DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT CORPS OF ENGINEERS
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

REPLY TO
ATTENTION OF:

MAR 29 2012

Programs and Project Management Division
Project Management Branch

Dear Sir or Madam:

The St. Louis District, Corps of Engineers, has developed a draft report that addresses underseepage problems with a portion of the Wood River levee adjacent to the Mel Price Lock and Dam. The report describes alternative solutions and presents a tentatively recommended plan. The report entitled "Draft Limited Reevaluation Report, Melvin Price – Wood River Underseepage Design Deficiency Project, Melvin Price Locks and Dam, Madison County, Illinois" and dated March 2012, is now available for public review.

You are receiving this letter because you may be interested in the project. The report also includes a Supplemental Environmental Assessment (SEA) with Draft Finding of No Significant Impact (FONSI). This document also serves to notify the public of the proposed project and requests assistance in identifying the probable environmental impacts of the project alternatives.

The 30-day public review period runs from 29 March to 30 April 2012. The Limited Reevaluation Report and SEA with FONSI are available for public review. The electronic version of these documents is available online at http://www.mvs.usace.army.mil/pm/pm-reports.html or you may request a copy be mailed to you.

This document is provided to you for your information and review. We invite your comments related to the content of Limited Reevaluation Report and SEA with FONSI. If you would like to submit comments, please address your comments or questions to Mr. Tim Kerr of the Project Management Branch (CEMVS-PM-N), at telephone number (314) 331-8780, facsimile number (314) 331-8041, or e-mail at Timothy.K.George@usace.army.mil, by close of business on 30 April 2012.

Sincerely,

Joseph P. Kellett, P.E.
Deputy District Engineer for
Programs and Project Management

LIMITED REEVALUATION REPORT
MELVIN PRICE - WOOD RIVER UNDERSEEPAGE DESIGN DEFICIENCY PROJECT

DRAFT REPORT

MELVIN PRICE LOCKS AND DAM
MADISON COUNTY, ILLINOIS

MARCH 2012

US Army Corps of Engineers
St. Louis District®

1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

LIMITED REEVALUATION REPORT
MELVIN PRICE - WOOD RIVER UNDERSEEPAGE
DESIGN DEFICIENCY PROJECT
MADISON COUNTY, ILLINOIS

Executive Summary

The purpose of this study is to examine the need for and feasibility of modifications to the Melvin Price Locks and Dam Project to correct a design deficiency which has led to underseepage along an adjacent levee.

In July 2009, uncontrolled underseepage and conveyance of material under the Wood River Levee was discovered in an area adjacent to the pool of the Melvin Price Locks and Dam. At the time this was discovered, the Locks and Dam was under normal operating conditions. By direct observation and a study of the design documentation associated with the construction of the Melvin Price Locks and Dam, the St. Louis District concludes that the uncontrolled underseepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam. The replacement structure, located two miles downstream from the original structure, resulted in a navigation pool raise that has impacted the levee foundation. Consequently, the Wood River Levee is at unacceptable risk during a high water event.

This section of the Wood River Levee (known as the Upper Wood River Levee) protects 88 commercial and industrial structures with a total structure value of approximately $365 million. Additionally, this levee serves as part of the containment system for the Melvin Price navigation pool. The Melvin Price Locks and Dam performs over 6,000 lockages each year for vessels carrying goods on the Upper Mississippi River between St. Louis and St. Paul and Chicago. If this part of the Wood River Levee were to fail, the possibility exists that the lower flank levee could also fail, resulting in the creation of a side channel around the dam and loss of the navigation pool. In this scenario, it is estimated that the transportation of goods on the Mississippi River upstream of St. Louis would be interrupted for approximately 12 months and result in economic losses greater than $1 billion.

To address the underseepage concerns, the study examined several alternatives consisting of relief wells, seepage berms, and slurry trench cutoff walls. The tentatively selected plan is the Slurry Trench Wall with Relief Wells, which had the least cost and the greatest net benefits of all of the alternatives. The current working estimate for this alternative is $31,851,000 and it has a benefit-to-cost ratio of 8.8.

The costs of the construction of the design deficiency correction will be borne entirely by the federal government. Operation, maintenance, repair, rehabilitation and replacement of the project features will be the responsibility of the Wood River Drainage and Levee District.

LIMITED REEVALUATION REPORT
MELVIN PRICE - WOOD RIVER UNDERSEEPAGE
DESIGN DEFICIENCY PROJECT
MADISON COUNTY, ILLINOIS

TABLE OF CONTENTS

MAIN REPORT

Tables

Figures

APPENDICES

LIMITED REEVALUATION REPORT
MELVIN PRICE - WOOD RIVER UNDERSEEPAGE
DESIGN DEFICIENCY PROJECT
MADISON COUNTY, ILLINOIS

1. STUDY AUTHORITY

The authority for a design deficiency correction study is found in section 216 of the Flood Control Act of December 31, 1970, Public Law 91-611, which states, "The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."

According to Engineer Regulation (ER) 1165-2-119, which refers to this law, whenever reporting officers find that changes in a completed project may be desirable, investigations should be undertaken to document the need for and feasibility of project modification. Per ER 1165-2-119, a design or construction deficiency is a flaw in the federal design or construction of a project that significantly interferes with the project's authorized purposes or full usefulness as intended by Congress at the time of original project development. The corrective action therefore, falls within the purview of the original project authorization. Work to correct a design or construction deficiency may be recommended for accomplishment under existing project authority without further Congressional authorization if the proposed corrective action meets all the following conditions:

- It is required to make the project function as initially intended by the designer in a safe, viable and reliable manner: e.g., pass the original design flow without failure. This does not mean the project must meet present-day design standards. If, however, current engineering analysis or actual physical distress indicates the project will fail, corrections may be considered a design or construction deficiency if the other criteria are met.

- It is not required because of changed conditions.

- It is generally limited to the existing project features. Remedial measures that require land acquisitions or new project features must not change the scope or function of the authorized project.

- It is justified by safety or economic considerations.

- It is not required because of inadequate local maintenance.

As will be demonstrated later in this report, the Melvin Price - Wood River underseepage design deficiency correction project meets all of these conditions; therefore, the design deficiency corrections are authorized by the original project authorization.

2. STUDY PURPOSE

The purpose of this study is to examine the need for and feasibility of modifications to the Melvin Price Lock and Dam Project to correct a design deficiency which has led to underseepage along an adjacent levee. The study examines alternative ways to correct the design deficiency, assesses the environmental impacts of the alternatives and the tentative selected plan, and discusses various reviews of the planning effort (including public review and Independent External Peer Review comments). Finally, this study will recommend a design deficiency correction project for implementation.

The Limited Reevaluation Report evaluates the design deficiency associated with the uncontrolled underseepage and conveyance of material that is occurring under the Wood River Levee, in an area adjacent to the pool of Melvin Price Locks and Dam during normal operating conditions. The uncontrolled underseepage was discovered in July 2009 while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular levee inspections and is in an area normally covered by several feet of water. By direct observation and a study of the design documentation associated with the construction of the Melvin Price Locks and Dam, the St. Louis District concludes that the uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam. The replacement structure, located two miles downstream from the original structure, resulted in a navigation pool raise that has impacted the levee foundation. It is unknown when this issue developed; however, it appears to have persisted for a significant length of time. Additionally, the degree of deterioration of the levee foundation is unknown. Consequently, the Wood River Levee is at unacceptable risk during a high water event.

As a function of this investigation, which utilized current engineering standards, the original design intent was compared to existing conditions, all identified problems were categorized, and design deficiencies were identified. The goal of the study is to evaluate levee underseepage conditions and determine the federal interest in addressing problems in the Wood River Levee that are a direct result of Melvin Price Locks and Dam navigation pool.

3. LOCATION OF PROJECT / CONGRESSIONAL DISTRICT

The Melvin Price Lock and Dam is located 21 miles north of St. Louis, Missouri, and two miles below Alton, Illinois, between the mouths of the Missouri River and the Illinois River. Specifically, the structure is located in Madison County, Illinois, and St. Charles County, Missouri, on the Upper Mississippi River at mile 200.78.

The Wood River Levee system includes two flank levees along Wood River effectively creating two sub-systems known as Upper Wood River and Lower Wood River. This decision document is focused on a section of the Upper Wood River levee from project station 0+00 to 115+00. This area is located opposite the permanent navigation pool for the Melvin Price Locks and Dam. A map of the study area can be seen in Figure 3.1. Figures 3.2 and 3.3 are photographs showing the spatial relationships between the Melvin Price Locks and Dam, the Wood River Levee, and the areas of underseepage concern.

The study area is located in the Illinois 12th District, which is currently held by Congressman Jerry Costello.

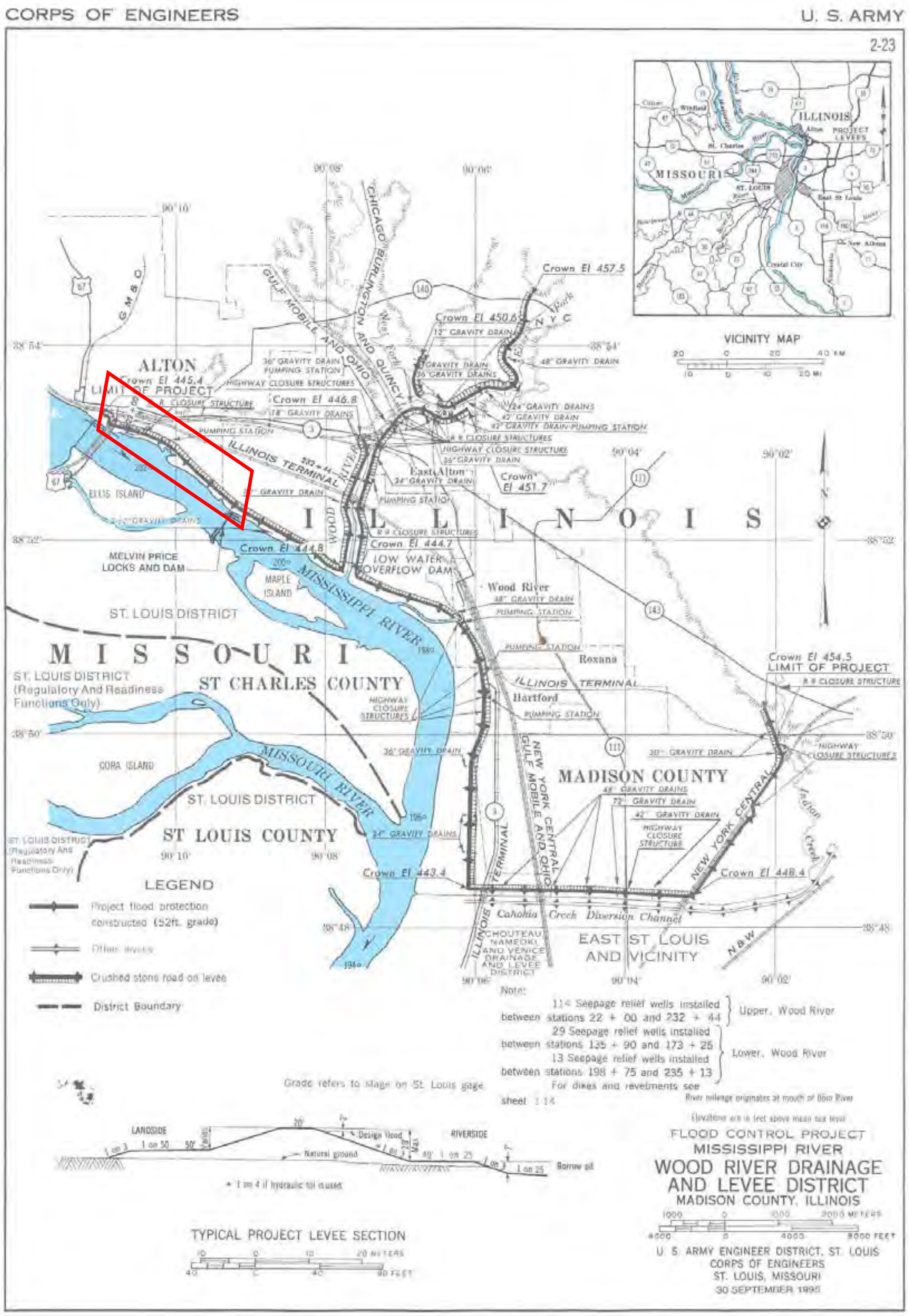

Figure 3.1 - Map of the Study Area

Figure 3.2 - Photograph of the Study Area

Figure 3.3 - Aerial Photograph Showing the Areas of Seepage Concern

4. DISCUSSION OF PRIOR STUDIES, REPORTS, AND RELATED WATER PROJECTS

4.1 Relevant Project Authorizations

4.1.1 Lock and Dam 26 Authorization. Lock and Dam 26 was authorized by the River and Harbor Act of 3 July 1930, as amended, as part of the 9-foot navigation project for the Upper Mississippi River.

4.1.2 Wood River Levee Authorization. The Wood River Levee project was authorized by the Flood Control Act of 28 June 1938, Flood Control Committee Document No. 1, 75^{th} Congress, First Session, to provide flood risk reduction to urban, agricultural and industrial areas.

UPPER MISSISSIPPI RIVER BASIN

> "The general comprehensive plan for flood control and other purposes in the Upper Mississippi River Basin, described in Flood Control Committee Document Numbered 1, Seventy-fifth Congress, first session, with such modifications thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable, is approved and there is hereby authorized $6,600,000 for reservoirs and $2,700,000 for local flood-protection works on the Upper Mississippi and Illinois Rivers; the reservoirs and local protection projects to be selected and approved by the Chief of Engineers: *Provided*, that this authorization shall include the enlargement and extension of a system of levees located on the south side of the Sangamon River east of the town of Chandlerville, Illinois, as set forth in House Document Numbered 604, Seventy-fifth Congress, third session."

4.1.3 Melvin Price Lock and Dam Authorization (Lock and Dam 26 Replacement). The Melvin Price Lock and Dam project was authorized by the Internal Revenue Code of 1954, as amended by Public Law 95-502, Title I - Replacement of Locks and Dam 26; Upper Mississippi River System Comprehensive Master Management Plan, October 21, 1978.

> "Section 102 (a). The Secretary of the Army, acting through the Chief of Engineers, is authorized to replace locks and dam 26, Mississippi River, Alton, Illinois, and Missouri, by constructing a new dam and a single, one-hundred-and-ten-foot by one-thousand-two-hundred-foot lock at a location approximately two miles downstream from the existing dam, substantially in accordance with the recommendations of the Chief of Engineers in his report on such project dated July 31, 1976, at an estimated cost of $421,000,000."

Public Law 99-662 dated November 17, 1986 (WRDA 1986) authorized the construction of the second lock at Melvin Price Lock and Dam. The second lock shall be one-hundred-and-ten feet by six-hundred feet. Public Law 102-580 dated October 31, 1992 (WRDA 1992) provided authority to construct the visitor center at the Melvin Price Locks and Dam.

4.2 Prior Studies and Reports

4.2.1 Design Memorandum No. 16 Wood River Drainage and Levee District Alteration, March 1985. This design memorandum documents changes required to the Upper Wood River Levee System resulting from the Lock and Dam No. 26 (Replacement), Mississippi River.

4.3 Related Water Projects

4.3.1 Wood River Levee Related Projects

There are three separate post-authorization reports addressing underseepage design deficiency corrections in the Upper Wood River Levee: (1) work approved in the 2007 Wood River General Reevaluation Report (GRR) underway from station 38+90 to 55+00 and 126+00 to 234+00; (2) work approved in the 2011 Wood River Limited Reevaluation Report (LRR) extending from station 0+00 to 38+90; and (3) The Mel Price Lock and Dam LRR extending from station 55+00 to 126+00 (this report).

In June 2007, the GRR for the Wood River Levee System was approved and the project was authorized by Title I, Section 1001, of the Water Resources Development Act of 2007 (Public Law 110-114). The report addressed both underseepage deficiency correction (new and replacement relief wells) and reconstruction of several project features (gravity drains, closure structures, and pump stations). For that report, underseepage analysis was based on existing geotechnical data. Based on that information and analysis, the GRR recommended replacing 163 existing relief wells and constructing 60 additional relief wells to address the design deficiency concerns. The area between Upper Wood River stations 55+00 and 126+00 (the subject of this LRR) was identified to need 86 new relief wells due to design deficiency underseepage concerns.

During the Plans and Specifications phase of development for the deficiency correction identified in the GRR, extensive subsurface investigation was performed. The underseepage analysis based on this new geotechnical information altered the recommended alternative for the design deficiency correction portion of the study, especially in the south flank area of the Lower Wood River Reach. The Wood River Levee System Design Deficiency Corrections Limited Reevaluation Report was approved in August 2011 and addresses these underseepage design deficiencies in the Wood River levee system. However, that report did not include the area between Upper Wood River stations 55+00 and 126+00.

The uncontrolled underseepage in this area adjacent to and upstream of the Locks and Dam was discovered in July 2009 while working on the Wood River Design Deficiency Correction project (work recommended by the GRR). By direct observation and a study of the design documentation associated with the construction of the Melvin Price Locks and Dam, the St. Louis District concludes that the uncontrolled seepage in this reach is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam and the deficiencies in the design for the relief wells installed at that time.

Although deficiency corrections in the Upper Wood River area are being addressed in separate reports, they are contingent upon one another to provide protection to the same general protected area. Table 4.1 below provides a comprehensive overview of the project including features recommended in this report along with those addressed in other reports, their location, which report they are addressed by, and the status of the report.

Levee Station	Features	Report	Status
0+00 to 38+90	2,875 linear feet of cutoff wall	Wood River LRR	Approved.
38+90 to 55+00	20 Relief Wells	Wood River GRR	Approved, construction contracts awarded
55+00 to 126+00	Not yet approved.	Mel Price LRR	Not yet approved
126+00 to 234+00	53 relief wells	Wood River GRR	Approved, construction contracts awarded

Table 4.2 - Upper Wood River Underseepage Correction Features by Reach

4.3.2 Federal Emergency Management Agency (FEMA) Accreditation. The Wood River levee has an overall levee grade of a 97% chance of passing the 0.2% chance exceedance event on the Mississippi River. However, the levee has significant underseepage problems that does not allow the levee system to meet requirements for FEMA accreditation. FEMA requires a professional engineer's certification to maintain accreditation; otherwise, after a period of time for public input and map preparation, FEMA will revise the Flood Insurance Rate Maps and change the designation of the areas behind the levees from protected areas to flood hazard areas. Loss of accreditation would negatively impact property values and flood insurance rates will increase dramatically if the area is designated a flood hazard area.

The nearby East St. Louis, Chain of Rocks, and Prairie du Pont and Fish Lake levee systems also have similar underseepage problems and share the concerns of the Wood River levee system. There is tremendous interest in the communities and region to complete the work that will allow certification by a professional engineer before FEMA changes the floodplain designations. The three counties in the Metro East area (Madison, St. Clair and Monroe counties) have formed flood prevention districts and passed sales taxes to generate revenues for levee improvements. The flood prevention districts of the three counties have formed the Southwestern Illinois Flood Prevention District Council. This council has hired an engineering firm to design the improvements needed to allow the East St. Louis, Wood River, and Prairie Du Pont/Fish Lake levees to be certified for a 0.1% or 100-year level of protection. The engineering firm has accomplished approximately 60% of the necessary designs and has submitted them to the St. Louis District for review as part of a Section 408 (Modifications and Alterations of Corps of Engineers Project) request.. The council plans to accomplish the necessary construction and then seek an engineering firm to certify these levee systems for a 100-year flood.

4.3.3 Levee Safety Action Classification. The underseepage concerns related to the Mel Price pool are being addressed in the Upper Wood River Levee safety screening. In mid-November 2011, a national team will provide comments on the screening and recommend a Levee Safety Action Classification (LSAC) for the levee system. After comments and recommendations have been incorporated, the screening will be presented to the Levee Senior Oversight Group, who will assign the final LSAC rating. This presentation is anticipated to occur in March of 2012.

5. PLAN FORMULATION

5.1 Project Background

Construction of Lock and Dam 26 at approximately Mississippi River Mile 203 was completed as part of the nine-foot navigation channel project for the Upper Mississippi River. Construction was completed and full pool was reached in 1938.

The original underseepage analysis of the Wood River Levee system was completed in October 1956 and is presented in the Corps' Technical Manual 3-430, "*Investigation of Underseepage Alton to Gale, Illinois*". This analysis looked solely at the underseepage regime created by the maximum flood height that corresponded to the urban flood elevation (52-feet on the St. Louis gage plus 2-feet). The 1956 analyses predicted the need for positive seepage controls for the design flood height. These positive seepage controls were to be installed at various locations throughout the project. The analyses recommended installation of relief wells at various spacing throughout the levee system resulting in the installation of 170 relief wells in the early 1960s. This original analysis did not take into account the impacts of the new Melvin Price Locks and Dam since the new Locks and Dam was not planned at that time.

Construction of the Wood River Levee system was initiated in 1949. The original levee construction consisted of either a hydraulically-placed sand core covered with clay or an earthen levee constructed of materials obtained from adjacent borrow pits, depending on the location and availability of construction materials. Subsequent levee improvements in 1956 included the addition of a clay riverside enlargement with an attendant levee raise.

In 1954, Congress authorized the replacement of Lock and Dam 26, which would later be re-named the Melvin Price Locks and Dam. Construction was completed in 1989 and Lock and Dam 26 was removed in 1991. Normal pool elevation is 419 feet NGVD (all elevations in the report correspond to the National Geodetic Vertical Datum (NGVD)).

In the years between the construction of the Wood River Levee and the completion of the Melvin Price Lock and Dam (1989), the portion of the Upper Wood River levee between Mississippi River miles 203 to 200.8 was located within the tailwater (downstream) of Lock and Dam #26. Following completion of the Melvin Price Locks and Dam at river mile 200.8 (2.2 miles downstream of the original LD #26) and the subsequent raising of the navigation pool in 1989, the 2.2-mile length of the Wood River levee (between project station 0+00 to 115+00) was now located opposite the permanent navigation pool of the new lock and dam. Anticipating negative impacts of the new navigation pool on the Upper Wood River Drainage and Levee District, the St. Louis District produced Design Memorandum (DM) #16 (March 1985) for Lock and Dam 26 Replacement entitled "*Wood River Drainage and Levee District Alteration*".

Paragraph 1-01 “PURPOSE AND SCOPE” of the DM states:

> “This Feature Design Memorandum (FDM) presents the proposed plan of remedial action for alteration, relocation, and protection of the Wood River Drainage and Levee District (WRD & LD) that will be affected by the new segment of Navigation Pool 26. The pool will permanently raise the water level against the existing levee thus increasing the water seepage into the protected area. The proposed plan includes the alteration to the existing drainage ditch and relief wells, relocation and increase in size of the Alton Pump Station, and the protection to the existing levee.”

This DM presents the results of Geotechnical, Hydraulic, Architectural, Structural, Civil, Mechanical, Electrical, Cost Estimate, Scheduling, and Real Estate studies as well as an Attorney’s Report. Section II, Levee Seepage and Stability, of DM16 presents the results of Geotechnical Studies related to the changes in pool conditions. This section presents the results of additional seepage analyses completed between approximate project stations 32+00 to 80+00. These analyses recommended the need to lower the flow-line elevation of 22 relief wells to provide additional seepage control in order to prevent negative impacts on the landside Owens Corning Glass facilities. No additional seepage analyses were completed between project stations 80+00 and 114+00 (the Mel Price centerline) and between project stations 114+00 and station 143+00 (just below the pumping station). In this reach, CEMVS only completed studies to determine the increased seepage flow rates into the levee district due to the change in pool conditions. This was done by simply pro-rating the flows calculated by the 1956 seepage analysis for differential heads resulting from various combinations of Melvin Price pool and landside ponding elevations. These results were used to support the final design of the necessary pumping capacity.

Comparisons of the 1985 seepage analyses with current observations indicate that the 1985 results are incorrect. For instance, in the 1985 analysis for the daily case of Melvin Price pool at elevation 419 (normal pool) and the landside ponding elevation of 406, the DM suggests average flow rates of 280 gallons per minute (gpm) per each of 37 existing wells between project station 32+00 and 80+00 and average flow rates of 135 gpm for each of 39 existing wells between project stations 80+00 and 114+00. In fact, recent observations of these existing wells at the stated conditions revealed essentially zero flow from any of the wells. In fact, recent observations of these existing wells at the stated conditions revealed the static groundwater elevation 4 to 6-feet below the well flowline. This indicates that the existing relief wells were designed and installed too high to function as intended. Had the St. Louis District completed additional seepage analyses of the reach between project stations 80+00 and 114+00, especially for the condition of normal pool and landside ponding at elevation 406, the critical nature of the current situation would have been discovered, and the necessary controls would have been constructed at that time.

Because the current underseepage concerns are the result of incorrect seepage analyses conducted for the Melvin Price Locks and Dam project, they are design deficiencies for that project. The underseepage concerns are not the result of any changed site conditions associated with the Wood River Levee project.

5.2 Existing Conditions

5.2.1 Project Description. The Melvin Price Locks and Dam project includes one 1,200-foot main lock, one 600-foot auxiliary lock, a dam with nine tainter gates, an overflow dike, and a visitors center. Mitigation lands were provided to compensate for wildlife losses due to creation of a new pool for the two-mile distance downstream of the original structure. The Melvin Price Locks and Dam was constructed at river mile 200.8 and is 2.2 miles downstream from the original Lock and Dam No. 26. The permanent navigation pool is now located adjacent to the Wood River Levee from levee stationing 0+00 to 115+00. The primary flood-related problem in the project area is the uncontrolled underseepage located in this section of the levee system.

The Wood River Flood Risk Reduction Project consists of levee, gravity drainage structures, closure structures at railroad and highway crossings, pump stations, seepage control measures, and a low-water dam at the mouth of Wood River. The project as intended provides protection against a 54-foot Mississippi River stage on the St. Louis Gage (52-foot design flood plus 2 feet of freeboard). In addition to providing protection to the land side area, the levee structure is a part of the containment features for the Melvin Price Locks and Dam Project.

5.2.2 Annual Operation and Maintenance. The Operations and Maintenance (O&M) for the Melvin Price Lock and Dam Project is 100 percent federally funded and is carried out by the U.S. Army Corps of Engineers utilizing appropriated funds. Although a portion of the Wood River levee functions as part of the containment features for the Melvin Price Locks and Dam project, the maintenance of that levee is entirely a non-federal responsibility.

The Wood River Drainage and Levee District is responsible for operating and maintaining the Wood River Levee system. Over the past 10 years, the Wood River Drainage and Levee District has averaged approximately $451,000 annually on the operation and maintenance. Inspection records kept by the St. Louis District and dating back to 1985 indicate that Wood River has achieved an acceptable or higher rating for the levee system with the exception of four inspections out of eighteen. A minimum acceptable rating was received four times, the first in 2002, but corrective measures were taken each time to fix identified deficiencies.

5.2.3 General System Conditions. Uncontrolled underseepage and conveyance of material is occurring under the Wood River Levee in an area adjacent to the pool of Melvin Price Locks and Dam. The uncontrolled underseepage occurs during normal operating conditions. In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The problem was not previously discovered during a regular levee inspection because the observation area is not within the footprint of regular inspections. Additionally, regular levee inspections are more often conducted during normal or low river stages. When river stages are high, this area is normally covered by several feet of water. During the flood of 1993, the area adjacent to the pool of Melvin Price Locks and Dam was kept flooded by the Wood River Drainage and Levee district per its established operation plan. The interior ponding was to an elevation no lower than about elevation 410. This interior water prevented the flood fight teams from noticing or observing any seepage activity in the area. Subsequent observation made by the St. Louis District during non-flood conditions showed uncontrolled underseepage and sand being transported from the flow channels at differential heads exceeding 12 feet.

5.2.3.1 Existing Interior Drainage. The area landside of the levee between project stations 0+00 and 115+00 is drained by a drainage ditch that parallels the levee centerline and is located 100 to 500-feet landside of the landside levee toe. This ditch begins at the City of Alton's Combined Sewer Outlet (CSO) and ends at the Alton Pumping Station. Fifty-four inch diameter gravity drain structures in the Alton Pump Station provide drainage to the Mississippi River when Melvin Price tailwater elevations are at/below elevation 405. When the gravity drains are closed, the levee district activates the Alton pumping station as necessary to control the landside ponding elevation.

Currently, a 30-inch main sewer line captures low flows at the city's two CSO outlets and diverts the effluent to the Alton wastewater treatment plant. These low flows backup behind a weir in the CSO and enter the 30-inch main. The top of the weir at the Central Avenue CSO is at elevation 410.7. The top of the weir at the Shields Valley CSO is at elevation 413.8. With local rainwater events, the runoff and wastewater mixture overflows the weirs, enters the drainage ditch, and flows from the CSO outlet to the Mississippi River via pumping station.

5.2.3.2 Underseepage and Sand Boils. During a data gathering mission in July of 2009, St. Louis District (CEMVS) geotechnical engineers discovered large expanses of very soft areas and numerous points of uncontrolled seepage landside of the Upper Wood River levee. These soft areas and seeps exist from the centerline of the Melvin Price Locks and Dam and extend upstream approximately 6,500-feet. At the time of initial discovery, the navigation pool was at elevation 419 and the landside ponding was at elevation 402.9. Heavy seepage was observed, but no sand movement was noticed. During the months of August, September, and October, CEMVS geotechnical engineers made weekly trips to the site to monitor for changes in seepage rates or the movement of sand. Fortunately, no changes were observed. On November 3, 2009; however, the observers found active sand boils with open-river at elevation 421.9 and the landside ponding elevation of 409. The difference between the interior water surface elevation and the exterior water surface elevation was 12.9 feet. There was 8 to 12 inches of water covering the sand boils. On November 4, 2009, the observers saw heavy flow from the boils, but no active sand movement. Regular monitoring is on-going to observe any changes on site. Due to the critical nature of the underseepage problem, a Melvin Price Wood River Underseepage Operation Plan was developed to describe the steps that would be taken to combat uncontrolled underseepage until a permanent solution could be implemented. The monitoring is in accordance with the current operation plan.

5.2.3.3 Instrumentation. CEMVS contracted in 2009 for the installation of two new piezometer ranges in the seepage area. The two piezometric ranges (four piezometers per range) were located in those areas that exhibited the most critical seepage conditions. A third piezometer range (with two additional piezometers) was added in 2010 near station 69+70. The data obtained from these piezometers has been used to supplement direct observations and calibrate the numerical seepage models. Instrumentation and cabling was added to these piezometers to allow collection of ground water levels in the coarse grained aquifer underlying the seepage areas. The piezometric instruments were programmed to obtain and store a reading every 4-hours. The data are collected on a weekly basis and can be collected more frequently as necessary. The locations of the ten piezometers can be seen in Figure 5.1.

5.2.3.4 Interim Risk Reduction Measures. Temporary measures were constructed in 2010 to help control the underseepage issues. Operational changes were implemented at the pump station to create higher ponding levels in order to counterbalance the pressure of water from the Mississippi River. Below is a status of the temporary measures in place:

- One manhole and two PVC shut-off valves were raised at City Pump Station.
- Dike A was constructed downstream of the Central Avenue CSO.
- Dike B was constructed downstream of the Shields Valley CSO.

The dikes were constructed to elevation 415.0 and contain 48-inch sluice gates. Both dikes also contain a 10-foot long “notch” at elevation 412.0 to limit damage to the structures caused by significant rain events. The dikes prevent the higher ponding levels, up to elevation 415.0, from impacting normal CSO operations. The locations of Dikes A and B can be seen in Figure 5.2.

Finally, the operation plan outlines the actions to be taken based on tail water gage readings at Melvin Price Locks and Dam. The necessary interim control measures range from weekly monitoring when at normal pool up to pumping of relief wells for tailwater gage readings approaching 40.52. Water control, emergency operations, engineering, project management, and personnel from the Rivers Project office are actively involved in monitoring the tail water readings on a daily basis to determine if additional measures need to be taken in accordance with the approved operations plan. The operations plan is provided in Section 5 of Appendix A.

A third dike, Dike C, was constructed to elevation 410 and is located south of Cut Road near Dike B. The dike is hydraulically transparent and was built to serve as a base on which to augment with rock to allow ponding up to elevation 420, when required. Its use, however, is not currently anticipated in accordance with the operation plan.

Figure 5.1 – Piezometer Locations
(Relief wells not shown for clarity)

Figure 5.2 – Locations of CSO Structures and Temporary Dikes A & B

5.2.4 General Conditions of the Protected Area

5.2.4.1 Geotechnical Setting. The geotechnical setting of the Wood River Drainage and Levee District can be conveniently treated by separate consideration of the bluff area bordering the east side of the Mississippi Valley and the valley flood plain. The bluffs are as high as 650 feet above sea level. The floodplain is characterized by ridge and swale topography, with a maximum natural relief of approximately 30 feet (elevations ranging from 435 to 405).

The line of bluffs that more or less define the eastern boundary of the levee district consist of relatively soft shales and sandstones. However, bedrock is not exposed as the bluffs are mantled with deposits of glacial drift overlain with loess. The drift is commonly an unsorted deposit of pebbly clay, very plastic clay, sandy clay, and occasional lenses of sand or gravelly sand. The loess that blankets the summit and faces of the bluffs consists of windblown silts and lean clays locally 50 feet or more in thickness. Adjacent to the bluffs are a series of sand and gravel deposits forming terraces which stand an average of 30 feet above the level of the surrounding plain. These terraces are remnants of an aggraded fill resulting from glacial melt water deposits.

Wood River, a tributary of the Mississippi River, divides just west of East Alton and the valleys of the two forks are coincident with the Mississippi flood plain for several miles upstream. The deepest part of the bedrock surface ranges in depth from 160 to 170 feet beneath the valley fill with an average thickness of 130 feet of overlying alluvial deposits. Immediately above the bedrock surface is a stratum consisting of coarse gravels and sands with occasional boulders. Overlying this stratum is a thick section of medium to fine sands. The surface deposits are complex and varied as they resulted from filled lakes and swamps, abandoned meander loops, and flood water deposition. The materials range from heavy plastic clays to fine sands. In addition, industrial waste and artificial deposits are also found as part of the surface deposits.

5.2.4.2 Climate and Weather. The Project area is adjacent to the Mississippi River and approximately 21 miles upstream from the City of St. Louis. It sits upstream from the confluence of the Missouri and Mississippi rivers, but downstream from the confluence of the Illinois and Mississippi rivers. The project area is also near the geographical center of the United States. Because of its central U.S. location, St. Louis feels the effects of warm moist air moving north from the Gulf of Mexico and the cold air masses moving south from Canada. The conflict along the frontal zones of these invading air masses provides a variety of weather conditions.

Winters are brisk with temperatures dropping to zero or below generally only two or three days per year. The record low temperature at the current weather station site is -18 degrees Fahrenheit (F), occurring in January 1985, although temperatures as low as -22 degrees F have been measured at other area sites. Snowfall averages about 20 inches per season. Daily temperatures of 32 degrees or less occur less than 25 days per year, while temperatures of 90 degrees F or higher occur about 35-40 days a year. The record high temperature for the area is 115 degrees F, occurring in July 1954. Temperatures exceeding 100 degrees F occur every other year generally, although some years may see 15 or more days with temperatures exceeding 100 degrees F. The prevailing wind direction is from the south for May through November and from the northwest for December through April.

Precipitation averages about 36 inches per year. The winter months are the driest while the months of May through July are the wettest. Rainfall can be severe at times with as much as eight inches of rain recorded in a 24-hour period in 1996. Thunderstorms occur between 40 and 50 days per year, with a few being severe, causing hail and damaging winds. Tornadoes have produced damage and loss of life in the St. Louis area. Climatological data for the area are summarized in Table 5-1. Data were collected at the National Weather Service meteorological station at Lambert-St. Louis International Airport.

An important condition affecting precipitation in the Project area is the St. Louis urban effect. Studies by the Illinois State Water Survey have shown substantial increases in rainfall downwind of the City of St. Louis. The increases tend to be the largest in relatively heavy rainstorms and most pronounced in spring and summer when most of the large rainstorms occur.

Month	**Temperature (°F)**			**Precipitation Average (IN)**	**Wind Velocity (MPH)**	**Wind Direction**
	Average Daily		**Average Monthly**			
	Min	**Max**	**Mean**			
January	19.9	37.6	28.8	1.90	10.6	NW
February	24.5	43.1	33.8	2.14	10.8	NW
March	33.0	53.4	43.2	3.36	11.8	WNW
April	45.1	67.1	56.1	3.63	11.4	WNW
May	54.7	76.4	65.6	3.93	9.5	S
June	64.3	85.2	74.8	3.78	8.8	S
July	68.8	89.0	78.9	3.99	8.0	S
August	66.6	87.4	77.0	2.78	7.6	S
September	58.6	80.7	69.7	2.85	8.1	S
October	46.7	69.1	57.9	2.77	8.9	S
November	35.1	54.0	44.6	3.13	10.1	S
December	25.7	42.6	34.2	2.54	10.4	WNW
Annual	**45.3**	**65.5**	**55.4**	**36.66**	**9.7**	**S**

Table 5.1 - Climatological Data for St. Louis, Missouri

Source: NOAA 1992, Local Climatological Data of St. Louis, Missouri, and NWS 1995, St. Louis WSCMO AP, St. Louis County, Missouri.

5.2.4.3 Hydrology and Hydraulic Conditions. The Wood River Levee project is intended to provide protection against a 52 foot Mississippi River stage on the St. Louis Gage, which has a current expected frequency of greater than 500 years. For the design flow of 1,300,000 cubic feet per second (cfs), the height of protection is based upon confinement by industrial and urban area projects with a design flood profile having a flow-line elevation of 443.4 feet NGVD at the upper end (opposite river-mile 202.7); elevation 442.7 feet NGVD at the mouth of Wood River; and elevation 441.4 feet NGVD at the lower end (Cahokia Creek Diversion Channel) of the District. Levee grade freeboard is 2 feet above water surface profile by design. The flood of record occurred during the summer of 1993 when the St. Louis gage recorded 49.58 feet. River elevations were above flood stage from 3 April to 7 October 1993. Peak flow was estimated at 1,080,000 cfs. The frequency of that event was 380 years. The project endured two other significant flood events; 43.3 feet on the St. Louis gage in 1973, and 41.9 feet on the St. Louis gage in 1995. For the flank levees, a net grade equal to the main stem design flood elevation plus 2-foot freeboard was projected back along the tributaries. The interior drainage system relies on two methods of conveyance, open drainage ditches and combined sewers. Only two of the seven pump stations are fed by open drainage ditches. Sewer fed pump stations must pump effluent irrespective of interior rainfall events whenever gravity flow is impeded by high river stages.

5.2.4.4 Hazardous, Toxic and Radiological Waste Conditions. As a result of the nature of the industries that have dominated the riverfront area, a number of sites inside the lower Wood River levee system are in the State Site Remediation Program including, Explorer Pipeline Company, Koch Pipeline Company, The Premcor Refining Group, Inc., Clark Oil Refinery, and Shell Oil Company. Resource Conservation and Recovery Act (RCRA) sites include BP, Conoco-Phillips, and Olin Corporation. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund sites in the area include Laclede Steel Company, Clark Oil Refinery, Owens Illinois Inc, and Chemetco. These combined sites occupy thousands of acres of the floodplain with Shell Oil being the largest with 2,220 acres. However, no RCRA or CERCLA sites are located in the upper Wood River levee system near the project site.

5.2.4.5 National Security Considerations. The Conoco-Phillips facility produces defense grade fuels including some 1,500,000 gallons per day of jet fuel. The Winchester Division of the Olin Corporation supports munitions production for the Defense Department and law enforcement agencies across the nation, while the Brass Division provides copper and copper alloy strip used to support a variety of industrial purposes as well as the U.S. Mint. These facilities, however, are located in the lower Wood River Levee system and thus are not near the project site.

5.2.5 Existing Economic Conditions. A risk-based economic analysis was completed for the study area in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance, using the National Economic Development Procedures Manual for Urban Flood Damage, prepared by the Water Resources Support Center, Institute for Water Resources, as a reference. A copy of this analysis is contained in the Economics Appendix. Table 5.1 shows the number and average structural value of residential, commercial, and industrial buildings inventoried for the Upper Wood River Levee area and their average values. The values were originally estimated for the Wood River Levee System General Reevaluatoin Report (March 2007) and were in 2006 price levels. Those values were escalated to 2011 price levels using the Corps of Engineers' Civil Works Construction Cost Index System (CWCCIS).

<table>
<tr><th colspan="6">Melvin Price - Wood River Underseepage
Design Deficiency Project
Structure Inventory</th></tr>
<tr><th>Area</th><th>Building Category</th><th>Number of Buildings</th><th>Average Value of Buildings ($) (2006)</th><th>CWCCIS Factor ** 19 Buildings</th><th>Average Value of Buildings ($) (2011)</th></tr>
<tr><td rowspan="4">Upper Wood River</td><td>Residential</td><td>0</td><td>$0</td><td rowspan="4">1.1417</td><td>$0</td></tr>
<tr><td>Commercial</td><td>59</td><td>$1,675,980</td><td>$1,913,531</td></tr>
<tr><td>Industrial</td><td>29</td><td>$7,631,884</td><td>$8,713,615</td></tr>
<tr><td>Total</td><td>88</td><td>n /a</td><td>n /a</td></tr>
<tr><td colspan="6">* Total structural value of residential, commercial, and industrial buildings inventoried in the study area is approximately $365 million.
** Index Q2-2006: 638.50
** Index Q3-2011: 729.00</td></tr>
</table>

Table 5.2 - Upper Wood River Structure Inventory

5.2.5.1 Socio-Economics. The Wood River levee area has a population of approximately 23,106, of which some 9,930 are employed. The following three tables (5.3, 5.4 and 5.5), taken from the 2000 U.S. Bureau of Census, provide an overview of the area's economic character.

Occupation	Number	Percentage
Management, professional	2,140	22
Service occupation	1,953	20
Sales and office occupation	2,731	28
Farming, fishing and forestry	11	---
Construction, extraction, and maintenance	1,054	10
Production, transportation and material moving	2,041	20
Total	**9,930**	**100**

Table 5.3 - Wood River Levee Area Occupations

The project area average median household income (Table 5.4) is below that of both Madison County and the State by 31.6% and 39.0% respectively.

Community	Median Household Income
East Alton	$28,404
Madison County	$41,541
State of Illinois	$46,590

Table 5.4 – Upper Wood River Levee Area Median Household Income

Approximately 16% of the Wood River levee system area's population is over 65 years of age compared to the State average of 12% and Madison County average of 14%. The following (Table 5.5) are retirement mean incomes as reported by the U.S. Bureau of Census. The project area average of $11,560 is 28.3% and 31.1% below the mean for Madison County and the State, respectively.

Community	Mean Retirement Income
East Alton	$11,560
Madison County	$16,117
State of Illinois	$16,770

Table 5.5 – Upper Wood River Levee Area Retirement Mean Incomes

5.3 Future Without Project Conditions.

Because both the 2007 GRR and the 2011 LRR are approved and construction is authorized, for the Future Without Project Condition the study team assumed that the actions recommended by those two reports (exclusive of the GRR recommendations for the area between Upper Wood River stations 55+00 and 126+00) would be implemented.

5.3.1 Consequences of Levee Failure. The probability that the project will fail will continue to increase as time passes. As the underseepage and associated removal of foundation material continues to deteriorate the levee foundation, the levee's ability to operate as intended becomes a greater concern. A levee failure would cause interior flooding that would likely impact industries, infrastructure, and transportation systems. Loss of life would be another potential consequence, especially considering the urban nature of this system. Figure 5.3 shows the area that would be inundated by a 1% or 100-year flood event if the Upper Wood River levee were to fail. The 1% flood is elevation 435 so all areas except those in red would be inundated.

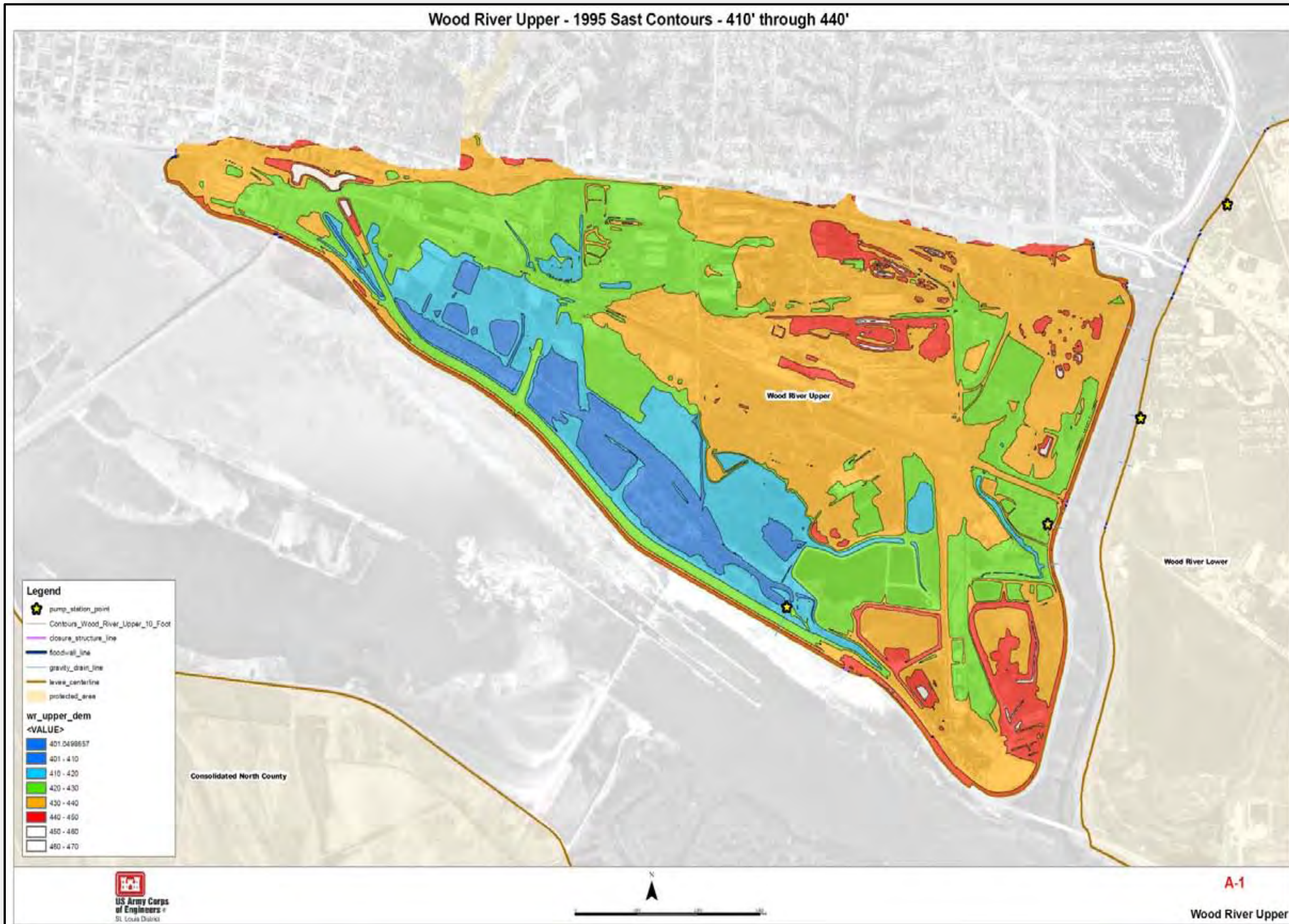

Figure 5.3 – Areas Inundated by the 100-year Flood Event with Levee Failure

Depending on the level and type of failure experienced, there is also a potential for the loss of pool at Melvin Price Locks and Dam resulting in a stoppage of river navigation. An initial levee breach would likely only delay navigation for three days as the pool equalized with the main river. The more significant risk lies in the fact that the lower flank levee along Wood River was not designed to keep water in, or maintain pool. If the Upper Wood River area were to fill with water, the pressure on the lower flank levee may create an opportunity for a failure below Melvin Price Locks and Dam. This lower flank failure could effectively create a side channel around the dam, causing a loss of pool and the complete loss of navigation until a coffer dam could be constructed to allow the levee to be repaired. The estimated time to construct the coffer dam is 12 months. Additional discussion of the construction timeline can be found in the Engineering Appendix. Loss of the navigation pool at the Melvin Price Locks and Dam would stop the movement of goods on the Upper Mississippi River System between St. Louis and St. Paul and Chicago.

5.3.2 Economic Future Without Project.

Structure Damage

In order to calculate the damages from the inundation of structures, their contents, and vehicles that would occur at each river stage, three relationships were developed for this analysis: depth-damage relationships, stage-frequency relationships, and levee system failure probabilities. The depth-damage (or stage-damage) relationship is the amount of damage that will occur to structures, their contents, and vehicles as the elevation of the water or stage rises. The stage-damage relationship for the Upper Wood River area is displayed in Table 5.6. The stage-frequency relationship is the probability of the water stages reaching various levels for each hydrologic reach.

Stage-Damage Relationships for the Upper Wood River Levee System (Without Project Condition)							
Exceedance		Damage by Category ($000)					
Probability	Stage	Residential	Auto	Commercial	Industrial	Public	Total
0.25	424.0	0	2	87	17	0	106
0.1	427.0	0	93	32,908	847	0	33,848
0.05	430.0	0	399	74,850	2,437	0	77,685
0.02	434.0	0	645	86,367	4,125	0	91,137
0.01	436.0	0	1,412	117,255	5,633	0	124,299
0.005	438.0	0	2,327	137,040	13,659	0	153,026
0.004	439.0	0	2,435	142,634	21,957	0	167,027
0.002	441.0	0	2,460	155,222	39,056	0	196,738

* HEC-FDA output
** In 2008 a 10-year event triggered the Emergency Operations Plan at Mel Price which currently operates 12 months of the year at stages beginning at normal pool (elevation 419 feet). Using the technique of proportionally reducing the PUPs to eliminate double counting, the HEC-FDA program indicates there is no economic benefit for a 10 year event. Without the Emergency Operations Plan (involves pumping and maintaining a landside pond) the underseepage would be completely without control and would likely result in much higher economic damages than for below a 10-year event.

Table 5.6 - Upper Wood River Stage-Damage Relationships

Probability of Unsatisfactory Performance

The purpose of identifying Probability of Unsatisfactory Performance (PUP) data is to generate a range of water surface elevations for the Wood River underseepage for which it is presumed that the probability of levee failure increases as water surface elevation increases. The requirement that, as the water surface elevation increases the probability of failure increases, incorporates the reasonable assumption that as the levee becomes more stressed, the levee is more likely to fail. These PUP calculations indicate the formation of sand boils which lead to an increased risk of failure. The District geotechnical branch calculated PUPs due to underseepage for the Upper Wood River area and the relationship between river stage and the PUP for the future without project condition can be seen in Table 5.7. Additional discussion of the PUP development can be found in the Engineering Appendix.

Probability of Unsatisfactory Performance (PUP) for Wood River Levee System (Without Project Condition)	
Exterior Stage	Levee System PUP*
420.7	0.38
425.7	0.44
427.8	0.54
430.3	0.60
442.9	0.64
443.8	1.00
PUP is Probability of Unsatisfactory Performance; i.e. a probability of failure at that return period/water surface elevation	

Table 5.7 - Upper Wood River Probability of Unsatisfactory Performance (Without Project Condition)

Navigation
As can be seen in Table 5.7, the calculated Probability of Unsatisfactory Performance is greater than 50% at river elevation 427.8. This roughly corresponds to an event slightly greater than a 10-year event. If the flank levee were also to fail, a 12-month closure to navigation could be expected at an economic cost of over $1 billion.

Operations Plan
An Operations Plan is in place to reduce the risk and ensure the levee will remain safely intact until the completion of the permanent construction tentatively selected in this report. The operation plan outlines the incremental actions to be taken based on tail water gage readings at Melvin Price Locks and Dam. This plan has real, ongoing, annual costs beginning with river elevations of 419 feet (normal pool) up to 436 feet, which is equivalent to the 100-year event. At lower river elevations near normal pool, increased ponding and monitoring are sufficient. Each increment requires increased landside ponding up to a maximum elevation of 415. Above river elevation 421, the required ponding level necessitates by-pass pumping at Dike A and the installation of relief well standpipes. Above river elevation 424, the required ponding level necessitates additional by-pass pumping at Dike B. Above river elevation 426, no further ponding is possible, so the Operations Plan calls for air-lift pumping of relief wells in order to maintain an acceptable differential head. Above river elevation 431, the air-lift pumping transitions to electrical submersible pumps in order to maintain an acceptable differential head.

From March through July 2011, over $662,000 will have been expended on interim control measures per the operation plan. While 2011 may be an abnormal year, the baseline cost of the plan is a $41,600 annual cost as this operation is ongoing through all 12 months of the year. If no federal action is taken to permanently address the underseepage concerns in this the study area, the interim control measures that have been implemented to date would remain in place and the operations plan would continue to be utilized.

5.4 Problems and Opportunities.

For the purpose of this investigation the primary problem facing the Wood River Drainage and Levee District is the deterioration of the existing levee system between stationing 0+00 and 115+00 due to a design deficiency on the levee underseepage control measures. The potential for levee failure is a major concern. As time continues to pass without implementing a permanent solution to address the underseepage issues, the probability that the project will fail continues to increase. The Wood River Drainage and Levee District is a good steward of the levee system and there are no routine operation and maintenance issues. The opportunity exists to proactively take action to correct the design deficiency now in order to prevent a future catastrophe caused by system deterioration.

5.5 Planning Objectives and Constraints.

The objective of this study is to identify potential actions and recommend a solution which avoids flood damages and navigation-related costs by restoring operational functionality of the levee.

Planning constraints are restrictions that limit the extent of the plan formulation process. Avoiding and minimizing environmental impacts is the only planning constraint for this study. Every effort has been made to avoid and minimize environmental impacts as discussed in Section 5.6.3.5 of this report.

5.6 Plan Formulation

5.6.1 Measures to Address Underseepage Problems. Seepage under a levee can be controlled by a variety of measures. Seepage through the main aquifer under a levee can be controlled by 1) landside relief wells, 2) seepage berms (generally landside), 3) cutoff walls (generally near the riverside levee toe or at the levee centerline), and 4) measures to increase the distance between the levee and the point where flood water is introduced to the aquifer (examples: placing a clay cap on riverside land, making a creek bottom impervious where it is directly connected to the aquifer). Three of the above options are applicable to the project site conditions and are described in the following paragraphs:

5.6.1.1 Seepage Berms. This measure would construct a seepage berm using sand dredged from the Mississippi River. The berms would extend from the existing relief well line beyond the existing landside drainage ditch.

5.6.1.2 Relief Wells. This measure would construct relief wells with outlets at substantially lower flow lines to provide the necessary underseepage protection for the river elevations ranging between normal pool and maximum project flood. The proposed relief well spacing would vary from 35 feet to 50 feet depending on the location; however, a spacing of 35 feet and closer was determined not to be feasible. The wells will have horizontal outlets at elevation 410 that extend an average of 100 feet landside of the relief well line.

5.6.1.3 Slurry Trench Cutoff Walls. This measure would construct a fully penetrating slurry trench cutoff wall. The cutoff wall will consist of a three foot wide trench extending from the riverside surface of the levee near the toe down to the top of rock. A cement-bentonite slurry would be pumped into the trench to make the wall.

5.6.2 Alternatives Developed and Screened. Five alternative plans were developed from the measures identified above. All action alternatives were designed to be equally effective in reducing flood risk and economic damages. These five action alternatives, along with the No Action alternative, are described in the following paragraphs.

5.6.2.1 No Action. The No Action alternative assumes no federal action would be taken. Under this scenario the Levee District would continue to perform its operation and maintenance responsibilities and maintain their standing in the P.L. 84-99 program, but no federal action to permanently address the underseepage concerns in this the study area would be taken. The interim control measures that have been implemented to date would remain in place and the actions outlined in the operations plan would continue to be taken. Since the Levee District's operation and maintenance responsibility does not address this underseepage concern, the levee foundation in the vicinity of the navigation pool of Melvin Price Locks and Dam would continue to deteriorate.

5.6.2.2 Seepage Berms Only. Landside seepage berms were evaluated using the results of the calibrated Seep/W model at the three piezometric lines (project stations 66+10, 95+80, and 112+30). To function as a semi-pervious berm, the constructed berm must have permeability equal to or greater than that of the blanket in order to function as intended. Studies have indicated that semi-pervious berms should be constructed of silty sand or fine sand (paragraph 723 of TM 3-424) and ETL 1110-2-569 makes this a design requirement. The St. Louis District anticipates that berm construction would be built of sands and silty sands dredged from the Mississippi River and hauled into the construction site. These dredged sands and silty sands should easily meet the assumptions implicit in the berm analyses and would meet the requirements for landside seepage berm construction. The berm thickness and width are designed to meet current Corps criteria as outlined in EM1110-2-1913 Design and Construction of Levees, ETL 1110-2-569 Design Guidance for Levee Underseepage, and DIVR 1110-1-400, Section 8, Part 6, Landside Seepage Berms for Mississippi River Levees.

5.6.2.3 Relief Wells Only. At each section, required well spacing was determined utilizing an Engineer Research and Development Center (ERDC) developed method that merged the 2D Seep/W analyses with the Mansur-Kaufmann partially penetrating well solution. The flow lines of the wells was set at elevation 406 and assumed to have landside ponding to elevation 410. The design flood was set in place. In order to meet current Corps criterion - a Factor of Safety (FS) equal to 1.6 midway between the relief wells - the solution required well spacing of 50-feet at station 66+10 and well spacing of 35 feet for stations 95+80 and 112+30, resulting in the need for 237 relief wells.

5.6.2.4 Slurry Trench Cutoff Wall Only. The St. Louis District completed seepage analyses of a fully penetrating slurry trench cutoff wall using the calibrated seepage model. The cutoff wall was modeled as a three-foot wide trench extending from the surface riverside of the levee down to the top of rock. The wall would extend from approximately levee station 55+00 to 125+00. The seepage model shows that all head losses between the river side and landside occur through this trench resulting in no excess head landside of the trench. The St. Louis District completed global stability analyses of the trench to ensure that its installation would not threaten the integrity of the existing Wood River levee. The stability analyses were completed with Slope/W using Spencer's method of analyses. The critical failure surfaces are presented in Appendix A. All Factors of Safety exceeded 1.30 for slurry unit weights of 80 to 90 pounds per cubic foot.

5.6.2.5 Seepage Berm and Relief Well Combination. The third alternative is to construct a seepage berm in combination with relief wells. Depending on the reach, the berm length would range from 150 feet to 250 feet and the well spacing would range from 45 feet to 100 feet. There are many combinations of seepage berm width and relief well spacing that can be utilized to meet Corps' criteria for seepage gradient at the berm toe. In this case, one trial utilizing a 150-foot wide berm was analyzed at each of the three piezometer lines using the calibrated Seep/W model. This width corresponded to the traditional minimum seepage berm in use within the Mississippi Valley Division. At each section, required well spacing was determined utilizing an ERDC developed method that merged the 2D Seep/W analyses with the Mansur-Kaufmann partially penetrating well solution, resulting in the need for 41 relief wells spaced 50 feet apart.

5.6.2.6 Slurry Trench Cutoff Wall and Relief Well Combination. This alternative utilizes the Slurry Trench Cutoff Wall measure described above between approximately levee stations 80+00 and 126+00. Between levee stations 55+00 and 80+00, approximately 46 relief wells would be installed because their spacing would be equal to or greater than 50 feet.

5.6.3 Alternatives Evaluation and Comparison. As specified in ER 1105-2-100, four general criteria were considered during alternative plan screening: completeness, effectiveness, efficiency, and acceptability. Because all action alternatives were designed to be equally effective in reducing flood risk and economic damages, only the following specific criteria were used to compare the alternatives:

- <u>Cost</u>: Total cost to include design, mitigation, construction, and OMRR&R.
- <u>Environmental Effects:</u> Cultural impacts and mitigation requirements
- <u>Operations, Maintenance, Repair, Rehabilitation, and Reconstruction:</u> What is required to operate and maintain the system?

5.6.3.1 Preliminary Screening of Alternatives. The study team was concerned that the close spacing of relief wells (less than 50 feet apart) between stations 95+80 and 112+30 for the Relief Wells Only alternative was not technically advisable. After consulting and confirming this concern with other experts in relief well design, the study team eliminated the Relief Wells Only alternative from further consideration.

The preliminary cost estimate for the Slurry Trench Cutoff Wall Only alternative was $46 million while the cost of the Slurry Trench Cutoff Wall with Relief Wells alternative was estimated to be $34 million. The study team determined the two alternatives did not differ significantly in cultural or environmental effects, or reliability. The primary difference was the somewhat higher OMRR&R requirements for the combination alternative, which the study team determined would be easily offset by the cost savings in the initial investment. The annual OMRR&R cost for the Cutoff Wall alternative was $2000 while the combination alternative would be $51,800. The Levee District did not object to the removal of the Slurry Trench Cutoff Wall alternative from further consideration.

Therefore, the array of alternatives carried forward for final evaluation and comparison are as follows:

- No Action
- Seepage Berms Only
- Seepage Berms with Relief Wells
- Slurry Trench Cutoff Wall with Relief Wells

5.6.3.2 No Action. Uncontrolled underseepage and conveyance of material would continue to occur under the Wood River Levee, in an area adjacent to the pool of Melvin Price Locks and Dam during normal operating conditions. The underseepage issue is continuing to deteriorate the levee foundation in the Wood River Levee and can potentially impact the operations of the Melvin Price Locks and Dam. In addition, failure of any reach of the Wood River levee would result in widespread and catastrophic flooding of the protected area of the Wood River Drainage and Levee District.

Under this alternative, the economic damages described in the Section 5.3.2 above would be anticipated. In addition to economic damages, the No Action alternative does not address the potential for loss of life in the event of a levee failure.

5.6.3.3 Economic Benefits of the Action Alternatives. Because each of the action alternatives fully addresses the underseepage problem, the economic benefits are the same for all of the alternatives. Implementation of any one of the action alternatives would effectively reduce the PUPs due to underseepage to zero (0.0001, a 1 in 10,000 probability), as presented in Table 5.8. Based on current calculations by the Geotechnical Branch, it is assumed that the current issues resulting in high PUPs would be corrected upon implementation of the corrections in this report.

Probability of Unsatisfactory Performance (PUP) for Wood River Levee System (With Project Condition)	
Exterior Stage	Levee System PUP*
420.7	0.0001
425.7	0.0001
427.8	0.0001
430.3	0.0001
442.9	0.0001
443.8	1.0000
* PUP is Probability of Unsatisfactory Performance; i.e. a probability of failure at that return period/water surface elevation	

Table 5.8 - Probability of Unsatisfactory Performance (With-Project Condition)

Flood Risk Reduction Benefits

Table 5.9 displays the flood risk damages reduced by the action alternatives.

Expected Annual Inundation Damage Reduced and Distributed for Wood River Levee*						
By Reach and Total	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
	Total Without Project	Total With Project	Damage Reduced (Benefits)	0.75	0.5	0.25
Upper Wood River	$6,773,930	$154,760	$6,619,170	$4,253,490	$6,277,960	$8,627,880
* *Price level: October 2010; Discount Rate:4.125%; Evaluation Period: 50 years*						

Table 5.9 - Expected Annual Inundation Damage

Operations Plan Benefits

The baseline of the plan is a $41,600 annual cost as this operation is ongoing through all 12 months of the year. This requires the pond to have a maintained landside elevation of 408 feet and weekly monitoring of the sand boils. Each increment requires increased landside ponding up to 415 feet. To continue to combat the force of the river during high water events, pumping is required in an increasing degree so that river elevations higher than 430 feet would require submersible pumps in the relief wells so that the maximum amount of underseepage can be alleviated. This project would eliminate the need for this emergency operations plan and has an economic benefit of an estimated $89,140 per year. These results are presented in Table 5.10.

Emergency Operations Plan Benefits For Upper Wood River Levee ($)				
Without Project				
Stage	Flood Frequency	Operations Plan Cost	Cost Per Event	Expected Annual Cost
419.0	0.9999	$41,600	$41,596	$36,236
420.5	0.5000	$206,751	$103,376	$22,347
422.5	0.3030	$407,674	$123,538	$18,272
424.5	0.1818	$978,750	$177,955	$10,432
427.5	0.0855	$451,584	$38,597	$1,499
432.0	0.0272	$473,700	$12,907	$352
			AA Cost	**$89,139**
With Project				
Stage	Flood Frequency	Operations Plan Cost	Cost Per Event	Expected Annual Cost
419.0	0.9999	$0	$0	$0
420.5	0.5000	$0	$0	$0
422.5	0.3030	$0	$0	$0
424.5	0.1818	$0	$0	$0
427.5	0.0855	$0	$0	$0
432.0	0.0272	$0	$0	$0
			AA Cost	**$0**
			AA Benefit**	**$89,139**

* Closure costs were provided by the Project Manager and are in 2011 thousands of dollars
** AA Benefit is the elimination of the current Emergency Operations Plan

Table 5.10 - Emergency Operations Plan Benefits For Upper Wood River Levee ($)

Navigation Benefits
The project's main benefit is avoidance of the loss of navigation on the Mississippi River.

An initial levee breach along the Mississippi River in this area would only delay navigation for three days while the pool equalizes with the main river. The much more significant risk lies in the fact that the flank levee along Wood River was not designed to keep water in, or maintain pool. If the Upper Wood River area was to fill with water, the additional stress on the flank levee may provide an opportunity for a failure below the Melvin Price Locks and Dam. This flank levee failure could effectively create a side channel around the dam, causing a loss of pool and the ability for navigation. If this were to occur, a coffer dam would need to be constructed to allow for the levee to be repaired. Once this coffer dam was completed, it would allow for the pool to be maintained once more. Based on previous contract information, district engineers were able to determine a coffer dam of this size would need 12 months for construction, resulting in a river closure time of 12 months.

Table 5.11 shows the navigation benefits associated with this project, which are derived from avoiding a river closure. This project results in an average annual navigation benefit of about $7,386,000.

Navigation Benefits For Upper Wood River Levee ($000)						
Without Project						
Stage	Flood Frequency	Levee PUP	Flank*** Levee PUP	12 month Closure Cost	Cost Per Event	Expected Annual Cost
432.0	0.0272	0.60	0.00	$0	$0	$418
433.2	0.0201	0.62	0.18	$1,047,524	$117,296	$6,756
441.9	0.0015	0.64	0.91	$1,047,524	$608,370	$580
443.8	0.0008	1.00	1.00	$1,047,524	$1,047,524	$838
					AA Cost	**$8,600**
With Project						
Stage	Flood Frequency	Levee PUP	Flank*** Levee PUP	12 month Closure Cost	Cost Per Event	Expected Annual Cost
432.0	0.0272	0.0001	0.00	$1,047,524	$0	$0
433.2	0.0201	0.0001	0.18	$1,047,524	$19	$1
441.9	0.0015	0.0001	0.91	$1,047,524	$95	$367
443.8	0.0008	1.0000	1.00	$1,047,524	$1,047,52	$838
					AA Cost	**$1,200**
					AA Benefit**	**$7,400**

* Closure costs were calculated for the Inland Navigation Lock Projects Estimations of Value and Main Chamber Closure Costs (March 2009) and are shown here in April 2011 dollars
** AA Benefit is the reduction in the risk of navigation delays
*** Flank Levee PUPs were pulled from the Wood River GRR and are based on a representative cross-section of the levee.

Table 5.11 - Navigation Benefits For Upper Wood River Levee ($000)

Table 5.12 summarizes the benefits described in the above paragraphs.

Summary of Annual Economic Benefits for the Action Alternatives	
Flood Damage Reduction Benefits	$6,619,000
Navigation Benefits	$7,386,000
Operation Plan Benefits	$89,000
Total	$14,094,000

Table 5.12 - Summary of Annual Economic Benefits

5.6.3.4 Economic Costs of the Action Alternatives. Table 5.13 displays the costs associated with each of the action alternatives, including the total investment and the total average annual investment. In this table, Construction First Costs includes all construction, Lands, Easements, Rights of Way, Relocations and Disposal (LERRD), engineering during construction, construction management and mitigation costs associated with each alternative. For this project, there are mitigation costs associated with the Interim Risk Reduction Measures (IRRM) that will be incurred regardless of the alternative chosen for implementation. These IRRM mitigation costs are considered financial costs for the project (and are therefore included in the implementation costs) but are not considered economic costs and are therefore not included in the economic analysis. The construction first costs cited in Table 5.13 do not include the IRRM mitigation costs. Table 5.14 compares the total average annual investment costs to the average annual benefits.

Construction and Investment Economic Costs			
	Slurry Trench Wall with Relief Wells	**Berms with Relief Wells**	**Berms Only**
Construction First Costs	$ 31,393,000**	$ 51,716,000	$ 108,383,000
Interest During Construction	$ 1,927,000	$ 3,173,800	$ 6,651,500
Total Investment	$ 33,320,000	$ 54,889,800	$ 115,034,500
Average Annual Investment	$ 1,551,000	$ 2,610,100	$ 5,470,000
Average Annual OMRR&R Costs	$ 51,000	$ 248,700	$ 500,000
Total Average Annual Investment	$ 1,601,000	$ 2,858,800	$ 5,970,000
* *Price level: April 2011; Discount Rate: 4.125%; Evaluation Period: 50 years*			

Table 5.13 - Construction and Investment Costs

Alternatives	Expected Annual National Economic Benefit and National Economic Benefit			
	Average Annual Benefits	**Average Annual Costs**	**Net Benefits**	**Benefit-Cost Ratio**
Slurry Trench Wall with Relief Wells	$14,094,000	**$1,601,000**	**$12,492,000**	**8.8**
Berms with Relief Wells	$14,094,000	$2,859,000	$11,110, 00	4.72
Berms Only	$14,094,000	$5,970,000	$7,861,000	2.26

Table 5.14 - Expected Value of Net Benefits

***5.6.3.5 Cultural and Environmental Effects of the Action Alternatives*.** No effects to any cultural resources have been identified for any of the alternatives. The project area was previously surveyed and no historic properties were identified. The St. Louis District has executed with the Illinois Historic Preservation Agency a Memorandum of Agreement (MOA) in conjunction with the concurrent Wood River Levee Limited Reevaluation Report (a separate project) specifying how preservation concerns that may arise from changes in project impacts will be addressed. The MOA will also cover any coordination activities associated with this project.

Environmental Effects of Interim Risk Reduction Measures

Regardless of which alternative is identified as the tentatively selected plan, the interim risk reduction measures have already been implemented and have caused unavoidable impacts to natural resources in the ponding area, including the loss of 0.5 acre of terrestrial habitat (bottomland hardwood forest) to construct Dike B, and the expected death of about 25 acres of trees in wetland forest due to the continuation of prolonged ponding until final risk reduction measures are constructed. These direct and indirect effects will be mitigated on-site by planting tree seedlings in the areas of clearing and expected tree mortality after the proposed action is implemented.

Environmental Effects of the Action Alternatives

Table 5.15 identifies the expected impacts and required mitigation for each of the final action alternatives. Both the Berms Only and the Berms with Relief Wells alternatives are anticipated to have impacts to wetlands and the Berms Only alternative is also anticipate to impact some non-wetland bottomland forest. Both are anticipated to require mitigation. The Slurry Trench Cutoff Wall with Relief Wells alternatives is not expected to adversely affect any natural resources. A 10-acre disposal site is required for implementation of the slurry trench cutoff wall. This site has been identified and will not adversely affect any natural resources.

Habitat Type	**Alternative**		
	Berm	**Wells and Berm**	**Wells and Cutoff Wall (1)**
	Expected Impacts (acres)		
Wetland - Open Water	8	3	0
Wetland - Marsh	29	16	0
Wetland - Bottomland Forest	15	11	0
Terrestrial – Non-wetland Bottomland Forest	1	0	0
Total	53	30	0
	Mitigation (acres)		
Total	111	50	0

(1) = tentatively selected plan

Table 5.15 - Estimated Permanent Losses to Aquatic and Terrestrial Habitats and Mitigation for Final Risk Reduction Alternatives

Table 5.16 summarizes the quantified comparison criteria contained in the above paragraphs.

Evaluation Criteria	Alternative			
	No Action	**Seepage Berms Only**	**Seepage Berms and Relief Wells**	**Slurry Trench Cutoff Wall and Relief Wells**
Reliability	The system is exposed to unacceptable uncontrolled underseepage at normal pool elevations.	All action alternatives are equally reliable.	All action alternatives are equally reliable.	All action alternatives are equally reliable.
Net Economic Benefits	None.	$7.9M	$11.1M	$12.4M
Total Cost	Zero cost to implement; however, costs to implement interim control measures will exceed $350K yearly.	$115M	$54.9M	$31.9M
Environmental Effects	Ponding requirements IAW the interim control measures OPLAN will degrade existing environment significantly.	111 acres mitigation	50 acres mitigation	No mitigation required.
OMRR&R	None.	$500,000 annually for additional mowing along seepage berm and maintenance of a large box culvert.	$248,700 annually for additional mowing along seepage berm and for additional 41 relief wells.	$51,800 annually for 55 relief wells.

Table 5.16 - Alternatives Evaluation and Comparison Matrix

5.6.3.6 Completeness, Effectiveness, Efficiency and Acceptability.

Completeness. Completeness is the extent to which an alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. All of the alternatives carried forward are complete because they account for all costs (construction, real estate, mitigation, etc.) and require no actions by others in order to realize the plans' benefits. The No Action alternative is not complete because it does not address the identified problems and does not allow for any realization of the planned effects.

Effectiveness. Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities. Effectiveness is also a measure of how a plan contributes to the planning objectives. All of the alternatives are effective because they fully address the underseepage control problems and identify measures that will restore the original functionality of the underseepage controls. The No Action alternative is not effective because it does not address the identified problems.

Efficiency. Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment. As demonstrated previously, all three of the final alternatives have positive net economic benefits. The Slurry Trench Cutoff Wall with Relief Wells alternative is the most cost-effective alternative which alleviates the identified problems. The second most efficient alternative is the Berms with Relief Wells and the third is Berms Only. The No Action alternative is not efficient because it does not alleviate the identified problems.

Acceptability. Acceptability is the workability and viability of the alternative plan with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies. The public has a strong interest in minimizing flood risk and obtaining FEMA levee certification. All three of the final alternatives address this public interest equally. State and Federal agencies have a strong preference for avoiding or minimizing ecological impacts. The Wood River Drainage and Levee District has a strong preference for minimizing additional OMRR&R requirements. The Slurry Trench Cutoff with Relief Wells alternative is the most acceptable alternative from these two perspectives. The No Action alternative is not acceptable because it leaves the public at risk for significant economic damages.

5.7 Findings and Conclusions.

Based on the analysis of the problems facing the flood risk reduction system, a series of alternatives designed to address identified problems were developed. Costs were associated with these various plans, and the plans were compared for completeness, effectiveness, efficiency, and acceptability.

Underseepage problems associated with the levee system are clearly a federal responsibility for design deficiency reasons and should be addressed immediately as such. The uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam, two miles downstream from the original structure. This replacement resulted in a navigation pool raise that has impacted the levee foundation. When designing the Melvin Price Locks and Dam, the designers did not adequately evaluate the underseepage issues in the vicinity of the new Locks and Dam. Subsequently, inadequate measures were implemented in conjunction with the construction of the Melvin Price Dam to protect the levee against the rise of the navigation pool. The Wood River Levee is at unacceptable risk during a high water event.

Among the action alternatives, the Slurry Trench Wall with Relief Wells alternative generates the highest expected annual net benefits, at $12,492,000, with a benefit-to-cost ratio of 8.8. This information is summarized in Table 5.17. It is the least-cost plan which addresses the design deficiency, and is identified as the National Economic Development (NED) plan.

Expected Average Annual NED Net Benefits Melvin Price - Wood River Levee Underseepage LRR Design Deficiency Project				
	Expected Average Annual NED Net Benefits			
Alternative	**Benefits****	**Costs**	**Net Benefits**	**Benefit-Cost Ratio**
Slurry Trench Wall with Relief Wells	$14,094,000	$1,601,000	$12,492,000	8. 8
* *Price level: April 2011; Discount Rate:4.125%; Evaluation Period: 50 years* ** *Benefits include structure, operation plan, and navigation impacts*				

Table 5.17 - Expected Average Annual NED Net Benefits

6. DESCRIPTION OF TENTATIVELY SELECTED PLAN

6.1 Slurry Trench Cutoff and Relief Wells Combination

Based on engineering experience and cost effectiveness and efficiency, the relief wells and cutoff wall alternative was identified as providing the best permanent solution to the underseepage problem. This alternative provides a long term solution to address the underseepage concerns and has been found to be the most economical. The tentatively selected plan for final risk reduction measures to address underseepage at the Wood River levee adjacent to Melvin Price Locks and Dam consists of the following components:

Slurry trench cutoff wall - 4,700 linear feet. The wall would be located on the Mississippi River side of the Wood River levee, and would extend from sta. 80+00 to sta. 126+00 (from about Cut St. to about 1,200 feet downriver from the centerline of Mel Price Dam). Construction would be within a limited working area (40 to 60 feet wide) along the riverside levee toe. A cement-bentonite slurry would be used to make the wall. The slurry would be pumped into the trench using a portable batch plant as excavation proceeds. A 100-foot wide gap would be established in the cutoff wall where an active utility line (Alton Steel 16" force main) crosses the levee; this crossing is located about 1,300 feet south of Cut St.

New relief wells - 55. Forty-six new relief wells would be installed along the landside toe of the levee from sta. 55+00 to sta. 80+00 (from the intersection with Ridge St. to about Cut St.). An additional 9 new relief wells would be installed along the landside toe of the levee to control underseepage at the 100-foot wide opening or gap in the cutoff wall.

Other features include:

Abandon and grout existing relief wells – 80
Remove existing headwalls and grout existing outlet pipes – 42
Grout two existing abandoned utility lines (Owens wastewater main, 36” diameter - 450 linear feet; Alton Box Board sewer effluent, 30” diameter concrete casing with 20" effluent line – 550 linear feet)
Establish grassy turf along levee – 25 acres
Mitigation plan – planting of 25.5 acres of tree seedlings in East Alton No. 1 pump station’s ponding area

An approximate 10-acre disposal site is needed for placement of earthen material to be excavated from the cutoff wall trench.

Figure 6.1 shows the layout of the primary features of the tentatively selected plan.

Figure 6.1 - Primary Features of the Tentatively Selected Plan

6.1.1 Cost. The current working estimate for the design deficiency correction work is $31,851,000.

6.1.1.2 Agreement with Local Interests. The current Wood River levee was originally constructed in cooperation with the Wood River Drainage and Levee District (WRDLD) under the authority of the Flood Control Act of 28 June 1938, Flood Control Committee Document No. 1, 75th Congress. The purpose of the Project is to provide flood risk reduction to urban, agricultural, and industrial areas. After the completion of construction, the Project was transferred to the WRDLD for operation and maintenance. The implementation of the tentatively selected plan will require a substantial alteration of the existing levee and appurtenances, as well as the acquisition of various lands, easements, and rights-of-way for the construction work. Accordingly, it may be necessary to negotiate a relocation/alteration contract with the WRDLD. Under such an agreement, the WRDLD would be asked to provide a right of entry over existing lands, easements, and rights-of-way owned by the District, which are required for the construction of the tentatively selected plan. Additionally, in the event that the implementation of the tentatively selected plan will require the acquisition of any additional lands, easements, or rights-of-way, the federal government will acquire such interests. The plan will be constructed at full federal expense, and at the conclusion of the work, the levee and all appurtenances thereto will be turned back over to the WRDLD for perpetual operation and maintenance.

6.1.2 Economic Benefits of the Tentatively Selected Plan (the With Project Condition).

Table 6.1 summarizes the economic benefits and costs of the tentatively selected plan.

Expected Average Annual NED Net Benefits Melvin Price - Wood River Levee Underseepage LRR Design Deficiency Project				
	Expected Average Annual NED Net Benefits			
Alternative	**Benefits****	**Costs**	**Net Benefits**	**Benefit-Cost Ratio**
Slurry Trench Wall with Relief Wells	$14,094,000	$1,601,000	$12,492,000	8.8

* *Price level: April 2011; Discount Rate: 4.125%; Evaluation Period: 50 years*
** *Benefits include structure, operation plan, and navigation impacts*

Table 6.1 Expected Average Annual NED Net Benefits

6.1.3. Environmental Consequences. The following is a summary of environmental consequences of the proposed plan. Comments submitted during the public review of the main report and EA are included in Appendix C, along with the District's written responses.

HTRW. No concerns with potential HTRW issues have been identified.

Air Quality. With respect to air quality, exhaust and dust from construction activities would have minor short term effects. Care would be taken to minimize all impacts on air quality.

Surface Water and Groundwater. No adverse effects are expected to surface water or groundwater or the quality of those resources. Proper storm water pollution prevention practices would be enacted during construction, and disturbed areas would be reseeded to restore levee turf or other groundcover

Noise. Minor intermittent noise impacts would be created by machinery during construction. Adverse impacts to sensitive receptors such as residential areas, schools, or hospitals are not expected.

Biological Resources. The interim measures have caused unavoidable impacts to natural resources, including the direct loss of about 0.5 acre of terrestrial forest and stress on about 25 acres of wetland forest trees due to prolonged ponding. These trees are likely to die during the next 4-5 years until final measures are constructed. These direct and indirect effects would be mitigated on-site by replanting tree seedlings in areas of clearing and mortality after the proposed action is implemented.

The tentatively selected plan will not adversely affect any natural resources. None of the six federally listed threatened and endangered species for the project area will be adversely affected, provided that measures to protect the decurrent false aster are implemented.

Similarly, no adverse impact to the bald eagle is expected. Bald eagles winter along the major rivers of Illinois and Missouri, and at scattered locations some remain throughout the year to breed. Perching and feeding occurs along the edge of open water, from which eagles obtain dead fish. The Mississippi River is a focal point for wintering eagles, especially upriver of the project area north of Alton. Nesting has been observed on islands near the confluence with the Illinois River, further upriver from Alton, and also at other locations. The bald eagle was removed from the List of Endangered and Threatened Species in August 2007 but it continues to be protected under the Bald and Golden Eagle Protection Act and by the Migratory Bird Treaty Act. Recommendations to minimize potential project impacts to the bird and its nest are provided by the U.S. Fish and Wildlife Service in that agency's National Bald Eagle Management Guidelines publication (USFWS, 2010b). Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. Specifically, construction activity is prohibited within 660 feet of an active nest during the nesting season, which in the Midwest is generally from late January through late

July. There is one known nest in the vicinity of the Wood River levee system and Mel Price Locks and Dam. It was last used in 2006.

A 10-acre disposal site is required for implementation of the slurry trench cutoff wall. This site has been identified and will not adversely affect any natural resources.

Farmland. There would be no impacts to agricultural or prime farmland.

Cultural Resources. No impacts to any known cultural sites would occur.

6.1.4 Views of the Sponsor. The sponsor has three primary concerns. First, the system must be reliable. Second, the solution must allow them to maintain their current standing in the P.L. 84-99 program and allow them to receive FEMA certification for the 0.1% flood. Finally, the system must minimize the yearly OMRR&R costs. All of the alternatives considered, if properly maintained, are considered equally reliable. Likewise, all of the alternatives would allow them to maintain their current standing in the P.L. 84-99 program and to receive FEMA certification. The sponsor understands the Corps' budget process and the impact it has on project completion, but because the project would be 100% federally funded, their primary financial concern is the long-term OMRR&R costs which they would prefer to be as low as practicable.

6.2 Meeting Environmental Operating Principles.

The U.S. Army Corps of Engineers has reaffirmed its commitment to the environment by formalizing a set of "Environmental Operating Principles" applicable to all its decision-making and programs. These principles foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, and ensure that employees consider conservation, environmental preservation and restoration in all Corps activities.

Sustainability can only be achieved by the combined efforts of federal agencies, tribal, state and local governments, and the private sector, each doing its part, backed by all citizens. These principles help the Corps define its role in that endeavor. By implementing these principles, the Corps will continue its efforts to develop the scientific, economic and sociological measures to judge the effects of its projects on the environment and to seek better ways of achieving environmentally sustainable solutions. The principles are being integrated into all project management process throughout the Corps.

The proposed project is consistent with each of these seven principles as described below. The principles are consistent with the National Environmental Policy Act, the Army Strategy for the Environment with its emphasis on sustainability and the triple bottom line of mission, environment and community, other environmental statutes, and the Water Resources Development Acts that govern Corps activities.

