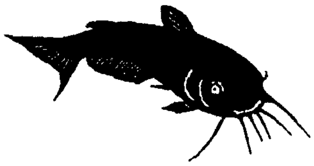
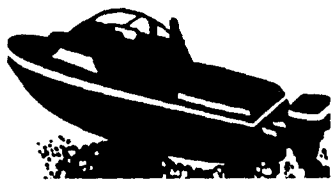
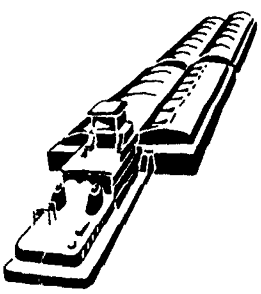
Upper Mississippi River - Illinois Waterway System Navigation Study





LARGE SCALE MEASURES OF REDUCING TRAFFIC CONGESTION

CONCEPTUAL LOCK DESIGNS



INTERIM REPORT

February 1996
(Revised July 1996)

US Army Corps
of Engineers

Rock Island District
St. Louis District
St. Paul District

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION

CONCEPTUAL LOCK DESIGNS

U.S. ARMY ENGINEER DISTRICTS,
ROCK ISLAND, ST. LOUIS, ST. PAUL
CORPS OF ENGINEERS

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION CONCEPTUAL LOCK DESIGNS

EXECUTIVE SUMMARY

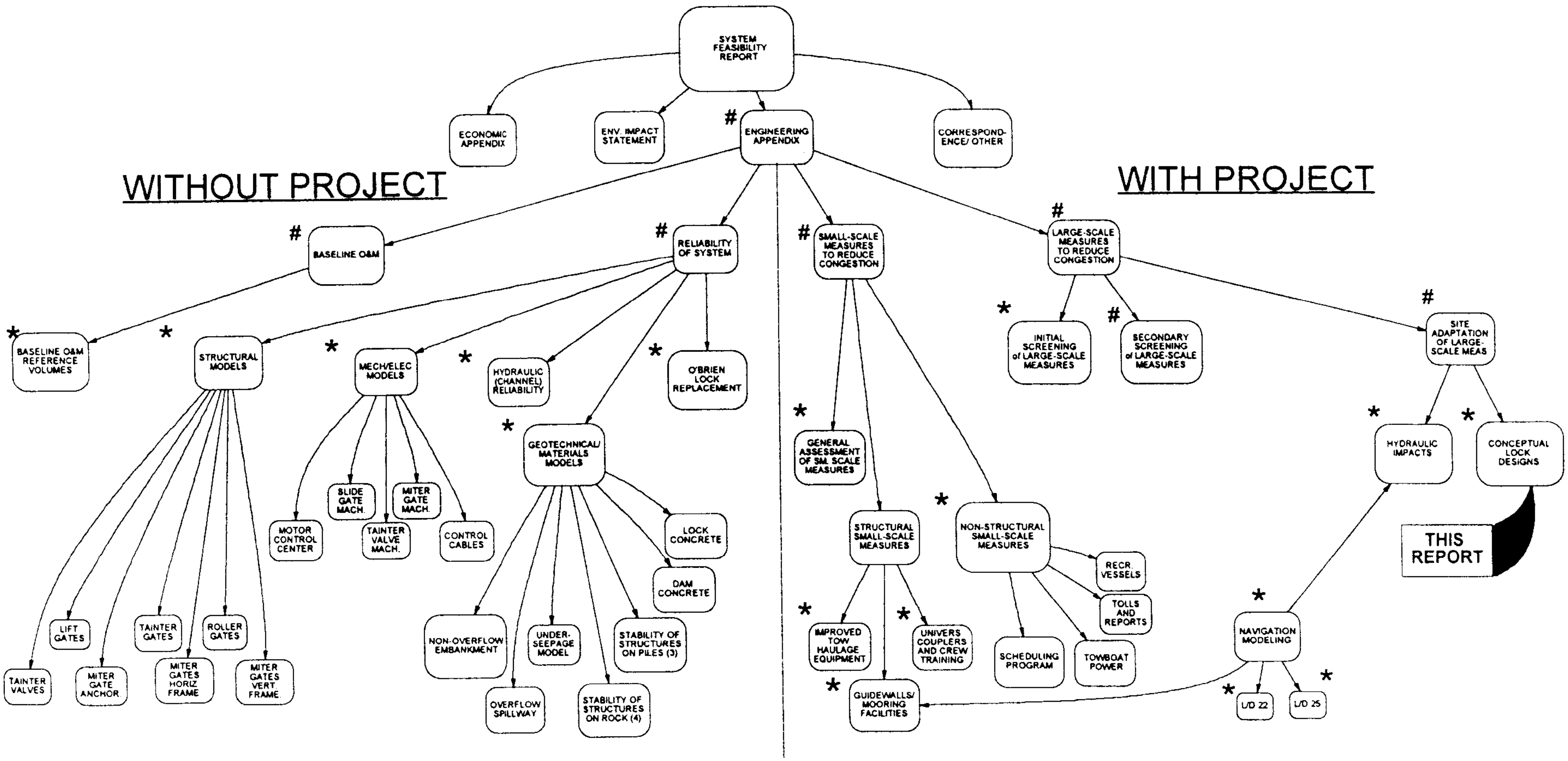
UMR&IW Navigation Study - Statement of Purpose (abbreviated). The ongoing UMR&IW System Navigation Study ("Navigation Study") is addressing navigation improvement planning for the Upper Mississippi River and Illinois Waterway System for the years 2000-2050.

Scope of this Investigation. The present report establishes engineeringly feasible conceptual designs, and the associated costs, for adding new locks at several alternative locations at a typical rock-founded lock and dam and at a typical pile-founded lock and dam. These so-called "generic" design concepts will be adapted to specific sites under a separate effort of the Navigation Study. The engineering product tree on the next page will help orient the reader to this report's relationship to the other engineering work.

Design Approach. Developing lock designs of reduced cost compared to traditional locks was a paramount objective. As such, several innovations were explored and developed, resulting in substantial savings. To give the plan formulation process a more comprehensive array of measures, three different lock types were developed (designated Types A, B, and C). These range from locks of traditional lock construction (with high performance) to locks of the lowest possible first cost (with trade-offs in performance). All lock designs were required to comply with two governing rules: 1) No locks will be considered that would be unsafe, and 2) No locks will be considered whose performance cannot be predicted.

Interim Results. This investigation has determined a number of conceptual lock designs that are feasible from an engineering perspective, i.e., each of the designs could be built. An array of alternatives that fit within the governing criteria of having predictable performance and safe operation is presented to give a full spectrum of cost versus performance choices. The engineering feasibility of each of these alternatives, however, does not constitute full consideration of the plan formulation criteria of completeness, effectiveness, efficiency, and acceptability. The next step in the feasibility study will be to combine the results of all engineering efforts into a comprehensive engineering appendix to the system feasibility report. The Navigation Study will incorporate plan formulation activities that will give balanced regard to all inputs to determine the best plan to be recommended to meet national interests.

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY



1. This product tree is a simplified representation of the engineering activities/products for the UMR&IW Navigation Study. It is subject to change as the study progresses.
2. In general the arrows point in the way one would normally read when the system feasibility report is complete, i.e., from general to specific.
3. # indicates a product (and those below unless marked with *) that is an integral part of the Engineering Appendix to the UMR&IW System Feasibility Report.
4. * indicates a product (and all those below it that is a "stand-alone", separate bound volume, included in the feasibility report by reference only.

ORGANIZATION OF ENGINEERING PRODUCTS FOR THE FEASIBILITY REPORT

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION
CONCEPTUAL LOCK DESIGNS

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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION

CONCEPTUAL LOCK DESIGNS

1. Purpose of UMR&IW Navigation Study. The Upper Mississippi River & Illinois Waterway System Navigation Study ("Navigation Study") is a feasibility study addressing navigation improvement planning for the Upper Mississippi River and Illinois Waterway (UMR&IW) system for the years 2000-2050. This study will assess the need for navigation improvements at 29 locks on the Upper Mississippi River and 8 locks on the Illinois Waterway and the impacts of providing these improvements (Figure 1 is a plan view of the UMR&IW system). More specifically, the principal problem to be addressed is congestion of commercial traffic at locks upstream of Melvin Price Lock and Dam due to limited lockage capacity and increasing traffic. The study will determine the location and appropriate sequencing of improvements on the UMR&IW, prioritizing navigation improvements for the 50-year planning horizon. The feasibility study will also include preparation of a system Environmental Impact Statement (EIS) and mitigation costs of environmental impacts.

2. Study Authority. Authority for the Navigation Study is contained in Section 216 of the Flood Control Act of 1970 (Public Law 91-611) which allows the review of the operation of Corps of Engineers navigation projects when found advisable due to significantly changed physical or economic conditions.

3. Scope of this Report. The present report establishes engineeringly feasible conceptual designs, and the associated costs, for adding new locks at several alternative locations at a typical rock-founded lock and dam and at a typical pile-founded lock and dam. These so-called "generic" design concepts will be adapted to specific sites under a separate effort of the Navigation Study. The engineering product tree included at the front of this report will help orient the reader to this report's relationship to the other engineering work.

4. Design Approach. With a large Federal debt, shrinking Federal budgets, and limited Inland Waterway Trust Fund resources, the Navigation Study design team is acutely aware of the need to develop lock conceptual designs of reduced cost compared to traditional locks. As such, all past design criteria and construction standards were open for reevaluation. The focus turned to those criteria and standards that significantly impact costs, leaving refinement of appurtenances to any later site-specific feasibility studies. To give the plan formulation process a more comprehensive array of measures, three different general lock types were developed (designated Types A, B, and C and defined later). These range from traditional

DISTRICT L/D RESPONSIBILITIES	
ST. PAUL DIST. (CENCS)	USAF - L/D 10
ROCK ISLAND DIST. (CENCR)	L/D 11 - L/D 22
	O'BRIEN - LAGRANGE
ST. LOUIS DIST. (CELMS)	L/D 24 - 27

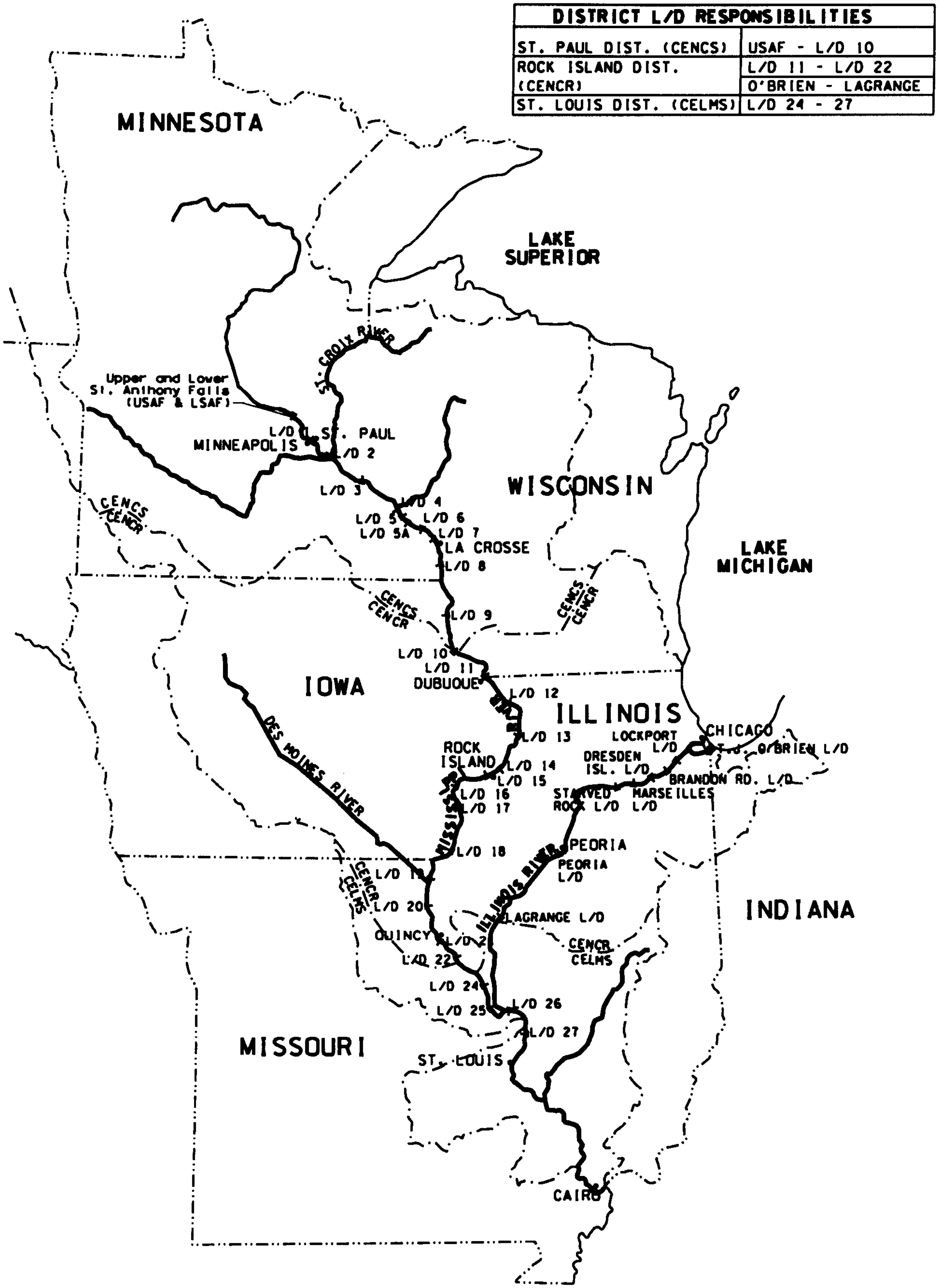

FIGURE 1
UPPER MISSISSIPPI RIVER & ILLINOIS
WATERWAY NAVIGATION SYSTEM

lock construction (with high performance) to locks of low first cost (with reductions in performance). All lock designs were required to comply with two governing rules: 1) no lock concepts will be considered that would be unsafe,[1] and 2) no lock concepts will be considered whose performance cannot be predicted. Compliance with these rules helped provide the assurance that the alternative designs remained within the realm of engineering "feasibility". The following were the main considerations for and influences on the design approach.

a. Innovation.

(1). Innovative Task Force. In September 1992, the U.S. Army Corps of Engineers (USACE) Task Force for Design and Construction Innovations for Locks and Dams (DCILD) was formed. The primary objective of the task force was to identify new technology and methods "for constructing navigation projects in a more efficient, cost effective, and environmentally sound manner." The task force completed the first phase of its charter to investigate prior efforts, explore new and innovative concepts, and assess the feasibility of applying innovative concepts to navigation projects. The results of this effort, including estimates of potential cost savings for various innovative measures, were published in a USACE pamphlet, dated 30 April 1994 (Reference 18). In subsequent phases, the DCILD study was also to prepare design guidance and tools, complete a demonstration project in the General Investigations (GI) or Preconstruction Engineering and Design (PED) stages, and continue research and development to include field testing of components, large scale models, and parametric studies. However, the remaining DCILD task force phases were unfunded and a directive was given to Corps Districts involved in navigation projects to continue the innovation initiatives.

(2). Continuing Innovative Efforts. Started by the DCILD task force, innovative lock design workshops continued to be held periodically with the involvement of Districts and Divisions with navigation missions and Headquarters USACE. These meetings were information sharing and technology transfer workshops intended to avoid duplication of effort while broadening the list of alternative designs. Several innovations were explored and developed by the three Districts working on the UMR&IW Navigation Study. Most of the innovations are estimated to provide substantial cost savings compared to traditional lock construction. These concepts are considered first generation technology in lock design. It is likely that successive efforts will generate new ideas or refinements to these innovations, achieving improved performance and/or additional cost savings. Innovative concepts that violate the governing rule of having predictable performance were not considered at this phase of the study. However, these concepts could be further considered during any later site-specific studies, particularly if it could be expected that the uncertainties

[1] All current design factors (for strength and structural capacity, etc.) will be adhered to. Navigational and operational safety will likewise not be compromised. The deviations from current standards discussed in paragraph 6 only effect performance and cost, not safety.

would be abated with additional investigation. The specific innovations that were considered for the Navigation Study are discussed with the overall descriptions of the conceptual lock designs below.

b. Technical Review Conferences. Conferences wherein Corps higher authority provides technical review to a District on completed or ongoing work of a feasibility study are routine. However, for the Navigation Study, the largest Civil Works study ever undertaken by the Corps, these Technical Review Conferences (TRC's) have become even more prudent. To date, TRC's have been held on 29-30 April 1993, 23-24 August 1993, 4-5 April 1994, and 27-28 September 1994, with each addressing study progress and an agenda of technical issues for direction (see References 4-7).

c. Engineering Coordinating Committee Meetings. The Navigation Study engineering work group has desired the input of the bordering states, academia, contractors, the towing industry and other interested public, and to keep the same groups informed of the study findings and progress. To that end, "Engineering Coordinating Committee Meetings" (ENCC's) have been held at pertinent times. These meetings usually began with study updates by the Corps' engineering work group, followed by question and answer periods and open discussions of relevant issues. To date, ENCC's have been held on 25 May 1994 and 6 April 1995 (see References 2 and 3). These meetings covering engineering concerns are typical of coordination meetings that are held for the other work groups covering environmental, economic, and general public involvement interests.

d. Environmental Considerations. The present engineering effort is intended to take a comprehensive look at possible generic lock designs, generally without regard to site-specific considerations. Later, these generic designs will be adapted to specific lock and dam sites. While general comment on the environmental effects is made below for the sites selected as "typical" for development of the generic lock concepts, the site-specific environmental impacts for all locations and sites will be more thoroughly addressed during the site adaption effort. Nevertheless, several design measures have been explored to avoid and minimize environmental impacts compared to traditional lock construction. These include use of less construction material through design innovations, beneficial use of dredged material, improved approach conditions to reduce tow maneuvering, designing for shorter construction durations, and construction without cofferdams, among other measures.

5. Definitions

a. Sites. Unless another meaning is obvious by the context, the use of "site" will mean any of the existing lock and dam sites included in the Navigation Study, e.g. Lock and Dam 11, Lock and Dam 20, Peoria Lock and Dam, etc. This distinction is necessary to avoid confusion with lock "locations" defined below.

b. Lock Locations. During the reconnaissance phase of this study, it was determined that it was unnecessary and uneconomical to build new dams along with the new locks. This left the lock placements to be made at the existing lock and dam sites. In the present investigation, six alternative locations at each lock and dam were considered (see Figure 2). With these six locations, any placement from overbank to overbank was possible, however, practical matters restricted some locations from their full range. For most locations, the cost effectiveness of a lock placement is dependent upon site-specific considerations that will be considered separately from this report. The locations considered are as follows:

(1). Location 1 is landward of the existing lock. For most sites, Location 1 would entail land-based construction techniques as opposed to the more costly and difficult marine construction required at most other locations. Large quantities of soil and/or rock excavation would be required at this location, necessitating large disposal areas. Location 1 typically would require relocations of railroad track, utilities, private property, and other infrastructure. For the most part, construction would not interfere with navigation access to the existing lock. A considerable amount of channel work would be required to allow tows to reach a Location 1 lock safely. Unlike locks at other locations, a Location 1 lock would disrupt access to the existing lock for materials and personnel. However, easier access (for personnel and supplies) would be available to the new lock site than locks at other locations.

(2). Location 2 is an extension of the existing 600-foot-long lock to result in a 1200-foot-long lock. The only viable designs are those that could be constructed while maintaining navigation with only minimal traffic interruptions and low risks of accidents. Little or no channel work would be required for a Location 2 lock.

(3). Location 3 utilizes the existing auxiliary lock miter gate bay (if present) to construct the new lock. This location would also require navigation interruptions during construction. However, it typically requires little or no channel work due to its close proximity to the existing channel. It also makes use of the existing intermediate lockwall and the existing auxiliary lock miter gate bay.

(4). Location 4 is through the gated section of the dam. Although any placement through the gated section is possible, placement toward the side of the existing lock is generally preferred because less channel work is required and the lock would be more accessible to lock personnel. Siting a lock at Location 4 eliminates one or more of the existing dam gates. This loss of flow capacity could impact upstream water surface elevations. To date, it has been assumed that any dam gates removed would be replaced one-for-one at another location along the axis of the dam (where there presently is lesser or no flow capacity). This assumption will be further addressed under a separate effort to address all hydraulic impacts of new lock construction. The possibility of providing flow through the new lock chamber (controlled by an upstream lift gate) will be considered as well.

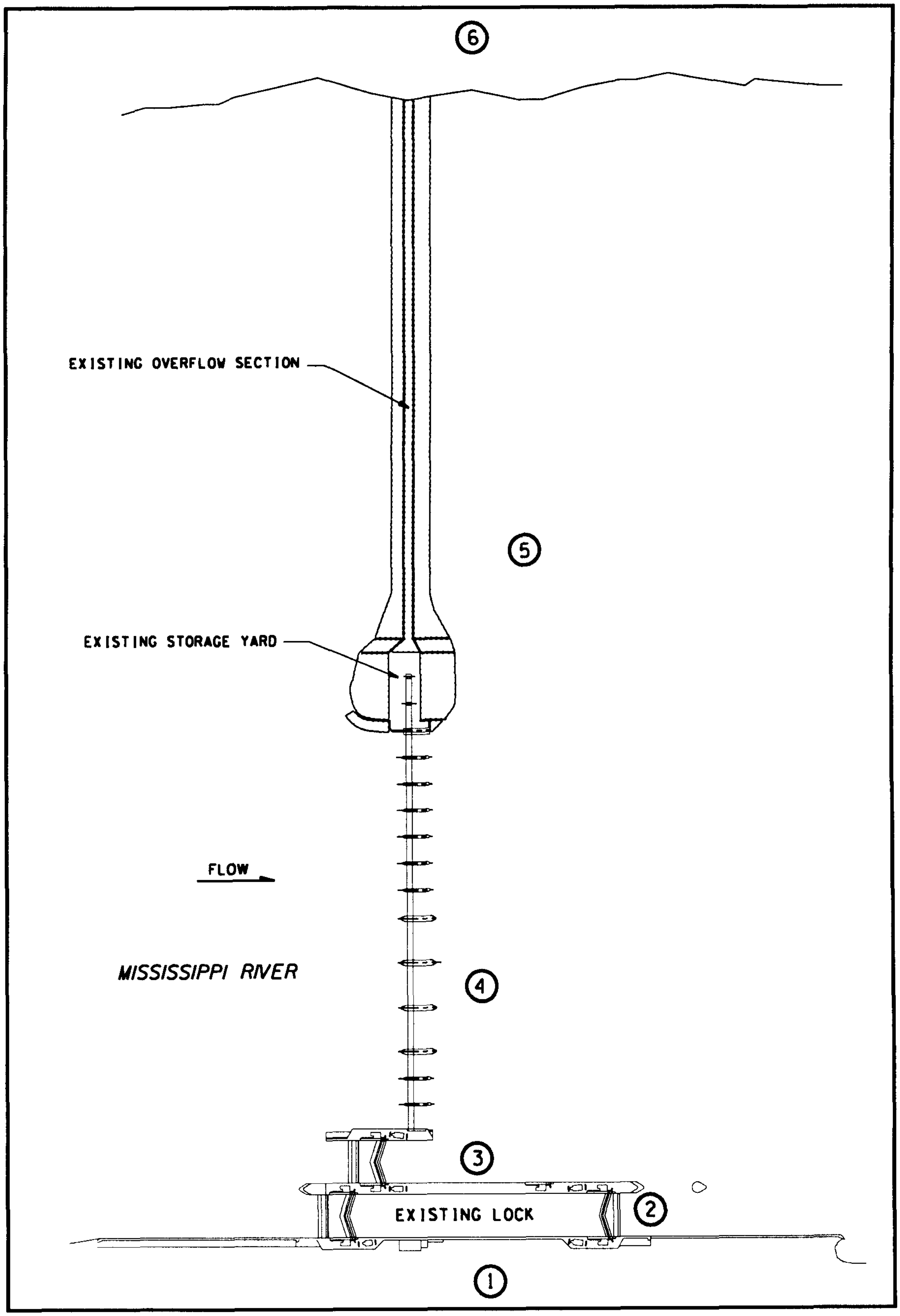

FIGURE 2 - ALTERNATIVE NEW LOCK LOCATIONS AT A TYPICAL EXISTING LOCK AND DAM SITE

(5). Location 5 places the lock in the non-overflow or overflow sections of the dam (if present) beyond the gated section of the dam. Again, the preferred location would be toward the existing lock side of the non-overflow or overflow sections. From the initial screening investigation, it appears that Location 5 would be infeasible (i.e., uneconomical) at all sites because of extensive channel work requirements, adverse environmental impacts, utility modifications, and poor accessibility. However, a Location 5 lock design has been developed in the present engineering investigation to determine first costs of Location 5 lock construction for quantitative comparison with other locations and further screening.

(6). Location 6 is a land-based location on the opposite bank from the existing lock. This location is infeasible at all sites for the same reasons as Location 5 appears to be, only to a greater and more certain measure. An additional problem at Location 6, resulting from the fact that there would be no flow adjacent to the new lock (unless additional dam gates were added), is that siltation would be a problem requiring frequent dredging work. No conceptual lock designs for Location 6 have been developed because the initial screening investigation determined that the added problems of this location were severe enough to eliminate all Location 6 Locks. Nevertheless, the basic lock cost of a Location 6 lock would be expected to be similar to Location 1, the other land-based location.

c. Performance. Where the word "performance" is used, it will generally refer to the lock's ability to perform its basic function of locking boats. A high performance lock would consistently lock boats efficiently. A low performance lock would lock boats more slowly. In addition, a low performance lock might perform less consistently, being less equipped for extreme conditions.

d. Conceptual Lock Design Types. As noted earlier, three conceptual lock design types conforming to the two governing rules (of safety and predictability) were developed to present an array of measures for the plan formulation process. Although there are site- and location-specific differences, these lock types are generally defined as follows:

(1). Type A. A "Type A" conceptual lock design is a lock designed according to current design standards and traditional construction methods for locks. It would be constructed within a dewatered cofferdam as were all the existing locks and dams on the Mississippi River and Illinois Waterway. This lock type would typically have concrete gravity or U-frame walls, a side port filling and emptying system, and a downstream miter gate and either an upstream miter gate or a lift gate. A Type A lock would be expected to have the highest performance levels but also the highest first cost. Construction risks would be low for this type of lock.

(2). Type B. A "Type B" conceptual lock design is a lower cost lock utilizing construction techniques proven in marine construction that heretofore have not commonly been used in lock construction. The construction techniques are innovative to the extent that the two governing rules (predictable and safe performance) would allow. A Type B lock would be expected to have a reduction in performance and a possible reduction in durability compared to a Type A lock. A Type B lock would present moderate risks to construct.

(3). Type C. A "Type C" conceptual lock design is the lowest first cost design that still is safe with predictable performance. This lock type would be expected to be less durable (probably requiring major rehabilitation within the 50-year planning horizon) and less reliable than Type A and B locks. To accomplish the cost savings, certain design standards were relaxed with resulting tradeoffs in performance. The Type C conceptual designs include innovative construction techniques taken a step further to "no frills" design. A Type C lock would present low to moderate risks to construct.

e. Design Life. The design life is the service life expected by the design engineers at the time of design. For lock construction, a figure of 50 years is typically selected since the project benefits usually far exceed the cost within this timeframe and a replacement in year 50 would be heavily discounted in terms of a present worth cost. This estimation is not an exact science and the actual service life typically varies from the design life.

f. Service Life. Service life is the actual length of time that the project remains in operation. This is not known until the project ceases to be functional. Service life is influenced by a number of factors including: quality of original construction, extent and timing of maintenance, environmental influences (corrosive environments, freeze-thaw cycles, etc.), random events (accidents, natural disasters, etc.), traffic levels experienced, and other similar site-specific factors.

6. Common Design Criteria and Features. **Unless otherwise noted,** all lock designs conform to the following *minimum* criteria and include the following design features:

a. Criteria. The minimum criteria used in developing the concept designs is shown in Table 1 and described herein.

(1). Sill Depth. For Type A locks, the upper and lower sill elevations would be at a depth of twice the authorized draft (for this study, the authorized draft, "d", is 9 feet, therefore, 2d=18') below the respective 95% exceedance duration upper and lower pool elevations.[2] For Type B and Type C locks, the upper and lower sill elevations would be shallower, raised to 1.7d (i.e., 15.3 feet) below the respective *minimum* upper and lower pool elevations.

[2] The Type A depth to sill (2d) is measured from 95% exceedance duration elevation per HL-89-5, "Hydraulic Design of Navigation Locks", Sep. 1989.

(2). Submergence. The "submergence", defined as the depth from minimum tailwater to the chamber floor, is 2d plus 2.0 feet (i.e., 20 feet) for the Type A locks.[3] The submergence for the Types B and C locks is 1.7d plus 2.0 feet, or 17.3 feet. This criterion for the Types B and C locks could reduce lock performance under certain circumstances (e.g., under heavy ice conditions at low pool stages). Some of the floor and sill elevations were rounded down to the nearest half-foot.

TABLE 1
COMMON LOCK DESIGN CRITERIA

	Lock Type		
Engineering Criteria	**A**	**B**	**C**
Depth to upper sill	2d[a]	1.7d[c]	1.7d[c]
Depth to lower sill	2d[b]	1.7d[c]	1.7d[c]
Chamber floor depth [d] ("Submergence")	2d+2	1.7d+2	1.7d+2
Filling and Emptying Times	Less than 20 minutes (w/ 5.0 ton max. hawser force)		
Usable chamber length	600 and 1200' alternatives for all Lock Types		
Chamber width	110'	110'	110'
Lockwall stability	Compliance with ETL 1110-2-256		
Dewaterable	Yes	Yes	Yes
Top of Lockwalls	Same as existing lockwalls[e]		
Cofferdam Height	0.10 probability flood + 2 ft. freeboard		
Load for dewatered lock	15 % duration elevation		

[a] Measured from 95% exceedance duration pool elevation per HL-89-5, "Hydraulic Design of Navigation Locks", Sep 89.
[b] Measured from 95% exceedance duration tailwater elevation per HL-89-5, "Hydraulic Design of Navigation Locks", Sep 89.
[c] Measured from minimum pool and tailwater for the upper and lower sills, respectively. These "lowest operating" elevations are determined from historical records.
[d] The reference water surface elevations are the same as for the lower sills of each lock type (A and B&C). The chamber floor would be deeper where miter gates swing since the sill is less than 3 ft. above the floor.
[e] Lockwall heights would be addressed in site-specific studies.

(3). Filling and Emptying Performance. While EM 1110-2-1604 (Reference 13) suggests an 8-minute filling or emptying time as a common goal for low lift locks, the goal of this phase of the Navigation Study was to keep all filling and emptying (F/E)

[3] EM 1110-2-1604 recommends a submergence value of 23 feet for 110-foot-wide, 9-foot-draft, side-port filling and emptying locks. However, this value is based on a goal of optimizing filling and emptying times, not achieving total cost savings as is the goal of the UMR&IW Navigation Study.

times below 20 minutes. New 1200-foot-long locks have so great an improvement in transit time by eliminating double lockages, that F/E times are not as critical. Later studies could optimize F/E times by economic analysis, considering benefits of reduced transit time versus costs of different F/E systems. However, for most of the conceptual lock designs, F/E times were estimated and favorable results were found. The estimates were determined using the computer program TFSIM (documented in Reference 12) and CORPS program H5320. The F/E systems must be designed, and the F/E times must be determined, such that hawser forces do not exceed the allowable maximum force of 5.0 tons during the filling and emptying operations. Excessive turbulence must also be avoided. With these constraints, the range of expected F/E times of the conceptual lock designs was estimated at approximately 7 to 15 minutes. If necessary, valve times can be slowed to reduce turbulence and hawser forces. While side-port F/E systems have been extensively studied, other F/E systems would require hydraulic modeling to ensure a safe and efficient design.[4]

(4). Chamber Size. All of the alternative new locks would be 110 feet wide, the same width as the existing locks. For the Types A, B, and C locks with miter gates at each end, the upstream to downstream pintle-to-pintle distance is 1,270 feet, providing a usable chamber length of 1200 feet. For the locks that utilize a lift gate upstream and a miter gate downstream, these gates would also be positioned to provide a usable chamber length of 1200. The same design concepts have also been developed for new locks with 110' by 600' usable size chambers for all types and locations except Location 2 (which already has a 600-foot-long lock). The drawings in this report only depict the 1200' lock alternative. However, the 600' lock alternatives are of the same construction except that the middle 600 feet of lockwall is eliminated. The tops of the new lockwalls were assumed to be the same as the existing lock. This assumption would need to be reviewed during later site-specific studies.

(5). Cofferdam Height. The top of any cofferdam used is equal to the 0.10 probability flood elevation plus two feet of freeboard. During the site-specific feasibility phase, the cofferdam heights would need to be optimized using a risk analysis approach. The risk analysis would include the construction duration within the cofferdam, the contractor's and Corps' loss if flooding of the cofferdam occurs, and the amount of float time in the overall construction period for the work requiring a cofferdam.

(6). Lock Dewatering. The design hydraulic load for overturning and sliding of the lockwalls assumes a dewatered chamber and a 15 percent duration exterior water surface elevation. All lock types would be dewaterable since this provision adds only

[4] A hydraulic model study is underway at the U.S. Army Corps of Engineers Waterways Experiment Station, primarily to investigate through-the-sill filling and emptying with a longitudinal floor culvert system. The results specific to the UMR&IW system were not available when the lock concepts in this report were developed.

a small percentage to the first cost. Some concepts may require the installation of deep wells at the time of dewatering to be fully dewaterable. All lock designs would have the majority of their lock chamber located in the lower pool because costs are lower with lower head for construction and maintenance dewatering.

b. Common Design Features. To avoid excessive repetition of text, design features that are common to all or many of the designs are described here.

(1). Guidewalls. Guidewall locations shown on the conceptual drawings indicate a reasonable location for determining costs. Actual locations are site-specific and would need to be further addressed in later studies. For most of the Type A locks, a guidewall similar to the design used for the Melvin Price Locks (described later with the Type A lock descriptions) would be used. Two guidewall concept designs, one rock-founded and one pile-founded, were developed for use for Lock Types B and C. These designs are significantly less expensive than the traditional guidewall design used at Melvin Price Locks. Although further refinement is possible, investigations to date indicated that basic stability and strength requirements will limit the amount of additional cost savings in subsequent design phases. The two basic guidewall designs are described below:

(a). Guardwall/Guidewall Concept for Rock Foundations. The concept for the rock-founded guardwall is adapted from the pile-founded guidewall concept described below and from a pile-founded guidewall design of a paper submitted at the 1995 Corps of Engineers Structural Engineering Conference (Reference 11). The primary difference between the guardwalls and guidewalls depends on the location of the wall. Usually the upstream guardwall is placed riverside to prevent the tows from being drawn into the dam. The design is preliminary and the calculations were made for purposes of determining quantities and should not to be considered as complete. The conceptual design for the rock-founded guidewall is shown on Plate RGW1.

The substructure would be comprised of 33.43 foot diameter sheet pile cells spaced at a distance of 80 feet and founded on limestone. It is uncertain what depth the sheet piling could be driven into the rock, but very little penetration may be possible at some sites due to the high strength of the rock. The cells derive their overturning stability from the cell diameter and mass. The bottom of the cell would be filled with tremie concrete to assist in stability and provide a seal to prevent the leakage of the gravel fill. Above the tremie seal, the sheet pile cells would be gravel-filled. Precast concrete beams would span between cells, providing the strength required for functioning as a guidewall. On the riverside face of the precast beams, precast panels would be attached to make up the rubbing surface. The panels would be removable to facilitate replacement. By having the rubbing surface a separate element, future guidewall rehabilitations would be easier and less costly and the integrity of the precast beams would not be compromised. The panels can be formed from abrasion resistant concrete and would also be armored for additional abrasion resistance. Inside the cell at the chamber side edge of the cell, concrete would be placed for the full height of the cell for support of the precast beams. The cell would be provided with a reinforced concrete cap to aid in cell structural integrity and stability. Manholes would be built into the concrete cap for inspection purposes and as an access for replacing fill material when required.

At least two prestressed concrete box beams comprised of not less than 4000 psi concrete would span between the sheet pile cells. Concrete columns would provide support between the beams. The beams would have to be designed with weep holes to flood the cavities and reduce beam buoyancy during flood events. A wearing surface for the top of the beams would be constructed using precast sections or cast-in-place concrete. Handrails, tow haulage and checkposts would form the complete guidewall.

A steel skirt would be provided to the upstream guardwalls to block off flow from the water line to a minimum depth of 11.0 feet. This skirt would reduce the volume of the water going through the guardwall and lower the surface velocity, thereby preventing tows from becoming "pinned" on the wall during lock entry and exit. A sheet pile wall would block the flow between the cells entirely for landside guidewalls . The steel skirt of the guardwall utilizes a braced, half-inch steel plate to reduce the amount of water flow through the sheet pile cell openings. The guidewall would be located landside and would utilize braced sheet piling as a soil retaining wall or water flow cutoff. The preliminary designs for the anchored retaining wall uses a PZ40 and the water flow cutoff wall uses a PZ35 sheet pile.

A 54.29 foot diameter cell would be constructed at the end of the guidewall to resist collisions from tows. The cells would be entirely filled with concrete to increase the mass of the cell for improved impact resistance. The beam and panel system would be continued to this end cell. A steel plate 1.75 inches in thickness would wrap 180 degrees around the end cell to protect the sheets from impact.

(b). Guidewall Concept for Sand Foundations. The following text briefly describes the guidewall concept for sand foundations used for the Navigation Study. The concept was adapted from the guidewalls used at Melvin Price Locks. This guidewall concept, shown on Plate PGW1 would be used in conjunction with each of the Type B and C pile-founded lock concepts described later.

The superstructure would be composed of conventionally reinforced, precast concrete beams spanning approximately 80 feet between bearing points. The beams would be stacked vertically like bulkheads, but would transfer their weight only to the bearing points and not along the length of the previously placed beam. Keyways would transfer lateral load between beams. The beams would be armored to resist abrasion and impact.

The substructure or bearing would be composed of the precast concrete bearing block which would be supported by two high capacity, cast-in-place concrete piles each with an approximate diameter of 42 inches. Both the bearing block and the piles could be increased in size if required by more detailed analysis. The piles would be permanently cased with 3/4 inch steel pipe. More detailed analysis could reduce or eliminate the length of casing required resulting in a possible cost savings. The bearing blocks would be precast concrete shells that would be lowered onto the completed concrete piles, leveled and filled with tremie concrete. They would be outfitted with pre-attached bearing devices (not designed at this level of investigation) that can be adjusted by divers to level the bearing surface. Each bearing point, 80 feet center to center, would be backed up by a 35 foot diameter sheet pile cell that would be filled with crushed stone and capped with a ring of reinforced concrete. The ring would reinforce the top of the cell against impact and keep the middle of the cell open for visual inspection for settlement of fill material. The cell would be designed to resist the lateral load from barge impact. For this concept, it was sized with reference to similar cells already constructed. There would be a gap between the completed cell and the vertical surface of the stack of guidewall beams that would be filled with concrete or grout. A method of forming this area to receive concrete would be to use a bladder (reinforced fabric bag) that would conform to the irregularly shaped gap. The bladder and concrete would be lodged in place by blocks welded to certain sheet piles and by deformations formed into the backside of the concrete beams. The bladder would remain in place. Alternatively, the connection could by formed by pneumatic forms that would also conform to the irregular configuration of the connection. They would function more like conventional formwork in that they would form the perimeter of the gap and be removed once the concrete has achieved sufficient strength.

To achieve more energy absorbing characteristics (flexible guidewall), the gap between the cell and the stack of beams could be closed by marine fenders that would deform upon impact. The deformations could be large with heavy impact loads. Many fender geometries are available that could be mounted to adjustable steel framework that in turn would be mounted to the sheet pile cell. The large deflection of the fenders would induce moment into the concrete bearing piles that must be considered in a detailed analysis.

The top guidewall beam would have a tension strap connection to the reinforced concrete ring on the top of the cell to resist the possible rebounding effect that the stack of beams could experience upon heavy barge impact. In order for the rebound restraining device to work for the entire stack of beams, post-tensioning rods would be installed vertically through the ends on the beams and anchor into the bearing seat. A more detailed analysis of the internal stability of the stack of guidewall beams could eliminate both the tension strap and the post-tensioning anchors.

The end cell of the guidewall would be approximately 57 feet in diameter and would be filled with concrete and founded on H-piles. The cell will be designed to resist a direct impact of a fully loaded 15 barge tow. The cell would be notched during construction at the bearing seat in order to receive the stack of guidewall beams.

(2). Miter Gates (Ref. EM 1110-2-2703). Double-leaf miter gates are the predominant lock gate type for locks in the United States and are fairly simple in their construction and operation. They can be opened or closed more rapidly than any other type of gate, and maintenance costs are generally low. A disadvantage of miter gates is that they normally cannot safely close off flow in an emergency situation with unbalanced head. Another concern is that they can be difficult to operate in ice conditions, although bubbler systems can improve winter operation. EM 1110-2-

2703 recommends horizontally framed miter gates over vertically framed miter gates "except for unusual applications and upon special approval." For the Navigation Study, it is proposed to use vertically framed miter gates at all sites for the following reasons. As noted in EM 1110-2-2703, vertically framed miter gates weigh less than horizontally framed gates when the ratio of the height of a leaf to its width is less than about 0.7 (the ratio for the UMR&IW miter gates varies from 0.38 to about 0.55). The low lift locks in the UMR&IW system make it more economical to transfer the load into the sill rather that to the lockwalls. Horizontally framed gates require dewatering of the miter gate bays to repair leaking seals, whereas vertically framed gates have seals on the gates, allowing seal work during gate removal. When repairs are needed, whether routine or accident related, a vertically framed miter gate can be easily replaced in the wet by a spare gate. Horizontally framed gates require dewatering to adjust the quoin and miter contact block for their full length. Because of framing differences, repairs to vertically framed gates are usually easier, faster, and therefore cheaper than to horizontally framed miter gates.

(3). Miter Gate Operating Machinery. One of the following two types of miter gate machinery would be used:

(a). Electric Driven: Each set of miter gate machinery would be driven by an electric motor and would include a brake, speed reducer, pinion gear, sector gear, sector arm, torque limiting coupling, rotary limit switch, strut arm which would connect to a miter gate leaf, and necessary shafts, couplings, and bearings. The motors would be located above the lockwall elevation to allow operation as long as the lock is otherwise still operational during high water periods.

(b). Hydraulic Driven: Each set of miter gate machinery would consist of a gate-attached strut assembly connected to a sector gear which would be driven by a rack gear. The rack gear would be attached to a hydraulic cylinder piston. The hydraulic system would consist of a central or local pumping system comprised of hydraulic equipment such as pumps, cylinders, directional control valves, relief valves, flow control valves, reservoirs, filters, accumulators, and piping.

(4). Tainter Valves. For most of the lock concepts, the lock filling and emptying would be accomplished by four tainter valves - two upstream for filling, and two downstream for emptying. These would be similar in design to those of the existing locks.

(5). Tainter Valve Machinery.

(a). Electric Driven: Each tainter valve would be raised and lowered with an electric motor operating through a speed reducer, to a cable drum wrapped with stainless steel wire rope that is connected to the tainter valve. Each set of machinery would also include a rotary limit switch, torque limiting coupling, brake, and necessary shafts, couplings, and bearings.

(b). Hydraulic Driven: Each tainter valve would be raised and lowered by a bell crank and strut assembly (or other similar arrangement) attached to the valve pickup point located along the centerline of the valve. The opposite end of the bell crank would be attached to a hydraulic cylinder piston. The hydraulic system would consist of a central or local pumping system comprised of hydraulic equipment such as pumps, cylinders, directional control valves, relief valves, flow control valves, reservoirs, filters, accumulators, and piping.

(6). Electrical Systems (Ref. EM 1110-2-2602). The lock electrical systems can be separated into two distinct functions; power and communications. The power systems produce, transport, and convert energy for utilization by equipment such as operating machinery, tow haulage units, bubblers, lighting, heating, controls, and ancillary equipment. Communications systems produce, transport, and utilize data and other information for control and monitoring of the equipment and environment. Sources of power have typically been from public utility connection backed up by an on-site standby diesel generator. Methods of distribution and conversion are not addressed for the system feasibility study. Communications systems at the locks are typically telephone, intercom, radio, traffic and safety signaling, surveillance, computer network, water level and weather monitoring, and control and monitoring of power utilization equipment. Although locks have historically been controlled by line voltage methods, EM 1110-2-2602 recommends low voltage or optical control methods. These methods of controlling lock operating equipment and operating voltages would minimize stresses on gates and other lock equipment. Communications systems could be employed to safely automate lock operations to any degree required, and low voltage and optical control methods provide less expense and greater flexibility in automation. The lock electrical systems comprise a relatively small percentage of the total cost of a lock. Thus, for the system feasibility study, minimal design effort has been expended on electrical design. Cost estimates were taken from recent projects with major lock electrical work.

(7). Maintenance Dewatering Provisions. In general, each of the locks would be equipped with bulkhead slots upstream and downstream of the miter or lift gates at each end of the lock chamber. This would allow dewatering of the entire lock chamber, or only an individual lock service gate bay, as needed for maintenance. Fabrication of additional bulkheads of the same design as those presently used in the UMR&IW system would be advisable due to the limited supply of them at present, their age and condition, and the increased demand with more locks added to the system. For the site-specific dewatering conditions at each lock, the necessary combination of sheetpile cutoffs, dewatering wells, and other provisions would be added as required to manage the dewatering operation.

(8). Removable Lockwall Facing. Many, but not all, of the lockwall designs include precast concrete panels as the lockwall face. These would be attached to the supporting lockwall in a manner that allows easy removal and replacement. By precasting the panels, a higher quality concrete could be obtained resulting in longer design life. By making the panels easily removable, future rehabilitation work would be less costly.

GENERIC LOCK DESIGN CONCEPTS

The existing locks and dams on the Mississippi River and Illinois Waterway can be categorized as either rock-founded or pile-founded. The new lock design concepts vary considerably depending upon which of the two general foundation conditions is present. The descriptions of the generic lock design concepts on the following pages are divided into the two foundation categories, and then further subdivided into the three design types at each of Locations 1 through 5.[5] The 600' locks are not shown, but the conceptual designs are the same as the 1200' locks (only the middle 600 feet of lockwall is eliminated). The conceptual designs have had only minimal computations to determine structural adequacy. A comprehensive analysis would need to be completed during any future site-specific studies after definitive locations and design types were chosen. Endless variation in design details is possible, but the objective in this phase of the study was to establish engineering feasibility not to optimize the various design elements.

The numerous lock alternatives are not all presented in the same level of detail. The more novel concepts were developed further to establish feasibility. Also there were differences in the availability of data, and, on a case-by-case basis, the return on obtaining additional information was considered before additional information was sought. The level of detail of a given alternative should not be construed as favoring or disfavoring an alternative.

Although considered to be "generic" lock concepts (adaptable to all other sites in the Navigation Study), these lock concepts necessarily had to address the site-specific conditions of the model (i.e., typical) rock-founded and pile-founded sites. Lock and Dam 22 was selected for a model rock-founded site. Among the rock-founded sites within the study area, there is considerable variability. However, L/D 22 is in a reach with the highest traffic levels and is therefore more likely to need navigation improvements before the other sites. Lock and Dam 25 was selected as the model pile-founded lock site. It is also in a high traffic area and represents the deepest water and highest lift of any of the pile-founded sites within the study area.

Summarized cost estimates for the rock-founded locks are shown in Table 2 and 3, for 1200' and 600' locks, respectively. Cost estimates for the pile-founded locks are in Table 4 and 5. Appendix A contains backup cost estimates from which the summarized cost estimates were derived. Since the scope of the present investigation is very broad, these estimates should not be considered absolute, however they are useful for comparison purposes. The more-focused efforts of a site-specific feasibility study are needed to produce more representative cost estimates for new lock construction. For further discussion on the cost estimates, see Appendix A.

[5] As noted earlier, Location 6 was eliminated from further consideration via the initial screening effort due to its adverse environmental impacts and extensive channel work at all sites. Therefore no Location 6 lock concepts are presented in this report.

TABLE 2
ROCK-FOUNDED 1200' LOCKS
COMPARISON OF SUMMARIZED COSTS ($1,000's)[1]

LOCK LOCATION AND TYPE[2]	BASIC LOCK COST[3]	OTHER FIRST COSTS[4]	TOTALS
LOCATION 1			
TYPE A	$ 188,000	$ 18,000	$ 206,000
TYPE B	176,000	19,000	195,000
TYPE C	171,000	20,000	191,000
LOCATION 2			
TYPE B	115,000	5,000	120,000
TYPE C	110,000	5,000	115,000
LOCATION 3			
TYPE B	131,000	6,000	137,000
TYPE C	122,000	5,000	127,000
LOCATION 4			
TYPE A	206,000	7,000	213,000
TYPE B	184,000	7,000	191,000
TYPE C	165,000	7,000	172,000
LOCATION 5			
TYPE A	234,000	12,000	246,000
TYPE B	187,000	12,000	199,000
TYPE C	161,000	12,000	173,000

NOTES:
[1] The costs shown above are not all-inclusive. They do not take into account impacts to navigation during construction, environmental impacts, or other site-specific costs and impacts. (See Appendix A for more information.)
[2] There are no Type A locks at Locations 2 and 3, and Location 6 was eliminated by the initial screening effort.
[3] The basic lock costs include the necessary dam modifications (mostly a consideration for Location 4 lock types), the 05 "Locks" account code, and the 05.60. "Guidewalls" account code. Contingencies; planning, engineering, and design; and construction management are included in these costs.
[4] The costs in this column include real estate costs, channel costs and some of the other first costs that tend to be more site-specific.

TABLE 3

ROCK-FOUNDED 600' LOCKS

COMPARISON OF SUMMARIZED COSTS ($1,000's)[1]

LOCK LOCATION AND TYPE[2]	BASIC LOCK COST[3]	OTHER FIRST COSTS[4]	TOTALS
LOCATION 1			
TYPE A	$ 168,000	$ 24,000	$ 192,000
TYPE B	152,000	24,000	176,000
TYPE C	147,000	25,000	172,000
LOCATION 3			
TYPE B	109,000	5,000	114,000
TYPE C	96,000	5,000	101,000
LOCATION 4			
TYPE A	176,000	7,000	183,000
TYPE B	163,000	7,000	170,000
TYPE C	154,000	7,000	161,000
LOCATION 5			
TYPE A	195,000	12,000	207,000
TYPE B	159,000	12,000	171,000
TYPE C	146,000	12,000	158,000

NOTES:

[1] The costs shown above are not all-inclusive. They do not take into account impacts to navigation during construction, environmental impacts, or other site-specific costs and impacts. (See Appendix A for more information.)

[2] Location 2 already has a 600' lock, there is no Type A lock at Location 3, and Location 6 was eliminated by the initial screening effort.

[3] The basic lock costs include the necessary dam modifications (mostly a consideration for Location 4 lock types), the 05 "Locks" account code, and the 05.60. "Guidewalls" account code. Contingencies; planning, engineering, and design; and construction management are included in these costs.

[4] The costs in this column include real estate costs, channel costs and some of the other first costs that tend to be more site-specific.

TABLE 4

PILE-FOUNDED 1200' LOCKS

COMPARISON OF SUMMARIZED COSTS ($1,000's)[1]

LOCK LOCATION AND TYPE[2]	BASIC LOCK COST[3]	OTHER FIRST COSTS[4]	TOTALS
LOCATION 1			
TYPE A	326,000	12,000	338,000
TYPE B	219,000	12,000	231,000
TYPE C	163,000	12,000	175,000
LOCATION 2			
TYPE B	160,000	1,000	161,000
TYPE C	151,000	1,000	152,000
LOCATION 3			
TYPE B	200,000	2,000	202,000
TYPE C	194,000	2,000	196,000
LOCATION 4			
TYPE A	373,000	0	373,000
TYPE B	283,000	0	283,000
TYPE C	248,000	0	248,000
LOCATION 5			
TYPE A	342,000	178,000	520,000
TYPE B	246,000	186,000	432,000
TYPE C	227,000	186,000	413,000

NOTES:

[1] The costs shown above are not all-inclusive. They do not take into account impacts to navigation during construction, environmental impacts, or other site-specific costs and impacts. (See Appendix A for more information.)

[2] There are no Type A locks at Locations 2 and 3, and Location 6 was eliminated by the initial screening effort.

[3] The basic lock costs include the necessary dam modifications (mostly a consideration for Location 4 lock types), the 05 "Locks" account code, and the 05.60. "Guidewalls" account code. Contingencies; planning, engineering, and design; and construction management are included in these costs.

[4] The costs in this column include real estate costs, channel costs and some of the other first costs that tend to be more site-specific.

TABLE 5

PILE-FOUNDED 600' LOCKS

COMPARISON OF SUMMARIZED COSTS ($1,000's)[1]

LOCK LOCATION AND TYPE[2]	BASIC LOCK COST[3]	OTHER FIRST COSTS[4]	TOTALS
LOCATION 1			
TYPE A	$ 273,000	$ 15,000	$ 288,000
TYPE B	191,000	14,000	205,000
TYPE C	149,000	16,000	165,000
LOCATION 3			
TYPE B	172,000	1,000	173,000
TYPE C	160,000	1,000	161,000
LOCATION 4			
TYPE A	339,000	0	339,000
TYPE B	232,000	0	232,000
TYPE C	217,000	0	217,000
LOCATION 5			
TYPE A	287,000	179,000	466,000
TYPE B	205,000	185,000	390,000
TYPE C	181,000	185,000	366,000

NOTES:

[1] The costs shown above are not all-inclusive. They do not take into account impacts to navigation during construction, environmental impacts, or other site-specific costs and impacts. (See Appendix A for more information.)

[2] Location 2 already has a 600' lock, there is no Type A lock at Location 3, and Location 6 was eliminated by the initial screening effort.

[3] The basic lock costs include the necessary dam modifications (mostly a consideration for Location 4 lock types), the 05 "Locks" account code, and the 05.60. "Guidewalls" account code. Contingencies; planning, engineering, and design; and construction management are included in these costs.

[4] The costs in this column include real estate costs, channel costs and some of the other first costs that tend to be more site-specific.

Rock-Founded Lock Design Concepts

Table 6: Lock and Dam 22 - Pertinent Data	
Data Description	Value
Upper Pool: Normal Operating Elevation	El. 459.5
Lower Pool: Normal Operating Elevation	El. 449.0
Lower Pool: Low Water Elevation	El. 447.8
Lower Pool: 15% Duration Elevation	El. 460.0
10 year Flood + 2 Feet of Free Board	El. 468.7
Existing Upper Sill Elevation (Location 2)	El. 441.5
Existing Lower Sill Elevation (Location 2)	El. 435.5
Existing Upper Sill El. Aux. Lock (Location 3)	El. 438.5
Maximum Upper Sill Elevation - Type A Locks	El. 441.1
Maximum Lower Sill Elevation - Type A Locks	El. 431.7
Maximum Upper Sill El. - Types B and C Locks	El. 443.8
Maximum Lower Sill El. - Types B and C Locks	El. 432.5
Existing Lock Floor Elevation	El. 435.0
Type A Lock Floor Elevation	El. 429.7
Types B and C Lock Floor Elevation	El. 430.5

7. **Location 1** (Rock-Founded)

a. Existing Conditions

(1). General Site Description. At L/D 22 a high bluff adjacent to the lock rises at about a 3.5:1 slope from its base at approximate elevation 470.0 to about elevation 600.0. Several residential properties and an actively used railroad track are located within the proposed lock area. These site-specific considerations were addressed for the lock concepts developed at L/D 22, but they may or may not be considerations at other sites.

(2). Foundation Conditions. From the foundation exploration work, the following soil and rock parameters were determined for use for stability and design calculations. The overburden consists of a thin layer of cohesive fill about 4.0-foot-thick overlying a sand layer 30 to 40 feet thick. The soil parameters determined for the clay layer are a cohesion of 500 psf, an angle of internal friction of 0°, a saturated unit weight of 120 pounds per cubic foot (PCF), and a moist unit weight of 120 PCF. The sand fill was determined to have an angle of internal friction of 25°, a saturated unit weight of 130 PCF, and a moist unit weight of 116 PCF. The ground water line varies from about elevation 454.0 at the lock house to about 460.0 at the end of the upper guidewall. The rock foundation consists of shale of varying thickness overlying a hard limestone. The shale was analyzed to exhibit an approximate unit weight of 135 PCF and compressive strength of 4 kips per square inch (KSI). The limestone was determined to be competent with an approximate unit weight of 165 PCF and compressive strength of 20 KSI.

b. **Type A (Location 1, Rock Founded)**. The Location 1, Type A lock is a traditional design based on current Corps standards. A plan view of this lock is shown on Plate R1A1. Unlike the original lock construction which required a sheetpile cellular cofferdam, the Location 1 Lock's landlocked position makes dewatering possible without sheetpile cells. Construction of this lock would require extensive excavation of soil and rock. The lockwalls would be a traditional gravity wall design depending on the concrete mass for stability from overturning and sliding. This type of design has proven low maintenance and indefinite service life. The in-the-dry construction allows for direct inspection and better quality control than underwater construction. The lock would have miter gates at each end and the filling and emptying would be controlled with tainter valves. The filling and emptying system culverts and ports would be integral with the lockwall monoliths. Most of the lock would be constructed with cast-in-place concrete. A more detailed description of the Type A lock is given by feature below.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The intakes would be rectangular openings in both walls upstream of the lock chamber that bypass the miter gate anchorage system and join with in-the-wall lock culverts. The intakes would be covered with steel trash racks. Water exits the lock chamber through the lower lock area outlet ports of similar design to the intake ports.

(b). Culverts and Distribution. The Location 1, Type A lock would utilize a conventional side-port filling and emptying system as recommended for low-lift locks by EM 1110-2-1604. The rectangular culverts (one in each wall) would be 12.5 feet wide by 14 feet high and the ports would be

3.75' high by 2.5' wide (9.375 square feet) and spaced at 28' along each lockwall. Water would be brought from the culverts into the lock chamber through lockwall side ports perpendicular to the culverts. The ports on one wall would be staggered with respect to the ports in the other opposite wall so that the jets issuing from one culvert would pass between the jets from the other culvert. The alternate operations of filling and emptying would be controlled by tainter valves located in the gate monoliths, both upstream and downstream.

(2). Geotechnical Considerations. While the following geotechnical considerations are specific to Lock 22, they are typical of the considerations at other sites.

(a). Site Preparation. Construction at Location 1 at Lock 22 would first entail relocation of utilities, private buildings, and railroad track. Relocation of the railroad track, in particular, would require extensive soil and rock excavation into the adjacent bluff and appropriate means of slope stabilization.

(b). Rock Excavation. The rock at Lock 22 rises landward of the existing lock. Thus the Location 1 site would require extensive rock excavation, estimated at approximately 65,000 cubic yards for Type A.

(c). Dewatering Measures. As noted above, this traditional lock would not require the traditional cellular cofferdam to construct in the dry. Rather the excavation for the lock would be kept dry by the surrounding in situ soil and rock, supplemented by sheetpiling and wells as required.

(3). Structural Features

(a). Lockwalls. The lockwalls would be concrete gravity walls 32 feet wide at the base narrowing in steps to 8 feet wide at the top (see Plate R1A2). The filling and emptying culverts would be integral with the wall. The lockwalls would be equipped with ladders, checkposts, and T-armor. No floating mooring bitts are proposed for this 10-foot-lift lock.

(b). Miter Gate Monoliths. The upstream and downstream miter gate sills would be constructed of cast-in-place concrete and would be excavated into- and founded directly on the underlying rock. The miter gate wall monoliths would be conventional cast-in-place concrete gravity walls.

(c). Guidewalls. This lock would have 1200-foot-long guidewalls, upstream and downstream. Slurry trench guidewalls would be used where the guidewalls cut through existing land, transitioning to the typical design described earlier for a rock-foundation (paragraph 6b(1)(a).) at the bank line and on into the area that is currently within the river.

(4). Construction Sequence and Procedures. A general construction sequence is shown on Plate R1A1. The construction sequence for this lock does not involve any unusual actions for lock construction.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. The Location 1 lock would have minimal impacts on navigation during construction. General construction activity would add to the number of boats in the area, which could have some adverse impact on navigation. Construction of the lock chamber itself would have only minor impacts due to disturbance of land access to the existing lock. Construction of the riverside guidewall tie-ins and channel excavation would have greater impacts, but these would be of short duration.

(b). Restrictions on the Use of the Existing Lock. A new lock at Location 1 would allow the full use of the existing lock. Additional studies would be required to determine whether simultaneous two-way traffic (utilizing both locks simultaneously without restrictions) would be feasible.

c. **Type B (Location 1, Rock Founded)**. A plan of the Location 1, Type B lock is shown on Plate R1B1. The Type B lock is to be designed and constructed utilizing innovative but proven methods. The design chosen for the Type B lock would be less expensive and require less time to construct than the Type A lock. The Type B lock would have miter gates at each end as does the Type A lock. The Type B lock is non-conventional due to the filling/emptying flume and use of slurry wall construction. The lock would be filled and emptied by a flume located riverward of the lock chamber. This filling/emptying design is in use at Locks 52 and 53 on the Ohio River. The main difference is that the lockwalls of Locks 52 and 53 are sheet pile wall construction and those shown for the Type B lock would be a combination of cast-in-place concrete and slurry wall construction.

The excavation for the lock would be almost as extensive as for Type A but a reduction in excavation would be realized by using slurry trench construction. This construction method can be used in unfavorable soil and ground water conditions. This technique would be used to construct the flume seepage control wall immediately adjacent to the existing lock landwall. The slurry wall would be needed to reduce seepage into the flume during normal and dewatering operations. The new lock's landwall would also be constructed by the slurry wall method and a reduction of construction time and costs should be realized. The new lock riverwall would be constructed using formed concrete. A feature description of this lock is provided below.

(1). Hydraulic Features.

(a). Side Flume. Unlike a conventional side-port filling and emptying system with wall culverts and ports, this lock would have a side-channel flume to fill and empty the lock chamber. The lock chamber would be filled through ports at the base of the riverwall, that divides the new lock and the flume. Filling the chamber from only one side can put a transverse slope on the chamber potentially raising the hawser forces of the tows. To prevent this, the filling time must be slowed down. While this is an economic disadvantage when looking at total transit time for each tow, the time difference is slight.

(b). Intake and Discharge Structures. The flume would be filled and emptied using two tainter valves, one located at the upstream end of the flume and the other located at the downstream end. Two intake ports lead to the upstream tainter valve and two discharge ports follow the downstream tainter valve.

(2). Geotechnical Considerations.

(a). Site Preparation. (See Location 1 Type A)

(b). Rock Excavation. The Location 1 site would require approximately 44,000 cubic yards for the Type B lock.

(c). Dewatering Measures. (See Location 1, Type A)

(d). Slurry Trench Design. (See paragraph (3).(a). "Lockwalls" below.)

(e). Rock Anchors. (See paragraph (3).(a). "Lockwalls" below.)

(3). Structural Features

(a). Lockwalls. The lockwalls are shown in cross section on Plate R1B2. One of the walls would be cast-in-place concrete and two of them would be of slurry wall construction. Slurry wall construction is a technique where walls are built by excavating a trench into the soil which acts as the form. The excavation would be kept open using a bentonite or similar slurry. Tremie concrete would be placed to displace the slurry and constitute the wall. This method typically results in rough wall surfaces. To finish the faces, precast concrete slabs will be attached.

Heat build up is a critical consideration for slurry walls regardless of the time of year because the soil acts as an insulating blanket around the concrete. This consideration results in a limit on the wall thickness that could be produced by a single pour. It is estimated that the thickness of the walls has to be less then about 6.0 ft thick to prevent thermal through-cracks. The slurry walls would probably have to be poured through a high water table that fluctuates with the pool and tailwater elevations. This would require special considerations and care in pouring the slurry wall.

Careful monitoring for slurry contamination and trench sloughing would be required when pouring the walls to ensure that a competent wall is constructed. The land side of the lockwalls can't readily be visually inspected for defects. Competency of the walls would be suspect if the slurry became contaminated. If the competency of the wall became suspect then a visual inspection would be required. The inspection would require excavation of the soil surrounding the wall to be able to verify any damage. Excavation would also be required for any repairs to the damaged areas. The adequacy of the rock excavation, required to take place through the slurry, could be uncertain since visual inspection is not easily performed.

A rock anchor system would be required to provide stability and make up for the lack of stability inherent with gravity walls. The number of rock anchors could be reduced if the wall is constructed with counterforts. This is discussed in more detail for the Type C lock.

(b). Miter Gate Monoliths. Due to the criticality of the miter gate monoliths, and the availability of a dewatered construction site, both miter gate monoliths of the Type B lock would be conventional cast-in-place concrete founded on rock.

(c). Guidewalls. The Type B guidewalls would be of slurry trench construction similar to the lockwalls. This would eliminate the need for dewatering and braced excavations. The ends of the walls, that leave the confinement of the existing soil bank would be of cellular sheetpile construction as described in paragraph 6b(1)(a). In addition, an end cell would be constructed to withstand barge impact at the most vulnerable location on the guidewalls.

(4). Mechanical Features. The Type B lock would have traditional miter gate and tainter valve machinery. With this design, however, the requirement for tainter valve machinery is half that required for a conventional side-port F/E system.

(5). Construction Sequence and Procedures. A general construction sequence is shown on Plate R1B1. The slurry trench construction is the main influence in making the construction sequence "non-traditional".

(6). Operational Considerations

(a). Impact on Navigation Traffic during Construction. (See discussion for Location 1, Type A.)

(b). Restrictions on the Use of the Existing Lock. (See discussion for Location 1, Type A.)

d. **Type C (Location 1, Rock Founded)**. The Type C lock is shown in plan on Plate R1C1. Similar to the Type B lock, the Type C lock makes extensive use of slurry wall construction for the lock chamber walls (although see discussion under paragraph (3).(a). "Lockwalls" below). Unlike the Type B lock, however, the chamber would be filled and emptied from a longitudinal culvert centered in the lock chamber. Eliminating the side flume reduces quantities of excavation and new concrete, and reduces the total lock construction duration. The advantages and disadvantages of slurry wall construction noted for the Type B lock are also applicable to the Type C lock. The miter gate monoliths would be a traditional cast-in-place design constructed in the dry. A description by feature of the Type C lock is provided below.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The intakes and discharge structures would be the same as for the Type A lock, bypassing the miter gates and controlled by tainter valves. However, between the miter gates is where the culverts differ.

(b). Culverts and Distribution. An 18' x 20' longitudinal culvert centered in the lock chamber would be excavated into the rock foundation of the chamber floor and would be constructed with about two-foot-thick concrete walls, roof, and floor. The top of the culvert would be constructed higher than the lock chamber floor, leaving the top portion of the side walls exposed above the rock. The ports would be located at the top of the side walls of the culvert, jetting the water out horizontally. This is as opposed to having the ports in the roof of the culvert which would aim the energy of the inflow directly at the barges causing high hawser forces and unacceptable turbulence.

(c). Filling and Emptying. The efficacy of this type of filling and emptying system would have to be determined by hydraulic model studies. However, it is anticipated that it would function in similar fashion to a traditional side-port filling and emptying system.

(2). Geotechnical Features

(a). Site Preparation. (See Location 1 Type A)

(b). Rock Excavation. The Type C lock would require less rock excavation than either the Type A or Type B locks.

(c). Dewatering Measures. (See Location 1, Type A)

(d). Slurry Trench Design. (See paragraph (3).(a). "Lockwalls" below.)

(e). Rock Anchors. (See paragraph (3).(a). "Lockwalls" below.)

(3). Structural Features

(a). Lockwalls. Two alternatives for the lockwalls were considered for this design type. The cost estimate is based upon the first alternative. The first alternative (shown on Plate R1C2) would be to construct a linear slurry wall and anchor it to the rock foundation with self drilling rock anchors. This wall would be approximately 4.0 feet wide. The height of this wall including a two-foot keyed-in section would be about 46.0 ft. The keyed section would provide resistance to sliding. An initial estimate requires four rows of anchors per linear foot of wall using 40 k per bolt allowable strength. The number of required anchors would be approximately 9,000 and would be labor intensive to install. The rock anchor installation would occur sequentially upon excavation of the lock chamber.

The other alternative would be to construct the slurry wall as a counterfort. The counterfort would provide stability against overturning and sliding. The WES stability program 3DSAD was used to determine the approximate length of counterfort required. The approximate length calculated is 34.0 ft, not including the thickness of the lock chamber wall itself. The number of rock anchors required could be reduced or even eliminated using the counterforts. The final anchoring requirements for the counterfort alternative would require additional study. The amount of additional concrete required for the counterfort design is about 8,400 cubic yards (CY) for the Type B lock and 15,500 CY for the Type C lock.

(b). Miter Gate Monoliths. Due to the criticality of the miter gate monoliths, and the availability of a dewatered construction site, both miter gate monoliths of the Type C lock would be conventional cast-in-place concrete founded on rock.

(c). Guidewalls. (See discussion for Location 1, Type B)

(4). Construction Sequence and Procedures. A general construction sequence is shown on Plate R1C1.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. (See discussion for Location 1, Type A.)

(b). Restrictions on the Use of the Existing Lock. (See discussion for Location 1, Type A.)

8. **Location 2 (Rock-Founded)**

a. Existing Conditions

(1). General Location Description and Problem Definition. The Location 2 lock placement would construct a 1200-foot-long lock by extending the existing 600-foot lock chamber. The feasibility of extending the existing main lock is highly dependent on existing conditions and any impact to navigation during construction. To construct a completely new lock is not feasible because the loss of benefits to shut down navigation during construction would be immense. However, with the use of innovative construction techniques an existing lock chamber could be extended with reduced impacts on navigation. The existing lock has large gravity type walls with filling and emptying culverts within the wall. For the lock extension, connecting to this existing system does not allow many alternatives such as thin structural walls with a bottom filling and emptying system or a system outside the lock wall. Therefore, the new lock extension design was constrained to have similar features as the existing lock. Pertinent data, elevations, and dimensions of the Location 2 locks are shown on Plate R2B1 and R2C1.

(a). Existing Lock Structure Stability. Stability of the existing intermediate wall was reviewed to determine if the lock walls met current design criteria. The existing walls are founded on rock and have performed well since the lock began operating in the late thirties. Computations show that the walls do meet current criteria and are considered stable. The stability of the existing lock chamber walls would not be affected by the lock extension.

(b). Guidewalls and Guard Walls. The existing upstream and downstream guidewalls consist of a landward solid wall on timber cribbing. The walls are gravity type concrete. The top of walls are at EL. 471.5 feet. Though no analysis was performed, it is reasonable to assume that the upstream guidewall is in a condition that would only require extension and not complete removal and replacement. The lower guidewall would be reconstructed. Further design work would need to be made during the site-specific study phase for the most appropriate final design.

(2). Foundation Conditions. (See Rock-Founded Location 3.)

(3). Deviations from the Common Type B and C Criteria. The criteria defined earlier as common to all conceptual lock designs must be deviated from for the Location 2 locks. The existing lock chamber floor elevation does not meet current criteria. The existing chamber floor provides 1.33D plus 2 feet of submergence. Lowering the existing lock floor is not feasible for several reasons. The cost of shutting down the river to lower the existing lock floor elevation would make the extension of the lock at Location 2 not feasible. Lowering the existing floor compromises the stability of the existing lock walls. Therefore, assumptions were made that the upper lock chamber floor and sill would remain and the new extension would be built to meet adopted common criteria of 1.7D plus 2 feet below minimum tailwater. The depth is more beneficial in the downstream portion of the chamber because it eases resistance to entry (traveling upstream) into the lock caused by the piston effect. When a tow enters a lock, it causes water to be displaced out of the chamber. The piston effect occurs when inadequate chamber depth is provided. When not enough depth is provided, swell in the chamber is created. When the water finally displaces, the tow tends to lunge forward. Consequently, gates could be damaged due to impact.

b. **Type A (Location 2, Rock Founded)**. A Type A lock at Location 2 is not feasible because navigation would be closed for an extended period by the sheet pile cellular cofferdam required for this lock type. An alternative considered is to first construct a "temporary" 600-foot-long lock at another location, and then close the existing lock with the cofferdam. However this alternative, which amounts to construction of 1200 feet of lock chamber plus extra guidewalls and a cofferdam, proved to be economically inefficient.

c. **Type B** (Location 2, Rock Founded). The existing main lock would be lengthened to 1200 feet by extending the land and intermediate walls 600 feet as shown on Plate R2B1. The lock is designed to be dewatered and utilizes the excavated rock as a floor. The filling and emptying systems would extend the existing culverts within the land and intermediate walls. While the lock chamber walls are under construction, tow traffic would not be able to use the existing downstream guidewall safely. A temporary mooring area would be constructed downstream until the lower guidewall is completed. The lock would be provided with approximately 1800 feet of new guidewall. These walls would extend upstream and downstream of the landward lock wall. The downstream lock approach would consist of a guidewall, whereas the upstream lock approach may have a guidewall or a guard wall. Guidewall lengths will be determined as a result of the model studies; however, it can be generally assumed that the structures will be 1200 feet in length for estimating purposes.

(1). Hydraulic Features

(a). Intake and Discharge Structures. For the 600-foot lock extension, the existing intake manifolds would be utilized. Outlet manifolds for this alternative are assumed to have a configuration similar to the existing lock. The performance of the outlet and determination of the need for a more elaborate discharge manifold will be determined in physical model studies if this alternative is studied further.

(b). Culverts and Distribution. The existing lock has a sidewall culvert/port system with 12.5-foot by 12.5-foot culverts on each side. Based on the results of a numerical model, the preliminary design of the extended lock requires 12.5-foot by 17.5-foot culverts in each wall, possibly closing some of the upstream existing ports, and additional ports in the new end that mirror the remaining ports in the existing lock. The culvert ceiling for the extension would not be lowered and the culvert heights would be maintained at low pool El. 449.0 feet.

(c). Lower Miter Gate Sill. The new sill elevation would be set 1.7 times the draft depth of 9 feet plus 2 feet below lowest operating tailwater resulting in 17.5 feet of submergence above the proposed sill elevation of 430.5 feet. The existing downstream sill of the main lock would be partially removed down to elevation 433.83 to provide the required depth in the lock chamber.

(d). Approach Conditions. Structures such as guidewalls, guard walls, and/or lateral dikes would be provided upstream and downstream of the lock to aid approach conditions. The preferred location and length of these structures will be investigated as part of the physical model tests of Lock and Dam 22. Some grading of the landward bank and/or dredging of the channel might be required to provide the depths and approach line for entrance to the lock. The removal of existing guard walls may be required.

i. Upstream Guidewall/Guard Wall. For the general design, the existing 600-foot guidewall would be extended to 1200 feet. The 600-foot guidewall extension would be a solid wall with backfill landward of the wall. Should outdraft conditions be severe at a given site, a ported guard wall may be required riverward of the approach. The decision to add a guardwall would be made based upon a comparison of the economic benefit to the construction cost of the guardwall.

ii. Downstream Guidewall. Because of the lock extension, the existing downstream guidewall must be removed. For the general design, a new 1200-foot guidewall would be constructed. The guidewall would be solid rather than ported.

(2). Geotechnical Features

(a). Sheetpiles. Where sheetpiles are to be used they would require keying into the rock with tremie concrete seals. The lengths of the sheetpiles would be about 45 feet. Sheetpiles would be attached to adjacent precast units with a suitable design shown on Plate R2C2.

(b). Site Preparation. Site preparation for construction of the lock extension includes constructing the temporary downstream mooring facility, the fabrication/storage area, excavation of the barge access channel behind the existing and new lower guidewalls. Site preparations for the new guidewalls would be incorporated into site-specific designs. The new lower guidewall would be essentially completed prior to float-in of the new gate bay monolith and the subsequent construction of the new lockwalls.

(c). Rock Excavation for Lock Extension. Excavation for the rock cradle would be accomplished in stages. Two monoliths at the downstream end of the guidewall would be removed prior to excavating for the gate bay monolith because of both the limited clearance between the end of the guidewall and the gate monolith and the required depth of the excavation (approximately 10 feet below the bottom of the guidewall cribs). Initial excavation would be for the gate sill monolith and the intermediate wall extension. The excavation would start at the riverward edge of the guidewall and extend riverward and downstream. Following construction of the gate sill monolith and the intermediate wall, the guidewall would be removed in increments, rock excavation and site preparation for the landward wall would also be performed in increments. Tie-in to the existing lock would require navigation shut down for removal of the existing discharge monoliths, completion of sheetpile installation and tie-in, excavation for tie-in of the lock floor and walls, and construction of the wall tie-in sections.

(d). Sheetpile Cells. Where used, the sheetpile cells and the walls of the lock extension would be supported on the rock at about El. 426.5 feet. Tremie seals would be required. During construction, sheetpile cells would be installed adjacent to completed structures, especially for the tie-in of the new lock wall to the existing lock.

(3). Structural Features

(a). Lockwalls. The lockwalls would be constructed using precast concrete units. They result in gravity type walls founded on rock (see Plate R2B2) and faced with removable precast concrete rub panels. Each unit would be picked and set into place with a crane barge. This method simplifies and speeds construction. It results in considerable cost savings compared to the float-in methods using the same size units. The lift-in units would be designed such that the tops of their walls would be above the tailwater elevation once permanently positioned. The walls would later be extended to the top-of-lock elevation with cast-in-place concrete.

The installation procedure of a lift-in unit begins with rock excavation to level the site. Then unit supports, or landing pads, would be constructed on the river floor under the four corners of the unit. Hydraulic jacks for leveling the unit would be placed on top of each landing pad. The unit would be lifted from a barge deck and lowered onto the hydraulic jacks. The units would then be leveled and aligned. Tremie concrete would then be placed in the bottom of the hollow unit up to where the culvert and port inverts would be located. Once the tremie concrete floor cures, the unit would be dewatered, and the remaining wall monolith construction performed in the dry. Anchors into the underlying rock foundation may be required to temporarily resist uplift forces on the tremie concrete floor. At some point during the wall construction, the anchors would become superfluous as the weight of the wall monolith becomes sufficient to resist uplift forces. After the unit is dewatered, the culvert and ports would be formed between the prefabricated openings in the lift-in unit's walls, and the remaining voids filled with concrete. Raising the height of the lift-in unit walls to top of lock elevation would proceed with cast-in-place concrete. The installation of precast panels to the surface of the lockwalls would complete construction. The precast rubbing panels may be used as a form for the upper cast-in-place concrete. Lift-in units would be installed according to the previously discussed construction steps until the lockwall is completed to the desired length.

The units were sized assuming that a 350-400 ton crane barge was available. The walls of the units have to be designed to resist handling stresses and the internal head of tremie concrete during pouring. Overall stability calculations were performed for normal lock operation and lock dewatering. Lateral movement of the walls would be resisted by keying into the rock floor strata.

(b). Lock Floor. The lock floor would consist of sound natural rock. Debris created during excavation would be removed.

(c). Downstream Miter Gate Monolith. The lower miter gate sill monolith is designed as a continuous U-frame (see Plate R2B3). A precast prestressed concrete U-frame structure is constructed away from the final location on barges or in a dry dock. Once completed, the monolith would be floated to the site and sunk into place. Filling of internal voids and along the outside of the gate monolith with tremie concrete would tie the monolith to the rock foundation. The U-frame structure is designed for loadings during float-in and all other loading conditions required for a navigation lock monolith. Gate loads were estimated and overall stability calculations were performed. The installation of a lower miter gate sill monolith would require some lock shut down time. This is discussed further in the Construction Sequence and Procedures Section.

(d). Miter Gates. The existing upper miter gate would be rehabilitated or replaced as appropriate. The existing lower miter gates would be removed. The new lower miter gate would be vertically framed with overall leaf dimensions of 39'-0" high by 60'-8" wide.

(e). Tie-in to Existing Lock. Culvert discharge walls would be demolished to the beginning of the interface of new work. The required lock shut down during construction is discussed in the Construction Sequence and Procedures Section. Tie-in to the existing lock walls would be accomplished by constructing a wall similar to the lock chamber walls. After tie-in, the existing structure and the new structure would act as independent monoliths. A water tight expansion joint would be formed between the structures. After removal of the existing culvert discharge walls, a standard 44-foot monolith would be constructed identical to the other new lock wall monoliths. A shorter 29-foot monolith would be cast-in-place to close the gap between the new monoliths and the end of the existing lock wall. Because the bottom of excavation for the wall and slab tie-in would be at the existing gate monolith elevation, the stability of the gate sill monoliths is not a concern.

(f). Temporary Mooring Wall. The wall would be designed for a very short term design life. Quantities were based on an assumed structure with no reduction for reuse.

(g). Guidewalls. The upper guidewall extension and lower guidewall would be constructed using the guidewall concepts for rock foundations, see paragraph 6 b(1)(a).

(4). Construction Sequence and Procedures. Construction planning at Location 2 would be critical. The construction sequence presented is only one of several possible sequences. Many of the steps could be accomplished concurrently. The philosophy is to first construct items which would enhance lock performance during construction. Therefore, the upstream guidewall would be extended and the downstream guidewall would be constructed prior to construction of the downstream lock extension. The following describes procedures required to accomplish each step of the construction, with an emphasis on the innovative construction procedures.

(a). *Install temporary mooring structure and dredge behind guidewall for barge access.* This work would be accomplished using typical river construction with no impact on navigation.

(b). *Extend upstream guidewall and construct downstream guidewall.* The downstream guidewall would be built from the landward side of the river. Helper boats to assist in lock approach would be required to ensure that the wall was not hit during construction.

(c). *Remove downstream portion of the existing lower guidewall.* Approximately 100 feet of the downstream end of the guidewall would have to be removed to allow placement of the miter gate sill monolith. Some inconveniences to river traffic would occur.

(d). *Pre-dredge site at future lock walls and chamber.* The areas would be excavated using methods to maintain an excavation tolerance of 5 inches. Some impact on navigation would be expected.

(e). *Install landing pads at site for the riverward lock wall and miter gate sill monolith.* Clean excavation debris and install landing pads.

(f). *Place float-in miter gate sill monolith.* Concurrent with Steps (a)-(e), the miter gate sill monolith would be constructed atop moored barges near the site. After the sill monolith construction is completed, the barges would be sunk until the sill floats off the barges. The sill, when floated, would have at a draft of 14 feet with at least 2 feet of underkeel clearance. Once floated to the site, positioning would be assisted by two 36 inch diameter master anchors and two moored barges at the site. The steps required to bring the gate sill monolith into its final position are similar to those shown on Plate P2B5. The monolith would be sunk on to the landing pads. Placement tolerances for the master anchors would be plus or minus 6 inches from their final position, and vertically 2 to 3 percent. Tighter tolerances would be achieved by an external sleeve that would be aligned and grouted to the master anchor. As necessary, the miter gate sill monolith could be tied to the rock foundation.

(g). *Construct approach walls monoliths and construct riverward chamber wall monoliths.* Lock wall units would be constructed on barges and brought to the site. Place landing pads as in step (e). A 350-400 ton crane barge would set the wall units on landing pads. Final positioning and leveling would be assisted by hydraulic rams attached to each unit, flat hydraulic jacks, and horn guides and steps on previous placed units. The open spaces between the base of the wall unit and the adjacent area would be sealed with sand bags preattached to the units or by placing a grout seal. The bottom of the wall units would be sealed with tremie concrete. Once the tremie concrete reaches its design strength, the unit would be dewatered. Construction of the rest of the wall would be in the dry. The construction of the new culvert discharge walls and riverward walls would start at the miter gate sill monolith.

(h). *Demolish the existing guidewall in increments.* Demolition of the existing guidewall would be accomplished using two techniques depending on proximity of the existing lock. Near the existing lock, concrete would be removed by line drilling and pressure wedging methods. Blasting of concrete would be more economical, if performed, away from existing structures. Timber cribbing, stone, and foundation soils would be excavated with a clam shell.

(i). *Construct landward lockwall monoliths.* Construction of the landward wall would begin by excavating the rock crib. Once the landing pads are installed, wall construction would proceed as in steps (g) and (h).

(j). *Tie-in to existing lock walls.* The tie-in of the intermediate and land walls would be done by removal of the existing culvert discharge walls. Because the culvert discharge walls house the emptying ports, the lock would not be able to operate. The two walls would be constructed simultaneously to reduce the amount of lock closure time. Construction of the walls would be the same as the other wall monoliths.

(k). *Dewater lock and plug existing filling and emptying ports.* Typical lock dewatering and construction methods would be used to plug existing ports and cut new ones.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. Both the designs and construction sequence were developed to minimize impacts to navigation and provide safe conditions during construction. During construction, navigation could be impacted in many different ways. Impacts include the use of helper boats, lock closure, temporary traveling kevels, width restrictions, and power restrictions. The impacts are quantified using experienced judgment and input received through Reference 8. The use of helper boats could be required for the entire construction period. During almost every phase of construction, tow boats would be passing directly next to unfinished construction or construction in progress.

An allowable daily schedule was assumed as follows: 8 hours of navigation closure per day (for construction within the river traffic path) and 16 hours of navigation traffic per day. Construction outside of the traffic path would take place 16 hours per day. Construction would be carried out 5 days a week. During the winter months, navigation slows down except on the Illinois Waterway and the downstream reach of the Upper Mississippi River. It is assumed that at least one month of shut down could take place without a significant loss of economic benefit. At the end of the 8 hour-per-day closure of navigation, unfinished construction would be left until the next day. During the 16 hour a day navigation period, a helper boat would be required for tows that pass next to unfinished construction that has not progressed to a level which could resist impact or rubbing forces. When an opposite lock wall is in place a temporary traveling kevel might be used to hold the tows to one side. The wall would have to be nearly complete with rub panels installed. Table 7 summarizes the estimated closure time required for the lock construction. The steps correspond to the letters in the construction sequence.

TABLE 7 - Lock Closure Time During Construction

Construction Sequence Step	Maximum Closure Time Per day (hrs/day)	Number of Working Days Required for Construction
(a)	0	--
(b)	8	280[a]
(c)	8	17
(d)	2	72
(e)	8	30
(f)	24	2
(g)approach walls	8	40
(g) riverwall	8	110
(h)	8	60
(i)	8	160
(j)	24	20
(k)	24	30

[a]Assumes upper and lower guidewalls are constructed concurrently.

Because many of the steps in Table 7 would be accomplished concurrently, the total construction time required for the assumed daily schedule is about 2.5 years. Most of the construction would be performed during the allowed 8 hour-per-day navigation closure. The total duration of required lock closures is about 52 days; 2 days during gate monolith placement (step i.), 20 days during the lock tie-in (step j.), and 30 days during lock dewatering for port modifications (step k.). If construction is planned so that the tie-in and lock dewatering occur during the allowed winter closure, then total lock closure could be reduced by about 1 month. All other construction would be performed within the navigation schedule.

Increasing the distance between tows and construction areas would increase the level of safety during navigation. One way of accomplishing this would be to impose width restrictions on the tows. Discussions need to be initiated with the towing industry to decide the most feasible scenario. This would also include the liability question in the event that a tow damages construction. Power restrictions would be imposed on the tows traveling in the construction area. Tows would have to operate at 50 percent power and even less for larger tows.

d. **Type C (Location 2, Rock Founded)**. Due to the culverts within the existing wall a typical sheet pile cellular chamber wall lock is not practical. For the Type C lock, the existing main lock would be extended to 1200 feet by extending the land and intermediate wall 600 feet as shown on Plate R2C1. The other portions of the lock are a scaled-back version of the Type B lock, primarily reducing the top wall width. The new lock would require approximately 2400 feet of guidewall.

(1). Hydraulic Features. The features and performance of the Lock Type C were assumed to be the same for the Lock Type B except that the filling and emptying culverts would be smaller.

(2). Geotechnical Features

(a). Modifications of Lock Type B Design. For the Type C lock, the lock floor design was changed slightly. The floor elevation remains at El. 430.5 with a slight banking at the walls. The design concept is the same as the floor design in the existing lock.

(b). Sheetpile. Installation of sheetpile, construction sequencing/staging, construction of the new gate sill monolith and the extension of the lock walls for the Type B lock would be identical to those of the Type B lock. The perimeter sheetpile for the Type C lock walls would be continuous, including the tie-ins to the existing lock and sill monoliths. Tie-ins as recommended for the Type B lock and the precast wall units are shown on Plate R2C4.

(c). Site Preparation. Site preparation would be the same as for the Type B lock.

(d). Excavation for Lock Extension. Excavation staging/sequencing is the same as the Type B lock, but excavation depths decrease for the walls since sheet pile tie-ins are furnished. It is recommended that sheetpile installation and excavation for the gate sill monolith be sequenced with the gate sill monolith float-in operation so that during excavation stone debris does not drop into the gate sill monolith cradle.

(e). Sheetpiles. The type of sheetpiles and installation concerns are the same as for the Type B lock.

(f). Scour and Erosion Protection. Scour protection along new guidewalls and apron edge remain the same as for the Type B lock, when required.
(g). Lock Floor System. The lock floor system is sound rock. Dewatering would be accomplished similar to the Type B lock.

(3). Structural Features

(a). Lockwalls. The lock walls are a scaled back version of the Lock Type B walls (see. Plate R2C2) and would be cast within a cofferdam of parallel Z-pile walls. The piling will also act as stay-in-place concrete forms and the cofferdam could envelope several monoliths simultaneously. The walls would be faced with removable timber fenders or precast concrete panels, depending upon which is favored by a later life-cycle cost analysis. A precast box and sheetpiles with studs on the inside would be placed to form a void in the tremie concrete. After the wall construction, the final chamber floor would be cast. Stability calculations were performed for normal lock operation and lock dewatering. Lateral movement of the walls would be resisted by keying the sheeting into the rock foundation.
(b). Lock Floor. The lock floor would be formed by sound rock at El. 430.5 with slightly inclined raises at the wall sections.
(c). Downstream Miter Gate Monolith. Similar to the Type B lock.
(d). Tie-in to Existing Lock. Similar to the Type B lock
(e). Temporary Mooring Wall. Similar to the Type B lock
(f). Guidewalls and Guardwalls. The guide and guardwalls will be of the standard design described in paragraph 6b(1)(a).

(4). Construction Sequence and Procedures. Considerations for construction are almost the same as for Lock Type B.

(5). Impact on Navigation Traffic during Construction. Impacts on navigation are almost the same as for Lock Type B.

9. **Location 3** (Rock-Founded)

a. Existing Conditions

(1). General Site Description. The existing locks were built with provisions for a second 360 foot auxiliary lock riverward of the main lock. The incomplete auxiliary lock bay is Location 3. This lock bay was completed in the 1930's at the same time as the main lock and consists of the upper miter gate sill, upper miter gates, and upper monoliths including the culvert intakes. The structural integrity of the existing miter gates would have to be evaluated to determine the rehabilitation or replacement needs of the gates if this lock location were selected. The existing miter gate sill and wall monoliths would be utilized in the new lock. Location 3 has the advantage of requiring little or no channel work (except to eliminate any existing channel deficiencies) due to its close proximity with the existing channel. Having a completed lock at Location 3 would allow the existing 600-foot lock to remain in use, however, restrictions on tow sequences or tow sizes might be required. This is because of the close proximity of the two locks and the potential interference in the approaches of the different guidewalls and required tow movements. Construction at Location 3 would also have some impacts on navigation during construction, possibly requiring short-term navigation closures and/or tow width restrictions. Having the lock located immediately adjacent to the dam would require consideration of the influence of gate operation sequences on approach conditions, but should not cause a scour concern for the sites founded on competent rock. Access to the dam would still be available across the miter gates, except with possible delays during lockages.

The existing intermediate wall has only one culvert and no room to add another one to service a new lock at Location 3. Since it would be desirable to have the two locks independent of each other and have the new lock fill from both sides, modification of the existing lock would be necessary. The ports in the existing intermediate wall of the lock chamber would need to be plugged. This task may require dewatering. Later, when the new lock chamber is dewatered, new ports would have to be constructed from the new lock chamber into the intermediate lockwall's culvert. These modifications would leave the existing lock with capability to fill and empty the lock chamber only from the landwall side. Filling from one side would necessitate slower filling and emptying times to limit hawser forces and turbulence. However, the new lock would be the primary lock used for commercial navigation. The navigation interruptions necessary for the work on the existing lock would provide an opportunity to work on much of the intermediate lockwall extension without adding a separate navigation closure.

(2). Foundation Conditions. The existing incomplete auxiliary lock is founded on competent limestone as would the extension of this lock to 1200 feet. An accumulation of silt on either side of the auxiliary lock miter gates would have to be removed.

b. **Type A** (Location 3, Rock Founded). During construction, navigation must be maintained in the existing lock with only minimal interruptions. The Type A lock construction requires a cellular cofferdam around the lock construction area that would encroach on the approach channel to the existing lock (see Plate R3A1). Because an extended closure to navigation would result, construction of this lock alternative is economically infeasible and is eliminated from further consideration.

c. **Type B** (Location 3, Rock Founded). The Type B design would implement precast concrete lift-in units for lockwall construction similar to the Location 2, Type B design. Because both the intermediate wall and riverwall would be composed of lift-in units, minimum cofferdam usage would be required to implement this design. Only the miter gate bays would be dewatered by cofferdam. Rock excavation in the new lock chamber and for lower sill installation would be performed in the dry after the precast lockwalls are installed and closure is made at each end of the lock. The large part of the work associated with this design is the off-site fabrication of the lift-in wall units. The placement, alignment, and filling of the units at the construction site would result in little interference to river traffic. Any closures required could be conducted simultaneously with the closure of the existing 600 foot lock required for its modifications.

(1). Hydraulic Features.

(a). Intake and Discharge Structures. The filling and emptying system would have intake ports upstream of the upper gates and outlet ports downstream of the lower gates. The existing auxiliary lock intake structure would be used for both lock Types B and C at Location 3. The existing structure consists of rectangular intakes in both walls upstream and rectangular culverts that bypass the miter gate anchorage system and join with in-the-wall lock culverts. The intakes would be covered with steel trash racks. Water exits the lock chamber through the lower lock area outlet ports of similar design to the intake ports.

