: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

04 Permanent Access Roads and Parking: The quantity has been reduced to 1445 SY from 33667 SY. The esplanade reconstruction will not have to be done in this phase.

09 Buildings, Project Operations: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

10 Earthwork for Structures: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

11 Foundation Work: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

57 Lock Gates and Operating Machinery: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

62 Approach Walls, Upper and Lower: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

63 Lock Structure: There was a very small change in this element due to the addition of a knockout panel at the upstream end of the culvert in the lock wall extension. Mainly, the additional cost was due to the increase in field office overhead, as discussed above.

64 Fill/Empty System: This element includes construction of the laterals, outlet culvert valve and operating machinery, and landside wall diffuser. Direct costs of these structures are unchanged from the Plan 3 estimate. However, there was additional cost due to the increase in field office overhead, as discussed above. The wrap around culvert, utilities relocations, intake structure, and inlet valve monolith are not required for Plan 2.

65 Piping System: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

66 Power and Lighting System: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

Feature 1900: Buildings, Grounds, and Utilities

Element:

04 Construction Moorage Area and Service Roads: There were no changes to quantities or scope. The additional cost was due to the increase in field office overhead, as discussed above.

06 Day Use Area, next to Esplanade: Deleted, as there will be no removal and restoration needed since the wrap around culvert is not constructed in Phase 1 of Plan 4.

08 Operations Mooring Facility Relocation: Deleted, since this will not be required in Phase 1 of Plan 4.

09 Miscellaneous Site Work: Site grading and landscaping has a little reduction in scope since construction of wrap around culvert and relocation of the operations moorage facility will not be required in Phase 1 of Plan 4. The cost is a little higher, nevertheless, due to the field office overhead increase discussed above. The downstream approach channel improvement is the largest cost item in this program element, and it remains unchanged.

21.5.2 Plan 4 – Phase 1 Work, Cost Estimate

The cost estimate summary for Plan 4 – Phased Construction, Phase 1 Work is provided on the following pages.

** PROJECT OWNER SUMMARY - Element (Rounded to 1000's) **

		QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500	LOCKS						
0500.01	Mob, Demob & Preparatory Work		5,896,000	1,356,000	7,252,000		
0500.02	Drainage		153,000	37,000	190,000		
0500.03	Care and Diversion of Water		293,000	59,000	352,000		
0500.04	Permanent Access Roads & Parking	1445.00 SY	31,000	5,000	37,000	25.48	
0500.09	Buildings, Project Operations	1584.00 SF	141,000	35,000	176,000	111.09	
0500.10	Earthwork for Structures		7,363,000	1,767,000	9,130,000		
0500.11	Foundation Work	6500.00 CY	1,992,000	398,000	2,390,000	367.72	
0500.57	Lock Gates & Operate Machine U/L		5,036,000	755,000	5,791,000		57
0500.62	Approach Walls, Upper and Lower		31,458,000	6,292,000	37,749,000		
0500.63	Lock Structure		26,976,000	6,744,000	33,720,000		
0500.64	Filling and Emptying System		6,562,000	1,444,000	8,006,000		
0500.65	Piping system		584,000	111,000	695,000		
0500.66	Power and Lighting System		2,240,000	403,000	2,643,000		
	TOTAL LOCKS		88,726,000	19,406,000	108,132,000		
1900	BUILDINGS, GROUNDS & UTILITIES						
1900.04	Construction Moorage & Svc Roads		1,831,000	458,000	2,289,000		
1900.09	Misc Sitework		3,673,000	735,000	4,407,000		
	TOTAL BUILDINGS, GROUNDS & UTILITIES		5,504,000	1,192,000	6,696,000		
	TOTAL 600 Ft Lock Exten Plan 4 Phase 1		94,229,000	20,599,000	114,828,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500 LOCKS							
0500.01 Mob, Demob & Preparatory Work							
0500.01.01 Mobilization & Demob of Equipmnt			1,011,000	232,000	1,243,000		
0500.01.02 Preparatory Work	22.50	ACR	1,366,000	314,000	1,681,000	74696	
0500.01.03 Dry Dock			3,519,000	809,000	4,328,000		
TOTAL Mob, Demob & Preparatory Work			5,896,000	1,356,000	7,252,000		
0500.02 Drainage							
0500.02.01 Catch Basins			13,000	3,000	16,000		
0500.02.03 Drainage Pipe, Size 12"-18"	3980.00	LF	141,000	34,000	174,000	43.84	
TOTAL Drainage			153,000	37,000	190,000		
0500.03 Care and Diversion of Water							
0500.03.05 Dewater Lock Chamber	3.00	MO	293,000	59,000	352,000	117358	
TOTAL Care and Diversion of Water			293,000	59,000	352,000		
0500.04 Permanent Access Roads & Parking							
0500.04.03 Upgrade Existing Roads	1445.00	SY	31,000	5,000	37,000	25.48	
TOTAL Permanent Access Roads & Parking	1445.00	SY	31,000	5,000	37,000	25.48	
0500.09 Buildings, Project Operations							
0500.09.02 Control Stations	1584.00	SY	141,000	35,000	176,000	111.09	
TOTAL Buildings, Project Operations	1584.00	SF	141,000	35,000	176,000	111.09	
0500.10 Earthwork for Structures							
0500.10.02 Common Excavation	92195	CY	739,000	177,000	916,000	9.94	
0500.10.03 Rock Excavation	3591.00	BCY	89,000	21,000	111,000	30.86	
0500.10.05 Backfill	170950	CY	783,000	188,000	971,000	5.68	
0500.10.07 Demolition	4870.00	CY	805,000	193,000	998,000	204.89	
0500.10.08 Dredging	417644	CY	4,943,000	1,186,000	6,129,000	14.68	
0500.10.09 Stone Slope Protection	100.00	CY	4,000	1,000	4,000	44.97	
TOTAL Earthwork for Structures			7,363,000	1,767,000	9,130,000		

** PROJECT OWNER SUMMARY - SubElemt (Rounded to 1000's) **

		QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.11	Foundation Work							
0500.11.05	Site Work	6500.00	CY	1,992,000	398,000	2,390,000	367.72	
	TOTAL Foundation Work	6500.00	CY	1,992,000	398,000	2,390,000	367.72	
0500.12	Seepage Control							
0500.12.01	Drilling and Grouting							
0500.57	Lock Gates & Operate Machine U/L							
0500.57.01	Miter Gates & Embedded Metals	820000	LB	3,613,000	542,000	4,155,000	5.07	
0500.57.02	Embedded Metals, Maint Bulkhead	208000	LB	846,000	127,000	973,000	4.68	
0500.57.04	Miter Gate Operating Machinery	2.00	EA	355,000	53,000	408,000	204218	
0500.57.05	Existing Miter Gate Removal	656000	LB	222,000	33,000	255,000	0.39	
	TOTAL Lock Gates & Operate Machine U/L			5,036,000	755,000	5,791,000		57
0500.62	Approach Walls, Upper and Lower							
0500.62.34	JT Myers Nose Piers, Upper Walls	2.00	EA	5,449,000	1,090,000	6,539,000	3269633	
0500.62.35	JT Myers Nose Piers, Lower Walls	2.00	EA	6,604,000	1,321,000	7,925,000	3962657	
0500.62.36	Pylon, Stand Alone, U/S River	1.00	EA	627,000	125,000	753,000	752958	
0500.62.37	Pylon, Attached, DS Guide Walls	2.00	EA	529,000	106,000	635,000	317626	
0500.62.38	Pylon, Attached, US Middle Wall	1.00	EA	92,000	18,000	110,000	110268	
0500.62.40	Upper & Lower Float Guide Walls	2660.00	LF	18,155,000	3,631,000	21,786,000	8190.38	
	TOTAL Approach Walls, Upper and Lower			31,458,000	6,292,000	37,749,000		
0500.63	Lock Structure							
0500.63.01	Concrete, Float-In, Stage I	6476.00	CY	3,162,000	790,000	3,952,000	610.28	
0500.63.04	Concrete, Precast, Stage 2 3 & 4	5567.00	CY	4,529,000	1,132,000	5,661,000	1016.91	
0500.63.05	Concrete, Mass, Stage 4	52731	CY	6,746,000	1,687,000	8,433,000	159.92	
0500.63.06	Concrete, CIP, Miter Gate Recess	2058.00	CY	556,000	139,000	694,000	337.42	
0500.63.07	Concrete, CIP, Wall Mono's L2-L5	2431.00	CY	2,605,000	651,000	3,256,000	1339.40	
0500.63.08	Reinforcing Steel	1836.00	TON	3,452,000	863,000	4,315,000	2350.18	
0500.63.09	Anchor Existing Monolith Walls	106.00	EA	1,999,000	500,000	2,499,000	23573	
0500.63.10	Floating Mooring Bitt	10.00	EA	646,000	161,000	807,000	80728	
0500.63.12	Steel Ladders	1900.00	VLF	162,000	41,000	203,000	106.89	
0500.63.22	Line Hooks			169,000	42,000	211,000		
0500.63.23	Check Posts			169,000	42,000	211,000		
0500.63.24	Wall Armor	80.00	TON	301,000	75,000	377,000	4708.22	
0500.63.40	Embedded Piping			1,372,000	343,000	1,715,000		
0500.63.70	Maintenance Bulkhead Sill	2900.00	CY	847,000	212,000	1,059,000	365.09	
0500.63.85	Metals	85.00	TON	262,000	65,000	327,000	3846.51	
	TOTAL Lock Structure			26,976,000	6,744,000	33,720,000		

		QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500.64	Filling and Emptying System							
0500.64.05	Backfill	266670	CY	471,000	104,000	575,000	2.16	
0500.64.09	Laterals, in New Lock Chamber	2600.00	CY	1,208,000	266,000	1,473,000	566.68	
0500.64.11	Culvert Valve & Embedded Metals	44000	LB	226,000	50,000	276,000	6.28	
0500.64.12	Culvert Valve Operating Machin-	2.00	EA	82,000	18,000	100,000	50116	
0500.64.13	Culvert Valve Bulkheads and	68000	LB	312,000	69,000	381,000	5.60	
0500.64.15	Float-in Diffuser Monolith	12427	CY	4,134,000	910,000	5,044,000	405.89	
0500.64.90	Miscellaneous Mechanical Work			128,000	28,000	156,000		
	TOTAL Filling and Emptying System			6,562,000	1,444,000	8,006,000		
0500.65	Piping system							
0500.65.01	Hydraulic System	2.00	EA	483,000	92,000	575,000	287406	
0500.65.02	Compressed Air Piping System			50,000	10,000	60,000		
0500.65.03	Raw Water Piping System			50,000	10,000	60,000		
	TOTAL Piping system			584,000	111,000	695,000		
0500.66	Power and Lighting System							
0500.66.01	Electrical Work			653,000	118,000	770,000		
0500.66.02	Control & Signal Systems			1,587,000	286,000	1,873,000		
	TOTAL Power and Lighting System			2,240,000	403,000	2,643,000		
	TOTAL LOCKS			88,726,000	19,406,000	108,132,000		
1900	BUILDINGS, GROUNDS & UTILITIES							
1900.04	Construction Moorage & Svc Roads							
1900.04.20	Temporary Construction Moorage			1,831,000	458,000	2,289,000		
	TOTAL Construction Moorage & Svc Roads			1,831,000	458,000	2,289,000		
1900.09	Misc Sitework							
1900.09.04	Downstream Channel Approach	318916	CY	3,094,000	619,000	3,712,000	11.64	
1900.09.10	Excavation and Grading	256000	SY	269,000	54,000	323,000	1.26	
1900.09.15	Landscaping	53.03	ACR	310,000	62,000	372,000	7007.86	
	TOTAL Misc Sitework			3,673,000	735,000	4,407,000		
	TOTAL BUILDINGS, GROUNDS & UTILITIES			5,504,000	1,192,000	6,696,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
TOTAL 600 Ft Lock Exten Plan 4 Phase 1			94,229,000	20,599,000	114,828,000		

21.6 PLAN 4 - PHASE 2 WORK

21.6.1 Plan 4 – Phase 2 Work, Assumptions and Revisions

The current feasibility cost estimate is a continuing effort to refine previous submittals. It is a refinement of the construction approach and includes some changes in scope. Plan 4 – Phase 2 includes construction of the wrap around culvert and relocation of the existing upstream mooring facility. It assumes that Plan 4 – Phase 1 was constructed at an earlier date, and lock improvements to provide a fast fill system are desired at a later date. The discussion and analysis here concern changes to the estimate and project from Plan 3. Plan 3 is the "Master Plan", since it contains the complete scope of work that was in previous submittals.

Mobilization, demobilization and preparation costs are incurred again, since the assumption is that Phase 2 construction will commence some time after Phase 1 construction is complete, and the extended lock is in operation. These costs are lower, however, as less mobilization/demobilization is needed for this phase. The duration of time that the contractor's equipment and batch plant is needed at the site is reduced from Plan 3.

Some quantity takeoffs from the Plan 3 estimate, especially site work, have been divided, separating out work for the wrap around culvert without the lock extension. The work associated with the lock extension construction was included in the Plan 4 – Phase 1 estimate.

As in previous estimates, it is assumed that there are no contaminated or hazardous materials on the site. It is anticipated that the on-site excavated material will be used as backfill for the entire project, with no significant quantities of imported borrow required. The primary components requiring backfill are the wrap around culvert and inlet valve monolith.

The contingencies averaged approximately 22% and were assigned based on the level of knowledge available for each element.

During the final preparation of this report, bids for similar work in the Ohio River System, at Olmsted Lock and Dam and Braddock Lock and Dam, were opened. Bid prices for several similar items of work in the current estimate were higher. As a result, analysis of the costs and prices for these work items will continue, and it may result in higher estimated costs in future submittals.

The major work breakdown structure (WBS) elements that were revised significantly from the Plan 3 estimate are discussed below. Costs include contingencies, unless otherwise noted.

Distributed Items

Distributed items from the "GP" contractor at Gallipolis are deleted as there are no float-in structures required for Phase 2 construction. Distributed items for the "LP" contractor at the Uniontown site are reduced nominally from 24 months to 18 months This results in a field office overhead rate of 8.81%, which is higher than the Plan 3 rate of 6.60% but a little lower than the Phase 1 rate of 9.11%. This is reflected in all of the WBS elements.

Helper tug requirements were reduced from approximately 600 days in the Plan 3 estimate to approximately 50 days in the Plan 4 – Phase 2 estimate.

Feature 0500: Locks

Element:

01 Mobilization and Preparatory Work: The site work has been reduced to approximately 19 acres in Plan 4 – Phase 2, due to elimination of the downstream channel improvements from this construction phase, when compared with Plan 3. Also, there are no graving dock preparation costs, as discussed above.

02 Drainage: Deleted; no work in this phase.

03 Care and Diversion of Water: Need to dewater the area near the wrap around culvert connection for removal of the knockout panel.

09 Buildings, Project Operations: Deleted; no work this phase.

10 Earthwork for Structures: Deleted; no work this phase. Excavation for the F/E system is included in Element 64.

11 Foundation Work: Deleted; no work this phase.

57 Lock Gates and Operating Machinery: Deleted; no work this phase.

62 Approach Walls, Upper and Lower: Deleted; no work this phase.

63 Lock Structure: Deleted; no work this phase. Knockout panel removal is included in Element 64.

64 Fill/Empty System: The laterals, lock wall culvert, and landside wall diffuser outlet were constructed in Phase 1 of Plan 4. The wrap around culvert, thrust block, and inlet valve monolith are constructed in Phase 2. This reduction in scope lowered the cost of this element.

66 Power and Lighting System: Deleted; no work this phase.

Feature 1900: Buildings, Grounds, and Utilities

Element:

04 Construction Moorage Area and Service Roads: Deleted; no work this phase.

08 Operations Mooring Facility Relocation: Required in Phase 2 of Plan 4 due to construction of the intake monolith and wrap around culvert.

09 Miscellaneous Site Work: Site grading and landscaping has a substantial reduction in scope, when compared with Plan 3, as downstream channel improvements and temporary construction moorage area are not required in this phase. The little remaining work was moved into Element 64, Fill/Empty System, and 1900.08, Operations Mooring Facility Relocation, as part of the earthwork directly relating to these program elements.

21.6.2 Plan 4 – Phase 2 Work, Cost Estimate

The cost estimate summary for Plan 4 – Phased Construction, Phase 2 Work is provided on the following pages.

** PROJECT OWNER SUMMARY - Element (Rounded to 1000's) **

	QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500 LOCKS						
0500.01 Mob, Demob & Preparatory Work		1,713,000	394,000	2,106,000		
0500.03 Care and Diversion of Water		209,000	42,000	251,000		
0500.64 Filling and Emptying System		15,583,000	3,428,000	19,011,000		
TOTAL LOCKS		17,504,000	3,864,000	21,368,000		
1900 BUILDINGS, GROUNDS & UTILITIES						
1900.08 Mooring Facility Relocation		2,124,000	531,000	2,655,000		
TOTAL BUILDINGS, GROUNDS & UTILITIES		2,124,000	531,000	2,655,000		
TOTAL 600 Ft Lock Exten Plan 4 Phase 2		19,628,000	4,395,000	24,023,000		

	QUANTITY	UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
0500 LOCKS							
0500.01 Mob, Demob & Preparatory Work							
0500.01.01 Mobilization & Demob of Equipmnt			711,000	164,000	875,000		
0500.01.02 Preparatory Work	143000	SY	1,001,000	230,000	1,232,000	8.61	
TOTAL Mob, Demob & Preparatory Work			1,713,000	394,000	2,106,000		
0500.03 Care and Diversion of Water							
0500.03.05 Dewater Lock Chamber	3.00	MO	209,000	42,000	251,000	83511	
TOTAL Care and Diversion of Water			209,000	42,000	251,000		
0500.64 Filling and Emptying System							
0500.64.01 Shoring, Type 27	3011.00	TON	4,225,000	929,000	5,154,000	1711.78	
0500.64.02 Unwatering			654,000	144,000	798,000		
0500.64.03 Excavation, Common, Wet & Dry	303106	CY	1,774,000	390,000	2,164,000	7.14	
0500.64.04 Excavation, Rock, Wet & Dry	9848.00	CY	393,000	87,000	480,000	48.73	
0500.64.05 Backfill	266670	CY	1,366,000	300,000	1,666,000	6.25	
0500.64.06 Screens & Nose Plates at Intake	1.00	EA	155,000	34,000	189,000	189092	
0500.64.07 Concrete, C.I.P. Intake Monolith	4000.00	CY	808,000	178,000	986,000	246.57	
0500.64.08 Concrete, Thrust Block	3500.00	CY	757,000	167,000	924,000	264.03	
0500.64.09 Concrete Culvert, 16.5 Ft dia	6830.00	CY	2,440,000	537,000	2,977,000	435.82	
0500.64.10 Ice & Debris Boom	230.00	LF	199,000	44,000	243,000	1054.81	
0500.64.11 Culvert Valve & Embedded Metals	44000	LB	159,000	35,000	194,000	4.41	
0500.64.12 Culvert Valve Operating Machin-	1.00	EA	58,000	13,000	70,000	70234	
0500.64.16 Valve Structure	6500.00	CY	1,465,000	322,000	1,787,000	274.94	
0500.64.22 Drilled Shaft Wing Wall	340.00	LF	1,130,000	249,000	1,379,000	4054.77	
TOTAL Filling and Emptying System			15,583,000	3,428,000	19,011,000		
TOTAL LOCKS			17,504,000	3,864,000	21,368,000		
1900 BUILDINGS, GROUNDS & UTILITIES							
1900.08 Mooring Facility Relocation							
1900.08.05 Remove Existing Boat Ramp			2,000	0	2,000		
1900.08.10 Remove Wharf Turn Around Area			4,000	1,000	5,000		
1900.08.15 Remove Boat Ramp Electrical			5,000	1,000	7,000		
1900.08.20 Construct New Boat Moorage			2,112,000	528,000	2,640,000		
TOTAL Mooring Facility Relocation			2,124,000	531,000	2,655,000		

	QUANTITY UOM	CONTRACT	CONTINGN	TOTAL COST	UNIT	NOTES
TOTAL BUILDINGS, GROUNDS & UTILITIES		2,124,000	531,000	2,655,000		
TOTAL 600 Ft Lock Exten Plan 4 Phase 2		19,628,000	4,395,000	24,023,000		

21.7 COST COMPARISON

21.7.1 Comparison Between Plan 3 and Plan 4 Cost Estimates

The Plan 3 cost estimate has been reviewed and revised, incorporating information from recently received bids for similar projects. However, since the other plans were screened out from further consideration, their cost estimates were not revised. Therefore, while the Plan 1, 2, and 4 cost estimates may be compared with each other, it is not appropriate to compare them with Plan 3.

However, in general terms, it is anticipated that the two-phase construction of Plan 4 would be approximately 5% higher in cost than the Plan 3 construction. The major reasons for this cost difference include the following:

- Duplication of mobilization, demobilization, and preparation costs.
- Duplication of haul road construction and project access road restoration.
- Higher field office overhead rates, as discussed in previous subsections.
- Duplication of excavation required landside of monoliths L-2 to L-5.
- Helper tug required for approximately 50 additional days.

For the duplication of excavation, excavation is needed in Phase 1 to construct new landside heels in order to stabilize monoliths L-2 to L-5 when they form a portion of the extended chamber. In Phase 2, excavation is needed to construct the wrap around culvert thrust block and connection to the lock wall culvert.) Both excavations will require some shoring. In addition, there will be some limited duplication of dewatering requirements. An alternative to this approach would stabilize these monoliths using rock anchors. However, the cost of rock anchor stabilization is also substantial. Therefore, it is unlikely that significant cost savings would be realized.

SECTION 22

DESIGN AND CONSTRUCTION SCHEDULES

22.1 DESIGN SCHEDULE

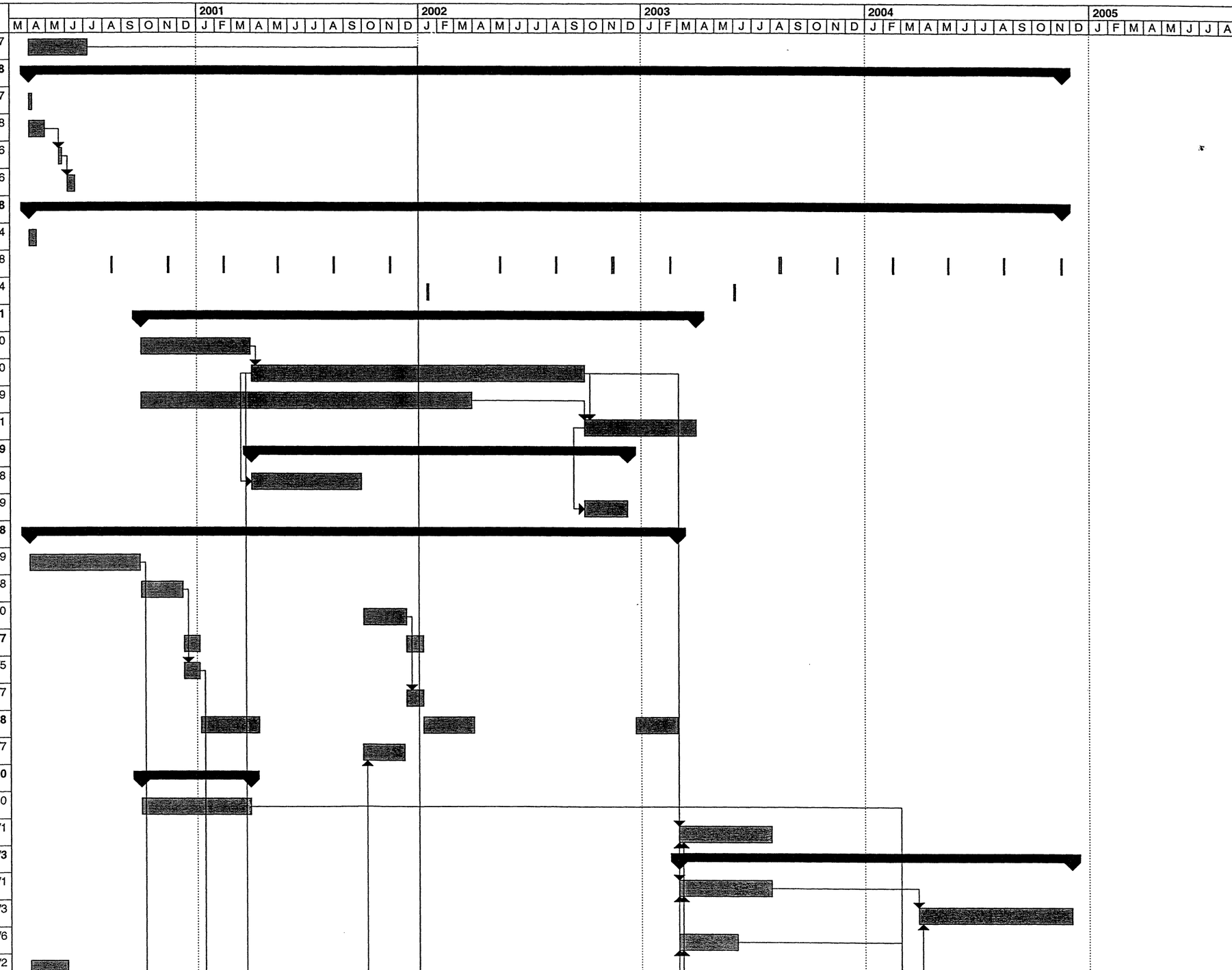
22.1.1 Plan 3 Design Schedule

The design schedule for Plan 3 is provided on the following pages.

Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION DESIGN SCHEDULE
PLAN 3

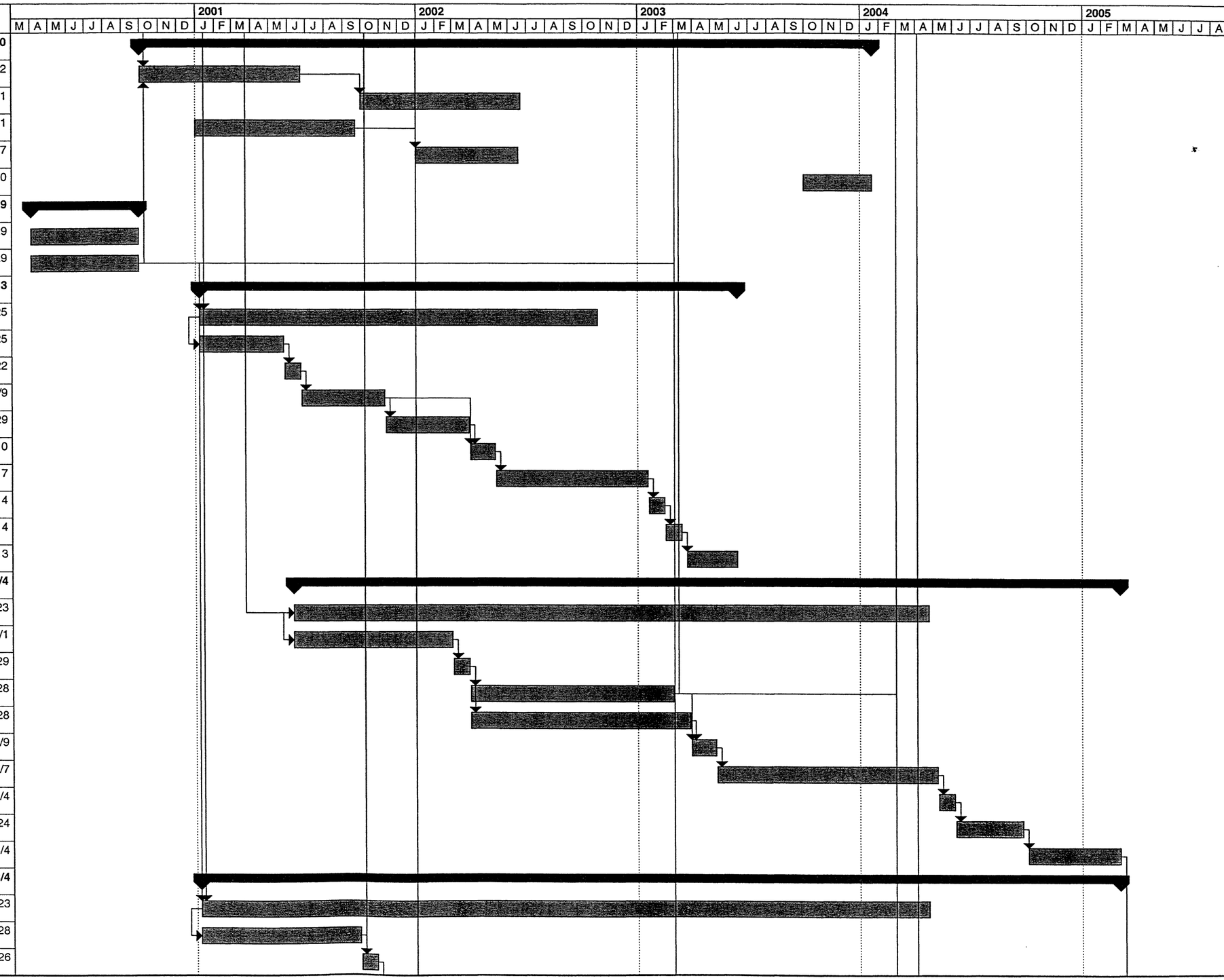
ID	Task Name	Start	Finish
1	**Initiate PED, Incl. Partnering & Quality Control Plan**	4/3	7/7
2	**Design Reviews**	**4/3**	**11/18**
3	Site Visit & Value Engineering Study (VE)	4/3	4/7
4	VE Documentation	4/3	4/28
5	Initial Design Conference (IDC)	5/22	5/26
6	IDC Documentation	6/5	6/16
7	**Quality Control - ITR Meetings and Conferences**	**4/3**	**11/18**
8	Quality Control Plan	4/3	4/14
9	ITR Meetings	8/15	11/18
26	Technical Review Conferences (TRC's)	1/15	6/4
29	**WES Model Studies**	**10/2**	**3/31**
30	Construct Navigation Model	10/2	3/30
31	Initial Studies - Navigation Model	4/2	9/30
32	Initial Studies - F/E Systems	10/2	3/29
33	Revisions, Refinements, and Final Studies	10/1	3/31
34	**H&H Design and Documentation**	**4/2**	**12/9**
35	Initial Design	4/2	9/28
36	Revise and document	10/1	12/9
37	**Geotechnical Engineering**	**4/3**	**2/28**
38	Develop Seismic Ground Motions	4/3	9/29
39	Exploratory Drilling and Testing - Phase I	10/2	12/8
40	Exploratory Drilling and Testing - Phase II	10/2	12/10
41	**Analysis of Test Results & Report Prep.**	**12/11**	**1/7**
42	Phase I Analysis & Report	12/11	1/5
43	Phase II Analysis & Report	12/11	1/7
44	Geotechnical Design, Incl. Dewatering Design	**1/8**	**2/28**
48	Construction Materials	10/1	12/7
49	**HTRW**	**10/2**	**3/30**
50	Field Sampling and Testing	10/2	3/30
51	**Environmental Engineering**	3/3	8/1
52	**Real Estate**	**3/3**	**12/3**
53	Evaluate Disposal Alternatives	3/3	8/1
54	Acquire Real Estate (for disposal area, if necessary)	3/29	12/3
55	**Cultural & Archeological Resources Investigation**	3/3	6/6
56	**Surveying and Mapping**	4/3	6/2



Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION DESIGN SCHEDULE
PLAN 3

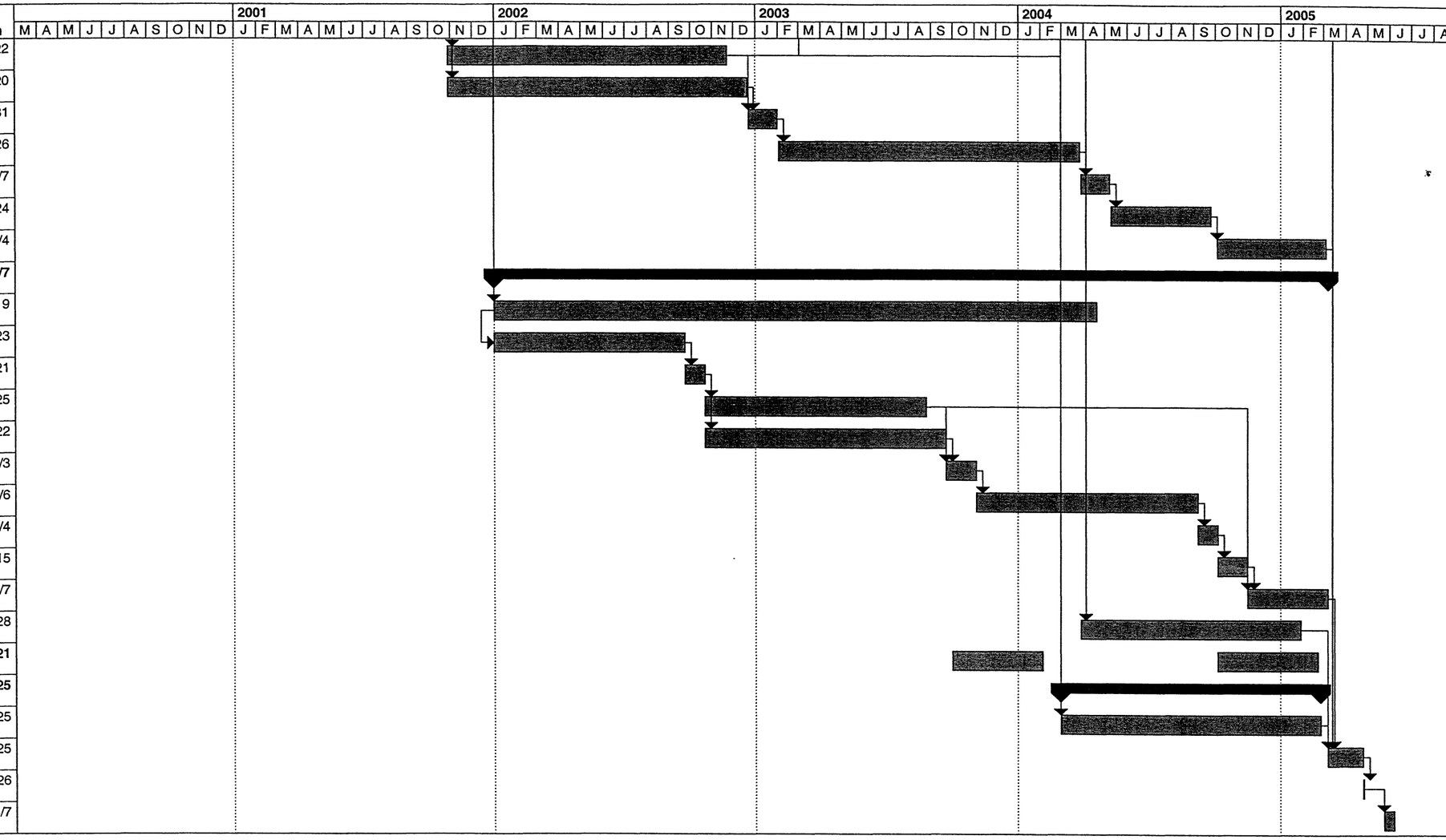
ID	Task Name	Start	Finish
57	**Special Studies**	**10/2**	**1/20**
58	Phase I Dynamic Analyses	10/2	6/22
59	Phase II Dynamic Analyses	10/1	6/21
60	Phase I NISA Analyses	1/1	9/21
61	Phase II NISA Analyses	1/1	6/17
62	Miscellaneous Analyses and Studies	10/1	1/20
63	**Overall Project Layout and Preliminary Design**	**4/3**	**9/29**
64	Civil, Structural, Mechanical, and Electrical Engineering	4/3	9/29
65	Initial Design Doc. Report (DDR) - Overall Proj. Design	4/3	9/29
66	**Wrap Around Culv., Valve Mon. & Mooring Fac.**	**1/8**	**6/13**
67	Civil, Structural, Mechanical, and Electrical Engineering	1/8	10/25
68	Feature Design Doc. Report (DDR) - Draft Submittal	1/8	5/25
69	Submittal Review	5/28	6/22
70	Plan, Specs. & Cost Est. - Preliminary	6/25	11/9
71	Feature DDR - Final Submittal	11/12	3/29
72	Submittal Review	4/1	5/10
73	Plan, Specs. & Cost Est. - Draft	5/13	1/17
74	Submittal Review	1/20	2/14
75	Biddability/Constructibility/Operability Review	2/17	3/14
76	Plan, Specs. & Cost Est. - Final	3/24	6/13
77	**Approach Walls**	**6/11**	**3/4**
78	Civil, Structural, Mechanical, and Electrical Engineering	6/11	4/23
79	Feature Design Doc. Report (DDR) - Draft Submittal	6/11	3/1
80	Submittal Review	3/4	3/29
81	Plan, Specs. & Cost Est. - Preliminary	4/1	2/28
82	Feature DDR - Final Submittal	4/1	3/28
83	Submittal Review	3/31	5/9
84	Plan, Specs. & Cost Est. - Draft	5/12	5/7
85	Submittal Review	5/10	6/4
86	Biddability/Constructibility/Operability Review	6/7	9/24
87	Plan, Specs. & Cost Est. - Final	10/4	3/4
88	**Lock Monoliths, Sills, and Laterals**	**1/8**	**3/4**
89	Civil, Structural, Mechanical, and Electrical Engineering	1/8	4/23
90	Feature Design Doc. Report (DDR) - Draft Submittal	1/8	9/28
91	Submittal Review	10/1	10/26



Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION DESIGN SCHEDULE
PLAN 3

ID	Task Name	Start	Finish
92	Plan, Specs. & Cost Est. - Preliminary	10/29	11/22
93	Feature DDR - Final Submittal	10/29	12/20
94	Submittal Review	12/23	1/31
95	Plan, Specs. & Cost Est. - Draft	2/3	3/26
96	Submittal Review	3/29	5/7
97	Biddability/Constructibility/Operability Review	5/10	9/24
98	Plan, Specs. & Cost Est. - Final	10/4	3/4
99	**Miter Gate**	**1/1**	**3/7**
100	Structural, Mechanical, and Electrical Engineering	1/1	4/19
101	Feature Design Doc. Report (DDR) - Draft Submittal	1/1	9/23
102	Submittal Review	9/24	10/21
103	Plan, Specs. & Cost Est. - Preliminary	10/22	8/25
104	Feature DDR - Final Submittal	10/22	9/22
105	Submittal Review	9/23	11/3
106	Plan, Specs. & Cost Est. - Draft	11/4	9/6
107	Submittal Review	9/7	10/4
108	Biddability/Constructibility/Operability Review	10/5	11/15
109	Plan, Specs. & Cost Est. - Final	11/16	3/7
110	**Misc. Design Work (Operations Bldg. Addition, etc.)**	3/29	1/28
111	**Prepare Construction Schedule**	**10/2**	**2/21**
114	**Permitting**	**3/1**	**2/25**
115	Obtain required permits	3/1	2/25
116	**Advertise**	3/8	4/25
117	**Open Bids**	4/26	4/26
118	**Award Construction Contract**	5/25	6/7



22.2 CONSTRUCTION SCHEDULE

The following assumptions were made in preparing the Plan 3 construction schedule:

1. While lock is open: two 10-hour shifts (20-hour work days) per day and 6 day work weeks

2. While lock is closed: two 10-hour shifts per day (20-hour work days) and 7 day work weeks

3. Effective production rates for 20 hour work days (on-site construction):
   1500 c.y./day for dredging
   700 c.y./day for shale excavation
   300 c.y./day for limestone excavation
   1500 c.y./day for backfill
   300 c.y./day for concrete demolition
   60 to 80 c.y./day for CIP structural concrete placement
   1600 c.y./day for tremie concrete placement (large quantities)
   800 c.y./day for tremie concrete placement (small quantities)
   1600 c.y./day for mass concrete placement
   300 to 500 c.y./day for underbase grout and perimeter concrete placement

   Effective production rates for 8 hour work days (off-site construction):
   40 to 60 c.y./day for precast concrete structures

4. Durations for limestone excavation and concrete demolition assume low level blasting will be allowed.

5. The 600' lock will be shut down during shaft construction of the middle approach walls.

6. The 1200' lock will remain open during most of the construction of the riverside approach wall and middle approach walls by working from the riverside and 600' lockside, respectively. If a crane is used, its boom will extend over the navigation channel. However, the boom will be approximately 50 to 100 feet above ground level and can quickly swing away from the channel while barges pass through the lock. While the shaft concrete is curing, it is partially protected by an oversized steel casing with sand between this casing and the concrete. However, a helper tug would be required to guide the tows through the lock during the drilled shaft construction to ensure controlled navigation of the lock and protect the integrity of the concrete shaft.

7. The 600' lock will remain open during most of the construction of the lower landside approach wall by working from the landside and using similar methods to those listed in item 6 above

8. Helper tug services have been assumed to be required during many phases of the construction in order to assure smooth operation of the locks. In general, the

criteria used to determine the necessity of the helper tug was as follows:

- When construction activity is in or is very close to the navigation channel.
- When structural elements would be damaged by scraping or minor impacts from the tows.

Earlier versions of these construction schedules were discussed with the following contractors who reviewed them and provided feedback:

- Al Johnson Construction Co. (for gate bay & concrete production rates)
- DBM Contractors, Inc. (for drilled shafts and construction methods)
- Malcolm Drilling Co., Inc. (for drilled shafts and rock excavation)
- American Divers (for underwater work)
- Fletcher General Construction (for complete schedule)
- Manson Construction & Engineering Company (for complete schedule)

All of the above contractors reviewed their areas of expertise and agreed that the construction schedules presented were feasible. They commented that one continuous closure of the 600' lock was much more desirable than a 12 hour closed/12 hour open schedule. A 12 hour closed/12 hour open scheme would greatly lengthen the total construction time required because most construction steps would become critical path items (in order to reopen the lock), and continual mobilization and demobilization would waste a lot of otherwise productive hours. Because of this feedback, a longer continuous closure was chosen over a short-term open/short-term closed schedule.

Table 22.2A, which follows the construction schedules, summarizes the existing lock closures required during construction of the 600' lock extension, Plan 3. In addition, a total of approximately 630 days of helper tug assistance are anticipated to be required.

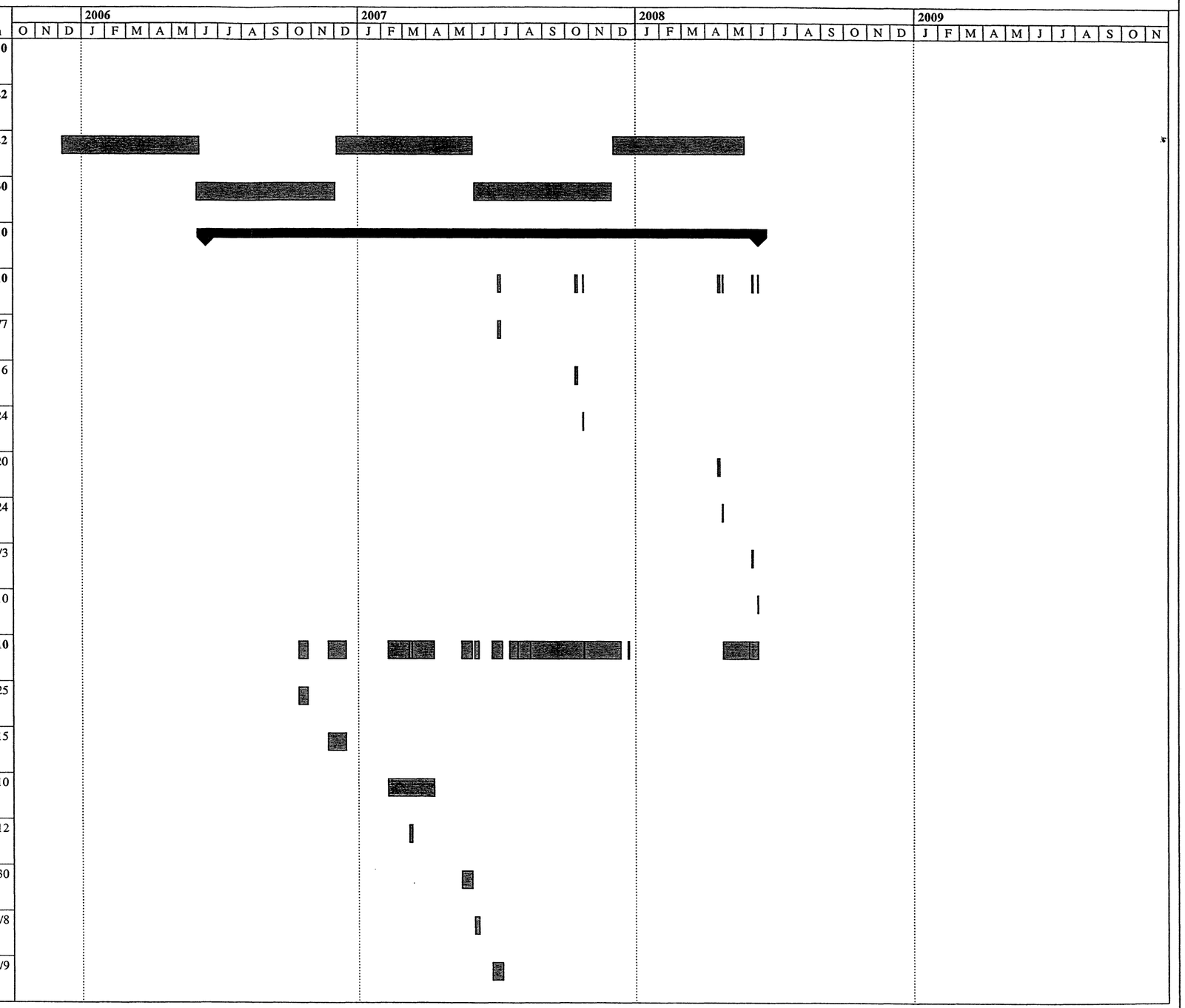
22.2.1 Plan 3 –Construction Schedule

The construction schedule for Plan 3 construction is provided on the following pages.

Plan 3

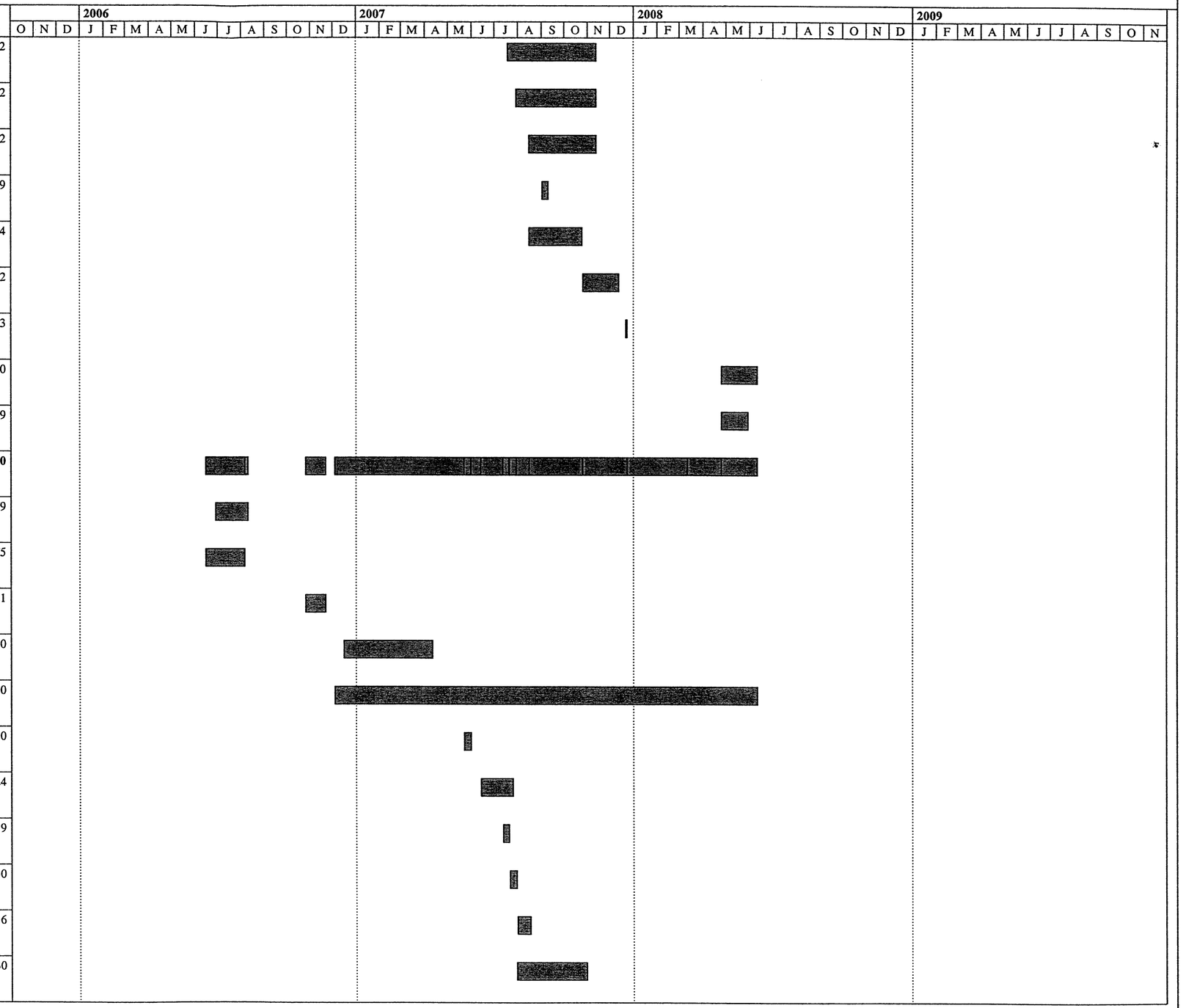
JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
1	1	**General**			12/6	6/10
2	1.1	**Flow Conditions**			12/6	5/22
3	1.1.1	**High Water Period**			12/6	5/22
7	1.1.2	**Low Water Period**			6/2	11/30
10	1.2	**Lock Closures & Helper Tug**			6/15	6/10
11	1.2.1	**Close 1200' Lock**			7/4	6/10
12	1.2.1.1	Close 1200' Lock (5.5 to 5.8)			7/4	7/7
13	1.2.1.2	Close 1200' Lock (9.4 to 9.6)			10/14	10/16
14	1.2.1.3	Close 1200' Lock (9.7 to 9.9)			10/24	10/24
15	1.2.1.4	Close 1200' Lock (11.3 to 11.5)			4/18	4/20
16	1.2.1.5	Close 1200' Lock (11.7 to 11.9)			4/24	4/24
17	1.2.1.6	Close 1200' Lock (12.5 to 12.7)			6/2	6/3
18	1.2.1.7	Close 1200' Lock (12.9 to 12.12)			6/10	6/10
19	1.2.2	**Close 600' Lock**			10/14	6/10
20	1.2.2.1	Close 600' Lock (2.4.2.1 to 2.4.2.3)			10/14	10/25
21	1.2.2.2	Close 600' Lock (2.4.2.5 to 2.4.2.7)			11/22	12/15
22	1.2.2.3	Close 600' Lock (2.4.2.9 to 2.4.2.11)			2/9	4/10
23	1.2.2.4	Close 600' Lock (4.1 to 4.3)			3/9	3/12
24	1.2.2.5	Close 600' Lock (4.7 to 4.9)			5/17	5/30
25	1.2.2.6	Close 600' Lock (4.11 to 4.14)			6/3	6/8
26	1.2.2.7	Close 600' Lock (5.1 to 5.10)			6/26	7/9



JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

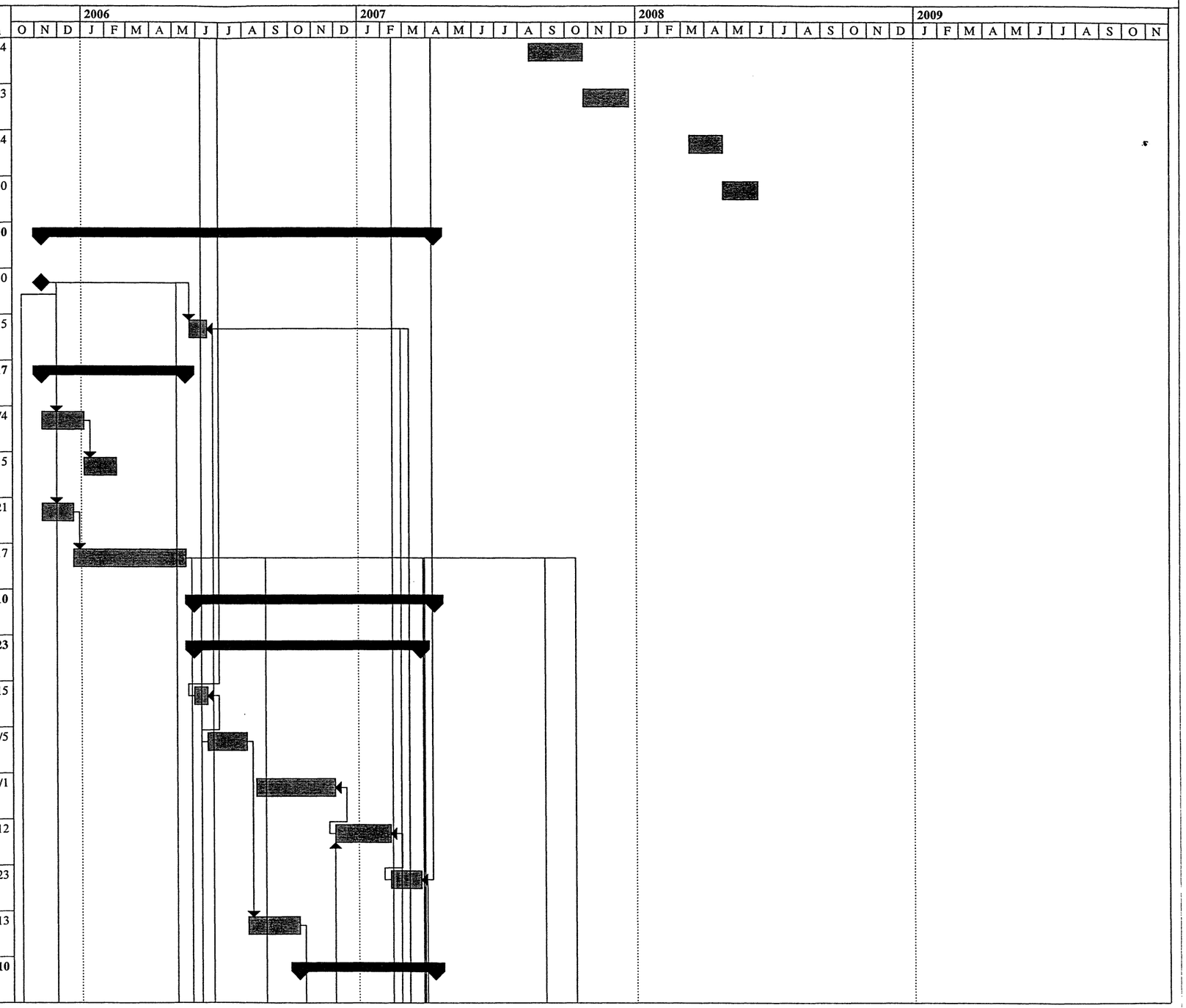
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
27	1.2.2.8	Close 600' Lock (5.12 to 5.20.14)			7/19	11/12
28	1.2.2.9	Close 600' Lock (5.20.6 to 5.20.14)			7/30	11/12
29	1.2.2.10	Close 600' Lock (6.1 to 6.5)			8/16	11/12
30	1.2.2.11	Close 600' Lock (7.2 to 7.6)			9/2	9/9
31	1.2.2.12	Close 600' Lock (9.1 to 9.10)			8/16	10/24
32	1.2.2.13	Close 600' Lock (10.1 to 10.4)			10/26	12/12
33	1.2.2.14	Close 600' Lock (10.6 to 10.8)			12/22	12/23
34	1.2.2.15	Close 600' Lock (12.1 to 12.11)			4/25	6/10
35	1.2.2.16	Close 600' Lock (13.1 to 13.3)			4/25	5/29
36	**1.2.3**	**Helper Tug Required**			**6/15**	**6/10**
37	1.2.3.1	Helper Tug Required (8.1.1.2)			6/28	8/9
38	1.2.3.2	Helper Tug Required (2.4.1.2)			6/15	8/5
39	1.2.3.3	Helper Tug Required (2.4.2.4)			10/26	11/21
40	1.2.3.4	Helper Tug Required (2.4.2.8 to 2.4.2.10)			12/16	4/10
41	1.2.3.5	Helper Tug Required (Structure in Construction Mooring Area, 600' Lock Open, Begin 3.3.3 continue to			12/4	6/10
42	1.2.3.6	Helper Tug Required (4.8)			5/22	5/30
43	1.2.3.7	Helper Tug Required (4.15 to 4.18)			6/13	7/24
44	1.2.3.8	Helper Tug Required (5.11)			7/12	7/19
45	1.2.3.9	Helper Tug Required (5.14 & 5.15)			7/21	7/30
46	1.2.3.10	Helper Tug Required (5.17 to 5.19)			7/31	8/16
47	1.2.3.11	Helper Tug Required (5.20.7 to 5.20.13)			7/30	10/30



Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

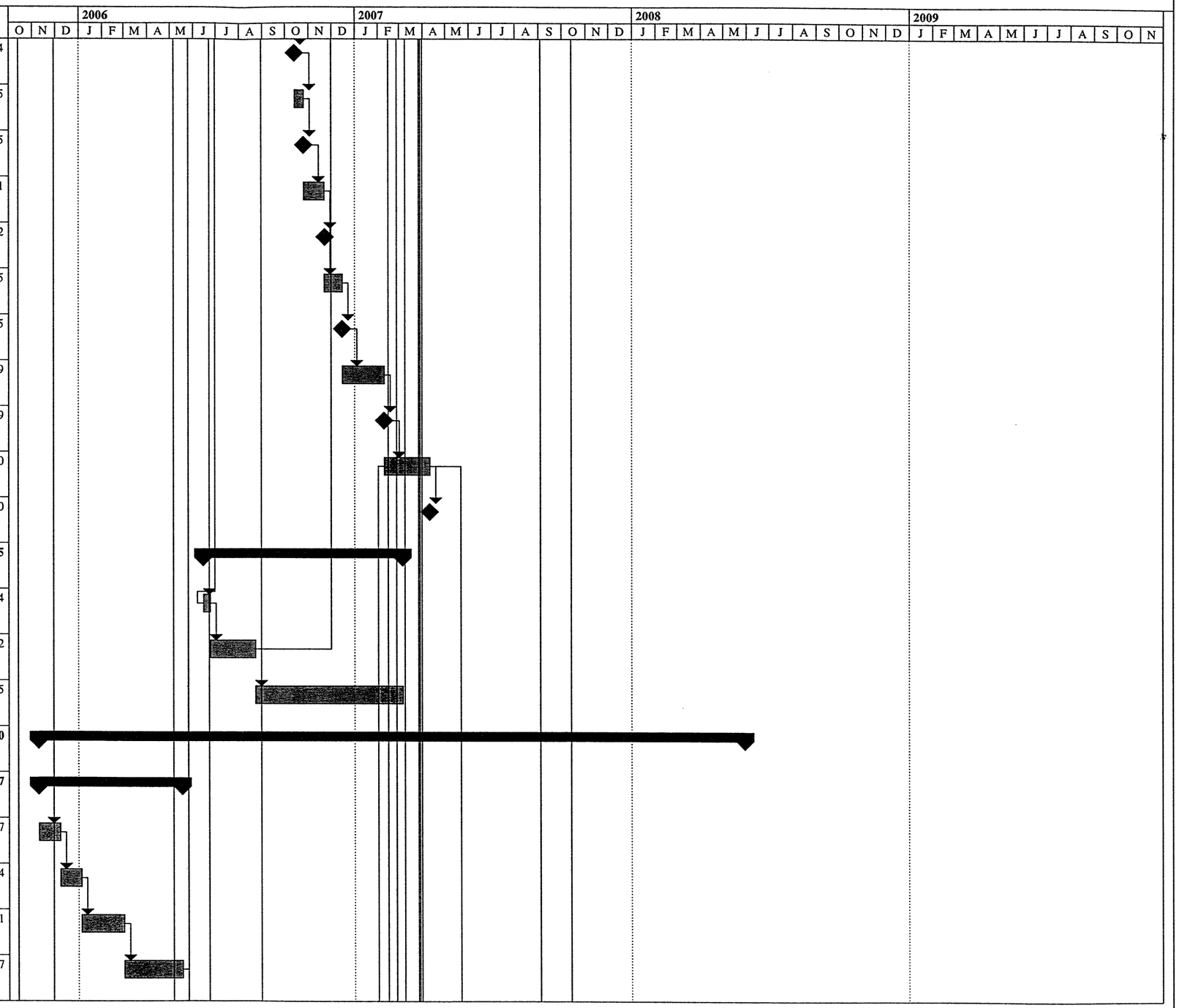
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
48	1.2.3.12	Helper Tug Required (9.1 to 9.10)			8/16	10/24
49	1.2.3.13	Helper Tug Required (10.1 to 10.8)			10/26	12/23
50	1.2.3.14	Helper Tug Required (11.1 to 11.9)			3/12	4/24
51	1.2.3.15	Helper Tug Required (12.1 to 12.12)			4/25	6/10
52	2	**Mobilization, Submittals, and Temporary Construction Mooring Area**			**11/10**	**4/10**
53	2.1	Notice To Proceed			11/10	11/10
54	2.2	Mobilization at Jobsite			5/23	6/15
55	2.3	**Submittals & Reviews**			**11/10**	**5/17**
56	2.3.1	Contractor's Submittals of Procedures & Schedule			11/10	1/4
57	2.3.2	Review & Approval of Contractor's Procedures & Schedule			1/5	2/15
58	2.3.3	Aggregate Sources & Concrete Mix Design Submittal			11/10	12/21
59	2.3.4	Review & Approval of Aggregate Sources & Mix Design			12/22	5/17
60	2.4	**Temporary Construction Area, Landwall Site Preparation & Bank Dredging**			**5/29**	**4/10**
61	2.4.1	**Temporary Construction Area**			**5/29**	**3/23**
62	2.4.1.1	Construct Access Road to Temporary Construction Mooring Area	22,000 cy	1500 cy/day	5/29	6/15
63	2.4.1.2	Dredge Temporary Construction Mooring Area	67,000 cy	1500 cy/day	6/15	8/5
64	2.4.1.3	Dredge Temporary Construction Mooring Area	133,000 cy	1500 cy/day	8/18	12/1
65	2.4.1.4	Build Laydown Area & Mound For Batch Plant	185,300 cy	3000 cy/day	12/1	2/12
66	2.4.1.5	Construct Concrete Batch Plant			2/12	3/23
67	2.4.1.6	Construct Temporary Construction Trestle			8/7	10/13
68	2.4.2	**Site Preparation for Monoliths**			**10/14**	**4/10**



Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

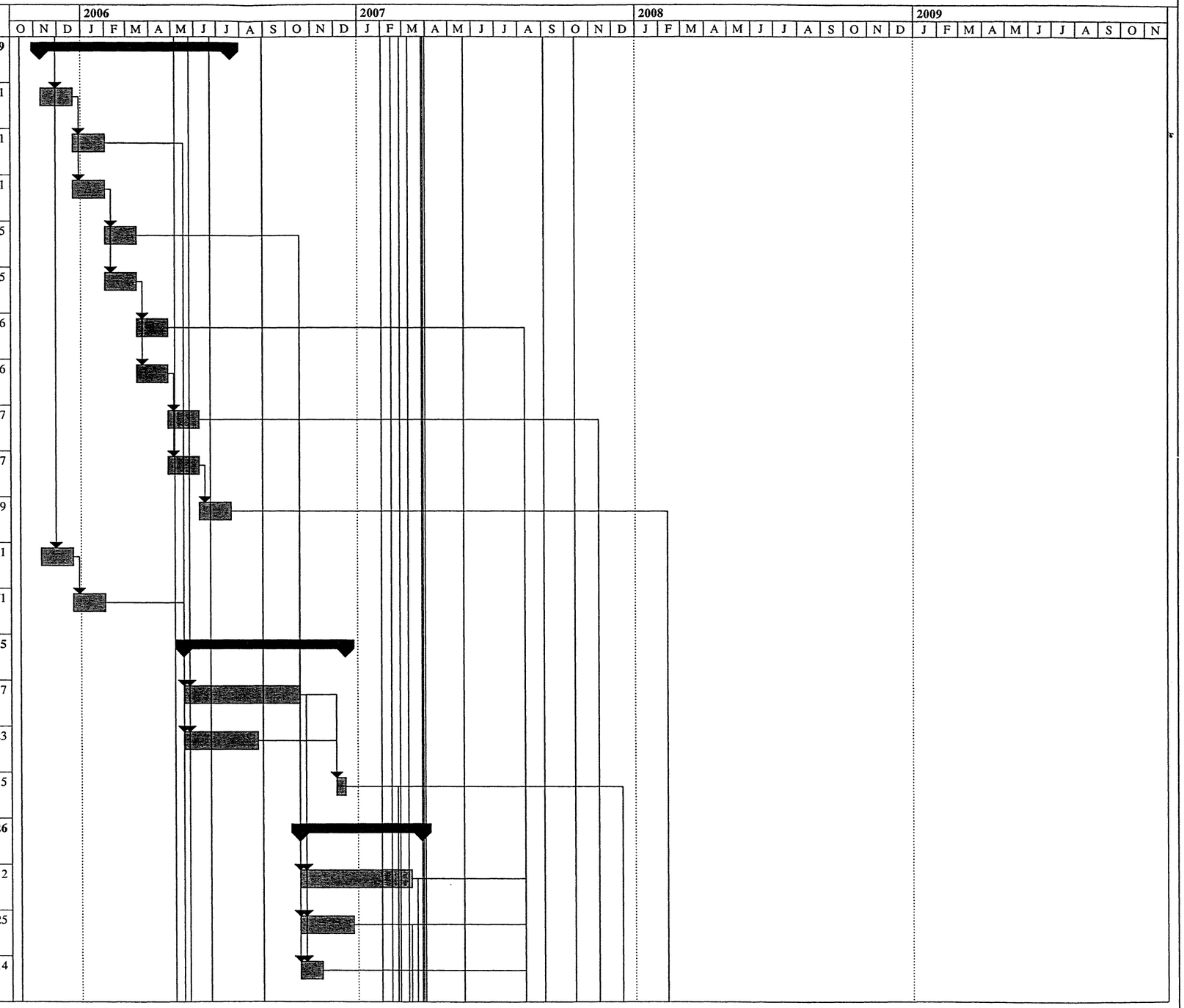
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
69	2.4.2.1	Close 600' Lock			10/14	10/14
70	2.4.2.2	Dredge Channel From Construction Mooring Area to Set-down Area From Lockside	17,000 cy	1500 cy/day	10/14	10/25
71	2.4.2.3	Open 600' Lock			10/25	10/25
72	2.4.2.4	Dredge Channel From Construction Mooring Area to Set-down Area From Landside	33,000 cy	1500 cy/day	10/26	11/21
73	2.4.2.5	Close 600' Lock			11/22	11/22
74	2.4.2.6	Dredge Set-down Area From Lockside (New Monolith Locations)	34,000 cy	1500 cy/day	11/22	12/15
75	2.4.2.7	Open 600' Lock			12/15	12/15
76	2.4.2.8	Dredge Set-down Area From Landside (New Monolith Locations)	66,000 cy	1500 cy/day	12/16	2/9
77	2.4.2.9	Close 600' Lock			2/9	2/9
78	2.4.2.10	Excavate Rock to El 282 at New Monolith Locations	30,000 cy	ay (limestone)	2/10	4/10
79	2.4.2.11	Open 600' Lock			4/10	4/10
80	2.4.3	**Bank Dredging D/S Channel Improvement**			**6/15**	**3/5**
81	2.4.3.1	Build Access Road			6/15	6/24
82	2.4.3.2	Excavate Bank Material - In the Dry	76,000 cy	1500 cy/day	6/24	8/22
83	2.4.3.3	Excavate Bank Material - In the Wet	250,500 cy	1500 cy/day	8/23	3/5
84	3	**Fabrication & Delivery of Pontoons & Other Precast Elements**			**11/10**	**5/30**
85	3.1	**Develop Graving Dock Site**			**11/10**	**5/17**
86	3.1.1	Acquire Site			11/10	12/7
87	3.1.2	Submit Development Permit			12/8	1/4
88	3.1.3	Review & Approval of Development Permit			1/5	3/1
89	3.1.4	Construct Graving Dock			3/2	5/17



Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

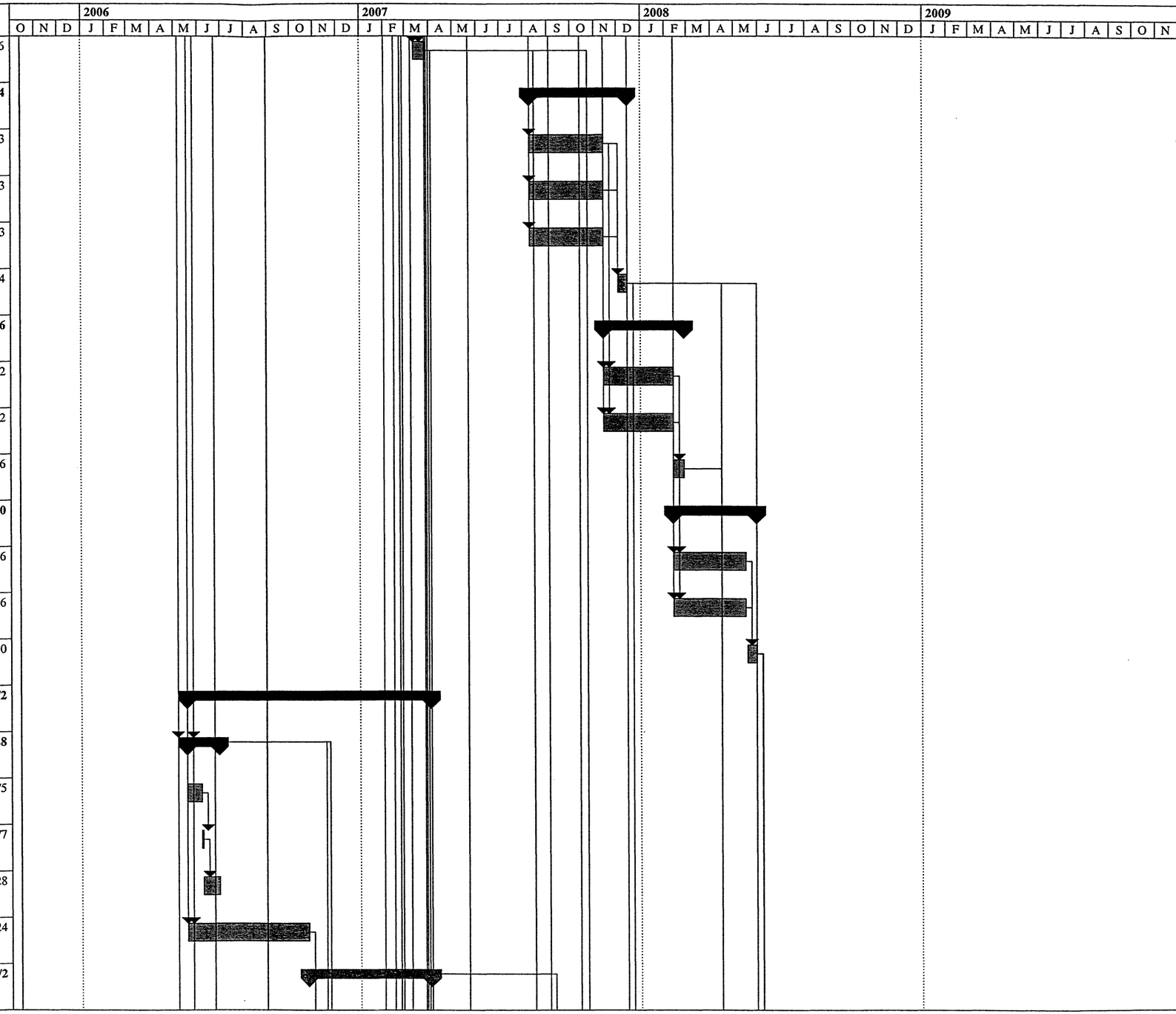
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
90	**3.2**	**Submittals & Reviews**			**11/10**	**7/19**
91	3.2.1	Contractor's Submittal of Graving Dock Cycle 1 Shop Drawings			11/10	12/21
92	3.2.2	Review & Approval of Graving Dock Cycle 1 Shop Drawings			12/22	2/1
93	3.2.3	Contractor's Submittal of Graving Dock Cycle 2 Shop Drawings			12/22	2/1
94	3.2.4	Review & Approval of Graving Dock Cycle 2 Shop Drawings			2/2	3/15
95	3.2.5	Contractor's Submittal of Graving Dock Cycle 3 Shop Drawings			2/2	3/15
96	3.2.6	Review & Approval of Graving Dock Cycle 3 Shop Drawings			3/16	4/26
97	3.2.7	Contractor's Submittal of Graving Dock Cycle 4 Shop Drawings			3/16	4/26
98	3.2.8	Review & Approval of Graving Dock Cycle 4 Shop Drawings			4/27	6/7
99	3.2.9	Contractor's Submittal of Graving Dock Cycle 5 Shop Drawings			4/27	6/7
100	3.2.10	Review & Approval of Graving Dock Cycle 5 Shop Drawings			6/8	7/19
101	3.2.11	Contractor's Submittal of Precast Shop Drawings			11/10	12/21
102	3.2.12	Review & Approval of Precast Shop Drawings			12/22	2/1
103	**3.3**	**Graving Dock Cycle 1**			**5/18**	**12/15**
104	3.3.1	Cast 463' Land Wall Monolith Base Raft	3900 cy		5/18	10/17
105	3.3.2	Cast 350' Lower Landside Floating Approach Wall Pontoon			5/18	8/23
106	3.3.3	Deliver to Site (Graving Dock Cycle 1)			12/4	12/15
107	**3.4**	**Graving Dock Cycle 2**			**10/18**	**3/26**
108	3.4.1	Cast Float-In Gate Bay Monolith Base Raft	3000 cy	40 cy/day	10/18	3/12
109	3.4.2	Cast Diffuser Section	750 cy	40 cy/day	10/18	12/25
110	3.4.3	Cast 100' Lower Middle Floating Wall Pontoon			10/18	11/14



Plan 3

JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

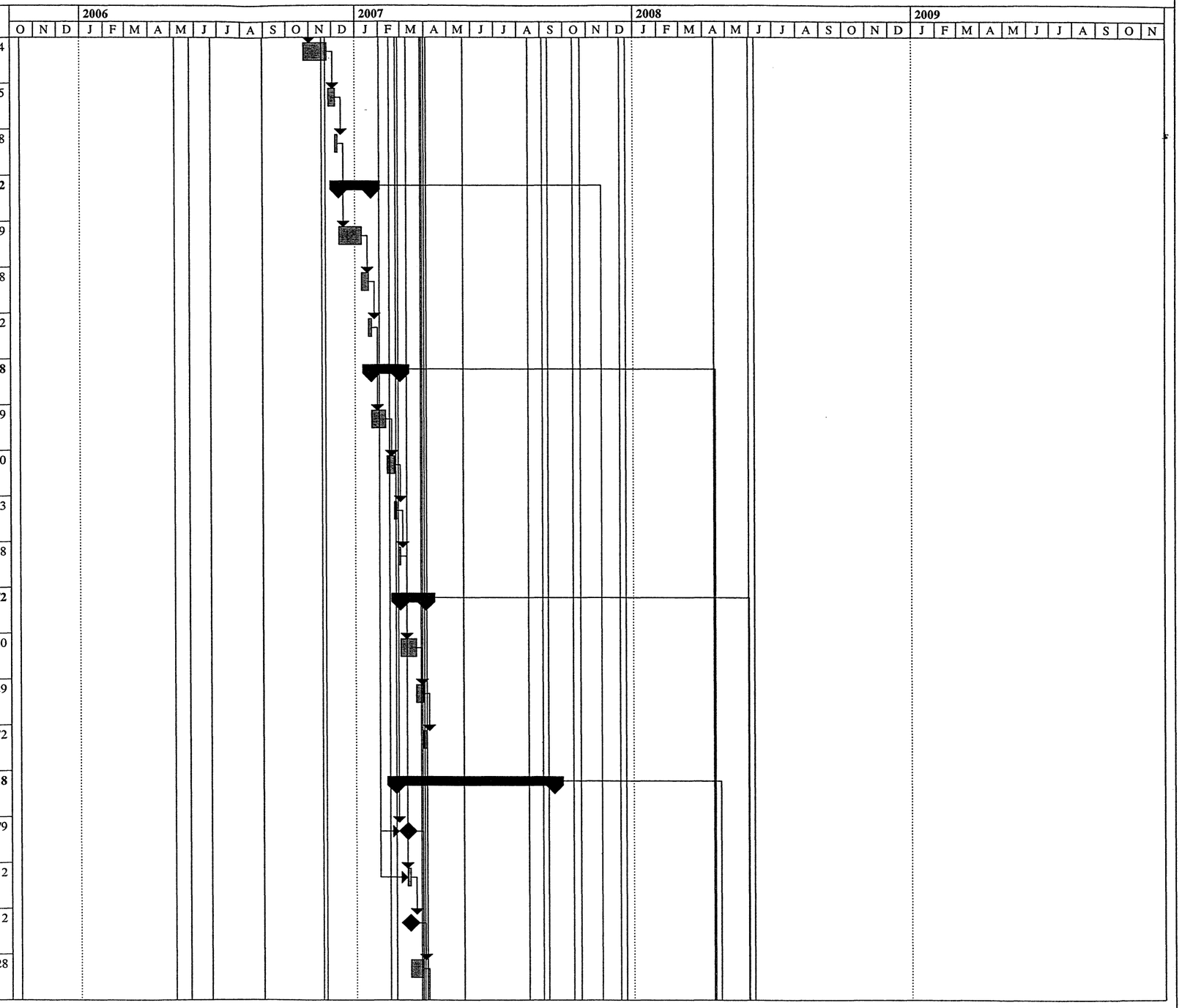
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
111	3.4.4	Deliver to Site (Graving Dock Cycle 2)			3/13	3/26
112	3.5	**Graving Dock Cycle 3**			**8/10**	**12/14**
113	3.5.1	Cast 310' Upper Riverside Floating Guard Wall Pontoon			8/10	11/13
114	3.5.2	Cast 290' Upper Middle Floating Approach Wall Pontoon			8/10	11/13
115	3.5.3	Cast 350' Lower Landside Floating Approach Wall Pontoon			8/10	11/13
116	3.5.4	Deliver to Site (Graving Dock Cycle 3)			12/3	12/14
117	3.6	**Graving Dock Cycle 4**			**11/14**	**2/26**
118	3.6.1	Cast 310' Upper Riverside Floating Guard Wall Pontoon			11/14	2/12
119	3.6.2	Cast 340' Upper Riverside Floating Guard Wall Pontoon			11/14	2/12
120	3.6.3	Deliver to Site (Graving Dock Cycle 4)			2/13	2/26
121	3.7	**Graving Dock Cycle 5**			**2/13**	**5/30**
122	3.7.1	Cast 300' Upper Middle Floating Approach Wall Pontoon			2/13	5/16
123	3.7.2	Cast 310' Upper Middle Floating Approach Wall Pontoon			2/13	5/16
124	3.7.3	Deliver to Site (Graving Dock Cycle 5)			5/19	5/30
125	3.8	**Precast Elements**			**5/18**	**4/2**
126	3.8.1	**Cast & Deliver Intake Wing Wall Panels**			**5/18**	**6/28**
127	3.8.1.1	Wall Panels	520 cy	40 cy/day	5/18	6/5
128	3.8.1.2	Cap Beam Shell	28 cy	40 cy/day	6/6	6/7
129	3.8.1.3	Shaft Enclosures	595 cy	40 cy/day	6/8	6/28
130	3.8.2	Cast & Deliver Land Wall Monolith Buttress Wall Sections & Top Deck Slab	nts, 18 decks		5/18	10/24
131	3.8.3	**Cast & Deliver 100' Lower Middle Floating Approach Wall Elements**			**10/25**	**4/2**



JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

Plan 3

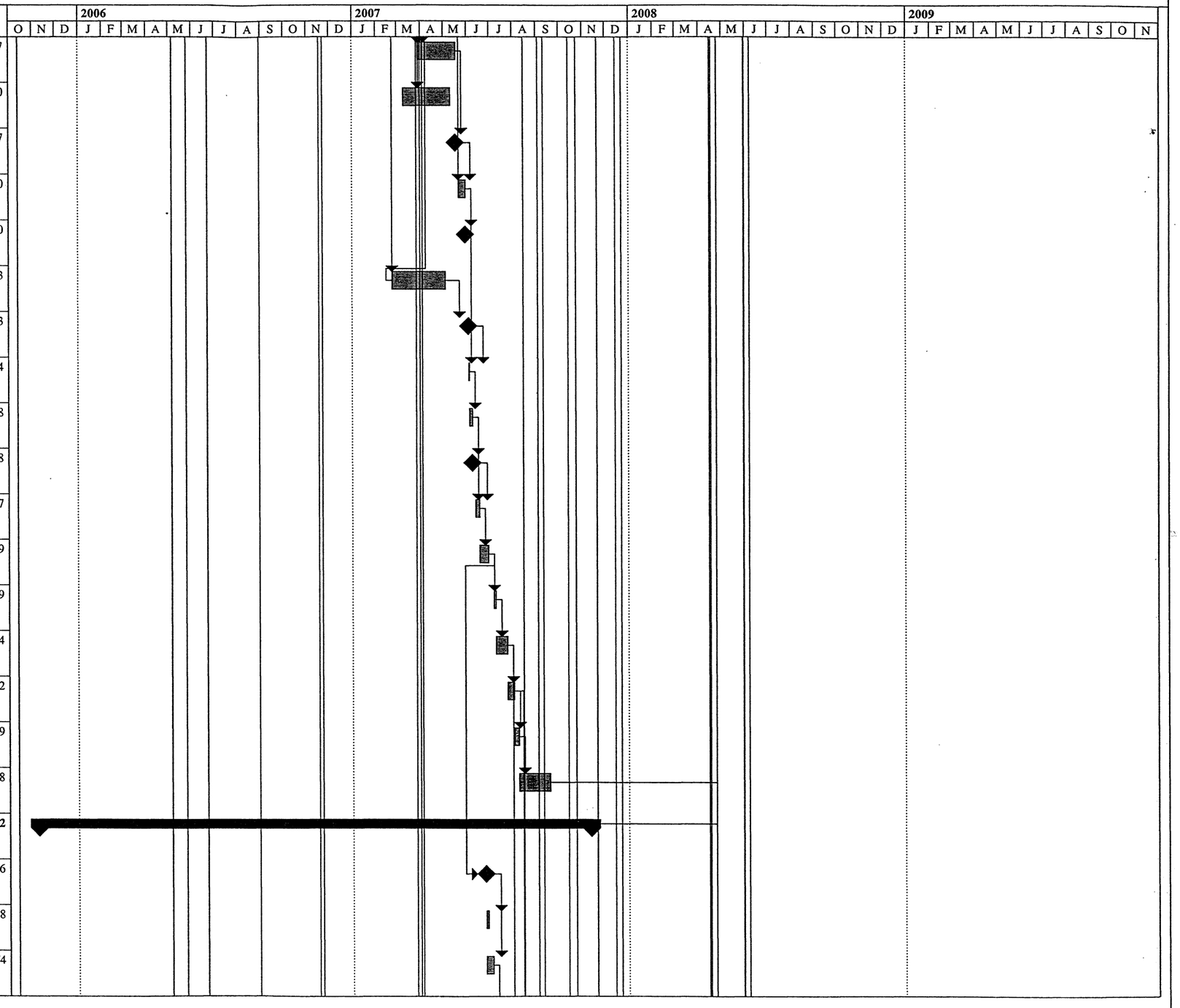
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
132	3.8.3.1	Nose Pier Cap	900 cy	40 cy/day	10/25	11/24
133	3.8.3.2	Nose Pier Wall Segments	250 cy	40 cy/day	11/27	12/5
134	3.8.3.3	Pylon Protrusion	85 cy	40 cy/day	12/6	12/8
135	**3.8.3.4**	**Cast & Deliver 700' Lower Land Floating Approach Wall Elements**			**12/11**	**1/22**
136	3.8.3.4.1	Nose Pier Cap	900 cy	40 cy/day	12/11	1/9
137	3.8.3.4.2	Nose Pier Wall Segments	250 cy	40 cy/day	1/10	1/18
138	3.8.3.4.3	Pylon Protrusion	80 cy	40 cy/day	1/19	1/22
139	**3.8.3.5**	**Cast & Deliver 960' Upper River Floating Guard Wall Elements**			**1/23**	**2/28**
140	3.8.3.5.1	Nose Pier Cap	550 cy	40 cy/day	1/23	2/9
141	3.8.3.5.2	Nose Pier Wall Segments	250 cy	40 cy/day	2/12	2/20
142	3.8.3.5.3	Pylon Base	70 cy	40 cy/day	2/21	2/23
143	3.8.3.5.4	Pylon Superstructure	75 cy	40 cy/day	2/26	2/28
144	**3.8.3.6**	**Cast & Deliver 900' Upper Middle Floating Aproach Wall Elements**			**3/1**	**4/2**
145	3.8.3.6.1	Nose Pier Cap	550 cy	40 cy/day	3/1	3/20
146	3.8.3.6.2	Nose Pier Wall Section	250 cy	40 cy/day	3/21	3/29
147	3.8.3.6.3	Pylon Protrusion	65 cy	40 cy/day	3/30	4/2
148	**4**	**Construct & Install Landwall Monolith**			**2/23**	**9/18**
149	4.1	Close 600' Lock			3/9	3/9
150	4.2	Demolish Interior Portion of Existing L-1 Monolith	1000 cy	300 cy/day	3/9	3/12
151	4.3	Open 600' Lock			3/12	3/12
152	4.4	Demolish Exterior Portion of Existing L-1 Monolith	4000 cy	300 cy/day	3/13	3/28



Plan 3

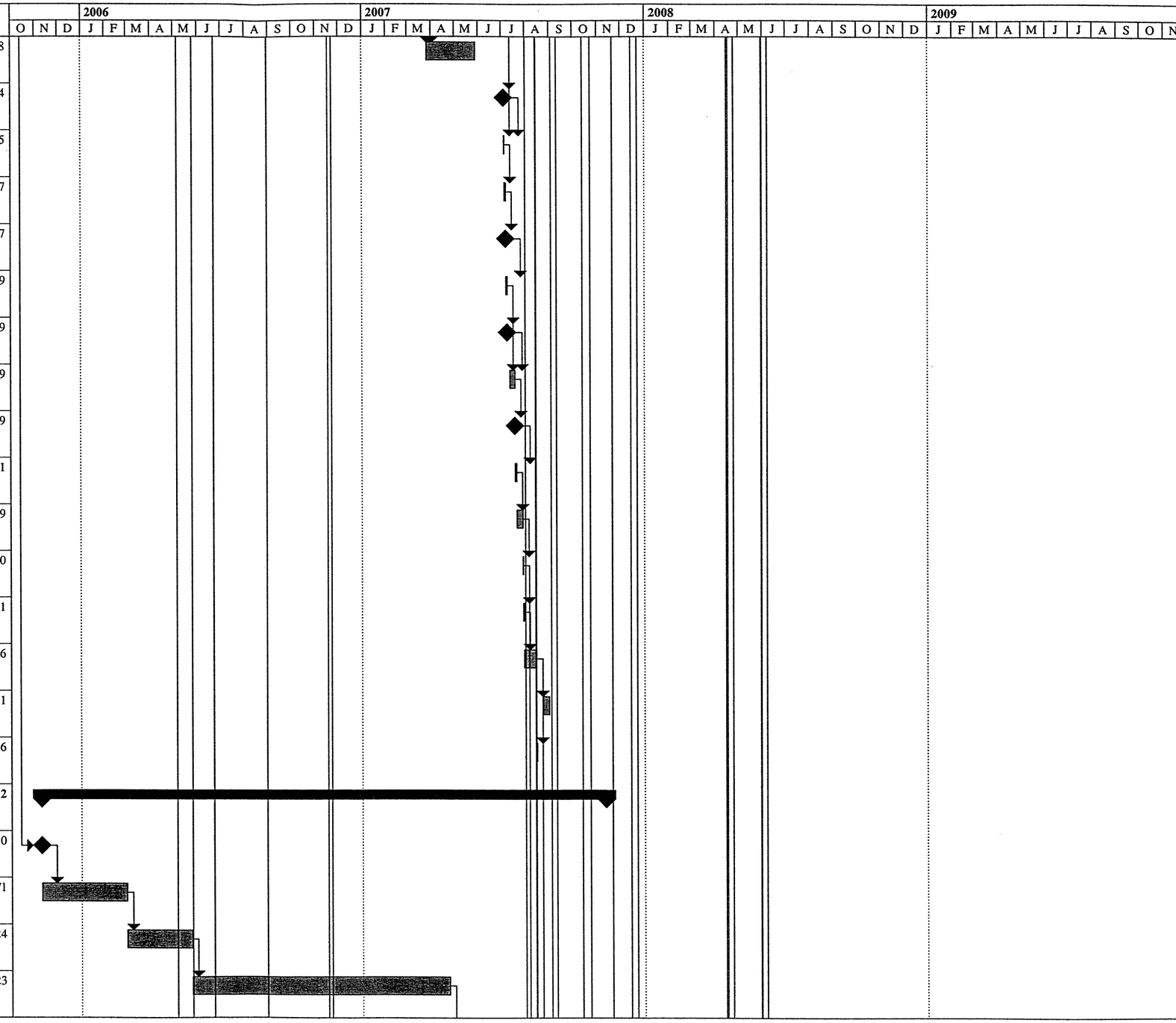
JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
153	4.5	Modify L-2 to L-5 Monoliths (add CIP Concrete on Landside)	6350 cy	150 cy/day	3/29	5/17
154	4.6	Install Rock Anchors at Monoliths M-1 to M-14	106 anchors	2 anchors/day	3/10	5/10
155	4.7	Close 600' Lock			5/17	5/17
156	4.8	Construct Underwater Support Pedestals for Float-In Monolith Set-down	8 ea	1/day	5/22	5/30
157	4.9	Open 600' Lock			5/30	5/30
158	4.10	Add Interior and Exterior Walls to Landwall Monolith at Temp. Const. Mooring Area to El 334			2/23	5/3
159	4.11	Close 600' Lock			6/3	6/3
160	4.12	Move Landwall Monolith to Set-down Site and Ballast Down Onto Pedestals			6/4	6/4
161	4.13	Inject Underbase Grout Followed by Tremie Concrete Around Perimeter	1500 cy	500 cy/day	6/5	6/8
162	4.14	Open 600' Lock			6/8	6/8
163	4.15	Tremie 10-foot Concrete Lift in Bottom Compartments	8000 cy	1600 cy/day	6/13	6/17
164	4.16	Cast Lean Concrete in Compartments From Top of Tremie to El. 331	19,000 cy	1600 cy/day	6/18	6/29
165	4.17	Place Structural Concrete From El. 331 to El. 334	1700 cy	800 cy/day	7/7	7/9
166	4.18	Erect Upper PC Walls & Buttresses from El. 334 to El 362 with Vertical PT bars	54 ea	4/day	7/10	7/24
167	4.19	Place & Compact Backfill Behind Wall & Inside Upper Buttress Walls and Form Berm for Lower Wrap Around Construction			7/24	8/2
168	4.20	Place Precast Concrete Top Slab at El. 362, Install Lights, Guardrails, Etc.			8/2	8/9
169	4.21	Install Reverse Tainter Gate Valve			8/9	9/18
170	5	**Construct & Install Float-In Gatebay Monolith**			**11/10**	**11/12**
171	5.1	Close 600' Lock			6/26	6/26
172	5.2	Install Steel Locator Frame on D/S Middle Wall Bullnose With Jacks to Provide Alignment for Gatebay Monolith Placement			6/26	6/28
173	5.3	Construct Underwater Set-down Pedestals for Float-in Monolith Installation	8 ea	1/day	6/26	7/4



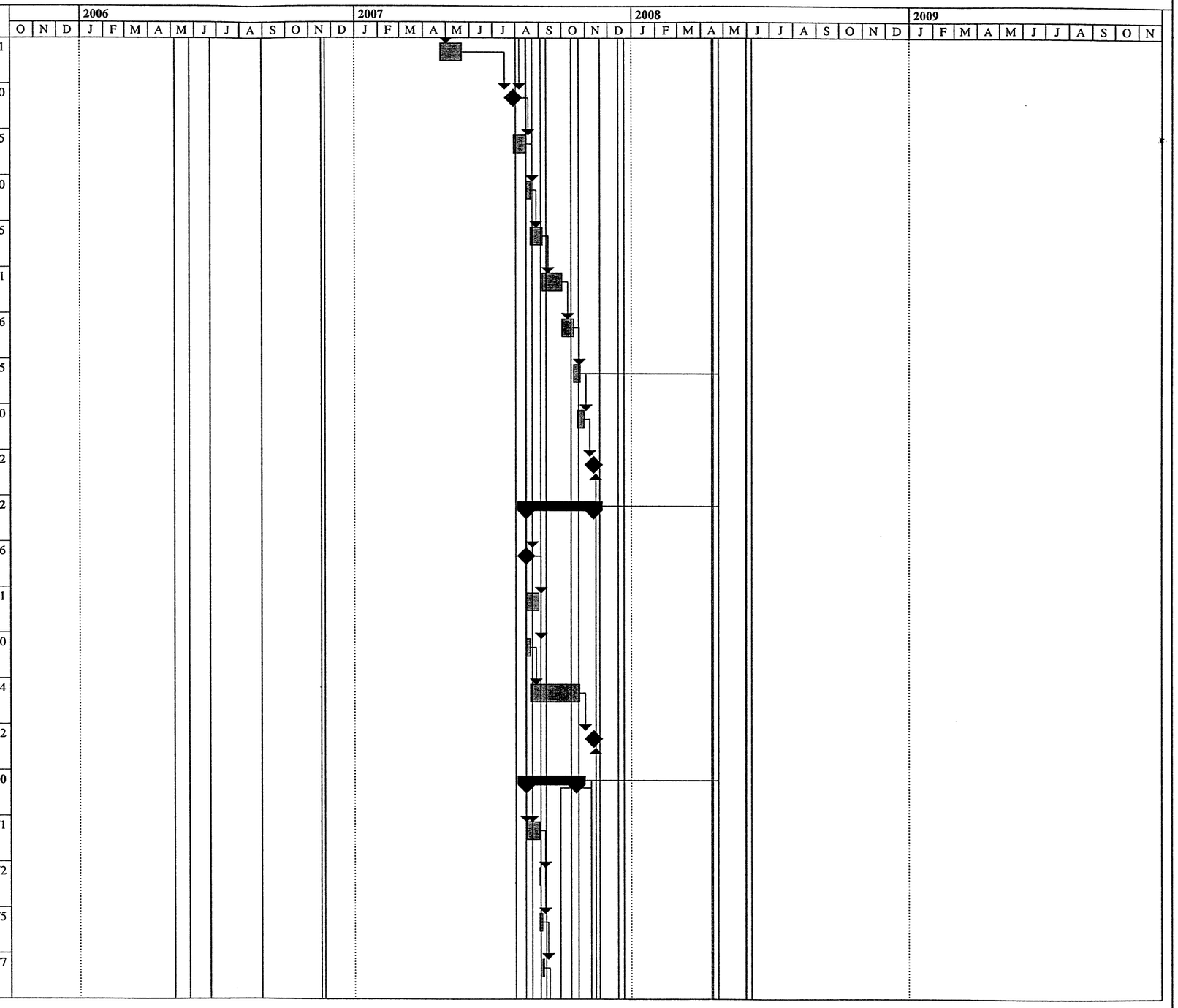
JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
174	5.4	Add Sill Concrete Slabs and Outer Side Walls to Gatebay Monolith at Temp. Const. Mooring Area	2500 cy	60 cy/day	3/27	5/28
175	5.5	Close 1200' Lock			7/4	7/4
176	5.6	Move Gatebay Monolith to Final Location and Ballast Down Onto Pedestals			7/4	7/5
177	5.7	Inject Underbase Grout and Perimeter Concrete with Pre-installed Tremie Tower (1200' Lockside)	500 cy	300 cy/day	7/5	7/7
178	5.8	Open 1200' Lock			7/7	7/7
179	5.9	Inject Underbase Grout and Perimeter Concrete With Pre-installed Tremie Tower (600' Lockside)	500 cy	300 cy/day	7/7	7/9
180	5.10	Open 600' Lock			7/9	7/9
181	5.11	Tremie 13' of Concrete in All Center Compartments and 20' in Side Wall Shells	10,000 cy	1600 cy/day	7/12	7/19
182	5.12	Close 600' Lock			7/19	7/19
183	5.13	Seal U/S Face of Gatebay Monolith to D/S End of Landwall Monolith with Grout Joint			7/19	7/21
184	5.14	Construct CIP Closure pour From U/S Face of Gatebay Monolith to Existing Middle Wall Bullnose			7/21	7/29
185	5.15	Install (5) 6' High Bulkheads in Gatebay Monolith Slots (to El. 338)			7/29	7/30
186	5.16	Dewater 600' Lock Extension			7/30	7/31
187	5.17	Complete Placement of Lean Concrete Inside the Monolith, Dewater One Compartment at a Time			7/31	8/16
188	5.18	CIP Top Lift of Structural Concrete to El. 362, Install Lights, Guardrails, Etc.			8/23	8/31
189	5.19	Install (1) Additional 6' High Bulkhead in Gatebay Monolith Slots (to El. 344)			8/16	8/16
190	**5.20**	**Assemble, Install, & Test Miter Gates, Machinery & Seals**			**11/10**	**11/12**
191	5.20.1	Order Miter Gates & Machinery			11/10	11/10
192	5.20.2	Prepare & Submit Shop Drawings			11/10	3/1
193	5.20.3	Review & Approve Shop Drawings			3/2	5/24
194	5.20.4	Fabricate Miter Gates & Machinery			5/25	4/23



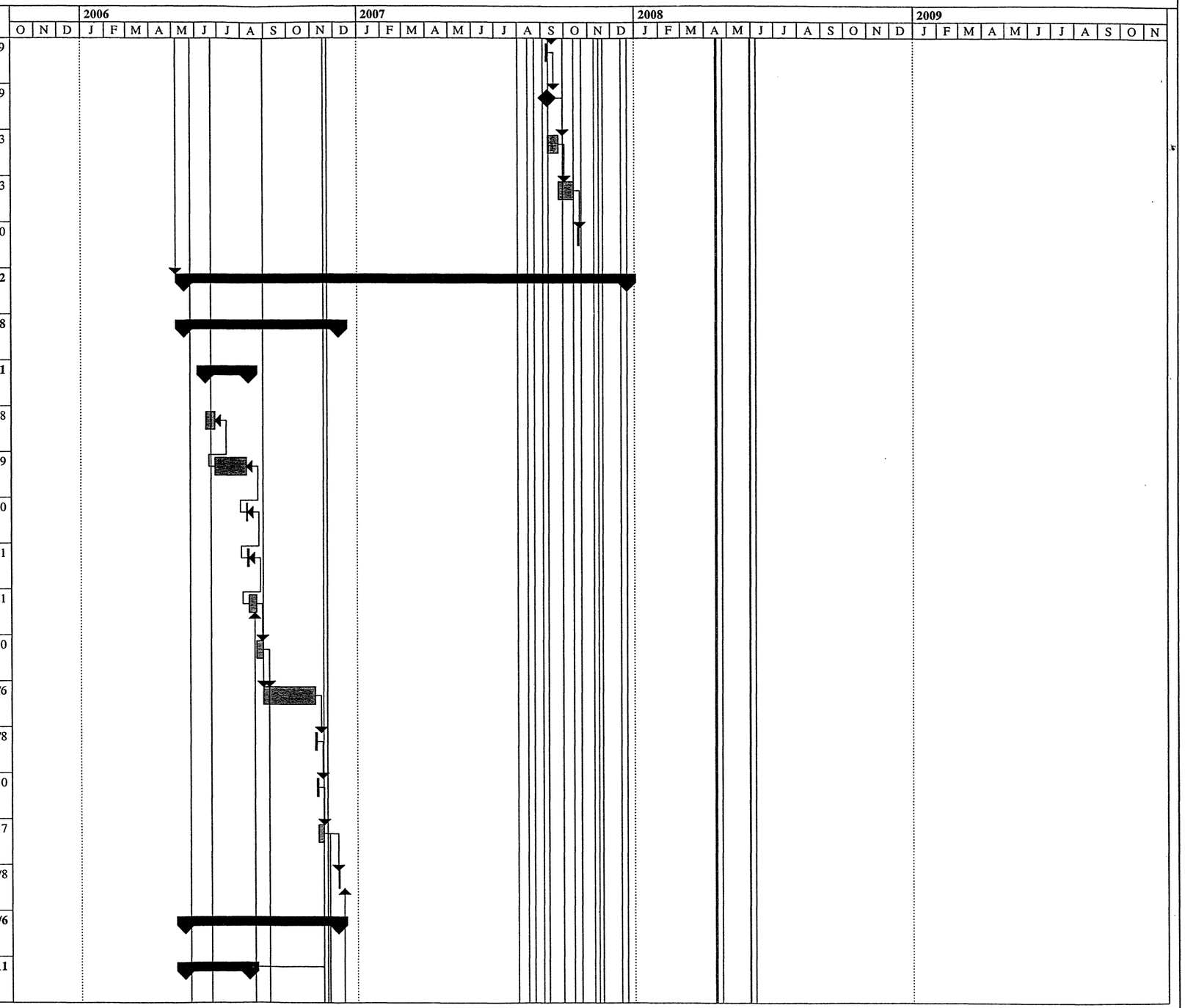
JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
195	5.20.5	Ship Miter Gates & Machinery			4/24	5/21
196	5.20.6	Close 600' Lock			7/30	7/30
197	5.20.7	Assemble Leaf Hinge Assemblies & Place Pintel Concrete			7/30	8/15
198	5.20.8	Move Gate Leaves & Erect Into Gatebay With Gatelifter Crane			8/16	8/20
199	5.20.9	Complete Installation of Diagonals, Bridgeway, and Framing Splices			8/21	9/5
200	5.20.10	Fit Gate Leaves Onto Pintels, Connect Actuators & Power			9/6	10/1
201	5.20.11	Adjust Seals & Place Second Stage Concrete at Seals			10/2	10/16
202	5.20.12	Test Gate Operations, Make Final Adjustments			10/17	10/25
203	5.20.13	Remove Old D/S Gate From Existing 600' Lock Chamber and Fill Recess With CIP Concrete			10/22	10/30
204	5.20.14	Open 600' Lock (After Some Backfill has Been Placed Behind Landwall Monolith As Well)			11/12	11/12
205	**6**	**Construct Fill/Empty Laterals & Maintenance Bulkhead Sill in Floor of 600' Extension**			**8/16**	**11/12**
206	6.1	Close 600' Lock			8/16	8/16
207	6.2	Excavate for F/E Laterals & Maintenance Bulkhead Sill	4600 cy	300 cy/day	8/16	8/31
208	6.3	Grout to Complete Seal Under Land Wall & Gatebay Monoliths			8/16	8/20
209	6.4	Construct F/E Laterals & Maintenance Bulkhead Sill	5000 cy	80 cy/day	8/21	10/24
210	6.5	Open 600' Lock (After Some Backfill has Been Placed Behind Landwall Monolith As Well)			11/12	11/12
211	**7**	**Construct & Install Landside Wall Diffuser Float-In Monolith**			**8/16**	**10/20**
212	7.1	Build Up Side Walls at Mooring Area	650 cy	60 cy/day	8/16	9/1
213	7.2	Close 600' Lock			9/2	9/2
214	7.3	Construct Underwater Set-down Pedestals for Float-in Installation	4 ea	1/day	9/2	9/5
215	7.4	Move Assembled Unit to Set-down Location & Ballast Down Onto Pedestals			9/6	9/7



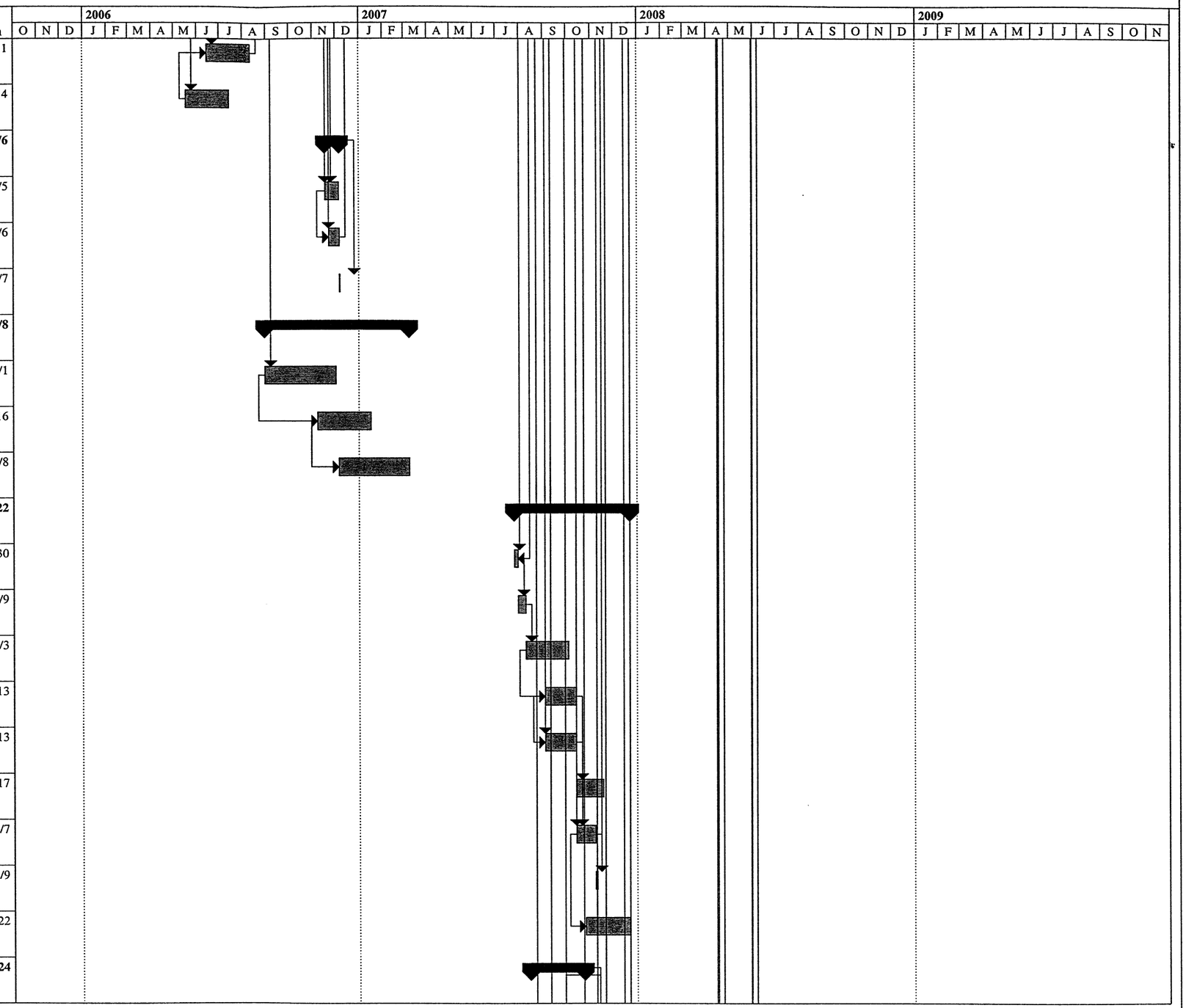
JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
216	7.5	Inject Underbase Grout and Perimeter Concrete around Perimeter	400 cy	500 cy/day	9/8	9/9
217	7.6	Open 600' Lock			9/9	9/9
218	7.7	Complete Wall Shells to El. 362	400 cy		9/10	9/23
219	7.8	Fill Diffuser Shell With Tremie Concrete to El. 359	10,300 cy		9/24	10/13
220	7.9	Fill Monolith Sidewalls with Structural Concrete to El. 362	500 cy	800 cy/day	10/19	10/20
221	**8**	**Construct Wrap-Around Culvert**			**5/18**	**12/22**
222	**8.1**	**Construct U/S Facility & Culvert Intake Structure**			**5/18**	**12/8**
223	**8.1.1**	**Remove & Replace Existing U/S Mooring Facility**			**6/16**	**8/11**
224	8.1.1.1	Construct Temporary Access Road			6/16	6/28
225	8.1.1.2	Construct Tieback Sheetpile Wall, Concrete-Filled Sheetpile Cell, and Dredge Area			6/28	8/9
226	8.1.1.3	Relocate Existing Floating Dock			8/9	8/10
227	8.1.1.4	Final Grading & Paving			8/10	8/11
228	8.1.2	Place Berm Along Existing Sheetpile Wall to Form Cofferdam			8/11	8/21
229	8.1.3	Dewater & Excavate For Intake Monolith			8/21	8/30
230	8.1.4	Construct CIP Concrete Intake Monolith	4,600 cy	80 cy/day	8/31	11/6
231	8.1.5	Backfill Intake Monolith			11/6	11/8
232	8.1.6	Remove Berm			11/8	11/10
233	8.1.7	Excavate Intake Channel			11/10	11/17
234	8.1.8	Construct Permanent Access Road to New U/S Mooring Facility			12/6	12/8
235	**8.1.9**	**Construct Wing Walls**			**5/18**	**12/6**
236	**8.1.9.1**	**Construct Drilled Shafts**			**5/18**	**8/11**



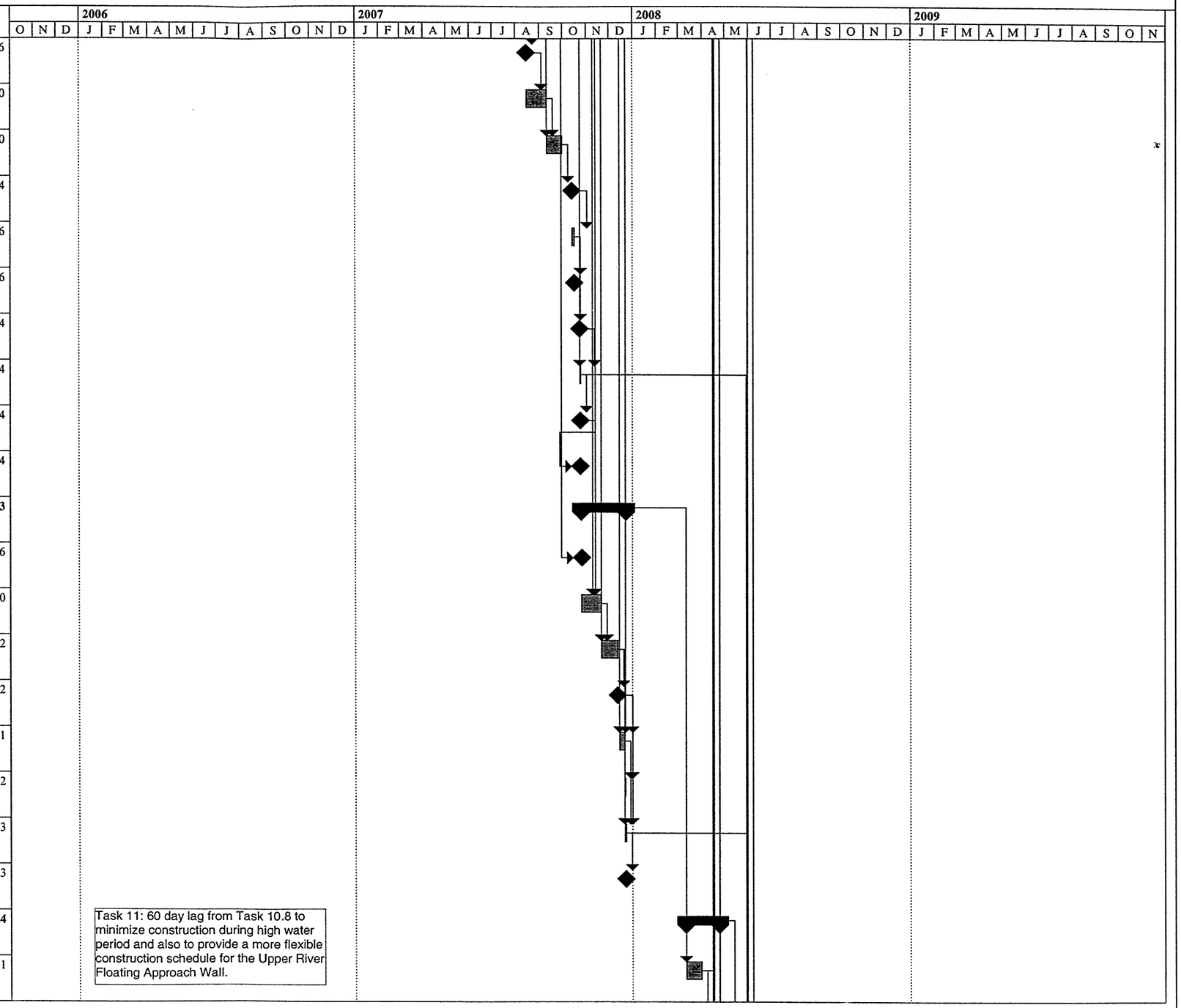
JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
237	8.1.9.1.1	Excavate Shafts			6/15	8/11
238	8.1.9.1.2	Place Reinforcement & Concrete	) lb; 1450 cy		5/18	7/14
239	8.1.9.2	**Install PC Concrete Elements**			**11/18**	**12/6**
240	8.1.9.2.1	Install PC Concrete Shaft Enclosures	29 ea		11/18	12/5
241	8.1.9.2.2	Install PC Concrete Wall Panels & Cap Beams	29 ea		11/23	12/6
242	8.1.10	Install Ice & Debris Boom			12/6	12/7
243	8.2	**Construct Wrap Around Culvert to Sta. 6+75**			**8/31**	**3/8**
244	8.2.1	Excavate, Drive Sheetpiling, and Place Gravel Bedding		1500 cy/day	8/31	12/1
245	8.2.2	Install PC Concrete Cradles, Pipe Culvert & Place Bedding Concrete		3 pcs/day	11/8	1/16
246	8.2.3	Backfill		1500 cy/day	12/6	3/8
247	8.3	**ConstructWrap Around Culvert From Sta. 6+75 to Land Wall Monolith and Construct Valve Monolith**			**7/26**	**12/22**
248	8.3.1	Place Temporary Berm	1000 cy	250 cy/day	7/26	7/30
249	8.3.2	Dewater			7/31	8/9
250	8.3.3	Excavate, Drive Sheetpiling, and Place Gravel Bedding		1500 cy/day	8/10	10/3
251	8.3.4	Install PC Concrete Cradles, Pipe Culvert & Place Bedding Concrete		3 pcs/day	9/4	10/13
252	8.3.5	Construct CIP Concrete Culvert Valve Monolith			9/4	10/13
253	8.3.6	Install Reverse Tainter Gate Valve			10/14	11/17
254	8.3.7	Complete D/S Elbow, Thrust Block & Connection			10/14	11/7
255	8.3.8	Connect to New Landside Monolith			11/8	11/9
256	8.3.9	Backfill		1500 cy/day	10/26	12/22
257	9	**Construct & Install 100' Lower Middle Floating Approach Wall**			**8/16**	**10/24**



JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

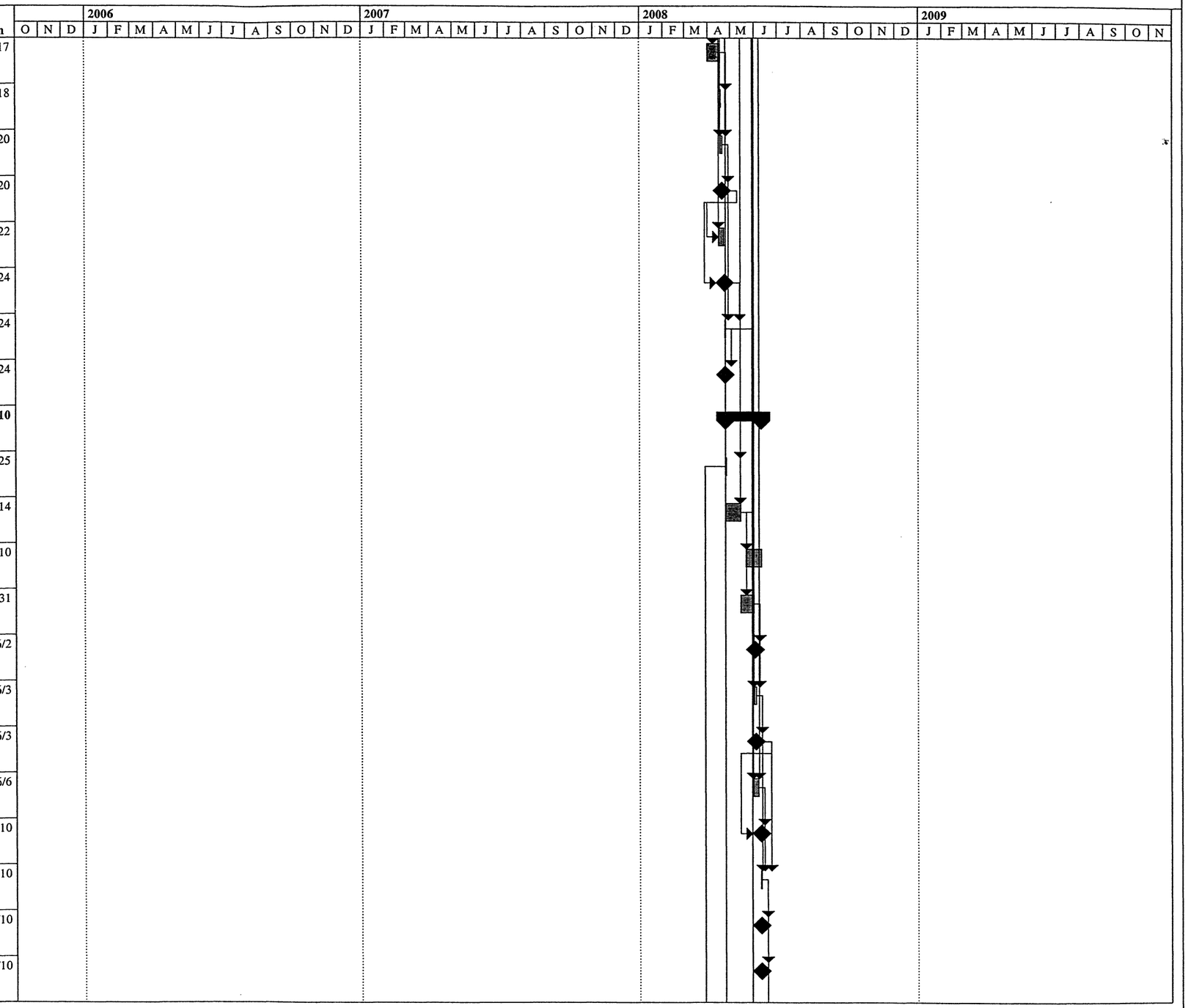
ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
258	9.1	Close 600' Lock			8/16	8/16
259	9.2	Drill Shafts & Install Nose Pier & Pylon			8/16	9/10
260	9.3	Complete Nose Pier & Pylon (1200' Lock Open)			9/11	9/30
261	9.4	Close 1200' Lock			10/14	10/14
262	9.5	Complete Nose Pier & Pylon (1200' Lock Closed)			10/14	10/16
263	9.6	Open 1200' Lock (But provide helper tug while concrete cures)			10/16	10/16
264	9.7	Close 1200' Lock			10/24	10/24
265	9.8	Install Floating Approach Wall			10/24	10/24
266	9.9	Open 1200' Lock			10/24	10/24
267	9.10	Open 600' Lock			10/24	10/24
268	**10**	**Construct & Install 700' Lower Landside Floating Approach Wall**			**10/26**	**12/23**
269	10.1	Close 600' Lock			10/26	10/26
270	10.2	Drill Shafts & Install Nose Pier & Pylon			10/26	11/20
271	10.3	Complete Nose Pier & Pylon			11/21	12/12
272	10.4	Open 600' Lock (But provide helper tug while concrete cures)			12/12	12/12
273	10.5	Mate & Bolt (3) Segments to Form Floating Approach Wall			12/15	12/21
274	10.6	Close 600' Lock			12/22	12/22
275	10.7	Install Floating Approach Wall			12/22	12/23
276	10.8	Open 600' Lock			12/23	12/23
277	**11**	**Construct & Install 960' Upper Riverside Floating Guard Wall**			**3/12**	**4/24**
278	11.1	Drill Shafts & Install Nose Pier & Pylon			3/12	3/31



Task 11: 60 day lag from Task 10.8 to minimize construction during high water period and also to provide a more flexible construction schedule for the Upper River Floating Approach Wall.

JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
279	11.2	Complete Nose Pier & Pylon (1200' Lock Open)			4/1	4/17
280	11.3	Close 1200' Lock			4/18	4/18
281	11.4	Complete Nose Pier & Pylon (1200' Lock Closed)			4/18	4/20
282	11.5	Open 1200' Lock (But provide helper tug while concrete cures)			4/20	4/20
283	11.6	Mate & Bolt (3) Segments to Form Floating Guard Wall			4/16	4/22
284	11.7	Close 1200' Lock			4/24	4/24
285	11.8	Install Floating Guard Wall			4/24	4/24
286	11.9	Open 1200' Lock			4/24	4/24
287	12	**Construct & Install 900' Upper Middle Floating Approach Wall**			**4/25**	**6/10**
288	12.1	Close 600' Lock			4/25	4/25
289	12.2	Drill Shafts & Install Nose Pier & Pylon			4/25	5/14
290	12.3	Dredge Area Under New Approach Wall to El. 308	30,000 cy	1500 cy/day	5/22	6/10
291	12.4	Complete Nose Pier & Pylon (1200' Lock Open)			5/15	5/31
292	12.5	Close 1200' Lock			6/2	6/2
293	12.6	Complete Nose Pier & Pylon (1200' Lock Closed)			6/1	6/3
294	12.7	Open 1200' Lock (But provide helper tug while concrete cures)			6/3	6/3
295	12.8	Mate & Bolt (3) Segments to Form Floating Approach Wall			5/31	6/6
296	12.9	Close 1200' Lock			6/10	6/10
297	12.10	Install Floating Approach Wall			6/10	6/10
298	12.11	Open 600' Lock			6/10	6/10
299	12.12	Open 1200' Lock			6/10	6/10



JOHN T. MYERS 600 FOOT LOCK EXTENSION CONSTRUCTION SCHEDULE
PLAN 3

ID	WBS	Task Name	Quantity	Prod Rate	Start	Finish
300	13	**Final Testing & Commissioning**			4/25	6/11
301	13.1	Close 600' Lock			4/25	4/25
302	13.2	Testing (While lock is closed for other tasks)			4/25	5/29
303	13.3	Open 600' Lock			5/29	5/29
304	13.4	Commissioning			6/10	6/11

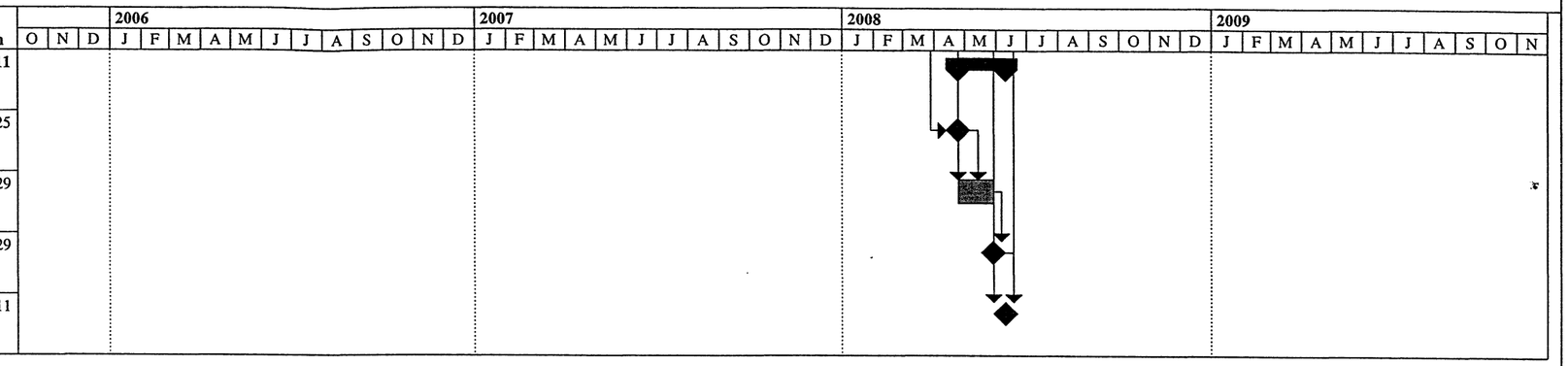


Table 22.2A, shown below, summarizes the existing lock closures and helper tug assistance required during construction of the 600' lock extension, Plan 3.

TABLE 22.2A
600' LOCK EXTENSION
CONSTRUCTION PERIODS AND LOCK CLOSURES

	Plan 3 Construction			
Construction Period (Months)	**25 On-site 31 Total**			
	Total Closure (Days) (Note 1)	**Duration (Days)**	**Tasks in Closure (From Schedule)**	**Task Description**
Full Closure of 600 Foot Lock Only	**315**	12	69-71	Dredge Construction Mooring Area Float-in Landwall Monolith
		24	73-75	Dredge Set-down Area From Lockside
		61	77-79 149-151	Rock Excavation Demolish Existing Monolith L-1
		20	155-157 159-162	Float-in Landwall Monolith Move to Set-down site
		10	171-174, 176-180	Float-in Gatebay Monolith
		113	182-189, 196-204 206-210 213-217 258-267	Dewater Lock and Install Miter Gate Construct Fill/Empty Laterals and Maintenance Bulkhead Sill In-the-Dry Float-in Landside Wall Diffuser Monolith Lower Middle Floating Approach Wall
		31	269-272, 274-276	Lower Landside Floating Approach Wall
		44	288-298, 303-303	Upper Middle Floating Approach Wall
Full Closure of 1200 Foot Lock Only	**4**	3 1	280-282 284-286	Upper Riverside Floating Approach Wall: Complete Nose Cells & Pylon Install Foating Guard Wall
Simultaneous Closure of 600 Foot and 1200 Foot Locks	**12***	4	175-178	Float-in Gatebay: Move Gatebay to Final Location Inject Underbase Grout on 1200' Lock Side
		3 1	261-263 264-266	Lower Middle Floating Approach Wall: Complete Nose Cells & Pylons Install Floating Approach Wall
		3 1	292-294 296-299	Upper Middle Floating Approach Wall: Complete Nose Cells & Pylon Install Floating Approach Wall

Notes:
*1. There are one 4-day, two 3-day, and two 1-day simultaneous closures of both locks required for Plan 3 Construction.

2. In addition, 627 days of helper tug assistance will be required for Plan 3 Construction.

22.3 SCHEDULE OF APPROPRIATIONS

The anticipated funding stream for Plan 3 was developed, based on the design and construction schedules included in this section. This funding stream is shown in ***Table 22.3A*** on the following page.

TABLE 22.3A

J. T. Myers Auxiliary Lock Extension

Plan 3 Funding Stream

Source	Category	Total Funds (x $1,000)	Funding Per Fiscal Year (All Costs Multiplied Times $1,000)								
			FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08
PED Funded	05 Locks										
	06 Fish & Wildlife Mitigation										
	19 Buildings, Grounds, and Utilities										
	30 Planning and Engineering Design	$16,200	1,000	3,800	3,800	3,800	3,800				
	31 Construction Management										
CG Funded	01 Real Estate	$50						50	0	0	0
	05 Locks	$130,908						0	22,908	80,000	28,000
	06 Fish & Wildlife Mitigation	$4,600						4,600	0	0	0
	19 Buildings, Grounds, and Utilities	$8,312						0	6,400	1,600	312
	30 Planning and Engineering Design	$3,600						1,500	500	1,000	600
	31 Construction Management	$9,500						0	2,200	5,500	1,800
	Total Funds	**$173,170**	**$1,000**	**$3,800**	**$3,800**	**$3,800**	**$3,800**	**$6,150**	**$32,008**	**$88,100**	**$30,712**
	Construction General	$86,585	$1,000	$3,800	$3,800	$3,800	$3,800	$0	$10,979	$44,050	$15,356
	Inland Waterways Trust Fund	$86,585	$0	$0	$0	$0	$0	$6,150	$21,029	$44,050	$15,356

Notes:

1. If aggregate sites, concrete mixes, etc. are preapproved, then the construction schedule may be reduced by approximately 6 months, and significantly more funds may be required in FY 06.

2. All funds are in 1999 Dollars.

SECTION 23

SPECIAL STUDIES

23.1 WES MODEL STUDIES

It is recommended that the following models be constructed and tested at the Waterways Experiment Station (WES) in Vicksburg, Mississippi.

23.1.1 Fill/Empty System Model

The current fill/empty system design is based on nume rical analyses, using the computer programs TFSIM and LOCKSIM. However, in order to evaluate the proposed and alternate designs of the filling and emptying system, physical modeling should be conducted for the J. T. Myers site. The fill/empty system mode l will help optimize the design of the intake and outlet structures. Additionally, the model will yield insight into hawser forces along the lock and approach structures during filling and emptying operations. It is anticipated that physical modeling wil l be completed during future design phases, as early as possible in the design process. Construction of preliminary models has started.

The anticipated duration of the physical modeling is approximately 24 months, spread out over a three year period. The total anticipated budget for this effort is approximately $325,000.

23.1.2 Navigation Model

Due to the nature of both the project and site location, a site-specific navigation model for J. T. Myers L&D is recommended in order to optimize the followi ng design elements:

- Locations of approach walls
- Lengths of approach walls
- Length and width of downstream bank excavation

The physical model should incorporate an appropriate length (currently estimated to be approximately 2 miles upstream and 2 miles do wnstream of the dam axis) of the river in the vicinity of the project site. It should also assist in determining the appropriate design forces for

the approach walls (See Section 23.1.3.). This effort should be started early in the next design phase of the project.

The anticipated duration of the navigation model construction and testing is approximately 30 months. The total anticipated budget for this effort is approximately $905,000.

23.1.3 Impact Loads

Impact loads are an integral component of th e design of the approach walls. The impact loads determine the thickness and weight of the impact wall. The weight of the impact wall then directly influences the width and draft of the pontoon cross section and, consequently, the cost of the wall.

At this point, the impact loads have been based on impact loads determined for the Olmsted approach walls. In order to refine these impact loads and the consequent pontoon designs, it is recommended that additional studies be conducted. These studies can inc lude video monitoring of existing lock traffic and/or scale model testing of radio controlled model approaches to the new lock configuration at the Waterways Experiment Station at Vicksburg, Mississippi. The test program could be modeled after the testing program conducted for the Olmsted approach walls. This program included both controlled and uncontrolled approaches by three different operators under four different flow conditions. This testing program budget and duration is included in the amounts pr ovided for the navigation model.

Full scale impact load testing has also been completed at Robert C. Byrd Locks. The results of this testing should also be incorporated into the final impact load determination and refinement.

23.2 NONLINEAR INCREMENTAL STRUCTURAL ANALYSES (NISA)

Preliminary concrete mix design and thermal analysis evaluations were completed for this feasibility study and were documented in Section 9.8. It was found that, if the initial concrete temperature is lowered to approximately 50° F or lower (by replacing a portion of the cement with pozzolan and precooling the aggregate and mix water), then postcooling requirements can be eliminated. However, this limitation on the initial concrete temperature increases the unit cost of the concrete. By performing a NISA study, it may be possible to reduce or modify the mass concrete restrictions on the contractor and minimize the construction cost of the float-in structures. As the U-shaped float-in miter gate bay structure is the most geometrically complex, it is the structure most likely to benefit from a NISA study. It is recommended that a NISA study be completed for this structure. If the NISA results indicate that construction cost savings may be realized by modifying the specificati ons in accordance with the findings of the analyses, then NISA studies are also recommended for the float -in land wall monolith and float -in landside wall diffuser monolith. However, if the miter gate bay NISA results do not turn up any potential construction cost savings, then further NISA studies are not

necessary, and the mass concrete heat generation can be controlled as described in Section 9.8. The NISA study for the U-shaped float-in miter gate bay structure should be completed early in the next design phase so that possible additional NISA studies, on other structures, can be completed within the design schedule if the initial miter gate bay NISA study yields construction cost savings.