1. *Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse and sustainable condition is necessary to support life.*

During the formulation process, careful consideration was given to avoiding and minimizing potential project impacts on existing development and environmental conditions and resources in the vicinity of the levee system. Where avoidance has not been possible, the project includes measures to ensure human safety, protect environmental resources during construction, and replace lost natural habitats in the same watershed.

2. *Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.*

   As was the case for this project, the Corps study process for project formulation and alternative development is founded upon a multidisciplinary approach that addresses all facets of the physical and human environment. Potential environmental consequences were considered for an array of alternatives, including potential effects on the natural and human environment. Stakeholders and the affected public have been part of the study process since the beginning.

3. *Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.*

   "Smart growth" or techniques such as master planning, zoning, and land use planning enhance the safety and livability of communities through the efficient application of programs that balance growth and conservation. It is the primary responsibility of local municipalities and not the USACE to control urban and rural growth and development within the Metro East and its levee systems' districts. However, the U.S. Army Corps of Engineering (USACE) in cooperation with Madison County will continue performing and be open to additional outreach initiatives with communities and municipalities about non-structural flood risk management measures that can help protect property and financial investments before a flood disaster happens.

4. *Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.*

   Our corporate responsibility and accountability will extend through the planning, preconstruction engineering and design, and construction phases of this project. The construction phase is currently projected to take place over a period of about four years. After construction, the Non-Federal sponsor is responsible for day-to-day operation of the project. The Corps would remain involved if post-construction monitoring revealed unexpected or unintended consequences.

5. *Seeks ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.*

The Corps is striving to improve its ability to assess cumulative effects associated with its activities and those of others by growing the technical capability of agency staff in the science of cumulative impact assessment. The alignment of our corporate business process with the project life cycle facilitates a systems approach to assessing long-term incremental changes in communities we serve.

6. *Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.*

   The St. Louis District has been sharing information with the public about its programs and projects for many years. To facilitate this sharing in recent years, the District website has been enhanced to provide wider coverage of current events, access to various data and electronic reports, and notification for public involvement. Electronic modes of access have also been broadened to include popular social networks such as Facebook and Twitter. A broader sharing and exchange of scientific, economic, and social information is a long-term goal.

7. *Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.*

   The St. Louis District has actively sought the views of stakeholders since the inception of this study, including local government as well as federal and state agencies with regulatory oversight. Public involvement will take place with the circulation of the study's draft report with environmental assessment. The District will carefully consider all comments that are received, and will respond to each party. We will continue to support the free exchange of views about this project.

7. PROJECT IMPLEMENTATION.

7.1. Project Implementation Process.

Construction of the design deficiency correction project requires no additional Congressional Authorization.

The underseepage controls will not be constructed outside the original project boundaries. Lands owned by the Wood River Drainage and Levee District may be utilized for temporary disposal areas if agreed to by the Levee District. If so utilized, a Project Partnership Agreement would be executed prior to the start of the first item of construction and would define the scope and cost of any disposal areas.

As discussed previously in this document, the project conditions meet the requirements described in Engineer Regulation (ER) 1165-2-119 which allows for work to be done under original project authorization. Specifically, Work to correct a design or construction deficiency may be recommended for accomplishment under existing project authority without further Congressional authorization if the proposed corrective action meets all the following conditions:

1) *The work is required to make the project function as initially intended by the designer in a safe, viable and reliable manner: e.g., pass the original design flow without failure. This does not mean the project must meet present-day design standards. However, if current engineering analysis or actual physical distress indicates the project will fail, corrections may be considered a design or construction deficiency if the other criteria are met.*

The corrective actions are required to make the project function as initially intended by the designer in a safe, viable and reliable manner. Engineering analysis performed as a result of uncontrolled underseepage identified in July 2009 by CEMVS geotechnical engineers, and actual physical experience during the 1993 and other floods indicate that the levee may fail during a major flood as a result of inadequately controlled underseepage. This uncontrolled underseepage is the direct result of incorrect analyses performed during the design of the Melvin Price Locks and Dam. The tentatively selected plan (slurry trench cutoff wall with relief wells) would make the project function as initially intended and is the most engineering and technically sound plan.

2) *The work is not required because of changed conditions.*

The underseepage design deficiency corrections are not required because of changed conditions. Land-use changed in some areas both landward and riverward of the levee, but these changes did not cause the underseepage problems. The materials in the levee and below the levee have not changed, and there have not been large excavations on the riverside or landside of the levee that changed the locations where water enters or exits the aquifer. This uncontrolled underseepage experienced by the Wood River levee system is the direct result of incorrect analyses performed during the design of the Melvin Price Locks and Dam.

3) *The work is generally limited to the existing project features. Remedial measures that require land acquisitions or new project features must not change the scope or function of the authorized project.*

The design deficiency correction project does not change the scope, function or purpose of the existing project. The scope, function, and purpose of the existing Wood River Levee are flood risk reduction against a 54 foot Mississippi River stage on the S. Louis Gage (design flood at 52 feet on the St.Louis gage plus two feet of freeboard). The work required via the tentatively selected plan (slurry trench cut off wall with relief wells) is an underseepage control feature that does not change the scope or function of the existing project.

4) *The work is justified by safety or economic considerations.*

The design deficiency correction project must be justified by either safety or economic considerations, but it is justified by both safety and economic considerations.

In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular inspections and is normally covered by several feet of water. The district concludes that the uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam two miles downstream from the original structure. This replacement resulted in a navigation pool raise that has impacted the levee foundation. The Wood River Levee is at unacceptable risk during a high water event. Failure of this levee and the immediate flooding of the major industrial, commercial and residential development behind the levee would be an immense catastrophe and could result in the loss of many lives. In addition, failure of the levee could result in the loss of navigation on the Mississippi River for 12 months.

The design deficiency correction project would restore the safety of the underseepage and through-seepage controls. Also as discussed in Section 5.6.3.4 (Economic Costs of the Alternative Plans) and Section 6 (Description of Recommended Plan) the tentatively selected plan is the most economically feasible.

5) *The work is not required because of inadequate local maintenance.*

The design deficiency correction project is not required because of inadequate local maintenance. As discussed in Section 5.2 (Existing Conditions), the Wood River Drainage and Levee District is responsible for the OMRR&R associated with the Wood River Levee system. Annual Inspection records dating back to 1985, as kept by the St. Louis District, indicate that Wood River has achieved an acceptable or higher rating for the levee with the exception of four years out of eighteen. A minimum acceptable rating was received four times but corrective measures were taken to fix identified deficiencies.

Implementation of the design deficiency correction project depends on the actions by Federal and Non-Federal authorities described below.

- The LRR is approved by the Commander, Mississippi Valley Division.
- Federal design and construction funding must be provided by annual appropriation.

7.2 Implementation Schedule.

A Project schedule has been developed based upon the assumption that this limited reevaluation report will be approved in fiscal year 2011. The Project schedule sequences design, and construction activities to allow immediate execution of the deficiency work construction beginning in FY2013. The development of this schedule assumes funding is available in the years required and that the real estate actions are completed on schedule.

The recommended schedule reflects the information currently available and the current departmental policies governing execution of projects. It does not reflect program and budgeting priorities inherent in either the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the schedule recommended may be modified before it is transmitted to higher authority for authorization and/or implementation funding. Under current plans, the schedule calls for completing PED activities in FY 2012. Advertisement and award of the first item of construction for deficiency work is scheduled in FY 2013, pending funding. Assuming funding availability, construction completion is planned for FY 2016.

7.3 Recommended Features.

The Project construction items have been categorized based on their contribution to project objectives. Additionally, the standard features of Lands and Damages, Relocations, Planning, Engineering and Design, and Construction Management are applicable to this Project. All estimated costs have been allocated among these feature accounts and will be managed in this manner. The Project Cost Estimate contained in Appendix E reflects the feature account breakout. Table 7.1 is a summary of costs by account.

Feature Accounts	Costs $	Contingency $	Total Costs $	Average Annual Benefit	Average Annual Economic Cost
Design Deficiency Correction –				$12,492,000	$1,601,000
01 Lands and Damages	250,000	0	250,000		
02 Relocations	158,000	36,000	194,000		
06 Fish and Wildlife Facilities	$196,000	$45,000	$241,000		
11 Levees and Floodwalls	19,490,000	4,473,000	23,963,000		
18 Cultural Resource Preservation	25,000	6,000	31,000		
30 Planning, Engineering & Design	3,845,000	882,000	4,727,000		
31 Construction Management	1,988,000	456,000	2,444,000		
Total Design Deficiency Correction	***25,952,000***	***5,899,000***	***31,851,000***	***BCR = 8.8***	

Table 7.1 - Summary of Cost for the Tentatively Selected Plan by Accounts

7.4 Financial Analysis.

Due to the Melvin Price Lock and Dam project's authorization, all costs of implementing the original project (the dam and the original lock, including punch-list items) have been funded at 100% Federal cost and there has been no cost-sharing with the Inland Waterways Trust Fund for this portion of the project. Therefore, the cost of correcting the design deficiencies of the original project will be a 100% Federal cost.

However, historically operation and maintenance of the underseepage controls for the project have been conducted by the Wood River Drainage and Levee District. Therefore, the Wood River Levee and Drainage District is expected to serve as the Sponsor for the OMRR&R of the additional underseepage controls recommended by this report. The Sponsor's share of the implementation cost is estimated to be $0 since the design deficiency is attributed to the construction of the Melvin Price Locks and Dam, a purely federal action. OMRR&R requirements for the tentatively selected plan are currently estimated to be $51,800 annually. Due to the net reduction in the total number of relief wells and the lack of OMRR&R costs for the slurry trench cutoff wall, the Sponsor's current OMRR&R budget for this reach is expected to be reduced. The Wood River Levee and Drainage District is authorized by the Illinois Drainage Act of 29 June 1955, to assess taxes in support of the levee system and its requirements.

8. PUBLIC INVOLVEMENT.

A public meeting was held on 2 April 2010; however, during the draft report comment period, an additional public meeting may be conducted to provide information and clarification of questions related to the project. Copies of the draft report will be provided to state and local officials, area libraries, local industry, and regional economic groups. Additionally, the draft report will be available on the District's website. Coordination has also occurred with the Levee and Drainage District, local units of government, the State of Illinois, business groups, and major industrial customers of the area.

9. RECOMMENDATIONS.

The study documented by this Limited Reevaluation Report shows that deficiencies in the original design of the Melvin Price Locks and Dam project resulted in underseepage problems in the Wood River Levee. Furthermore, that the design deficiencies may be corrected without additional Congressional authority by a design deficiency correction project as described by the tentatively selected plan.

Although the costs of the additional underseepage controls proposed by this report will cause the project to exceed its original authorized cost, it is the position of the St. Louis District that the cost increase does not exceed the Chief of Engineers' discretionary authority to approve the report. Calculations supporting this position can be found in the Economic Appendix (Appendix B).

I recommend the approval of this Limited Reevaluation Report. When the report is approved a relocation/alteration contract based on this decision document will be negotiated with the Wood River Drainage and Levee District, and work may proceed on the design deficiency correction project.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program or the perspective of higher review levels within the Executive Branch.

(UNSIGNED)

Christopher G. Hall
Colonel, U.S. Army
District Commander

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
WITH
DRAFT FINDING OF NO SIGNIFICANT IMPACT

MELVIN PRICE – WOOD RIVER LEVEE UNDERSEEPAGE PROJECT
PROJECT COMPLETION REPORT
MADISON COUNTY, ILLINOIS

MARCH 2012

Prepared by:
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Table of Contents

List of Tables

List of Figures

List of other Environmental Documents

Introduction

The U.S. Army Corps of Engineers (USACE), Mississippi Valley Division, St. Louis District, has prepared this Supplemental Environmental Assessment (SEA) to document the environmental impacts associated with interim underseepage corrections implemented in 2010 and to evaluate the environmental impacts associated with proposed permanent underseepage corrections to the Wood River levee adjacent to the Melvin Price Locks and Dam, in Wood River, Madison County, southwestern Illinois. The Wood River levee system is located along the east bank of the Mississippi River between river miles 195 and 203 above the Ohio River. This urban design levee system is across the Mississippi River from St. Louis and St. Charles counties in Missouri, just upriver of the City of St. Louis (Figure EA-1, vicinity map). The Melvin Price Locks and Dam is located about 2 miles below Alton, Illinois, in Madison County, Illinois, and St. Charles County, Missouri, at Mississippi River mile 200.78, between the mouth of the Illinois and Missouri rivers.

This SEA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and the Council on Environmental Quality's Regulations (40 Code of Federal Regulations §1500-1508), as reflected in the USACE Engineering Regulation 200-2-2. It supplements the 1976 Environmental Impact Statement prepared for the Melvin Price Locks and Dam that replaced Locks and Dam No. 26 at Alton (USACE, 1976). The EIS addressed the impacts of the project for identified significant resources of the study area. The study area includes the Upper Mississippi River System. This area is composed of nearly 1,300 commercially navigable miles of the Upper Mississippi, Illinois, Kaskaskia, Black, St. Croix, and Minnesota Rivers. Bordering states include Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

The Wood River levee system provides protection against flooding from the Mississippi River, as well as headwater flooding from Wood River Creek and the Cahokia Creek Diversion Channel. The system also removes drainage from the flood-protected bottomland resulting from rainfall, run-off, and underseepage. In addition to providing protection from river flooding, the levee structure is a part of the containment features for the Melvin Price Locks and Dam Project. Modifications made to the original Lock and Dam 26 at Alton resulted in construction of the Melvin Price Locks and Dam two miles downriver and raised the height of the navigation pool on the intervening stretch of the existing levee. The increased seepage in this levee reach necessitated the construction of a new pump station in this vicinity in the late 1980s.

In 2010, the St. Louis District identified uncontrolled seepage in this upper reach of the Wood River levee. Alternative solutions to correct the problem in this reach of the Wood River levee are the focus of a project completion report prepared by the St. Louis District. The report is scheduled to be completed in 2012 and serves to identify a recommended permanent underseepage corrections plan for federal funding.

The St. Louis District has also identified underseepage problems at other locations within the Wood River levee system. Alternative solutions for correcting the seepage problems at these additional locations have been documented in a separate report and potential environmental impacts have been described in a separate Environmental Assessment that were completed in 2011.

Description of Wood River Drainage and Levee District

The Wood River levee system (Figure EA-1) is an urban levee design that protects approximately 12,700 acres, 200,000 inhabitants and over $1 billion in property assets. The Wood River Drainage and Levee District operates and maintains 21 miles of riverfront and flank levees, 170 relief wells, 26 closure structures, and 41 gravity drains for flood protection. It also operates and maintains 7 pump stations with ponding areas for removal of interior drainage to the Mississippi River.

The drainage and levee district consists of three separate protected areas – upper, lower, and East-West Forks.

> The Upper Wood River Drainage and Levee District (Figure EA-2) originates near the intersection of Langdon and Front Streets (US highway 67) in Alton, Illinois, at Mississippi River mile 203. From this point the riverfront levee extends downstream past the Melvin Price Locks and Dam to the mouth of Wood River Creek at river mile 199.4 for a distance of about 5.2 miles. At this point the levee turns and proceeds upstream as a flank levee along the right descending bank of the Wood River Creek for 1.6 miles to the project terminus. About 1,641 acres of Mississippi River floodplain are protected by this portion of the levee system.
>
> The Lower Wood River Drainage and Levee District originates at high ground on the left descending bank of the West Fork of Wood River Creek, near Powder Mill Road in East Alton, Illinois. From this point the flank levee extends 1.7 miles to the confluence with the East Fork of Wood River Creek. The levee then continues downstream along the left descending bank of Wood River Creek for 2.3 miles to the mouth of Wood River Creek at Mississippi River mile 199.4. At this point the levee becomes a riverfront levee and continues along the left descending bank of the Mississippi for 4.76 miles to the mouth of the Cahokia Creek Diversion Channel at Mississippi River mile 195. There the levee turns and proceeds upstream as a flank levee along the right descending bank of the diversion channel for 2.6 miles and then turns and follows the obsolete New York Central railroad tracks for 3.0 miles in a north-easterly direction. The levee then veers north for 0.5 miles to its terminus in South Roxana, Illinois. About 10,687 acres of Mississippi River floodplain are protected by this portion of the levee system.
>
> The flank levee of the East-West Forks portion of the Wood River Drainage and Levee District is 2.68 miles long and occurs on the north side of the East and West Forks of the Wood River. About 428 acres of Mississippi River floodplain are protected by this portion of the levee system.

1.1 Purpose of and Need for Action

The primary problem facing the Wood River Drainage and Levee District is the deterioration of the existing levee system adjacent to the Melvin Price Locks and Dam due to non-effective underseepage control measures. Uncontrolled underseepage and conveyance of earthen materials that form the foundation of the levee is occurring, and the potential for levee failure is a major problem. As time passes the probability that the project will fail continues to increase.

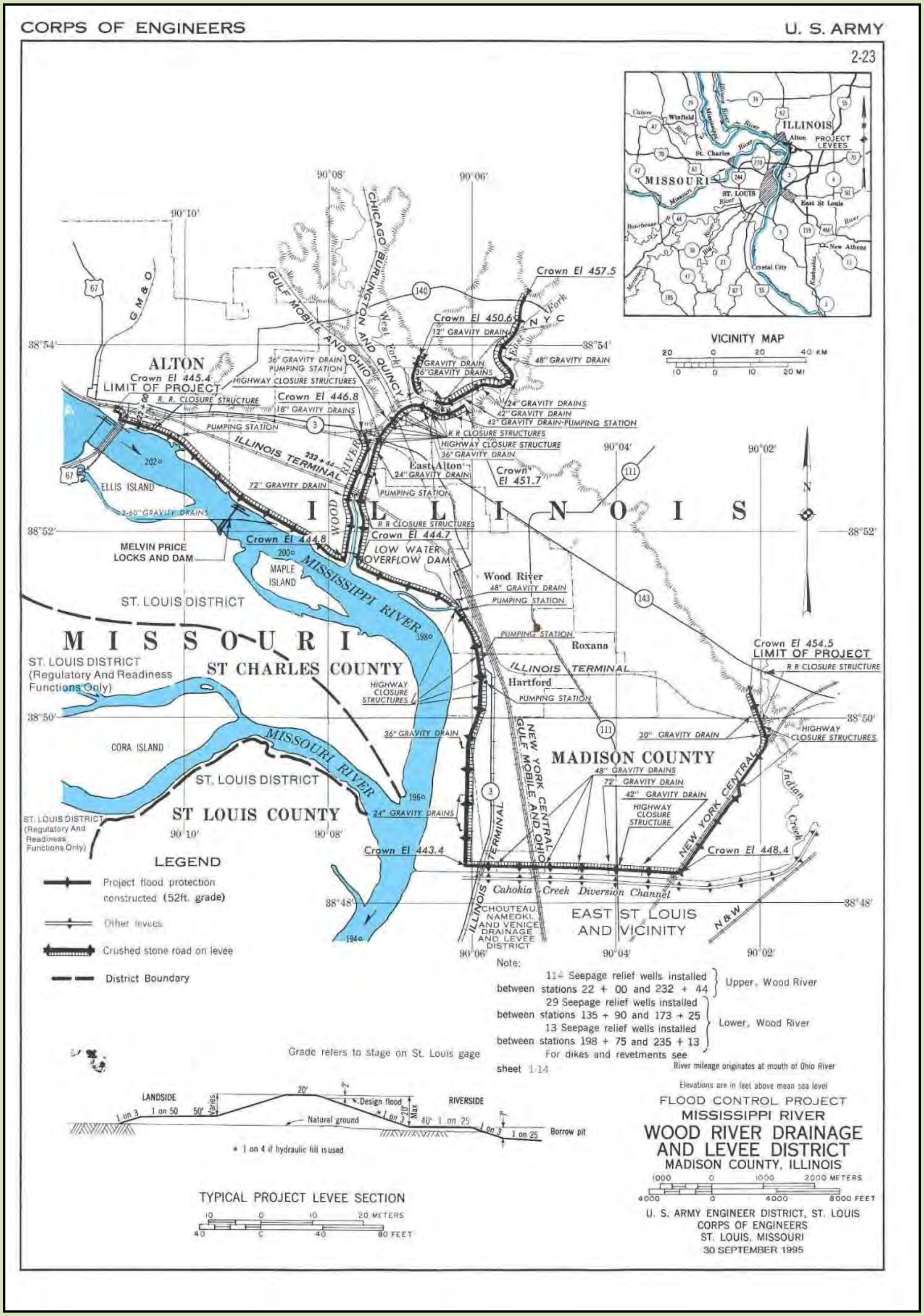


Figure EA-1. Map of Project Area - Wood River Levee System and Melvin Price Locks and Dam

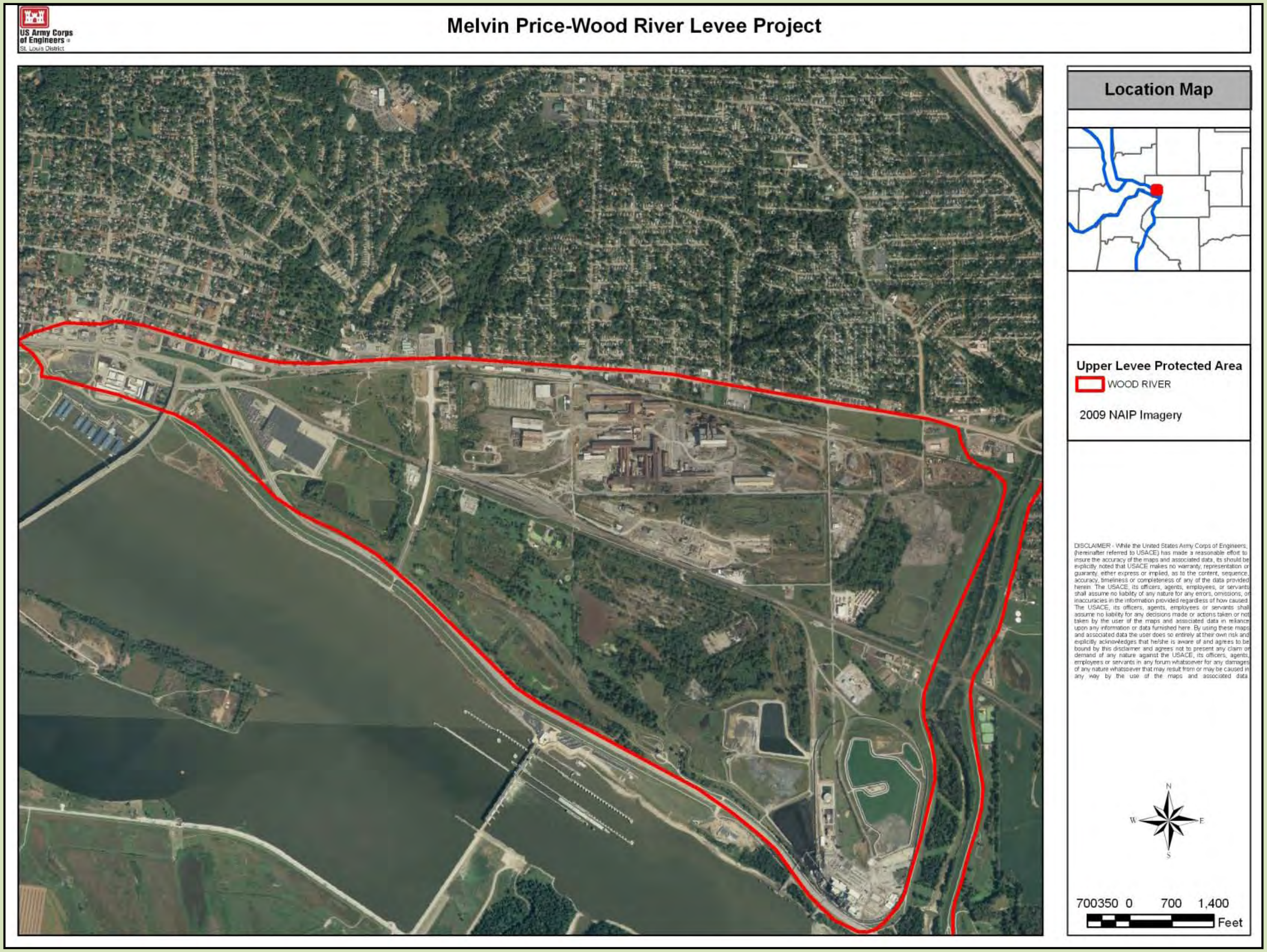


Figure EA-2. Upper Portion of Wood River Drainage and Levee District.

Specifically, the low, marshy area located landside of the levee extending about 3,500-feet upstream from the centerline of the Melvin Price Locks and Dam exhibits heavy seepage of groundwater under the levee and displays very soft ground conditions. Wood River Drainage and Levee District and Corps officials first observed many large, flowing seeps (3 to 5 inch diameter and at least 6-feet deep) during the summer of 2009 while the Melvin Price pool was at or near its normal elevation of 419 feet NGVD (all elevations in this document correspond to the National Geodetic Vertical Datum (NGVD)).

1.2 Authority for the Proposed Action

The Melvin Price Locks and Dam project was authorized by the Internal Revenue Code of 1954 - Bingo - Tax - Exempt Organizations, Public Law 95-502 (H.R. 85331), October 21, 1978. Title I - Replacement of Locks and Dam 26; Upper Mississippi River System Comprehensive Master Management Plan.

"Sec. 102. (a) The Secretary of the Army, acting through the Chief of Engineers, is authorized to replace locks and dam 26, Mississippi River, Alton, Illinois, and Missouri, by constructing a new dam and a single, one-hundred-and-ten-foot by one-thousand-two-hundred-foot lock at a location approximately two miles downstream from the existing dam, substantially in accordance with the recommendations of the Chief of Engineers in his report on such project dated July 31, 1976, at an estimated cost of $421,000,000."

1.3 Prior Studies, Reports, and Related Water Projects

Melvin Price Locks and Dam Project

Final Environmental Statement, Locks and Dam No. 26, Mississippi River, Alton, Illinois. Volume 1, to accompany the final report of the Chief of Engineers. Department of the Army, Office of the Chief of Engineers, Washington, D.C. 20314. Dated July 1976. The document described potential impacts associated with improvements described in the draft Reevaluation Report of December 2004.

Supplemental Appropriations Act, 1985. Public Law 99-88 dated January 3, 1985, authorized the second lock at the Melvin Price Locks and Dam Project.

Water Resources Development Act 1986. Public Law 99-662 dated November 17, 1986, authorized the construction of the second lock at Melvin Price Locks and Dam.

Water Resources Development Act 1990. Public Law 101-640 dated November 28, 1990, provided authority to provide project-related recreational development at the Melvin Price Locks and Dam subject to cost sharing with the state of Illinois.

Water Resources Development Act 1992. Public Law 102-580 dated October 31, 1992, provided authority to construct the visitor center at the Melvin Price Locks and Dam.

Water Resources Development Act 1996. Section 322 of WRDA 1996 modified the Melvin Price Locks and Dam authorization.

Wood River Levee Authorization

Original Project Authority. The Wood River Levee project originally was authorized by the Flood Control Act of 28 June 1938, Flood Control Committee Document No. 1, 75th Congress, and First Session to provide flood protection to urban, agricultural and industrial areas. Much of the construction took place in the 1950s and 1960s.

Grassy Lake Pump Station Authority. The Flood Control Act, approved 27 October 1965, by Public Law 89-298, House Document No. 150, 88th Congress, First Session, modified the project to provide for construction of a pumping station with collector ditches and necessary appurtenant facilities for removal of interior water impounded by the existing levee. This project was never constructed and a Reconnaissance study for the Wood River Drainage and Levee District, Illinois - Pump Station, dated January 1998, was approved for Pre-Engineering Design. The purpose of this project is to solve interior flooding near the southern end of District through the addition of a 45-cfs pump station as a new feature to the original system. This station was constructed in 2007.

Mel Price Lock and Dam Authority. The Internal Revenue Code of 1954 - Bingo - Tax - Exempt Organizations, Public Law 95-502 (H.R. 85331), October 21, 1978. Title I - Replacement of Locks and Dam 26; Upper Mississippi River System Comprehensive Master Management Plan. This project resulted in pool modifications that authorized the addition of a pump station for the Wood River Levee System.

Design Memorandum No. 16, Wood River Drainage and Levee District Alteration, March 1985. DM documents changes required to the Upper Wood River Levee System resulting from the Lock and Dam No. 26 (Replacement), Mississippi River, including relocation and increase in size of the Alton Pump Station, main drainage ditch modifications, access road construction, construction and replacement of relief wells, construction of seepage conveyance channels, and protection of the existing levee.

Environmental Assessment, Wood River Drainage and Levee District Alterations, Locks and Dam No. 26 (Replacement), Mississippi River, Alton, Illinois, April 1986. The document described potential impacts associated with alterations described in Design Memorandum No. 16 of March 1985. Finding of No Significant Impact signed (no date).

1993 P.L. 84-99 Memorandum. Memorandum, CELMV-CO-E, dated 9 March 1994, Subject: Project Approval/Funding Request, Final Repairs, Wood River Drainage and Levee District, Madison County, Illinois, provided assessment of system performance failures recommended for emergency repairs, under authority of PL84-99/PL99-662, resulting from the flood of 1993.

Periodic Inspection No. 7. Periodic Inspection No. 7, Levee and Closure Structures, Wood River Flood Protection Project, dated March 1997, documents system performance deficiencies identified as a result of problems experienced during the 1993 flood.

Environmental Assessment, Proposed Pump Station and Ditch Improvements, Grassy Lake Area, Wood River Drainage and Levee District, Madison County, Illinois. February 1998. The document described potential impacts associated with improvements described in the Grassy Lake Pump Station Reconnaissance study of January 1998. Finding of No Significant Impact signed July 31, 1998.

Reconnaissance 905(b) Report. Wood River Levee, Illinois, Flood Damage Reduction 905b Report dated April 1999. This report was prepared in response to the original project authorization above, and details problems identified during and after the flood of 1993 and recommends project reconstruction be further investigated.

Final General Reevaluation Report, Wood River Levee System Reconstruction Project, Wood River Levee System, Madison County, Illinois, dated March 2006. This report recommends rehabilitation of the levee system to include installation of additional relief wells and rehabilitation of existing relief wells, pumping plants and select closure structures and replacement or lining of gravity drains. These recommended actions are required to maintain the system's authorized level of protection.

Environmental Assessment, Proposed Reconstruction of the Flood Protection System, Wood River Drainage and Levee District, Madison County, Illinois, July 2005. The document described potential impacts associated with improvements described in the draft Reevaluation Report of December 2004. Finding of No Significant Impact signed July 27, 2005.

Supplemental Environmental Assessment, Wood River Levee System Limited Reevaluation Report For Design Deficiency Corrections Project, Madison County, Illinois, August 2011. The document described potential impacts associated with improvements described in the draft Reevaluation Report of August 2, 2011. Finding of No Significant Impact signed August 31, 2011.

1.4 Public Concerns

Although the Wood River levee system has net levee grades higher than a 500-year flood, the Corps of Engineers cannot certify that the levee system will protect against a 100-year flood without correcting the significant underseepage problems. The Federal Emergency Management Agency (FEMA) requires a professional engineer's certification that the levees will protect against a 100-year flood, otherwise, after a period of time for public input and map preparation, FEMA will revise the Flood Insurance Rate Maps and change the designation of the areas behind the levees from protected areas to flood hazard areas. The lack of certification is negatively impacting property values in the Wood River levee district area, and flood insurance rates will increase dramatically if the area becomes designated a flood hazard area. There is tremendous interest in the communities and region to complete the work that will allow certification by a professional engineer before FEMA changes the floodplain designations. The top priority of local interests is to achieve the 100-year certification. In addition, there is a strong desire to have the levees brought back to their original level of protection which is greater than 500-year.

1.5 Data Gaps and Uncertainties

The issue of uncontrolled underseepage and conveyance of material under the Wood River levee adjacent to the Melvin Price Locks and Dam was first discovered in July of 2009, but when this condition first developed is unknown. However, it appears to have persisted for a significant time. Additionally, the degree of deterioration of the levee foundation is unknown.

Available Lidar ground surface elevation data for the study area extends landward about 700 feet out from the toe of the Wood River levee. It extends more or less up to the ditch that drains to the East Alton No. 1 pump station, and encompasses roughly half of the pump station's ponding area. Additional ground surface data of lesser accuracy was used to delineate the entire ponding area at various ponding elevations. There is some degree of error in the delineations of ponding areas at one to two-foot increments. That error has introduced some uncertainty into the description of the relationship of various existing wetland resources within the ponding area with topography, and the effect of standing water at various ponding elevations on wetland vegetation.

2.0 ALTERNATIVES

This section describes the temporary or interim risk reduction measures that were implemented in early 2010 to control seepage under the levee embankment of the Wood River levee adjacent to the Melvin Price Locks and Dam. It also describes the need for final risk reduction measures to be implemented to permanently control seepage in this levee reach, then presents the formulation and evaluation of final alternatives, and lastly presents the proposed permanent solution.

This SEA documents the environmental impacts of the interim risk reduction measures as an after the fact action. These impacts are described in Section 3 Existing Resources.

2.1 Interim Risk Reduction Measures – Implemented in 2010

Temporary precautionary measures were implemented in early 2010 to help control the underseepage and minimize risk to the levee system and protected public. The planning of these measures and their implementation was coordinated with Wood River Drainage and Levee District and City of Alton officials in the fall of 2009.

The interim plan involves the ponding of surface water in the uncontrolled underseepage area adjacent to the levee (Figure EA-3). The depth of ponding (Figure EA-4) is dependent on the stage of the Melvin Price pool (Table EA-1). This ponding must not impact the City of Alton's combined sewage outflow (CSO) operations. Flow from two outlets (Central Avenue, Shields Valley) is carried into the pump station's ponding area through ditches. Ponding levels higher than elevation 410.7 feet NGVD would potentially back up the ditches and overtop a CSO weir, sending excess water through the wastewater bypass and flood the City's wastewater treatment plant. Three temporary rock dikes were constructed to prevent ponded water from backing up into the ditches and impacting CSO operations, and to prevent water from flowing onto property without flowage easements (Figure EA-5). This construction was completed in April 2010. The rock dikes will be kept in place until final risk reduction measures are implemented, and then they will be removed.

- Dike A constructed to elevation 415.0 feet NGVD with 10' notch at elevation 412.0 feet NGVD with one 48" sluice gate.
- Dike B constructed to elevation 415.0 feet NGVD with two 48" sluice gate
- Dike C constructed to elevation 411.0 feet NGVD with 10' notch at elevation 410.0 feet NGVD with one 48" sluice gate.

The interim plan calls for a graduated response to control underseepage and protect the City of Alton. It is initiated at a Mel Price pool elevation of 419 feet with a forecast of higher crest of a given duration. The interim plan enables surface ponding to elevation 415.0 feet and reduces risk up to a river elevation of 430 feet (Mel Price pool). In addition, the graduated operation plan involves monitoring of site conditions (including groundwater conditions using piezometers), by-pass pumping of CSO flows around dikes A and B, filling in the notches in dikes A and B, installing standpipes in relief wells, closing gravity drains, air lift pumping of relief wells, and installation of an interim seepage berm. Air lifting could be used as an emergency measure for river elevations above 430 feet. The interim plan of surface water ponding and operation of the three dikes is to remain in effect until a permanent solution to the seepage problem can be installed. To date there has been no need to mobilize for the installation of an interim seepage berm (Table EA-1).

Figure EA-3. Area of Uncontrolled Underseepage (shaded in yellow, green dots represent piezometer locations).

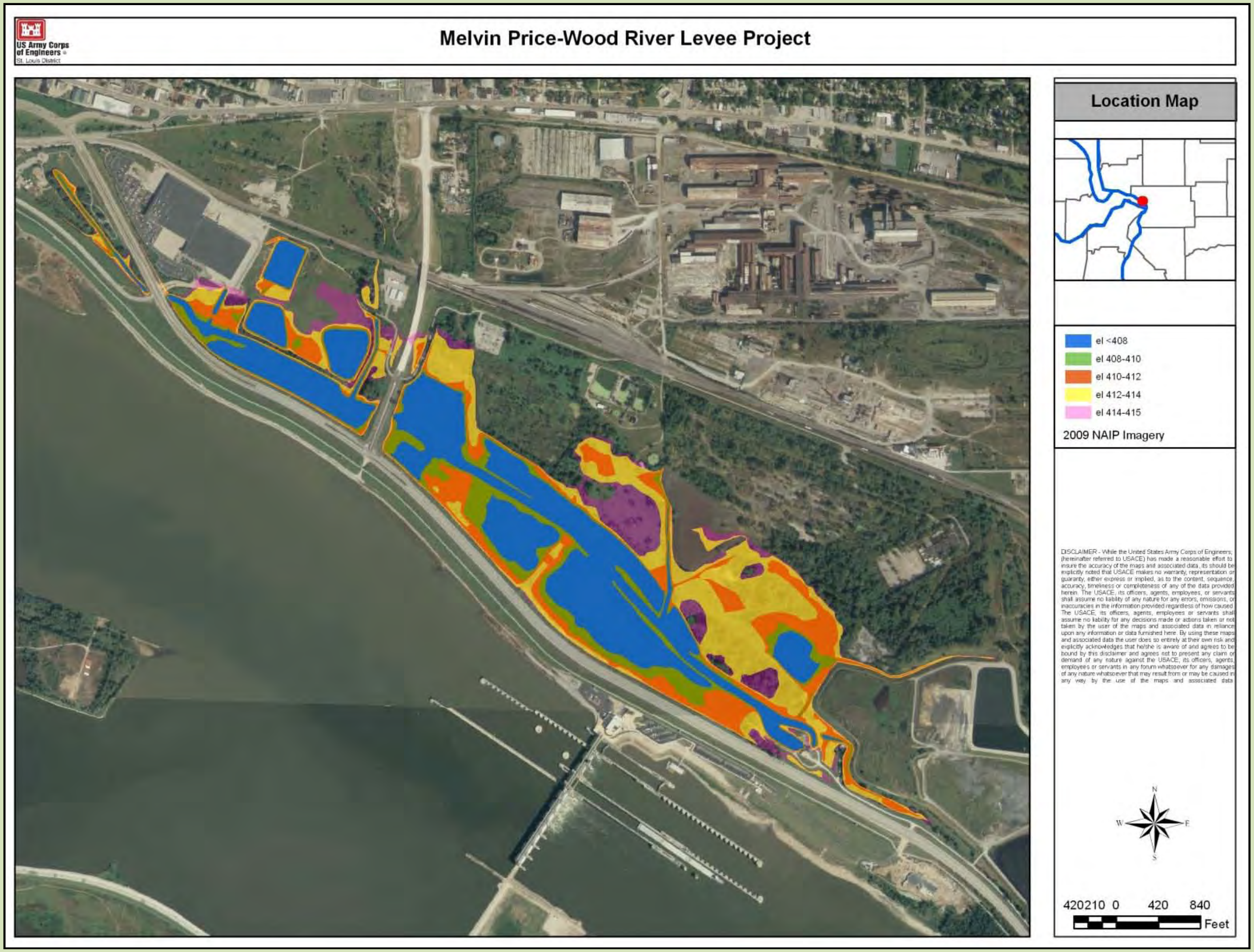


Figure EA-4. Interim Risk Reduction Measures – Extent of Surface Ponding at Various Elevations.

Table EA-1. Operation Plan for Interim Underseepage Measures.

Pool Elevation[1]	Action
419	●Conduct weekly monitoring ●Raise/maintain landside ponding at elevation 408 ●Activate instrumentation system and collect data ●Begin calibrating seepage models with field data
419 - 421	●Raise/maintain landside ponding at elevation 410 to 411 ●Continue collecting data from instrumentation system ●Begin calibrating seepage models with field data ●Continue weekly monitoring ●Advise Alton waste water of need to increase ponding elevation if higher river predicted
421 - 424	●Raise/maintain landside ponding at elevation 413 ●Continue collecting data from instrumentation system ●Continue calibrating seepage models with field data ●Begin daily monitoring ●Plan to acquire air lift pumping equipment if higher river predicted
424 - 428	●Maintain landside ponding at elevation 413 ●Mobilize/install air-lift system in relief wells and pump 24/7 ●Continue collecting data from instrumentation system ●Continue calibrating seepage models with field data ●Continue daily monitoring ●Plan to construct seepage berm if higher river predicted
428 – 429+	●Maintain landside ponding at elevation 413 ●Continue continuous monitoring, pumping, data collection, and modeling. ●Mobilize/install landside seepage berm

[1] Expressed in feet NGVD

2.2 Final Risk Reduction Measures

2.2.1 Planning Objectives

The objective of this study is to identify potential actions and recommend a solution which avoids flood damages and navigation-related costs by restoring operational functionality of the levee..

2.2.2 Plan Formulation

Alternative plans for a permanent solution were developed by identifying three potential measures which may be used to control seepage under a levee. The potential measures include relief wells, seepage berms, and slurry trench cutoff walls.

Figure EA-5. Interim Risk Reduction Measures – Location of Three Rock Dikes.

Relief wells would be constructed on the protected side of the levee to relieve excessive hydrostatic pressures beneath a levee during high water conditions. Seepage berms are structures constructed of low permeability earthen material on the protected side of the levee. They act to hold seepage water, thereby counteracting the upward seepage forces resulting from high water conditions. Cutoff walls are a low permeability physical barrier advanced to the bedrock or an appropriate confining layer on the riverside of the levee, and are designed to impede seepage flows beneath a levee during high water conditions. Because the underseepage problem area along the levee can be regarded as consisting of three distinct sections (55+00 – 80+00, 80+00 – 99+50, 99+50 – 126+00, from upriver to downriver as defined by levee stationing), combinations of these plans could also be considered.

Five potential alternatives were developed as permanent solutions: 1) relief wells only, 2) seepage berm only, 3) cutoff wall only, 4) relief wells-seepage berm combination, and 5) relief wells-cutoff wall combination. Lifecycle costs were calculated for each option. A No Action alternative was also considered. A discussion of each alternative follows.

No Action Plan. The No Action alternative assumes that no action would be taken to implement a permanent underseepage solution. The interim risk reduction measures would remain in effect into the future; the operation plan for interim risk reduction measures described in Section 2.1 would continue indefinitely. Under this scenario, the Levee District would continue to perform its operation and maintenance responsibilities and maintain its standing in the Public Law (P.L.)

84-99 program, but no Federal action outside of the P.L. 84-99 program would be taken. P.L. 84-99 is the authority by which the Army Corps of Engineers responds to emergencies. Under this law these authorities are delegated to the Corps Districts for disaster preparedness, emergency operations, rehabilitation of flood control works threatened or destroyed by flood, emergency water supplies and drought assistance, advance measures and hazard mitigation. Since the Levee District's operation and maintenance responsibility does not address this underseepage concern, the levee foundation in the vicinity of the navigation pool of Melvin Price Locks and Dam would continue to deteriorate.

Relief Wells Plan. This alternative (Figures EA-6 - 9) involves the construction of a series of landside relief wells. The relief well spacing would vary from 35 feet to 50 feet depending on the location. Flow lines for these new wells would be substantially lower than the flow lines of existing relief wells to provide the necessary underseepage protection for river elevations ranging between normal pool and maximum project flood. New wells would have horizontal outlets at elevation 406 that extend about 100 feet landside of the existing relief well line. The following table describes the number of required wells and the required spacing.

Levee Reach (by station)	Relief Wells	Average Spacing (ft)
55+00 – 80+00	46	50
80+00 – 99+50	56	35
99+50 – 126+00	73	35
Total	175	

Seepage Berm Plan. This alternative (Figures EA-6 - 9) involves constructing a seepage berm along the landside of the levee. The berm would extend along the levee for a distance of about 7,200 feet. Depending on the location, it would extend out from the toe of the levee for a distance of about 400 or 500 feet. The top of the berm would be built to elevation 412 and it would slope toward the drainage ditch leading to the pump station. Where the berm would cross the drainage ditch, the ditch would need to be relocated inside of a concrete box culvert. The berm design would reflect a factor of safety of 1.0. Sand dredged from the Mississippi River would be used to construct the core of the berm. The following table describes the extent of the berms and the quantities of sand and topsoil needed for construction.

Levee Reach (by station)	Sand (cy)	Topsoil (cy)	Berm Area (ac)
55+00 – 80+00	248,000	40,000	18
80+00 – 99+50	198,000	51,000	23
99+50 – 126+00	210,000	43,000	19
Total	656,000	134,000	60

Cutoff Wall Plan. This alternative (Figures EA-6 - 9) involves the construction of a slurry trench cutoff wall. The cutoff wall would consist of a three foot wide trench located riverside of the levee and extending from the ground surface down to the top of bedrock. Earthen material excavated from the trench would need to be placed at a disposal site. The trench would be filled with a slurry of cement and bentonite. The following table describes the depth of the wall and disposal area required.

Levee Reach (by station)	Average Wall Depth (ft)	Wall Width (ft)	Disposal Area (ac, 5-ft depth)
55+00 – 80+00	110	3	5
80+00 – 99+50	125	3	4
99+50 – 126+00	145	3	6
Wall – 7,100 linear feet			15

Relief Wells and Seepage Berm Plan. This alternative (Figures EA-6 - 9) involves the construction of a seepage berm in combination with relief wells. Depending on the reach, the berm would extend out from the levee from 150 feet to 250 feet. The relief well spacing would range from 45 feet to 100 feet. The berm design would reflect a factor of safety of 1.0. The following table describes the extent of the berms, the quantities of sand and topsoil needed for construction, and the number of required relief wells.

Levee Reach (by station)	Sand (cy)	Topsoil (cy)	Berm Area (ac)	Relief Wells
55+00 – 80+00	114,617	21,713	7	23
80+00 – 99+50	151,854	31,382	10	46
99+50 – 126+00	92,431	22,453	7	32
Total	358,902	75,548	24	101

Relief Wells and Cutoff Wall Plan. This alternative (Figures EA-6 - 9) involves the construction of a cutoff wall along the lower portion of the levee reach, along with relief wells in the upper portion of the reach. The relief well spacing would be about 50 feet. The following table describes the extent of the cutoff wall, the disposal area required, and the number of required relief wells.

Levee Reach (by station)	Average Wall Depth (ft)	Wall Width (ft)	Disposal Area (ac, 5-ft depth)	Relief Wells
55+00 – 80+00	-	-	-	46
80+00 – 99+50	125	3	4	0
99+50 – 126+00	145	3	6	0
Wall – 4,700 linear feet			10	46

2.2.3 Alternative Screening

The relief wells plan was considered not to be feasible by St. Louis District geotechnical engineers because the average spacing would be about 35 feet. The state-of-the-practice by the Corps along the Mississippi River is to not install relief wells on spacings as small as 50 feet. Therefore, the relief well only alternative was screened out from further analysis.


US Army Corps of Engineers St. Louis District
10-acre disposal area
ALTON
DISCOVERY PKWY
CUT ST
CLARK BRIDGE
30+00
40+00
50+00
110+00
120+00
130+00
140+00
RT. 143 (BERM HIGHWAY)
LOCK AND DAM WAY
MISSISSIPPI RIVER
MEL PRICE LOCKS AND DAM
MEL PRICE UNDERSEEPAGE ALTERNATIVES
HYBRID BERM / RELIEF WELL FOOTPRINT
BERM EMBANKMENT FOOTPRINT
PROPOSED RELIEF WELL
CUTOFF WALL
NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE
SCALE: 1" = 400'
400' 0 400'
N
MARK
DESCRIPTION
DATE
APPR
DESIGNED BY: X
DWN BY: X
CKD BY: X
SUBMITTED BY: GARY J. LEE, P.E.
PLOT SCALE: X
PLOT DATE: X
SIZE: ANSI D
FILE NAME:
DATE: JUNE 2010
SOLICITATION NO.: XXXXXX-XX-XXXX
CONTRACT NO.: XXX-XX-X-XXXX
FILE NUMBER: XX-X-XX/XXX
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT
ST. LOUIS, MISSOURI 63103
UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI, ILLINOIS
MADISON COUNTY, ILLINOIS
WOOD RIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE
CIVIL
X
PLATE

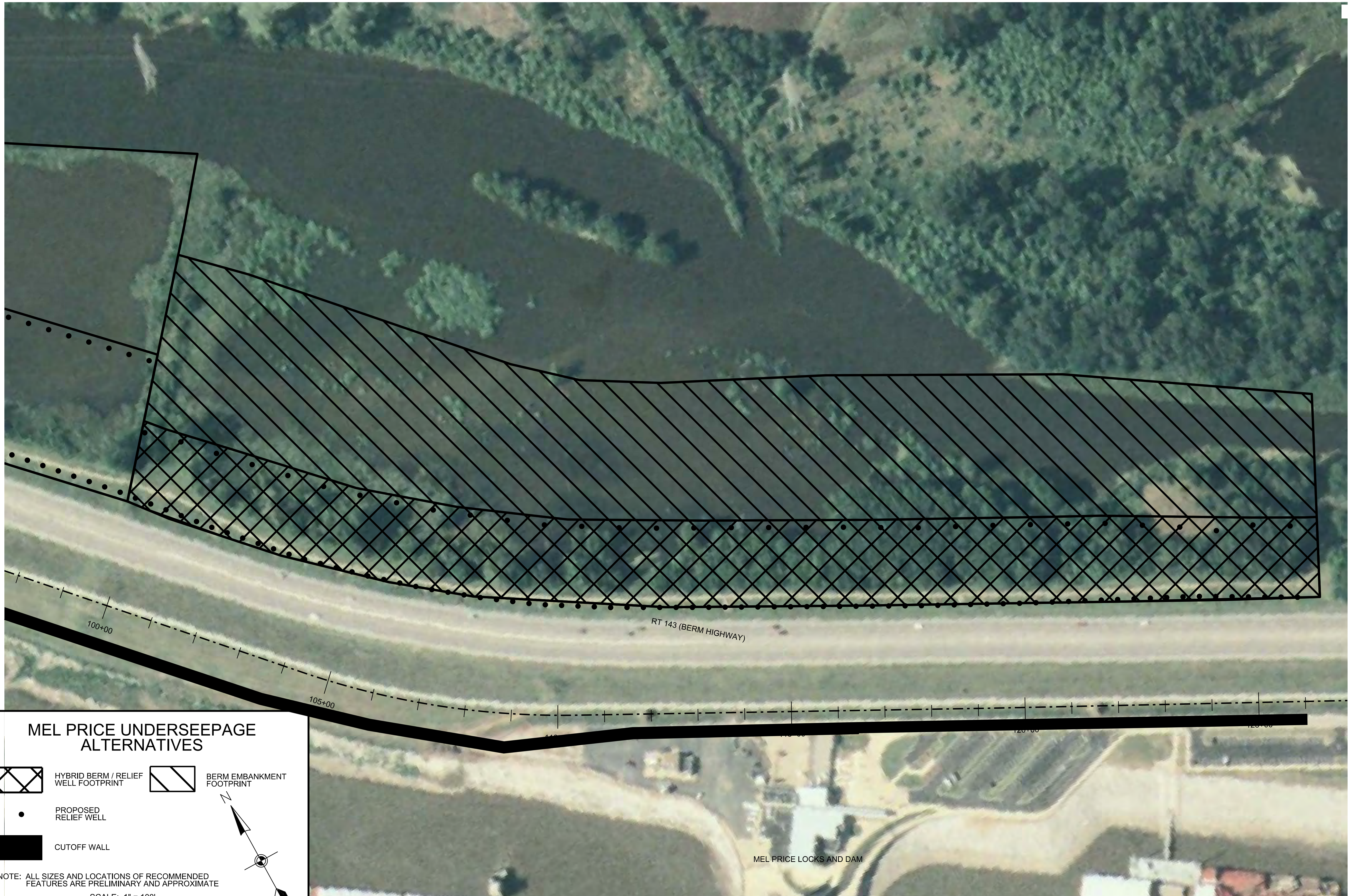
Figure EA-6


RT 143 (BERM HIGHWAY)
CUT ST.
MISSISSIPPI RIVER
55+00
60+00
65+00
70+00
75+00
80+00
MEL PRICE UNDERSEEPAGE ALTERNATIVES
HYBRID BERM / RELIEF WELL FOOTPRINT
BERM EMBANKMENT FOOTPRINT
PROPOSED RELIEF WELL
CUTOFF WALL
NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE
SCALE: 1" = 100'
100'
0
100'
N
US Army Corps of Engineers
St. Louis District
DESIGNED BY: X
DWN BY: X
CKD BY: X
SUBMITTED BY: GARY J. LEE, P.E.
PLOT SCALE: X
PLOT DATE: X
SIZE: ANSI D
FILE NAME:
DATE: JUNE 2010
SOLICITATION NO.: XXXXXX-XX-XXXX
CONTRACT NO.: XXX-XX-X-XXXX
FILE NUMBER: XX-X-XX/XXX
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT
ST. LOUIS, MISSOURI 63103
UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI, ILLINOIS
MADISON COUNTY, ILLINOIS
WOOD RIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE
CIVIL
STA 55+00 TO STA 80+00
PLATE

Figure EA-7

CUT ST.
80+00
85+00
90+00
95+00
100+00
RT 143 (BERM HIGHWAY)
MISSISSIPPI RIVER
MEL PRICE UNDERSEEPAGE ALTERNATIVES
HYBRID BERM / RELIEF WELL FOOTPRINT
BERM EMBANKMENT FOOTPRINT
PROPOSED RELIEF WELL
CUTOFF WALL
NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE
SCALE: 1" = 100'
100'
0
100'
N
US Army Corps of Engineers®
St. Louis District
MARK
DESCRIPTION
DATE
APPR
DESIGNED BY: X
DWN BY: X
CKD BY: X
DATE: JUNE 2010
SOLICITATION NO.: XXXXXX-XX-XXXX
SUBMITTED BY: GARY J. LEE, P.E.
CONTRACT NO.: XXX-XX-X-XXXX
PLOT SCALE: X
PLOT DATE: X
FILE NUMBER: XX-X-XX/XXX
SIZE: ANSI D
FILE NAME:
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT
ST. LOUIS, MISSOURI 63103
UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI, ILLINOIS
MADISON COUNTY, ILLINOIS
WOOD RIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE
CIVIL
STA 80+00 TO STA 99+50
PLATE

Figure EA-8



MEL PRICE UNDERSEEPAGE ALTERNATIVES

HYBRID BERM / RELIEF WELL FOOTPRINT

BERM EMBANKMENT FOOTPRINT

PROPOSED RELIEF WELL

CUTOFF WALL

NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE

SCALE: 1" = 100'

100' 0 100'

US Army Corps of Engineers St. Louis District

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT
ST. LOUIS, MISSOURI 63103

UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI, ILLINOIS
MADISON COUNTY, ILLINOIS

WOOD RIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE
CIVIL

STA 99+50 TO STA 126+00

Figure EA-9

2.2.4 Plan Comparison

The remaining four alternative plans were evaluated and compared. Construction and operation and maintenance costs were estimated to allow for cost comparison. A screening was conducted of the alternative plans in consideration of four key planning criteria: completeness, effectiveness, efficiency and acceptability. Completeness is defined as the extent to which the alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planning objectives. Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. Efficiency is the extent to which an alternative plan is the most cost effective means of achieving the objectives. Acceptability is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies.

2.2.5 Tentatively Selected Plan for Final Risk Reduction Measures – Relief Wells and Cutoff Wall

Based on engineering experience and cost effectiveness and efficiency, the relief wells and cutoff wall alternative was identified as providing the best permanent solution to the underseepage problem. This is the proposed action and it is carried forward for analysis in Section 4.0 – Environmental Consequences, along with the No Action Plan, and three other final risk reduction alternatives including the seepage berm, cutoff wall, and relief wells and seepage berm options. This alternative provides a long term solution to address the underseepage concerns and has been found to be the most economical. The tentatively selected plan for final risk reduction measures at the Wood River levee adjacent to Melvin Price Locks and Dam for a flood at 54 ft on the St. Louis gage (design flood at 52 feet on the St. Louis gage plus 2 feet of freeboard) consists of the following components:

<u>Slurry trench cutoff wall - 4,700 linear feet</u>. The wall would be located on the Mississippi River side of the Wood River levee, and would extend from sta. 80+00 to sta. 126+00 (from about Cut St. to about 1,200 feet downriver from the centerline of Mel Price Dam). Construction would be within a limited working area (40 to 60 feet wide) along the riverside levee toe. A cement-bentonite slurry would be used to make the wall. The slurry would be pumped into the trench using a portable batch plant as excavation proceeds. A 100-foot wide gap would be established in the cutoff wall where an active utility line (Alton Steel 16" force main) crosses the levee; this crossing is located about 1,300 feet south of Cut St.

<u>New relief wells – 55</u>. Forty-six new relief wells would be installed along the landside toe of the levee from sta. 55+00 to sta. 80+00 (from the intersection with Ridge St. to about Cut St.). An additional 9 new relief wells would be installed along the landside toe of the levee to control underseepage at the 100-foot wide opening or gap in the cutoff wall.

<u>Other features</u> include:

Disposal site – 10 acres (displayed on Figure EA-6)
Abandon and grout existing relief wells – 80
Remove existing headwalls and grout existing outlet pipes – 42

Grout two existing abandoned utility lines (Owens wastewater main, 36” diameter - 450 linear feet; Alton Box Board sewer effluent, 30” diameter concrete casing with 20" effluent line – 550 linear feet)

Establish grassy turf along levee – 25 acres

Implementation Schedule. The implementation schedule for the final risk reduction measures begins with preliminary engineering and design activities being completed in Fiscal Year (FY) 2012. Advertisement and award of the first item of construction is scheduled in FY2013. Construction is scheduled to be completed in early FY2016 (late 2015, three year duration).

3.0 AFFECTED ENVIRONMENT

This section describes existing conditions in the project area, which are referred to under the NEPA process as the Affected Environment. The resources described in this section are those recognized as significant by laws, executive orders, regulations, and other standards of national, state, or regional agencies and organizations; technical or scientific agencies, groups, or individuals; and the general public.

The project area is defined as the Upper Wood River Drainage and Levee District. These descriptions reflect conditions in this area prior to the St. Louis District’s implementation in March 2010 of interim risk mitigation measures to control underseepage along the levee stretch adjacent to Melvin Price Locks and Dam, as well as the changes that have taken place because of the implementation of those measures. Therefore, this SEA documents in this section the environmental impacts associated with the interim risk reduction measures, including the three temporary rock dikes and the ponding of surface water within the East Alton No. 1 pump station’s ponding area.

3.1 Socioeconomics

The upper Wood River levee protects an urban area consisting of industrial and commercial businesses. No residential buildings are located within this area. Municipalities that are protected in part by the Wood River levee include Alton and East Alton. The flood-protected area is traversed by several railroads that service industrial development. Illinois Routes 3 and 143 provide highway access. Illinois Highway 143 is located on the landside levee slope. In addition to affording protection to the highway, the levee also protects the Alton Sewage Treatment Plant, portions of the City of Alton, Illinois Power Company, Laclede Steel Company, Owens-Illinois, Inc., and the Alton Packaging Company from flooding during high river stages.

A risk based economic analysis was completed for the study area in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance, using the National Economic Development Procedures Manual for Urban Flood Damage, prepared by the Water Resources Support Center, Institute for Water Resources, as a reference. Table EA-2 provides inventory results showing a structural value of residential, commercial and industrial buildings for the Upper Wood River Levee area. The total structural value of commercial and industrial buildings inventoried in the upper Wood River area is about $365 million.

Table EA-2. Structure Inventory.

Area	Building Category	Number of Buildings	Average Value of Buildings ($)
Upper Wood River	Residential	0	$0
	Commercial	59	$1,904,717
	Industrial	29	$8,673,478
	Total	88	

Interim Risk Reduction Measures. The construction of the three rock dikes and establishment of interim ponding has not affected any socioeconomic resources within the upper Wood River levee-protected area.

3.2 Topography and Geology

In the upper drainage and levee district, topography ranges from a low of about 405 feet along the landside toe of the levee to about 440 feet along the base of the bluff. A series of islands and side channels existed in the vicinity of the riverfront levee adjacent to Melvin Price Locks and Dam prior to the levee's construction. The naturally low area along the landside of the levee serves as a ponding area for temporary storage of local storm and seepage water before it drains into the adjacent Mississippi River. In the area of this landside ponding, bedrock is overlain by a layer of sands about 130 feet thick, which in turn is blanketed by a mixture of silts and clays ("topsoil") that ranges in depth from about 18 inches to 30 inches. Soil investigations conducted as part of this study revealed that this blanket generally increases in thickness away from the levee, as does the percentage of clay, which ranges from about 30% near the levee and 60% further away from the levee. The crown of the riverfront levee is at an elevation of about 445 feet, and the adjacent river upstream of Mel Price Locks and Dam has a normal pool elevation of 419 feet.

Interim Risk Reduction Measures. The construction of the three rock dikes has had minor impacts to topography in the East Alton No. 1 pump station's ponding area. Crown elevations of these structures are at elevation 415.0 (Dikes A and B) and elevation 411.0 (Dike C). They range in height from about 10 to 15 feet. The footprints of Dikes A and B are about 0.05 acre, and that of Dike C is about 0.5 acre. Constructed in March 2010, the rock dikes will be kept in place until final risk reduction measures are implemented, and then they will be removed.

3.3 Air Quality

The project area is located to the east of St. Louis, within the Metropolitan St. Louis Interstate Air Quality Control Region (AQCR). This AQCR covers part of Missouri and Illinois. Areas within the AQCR are further defined according to the attainment status of criteria pollutants. The Metropolitan St. Louis AQCR includes the Illinois counties of Jersey, Madison, Monroe, and St. Clair, which are referred to as the Metro-East Nonattainment Area (EWGCG, 2010a). The Metropolitan St. Louis AQCR is in attainment for most of the criteria pollutants, including sulfur dioxide, carbon monoxide, nitrogen dioxide, and lead. The Metro-East Nonattainment

Area is a moderate nonattainment area for ozone (8-hr). It is a maintenance area for particulate matter (PM-2.5); this area includes Jersey, Madison, and St. Clair Counties, and Baldwin Township within Randolph County (USACE, 2003; EWGCG, 2010a; USEPA, 2010). A small area in Granite City, Illinois, is classified as nonattainment for lead 2008 (USEPA, 2010).

Ozone is not emitted directly into the air by specific sources. Ozone is created by sunlight acting on nitrogen oxides (NOx) and volatile organic compounds (VOC's) in the air. There are many sources of these gases. Some common sources include gasoline vapors, chemical solvents, fuel combustion products, and some consumer products (USACE, 2003).

Interim Risk Reduction Measures. In April 2010, heavy equipment used to construct the three rock dikes and trucks hauling construction material to the construction sites emitted exhaust and generated some dust during operation. Air quality impacts were minor because they were temporary and of short duration.

3.4 Surface Water and Surface Water Quality

The project area is within the watershed referred to as the Mississippi South Central River Watershed by the Illinois Environmental Protection Agency (IEPA, 2008). Wood River Creek borders the lower end of the upper levee district, and the Mississippi River borders the riverfront levee. According to the IEPA (2008, 2010a), impaired uses and causes for impairment (within parentheses) for these waterways include: Mississippi River - fish consumption (mercury, polychlorinated biphenyls), primary contact recreation (fecal coliform), and public water supplies (manganese); Wood River Creek and its two forks – aquatic life (manganese, total suspended solids, sedimentation/siltation), and primary contact recreation (fecal coliform).

In the upper portion of the drainage and levee district, surface waters on the landside of the Wood River levee include a drainage ditch leading to the East Alton No. 1 Pump Station, and shallow open water areas and vegetated wetlands bordering this ditch that are remnants of historic side channels of the Mississippi River. Several man-made water bodies also are present but at a greater distance from the levee. The naturally low topography occupied by the ditch, open water and wetlands areas serves as a ponding area for temporary storage of local storm and seepage water before it drains into the adjacent Mississippi River.

Surface water quality of the ditch and its adjacent open water and vegetated wetlands areas is impaired from two main sources. Urban runoff from the City of Alton is carried by several small ditches into the drainage ditch that leads to the pump station. In addition, two combined sewer outfalls from the City (Central Avenue and Shields Valley) also outlet into this ditch system. During wet weather, these combined sewer outfalls can release a mixture of runoff from precipitation and treated or partially treated sewage into the ditch that leads to the pump station, as well as the adjacent open water and vegetated wetlands areas.

Interim Risk Reduction Measures. Since April 2010, the East Alton No. 1 pump station is being operated to intentionally pond surface water within its ponding area to a greater depth and duration than normal. This enhanced ponding has increased the area of surface water within the ponding area from roughly 25 acres under normal pump station operations to over 100 acres, depending on surface elevation. This enhanced ponding will continue until final risk reduction measures are implemented.

With respect to water quality, construction of the three rock dikes likely caused temporary and localized increases in levels of suspended particulates and turbidity at the construction sites and for relatively short distances downstream. As water quality in these areas is generally poor, adverse effects were likely minor.

3.5 Groundwater and Groundwater Quality

The bottomland portion of the study area is underlain by a sand and gravel aquifer that has historically supplied groundwater for industrial purposes. The municipalities of East Alton, Bethalto, Wood River, and Hartford have community water supply facilities that currently withdraw from these groundwater sources. In the vicinity of the East Alton community water supply, there is a plume of groundwater contamination coming from two sites that consist of leaking underground storage tanks, and the contaminants include various volatile organic compounds (IEPA, 2010b). The Illinois EPA's Bureau of Land is implementing a groundwater contamination response strategy for East Alton (IEPA, 2010b).

In the upper drainage and levee district, upon completion of Melvin Price Locks and Dam in 1989, a 2.2 mile length of Wood River levee became located within the permanent navigation pool of the new lock and dam. Long-term maintenance of the pool at elevation 419 has resulted in an increase (rise) in the normal level of the groundwater landward of this section of levee. Numerous existing groundwater relief wells located along the landside toe of this levee reach were intended to relieve this groundwater pressure. However, recent observations in this levee reach indicate that these relief wells do not function as they were intended. St. Louis District geotechnical engineers first noted uncontrolled seepage of groundwater along the landside of the levee in July 2009 when the Mel Price navigation pool was at elevation 419 and the landside ponding was at 402.9. Active sand boils carrying sand were noted in the same area in November 2009 during open-river conditions at elevation 421.93 and landside ponding at elevation 409. The area of uncontrolled underseepage is played in Figure EA-3. This movement of sand is significant because it raises the possibility that it came from the levee foundation, which would put the structural integrity of the levee at risk.

Ten piezometers were installed in late 2009 in the seepage area exhibiting the most critical conditions. Eight of these were arranged in 2-ranges of 4 piezometers each located downstream of Cpl. Belacek Road. A third range of two piezometers was installed upstream of Cpl. Belacek Road. The final piezometer was installed in the Alton Pump station inlet bay to measure the landside ponding elevation. Instrumentation and cabling were added to these piezometers to automate the collection of the piezometric data. The piezometric data are used to supplement direct observations of underseepage conditions and to calibrate numerical seepage models.

Groundwater model predictions for piezometric levels between the levee and the landside drainage ditch are excellent, with no difference exceeding 0.70-feet. But the model results for two piezometers on the far side of the drainage ditch are about +/- 2.0-feet off of the predicted value. This indicates that some other local feature, other than the Melvin Price pool and tailwater, is impacting the groundwater regime. Given the highly industrialized nature of the area, the most likely features include groundwater domes caused by broken water mains and groundwater drawdowns caused by industrial groundwater extraction.

Groundwater seeping from the area along the landside toe of the levee moves across the ground surface to the drainage ditch that leads to the pump station, and does so in a sheet-flow fashion or along minor topographic depressions. Because the groundwater has naturally high concentrations of iron and manganese, it leaves an orange-brown precipitate on the ground surface and low-lying vegetation.

Interim Risk Reduction Measures. The interim measures have not changed any groundwater movement patterns in the vicinity of the Wood River levee adjacent to the Melvin Price Locks and Dam. Likewise, groundwater elevations have not changed. The intentional ponding of surface water within the pump station's landside ponding area is intended to reduce the groundwater's uplift pressure. Based on periodic observations since March of 2010, the ponding appears to be controlling the movement of sand from under the levee foundation. No changes are expected to groundwater quality.

3. 6 Hazardous, Toxic, and Radioactive Wastes

Phase I Environmental Site Assessments were conducted in conformance with the scope and limitations of ASTM Practice E 1527. In addition to these assessments, sampling was conducted in the upper portion of the Wood River levee system in September of 2009 in the area of uncontrolled underseepage. Levels of metals were higher in the seep water than the river water, but this may be the result of leaching from the soils in the seep area. An old industrial area is just to the east of the wetland area which included Laclede Steel, Alton Box Board, American Smelting & Refining, and Owens Illinois Glass Company. Residues from glass manufacturing furnaces have been found to contain elevated levels of Zirconium, Strontium, Chromium, Copper, Magnesium, Zinc, Iron, Barium, Vanadium, and Manganese. Manganese, Nickel, Copper, Chromium, Zinc, Aluminum, and Iron are also widely used in steel production. At this time it cannot be determined if either or both of these industries are in fact sources of these inorganic elements. Further investigation would be needed in order to determine if these elements are migrating in ground water from these sources. In addition, historical topographic maps indicate a possible sewage disposal facility in the area. Some drilling muds contain barium, so there is a possibility that the drilling mud could have been leaching barium into the seeps. However, a review of the Material Safety Data Sheet for Quick-Gel which is used in the drilling process indicates that barium is not a component of the substance.

Interim Risk Reduction Measures. The construction of the three rock dikes and establishment of interim ponding has not affected any hazardous, toxic, or radioactive wastes within the upper Wood River levee-protected area.

3.7 Hydrologic Conditions

The Wood River levee project is intended to provide protection against a 52 foot Mississippi River stage on the St. Louis gage, which has a current expected frequency of greater than 500 years. For the design flow of 1,300,000 cfs, the height of protection is based upon confinement by industrial and urban area projects with a design flood profile having a flow-line elevation of 443.4 feet, m.s.l. at the upper end (opposite river-mile 202.7); elevation 442.7 feet, m.s.l, at the mouth of Wood River; and elevation 441.4 feet, m.s.l, at the lower end (Cahokia Creek Diversion Channel) of the levee district. Levee grade freeboard is 2 feet above water surface profile by design. The flood of record occurred during the summer of 1993 when the St. Louis gage recorded 49.58 ft. River elevations were above flood stage from 3 April to 7 October. Peak flow was estimated at 1,080,000 cfs. The frequency of that event was 175 years. The project endured two other significant flood events; 43.3 feet on the St. Louis gage in 1973, and 41.9 feet on the St. Louis gage in 1995. For the flank levees, a net grade equal to the main stem design flood elevation plus 2-foot freeboard was projected back along the tributaries. The interior drainage system relies on two methods of conveyance, open drainage ditches and combined sewers. Open drainage ditches feed two of the levee and drainage district's seven pump stations, and these are Lakeside and Homegarden. Sewer fed pump stations must pump effluent irrespective of interior rainfall events whenever gravity flow is impeded by high river stages.

In the upper portion of the drainage and levee district, a ponding area on the landside of the levee serves to store local storm and seepage water temporarily. The East Alton Pump Station No. 1, completed in 1989, services this ponding area and the surrounding 4.17 square mile watershed. This drainage area enlarges to 5.81 square miles when the gravity drain to Wood River Creek is closed (elevation 417.0) and its flow is diverted to the ponding area. The Wood River Drainage and Levee District owns impoundment easements allowing the ponding of water up to elevation 415.8 feet. At this elevation, ponding would encompass roughly 250 acres.

The ponding area is drained by a main ditch that parallels the levee and is located 100 to 500 feet landside of the landside levee toe. Some smaller drainage ditches and storm sewers from the City of Alton are connected to this main drainage ditch. The main ditch begins at the City of Alton's Central Avenue Combined Sewer Outlet (CSO) and ends at the East Alton Pump Station. Two 54-inch diameter gravity drain structures in the East Alton Pump Station drain this main ditch to the Mississippi River when Melvin Price tailwater elevations are at or below elevation 405. When the gravity drains are closed due to tailwater conditions above elevation 405, the levee district activates the East Alton pumping station when the landside ponding elevation is at or above elevation 406.0.

A substantial portion of the City of Alton combined sewer system terminates at the Central Avenue CSO. "Dry weather" sewer flows backup behind a weir in the CSO, are captured by a 30-inch main, and are diverted to the Alton wastewater treatment plant. The top of the weir is at elevation 410.7. When significant local rainwater events occur over the City, the mixture of precipitation runoff and wastewater overflow the weir, enter the ditch, and flow to the Mississippi River via the East Alton Pump Station. Another part of the City of Alton combined sewer system terminates at the Shields Valley CSO. This system operates in similar fashion, but the top of the Shields Valley CSO weir is at elevation 413.8.

Table EA-3 presents estimates of stormwater runoff volumes that come to the pump station for various rainfall events. Underseepage also collects in the ponding area, and the rate of underseepage has been estimated using SEEP/W© 2007, a finite element software product for analyzing groundwater seepage. The amount of underseepage entering the ponding area per unit time depends on various soil, geological, and hydrological conditions, including the elevation of the Melvin Price pool as well as the surface elevation of any ponding within the ponding area. In general, the rate of underseepage increases with increasing pool elevations and decreases with increasing landside ponding elevations. Based on a normal pool elevation of 419.0 feet and an interior ponding elevation of 406.0 feet, the underseepage rate into the ponding area is estimated to be 15,000 gallons per minute, or 33.42 cubic feet per second. By comparison, for a 24-hour period, this amount of underseepage would be 2,887,488 cubic feet of water, which is similar to the estimated runoff volume of a 2-year rainfall event of one hour duration (Table EA-3).

Table EA-3. Estimated Stormwater Runoff Volumes (cubic feet) for East Alton No.1 Pump Station.

Runoff Volume (ft^3)							
Duration (hrs)	Probability (%)						
	50	20	10	4	2	1	0.2
	Reoccurrence Interval						
	2-year	5-year	10-year	25-year	50-year	100-year	500-year
0.08	2,627	11,947	51,212	157,360	275,866	423,166	544,800
0.17	221,417	519,422	825,975	1,370,227	1,845,447	2,371,097	2,795,179
0.25	651,400	1,260,010	1,762,585	2,698,853	3,448,506	4,311,851	4,997,601
0.5	1,721,687	3,090,990	4,256,124	6,018,782	7,547,077	9,161,880	10,563,906
1	2,991,267	5,591,639	7,416,209	10,279,760	12,600,171	15,016,155	17,195,430
2	5,232,856	8,547,104	10,849,826	14,100,103	16,332,680	19,587,495	24,934,390
3	6,707,532	10,279,760	13,345,762	16,332,680	19,345,883	22,524,082	28,740,936
6	9,507,895	14,100,103	17,511,154	22,194,594	26,194,862	29,596,488	36,985,134
12	13,121,142	18,384,637	22,854,319	27,888,713	32,615,179	37,425,429	45,436,401
24	16,410,770	23,268,146	28,399,639	34,617,594	40,700,177	46,155,432	57,230,541
48	20,965,937	29,510,787	35,580,045	44,718,397	51,941,551	58,604,459	71,061,937
96	26,110,557	38,131,049	46,515,324	59,062,945	66,892,738	76,642,703	94,445,313
168	33,919,532	46,785,405	56,315,916	70,134,161	78,507,945	92,563,578	115,234,796
240	38,307,671	52,214,137	65,506,464	79,441,433	94,445,313	104,348,600	138,054,721

Interim Risk Reduction Measures. The goal of the interim measures is to provide risk reduction up to a Mel Price pool river elevation of 430 feet. To accomplish this, surface water elevations in the pump station's ponding area have been manipulated to maintain a differential of no more than 11 feet between the Melvin Price pool elevation and the surface elevation of the ponding area. Accordingly, a ponding elevation of 408 feet is required for a normal pool elevation of 419 feet.

Recorded ponding elevations are displayed in Figure EA-10 for time periods before and after the onset of intentional ponding as an interim underseepage control measure, which started about 29 March 2010. Whereas ponding elevations prior to that date fluctuated and often dipped down to the 403 to 405 range, after that date they became more uniform and often stayed above elevation 408. Table EA-4 presents the frequency of ponding at various ponding intervals before and after the onset of intentional ponding. Figure EA-10 displays the recorded ponding elevations over time, along with corresponding elevations in the adjacent Mississippi River at the Mel Price pool and tailwater.

3.8 Noise

The Metro-East area includes industrial, transportation, recreational, residential, retail and agricultural zones. These areas are dispersed in pockets of varying sizes and density, and each makes its own contribution to the noise characteristics of the region. Agricultural and open

Table EA-4. Frequency of Ponding at Various Elevation Intervals in the Pump Station's Ponding Area.

Ponding Interval	Pre Interim Ponding (07 Dec 2009 – 31 Mar 2010)		Interim Ponding (01 Apr 2010 - 31 Jan 2012)	
	Frequency (%)	**# days total**	**Frequency (%)**	**# days total**
<408	51.6	59.3	39.8	254.9
408-410	44.8	51.5	38.0	243.1
410-412	3.6	4.2	15.3	97.7
412-414	0.0	0.0	6.9	44.3
414-415	0.0	0.0	0.0	0.0
>415	0.0	0.0	0.0	0.0
	100.0	115.0	100.0	640.0

space areas typically have noise levels in the range of 34-70 decibels (dB) depending on their proximity to transportation arteries. Noise associated with transportation arteries such as highways, railroads, etc., would be greater than those in rural areas. Other sources of noise include operations of commercial and industrial facilities, and operation of construction and landscaping equipment. In general, urban noise emissions do not typically exceed about 60 dB, but may attain 90 dB or greater in busier urban areas or near high volume transportation arteries.

In the upper drainage and levee district, most noise is generated by traffic using Illinois Highway 143 and other nearby routes in Alton and East Alton. Noise generated by tows passing through Melvin Price Locks and Dam intermittently is shielded by the levee.

Interim Risk Reduction Measures. Noise was generated during construction activities in April-May 2010, and was created by construction equipment used to establish a short access road at Dike B and place rock at all three dike sites. Also, trucks transported the rock to the construction sites from local commercial sources. These noise impacts were of short duration and minor.

3.9 Prime Farmland

According to the digital soil survey of Madison County (NRCS, 2010), in the upper levee-protected area, most soils are classified as "not prime", including along the landside toe of the riverfront levee. There are relatively small areas within the protected area at some distance from the riverfront levee that are classified as "prime" and "prime if drained". However, the entire

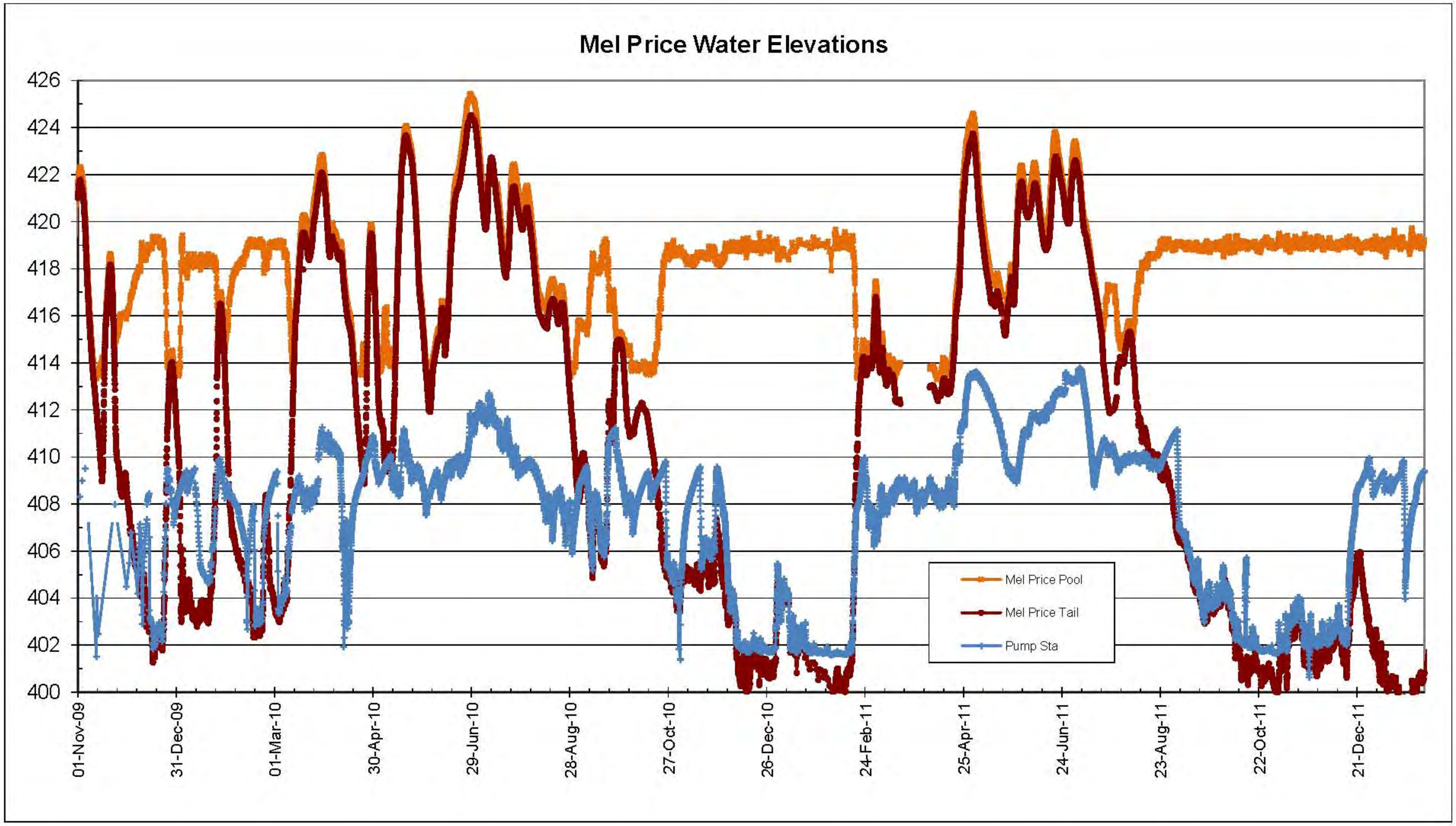


Figure EA-10. Ponding Elevations in the Pump Station's Ponding Area.

levee-protected area is zoned for nonagricultural use (USACE, 1986). There are no prime farmland soils outside the upper Wood River levee system and along the Mississippi River.

Interim Risk Reduction Measures. Because land zoned for agricultural use does not exist within the upper levee-protected area, the interim measures have not affected this resource.

3.10 Biological Resources

Various biological resources occur adjacent to and within the upper levee-protected area. Aquatic resources bordering the exterior of the levee system include the Mississippi River along the riverfront levee, Wood River Creek along the southern end of the protected area, and narrow areas of forested wetlands along the channel of Wood River Creek. A variety of aquatic and terrestrial resources occur within the upper levee-protected area, and they are concentrated in the vicinity of the pump station's 250-acre ponding area along the landside of the riverfront levee.

Wetlands are protected by the Clean Water Act of 1977, as amended, and Executive Order 11990 of 1977, Protection of Wetlands. Project-related wetland losses require compensatory mitigation or replacement in accordance with Corps of Engineers' requirements. Project-related losses of bottomland hardwood forests also require compensatory mitigation or replacement in accordance with Corps of Engineers' requirements. These forests are drier and do not meet the definition of a wetland because they occur on slightly higher ground that is better drained.

The various aquatic and terrestrial resources supported in the vicinity of the pump station's ponding area are described below. Their spatial distribution and relative abundance has been approximated using geographic information systems technology. A cover type map of the project vicinity (Figure EA-11) was superimposed upon various ponding depths (Figure EA-4) to estimate the location and amounts of various habitats in each ponding zone (Figure EA-12, Table EA-5).

Aquatic Habitats. Various types of aquatic habitats are present in the roughly 250 acre ponding area of the East Alton pumping station. The maximum ponding elevation is elevation 415.8 feet. These aquatic habitats are remnants of the islands and side channels that historically existed in this location before the levee system was constructed in the 1950s and 1960s. According to historic aerial photos from the early 1940s, the islands in this vicinity were not densely tree-covered but appeared to be used primarily as pasture, with some areas of trees and shrubs.

According to the digital soil survey for Madison County, Illinois (NRCS, 2010), the soil in the ponding area is considered to be a hydric or wetlands soil. This soil is 1070L, "Beaucoup silty clay loam, undrained, 0 to 2 percent slopes, occasionally flooded, long duration". According to NRCS (2004), this particular soil was formed from alluvium of silty clay loam, is considered to be very poorly drained, and meets the definition of hydric or wetlands soils. The upper limit of the water table is considered to typically occur within 12 inches of the ground's surface during all months of the year. This soil coincides with that portion of the ponding area below approximate elevation 412 feet.