(b). Culverts and Distribution. The in-the-wall culverts in the miter gate monoliths continue through the lockwalls and extend to the outlet end of the lock chamber. Water would be brought from the culverts into the lock chamber through lockwall side ports perpendicular to the culverts. The alternate operations of filling and emptying would be controlled by tainter valves located in the gate monoliths, both upstream and downstream.

(2). Geotechnical Features

(a). Site Preparation. Site preparation for construction of a Location 3 lock would be minimal and would primarily include silt removal and construction of temporary navigation aides as needed. An extension of the lower guidewall of the existing lock would be required to guide tows passed the Location 3 lock construction.

(b). Rock Excavation. Underwater rock excavation would take place for preparing the foundation of the lockwalls. Rock excavation in the dry would occur for obtaining the desired lock chamber floor elevation. The total quantity of rock excavation for the lock chamber is estimated at 30,000 cubic yards.

(c). Cofferdam and Dewatering Measures. The main features of the Type B lock would be constructed in the wet. As indicated in the construction sequence on Plate R3B1, a short line of temporary cofferdam cells would be required across the downstream end of the lock between opposite walls. These cells are to complete construction of the lower miter gate sill and other work requiring dewatering. The upstream end would be closed off by installation of a poiree dam. The rock is not heavily fractured and it is expected that dewatering could be accomplish by pumping out of sumps excavated into the rock.

(3). Structural Features

(a). Lockwalls. The Type B lockwalls, shown on Plate R3B2, would be precast modular construction of the same design as Location 2, Type B. For a description of this type of lockwall, see "Structural Features" of the Location 2, Type B lock (paragraph 8c(3)(a).).

(b). Miter Gate Monoliths. The upstream miter gate sill and wall monoliths would be those of the existing incomplete auxiliary lock. The downstream miter gate wall monoliths would be precast float-in units of the same design as Location 2, Type B. Once the walls were completed, the chamber could be dewatered and the downstream miter gate sill would be constructed of cast-in-place concrete in the dry. The sill would be excavated into- and founded directly on the underlying rock.

(c). Guidewalls. This lock would have 1200-foot-long guidewalls, upstream and downstream, of the typical design for a rock-foundation described earlier in paragraph 6b(1)(a).

(4). Construction Sequence and Procedures. A general construction sequence is shown on Plate R3B1. Most of the activities identified in this sequence must be done in the order shown due to several constraints on the construction. The constraints include safely maintaining traffic to the existing lock, having all components necessary for dewatering in place prior to dewatering, and having to modify the filling ports of the existing intermediate lockwall prior to completion of the new lock.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. (See discussion under the Location 3 "Existing Conditions, General Site Description" paragraph above.)

(b). Restrictions on the Use of the Existing Lock. (See discussion under the Location 3 "Existing Conditions, General Site Description" paragraph above.)

d. **Type C (Location 3, Rock Founded)**. The Type C lock is shown in plan on Plate R3C1. The Type C lockwalls would be constructed with soil- or concrete-filled sheet pile cells. Although not many locks have been built of sheet pile cells, construction of sheet pile cells for other purposes is common in the UMR&IW system and the pool of qualified contractors is large for this type of work. Although possible to do, placing a wall culvert through sheet pile cells was not considered practical. Therefore, the filling/emptying system for the Type C lock would include a longitudinal culvert excavated into the rock along the centerline of the lock chamber.

This work would be done in the dry allowing the use of cast-in-place concrete. The lower gate monoliths would be composed of float-in units similar to the Type B design. As with the Type B lock, river traffic would be halted or restricted in width during the extension of the intermediate wall. Again, much of this work could be accomplished during the closure of the existing 600 foot lock for its modifications.

(1). Hydraulic Features.

(a). Intake and Discharge Structures. (See discussion under Type B.)

(b). Culverts and Distribution. The in-the-wall culverts in the miter gate monoliths transition to a longitudinal culvert centered in the lock chamber and excavated into the rock. The top of the culvert would be constructed higher than the lock chamber floor, leaving the top portion of the side walls exposed above the rock. The ports would be located at the top of the side walls of the culvert, jetting the water out horizontally. This is as opposed to having the ports in the roof of the culvert which would aim the energy of the inflow directly at the barges causing high hawser forces and unacceptable turbulence. The alternate operations of filling and emptying would be controlled by tainter valves located in the gate monoliths, both upstream and downstream. At the downstream end of the center culvert, a transition would be made back to the in-the-wall culverts in the downstream miter gate monoliths. Water exits the lock chamber through the lower lock area outlet ports in a similar manner as it enters the intake ports of the lock chamber.

(2). Geotechnical Features

(a). Site Preparation. (See discussion for Type B)

(b). Rock Excavation. Rock excavation would occur for the same purposes as for Type B and for excavation of the filling and emptying culvert. The total quantity of rock excavation for the lock chamber is estimated at 39,000 cubic yards.

(c). Cofferdam and Dewatering Measures. The main features of the Type C lock would be constructed in the wet. As indicated in the construction sequence on Plate R3C1, a short line of temporary cofferdam cells would be required across the downstream end of the lock between opposite walls. Just as for the Type B locks, these cells would be needed to complete construction of the lower miter gate sill and other work requiring dewatering (including the F/E culvert). The upstream end would be closed off by installation of a poiree dam. The rock is not heavily fractured and it is expected that dewatering could be accomplish by pumping out of sumps excavated into the rock.

(3). Structural Features

(a). Lockwalls. As noted above, the Type C lockwalls would be constructed of sheet pile cells, a proven method for water retention. A plan and cross section of these lockwalls is shown on Plates R3C1 and R3C2, respectively. The intermediate wall cells would have to be concrete-filled since these cells must be cut to allow placement of precast lockwall panels without projecting wider than the existing intermediate lockwall. Concrete-filled cells would be the most stable and durable, expected to last indefinitely, but these cells would also be more costly than cells with other fill types. The riverwall is presently shown gravel-filled to save cost. The riverwall could be upgraded with concrete fill also. The gravel-filled sheetpile cells would have higher maintenance costs, more emergency repairs, and shorter service life than concrete-filled cells. Gravel-filled cells would be capped with concrete with access provided for replacement of lost fill material. During any future design studies, a life-cycle cost analysis should be performed on cellular walls with the alternative fill materials. Precast concrete rubbing surfaces would be installed on both faces of the intermediate lockwall and on the lockside face of the riverwall cells. Unlike the intermediate wall (which has width constraints), the riverwall alignment would be adjusted to allow the panels to be placed external to the cells, maintaining the cell integrity and allowing the use of gravel fill. Tie-ins to existing lockwalls would require localized cofferdams and these wall monoliths would be concrete gravity wall construction.

(b). Miter Gate Monoliths. (See discussion for Type B..)

(c). Guidewalls. This lock would have 1200-foot-long guidewalls, upstream and downstream, of the typical design for a rock-foundation described earlier in paragraph 6b(1)(a).

(4). Construction Sequence and Procedures. A general construction sequence is shown on Plate R3C1. Most of the activities identified in this sequence must be done in the order shown for the same reasons as for the Type B lock.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. (See discussion under the Location 3 "Existing Conditions, General Site Description" paragraph above.)

(b). Restrictions on the Use of the Existing Lock. (See discussion under the Location 3 "Existing Conditions, General Site Description" paragraph above.)

10. **Location 4 (Rock-Founded)**

a. Existing Conditions

(1). General Site Description. Location 4 is through the gated section of the dam. Although any placement along the gated section is possible, the one selected for development of the Location 4 rock-founded concept design minimized the number of dam gates eliminated. The selected placement, shown on Plate R4GP, only eliminates one tainter gate bay from the dam. The loss of flow capacity would be mitigated by constructing a new tainter gate bay through the non-overflow section of the dam. This requirement is reflected in the cost estimates for each of the Location 4 lock types. A new lock at Location 4 would require removal of the incomplete riverwall of the auxiliary lock and the end pier of the dam. This location would allow use of both the existing lock and the new lock for commercial traffic due to the separation between locks. In addition, minimal channel work would be required due to the close proximity of the new approach channels to the old approach channels. Access to the dam would be slowed on occasion due to the need for the dam operators to cross a second active lock instead of only one. The regulation schedule for the dam gates would have to be reexamined to minimize adverse effect on navigation.

(2). Foundation Conditions. The footprint of the entire Location 4 lock at L/D 22 would rest on competent limestone at a relatively uniform elevation. This may not be the case at all rock-founded sites. Some silt removal would be required at all sites.

b. **Type A** (Location 4, Rock Founded). The Location 4, Type A, rock-founded lock would be a traditional lock design with concrete gravity walls built in the dry within a large cellular cofferdam (see Plate R4A1). The existing intermediate wall and one of the dam piers would be incorporated into the cofferdam layout for this lock. An extension of the existing lock's downstream guidewall would be necessary to allow for safe passage of tows into the existing lock during construction. No underwater excavation would be required since the entire lock chamber area would be dewatered. Most of the lock would be constructed with cast-in-place concrete. The lockwalls would be a traditional gravity wall design depending on the concrete mass for stability from overturning and sliding. This type of design has proven low maintenance and indefinite service life. The in-the-dry construction allows for direct inspection and better quality control than underwater construction. The lock would have miter gates at each end and the filling and emptying would be controlled with tainter valves. The filling and emptying system culverts and ports would be integral with the lockwall monoliths. A more detailed description of the Type A lock is given by feature below.

(1). Hydraulic Features. The hydraulic features of the Location 4, Type A lock are identical to those of the Location 1, Type A lock (see paragraph 7b(1).).

(2). Geotechnical Features

(a). Site Preparation. Site preparation for construction of a Location 4 lock would be minimal and would primarily include silt removal and construction of temporary navigation aides as needed. An extension of the lower guidewall of the existing lock would be required to guide tows passed the Location 4 cofferdam.

(b). Rock Excavation. All rock excavation would occur in the dry within the dewatered cofferdam. Total rock excavation quantity is estimated at 50,300 cubic yards.

(c). Cofferdam and Dewatering. The cofferdam would be a traditional design of soil-filled sheet pile cells. The rock is not heavily fractured and it is expected that dewatering could be accomplished by pumping out of sumps excavated into the rock.

(3). Structural Features

(a). Lockwalls. The Location 4, Type A lockwalls are shown in cross section on Plate R4A2. The lockwalls would be traditional concrete gravity walls 28 feet wide with integral filling and emptying culverts. The lockwalls would be equipped with ladders, checkposts, and T-armor. No floating mooring bitts are proposed for this 10-foot-lift lock.

(b). Miter Gate Monoliths. The upstream and downstream miter gate sills would be constructed of cast-in-place concrete and would be excavated into- and founded directly on the underlying rock. The miter gate wall monoliths would be conventional cast-in-place concrete gravity walls.

(c). Guidewalls. This lock would have 1200-foot-long guidewalls, upstream and downstream, based on the Melvin Price Lock guidewalls, adapted to a rock foundation. (See description of guidewalls for Location 1, Type A, pile-founded)

(4). Construction Sequence and Procedures. A general construction sequence is shown on Plate R4A1. The construction sequence for this traditional lock design is straightforward, having been repeated many times in lock construction.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. During construction of the cofferdam and during the time the cofferdam would be present, aides to navigation would be required for safe access to the existing lock chamber. The existing lock's lower guidewall would be extended to allow tows to align themselves with the lock at a greater distance from the lock. A traveling kevel on this wall might be necessary to handle the unpowered first cut of tows longer than 600 feet (the length of the existing lock).

(b). Restrictions on the Use of the Existing Lock. Once the Location 4 lock work was completed, it would be expected that commercial traffic could fully use both locks (the existing lock and the new lock). The lock placement shown in the plan view (Plate R4GP) was selected to displace as few dam gates as possible. If model studies reveal that greater separation between locks is needed for full use of both locks, then the Location 4 lock would be sited accordingly.

c. **Type B** (Location 4, Rock Founded). The Location 4, Type B design would be constructed using both lift-in units and traditional cast-in-place techniques. This lock is shown in plan and cross section on Plates R4B1 and R4B2, respectively. The upper gate monolith would be built in the dry within a cellular sheet pile cofferdam. The existing intermediate wall would be part of the cofferdam for construction of the upper gate monoliths. A cofferdam around the entire lock would not be needed or constructed; this is a substantial cost savings of the Type B lock compared to the Type A lock. The lower gate and lockwall monoliths would be composed of precast float-in units, meaning the majority of the lockwall fabrication would take place off-site as proposed for the Location 2, Type B lock. The emptying/filling culverts, ports, and utility lines would be located within the lockwalls.

(1). Hydraulic Features
(a). Intake and Discharge Structures. (See discussion under Type A)
(b). Culverts and Distribution. (See discussion under Type A)

(2). Geotechnical Features
(a). Site Preparation. (See discussion under Type A.)
(b). Rock Excavation. Underwater rock excavation would take place for preparing the foundation of the lockwalls. Rock excavation in the dry would occur for obtaining the desired lock chamber floor elevation. Total rock excavation quantity is estimated at 26,000 cubic yards.
(c). Cofferdam and Dewatering. The upper miter gate bay cofferdam would be a traditional design of soil-filled sheet pile cells. As indicated in the construction sequence on Plate R4B1, a short line of temporary cofferdam cells would be required across the downstream end of the lock between opposite walls. These cells would be needed to complete construction of the lower miter gate sill and other work requiring dewatering. The upstream end would be closed off by installation of lock bulkheads. The rock is not heavily fractured and it is expected that dewatering could be accomplished by pumping out of sumps excavated into the rock.

(3). Structural Features

(a). Lockwalls. The Location 4, Type B lockwalls would be of the same design as those for the Locations 2 and 3, Type B locks. For a description of this lockwall design see those respective write-ups.
(b). Miter Gate Monoliths. The upstream miter gate wall monoliths would be conventional cast-in-place concrete gravity walls. The downstream miter gate wall monoliths would be of precast modular construction. Both miter gate sills would be constructed of cast-in-place concrete in the dry.
(c). Guidewalls. This lock would have 1200-foot-long guidewalls, upstream and downstream, of the typical design for a rock-foundation described earlier in paragraph 6b(1)(a).

(4). Construction Sequence and Procedures. A basic construction sequence for the Location 4, Type B lock is shown on Plate R4B1.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. During construction of the landside lockwall, lower miter gate bay, and guidewalls, navigation aides (e.g., helper boats) would be required to allow tows to reach the existing lock safely. Few or no complete closures or width restrictions should be necessary.
(b). Restrictions on the Use of the Existing Lock. (See discussion for the Type A lock.)

d. **Type C** (Location 4, Rock Founded). The Location 4, Type C lock is shown on Plate R4C1. The Type C lockwalls would be constructed with sheetpile cells. The filling/emptying system for the Type C lock would include a longitudinal culvert excavated into the rock along the centerline of the lock chamber. This work would be done in the dry allowing the use of cast-in-place concrete. The upstream gate monoliths would consist of cast-in-place concrete gravity walls. The lower gate monoliths would be composed of float-in units similar to the Type B design. A cofferdam would be built for the cast-in-place construction of the upstream gate monolith. The construction of the upper gate monoliths, and the removal of the existing components required for their construction is identical to the Type B design at this location. A more detailed lock description, by feature, is provided below.

(1). Hydraulic Features. (See discussion for Location 3, Type C.)

(2). Geotechnical Features
(a). Site Preparation. (See discussion for Type A.)
(b). Rock Excavation. Underwater rock excavation would take place for preparing the foundation of the lockwalls. Rock excavation in the dry

would occur for obtaining the desired lock chamber floor elevation. Total rock excavation quantity is estimated at 37,000 cubic yards.

(c). Cofferdam and Dewatering. The dewatering requirements and provisions would be the similar to those for the Type B lock.

(3). Structural Features

(a). Lockwalls. As noted above, the Type C lockwalls would be constructed of sheet pile cells. A plan and cross section of these lockwalls is shown on Plates R4C1 and R4C2, respectively. Precast concrete rubbing surfaces would be installed on the cell walls exposed to barge traffic, both sides of the intermediate wall and the lock side of the riverwall. The lockwall alignments would be such that they would allow the panels to be placed external to the cells, maintaining the cell integrity and allowing the use of gravel fill. The lockwalls are presently shown gravel-filled to save cost, but they could be upgraded with concrete fill. The gravel-filled sheetpile cells would have higher maintenance costs, more emergency repairs, and shorter service life than concrete-filled cells. Concrete-filled cells would be the most stable and durable, expected to last indefinitely, but these cells would also be initially more costly than gravel-filled cells. During any future design studies, a life-cycle cost analysis should be performed on cellular walls with these alternative fill materials. Tie-ins to existing lockwalls would require localized cofferdams and these wall monoliths would be concrete gravity wall construction.

(b). Miter Gate Monoliths. (See discussion for Type B locks.)

(c). Guidewalls. This lock would have 1200-foot-long guidewalls, upstream and downstream, of the typical design for a rock-foundation described earlier in paragraph 6b(1)(a).

(4). Construction Sequence and Procedures. A basic construction sequence for the Location 4, Type C lock is shown on Plate R4C1.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. (See discussion for the Location 4, Type B lock.)

(b). Restrictions on the Use of the Existing Lock. (See discussion for the Location 4, Type A lock.)

11. **Location 5 (Rock-Founded)**. The Location 5 locks of all three design types would be identical to those described above for Location 4, with only a few exceptions described below. Plan views of the Location 5, Types A, B, and C locks are shown on Plates R5A1, R5B1, and R5C1, respectively. While constructing a lock in this location would be feasible from an engineering standpoint (i.e., it is possible to construct), these locks are economically infeasible at all sites because of extensive channel work requirements and adverse environmental impacts. The incremental cost of the channel work and the environmental mitigation for lock construction at Location 5 eliminates this alternative from further consideration. The site adaption write up further documents the reasons for the elimination of Location 5 locks from further consideration. A complete feature-by-feature description is not provided for these locks because of the similarities to the Location 4 locks, but differing items are described below.

a. General Site Description. The Location 5 lock placement sites a lock in the non-overflow or overflow section of a dam, if there is one. At Lock and Dam 22, the selected Location 5 lock placement was adjacent to the dam storage yard (where dam bulkheads are stored). The further the lock would be placed from the gated section of the dam, the higher the lock costs would be because of the channel work required to join with- or realign the existing navigation channel. The non-overflow section consists of an embankment with a core of sheet pile cells. Cutting through this section with a new lock presents a challenge in maintaining damming capability at all phases of construction (see paragraph b(1)(b) below). Placing a lock and associated channel at Location 5 would require removal of at least two islands. This undesirable environmental loss, which is typical at other sites besides L/D 22, is not involved with Locations 1 through 4.

b. Features Unique to Location 5 (for all three lock types)

(1). Geotechnical Considerations.

(a). Site Preparation. To have access to the construction site both upstream and downstream of the dam, dredging would be required to obtain adequate depths.

(b). Tie-In to Non-Overflow Section. Cellular sheetpile walls would be used to pass through the non-overflow section of the dam and tie-in to the upper miter gate bay of the lock. Before the upstream lock approach could be excavated through the non-overflow dike, the cells would have to be capable of retaining the adjacent dike material on both sides and providing damming capability to hold pool. First the riprap would have to be removed from the non-overflow section and cells driven (both upstream and downstream) to the centerline of the dike where there is an existing cellular sheetpile diaphragm. The downstream cellular wall must tie-in to a completed upper miter gate bay or cofferdam. By chemical grout or jet grouting a seepage cutoff would be constructed between sheet piling extending from the new cells and the sheetpiling of the diaphragm cells to remain in the dike. Then the piling of the diaphragm cells between walls would be pulled. The upstream and downstream cellular walls could then be completed by driving the connecting cells. After this, the embankment material of the dike between walls would be removed.

(2). Construction Sequence and Procedures. A general construction sequence for each of the three lock types is shown on Plates R5A1, R5B1, and R5C1.

(3). Operational Considerations/ Navigation Impacts. Due to its removal from the existing lock, construction of the lock itself should have little impact on navigation, other than the added number of boats due to general construction activity. However, constructing the *channel* could have major impacts on navigation, particularly during the transition period from using the existing channel to having the new channel adequately completed. It is not expected that the two widely separated channels could be maintained simultaneously. To maintain the existing navigation channel, river training works are constructed and periodic dredging is performed. Some of these river training structures would have to be removed and others added to retrain the river to a new course. There would likely to be a period before the new channel is complete, when neither channel is adequate for 9-foot-draft navigation. Once the new channel is complete, the old approach channels to the existing lock would likely be good only for recreation craft without extensive dredging.

Pile-Founded Lock Design Concepts

Pile founded lock concept designs were based on the Lock and Dam 25. Pertinent data, elevations, and dimensions are tabulated below.

Table 8: Lock and Dam 25 - Pertinent Data

Data Description	Value
Upper Pool: Normal Operating Elevation	El. 434.0
Maximum drawdown of Upper Pool	El. 429.7
Lower Pool: Normal Operating Elevation	El. 419.0
Lower Pool: Low Water Elevation	El. 415.8
Lower Pool: 15% Duration Elevation (Cofferdam Height)	El. 429.3
10 year Flood + 2 Feet of Free Board (For lock dewatering load)	El. 443.0
Existing Upper Sill Elevation (Location 2)	El. 415.0
Existing Lower Sill Elevation (Location 2)	El. 407.0
Existing Upper Sill El. Aux. Lock (Location 3)	El. 407.0
Maximum Upper Sill Elevation - Type A Locks	El. 416.0
Maximum Lower Sill Elevation - Type A Locks	El. 401.0
Maximum Upper Sill El. - Types B and C Locks	El. 418.7
Maximum Lower Sill El. - Types B and C Locks	El. 403.7
Existing Lock Floor Elevation	El. 405.0
Type A Lock Floor Elevation	El. 399.0
Types B and C Lock Floor Elevation	El. 401.7

12. **Location 1** (Pile-Founded)

a. Existing Conditions

(1). General Site Description. The Location 1 lock placement is landward of the existing lock and as close as possible to the existing lock to minimize the approach excavation. The lock could be moved further from the existing lock if required due to reasons related to approach conditions, relocations, existing infrastructure, etc. Optimizing the alignment is out of the scope of this study. The location requires significant changes to existing river training structures that are on the same side of the river as the lock. Types A, B, and C are all feasible at Location 1 at Lock and Dam 25.

The existing riverfront area features drainage areas, access roads, utilities, recreation, parking, residential and commercial property, etc. that would have to be removed, rerouted, relocated or abandoned to accommodate the right of way for the new lock, cofferdam, guidewalls and approach channels. The existing approach channels and training structures on the near side of the river would have to be modified. During this transition time, approach conditions to the existing lock would be altered. Some delays might occur.

b. **Type A** (Location 1, Pile-Founded). The Type A lock would be a reinforced concrete U-frame structure constructed in the dry within a dewatered cofferdam. The cofferdam consists partly of the existing lock and guidewall and would be completed with sheet pile cells and arcs (an earthen cofferdam with a concrete slurry wall core is an option, but not presented). The lock service gates would be a two-leaf lift gate upstream and miter gates downstream. The filling and emptying system uses intake ports and discharge outlet that would be directed into the approaches. Flow would be distributed in the chamber by side ports leading from culverts in the lock walls. The concept features 1,200-foot-long guidewalls upstream and downstream that would be constructed in the wet.

(1). Hydraulic Features. See discussion for rock-founded Location 1, Type B (paragraph 7b(1).).

(2). Geotechnical Features

(a). Cofferdam. The cellular cofferdam partially surrounds the lock and provides space for lock construction and access around the lock. A road on top of the cofferdam would also provide access. The cofferdam would be constructed of sheet pile cells with connecting arcs. Both cells and arcs would be filled with sand. The site would have to be partially excavated to reduce the driven length of piles and to reduce the lateral loads on the completed cells. An earthen berm would help stabilize the cells after dewatering. The riverward leg of the cofferdam would be formed by two cantilevered Z-pile walls that run parallel to the existing lock. They would be separated from the existing lock and guidewall by about 60 feet to minimize adverse effects on the stability of these two structures. The lower of the two walls will be driven at least to elevation 360 to also serve as a seepage cutoff barrier. The cutoff will be at the end of a 175 foot seepage path. The cellular cofferdam only requires partial removal after the project is complete. A portion of the landward leg could remain.

(b). Site Preparation. The levee that contains pool at Lock 25 requires relocating and the relocated levee would have to be built before the existing levee would be removed. For the cofferdam, two levels of cantilevered Z-pile walls would be driven parallel to the existing lock alignment. The upper level would support the existing esplanade and other backfill at elevation 444 and the lower level would permit a general excavation to about elevation 405. After this, the sheet pile cofferdam cells would be driven to elevation 355. The existing road would have to be temporarily rerouted as the existing embankment is excavated to prepare for sheet pile driving. The remainder of the excavation would occur within the confines of the cofferdam to reduce the amount of the overall excavation. Utilities would be relocated and temporary access to the existing lock would be restored by a road on top of the cofferdam.

(c). Scour Protection During Construction. As a minimum, the upper and lower legs of the cofferdam would require scour protection due to their exposure to river velocities and to river traffic.

(d). Sheet Pile Cutoffs around Lock Perimeter. Sheet pile cutoff walls would border the portions of the lock wall that are exposed to river velocities. Sheet piles would be embedded into the concrete monoliths. The purpose of the walls would be to provide scour protection against the loss of material from around the bearing piles and to provide a seepage cutoff.

(e). Bearing Piles. The gate monoliths and the chamber structures would be supported by steel H-piles driven to refusal. The presence of cobbles and boulders at the site dictate that steel H-piles be used for the foundation. Pile capacities were developed from Design Memorandum No. 21 for the design of the auxiliary lock at Melvin Price Locks and Dam on the Mississippi River. The compressive capacity was assumed to be the same at 345 kips for an HP 14x117. The tension capacity of 31 kips was calculated by interpolating the available embedment depth at Lock and Dam No. 25 with the tension capacities and corresponding pile depths at Melvin Price.

(f). Scour and Erosion Protection. Permanent scour protection would be required in the upstream and downstream channel. Some earthen slopes would have to be protected from scour. The depth, type and number of layers of stone vary. Most areas would be covered with a six-foot thick layer of stone. The sides of the lock would be backfilled to the top of the lock and would not require scour protection.

(3). Structural Features

(a). Lockwalls. The lock chamber walls would be U-frame monoliths founded on steel H-piles driven to bedrock. The base and the walls would be constructed of cast-in-place reinforced concrete. Concrete would be placed in lifts that are limited in height due to practical batch plant and labor force capacity and to reduce stresses from the heat of hydration of the cement. The walls would contain the longitudinal filling and emptying culvert, line hooks, check posts, wall armor, ladders, floating mooring bitts, and other lock wall appurtenances.

(b). Upstream Lift Gate Monolith. The upstream lift gate monolith would be constructed of cast-in-place reinforced concrete and exhibits U-frame action. Foundation H-piles would be driven to bedrock. Battered piles would be required to resist lateral loads on the lock service gate or bulkheads. Two lift gate leaves would be required for operation of the lock. There would be a concrete sill for the lift gate that limits the height and number of leaves required. The monolith contains the filling and emptying culvert, lift gate machinery and recesses, bulkhead recesses, floating mooring bitts, machinery rooms and control house structure. Also featured is a cross over gallery for utilities and personnel access.

(c). Downstream Miter Gate Monolith. The downstream miter gate monolith would be constructed of reinforced concrete and exhibits U-frame action. Foundation H-piles would driven to bedrock. Battered piles would be required to resist lateral loads on the lock service gate or bulkheads. Two miter gate leaves would be required for operation of the lock. The gate would have a personnel access bridge across the top. There would be a concrete sill for the gate that would provide a clearance above the lock floor during gate operation. The monolith contains the filling and emptying culvert, discharge ports, miter gate machinery and recesses, bulkhead recesses, floating mooring bitts, and machinery rooms.

(d). Guide- and Guardwalls. The upstream guardwall (riverside) and the downstream guidewall (landside) would consist of multiple stacked precast concrete rubbing beams supported by mass concrete cells on 57-foot centers. The intermediate cells would be 35 feet in diameter and the end cells would be 57 feet in diameter. The cells would be constructed by placing tremie concrete in sheetpile cell forms. All cells would be founded on steel H-piles driven to bedrock. The sheet piles serve only as a concrete form and will be cut off below the water level. The rubbing beams would be simply supported on their bearings. The beams would be heavily reinforced and armored to resist the abrasion of the tows. The upstream wall would be open, ported between cells and below the beams. The ports permit flow through the wall, creating forces that draw tows to the wall. The size of the ports would be finalized by the model study. The downstream wall would not be ported and would have a taller rubbing surface due to the larger water level fluctuations in the lower pool.

(4). Construction Sequence and Procedures

(a). The site would be partially excavated to reduce the driving length of the sheet-pile cell cofferdam and to reduce the lateral load from the soil on the cells after dewatering. The top of cofferdam would be El. 440 and would have a gravel road for construction and accesses the existing lock. The cells would be driven to El. 355, 30 ft below the new foundation level. The cofferdam would be equipped with a floodway and spillway. Only 16 cells and arcs require removal at completion of the project. The remainder could remain in place to reduce costs.

(b). The slope of the excavation near the existing lock would be terraced with two levels of retaining walls due to the close proximity of the new lock. The placement of the upper retaining wall must accommodate a minimum esplanade for operations of the existing lock. The walls could be tied-back.

(c). The dewatering system is installed. Excavation to the foundation level could be done in the dry and/or in the wet. Berms would be constructed in the wet. The cofferdam is fully dewatered. Final grading of stability berms occurs in the dry.

(d). Bearing piles are driven. Sheet pile cut-off walls only at the upstream and downstream ends are driven.

(e). Concrete monoliths are constructed conventionally with lifts of cast in place concrete. The order of monolith construction is an important part of the constructibility of the project, but not worth detailed attention in this report since many combinations are feasible. Monoliths that support the bascule bridge should be completed first so as to not delay its construction.

(f). As monolith construction progresses, backfill could be placed and compacted. Since many of the cofferdam cells are to remain in place, the additional fill would not interfere with sheet pile removal. There would be some risk to the contractor of scour of the backfill, site contamination, and clean-up costs of scoured fill if the cofferdam requires flooding. Early backfill would enable the contractor to get out of the cofferdam hole quicker and expedite the construction schedule.

(g). Equipment is installed. Stone scour protection in the approaches is placed. The cofferdam is rewatered and partially removed.

(h). The guidewalls are constructed concurrent with the lock up to the intersection with the cofferdam. After cofferdam removal, the tie-in of the guidewalls to the lock is made and the lock put into service.

(i). A Bascule bridge is constructed over the new lock for permanent access to the existing lock. Its founding monolith should be one of the first completed to facilitate construction of the bridge. Control house and lock appurtenances are constructed.

(j). Concurrent with lock and guidewall construction, approach channels are dredged/excavated. New wing dams might require installation and old wing dams moved/modified. This work should be scheduled to be completed during the guidewall tie-in so it does not delay the in-service date for the lock.

(5). Operational Considerations. The operational considerations for the pile-founded Location 1 locks are the same as those for the rock-founded Location 1 locks. (Refer to the same subject heading for rock-founded Location 1, Type A.)

c. **Type B (Location 1, Pile-Founded)**. The chamber for Type B locks would be constructed using a pile-reinforced, concrete slurry wall. The chamber structures would be constructed without the use of a cofferdam. The culverts would be located in the chamber floor and would be constructed on a reinforced tremie concrete base slab founded on bearing piles. Areas between the completed culverts and slurry walls would be filled with crushed stone and covered with a layer of cast-in-place concrete. The upstream miter gate monolith and the downstream miter gate monolith would be constructed within a concrete-filled slurry wall that functions as a cofferdam. The lock filling intake would be through the sill of the miter gate monolith. Lock emptying would be through an outlet manifold in the miter gate monolith.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The culvert system would be filled through a set of five butterfly valves installed in the upstream face of the upper sill. Each valve would open onto a short passage leading to a manifold or mixing chamber inside the lock sill that extends across the 110-foot width of the chamber. Two 20-foot-wide passages opening off the downstream wall of the manifold lead through the monolith floor and into the chamber culverts. The culvert system would be emptied through a manifold in the downstream miter gate monolith, controlled by two sluice valves, one on each side of the monolith. The butterfly valves and sluice valves can be bulkheaded off for closure of the filling and emptying system.

(b). Culverts and Distribution. The chamber would feature bottom longitudinal culverts that would extend over the entire length of the chamber. They would be immediately adjacent to each other at entry and exit to the chamber, but would separate at the middle half of the chamber to improve distribution. The culverts would consist of cast-in-place walls founded on the tremie layer and precast cover panels. Regularly spaced ports would be situated along the culverts. The remainder of the chamber floor above the tremie concrete will be filled with crushed stone and covered with cast-in-place concrete.

(2). Geotechnical Features

(a). Site Preparation. The entire lock area would be initially graded to El. 432 prior to construction. Flood protection levees would be built of the excavated material for low lying areas. Excavated material for the lock construction would be used to back fill around the completed structure, but much of it would require disposal.

(b). Braced Cofferdams for Service Gate Monoliths. Both service gate monoliths would be constructed inside a pile-reinforced, concrete-filled slurry wall that would serve as a cofferdam to El. 432. At chamber ends, the concrete wall would be placed to a top elevation of El. 399 upstream and to El. 401.7 downstream. The balance of the height would be made with Z-piling braced against soldier piles. After installation, the Z-pile would have to be backfilled and compacted to facilitate the drilling of soldier piles and the short slurry walls. The tip of the slurry wall would be at El. 360. The primary slurry wall soldier piles extend to El. 325 and the intermediate soldier piles extend to El. 360. The slurry wall provides scour protection and seepage cutoff underneath the completed monoliths. Wall heights to complete cofferdam protection levels could be made of a cast-in-place cap extending above the slurry wall to complete cofferdam protection levels. Earthen levees could be a substitute where feasible, but are not presented herein. Foundation dewatering of the gate monoliths would not be required during construction because of the five-foot-thick tremie seal coat in the bottom of the cofferdam. Some uplift pressure relief holes in the base may be required.

(c). Scour Protection During Construction. Protection of the site during construction would be provided by the cofferdams and slurry walls. Stone scour protection may be required on the two ends of the lock.

(d). Slurry Cutoff Along Chamber. The chamber would be constructed between parallel pile-reinforced slurry walls similar to and connecting the slurry walls surrounding the service gate monoliths. These walls would delineate the construction area, support the chamber rubbing panels and provide a permanent seepage cutoff along the chamber.

(e). Bearing Piles. (See discussion for Location 1, Type A).

(f). Scour and Erosion Protection. The finished guidewall structures and approaches require a six-foot-thick layer of scour protection.

(3). Structural Features

(a). Lockwalls. The lock chamber walls would consist of pile-reinforced slurry walls, capped with a cast-in-place concrete wall and supporting precast rubbing panels that would be backfilled with grout. The walls would be tied-back to deadmen for added strength. The precast concrete rubbing panels could be removable to ease future lock wall refacing. The panels also contain lock wall appurtenances. At line hook and check post location added wall strength in the form of anchors or backup soldier piles could be added. The top eight feet of the walls would be a cast-in-place cap over the top of the slurry wall and soldier piles. The lock walls would be designed to resist normal operating loads and those caused by completely dewatering the chamber.

(b). Lock Floor and Culverts. The entire chamber floor would be covered with a five-foot-thick layer of reinforced tremie concrete. The floor would be designed to act as a compression strut between the chamber walls and to distribute uplift forces to piles during dewatering. The culverts would be cast upon the tremie concrete which might require some grinding to achieve desired smoothness. The sides of the filling and emptying culverts would be constructed of cast-in-place concrete walls, five feet thick by 7.5 feet high. The culverts would be covered by two-foot-thick precast panels. The culverts would have ports spaced at regular intervals. The area between the culverts and between the culverts and the slurry walls on the sides of the chamber would be filled with a 7.5-foot thick layer of crushed stone and covered with a two-foot-thick layer of cast-in-place concrete.

(c). Upstream Miter Gate Monolith. The upstream miter gate monolith would be constructed inside a pile-reinforced, concrete-filled, slurry wall that would serve as the cofferdam. The cofferdam would have at least two layers of internal bracing supported at intervals by bearing piles. The bracing would interfere with pile driving and many other construction activities. Some of the bracing might have to be cast into the concrete. A five-foot-thick reinforced concrete slab would be placed in the bottom of the cofferdam by the tremie method. Uplift pressure relief holes may be required in the base slab. The monolith would be pile founded. After dewatering the cofferdam, the tremie concrete surface will be prepared as a construction joint for bond to the next concrete placement. The portion of the monolith upstream from the sill acts as a U-frame. The downstream portion of the monolith would not exhibit U-frame action due to the discontinuity caused by the culverts in the floor. It would act as an articulated U-frame which will require a more complex analysis. The gate recesses, bulkhead recesses and other appurtenances would be laid out similarly to Melvin Price Locks and Dam, except that at the downstream end of the monolith a single slot would be provided for the floating mooring bitts which would be removed prior to installation of the maintenance bulkheads.

(d). Downstream Miter Gate Monolith. The downstream miter gate monolith would be similar, except as noted, to the upstream gate monolith. The portion of the monolith downstream from the sill acts as a U-frame. The upstream portion of the monolith would not exhibit U-frame action due to the discontinuity caused by the culverts in the floor. The miter gate pintles, maintenance bulkhead recesses and line hooks and check posts would be laid out similarly to Melvin Price Locks and Dam, except that at the upstream end of the monolith a single slot would be provided for the floating mooring bitts which would be removed prior to installation of the maintenance bulkheads.

(e). Guide- and Guardwalls. The upstream guardwall (riverside) and the downstream guidewall (landside) would both be of the standard pile-founded walls described in paragraph 6b(1)(b).

(4). Construction Sequence and Procedures

(a). Drill holes on 12-foot centers for primary soldier piles using a bentonite slurry. Install temporary casing in the top 20 feet of each hole.

(b). Install soldier piles in holes to bedrock. Plumb piles and grout into place with a low-strength mix. Excavate a three-foot-wide trench between primary piles (including low-strength grout) to El. 360 and place intermediate piles between primary piles.

(c). Fill the trench with tremie concrete uniformly on both sides of the intermediate pile. The fill concrete would be unreinforced.

(d). Excavate the chamber area between slurry walls to approximately El. 420. Dewater inside walls to approximately El. 415. Excavate trenches for installation of deadmen for tiebacks along chamber wall. Install tieback anchors through sleeves in the concrete wall and attach to a deadman. Pre-stress the anchors.

(e). Excavate to approximately El. 386. Place two-foot-thick layer of gravel in base of excavation.

(f). Drive foundation bearing piles to rock at approximately El. 325. Cover with a five-foot-thick layer of reinforced tremie concrete.

(g). Construct cast-in-place wall on top of slurry wall to El. 444.

(h). Attach eight-inch-thick precast rubbing panels to primary piles in the slurry wall with stud fasteners. Grout behind the rubbing panels.

(i). At gate monolith openings at upstream and downstream ends of the lock, the construction procedure must be adjusted. Drive a sheet pile wall outside the limits of the slurry wall. Backfill as necessary on both sides of the slurry wall location.

(j). Install primary soldier piles as above. Excavate trench for slurry wall. Install tremie concrete to elevation of lock floor (El. 399 upstream, El. 401.7 downstream). Intermediate soldier piles would not be used.

(k). Install a wale between the soldier piles and the sheet piling. Begin excavation inside the sheet piling.

(l). Excavate to approximately El. 385. Install grout between the soldier piles and the sheet pile wall. Place a two-foot-thick layer of crushed stone. Drive bearing piles and install reinforced tremie concrete floor in base of cofferdam as above.

(m). Install top level of bracing inside the service gate monolith area.

(n). Dewater to El. 415. place a second layer of internal bracing. Complete dewatering. Construct service gate monoliths by using traditional methods of cast in place concrete.

(o) Construct culverts on top of the tremie concrete in the chamber.

(p). Fill chamber floor areas between finished culverts with crushed stone and cover with a two-foot-thick layer of cast-in-place concrete.

(q). Excavate fill outside the sheet piles to establish entry and exit channels to the lock. Rewater the lock. Cut off exposed sheet piling and soldier piles underwater.

(r). Construct guidewalls concurrently with the lock.

(s). Complete excavation for channels and approaches.

(t). Install stone scour protection.

(5). Operational Considerations. The operational considerations for the pile-founded Location 1 locks are the same as those for the rock-founded Location 1 locks. (Refer to the same subject heading for rock-founded Location 1, Type A.)

d. **Type C (Location 1, Pile-Founded)**. The chamber for Type C locks would be constructed without a cofferdam. The landward chamber wall would be a steel sheet pile wall anchored to a deadman and armored with concrete. A traveling kevel that runs on top of the wall keeps the tows against this wall. Consequently, the riverward, tied back wall would not be armored, but would be recessed to avoid impact with the tow. A single filling and emptying culvert would be located behind the landward wall and would be ported into the chamber. Filling and emptying would be through the landward walls of the service gate monoliths. The upstream and downstream miter gate monoliths would be constructed within internally-braced, single sheet pile wall cofferdams, using traditional constructed methods. The lock floor would consist of heavy stone that would protect it against scour from propeller wash.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The culvert system would be filled through an intake manifold in the upstream approach. The culvert gates would be sluice gates installed in the landward wall of the upstream and downstream miter gate monoliths. The gates could be bulkheaded off for maintenance closure of the filling an emptying system. Emptying of the culvert would discharge behind the downstream guidewall through ports in the guidewall.

(b). Culverts and Distribution. The chamber would be side-filled from a single, precast concrete culvert installed on the land side of the chamber and having inner dimensions of 19 feet wide by 16 feet tall. The base of the culvert would be at El. 395.7 at the bottom of the chamber scour protection, except at the upstream and downstream ends of the chamber, where the precast culvert must rise to meet the culvert profile inside the service gate monoliths. If a single valve system were to go out, the lock would shut down. This would be a rare occurrence, however, and a spare valve could be available on site to replace the damaged valve thus minimizing downtime.

(2). Geotechnical Features

(a). Braced Cofferdams for Service Gate Monoliths. Each service gate monolith would be constructed inside an internally-braced single sheet pile wall cofferdam as described for Locations 4 and 5, Types B and C below.

(b). Site Preparation. A sheet pile wall would be driven adjacent to the existing lock wall and anchored to a deadman as the excavation progresses. A six-foot-thick layer of stone scour protection would be placed over the lock floor.

(c). Scour Protection During Construction. Stone scour protection will be required upstream and downstream of the lock. This will provide both interim scour protection (during construction) and permanent protection.

(d). Sheet Pile Cutoffs around Lock Perimeter. Sheet pile cutoff walls would be provided by the Z-pile chamber walls and the cofferdam walls.

(e). Bearing Piles. The gate monoliths would be supported by steel H-piles driven as described for Types A and B above.

(f). Scour and Erosion Protection. In addition to the scour protection in the chamber, the upstream and downstream guidewalls would be surrounded with a six-foot-thick layer of stone protection.

(3). Structural Features

(a). Lockwalls. The riverward lock chamber wall would consist of a line of steel sheet piles tied-back to Z-pile deadmen. The top of the lock wall would be at El. 444 and the tip of the piles would be at El. 360. The face of the riverward lock wall does not have precast panels on it, but would be recessed ten feet resulting in a chamber width of 120 feet. The landward wall would also be a tied-back Z-pile wall but would have precast concrete rubbing panels that can be removed for future lockwall refacing. The panels would support lock wall appurtenances. For check posts and mooring bitts extra strength would be added to the wall in the form of high strength piling, master piles, additional tiebacks and or battered H-piles.

(b). Lock Floor and Culvert. A single precast culvert would be installed on the landward side of the chamber floor. It would be placed on bearing piles and grouted to them at the same elevation as the base of the chamber scour protection, except at the upstream and downstream ends, where it would be necessary to have the culvert rise to meet the culvert elevation inside the gate monoliths. The Z-pile wall would be used as a guide for culvert installation. The ports from the culvert would be burned through the Z-pile and lined with a steel liner installed by divers. The ports should be no wider than one Z-pile. The void between the culvert and Z-pile would be grouted. The grout and the liner would eliminate the scouring of material from below the culvert.

(c). Upstream Miter Gate Monolith. The upstream miter gate monolith would be constructed inside an internally-braced, single sheet pile wall cofferdam using traditional concrete construction methods. The landward monolith wall would be wider than the riverward monolith wall to accommodate the culvert and gates. The culvert within the wall would be situated sufficiently above the lock floor to allow U-frame behavior of the monolith. The miter gate pintles, gate recesses, bulkhead recesses and other appurtenances would be laid out similarly to the auxiliary gate at Melvin Price Locks and Dam, except that at the downstream end of the monolith a single slot would be provided for the floating mooring bitts which would be removed prior to installation of the maintenance bulkheads.

(d). Downstream Miter Gate Monolith. The downstream miter gate monolith would be similar to the Upstream Gate Monolith.

(e). Guide- and Guardwalls. This lock would have an upstream guardwall (riverside) and a downstream guidewall (landside) of the standard design for sand foundations described in paragraph 6b(1)(b).

(4). Construction Sequence and Procedures

(a). Construct internally-braced, single sheet pile cofferdams for the upstream and downstream service gate monoliths, similar to those used for Location 4, Types B and C options. Excavate interior of cofferdams to base of monoliths. Construct monoliths by traditional means.

(b). Install a line of steel sheet piles riverward and parallel to the existing lock landside wall, between the upstream and downstream service gate monoliths. Install tiebacks attaching them to deadmen and the sheet pile wall.

(c). Excavate for the lock chamber and culvert installation. The chamber floor is excavated to El. 395.7. The land side of the excavation slopes up to meet thc existing ground at a slope of 1V on 4 H. The excavation is warped to meet the existing ground at the far ends of the service gate monoliths. Construct a levee at the top of the slope to increase project protection from floods.

(d). Install the landward Z-pile wall and use it as a guide in placing the culvert which is to be installed underwater.

(e). Place precast concrete culvert along the landside on piles. Grout the culvert to the piles. The upstream and downstream ends of the culvert would slope upward to meet the culvert elevations in the service gate monoliths.

(f). Divers would enter the culvert and burn out Z-pile at the location of ports. The void between the culvert and Z-pile would be lined with a steel box that was outfitted to the culvert prior to installation. The box would form the port when grout is placed between the culvert and Z-pile.

(g). Backfill behind landward wall and anchor as required.

(h). Install six feet of stone scour protection in the floor of the chamber.

(i). Install upstream and downstream guidewalls on the land side of the channel.

(5). Operational Considerations. The operational considerations for the pile-founded Location 1 locks are the same as those for the rock-founded Location 1 locks. (Refer to the same subject heading for rock-founded Location 1, Type A.)

13. **Location 2** (Pile-Founded)

a. Existing Conditions

(1). General Location Description and Problem Definition. Refer to the rock-founded Location 2 discussion (paragraph 8a(1).) for the general location description and problem definition. Pertinent data, elevations, and dimensions of the pile-founded Location 2 locks are shown on Plates P2B1 and P2C1.

(a). Existing Lock Structure Stability. Based on performance history of the existing locks, the existing walls are considered stable. Site-specific designs would require analysis to determine if the existing structures are safe.

(b). Guidewalls and Guardwalls. The existing upstream guidewall consists of a landward solid wall. The wall would be a concrete gravity type founded on piles. Though no analysis was performed, it is reasonable to assume that the upstream guidewall is in a condition that would only require extension and not complete removal and replacement. An economic analysis needs to be performed concerning construction of a riverside guardwall in lieu of extending the landside guidewall. Preliminary model study results indicated better approach conditions with a riverside guardwall although costs would be higher for the guardwall (which would also require demolition of the existing landside wall). The lower guidewall would be demolished due to the new lock extension and a new landside guidewall would be constructed. The design type for both walls would be as described in paragraph 6b(1)(b).

(2). Deviations from the Common Type B and C Criteria. (See discussion for rock-founded Location 2 in paragraph 8a(3).)

(3). Foundation Conditions.

b. **Type A** (Location 2, Pile-Founded). A Type A lock at Location 2 is not feasible because navigation would be closed for an extended period by the sheet pile cellular cofferdam required for this lock type. An alternative considered is to first construct a "temporary" 600-foot-long lock at another location, and then close the existing lock with the cofferdam. However this alternative, which amounts to construction of 1200 feet of lock chamber plus extra guidewalls and a cofferdam, proved to be economically inefficient.

c. **Type B** (Location 2, Pile-Founded). The Location 2, Type B lock is shown on Plate P2B1. Most on-site construction for the Location 2, Type B lock would be done in the wet requiring technologies borrowed from offshore platform work, major bridge construction, and tunnel construction that will be adapted to lock construction. The walls would be armored with only abrasion-resistant concrete and special joint details. Miter gates would be used upstream and downstream. The lock is designed to be dewatered and utilizes a structural floor to resist differential water pressures across the slab. The filling and emptying system would include extending the existing culverts within the land and intermediate walls. The filling and emptying system would have a reduced culvert size resulting in lengthened filling and emptying times. While the lower guidewall would be under construction, tow traffic would not be able to use the existing downstream guidewall safely. A temporary mooring area would be constructed downstream until the lower guidewall would be completed. The lock would be provided with approximately 1800 feet of new guidewall. These walls would extend upstream and downstream of the landward lock wall. The downstream lock approach would consist of a guidewall, whereas the upstream lock approach may have a guidewall or a guard wall. Final guidewall and guardwall configurations would need to be determined in site-specific studies. It is assumed that the guidewalls would be 1200 feet in length for estimating purposes.

(1). Hydraulic Features

(a). Intake and Discharge Structures. For the 600-foot lock extension, the existing intake manifolds would be utilized. Outlet manifolds for this alternative are assumed to have a configuration similar to the existing lock. The performance of the outlet and determination of the need for a more elaborate discharge manifold would be determined in physical model studies if this alternative is studied further.

(b). Culverts and Distribution. Based on the results of a numerical model, the preliminary design of the extended lock requires 12.5 foot by 12.5 foot culverts in each wall, closing the upstream three-fourths of the existing ports, and additional ports in the new end that mirror the remaining ports in the existing lock.

(c). Ports. Waterways Experiment Station (WES) recommends that the total port area divided by the total culvert area should never exceed unity. If it exceeds 1.0, experience has shown that flow bypasses some of the ports resulting in poor flow distribution into the lock chamber. The ratio for the existing lock is 1.5 (240 square feet / 156 square feet) which is too high. Based on this criteria the only acceptable alternative studied is the one that uses a total port area equal to 1/2 (120 square feet / 240 square feet) the existing port area. This alternative requires closing some of the existing ports. WES recommends having the ports as close to the center of the new lock as possible/practical and symmetrical about the centerline of the lock.

(d). Approach Conditions. See the discussion on guidewalls and guardwalls in the pile-founded Location 2 introductory text, paragraph 14a(1)(b).

(2). Geotechnical Features

(a). Site Preparation. Site preparation for construction of the lock extension would include constructing the temporary downstream mooring facility, the fabrication/storage area, excavation of the barge access channel behind the existing and new lower guidewalls. Site preparations for the new guidewalls would need to be incorporated into the site-specific designs. The new lower guidewall would be essentially completed prior to float-in of the new gate bay monolith and the subsequent construction of the new lock walls.

(b). Sheet Piling. Sheet piling would be driven 12 inches outside the exterior faces of the new lock wall extensions, along the upstream and downstream faces of the new downstream gate sill, and across the downstream face of the downstream apron. Depths of the sheet pile would be in the range of 20 to 40 feet, depending on location and purpose. Along the exterior faces of the lock wall extensions the sheet pile would serve as a retaining wall for required excavation and would extend above grade to elevation 408.00 feet to divert current and alluvial sediment past the excavated area for the lock extension. The sheet pile along the upstream and downstream faces of the new gate bay monolith serve primarily as retaining walls for the required excavation for the new gate monolith. These sheet piles would be connected to the sheet piling along the exterior faces of the lock wall extensions and the combination, when tied-in to the sheet pile beneath the existing lock, would provide significant seepage control.

One method of accomplishing a tie-in to the sheet pile beneath the existing lock is shown on Plate P2B4. This, or a similar type sheet pile tie-in, is recommended since it is relatively inexpensive and provides significantly enhanced seepage control. The primary purpose of the sheet pile across the downstream face of the new downstream apron would be to prevent undermining of the new apron in the event that tow boat prop wash causes severe scour at that location. This sheet pile should extend approximately 30 feet below the base of the precast concrete sections and be connected to the sheet pile along the exterior faces of lock wall extensions. The tops of all sheet pile would be attached to adjacent precast units with suitable ties and tremie concrete.

The tops of sheet pile in the area where the new gate bay monolith would be floated in may need to be cut off under water just prior to beginning the gate monolith float-in operation in order to provide adequate water depth over the sheet pile. Required water depth, including a minimum 2 feet of clearance beneath the gate bay monolith is about 16 feet for the monolith proposed. Actual underwater sheet pile cut off requirements for the float-in operation would depend on the lower pool elevation during float-in, draft and clearance requirements for the final monolith design, and top elevation to which the sheet pile are initially driven.

(c). Excavation for Lock Extension. Excavation for the lock extension would be accomplished in stages once sheet pile have been driven around the lock extension perimeter to the existing stone protection along the downstream edge of the existing 2 foot thick reinforced concrete scour protection apron. The majority of the concrete scour protection apron and associated stone scour protection should remain in place until navigation is shut down to remove the existing outlet monoliths and construct the tie-ins for the lock walls. The existing guidewall and associated stone scour protection would remain in place until the new gate bay monolith and intermediate wall are essentially complete. Two guidewall monoliths at the downstream end of the guidewall would be removed prior to excavating for the gate bay monolith because of both the limited clearance between the end of the guidewall and the gate monolith and the required depth of the excavation (approximately 13 feet below the bottom of the guidewall cribs). Initial excavation would be for the gate bay monolith and the intermediate wall, extension downstream of the apron scour stone. The excavation would start at the riverward edge of the guidewall scour stone and the downstream edge of the downstream apron scour stone and extend riverward and downstream. Following construction of the gate bay monolith and the intermediate wall, the guidewall would be removed in increments. Excavation and site preparation for the landward wall would also be performed in increments.

Tie-in to the existing lock would require navigation shut down for removal of the existing discharge monoliths and associated scour protection slab and stone, completion of sheet pile installation and tie-in, excavation for tie-in of the lock floor and walls, and construction of the wall and floor tie-in sections.

Placement of the float-in floor units would start at the new gate monolith and progress downstream and upstream. Placement of the floor units could proceed as the new walls are completed or could be delayed until the seasonal navigation shut down to accomplish the tie-in of the new lock extension to the existing lock.

(d). <u>Scour Protection During Construction</u>. Maintaining navigation through the construction area for the lock extension would be expected to result in damage (scour/deposition) to excavation surfaces in the sand foundation, unless scour protection would be placed on the exposed sand surfaces. Unretained excavation slopes in the sand foundation would be no steeper than 1V on 3H and would be protected with a 36 inch thick layer of riprap. Horizontal excavation surfaces would be protected with an 18 inch thick layer of riprap. Assumptions for the riprap designs included: (1) 165 pcf stone, (2) turbulent flow conditions, (3) short term design (construction period only), (4) towboats traveling through the construction area either to or from the existing lock would be operating at significantly less than full power (50 percent power and even less for the larger towboats up to 10,000 horsepower), (5) no granular or geotextile filter beneath the riprap, and (6) reworking of the riprap or removal of silt prior to placing the precast concrete units would be acceptable. Riprap placed in 36 inch thick layers would be excavated and salvaged along with the existing scour stone when the excavation is expanded.

(e). <u>Sheet Pile Cutoffs around Lock Perimeter</u>. (See paragraph (b) "Sheet Piling" above.)

(f). <u>Bearing Piles</u>. The gate bay monolith and the walls of the lock extension would be supported on piling bearing on the rock at about elevation 325.00 feet. The floor units would be attached to and supported by the walls in order to avoid driving piles in the navigation channel to support the lock floor. The use of bearing piles would provide a pile-supported lock extension somewhat similar to the timber friction-pile-supported existing lock. The piles would minimize the possibility of differential settlement between precast lock units and between the new lock extension and the existing lock. Increased uplift resistance would be obtained by properly embedding the pile tops in the tremie concrete seal.

The design and cost estimate was based on using steel H-piles driven to refusal on rock to take advantage of high pile capacities. Depending on the site, steel H-piles might not be the most cost-effective pile type to use. However, they can accommodate many adverse pile driving conditions and are considered a reasonable choice until site-specific studies are conducted. A discussion on the potential use of precast concrete piles is presented in paragraph 17 (Alternative Elements of Design). To reduce impacts to navigation during the gate sill monolith construction, cased cast-in-place reinforced concrete piles would be used. The concrete piles provide much larger capacities which reduces the number of piles required.

During construction, piles would be installed adjacent to existing pile-supported structures, especially for tie-in of the new lock walls to the existing lock. Pile driving operations could cause detrimental movement of the adjacent completed structures, particularly if the adjacent structures have significant unbalanced lateral loading. Lateral load on existing structures could be minimized by holding water levels constant within the lock chamber. However, holding water levels constant within the lock chamber will cause the existing lock to cease locking boats temporarily. If it becomes evident that the pile driving operations may cause detrimental movement of existing structures, then alternative pile installation methods that transfer less energy into the surrounding foundations would be necessary. Possible alternatives would include using augured holes held open with bentonite drilling fluid in which piles are set and grouted to displace the bentonite. Piles could also be cast-in-place inside cased, augered holes.

(g). Existing Timber Piles in the Construction Area. The existing discharge monoliths and the downstream guidewall are founded on timber piles having a minimum designed center to center spacing of 3 feet. Removal of the discharge and guidewall monoliths and excavation to required depth would leave an estimated 15 feet of timber pile below the excavation line at the guidewall location and an estimated 20 feet of timber pile below the excavation line at the locations of the discharge monoliths. The timber piling or selected timber piles could be pulled, however, for the current design and cost estimate it was assumed that the timber piles would be cutoff at the excavation line and the steel H-piles for the new walls would be driven between the existing timber piles. This approach would undoubtedly require field adjustment to the designed locations of some of the steel H-piles and may well require some additional piles as a consequence of the field adjusted locations. With the timber piles cut off in place, the most challenging locations for installing new piles would be the discharge monolith locations because of the significantly increased number of timber piles under those monoliths. A greater number of smaller sized piles is a potential design option at the discharge monoliths since design pile spacing would be significantly restricted by the large number and close spacing of existing timber piles.

(h). Scour and Erosion Protection. Riprap erosion protection would be placed along the riverside of the intermediate wall extension for its full length. A concrete apron would not be required on the riverside of the new intermediate wall since discharge ports would only be on the land side of the new intermediate wall discharge monoliths. A 50-foot-wide, six-foot-thick band of graded Stone B would be placed along the intermediate wall extension from the stone protection along the existing concrete scour protection apron to the downstream end of the intermediate wall extension.

Stone protection to prevent scour from towboat prop wash has been included in the estimate. A six-foot layer of stone, 40 feet wide would be placed along the downstream edge of the new downstream apron, along the riverside of the new downstream guidewall and along any new extension of the existing upstream landward guidewall.

(3). Structural Features

(a). Lockwalls. The lock walls would be constructed using precast concrete units. They would be gravity type walls founded on piles (see Plate P2B2) and would be faced with removable precast concrete rub panels. Each unit would be picked and set into place with a crane barge. This method simplifies and speeds up construction which results in considerable cost savings compared to float-in methods using the same size units. The units were sized assuming that a 350-400 ton crane barge was available. The walls of the units have to be designed to resist handling stresses and the internal head of tremie concrete during pouring.

Overall stability calculations were performed for normal lock operation and lock dewatering. Lateral movement of the walls would be resisted by the floor units acting both as a compression strut and tension tie. Stability calculations for pile selection assumed no foundation support under the lock floor. This is conservative, but demonstrates that the wall/floor system would be feasible when no piles are installed under the floor.

The landward lock chamber wall poses a special problem in that it would be built at the location of the existing downstream guidewall. As the existing guidewall is demolished, a portion of the existing timber piles would remain. Placement of the new walls would need to accommodate the existing timber piles. Discussion of driving piles at the existing timber piles is provided in the Geotechnical Features section.

(b). Lock Floor. The lock floor would be precast concrete units which are floated in and connected to the lock walls (see Plate P2B2). The floor units are designed to resist uplift pressures during dewatering and water loads during lock operation. During dewatering the floor must support an upward pressure of 2.3 kips/ft^2 from the differential head (429.3-393.5). Calculations show that prestressing strands would be required to resist the uplift pressures. The connection between the floor and wall must be designed to transfer the lateral wall load of 123 kip/ft of lock wall. The load would be transferred through grouted H-pile studs. Each floor unit would be constructed with openings at each end which fit over the H-pile studs extending from the wall. After setting the units the openings would be grouted using a thixotropic grout (see Plate P2B2, Detail A). The connection is very complicated and transfers several combined loadings. During design, advanced methods of analysis would be required to verify the strength and behavior of the connection.

When the floor and walls are connected and neglecting tension pile capacity, the factor of safety against flotation is 1.85 under scheduled dewatering and 1.33 under extreme dewatering.

(c). <u>Miter Gates.</u> The existing upper miter gate would be rehabilitated or replaced as appropriate. The existing lower miter gates would be removed. The new lower miter gate would be vertically framed with overall leaf dimensions of 39'-0" high by 60'-8" wide.

(d). <u>Downstream Miter Gate Monolith</u>. The lower miter gate monolith is designed as a continuous U-frame (see Pate 2B-P-3). A precast prestressed concrete U-frame structure would be constructed away from the final location on barges or in a dry dock. Once completed, the monolith would be floated to the site, sunk into place, and piles driven through sacrificial diaphragms. Filling of internal voids with tremie concrete would tie the monolith to the piles.

The U-frame structure is designed for both loadings during float-in and all other loading conditions required for navigation lock monoliths. Gate loads were estimated and overall stability calculations were performed. A pile analysis was not performed but the number of piles required were estimated based on resultant loads. Depending on the pile type the downstream approach monoliths might have to interact with the gate monolith to resist lateral loads. This provision is feasible and could be determined in site-specific analysis at a later date.

The installation of a lower miter gate monolith would require some lock shutdown time. This is discussed further in the Construction Sequence and Procedures Section.

(e). <u>Tie-in to Existing Lock</u>. The existing culvert discharge walls do not have similar pile density as the existing chamber walls and no sheet pile cut-off wall exists. Therefore, the entire culvert discharge walls would be demolished up to the interface of the existing lower miter gate monolith. The proposed removal would stop at an existing monolith joint which would give a flat surface to interface with.

(i.) Landward Wall. Tie-in to the existing lock walls would be accomplished by constructing a wall similar to the lock chamber walls (see Plate P2B4). After tie-in, the existing structure and the new structure would act as independent monoliths. A water tight expansion joint would be formed between the structures.

After removal of the existing culvert discharge walls, a standard 45 foot monolith would be constructed identical to the other new lockwall monoliths. A shorter monolith would be used to close the gap between the standard monoliths and the end of the existing wall. This monolith would have to be designed such that a sealing surface is formed with the existing lock to allow dewatering. This seal could be a compression seal or an external seal bridging the joint between the existing wall and the precast wall unit.

Because the bottom of excavation (for the wall and slab tie-in) would be below the existing gate monolith, stability of the gate sill monoliths would be a concern. The existing sheet pile under the gate sill monolith runs along the downstream edge of the gate sill monolith and would provide soil stabilization during excavation. After excavation, construction of the wall would proceed the same as the lock chamber walls.

Because the new extension is designed for full uplift pressures, a sheet pile cut-off wall would not be required. However, the sheet pile wall would be connected to the existing sheet pile. The "splice" would be accomplished using a grout plug (see Plate P2B4). The sand within a two-foot by ten-foot area "confined" between the new and existing sheet pile would be injected with chemical grout and capped with tremie concrete.

(ii.) Intermediate Wall. The tie-in for the intermediate wall would be similar to the landward wall (see Plate P2B4). Along the downstream riverward corner of the gate monolith, the existing sheet pile deviates back into the monolith. Upon excavation in this area, a void would most likely form under that corner. Stability of the monolith is not a concern, however the void would have to be filled. During sealing of the sheet pile and precast wall units with tremie concrete, the void would become filled with concrete.

(iii.) Lock Floor. The tie-in floor units would be similar to the other floor units, except that they would have a sloping top. The sloping top transitions the existing floor (elevation 405.00 feet) down to the extension floor (elevation 401.5 feet). A sealed joint would be required along the interface between the existing and new structure. They would be tied to the walls in the same manner as the other floor units.

(f). Temporary Mooring Wall. The wall would be designed for a very short term design life. Quantities were based on an assumed structure with no reduction for reuse.

(g). Guidewalls. The guidewall design to be used for sand foundations is described in paragraph 6b(1)(b) above.

(4). <u>Construction Sequence and Procedures.</u> Construction planning at Location 2 would be critical. The construction sequence presented is only one representation of several possible sequences. Many of the steps could be accomplished concurrently. The philosophy is to first construct items which would enhance lock performance during construction. Therefore, the upstream guidewall would be extended and the downstream guidewall would be constructed prior to construction of the downstream lock extension. The following describes the sequence and procedures required to accomplish the construction.

(a). *Install temporary mooring structure and dredge behind guidewall for barge access.* These work items could be accomplished using typical river construction with no impact on navigation.

(b). *Extend upstream guide wall and construct downstream guidewall.* The downstream guidewall would be built from the landward side of the river. Helper boats to assist in lock approach would be required to ensure that the wall was not hit during construction.

(c). *Remove downstream portion of the existing lower guidewall.* Approximately 100 feet of the downstream end of the guidewall would have to be removed to allow placement of the miter gate monolith.

(d). *At existing downstream approach, remove existing riprap and partially remove concrete scour protection apron.* Only the downstream portions of the slab would be removed to maximize the number of wall monoliths to be installed prior to the new lock tie-in. The scour protection apron is 2 feet thick and must be removed underwater. The slabs would be cut into approximately 15 foot squares and lifted onto a barge with a crane. The slabs would be hauled to land for disposal. Methods for cutting slabs under water would need to be developed. Stone protection could simply be removed using a clam shell.

(e). *Drive sheet pile cut-off walls.* Sheet pile for the riverward wall, miter gate monolith, and downstream apron would be placed. Sheet pile at the landward wall and tie-in area would be placed later. Since the sheets would be on the outside of the structures, tolerance to horizontal alignment of the sheet pile would be specified as 10 to 16 inches. This would account for misplacement, deflections from excavation, and driving bearing piles. Therefore, a moored barge with a pile driving rig and telescoping leads could install the sheet piles.

(f). *Pre-dredge site within sheet pile to El. 391.0 feet.* The sheet pile wall would delineate the area to be dredged with the exception of the existing lower guidewall area and the tie-in area. The area would be dredged in stages using a hydraulic suction dredge to the line below the scour protection (El. 391.0 feet), with a level tolerance of 10 inches. Use of a special dust-pan dredge head after the initial dredging would further reduce the tolerance to 5 inches.

(g). *Backfill site within sheet pile with scour stones to El. 392.5 feet.* Depending on the type of dredge, a 12 to 24 inch layer of scour stone would be placed within the sheet pile. Typically, leveling and compacting are done with a screed suspended from barges or for more accuracy, a bottom supported screed could be used. The stone layer would be screeded or compacted to a level tolerance of 4 inches.

(h). *Install the piles and landing pads at site for the riverward lock wall and miter gate monoliths.* Bearing piles and piles for landing pads would be driven using techniques consistent with pile type and river construction. The bearing piles to rock would have to be driven prior to the landing pad piles, except at the miter gate monolith where piles are installed after monolith placement. After installation of the landing pad piles, a steel open box is placed precisely where the pad would be. The steel box acts as a form for the tremie concrete which ties the landing pads to the piles.

(i). *Place float-in miter gate monolith.* Concurrent with Steps (a)-(h), the miter gate sill monolith would be constructed atop moored barges near the site. After the sill monolith construction is complete, the barges would be sunk until the sill floated off the barges. The sill would be floated at a draft of 14 feet with at least 2 feet of underkeel clearance. Once floated to the site, positioning would be assisted by two 36 inch diameter master piles and two moored barges at the site. Plate P2B5 describes the steps required to bring the gate sill monolith into its final placement. The monolith would be sunk on to the landing pads. After final positioning, pile would be driven through the sacrificial diaphragms. The monolith would be tied to the piles using tremie concrete. Driving tolerances for the master piles would be plus or minus 6 inches from their final position, and vertically 2 to 3 percent. Tighter tolerances would be achieved by an external sleeve that is aligned and grouted to the master pile.

(j). *Construct approach walls monoliths, riverward chamber wall monoliths.* Lock wall units would be constructed on barges and brought to the site. Place piles and landing pads as in step (h). A 350-400 ton crane barge would set the wall units on landing pads. Final positioning and leveling would be assisted by hydraulic rams attached to each unit, flat hydraulic jacks, and horn guides and steps on previously placed units. The open spaces between the base of the wall unit and the adjacent area would be sealed with sand bags preattached to the units or by placing a grout seal.

The bottom of the wall units would be sealed with tremie concrete. Once the tremie concrete reaches its design strength, the unit would be dewatered. Construction of the rest of the wall would be in the dry. The construction of the new culvert discharge walls and riverward walls would start at the miter gate monolith.

(k). *Demolish the existing guidewall in increments.* Demolition of the existing guidewall would be accomplished using two techniques depending on proximity of the existing lock. Near the existing lock, concrete would be removed by line drilling and pressure wedging methods. Blasting of concrete would be more economical, if performed, away from existing structures . Timber cribbing, stone, and foundation soils would be excavated with a clam shell and the timber piles would be cut off underwater at the excavation line.

(l). *Install piles and construct landward lock wall monoliths.* Construction of the landward wall would begin by placing bearing piles within the existing timber piles. Once bearing piles are installed, wall construction would proceed as in steps (h), (j), and (k).

(m). *Place precast floor units.* Each precast lock floor unit would be floated into its position. Two vertical guide poles would be set up on the previously placed floor unit and used as a guide during sinking of the units. Steel cables extending from winches mounted atop the lock walls would be attached to the floor units. During ballasting, stability of the unit would be controlled by the pulling forces from the winches.

(n). *Tie-in lock walls.* The tie-in of the intermediate and land wall would be done by removal of the existing culvert discharge walls. Because the culvert discharge walls house the emptying ports, the lock would not be able to operate. The two walls would be constructed simultaneously to reduce the amount of lock closure time. Construction of the walls would be the same as the other wall monoliths.

(o). *Tie-in lock floor.* The tie-in floor units would be installed the same as the floor units of step (l) with one exception. Since the units would have a sloping top, temporary ballasting would be required during floating to keep the unit level. Ballasting could be built into the unit or be temporary and removed prior to sinking.

(p). *Underbase infilling.* Underbase grouting must be carried out in isolated compartments. Sand bags would be preattached to the leading edge of the floor slabs. Once the floor is in place, the sand bags sit on the prepared foundation. As a result, the sand bags and the lock wall form an isolated compartment under the floor unit. Vertical sleeve holes would be formed through each floor unit during prefabrication. These holes would be the inlet and outlets for the grout and water during the infilling.

(q). *Infilling floor unit voids.* The chamber floor voids would be filled using sand injection methods. A vertical sleeves would be formed through the top of each floor unit compartment during prefabrication. The sleeves would be fabricated with a plug. Each compartment would require two sleeves, one being the inlet and the other the outlet. After the compartment is filled a permanent plug would be installed.

(r). *Dewater lock and plug existing filling and emptying ports.* Typical lock dewatering and construction methods to fill existing ports.

(5). <u>Operational Considerations</u>

(a). <u>Impact on Navigation Traffic during Construction</u>. Both the lock design and construction sequence were developed to minimize impacts to navigation and provide safe conditions during construction. During construction, navigation could be impacted in many different ways. Impacts include use of helper boats, lock closure, temporary traveling kevels, width restrictions, and power restrictions. The impacts have been quantified using experienced judgment and input received through Reference 8. The use of helper boats could be required for the entire construction period. During almost every phase of construction, tow boats would be passing directly next to unfinished construction or construction in progress.

An allowable daily schedule was assumed as follows: construction along the river traffic path would take place 8 hours per day; the construction outside the river traffic path would take place 16 hours per day; construction would be carried out 5 days a week. During the winter months, navigation slows down except on the Illinois Waterway and the downstream reach of the Upper Mississippi River. It is assumed that at least one month of shut down would be allowed without significant loss of economic benefits. At the end of the 8 hour per day construction period requiring navigation closure, unfinished construction would be left until the next day. During the 16 hour per day navigation period, tows that must pass next to unfinished construction that has not progressed to a level which could resist impact or rubbing forces, a helper boat would be required. When an opposite lock wall is in place a temporary traveling kevel might be used to hold the tows to one side. The wall would have to be nearly complete with rub panels installed to resist tow impacts.

The table below summarizes the estimated closure time required for the lock construction. The steps correspond the letters in the construction sequence.

TABLE 9 - Lock Closure Time During Construction

Construction Sequence Step	Maximum Closure Time Per day (hrs/day)	Number of Working Days Required for Construction
(a)	0	30
(b)	8	280[a]
(c)	8	17
(d)	24 8	2 26
(e)	2 0	20 40
(f)	8	36
(g)	8	23
(h)	8 0	20 20
(i)	24 8	9 20
(j) approach walls	8	40
(j) riverwall	8	110
(k)	8	120
(l)	24 8	60 100
(m)	8	92
(n)	24	20
(o)	8	46
(p)	8	24
(q)	8	24
(r)	24	30

[a]Assumes that the upper and lower guidewalls are constructed concurrently.

Because many of the steps in Table 9 could be accomplished concurrently, the total time required for the assumed daily schedule is about 2 to 2.5 years. Most of the construction would be performed during the 8 hour/day navigation closure. Total lock closure required would be about 121 days; 2 days during demolition of upstream slabs (step d), 9 days during gate monolith placement (step i), 20 days during the lock tie-in (steps n-o), 60 days for concreting of lockwalls, and 30 days during lock dewatering for port modifications. If construction is planned so that the tie-in and lock dewatering would occur during the allowed winter closure, then loss of benefits to the towing industry could be minimized.

Increasing the distance between tows and construction would increase the level of safety during navigation. One way of accomplishing this would be to impose width restrictions on the tows. Discussions would be initiated with the tow industry to decide the most feasible scenario. This would also include liability in the event that a tow damages construction. Substitute wall units could be made to replace one that becomes heavily damaged.

Power restrictions would be imposed on the tows traveling over scour protection in the construction area. Tows would have to operate at 50 percent power and even less for larger tows.

d. **Type C (Location 2, Pile-Founded)**. Due to the culverts within the existing wall a typical cellular chamber wall lock is not practical. This lock has features comparable to Type B (see Plate P2C1). The lock chamber is designed to be dewatered utilizing an in-floor weep hole system in conjunction with a subdrainage blanket to reduce uplift pressures beneath the slab panels. Intermediate tie/struts would be used to resist lateral movement of the chamber walls. The other portions of the lock are a scaled-back version of the Type B lock, primarily reducing the top wall width. The new lock would require approximately 2400 feet of new guidewall.

(1). Hydraulic Features. The features and performance of the Lock Type B are assumed to be the same for the Lock Type C.

(2). Geotechnical Features

(a). Modifications of Lock Type B Design. For the Type C lock, the Type B lock floor design was changed from an uplift-pressure-resisting design to an uplift-pressure-relief design for lock dewatering. The design concept is basically the same as the floor design in the existing lock. Changes from the existing lock floor design include tying the floor struts to the lock walls so the struts act as tension as well as compression members, a much more elaborate floor drain system, thicker precast floor slabs, and sealing of the floor drain system (including capping of the floor slab weep holes) to prevent contamination of the drain system with finer-grained materials during normal lock operation. The floor drain system would be operational (weep hole caps removed) only during lock dewatering.

(b). Sheet Pile. Installation of sheet pile, construction sequencing/staging, construction of the new gate bay monolith and the extension of the lock walls would be almost identical to the Type B lock. However, the perimeter sheet pile for the Type C lock must be continuous and must tie-in to the sheet pile beneath the existing lock to provide needed seepage cutoff/control for lock dewatering and in case a major leak should develop in the lock extension during normal lock operation. Tie-ins to existing sheet pile could be the same as recommended for the Type B lock (Plate P2B4).

(c). Site Preparation. Site preparation would be the same as for the Type B lock.

(d). Excavation for Lock Extension. Excavation staging/sequencing is the same as the Type B lock, but excavation depths decrease. With the precast wall units setting 2 feet higher, the excavation line for placement of the construction scour protection stone beneath the new lock walls would also be 2 feet higher. The excavation line for the lock floor would be 3.5 feet higher than for the Type B lock because the stone scour protection during construction will be removed prior to installation of the floor system. Decreasing the depth of excavation beneath the lock floor raises the scour stone layer significantly and thus increases scour stone size and layer thickness for horizontal excavation surfaces. It was assumed that unretained excavation slopes would be no steeper than 1V on 3H. The gate bay monolith would be the same as for the Type B lock (uplift-pressure-resisting design.)

(e). Stone Scour Protection During Construction. The reason for stone scour protection during construction for the Type C lock is essentially the same as for the Type B lock, i.e., tows moving through the construction area to and from the existing lock. Stone sizes and layer thickness would be also the same for the Type B lock, however, the 18 inch thick stone layer would be placed only beneath the lock walls and the 36 inch thick stone layer would be placed on the 1V and 3H excavation slopes and on the horizontal excavation surfaces beneath the lock floor. The 36 inch thick scour stone beneath the lock floor would be excavated and salvaged prior to constructing the lock floor system. It is assumed that excavation for, and float-in of, the new gate bay monolith would be sequenced such that scour stone would not be needed beneath the gate bay monolith.

(f). Sheet Pile Cutoffs around Lock Perimeter.

(g). Bearing Piles. The type of piles and pile installation concerns are the same as for the Type B lock.

(h). Existing Timber Piles in the Construction Area. Excavation depth in the areas of the timber piles decreases 2 feet, but otherwise there is no significant change from the Type B lock.

(i). Scour and Erosion Protection. Scour protection along new guidewalls and apron edge is the same as for the Type B lock.

(j). Lock Floor System. The lock floor system would be the same as for the downstream portion of the Types B and C locks at location 3, with the exception of the gate bay monolith. It is assumed that the gate bay monolith at location 2 would be the same for either the Type B and C lock extension. The floor system is shown in Section A on Plate P2C2. The floor system consists of floor beams between the walls, a subdrainage system, and precast concrete floor slabs. The subdrainage system consists of a geotextile fascine mattress to filter and prevent migration of foundations soils, a 2-foot-thick layer of granular filter material to filter foundation soils, a 2-foot-thick layer of coarse granular filter/drainage gravel, and 3-foot-thick precast concrete floor slabs. Collector channels for drainage would be formed in the bottom of the floor slabs and would be covered with non-corrosive wire mesh to retain the coarse granular filter/drainage gravel. Weep holes in the floor units would be capped except during lock dewaterings. To prevent contamination of the filter/drainage layers due to sediments being carried into these layers through joints in the lock floor during normal lock operation, a compression or other type seal would be required at joints in the lock floor to prevent flow through the joints.

The sill and HP studs along the bottom of the lock chamber face of the precast wall unit would be deleted for the Type C lock so that the precast floor beams, when set and grouted, would bear against the vertical lock chamber face of the wall unit. A blockout would also be included in the precast wall units at floor beam locations for installations of tension ties between the floor beams and walls following initial dewatering.

Construction of the lock floor system would require shut down of navigation, removal of the 36 inch thick layer of stone placed for scour protection during construction of the walls and leveling of the foundation materials as close to the base of strut elevation as practical. Granular filter material could be added to fill low areas to the required elevation. The precast struts with attached geotextile fascines would then be lowered into position and the geotextile fascines lowered to rest on the leveled foundation materials. If the width of the geotextile fascine mattress is attached to the struts is equal to one-half the strut spacing, the geotextile fascines attached to adjacent struts would overlap 5 feet when lowered onto the foundation materials.

Once a strut and the attached fascines are lowered into positions, bearing piles would be driven through holes in the strut and be subsequently grouted to the strut. The ends of the strut would also be grouted to provide solid bearing against walls for subsequent compression loading when the lock extension is dewatered. When adjacent struts (or sill and adjacent strut) are in place, the 2 foot layer of granular filter would be placed and leveled followed by placement and leveling of the 2 foot thick layer of coarse granular filter/drainage gravel. The 2 foot thick precast floor slabs would then be slowly lowered into final position and the weepholes subsequently capped by divers. The strut/wall tension ties and floor joint seals would be installed during the initial dewatering prior to placing the lock back in service. Construction of the lock floor system should be sequenced to minimize contamination of the floor drain system with sediment, to the maximum extent practical.

If the lock floor system design shown is evaluated further at some future date, it is recommended that consideration be given to changing some portions of the design. The geotextile fascine would be a back-up for the granular filter that could be placed directly on the foundation materials. Since the granular filter layer would be 2 feet thick, the geotextile fascine mattress would probably not be necessary. It also appears that the size of the precast floor units could be significantly increased (combining 2, or possibly 4, units into 1) which would significantly decrease the lineal feet of floor joints and allow the use of fewer (but larger) weepholes. Since all weepholes would need to be located and uncapped prior to dewatering, a significant reduction in their number is an attractive option.

(3). Structural Features

(a). Lockwalls. The lock walls are a scaled back version of the Lock Type B walls (see. Plate P2C2). The walls would be faced with removable precast concrete rub panels and they would be constructed using the same methods presented for the Lock Type B except for the void at the floor beam tie-in. A precast box with studs on the outside would be placed to form a void in the tremie concrete. After wall construction, the void would be used to tie the floor beams to the lock walls.

Stability calculations were performed for normal lock operation and lock dewatering. Lateral movement of the walls would be resisted by the intermediate floor beams which would act as a compression strut and a tension tie. Less piles would be required since the walls would no longer be supporting the slab system. Based on the stability analysis, the type and required number of piles are shown on Plate P2C2.

(b). Lock Floor. (See also the discussion under Geotechnical Features above in paragraph (j) Lock Floor System.) The floor system consists of floor beams between the walls, a subdrainage system, and precast concrete floor slabs. The sill and HP studs along the bottom of the lock chamber face of the precast wall units would be deleted for the Type C lock so that the precast floor beams, when set and grouted, would bear against the vertical lock chamber face of the wall unit. A blockout would also be included in the precast wall units at floor beam locations for installations of tension ties between the floor beams and walls following initial dewatering.

(i) Floor Beams. Assuming 45-foot-long monoliths, the connection between the floor beams and wall must resist 1435 kips in tension for normal operation, and 1790 kips compression for extreme maintenance. The floor beams would be precast concrete and would be post-tensioned or prestressed. The floor beams would be founded on piles to resist differential water loads.

(ii) Slab Panels and Subdrainage System. The slab panels are designed to relieve uplift pressures during dewatering. In the upper chamber (floor El. 405 feet), the weep holes are required to relieve an uplift pressure of 1.83 ksf. In lower chamber (floor El. 401.5 feet) a pressure of 2.3 ksf must be relieved. The weep holes would be augmented by a subdrainage system which is described under the Geotechnical Features.

(c). Downstream Miter Gate Monolith. Similar to the Type B lock.

(d). Tie-in to Existing Lock. Similar to the Type B lock.

(e). Temporary Mooring Wall. Similar to the Type B lock.

(f). Guidewalls. The guidewall design to be used for sand foundations is described in paragraph 6b(1)(b) above.

(4). Construction Sequence and Procedures. Considerations for construction are nearly the same as the Lock Type B. The Lock Type C has a different floor system and is represented below. The construction sequence presented below is only one representation of several possible sequences. Many of the steps could be accomplished concurrently. The following describes sequence procedures required to accomplish the construction.

Steps (a) -(l) are the same as for the Type B lock.

(m). *Construct floor system.* Floor beam tie-in is as shown in section for Location 3, Plate P3B4. Floor beams would be placed underwater to align with blockouts in the wall. H-piles would be driven through the pile ports and grouted to the floor beams. Tremie concrete would be placed at the ends, between the beam and the lock wall to resist compressive forces during dewatering done in step (p). Once beams were installed the filter layers would be placed and slab panels would be installed.

(n). *Tie in at lockwalls. (Same as for the Type B lock.)*

(o). *Tie-in of floor slab.* The tie-in for the floor would be installed the same as the floor system of step (m).

(p). *Tie floor beams to lock wall monoliths.* The lock would be dewatered. From inside the culvert, holes would be bored through the tremie concrete (placed in step (m)) to connect the block-out in the wall with the block out in the floor beam. Reinforcing bars would be passed through the holes and threaded into couplers in the beams. Blockouts would then be filled with concrete. Concurrently, the filling and emptying ports would be modified.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. In general, impacts to navigation for the Type C lock are the same as for the Type B Lock. The lock closure times are different due to the different floor system. Table 10 summarizes the estimated closure time required for the lock construction. The steps correspond the letters in the construction sequence.

TABLE 10 - Lock Closure Time During Construction

Construction Sequence Step	Maximum Closure Time Per day (hrs/day)	Number of Working Days Required for Construction
(a)	0	30
(b)	8	420
(c)	8	17
(d)	24 8	2 26
(e)	2 0	20 40
(f)	8	36
(g)	8	23
(h)	8 0	20 20
(i)	24 8	9 20
(j) approach walls	8	40
(j) riverwall	8	110
(k)	8	120
(l)	24 8	60 100
(m)	8	110
(n)	24	20
(o)	8	46
(p)	24	30

As with the Type B Lock, some of the steps in Table 10 would be accomplished concurrently, and the total time required for the assumed daily schedule is about 2 to 2.5 years. Based on Table 10, the total required lock closure would be about 121 days; 9 days during demolition of upstream slabs (step d), 2 days during gate monolith placement (step i), 20 days during the lock tie-in (steps n and o), 60 days for the landwall monolith construction, and 30 days for floor beam tie-ins and port modifications (step p). If construction is planned so that the tie-in and lock dewatering occurs during the allowed winter closure, then the total lock closure could be reduced to about 34 days.

Power restrictions would be imposed on the tows traveling over scour protection in the construction area. Tows would have to operate at 50 percent power and even less for larger tows. Even with reduced power tows would not be able to navigate over exposed filter layers for the floor system. Therefore, the floors could be installed during the winter closure concurrent with the tie-in or filter layers and slab panels would have to be placed by the end of the 8 closure period per day.

14. **Location 3 (Pile-Founded)**. The existing locks were built with provisions for a second 360 foot auxiliary lock riverward of the main lock. The provisions included an upstream gate monolith with gates and appropriate recesses for a miter gate installed 360 feet downstream within the intermediate wall. Constructing a lock at this location would take advantage of some of the provisions.

Similar to Location 2, a new conventional lock cannot be constructed at Location 3 without shutting down navigation for an extended period of time. The existing partial auxiliary lock structure can be extended while maintaining navigation.

If a Location 3 lock were constructed, the final configuration would be a two lock system. The new lock would become the primary lock while the existing lock would be secondary. The secondary lock would have one-side filling and emptying and would be used for small tows, recreation, and used during major maintenance of the primary lock.

The feasibility of constructing a lock within the auxiliary lock location poses many of the same problems as Location 2. Because the auxiliary lock is not directly in the path of navigation, impact to navigation during construction would be less than at Location 2.

a. Existing Conditions

(1). General Site Description. The existing provisions for a 360 foot auxiliary lock would constrain the new lock geometry and filling system. The upper gate sill is in place and the intermediate and riverward walls have existing culverts and thus, Location 3 does not lend itself to other filling and emptying systems. The available culvert area is limited by the 12.5 by 12.5 feet or 14 feet diameter existing culverts. The location of the culverts within the wall forces the option of a large gravity type wall. Descriptions of some of the more pertinent aspects of the existing conditions are given below.

(a). Upper Sill. It is assumed that the sill is stable; this assumption should be verified in future design stages. Depending on the site, the existing timber seal would be replaced with a steel seal.

(b). Intermediate Lock Wall. The stability of the existing intermediate wall was investigated and is presented in the text for Location 2. At Location 3, once the new lock floor is in place, it would act to resist lateral loads applied to the intermediate wall.

(c). Guidewalls and Guard Walls. The existing upper and lower guidewalls for the main lock consist of landward solid walls. The walls would be a concrete gravity type founded on timber piles. Though no analysis was performed, it is reasonable to assume that the guidewalls are in a condition that would only require extension and not complete removal and replacement. The final determinations whether the existing guidewalls require extension would be determined as part of the physical model tests at WES. Some locks may have an upper guardwall off of the riverward culvert entrance wall and would be removed to accommodate construction of the new upper guidewall for Location 3.

(d). Scour Hole. The riverward lock location is adjacent to the dam outlets. Based on topography from 1989 surveys (see Plate P3B1) a scour hole has developed downstream of the dam outlet works. The scour hole extends into the auxiliary lock location which would require much of the new lock extension to be constructed on fill. The size and depth of the scour hole most likely varies depending on the site. To give stability to the new riverward wall, the sand fill would have to extend a significant distance from the new lock chamber. The scour hole at Lock and Dam 25 was assumed for quantity calculations. The scour hole would be partially filled using dredged river sand and armored with capstone and riprap.

(2). Deviations from Common Criteria. The intended auxiliary lock chamber floor elevation does not meet the submergence criteria set forth for the other locations in paragraph 6a above. The intended chamber floor provides 1.33D plus 2 feet of submergence. The standard criteria states that the chamber floor shall be 1.7D plus 2 feet below normal pool. To meet criteria, the floor elevation would have to be lowered from EL. 405.0 to EL. 401.5. Lowering the lock floor to meet criteria is not feasible for several reasons. The founding elevation of the existing intermediate lock wall is at EL. 400.0. If the floor was lowered the stability of the existing lock walls would be compromised. Based on the these constraints, it was assumed the chamber floor elevation for the upper portion of the new lock extension would remain as intended (El. 405.0). The new extension downstream of the existing main lock would be built to meet criteria. This configuration is similar to the lock extension at Location 2.

b. **Type A (Location 3, Pile-Founded)**. The Type A lock construction requires a cellular cofferdam around the lock construction area that would encroach on the approach channel to the existing lock (see Plate P3A1). Because of the resulting extended closure to navigation, construction of this lock alternative is economically inefficient and is eliminated from further consideration.

c. **Type B** (Location 3, Pile-Founded). The existing partially constructed auxiliary lock would be lengthened to 1200 feet by extending the intermediate wall 660 feet and extending the riverward wall 1150 feet as shown on Plate P3B1. The lock is designed to be dewatered utilizing a subdrainage system to relieve uplift pressures beneath the lock floor. Floor beams would resist lateral loads applied to lock walls. The floor beams would act both as compression struts during dewatering and tension ties during lock operation.

The filling and emptying system would include plugging ports from the existing intermediate wall and rerouting them to the new chamber. The culverts would be similar to the existing main lock.

While portions of the lock extension are being constructed, the tow traffic would not be able to easily access the existing lock. The existing downstream guidewall would be extended 600 feet prior to starting construction of the intermediate wall extension to ease approach conditions during and after construction. This guidewall extension could also be used in the future during major maintenance of the new lock chamber.

The new lock would require approximately 2400 feet of new guidewall. These walls would extend upstream and downstream of the riverward lock wall. Prior to installing the upstream guide wall, the existing 400-foot-long guard wall would be removed. A reasonable configuration for guidewalls would be determined as part of the physical model tests at WES.

(1). Hydraulic Features. The Location 3 features and performance are assumed similar to Location 2 for the purpose of this study. For the Location 3 alternative, the river wall lock culvert of the existing 600 foot lock would be utilized for the new lock. Lockages through the existing lock would then be accomplished with a single valve operation (using the landwall culvert only) thereby impacting the filling and emptying time of the existing lock.

(2). Geotechnical Features

(a). Site Preparation. Because excavation within the sheet pile cofferdams is difficult and to keep the recesses in the sheets as clean as possible, excavation done prior to placing sheet pile cofferdam walls would be preferred. The upstream portion of the lock (at scour hole) would be built primarily on fill (see Plate P3B3). After removal of any existing scour protection, this area would be prefilled to EL. 394.5 feet. The downstream area requires approximately 5-8 feet of excavation. Much of this material could be used to fill the scour hole. Sand fill for the scour hole would be required for a distance of 80 feet from the riverward face (see Plate P3B3). The sand fill would form angle of repose at that point, forming an underwater slope of approximately 1V to 10H. The slope would intersect the existing downstream stone protection or river bottom.

(b). Sheet pile cut-off wall. The outer wall of the stay-in place cofferdam would provide the cut-off wall required during dewatering of the lock. It is estimated that the outer sheet piles would be driven approximately 35-40 foot deep. The inner sheet piles for the wall cofferdams would only be required for construction and only require an embedment of 25 feet. Sheet piles would also be driven along the perimeter of the gate monolith to provide seepage control during dewatering of the gate bay. Sheet piles at the gate monolith would be driven to the same depths as the outer sheet piles of the wall cofferdam.

(c). Excavation Along the Existing I-wall. The founding elevation of the existing I-wall is at El. 400.0 feet. The bottom of the floor beams would be at El. 398.0 feet. To install the floor, overexcavation of at least 1 foot would be required lowering the excavation to El. 397.0 feet. To further complicate the situation, the bottom of the existing timber cribbing is at El. 396.0 feet. During excavation, material would migrate from below the wall creating a void. The void would have to be grouted. It is assumed that the wall would require some amount of underpinning. The cribbing would have to be removed incremental while driving sheet pile and grouting behind to ensure stability of the wall. Sheet piles could be driven underwater within a foot of the wall (see Plate P3B4).

(d). Cofferdams:

Gate Bay Cofferdam. The gate bay will be constructed within a braced sheetpile cofferdam. The gate bay cofferdam height and design load is based on the common criteria for all designs.

Lockwall Cofferdam. The tops of the lockwall cofferdams are below the elevation required by the common criteria. This is considered acceptable because the walls would be dewatered/ constructed in 35- to 45-foot monoliths and the consequences of overtopping are less of a concern. If a wall cofferdam would be overtopped, only a small area would be affected. When water levels recede, wall construction could continue without major loss.

(e). Scour Protection During Construction. Prior to significant construction the scour hole would be filled. The first 1-3 gates would be closed until the rock protection and the outside of the riverward wall was in-place. Due to the size of the rock required. Placement of the rock would have to occur after driving the outer cofferdam sheet piling and wall construction had proceeded to a point to resist the lateral pressures imposed by the rock. Construction of the new chamber floor would be protected by the stilling effect of the wall cofferdams. The sheetpile wall cofferdams would provide a barrier against alluvial sediment and scour for the construction within the new chamber.