In either case, an evaluation of the need for crack control joints should be completed during future design phases, but a NISA study is not necessary for this determination. Either past experience or a simplified linear analysis should be sufficient for determining the necessity and spacing of crack control joints.

The anticipated duration of the NISA studies is approximately 18 months, spread out over a two year period. The total anticipated budget for this effort is approximately $500,000.

23.3 SEISMIC ANALYSES

For feasibility level design, the pseudostatic seismic coefficient method was used in the seismic analyses that were performed. For selected structures, such as the approach walls and nose piers, a dynamic analysis may be appropriate for future design phases. If the impact loading governs, however, a refined seismic analysis is unnecessary. As reductions in both impact loading and seismic loading are anticipated for future design phases, it is unknown which load case will govern the approach wall design.

For the lock wall monolith designs, EC 1110-2-291 states that "when K_h exceeds 0.2, this [pseudostatic] analysis results in structures that are excessively large." (p. 5-17) As the MDE acceleration coefficient specified for feasibility level design is 0.2g, the seismic analysis results for the lock wall monoliths are currently borderline. As seismic load cases governed several of the stability calculations, these designs (especially the anchoring of existing monoliths) may benefit from dynamic analyses. On the other hand, preliminary seismological study results indicate that the refined seismic accelerations may be lower than those used for the feasibility study. In that case, if the seismic load conditions no longer govern the design of the wall monoliths, then refined seismic analyses may be unnecessary. Further screening will be required when the seismological study is completed.

The seismological study will be completed early in the next design phase, and it will include a determination of the appropriate ground motions for the OBE and MDE load cases at the J. T. Myers site. If the ground motions are determined to be excessive or borderline, or the design of the major structures are controlled by seismic load cases, then dynamic analyses will be performed for these structures.

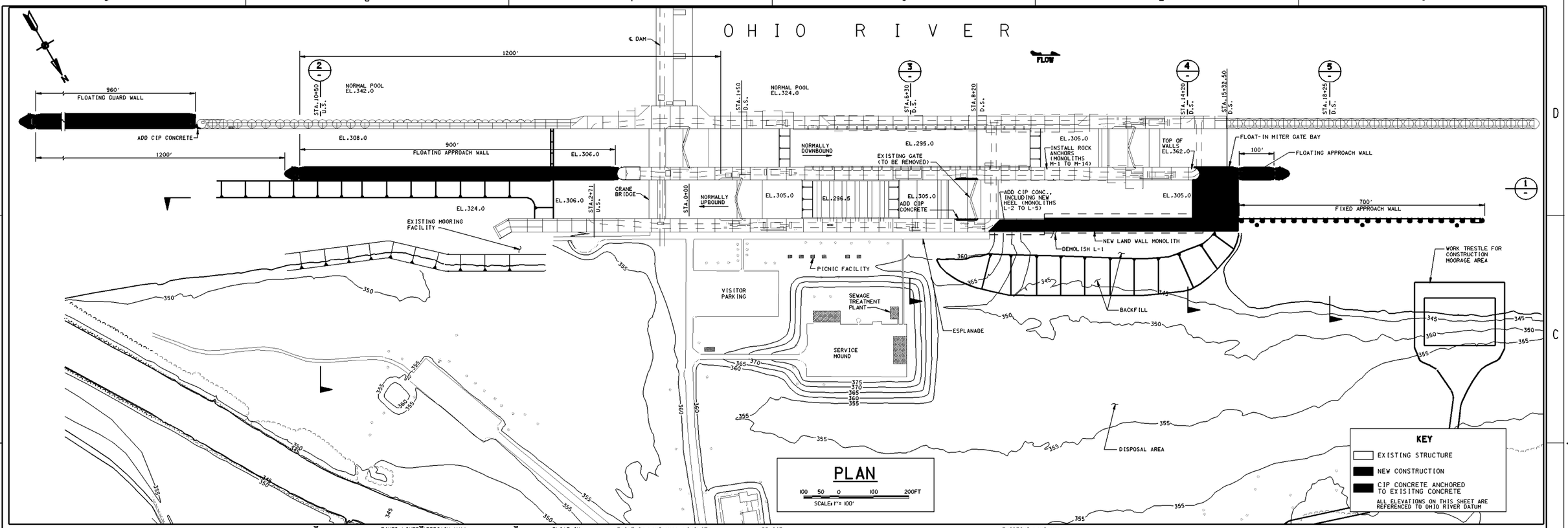
In the breakdown of future design costs, funds will be budgeted for the, potentially required, dynamic analyses of major structures at the J. T. Myers site. If needed, the anticipated duration of the seismic analyses is approximately 18 months, spread out over a two year period. The total anticipated budget for this effort is approximately $300,000.

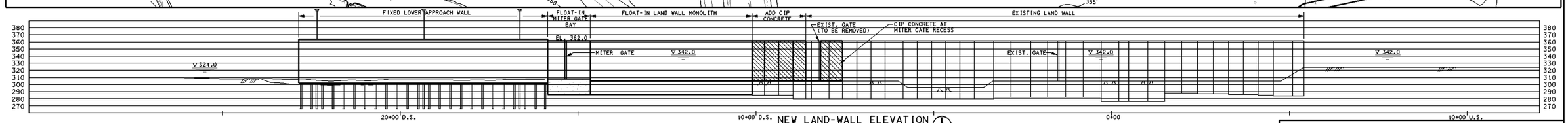
23.4 STUDIES TO MINIMIZE ZEBRA MUSSEL IMPACTS

Zebra mussels are prevalent at the J. T. Myers Locks & Dam site. Studies to investigate methods of minimizing the impact o f the zebra mussel infestation will be required during future design phases. Currently, the proposed design is consistent with the existing structures and does not provide maintenance bulkhead sills upstream of the inlet area and downstream of the outlet. However, the existing structures were constructed prior to the current zebra mussel infestation. Construction of these sills may or may not be economically justified. Consideration of these structures, and other methods to minimize the effects of zebra mussels on lock operations and maintenance, should be completed during future design phases in order to develop a cost effective approach to zebra mussel management.

23.5 FLOOD PLAIN ANALYSIS

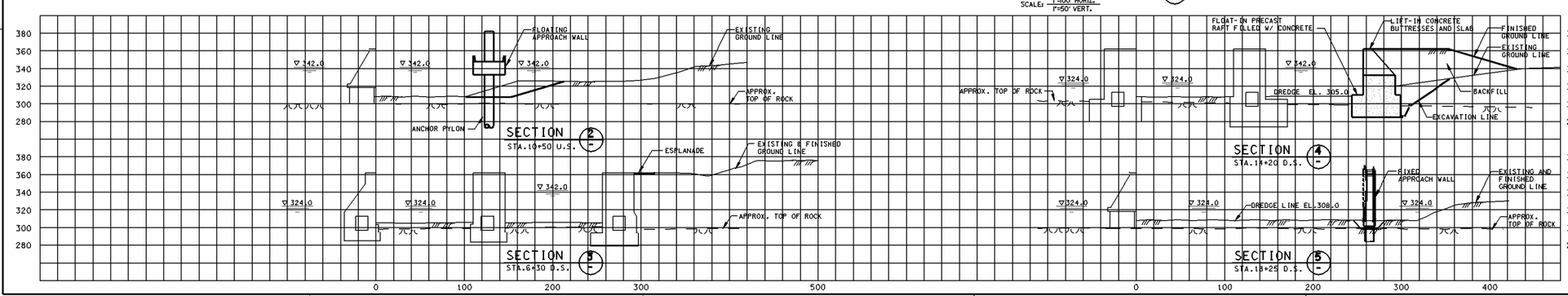
During future design phases, a flood plain analysis may be required in order to evaluate the effect of the disposal mound (formed from material excavated for the 600' lock extension) on the water surface elevations during flood events. The geometry of the proposed disposal mound is shown in ***Drawings 8.3A*** and ***8.3B***.





NEW LAND-WALL ELEVATION (1)

SCALE: 1"=100' HORIZ. 1"=50' VERT.



Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US army Corps of Engineers

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

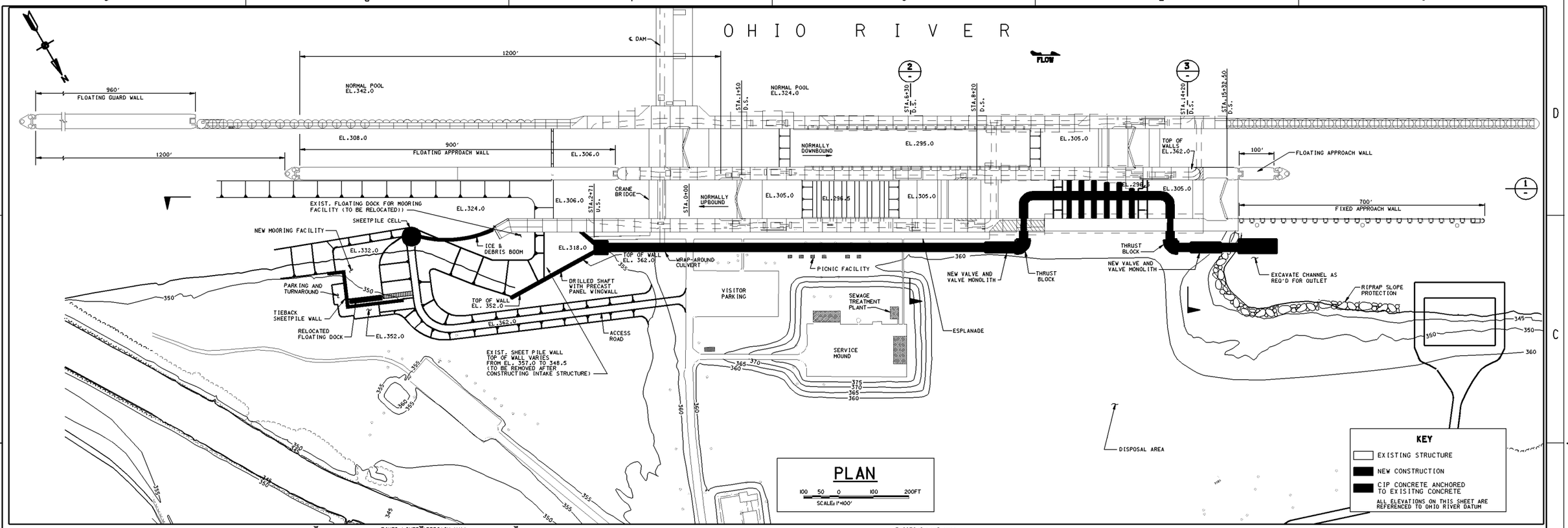
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

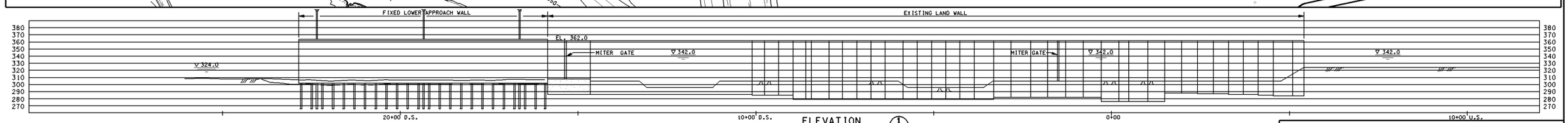
600' LOCK EXTENSION PLAN 1

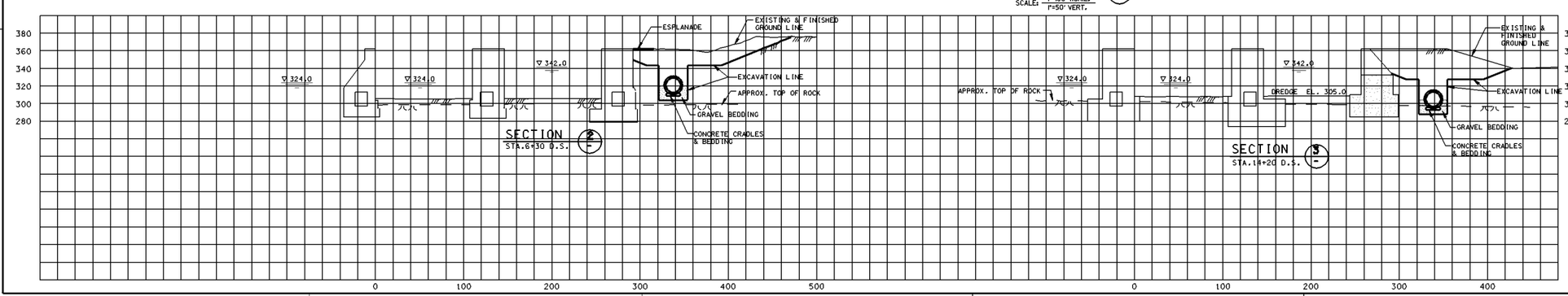
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 1 of _____

DRAWING 1.3A

$FILE$
$DATE$
$TIME$







Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US Army Corps of Engineers

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

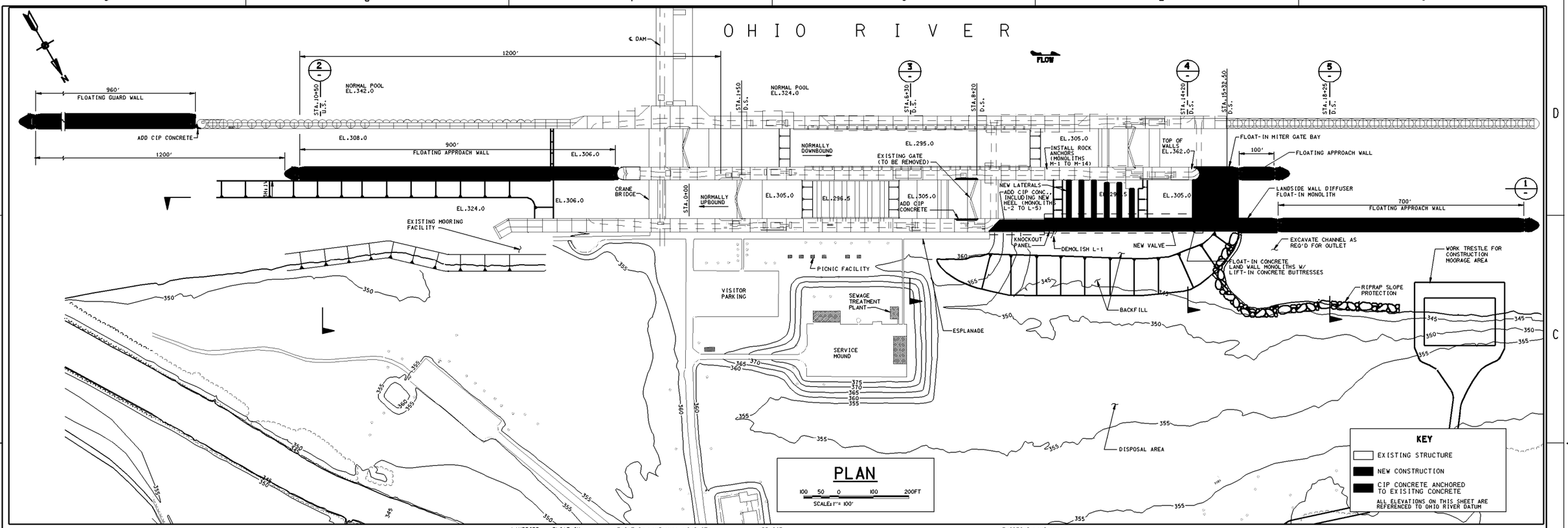
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

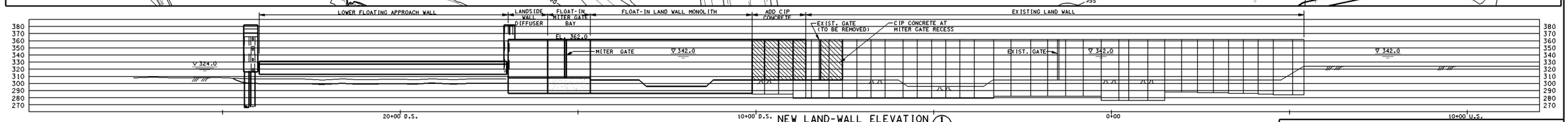
600' LOCK EXTENSION PHASE 2 OF PLAN 1 PLAN 1A

Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 2 of ____

DRAWING 1.3B

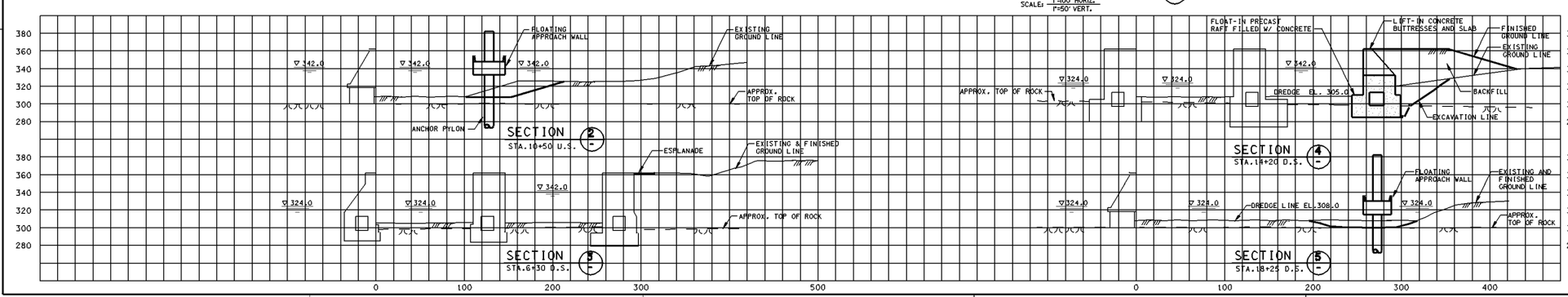
$FILE$
$DATE$
$TIME$





NEW LAND-WALL ELEVATION 1

SCALE: 1"=100' HORIZ. 1"=50' VERT.



Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

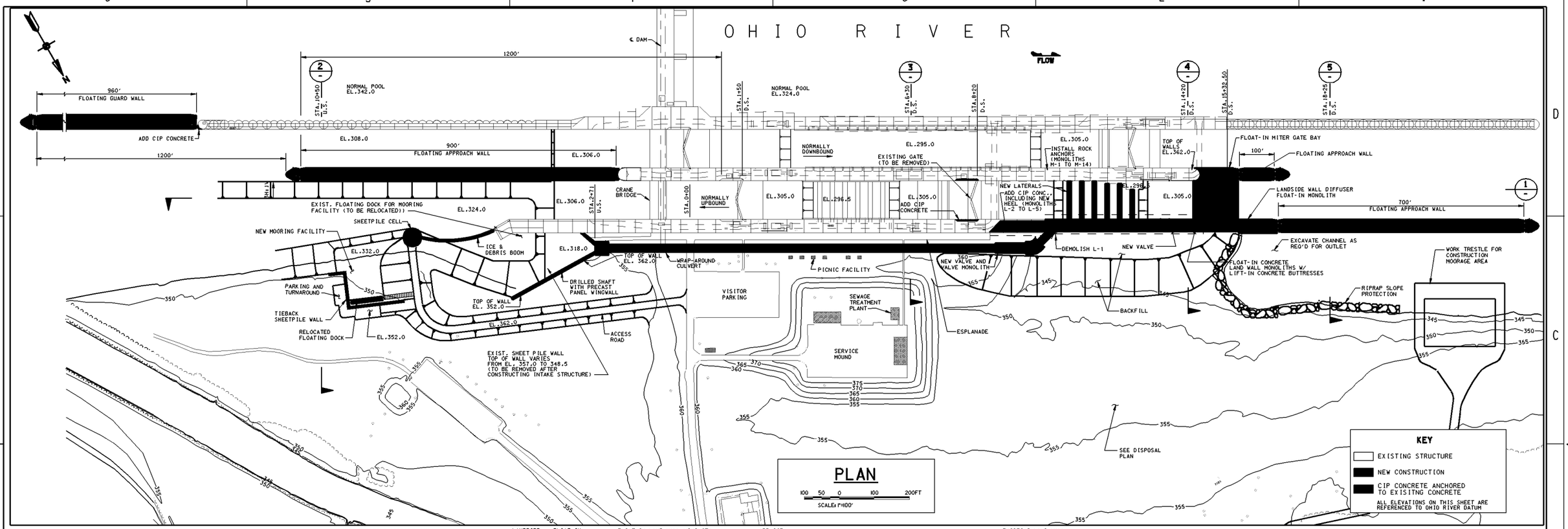
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

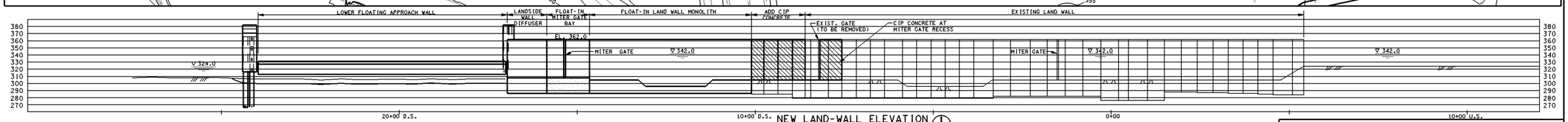
600' LOCK EXTENSION WITH MODIFICATIONS PLAN 2

Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 3 of

DRAWING 1.3C

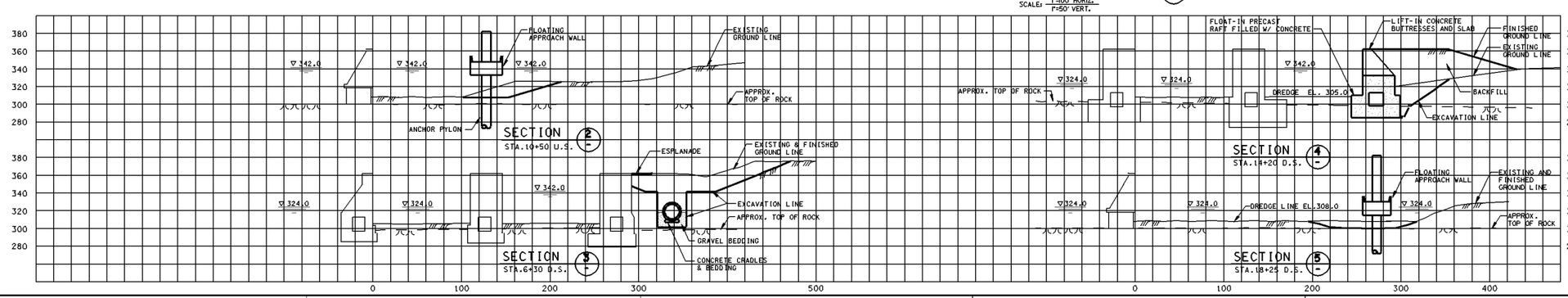
$FILE$
$DATE$
$TIME$





NEW LAND-WALL ELEVATION (1)

SCALE: 1"=100' HORIZ. 1"=50' VERT.



Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

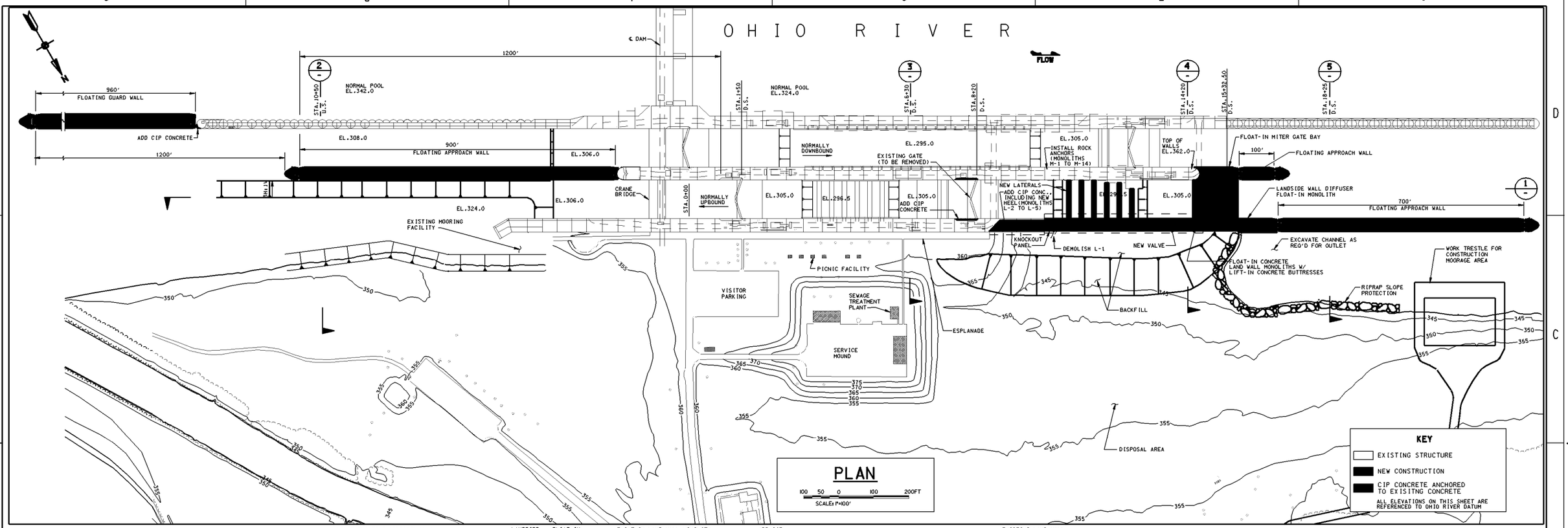
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

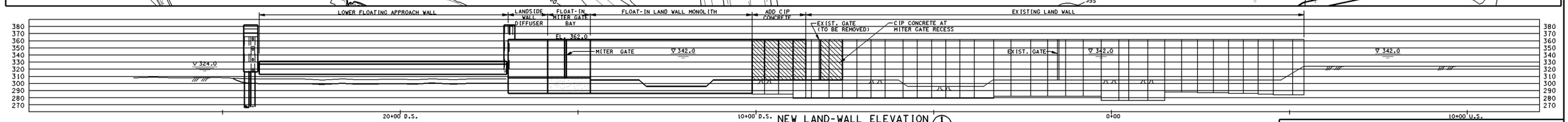
600' EXTENSION WITH CULVERTS PLAN 3

Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 4 of

DRAWING 1.3D

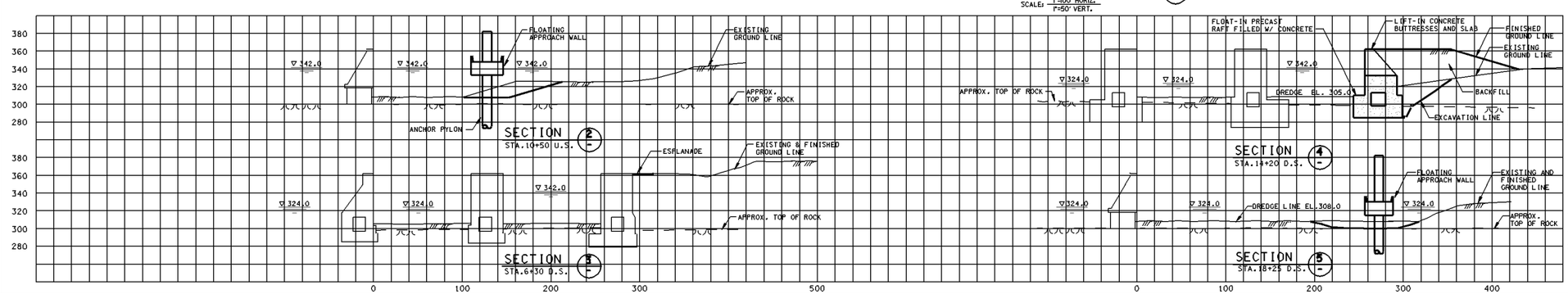
$FILE$
$DATE$
$TIME$





NEW LAND-WALL ELEVATION 1

SCALE: 1"=100' HORIZ. 1"=50' VERT.



Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

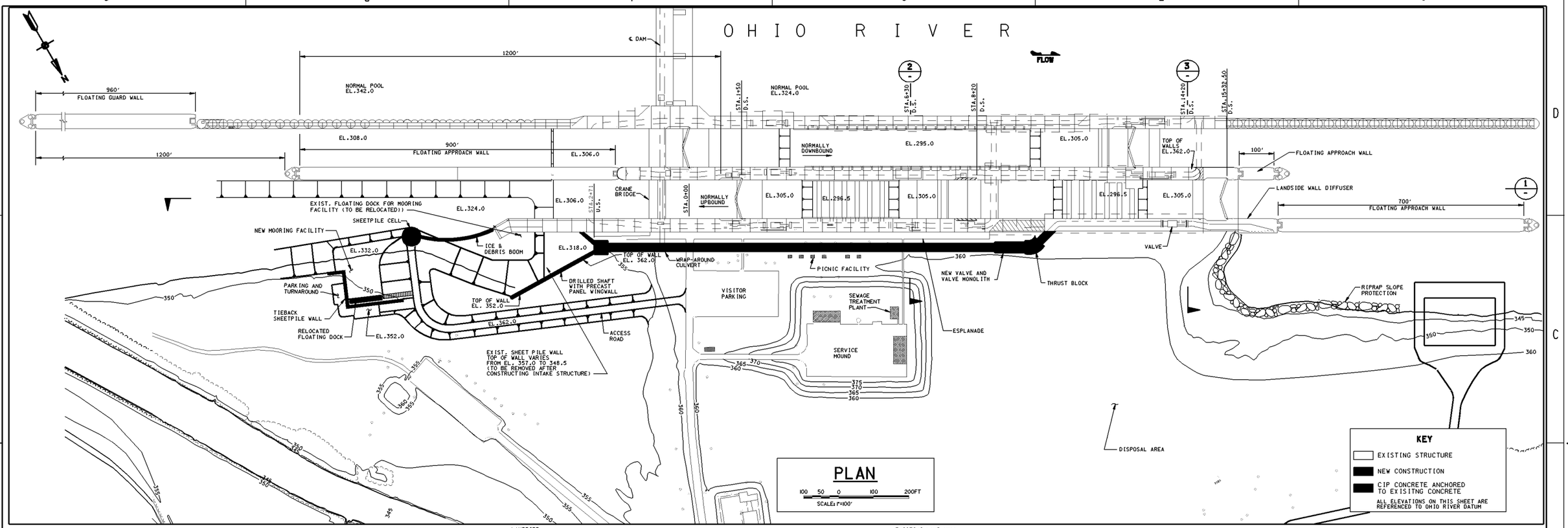
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

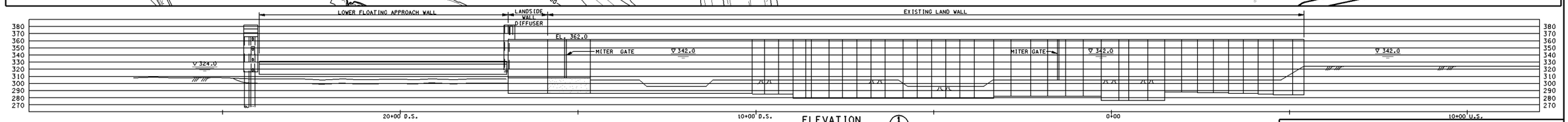
600' LOCK EXTENSION PHASED CONSTRUCTION PLAN 4 - PHASE 1

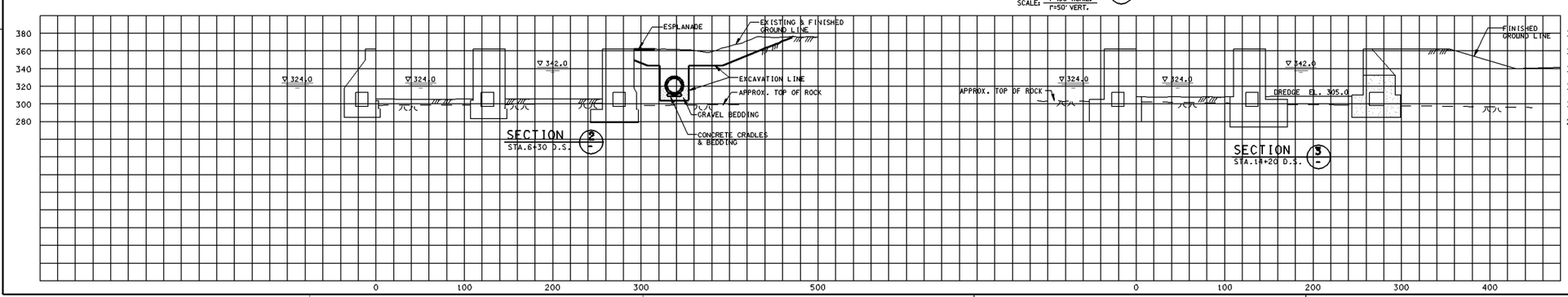
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 5 of

DRAWING 1.3E

$FILE$
$DATE$
$TIME$







Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US army Corps of Engineers

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

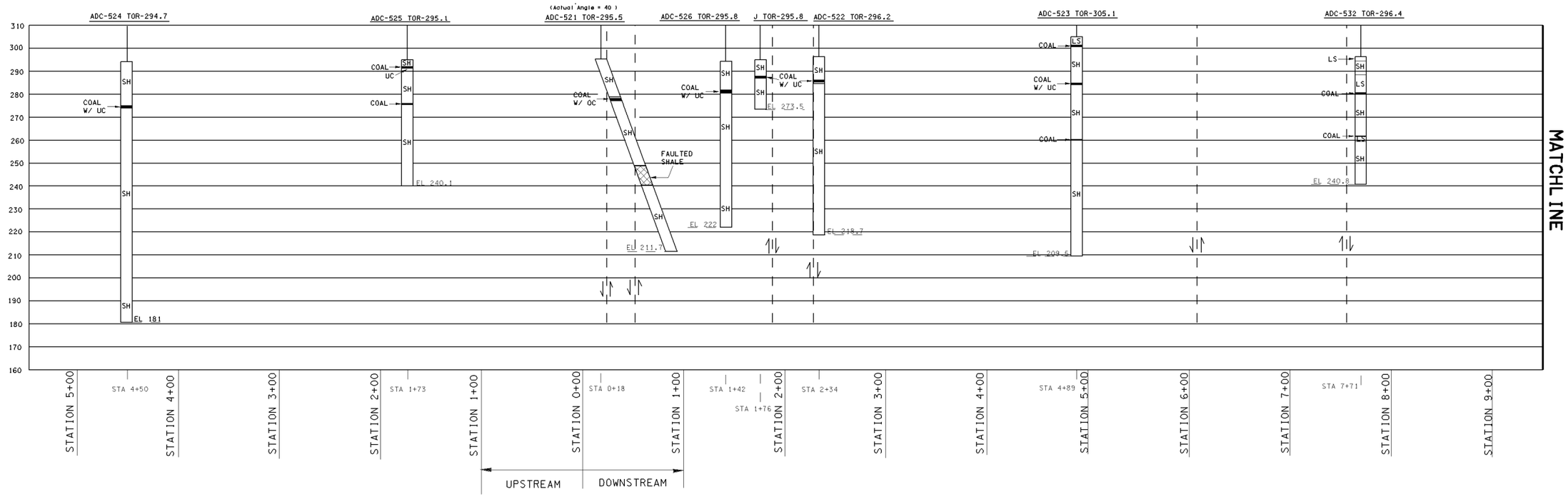
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

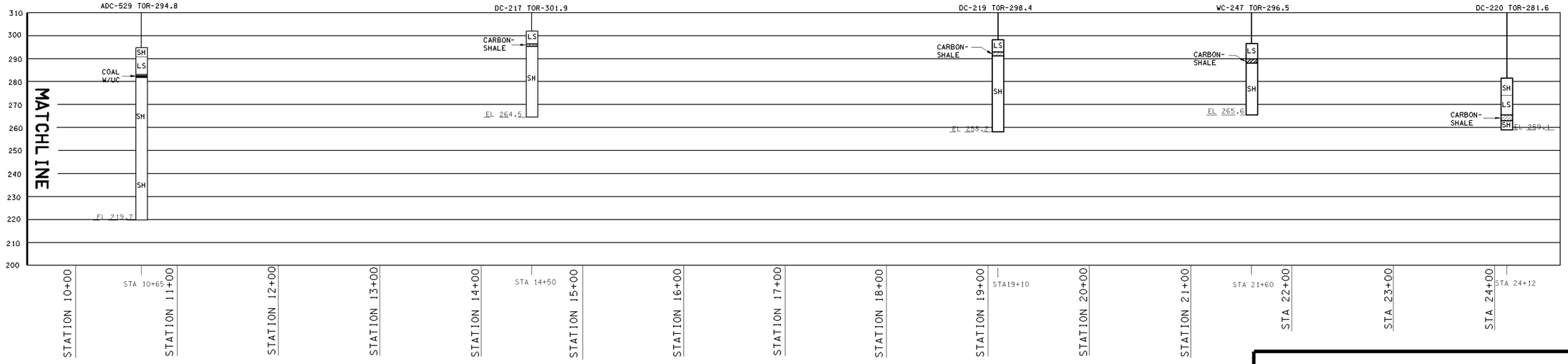
600' LOCK EXTENSION PHASED CONSTRUCTION PLAN 4 - PHASE 2

Scale: AS SHOWN
Sheet reference number:
Date: DECEMBER 1999
Drawing Code:
Sheet 6 of ____

DRAWING 1.3F

$FILE$
$DATE$
$TIME$





LEGEND:

FAULT — —

TOR = TOP OF ROCK

NOTE:

① ALL BORINGS WERE PROJECTED PERPENDICULAR TO LOCK STRUCTURE WITH THE EXCEPTION OF BORINGS J, ADC-521, ADC-522, AND ADC-526 WHICH WERE PROJECTED PARALLEL WITH GEOLOGIC STRUCTURE

② REPRESENTATIVE ANGLES OF FAULTS AT THIS EXAGGERATED SCALE ARE MISLEADING. ACTUAL ANGLES LIE BETWEEN 5 TO 10 DEGREES AWAY FROM THE NORMAL

HORIZONTAL:

50 25 0 50 100FT

SCALE:1.1"=50'

VERTICAL:

20 10 0 20 40FT

SCALE:1"= 20'

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

GEOLOGIC PROFILE

Designed by: KEH
Drawn by: JAL
Checked by: STH
Reviewed by:
Scale:
Date: 20-APR-99
Drawing Code:
Sheet reference number:
Sheet 7 of

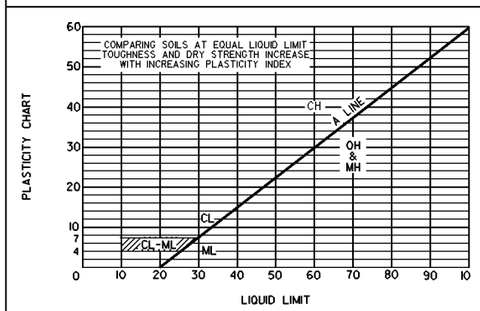
DRAWING 4.1A

$FILE$
$DATE$
$TIME$

UNIFIED SOIL CLASSIFICATION
(INCLUDING IDENTIFICATION AND DESCRIPTION)

MAJOR DIVISIONS (1)	(2)		GROUP SYMBOLS (3)	TYPICAL NAMES (4)	FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 INCHES AND BASING FRACTIONS ON ESTIMATED WEIGHTS) (5)			LABORATORY CLASSIFICATION CRITERIA (6)
COARSE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE.	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE. (FOR VISUAL CLASSIFICATION, THE 1/4 IN SIZE MAY BE USED AS EQUIVALENT TO THE NO.4 SIEVE SIZE)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OF NO FINES.	WIDE RANGE IN GRAIN SIZES AND SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES.			DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN-SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN NO. 200 SIEVE SIZE) COARSE-GRAINED SOILS ARE CLASSIFIED AS FOLLOWS: GW, GP, SW, SP, GM, GC, SM, SC. BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS. LESS THAN 5% MORE THAN 12% 5% TO 12%
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING.			$C_U = \frac{D_{60}}{D_{10}}$ GREATER THAN 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN ONE AND 3; NOT MEETING ALL GRADATION REQUIREMENTS FOR GW
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.	NONPLASTIC FINES OF FINES WITH LOW PLASTICITY (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			ATTERBERG LIMITS BELOW "A" LINE WITH PI LESS THAN 4; ATTERBERG LIMITS ABOVE "A" LINE WITH PI GREATER THAN 7; ABOVE "A" LINE WITH PI BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS.
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.	PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW).			
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE.	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	WIDE RANGE IN GRAIN SIZE AND SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES.			$C_U = \frac{D_{60}}{D_{10}}$ GREATER THAN 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN ONE AND 3; NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING.			
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES.	NONPLASTIC FINES OR FINES WITH PLASTICITY (FOR IDENTIFICATION PROCEDURES SEE ML BELOW).			ATTERBERG LIMITS BELOW "A" LINE WITH PI LESS THAN 4; ATTERBERG LIMITS ABOVE "A" LINE WITH PI GREATER THAN 7; LIMITS PLOTTING IN HTCHED ZONE WITH PI BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS.
			SC	CLAYEY SANDS, AND-CLAY MIXTURES.	PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW).			
FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE. (THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE.	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50				IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN NO. 40 SIEVE SIZE.	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PL)
			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.		NONE TO SLIGHT	QUICK TO SLOW	NONE
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.		MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.		SLIGHT TO MEDIUM	SLOW	SLIGHT
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.		SLIGHT TO MEDIUM	SLOW TO NONE	SLIGHT TO MEDIUM
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.		HIGH TO VERY HIGH	NONE	HIGH
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASITICITY, ORGANIC SILTS.		MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS.		READILY IDENTIFIED BY COLOR, ODOR, SPONGY FEEL AND FREQUENTLY BY FIBROUS TEXTURE.		

USE GRAIN-SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION.



PLASTICITY CHART

FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

GENERAL NOTES

1. REFUSAL IS DEFINED AS THE POINT BEYOND WHICH FURTHER PENETRATION WAS IMPRACTICAL WITH THE EXPLORATION METHOD USED. SEE "METHODS OF EXPLORATION" THIS SHEET INDICATING MEANS BY WHICH THE BORINGS WERE ADVANCED.
2. WATER ELEVATIONS INDICATED (▽) IN CORE (C), STANDARD PENETRATION (SPT), FISHTAIL (F), DENISON (U) AND WASH (W) BORINGS MAY HAVE BEEN INFLUENCED BY DRILLING OPERATIONS AND SHOULD NOT BE CONSTRUED AS INDICATING THE TRUE GROUND WATER LEVEL.
3. GROUND WATER LEVELS WILL VARY IN ACCORDANCE WITH RAINFALL AND STREAM STAGES, THEREFORE, ACTUAL LEVEL OF GROUND WATER ON ANY DATE OTHER THAN THAT SHOWN ON THE LOGS MUST BE DETERMINED BY SEPARATE OBSERVATIONS. THE OMISSION OF GROUND WATER ELEVATIONS SHALL NOT NECESSARILY BE CONSTRUED AS INDICATING THE ABSENCE OF GROUND WATER AT A PARTICULAR BORING LOCATION.
4. WHEREVER THE METHOD OF EXPLORATION PRECLUDED THE POSSIBILITY OF RECOVERING SAMPLES ABOVE ROCK, SUITABLE FOR EXAMINATION OR TESTS, THE MATERIAL IS DENOTED AS OVERBURDEN.
5. CLASSIFICATIONS AND PHYSICAL CHARACTERISTICS OF SOIL AND ROCK AS SHOWN ON THE LOGS WERE DETERMINED IN THE FIELD AND LATER SUPPLEMENTED BY ANALYSIS MADE BY THE DISTRICT GEOLOGIST AND THE LABORATORY TECHNICANS.
6. FIELD BOOKS, FIELD LOGS, LABORATORY LOGS (PRESENTING THE RESULTS OF LABORATORY TESTS FOR SHEAR, CONSOLIDATION, PERMEABILITY, ETC, WHEN PERFORMED) AND EDITED LOGS MAY BE VIEWED IN THE OFFICE OF THE DISTRICT ENGINEER. U.S. ARMY ENGINEER DISTRICT, LOUISVILLE, CORPS OF ENGINEERS, FEDERAL OFFICE BUILDING, LOUVILLE, KY..FAILURE OF THE CONTRACTOR TO AVAIL HIMSELF OF THE INFORMATION REPRESENTED BY THE BORING LOGS, INCLUDING LABORATORY TEST RESULTS, SHALL NOT BE GROUNDS FOR A CLAIM THAT THE GOVERNMENT WITHELD INFORMATION ON SUBSURFACE CONDITIONS.
7. THE TERM "LOST WATER" AS SHOWN ON THE LOGS INDICATES A QUANTITY OF DRILLING WATER LOST IN THE DRILL HOLE.
8. DRIVE SAMPLES WERE TAKEN WITH A 1 3/8" I.D.-2" O.D. X 2'-8" SPLIT SPOON SAMPLER USING A 140# HAMMER WITH A 30" DROP, UNLESS OTHERWISE INDICATED ON GRAPHIC LOGS.
9. CORE HOLES WERE COMPLETED BY AN NXM OR NQ WIRE LINE SIZE CORE BARREL WITH DIAMOND BIT, UNLESS OTHERWISE INDICATED ON THE GRAPHIC LOG.
10. WATER CONTENT (WC) AS SHOWN ON GRAPHIC LOG REPRESENTS THE MOISTURE CONTENT OF MATERIAL ON DATE MADE.
11. "X-RAY DIFFRACTION ANALYSIS" PERFORMED ON SAMPLES DENOTED BY DOUBLE ASTERISK.
12. TOP OF GROUND SHOWN ON THE GRAPHIC LOGS IS THE ELEVATION AT THE TIME OF DRILLING. THE ELEVATION MAY HAVE CHANGED SINCE THAT TIME.
13. OPTIMUM MOISTURE WAS OBTAINED BY STANDARD PROCTOR OR CE 55 COMPACTION TESTS IN ACCORDANCE WITH EM 1110-2-1906, APP. VI OR MIL. STD. 621A METHOD 100; RESPECTIVELY, AS NOTED ON BORING LOG.
14. THE LETTER DESIGNATION USED BEFORE BORING NUMBER INDICATES THE METHOD OF EXPLORATION FOR EXAMPLE: DC=DRIVE SAMPLER AND CORE BORING.

    DC-10 / 7-26-56 =BORING NO. & DATE MADE
15. GENERAL NOTES 5 AND 6 MAY NOT BE APPLICABLE WHEN EXPLORATION AND TESTING IS PERFORMED BY OTHERS.

WEATHERING

SEVERE WEATHERING - LOSS OF ROCK COHERANCE, MATERIAL CAN BE REMOVED BY HAND TOOLS. RETAINES SOME EVIDENCE OF ROCK STRUCTURE

MODERATE WEATHERING - MATERIAL MAY BE OXIDIZED BUT MOST PHYSICAL CHARACTERISTIC REMAIN. OCCASIONAL BLOCKS MAY BE REMOVED WITH HAND TOOLS.

SLIGHT WEATHERING - MATERIAL GENERALLY FRESH, WITH VARIOUS DEGREES OF WEATHERING ALONG JOINTS AND BEDDING.

TERMS FOR HARDNESS OF BEDROCK

VERY SOFT OR PLASTIC- CAN BE INDENTED EASILY WITH THUMB.

SOFT- CAN BE SCRATCHED WITH FINGERNAIL.

MODERATELY HARD- CAN BE SCRATCHED EASILY WITH KNIFE; CANNOT BE SCRATCHED WITH FINGERNAIL.

HARD- DIFFICULT TO SCRATCH WITH KNIFE.

VERY HARD- CANNOT BE SCRATCHED WITH KNIFE.

TERMS FOR THICKNESS OF ROCK BEDDING

PARTING	< 0.02'
BAND	0.02'-0.2'
THIN BED	0.2'-0.5'
MEDIUM BED	0.5'-1.0'
THICK BED	1.0'-3.0'
MASSIVE	> 3.0'

CORRELATION OF PENETRATION RESISTANCE (ASTM D 1586) WITH RELATIVE DENSITY AND CONSISTENCY

	PENETRATION RESISTANCE, N Blows per foot	RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Med Dense
	31 - 50	Dense
	Over 50	Very Dense

	PENETRATION RESISTANCE, N Blows per foot	
SILTS AND CLAYS	0 - 2	Very Soft
	3 - 4	Soft
	5 - 8	Med Stiff
	9 - 15	Stiff
	16 - 30	Very Stiff
	31+	Hard

LEGEND

F = FILL
T = TOP SOIL
OB = OVERBURDEN (SEE GENERAL NOTE 4)
SS = SANDSTONE
SH = SHALE
SLS = SILTSTONE
LS = LIMESTONE
CO = COAL
UC = UNDERCLAY
IC = INDURATED CLAY
DOL = DOLOMITE
CON = CONGLOMERATE
QTZ = QUARTZ
ROD = ROCK QUALITY DESIGNATION
NOD = NODULES
GRAV = GRAVEL OR GRAVELLY
LT = LIGHT
DK = DARK
SL = SLIGHTLY
MOD = MODERATELY
MED = MEDIUM
TR = TRACE
HD = HARD
NUM = NUMEROUS
WOR = WEIGHT OF RODS
WOH = WEIGHT OF HAMMER
WT = WEIGHT
VIS = VISCOSITY (MARSH)

WP = WELL POINT
(W) = WEATHERED
W/ = WITH
GR = GRAIN
OCC = OCCASIONAL
BD = BEDDED OR BEDS
INTBD = INTERBEDDED
LAM = LAMINAE
XLYN = CRYSTALLINE
ARGIL = ARGILLACEOUS
V = VERY
BLK = BLACK
BR = BROWN
GRY = GRAY
BLU = BLUE
GRN = GREEN
YEL = YELLOW
OB/P = OPEN BEDDING PLANE
CAL = CALCAREOUS
CARBO = CARBONACEOUS
FREQ = FREQUENT
FOS = FOSSILIFEROUS
CMTD = CEMENTED
MOT = MOTTLED
FRAG = FRAGMENTS

DIAG = DIAGONAL
ALT = ALTERNATING
VERT = VERTICAL
HOR = HORIZONTAL
FRAC = FRACTURE
X-BD = CROSSBEDDING
SP = SHEAR PLANE
V/J = VERTICAL JOINT
JT = JOINT
SOL = SOLUTION
= CAVITY (OPEN OR FILLED)
MICA = MICACEOUS
STY = STYLOLITIC
B/P = BEDDING PLANE
F/W = FREE WATER
H/A = HIGH ANGLE
PIEZ = PIEZOMETER
BOH = BOTTOM OF HOLE
TOR = TOP OF ROCK
ST = STAIN, STAINED
ANG = ANGULAR
RND = ROUNDED
*R = X-RAY DIFFRACTION ANALYSIS (SEE GENERAL NOTE 11)

METHODS OF EXPLORATION

VEL = SEISMIC
S = SHELBY TUBE OR PISTON SAMPLER
HA = HAND AUGER
A = POWER AUGER
C = CORE BORING
D = DRIVE SAMPLER
F = FISHTAIL
U = UNDISTURBED DENSION
W = WASH BORING
T = TRENCH
TP = TEST PIT
R = ROCK BIT
P = PROBE ROD

SOIL DESCRIPTIVE TERMS

	SIZE
BOULDER	> 8 INCHES
COBBLE	3 INCHES TO 8 INCHES
COARSE GRAVEL	3/4 INCH TO 3 INCH
FINE GRAVEL	1/4 INCH TO 3/4 INCH
COARSE SAND	2 MM TO 1/4 INCH
MEDIUM SAND	0.4 MM TO 2 MM
FINE SAND	0.075 MM TO 0.4 MM
TRACE	1 TO 10%
OCCASIONAL	11 TO 35%
AND	36 TO 50%
LAMINAE	0 TO 10 MM
LENSE	10 MM TO 50 MM
BAND	50 MM TO 2.5 INCH
LAYER	2.5 INCH TO 6 INCH+

SAMPLE TYPE

DS = DRIVE SAMPLE (STANDARD PENETRATION TEST)
S = UNDISTURBED SHELBY TUBE
A = AUGER
F = FISHTAIL
U = UNDISTURBED DENISON
CU = UNDISTURBED CUBE
C = CORE
J = JAR
BX = BOX (CORE)

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

Designed by: S. DURRETT
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:

SOIL CLASSIFICATION

Scale:
Date:
Drawing Code:
Sheet reference number: 4.2A
Sheet 8 of

DRAWING 4.2A

#FILE#
#DATE#
#TIME#

BORING NO. AC-521

PROJECT John T. Myers LAD
DATE START: 12/01/98 COMPLETE: 12/02/98
LOCATION: N 539,580 E 1,352,613
DRILLING AGENCY FMSM Engineers
DRILLER: G. Thompson INSPECTOR: D.L. Black
DRILL TYPE: CME-45
DRILL METHOD: 3 1/4" HSA, NQ
THICKNESS OF OVERBURDEN: 86.2
DEPTH CORED INTO ROCK: 109.5
TOTAL DEPTH OF BORING: 195.7
DIR. OF BORING VERT. X INCLINED 40 DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 361.5'
DATUM FOR ELEV. Top of Land Lock Wall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
361.5	SURFACE COVER-									
360.7	Topsoil - Dk brown silty CLAY w/ roots, dry, SOFT	CL								
	Brown silty CLAY, mst, MED SOFT	CL			A					
334.7										

SHEET 1 OF 9 BORING NO. AC-521

BORING NO. AC-521

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	Gray silty CLAY, mst, MED SOFT to MED STIFF	CL			A					
304.0										
	Brown med to coarse SAND, wet, MED LOOSE	SP			A					

SHEET 2 OF 9 BORING NO. AC-521

BORING NO. AC-521

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
297.9	Brown coarse SAND & GRAVEL, wet, LOOSE Pea Gravel on top of Rock	SP GP			A					
295.5	Top of Rock									
	Limestone, Lt. Gray, xlyn, occ Foss, v Hd, med Bd, Lost 0.8' of core in Broken areas	LS		55%					Auger Refusal RUN# 1 86.8-89.9 CORED: 3.1 REC: 1.7 LOSS: 1.4 RQD(%): 22.6	
293.1	Loss 0.6 v. soft Loss 1.9 Shale, Gray, Thin Bd, v soft to med soft v. soft B/p B/p B/p B/p B/p soft soft soft B/p B/p B/p B/p B/p B/p B/p B/p B/p B/p B/p B/p B/p B/p soft B/p soft B/p v. soft, washed away, rod drop B/p B/p soft B/p Broken B/p organic shale, Dk Gray to Black	SH		63% 84% 92% 103% 99%	BOX 1 BOX 2			Lost Drill Water @ 89.5 RUN# 2 89.9-90.7 CORED: .8 REC: .5 LOSS: .3 RQD(%): .0 No Drill Water Return RUN# 3 90.7-100.7 CORED: 10.0 REC: 8.4 LOSS: 1.6 RQD(%): 58.0 100% Drill Water Return RUN# 4 100.7-107.3 CORED: 6.6 REC: 6.1 LOSS: .5 RQD(%): 65.2 100% Drill Water Return Rod drop 105.5' to 106.0' Blocked off RUN# 5 107.3-110.7 CORED: 3.4 REC: 3.5 LOSS: -.1 RQD(%): 35.3 100% Drill Water Return RUN# 6 110.7-120.7 CORED: 10.0 REC: 9.9 LOSS: .1 RQD(%): 62.0 100% Drill Water Return	
278.2										
277.5	Coal, Black, Thin Bd, Hd, Broken	CO								
	Shale, Gray, silty, Thin Bd, Mod Hd w/ Lt Gray Silt Lamina v/J strike 170° v/J strike 90° B/p soft soft, Broken mod. soft Broken Broken num B/p's, num Silt Lamina B/p B/p	SH								

SHEET 3 OF 9 BORING NO. AC-521

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

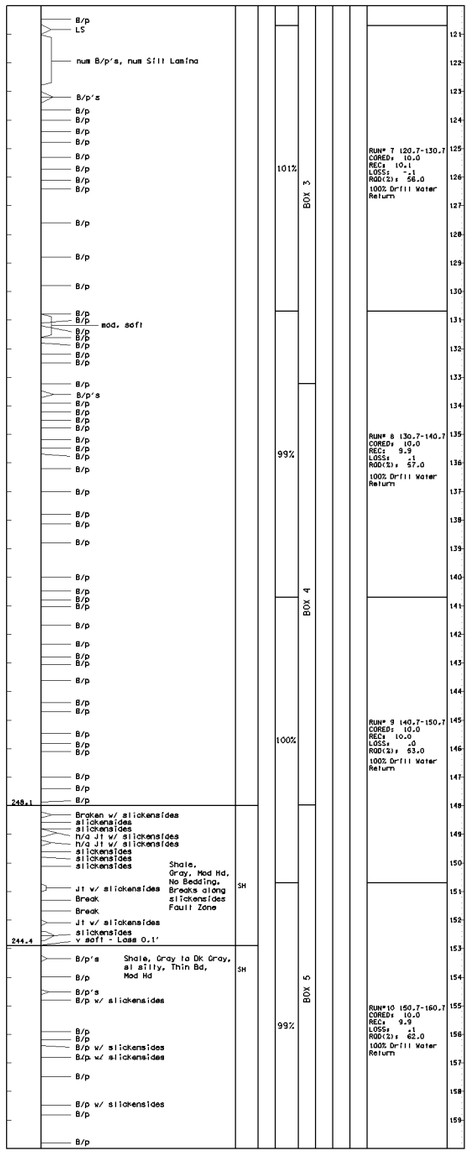
BORING LOGS AC-521

Scale:
Date:
Drawing Code:
Sheet reference number: 4.2B
Sheet 9 of

DRAWING 4.2B

#FILE#
#DATE#
#TIME#

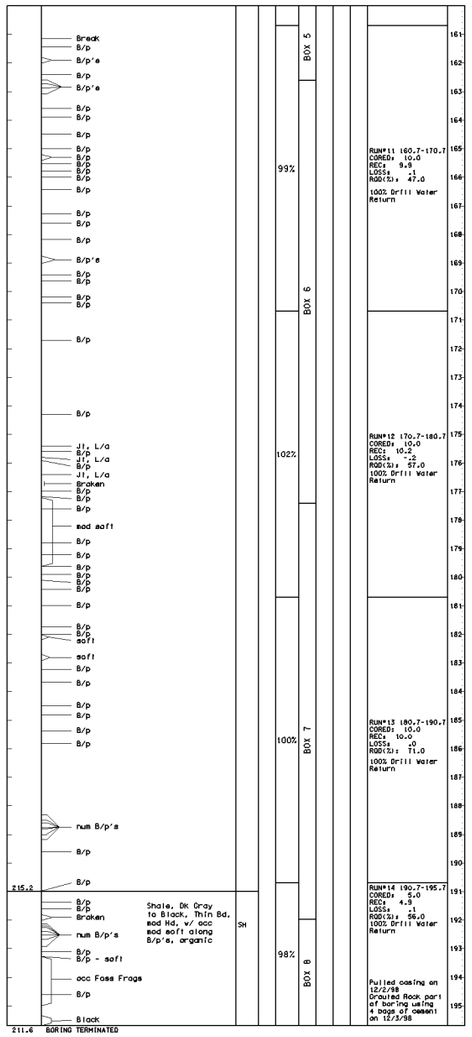
BORING NO. AC-521



SHEET 4 OF 5

BORING NO. AC-521

BORING NO. AC-521



SHEET 5 OF 5

BORING NO. AC-521

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS
AC-521

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale:
Date:
Drawing Code:
Sheet reference number: 4.2C
Sheet 10 of

DRAWING 4.2C

#FILE#
#DATE#
#TIME#

BORING NO. ADC-522

PROJECT J.T. Myers L&D
DATE START:11/03/98 COMPLETE:11/04/98
LOCATION: N 539,704 E 1,352,384
DRILLING AGENCY FMSM Engineers
DRILLER:D. Jessie INSPECTOR:D.L. Black
DRILL TYPE: CME-85
DRILL METHOD: 6"/HSA, SPT, PQ
THICKNESS OF OVERBURDEN: 66.0
DEPTH CORED INTO ROCK: 77.5
TOTAL DEPTH OF BORING: 143.5'
DIR. OF BORING X VERT. __INCLINED__ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 362.2'
DATUM FOR ELEVATION Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
362.2	SURFACE COVER-									
361.9	Blacktop									
361.4	Concrete									
360.8	Crushstone									
	Brown fine to med SAND, dry, DENSE to MED DENSE	SP	8 15 28	1.2	1	DS	12			
			18 6 9	1.2	2	DS	11			
			8 8 7	1.4	3	DS	10			
344.2	Brown fine to med SAND w/ tr of sm. gravel, mst, MED DENSE	SP	8 8 11	1.1	4	DS	12			
			11 11 7	1.5	5	DS	9			
			15 8 15	1.2	6	DS	10			
329.2	Brownish Gray sandy clayey SILT, mst, LOOSE	ML	3 3 6	1.0	7	DS	20			

SHEET 1 OF 4

BORING NO. ADC-522

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
320.2	Gray gravelly silty CLAY, mst, VERY STIFF	CL	8 20 20	1.0	8	DS	20			
			14 16 10	1.5	9	DS	14			
			10 7 6	1.5	10	DS	15			
			8 6 6	1.5	11	DS	16			
302.2	Brown fine SAND w/ tr of sm. gravel, wet, DENSE	SP	10 6 9	1.5	12	DS	15			
301.2					13	DS	12			
	Brown coarse GRAVEL, wet, DENSE	GP								
297.7	Brown coarse to large LS cobbles, wet	LS	50	0.5	14	DS	6			
296.2	Top of Rock								Auger Refusal	
	B/p's; B/p; B/p; B/p; B/p; B/p; B/p; Shale, Gray, Thin Bd, Med. Soft	Sh		40%	BOX 1				RUN# 1 67.5-69.5 CORED: 2.0 REC: .8 LOSS: 1.2 RQD(%): 40.0	
				108%					RUN# 2 69.5-74.5 CORED: 5.0 REC: 5.4 LOSS: -.4 RQD(%): 75.0; 100% Drill Water Return	
286.5	Coal, Black, Hd	CO								
286.0	Shale, organic, DK Gray-Black, Med Hd	Sh								
285.6	B/p; B/p; B/p; B/p; Shale, Gray, w/ num silty sandy lamina, Lt Gray, Hd, Thin Bd.	Sh		100%	BOX 2				RUN# 3 74.5-79.5 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 58.0; 100% Drill Water Return	
282.7	B/p									

SHEET 2 OF 4

BORING NO. ADC-522

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	Shale, Gray, Thin Bd, Med Hd	Sh								
280.8										
	B/p; Siltstone w/ v/Jt.			100%	BOX 2				RUN# 4 79.5-84.5 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 58.0	
279.5	Shale, w/ occ Silt lamina & lenses, Hd, Gray, Thin Bd; Shale, Dk Gray w/ num silt lamina, Lt Gray, Hd., Thin Bd silt lamina	Sh								
	B/p; 30° Jt; B/p; B/p	Sh		100%	BOX 3				RUN# 5 84.5-89.5 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 32.0	
273.9	B/p; Shale, Gray, silty, Thin Bd, Med Hd, w/ occ thin Lt Gray silt lamina									
	B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; v/J; Broken			104%	BOX 4				RUN# 6 89.5-94.5 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 46.0	
	B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; 45° Jt			94%	BOX 5				RUN# 7 94.5-99.5 CORED: 5.0 REC: 4.7 LOSS: .3 RQD(%): 62.0	
	B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; B/p; Broken; B/p; 45° Jt; B/p; B/p; B/p; 45° Jt; B/p; B/p; 45° Jt; 45° Jt; B/p			106%	BOX 6				RUN# 8 99.5-104.5 CORED: 5.0 REC: 5.3 LOSS: -.3 RQD(%): 16.0	
				94%	BOX 7				RUN# 9 104.5-109.5 CORED: 5.0 REC: 4.7 LOSS: .3 RQD(%): 60.0	
				106%	BOX 8				RUN#10 109.5-114.5 CORED: 5.0 REC: 5.3 LOSS: -.3 RQD(%): 44.0	
				96%					RUN#11 114.5-119.5 CORED: 5.0 REC: 4.8 LOSS: .2 RQD(%): 32.0	

SHEET 3 OF 4

BORING NO. ADC-522

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	B/p; B/p; B/p; B/p			104%	BOX 8				RUN#12 119.5-124.5 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 90.0; 100% Drill Water Return	
	30° Jt; B/p; B/p; 30° Jt			100%	BOX 9				RUN#13 124.5-129.5 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 58.0; 100% Drill Water Return	
				100%	BOX 10				RUN#14 129.5-134.5 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 42.0; 100% Drill Water Return	
				76%					RUN#15 134.5-139.5 CORED: 5.0 REC: 3.8 LOSS: 1.2 RQD(%): 88.0; 100% Drill Water Return	
				130%	BOX 11				RUN#16 139.5-143.5 CORED: 4.0 REC: 5.2 LOSS: -1.2 RQD(%): 90.0; 100% Drill Water Return	
218.7	BORING TERMINATED									

SHEET 4 OF 4

BORING NO. ADC-522

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS
ADC-522

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2D
Sheet 11 of ____

DRAWING 4.2D

$FILE$
$DATE$
$TIME$

BORING NO. ADC-523

PROJECT J.T. Myers L&D
DATE START:11/03/98 COMPLETE:11/06/98
LOCATION: N 539,849 E 1,352,150
DRILLING AGENCY FMSM Engineers
DRILLER:D. Jessie INSPECTOR:D.L. Black
DRILL TYPE: CME-75/CME-85
DRILL METHOD: Auger, PQ Core, SPT
THICKNESS OF OVERBURDEN: 57.0
DEPTH CORED INTO ROCK: 95.6
TOTAL DEPTH OF BORING: 152.6'
DIR. OF BORING X VERT. __INCLINED__ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 362.1'
DATUM FOR EL. Top of Land Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
362.1	SURFACE COVER-									
353.9	Gray silty SAND, damp, DENSE	SM	8 20 31	1.5	1	DS	9			
348.9			7 8 16	1.5	2	DS	8			
343.9	Gray silty SAND, damp, MED DENSE	SM	7 7 7	1.5	3	DS	8			
338.9	Gray clayey silty SAND w/ subangular rock frags up to 1/2", damp, LOOSE	SM SC	6 2 5	1.5	4	DS	11			
333.9	Brown clayey silty SAND, damp, DENSE	SM SC	7 6 7	1.5	5	DS	9			
328.9	Brown silty SAND, damp, DENSE	SM	8 14 22	1.5	6	DS	11			
323.9	Gray silty CLAY, damp, pl, STIFF	CL	5 6 7	1.5	7	DS	17			
322.1										