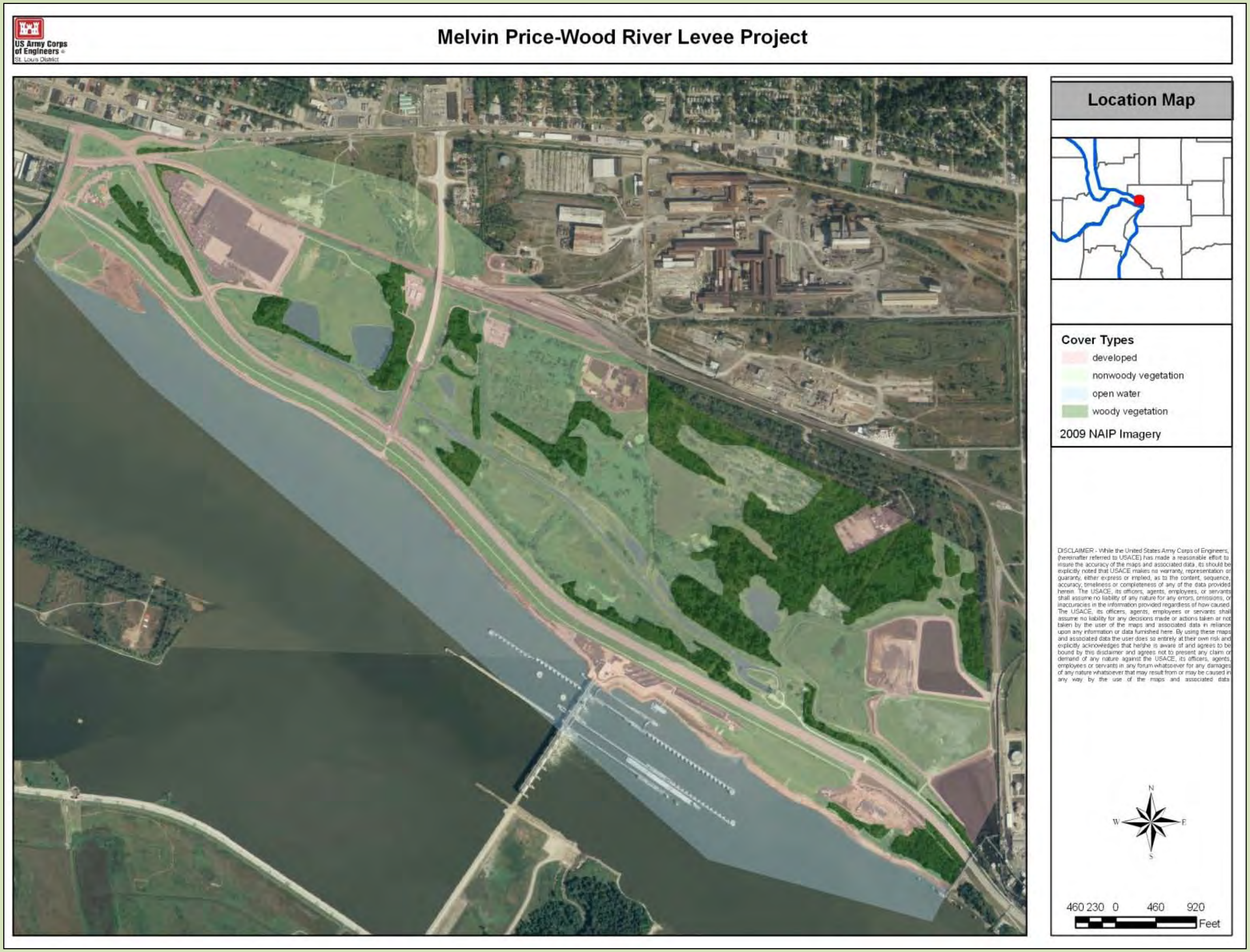


Figure EA-11. Cover Types in Project Area.

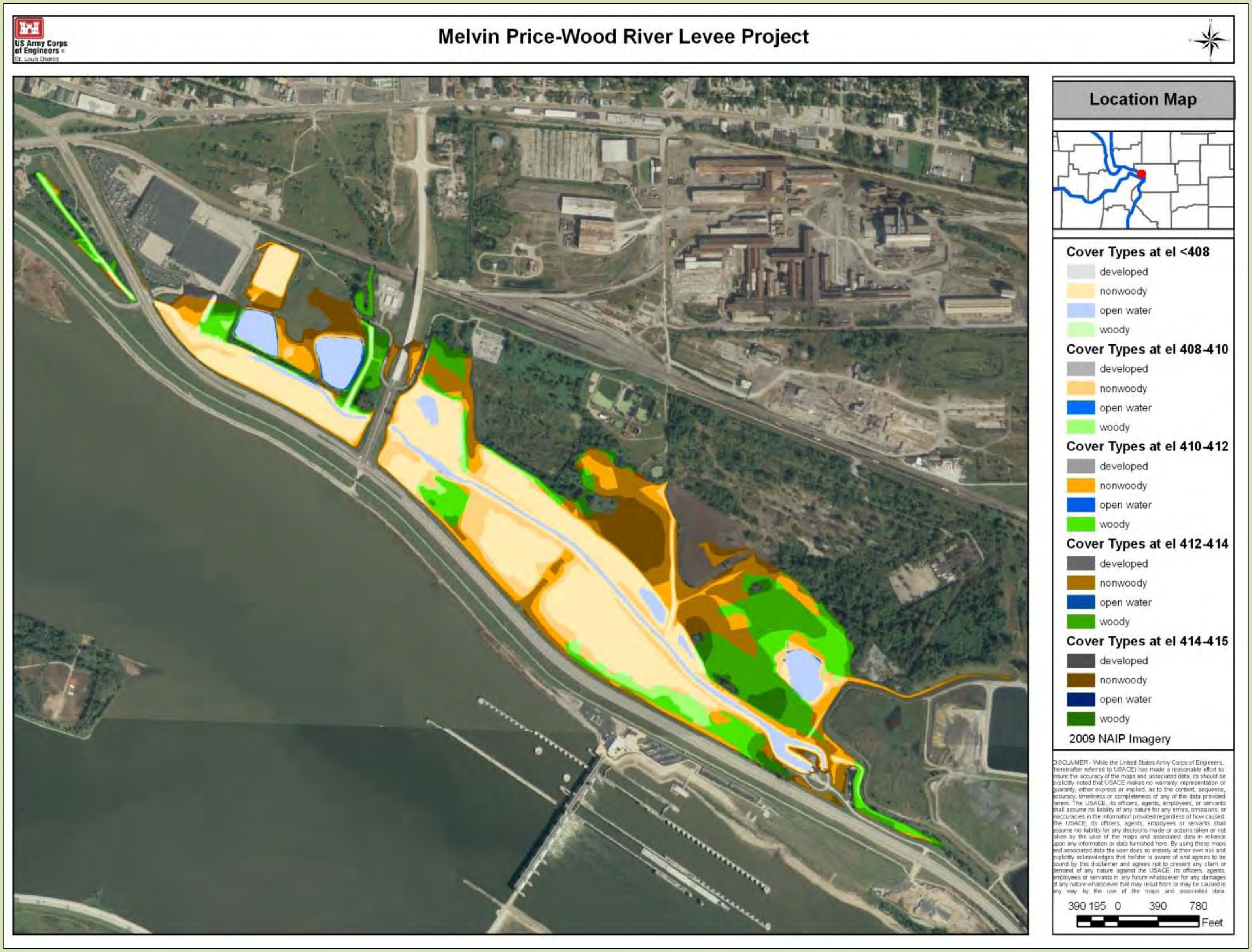


Figure EA-12. Distribution of Cover Types by Elevation within Ponding Area.

Open water wetlands. These wetlands occupy the lowest topography, and are represented by standing water and mud flats. When the ponding area is not storing storm water, standing water typically is found in the drainage ditch leading to the East Alton pumping station and in scattered low areas adjacent to the ditch. Water depths are typically less than two feet. Poor water quality due to urban runoff and intermittent combined sewer outflows prohibits the growth of submerged aquatic vegetation in these areas. Mud flats border the standing water at a slightly higher elevation, and they are broad and barren of any vegetation. These wetlands experience very frequent fluctuations in stormwater ponding. They occur below approximate elevation 406 feet.

Scrub-shrub wetlands. This wetland type occurs in areas slightly above the mud flats and is characterized by a dense growth of woody shrubs such as buttonbush (*Cephalanthus occidentalis*) and indigo bush (*Amorpha fruticosa*). These wetlands are a minor component and they occur in irregularly shaped areas. These wetlands also experience very frequent fluctuations in stormwater ponding. Scrub-shrub wetlands occur below approximate elevation 407 feet.

Table EA-5. Cover Types by Ponding Elevation (in feet NGVD).

Ponding Elevation	Cover Type (acres)				Total
	Open Water	Non woody	Woody	Developed	
< 408	18.0	68.1	1.9	0.0	88.0
408 - 410	0.6	19.1	6.3	0.0	26.0
410 - 412	0.2	19.7	15.0	0.1	35.0
412 - 414	0.1	27.7	23.9	0.2	51.9
414 - 415	0.0	16.9	8.5	1.0	26.4
Total	18.9	151.5	55.6	1.3	227.3

Deep and shallow marsh wetlands. Prior to about 2009, marshes typically bordered the mudflats on slightly higher ground along both sides of the ditch leading to the pump station. On the levee side of the ditch, they typically occupied relatively large broad areas that extend toward the levee. Cattail (*Typha latifolia*) is the dominant plant. Shallow marshes support a dense growth of cattails, whereas in deep marshes the plants are interspersed by areas of open water. These wetlands experience frequent to somewhat frequent fluctuations in stormwater ponding. Deep marshes occur in the approximate elevation range of 407-408 feet, and shallow marshes in the approximate range of 408-410 feet.

It should be noted that the condition of the marshes on the levee side of the ditch has changed recently and most likely in response to the uncontrolled underseepage condition. When the uncontrolled underseepage condition first developed is uncertain, but it was first noted by the St. Louis District in the summer of 2009. Although site conditions have not been monitored regularly over the last several years, marshes in this area were noted to be well represented by cattail vegetation in the summer of 2007. However, in late 2009, prior to the start of interim ponding, much of the cattail vegetation located between the levee and the ditch was gone and replaced by mud flats. This is the area of uncontrolled underseepage (see Figure EA-3). It is reasonable to believe that the underseepage condition (the constant uplift of groundwater to the ground surface) has caused the disappearance of much of the cattail vegetation on the levee side of the ditch (and not the interim ponding, as discussed in Section 4.1 Biological Resources).

Wet meadow wetlands. This wetland type occurs on relatively high ground and supports mainly herbaceous vegetation consisting of a dense growth of forbs (such as smartweeds, *Polygonum* spp.), grasses and sedges (*Carex* spp.). Woody species typically consist of scattered tree saplings, such as green ash (*Fraxinus pennsylvanica*) and silver maple (*Acer saccharinum*). It is another minor component, and is most common along the landside toe of the levee in a relatively narrow band, where it intercepts groundwater seepage. Wet meadows are affected somewhat frequently to infrequently by stormwater ponding. They occur in the approximate elevation range of 410-412 feet.

Wet and wet-mesic bottomland forest wetlands. These forested wetlands are a relatively minor component along the landside of the riverfront levee. They typically border areas of deep or shallow marsh, and often occur near the landside toe of the levee. Because wet bottomland forest occupies slightly lower elevations and is wetter, it supports a lower diversity of tree species, such as willow (*Salix* sp.), silver maple, and green ash. Groundcover may not be present at all or may be represented by a discontinuous layer of various sedges, forbs, and grasses. Wet-mesic bottomland forest occupies higher ground, and often supports a greater diversity of tree species, including silver maple, green ash, cottonwood (*Populus deltoides*), red mulberry (*Morus rubra*), and dogwood (*Cornus* sp.). Hard mast tree species such as oaks and hickories are not represented in this type of forest, although they were present historically and provided an important food source to some wildlife species such as turkey and deer. Groundcover is typically dense, notably taller, and similarly greater in herbaceous plant diversity. Wet bottomland forest experiences frequent to somewhat infrequent fluctuations in stormwater ponding. Wet-mesic bottomland forest is infrequently affected, and intercepts groundwater seepage where it occurs along the landside toe of the levee. Wet bottomland forest occurs in the approximate elevation range of 408-410 feet, and wet-mesic forest in the range of 410-412 feet.

Terrestrial Habitats. Terrestrial habitats are non-wetland habitats for which site conditions do not meet the federal criteria for positive indicators of wetland vegetation, soils, and hydrology (USACE, 2010a, 2010c). In the landside area along the levee they include floodplain or bottomland forest and old fields as well as grassy areas.

Bottomland forest. Floodplain forest occupies elevations above approximate elevation 412 feet, and rarely experiences ponding of stormwater. Because of the relatively high ground elevations, this type of forest generally does not intercept groundwater seepage from the levee as sheet flow. Also, the tree roots are usually high enough above the prevailing groundwater table to not be influenced by saturated soil conditions. Tree species that are typically present overlap with those of wet-mesic bottomland forest, and include additional species such as hackberry (*Celtis* spp.) and black locust (*Robinia pseudoacacia*). Groundcover is usually very dense and includes a number of tall forb species such as aster (*Aster* spp.). This type of forest occurs in the vicinity of the East Alton pump station, at various locations on the north side of the ditch leading to the pump station, and along the smaller ditches that feed into the main ditch. Like wet-mesic bottomland forest, this forest also does not include hard mast tree species such as oaks and hickories that were present historically and provided an important food source to some wildlife species such as turkey and deer.

Old fields, Grassy areas. Old field habitat represents areas previously cleared of trees or formerly developed sites. Like bottomland forest, it occupies sites that are above approximate elevation 412 feet. A small amount of old field habitat is located between the levee and ditch to the pump station, but most occurs on the north side of the ditch. Similarly, maintained grassy areas occur at higher elevations, such as along the sideslopes of the levee and Highway 143 or in the vicinity of the pump station.

Fish and Wildlife. The Mississippi River is an aquatic resource of major significance, and provides habitat to numerous species of invertebrates, fish, birds, and other animals.
A variety of animal species uses the area on the landside of the levee. Most wildlife species are adapted to human disturbance or tolerant of fragmented habitats or poor water quality, and consist of a variety of amphibians, reptiles, birds, and mammals. For example, fishes observed in the open water wetlands are tolerant of high turbidity, and include mosquito fish and carp. Wading birds such as the great blue heron (*Ardea herodias*) and great egret (*Ardea alba)* typically feed along the ditch and shallow ponded areas. Turkey may also be found in the ponding area, and red-winged blackbirds use the marshes. The open water and herbaceous wetlands serve as resting and feeding areas for some migratory ducks and geese. Larger mammals include raccoon, opossum, and deer.

Bald eagles winter along the major rivers of Illinois and Missouri, and at scattered locations some remain throughout the year to breed. Perching and feeding occurs along the edge of open water, from which eagles obtain dead fish. The Mississippi River is a focal point for wintering eagles, especially upriver of the project area north of Alton. Nesting has been observed on islands near the confluence with the Illinois River, further upriver from Alton, and also at other locations. The bald eagle was removed from the List of Endangered and Threatened Species in August 2007 but it continues to be protected under the Bald and Golden Eagle Protection Act and by the Migratory Bird Treaty Act. Recommendations to minimize potential project impacts to the bird and its nest are provided by the U.S. Fish and Wildlife Service in that agency's National Bald Eagle Management Guidelines publication (USFWS, 2010b). Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. Specifically, construction activity is prohibited within 660 feet of an active nest during the nesting season, which in the Midwest is generally from late January through late July. There is one known nest in the vicinity of the Wood River levee system and Mel Price Locks and Dam. It was last used in 2006.

Interim Risk Reduction Measures.

Direct Impacts. Direct impacts associated with the construction of the three rock dikes in early 2010 include the temporary loss of about 0.5 acre of aquatic resources, and the permanent loss of about 0.5 acre of terrestrial resources. Both of these impacts are minor and details are given below.

The three rock dike structures were constructed in herbaceous or open water wetlands. Dikes A and B are located in man-made ditches (a water of the United States) and each has a footprint of about 0.05 acre. Dike C, the largest of the three structures, has a footprint of about 0.4 acre in the main ditch leading to the pump station. After these dikes were initially constructed, a substantial rainfall event occurred and stormwater overtopped these structures, causing damage at each one by scouring away some rock. This dislodged material was washed downstream and soon replaced at each structure. The dikes are needed until a permanent underseepage solution is constructed. The expected duration of this temporary impact is about 6 years (2010-2016). The affected sites would be restored to their original condition after the permanent underseepage solution is completed.

At Dike B, about 0.5 acre of terrestrial bottomland hardwood forest was cleared to allow access for equipment to construct the dike. The crushed rock access road was aligned to avoid removal of larger trees. About 42 trees were cleared in early April 2010, and affected tree species include hackberry (*Celtis occidentalis*), honey locust (*Gledistia triacanthos*), cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), red mulberry (*Morus rubra*), American elm (*Ulmus americana*), and red bud (*Cercis canadensis*). The average tree diameter at breast height (dbh) was about 7 inches (range 4-20). One large hollow cottonwood (dbh = 44 inches) was removed for safety reasons. Mitigation for this 0.5 acre loss is discussed in Section 4.10.

Indirect Impacts. Wetland vegetation has become stressed by the intentional ponding of seepage and storm waters in the pump station's ponding area. The elevated ponding levels and extended ponding durations have caused observable effects in various wetland plant communities during the 2010 growing season. The average growing season for the St. Louis area is defined as the period from 1 April to October 15 (198 days).

Ponding elevations in the pump station's ponding area are displayed in Figure EA-7 for time periods before and after the onset of intentional ponding as an interim underseepage control measure, which occurred about 29 March 2010. Whereas ponding elevations prior to that date fluctuated and often dropped down to 403 and 405 feet, after that date they became more uniform and often stayed above 408 feet. As shown in Table EA-6, ponding was maintained during the 2010 growing season between elevations 408 and 410 for more than 100 total days (not consecutive), and between elevations 410 and 412 for over 45 total days (not consecutive).

Table EA-6. Frequency of Ponding in the Pump Station's Ponding Area at Various Elevation Intervals during the Growing Season.

Ponding Interval	01 Apr - 15 Oct 2010		01 Apr - 17 May 2011	
	Frequency (%)	# Days Total	Frequency (%)	# Days Total
<408	18.1	35.9	2.4	1.1
408-410	55.5	109.8	39.8	18.3
410-412	24.1	47.7	20.5	9.5
412-414	2.3	4.6	37.3	17.1
414-415	0.0	0.0	0.0	0.0
>415	0.0	0.0	0.0	0.0
Sum	100.0	198.0	100.0	46.0

As of early October 2010, effects on vegetation were noted in scrub-shrub and wet bottomland forest wetlands. In the buttonbush scrub-shrub wetlands, ponding has caused a dramatic visual effect on the vegetation. The lower half of the shrubs in these thickets exhibits a complete loss of leaves, whereas the upper half of these woody plants remains green. In the wet bottomland forest community, trees generally display signs of stress in their leaves. These symptoms vary from tree to tree and across species, and include yellowing, early leaf drop, or partial death of individual leaves. Signs of stress are generally not apparent in wet-mesic bottomland forest wetlands within the ponding area.

The ponding of water in wetlands for extended periods of time can stress wetland vegetation, which in turn can slow individual plant growth; shift plant species composition over time to those more tolerant of flooding; increase susceptibility of woody species to invasion by boring insects and disease, which can lead to early death; or cause mortality due to waterlogged soils that prevent oxygen from reaching root systems that is needed for respiration (Baughman 2010). If the current ponding regime would continue for the next 6 years until the final underseepage repairs are completed (scheduled for early 2016), the scrub-shrub wetlands may survive, but trees comprising the wet bottomland forest wetlands are expected to die. Based upon the spatial distribution of woody covertypes within the ponding area and water surface elevation ponding data collected into May 2011, this expected tree mortality is likely to envelop an estimated 25 acres of wet and wet-mesic bottomland forest (Table EA-5). Mitigation for this loss is discussed in Section 4.10 and Appendix C of this SEA.

Coordination and Environmental Compliance. In November 2009, the St. Louis District notified the Illinois Department of Natural Resources, Illinois Environmental Protection Agency, and U.S. Fish and Wildlife Service of the underseepage project, including the likelihood that the District would declare an emergency to implement interim measures, and that interim ponding had the potential to adversely affect local vegetation. The agencies were also informed that an Environmental Assessment would be prepared addressing the interim and final measures, and that the long-term solution would require issuance of a public notice to allow for a more extensive review of possible impacts. The District’s Regulatory Branch authorized the construction of the three rock dikes under Nationwide Permit #30 (Maintenance of Existing Flood Control Facilities) of Section 404 of the Clean Water Act in early 2010. Nationwide Permit #30 is not to be used for projects requiring mitigation, and the impacts addressed in this SEA are more extensive than originally anticipated.

3.11 Threatened and Endangered Species

In compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, the St. Louis District initiated coordination with the U.S. Fish and Wildlife Service in November 2009, and obtained a listing of federally threatened or endangered species, currently classified or proposed for classification that may occur in Madison County, Illinois, in the vicinity of the Wood River levee system (USFWS 2010). Six species listed for this county are applicable to the project area (Table EA-7). There is no designated critical habitat within Madison County for any of these species.

Table EA-7. List of Federally Endangered (E), Threatened (T), and Candidate (C) Species in the Vicinity of the Project Area.

Common Name (Scientific Name)	Status	Habitat
Least tern (*Sterna antillarum*)	E	Sparsely vegetated sand and gravel bars on large rivers (nesting)
Indiana bat (*Myotis sodalis*)	E	Caves, mines (hibernacula); small stream corridors with well developed riparian woods, upland forests (foraging)
Pallid sturgeon (*Scaphirhynchus albus*)	E	Large rivers
Decurrent false aster (*Boltonia decurrens*)	T	Disturbed alluvial soils
Eastern massasauga (*Sistrurus c. catenatus*)	C	Floodplain forests, marshlands, bogs, and old fields,
Eastern prairie fringed orchid (*Platanthera leucophaea*)	T	Mesic to wet prairies

The following discussion addresses the potential presence and life habits of these six federally listed species within the vicinity of the Wood River levee system.

Least tern. Nesting colonies of the least tern have been recorded in southern Illinois from Jackson and Alexander counties (Herkert, 1992). The least tern has occasionally been observed in the Metro-East area at Horseshoe Lake during spring migration (McMullen 2001). The only known nesting habitat of the least tern that occurs in the vicinity of the project area is an abandoned barge located near Melvin Price Locks and Dam. This bird forages for small fish in shallow water areas along the river and in backwater areas, such as side channels and sloughs. Foraging and nesting habitat are located in close proximity to each other. From late April to August, least terns nest on sparsely vegetated alluvial or dredge spoil islands and sand/gravel bars in or adjacent to rivers, lakes, gravel pits and cooling ponds. They nest in colonies with conspecifics and sometimes with the piping plover (*Charadrius melodus*). Nesting locations usually are at the higher elevations and away from the water's edge. Dams, reservoirs, and other changes to river systems have eliminated most historic least tern habitat. Narrow forested river corridors have replaced historical wide channels dotted with sandbars that are preferred by the terns. Furthermore, recreational activities on rivers and sandbars disturb the nesting terns, causing them to abandon their nests.

Indiana bat. Indiana bats winter in caves or mines, but such features used by this bat are not known in the Metro-East area (Herkert, 1992). Females use trees in the summer months as nursery roosts, and forage for insects in the tree canopy. The presence of this species within the project area during the maternity season is assumed. Trees preferred for maternity roosting in Illinois have included dead individuals with shaggy or loose bark, and diameters at breast height (dbh) greater than 9 inches. Species have included slippery elm, American elm, northern red oak, white oak, post oak, shagbark hickory, bitternut hickory, cottonwood, silver maple, green ash, white ash, and sycamore (Hofmann, 1994). Live shagbark hickory trees with loose bark or cavities are also used. Males have been known to roost in single oak, sassafras, and sugar maple (Hofmann, 1994). Some dead cottonwood, silver maple and sycamore greater than 10 inches dbh are present near the railroad embankment and the riverside depressions.

Pallid sturgeon. This fish is found in the Mississippi River downstream of its confluence with the Missouri River, which is about 4 miles downriver of the Melvin Price Locks and Dam. The entire stretch of river below the mouth of the Missouri River is considered potential habitat. Pallid sturgeon are most frequently caught over a sand bottom, which is the predominant bottom substrate within the species' range on the Missouri and Mississippi rivers. Pallid sturgeons have been found in water 1.2 to 7.6 meters deep with velocities of 0.33 to 90 centimeters per second (USFWS 1993). These data probably better reflect where data have been collected rather than actual habitat preferences. Recent tag returns have also shown that the species may be using a range of habitats in off-channel areas, including tributaries of the Mississippi River.

Decurrent false aster. The decurrent false aster is a perennial floodplain plant of open, wetland habitats, and its distribution includes Madison and St. Clair counties, Illinois (USFWS 2001). Historically it occurred in wet prairies, shallow marshes, and shores of rivers, creeks, and lakes on the floodplain of the Illinois and Mississippi Rivers (Schwegman and Nyboer 1985). Currently it is found most often in old agricultural fields and along roadsides and lake shores where alluvial soils have been disturbed (USDOT 2000). This plant is an early successional species that requires either natural or human disturbance to create and maintain suitable habitat. In the past, the annual flood/drought cycle of the Illinois and Mississippi rivers provided the natural disturbance required by this species. Annual spring flooding created open, high-light habitat and reduced competition by killing other less flood-tolerant, early successional species. Field observations indicate that in “weedy” areas without disturbance, the species is eliminated by competition within 3 to 5 years (USFWS 1990). *Boltonia decurrens* has high light requirements for growth and seed germination (Smith *et al.* 1993, Smith *et al.* 1995), and shading from other vegetation is thought to contribute to its decline in undisturbed areas. Seeds of this plant can be dispersed by flooding, or carried by wind and animals (Keevin, 2010).

Records of this plant occur to the south of the Wood River Drainage and Levee District in the Metro East area. These sites “are predominantly located on old or mowed fields, in wetlands, or on the edges of active fields, farm facilities, golf courses, or a railroad” (USDOT 2000:60).

Eastern massasauga rattlesnake. This rattlesnake, a candidate for listing, is known from the historic floodplain of the Mississippi River in the Metro East area near Horseshoe Lake, to the south of the Wood River Drainage and Levee District. The massasauga or pygmy rattler historically lived in prairies of the Midwest, apparently in the wetter areas, and today inhabits old fields, floodplain forests, marshlands, and bogs. It is active from April through October, and often suns on clumps of grass, in branches of small shrubs, or near crayfish burrows. It feeds on small rodents, and overwinters in crayfish burrows, hibernating until spring.

Eastern prairie fringed orchid. Also known as the prairie white fringed orchid, this species formerly occurred over much of north and central Illinois, including Madison County, but is now confined to the northeast corner of the state (Herkert 1991). This plant is found in mesic to wet prairies located on uplands and in river valleys. It may be present wherever prairie remnants are encountered. There are no known prairie remnants on the historic floodplain of the Mississippi River in the Wood River levee protected area.

Interim Risk Reduction Measures. It is the St. Louis District's opinion that implementation of the interim risk reduction measures consisting of construction of the three rock dikes, clearing of about 0.5 acre of terrestrial bottomland forest, and intentional ponding of water in the pump station's ponding area has not adversely affected any of the six listed species. With respect to the Indiana bat, tree clearing was completed within the first week of April 2010, and no trees that were felled displayed suitable roost tree characteristics, except for the large hollow cottonwood. Likewise, this phase of the project has not affected the bald eagle or the known bald eagle roost tree in the vicinity of the levee. Information supporting this determination of no adverse effect is also included in the discussion of potential effects for final risk reduction measures provided in Section 4.11.

3.12 Recreation

Madison County Transit supports a system of recreational trails in Madison County that are used for walking, running, roller-blading, and cycling (MCT, 2010). The Confluence Trail follows the top of the riverfront levee along the Mississippi River. This trail extends nine miles from the Cahokia Creek Diversion Channel at the south to Alton at the north, and passes by the Melvin Price Locks and Dam. The trail is crossed at a number of locations by public and private roads. A two-mile extension branches off at Wood River Creek and follows the creek upstream to about Illinois Route 3. A second trail, the Watershed Trail, occurs in the southeast portion of the lower levee and drainage district and was built along an abandoned rail corridor.

Interim Risk Reduction Measures. The construction of the three rock dikes and establishment of interim ponding has not affected the Confluence Trail on top of the levee along the Mississippi River or any other recreational resource.

3.13 Aesthetics

Aesthetic resources are represented by those aspects of the natural and human environment that are pleasant or pleasing to people, especially to look at. For many people aesthetic resources include the natural channel of the Mississippi River, undeveloped open spaces such as agricultural lands, natural habitats, and some development, such as residential areas. The project area's industrial areas are expected to be aesthetically attractive to relatively few people.

Interim Risk Reduction Measures. Dikes B and C are visible from Highway 143, but their relatively small size does not present much visual impact. Elevated ponding of extended duration is also noticeable by the public driving by on Highway 143 and Cut St. because this condition deviates from normal. The overall effect of the interim measures on aesthetics is considered to be minor because the area has functioned as a ponding area for decades.

3.14 Historic Properties

The project area was surveyed by Sydney J. Danny in 1974 (IHPA Document #1432) in preparation for the construction of Melvin Price Locks and Dam. The survey included the project area from the banks of the river and a quarter of a mile inland. Danny found no evidence of archaeological sites in the area and interviews of local artifact hunters indicated that no artifacts had been found in the area in the last 50 years.

The lack of sites in the area is attributable to the low-lying, swampy land surface. Prior to the construction of the levee system, the project area would have been annually flooded. The 1892 map of the Missouri River commission (Figure EA-13) indicates that the project area was composed of swamps prior to the construction of the levees.

In addition to the lack of previously reported sites, the area on the landward side of the levee was disturbed during construction with some of the fill being taken from this area.

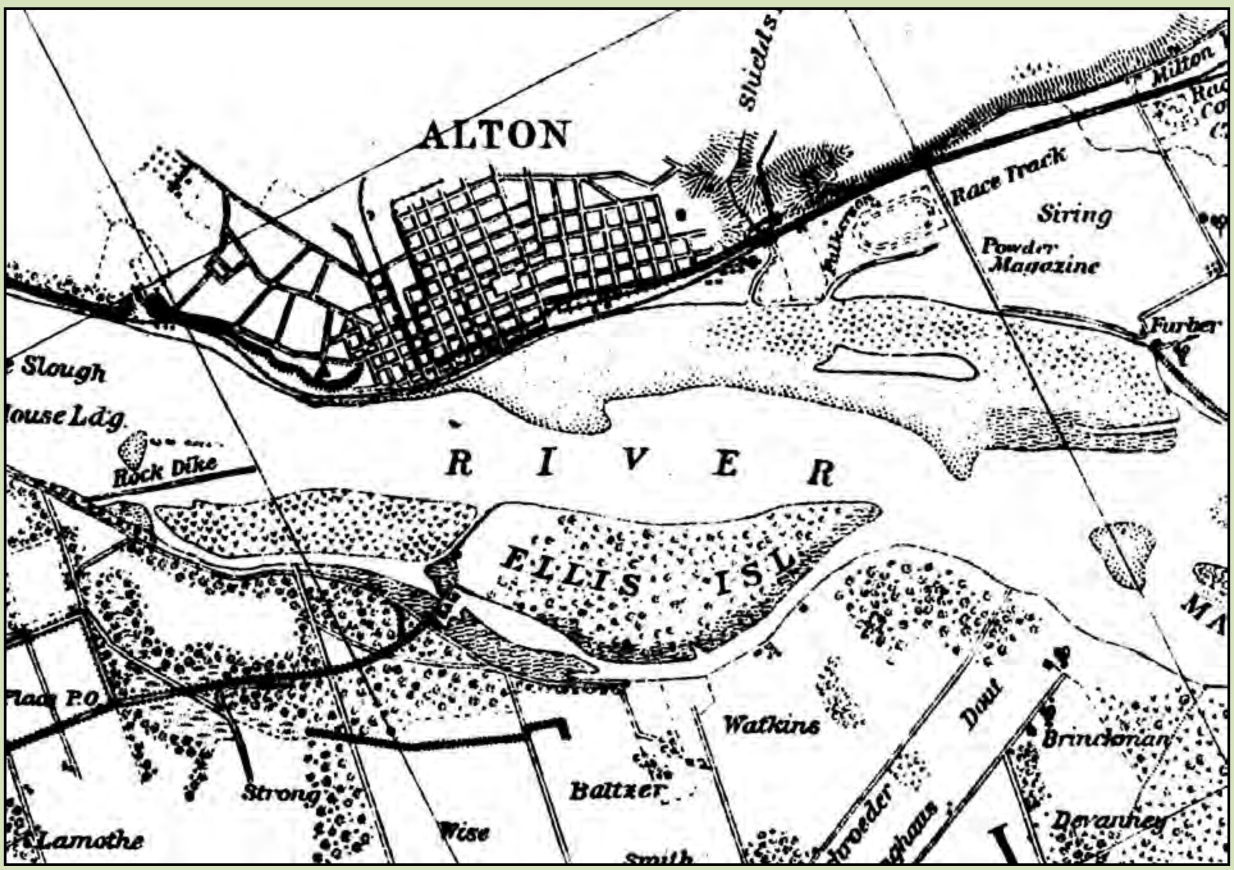


Figure EA-13. Missouri River Commission map of the project area, 1892.

Interim Risk Reduction Measures. The construction of the three rock dikes and establishment of interim ponding has not affected any historic properties.

3.15 Environmental Justice

Environmental justice refers to fair treatment of all races, cultures and income levels with respect to development, implementation and enforcement of environmental laws, policies and actions. The purpose of environmental justice analysis is to identify and address human health or environmental effects of actions proposed by federal agencies on resident minority and low-income populations. According to an inventory of buildings (Table EA-2), there are no residential structures within the upper levee-protected area. Therefore there is no residential population within the project area, and no need to address environmental justice for this project.

4.0 ENVIRONMENTAL CONSEQUENCES

The discussion of impacts (environmental consequences) details those resources that could be impacted, directly or indirectly, by the no-action alternative, and the proposed final risk reduction action, along with the alternatives to the proposed action. The no-action alternative includes continuing the operation of the interim flood risk reduction measures, but without implementation of any final risk reduction plan. The proposed final risk reduction plan is tentatively identified as the relief well-slurry trench cutoff wall alternative. The other final risk reduction alternatives include the relief well, seepage berm, and relief well-seepage berm options.

Direct impacts are those that would take place at the same time and place (40 CFR §1508.8(a)) as the action under consideration. Indirect impacts are those that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR §1508.8(b)).

The discussion of cumulative impacts considers the effects on the resource that result from the incremental impact of the action being considered when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taken place over a period of time (40 CFR §1508.7).

4.1 Socioeconomics

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.1, implementation of these interim measures in early 2010 has not affected any existing socioeconomic resources. Continuing the operation of these measures into the future is not expected to result in any new effects to socioeconomic resources.

Under the no action plan, development is expected to continue in the levee-protected portion of the project area. However, as the levee system’s features continue to degrade as a result of flood events and to exceed their performance life, the system's ability to operate as originally intended under future flood events becomes an even greater concern. If no action is taken, underseepage problems could cause interior flooding that can impact industries, infrastructure and interrupt the transportation system. The chances of a significant failure in the future increase under the no action alternative. Public safety will continue to be jeopardized.

Economic losses associated with failure of the Upper Wood River levee would consist of structure damages due to flooding and loss of navigation on the Mississippi River. With regard to damages due to overtopping, within the Upper Wood River levee protected area, total expected structure damages are estimated at $365 million. The number of commercial and industrial structures likely to be damaged is displayed in Table EA-2.

With regard to the potential loss of navigation on the Mississippi River, an initial levee breach would only delay navigation for an estimated three days as time would be needed for the pool to equalize with the main river. The much more significant risk is that the lower flank levee of the Upper Wood River levee system was not designed to keep water in, or maintain pool. If the Upper Wood River area was to fill with water, stress levels would be extreme on the lower flank, providing an opportunity for a failure below the Mel Price Lock and Dam. This lower flank failure would effectively create a side channel around the dam, causing a loss of pool and the ability for navigation. If this were to occur, a coffer dam would need to be built to allow for the levee to be repaired. Once this coffer dam was constructed, it would allow for the pool to be maintained once more. It is estimated that a coffer dam of this size would require 12 months for construction, resulting in a river closure time of 12 months.

Final Risk Reduction Measures

The following discussion describes the effects on socioeconomic resources of the Seepage Berm, Cutoff Wall, Relief Wells and Seepage Berm, and Relief Wells and Cutoff Wall (Proposed Action) alternatives. The effects of each alternative are considered to be essentially the same.

According to the U. S. Department of Housing and Urban Development, "Economic development is an important part of strengthening communities by creating and retaining jobs" (USDHUD, 2010). The creation of jobs that could reasonably be expected to occur or continue once the 100-year flood event level of protection is restored within the Metro East Levee System, would invariably lead to or complement other types of development such as single-family and multi-family housing, commercial and service industry, retail, and industrial developments.

Job creation would bring more people to the area, and more people would create a demand for services, thereby creating a demand for new, improved, and/or an expansion of infrastructure. Examples of infrastructure include roads and bridges; recreation and open spaces such as parks, sports facilities and community gardens; public or institutional facilities such as hospitals, airports, and cultural attractions; utility and sewer capacity; and health and human, and environmental services.

The Wood River Levee System falls within Madison County, Illinois, which is located in the southwestern part of the state. The East-West Gateway Council of Governments states that

“Southwest Illinois has more than $9 billion dollars in its economic development pipeline”; and that “in recent years the area has seen significant new investments in commercial, office and institutional projects across the region while major industrial facilities are reinvesting in and expanding their operations in the Metro East”. In addition, “public and private investment in the region’s infrastructure has created a transportation network that makes Madison, St. Clair, and Monroe counties prime locations for development and their development potential will only be enhanced upon completion of the new Mississippi River Bridge” (EWGCG, 2010b).

It is clear that “growth and development can improve quality of life by adding services, creating opportunity, and enhancing access to amenities. But it can also drive disinvestment, reduce competitiveness, and degrade the environment” (Smart Growth Network, 2010). “Smart growth”, techniques such as master planning, zoning, and land use planning enhance the safety and livability of communities through the efficient application of programs that balance growth and conservation.

USACE does not control what may be developed within the 100-year floodplain. It is the primary responsibility of local municipalities to control urban and rural growth and development within the project levee system’s districts. However, USACE in cooperation with Madison County will continue performing and be open to additional outreach initiatives with communities and municipalities about non-structural flood risk management measures that can help protect property and financial investments before a flood disaster happens.

Even with FEMA-certified structural levee protections in place (the Metro East Levee System); there is still a risk of flooding in the study area. From a risk standpoint, FEMA-certified protection from a 100-year flood event is loosely defined as the levee system provides protection from a computed level flood event having a probability of occurrence of 1.0 percent, or 1 chance (year) out of 100 (years), which is where the ‘100-year’ label comes from (i.e., once in 100 years). However, the specific definition is the FEMA-certified levee system in place, would provide protection against a computed level flood event having that 1.0 percent probability of occurrence *in any given year*. Hypothetically, if this 100-year or 1.0 percent level flood event occurred last year, there is still a 1.0 percent probability of this same level flood event happening this year, next year and every year thereafter. The risk of a 1.0 percent probability flood event is a very rare risk, yet every year that 1.0 percent risk of occurrence exists, as well as the risk of even rarer percentage probability, higher level flood events. Therefore, there are many non-structural measures that can be implemented and steps that can be taken by the counties, residents and business-owners to help reduce damage to homes, business and other financial investments within the floodplain to provide additional protection against such risk.

Non-structural measures can be used to help reduce damage from flood events. Such measures include elevating homes and businesses with foundation walls, piers, posts/columns, piles, and fill; non-structural floodwalls and levees; non-structural floodwalls and levees with closures; dry flood-proofing and wet flood-proofing; flood warnings such as sirens and posted signage; flood warning preparedness instruction; public service announcements about the risk of flooding; purchasing flood insurance; and possible relocation and buyout and acquisition options (USACE, 2010b).

It is reasonable to expect the project area to experience some increase in economic growth and development due to repair of the levee system because future plans depend on the levee repair keeping FEMA from de-certifying the levee districts; however, there is no indication that a rapid or significant increase in development will arise “solely due to” the repair of the levee or that an increase in economic growth and development will arise “in addition to” the growth and developments already slated to occur.

The “smart growth” management, planning initiatives, and code enforcement instruments already adopted or in draft form pending adoption, by Madison County, IL, include but are not limited to the following:

Comprehensive Plans and Comprehensive Land Use Plans, generally plan for growth and development up to twenty years in the future. Madison County’s 2020 Land Use Plan considers the preservation or construction of greenways; public preserves; designated urban areas; parks; wetlands; planned high and low density residential, commercial, retail, industrial areas; and preservation of agricultural areas and open spaces (MCG, 2010).

Short and Long Range Transportation and Growth Management Plans of Madison County study IL-255 interchanges and the widening of lanes, improved access management, improved street signal operations, proposed construction of new roads, and widening of roads (MCG, 2010).

Enterprise Zones, which are areas targeted for economic revitalization encourage economic growth and investment in distressed areas by offering tax advantages and incentives to businesses locating within the zone boundaries. Madison County plans for designated Enterprise Zones along the Mississippi River in the cities of Alton, East Alton, Wood River, Hartford and South Roxana, Granite City, Madison and Venice (MCG, 2010).

Ordinances enforce safety and enhance the livability of communities. Madison County enforces a Fill Ordinance, Liquor Ordinance, Noise Ordinance, Zoning Ordinance, Private Sewage System Ordinance, Recycling Ordinance, Storm Water and Erosion Control Ordinance, Subdivision Control Ordinance, Cell Tower Ordinance (MCG, 2010).

Detailed growth management and development plans for Madison County can be found at MCG (2010).

4.2 Topography and Geology

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.2, implementation of these interim measures in early 2010 has had minor effects on topography within the ponding area of the East Alton No. 1 pump station. Continuing the operation of these measures into the future is not expected to result in any new effects to topography or geology.

Under the no action plan, minor filling activities within the Upper Wood River levee protected area are expected for site development. Effects of a levee failure on topography within the upper levee protected area include the formation of localized scour holes and the broad deposition across the ground of sand and finer sediments by flood waters.

Final Risk Reduction Measures

Seepage Berm Alternative

Of the four alternatives, the Seepage Berm Alternative would affect topography the most. Existing ground elevations where berms would be constructed would be permanently raised. Berms would range in thickness from 6 to 9 feet and cover a total of about 60 acres (Figure EA-6). They would extend out from the landside toe of the levee for a distance varying from 250 to 500 feet. About 41 acres of borrow from an unidentified location would be needed to furnish topsoil to cover the sand used to construct the berms; borrow depth was estimated to be two feet.

Cutoff Wall Alternative

The Cutoff Wall Alternative would have relatively little effect on topography. A trench varying in depth from 110 to 145 feet deep and three feet wide would be excavated to the top of bedrock along the riverside of the embankment (Figure EA-6). After filling the trench with a cement-bentonite mixture, existing ground elevations would be restored. All materials excavated from the trench would be taken to a nearby 10-acre disposal area where it would be placed at an average depth of 5 feet (location displayed in Figure EA-6).

Relief Wells and Seepage Berm Alternative

The Relief Wells and Seepage Berm Alternative would affect topography to a lesser extent than the Seepage Berm Alternative. Existing ground elevations where berms would be constructed would be permanently raised. Berms would be about 5 feet thick and cover a total of about 36 acres (Figure EA-6). They would extend out from the landside toe of the levee for a distance varying from 150 to 250 feet. About 24 acres of borrow from an unidentified location would be needed to furnish topsoil to cover the sand used to construct the berms; borrow depth was estimated to be two feet. Installation of relief wells would have very minimal effects to topography.

Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan)

The Relief Wells and Cutoff Wall Alternative would have relatively little effect on topography. A trench varying in depth from 110 to 145 feet deep and three feet wide would be excavated to the top of bedrock along the riverside of the embankment (Figure EA-6). After filling the trench with a cement-bentonite mixture, existing ground elevations would be restored. All materials excavated from the trench would be taken to a 10-acre disposal area where it would be placed at an average depth of 5 feet. Installation of relief wells would have very minimal effects to topography.

4.3 Air Quality

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.3, implementation of these interim measures in early 2010 has had minor effects on air quality. Continuing the operation of these measures into the future is not expected to result in any new effects to air quality.

Because the St. Louis metropolitan area is a nonattainment area for ozone and PM-2.5, control strategies resulting in reduced emissions have been implemented across the region. Control measures targeted at transportation include physical improvements in regional transportations systems and management strategies to reduce hydrocarbons and carbon monoxide emissions from motor vehicles (EWGCG, 2010a).

Final Risk Reduction Measures

The following discussion describes air quality effects for the Seepage Berm, Cutoff Wall, Relief Wells and Seepage Berm, and Relief Wells and Cutoff Wall (Proposed Action) alternatives. The effects of each alternative are considered to be essentially the same.

For all alternatives, minor short term effects on air quality are expected during construction from exhaust and dust. Care would be taken to minimize all impacts on air quality, such as wetting down excavated materials/construction areas and wearing appropriate respiratory protection as needed. These impacts would cease once construction was completed.

A contingency plan would be developed to handle any unexpected encounters with contaminated materials and their potential effects on air quality. If ground disturbance during construction activities were to uncover unknown significant soil and/or groundwater contamination, certain contaminants can be volatilized, potentially causing impacts to air quality. If this were to occur, depending on site conditions, on-site construction workers may need to wear respiratory protection. Activities associated with stockpiling or handling contaminated soils could also cause impacts to air quality. Care would be taken to minimize soil contamination impacts on air quality, such as covering stockpiled materials or wetting down excavated materials.

4.4 Surface Water and Surface Water Quality

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.4, implementation of these interim measures since early 2010 has affected the ponding area of the East Alton No. 1 pump station by increasing ponding elevations and durations. No adverse changes to surface water quality have been noted. Continuing the operation of these measures into the future is not expected to result in any new effects to surface water or surface water quality.

Under the no action plan, the surface water quality within the vicinity of the project area has a wide variety of impairments. There is a general increasing trend in population and commercialization/industrialization within this larger area. Based upon this trend, surface water quality would most likely have additional impairment loads placed upon it over time.

Downstream receiving waters would then have increased impairment loads, which decreases water quality within those regions. Degrading water quality could result in a decreased amount of designated uses (USACE, 2003).

At the same time, the land use planning strategy in Madison and St. Clair counties includes adopting strict stormwater/watersheds management standards, working with various governmental entities to upgrade aging storm water drainage facilities in the Mississippi River floodplain, and extending public water and sewer facilities (USACE, 2003). These efforts are expected to result in some improvements in surface water quality coming from the watershed that drains into the upper levee protected area and the landside ponding area.

Final Risk Reduction Measures

The interim risk reduction measure consisting of ponding in the East Alton No. 1 pump station's ponding area would cease. As a result, there would be a decrease in the amount of water stored in the ponding area. This condition would be the equivalent of the surface water condition that was present in the ponding area prior to implementation of interim ponding in 2010.

Seepage Berm Alternative

Of the four alternatives, the Seepage Berm Alternative would have the greatest effect on surface waters in the ponding area. The berms would extend from the landside of the levee out into the ponding area and cover much of the existing main ditch, thereby decreasing the area of surface waters to the greatest extent of all alternatives.

Cutoff Wall Alternative

The Cutoff Wall Alternative would not affect surface waters in the ponding area at all.

Relief Wells and Seepage Berm Alternative

The Relief Wells and Seepage Berm Alternative would affect surface waters to a lesser extent than the Seepage Berm Alternative. The berms would extend from the landside of the levee out into the ponding area for a relatively short distance, and decrease the area of surface waters to a lesser extent than the Seepage Berm Alternative. Relief wells flowing during high river stages would introduce groundwater with iron and manganese into adjacent wetlands.

Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan)

The Relief Wells and Cutoff Wall Alternative would not affect surface waters in the ponding area at all. Relief wells flowing during high river stages would introduce groundwater with iron and manganese into adjacent wetlands.

The proposed action is not expected to cause short term impacts to surface water quality. Proper stormwater pollution prevention practices would be employed in construction areas where the ground surface is disturbed. If it becomes necessary to pump out groundwater or precipitation that fills cutoff wall excavations or relief well holes during construction, proper environmental protocols would be followed (e.g., any contaminated water would be tested and treated/properly disposed of if conditions warrant).

With regard to permitting requirements, the St. Louis District would need to receive from the Illinois Environmental Protection Agency (IEPA) a water quality certification issued under Section 401 of the Clean Water Act for the proposed action. Similarly, because proposed construction activities would disturb a relatively large ground surface area and could potentially affect water quality due to land erosion, the St. Louis District would also need to receive a National Pollutant Discharge Elimination System (NPDES) permit from the IEPA under Section 402 of the Clean Water Act. Issuance of these authorizations would need to precede the commencement of any work. The permit conditions contained in these authorizations specifying standard erosion control measures and any other measures deemed specific to the proposed action would be implemented to protect water quality.

4.5 Groundwater and Groundwater Quality

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.5, implementation of these interim measures since early 2010 has not changed any groundwater movement patterns or affected groundwater quality. Continuing the operation of these measures into the future is not expected to result in any new effects to groundwater or groundwater quality.

Under the no action plan, there is a general trend toward increasing population, commercialization and industrialization in the vicinity of the project area (USACE, 2003), and it is likely that overall groundwater quality will decline slightly over time due to the infiltration of surface water of declining quality.

Final Risk Reduction Measures

Automated monitoring of the ten piezometers that were installed in late 2009 at three locations along the seepage area would continue during construction and thereafter to assess the response of groundwater to the final risk reduction measures.

Seepage Berm Alternative

With regard to groundwater movement patterns, the Seepage Berm Alternative would not impede the prevailing movement of groundwater from the river underneath the levee toward the protected side, which occurs in a direction mainly perpendicular to the river’s channel.

With regard to groundwater elevations on the landside of the levee in the ponding area, they would no longer coincide with the ground’s surface, and instead would be permanently lowered by a few feet. Based on groundwater modeling using SEEP/W© 2007, a finite element software product for analyzing groundwater seepage, it is expected that groundwater surface elevations in the ponding area would remain relatively close to the ground surface when the Melvin Price pool is at normal elevation.

Cutoff Wall Alternative

With regard to groundwater movement patterns, the Cutoff Wall Alternative is designed to impede the prevailing movement of groundwater sideways from the river channel and then underneath the levee. This underground wall would be built parallel to the levee on the riverside of the levee's centerline for a distance of about 6,600 feet and extend from the ground surface down to the top of bedrock. Because neither end of the cutoff wall would tie underground into the Illinois bluff, groundwater from the river would flow around both ends and still reach the landside ponding area and vicinity, but in an indirect fashion. A relatively small amount of direct lateral movement of groundwater from the river would still occur through two 100-foot wide windows or gaps established where active utilities cross the levee. Relief wells installed on the landside of the windows would control underseepage by carrying groundwater at these two locations.

With regard to groundwater elevations on the landside of the levee, it is expected that groundwater surface elevations in the ponding area would be controlled by the surface elevation of water stored in the ponding area. Groundwater modeling using SEEP/W© 2007 indicates that current or without-project groundwater elevations are at the ground's surface. Figure EA-14 displays this condition at Sta. 112+30 (where a range of piezometers has been installed) for the Melvin Price pool at normal elevation (419 feet NGVD) and interior ponding at 406 feet NGVD. Figure EA-15 displays the modeled response of groundwater surface elevation at the same location and conditions with the cutoff wall in place.

<u>Relief Wells and Seepage Berm Alternative</u>

With regard to groundwater movement patterns, the Relief Wells and Seepage Berm Alternative also would not impede the prevailing movement of groundwater from the river underneath the levee.

With regard to groundwater elevations on the landside of the levee in the ponding area, it is expected that groundwater surface elevations in the ponding area would remain close to the ground surface.

<u>Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan)</u>

With regard to groundwater movement patterns, no change is expected in the reach of the proposed relief wells (Sta. 55+00 - Sta. 80+00), but the cutoff wall (Sta. 80+00 - Sta. 126+00) would impede groundwater movement patterns as described under the Cutoff Wall Alternative.

With regard to groundwater elevations on the landside of the levee in the ponding area, groundwater modeling using SEEP/W© 2007 for the reach of the proposed relief wells (Sta. 55+00 - Sta. 80+00) indicates that groundwater elevations are expected to remain close to the ground surface. In contrast, along the reach where the cutoff wall is proposed (Sta. 80+00 - Sta. 126+00), groundwater elevations are expected to be controlled by the surface elevation of water stored in the ponding area (see Figures EA-14 and EA-15).

With regard to groundwater movement patterns, the Relief Wells and Cutoff Wall Alternative is also designed to impede the lateral movement of groundwater underneath the levee. This underground wall would be about 4,700 feet long, and would have one 100-foot wide window or

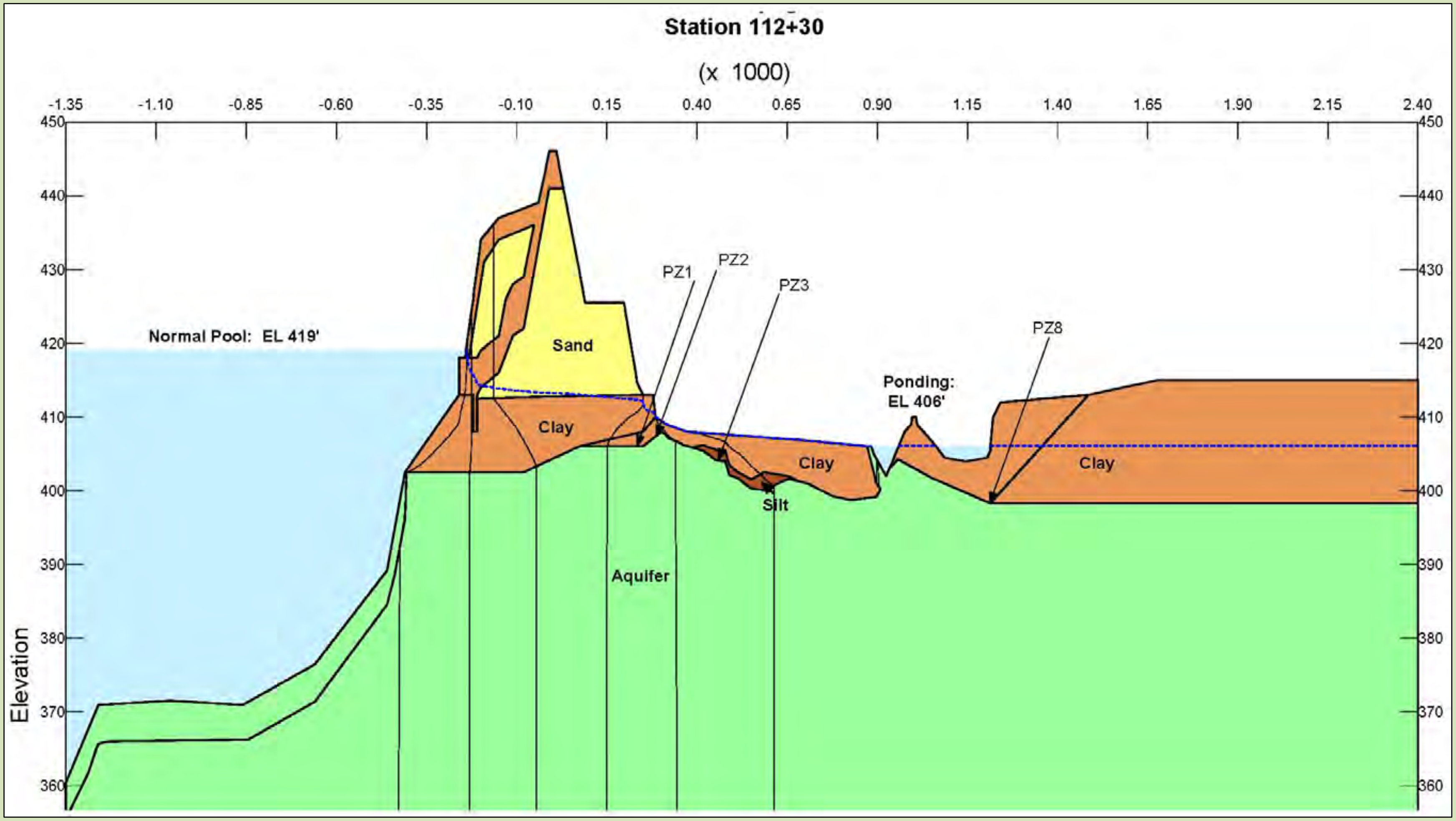


Figure EA-14. Modeled Groundwater Surface Elevation (dashed blue line) under Existing Conditions at Sta. 112+30.

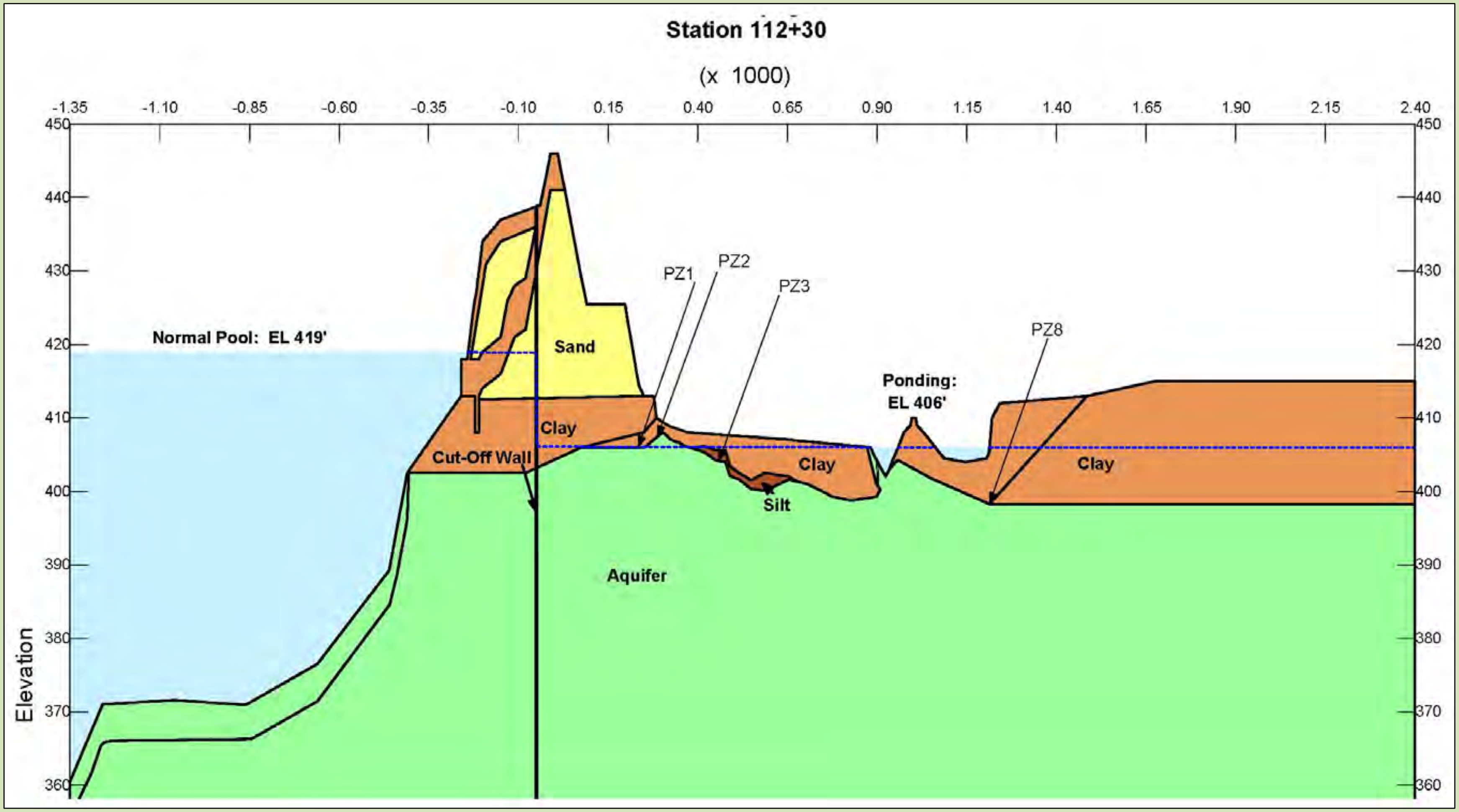


Figure EA-15. Modeled Groundwater Surface Elevation (dashed blue line) under Tentatively Selected Plan (cutoff wall) at Sta. 112+30.

gap established where an active utility crosses the levee. Relief wells installed on the landside of the window would control underseepage at this location.

With regard to groundwater elevations on the landside of the levee in the ponding area, it is expected that groundwater surface elevations in the ponding area would remain about two feet below the ground surface when the Melvin Price pool is at normal elevation.

None of the alternatives are expected to cause any impacts to groundwater quality.

4.6 Hazardous, Toxic, and Radioactive Wastes

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.6, implementation of these interim measures since early 2010 has not affected any hazardous, toxic, or radioactive wastes. Continuing the operation of these measures into the future is not expected to result in any new concerns related to these kinds of wastes.

Final Risk Reduction Measures

The Cutoff Wall Alternative, Relief Wells and Seepage Berm Alternative, and Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would disturb both soil and groundwater, and all have the potential to encounter HTRW material if it is there. However, the Cutoff Wall Alternative and Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would disturb a greater amount of soil and therefore have a greater potential to encounter HTRW material. Construction of the Seepage Berm Alternative would only disturb the surface of the soil and thereby would have the least likelihood of encountering HTRW material in the landside ponding area.

A contingency plan would be developed to handle any unexpected encounter with contaminated materials. During construction of the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan), excavated materials would be monitored to determine if any contaminants of concern are present that might require such materials to be considered a special waste. A Site Health and Safety Plan, and a Quality Control Plan should be required, discussed with contractors, and implemented to avoid any environmental hazards.

4.7 Hydrologic Conditions

No Action Plan

Under the no action alternative (a continuation of the current interim flood damage reduction measures), the inflows to the ponding area consist of storm water runoff, seepage, and combined sewer outflow. As discussed in Section 3.7, implementation of these interim measures since early 2010 has affected the hydrologic conditions of the ponding area of the East Alton No. 1 pump station. Continuing the operation of these measures into the future is not expected to result in any new effects to hydrologic conditions of the ponding area or any other waterbody.

No significant climatological changes are expected to occur over the next 50 years. In addition, in regard to surface flows carried by the project area's interior drainage system to the Mississippi River, in 2000 Madison County adopted a comprehensive storm water management ordinance (USACE, 2003). This ordinance requires new developments to implement permanent facilities on site for the temporary detention of stormwater before release to downstream tributaries. Because of these factors, no significant changes in hydrologic characteristics of the Mississippi River or landside ponding area are expected.

Final Risk Reduction Measures

The interim risk reduction measure consisting of ponding in the East Alton No. 1 pump station's ponding area would cease. As a result, there would be an increase in the storage capacity of the ponding area. This condition would be the equivalent of the storage capacity that was present in the ponding area prior to implementation of interim ponding in 2010.

Expected inflows to the pump station were considered for each design alternative. Each of these flows includes 36,356 GPM flow from storm water runoff which was calculated for the 1984 report using HEC1N. A simple analysis was done where it was assumed that for each acre-foot lost in storage, that volume could be pumped out of the system over a 24-hour period. Thus, each acre-foot was assumed to be an acre-foot/day to easily compare with seepage flows, well flow and flow from storm water runoff. Also, the storage capacity given in the 1984 report is assumed to be accurate, since more recent information was not available.

Seepage Berm Alternative

The berm only option included placing large berms in what is the existing ponding area to minimize seepage into the area. The total fill into the area would be 788,000 cubic yards, approximately 490 acre-feet. This option resulted in the largest flow into the pump station due to the large amount of fill taking up storage capacity. Expected inflows to the pump station would be 187,250 gallons per minute (GPM).

Cutoff Wall Alternative

This alternative would not take up any storage capacity in the ponding area, and would not increase flows to the pump station.

Relief Wells and Seepage Berm Alternative

For the wells and berm option, fewer wells were considered along with smaller berms, which would occupy 435,000 cubic yards, approximately 270 acre-feet, of the existing storage area. Expected inflows to the pump station would be 142,381 GPM.

Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan)

This alternative would not take up any storage capacity in the ponding area. Expected inflows to the pump station would be 84,645 GPM.

4.8 Noise

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.8, implementation of these measures resulted in noise generated during construction that was of short duration and minor. Continuing the operation of these measures into the future is not expected to result in any new noise impacts.
Under the no action plan, industrial and commercial development on the upper levee-protected floodplain of the Mississippi River is expected to gradually increase. The land use planning strategy in Madison County includes the formation of residential and agricultural zoning districts, and applying zoning and subdivision regulations to reduce non-managed growth in agricultural areas (USACE, 2003). Because agricultural and residential areas are not present within the upper levee-protected area, noise levels are expected to gradually increase.

Final Risk Reduction Measures

The Wood River levee embankment that is adjacent to and parallels the Mississippi River is a prominent feature topographically, and is expected to buffer or deflect noise. As such, noise or sound generated along the base of one side of the levee would be much reduced on the other side of the levee. Therefore, noise generated during construction of the Cutoff Wall Alternative and Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would be largely limited to the Mississippi River side of the levee. In contrast, construction noise generated by the Seepage Berm Alternative and Relief Wells and Seepage Berm Alternative would be largely confined to the protected side of the levee.

Noise receptors consisting of residential areas or facilities such as schools or hospitals are not located near the area of final risk reduction measures. Therefore noise generated by each of the four alternatives is not expected to impact these kinds of receptors. Short-term noise impacts would be generated by each alternative during the operation of various types of construction machinery, and these impacts would occur during the day and be intermittent in nature. The duration of construction is expected to be about three years. Overall, none of the alternatives are expected to significantly create noise effects for the short or long-term.

4.9 Prime Farmland

No Action Plan
Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.9, implementation of these measures did not affect any areas of prime farmland soils. Continuing the operation of these measures into the future is not expected to result in any new impacts to prime farmland.

Under the no action plan, the existing land use planning strategy in Madison and St. Clair counties includes the conservation of agricultural lands, including preservation of crop lands for specialty crops (e.g., horseradish). This is to be accomplished by strengthening the downtown areas and the residential neighborhoods of municipalities in the vicinity of the project area to reduce the premature conversion of agricultural lands outside of those municipalities. Agricultural lands would remain a significant form of land use, but increasingly, these lands are expected to be converted to other uses (USACE, 2003).

Final Risk Reduction Measures

The footprints of each of the four final risk reduction alternatives in terms of proposed locations of seepage berms, relief wells, and cutoff walls would not affect any areas classified as prime farmland soils nor would construction of those proposed features result in any conversions of agricultural lands to nonagricultural use. The 10-acre disposal area required for the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) also would not affect any prime farmland soils. Temporary staging areas of construction equipment and materials would be established within existing levee right of way to the maximum extent practicable.

To evaluate potential impacts to agricultural land and initiate compliance with the federal Farmland Preservation Act and Illinois Farmland Preservation Act, the proposed action will be coordinated with the Natural Resources Conservation Service (NRCS) and Illinois Department of Agriculture (IDOA) by the St. Louis District. Correspondence documenting this coordination will be included as an attachment to this SEA.

4.10 Biological Resources

No Action Plan

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.10, implementation of these interim measures since early 2010 has resulted in the loss of 0.5 acre of bottomland hardwood forest (nonwetland). In addition, the detention of surface water in the East Alton No. 1 pump station's ponding area to reduce underseepage pressures has stressed vegetation in the ponding area. This stress was noted in the fall of 2010, especially in trees found in floodplain forest along the ponding area's margins. The continuation of ponding until late 2015, when the construction of final risk reduction measures is scheduled to be completed, is expected to result in tree mortality affecting an estimated 25 acres. Mitigation for these forest impacts is proposed and described below as part of the tentatively selected plan for final risk reduction measures. Continuation of the interim measures is not expected to give rise to any new impacts to biological resources.

Under the no action plan, the existing land use planning strategy in Madison County includes the protection of wetlands by avoiding their destruction, establishment of wetlands retention areas as temporary storage areas for surface drainage, development of new wetlands via wetlands banking, and the guiding of new development to non-environmentally sensitive areas, including enterprise zones for industrial development (USACE, 2003).

However, due to past and ongoing development, current ecological problems for the project area's biological resources, including forested and emergent wetlands and nonwetland bottomland forest, are expected to continue. These problems include fragmentation and degradation resulting from altered hydrologic regimes that depart from natural conditions, the addition of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and the prevalence of disturbance-tolerant native plant species in local plant communities (USACE, 2003).

Final Risk Reduction Measures

Direct Impacts   Estimates of losses to aquatic and terrestrial habitats are displayed in Table EA-8 by alternative. The Seepage Berm Alternative and Relief Wells and Seepage Berm Alternative would directly affect various wetlands and terrestrial forest, whereas the Cutoff Wall Alternative and Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would not result in any losses. Mitigation requirements to compensate for these habitat losses are also displayed in the table for each alternative.

With regard to the Cutoff Wall Alternative and Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan), the cutoff wall would be constructed on the river side of the levee in the existing grassy levee right of way. Construction would be confined to a limited working area (40 to 60 feet wide) along the riverside levee toe. Relief wells installed as part of the Relief Wells and Seepage Berm Alternative would be located within the pump station's ponding area and in wetlands. Relief wells installed as part of the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would be located at the edge of the pump station's ponding area (Sta. 55+00 - Sta. 80+00), along the grassy landside toe of the levee. The Tentatively Selected Plan's 9 new relief wells that would be installed along the landside toe of the levee at the 100-foot wide opening or gap in the cutoff wall are also not expected to be installed in adjacent wetlands. It is not expected that construction of these 54 relief wells would result in any permanent wetland losses.

The 10-acre disposal area required for the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) is located at a previously disturbed site, and would not result in the loss of any wetlands or trees.

However, the installation of these new relief wells may involve the temporary placement of fill materials into wetlands, which would be subject to Section 404 of the Clean Water Act. Creation

Creation of temporary work pads may be necessary if conditions are wet at the time of construction. Discharges of clean fill materials associated with this type of construction activity would be stipulated in the construction contract. If placement of work pads or drilling materials in wetlands is needed, these actions would be temporary, and fill materials would be removed and affected sites restored to pre-project conditions. Adverse effects to wetlands would be temporary and not significant. Construction of the three rock dikes would require after-the-fact authorization under Section 404 of the Clean Water Act, and a Section 404(b)(1) Guidelines Evaluation is attached to this SEA.

Indirect Impacts Indirect impacts to habitats located in the ponding area on the landside of the levee could potentially include the permanent lowering of groundwater elevations, and the resulting reduction or loss of groundwater hydrology to aquatic resources such as wetlands. Groundwater elevations are expected to remain essentially the same for alternatives that control

Table EA-8. Estimated Permanent Losses to Aquatic and Terrestrial Habitats and Mitigation for Final Risk Reduction Alternatives.

Habitat Type	Alternative			
	Berm	Cutoff Wall	Wells and Berm	Wells and Cutoff Wall (1)
	Expected Impacts (acres)			
Wetland - Open Water	8	0	3	0
Wetland - Marsh	29	0	16	0
Wetland - Bottomland Forest	15	0	11	0
Terrestrial - Nonwetland Bottomland Forest	1	0	0	0
Total	53	0	30	0
	Mitigation (acres)			
Total	111	0	50	0

(1) = tentatively selected plan

underseepage by either seepage berms or relief wells, but cutoff walls are expected to reduce groundwater surface elevations in the ponding area (see Section 4.5).

For the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan), changed groundwater conditions are not expected in the ponding area in the area of the proposed relief wells (Sta. 55+00 - Sta. 80+00). However, aquatic habitats on the landside of the levee are expected to experience “drier” or less wet hydrological conditions in the reach of the proposed cutoff wall (Sta. 80+00 - Sta. 126+00) because of permanently lowered groundwater elevations. It is likely that the modified hydrological conditions in this area would be similar to those that existed prior to construction of the Melvin Price Locks and Dam in the late 1980s, which supported wetlands in the ponding area at that time (USACE 1986).

The likely lowering of groundwater elevations along the reach of the cutoff wall is not expected to result in a conversion of adjacent aquatic habitats to terrestrial (non-wetland) habitats. Groundwater is expected to remain in the underlying sandy substrate (labeled as “aquifer” in Figures C-11 and C-12). Under these conditions, capillary fringe action of the soil (alluvial silts and clays on top of the underlying sands) would be expected to draw groundwater upward into the root zone of the existing wetland plant communities. As such, the ponding area below elevation 412 feet would likely meet the criterion of wetland hydrology by exhibiting inundation or saturation to the surface continuously for at least 5% of the growing season in most years (50% probability of recurrence) (USACE 2010). The actual changes in groundwater levels will be monitored after completion of construction using existing piezometer wells installed at various locations in the ponding area.

As a result of less wet conditions in the ponding area, shifts in the abundance and spatial extent of several wetland plant communities are expected. The currently extensive mud flats would be expected to diminish in area and be offset by expansion of shallow marshes and wet meadows. Wet bottomland forest located between the levee and the ditch leading to the pump station is likely to change to wet-mesic bottomland forest.

Habitat Evaluation – Interim Measures and Final Measures (Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan)

A habitat evaluation was conducted for aquatic habitats located within the pump station's ponding area that have been affected by the interim measures and would be affected by the proposed final measures (tentatively selected plan). This assessment focused on forested and non-forested (herbaceous and open water) wetlands located below elevation 412 feet NGVD, which encompass an area of about 149 acres. According to this evaluation, the habitats affected by the interim measure of ponding are of low to moderate quality. Tables C-9 and C-10 display estimates of habitat quality for these areas, in terms of habitat suitability indices generated by the Wildlife Habitat Appraisal Guide (WHAG). The estimates of habitat quality include baseline conditions before interim measures were implemented. WHAG was developed by the Missouri Department of Conservation and the U.S. Department of Agriculture, Soil Conservation Service (now Natural Resources Conservation Service) (MDC and USDA-SCS 1991). It was adapted from the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (USFWS 1980). WHAG is widely accepted by local agencies, and it has become the primary wetland/terrestrial habitat evaluation method used in the St. Louis District. The review of this model for certification under the Corps Planning Models Improvement Program has been completed.

WHAG is a numerical model that evaluates the quality and quantity of particular habitats for various wildlife species. The qualitative component of the analysis is known as the habitat suitability index (HSI) and is rated on a 0 to 1.0 scale, with higher values indicating better habitat. The HSI for a particular habitat type is determined by selecting values that reflect present and future project area conditions from a series of abiotic and biotic metrics. Each value corresponds to a suitability index for each species. Future values are determined using management plans, historical conditions, and best professional judgment.

The habitat evaluation (Tables C-9 and C-10) indicated that conditions 50 years into the future with interim measures (ponding) would remain low to moderate in quality (target year 0 to target year 50). Future habitat conditions under the tentatively selected plan for final risk reduction measures are expected to improve in forested wetlands to a slight degree after interim ponding ceases. Trees expected to be killed from prolonged interim ponding would be replaced by natural regeneration of light seeded species such as cottonwood, elm, and sycamore. After construction of the cutoff wall, the planting of tree seedlings in areas of expected tree mortality due to prolonged interim flooding would also increase habitat quality to a slight degree (Table EA-9). The habitat evaluation for nonforested wetlands reflects the expected shift toward "drier" or less wet hydrological conditions in the reach of the proposed cutoff wall (Sta. 80+00 - Sta. 126+00). Details of the habitat evaluation are provided in a separate document attached to this SEA.

Mitigation

Mitigation includes (a) avoiding biological resource impacts altogether by not taking a certain action or part of an action; (b) minimizing such impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or

Mel Price - Wood River	Mallard	Green-Backed Heron	Wood duck	Beaver	Northern Parula	Prothon Warbler	Ave HSIs	TY	Acres	HUs	Net Years	Cumulative HU	AAHUs	Net AAHUs
Baseline	0.00	0.68	0.54	0.62	0.65	0.24	0.45	0	23.2	10.53	1			
Without Project (Interim Measures)	0.11	0.68	0.54	0.63	0.65	0.26	0.48	1	23.2	11.07	5	493.51	9.87	0.000
	0.10	0.72	0.57	0.58	0.47	0.28	0.45	6	23.2	10.52	4			
	0.09	0.63	0.46	0.58	0.50	0.27	0.42	10	23.2	9.79	15			
	0.09	0.63	0.46	0.58	0.50	0.27	0.42	25	23.2	9.79	25			
	0.09	0.63	0.42	0.58	0.50	0.24	0.41	50	23.2	9.51				
								Total HUs		50.68				
With Project (Final Measures, no tree seedlings)	0.11	0.68	0.54	0.62	0.65	0.26	0.48	1	23.2	11.03	5	529.05	10.58	0.711
	0.09	0.66	0.57	0.58	0.47	0.28	0.44	6	23.2	10.24	4			
	0.11	0.62	0.48	0.60	0.65	0.23	0.45	10	23.2	10.43	15			
	0.12	0.56	0.57	0.53	0.75	0.29	0.47	25	23.2	10.92	25			
	0.12	0.53	0.62	0.46	0.75	0.36	0.47	50	23.2	10.98				
								Total HUs		53.60				
With Project (Final Measures, tree seedlings)	0.11	0.68	0.54	0.62	0.65	0.26	0.48	1	23.2	11.03	5	533.00	10.66	0.079
	0.10	0.66	0.59	0.56	0.47	0.28	0.44	6	23.2	10.26	4			
	0.12	0.62	0.50	0.58	0.65	0.23	0.45	10	23.2	10.45	15			
	0.13	0.56	0.59	0.51	0.80	0.30	0.48	25	23.2	11.18	25			
	0.13	0.53	0.64	0.44	0.80	0.37	0.48	50	23.2	11.24				
								Total HUs		54.17				

Note: HSI = habitat suitability index, TY= target year, HU = habitat unit, AAHU = average annual habitat unit

Table EA-9. Habitat Evaluation for Forested Wetlands in Ponding Area.

Mel Price-Wood River		Average Annual Habitat Unit Summary														
	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-Backed Heron	American Coot	Ave HSIs	TY	Acres	HUs	Net Years	Cumulative HU	AAHUs	Net AAHUs
Baseline	0.08	0.11	0.59	0.73	0.24	0.59	0.51	0.00	0.35	0	125.7	44.52	1			
Without Project (Interim Measures)	0.08	0.11	0.59	0.73	0.24	0.59	0.51	0.00	0.35	1	125.7	44.52	5	2181.42	43.63	0.00
	0.08	0.11	0.59	0.73	0.24	0.59	0.51	0.00	0.35	6	125.7	44.52	4			
	0.08	0.11	0.59	0.73	0.24	0.59	0.51	0.00	0.35	10	125.7	44.52	15			
	0.08	0.11	0.59	0.73	0.24	0.59	0.51	0.00	0.35	25	125.7	44.52	25			
	0.08	0.11	0.59	0.73	0.24	0.59	0.51	0.00	0.35	50	125.7	44.52				
											total HUs	222.59				
With Project (Final Measures)	0.00	0.00	0.60	0.73	0.10	0.64	0.52	0.00	0.32	1	125.7	40.69	5	2299.53	45.99	2.36
	0.00	0.00	0.60	0.68	0.11	0.63	0.61	0.43	0.38	6	125.7	47.98	4			
	0.00	0.00	0.66	0.64	0.11	0.59	0.54	0.45	0.37	10	125.7	46.84	15			
	0.00	0.00	0.66	0.64	0.11	0.61	0.54	0.45	0.38	25	125.7	47.29	25			
	0.00	0.00	0.66	0.64	0.11	0.61	0.54	0.45	0.38	50	125.7	47.29				
											total HUs	230.09				

Note: HSI = habitat suitability index, TY= target year, HU = habitat unit, AAHU = average annual habitat unit

Table EA-10. Habitat Evaluation for Herbaceous and Open Water Wetlands in Ponding Area.

preservation and maintenance operations during the life of the action; (e) compensating for the impact by replacing or providing substitute resources or environments.

As part of the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan), mitigation is proposed for forest impacts that have resulted from implementing the interim measures. This mitigation would rectify forest impacts that occurred 1) during construction of Dike B and 2) that are expected to result from the prolonged detention of surface water in the pump station's ponding area. Once the final risk reduction measures are completed, the haul road to Dike B, consisting of crushed stone, would be removed and the area would be restored. The 0.5 acre of trees cleared in bottomland hardwood forest (nonwetland) in April 2010 would be reforested. Root production method tree seedlings would be planted at a density of 50 per acre and would consist of native species attractive to wildlife. To rectify the estimated 25 acres of tree mortality expected to occur in forested wetlands located along the margins of the ponding area, tree seedlings would be planted in areas of dead trees once the final risk reduction measures are completed. In these areas, tree seedlings would be planted in small clearings at a density of 50 per acre, and native species attractive to wildlife would be used. The mitigation plan is described in a separate document that is attached to this SEA.

The National Environmental Policy Act (NEPA) process would continue to address potential effects of any yet to be defined, revised, or new project features that might be developed during the design phase. A second Supplemental Environmental Assessment would be prepared and circulated to fulfill this requirement for public disclosure and involvement.

4.11 Threatened and Endangered Species

This section, along with Section 3.11 (existing conditions for threatened and endangered species), represents the St. Louis District's Biological Assessment of the project's effect on federally-listed species that may occur within the project area. This Biological Assessment is prepared in compliance with Section 7(c) of the Endangered Species Act of 1973, as amended.

<u>No Action Plan</u>

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.11, implementation of these measures has not resulted in any adverse effects to the six federally listed species that may occur in the project area. Similarly, no adverse effects to the bald eagle or known bald eagle nest tree occurred. Continuing the operation of these measures into the future is not expected to result in any new impacts to these species.

Under the no action plan, the status of threatened and endangered species that may occur within the project area is expected to remain the same, including their listing designations.

<u>Final Risk Reduction Measures</u>

Potential impacts of the Final Risk Reduction alternatives including the Tentatively Selected Plan are described for each species below.

Least tern. None of the four alternatives would affect any known least tern nesting habitat, any habitats along the Mississippi River, or any sand or gravel bars within or adjacent to waterbodies. Therefore, the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) is unlikely to adversely affect the least tern.

Indiana bat. The Seepage Berm Alternative and Relief Wells and Seepage Berm Alternative would require some tree clearing, and for these plans tree felling would need to be restricted to the colder months when maternity roosting is known not to occur (October 1 to March 31). However, the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) does not involve any tree clearing, and adverse impacts to the Indiana bat are not likely to occur.

Pallid sturgeon. The Seepage Berm Alternative and Relief Wells and Seepage Berm Alternative would require the dredging of sand from the Mississippi River, and the confluence with the Missouri River is the likely source. As this fish species is known from this location, potential impacts would include entrainment of individual fish by the dredge. However, the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) does not involve any dredging from the river, and is unlikely to adversely affect the pallid sturgeon.

Decurrent false aster. Colonies or populations of this plant are not known from the Wood River Drainage and Levee District, including the levee reach adjacent to the Melvin Price Locks and Dam and the landside ponding area for the East Alton No. 1 pump station. However, suitable habitat consisting of open wet areas does occur in the vicinity of the levee. Because of the opportunistic nature of this species to colonize open moist or wet areas that experience natural or man-made disturbances, its ability to disperse over shorter distances by seeds carried by wind or animals, and the approximate 5 years before Final Risk Reduction Measures would be implemented, field surveys for this plant will be conducted by the St. Louis District on the landside of the levee prior to any construction activities. If any individual plants or colonies are identified, the U.S. Fish and Wildlife Service will be notified and a course of action will be established. Therefore, it is unlikely that the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) will adversely affect the decurrent false aster.

Eastern massasauga rattlesnake. Although suitable habitat for this snake consisting of herbaceous and forested wetlands and old fields occurs on the Mississippi River floodplain, the eastern massasauga is not known to currently occur anywhere in the Metro-East area of Madison County, Illinois. Therefore, it is unlikely that the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) will adversely affect this species.

Eastern prairie fringed orchid. This plant is known historically from Madison County. Suitable habitat consisting of remnant mesic or wet prairies does not exist in the immediate vicinity of the Wood River levee system. It is unlikely that the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) will adversely affect the eastern prairie fringed orchid.