(f). Bearing Piles. Bearing piles are recommended because of the weight of the new lock, the difficult site conditions, and the fact that the existing lock is pile founded. Bearing piles are a significant cost item. Pile capacity would have a large effect on foundation cost. To take advantage of the economy of large pile capacities, it would be recommended to place piles directly bearing on the underlying rock. For estimating purposes, the rock elevation was assumed to be El. 325.0 feet.

Three pile types were analyzed and are presented on the drawings. Steel H-piles, prestressed concrete piles, and steel cased cast in-place piles were analyzed. Capacities for the steel H-piles were based on load tests conducted for Melvin Price Locks and Dam and Lock and Dam 26. Capacities for the prestressed and cast in place concrete piles were based on allowable stresses in the pile.

Steel H-piles were selected for the cost estimates since they can accommodate many adverse pile driving conditions and in general are economically conservative. Site-specific design work would select the most feasible/economic pile type. A discussion on the use of precast concrete piles is presented in paragraph 17, Alternative Elements of Design.

Similar to Location 2, piles would be driven near the existing structures. This situation produces forces and movements that are not easily predicted. This is especially true at Location 3 due to the significant excavation along the existing I-wall. An extensive instrumentation program would be established during construction to monitor the movement of the existing structures.

(g). Scour and Erosion Protection. Riprap erosion protection would be placed along the riverside of the riverward wall extension in two reaches. The upper reach would be downstream to station 9+00B. This reach is in the area of the scour hole. Stone protection consisting of 6 foot of capstone on 3 foot of Graded Stone C would be placed on the sand fill for 80 feet from the riverward face of the riverward wall. The remaining sand fill slope (1V on 10H), will be protected with 5 feet of 3500 pound topsize riprap on 3 foot of Graded Stone C (see Plate P3B3). The lower reach downstream of station 9+00B to the end of the lock would be protected with a 50 foot width of a 6 foot layer of Graded Stone B (see Plate P3B2). A tremie concrete apron would be required in front of the lock discharge ports.

Towboat propwash along the guidewalls and lock approach would create the need for scour protection. An important factor is the depth of water over the scour protection stone. As water depths decrease below 25 feet, the stone size (and therefore, the stone layer thickness) increases rapidly. The minimum water depth along the new downstream guidewall and along any new extension of the upstream landward guidewall would be about 19 feet. Stone protection to prevent scour from towboat prop wash has been included in the estimate. A six-foot-layer of stone, 40 feet wide, would be placed along the downstream edge of the new lower apron, along both sides of the new lower guidewall, riverside of the downstream extension, and along both sides of the new upper guardwall.

(3). Structural Features

(a). Lockwalls. The lockwalls would be of gravity type founded on piles (see Plates P3B2 and P3B3) and faced with removable precast concrete rub panels. The walls would be constructed using stay-in-place braced sheet pile cofferdams. The outer sheet piles would serve as: (i) cut-off wall for seepage control, (ii) permanent scour protection, and (iii) forms for dewatering and concrete placement. The estimated depth for the outer sheet pile wall is 35 feet, primarily for seepage control. The inner sheet pile wall serves only as a form for dewatering and concrete placement. To resist lateral pressures during excavation and dewatering the embedment depth for the inner sheet piles would be 25 feet.

A reinforced concrete tremie slab would be poured in the wet onto predriven bearing piles to provide a bottom seal for the cofferdam. Once the cofferdam is dewatered the remainder of the wall would be constructed using traditional methods except that the sheet pile would act as permanent concrete forms. A reusable bulkhead could be installed to limit the amount of dewatering and allow the wall to be placed as separate 35-45 feet monoliths. Once concrete has been brought up to the top of the culvert the cofferdam bracing would be removed.

Stability calculations were performed for normal lock operation and lock dewatering. Lateral movement of the walls would be resisted by floor beams which act as both compression struts and tension ties. The sheet pile was neglected in the stability calculations.

(b). Lock Floor. The floor would extend from the existing utility chase. At sites where the utilities do not cross through the lock floor, the floor would extend from the existing upper sill monolith. The new floor system consists of floor beams between the walls, a subdrainage system, and precast concrete floor slabs. Weepholes in the floor slabs would be capped to prevent siltation from plugging the weephole. Prior to lock dewaterings, the weephole caps would removed using a diver.

The precast floor beams, when set and grouted, would bear against the vertical face of lock chamber wall. A blockout would be formed within the cofferdam at floor beam locations for installations of tension ties between the floor beams and walls following initial dewatering.

(i.) Floor Beams. Assuming 35 foot monoliths, the connection between the floor beams and wall must resist 1435 kips in tension for normal operation, and 1034 kips compression for extreme maintenance. The floor beams would be precast concrete and would be post-tensioned or prestressed. The floor beams would be founded on piles to resist differential water loads. The piles would be grouted to the floor beams using a thixotropic grout.

(ii.) Slab Panels and Subdrainage System. The slab panels are designed to relieve uplift pressures during dewatering. The slabs would be 2 feet thick precast concrete with preinstalled weep holes and an under slab void system (see Plate P3B4). The size of the slabs allow adequate movement so that water loads during lock operation do not damage or crack the panels. In the upper chamber (floor El. 405.0 feet), the weep holes would be required to relieve an uplift pressure of 1.83 ksf. In lower chamber (floor El. 401.5 feet) a pressure of 2.3 ksf must be relieved. The weep holes would be augmented by a subdrainage system. The subdrainage system was previously described for the Location 2, Type B, pile-founded lock.

(c). Miter Gates

(i.) Upper Gates. The upstream miter gates for most of the locks with provisions for an auxiliary lock have the miter gate leafs installed. Theses leafs have exhibited corrosion over the years but typically no more than the gate at the main lock. The gates have not been operated and loading is from differential pool elevation. The only fatigue loading would be from flood events which could only represent a maximum of 50 cycles. Therefore, at sites where the gates have been maintained or are in good condition reuse would be considered. The cost estimate for the generic designs assumes the upper gate would be replaced. The upper gate leaf dimensions are 35'-0" high by 60'-8" wide and would not be interchangeable with the 39'-0" high lower gates.

(ii.) Lower Gates. The lower miter gate would be vertically framed with leaf dimensions of 39'-0" high by 60'-8" wide. With the walk way installed the vertical dimension would be 40.5 feet. Gate weights were interpolated from gates used at the Melvin Price Lock and Dam 26.

(d). Downstream Miter Gate Monolith. The proposed downstream miter gate monolith is designed as a continuous U-frame. The entire gate sill, gate recesses, maintenance bulkhead slots, and filling and emptying valves are included. The monoliths would be constructed within a braced sheet pile cofferdam using conventional methods. Because this type of structure is a proven design, no stability calculations were performed. A detailed description of the cofferdam and gate monoliths is presented for the Location 4 pile founded lock. The conventional cofferdam approach tends to be lengthy and expensive. Two alternatives for installing the miter gate monoliths are presented in paragraph 17, Alternative Elements of Design.

(e). Tie-in to Existing Lock. The existing riverward culvert discharge wall does not have similar pile density as the existing chamber walls and no sheet pile cut-off wall exists. Therefore, the entire riverward culvert discharge wall would be demolished up to the interface of the existing lower miter gate monolith. The proposed removal would stop at an existing monolith joint which would give a flat surface to interface with.

(i.) Intermediate Wall. Tie-in to the existing lock walls would be accomplished by constructing a wall similar to the lock chamber walls. After tie-in, the existing structure and the new structure would act as independent monoliths. A water tight expansion joint would be formed between the structures. After removal of the existing culvert discharge wall, monoliths would be constructed identical to the other lock wall monoliths. A shorter monolith would be used to close the gap between the standard monoliths and the end of the existing wall. This monolith would have to be designed such that a sealing surface is formed with the existing lock to allow dewatering. This seal could be a compression seal or an external seal bridging the joint between the existing wall and the sheet pile cofferdam.

The existing sheet pile under the gate sill monolith does not run the entire length of the downstream edge of the gate sill monolith and would provide partial soil stabilization during excavation. Along the downstream riverward corner of the gate monolith, the existing sheet pile deviates back into the monolith. Upon excavation in this area, a void would most likely form under that corner. Stability of the monolith is not a concern, however the void would have to be filled. During sealing of the sheet pile cofferdams, the void would become filled with tremie concrete. After cofferdam sealing, construction of the wall would proceed the same as the lock chamber walls.

The outer sheet pile would tie into the existing sheet pile cut-off wall. The "splice" would be accomplished using a grout plug similar to that used at Location 2 (see Plate P2B4). The sand within a two feet by ten feet area "confined" between the new and existing sheet pile would be injected with chemical grout and capped with tremie concrete.

(ii.) Riverward Wall. The tie-in for the intermediate wall would be similar the intermediate wall with the exception that little or no demolition of the existing riverward wall would be required.

(iii.) Lock Floor. The tie-in floor panels would be similar to the other floor panels, except that they would have a sloping top. The sloping top transitions the existing floor (elevation 405.00 feet) down to the extension floor (elevation 401.5 feet). The floor transition would start at the lower edge of a floor beam sloping down at about 1 vertical to 4 horizontal.

(f). Temporary Mooring Wall. Depending on the riverward bank configuration, a temporary mooring structure may be required during construction of the lower guidewall. If required, the wall would be designed for a short design life. Quantities were based on an assumed structure with no reduction for reuse. Quantities do not reflect any bank realignment and where required would be incorporated into site-specific designs.

(g). Guidewalls. The Location 3, Type B guidewalls would be of the standard design described in paragraph 6b(1)(b) above.

(4). Construction Sequence and Procedures. Construction planning at Location 3 would be critical. The construction sequence is presented and is only one representation of several possible sequences. Many of the steps could be accomplished concurrently. The philosophy is to first construct items which would enhance lock performance during construction.

The construction sequence and procedures are listed below. Special attention is given to the innovative construction procedures.

(a). *Close dam gates adjacent to auxiliary lock and install instrumentation.* To augment filling the scour hole and reducing disturbance at prepared foundations, gates would be closed during construction. The number of gates would be site-specific, however, in most cases the first two gates would be closed during construction. Install instrumentation on existing structures to monitor movement during excavation, pile driving, and dewatering.

(b). *Remove existing riprap and concrete apron within the auxiliary lock.* Riprap at the downstream approach and within auxiliary chamber would be removed using a clam shell or backhoe. The concrete apron is 2 feet thick and must be removed underwater. The slabs would be cut into approximately 15' squares and lifted onto a barge with a crane. The slabs would be hauled to land for disposal.

(c). *Remove existing cribbing and riprap and underpin existing I-wall.* Timber cribbing and associated stone protection along intermediate lock wall could simply be removed using a clam shell, or backhoe. Removal must be incremental so that the stability of the I-wall is not compromised. As portions of the cribbing are removed, underpinning of the wall could be done by driving sheet piling within 1 foot of the I-wall. Sheets would be driven using an extension pile. The void under the wall and between the wall and the sheet pile would be filled with grout or tremie concrete.

(d). *Extend existing main lock guide wall.* Extend existing downstream guidewall at main lock. Depending on the site, the walls would be constructed from the landward side, minimizing traffic delays. The construction procedure would be finalized during site-specific designs after the guidewall design and configuration are complete.

(e). *Excavate site and fill scour hole.* The downstream area of the extension requires 5-8 feet of excavation. This material would be excavated using a hydraulic dredge to fill river sand into scour hole. The scour protection would be placed to within 20 feet of outer sheet pile wall. The remainder of the scour protection would be placed after wall construction.

(f). *Install sheet pile cofferdams for walls and miter gate monoliths.* The sheet pile walls are considerably long and impose relatively strict alignment requirements on the sheet pile placement. To achieve the alignment requirements a fixed template would be required. The template would consist of a fixed framed with four spud pile sleeves. The frame would be about 29 feet in width, 35-45 feet in length, and 8 feet deep. The template would be floated to its position on a pontoon. After the template is aligned, the 4 spud piles would be driven through the sleeves into the river bed. Sheet piles would be set up against the framing and blocked to maintain horizontal and vertical alignment. The four spud piles would be pulled and the template would be moved to the next location. Bracing could be installed while the template was in place or after it is moved.

The miter gate monoliths would be constructed within a braced single sheet pile cofferdam. The sheet pile for the miter gate cofferdam would be installed using conventional construction methods. Due to the height of the cofferdam two rows of bracing would be required. The lower bracing would be installed underwater prior to dewatering. The outer walls in the direction of flow would be used as concrete forms. The other sheet piles along with bracing would be removed.

(g). *Drive piles for lock walls and miter gate monoliths and seal cofferdams.* Within the cofferdam, the foundation would be excavated and leveled. Bearing piles would be driven using techniques consistent with pile type and river construction. Bracing for the wall cofferdams could be designed to act as a pile driving templates. After pile placement, top reinforcement of tremie slab is lowered to rest on preset anchors in sheet pile. Reinforced tremie concrete is placed at the base of the cofferdam to provide a seal for dewatering. After dewatering, the monolith is constructed within the cofferdam using traditional construction methods.

(h). *Construct miter gate monolith.* The miter gate cofferdam would be dewatered and the gate monoliths would be constructed using conventional construction techniques. After construction within the cofferdam is complete, sheet pile walls perpendicular to flow would be removed. Depending on construction staging the removed sheet piles would be reused for the lock wall cofferdams.

(i). *Construct lock chamber walls.* Construct riverward lock chamber wall in the braced single sheet pile wall cofferdam. The cofferdam would tie into the completed downstream gate monolith and the existing upstream lock walls. Away from recesses, the Z-pile cofferdam walls form the edges of the wall and serve as formwork and permanent scour protection. At mooring bitts, bulkhead slots, and other recesses, the sheet pile wall would flair out to accommodate forming recess geometry at face of wall. After completion, the flared sheet pile would be cut along the bottom and removed. Intermediate bulkheads could be placed along the wall to allow partial dewatering of cofferdam.

Construct I-wall extension using same methods as riverward wall. Construction barges would operate from inside the new lock chamber. A traveling mooring line would be required along the existing downstream guide wall to ensure that the tow does not impact the I-wall under construction.

(j). *Tie-in lockwalls to existing lock.* The tie-in of the intermediate wall would be done by removal of the existing culvert discharge wall monoliths. Line drilling and pressure wedge techniques could be used for demolition. Because the intermediate wall culvert discharge monoliths house the emptying ports, the existing lock will operate using the landward culvert only. Tie-in at the riverward wall is similar, except little or no demolition would be required. Other than tieing the sheetpile cofferdam to the existing concrete wall, construction of the walls will be the same as the other wall monoliths.

(k). *Prepare foundation for chamber floor.* Once site preparation is completed in the chamber area, the foundation base within the chamber would be screeded to a level tolerance of 2 inches.

(l). *Install floor beams and fascine mattress.* A 100 foot catamaran barge would be used to place the precast floor beams at 35 foot spacing. Two 18 foot by 110 foot geotextile fascine mattresses would be attached (in a flexible manner) to the either side of the floor beam. Once the beam is lowered using linear jacks, the fascine mattresses would be laid out flat by lines connected to the two barges of the Catamaran. The two adjacent fascine mattresses would have a 5 foot overlap.

(m). *Drive bearing piles and grout to floor beams.* Small H-pile bearing piles would be driven through the pile ports in the floor beams. A thixotropic grout would be used to grout the piles to the floor beams.

(n). *Place filter material and install slab panels between floor beams.* In the wet, a 2 foot layer of granular filter material would be placed on top of the fascine mattresses, and compacted and leveled to a level tolerance of 2 inches. A 2 foot layer of graded drainage gravel would then be placed on top of the filter sand and leveled to a level tolerance of 1 to 2 inches. The Catamaran barge would then be used to lift 16 precast paving slabs simultaneously with a strong back. The strong back would lower the panels to the floor level and set them on the drainage gravel.

(o). *Tie floor beams to lock wall monoliths and modify existing lock.* The filling and emptying ports in the existing I-wall would be plugged (putting the existing lock out of operation for 4 weeks), after which, the new lock would be dewatered. For the new wall extension (see Plate P3B4), holes would be bored through the tremie concrete (placed in step (g)) to connect the blockout in the wall with the block out in the floor beam. Reinforcing bars would be passed through the holes and threaded into couplers in the beams. Blockouts in the beam and wall would then be filled with concrete tying the beams to the wall. Holes would be drilled from the lock side through the floor beams into the existing intermediate wall (see Plate P3B3). Rock anchors would be inserted and grouted into place. Using this method, operation of the existing lock is not interrupted. Also, the new filling and emptying ports would be cut into the existing I-wall for the new lock operation.

(p). *Demolish upstream guardwall.* Upstream guardwall would be dismantled and removed. After removal of the guardwall, a helper boat would be required to ensure tows do not drift into the dam or construction area. This is especially true where significant outdraft is exhibited.

(q). *Construct upstream and downstream guidewalls.* The guidewall and guardwall construction could be accomplished concurrently with the above steps.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. Navigational impacts would be similar to impacts at Location 2, but to a lesser degree. Much of the construction at Location 3 would be away from the navigation channel. When construction is near the path of navigation traffic, the daily schedule for Location 2 would be used (that is, 8 hours of navigation closure per day and 16 hours with navigation).

Helper boats will be required during construction to ensure that tows navigate safely past construction areas. This is especially true during construction of the upper guardwall, lower guidewall, and the extension of the intermediate lockwall. A traveling kevel will be installed along the existing guidewall and its extension to hold tows away from construction of the intermediate wall extension.

Table 11 summarizes the estimated closure time required for the lock construction. The steps correspond the letters in the construction sequence. Many of the steps in Table 11 would be accomplished concurrently, and the total duration of construction would be about 2 years. The total lock closure time is estimated at 30 days; this would be required to make modifications to the existing lock's filling and emptying ports (step o). Once the tie-in of the intermediate wall is initiated (step j), the existing lock would thereafter fill and empty only from the landwall.

Increasing the distance between tows and construction would increase the level of safety during navigation. One way of accomplishing this would be to impose width restrictions on the tows. Discussions would have to be initiated with the tow industry to decide the most feasible scenario. This would also include liability in the event that a tow damages construction.

Unlike Location 2, power restrictions for Location 3 would be minimal and only related to a save traveling speed when navigating next to unfinished construction.

TABLE 11 - Lock Closure Time During Construction

Construction Sequence Step	Maximum Closure Time Per day (hrs/day)	Number of Working Days Required for Construction
a	0	30
b	0	45
c	24 0	10 70
d	8	120
e	8 0	21 130
f	8	36
g	24 0	15 100
h	8	90
i	24 8 0	10 160 110
j	8	60
k	0	55
l	0	65
m	0	25
n	0	65
o	24	30
p	0	110[a]
q	8	260

[a]Assumes upper and lower guidewalls are constructed concurrently.

(b). Restrictions on the Use of the Existing Lock.

Filling and Emptying. After construction of the new lock, the existing lock will operate with only one-half of its present filling and emptying capacity. At a minimum, this will double the filling and emptying times. The valve operation rate might have to be slowed to prevent a lateral swell in the chamber, thus further slowing filling.

Approach Conditions. The approach to the existing lock might be difficult after construction of the new lock. Approach conditions for existing conditions and various lock placements are being studied as part of the model studies at Waterways Experiment Station. These results would be incorporated into any future site-specific designs.

d. **Type C** (Location 3, Pile-Founded). Due to the culverts within the existing wall a typical cellular chamber wall lock was not considered practical. The Type C lock is nearly identical to the Type B lock. The existing lower guidewall would be extended using a temporary floating guidewall (see Plate P3C1) and the top of lockwall widths would be reduced (see Plates P3C2 and P3C3). All features other than those are similar to the Type B lock.

(1). Hydraulic Features. The hydraulic features for the Type C lock are the same as for Type B.

(2). Geotechnical Features. The geotechnical features are the same as those for the Type B lock except in the area of the existing lower guidewall extension. Because the lower guidewall extension would be a temporary floating system, the site preparation and excavation would nearly be eliminated. Scour protection at anchor locations and along the floating structure would be needed.

(3). Structural Features

(a). Lockwalls. The riverward lock chamber wall would have a reduced top width compared to the Type B lock. Concrete and fill along the riverward side of the wall is deleted (see Plates P3C2 and P3C3). Because the existing lock would still be used for navigation, the top width of the intermediate wall would not be reduced.

(b). Lock Floor. The lock floor would be precast concrete sections which are connected to the lock walls (see Plate P3B2). The slabs are designed to resist uplift pressures during dewatering and water loads during lock operation. During dewatering the floor must support a upward pressure of 2.3 ksf from the differential head (429.3-393.5). The connection between the floor and wall must be designed to transfer the lateral wall load of 123 kip/ft/ft of lock. When the floor and walls are connected a factor of safety against floating is 2.86 (need back-up) under normal dewatering.

(c). Guidewalls. The existing lower guidewall would be extended using a floating barge type guidewall. Retired barges would be tied together and anchored to the riverbed below. This is under the assumption that the guidewall would only be used during construction of the new lock extension. If the existing lock were routinely used for commercial navigation, an improved guidewall may be required.

(4). Construction Sequence and Procedures. The construction sequence and procedures for the Type C lock are essentially the same as the Type B lock.

(5). Operational Considerations. The operational considerations for the Type C lock are essentially the same as for the Type B lock.

15. **Location 4** (Pile-Founded)

a. Existing Conditions

(1). General Site Description. Location 4 can be defined as any location along the centerline of the existing dam, between the auxiliary lock bay and the storage yard. The location is best sited as close to the existing lock as possible to take advantage of the established channel. This location is favorable for approaches since it is near the middle of the river. For the purposes of this study, the Location 4 lock options have been positioned with the centerline of the lock within 100 feet of the riverward wall of the auxiliary gate bay. The centerline of the new lock would be situated far enough from the existing lock to provide for minimal interruption to navigation during construction.

Up to five of the tainter gate bays must be closed temporarily for construction, depending on the lock concept. Two or three tainter gates would be permanently removed with this lock placement. This loss of flow capacity would be mitigated for each of the Location 4 lock types by adding an equal number of new tainter gates in the overflow dike area. Besides the tainter gates, other portions of the existing lock and dam structures, including dam piers and service bridge spans, must be removed. Utilities must be rerouted to accommodate the breach in the dam. The scoured area downstream from the dam must be filled in to make a foundation for the tremie floor slab in the approach channel and for the other monoliths at the upstream end of the lock. Some of the stone scour protection and the timber mattress downstream from the stilling basin must be removed for construction of cutoffs underneath the approach walls. The silt and stone adjacent to the existing riverward lock wall must also be removed. Portions of the existing guardwall extending above El. 416 must be removed to provide 2D clearance for navigation. Additionally, for the Type C lock, portions of the riverward wall of the existing auxiliary lock bay which extend above El. 416 must be removed.

b. **Type A** (Location 4, Pile-Founded). The Location 4, Type A Lock is shown on Plate P4A1. This lock is similar to the main lock at Melvin Price Lock and Dam.

The lock is a reinforced concrete U-frame structure constructed in the dry within a dewatered, cellular cofferdam. The upstream end of the cofferdam would be situated a sufficient distance from the capstone downstream from the dam to facilitate cofferdam pile driving. The lock service gates would consist of a triple-leaf lift gate upstream and miter gates downstream. The filling and emptying system would use intake ports in the upstream approach and discharge outlets directed outside of the downstream approach. The culverts would fill the chamber through side ports in the chamber walls. The Type A lock concept would include 1,200-foot-long guidewalls upstream and downstream that are constructed in the wet. A soil-founded approach structure would connect the new lock with the existing dam and forms a portion of the upstream guidewall.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The culvert system would be filled and emptied through manifolds at the upstream and downstream ends of the lock. The intake manifold would lead from the upstream approach and into the culverts. The outlet manifold would release flow from the culverts into the river. Flow would be controlled by tainter valves at the upstream and downstream ends of the lock. The culvert valves could be bulkheaded off on both sides for maintenance closure of the filling and emptying system.

(b). Culverts and Distribution. The chamber would be side-filled. Conventional culverts in the lock walls would extend over the entire length of the chamber. Regularly spaced ports would extend from the culverts through the lock walls and into the chamber.

(2). Geotechnical Features

(a). Cofferdam. The cofferdam surrounds the lock and provides room for lock construction and access within the cofferdam. A road on top of the cofferdam would also provide access. The top of the cofferdam would be El. 440, which gives 10 year flood protection with 2 feet of freeboard. The cofferdam would be constructed of sheet pile cells with connecting arcs, both of which would be filled with sand. An earthen stability berm would be placed against the cells before dewatering. The cofferdam would be independent of the existing lock, but due to its close proximity the effects of pile driving would require monitoring. The cofferdam would be completely removed after the project is complete.

(b). Approach Structures. The portion of the stilling basin in the approach area must have its foundation completely reinforced with grout to resist downward forces from upper pool for which it was not originally designed. Sheet piling would be driven where soil conditions permit to construct cutoff walls underneath the approach walls. In areas adjacent to capstone, where sheet piling could not be driven, grout curtains would form the seepage cutoff.

(c). Site Preparation. The footprint of the interior of the cofferdam would be dredged/filled to approximately El. 388 (the founding elevation of majority of monoliths) prior to construction of the cofferdam. This site preparation scheme would fill the scoured-out areas in the vicinity of the new lock and would reduce soil loads on the cofferdam. The approach area would be filled with crushed stone (1" minus) to El. 397.0 after cofferdam construction and prior to construction of the approach structures. The stone would be the foundation material for the approach structure. Stone would be placed on both sides of the cofferdam to minimize differential load on the cofferdam. The approach structure should not be constructed until after the cofferdam removed.

(d). Scour Protection During Construction. Stone scour protection would be installed around the cofferdam. Scour monitoring would be performed as required.

(e). Sheet Pile Cutoffs around Lock Perimeter. Sheet pile cutoff walls would border the perimeter of the lock and be embedded in the concrete monoliths. The cutoff walls would provide scour protection against the loss of material from around the bearing piles and provide a seepage cut-off wall.

(f). Bearing Piles. See discussion for Location 1.

(g). Scour and Erosion Protection. The finished structures would be surrounded by stone scour protection. The depth, type and number of layers of stone vary. Most areas would be covered with a six-foot-thick layer of stone. The area between the new lock and the existing lock would be covered with about 8 feet of stone placed over geotextile. This area receives greater protection in anticipation of possible use as an overflow area in the future. An approximately 6-foot-thick layer of stone would be placed on the riverward side of the approach structure and the upstream lift gate monolith. In-place stone protection removed from downstream of the dam for lock construction would be replaced after construction is completed.

(3). Structural Features

(a). Lockwalls. See discussion for Location 1.

(b). Upstream Miter Gate Monolith. See discussion for Location 1.

(c). Downstream Miter Gate Monolith. See discussion for Location 1.

(d). Approach Structures. A soil founded U-frame approach structure connects the new lock with the existing dam. The structure would be constructed with a tremie concrete floor slab and precast concrete wall units. The tremie concrete floor of the approach would be delineated on either side of the channel by precast underwater formwork placed on top of the foundation stone fill. After the floor is in place, the foundation would be grouted (see geotechnical discussion). Precast concrete boxes, similar to those used for the chamber walls, would be placed on top of the completed floor slab. The boxes would be filled with concrete and post-tensioned to the floor with multi-strand anchors. The walls tie into the existing auxiliary lock wall on the landward side and to the dam pier on the riverward side.

(e). Guidewalls. The upstream guidewall extends 1,200 feet from the centerline of the first upstream cell to the upstream end of the existing auxiliary miter gate monolith. Part of the guided approach would be formed by the lock approach structure constructed over the dam. The actual length of the new guidewall structures would be approximately 850 feet. The guidewall would be situated on the river side of the upstream approach and would be ported. The downstream guidewall extends 1,200 feet from the downstream face of the miter gate monolith to the centerline of the last downstream cell. It would be situated on the landward side of the downstream approach. The design of these walls is described for the pile-founded Location 1, Type A lock.

(4). Construction Sequence and Procedures

(a). Shut five tainter gates upstream from the site to limit turbulent flow against the cofferdam. They should remain shut until all permanent scour protection is placed. Prior to lock construction, additional spillway capacity would be added in the non-overflow section and/or in the auxiliary gate bay. Three gate bays would be lost permanently.

(b). Remove existing stone scour protection which would interfere with the construction of the lock. Stone scour protection could be reused around the cofferdams.

(c). Dredge sand fill into scour holes as required to level the construction area. Compaction of this fill would be not required.

(d). The site is partially excavated to reduce the driving length of the sheet-pile cofferdam and to reduce the lateral load from the soil on the cells. The top of cofferdam would be El. 440 and the tips would be driven to El. 355, thirty feet below the new foundation level. The cofferdam would include a gravel road for construction access, a floodway and a spillway. Place scour protection for the cofferdam as required. (Note: Pile driving effects (cofferdam only) on the existing I-wall require close monitoring. If the I-wall experiences movement, the tailwater would have to be maintained in the existing lock during pile driving to stabilize the I-wall. This would affect traffic through the existing lock.)

(e). The dewatering system is installed and the cofferdam dewatered. Excavation to the foundation level could be done in the dry and/or in the wet. Final grading is done in the dry.

(f). Bearing piles are driven vertically and designed to resist compression, tension and lateral loads. Perimeter Z-pile cut-off walls are driven to control seepage and scour.

(g). Concrete monoliths are U-frames that are conventionally constructed. The order of monolith construction is important, but many combinations are feasible. The monoliths would contain a conventional side-port filling and emptying system with reverse tainter valves.

(h). Equipment is installed. Stone scour protection for the lock is placed within the cofferdam. The cofferdam is rewatered and removed.

(i). The dam tie-in is constructed. The centerline of the uppermost cofferdam cells is located at Sta. 2+79.98B to avoid the capstone that protects a large scour hole downstream of the stilling basin. The stone protection is deep, and its removal would endanger the stability of the dam. The gap between the dam and the new lock would be spanned with a soil/stone founded "U" shaped approach structure since piles cannot be driven through the stone protection. It also forms the upstream guardwall and a part of the upstream guidewall. To construct the base of the tie-in, the derrick stone, capstone, riprap, bedding material, lumber mattress and sand would be removed to El. 398, from Sta. 1+46.00B to Sta. 1+81.00B. Two rows of Z-piling would be driven to El. 360. Overexcavation to El. 398 would be done for stone blanket after stilling basin is grouted (step o).

(j). Install three rows of grout sleeve pipes under the approach walls, through the stone and sand foundation to El. 360, from Sta. 1+81.00B to Sta. 3+47.96B. The inner and outer rows would be spaced on five- to six-foot centers and the center row would have staggered spacing. The grout holes would be drilled with an eccentric head, down-the-hole, rotary percussion hammer.

(k). Fill the scour hole between Sta. 1+81.00B to Sta. 3+47.96B with a clean 1-inch stone to El. 399. Slope the stone outside the limits of the tie-in structure to stabilize the fill. Provide scour protection for the fill.

(l). The existing stilling basin would be grouted with cement bentonite grout for an area of 39 feet long by 150 feet wide. The grout injection pattern is a 5-foot to 6-foot grid with additional sleeves installed in the center of each grid pattern. The grout would extend 40 feet beneath the stilling basin and would carry the load imposed by upper pool and the new concrete floor and walls.

(m). Place precast concrete forms (boxes) outside the limits of the grout pipes. Fill the precast boxes with tremie concrete. The floor would be overexcavated at least one foot (minimum) to accommodate a one-foot-thick layer of crushed stone that would keep the tremie concrete from being contaminated with foundation material.

(n). Place reinforcement cages for the floor and support them above the previously placed crushed stone. Place tremie concrete from El. 399 to El. 409.

(o). Grout the foundation through the outer row of pipes first. Cement-bentonite grout would be used except where voids are too small, in which case sodium silicate grout would be used. Sodium silicate grout would be used for connecting the new z-piles to the sheet-pile cut-off wall for the existing stilling basin. (Note: In lieu of the z-pile cut-off wall, a grout curtain cut-off wall could be used.)

(p). Place precast concrete wall units on the tremie slab and level them with flat jacks and shims. Seal the perimeter of the units with skirts or sandbags and fill with tremie concrete. The units would be post tensioned to the base slab. Drilling for the tendons could be done through holes cast into the wall units.

(q). Unwater the gate bays adjacent to each pier to be removed, by placing upstream and downstream bulkheads. Remove tainter gates.

(r). Line drill each pier base and place charges/expansive agents for pier removal. Rewater gate bays and remove bulkheads. Remove each dam pier stem. The dam sill would remain.

(s). Construct guidewalls of precast concrete beams supported by concrete-filled cellular structures founded on bearing piles. Guidewalls would be constructed concurrently with the lock and/or tie-in. The final tie-in to the lock must be made after the cofferdam is removed.

(t). Concurrent with lock and guidewall construction, approach channels are dredged/excavated. New wing dams may require installation and old wing dams moved/modified. This work would be scheduled so it does not delay completion date of the lock. Control house and lock appurtenances are constructed.

(u). Place stone scour protection around guidewalls and in the approaches as required.

(5). Operational Considerations

(a). Impact on Navigation Traffic during Construction. The completed cofferdam would create a 140 foot wide approach canal to the existing lock at the downstream guidewall. The bank could be excavated to widen the canal beyond the guidewall. The narrow canal would slow approaches to the lock during the life of the cofferdam. The new downstream guidewall would effectively lengthen the canal and could further lengthen approach times. The approach should still be safe for navigation. Also, the driving of a cellular sheetpile cofferdam adjacent to the existing lock could require that lower pool be held in the chamber. This would impact navigation.

(b). Restrictions on the Use of the Existing Lock. See discussion for Location 4, rock-founded.

c. **Type B** (Location 4, Pile-Founded). The Location 4, Type B lock is shown on Plates P4B1 through P4B6. The Type B lock would be constructed primarily in the wet, downstream from the dam. Both gate monoliths will be constructed within internally-braced single sheet pile wall cofferdams, using traditional construction methods. The upstream end of the upstream service gate monolith would be situated a sufficient distance from the capstone downstream from the dam to facilitate cofferdam pile driving. The chamber structures would be constructed in the wet. The central portion of the chamber floor would be constructed using precast concrete units. The filling and emptying culverts would be installed inside these units. The floor units would be floated into position, lowered onto their supports, and filled with tremie concrete. The remainder of the chamber floor would be tremie concrete. The walls would be constructed using precast concrete boxes filled with concrete. All of the lock structures would be pile-founded, with the exception of the approach structures, which would be founded on the existing sand substrate and overlying stone protection, grouted to form a stronger composite foundation. The intake and discharge for filling and emptying would be through the upstream gate monolith.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The culvert system would be filled through a set of five butterfly valves installed in the upstream face of the upper sill. Each valve would open onto a short passage leading to a manifold or mixing chamber inside the lock sill. This culvert would be 12.5 feet wide by 16.3 feet high and extend across the entire width of the monolith. Five eight-foot-diameter passages opening off the downstream wall of the manifold lead through the monolith floor and into the chamber culverts. The culvert system would be emptied through the manifold, controlled by two vertically-operated sluice gates, one on each side of the monolith. The sluice gates could be bulkheaded off on both sides for maintenance closure of the filling and emptying system. The vertical operation of the gates permits them to be removed for maintenance and inspection through the top of the slot.

(b). Culverts and Distribution. The chamber would be bottom-filled. Culverts would extend over approximately the first 70 percent of the chamber. These would consist of five eight-foot diameter steel culverts embedded in concrete in the chamber floor. Regularly spaced ports would extend from the culverts through the floor and into the chamber. Port geometry and baffles (if any) would require model testing.

(2). Geotechnical Features

(a). Braced Cofferdams for Service Gate Monoliths. Each service gate monolith would be constructed inside an internally-braced, single sheet pile wall cofferdam. The top of the cofferdam would be at El. 440.0 and the tip of the sheet piling would be at El. 360.0. Cofferdam piles would be left in place after construction of the monoliths, except that the areas of piling between the lockwalls would be cut out to open up the channel and expose the culverts. These piles provide scour protection and seepage cutoffs beneath the completed monoliths. The cofferdam for the upstream miter gate monolith would be dewatered during construction with a system of deep wells, submersible pumps, and tremie concrete seal.

(b). Approach Structures. A grouting program would provide stability beneath the lock approach structures. The portion of the stilling basin in the approach area must be completely grout stabilized to resist downward forces from upper pool for which it was not originally designed. Sheet piling would be driven where feasible to construct seepage barriers underneath the approach walls. In areas adjacent to capstone, where sheet piling cannot be driven, grout curtains would form the seepage cutoff.

(c). Site Preparation. The entire chamber area and the service gate monolith areas would be excavated/backfilled to El. 387.7 prior to construction. The approach area would be filled with crushed stone (1" minus) rock to El. 397.0 prior to construction of approach structures. This site preparation scheme would fill the scoured-out areas in the vicinity of the new lock and would limit the loads on the cofferdams during construction.

(d). Scour Protection During Construction. This would be provided by the cofferdams and cutoff walls as described previously.

(e). Sheet Pile Cutoffs along Chamber. The chamber would be constructed between parallel rows of steel sheet piles permanently installed between the service gate monoliths. These barriers would delineate the construction area, control currents through the construction area and provide a scour protection and seepage cutoff for the completed chamber structures.

(f). Bearing Piles. The gate monoliths and the chamber structures would be supported by steel H-piles driven to bedrock. Previous experience in this geographic region and the possibility of encountering cobbles during driving dictate that steel H-piles be used for the foundation. For the current study, the pile capacities were developed from Design Memorandum No. 21 for the design of the auxiliary lock at Melvin Price Locks and Dam on the Mississippi River. The compressive capacity was assumed to be the same at 345 kips for an HP 14x117 pile. The tension capacity of 31 kips was calculated by interpolating the available embedment depth at Lock and Dam No. 25 with the tension capacities and corresponding pile depths at Melvin Price.

(g). Scour and Erosion Protection. The finished structures would be surrounded by stone scour protection. The depth, type and number of layers of stone vary by location. Most areas would be covered with a six-foot-thick layer of stone. The part of the upstream approach channel width away from the guidewall would be covered with three feet of stone. The area between the new lock and the existing lock would be covered with approximately 8 feet of stone placed over geotextile. This area receives greater protection in anticipation of possible use as an overflow area. An approximately 6-foot thick layer of stone would be placed on the riverward side of the approach structure and the upstream lift gate monolith. In-place stone protection removed for lock construction would be replaced after construction is completed.

(3). Structural Features

(a). Lockwalls. The lock chamber walls would consist of precast concrete boxes supported by H-piles and filled with concrete. The boxes would have internal diaphragm walls and ties for stability. The overall box dimensions in plan are 50 feet long by ten feet wide. There would be two courses of boxes. The lower boxes would be sealed on the bottom to retain concrete fill. The sealing mechanism would be steel skirts or sandbags. Boxes in the lower course would be 34 feet high, which would allow the wall joint to be constructed in the dry above lower pool. The upper and lower wall boxes would be bonded together across the joint by reinforcing steel placed in the fill concrete. Boxes in the upper course would be 18 feet high. The upper box face concrete would be removable by the use of a bond breaker material. This would ease lock wall refacing in the future. The top approximately 2 feet of the walls would be cast in place, to ensure watertight construction and to even out any irregularities in the top of the wall due to differences in installed elevation between adjacent wall units. Reinforcing dowels extending from the lower wall boxes into the tremie floor fill provide structural continuity.

(b). Lock Floor. The central 73.0 feet of the lock chamber floor would be constructed using barge-like, precast concrete units. Each unit (with the exception of the most downstream unit) would be 73.0 feet wide by 100 feet long by 12 feet deep. The side and end walls of the unit would be 1.5 feet thick. The interior longitudinal and lateral diaphragms, which stiffen the unit, and the floor would be 1.0 foot thick. The ends of the floor slab would be offset 3.0 feet from the upstream end of the unit and extended 2.5 feet from the downstream end of the unit to create shear seats for installation of succeeding units. There is no top slab. The interior diaphragms stiffen the floor units and support the culvert pipes. For the upstream 70 percent of the chamber length, the units would include five eight-foot-diameter steel pipes, supported by the lateral diaphragms and bulkheaded during installation, which form the filling and emptying culverts. Over the remainder of the chamber length, the units would not include these pipes. Seals would be installed on the downstream wall of each unit around the perimeter of the wall and around each culvert (if present). Each unit would be floated into the construction area and ballasted for controlled lowering onto pile-supported landing pads. Foundation H-piles would be driven through knockouts located in the floor of the unit. Weld beads on the driving end of each pile would ensure a strong embedded connection with the concrete in the finished floor. Tremie concrete would be placed in the unit recesses to complete the floor. After seating of adjacent floor units and installation of the tremie fill, the bulkheads would be removed and the steel pipes connected internally to form the culvert joints. The culverts feed flow to the chamber through ports spaced at regular intervals. Dowels extending from the sides of the units and formed shear keys would bond the unit to the adjacent tremie concrete-filled floor. The remaining 18.5 feet of chamber on each side of the precast units would consist of tremie concrete over pre-driven H-piles and pre-placed reinforcing cages.

(c). Upstream Miter Gate Monolith. The upstream miter gate monolith would be constructed inside an internally-braced, single sheet pile wall cofferdam using traditional concrete construction methods. The portion of the monolith upstream from the sill would be a U-frame. The downstream portion of the monolith would not exhibit U-frame action due to the discontinuity caused by the culverts in the floor. Consequently, a more complex analysis of this area is needed. A comparison of the project heads at Lock and Dam No. 25 and Melvin Price Locks and Dam indicated that for preliminary design a two-leaf lift gate could be used. The gate recesses, bulkhead recesses and other appurtenances would be laid out similarly to the Melvin Price Locks, except that at the downstream end of the monolith a single slot would be provided for the floating mooring bitts (which would be removed prior to gate maintenance operations) and installation of the maintenance bulkheads. The monolith would be constructed in the dry within an internally braced single sheet pile wall cofferdam with a tremie concrete seal. After dewatering the tremie concrete seal would be bonded to the next concrete placement.

(d). Downstream Miter Gate Monolith. The downstream miter gate monolith would be constructed inside an internally-braced, single sheet pile wall cofferdam using traditional construction methods. The cofferdam would be dewatered after the full thickness of the floor is installed with tremie concrete. Uplift would be resisted with mass concrete and tension piles. The miter gate pintles, maintenance bulkhead recesses and line hooks and check posts would be laid out similarly to the Melvin Price Locks, except that at the upstream end of the monolith a single slot would be provided for the floating mooring bitts (which would be removed prior to gate maintenance operations) and installation of the maintenance bulkheads.

(e). Approach Structures. Specialized approach structures lead traffic through the existing dam and into the lock. The tremie concrete floor of the approach would be delineated on either side of the channel by precast underwater formwork placed on top of the foundation stone fill. After the floor is in place, precast concrete boxes similar to those used for the chamber walls would be placed on top of the floor directly over the previously installed grout/sheet pile cutoff curtains. These boxes would be filled with concrete and tied to the floor with post-tensioned anchors. The walls tie in to the existing auxiliary lock wall on the landward side and to the dam pier on the riverward side.

(f). Guidewalls. The upstream guidewall extends 1,200 feet from the centerline of the first upstream cell to the upstream end of the auxiliary miter gate monolith. Part of the guided approach would be formed by the lock approach structure constructed over the dam. The guidewall would be situated on the river side of the upstream approach. The downstream guidewall would extend 1,200 feet from the downstream face of the miter gate monolith to the centerline of the last downstream cell. It would be situated on the landward side of the downstream approach. A description of the guidewall design is presented in paragraph 6b(1)(b).

(4). Construction Sequence and Procedures

(a). Close the three tainter gates immediately upstream from the construction site. These should be closed before any existing stone scour protection is removed and should remain closed for the duration of the construction.

(b). Remove stone scour protection in the vicinity of the construction site, downstream from the dam and along the existing lock.

(c). Perform a general site excavation/backfill to El. 387.7. This would include filling the scour hole downstream from the dam.

(d). Construct the service gate monoliths inside internally-braced, single steel sheet pile wall cofferdams. Use modular framing for internal bracing. The upstream miter gate monolith cofferdam would utilize a deep well dewatering system. The tremie concrete seal in the bottom of the cofferdam would be bonded to the subsequent cast-in-place concrete construction. The full depth of the base of the downstream miter gate monolith would be tremie concrete. Dewater the cofferdams and construct the remainder of the monolith concrete using traditional methods. Install gates and appurtenances. Cut out sheet piling in the channel and culvert areas.

(e). Drive two parallel rows of sheet piles between the service gate monoliths.

(f). Drive bearing piles for the tremie concrete portions of the floor on either side of the culvert units and for the lock walls. Drive four leveling piles for each lower course wall box. Drive piles for landing pads for the float-in culvert units.

(g). Install a layer of crushed stone over the entire chamber area.

(h). Install the lower course of precast wall units. Each unit is supported by a dogging beam attached to the leveling piles as it is leveled into its proper position. Install a reinforcing cage for the interior of the wall and place the upper course wall box. Fill the interior of the boxes with tremie concrete. Install cast-in-place concrete over the completed assembly to bring the top of wall up to its final position and to level out any irregularities in installation.

(i). Install landing pads for float-in culvert units.

(j). Install float-in culvert units. Float each unit into position over the landing pads and the end of the preceding unit. Using a system of winches and spud piles for positioning, lower the unit into its final position using controlled flooding. Drive foundation bearing piles through the knockouts cast in the floor of the unit. Grout underneath the units. Fill the cellular compartments of the unit with tremie concrete.

(k). Remove interior bulkheads in the steel culvert pipes and install internal sleeves to complete the culvert construction.

(l). Place tremie concrete on either side of the float-in units to complete the chamber construction. Delineate individual mass concrete tremie placements with precast formwork.

(m). Dewater the lock to inspect all joints. Rewater the lock.

(n). Fill in the area upstream from the lift gate monolith with crushed stone to El. 397.

(o). Delineate the boundaries of the upstream approach area with precast formwork placed on the fill material.

(p). Install sheet pile cutoffs and (where pile driving is not possible) grout curtains along the location of the approach walls.

(q). Stabilize the stilling basin in the approach channel with grout columns.

(r). Install tremie concrete floor within the approach floor boundaries.

(s). When the approach floor is complete, install approach wall boxes similar to those used to construct the lock walls. In addition to internal reinforcing, post-tensioning strands would be installed to tie the walls to the approach floor.

(t). Construct upstream and downstream guidewalls. These could be constructed concurrently with the lock chamber.

(5). Operational Considerations. See the discussion for the Location 4, Type B lock, rock-founded.

d. **Type C** (Location 4, Pile-Founded). The Location 4, Type C lock is shown on Plates P4C1 and P4C2. The Type C lock would be constructed primarily in the wet, downstream from the tainter gates on the Missouri end of the dam. The upstream and downstream miter gate monoliths would be constructed within internally-braced single sheet pile wall cofferdams, using traditional construction methods. The upstream end of the upstream service gate monolith would be situated a sufficient distance from the capstone downstream from the dam to facilitate cofferdam pile driving. The chamber walls would consist of interconnected sheet pile cells, which would form a cofferdam for dry installation of the chamber floor and culverts. The centerline of the new lock would be situated far enough from the existing lock to avoid interference between the driving of new sheet pile and the timber cribbing on the existing I-wall. The filling and emptying culverts would be ported precast concrete units, founded on piles and surrounded with stone fill. The culvert system extends over 75 percent of the chamber length. The downstream 25 percent would be paved with precast panels. The service gate monoliths would be pile-founded. Intake and discharge openings for filling and emptying would be through the upstream miter gate monolith.

(1). Hydraulic Features

(a). Intake and Discharge Structures. The culvert system would be filled through a set of five butterfly valves installed in the upstream face of the upper sill. Each valve would open onto a short passage leading to a manifold or mixing chamber inside the lock sill. This manifold would be 12.5 feet wide by 15.8 feet high and extend across the entire 190-foot width of the monolith. Two 20-foot-wide by 7.5-foot high passages opening off the downstream wall of the manifold lead through the monolith floor and into the chamber culverts. System discharge through the manifold would be controlled by two vertically-operated sluice gates, one on each side of the monolith. The sluice gates could be bulkheaded off on both sides for maintenance.

(b). Culverts and Distribution. The chamber would be bottom-filled. Culverts would extend over the first 75 percent of the chamber. These would consist of dual precast concrete culverts ported to the chamber.

(2). Geotechnical Features

(a). Braced Cofferdams for Service Gate Monolith. Each service gate monolith would be constructed inside a cofferdam as described for Type B above.

(b). Approach Structures. (See discussion for Location 4 Type B above.)

(c). Site Preparation. Existing stone protection in the vicinity of the new landward chamber would be removed before construction to facilitate installation of the landward chamber wall cells. The chamber area and the service gate monolith areas would then be excavated/backfilled to El. 390.2 prior to construction. The approach area would be filled with crushed stone (1" minus) to El. 397 prior to construction of approach structures. This site preparation scheme would fill the scoured-out areas in the vicinity of the new lock and would limit the loads on the cofferdams during construction.

(d). Scour Protection During Construction. The cellular chamber walls and cofferdam embedded piling would provide scour protection both during construction and permanently.

(e). Sheet Pile Cutoffs around Lock Perimeter. This function will be performed by the Z-pile in the cofferdams remaining in place and the cells that compose the chamber.

(f). Bearing Piles. The gate monoliths would be supported by steel H-piles driven as described for Type B above.

(g). Scour and Erosion Protection. The cellular chamber walls would provide a cofferdam for chamber culvert construction as described previously. The outside perimeter of this cofferdam would require scour protection which would be left in place as permanent scour protection when construction is completed. The other finished structures would also be surrounded by stone scour protection. The depth, type and number of layers of stone vary. Most areas would be covered with a six-foot-thick layer of stone. The part of the upstream approach channel width away from the guidewall would be covered with three feet of stone. The area between the new lock and the existing lock would be covered with about 8 feet of stone over a sheet of geotextile. This area receives greater protection in anticipation of possible use as an overflow area. An approximately 6-foot-thick layer of stone would be placed on the riverward side of the approach structure and the upstream miter gate monolith. In-place stone protection removed for lock construction would be replaced after construction is completed.

(3). Structural Features

(a). Lockwalls. The lock chamber walls would consist of parallel rows of sheet pile cells and connecting arcs. The top of the cells would be at El. 444.0 and the tip of the piles would be at El. 360.0. The cells and arcs would be filled with crushed stone and would have a two-foot-thick concrete cap. The cells would be armored to resist the abrasive forces of the tows. Armor to protect the sheetpile interlocks would be installed in the dry.

(b). Lock Floor. Precast concrete culverts, founded on piles and surrounded with stone fill, would be installed in the upstream 75 percent of the chamber. These culverts would form the filling and emptying culverts. They have exterior dimensions of 22 feet wide by 10.5 feet high and interior dimensions of 20 feet wide by 7.5 feet high, with a two-foot thick ceiling. The downstream 25 percent of the chamber consist of precast paving slabs over rock fill. The culverts, floor slabs and stone would be installed in the dry, using the chamber walls as a cofferdam.

(c). Upstream Miter Gate Monolith. (See Location 4, Type B above.)

(d). Downstream Miter Gate Monolith. The downstream miter gate monolith would be constructed similarly to that for Location 4, Type B.

(e). Approach Structures. (See Location 4, Type B above.)

(f). Guidewalls. (See discussion for the Type B lock.)

(4). Construction Sequence and Procedures

(a). To limit turbulent flow immediately upstream from the lock construction site, the three tainter gates directly upstream of the site would be shut.

(b). Remove the existing rip-rap scour protection, which would interfere with the construction of the lock, downstream from the dam and auxiliary lock gate bay.
(c). Dredge sand into scour holes as required.
(d). Construct service gate monoliths in internally-braced single sheet pile wall cofferdams. (See discussion above for the Type B lock.)
(e). Construct a series of 22 sheet pile cells, 45.96 feet in diameter, and connecting arcs on the land side of the chamber centerline between the gate monoliths., The upstream and downstream cells tie into the gate monoliths.
(f). Fill the cells and arcs with crushed stone.
(g). In the wet, excavate/backfill the chamber and the general site to roughly El. 390.2 to accommodate installation of the chamber floor and culvert. Final grading would be done in the dry.
(h). Construct the riverward line of sheet pile cells. Install dewatering system.
(i). Dewater the lock for chamber floor construction and culvert and rubbing panel installation.
(j). Place a one-foot layer of bedding material in the bottom of the chamber excavation, and drive piles to support precast culverts.
(k). Place the precast culverts on the piles. Level the culverts and place underbase grout to tie them to the piles.
(l). Place bedding material in the areas around and downstream from the culverts. Cover areas between and beside culverts with a six-foot-thick layer of stone protection. Cover the area downstream from the culverts with precast concrete panels (cast-in-place floor cover is optional).
(m). Complete excavation/backfill around the lock structures as necessary for installation of stone scour protection. Some of this excavation may need to be accomplished earlier in the construction sequence to stabilize the sheet pile cells.
(n). Construct guidewalls upstream and downstream from the lock structures. The guidewalls could be constructed concurrently with the lock. Install stone scour protection around guidewalls.

(5). Operational Considerations/ Navigation Impacts. These would be the same for Type C as they would be for the Type B lock.

16. **Locations 5 (Pile-Founded)**.

a. Existing Conditions

(1). General Site Description. Location 5 can be defined as any location along the submersible dike. The dike (which is not featured at some lock and dam sites) is on the opposite side of the river from the existing lock and beyond the storage yard. The lock location would be best sited as close to the storage yard as possible to minimize excavation for the lock and approach channels. The location requires significant changes to existing river training structures to move the channel to the other shore. For the purposes of this study, the Location 5 lock options are positioned with the centerline of the lock 215 feet from the end of the storage yard. It should be noted that Location 5 is located on higher ground than Location 4 and consequently requires large excavations, for lock structures and outlet channels, and large disposal areas. All three options require specialized approach structures which tie into and create a passage through the overflow dike.

Part of the existing submersible dike must be removed to accommodate construction of the approach to the new lock. This involves removal of stone protection, excavation of the dike fill, removal of dike cells in the path of the channel and tie-in of new approach cells to the remaining dike cells. The new approach channel must be excavated down to the entrance elevation of the lock. Excavation would occur after the new cells are completed and tied-in to the new lock. Construction for all lock options would include river training actions, to move the main channel to the new lock location, and excavation of a short side channel on the river side of the lock and a longitudinal channel on the land side of the lock to accommodate chamber emptying.

b. **Type A (Location 5, Pile-Founded)**. The Location 5, Type A lock is shown on Plates P5A1. The Type A lock is a U-frame structure constructed in the dry within a dewatered, cellular cofferdam. The upstream end of the cofferdam would be situated a sufficient distance downstream from the overflow dike to clear the downstream toe of the dike. The lock service gates would consist of a triple-leaf lift gate upstream and miter gates downstream. The filling and emptying system would use intake ports that are directed into the approach and discharge outlets directed out of the approach. Distribution would be made in the chamber from side ports from the culverts in the walls. The lock would be constructed in the dry within a cellular cofferdam. The concept features 1,200-foot-long guidewalls upstream and downstream that would be constructed in the wet. A cellular sheet pile wall connects the new lock with the existing dam. The approach structure also forms a portion of the upstream guidewall. The centerline of the new lock would be situated far enough from the existing lock to provide for minimal interruption to navigation during construction of the lock itself. Channel construction could result in greater delays to navigation.

(1). Hydraulic Features. The Location 5, Type A lock hydraulic features would be the same as those for the Location 4, Type A lock.

(2). Geotechnical Features

(a). Cellular Cofferdam. The cofferdam will be the same as for the Location 4, Type A lock except that the landward leg of the cofferdam could remain in place to reduce cost.

(b). Site Preparation. The footprint of the interior of the cofferdam would be dredged/filled to approximately El. 388 (the founding elevation of majority of monoliths) prior to construction of the cofferdam. This site preparation scheme would even out the ground surface in the vicinity of the new lock and would reduce soil loads on the cofferdam. The approach structure should not be constructed until after the cofferdam is removed. The remainder of the excavation would occur within the confines of the cofferdam to reduce the amount of the overall excavation.

(c). Approach Structures. (See structural features below)

(d). Scour Protection During Construction. Stone scour protection would be installed around the cofferdam. Scour monitoring would be performed as required.

(e). Sheet Pile Cutoffs around Lock Perimeter. Sheet pile cutoff walls would border the perimeter of the lock and be embedded in the concrete monoliths. The cutoff walls would provide scour protection against the loss of material from around the bearing piles and provide a seepage cutoff.

(f). Bearing Piles. See discussion for Location 1.

(g). Scour and Erosion Protection. The finished structures would be surrounded by stone scour protection. The depth, type and number of layers of stone vary. Most areas would be covered with a six-foot-thick layer of stone where necessary. In-place stone protection removed for lock construction would be replaced after construction is completed.

(3). Structural Features

(a). Lockwalls. See discussion for Location 1.

(b). Upstream Lift Gate Monolith. See discussion for Location 1.

(c). Downstream Miter Gate Monolith. See discussion for Location 1.

(d). Approach Structure. The approach structure would be constructed of two rows of sheet pile cells that breach the submersible dike and are mechanically connected to the lift gate monolith. These cells would also be tied into the submersible dike cells to provide a watertight connection. The tie would be made with mechanical interlocks where new structures meet and chemical grout where new sheet pile interfaces with existing sheet pile. The new cells would be armored with concrete to protect the interlocks from damage. The floor of the approach would be excavated on a gentle downhill slope from El. 412 at STA. 1+30B to El. 403 at the lift gate monolith. This area would be covered with six feet of stone protection.

(e). Guidewalls. The upstream guidewall extends 1,200 feet from the centerline of the first upstream cell to the upstream end of the landward approach cells. The guidewall would be situated on the river side of the upstream approach. Part of the guided approach would be formed by the lock approach structure constructed through the dam. The guidewall would be ported. The downstream guidewall extends 1,200 feet from the downstream face of the miter gate monolith to the centerline of the last downstream cell. It would be situated on the landward side of the downstream approach. The guidewall design is described for the pile-founded Location 1, Type A lock.

(4). <u>Construction Sequence and Procedures</u>

(a). Remove the existing stone scour protection on the overflow section which would interfere with the construction of the lock or cofferdam. Stone scour protection could be reused around the cofferdam.

(b). Dredge sand fill into low areas to El. 387 (average foundation elevation). Compaction of this fill would be not required.

(c). Drive the upstream leg of the cofferdam to hold the slope of the overflow dike and excavate the site to El. 388 to reduce driving depths of the sheets and to reduce the lateral load from the soil on the cells. Drive the remainder of the cofferdam cells. The top of cofferdam would be El. 440 and the tips would be driven to El. 357, thirty feet below the new foundation level. Pile driving effects (cofferdam only) on the existing overflow dike would require close monitoring. If the overflow dike experiences movement, it may have to be built-up. The cofferdam would be equipped with a gravel road for construction access, a floodway and spillway. Place scour protection for the cofferdam as required. Underwater excavation slopes would be 1V on 5H. Stability berms would be constructed in the wet.

(d). The dewatering system is installed and the cofferdam dewatered. Final grading is done to the stability berms and to prepare the foundation.

(e). Bearing piles would be driven vertically and designed to resist compression, tension and lateral loads. Perimeter Z-pile cut-off walls would be driven to control seepage and scour.

(f). Concrete monoliths, which are U-frames, would be conventionally constructed. The order of monolith construction is an important part of the constructibility of the project, but many combinations are feasible. The monoliths contain a conventional side-port filling and emptying system with reverse tainter valves.

(g). Equipment is installed. Stone scour protection for the lock is placed within the cofferdam. The cofferdam is rewatered. Upstream, downstream, and riverward legs of the cofferdam are removed. Other cells could remain to reduce costs.

(h). Construct dam tie-in. Tie-in cells are permanent construction that require protection from damage to the interlocks by the tows. Remove stone protection on the upstream side of the dike and drive new cells up to the existing cells in the dike. Stabilize these cells by driving bearing piles in them and filling with tremie concrete.

(i). Drive two arcs (one on the outer side of each of the approach walls) thirty-feet long between the new cells and the existing cells and connect with mechanical interlocks (to the new cells) and grout (to the existing cells) to prevent loss of the dike material. Drive two additional arcs twenty-feet long (one on the inside of each of the approach walls) and connect similarly. Twenty-foot long arcs would eventually be removed.

(j). Remove the dike cells that interfere with completion of the new cells. Remove downstream stone scour protection and drive and stabilize remaining tie-in cells.

(k). Remove the remainder of the existing dike cells in the approach and excavate the fill material to El. 409. Outfit the cells with precast concrete rubbing surfaces. The tie-in cells also form the upstream guardwall and a part of the upstream guidewall.

(l). Construct guidewalls of precast concrete beams supported by concrete-filled cellular structures founded on bearing piles. Guidewalls could be constructed concurrently with the lock and/or tie-in. The final tie-in to the lock must be made after the cofferdam is removed.

(m). Concurrent with lock and guidewall construction, approach channels are dredged/excavated. New wing dams may require installation and old wing dams may need to be moved/modified. This work could be scheduled so it does not delay the completion date of the lock. Control house and lock appurtenances are constructed.

(n). Place stone scour protection around guidewalls and in approaches as required.

(5). Operational Considerations/ Navigation Impacts. (See discussion for Location 5, Rock-Founded.)

c. **Type B** (Location 5, Pile-Founded). The Location 5, Type B lock is shown on Plates P5B1. The Type B lock would consist of a 1,200-foot bottom-fill chamber, an upstream miter gate monolith, a downstream miter gate monolith, an approach structure leading through the existing submersible dike to the miter gate monolith, and 1,200-foot guidewalls upstream and downstream. The Type B lock monoliths and chamber structures would be similar to those at Location 4. The approach structure through the dike forms part of the upstream guided approach. The downstream guide wall would be similar to Location 4. Discharge from the manifold in the upstream miter gate monolith would be conveyed away form the outlet via discharge channels, one on the riverward side leading directly to the river and one on the land side running parallel to the lock and leading downstream. The upstream end of the upstream service gate monolith would be situated a sufficient distance from the centerline of the dike to clear the downstream toe of the dike. The centerline of the new lock would be situated far enough from the existing lock that navigation should be unimpeded during construction; however, river training actions could affect navigation.

(1). Hydraulic Features. The Hydraulic Features for this lock would be the same as for Location 4, Type B.

(2). Geotechnical Features

(a). Braced Cofferdams for Service Gate Monolith. (Same as Location 4, Type B)

(b). Approach Structures. (Same as Location 5, Type A)

(c). Site Preparation. The entire chamber area and the service gate monolith areas would be excavated/backfilled to El. 387.7 prior to construction. This initial excavation would include the base and side slope of the outlet channel on the land side of the lock. This site preparation scheme would include filling the scoured-out areas in the vicinity of the new lock and would limit the loads on the cofferdams during construction.

(d). Scour Protection During Construction. This would be provided by the cutoff walls as described previously.

(e). Sheet Pile Cutoffs along Chamber. The chamber would be constructed between parallel rows of steel sheet piles, similar to the Location 4, Type B lock as described above.

(f). Bearing Piles. The gate monoliths and the chamber structures would be supported by steel H-piles driven to bedrock, similar to the Location 4, Type B lock described above. Pile capacities are presumed to be the same as calculated for Location 4.

(g). Scour and Erosion Protection. The finished structures would be surrounded by a six-foot-thick layer of stone protection. Existing stone protection removed for lock construction would be replaced after construction is completed.

(3). Structural Features

(a). Lockwalls. The lock chamber walls would be constructed in the same fashion as Location 4, Type B.

(b). Lock Floor. The lock chamber floor would be constructed with the same components and procedures as Location 4, Type B.

(c). Upstream Miter Gate Monolith. The upstream miter gate monolith would be constructed similarly to Location 4, Type B.

(d). Downstream Miter Gate Monolith. The downstream miter gate monolith would be constructed similarly to Location 4, Type B.

(e). Approach Structures. The approach structures for this lock are similar to those of Type A except the Type B approach structure is not as long.

(f). Guidewalls. (See Location 4, Type B.)

(4). Construction Sequence and Procedures

(a). Fill scour areas downstream from the dam with sand as needed. Perform a general site excavation/backfill of the construction area, including the side channel on the land side of the lock. This leveling of the site would reduce construction loads on the cofferdams and other structures during construction. Lay back the slopes of the excavated area as necessary to meet the existing contours and transition the floor elevation at the end of the lock chamber.

(b). Construct the lock structures according to the construction sequence for Location 4, Type B.

(c). The lock approach would consist of parallel rows of sheet pile cells passing through the existing dike. Remove stone scour protection from the upstream side of the dike in the areas where the new cells would pass through the dike. Drive the upstream cells through the existing dike material. Drive bearing piles and fill all cells with tremie concrete.

(d). Drive sheet pile arcs on the front and back of the new cells, connecting them to the existing diaphragm cells in the dike. The arcs on the channel side of the new cells are temporary. Grout these connections to prevent loss of dike material from behind the new cells during construction.

(e). Remove diaphragm cells, material on the top of the dike, and downstream stone protection on the dike in the line of new approach cells. Drive the new downstream cells between the diaphragm and the upstream service gate monolith. Drive sheet pile arcs on the front and back of the new cells, connecting them to the existing diaphragm cells in the dike. The arcs on the channel side of the new cells are temporary. Grout these connections to prevent loss of dike material from behind the new cells during construction. Fill the new cells with concrete similar to those already completed.

(f). Remove the remaining diaphragm cells crossing the lock approach. Excavate the remaining dike material in the lock approach to approximately El. 403.

(g). Rewater the chamber.

(h). Build guidewalls upstream and downstream from the lock. (These could also be constructed concurrently with the lock.)

(i). Complete the excavation/backfill of the land side discharge channel and the river side discharge chute. Install stone protection around all structures and on the slope of the discharge channel and chute.

(5). Operational Considerations. See the discussion for the rock-founded Location 5 lock.

d. **Type C (Location 5, Pile-Founded)**. See discussion for Location 5, Type B and Location 4, Type C. The Location 5, Type C lock is shown on Plates P5C1.

(1). Hydraulic Features. The hydraulic features internal to the lock for the Type C lock are the same as those for the Location 4, Type C lock. The features external to the lock are similar to those for Location 5, Type B.

(2). Geotechnical Features.

(a). Braced Cofferdams for Service Gate Monoliths. Each service gate monolith would be constructed inside a cofferdam as described for Location 5, Type B above.

(b). Approach Structures. See discussion for Location 5, Type B.

(c). Site Preparation. The entire chamber area and the service gate monolith areas would be excavated/backfilled to El. 390.2 prior to construction. This initial excavation would include the base and side slope of the outlet channel on the land side of the lock. This site preparation scheme would include filling the scoured-out areas in the vicinity of the new lock and would limit the loads on the cofferdams during construction.

(d). Scour Protection During Construction. The cellular chamber walls and cofferdam embedded piling would provide scour protection during construction and permanently.

(e). Sheet Pile Cutoffs around Lock Perimeter. (Same as Location 4, Type C).

(f). Bearing Piles. The gate monoliths would be supported by steel H-piles driven to bedrock, similar to Type B.

(g). Scour and Erosion Protection. The finished structures would be surrounded by a six-foot-thick layer of stone protection. Stone protection removed for lock construction would be replaced after construction is completed.

(3). Structural Features

(a). Lockwalls. The lock chamber walls are similar to Location 4, Type C.

(b). Lock Floor. The lock floor would be similar to that of Location 4, Type C.

(c). Upstream Miter Gate Monolith. The upstream miter gate monolith would be similar to that at Location 4, Type C.

(d). Downstream Miter Gate Monolith. The downstream miter gate monolith would be similar to that at Location 4, Type C.

(e). Guidewalls. See discussion for Type B.

(4). Construction Sequence and Procedures

(a). Fill scour areas downstream from the dam with sand as needed. Perform a general site excavation/backfill of the construction area, including the side channel on the land side of the lock. This leveling of the site would reduce construction loads on the cofferdams and other structures during construction. Transition the elevation of the excavated area as necessary for the floor of the side channel and for the transition at the end of the lock chamber.

(b). Construct the lock structures according to the construction sequence for Location 4, Type C.

(c). Construct the approach structures and guidewalls according to the construction sequence for Location 5, Type B.

(5). Operational Considerations. See the discussion for the rock-founded Location 5 lock.

17. Alternative Elements of Design. As noted at the start of the descriptions of the lock conceptual designs, endless variation in design details is possible. Further refinement of the lock designs would need to take place in any future studies to optimally reduce costs while maintaining or improving the functioning of the lock. The following is a partial list of some of the alternative design elements that were at least briefly considered. Some of them hold future promise while others have been eliminated from further consideration due to the availability of better alternatives that would be used.

a. Hybrid Lock Designs. To make the number of lock alternatives manageable, lock types were limited to three general design types. In general the lock features of a given lock type and location would match the lock features of the same type lock at another location (for the same foundation conditions). However, there may be site- and location-specific differences that make it possible or even advisable to alter a design from the standard. For example, at some sites, the current directions and velocities may be such that shorter guidewalls could be used without adverse impacts on navigation. Or the Type A lock design could be built to Type B sill depths and submergence. As stated above, there are an endless variety of combinations. The more promising alternative combinations would need to be examined during any site-specific feasibility studies.

b. Lift Gates. While some of the Type A locks are shown with lift gates, the majority of all lock types and locations are shown with miter gates. Lift gates cost more initially and are more difficult to repair than miter gates. However, they do provide a means of passing ice and debris that miter gates don't. A preliminary economic analysis indicated that the added costs of lift gates exceed the added benefits. Lift gates might allow flow through the lock chamber during high flow periods (after navigation ceases). If this proves feasible, lift gates could save the cost of adding flow capacity elsewhere for Location 4 locks that take some of the existing dam gates out of service. Lift gates would be considered again during any site-specific studies that may follow.

c. Sector Gates. Sector Gates have been used on navigation locks but are not proposed for the Navigation Study locks. The locks in the UMR&IW navigation system have heads at the upper range that sector gates are capable of handling. In addition, sector gates require wider lockwalls which results in associated higher construction costs and other adverse impacts.

d. Emergency Closure. In the event that both the upper and lower miter gates were critically damaged, an emergency closure gate could stop the flow of water through the lock to prevent the loss of pool. Again, however, a preliminary economic analysis indicated that the costs of providing the emergency closure would exceed the benefits. This is true because of the low probability of losing both sets of miter gates and losing pool. Emergency closure gates are not recommended for locks with miter gates. However, since lift gates are used for passing ice and debris through the lock chamber (which increases the risk of failure of the function of the lift gates), emergency closure bulkheads should be further considered for any locks with lift gates.

e. Trapezoidal Rock-Lined Lock Chamber. An alternative to eliminate concrete walls and replace them with embankment was briefly considered, but is not recommended. This lock design would require end-filling which is slower. However, the most significant disadvantage is the greatly increased lock area require for this lock design. The existing lock and dam sites do not have any location where a lock of this type would fit without incurring additional costs to replace lost dam gate capacity and handle the other impacts.

f. Other Lock Sizes. This report only considered locks 110 feet wide by either 600 feet or 1200 feet in length. While it is engineeringly feasible to construct locks of other sizes, the Initial Screening report determined that all other-sized locks provide a lesser value (i.e., a lower benefit-to-cost ratio).

g. Parallel Sheetpile Walls. Parallel sheetpile walls are an alternative type of lockwall construction that has potential at the rock-founded Location 3 and would result in concrete gravity walls without using a cofferdam. The lockwalls would consist of two rows of sheet piling driven parallel to one another and filled between with concrete. The erection of this wall type would begin by excavating a trench down to sound rock along the centerline of the future wall. This trench would provide the necessary depth required for placement of a concrete floor beneath the culvert. Anchors would be installed into the trench's rock foundation to secure the concrete floor against uplift forces during construction. The sheet pile rows would be keyed into the undisturbed rock foundation on either side of the trench. Internal bracing would be required to support the straight pile walls. Once the two parallel sheet pile rows and bracing are in place, a tremie concrete floor would be placed between the rows. After the floor reached design strength, the area between the rows would be dewatered. The remaining wall construction would be performed in the dry by cast-in-place techniques. Culverts and ports would be formed on top of the tremie concrete floor. Protection against barge impacts, such as precast rubbing panels, would be installed over the exterior surfaces of the sheet pile wall exposed to river traffic. Openings in the sheet piling must be made to permit the emptying/filling ports passage of water.

This type of wall construction presents a number of challenges including constructing the culverts within the congested work space, and maintaining a tight seal all around the dewatered area. This design probably has higher risks than the other design types and preliminary cost estimates indicate a higher cost than the rock-founded Location 3, Type B walls. However, further refinements could lower the costs. This lockwall design concept could probably be adapted to the pile-founded sites as well.

h. Alternative Design Items for the Location 2, Pile-Founded Lock

(1). Prestressed Concrete Piles. Where gravel and cobbles are not present within the sand column, prestressed concrete piles are a feasible option over H-piles. The use of prestressed concrete piles have the potential for savings.

For Location 2, lock type B: Based on the proposed 18 inch square prestressed concrete piles bearing on sound stratum at EL. 325.0 feet, an initial savings of $900,000 (23%) could be realized. If pile depth averaged 60 feet and bearing were above (11.5 feet) the bedrock, a total initial savings of $1.4 million (35%) could be realized. If a larger prestressed pile (more than 24 inches) was used, saving should increase.

(i). Size and depth. If prestressed concrete piles are shown to be feasible at some sites, larger concrete piles would typically offer more economy. Square prestressed concrete piles 36 inches or larger would have capacities at or above 650 tons. To ensure pile capacities in this range the pile would probably require socketing into the rock to avoid overstressing the rock. Also, transferring theses loads to the walls would require additional analysis. Therefore, at this time it is recommended to use concrete piles limited to 24 inches. From Reference 8, 18 inch piles develop their capacity in friction at 18 to 21 feet. With a scour allowance, the piles could effectively bear 12 to 15 feet above the bedrock.

(j). Installation. Installation of the piles occurs after placement of the stone blanket. Driving or a combination of driving and jetting would clear a hole through the scour stone to allow further driving of the displacement pile. The proposed piling method would be to jet and drive 18 inch square prestressed concrete piles to be bedrock without a stinger. An internal 3 inch jet with a 2 inch nozzle is recommended. External jets may supplement if required; larger piles would probably require external jetting. The pile would bear on sound bedrock or the dense gravel just above the bed rock. If weak rock is encountered at a site then a stinger could be used. A heavy wide-flange shape could be used and driven through the weak rock to sound stratum.

(2). Weeping Floor Slab System. A floor system as presented for Location 2, lock type C, and Location 3, could be used with the lock type B. Though maintenance cost increase, the weep hole floor system has potential for significant first cost savings over the structural floor.

(3). Reactive Powder Concrete for Wall Armor. Reactive powder concrete (RPC) is a relatively new material. However, the Corps and industry representatives have done research on RPC pipe and pole sections.

The material is very strong and durable. RPC cured at ambient temperatures for 28 days has modest strengths of 20,000 psi and are extremely durable. Application to rub panels could possibly minimize damage to lock walls due to impact and abrasion. This is especially true at corners, monolith joints, and other recesses which would be poured as second placements. The proposed idea is not to replace the rub panels but face them with a thin layer of the RPC concrete (1-2 inches). Currently the cost of RPC is substantially higher than conventional concrete. The thin layer would help hold down costs.

i. Alternative Design Items for the Location 3, Type C, Pile-Founded Lock
(1) Lower Gate Sill Monolith. After construction of the lock walls, the gate sill would be constructed in the dry within the maintenance bulkheads. The sill would be constructed on top of the tremie base slab. The sill would tied to the gate monolith walls using grouted reinforcement

18. Remaining Study Work. This interim report has summarized the investigation of a range of engineeringly feasible concept designs for construction of new locks at existing locks and dams within the Upper Mississippi and Illinois Waterway Navigation System. This lock design investigation is incomplete, in itself, in determining Federal interest for any navigation improvements. The following discussion presents some of the activities that will take place and considerations that will be addressed regarding lock concepts in the remainder of the Navigation Study.

a. Determining Performance Differences. The alternative lock concepts presented in this report would vary in their level of performance. These differences must be quantified to make a meaningful comparison of alternatives.

b. Determination of Costs. For each of the concept designs, site-specific cost estimates will be developed. These all-encompassing cost estimates will be broken down into the following general categories:

- (1). First Costs‡
  - (a). Lock Chamber
  - (b). Guidewalls
  - (c). Channel Work
  - (d). Dam Modifications (if required)
- (2). Replacement Costs (and interval)
- (3). Maintenance Costs
- (4). Operations Costs
- (5). Environmental Impacts and Mitigation
- (6). Impacts to Navigation During Construction
- (7). Relocation Requirements

‡ First costs for the selected typical rock-founded site (L/D 22) and typical pile-founded site (L/D 25) are included in this report.

c. Determination of Impacts to Navigation During Construction. The extent of delays and closures to navigation necessitated by construction activity must be determined for each alternative. This will vary for each alternative and is an important cost consideration.

d. Comparison with Other Alternatives. Although this interim report has focused on new locks, a number of "small-scale measures" (also to reduce navigation delays) are being given equal consideration as alternative navigation improvements. Both the large-scale and small-scale measure alternatives will be compared with the alternative of no Federal action.

19. Conclusions. This investigation has determined a number of conceptual lock designs that are feasible from an engineering perspective, i.e., each of the designs could be built. An array of alternatives that fit within the governing criteria of having predictable performance and safe operation was presented to give a full spectrum of cost versus performance choices. The engineering feasibility of each of these alternatives, however, does not constitute full consideration of the plan formulation criteria of completeness, effectiveness, efficiency, and acceptability. The Navigation Study will incorporate plan formulation activities that will give balanced regard to all inputs to determine the best plan to be recommended.

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION

CONCEPTUAL LOCK DESIGNS

REFERENCES

1. Bowles, Joseph E., "Foundation Analysis and Design", McGraw-Hill, 1988.
2. CELMS-ED-DA, letter, dated 22 June 1994, subject: "Engineering Coordinating Committee Meeting Minutes."
3. CELMS-ED-DA, letter, dated 7 June 1995, subject: "Engineering Coordinating Committee Meeting Minutes."
4. CENCR-ED-DM, Memorandum for Record, dated 7 May 1993, subject: "Upper Mississippi River-Illinois Waterway Navigation Study, Technical Review Conference No. 1."
5. CENCR-ED-DM, Memorandum for Record, dated 7 September 1993, subject: "Upper Mississippi River-Illinois Waterway Navigation Study, Technical Review Conference No. 2."
6. CENCR-ED-DM, Memorandum for Record, dated 3 June 1994, subject: "Upper Mississippi River-Illinois Waterway Navigation Study, Technical Review Conference No. 3."
7. CENCR-ED-DM, Memorandum for Record, dated 2 November 1994, subject: "Upper Mississippi River and Illinois Waterway Navigation Study, Technical Review Conference No. 4."
8. Gerwick, Ben C., Inc., "Upper Mississippi River-Illinois Waterway System Navigation Study Innovative Lock Concept Review: 1200 foot Lock Capacity, Alternate Construction Techniques and Constructibility Review", Volumes I and II, Draft Report, 1994.
9. Hajnal, Marton, and Regele, "Construction of Diaphragm Wall", John Wiley and Sons, 1984.
10. Hobst and Zajic, "Anchoring in Rock and Soil", Elsevier Scientific Publishing, 1983.
11. Sullivan et. al., 1995 Corps of Engineers Structural Engineering Conference paper, "Innovative Design of Approach Walls at Olmstead Locks."

12. Tennessee Valley Authority, Engineering Laboratory Report No. WR28-1-720-100 prepared by Gerald A. Schohl, "Numerical Model For Navigation Lock Filling And Emptying Systems," Norris, Tennessee, May 1992.

13. U.S. Army Corps of Engineers, EM 1110-2-1604, "Engineering and Design: Hydraulic Design of Navigation Locks," dated 30 June 1995.

14. U.S. Army Corps of Engineers, EM 1110-2-1611, "Engineering and Design: Layout and Design of Shallow-Draft Waterways," dated 31 December 1980.

15. U.S. Army Corps of Engineers, EM 1110-2-2104, "Strength Design for Reinforced-Concrete Hydraulic Structures", 30 June 1992,

16. U.S. Army Corps of Engineers, EM 1110-2-2502, "Retaining Wall Designs", 29 Sep 89.

17. U.S. Army Corps of Engineers, EM 1110-2-2602, "Planning and Design of Navigation Locks", Draft III, November 1992.

18. U.S. Army Corps of Engineers, EP-1110-1-14, "Report of the USACE Task Force on Design and Construction Innovations for Locks and Dams", dated 30 April 1994.

19. U.S. Army Corps of Engineers, ER 1105-2-100, "Guidance for Conducting Civil Works Planning Studies," dated 28 December 1990.

20. U.S. Army Corps of Engineers, ER 1110-2-1150, "Engineering and Design: Engineering and Design for Civil Works Projects," dated 31 March 1994.

21. U.S. Army Corps of Engineers, ER 1110-2-1458, "Engineering and Design: Hydraulic Design of Shallow Draft Navigation Projects," dated 5 August 1985.

22. U.S. Army Corps of Engineers, HL-75-7, "Lock Design - Sidewall Port Filling and Emptying System, July 1975.

23. U.S. Army Corps of Engineers, HL-89-5, "Hydraulic Design of Navigation Locks," September 1989.

24. U.S. Army Corps of Engineers, Rock Island District, "Feasibility Report for Hydropower, Lock and Dam 22, Mississippi River," Technical Appendices, Volume 2 of 2, August 1984.

25. United States Steel Corporation, "USS Steel Sheet Piling Design Manual", Pittsburgh, Pennsylvania, 1970.

26. United States Steel Corporation, "USS Steel Sheet Piling Handbook", Pittsburgh, Pennsylvania, 1983.

27. Xanthakos, Petros, "Slurry Walls", McGraw-Hill, 1994.

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION
CONCEPTUAL LOCK DESIGNS

PLATES

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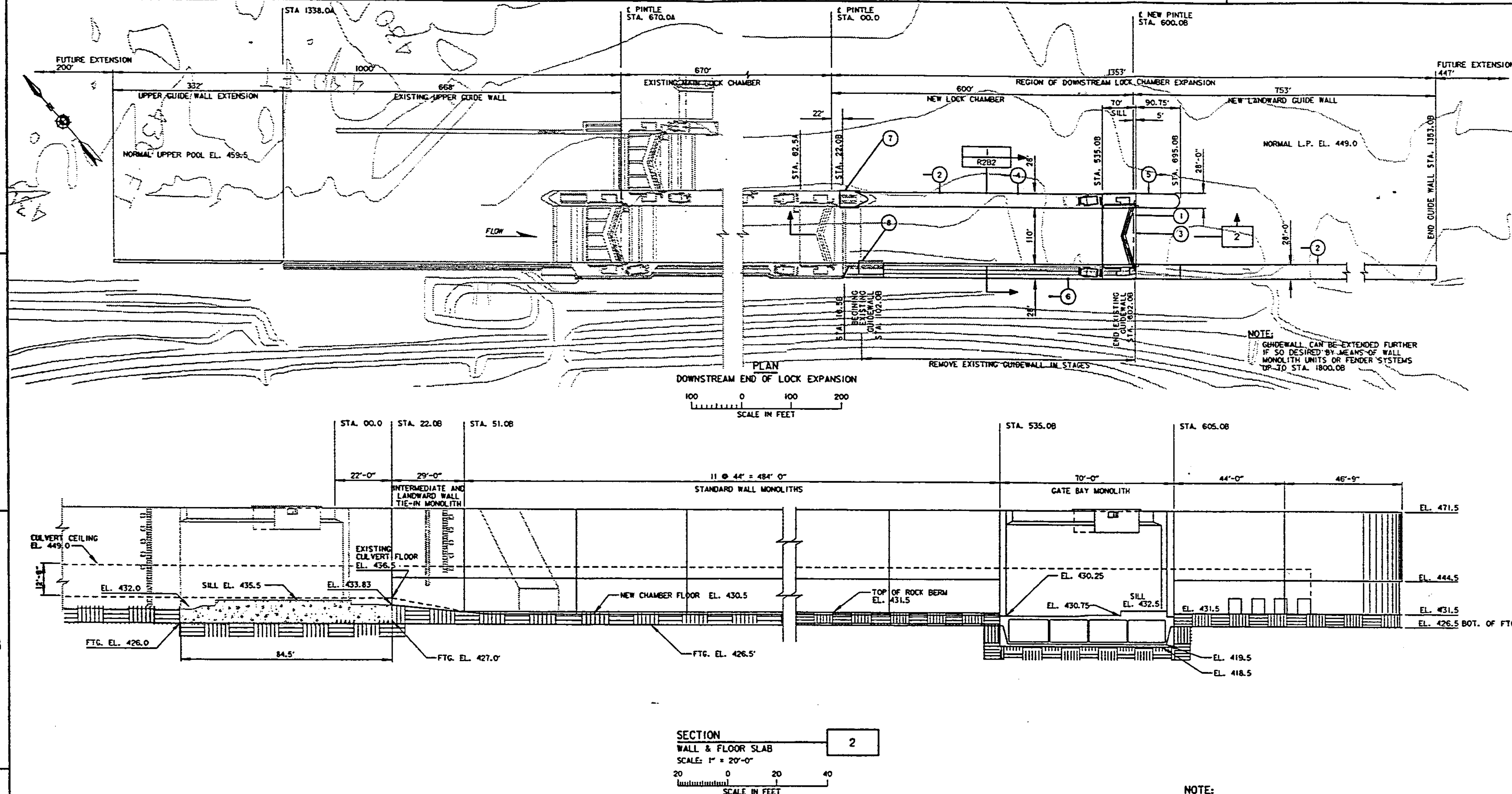

CONSTRUCTION SEQUENCE

1. EXCAVATE ROCK CRADLE TO PLACE SILL. REMOVE PORTION OF EXISTING GUIDEWALL DOWNSTREAM END (STA. 535.0B).
2. EXCAVATE ROCK CRADLES TO PLACE GUIDEWALL UNITS FOR RIVERSIDE WALL AND LANDWARD GUIDEWALL.
3. PLACE SILL UNIT BY FLOATING INTO ROCK CRADLE.
4. PLACE UNITS INTO ROCK CRADLE ON RIVERSIDE AT STA. 535.0B FROM DOWNSTREAM TO UPSTREAM AND FOR LANDWARD GUIDEWALL FROM SILL STA. 605.0B DOWNSTREAM.
5. CONTINUE WITH RIVER SIDE WALL CONSTRUCTION DOWNSTREAM FROM SILL.
6. REMOVE EXISTING GUIDEWALL ON LANDWARD SIDE IN SECTIONS. EXCAVATE ROCK CRADLE AND PLACE UNITS.
7. COMPLETE RIVER SIDE CLOSURE BETWEEN EXISTING INTERMEDIATE AND NEWLY INSTALLED WALL.
8. COMPLETE LANDWARD CLOSURE BETWEEN EXISTING AND NEWLY INSTALLED WALL.

NOTE:
LOCK CHAMBER DESIGN IS SITUATED IN A ROCK ENVIRONMENT

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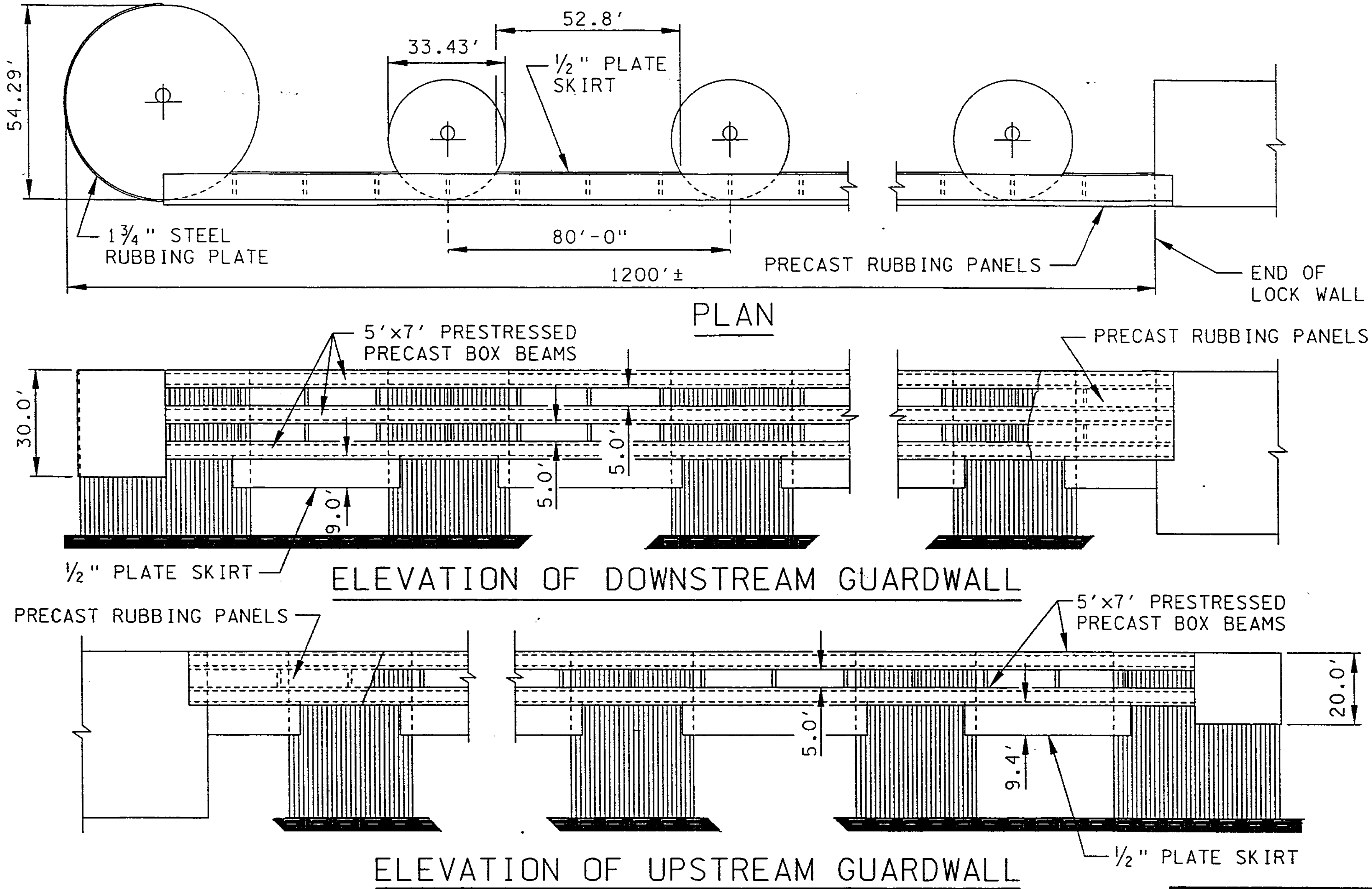
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
LOCK TYPE B
PLAN & SECTIONS

Scale:

PLATE R2B1

LD22-DS.DGN



30 15 0 30 60FT

SCALE: 1"= 30'

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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

PORTED GUARDWALL PLAN AND ELEVATION

Scale: As Shown

PLATE RGW1

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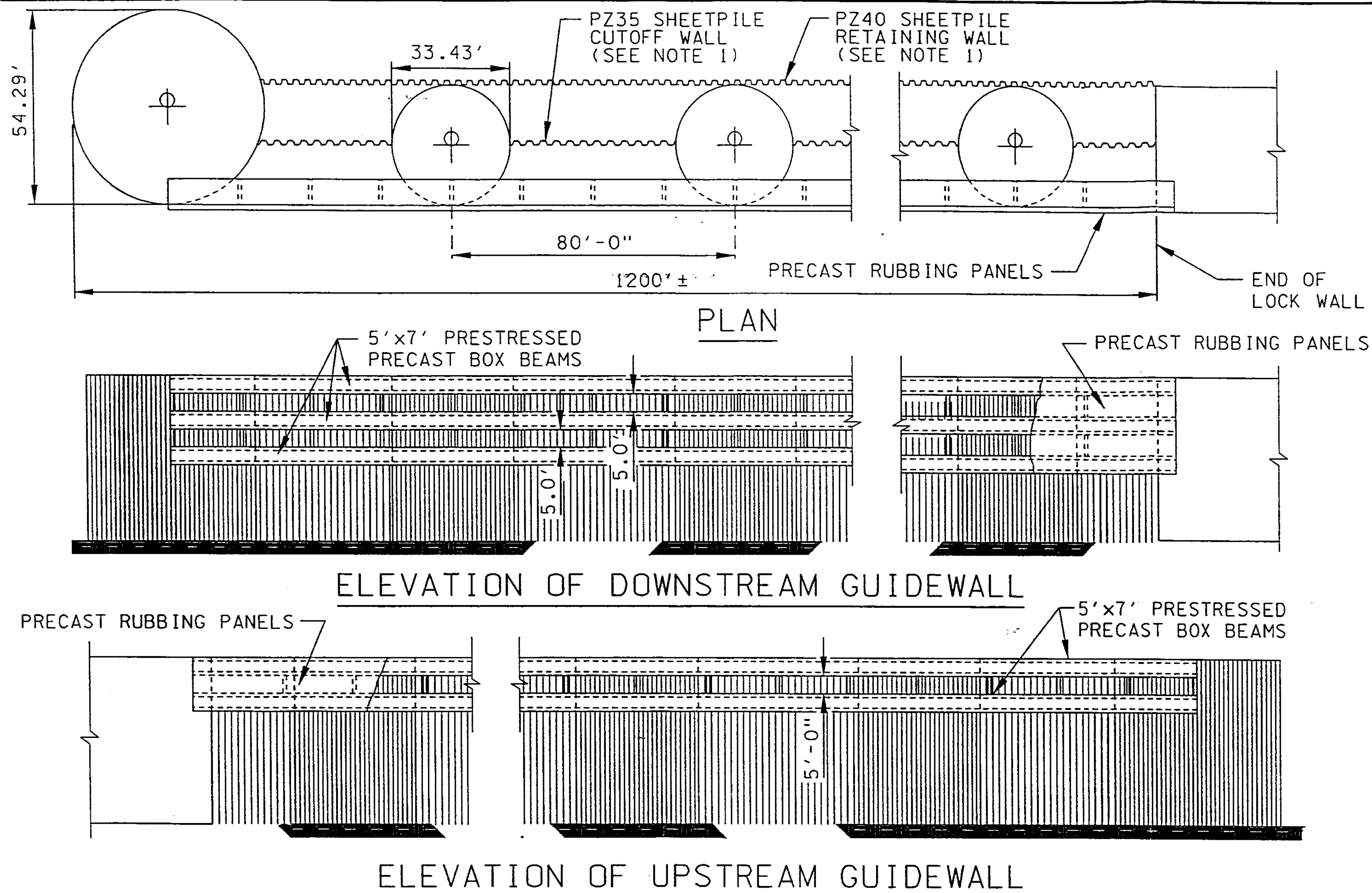

NOTES:

1. IF THE GUIDEWALL IS LOCATED WHERE IT ALSO FUNCTIONS AS A RETAINING WALL, THE PZ40 SHEETPILING WILL BE USED AS SHOWN, AND IT WILL BE BRACED AND ANCHORED. IF THE GUIDEWALL IS NOT FUNCTIONING AS A RETAINING WALL, FLOW BETWEEN CELLS WILL BE STOPPED BY THE PZ35 SHEETPILE CUTOFF WALL AS SHOWN. ONE OR THE OTHER LINES OF SHEETPILING WILL BE USED, NOT BOTH.