SHEET 1 OF 4

BORING NO. ADC-523

BORING NO. ADC-523

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	Gray silty CLAY, damp, pl, VERY STIFF	CL	11 10 10	1.5	8	DS	13			
318.9						A				
	Gray/brown silty CLAY w/ occ rock frags & pebbles up to ½", pl, VERY STIFF	CL	17 10 10	1.5	9	DS	19			
313.9						A				
	Gray silty CLAY, damp, pl, STIFF	CL	7 6 6	1.5	10	DS	18			
308.9						A				
	Gray silty CLAY, damp, pl, HARD	CL	32 24 17	1.5	11	DS	14			
305.1	TOP of ROCK		50	0.1	12	DS	0.3			
						A			Auger Refusal	
301.5	Limestone, Lt Gray, xlyn, occ Foss, med Bd, v. Hd	LS		100%					RUN# 1 58.1-60.9 CORED: 2.8 REC: 2.8 LOSS: .0 RQD(%): .0	
301.2	Shale, DK Gray, soft, Thin Bd	SH								
300.7	Black COAL	CO								
	Shale, Gray w/ organics along B/p's, med soft, Thin Bd, w/ occ Lt Gray silt lenses	SH		100%				BOX 1	RUN# 2 60.9-64.4 CORED: 3.5 REC: 3.5 LOSS: .0 Lost Water Return @ 64.4' RQD(%): 22.9	
				104%				BOX 2	RUN# 3 64.4-69.4 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 42.0 No Drill Water Return	
				102%				BOX 3	RUN# 4 69.4-74.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 36.0 No Drill Water Return	
	v. soft			88%					RUN# 5 74.4-79.4 CORED: 5.0 REC: 4.4 LOSS: .6 RQD(%): 20.0 No Drill Water Return	
284.9	DK Gray organic Sh									
284.7	COAL, Black	CO								
284.2	Under Clay, Gray, w/ organics, med soft, Thin Bd	UC								
	Shale, calc., Lt gray, v. Hd, Thin Bd, w/ Foss frags	SH								
282.4										

SHEET 2 OF 4

BORING NO. ADC-523

BORING NO. ADC-523

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	Broken									
	B/p	SH		88%				BOX 4	RUN# 6 79.4-84.4 CORED: 5.0 REC: 4.4 LOSS: .6 RQD(%): 30.0 No Drill Water Return	
	B/p									
	Soft									
	v. Silty, Hd			120%					RUN# 7 84.4-89.4 CORED: 5.0 REC: 6.0 LOSS: -1.0 RQD(%): 80.0 No Drill Water Return	
	DK Gray organic									
	B/p							BOX 5	RUN# 8 89.4-94.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 78.0 50% Drill Water Return	
	B/p			100%						
	Siderite nodual									
	B/p								RUN# 9 94.4-99.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 84.0 No Drill Water Return	
	Siderite nodual			100%				BOX 6		
									RUN#10 99.4-104.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 28.0 No Drill Water Return	
260.5										
260.0	Coal, Black, Hd, Broken	CO		102%						
	Shale, Gray, Thin Bd, mod Hd, w/ occ Lt Gray silt lamina	SH						BOX 7	RUN#11 104.4-109.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): .0 No Drill Water Return	
				102%						
	B/p									
	B/p							BOX 8	RUN#12 109.4-114.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): .0 No Drill Water Return	
				102%						
								BOX 9	RUN#13 114.4-119.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 38.0 No Drill Water Return	
				102%						

SHEET 3 OF 4

BORING NO. ADC-523

BORING NO. ADC-523

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
				98%				BOX 9	RUN#14 119.4-124.4 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 82.0 No Drill Water Return	
				102%				BOX 10	RUN#15 124.4-129.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 72.0 No Drill Water Return	
				100%				BOX 11	RUN#16 129.4-134.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 34.0 No Drill Water Return	
				100%					RUN#17 134.4-139.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 62.0 No Drill Water Return	
				100%				BOX 12	RUN#18 139.4-144.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 56.0 No Drill Water Return	
	L/a J1									
				102%				BOX 13	RUN#19 144.4-149.4 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 94.0 No Drill Water Return	
				100%					RUN#20 149.4-152.6 CORED: 3.2 REC: 3.2 LOSS: .0 RQD(%): 96.8 No Drill Water Return	
209.5	BORING TERMINATED									

SHEET 4 OF 4

BORING NO. ADC-523

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS
ADC-523

Scale:
Date:
Drawing Code:
Sheet reference number: 4.2E
Sheet 12 of ____

DRAWING 4.2E

$FILE$
$DATE$
$TIME$

BORING NO. ADC-524

PROJECT John T. Myers Lock & Dam
DATE START: 11/23/98 COMPLETE:
LOCATION: N 539,434 E 1,353,049
DRILLING AGENCY FMSM Engineers
DRILLER: G. Hopkins INSPECTOR: B. Brosi
DRILL TYPE: CME-85
DRILL METHOD: 6.25 HSA, SPT (2"), PQ
THICKNESS OF OVERBURDEN: 53.1
DEPTH CORED INTO ROCK: 75.7
TOTAL DEPTH OF BORING: 129.7
DIR. OF BORING X VERT. ___INCLINED ___ DEG

INSTRUMENT INSTALLED PIEZOMETER
SURFACE ELEVATION: 347.8'
DATUM FOR ELEVATION TOP OF LOCK WALL

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER/FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
347.8	SURFACE COVER-									
347.2	TOPSOIL									
	SAND with Clay, Brown, moist, Stiff, med. grained	SM	2 5 8	1.5	1	DS	13			
340.6	CLAY w/ Silt, Brown w/ Gray mottling, dry, stiff	CL				A				
338.3	Sand lenses, Brown, moist, Med. Grained	SP	2 3 4	1.5	2	DS	23			
337.8	Clay w/ Silt, Brown w/ Gray mottling, dry, Stiff	CL								
335.6	Sandy Clay, Brown, slightly moist, Gray mottling Fine Sand	CL				A				
333.3	Gray thickly laminated SHALE & silt in minor amounts, dry	SH	3 18 7	1.5	3	DS	18			
330.6	Gray well sorted CLAY, moist, plastic, VERY SOFT	CL				A			140 lb. Automatic Hammer	
327.8	Gray CLAY, moist, plastic, VERY SOFT	CL	1 0 1	1.5	4	DS	29			
325.6	Gray CLAY, plastic, moist, SOFT	CL				A				
320.6	Gray CLAY, SOFT, plastic, moist	CL	1 1 2	1.5	5	DS	33			
318.3	Organic matter - Wood, Black, SOFT	CL				A				
318.1	Pebbly Sand, coarse-grained, wet, Lt Gray, LOOSE	SP	4 5 5	1.5	6	DS	30			
315.6	Pebbly Sand, coarse sand, wet, Lt Gray, Stiff, dispersed organic matter(plant)	SP				A				
310.6	Clayey Sand, Dk Gray, wet, poorly sorted, STIFF	SM	2 7 10	1.5	7	DS	12			
307.8			6 9	1.5	8	DS	12			

19.5 Water Table

SHEET 1 OF 4

BORING NO. ADC-524

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER/FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
307.3	Clayey Sand, Dk Brown, wet, poorly sorted, STIFF	SM	7							
305.6						A				
	Pebbly Sand w/ cobbles & clay, Dk Gray, wet, chert abundant, MED DENSE	SP	9 10 9	1.5	9	DS	14			
300.6						A				
	Clayey Sand w/ pebbles, Dk Brown, poorly sorted, wet, MED DENSE	SP	6 5 13	1.5	10	DS	11			
294.7	TOP of ROCK									
	Gray SHALE, contains Silt, calcareous, SOFT	SH		100%					Auger Refusal 54.0 RUN# 1 54.0-55.7 CORED: 1.7 REC: 1.7 LOSS: .0 RQD(%): 65.0	
	B/p									
	B/p									
	B/p								RUN# 2 55.7-59.7 CORED: 4.0 REC: 4.1 LOSS: -.1 RQD(%): 95.0	
	B/p									
288.1										
287.8	LIMESTONE, Lt Gray, Foss, Hd	LS								
	SHALE, Gray, silty, calcareous, w/ siderite nodules, mod. Soft	SH		104%					RUN# 3 59.7-64.7 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 94.0	
	B/p									
	Sid. Nod									
	Siderite									
	B/p									
	Siderite									
	B/p			104%					RUN# 4 64.7-69.7 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 100.0	
	B/p								RUN# 5 69.7-74.7 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 98.0	
275.7										
275.6	Coal, Black, Bitumenous, Hd	CO		98%						
275.0	Under Clay, Gray, SOFT	SH								
	SHALE, Gray, Hd, silty, calcareous	SH								
	B/p									
	B/p								RUN# 6 74.7-79.7 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 88.0	
267.8	B/p			104%						

BOX 1 BOX 2 BOX 3 BOX 4

SHEET 2 OF 4

BORING NO. ADC-524

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER/FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	SHALE, Gray, Hd, silty, calcareous	SH		102%					RUN# 7 79.7-84.7 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 82.0	
	B/p									
	B/p									
	B/p			98%					RUN# 8 84.7-89.7 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 66.0	
	B/p									
	B/p			98%					RUN# 9 89.7-94.7 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 100.0	
	B/p									
	B/p			94%					RUN#10 94.7-99.7 CORED: 5.0 REC: 4.7 LOSS: .3 RQD(%): 100.0	
247.8										
	SHALE, Gray, Hd, calcareous	SH		102%					RUN#11 99.7-104.7 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 80.0	
				100%					RUN#12 104.7-109.7 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 100.0 (1 piece)	
				100%					RUN#13 109.7-114.7 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 88.0 (2 pieces)	
	B/p			102%					RUN#14 114.7-119.7 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 82.0	
227.8										

BOX 4 BOX 5 BOX 6 BOX 7 BOX 8 BOX 9

SHEET 3 OF 4

BORING NO. ADC-524

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER/FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	SHALE, Gray, Hd, calcareous	SH		96%					RUN#15 119.7-124.7 CORED: 5.0 REC: 4.8 LOSS: .2 RQD(%): 84.0	
				102%					RUN#16 124.7-129.7 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 96.0	
218.1	BORING TERMINATED									

BOX 10 BOX 11

SHEET 4 OF 4

BORING NO. ADC-524

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS
ADC-524

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2F
Sheet 13 of ____

DRAWING 4.2F

$FILE$
$DATE$
$TIME$

BORING NO. ADC-525

PROJECT John T. Myers L&D
DATE START:11/23/98 COMPLETE:11/25/98
LOCATION: N 539,542 E 1,352,854
DRILLING AGENCY FMSM Engineers
DRILLER:C.Thompson INSPECTOR:D.L. Black
DRILL TYPE: CME-75
DRILL METHOD: SPT, 5¼" HSA, PQ
THICKNESS OF OVERBURDEN: 55.1
DEPTH CORED INTO ROCK: 54.9
TOTAL DEPTH OF BORING: 110.0
DIR. OF BORING X VERT. INCLINED DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 350.2
DATUM FOR EL. Top of Land Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
350.2	SURFACE COVER-									
349.4	Topsoil : Dk brown silty CLAY w/ roots, dry, SOFT	TS								
	Brown clayey med SAND w/ tr of gravel, dry, MED DENSE	SC			A				SPT w/ CME Automatic hammer & AW rods	1 2 3 4
345.2			3 3 3	1.3	1	DS	17			5 6
	Gray gravelly sandy CLAY, mst, MED STIFF	CL								7
342.2					A					8 9
	Gray med SAND w/ tr of sm gravel, mst, MED DENSE	SP	4 3 3	1.5	2	DS	14			10 11 12
					A					13
336.2										14
	Gray silty CLAY w/ tr of sm gravel & tr of organics, mst, MED STIFF to SOFT	CL	3 3 4	1.5	3	DS	23			15 16 17
					A					18
			3 2 2	0.5	4	DS	28			19 20 21
327.2					A					22 23
	Brown, w/ tr of gray, v silty CLAY w/ tr of organics, mst, MED STIFF	CL	3 4 6	1.5	5	DS	27			24 25 26
322.2					A					27 28
	Gray clayey SILT w/ tr of organics, mst, SOFT	ML	2 2 3	1.5	6	DS	38			29 30 31
					A					32 33
			0 0 4	1.5	7	DS	42			34 35 36
312.2					A					37 38 39

SHEET 1 OF 3

BORING NO. ADC-525

BORING NO. ADC-525

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	Gray silty fine SAND, wet, LOOSE	SP	5 5 3	1.2	8	DS	22			41
										42 43
					A					
306.2										44
	Gray fine sandy SILT w/ occ lenses of clayey silt, wet, LOOSE	ML	2 3 3	1.5	9	DS	34			45 46
										47
					A					48
			2 3 3	1.5	10	DS	38			49 50
										51
										52
					A					53
297.2										
	Gray fine to med SAND, wet, LOOSE	SP								54
295.1	Top of Rock		50	0.5	11	DS	16		Auger Refusal	55
	v. Soft SHALE, Gray, sl silty, Thin Bd, Mod. Soft	SH								56
	B/p									57
292.4										
291.8	COAL, Black, mod. Hd, Thin Bd	CO								58
	UNDER CLAY, Dk Gray to Gray, Thin Bd, Soft	UC								59
	B/p									
290.0	v. Soft									60
	B/p, v. Soft	SH								61
	Siderite nodual									
	B/p									
	B/p									62
	B/p									
	B/p									
	B/p									
	B/p, v. Soft									63
	B/p w/ Siderite nodual									64
	B/p, v. Soft									65
	B/p									66
	B/p									67
	B/p									68
	B/p									69
	Siderite nodual									70
	B/p									71
276.2										
275.6	COAL, Black, Thin to mod. Bd, mod. Hd	CO								72
	B/p									73
	SHALE, Gray, Silty, mod. Hd, Thin Bd, w/ occ Lt gray Silt, lamina & lenses	SH								74
	B/p									75
	B/p									76
	B/p									77
	B/p									78
	B/p									79

Box 1: 100%; Box 2: 96%; Box 3: 102%; Box 4: 98%

RUN# 1 55.7-60.0 CORED: 4.3 REC: 4.3 LOSS: .0 RQD(%): 56.0 100% Drill Water Return

RUN# 2 60.0-65.0 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 52.0 100% Drill Water Return

RUN# 3 65.0-70.0 CORED: 5.0 REC: 4.8 LOSS: .2 RQD(%): 78.0 100% Drill Water Return

RUN# 4 70.0-75.0 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 64.0 100% Drill Water Return

RUN# 5 75.0-80.0 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 76.0 100% Drill Water Return

SHEET 2 OF 3

BORING NO. ADC-525

BORING NO. ADC-525

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	B/p									81
	B/p									82
	B/p									83
	B/p									84
	B/p - soft									
	B/p									
	B/p									
	B/p									
	B/p									85
	B/p									86
	B/p									87
	B/p									88
	B/p									89
	B/p									90
	B/p									91
	B/p									92
	B/p									93
	B/p									94
	B/p									95
	B/p									96
	B/p									97
	B/p									98
	B/p									99
	B/p									100
	B/p									101
	B/p									102
	B/p									103
	B/p									104
	B/p									105
	B/p									106
	B/p									107
	B/p									108
	B/p									109
240.2	BORING TERMINATED									

Box 4: 100%; Box 5: 102%; Box 6: 102%; Box 7: 96%; Box 8: 104%; 92%

RUN# 6 80.0-85.0 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 18.0 100% Drill Water Return

RUN# 7 85.0-90.0 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 68.0 100% Drill Water Return

RUN# 8 90.0-95.0 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 88.0 100% Drill Water Return

RUN# 9 95.0-100.0 CORED: 5.0 REC: 4.8 LOSS: .2 RQD(%): 88.0 100% Drill Water Return

RUN#10 100.0-105.0 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 100.0 100% Drill Water Return

RUN#11 105.0-110.0 CORED: 5.0 REC: 4.6 LOSS: .4 RQD(%): 64.0 100% Drill Water Return

Pulled Augers on 11/25/98 & 12/1/98

Grouted Rock portion of boring with 4 bags of

Pulled PQ casing on 11/25/98 and 12/01/98.

SHEET 3 OF 3

BORING NO. ADC-525

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS

ADC-525

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2G
Sheet 14 of

DRAWING 4.2G

$FILE$
$DATE$
$TIME$

BORING NO. ADC-526

PROJECT John T. Myers L&D
DATE START:12/03/98 COMPLETE:12/04/98
LOCATION: N 539,787 E 1,352,496
DRILLING AGENCY FMSM Engineers
DRILLER:G. Hopkins INSPECTOR:B. Brosi
DRILL TYPE: CME-85
DRILL METHOD: 6 1/4" HSA, SPT
THICKNESS OF OVERBURDEN: 66.3
DEPTH CORED INTO ROCK: 73.8
TOTAL DEPTH OF BORING: 140.1'
DIR. OF BORING X VERT. __INCLINED __ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 362.1'
DATUM FOR EL. Top of Land Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS (SPT using CME automatic hammer & AW rods.)	DEPTH SCALE (FT)
362.1	SURFACE COVER-									
361.3	BLACKTOP									
	Gray CLAY w/ gravel, dry, MED STIFF	CL	7 4 5	1.1	1	DS	16			
354.9	Gray CLAY w/ occ gravel, dry, STIFF	CL	6 5 6	1.5	2	DS	11			
349.9	Gray CLAY /w occ gravel, dry, MED STIFF	CL	6 5 5	1.5	3	DS	13		Black carbonaceous Shale	
344.9	Gray CLAY, dry, STIFF	CL	3 5 3	1.5	4	DS	8			
342.1	Gray CLAY, dry, MED STIFF	CL								
339.9	Brown silty CLAY w/ gray mottling, very slightly damp, plastic, MED STIFF	CL	1 4 5	1.5	5	DS	25			
334.9	Orange-Brown very fine SAND w/ silt & clay, well-sorted, very moist, very plastic, VERY LOOSE	SM	2 2 2	1.5	6	DS	28			
329.9	Gray very fine grained silty SAND, well-sorted, moist, very plastic, VERY LOOSE	SM	1 1 1	1.5	7	DS	28			
324.9			2 2	1.5	8	DS	32			
322.1										

SHEET 1 OF 4

BORING NO. ADC-526

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	Gray very fine silty SAND, moist, plastic, LOOSE	SM	3		A					
317.7	Lt brown coarse SAND, coarse-grained, wet, LOOSE	SP	2 2 5	1.5	9	DS	35 18			
314.9					A					
312.8	Gray fine SAND, moist, LOOSE	SP								
	Lt Brown coarse SAND, well-sorted, wet, LOOSE	SP	3 3 4	1.5	10	DS	35			
309.9					A					
	Lt Brown coarse SAND w/ small gravel, wet, MED DENSE	SP	11 7 8	1.5	11	DS	16			
304.9					A					
302.8										
302.2	Gray CLAY, dry, STIFF	CL	4 6 4	1.5	12	DS	20			
	Lt Brown gravelly SAND, wet, LOOSE	SP			A					
297.4	Gray silty SAND, very fine grained, well sorted, MED DENSE	SM	1 3 10	0.0	13	DS	15			
295.8	TOP of ROCK - 66.3				A					
293.0					A				Auger Refusal Begin Core 69.1 RUN# 1 69.1-70.1 CORED: 1.0 REC: .9 LOSS: .1 RQD(%): 100.0	
292.0	Shale, Gray, HARD	SH		90%						
291.1	Gray SHALE, plastic, SOFT	SH							RUN# 2 70.1-75.1 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 64.0	
	Gray SHALE, HARD	SH		98%	BOX 1					
	B/p 51° Fracture									
	B/p									
	B/p								RUN# 3 75.1-80.1 CORED: 5.0 REC: 5.3 LOSS: -.3 RQD(%): 90.0	
	23° Fracture oxidized Surface			106%	BOX 2					
282.9	Black COAL, bitumenous, fractured, HARD	CO								
282.3	Under Clay	UC								

SHEET 2 OF 4

BORING NO. ADC-526

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
282.0	SHALE, Gray, calcareous, Hd	SH								
	B/p B/p (Limestone Stringers - 75%)									
	B/p			100%	BOX 2				RUN# 4 80.1-85.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 80.0	
	B/p B/p B/p									
	B/p			106%	BOX 3				RUN# 5 85.1-90.1 CORED: 5.0 REC: 5.3 LOSS: -.3 RQD(%): 20.0	
	B/p									
272.0	SHALE, Gray, calcareous, Hd	SH								
	B/p (Limestone Stringers - 7%)									
	B/p			100%	BOX 4				RUN# 6 90.1-95.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 96.0	
	B/p									
	B/p B/p B/p			102%	BOX 5				RUN# 7 95.1-100.1 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 34.0 Convoluted bedding observed in run & throughout	
	B/p B/p B/p B/p									
262.0	SHALE, Gray, calcareous, Hd	SH								
	B/p (Limestone Stringers - 7%)			100%	BOX 6				RUN# 8 100.1-105.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 32.0	
	B/p B/p B/p B/p B/p B/p									
	B/p B/p B/p			100%	BOX 7				RUN# 9 105.1-110.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 82.0	
	B/p									
	B/p B/p			100%	BOX 8				RUN#10 110.1-115.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 82.0	
	B/p									
244.0	B/p B/p B/p			96%					RUN#11 115.1-120.1 CORED: 5.0 REC: 4.8 LOSS: .2 RQD(%): 88.0	
	SHALE, Gray, well-cemented, Hd	SH								

SHEET 3 OF 4

BORING NO. ADC-526

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
	SHALE, Gray, well-cemented, med Bd	SH								
	B/p			100%	BOX 8				RUN#12 120.1-125.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 90.0	
	B/p B/p									
	B/p B/p			108%	BOX 9				RUN#13 125.1-130.1 CORED: 5.0 REC: 5.4 LOSS: -.4 RQD(%): 90.0	
	B/p									
	B/p			98%					RUN#14 130.1-135.1 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 98.0	
	B/p									
	B/p			104%					RUN#15 135.1-140.1 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 100.0	
	B/p				BOX 11					
222.0	BORING TERMINATED									

SHEET 4 OF 4

BORING NO. ADC-526

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS
ADC-526

Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2H
Sheet 15 of ____

DRAWING 4.2H

#FILE#
#DATE#
#TIME#

BORING NO. ADC-527

PROJECT John T. Myers L&D
DATE START:12/03/98 COMPLETE:12/04/98
LOCATION: N 539,910 E 1,352,244
DRILLING AGENCY FMSM Engineers
DRILLER:C. Hoskins INSPECTOR:B. Brosi
DRILL TYPE: CME-85
DRILL METHOD: 6 1/4" HSA, SPT
THICKNESS OF OVERBURDEN: 56.1
DEPTH CORED INTO ROCK: 13.4
TOTAL DEPTH OF BORING: 69.5'
DIR. OF BORING X VERT. __INCLINED __ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 360.1'
DATUM FOR ELEVATION Top of Lock Wall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
360.1	SURFACE COVER-								6 1/4 Augers Automatic hammer 140 lbs.	
359.1	TOPSOIL, Dk Gray, Silty CLAY, moist, Soft, w/ roots	TS CL								1
357.9						A				2
	Gravel w/ cobbles, clay lenses 0.3', gray, wet, VERY LOOSE	GP	2 2 2	0.7	1	DS	18			3 4 5
352.9						A				6 7
	Gray clayey cobbly SAND, med grained, moist, MED DENSE	SP	7 6 10	1.5	2	DS	13			8 9 10
347.9						A				11 12
	LOST SAMPLE		3 2 5	0.0	3	DS				13 14 15
342.9						A				16 17
	Gray CLAY, contains wood fossil, 2 inch sand lense, dry to slightly moist, STIFF	CL	2 6 11	1.5	4	DS	15			18 19 20
337.9						A				21 22
	Gray weathered calcareous SHALE, laminations obsereved, slightly moist, STIFF Shale Boulder	SH	2 4 7	1.5	5	DS	12			23 24 25
332.9						A				26 27
	Gray CLAY, moist, slightly plastic, w/ water, VERY STIFF	CL	5 6 10	0.2	6	DS	56			28 29 30
327.9						A				31 32
	Gray sandy CLAY, moist, slightly plastic, coarse-grained sand, VERY STIFF	CL	5 11 8	1.5	7	DS	21			33 34 35
322.9						A				36 37
	Gray sandy lean CLAY, med grained w/ fine grained (Sand), moist, MED STIFF	CL	3 4	1.5	8	DS	26			38 39

SHEET 1 OF 2

BORING NO. ADC-527

BORING NO. ADC-527

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
			5							41
317.9						A				42
										43
	Same (w/ fine Sand only)		6							44
315.3	Lt brown coarse SAND w/ clay, wet, MED DENSE	SP	5 6	1.5	9	DS	32			45
312.9						A				46 47
	Lt brown coarse SAND w/ clay, well-sorted, wet, MED DENSE	SP	7 4 6	1.5	10	DS	16			48 49 50
307.9						A				51 52
	Lt brown coarse SAND w/ minor clay, well-sorted, wet, MED DENSE	SP	6 12 6	1.5	11	DS	20			53 54 55
304.0	TOP of ROCK					A			Auger Refusal RUN# 1 56.1-57.1 CORED: 1.0 REC: 1.1 LOSS: -.1 RQD(%): .0	56
302.5	B/p v/Jt B/p B/p B/p B/p LIMESTONE, Lt Gray, Foss, Hd, well-cemented	LS		110%	BOX 1					57
302.1	Dk gray to black carbonaceous SHALE, VERY SOFT	SH								
301.8	Black COAL,bituminous, frag, Hd	CO								
301.3	Gray UNDERCLAY, VERY SOFT	SH		54%					RUN# 2 57.1-60.6 CORED: 3.5 REC: 1.9 LOSS: 1.6 RQD(%): .0	58 59
	Gray SHALE, SOFT	SH								60
299.1										61
	SHALE, Gray, calcareous, Hd	SH		104%					RUN# 3 60.6-65.6 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): .0	62 63 64 65
	B/p B/p B/p B/p			100%	BOX 2				RUN# 4 65.6-69.5 CORED: 3.9 REC: 3.9 LOSS: .0 RQD(%): .0	66 67 68
290.6	BORING TERMINATED									69

SHEET 2 OF 2

BORING NO. ADC-527

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS
ADC-527

Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.21
Sheet 16 of ____

DRAWING 4.21

#FILE#
#DATE#
#TIME#

BORING NO. ADC-528

PROJECT John T. Myers L&D
DATE START:11/18/98 COMPLETE:11/20/98
LOCATION: N 540,072 E 1,352,006
DRILLING AGENCY FMSM Engineers
DRILLER:G.Thompson INSPECTOR:D.L. Black
DRILL TYPE: CME-75
DRILL METHOD: 6¼" HSA, SPT, PQ
THICKNESS OF OVERBURDEN: 59.5
DEPTH CORED INTO ROCK: 56.6
TOTAL DEPTH OF BORING: 116.1'
DIR. OF BORING X VERT. __INCLINED__ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 355.8'
DATUM FOR EL. Top of Land Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
355.8	SURFACE COVER-									
355.0	Topsoil: Dk brown sandy silty CLAY w/ roots, dry, SOFT	T								1
	Brown fine to med SAND w/ tr of sm gravel, dry, MED DENSE	SP	5 6 7	1.5	1	DS	8			2 3 4 5 6 7 8 9
346.8										
	Gray med SAND w/ tr of gravel, damp, MED DENSE	SP	3 5 7	1.5	2	DS	8			10 11 12
342.8										
	Gray clayey coarse SAND & sm GRAVEL, damp, MED DENSE, w/ occ med sand lenses	SP	3 4 8	1.5	3	DS	12			13 14 15 16 17 18 19 20 21 22 23 24
			3 5 8	1.5	4	DS	14			25
	Shale frag 1" Thick		5 8 14	1.5	5	DS	14		wet @ 27.5 +/-	26 27 28 29
326.8										
	Brown sandy clayey SILT, mst, LOOSE	ML	3 3 3	1.5	6	DS	28			30 31 32
322.8										
	Brown fine to med SAND w/ tr of gravel, wet, LOOSE	SP	5 3 3	1.2	7	DS	16			33 34 35 36 37 38 39
316.8										

SHEET 1 OF 3 BORING NO. ADC-528

BORING NO. ADC-528

	Gray w/ brown med SAND w/ tr of gravel, wet, MED DENSE	SP	5 8 9	1.5	8	DS	17		41 42 43 44
			17 12 13	1.5	9	DS	17		45 46 47 48
			16 17 10	1.5	10	DS	17		49 50 51 52
			16 10 9	1.5	11	DS	14		53 54 55 56 57 58 59
296.3	TOP of ROCK								
	B/p Shale, Gray, sl silty, Thin Bd, mod Hd w/ occ mod soft along B/p's	SH		100%				RUN# 1 60.1-61.1 CORED: 1.0 REC: 1.0 LOSS: .0 RQD(%): 100.0 100% Drill Water Return	60 61
	B/p			100%	BOX 1			RUN# 2 61.1-66.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 78.0 100% Drill Water Return	62 63 64
	B/p - soft B/p - v. soft			100%					65
290.8	Shaley & Foss B/p								
	Limestone, Lt Gray, xlyn, occ Foss, v. Hd, Thick Bd	LS		100%				RUN# 3 66.1-69.7 CORED: 3.6 REC: 3.6 LOSS: .0 RQD(%): 38.9 50% Drill Water Return Blocked off starting @ 67.5	66 67
	h/a Jt approx. 70° B/p B/p num h/a jts - Broken								68 69
	B/p			114%	BOX 2			RUN# 4 69.7-71.1 CORED: 1.4 REC: 1.6 LOSS: -.2 RQD(%): 100.0 50% Drill Water Return	70 71
	B/p								72
282.9									
282.0	COAL, Black, Bitumenous, med Bd, HARD	CO		98%				RUN# 5 71.1-76.1 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 54.0 Lost Drill Water 73.7'	73 74
281.5	Gray UNDERCLAY, Thin Bd, MED SOFT	UC							
	Shale, Gray, Silty, Thin Bd, Med Hd w/ occ mod soft along B/p's w/ occ Lt Gray Silt Lamina. Plant Foss @ B/p's								75
	B/p	SH						RUN# 6 76.1-81.1 CORED: 5.0 REC: 4.6 LOSS: .2 RQD(%): 46.0	76 77
	B/p soft B/p B/p B/p B/p B/p			96%	BOX 3			Drill water Return 0 to 25% "Comes & goes"	78 79

SHEET 2 OF 3 BORING NO. ADC-528

BORING NO. ADC-528

	B/p B/p				BOX 3	81
	B/p increasing silt lamina @ 82.3'					82
	B/p		106%		BOX 4	RUN# 7 81.1-86.1 CORED: 5.0 REC: 5.3 LOSS: -.3 RQD(%): 100.0 10% Drill Water Return 83 84
	B/p B/p					85
	B/p Ls nodual B/p					86 87
	B/p Ls nodual B/p		100%			RUN# 8 86.1-91.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 72.0 25% Drill Water Return 88 89
266.3						
	Shale, Dk Gray, silty, organic, Thin Bd, med Hd	SH				90
	num B/p Breaks - Loss 0.1' - soft					91
	B/p Black, organic, Sh					92
263.5						
263.2	Coal, Black, Hd, Broken	CO				
262.8	Under Clay, med Soft, Thin Bd, Lt Gray	UC				
	B/p Ls Frag Ls Frag Shale, Lt Gray to Gray, med Hd, Thin Bd, calc., silty	SH	98%		BOX 5	RUN# 9 91.1-96.1 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 46.0 25% Drill Water Return 93 94
	Ls Frag					95
	B/p					96 97
	mod soft mod soft B/p B/p Ls concretion		100%			RUN#10 96.1-101.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 76.0 25% Drill Water Return 98 99
	B/p				BOX 6	100
	B/p Siderite nodual		100%			RUN#11 101.1-106.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 100.0 25% Drill Water Return 103 104 105
	B/p num B/p's - soft along B/p's B/p - soft		98%		BOX 7	RUN#12 106.1-111.1 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 80.0 30% Drill Water Return 108 109 110
	B/p B/p Coal under Clay, v. soft B/p		98%		BOX 8	RUN#13 111.1-116.1 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 80.0 30% Drill Water Return 112 113 114
239.7	BORING TERMINATED B/p					115 116

SHEET 3 OF 3 BORING NO. ADC-528

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS

ADC-528

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2J
Sheet 17 of ____

DRAWING 4.2J

#FILE#
#DATE#
#TIME#

BORING NO. ADC-529

PROJECT John T. Myers L&D
DATE START:11/16/98 COMPLETE:11/17/98
LOCATION: N 540,213 E 1,351,810
DRILLING AGENCY FMSM Engineers
DRILLER:G.Thompson INSPECTOR:D.L. Black
DRILL TYPE: CME-75
DRILL METHOD: 6 1/4" HSA, SPT,
THICKNESS OF OVERBURDEN: 49.6
DEPTH CORED INTO ROCK: 75.1
TOTAL DEPTH OF BORING: 124.7
DIR. OF BORING X VERT. __INCLINED__ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 344.40
DATUM FOR ELEVATION Land Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER/FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
344.4	SURFACE COVER-									
343.8	Topsoil: Dk brown silty sandy CLAY, /w roots, dry, STIFF	T								
	Brown silty sandy CLAY, msl, STIFF	CL			A				SPT using CME automatic hammer & AW rods.	1 2 3 4
341.4										
	Brown med SAND, wet, LOOSE	SP	5 4 4	1.3	1	DS	18			5 6 7 8
336.4										
	Gray clayey coarse SAND & sm gravel, msl, MED DENSE	SP	5 7 4	0.8	2	DS	8			9 10 11 12
331.4										
	Brown clayey SILT w/ tr of sand & occ LS cobble, msl, STIFF	ML	3 4 10	0.7	3	DS	21			13 14 15 16 17 18
			3 4 6	0.7	4	DS	25			19 20 21
321.4										
	Brown silty CLAY, msl, MED STIFF	CL	1 3 4	1.5	5	DS	32			22 23 24 25 26
316.4										
	Brown med to coarse SAND w/ sm gravel, wet, LOOSE to MED DENSE	SP	3 4 2	1.5	6	DS	20			27 28 29 30 31 32
			5 9 13	1.5	7	DS	14		5' of heaved sand in augers	33 34 35 36 37 38 39

SHEET 1 OF 4

BORING NO. ADC-529

BORING NO. ADC-529

			6 7 8	1.5	8	DS	21			41 42 43
			6 6 4	1.5	9	DS	18			44 45 46
294.8	TOP of ROCK		16 50	0.9	10 11	DS DS	16 10		Auger Refusal 50.0	47 48 49
	B/p, B/p	SH Shale, Gray, Thin Bd, mod Hd		90%					RUN# 1 50.0-51.0 CORED: 1.0 REC: .9 LOSS: .1 RQD(%): .0 100% Drill Water Return	50 51
	B/p, B/p			98%	BOX 1				RUN# 2 51.0-56.0 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 56.0 100% Drill Water Return	52 53 54
290.6	Shaley, B/p, B/p	LS LIMESTONE, Gray, xyln, occ Foss. med to Thick Bd, v. Hd								55
	B/p			102%	BOX 2				RUN# 3 56.0-61.0 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 88.0 100% Drill Water Return	56 57 58 59
	B/p, B/p, B/p, B/p									60
283.0	Shaley			98%					RUN# 4 61.0-66.0 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 56.0 100% Drill Water Return	61 62 63 64
282.6	Shale, Dk Gray, organic, Thin Bd, mod Hd	SH								
282.1	Coal, Black, Hd	CO								
	B/p, B/p, B/p	Shale, Gray, sl silty, occ plant poss along B/p's, Thin Bd, mod Hd, w/ occ silt lamina	SH							65
	B/p, B/p			104%	BOX 3				RUN# 5 66.0-71.0 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 74.0 100% Drill Water Return	66 67 68 69
	B/p, B/p, B/p, B/p, B/p, B/p									70 71 72
	Ls			100%					RUN# 6 71.0-76.0 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 64.0 100% Drill Water Return	73 74 75
269.1	L/a Jt, L/a Jt, B/p	Shale, Gray, Highly Dist w/ Thin Bedded Sh Frags, mod soft to soft	SH							
	Break w/ Ls Frag, soft, L/a Jt, L/a Jt, Break w/ Ls Frags, Break w/ Ls Frag			104%	BOX 4				RUN# 7 76.0-81.0 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 18.0 100% Drill Water Return	76 77 78 79

SHEET 2 OF 4

BORING NO. ADC-529

BORING NO. ADC-529

	30°Jt w/ Slicken sides, 30°Jt w/ Slicken sides									81
263.1	L/a Jt	Shale, Gray, Mod Disturb shows some Bd, Thin Bd, mod Hd	SH							82
261.9	B/p, B/p	Shale, Gray, Thin Bd, mod Hd, sl silty	SH	100%	BOX 5				RUN# 8 81.0-86.0 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 60.0 100% Drill Water Return	83 84
	B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p			94%	BOX 6				RUN# 9 86.0-91.0 CORED: 5.0 REC: 4.7 LOSS: .3 RQD(%): 58.0 100% Drill Water Return	85 86 87 88 89 90
	B/p, B/p - Broken - soft, B/p - soft			104%	BOX 7				RUN#10 91.0-96.0 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 44.0 100% Drill Water Return	91 92 93 94
	B/p, V/J healed, B/p, L/a Jt (30°), L/a Jt, L/a Jt			102%					RUN#11 96.0-101.0 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 86.0 100% Drill Water Return	95 96 97 98 99
	Siderite nodual, B/p, Siderite nodual			98%	BOX 8				RUN#12 101.0-106.0 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 56.0 100% Drill Water Return	100 101 102 103 104
	30°Jt B/p, 30°Jt B/p									105
238.2	B/p, B/p	Shale, Dk Gray, sl organic, silty, w/ num Lt gray silt lamina, Hd, Thin Bd	SH	102%	BOX 9				RUN#13 106.0-111.0 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 82.0 100% Drill Water Return	106 107 108 109 110
	B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p			100%	BOX 10				RUN#14 111.0-116.0 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 94.0 100% Drill Water Return	111 112 113 114 115 116
	B/p			104%					RUN#15 116.0-121.0 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 92.0 100% Drill Water Return	117 118 119

SHEET 3 OF 4

BORING NO. ADC-529

BORING NO. ADC-529

	B/p, B/p, B/p, B/p			100%	BOX 11				RUN#16 121.0-124.7 CORED: 3.7 REC: 3.7 LOSS: .0 RQD(%): 81.0 100% Drill Water Return Grouted on 11/18/98 using 5 bags of cement	121 122 123 124
219.7	BORING TERMINATED									

SHEET 4 OF 4

BORING NO. ADC-529

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS

ADC-529

Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2K
Sheet 18 of ____

DRAWING 4.2K

$FILE$
$DATE$
$TIME$

BORING NO. ADC-530

PROJECT John T. Myers L&D
DATE START:12/03/98 COMPLETE:12/03/98
LOCATION: N 539,651 E 1,352,931
DRILLING AGENCY FMSM Engineers
DRILLER:G.Thompson INSPECTOR:D.L. Black
DRILL TYPE: CME-45
DRILL METHOD: SPT, 3¼" HSA, NO
THICKNESS OF OVERBURDEN: 55.0
DEPTH CORED INTO ROCK: 45.1
TOTAL DEPTH OF BORING: 100.1
DIR. OF BORING X VERT. INCLINED DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 351.1
DATUM FOR EL. Top of Land Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
351.1	-SURFACE COVER-									
350.3	Topsoil: Brown silty CLAY w/ roots, mst, soft	T							SPT using cathead & AW rods.	
349.7	Large (cobblesize) CRUSHSTONE	LS								1
					13	A				2
										3
	Gray silty CLAY w/ occ LS frags, dry, VERY STIFF	CL								4
			10 13 12	0.9	1	DS	15			5
										6
										7
343.1						A				8
										9
			3 2 3	0.5	2	DS	29			10
										11
										12
						A				13
										14
			2 3 4	0.8	3	DS	30			15
										16
										17
						A				18
										19
			1 3 3	1.0	4	DS	32			20
										21
										22
	Gray silty CLAY w/ tr of black organics, mst, SOFT to MED SOFT	CL				A				23
										24
			2 2 3	1.5	5	DS	32			25
										26
										27
						A				28
										29
			2 2 3	1.5	6	DS	47			30
										31
										32
						A				33
										34
			2 2 3	1.5	7	DS	47			35
										36
										37
313.1						A				38
	Gray silty CLAY w/ silt lamina, mst to wet, SOFT	CL								39

SHEET 1 OF 3

BORING NO. ADC-530

BORING NO. ADC-530

	Gray silty CLAY w/ silt lamina, mst to wet, SOFT	CL	1 1 2	1.5	8	DS	42		41
									42
308.1						A			43
	Gray silty CLAY /w fine sand & silt lenses, wet, SOFT	CL							44
			2 2 2	1.5	9	DS	43		45
									46
									47
						A			48
									49
			2 3 3	1.5	10	DS	30		50
									51
299.1									52
	Brown med to coarse SAND w/ sm gravel, wet, LOOSE	SP				A			53
				1.0	11	A	18		54
296.1	TOP of ROCK								55
	Shale, Gray, sl. silty, Thin Bd, Med. Hd	SH	50	0.4	12	DS	14		56
	Lass core, v. soft, wash away							Auger Refusal	57
	B/p's B/p								58
	B/p B/p								59
292.4									
	Coal, Black, Hd, Broken	CO							
291.4									
	B/p B/p Shale, Gray, sl silty, Thin Bd, Med Hd w/ occ Med Soft along B/p's	SH						RUN# 1 56.5-64.7 CORED: 8.2 REC: 8.0 LOSS: .2 RQD(%): 50.0 100% Drill Water Return	60
	B/p B/p		98%						61
									62
	Ls								63
									64
	B/p B/p								65
									66
	B/p B/p B/p								67
	B/p > soft								68
	B/p B/p		96%					RUN# 2 64.7-74.7 CORED: 10.0 REC: 9.6 LOSS: .4 RQD(%): 71.0 100% Drill Water Return Loss core dist. throughout Run - Loss due to washing away v. soft areas along B/p's	69
	B/p B/p								70
									71
									72
	B/p B/p B/p								73
									74
	B/p B/p								75
	B/p B/p B/p								76
274.7									77
274.3	Coal, Black, Hd	CO							
	B/p B/p's Shale, Gray, Silty, w/ occ silt lamina, Lt Gray, Thin Bd. med Hd	SH						RUN# 3 74.7-84.7 CORED: 10.0 REC: 10.0 LOSS: .0 RQD(%): 48.0 100% Drill Water Return	78
	B/p B/p B/p								79
271.7	B/p		100%						

BOX 1 BOX 2

SHEET 2 OF 3

BORING NO. ADC-530

BORING NO. ADC-530

	B/p B/p Shale, Gray, Calc., Thin Bd, Hd	SH							81
268.8									82
	B/p's B/p Shale, Gray, Silty, Thin Bd, Med Hd, w/ num Lt Gray silt lamina	SH							83
	B/p								84
	B/p's B/p's B/p's B/p's								85
									86
	B/p B/p B/p B/p B/p B/p B/p's B/p's								87
									88
								RUN# 4 84.7-94.7 CORED: 10.0 REC: 10.0 LOSS: .0 RQD(%): 21.0 100% Drill Water Return	89
	B/p B/p			100%					90
	B/p								91
	B/p B/p B/p B/p B/p								92
									93
	B/p B/p B/p	SH							94
								RUN# 5 94.7-100.1 CORED: 5.4 REC: 5.4 LOSS: .0 RQD(%): 64.8 100% Drill Water Return	95
	B/p								96
	B/p's								97
	B/p B/p B/p B/p B/p B/p B/p B/p			100%				Pulled NQ rods on 12/3/98 Grouted Rock part of boring w/ 4 bags of cement on 12/3/98 Pulled augers on 12/3/98	98
									99
251.0	BORING TERMINATED								100

BOX 2 BOX 3

SHEET 3 OF 3

BORING NO. ADC-530

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS

ADC-530

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2L
Sheet 19 of

DRAWING 4.2L

#FILE#
#DATE#
#TIME#

BORING NO. ADC-531

PROJECT John T. Myers L&D
DATE START:11/30/98 COMPLETE:12/02/98
LOCATION: N 539,833 E 1,352,615
DRILLING AGENCY FMSM Engineers
DRILLER:G. Hoskins INSPECTOR:B. Bros:
DRILL TYPE: CME-85
DRILL METHOD: 6¼" HSA, 2" SPT, PQ
THICKNESS OF OVERBURDEN: 66.4
DEPTH CORED INTO ROCK: 44.7
TOTAL DEPTH OF BORING: 111.1'
DIR. OF BORING X VERT. __INCLINED__ DEG

INSTRUMENT INSTALLED PIEZOMETER
SURFACE ELEVATION: 361.4'
DATUM FOR ELEVATION Top of Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
361.4	SURFACE COVER-									
360.9	Topsoil: Brown silty CLAY w/ roots, mst.	CL								
	Gray CLAY, brown mottling, w/ sand (med. grained) and occ pebbles, dry, STIFF	CL	5 5 7	1.5	1	DS	17		Automatic Hammer 140 lbs.	
354.2	Gray CLAY, homogeneous, w/ thin (0.1') sand lenses, med. grained, dry, MED STIFF	CL	3 2 6	1.5	2	DS	20			
349.2	DK gray w/ gray mottling CLAY and occ pebbles, sl moist, plastic, SOFT	CH	4 2 3	1.3	3	DS	19			
344.2	Brown CLAY, moist, plastic, Uniform, VERY SOFT	CH	0 1 1	1.5	4	DS	26			
339.2	Brown CLAY, plastic, moist, Uniform, SOFT	CH	1 2 3	1.5	5	DS	31			
334.2	Same, VERY SOFT	CL	0 1 1	1.5	6	DS	25			
329.2	Brown w/ gray mottling sandy CLAY, wet to moist, plastic, SOFT	CH	0 1 2	1.5	7	DS	22			
324.2	Gray sandy CLAY, moist, plastic, SOFT	CH	2 2	1.5	8	DS	24			

SHEET 1 OF 3 BORING NO. ADC-531

BORING NO. ADC-531

319.2			3							
317.0	Gray med grained SAND, wet, LOOSE	SP	3 5 5	1.5	9	DS	24			
314.2										
311.7	Gray CLAY, sl plastic, moist, STIFF	CL	5 6 7	1.5	10	DS	24			
	Gray med grained SAND, wet, MED DENSE	SP								
309.2	Gray med grained SAND w/ lesser coarse grains, wet, MED DENSE (1 Clay lense, Gray, STIFF, dry)	SP	5 9 9	1.5	11	DS	18		revert used to control Blowback	
304.2	Gray med grained SAND w/ coarse grains, med gravel, wet, MED DENSE	SP	5 7 9	1.0	12	DS	15			
299.2										
297.2	Brown moist Clay lens	CL	5 6 9	1.5	13	DS	14			
296.6	Gray gravelly SAND, coarse to med grained, med sorted, wet, MED DENSE	SP								
295.0	TOP of ROCK									
292.4										
292.1	Shale, Gray, soft, Laminated internally	SH		0.3	14	DS	9			
291.6	Shale, Gray, Soft,	SH							RUN# 1 69.3-71.1 CORED: 1.8 REC: 1.8 LOSS: .0 RQD(%): 61.0 Water Recovered	
291.4	LIMESTONE, Gray, HARD, w/ SIDERITE	LS		100%						
	SHALE, Gray, Silty, HARD	SH							RUN# 2 71.1-76.1 CORED: 5.0 REC: 3.7 LOSS: 1.3 RQD(%): 0.0 Broken below 72.6 due to coring problem - barrel catching	
288.8	Shale, Gray, Soft	SH		74%	BOX 1					
284.9	B/p									
	SHALE, Gray, calc, common Siderite nodules, HARD, well-cemented	SH		92%					RUN# 3 76.1-81.1 CORED: 5.0 REC: 4.6 LOSS: .4 RQD(%): 52.0	
	54° fracture									
	B/p									
	B/p									
281.4										

SHEET 2 OF 3 BORING NO. ADC-531

BORING NO. ADC-531

	SHALE, Gray, HARD, well-cemented, common Siderite nodules	SH							
279.5									
279.3	Carbonaceous SHALE, Black, SOFT	SH							
278.8	COAL, Bituminous, Black, Hd, Fractured	CO							
	SHALE, Gray, HARD, well-cemented, calcite stringers & nodules, calc	SH	108%	BOX 2					RUN# 4 81.1-86.1 CORED: 5.0 REC: 5.4 LOSS: -.4 RQD(%): 74.0
	Slickensides visible in artifical fracture								
274.6									
	B/p								
	B/p								
	SHALE w/ Limestone Stringers, Hard, Gray w/ Lt. Gray, calc	SH	102%	BOX 3					RUN# 5 86.1-91.1 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 78.0
	B/p								
	B/p								
	B/p								
			100%						RUN# 6 91.1-96.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 88.0
	22° plane (fracture Bedding)		100%	BOX 4					RUN# 7 96.1-101.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 66.0
	B/p								
	B/p								
259.8									
	SHALE, Gray, Hard, minor Limestone stringers (<5%)	SH	100%						RUN# 8 101.1-106.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 90.0
	B/p								
	B/p								
	B/p		100%	BOX 5					RUN# 9 106.1-111.1 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 100.0
250.3	BORING TERMINATED								

SHEET 3 OF 3 BORING NO. ADC-531

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS

ADC-531

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2M
Sheet 20 of ____

DRAWING 4.2M

#FILE#
#DATE#
#TIME#

BORING NO. ADC-532

PROJECT John T. Myers L&D
DATE START:11/16/98 COMPLETE:11/19/98
LOCATION: N 539,932 E 1,351,919
DRILLING AGENCY FMSM Engineers
DRILLER:G. Hoskins INSPECTOR:B. Brosi
DRILL TYPE: CME-85
DRILL METHOD:
THICKNESS OF OVERBURDEN: 65.7
DEPTH CORED INTO ROCK: 55.7
TOTAL DEPTH OF BORING: 121.4'
DIR. OF BORING X VERT. INCLINED DEG

INSTRUMENT INSTALLED Piezometer
SURFACE ELEVATION: 362.2'
DATUM FOR ELEVATION Top of Lockwall

ELEV.	SOIL CLASSIFICATION	USGS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
362.2	SURFACE COVER-								Automatic Hammer for all SPT sampling	
361.5	Blacktop on concrete									
	Lt brown medium SAND, dry, WELL-SORTED, LOOSE	Fr SP	18 4 6	0.7	1	DS	5			
355.0						A				
	Brown med SAND, dry, WELL-SORTED, LOOSE	Fr SP	2 2 4	1.2	2	DS	8			
350.0						A				
	Med to coarse SAND, brown w/ gray mottling, moist, DENSE	Fr SP	6 12 25	0.9	3	DS	7			
345.0						A				
	Med SAND w/ occ pebbles, brown, slightly moist, MED DENSE	Fr SP	4 12 18	1.5	4	DS	7			
340.0						A				
	Med to coarse SAND w/ clay, gray w/ brown mottling, moist, MED DENSE	Fr SC	4 11 11	1.5	5	DS	10			
335.0						A				
	Clayey SAND, brown w/ gray mottling, moist, (med grained sand) clay occurs in thin lenses, VERY LOOSE	Fr SC	1 2 3	1.5	6	DS	14			
329.7						A				
	Sandy Clay w/ sand lenses, gray w/ brown mottling, STIFF	Fr CL	6 8 10	1.5	7	DS	15			
326.5	Green brown CLAY, organics, slightly moist, STIFF									
325.0						A				
			4							

SHEET 1 OF 4

BORING NO. ADC-532

BORING NO. ADC-532

	DK gray CLAY, plant stems, contains organic odor, slightly moist, VERY STIFF, (lean clay)	Fr CL	8 10	1.5	8	DS	21		
320.0						A			
	Gray CLAY w/ silt & sand (dispersed), brown mottling, VERY STIFF, sl damp, organic odor	Fr CL	6 10 10	1.5	9	DS	13		end 11/16/98 begin 11/17/98
315.0						A			
	DK gray CLAY w/ dispersed pebbles and sand, contains organic matter, MED STIFF, moist, organic odor	Fr CL	3 3 5	1.3	10	DS	17		
310.0						A			
	DK gray sandy CLAY, organic odor, MED STIFF to STIFF	Fr CL	2 3 4	1.5	11	DS	19		
305.0						A			
	Gray CLAY w/ brown mottling, w/ sand, contains charcoal (paleo wood), slightly moist, SOFT	Fr CL	4 3 2	1.5	12	DS	22		
300.0						A			
	Silty CLAY, gray, moist, VERY STIFF	Fr CL	7 10 44	1.5	13	DS	18		
296.2									
295.8	SHALE	SH							
294.8	LIMESTONE, Foss, Gray, Sparry HARD, Med Bedded	LS							
	SHALE, Gray, SOFT, Thin Bedded	SH		100%	BOX 1				RUN# 1 66.4-69.4 CORED: 3.0 REC: 3.0 LOSS: .0 RQD(%): 41.7
	vert. fracture - fresh			100%					RUN# 2 69.4-74.6 CORED: 5.2 REC: 5.2 LOSS: .0 RQD(%): 40.4 100% Drill Water Return
288.6	LIMESTONE, Lt. Gray, Hd, Massively Bedded, Occ Fossils	LS							
	B/p			100%	BOX 2				RUN# 3 74.6-79.6 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 70.0 100% Drill Water Return
	86° fracture - sl weathered								
	B/p								
	B/p								
282.2									RUN# 4 79.6-81.3

SHEET 2 OF 4

BORING NO. ADC-532

BORING NO. ADC-532

	LIMESTONE, Lt. Gray, Massive Bedded,	LS	100%	BOX 2	CORED: 1.7 REC: 1.7 LOSS: .0 RQD(%): 100.0
280.9					
280.6	Carboniferous SHALE, Dk Gray, SOFT	SH			
280.0	COAL, Black, Bitumenous, HARD	CO			
	SHALE, Gray, SOFT	SH	98%	BOX 3	RUN# 5 81.3-86.3 CORED: 5.0 REC: 4.9 LOSS: .1 RQD(%): 68.0 100% Drill Water Return
	B/p				
	B/p				
	52° fracture - fresh				
	B/p				
	B/p				
274.5	B/p				
	SHALE, Gray, SOFT, silty, calcareous	SH	102%	BOX 4	RUN# 6 86.3-91.3 CORED: 5.0 REC: 5.1 LOSS: -.1 RQD(%): 56.9 100% Drill Water Return
	B/p				
	B/p				
	B/p				
	B/p		100%		RUN# 7 91.3-96.4 CORED: 5.1 REC: 5.1 LOSS: .0 RQD(%): 64.7 100% Drill Water Return
	B/p				
	B/p				
	B/p		96%	BOX 5	RUN# 8 96.4-101.4 CORED: 5.0 REC: 4.8 LOSS: .2 RQD(%): 76.0 100% Drill Water Return
261.9					
261.6	Black COAL, Bitumenous, Frac, Hd, pyrite	CO			
	LIMESTONE, Gray, carboniferous, HARD, contains coal stringers & Siderite nodules	LS			
	B/p				
	27° fracture				
259.3	B/p				
	B/p horiz. fracture		100%	BOX 6	RUN# 9 101.4-106.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 74.0 100% Drill Water Return
	B/p, calcite vein 0.1 +/-				
	B/p				
	SHALE, calcareous, Limestone, nodules & lenses, SOFT, Lt gray occ Siderite nodules	SH			
255.7					
	SHALE, Gray, HARD, WELL-LITHIFIED, rare Siderite nodules.	SH	100%		RUN#10 106.4-111.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 82.0 100% Drill Water Return
	B/p				
	B/p				
	62° fracture curved				
	B/p		100%	BOX 7	RUN#11 111.4-116.4 CORED: 5.0 REC: 5.0 LOSS: .0 RQD(%): 90.0 100% Drill Water Return
	27° fracture		104%	BOX 8	RUN#12 116.4-121.4 CORED: 5.0 REC: 5.2 LOSS: -.2 RQD(%): 100.0 100% Drill Water Return
	17° fracture				
	31° fracture				
242.2					

SHEET 3 OF 4

BORING NO. ADC-532

BORING NO. ADC-532

	SHALE, Gray, HARD,	SH			BOX 8			
240.8	BORING TERMINATED							121+

SHEET 4 OF 4

BORING NO. ADC-532

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

BORING LOGS

ADC-532

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2N
Sheet 21 of

DRAWING 4.2N

#FILE#
#DATE#
#TIME#

BORING NO. ADC-533

PROJECT John T. Myers L&D
DATE START: 11/10/98 COMPLETE: 11/11/98
LOCATION: N 540,194 E 1,352,054
DRILLING AGENCY FMSM Engineers
DRILLER: G. Thompson INSPECTOR: D.L. Black
DRILL TYPE: CME-75
DRILL METHOD: SPT, 4¼" HSA, NQ
THICKNESS OF OVERBURDEN: 57.7
DEPTH CORED INTO ROCK: 142.0
TOTAL DEPTH OF BORING: 199.7'
DIR. OF BORING X VERT. _INCLINED__ DEG

INSTRUMENT INSTALLED NONE
SURFACE ELEVATION: 351.6'
DATUM FOR ELEVATION Lockwall

ELEV.	SOIL CLASSIFICATION	USCS CLASSIFICATION	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	GROUNDWATER-FLUID LOSS	LABORATORY RESULTS AND REMARKS	DEPTH SCALE (FT)
351.6	SURFACE COVER-									
350.8	Topsoil: Brown sandy SILT, mst, LOOSE	TS							SPT w/ CME Automatic Hammer & AW rods	
						A				2–3
	Brown f. sandy clayey SILT, mst, LOOSE	ML	4 / 3 / 5	1.0	1	DS	26			5–6
343.6						A				8
	Brown silty CLAY, mst, MED STIFF	CL	4 / 4 / 4	1.1	2	DS	27			10–11
						A				13
337.6	Brown v. silty CLAY, mst, SOFT	CL	0 / 3 / 2	1.5	3	DS	30			15–16
						A				18
			2 / 2 / 2	1.5	4	DS	30			20–21
329.6	Brown sandy SILT, wet, LOOSE	ML				A				23
			3 / 4 / 10	1.5	5	DS	23			25–26
325.4	Brown med SAND, wet, LOOSE	SP				A				28
			5 / 2 / 4	1.5	7	DS	19			30–31
318.6						A				33
			10 / 10 / 10	1.5	8	DS	22			35–36
						A				38

SHEET 1 OF 5 — BORING NO. ADC-533

BORING NO. ADC-533

ELEV.	SOIL CLASSIFICATION	USCS	BLOWS PER 6-INCH	RECOVERY	SAMPLE NUMBER	SAMPLE TYPE	MOISTURE CONTENT (%)	REMARKS	DEPTH (FT)
	Brown med SAND, wet, MED DENSE	SP	17 / 18 / 21	1.5	9	DS	13		40–41
						A			43
			20 / 18 / 11	1.5	10	DS	15		45–46
						A			48
			18 / 11 / 12	1.5	11	DS	14		50–51
						A			53
297.6	Brown med to coarse SAND w/ occ cobbles, wet, VERY DENSE	SP	21 / 38 / 37	1.5	12	DS	12		55–56
293.9	TOP of ROCK								57.7

ELEV.	ROCK DESCRIPTION		RECOVERY	BOX	REMARKS
293.9	LIMESTONE, Gray, xlyn, occ Foss, Thick Bd, v. Hd (B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, h/a Jt(85°))	LS	99%	BOX 1	RUN# 1 57.9-64.7 CORED: 6.8 REC: 6.7 LOSS: .1 RQD(%): 85.3 100% Drill Water Return
286.5	COAL, Black, Hd, Thin Bd	CO			
285.3	UNDER CLAY, Gray, SOFT	UC			
284.9	LIMESTONE, Foss	LS			
284.7	SHALE, Gray, sl silty, Thin Bd, mod. Soft w/ Soft to v. Soft along B/p's, w/ occ Lt Gray silt Lamina (calc Shale, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, 45° Jt)	SH	101%	BOX 1	RUN# 2 64.7-74.7 CORED: 10.0 REC: 10.1 LOSS: -.1 RQD(%): 47.0 100% Drill Water Return
	(B/p, B/p, B/p, B/p, B/p, B/p, B/p, Siderite nodual, B/p, B/p)		100%	BOX 2	RUN# 3 74.7-84.7 CORED: 10.0 REC: 10.0 LOSS: .0 RQD(%): 59.0 100% Drill Water Return

SHEET 2 OF 5 — BORING NO. ADC-533

BORING NO. ADC-533

ELEV.	ROCK DESCRIPTION		RECOVERY	BOX	REMARKS
271.2	v. soft, Broken			BOX 2	
	SHALE, Thin Bd, calc, Lt Gray to Gray, mod Soft to v. Soft along B/p's (30°Jt, 30°Jt, B/p w/ Ls Lens, B/p, B/p, B/p, Ls Lens, B/p, B/p, B/p, B/p, Ls Lens, B/p, B/p, B/p, v/Jt, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, Ls)	SH	101%	BOX 2 / BOX 3	RUN# 4 84.7-94.7 CORED: 10.0 REC: 10.1 LOSS: -.1 RQD(%): 42.0 100% Drill Water Return
	(B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p's, B/p, B/p, B/p, B/p, v. Soft, B/p, B/p's, B/p's, B/p, B/p, B/p, B/p, soft, Ls, B/p, B/p, B/p, B/p, v/Jt)		102%	BOX 3	RUN# 5 94.7-104.7 CORED: 10.0 REC: 10.2 LOSS: -.2 RQD(%): 22.0 100% Drill Water Return
247.0	SHALE, Dk Gray to Black, organic, mod Hd, Thin Bd (B/p, B/p, B/p)	SH			
245.4	COAL, Black, Hd, /w shale	CO			
245.1	SHALE, silty, w/ num Silt Lamina, Gray to Lt Gray, mod Hd w/ occ Soft along B/p's, Thin Bd (B/p's, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p)	SH	100%	BOX 4	RUN# 6 104.7-114.7 CORED: 10.0 REC: 10.0 LOSS: .0 RQD(%): 10.0 100% Drill Water Return
	(B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, B/p, soft, B/p, B/p, B/p, B/p, B/p)		100%	BOX 4 / BOX 5	RUN# 7 114.7-124.7 CORED: 10.0 REC: 10.0 LOSS: .0 RQD(%): 34.0 100% Drill Water Return

SHEET 3 OF 5 — BORING NO. ADC-533

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

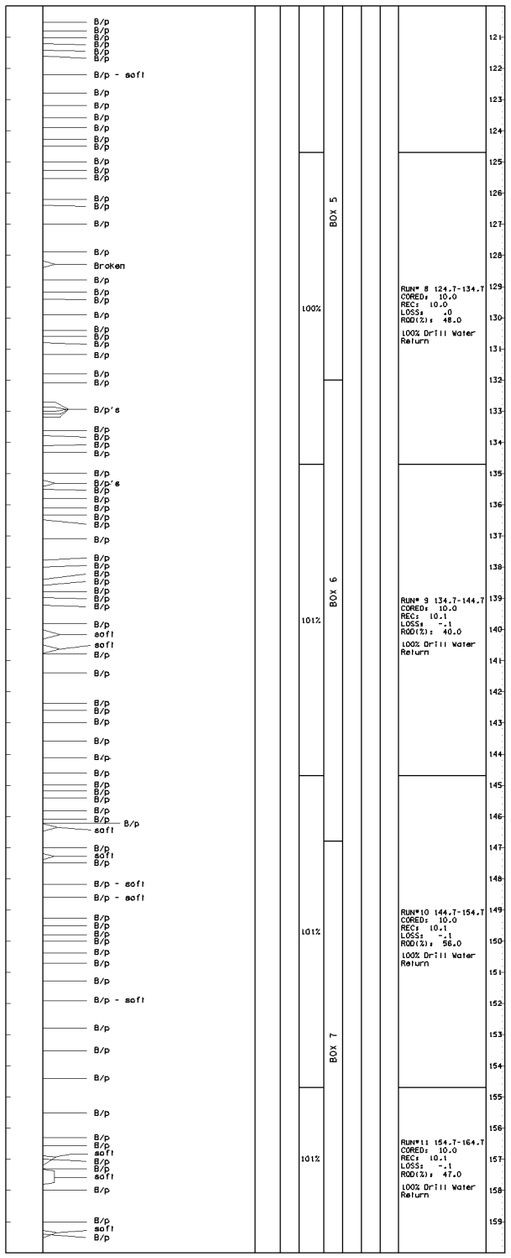
BORING LOGS
ADC-533

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.20
Sheet 22 of ____

DRAWING 4.20

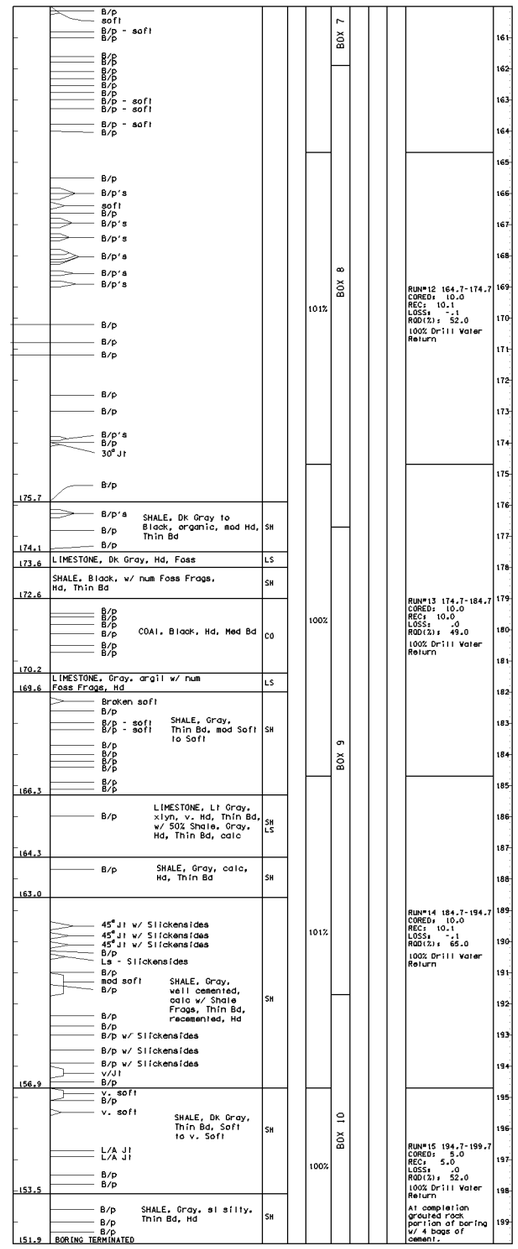
$FILE$
$DATE$
$TIME$

BORING NO. ADC-533



SHEET 4 OF 5

BORING NO. ADC-533



SHEET 5 OF 5

BORING NO. ADC-533

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

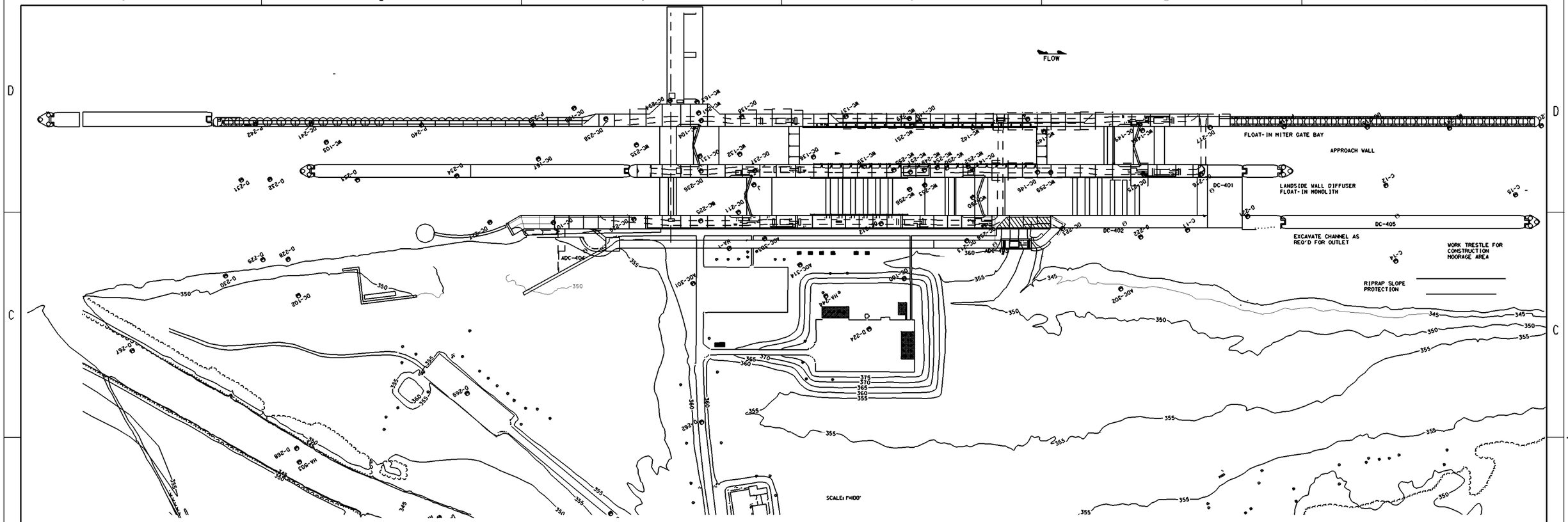
BORING LOGS

ADC-533

Designed by: D. BLACK
Drawn by: J. HOLT
Checked by: L. DAVIS
Reviewed by:
Scale: AS SHOWN
Date: 10 MAY 1999
Drawing Code:
Sheet reference number: 4.2P
Sheet 23 of

DRAWING 4.2P

#FILE#
#DATE#
#TIME#



Revisions			
Symbol	Descriptions	Date	Approved

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: K. HENN
Drawn by: D. BRECKINRIDGE
Checked by: L. DAVIS

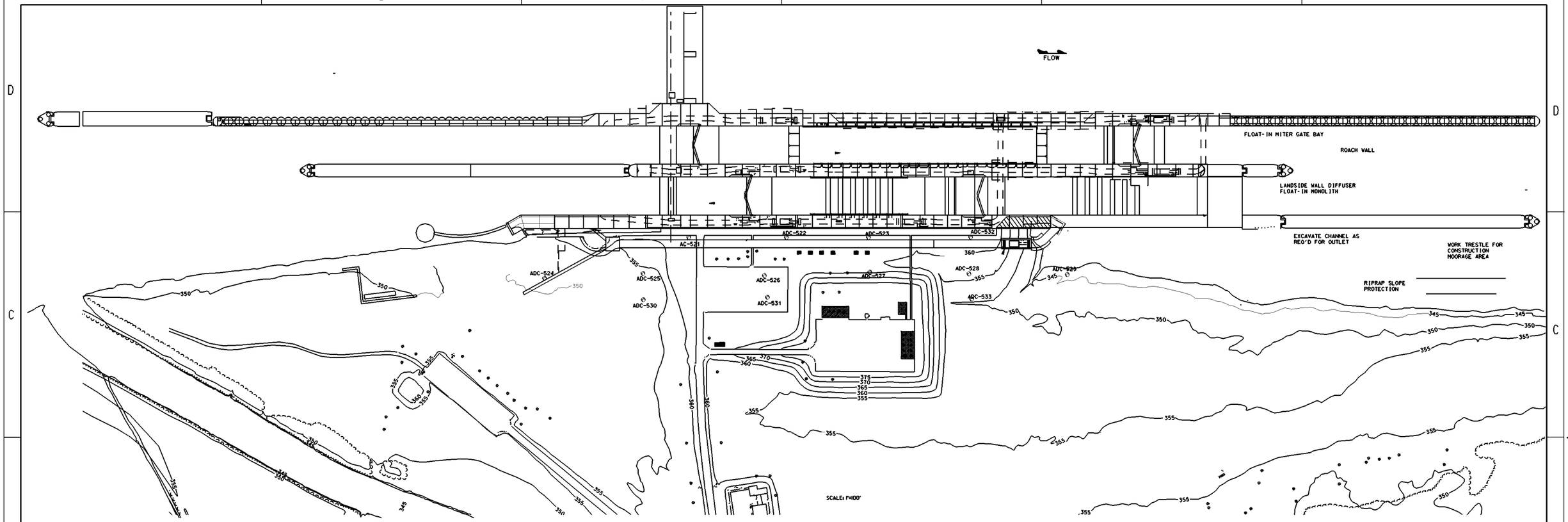
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

HISTORICAL BORING LOCATIONS

Scale:
Date:
Drawing Code:
Sheet reference number: 4.6A
Sheet 24 of

DRAWING 4.6A

$FILE$
$DATE$
$TIME$



Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: K. HENN
Drawn by: D. BRECKINRIDGE
Checked by: L. DAVIS

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

FALL 1998 BORING LOCATIONS

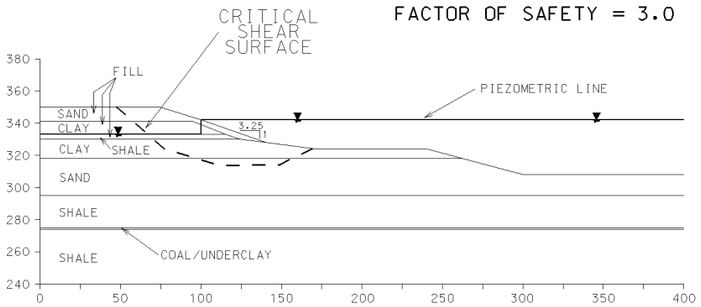
Scale:
Date:
Drawing Code:
Sheet reference number: 4.6B
Sheet 25 of

DRAWING 4.6B

$FILE$
$DATE$
$TIME$

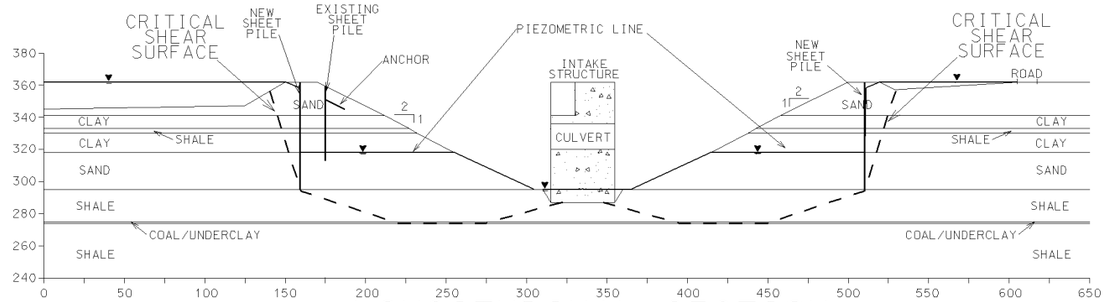
SLOPE STABILITY ANALYSIS

FACTOR OF SAFETY = 3.0



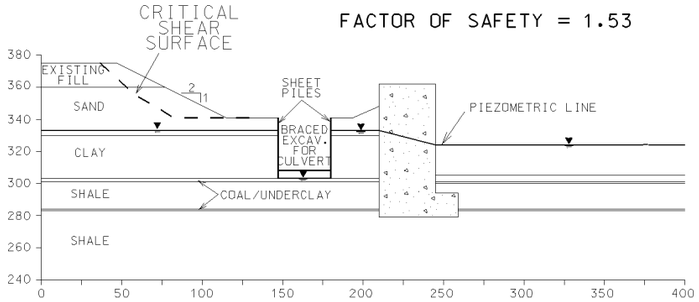
BERM 1
U/S APPROACH CHANNEL
STA 8+00 U.S.