With regard to the bald eagle and its protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, the Seepage Berm Alternative and Relief Wells and Seepage

Berm Alternative would require the removal of a bald eagle nest tree that was last used in 2006. The Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would not require removal of this tree. Because the nest tree has not been in use for about 5 years, at this time there is no identified need to implement any of the management guidelines. Because the proposed completion of the Final Rick Reduction Measures is likely to be 5 years in the future, and there is the potential for conditions to change over time, the District will continue to evaluate potential impacts to the bald eagle as design plans are developed, and will coordinate in this regard with the U.S. Fish and Wildlife Service.

It is the St. Louis District's opinion that the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) will not adversely impact any of the six federally listed species that might occur in the project area, provided that conditions for the protection of the decurrent false aster are implemented. The USFWS will be given an opportunity to review this SEA and comment on this Biological Assessment.

4.12 Recreation

<u>No Action Plan</u>

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.12, implementation of these measures has not affected any recreational resources within the project area. Continuing the operation of these measures into the future is not expected to result in any new impacts to recreational resources.

Under the no action plan, as urban growth continues in the project area, the demand for open space preservation and the development of recreational opportunities is expected to increase. The future land use plans for Madison and St. Clair counties document these needs (USACE, 2003).

<u>Final Risk Reduction Measures</u>

Construction activities associated with the Seepage Berm Alternative and Relief Wells and Seepage Berm Alternative would not affect use of the Confluence Trail on top of the levee. Construction of the Cutoff Wall Alternative and Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) on the riverside of the levee centerline would require heavy equipment to cross over the levee periodically during the construction period. Coordination between the St. Louis District and trail officials would occur in the early design phase to ensure that appropriate measures at such crossings are included in the contract specifications to ensure the safety of trail users. Recreational use of the trail is expected to continue during the construction process with appropriate safety measures in place. Recreational use of the Mississippi River would not be affected.

4.13 Aesthetics

<u>No Action Plan</u>

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.13, implementation of these measures has had a noticeable effect on aesthetics according to some of the public that drive by the ponding area and see the increased surface area of ponding. The anticipated tree mortality along forested margins of the ponding area may also become notable as time passes. Continuing the operation of the interim measures into the future is not expected to result in any new impacts to aesthetics.

Under the no action plan, the overall aesthetics of the project area are expected to progressively change. In the upper protected area, new commercial and industrial development is likely to be located on previously used lands.

<u>Final Risk Reduction Measures</u>

Because the Seepage Berm Alternative and Relief Wells and Seepage Berm Alternative would be constructed on the landside of the levee in the ponding area, relatively large areas of natural habitats along Highway 143 would be replaced by broad grassy extensions of the levee system. These alternatives would probably create a substantial adverse aesthetic impact. The Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) would not disrupt the appearance of the ponding area and its natural habitats. The cutoff wall, to be constructed on the riverside of the levee in a grassy area along the levee toe, would not be visible at all after construction is completed because it would be entirely underground.

The aesthetics of the project area would be temporarily impacted by the presence of construction equipment, removal of vegetation, and the creation of noise, fumes and dust during the construction phase. Once constructed, none of the proposed action’s features are likely to be considered as aesthetically unpleasant, as they would likely blend in with the existing levee system and surroundings. Areas where the ground surface is disturbed would be reseeded and returned to pre-project conditions.

4.14 Historic Properties

<u>No Action Plan</u>

Under the no action plan, the interim risk reduction measures would remain in effect. As discussed in Section 3.14, implementation of these measures has not affected any historic properties. Continuing the operation of these measures into the future is not expected to result in any new impacts to historic properties.

<u>Final Risk Reduction Measures</u>

The USACE has consulted with the Illinois Historic Preservation Agency (IHPA) regarding impacts within the known construction footprint. The project area lies within an area previously surveyed for cultural resources of which none were located. In addition, the USACE has executed with IHPA a Memorandum of Agreement (MOA) in conjunction with the Wood River Limited Reevaluation Report specifying how USACE will address any preservation concerns that may arise from changes in project impacts. A MOA is a contract between the signatories specifying the procedures to be followed to achieve compliance with historic preservation laws. The MOA will cover any activities undertaken on the Wood River Levee system although those activities may arise from separate projects under different funding streams.

In addition to consulting with the Illinois SHPO, USACE contacted 28 tribal organizations of which one, the Osage Nation, indicated a desire to be a concurring party to the MOA with the IHPA. The MOA will outline and ensure the completion of all compliance activities prior to the start of construction. For any site identified within the project Area of Potential Effect (APE), a determination of eligibility (DOE) for the National Register of Historic Places must be submitted to the Illinois SHPO for concurrence. For archaeological sites determined eligible, a data recovery plan would be formulated and carried out under the stipulations of the MOA for the mitigation of adverse impacts. As a result of completing those activities, any adverse effects on historic properties within the project area will be mitigated.

The consultation process described above will be used to address potential effects of any yet to be defined, revised, or new project features.

4.15 Relationship of the Proposed Project to Land-Use Plans

The Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan), which is to restore a fully functional flood protection project for the reach of Wood River levee adjacent to the Melvin Price Locks and Dam, is consistent with the original purpose of the Wood River and Melvin Price projects and the need to protect a relatively large urban area from Mississippi River flooding. The City of Alton has plans to upgrade its existing sewage treatment plant with combined flow outfalls that discharge into the ponding area of the East Alton No. 1 pump station. One preliminary option for improvements is to use the existing wetlands in the pump station's ponding area for treatment of effluent. The Tentatively Selected Plan is compatible with the City's preliminary plan.

4.16 Adverse Effects Which Cannot Be Avoided

There are unavoidable impacts associated with the Interim Risk Reduction Measures. Initially, there is the temporary loss of about 0.5 acre of nonwoody wetlands to construct Dike B. Secondly, stress has been placed on wetland vegetation within the East Alton No. 1 pump station's ponding area due to intentional ponding at depths and durations greater than normal. An estimated 25 acres of trees in forested wetland are expected to die as ponding continues over the next 5 years until Final Risk Reduction Measures are constructed. Unavoidable impacts associated with the Final Risk Reduction Measures - the Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) - includes noise and exhaust generated by equipment during construction, and the prevention by the cutoff wall of direct lateral groundwater movement for a distance of about 5,000 feet along the levee.

4.17 Short-Term Use versus Long-Term Productivity

The ongoing Interim Risk Reduction Measures are a short-term use of the environment to reduce unacceptable flood risk to a large area of industrial, commercial, residential, and agricultural land use. The long-term biological productivity of the stressed wetland areas will return relatively soon after the final measures are completed. The Relief Wells and Cutoff Wall Alternative (Tentatively Selected Plan) does not represent a short-term use of the environment, but a long-term or permanent solution to underseepage problems that require corrective measures. These levee problems raise the risk of levee failure and resulting catastrophic damage to property and infrastructure, and disruption of the livelihoods of many people. The identified areas of impact are within the existing levee right of way.

4.18   Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments that have occurred to date include those associated with implementation of the Interim Risk Reduction Measures, the acquisition of geotechnical data for the Wood River levee system, the development of alternative underseepage solutions, and the preparation of planning reports and environmental compliance documents in support of the proposed action.

4.19   Cumulative Impacts

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR Section 1508.7). Cumulative effects are defined as, "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

The Council on Environmental Quality (CEQ) issued a manual entitled "Considering Cumulative Effects under the National Environmental Policy Act". The manual details an 11 step procedure for addressing cumulative impact analysis. The 11 step procedure is broken down into three main components – scoping, describing the affected environment and determining the environmental consequences. Much of the information used in the following discussion is taken from USACE (2003).

Scoping: Past, Present and Future Actions

Flood control or flood damage reduction activities in the Metro East area of southwestern Illinois began soon after European settlement. Initial attempts to keep Mississippi River floodwaters out of the area were unsuccessful because early levees were relatively low and constructed in a piece-meal fashion. Earthen embankments constructed to bear a system of railroad tracks that converged on East St. Louis from different directions proved more effective. Flood control activities in the area between the river and bluff, interior to riverside levees, began with minor ditch systems to drain low areas of ponded water. About 90 years ago, Cahokia Creek, which entered what is now the lower portion of the Wood River Drainage and Levee District, was diverted from its historic course to the Mississippi River using a shorter man-made route (Cahokia Creek Diversion Channel). The existing urban river front levee built about 50 years ago has protected the bottoms from Mississippi River overflows.

The Wood River Levee and Drainage District – Lock and Dam No. 26 Replacement project completed in the late 1980s included relocation and increase in the size of the Alton pump station by constructing East Alton No .1 pump station, main drainage ditch modification, access road construction, replacement of relief wells, and construction of seepage conveyance channels. According to the EA (USACE, 1986), a total of 48.5 acres of terrestrial/wetland habitat were to be impacted by construction activities. A total of 19.2 acres of woody and 29.3 acres of herbaceous vegetation were to be cleared. Of this acreage, 6 acres was to be permanently lost by construction of the pump station, parking lot, concrete seepage conveyance channels and relief wells. The remaining 42.5 acres were expected to revegetate soon after construction was complete.

The Grassy Lake pump station in the lower portion of the Wood River Drainage and Levee District was constructed in 2007. This small facility did not impact any significant natural resources (USACE, 1998).

The Corps ongoing Wood River Levee System Reconstruction Project is intended to rehabilitate the riverfront and flank systems that have protected the area from river overflow and interior flooding for many years. The project includes replacing 163 of 170 existing relief wells and installing 60 new relief wells as a deficiency correction under the existing project authorization. Additional reconstruction and replacement is proposed for various components of 26 closure structures, 38 gravity drains, and 7 pump stations. These recommended actions are required to maintain the system's authorized level of protection. The EA for this project stated that no significant impacts were anticipated on natural resources, including fish and wildlife and forest resources (USACE, 2005).

The design deficiency corrections for the East St. Louis, Illinois, Flood Protection Project would correct deficiencies or flaws in the levee system's underseepage and through-seepage designs. Major features of the approved recommended plan include 369 new relief wells; 2,410 linear feet of seepage berms; 12,300 linear feet of slurry trench cutoff wall through the levee and to bedrock; 2,640 linear feet of shallow (40 ft deep) cutoff wall at the riverside levee toe; 3,640 linear feet of clay filled cutoff trench; and 1,320 linear feet of 5 foot thick riverside clay blanket. The EA for this project described direct losses of about 8.6 acres of habitats, including about 7.7 acres of emergent and forested wetlands and about 0.9 acres of bottomland forest. With the inclusion of a compensatory mitigation plan as part of the overall plan, the EA also stated these direct impacts would not have a significant impact on biological resources (USACE, 2010d, 2011a).

Similar design deficiency corrections for the larger Wood River Levee Flood Protection Project would fix problems in the levee system's underseepage and through-seepage designs. Major features of the approved recommended plan include 94 new relief wells; filling 83 existing wood stave relief wells with grout; ditching; two 25-cubic feet per second(cfs) pump stations and one 20-cfs pump station; 815 linear feet of seepage berm; 1,010 linear feet of landside clay fill; 2,910 linear feet of slurry trench cutoff wall at the riverside levee toe and to bedrock (140 ft deep); 1,060 linear feet of slurry trench cutoff wall (100 ft deep) at the riverside levee toe; and 2,875 linear feet of slurry trench cutoff wall (25 ft deep) at the riverside levee toe. The SEA for this project described direct losses of 5 acres of various natural habitats that require mitigation, including about 3 acres of various wetlands and about 2 acres of non-wetland bottomland hardwood forest. With the inclusion of a compensatory mitigation plan as part of the overall plan, the EA also stated these direct impacts would not have a significant impact on biological resources (USACE 2011b).

The District is also studying underseepage problems at the Prairie Dupont and Fish Lake flood protection projects that lie south of East St. Louis levee system. Preliminary assessments of effects to biological resources include a total of about 20 acres of wetland and terrestrial bottomland forest impacts, which would be mitigated off-site within the same watershed. NEPA documents describing these effects are under preparation. Probable future projects associated with flood risk reduction in the drainage and levee district would consist of maintaining the existing flood protection system, and possibly building new smaller projects affecting more localized areas. Future ecosystem restoration projects are possible (USACE, 2003), but most likely would involve small-scale habitat restoration projects. Such projects most likely would not make any large-scale changes to the interior flood control system for environmental purposes.

Scoping: Geographic and Spatial Boundary

The geographic limits for this analysis include those portions of Madison County that are protected by the Wood River levee system. To establish the temporal frame for analysis, the most commonly used practice is the length of the project life. The project life for this underseepage corrections project is 50 years.

Identification of Affected Environment

The essential components of determining the affected environment is the characterization of stressors and defining the baseline of the environment. Stressors result from natural events or human actions that cause a subsequent population, community or ecosystems level response. The goal of characterizing stressors is to determine whether the resources, ecosystems and human communities of concern are approaching conditions where additional stresses will have an important cumulative effect (CEQ, 2010). Generally, those occurring for a short duration at a localized site, such as the proposed underseepage corrections project, are of less concern than those occurring for an extended time over a wide geographical region.

As a result of development over the last two centuries, the levee protected area is a major part of the second largest concentration of residential, commercial, and industrial land use on the Mississippi River floodplain, after New Orleans. The primary water and land resource problems of the levee protected area include ecosystem degradation, sedimentation from hillside tributaries, and recurring interior flooding. Ecosystem degradation is characterized by: the loss of biodiversity and the fragmentation of natural systems caused primarily by intensive urbanization over the years; the loss of historic ecosystem disturbances such as natural flooding and wildfires; the loss of habitat quality; and the degradation of tributary stream resources due to development in the adjacent uplands.

In 2000, Madison County passed a 100-year stormwater control ordinance requiring new development to incorporate post-construction measures to temporarily detain runoff onsite, up to and including the 100-year storm, with release of stormwater to the local watershed at a rate no greater than that of preconstruction conditions. The Federal Emergency Management Agency, acting through local counties, bought out some flood-damaged properties after flooding in the mid-1990s. Finally, the Metro East Regional Storm Water Committee issued in 2000 a framework for coordinated storm water work in the Metro East.

The existing land use planning strategy in Madison and St. Clair counties can be summarized as follows: conserve agricultural lands; diversify employment opportunities; give the environment consideration in land use decisions; ensure housing availability; manage growth in a sensible manner; utilize best management conservation practices; provide open space and recreational opportunities; and provide a safe, efficient, and compatible transportation system.

Description of Environmental Consequences
For this underseepage corrections project, key stressors of concern include changes in land cover or land use, natural habitats, water quality, and hydrologic regime. These stressors act to reduce environmental quality within the levee protected area and decrease the overall quality of life.

The hydrologic regime of natural habitats located within the ponding area of East Alton No. 1 pump station adjacent to the Melvin Price Locks and Dam has been altered by the detention of surface water to prevent uncontrolled underseepage, and stress to woody vegetation is occurring in forested wetlands. This stress would continue for another 5 years until Final Risk Reduction Measures are implemented, at which time the vegetation would eventually rebound. The proposed project would not directly affect land use, nor would it have significant effects on natural resources. Best management practices for the protection of water quality at the project construction site would be implemented.

5.0 RELATIONSHIP OF RECOMMEND ALTERNATIVE TO ENVIRONMENTAL REQUIREMENTS

Table EA-11. Relationship of Plan to Environmental Requirements

Guidance	Degree of Compliance
Federal Statutes	
Archaeological and Historic Preservation Act, as Amended, 16 U.S.C. 469, et seq.	PC[1]
Clean Air Act, as Amended, 42 U.S.C. 7609	FC
Clean Water Act, as Amended 33 U.S.C. 466 et seq.	PC[2]
Endangered Species Act, as Amended, 16 U.S.C. 1531. et seq.	PC[2]
Farmland Protection Policy Act, 7 U.S.C. 4201, et seq.	FC
Federal Water Project Recreation Act, as Amended. 16 U.S.C. 4601, et seq.	FC
Fish and Wildlife Coordination Act, as Amended, 16 U.S.C. 4601, et seq.	PC[2]
Land and Water Conservation Fund Act, as Amended, 16 U.S.C. 4601, et seq.	FC
National Environmental Policy Act, as Amended, 42 U.S.C. 4321, et seq.	PC
National Historic Preservation Act, as Amended, 16 US. C. 470a, et seq.	PC[1]
Executive Orders	
Flood Plain Management, E.O. 11988 as amended by E.O. 12148	FC
Protection of Wetlands, E.O 11990 as amended by E.O. 12608	FC

Protection and Enhancement of the Cultural Environment, E.O. 11593	PC[1]
Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, CEQ Memorandum, August 11, 1980.	FC

FC = Full Compliance, PC = Partial Compliance.
1. Full compliance will be attained after all required archaeological investigations, reports and coordination have been completed.
2. Full compliance will be attained upon completion of any permitting requirements or coordination with other agencies.

The National Environmental Policy Act (NEPA) process would continue if future design of the proposed features leads to the identification of new environmental impacts. The NEPA process would be followed to coordinate and account for these changes. A 2nd Supplemental Environmental Assessment would be prepared by the St. Louis District and circulated to fulfill this requirement for public disclosure and involvement. Coordination would continue with the U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, Natural Resources Conservation Service, Illinois Department of Agriculture, and Illinois State Historic Preservation Office.

6.0 LITERATURE CITED

Baughman, M. 2010. Flooding Effects on Trees. University of Minnesota Extension. http://www.extension.umn.edu/distribution/naturalresources/M1289.html.

Council on Environmental Quality (CEQ). 2010. The 1997 Annual Report of the Council on Environmental Quality. Environmental Quality - The World Wide Web. http://ceq.hss.doe.gov/nepa/reports/1997/index.html.

East-West Gateway Council of Governments (EWGCG). 2010a. Air Quality in the St. Louis Area, updated as of June 05, 2009. Website accessed April 10, 2010. http://www.ewgateway.org/environment/aq/AQHistory/aqhistory.htm.

East-West Gateway Council of Governments (EWGCG). 2010b. East-West Gateway Council of Governments. Expanding Employers and Developers. http://www.swillinoislevees.com/html/employers.htm.

Herkert, J. R., editor. 1991. Endangered and threatened species of Illinois: status and distribution, volume 1 - plants. Illinois Endangered Species Protection Board, Springfield, Illinois, 158 pp.

Herkert, J.R., editor. 1992. Endangered and threatened species of Illinois: status and distribution, volume 2 - animals. Illinois Endangered Species Protection Board, Springfield, Illinois, 142 pp.

Hofmann, J. 1994. Letter dated June 30, 1994, from J. Hofmann, biologist, Illinois State Natural History Survey, Champaign, to J. Collins, U.S. Fish and Wildlife Service, Marion, Illinois.

Illinois Environmental Protection Agency (IEPA). 2008. Illinois Integrated Water Quality Report and Section 303(d) List – 2008, 6-30-08 Final Draft to USEPA . Appendix A-1. 303(d) List. Website accessed August 1, 2010 at http://www.epa.state.il.us/water/tmdl/303d-list.html#2008.

Illinois Environmental Protection Agency (IEPA). 2010a. Illinois Integrated Water Quality Report and Section 303(d) List - Volume I - Surface Water – 2010, 3-29-10. Draft Appendix A-1. Category 5 - 303(d) List. IEPA, Bureau of Water, Springfield, IL. Website accessed August 1, 2010 at http://www.epa.state.il.us/water/tmdl/303d-list.html#2008.

Illinois Environmental Protection Agency (IEPA). 2010b. Illinois Groundwater Protection Program Biennial Comprehensive Status and Self-Assessment Report 2008-2009, Prepared by the Interagency Coordinating Committee on Groundwater. January 2010. Illinois Environmental Protection Agency Bureau of Water. Website accessed August 1, 2010 at http://www.epa.state.il.us/water/groundwater/groundwater-protection/2008-2009/full-report09.pdf.

Keevin, T. 2010. Personal communication on April 9, 2010, with Thomas M. Keevin, Ph.D., Planning and Environmental Branch, St. Louis District, U.S. Army Corps of Engineers.

Madison County Government (MCG). 2010. Planning and Development, Madison County Government, Edwardsville, Illinois. http://www.co.madison.il.us/planning/Planning.shtml.

Madison County Transit (MCT). 2010. Madison County Transit Online Bikeway Map. Website accessed August 1, 2010 at http://www.mcttrails.org/viewer.htm.

McMullen, K. 2001. Personal communication on July 3, 2001, with Keith McMullen, Regulatory Branch, St. Louis District, U.S. Army Corps of Engineers.

Missouri Department of Conservation and U.S. Department of Agriculture-Soil Conservation Service (MDC and USDA-SCS). 1991. Wildlife Habitat Appraisal Guide (WHAG) User's Guide. April 1991.

Natural Resources Conservation Service (NRCS). 2004. Soil Survey of Madison County, Illinois. http://soildatamart.nrcs.usda.gov/Manuscripts/IL119/0/madison_IL.pdf.

Natural Resources Conservation Service (NRCS). 2010. Madison County, Illinois, digital soil survey. Available at ftp://ftp.ftw.nrcs.usda.gov/pub/ssurgo/online98/data/il119/.

Schwegman, J.E., and R.W. Nyboer. 1985. The taxonomic and population status of *Boltonia decurrens*. Castanea 50 (2):112-115.

Smart Growth Network. 2010. About Smart Growth, Smart Growth Network Online. http://www.smartgrowth.org/about/default.asp?res=1680.

Smith, M., Y. Wu, and O. Green. 1993. Effect of light and water stress on photosynthesis and biomass production in *Boltonia decurrens*, a threatened species. *American Journal of Botany*, 80(8):859-864.

Smith, M., T. Brandt, and J. Stone. 1995. Effect of soil texture and microtopography on germination and seedling growth in *Boltonia decurrens* (Asteraceae), a threatened floodplain species. *Wetlands Journal*, 15:392-396.

U.S. Army Corps of Engineers (USACE). 1976. Final Environmental Statement, Locks and Dam No. 26, Mississippi River, Alton, Illinois. Volume 1, to accompany the final report of the Chief of Engineers. Department of the Army, Office of the Chief of Engineers, Washington, D.C. 20314. Dated July 1976.

U. S. Army Corps of Engineers (USACE). 1986. Environmental Assessment, Wood River Drainage and Levee District Alterations, Locks and Dam No. 26 Replacement, Mississippi River, Alton, Illinois, April 1986.

U. S. Army Corps of Engineers (USACE). 1998. Environmental Assessment, Proposed Pump Station and Ditch Improvements, Grassy Lake Area, Wood River Drainage and Levee District, Madison County, Illinois. February 1998.

U. S. Army Corps of Engineers (USACE). 2003. East St. Louis and Vicinity, Illinois Ecosystem Restoration And Flood Damage Reduction Project. General Reevaluation Final Report with Integrated Environmental Impact Statement (EIS), St. Louis District, St. Louis.

U. S. Army Corps of Engineers (USACE). 2005. Environmental Assessment, Proposed Reconstruction of the Flood Protection System, Wood River Drainage and Levee District, Madison County, Illinois, July 2005.

U. S. Army Corps of Engineers (USACE). 2009. HTRW Initial Hazard Assessment, Phase I Environmental Site Assessment for Wood River Levee Relief Well Installation Project. May 5, 2008, amended March 19, 2009. Prepared by U.S. Army Corps of Engineers, St. Louis District.

U.S. Army Corps of Engineers (USACE). 2010a. Electronic version of the 1987 *Corps of Engineers Wetlands Delineation Manual* (the 1987 Manual). Wetlands Research Program Technical Report Y-87-1. Environmental Laboratory, Waterways Experiment Station, US Army Corps of Engineers. http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf.

U.S. Army Corps of Engineers (USACE). 2010b. National Nonstructural/Flood Proofing Committee. http://www.nwo.usace.army.mil/nfpc.

U. S. Army Corps of Engineers (USACE). 2010c. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (Version 2.0), ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-16. Vicksburg, MS: U.S. Army Engineer Research and Development Center.
http://www.usace.army.mil/CECW/Documents/cecwo/reg/erdc-el-tr-10-16.pdf

U. S. Army Corps of Engineers (USACE). 2010d. Revisions to Environmental Assessment dated June 2010 as a result of ATR, IEPR, Corps, and Public Reviews; Signed FONSI; Environmental Assessment with Draft Finding of No Significant Impact, Design Deficiency Corrections, East St. Louis, IL Flood Protection Project, June 2010. http://www.mvs.usace.army.mil/pm/EstlRehabLRR/Appendix%20A%20EA%20and%20FONSI.pdf

U. S. Army Corps of Engineers (USACE). 2011a. Supplemental Environmental Assessment with Signed Finding of No Significant Impact and Appendix, Final Limited Reevaluation Report on Design Deficiency Corrections for East St. Louis, IL Flood Protection Project, August 2011. http://www.mvs.usace.army.mil/pm/EstlRehabLRR/Appendix%20A%20EA%20and%20FONSI.pdf

U. S. Army Corps of Engineers (USACE). 2011b. Supplemental Environmental Assessment with Signed Finding of No Significant Impact and Appendices, Limited Revaluation Report, Wood River Levee System Design Deficiency Corrections, Madison County, Illinois, August 2011. http://www.mvs.usace.army.mil/pm/woodriverlrr/final/Appendix_A_31AUG2011.pdf

U. S. Department of Housing and Urban Development (USDHUD). 2010. Economic Development. http://portal.hud.gov/portal/page/portal/HUD/topics/economic_development.

U.S. Department of Transportation, Federal Highway Administration (USDOT). 2000. Draft environmental impact statement/section 4(f) evaluation, Federal aid primary 999, new Mississippi River crossing, relocated I-70 and I-64 connector, FHWA-IL-EIS-98-01- D/4(f). U.S. Department of Transportation, Federal Highway Administration, and Illinois and Missouri Departments of Transportation, April 2000.

U. S. Environmental Protection Agency (USEPA). 2010. Currently Designated Nonattainment Areas for All Criteria Pollutants as of January 06, 2010. Website accessed April 10, 2010 at http://www.epa.gov/air/oaqps/greenbk/ancl3.html.

U.S. Fish and Wildlife Service (USFWS). 1980. Habitat evaluation procedure (HEP) 102 ESM. U.S. Fish and Wildlife Service, Washington, DC.

U.S. Fish and Wildlife Service (USFWS). 1990. Decurrent false aster recovery plan. U.S. Fish and Wildlife Service, Twin Cities, Minnesota. 26 pp.

U.S. Fish and Wildlife Service (USFWS). 1993. Pallid sturgeon recovery plan. U.S. Fish and Wildlife Service, Bismarck, North Dakota, 55 pp.

U.S. Fish and Wildlife Service (USFWS). 2001. Decurrent false aster recovery plan. U.S. Fish and Wildlife Service, Twin Cities, Minnesota.

U.S. Fish and Wildlife Service (USFWS). 2010. Illinois County Distribution - Federally Endangered, Threatened, Proposed, and Candidate Species. List Revised November 2009. Website accessed February 24, 2010 at http://www.fws.gov/midwest/endangered/lists/illinois-cty.html.

U.S. Fish and Wildlife Service (USFWS). 2010b. National Bald Eagle Management Guidelines. http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BaldEagle/NationalBaldEagleManagementGuidelines.pdf.

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8.0 COORDINATION, DISTRIBUTION LIST, PUBLIC VIEWS, AND RESPONSES

Coordination. In the fall of 2009, the St. Louis District coordinated the planning of the interim risk reduction measures and their implementation with officials from the Wood River Drainage and Levee District, City of Alton, and Alton Wastewater Division, as well as other local stakeholders during several meetings.

In November 2009, the St. Louis District notified the Illinois Department of Natural Resources, Illinois Environmental Protection Agency, and U.S. Fish and Wildlife Service of the underseepage project, the need for interim and final risk reduction measures, and the potential for interim ponding to affect vegetation. The agencies were informed that an after-the-fact NEPA document and Biological Assessment of listed species would be prepared addressing the interim and final measures, and that the long-term solution would require issuance of a public notice to allow for a more extensive review of possible impacts.

On December 10, 2009, a Corps of Engineers meeting was held among representatives from various levels of the agency, including the St. Louis District, Mississippi Valley Division and Headquarters offices.

On April 2, 2010, the St. Louis District hosted a public meeting at 3:00 p.m. at the National Great Rivers Museum to update the Alton, East Alton and surrounding communities on the status of the upper portion of the Wood River Levee system that is protecting them and to describe actions that would be taken to maintain the level of risk at an acceptable level.
On April 29, 2010, the St. Louis District met with a representative from the Illinois Environmental Protection Agency to discuss the potential for any hazardous, toxic, and radioactive waste concerns in light of the ponding of surface water as an interim risk reduction measure.

The project is being coordinated with the Illinois Historic Preservation Agency. A letter dated October 12, 2010, was sent by the St. Louis District to initiate the consultation and review process mandated by the National Historic Preservation Act of 1966, as amended. A copy of the letter is included in Appendix C-A.

Distribution List. The Draft Environmental Assessment and Unsigned Finding of No Significant Impact will be sent to the following elected officials, agencies, organizations and individuals for review and comment. All responses will be filed with this document.

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DRAFT FINDING OF NO SIGNIFICANT IMPACT

MEL PRICE-WOOD RIVER LEVEE UNDERSEEPAGE PROJECT
MADISON COUNTY, ILLINOIS

1. I have reviewed and evaluated the Project Completion Report and Supplemental Environmental Assessment for the Mel Price-Wood River Levee Underseepage Project. The purpose of this project is to correct underseepage problems in the Wood River levee adjacent to the Melvin Price Locks and Dam, Madison County, Illinois.

2. An interim flood damage risk reduction solution that was implemented in early 2010 will remain in place until a final solution is constructed. Several alternatives for final risk reduction were considered. After consideration of logistical, environmental, and cost factors, the proposed action is the least cost option. By not making any design corrections, the "No Action" for final risk reduction would not eliminate the unacceptable level of flood risk associated with the underseepage problem.

3. The tentatively selected plan, the Relief Wells and Cutoff Wall Alternative, includes the installation of 46 new relief wells along the landside toe of the levee for a distance of 2,500 feet (Sta. 55+00 - Sta. 80+00) and the construction of a slurry trench cutoff wall along the riverside toe of the levee for a distance of 4,600 feet (Sta. 80+00 - Sta. 126+00). The cutoff wall would consist of a three foot wide trench extending from the ground surface down to the top of bedrock filled with a cement-bentonite slurry. An additional 9 new relief wells would be installed along the landside toe of the levee to control underseepage at a 100-foot wide opening or gap in the cutoff wall where an active utility line crosses the levee. The plan also includes a 10-acre disposal site and other appurtances. Implementation is scheduled over three fiscal years (FY2013 – early FY2016).

4. The proposed plan has been studied for physical, biological and socioeconomic effects. Major findings of this investigation include the following:

a. The proposed plan provides an engineering solution to the problem consistent with the preservation of the environment.

b. The proposed plan will permanently correct the uncontrolled underseepage along the Wood River levee adjacent to Melvin Price Locks and Dam. Groundwater elevations in the East Alton Pump Station No. 1 ponding area on the landside of the levee are expected to be permanently lowered along the reach of the cutoff wall, but not along the reach of the 46 relief wells. Hydrologic impacts to surface water in the ponding area are considered to be minimal.

c. No concerns with potential HTRW issues have been identified. A contingency plan will be developed to handle any unexpected encounter with contaminated materials. During construction of the proposed relief wells and cutoff wall, excavated materials will be monitored to determine if any contaminants of concern are present that might require such materials to be considered a special waste.

d. No effects to any cultural resources have been identified. The St. Louis District has executed with the Illinois Historic Preservation Agency a Memorandum of Agreement (MOA) in conjunction with the concurrent Wood River Levee Limited Reevaluation Report (a separate project) specifying how preservation concerns that may arise from changes in project impacts will be addressed. That MOA will cover any coordination activities associated with this project.

e. The interim risk reduction measures have caused unavoidable impacts to natural resources in the ponding area, including the loss of 0.5 acre of terrestrial habitat (bottomland hardwood forest) to construct Dike B, and the expected death of about 25 acres of trees in wetland forest due to the continuation of prolonged ponding until final risk reduction measures are constructed. These direct and indirect effects will be mitigated on-site by planting tree seedlings attractive to wildlife in the areas of clearing and expected tree mortality after the proposed action is implemented. The proposed relief wells and cutoff wall are not expected to adversely affect any natural resources.

f. The proposed plan will result in temporary and minor impacts to recreational use of the Confluence Trail on top of the levee. Use of the trail is expected to continue during construction with appropriate safety measures in place.

g. Minor and temporary impacts are expected on air quality, surface water quality, traffic movement, recreation, aesthetics, and noise. The plan will result in minor and permanent impacts on biological resources, surface hydrology, and groundwater movement and groundwater elevations. Proper stormwater pollution prevention practices will be enacted during construction, and disturbed areas will be reseeded to restore levee turf or other groundcover. The plan will not adversely affect any threatened and endangered species or the bald eagle, socioeconomic resources, environmental justice, or agricultural lands and prime farmland soils. Measures to protect the decurrent false aster will be implemented.

5. Based on my analysis and evaluation of the alternative courses of action presented in these documents, I have determined that the Melvin Price-Wood River Levee Underseepage Corrections Project will not have significant effects on the quality of the human environment. Therefore, no Environmental Impact Statement will be prepared prior to proceeding with this action.

Date /unsigned/_

Christopher G. Hall
Colonel, U.S. Army
District Commander

PRELIMINARY DRAFT

LIMITED REEVALUATION REPORT
ON DESIGN DEFICIENCY CORRECTIONS FOR
WOOD RIVER MEL PRICE UNDERSEEPAGE PROJECT

APPENDIX A

ENGINEERING

SECTION 1 – HYDRAULIC AND HYDROLOGIC CONSIDERATIONS

A. History

In July 1984, the report "Lock and Dam No. 26 (Replacement) Wood River Drainage and Levee District, Alton Pump Station Relocation: Pump Station Capacity Study" was published in response to the required relocation of the Alton Pump Station. The Alton Pump Station was put into operation in 1952 and went through many changes during its 30+ year life cycle. When constructed, the station had a capacity of 116 cfs, and by 1984 it had a capacity of 138 cfs, with only 127 cfs capable of being pumped due to maintenance issues. The replacement for the Alton Pump station was the East Alton No. 1 Pump Station which is currently in operation just downstream of Mel Price Lock & Dam at Mississippi River Mile 200.5. From the report dated July 1984, the intended size of the East Alton No. 1 Pump Station was 223 cfs (approximately 100,000 GPM), 138 cfs from the existing Alton Pump Station, and an additional 85 cfs due to changed conditions from relocating Lock & Dam 26 to the current Mel Price Lock & Dam.

B. Current Capacity and Inflows

The current capacity of the East Alton No. 1 Pump Station is 79,200 GPM, approximately 176.5 cfs. While this is significantly lower than the recommended capacity from 1984, it was determined that seepage was greatly overestimated and this capacity was actually sufficient for the area. The current pump station is sufficient to pump the existing capacity in the sewers. In the case of an event where the sewer capacity is exceeded, water begins to pond in the ponding area adjacent to the East Alton Pump Station No. 1 and is eventually pumped out of the system once the exterior stage has receeded. Further discussion on the seepage analysis can be found in the geotechnical section of this appendix.

C. Expected Inflows for Design Alternatives

Inflows to the pump station were considered for each design alternative and are shown below in Table 1.1. Each of these flows includes 36,356 GPM flow from storm water runoff which was calculated for the 1984 report using HEC1N. Calculations for each alternative can be found at the end of this section. Due to time constraints, a simple analysis was done where it was assumed that for each acre-foot lost in storage, that volume could be pumped out of the system over a 24-hour period. Thus, each acre-foot was assumed to be an acre-foot/day to easily compare with seepage flows, well flow and flow from storm water runoff. Also, the storage capacity given in the 1984 report (see Table 1.2 below) is assumed to be accurate, since nothing has been done to the storage area since the original construction to infer that the storage area has changed and current pump operation does not indicate that a reduction of volume has occurred.

Table 1.1: Total Flows To East Alton No. 1 Pump Station

Design Alternative	Flow to Pump Station (GPM)
Wells Only	104,483
Wells and Berm	142,381
Berms Only	187,250

Table 1.2: Storage Capacity

Elevation (ft, NGVD)	Volume (ac-ft)	Cumulative Volume (ac-ft)
400	0.34	0.34
402	5.12	5.46
404	18.52	23.98
406	92.32	116.3
408	121.68	237.98
410	207.90	445.88
412	282.80	728.68
414	357.40	1086.08
415	67.48	1153.56
416	453.30	1606.88
418	501.50	2108.38
420	544.20	2652.58
424	1210.72	3863.30
428	1536.88	5400.18

Wells Only

This design alternative includes all of the recalculated seepage flow through the levee and flow from wells being installed by USACE and The City of Wood River. Since this option resulted in the lowest total flow to the station, it would require the least additional pumping to supplement the existing station. This option included only installing new wells to the system so there was no loss in storage taken into account.

Berm Only

The berm only option included placing large berms in what is the existing ponding area to minimize seepage into the area. The total fill into the area would be 788,000 cubic yards, approximately 490 acre-feet. This option resulted in the largest flow into the pump station due to the large amount of fill taking up storage capacity.

Wells and Berm (Combo) Option

The wells and berm option, also referred to as the combo option, utilized a hybrid of the two previously mention plans. Fewer wells were considered for this option along with smaller berms, which would occupy 435,000 cubic yards, approximately 270 acre-feet, of the existing storage area.

D. Interim Risk Reduction Measures

For the time period before the permanent seepage prevention measures are put in place, interim measures were taken to reduce the risk of excessive seepage that could lead to a levee failure. This section describes the hydraulic analysis of these interim measures, which included temporary dikes across two drainage paths in the levee interior area, as well as temporary pumps at the dike locations, when necessary.

An unsteady flow HEC-RAS hydraulic model was created in order to study the water surface elevations, ponding durations, and velocities associated with the use of the temporary measures. The model was created utilizing LIDAR data from the interior of the levee district, along with Storm Water Plans from the city of Alton, which provided an estimate of the Flood Flows from the Central Avenue and Shields Valley CSO. The goal of the unsteady analysis was to determine what configuration of dikes and pumps would perform best, in terms of minimizing the CSO overtopping duration and maintaining structure integrity during heavy rainfall events.

Tables 1.3 through 1.6 below are the output of the HEC-RAS study. Each chart will be preceded by an explanation of what is being shown by the chart and how they were used to inform decisions about the temporary measures.

The data in Table 1.3 was used as an indication of the effects of the dikes on the CSO weir overtopping. Because each of the dikes will maintain a pool of water upstream, they will increase flood heights during rain events, potentially causing a greater amount of overtopping at the CSO weirs. The tables show 3 different conditions, 3 different rainfall events, and the resulting overflow heights and the duration of overflow at the 3 CSO weirs. This table was used to compare each of the alternative plans for interim protection, to minimize impacts to the CSO's.

Table 1.3: Effects of the Dikes on the CSO weir overtopping

	Pre-Existing Conditions Peak Overtopping Height, Ft			Dikes A&B with Notch at 412 Peak Overtopping Height, Ft			Dikes A&B at 415 Peak Overtopping Height, Ft		
Location	**2-Year**	**5-Year**	**10-Year**	**2-Year**	**5-Year**	**10-Year**	**2-Year**	**5-Year**	**10-Year**
Central Avenue CSO	4.1	5.1	6.0	5.1	6.2	6.6	6.0	6.6	6.9
Shields Valley (upper)	2.9	3.0	3.1	3.9	4.2	4.3	4.8	5.1	5.1
Shields Valley (lower)	2.9	3.1	4.3	4.4	4.5	4.7	4.8	5.0	5.0

	Pre-Existing Conditions Duration of Overtopping, hrs			Dikes A&B with Notch at 412 Duration of Overtopping, hrs			Dikes A&B at 415 Duration of Overtopping, hrs		
Location	**2-Year**	**5-Year**	**10-Year**	**2-Year**	**5-Year**	**10-Year**	**2-Year**	**5-Year**	**10-Year**
Central Avenue CSO	1.5	2.2	2.9	5.2	6.2	6.7	* INDEFINITE		
Shields Valley (upper)	3.1	3.6	3.9	3.2	3.7	4.0	3.3	3.8	4.1
Shields Valley (lower)	1.9	2.3	2.9	2.0	2.7	3.1	* INDEFINITE		

* INDEFINITE indicates that overtopping of CSO would be indefinite without pumping, due to project ponding height
(For the duration of overtopping with pumping at Dikes A and B, see Table #2 of 3.)

Table 1.4 shows the peak velocities through and over Dikes A and B, as computed by the unsteady flow model. This was used to compare the velocity of flow over the weirs during various rainfall events. Alternatives were modified to maintain safe velocities and prevent erosion of these interim protection dikes. Without the notches in the dikes, the overtopping velocity was found to be too great, and this was evident in the damage sustained by an early attempt at interim protection.

Table 1.4: Peak Overtopping Velocities, Dikes A and B

	Peak Velocity (feet/sec) Dike NOTCH only (> 412.0)			Peak Velocity (feet/sec) ENTIRE Dike (> 415.0)		
Location	2-Year	5-Year	10-Year	2-Year	5-Year	10-Year
Dike A	3.7	3.6	3.6	3.3	3.8	4.0
Dike B	2.9	3.9	3.9	2.5	4.0	4.0

Tables 1.5 and 1.6 show a range of pumping capacities and the time each pump would take to reduce ponding below the overtopping height (for Dike A and B). These tables were used to find the most effective pumping capacity for each dike location, based on the length of time that pumping requires. Project managers made a decision on temporary pumping based on the cost of purchasing the pumps, the operating costs, and the benefit gained from pumping.

Table 1.5: Duration of CSO Overtopping with Pumping (Dike A)

DIKE A PUMPING:	**Start Pumping @ 415 Time to reduce stage to 410.8**	**CSO OVERTOPPING TIME (INCLUDING STORM TIME)**		
		2-YEAR	**5-YEAR**	**10-YEAR**
PUMP CAPACITY (GPM)	**PUMPING TIME (HRS)**	**O.T. TIME (HRS)**	**O.T. TIME (HRS)**	**O.T. TIME (HRS)**
2244	19.5	25.3	26.1	26.4
4488	9.7	15.5	16.3	16.6
6732	6.5	12.3	13.1	13.4
8976	4.9	10.7	11.5	11.8
11220	3.9	9.7	10.5	10.8
13464	3.2	9.0	9.8	10.1
15708	2.8	8.6	9.4	9.7
17952	2.4	8.2	9.0	9.3
20196	2.2	8.0	8.8	9.1
22440	1.9	7.7	8.5	8.8
24684	1.8	7.6	8.4	8.7
26928	1.6	7.4	8.2	8.5
29172	1.5	7.3	8.1	8.4
31416	1.4	7.2	8.0	8.3
33660	1.3	7.1	7.9	8.2
35904	1.2	7.0	7.8	8.1
38148	1.1	6.9	7.7	8.0
40392	1.1	6.9	7.7	8.0
42636	1.0	6.8	7.6	7.9
44880	1.0	6.8	7.6	7.9
CSO Overtopping Time for Storm Event Only -------->		5.8	6.6	6.9
PRE-DIKE CONSTRUCTION Overtopping Time --------->		1.5	2.2	2.9

Table 1.6: Duration of CSO Overtopping with Pumping (Dike B)

DIKE B PUMPING:	**Start Pumping @ 415 Time to reduce stage to 413.8**	**CSO OVERTOPPING TIME (INCLUDING STORM TIME)**		
		2-YEAR	**5-YEAR**	**10-YEAR**
PUMP CAPACITY (GPM)	**PUMPING TIME (HRS)**	**O.T. TIME (HRS)**	**O.T. TIME (HRS)**	**O.T. TIME (HRS)**
2244	12.8	17.1	17.5	17.8
4488	6.4	10.7	11.1	11.4
6732	4.3	8.6	9.0	9.3
8976	3.2	7.5	7.9	8.2
11220	2.6	6.9	7.3	7.6
13464	2.1	6.4	6.8	7.1
15708	1.8	6.1	6.5	6.8
17952	1.6	5.9	6.3	6.6
20196	1.4	5.7	6.1	6.4
22440	1.3	5.6	6.0	6.3
24684	1.2	5.5	5.9	6.2
26928	1.1	5.4	5.8	6.1
29172	1.0	5.3	5.7	6.0
31416	0.9	5.2	5.6	5.9
33660	0.9	5.2	5.6	5.9
35904	0.8	5.1	5.5	5.8
38148	0.8	5.1	5.5	5.8
40392	0.7	5.0	5.4	5.7
42636	0.7	5.0	5.4	5.7
44880	0.6	4.9	5.3	5.6
CSO Overtopping Time for Storm Event Only --------->		4.3	4.7	5.0
PRE-DIKE CONSTRUCTION Overtopping Time --------->		1.9	2.3	2.9

E. Wood River Interior Drainage

E1. - Existing Conditions

Due to the nature of this project, a simple unit analysis was done to determine the most economically feasible option. The storm runoff was assumed to be the same as the 1984 report (36,356 gpm) since there has been no new development in the area in the last 27 years. In addition to the storm water flow, the City of Wood River is installing wells in the area that will add 2,527 gpm to the interior flows which will need to be pumped out of the system. Finally, the last inflow is the assumed seepage from the 1984 report which would add another 78,100 gpm of water to the land side of the levee which would need to be removed from the system. The seepage value is bases on approximately 21.5 ft of differential head. The total flow that the Alton Pump Station must be able to pump for the existing pump station is 116,983 gpm.

Calculations:
Flow from storm runoff (from 1984 report): 81 $cfs = 36{,}356\ gpm$
Flow from wells being installed by The City of Wood River: 2,527 gpm
Design seepage flow: 78,100 gpm
Total flow to pump station= 36,356 gpm + 2,527 gpm + 78,100 gpm = 116,983 gpm

E2. - Berm Only Option

For the berm only option, 790,000 cy (490 ac ft) of fill would need to be placed in the current ponding area to sufficiently reduce the seepage. Assuming that for every 1.984 acre feet of fill placed in the ponding area, it would take one day to pump that amount of displaced water out of the system, the fill would result in an additional 110,850 gpm to be removed from the system due to lack of storage. In total, that would require that the Alton Pump Station and/or any additional pump stations placed at the site be capable of pumping 187,250 gpm.

Calculations:
Includes up to elevation 443.3 on exterior, differential head of 33.3 ft
Loss in storage from seepage berm: $790{,}000cy\left(\frac{1\ acft}{1{,}613.3cy}\right) = 490\ acft$
Additional pumping required due to storage change: $490\ acft\left(\frac{448.83\ gal/min}{1.984\ acft/day}\right) = 110{,}850\ gpm$
Seepage: 40,027 gpm (see Geotechnical analysis)
Total flow to the pump station: $110{,}850\ gpm + 40{,}027\ gpm + 36{,}356\ gpm = 187{,}250\ gpm$

E3. - Combo Option

For the alternative which utilized berms and wells, a similar analysis was done. The berm in this case would only require 435,000 cy of material to be place in the current storage area. Due to the reduced amount of fill, and the additional relief wells in the system, the Alton Pump Station and/or any supplemental pump stations would need to have a capacity of 142,381 gpm.

Calculations:

Includes up to elevation 443.3 on exterior, differential head of 33.3 ft
Loss in storage from seepage berm: $435{,}000cy\left(\frac{1\,acft}{1{,}613.3cy}\right) = 269.6\ acft$
Additional pumping required due to storage change: $269.6\ acft\left(\frac{448.83\ gal/min}{1.984\ acft/day}\right) = 60{,}998\ gpm$
Seepage: 45,027 gpm (see Geotechnical analysis)
Total flow to pump station: $60{,}998\ gpm + 45{,}027\ gpm + 36{,}356\ gpm = 142{,}381\ gpm$

E4. - Wells Only Option

For the wells only option, all of the flows going to the pump station were simply added to determine the required size of the station. In total, the station would need to have a capacity of 104,483 gpm. While this is a much small flow than the other two options, the wells would need to be placed so close together that this was not a feasible option.

Calculations:
Includes up to elevation 443.3 on exterior, differential head of 33.3 ft
Flow into ponding area: 68,127gpm
Total flow to pump station: $68{,}127\ gpm + 36{,}356\ gpm = 104{,}483\ gpm$

F. RISK/UNCERTAINTY FOR THE MISSISSIPPI RIVER

Risk/uncertainty was used in the HEC-FDA (Flood Damage Reduction Analysis) program for probabilistic analysis. Corps of Engineer regulations directs that flood risk for levees be described using expected annual stage exceedance probability, long-term risk, and conditional probability of non-exceedance instead of freeboard (*EM 1110-2-1619* and *ER 1105-2-101*). The analysis assumed that the levee would fail at the top of net levee grade elevation and geotechnical conditional probability of failure point is a separate analysis.

The frequency profiles for the Mississippi River were taken from the **Upper Mississippi River System Flood Flow Frequency Study**, U. S Army Corps of Engineers, January 2004. The risk uncertainty assumptions in the HEC-FDA program are based on stage-discharge functions with uncertainty and exceedance probability functions with uncertainty using an equivalent record length of 100 years. Table D-4 displays the results of the HEC-FDA model when the top of levee height is at 54 ft at the St. Louis gage.

Table 7
Risk/Uncertainty

Target Stage Annual Exceedance Prob.			Long Term Risk(1)		
Location	Median	Expected	10-yr	30-yr	50-yr
Mississippi	0.0003	0.0006	0.0062	0.0154	0.0306

(1) The expected value of long term risk (the risk of flooding one or more times in 10, 30 or 50 years) is reported from HEC-FDA as the average over all Monte Carlo simulations.

Table 7 Continued
Risk/Uncertainty

	Conditional Non-Exceedance Probability by Events					
Location	0.10	0.04	0.02	0.01	0.004	0.002
Mississippi	1.0000	1.0000	1.0000	1.0000	0.9982	0.9718

SECTION 2 – GEOTECHNICAL CONSIDERATIONS

A. – Historical Perspective

A1. – Authorization and Construction

The Wood River Levee project was originally authorized by the 1938 Flood Control Act and between 1949 and 1960, the St. Louis District issued numerous construction contracts to build/improve levees in the Wood River Drainage and Levee District. As originally authorized, the project includes approximately 21-miles of mainline levee, 170 relief wells, 26 closure structures, 41 gravity drains, and 7 pump stations. Figure 2.1 presents the official project map. The levee is authorized to provide protection to flood height equal to a level of 52-feet on the St. Louis gage plus 2-feet of freeboard, this corresponds to a flood elevation ranging from 443 to 443.5. The entire levee district exists in Madison County Illinois and is situated on the left descending bank of the Mississippi River in three separate sections described as follows:

The Upper Wood River Drainage and Levee District originates near the intersection of Langdon and Front Streets (US highway 67) in Alton Illinois at Mississippi River mile 203. From there it extends downstream past the Melvin Price Locks and Dam (approx river mile 200.8) to the mouth of the Wood River at river mile 199.4. There the levee turns and proceeds upstream along the right descending bank of the Wood River for 1.6 miles to the project terminus.

The Lower Wood River Drainage and Levee District originates at high ground on the left descending bank of the West Fork of the Wood River, near Powder Mill Road in East Alton Illinois. It extends 1.7-miles to the confluence with the East Fork of the Wood River. There the levee continues downstream along the left descending bank of the Wood River for 2.3-miles to the mouth of the Wood River at Mississippi River mile 199.4. The lower Wood River Drainage and Levee District then continues along the left descending bank of the Mississippi for 4.76 miles to the mouth of the Cahokia Canal at Mississippi River mile 195. There the levee turns and proceeds upstream along the right descending bank of the Cahokia Canal for 2.6 miles and then turns and follows the defunct New York Central railroad tracks for 3.0 miles in a north-easterly direction. Then the levee veers the north for 0.50-miles to its terminus in South Roxana Illinois.

The East-West Forks portion of the Wood River Drainage and Levee District is 2.68 miles long on the north side of the East and West Forks of the Wood River.

The original underseepage analysis of the Wood River Levee system was completed in October 1956 and is presented in the Corps Technical Manual 3-430 "*Investigation of Underseepage Alton to Gale, Illinois*". This analysis looked solely at the underseepage regime created by the maximum flood height that corresponded to the urban flood elevation (52-feet on the St. Louis gage plus 2-feet). The 1956 analyses predicted the need for positive seepage controls for the design flood height. These positive seepage controls were to be installed at various locations throughout the project. The analyses recommended installation of relief wells at various spacing throughout the levee system resulting in the installation of 170 relief wells in the early 1960s.

Figure 2.1 – Wood River Drainage and Levee District Project Map

A2. – Impacts of New Melvin Price Locks and Dam

From its construction until the year 1989, the upstream most 2.2-miles, of the Upper Wood River levee between Mississippi River miles 203 to 200.8 (project station 0+00 to 115+00) was located within the tailwater of Lock and Dam #26. The original Lock and Dam #26 was constructed in 1936 at river mile 203. With the completion of the Melvin Price Locks and Dam at river mile 200.8 (2.2 miles downstream of the original LD #26) and the subsequent raising of the navigation pool in 1989, the 2.2-mile length of the Wood River levee (between project station 0+00 to 115+00) was now located within the permanent navigation pool of the new lock and dam.

Anticipating negative impacts of the new navigation pool on the Upper Wood River Drainage and Levee District, the St. Louis District produced DM 16 (March 1985) for Lock and Dam 26(R) entitled "*Wood River Drainage and Levee District Alteration*". This DM presents the results of Geotechnical, Hydraulic, Architectural, Structural, Civil, Mechanical, Electrical, Cost Estimate, Scheduling studies and an Attorney's Report. Paragraph 1-01 "PURPOSE AND SCOPE" of the DM states:

> "This Feature Design Memorandum (FDM) presents the proposed plan of remedial action for alteration, relocation, and protection of the Wood River Drainage and Levee District (WRD & LD) that will be affected by the new segment of Navigation Pool 26. The pool will permanently raise the water level against the existing levee thus increasing the water seepage into the protected area. The proposed plan includes the alteration to the existing drainage ditch and relief wells, relocation and increase in size of the Alton Pump Station, and the protection to the existing levee."

The area covered by this DM is shown in Figures 2.2. Melvin Price Locks and Dam is visible in the upper right hand corner of the photo. The levee stationing is annotated by the yellow dots. Existing relief well locations are superimposed on the landside toe. Figure 2.3 is looking upstream along the landside of the Wood River Levee, through the area covered by DM16, and shows the area as it existed in September 1988 before the navigation pool was raised against the new Melvin Price Locks and Dam. The Alton Pump Station construction is visible in the foreground.

A3. – 1993 Flood of Record

The existing Wood River Drainage and Levee district is designed to protect against a maximum flood height equivalent to 52-feet on the St. Louis gage plus 2-feet of freeboard, this corresponds to a flood elevation ranging from 443 to 443.5. The flood of record occurred on 1 August, 1993 during the 1993 Mississippi River flood. Based on high water marks surveyed after the flood and the US Geological Service's *Hydraulic Investigations Atlas #HA 735-F*, there was 6 to 7-feet of freeboard available on the Wood River levee embankment during the peak stage.

CEMVS mounted a substantial flood fight during this event. Two locations of excess seepage caused enough concern that the district took proactive action to control the seepage, but these areas were not located within the project reach that is in question here.

During the flood, the Wood River drainage and levee district flooded the area addressed by DM 16 per its established operation plan. The district maintained the interior ponding at an elevation no lower than about elevation 410. This interior water prevented the flood fight teams from observing

Figure 2.2 – Area Landside of Wood River Levee. Subject of DM-16 Report.
(All existing relief wells superimposed on aerial image.)

any seepage activity in the area.

A4. – Existing Interior Drainage.

The area landside of the levee is drained by a ditch that parallels the levee located 100 to 500-feet landside of the landside levee toe. The ditch is visible in Figure 2.4. This ditch begins at the City of Alton's Central Avenue Combined Sewer Outlet (see Figure 2.11) and ends at the Alton Pumping Station. Two 54-inch diameter gravity drain structures in the Alton Pump Station (at project station 134+00) drain this ditch to the Mississippi River when Melvin Price tailwater elevations are at/below elevation 405. When the gravity drains are closed, the levee district activates the Alton pumping station as necessary to control the landside ponding elevation.

A substantial portion of the City of Alton combined sewer system terminates at the Central Avenue CSO. "Dry weather" flows backup behind a weir in the CSO, are captured by a 30-inch main, and are diverted to the Alton wastewater treatment plant. The top of the weir is at elevation 410.7. When local rainwater events occur over the City, the precipitation runoff and wastewater mixture overflow the weir, enter the ditch, and flow to the Mississippi River via the Alton Pump Station. A hydraulic analysis of this system is located within the Hydraulic Engineering section of this Engineering Appendix.

Another part of the City of Alton combined sewer system terminates at the Shields Valley CSO (see Figure 2.11). This system operates in similar fashion, but the top of the Shields Valley CSO weir is at elevation 413.8.

Figure 2.3 – Landside of Wood River Levee (Sept 1988)

A5. – Discovery of Uncontrolled Seepage and Sand Boils.

During a data gathering mission in July of 2009, CEMVS geotechnical engineers discovered large expanses of very soft areas and numerous points of uncontrolled seepage landside of the Upper Wood River levee. These soft areas and seeps exist from just below the centerline of the Melvin Price Locks and Dam and extend upstream 7,100-feet. Figure 2.4 shows the extent of this seepage area. This is the same area that was the subject of the studies in DM 16. The initial discovery of uncontrolled seepage was made in late July, 2009 when the Melvin Price navigation pool was at elevation 419 and the landside ponding was 402.9. Heavy seepage was observed but no sand movement noticed.

B. – Recent Developments

B1. – Continued Observations and Data Gathering.

Upon discovery of this uncontrolled seepage, the St. Louis District advised the Wood River drainage and levee district to pond a greater depth of water over the soft areas to minimize/prevent the continuation of the seepage. And CEMVS instituted a program of regular observations and monitoring in which the frequency of site visits increases with increased pool elevation above the normal level of 419. During the months of August, September, October, and the first few days of

November 2009, CEMVS geotechnical engineers made weekly trips to the site to monitor for changes in seepage rates or the movement of sand. No changes were observed.

On 28 October, 2009 10 CEMVS personnel performed a detailed walk-over inspection of the seepage area, obtaining coordinates of active seepage areas with hand held GPS units. Due to the extremely soft conditions, none of the inspectors were able to venture more than 200-feet landside of the levee without becoming mired up to knee or hip level and needing substantial assistance. The red dots on Figure 2.5 show the locations of the observed seeps that the inspectors could get to.

On November 3, 2009, the observers found active sand boils moving material with open-river at elevation 421.93 and landside ponding elevation of 409 (ΔH = 12.93-feet). On November 4, 2009, the observers observed heavy flow from the boils but no active sand movement with the open-river at elevation 421.59 and landside ponding at elevation 409.5 (ΔH = 12.09-feet). This observation of soil transport greatly increased the district's concern for this area.

B2. – Study of DM 16 "*Wood River Drainage and Levee District Alteration*".

In March 1985, CEMVS produced DM 16 for Lock and Dam 26(R) entitled "*Wood River Drainage and Levee District Alteration*". This DM presents the results of Geotechnical, Hydraulic, Architectural, Structural, Civil, Mechanical, Electrical, Cost Estimate, and Scheduling studies. Appendix A of the DM presents an Attorney's Report containing the Memorandum of Opinion describing various compensable interests of the WRD & LD and the legal obligations upon the Government to make these just compensations.

Section II of the DM is entitled *Levee Seepage and Stability*, which presents the results of additional seepage analyses related to the changes in pool conditions.

The additional analyses completed between project stations 32+00 to 80+00 recommended the need to lower the flow-line elevation of 22 relief wells to provide additional seepage control in order to prevent negative impacts on the landside Owens Corning Glass facilities.

No additional seepage analyses were completed between project stations 80+00 and 114+00 (the Mel Price centerline) and between project stations 114+00 and station 143+00 (just below the pumping station). In this reach, CEMVS only completed studies to determine the increased seepage flow rates into the levee district due to the change in pool conditions. This was done by simply pro-rating the flows calculated by the 1956 seepage analysis for differential heads resulting from various combinations of Melvin Price pool and landside ponding elevations. These results were used to support the final design of the necessary pumping capacity.

Comparisons of the 1985 seepage analyses with current observations indicate that the 1985 results are incorrect. For instance, for the daily case of Melvin Price Pool at elevation 419 (normal pool) and the landside ponding elevation of elevation 406, the DM suggests average flow rates of 280 gpm per each of 37 wells between project station 32+00 and 80+00 and average flow rates of 135 gpm for each of 39 wells between project stations 80+00 and 114+00. In fact, recent observations of these wells at the stated conditions revealed the static groundwater elevation 4 to 6-feet below the well flowline and zero flow from any of the wells.

While completing DM16, had CEMVS completed additional seepage analyses of the reach between project stations 80+00 and 114+00, especially for the condition of normal pool and landside ponding at elevation 406, the critical nature of the current situation would have been discovered, and the necessary controls would have been constructed at that time.

B3. – Installation of Piezometers and Instrumentation.

CEMVS contracted for the installation of 10 new piezometers in the seepage area exhibiting the most critical conditions. 8 of these were arranged in 2-ranges of 4 piezometers located downstream of Cpl Belecek Road as follows:

- 1st piezometer at the landside levee toe along the existing line of relief wells;
- 2nd piezometer located approximately 70-feet landside of the well line;
- 3rd piezometer located approximately 170-feet landside of the well line;
- 4th piezometer located approximately 700-feet landside of the well line.

A third range of two piezometers was installed upstream of Cpl Belacek Road. The final piezometer was installed in the Alton Pumpstation inlet bay to measure the landside ponding elevation. Figure 2.4 locates all of the piezometer ranges and Table 2.1 identifies and locates these instruments as well as their installation date and the date that the instrumentation was activated.

The extremely soft conditions prevented use of truck or track mounted drilling rig so the 10 piezometers landside of the relief wells were installed by hand. CEMVS-EC-G personnel created a board walk of wooden pallets to access the piezometer locations. All piezometers are of stainless steel construction and the 18-inch long screened tips are installed 15-feet below the ground surface. The piezometric data will be used to supplement direct observations and calibrate the numerical seepage models.

Figure 2.4 – Piezometer Locations and Extents of Serious Seepage Area
(Relief Wells and Stationing not shown for clarity)

Figure 2.5 – Locations of Seeps
(Relief Wells and Stationing Not Shown for Clarity)

Instrumentation and cabling was added to these piezometers to automate the collection of the piezometric data. The piezometric instruments are the *LevelLogger-Gold* as manufactured by Solinst. The cabling from each piezometer (on the levee side of the drainage ditch) was run back toward the levee toe and terminated in weather proof housings. This enables the technician to poll multiple instruments from one location. Due to their relatively remote locations, piezometers PZ-07, PZ-08, and PZ-Land must be individually visited.

Table 2.1 – Piezometer Locations

Piezometer Name	Date Installed	Project Station	Offset Levee CL (Landside)	Date Instrument Activated
Piezometer Line #1				
PZ-01	11/09/2009	112+00	220-ft (Along well line	11/12/2009
PZ-02	10/28/2009	112+00	290	10/31/2009
PZ-03	11/02/2009	112+00	450	11/11/2009
PZ-08	11/11/2009	112+00	1000*	11/13/2009
Piezometer Line #2				
PZ-04	11/10/2009	96+00	220-ft (Along well line	11/12/2009
PZ-05	11/06/2009	96+00	280	11/06/2009
PZ-06	11/11/2009	96+00	450	11/12/2009
PZ-07	11/11/2009	96+00	990*	11/13/2009
Piezometer Line #3				
PZ-09	11/13/2009	66+00	220-ft (Along well line	12/17/2009
PZ-10	11/13/2009	66+00	600	12/17/2009
Piezometer at Alton Pumpstation				
PZ-Land	12/07/2009	134+00	In Inlet Bay	12/07/2009

*Note: PZ-08 and PZ-09 installed on opposite side of the drainage ditch.

The instruments were programmed to obtain and store a reading every 4-hours. The data is collected on a weekly basis and can be collected more frequently as necessary. Initial operational difficulties (icing and flooding) were overcome and CEMVS has been collecting the piezometric data on a regular basis. Figures 2.6a, b, and c present plots of measured piezometric elevations, Melvin Price pool and tailwater elevations, and landside ponding elevations with respect to time for piezometric lines 1, 2, and 3. Figures 2.7 and 2.8 plot the piezometric response of the Line 1 and Line 2 piezometers with respect to the Melvin Price pool elevations. Study of the data in Figures 2.7 and 2.8 shows that the ground water regime landside of the levee responds to both changes in the Melvin Price pool elevation as well as changes in the landside ponding elevation. It is difficult to separate the exact contribution of both of these phenomenon.

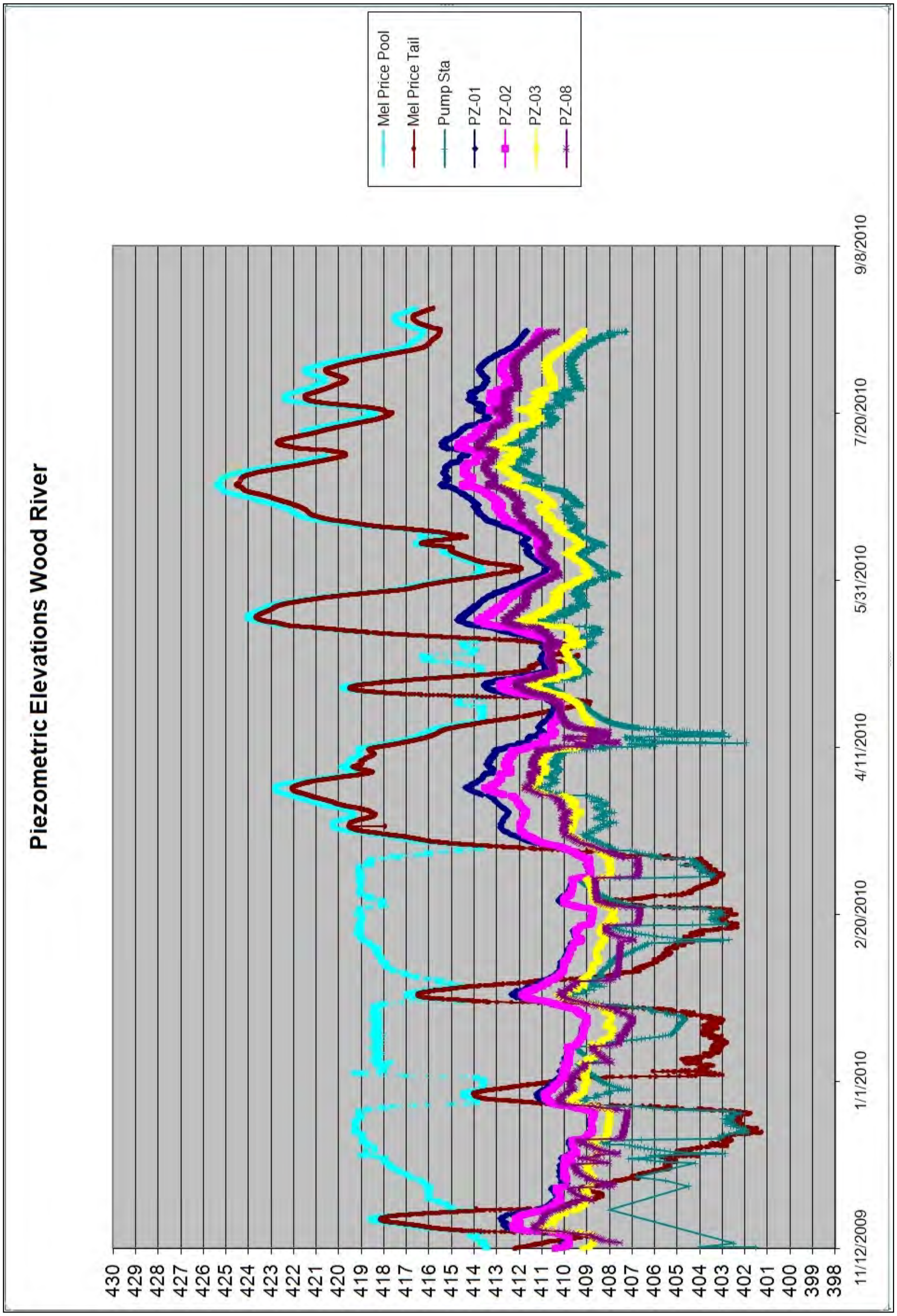


Figure 2.6a – Piezometric, Pool, TW, and LS Ponding Elevations with Time
Piezometer Line #1

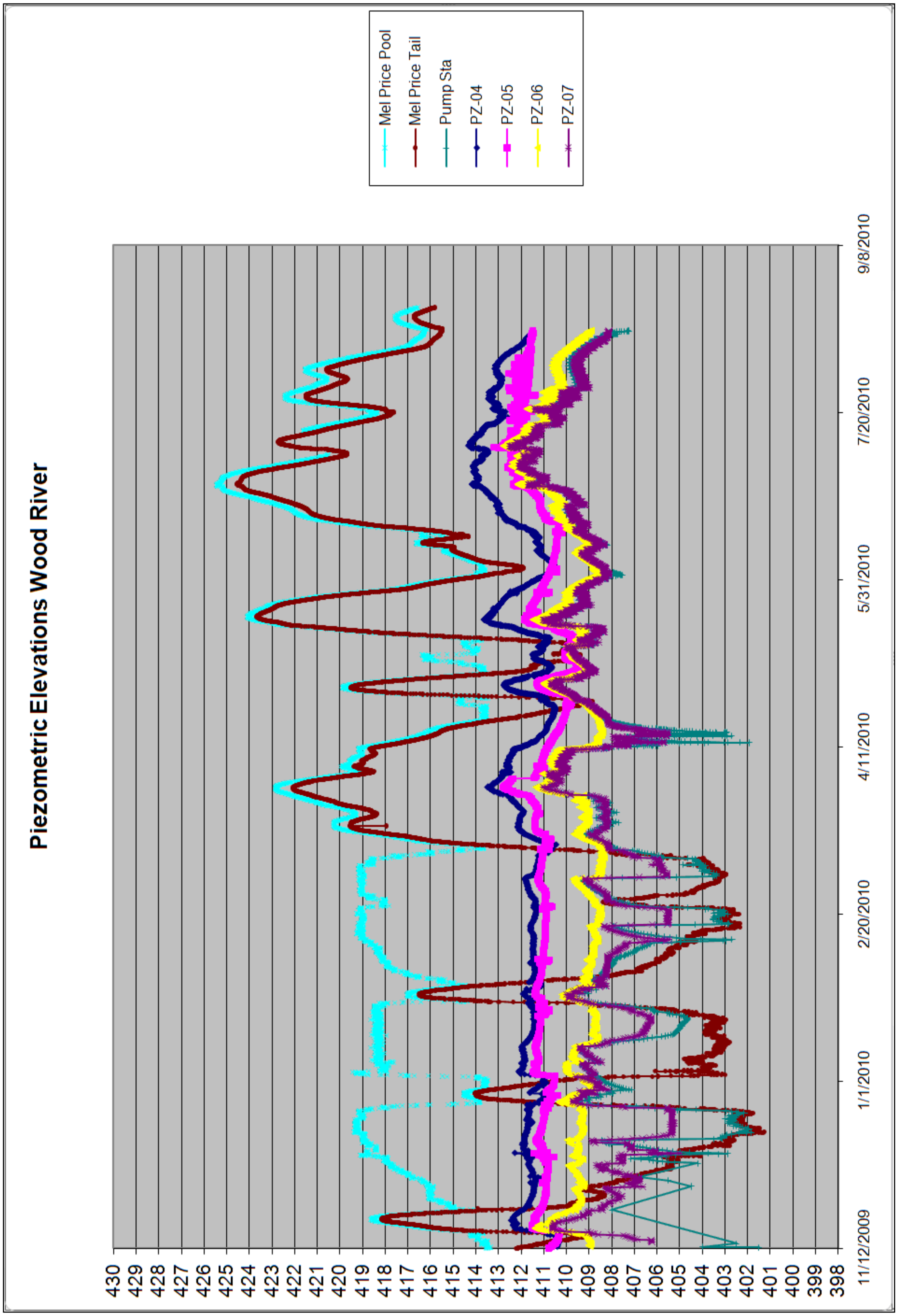


Figure 2.6b – Piezometric, Pool, TW, and LS Ponding Elevations with Time
Piezometer Line #2

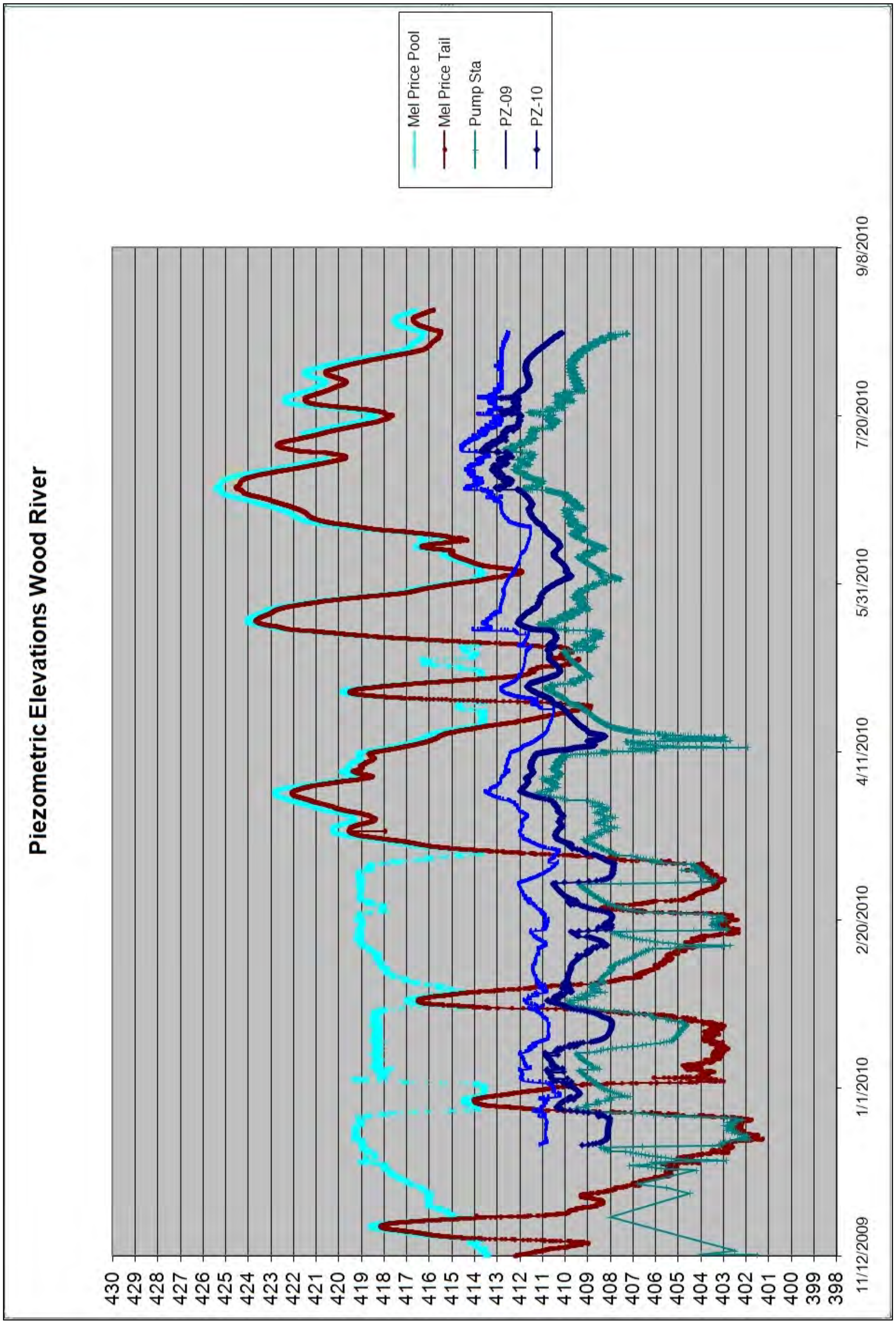


Figure 2.6c – Piezometric, Pool, TW, and LS Ponding Elevations with Time
Piezometer Line #3

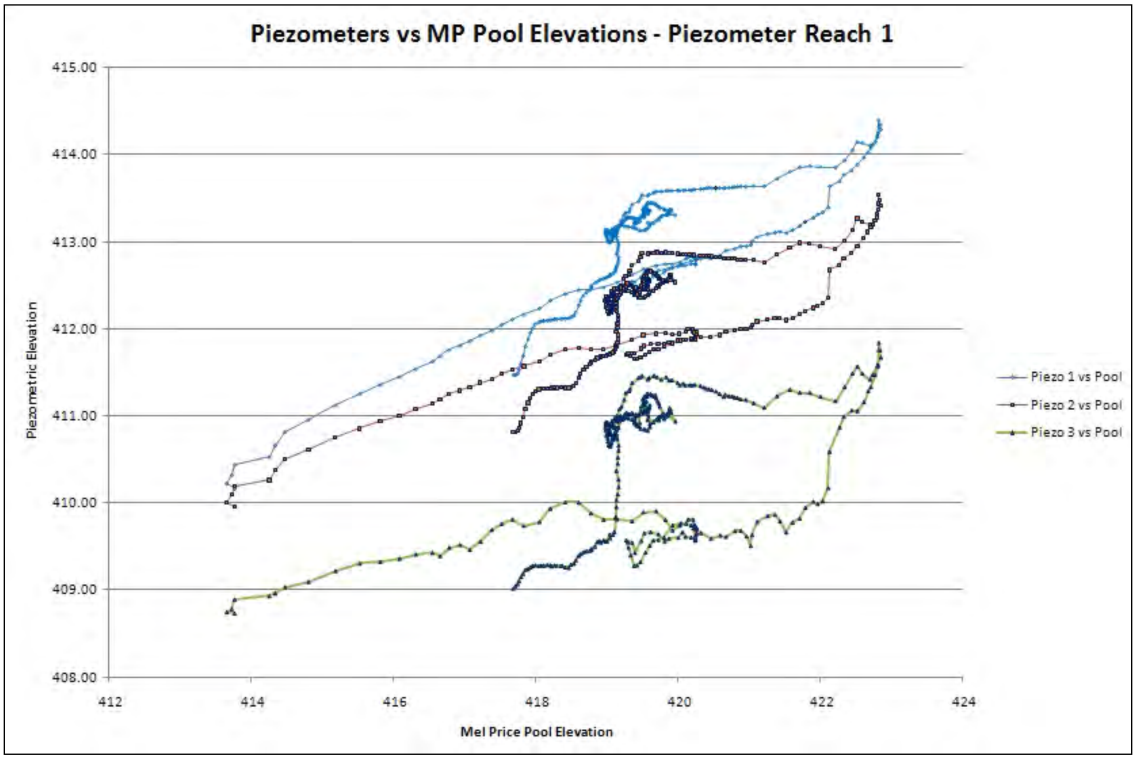


Figure 2.7a: Piezometric Elevation vs MP Pool Elevations Piezometer Line 1

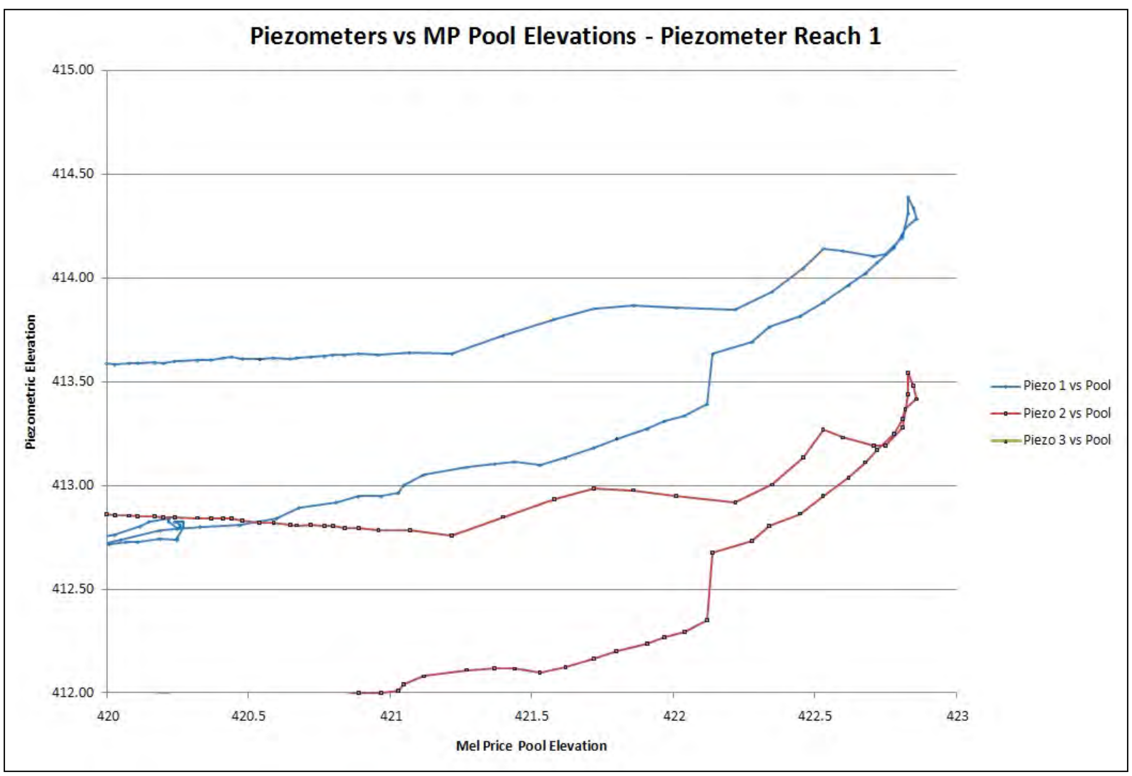


Figure 2.7b: Piezometric Elevation vs MP Pool Elevations (Close Up Line 1)

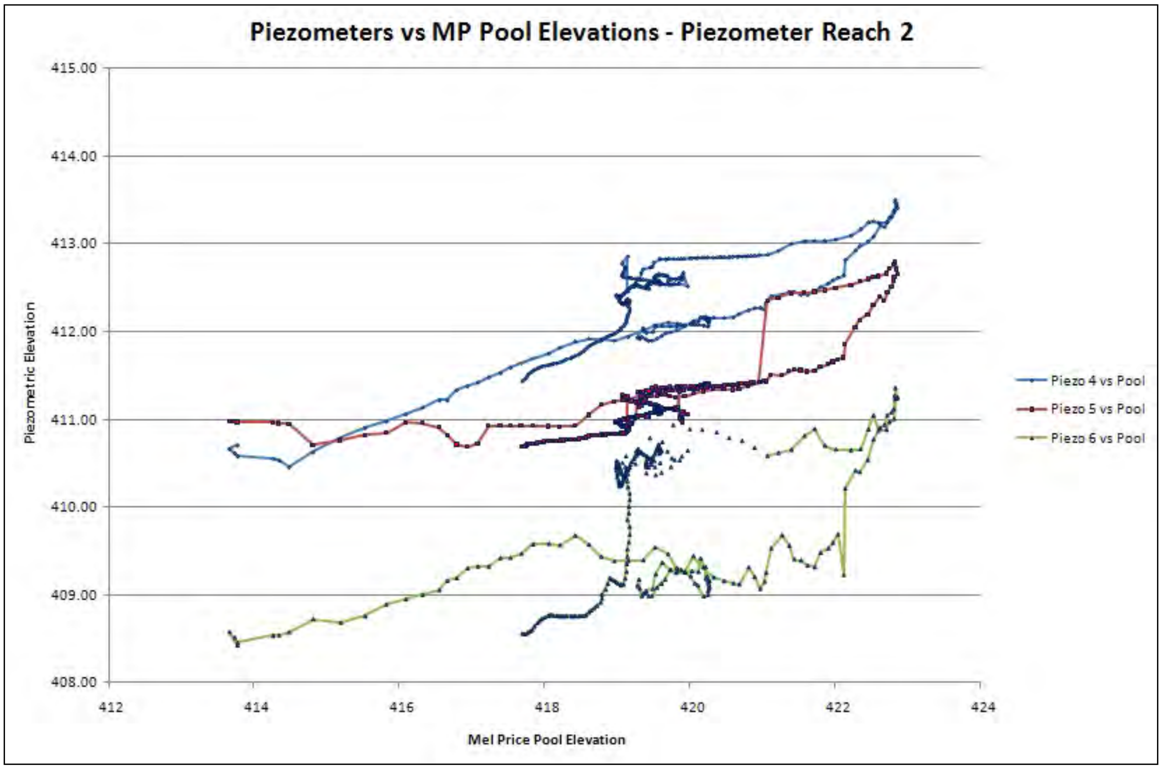


Figure 2.8a: Piezometric Elevation vs MP Pool Elevations Piezometer Line 2

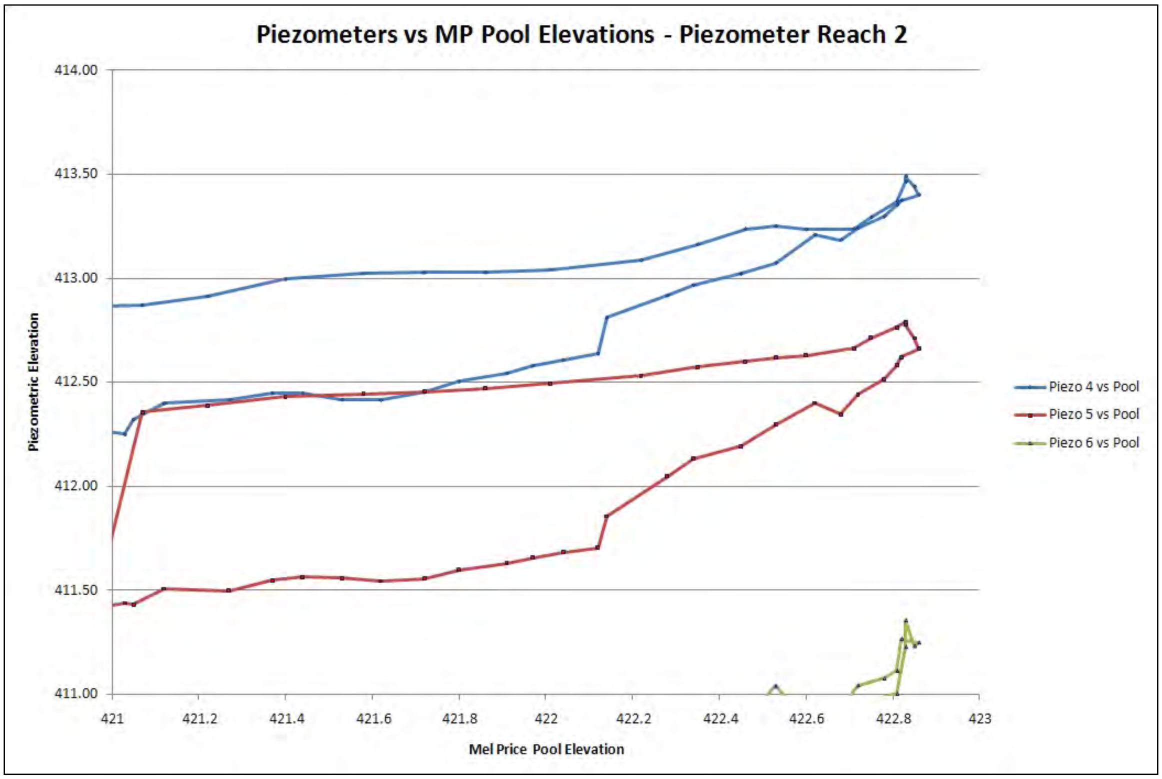


Figure 2.8b: Piezometric Elevation vs MP Pool Elevations (Close Up Line 2)

Piezometers PZ-01, -02, and -03 (in Figure 2.7a) and PZ-04 and -06 (in Figure 2.8a) show a relatively constant piezometric response for steadily rising river between elevations 414.26 and 418.61 (12 March and 16 March 2010). The piezometric response at the landside toe (PZ-01 and PZ-04) ranges between 39% and 32%. The piezometric response 450-feet from the landside toe (PZ-03 and PZ-06) show less response, ranging between 19% and 27%. But these values do not represent solely response to the Mel Price pool because the landside ponding also increased 1-foot from 408.06 to 409.07.