30 15 0 30 60FT

SCALE: 1"= 30'

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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

UNPORTED GUIDEWALL PLAN AND ELEVATION

Scale: As Shown

PLATE RGW2

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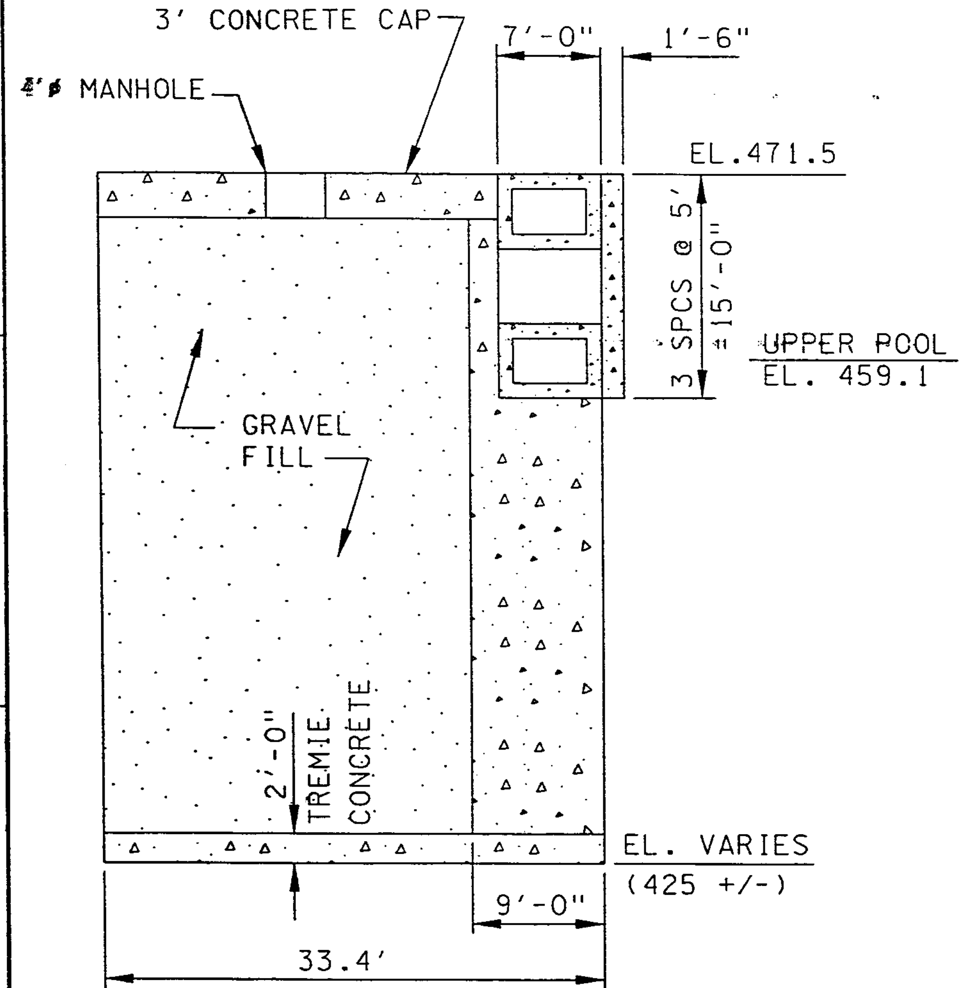
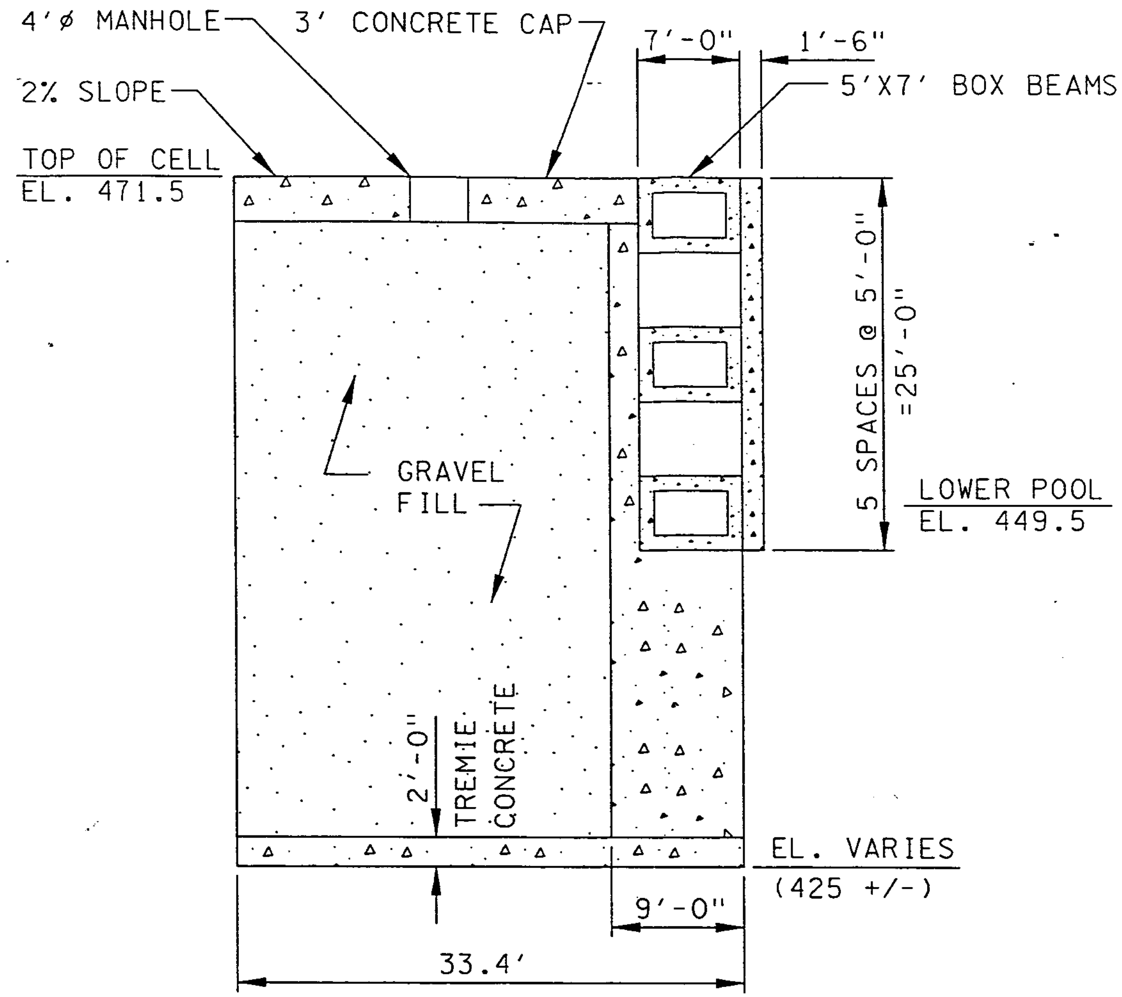


UPSTREAM GUIDE/GUARDWALL CELL



DOWNSTREAM GUIDE/GUARDWALL CELL

10 5 0 10 20FT

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Scale: As Shown	PLATE RGW3

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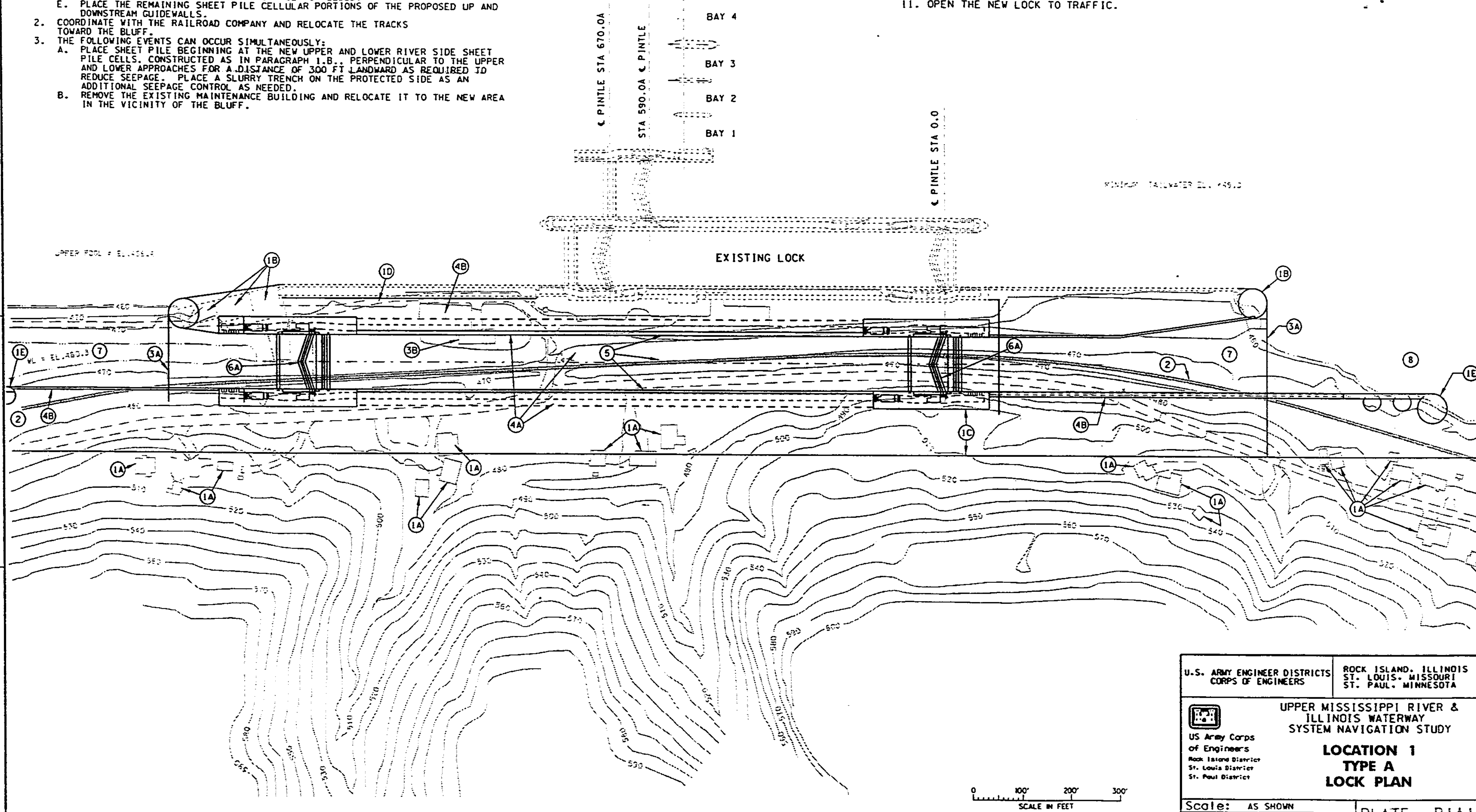
SEQUENCE OF CONSTRUCTION

1. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. REMOVE BUILDINGS FROM THE EASEMENT AREAS.
   B. REMOVE THE EXISTING SHEET PILE CELLS LOCATED NEAR THE UPSTREAM GUIDEWALL AND CONSTRUCT THE NEW UPSTREAM RIVER SIDE SHEET PILE CELL AND GUIDEWALL STRUCTURE. SIMILARLY PLACE THE NEW DOWNSTREAM SHEET PILE CELL TO BE LOCATED NEAR THE EXISTING DOWNSTREAM GUIDEWALL.
   C. REMOVE SOIL AND ROCK FROM THE BLUFF AREA FOR A DISTANCE OF ABOUT 130 FT. (DISTANCE IS TO BE DETERMINED BY COE AND RAIL ROAD REQUIREMENTS). TOWARD THE BLUFF FROM THE PROPOSED LANDSIDE LOCKWALL CHAMBER FACE. GRADE AND OR BUILD A RETAINING WALL AS REQUIRED. CONSTRUCT A DRAINAGE SYSTEM TO DRAIN RUNOFF WATER FROM THE BLUFF AREA.
      NOTE: UNDERGROUND UTILITIES MAY HAVE TO BE RELOCATED/REROUTED. THE EXISTING LOCK OPERATIONS MUST NOT BE INTERRUPTED.
   D. PLACE SHEET PILE ALONG THE LAND SIDE PERIMETER OF THE EXISTING LANDSIDE LOCKWALL AND THE EXISTING UPPER AND LOWER GUIDEWALLS AS REQUIRED TO REDUCE SEEPAGE. PLACE A SLURRY TRENCH WALL LANDWARD OF THE SHEET PILE WALL AS AN ADDITIONAL SEEPAGE CONTROL AS NEEDED.
   E. PLACE THE REMAINING SHEET PILE CELLULAR PORTIONS OF THE PROPOSED UP AND DOWNSTREAM GUIDEWALLS.
2. COORDINATE WITH THE RAILROAD COMPANY AND RELOCATE THE TRACKS TOWARD THE BLUFF.
3. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. PLACE SHEET PILE BEGINNING AT THE NEW UPPER AND LOWER RIVER SIDE SHEET PILE CELLS. CONSTRUCTED AS IN PARAGRAPH 1.B., PERPENDICULAR TO THE UPPER AND LOWER APPROACHES FOR A DISTANCE OF 300 FT LANDWARD AS REQUIRED TO REDUCE SEEPAGE. PLACE A SLURRY TRENCH ON THE PROTECTED SIDE AS AN ADDITIONAL SEEPAGE CONTROL AS NEEDED.
   B. REMOVE THE EXISTING MAINTENANCE BUILDING AND RELOCATE IT TO THE NEW AREA IN THE VICINITY OF THE BLUFF.
4. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. EXCAVATE THE LAND AND RIVER SIDE LOCK WALLS. GATE BLOCKS. CHAMBER FLOOR AND ANY REQUIRED WORK AREAS.
   B. CONSTRUCT SLURRY TRENCH GUIDEWALLS. PLACE SHEET PILE SEEPAGE CONTROL AS REQUIRED.
5. CONSTRUCT THE NEW 1200 FT LOCK.
6. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. PLACE GATES AND CONTINUE INSTALLATION OF EQUIPMENT UNTIL FINISHED.
   B. REMOVE ANY SHEET PILING NOT REQUIRED FOR SEEPAGE CONTROL OR CONSTRUCTION.
7. EXCAVATE THE REMAINING LAND MASSES ON THE UP AND DOWNSTREAM APPROACH AREAS.
8. DREDGE THE UPSTREAM AND DOWNSTREAM APPROACH AREAS TO THE 9-FOOT CHANNEL DEPTH.
9. FLOOD THE LOCK CHAMBER.
10. LANDSCAPE FOR EROSION PROTECTION. RUNOFF REDUCTION AND BEAUTIFICATION.
11. OPEN THE NEW LOCK TO TRAFFIC.



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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 1
TYPE A
LOCK PLAN

Scale: AS SHOWN

PLATE R1A1

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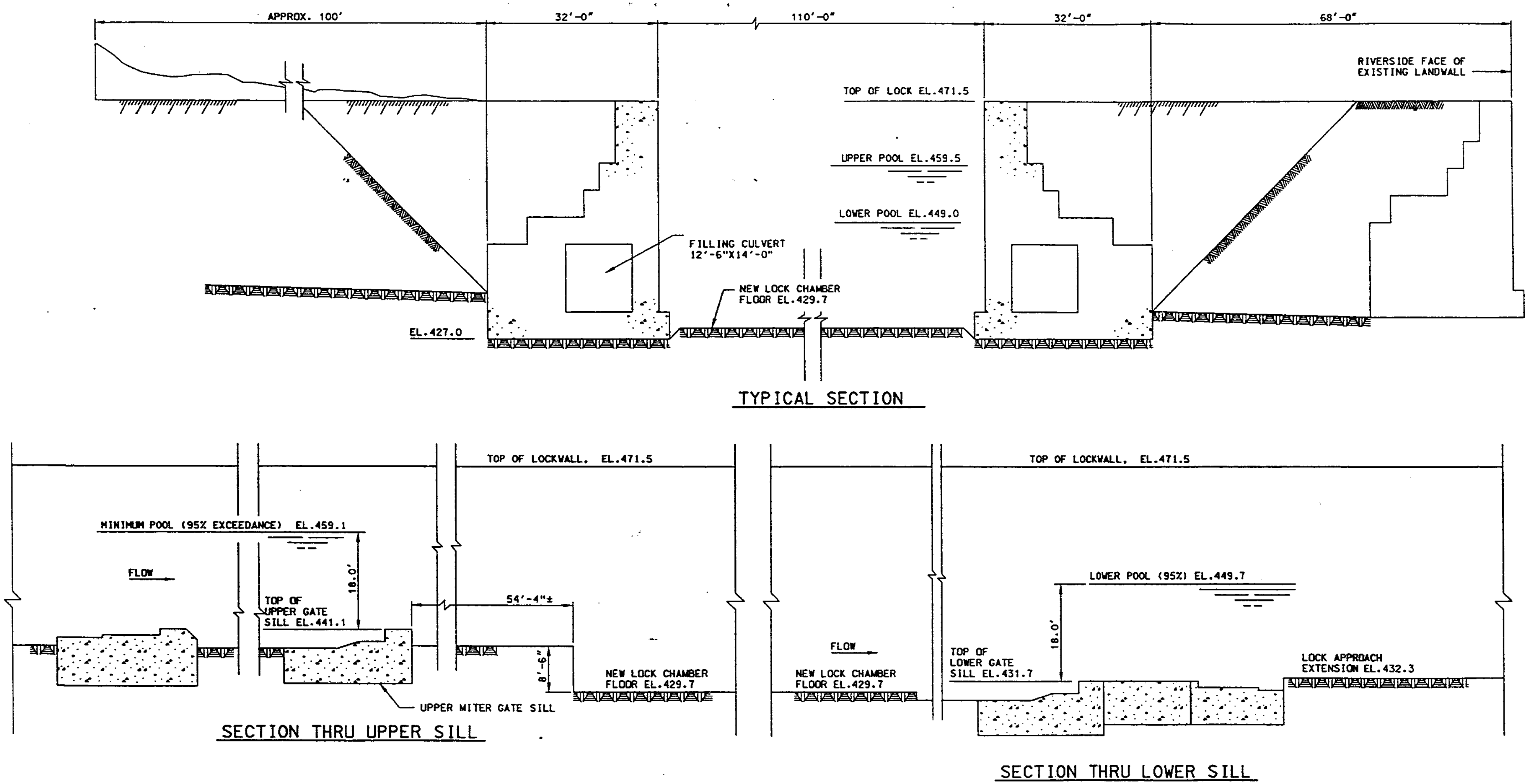

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UPPER MISSISSIPPI RIVER &
ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LOCATION 1
TYPE A
SECTIONS

Scale: AS SHOWN

PLATE R1A2

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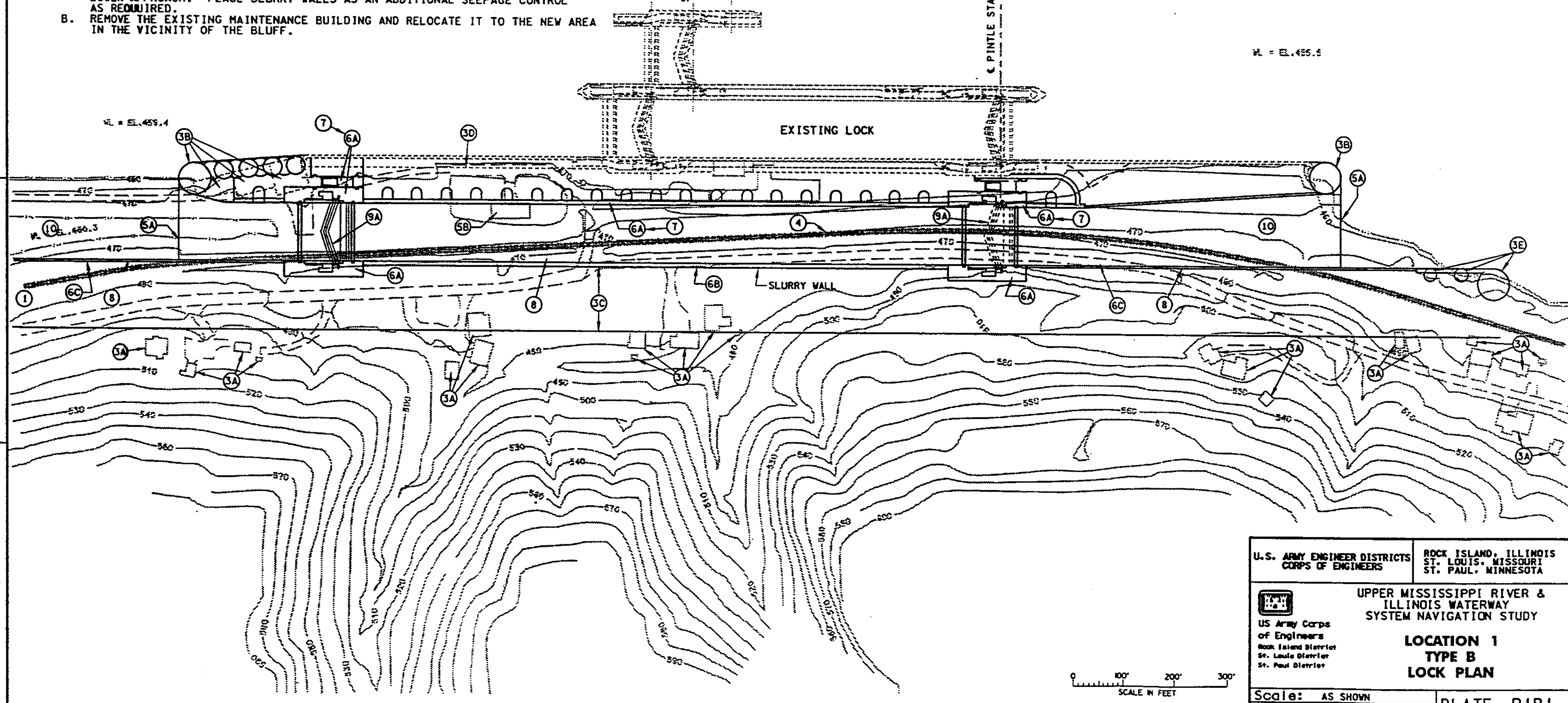
SEQUENCE OF CONSTRUCTION

1. OBTAIN LAND EASEMENTS.
2. PERFORM SOIL EXPLORATIONS ALONG THE BLUFF AREAS, PROPOSED LOCK WALLS, GUIDE WALLS, AND LOCK CHAMBER FLOOR.
3. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. REMOVE BUILDINGS FROM THE EASEMENT AREAS.
   B. REMOVE THE EXISTING SHEET PILE CELLS LOCATED NEAR THE UPSTREAM GUIDE WALL AND CONSTRUCT THE NEW UPSTREAM RIVER SIDE SHEET PILE CELL AND GUIDE WALL STRUCTURE.
   C. REMOVE SOIL AND ROCK FROM THE BLUFF AREA FOR A DISTANCE OF ABOUT 120 FT. (DISTANCE IS TO BE DETERMINED BY COE AND RAIL ROAD REQUIREMENTS), TOWARD THE BLUFF FROM THE PROPOSED LAND SIDE LOCK WALL CHAMBER FACE. GRADE AND OR BUILD A RETAINING WALL AS REQUIRED. CONSTRUCT A DRAINAGE SYSTEM TO DRAIN RUN OFF WATER FROM THE BLUFF AREA.
      NOTE: UNDERGROUND UTILITIES MAY HAVE TO BE RELOCATED/REROUTED. THE EXISTING LOCK OPERATIONS MUST NOT BE INTERRUPTED.
   D. PLACE SHEET PILE ALONG THE LAND SIDE PERIMETER OF THE EXISTING LAND SIDE LOCK WALL AND THE EXISTING UPPER AND LOWER GUIDE WALLS AS REQUIRED TO REDUCE SEEPAGE. PLACE A SLURRY TRENCH WALL LAND WARD OF THE SHEET PILE WALL TO FORM PART OF THE FILLING/EMPTYING POOL.
   E. PLACE THE REMAINING SHEET PILE CELLULAR PORTIONS OF THE PROPOSED UP AND DOWNSTREAM GUIDE WALLS.
4. COORDINATE WITH THE OWNING RAILROAD COMPANY AND RELOCATE THE TRACKS TO THE NEW LOCATION.
5. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. PLACE SHEET PILES BEGINNING AT THE NEW UPPER SHEET PILE CELL CONSTRUCTED IN PARAGRAPH 3.B. PERPENDICULAR TO THE PROPOSED UPPER APPROACH FOR A DISTANCE OF ABOUT 300 FT LANDWARD AS REQUIRED TO REDUCE SEEPAGE. SIMILARLY CONSTRUCT A SHEET PILE WALL DOWNSTREAM AS REQUIRED FOR THE LOWER APPROACH. PLACE SLURRY WALLS AS AN ADDITIONAL SEEPAGE CONTROL AS REQUIRED.
   B. REMOVE THE EXISTING MAINTENANCE BUILDING AND RELOCATE IT TO THE NEW AREA IN THE VICINITY OF THE BLUFF.
6. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. EXCAVATE AND CONSTRUCT THE PROPOSED RIVER SIDE COLUMNS AND INTEGRATED LOCK WALL AREAS, GATE BLOCKS, TAINTER BLOCK, FILLING/EMPTYING FLUME AND REQUIRED WORK AREAS.
   B. CONSTRUCT THE LAND SIDE LOCK CHAMBER SLURRY WALL.
   C. CONSTRUCT THE UP AND DOWNSTREAM GUIDE WALLS. PLACE SHEET PILE WALLS AS NEEDED FOR SEEPAGE CONTROL.
7. CONSTRUCT THE RIVER SIDE LOCK ELEMENTS.
8. PLACE THE LOCK CHAMBER AND GUIDE WALL PRE-FABRICATED LOCK WALL FACING / ARMOR SECTIONS.
9. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. PLACE MITER AND TAINTER GATES. CONTINUE WITH INSTALLATION OF EQUIPMENT UNTIL FINISHED.
   B. REMOVE ANY SHEET PILING NOT REQUIRED FOR SEEPAGE CONTROL OR CONSTRUCTION.
10. EXCAVATE THE REMAINING LAND MASSES ON THE UP AND DOWNSTREAM APPROACH AREAS.
11. CLEAN UP AREAS.
12. FLOOD THE LOCK CHAMBER.
13. LANDSCAPE THE AREA FOR EROSION PROTECTION, RUNOFF REDUCTION AND BEAUTIFICATION.
14. OPEN NEW LOCK TO TRAFFIC.



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Scale: AS SHOWN	PLATE R1B1

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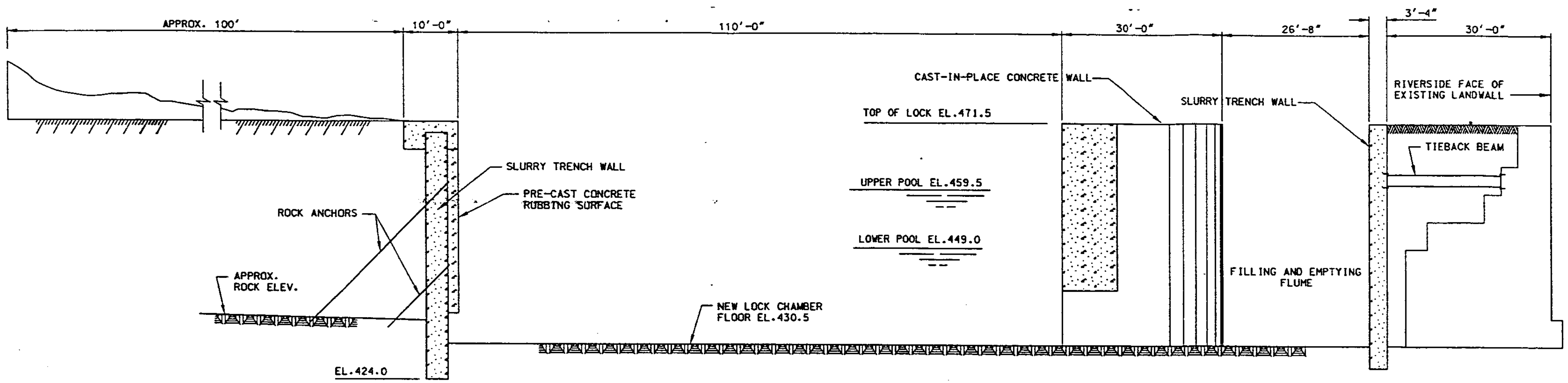
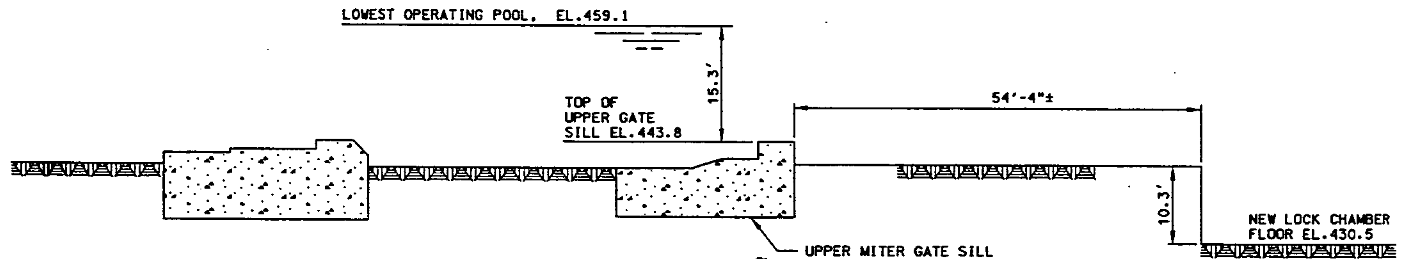
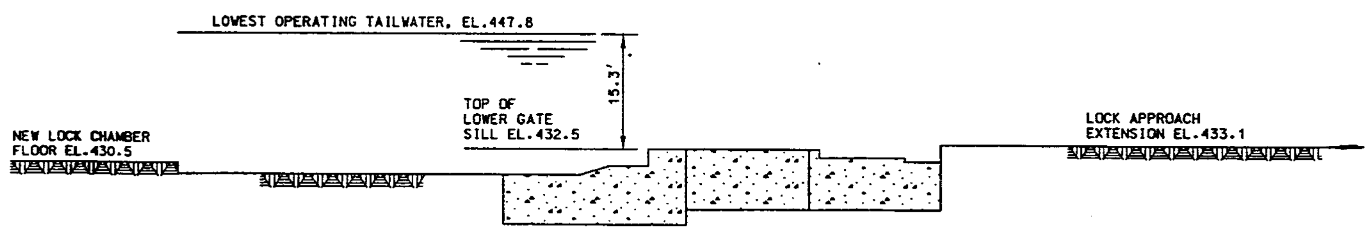


TYPICAL SECTION



SECTION THRU UPPER SILL



SECTION THRU LOWER SILL

0 10' 20' 30'
SCALE IN FEET

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Scale: AS SHOWN	PLATE RIB2

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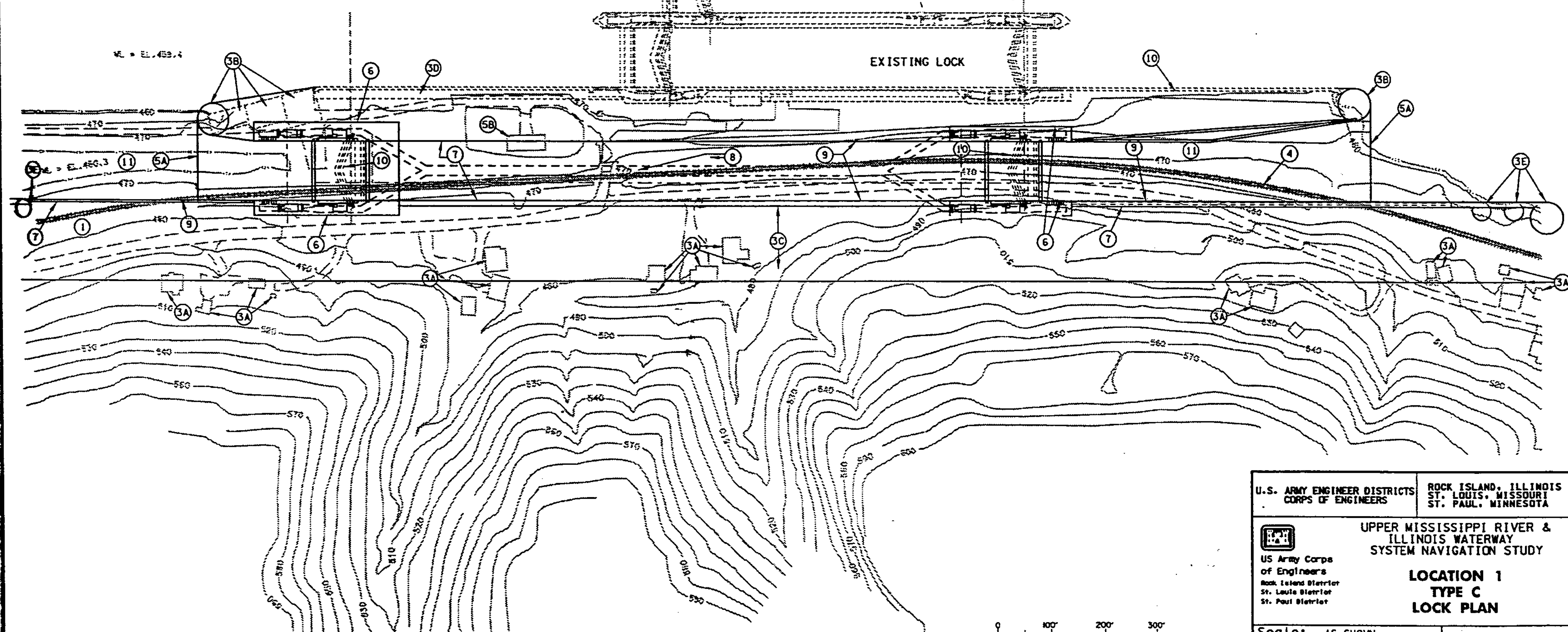
SEQUENCE OF CONSTRUCTION

1. OBTAIN LAND EASEMENTS.
2. PERFORM SOIL EXPLORATIONS ALONG THE BLUFF AREAS, PROPOSED LOCK WALLS, GUIDE WALLS, AND LOCK CHAMBER FLOOR.
3. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. REMOVE BUILDINGS FROM THE EASEMENT AREAS.
   B. REMOVE THE EXISTING SHEET PILE CELLS LOCATED NEAR THE UPSTREAM GUIDE WALL AND CONSTRUCT THE NEW UPSTREAM RIVER SIDE SHEET PILE CELL AND GUIDE WALL STRUCTURE.
   C. REMOVE SOIL AND ROCK FROM THE BLUFF AREA FOR A DISTANCE OF ABOUT 120 FT. (DISTANCE IS TO BE DETERMINED BY COE AND RAIL ROAD REQUIREMENTS), TOWARD THE BLUFF FROM THE PROPOSED LAND SIDE LOCK WALL CHAMBER FACE, GRADE AND OR BUILD A RETAINING WALL AS REQUIRED. CONSTRUCT A DRAINAGE SYSTEM TO DRAIN RUN OFF WATER FROM THE BLUFF AREA.
      NOTE: UNDERGROUND UTILITIES MAY HAVE TO BE RELOCATED/REROUTED. THE EXISTING LOCK OPERATIONS MUST NOT BE INTERRUPTED.
   D. PLACE SHEET PILE ALONG THE LAND SIDE PERIMETER OF THE EXISTING LAND SIDE LOCK WALL AND THE EXISTING UPPER AND LOWER GUIDE WALLS AS REQUIRED TO REDUCE SEEPAGE. PLACE A SLURRY TRENCH LANDWARD OF THE SHEET PILE WALL FOR ADDITIONAL SEEPAGE AS REQUIRED.
   E. PLACE THE REMAINING SHEET PILE CELLULAR PORTIONS OF THE PROPOSED UP AND DOWNSTREAM GUIDE WALLS.
4. COORDINATE WITH THE OWNING RAIL ROAD COMPANY AND RELOCATE THE TRACKS TO THE NEW LOCATION.
5. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. PLACE SHEET PILE BEGINNING AT THE NEW UPPER AND LOWER RIVER SIDE SHEET PILE CELLS, CONSTRUCTED AS IN PARAGRAPH 3.B., PERPENDICULAR TO THE UPPER AND LOWER APPROACHES FOR A DISTANCE OF 300 FT LANDWARD AS REQUIRED TO REDUCE SEEPAGE. PLACE A SLURRY TRENCH ON THE PROTECTED SIDE AS AN ADDITIONAL SEEPAGE CONTROL AS NEEDED.
   B. REMOVE THE EXISTING MAINTENCE BUILDING AND RELOCATE IT TO THE NEW AREA IN THE VACINITY OF THE BLUFF.
6. EXCAVATE THEN COSTRUCT THE UP-ER AND LOWER GATE MONOLITHS.
7. CONSTRUCT THE RIVER AND LAND SIDE LOCK CHAMBER SLURRY TRENCH WALLS AND THE UPPER AND LOWER SLURRY TRENCH GUIDE WALLS.
8. EXCAVATE THE LOCK CHAMBER AND AND THE CENTER FILL SECTION OF THE FILL/EMPTYING SYSTEM.
9. PLACE THE LOCK CHAMBER AND GUIDE WALL PRE-FABRICATED LOCK WALL FACING/ARMOR SECTIONS.
10. THE FOLLOWING EVENTS CAN OCCUR SIMULTANEOUSLY:
   A. PLACE MITER GATES AND CONTINUE WITH THE INSTALLATION OF REMAINDER OF THE MACHINARY AND EQUIPMENT UNTIL FINISHED.
   B. REMOVE ANY SHEET PILING NOT REQUIRED FOR SEEPAGE CONTROL OR CONSTRUCTION.
11. EXCAVATE THE REMAINING LAND MASSES ON THE UP AND DOWN STREAM APPROACH AREAS.
12. CLEAN UP AREAS.
13. FLOOD THE LOCK CHAMBER.
14. LANDSCAPE THE AREA FOR EROSION PROTECTION, RUNOFF REDUCTION AND BEAUTIFICATION.
15. OPEN NEW LOCK TO TRAFFIC.



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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 1
TYPE C
LOCK PLAN

Scale: AS SHOWN

PLATE R1C1

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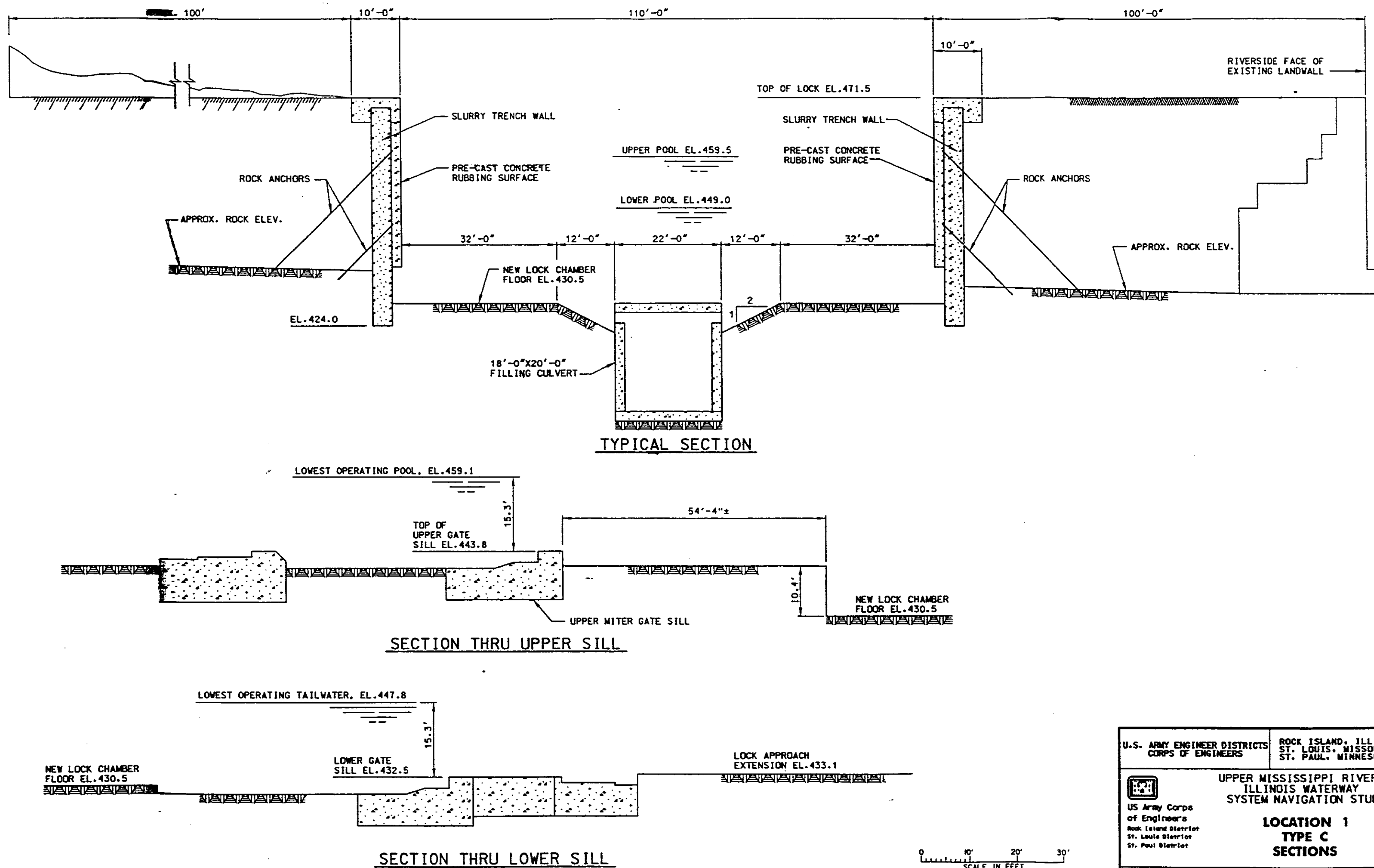

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US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 1** **TYPE C** **SECTIONS**
Scale: AS SHOWN	PLATE R1C2

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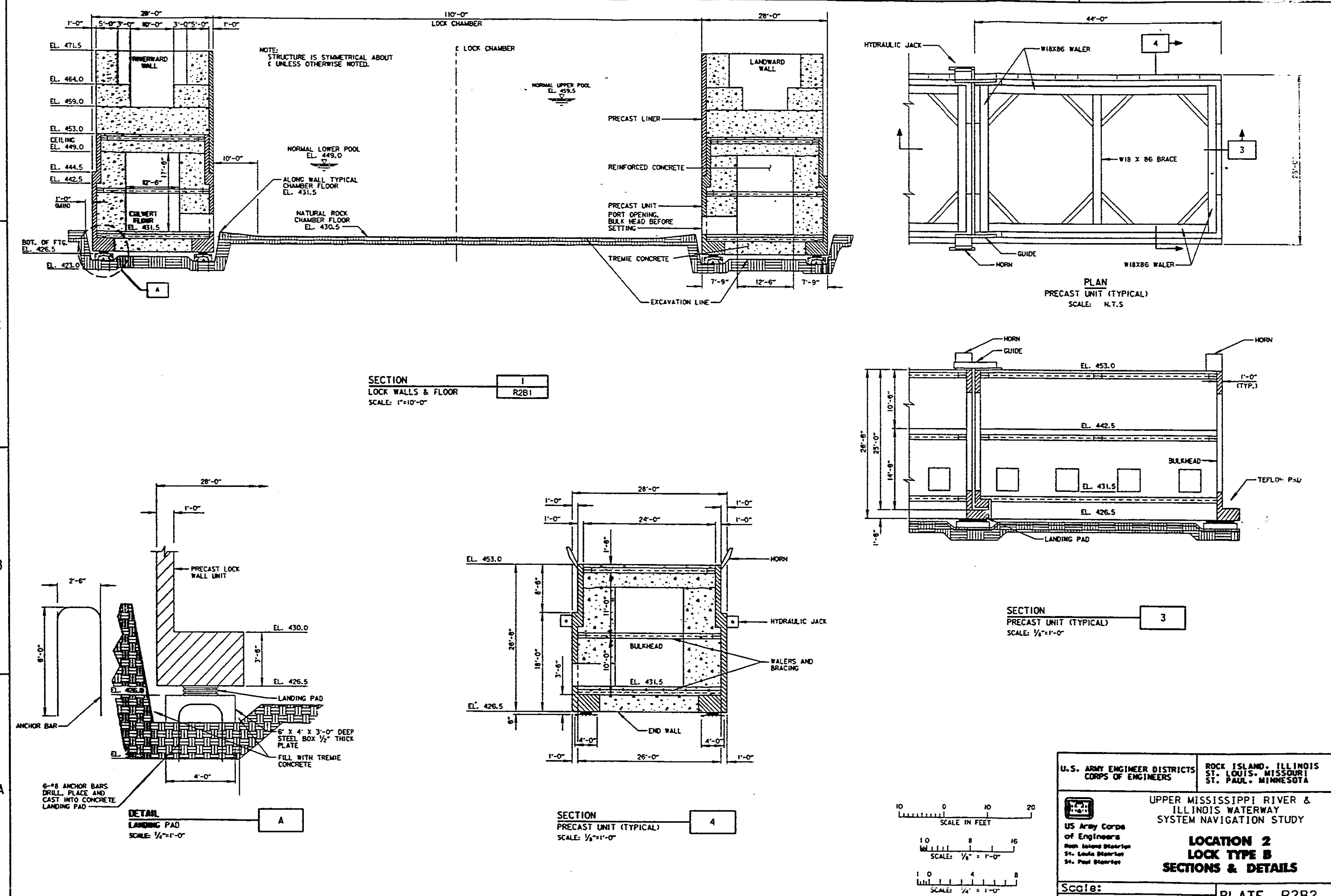

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS

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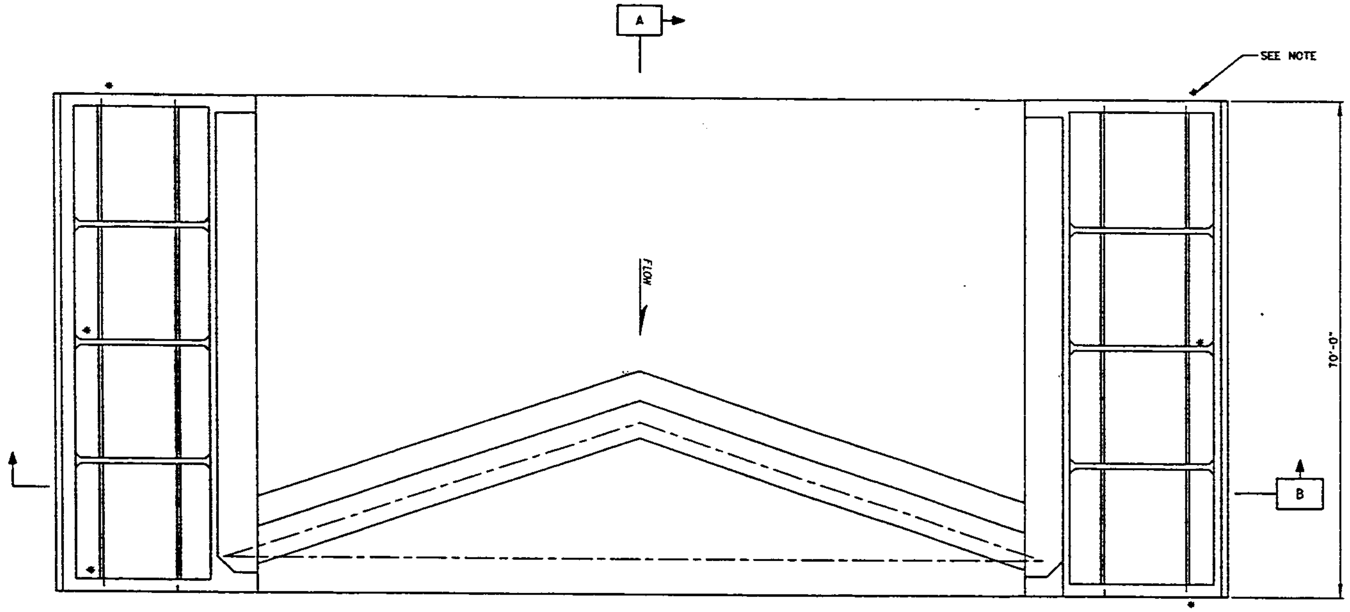
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
LOCK TYPE B
SECTIONS & DETAILS

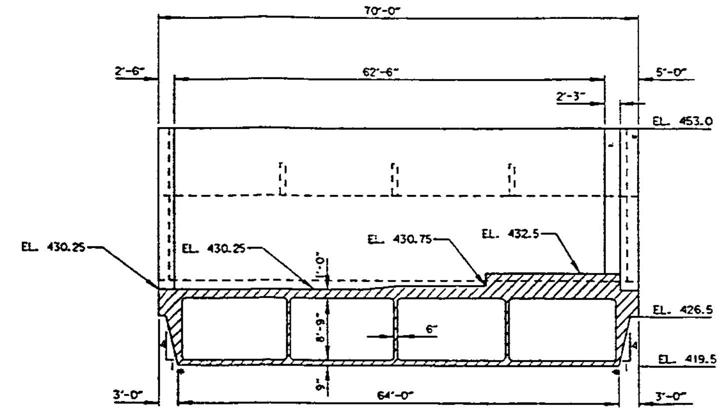
Scale:

PLATE R2B2

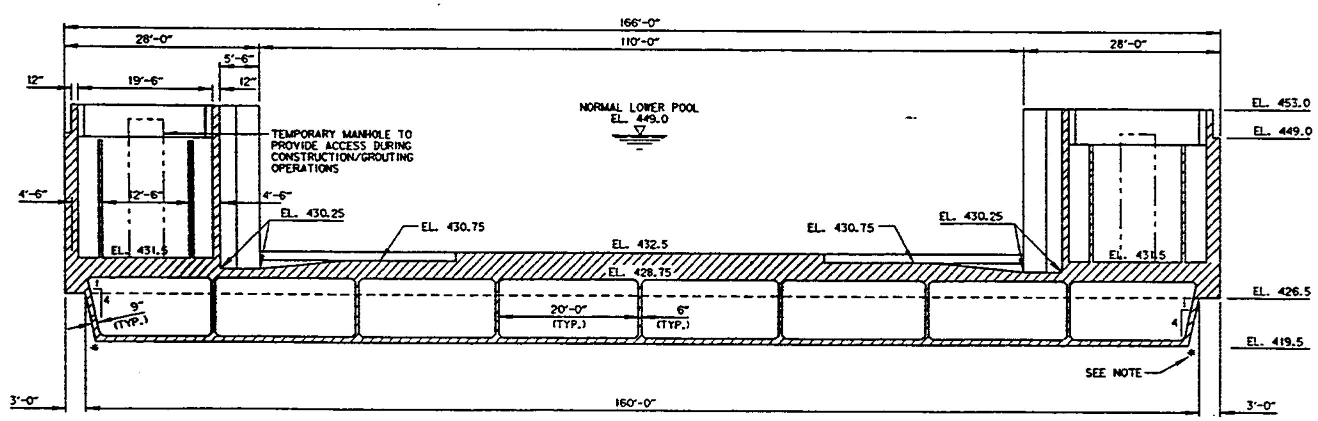
DTLS-2D.DGN



PLAN
LOCK CHAMBER FLOOR AND SILL
SCALE: 3/32" = 1'-0"



SECTION
℄ LOCK CHAMBER @ SILL
SCALE: 3/32" = 1'-0"
A



SECTION
SILL
SCALE: 3/32" = 1'-0"
B

NOTE:
* IN ORDER TO PLACE SILL MONOLITH, LANDING PADS AS SHOWN IN DETAIL A PLATE R2B2, WILL BE INSTALLED PRIOR TO FLOAT-IN OF SILL MONOLITH

SCALE: 3/32" = 1'-0"

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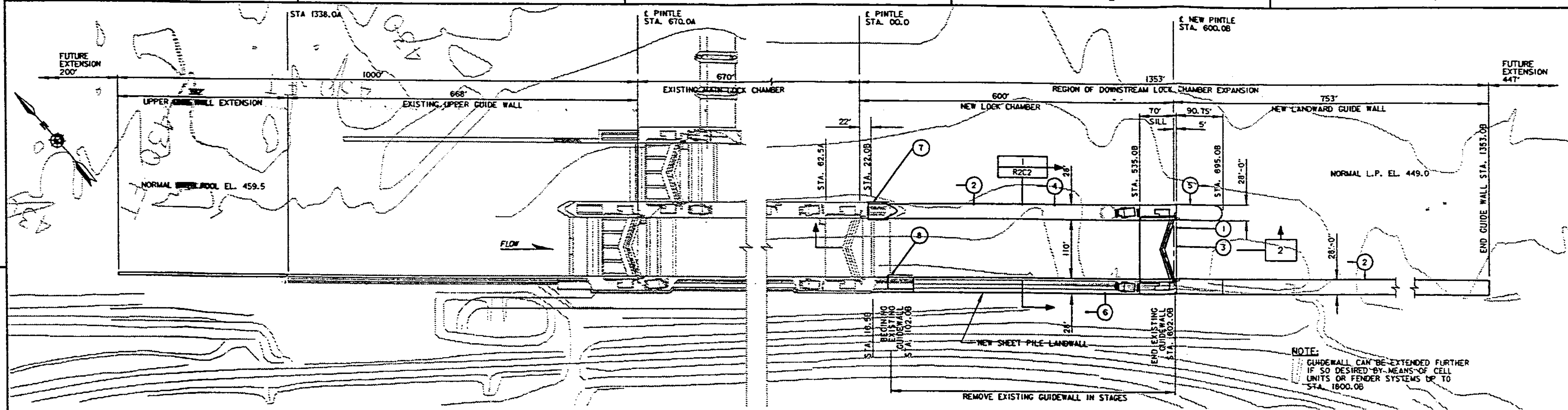
Scale:	PLATE R2B3

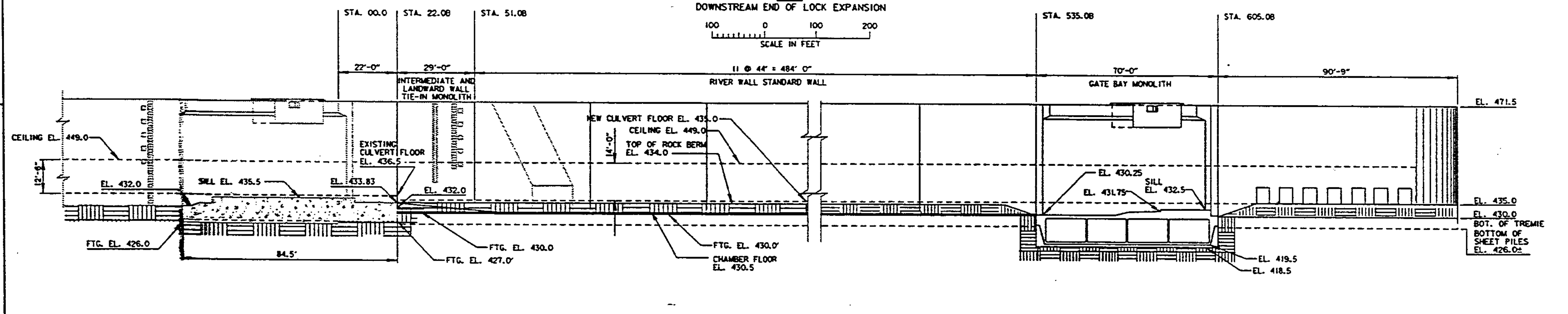
DTL-SIL.DGN



PLAN

DOWNSTREAM END OF LOCK EXPANSION

100 0 100 200
SCALE IN FEET



SECTION **2**

WALL & FLOOR SLAB

SCALE: 1" = 20'-0"

20 0 20 40
SCALE IN FEET

NOTE:

LOCK CHAMBER DESIGN IS SITUATED IN A ROCK ENVIRONMENT

CONSTRUCTION SEQUENCE

1. EXCAVATE ROCK CRADEE[redacted] SILL MONOLITH REMOVE PORTION OF EXISTING GUIDEWALL DOWNSTREAM END (STA. [redacted].
2. EXCAVATE ROCK CRADE[redacted] SHEET PILE CELL UNITS FOR RIVERSIDE WALL AND LANDWARD GUIDEWALL.
3. PLACE SILL UNIT BY [redacted] INTO ROCK CRADLE.
4. PLACE CELL UNITS IN[redacted] CRADLE ON RIVERSIDE AT STA. 535.0B FROM DOWNSTREAM TO UPSTREAM AND FOR L[redacted] GUIDEWALL FROM SILL STA. 605.0B DOWNSTREAM.
5. CONTINUE WITH RIVERS[redacted] CONSTRUCTION DOWNSTREAM FROM SILL.
6. REMOVE EXISTING GUIDEWALL ON LANDWARD SIDE IN SECTIONS. EXCAVATE ROCK CRADLE AND PLACE UNITS.
7. COMPLETE RIVER SIDE CLOSURE BETWEEN EXISTING INTERMEDIATE AND NEWLY INSTALLLED WALL.
8. COMPLETE LANDWARD CLOSURE BETWEEN EXISTING AND NEWLY INSTALLED WALL.

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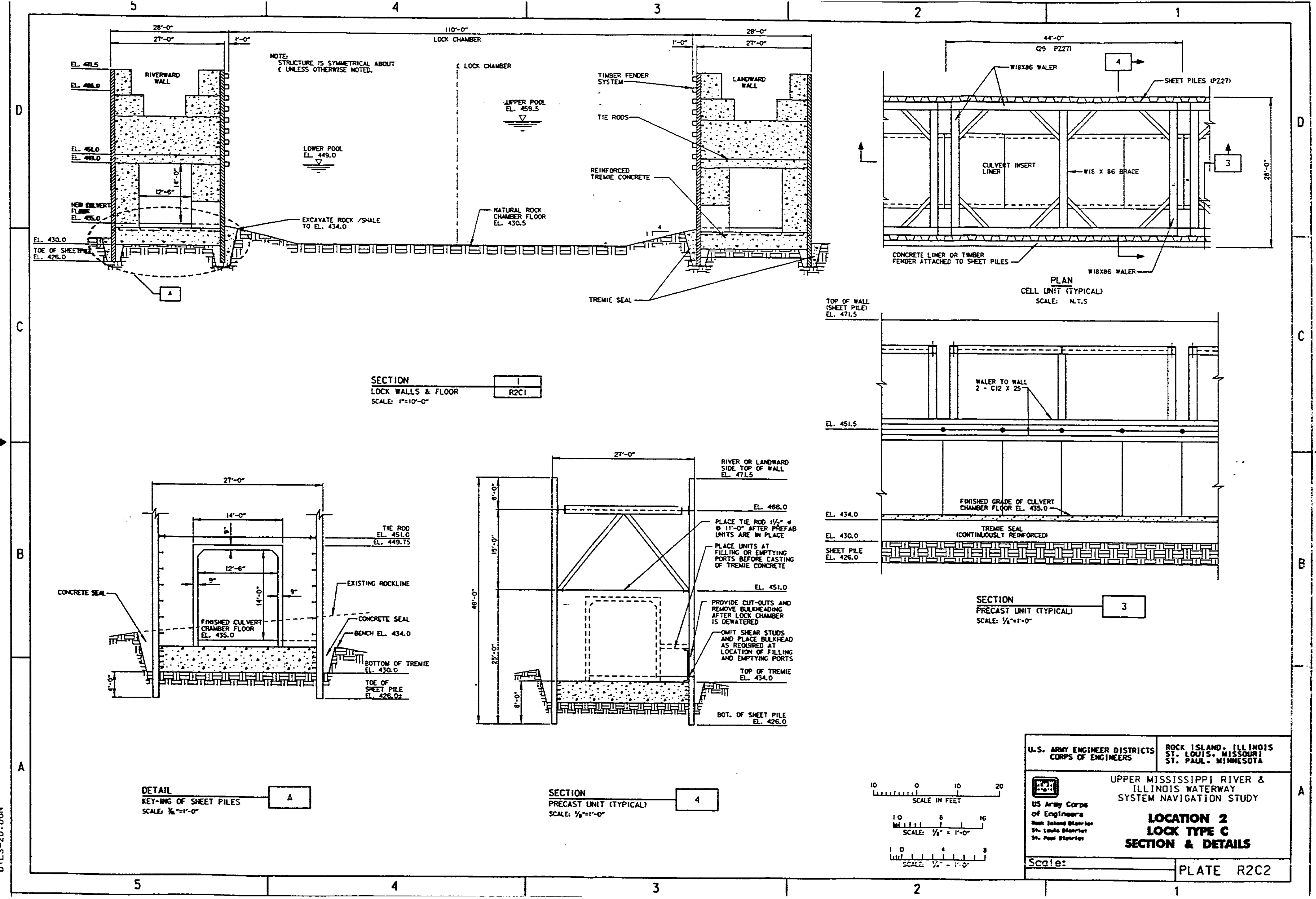
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 2C LOCK TYPE C PLAN & SECTIONS**
Scale:	PLATE R2C1

LD22-DS.DGN



NOTE:
STRUCTURE IS SYMMETRICAL ABOUT ℄ UNLESS OTHERWISE NOTED.
110'-0"
LOCK CHAMBER
28'-0"
27'-0"
1'-0"
RIVERWARD WALL
LANDWARD WALL
℄ LOCK CHAMBER
UPPER POOL EL. 459.5
LOWER POOL EL. 449.0
EL. 471.5
EL. 466.0
EL. 451.0
EL. 449.0
NEW CULVERT FLOOR EL. 435.0
EL. 430.0
TOE OF SHEETPILE EL. 426.0
12'-6"
14'-0"
EXCAVATE ROCK /SHALE TO EL. 434.0
NATURAL ROCK CHAMBER FLOOR EL. 430.5
TIMBER FENDER SYSTEM
TIE RODS
REINFORCED TREMIE CONCRETE
TREMIE SEAL
A
SECTION
LOCK WALLS & FLOOR
SCALE: 1"=10'-0"
1
R2C1
44'-0"
(29 PZ27)
W18X86 WALER
SHEET PILES (PZ27)
CULVERT INSERT LINER
W18 X 86 BRACE
28'-0"
CONCRETE LINER OR TIMBER FENDER ATTACHED TO SHEET PILES
W18X86 WALER
4
3
PLAN
CELL UNIT (TYPICAL)
SCALE: N.T.S
TOP OF WALL (SHEET PILE) EL. 471.5
WALER TO WALL 2 - C12 X 25
EL. 451.5
FINISHED GRADE OF CULVERT CHAMBER FLOOR EL. 435.0
EL. 434.0
EL. 430.0
TREMIE SEAL (CONTINUOUSLY REINFORCED)
SHEET PILE EL. 426.0
SECTION
PRECAST UNIT (TYPICAL)
SCALE: 1/8"=1'-0"
3
27'-0"
14'-0"
9"
12'-6"
TIE ROD EL. 451.0
EL. 449.75
EXISTING ROCKLINE
CONCRETE SEAL
FINISHED CULVERT CHAMBER FLOOR EL. 435.0
BENCH EL. 434.0
BOTTOM OF TREMIE EL. 430.0
TOE OF SHEET PILE EL. 426.0±
4'-0"
DETAIL
KEY-ING OF SHEET PILES
SCALE: 3/8"=1'-0"
A
RIVER OR LANDWARD SIDE TOP OF WALL EL. 471.5
EL. 466.0
PLACE TIE ROD 1½" ⌀ @ 11'-0" AFTER PREFAB UNITS ARE IN PLACE
PLACE UNITS AT FILLING OR EMPTYING PORTS BEFORE CASTING OF TREMIE CONCRETE
EL. 451.0
PROVIDE CUT-OUTS AND REMOVE BULKHEADING AFTER LOCK CHAMBER IS DEWATERED
OMIT SHEAR STUDS AND PLACE BULKHEAD AS REQUIRED AT LOCATION OF FILLING AND EMPTYING PORTS
TOP OF TREMIE EL. 434.0
BOT. OF SHEET PILE EL. 426.0
6'-0"
15'-0"
25'-0"
46'-0"
8'-0"
SECTION
PRECAST UNIT (TYPICAL)
SCALE: 1/8"=1'-0"
4
SCALE IN FEET
SCALE: 1/8" = 1'-0"
SCALE: 1/4" = 1'-0"
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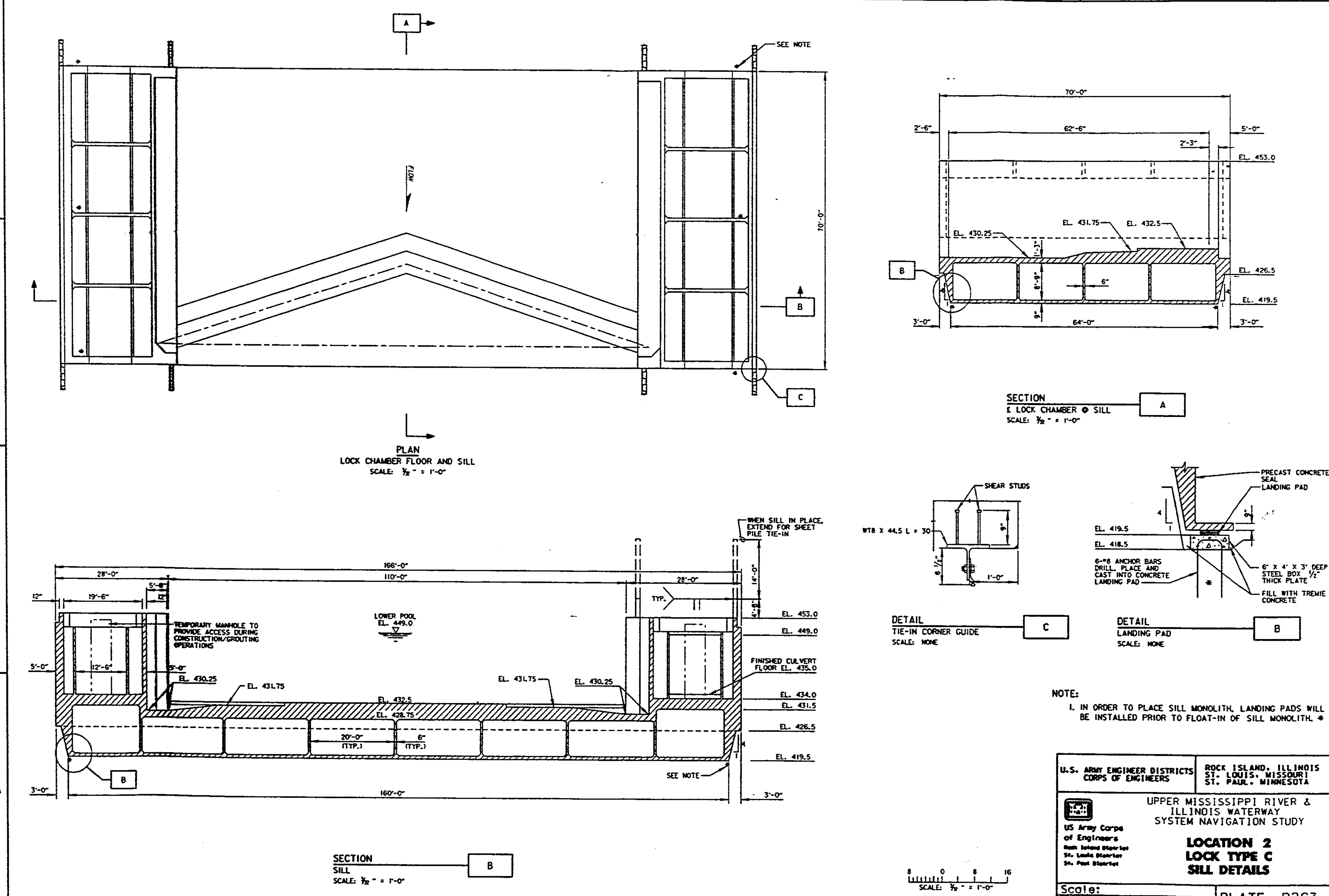
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY
LOCATION 2
LOCK TYPE C
SECTION & DETAILS
Scale:
PLATE R2C2
DTLS-2D.DGN



NOTE:

1. IN ORDER TO PLACE SILL MONOLITH, LANDING PADS WILL BE INSTALLED PRIOR TO FLOAT-IN OF SILL MONOLITH. *

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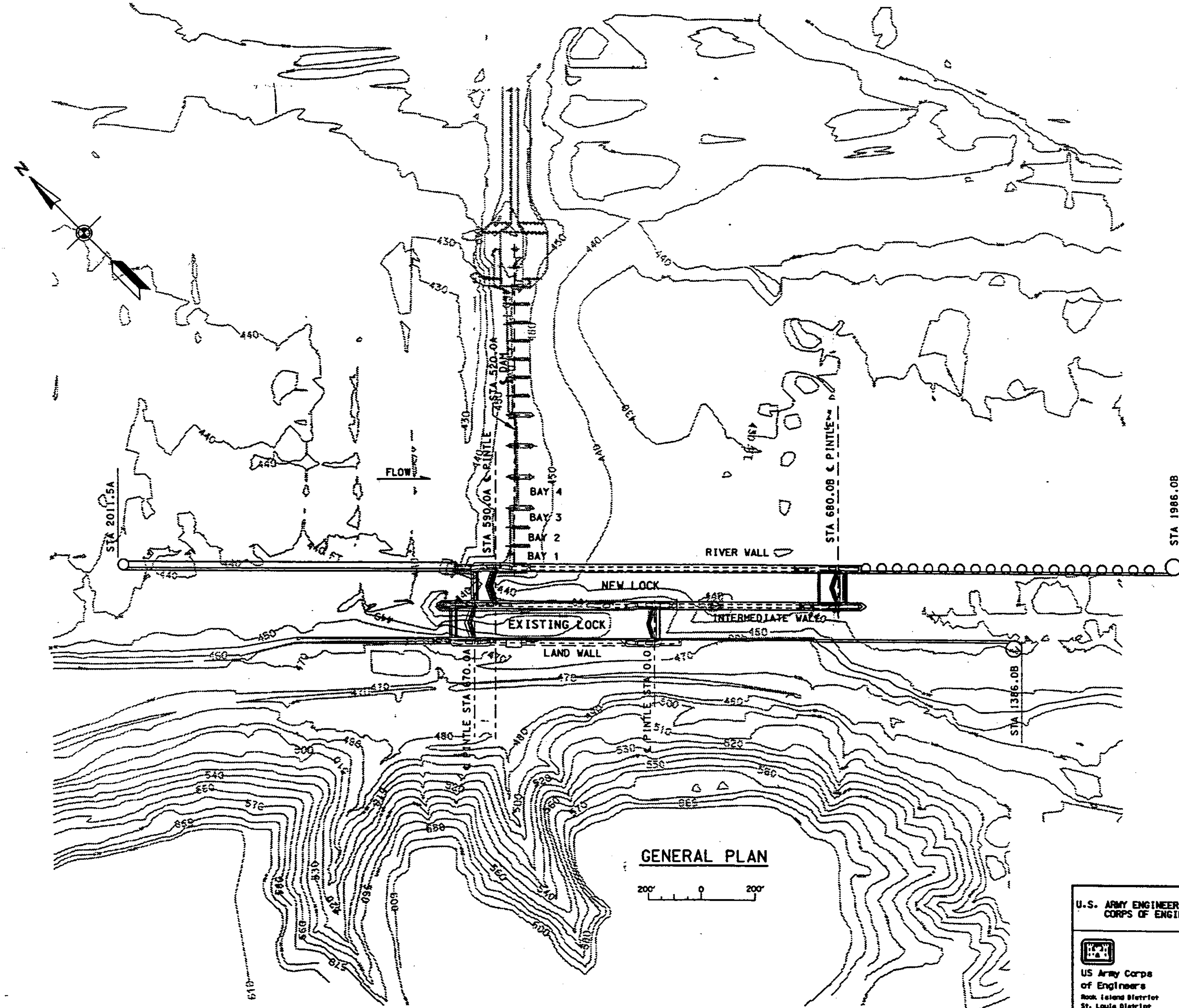
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
LOCK TYPE C
SILL DETAILS

Scale:

PLATE R2C3

DTL-SIL.DGN



GENERAL PLAN

200' 0 200'

U.S. ARMY ENGINEER DISTRICTS
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UPPER MISSISSIPPI RIVER &
ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LOCATION 3
GENERAL PLAN

Scale: As Shown

PLATE R3GP

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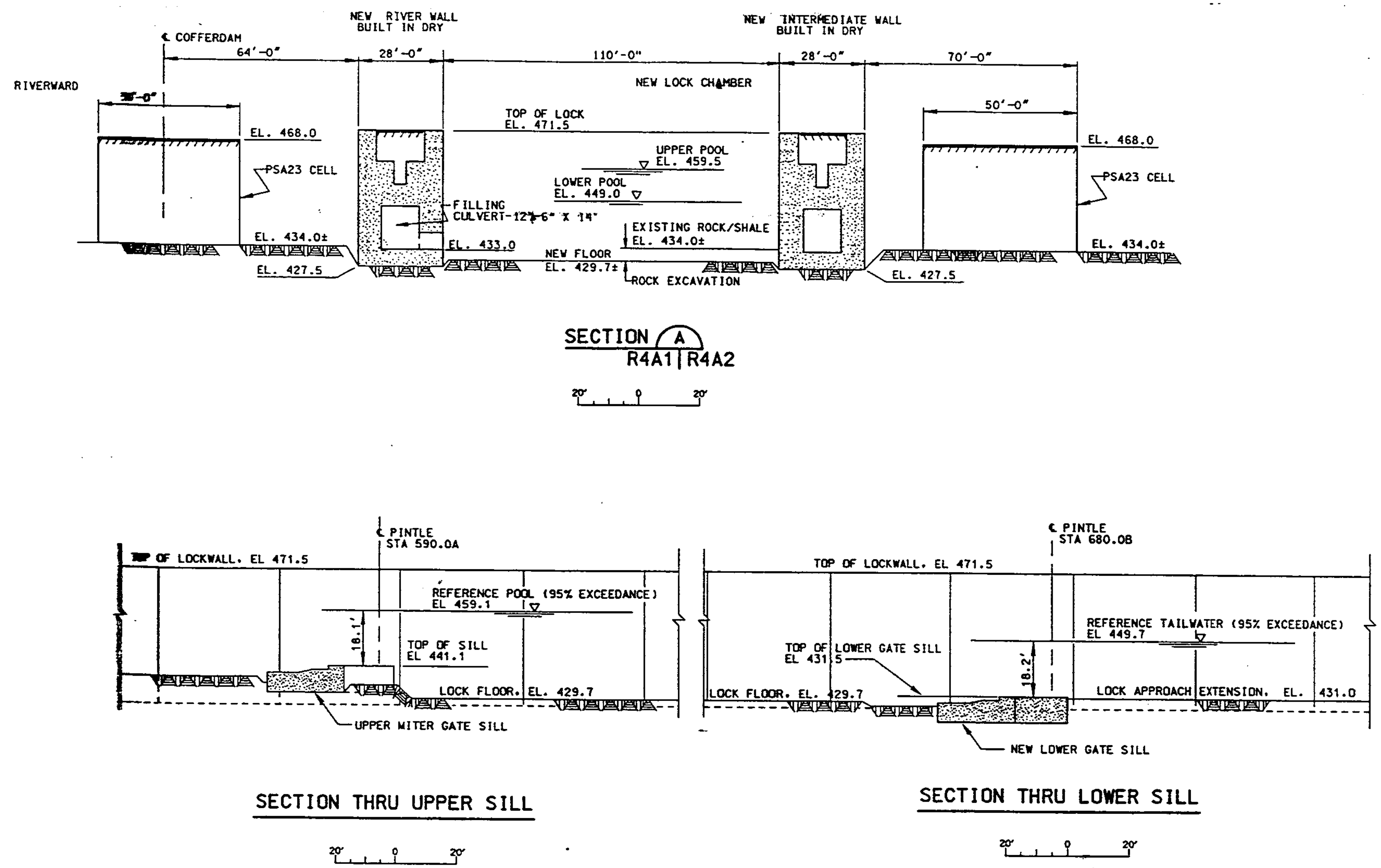

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS | ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 4
TYPE A
SECTIONS

Scale: As Shown

PLATE R4A2

02-FEB-1996 09:57
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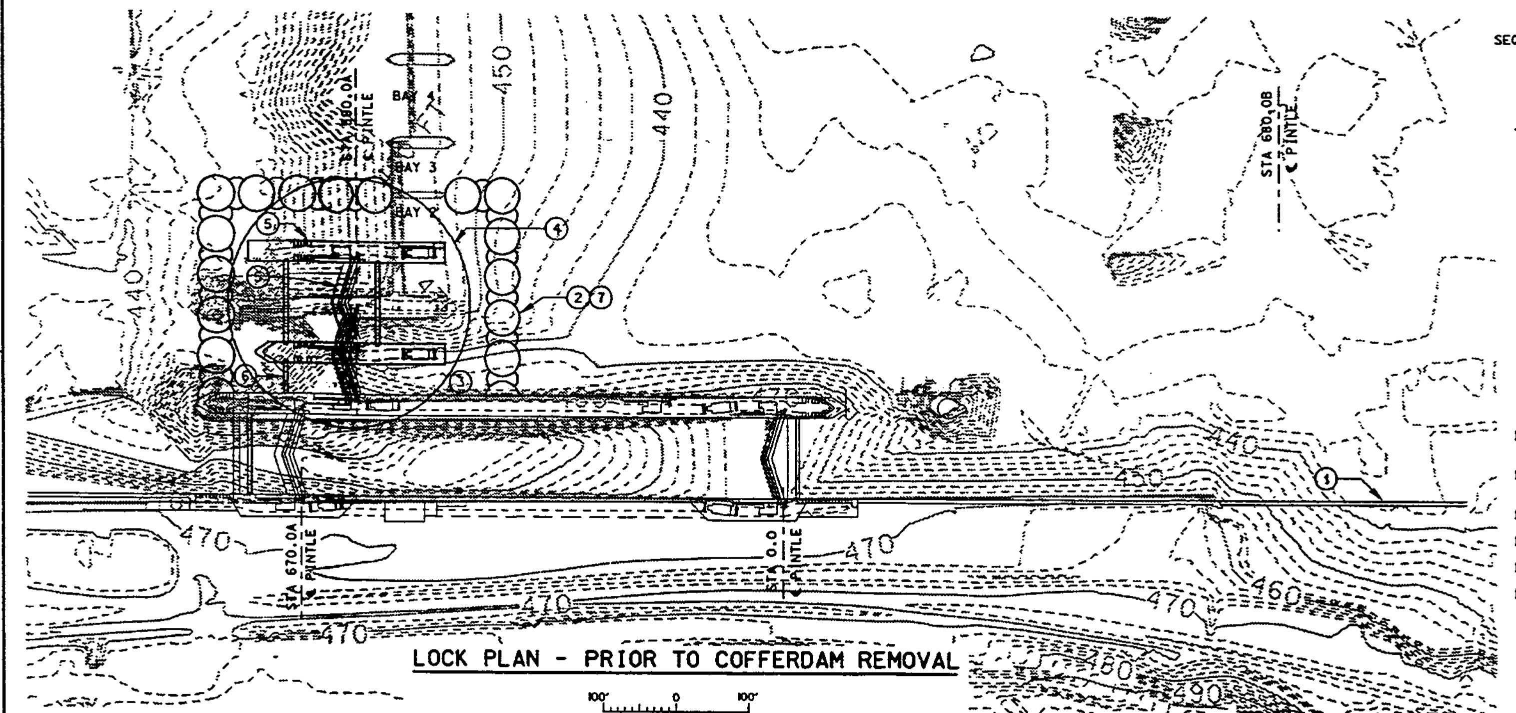
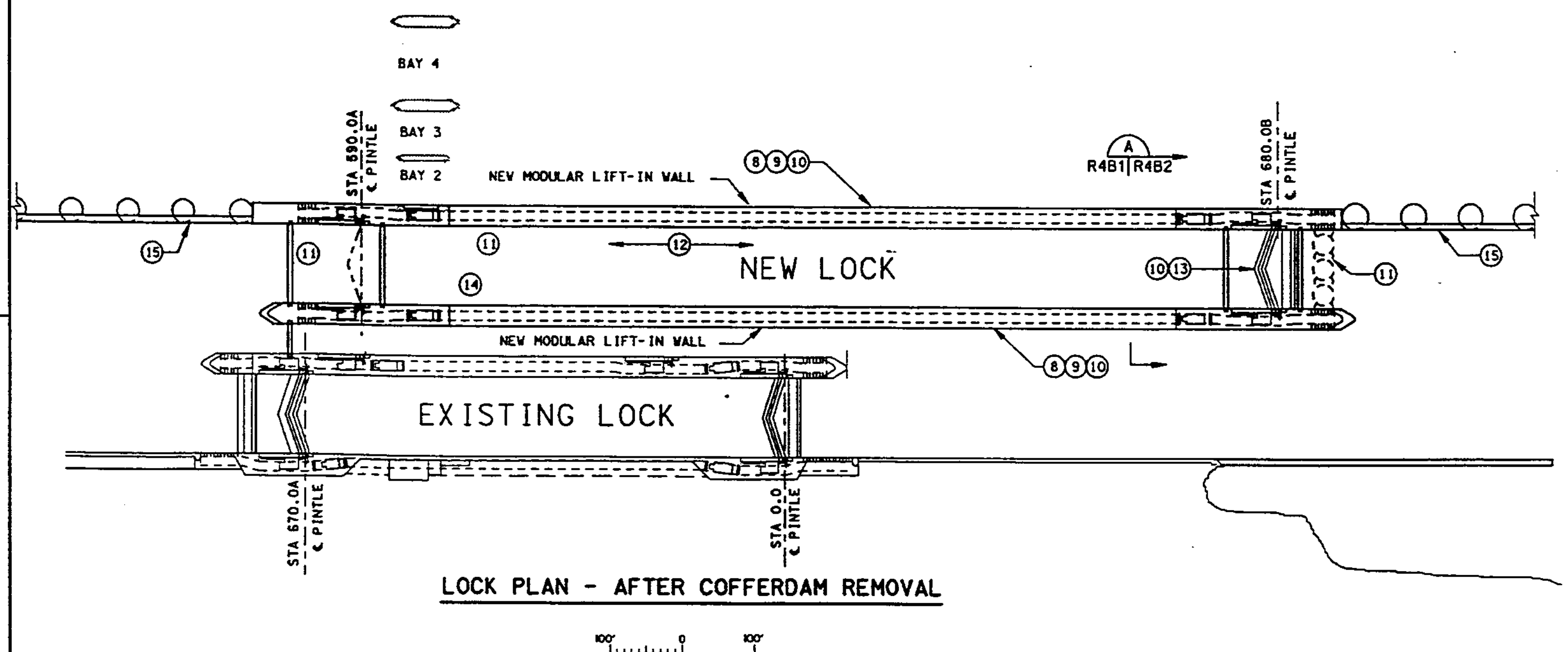


LOCK PLAN - PRIOR TO COFFERDAM REMOVAL

SEQUENCE OF CONSTRUCTION

1. CONSTRUCT LOWER GUIDEWALL EXTENSION. INSTALL TRAVELING KEVEL.
2. CONSTRUCT COFFERDAM FOR UPPER GATE MONOLITH.
3. DEWATER COFFERDAM.
4. REMOVE EXISTING COMPONENTS:
   - A. AUXILIARY LOCK MITER GATE.
   - B. AUXILIARY LOCK RIVER WALL.
   - C. AUXILIARY LOCK MITER GATE SILL.
   - D. SERVICE BRIDGE SPAN 1.
   - E. DAM GATE 1.
   - F. DAM PIER 1.
   - G. DAM BAY 1 SILL.
5. CONSTRUCT UPPER GATE MONOLITH. INSTALL UPPER MITER GATE.
6. INSTALL FIXED DAM BETWEEN LOCKS. (IF THERE IS WIDER SEPARATION BETWEEN LOCKS IN THE FINAL PLACEMENT, AN ICE PASSAGE GATE COULD BE INSTALLED BETWEEN LOCKS.)
7. REWATER COFFERDAM AREA, AND REMOVE COFFERDAM.
8. EXCAVATE ROCK/SHALE TO DESIGN ELEVATIONS UNDERWATER IN AREA OF NEW LOCK WALLS AND LOWER GATE MONOLITHS.
9. INSTALL LANDING PADS AND JACKS FOR LIFT-IN WALL UNITS.
10. PLACE LIFT-IN WALL UNITS FOR BOTH WALLS INCLUDING LOWER GATE MONOLITHS AND LOWER GATE SILL.
11. INSTALL UPPER BULKHEADS AND CLOSE OFF LOWER LOCK AREA WITH CELULAR COFFERDAM. DEWATER NEW LOCK.
12. EXCAVATE ROCK/SHALE TO FINISHED FLOOR ELEVATION.
13. INSTALL LOWER MITER GATE.
14. REWATER NEW LOCK.
15. CONSTRUCT NEW LOCK GUIDEWALLS. OPEN NEW LOCK TO TRAFFIC.



LOCK PLAN - AFTER COFFERDAM REMOVAL

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US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 4 TYPE B LOCK PLANS**
Scale: As Shown	PLATE R4B1

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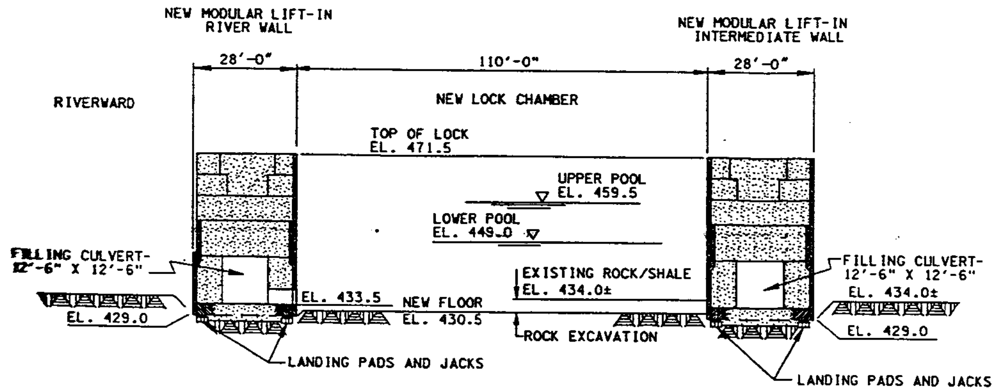
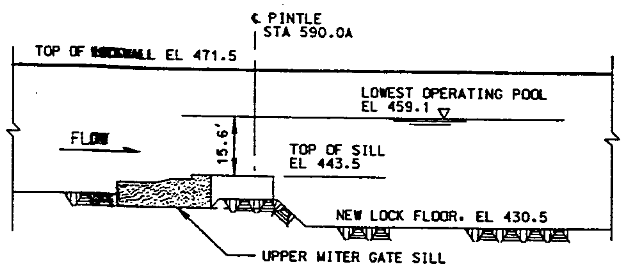


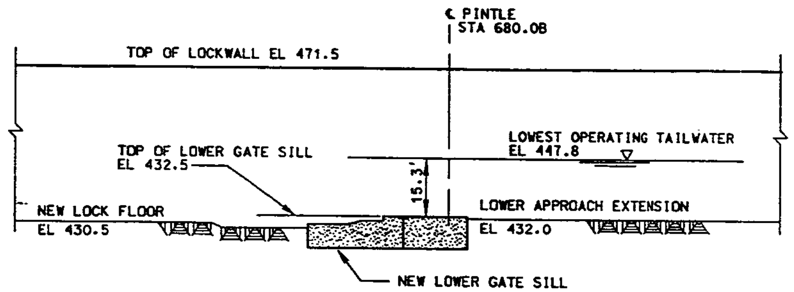
SECTION A R4B1 | R4B2

20' 0 20'



SECTION THRU UPPER SILL

20' 0 20'



SECTION THRU LOWER SILL

20' 0 20'

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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

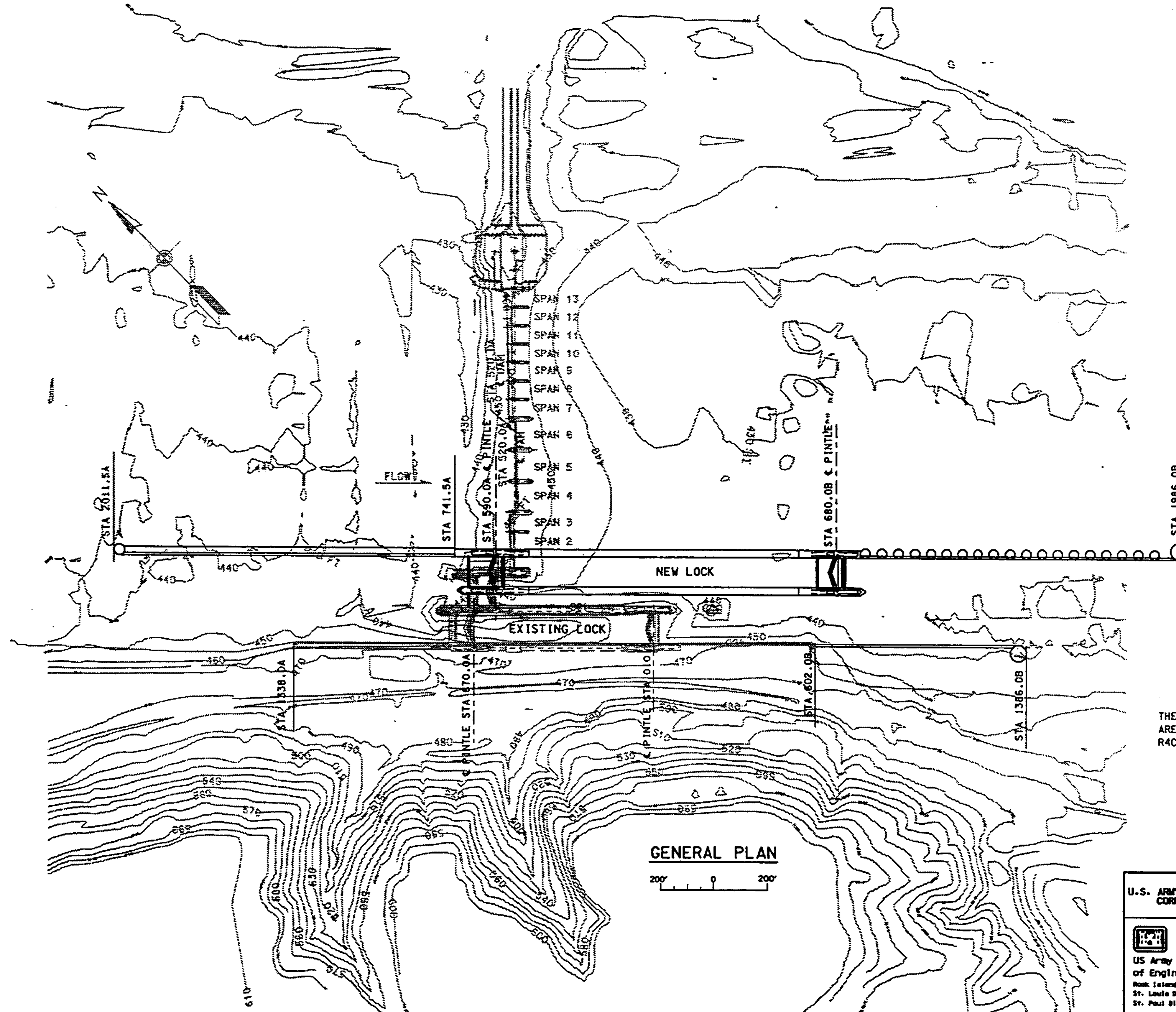
LOCATION 4
TYPE B
SECTIONS

Scale: As Shown

PLATE R4B2

31-JAN-1996 13:51
e:*projects*ns00*PLATR4B2.dgn

5 4 3 2 1
D C B A



THE LOCATION 4, TYPES A, B, AND C LOCKS ARE SHOWN ON PLATES R4A1, R4B1, AND R4C1, RESPECTIVELY.