FACTOR OF SAFETY = 1.38



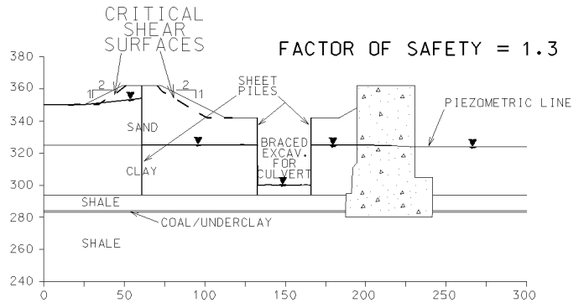
LONGITUDINAL SECTION
THROUGH CULVERT INTAKE AND BERM 1

FACTOR OF SAFETY = 1.53



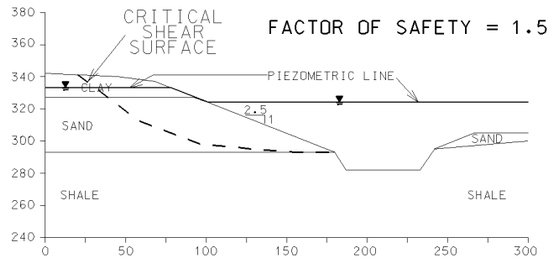
BERM 2
SEWAGE PLANT AREA
STA 6+30 D.S.

FACTOR OF SAFETY = 1.3



BERM 2/3
MONOLITHS L6-10
STA 8+00 D.S.

FACTOR OF SAFETY = 1.5



EXCAVATION FOR
FLOAT-IN MONOLITH
STA 8+20 D.S.

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

SLOPE STABILITY ANALYSIS

Designed by: L. DAVIS
Drawn by: K. WOODARD
Checked by: L. DAVIS
Reviewed by:

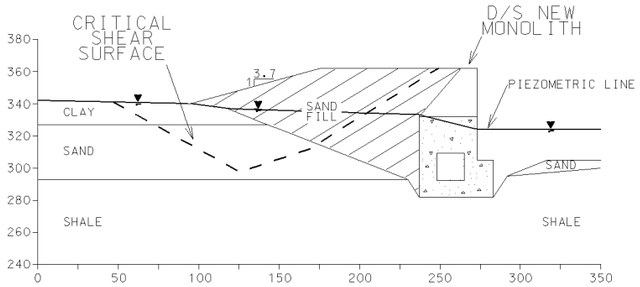
Scale: AS SHOWN
Date: 30 JUN 1999
Drawing Code:
Sheet reference number: 4.6C
Sheet 26 of ____

DRAWING 4.6C

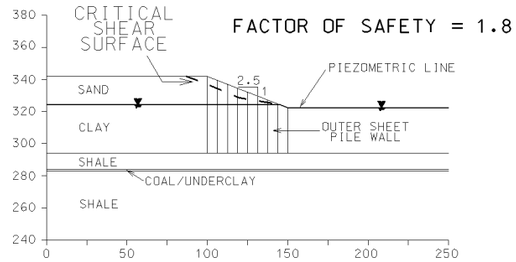
#FILE#
#DATE#
#TIME#

SLOPE STABILITY ANALYSIS

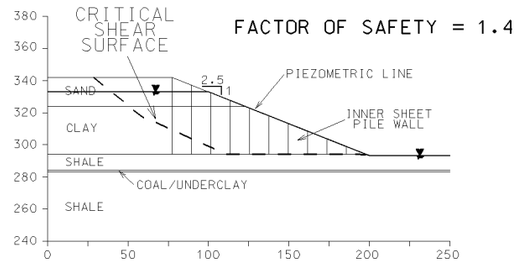
FACTOR OF SAFETY = 3.9



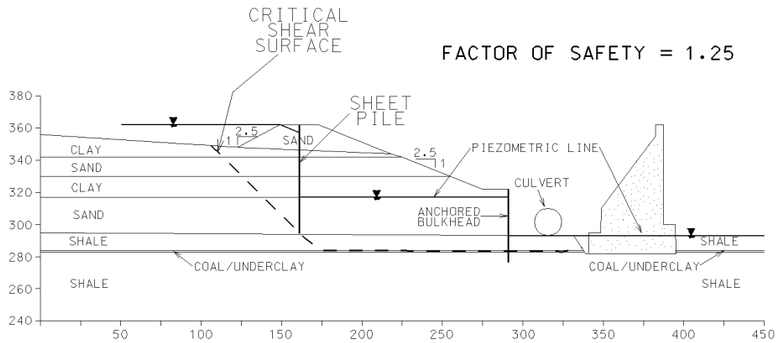
MONOLITH
FINAL BACKFILL
STA 8+20 D.S.



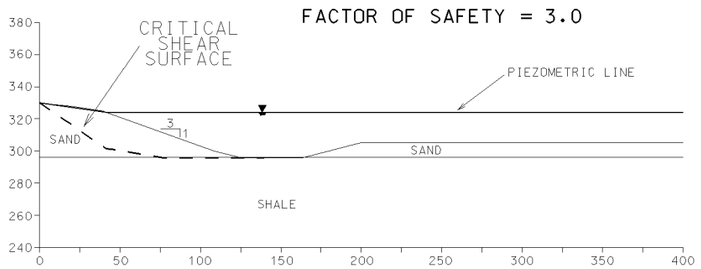
LONGITUDINAL SECTION
LAND SIDE OF CULVERT



LONGITUDINAL SECTION
LOCK SIDE OF CULVERT



BERM 3
THRUST BLOCK
STA 9+50 D.S.



SECTION 5
D/S APPROACH CHANNEL
STA 18+25 D.S.

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

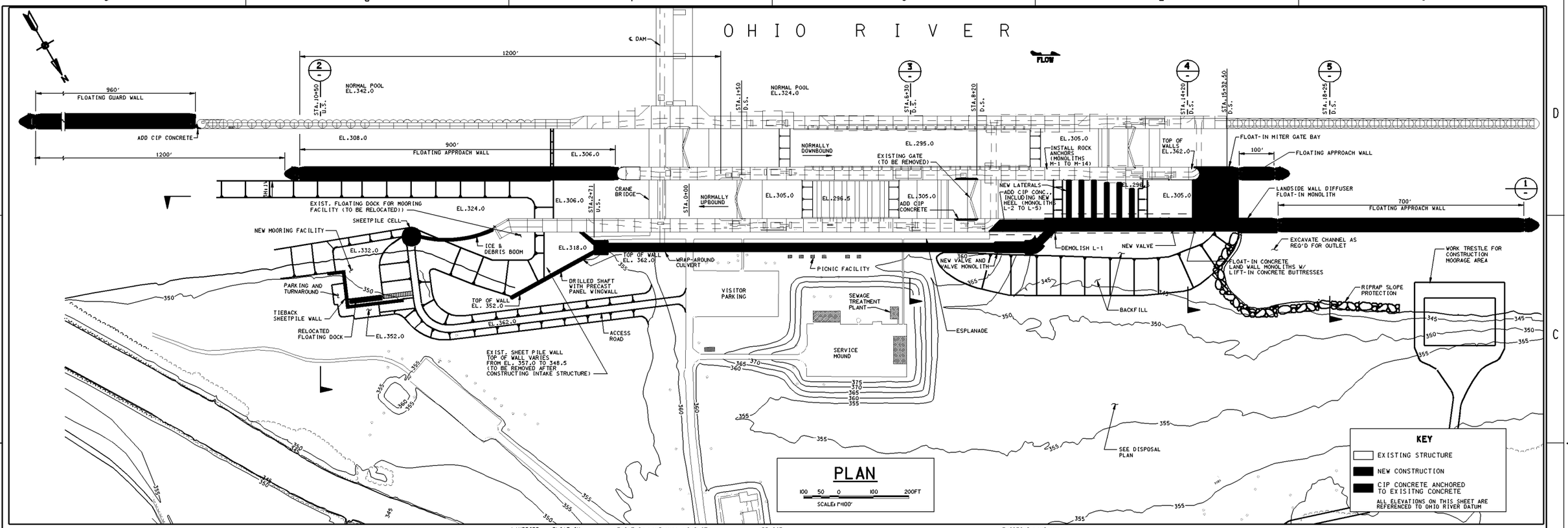
SLOPE STABILITY ANALYSIS

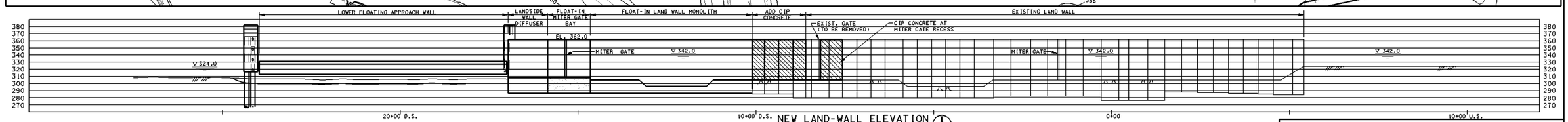
Designed by: L. DAVIS
Drawn by: K. WOODARD
Checked by: L. DAVIS
Reviewed by:

Scale: AS SHOWN
Date: 30 JUN 1999
Drawing Code:
Sheet reference number: 4.6D
Sheet 27 of ____

DRAWING 4.6D

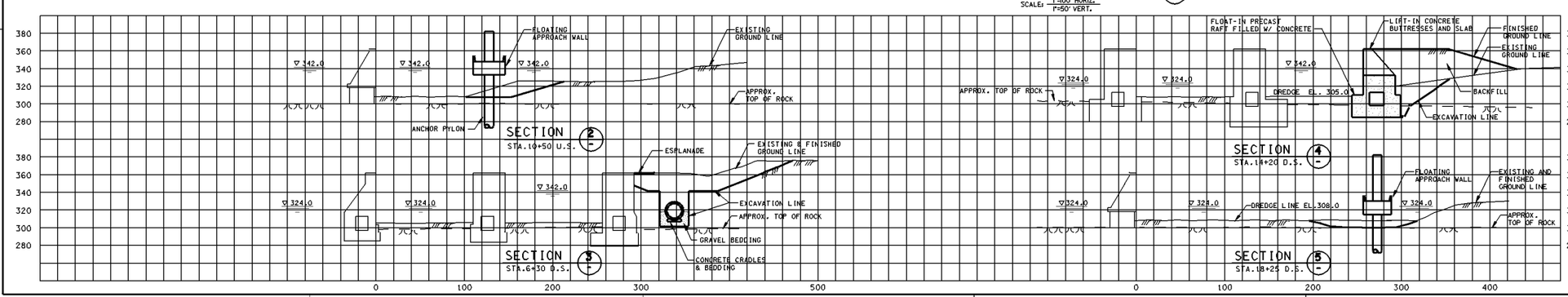
#FILE#
#DATE#
#TIME#





NEW LAND-WALL ELEVATION (1)

SCALE: 1"=100' HORIZ. 1"=50' VERT.



Revisions			
Symbol	Descriptions	Date	Approved

INCA Engineers, Inc.

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

Designed by: S. TEO
Drawn by: K. TANG
Checked by: L. PIERCE

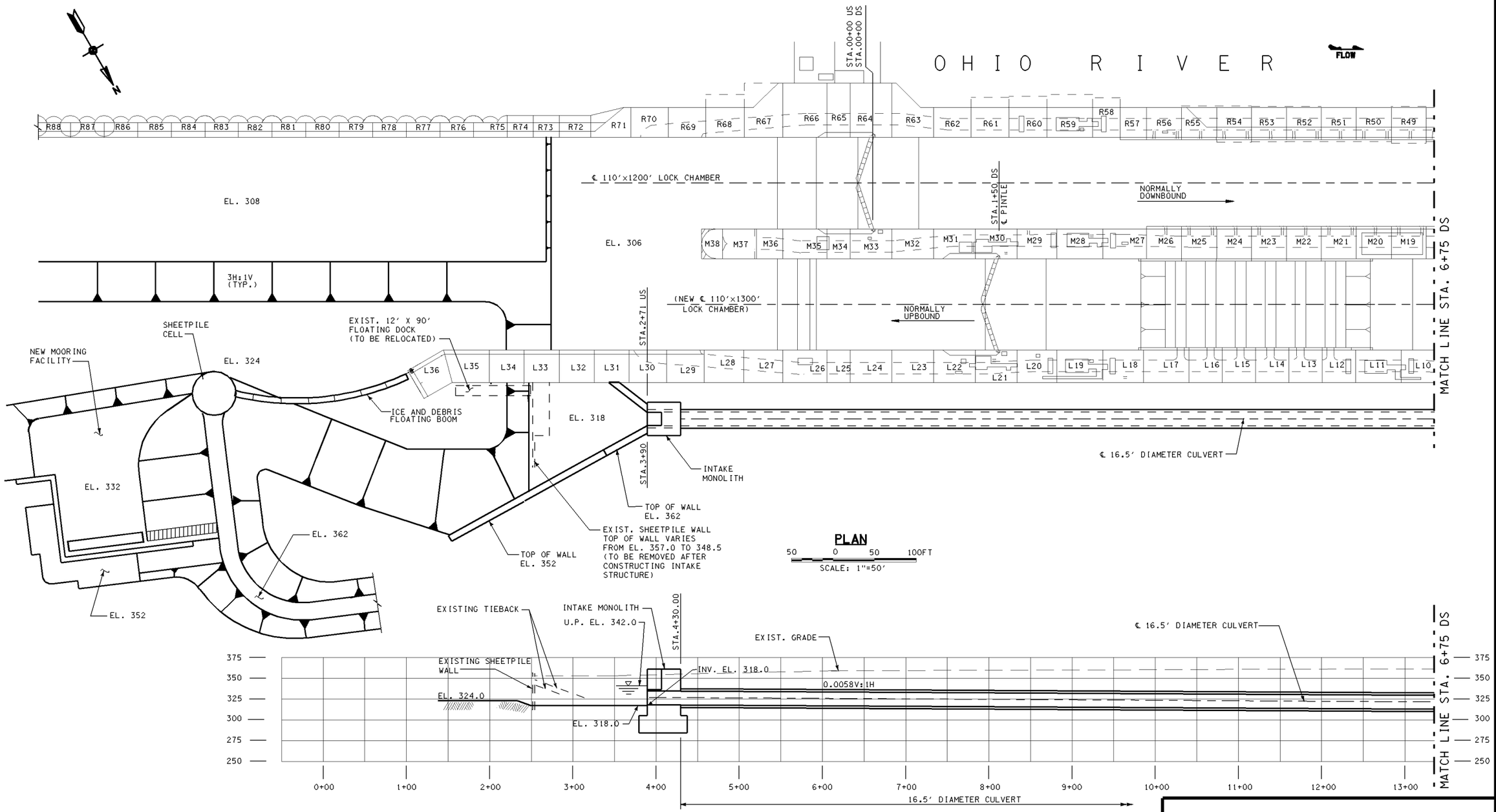
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY-INDIANA

600' EXTENSION DOCUMENTED DESIGN

Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 28 of

DRAWING 6.0A

$FILE$
$DATE$
$TIME$



Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

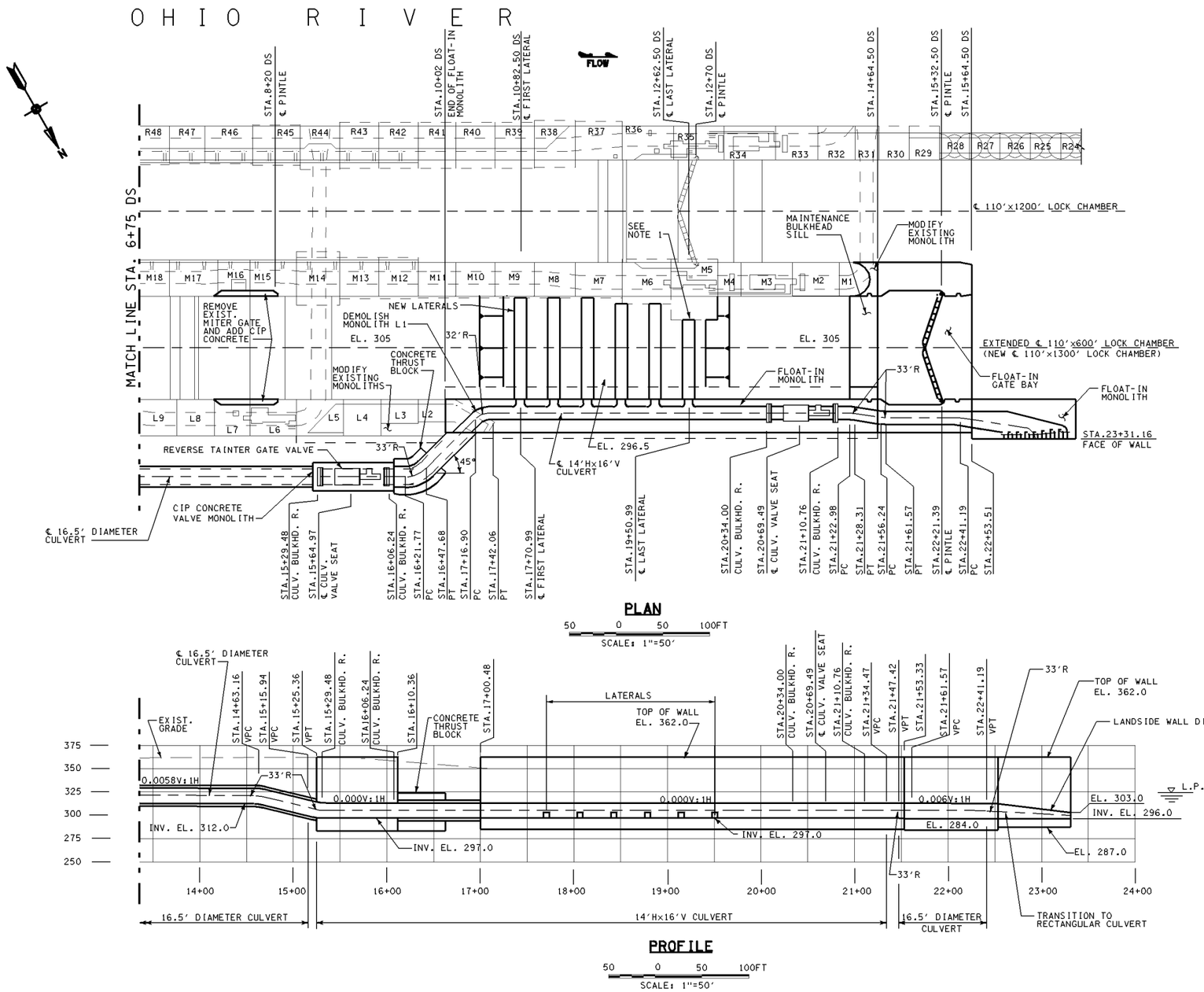
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION FILLING & EMPTYING SYSTEM - PLAN & PROFILE DRAWING 1

Designed by: SKT
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: 1" = 50'
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 29 of

DRAWING 6.OB

#FILE#
#DATE#
#TIME#



PLAN

50 0 50 100FT

SCALE: 1"=50'

PROFILE

50 0 50 100FT

SCALE: 1"=50'

NOTE:

1. COMPENSATE FOR ONE SHORT LATERAL BY INCREASING THE PORT SIZE IN THIS LATERAL. MATCH TOTAL PORT AREA OF ADJACENT LATERAL.

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

U.S. Army Corps of Engineers

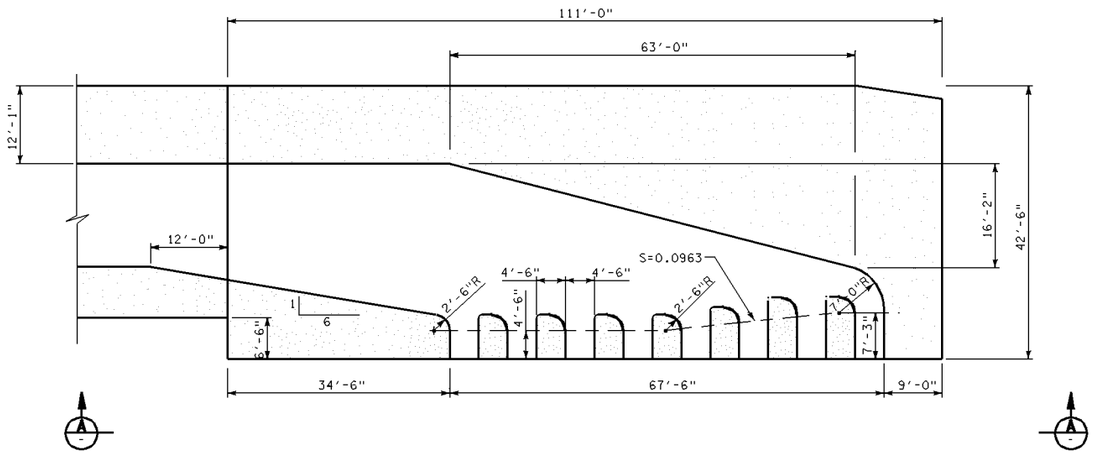
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION FILLING & EMPTYING SYSTEM - PLAN & PROFILE DRAWING 2

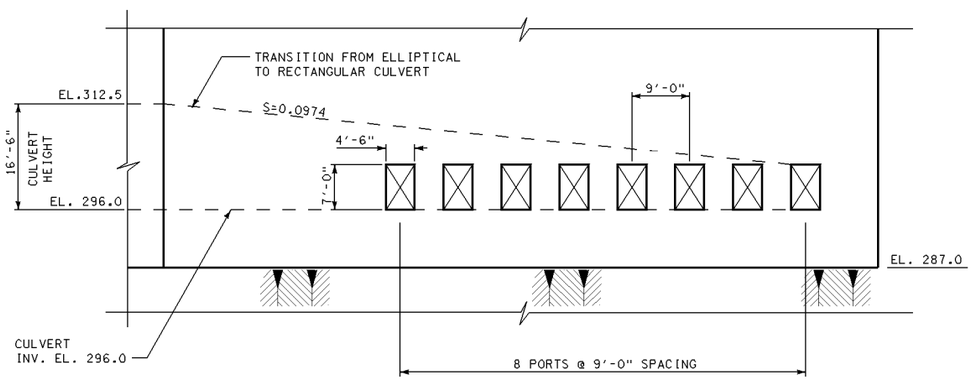
Designed by: SKT
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: 1" = 50'
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 30 of ____

DRAWING 6.0C

&FILE&
&DATE&
&TIME&



SECTIONAL PLAN



VIEW A

600' LOCK EXTENSION OUTLET WALL DIFFUSER

SCALE: 1"=10'

GRAPHIC SCALE

10 5 0 10 20FT

SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

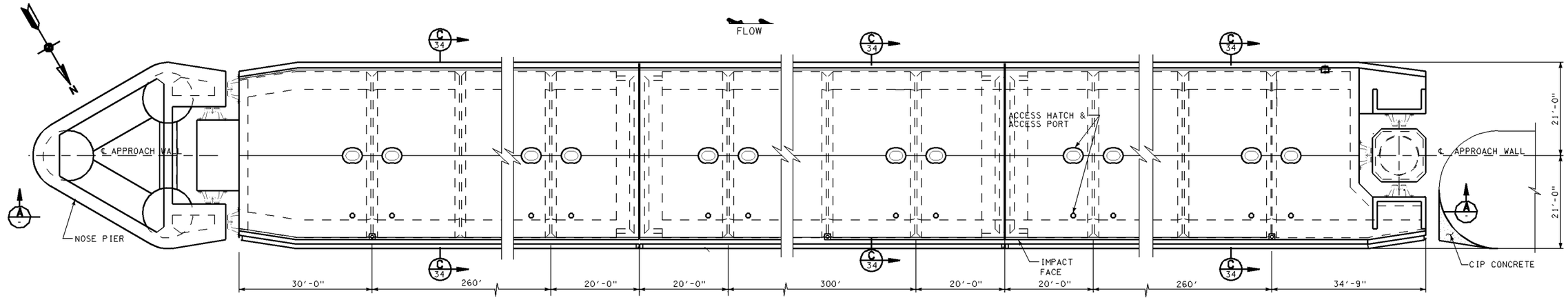
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

LANDSIDE WALL DIFFUSER DETAILS

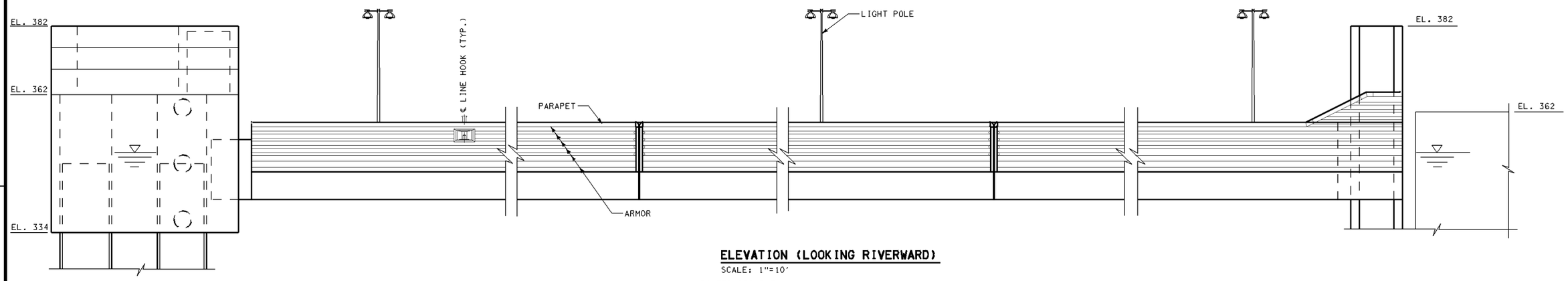
Designed by: SKT
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: 1" = 10'
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 31 of ____

DRAWING 6.0D

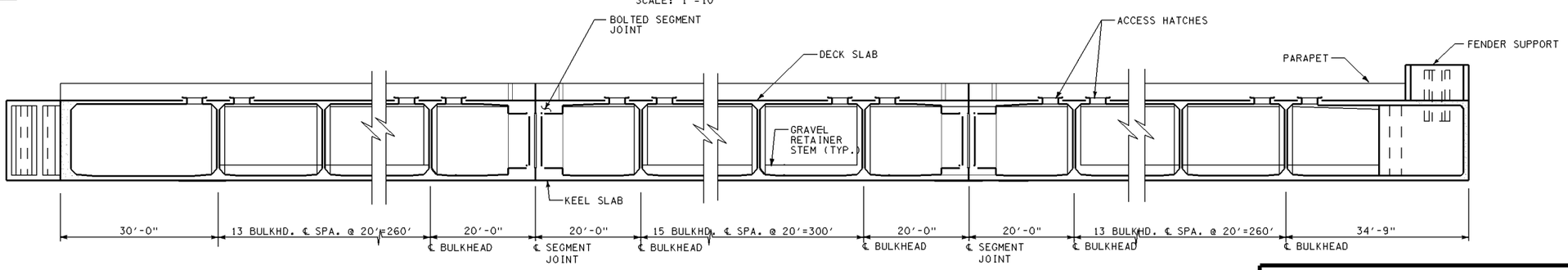
#FILE#
#DATE#
#TIME#



UPPER RIVER WALL PLAN
SCALE: 1"=10'



ELEVATION (LOOKING RIVERWARD)
SCALE: 1"=10'



SECTION A
SCALE: 1"=10'
NOSE PIER & PYLON ARE NOT SHOWN

GRAPHIC SCALE
10 5 0 10 20FT
SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

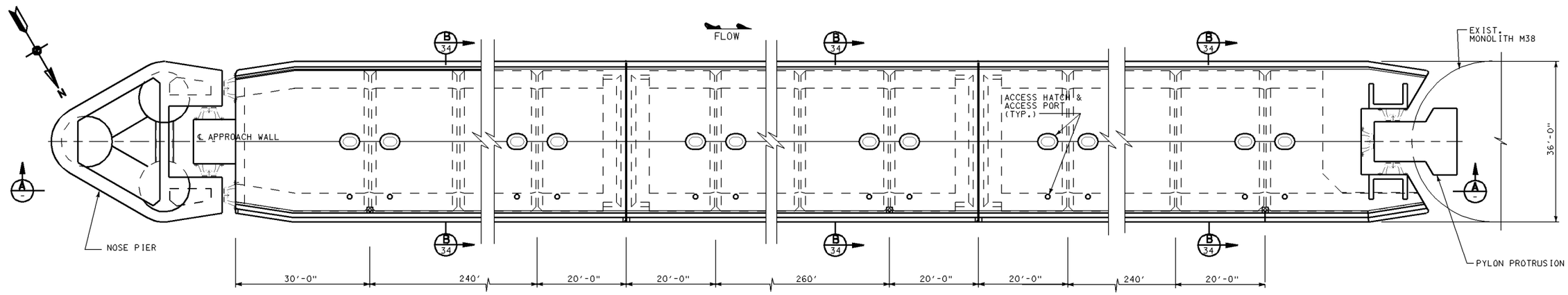
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION UPPER RIVER APPROACH WALL

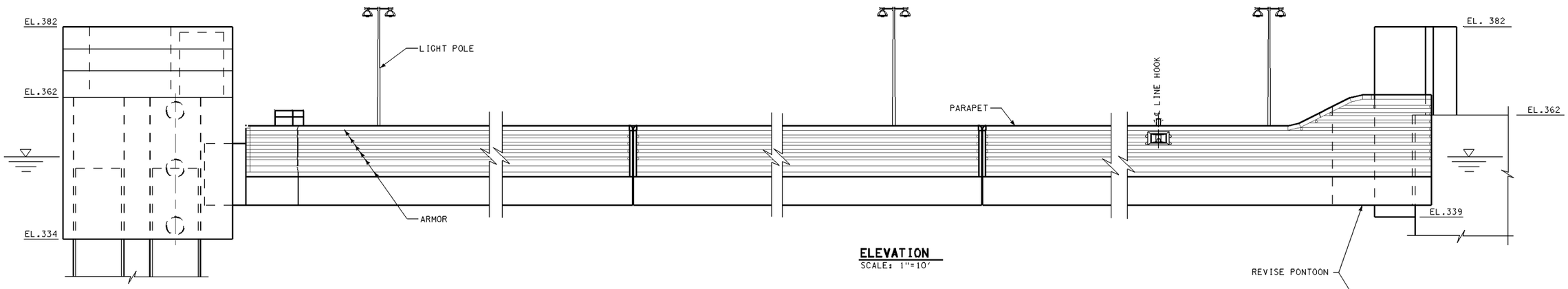
Designed by: JZ
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: 1"=10'
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 32 of ____

DRAWING 6.OE

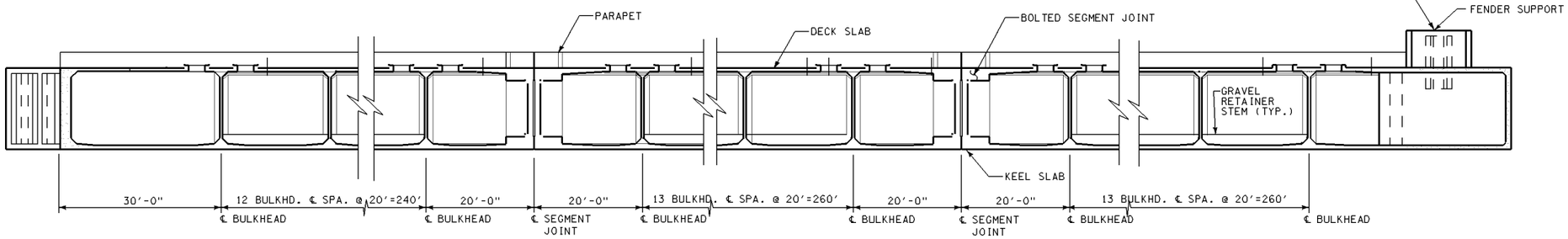
$FILE$
$DATE$
$TIME$



UPPER MIDDLE WALL PLAN
SCALE: 1"=10'



ELEVATION
SCALE: 1"=10'



SECTION A
SCALE: 1"=10'
NOSE PIER & PYLON ARE NOT SHOWN

GRAPHIC SCALE
10 5 0 10 20FT
SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

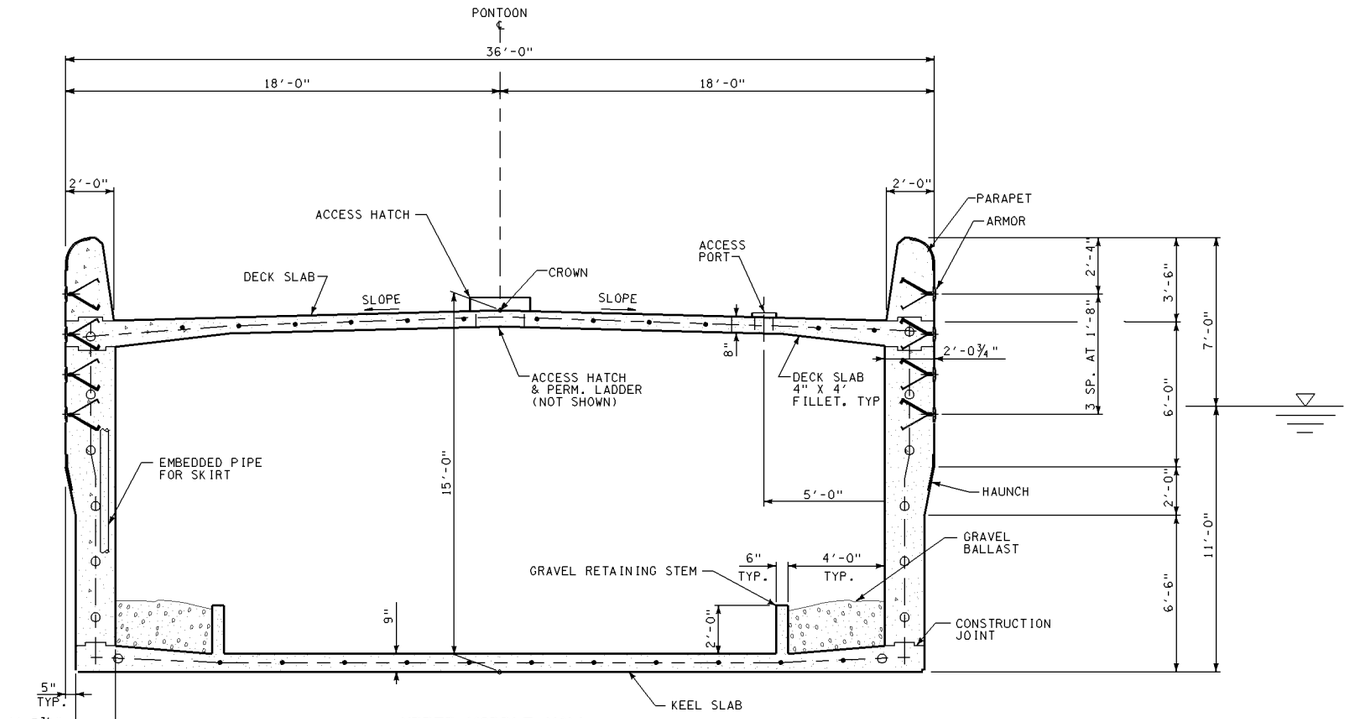
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION UPPER MIDDLE APPROACH WALL

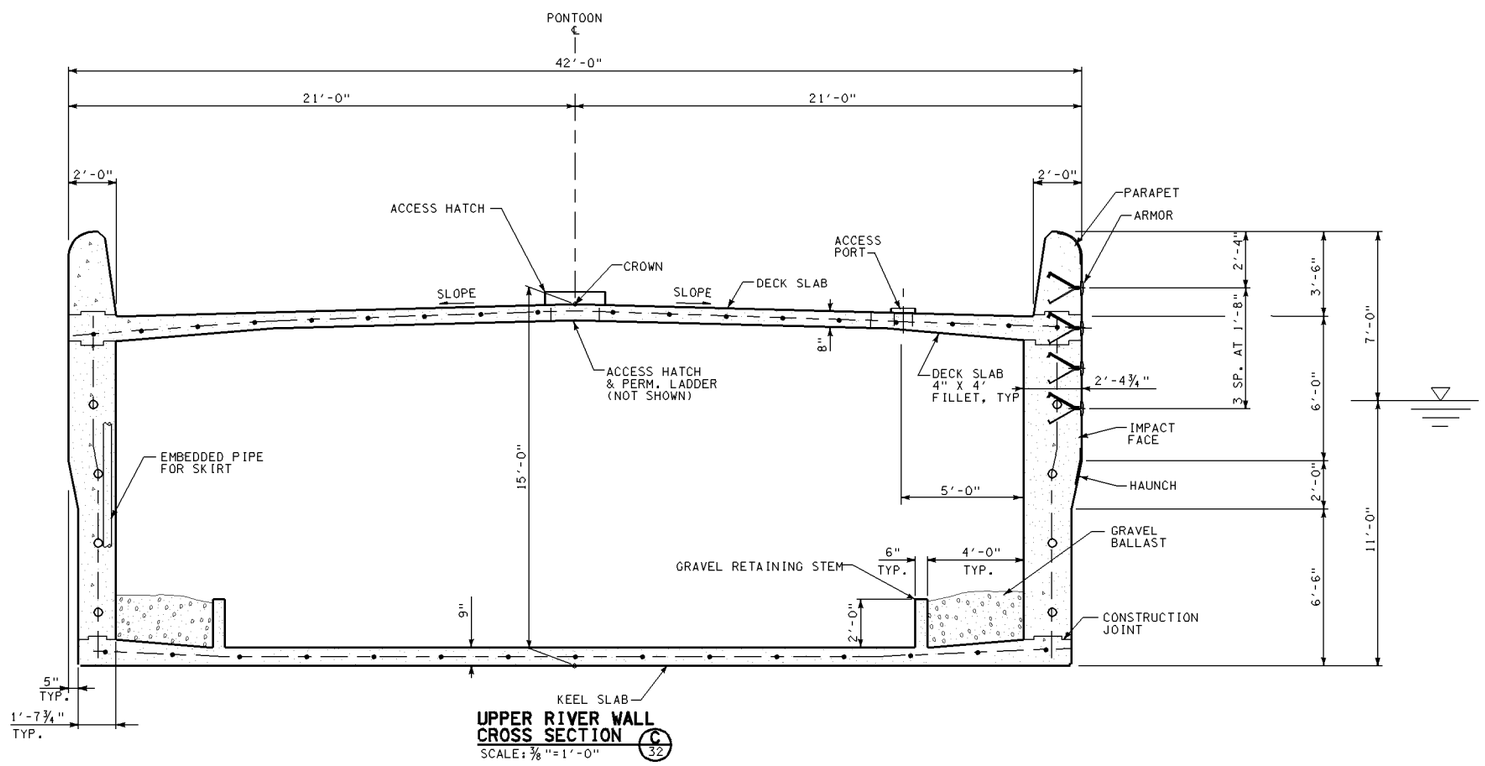
Designed by: JZ
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: 1"=10'
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 33 of ____

DRAWING 6.OF

$FILE$
$DATE$
$TIME$



UPPER MIDDLE WALL CROSS SECTION (B / 33)
SCALE: ⅜"=1'-0"



UPPER RIVER WALL CROSS SECTION (C / 32)
SCALE: ⅜"=1'-0"

GRAPHIC SCALE

2 0 2 4FT
SCALE: 3/8"= 1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

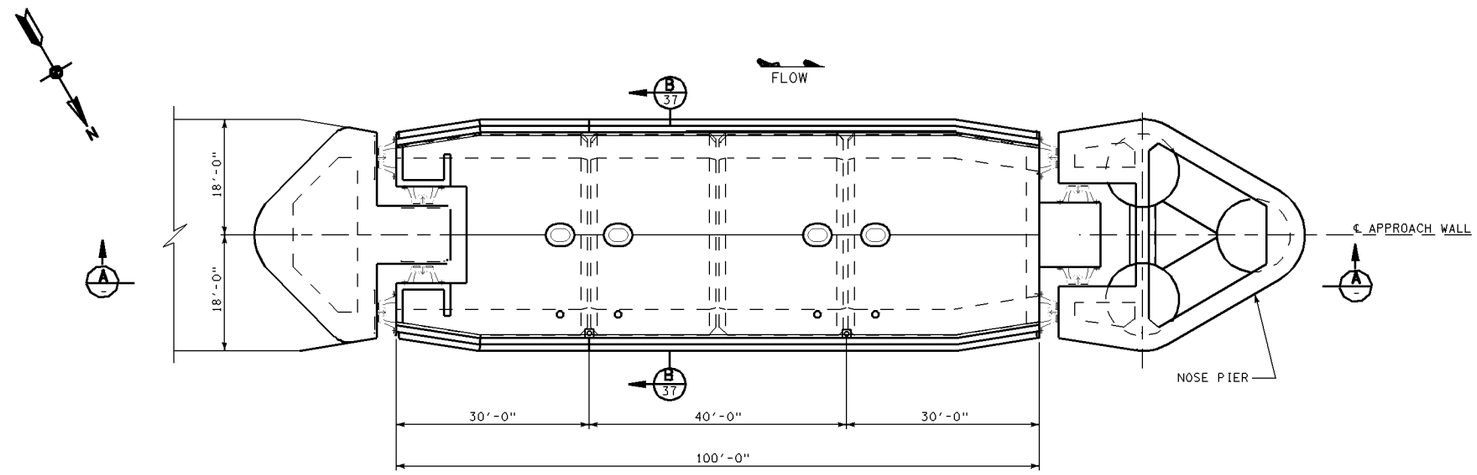
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT. - UPPER MIDDLE & RIVER APPROACH WALL CROSS SECTIONS

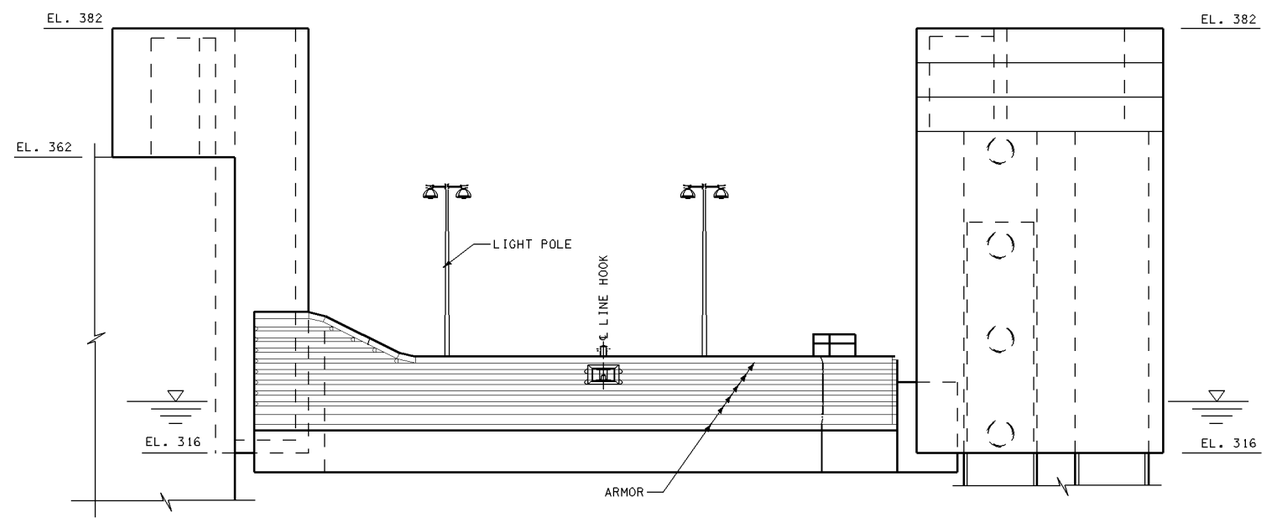
Designed by: JZ
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: ⅜"=1'-0"
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 34 of ____

DRAWING 6.DG

#FILE#
#DATE#
#TIME#



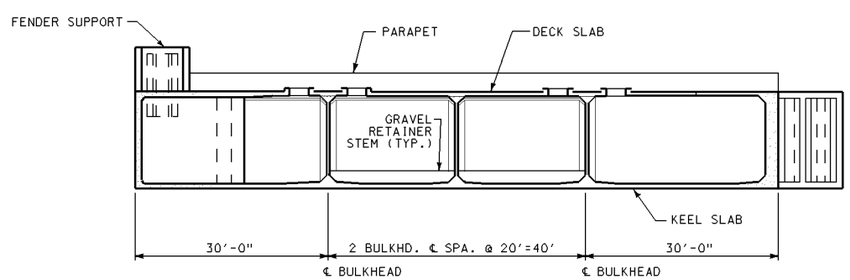
LOWER MIDDLE WALL PLAN
SCALE: 1"=10'



ELEVATION
SCALE: 1"=10'

GRAPHIC SCALE

10 5 0 10 20FT
SCALE: 1"= 10'



SECTION A
SCALE: 1"=10'
NOSE PIER & PYLON ARE NOT SHOWN

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

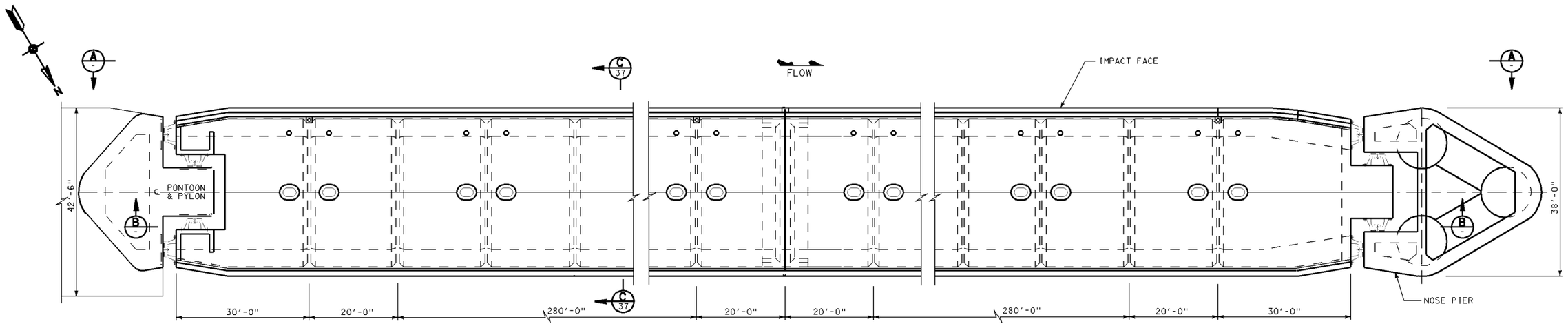
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY – INDIANA

600' LOCK EXTENSION
LOWER MIDDLE
APPROACH WALL

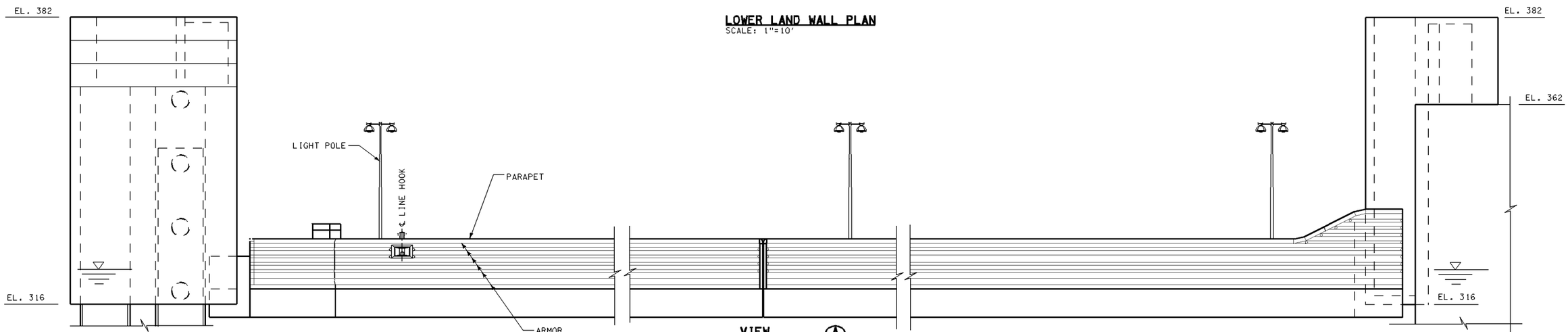
Designed by: LRP
Drawn by: KT
Checked by: MI
Reviewed by:
Scale: 1"=10'
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 35 of ____

DRAWING 6.OH

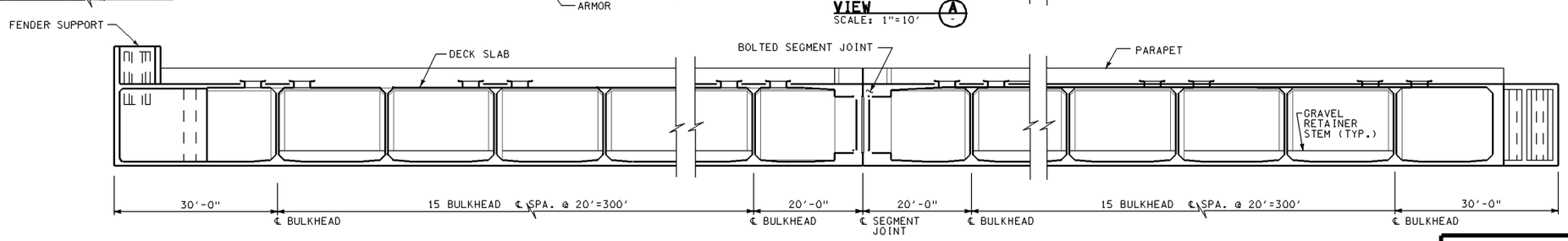
#FILE#
#DATE#
#TIME#



LOWER LAND WALL PLAN
SCALE: 1"=10'



VIEW A
SCALE: 1"=10'



SECTION B
SCALE: 1"=10'
NOTE: NOSE PIER & PYLON ARE NOT SHOWN.

GRAPHIC SCALE
10 5 0 10 20FT
SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

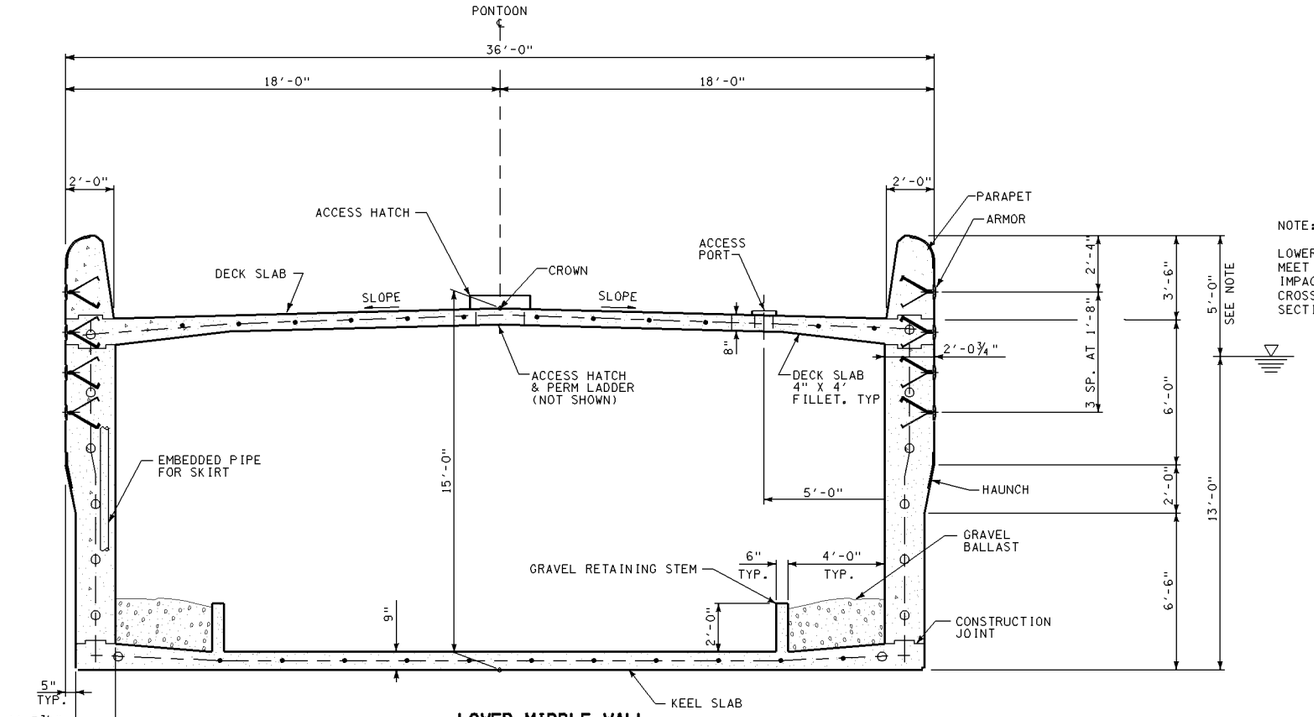
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY – INDIANA

600' LOCK EXTENSION
LOWER LAND
APPROACH WALL

Designed by: ST
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: 1"=10'
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 36 of ____

DRAWING 6.01

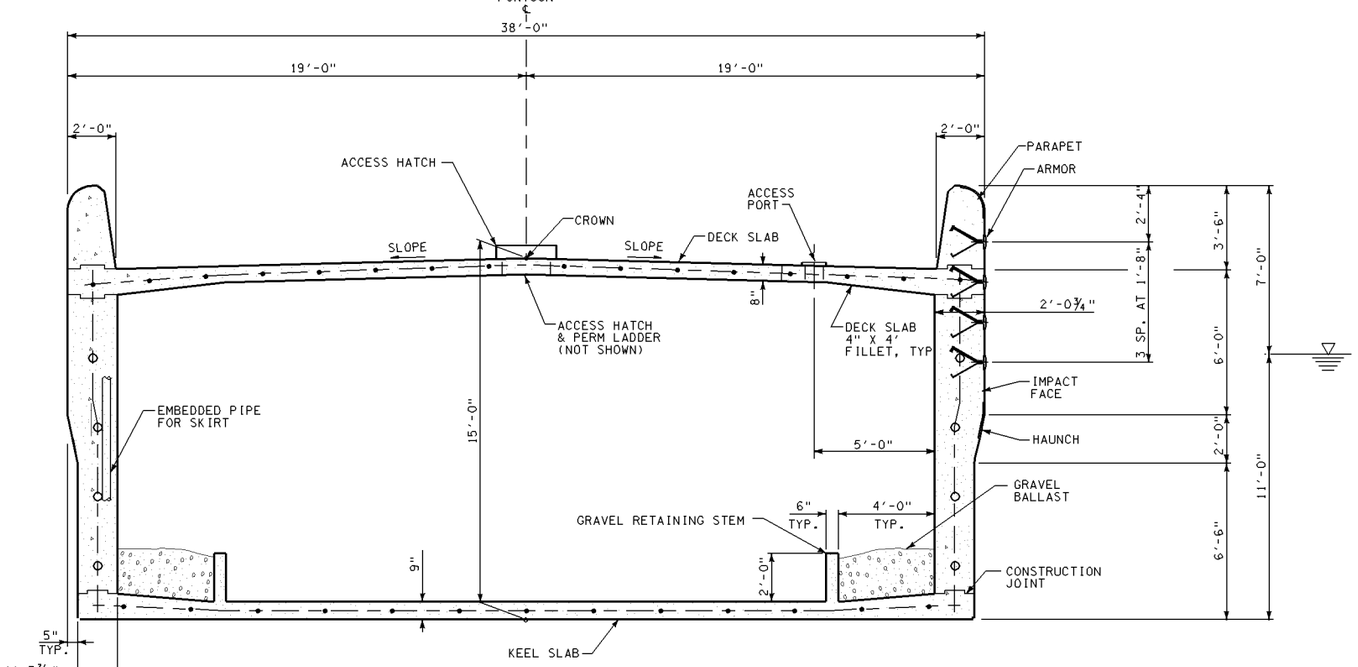
$FILE$
$DATE$
$TIME$



NOTE:

LOWER MIDDLE WALL FREEBOARD DOES NOT MEET STANDARD CRITERIA FOR EXPOSED IMPACT HEIGHT WITH CURRENTLY SHOWN CROSS SECTION. SEE DISCUSSION IN SECTION 9.6.3.