Figures 2.7b and 2.8b show a 'close-up' view of the data that indicates a greater piezometric response beginning at/about Melvin Price Pool elevation of 422. During this 48-hour interval (27 March to 29 March 2010), the Wood River Drainage and Levee District opened the Alton Pumpstation gravity drain and raised the landside ponding elevation by 2-feet while the river increased only 0.74-feet.

An even closer inspection of the data shows that when the Wood River Drainage and Levee District increased the landside ponding elevation by 0.85-feet in 4-hours on 27 March, 2010, the immediate piezometer response was 0.20-ft. The pool elevation was at 422.1 when this occurred.

B4. – Geotechnical Exploration and Testing

As part of the ongoing Deficiency Study of the Wood River Drainage and Levee District, the Corps completed conventional borings and cone penetrometer borings riverside and landside of the levee.

SPT sampling was performed using a standard 2-inch outer diameter split-spoon sampler per ASTM D1586, Method for Penetration Test and Split-Barrel Sampling of Soils.

Electronic CPT borings were performed in accordance with ASTM D 5778, Standard Test Method for Deep, Quasi-Static, Cone and Friction-Cone Penetration Tests of Soil. The values that were measured and calculated include corrected cone tip resistance (q_T), sleeve friction (f_s), friction ratio (R_f), penetration-induced porewater pressure (u_p), hydrostatic porewater pressure (u_o), normalized cone tip resistance (Q), normalized sleeve friction, (F), soil behavior type index (I_c), SPT (N), normalized SPT (N_1), to one TSF overburden pressure, undrained shear strength (S_u), soil unit weight (γ), and effective overburden pressure (σ). RapidCPT© software was used to interpret the raw data.

The soils testing program included classification of all samples, Atterberg Limits testing of all fine grained soils, and mechanical sieve analyses of all coarse grained soils. Soil samples were classified in the laboratory according to ASTM D2487, Test Method for Classification of Soils for Engineering Purposes and ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock. Figure 2.9 provides only a representative sampling of the landside exploration.

A Light Detection and Ranging (LIDAR) survey was performed for the Wood River levee in April 2009. And survey-grade GPS was used to obtain x,y,z coordinates at each boring location. NGS survey control was used. These x,y,z coordinates were superimposed on the LIDAR generated topography and verified the accuracy of LIDAR. The survey was performed to obtain current ground surface topography information. The data was used to generate topographic maps and cross sections at each boring location. The ground elevations and levee geometries used in underseepage analysis were obtained from this survey information.

The locations, graphical logs, and cross-sections of all exploration are presented on the Plates at the end of this appendix. These results provide excellent data on the thickness and permeability of the underlying coarse grained aquifer.

B5. – Geotechnical Seepage Analyses

In order to evaluate potential solutions to the problem, CEMVS built a numerical seepage model using the GeoStudio Seep/W product and the following information:

- The April 2009 LIDAR survey provided up to date information on the existent topography. Data from this aerial survey was supplemented with spot-elevations obtained in July 2009. The contour maps created from this survey are accurate to within +/-6 inches. The contours developed from the LIDAR survey are plotted on the aerial photography and shown on the plates at the end of this appendix.
- As-built data from the original levee construction and subsequent improvements dated 1949 and 1956. The initial levee construction consisted of a hydraulically-placed sand core that was covered with 18-inches of clay. A clay riverside enlargement was subsequently added with an attendant levee raise. These as-built drawings indicate landside borrow pits with excavations allowed down to elevation 407.
- As-built data from the Lock and Dam 26(R) esplanade construction on the riverside slope of the Wood River levee. Notes on these drawings indicate that the esplanade was constructed using materials dredged from the nearby Mississippi River bottom. These are assumed to be a mixture of sands and silty sands. The drawings show this fill was covered with a clay cap.
- CEMVS used the seepage related design parameters of the American Bottom aquifer presented in DM-2, Appendix E *"Pumping Tests and Underseepage Investigations"*. This document provides the results of boring #521 (drilled for Melvin Price Locks and Dam) located riverside of the Wood River levee. The average permeability of the course grained aquifer represented in this boring was obtained by applying the d_{10} vs permeability relationships (found in EM 1110-2-1913 *Design and Construction of Levees*) to the sands found in the boring. Its average permeability is $1200*10e^{-4}$ cm/sec. The same d_{10} vs permeability relationships was applied to the sands found in borings located landside of the Wood River levee. The average aquifer permeability of borings WRPH-82U, WRPH-52U, and WRPH-13U is $1360*10e^{-4}$ cm/sec, $950*10e^{-4}$ cm/sec, and $1500*10e^{-4}$ cm/sec. The average permeability of these four boring is $1250*10e^{-4}$ cm/sec. A value of $1200*10e^{-4}$ cm/sec was used in the Seep/W model. Since this permeability is determined from site specific exploration and testing, CEMVS considers it to be representative for this site. The average k_h/k_v permeability ratio of 2.6 determined from the pumping test on the Missouri side of the river was included in the model.
- Based on experience with the piezometric data obtained from the adjacent Melvin Price Lock and Dam, CEMVS is of the opinion that the surficial portion of the Mississippi River bottom is slightly clogged with fine grained materials. The Seep/W model includes a 5-foot thick surficial layer of silty sand in the river bottom with k_v=7*10e-4 cm/sec (based on DIVR-1110-400).
- Due to the extremely soft conditions, no machine based soils samples of the landside blanket are available. CEMVS-EC-GT employees and a soils scientist from the CEMVS regulatory branch explored the site on foot (aka 'hip waders') probing the thickness of the landside blanket with a 1-inch diameter sampler. The upward seepage and the nature of the blanket materials made it quite easy to push the sampler and discern the top of the sands. The

blanket thickness ranged from 18-inches (near piezometer PZ-02) to 30-inches near (near piezometer PZ-03). The soil scientist estimated that the fine grained materials were a mixture of silt and clay with clay percentages ranging from 30% near the levee and 60% further away from the levee. The increased thickness and clay percentage closer to the ditch are indicative of natural levee formation from the adjacent drainage ditch. Initial landside blanket permeabilities for silty clay were assigned based on Table 2.1 in DIVR-1110-1-400.

- A 2004 hydrographic Mississippi River survey measured immediately upstream of the Melvin Price Lock and Dam was used to define the river bottom topography.
- The Seep/W model includes boundary conditions defined by the geographic center of the Mississippi River as surveyed by the 2004 Hydrographic survey and informed by the piezometric data obtained from piezometer located furthest landside from the levee (PZ-8). The geographic center of the river was considered to be a point of symmetry for ground water flow. A vertical, no-flow boundary was located at this point. The seepage model has been and will continue to be calibrated against newly obtained piezometric data sets.
- CEMVS Geotechnical engineers obtained additional intensive training in the GeoStudio Seep/W numerical seepage analyses program. This training was completed the week of 18 November, 2009 and was facilitated by Dr. John Krone of GeoStudio. This program has been used throughout the Corps and the private geotechnical community and its results are widely accepted.

Figures 2.10a, b, and c illustrate the cross section of the Seep/W model built for Piezometer Line #1according to the listed assumptions. Similar models were built for Piezometer Lines 2 and 3.

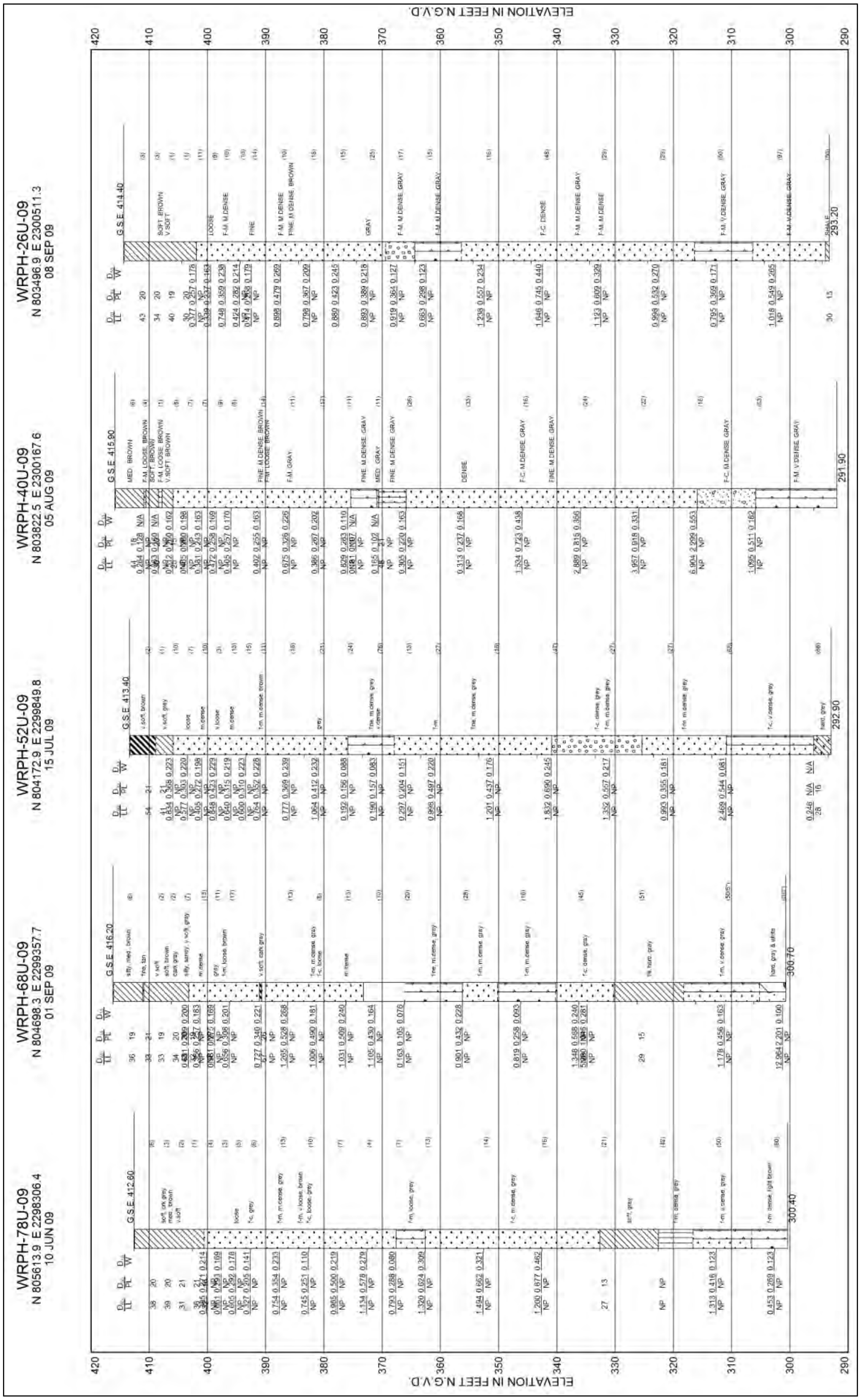


Figure 2.9 – Representative Borings Logs of American Bottom Aquifer

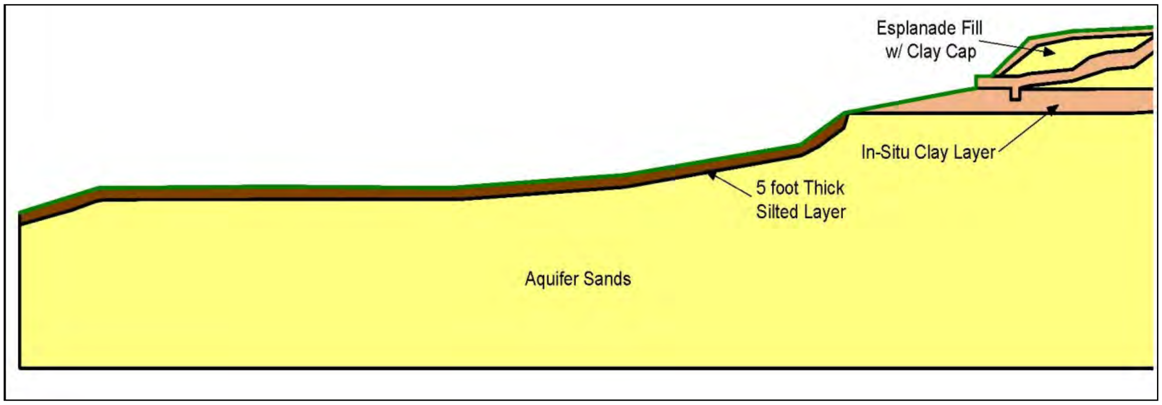


Figure 2.10a –Cross Section of Seepage Model: Riverside

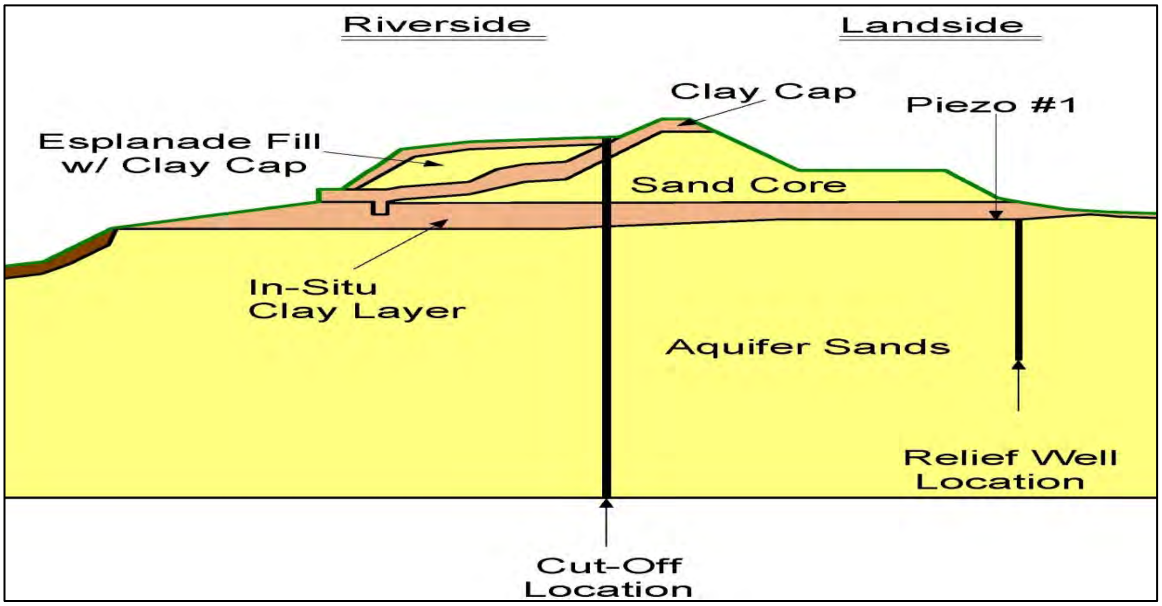


Figure 2.10b –Cross Section of Seepage Model: Levee

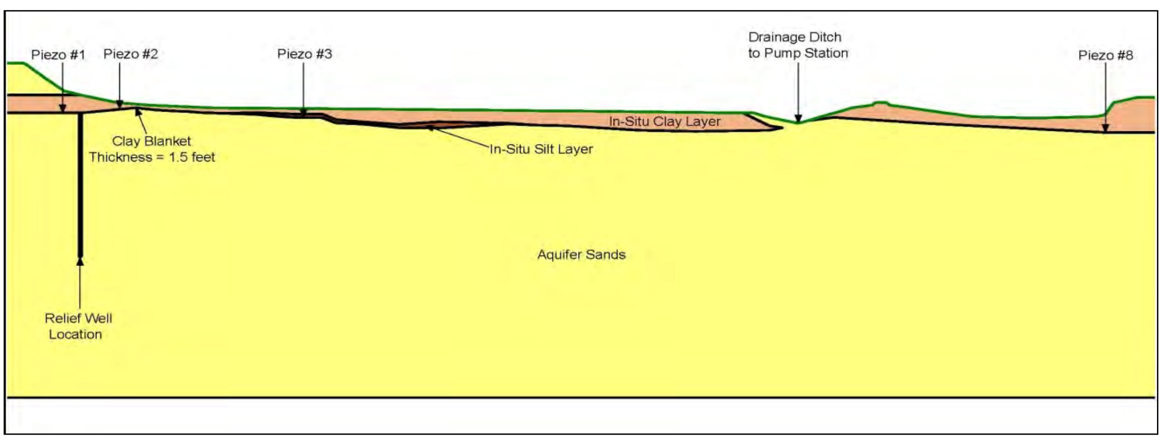


Figure 2.10c –Cross Section of Seepage Model: Landside

B6. – Model Calibration

The first seepage model was completed and calibrated against a limited set of piezometric data on/about 10 November, 2009. The model predicted a total pressure head at the line of relief wells that was within 0.75-feet of actual field measurements of the static pressure head at the relief wells. This model was vetted with subject matter experts at CEMVD (Mr. Ken Klaus and Mr. Duane Stagg), CEMVP (Mr. Neil Schwanz), and CEMVK (Mr. Noah Vroman), who provided valuable advice and technical comments on the model creation.

CEMVS revised the model based on these comments and re-calibrated it against a set of piezometric data obtained on 2 December and 17 December, 2009. The automated data set was checked against a manually-obtained data set to ensure accuracy. This data date was chosen because, at the time of the analyses, it was the only time that the Melvin Price Pool and Tailwater remained in a somewhat steady state condition. Adjustments to the landside blanket permeability and right-hand constant head boundary location resulted in a Seep/W model that predicted piezometric pressures very close to the measured data set. Table 2.2 compares the measured piezometric heads with the model's predicted heads.

Table 2.2 – Comparison Between Measured and Predicted Piezometric Elevations

Piezo Line #1

MP Pool – 416.3 MP TW - 407.8 LS Ponding – 405.5

Piezometer Name	12/02/2009 Measurement	Model Prediction	Difference (feet)
PZ-01	410.01	410.4	+0.4
PZ-02	409.83	410.0	+0.17
PZ-03	408.95	408.85	-0.1
PZ-08	408.76	406.6	-2.1

Piezo Line #2

MP Pool – 419.26 MP TW - 401.61 LS Ponding – 401.8

Piezometer Name	12/02/2009 Measurement	Model Prediction	Difference (feet)
PZ-04	411.69	411.73	+0.04
PZ-05	411.04	410.96	-0.08
PZ-06	409.29	408.59	-0.7
PZ-07	405.33	405.52	+0.19

Piezo Line #3

MP Pool – 416.3 MP TW - 407.8 LS Ponding – 405.5

Piezometer Name	12/02/2009 Measurement	Model Prediction	Difference (feet)
PZ-09	410.82	410.67	-0.15
PZ-10	407.77	409.63	+1.8

The model predictions for piezometric levels between the levee and the landside drainage ditch are excellent, with no difference exceeding 0.70-feet. But the model results for PZ-08 and PZ-10 (on the opposite side of the drainage ditch) are about +/- 2.0-feet off of the predicted value. This indicates that some other local feature, other than the Melvin Price Pool and Tailwater, is impacting the groundwater regime. CEMVS feels that this model gives excellent agreement with the actual measurements in the areas where the work is to be done.

C. – Applications of Lessons Learned from Hurricanes Katrina and Rita.

The development of the Geotechnical Solutions will be consistent with each of the Chief of Engineers' Actions for Change for Applying Lessons Learned during Hurricanes Katrina and Rita issued 24 August 2006. The twelve actions are grouped into the following four themes.

Actions in the first theme, Comprehensive Systems Approach, include employing integrated, comprehensive systems-based approach; employing adaptive planning and engineering systems; and focusing on sustainability. This theme with all three actions was implemented by using TM 3-424 Investigation of Underseepage and its Control Lower Mississippi River Levees. The plan formulation, referred to the deficiency study of the Wood River Drainage and Levee system. Even though the seepage area was independently studied, impacts on the proposed deficiency study solution were considered maintaining a comprehensive, systemic approach.

Actions in the second theme, Risk Informed Decision Making, include employing risk-based concepts in planning, design, construction, operations, and major maintenance; and reviewing and inspecting completed works. Each action was implemented by selecting the most suitable underseepage controls for a specific problem area and based on a cost-benefit analysis. The planning phase took into account the importance of the Wood River system to the Corp’s navigation and flood damage reduction business lines.

Actions in the third theme, Communication of Risk to the Public, include effectively communicating risk; and establishing public involvement risk reduction strategies. The report establishes the current condition of the Wood River system and also how this condition relates to public safety. These findings are based on extensive exploration, testing, and analysis. Several meetings took place during the design process between CEMVS, the project sponsor, the City of Alton, the Alton Wastewater Division, and other stakeholders.

Actions in the fourth theme, Professional and Technical Expertise, include continuously reassessing and updating policy for program development, planning guidance, design and construction standards; dynamic independent reviews; assessing and modifying organizational behavior; managing and enhancing technical expertise and professionalism; and investing in research. The engineering analyses were completed using site specific data and state of the art analyses techniques. The LRR report was continuously reassessed during the development. The currently approved review plan anticipates that this report will be subject to an Agency Technical Review and an External Independent Peer Review.

D. – Interim Risk Reduction Measures (IRMs).

D1.– Interim Risk Reduction Measures: Increased Ponding.

Since differential head is a major driver in underseepage, CEMVS used its observations of the seepage and sand movement to develop a maximum allowable differential head between the river and the landside ponding elevation. The November 3, 2009 observation found active sand boils with a differential head of 12.93-feet.   The November 4, 2009 observation noted heavy flow but no active sand movement with a differential head of 12.09-feet. The first Interim Risk Reduction Measures (IRM) is to pond water over the seepage area to a maximum elevation 415. Assuming that the allowable, maximum differential head is 11-feet, this measure will provide the necessary protection to river elevation of 426. The first step in limiting the ΔH is to change the Wood River Drainage and Levee District pumping operations at the Alton Pump Station. Instead of routinely pumping down the landside area, CEMVS-EC-G has recommended to the levee district that they allow the ponding area to fill during times of high water. The maximum allowable ponding elevation is limited by two physical conditions.

The first condition is the City of Alton's Central Avenue Combined Sewer Outlet (CSO) located at the upstream-most extent of the ponding area as shown on Figure 2.11. The Central Avenue CSO contains a concrete weir that is designed to divert low volume, 'dry-weather flow' into a bypass pipe leading to a waste water treatment plant. During rainfall events, precipitation runoff mixes with the 'dry-weather flow' and this combined flow overtops the weir and flows downstream through the serious seepage area to the Alton Pumpstation. The CEMVS-EC-G proposal to limit the ΔH by ponding water in the serious seepage area must not impact the City's CSO operations. Ponding levels higher than elevation 410.7 will overtop the CSO weir and send excess water through the wastewater bypass and flood the City's wastewater treatment plant.

The second condition is related to the existing topography. The topography will contain water ponded to elevation 415 except where the City of Alton's Shields Valley CSO and drainage ditch enters the serious seepage area as shown on Figure 2.11. Generally, the same type of conditions exist here as at the Central Avenue CSO. CEMVS-EC-G's proposal to limit the ΔH by ponding water in the serious seepage area must not impact the City's Shields Valley CSO operations. Ponding levels higher than elevation 413.8 will overcome the Shields Valley CSO weir and send excess water through the wastewater bypass and flood the City's wastewater treatment plant.

The Central CSO has been protected from flooding by building Dike A (Figure 2.12) approximately 1,400-feet downstream of the CSO shown on Figure 2.11. The dike is approximately 80-feet long with a crest elevation at 415; is constructed of 1-inch (-) coarse aggregate and is covered with 400# (topsize) riprap for erosion protection. The downstream end of the notch is protected by 650# (topsize) riprap. This Dike contains one 48-inch CMP gravity drain with flowline at elevation 406. A channel has been cut through the dike to increase the dike's ability to pass the combined flow from the CSO. The flow line of the notch is 3-feet lower (elevation 412) than the crest of the dike.   During times of normal Mississippi River pool, the gravity drain and notch at the Dike are left open allowing combined CSO flow to pass through the dike and continue to the Alton Pumpstation/Gravity Drain. When the river rises, and the water must be ponded higher than 410.7 in the seepage area, the Dike A gravity drain must be closed and notch filled so that the ponded water does not flood the CSO. During rainfall events with the Dike A notch and gravity drain closed, bypass pumping will be needed to pump the excess CSO flow across Dike A.

The Shields Valley CSO has been protected from flooding by building Dike B (Figure 2.13) at the mouth of the Shields Valley ditch. The dike is approximately 110-feet long with a crest elevation at 415. The dike is constructed of 1-inch (-) coarse aggregate and is covered with 400# (topsize) riprap for erosion protection. This Dike contains two 48-inch CMP gravity drains. A channel has been cut through the dike to increase the dike's ability to pass the combined flow from the CSO and drainage ditch. The flow line of the notch is 3-feet lower than the crest of the dike. During times of normal Mississippi River pool, the gravity drain and notch at the Dike are left open allowing combined CSO flow to pass through the dike and continue to the Alton Pumpstation/Gravity Drain. When the river rises, and the water must be ponded higher than 413.8 in the seepage area, the Dike B gravity drains must be closed and notch filled so that the ponded water does not flood the CSO. During rainfall events with the Dike B notch and gravity drain closed, bypass pumping will be needed to pump the excess CSO flow across Dike B.

Interim Risk Reduction Measure at Dike C is to allow landside ponding to a higher elevation (elevation 420) in what CEMVS considers to be the worst seepage area, downstream of Cpl. Belechik Road. Dike C would be located immediately downstream of Cpl. Belechik Road. This elevation is 5-feet higher than the landside ponding capability at Dikes A and B. The lowermost 5-foot portion of Dike C has been constructed, and a 48-inch CMP gravity drain and positive closure has been installed. A wide notch has been cut through the fill. The notch and the dike is heavily protected by reinforced plastic sheeting and 400# riprap. The notch is wide enough to make the structure transparent to water flowing from upstream to downstream of the dike. A photo is attached. Further study shows that substantial, additional real estate effort and land acquisition would be required for ponding above elevation 415. Landside ponding elevations above 415 will put water on lands that the sponsor currently has no rights to flood. The funds required for this additional acquisition are currently unavailable to this project. The partial construction of Dike C represents a minimum provision that would allow additional, emergency construction of a taller dike, should those dire conditions arise. The following photo, Figure 2.11, shows the existing condition of Dike C.

Figure 2.11 – Partially constructed Dike C

CEMVS has completed a detailed, calibrated hydraulic analysis of the City of Alton CSOs. This analysis shows that prior to the Dikes A and B construction, the Central Avenue and Shields Valley CSO structures would overflow for 1.5 to 2.9 hours for the 2-year, 5-year, and 10-year storms. The peak flow velocity at the dikes depends on whether or not the Mississippi River is flooding requiring additional ponding in the seepage area. If additional ponding is not required, the dike gravity drains and notches are left open and the peak flow velocity through the open gravity drain and notch is 2.9 to 3.9 fps depending on the storm (2, 5, or 10-yr). If additional ponding is required, and the gravity drains and notches are closed, then the peak flow velocity during dike overtopping is 2.5 to 4.0 fps depending on the storm (2, 5, or 10-yr). The hydraulic analyses shows peak flows of 250 to 300 cfs at each dike depending on the storm's intensity and duration. Details on this analyses may be found in the Hydraulics Engineering section.

Since construction of Dikes A and B, and fielding of the by-pass pumping, this IRM's resiliency and functionality has been tested numerous times during the summer of 2010. During May, June, and July (2010), the Mississippi River at Melvin Price Locks and Dams has been at higher levels requiring landside ponding to elevation 412. This required closure of the Dike A gravity drain. During the closures, several, high-intensity, short-duration storms (1-inch of rain per hour) occurred over the City of Alton with associated high-intensity, short-duration flows from the Central CSO and through the Dike A notch.

CEMVS-EC-H installed an automated system that collects rain-fall information from the automated rainfall gage at Melvin Price Locks and Dam. This data is collected and automatically analyzed. When the rainfall exceeds a threshold value, the system alerts the cellphones/Blackberrys of key individuals. These individuals report to Dikes A and B to assess the situation.

First hand observations of the Dike A notch during one of these flow events are that the notch flow is 'violent' and very turbulent. On one occasion, the eye-witness reported that the upstream elevation was very close to the top of Dike A crest (about 415). And that a 3-foot tall standing wave existed where the flow existed the notch on the downstream side of Dike A. The riprap in the notch remains serviceable. To date, a general overtopping of Dike A has not been reported.

The by-pass pumping consists of an 11,000 gpm portable pump that is automatically activated by a float system. Since the pump cannot pump the peak flows from the CSO, some temporary overtopping of the Central CSO is expected, but that time is limited to a few hours following the storm event. Close coordination between the Corps, the Woodriver Levee District, and the City of Alton's water treatment department has produced good cooperation between all parties.

Since the landside ponding elevation has not risen above elevation 412, the gravity drains and notch at Dike B have not yet been closed.

The interim control structures (Dikes A and B) will remain in-place and operated as necessary until a permanent solution to the seepage problem can be installed.

The partial construction of Dike C represents a minimum provision that would allow additional, emergency construction of a taller dike, should those dire conditions arise.

Figure 2.12 – Locations of CSO Structures and Temporary Dikes A & B

Figure 2.13 – Dike A

Figure 2.14 – Dike B

D2. – Interim Risk Reduction Measures: Air Lift Pumping.

The existent relief well system was designed for the maximum design flood elevation of 443 and a landside ponding elevation of 413. Unfortunately, the wells were constructed with flow lines elevations that are too high to relieve pressure for the normal Melvin Price Pool of 419. At this normal pool, the static water surface elevation in the relief wells was measured to be 4 to 5-feet below the well's flow line elevation.

The wells can be pumped to exert active seepage control on the aquifer. After discussion with its CEMVD counterparts on the plan's merits, CEMVS used air-lift techniques to test pump 8 existing relief wells. Pumping the wells with individual submersible wells or a distributed suction header system would be costly. Air lift pumping can be deployed quickly and relatively cheaply.

CEMVS completed an air lift pumping test on Friday, 6 November, 2009. This test involved pumping 8 adjacent relief wells with two 450-cfm air compressors. The air flow from each compressor was split into 4-individually controlled flows via a manifold specifically built for this purpose. Figure 2.15a and 2.15b shows the prototype manifold used in this test and its installation at the rear of a compressor. The 4 equivalent air-flows from each manifold were delivered to four individual wells via a 1.875-inch air hose submerged approximately 50-feet below the static water surface in each relief well. The application of 34 psi of pressure to each air hose caused approximately 150 to 180 gpm of flow from each well. The test reach of 8 adjacent pumped relief wells was centered on piezometer PZ-02. This piezometer was located 70-ft landside of the pumped well. Figures 2.16a and 2.16b shows the typical flow from each of the wells during the air-lift pumping test. This test lowered the piezometric level 4-feet in PZ-02. Figure 2.17 shows the drawdown response of piezometer PZ-02 and adjacent relief wells to the air-lift pumping of the 8 relief wells.

Based on this successful test, CEMVS contracted for the manufacture of 16 manifolds and rental of 17 compressors and support equipment. This contract will provide the necessary capability to airlift pump 61 existing relief wells existent within the serious seepage area should the Mississippi River rise to higher elevations.

Figures 2.15a and 2.15b – Air Line Manifold

Figures 2.16a and 2.16b – Typical Well Flow During Air Lift Pumping

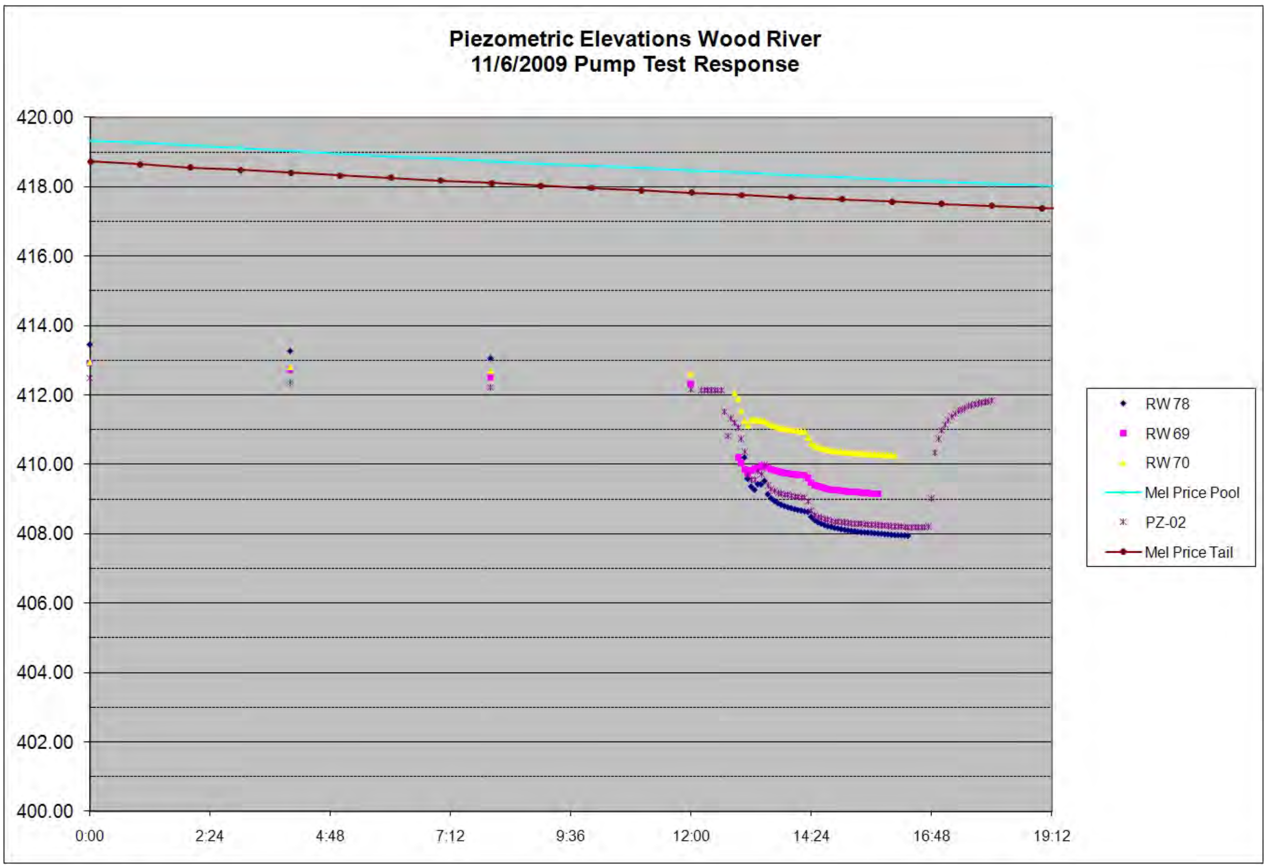


Figure 2.17 – Piezometric Pressure Reduction During Air-Lift Pumping

This contract also included tasks to increase the height of the existing relief well risers to elevation 416, 1-foot above the maximum ponding elevation. The standpipe addition will allow the relief wells to be operable and able to be airlift pumped at the maximum ponding elevation. Figure 2.18 shows a prototype of a typical standpipe installation. The turnbuckles secures the PVC standpipe against the existing gasket at the top of the well, providing a watertight seal.

Figure 2.18 – Standpipe Prototype

D3. – Interim Risk Reduction Measure: Modify Existing Relief Wells

As previously described, the flow line elevations of the existing relief wells are too high to effect any pressure relief in the aquifer when the Mississippi River is at the elevation of the Melvin Price Normal Pool. In order to construct this IRM, an 8 to 10-foot deep trench excavation is required in front of each well to expose the well riser pipe at elevation 406. The 60-year old wooden well structure above this excavation would have to be supported to prevent its collapse. The side of the wooden riser pipe would have to be cut out and a horizontal outlet affixed/sealed into this opening. The horizontal outlet would have to extend 75 to 80-feet to the corresponding elevation further landside of the existing relief well line. The end of the horizontal outlet would be fitted with a flap gate or flexible 'duck-bill' to prevent back flooding of the well. The trench would have to be carefully backfilled around the relief well and the new connection to assure continued support and stability. A short, 10-foot wide, crushed stone access road would have to be built to the end of the horizontal outlet in order to maintain it.

The Seep/W model was used to evaluate the effectiveness of the existing 60-year old relief wells that are spaced at 60 to 80-foot centers throughout the serious seepage area. The analysis was completed assuming well spacing of 75-feet. The wells were evaluated assuming that ponding elevations between 406 and 410 were in place.

CEMVS construction cost engineers have estimate that this work would cost $50k per well. Construction of this measure would likely weaken the existing wooden relief wells and limit their useful life to no more than 2 additional years. No further evaluation has been done on this measure.

D4. – Combination of Increased Ponding and Air-Lift Pumping IRMs.

The combination of IRM-1 "Increased Ponding" , IRM-2 "Air Lift Pumping", and IRM-3 "Modify Existing Relief Wells" will provide protection to Mississippi River Elevation 430.

CEMVS created a standard operating procedure that identified critical river elevation 'triggers', required activities at each trigger, and the responsible parties for each activity. The latest version of the SOP can be found at the end of this Engineering Appendix.

E. - Probability of Unsatisfactory Performance (PUP)

E1. – General

The purpose of this analysis is to determine the Probability of Unsatisfactory Performance (PUP). The PUP is the elevation at which there is an 85% chance of unsatisfactory performance. In these probabilistic seepage analyses, unsatisfactory performance is defined as underseepage gradients that exceed a value of 0.80. These elevations were determined by probabilistic analyses of the failure mechanism in question or by application of judgment to observed performance during prior flood events. The St. Louis District used the results of land surveys, existing geotechnical exploration, and the guidance presented in ETL 1110-2-328, *Reliability Assessment of Existing Levees for Benefit Determination*.

E2. – Calculations of PUP

Probabilistic underseepage analyses were completed to determine a PUP for the hot spot between project stations 103+00 to 113+00. The probabilistic models used in these analyses are based on the Mansur/Kaufmann Leaky Blanket Theory. The St. Louis District adapted this method to the Excel Spreadsheet and modified it to include random variables and a Taylor Series expansion of the performance function (the underseepage analyses). The Taylor series is a 'first-order, second moment' method which means that only the first order (linear) terms are retained and only the first two moments of the random variables (the expected value and the standard deviation) are considered. In this analysis, the standard deviation is derived by multiplying the expected value by an appropriate coefficient of variability. Those variables considered as random variables are listed below along with a description of how the expected value (the first moment) and standard deviation (the second moment) are determined.

The spreadsheet based analyses incorporates increasing river elevation. For each river elevation, the expected vertical seepage gradient is determined at the landside levee toe (per the deterministic, Leaky Blanket seepage analyses). Then a Taylor Series expansion of the underseepage analyses is completed (at the same river elevation) to determine the probability of unsatisfactory performance at this river elevation. In these probabilistic seepage analyses, unsatisfactory performance is defined as underseepage gradients that exceed a value of 0.80.

These computations are repeated for the increasing river elevations. The river elevation that causes an 85% chance of critical gradient formation is reported as the Probability of Unsatisfactory Performance.

In this case of the Melvin Price-Woodriver seepage area, the landside tailwater elevation is increased along with the Mississippi River elevations per the Interim Risk Reduction plan.

E2.1 - Landside Blanket Thickness

The stratigraphy of each reach was described by Corps of Engineers borings. The natural stratigraphy in each boring was transformed to determine the z_{BL} (blanket thickness used for Q and X_3 determination) and z_T (blanket thickness used for gradient determination). This analysis utilizes a value of 25% for the coefficient of variation for z_T.

E2.2 - Aquifer Permeability

The expected value of the aquifer permeability is typically defined by the relationship between the D_{10} size of the sand and its permeability shown on Figure 3.5, in EM 1110-2-1913, "Design and Construction of Levees." Harr, *Reliability Based Design in Civil Engineering*, table 1.8.1 shows that the coefficient of variation for permeability should be taken as 90% for saturated conditions. If more reliable data were available, such as from a pump test, this coefficient could be reduced. Since no pump tests have been completed in this levee district, a coefficient of variation of 90% was assigned to the variable $K_{f.}$

E2.3 - Landside Blanket Permeability

The expected value of the landside blanket permeability, $K_{BL,}$ is based on the value of Z_{BL} and a relationship defined by Plate 4 in DIVR 1110-1-400, Sec 8, Part 6, item 1. No other reliable data exists which measures the landside blanket permeability so this analyses utilizes a coefficient of variation of 90% for the $K_{BL.}$

F. – Permanent Measures.

CEMVS developed, analyzed, and reviewed permanent seepage control measures including landside seepage berm, a combination seepage-berm/relief well solution, a slurry trench cutoff wall, and new relief wells with lower flow-line elevations,. Each of these solutions was designed for the project flood elevation with landside ponding limited to elevation 410. Each solution was checked for the daily occurrence of normal pool elevation. Table 2.3 summarizes the underseepage solutions. Detailed discussions of each solution follow the table.

Table 2.3 – Summary of Underseepage Solutions

		Berm Only			Wells Only		Wells – Berm Combo				Cutoff
Station		Thickness	Width		Spacing		Thickness	Width	Spacing		Depth
66+10		9	285		50		5	150	100		110
95+80	5	7	500		35		5	250	45		125
112+30		6	250		35		5	150	80		145

F1. – Landside Seepage Berms

Landside seepage berms were evaluated using the results of the calibrated Seep/W model at the three piezometric lines (project stations 66+10, 95+80, and 112+30). To function as a semi-pervious berm, the constructed berm must have a permeability equal to or greater than that of the blanket in order to function as intended. Studies have indicated that semi-pervious berms should be constructed of silty sand or fine sand (paragraph 723 of TM 3-424) and ETL 1110-2-569 makes this design requirement. CEMVS anticipates that berm construction will be built of sands and silty sands dredged from the Mississippi River and hauled into the construction site. These dredged sands and silty sands will easily meet the assumptions implicit in the berm analyses and will meet the requirements for landside seepage berm construction. The berm thickness and width are designed to meet current Corps criteria as outlined in EM1110-2-1913 *Design and Construciton of Levees*, ETL 1110-2-569 *Design Guidance for Levee Underseepage*, and DIVR 1110-1-400, Section 8, Part 6, *Landside Seepage Berms for Mississippi River Levees*.

The Seep/W analyses at station 66+10 (Figure 2.19) upstream of Cpl Belechick road) show that the seepage berm must extend 285-feet to the far side of the drainage ditch. To maintain existing drainage, the ditch must be relocated into a concrete box culvert on its existing alignment.

The analyses at station 95+80 (Figure 2.20) show that a 500-foot long seepage berm is required. But just beyond the berm toe, the ground surface rises in the vicinity of the drainage ditch. CEMVS extended the seepage berm to a total width of 585-feet to tie into the high ground so as not to create a seepage concentration between the berm and the high ground.

The analyses at station 112+30 (Figure 2.21) show that a 250-foot long seepage berm is required. Detailed Seep/W reports on each seepage berm analyses are included at the end of this report.

F2. – Borrow Pit Locations

The sands used to construct the seepage berms will be obtained from Mississippi River dredging. A dredge site near the confluence of the Mississippi and Missouri Rivers is currently being utilized to provide sand for berm construction in another CEMVS project. But state Highway 143 (aka "The Berm Highway") presents a physical obstruction to directly pumping the dredged material into the seepage berm construction site. Reconnaissance by CEMVS engineers revealed no safe, practical, ways to install a dredge pipe without closing the highway, although some consideration was given to using directional drilling techniques to install a casing through the levee and under the highway. This casing would provide a way to dredged sand directly to the construction site without double handling of the material. Although slightly cheaper, this revised alternative did not change the recommended plan.

CEMVS would dredge the sand from the river to a stockpile located landside of the levee and then load over-the-road-trucks and haul the sand to the construction site. The best site for a stockpile would be existing fields located immediately landside of the levee, located between the sand source and the construction site, and in close proximity to a highway. Fields meeting these requirements exist 6.5-miles south of the construction site, near the mouth of the Cahokia Diversion Canal at the Mississippi River. The fields are large enough to support the stockpiling of sand, decanting and handling the dredge water, and the operations necessary to load the trucks.

Top soil for the seepage berms could be obtained from existing borrow sites located near industrial developments along Interstate 255 in the Wood River Drainage and Levee District.

F3. – Relief Wells.

At each section, required well spacing was determined utilizing an ERDC developed method that merges the 2D Seep/W analyses with the Mansur-Kaufmann partially penetrating well solution. The method is defined on Figure 2.22. The flow lines of the wells was set at elevation 406 and assumed to have landside ponding to elevation 410. The design flood was set in place. To meet current Corps criterion of a FS = 1.6 midway between the wells, the solution required well spacing of 50-feet at station 66+10 and 35-feet for stations 95+80 and 112+30.

CEMVS-EC-G does not believe that relief well spacing less than 50-feet is wise. Close read of Corps documents dealing with relief well design (EM 1110-2-1913, EM 1110-2-1901, EM 1110-2-1914) fail to unearth any guidance on practical, minimum well spacing. Figures 55 and 56 in TM 3-424 originate from TM 3-304 *Relief Well Systems for Dams and Levees on Pervious Foundations (Model Investigation)* published in November 1949. TM-304 presents results of various measurements of uplift pressures on miniature scale sand models constructed to represent the underseepage regime under levees. Although the figures from TM-304 do show 'well-spacing' as small as 25-feet, that is because the "wells" were modeled at scale distances of 23.6, 43.3, 86.6, 130, and 260 feet, and the report thoroughly presents all of the collected data. But the minimum well spacing included in the design curves (figures 63 through 66 in TM 3-424), that have been generated based on the sand model tests, is 60-feet. Also, figures 24 through 29, "Design Curves for Computed Well Spacing" in TM 3-430, *Investigation of Underseepage, Alton to Gale, Illinois* present minimum well spacing of 50-feet. And finally, paragraph 123 on page 75 of TM 3-430, presents an example problem of well spacing computation. The design methodology recommended a spacing of 50-feet but the authors write that "In view of the close spacing, it was decided to install wells on 100-ft centers until the adequacy of the installed system could be checked."

Although nothing in current Corps guidance recommends against well spacing less than 50-feet, there is evidence that the original authors of the Corps relief well design methodology (Charles Mansur and Robert Kaufmann) did not recommend well spacing less than 50 to 60-feet. Based on expert elicitation from other relief well design experts in CEMVM, CEMVK, and CEMVD , the state-of-the-practice in MVD is to not install relief wells less than 50-feet.

In this case, the computed well spacing of 50-feet will be used upstream of Cpl. Belecek Road (section at station 66+10). But well spacing of 35-feet downstream of Cpl. Belecek Road (sections at 95+80 and 112+30) will be given no further consideration.

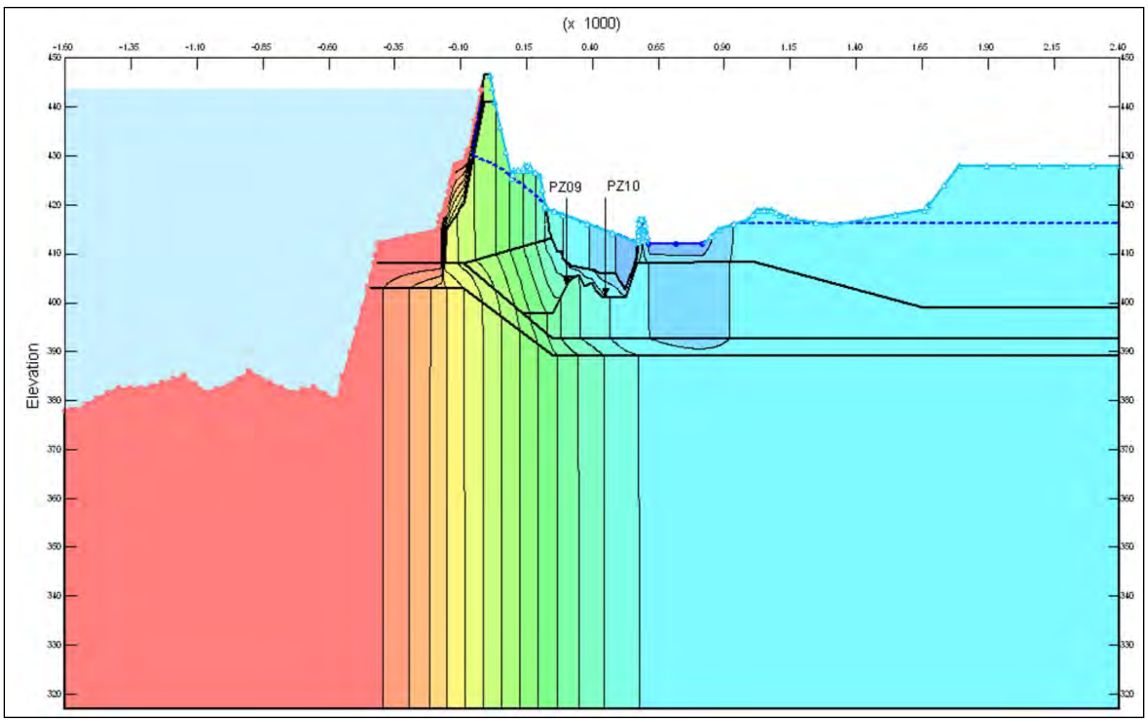


Figure 2.19 – Seepage Berm Solution Sta 66+10

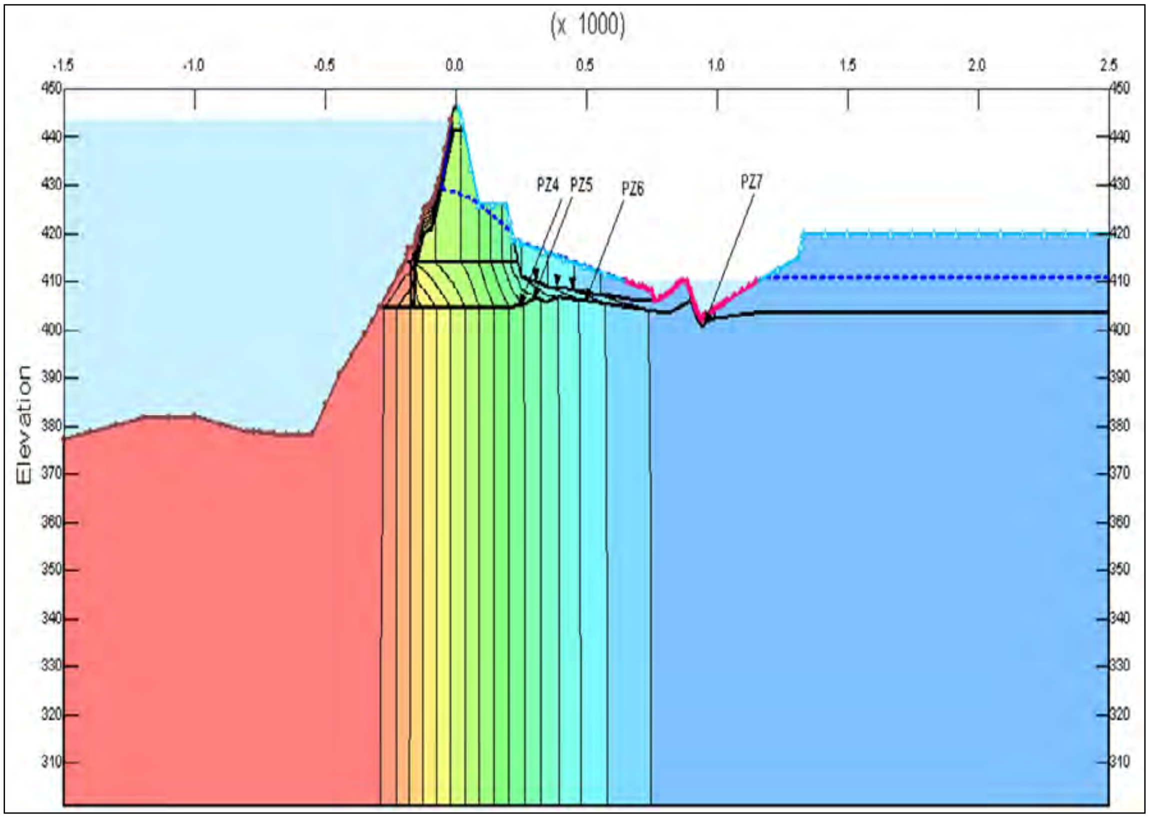


Figure 2.20 – Seepage Berm Solution Sta 95+80

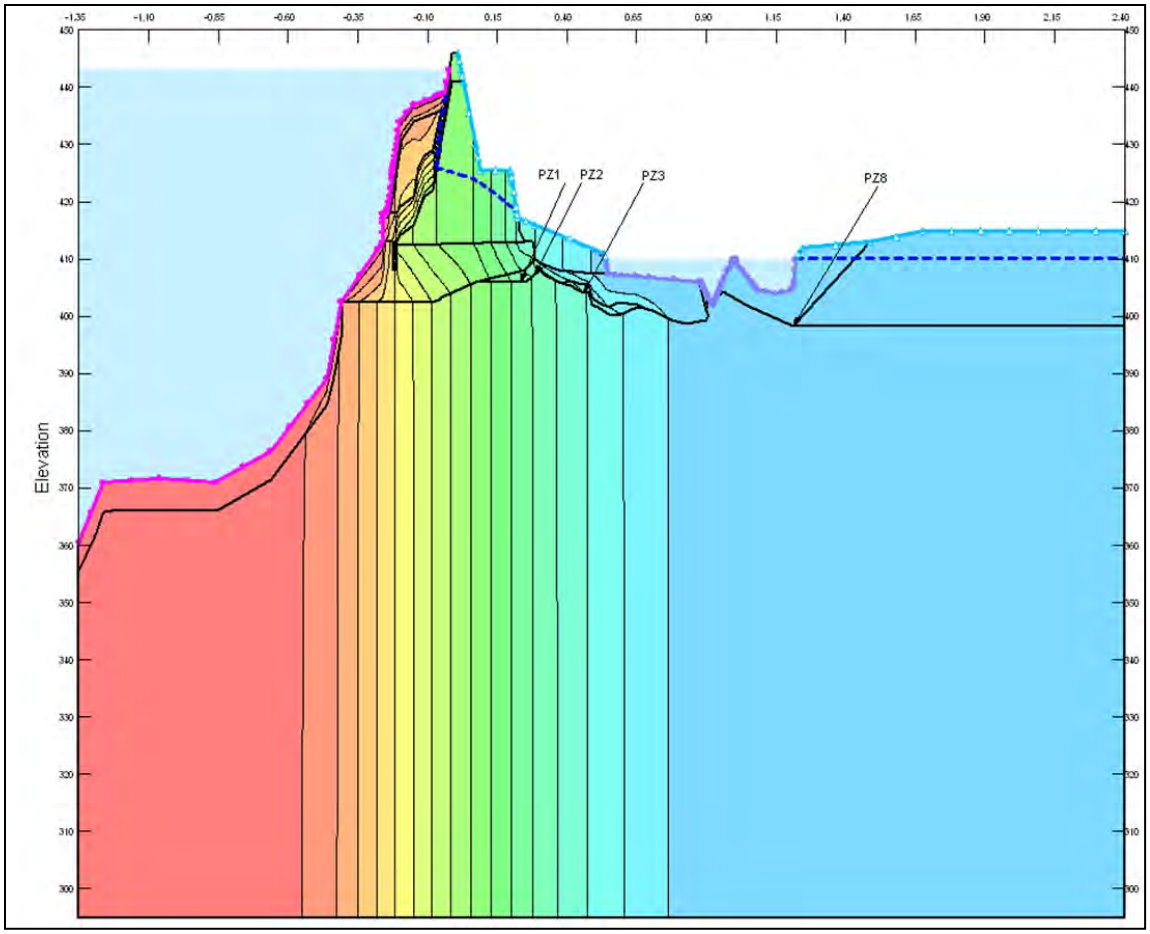


Figure 2.21 – Seepage Berm Solution Sta 112+30

F5. – Combination Landside Seepage Berms and Relief Wells.

There are many combinations of seepage berm width and relief well spacing that can be utilized to meet Corps criteria for seepage gradient at the berm toe. In this case, one trial utilizing a 150-foot wide berm width (corresponding to the traditional minimum berm used within the Mississippi Valley Division) was analyzed at each of the three piezometer lines using the calibrated Seep/W model. At each section, required well spacing was determined utilizing the ERDC method (previously defined and described in Figure 2.22). Figures 2.23, 2.24, and 2.25 show the Seep/W results.

The combined Seep/W Mansur-Kaufmann analyses at station 66+10 show that relief wells on 100 centers with a 150-ft wide berm yield a FS of 1.6.

The combined Seep/W Mansur-Kaufmann analyses at station 95+80 show that relief wells on 45-foot centers with a 250-ft wide berm yield a FS of 1.6. Berms shorter than 250-feet resulted in unacceptably small relief well spacings.

The combined analyses at station 112+30 show that relief wells on 80-foot centers with a 150-ft wide berm yield a FS of 1.6.

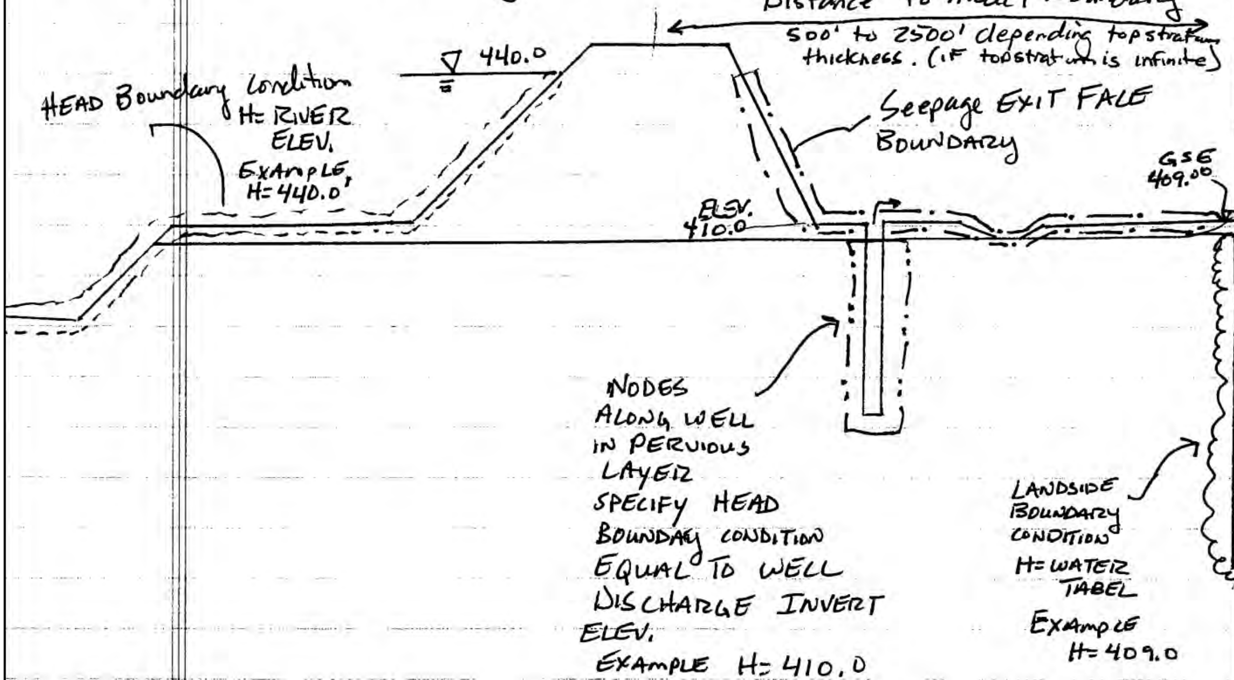
Detailed Seep/W reports on each combination seepage-berm/relief-well analyses are included at the end of this report.

5/3/09

RELIEF WELLS
DESIGN w/ GMS
St. LOUIS DISTRICT

PAGE 1

STEP (1) GMS BOUNDARY CONDITIONS



STEP (2) Sum NODAL FLOW RATE ALONG WELL. THIS FLOW RATE (Q) Is the Flow per Foot along levee.

Step (3) with an assumed ~~space~~ well spacing (a), determined Flow rate per well $(Q_w) = Q \times a$

Step (4) Compute head loss for wells

– ~~Flow~~ Head loss due to flow to converging wells $= \dfrac{H \cdot \theta_a}{\frac{S}{a} + \theta_a} = H_{av}$
(FROM EM 1110-2-1914, pg 5-7)

Plus Hydraulic Head Losses (Pg 6-4 From EM 1110-2-1914)

– Hydraulic Head LOSSES = Screen & Filter entrance Head loss + Friction head loss from ~~flow~~ flow in screen & riser, + Velocity head loss

Figure 2.22 – Page 1 of 3

Page 2

Step(4) Hav can also be computed from $\frac{Q_w \Theta_a}{K_f D}$

Cont' Note FOR Θ_a use Figure 5-8 in EM 1110-2-1914 (Pg 5-12)

ASLO NOTE THAT WELL PENETRATION (W/D) IS BASED ON THE EFFECTIVE PENETRATION AS CALCULATED ON PG 4-8 in Figure 4-5 of EM 1110-2-1914

Step(5) - Go back to GMS MODEL and add the computed head loss for wells to Head Boundary condition along the well screen as specified in Step 1.
Thus, Head Baundary condition along wells = well discharge invert elevation + Hav + hydraulic head losses.

~~Repeat~~

Step (6) Rerun GMS model w/ new Boundary Condition as determined in step 5

Step (7) Repeat steps (2) through (5) until Qw, Head Boundary condition along the wells, and head losses for wells match the GMS model.

Step(8) Determine head between wells Hm
From pg 5-7 EM 1110-2-1914 $H_m = \frac{H \Theta_m}{\frac{S}{a} + \Theta_a}$ or by

$H_m = \frac{Q_w \cdot \Theta_m}{K_f D}$ (From G.A Leonards Fnd. Engineering 1962 McGRAW HILL)

~~Step(9) Compare the~~

Figure 2.22 – Page 2 of 3

Step (9)

Check whether Hav (average head) from step 7 or Hm (head between wells) from step 8 is greater

If Hav is greater then use values from GMS Model From step 7 to determine Factor of Safety against uplift (allowable FOS = 1.6)

If Hm is greater then subtract Hav from the values in the GMS model (from step 7) and add Hm to the head values to determine Factor of Safety against uplift.

Figure 2.22 – Page 3 of 3

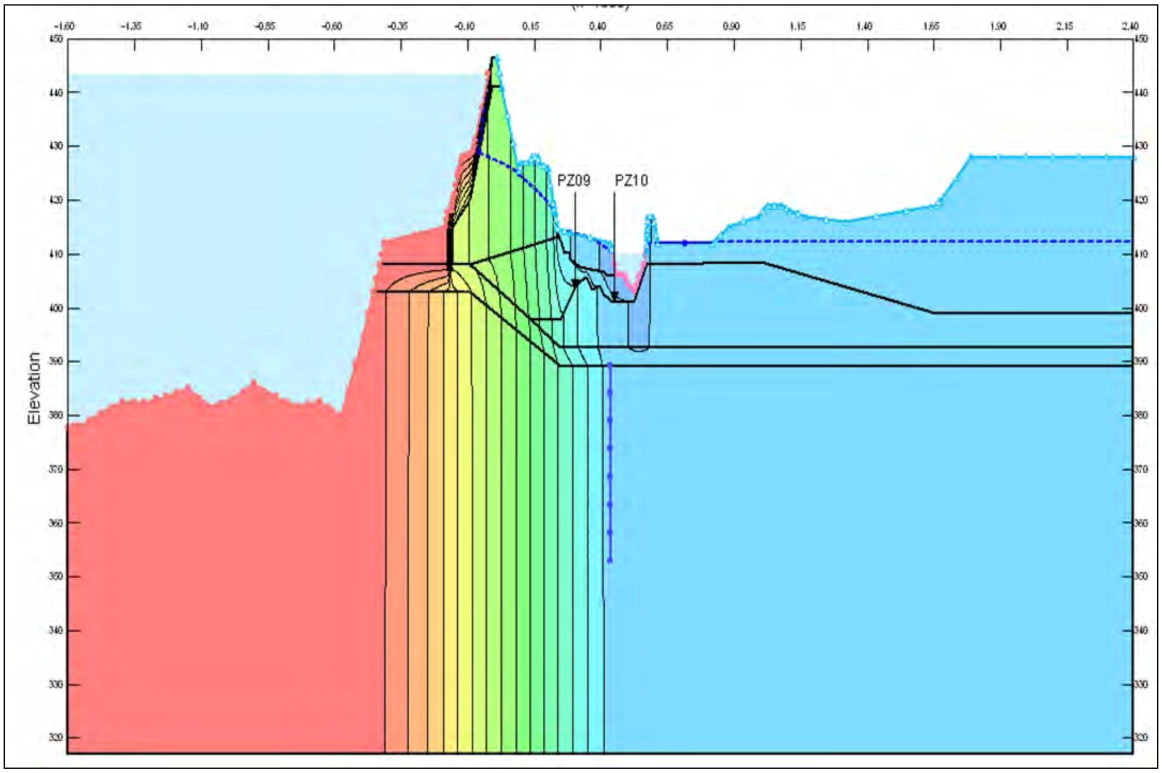


Figure 2.23 – Solution for Seepage Berm/Relief Well Combination Solution Sta 66+10

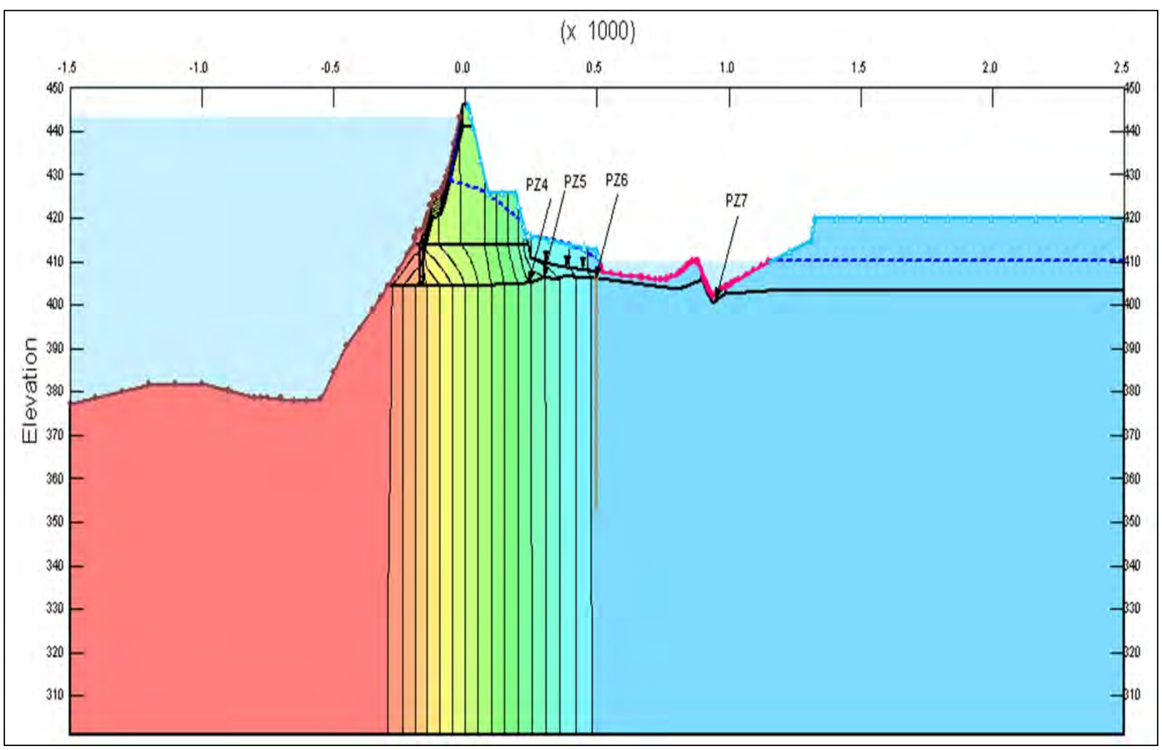


Figure 2.24 – Solution for Seepage Berm/Relief Well Combination Solution Sta 95+80

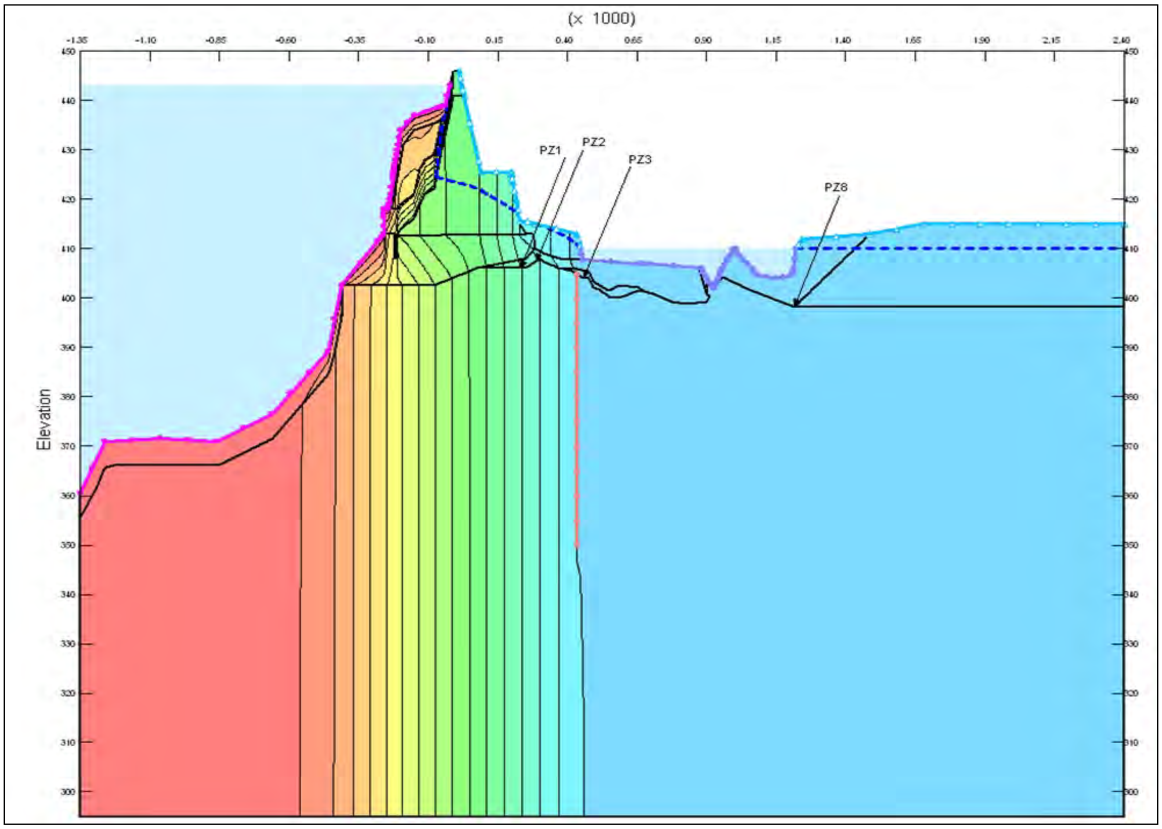


Figure 2.25 – Solution for Seepage Berm/Relief Well Combination Solution Sta 112+30

F6. – Fully Penetrating Slurry Trench Cutoff

CEMVS completed seepage analyses of a fully penetrating slurry trench cutoff using the calibrated seepage model. The cutoff was modeled as a three-foot wide trench extending from the riverside of the levee to the top of rock. CEMVS assigned the trench backfill a permeability of $2*10^{-6}$ cm/sec (Xantakos, 1976, *Design and Construction of Slurry Trenches*). The seepage model shows that all head losses between the river side and landside occur through this trench resulting in no excess head landside of the trench.

Three types of slurry cutoff walls are considered during this study. The first is a cement-bentonite wall that can be built using panel or continuous trench construction methods. For panel type construction, a 50-foot long trench is excavated to bedrock and the trench is held open with a cement-bentonite slurry. The slurry is mixed in a portable batch plant and pumped into the trench as the excavation proceeds. The slurry will harden into a relatively impermeable wall. Once the panel is complete, a 50-foot section of ground is skipped and the second panel is constructed in the next 50-foot increment. When the first pass of panels becomes sufficiently strong, the intermediate panels are constructed to overlap the existing panels, forming a continuous cutoff wall. Advantages of this method include good global stability and minimal real estate needs. The main disadvantage is that excavated soils are not reused in the wall. If the excavated soils are contaminated, this disadvantage becomes more important.

The second type of slurry cutoff wall is a soil-bentonite wall that is built using continuous trench construction methods. The trench is excavated continuously along the wall alignment and is held open with bentonite slurry. As the excavation advances, dozers are used to mix the excavated soils with bentonite on the ground surface adjacent to the trench excavation. The mixture is then pushed into the trench forming a sloping surface of soil-bentonite in the trench. The slurry is partially displaced by the soil-bentonite. Advantages of this method include the reuse of a larger percentage of excavated materials and a cheaper material since cement is not used. Disadvantages include lower global stability, particularly at a levee toe, and the need for a large working area (about 100 feet wide) along the entire length of the wall. If soils are contaminated, mixing the soil-bentonite on the ground surface may spread contamination if proper controls are not in place.

The third type of wall, soil-cement-bentonite, is a variation of soil-bentonite construction. The same continuous trench construction method is used, but cement is also added to the soil-bentonite mixture. Since this material is stronger than soil-bentonite, the sloping surface on material in the trench is steeper and thus less length of open trench is needed. The trench stability is generally higher when a soil-cement-bentonite mixture is used. This method requires a grout plant for mixing the cement. An advantage of this method is that the mix design includes on-site soils removed from the trench and thus disposal quantities of soil can be minimized. With any of these methods, the wall is capped off at the ground surface once construction is complete. The cutoff wall is also tied into the existing blanket or levee.

Due to the deep proposed wall depths, concerns about global stability, the need to ensure that the permeability of the finished wall would reduce landside seepage gradients to Corps criteria, and the limited working area (40 to 60-feet wide) along the riverside levee toe, cement-bentonite walls using the panel construction method was selected for the design deficiency correction project. The plotted cross sections in the plates at the end of this appendix show the limited area riverside of the levee. No excavated soil was assumed to be reused in the wall.

Existing utilities that cross the levee exist in the area of the planned cutoff walls. Of the four identified crossings, two appear to be abandoned. The abandoned utilities could be cut out and not impact the slurry trench. The two remaining, active utility pipes could be left in-place and 100-foot wide windows left in the cutoff wall at the location of these active utilities. Relief wells installed landside of the windows will control the underseepage.

This trench will be too deep to accomplish with “long-stick” backhoes and thus must be constructed using cable suspended clam shells or hydromill type machines. To further ensure levee stability, the cutoff trench will be constructed using primary and secondary panels. The length of the primary panels is unknown at this point but they may be on the order of 25 to 50-feet long. There will be a matching length of unexcavated trench left in-place between the primary panels. Once the backfill in the primary panels has setup, then the secondary panels will be excavated between the completed primary panels. During the final design phase, CEMVS will consider other trench construction technologies that are currently emerging in the construction industry.

CEMVS-EC-G completed global stability analyses of the trench to ensure that its installation would not threaten the integrity of the existing Wood River levee. The stability analyses were completed with Slope/W using Spencer's method of analyses. Do to the limitations of Slope/W (the inability to place a linearly increasing distributed load on a near vertical boundary line), the preliminarily stability analysis looked at various failure elevations along the depth of trench. The static pressure of the slurry was simulated by a resultant point load placed two-thirds of the depth between the surface and the location where the failure surface emanates from. The exit condition needed to be fixed because the point load is fixed. Only the most critical failure elevations (highest slurry density) were selected for the report. The critical surface reported in the report was found by allowing Slope/W to search various angles of the failure surface. The critical failure surfaces are presented in Figures 2.26, 2.27, and 2.28. All FS exceeded 1.30 for slurry unit weights of 80 to 90 pcf.

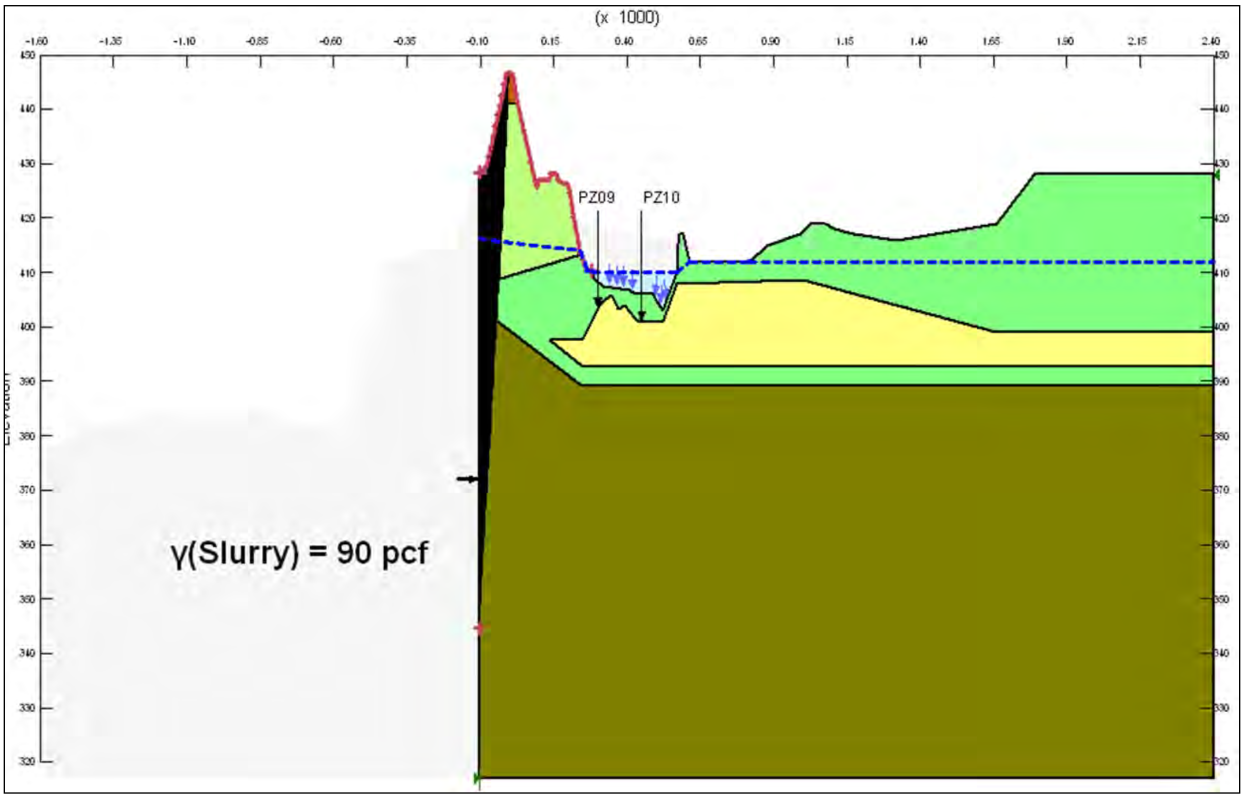


Figure 2.26 – Slurry Trench Stability Sta 66+10 (FS = 1.34)

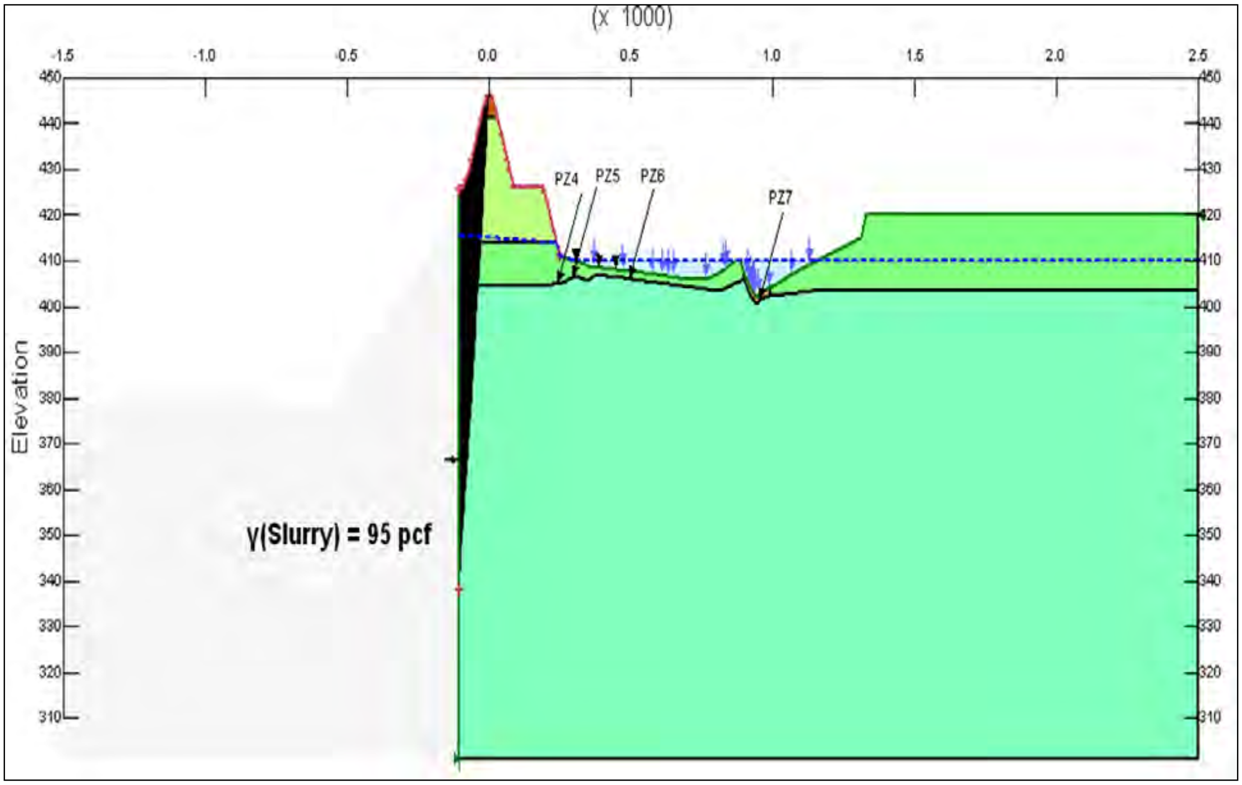


Figure 2.27 – Slurry Trench Stability Sta 95+80 (FS = 1.42)

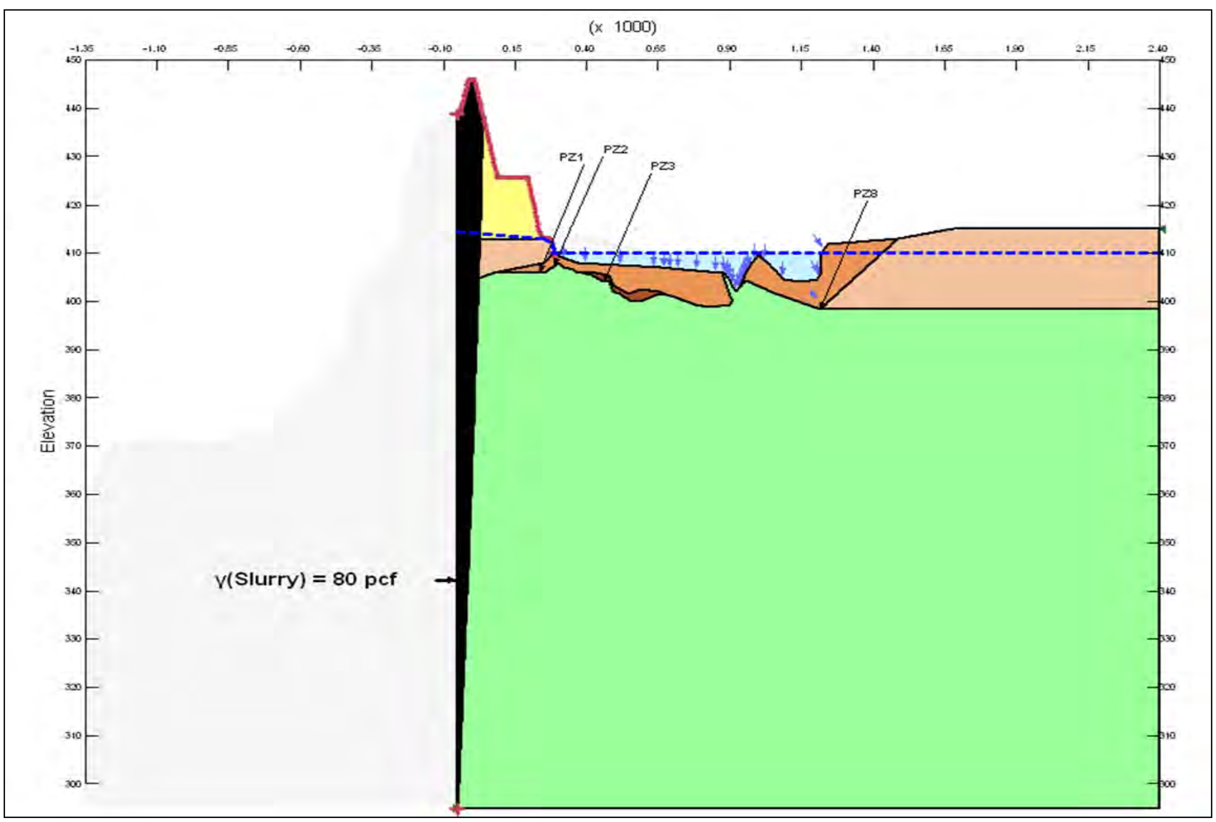


Figure 2.28 – Slurry Trench Stability Sta 112+30 (FS = 1.35)

G. –Time Frame to Construct Temporary Breach Closure.

The St. Louis District has firsthand experience with levee breaches caused by excess underseepage at the Bois Brule Levee District and the Kaskaskia Island Levee District during the 1993 Mississippi River flood. Given the stratigraphic similarities between the Wood River levee and the Bois Brule and Kaskaskia levees, a breach of the Wood River Levee would likely create damage similar to that experienced in the 1993 levee breaches. In those events, a 600-foot section of the levee was washed out and the scour directly beneath the levee was 50 feet deep, and 75 feet deep landside of the levee. At the surface, these scour holes were nominally measured to be 1000 to 1200 feet long, extending both landside and riverside of the levee centerline. In excess of 1,000,000 cubic yards of material was needed to repair the levee and the scoured hole. The permanent repairs to these two levees were made after the flood waters receded. In the case of the Wood River levee, the repairs are likely to be made with water at or near the normal pool level of Melvin Price Locks and Dam.