U.S. ARMY ENGINEER DISTRICTS
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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 4
GENERAL PLAN

Scale: As Shown

PLATE R4GP

07-FEB-1996 08:21
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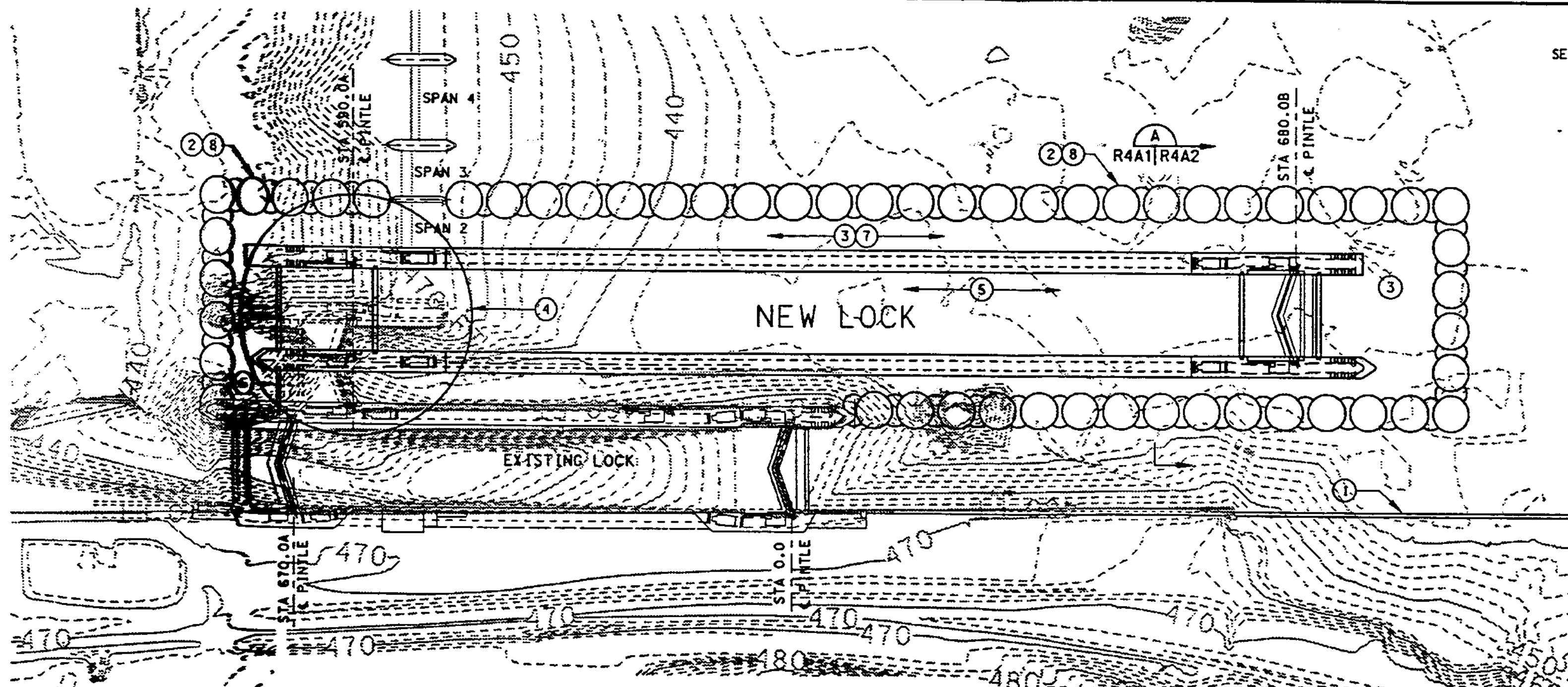
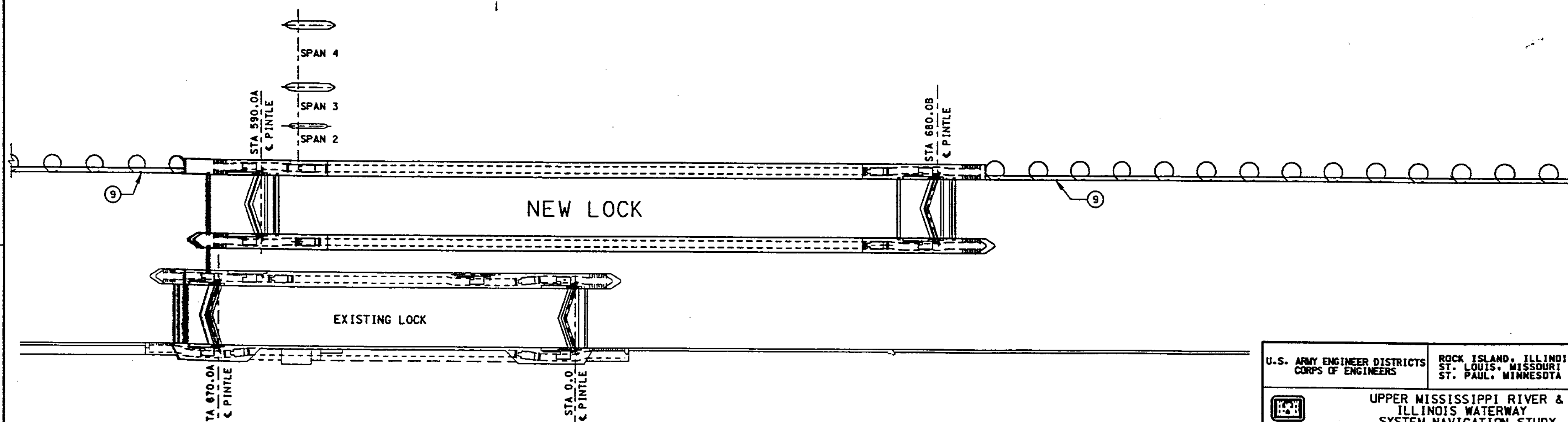


LOCK PLAN - PRIOR TO COFFERDAM REMOVAL

SEQUENCE OF CONSTRUCTION

1. CONSTRUCT LOWER GUIDEWALL EXTENSION. INSTALL TRAVELING KEVEL.
2. CONSTRUCT COFFERDAM.
3. DEWATER COFFERDAM AREA.
4. REMOVE EXISTING LOCK AND DAM COMPONENTS:
   A. AUXILIARY LOCK MITER GATE.
   B. AUXILIARY LOCK RIVER WALL.
   C. AUXILIARY LOCK MITER GATE SILL.
   D. DAM GATE 1.
   E. PIER 1.
   F. DAM BAY 1 SILL.
5. CONSTRUCT NEW LOCK:
   A. CONSTRUCT UPPER AND LOWER MITER GATE BAYS.
   B. CONSTRUCT LOCKWALLS.
   C. INSTALL MECHANICAL, ELECTRICAL AND OTHER APPURTENANT SYSTEMS.
   D. INSTALL TAINTER VALVES AND UPPER AND LOWER MITER GATES.
6. INSTALL FIXED WALL BETWEEN LOCKS. (IF THERE IS WIDER SEPARATION BETWEEN LOCKS IN THE FINAL PLACEMENT, AN ICE PASSAGE GATE COULD BE INSTALLED BETWEEN LOCKS.)
7. REWATER COFFERDAM AREA.
8. REMOVE COFFERDAM.
9. CONSTRUCT NEW LOCK GUIDE WALLS.
10. OPEN NEW LOCK TO TRAFFIC.



LOCK PLAN - AFTER COFFERDAM REMOVAL

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 4 TYPE A LOCK PLANS**
Scale: As Shown	PLATE R4A1

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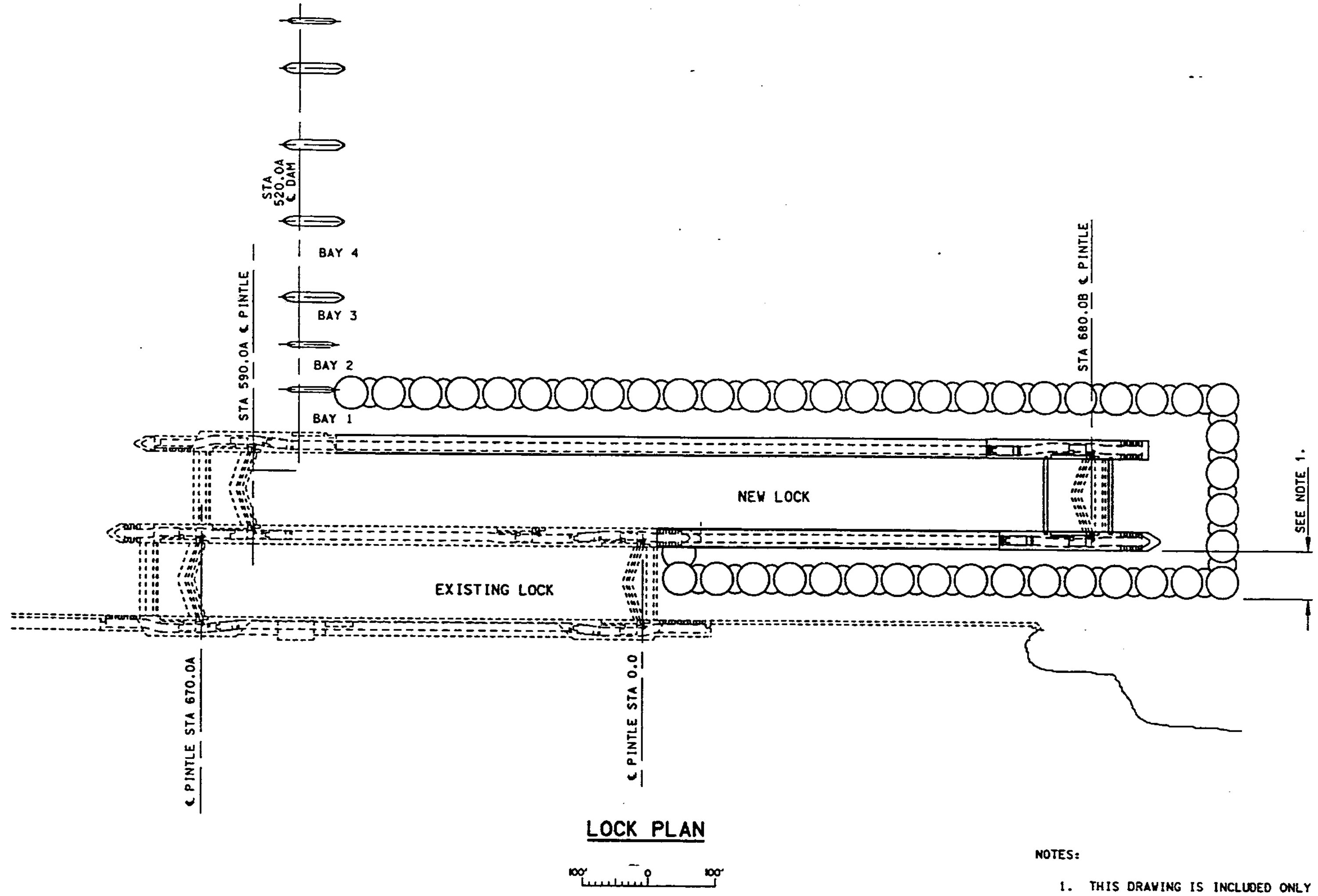

LOCK PLAN

NOTES:

1. THIS DRAWING IS INCLUDED ONLY TO SHOW THAT A CONVENTIONAL LOCK AT LOCATION 3, REQUIRING A CELLULAR SHEETPILE COFFERDAM, IS INFEASIBLE DUE TO THE INTERFERENCE IN THE APPROACH TO THE EXISTING LOCK. THIS INTERFERENCE WOULD BE OF LONG DURATION, HAVING SIGNIFICANT ADVERSE ECONOMIC IMPACT ON THE NAVIGATION INDUSTRY.

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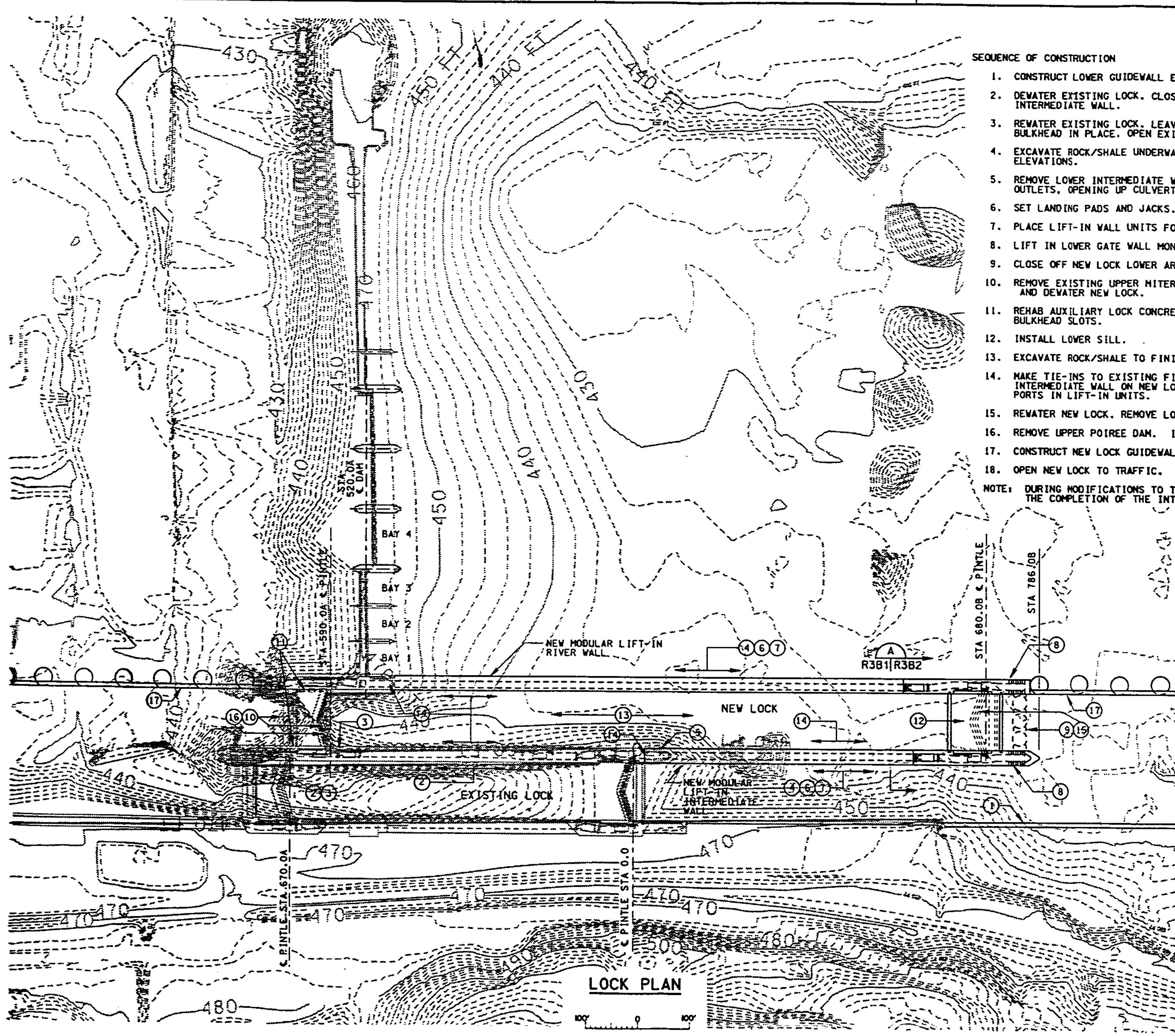
Scale: As Shown	PLATE R3A1



SEQUENCE OF CONSTRUCTION

1. CONSTRUCT LOWER GUIDEWALL EXTENSION. INSTALL TRAVELING KEVEL.
2. DEWATER EXISTING LOCK. CLOSE OFF EXISTING PORTS IN EXISTING INTERMEDIATE WALL.
3. REWATER EXISTING LOCK. LEAVE INTERMEDIATE WALL UPSTREAM TAINTER VALVE BULKHEAD IN PLACE. OPEN EXISTING LOCK TO TRAFFIC.
4. EXCAVATE ROCK/SHALE UNDERWATER IN AREA OF NEW LOCK WALLS TO DESIGN ELEVATIONS.
5. REMOVE LOWER INTERMEDIATE WALL BULLNOSE UPSTREAM OF THE EXISTING OUTLETS, OPENING UP CULVERT TO EXTENSION.
6. SET LANDING PADS AND JACKS.
7. PLACE LIFT-IN WALL UNITS FOR BOTH INTERMEDIATE WALL EXTENSION AND RIVER WALL.
8. LIFT IN LOWER GATE WALL MONOLITHS. FILL UNITS WITH CONCRETE.
9. CLOSE OFF NEW LOCK LOWER AREA WITH CELLULAR COFFERDAM.
10. REMOVE EXISTING UPPER MITER GATE. INSTALL AUXILIARY LOCK UPPER POIREE AND DEWATER NEW LOCK.
11. REHAB AUXILIARY LOCK CONCRETE IN UPPER GATE AREA. INSTALL UPPER BULKHEAD SLOTS.
12. INSTALL LOWER SILL.
13. EXCAVATE ROCK/SHALE TO FINISHED FLOOR ELEVATION.
14. MAKE TIE-INS TO EXISTING FILLING CULVERTS. OPEN UP PORTS IN EXISTING INTERMEDIATE WALL ON NEW LOCK CHAMBER SIDE. REMOVE BULKHEADS FROM PORTS IN LIFT-IN UNITS.
15. REWATER NEW LOCK. REMOVE LOWER AREA CELLULAR COFFERDAM. INSTALL NEW LOWER MITER GATE.
16. REMOVE UPPER POIREE DAM. INSTALL NEW UPPER MITER GATE.
17. CONSTRUCT NEW LOCK GUIDEWALLS.
18. OPEN NEW LOCK TO TRAFFIC.

NOTE: DURING MODIFICATIONS TO THE EXISTING LOCK, PRIORITY SHOULD BE GIVEN TO THE COMPLETION OF THE INTERMEDIATE WALL EXTENSION.

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Scale: 1"=100'	PLATE R3B1

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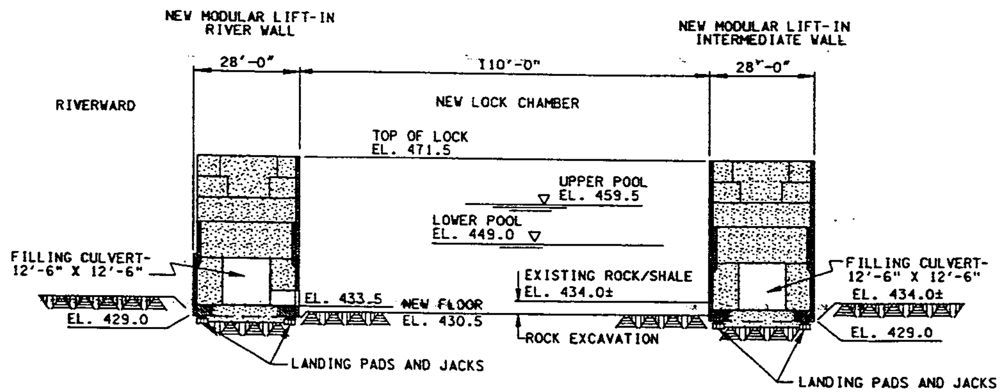
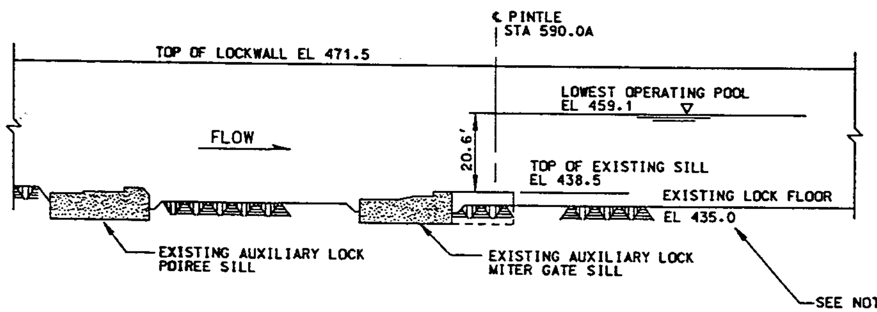


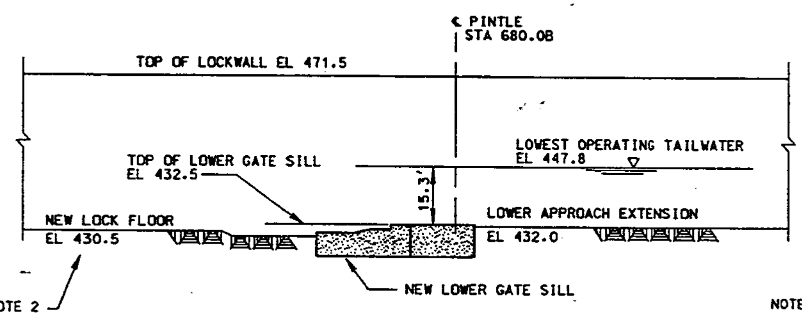
SECTION A R3B1|R3B2

20' 0 20'



SECTION THRU UPPER SILL

20' 0 20'



SECTION THRU LOWER SILL

20' 0 20'

NOTES:

1. DETAILS OF THIS LOCKWALL DESIGN ARE NOT SHOWN HERE. HOWEVER, THEY ARE SIMILAR TO THOSE OF THE LOCATION 2, TYPE B LOCK.

2. BECAUSE THE BASE OF THE EXISTING INTERMEDIATE LOCK-WALL IS AT ELEV. 431.5, THE EXISTING ROCK FLOOR WILL NOT BE EXCAVATED TO THE NEW FLOOR ELEVATION UNTIL A POINT DOWNSTREAM OF THE END OF THE I-WALL. THE TRANSITION WILL BE SLOPED 1V:3H OR FLATTER.

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 3 TYPE B SECTIONS**
Scale: As Shown	PLATE R3B2

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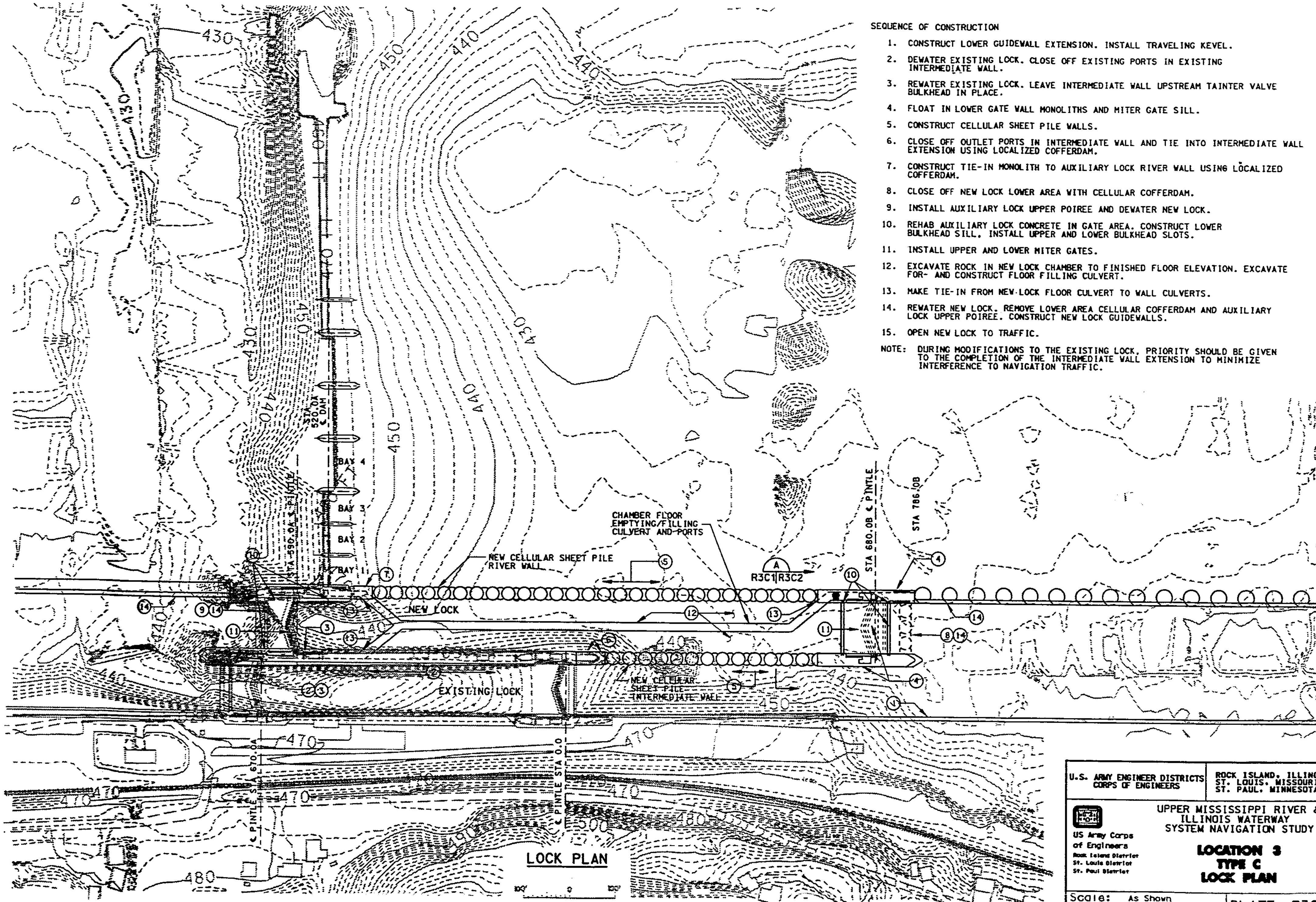

SEQUENCE OF CONSTRUCTION

1. CONSTRUCT LOWER GUIDEWALL EXTENSION. INSTALL TRAVELING KEVEL.
2. DEWATER EXISTING LOCK. CLOSE OFF EXISTING PORTS IN EXISTING INTERMEDIATE WALL.
3. REWATER EXISTING LOCK. LEAVE INTERMEDIATE WALL UPSTREAM TAINTER VALVE BULKHEAD IN PLACE.
4. FLOAT IN LOWER GATE WALL MONOLITHS AND MITER GATE SILL.
5. CONSTRUCT CELLULAR SHEET PILE WALLS.
6. CLOSE OFF OUTLET PORTS IN INTERMEDIATE WALL AND TIE INTO INTERMEDIATE WALL EXTENSION USING LOCALIZED COFFERDAM.
7. CONSTRUCT TIE-IN MONOLITH TO AUXILIARY LOCK RIVER WALL USING LOCALIZED COFFERDAM.
8. CLOSE OFF NEW LOCK LOWER AREA WITH CELLULAR COFFERDAM.
9. INSTALL AUXILIARY LOCK UPPER POIREE AND DEWATER NEW LOCK.
10. REHAB AUXILIARY LOCK CONCRETE IN GATE AREA. CONSTRUCT LOWER BULKHEAD SILL. INSTALL UPPER AND LOWER BULKHEAD SLOTS.
11. INSTALL UPPER AND LOWER MITER GATES.
12. EXCAVATE ROCK IN NEW LOCK CHAMBER TO FINISHED FLOOR ELEVATION. EXCAVATE FOR- AND CONSTRUCT FLOOR FILLING CULVERT.
13. MAKE TIE-IN FROM NEW LOCK FLOOR CULVERT TO WALL CULVERTS.
14. REWATER NEW LOCK. REMOVE LOWER AREA CELLULAR COFFERDAM AND AUXILIARY LOCK UPPER POIREE. CONSTRUCT NEW LOCK GUIDEWALLS.
15. OPEN NEW LOCK TO TRAFFIC.

NOTE: DURING MODIFICATIONS TO THE EXISTING LOCK, PRIORITY SHOULD BE GIVEN TO THE COMPLETION OF THE INTERMEDIATE WALL EXTENSION TO MINIMIZE INTERFERENCE TO NAVIGATION TRAFFIC.

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 3** **TYPE C** **LOCK PLAN**
Scale: As Shown	PLATE R3C1

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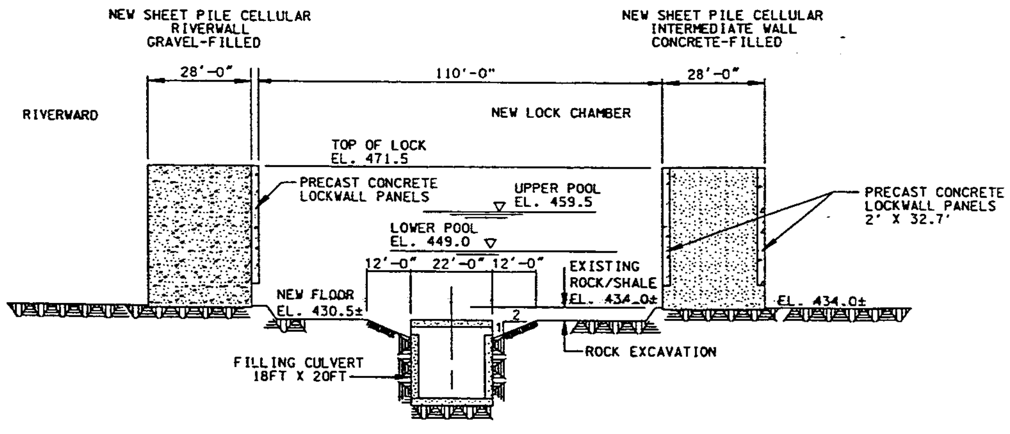
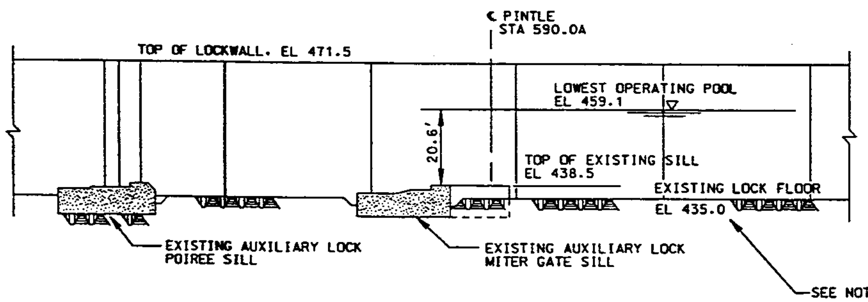


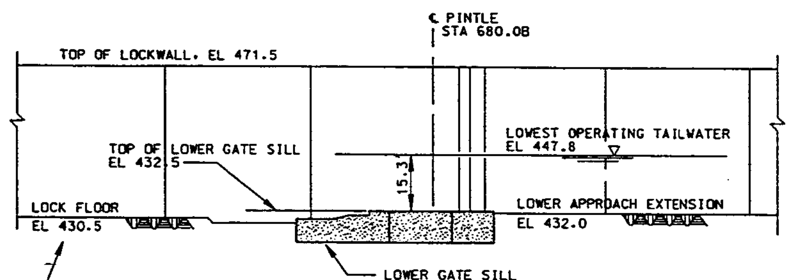
SECTION A R3C1|R3C2

20' 0 20'



SECTION THRU UPPER SILL

20' 0 20'



SECTION THRU LOWER SILL

20' 0 20'

NOTES:

1. BECAUSE THE BASE OF THE EXISTING INTERMEDIATE LOCK-WALL IS AT ELEV. 431.5, THE EXISTING ROCK FLOOR WILL NOT BE EXCAVATED TO THE NEW FLOOR ELEVATION UNTIL A POINT DOWNSTREAM OF THE END OF THE I-WALL. THE TRANSITION WILL BE SLOPED 1V:3H OR FLATTER.

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS | ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 3
TYPE C
SECTIONS

Scale: As Shown

PLATE R3C2

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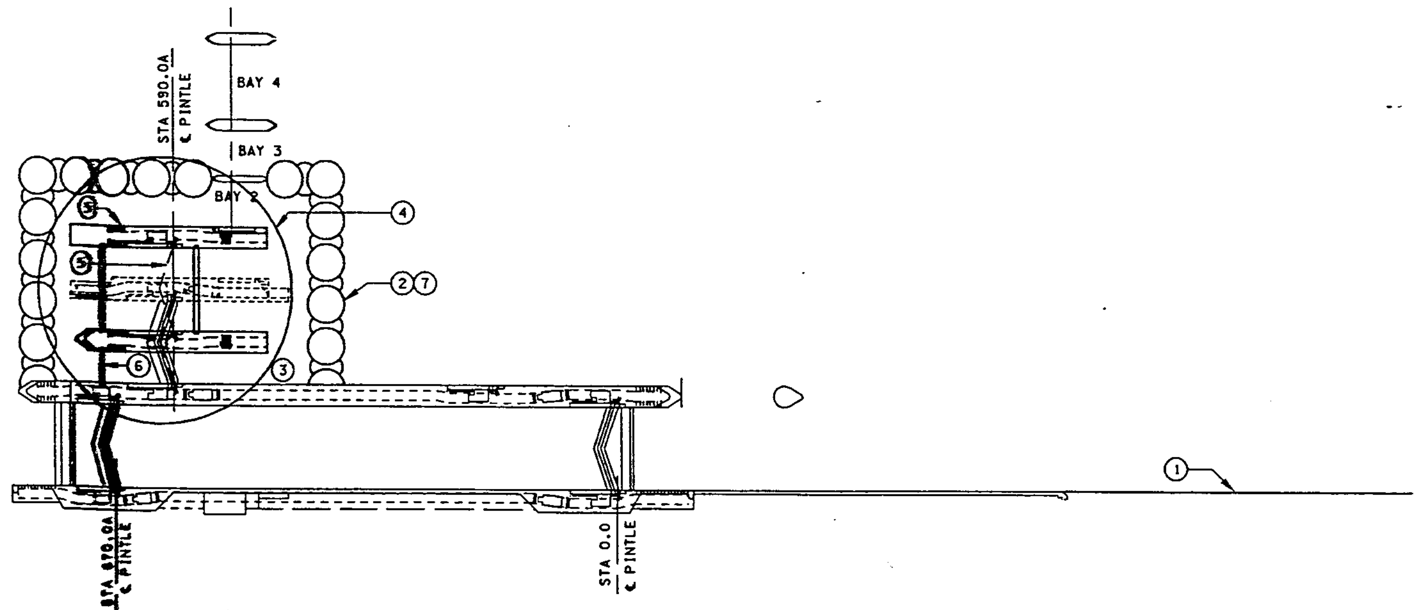
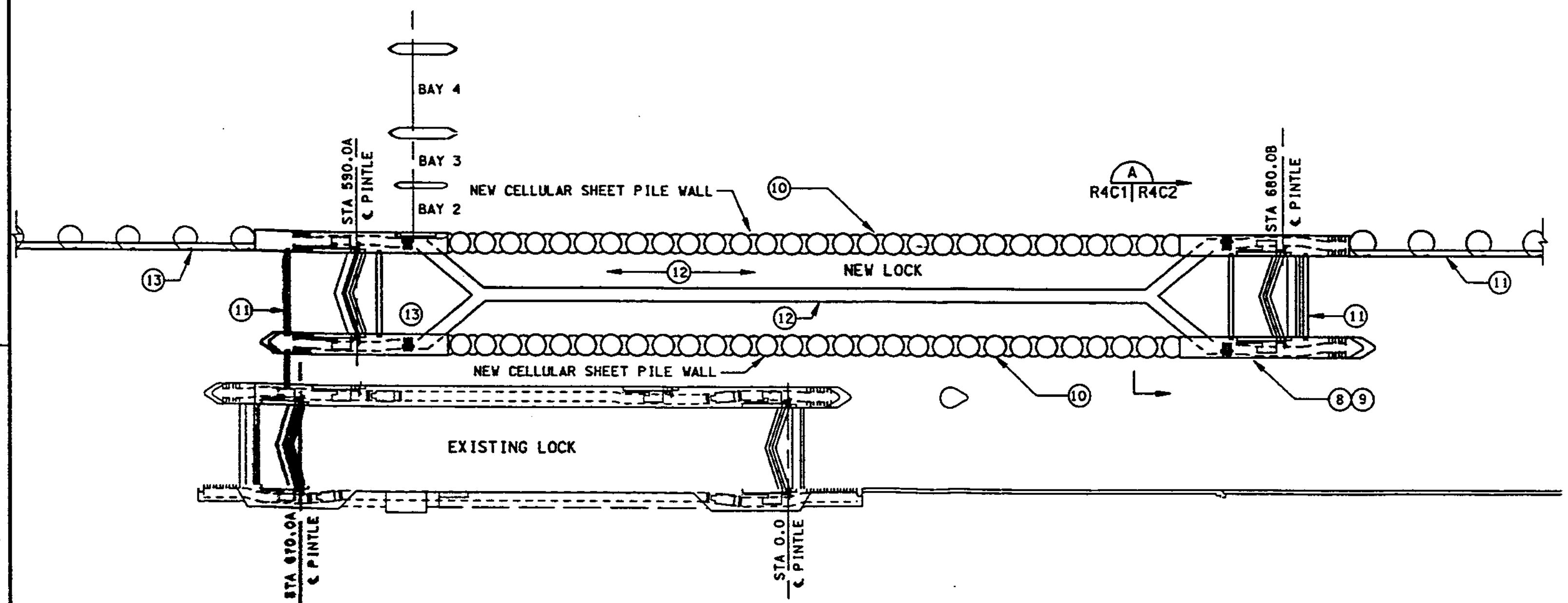


LOCK PLAN - PRIOR TO COFFERDAM REMOVAL

SEQUENCE OF CONSTRUCTION

1. CONSTRUCT LOWER GUIDEWALL EXTENSION. INSTALL TRAVELING KEVEL.
2. CONSTRUCT COFFERDAM FOR UPPER GATE MONOLITH.
3. DEWATER COFFERDAM.
4. REMOVE EXISTING COMPONENTS:
   A. AUXILIARY LOCK MITER GATE.
   B. AUXILIARY LOCK RIVER WALL.
   C. AUXILIARY LOCK MITER GATE SILL.
   D. SERVICE BRIDGE SPAN 1.
   E. DAM GATE 1.
   F. DAM PIER 1.
   G. DAM BAY 1 SILL.
5. CONSTRUCT UPPER GATE MONOLITH. INSTALL UPPER GATES.
6. INSTALL TIE-IN WALL TO INTERMEDIATE LOCKWALL.
7. REWATER AND REMOVE COFFERDAM.
8. EXCAVATE ROCK TO DESIGN ELEVATIONS IN THE AREA OF THE NEW LOWER MITER GATE MONOLITH.
9. PLACE FLOAT-IN LOWER MITER GATE MONOLITH.
10. CONSTRUCT CELLULAR SHEET PILE LOCK WALLS.
11. INSTALL UPPER AND LOWER BULKHEADS. DEWATER NEW LOCK.
12. EXCAVATE NEW LOCK FLOOR. EXCAVATE FLOOR FILLING CULVERT AND TIE INTO GATE MONOLITH WALL CULVERTS.
13. REWATER NEW LOCK. CONSTRUCT NEW LOCK GUIDE WALLS.
14. OPEN NEW LOCK TO TRAFFIC.



LOCK PLAN - AFTER COFFERDAM REMOVAL

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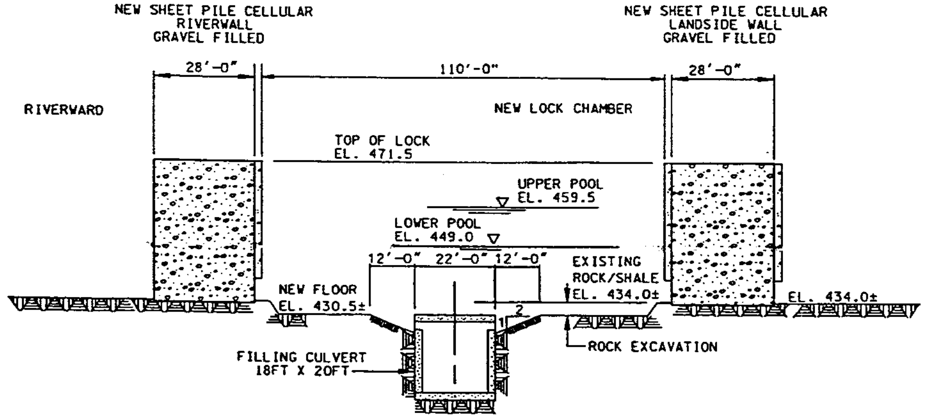
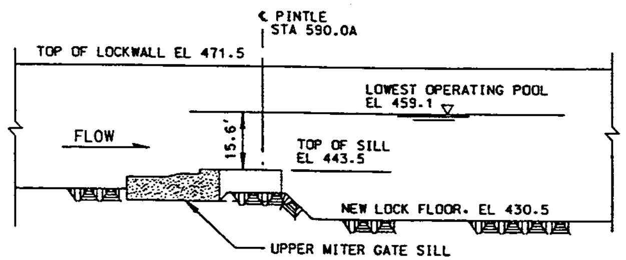
U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 4** **TYPE C** **LOCK PLANS**
Scale: As Shown	PLATE R4C1



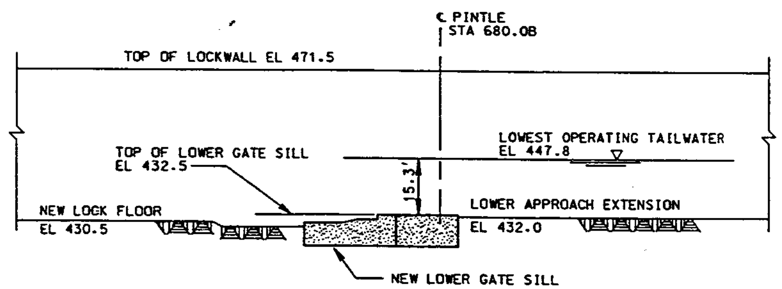
SECTION A R4C1|R4C2

20' 0 20'



SECTION THRU UPPER SILL

20' 0 20'



SECTION THRU LOWER SILL

20' 0 20'

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 4** **TYPE C** **SECTIONS**
Scale: As Shown	PLATE R4C2

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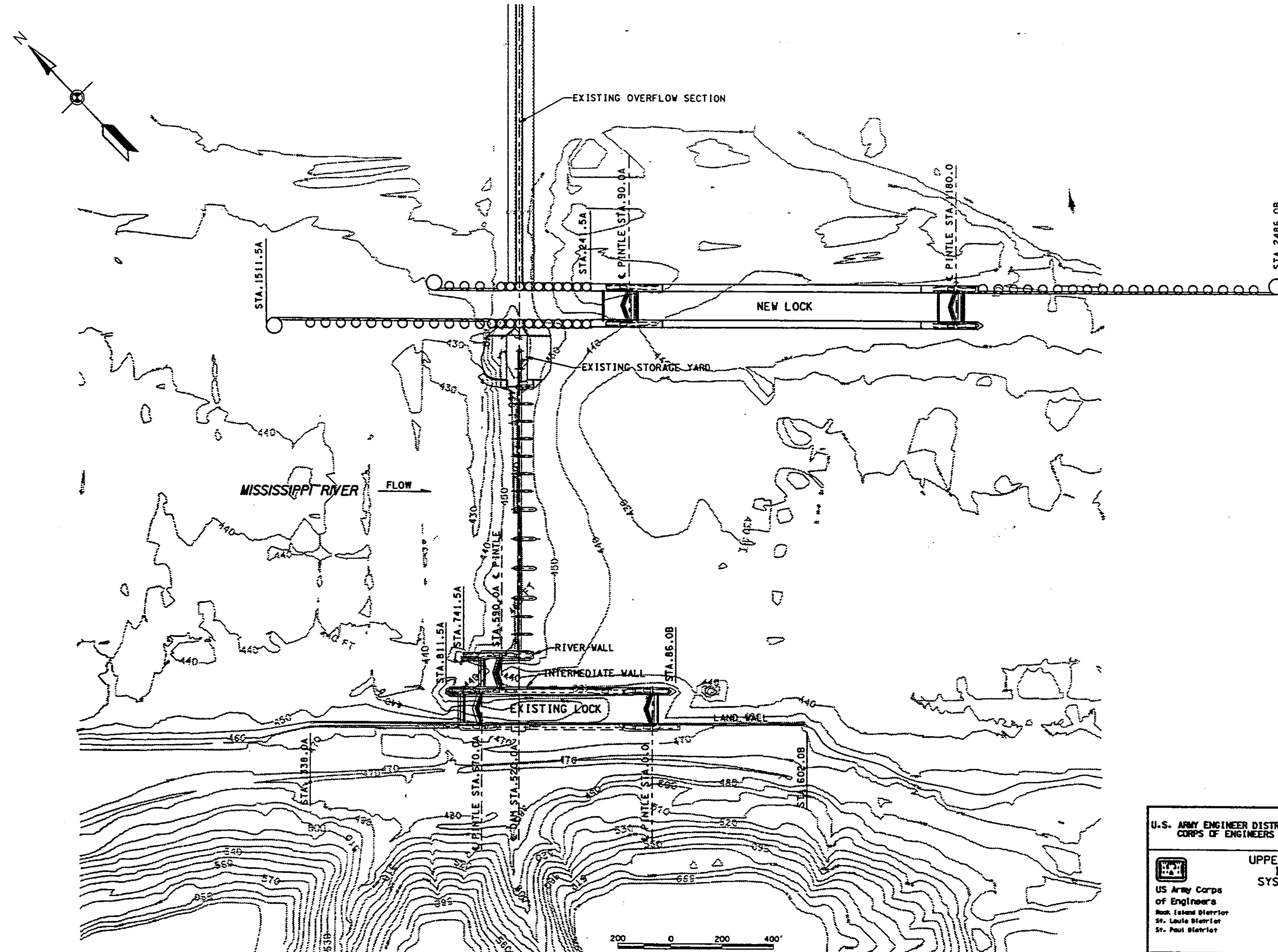

U.S. ARMY ENGINEER DISTRICTS
CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

US Army Corps
of Engineers
Rock Island District
St. Louis District
St. Paul District

UPPER MISSISSIPPI RIVER &
ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LOCATION 5
GENERAL PLAN

Scale: As Shown

PLATE R5GP

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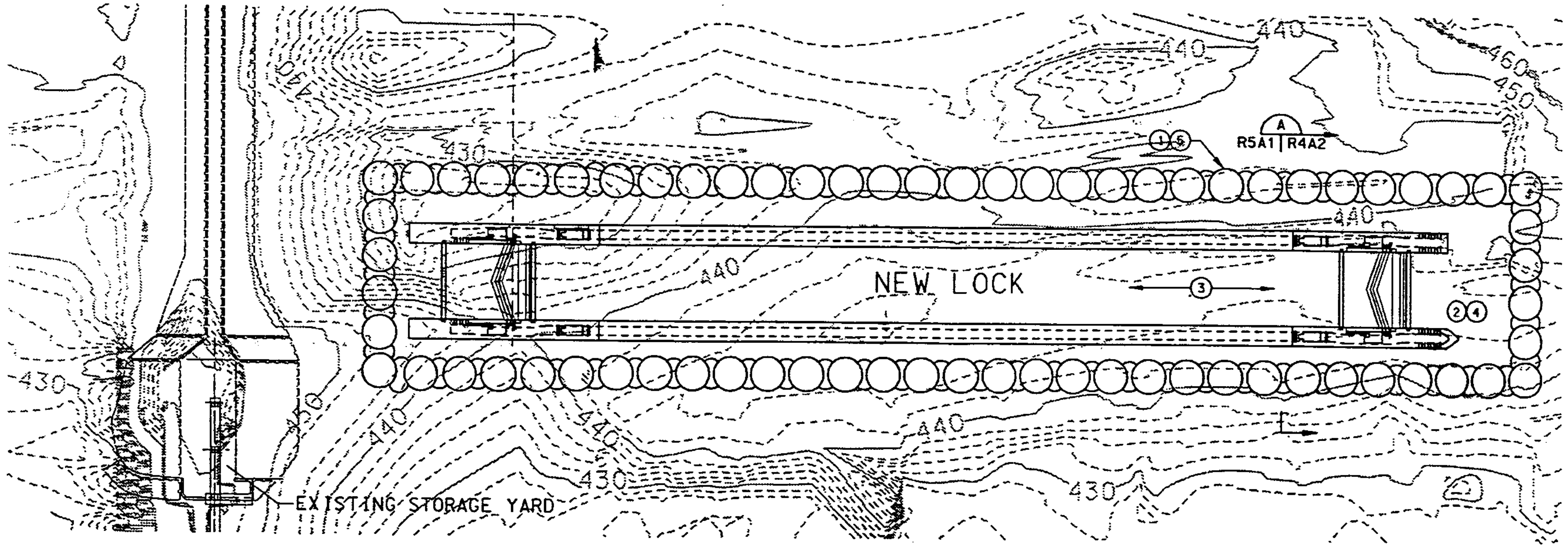
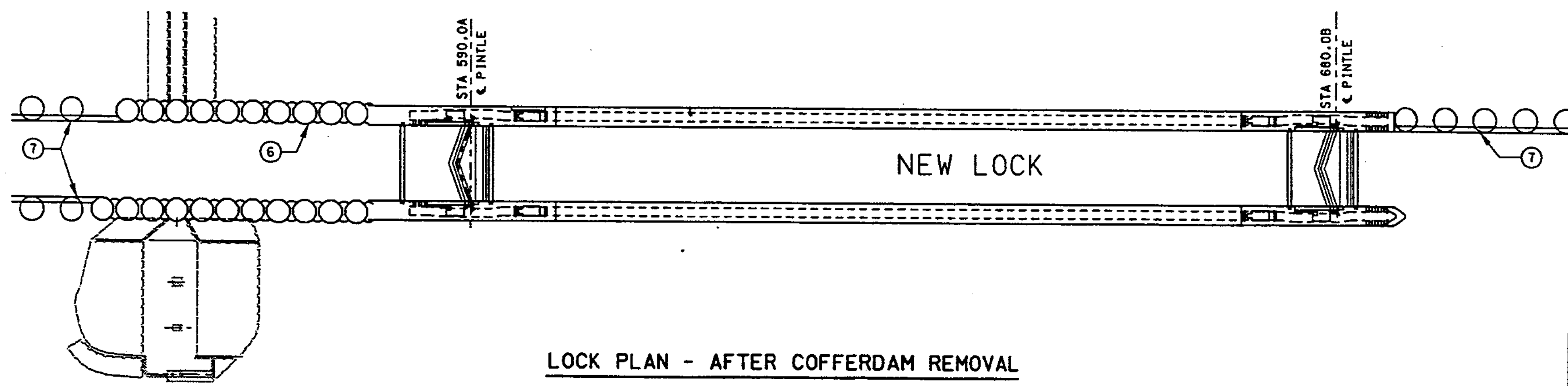


LOCK PLAN - PRIOR TO COFFERDAM REMOVAL

GENERAL SEQUENCE OF CONSTRUCTION

1. CONSTRUCT COFFERDAM (DREDGE ACCESS TO SITE AS REQUIRED).
2. DEWATER COFFERDAM AREA.
3. CONSTRUCT UPPER AND LOWER MITER GATE BAYS AND LOCK CHAMBER WALLS. EXCAVATE CHAMBER FLOOR.
4. REWATER COFFERDAM AREA.
5. REMOVE COFFERDAM.
6. CONSTRUCT APPROACH STRUCTURE:
   - A. REMOVE RIPRAP AND SLUSH CONCRETE FROM THE FACE OF THE EXISTING OVERFLOW SECTION.
   - B. DRIVE SHEETPILE CELLS FROM NEW LOCK TO THE EXISTING SHEETPILE DIAPHRAGM OF THE OVERFLOW SECTION OF THE DAM.
   - C. DRIVE CELLS FROM THE UPSTREAM SIDE, ALSO CONNECTING TO THE EXISTING SHEETPILE DIAPHRAGM.
   - D. COMPLETE SEEPAGE CUTOFF BY GROUTING BETWEEN THE NEW SHEETS AND THE OLD.
   - E. REMOVE DIAPHRAGM SHEETPILING AND FILL BETWEEN THE WALLS.
7. CONSTRUCT NEW LOCK GUIDE WALLS.
8. DREDGE NEW APPROACH CHANNEL AND CONSTRUCT TRAINING DIKES (NOT SHOWN).
9. OPEN NEW LOCK TO TRAFFIC.



LOCK PLAN - AFTER COFFERDAM REMOVAL

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 5 TYPE A LOCK PLANS**
Scale: As Shown	PLATE R5A1

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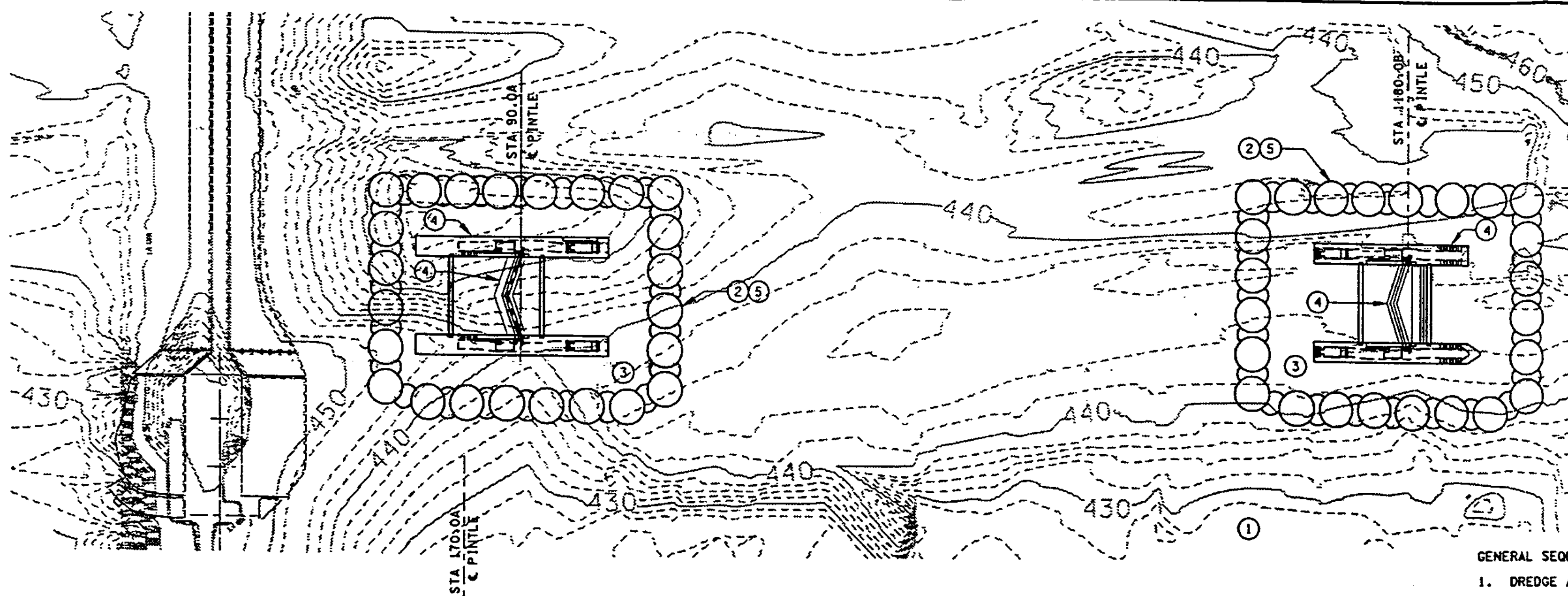
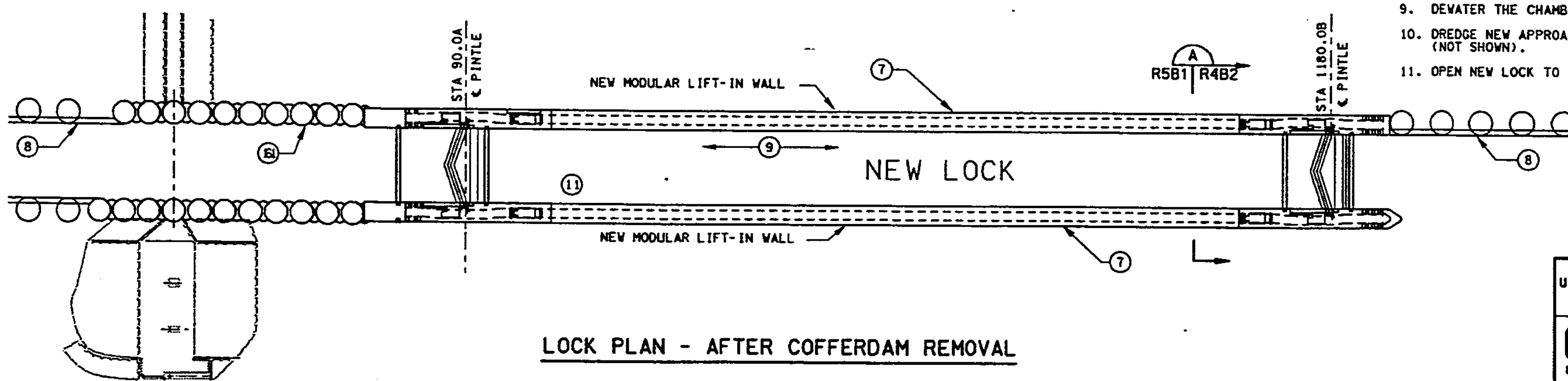


LOCK PLAN - PRIOR TO COFFERDAM REMOVAL

GENERAL SEQUENCE OF CONSTRUCTION

1. DREDGE ACCESS TO THE CONSTRUCTION SITE AS REQUIRED.
2. CONSTRUCT COFFERDAMS FOR UPPER AND LOWER GATE BAYS (THIS COULD BE DONE SEQUENTIALLY TO USE LESS SHEETPILING).
3. DEWATER COFFERDAM AREAS.
4. CONSTRUCT UPPER AND LOWER GATE BAYS AND INSTALL MITER GATES.
5. REWATER AND REMOVE COFFERDAMS.
6. CONSTRUCT APPROACH STRUCTURE:
   - A. REMOVE RIPRAP AND SLUSH CONCRETE FROM THE FACE OF THE EXISTING OVERFLOW SECTION.
   - B. DRIVE SHEETPILE CELLS FROM NEW LOCK TO THE EXISTING SHEETPILE DIAPHRAGM OF THE OVERFLOW SECTION OF THE DAM.
   - C. DRIVE CELLS FROM THE UPSTREAM SIDE, ALSO CONNECTING TO THE EXISTING SHEETPILE DIAPHRAGM.
   - D. COMPLETE SEEPAGE CUTOFF BY GROUTING BETWEEN THE NEW SHEETS AND THE OLD.
   - E. REMOVE DIAPHRAGM SHEETPILING AND FILL BETWEEN THE WALLS.
7. CONSTRUCT MODULAR LIFT-IN LOCKWALLS (PER DETAILS OF LOCATION 2, TYPE B).
8. CONSTRUCT NEW LOCK GUIDE WALLS.
9. DEWATER THE CHAMBER AND EXCAVATE CHAMBER FLOOR TO GRADE.
10. DREDGE NEW APPROACH CHANNEL AND CONSTRUCT TRAINING DIKES (NOT SHOWN).
11. OPEN NEW LOCK TO TRAFFIC.



LOCK PLAN - AFTER COFFERDAM REMOVAL

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 5 TYPE B LOCK PLANS**
Scale: As Shown	PLATE R5B1

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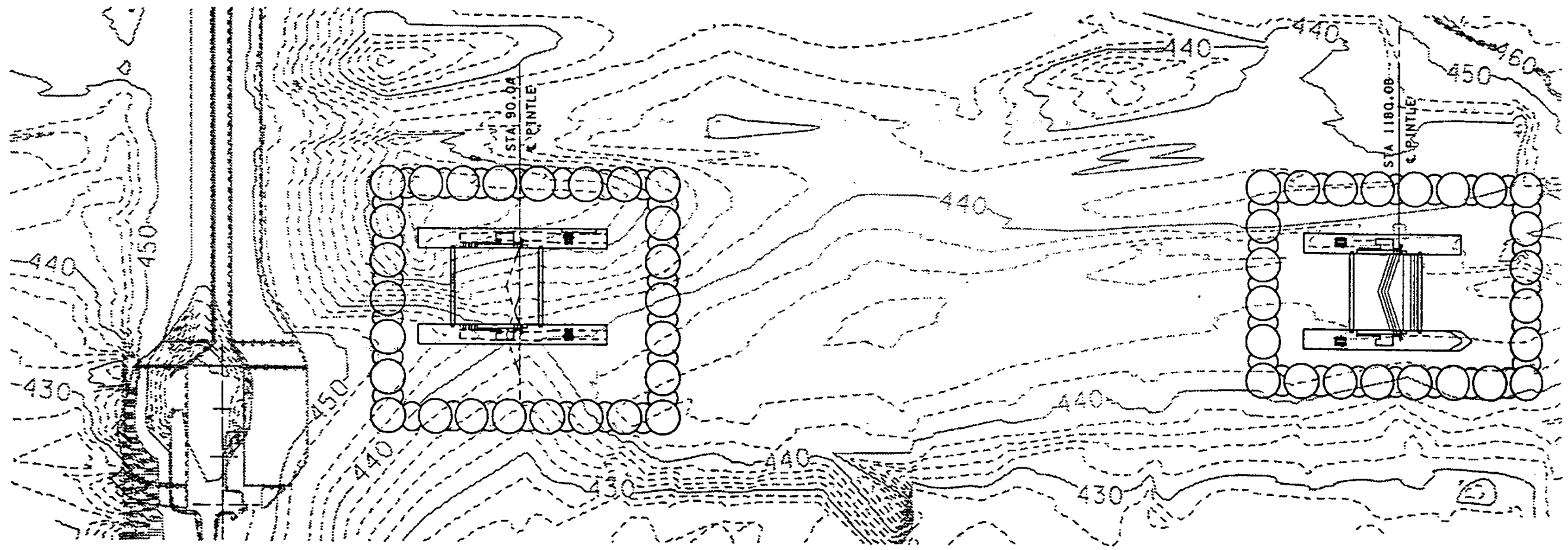
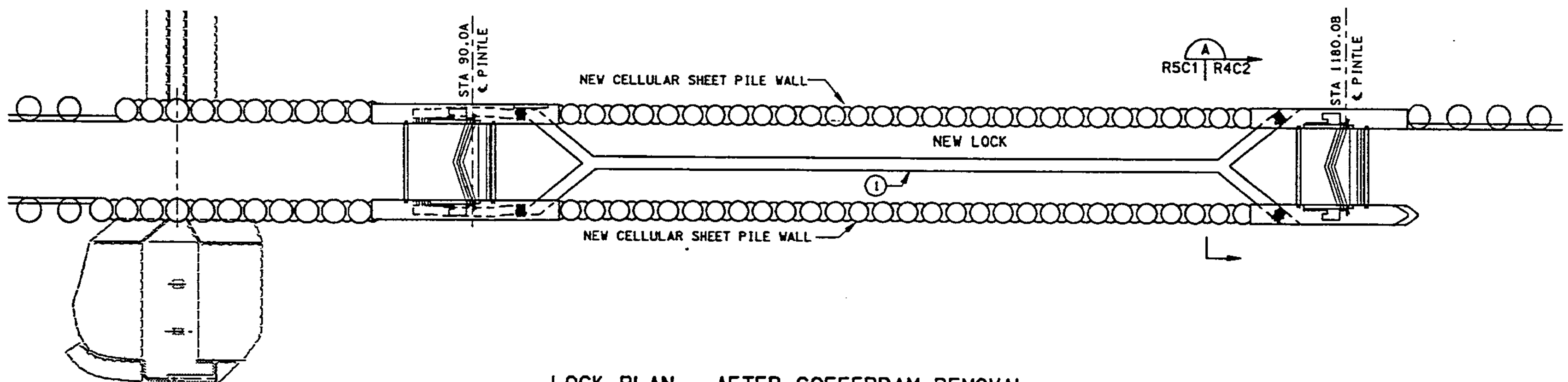


LOCK PLAN - PRIOR TO COFFERDAM REMOVAL

100' 0 100'



LOCK PLAN - AFTER COFFERDAM REMOVAL

100' 0 100'

SEQUENCE OF CONSTRUCTION NOTE:

1. THE SEQUENCE OF CONSTRUCTION FOR THE TYPE C LOCK IS GENERALLY THE SAME AS SHOWN ON PLATE R5B1 FOR THE TYPE B LOCK. THE MAIN EXCEPTION IS THAT EXCAVATION FOR- AND CONSTRUCTION OF THE FILLING AND EMPTYING CULVERT WOULD OCCUR AFTER THE LOCK CHAMBER WAS DEWATERED.

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 5** **TYPE C** **LOCK PLANS**
Scale: As Shown	PLATE R5C1

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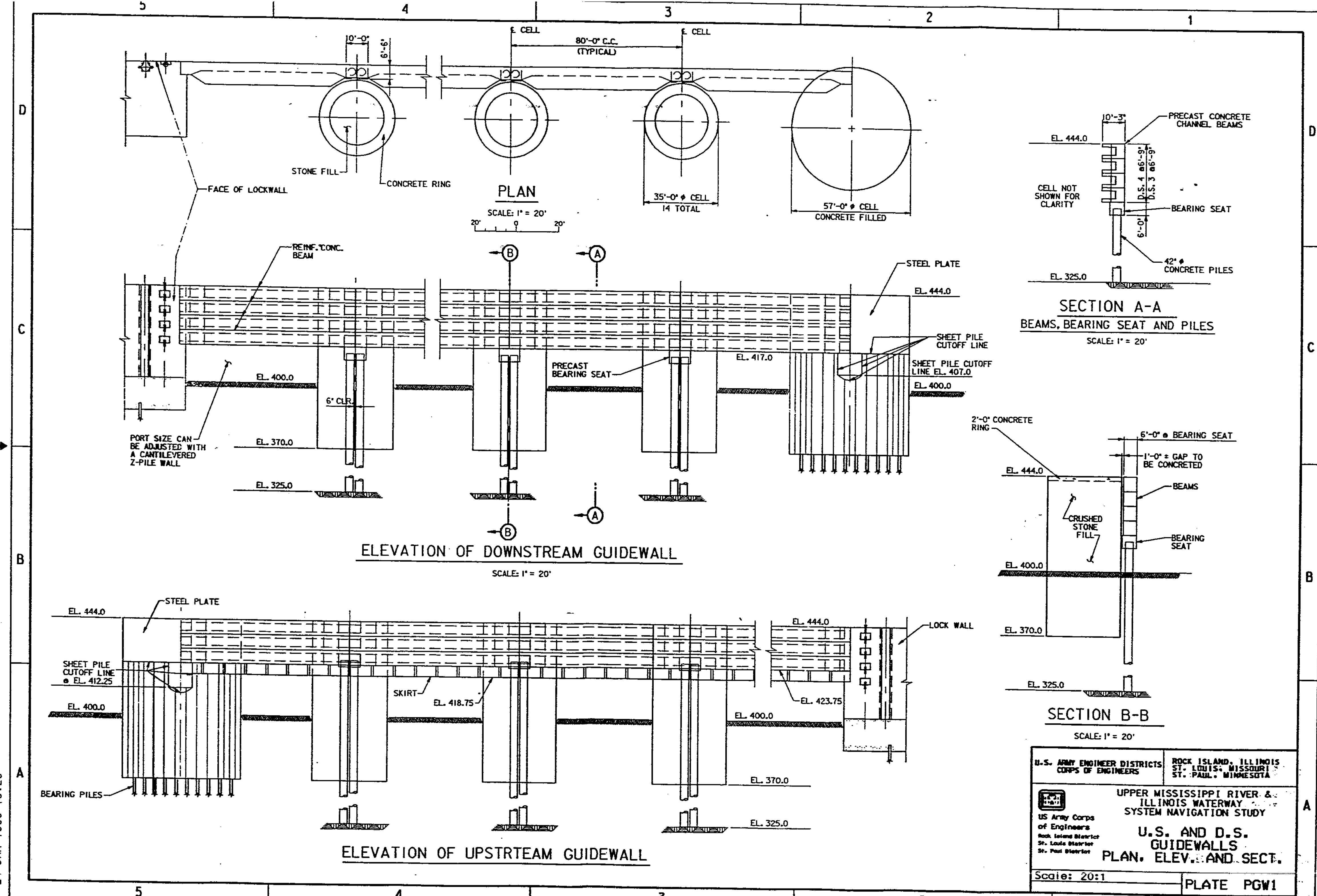

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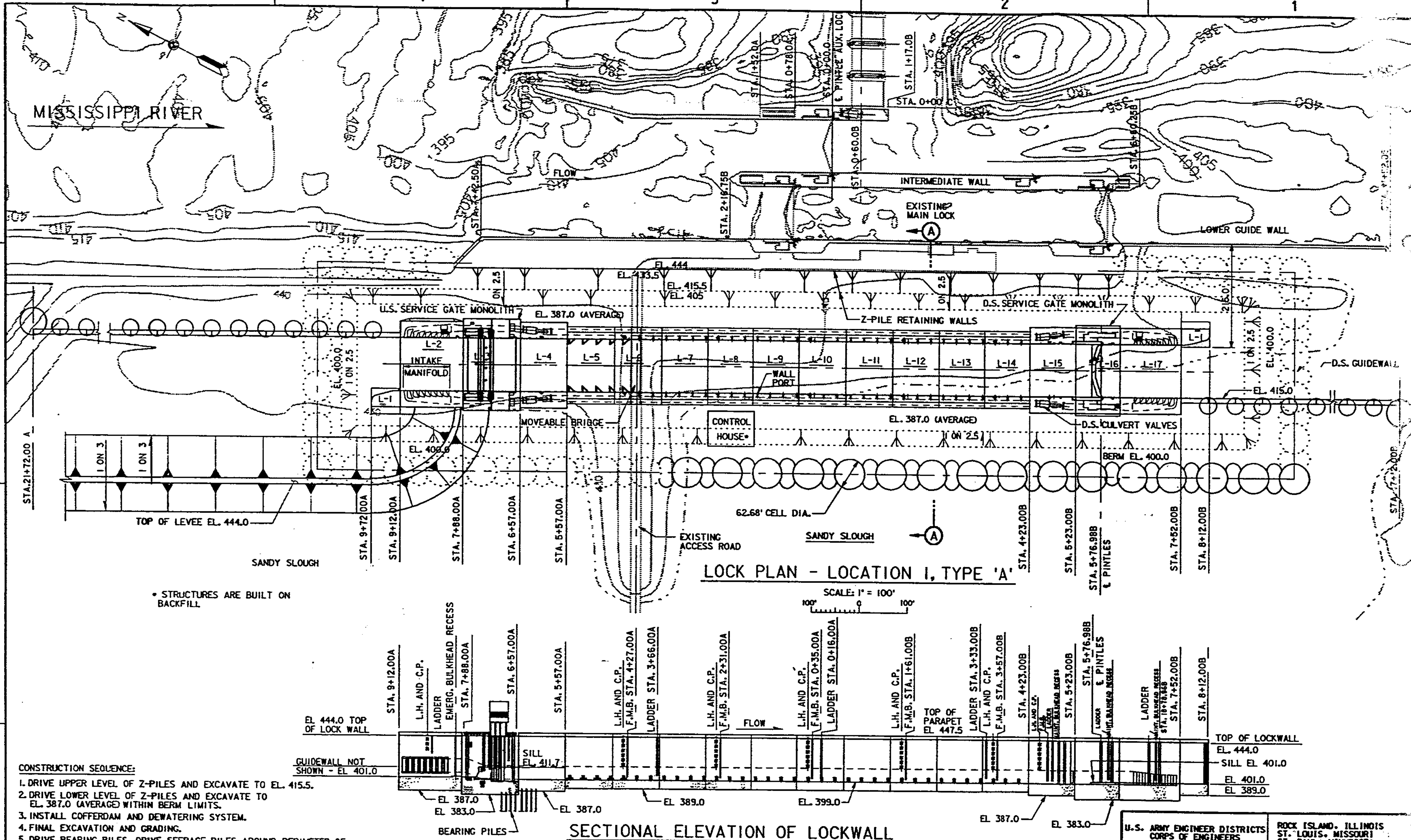


CONSTRUCTION SEQUENCE:

1. DRIVE UPPER LEVEL OF Z-PILES AND EXCAVATE TO EL. 415.5.
2. DRIVE LOWER LEVEL OF Z-PILES AND EXCAVATE TO EL. 387.0 (AVERAGE) WITHIN BERM LIMITS.
3. INSTALL COFFERDAM AND DEWATERING SYSTEM.
4. FINAL EXCAVATION AND GRADING.
5. DRIVE BEARING PILES. DRIVE SEEPAGE PILES AROUND PERIMETER OF UPPER AND LOWER 3 MONOLITHS.
6. CONSTRUCT CONCRETE MONOLITHS AND INSTALL EQUIPMENT.
7. BACKFILL.
8. REWATER COFFERDAM AND REMOVE END CELLS AND RIVERWARD CELLS.
9. CONSTRUCT ESPLANADE AND CONTROL HOUSE.
10. CONSTRUCT BASCULE BRIDGE.
11. CONSTRUCT GUIDEWALLS AND EXCAVATE APPROACHES.
12. PLACE STONE PROTECTION

NOTES:

1. DASHED COFFERDAM CELLS ARE TO BE REMOVED.
2. TOP OF COFFERDAM EL. 440.0.
3. LOCAL EXCAVATION FOR DEEPER FOUNDED MONOLITHS NOT SHOWN.
4. NEW CONTROL HOUSE LOCATION CAN VARY.
5. A SHEET PILE CUT-OFF WALL SHOULD EXTEND FROM U.S. GATE MONOLITH OF NEW LOCK TO U.S. GATE MONOLITH OF EXISTING LOCK.

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS — ROCK ISLAND, ILLINOIS; ST. LOUIS, MISSOURI; ST. PAUL, MINNESOTA

US Army Corps of Engineers — Rock Island District, St. Louis District, St. Paul District

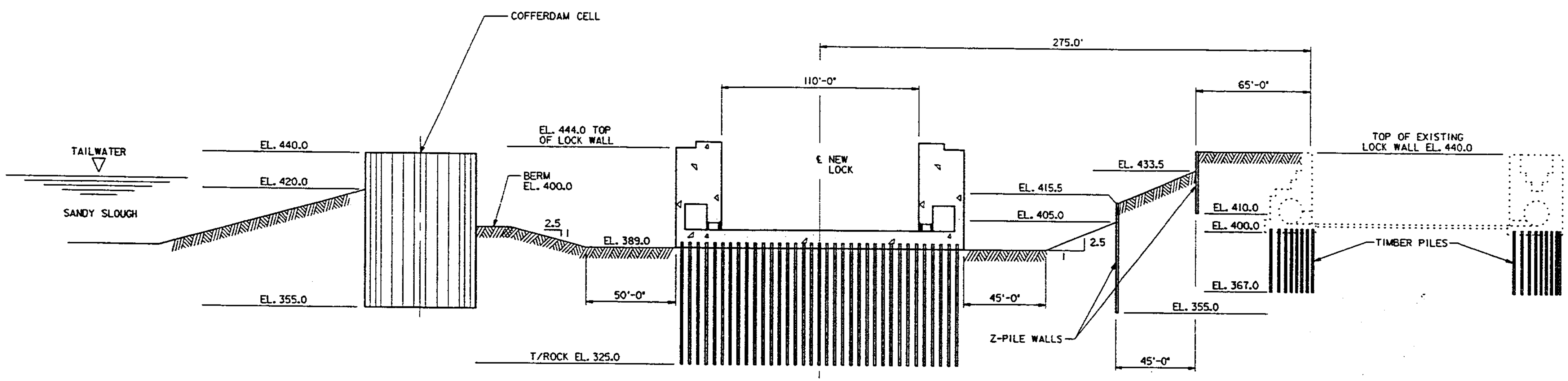
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

LOCATION 1
TYPE A
LOCK PLAN

Scale: 100:1

PLATE P1A1

25-JAN-1996 13:37



SECTION A-A

SCALE: 1" = 30'

30' 0 30'

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

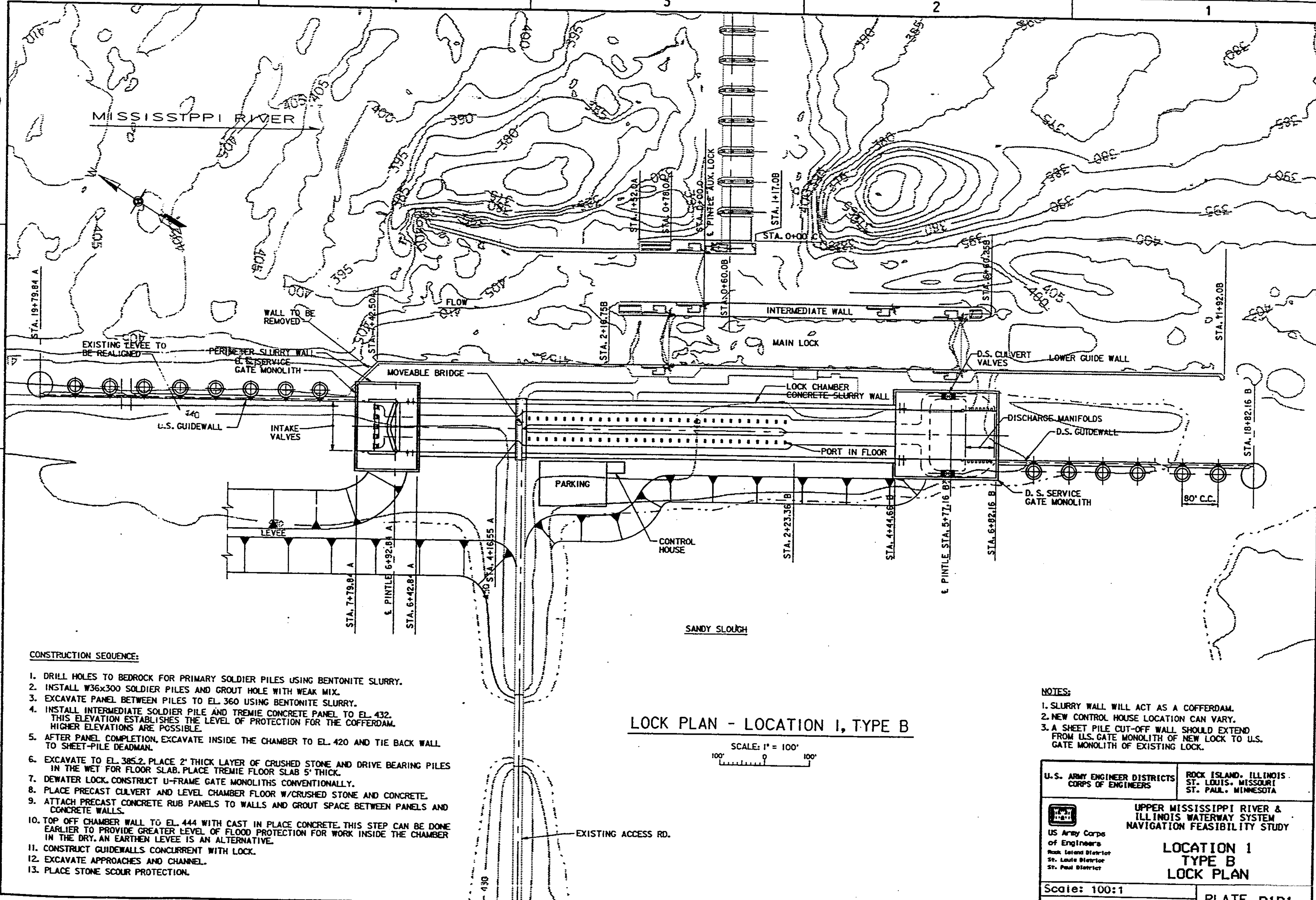
US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

LOCATION 1
TYPE A
SECTION A

Scale: 30:1

PLATE P1A2

9-JAN-1996 09:53



LOCK PLAN - LOCATION 1, TYPE B

SCALE: 1" = 100'

CONSTRUCTION SEQUENCE:

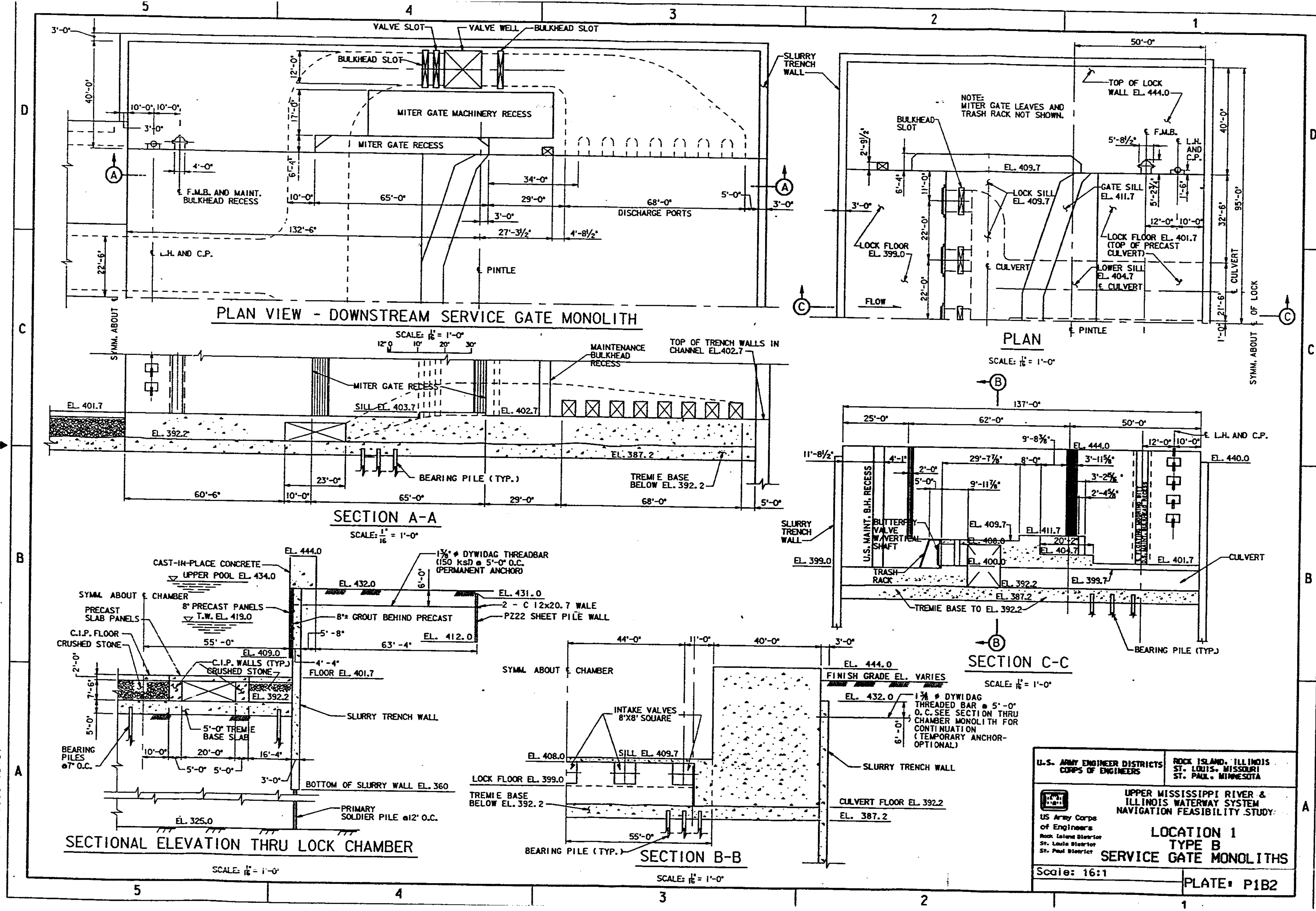
1. DRILL HOLES TO BEDROCK FOR PRIMARY SOLDIER PILES USING BENTONITE SLURRY.
2. INSTALL W36x300 SOLDIER PILES AND GROUT HOLE WITH WEAK MIX.
3. EXCAVATE PANEL BETWEEN PILES TO EL. 360 USING BENTONITE SLURRY.
4. INSTALL INTERMEDIATE SOLDIER PILE AND TREMIE CONCRETE PANEL TO EL. 432. THIS ELEVATION ESTABLISHES THE LEVEL OF PROTECTION FOR THE COFFERDAM. HIGHER ELEVATIONS ARE POSSIBLE.
5. AFTER PANEL COMPLETION, EXCAVATE INSIDE THE CHAMBER TO EL. 420 AND TIE BACK WALL TO SHEET-PILE DEADMAN.
6. EXCAVATE TO EL. 385.2. PLACE 2' THICK LAYER OF CRUSHED STONE AND DRIVE BEARING PILES IN THE WET FOR FLOOR SLAB. PLACE TREMIE FLOOR SLAB 5' THICK.
7. DEWATER LOCK. CONSTRUCT U-FRAME GATE MONOLITHS CONVENTIONALLY.
8. PLACE PRECAST CULVERT AND LEVEL CHAMBER FLOOR W/CRUSHED STONE AND CONCRETE.
9. ATTACH PRECAST CONCRETE RUB PANELS TO WALLS AND GROUT SPACE BETWEEN PANELS AND CONCRETE WALLS.
10. TOP OFF CHAMBER WALL TO EL. 444 WITH CAST IN PLACE CONCRETE. THIS STEP CAN BE DONE EARLIER TO PROVIDE GREATER LEVEL OF FLOOD PROTECTION FOR WORK INSIDE THE CHAMBER IN THE DRY. AN EARTHEN LEVEE IS AN ALTERNATIVE.
11. CONSTRUCT GUIDEWALLS CONCURRENT WITH LOCK.
12. EXCAVATE APPROACHES AND CHANNEL.
13. PLACE STONE SCOUR PROTECTION.

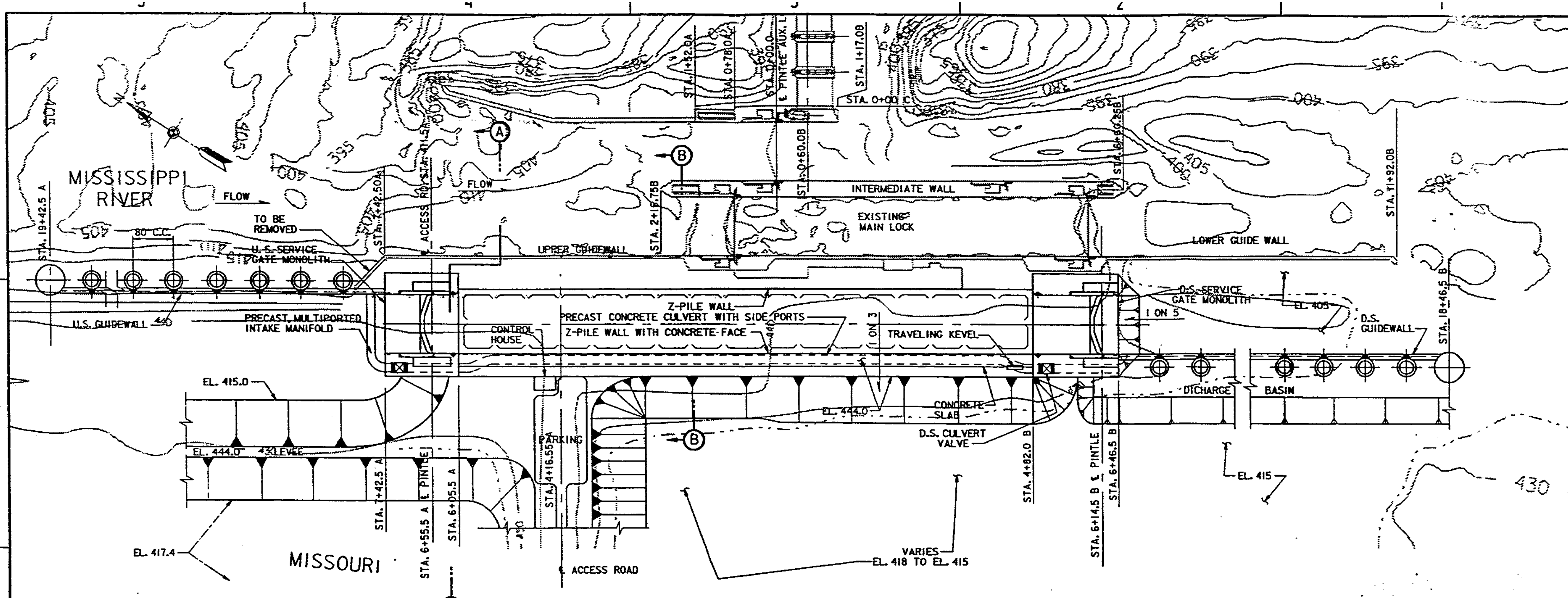
NOTES:

1. SLURRY WALL WILL ACT AS A COFFERDAM.
2. NEW CONTROL HOUSE LOCATION CAN VARY.
3. A SHEET PILE CUT-OFF WALL SHOULD EXTEND FROM U.S. GATE MONOLITH OF NEW LOCK TO U.S. GATE MONOLITH OF EXISTING LOCK.

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS	ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY LOCATION 1 TYPE B LOCK PLAN
Scale: 100:1	PLATE P1B1

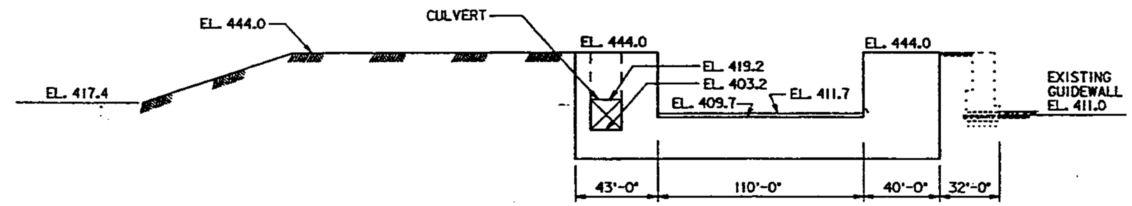
25-JAN-1996 11:18


PLAN VIEW - DOWNSTREAM SERVICE GATE MONOLITH
SCALE: 1/16" = 1'-0"
VALVE SLOT
VALVE WELL
BULKHEAD SLOT
MITER GATE MACHINERY RECESS
MITER GATE RECESS
SLURRY TRENCH WALL
℄ F.M.B. AND MAINT. BULKHEAD RECESS
DISCHARGE PORTS
℄ L.H. AND C.P.
℄ PINTLE
PLAN
NOTE: MITER GATE LEAVES AND TRASH RACK NOT SHOWN.
TOP OF LOCK WALL EL. 444.0
LOCK SILL EL. 409.7
GATE SILL EL. 411.7
LOCK FLOOR EL. 399.0
LOCK FLOOR EL. 401.7 (TOP OF PRECAST CULVERT)
LOWER SILL EL. 404.7
℄ CULVERT
FLOW
SYMM. ABOUT ℄ OF LOCK
SECTION A-A
MAINTENANCE BULKHEAD RECESS
TOP OF TRENCH WALLS IN CHANNEL EL. 402.7
SILL EL. 403.7
BEARING PILE (TYP.)
TREMIE BASE BELOW EL. 392.2
SECTION C-C
U.S. MAINT. B.H. RECESS
BUTTERFLY VALVE W/VERTICAL SHAFT
TRASH RACK
TREMIE BASE TO EL. 392.2
CULVERT
BEARING PILE (TYP.)
SECTIONAL ELEVATION THRU LOCK CHAMBER
CAST-IN-PLACE CONCRETE
UPPER POOL EL. 434.0
1 3/8" ⌀ DYWIDAG THREADBAR (150 ksi) @ 5'-0" O.C. (PERMANENT ANCHOR)
SYMM. ABOUT ℄ CHAMBER
PRECAST SLAB PANELS
8" PRECAST PANELS
T.W. EL. 419.0
8"± GROUT BEHIND PRECAST
2 - C 12x20.7 WALE
PZ22 SHEET PILE WALL
C.I.P. FLOOR
CRUSHED STONE
C.I.P. WALLS (TYP.)
FLOOR EL. 401.7
SLURRY TRENCH WALL
5'-0" TREMIE BASE SLAB
BEARING PILES @7' O.C.
BOTTOM OF SLURRY WALL EL. 360
PRIMARY SOLDIER PILE @12' O.C.
EL. 325.0
SECTION B-B
INTAKE VALVES 8'X8' SQUARE
SILL EL. 409.7
LOCK FLOOR EL. 399.0
TREMIE BASE BELOW EL. 392.2
FINISH GRADE EL. VARIES
1 3/8" ⌀ DYWIDAG THREADED BAR @ 5'-0" O.C. SEE SECTION THRU CHAMBER MONOLITH FOR CONTINUATION (TEMPORARY ANCHOR-OPTIONAL)
CULVERT FLOOR EL. 392.2
BEARING PILE (TYP.)
U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS ST. LOUIS, MISSOURI ST. PAUL, MINNESOTA
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY
US Army Corps of Engineers
LOCATION 1
TYPE B
SERVICE GATE MONOLITHS
Scale: 16:1
PLATE: P1B2
24-JAN-1996 15:37



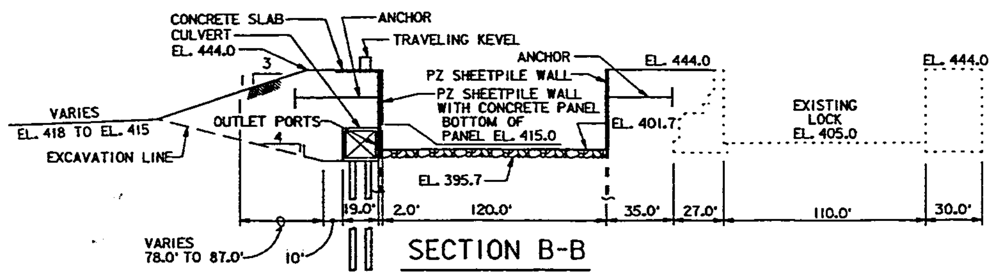
SITE PLAN LOCATION 1

SCALE: 1" = 100'



SECTION A-A

SCALE: 1" = 40'



SECTION B-B

SCALE: 1" = 40'

CONSTRUCTION SEQUENCE

1. CONSTRUCT SINGLE SINGLE SHEET PILEWALL COFFERDAMS FOR U.S. AND D.S. GATE MONOLTIHS.
2. EXCAVATE WITHIN COFFERDAMS, BRACE, AND DRIVE BEARING PILES.
3. TREMIE SEAL BOTTOM OF COFFERDAM, DEWATER AND CONSTRUCT REMAINDER OF MONOLITH IN THE DRY.
4. FOR THE CHAMBER WALLS, DRIVE RIVERWARD Z-PILE WALL AND ANCHOR.
5. EXCAVATE FOR CHAMBER, INSTALL ADDITIONAL ANCHORS AS REQ'D. INSTALL CULVERT IN THE WET ON BEARING PILES.
6. DRIVE LANDWARD Z-PILE WALL, PORT CULVERT THROUGH Z-PILE WALL IN THE WET.
7. BACKFILL Z-PILES AND ANCHOR, INSTALL CONCRETE RUBBING PANELS.
8. PLACE STONE SCOUR PROTECTION IN CHAMBER.
9. INSTALL TRAVELING KEVEL AND MACHINERY.
10. CONSTRUCT GUIDEWALLS CONCURRENT WITH LOCK.
11. PLACE PERMANENT SCOUR PROTECTION.