LOWER MIDDLE WALL CROSS SECTION (B / 35)
SCALE: ⅜"=1'-0"



LOWER LAND WALL CROSS SECTION (C / 36)
SCALE: ⅜"=1'-0"

GRAPHIC SCALE

2 0 2 4FT
SCALE: 3/8"= 1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

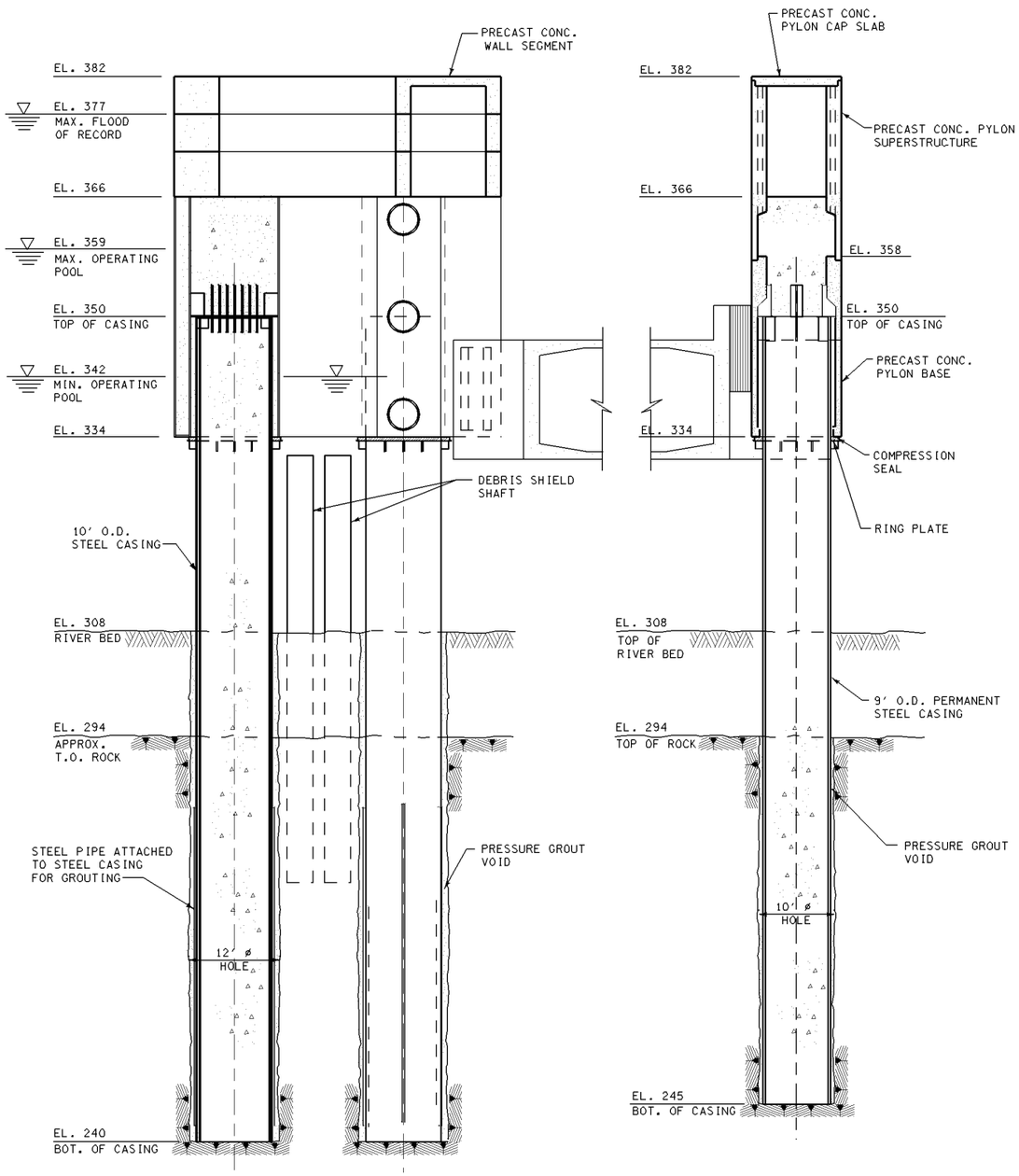
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT. LOWER MIDDLE & LAND APPROACH WALL CROSS SECTIONS

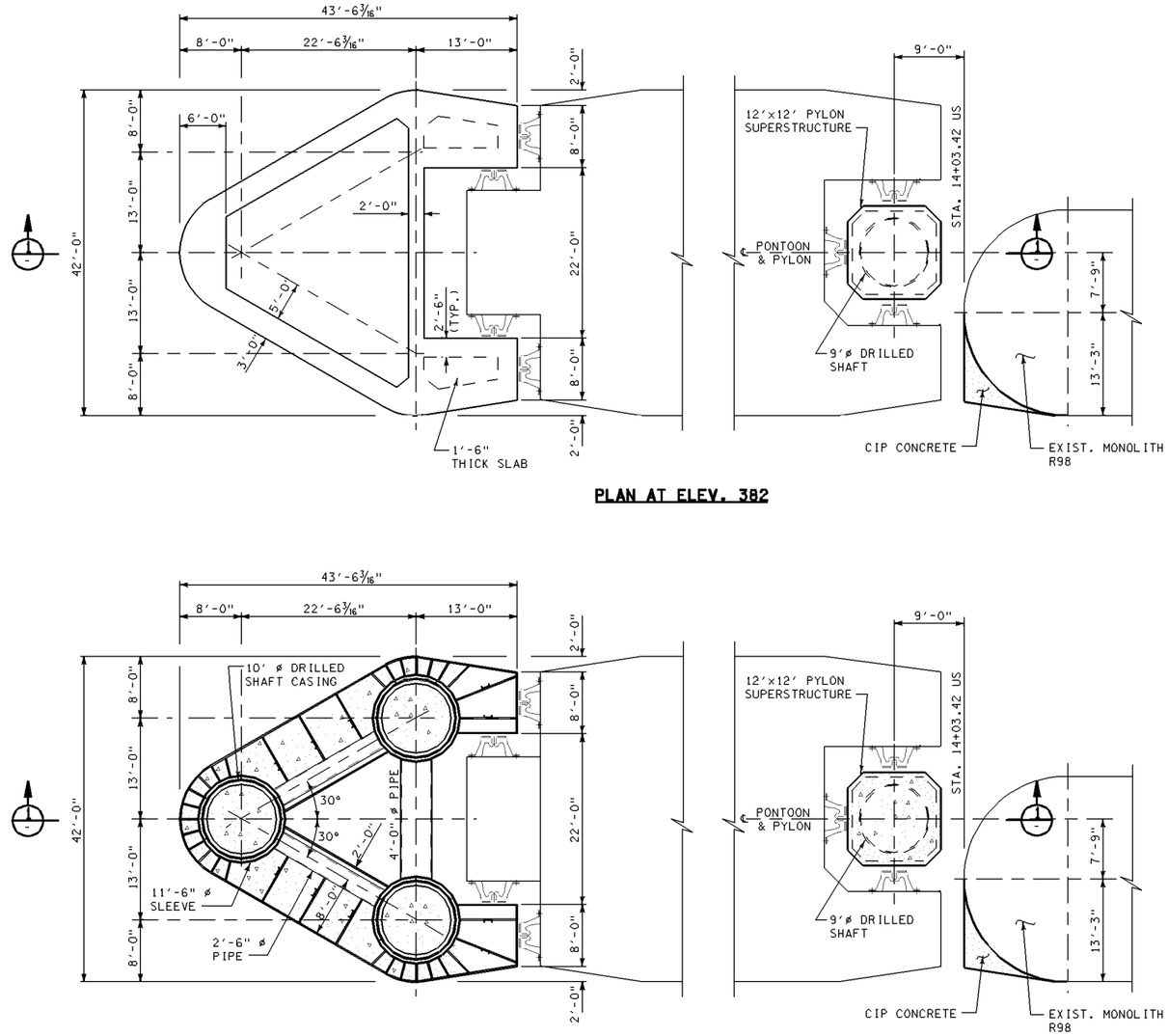
Designed by: ST
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 37 of

DRAWING 6.0J

$FILE$
$DATE$
$TIME$



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



PLAN AT ELEV. 382

PLAN AT ELEV. 360

UPPER RIVER APPROACH WALL NOSE PIER & PYLON

GRAPHIC SCALE
8 6 4 2 0 8 16FT
SCALE: 1/8"=1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

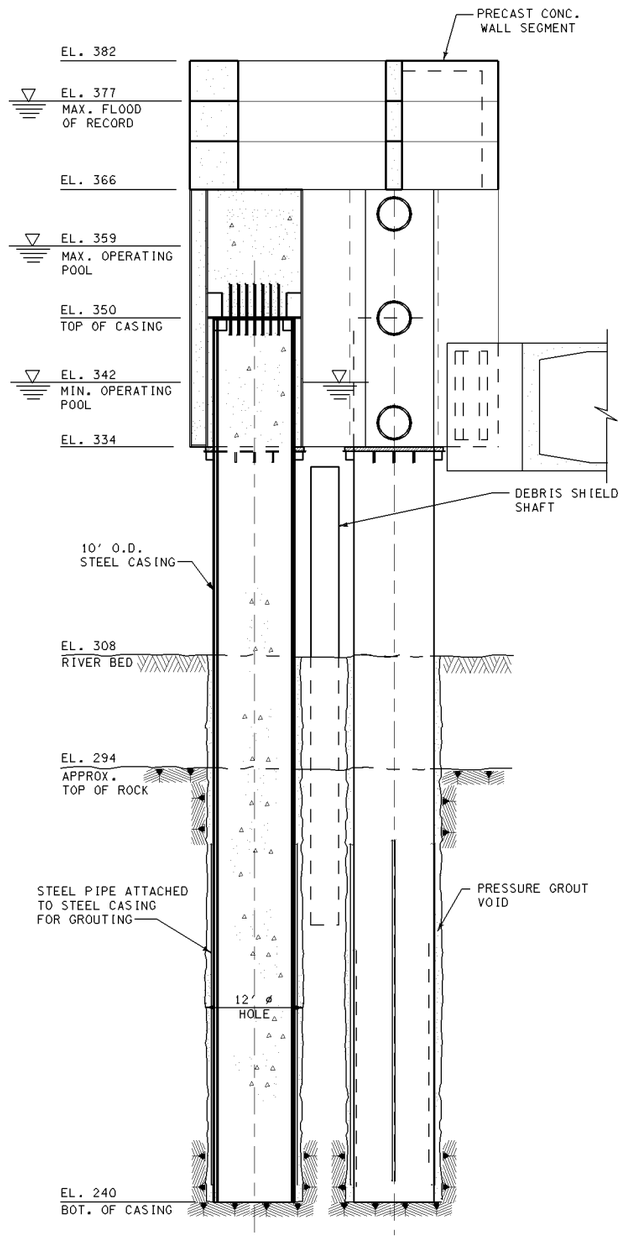
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION UPPER RIVER WALL NOSE PIER & PYLON DETAILS

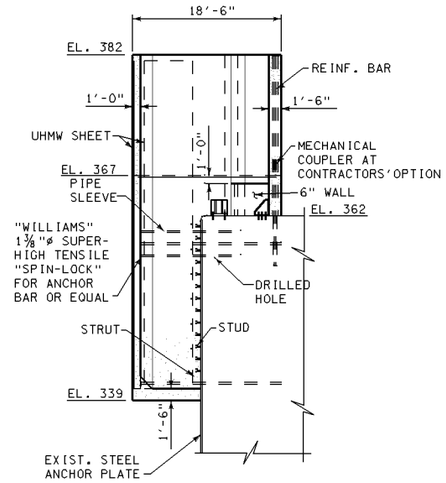
Designed by: MI
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 38 of

DRAWING 6.OK

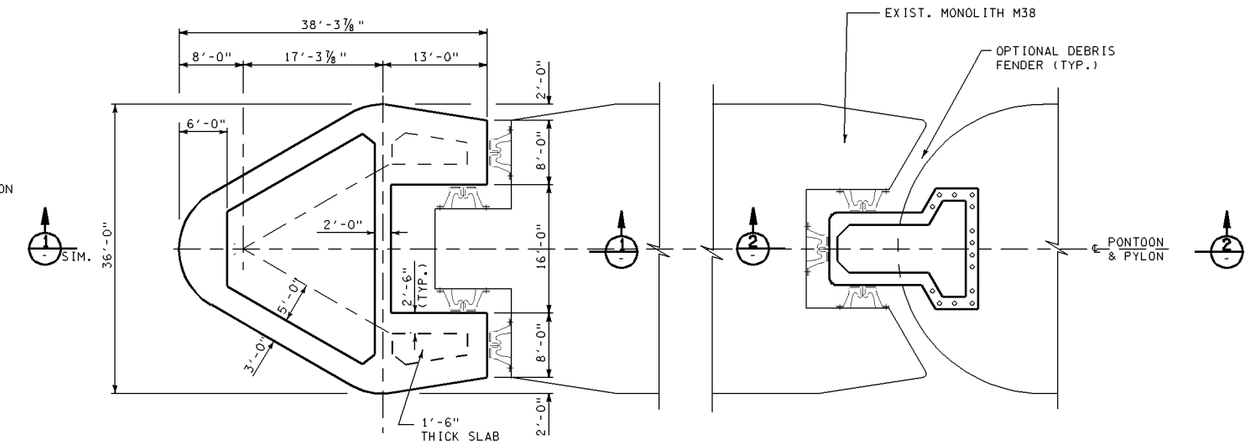
#FILE#
#DATE#
#TIME#



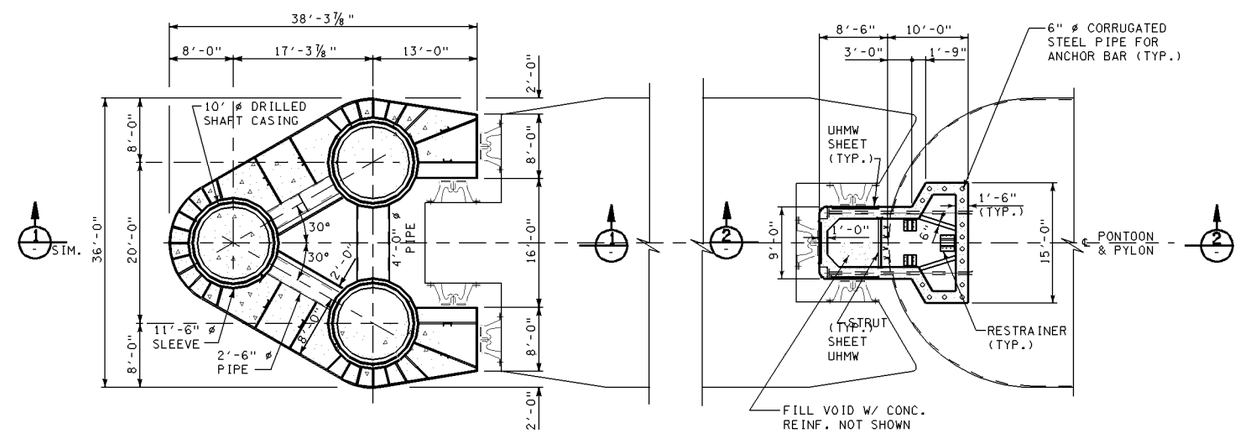
SECTION 1
SCALE: 1/8"=1'-0"



SECTION 2
SCALE: 1/8"=1'-0"



PLAN AT ELEV. 382



PLAN AT ELEV. 360

UPPER MIDDLE APPROACH WALL NOSE PIER & PYLON
SCALE: 1/8"=1'-0"

GRAPHIC SCALE
8 6 4 2 0 8 16FT
SCALE: 1/8"=1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

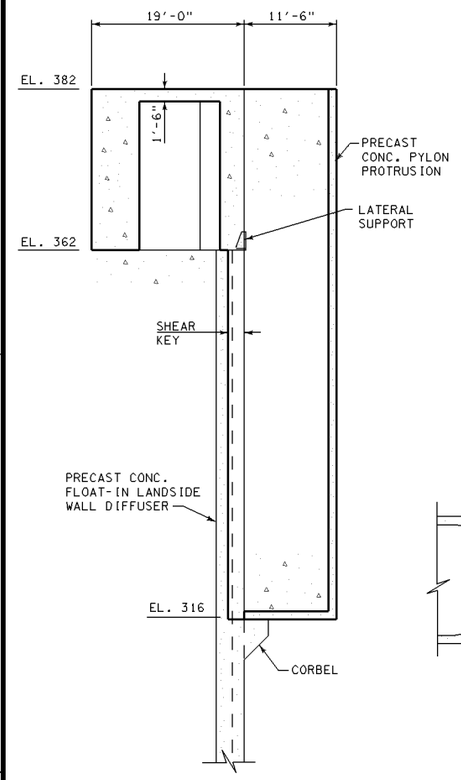
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION UPPER MIDDLE WALL NOSE PIER & PYLON DETAILS

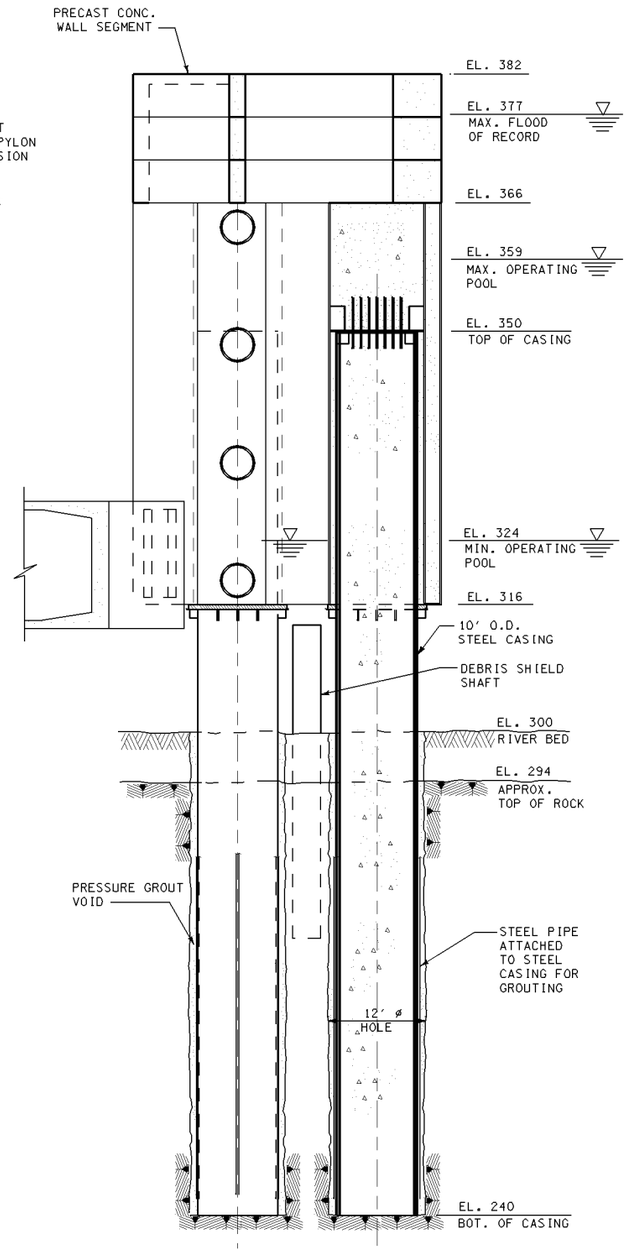
Designed by: MI
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 39 of

DRAWING 6.OL

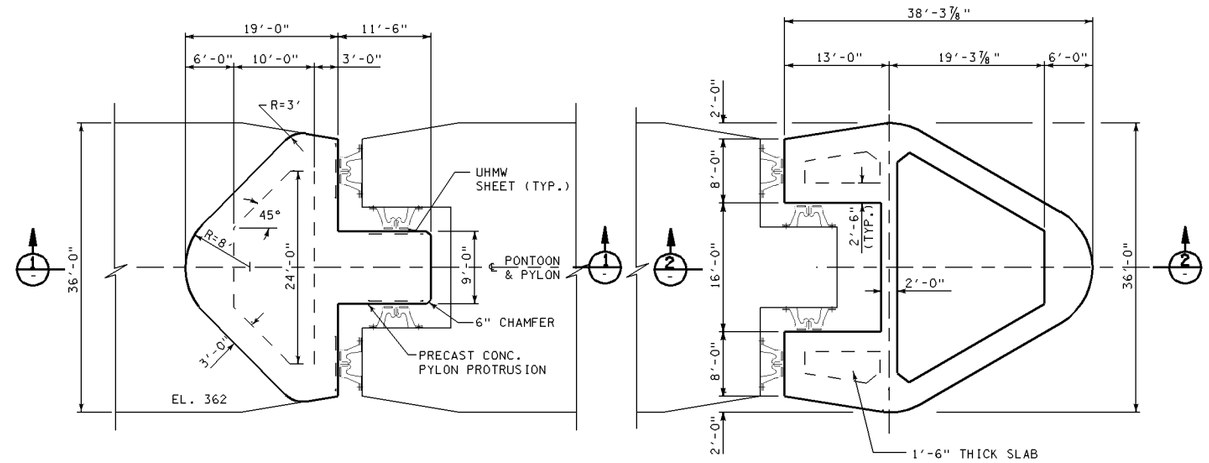
$FILE$
$DATE$
$TIME$



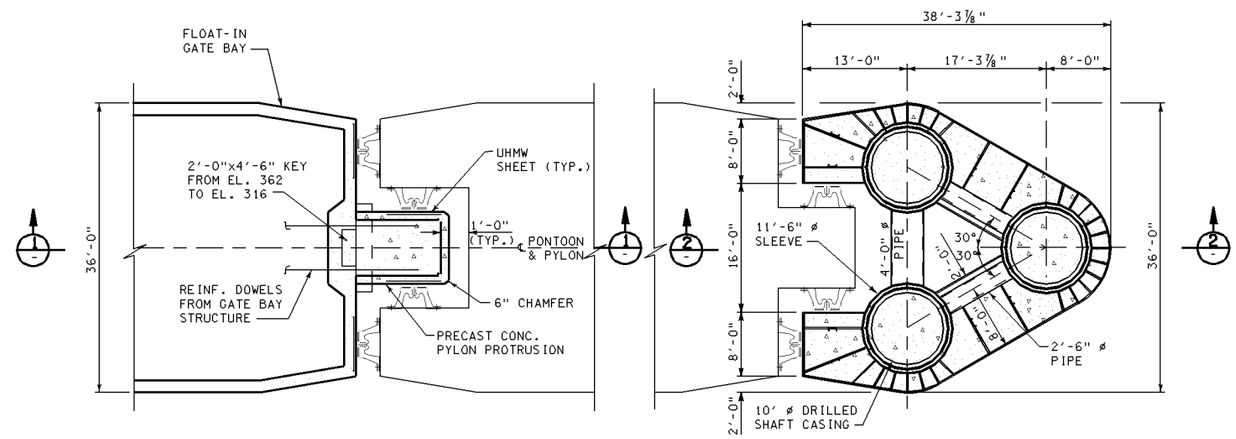
SECTION 1
SCALE: 1/8"=1'-0"



SECTION 2
SCALE: 1/8"=1'-0"



PLAN AT ELEV. 382



PLAN AT ELEV. 330

LOWER MIDDLE APPROACH WALL NOSE PIER & PYLON
SCALE: 1/8"=1'-0"

GRAPHIC SCALE
8 6 4 2 0 8 16FT
SCALE: 1/8"=1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

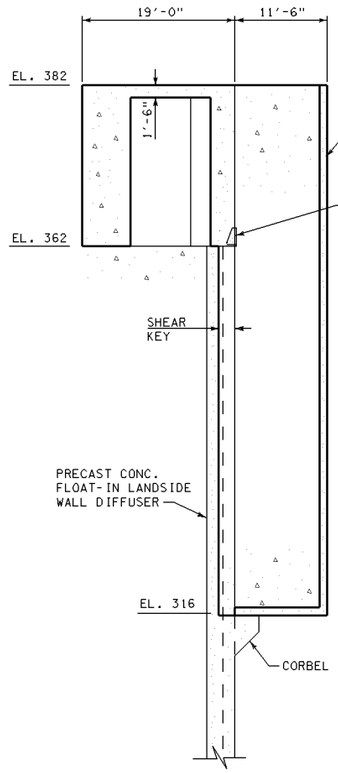
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY – INDIANA

600' LOCK EXT. LOWER APPR. MIDDLE WALL NOSE PIER & PYLON DETAILS

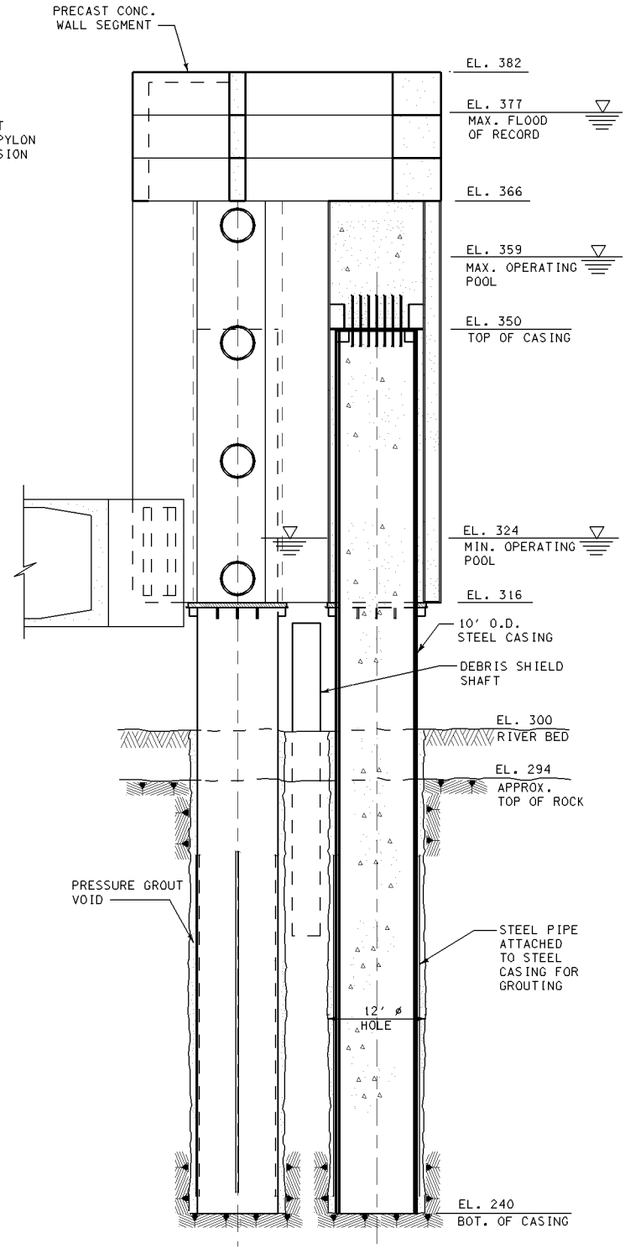
Designed by: MI
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 40 of ____

DRAWING 6.OM

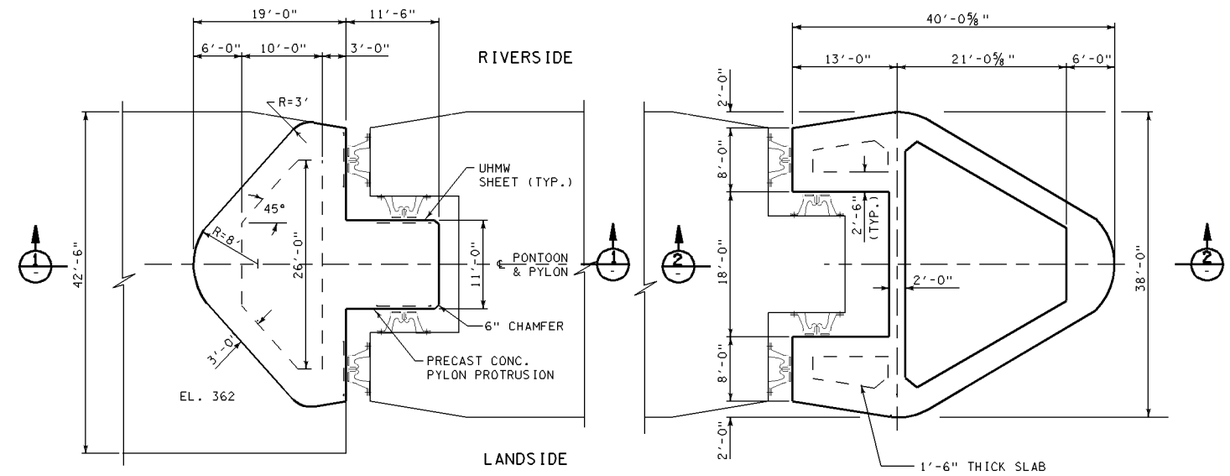
$FILE$
$DATE$
$TIME$



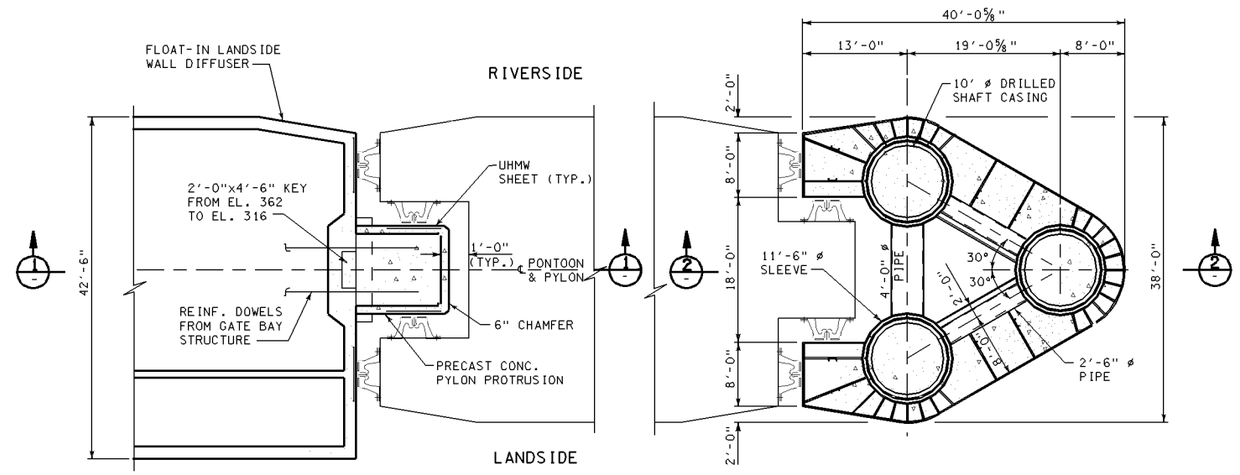
SECTION 1
SCALE: 1/8"=1'-0"



SECTION 2
SCALE: 1/8"=1'-0"



PLAN AT ELEV. 382



PLAN AT ELEV. 330

LOWER LAND APPROACH WALL NOSE PIER & PYLON
SCALE: 1/8"=1'-0"

GRAPHIC SCALE
8 6 4 2 0 8 16FT
SCALE: 1/8"=1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

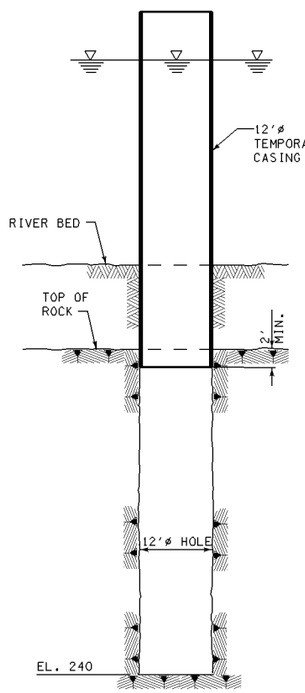
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

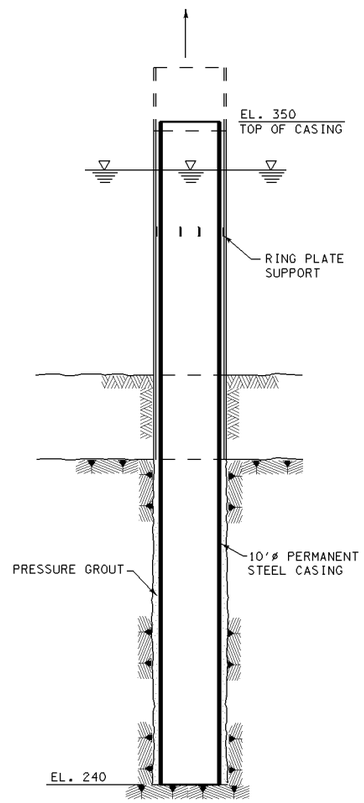
600' LOCK EXT. LOWER LAND APPROACH WALL NOSE PIER & PYLON DETAILS

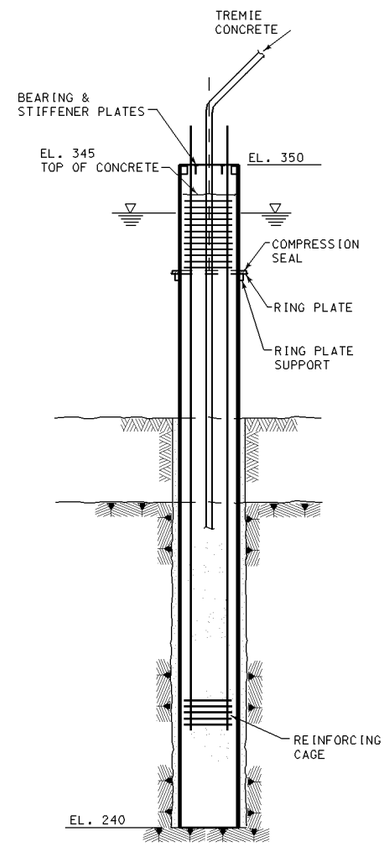
Designed by: MI
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 41 of

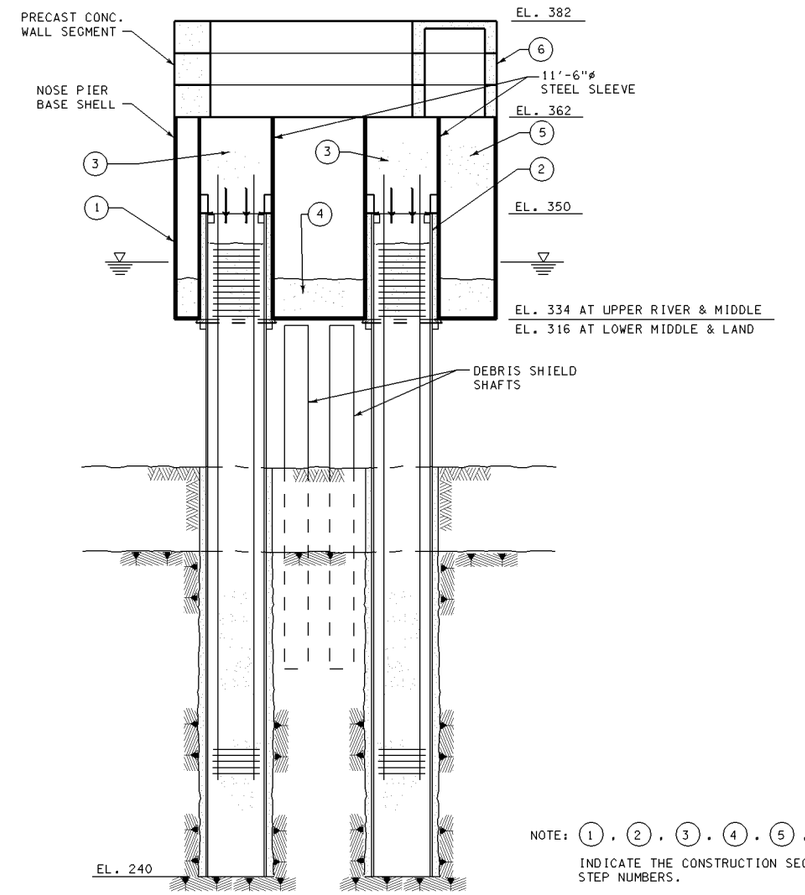
DRAWING 6.ON

$FILE$
$DATE$
$TIME$









NOTE: 1, 2, 3, 4, 5, INDICATE THE CONSTRUCTION SEQUENCE STEP NUMBERS.

NOSE PIER & PYLON CONSTRUCTION SEQUENCE

THE CONSTRUCTION SEQUENCE SHOWN IS FOR THE NOSE PIERS ONLY. THE CONSTRUCTION SEQUENCE FOR THE UPPER RIVER PYLON IS SIMILAR TO THE NOSE PIERS EXCEPT FOR THE TEMPORARY AND PERMANENT STEEL CASING SIZES.

DRILLED SHAFT CONSTRUCTION SEQUENCE

1. INSTALL 12' DIA. TEMPORARY STEEL CASING AT LEAST 2 FEET MINIMUM INTO THE ROCK LAYER. EXCAVATE INSIDE THE CASING AS REQUIRED TO LOWER THE CASING.
2. DRILL 12' DIA. HOLE IN THE ROCK LAYER TO FINAL SHAFT TIP ELEVATION.
3. INSTALL 10' DIA. PERMANENT STEEL CASING WITH THE RING PLATE SUPPORTS (FIELD WELD OR SHOP WELD AT CONTRACTOR'S OPTION). IF THE RING PLATE SUPPORTS ARE INSTALLED IN THE FIELD, THE SUPPORTS SHALL BE INSTALLED ABOVE WATER DURING THE CASING INSTALLATION.
4. PRESSURE GROUT AROUND THE 10' DIA. CASING. PULL OUT THE 12' DIA. CASING WHILE GROUTING AROUND THE 10' DIA. CASING ABOVE THE ROCK LAYER.
5. INSTALL THE RING PLATE.
6. INSTALL THE REINFORCING CAGE AND PLACE TREMIE CONCRETE TO ELEV. 345.
7. DEWATER INSIDE THE CASING AND INSTALL BEARING AND STIFFENER PLATES.
8. CONSTRUCT REMAINING TWO SHAFTS FOR THE NOSE PIER.
9. INSTALL THE DEBRIS SHIELD SHAFTS. THE DEBRIS SHIELD SHAFTS SHALL BE INSTALLED PRIOR TO NOSE PIER SUPERSTRUCTURE INSTALLATION. THE SHAFTS MAY BE CONSTRUCTED AT THE SAME TIME AS THE NOSE PIER DRILLED SHAFT CONSTRUCTION.

SUPERSTRUCTURE CONSTRUCTION SEQUENCE

1. INSTALL THE BASE SHELL STRUCTURE ON THE DRILLED SHAFTS.
2. PLACE GROUT IN THE GAP BETWEEN 10' DIA. CASING AND 11'-6" DIA. STEEL SLEEVES TO ELEV. 350.
3. AFTER THE GROUT IN STEP 2 IS SET, PLACE CONCRETE INSIDE THE 10' DIA. CASINGS AND 11'-6" DIA. SLEEVES TO ELEV. 362.
4. PLACE CONCRETE INSIDE THE BASE SHELL TO APPROXIMATELY 5 FEET DEEP. ALLOW THE CONCRETE TO REACH 2000 PSI MINIMUM STRENGTH.
5. PLACE CONCRETE INSIDE THE BASE SHELL (NOT MORE THAN 8 FEET DEEP) AND ALLOW THE CONCRETE TO REACH 2000 PSI MINIMUM STRENGTH. REPEAT THIS STEP AS REQUIRED TO FILL CONCRETE INSIDE THE SHELL TO ELEV. 366.
6. INSTALL PRECAST CONCRETE WALL SEGMENTS.

GRAPHIC SCALE

8 0 8 16FT

SCALE: 3/32"= 1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

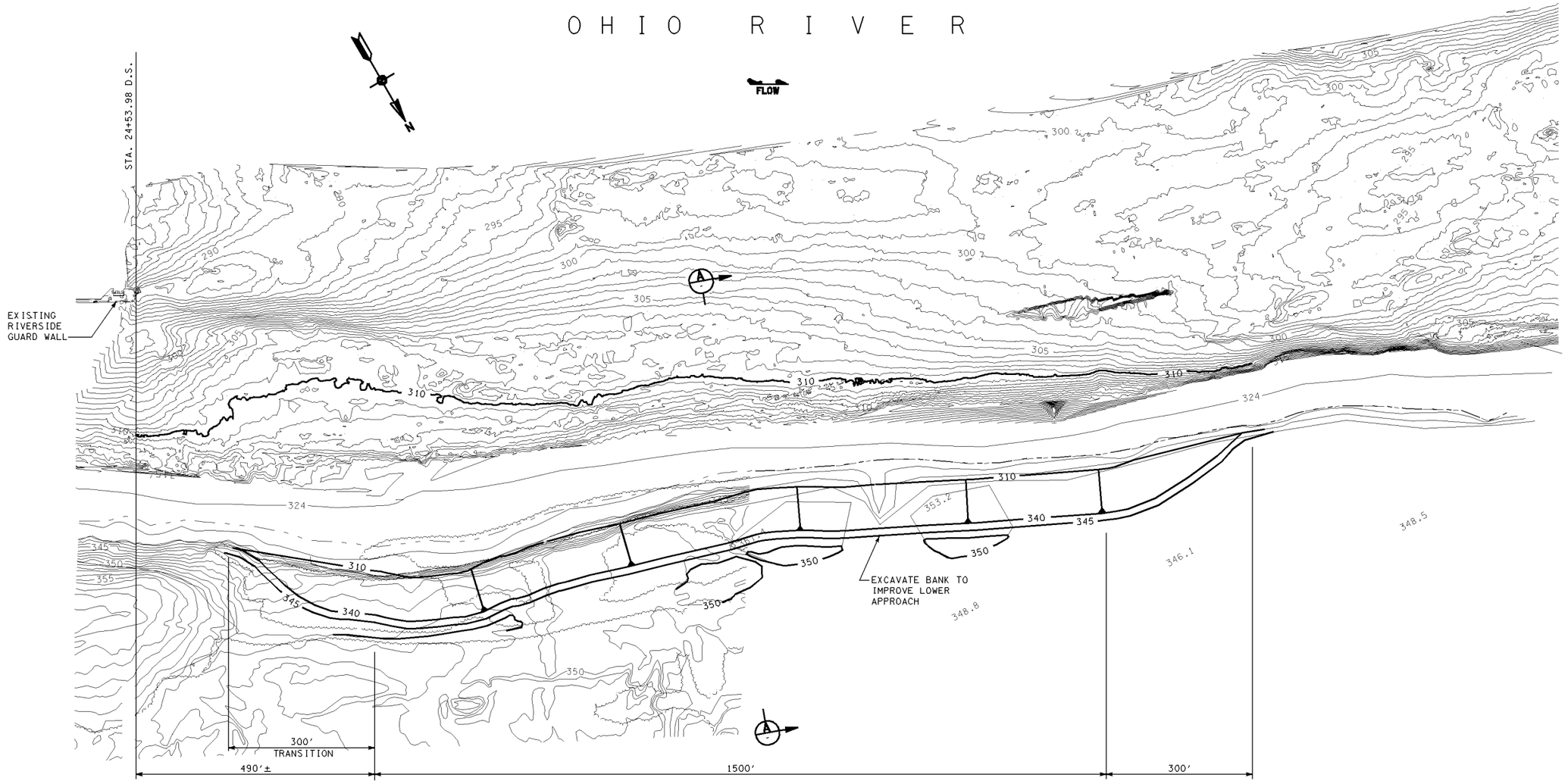
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION NOSE PIER & PYLON CONSTRUCTION SEQUENCE

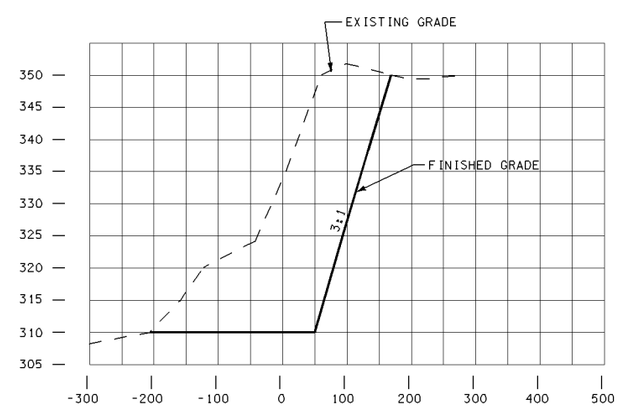
Designed by: MI
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 42 of

DRAWING 6.00

#FILE#
#DATE#
#TIME#



PLAN
SCALE: 1"=100'



SECTION
VERT. SCALE: 1"=10'
HORIZ. SCALE: 1"=100'

GRAPHIC SCALE

SCALE: 1"= 10'

SCALE: 1"= 100'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

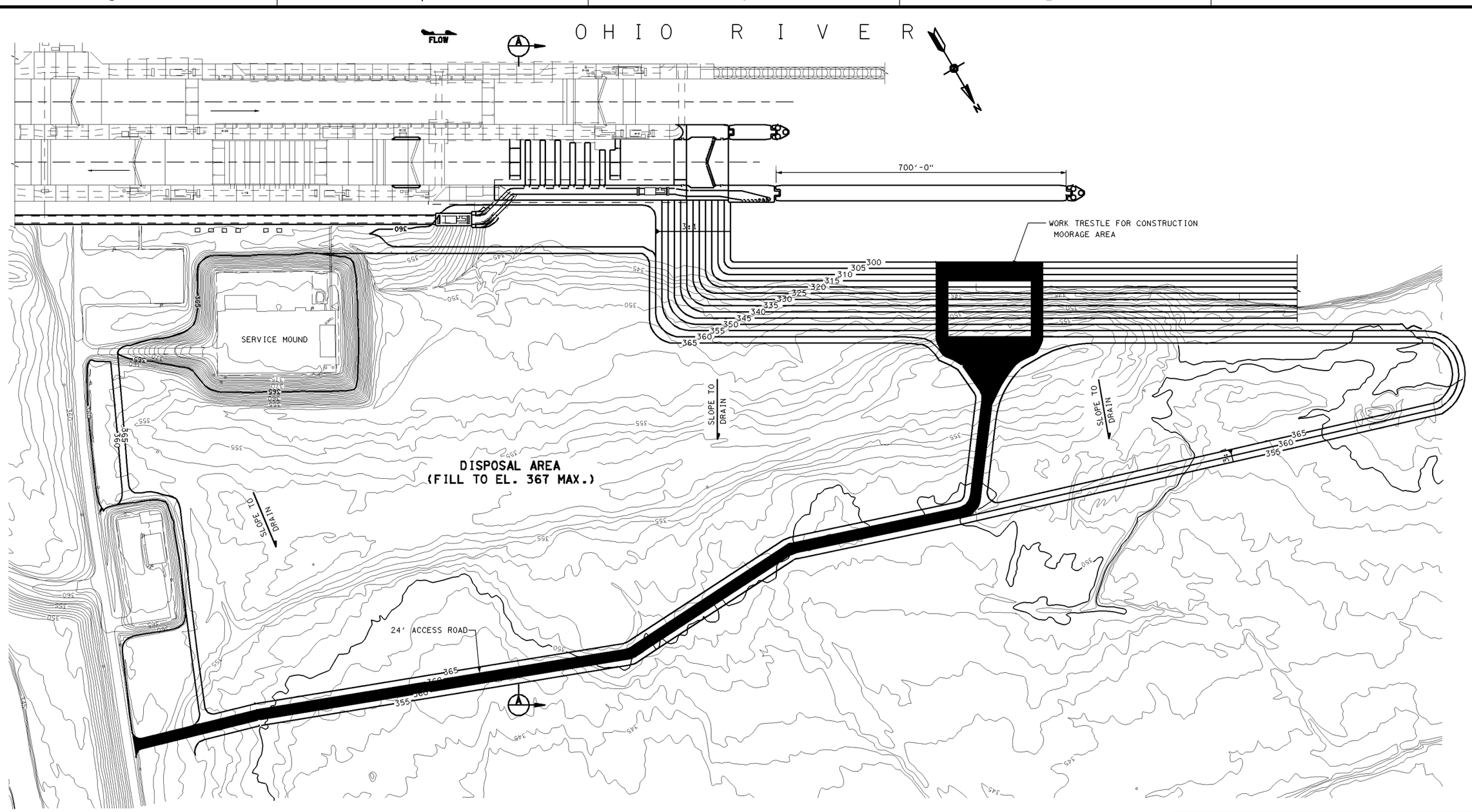
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION LOWER APPROACH CHANNEL IMPROVEMENT

Designed by: JE/ST
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 43 of ____

DRAWING 8.1.1A

$FILE$
$DATE$
$TIME$



PLAN

100 50 0 50 100 200FT

SCALE: 1"=100'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

Designed by: JE

Drawn by: KT

Checked by: LRP

Reviewed by:

600' LOCK EXTENSION DISPOSAL AREA PLAN

Scale: 1"=100'

Date: AUGUST 1999

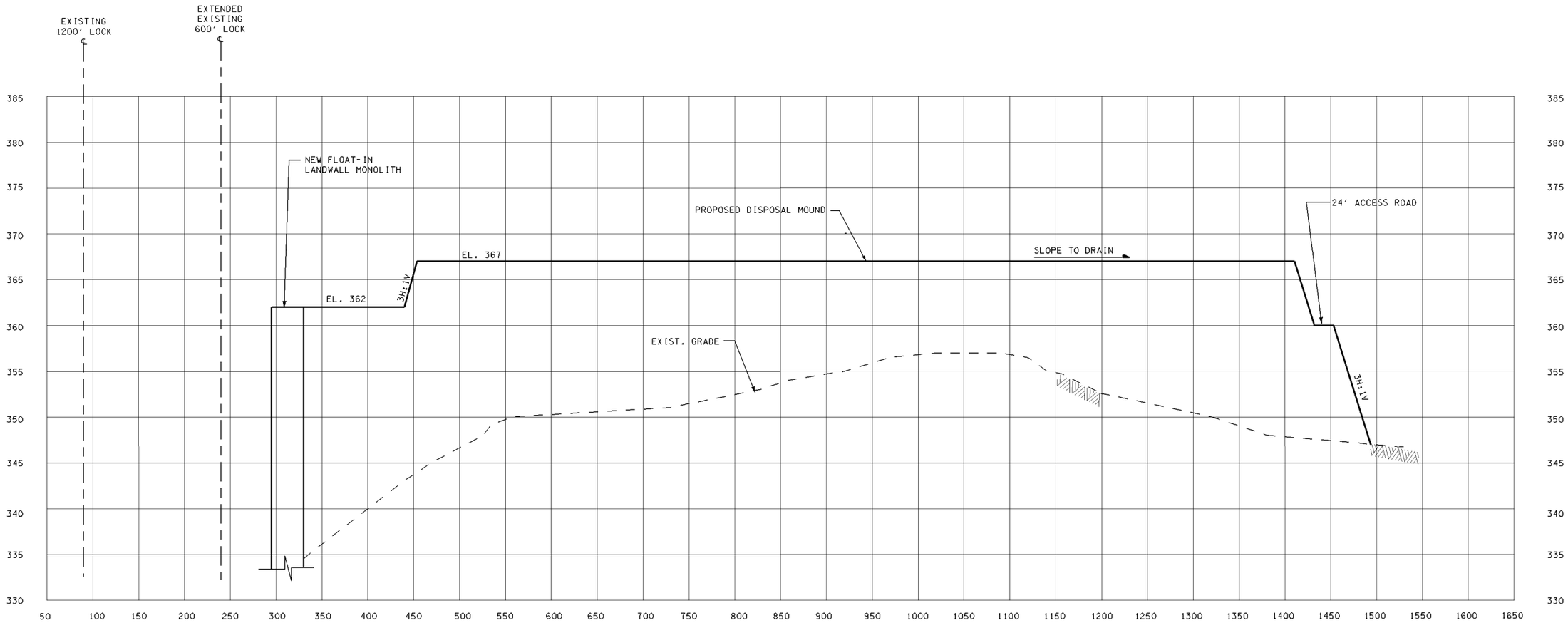
Drawing Code:

Sheet reference number:

Sheet 44 of ____

DRAWING 8.3A

#FILE#
#DATE#
#TIME#



CROSS SECTION (A)
HORIZ. SCALE: 1"=50'
VERT. SCALE: 1"=5'

GRAPHIC SCALE

50 25 0 50 100FT
SCALE: 1"= 50'

5 0 5 10FT
SCALE: 1"= 5'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY – INDIANA

600' LOCK EXTENSION
DISPOSAL MOUND
CROSS SECTION

Designed by: ST
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 45 of ____

DRAWING 8.3B

$FILE$
$DATE$
$TIME$

OHIO RIVER
FLOW
NORMAL UPPER POOL EL. 342.00'

EXISTING ℄ 110'×600' LOCK CHAMBER

EXISTING 2 - 500 MCM BARE COPPER GROUND 3'-0" UNDERGROUND SEE NOTE 4

PROVIDE NEW ELECTRIC SERVICE BETWEEN OPERATION BUILDING AND MOORING BASIN

OPERATIONS BUILDING

RELOCATE EXIST. UTILITIES AND SUPPORT ON SIDE OF WALL DURING CULVERT EXCAVATION

RELOCATE EXIST. COPPER GROUND PLATES

EXTEND 4" RAW WATER LINE PAST NEW GATE BAY

PROPOSED VALVE MONOLITH

REMOVE EXIST. RAW WATER OUTLET

REMOVE EXIST. 4" RAW WATER

EXIST. SEWER DRAIN FIELD TO BE RELOCATED

REMOVE 2" WATER

CONCRETE WALK

SEE NOTE 3

REMOVE EXIST. RAW WATER OUTLET

REMOVE EXIST. 2" RAW WATER

PICNIC AREA SEE NOTE 2

4" FORCE MAIN

1½" HYDRAULIC OIL FILL LINE

RELOCATE UTILITIES SEE NOTE 6

EXIST. 500 MCM BARE COPPER GROUND

1½" FUEL OIL

RELOCATE EXIST. TELEPHONE, OIL AND ELECTRIC LINES TO RUN PARALLEL TO OTHER UTILITIES. SUPPORT UTILITIES ON TEMPORARY PEDESTRIAN & UTILITY BRIDGE STRUCTURE OVER CULVERT EXCAVATION.

REMOVE 4" EXIST. PLUGGED TEE

RELOCATE EXIST. GROUND CABLES BOLTED AND BRAZED TO PILINGS @ 20'-0"± CENTERS. TOP WIRE IS APPROX. 3'-0" BELOW GROUND SURFACE AND SECOND WIRE IS 2'-0" LOWER.

REMOVE EXISTING RAW WATER OUTLET

PROPOSED 4" RAW WATER LINE WITH 4 OUTLETS SEE NOTE 5

EXIST. RAW WATER OUTLET TO REMAIN

SEWAGE TREATMENT PLANT

EXTEND 4" RAW WATER LINE ACROSS CULVERT EXCAVATION. MAKE CONNECTION TO EXIST. RAW WATER OUTLET AND TO NEW 4" LINE RUNNING PARALLEL TO LOCKS. PROVIDE NEW OUTLETS AS SHOWN. SEE NOTE 5.

4" PLUGGED TEE

EXIST. PARKING AREA

2" WATER

PUBLIC COMFORT STATION

RAW WATER OUTLET (2 LOCATIONS AT MOORING BASIN)

4" FORCE MAIN

(ABANDONED) EXISTING OVERHEAD POWER AND UTILITY POLES TO SMALL BOAT BASIN TO BE REMOVED

NEW 4" RAW WATER TO MOORING BASIN

2/C 10 1" C 3'-0" UNDER PAVEMENT

3 #10. ¾" C 2'-0" UNDER SURFACE

SERVICE BUILDING

DRIVE TO SERVICE BUILDING

EXISTING 3/C #12 DIRECT BURIED CABLE 3'-0" UNDER SURFACE

EXIST. TELEPHONE LINE

EXIST. 2 - 3/C 500 MCM DIRECT BURIED POWER CABLES 3'-0" UNDERGROUND

(ABANDONED) EXISTING 3/C #6 1¼" CONDUIT-3'-0" UNDER SURFACE

EXISTING 3/C #6 DIRECT BURIED CABLE 3'-0" UNDER SURFACE

EXISTING 3/C #12 DIRECT BURIED CONTROL CABLE FOR HYDRAULIC OIL TRANSFER PUMP 3'-0" UNDERGROUND

2" WATER

(ABANDONED)

(ABANDONED)

ENTRANCE ROAD

2" WATER

CONC. LAB

FIELD OFFICE

6" V.C.P.

3ø, 13,000 V POWER LINE

LEGEND

- EXISTING ELECTRIC
- EXISTING POWER
- EXISTING TELEPHONE
- EXISTING WATER
- EXISTING SEWER
- EXISTING HYDRAULIC OR FUEL OIL
- PROPOSED ELECTRIC
- PROPOSED POWER
- PROPOSED TELEPHONE
- PROPOSED WATER
- PROPOSED SEWER
- PROPOSED HYDRAULIC OR FUEL OIL

NOTES:

1. EXISTING UTILITY LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE FIELD VERIFIED.
2. ALL PICNIC TABLES AND OTHER FIXTURES FOR PUBLIC USE SHALL BE REMOVED. STORED AND PROTECTED FROM THE WEATHER DURING ALL WORK ON THE LOCKS. THE TABLES AND FIXTURES SHALL BE REINSTALLED AT THE COMPLETION OF LOCK WORK.
3. REMOVE AND STORE EXISTING LIGHT POLE DURING CULVERT EXCAVATION. REINSTALL POLE ON NEW CONCRETE BASE WHEN CULVERT WORK HAS BEEN COMPLETED.
4. RELOCATE AND SUPPORT GROUND CABLES ALONG FACE OF LAND WALL. CONNECT TO RELOCATED GROUND PLATES.
5. THE NEW RAW WATER LINE MUST BE INSTALLED AND OPERATIONAL BEFORE THE EXISTING LINE IS SHUTDOWN AND REMOVED.
6. ALL RELOCATED UTILITIES SHALL BE SUPPORTED ON TEMPORARY BRIDGE OVER CULVERT EXCAVATION. PROTECT UTILITIES FROM FREEZING.

PLAN

60 30 0 60 120FT

SCALE: 1"= 60'

Revisions				
Symbol	1:50	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

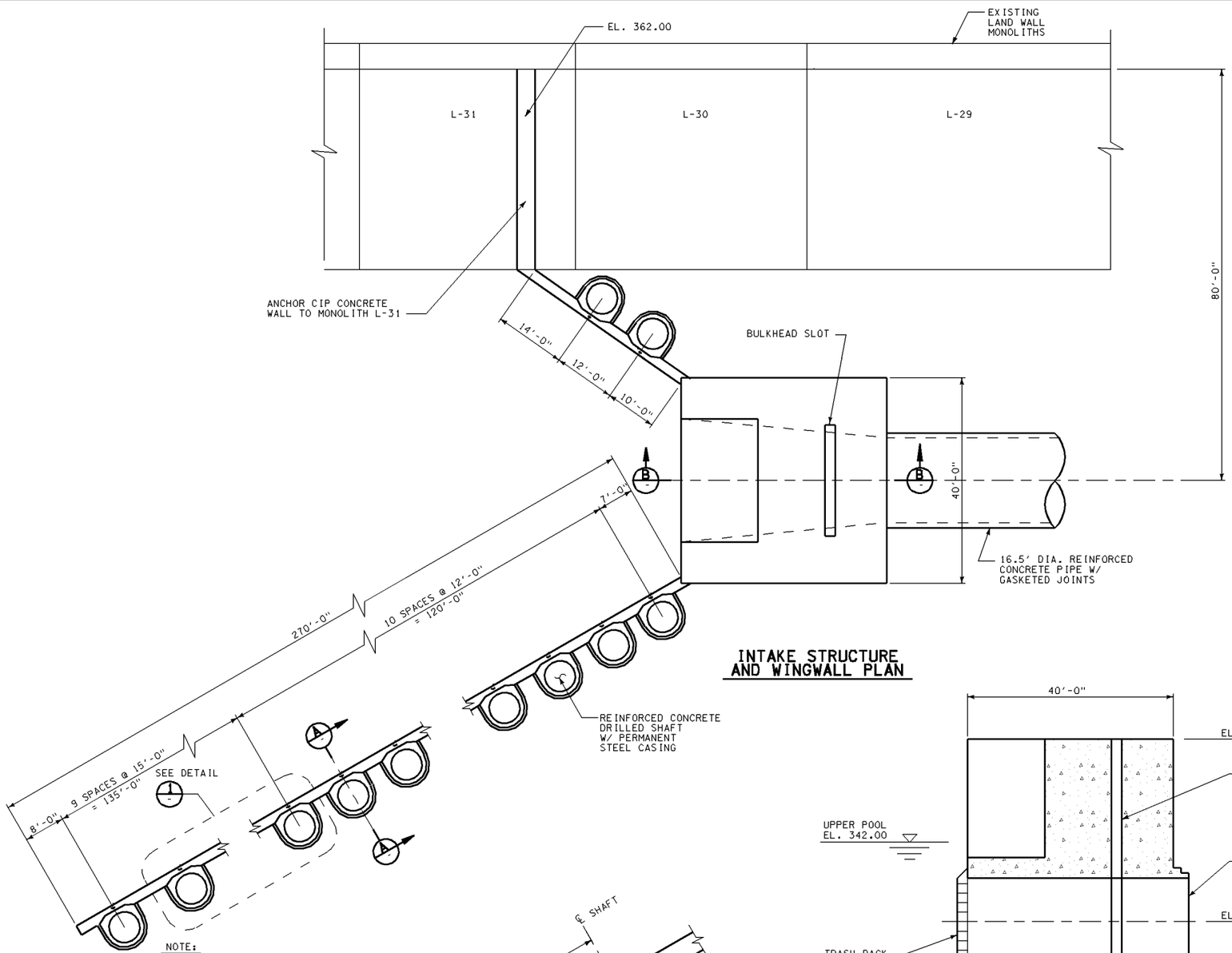
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION UTILITIES

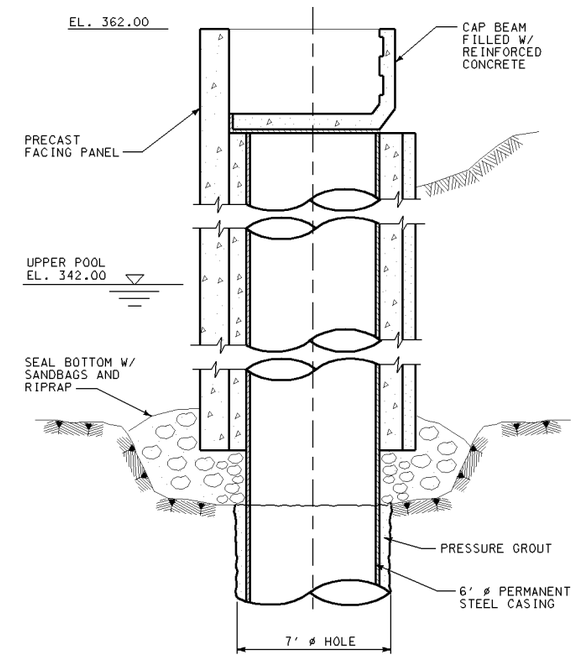
Designed by: JE	Scale: 1:60	Sheet reference number:	
Drawn by: KT	Date: AUGUST 1999		
Checked by: LP	Drawing Code:		Sheet 46 of ____
Reviewed by:			

DRAWING 8.4.3A

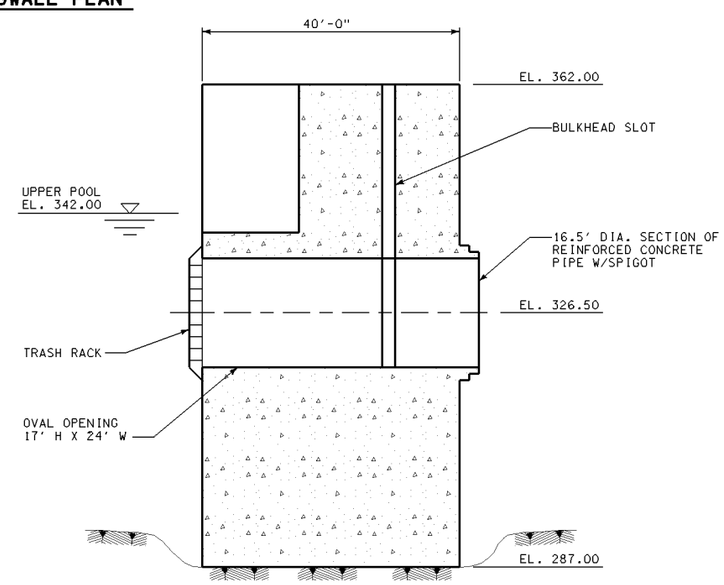
$FILE$
$DATE$
$TIME$



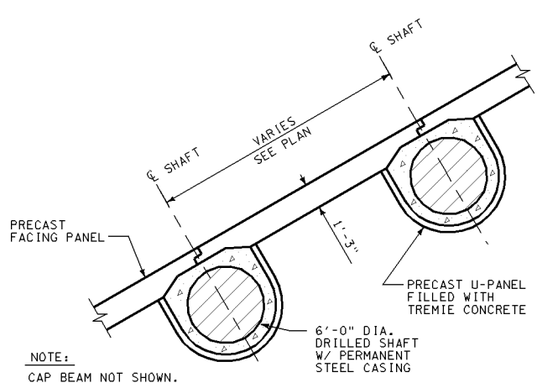
INTAKE STRUCTURE AND WINGWALL PLAN



SECTION A



SECTION B



WINGWALL DETAIL 1

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

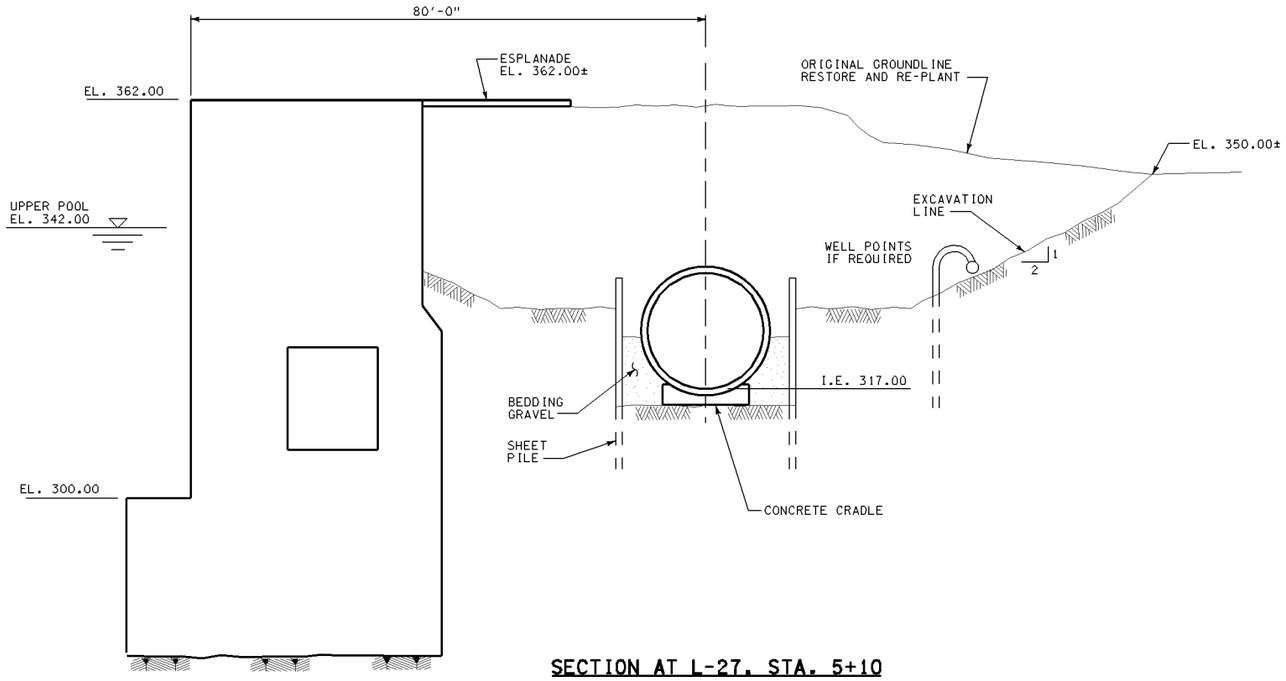
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT., WRAP AROUND CULVERT INTAKE STRUCTURE & WINGWALL

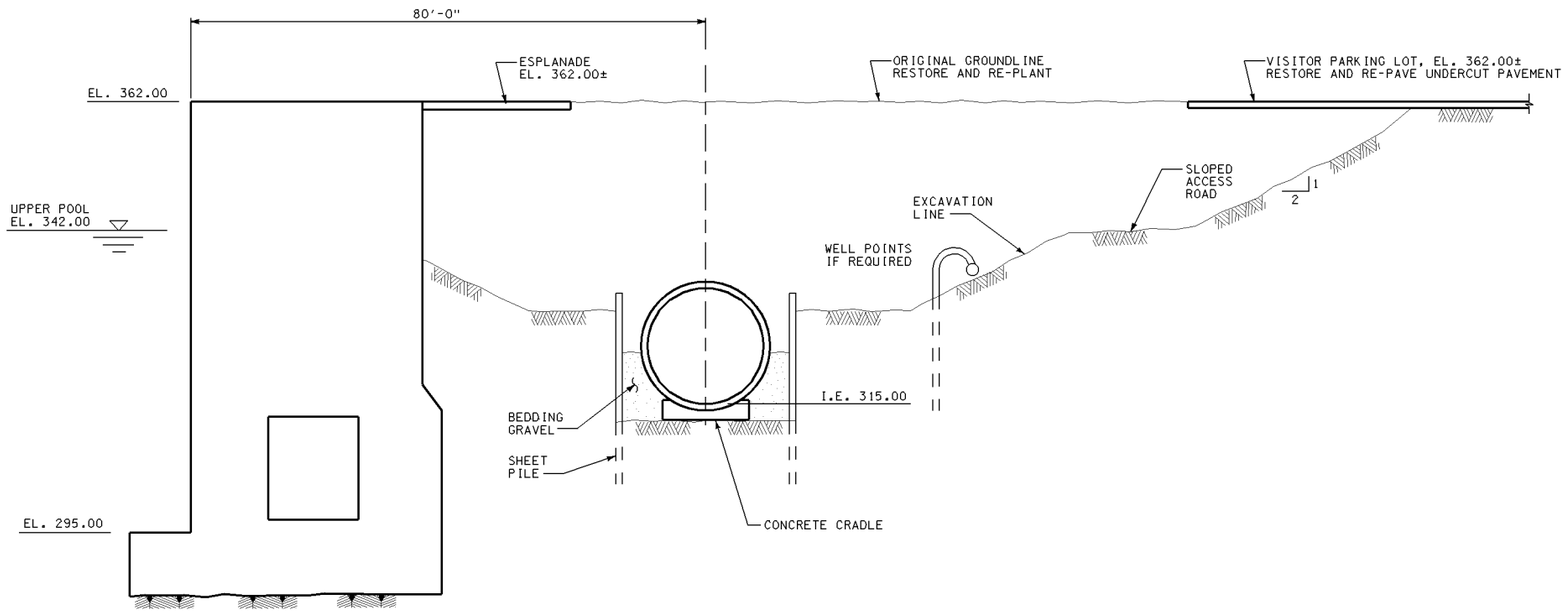
Designed by: LP
Drawn by: CS
Checked by: AA
Reviewed by:
Scale: N.T.S.
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 47 of

DRAWING 9.4.1A

$FILE$
$DATE$
$TIME$



SECTION AT L-27, STA. 5+10



SECTION AT L-18, STA. 9+65

OPTION "A" CONSTRUCTION SEQUENCE:

1. CONSTRUCT PORTION OF WINGWALLS, CONSTRUCT BERM AROUND EXISTING MOORING FACILITY SHEETPILE WALL TO CUT OFF WATER AT UPSTREAM END, CONSTRUCT BERM AT DOWNSTREAM END OF WRAP-AROUND CULVERT, DEWATER, AND CONSTRUCT INTAKE STRUCTURE AND REMAINING PORTION OF WINGWALLS.
2. EXCAVATE TO A LEVEL APPROXIMATELY 10 FEET ABOVE THE INVERT ELEVATION, USING EARTH MOVING EQUIPMENT. STOCKPILE MATERIAL ON SITE SO IT CAN BE RECOVERED. GRADE AN ACCESS ROADWAY FROM THE TOP DOWN TO THIS BOTTOM LEVELFOR TRUCK AND EQUIPMENT ACCESS TO THE PIPE CONSTRUCTION.
3. BASED ON TEST HOLES. DESIGN AND INSTALL WELL POINT SYSTEM FOR DRAWING DOWN THE WATER TABLE TO PERMIT EXCAVATION AND INSTALLATION OF THE CULVERT PIPE IN THE DRY.
4. INSTALL A DOUBLE ROW OF Z-SHEETPILES EACH SIDE OF THE CENTERLINE OF CULVERT PIPE. LENGTH OF SHEETPILE RUNS AND NUMBER OF REUSES OF SHEETPILES SHALL BE AT CONTRACTOR'S OPTION.
5. EXCAVATE INSIDE THE SHEETPILES ROWS TO ABOUT 3 FEET BELOW INVERT ELEVATION.
6. INSTALL 16.5' DIA. REINFORCED CONCRETE PIPE WITH FLUSH SPIGOT JOINTS AND NEOPRENE GASKETS, PIPE LENGTHS SHALL BE CONTRACTOR'S OPTION WITHIN 8' TO 12' RANGE BASED ON FORMWORK AND HANDLING EQUIPMENT. USE APPROVED, WASHED BEDDING GRAVEL UNDER PIPE AND UP TO THE SPRING LINE.
7. INTEGRATE REINFORCED CONCRETE PIPE WITH UPSTREAM INTAKE STRUCTURE AND DOWNSTREAM 45° C.I.P. ELBOW TRANSITION INTO LOCK WALL.
8. BACKFILL ABOVE PIPE WITH MATERIAL EXCAVATED AND STORED (UNLESS UNSUITABLE). USING APPROPRIATE MECHANICAL COMPACTION.
9. PULL AND REUSE SHEETPILES. RETRIEVE WELL POINT SYSTEM.
10. FILL TO ORIGINAL GROUND LEVEL WITH STORED MATERIAL, AND RESTORE PLANTINGS.