Given the proximity of an assumed breach location to the Mississippi River and its navigation channels, the differential heads involved in the design, and the required heights and lengths of a temporary closure, CEMVS has assumed that breach closure will be made with circular coffercells and connecting arcs similar in size and scope to those used during the construction of the Melvin Price Locks and Dam in the 1980s and 1990s. Based on CEMVS's actual experience with those coffercells, this district anticipates a 12-month time frame to establish such a temporary cofferdam closure. The Melvin Price coffercells were 64-feet in diameter and were constructed of 70-foot long sheet piles.

In those construction contracts, such a cell took 1-month each to construct and the connecting arc took another week. Based on the assumed width of breach, a total of 12 cells and connecting arcs would be necessary. Given that each cell and connecting arc requires 5-weeks to construct, the closure would take 60 weeks to construct assuming one crew. Assuming that two crews worked, the construction time is cut in half to 30 weeks, but when time for the contractor mobilization, acquisition of the necessary sheet piles, and fabrication of the cell templates, a 9-month period of construction emerges.

Including the upfront time needed for necessary authorizations and appropriations, design of the solution, assemblage of plans and specifications, contract acquisition, and finally contractor mobilization, a one year time frame for breach closure emerges.

SECTION 3 – CIVIL ENGINEERING CONSIDERATIONS

CEMVS developed preliminary designs and computed quantities for the permanent measures outlined in Paragraph E of Geotechnical Considerations. The Plates at the end of this Appendix show the layout of the alternatives under consideration.

A. – Relief Wells

Drainage of water emitted from proposed relief wells will flow directly into the existing low areas currently pooling water as an interim risk reduction measure, and eventually be pumped through the Alton Pump Station. Information regarding capacity and upgrades to this station can be found in the Mechanical Considerations Section. No significant site work will be required other than minor local grading to facilitate relief well drainage at the proper elevation. 175 total wells will be required to adequately control underseepage.

B. – Seepage Berms

Seepage berms were modeled with Inroads in Microstation to calculate embankment quantities and the real estate requirements for easements and mitigation. During the underseepage analysis, the minimum required size of berm was determined. This theoretical thickness was added to the prevailing ground elevation at the levee toe to determine the height of the berm. The berm top was sloped away from the levee to a minimum thickness of 2’ at the most landward edge. Berm sides were sloped at 1 on 3 to natural ground.

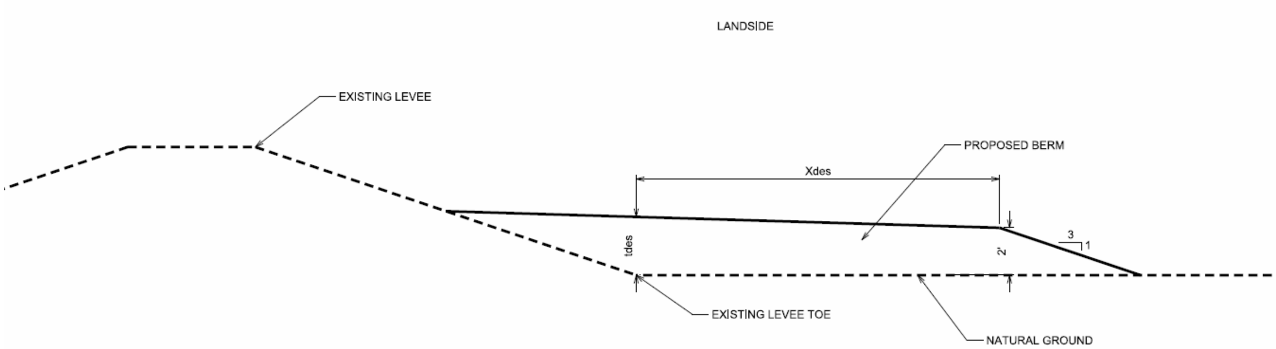


Figure 3.1 - Theoretical Typical Berm Section

The Inroads model was then compared to a surface created from the LIDAR survey to determine a sand embankment quantity. 18” of topsoil will be placed over the sand to establish turf. A 15’ clear zone was added to the landward, upstream, and downstream ends of each berm footprint to determine a real estate area.

sta to	sta	Sand (cy)	Topsoil (cy)	Area (ac)
55+00	80+00	248,000	40,000	18
80+00	99+50	198,000	51,000	23
99+50	126+00	210,000	43,000	19

Table 3.1 - Seepage berm volumes and real estate areas

C. - Slurry Cutoff Walls

Locations where slurry cutoff walls are required and depths to bedrock were determined as part of the geotechnical underseepage analysis. Volumes for the slurry cutoff walls were computed by multiplying the length, average depth to bedrock, and width.

sta to	sta	average depth (ft)	width (ft)	in place volume (cy)	Disposal volume - 1.2 bulk factor (cy)	Disposal Area -5' depth (ac)
55+00	80+00	110	3	30556	36667	5
80+00	99+50	125	3	27083	32500	4
99+50	126+00	145	3	42694	51233	6

Table 3.2 – Slurry cutoff wall quantities

D. – Relief Well / Seepage Berm Combination

A final alternative was considered that consists of both seepage berms and relief wells. The berms are smaller in width than the berm solution, but have relief wells at a larger spacing than the relief well solution along the interior berm edge.

sta to	sta	Sand (cy)	Topsoil (cy)	Area (ac)	Relief Wells
55+00	80+00	114,617	21,713	7	23
80+00	99+50	151,854	31,382	10	46
99+50	126+00	92,431	22,453	7	32

Table 3.3 – Relief Well / Seepage Berm Combination quantities

E. – Relocations

To determine the location of utilities potentially conflicting with proposed alternatives, a design locate was requested through JULIE, Illinois' one-call system. Additional information was obtained through levee crossing permits on file and GIS data. CEMVS coordinated with utility owners in the area to incorporate existing facilities into the design. Figure 3.2 shows four significant lines impacting the project. These lines will have a minimal effect on the relief well plan. Slight spacing adjustments may be required during the plans and specification phase to avoid any conflict. The berm plan will require relocation of the two active lines over the top of the theoretical berm section and grouting the two abandoned lines.

	Status	Length of Relocation	Length of Grouting
Owens 36" concrete wastewater main	Abandonded	-	825'
Ameren gas line	Active	525'	-
Alton Steel 16" force main	Active	825'	-
Alton Box Board 30" concrete casing with 20" effluent line	Abandonded	-	1150'

Table 3.4 – Relocations for berm plan

The cutoff plan will incorporate windows in the slurry wall where the levee crossings are located. Both abandoned lines will still require grouting, but for a shorter length than the berm solution.

	Status	Window in cutoff wall	Length of Grouting
Owens 36" concrete wastewater main	Abandonded	-	450'
Ameren gas line	Active	yes	-
Alton Steel 16" force main	Active	yes	-
Alton Box Board 30" concrete casing with 20" effluent line	Abandonded	-	550'

Table 3.5 – Relocations for cutoff plan

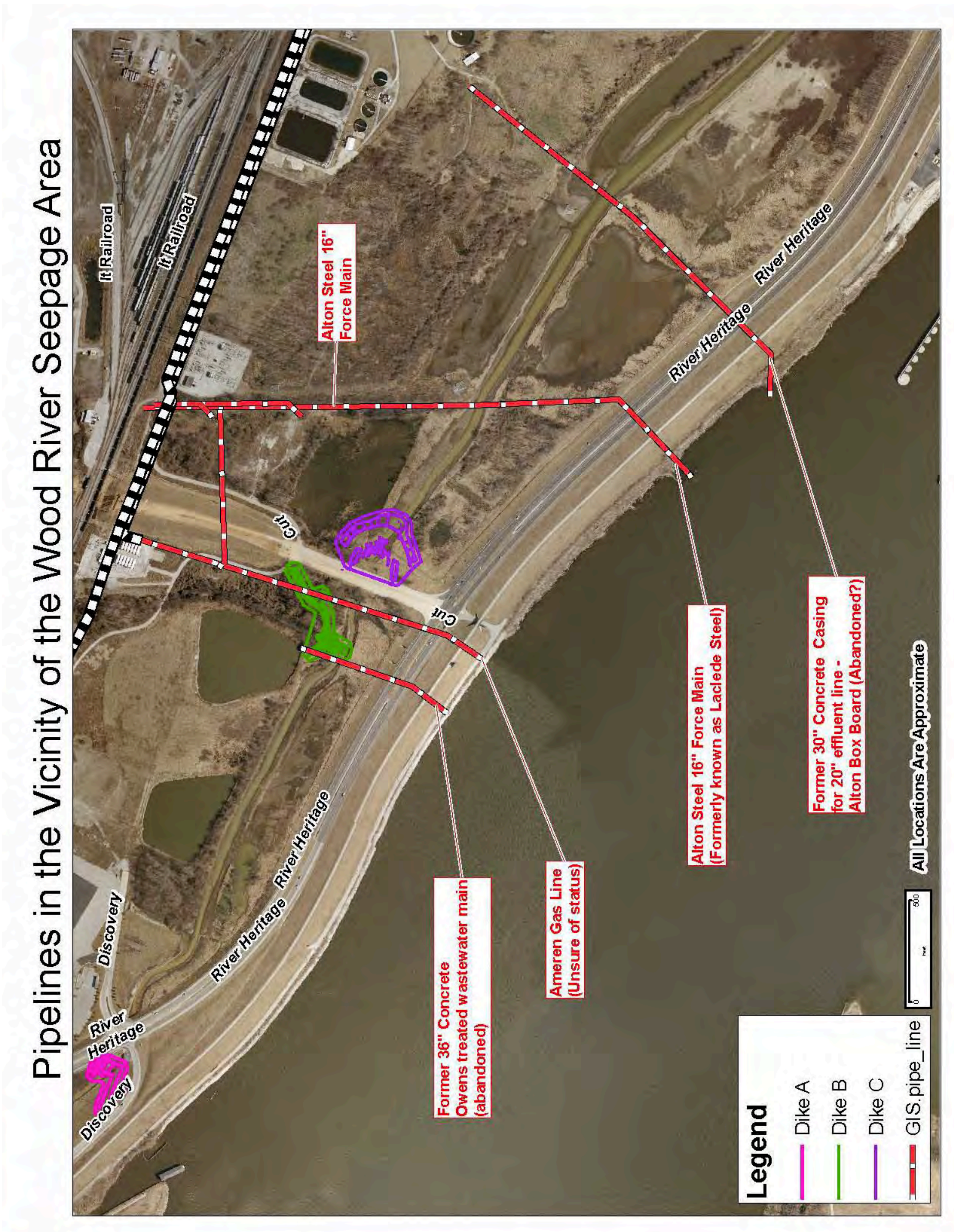

Pipelines in the Vicinity of the Wood River Seepage Area
Alton Steel 16" Force Main
Former 36" Concrete Owens treated wastewater main (abandoned)
Ameren Gas Line (Unsure of status)
Alton Steel 16" Force Main (Formerly known as Laclede Steel)
Former 30" Concrete Casing for 20" effluent line - Alton Box Board (Abandoned?)
All Locations Are Approximate
River Heritage
Discovery
Railroad
Cut
Legend
Dike A
Dike B
Dike C
GIS.pipe_line

Figure 3.2

SECTION 4 – MECHANICAL CONSIDERATIONS

A. – Current Pumping Capacity

Stormwater runoff and seepage/relief well flow in this section of the levee currently flows to the East Alton No. 1 Pump Station where it is either pumped into the station's discharge chamber when the Mississippi River is high or flows by gravity through the gravity drain and into the Mississippi River when the river is low. The East Alton No. 1 Pump Station is equipped with three (3) Reddy-Buffaloes vertical, mixed flow stormwater pumps. The pump station is sized to accommodate seepage/relief well flow plus 36,350 gallons per minute (GPM) for stormwater flow.

Figure 4.1a & 4.1b: East Alton Number 1 Pump Station

The hydraulic analyses to determine seepage/relief well flow for the alternative solutions were conducted with a Mississippi River elevation of 443.0. According to the Pump Operation Schedule in Section B of the Operations and Maintenance Manual for East Alton Number 1 Pump Station, a Mississippi River elevation of 443.0 falls into hydraulic condition number 5 (see Table 4.1). During hydraulic condition number 5, the minimum interior water level that pumping occurs at is elevation 412.0.

Table 4.1 - Pump Operation Schedule

PUMP OPERATION SCHEDULE

HYDRAULIC CONDITION NUMBER	MELVIN PRICE L&D TAILWATER RIVER ELEVATION	PEAK HOURS: RISING SUMP START PUMP ELEVATION			PEAK HOURS: FALLING SUMP STOP PUMP ELEVATION			NON-PEAK HOURS: RISING SUMP START PUMP ELEVATION			NON-PEAK HOURS: FALLING SUMP STOP PUMP ELEVATION		
		1	2	3	1	2	3	1	2	3	1	2	3
1	406.0 - 423.0	406.0	408.5	409.0	405.5	407.0	407.0	406.0	406.5	408.5	405.0	406.0	407.0
2	423.1 - 428.0	408.0	408.0	409.5	406.0	407.5	408.0	408.0	408.5	408.5	406.0	407.5	408.0
3	428.1 - 431.0	408.5	409.0	410.5	407.5	408.5	409.5						
4	431.1 - 435.0	409.0	411.5	412.0	407.5	410.5	411.0						
5	435.1 - 444.2	413.0	413.0	413.5	412.0	412.5	413.0						

This operation schedule is programmed into the PLC in the AUTO 2 mode.

B-1

With the Mississippi River at an elevation of 443.0 and the interior water level at an elevation of 412.0 the static head on the pumps is 31 feet. Adding 2 feet for friction losses in the pump elbow, discharge pipe, and flap gate, the total dynamic head (TDH) of the pumps will be 33 feet. From the pump curve for the Reddy-Buffaloes Pump Inc. pumps installed at the station, the pumps will have a capacity each of 26,400 GPM at 33’ TDH. Since there are 3 of these pumps at the station, East Alton Number 1 Pump Station has a pumping capacity of **79,200 GPM**.

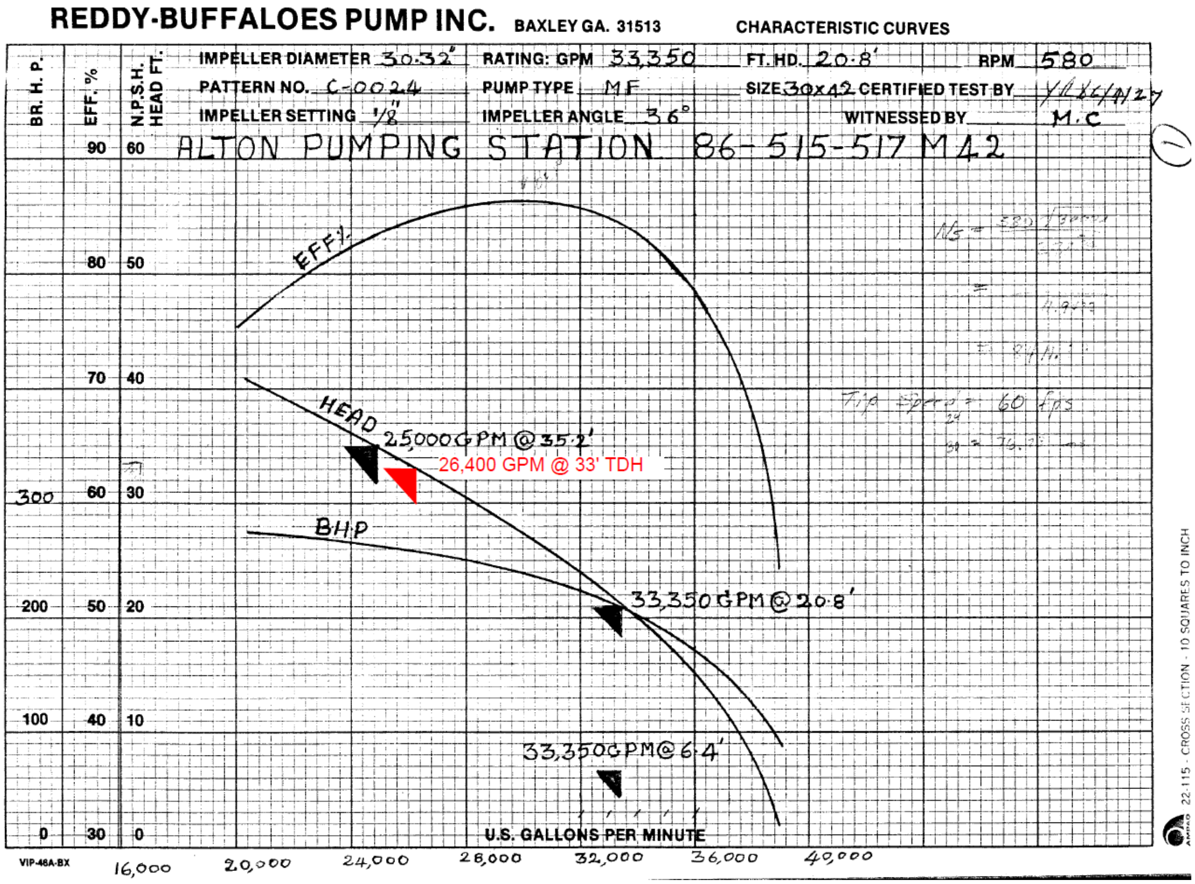


Figure 4.2: Reddy-Buffaloes Pump Inc. Pump Curve

B. – Additional Pumping Needed

B1. – Slurry Trench Cutoff Wall Alternative

The slurry trench cutoff wall alternative will not increase seepage/relief well flows to the pump station. With no increase in seepage/relief well flows to the station, the current capacity of the station will be sufficient. Therefore, the slurry trench cutoff wall alternative will require **no additional pumping**.

B2. – Seepage Berm Alternative

The seepage berm alternative will result in 150,900 GPM of seepage/relief well flow to enter the pump station. Combined with the 36,350 GPM from stormwater flow, the net flow to the station is 187,250 GPM. Subtracting the 79,200 GPM capacity that East Alton Pump Station No. 1 currently has results in the seepage berm alternative requiring **108,050 GPM additional pumping**. This will require building an additional pump station with roughly the capacity of the existing East Alton Number 1 Pump Station.

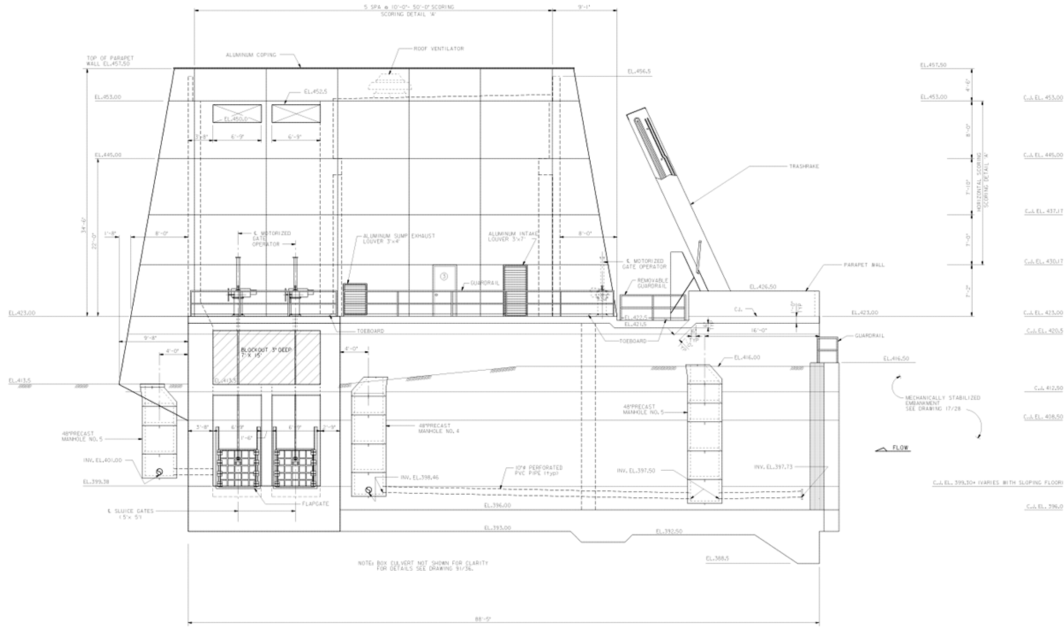


Figure 4.3: East Alton Number 1 Pump Station – East Elevation

B3. – Relief Well Alternative

The relief well alternative will result in 68,133 GPM of seepage/relief well flow to enter the pump station. Combined with the 36,350 GPM from stormwater flow, the net flow to the station is 104,483 GPM. Subtracting the 79,200 GPM capacity that East Alton Pump Station No. 1 currently has results in the relief well alternative requiring **25,283 GPM additional pumping**. This will require building an additional pump station which will have roughly the capacity of the existing Grassy Lake Pump Station. Grassy Lake Pump Station is located in the Wood River Levee District.

Figure 4.4: Grassy Lake Pump Station

B4. – Seepage Berm/Relief Well Combination Alternative

The seepage berm/relief well combination alternative will result in 106,031 GPM of seepage/relief well flow to enter the pump station. Combined with the 36,350 GPM from stormwater flow, the net flow to the station is 142,381 GPM. Subtracting the 79,200 GPM capacity that East Alton Pump Station No. 1 currently has results in the seepage berm/relief well combination alternative requiring **63,181 GPM additional pumping**. This will require building an additional pump station which will have roughly the capacity of the designed new Chain of Rocks Pump Station. The new Chain of Rocks Pump Station will be constructed along the east side of the Chain of Rocks Canal.

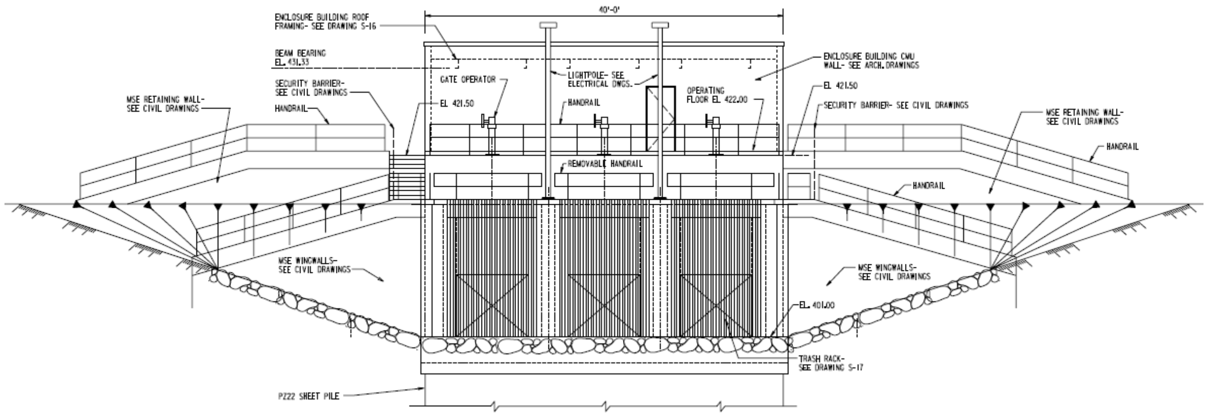


Figure 4.5: Chain of Rocks Pump Station – East Elevation

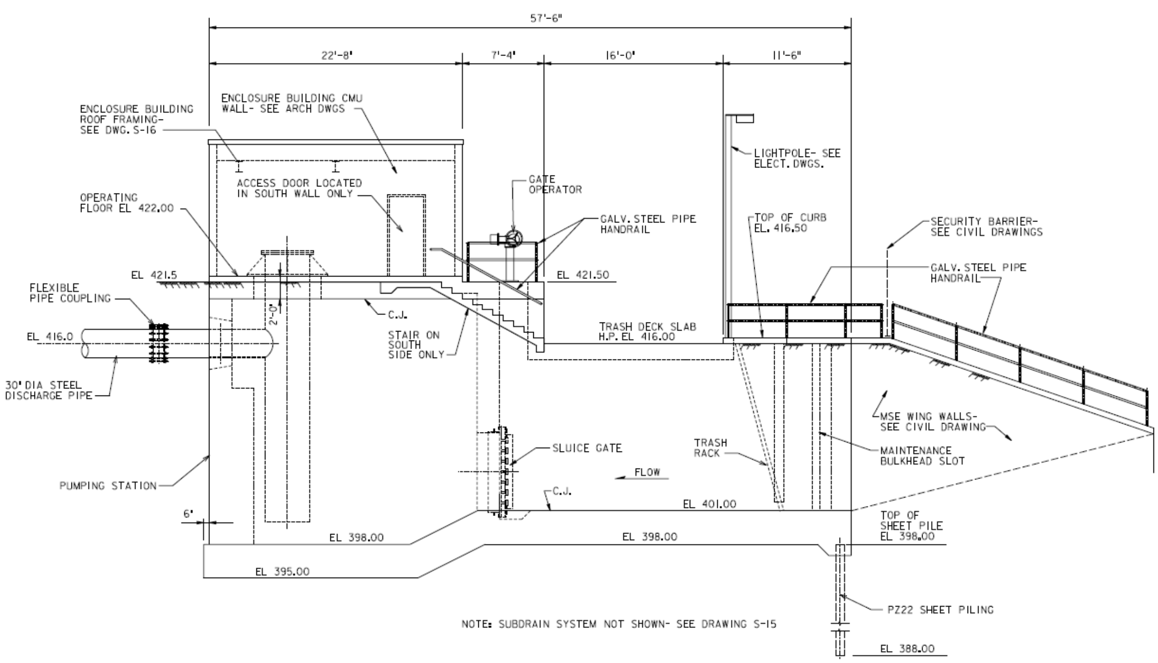


Figure 4.6: Chain of Rocks Pump Station – South Elevation

SECTION 5 – MELVIN PRICE WOOD RIVER UNDERSEEPAGE OPERATION PLAN

Last Updated: 22 March 2011

1. SITUATION

a. Description of Issue. Uncontrolled underseepage and conveyance of material is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. The uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam, two miles downstream from the original structure. This replacement resulted in a navigation pool raise that has impacted the levee foundation. When the issue developed is unknown, but it appears to have persisted for a significant period of time. Additionally, the degree of deterioration of the levee foundation is unknown. The Wood River Levee is at unacceptable risk during a high water event, particularly river elevations above normal pool.

b. Purpose of OPLAN. Provide details of a monitoring plan and actions to be taken given a local flood event. Trigger points are based on Mel Price tailwater readings.

c. Current Situation. Temporary measures have been constructed to help control the underseepage issues. Below is a status of the temporary measures in place:

(1) Dikes A constructed to elev. 415.0' with a 10-foot wide notch at elev. 412.0' and one 48" sluice gate drain.

(2) Dike B constructed to elev. 415.0' with a 10-foot wide notch at elev. 412.0' and two 48" sluice gate drains.

(3) Dike C constructed to elev. 411.0' with a 10-foot wide notch at elev. 410.0' and one 48" sluice gate drain.

(4) Manhole and two PVC shut offs have been raised at the city pump station.

d. Assumptions. Below are several key assumptions made during the development of this plan:

(1) Allowable maximum differential head between river elevation and landside ponding elevation is 11 feet.

(2) Bypass pumps for use at Dikes A and B are available through an existing IDIQ contract with Georgewitz. GPM is the contractor under contract to install standpipes on the relief wells and operate air-lift pumping of relief wells.

(3) Manpower and equipment to backfill the notches at Dikes A and B is also available through an existing Georgewitz IDIQ contract.

2. MISSION

Upon elevated tail water readings at Melvin Price Locks and Dam, a graduated response will be initiated to control the underseepage concerns and protect the City of Alton, Illinois. The response required is initiated by the tail water reading at Melvin Price Locks and Dam.

3. EXECUTION

a. Concept of Operations. The Emergency Operations Center (EOC), in conjunction with Water Control, will closely monitor the tail water (TW) levels at Melvin Price Locks and Dam (MP) and local rainwater events impacting the City of Alton. Upon a change in tail water at Melvin Price Locks and Dam or the indication that a local flood event will occur, EOC will provide notifications to EC-G (Conroy) and PM-N (Kessler). Based upon the level of response required, EC-G and PM-N will make the appropriate notifications and take the appropriate actions as described in the paragraphs below. If the City of Alton has a concern regarding a local flood event, they will call the EOC. The POC for the EOC is Linda Werdebaugh and the Alternate POC is Jake Scanlon. The POC for the Rivers Project Office (RPO) is Karen Watwood. After hour and emergency contact information is provided in Attachment A for all action officers.

b. Actions required based upon specific tail water readings at Mel Price L&D. Below are the actions required based upon the specific tail water reading identified:

(1) Normal Pool (elev. 419') (or Open River, but TW less than elev. 419'):

a) Levee District will pond to elev. 408' to maintain maximum 11-ft differential head
b) EC-G will monitor sand boils weekly

(2) TW greater than elev. 419' and less than or equal to elev. 421' (MP Tail Water Gage Readings between 23.52 and 25.52):

a) Levee District will increase ponding from elev. 408' to elev. 410' to maintain 11-ft differential head
b) EC-G will conduct daily monitoring

If the river is predicted to crest near elev. 423':

c) RPO will mobilize the contractor for by-pass pumping at Dike A
d) Rivers Project Office will mobilize the contractor to fill notch at Dike A

(3) TW greater than elev. 421' and less than or equal to elev. 423' (MP Tail Water Gage Readings between 25.52 and 27.52):

a) Levee District will increase ponding from elev. 410' to elev. 412' to maintain 11-ft differential head
b) EC-G will continue daily monitoring
c) RPO will notify contractor to fill in the notch at Dike A
d) RPO will close the gravity drain at Dike A when the ponding level reaches elev. 410.9'
e) RPO will begin by-pass pumping at Dike A when the gravity drain is closed (and rain events require)
f) RPO will notify contractor to install relief well (RW) standpipes to elev. 416'

If the river is predicted to crest near elev. 426':

g) RPO will mobilize the contractor to fill in the notch at Dike B
h) RPO will mobilize the contractor for by-pass pumping at Dike B
i) RPO will mobilize the contractor for Air-Lift Pumping of relief wells

(4) TW greater than elev. 423' and less than or equal to elev. 425' (MP Tail Water Gage Readings between 27.52 and 29.52):

a) Levee District will increase ponding from elev. 412' to elev. 414' to maintain 11-ft differential head
b) EC-G will continue daily monitoring
c) When ponding elevation reaches elev. 413', RPO will close the sluice gate drains at Dike B
d) When ponding elevation reaches elev. 413', RPO will notify the contractor to fill in the notch at Dike B
e) RPO will begin by-pass pumping at Dike B when the ponding level reaches elev. 413.9'

(5) TW equal to elev. 425' (MP Tail Water Gage Reading equal to 29.52):

a) Levee District will pond to elev. 414'
b) EC-G will monitor continuously
c) Continued actions from previous trigger points:
    i. Sluice Gate Drains closed at Dikes A and B
    ii. Notches filled at Dikes A and B
    iii. By-pass pumping at Dikes A and B
    iv. Relief Well standpipes installed to elev. 416'

(6) TW equal to elev. 426' (MP Tail Water Gage Reading equal to 30.52):

a) Levee District will pond to elev. 415'
b) RPO will notify contractor to begin Air Lift Pumping of Relief Wells
c) Continued actions from previous trigger points:
    i. EC-G monitoring continuously
    ii. Sluice Gate Drains closed at Dikes A and B
    iii. Notches filled at Dikes A and B
    iv. By-pass pumping at Dikes A and B
    v. Relief Well standpipes installed to elev. 416'

(7) TW equal to elev. 427' (MP Tail Water Gage Reading equal to 31.52):

a) Continued actions from previous trigger points:
    i. EC-G monitoring continuously
    ii. Sluice Gate Drains closed at Dikes A and B
    iii. Notches filled at Dikes A and B
    iv. By-pass pumping at Dikes A and B
    v. Relief Well standpipes installed to elev. 416'
    vi. Continue air lift pumping of relief wells

(8) TW equal to elev. 428' (MP Tail Water Gage Reading equal to 32.52):

a) Continued actions from previous trigger points:
    i. EC-G monitoring continuously
    ii. Sluice Gate Drains closed at Dikes A and B
    iii. Notches filled at Dikes A and B
    iv. By-pass pumping at Dikes A and B
    v. Relief Well standpipes installed to elev. 416'
    vi. Continue air lift pumping of relief wells

(9) TW equal to elev. 429’ (MP Tail Water Gage Reading equal to 33.52):

a) Continued actions from previous trigger points:

i. EC-G monitoring continuously
ii. Sluice Gate Drains closed at Dikes A and B
iii. Notches filled at Dikes A and B
iv. By-pass pumping at Dikes A and B
v. Relief Well standpipes installed to elev. 416’
vi. Continue air lift pumping of relief wells

(10) TW equal to elev. 430’ (MP Tail Water Gage Reading equal to 34.52):

a) RPO will mobilize the contractor for pumping of the relief wells using electric submersible pumps

b) Continued actions from previous trigger points:

i. EC-G monitoring continuously
ii. Sluice Gate Drains closed at Dikes A and B
iii. Notches filled at Dikes A and B
iv. By-pass pumping at Dikes A and B
v. Relief Well standpipes installed to elev. 416’
vi. Continue air lift pumping of relief wells

(11) TW equal to elev. 431’ (MP Tail Water Gage Reading equal to 35.52):

a) RPO will notify the contractor(s) to begin the transition from air lift pumping of the relief wells to pumping of the relief wells using electric submersible pumps

b) Continued actions from previous trigger points:

i. EC-G monitoring continuously
ii. Sluice Gate Drains closed at Dikes A and B
iii. Notches filled at Dikes A and B
iv. By-pass pumping at Dikes A and B
v. Relief Well standpipes installed to elev. 416’
vi. Continue air lift pumping of relief wells not transitioned to pumping with electric submersible pumps

(12) TW equal to elev. 432’ and less than or equal to elev. 436’ (MP Tail Water Gage Readings between 36.52 and 40.52):

a) Continued actions from previous trigger points:

i. EC-G monitoring continuously
ii. Sluice Gate Drains closed at Dikes A and B
iii. Notches filled at Dikes A and B
iv. By-pass pumping at Dikes A and B
v. Relief Well standpipes installed to elev. 416’
vi. Continue pumping of relief wells with electric submersible pumps

c. Monitoring. Upon initiation of various stages of monitoring, EC-G will coordinate with internal elements to ensure off duty hours are covered by personnel and will ensure the appropriate information is disseminated. A trip report will be provided to EC-G (Conroy) and PM-N (Kessler) every day that monitoring is conducted at the site. Upon receiving the trip report, PM-N (Kessler) will provide a SITREP to the chain of command.

d. Changes to Ponding Elevations. EC-G (Conroy) will coordinate directly with the Wood River Levee District to initiate changes in the ponding elevation at dikes A, B, and C. EC-G (Conroy) will notify PM-N (Kessler) once changes in ponding elevation are complete.

e. By-Pass Pumping. By-pass pumping capability is necessary at the project site when the ponding elevation is above 410.9' (TW greater than 421.9'). Once the notice is provided by the EOC that the need for pumping is likely, PM-N (Kessler) or EC-G (Conroy) will contact the Rivers Project Office (Karen Watwood) to mobilize the contractor's operator to the site. The pump, (traditionally a 14'x14', 13,500 GPM, self-priming, skid-mounted, diesel operated pump with an automatic float system) is on site, RPO personnel will monitor to ensure pumps are operating properly and adequately pumping down the water level behind the dikes. If necessary, RPO will contact the contractor to address any noted deficiencies and ensure the pump can be operational within an hour. A similar pump will be rented for use at Dike B. Should additional pumping capacity be required, an additional standby pump is available from Mark Twain Lake and can be stored at Mel Price. Rivers Project Office Personnel are trained in operation for this pump and can operate the pump as required; however, it is preferred that Mark Twain Lake personnel do so.

f. Contractual Changes. Should any of the contracts require modifications, this will be coordinated with PM-N (Kessler) and CT (Mercer and Killiebrew). Notifications will be made to PM-N (Kessler) immediately upon the identification of the potential modification.

g. Communications with the City of Alton. EC-G (Conroy) will maintain dialogue with Mr. Bob Roth (Mgr Alton Wastewater Treatment Plant) and Mr. William Kerr (Alton Public Works Director). EC-G (Conroy) will inform and coordinate the by-pass pumping with these entities.

h. Maximum Ponding Elevation. Current flowage easements allow ponding to elevation 415'. At this time, water cannot be ponded above this elevation. In order to pond to higher elevations, Real Estate will need to acquire and purchase additional flowage easements, but the project does not have the funding required to initiate this effort. The permanent solution that is being developed may be able to fund this requirement at a later date should it be necessary in the execution of the recommended plan.

4. SERVICE SUPPORT

Upon notification of a local rainfall event affecting the City of Alton or a change in tail water at Melvin Price Locks and Dam, EC-G (Conroy) and PM-N (Kessler) will coordinate with the various elements to initiate the appropriate actions on site.

5. COMMAND AND SIGNAL

a. EOC and Water Control will monitor Melvin Price Locks and Dam tail water elevations and local rainfall events impacting the City of Alton. EOC will notify EC-G and PM-N upon indication that Mel Price tail water will change or of an upcoming local rainfall event impacting the City of Alton, Illinois.

b. EC-G and PM-N will initiate appropriate response based on tail water elevations or rainfall events. EC-G and PM-N will make contact with the appropriate personnel to initiate response actions.

c. Karen Watwood will coordinate with the contractor based on the direction provided by EC-G and PM-N.

d. EC-G will coordinate with the Wood River Levee District to initiate changes in dike ponding elevations. EC-G will also coordinate pumping efforts with Alton Public Works and Wastewater Treatment plant.

e. EC-G will conduct monitoring as required by the OPLAN and will provide trip reports to PM-N (Kessler)

f. PM-N will provide SITREP to command group upon initiating any action once tail water is above normal pool.

g. Emergency Contact Numbers are provided in Attachment A for individuals identified in this section.

6. Attachments:
Attachment A: Phone Roster with Emergency Contact Numbers
Attachment B: Area Map
Attachment C: Checklist
Attachment D: SOP Matrix

Attachment A – Phone Roster for Emergency Contact Numbers

Name	Title	Office Symbol	Primary Phone Number	Alternative Phone Number
Mike Kessler	Project Manager	PM-N	(314) 606-9817 (Gov't Cell)	(636) 528-6289 (Home)
Karen Watwood	River's Project Office	OD-R	(314) 581-9055 (Cell)	(618) 278-4434 (Home)
Patrick Conroy	Geotechnical Engineer	EC-G	(314) 630-6295 (Cell)	(314) 351-6603 (Home)
Linda Werdebaugh	Emergency Operations	EOC	(314) 541-6090 (Gov't Cell)	(618) 580-6975 (Personal Cell)
Jake Scanlon	Emergency Operations	EOC	(314) 346-8865 (Gov't Cell)	(636) 441-8926 (Home)
John Boeckmann	Hydraulics Engineer	EC-HW	(314) 341-3878 (Personal Cell)	

Attachment B – Area Map

Checklist for the Inspection of Wood River Dikes

Inspected by: ______________________ Date: __________ Time: __________

LOCATION:	**What is the depth of flow, relative to the bottom of the notch (if applicable)?**	**What is the depth of flow, relative to the top of the dike/weir?**	**Is the water moving slowly or quickly? Smooth or turbulent?**	**Is there any visible damage to the structure? Is rock or gravel being moved?**	**Estimated Water Elevations (feet)**
Dike A (Notch=412', Crest=415')					US of Dike = __________ DS of Dike = __________
Dike B (Notch=412', Crest=415')					US of Dike = __________ DS of Dike = __________
Dike C (Notch=410', Crest=411')					US of Dike = __________ DS of Dike = __________
Central Avenue CSO Weir (Crest=410.8')	**N/A**			**N/A**	Water Elevation on the weir = _______ (Only if flowing over)
Shields Avenue CSO Weir #1 (Crest=413.9')	**N/A**			**N/A**	Water Elevation on the weir = _______ (Only if flowing over)

Shields Avenue CSO Weir #2 **(Crest=415.8')**	**N/A**			**N/A**	Water Elevation on the weir = _______ (Only if flowing over)

Attachment C – Checklist (page 2 of 2)

ADDITIONAL OBSERVATIONS AND NOTES:

Inspected by: ___________________________________ Date: __________ Time: __________

Drawings / Sketches:	**Notes:**__________________________________

Attachment D – SOP Matrix (page 1 of 2)

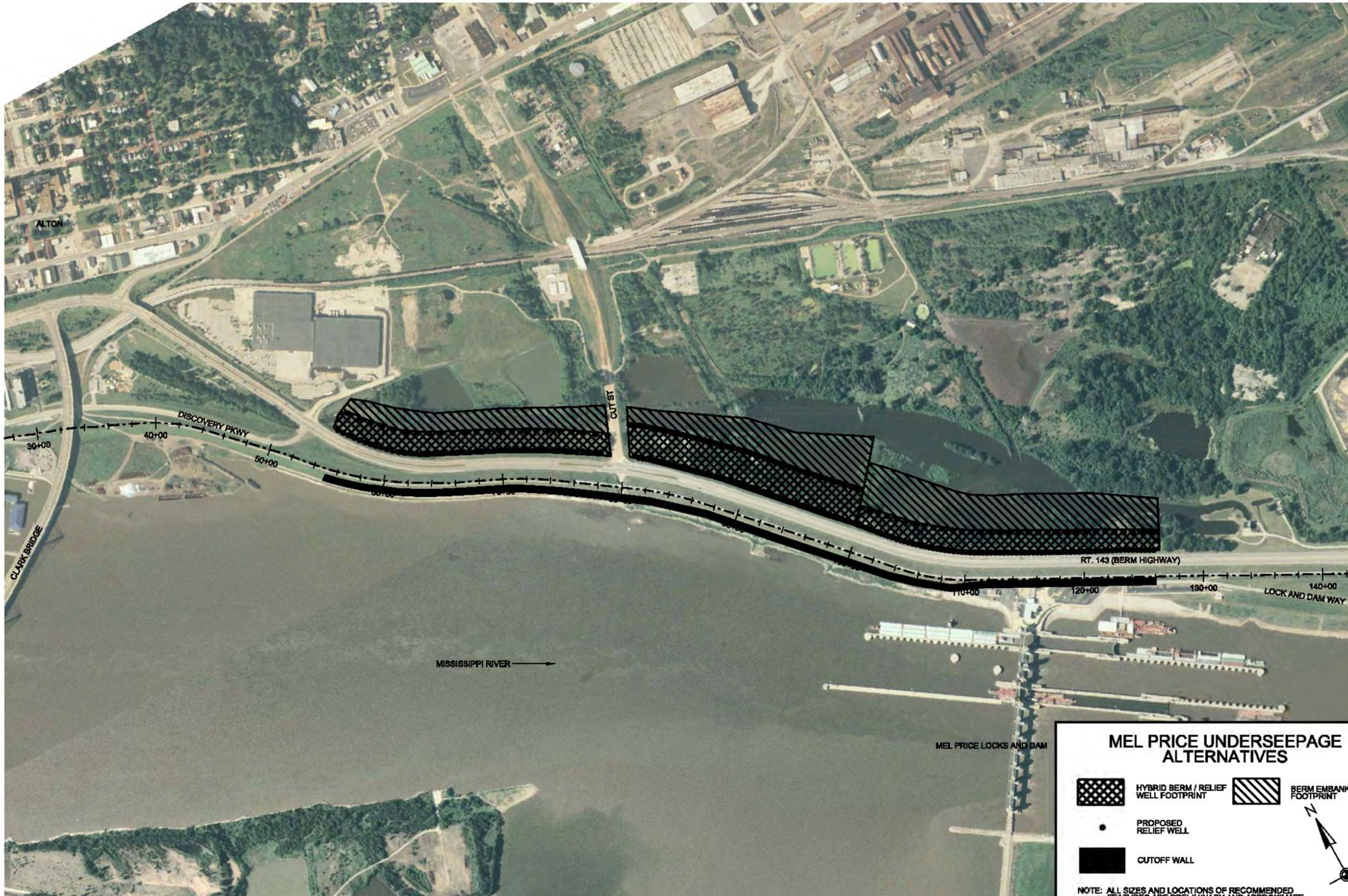
MP Tailwater Elevation (unless noted)	**MP Tailwater Gage Reading** (Zero = 395.48')	**New Required Action**	**Who Owns the Action**	**Continued Action**
Regulated Pool (normally 419') *or* Open River; TW less than 419'	Varies, but less than or equal to 23.52	1. Pond to Elev. 408' to maintain 11' ΔH 2. Monitor Sand Boils Weekly	1. WR D&LD 2. EC-G	
TW greater than 419' and less than or equal to 421'	23.52 to 25.52	1. Increase Ponding to Elev. 410' 2. Monitor Daily *If the river is predicted to crest near Elev. 423':* 3. Mobilize by-pass pumping contractor to Dike A 4. Mobilize contractor to fill in notch at Dike A	1. WR D&LD 2. EC-G 3. RPO 4. RPO	
TW greater than 421' and less than or equal to 423'	25.52 to 27.52	1. Increase Ponding to Elev. 412' 2. Fill in notch at Dike A 3. Close Drain at Dike A 4. Begin by-pass pumping at Dike A when ponding elevation reaches 410.9' 5. Install Relief Well (RW) standpipes to Elev. 416' *If the river is predicted to crest near Elev. 426':* 6. Mobilize contractor to fill in notch at Dike B 7. Mobilize by-pass pumping contractor to Dike B *8.* Mobilize Air-Lift Pumping	1. WR D&LD 2. RPO-KTR 3. RPO 4. RPO-KTR 5. RPO-KTR 6. RPO 7. RPO 8. RPO	Monitor Daily
TW greater than 423' and less than 425'	27.52 to 29.52	1. Increase Ponding to Elev. 414' *When the ponding reaches Elev. 413':* 2. Fill in notch at Dike B 3. Close Drain at Dike B 4. Begin by-pass pumping at Dike B when ponding elevation reaches 413.9'	1. WR D&LD 2. RPO-KTR 3. RPO 4. RPO-KTR	Monitor Daily Drain Closed at Dike A Notch filled at Dike A Bypass Pumping at Dike A RW Standpipes Installed to elev. 416'
425'	29.52	1. Pond to Elev. 414' 2. Monitor Continuously	1. WR D&LD 2. EC-G	Drains Closed at Dikes A and B Notches filled at Dikes A and B Continue Bypass Pumping at Dikes A and B RW Standpipes Installed to elev. 416'
426'	30.52	1. Increase Ponding to Elev. 415' 2. Begin Air Lift Pumping of Relief Wells	1. WR D&LD 2. RPO-KTR	Monitor Continuously Drains Closed at Dikes A and B Notches filled at Dikes A and B Continue Bypass Pumping at Dikes A and B RW Standpipes Installed to elev. 416'

Attachment D – SOP Matrix (page 2 of 2)

MP Tailwater Elevation (unless noted)	**MP Tailwater Gage Reading** (Zero = 395.48’)	**New Required Action**	**Who Owns the Action**	**Continued Action**
427 and 428’	31.52 and 32.52’			Monitor Continuously Ponding at Elev. 415’ Drains Closed at Dikes A and B Notches filled at Dikes A and B Continue Bypass Pumping at Dikes A and B RW Standpipes Installed to elev. 416’ Continue to Air-Lift Pump RWs
429’	33.52	1. Mobilize contractor to install Submersible Pumps in Relief Wells	1. RPO	Same as above
430’	34.52			Monitor Continuously Ponding at Elev. 415’ Drains Closed at Dikes A and B Notches filled at Dikes A and B Continue Bypass Pumping at Dikes A and B RW Standpipes Installed to elev. 416’ Continue to Air-Lift Pump RWs
431’	35.52	1. Transition from Air Lift Pumping of Relief Wells to pumping with Electric Submersible Pumps	1. RPO-KTR	Monitor Continuously Ponding at Elev. 415’ Drains Closed at Dikes A and B Notches filled at Dikes A and B Continue Bypass Pumping at Dikes A and B RW Standpipes Installed to elev. 416’
432’ to 436’	36.52 to 40.52			Monitor Continuously Ponding at Elev. 415’ Drains Closed at Dikes A and B Notches filled at Dikes A and B Continue Bypass Pumping at Dikes A and B RW Standpipes Installed to elev. 416’ Continue to Pump RWs using the Electrical Submersible Pumps

Notes: Allowable maximum differential head between river elevation and landside ponding elevation is 11-feet.
Dikes A and B installed to elevation 415’ with notches at elevation 412’; Dike C installed to elevation 411’.
Bypass pumps for Dikes A and B; Manpower and equipment to backfill notches available through existing Georgewitz IDIQ contract.
GPM under contract to install standpipes on relief wells and operate air-lift pumping of relief wells.
The estimated cost for Electrical Submersible Pumps is currently undetermined. This method is estimated to provide at least 10’ of additional ΔH in lieu of air lift pumping.

SECTION 6 – ENGINEERNG PLATES



MEL PRICE UNDERSEEPAGE ALTERNATIVES

HYBRID BERM / RELIEF WELL FOOTPRINT

BERM EMBANKMENT FOOTPRINT

PROPOSED RELIEF WELL

CUTOFF WALL

NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE

SCALE: 1" = 400'

400' 0 400'

N

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LOWER MISSISSIPPI RIVER BASIN
LOWER MISSISSIPPI RIVER

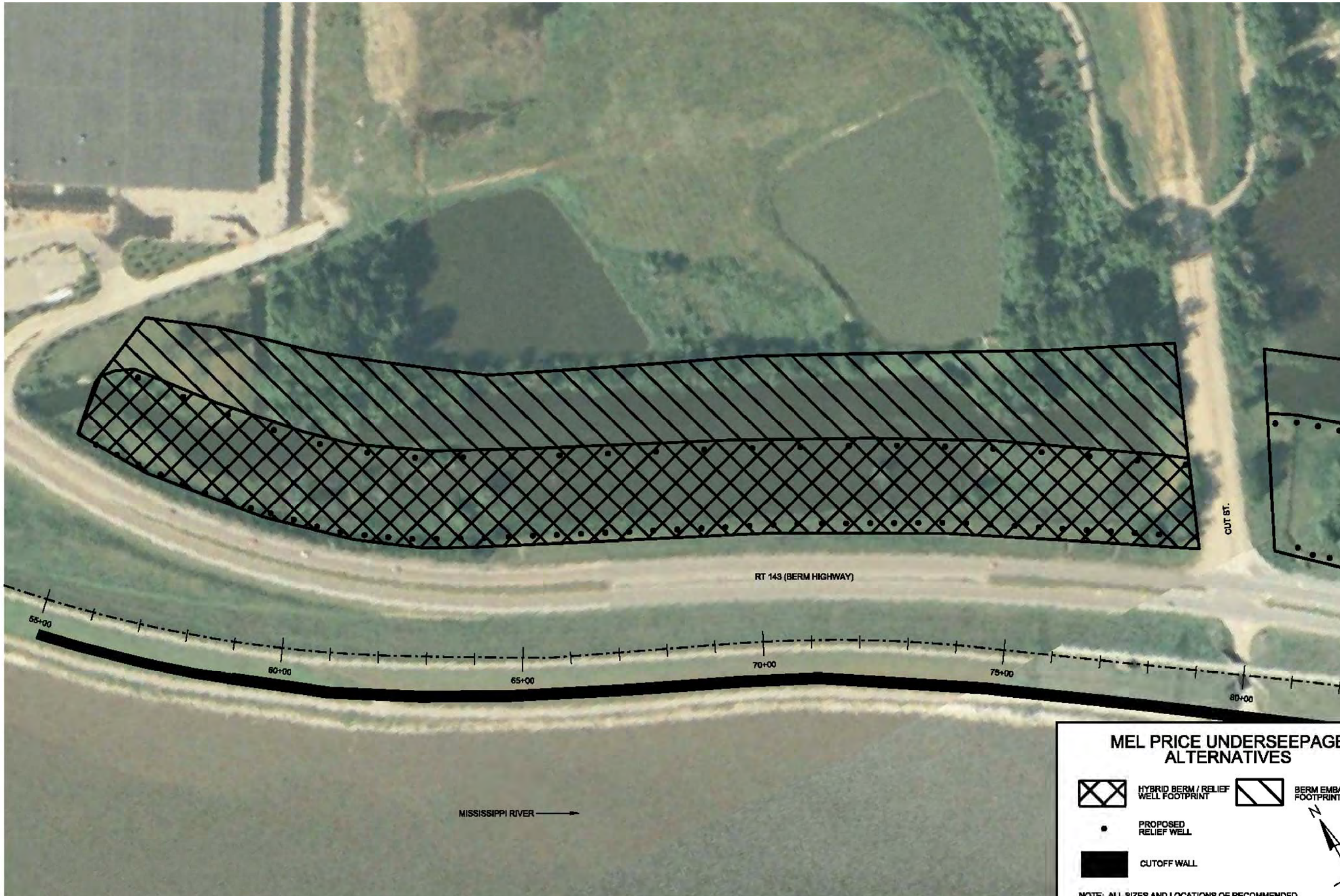
DESIGNED BY: P.J.CONROY
DWN BY: R.M.G
CKD BY: P.J.CONROY
SUBMITTED BY: P.J.CONROY
PLOT SCALE:
PLOT DATE:
SIZE:
FILE NAME:
DATE: OCTOBER 2010
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE ALTERNATIVES

GEOTECHNICAL

DRAWING (E)A-1.1

DRAWING NUMBER



MEL PRICE UNDERSEEPAGE ALTERNATIVES

HYBRID BERM / RELIEF WELL FOOTPRINT

BERM EMBANKMENT FOOTPRINT

PROPOSED RELIEF WELL

CUTOFF WALL

NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE

SCALE: 1" = 100'

100' 0 100'

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WOODRIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE
ALTERNATIVES

GEOTECHNICAL

DRAWING (E)A-1.2

DRAWING NUMBER

MEL PRICE UNDERSEEPAGE ALTERNATIVES

HYBRID BERM / RELIEF WELL FOOTPRINT

BERM EMBANKMENT FOOTPRINT

PROPOSED RELIEF WELL

CUTOFF WALL

NOTE: ALL SIZES AND LOCATIONS OF RECOMMENDED FEATURES ARE PRELIMINARY AND APPROXIMATE

SCALE: 1" = 100'

100' 0 100'

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LOWER MISSISSIPPI RIVER

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DWN BY: R.M.G

CKD BY: P.J.CONROY

SUBMITTED BY: P.J.CONROY

DATE: OCTOBER 2010

SOLICITATION NO.:

CONTRACT NO.:

PLOT SCALE:

PLOT DATE:

FILE NUMBER:

SIZE:

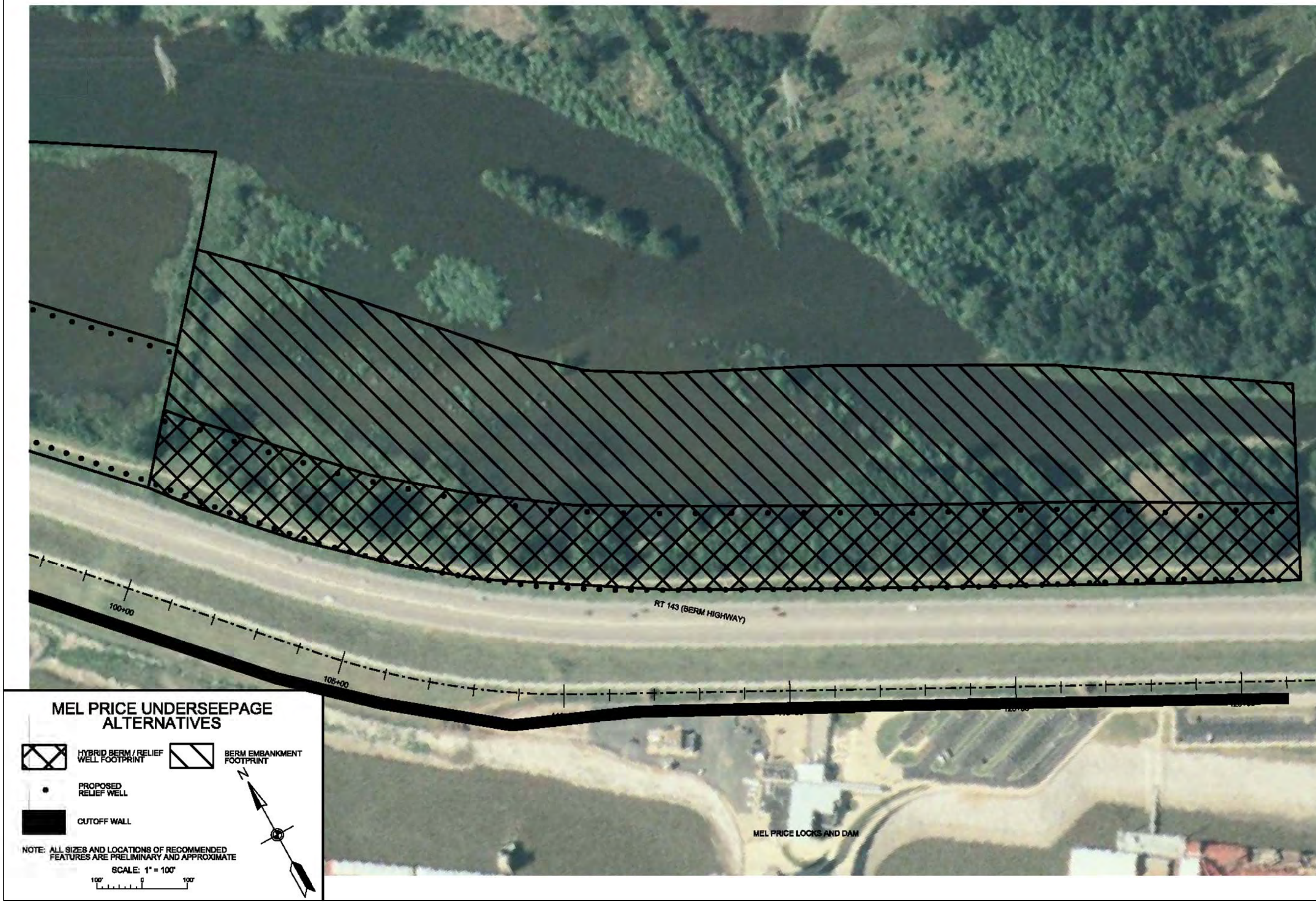
FILE NAME:

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE
ALTERNATIVES

GEOTECHNICAL

DRAWING (E)A-1.3

DRAWING NUMBER



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SUBMITTED BY: P.J.CONROY
CONTRACT NO.:
PLOT SCALE:
PLOT DATE:
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LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
MEL PRICE UNDERSEEPAGE ALTERNATIVES

GEOTECHNICAL

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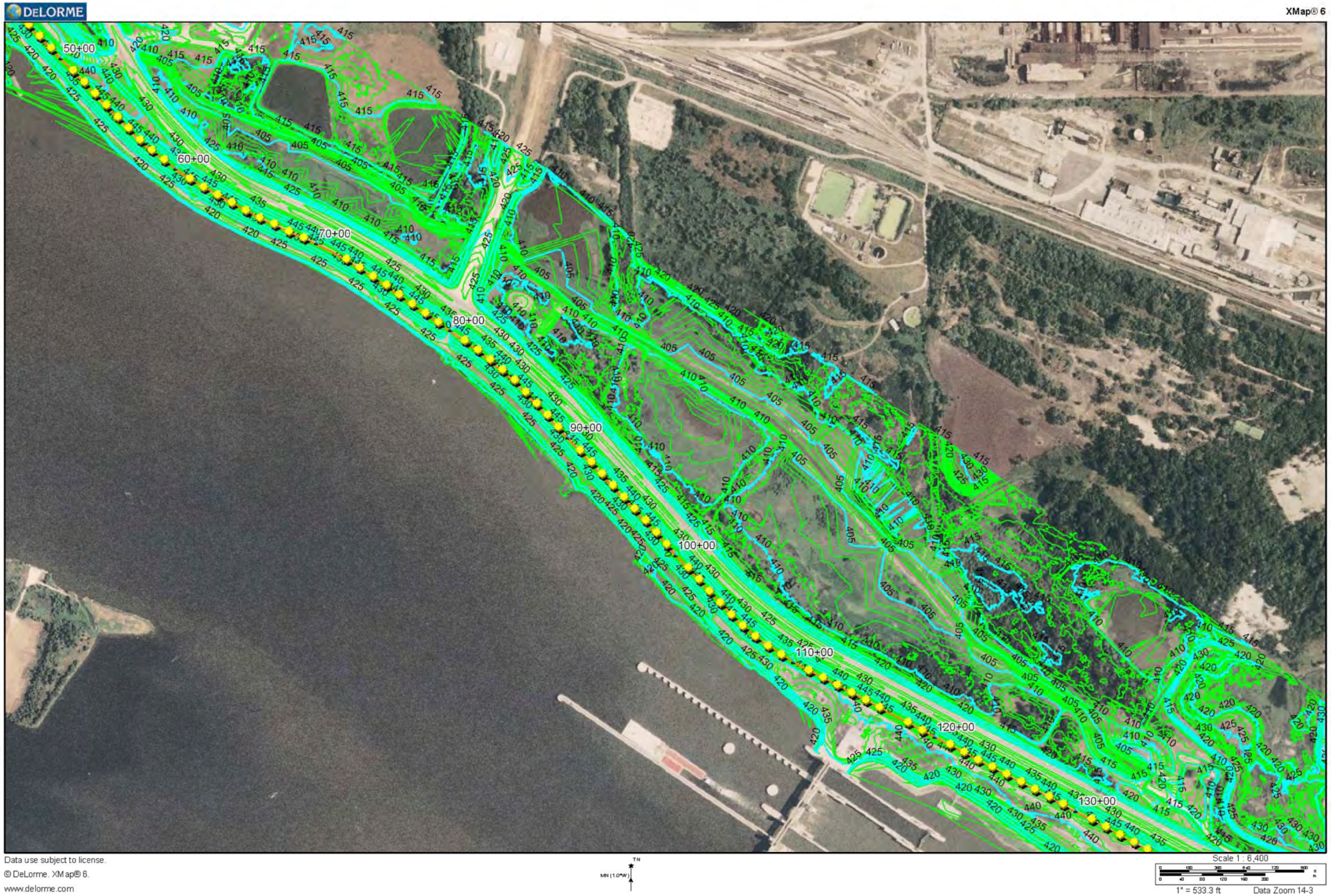

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LOWER MISSISSIPPI RIVER BASIN
LOWER MISSISSIPPI RIVER

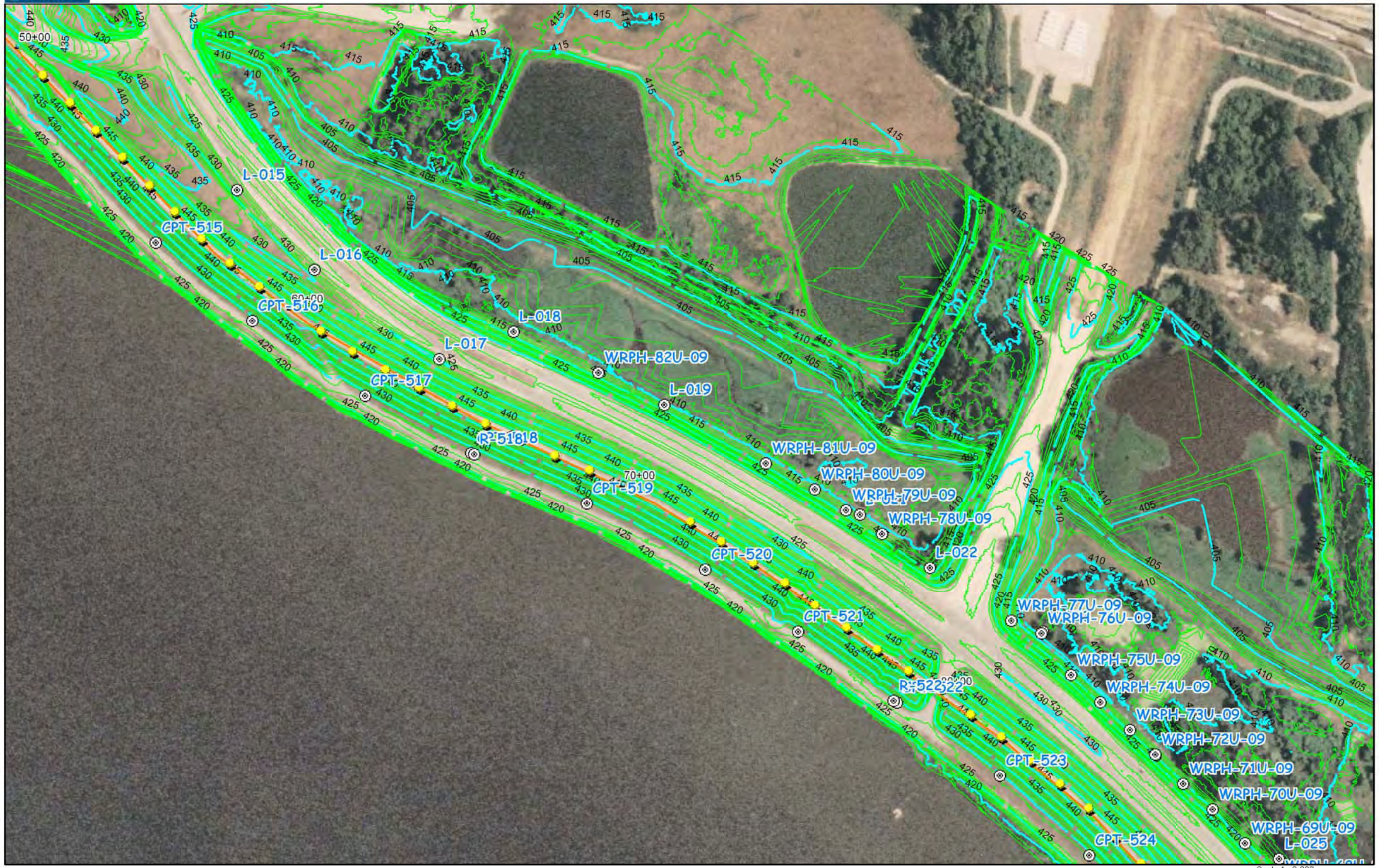
LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
PROJECT AREA

STA. 50+00-140+00

GEOTECHNICAL

DRAWING (E)A-1

DRAWING NUMBER



DELORME

XMap® 6

TN
MN (1.0°W)

Scale 1 : 2,800
1" = 233.3 ft
Data Zoom 15-5

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SUBMITTED BY: P.J.CONROY
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FILE NUMBER:
SIZE:
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LOWER MISSISSIPPI RIVER BASIN
LOWER MISSISSIPPI RIVER

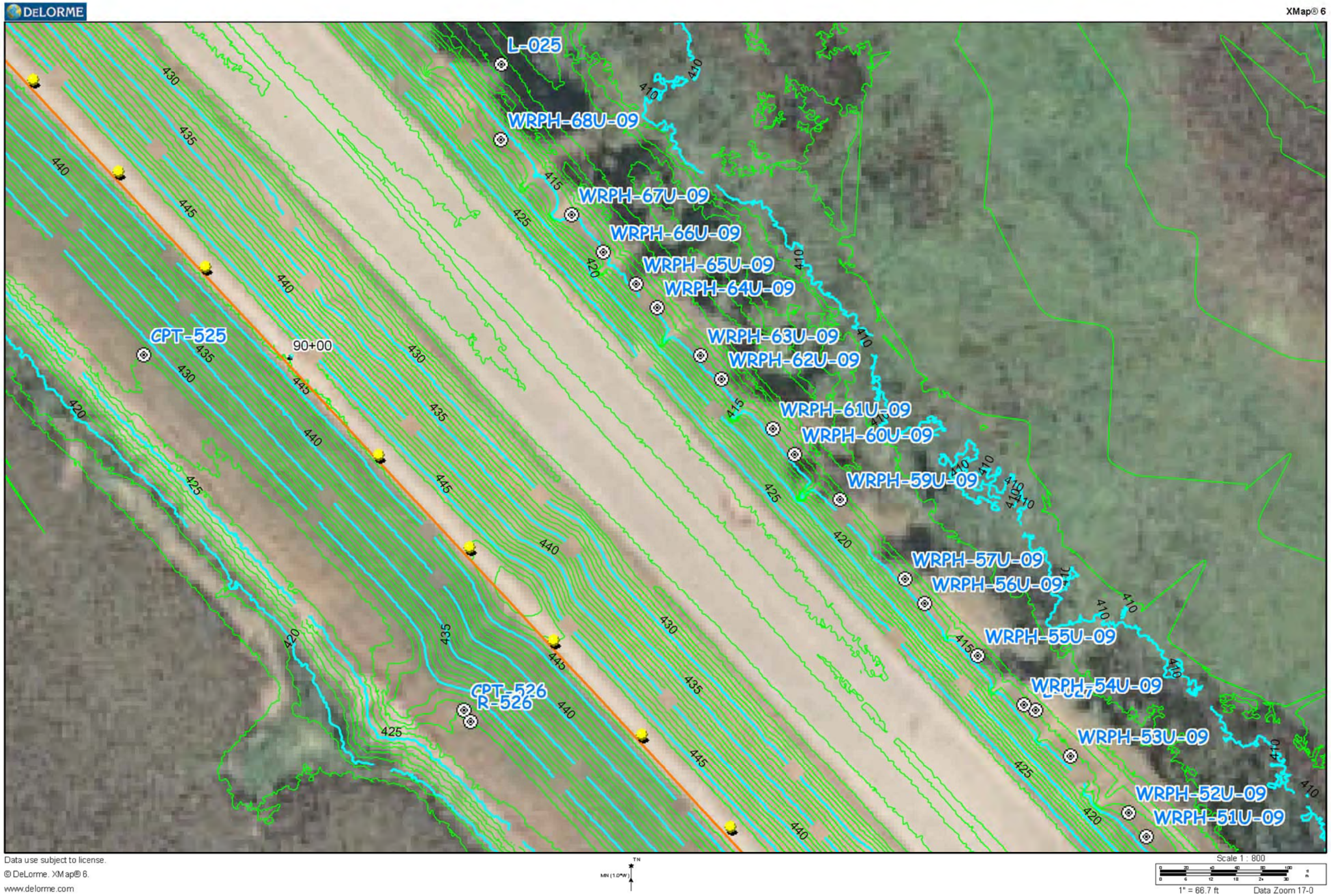
LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
BORING LOCATIONS

STA. 50+00-87+00

GEOTECHNICAL

DRAWING (E)A-2

DRAWING NUMBER



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LOWER MISSISSIPPI RIVER

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DWN BY: R.M.G
CKD BY: P.J.CONROY
SUBMITTED BY: P.J.CONROY
DATE: OCTOBER 2010
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:
PLOT SCALE:
PLOT DATE:
SIZE:
FILE NAME:

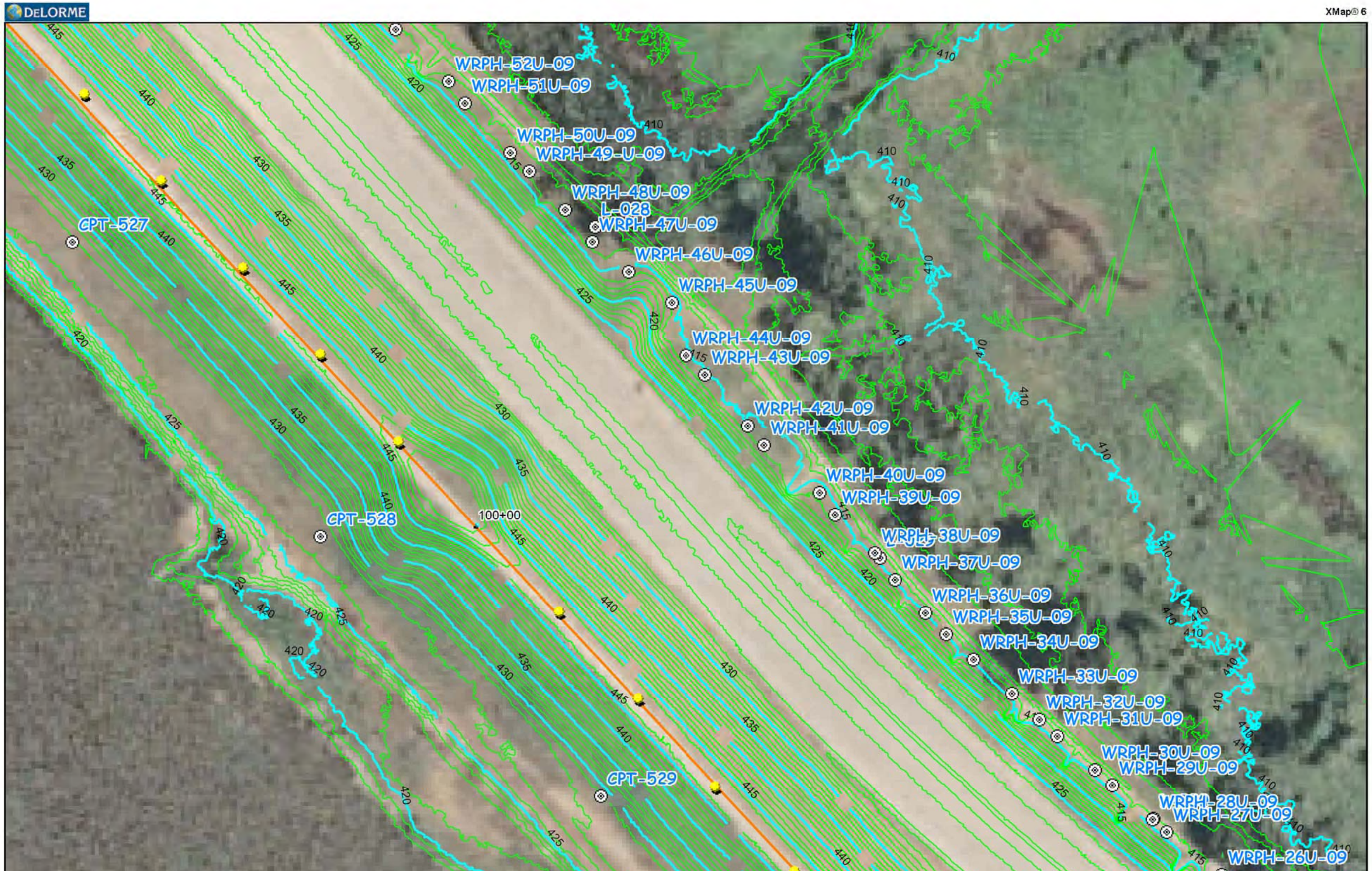
LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
BORING LOCATIONS

STA. 87+00-95+00

GEOTECHNICAL

DRAWING (E)A-3

DRAWING NUMBER



TN
MN (1.0°W)

Scale 1 : 900
1" = 75.0 ft
Data Zoom 17-0

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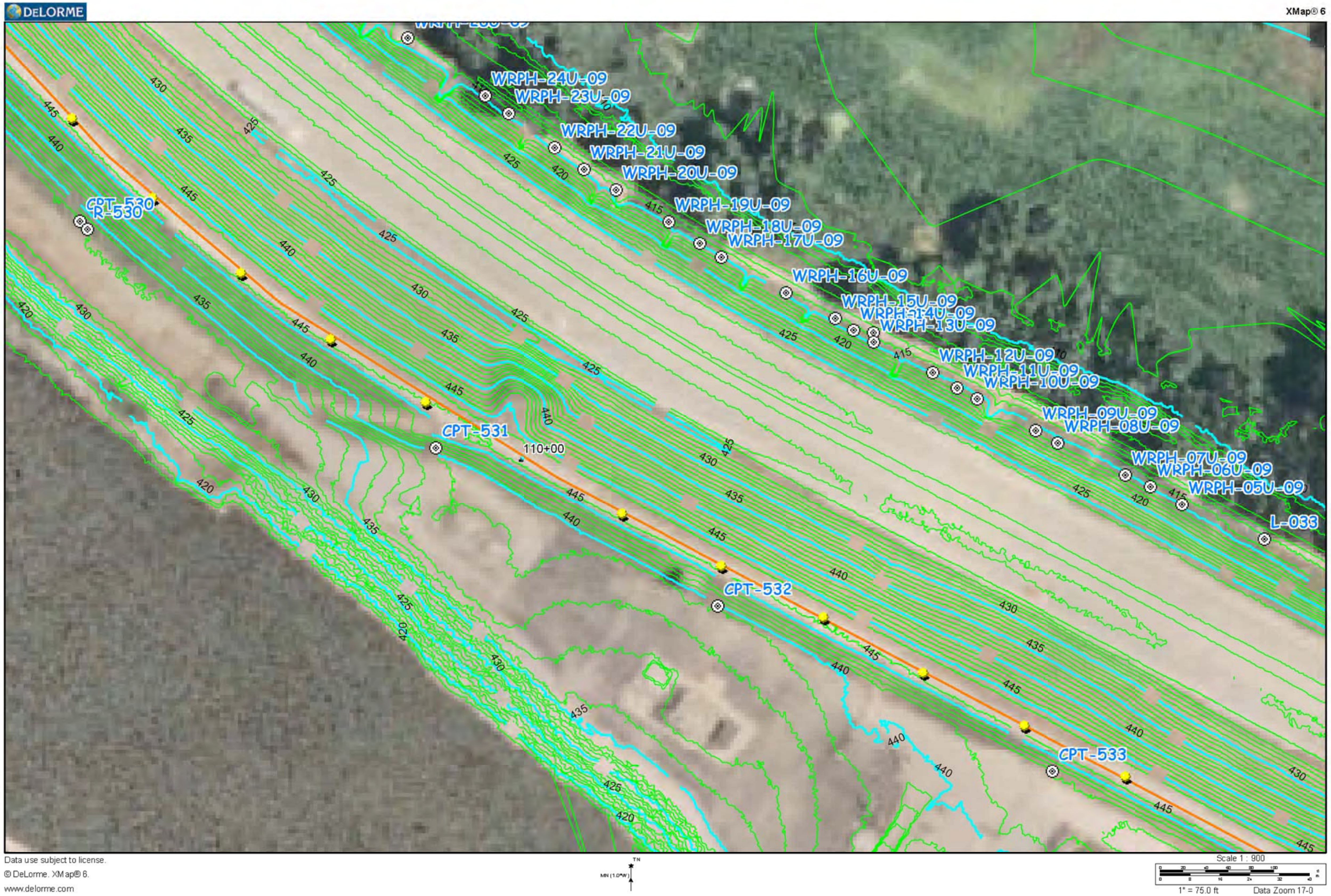
LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
BORING LOCATIONS
STA. 95+00-104+00
GEOTECHNICAL

DRAWING (E)A-4

DRAWING NUMBER



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CONTRACT NO.:
FILE NUMBER:
PLOT SCALE:
PLOT DATE:
SIZE:
FILE NAME:

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
BORING LOCATIONS

STA. 104+00-116+00

GEOTECHNICAL

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DRAWING NUMBER

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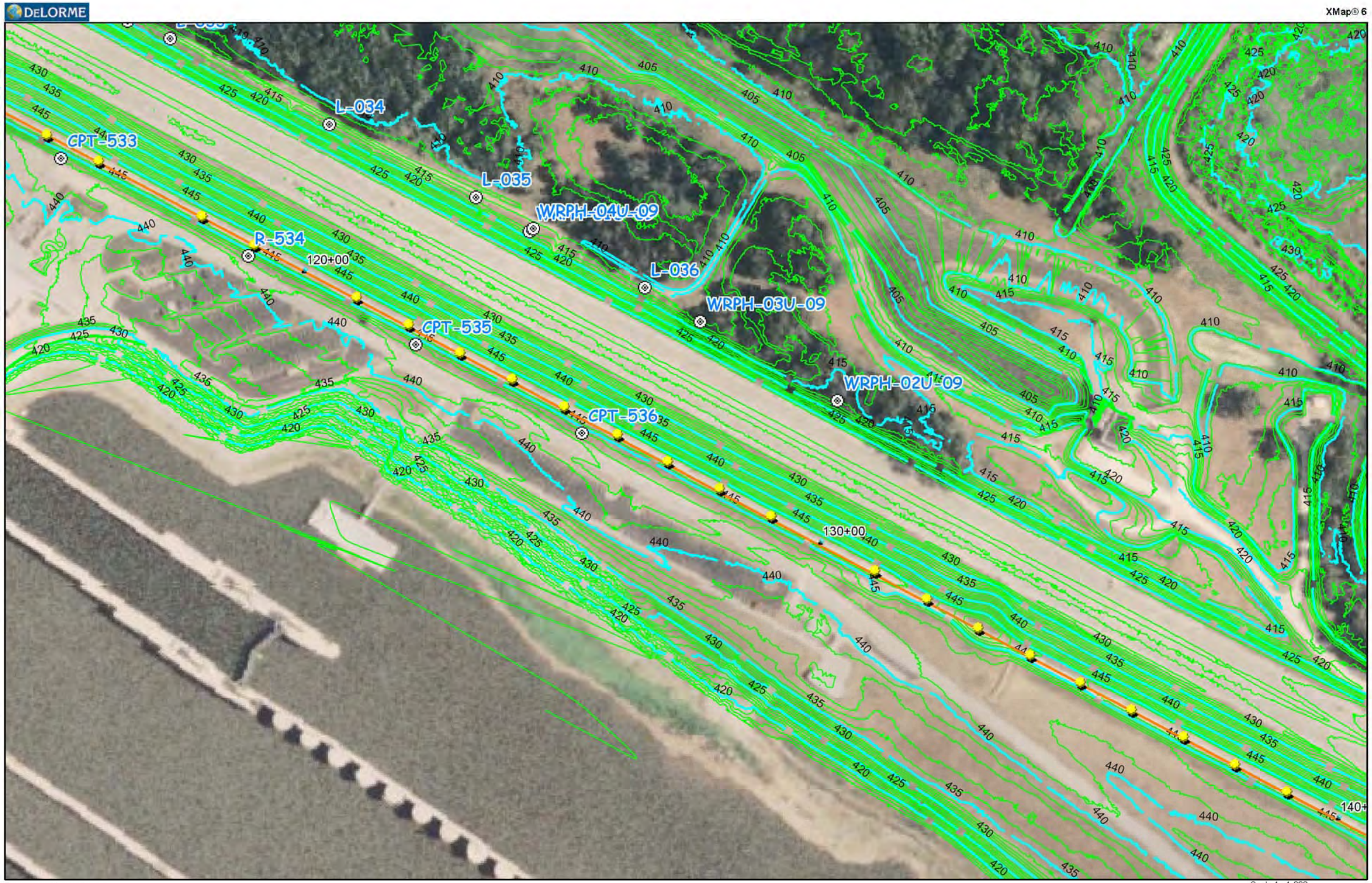
D C B A



TN
MN (1.0°W)

Scale 1 : 1,800
1" = 150.0 ft
Data Zoom 16-0

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CONTRACT NO.:
PLOT SCALE:
PLOT DATE:
FILE NUMBER:
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LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
BORING LOCATIONS

STA. 116+00-140+00

GEOTECHNICAL

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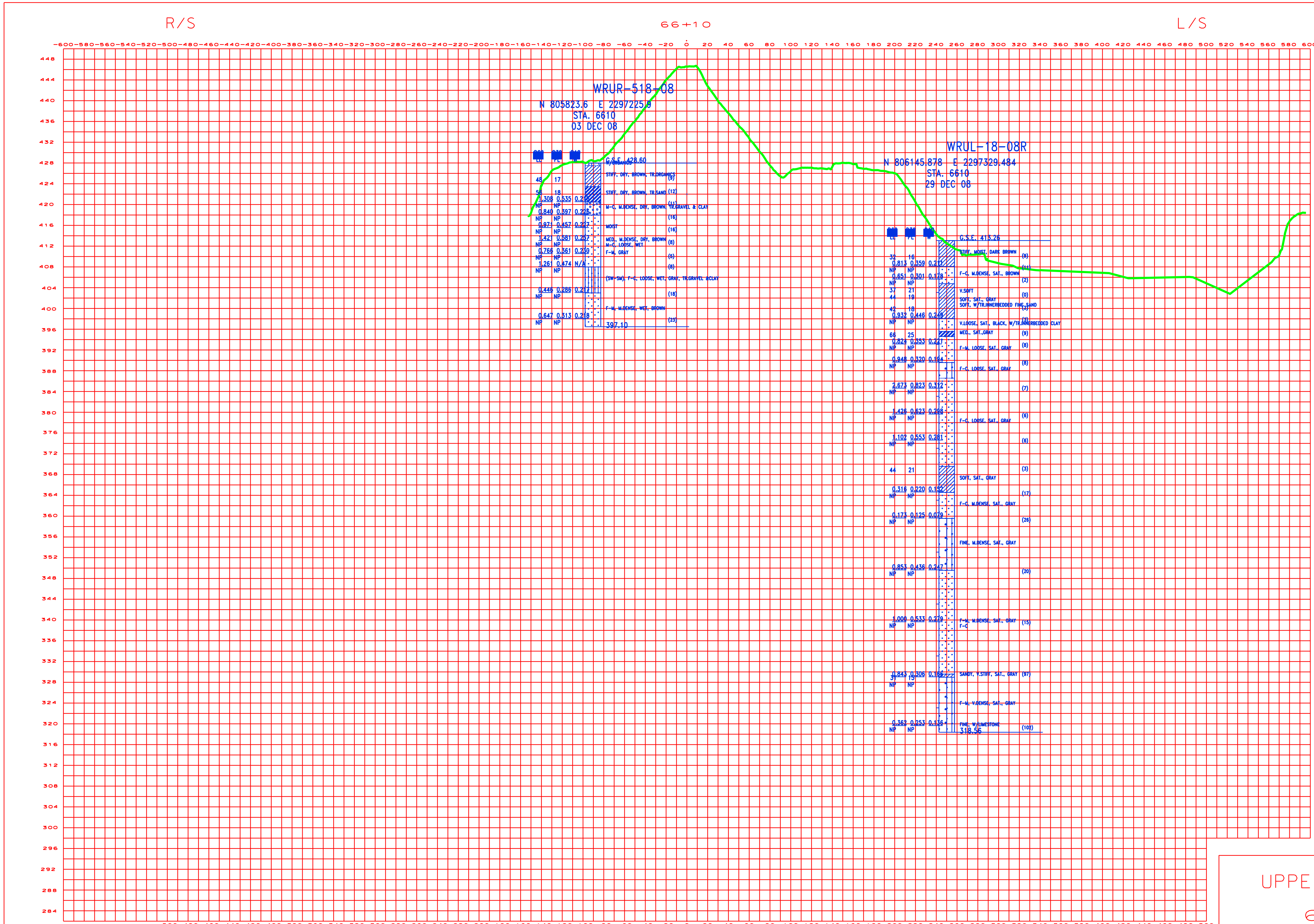

UPPER WOOD RIVER

66+10

Controlled Unclassified Information

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LOWER MISSISSIPPI RIVER

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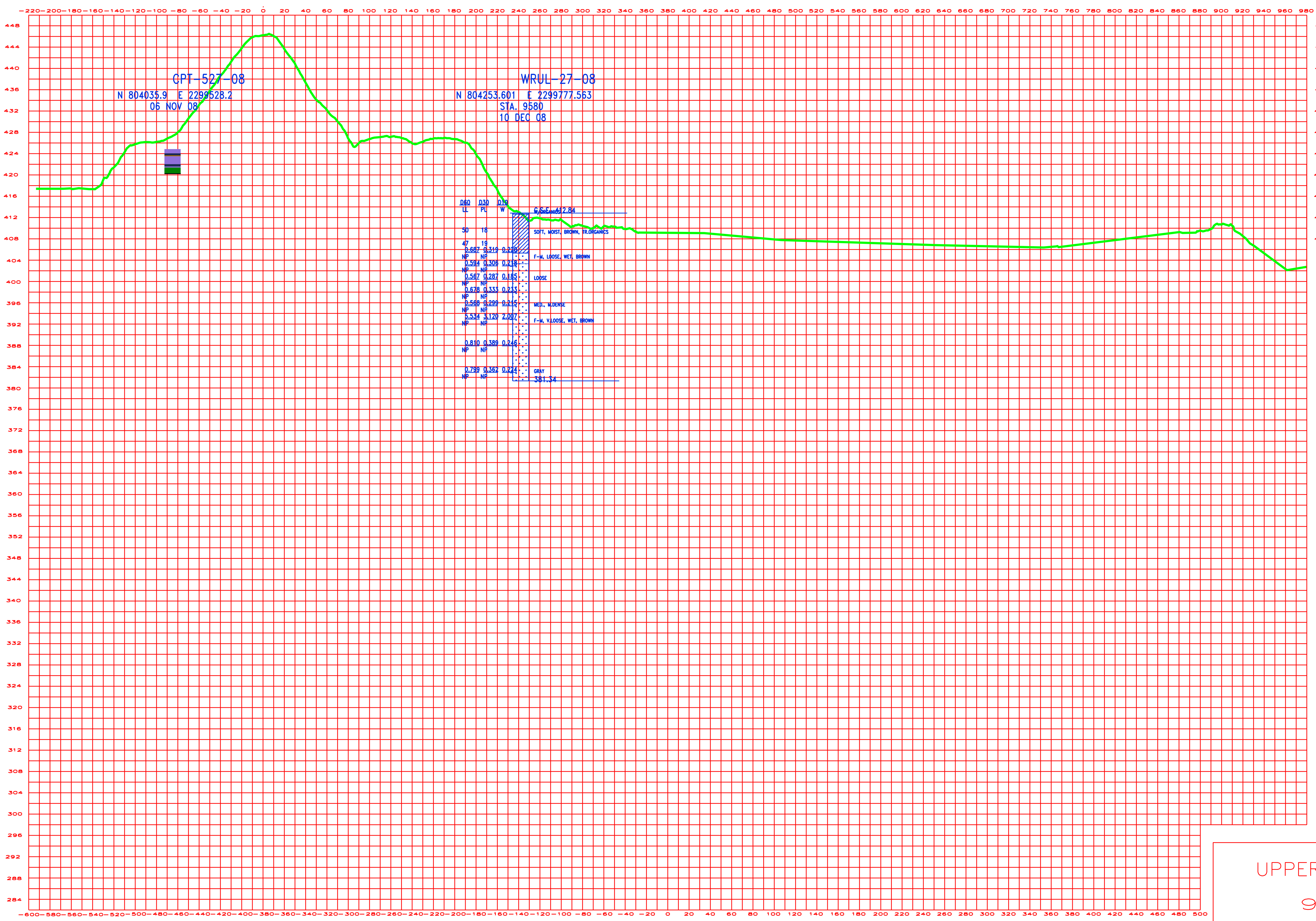
LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
CROSS SECTIONS

GEOTECHNICAL

DRAWING (E)A-10

DRAWING NUMBER



UPPER WOOD RIVER

95+80

UPPER FLANK

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CONTRACT NO.:
PLOT SCALE:
PLOT DATE:
FILE NUMBER:
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FILE NAME:

U.S. ARMY ENGINEERS DIVISION
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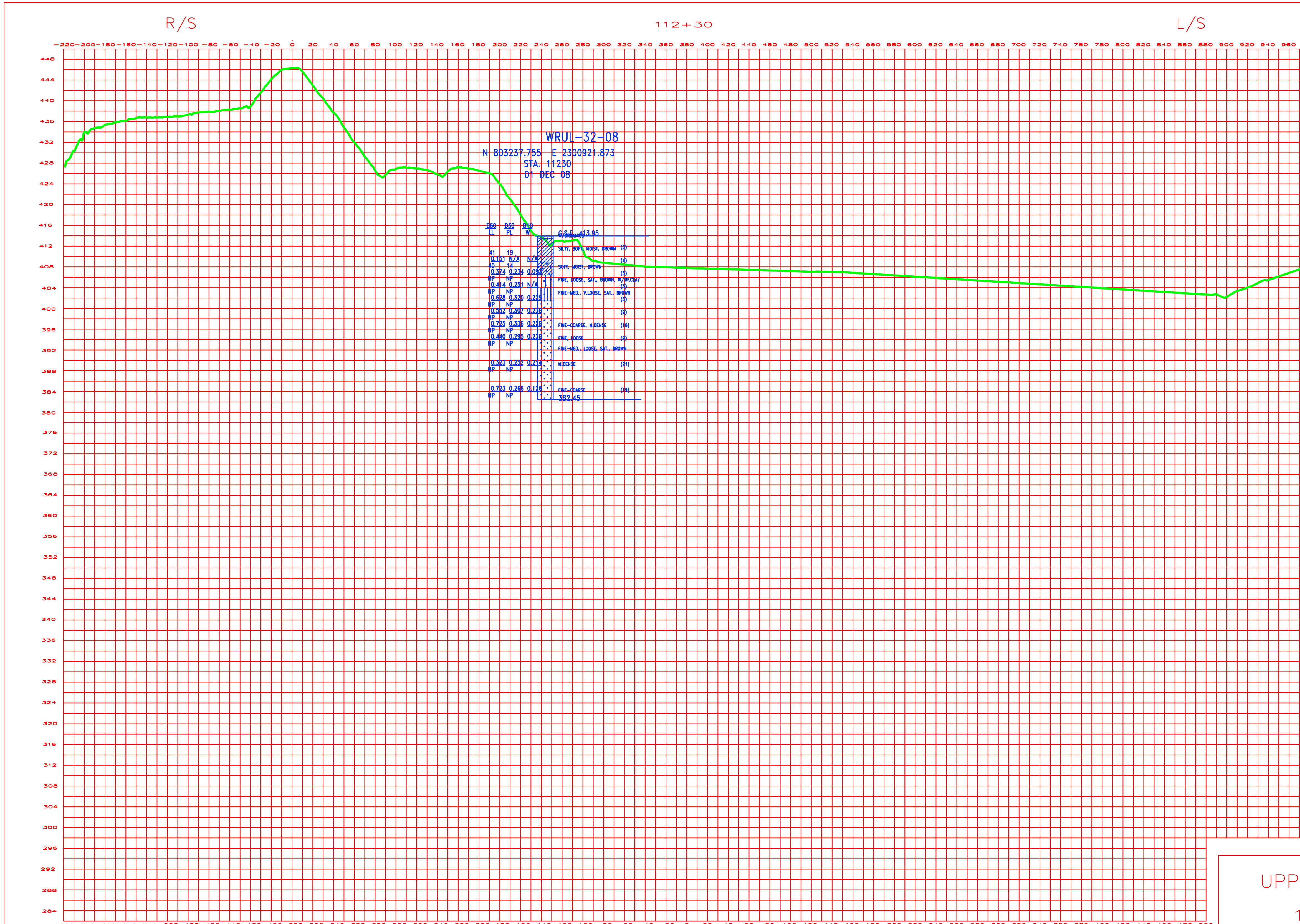
LOWER MISSISSIPPI RIVER BASIN
LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
CROSS SECTIONS

GEOTECHNICAL

DRAWING (E)A-18

DRAWING NUMBER



UPPER WOOD RIVER

112+30

UPPER FLANK

US Army Corps of Engineers
Saint Louis District

MARK | DATE | DESCRIPTION | APPR

DATE: OCTOBER 2010
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CONTRACT NO.:
FILE NUMBER:
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CKD BY: P.J.CONROY
SUBMITTED BY: P.J.CONROY
PLOT SCALE:
PLOT DATE:
SIZE:
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LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
CROSS SECTIONS

GEOTECHNICAL

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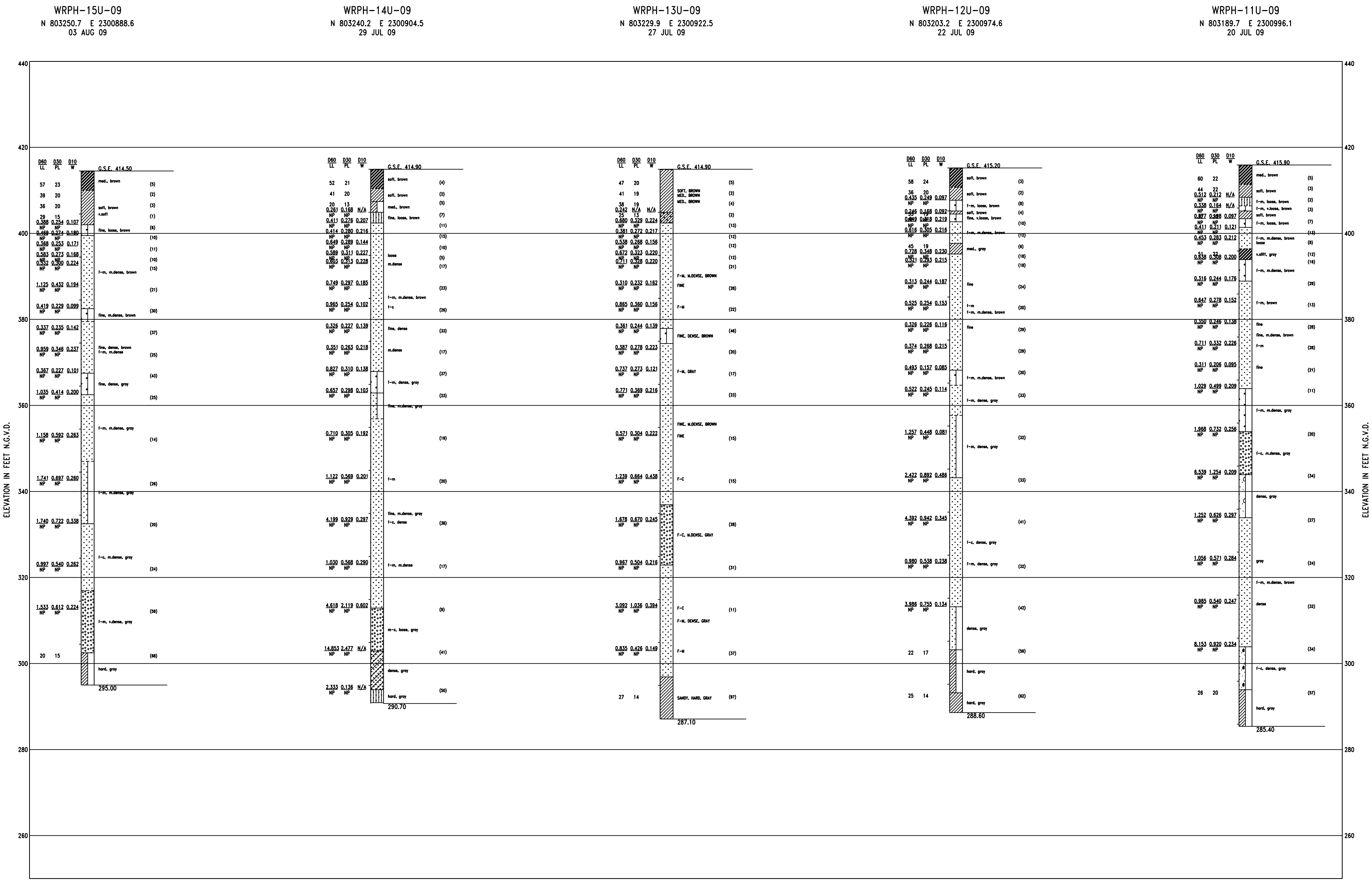

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SIZE:
FILE NAME:

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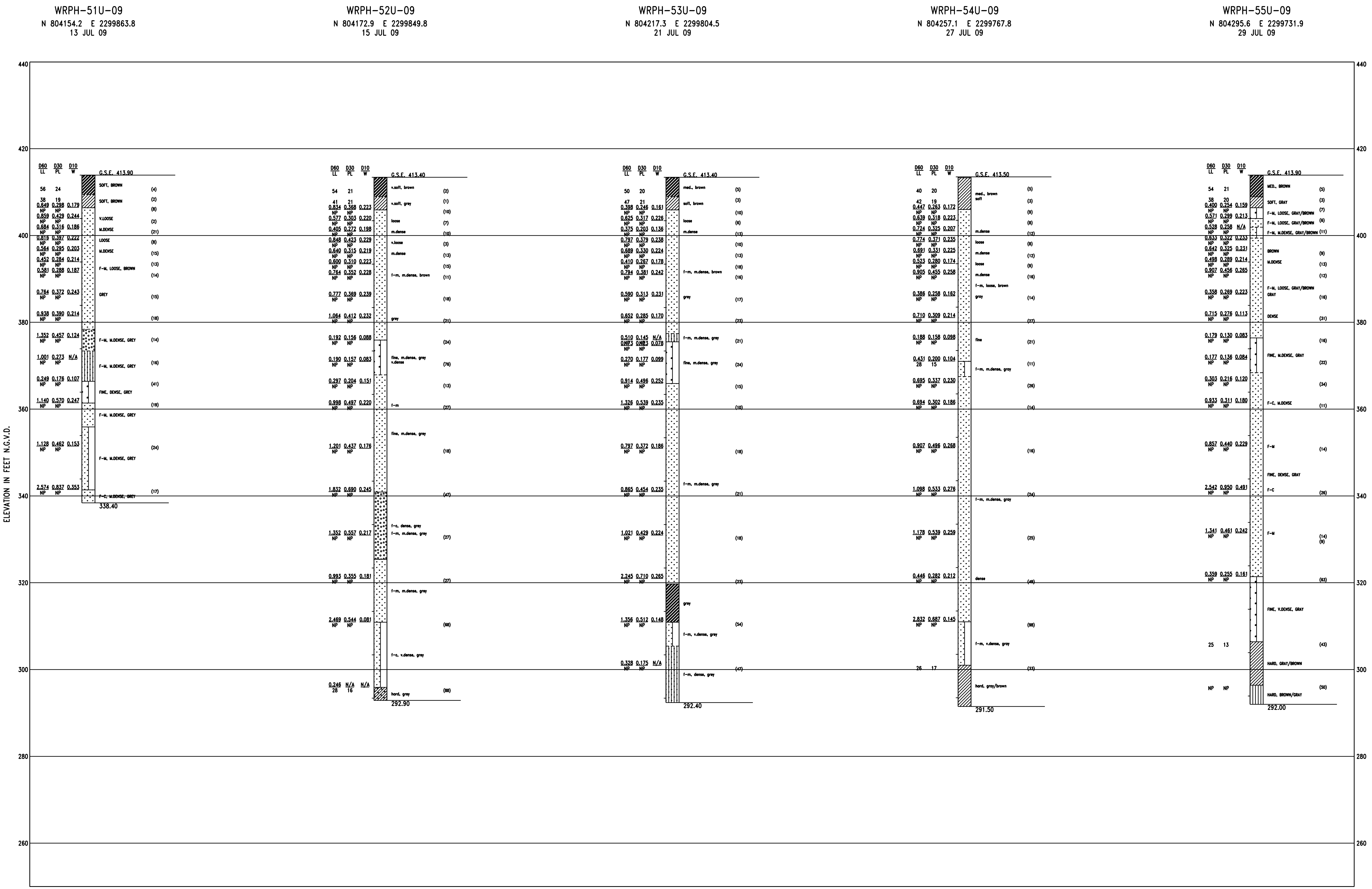
LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
PILOT HOLES 2008

GEOTECHNICAL

DRAWING (E)A-38

DRAWING NUMBER



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CONTRACT NO.:
FILE NUMBER:
PLOT SCALE:
PLOT DATE:
FILE NAME:
SIZE:

U.S. ARMY ENGINEERS DIVISION
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LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
PILOT HOLES 2008

GEOTECHNICAL

DRAWING (E)A-46

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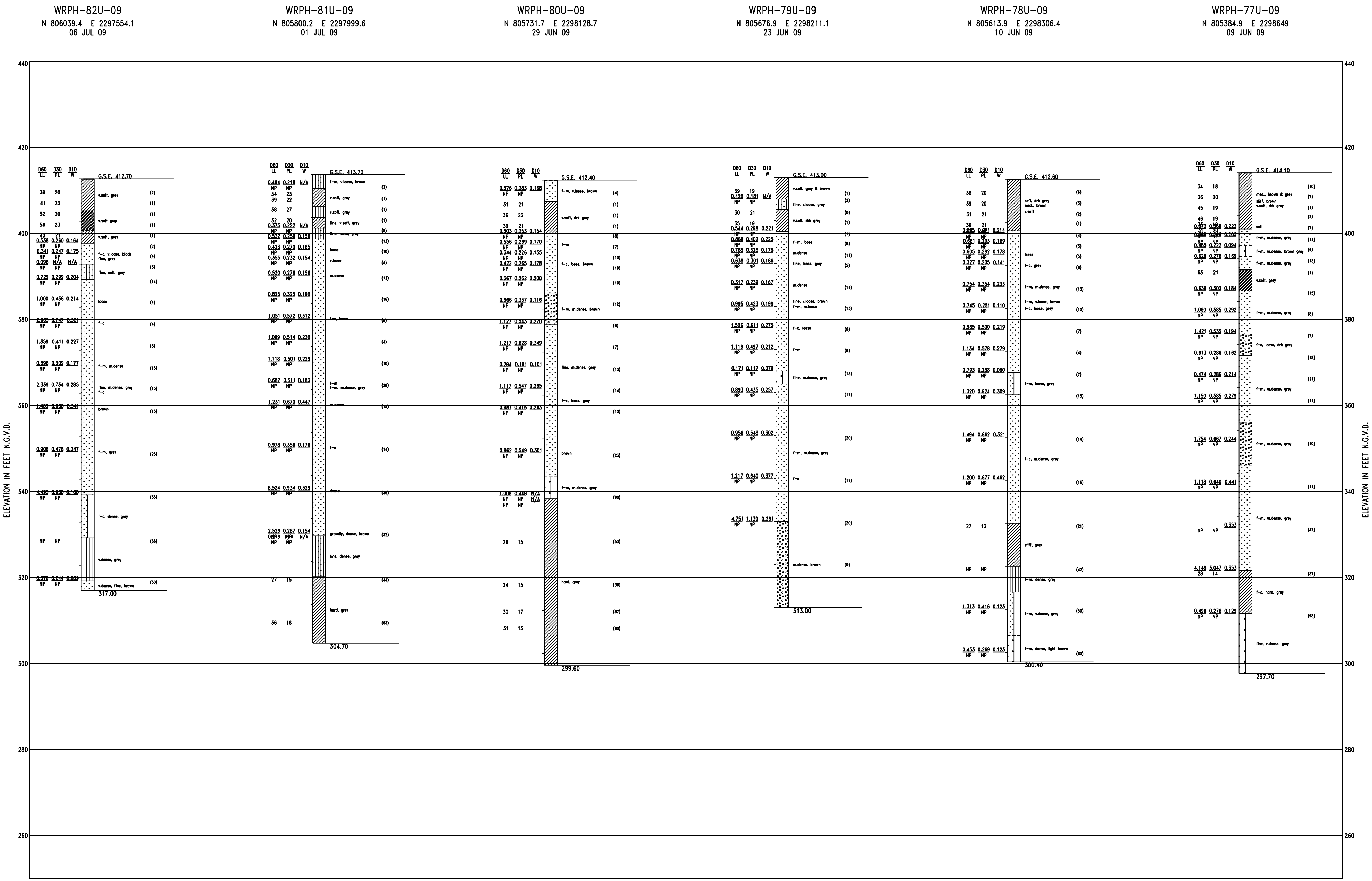

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PLOT SCALE:
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SIZE:

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LOWER MISSISSIPPI RIVER BASIN
LOWER MISSISSIPPI RIVER

LOWER MISSISSIPPI RIVER BASIN
WOODRIVER DRAINAGE AND LEVEE DISTRICT
PILOT HOLES 2008

GEOTECHNICAL

DRAWING (E)A-51

DRAWING NUMBER

LIMITED REEVALUATION REPORT
FOR
WOOD RIVER MEL PRICE UNDERSEEPAGE PROJECT

APPENDIX B

ECONOMICS

01. Introduction

This report addresses the National Economic Development (NED) *incremental* contributions of the Wood River Project components. In accordance with Engineering Regulation (ER) 1105-2-100, dated April 2000, an NED benefit-cost analysis is undertaken to assure that the value of the outputs (the NED benefits) produced by operation of the pump stations exceed the value of the inputs used (the NED cost).

Important assumptions employed in the NED evaluation of pump stations are:

(1) All benefits and costs are expressed in April 2011 price levels;
(2) The project period of evaluation is estimated to be 50 years with the appropriate operation, maintenance, repair, replacement and rehabilitation;
(3) Project discount rate for the evaluation of NED benefits and costs is 4.000 percent;
(4) All structural computations are based on industrial, commercial and residential depreciated replacement values;
(5) Resources have alternative uses and, consequently, opportunity costs;
(6) Individuals are risk neutral and rational economic agents;
(7) All elevations are expressed in feet and are understood to represent "Ft. NGVD" (Feet National Geodetic Vertical Datum 1929).
(8) This report has the critical assumption that the LRR for Wood River Underseepage (2011), correcting 2295 linear feet of underseepage at the northern reach of the Upper Wood River area will be constructed. This report will result in a correction to the remaining 7700 feet of levee currently experiencing extreme underseepage. The PUP values have been proportionally adjusted in both reports as to eliminate any double counting of benefits.

02. Purpose and Project Description

The purpose of this study is to examine the need for and feasibility of modifications to the Melvin Price Lock and Dam Project to correct an underseepage design deficiency. The study examines alternative ways to correct the design deficiency, assesses the environmental impacts of the alternatives and the tentative recommended plan, discusses various reviews of the planning effort (including public review and Independent External Peer Review comments), and will recommend a design deficiency correction project for implementation.

This Limited Reevaluation Report (LRR) evaluates the design deficiency associated with the uncontrolled underseepage and conveyance of material that is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular inspections and is normally covered by several feet of water. The district concludes that the uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam, two miles downstream from the original structure. This replacement resulted in a navigation pool raise that has impacted the levee foundation. It is unknown when this issue developed, however it appears to have persisted for a significant time.

Additionally, the degree of deterioration of the levee foundation is unknown. The Wood River Levee is at unacceptable risk during a high water event.

The Melvin Price Lock and Dam project includes one 1,200-foot lock, one 600-foot lock, a dam with nine tainter gates, an overflow dike, and a visitor center. Mitigation lands were provided to compensate for wildlife losses due to creation of a new pool for the two-mile distance downstream of the original structure. The Melvin Price Locks and Dam was constructed at river mile 200.8 and is 2.2 miles downstream from the original Lock and Dam No. 26. The permanent navigation pool is now located opposite of the Wood River Levee from levee stationing 0+00 to 115+00. The primary flood-related problem in the project area is the uncontrolled underseepage located in a section of the Wood River Levee from project station 0+00 to 115+00.

The Wood River Flood Damage Reduction Project consists of levee, gravity drainage structures, closure structures at railroad and highway crossings, pump stations, seepage control measures, and a low-water dam at the mouth of Wood River. The project as intended provides reduced inundation risk against a 52 foot Mississippi River stage on the St. Louis Gage. In addition to providing reduced damages to the land side area, the levee structure is a part of the containment features for the Melvin Price Locks and Dam Project.

Uncontrolled underseepage and conveyance of material is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular inspections and is normally covered by several feet of water. During the flood of 1993, the area adjacent to the upper pool of Melvin Price Locks and Dam was kept flooded by the Wood River Drainage and Levee district per its established operation plan. The interior ponding was to an elevation no lower than about elevation 410. This interior water prevented the flood fight teams from noticing or observing any seepage activity in the area. A catastrophic failure on the Upper Wood River Levee due to Mel Price / Wood River area underseepage could also impact the Lower Wood River Levee, while the Lower Wood River Levee could impact the downstream levee (East St. Louis).

The purpose of this economic analysis for this LRR is to address the economic feasibility of a design deficiency correction designed to correct the current unacceptable risk associated with the Wood River Levee system.

03. <u>Structure Inventory Methodology</u>

Structure inventory methodology, data and content valuation are taken from the March 2007 Wood River Levee System General Re-evaulation Report (hereto: GRR), specifically the Lower and Upper Wood River reaches, updated to current price levels via Corps of Engineers' Engineering Manual (EM) 1110-2-1304, the Civil Works Construction Cost Index System (CWCCIS) (31 March 2010). In this section of the analysis, the methodology used to compile an inventory of the residential, commercial, and industrial structures in the study area will be discussed. Only the information pertaining to the Upper Wood River area was used in this report, therefore no residential structures were impacted. The methods used in the valuation of these structures, their contents, and the vehicles associated with these structures will be presented. Finally, the procedures used to assign elevations to the structures, contents, and vehicles will be provided. The uncertainty inherent in the methods used to estimate each of these economic variables is addressed by the risk-based analysis included in this section of the report.

The Wood River project area was divided into three study area reaches. Structures at risk were defined as those structures that would flood by the stage associated with a 700-year event provided by the St. Louis District Hydraulics and Hydrology (H&H) Branch. The structural damage categories included: commercial, industrial, and vehicles. Aerial photographs provided by the St. Louis District were used to identify each of these structural damage categories in the Wood River Project area.

Field surveys conducted in 2002 were used to develop a structure inventory for each of the three (3) reaches in the Wood River study area (This report only addresses the Upper Wood River reach). Data was collected on all of the commercial properties and smaller industrial structures within the Upper Wood River study area. Structural information obtained during the field surveys included type of structure, number of stories, type of foundation and construction, structure dimensions, physical condition of the structure, and the location. Based on the structural information collected during the field surveys, the Marshall and Swift Evaluation Service (M&S) was used to calculate the depreciated replacement cost for and commercial structures. The value of the land was not included in the analysis.

Commercial structures were classified into one of eight (8) building types including: eating and recreation, groceries and gas stations, multi-family complexes greater than five (5) units, professional, public and semi-public, repairs and home use, retail and personal, and warehouses and contractor services.

Large industrial complexes containing several structures within a confined area were inventoried using Office of Management and Budget (OMB) approved survey forms. The survey was used to determine the depreciated replacement value of the structures and their contents, and vehicles. A complete description of the procedures used to value all the residential, commercial and industrial structures is included in the Wood River Inventory Procedures Final Report dated April 2003.

Table 1 shows the number and value of residential, commercial, and industrial structures for the Upper Wood River Levee areas.

Table 1* Mel Price / Wood River Underseepage Design Deficiency Project Structure Inventory					
Area	**Building Category**	**Number of Buildings**	**Average Value of Buildings ($) (2006)**	**CWCCIS ** Factor 19 Buildings**	**Average Value of Buildings ($) (2010)**
Upper Wood River	**Residential**	0	$0		$0
	Commercial	59	$1,675,980		$1,913,531
	Industrial	29	$7,631,884		$8,713,615
	Total	88	n /a	1.1417	n /a

*** Total structural value of residential, commercial, and industrial buildings inventoried in the study area is approximately $365 million.**
**** Index Q2-2006: 638.50**
**** Index Q3-2011: 729.00**

Estimates of Measurement Uncertainty. In order to determine the uncertainty associated with the residential and commercial structure valuation process discussed previously, detailed field surveys were used to determine the Marshall and Swift (M&S) values for a sample of fifteen (15) residential and fifteen (15) commercial properties in the study area. These precise values were then compared to the M&S values compiled using the square footage of a structure assigned in the GIS database. The uncertainty regarding the square footage of the residential and commercial structures was represented by a normal probability density function with a standard deviation of 11.3 percent for residential structures, and 26.1 percent for commercial structures. An uncertainty range was not assigned to the value of the structures on the industrial complex. The facility operators provided the value of these buildings.

Content Valuation. The IWR report (Depth Damage Functions for Corps of Engineers Flood Damage Reduction Studies) did not address commercial content values; therefore information gathered for the New Orleans District in support of recent feasibility studies was utilized. Since the urbanized areas of the Wood River study area contained a similar mix of commercial structures as in Jefferson and Orleans Parishes, these assignments were deemed appropriate. The value of contents for commercial properties was determined from on-site interviews with business operators of eight (8) commercial content categories in Jefferson and Orleans Parishes of southern Louisiana. The content-to-structure value ratios (CSVRs) developed for each of the eight (8) commercial content classifications can be found in the final report dated June 1996 entitled Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-To- Structure Value Ratios (CSVRs) in Support of the Jefferson and Orleans Flood Control Feasibility Studies.

The operators of the industrial facilities located in the Wood River study area provided the value of the contents for each structure located on their industrial complex. The values of the contents of each structure was totaled and then compared to the total value of the structure in order to develop a content-to-structure value ratio. If the content information requested was not provided then an average CSVR for all surveyed warehouses was used and applied to the value of the industrial building in order to calculate the value of the contents.

Estimates of Measurement Uncertainty. A probability distribution function was used to describe the distribution of surveyed content value observations around the expected mean content value. A normal probability density function was used for each of the residential and commercial content categories. The expected values and standard deviations are shown for each of the seven (7) residential categories in the IWR Report. Also, the eight (8) non-residential content categories are shown in the final report dated June 1996 entitled Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-To-Structure Value Ratios (CSVRs) in Support of the Jefferson and Orleans Flood Control Feasibility Studies. An uncertainty range was not assigned to the content value of the structures on the industrial complex. The facility operators provided the value of the contents for these buildings.

Inventory of Vehicles. Damages to vehicles can also result from flooding in the study area. These damages are based on the number of vehicles such as pick-up trucks and panel trucks associated with large industrial complexes which were provided by the industrial facility operators on the OMB survey forms. Based on field observation, collected data, and photographs, it was estimated that the average elevation of automobiles was two feet below the first floor elevation of the structure. Automobile damages are then calculated by correlating depth of flooding, depth-damage per automobile, and damage per inundated automobile.

Estimates of Measurement Uncertainty. A triangular probability distribution function was used to determine the uncertainty surrounding the values assigned to the private automobiles in the inventory. The most likely value is $9,128, based on the Manheim Used Vehicle Value Index. The index is based on over 4 million transactions annually at Manheim U.S. auctions. The maximum value was assumed to be the average value of a new car before taxes, license, and shipping charges ($16,800). The average 10-year depreciation value of an automobile ($2,000) was used as the minimum value. An uncertainty range was not assigned to the value of the vehicles associated with the industrial facilities. The facility operators provided the value of these vehicles.

Structure and Vehicle Elevations. Approximately 600 surveyed spot elevations with (x,y) coordinates were collected throughout the study area. These spot elevations and coordinates were entered into a GIS database together with other available contour information from USGS quad maps. These elevations were used to assign ground elevations to the residential structures in the sample and to each of the commercial and industrial structures. The spot elevations were selected in locations that would enhance the accuracy of the ground elevation assignments. Hand levels were used to estimate the height above ground of the first floor of each surveyed structure. Based on field observation and photographs taken in the field, the elevation of the garage in relation to the structure, it was estimated that the average elevation of automobiles was two feet below the first floor elevation of the structure. Since industrial facility operators did not provide elevations for trucks and heavy vehicles they were assumed to have the same elevation as the adjacent industrial structure.

Estimates of Measurement Uncertainty. Engineering surveys were used to determine the actual first floor elevation for a sample of 30 structures, and these first floor elevations were then compared to the elevations estimated using the procedures discussed in the previous section. Based on this comparison, a normal probability density function was used to describe the uncertainty associated with this variable. A standard deviation of 1.1 feet was calculated for first floor elevation assignments.

04. Stage-Damage Relationships for Residential, Commercial and Industrial Structures with Uncertainty

Computation of stage-damage relationships for all structure inventory methodology and data, content valuation, plus relevant probabilities of unsatisfactory performance (PUP) are taken from the March 2007 Wood River Levee System General Re-evaulation Report (hereto: GRR), specifically the Lower and Upper Wood River reaches, updated to current price levels via Corps of Engineers' Engineering Manual (EM) 1110-2-1304, the Civil Works Construction Cost Index System (CWCCIS) (30 April 2011).

General. In order to calculate the damages from the inundation of structures, their contents, and vehicles that would occur at each stage, three relationships were developed for this analysis: depth-damage relationships, stage-frequency relationships, and levee system failure probabilities. The depth-damage relationship is the amount of damage that will occur to structures, their contents, and vehicles as the elevation of the water or stage rises. The stage-frequency relationship is the probability of the water stages reaching various levels for each hydrologic reach. The probability of levee system failure is the probability of the levee system failing as the water level rises.

The uncertainties associated with the development of these relationships are addressed by risk-based analysis. A range of possible values, with a maximum and a minimum value, or a standard deviation, was calculated for each economic variable (structure and content values, first floor elevation, and depth-damage relationships). These statistics were entered into the Hydrologic Engineering Center's Flood Damage Analysis Program (HEC-FDA) to calculate the uncertainty or error surrounding the elevation- or stage-damage curves (shown in Table 2). The program also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-frequency curves and the probability of levee system failure as the stages increased. The possible occurrences of each variable were derived through the use of Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, the computerized Latin Hypercube sampling technique was used to sample from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results.

The sum of all sampled values divided by the number of samples yielded the expected value, or mean. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes.

Table 2* Stage-Damage Relationships For Wood River Levee System (Without Project Condition)							
Exceedance		Damage by Category ($000)					
Upper Wood River							
Probability	Stage	Residential	Auto	Commercial	Industrial	Public	Total
0.25	424.0	0	2	87	17	0	106
0.1	427.0	0	93	32,908	847	0	33,848
0.05	430.0	0	399	74,850	2,437	0	77,685
0.02	434.0	0	645	86,367	4,125	0	91,137
0.01	436.0	0	1,412	117,255	5,633	0	124,299
0.005	438.0	0	2,327	137,040	13,659	0	153,026
0.004	439.0	0	2,435	142,634	21,957	0	167,027
0.002	441.0	0	2,460	155,222	39,056	0	196,738

*HEC-FDA output
**In 2008 a 10-year event triggered the Emergency Operations Plan at Mel Price which currently operates 12 months of the year at stages beginning at normal pool (elevation 419 feet). Using the technique of proportionally reducing the PUPs to eliminate double counting, the HEC-FDA program indicates there is no economic benefit a 10 year event. Without the Emergency Operations Plan (involves pumping and maintaining a landside pond) the underseepage would be completely without control and would likely result in much higher economic damages below a 10-year event.

05. Analysis of the Underseepage Project

Melvin Price Lock and Dam includes one 1,200-foot lock, one 600-foot lock, a dam with nine tainter gates, an overflow dike, and a visitor center. Mitigation lands were provided to compensate for wildlife losses due to creation of a new pool for the two-mile distance downstream of the original structure. The Melvin Price Locks and Dam was constructed at river mile 200.8 and is 2.2 miles downstream from the original Lock and Dam No. 26. The permanent navigation pool is low located opposite of the Wood River Levee from levee stationing 0+00 to 115+00. The primary flood-related problem in the project area is the uncontrolled underseepage located in a section of the Wood River Levee from project station 0+00 to 115+00.

Probability of Unsatisfactory Performance. The purpose of identifying any quantifiable Probability of Unsatisfactory Performance (PUP) points is to generate a range of water surface elevations for the Wood River underseepage for which it is presumed that the probability of levee failure increases as water surface elevation increases. The requirement that, as the water surface elevation increases the probability of failure increases, incorporates the reasonable assumption that as the levee becomes more stressed, the levee is more likely to fail. These PUP calculations indicate the formation of sand boils which lead to an increased risk of failure. Since current geotechnical policy prevents the calculation for the probability of failure, these values were used to calculate the economic impacts.

The District geotechnical branch calculated PUPs due to underseepage for the Upper Wood River area. These PUPs are used to compute the existing reliability of the underseepage affected section of the Upper Wood River Levee and are calculated based on 2 cross-sections in this levee area. These values were combined to provide a representative value of the levee. The PUPs used for this report are significantly higher than what was seen in the 2007 Wood River Levee System GRR. These values are supported by additional borings and investigations that were done during the construction of the GRR improvements and are supported by observed conditions of underseepage in the field.

The Upper Wood River PUPs were calculated using two different sections of the levee. These values were then combined proportionally. This was done because of the ongoing Wood River LRR (2010) which is correcting 2995 linear feet of deficient levee, while this report is addressing a separate 7700 foot section. Also, to avoid double counting benefits between the two reports, each report assumes the other project will be constructed. In order to account for this, the Without Project PUPs were reduced proportionately to account for the completion of correction by the other project. The PUPs used for determining the economic benefits in this report are 72% (7700 feet) of the total value, as this report addresses 72% of the deficient levee.

Table 3* Probability of Unsatisfactory Performance (PUP) For Wood River Levee System (Without Project Condition)	
Exterior Stage	Levee System PUP*
Upper Wood River - River Mile 201	
420.7	0.38
425.7	0.44
427.8	0.54
430.3	0.60
442.9	0.64
443.8	1.00
**PUP is Probability of Unsatisfactory Performance; i.e. a probability of failure at that return period/water surface elevation*	

Implementation of the project alternative would effectively reduce the PUPs due to underseepage to zero (0.0001, a 1 in 10,000 probability), as presented in Table 4. Based on current calculations by the Geotechnical Branch, it is assumed that the current issues resulting in high PUPs will be corrected upon implementation of the corrections in this report.

Table 4* Probability of Unsatisfactory Performance (PUP) For Wood River Levee System (With Project Condition)	
Exterior Stage	Levee System PUP*
Upper Wood River - River Mile 201	
420.7	0.0001
425.7	0.0001
427.8	0.0001
430.3	0.0001
442.9	0.0001
443.8	1.0000
**PUP is Probability of Unsatisfactory Performance; i.e. a probability of failure at that return period/water surface elevation*	

06. Benefit and Cost Analysis

Flood Damage Reduction Benefits. The NED plan reasonably maximizes average annual net national economic development benefits, consistent with a federal objective for maximizing economic benefits. The NED plan should be formulated using four criteria; (1) completeness; (2) effectiveness; (3) efficiency; and (4) acceptability.

Conditional Probability of Design Non-Exceedance for the underseepage project Alternative, are presented in Table 5. For example, the probability of non-exceedance for the 0.2 percent (500-year) flood event for Upper Wood River Levee given the with-project Alternative (e.g. the probability of the with-project Alternative containing the 0.2 percent flood event for Upper Wood River Levee) is estimated at 90.02 percent. This can also be stated as "the reliability of the with-project Alternative containing the 0.2 percent flood event for Upper Wood River Levee is estimated at 90.02 percent."

Table 5*
Probability of Design Non-Exceedance
Without and Future-With-Project Condition
Wood River Levee

		Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Probability of Design Containing Indicated Event					
Underseepage Project	**Target Stage**	**Median**	**Expected**	**10**	**30**	**50**	**10.00%**	**4.00%**	**2.00%**	**1.00%**	**0.40%**	**0.20%**
Without-Project Upper Wood River	443.8	21.592%	21.414%	91.02%	99.76%	100.00%	49.32%	40.11%	38.45%	38.17%	37.11%	34.27%
With-Project Upper Wood River	443.8	0.034%	0.041%	0.41%	1.02%	2.02%	100.00%	100.00%	100.00%	99.96%	97.37%	90.02%

*HEC-FDA Output

Expected Annual Inundation Damage Reduced and Distributed for the Upper Wood River Levee System are presented in Table 6.

Table 6
Expected Annual Inundation Damage Reduced and Distributed for Wood River Levee*

By Reach and Total	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
	Total Without Project	Total With Project	Damage Reduced (Benefits)	0.75	0.5	0.25
Upper Wood River	$6,773,930	$154,760	$6,619,170	$4,253,490	$6,277,960	$8,627,880

** Price level: April 2011; Discount Rate:4.000%; Evaluation Period: 50 years*

Please note expected annual damages, damages prevented, and damages reduced (benefits) are equal for all three (3) Alternatives (Slurry Trench Wall with Relief Wells, Berms with Relief Wells, Berms), as implementation of any of the three Alternatives is assumed to provide the same level of with-project condition underseepage design deficiency correction.

Operations Plan Benefits. In 2008, a 10-year equivalent flood caused severe underseepage problems and resulted in the creation of an Emergency Operations Plan to ensure the levee would remain safely in-tact until the completion of the construction resulting from this report. This plan combats the current underseepage issues by controlling the elevation of a landside pond. The operation of this emergency plan has resulted in many incremental actions, triggered by increasing river elevations. This plan has real, ongoing, annual costs ranging from river elevations of 419 feet (normal pool), to 432 feet which is equivalent to about a 37-year event.

The baseline of the plan is a $41,600 annual cost as this operation is ongoing through all 12 months of the year. This requires the pond to have a maintained landside elevation of 408 feet and weekly monitoring of the sand boils. Each increment requires increased landside ponding up to 415 feet. To continue to combat the force of the river during high water events, pumping is required in an increasing degree so that river elevations higher than 430 feet will require submersible pumps in the relief wells so that the maximum amount of underseepage can be alleviated. This project will eliminate the need for this emergency operations plan and has an economic benefit of an estimated $89,140 per year. These results are presented in table 7.

Table 7* Emergency Operations Plan Benefits For Upper Wood River Levee ($)				
Without Project				
Stage	Flood Frequency	Operations Plan Cost	Cost Per Event	Expected Annual Cost
419.0	0.9999	$41,600	$41,596	
420.5	0.5000	$206,751	$103,376	$36,236
422.5	0.3030	$407,674	$123,538	$22,347
424.5	0.1818	$978,750	$177,955	$18,272
427.5	0.0855	$451,584	$38,597	$10,432
432.0	0.0272	$473,700	$12,907	$1,499
				$352
			AA Cost	**$89,000**
With Project				
Stage	Flood Frequency	Operations Plan Cost	Cost Per Event	Expected Annual Cost
419.0	0.9999	$0	$0	
420.5	0.5000	$0	$0	$0
422.5	0.3030	$0	$0	$0
424.5	0.1818	$0	$0	$0
427.5	0.0855	$0	$0	$0
432.0	0.0272	$0	$0	$0
				$0
			AA Cost	**$0.00**
			AA Benefit**	**$89,000**
*Closure costs were provided by the Project Manager and are in 2011 thousands of dollars **AA Benefit is the elimination of the current Emergency Operations Plan				

<u>Navigation Benefits</u>. This Mel Price project's main benefit is derived from the potential loss of navigation on the Mississippi River. Once constructed, the highest risk section (7700 linear feet) will be corrected and greatly reduce the potential loss of navigation. This Wood River report (2011) is another ongoing report that focuses primarily on the Lower Wood River area, but is also addressing 2995 linear feet along the northern section of the Upper Wood River area. If this section is not repaired, there is still a low level risk for the loss of use of this lock. This Mel Price report addresses the highest risk section of 7700 linear feet.

An initial levee breach would only delay navigation for 3 days as time would be needed for the pool to equalize with the main river. The much more significant risk is that the lower flank was not designed to keep water in, or maintain pool. If the Upper Wood River area was to fill with water, stress levels would be extreme on the lower flank, providing an opportunity for a failure below the Mel Price Lock and Dam. This lower flank failure would effectively create a side channel around the dam, causing a loss of pool and the ability for navigation. If this were to occur, a coffer dam would need to be built to allow for the levee to be repaired. Once this coffer dam was constructed, it would allow for the pool to be maintained once more. Based on previous contract information, district engineers were able to determine a coffer dam of this size would need 12 months for construction, resulting in a river closure time of 12 months. Table 8 shows the navigation benefits associated with this project. This project results in an average annual navigation benefit of about $7,385,970. The remainder of the navigation benefits is being claimed in the Wood River Mel Price Underseepage report (2011).

Table 8* Navigation Benefits For Upper Wood River Levee ($000)						
Without Project						
Stage	Flood Frequency	Levee PUP	Flank*** Levee PUP	12 month Closure Cost	Cost Per Event	Expected Annual Cost
432.0	0.0272	0.60	0.00	$0	$0	
433.2	0.0201	0.62	0.18	$1,047,524	$117,296	$418.0
441.9	0.0015	0.64	0.91	$1,047,524	$608,370	$6,756.2
443.8	0.0008	1.00	1.00	$1,047,524	$1,047,524	$579.6
						$838.0
					AA Cost	**$8,600**
With Project						
Stage	Flood Frequency	Levee PUP	Flank*** Levee PUP	12 month Closure Cost	Cost Per Event	Expected Annual Cost
432.0	0.0272	0.0001	0.00	$1,047,524	$0	
433.2	0.0201	0.0001	0.18	$1,047,524	$19	$0.1
441.9	0.0015	0.0001	0.91	$1,047,524	$95	$1.1
443.8	0.0008	1.0000	1.00	$1,047,524	$1,047,524	$366.7
						$838.0
					AA Cost	**$1,200**
					AA Benefit**	**$7,400**

*Closure costs were calculated for the Inland Navigation Lock Projects Estimations of Value and Main Chamber Closure Costs (March 2009) and are shown here in April 2011 dollars
**AA Benefit is the reduction in the risk of navigation delays
***Flank Levee PUPs were pulled from the Wood River GRR and are based on a representative cross-section of the levee.

Construction First Costs and Interest During Construction

Construction first costs and interest during construction (IDC) are determined. For this project, there are mitigation costs associated with the Interim Risk Reduction Measures (IRRM) that will be incurred regardless of the alternative chosen for implementation. These IRRM mitigation costs are considered financial costs for the project (and are therefore included in the implementation costs) but are not considered economic costs and are therefore not included in the economic analysis. The construction first costs cited in Table 9 do not include the IRRM mitigation costs.

In calculating IDC, interest is charged for each month funds are expended during the construction period due to the time value of money and project construction preventing alternative uses of such funds. A three-year construction period is assumed for underseepage correction. The mid-month convention is assumed for the construction period.

Average annual costs are subsequently calculated for construction first costs, interest during construction, and all operation, maintenance, repair, replacement and rehabilitation (OMRR&R) costs. The O&M costs necessary to maintain full reliability of the relief wells required for all three alternatives are based on O&M costs per relief well computed for the Limited Reevaluation Report (LRR) on Design Deficiency Corrections for East St. Louis, IL Flood Protection Project (August 2010).

Construction first costs, interest during construction, total investment (construction first costs plus interest during construction) and all average annual costs are presented in Table 9.

Table 9*
Construction and Investment Costs

	Slurry Trench Wall with Relief Wells	Berms with Relief Wells	Berms Only
Construction First Costs	$ 31,393,000	$ 51,716,000	$ 108,383,000
Interest During Construction	$ 1,927,000	$ 3,174,000	$ 6,651,000
Total Investment	$ 33,320,000	$ 54,890,000	$ 115,034,000
Average Annual Investment	$ 1,551,000	$ 2,555,000	$ 5,355,000
Average Annual OMRR&R Costs	$ 51,000	$ 248,000	$ 500,000
Total Average Annual Investment	$ 1,601,000	$ 2,803,000	$ 5,855,000

**Price level: April 2011; Discount Rate: 4.000%; Evaluation Period: 50 years*

Benefit and Cost Analysis

The expected average annual net benefits for the Slurry Trench Wall with Relief Wells Alternative are estimated at $12,492,000, generating a benefit-cost ratio of 8.8. The expected average annual net benefits for the Berms with Relief Wells Alternative are estimated at $11,291,000, generating a benefit-cost ratio of 5.0. The expected average annual net benefits for the Berms Only Alternative are estimated at $8,239,000 generating a benefit-cost ratio of 2.4. Given all Alternatives, the Slurry Trench Wall with Relief Wells Alternative generates the highest expected annual net benefits, at $12,492,000, and is therefore recommended as the NED plan.

The Expected Average Annual Benefits, Costs, Net Benefits and Benefit-Cost Ratio for the recommended LRR Design Deficiency Alternative are presented in Table 10.

Table 10* Expected Average Annual NED Net Benefits LRR Mel Price / Wood River Levee Underseepage Design Deficiency Project				
	Expected Average Annual NED Net Benefits			
Alternative	**Benefits****	**Costs**	**Net Benefits**	**Benefit-Cost Ratio**
Slurry Trench Wall with Relief Wells 4% Project Rate	**$14,094,000**	**$1,601,000**	**$12,492,000**	**8.8**
Slurry Trench Wall with Relief Wells 7% OMB Rate	*$14,094,000*	*$2,467,000*	*$11,627,000*	*5.7*
** Price level: April 2011; Discount Rate:4.000%; Evaluation Period: 50 years **Benefits include structure, operation plan, and navigation impacts*				

07. Chief's Discretionary Authority

The 902 limit tool was used to determine the maximum project cost. Table G-4 (below) displays the authorized cost at current price levels ($740,355,000) under Line 1d. The current project estimate at current price levels ($773,894,000) exceeds the authorized cost but falls within the maximum cost limited by section 902 ($824,367,000). This means that this project does not have a 902 limit "bust."

Table G-4 (ER 1105-2-100 Appendix G) MAXIMUM COST INCLUDING INFLATION THROUGH CONSTRUCTION FY11 Thousands Dollars (000's)**		
Line 1		
a.	Current Project estimate at current price levels:	$773,894
b.	Current project estimate, inflated through construction:	$775,044
c.	Ratio: Line 1b / line 1a	1.0015
d.	Authorized cost at current price levels:	$740,355
e.	Authorized cost, inflated through construction:	$741,455
	(Line c x Line d)	
Line 2	Cost of modifications required by law:	$0
Line 3	20 percent of authorized cost:	$82,912
	.20 x (table G-3, columns (f) + (g)	
Line 4	Maximum cost limited by section 902:	$824,367
	Line 1e + line 2 + line 3	

SECTION 404(b)(1) EVALUATION REPORT
APPENDIX C-A

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

PROJECT COMPLETION REPORT
Melvin Price – Wood River Levee Underseepage Project
Madison County, Illinois

MARCH 2012

U.S. Army Corps of Engineers, St. Louis District
Planning and Environmental Branch (CEMVS-PD-E)
Environmental Compliance Section
1222 Spruce Street
St. Louis, Missouri 63103-2833
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SECTION 404(b)(1) EVALUATION REPORT ON THE EFFECTS OF THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES

PROJECT COMPLETION REPORT
MELVIN PRICE – WOOD RIVER LEVEE UNDERSEEPAGE PROJECT
MADISON COUNTY, ILLINOIS

I. PURPOSE OF THIS EVALUATION

This document presents a Section 404(b)(1) Guideline evaluation for corrective measures associated with the uncontrolled underseepage and conveyance of material that is occurring under the Wood River Levee, in an area adjacent to the pool of Melvin Price Locks and Dam during normal operating conditions. The St. Louis District concludes that the uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam, two miles downstream from the original structure.

The Melvin Price Locks and Dam is located in Madison County, Illinois, and St. Charles County, Missouri, at Mississippi River Mile 200.78, 2 miles below Alton Illinois, between the mouth of the Missouri River and the Illinois River. This project is focused on a section of the Wood River Levee from project station 0+00 to 115+00 which is located opposite the permanent navigation pool at the Melvin Price Lock and Dam. This evaluation is based on the regulations found at 40 CFR 230, Section 404(b)(1): Guidelines for Specification of Disposal Sites for Dredged or Fill Material.

The purpose of these Guidelines is to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material. Fundamental to these Guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern. From a national perspective, the degradation or destruction of special aquatic sites, such as filling operations in wetlands, is considered to be among the most severe environmental impacts covered by these Guidelines. The guiding principle should be that degradation or destruction of special sites may represent an irreversible loss of valuable aquatic resources.

These Guidelines have been developed by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army acting through the Chief of Engineers under section 404(b)(1) of the Clean Water Act (33 U.S.C. 1344). The Guidelines are applicable to the specification of disposal sites for discharges of dredged or fill material into waters of the United States.

II. PROJECT DESCRIPTION

A. Location – The Melvin Price Locks and Dam is located in Madison County, Illinois, and St. Charles County, Missouri, at Mississippi River Mile 200.78, 2 miles below Alton, Illinois, between the mouth of the Missouri River and the Illinois River. This project is focused on a section of the Wood River Levee from project station 50+00 to 130+00 which is located opposite the permanent navigation pool at the Melvin Price Locks and Dam.

The Wood River levee system provides protection against flooding from the Mississippi River, as well as headwater flooding from Wood River Creek and the Cahokia Creek Diversion Channel. The system also removes drainage from the flood-protected bottomland resulting from rainfall, run-off, and underseepage. In addition to providing protection from river flooding, the levee structure is a part of the containment features for the Melvin Price Locks and Dam Project. Modifications made to the original Lock and Dam 26 at Alton resulted in construction of the Melvin Price Locks and Dam two miles downriver and raised the height of the navigation pool on the intervening stretch of the existing levee. The increased seepage in this levee reach necessitated the construction of a new pump station in this vicinity in the late 1980s.

The U.S. Army Corps of Engineers (USACE), Mississippi Valley Division, St. Louis District, has prepared this Section 404(b)(1) Evaluation Report to document the effects of the discharge of dredged or fill material into waters of the United States with interim underseepage corrections implemented in 2010 as well as the proposed permanent underseepage corrections to the Wood River levee adjacent to the Melvin Price Locks and Dam.

In 2010, the St. Louis District identified the increased seepage in this upper reach of the Wood River levee system. Alternative solutions to correct the problem in this reach of the Wood River levee are the focus of a Project Completion Report prepared by the St. Louis District. The report is scheduled to be completed in 2012 and serves to identify a recommended permanent underseepage corrections plan for federal funding.

B. General Description

1. Area Subject to Section 404 Jurisdiction - Those portions of the project area that are considered to be waters of the United States, and therefore subject to Section 404 review requirements, include waterways bordering the project area, namely the Mississippi River and Wood River Creek; various herbaceous and woody wetlands located along the waterways bordering the exterior of the levee system; open water areas and various wetlands located on the protected side of the levee system occupying depressions within the levee protected area. Wetland types and amounts are described in the Supplemental Environmental Assessment (SEA), sections 3.10 and 4.10, Biological Resources.

Although temporary changes have occurred as a result of the underseepage and interim risk reduction measures, no permanent impacts to jurisdictional wetlands are anticipated.

2. Proposed Project Features for Interim Risk Reduction Measures (Implemented in 2010) and Tentatively Selected Plan –

Temporary precautionary measures were implemented in early 2010 to help control the underseepage and minimize risk to the levee system and protected public. The planning of these measures and their implementation was coordinated with Wood River Drainage and Levee District and City of Alton officials in the fall of 2009.

Details of the interim plan are described in the SEA. Three rock dikes were constructed to prevent ponded water from backing up into the ditches and impacting combined sewage outflow (CSO) operations at the City of Alton, and to prevent water from flowing onto property without flowage easements. This construction was completed in April 2010. The rock dikes will be kept in place until final risk reduction measures are implemented, and then they will be removed. Construction consisted of:

- Dike A - rock constructed to elevation 415.0 with 10' notch at elevation 412.0 with one 48" sluice gate. Footprint approximately 0.05 acre.

- Dike B - rock constructed to elevation 415.0 with two 48" sluice gates. Footprint approximately 0.05 acre.

- Dike C - rock constructed to elevation 411.0 with 10' notch at elevation 410.0 with one 48" sluice gate. Footprint approximately 0.5 acre.

The tentatively selected plan to correct the underseepage problems is summarized below. The plan includes:

- Deep slurry trench cutoff wall - 4,700 linear feet. The wall would be located on the Mississippi River side of the Wood River levee, and would extend from Sta. 80+00 to Sta. 126+00 (from about Cut St. to about 1,200 feet downriver from the centerline of Mel Price Dam). Construction would be within a limited working area (40 to 60 feet wide) along the riverside levee toe. A cement-bentonite slurry would be used to make the wall. The slurry would be pumped into the trench using a portable batch plant as excavation proceeds. A 100-foot wide gap would be established in the cutoff wall where an active utility line (Alton Steel 16" force main) crosses the levee; this crossing is located about 1,300 feet south of Cut St.

- New relief wells – 55. Forty-six new relief wells would be installed along the landside toe of the levee from Sta. 55+00 to Sta. 80+00 (from the intersection with Ridge St. to about Cut St.). An additional 9 new relief wells would be installed along the landside toe of the levee to control underseepage at the 100-foot wide opening or gap in the cutoff wall.

- Other features include - Abandon and grout 80 existing relief wells; remove 42 existing headwalls and grout existing outlet pipes; grout two existing abandoned utility lines (Owens wastewater main, 36” diameter - 450 linear feet; Alton Box

Board sewer effluent, 30” diameter concrete casing with 20" effluent line – 550 linear feet); 10-acre disposal site for placement of earthen material excavated from cutoff wall trench; and establish 25 acres of grassy turf along the levee.

3. Authority and Purpose - The Melvin Price Lock and Dam project was authorized by the Internal Revenue Code of 1954 - Bingo - Tax - Exempt Organizations, Public Law 95-502 (H.R. 85331), October 21, 1978. Title I - Replacement of Locks and Dam 26; Upper Mississippi River System Comprehensive Master Management Plan.

The Wood River Levee project originally was authorized by the Flood Control Act of 28 June 1938, Flood Control Committee Document No. 1, 75th Congress, and First Session to provide flood protection to urban, agricultural and industrial areas.

Additional authorities are discussed in the project SEA.

The primary problem facing the Wood River Drainage and Levee District is the deterioration of the existing levee system adjacent to the Melvin Price Locks and Dam due to a problem in the levee underseepage control measures. Uncontrolled underseepage and conveyance of earthen materials that form the foundation of the levee is occurring, and the potential for levee failure is a major problem. As time passes the probability that the project will fail continues to increase.

Specifically, the low, marshy area located landside of the levee extending about 3,500-feet upstream from the centerline of the Melvin Price Locks and Dam exhibits heavy seepage of groundwater under the levee and displays very soft ground conditions. Wood River levee district and Corps officials first observed many large, flowing seeps (3 to 5 inch diameter and at least 6-feet deep) during the summer of 2009 while the Melvin Price pool was at or near its normal elevation of 419.

4. General Description of Dredged or Fill Material

(1) General Characteristics of Material (grain size, soil type)

(a) Fill Material - Fill materials include rock used to construct dikes for the interim risk reduction measures. These materials will be removed once the tentatively selected plan has been implemented. Crushed stone might be used at the discretion of a contractor to construct work pads for temporary access easement areas for relief well sites that might be soft or wet.

(b) Dredged Material - Dredged material is defined as material that is either dredged or excavated from waters of the United States. The interim risk reduction measures did not include any dredged material. The tentatively selected plan for final risk reduction measures includes the removal of rock used to construct the dikes, and this rock would be excavated from jurisdictional wetlands once construction of final measures is completed.

(2) Quantity of Material - Rock used to construct dikes for the interim risk reduction measures will be removed once the tentatively selected plan has been implemented. No permanent fill will be placed in jurisdictional wetlands. No quantities have been determined for crushed stone which might be used at the discretion of a contractor to construct work pads for temporary access easement areas or relief well sites that might be soft or wet.

(3) Source of Material - Fill material consisting of rock was obtained from landside commercial suppliers; no dredging of sand from the river would be required. Crushed stone would be obtained from commercial quarries.

e. Description of the Proposed Discharge Sites

(1) Location - The location of the proposed features and work is displayed in the project's Limited Reevaluation Report and SEA. No permanent proposed discharge sites located in waters of the United States consisting of wetlands are anticipated. Although specific locations have yet to be identified, wetland sites will be avoided.

(2) Size (acres) and Types of Habitat – The footprints of the three rock dikes total 0.5 acre. These dikes were constructed in herbaceous wetlands. No permanent proposed discharge sites located in waters of the United States consisting of wetlands are anticipated.

(3) Type of Site (confined, unconfined, open water)

(a) Permanent Deposits of Dredged and Fill Material - No permanent proposed discharge sites located in waters of the United States consisting of wetlands are anticipated.

(b) Temporary Deposits of Fill Materials – Rock used for the construction of the interim risk reduction measures is unconfined. Temporary easement areas for access of heavy construction equipment are located adjacent to the levee on either side. If ground conditions within these easement areas are wet during construction, access may be facilitated by the contractor by placing either timber matting or crushed stone. The placement of any crushed stone would be unconfined.

(4) Timing and Duration of Discharge - Interim risk reduction measures were put in place in early 2010. Rock dikes used for the interim risk reduction measures will be removed upon completion of the tentatively selected plan, which is scheduled in late 2015. The estimated duration of the construction period for the tentatively selected plan is expected to be about three years (2013-2015). Construction would occur any time during the typical construction season over this period of time. Actual duration of discharges will only be a fraction of the total construction time.

f. Description of Disposal Method (hydraulic, drag line, etc.) - If any crushed stone would be needed for temporary access easement areas, this material would be transported and dumped by trucks. The temporary rock dikes were constructed in this manner.

III. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope. Natural ground elevations in the vicinity of the Upper Wood River levee where it ties into high ground near the Alton Argosy Casino is about elevation 430 feet NGVD. Closer to the Clark Bridge, the prevailing natural ground is about elevation 425 NGVD. On the protected side of the levee within the ponding area of the East Alton No. 1 pump station, land elevations range from about 430 feet NGVD to about 400 feet NGVD. Here the slope of natural ground varies by location, with relatively flat areas where wetlands occur (1-2%) and gentle slopes in other areas (2-5%). Levee embankment sideslopes are typically about 30%.

2. Sediment Type (grain size). Soils within the project area consist of alluvial materials consisting of silts, sands, and clays. Alluvial material extending down to bedrock consists of various layers of these materials, primarily sands and gravels.

3. Dredged/Fill Material Movement. Materials placed on the protected side of the levee system will be subject to erosion forces related to the slope of the land. As none of the disposal (construction) sites will be confined (as with a cofferdam), all materials will have the potential to migrate downhill. Materials placed on the unprotected side of the levee system would be confined to trenches.

4. Physical Effects on Benthos (burial, changes in sediment type, etc.) Benthos (organisms that live on the bottom of water bodies) are found in the aquatic portions of the project area. Aquatic areas with benthos were affected by construction of the temporary dikes, when rock was placed on top of muddy substrate. Physical effects on benthos from permanent structures are not anticipated.

5. Other Effects No other effects are expected.

6. Actions Taken to Minimize Impacts The primary actions taken to avoid adverse effects on the substrate are designing stable slopes on structures, placement of silt fences or hay bales to arrest the migration of material, and revegetation measures to minimize erosion (lateral movement) of fill or dredged materials.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water
   a. Salinity Not applicable.

b. Water Chemistry No changes in water chemistry are anticipated.

c. Clarity No changes in water clarity are anticipated to any waterbodies, including the Mississippi River or Wood River Creek.

d. Color No change is expected to any waterbodies.

e. Odor The recommended plan is not expected to have an impact on water odors in any waterbodies.

f. Taste The project is not expected to impact water taste of any waterbodies. The Mississippi River is a source for public and private water supplies in the St. Louis area.

g. Dissolved Gas Levels Construction activities associated with the project will not affect dissolved gas levels of any waterbodies.

h. Nutrients. Nutrients are not expected to be released to wetland or aquatic areas during the construction process.

i. Eutrophication. The project is not expected to contribute toward eutrophication of the water column in any aquatic areas.

j. Water Temperature Water temperatures are not expected to change in any aquatic areas.

2. Current Patterns and Circulation

a. Current Patterns and Flow. Project features located on either side of the levee of the Upper levee system will not have the potential to affect any current patterns or flow of any natural waterways.

b. Velocity. No changes in water velocities within natural waterways are expected.

c. Stratification. No stratification is expected to occur in any waterways or waterbodies.

d. Hydrologic Regime. The project will not directly or indirectly alter the seasonal or annual hydrologic regime of any adjacent waterways or waterbodies.

3. Normal Water Level Fluctuations (tides, river stage, etc.) The project will not directly or indirectly alter normal water level fluctuations of the Mississippi River or Wood River Creek.

4. Salinity Gradients Not applicable.

5. Actions Taken to Minimize Impacts The primary actions taken to avoid adverse effects to the water are designing stable slopes on structures, placement of silt fences or hay bales to arrest the migration of material, and revegetation measures to minimize erosion (lateral movement) of fill or dredged materials.

C. Suspended Particulate/Turbidity Determinations

1. Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. With respect to water quality, construction of the three rock dikes likely caused temporary and localized increases in levels of suspended particulates and turbidity at the construction sites and for relatively short distances downstream. As water quality in these areas is generally poor, adverse effects were likely minor. No permanent detrimental impacts to suspended particulate/turbidity determination are anticipated as a result of the tentatively selected plan.

2. Effects (degree and duration) on Chemical and Physical Properties of the Water Column. The project does not involve any construction in the Mississippi River or Wood River Creek. No permanent waterbody will be impacted.

a. Light Penetration. Decreases in light penetration of the water column are not expected.

b. Dissolved Oxygen. Changes in dissolved oxygen levels are not expected.

c. Toxic Metals and Organics. Toxic metals or organics are not expected.

d. Pathogens. There is reason to believe pathogens could exist in the proposed areas of construction because at times the City of Alton discharges sewage from its sewage treatment plant along with stormwater into the ponding area of the East Alton No. 1 pump station.

e. Aesthetics. Aesthetics of work sites are likely to be temporarily adversely affected during construction, but are expected to improve with the establishment of vegetation after construction.

f. Water Temperature. No changes in water temperatures are expected to occur in the water column of any waterbodies.

3. Effects on Biota

a. Primary Production, Photosynthesis. No impacts to primary production and photosynthetic processes are expected to occur.

b. Suspension/Filter Feeders. No permanent reduction in benthos production is expected in any waterbodies.

c. Sight Feeders. No temporary or permanent impacts to sight-feeders are expected in any waterbodies.

4. Actions taken to Minimize Impacts. Actions to minimize impacts associated with suspended particulates and turbidity include best management erosion control practices, such as the installation of silt fencing and straw bales around the perimeter of areas of ground disturbance, and the seeding of work areas following construction.

D. Contaminant Determinations. Sampling was conducted in the upper portion of the Wood River levee system in September of 2009 in the area of uncontrolled underseepage. Results of the samples indicated elevated levels of metals, but this may be a result of leaching in the soils. An old industrial area to the east included Laclede Steel, Alton Box Board, American Smelting & Refining, and Owens Illinois Glass Company. Elevated levels of metals have been associated with glass manufacturing and steel production, but it could not be determined if these industries were the source of these inorganic elements.

The construction of the three rock dikes and establishment of interim ponding has not affected any hazardous, toxic, or radioactive wastes within the upper Wood River levee-protected area.

A contingency plan would be developed to handle any unexpected encounter with contaminated materials. During the installation of the cutoff wall, excavated materials would be monitored to determine if any contaminants of concern are present that might require such materials to be considered a special waste. A Site Health and Safety Plan, and a Quality Control Plan should be required, discussed with contractors, and implemented to avoid any environmental hazards.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on Plankton. No impacts on phytoplankton production are expected.

2. Effects on Benthos. No permanent aquatic areas with benthos will be permanently affected by the project.

3. Effects on Nekton. The term "nekton" refers basically to larger, free-swimming aquatic organisms, such as fishes. No impacts on nekton are expected.

4. Effects on Aquatic Food Web. Construction activities are not expected to disrupt the aquatic food chain.

5. Effects on Special Aquatic Sites

a. Sanctuaries and Refuges. No sanctuaries or refuges will be affected by this project.

b. Wetlands. Project activities are not expected to permanently impact jurisdictional wetlands.

c. Mud Flats. By late 2009, prior to the start of interim ponding, mud flats had replaced much of the cattail vegetation located between the levee and the ditch. It is expected that following discontinuation of the interim ponding and construction of the final risk reduction measures, the mud flats would diminish in area and transition back to shallow marshes and wet meadows.

d. Vegetated Shallows. No vegetated shallows occur at any proposed disposal sites.

e. Coral Reefs. Not applicable.

f. Riffle and Pool Complexes. Riffle and pool complexes do not occur at any proposed discharge (construction) sites.

6. Threatened and Endangered Species In compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, the St. Louis District obtained a listing of federally threatened or endangered species, currently classified or proposed for classification that may occur in Madison County, Illinois, in the vicinity of the Wood River levee system (USFWS 2010). Six species listed for this county are applicable to the project area (Table C-A-4). There is no designated critical habitat within Madison County for any of these species.

Table C-A-4. List of Federally Endangered (E), Threatened (T), and Candidate (C) Species in the Vicinity of the Project Area.

Common Name (Scientific Name)	Status	Habitat
Least tern (*Sterna antillarum*)	E	Sparsely vegetated sand and gravel bars on large rivers (nesting)
Indiana bat (*Myotis sodalis*)	E	Caves, mines (hibernacula); small stream corridors with well developed riparian woods, upland forests (foraging)
Pallid sturgeon (*Scaphirhynchus albus*)	E	Large rivers
Decurrent false aster (*Boltonia decurrens*)	T	Disturbed alluvial soils

Eastern massasauga (*Sistrurus c. catenatus*)	C	Floodplain forests, marshlands, bogs, and old fields,
Eastern prairie fringed orchid (*Platanthera leucophaea*)	T	Mesic to wet prairies

It is the St. Louis District's opinion that the proposed project will not adversely impact any of the six federally listed species that might occur in the project area, provided that conditions for the protection of the decurrent false aster are implemented.

With regard to the decurrent false aster, colonies or populations of this plant are not known from the Wood River levee district, including the levee reach adjacent to the Melvin Price Locks and Dam and the landside ponding area for the East Alton No. 1 pump station. However, suitable habitat consisting of open wet areas does occur in the vicinity of the levee. Because of the opportunistic nature of this species to colonize open moist or wet areas that experience natural or man-made disturbances, its ability to disperse over shorter distances by seeds carried by wind or animals, and the approximate 4-5 years before final measures would be implemented, field surveys for this plant will be conducted by the St. Louis District on the landside of the levee prior to any construction activities. If any individual plants or colonies are identified, the U.S. Fish and Wildlife Service will be notified and a course of action will be established.

7. Other Fish and Wildlife. Given the urban setting, a variety of animal species use the area on the landside of the levee. Most wildlife species are adapted to human disturbance or tolerant of fragmented habitats or poor water quality, and consist of a variety of amphibians, reptiles, birds, and mammals.

8. Actions to Minimize Impacts. As required under Section 404 of the Clean Water Act, any direct impacts to wetlands would require mitigation as compensation for these losses. Since no permanent direct losses are anticipated as a result of the project, there would be no significant impact on biological resources.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination. A mixing zone is that volume of water at a placement site or discharge site required to dilute contaminant concentrations associated with a discharge of dredged material to an acceptable level. Discharges in areas of permanent water will not occur. There is no need to develop a mixing zone determination for the discharge sites since they lack permanent water.

2. Determination of Compliance with Applicable Water Quality Standards. Section 401 water quality certification will be required from the Illinois Environmental Protection Agency. Effluent limitations guidelines and new source performance standards promulgated in 2009 by the U.S. Environmental Protection Agency to control the discharge of pollutants from construction sites are likely to apply to this project,

requiring the implementation of a range of erosion and sediment control measures and pollution prevention practices.

3. Potential Effects on Human Use Characteristics

a. Municipal and Private Water Supply. No municipal water supply will be adversely impacted by project construction.

b. Recreational and Commercial Fisheries. Commercial fishing activities occur in the Mississippi River at some distance from St. Louis, and recreational fishing occurs at many locations along the river. Because this project will not directly affect any river or waterbody, it is not expected to diminish fishing opportunities.

c. Water Related Recreation. Although water-related recreation is an important activity in the Mississippi River, the project will not impact this kind of recreation.

d. Aesthetics. Construction activities will have minor impacts on the aesthetic quality of the project area during the duration of the work. Noise and exhaust will be generated by heavy equipment during the construction process.

e. Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. The project will not impact any of these resources.

f. Determination of Cumulative Effects on the Aquatic Ecosystem. Past, present, and reasonably foreseeable future Corps activities in Pools 25 and 26 of the Mississippi River include 1) the navigation project, 2) channel maintenance work including maintenance dredging and dikes and revetments, 3) other existing EMP-HREP projects (Batchtown, Stag Island, Cuivre Island, Calhoun Point, Dresser Island), 4) existing bullnose dikes at Slim, Peruque, and Portage Islands (constructed under the Avoid and Minimize Program), 5) and activities under the Navigation and Environmental Sustainability Program, including a dam point control study for Pool 25, design of lock expansion at Lock and Dam 25, and a fish passage study at Lock and Dam 26. Between these projects, there are no significant cumulative impacts on the aquatic ecosystem.

g. Determination of Secondary Effects on the Aquatic Ecosystem. No significant secondary impacts to the aquatic ecosystem have been identified.

IV. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

A. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation. In this evaluation of discharges proposed as part of the corrections for the Melvin Price - Wood River Levee Underseepage Project, the Environmental Protection Agency's Section 404(b)(1) Guidelines of 24 December 1980 were applied without significant adaptation.

B. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem. No practicable alternatives exist which meet the study objectives and do not involve discharge of fill or dredged material into waters of the United States. Alternatives for corrections to underseepage problems were considered, and these fell into three general kinds of solutions: seepage berms, relief wells, and cutoff walls. For this project, these three kinds of solutions were evaluated. Design requirements for each solution were developed, impacts on wetlands and nonwetland forest were identified, and total costs were developed for each solution, including any required for mitigation. Of the three kinds of solutions, seepage berms present the greatest potential for impacts to waters of the United States, whereas relief wells and cutoff walls in general present a lower potential. In all cases where impacts to wetlands are proposed, there is no practicable alternative that would avoid or minimize the placement of fill or dredged material into those affected wetlands.

C. Compliance with Applicable State Water Quality Standards. Water quality certification under Section 401 of the Clean Water Act will be required from the Illinois Environmental Protection Agency. The certification and permit conditions will be incorporated into the project's plans and specifications. Coordination of the proposed plan with the IEPA will be accomplished.

D. Compliance with Applicable Toxic Effluent Standard or Prohibition under Section 307 of the Clean Water Act. The proposed activities are not expected to violate the toxic effluent standards of Section 307 of the Clean Water Act.

E. Compliance with Endangered Species Act of 1973. The recommended plan is not expected to adversely affect any of the six federally listed endangered, threatened, or candidate species or their critical habitat, provided that restrictions pertaining to the Indiana bat and decurrent false aster are imposed.

F. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972. Not applicable.

G. Findings of Significant Degradation of the Waters of the United States. The proposed project will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. Life stages of aquatic organisms and other wildlife would not be adversely affected in a significant manner. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values would not occur.

H. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem. All appropriate and practicable measures have been taken through application of procedures contained in Subpart H of the Guidelines to insure minimal adverse effects of the proposed discharges.

I. On the Basis of the Guidelines the Proposed Disposal Sites for the Discharge of Dredged and Fill Material. Based on this evaluation, the proposed corrections for the Melvin Price - Wood River Levee Underseepage Project is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

Prepared by: ______________________________

Timothy K. George
Ecologist, Planning and Environmental Branch, Regional Planning and Environment Division North

Approved by: ______________________________

John Peukert.
Acting Chief, Planning and Environmental Branch, Regional Planning and Environment Division North

____________________ ______________________________

Date

Christopher G. Hall
Colonel, U.S. Army
District Commander

To be signed following the review of comments received during the public comment period.

HABITAT EVALUATION AND CE/ICA FOR PROJECT MITIGATION
APPENDIX C-B

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

PROJECT COPLETION REPORT
MEL PRICE-WOOD RIVER LEVEE UNDESEEPAGE PROJECT
MADISON COUNTY, ILLINOIS

MARCH 2012

U.S. Army Corps of Engineers, St. Louis District
Planning and Environmental Branch (CEMVS-PD-E)
Environmental Compliance Section
1222 Spruce Street
St. Louis, Missouri 63103-2833
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HABITAT EVALUATION AND CE/ICA FOR PROJECT MITIGATION

PROJECT COMPLETION REPORT
MEL PRICE-WOOD RIVER LEVEE UNDERSEEPAGE PROJECT
MADISON COUNTY, ILLINOIS

MARCH 2012

Table of Contents

1. *Introduction*

The tentatively selected plan for final flood risk reduction measures of the Mel Rice-Wood River levee underseepage project includes mitigation for forest impacts resulting from implementation of interim flood risk reduction measures. These forest impacts are unavoidable and require mitigation to rectify the impacts by repairing or restoring the affected environment.

To assist in developing mitigation, this appendix describes two analyses that are required for the formulation, evaluation, and selection of a mitigation plan. First, a habitat evaluation was conducted to quantify the benefits of establishing mitigation measures (tree plantings) in various ways. Second, a cost effectiveness/incremental cost analysis was performed to compare the costs of alternative ways of planting tree seedlings, determine which alternatives are cost inefficient and ineffective, and identify the "best buy" or least cost alternative.