NOTES:

1. CONTOURS SHOWN ARE FOR EXISTING CONDITIONS AT LOCK AND DAM NO. 25 UNLESS NOTED OTHERWISE.
2. ANCHORS COULD TIE TO EXISTING LOCKWALL WHERE POSSIBLE.
3. DISCHARGE BASIN IS CONCEPTUAL. ACTUAL SIZE AND SHAPE MAY CHANGE.
4. TRAVELING KEVEL WILL KEEP TOWS FROM RUBBING THE EAST LOCKWALL.
5. MOVABLE BRIDGE OVER LOCK NOT FEATURED TO REDUCE COST.
6. A SHEET PILE CUT-OFF WALL SHOULD EXTEND FROM U.S. GATE MONOLITH OF NEW LOCK TO U.S. GATE MONOLITH OF EXISTING LOCK.

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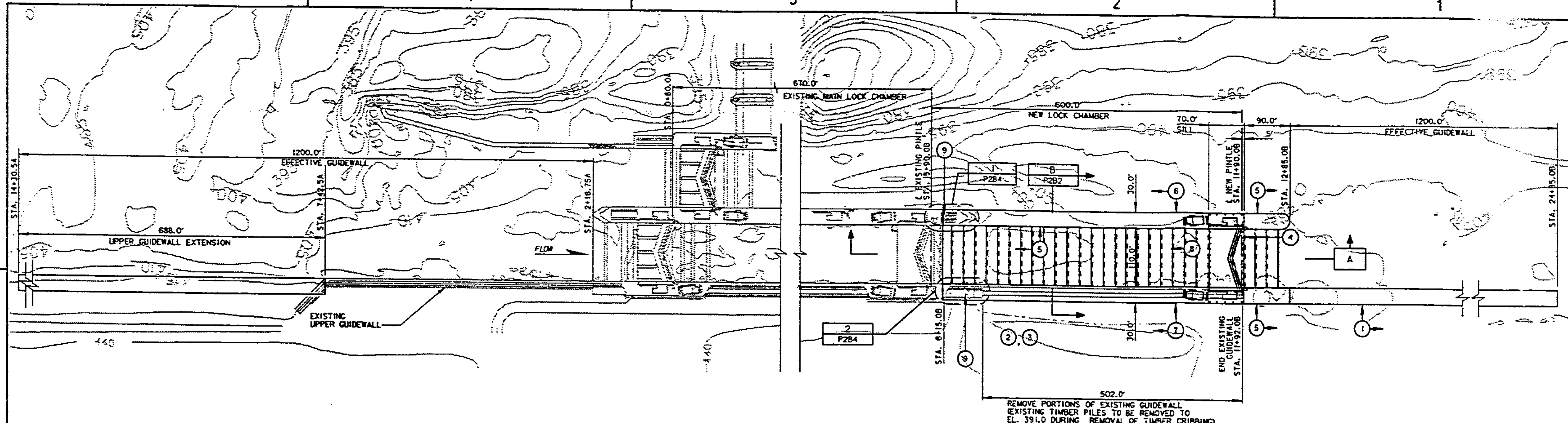
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

LOCATION 1
TYPE C
LOCK PLAN

Scale: 100:1

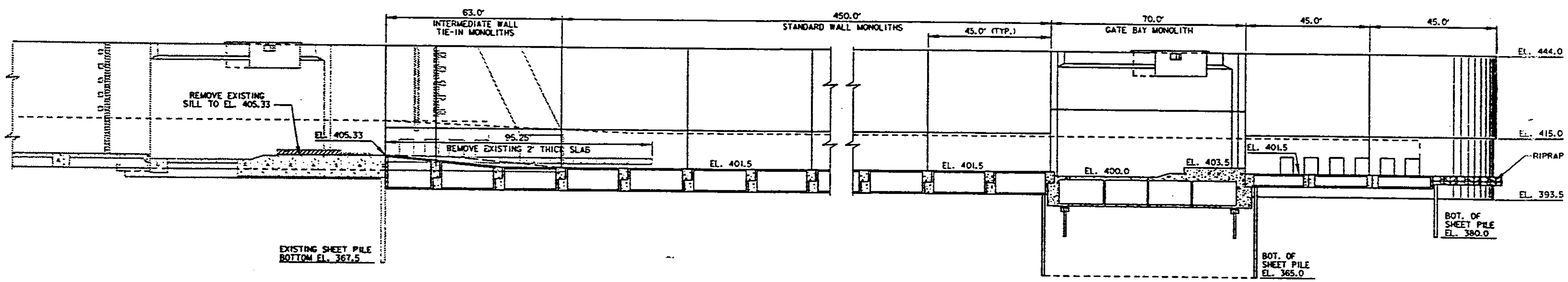
PLATE P1C1

25-JAN-1996 11:20



PLAN
DOWNSTREAM END OF LOCK EXPANSION

100 0 100 200
SCALE IN FEET



SECTION
WALL & FLOOR SLAB
SCALE: 1" = 20'-0"

A

20 0 20 40
SCALE IN FEET

CONSTRUCTION SEQUENCE
LOCK EXTENSION

1. WORKING FROM UPSTREAM TO DOWNSTREAM, CONSTRUCT DOWNSTREAM GUIDEWALL.
2. PLACE SHEET PILE WALL FOR DOWNSTREAM EXTENSION
3. PRE-DREDGE SITE WITHIN SHEET PILES, EXCEPT AT EXISTING GUIDEWALL AND TIE-IN. PLACE SCOUR STONES WITHIN SHEET PILES.
4. AFTER DREDGING, FLOAT PRECAST SILL MONOLITH AND SINK ON TO LANDING PADS. (SEE PLATE 2B-P-5)
5. CONSTRUCT DOWNSTREAM APPROCH MONOLITHS.
6. CONSTRUCT RIVERWARD WALL MONOLITHS.
7. INCREMENTALLY DEMOLISH EXISTING GUIDEWALL AND CONSTRUCT LANDWARD WALL.
8. PLACE FLOOR UNITS.
9. DEMOLISH EXISTING DISCHARGE MONOLITHS AND CONSTRUCT TIE-IN WALL MONOLITHS AND SLAB

NOTE:
1. GUIDEWALLS ARE SHOWN SCHEMATICALLY.

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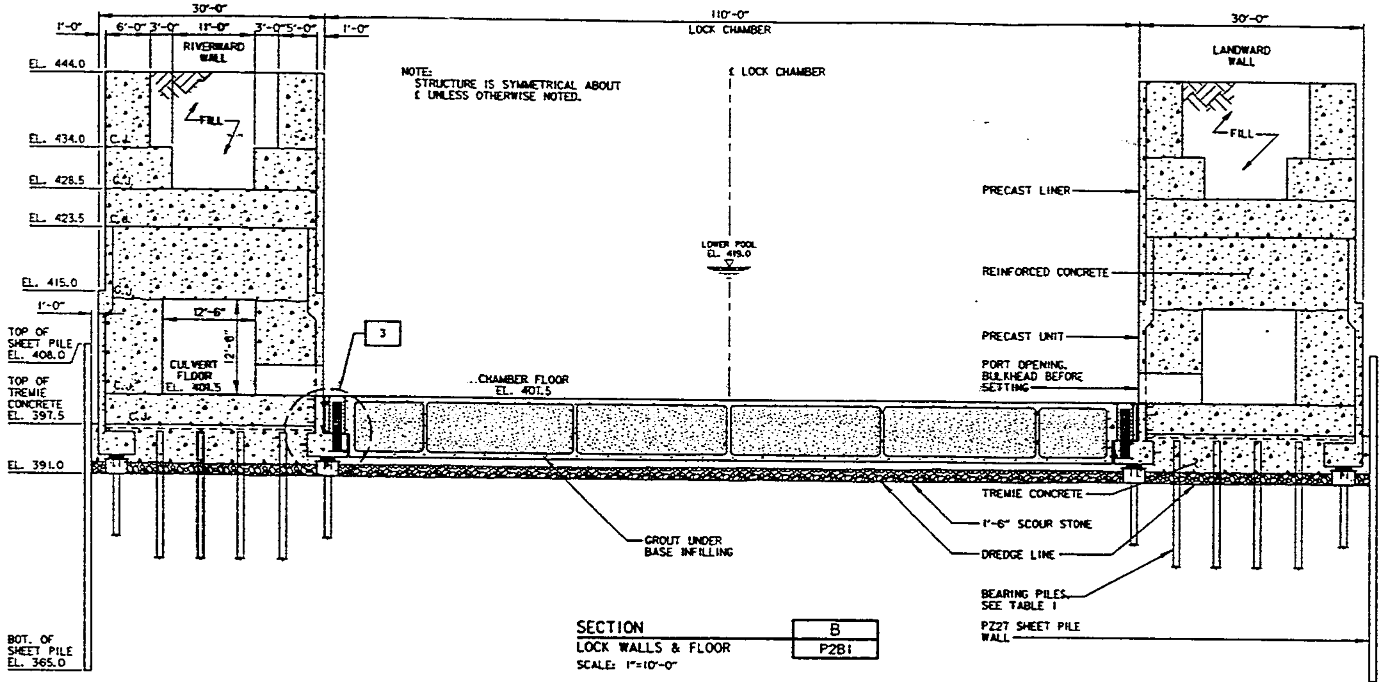
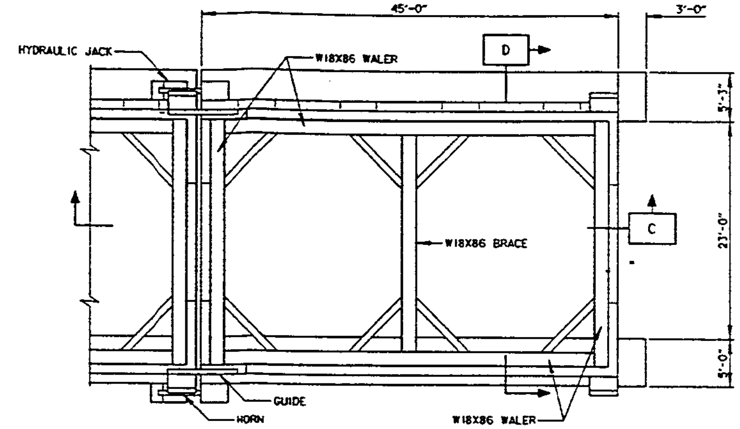
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY **LOCATION 2 TYPE B LOCK PLAN & SECTION**
Scale:	PLATE P2B1

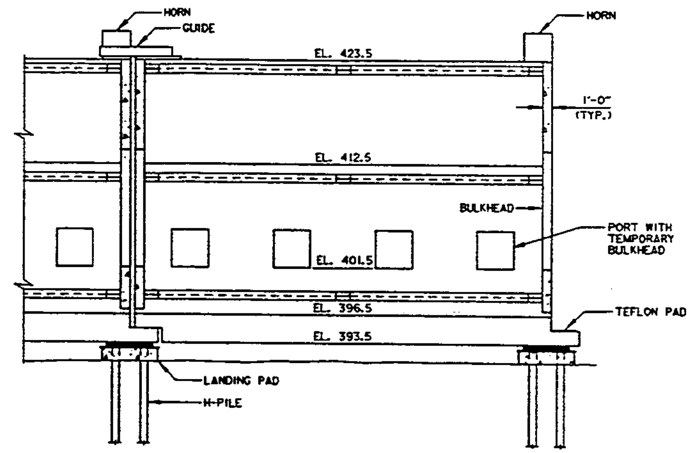
LD25-DS.DGN



SECTION B
LOCK WALLS & FLOOR P2B1
SCALE: 1"=10'-0"

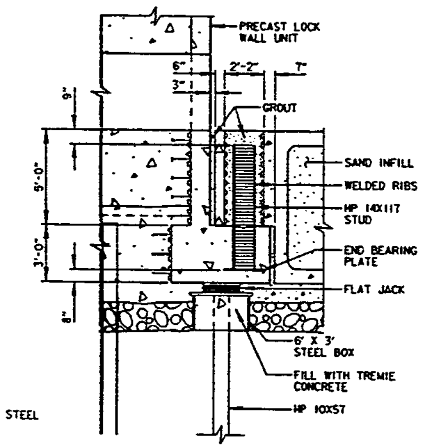


PLAN
PRECAST UNIT (TYPICAL)
SCALE: 1/8" = 1'-0"



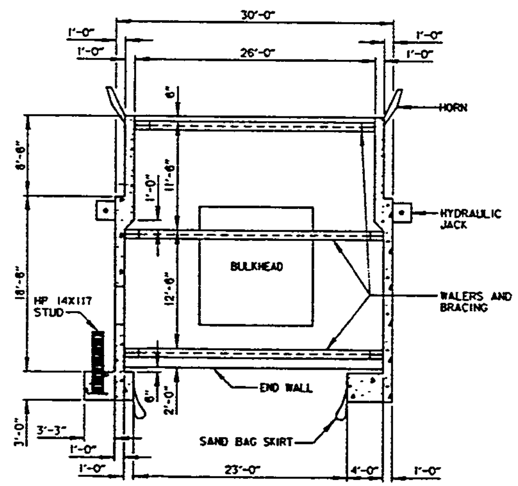
SECTION C
PRECAST UNIT (TYPICAL)
SCALE: 1/8"=1'-0"

TABLE 1 - PILE REQUIREMENTS (SEE NOTES 1 AND 2)				
PILE TYPE	SIZE	TRAN. ROW SPACING	LONG. ROW SPACING	NO. OF PILES PER 45' MONOLITH
HP SECTION, GR. 50	HP 14X89	9@5'-0"	6@5'-0"	54
PRESTRESS	20"±	7@6'-8"	4@8'-4"	28
CAST-IN-PLACE	24"±	8@5'-8½"	4@8'-4"	32



NOTE:
REINFORCING STEEL NOT SHOWN

DETAIL 3
LOCK WALL/FLOOR CONNECTION
SCALE: 1/4"=1'-0"



SECTION D
PRECAST UNIT (TYPICAL)
SCALE: 1/8"=1'-0"

SCALE: 1" = 10'-0"
SCALE: 1/8" = 1'-0"
SCALE: 1/4" = 1'-0"

NOTE:
1. THE NUMBER/DEPTH OF BEARING PILES MAY VARY AT EACH SITE.
2. PILE ANALYSIS ASSUMES NO SOIL SUPPORT UNDER SLAB.

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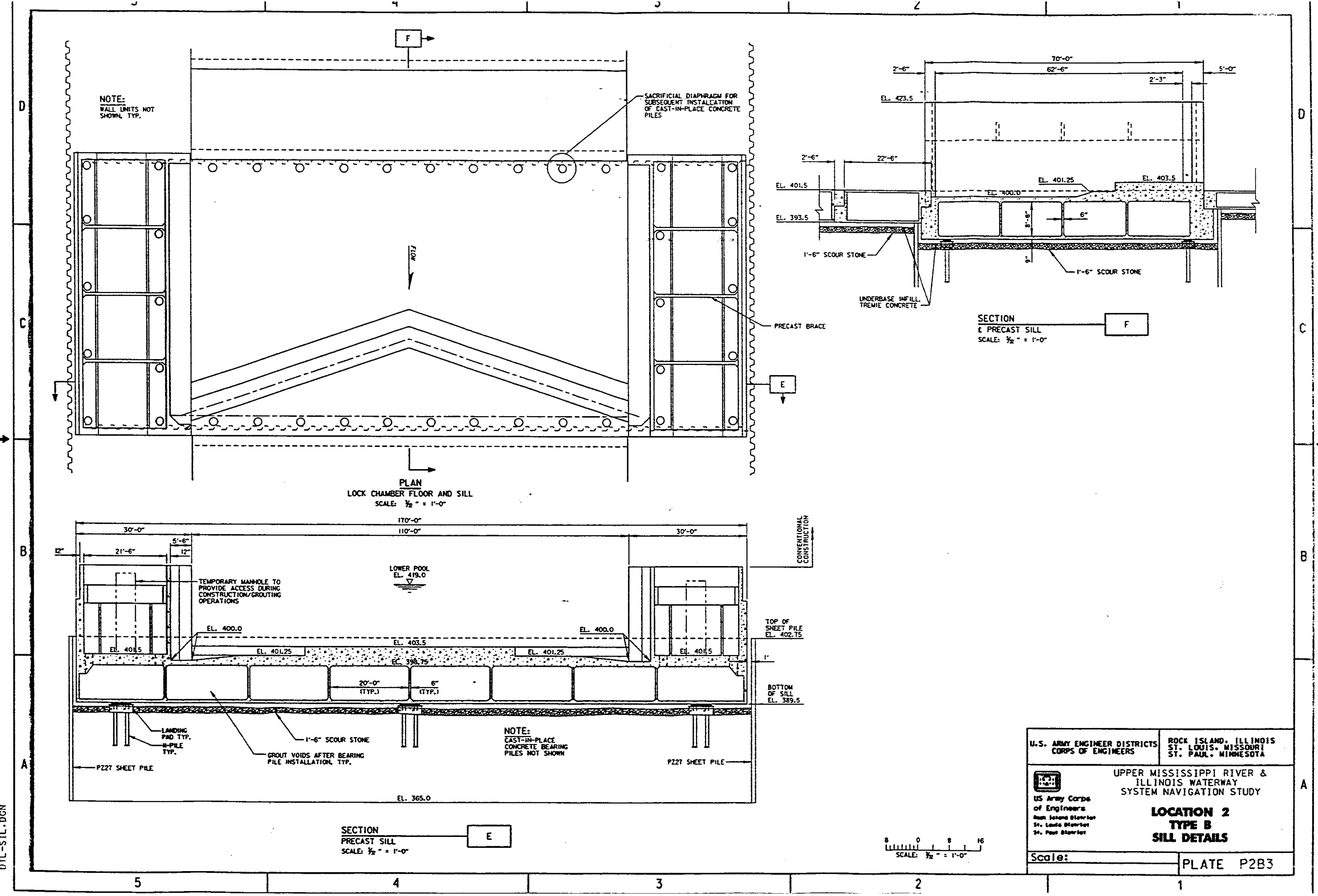
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
TYPE B
PLAN, SECTIONS & DETAIL

Scale:
PLATE P2B2

DTLS-2D.DGN


NOTE:
WALL UNITS NOT SHOWN, TYP.
SACRIFICIAL DIAPHRAGM FOR SUBSEQUENT INSTALLATION OF CAST-IN-PLACE CONCRETE PILES
FLOW
PRECAST BRACE
F
E
PLAN
LOCK CHAMBER FLOOR AND SILL
SCALE: 3/32" = 1'-0"
70'-0"
62'-6"
2'-6"
5'-0"
2'-3"
EL. 423.5
22'-6"
EL. 401.5
EL. 401.25
EL. 403.5
EL. 400.0
EL. 393.5
8'-6"
6"
9"
1'-6" SCOUR STONE
UNDERBASE INFILL TREMIE CONCRETE
SECTION
℄ PRECAST SILL
SCALE: 3/32" = 1'-0"
170'-0"
110'-0"
30'-0"
21'-6"
5'-6"
12"
LOWER POOL
EL. 419.0
TEMPORARY MANHOLE TO PROVIDE ACCESS DURING CONSTRUCTION/GROUTING OPERATIONS
CONVENTIONAL CONSTRUCTION
TOP OF SHEET PILE
EL. 402.75
1'
EL. 398.75
20'-0" (TYP.)
6" (TYP.)
BOTTOM OF SILL
EL. 389.5
LANDING PAD TYP.
H-PILE TYP.
GROUT VOIDS AFTER BEARING PILE INSTALLATION, TYP.
NOTE:
CAST-IN-PLACE CONCRETE BEARING PILES NOT SHOWN
PZ27 SHEET PILE
EL. 365.0
SECTION
PRECAST SILL
SCALE: 3/32" = 1'-0"
SCALE: 3/32" = 1'-0"
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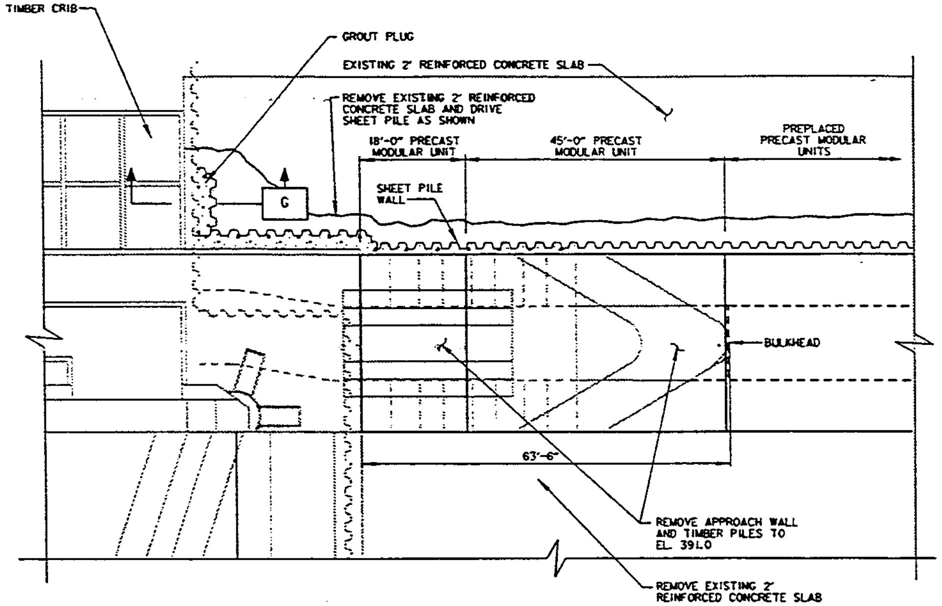
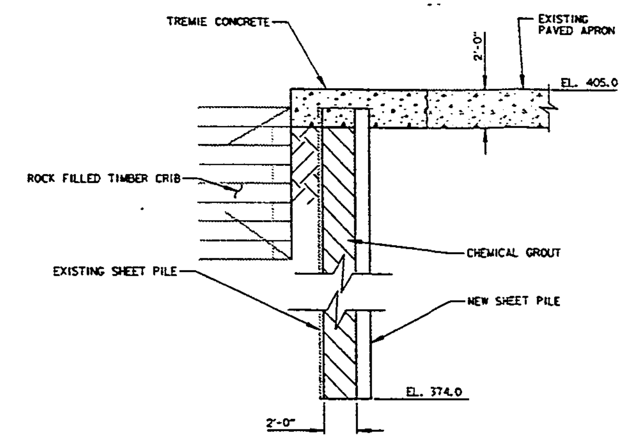
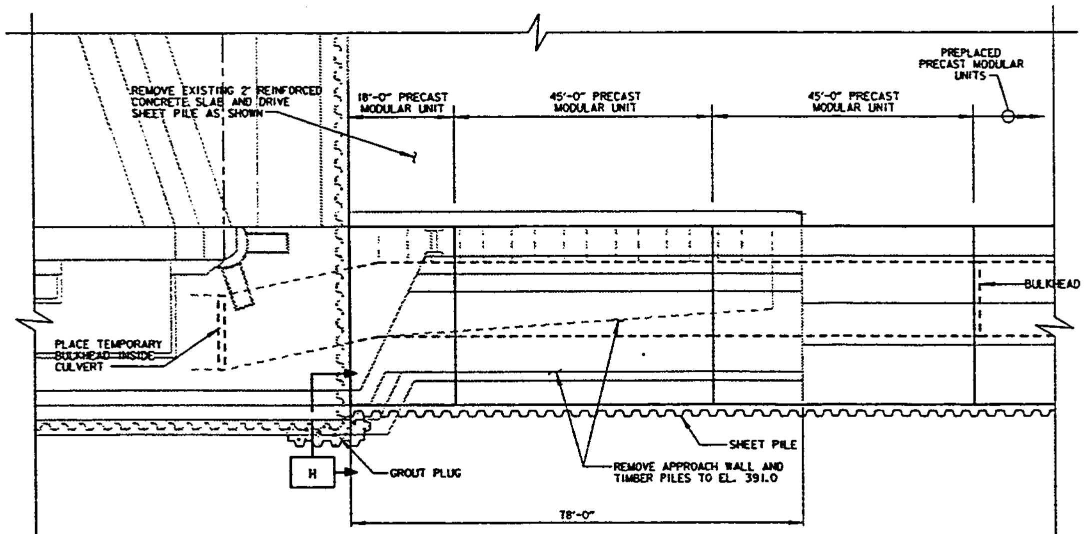
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY
LOCATION 2
TYPE B
SILL DETAILS
Scale:
PLATE P2B3
DTL-SIL.DGN



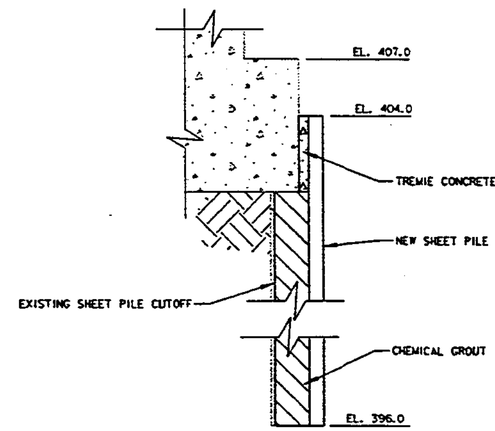
DETAIL 1
INTERMEDIATE WALL TIE-IN P2B1
SCALE: 1" = 5'-0"



SECTION G
GROUT PLUG
SCALE: 1/4" = 1'-0"



DETAIL 2
LANDWALL TIE-IN P2B1
SCALE: 1" = 5'-0"



SECTION H
GROUT PLUG
SCALE: 1/4" = 1'-0"

SCALE: 1/4" = 1'-0"
SCALE 1" = 5'-0"

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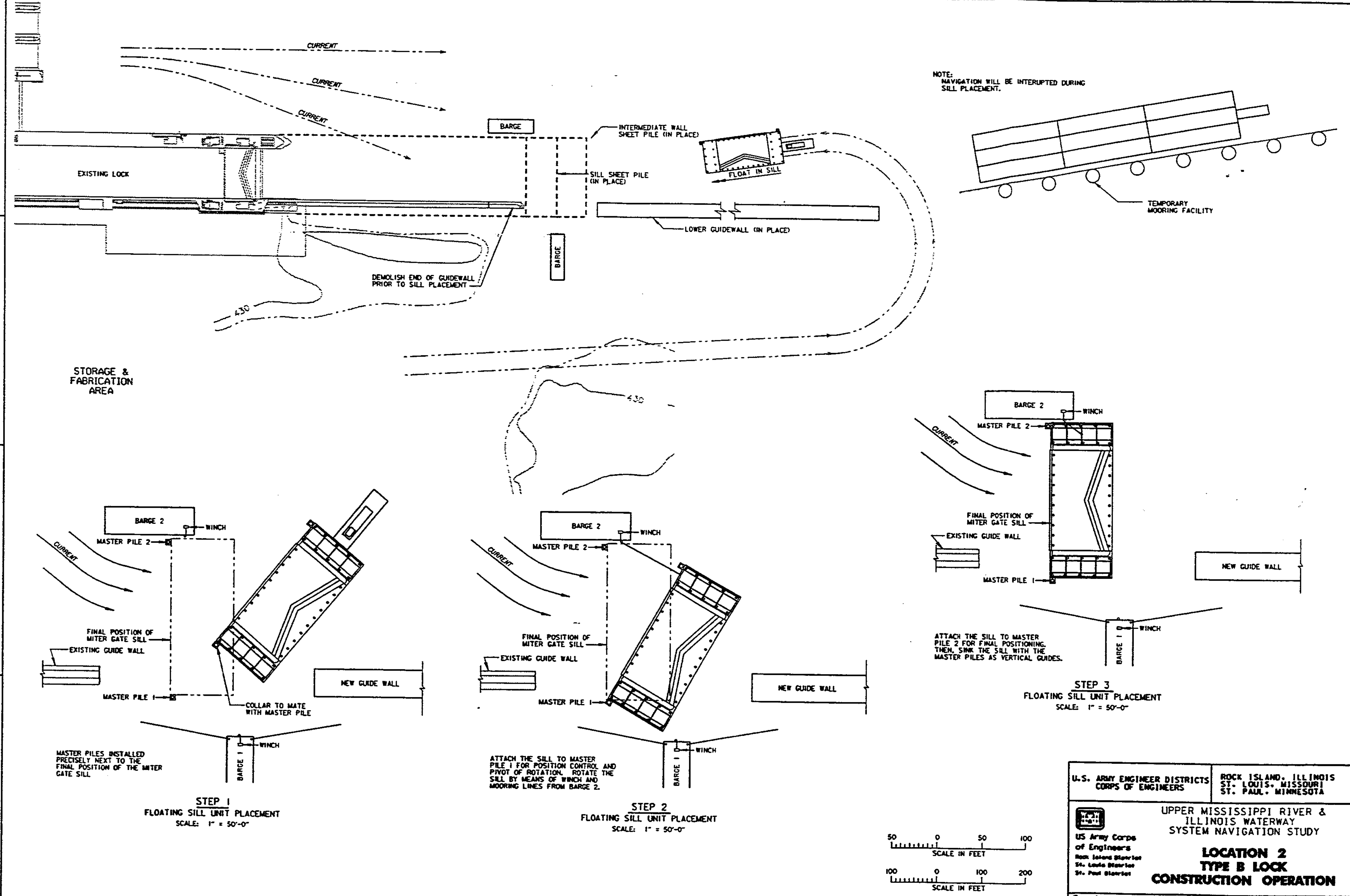
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
TYPE B
SECTIONS & DETAILS

Scale:
PLATE P2B4

DTLS-3D.DGN



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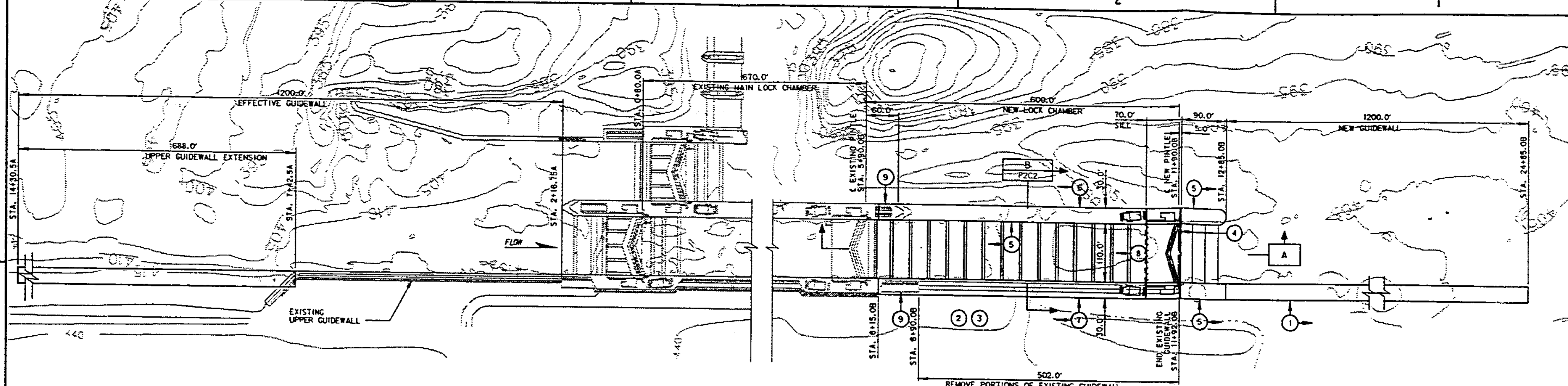
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
TYPE B LOCK
CONSTRUCTION OPERATION

Scale:

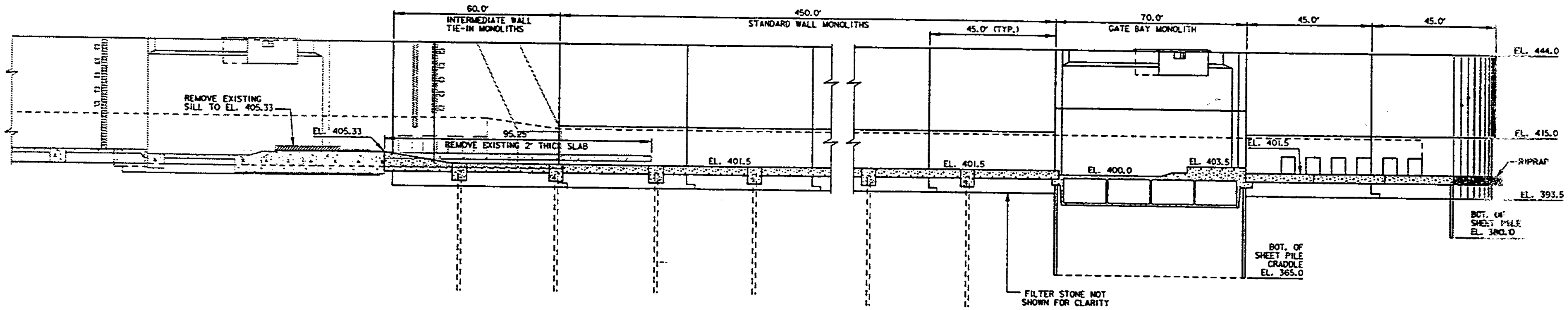
PLATE P2B5

CONST2.DGN



PLAN
DOWNSTREAM END OF LOCK EXPANSION

SCALE IN FEET: 100 0 100 200



SECTION A
WALL & FLOOR SLAB
SCALE: 1" = 20'-0"

SCALE IN FEET: 20 0 20 40

CONSTRUCTION SEQUENCE
LOCK EXTENSION

1. WORKING FROM UPSTREAM TO DOWNSTREAM CONSTRUCT DOWNSTREAM GUIDEWALL.
2. PLACE SHEET PILE WALL FOR DOWNSTREAM EXTENSION
3. PRE-DREDGE SITE WITHIN SHEET PILES, EXCEPT AT EXISTING GUIDEWALL AND TIE-IN. PLACE SCOUR STONES WITHIN SHEET PILES.
4. AFTER DREDGING, FLOAT PRECAST SILL MONOLITH AND SINK ON TO LANDING PADS. (SEE PLATE 2B-P-5)
5. CONSTRUCT DOWNSTREAM APPROCH MONOLITHS.
6. CONSTRUCT RIVERWARD WALL MONOLITHS.
7. INCREMENTALLY DEMOLISH EXISTING GUIDEWALL AND CONSTRUCT LANDWARD WALL.
8. CONSTRUCT FLOOR SYSTEM.
9. DEMOLISH EXISTING DISCHARGE MONOLITHS AND CONSTRUCT TIE-IN WALL MONOLITHS AND SLAB

NOTE:
1. GUIDEWALLS ARE SHOWN SCHEMATICALLY

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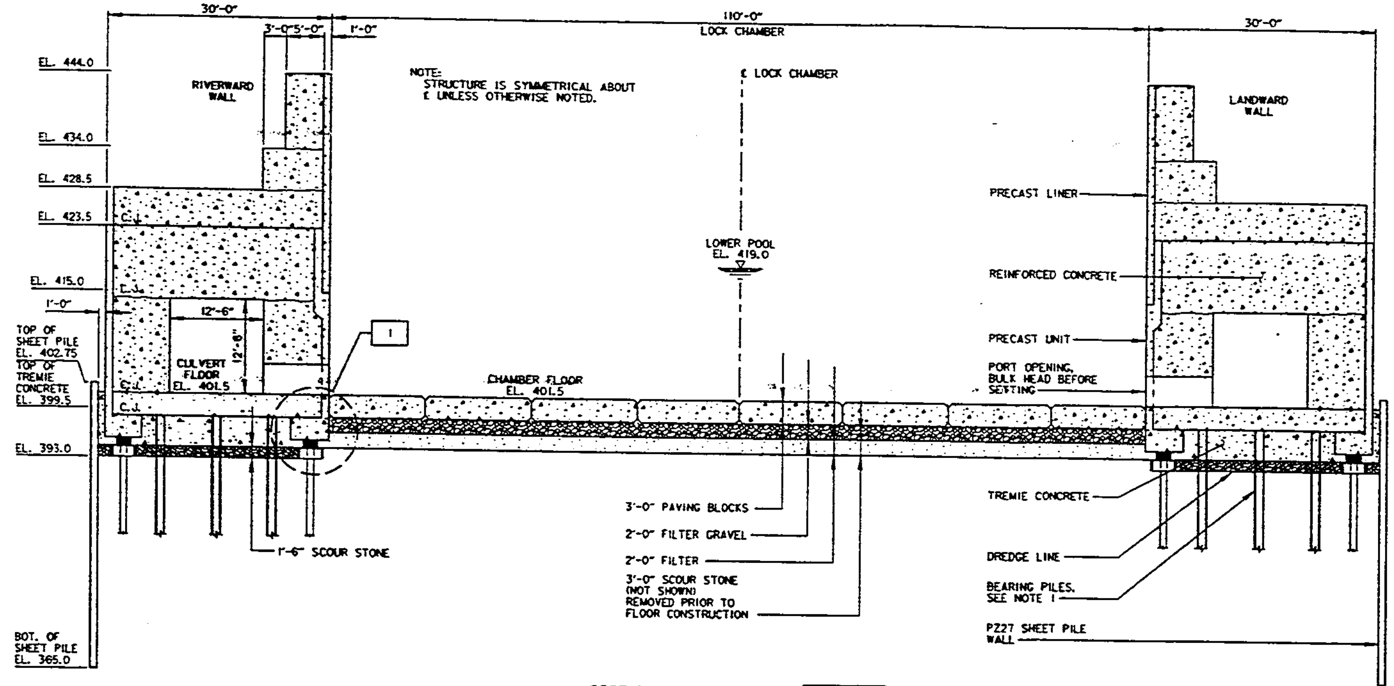
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
TYPE C LOCK
PLAN & SECTION

Scale:

PLATE P2C1

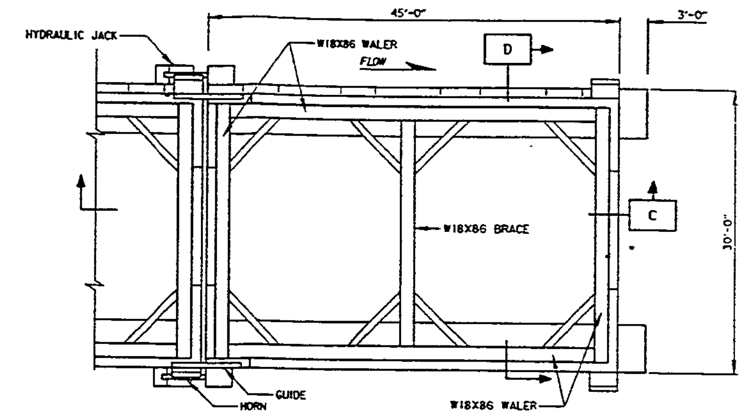
LD25-DS.DGN



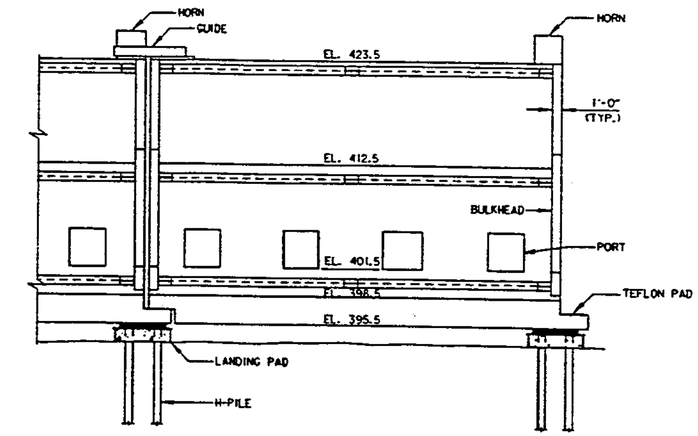
SECTION B / P2C1
LOCK WALLS & FLOOR
SCALE: 1"=10'-0"

TABLE 1 - PILE REQUIREMENTS (SEE NOTES 1 AND 2)

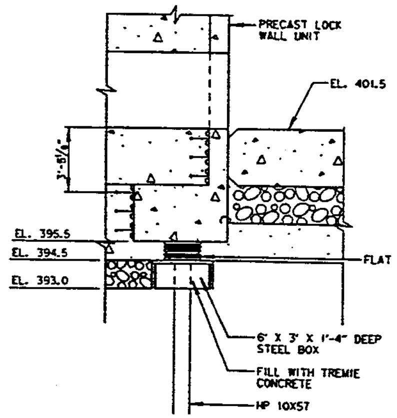
PILE TYPE	SIZE	TRAN. ROW SPACING	LONG. ROW SPACING	NO. OF PILES PER 45' MONOLITH
HP SECTION, GR.50	HP 14X89	6@8'-0"	4@8'-4"	24
PRESTRESS	18"φ	5@10'-0"	3@12'-6"	15
CAST-IN-PLACE	18"φ	7@6'-8"	3@12'-6"	21



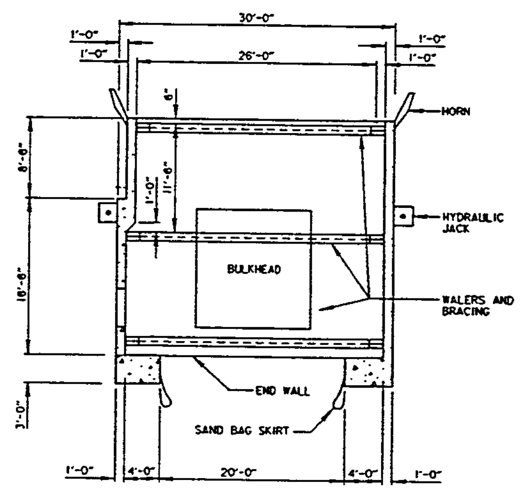
PLAN
PRECAST UNIT (TYPICAL)
SCALE: 1/8" = 1'-0"



SECTION C
PRECAST UNIT (TYPICAL)
SCALE: 1/8"=1'-0"



DETAIL 1
LOCK WALL/FLOOR CONNECTION
SCALE: 1/2"=1'-0"



SECTION D
PRECAST UNIT (TYPICAL)
SCALE: 1/8"=1'-0"

NOTE:

1. THE NUMBER/DEPTH OF BEARING PILES MAY VARY AT EACH SITE.
2. PILE ANALYSIS ASSUMES NO SOIL SUPPORT UNDER SLAB.

SCALE IN FEET
SCALE: 1/8" = 1'-0"
SCALE: 1/4" = 1'-0"

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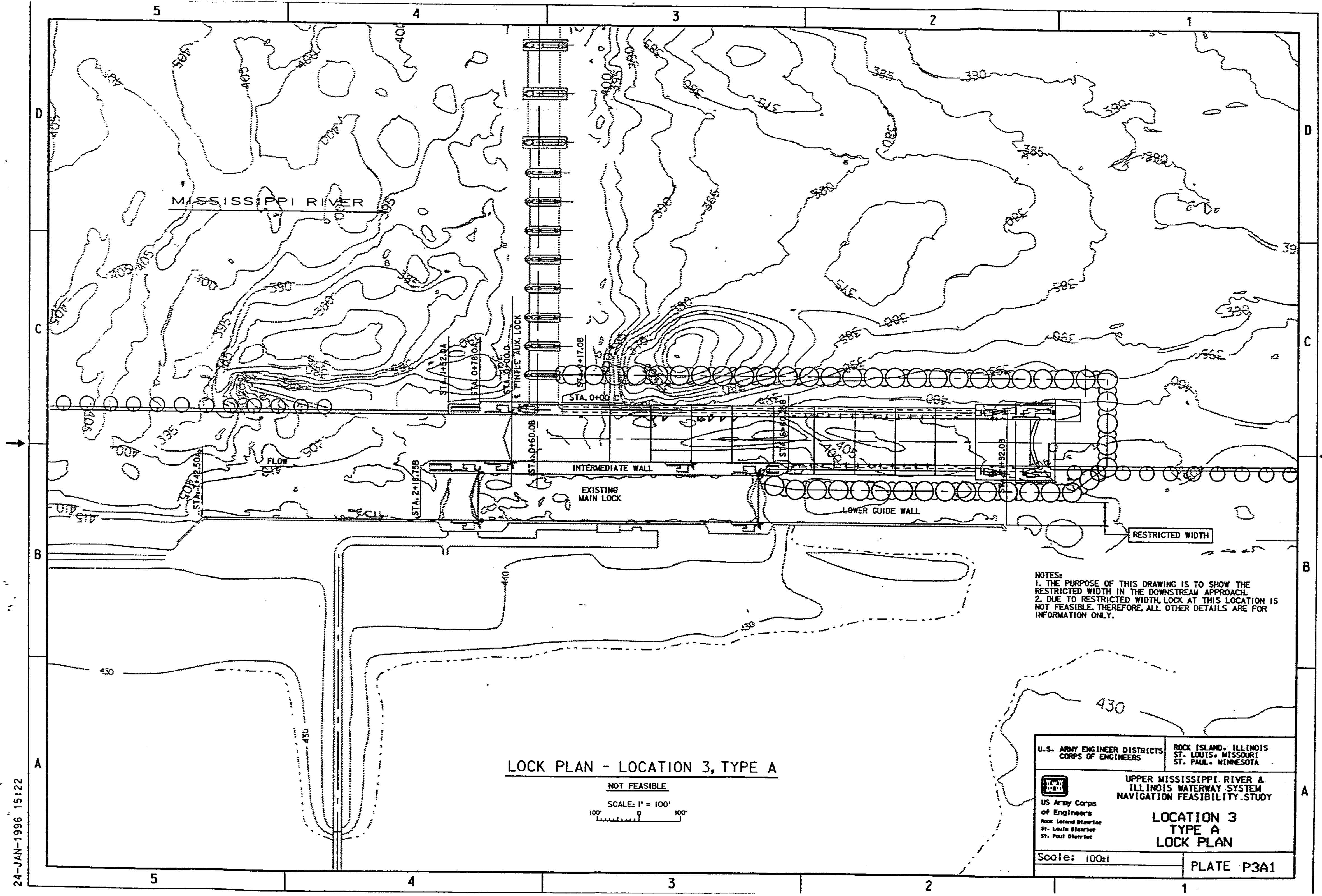
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 2
TYPE C LOCK
PLAN, SECTIONS & DETAIL

Scale:
PLATE P2C2

LOC2C_S1.DGN



MISSISSIPPI RIVER
FLOW
STA. 1+42.50
STA. 2+16.75B
STA. 1+52.0A
STA. 0+78.0A
STA. 0+00.0
℄ PINTLE AUX. LOCK
STA. 0+60.0B
STA. 1+17.0B
STA. 0+00 C
STA. 6+94.8
STA. 4+92.0B
INTERMEDIATE WALL
EXISTING
MAIN LOCK
LOWER GUIDE WALL
RESTRICTED WIDTH
NOTES:
1. THE PURPOSE OF THIS DRAWING IS TO SHOW THE RESTRICTED WIDTH IN THE DOWNSTREAM APPROACH.
2. DUE TO RESTRICTED WIDTH, LOCK AT THIS LOCATION IS NOT FEASIBLE. THEREFORE, ALL OTHER DETAILS ARE FOR INFORMATION ONLY.
LOCK PLAN - LOCATION 3, TYPE A
NOT FEASIBLE
SCALE: 1" = 100'
100' 0 100'
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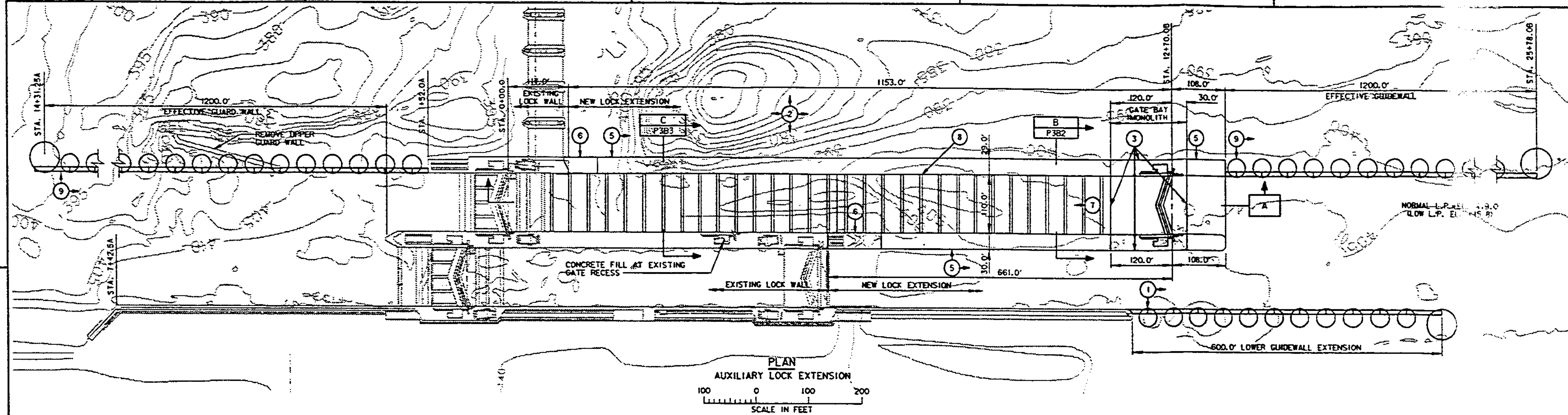
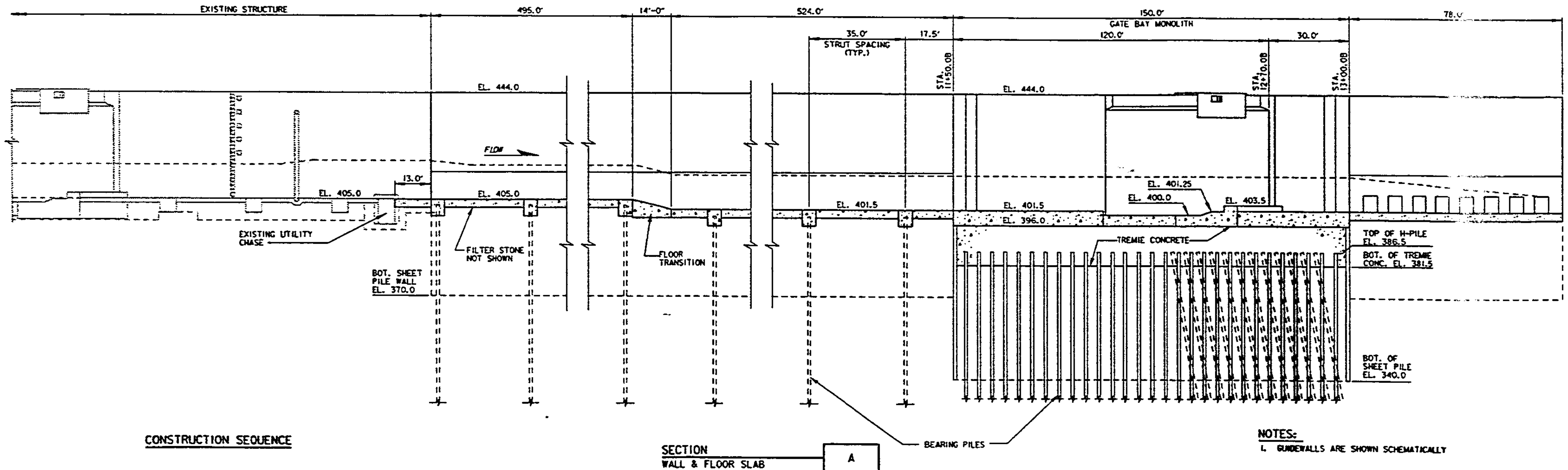
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY
LOCATION 3
TYPE A
LOCK PLAN
Scale: 100:1
PLATE P3A1
24-JAN-1996 15:22





CONSTRUCTION SEQUENCE

1. PLACE 600' GUIDEWALL EXTENSION.
2. EXCAVATE SITE AND FILL SCOUR HOLE.
3. INSTALL SHEET PILE COFFER DAMS FOR WALLS AND MITER GATE MONOLITHS, AND DRIVE PILES.
4. CONSTRUCT MITER GATE MONOLITHS WITHIN BRACED SHEET PILE COFFERDAM.
5. CONSTRUCT CHAMBER AND CULVERT DISCHARGE WALLS WITHIN SHEET PILE COFFERDAM TO 423.5. CONVENTIONAL CONSTRUCTION ABOVE EL. 423.5.
6. CONSTRUCT TIE-IN FOR LOCK WALLS.
7. INSTALL FLOOR SYSTEM.
8. TIE BEAMS TO LOCK WALLS AND MODIFY EXISTING INTERMEDIATE WALL.
9. CONSTRUCT UPPER AND LOWER GUIDEWALLS.

NOTES:
1. GUIDEWALLS ARE SHOWN SCHEMATICALLY

U.S. ARMY ENGINEER DISTRICTS
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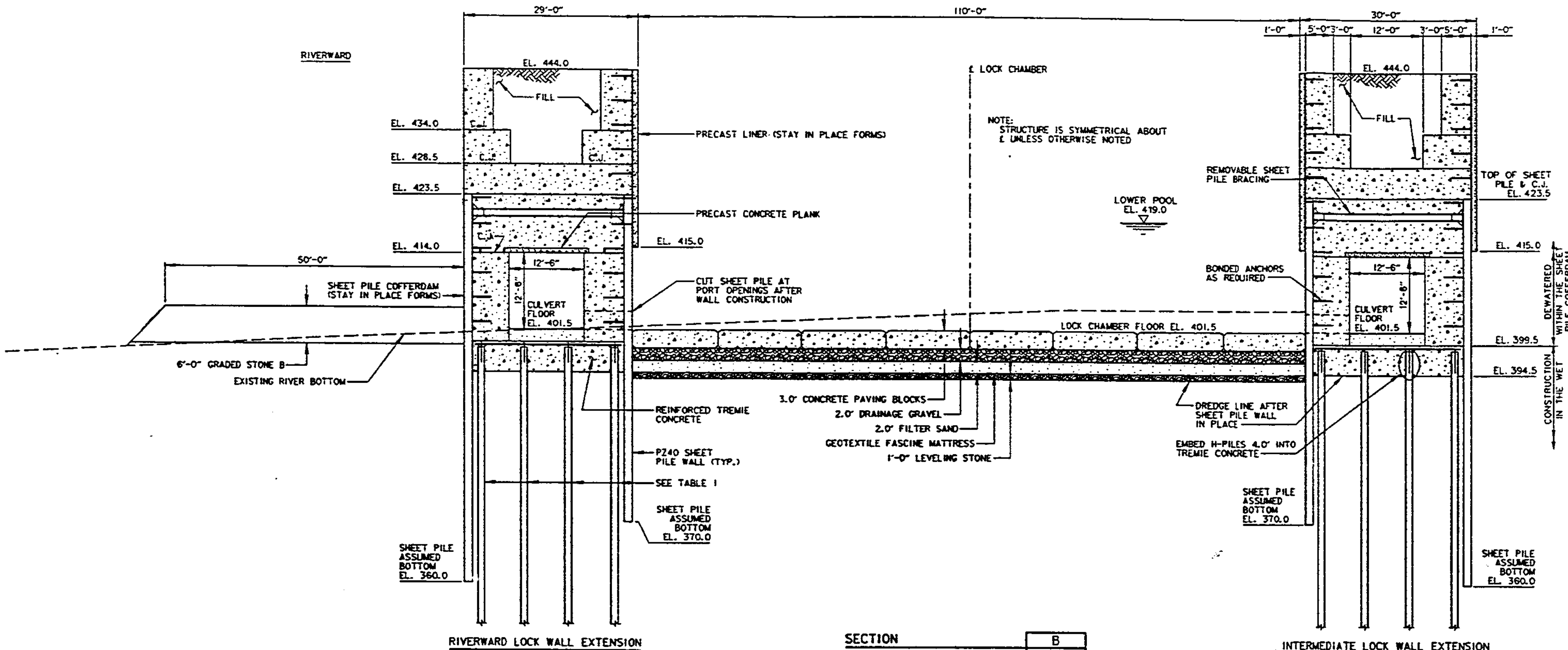
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 3
TYPE B LOCK
PLAN & SECTION

Scale:

PLATE P3B1

LOC3_DS.DGN



SECTION B
DOWNSTREAM LOCK CHAMBER P3B1
SCALE: 1" = 10'-0"

NOTE:

1. THE NUMBER/DEPTH OF BEARING PILES MAY VARY AT EACH SITE
2. LATERAL LOADS ON WALLS RESISTED BY FLOOR BEAMS WHICH ACTS AS A TENSION TIE/COMPRESSION STRUT.

TABLE 1 - PILE REQUIREMENTS (SEE NOTES 1 AND 2)

PILE TYPE	SIZE	TRAN. ROW SPACING	LONG. ROW SPACING	NO. OF PILES PER 45' MONOLITH
HP SECTION, GR. 50	HP 14X89	9 @ 5'-0"	6 @ 5'-0"	54
PRESTRESS	20" ⌀	8 @ 5'-8½"	4 @ 8'-4"	32
CAST-IN-PLACE	24" ⌀	8 @ 5'-8½"	4 @ 8'-4"	32

10 0 10 20
SCALE IN FEET

U.S. ARMY ENGINEER DISTRICTS CORPS OF ENGINEERS

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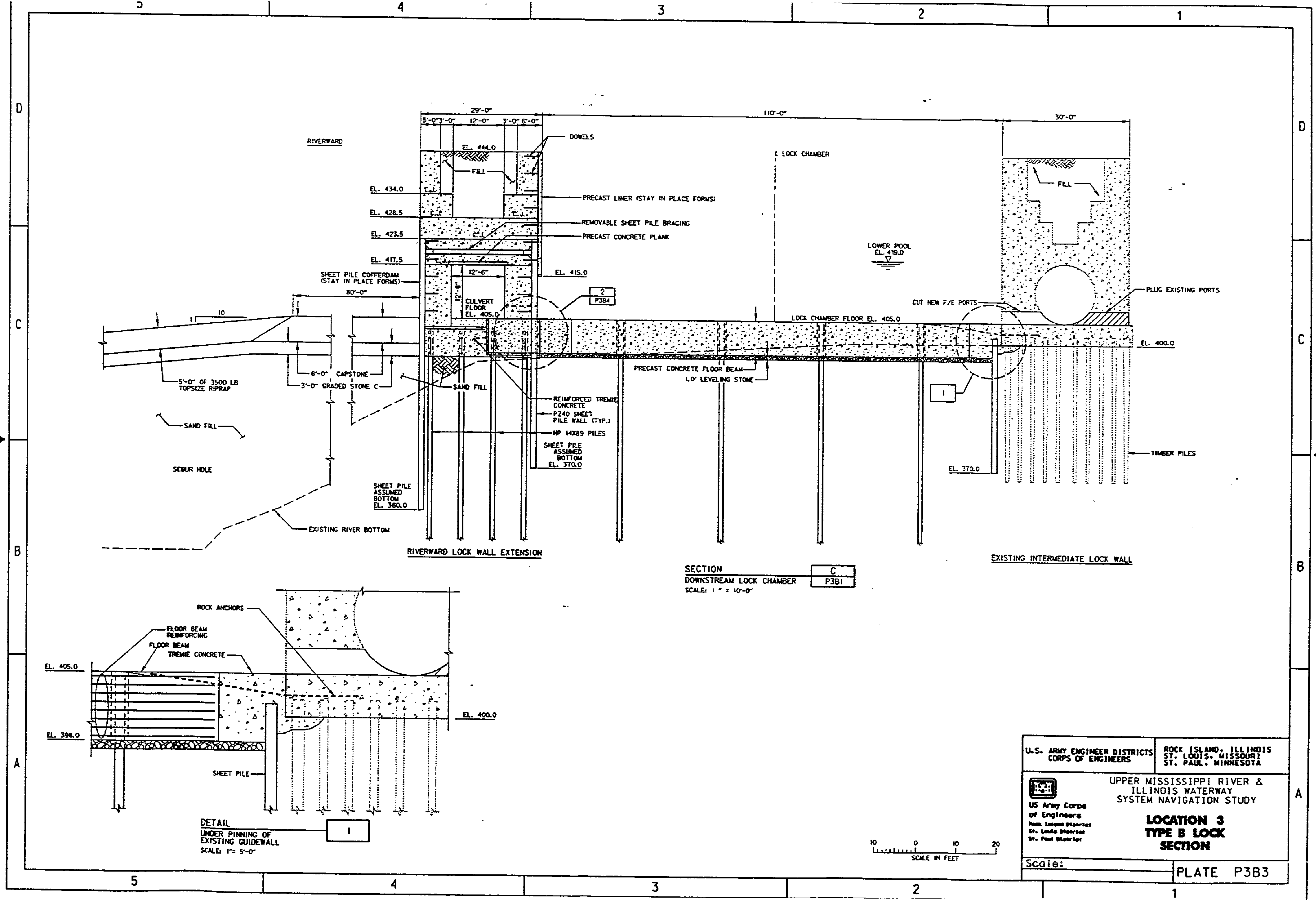
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 3
TYPE B LOCK
SECTION

Scale:

PLATE P3B2

LOC3_S1.DGN



RIVERWARD
29'-0"
5'-0" 3'-0" 12'-0" 3'-0" 6'-0"
110'-0"
30'-0"
DOWELS
EL. 444.0
FILL
℄ LOCK CHAMBER
EL. 434.0
PRECAST LINER (STAY IN PLACE FORMS)
EL. 428.5
REMOVABLE SHEET PILE BRACING
EL. 423.5
PRECAST CONCRETE PLANK
EL. 417.5
12'-6"
EL. 415.0
LOWER POOL
EL. 419.0
SHEET PILE COFFERDAM (STAY IN PLACE FORMS)
80'-0"
12'-6"
CULVERT FLOOR EL. 405.0
2
P3B4
PLUG EXISTING PORTS
CUT NEW F/E PORTS
LOCK CHAMBER FLOOR EL. 405.0
EL. 400.0
10
1
5'-0" OF 3500 LB TOPSIZE RIPRAP
6'-0" CAPSTONE
3'-0" GRADED STONE C
SAND FILL
PRECAST CONCRETE FLOOR BEAM
1.0' LEVELING STONE
REINFORCED TREMIE CONCRETE
PZ40 SHEET PILE WALL (TYP.)
HP 14X89 PILES
SAND FILL
SHEET PILE ASSUMED BOTTOM EL. 370.0
TIMBER PILES
SCOUR HOLE
EL. 370.0
SHEET PILE ASSUMED BOTTOM EL. 360.0
EXISTING RIVER BOTTOM
RIVERWARD LOCK WALL EXTENSION
EXISTING INTERMEDIATE LOCK WALL
SECTION
DOWNSTREAM LOCK CHAMBER
SCALE: 1" = 10'-0"
C
P3B1
ROCK ANCHORS
FLOOR BEAM REINFORCING
FLOOR BEAM
TREMIE CONCRETE
EL. 405.0
EL. 400.0
EL. 396.0
SHEET PILE
DETAIL
UNDER PINNING OF EXISTING GUIDEWALL
SCALE: 1"= 5'-0"
10 0 10 20
SCALE IN FEET
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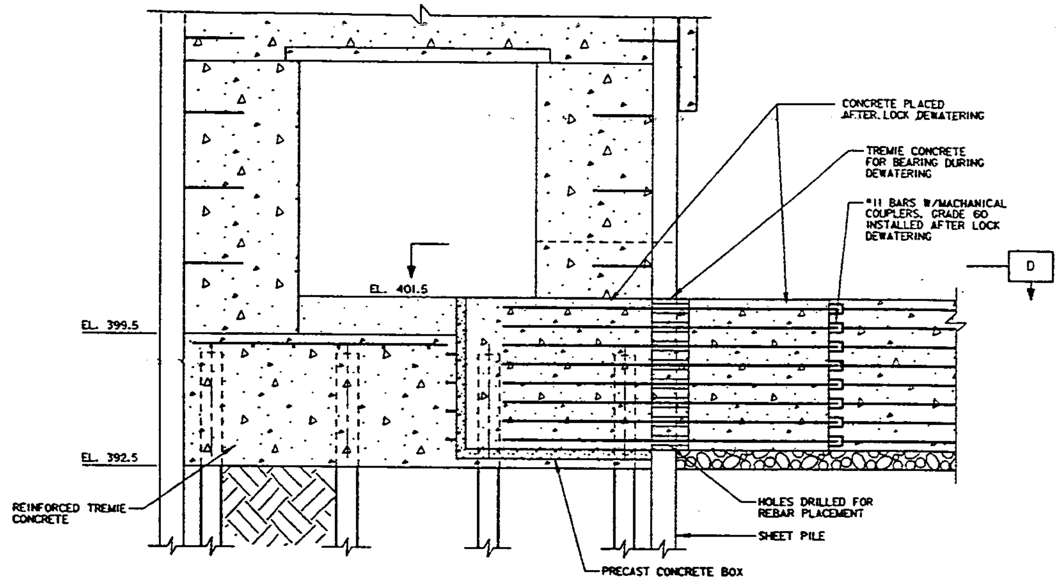
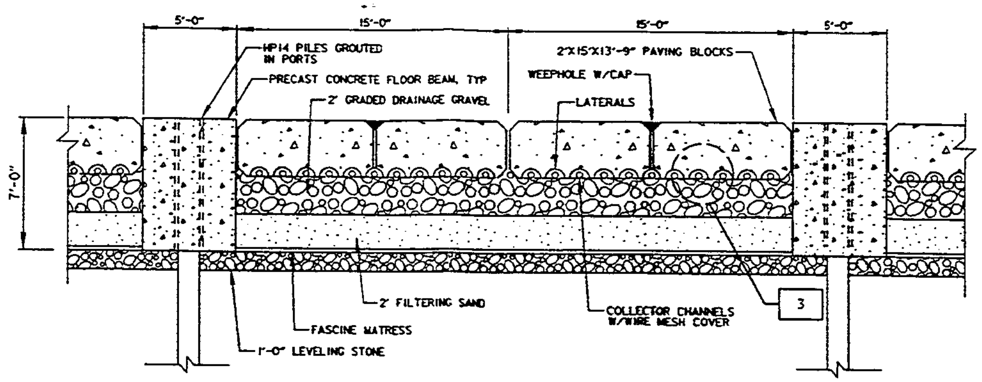
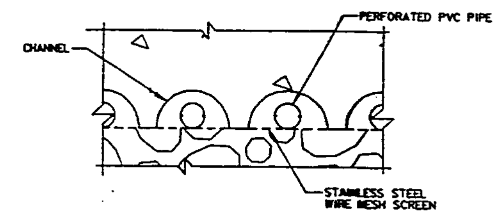
LOCATION 3
TYPE B LOCK
SECTION
Scale:
PLATE P3B3
LOC3_S1A.DGN



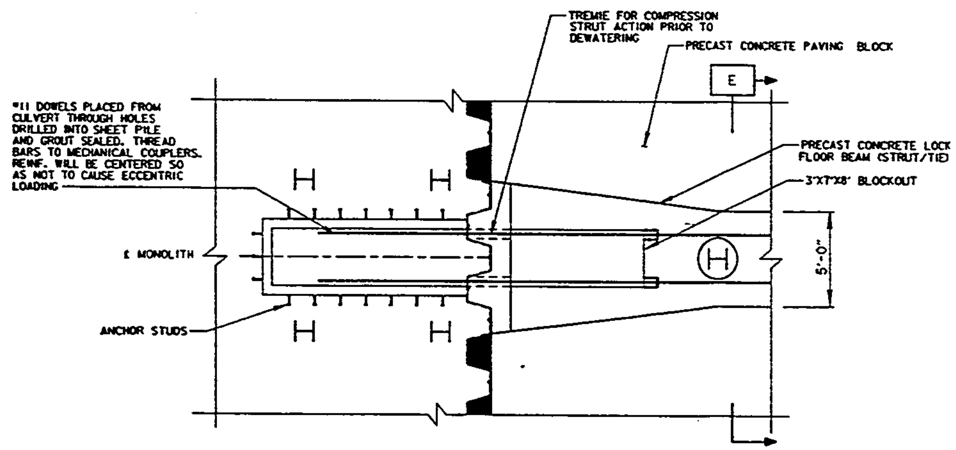
DETAIL 2
FLOOR BEAM/WALL CONNECTION P3B3
SCALE: 1/4"=1'-0"



SECTION E
SUBDRAINAGE SYSTEM
SCALE: 1/4"=1'-0"



DETAIL 3
COLLECTOR SYSTEM
SCALE: 1"=1'-0"



SECTION D
PLAN AT FLOOR BEAM CONNECTION
SCALE: 1/4"=1'-0"

SCALE: 1" = 1'-0"

SCALE IN FEET

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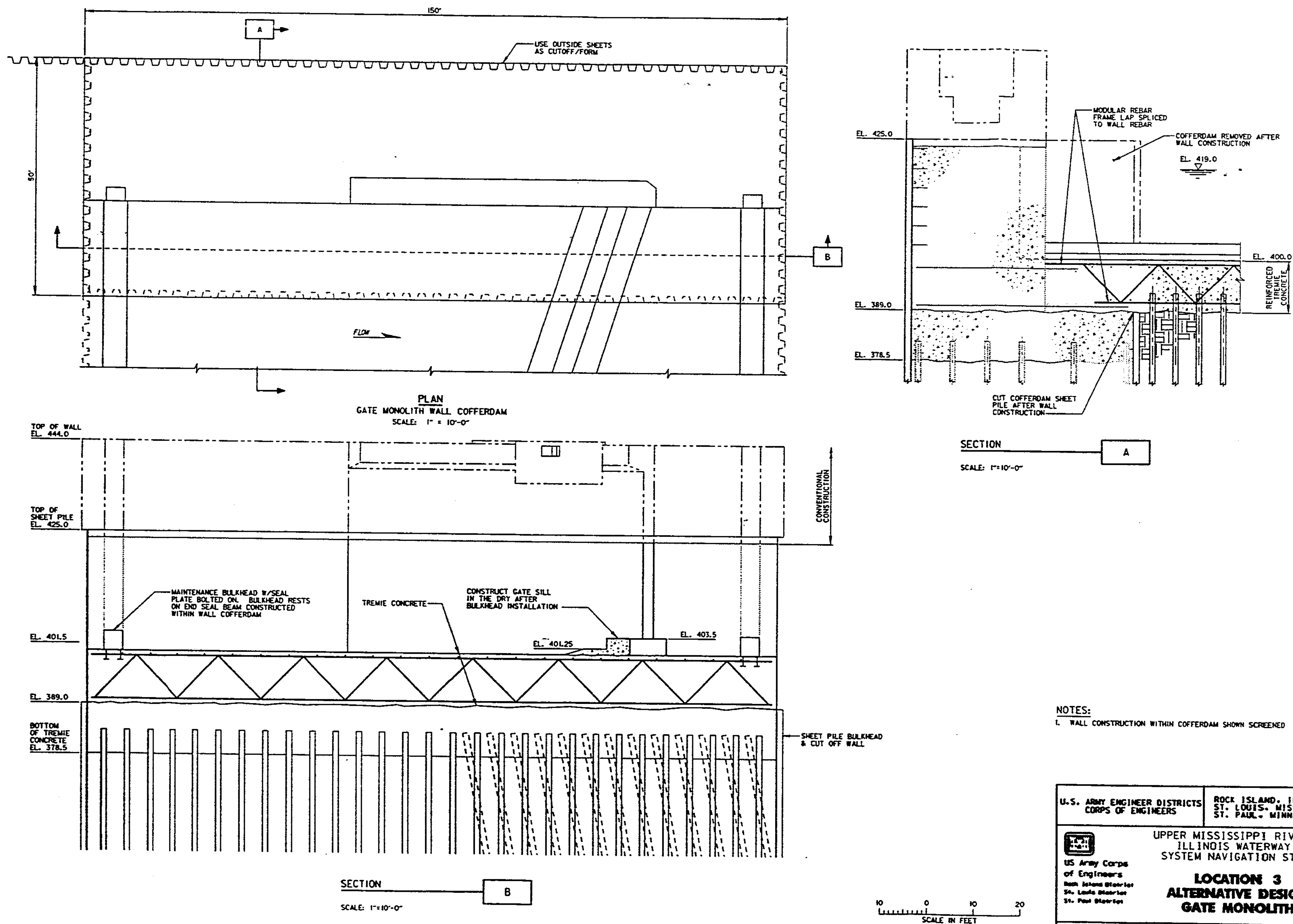
Scale:	PLATE P3B4

LOC3_S1B.DGN



NOTES:
1. WALL CONSTRUCTION WITHIN COFFERDAM SHOWN SCREENED

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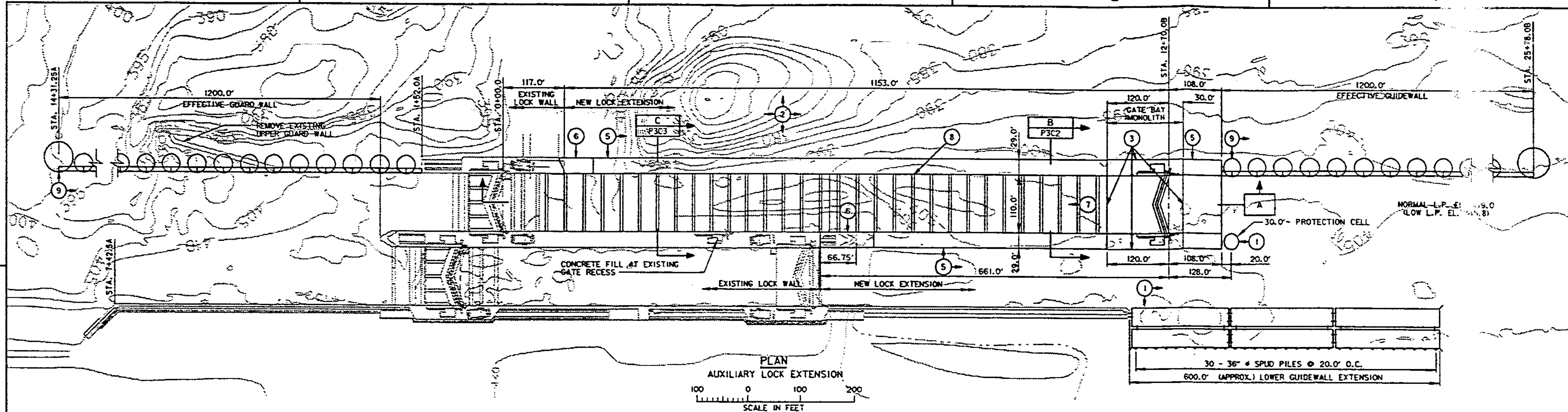
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 3
ALTERNATIVE DESIGN
GATE MONOLITH

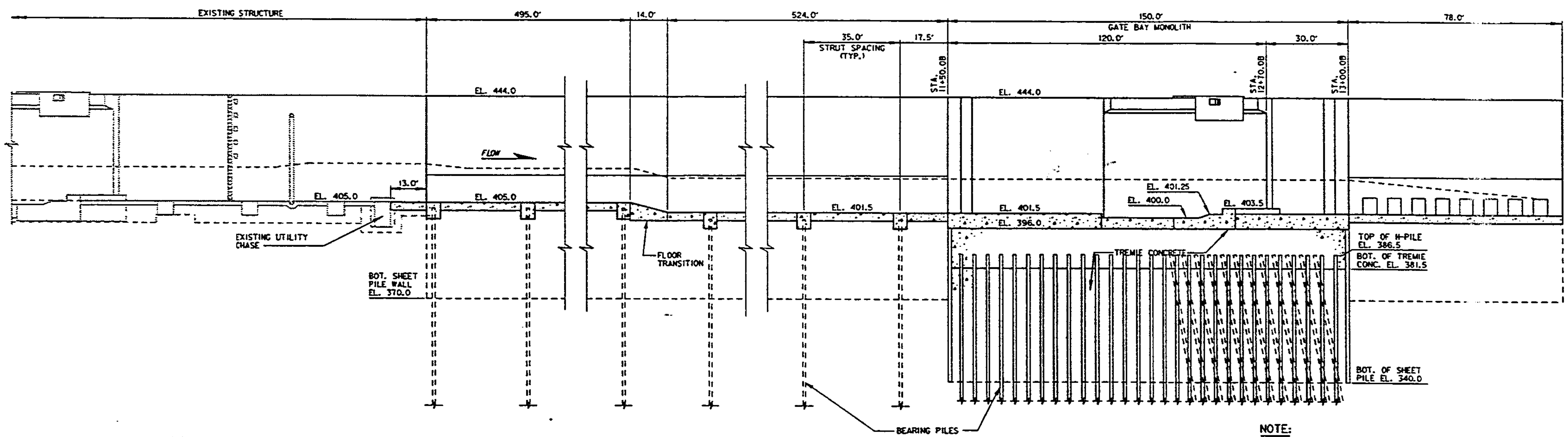
Scale:

PLATE P3B5

LOC3_ALT.DGN



PLAN
AUXILIARY LOCK EXTENSION



SECTION A
WALL & FLOOR SLAB

20 0 20 40
SCALE IN FEET

CONSTRUCTION SEQUENCE

1. PLACE 600' GUIDEWALL EXTENSION.
2. EXCAVATE SITE AND FILL SCOUR HOLE.
3. INSTALL SHEET PILE COFFER DAMS FOR WALLS AND MITER GATE MONOLITHS, AND DRIVE PILES.
4. CONSTRUCT MITER GATE MONOLITHS WITHIN BRACED SHEET PILE COFFERDAM.
5. CONSTRUCT CHAMBER AND CULVERT DISCHARGE WALLS WITHIN SHEET PILE COFFERDAM TO 423.5. CONVENTIONAL CONSTRUCTION ABOVE EL. 423.5.
6. CONSTRUCT TIE-IN FOR LOCK WALLS.
7. INSTALL FLOOR SYSTEM.
8. TIE BEAMS TO LOCK WALLS AND MODIFY EXISTING INTERMEDIATE WALL.
9. CONSTRUCT UPPER AND LOWER GUIDEWALLS.

NOTE:
1. GUIDEWALLS ARE SHOWN SCHEMATICALLY

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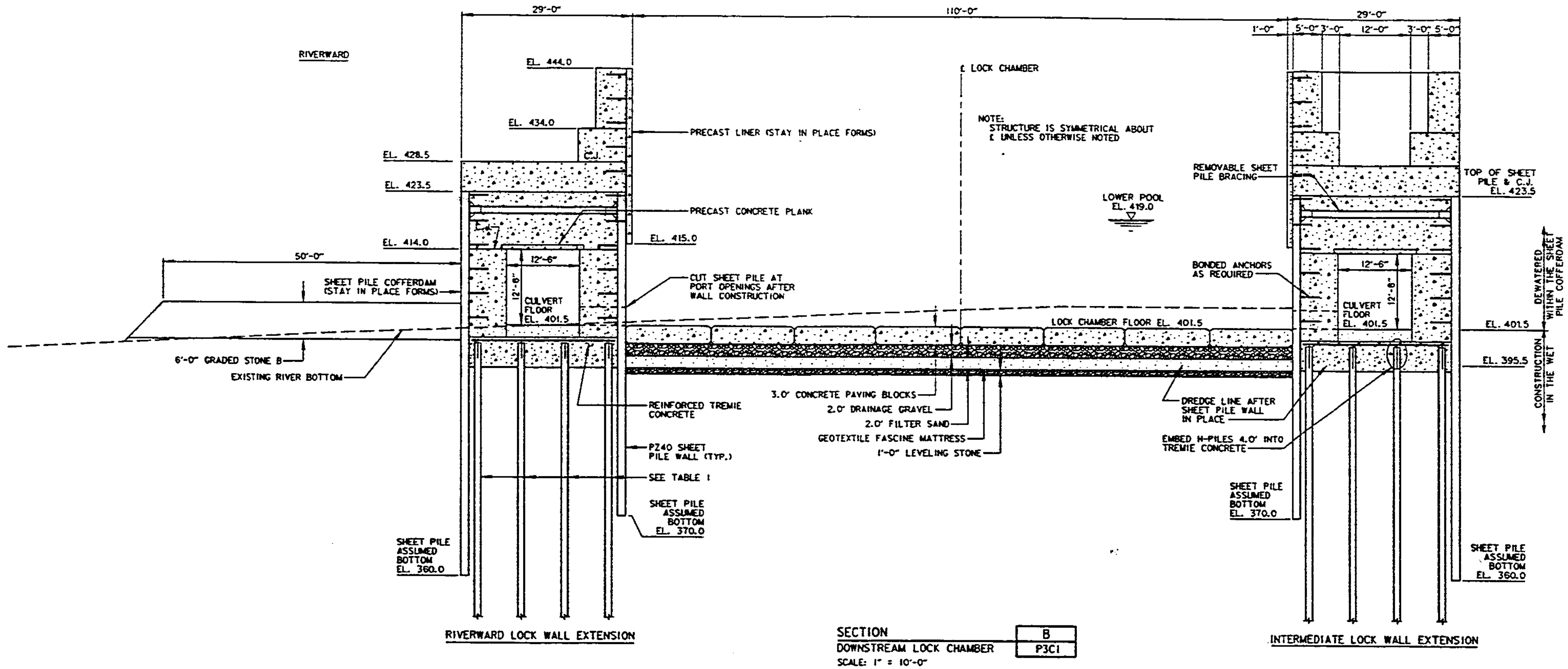
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LOCATION 3
LOCK TYPE C
PLAN & ELEVATION

Scale:

PLATE P3C1

LOC3C_DS.DGN



NOTE:

1. THE NUMBER/DEPTH OF BEARING PILES MAY VARY AT EACH SITE
2. LATERAL LOADS ON WALLS RESISTED BY FLOOR BEAMS WHICH ACTS AS A TENSION TIE/COMPRESSION STRUT.

TABLE 1 - PILE REQUIREMENTS (SEE NOTES 1 AND 2)

PILE TYPE	SIZE	TRAN. ROW SPACING	LONG. ROW SPACING	NO. OF PILES PER 45' MONOLITH
HP SECTION, GR. 50	HP 14X89	9 @ 5'-0"	6 @ 5'-0"	54
PRESTRESS	20" ⌀	8 @ 5'-8½"	4 @ 8'-4"	32
CAST-IN-PLACE	24" ⌀	8 @ 5'-8½"	4 @ 8'-4"	32

10 0 10 20
SCALE IN FEET

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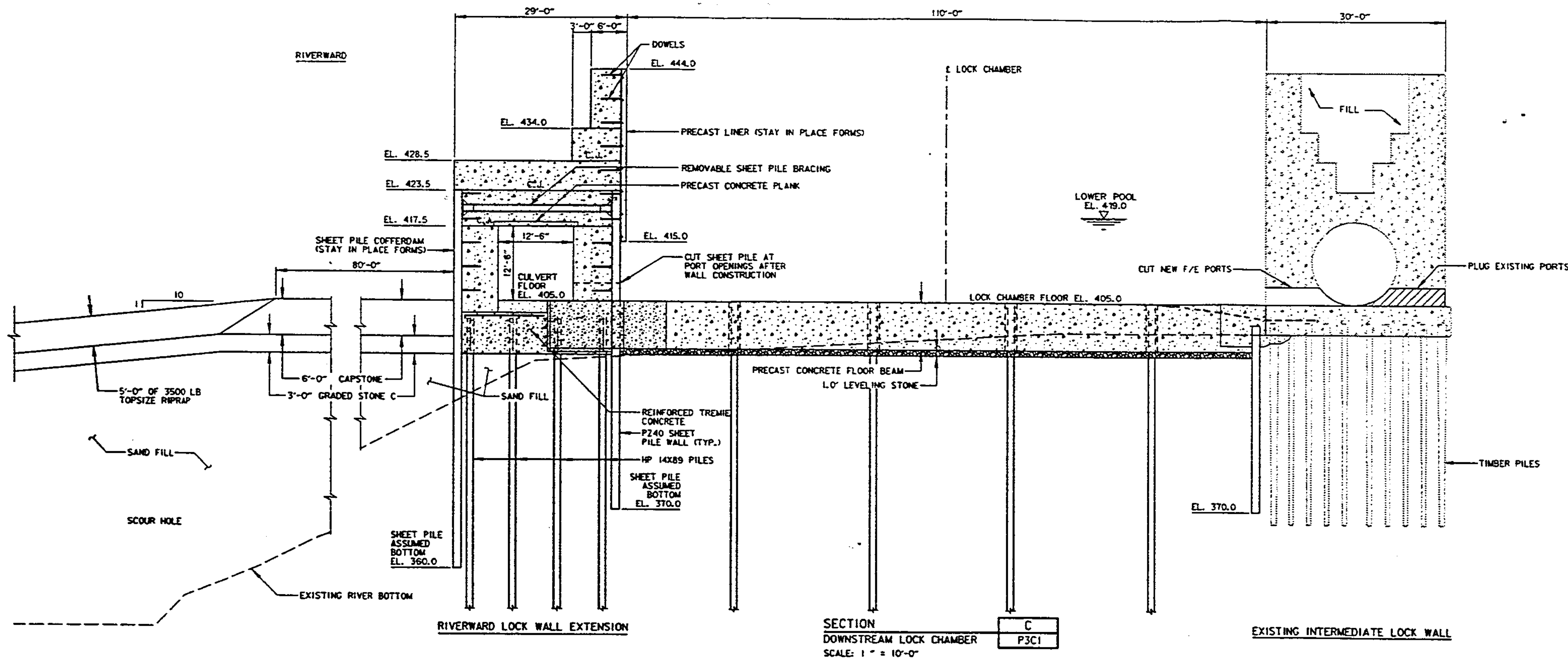
LOCATION 3
LOCK TYPE C
SECTION

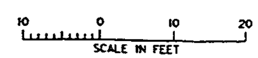
Scale:

PLATE P3C2

LOC3C_S1.DGN



SECTION | C
DOWNSTREAM LOCK CHAMBER | P3C1
SCALE: 1" = 10'-0"



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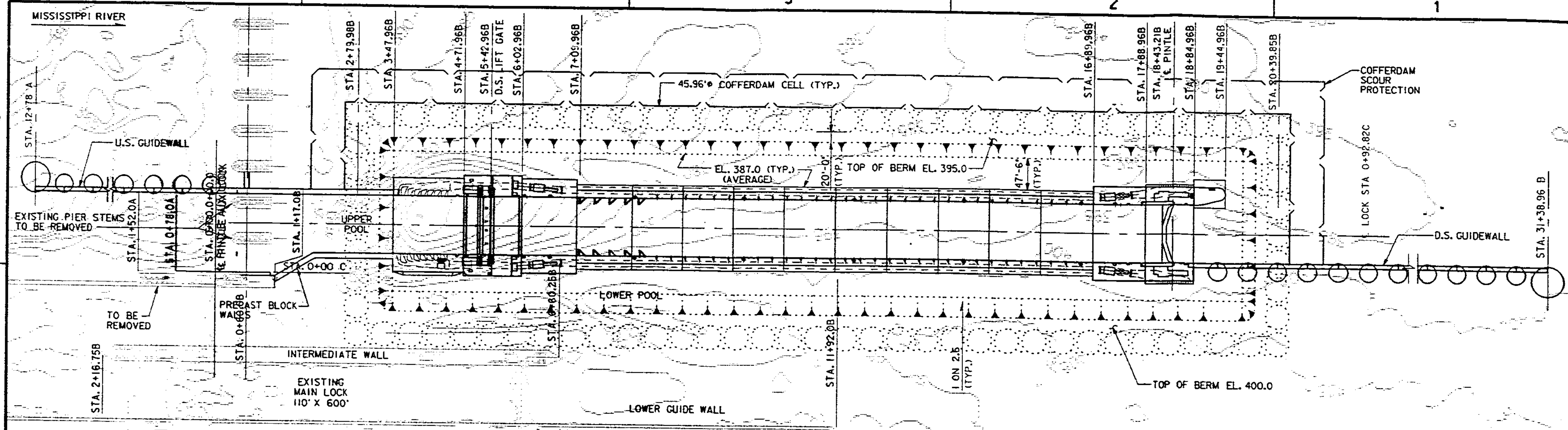
LOCATION 3
LOCK TYPE C
SECTION

Scale:

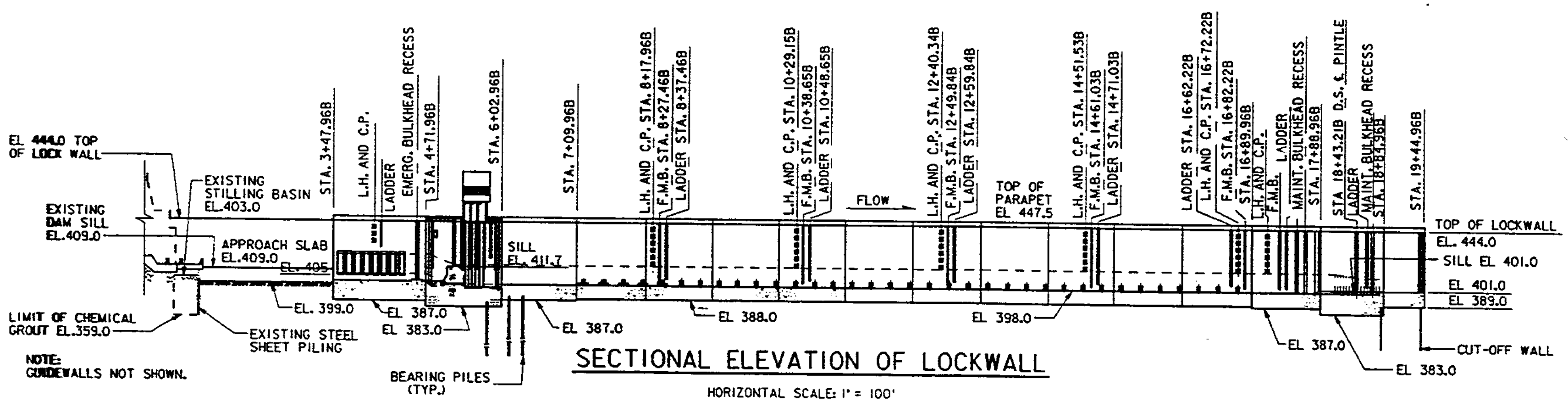
PLATE P3C3

LOC3_S2.DGN



SITE PLAN - LOCATION 4, TYPE 'A'

SCALE: 1" = 100'



SECTIONAL ELEVATION OF LOCKWALL

HORIZONTAL SCALE: 1" = 100'

VERTICAL SCALE: 1" = 50'

CONSTRUCTION SEQUENCE:

1. REMOVE EXISTING SCOUR PROTECTION.
2. FILL SCOUR HOLE.
3. DREDGE SITE.
4. INSTALL COFFERDAM, STABILITY BERM AND DEWATER.
5. PERFORM FINAL GRADING.
6. DRIVE BEARING PILES AND SHEET PILE CUT-OFF WALL.
7. BUILD CONCRETE MONOLITHS.
8. CONSTRUCT GUIDE WALLS (CONCURRENT WITH LOCK) AND EXCAVATE APPROACHES.
9. CONSTRUCT TIE-IN WITH DAM AND FOUNDATION GROUTING. COMPLETE AFTER COFFERDAM REMOVAL.
10. PLACE STONE SCOUR PROTECTION.
11. REWATER COFFERDAM AND REMOVE.

NOTES:

1. EXISTING STONE PROTECTION TO BE REMOVED PRIOR TO COFFERDAM CONSTRUCTION.
2. ALL COFFERDAM CELLS WILL BE REMOVED.
3. STONE PROTECTION CAN BE INSTALLED IN THE WET.
4. T/COFFERDAM EL.440
5. LOCAL EXCAVATION FOR DEEPER FOUNDED MONOLITHS NOT SHOWN. GRADING PLAN IS GENERALIZED.