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

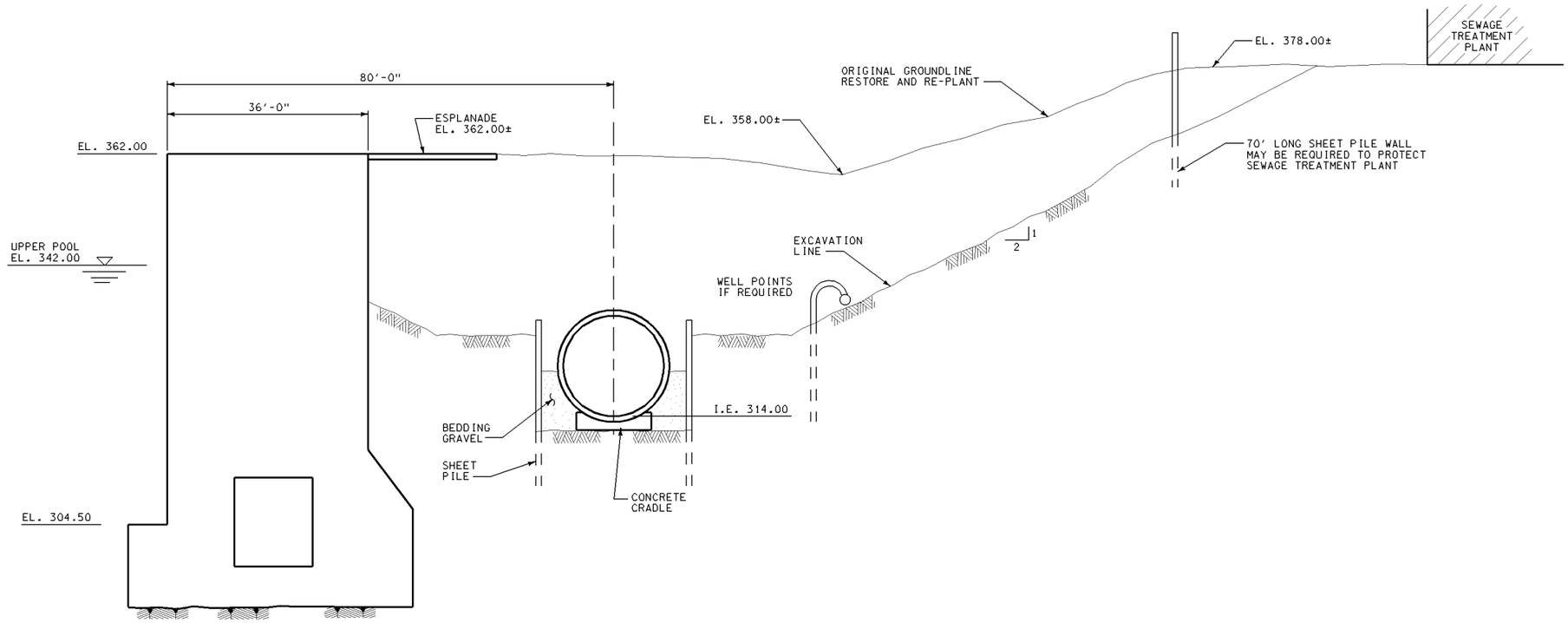
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION
WRAP AROUND CULVERT
OPTION "A"
DRAWING 1

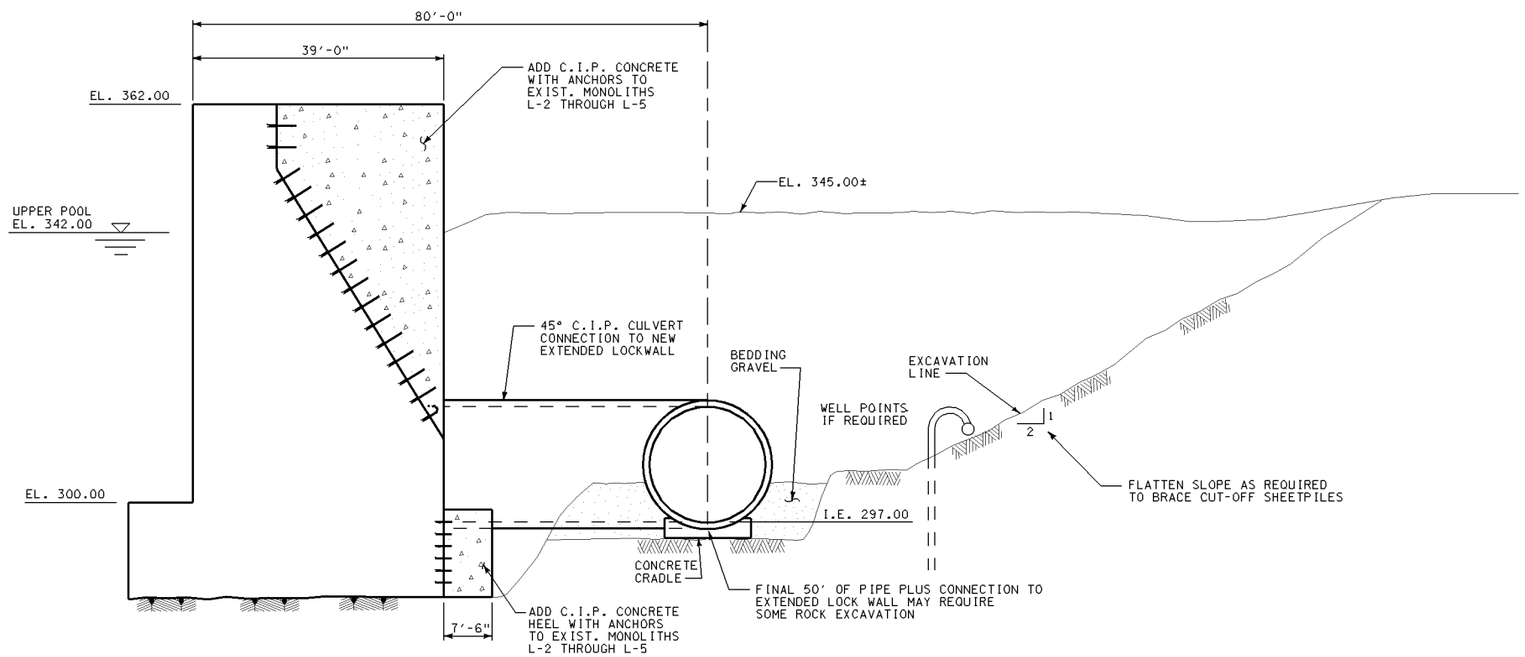
Designed by: LP
Drawn by: CS
Checked by: AA
Reviewed by:
Scale: N.T.S.
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 48 of ____

DRAWING 9.4.1B

#FILE#
#DATE#
#TIME#



SECTION AT L-12, STA. 12+20



SECTION AT L-3, STA. 16+00

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

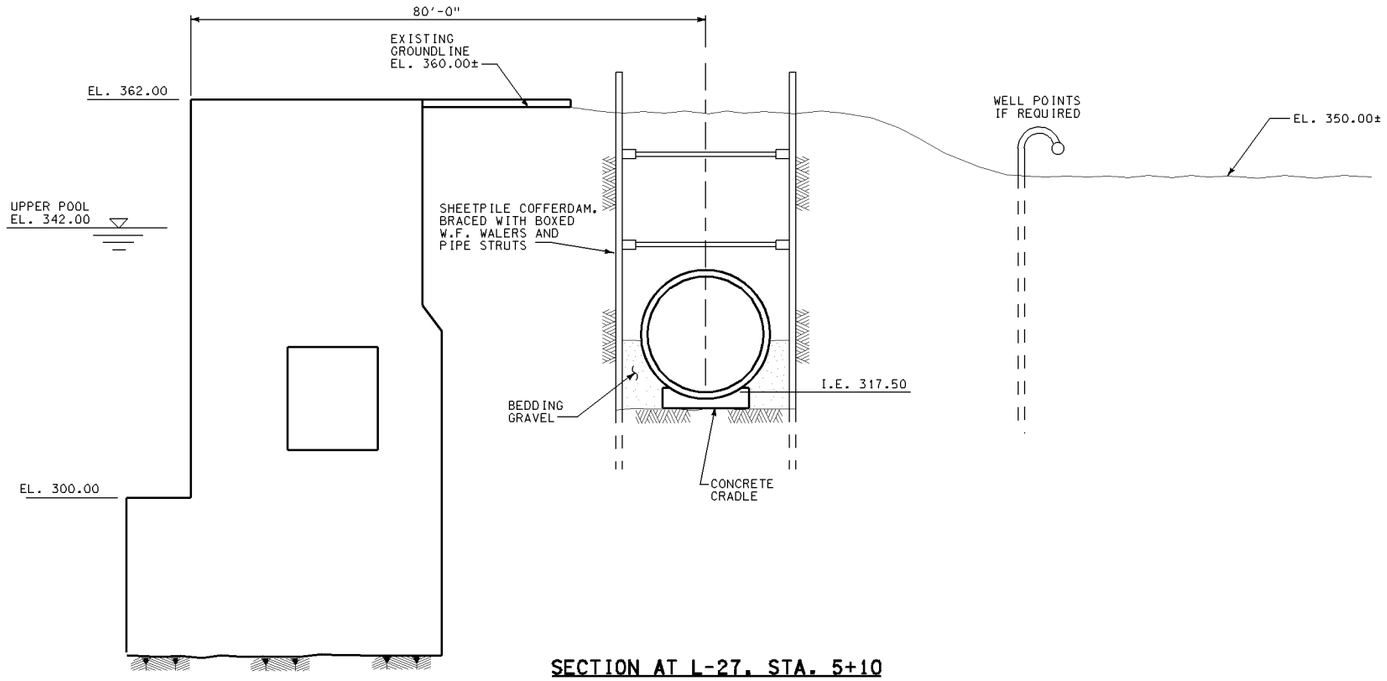
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION WRAP AROUND CULVERT OPTION "A" DRAWING 2

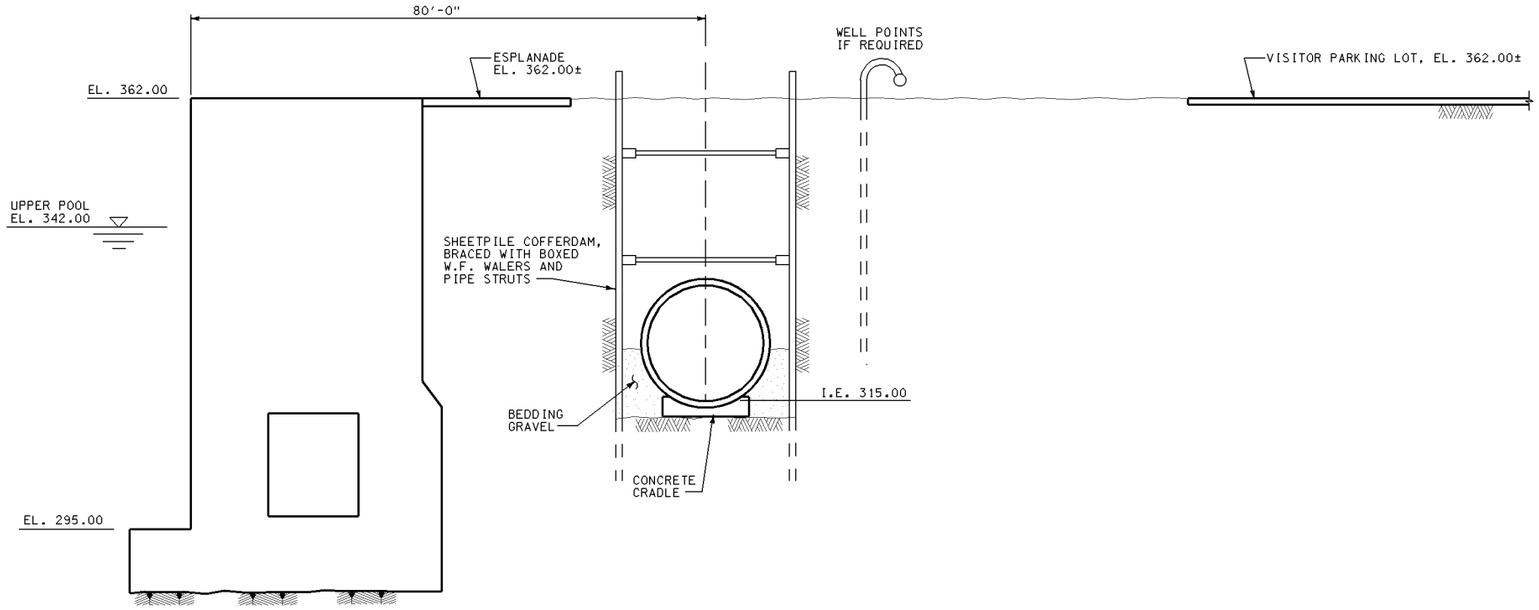
Designed by: LP
Drawn by: CS
Checked by: AA
Reviewed by:
Scale: N.T.S.
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 49 of ____

DRAWING 9.4.1C

#FILE#
#DATE#
#TIME#



SECTION AT L-27, STA. 5+10



SECTION AT L-18, STA. 9+65

OPTION "B" CONSTRUCTION SEQUENCE:

1. CONSTRUCT PORTION OF WINGWALLS, BERM AROUND EXISTING MOORING FACILITY SHEETPILE WALL TO CUT OFF WATER AT UPSTREAM END, CONSTRUCT BERM AT DOWNSTREAM END OF WRAP-AROUND CULVERT, DEWATER, AND CONSTRUCT INTAKE STRUCTURE AND REMAINING PORTION OF WINGWALLS.
2. BASED ON TEST HOLES, DESIGN AND INSTALL WELLPOINT SYSTEM FOR DRAWING DOWN THE WATER TABLE TO PERMIT EXCAVATION AND INSTALLATION OF THE CULVERT PIPE IN THE DRY.
3. INSTALL BRACED COFFERDAM ALONG CENTERLINE OF CULVERT PIPE. LENGTH OF COFFERDAM SECTIONS AND NUMBER OF REUSES OF SHEETPILES AND BRACING SYSTEM SHALL BE AT CONTRACTOR'S OPTION.
4. EXCAVATE INSIDE THE COFFERDAM, INSTALLING WALERS AND BRACES AS REQUIRED.
5. INSTALL 16.5' DIA. REINFORCED CONCRETE PIPE WITH FLUSH SPIGOT JOINTS AND NEOPRENE GASKETS. PIPE LENGTH SHALL BE CONTRACTOR'S OPTION WITHIN 8' TO 12' RANGE BASED ON FORMWORK, HANDLING EQUIPMENT, AND DESIGN OF BRACING STRUT SPACING IN BRACED COFFERDAM.
6. INTEGRATE REINFORCED CONCRETE PIPE WITH FLUSH SPIGOT JOINTS AND NEOPRENE GASKETS. PIPE LENGTH SHALL BE CONTRACTOR'S OPTION WITHIN 8' TO 12' RANGE BASED ON FORMWORK, HANDLING EQUIPMENT, AND DESIGN OF BRACING STRUT SPACING IN BRACED COFFERDAM.
7. USE APPROVED, WASHED BEDDING GRAVEL UNDER PIPE AND UP TO THE SPRING LINE.
8. BACKFILL ABOVE PIPE WITH MATERIAL EXCAVATED FROM THE TRENCH (UNLESS UNSUITABLE) USING APPROPRIATE MECHANICAL COMPACTION. REMOVE STRUTS AND WALERS AS BACKFILLING PROGRESSES.
9. PULL AND REUSE SHEETPILES.
10. RESTORE ORIGINAL GROUND LEVEL AND PLANTINGS.

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

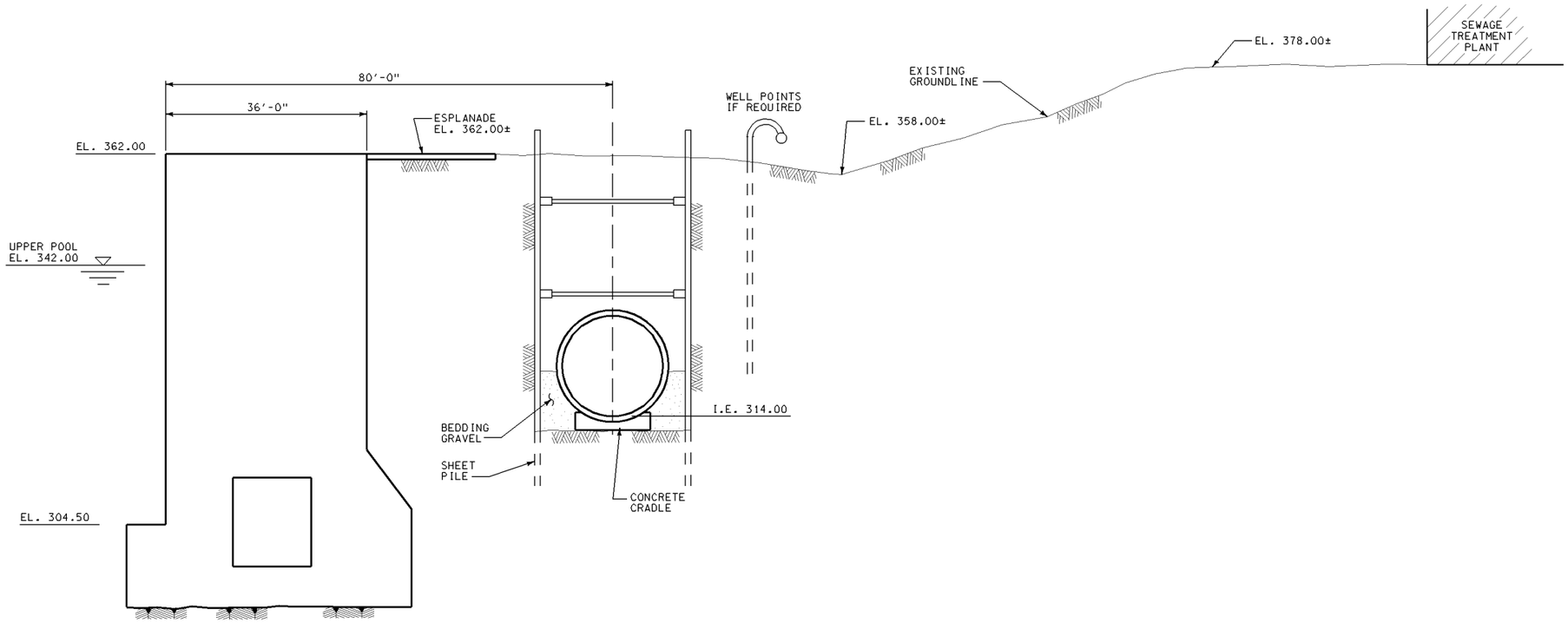
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION WRAP AROUND CULVERT OPTION "B" DRAWING 1

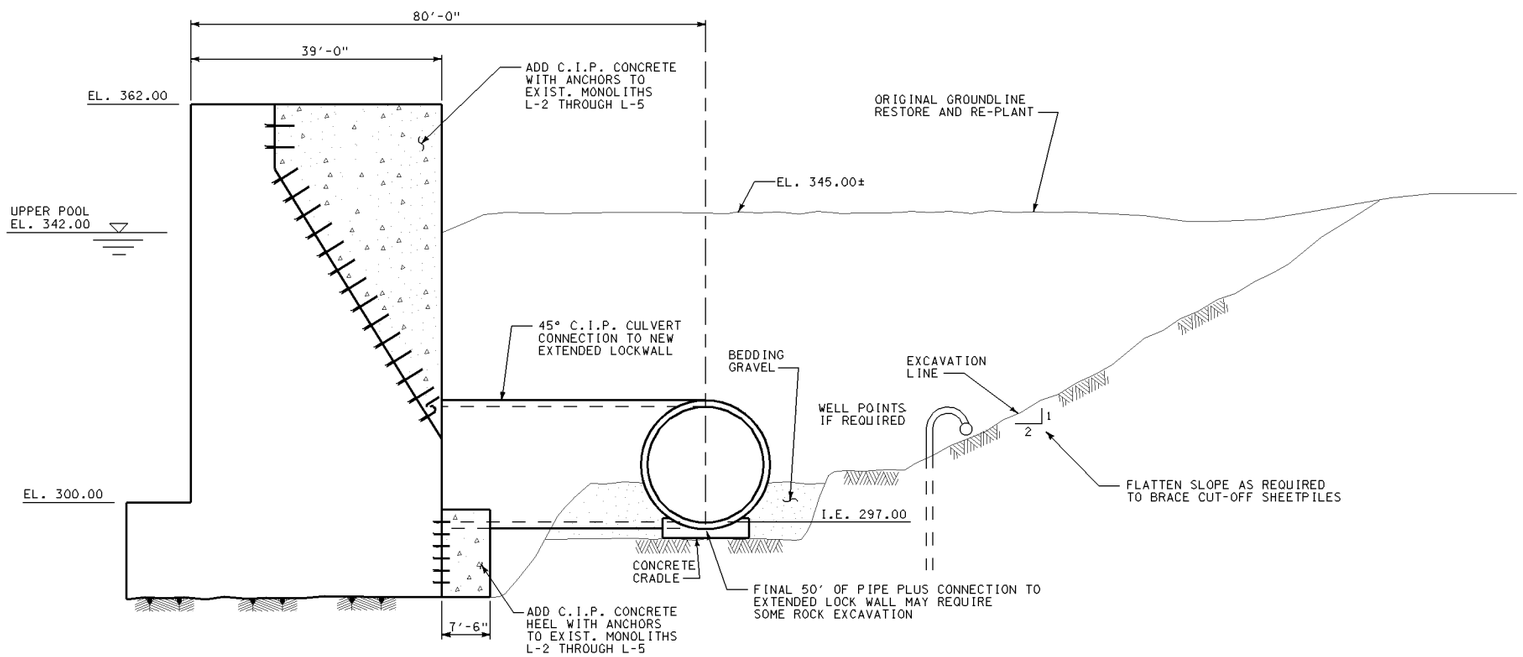
Designed by: LP
Drawn by: CS
Checked by: AA
Reviewed by:
Scale: N.T.S.
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 50 of ____

DRAWING 9.4.1D

#FILE#
#DATE#
#TIME#



SECTION AT L-12, STA. 12+20



SECTION AT L-3, STA. 16+00

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

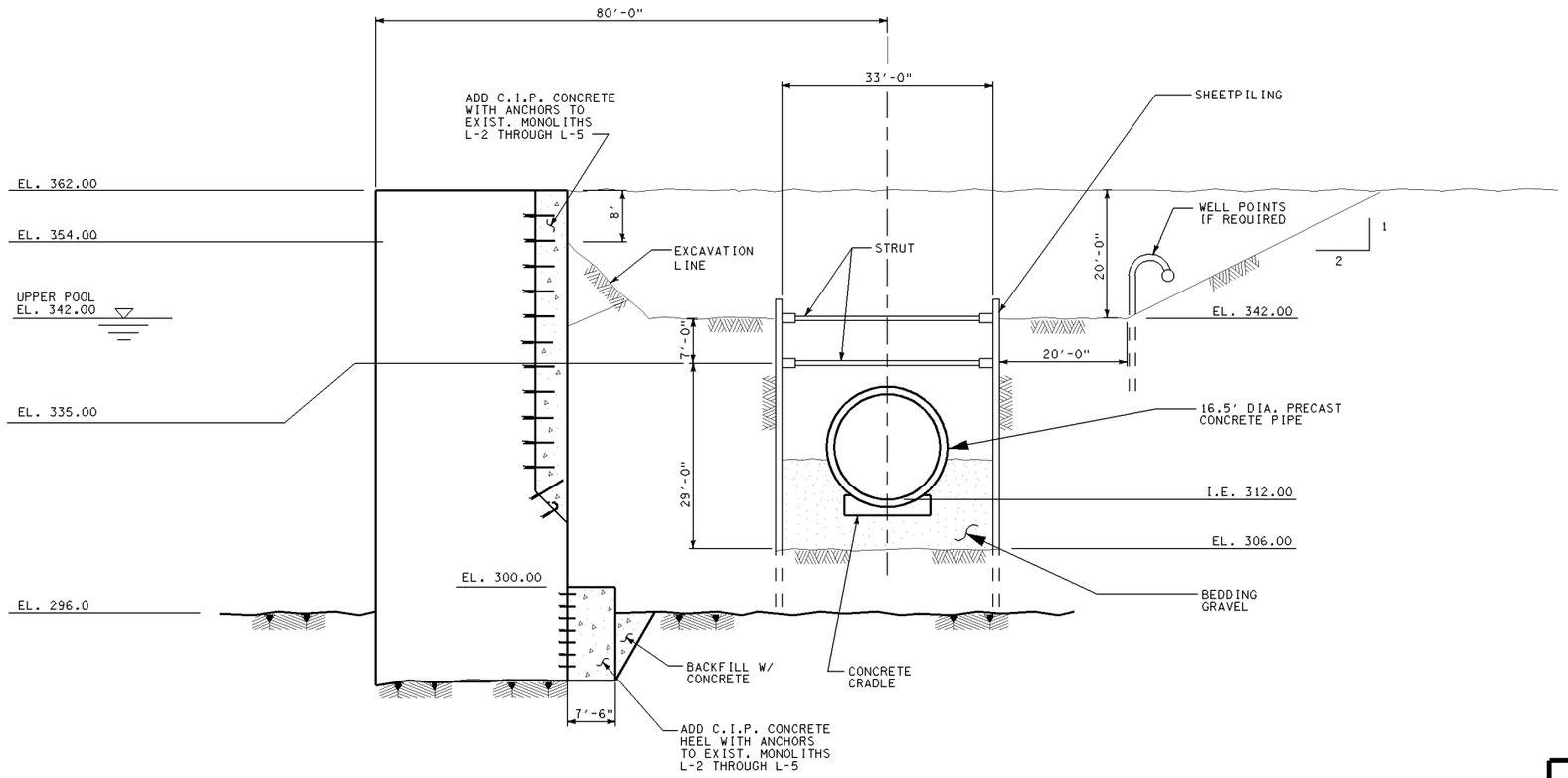
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION WRAP AROUND CULVERT OPTION "B" DRAWING 2

Designed by: LP
Drawn by: CS
Checked by: AA
Reviewed by:
Scale: N.T.S.
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 51 of ____

DRAWING 9.4.1E

#FILE#
#DATE#
#TIME#



SECTION AT MONOLITH L-5

STA. 15+40

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

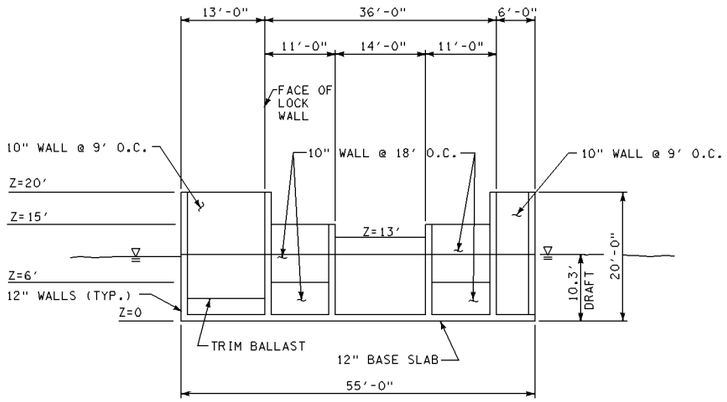
600' LOCK EXTENSION WRAP AROUND CULVERT TYPICAL SECTION

Designed by: LP
Drawn by: CS
Checked by: AA
Reviewed by:

Scale: N.T.S.
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 52 of ____

DRAWING 9.4.1F

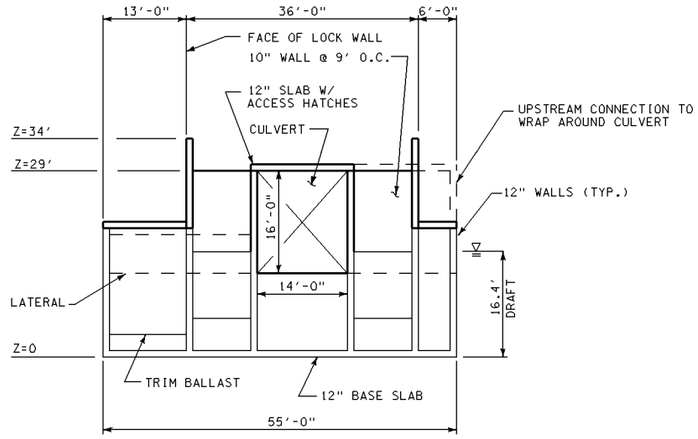
#FILE#
#DATE#
#TIME#



TRANVERSE SECTION
SCALE: 1"=10'

STAGE 1

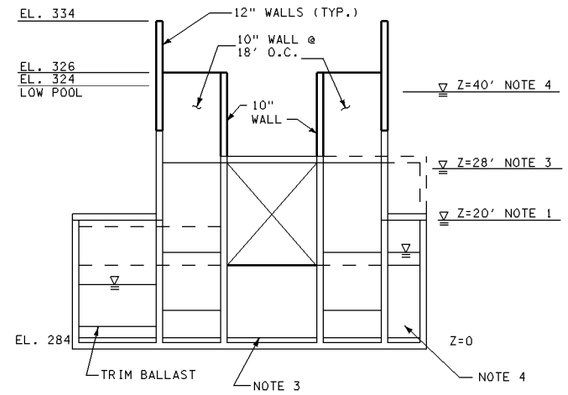
1. CONSTRUCT BASE RAFT WITHOUT TOP DECK/ROOF.
2. INSTALL TEMPORARY BULKHEADS AT CULVERT ENDS AND OPENINGS FOR LATERALS.
   DELIVERY DRAFT = 10.3'



TRANVERSE SECTION
SCALE: 1"=10'

STAGE 2

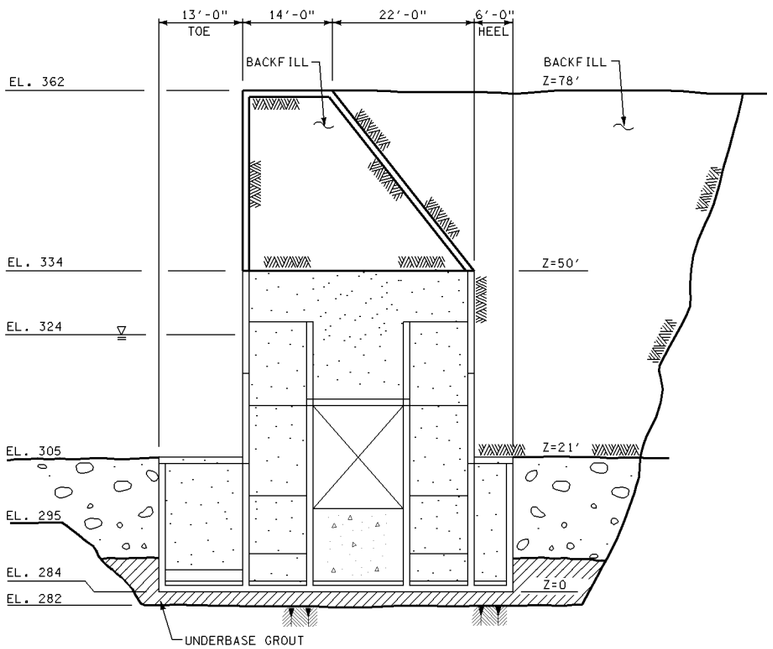
1. AFTER DELIVERY TO TEMPORARY CONSTRUCTION MOORAGE. CONSTRUCT 12" DECK AT TOE AND HEEL SECTION. CONSTRUCT SIDEWALLS TO 34' ABOVE BOTTOM OF BASE RAFT WHILE AFLOAT. COMPLETE CULVERT AND LATERAL CONSTRUCTION.
2. TRIM BALLAST AT TOE AND HEEL COMPARTMENTS AS REQUIRED FOR LEVELING.
3. INSTALL FULL TEMPORARY BULKHEAD OVER CULVERT AND LATERAL OPENINGS.
   DRAFT = 16.4'



TRANVERSE SECTION
SCALE: 1"=10'

STAGE 3

1. CONTINUE SIDEWALL CONSTRUCTION TO 50' ABOVE BOTTOM OF BASE RAFT.
   DRAFT = 20'
2. TOW TO FINAL LOCATION.
3. TIE ADDITIONAL 12" THICKNESS STRUCTURAL CONCRETE SLAB TO KEEL SLAB.
4. BALLAST BENEATH CULVERT. HEEL AND TOE COMPARTMENTS TO LOWER WALL STRUCTURE TO EL. 284.



TRANVERSE SECTION
SCALE: 1"=10'

STAGE 4

1. USE EITHER JACKING LEGS OR CONCRETE PEDESTALS TO PROVIDE TEMPORARY SUPPORT FOR THE STRUCTURE. INJECT UNDERBASE GROUT.
2. FILL THE HEEL & TOE COMPARTMENTS WITH PUMPED CONCRETE AND GROUT. FILL REMAINING COMPARTMENTS WITH MASS CONCRETE.
3. PLACE LIFT-IN PRECAST CONCRETE BUTTRESSES, CONCRETE SLAB, AND BACKFILL TO COMPLETE STRUCTURE.

GRAPHIC SCALE

10 5 0 10 20FT
SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

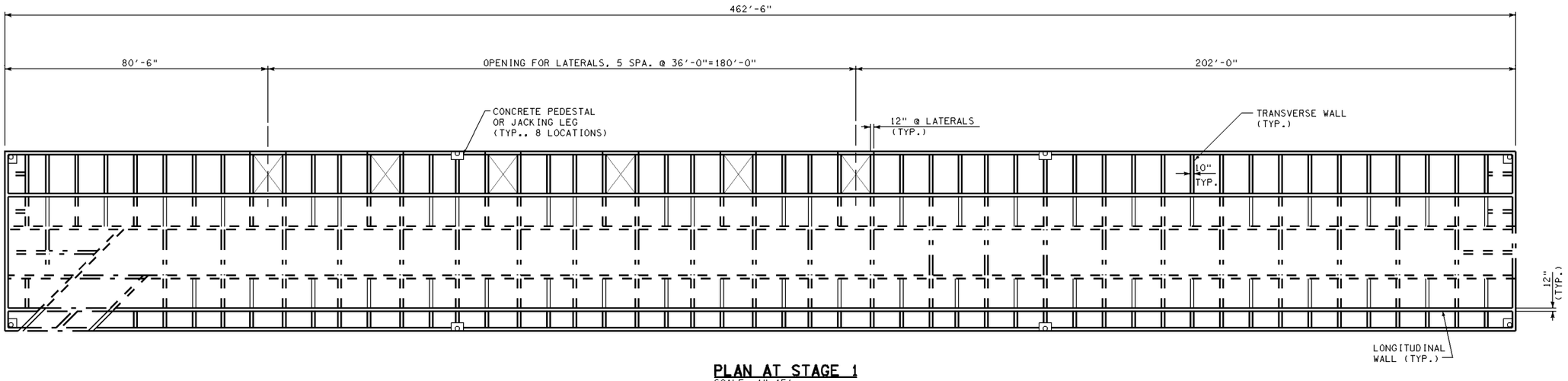
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION FLOAT-IN WALL MONOLITH SECTIONS

Designed by: SS
Drawn by: KT
Checked by: DAS
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 53 of ____

DRAWING 9.4.2A

$FILE$
$DATE$
$TIME$



PLAN AT STAGE 1

SCALE: 1"=15'

LEGEND

- 19' HIGH WALL
- 14' HIGH WALL
- 12' HIGH WALL
- 11' HIGH WALL
- 5' HIGH WALL

GRAPHIC SCALE

15 0 15 30FT

SCALE: 1"= 15'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

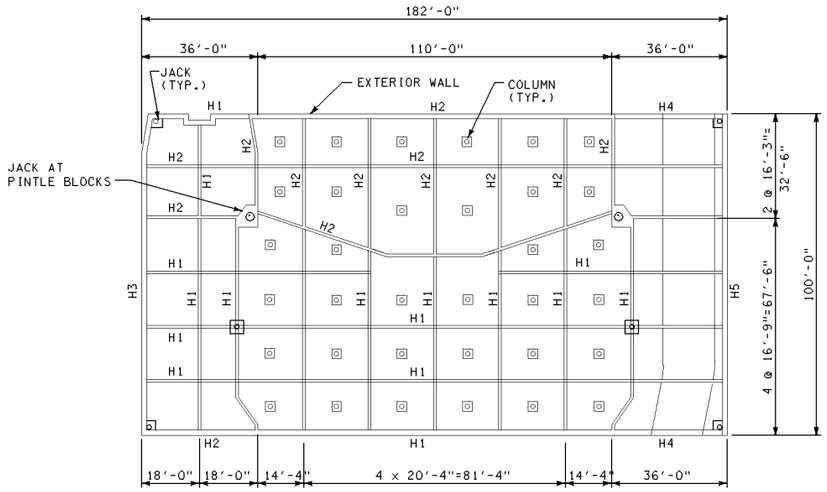
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION FLOAT-IN WALL MONOLITH PLAN

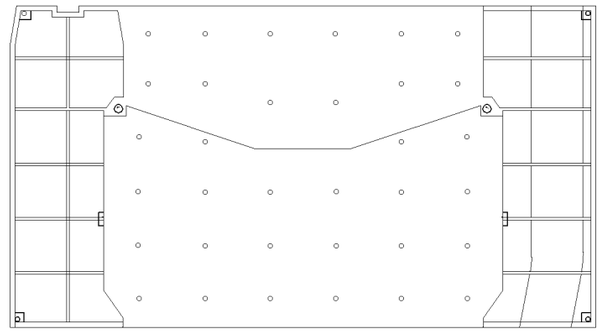
Designed by: SS
Drawn by: KT
Checked by: DAS
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 54 of ____

DRAWING 9.4.2B

#FILE#
#DATE#
#TIME#



PLAN
SCALE: 1"=20'



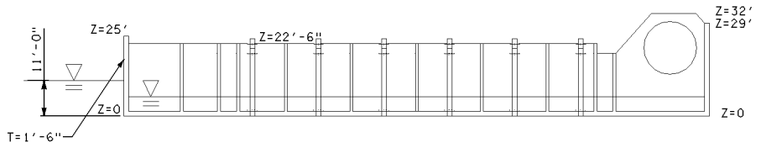
PLAN
SCALE: 1"=20'

NOTES:

TYPICAL DIMENSIONS UNLESS NOTED OTHERWISE:

1. EXTERIOR WALL THICKNESS, T=18"
2. INTERIOR WALL THICKNESS, T=10"
3. KEEL SLAB THICKNESS, T=18"
4. ROOF/DECK SLAB THICKNESS, T=18"
5. CULVERT BRACE THICKNESS, T=10"
6. PIPE = 18"ø
7. STEEL COLUMN/UNDERBASE GROUT ACCESS PIPES = 18"ø

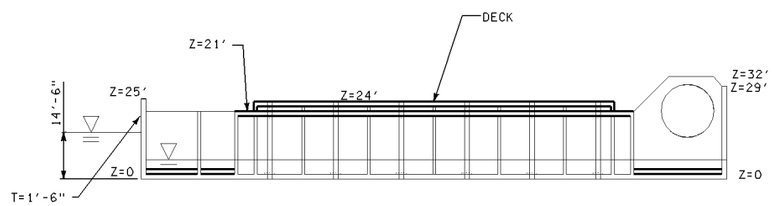
WALL HEIGHT	
H1	18'
H2	21'
H3	23.5'
H4	30'
H5	27.5'



ELEVATION
SCALE: 1"=20'

STAGE 1

1. CONSTRUCT BASE RAFT WITH 16.5' DIAMETER STEEL CULVERT AND TEMPORARILY BRACED 18" DIAMETER STEEL TUBE COLUMNS.
2. INSTALL TEMPORARY BULKHEADS AT CULVERT ENDS. DELIVERY DRAFT = 11 FEET.
3. TRIM BALLAST AS REQUIRED FOR LEVELING.



ELEVATION
SCALE: 1"=20'

STAGE 2

1. AFTER DELIVERY, CONSTRUCT 18" DECK AT SILL SECTION AND PLACE 18" THICK STRUCTURAL CONCRETE IN ORDER TO THICKEN KEEL SLAB AT THE SIDE WALLS. DRAFT = 14.5 FEET.
2. TRIM BALLAST AS REQUIRED FOR LEVELING.

GRAPHIC SCALE

20 10 0 20 40FT
SCALE: 1"= 20'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION
FLOAT-IN GATE BAY
DRAWING 1

Designed by: SKT
Drawn by: KT
Checked by: DAS
Reviewed by:
Scale: 1" = 20'
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 55 of ____

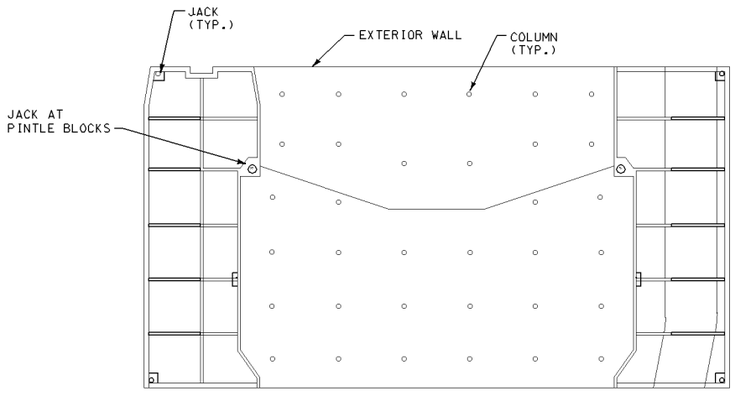
DRAWING 9.4.3A

$FILE$
$DATE$
$TIME$

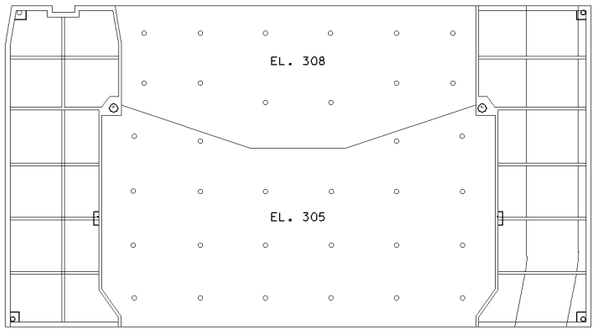
NOTES:

TYPICAL DIMENSIONS UNLESS NOTED OTHERWISE:

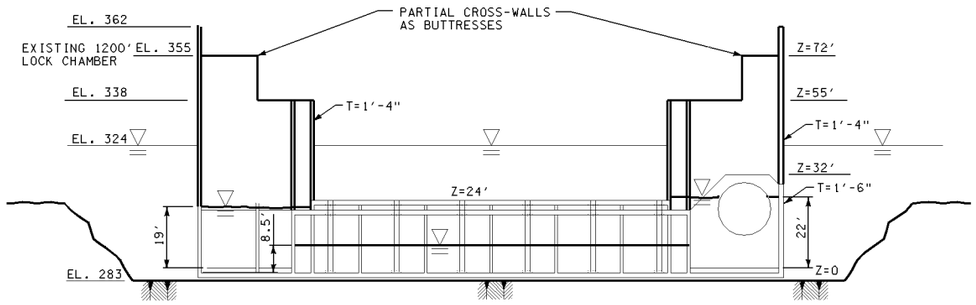
1. EXTERIOR WALL THICKNESS, T=16" ABOVE BASE RAFT.
2. INTERIOR WALL THICKNESS, T=10"
3. KEEL SLAB THICKNESS, T=18"
4. ROOF/DECK SLAB THICKNESS, T=18"
5. CULVERT BRACE THICKNESS, T=10"
6. PIPE = 18"ø
7. STEEL COLUMN/UNDERBASE GROUT ACCESS PIPES = 18"ø



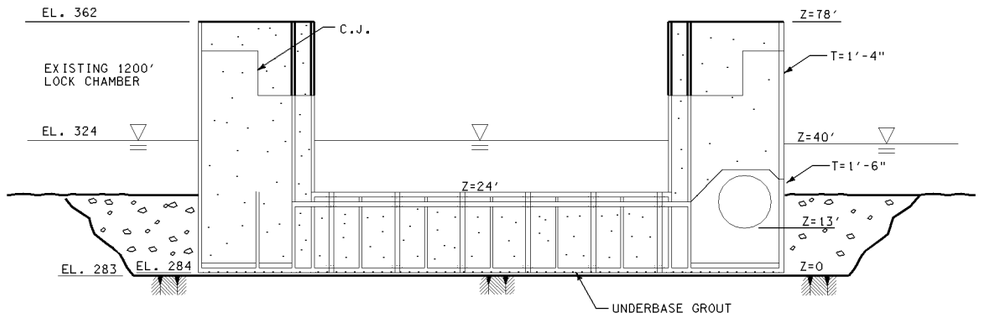
PLAN
SCALE: 1"=20'



PLAN
SCALE: 1"=20'



ELEVATION
SCALE: 1"=20'



ELEVATION
SCALE: 1"=20'

STAGE 3

1. CONSTRUCT EXTERIOR SIDE WALLS TO EL. 362 AND INSIDE SIDE WALLS TO EL. 338. USE WATER BALLAST FOR TRIM.
2. TOW FROM OUTFITTING PIER (CONSTRUCTION MOORAGE AREA) TO SET-DOWN LOCATION. DRAFT APPROX. 21.1'.
3. ADD WATER BALLAST IN ACCORDANCE WITH ENGINEERED AND APPROVED BALLAST PLAN TO SET-DOWN STRUCTURE ON EITHER JACKING LEGS OR CONCRETE PEDESTALS WITH FLAT JACKS.

STAGE 4

1. JACK UP TO EL. 284.0 OR USE CONCRETE PEDESTALS WITH FLAT JACKS TO ADJUST FOUNDATION ELEVATION. INJECT UNDERBASE GROUT THROUGH 18" PIPE COLUMNS.
2. COMPLETE SIDE WALL SHELLS TO FULL HEIGHT. REMOVE TEMPORARY CULVERT BULKHEADS.
3. FILL LOWER COMPARTMENTS/SILL WITH LOW STRENGTH CONCRETE. FILL SIDE COMPARTMENTS WITH MASS CONCRETE.
4. COMPLETE EQUIPMENT AND ACCESS RECESSES. COMPLETE GATE AND EQUIPMENT INSTALLATION.

GRAPHIC SCALE

20 10 0 20 40FT
SCALE: 1"= 20'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

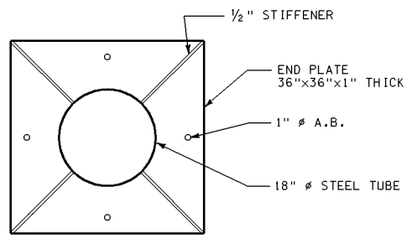
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION FLOAT-IN GATE BAY DRAWING 2

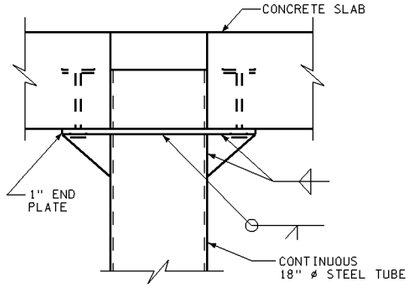
Designed by: SKT
Drawn by: KT
Checked by: DAS
Reviewed by:
Scale: 1" = 20'
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 56 of ____

DRAWING 9.4.3B

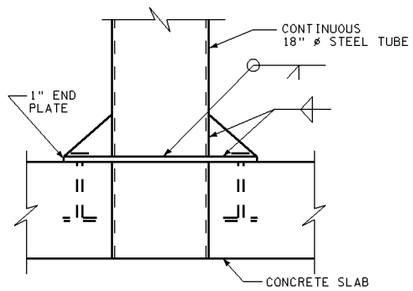
$FILE$
$DATE$
$TIME$



PLAN



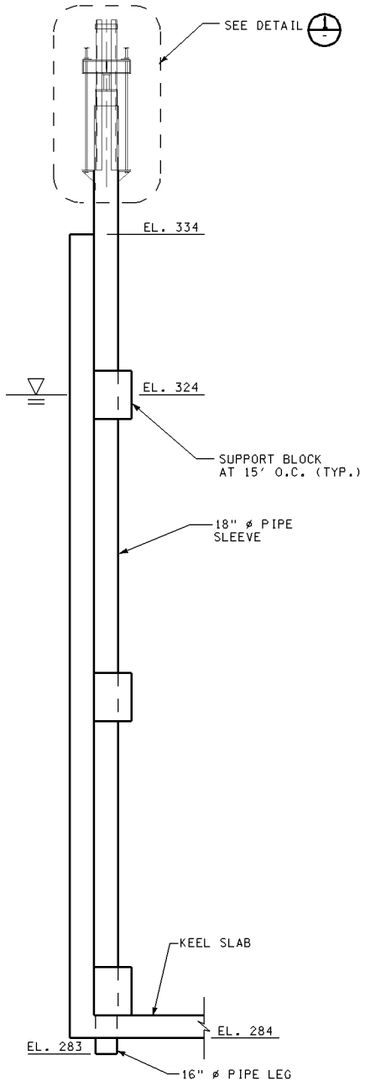
SECTION @ TOP SLAB



SECTION @ BASE SLAB

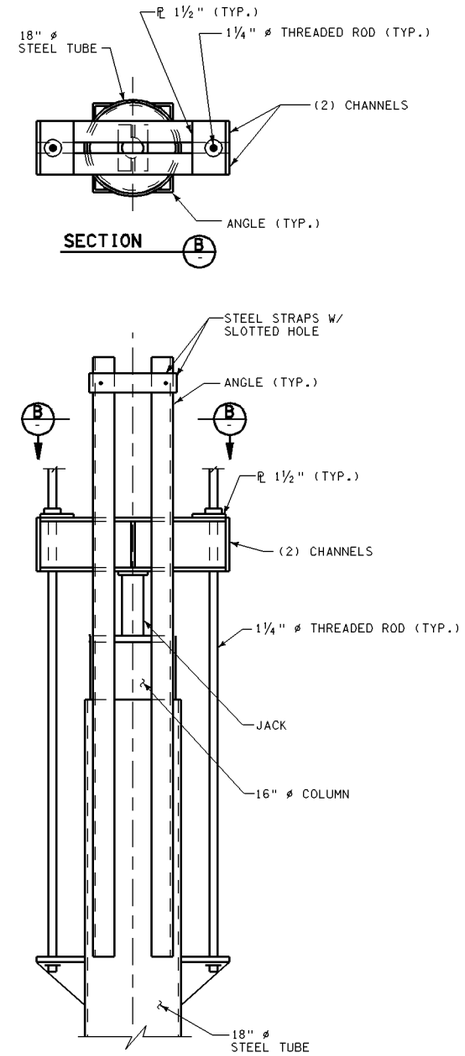
STEEL PIPE COLUMN/UNDERBASE GROUT ACCESS DETAILS

SCALE: 1"=1'-0"



SECTION

SCALE: ¼"=1'-0"



DETAIL 1

SCALE: 1"=1'-0"

JACKUP LEG DETAILS

GRAPHIC SCALE

4 3 2 1 0 4

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

1 0 1 2FT

SCALE: 1"=1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

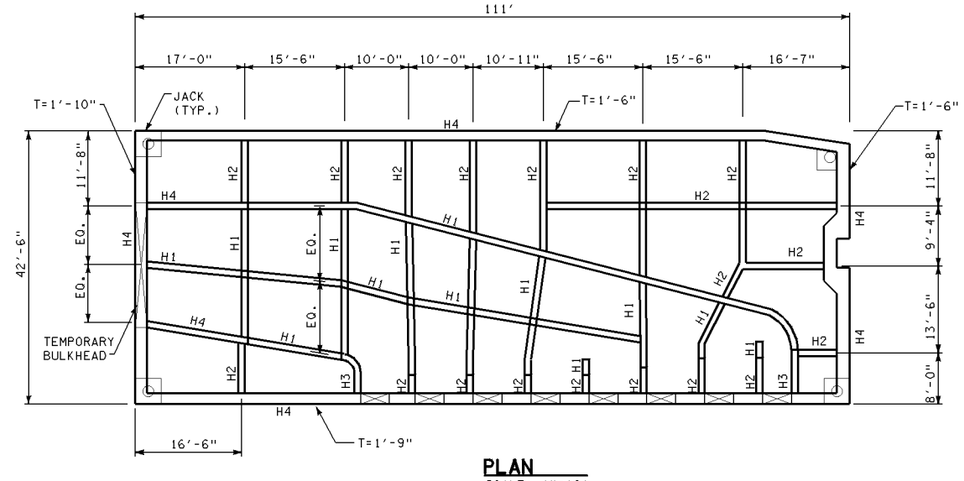
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION
FLOAT-IN GATE BAY-STEEL PIPE COLUMN AND JACKUP LEG DETAILS

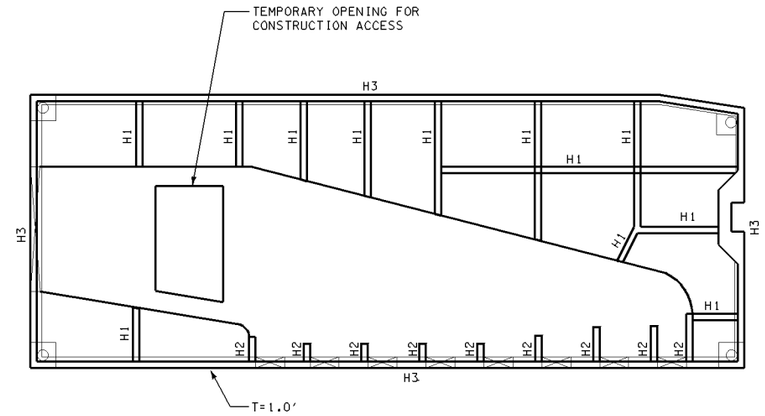
Designed by: SKT
Drawn by: KT
Checked by: DAS
Reviewed by:
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 57 of ____

DRAWING 9.4.3C

$FILE$
$DATE$
$TIME$



PLAN
SCALE: 1"=10'

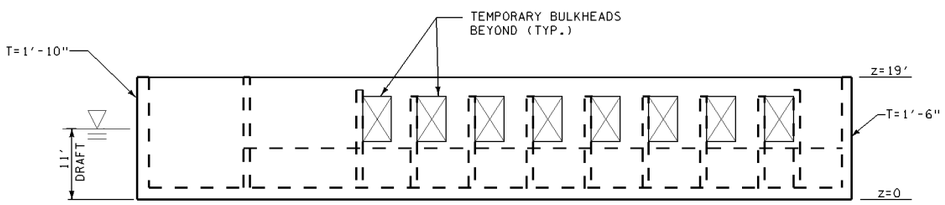


PLAN
SCALE: 1"=10'

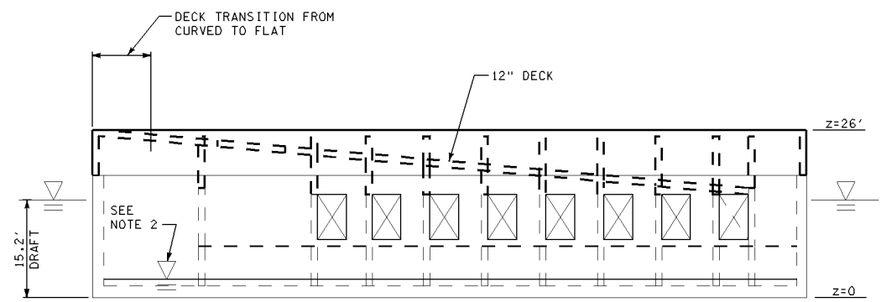
NOTES:

TYPICAL DIMENTSIONS UNLESS NOTED OTHERWISE:

1. EXTERIOR WALL THICKNESS, T=1'-0".
2. INTERIOR WALL THICKNESS, T=10"
3. KEEL SLAB THICKNESS, T=1'-6"
4. ROOF/DECK SLAB THICKNESS. T = 12".



ELEVATION
SCALE: 1"=10'



ELEVATION
SCALE: 1"=10'

STAGE 1

1. CONSTRUCT BASE RAFT WITHOUT TOP DECK/ROOF.
2. INSTALL TEMPORARY BULKHEADS AT CULVERT END AND DIFFUSER PORTS. DELIVERY DRAFT = 11'

WALL HEIGHT	
H1	8'
H2	16'
H3	17'
H4	19'

STAGE 2

1. AFTER DELIVERY TO TEMPORARY CONSTRUCTION MOORAGE AREA. CONSTRUCT 12" DECK AT TOP OF CULVERT. CONSTRUCT SIDE WALLS TO 26' ABOVE BOTTOM OF BASE RAFT WHILE AFLOAT. DRAFT = 15.2'.
2. TRIM BALLAST AS REQUIRED FOR LEVELING.