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UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

LOCATION 4
TYPE A
LOCK PLAN AND ELEVATION

Scale: 100:1

PLATE P4A1

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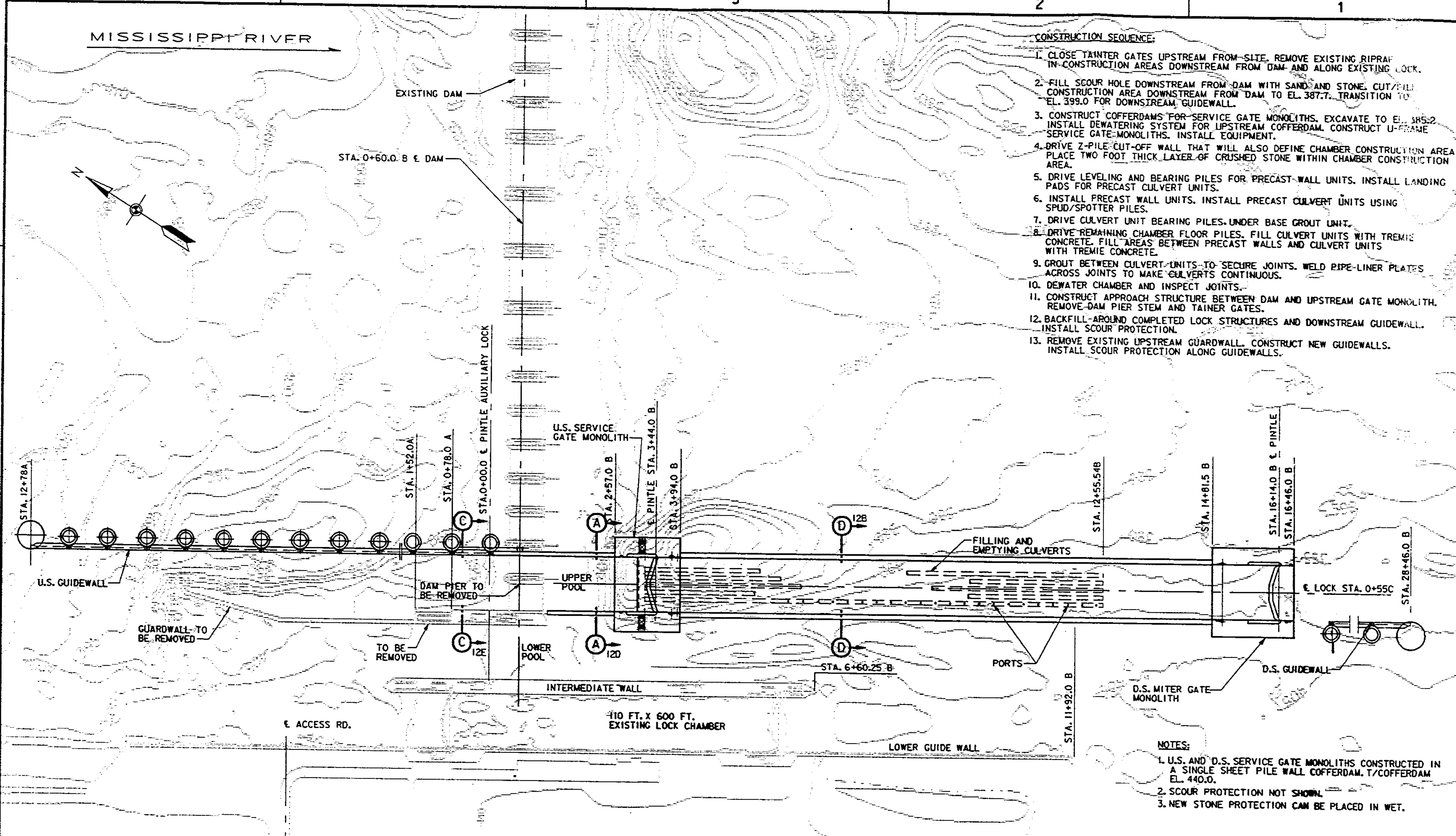

CONSTRUCTION SEQUENCE:

1. CLOSE TAINTER GATES UPSTREAM FROM SITE. REMOVE EXISTING RIPRAP IN CONSTRUCTION AREAS DOWNSTREAM FROM DAM AND ALONG EXISTING LOCK.
2. FILL SCOUR HOLE DOWNSTREAM FROM DAM WITH SAND AND STONE. CUT/FILL CONSTRUCTION AREA DOWNSTREAM FROM DAM TO EL. 387.7. TRANSITION TO EL. 399.0 FOR DOWNSTREAM GUIDEWALL.
3. CONSTRUCT COFFERDAMS FOR SERVICE GATE MONOLITHS. EXCAVATE TO EL. 385.2 INSTALL DEWATERING SYSTEM FOR UPSTREAM COFFERDAM. CONSTRUCT U-FRAME SERVICE GATE MONOLITHS. INSTALL EQUIPMENT.
4. DRIVE Z-PILE CUT-OFF WALL THAT WILL ALSO DEFINE CHAMBER CONSTRUCTION AREA PLACE TWO FOOT THICK LAYER OF CRUSHED STONE WITHIN CHAMBER CONSTRUCTION AREA.
5. DRIVE LEVELING AND BEARING PILES FOR PRECAST WALL UNITS. INSTALL LANDING PADS FOR PRECAST CULVERT UNITS.
6. INSTALL PRECAST WALL UNITS. INSTALL PRECAST CULVERT UNITS USING SPUD/SPOTTER PILES.
7. DRIVE CULVERT UNIT BEARING PILES. UNDER BASE GROUT UNIT.
8. DRIVE REMAINING CHAMBER FLOOR PILES. FILL CULVERT UNITS WITH TREMIE CONCRETE. FILL AREAS BETWEEN PRECAST WALLS AND CULVERT UNITS WITH TREMIE CONCRETE.
9. GROUT BETWEEN CULVERT UNITS TO SECURE JOINTS. WELD PIPE-LINER PLATES ACROSS JOINTS TO MAKE CULVERTS CONTINUOUS.
10. DEWATER CHAMBER AND INSPECT JOINTS.
11. CONSTRUCT APPROACH STRUCTURE BETWEEN DAM AND UPSTREAM GATE MONOLITH. REMOVE DAM PIER STEM AND TAINER GATES.
12. BACKFILL AROUND COMPLETED LOCK STRUCTURES AND DOWNSTREAM GUIDEWALL. INSTALL SCOUR PROTECTION.
13. REMOVE EXISTING UPSTREAM GUARDWALL. CONSTRUCT NEW GUIDEWALLS. INSTALL SCOUR PROTECTION ALONG GUIDEWALLS.

NOTES:

1. U.S. AND D.S. SERVICE GATE MONOLITHS CONSTRUCTED IN A SINGLE SHEET PILE WALL COFFERDAM. T/COFFERDAM EL. 440.0.
2. SCOUR PROTECTION NOT SHOWN.
3. NEW STONE PROTECTION CAN BE PLACED IN WET.

LOCK PLAN - LOCATION 4, TYPE B

SCALE: 1" = 100'

100' 0 100'

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LOCATION 4
TYPE B
LOCK PLAN

Scale: 100:1

PLATE P4B1

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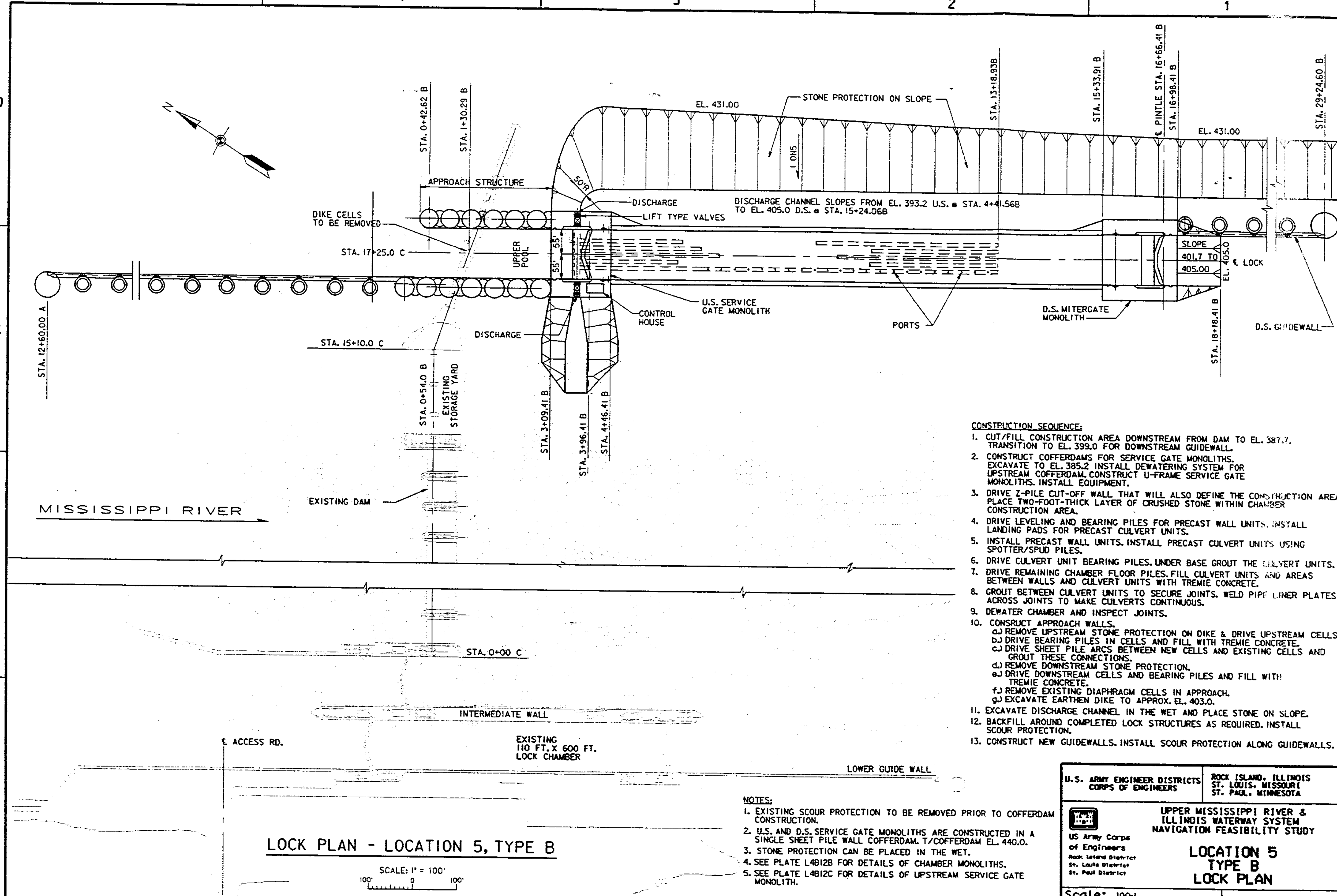

CONSTRUCTION SEQUENCE:

1. CUT/FILL CONSTRUCTION AREA DOWNSTREAM FROM DAM TO EL. 387.7. TRANSITION TO EL. 399.0 FOR DOWNSTREAM GUIDEWALL.
2. CONSTRUCT COFFERDAMS FOR SERVICE GATE MONOLITHS. EXCAVATE TO EL. 385.2 INSTALL DEWATERING SYSTEM FOR UPSTREAM COFFERDAM. CONSTRUCT U-FRAME SERVICE GATE MONOLITHS. INSTALL EQUIPMENT.
3. DRIVE Z-PILE CUT-OFF WALL THAT WILL ALSO DEFINE THE CONSTRUCTION AREA. PLACE TWO-FOOT-THICK LAYER OF CRUSHED STONE WITHIN CHAMBER CONSTRUCTION AREA.
4. DRIVE LEVELING AND BEARING PILES FOR PRECAST WALL UNITS. INSTALL LANDING PADS FOR PRECAST CULVERT UNITS.
5. INSTALL PRECAST WALL UNITS. INSTALL PRECAST CULVERT UNITS USING SPOTTER/SPUD PILES.
6. DRIVE CULVERT UNIT BEARING PILES. UNDER BASE GROUT THE CULVERT UNITS.
7. DRIVE REMAINING CHAMBER FLOOR PILES. FILL CULVERT UNITS AND AREAS BETWEEN WALLS AND CULVERT UNITS WITH TREMIE CONCRETE.
8. GROUT BETWEEN CULVERT UNITS TO SECURE JOINTS. WELD PIPE LINER PLATES ACROSS JOINTS TO MAKE CULVERTS CONTINUOUS.
9. DEWATER CHAMBER AND INSPECT JOINTS.
10. CONSRUCT APPROACH WALLS.
    a.) REMOVE UPSTREAM STONE PROTECTION ON DIKE & DRIVE UPSTREAM CELLS.
    b.) DRIVE BEARING PILES IN CELLS AND FILL WITH TREMIE CONCRETE.
    c.) DRIVE SHEET PILE ARCS BETWEEN NEW CELLS AND EXISTING CELLS AND GROUT THESE CONNECTIONS.
    d.) REMOVE DOWNSTREAM STONE PROTECTION.
    e.) DRIVE DOWNSTREAM CELLS AND BEARING PILES AND FILL WITH TREMIE CONCRETE.
    f.) REMOVE EXISTING DIAPHRAGM CELLS IN APPROACH.
    g.) EXCAVATE EARTHEN DIKE TO APPROX. EL. 403.0.
11. EXCAVATE DISCHARGE CHANNEL IN THE WET AND PLACE STONE ON SLOPE.
12. BACKFILL AROUND COMPLETED LOCK STRUCTURES AS REQUIRED. INSTALL SCOUR PROTECTION.
13. CONSTRUCT NEW GUIDEWALLS. INSTALL SCOUR PROTECTION ALONG GUIDEWALLS.

LOCK PLAN - LOCATION 5, TYPE B

SCALE: 1" = 100'
100' 0 100'

NOTES:

1. EXISTING SCOUR PROTECTION TO BE REMOVED PRIOR TO COFFERDAM CONSTRUCTION.
2. U.S. AND D.S. SERVICE GATE MONOLITHS ARE CONSTRUCTED IN A SINGLE SHEET PILE WALL COFFERDAM. T/COFFERDAM EL. 440.0.
3. STONE PROTECTION CAN BE PLACED IN THE WET.
4. SEE PLATE L4B12B FOR DETAILS OF CHAMBER MONOLITHS.
5. SEE PLATE L4B12C FOR DETAILS OF UPSTREAM SERVICE GATE MONOLITH.

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LOCATION 5
TYPE B
LOCK PLAN

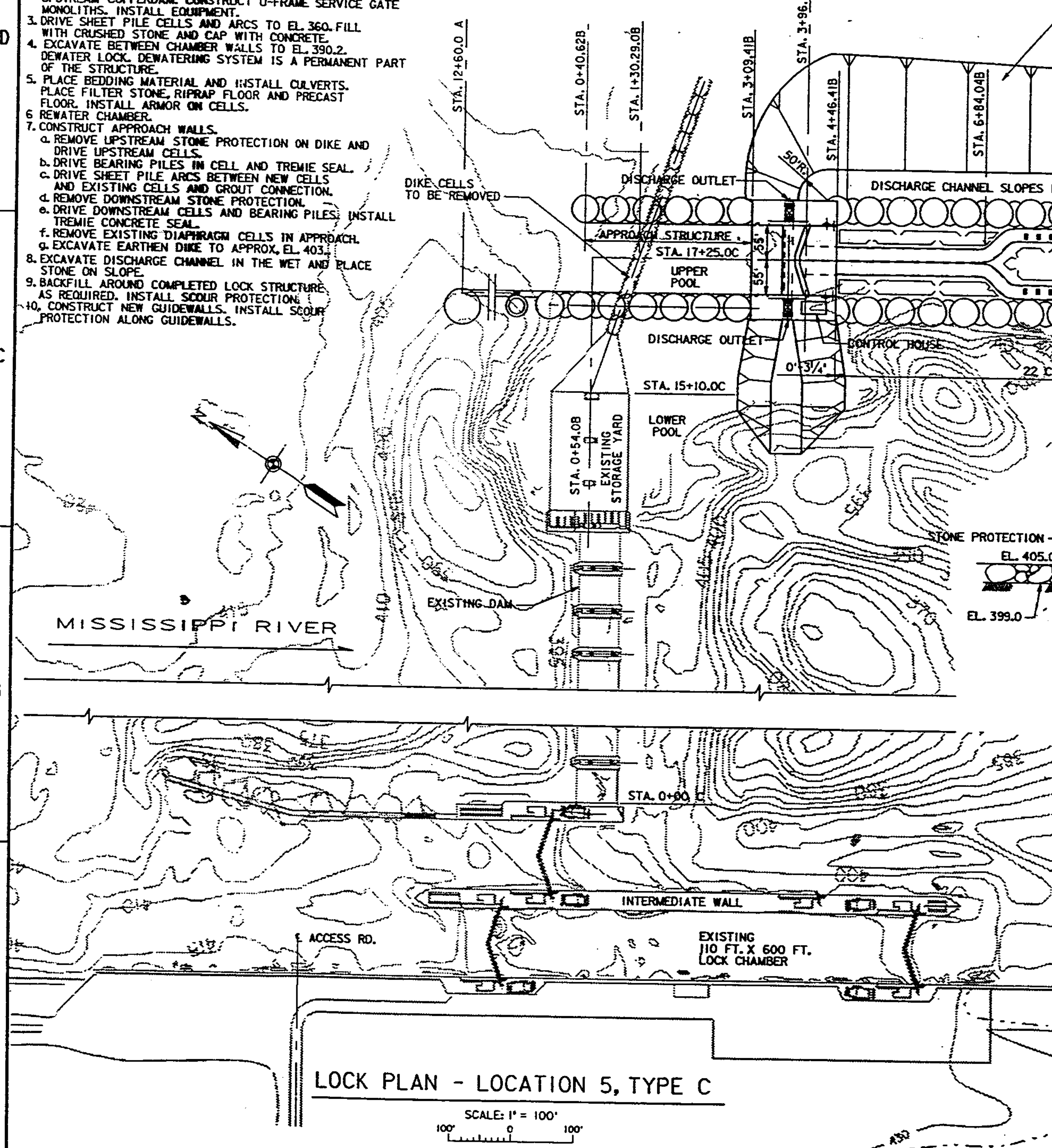
Scale: 100:1

PLATE P5B1

9-JAN-1996 11:04

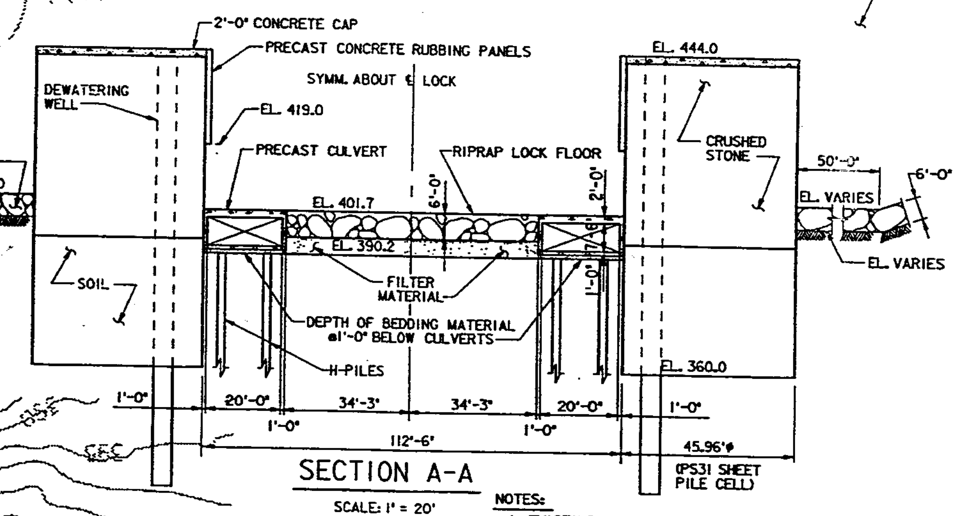
CONSTRUCTION SEQUENCE:

1. CUT/FILL CONSTRUCTION AREA DOWNSTREAM FROM DAM TO EL. 391.2 TRANSITION TO EL.399 FOR DOWNSTREAM GUIDEWALL.
2. CONSTRUCT COFFERDAMS FOR SERVICE GATE MONOLITHS. EXCAVATE TO EL. 385.2. INSTALL DEWATERING SYSTEM FOR UPSTREAM COFFERDAM. CONSTRUCT U-FRAME SERVICE GATE MONOLITHS. INSTALL EQUIPMENT.
3. DRIVE SHEET PILE CELLS AND ARCS TO EL. 360. FILL WITH CRUSHED STONE AND CAP WITH CONCRETE.
4. EXCAVATE BETWEEN CHAMBER WALLS TO EL. 390.2. DEWATER LOCK. DEWATERING SYSTEM IS A PERMANENT PART OF THE STRUCTURE.
5. PLACE BEDDING MATERIAL AND INSTALL CULVERTS. PLACE FILTER STONE, RIPRAP FLOOR AND PRECAST FLOOR. INSTALL ARMOR ON CELLS.
6. REWATER CHAMBER.
7. CONSTRUCT APPROACH WALLS.
   a. REMOVE UPSTREAM STONE PROTECTION ON DIKE AND DRIVE UPSTREAM CELLS.
   b. DRIVE BEARING PILES IN CELL AND TREMIE SEAL.
   c. DRIVE SHEET PILE ARCS BETWEEN NEW CELLS AND EXISTING CELLS AND GROUT CONNECTION.
   d. REMOVE DOWNSTREAM STONE PROTECTION.
   e. DRIVE DOWNSTREAM CELLS AND BEARING PILES. INSTALL TREMIE CONCRETE SEAL.
   f. REMOVE EXISTING DIAPHRAGM CELLS IN APPROACH.
   g. EXCAVATE EARTHEN DIKE TO APPROX. EL. 403.
8. EXCAVATE DISCHARGE CHANNEL IN THE WET AND PLACE STONE ON SLOPE.
9. BACKFILL AROUND COMPLETED LOCK STRUCTURE AS REQUIRED. INSTALL SCOUR PROTECTION.
10. CONSTRUCT NEW GUIDEWALLS. INSTALL SCOUR PROTECTION ALONG GUIDEWALLS.



LOCK PLAN - LOCATION 5, TYPE C

SCALE: 1" = 100'



SECTION A-A

SCALE: 1" = 20'

NOTES:

1. EXISTING SCOUR PROTECTION TO BE REMOVED PRIOR TO COFFERDAM CONSTRUCTION.
2. STONE PROTECTION CAN BE INSTALLED IN THE WET.
3. CHAMBER WALLS WILL ACT AS A COFFERDAM DURING CULVERT AND WALL ARMOR INSTALLATION.
4. U.S. & D.S. SERVICE GATE MONOLITHS ARE CONSTRUCTED IN A SINGLE SHEET PILE WALL COFFERDAM. T/COFFERDAM EL. 440.0.
5. FOR DETAILS OF UPSTREAM SERVICE GATE MONOLITH, SEE PLATE P4C2.

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Scale: 100:1	PLATE P5C1

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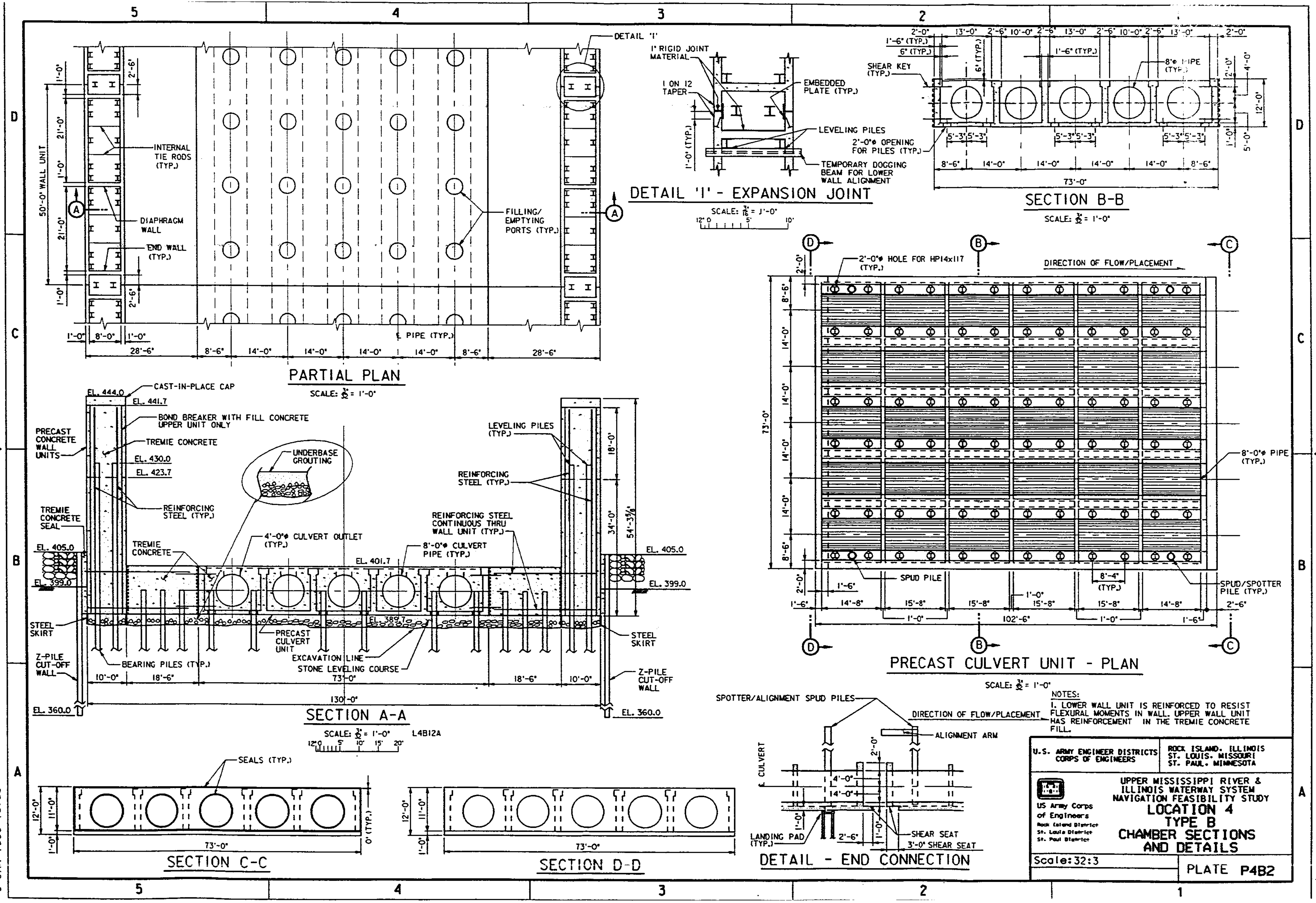
DETAIL 'I'
INTERNAL TIE RODS (TYP.)
50'-0" WALL UNIT
DIAPHRAGM WALL
END WALL (TYP.)
FILLING/ EMPTYING PORTS (TYP.)
℄ PIPE (TYP.)
28'-6"
8'-6"
14'-0"
8'-6"
PARTIAL PLAN
SCALE: 3/32" = 1'-0"
1" RIGID JOINT MATERIAL
1 ON 12 TAPER
EMBEDDED PLATE (TYP.)
LEVELING PILES
TEMPORARY DOGGING BEAM FOR LOWER WALL ALIGNMENT
DETAIL 'I' - EXPANSION JOINT
SCALE: 3/16" = 1'-0"
SHEAR KEY (TYP.)
8'φ PIPE (TYP.)
2'-0"φ OPENING FOR PILES (TYP.)
73'-0"
SECTION B-B
SCALE: 3/32" = 1'-0"
CAST-IN-PLACE CAP
EL. 444.0
EL. 441.7
BOND BREAKER WITH FILL CONCRETE UPPER UNIT ONLY
PRECAST CONCRETE WALL UNITS
TREMIE CONCRETE
EL. 430.0
EL. 423.7
UNDERBASE GROUTING
REINFORCING STEEL (TYP.)
TREMIE CONCRETE SEAL
EL. 405.0
EL. 399.0
4'-0"φ CULVERT OUTLET (TYP.)
8'-0"φ CULVERT PIPE (TYP.)
EL. 401.7
REINFORCING STEEL CONTINUOUS THRU WALL UNIT (TYP.)
LEVELING PILES (TYP.)
STEEL SKIRT
Z-PILE CUT-OFF WALL
BEARING PILES (TYP.)
PRECAST CULVERT UNIT
EXCAVATION LINE
STONE LEVELING COURSE
EL. 389.7
EL. 360.0
10'-0"
18'-6"
73'-0"
130'-0"
SECTION A-A
SCALE: 3/32" = 1'-0"
L4B12A
2'-0"φ HOLE FOR HP14x117 (TYP.)
DIRECTION OF FLOW/PLACEMENT
8'-0"φ PIPE (TYP.)
SPUD PILE
SPUD/SPOTTER PILE (TYP.)
102'-6"
PRECAST CULVERT UNIT - PLAN
SCALE: 3/32" = 1'-0"
NOTES:
1. LOWER WALL UNIT IS REINFORCED TO RESIST FLEXURAL MOMENTS IN WALL. UPPER WALL UNIT HAS REINFORCEMENT IN THE TREMIE CONCRETE FILL.
SEALS (TYP.)
SECTION C-C
SECTION D-D
SPOTTER/ALIGNMENT SPUD PILES
ALIGNMENT ARM
℄ CULVERT
LANDING PAD (TYP.)
SHEAR SEAT
3'-0" SHEAR SEAT
DETAIL - END CONNECTION
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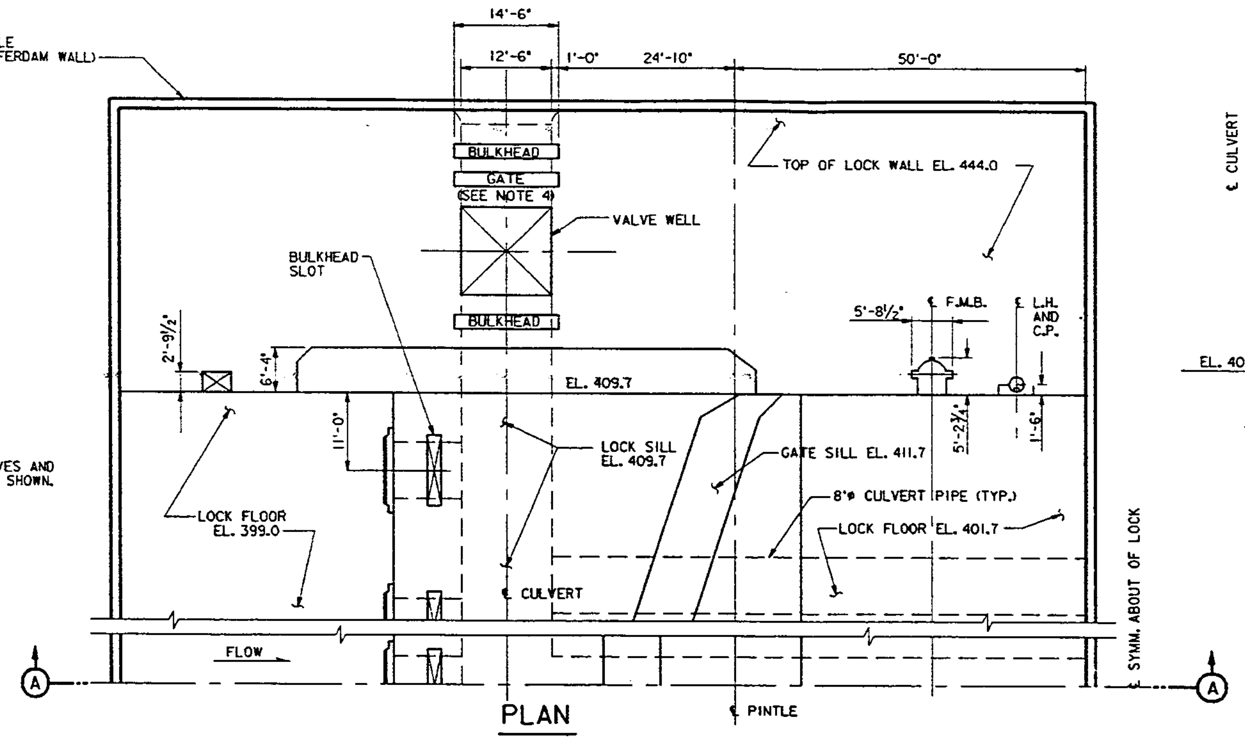
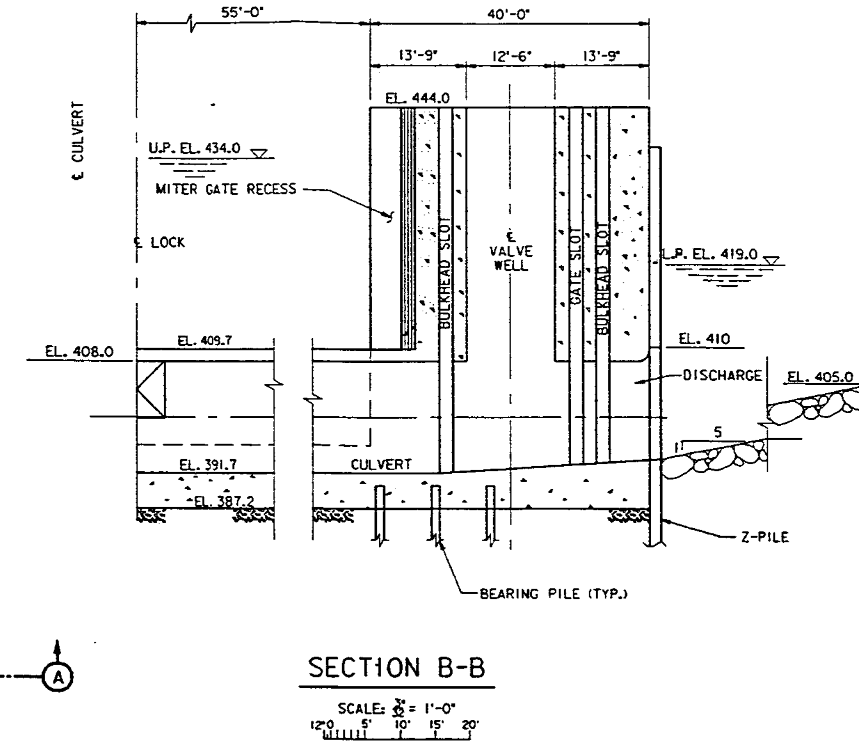
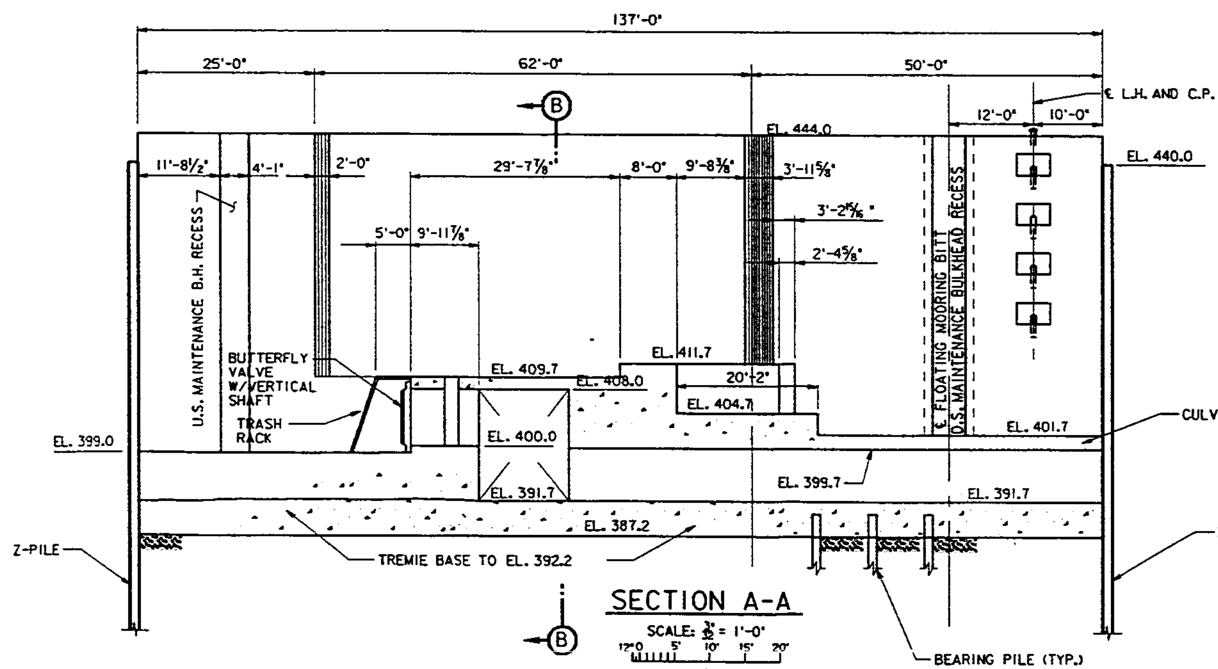
LOCATION 4
TYPE B
CHAMBER SECTIONS AND DETAILS
Scale: 32:3
PLATE P4B2
9-JAN-1996 10:06



NOTE:
MITER GATE LEAVES AND TRASH RACK NOT SHOWN.





NOTES:

1. FOR DETAILS OF PRECAST CULVERT SEE DRAWING L4B12B.
2. MONOLITH IS CONSTRUCTED WITHIN A DEWATERED, SINGLE SHEET PILE WALL COFFERDAM WITH A TREMIE CONCRETE SEAL.
3. DEWATERING SYSTEM IS DEEP WELLS WITH SUBMERSIBLE PUMPS (NOT SHOWN).
4. CULVERT EMPTYING GATES ARE VERTICAL SLIDE GATES. LIFTING EQUIPMENT NOT SHOWN.

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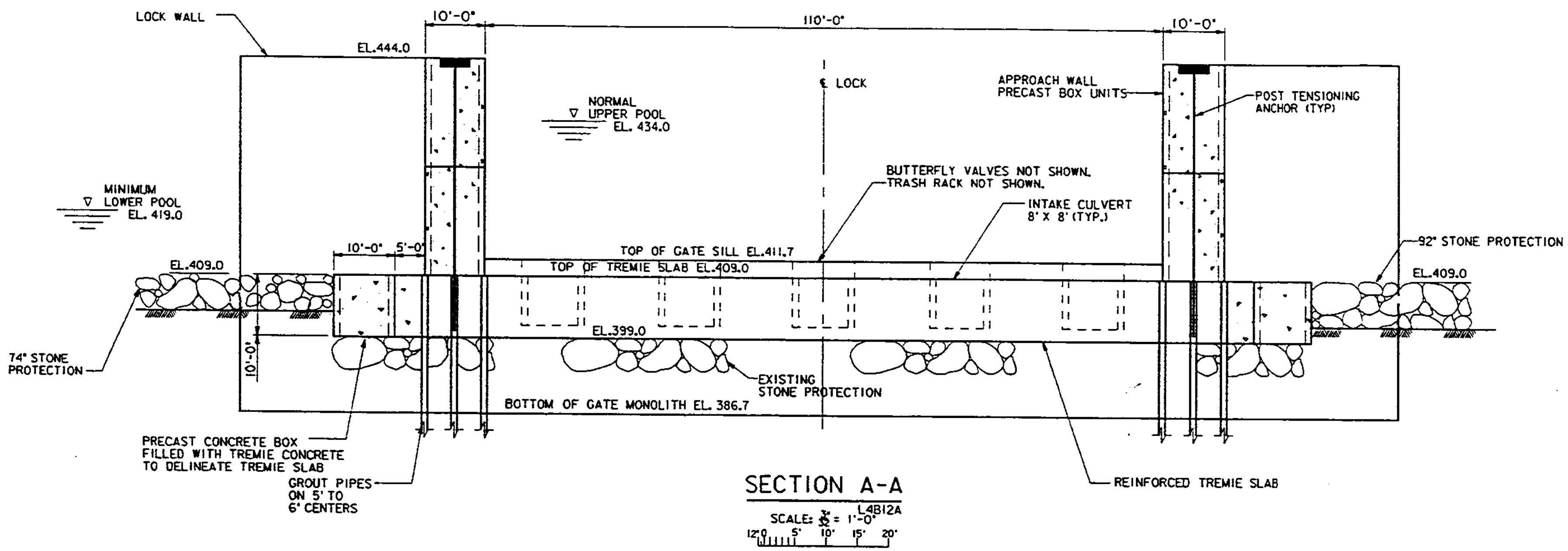
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

LOCATION 4
TYPE B
MITER GATE MONOLITH PLAN AND SECTIONS

Scale: 32:3

PLATE P4B3

9-JAN-1996 10:11



SECTION A-A

SCALE: 3/32" = 1'-0"

L4B12A

NOTES:
1. TREMIE IS FORMED BY LARGE PRECAST CONCRETE BLOCK FORMS.
2. APPROACH WALLS ARE CONSTRUCTED OF LARGE PRECAST CONCRETE BLOCKS FILLED WITH TREMIE CONCRETE.

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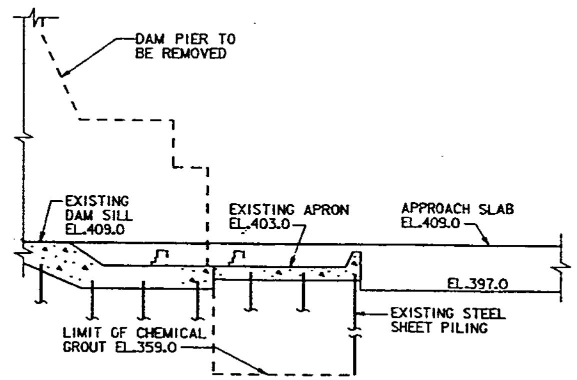
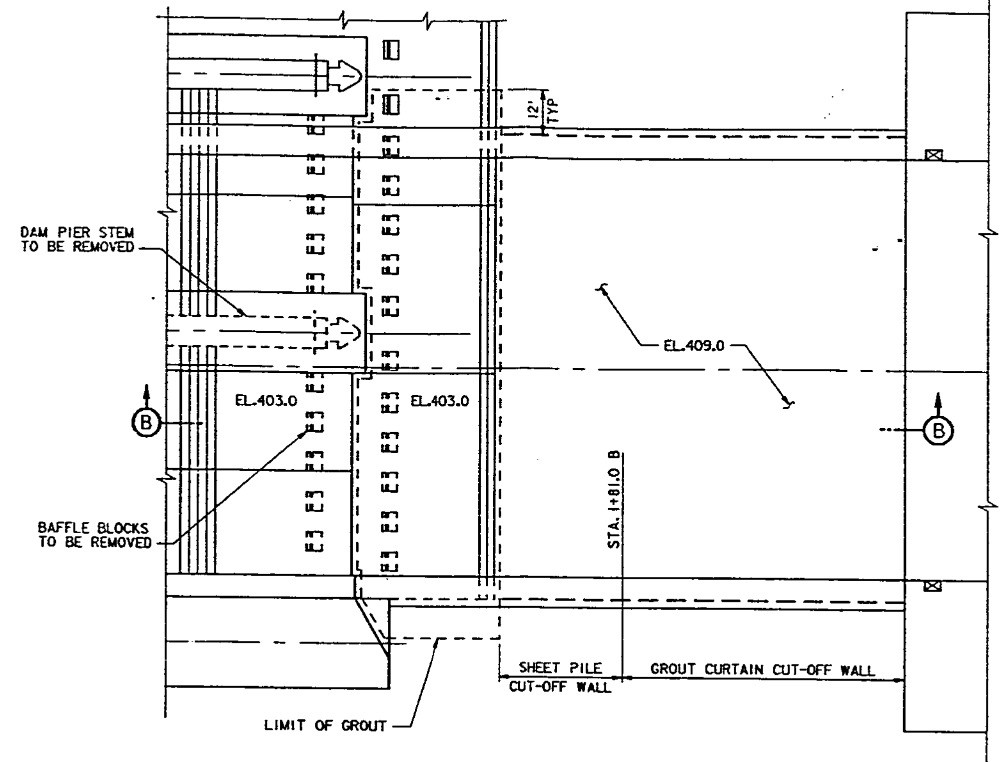
Scale: 10.6667:1	PLATE P4B4

JAN-1996 10:10



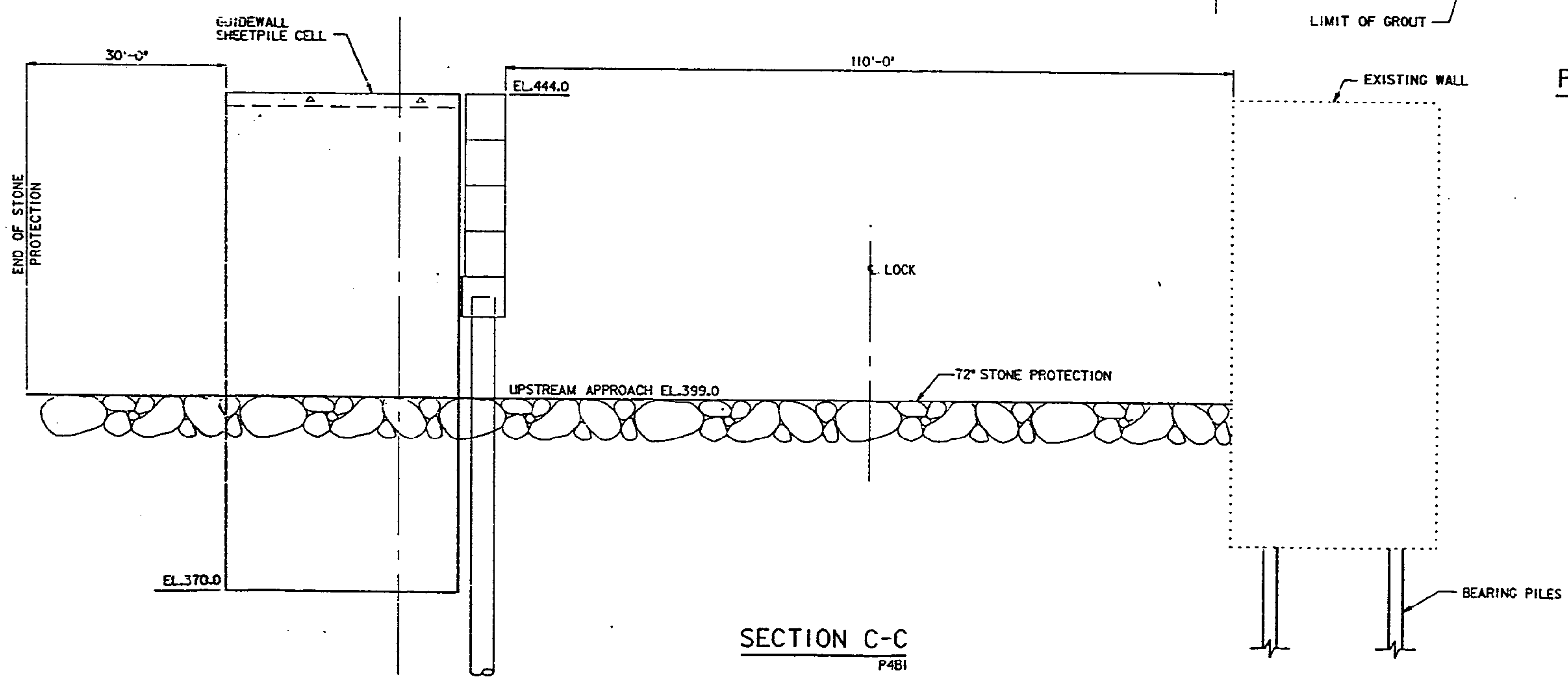
SECTION B-B

SCALE: 1" = 20'



PARTIAL PLAN

SCALE: 1" = 20'



SECTION C-C

P4B1

NOTES:

1. EXISTING APRON IS TO HAVE FOUNDATION CHEMICALLY GROUTED BEFORE PLACEMENT OF FRESH CONCRETE.
2. BAFFLE BLOCKS ON APRON WILL BE REMOVED UNDER WATER. UPPER BLOCKS CAN BE REMOVED WHEN GATE BAY IS UNWATERED.

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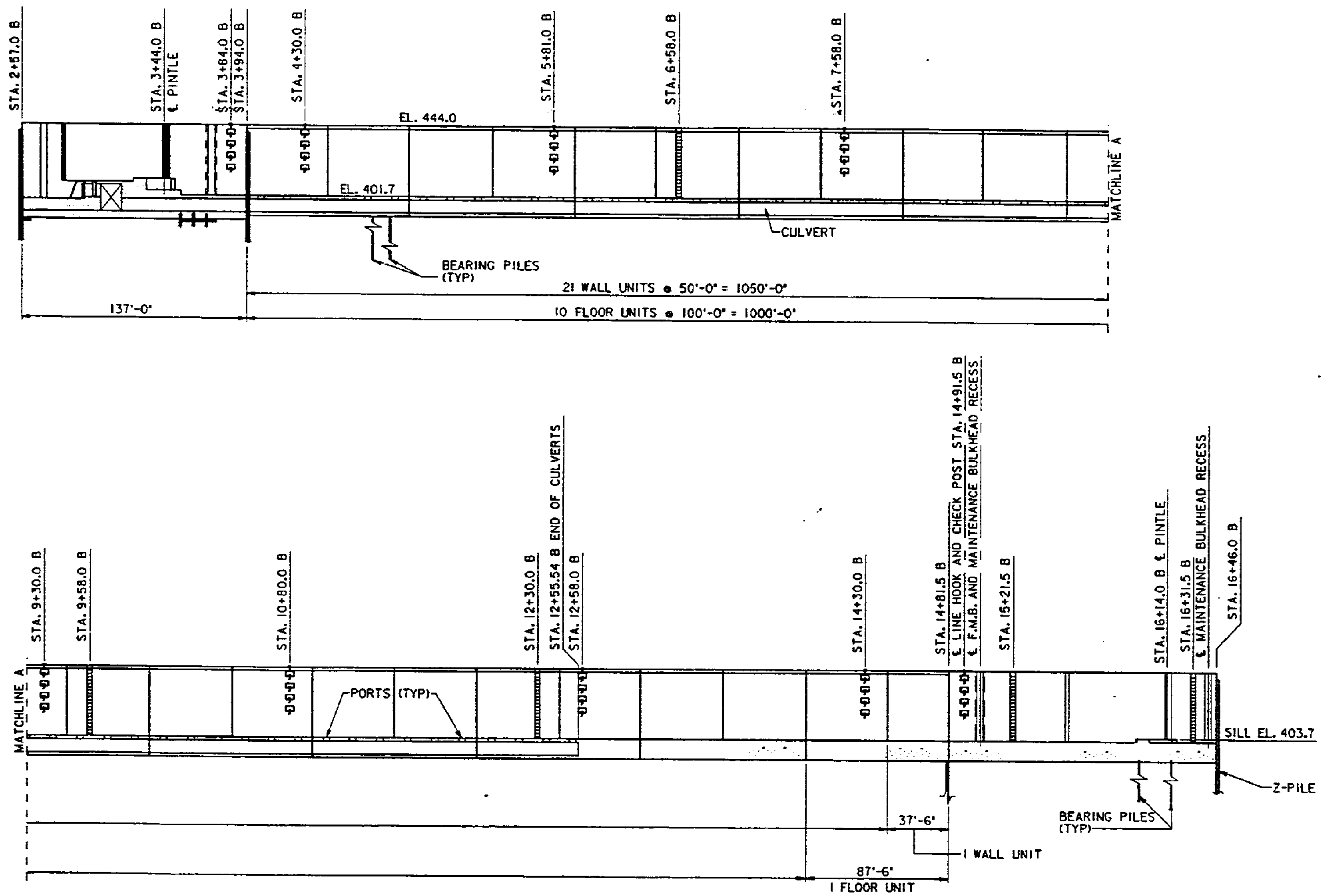
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

LOCATION 4
TYPE B
U.S. APPROACH AND SECTIONS

Scale: 32:3

PLATE P4B5

23-JAN-1996 10:13



FILLING AND EMPTYING

LONGITUDINAL SECTION THRU LOCK

SCALE: 1" = 40'

40' 0 40'

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ILLINOIS WATERWAY SYSTEM
NAVIGATION FEASIBILITY STUDY

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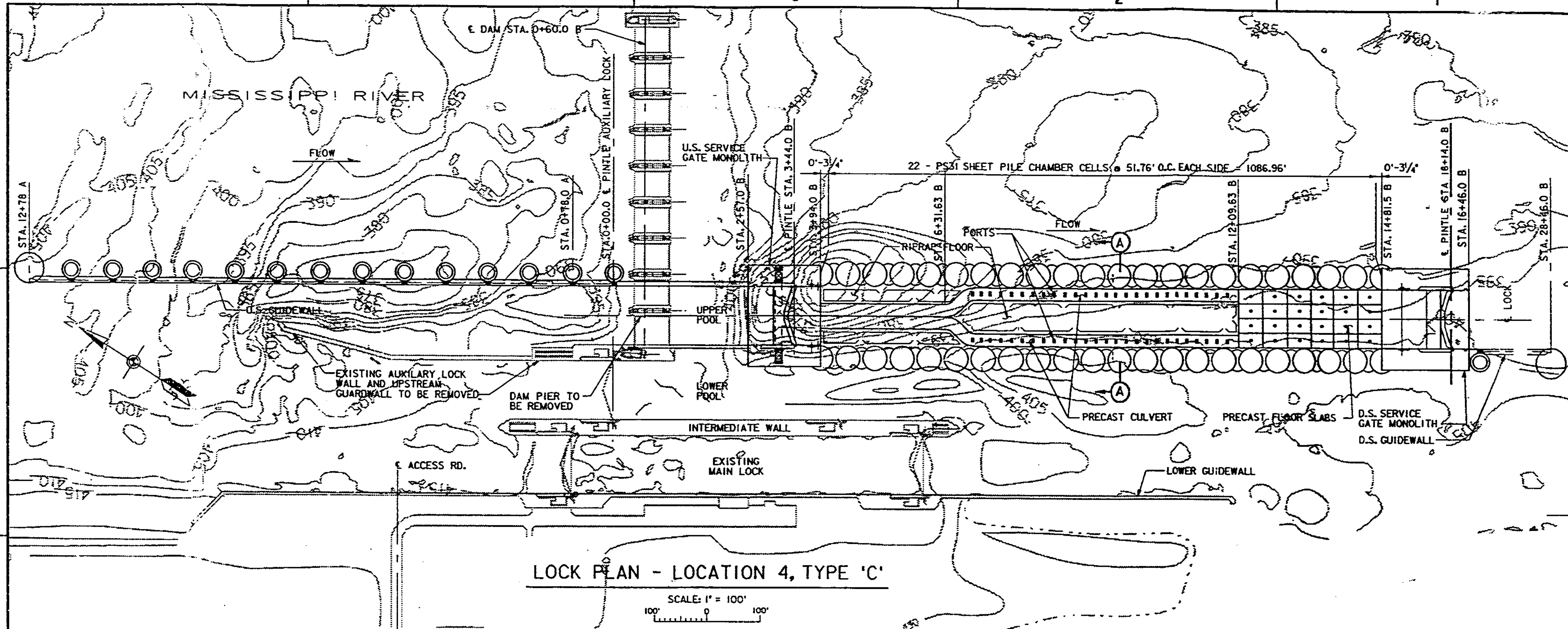
LOCATION 4
TYPE B
LONGITUDINAL SECTION

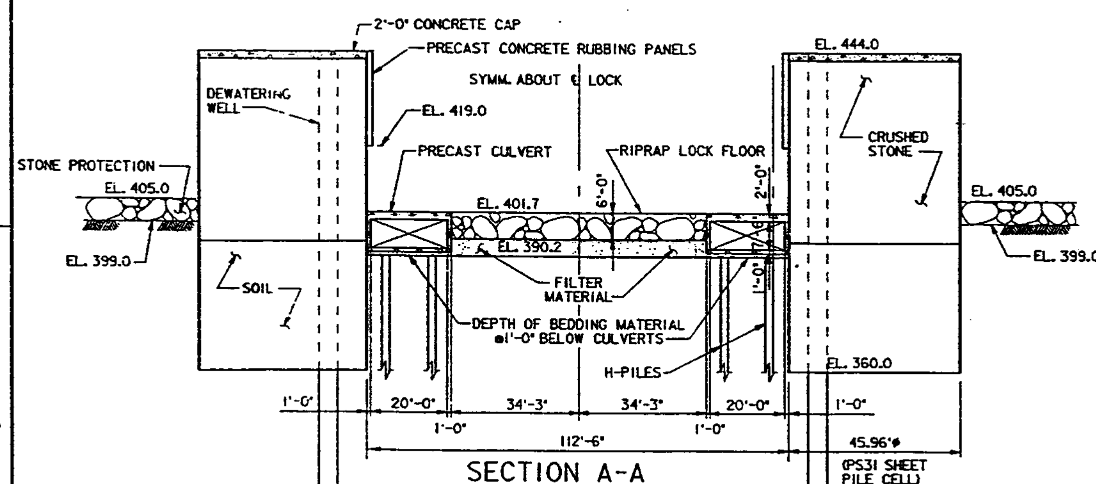
Scale: 40:1

PLATE P4B6



LOCK PLAN - LOCATION 4, TYPE 'C'

SCALE: 1" = 100'



SECTION A-A

SCALE: 1" = 20'

CONSTRUCTION SEQUENCE:

1. CLOSE TAINTER GATES UPSTREAM FROM SITE.
2. REMOVE EXISTING RIPRAP IN CONSTRUCTION AREAS DOWNSTREAM FROM DAM AND ALONG EXISTING LOCK.
3. FILL SCOUR HOLE DOWNSTREAM FROM DAM WITH SAND AND STONE. CUT/FILL CONSTRUCTION AREA DOWNSTREAM FROM DAM TO EL. 390.2. TRANSITION TO EL. 399 FOR DOWNSTREAM GUIDEWALL.
4. CONSTRUCT COFFERDAMS FOR SERVICE GATE MONOLITHS. EXCAVATE TO EL. 385.2. INSTALL DEWATERING SYSTEM FOR UPSTREAM COFFERDAM. CONSTRUCT U-FRAME SERVICE GATE MONOLITHS.
5. DRIVE SHEET PILE CELLS AND ARCS TO EL. 360. FILL WITH CRUSHED STONE AND CAP WITH CONCRETE.
6. DEWATER CHAMBER. DEWATERING SYSTEM IS A PERMANENT PART OF THE STRUCTURE.
7. PLACE BEDDING MATERIAL AND INSTALL CULVERTS. PLACE FILTER STONE, RIPRAP FLOOR AND PRECAST FLOOR, INSTALL ARMOR ON CELLS.
8. REWATER CHAMBER.
9. REMOVE SERVICE BRIDGE, DAM PIER AND TAINTER GATES. CONSTRUCT APPROACH STRUCTURE BETWEEN DAM AND UPSTREAM GATE MONOLITH.
10. BACKFILL AROUND COMPLETED STRUCTURES. INSTALL SCOUR PROTECTION.
11. REMOVE EXISTING UPSTREAM GUARDWALL. CONSTRUCT NEW GUIDEWALLS. INSTALL SCOUR PROTECTION ALONG GUIDEWALL.

NOTES:

1. STONE PROTECTION CAN BE INSTALLED IN THE WET.
2. CHAMBER WALLS WILL ACT AS A COFFERDAM DURING CULVERT INSTALLATION.
3. U.S. & D.S. SERVICE GATE MONOLITHS ARE CONSTRUCTED IN A SINGLE SHEET PILE WALL COFFERDAM. T/COFFERDAM EL. 440.0.

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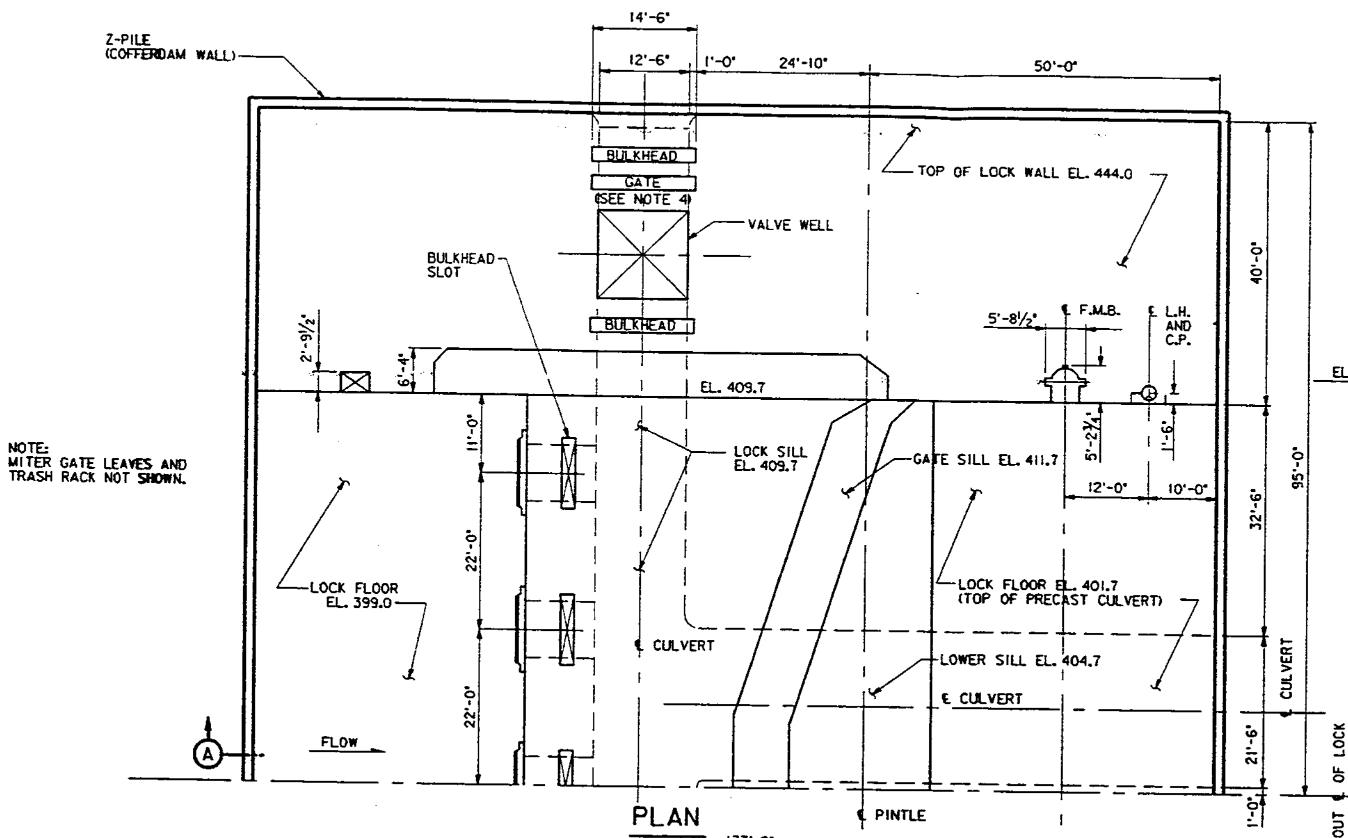
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY

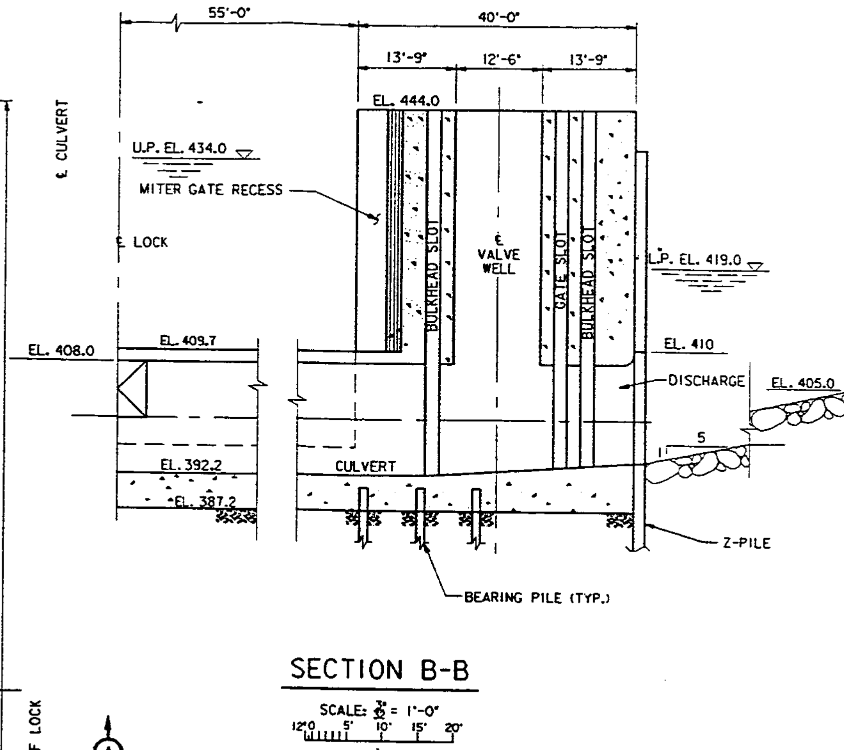
LOCATION 4 TYPE C LOCK PLAN AND SECTIONS

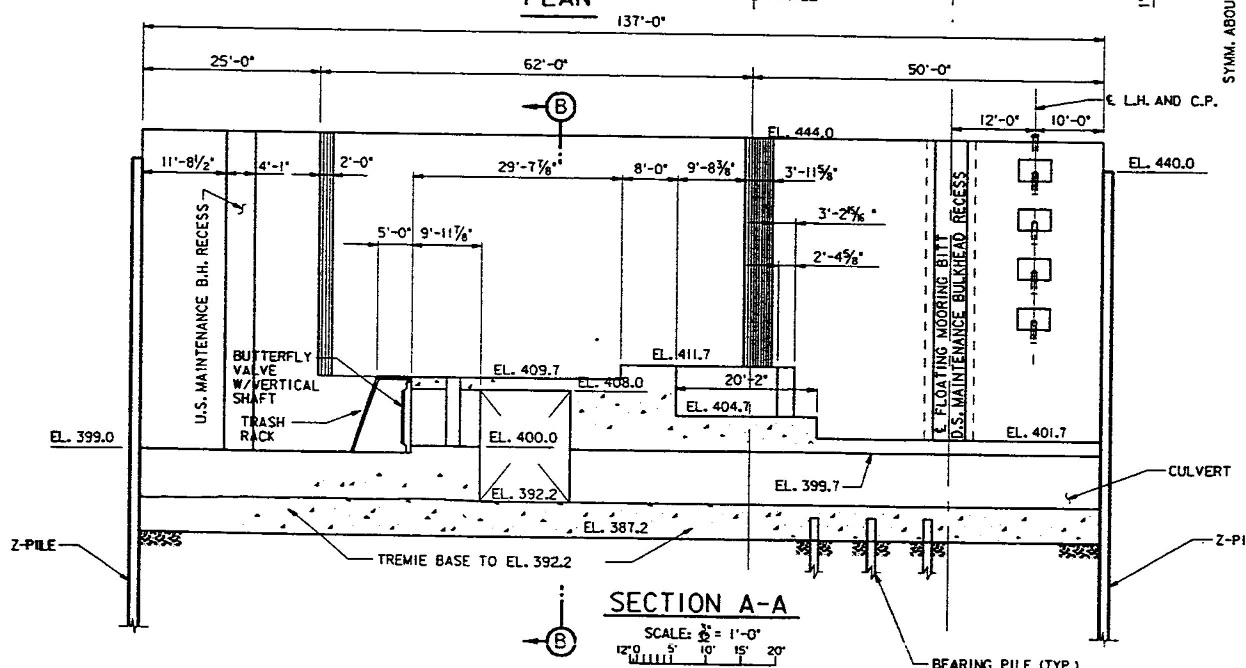
Scale: [illegible]

PLATE P4C1

23-JAN-1996 10:14







NOTES:

1. FOR DETAILS OF PRECAST CULVERT SEE DRAWING L4C12A.
2. MONOLITH IS CONSTRUCTED WITHIN A DEWATERED, SINGLE SHEET PILE WALL COFFERDAM WITH A TREMIE CONCRETE SEAL.
3. DEWATERING SYSTEM IS DEEP WELLS WITH SUBMERSIBLE PUMPS (NOT SHOWN).
4. CULVERT EMPTYING GATES ARE VERTICAL SLIDE GATES. LIFTING EQUIPMENT NOT SHOWN.

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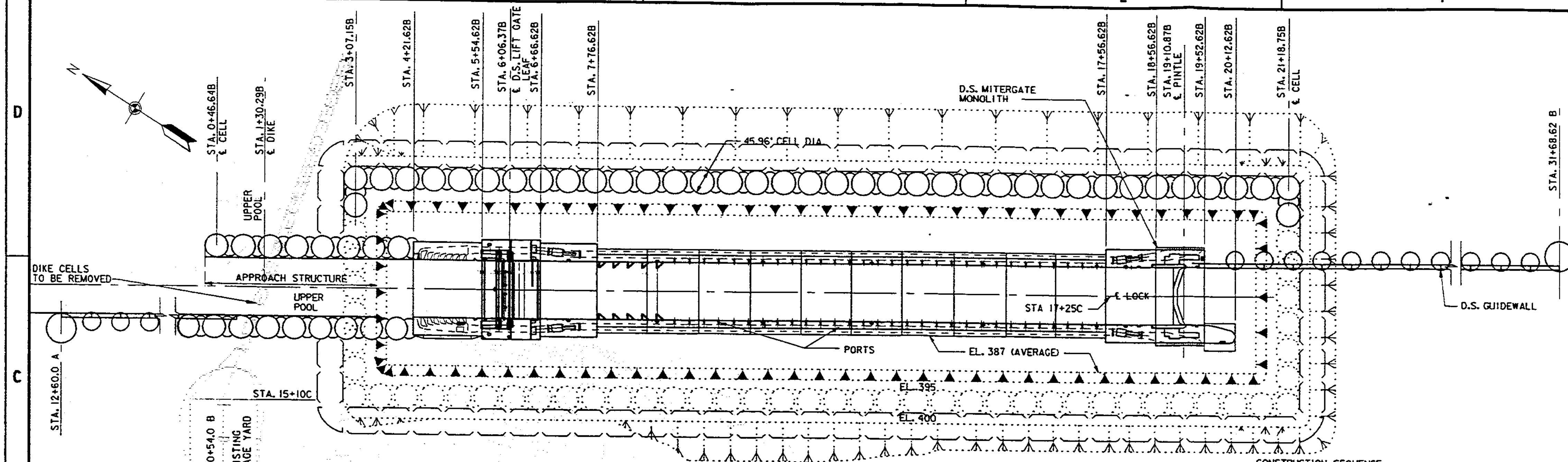
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY LOCATION 4 TYPE C MITER GATE MONOLITH PLAN AND SECTIONS
Scale: 32:3	PLATE P4C2

9-JAN-1996 10:29

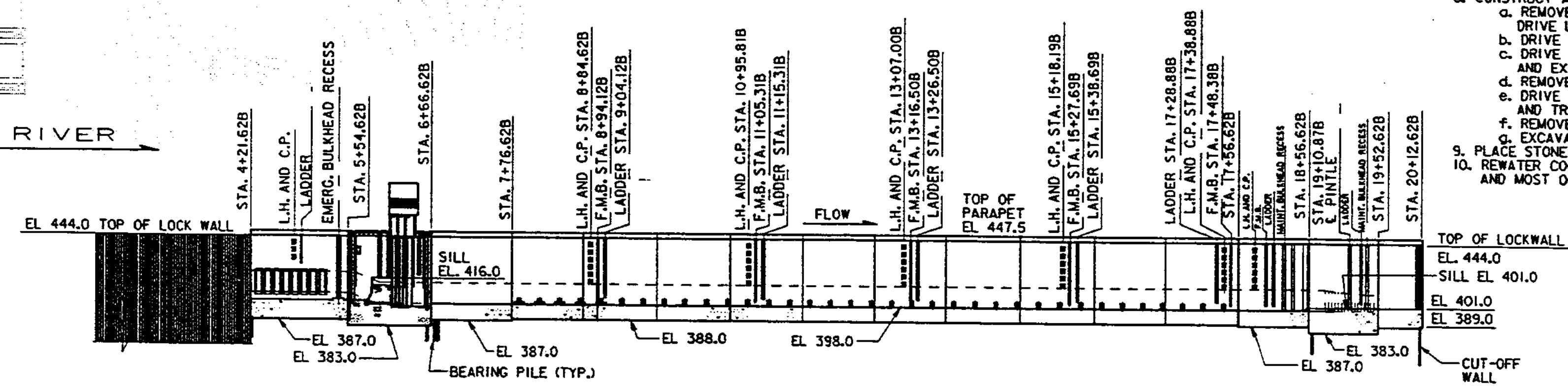


LOCK PLAN - LOCATION 5, TYPE A

SCALE: 1" = 100'

CONSTRUCTION SEQUENCE:

1. INSTALL UPSTREAM LEG OF COFFERDAM
2. EXCAVATE COFFEDAM FOOTPRINT TO EL. 400. FILL SCOUR HOLE TO EL. 387.
3. DRIVE REMOVABLE COFFER CELLS
4. EXCAVATE TO FOUNDATION ELEVATION AND CONSTRUCT STABILITY BERM.
5. DEWATER COFFERDAM AND DRIVE BEARING PILES AND CUT-OFF WALL.
6. BUILD CONCRETE MONOLITHS
7. CONSTRUCT GUIDEWALLS CONCURRENT WITH LOCK.
8. CONSTRUCT APPROACH WALLS.
   a. REMOVE UPSTREAM STONE PROTECTION ON DIKE & DRIVE UPSTREAM CELLS
   b. DRIVE BEARING PILES IN CELLS AND TREMIE SEAL
   c. DRIVE SHEET PILE ARCS BETWEEN NEW CELLS AND EXISTING CELLS AND GROUT THIS CONNECTION
   d. REMOVE DOWNSTREAM STONE PROTECTION
   e. DRIVE DOWNSTREAM CELLS, BEARING PILES AND TREMIE CONCRETE SEAL
   f. REMOVE EXISTING DIAPHRAGM CELLS IN APPROACH
   g. EXCAVATE EARTHEN DIKE TO APPROX. EL. 409.
9. PLACE STONE SCOUR PROTECTION
10. REWATER COFFERDAM AND REMOVE RIVERWARD LEG AND MOST OF UPSTREAM AND DOWNSTREAM LEGS.



SECTIONAL ELEVATION OF LOCKWALL

HORIZONTAL SCALE: 1" = 100'

VERTICAL SCALE: 1" = 50'

NOTES:
1. EXISTING STONE PROTECTION TO BE REMOVED PRIOR TO COFFERDAM CONSTRUCTION.
2. STONE PROTECTION FOR LOCK CAN BE INSTALLED IN THE WET.
3. T/COFFERDAM ELEVATION 440
4. DASHED COFFERDAM CELLS TO BE REMOVED.
5. LOCAL EXCAVATION FOR DEEPER FOUNDED MONOLITHS NOT SHOWN.

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US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION FEASIBILITY STUDY LOCATION 5 TYPE A LOCK PLAN AND ELEVATION
Scale: 100:1	PLATE P5A1

9-JAN-1996 10:32

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION CONCEPTUAL LOCK DESIGNS

APPENDIX A: COST ESTIMATES

U.S. ARMY ENGINEER DISTRICTS,
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CORPS OF ENGINEERS

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION
CONCEPTUAL LOCK DESIGNS

APPENDIX A: COST ESTIMATES

Table of Contents

List of Cost Estimates

Rock Founded

Pile-Founded

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION

CONCEPTUAL LOCK DESIGNS

APPENDIX A: COST ESTIMATES

1. General. This appendix contains the cost estimates prepared for the conceptual lock designs described in this report, both pile and rock founded, 600 feet and 1200 feet long. The estimates include Federal construction, planning, engineering, design, and construction management costs. The current working estimates for this study were developed from the concept drawings and descriptions contained in this report. As further noted below, these cost estimates do not include certain site-specific impacts, and thus cannot be used alone to make a conclusive comparison between alternatives.

2. Price Level. Project element costs are based on January 1996 prices. These costs are considered fair and reasonable to a well-equipped and capable contractor and include overhead and profit.

3. Contingencies. Uncertainties inherent at this conceptual stage of design require large contingencies to be incorporated into the cost estimates. These contingencies are needed to provide for potential cost increases as the designs are developed in more detail during site-specific studies. Appendix C of ER 1110-2-1302, "Types of Cost Estimates", recommends a contingency of 20% during the reconnaissance and feasibility study stages for projects with construction estimates greater than $10,000,000. This guidance further states that,

> "...adjustments [to contingency levels] may be warranted by virtue of additional studies or investigations having been made which further refine the knowledge and information relating to any project feature or *point out any further areas of uncertainties regarding the project estimate*." (italics added)

The greatest amount of design and construction uncertainty is with the lock Types B and C, and the least uncertainty is with the Type A locks. Accordingly, contingencies of 20% were used for Type A lock designs and contingencies of 25% were used for Type B and C designs.

4. Justification of Unit Price. The unit prices for this study include labor, material, equipment, overhead and profit. Normally a feasibility study results in a selected alternative requiring a detailed Micro Computer Aided Cost Estimate System (MCACES) estimate. However, due to the vast array of alternatives, use of unit prices was recommended by the Engineering Work Group of the Navigation Study. This

recommendation was supported by HQUSACE. The labor rates are from the St. Louis Area. For this study, three primary resources were used to find the unit prices:

a. A report from Ben C. Gerwick, Inc. titled "Upper Mississippi River - Illinois Waterway System, Navigation Study, Innovative Lock Concept Review: 1200' Lock Capacity, Alternate Construction Techniques and Constructibility Review" , December, 1994. The primary purpose of this report was to review the constructability of extending an existing lock from 600 feet to 1200 feet long (Location 2). Brief constructability reviews of other lock locations were reported as well. Included in this report are cost estimates for the various options and a detailed explanation of the unit prices used in the cost estimates.

b. Historical Cost Data from Melvin Price Locks and Dam. The Melvin Price Locks and Dam was the most recent major lock construction project and it included a new 1200-foot-long lock, a new 600-foot lock, and a new dam. Much of the bid items in that project have similar requirements to the cost items of the Navigation Study.

c. U.S. Army Corps of Engineers, EP-1110-1-14, "Report of the USACE Task Force on Design and Construction Innovations for Locks and Dams", dated 30 April 1994. This report contains cost estimates for alternative innovative lock designs.

5. Planning, Engineering, and Design. Planning, engineering, and design (PE&D) includes design memorandums, all stages of plans and specifications, and engineering during construction; it does not, however, include work during the site-specific feasibility phase. A uniform rate of 10 percent of construction costs was used for PE&D costs since it was determined that adjusting the PE&D rate for each lock alternative would not change the cost rank of lock alternatives. Nevertheless, there would be differences in PE&D rates among design alternatives which would need to be considered in site-specific studies. Construction cost savings do not necessarily result in design cost savings, and some of the innovative lock designs may actually have higher design rates than conventional designs. However, use of repetitive construction and design simplification can reduce design effort. There is a minimum PE&D cost for lock design since certain design activities are required for all lock alternatives (design work to ensure structural stability, adequate strength/durability, safe navigation conditions, safe construction conditions, etc.). The PE&D rate would also reach a maximum as construction costs passed a certain threshold, above which cost increases were only due to more of the same type of construction (i.e., increased quantities) or costlier materials. Many of the factors influencing PE&D rates tend to be offsetting, and this contributed to the decision to use a uniform rate for PE&D costs.

6. Construction Management. A uniform rate of 10 percent was also used for construction management since it was determined that adjusting the rate by lock alternative would not change the cost rank of alternatives. Construction management costs are generally proportionate to construction duration, construction difficulty, and construction risk, among other factors. However, these are likewise proportionate to construction cost. This was further reason to use the uniform rate. More-detailed studies would be needed to more accurately reflect construction management costs.

7. Limitations of Cost Estimates. The cost estimates on the following pages do not address all costs and impacts of construction of a new lock. Specifically not included are impacts to navigation during construction, environmental impacts, variations in construction duration (variation in time to receive project benefits), and a number of site-specific concerns. A low-cost alternative may have high impacts to navigation during construction, making definitive comparison less clear. For locks at Locations 1, 4, or 5, a shift in alignment can significantly change the cost estimate. Therefore, further site-specific studies would be needed to obtain more certain cost estimates. Another notable difference between L/D 22 (the model rock-founded site) and L/D 25 (the model pile-founded site) is that the depth of water is greater at L/D 25. The quantities and costs reflect this site-specific difference as well as other site-specific differences between L/D 22 and L/D 25.

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION CONCEPTUAL LOCK DESIGNS

COST ESTIMATES OF 1200'

ROCK-FOUNDED LOCKS

U.S. ARMY ENGINEER DISTRICTS,
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LOCK AND DAM NO. 22, LOCATION 1, TYPE A
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,240
02.	**RELOCATION**	1	JOB	SUM	2,750
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION	1	JOB	SUM	500
	EXCAVATION/ DREDGING	810,000	CY	4.50	3,645
	BACKFILL	327,800	CY	15.00	4,917
	ROCK EXCAVATION	65,000	CY	45.00	2,925
	RAILROAD RETAINING WALL	1	JOB	SUM	3,500
	SCOUR PROTECTION	1	JOB	SUM	500
	PERMANENT CELL FILL (GRAVEL)	9,100	CY	15.00	137
	FOUNDATION DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	SLURRY WALL	10,600	CY	705.00	7,473
	CAST IN PLACE REINFORCED CONCRETE	122,400	CY	280.00	34,272
	METALS				
	SHEETPILING - PERMANENT CELLS	28,600	SF	25.00	715
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ANCHORS AND ROD	249,500	LF	26.00	6,487
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	9,612
	05 LOCKS SUBTOTAL				105,736
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	37,100	CY	280.00	10,388
	PRESTRESSED PRECAST CONCRETE BEAMS	3,800	LF	1,250.00	4,750
	PRECAST CONCRETE (W/REINFORCEMENT)	1,600	CY	400.00	640
	TREMIE CONCRETE (WITH REINFORCEMENT)	21,400	CY	210.00	4,494
	METALS				
	SHEETPILING FOR CELLS	1	JOB	SUM	2,593
	SHEETPILE CUTOFF WALL (PZ35) - UPSTREAM	21,800	SF	30.00	654
	SHEETPILE RETAINING WALL (PZ35) - DOWNSTREAM	9,580	SF	30.00	287
	STRUCTURAL STEEL	1	JOB	SUM	900
	05.60 GUIDEWALLS SUBTOTAL				24,706
09.	**CHANNEL WORK**	1	JOB	SUM	7,800
	PROJECT SUBTOTAL				143,232
	CONTINGENCIES (20%)				28,768
	PROJECT SUBTOTAL WITH CONTINGENCIES				172,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				17,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				17,000
	PROJECT TOTAL				206,000

TOTAL BASIC LOCK COST (04., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 188,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 1, TYPE B
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,240
02.	**RELOCATION**	1	JOB	SUM	2,750
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	1,000
	EXCAVATION/ DREDGING	800,000	CY	4.50	3,600
	ROCK EXCAVATION	58,300	CY	45.00	2,624
	RAILROAD RETAINING WALL	1	JOB	SUM	3,500
	SCOUR PROTECTION	1	JOB	SUM	500
	PERMANENT CELL FILL (GRAVEL)	17,600	CY	15.00	264
	FOUNDATION DEWATERING	1	JOB	SUM	5,000
	CONCRETE				
	SLURRY WALL	15,400	CY	705.00	10,857
	CAST IN PLACE REINFORCED CONCRETE	54,800	CY	280.00	15,344
	CAST IN PLACE REINFORCED CONCRETE	18,400	CY	500.00	9,200
	PRECAST CONCRETE (W/REINFORCEMENT)	3,300	CY	400.00	1,320
	METALS				
	SHEETPILING - PERMANENT	42,200	SF	25.00	1,055
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ANCHORS AND ROD	125,400	LF	26.00	3,260
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,500
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	8,308
	05 LOCKS SUBTOTAL				91,385
05.60.	**GUIDEWALLS**				
	CONCRETE				
	SLURRY WALL	11,400	CY	705.00	8,037
	ANCHORS AND ROD	153,000	LF	26.00	3,978
	CAST IN PLACE REINFORCED CONCRETE	6,100	CY	280.00	1,708
	PRECAST CONCRETE (W/REINFORCEMENT)	2,940	CY	400.00	1,176
	PRECAST CONCRETE BEAMS (PRESTRESSED)	2,500	LF	1,170.00	2,925
	TREMIE CONCRETE (WITH REINFORCEMENT)	6,370	CY	210.00	1,338
	GRAVEL FILL	12,400	CY	15.00	186
	METALS				
	SHEETPILING FOR CELLS (PS31)	77,700	SF	25.00	1,943
	SHEETPILE CUTOFF WALL (PZ35) - UPSTREAM	21,800	SF	30.00	654
	SHEETPILE RETAINING WALL (PZ40) - DOWNSTREAM	9,580	SF	30.00	287
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				26,043
09.	**CHANNEL WORK**	1	JOB	SUM	7,800
	PROJECT SUBTOTAL				130,217
	CONTINGENCIES (25%)				32,783
	PROJECT SUBTOTAL WITH CONTINGENCIES				163,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				16,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				16,000
	PROJECT TOTAL				195,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 176,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 1, TYPE C
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,240
02.	**RELOCATION**	1	JOB	SUM	2,750
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	500
	EXCAVATION/ DREDGING	483,000	CY	4.50	2,174
	ROCK EXCAVATION	79,000	CY	45.00	3,555
	RAILROAD RETAINING WALL	1	JOB	SUM	3,500
	SCOUR PROTECTION	1	JOB	SUM	500
	PERMANENT CELL FILL (GRAVEL)	9,100	CY	15.00	137
	FOUNDATION DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	SLURRY WALL	13,500	CY	705.00	9,518
	CAST IN PLACE REINFORCED CONCRETE	71,800	CY	280.00	20,104
	PRECAST CONCRETE (W/REINFORCEMENT)	6,000	CY	400.00	2,400
	METALS				
	SHEETPILING - PERMANENT	28,600	SF	25.00	715
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ANCHORS AND ROD	204,000	LF	26.00	5,304
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	7,746
	05 LOCKS SUBTOTAL				85,204
05.60.	**GUIDEWALLS**				
	CONCRETE				
	SLURRY WALL	12,700	CY	705.00	8,954
	ANCHORS AND ROD	194,000	LF	26.00	5,044
	CAST IN PLACE REINFORCED CONCRETE	2,970	CY	280.00	832
	PRECAST CONCRETE BEAMS (PRESTRESSED)	2,520	LF	1,170.00	2,948
	PRECAST CONCRETE (W/REINFORCEMENT)	7,040	CY	400.00	2,816
	TREMIE CONCRETE (WITH REINFORCEMENT)	6,370	CY	210.00	1,338
	GRAVEL FILL	12,400	CY	15.00	186
	METALS				
	SHEETPILING FOR CELLS (PS31)	77,670	SF	25.00	1,942
	SHEETPILE CUTOFF WALL (PZ35) - UPSTREAM	21,800	SF	30.00	654
	SHEETPILE RETAINING WALL (PZ40) - DOWNSTREAM	9,580	SF	30.00	287
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				28,811
09.	**CHANNEL WORK**	1	JOB	SUM	7,800
	PROJECT SUBTOTAL				126,806
	CONTINGENCIES (25%)				32,194
	PROJECT SUBTOTAL WITH CONTINGENCIES				159,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				16,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				16,000
	PROJECT TOTAL				191,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 171,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 2, TYPE B
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	150
04.	DAMS				
	04 DAMS SUBTOTAL				0
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	1,117
	ROCK EXCAVATION	64,000	CY	45	2,880
	LOCK DEWATERING	1	JOB	SUM	1,250
	COFFERDAM REMOVAL	1	JOB	SUM	81
	MARINE FACILITIES, TEMP MOORING STRUCTURE	1	JOB	SUM	3,900
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	30,520	CY	217	6,623
	PRECAST CONCRETE CHAMBER AND APPROACH WALLS, FLOOR	11,110	CY	400	4,444
	TREMIE CONCRETE	6,500	CY	165	1,073
	PRESTRESSING/POST TENSION STEEL	1,110,000	LB	2.5	2,775
	FURNISH AND SET LANDING PADS	74	EA	19000	1,406
	SET PRECAST WALL UNITS	56	EA	16000	896
	FLOAT IN AND SET MITER GATE SILL	1	EA	140000	140
	STEEL REINFORCEMENT	1,832,000	LB	0.75	1,374
	METALS				
	SHEET PILING	1	JOB	SUM	220
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	3,250
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				55,068
05.60.	GUIDEWALLS				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	CHANNEL WORK	1	JOB	SUM	3,200
	PROJECT SUBTOTAL				80,332
	CONTINGENCIES 25%				19,668
	PROJECT SUBTOTAL WITH CONTINGENCIES				100,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				10,000
31.	CONSTRUCTION MANAGEMENT (10%)				10,000
	PROJECT TOTAL				120,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* $ 115,000

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 2, TYPE C
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
04.	**DAMS**				
	04 DAMS SUBTOTAL				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	1,117
	ROCK EXCAVATION	50,500	CY	45	2,273
	LOCK DEWATERING	1	JOB	SUM	1,250
	COFFERDAM REMOVAL	1	JOB	SUM	81
	MARINE FACILITIES, TEMP MOORING STRUCTURE	1	JOB	SUM	3,900
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	30,520	CY	217	6,623
	PRECAST CONCRETE CHAMBER AND APPROACH WALLS, FLO	2,400	CY	400	960
	TREMIE CONCRETE	6,300	CY	165	1,040
	PRESTRESSING STEEL	240,000	LB	2.5	600
	FURNISH AND SET LANDING PADS	18	EA	19000	342
	SET CULVERT UNITS	88	EA	16000	1,408
	FLOAT IN AND SET MITER GATE SILL	1	EA	140000	140
	STEEL REINFORCEMENT	1,832,000	LB	0.75	1,374
	TIMBER				
	12"X12" TIMBER FENDERS	12,100	LF	25	303
	METALS				
	SHEET PILING AND BRACING	1	JOB	SUM	2,900
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	3,250
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				51,199
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	**CHANNEL WORK**	1	JOB	SUM	3,200
	PROJECT SUBTOTAL				76,463
	CONTINGENCIES 25%				19,537
	PROJECT SUBTOTAL WITH CONTINGENCIES				96,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				9,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				9,500
	PROJECT TOTAL				$ 115,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 110,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 3, TYPE B
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION AND REHABILITATION	1	JOB	SUM	1,800
	DREDGING	55,029	CY	4.50	248
	ROCK EXCAVATION	30,243	CY	45.00	1,361
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL (DOWNSTREAM CLOSURE)	9720	CY	14.50	141
	EXISTING LOCK DEWATERING	1	JOB	SUM	440
	NEW LOCK DEWATERING	1	JOB	SUM	440
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	53,700	CY	280.00	15,036
	PRECAST CONCRETE (W/REINFORCEMENT)	10,210	CY	400.00	4,084
	SET LANDING PADS & WALL UNITS	1	JOB	SUM	3,070
	TREMIE CONCRETE (WITH REINFORCEMENT)	6,210	CY	210.00	1,304
	GRAVEL FILL	10,570	CY	15.00	159
	METALS				
	SHEETPILING (DOWNSTREAM CLOSURE, PSA23)	15,920	SF	30.00	478
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	3,250
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	5,966
	05 LOCKS SUBTOTAL				65,629
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	**CHANNEL WORK**	1	JOB	SUM	3,400
	PROJECT SUBTOTAL				90,958
	CONTINGENCIES (25%)				23,042
	PROJECT SUBTOTAL WITH CONTINGENCIES				114,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				11,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				11,500
	PROJECT TOTAL				137,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 131,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 3, TYPE C
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	1,800
	DREDGING	43,131	CY	4.50	194
	ROCK EXCAVATION	39,194	CY	45.00	1,764
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL (DOWNSTREAM CLOSURE)	9720	CY	14.50	141
	EXISTING LOCK DEWATERING	1	JOB	SUM	440
	NEW LOCK DEWATERING	1	JOB	SUM	440
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	26,283	CY	280.00	7,359
	PRECAST CONCRETE (W/REINFORCEMENT)	2,325	CY	400.00	930
	TREMIE CONCRETE	4,114	CY	210.00	864
	PERMANENT CELL FILL -GRAVEL** (RIVERWALL)	33,650	CY	15.00	505
	PERMANENT CELL FILL - CONCRETE (I-WALL)	16,140	CY	280.00	4,519
	OTHER GRAVEL FILL	2,900	CY	15.00	44
	PRECAST PANELS FOR CELLULAR WALL (RIVERWALL)	2,370	CY	600.00	1,422
	PRECAST PANELS FOR CELLULAR WALL (I-WALL)	2,270	CY	800.00	1,816
	METALS				
	SHEETPILING (DOWNSTREAM CLOSURE, PSA23)	15,920	SF	25.00	398
	SHEETPILING - PERMANENT PSA23 (LOCKWALLS)	189,560	SF	25.00	4,739
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	3,250
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	5,848
	05 LOCKS SUBTOTAL				64,325
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	152,602	SF	25.00	3,815
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				17,280
09.	**CHANNEL WORK**	1	JOB	SUM	3,400
	PROJECT SUBTOTAL				85,020
	CONTINGENCIES (25%)				20,980
	PROJECT SUBTOTAL WITH CONTINGENCIES				106,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				10,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				10,500
	PROJECT TOTAL				127,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 122,000**

*EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.