WALL HEIGHT	
H1	24'
H2	25'
H3	26'

GRAPHIC SCALE

10 5 0 10 20FT

SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

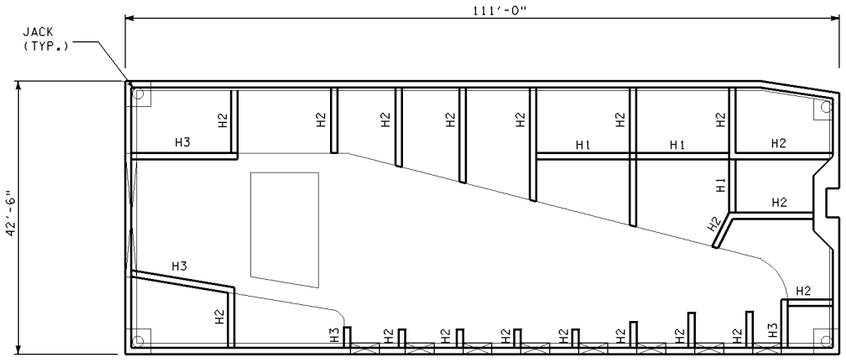
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT. FLOAT-IN LANDSIDE WALL DIFFUSER CONSTRUCTION - DWG. 1

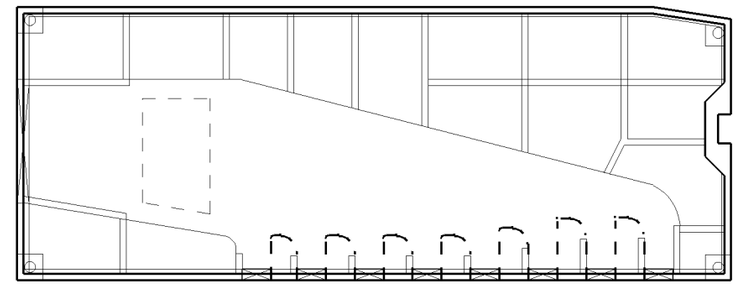
Designed by: SKT
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 58 of ____

DRAWING 9.4.4A

$FILE$
$DATE$
$TIME$



PLAN
SCALE: 1"=10'

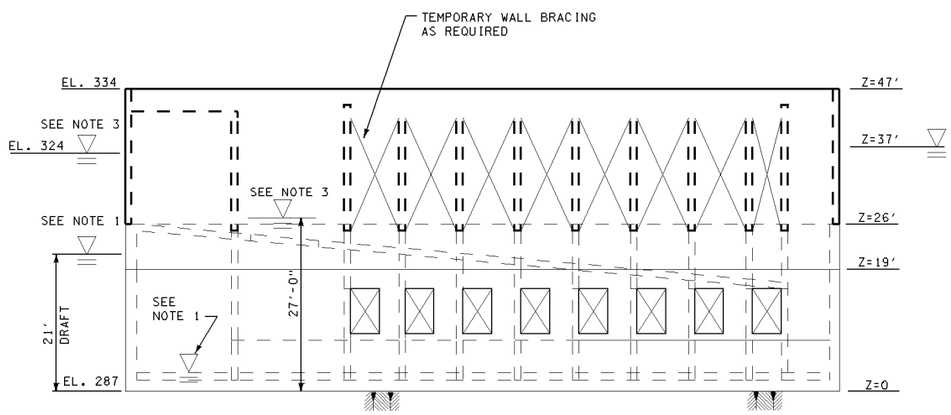


PLAN
SCALE: 1"=10'

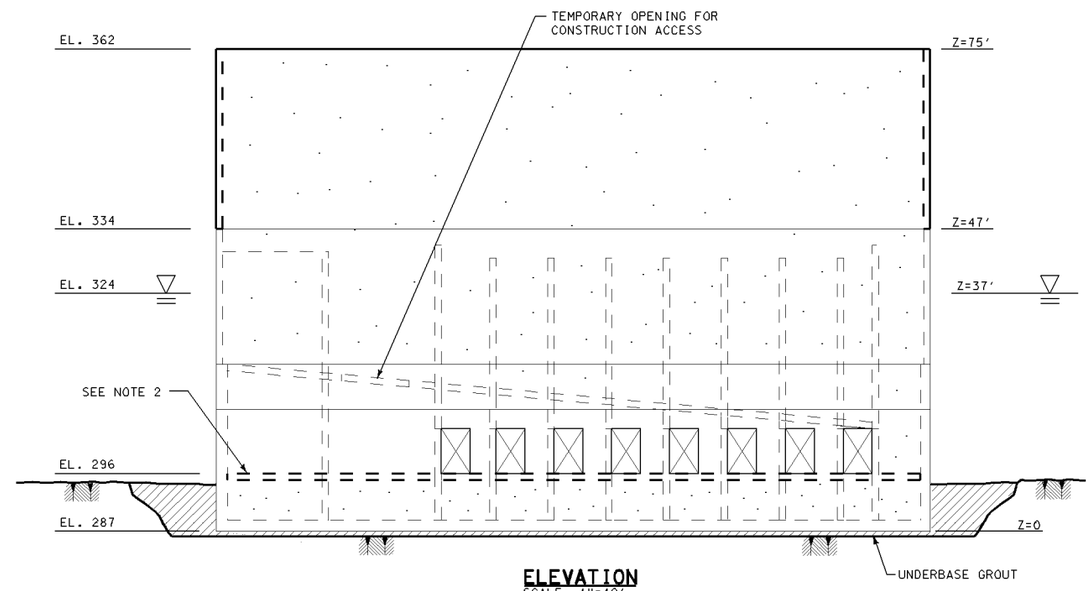
NOTES:

TYPICAL DIMENSIONS UNLESS NOTED OTHERWISE:

1. EXTERIOR WALL THICKNESS, T=1'-0".
2. INTERIOR WALL THICKNESS, T=10".
3. KEEL SLAB THICKNESS, T=1'-6".
4. ROOF/DECK SLAB THICKNESS, T = 12".



ELEVATION
SCALE: 1"=10'



ELEVATION
SCALE: 1"=10'

STAGE 3

1. CONTINUE SIDE WALL CONSTRUCTION TO 47' ABOVE BOTTOM OF BASE RAFT. INSTALL TEMPORARY WALL BRACING AS REQUIRED. TRIM BALLAST AS REQURED FOR LEVELING. DRAFT = 21'.
2. TOW TO FINAL LOCATION.
3. BALLAST TO LOWER WALL STRUCTURE TO EL. 287.

WALL HEIGHT	
H1	24'
H2	39'
H3	42'

STAGE 4

1. USE EITHER JACKING LEGS OR CONCRETE PEDESTALS TO PROVIDE TEMPORARY SUPPORT FOR THE STRUCTURE. INJECT UNDERBASE GROUT.
2. FILL SPACE BENEATH CULVERT WITH MASS CONCRETE TO 1 FOOT BELOW CULVERT INVERT ELEVATION (EL.295). AFTER CONCRETE HAS HARDENED, LAY HORIZONTAL REINFORCEMENT ON TOP AND PLACE STRUCTURAL CONCRETE TO CULVERT INVERT ELEVATION (EL. 296).
3. COMPLETE CULVERT AND PORT CONSTRUCTION.
4. FILL SHELL STRUCTURE WITH MASS CONCRETE TO FULL HEIGHT.

GRAPHIC SCALE

10 5 0 10 20FT

SCALE: 1"= 10'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

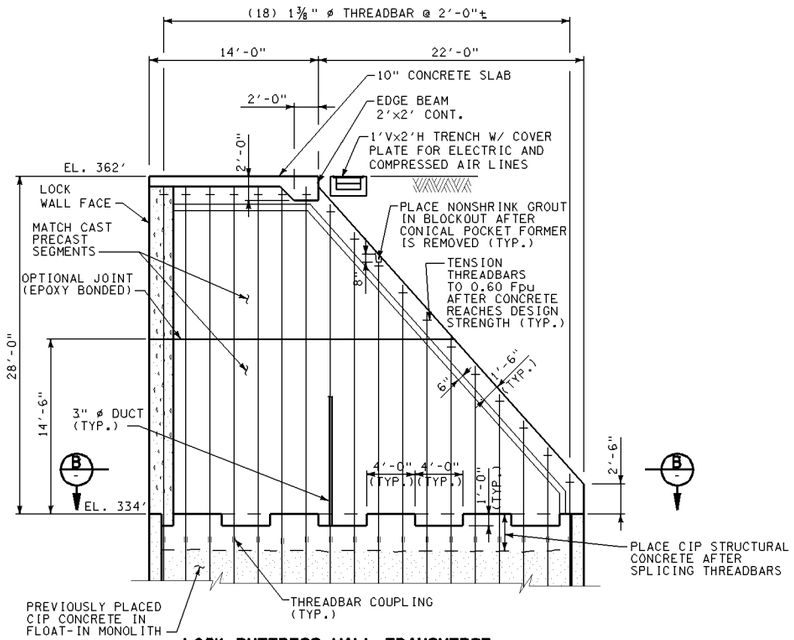
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT. FLOAT-IN LANDSIDE WALL DIFFUSER CONSTRUCTION - DWG. 2

Designed by: SKT
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: DECEMBER 1999
Drawing Code:
Sheet reference number:
Sheet 59 of ____

DRAWING 9.4.4B

$FILE$
$DATE$
$TIME$

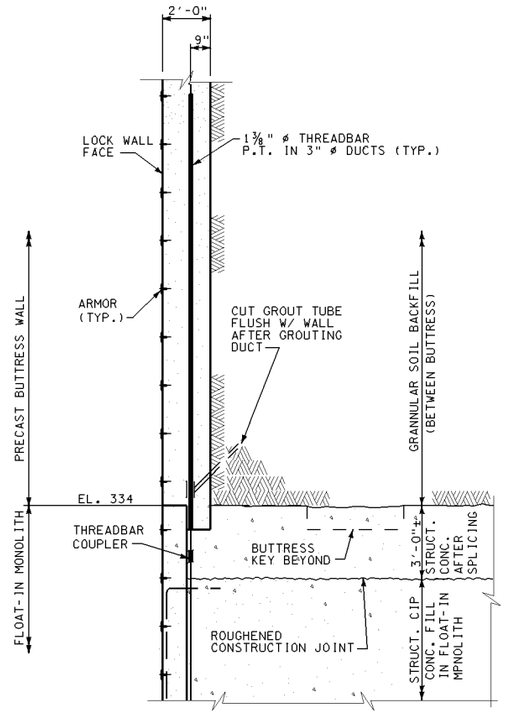


LOCK BUTTRESS WALL TRANSVERSE

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

NOTES:

1. TOTAL PRECAST WEIGHT WITHOUT OPTIONAL JOINT IS 360 TONS PER 54' LONG WALL SEGMENT.
2. MILD STEEL REINF. NOT SHOWN FOR CLARITY.

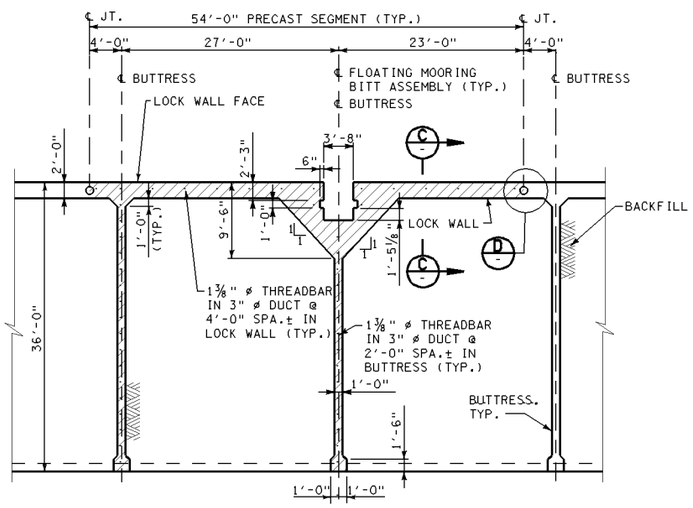


LOCK WALL SECTION

DETAIL (C)
SCALE: ⅜"=1'-0"

NOTE:

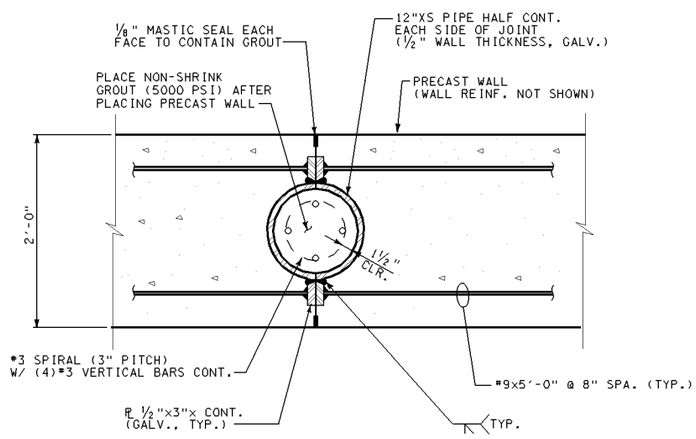
MILD REFORCING NOT SHOWN.



LOCK BUTTRESS WALL PLAN

SECTION (B)
SCALE: ⅛"=1'-0"

NOTE: CONCRETE DECK SLAB AND TRENCH FOR ELECTRIC AND COMPRESSED AIR LINES NOT SHOWN FOR CLARITY.



VERTICAL WALL JOINT

DETAIL (D)
SCALE: 1½"=1'-0"

GRAPHIC SCALE

8 6 4 2 0 8 16FT
SCALE: 1/8"=1'-0"
4 0 4 8FT
SCALE: 3/16"= 1'-0"
2 0 2 4FT
SCALE: 3/8"= 1'-0"
1 0 1FT
SCALE: 1 1/2"= 1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

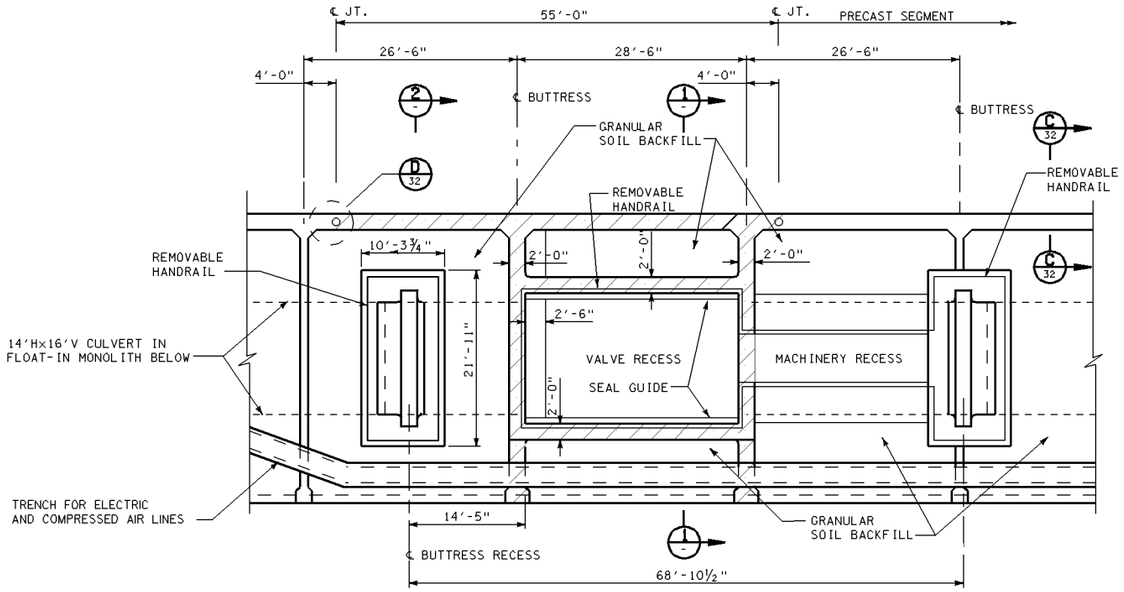
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT. LAND WALL LIFT-IN BUTTRESS DETAILS - SHEET 1

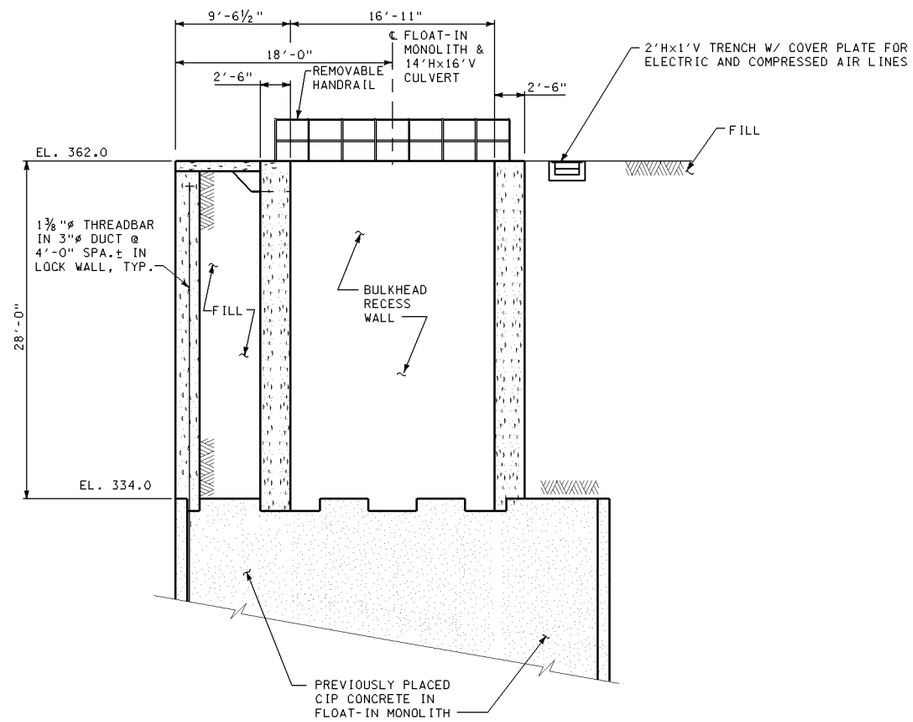
Designed by: GK
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 60 of ____

DRAWING 9.6.2A

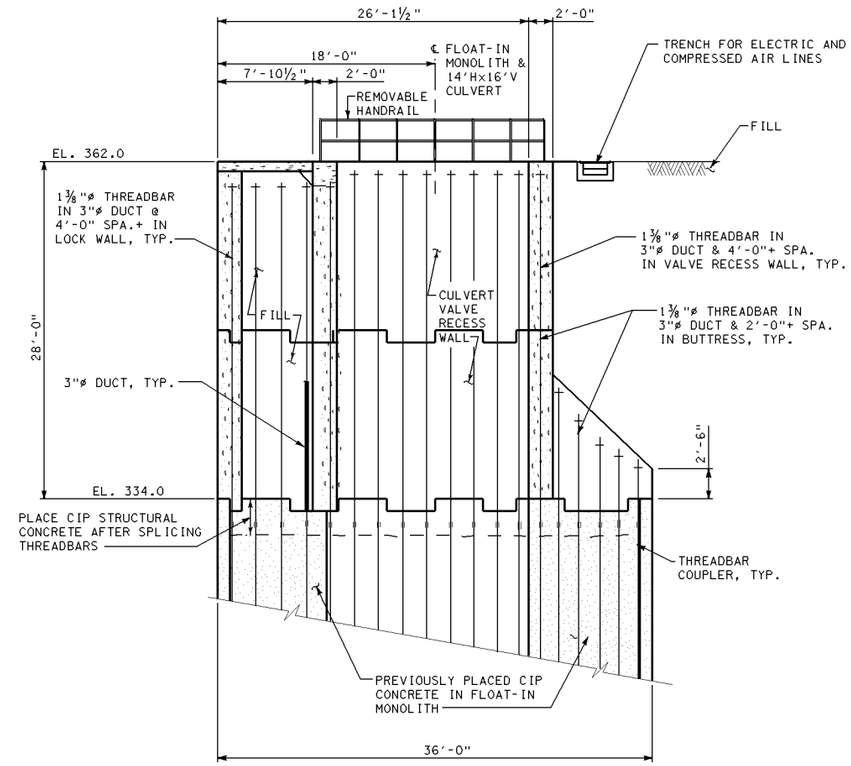
#FILE#
#DATE#
#TIME#



LOCK BUTTRESS WALL PLAN @ VALVE
SCALE: ⅛"=1'-0"



BULKHEAD RECESS
SECTION 2
SCALE: 3/16"=1'-0"



VALVE RECESS
SECTION 1
SCALE: 3/16"=1'-0"

GRAPHIC SCALE

8 6 4 2 0 8 16FT
SCALE: 1/8"=1'-0"

4 0 4 8FT
SCALE: 3/16"= 1'-0"

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

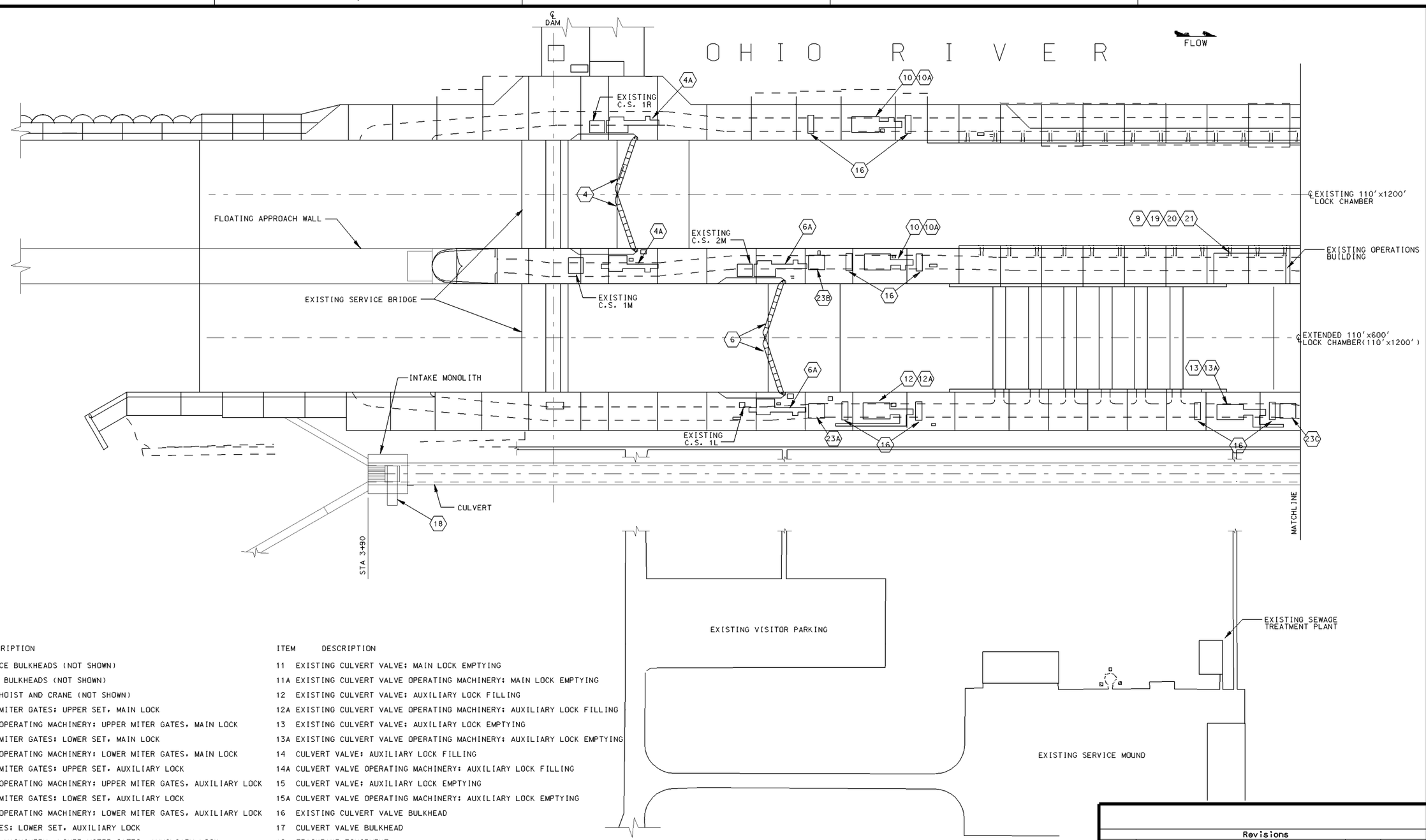
OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXT. LAND WALL LIFT-IN BUTTRESS DETAILS - SHEET 2

Designed by: GK
Drawn by: KT
Checked by: LP
Reviewed by:
Scale: AS SHOWN
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 61 of ____

DRAWING 9.6.2B

#FILE#
#DATE#
#TIME#



ITEM	DESCRIPTION
1	MAINTENANCE BULKHEADS (NOT SHOWN)
2	EMERGENCY BULKHEADS (NOT SHOWN)
3	BULKHEAD HOIST AND CRANE (NOT SHOWN)
4	EXISTING MITER GATES; UPPER SET, MAIN LOCK
4A	EXISTING OPERATING MACHINERY; UPPER MITER GATES, MAIN LOCK
5	EXISTING MITER GATES; LOWER SET, MAIN LOCK
5A	EXISTING OPERATING MACHINERY; LOWER MITER GATES, MAIN LOCK
6	EXISTING MITER GATES; UPPER SET, AUXILIARY LOCK
6A	EXISTING OPERATING MACHINERY; UPPER MITER GATES, AUXILIARY LOCK
7	EXISTING MITER GATES; LOWER SET, AUXILIARY LOCK
7A	EXISTING OPERATING MACHINERY; LOWER MITER GATES, AUXILIARY LOCK
8	MITER GATES; LOWER SET, AUXILIARY LOCK
8A	OPERATING MACHINERY; LOWER MITER GATES, AUXILIARY LOCK
9	EXISTING HYDRAULIC POWER UNIT-CENTRAL PUMPING SYSTEM
10	EXISTING CULVERT VALVE; MAIN LOCK FILLING
10A	EXISTING CULVERT VALVE OPERATING MACHINERY; MAIN LOCK FILLING

ITEM	DESCRIPTION
11	EXISTING CULVERT VALVE; MAIN LOCK EMPTYING
11A	EXISTING CULVERT VALVE OPERATING MACHINERY; MAIN LOCK EMPTYING
12	EXISTING CULVERT VALVE; AUXILIARY LOCK FILLING
12A	EXISTING CULVERT VALVE OPERATING MACHINERY; AUXILIARY LOCK FILLING
13	EXISTING CULVERT VALVE; AUXILIARY LOCK EMPTYING
13A	EXISTING CULVERT VALVE OPERATING MACHINERY; AUXILIARY LOCK EMPTYING
14	CULVERT VALVE; AUXILIARY LOCK FILLING
14A	CULVERT VALVE OPERATING MACHINERY; AUXILIARY LOCK FILLING
15	CULVERT VALVE; AUXILIARY LOCK EMPTYING
15A	CULVERT VALVE OPERATING MACHINERY; AUXILIARY LOCK EMPTYING
16	EXISTING CULVERT VALVE BULKHEAD
17	CULVERT VALVE BULKHEAD
18	TRASHRAKE EQUIPMENT
19	EXISTING RAW WATER SUPPLY STATION
20	EXISTING COMPRESSED AIR SUPPLY STATION
21	EXISTING STANDBY GENERATOR
23A	HYDRAULIC POWER UNIT (FOR ONE MITER GATE AND CULVERT VALVE)
23B	HYDRAULIC POWER UNIT (FOR ONE MITER GATE ONLY)
23C	HYDRAULIC POWER UNIT (FOR ONE CULVERT VALVE ONLY)

NOTES:

1. SEE DRAWING 10.0B FOR NOTES.

PLAN

40 0 40 80 FT

SCALE: 1"=80'

N

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION EQUIPMENT LOCATION

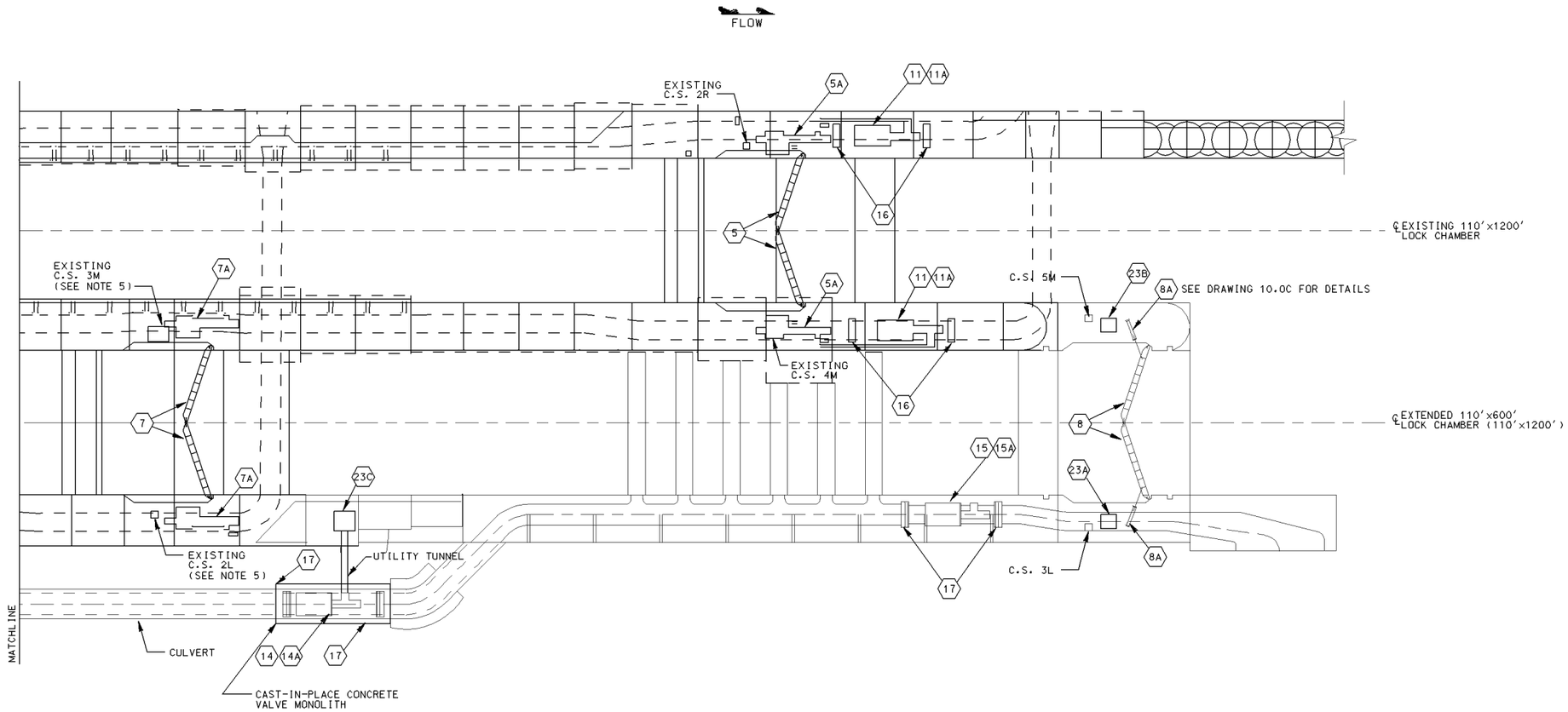
DRAWING 1

Designed by: M. HAMMER
Drawn by:
Checked by: S. STEARNS
Reviewed by: H. TONDRAVI

Scale: AS SHOWN
Date: DECEMBER, 1999
Drawing Code: IAD03003
Sheet reference number:
Sheet 62 of X

DRAWING 10.0A

#FILE#
#DATE#
#TIME#



NOTES:

1. HPU NEAR C.S. 1L AND 3L TO OPERATE MITER GATE AND CULVERT VALVE, ITEMS 6, 8, 12, AND 15.
2. HPU NEAR C.S. 2M AND 5M TO OPERATE MITER GATES ONLY, ITEMS 6 AND 8.
3. HPU FOR NEW AUXILIARY LOCK FILLING VALVE, ITEM 14, AND NEW AUXILIARY LOCK EMPTYING VALVE, ITEM 13.
4. NEW CONTROL STATIONS (C.S. 3L AND 5M) TO BE ADDED FOR NEW LOWER MITER GATES AND NEW CULVERT VALVES IN AUXLIARY LOCK.
5. EQUIPMENT FROM C.S. 2L AND 3M TO BE REMOVED.

PLAN

40 0 40 80 FT

SCALE: 1"=80'

N

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

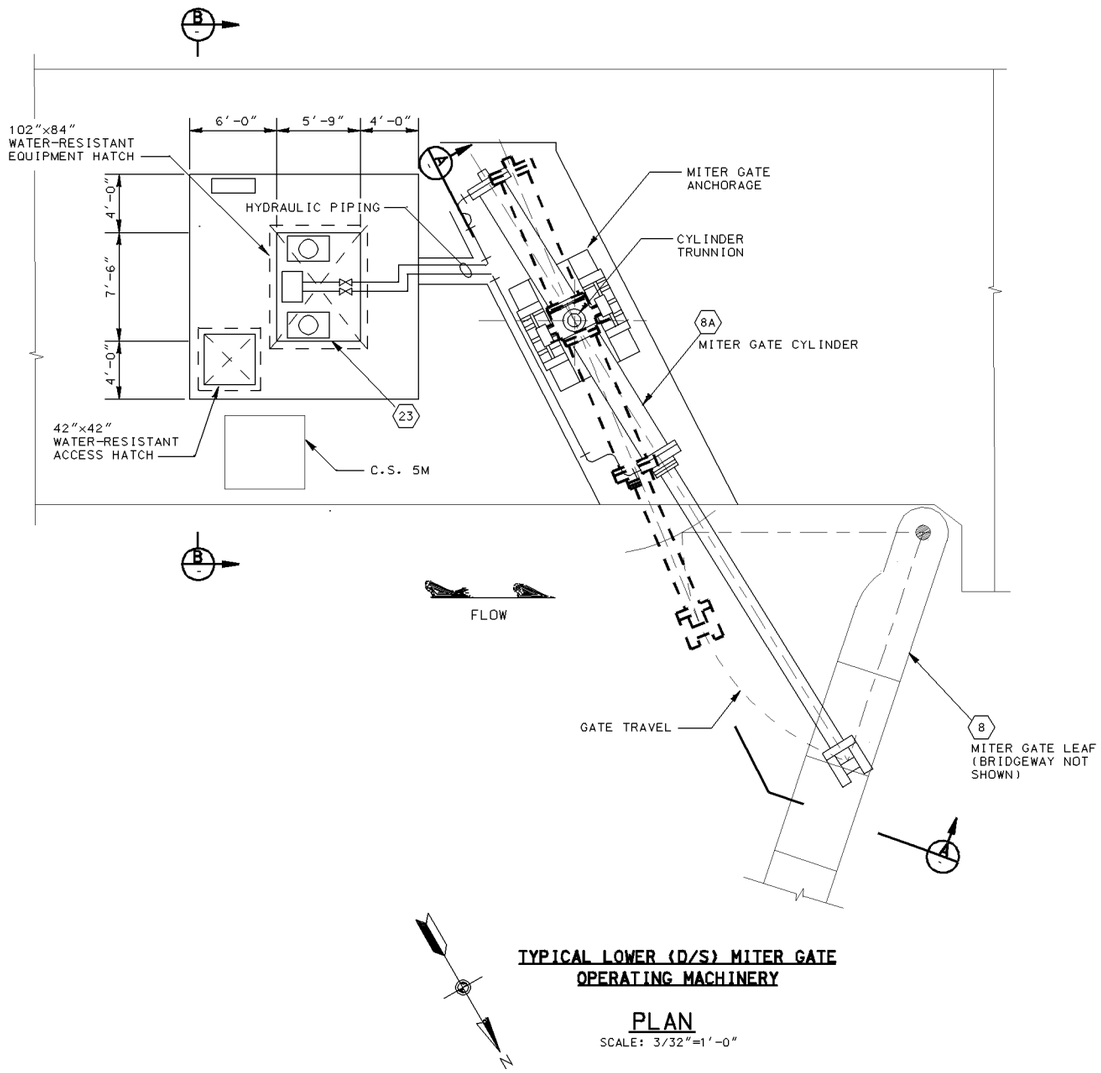
600' LOCK EXTENSION EQUIPMENT LOCATIONS

DRAWING 2

Designed by: M. HAMMER
Drawn by: S. STEARNS
Checked by: H. TONDRAVI
Reviewed by:
Scale: AS SHOWN
Sheet reference number:
Date: DECEMBER, 1999
Drawing Code: IAD03004
Sheet 63 of X

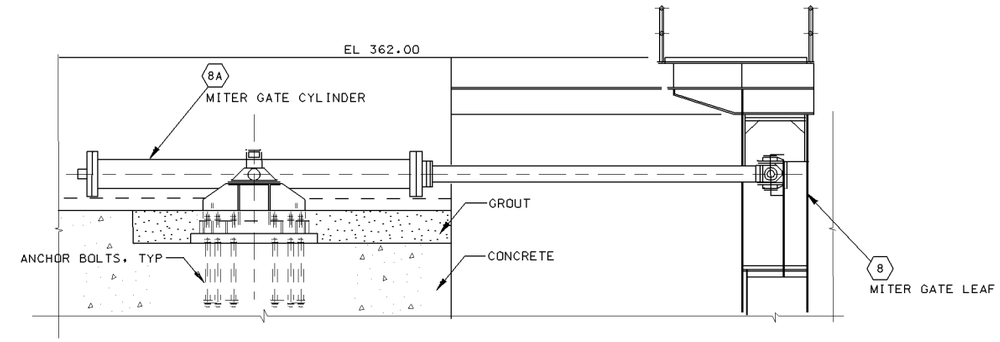
DRAWING 10.0B

$FILE$
$DATE$
$TIME$

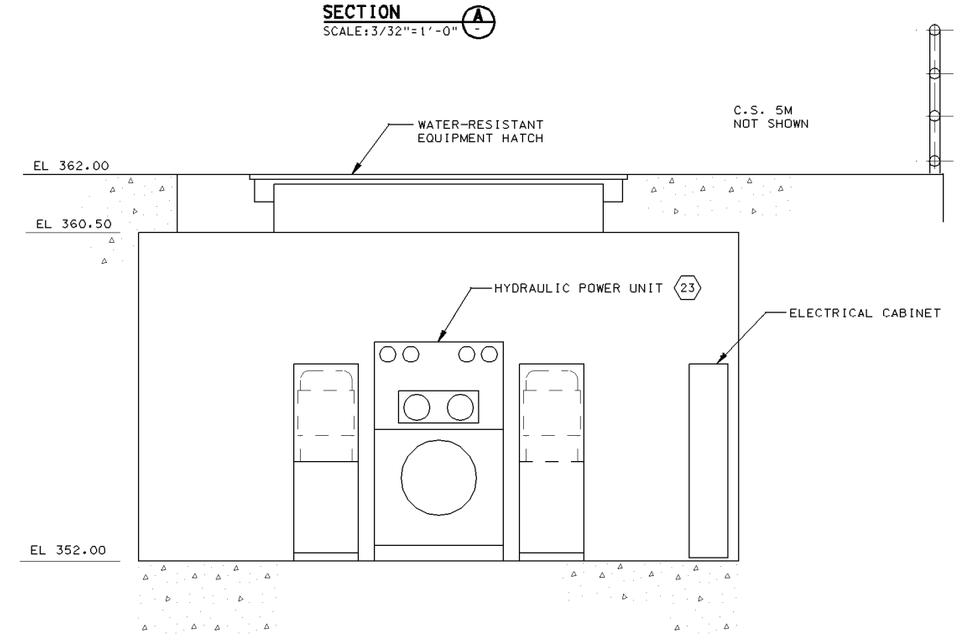


TYPICAL LOWER (D/S) MITER GATE OPERATING MACHINERY

PLAN
SCALE: 3/32"=1'-0"



SECTION A
SCALE:3/32"=1'-0"



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

Revisions			
Symbol	Descriptions	Date	Approved

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

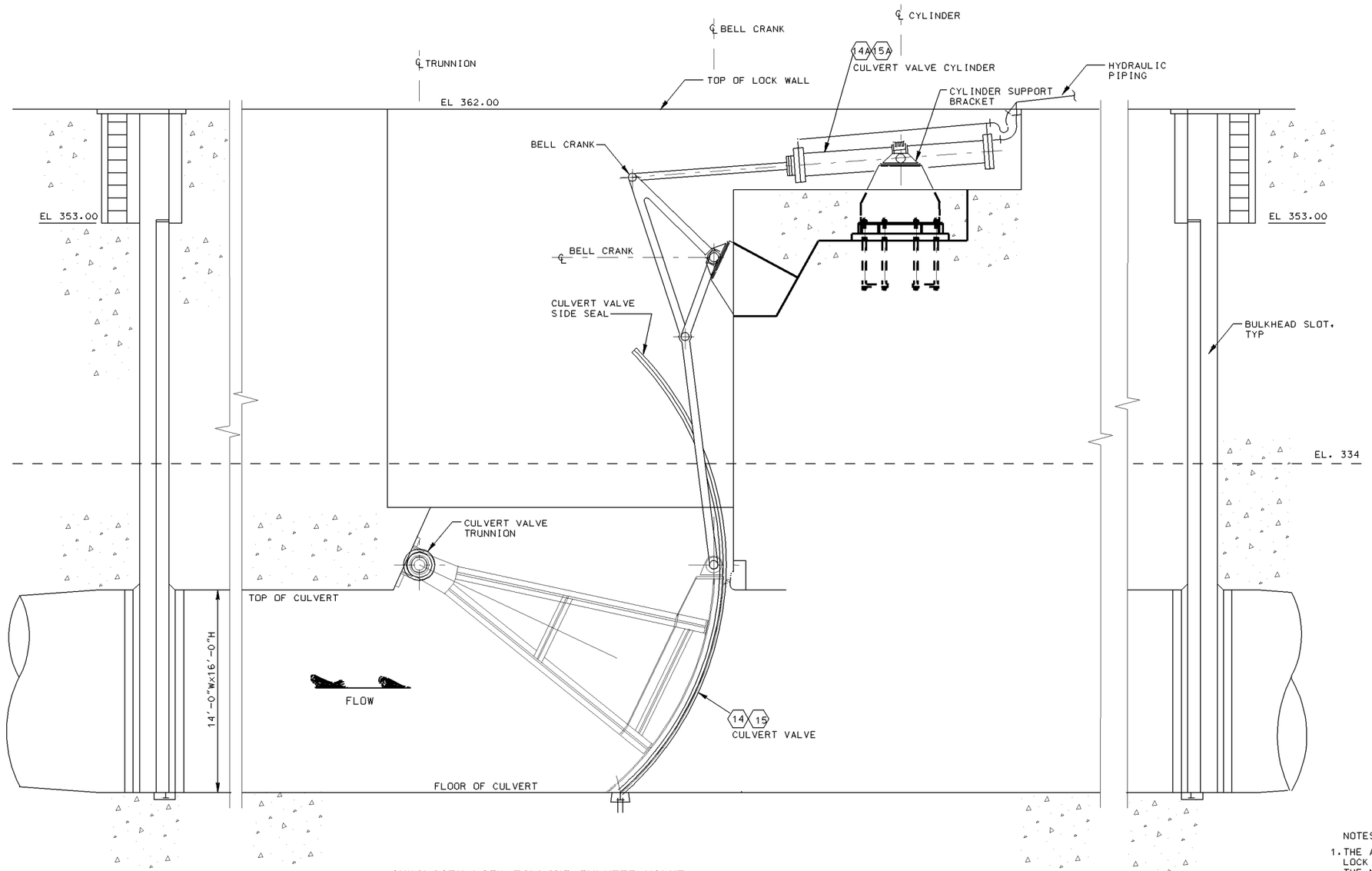
600' LOCK EXTENSION MITER GATE MACHINERY
GENERAL ARRANGEMENT

Designed by: M. HAMMER
Drawn by: D. NUPCHAROEN
Checked by: H. TONDRAVI
Reviewed by:

Scale: AS SHOWN
Date: DECEMBER, 1999
Drawing Code: IAD03009
Sheet reference number:
Sheet 64 of X

DRAWING 10.OC

$FILE$
$DATE$
$TIME$



AUXILIARY LOCK FILLING CULVERT VALVE

SECTION
SCALE:3/32"=1'-0"

NOTES:

1. THE ARRANGEMENT SHOWN IS FOR THE NEW AUXILIARY LOCK FILLING CULVERT VALVE. THE ARRANGEMENT FOR THE NEW AUXILIARY LOCK EMPTYING CULVERT VALVE WILL BE SLIGHTLY DIFFERENT ABOVE EL 334 WHERE PRE-CAST WALL BUTTRESSES WILL BE INSTALLED IN LIEU OF CAST-IN-PLACE CONCRETE. REFER TO DRAWING 9.6.2B.

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

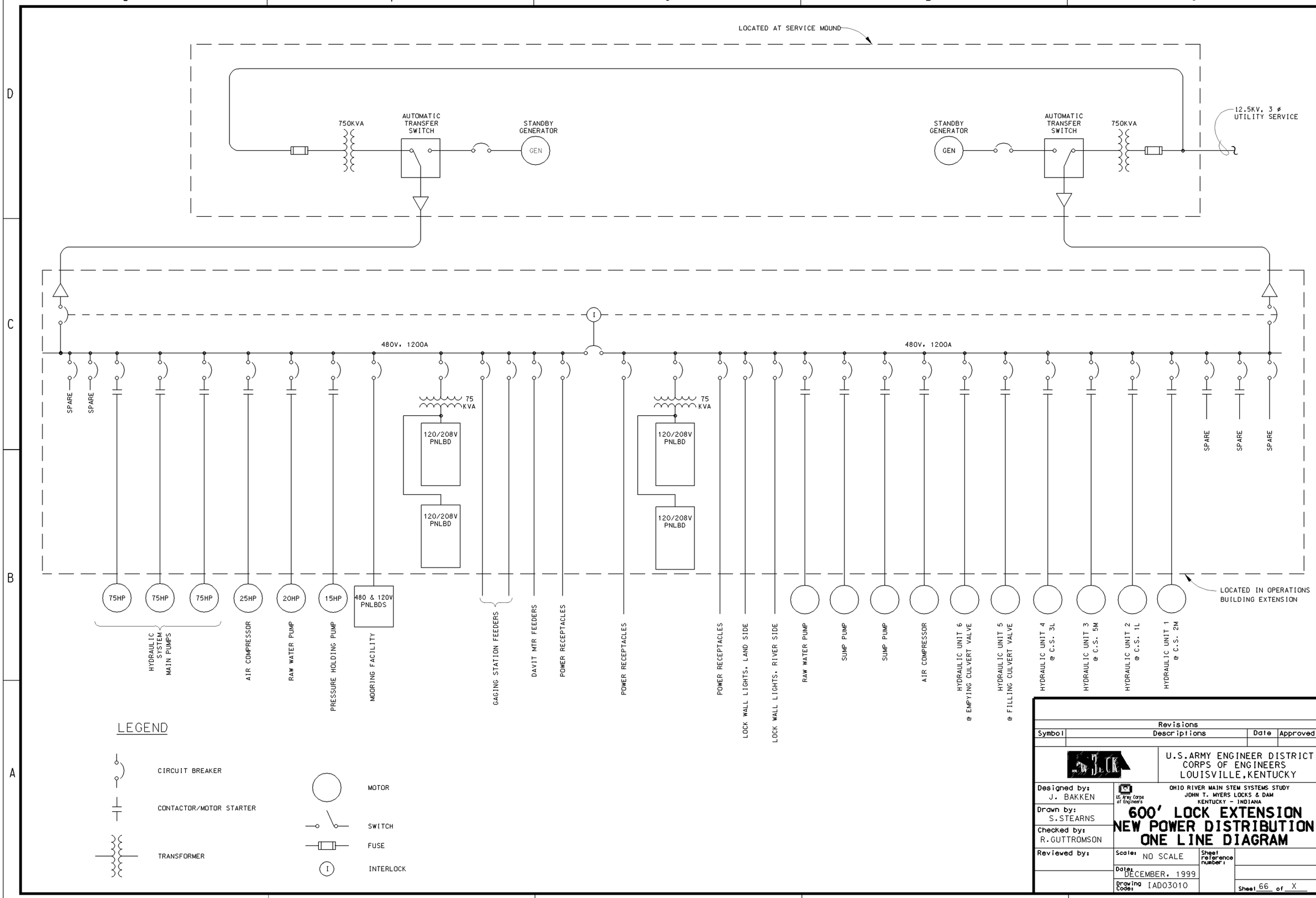
600' LOCK EXTENSION CULVERT VALVE
GENERAL ARRANGEMENT

Designed by: M. HAMMER
Drawn by: D. NUPCHAROEN
Checked by: H. TONDRAVI
Reviewed by:

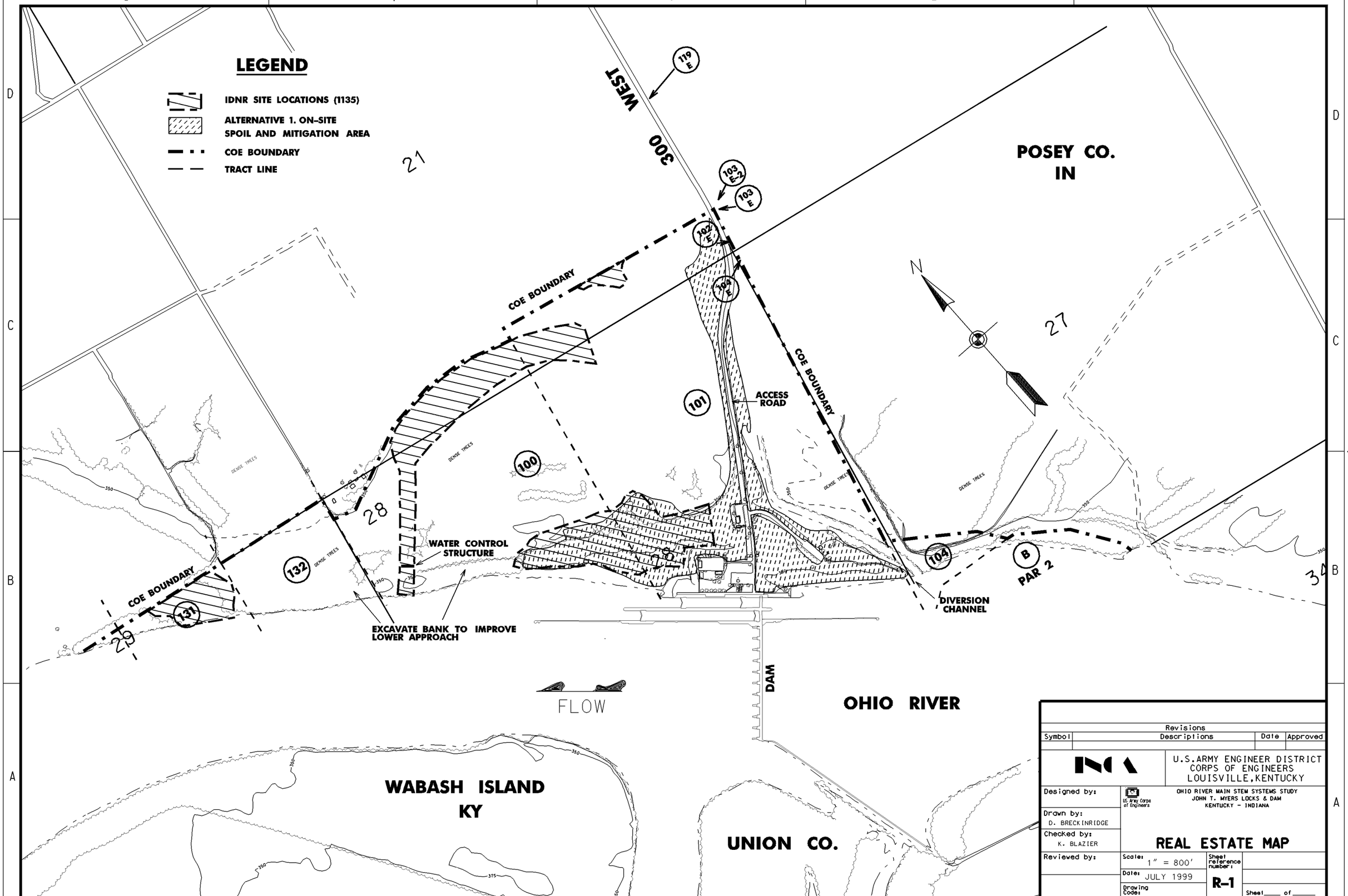
Scale: AS SHOWN
Date: DECEMBER, 1999
Drawing Code: IAD03012
Sheet reference number:
Sheet 65 of X

DRAWING 10.OD

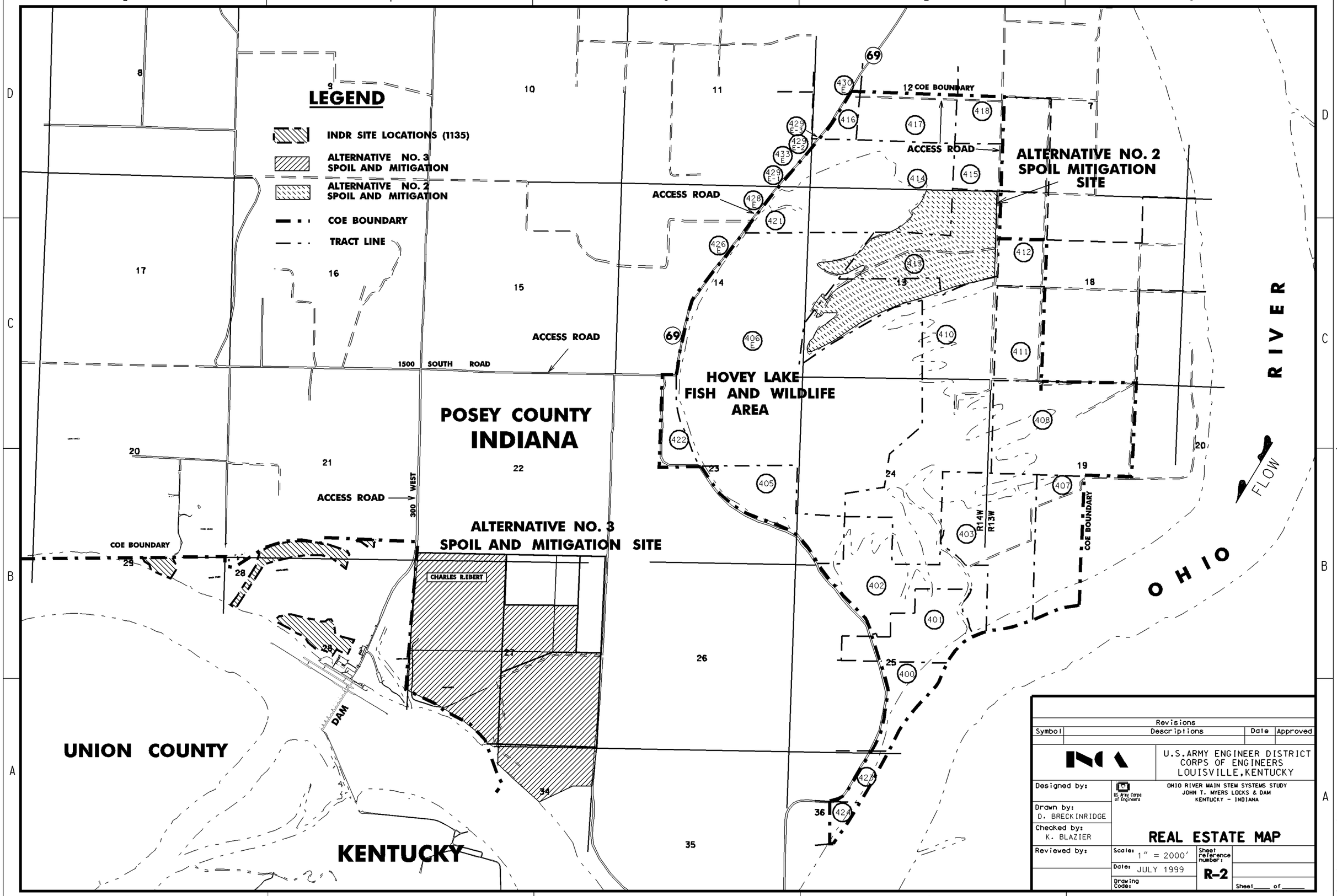
$FILE$
$DATE$
$TIME$



$FILE$
$DATE$
$TIME$

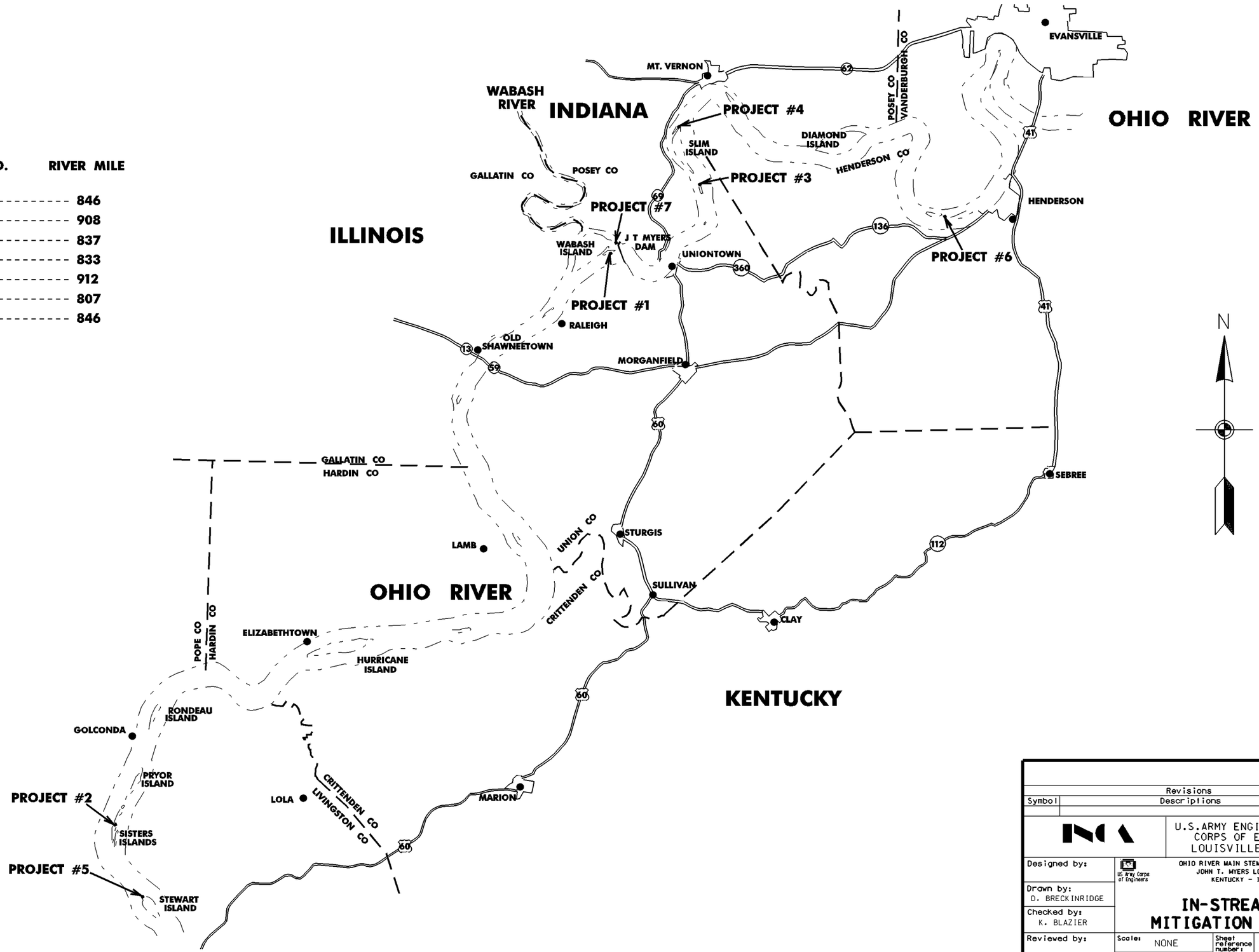


#FILE#
#DATE#
#TIME#



$FILE$
$DATE$
$TIME$

PROJECT NO.	RIVER MILE
#1	846
#2	908
#3	837
#4	833
#5	912
#6	807
#7	846



Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

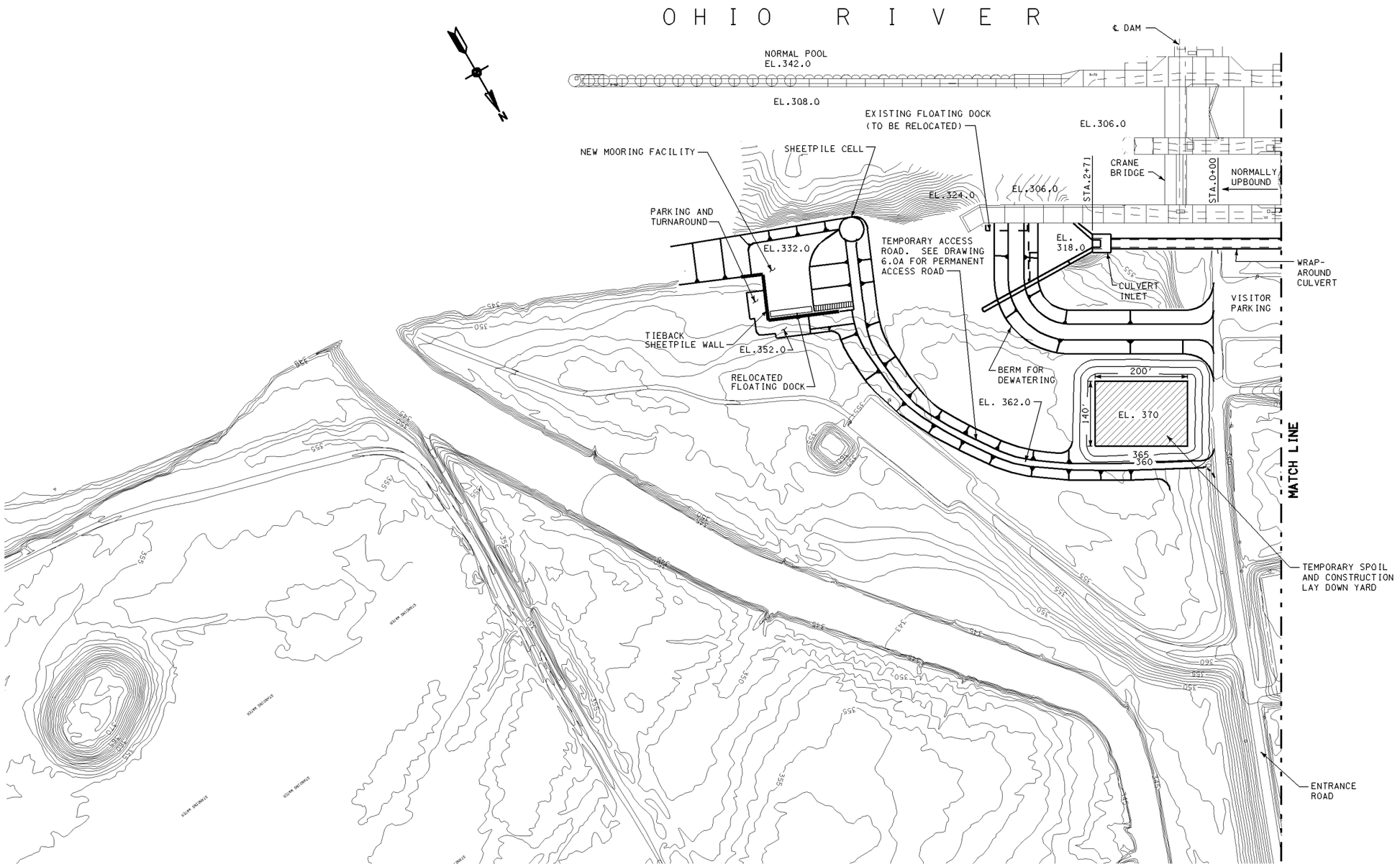
Designed by:
Drawn by: D. BRECKINRIDGE
Checked by: K. BLAZIER
Reviewed by:

IN-STREAM MITIGATION SITES

Scale: NONE
Date: JULY 1999
Drawing Code:
Sheet reference number: R-3
Sheet ____ of ____

DRAWING 13.0C

#FILE#
#DATE#
#TIME#



PLAN

100 50 0 50 100 200FT

SCALE: 1"=100'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S.ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE,KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

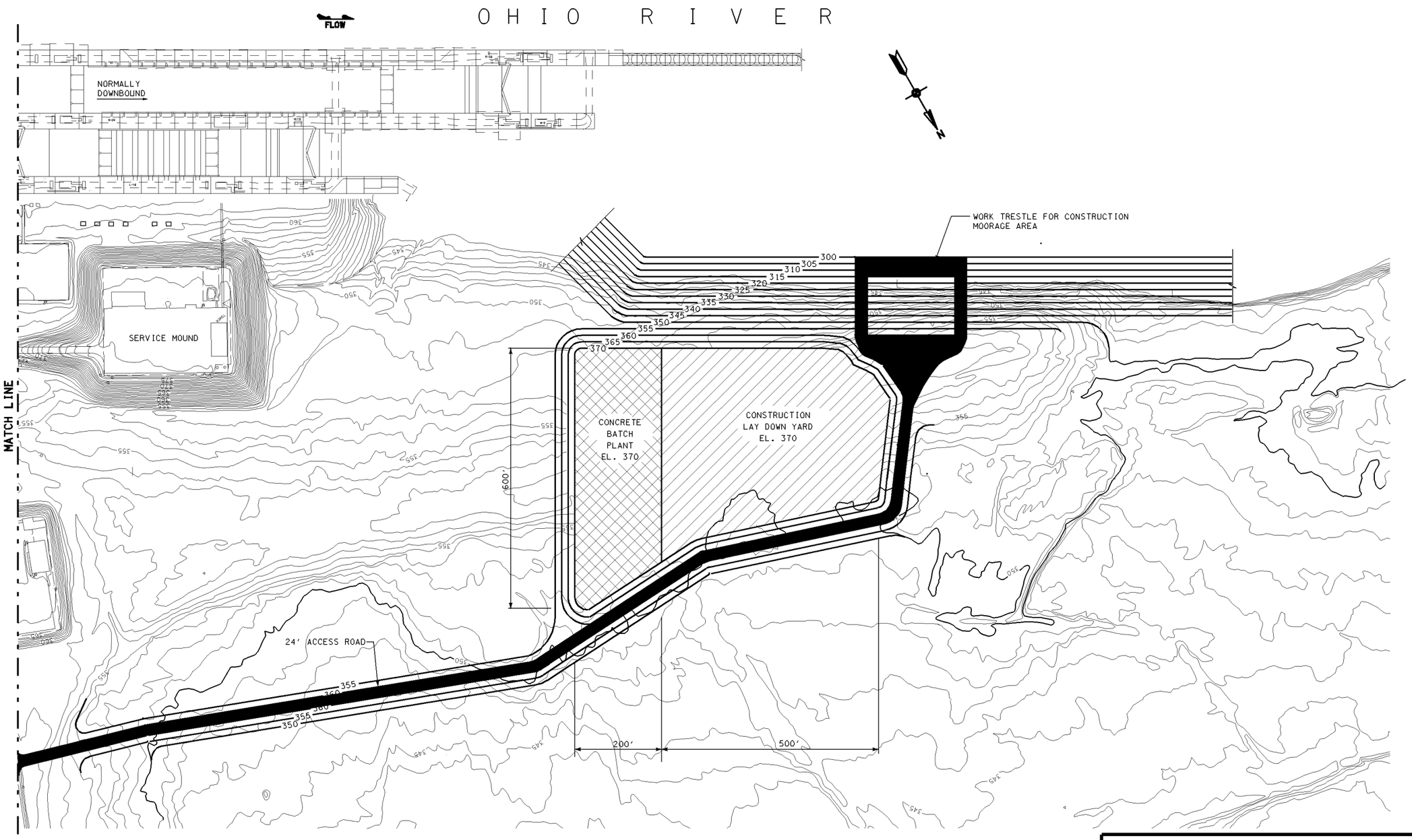
600' LOCK EXTENSION.
UPSTREAM TEMP.
CONST. REQUIREMENTS

Designed by: PC
Drawn by: KT
Checked by: LRP
Reviewed by:

Scale: 1"=100'
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 70 of ____

DRAWING 14.9.2A

#FILE#
#DATE#
#TIME#



PLAN

100 50 0 50 100 200FT

SCALE: 1"=100'

Revisions			
Symbol	Descriptions	Date	Approved

INCA ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

US Army Corps of Engineers

OHIO RIVER MAIN STEM SYSTEMS STUDY
JOHN T. MYERS LOCKS & DAM
KENTUCKY - INDIANA

600' LOCK EXTENSION DOWNSTREAM TEMP. CONST. REQUIREMENTS

Designed by: PC
Drawn by: KT
Checked by: LRP
Reviewed by:
Scale: 1"=100'
Date: AUGUST 1999
Drawing Code:
Sheet reference number:
Sheet 71 of ____

DRAWING 14.9.2B

#FILE#
#DATE#
#TIME#