**NOTE: THE RIVERWALL COULD BE UPGRADED WITH CONCRETE-FILLED CELLS FOR AN ADDITIONAL $14,000K.

LOCK AND DAM NO. 22, LOCATION 4, TYPE A
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION (TAINTER GATE BAY NO. 1)	1	JOB	SUM	1,504
	CONCRETE (TIE-IN TO EXISTING LOCK)	362	CY	280.00	101
	MISCELLANEOUS	1	JOB	SUM	150
	REPLACEMENT TAINTER GATE	1	JOB	SUM	10,200
	04 DAMS SUBTOTAL				11,956
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION (AUXILIARY LOCK AREA)	1	JOB	SUM	5,713
	DREDGING	86,504	CY	4.50	389
	ROCK EXCAVATION	50,299	CY	45.00	2,263
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL	167,280	CY	14.50	2,426
	COFFERDAM DEWATERING	1	JOB	SUM	8,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	100,600	CY	280.00	28,168
	GRAVEL FILL	21,310	CY	15.00	320
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	375,490	SF	25.00	9,387
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	9,022
	05 LOCKS SUBTOTAL				99,241
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	19,030	CY	280.00	5,328
	PRECAST CONCRETE BEAMS (W/REINFORCEMENT)	8,960	LF	1,250.00	11,200
	TREMIE CONCRETE	50,030	CY	165.00	8,255
	METALS				
	SHEETPILING FOR CELLS (PS31)	1	JOB	SUM	6,173
	STRUCTURAL STEEL	1	JOB	SUM	900
	05.60 GUIDEWALLS SUBTOTAL				31,856
09.	**CHANNEL WORK**	1	JOB	SUM	4,700
	PROJECT SUBTOTAL				147,768
	CONTINGENCIES (20%)				29,232
	PROJECT SUBTOTAL WITH CONTINGENCIES				177,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				18,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				18,000
	PROJECT TOTAL				213,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 206,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 4, TYPE B
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION (TAINTER GATE BAY NO. 1)	1	JOB	SUM	1,504
	CONCRETE (TIE-IN TO EXISTING LOCK)	362	CY	280.00	101
	MISCELLANEOUS	1	JOB	SUM	161
	REPLACEMENT TAINTER GATE	1	JOB	SUM	10,200
	04 DAMS SUBTOTAL				11,966
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION (AUXILIARY LOCK AREA)	1	JOB	SUM	5,713
	DREDGING	87,754	CY	4.50	395
	ROCK EXCAVATION	25,819	CY	45.00	1,162
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL	58,580	CY	14.50	849
	COFFERDAM AND NEW LOCK DEWATERING	1	JOB	SUM	2,500
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	83,877	CY	280.00	23,486
	PRECAST CONCRETE (W/REINFORCEMENT)	12,978	CY	400.00	5,191
	SET LANDING PADS & WALL UNITS	1	JOB	SUM	4,600
	TREMIE CONCRETE (WITH REINFORCEMENT)	7,716	CY	210.00	1,620
	GRAVEL FILL	16,010	CY	15.00	240
	METALS				
	SHEETPILING (UPPER GATE BAY COFFERDAM, DS CLOSURE)	126,720	SF	25.00	3,168
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	8,048
	05 LOCKS SUBTOTAL				88,525
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	**CHANNEL WORK**	1	JOB	SUM	4,700
	PROJECT SUBTOTAL				127,120
	CONTINGENCIES (25%)				31,880
	PROJECT SUBTOTAL WITH CONTINGENCIES				159,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				16,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				16,000
	PROJECT TOTAL				191,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 184,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 4, TYPE C
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	15
02.	RELOCATION	1	JOB	SUM	0
04.	DAMS				
	DEMOLITION (TAINTER GATE BAY NO. 1)	1	JOB	SUM	1,504
	CONCRETE (TIE-IN TO EXISTING LOCK)	362	CY	280.00	101
	MISCELLANEOUS	1	JOB	SUM	161
	REPLACEMENT TAINTER GATE	1	JOB	SUM	10,200
	04 DAMS SUBTOTAL				11,966
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	5,713
	DREDGING	61,085	CY	4.50	275
	ROCK EXCAVATION	36,897	CY	45.00	1,660
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL	49,360	CY	14.50	716
	PERMANENT CELL FILL (GRAVEL)	69,144	CY	15.00	1,037
	COFFERDAM AND LOCK DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	32,193	CY	280.00	9,014
	PRECAST CONCRETE (W/REINFORCEMENT)	2,578	CY	400.00	1,031
	TREMIE CONCRETE (WITH REINFORCEMENT)	5,319	CY	210.00	1,117
	FLOAT-IN AND SET MITER GATE SILL	1	JOB	SUM	140
	GRAVEL FILL (FOR CONCRETE LOCKWALLS)	5,465	CY	15.00	82
	PRECAST CONCRETE LOCKWALL PANELS (W/REINFO	6,150	CY	600.00	3,690
	METALS				
	SHEETPILING (UPPER GATE BAY COFFERDAM)	110,800	SF	25.00	2,770
	SHEETPILING (LOCKWALLS)	263,310	SF	25.00	6,583
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	6,938
	05 LOCKS SUBTOTAL				76,319
05.60.	GUIDEWALLS				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	CHANNEL WORK	1	JOB	SUM	4,700
	PROJECT SUBTOTAL				114,914
	CONTINGENCIES (25%)				29,086
	PROJECT SUBTOTAL WITH CONTINGENCIES				144,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				14,000
31.	CONSTRUCTION MANAGEMENT (10%)				14,000
	PROJECT TOTAL				172,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 165,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 5, TYPE A
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	43
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION AND MISC.	1	JOB	SUM	230
	SHEETPILING - APPROACH STRUCTURE (DAM TIE-IN)	146,400	SF	25.00	3,660
	PERMANENT CELL FILL (CONCRETE) - APPROACH STRUCTURE	43,500	CY	280.00	12,180
	PRECAST CONCRETE RUBBING SURFACE PANELS	950	CY	600.00	570
	04 DAMS SUBTOTAL				16,640
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DREDGING	271,000	CY	4.50	1,220
	ROCK EXCAVATION	0	CY	45.00	0
	SCOUR PROTECTION	1	JOB	SUM	500
	COFFERDAM FILL	302,700	CY	14.50	4,389
	COFFERDAM DEWATERING	1	JOB	SUM	9,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE (WALLS, SILL	134,600	CY	280.00	37,688
	CAST IN PLACE REINFORCED CONCRETE (FLOOR SLA	15,280	CY	280.00	4,278
	GRAVEL FILL	21,310	CY	15.00	320
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	679,500	SF	25.00	16,988
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	10,044
	05 LOCKS SUBTOTAL				110,479
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	24,740	CY	280.00	6,927
	PRECAST CONCRETE BEAMS (W/REINFORCEMENT)	8,960	LF	1,250.00	11,200
	TREMIE CONCRETE	50,030	CY	165.00	8,255
	METALS				
	SHEETPILING FOR CELLS (PS31)	1	JOB	SUM	8,025
	STRUCTURAL STEEL	1	JOB	SUM	900
	05.60 GUIDEWALLS SUBTOTAL				35,307
09.	**CHANNEL WORK**	1	JOB	SUM	8,300
	PROJECT SUBTOTAL				170,769
	CONTINGENCIES (20%)				34,231
	PROJECT SUBTOTAL WITH CONTINGENCIES				205,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				20,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				20,500
	PROJECT TOTAL				246,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 234,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 5, TYPE B
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	43
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION AND MISC.	1	JOB	SUM	230
	SHEETPILING - APPROACH STRUCTURE (DAM TIE-IN)	146,400	SF	25.00	3,660
	PERMANENT CELL FILL - APPROACH STRUCTURE	43,500	CY	15.00	653
	PRECAST CONCRETE RUBBING SURFACE PANELS	950	CY	600.00	570
	04 DAMS SUBTOTAL				5,113
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	9,000
	DREDGING	239,800	CY	4.50	1,079
	ROCK EXCAVATION	0	CY	45.00	0
	SCOUR PROTECTION	1	JOB	SUM	500
	COFFERDAM FILL	105,050	CY	29.00	3,046
	COFFERDAM DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	112,200	CY	280.00	31,416
	PRECAST CONCRETE (W/REINFORCEMENT)	17,360	CY	400.00	6,944
	SET LANDING PADS & WALL UNITS	1	JOB	SUM	4,600
	TREMIE CONCRETE (WITH REINFORCEMENT)	7,716	CY	210.00	1,620
	GRAVEL FILL	16,010	CY	15.00	240
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	235,800	SF	40.00	9,432
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHE	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	8,793
	05 LOCKS SUBTOTAL				96,724
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE	15,186	CY	210.00	3,189
	GRAVEL FILL	32,840	CY	15.00	493
	METALS				
	SHEETPILING FOR CELLS (PS31)	205,800	SF	25.00	5,145
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				22,473
09.	**CHANNEL WORK**	1	JOB	SUM	8,300
	PROJECT SUBTOTAL				132,653
	CONTINGENCIES (25%)				33,347
	PROJECT SUBTOTAL WITH CONTINGENCIES				166,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				16,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				16,500
	PROJECT TOTAL				199,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 187,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 5, TYPE C
1200' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	43
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION AND MISC.	1	JOB	SUM	230
	SHEETPILING - APPROACH STRUCTURE (DAM TIE-IN)	146,400	SF	25.00	3,660
	PERMANENT CELL FILL - APPROACH STRUCTURE	43,500	CY	15.00	653
	PRECAST CONCRETE RUBBING SURFACE PANELS	950	CY	600.00	570
	04 DAMS SUBTOTAL				5,113
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	9,000
	DREDGING	219,720	CY	4.50	989
	ROCK EXCAVATION	9,356	CY	45.00	421
	SCOUR PROTECTION	1	JOB	SUM	500
	COFFERDAM FILL	105,050	CY	29.00	3,046
	PERMANENT CELL FILL (GRAVEL)	92,500	CY	15.00	1,388
	COFFERDAM AND LOCK DEWATERING	1	JOB	SUM	6,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	43,100	CY	280.00	12,068
	TREMIE CONCRETE (WITH REINFORCEMENT)	5,319	CY	210.00	1,117
	GRAVEL FILL (FOR CONCRETE LOCKWALLS)	7,310	CY	15.00	110
	PRECAST CONCRETE LOCKWALL PANELS	6,150	CY	600.00	3,690
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	235,800	SF	40.00	9,432
	SHEETPILING (LOCKWALLS)	352,300	SF	25.00	8,808
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHE	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	7,262
	05 LOCKS SUBTOTAL				79,883
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE	15,186	CY	210.00	3,189
	GRAVEL FILL	32,840	CY	15.00	493
	METALS				
	SHEETPILING FOR CELLS (PS31)	205,800	SF	25.00	5,145
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				22,473
09.	**CHANNEL WORK**	1	JOB	SUM	8,300
	PROJECT SUBTOTAL				115,812
	CONTINGENCIES (25%)				29,188
	PROJECT SUBTOTAL WITH CONTINGENCIES				145,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				14,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				14,000
	PROJECT TOTAL				173,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 161,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION
CONCEPTUAL LOCK DESIGNS

COST ESTIMATES OF 600'

ROCK-FOUNDED LOCKS

U.S. ARMY ENGINEER DISTRICTS,
ROCK ISLAND, ST. LOUIS, ST. PAUL
CORPS OF ENGINEERS

LOCK AND DAM NO. 22, LOCATION 1, TYPE A
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,240
02.	**RELOCATION**	1	JOB	SUM	2,750
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION	1	JOB	SUM	500
	EXCAVATION/ DREDGING	810,000	CY	4.50	3,645
	BACKFILL	260,600	CY	15.00	3,909
	ROCK EXCAVATION	65,000	CY	45.00	2,925
	RAILROAD RETAINING WALL	1	JOB	SUM	3,500
	SCOUR PROTECTION	1	JOB	SUM	500
	PERMANENT CELL FILL (GRAVEL)	9,100	CY	15.00	137
	FOUNDATION DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	SLURRY WALL	0	CY	705.00	0
	CAST IN PLACE REINFORCED CONCRETE	88,100	CY	280.00	24,668
	PRECAST CONCRETE (W/REINFORCEMENT)	0	CY	400.00	0
	GRAVEL FILL	24,500	CY	15.00	368
	METALS				
	SHEETPILING - TEMPORARY SEEPAGE CUTOFF	80,100	SF	25.00	2,003
	SHEETPILING - PERMANENT	28,600	SF	25.00	715
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ANCHORS AND ROD	1	JOB	SUM	2,710
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	7,663
	05 LOCKS SUBTOTAL				84,295
05.60.	**GUIDEWALLS**				
	CONCRETE				
	SLURRY WALL	7,000	CY	705.00	4,935
	CAST IN PLACE REINFORCED CONCRETE	46,800	CY	280.00	13,104
	PRECAST CONCRETE (W/REINFORCEMENT)	3,800	CY	1,250.00	4,750
	TREMIE CONCRETE (WITH REINFORCEMENT)	21,400	CY	210.00	4,494
	GRAVEL FILL	12,400	CY	15.00	186
	METALS				
	SHEETPILING FOR CELLS (PS31)	77,700	SF	25.00	1,943
	SHEETPILE RETAINING WALL (PZ35) - GUIDEWALLS	1	JOB	SUM	2,593
	STRUCTURAL STEEL	1	JOB	SUM	378
	05.60 GUIDEWALLS SUBTOTAL				32,383
09.	**CHANNEL WORK**	1	JOB	SUM	11,300
	PROJECT SUBTOTAL				132,967
	CONTINGENCIES (20%)				27,033
	PROJECT SUBTOTAL WITH CONTINGENCIES				160,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				16,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				16,000
	PROJECT TOTAL				192,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 168,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 1, TYPE B
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	2,240
02.	RELOCATION	1	JOB	SUM	2,750
04.	DAMS				0
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	500
	EXCAVATION/ DREDGING	800,000	CY	4.50	3,600
	BACKFILL	63,000	CY	15.00	945
	ROCK EXCAVATION	58,300	CY	45.00	2,624
	RAILROAD RETAINING WALL	1	JOB	SUM	3,500
	SCOUR PROTECTION	1	JOB	SUM	500
	PERMANENT CELL FILL (GRAVEL)	17,600	CY	15.00	264
	FOUNDATION DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	SLURRY WALL	3,300	CY	705.00	2,327
	CAST IN PLACE REINFORCED CONCRETE	52,500	CY	280.00	14,700
	PRECAST CONCRETE (W/REINFORCEMENT)	1,500	CY	400.00	600
	GRAVEL FILL	14,800	CY	15.00	222
	METALS				
	SHEETPILING - TEMPORARY SEEPAGE CUTOFF	80,100	SF	25.00	2,003
	SHEETPILING - PERMANENT	42,200	SF	25.00	1,055
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ANCHORS AND ROD	228,600	LF	26.00	5,944
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	8,819
	05 LOCKS SUBTOTAL				76,654
05.60.	GUIDEWALLS				
	CONCRETE				
	SLURRY WALL	18,300	CY	705.00	12,902
	CAST IN PLACE REINFORCED CONCRETE	3,300	CY	280.00	924
	PRECAST CONCRETE (W/REINFORCEMENT)	8,300	CY	400.00	3,320
	TREMIE CONCRETE (WITH REINFORCEMENT)	6,370	CY	210.00	1,338
	GRAVEL FILL	12,394	CY	15.00	186
	METALS				
	SHEETPILING FOR CELLS (PS31)	77,670	SF	25.00	1,942
	SHEETPILE RETAINING WALL (PZ35) - DOWNSTREAM	9,580	SF	30.00	287
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				24,709
09.	CHANNEL WORK	1	JOB	SUM	11,300
	PROJECT SUBTOTAL				117,653
	CONTINGENCIES (25%)				29,347
	PROJECT SUBTOTAL WITH CONTINGENCIES				147,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				14,500
31.	CONSTRUCTION MANAGEMENT (10%)				14,500
	PROJECT TOTAL				176,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 152,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 1, TYPE C
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,240
02.	**RELOCATION**	1	JOB	SUM	2,750
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	500
	EXCAVATION/ DREDGING	483,000	CY	4.50	2,174
	ROCK EXCAVATION	79,000	CY	45.00	3,555
	RAILROAD RETAINING WALL	1	JOB	SUM	3,500
	SCOUR PROTECTION	1	JOB	SUM	500
	PERMANENT CELL FILL (GRAVEL)	9,100	CY	15.00	137
	FOUNDATION DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	SLURRY WALL	5,600	CY	705.00	3,948
	CAST IN PLACE REINFORCED CONCRETE	62,000	CY	280.00	17,360
	PRECAST CONCRETE (W/REINFORCEMENT)	2,500	CY	400.00	1,000
	METALS				
	SHEETPILING - PERMANENT	28,600	SF	25.00	715
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS+D51)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	2,000
	ANCHORS AND ROD	84,000	LF	26.00	2,184
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,000
	INSTRUMENTATION	1	JOB	SUM	1,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	6,293
	05 LOCKS SUBTOTAL				69,218
05.60.	**GUIDEWALLS**				
	CONCRETE				
	SLURRY WALL	13,300	CY	705.00	9,377
	ANCHORS AND ROD	201,000	LF	26.00	5,226
	CAST IN PLACE REINFORCED CONCRETE	2,400	CY	280.00	672
	PRECAST CONCRETE BEAMS (PRESTRESSED)	2,520	LF	1,170.00	2,948
	PRECAST CONCRETE (W/REINFORCEMENT)	6,000	CY	400.00	2,400
	TREMIE CONCRETE (WITH REINFORCEMENT)	6,370	CY	210.00	1,338
	GRAVEL FILL	12,400	CY	15.00	186
	METALS				
	SHEETPILING FOR CELLS (PS31)	77,670	SF	25.00	1,942
	SHEETPILE CUTOFF WALL (PZ35) - UPSTREAM	21,800	SF	30.00	654
	SHEETPILE RETAINING WALL (PZ40) - DOWNSTREAM	9,580	SF	30.00	287
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				28,841
09.	**CHANNEL WORK**	1	JOB	SUM	11,300
	PROJECT SUBTOTAL				114,348
	CONTINGENCIES (25%)				28,652
	PROJECT SUBTOTAL WITH CONTINGENCIES				143,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				14,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				14,500
	PROJECT TOTAL				172,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 147,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 3, TYPE B
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION AND REHABILITATION	1	JOB	SUM	1,800
	DREDGING	55,029	CY	4.50	248
	ROCK EXCAVATION	30,243	CY	45.00	1,361
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL (DOWNSTREAM CLOSURE)	9720	CY	14.50	141
	EXISTING LOCK DEWATERING	1	JOB	SUM	440
	NEW LOCK DEWATERING	1	JOB	SUM	440
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	22,420	CY	280.00	6,278
	PRECAST CONCRETE (W/REINFORCEMENT)	3,940	CY	400.00	1,576
	SET LANDING PADS & WALL UNITS	1	JOB	SUM	2,070
	TREMIE CONCRETE (WITH REINFORCEMENT)	1,470	CY	210.00	309
	GRAVEL FILL	4,210	CY	15.00	63
	METALS				
	SHEETPILING (DOWNSTREAM CLOSURE, PSA23)	15,920	SF	30.00	478
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	3,250
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	4,631
	05 LOCKS SUBTOTAL				50,936
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	**CHANNEL WORK**	1	JOB	SUM	3,400
	PROJECT SUBTOTAL				76,265
	CONTINGENCIES (25%)				18,735
	PROJECT SUBTOTAL WITH CONTINGENCIES				95,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				9,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				9,500
	PROJECT TOTAL				114,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 109,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 3, TYPE C
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	1,800
	DREDGING	43,131	CY	4.50	194
	ROCK EXCAVATION	39,194	CY	45.00	1,764
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL (DOWNSTREAM CLOSURE)	9720	CY	14.50	141
	EXISTING LOCK DEWATERING	1	JOB	SUM	440
	NEW LOCK DEWATERING	1	JOB	SUM	440
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	16,980	CY	280.00	4,754
	PRECAST CONCRETE (W/REINFORCEMENT)	1,940	CY	400.00	776
	TREMIE CONCRETE	1,886	CY	210.00	396
	PERMANENT CELL FILL -GRAVEL** (RIVERWALL)	13,010	CY	15.00	195
	PERMANENT CELL FILL - CONCRETE (I-WALL)	0	CY	280.00	0
	OTHER GRAVEL FILL	2,920	CY	15.00	44
	PRECAST PANELS FOR CELLULAR WALL (RIVERWALL)	920	CY	600.00	552
	PRECAST PANELS FOR CELLULAR WALL (I-WALL)	0	CY	800.00	0
	METALS				
	SHEETPILING (DOWNSTREAM CLOSURE, PSA23)	15,920	SF	25.00	398
	SHEETPILING - PERMANENT PSA23 (LOCKWALLS)	49,520	SF	25.00	1,238
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	3,250
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	3,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	4,274
	05 LOCKS SUBTOTAL				47,009
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	152,602	SF	25.00	3,815
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				17,280
09.	**CHANNEL WORK**	1	JOB	SUM	3,400
	PROJECT SUBTOTAL				67,703
	CONTINGENCIES (25%)				16,297
	PROJECT SUBTOTAL WITH CONTINGENCIES				84,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				8,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				8,500
	PROJECT TOTAL				101,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 96,000**

*EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.

**NOTE: THE RIVERWALL COULD BE UPGRADED WITH CONCRETE-FILLED CELLS FOR AN ADDITIONAL $14,000K.

LOCK AND DAM NO. 22, LOCATION 4, TYPE A
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION (TAINTER GATE BAY NO. 1)	1	JOB	SUM	1,504
	CONCRETE (TIE-IN TO EXISTING LOCK)	362	CY	280.00	101
	MISCELLANEOUS	1	JOB	SUM	150
	REPLACEMENT TAINTER GATE	1	JOB	SUM	10,200
	04 DAMS SUBTOTAL				11,956
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION (AUXILIARY LOCK AREA)	1	JOB	SUM	5,713
	DREDGING	86,504	CY	4.50	389
	ROCK EXCAVATION	50,299	CY	45.00	2,263
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL	99,120	CY	14.50	1,437
	COFFERDAM DEWATERING	1	JOB	SUM	5,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	62,070	CY	280.00	17,380
	GRAVEL FILL	12,850	CY	15.00	193
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	222,490	SF	25.00	5,562
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	7,149
	05 LOCKS SUBTOTAL				78,640
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	19,030	CY	280.00	5,328
	PRECAST CONCRETE BEAMS (W/REINFORCEMENT)	8,960	LF	1,250.00	11,200
	TREMIE CONCRETE	50,030	CY	165.00	8,255
	METALS				
	SHEETPILING FOR CELLS (PS31)	1	JOB	SUM	6,173
	STRUCTURAL STEEL	1	JOB	SUM	900
	05.60 GUIDEWALLS SUBTOTAL				31,856
09.	**CHANNEL WORK**	1	JOB	SUM	4,700
	PROJECT SUBTOTAL				127,167
	CONTINGENCIES (20%)				25,833
	PROJECT SUBTOTAL WITH CONTINGENCIES				153,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				15,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				15,000
	PROJECT TOTAL				183,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 176,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 4, TYPE B
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION (TAINTER GATE BAY NO. 1)	1	JOB	SUM	1,504
	CONCRETE (TIE-IN TO EXISTING LOCK)	362	CY	280.00	101
	MISCELLANEOUS	1	JOB	SUM	161
	REPLACEMENT TAINTER GATE	1	JOB	SUM	10,200
	04 DAMS SUBTOTAL				11,966
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION (AUXILIARY LOCK AREA)	1	JOB	SUM	5,713
	DREDGING	87,754	CY	4.50	395
	ROCK EXCAVATION	25,819	CY	45.00	1,162
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL	58,580	CY	14.50	849
	COFFERDAM AND NEW LOCK DEWATERING	1	JOB	SUM	2,500
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	52,590	CY	280.00	14,725
	PRECAST CONCRETE (W/REINFORCEMENT)	6,700	CY	400.00	2,680
	SET LANDING PADS & WALL UNITS	1	JOB	SUM	4,600
	TREMIE CONCRETE (WITH REINFORCEMENT)	3,980	CY	210.00	836
	GRAVEL FILL	9,650	CY	15.00	145
	METALS				
	SHEETPILING (UPPER GATE BAY COFFERDAM, DS CLOSURE)	126,720	SF	25.00	3,168
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	6,833
	05 LOCKS SUBTOTAL				75,158
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	**CHANNEL WORK**	1	JOB	SUM	4,700
	PROJECT SUBTOTAL				113,753
	CONTINGENCIES (25%)				28,247
	PROJECT SUBTOTAL WITH CONTINGENCIES				142,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				14,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				14,000
	PROJECT TOTAL				170,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 163,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 4, TYPE C
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	15
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION (TAINTER GATE BAY NO. 1)	1	JOB	SUM	1,504
	CONCRETE (TIE-IN TO EXISTING LOCK)	362	CY	280.00	101
	MISCELLANEOUS	1	JOB	SUM	161
	REPLACEMENT TAINTER GATE	1	JOB	SUM	10,200
	04 DAMS SUBTOTAL				11,966
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	5,713
	DREDGING	61,085	CY	4.50	275
	ROCK EXCAVATION	36,897	CY	45.00	1,660
	EXTENSION OF EXISTING DOWNSTREAM GUIDEWALL	1	JOB	SUM	7,700
	COFFERDAM FILL	49,360	CY	14.50	716
	PERMANENT CELL FILL (GRAVEL)	27,860	CY	15.00	418
	COFFERDAM AND LOCK DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	31,060	CY	280.00	8,697
	PRECAST CONCRETE (W/REINFORCEMENT)	2,578	CY	400.00	1,031
	TREMIE CONCRETE (WITH REINFORCEMENT)	3,050	CY	210.00	641
	FLOAT-IN AND SET MITER GATE SILL	1	JOB	SUM	140
	GRAVEL FILL (FOR CONCRETE LOCKWALLS)	5,465	CY	15.00	82
	PRECAST CONCRETE LOCKWALL PANELS (W/REINFO	3,250	CY	600.00	1,950
	METALS				
	SHEETPILING (UPPER GATE BAY COFFERDAM)	110,800	SF	25.00	2,770
	SHEETPILING (LOCKWALLS)	106,110	SF	25.00	2,653
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	2,900
	MISCELLANEOUS	1	JOB	SUM	6,230
	05 LOCKS SUBTOTAL				68,528
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE (WITH REINFORCEMENT)	15,186	CY	210.00	3,189
	GRAVEL FILL	29,582	CY	15.00	444
	METALS				
	SHEETPILING FOR CELLS (PS31)	185,377	SF	25.00	4,634
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				21,914
09.	**CHANNEL WORK**	1	JOB	SUM	4,700
	PROJECT SUBTOTAL				107,123
	CONTINGENCIES (25%)				26,877
	PROJECT SUBTOTAL WITH CONTINGENCIES				134,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				13,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				13,500
	PROJECT TOTAL				161,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 154,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 5, TYPE A
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	43
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION AND MISC.	1	JOB	SUM	230
	SHEETPILING - APPROACH STRUCTURE (DAM TIE-IN)	146,400	SF	25.00	3,660
	PERMANENT CELL FILL (CONCRETE) - APPROACH STRUCTURE	43,500	CY	280.00	12,180
	PRECAST CONCRETE RUBBING SURFACE PANELS	950	CY	600.00	570
	04 DAMS SUBTOTAL				16,640
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DREDGING	271,000	CY	4.50	1,220
	ROCK EXCAVATION	0	CY	45.00	0
	SCOUR PROTECTION	1	JOB	SUM	500
	COFFERDAM FILL	193,880	CY	14.50	2,811
	COFFERDAM DEWATERING	1	JOB	SUM	9,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE (WALLS, SILL	83,050	CY	280.00	23,254
	CAST IN PLACE REINFORCED CONCRETE (FLOOR SLA	7,330	CY	280.00	2,052
	GRAVEL FILL	10,655	CY	15.00	160
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	469,890	SF	25.00	11,747
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	7,560
	05 LOCKS SUBTOTAL				83,157
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	24,740	CY	280.00	6,927
	PRECAST CONCRETE BEAMS (W/REINFORCEMENT)	8,960	LF	1,250.00	11,200
	TREMIE CONCRETE	50,030	CY	165.00	8,255
	METALS				
	SHEETPILING FOR CELLS (PS31)	1	JOB	SUM	8,025
	STRUCTURAL STEEL	1	JOB	SUM	900
	05.60 GUIDEWALLS SUBTOTAL				35,307
09.	**CHANNEL WORK**	1	JOB	SUM	8,300
	PROJECT SUBTOTAL				143,447
	CONTINGENCIES (20%)				28,553
	PROJECT SUBTOTAL WITH CONTINGENCIES				172,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				17,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				17,500
	PROJECT TOTAL				207,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 195,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 5, TYPE B
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	43
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION AND MISC.	1	JOB	SUM	230
	SHEETPILING - APPROACH STRUCTURE (DAM TIE-IN)	146,400	SF	25.00	3,660
	PERMANENT CELL FILL - APPROACH STRUCTURE	43,500	CY	15.00	653
	PRECAST CONCRETE RUBBING SURFACE PANELS	950	CY	600.00	570
	04 DAMS SUBTOTAL				5,113
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	9,000
	DREDGING	239,800	CY	4.50	1,079
	ROCK EXCAVATION	0	CY	45.00	0
	SCOUR PROTECTION	1	JOB	SUM	500
	COFFERDAM FILL	105,050	CY	29.00	3,046
	COFFERDAM DEWATERING	1	JOB	SUM	4,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	70,360	CY	280.00	19,701
	PRECAST CONCRETE (W/REINFORCEMENT)	8,960	CY	400.00	3,584
	SET LANDING PADS & WALL UNITS	1	JOB	SUM	4,600
	TREMIE CONCRETE (WITH REINFORCEMENT)	5,320	CY	210.00	1,117
	GRAVEL FILL	12,910	CY	15.00	194
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	235,800	SF	40.00	9,432
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHE	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	7,111
	05 LOCKS SUBTOTAL				78,217
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE	15,186	CY	210.00	3,189
	GRAVEL FILL	32,840	CY	15.00	493
	METALS				
	SHEETPILING FOR CELLS (PS31)	205,800	SF	25.00	5,145
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				22,473
09.	**CHANNEL WORK**	1	JOB	SUM	8,300
	PROJECT SUBTOTAL				114,146
	CONTINGENCIES (25%)				28,854
	PROJECT SUBTOTAL WITH CONTINGENCIES				143,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				14,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				14,000
	PROJECT TOTAL				171,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 159,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 22, LOCATION 5, TYPE C
600' LOCK ALTERNATIVE (ROCK-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	43
02.	**RELOCATION**	1	JOB	SUM	0
04.	**DAMS**				
	DEMOLITION AND MISC.	1	JOB	SUM	230
	SHEETPILING - APPROACH STRUCTURE (DAM TIE-IN)	146,400	SF	25.00	3,660
	PERMANENT CELL FILL - APPROACH STRUCTURE	43,500	CY	15.00	653
	PRECAST CONCRETE RUBBING SURFACE PANELS	950	CY	600.00	570
	04 DAMS SUBTOTAL				5,113
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	9,000
	DREDGING	219,720	CY	4.50	989
	ROCK EXCAVATION	9,356	CY	45.00	421
	SCOUR PROTECTION	1	JOB	SUM	500
	COFFERDAM FILL	105,050	CY	29.00	3,046
	PERMANENT CELL FILL (GRAVEL)	37,300	CY	15.00	560
	COFFERDAM AND LOCK DEWATERING	1	JOB	SUM	6,000
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	41,560	CY	280.00	11,637
	TREMIE CONCRETE (WITH REINFORCEMENT)	4,080	CY	210.00	857
	GRAVEL FILL (FOR CONCRETE LOCKWALLS)	7,310	CY	15.00	110
	PRECAST CONCRETE LOCKWALL PANELS	4,350	CY	600.00	2,610
	METALS				
	SHEETPILING - COFFERDAM (PSA23)	235,800	SF	40.00	9,432
	SHEETPILING (LOCKWALLS)	142,960	SF	25.00	3,574
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, OTHER)	1	JOB	SUM	3,200
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,000
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,053
	MECHANICAL SYSTEMS	1	JOB	SUM	3,100
	MISCELLANEOUS	1	JOB	SUM	6,359
	05 LOCKS SUBTOTAL				69,947
05.60.	**GUIDEWALLS**				
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	2,316	CY	280.00	648
	PRECAST CONCRETE BEAMS (PRESTRESSED)	6,000	LF	1,170.00	7,020
	PRECAST CONCRETE (W/REINFORCEMENT)	2,960	CY	400.00	1,184
	TREMIE CONCRETE	15,186	CY	210.00	3,189
	GRAVEL FILL	32,840	CY	15.00	493
	METALS				
	SHEETPILING FOR CELLS (PS31)	205,800	SF	25.00	5,145
	SHEETPILE CUTOFF WALL (PZ35)	32,775	SF	30.00	983
	STRUCTURAL STEEL	1	JOB	SUM	3,811
	05.60 GUIDEWALLS SUBTOTAL				22,473
09.	**CHANNEL WORK**	1	JOB	SUM	8,300
	PROJECT SUBTOTAL				105,876
	CONTINGENCIES (25%)				26,124
	PROJECT SUBTOTAL WITH CONTINGENCIES				132,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				13,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				13,000
	PROJECT TOTAL				158,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 146,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION
CONCEPTUAL LOCK DESIGNS

COST ESTIMATES OF 1200'

PILE-FOUNDED LOCKS

U.S. ARMY ENGINEER DISTRICTS,
ROCK ISLAND, ST. LOUIS, ST. PAUL
CORPS OF ENGINEERS

LOCK AND DAM NO. 25, LOCATION 1, TYPE A
1200' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	LS	SUM JOB	1,742
02.	**RELOCATION**	1	LS	SUM JOB	300
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	LS	SUM JOB	10,000
	DEMOLITION	1	LS	SUM JOB	406
	EXCAVATION	1,080,877	CY	4.5	4,864
	BACKFILL	927,110	CY	6.25	5,794
	COFFERDAM FILL AND ROAD	1	LS	SUM JOB	200
	DEWATERING AND COFFERDAM MISC	1	LS	SUM JOB	10,525
	SCOUR PROTECTION	1	LS	SUM JOB	6,550
	COFFERDAM REMOVAL	1	LS	SUM JOB	2,591
	GRADING	1	LS	SUM JOB	250
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	207,440	CY	217.00	45,014
	STEEL REINFORCEMENT	16,360,000	LB	0.75	12,270
	WATERSTOPS AND JOINT FILLER	1	LS	SUM JOB	314
	METALS				
	SHEET PILING	1	LS	SUM JOB	25,264
	FOUNDATION PILING AND TESTING	1	LS	SUM JOB	17,815
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	LS	SUM JOB	19,908
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC	1	LS	SUM JOB	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	LS	SUM JOB	4,700
	INSTRUMENTATION	1	LS	SUM JOB	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	LS	SUM JOB	600
	MECHANICAL SYSTEMS	1	LS	SUM JOB	3,200
	MISCELLANEOUS	1	LS	SUM JOB	3,450
	MOVEABLE BRIDGE	1	LS	SUM JOB	1,000
	05 LOCKS SUBTOTAL				178,466
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	496,720	CY	4.5	2,235
	BACKFILL	43,218	CY	10	432
	SCOUR PROTECTION	168,330	TON	15	2,525
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	21,202	CY	217	4,601
	PRECAST BEAMS	8,960	LF	1250	11,200
	TREMIE CONCRETE	50,035	CY	165	8,256
	STEEL REINFORCEMENT	1,371,739	LB	0.75	1,029
	METALS				
	SHEET PILING	1	LS	SUM JOB	10,308
	FOUNDATION PILING	1	LS	SUM JOB	6,534
	STRUCTURAL STEEL	1	LS	SUM JOB	893
	05.60 GUIDEWALLS SUBTOTAL				48,013
09.	**CHANNEL WORK**	1	LS	SUM JOB	3,866
11.	**LEVEES AND FLOODWALLS**	1	LS	SUM JOB	2,369
	PROJECT SUBTOTAL				**234,756**
	CONTINGENCIES (20%)				47,244
	PROJECT SUBTOTAL WITH CONTINGENCIES				**282,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				28,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				28,000
	PROJECT TOTAL				**338,000**

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$326,000**

* (EXCLUDES REAL ESTATE, RELOCATION, CHANNEL WORK, AND LEVEES AND FLOODWALLS WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 1, TYPE B
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	1,577
02.	**RELOCATION**	1	JOB	SUM	300
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	406
	EXCAVATION	340,076	CY	4.50	1,530
	GRADING	1	JOB	SUM	250
	BACKFILL	5,440	CY	6.25	34
	SCOUR PROTECTION	157,630	TN	15.00	2,364
	FOUNDATION DEWATERING	1	JOB	SUM	54
	COFFERDAM REMOVAL	1	JOB	SUM	81
	CONCRETE				
	SLURRY WALL	27,000	CY	705	19,035
	TIEBACK ANCHORS	810	EA	2500	2,025
	STRUCTURAL GROUTING	1,240	CY	272	337
	CAST IN PLACE REINFORCED CONCRETE	88,218	CY	217	19,143
	PRECAST CONCRETE	5,950	CY	307	1,827
	TREMIE CONCRETE	35,556	CY	165	5,867
	STEEL REINFORCEMENT	8,128,780	LB	0.75	6,097
	GRAVEL FILL		TON	15	738
	METALS				
	SHEET PILING	1	JOB	SUM	473
	SHEET PILE BRACING	1	JOB	SUM	1,850
	FOUNDATION PILING AND TESTING	1	JOB	SUM	12,268
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	10,337
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,050
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,500
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	MOVEABLE BRIDGE	1	JOB	SUM	1,000
	05 LOCKS SUBTOTAL				111,866
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	49,210	CY	4.5	2,235
	BACKFILL	496,720	CY	10	113
	SCOUR PROTECTION	11,300	TON	15	2,364
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (C0NCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				34,027
09.	**CHANNEL WORK**	1	JOB	SUM	3,866
11.	**LEVEES AND FLOODWALLS**	1	JOB	SUM	2,369
	PROJECT SUBTOTAL				**$154,004**
	CONTINGENCIES 25%				$38,996
	PROJECT SUBTOTAL WITH CONTINGENCIES				**$193,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				$19,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				$19,000
	PROJECT TOTAL				**$231,000**

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 219,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 1, TYPE C
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	1,577
02.	RELOCATION	1	JOB	SUM	300
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	190
	EXCAVATION	514,370	CY	5.3	2,726
	BACKFILL	186,760	CY	6.25	1,167
	SCOUR PROTECTION	4,660	TN	15	70
	FOUNDATION DEWATERING	1	JOB	SUM	158
	GRADING	1	JOB	SUM	250
	COFFERDAM REMOVAL	1	JOB	SUM	81
	CONCRETE				
	TIEBACK ANCHORS	810	EA	2500	2,025
	STRUCTURAL GROUTING	1,170	CY	272	318
	CAST IN PLACE REINFORCED CONCRETE	56,585	CY	217	12,279
	PRECAST CONCRETE WALL PANELS	1,170	CY	307	359
	PRECAST CONCRETE INTAKE PIPE AND CULVERT	4,930	CY	600	2,958
	TREMIE CONCRETE .	10,859	CY	165	1,792
	STEEL REINFORCEMENT	4,654,842	LB	0.75	3,491
	GRAVEL BEDDING	1,240	TON	15	19
	RIPRAP FLOOR	37,120	TON	20	742
	METALS				
	SHEET PILING	1	JOB	SUM	9,309
	SHEET PILE BRACING	1	JOB	SUM	1,514
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,157
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHEADS)	1	JOB	SUM	4,588
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,050
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	1,500
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	MOVEABLE BRIDGE	1	JOB	SUM	1,000
	05 LOCKS SUBTOTAL				74,343
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	496,720	CY	4.5	2,235
	BACKFILL	11,300	CY	10	113
	SCOUR PROTECTION	157,630	TON	15	2,364
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (C0NCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				34,027
09.	CHANNEL WORK	1	JOB	SUM	3,866
11.	LEVEES AND FLOODWALLS	1	JOB	SUM	2,369
	PROJECT SUBTOTAL				$116,482
	CONTINGENCIES 25%				$29,518
	PROJECT SUBTOTAL WITH CONTINGENCIES				$146,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				$14,500
31.	CONSTRUCTION MANAGEMENT (10%)				$14,500
	PROJECT TOTAL				$175,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* $ 163,000

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 2, TYPE B
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
04.	**DAMS**				
	04 DAMS SUBTOTAL				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,650
	DEMOLITION	1	JOB	SUM	1,910
	EXCAVATION	69,200	CY	4.5	311
	BACKFILL	22,000	CY	6.25	138
	WALL FILL	11,440	CY	10.00	114
	SCOUR PROTECTION	13,125	TN	20.00	263
	SCOUR STONE IN LOCK FLOOR	10,680	TN	25.00	267
	FOUNDATION/LOCK DEWATERING	1	JOB	SUM	3,000
	MARINE FACILITIES, TEMP. MOORING STR.	1	JOB	SUM	3,900
	CONCRETE				
	UNDERBASE GROUTING	3,670	CY	200	734
	CAST IN PLACE REINFORCED CONCRETE	42,520	CY	217	9,227
	PRECAST CONCRETE	15,380	CY	400	6,152
	TREMIE CONCRETE	22,770	CY	165	3,757
	POST TENSION STEEL	135,000	LB	2.5	338
	FURNISH AND SET LANDING PADS	74	EA	19000	1,406
	SET PRECAST WALL UNITS	28	EA	16000	448
	FLOAT IN AND SET FLOOR UNITS	26	EA	16000	416
	FLOAT IN AND SET MITER GATE SILL	1	JOB	SUM	140
	STEEL REINFORCEMENT	4,098,000	LB	0.75	3,074
	METALS				
	SHEET PILING	69,720	SF	21.52	1,500
	WALL UNIT BRACING	1	JOB	SUM	250
	FOUNDATION PILING AND TESTING	1	JOB	SUM	5,300
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHEA	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				81,797
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	118,490	CY	4.5	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	18,900	TON	15	284
	CONCRETE				
	42" DIAMETER PILES	4,000	LF	400	1,600
	CAST IN PLACE REINFORCED CONCRETE	1,570	CY	150	236
	PRECAST BEAMS	10,900	CY	500	5,450
	PRECAST BEAM SEATS	165	CY	1000	165
	TREMIE CONCRETE	130	CY	500	65
	PERMANENT CELL FILL (CONCRETE)	6,550	CY	200	1,310
	GROUT FOR BEAMS	490	CY	1000	490
	STEEL REINFORCEMENT	1,840,000	LB	0.75	1,380
	GRAVEL FILL	33,000	CY	10	330
	METALS				
	SHEET PILING	1	JOB	SUM	7,616
	FOUNDATION PILING		JOB	SUM	318
	POST TENSIONING	1,280	LF	30	38
	STRUCTURAL STEEL	1	JOB	SUM	4,060
	05.60 GUIDEWALLS SUBTOTAL				24,611
09.	**CHANNEL WORK**	1	JOB	SUM	680
	PROJECT SUBTOTAL				107,238
	CONTINGENCIES 25%				26,762
	PROJECT SUBTOTAL WITH CONTINGENCIES				134,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				13,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				13,500
	PROJECT TOTAL				$ 161,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 160,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 2, TYPE C
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
04.	**DAMS**				
	04 DAMS SUBTOTAL				0
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,650
	DEMOLITION	1	JOB	SUM	1,910
	EXCAVATION	62,600	CY	4.5	282
	BACKFILL	19,700	CY	10.00	197
	SCOUR PROTECTION	13,125	TN	15.00	197
	SCOUR STONE IN LOCK FLOOR	16,860	TN	15.00	253
	GRAVEL FILTER IN LOCK FLOOR	16,090	TN	20.00	322
	FOUNDATION/LOCK DEWATERING	1	JOB	SUM	3,000
	MARINE FACILITIES, TEMP. MOORING STR.	1	JOB	SUM	3,900
	CONCRETE				
	STRUCTURAL GROUTING	700	CY	200	140
	CAST IN PLACE REINFORCED CONCRETE	37,140	CY	217	8,059
	CAST IN PLACE CONNECTIONS	200	CY	725	145
	PRECAST CONCRETE	8,240	CY	400	3,296
	TREMIE CONCRETE, BASE	9,367	CY	165	1,546
	PRECAST FLOOR PANELS	8,210	CY	286	2,348
	POST TENSION STEEL	185,300	LB	2.5	463
	FURNISH AND SET LANDING PADS	74	EA	19000	1,406
	SET PRECAST WALL UNITS	28	EA	16000	448
	FLOAT IN AND SET MITER GATE SILL	1	JOB	SUM	140
	STEEL REINFORCEMENT	4,852,000	LB	0.75	3,639
	METALS				
	SHEET PILING	63,420	SF	21.52	1,365
	WALL UNIT BRACING	1	JOB	SUM	250
	FOUNDATION PILING AND TESTING	1	JOB	SUM	3,487
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHEA	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				75,945
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	118,490	CY	4.5	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	18,900	TON	15	284
	CONCRETE				
	42" DIAMETER PILES	4,000	LF	400	1,600
	CAST IN PLACE REINFORCED CONCRETE	1,570	CY	150	236
	PRECAST BEAMS	10,900	CY	500	5,450
	PRECAST BEAM SEATS	165	CY	1000	165
	TREMIE CONCRETE	130	CY	500	65
	PERMANENT CELL FILL (CONCRETE)	6,550	CY	200	1,310
	GROUT FOR BEAMS	490	CY	1000	490
	STEEL REINFORCEMENT	1,840,000	LB	0.75	1,380
	GRAVEL FILL	33,000	CY	10	330
	METALS				
	SHEET PILING	1	JOB	SUM	7,616
	FOUNDATION PILING	1	JOB	SUM	318
	POST TENSIONING	1,280	LF	30	38
	STRUCTURAL STEEL	1	JOB	SUM	4,060
	05.60 GUIDEWALLS SUBTOTAL				24,611
09.	**CHANNEL WORK**	1	JOB	SUM	680
	PROJECT SUBTOTAL				101,386
	CONTINGENCIES 25%				25,614
	PROJECT SUBTOTAL WITH CONTINGENCIES				127,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				12,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				12,500
	PROJECT TOTAL				$ 152,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* — **$ 151,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 3, TYPE B
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
04.	**DAMS**				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	150
	04 DAMS SUBTOTAL				150
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,650
	DEMOLITION	1	JOB	SUM	1,910
	EXCAVATION	48,960	CY	6.25	306
	FOUNDATION FILL AT SCOUR HOLE	125,000	CY	18.75	2,344
	WALL FILL	15,760	CY	10.00	158
	CAPSTONE	52,660	TN	25.00	1,317
	RIPRAP	33,380	TN	20.00	668
	LEVELING STONE IN LOCK FLOOR	4,580	TN	15.00	69
	GRAVEL FILTER IN LOCK FLOOR	16,606	TN	15.00	249
	GEOTEXTILE	13,740	SY	6.00	82
	FOUNDATION/LOCK DEWATERING	1	JOB	SUM	3,000
	MARINE FACILITIES, TEMP. MOORING STR.	1	JOB	SUM	3,900
	CONCRETE				
	STRUCTURAL GROUTING	450	CY	200	90
	CAST IN PLACE REINFORCED CONCRETE	69,180	CY	217	15,012
	CAST IN PLACE CONNECTIONS	964	CY	725	699
	PRECAST CONCRETE	3,730	CY	400	1,492
	TREMIE CONCRETE, BASE .	10,340	CY	165	1,706
	PRECAST FLOOR PAVERS AND STRUTS	15,450	CY	286	4,419
	SET PRECAST FLOOR BEAMS	31	EA	16000	496
	SET FLOOR PANELS	62	EA	10000	620
	STEEL REINFORCEMENT	7,614,000	LB	0.75	5,711
	METALS				
	SHEET PILING	272,800	SF	35.80	9,766
	SHEET PILE BRACING	1	JOB	SUM	350
	FOUNDATION PILING AND TESTING	209,190	LF	39.75	8,315
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHE	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM		JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				101,831
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	118,490	CY	4.5	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	46,350	TON	15	695
	CONCRETE				
	42" DIAMETER PILES	6,360	LF	400	2,544
	CAST IN PLACE REINFORCED CONCRETE	2,500	CY	150	375
	PRECAST BEAMS	17,325	CY	500	8,663
	PRECAST BEAM SEATS	262	CY	1000	262
	TREMIE CONCRETE	209	CY	500	105
	PERMANENT CELL FILL (CONCRETE)	10,400	CY	200	2,080
	GROUT FOR BEAMS	778	CY	1000	778
	STEEL REINFORCEMENT	2,921,700	LB	0.75	2,191
	GRAVEL FILL	52,500	CY	10	525
	METALS				
	SHEET PILING	1	JOB	SUM	7,616
	FOUNDATION PILING	1	JOB	SUM	318
	POST TENSIONING	2,030	LF	30	61
	STRUCTURAL STEEL	1	JOB	SUM	4,060
	05.60 GUIDEWALLS SUBTOTAL				31,542
09.	**CHANNEL WORK**	1	JOB	SUM	680
	PROJECT SUBTOTAL				134,353
	CONTINGENCIES 25%				33,647
	PROJECT SUBTOTAL WITH CONTINGENCIES				168,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				17,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				17,000
	PROJECT TOTAL				$ 202,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* — **$ 200,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 3, TYPE C
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
04.	**DAMS**				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	150
	04 DAMS SUBTOTAL				150
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,650
	DEMOLITION	1	JOB	SUM	1,910
	EXCAVATION	48,960	CY	6.25	306
	FOUNDATION FILL AT SCOUR HOLE	125,000	CY	18.75	2,344
	WALL FILL	15,760	CY	10.00	158
	CAPSTONE	52,660	TN	25.00	1,317
	RIPRAP	33,380	TN	20.00	668
	LEVELING STONE IN LOCK FLOOR	4,580	TN	15.00	69
	GRAVEL FILTER IN LOCK FLOOR	16,606	TN	15.00	249
	GEOTEXTILE	13,740	SY	6.00	82
	FOUNDATION/LOCK DEWATERING	1	JOB	SUM	3,000
	MARINE FACILITIES, TEMP. MOORING STR.	1	JOB	SUM	3,900
	CONCRETE				
	STRUCTURAL GROUTING	450	CY	200	90
	CAST IN PLACE REINFORCED CONCRETE	64,790	CY	217	14,059
	CAST IN PLACE CONNECTIONS	964	CY	725	699
	PRECAST CONCRETE	2,904	CY	400	1,162
	TREMIE CONCRETE	10,340	CY	165	1,706
	PRECAST FLOOR PAVERS AND STRUTS	15,450	CY	286	4,419
	SET PRECAST FLOOR BEAMS	31	EA	16000	496
	SET FLOOR PANELS	62	EA	10000	620
	STEEL REINFORCEMENT	7,268,000	LB	0.75	5,451
	METALS				
	SHEET PILING	272,800	SF	35.80	9,766
	SHEET PILE BRACING	1	JOB	SUM	350
	FOUNDATION PILING AND TESTING	209,190	LF	39.75	8,315
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHEA	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				100,288
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	95,384	CY	4.5	429
	BACKFILL	59,280	CY	10	593
	SCOUR PROTECTION	37,312	TON	15	560
	CONCRETE				
	42" DIAMETER PILES	5,120	LF	400	2,048
	CAST IN PLACE REINFORCED CONCRETE	2,013	CY	150	302
	PRECAST BEAMS	13,947	CY	500	6,973
	PRECAST BEAM SEATS	211	CY	1000	211
	TREMIE CONCRETE	168	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,372	CY	200	1,674
	GROUT FOR BEAMS	626	CY	1000	626
	STEEL REINFORCEMENT	2,351,969	LB	0.75	1,764
	GRAVEL FILL	42,263	CY	10	423
	METALS				
	SHEET PILING	1	JOB	SUM	6,131
	FOUNDATION PILING	1	JOB	SUM	256
	POST TENSIONING	1,634	LF	30	49
	STRUCTURAL STEEL	1	JOB	SUM	3,268
	FLOATING GUIDEWALL	1	JOB	SUM	3,750
	05.60 GUIDEWALLS SUBTOTAL				29,141
09.	**CHANNEL WORK**	1	JOB	SUM	680
	PROJECT SUBTOTAL				130,409
	CONTINGENCIES 25%				32,591
	PROJECT SUBTOTAL WITH CONTINGENCIES				163,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				16,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				16,500
	PROJECT TOTAL				$ 196,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* — **$ 194,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 4, TYPE A
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	21
04.	**DAMS**				
	REPLACEMENT TAINTER GATES (2)	1	JOB	SUM	19,000
	MISCELLANEOUS	1	JOB	SUM	116
	04 DAMS SUBTOTAL	1	JOB	SUM	19,116
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION	1	JOB	SUM	217
	EXCAVATION	215,566	CY	4.50	970
	BERM FILL	49,250	CY	10.00	493
	COFFERDAM FILL AND ROAD	1	JOB	SUM	3,521
	DEWATERING AND COFFERDAM MISC	1	JOB	SUM	10,525
	SCOUR PROTECTION	1	JOB	SUM	3,461
	COFFERDAM REMOVAL	1	JOB	SUM	8,397
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	182,259	CY	217.00	39,550
	PRECAST CONCRETE	1,744	CY	400.00	698
	TREMIE CONCRETE WALLS	5,231	CY	175.00	915
	TREMIE CONCRETE BASE	17,113	CY	165.00	2,824
	STEEL REINFORCEMENT	16,300,000	LB	0.75	12,225
	POST TENSION STEEL	6,020	LF	75.00	452
	STRUCTURAL GROUT	1	JOB	SUM	7,853
	WATERSTOPS AND JOINT FILLER	1	JOB	SUM	314
	METALS				
	SHEETPILING	1	JOB	SUM	44,694
	FOUNDATION PILING AND TESTING	1	JOB	SUM	17,000
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	7,989
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	6,000
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	05 LOCKS SUBTOTAL				193,197
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	107,130	CY	4.50	482
	BACKFILL	43,218	CY	10.00	432
	SCOUR PROTECTION	168,330	TON	15.00	2,525
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	21,202	CY	217.00	4,601
	PRECAST BEAMS	8,960	LF	1,250.00	11,200
	TREMIE CONCRETE	50,035	CY	165.00	8,256
	STEEL REINFORCEMENT	1,371,739	LB	0.75	1,029
	METALS				
	SHEETPILING	1	JOB	SUM	10,578
	FOUNDATION PILING	1	JOB	SUM	6,534
	STRUCTURAL STEEL	1	JOB	SUM	893
	05.60 GUIDEWALLS SUBTOTAL				46,530
09.	**CHANNEL WORK**	1	JOB	SUM	0
	PROJECT SUBTOTAL				258,863
	CONTINGENCIES (20%)				52,137
	PROJECT SUBTOTAL WITH CONTINGENCIES				311,000
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				31,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				31,000
	PROJECT TOTAL				373,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 373,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 4, TYPE B
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	21
04.	DAMS				
	REPLACEMENT TAINTER GATES (2)	1	JOB	SUM	19,000
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	1,664
	04 DAMS SUBTOTAL				20,664
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	146
	EXCAVATION	141,140	CY	4.5	635
	BACKFILL	194,340	CY	6.25	1,215
	SCOUR PROTECTION	1	JOB	SUM	2,305
	RIP RAP	143,700	TN	20	2,874
	CAPSTONE	22,000	TN	25	550
	GEOTEXTILE	8,960	SQ. YD.	6	54
	STONE FILL	6,950	TN	15	104
	FOUNDATION DEWATERING	1	JOB	SUM	2,410
	COFFERDAM REMOVAL	1	JOB	SUM	81
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	5,675
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	5,400
	CAST IN PLACE REINFORCED CONCRETE	78,010	CY	217	16,928
	CHAMBER WALLS	30,320	CY	160	4,851
	CAST IN PLACE CONNECTIONS	166	CY	725	120
	PRECAST CONCRETE CHAMBER AND APPROACH WAL	20,520	CY	400	8,208
	TREMIE CONCRETE, BASE .	37,770	CY	165	6,232
	TREMIE CONCRETE, WALL .	25,450	CY	175	4,454
	POST TENSION STEEL	60,000	LB	2.5	150
	FURNISH AND SET LANDING PADS	24	EA	19,000	456
	SET PRECAST WALL UNITS	88	EA	16,000	1,408
	FLOAT IN AND SET FLOOR UNITS	11	EA	40,000	440
	STEEL REINFORCEMENT	9,801,300	LB	0.75	7,351
	STEEL CULVERT PIPE	5,278,500	LB	0.65	3,431
	METALS				
	SHEET PILING	1	JOB	SUM	6,364
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	15,069
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				134,015
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	118,490	CY	4.5	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	211,130	TON	15	3,167
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				33,751
	PROJECT SUBTOTAL				188,451
	CONTINGENCIES 25%				47,549
	PROJECT SUBTOTAL WITH CONTINGENCIES				236,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				23,500
31.	CONSTRUCTION MANAGEMENT (10%)				23,500
	PROJECT TOTAL				$283,000

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 283,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 4, TYPE C
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	21
04.	DAMS				
	REPLACEMENT TAINTER GATES (2)	1	JOB	SUM	19,000
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	1,664
	04 DAMS SUBTOTAL				20,664
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	146
	EXCAVATION	98,470	CY	4.50	443
	BACKFILL	187,090	CY	6.25	1,169
	SCOUR PROTECTION	1	JOB	SUM	2,699
	RIP RAP	143,700	TN	20.00	2,874
	CAPSTONE	22,000	TN	25.00	550
	GEOTEXTILE	7,555	SQ. YD.	6.00	45
	STONE FILL	6,935	TN	15.00	104
	FOUNDATION DEWATERING	1	JOB	SUM	8,060
	COFFERDAM REMOVAL	1	JOB	SUM	81
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	2,175
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	5,400
	CAST IN PLACE REINFORCED CONCRETE	54,760	CY	217.00	11,883
	CONCRETE CELL CAPS	6,509	CY	150.00	976
	CAST IN PLACE CONNECTIONS	166	CY	725.00	120
	PRECAST CONCRETE APPROACH WALLS	1,532	CY	400.00	613
	PRECAST FLOOR SLABS	3,398	CY	150.00	510
	PRECAST CULVERTS	4,990	CY	600.00	2,994
	PRECAST RUB PANELS	54,375	SQ. FT.	40.00	2,175
	TREMIE CONCRETE, BASE .	19,130	CY	165.00	3,156
	TREMIE CONCRETE, WALL .	4,527	CY	175.00	792
	POST TENSION STEEL	60,000	LB	2.50	150
	STEEL REINFORCEMENT	6,200,000	LB	0.75	4,650
	CELL FILL, GRAVEL	150,707	CY	10.00	1,507
	STONE IN CHAMBER	58,011	TONS	15.00	870
	METALS				
	SHEET PILING	1	JOB	SUM	22,509
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,773
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	4,783
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	2,750
	05 LOCKS SUBTOTAL				111,959
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	118,490	CY	4.50	533
	BACKFILL	73,640	CY	10.00	736
	SCOUR PROTECTION	211,130	TON	15.00	3,167
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400.00	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150.00	300
	PRECAST BEAMS	13,860	CY	500.00	6,930
	PRECAST BEAM SEATS	210	CY	1,000.00	210
	TREMIE CONCRETE	167	CY	500.00	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200.00	1,664
	GROUT FOR BEAMS	622	CY	1,000.00	622
	STEEL REINFORCEMENT	1,753,013	LB	0.75	1,315
	GRAVEL FILL	42,000	CY	10.00	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				33,313
	PROJECT SUBTOTAL				165,956
	CONTINGENCIES 25%				41,044
	PROJECT SUBTOTAL WITH CONTINGENCIES				207,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				20,500
31.	CONSTRUCTION MANAGEMENT (10%)				20,500
	PROJECT TOTAL				$248,000

TOTAL BASIC LOCK COST (04., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* $ 248,000

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 5, TYPE A
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC ($'s)	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,944
04.	**DAMS**				
	04 DAMS SUBTOTAL	1	JOB	SUM	102
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	EXCAVATION	655,145	CY	4.5	2,948
	BERM FILL	40,450	CY	10	405
	COFFERDAM FILL AND ROAD	1	JOB	SUM	3,017
	DEWATERING AND COFFERDAM MISC	1	JOB	SUM	10,525
	SCOUR PROTECTION	1	JOB	SUM	2,585
	COFFERDAM REMOVAL	1	JOB	SUM	3,893
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	184,582	CY	217	40,054
	PRECAST CONCRETE RUB PANELS	11,830	SQ. FT.	40	473
	TREMIE CONCRETE PILE CAP	28,320	CY	165	4,673
	STEEL REINFORCEMENT	14,353,000	LB	0.75	10,765
	STRUCTURAL GROUTING	1	JOB	SUM	96
	WATERSTOPS AND JOINT FILLER	1	JOB	SUM	314
	METALS				
	SHEET PILING	1	JOB	SUM	50,104
	FOUNDATION PILING AND TESTING	1	JOB	SUM	16,272
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS)	1	JOB	SUM	7,989
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	6,000
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	05 LOCKS SUBTOTAL				185,213
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	679,770	CY	4.5	3,059
	BACKFILL	3,380	CY	10	34
	SCOUR PROTECTION	380,320	TON	15	5,705
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	21,202	CY	217	4,601
	PRECAST BEAMS	8,960	LF	1250	11,200
	TREMIE CONCRETE	50,035	CY	165	8,256
	STEEL REINFORCEMENT	1,371,739	LB	0.75	1,029
	METALS				
	SHEET PILING	1	JOB	SUM	10,578
	FOUNDATION PILING	1	JOB	SUM	6,534
	STRUCTURAL STEEL	1	JOB	SUM	893
	05.60 GUIDEWALLS SUBTOTAL				51,888
09.	**CHANNELS AND CANALS**	1	JOB	SUM	121,000
	PROJECT SUBTOTAL				**$361,146**
	CONTINGENCIES 20%				$71,854
	PROJECT SUBTOTAL WITH CONTINGENCIES				**$433,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				$43,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				$43,500
	PROJECT TOTAL*				**$520,000**

* The cost is high due to large amount of rock and soil excavation required to provide a channel to the location 5 lock.

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* **$ 342,000**

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 5, TYPE B
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	2,944
04.	DAMS				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	102
	04 DAMS SUBTOTAL				102
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	EXCAVATION	743,200	CY	4.5	3,344
	BACKFILL	106,984	CY	6.25	669
	SCOUR PROTECTION	172,364	TN	15	2,585
	GEOTEXTILE	8,960	SQ. YD.	6	54
	STONE FILL	6,950	TN	15	104
	FOUNDATION DEWATERING	1	JOB	SUM	2,289
	COFFERDAM REMOVAL	1	JOB	SUM	81
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	5,300
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	96
	CAST IN PLACE REINFORCED CONCRETE	84,202	CY	217	18,272
	CAST IN PLACE REINFORCED CONCRETE	1,745	CY	160	279
	CHAMBER WALLS	30,320	CY	160	4,851
	CAST IN PLACE CONNECTIONS	166	CY	725	120
	PRECAST RUB PANELS	9,376	SQ. FT.	40	375
	PRECAST CONCRETE CHAMBER AND APPROACH WAL	18,972	CY	400	7,589
	TREMIE PILE CAP	727	CY	165	120
	TREMIE CONCRETE, BASE .	28,930	CY	165	4,773
	TREMIE CONCRETE, WALL .	20,910	CY	175	3,659
	POST TENSION STEEL	60,000	LB	2.5	150
	FURNISH AND SET LANDING PADS	24	EA	19000	456
	SET PRECAST WALL UNITS	88	EA	16000	1,408
	FLOAT IN AND SET FLOOR UNITS	11	EA	40000	440
	STEEL REINFORCEMENT	8,970,090	LB	0.75	6,728
	STEEL CULVERT PIPE	385,000	LB	0.65	250
	CELL FILL, GRAVEL	19,675	CY	10	197
	METALS				
	SHEET PILING	1	JOB	SUM	9,525
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	15,061
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHEADS)	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				125,880
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	679,762	CY	4.5	3,059
	BACKFILL	3,373	CY	10	34
	SCOUR PROTECTION	380,309	TON	15	5,705
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				38,112
09.	CHANNEL WORK	1	JOB	SUM	121,000
	PROJECT SUBTOTAL				$288,037
	CONTINGENCIES 25%				$71,963
	PROJECT SUBTOTAL WITH CONTINGENCIES				$360,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				$36,000
31.	CONSTRUCTION MANAGEMENT (10%)				$36,000
	PROJECT TOTAL*				$432,000

* The cost is high due to large amount of rock and soil excavation required to provide a channel to the location 5 lock.

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* $ 246,000

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

LOCK AND DAM NO. 25, LOCATION 5, TYPE C
1200' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE ($'s)	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	2,944
04.	DAMS				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	102
	04 DAMS SUBTOTAL				102
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	EXCAVATION	715,197	CY	4.5	3,218
	BACKFILL	67,264	CY	6.25	420
	SCOUR PROTECTION, DIKE	1	JOB	SUM	2,585
	FOUNDATION DEWATERING	1	JOB	SUM	9,789
	COFFERDAM REMOVAL	1	JOB	SUM	81
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	1,800
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	96
	CAST IN PLACE REINFORCED CONCRETE	56,513	CY	217	12,263
	CAST IN PLACE CELL CAPS	6,510	CY	150	977
	PRECAST RUB PANELS	54,380	SQ. FT.	40	2,175
	PRECAST CULVERTS	4,990	CY	600	2,994
	PRECAST FLOOR SLABS	3,400	CY	150	510
	TREMIE PILE CAP	727	CY	165	120
	TREMIE CONCRETE, BASE	11,025	CY	165	1,819
	STEEL REINFORCEMENT	4,051,771	LB	0.75	3,039
	CELL FILL, GRAVEL	185,004	CY	10	1,850
	CHAMBER STONE FILL	19,930	TONS	15	299
	METALS				
	SHEET PILING	1	JOB	SUM	33,925
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,870
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, BULKHEADS)	1	JOB	SUM	4,783
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.)	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				113,104
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	679,762	CY	4.5	3,059
	BACKFILL	3,373	CY	10	34
	SCOUR PROTECTION	380,309	TON	15	5,705
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				38,112
09.	CHANNEL WORK	1	JOB	SUM	121,000
	PROJECT SUBTOTAL				$275,261
	CONTINGENCIES 25%				$68,739
	PROJECT SUBTOTAL WITH CONTINGENCIES				$344,000
30.	PLANNING, ENGINEERING, AND DESIGN ($10%)				$34,500
31.	CONSTRUCTION MANAGEMENT (10%)				$34,500
	PROJECT TOTAL*				$413,000

* The cost is high due to large amount of rock and soil excavation required to provide a channel to the location 5 lock.

TOTAL BASIC LOCK COST (O4., 05., 05.60.) WITH CONTINGENCIES, PED, & CM* $ 227,000

*(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC.)

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

LARGE-SCALE MEASURES OF REDUCING TRAFFIC CONGESTION
CONCEPTUAL LOCK DESIGNS

COST ESTIMATES OF 600'

PILE-FOUNDED LOCKS

U.S. ARMY ENGINEER DISTRICTS,
ROCK ISLAND, ST. LOUIS, ST. PAUL
CORPS OF ENGINEERS

LOCK AND DAM NO. 25, LOCATION 1, TYPE A,
600' LOCK ALTERNATIVE (PILE-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	1,742
02.	RELOCATION	1	JOB	SUM	300
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION	1	JOB	SUM	4,055
	EXCAVATION	721,111	CY	4.5	3,245
	BACKFILL	619,000	CY	6.25	3,869
	COFFERDAM FILL AND ROAD	1	JOB	SUM	133
	DEWATERING AND COFFERDAM MISC	1	JOB	SUM	7,195
	SCOUR PROTECTION	1	JOB	SUM	459
	COFFERDAM REMOVAL	1	JOB	SUM	1,730
	GRADING	1	JOB	SUM	175
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	143,134	CY	217.00	31,060
	STEEL REINFORCEMENT	11,450,667	LB	0.75	8,588
	WATERSTOPS AND JOINT FILLER	1	JOB	SUM	220
	METALS				
	SHEET PILING	1	JOB	SUM	19,931
	FOUNDATION PILING AND TESTING	1	JOB	SUM	11,129
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	18,436
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	6,000
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,375
	MOVEABLE BRIDGE	1	JOB	SUM	1,000
	05 LOCKS SUBTOTAL				141,750
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	496,720	CY	4.5	2,235
	BACKFILL	43,218	CY	10	432
	SCOUR PROTECTION	168,330	TON	15	2,525
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	21,202	CY	217	4,601
	PRECAST BEAMS	8,960	LF	1250	11,200
	TREMIE CONCRETE	50,035	CY	165	8,256
	STEEL REINFORCEMENT	1,371,739	LB	0.75	1,029
	METALS				
	SHEET PILING	1	JOB	SUM	10,308
	FOUNDATION PILING	1	JOB	SUM	6,534
	STRUCTURAL STEEL	1	JOB	SUM	893
	05.60 GUIDEWALLS SUBTOTAL				48,013
09.	CHANNEL WORK	1	JOB	SUM	5,520
11.	LEVEES AND FLOODWALLS	1	JOB	SUM	2,350
	PROJECT SUBTOTAL				199,675
	CONTINGENCIES 20%				40,325
	PROJECT SUBTOTAL WITH CONTINGENCIES				240,000
30.	PLANNING, ENGINEERING, AND DESIGN				24,000
31.	CONSTRUCTION MANAGEMENT				24,000
	PROJECT TOTAL				288,000

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$273,000**

* (EXCLUDES REAL ESTATE, RELOCATION, CHANNEL WORK, AND LEVEES AND FLOODWALLS WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 1, TYPE B
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	1,577
02.	**RELOCATION**	1	JOB	SUM	300
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	406
	EXCAVATION	215,777	CY	4.50	971
	GRADING	1	JOB	SUM	150
	BACKFILL	2,720	CY	6.25	17
	SCOUR PROTECTION	157,630	TN	15.00	2,364
	FOUNDATION DEWATERING	1	JOB	SUM	54
	COFFERDAM REMOVAL	1	JOB	SUM	81
	CONCRETE				
	SLURRY WALL	17,716	CY	705	12,490
	TIEBACK ANCHORS	810	EA	2500	2,025
	STRUCTURAL GROUTING	620	CY	272	169
	CAST IN PLACE REINFORCED CONCRETE	77,447	CY	217	16,806
	PRECAST CONCRETE	2,975	CY	307	913
	TREMIE CONCRETE	25,655	CY	165	4,233
	STEEL REINFORCEMENT	6,579,973	LB	0.75	4,935
	METALS				
	SHEET PILING	1	JOB	SUM	473
	SHEET PILE BRACING	1	JOB	SUM	1,850
	FOUNDATION PILING AND TESTING	1	JOB	SUM	8,836
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	10,337
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC.	1	JOB	SUM	2,825
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,500
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	MOVEABLE BRIDGE	1	JOB	SUM	1,000
	05 LOCKS SUBTOTAL				93,035
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	496,720	CY	4.5	2,235
	BACKFILL	11,300	CY	10	113
	SCOUR PROTECTION	157,630	TON	15	2,364
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (C0NCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,682
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				34,028
09.	**CHANNEL WORK**	1	JOB	SUM	5,520
11.	**LEVEES AND FLOODWALLS**	1	JOB	SUM	2,351
	PROJECT SUBTOTAL				**136,811**
	CONTINGENCIES (25%)				34,189
	PROJECT SUBTOTAL WITH CONTINGENCIES				**171,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				17,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				17,000
	PROJECT TOTAL				**205,000**

TOTAL BASIC LOCK COST (05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$191,000**

* (EXCLUDES REAL ESTATE, RELOCATION, CHANNEL WORK, AND LEVEES AND FLOODWALLS WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 1, TYPE C
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	1,577
02.	RELOCATION	1	JOB	SUM	300
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	190
	EXCAVATION	318,995	CY	5.3	1,691
	BACKFILL	92,480	CY	6.25	578
	SCOUR PROTECTION	4,660	TN	15	70
	FOUNDATION DEWATERING	1	JOB	SUM	137
	GRADING	1	JOB	SUM	150
	COFFERDAM REMOVAL	1	JOB	SUM	81
	CONCRETE				
	TIEBACK ANCHORS	450	EA	2500	1,125
	STRUCTURAL GROUTING	585	CY	272	159
	CAST IN PLACE REINFORCED CONCRETE	56,585	CY	217	12,279
	PRECAST CONCRETE WALL PANELS	585	CY	307	180
	PRECAST CONCRETE INTAKE PIPE AND CULVERT	2,465	CY	600	1,479
	TREMIE CONCRETE .	10,859	CY	165	1,792
	STEEL REINFORCEMENT	4,377,600	LB	0.75	3,283
	GRAVEL BEDDING	620	TON	15	9
	RIPRAP FLOOR	18,560	TON	20	371
	METALS				
	SHEET PILING	1	JOB	SUM	6,855
	SHEET PILE BRACING	1	JOB	SUM	1,514
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,157
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	4,588
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,775
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	1,500
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	MOVEABLE BRIDGE	1	JOB	SUM	1,000
	05 LOCKS SUBTOTAL				65,563
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	496,720	CY	4.5	2,235
	BACKFILL	11,300	CY	10	113
	SCOUR PROTECTION	157,630	TON	15	2,364
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (C0NCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	9,681
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				34,027
09.	CHANNEL WORK	1	JOB	SUM	5,520
11.	LEVEES AND FLOODWALLS	1	JOB	SUM	2,351
	PROJECT SUBTOTAL				**109,338**
	CONTINGENCIES 25%				27,662
	PROJECT SUBTOTAL WITH CONTINGENCIES				**137,000**
30.	PLANNING, ENGINEERING, AND DESIGN				14,000
31.	CONSTRUCTION MANAGEMENT				14,000
	PROJECT TOTAL				**165,000**

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$149,000**

* (EXCLUDES REAL ESTATE, RELOCATION, CHANNEL WORK, AND LEVEES AND FLOODWALLS WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 3, TYPE B,
600 ' LOCK ALTERNATIVE (PILE-FOUNDED)

CCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRIC	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
02.	**RELOCATION**	1	JOB	SUM	150
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,650
	DEMOLITION	1	JOB	SUM	1,910
	EXCAVATION	38,300	CY	4.50	172
	FOUNDATION FILL AT SCOUR HOLE	125,000	CY	19	2,344
	WALL FILL, CRUSHED STONE	38,350	TN	15	575
	SCOUR PROTECTION	1	JOB	SUM	655
	FOUNDATION DEWATERING	1	JOB	SUM	2,000
	COFFERDAM REMOVAL	1	JOB	SUM	40
	LEVELING STONE IN LOCK FLOOR	2,333	TN	15	35
	GRAVEL FILTER IN LOCK FLOOR	8,333	TN	15	125
	GEOTEXTILE	6,870	SY	6	41
	MARINE FACILITIES, TEMP MOORING STRUCTURE	1	JOB	SUM	3,900
	CONCRETE				
	STRUCTURAL GROUTING	250	CY	200	50
	CAST IN PLACE REINFORCED CONCRETE	37,356	CY	217	8,106
	CAST IN PLACE CONNECTIONS	482	CY	725	349
	PRECAST CONCRETE	1,996	CY	400	798
	TREMIE CONCRETE	16,256	CY	165	2,682
	PRECAST FLOOR, PAVERS, STRUTS	7,830	CY	286	2,239
	SET PRECAST FLOOR BEAMS	16	EA	16,000	256
	SET FLOOR PANELS	34	EA	10,000	340
	STEEL REINFORCEMENT	4,884,730	LB	0.75	3,664
	METALS				
	SHEET PILING	1	JOB	SUM	5,015
	SHEET PILE BRACING	1	JOB	SUM	350
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,841
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,500
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	05 LOCKS SUBTOTAL				79,892
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	118,490	CY	4.50	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	46,350	TON	15	695
	CONCRETE				
	42" DIAMETER PILES	6,360	LF	400	2,544
	CAST IN PLACE REINFORCED CONCRETE	2,500	CY	150	375
	PRECAST BEAMS	17,325	CY	500	8,663
	PRECAST BEAM SEATS	262	CY	1,000	262
	TREMIE CONCRETE	209	CY	500	105
	PERMANENT CELL FILL (CONCRETE)	10,400	CY	200	2,080
	GROUT FOR BEAMS	778	CY	1,000	778
	STEEL REINFORCEMENT	2,921,700	LB	1	2,191
	GRAVEL FILL	52,500	CY	10	525
	METALS				
	SHEET PILING	1	JOB	SUM	8,230
	FOUNDATION PILING	1	JOB	SUM	318
	POST TENSIONING	2,030	LF	30	61
	STRUCTURAL STEEL	1	JOB	SUM	6,525
	05.60 GUIDEWALLS SUBTOTAL				34,621
09.	**CHANNEL WORK**	1	JOB	SUM	680
	PROJECT SUBTOTAL				**115,493**
	CONTINGENCIES (25%)				28,507
	PROJECT SUBTOTAL WITH CONTINGENCIES				**144,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				14,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				14,500
	PROJECT TOTAL				**173,000**

TOTAL BASIC LOCK COST (05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$172,000**

* (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 3, TYPE C, 600 ' LOCK ALTERNATIVE (PILE-FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	150
02.	**RELOCATION**	1	JOB	SUM	150
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,650
	DEMOLITION	1	JOB	SUM	1,910
	EXCAVATION	38,300	CY	4.50	172
	FOUNDATION FILL AT SCOUR HOLE	125,000	CY	19	2,344
	SCOUR PROTECTION	1	JOB	SUM	655
	FOUNDATION DEWATERING	1	JOB	SUM	2,000
	COFFERDAM REMOVAL	1	JOB	SUM	40
	LEVELING STONE IN LOCK FLOOR	2,333	TN	15	35
	GRAVEL FILTER IN LOCK FLOOR	8,333	TN	15	125
	GEOTEXTILE	6,870	SY	6	41
	MARINE FACILITIES, TEMP MOORING STRUCTURE	1	JOB	SUM	3,900
	CONCRETE				
	STRUCTURAL GROUTING	250	CY	200	50
	CAST IN PLACE REINFORCED CONCRETE	35,643	CY	217	7,735
	CAST IN PLACE CONNECTIONS	482	CY	725	349
	PRECAST CONCRETE	1,996	CY	400	798
	TREMIE CONCRETE	16,256	CY	165	2,682
	PRECAST FLOOR, PAVERS, STRUTS	7,830	CY	286	2,239
	SET PRECAST FLOOR BEAMS	16	EA	16,000	256
	SET FLOOR PANELS	34	EA	10,000	340
	STEEL REINFORCEMENT	4,752,825	LB	0.75	3,565
	METALS				
	SHEET PILING	1	JOB	SUM	5,015
	SHEET PILE BRACING	1	JOB	SUM	350
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,841
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	3,040
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,500
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	3,450
	05 LOCKS SUBTOTAL				78,846
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	95,384	CY	4.50	429
	BACKFILL	59,280	CY	10	593
	SCOUR PROTECTION	37,312	TON	15	560
	CONCRETE				
	42" DIAMETER PILES	5,120	LF	400	2,048
	CAST IN PLACE REINFORCED CONCRETE	2,013	CY	150	302
	PRECAST BEAMS	13,947	CY	500	6,974
	PRECAST BEAM SEATS	211	CY	1,000	211
	TREMIE CONCRETE	168	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,372	CY	200	1,674
	GROUT FOR BEAMS	626	CY	1,000	626
	STEEL REINFORCEMENT	2,351,969	LB	0.75	1,764
	GRAVEL FILL	42,263	CY	10	423
	METALS				
	SHEET PILING	1	JOB	SUM	6,583
	FOUNDATION PILING	1	JOB	SUM	256
	POST TENSIONING	1,634	LF	30	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	FLOATING GUIDEWALL	1	JOB	SUM	3750
	05.60 GUIDEWALLS SUBTOTAL				27,738
09.	**CHANNEL WORK**	1	JOB	SUM	680
	PROJECT SUBTOTAL				**107,564**
	CONTINGENCIES (25%)				27,436
	PROJECT SUBTOTAL WITH CONTINGENCIES				**135,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				13,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				13,000
	PROJECT TOTAL				**161,000**

TOTAL BASIC LOCK COST (05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$160,000**

* (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 4, TYPE A
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	21
04.	**DAMS**				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	1,664
	REPLACEMENT TAINTER GATES (3)	1	JOB	SUM	28,500
	04 DAMS SUBTOTAL				30,164
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	DEMOLITION	1	JOB	SUM	217
	EXCAVATION	144,444	CY	4.50	650
	BERM FILL	32,850	CY	10.00	329
	COFFERDAM FILL AND ROAD	1	JOB	SUM	2,349
	DEWATERING AND COFFERDAM MISC	1	JOB	SUM	7,225
	SCOUR PROTECTION	1	JOB	SUM	2,417
	COFFERDAM REMOVAL	1	JOB	SUM	5,600
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	125,760	CY	217	27,290
	PRECAST CONCRETE	1,744	CY	400	698
	TREMIE CONCRETE WALLS	5,231	CY	175	915
	TREMIE CONCRETE BASE	17,113	CY	165	2,824
	STEEL REINFORCEMENT	11,907,107	LB	0.75	8,930
	POST TENSION STEEL	6,020	LF	75	452
	STRUCTURAL GROUT	1	JOB	SUM	7,853
	WATERSTOPS AND JOINT FILLER	1	JOB	SUM	220
	METALS				
	SHEET PILING	1	JOB	SUM	29,811
	FOUNDATION PILING AND TESTING	1	JOB	SUM	11,900
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	19,086
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	6,000
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,375
	05 LOCKS SUBTOTAL				159,290
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	107,130	CY	4.5	482
	BACKFILL	43,218	CY	10	432
	SCOUR PROTECTION	168,330	TON	15	2,525
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	21,202	CY	217	4,601
	PRECAST BEAMS	8,960	LF	1250	11,200
	TREMIE CONCRETE	50,035	CY	165	8,256
	STEEL REINFORCEMENT	1,371,739	LB	0.75	1,029
	METALS				
	SHEET PILING	1	JOB	SUM	10,578
	FOUNDATION PILING	1	JOB	SUM	6,534
	STRUCTURAL STEEL	1	JOB	SUM	893
	05.60 GUIDEWALLS SUBTOTAL				46,530
	PROJECT SUBTOTAL				**236,005**
	CONTINGENCIES (20%)				46,995
	PROJECT SUBTOTAL WITH CONTINGENCIES				**283,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				28,000
31.	**CONSTRUCTION MANAGEMENT (10%)**				28,000
	PROJECT TOTAL				**339,000**

TOTAL BASIC LOCK COST (04, 05, 05,60.) WITH CONTINGENCIES, PED, &CM* **$339,000**

* (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 4, TYPE B
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	21
04.	DAMS				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	1,664
	REPLACEMENT TAINTER GATES (2)	1	JOB	SUM	19,000
	04 DAMS SUBTOTAL				20,664
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	146
	EXCAVATION	91,705	CY	4.5	413
	BACKFILL	194,340	CY	6.25	1,215
	SCOUR PROTECTION	1	JOB	SUM	122
	RIP RAP	98,575	TN	20	1,972
	CAPSTONE	16,320	TN	25	408
	GEOTEXTILE	6,983	SQ. YD.	6	42
	STONE FILL	3,468	TN	15	52
	FOUNDATION DEWATERING	1	JOB	SUM	2,289
	COFFERDAM REMOVAL	1	JOB	SUM	87
	MARINE FACILITIES AND SPECIAL COSTS		JOB	SUM	5,675
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	5,400
	CAST IN PLACE REINFORCED CONCRETE	44,511	CY	217	9,659
	CHAMBER WALLS	30,320	CY	160	4,851
	CAST IN PLACE CONNECTIONS	82	CY	725	59
	PRECAST CONCRETE CHAMBER AND APPROACH WAL	11,030	CY	400	4,412
	TREMIE CONCRETE, BASE .	28,788	CY	165	4,750
	TREMIE CONCRETE, WALL .	14,990	CY	175	2,623
	POST TENSION STEEL	60,000	LB	2.5	150
	FURNISH AND SET LANDING PADS	12	EA	19000	228
	SET PRECAST WALL UNITS	44	EA	16000	704
	FLOAT IN AND SET FLOOR UNITS	6	EA	40000	240
	STEEL REINFORCEMENT	7,336,647	LB	0.75	5,502
	STEEL CULVERT PIPE	2,639,230	LB	0.65	1,715
	METALS				
	SHEET PILING	1	JOB	SUM	5,149
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	9,945
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	11,616
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,771
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				103,646
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	118,490	CY	4.5	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	211,130	TN	15	3,167
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	6,583
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				30,653
	PROJECT SUBTOTAL				154,983
	CONTINGENCIES (25%)				39,017
	PROJECT SUBTOTAL WITH CONTINGENCIES				194,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				19,000
31.	CONSTRUCTION MANAGEMENT (10%)				19,000
	PROJECT TOTAL				232,000

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM* **$232,000**

* (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 4, TYPE C
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000's)
01.	LANDS AND DAMAGES				
	REAL ESTATE	1	JOB	SUM	21
04.	DAMS				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	1,663
	REPLACEMENT TAINTER GATES (2)	1	JOB	SUM	19,000
	04 DAMS SUBTOTAL				20,663
05.	LOCKS				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	DEMOLITION	1	JOB	SUM	146
	EXCAVATION	60,000	CY	4.5	270
	BACKFILL	187,090	CY	6.25	1,169
	SCOUR PROTECTION	1	JOB	SUM	1,958
	RIP RAP	143,700	TN	20	2,874
	CAPSTONE	20,840	TN	25	521
	GEOTEXTILE	6,950	SQ. YD.	6	42
	STONE FILL	6,935	TN	15	104
	FOUNDATION DEWATERING	1	JOB	SUM	6,000
	COFFERDAM REMOVAL	1	JOB	SUM	87
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	2,175
	CONCRETE				
	STRUCTURAL GROUTING		CY	SUM	5,400
	CAST IN PLACE REINFORCED CONCRETE	56,549	CY	217	12,271
	CONCRETE CELL CAPS	3,255	CY	150	488
	CAST IN PLACE CONNECTIONS	83	CY	725	60
	PRECAST CONCRETE APPROACH WALLS	10,730	CY	400	4,292
	PRECAST FLOOR SLABS	1,700	CY	150	255
	PRECAST CULVERTS	2,492	CY	600	1,495
	PRECAST RUB PANELS	31,900	SQ. FT.	40	1,276
	TREMIE CONCRETE, BASE .	19,130	CY	165	3,156
	TREMIE CONCRETE, WALL .	4,527	CY	175	792
	POST TENSION STEEL	60,000	LB	2.5	150
	STEEL REINFORCEMENT	4,022	LB	0.75	3
	CELL FILL, GRAVEL	75,400	CY	10	754
	STONE IN CHAMBER	46,000	TONS	15	690
	METALS				
	SHEET PILING	1	JOB	SUM	13,114
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,673
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	4,783
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	2,750
	05 LOCKS SUBTOTAL				93,749
05.60.	GUIDEWALLS				
	SITEWORK				
	EXCAVATION	118,490	CY	4.5	533
	BACKFILL	73,640	CY	10	736
	SCOUR PROTECTION	211,130	TON	15	3,167
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,333	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	6,583
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				30,653
	PROJECT SUBTOTAL				145,086
	CONTINGENCIES (25%)				35,914
	PROJECT SUBTOTAL WITH CONTINGENCIES				181,000
30.	PLANNING, ENGINEERING, AND DESIGN (10%)				18,000
31.	CONSTRUCTION MANAGEMENT (10%)				18,000
	PROJECT TOTAL				217,000

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM* — $217,000

* (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 5, TYPE A
600' LOCK ALTERNATVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000's)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE		JOB	SUM	2,944
04.	**DAMS**				
	04 DAMS SUBTOTAL				102
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	10,000
	EXCAVATION	444,444	CY	4.5	2,000
	BERM FILL	26,980	CY	10	270
	COFFERDAM FILL AND ROAD	1	JOB	SUM	1,960
	DEWATERING AND COFFERDAM MISC	1	JOB	SUM	7,225
	SCOUR PROTECTION	1	JOB	SUM	1,810
	COFFERDAM REMOVAL	1	JOB	SUM	2,596
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	125,760	CY	217	27,290
	PRECAST CONCRETE RUB PANELS	11,830	SQ. FT.	40	473
	TREMIE CONCRETE PILE CAP	28,320	CY	165	4,673
	STEEL REINFORCEMENT	9,960,352	LB	0.75	7,470
	STRUCTURAL GROUTING	1	JOB	SUM	96
	WATERSTOPS AND JOINT FILLER	1	JOB	SUM	220
	METALS				
	SHEET PILING	1	JOB	SUM	35,003
	FOUNDATION PILING AND TESTING	1	JOB	SUM	11,445
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	14,086
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,000
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	6,000
	MECHANICAL SYSTEMS	1	JOB	SUM	3,200
	MISCELLANEOUS	1	JOB	SUM	3,375
	05 LOCKS SUBTOTAL				147,142
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	679,770	CY	4.5	3,059
	BACKFILL	3,380	CY	10	34
	SCOUR PROTECTION	380,320	TON	15	5,705
	CONCRETE				
	CAST IN PLACE REINFORCED CONCRETE	21,202	CY	217	4,601
	PRECAST BEAMS	8,960	LF	1250	11,200
	TREMIE CONCRETE	50,035	CY	165	8,256
	STEEL REINFORCEMENT	1,371,739	LB	0.75	1,029
	METALS				
	SHEET PILING	1	JOB	SUM	10,578
	FOUNDATION PILING	1	JOB	SUM	6,534
	STRUCTURAL STEEL	1	JOB	SUM	893
	05.60 GUIDEWALLS SUBTOTAL				51,888
09.	**CHANNELS AND CANALS**	1	JOB	SUM	121,000
	PROJECT SUBTOTAL				**323,076**
	CONTINGENCIES 20%			0.20	64,924
	PROJECT SUBTOTAL WITH CONTINGENCIES				**388,000**
30.	**PLANNING, ENGINEERING, AND DESIGN**			0.10	39,000
31.	**CONSTRUCTION MANAGEMENT**			0.10	39,000
	PROJECT TOTAL*				**466,000**

* The cost is high due to large amount of rock and soil excavation required to provide a channel to the location 5 lock.

TOTAL BASIC LOCK COST (04, 05, 05,60.) WITH CONTINGENCIES, PED, &CM** — **$287,000**

** (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 5, TYPE B
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT ($1,000'S)
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,944
04.	**DAMS**				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	102
	04 DAMS SUBTOTAL				102
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	EXCAVATION	371,600	CY	4.5	1,672
	BACKFILL	103,492	CY	6.25	647
	SCOUR PROTECTION	86,182	TN	15	1,293
	GEOTEXTILE	4,480	SQ. YD.	6	27
	STONE FILL	3,475	TN	15	52
	FOUNDATION DEWATERING	1	JOB	SUM	2,410
	COFFERDAM REMOVAL	1	JOB	SUM	87
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	5,675
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	96
	CAST IN PLACE REINFORCED CONCRETE	44,511	CY	217	9,659
	CAST IN PLACE REINFORCED CONCRETE	1,745	CY	160	279
	CHAMBER WALLS	30,320	CY	160	4,851
	CAST IN PLACE CONNECTIONS	83	CY	725	60
	PRECAST RUB PANELS	9,376	SQ. FT.	40	375
	PRECAST CONCRETE CHAMBER WALLS, FLOOR	9,490	CY	400	3,796
	TREMIE PILE CAP	727	CY	165	120
	TREMIE CONCRETE, BASE .	28,788	CY	165	4,750
	TREMIE CONCRETE, WALL .	14,990	CY	175	2,623
	POST TENSION STEEL	60,000	LB	2.5	150
	FURNISH AND SET LANDING PADS	12	EA	19,000	228
	SET PRECAST WALL UNITS	44	EA	16,000	704
	FLOAT IN AND SET FLOOR UNITS	6	EA	40,000	240
	STEEL REINFORCEMENT	7,336,647	LB	0.75	5,502
	STEEL CULVERT PIPE	2,639,230	LB	0.65	1,715
	CELL FILL, GRAVEL	19,675	CY	10	197
	METALS				
	SHEET PILING	1	JOB	SUM	8,248
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	9,945
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS,	1	JOB	SUM	11,613
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ET	1	JOB	SUM	2,771
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				101,236
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	679,762	CY	4.5	3,059
	BACKFILL	3,373	CY	10	34
	SCOUR PROTECTION	380,309	TON	15	5,705
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	6,583
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				35,014
09.	**CHANNEL WORK**	1	JOB	SUM	121,000
	PROJECT SUBTOTAL				**260,296**
	CONTINGENCIES (25%)				64,704
	PROJECT SUBTOTAL WITH CONTINGENCIES				**325,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				32,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				32,500
	PROJECT TOTAL*				**390,000**

* The cost is high due to large amount of rock and soil excavation required to provide a channel to the location 5 lock.

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM** **$205,000**

**(EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)

LOCK AND DAM NO. 25, LOCATION 5, TYPE C
600' LOCK ALTERNATIVE (PILE FOUNDED)

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
01.	**LANDS AND DAMAGES**				
	REAL ESTATE	1	JOB	SUM	2,944
04.	**DAMS**				
	REMOVAL OF EXISTING STRUCTURES	1	JOB	SUM	102
	04 DAMS SUBTOTAL				102
05.	**LOCKS**				
	SITEWORK				
	MOBILIZATION	1	JOB	SUM	8,000
	EXCAVATION	357,556	CY	4.5	1,609
	BACKFILL	33,760	CY	6.25	211
	SCOUR PROTECTION, DIKE	1	JOB	SUM	1,295
	FOUNDATION DEWATERING	1	JOB	SUM	6,000
	COFFERDAM REMOVAL	1	JOB	SUM	87
	MARINE FACILITIES AND SPECIAL COSTS	1	JOB	SUM	2,175
	CONCRETE				
	STRUCTURAL GROUTING	1	JOB	SUM	96
	CAST IN PLACE REINFORCED CONCRETE	54,770	CY	217	11,885
	CAST IN PLACE CELL CAPS	3,255	CY	150	488
	PRECAST RUB PANELS	31,900	SQ. FT.	40	1,276
	PRECAST CULVERTS	2,492	CY	600	1,495
	PRECAST FLOOR SLABS	1,700	CY	150	255
	TREMIE PILE CAP	727	CY	165	120
	TREMIE CONCRETE, BASE .	11,025	CY	165	1,819
	STEEL REINFORCEMENT	7,385,229	LB	0.75	5,539
	CELL FILL, GRAVEL	102,345	CY	10	1,023
	CHAMBER STONE FILL	10,000	TONS	15	150
	METALS				
	SHEET PILING	1	JOB	SUM	16,370
	SHEET PILE BRACING	1	JOB	SUM	600
	FOUNDATION PILING AND TESTING	1	JOB	SUM	4,631
	STRUCTURAL STEEL (GATES, VALVES, TRASHRACKS, B	1	JOB	SUM	4,783
	STRUCTURAL STEEL (MISCELLANEOUS - LADDERS, ETC	1	JOB	SUM	2,500
	ELECTRICAL				
	ELECTRICAL SYSTEM	1	JOB	SUM	4,700
	INSTRUMENTATION	1	JOB	SUM	1,250
	MECHANICAL				
	GATE AND VALVE OPERATING MACHINERY	1	JOB	SUM	2,750
	MECHANICAL SYSTEMS	1	JOB	SUM	2,200
	MISCELLANEOUS	1	JOB	SUM	1,950
	05 LOCKS SUBTOTAL				85,258
05.60.	**GUIDEWALLS**				
	SITEWORK				
	EXCAVATION	679,762	CY	4.5	3,059
	BACKFILL	3,373	CY	10	34
	SCOUR PROTECTION	380,309	TON	15	5,705
	CONCRETE				
	42" DIAMETER PILES	5,088	LF	400	2,035
	CAST IN PLACE REINFORCED CONCRETE	2,000	CY	150	300
	PRECAST BEAMS	13,860	CY	500	6,930
	PRECAST BEAM SEATS	210	CY	1000	210
	TREMIE CONCRETE	167	CY	500	84
	PERMANENT CELL FILL (CONCRETE)	8,320	CY	200	1,664
	GROUT FOR BEAMS	622	CY	1000	622
	STEEL REINFORCEMENT	2,337,350	LB	0.75	1,753
	GRAVEL FILL	42,000	CY	10	420
	METALS				
	SHEET PILING	1	JOB	SUM	6,583
	FOUNDATION PILING	1	JOB	SUM	404
	POST TENSIONING	1,624	LF	30.00	49
	STRUCTURAL STEEL	1	JOB	SUM	5,163
	05.60 GUIDEWALLS SUBTOTAL				35,014
09.	**CHANNEL WORK**	1	JOB	SUM	121,000
	PROJECT SUBTOTAL				**244,318**
	CONTINGENCIES (25%)				60,682
	PROJECT SUBTOTAL WITH CONTINGENCIES				**305,000**
30.	**PLANNING, ENGINEERING, AND DESIGN (10%)**				30,500
31.	**CONSTRUCTION MANAGEMENT (10%)**				30,500
	PROJECT TOTAL*				**366,000**

* The cost is high due to large amount of rock and soil excavation required to provide a channel to the location 5 lock.

TOTAL BASIC LOCK COST (04, 05, 05.60.) WITH CONTINGENCIES, PED, &CM** — **$181,000**

** (EXCLUDES REAL ESTATE, RELOCATION, AND CHANNEL WORK WHICH ARE MORE SITE-SPECIFIC)