These habitat and cost evaluation analyses were conducted for proposed on-site plantings within forested wetlands located along the margins of the ponding area of the East Alton No. 1 pump station.

2. *Habitat Evaluation.*

The habitat evaluation analyses for the Melvin Price-Wood River Levee mitigation project were conducted by a multi-agency team with representatives from the U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, and U.S. Army Corps of Engineers.

The Wildlife Habitat Appraisal Guide (WHAG), developed by the Missouri Department of Conservation and the U.S. Department of Agriculture, Soil Conservation Service (now NRCS) (MDC and USDA-SCS 1990), was used to evaluate the quality of forested wetland affected by the interim risk reduction measures. The WHAG was adapted from the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (USFWS 1980). WHAG is widely accepted by local agencies. It has become the primary terrestrial habitat evaluation method used in the St. Louis District.

The WHAG is a numerical model that evaluates the quality and quantity of particular habitats for species selected by team members. Evaluation species that were chosen are displayed in Table C-B-1. The qualitative component of the analysis is known as the habitat suitability index (HSI) and is rated on a 0.1 to 1.0 scale, with higher values indicating better habitat. The evaluation team determines the HSI for a particular habitat type by answering questions that establish values for various biotic and abiotic conditions under present and future conditions. Future conditions are determined by the team using management plans and best professional judgment. The quantitative component is the number of acres of the habitat being evaluated. From the calculated qualitative and quantitative values, the standard unit of measure, the habitat unit (HU) is calculated using the formula (HSI x Acres = HUs). Habitat units are calculated for specific target years to forecast changes in habitat values over the life of the project for with-project and without-project conditions and are then annualized to yield the Average Annual Habitat Unit (AAHU). Target years are set to capture the change in habitat that occurs with habitat maturation and changes caused by constructed features. The benefits of each proposed project feature are then determined by subtracting with-project benefits from without-project benefits, expressed as net AAHUs. The efficiency of various mitigation alternatives can then be evaluated by comparing the net AAHUs and costs for each alternative considered.

The target years selected for use in the WHAG habitat assessment were primarily chosen to reflect expected future changes in woody vegetation planted at the mitigation site. Five target years were chosen (years 1, 6, 10, 25, 50) over a 50-year project life. Woody species such as hard mast tree species that could be planted as Root Production Method seedlings can produce acorns and nuts as early as 5 years after planting. These target years would allow for capturing this onset of mast production. Hard mast tree species such as oaks and hickories are not represented in the various types of forest located along the Wood River levee in the vicinity of the East Alton No. 1 pump station. They were present historically and provided an important food source to some wildlife species such as turkey and deer.

Table C-B-1. WHAG animal species used to evaluate quality of forested wetland at pump station's ponding area.

Evaluation Species	Purpose as Evaluation Species	Forested Wetland
Mallard	Early succession wetland habitat, game species	X
Canada goose	Early succession wetland habitat, game species	
Least bittern	Permanent summer wetland habitat, mid successional herbaceous wetland habitat	
Lesser yellowlegs	Waterlogged wetland substrate, initial successional wetland habitat	
Muskrat	Permanent summer wetland habitat, mid successional herbaceous wetland habitat	
King rail	Permanent summer wetland habitat, sedge dominate wetlands, rare species	
Green-backed heron	Mid successional herbaceous and shrub dominated wetland habitat	X
Wood duck	Old growth, riparian habitat, snag and cavity trees	X
Beaver	Early successional forest habitat	X
American coot	Permanent summer wetland habitat	
Northern parula	Wooded riparian habitat	X
Prothonotary warbler	Wooded riparian habitat	X

The Wood River Levee System WHAG Team established the following assumptions: For the purpose of planning, design, impact and mitigation analysis, project life was established as 50 years. The multi-agency team made the following assumptions during the habitat evaluation: (1) the No Action Alternative assumed that interim ponding would continue indefinitely into the future and that no mitigation features would be instituted; (2) target years selected are sufficient to annualize HUs and to characterize habitat changes over the life of the mitigation project; (2) target species were selected based on mitigation location, habitat type, and management objectives; (3) the existing HSI values developed are a fair representation of the quality of habitat in all target years and for all future conditions with or without a project; (4) water input to the system is solely reliant on precipitation, runoff, ground water, and seepage through/under the levee; and (5) Mississippi River level fluctuations under future without project conditions would result in water level fluctuations within the ponding area due to seepage under the levee.

As displayed in Table C-B-2, the quality of forested wetlands is low to moderate for the next 50 years with interim measures (ponding) in place. This is the future-without condition of not constructing any final flood damage reduction measures. This condition also does not include any mitigation or repair of damages to forest resources caused by the interim measures. The interim measure of detaining water in the pump station's ponding area would continue for the next 50 years. A total of 50.7 habitat units were generated by WHAG for this condition using the six evaluation species and five target years.

Future habitat conditions with final risk reduction measures in place are expected to improve the quality of forested wetlands to a slight degree after interim ponding ceases, yielding 53.6 habitat units without any planting of tree seedlings. Trees expected to be killed from prolonged interim ponding would be replaced by natural regeneration of light seeded species such as cottonwood, elm, and sycamore. Because hard mast tree species are not present locally, these species would not be expected to regenerate naturally and would continue to be absent in the future from the forested areas within the ponding area.

Three alternatives for planting tree seedlings were identified, and they include balled and burlap seedlings, root production method seedlings, and bare-root seedlings. For each type of seedling the WHAG team assumed certain planting survival rates and years to achieve desired output (seed producing trees). These assumptions are displayed in Table C-B-3. The WHAG team considered balled and burlap seedlings to be indistinguishable from root production method seedlings with regard to the WHAG assessment (the generation of habitat units) and these two planting alternatives were scored the same. However, bare root seedlings were scored differently from the other two seedling alternatives because of assumed differences in years to desired output (5 versus 10). Under these planting alternatives, tree seedlings would consist of hard mast tree species such as oaks and hickories, and not light-seeded species which are already abundant at the impact sites.

3. *Mitigation Benefits.*

Under the future-with condition of implementing mitigation (and as part of the tentatively selected plan for final risk reduction measures), the tree planting alternatives consisting of the planting of hard mast tree species are expected to increase habitat quality to a slight degree over the without mitigation alternative, and provide habitat benefits to varying degrees (Table C-B-2). Natural regeneration (not planting any tree seedlings) would yield a total of 53.6 habitat units for an approximate impact (planting) area of 25 acres, whereas planting balled and burlap or root production method seedlings would generate 54.17 habitat units, or 0.79 habitat units more than natural regeneration. The bare root seedling alternative would give rise to 53.69 habitat units, or 0.73 habitat units more than not planting any seedlings. The WHAG habitat evaluation calculations are on file at the U. S. Army Corps of Engineers, St. Louis District.

Mel Price - Wood River	Mallard	Green-Backed Heron	Wood duck	Beaver	Northern Parula	Prothon Warbler	Ave HSIs	TY	Acres	HUs	Net Years	Cumulative HU	AAHUs	Net AAHUs
Baseline	0.00	0.68	0.54	0.62	0.65	0.24	0.45	0	23.2	10.53	1			
Without Project (Interim Measures)	0.11	0.68	0.54	0.63	0.65	0.26	0.48	1	23.2	11.07	5	493.51	9.87	0.00
	0.10	0.72	0.57	0.58	0.47	0.28	0.45	6	23.2	10.52	4			
	0.09	0.63	0.46	0.58	0.50	0.27	0.42	10	23.2	9.79	15			
	0.09	0.63	0.46	0.58	0.50	0.27	0.42	25	23.2	9.79	25			
	0.09	0.63	0.42	0.58	0.50	0.24	0.41	50	23.2	9.51				
								Total HUs		50.68				
With Project (Final Measures, no tree seedlings)	0.11	0.68	0.54	0.62	0.65	0.26	0.48	1	23.2	11.03	5	529.05	10.58	0.71
	0.09	0.66	0.57	0.58	0.47	0.28	0.44	6	23.2	10.24	4			
	0.11	0.62	0.48	0.60	0.65	0.23	0.45	10	23.2	10.43	15			
	0.12	0.56	0.57	0.53	0.75	0.29	0.47	25	23.2	10.92	25			
	0.12	0.53	0.62	0.46	0.75	0.36	0.47	50	23.2	10.98				
								Total HUs		53.60				
With Project (Final Measures, RPM seedlings)	0.11	0.68	0.54	0.62	0.65	0.26	0.48	1	23.2	11.03	5	533.00	10.66	0.79
	0.10	0.66	0.59	0.56	0.47	0.28	0.44	6	23.2	10.26	4			
	0.12	0.62	0.50	0.58	0.65	0.23	0.45	10	23.2	10.45	15			
	0.13	0.56	0.59	0.51	0.80	0.30	0.48	25	23.2	11.18	25			
	0.13	0.53	0.64	0.44	0.80	0.37	0.48	50	23.2	11.24				
								Total HUs		54.17				
With Project (Final Measures, BR seedlings)	0.11	0.68	0.54	0.62	0.65	0.26	0.48	1	23.2	11.03	5	530.06	10.60	0.73
	0.10	0.66	0.59	0.56	0.47	0.28	0.44	6	23.2	10.26	4			
	0.12	0.62	0.50	0.58	0.65	0.23	0.45	10	23.2	10.45	15			
	0.13	0.56	0.57	0.53	0.75	0.29	0.47	25	23.2	10.95	25			
	0.13	0.53	0.64	0.44	0.75	0.36	0.47	50	23.2	11.00				
								Total HUs		53.69				

Note: HSI = habitat suitability index, TY= target year, HU = habitat unit, AAHU = average annual habitat unit, Final Measures = Tentatively Selected Plan

Table C-B-2. Habitat Evaluation for Forested Wetlands in Pump Station's Ponding Area.

Table C-B-3. Assumptions for survival rates of tree seedling plantings and time delay (years) to achieve reproducing individuals.

	Alternatives for Tree Plantings		
	Balled & Burlap Seedling	Root Production Method Seedling	Bare Root Seedling
% Planting Survival	0.8	0.9	0.5
Years to desired output	5	5	10

The habitat assessment shows that the magnitude of the benefits or habitat units generated by these planting alternatives for the approximate 25 acre area of forest "damages" is not very great because the average change in forest habitat quality for the six WHAG evaluation species over the project life is very slight.

4. *Cost Effectiveness/Incremental Cost Analysis*

A cost effectiveness analysis was carried out to determine the "best buy" options for establishing tree seedlings on the mitigation sites. To conduct this analysis, total estimated costs were developed for the three tree planting alternatives.

Table C-B-4 displays a comparison of the costs for the various planting alternatives. The costs included construction or initial planting costs (material, labor, equipment) and maintenance or replacement costs for the year after. Replacement costs consist of assumed replanting to attain the minimal 80% plant survivability.

Table C-B-4. Estimated Annual Costs (per acre) to Establish Vegetation at Proposed Mitigation Site by Planting Alternative.

Year	Alternatives for Tree Plantings (per acre)			Type of Activity
	Balled & Burlap	Root Production Method Seedling	Bare Root Seedling	
0	$282,655	$169,773	$34,192	Construction
1	$67,452	$21,964	$21,736	Replacement
2-50	$0	$0	$0	

Table C-B-5 presents total estimated costs (net present value and average annual costs), as well as a comparison of the cost effectiveness of each of these alternatives. The net present value and average annual costs reflect an annual inflation rate of 4.125% for FY11.

Table C-B-5. Comparison of Estimated Total Costs (per acre) to Establish Vegetation at Proposed Mitigation Site by Planting Alternative.

Comparison Factor[1]	Alternatives for Tree Plantings (per acre)		
	Balled & Burlap	Root Production Method Seedling	Bare Root Seedling
Net Present Value	$333,671	$183,306	$52,885
Average Annual (AA) Cost	$15,866	$8,716	$2,515
Average Annual Habitat Units (AAHU)[2]	0.08	0.08	0.02
AA Cost/ AAHU	$198,330	**$108,955**	$125,737

[1] Based on 50-year project life
2 From Table A-C-4

The cost effectiveness analysis shows that the root production method alternative is the "best buy" for tree planting because it has the lowest AA cost/AAHU. However, the magnitude of this comparison factor (over $100,000) is high compared to typical values for Corps restoration or mitigation projects. Nevertheless, according to the Corps' Planning Guidance Notebook (Engineering Regulation 1105-2-100, Appendix C, dated 22 April 2000), "District commanders shall ensure that adverse impacts to wetland resources are fully mitigated." Without any mitigation or tree planting, there is no certainty about the course and end state of natural regeneration within the impacted forest areas. Light seeded species such as willows and silver maple could regenerate, or non-native woody species like bush honeysuckle could invade these areas after expected tree mortality occurs and once intentional ponding is no longer required. The planting of hard mast tree species seedlings would provide a desirable direction for the succession of tree species in these impacted areas. Therefore, the mitigation plan will incorporate this "best buy" alternative for establishing tree seedlings on the proposed mitigation sites.

5. *References*

Missouri Department of Conservation and U.S. Department of Agriculture-Soil Conservation Service (MDC and USDA-SCS). 1991. Wildlife Habitat Appraisal Guide (WHAG) User's Guide. April 1991.

U.S. Fish and Wildlife Service (USFWS). 1980. Habitat evaluation procedure (HEP) 102 ESM. U.S. Fish and Wildlife Service, Washington, DC.

MITIGATION PLAN
APPENDIX C-C

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

PROJECT COMPLETION REPORT
MEL PRICE-WOOD RIVER LEVEE UNDERSEEPAGE PROJECT
MADISON COUNTY, ILLINOIS

MARCH 2012

U.S. Army Corps of Engineers, St. Louis District
Planning and Environmental Branch (CEMVS-PD-E)
Environmental Compliance Section
1222 Spruce Street
St. Louis, Missouri 63103-2833
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MITIGATION PLAN

Table of Contents

1) *Introduction*

Interim flood risk reduction measures implemented in early 2010 for the Melvin Price-Wood River Levee Underseepage Project have resulted in the loss of a small area of bottomland hardwood forest (nonwetland) and are expected to cause over time the mortality of an estimated 25 acres of forested wetland. These impacts require mitigation. The tentatively selected plan for final risk reduction measures is not expected to result in any permanent ecological impacts requiring mitigation.

Mitigation includes (a) avoiding biological resource impacts altogether by not taking a certain action or part of an action; (b) minimizing such impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; (e) compensating for the impact by replacing or providing substitute resources or environments.

Because the interim measures are needed on only a temporary basis and forested areas affected by these measures could be repaired or restored, the proposed mitigation plan would rectify these impacts by the planting of tree seedlings in these affected areas.
The Water Resources Development Act (WRDA) of 2007 details mitigation requirements for fish and wildlife and wetland losses caused by water resources projects. An excerpt from Title VIII, Section 2036 of WRDA 2007 states:

> *(3) MITIGATION REQUIREMENTS.—*
>
> > *(A) IN GENERAL.—To mitigate losses to flood damage reduction capabilities and fish and wildlife resulting from a water resources project, the Secretary shall ensure that the mitigation plan for each water resources project complies with the mitigation standards and policies established pursuant to the regulatory programs administered by the Secretary.*
> >
> > *(B) INCLUSIONS.—A specific mitigation plan for a water resources project under paragraph (1) shall include, at a minimum—*
> >
> > > *(i) a plan for monitoring the implementation and ecological success of each mitigation measure, including the cost and duration of any monitoring, and, to the extent practicable, a designation of the entities that will be responsible for the monitoring;*
> > >
> > > *(ii) the criteria for ecological success by which the mitigation will be evaluated and determined to be successful based on replacement of lost functions and values of the habitat, including hydrologic and vegetative characteristics;*
> > >
> > > *(iii) a description of the land and interests in land to be acquired for the mitigation plan and the basis for a determination that the land and interests are available for acquisition;*
> > >
> > > *(iv) a description of—*

(I) the types and amount of restoration activities to be conducted;
(II) the physical action to be undertaken to achieve the mitigation objectives within the watershed in which such losses occur and, in any case in which the mitigation will occur outside the watershed, a detailed explanation for undertaking the mitigation outside the watershed; and
(III) the functions and values that will result from the mitigation plan; and

(v) a contingency plan for taking corrective actions in cases in which monitoring demonstrates that mitigation measures are not achieving ecological success in accordance with criteria under clause (ii).

(C) RESPONSIBILITY FOR MONITORING.—In any case in which it is not practicable to identify in a mitigation plan for a water resources project the entity responsible for monitoring at the time of a final report of the Chief of Engineers or other final decision document for the project, such entity shall be identified in the partnership agreement entered into with the non-Federal interest under section 221 of Flood Control Act of 1970 (42 U.S.C. 1962d–5b).

(4) DETERMINATION OF SUCCESS.—

(A) IN GENERAL.—A mitigation plan under this subsection shall be considered to be successful at the time at which the criteria under paragraph (3)(B)(ii) are achieved under the plan, as determined by monitoring under paragraph (3)(B)(i).

(B) CONSULTATION.—In determining whether a mitigation plan is successful under subparagraph (A), the Secretary shall consult annually with appropriate Federal agencies and each State in which the applicable project is located on at least the following:

(i) The ecological success of the mitigation as of the date on which the report is submitted.
(ii) The likelihood that the mitigation will achieve ecological success, as defined in the mitigation plan.
(iii) The projected timeline for achieving that success.
(iv) Any recommendations for improving the likelihood of success.

(5) MONITORING.—Mitigation monitoring shall continue until it has been demonstrated that the mitigation has met the ecological success criteria.

The following paragraphs outline the St. Louis District's plans for mitigation and monitoring to assess ecological success of the mitigation for the Mel Price-Wood River Levee Underseepage Project. The project area consists of a portion of the riverfront levee of the Wood River Drainage and Levee District that is adjacent to the Mel Price Locks and Dam, the associated levee right of way, and the East Alton No. 1 pump station's ponding area.

2) ***Objectives.***

The objective is to restore forested areas affected by interim measures by reforesting the 0.5 acre of bottomland hardwood forest that was cleared of trees to construct Dike B, and the estimated 25 acres of forested wetlands expected to die due to the prolonged detention of surface water in the pump station's ponding area.

3) ***Site Selection.***

Mitigation is proposed on-site within the project area, specifically within the ponding area of the East Alton No. 1 pump station.

4) ***Site Protection Instrument.***

A site protection instrument is proposed. Fee acquisition with a conservation easement will be required to provide perpetual protection to the sites replanted with trees.

5) ***Baseline Information.***

Impact Sites: Areas impacted by interim measures include 0.5 acre of non-wetland bottomland hardwood forest adjacent to Dike B, and an estimated 25 acres of forested wetlands located along the margins of the ponding area.

Non-wetland bottomland hardwood forest occurs in the vicinity of the East Alton pump station, at various locations on the north side of the ditch leading to the pump station, and along the smaller ditches that feed into the main ditch. This type of forest occupies elevations above approximate elevation 412 feet, and rarely experiences ponding of stormwater. Because of the relatively high ground elevations, this type of forest generally does not intercept groundwater seepage from the levee as sheet flow. Also, the tree roots are usually high enough above the prevailing groundwater table to not be influenced by saturated soil conditions. Tree species that were cleared include hackberry (*Celtis occidentalis*), honey locust (*Gledistia triacanthos*), cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), red mulberry (*Morus rubra*), American elm (*Ulmus americana*), and red bud (*Cercis canadensis*). The average tree diameter at breast height (dbh) was about 7 inches (range 4-20). Groundcover is usually very dense and often includes exotic species such as bush honeysuckle.

Forested wetlands are a relatively minor component along the landside of the riverfront levee. They typically border areas of deep or shallow marsh, and often occur near the landside toe of the levee. Areas of forested wetland that occupy slightly lower elevations and are wetter support a lower diversity of tree species, such as willow (*Salix* sp.), silver maple, and green ash. Groundcover may not be present at all or may be represented by a discontinuous layer of various sedges, forbs, and grasses. Areas of forested wetland that occupy higher ground often support a greater diversity of tree species, including silver maple, green ash, cottonwood (*Populus deltoides*), red mulberry (*Morus rubra*), and dogwood (*Cornus* sp.). Groundcover is typically dense, notably taller, and similarly greater in herbaceous plant diversity. Lower forested wetland normally experiences frequent to somewhat infrequent fluctuations in stormwater ponding. Higher areas of forested wetland are infrequently flooded, and they intercept groundwater seepage where this forest occurs along the landside toe of the levee. Lower forested wetland occurs in the approximate elevation range of 408-410 feet, and higher forested wetland in the range of 410-412 feet.

The areas of impacted forest have been disturbed by various human activities. A variety of animal species use the urbanized project area. Most wildlife species are adapted to human disturbance or tolerant of fragmented habitats or poor water quality, and consist of a variety of amphibians, reptiles, birds, and mammals. Herbaceous wetlands adjacent to forested areas serve as resting and feeding areas for some migratory ducks. Turkey may also be seen as well as red-winged blackbirds in herbaceous wetlands.

Mitigation Sites: The forested sites impacted by interim measures are the proposed mitigation sites.

6) ***Determination of Credits.***

Because this mitigation plan proposes to rectify or replace trees impacted by the implementation of interim measures, a traditional ecological benefit analysis was not conducted. However, the benefit of planting tree seedlings in forested wetlands with expected tree mortality was calculated using a habitat evaluation. A cost effectiveness/incremental cost analysis was also conducted to identify the most cost effective method of planting tree seedlings. The results of these exercises are presented in Attachment C-B of Appendix C.

7) ***Mitigation Work Plan.***

Once the final risk reduction measures are completed, the haul road to Dike B, consisting of crushed stone, would be removed and the ground surface would be restored. The 0.5 acre of tree clearing would be reforested. Similarly, once the interim measure of surface water detention in the pump station's ponding area is no longer required, the areas of expected tree mortality would also be reforested. Native containerized Root Production Method (RPM) bottomland hardwood and forested wetland tree species would be planted at the impact sites. RPM trees are grown from locally-collected seed and are better able to survive the herbivory, competition, and flooding that occurs in the floodplain environment. Planting density would be 50 seedlings per acre. The bottomland hardwood site would be planted with a mixture of softwood species, such as green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*), and box elder (*Acer negundo*); pecan (*Carya illinoinensis*) would also be included. Tree species to be planted in forested wetlands along the margins of the ponding area would include a mixture of softwood and hardwood species, such as green ash (*Fraxinus pennsylvanica*), river birch (*Betula nigra*), box elder (*Acer negundo*), pin oak (*Quercus palustris*), and bur oak (*Quercus macrocarpa*). For each tree seedling planted in forested wetlands with dead trees a small clearing would be created to increase sunlight. Planted trees will be tagged to facilitate monitoring.

8) ***Performance Standards.***

Percent survival of planted tree seedlings will be used as the performance standard for measuring success. Bottomland hardwood and forested wetland plantings shall be considered to be successful if after one year there is a minimum of 80% survivorship.

9) ***Monitoring Requirements.***

Monitoring will commence the year after the planting of tree seedlings is completed.

A survey of planted areas will be conducted during the growing season of the year following the completion of planting. At the 0.5 acre planting site, all planted seedlings will be examined. At the forested wetland planting sites, ten points will be randomly selected from the planting areas. Each of these points will form the center of a square $1/5^{th}$ acre sampling plot. If plots overlap or extend beyond the planting site boundaries, additional random points shall be selected until 5 suitable plots are found. The GPS coordinate for the center of each plot will be recorded to allow for relocation of the plot. All planted trees within the 5 plots will be examined and recorded by species and state (alive/dead). From this data, the overall survival rate of planted trees will be calculated. Any additional information such as storm damage or diseases should also be noted.

If survivorship is at least 80%, the bottomland hardwood forest and forested wetland plantings will be considered successful. If survivorship is less than 80%, a maintenance plan will be required, and will consist of the replanting of additional seedlings to make up the difference. Monitoring and replanting will continue on an annual basis until 80% survival is attained..

The monitoring and potential replanting described above would be included as a construction cost, which is a 100 percent Federal cost.

10) ***Long-Term Management Plan.***

A long-term management plan will not be required.

11) ***Adaptive Management Plan.***

An adaptive management plan will not be required.

12) ***Financial Assurances.***

Financial assurances are usually designed to ensure that sufficient funds are available for mitigation site acquisition, preparation, monitoring, adaptive management, and perpetual maintenance of the mitigation site. In the case of this mitigation feature or project, no financial assurances would be required of any non-Federal sponsor.

13) Cost.
The cost of monitoring is estimated to be $1,500.

14) Other Information.

No non-Federal sponsor will be held responsible for mitigation site failure due to natural catastrophes, extreme weather conditions (i.e., drought or flooding), extreme predation of plantings or other events that the USACE determines is out of a non-Federal sponsor's control to anticipate, prevent or reasonably repair within the constraints of the original financial resources.

REAL ESTATE PLAN FOR
DESIGN DEFICIENCY REPORT
FOR
WOOD RIVER MELVIN PRICE UNDERSEEPAGE PROJECT

APPENDIX D

REAL ESTATE PLAN

Project Description

The existing Wood River levee system protects the metropolitan area of Madison County in southwestern Illinois. The system provides flood protection to approximately 14,000 acres of primarily industrial, commercial, agricultural and residential land including the Cities of East Alton, Hartford, Roxana, and Wood River. The flood control system is located between the City of Alton on the northwest and the Cahokia Diversion Canal on the southeast. Construction of Melvin Price Locks and Dam caused uncontrolled seepage and conveyance of material under the Wood River Levee in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions, requiring additional protection.

The proposed project includes relief wells from station 55+00 to 80+00 and cutoff wall from 81+00 to 126+00, opposite the permanent navigation pool at the Melvin Price Locks and Dam.

1. Purpose

The Flood Control Act of December 31, 1970, Public Law 91-611 authorized the review of the operation of projects due to significant changes. This legislation combined with Engineer Regulation ER 1165-2-119, which indicates corrective action falls within the original project authorization, directed the St. Louis District to investigate the need for project modification. The purpose of this Limited Reevaluation Report is to serve as the "decision document." This Real Estate Plan is in support of the Limited Reevaluation Report (LRR). Deficiencies in the system consist of under seepage problems discovered in July 2009 while working on the Wood River Design Deficiency Correction project. The design deficiency correction project will restore the underseepage controls for the Wood River levee so they function safely with floods at the originally constructed net levee grade which corresponds to 52 ft on the St. Louis gage.

The Construction and subsequent Operation and Maintenance (O&M) for the Melvin Price Locks and Dam Project is 100 percent federally funded. The underseepage problem was caused by a design deficiency in the Melvin Price Locks and Dam. The responsibility to acquire Right-of-Way (ROW) will therefore be fully Federal.

This Federal project will include the Wood River Drainage and Levee District (WRDLD) taking responsiblity for the Operation, Maintenance, Repairs, Replacements and Rehabilitation (OMRRR) of the underseepage modifications to the levee. This Real Estate Plan supports the recommendations contained in the LRR.

2. Lands, Easements, and Rights-of-Way (LER)

a. Description of Lands, Easements and Rights-of-Way (LER) required for the construction operation and maintenance of the project

The recommended plan provides for the completion of the project with flood control features as follows: slurry trench cutoff walls and relief wells.

b. Total LER required for each project purpose and feature.

Fee

25 acres will be the maximum required for mitigation. The actual locations have not been identified at this time. Final acquisition will occur prior to project completion.

Permanent Easement

1.5 acres of permanent easement will be required for the pipes on the T-type relief wells. The landowners are Alton Center Business Park and Illinois Department of Transportation.

Temporary Easement

10 acres of temporary easement will be required for disposal. The landowners are ASARCO and Green Investment Group.

Corps approved estates are depicted in Exhibit "A".

3. LER Required that is Owned by Sponsor

Sponsor-owned lands that lie within the project area are those associated with the current levee right-of-way and flood protection features. WRDLD owns fee and/or permanent easement for the entire Wood River Levee from river mile 195 to 202. While some of the new project features will be performed within current right-of-way; additional LER will be required for this project.

4. Proposed non-standard estates

No non-standard estates are required for the project.

5. Existing Federal Project within the LER Required for the Project

The original flood protection project was partially federally funded through the Flood Control Act of 1938. Melvin Price Lock and Dam is located within the boundaries of the Wood River Drainage and Levee District.

6. Federally Owned Land Required for the Project

Approximately 10.5 acres of federally owned land are required for the project for contracting staging and access. This land is managed by the Corps of Engineers, St. Louis District.

7. Navigation Servitude

Navigation servitude is not applicable to this project.

8. Map depicting the area

A project map of the area is included as Exhibit "B."

9. Possibility of Induced Flooding Due to Project

No induced flooding has been identified for this project.

10. Baseline Cost Estimate

For a summary of total real estate costs see Exhibit "C."

11. Relocation Assistance Benefits under Public Law 91-646

No persons, farms, or businesses will require relocation assistance as a result of this project.

12. Mineral Activity in Project Area

No mineral activity is located in the project area.

13. Sponsors Legal and Professional Capability to Acquire LER

This fully federal project does not include Non-Federal sponsor acquisition. The Government has the capability and legal right to acquire property.

14. Zoning ordinances proposed

No zoning ordinances are proposed.

15. Schedule of Land Acquisition Milestones

A detailed schedule will be developed when final ROW is determined. Normally, a period of one-year is allowed to acquire the ROW after receipt of the final ROW limits. This one-year period does not include land which may have to be condemned.

16. Facility or Utility Relocations/Alterations

The following are the known utilities in the area: Owens Corning abandoned wastewater main, Ameren Gas Line, Alton Steel force main, and Alton Box Board effluent line. Further actions will be determined as additional information becomes available from Engineering.

17. Impacts of Suspected or Known Contaminants

The existence of HTRW is unknown. Contingencies will be put in place to properly dispose of HTRW, if discovered.

18. Landowner Support or Opposition to the Project

No opposition is known to exist for the project.

19. Notification to the Non-Federal Sponsor Regarding the Risks Associated With Land Acquisition before Execution of the Project Partnership Agreement (PPA)

The Non-Federal sponsor will not be responsible for the acquisition on this direct federal project.

20. Other Real Estate Issues Relevant to the Project

A Supplemental REDM will be prepared for this direct federal acquisition. While the Non-Federal sponsor will not acquire the LER, an agreement will be put into place assigning operation and maintenance responsibility to Wood River Drainage and Levee District.

Timothy J. Nelson
Chief, Real Estate Division
USACE, St. Louis District

Real Estate Plan-Tim Kennedy
Cost Estimate-Jim Lovelace

EXHIBIT A

CORPS APPROVED ESTATES

1. FEE.

The fee simple title to (the land described in Schedule A) (Tracts Nos. , and), Subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines. 1

2. PERPETUAL WELL EASEMENT.

A perpetual easement and right-of-way in, on, over and across (the land described in Schedule A)(Tracts Nos. ___, ___ and ___) (for a period not of ___ years beginning with [_(date)_])(the date this instrument is accepted by the United States)(the date possession of the land is granted to the United States)for use by the United States, its representatives, agents and contractors for the construction, operation, maintenance, alteration, repair, monitoring and removal of relief wells, pipelines and appurtenant facilities and to perform any other work necessary in connection with the _________ Project, together with the continuing right to trim, cut, fell and remove therefrom all trees, underbrush, other vegetation, structures or obstructions within the limits of the rights-of-way, reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

3. TEMPORARY WORK AREA EASEMENT.

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed ___________________, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the ____________________ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

---

1 Where an outstanding interest in the subsurface mineral estate is part of a block ownership which is to be excluded from the taking in accordance with paragraph 5-289 (2), the following clause will be added: "excepting and excluding from the taking all interests in the (coal) (oil and gas)which are outstanding in parties other than the surface owners and all appurtenant rights for the exploration, development and removal of said (coal) (oil and gas) so excluded."

Exhibit B (page 1 of 3)

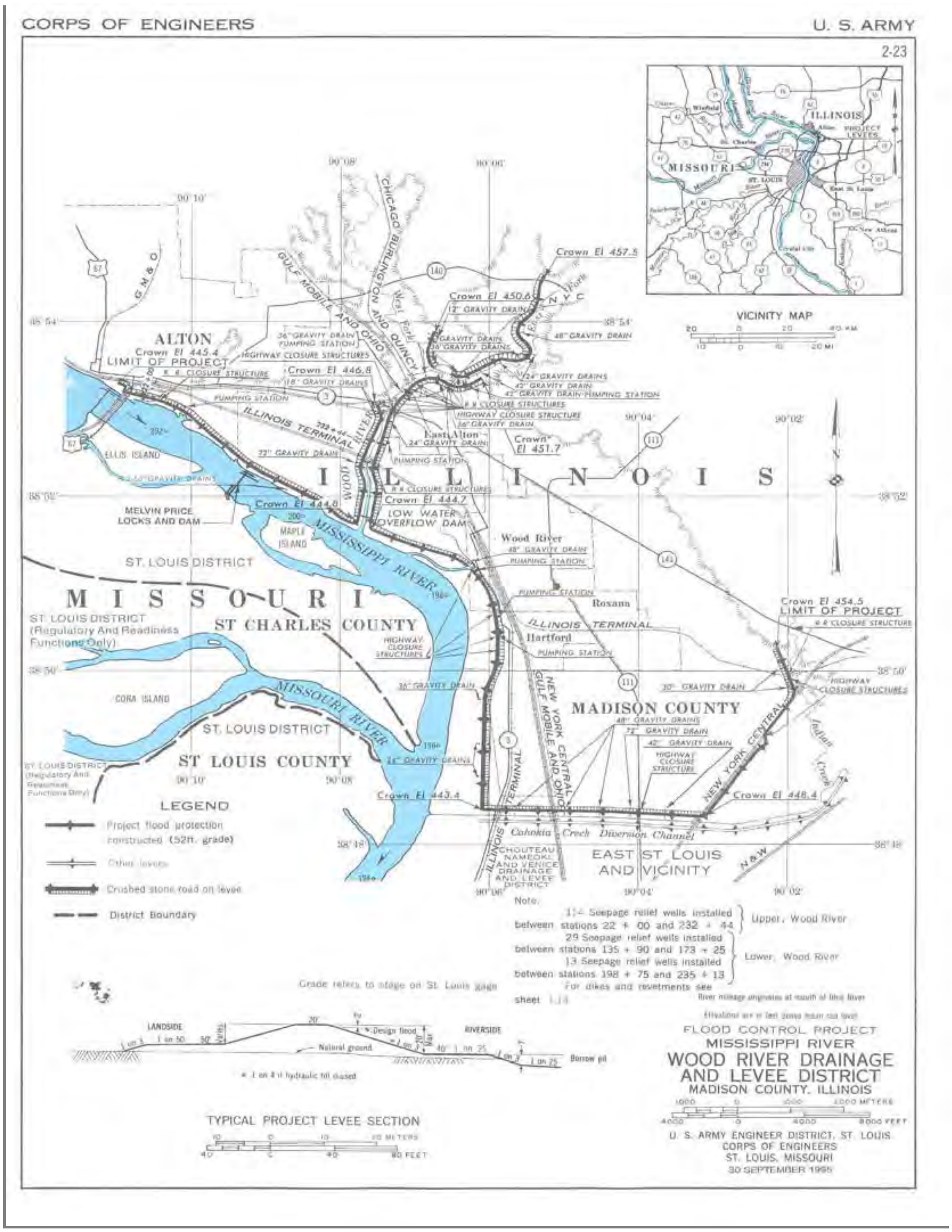


Exhibit B (pg 2 of 3)
Permanent Easement

Exhibit B (3 of 3)
Disposal Site

MEL PRICE / WOOD RIVER UNDERSEEPAGE PROJECT
LIMITED RE-EVALUATION REPORT
Date of Estimate: 28 Sep 2011
(1st Revision: 29 Feb 2012)

(a) Lands and Damages	**Unit**	**Unit Value**	**% of Fee**	**Total**
	(acres)			
Permanent Easement				
Light Industrial				
Unimproved (Marginal w/Ponding, Encumbered)	1.5	$4,500	100%	$6,750
Temporary Disposal Easement				
Light Industrial				
Unimproved (development potential)	10	$25,000	10%	$25,000
Mitigation (Fee)				
Light Industrial				
Unimproved (Marginal w/Ponding, Encumbered)	25	$4,500	100%	$112,500
Subtotal (Rounded)				**$144,500**
(b) Incremental Costs 35% (Rounded)				$50,500
(c) Total Lands, Easements, and Right-of-Way				**$195,000**
(d) Acquisition Costs per Owner				
Planning $2,000	3	$17,000		$51,000
Acquisition $10,000				
Appraisal $5,000				
Total $17,000				
(e) Relocation Costs per Owner				
Title III Payments	3	$500		$1,500
(f) Total Non-Federal Project Cost (Rounded)				**$250,000**

Appraiser: James T. Lovelace

Notes:

Permanent Easement is considered to be tantamount to fee simple.

Temporary Disposal Area is considered tantamount to market rental or 10% of the fee value. Term = 1 yr.

LIMITED REEVALUATION REPORT
ON DESIGN DEFICIENCY CORRECTIONS FOR
WOOD RIVER MEL PRICE UNDERSEEPAGE PROJECT

APPENDIX E

COST ESTIMATES

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: Melvin Price Wood River Underseepage Design Deficiency Project
LOCATION: Wood River, Illinois

DISTRICT: MVS - St. Louis PREPARED: 3/5/2012
POC: CHIEF, COST ENGINEERING

This Estimate reflects the scope and schedule in report; Limited Reevaluation Report

						Program Year (Budget EC): 2014								
						Effective Price Level Date: 1 OCT 13				TOTAL PROJECT COST (FULLY FUNDED)				
		ESTIMATED COST				**PROJECT FIRST COST**				Spent Thru:				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	5-Mar-12 ($K)		COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
02	RELOCATIONS	$158	$36	23%	$194	2.9%	$163	$37	**$200**			$166	$38	$204
06	FISH & WILDLIFE FACILITIES	$196	$45	23%	$241	2.9%	$202	$46	**$248**			$206	$47	$253
11	LEVEES & FLOODWALLS	$19,490	$4,473	23%	$23,963	2.9%	$20,054	$4,602	**$24,656**			$20,718	$4,755	$25,473
18	CULTURAL RESOURCE PRESERVATION	$25	$6	23%	$31	2.9%	$26	$6	**$32**			$26	$6	$32
	CONSTRUCTION ESTIMATE TOTALS:	$19,869	$4,560		**$24,429**	2.9%	$20,444	$4,692	**$25,136**			$21,116	$4,846	$25,962
01	LANDS AND DAMAGES	$250			$250	2.9%	$257		**$257**			$264		$264
30	PLANNING, ENGINEERING & DESIGN	$3,845	$882	23%	$4,727	6.3%	$4,087	$938	**$5,025**			$4,292	$985	$5,278
31	CONSTRUCTION MANAGEMENT	$1,988	$456	23%	$2,444	6.3%	$2,113	$485	**$2,598**			$2,283	$524	$2,807
	PROJECT COST TOTALS:	$25,952	$5,899	23%	**$31,851**	3.7%	$26,901	$6,115	**$33,015**			$27,956	$6,355	$34,311

Gary J. Lee, P.E. — CHIEF, COST ENGINEERING

Timothy J. Kerr — PROJECT MANAGER

Timothy J. Nelson — CHIEF, REAL ESTATE

CHIEF, PLANNING,xxx

CHIEF, ENGINEERING, xxx

CHIEF, OPERATIONS, xxx

CHIEF, CONSTRUCTION, xxx

CHIEF, CONTRACTING,xxx

CHIEF, PM-PB, xxxx

CHIEF, DPM, xxx

ESTIMATED FEDERAL COST: 100% **$34,311**
ESTIMATED NON-FEDERAL COST:

ESTIMATED TOTAL PROJECT COST: $34,311

O&M OUTSIDE OF TOTAL PROJECT COST:

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Melvin Price Wood River Underseepage Design Deficiency Project
LOCATION: Wood River, Illinois
This Estimate reflects the scope and schedule in report; Limited Reevaluation Report

DISTRICT: MVS - St. Louis PREPARED: 3/5/2012
POC: CHIEF, COST ENGINEERING

Estimate Prepared: 5-Mar-12
Effective Price Level: 5-Mar-12

Program Year (Budget EC): 2014
Effective Price Level Date: 1 OCT 13

WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED PROJECT ESTIMATE Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***P***	***L***	***M***	***N***	***O***
	PHASE 1													
02	RELOCATIONS													
06	FISH & WILDLIFE FACILITIES													
11	LEVEES & FLOODWALLS	$3,611	$829	23%	$4,440	2.9%	$3,715	$853	$4,568	2014Q3	0.9%	$3,747	$860	$4,607
18	CULTURAL RESOURCE PRESERVATION	$25	$6	23%	$31	2.9%	$26	$6	$32	2014Q3	0.9%	$26	$6	$32
	CONSTRUCTION ESTIMATE TOTALS:	$3,636	$834	23%	**$4,470**		$3,741	$859	$4,600			$3,773	$866	$4,639
01	LANDS AND DAMAGES			23%										
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$73	$17	23%	$90	6.3%	$78	$18	$95	2014Q1		$78	$18	$95
1.0%	Planning & Environmental Compliance	$36	$8	23%	$44	6.3%	$38	$9	$47	2014Q1		$38	$9	$47
9.5%	Engineering & Design	$345	$79	23%	$424	6.3%	$367	$84	$451	2014Q1		$367	$84	$451
1.5%	Engineering Tech Review	$55	$13	23%	$68	6.3%	$58	$13	$72	2014Q1		$58	$13	$72
1.0%	Contracting	$36	$8	23%	$44	6.3%	$38	$9	$47	2014Q1		$38	$9	$47
2.0%	Engineering During Construction	$73	$17	23%	$90	6.3%	$78	$18	$95	2014Q3	2.1%	$79	$18	$97
	Geotechnical Investigations	$468	$107	23%	$575	6.3%	$497	$114	$612	2014Q3	2.1%	$508	$117	$624
31	CONSTRUCTION MANAGEMENT													
8.0%	Construction Management	$291	$67	23%	$358	6.3%	$309	$71	$380	2014Q3	2.1%	$316	$72	$388
2.0%	Project Management	$73	$17	23%	$90	6.3%	$78	$18	$95	2014Q3	2.1%	$79	$18	$97
	CONTRACT COST TOTALS:	$5,086	$1,167		**$6,253**		$5,282	$1,212	$6,495			$5,334	$1,224	**$6,559**

**** TOTAL PROJECT COST SUMMARY ****

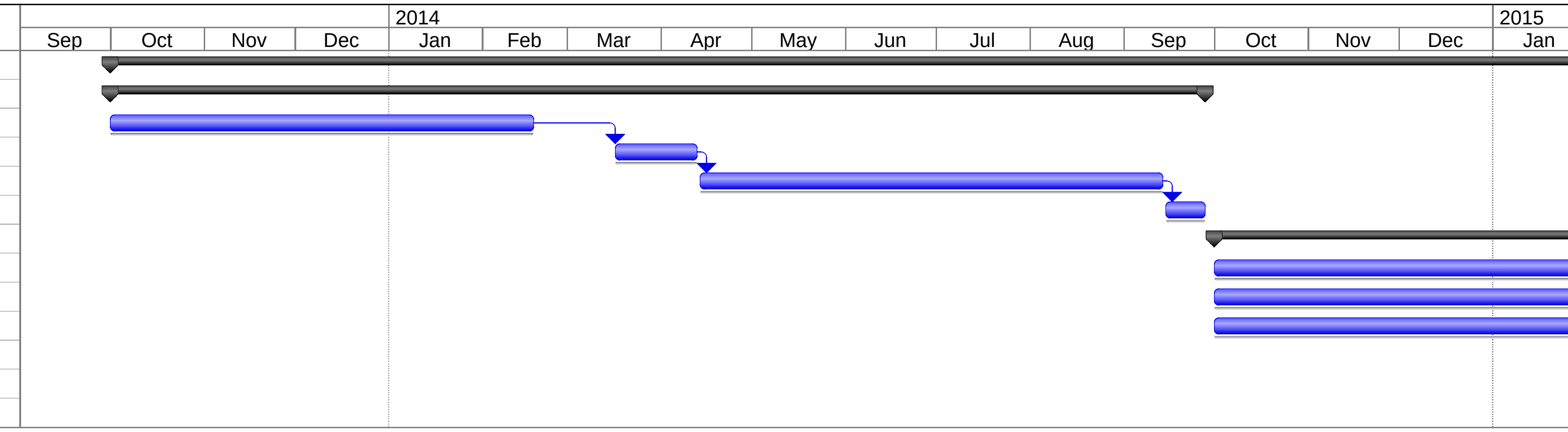
**** CONTRACT COST SUMMARY ****

PROJECT: Melvin Price Wood River Underseepage Design Deficiency Project
LOCATION: Wood River, Illinois
This Estimate reflects the scope and schedule in report; Limited Reevaluation Report

DISTRICT: MVS - St. Louis
POC: CHIEF, COST ENGINEERING
PREPARED: 3/5/2012

	Estimate Prepared:	5-Mar-12				Program Year (Budget EC):			2014	FULLY FUNDED PROJECT ESTIMATE				
	Effective Price Level:	5-Mar-12				Effective Price Level Date:			1 OCT 13					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***P***	***L***	***M***	***N***	***O***
	PHASE 2 - SLURRY TRENCH WALL													
02	RELOCATIONS	$158	$36	23%	$194	2.9%	$163	$37	$200	2015Q2	2.1%	$166	$38	$204
06	FISH & WILDLIFE FACILITIES	$196	$45	23%	$241	2.9%	$202	$46	$248	2015Q2	2.1%	$206	$47	$253
11	LEVEES & FLOODWALLS	$15,879	$3,644	23%	$19,523	2.9%	$16,338	$3,750	$20,088	2016Q2	3.9%	$16,971	$3,895	$20,865
18	CULTURAL RESOURCE PRESERVATION													
	CONSTRUCTION ESTIMATE TOTALS:	$16,233	$3,725	23%	**$19,958**		$16,703	$3,833	$20,536			$17,343	$3,980	$21,323
01	LANDS AND DAMAGES	$250			$250	2.9%	$257		$257	2015Q3	2.6%	$264		$264
30	PLANNING, ENGINEERING & DESIGN													
2.0%	Project Management	$325	$75	23%	$400	6.3%	$345	$79	$425	2015Q3	6.2%	$367	$84	$451
1.0%	Planning & Environmental Compliance	$162	$37	23%	$199	6.3%	$172	$40	$212	2015Q3	6.2%	$183	$42	$225
9.5%	Engineering & Design	$1,542	$354	23%	$1,896	6.3%	$1,639	$376	$2,015	2015Q3	6.2%	$1,741	$400	$2,141
1.5%	Engineering Tech Review	$243	$56	23%	$299	6.3%	$258	$59	$318	2015Q3	6.2%	$274	$63	$337
1.0%	Contracting	$162	$37	23%	$199	6.3%	$172	$40	$212	2015Q3	6.2%	$183	$42	$225
2.0%	Engineering During Construction	$325	$75	23%	$400	6.3%	$345	$79	$425	2016Q2	9.4%	$378	$87	$465
31	CONSTRUCTION MANAGEMENT													
8.0%	Construction Management	$1,299	$298	23%	$1,597	6.3%	$1,381	$317	$1,698	2016Q2	9.4%	$1,510	$347	$1,857
2.0%	Project Operation:	$325	$75	23%	$400	6.3%	$345	$79	$425	2016Q2	9.4%	$378	$87	$465
	CONTRACT COST TOTALS:	$20,866	$4,731		**$25,597**		$21,618	$4,902	$26,521			$22,621	$5,131	**$27,752**

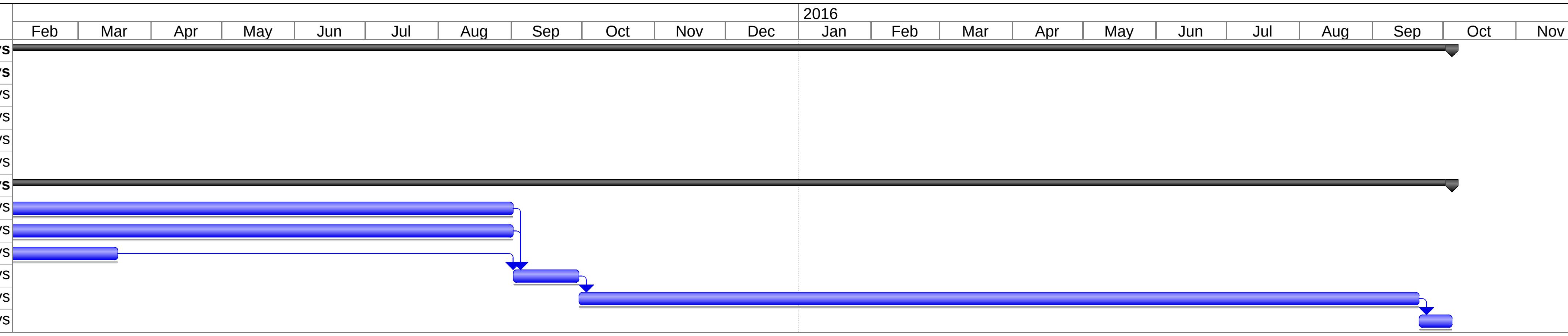
ID		ID	Task Name	Duration	Start	Finish	Predecessors
1		1	**Melvin Price Underseepage**	**884.06 days**	**Tue 10/1/13**	**Tue 10/4/16**	
2		2	**Relief Wells**	**291.56 days**	**Tue 10/1/13**	**Sat 9/27/14**	
3		3	Engineering Design	100 days	Tue 10/1/13	Mon 2/17/14	
4		4	Mobilization	30 days	Mon 3/17/14	Sat 4/12/14	3
5		5	Relief Well Construction	165 days	Mon 4/14/14	Sat 9/13/14	4
6		6	Demobilization	15 days	Mon 9/15/14	Sat 9/27/14	5
7		7	**Slurry Trench**	**590.63 days**	**Wed 10/1/14**	**Tue 10/4/16**	
8		8	Engineering Design	240 days	Wed 10/1/14	Tue 9/1/15	
9		9	Real Estate Acquisition	240 days	Wed 10/1/14	Tue 9/1/15	
10		10	Utility Relocation	120 days	Wed 10/1/14	Tue 3/17/15	
11		11	Mobilization	30 days	Wed 9/2/15	Tue 9/29/15	9,10,8
12		12	Slurry Wall Construction	240 days	Wed 9/30/15	Tue 9/20/16	11
13		13	Demobilization	15 days	Wed 9/21/16	Tue 10/4/16	12



Project: Mel Price Underseepage Sche
Date: Thu 3/1/12

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

ID	ID	Task Name	Duration
1	1	**Melvin Price Underseepage**	**884.06 days**
2	2	**Relief Wells**	**291.56 days**
3	3	Engineering Design	100 days
4	4	Mobilization	30 days
5	5	Relief Well Construction	165 days
6	6	Demobilization	15 days
7	7	**Slurry Trench**	**590.63 days**
8	8	Engineering Design	240 days
9	9	Real Estate Acquisition	240 days
10	10	Utility Relocation	120 days
11	11	Mobilization	30 days
12	12	Slurry Wall Construction	240 days
13	13	Demobilization	15 days



Project: Mel Price Underseepage Sche
Date: Thu 3/1/12

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

COST ESTIMATE ASSUMPTIONS

RECOMENDED DESIGN - The recommended design is a Slurry Trench Cut-off Wall with Relief Wells. The analysis of underseepage requirements for the Mel Price/Wood River flood protection system indicates that a cutoff needs to be a three-foot wide trench extending from the riverside of the levee to the top of rock.

COST ESTIMATE – The cost estimate has been prepared based on current concept designs and site information available to date. Pricing data was developed from recent contract estimates for similar projects in the St. Louis Area. This cost estimate is considered the Current Working Estimate and considers costs for all phases of the project.

SITE DEMO – The concrete headwalls at the outlets of existing relief wells shall be removed and disposed of. The areas will be backfilled with impervious fill after the outlet pipes are grouted. Also the existing concrete lined ditch that drains the relief well flows shall be removed and disposed of. The area will be backfilled and graded after the removal.

RELIEF WELLS – There are 55 new relief wells to be installed. The area upstream of Cpl Belececk Rd from sta. 55+00 to sta. 80+00 will require 46 new relief wells for underseepage protection. An additional 9 relief wells will be required for the construction of the slurry wall. Two will be just downstream of Cpl Belececk Rd and 7 will be required for the slurry trench window at the Alton Steel force main at approximate sta 93+00. (assume a 100' window) The average depth of relief wells is assumed to be 60'.

The new relief wells will be drilled using the reverse rotary method. The diameter of the hole shall be such that will permit placement of the minimum thickness of filter pack required. Relief well development shall be accomplished by high-velocity, horizontal jetting and simultaneous airlift pumping. Pumping tests will be required to determine whether the well has been adequately developed. Pumping tests are assumed to be accomplished using a deep-well submersible pump.

All existing wells are to be grouted shut.

SLURRY TRENCH WALL – The slurry trench wall will be a cement/bentonite wall. The mix design is based on a previous contract and consists of 83lb of cement and 23lb of bentonite per sf. Water is assumed to be pumped from local sources.

The slurry trench is assumed to be 3' wide, 120' deep and 4700lf in length. There's approximately 61,300 cy of material to be excavated for the slurry wall trench. The slurry trench wall will start at sta. 79+00 and end at sta. 126+00. The wall will be constructed along the riverside toe. The average depth to top of rock at this location is 120'. An opening will be left in the wall downstream of Cpl Belececk Rd at the Alton Steel force main at approximate sta 93+00. (assume a 100' window) All excavated material is to be replaced with a cement - bentonite slurry mix. Assume excavated material to be disposed of onsite at a site yet to be determined. Assume Panel construction. A productivity factor has been considered for anticipated downtime.

Assume two different type pieces of equipment will be required for trench excavation. (long reach backhoe & dragline) The same operator will alternate equipment usage.

CULTURAL RESOURCES – In accordance with Section 106 of the National Historic Preservation Act (NHPA), the project area will require further testing, as well as coordination and consultation with the Illinois SHPO, interested Native American Tribes, and stakeholders. Testing will consist of background research, coordination, fieldwork, compliance documentation, as well as curation. The cost considered is based on a system wide cost to be incurred for all Metro East projects.

Mel Price Wood River Underseepage LRR Post AFB 5 Mar 2012 ver 4

LIMITED REEVALUATION REPORT
MELVIN PRICE WOOD RIVER UNDERSEEPAGE
DESIGN DEFICIENCY PROJECT

COST ESTIMATE

MELVIN PRICE LOCK AND DAM
MADISON COUNTY, ILLINOIS

Estimated by	St. Louis District
Designed by	
Prepared by	Gregory Dyn
Preparation Date	3/5/2012
Effective Date of Pricing	3/5/2012
Estimated Construction Time	Days

Description	Page

Table of Contents

Date	Author	Note
9/24/2010	Dyn	STUDY PURPOSE -

The purpose of this study is to examine the need for and feasibility of modifications to the Melvin Price Lock and Dam Project to correct an underseepage design deficiency. The study examines alternative ways to correct the design deficiency, assesses the environmental impacts of the alternatives and the tentative recommended plan, discusses various reviews of the planning effort (including public review and Independent External Peer Review comments), and will recommend a design deficiency correction project for implementation.

The Limited Reevaluation Report evaluates the design deficiency associated with the uncontrolled underseepage and conveyance of material that is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular inspections and is normally covered by several feet of water. The district concludes that the uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam, two miles downstream from the original structure. This replacement resulted in a navigation pool raise that has impacted the levee foundation. It is unknown when this issue developed, however it appears to have persisted for a significant time. Additionally, the degree of deterioration of the levee foundation is unknown. The Wood River Levee is at unacceptable risk during a high water event.

As a function of this investigation current engineering standards were utilized, original design intent was compared to existing conditions, and problems identified were categorized as a design deficiency. The goal of the study is to evaluate levee underseepage conditions and determine the federal interest in addressing problems in the Wood River Levee that are a direct result of Melvin Price Lock and Dam navigation pool.

LOCATION OF PROJECT/ CONGRESSIONAL DISTRICT -
The Melvin Price Lock and Dam is located in Madison County, Illinois, and St. Charles County, Missouri, at Mississippi River Mile 200.78, 2 miles below Alton Illinois, between the mouth of the Missouri River and the Illinois River. This decision document is focused on a section of the Wood River Levee from project station 0+00 to 115+00 which is located opposite the permanent navigation pool at the Melvin Price Lock and Dam. This portion of the Wood River Levee has experienced uncontrolled underseepage caused by the navigation pool at the Melvin Price Lock and Dam.

The study area is located in both the Illinois 12th and 19th Congressional Districts, which are currently held by Congressman Jerry Costello and John Shimkus respectively.

PROJECT DESCRIPTION -
The Melvin Price Lock and Dam project includes one 1,200-foot lock, one 600-foot lock, a dam with nine tainter gates, an overflow dike, and a visitor center. Mitigation lands were provided to compensate for wildlife losses due to creation of a new pool for the two-mile distance downstream of the original structure. The Melvin Price Locks and Dam was constructed at river mile 200.8 and is 2.2 miles downstream from the original Lock and Dam No. 26. The permanent navigation pool is low located opposite of the Wood River Levee from levee stationing 0+00 to 115+00. The primary flood-related problem in the project area is the uncontrolled underseepage located in a section of the Wood River Levee from project station 0+00 to 115+00.

The Wood River Flood Protection Project consists of levee, gravity drainage structures, closure structures at railroad and highway crossings, pump stations, seepage control measures, and a low-water dam at the mouth of Wood River. The project as intended provides protection against a 52 foot Mississippi River stage on the St. Louis Gage. In addition to providing protection to the land side area, the levee structure is a part of the containment features for the Melvin Price Locks and Dam Project.

GENERAL SYSTEM CONDITIONS -
Uncontrolled underseepage and conveyance of material is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular inspections and is normally covered by several feet of water. During the flood of 1993, the area adjacent to the upper pool of Melvin Price Locks and Dam was kept flooded by the Wood River Drainage and Levee district per its established operation plan. The interior ponding was to an elevation no lower than about elevation 410. This interior water prevented the flood fight teams from noticing or observing any seepage activity in the area.

RECOMENDED DESIGN -
The recomended design consists of utilizing relief wells upstream of Cpl Belecek Rd from Sta 55+00 to Sta 80+00. The upper reaches, from Sta 79+00 to Sta 126+00,

Date	Author	Note
9/24/2010	Dyn	will require the construction of a Slurry Trench Cut-off Wall with Relief Wells at the Slurry Trench windows. The analysis of underseepage requirements for the Wood River flood projection system indicates that a cutoff needs to be a three-foot wide trench extending from the riverside of the levee to the top of rock. COST ESTIMATE - The cost estimate has been prepared based on current concept designs and site information available to date. Pricing data was developed from recent contract estimates for similar projects in the St. Louis Area. This cost estimate is considered the Current Working Estimate and considers costs for all phases of the project.

Description	UOM	Quantity	DirectCost	CostToPrime	ContractCost	Contingency	ProjectCost
Owner Cost Level 1			**20,890,287.48**	**15,781,900.76**	**25,953,745.88**	**5,899,009.68**	**31,852,755.56**
01 Lands and Damages	**LS**	**1.0000**	**250,000.00**	**0.00**	**250,000.00**	**0.00**	**250,000.00**
02 Relocations	**LS**	**1.0000**	**121,276.90**	**121,276.90**	**157,937.15**	**36,246.58**	**194,183.73**
06 Fish and Wildlife Facilities	**LS**	**1.0000**	**150,739.76**	**150,739.76**	**196,306.22**	**45,052.28**	**241,358.49**
11 Levees and Floodwalls	**LS**	**1.0000**	**14,617,597.26**	**15,150,210.54**	**19,490,104.80**	**4,472,979.05**	**23,963,083.85**
18 Cultural Resource Preservation	**LS**	**1.0000**	**25,000.00**	**0.00**	**25,000.00**	**5,737.50**	**30,737.50**
30 Planning, Engineering and Design	**LS**	**1.0000**	**3,737,673.57**	**359,673.57**	**3,846,397.71**	**882,748.27**	**4,729,145.98**
31 Construction Management	**LS**	**1.0000**	**1,988,000.00**	**0.00**	**1,988,000.00**	**456,246.00**	**2,444,246.00**

Description	UOM	Quantity	DirectCost	CostToPrime	ContractCost	Contingency	ProjectCost
Owner Cost Level 2			**20,890,287.48**	**15,781,900.76**	**25,953,745.88**	**5,899,009.68**	**31,852,755.56**
01 Lands and Damages	**LS**	**1.0000**	**250,000.00**	**0.00**	**250,000.00**	**0.00**	**250,000.00**
Total Non-Federal Project Costs	**LS**	**1.0000**	**250,000.00**	**0.00**	**250,000.00**	**0.00**	**250,000.00**
02 Relocations	**LS**	**1.0000**	**121,276.90**	**121,276.90**	**157,937.15**	**36,246.58**	**194,183.73**
			145.6228	*145.6228*	*189.6424*		*233.1654*
Grout Existing Owens Wastewater Main (36"dia)	**LF**	**450.0000**	**65,530.24**	**65,530.24**	**85,339.09**	**19,585.32**	**104,924.41**
			101.3575	*101.3575*	*131.9965*		*162.2897*
Grout Existing Alton Box Board Sewer Effluent (30"dia)	**LF**	**550.0000**	**55,746.65**	**55,746.65**	**72,598.06**	**16,661.26**	**89,259.32**
06 Fish and Wildlife Facilities	**LS**	**1.0000**	**150,739.76**	**150,739.76**	**196,306.22**	**45,052.28**	**241,358.49**
06 01 Environmental Mitigation	**LS**	**1.0000**	**150,739.76**	**150,739.76**	**196,306.22**	**45,052.28**	**241,358.49**
11 Levees and Floodwalls	**LS**	**1.0000**	**14,617,597.26**	**15,150,210.54**	**19,490,104.80**	**4,472,979.05**	**23,963,083.85**
11 01 Levees	**LS**	**1.0000**	**14,617,597.26**	**15,150,210.54**	**19,490,104.80**	**4,472,979.05**	**23,963,083.85**
18 Cultural Resource Preservation	**LS**	**1.0000**	**25,000.00**	**0.00**	**25,000.00**	**5,737.50**	**30,737.50**
Project Area Archeological Investigations	**LS**	**1.0000**	**25,000.00**	**0.00**	**25,000.00**	**5,737.50**	**30,737.50**
30 Planning, Engineering and Design	**LS**	**1.0000**	**3,737,673.57**	**359,673.57**	**3,846,397.71**	**882,748.27**	**4,729,145.98**
PED Through Completion of Project	**LS**	**1.0000**	**3,378,000.00**	**0.00**	**3,378,000.00**	**775,251.00**	**4,153,251.00**
Geotechnical Investigations	**LS**	**1.0000**	**359,673.57**	**359,673.57**	**468,397.71**	**107,497.27**	**575,894.98**
31 Construction Management	**LS**	**1.0000**	**1,988,000.00**	**0.00**	**1,988,000.00**	**456,246.00**	**2,444,246.00**
CM Through Completion of Project	**LS**	**1.0000**	**1,988,000.00**	**0.00**	**1,988,000.00**	**456,246.00**	**2,444,246.00**

Description	UOM	Quantity	DirectCost	CostToPrime	ContractCost	Contingency	ProjectCost
Owner Cost Level 3			**20,890,287.48**	**15,781,900.76**	**25,953,745.88**	**5,899,009.68**	**31,852,755.56**
01 Lands and Damages	**LS**	**1.0000**	**250,000.00**	**0.00**	**250,000.00**	**0.00**	**250,000.00**
Total Non-Federal Project Costs	**LS**	**1.0000**	**250,000.00**	**0.00**	**250,000.00**	**0.00**	**250,000.00**
02 Relocations	**LS**	**1.0000**	**121,276.90**	**121,276.90**	**157,937.15**	**36,246.58**	**194,183.73**
Grout Existing Owens Wastewater Main (36"dia)	**LF**	**450.0000**	*145.6228* **65,530.24**	*145.6228* **65,530.24**	*189.6424* **85,339.09**	**19,585.32**	*233.1654* **104,924.41**
Grout Existing Alton Box Board Sewer Effluent (30"dia)	**LF**	**550.0000**	*101.3575* **55,746.65**	*101.3575* **55,746.65**	*131.9965* **72,598.06**	**16,661.26**	*162.2897* **89,259.32**
06 Fish and Wildlife Facilities	**LS**	**1.0000**	**150,739.76**	**150,739.76**	**196,306.22**	**45,052.28**	**241,358.49**
06 01 Environmental Mitigation	**LS**	**1.0000**	**150,739.76**	**150,739.76**	**196,306.22**	**45,052.28**	**241,358.49**
Forested Wetland Mitigation	**ACR**	**25.0000**	*6,029.5903* **150,739.76**	*6,029.5903* **150,739.76**	*7,852.2487* **196,306.22**	**45,052.28**	*9,654.3397* **241,358.49**
11 Levees and Floodwalls	**LS**	**1.0000**	**14,617,597.26**	**15,150,210.54**	**19,490,104.80**	**4,472,979.05**	**23,963,083.85**
11 01 Levees	**LS**	**1.0000**	**14,617,597.26**	**15,150,210.54**	**19,490,104.80**	**4,472,979.05**	**23,963,083.85**
Site Demolition of Exist Structures	**LS**	**1.0000**	**388,752.70**	**388,752.70**	**506,267.05**	**116,188.29**	**622,455.33**
New Relief Wells - avg depth 60'	**EA**	**55.0000**	*35,402.0438* **1,947,112.41**	*45,085.9216* **2,479,725.69**	*54,354.8152* **2,989,514.83**	**686,093.65**	*66,829.2452* **3,675,608.49**
Grout Existing Wells	**EA**	**80.0000**	*1,108.1999* **88,655.99**	*1,108.1999* **88,655.99**	*1,443.1928* **115,455.42**	**26,497.02**	*1,774.4055* **141,952.44**
Slurry Trench Wall	**SF**	**552,000.0000**	*22.0889* **12,193,076.16**	*22.0889* **12,193,076.16**	*28.7661* **15,878,867.50**	**3,644,200.09**	*35.3679* **19,523,067.59**
18 Cultural Resource Preservation	**LS**	**1.0000**	**25,000.00**	**0.00**	**25,000.00**	**5,737.50**	**30,737.50**
Project Area Archeological Investigations	**LS**	**1.0000**	**25,000.00**	**0.00**	**25,000.00**	**5,737.50**	**30,737.50**
Consultation and Coordination	**LS**	**1.0000**	**5,000.00**	**0.00**	**5,000.00**	**1,147.50**	**6,147.50**
Geomorphological Probe and Report	**LS**	**1.0000**	**6,000.00**	**0.00**	**6,000.00**	**1,377.00**	**7,377.00**
Background Research and Report Preparation	**LS**	**1.0000**	**8,000.00**	**0.00**	**8,000.00**	**1,836.00**	**9,836.00**
Unexpected Discovery	**LS**	**1.0000**	**6,000.00**	**0.00**	**6,000.00**	**1,377.00**	**7,377.00**
30 Planning, Engineering and Design	**LS**	**1.0000**	**3,737,673.57**	**359,673.57**	**3,846,397.71**	**882,748.27**	**4,729,145.98**
PED Through Completion of Project	**LS**	**1.0000**	**3,378,000.00**	**0.00**	**3,378,000.00**	**775,251.00**	**4,153,251.00**
Geotechnical Investigations	**LS**	**1.0000**	**359,673.57**	**359,673.57**	**468,397.71**	**107,497.27**	**575,894.98**
Relief Well Investigation	**LS**	**1.0000**	**359,673.57**	**359,673.57**	**468,397.71**	**107,497.27**	**575,894.98**
31 Construction Management	**LS**	**1.0000**	**1,988,000.00**	**0.00**	**1,988,000.00**	**456,246.00**	**2,444,246.00**

Description	UOM	Quantity	DirectCost	CostToPrime	ContractCost	Contingency	ProjectCost
CM Through Completion of Project	**LS**	**1.0000**	**1,988,000.00**	**0.00**	**1,988,000.00**	**456,246.00**	**2,444,246.00**

US Army Corps
of Engineers®

LIMITED REEVALUATION REPORT
MELVIN PRICE WOOD RIVER UNDERSEEPAGE
DESIGN DEFICIENCY PROJECT
FOR
ST. LOUIS DISTRICT, ST. LOUIS, MO

Prepared for:

St. Louis District, St. Louis, MO ___

Prepared by:

Paige Scott ____________________

Date: __5 March 2012 _____

TABLE OF CONTENTS

LIST OF TABLES

FIGURE

APPENDIX

EXECUTIVE SUMMARY

This report discusses the cost and schedule risk analysis (CSRA) process and results for the Melvin Price Wood River Underseepage Design Deficiency Project LRR Report. The Melvin Price Wood River Underseepage project is located in the vicinity of Alton, IL. A CSRA was performed to study project elements that could have an impact on the project cost and schedule. The CSRA measures that impact with a contingency calculation outcome based on an eighty (80) percent confidence level for both cost and schedule that are measured in terms of dollars and months, respectively.

The Melvin Price Wood River Underseepage Design Deficiency Project LRR evaluates the design deficiency associated with the uncontrolled underseepage and conveyance of material that is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. The Melvin Price Wood River Underseepage project is authorized in section 216 of the Flood Control Act of December 31, 1970, Public Law 91-611. Currently, the Melvin Price Wood River Underseepage project is at feasibility design development phase. The Melvin Price Wood River Underseepage project involves construction of a fully penetrating slurry trench cutoff. The cutoff will consist of a three foot wide trench extending from the levee crown down to the top of rock.

A cost and schedule risk analysis is conducted by identifying and assessing risk items for use in the risk analysis. These quantitative impacts of these risk items are then analyzed using a combination of professional judgment, empirical data, and analytical techniques. The total project cost contingency is then analyzed using the Crystal Ball software. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. A PDT meeting was held at the RAY Building in St. Louis, Missouri, for the purpose of identifying and assessing risk factors. The meeting included the Real Estate team member, Environmental team member, Civil Engineer, Cost Engineer, Hydraulic Engineer, Mechanical Engineer, and Geotechnical Engineer /Technical Manager.

Some key project assumptions were made to complete the risk analysis. To complete the schedule analysis, it was assumed that the first phase of construction would start at the beginning of FY 2014. This assumption also affects the cost estimate escalation amount used. In the cost analysis & estimate, it was assumed that the project would be constructed under one contract with a prime contractor and a subcontractor.

The cost and schedule risk analysis resulted in a recommended cost contingency of $4,295,347 and a schedule recommended contingency of 16.1 months. Those two results are combined to produce a total project contingency. The recommended total project contingency is 23%, or $5,899,107, based on the 80% confidence level. This contingency was applied to the detailed estimate for the recommended plan for the Melvin Price Wood River Underseepage project.

1. PURPOSE

This report discusses the cost and schedule risk analysis (CSRA) process and results for the Melvin Price Wood River Underseepage Design Deficiency Project LRR Report. The Melvin Price Wood River Underseepage project is located in the vicinity of Alton, IL. A CSRA was performed to study project elements that could have an impact on the project cost and schedule. The CSRA measures that impact with a contingency calculation outcome based on an eighty (80) percent confidence level for both cost and schedule that are measured in terms of dollars and months, respectively.

2. BACKGROUND

The Melvin Price Wood River Underseepage Design Deficiency Project LRR evaluates the design deficiency associated with the uncontrolled underseepage and conveyance of material that is occurring under the Wood River Levee, in an area adjacent to the upper pool of Melvin Price Locks and Dam during normal operating conditions. In July 2009, uncontrolled seepage was discovered while working on the Wood River Design Deficiency Correction project. The observation area is not within the footprint of regular inspections and is normally covered by several feet of water. The district concludes that the uncontrolled seepage is a result of replacing Lock and Dam 26 with the Melvin Price Locks and Dam, two miles downstream from the original structure. This replacement resulted in a navigation pool raise that has impacted the levee foundation. It is unknown when this issue developed, however it appears to have persisted for a significant time. Additionally, the degree of deterioration of the levee foundation is unknown. The Wood River Levee is at unacceptable risk during a high water event.

The Melvin Price Wood River Underseepage project is authorized in section 216 of the Flood Control Act of December 31, 1970, Public Law 91-611. Currently, the Melvin Price Wood River Underseepage project is at feasibility design development phase.

3. REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for both cost and schedule risks for all project features. The study and presentation can include or exclude consideration for operation and maintenance or life cycle costs, depending upon the program or decision document intended for funding.

3.1 Project Scope

Section 216 of the Flood Control Act of December 31, 1970, Public Law 91-611 authorizes the Melvin Price Wood River Underseepage Design Deficiency Project LRR Report. Engineer Regulation ER 1165-2-119 refers to this law. According to the ER, whenever reporting officers find that changes in a completed project may be desirable, investigations should be undertaken to document the need for and feasibility of project modification. Per the ER, a design or construction deficiency is a flaw in the Federal design or construction of a project that significantly interferes with the project's authorized purposes or full usefulness as intended by Congress at the time of original project development. Corrective action, therefore, falls within the purview of the original project authorization. Work to correct a design or construction deficiency may be recommended for accomplishment under existing project authority without further Congressional authorization if the proposed corrective action meets all the following conditions.

The Melvin Price Wood River Underseepage project involves construction of a fully penetrating slurry trench cutoff. The cutoff will consist of a three foot wide trench extending from the levee crown down to the top of rock.

The report includes the project technical scope, estimates, and schedules as developed and presented by the St. Louis District. Consequently, these documents serve as the basis for the risk analysis. In general terms, the construction scope consists of the following:

- Major project features studied from the civil works work breakdown structure (CWWBS) include:
  - 01 LANDS AND DAMAGES
  - 02 RELOCATIONS
  - 06 FISH AND WILDLIFE FACILITIES
  - 11 LEVEES AND FLOODWALLS
  - 18 CULTURAL RESOURCE PRESERVATION
  - 30 PLANNING, ENGINEERING & DESIGN
  - 31 CONSTRUCTION MANAGEMENT

The Melvin Price Wood River Underseepage project is currently at a feasibility study design phase with a Recommended Plan after considering several alternatives.

3.2 USACE Risk Analysis Process

The risk analysis process follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering DX). The risk analysis process reflected within the risk analysis report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. The risk analysis results are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analyses should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

- ER 1110-2-1150, Engineering and Design for Civil Works Projects.
- ER 1110-2-1302, Civil Works Cost Engineering.
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works.
- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering DX.
- Memorandum from Major General Don T. Riley (U.S. Army Director of Civil Works), dated July 3, 2007.
- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.

4. METHODOLOGY/PROCESS

The Melvin Price Wood River Underseepage Team consists of a Civil Engineer, Geotechnical Engineer, Hydraulic Engineer, Cost Engineer, Mechanical Engineer, Planning and Policy member, Environmental member, Real Estate, HTRW members, project managers, and oversight team members. Team members who took part in the risk analysis process included Real Estate, Environmental member, Civil Engineer, Cost Engineer, Hydraulic Engineer, Mechanical Engineer, and Geotechnical Engineer /Technical Manager. The Melvin Price Wood River Underseepage LRR started in April 2010 and will conclude in FY2012.

The MCACES detailed cost estimate and the construction schedule have successfully passed an Agency Technical Review (ATR). As such, the risk analysis outcome is based upon an approved product.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. A parallel process is also used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions, or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Engineering DX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk adverse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. Because Crystal Ball is an Excel add-in, the schedules for each option are recreated in an Excel format from their native format. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. The key assumptions in the ARTM risk analysis are provided in section 5. The risk analysis results are provided in section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT are considered a qualitative process that results in establishing a risk register that serves as the document for the further study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

A formal PDT meeting was held at the RAY Building in St. Louis, Missouri, for the purpose of identifying and assessing risk factors. The meeting on October 21, 2010 included the Real Estate team member, Environmental team member, Civil Engineer, Cost Engineer, Hydraulic Engineer, Mechanical Engineer, and Geotechnical Engineer /Technical Manager.

The first half of the formal meeting focused on risk factor identification using brainstorming techniques and some facilitated discussions based on risk factors common to projects of similar scope and geographic location. The second half of the formal meeting focused on risk factor assessment and quantification.

Additionally, calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions), because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The following is an example of the PDT quantifying risk factor impacts by using an iterative, consensus-building approach to estimate the elements of each risk factor:

- Maximum possible value for the risk factor.
- Minimum possible value for the risk factor.
- Most likely value (the statistical mode), if applicable.
- Nature of the probability density function used to approximate risk factor uncertainty.
- Mathematical correlations between risk factors.
- Affected cost estimate and schedule elements.

In this example, the risk discussions focused on the various project features as presented within the USACE Civil Works Work Breakdown Structure for cost accounting purposes. It was recognized that the various features carry differing degrees of risk as related to cost, schedule, design complexity, and design progress. The example features under study are presented in Table 1:

Table 1. Work Breakdown Structure by Feature

01	LANDS AND DAMAGES
02	RELOCATIONS
06	FISH AND WILDLIFE FACILITIES
11	LEVEES AND FLOODWALLS
18	CULTURAL RESOURCE PRESERVATION
30	PLANNING, ENGINEERING & DESIGN
31	CONSTRUCTION MANAGEMENT

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the base cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

For schedule contingency analysis, the option schedule contingency is calculated as the difference between the P80 option duration forecast and the base schedule duration. These contingencies are then used to calculate the time value of money impact of project delays that are included in the presentation of total cost contingency in section 6. The resulting time value of money, or added risk escalation, is then added into the contingency amount to reflect the USACE standard for presenting the "total project cost" for the fully funded project amount.

Schedule contingency is analyzed only on the basis of each option and not allocated to specific tasks. Based on Cost Engineering DX guidance, only critical path and near critical path tasks are considered to be uncertain for the purposes of contingency analysis.

5. KEY ASSUMPTIONS

To complete the schedule analysis, it was assumed that the first phase of construction would start at the beginning of FY 2014. This assumption also affects the cost estimate escalation amount used. In the cost analysis & estimate, it was assumed that the project would be constructed under one contract with a prime contractor and a subcontractor.

The cost estimate and risk analysis have undergone an ATR review to date. As such, the risk analysis is based on the approved detailed cost estimate for the recommended plan.

The risk analysis studied the high and moderate impact levels for the activities listed on the risk register. The low impact level activities were not studied because of the minimal impact of the activities on the cost or schedule duration.

6. RISK ANALYSIS RESULTS

The following sections discuss the risk register, cost risk analysis results, schedule risk analysis results, and the combined cost and schedule risk analysis results.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk studies and Crystal Ball risk models. A summary risk register that includes the risk events studied in the ARTM Risk analysis is shown in Table 2 below. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. A more detailed risk register is provided in appendix A. The detailed risk register in appendix A include low level and unrated risks, as well as additional information regarding the specific nature and impacts of each risk.

Table 2. Studied Risk Register

Risk No.	Risk/Opportunity Event	Project Cost		
		Likelihood*	Impact*	Risk Level*
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)				
PROJECT & PROGRAM MGMT				
PPM-1	Congressional Funding Stream	Likely	Significant	HIGH
CONTRACT ACQUISITION RISKS				
CA-1	Undefined Acquisition Strategy	Likely	Significant	HIGH
TECHNICAL RISKS				
TL-2	Unknown Active Utilities	Likely	Marginal	MODERATE
LANDS AND DAMAGES RISKS				
LD-4	Unidentified Trench Cutting Disposal Location	Unlikely	Significant	MODERATE
REGULATORY AND ENVIRONMENTAL RISKS				
RE-1	Wetland Mitigation	Likely	Marginal	MODERATE
CONSTRUCTION RISKS				
CON-2	Contract Modifications	Likely	Marginal	MODERATE
ESTIMATE AND SCHEDULE RISKS				
EST-1	Batch Plant Location	Likely	Marginal	MODERATE
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)				
PR-3	Cost of Commodities (Bentonite & Cement)	Unlikely	Significant	MODERATE

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

In simple terms, a correlation is a dependency that exists between two risks and may be direct or indirect. An indirect correlation is one in which large values of one risk are associated with small values of the other. Indirect correlations have correlation coefficients between 0 and -1. A direct correlation is one in which large values of one risk are associated with large values of the other. Direct correlations have correlation coefficients between 0 and 1.

Correlations are important to understand the logic used in the risk analyses. The mathematical correlations used in the *Monte Carlo* simulations are as follows:

- Present any risk event correlations, addressing their relationships.
- Present the final risk register or the condensed version. At a minimum include those risk events studied (an appendix can include the complete risk register):
    - Risk event identifying number.
    - Risk or opportunity event.
    - PDT concerns.
    - PDT discussions.
    - Project cost likelihood, impact, and risk level.
    - Project schedule likelihood, impact, and risk level.

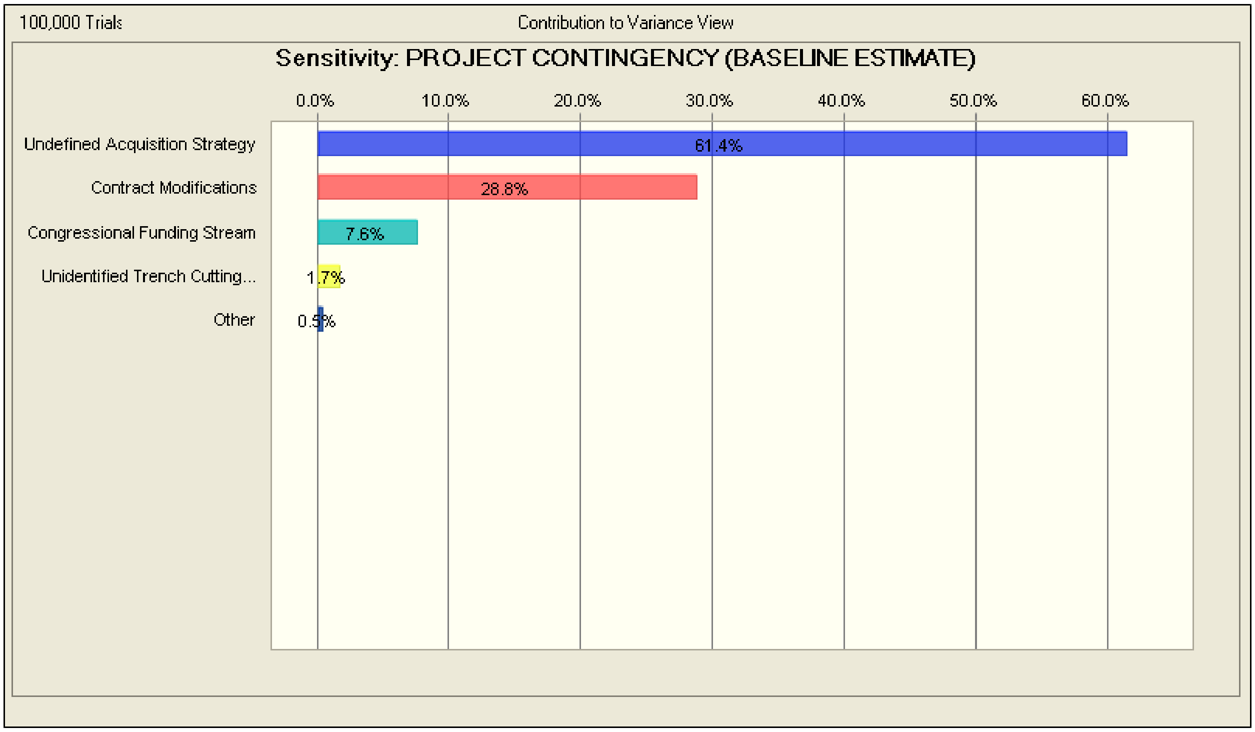
6.2 Cost Risk Analysis - Cost Contingency Results

A cost risk analysis was conducted on the eight risks on the risk register, shown in Appendix A, which had a cost impact of moderate or high. The risk was analyzed using the low, most likely, and high estimates for each risk item and the items associated variance distribution. The analysis produced a sensitivity chart of the risk items and confidence levels from 0 to 100% and the associated contingency amount.

The cost sensitivity chart is shown in Figure 1 below. The sensitivity chart shows the influence of each risk items on the resulting cost contingency. The risk items are ranked according to their importance to the cost contingency. As shown in the Cost Sensitivity Chart, the Undefined Acquisition Strategy and Contract Modifications items had the most influence on the cost contingency. The items that had the least amount of influence on the cost contingency are:

- Unidentified Trench Cutting Disposal Location
- Wetland Mitigation
- Batch Plant Location
- Cost of Commodities

Figure 1. Cost Sensitivity Chart



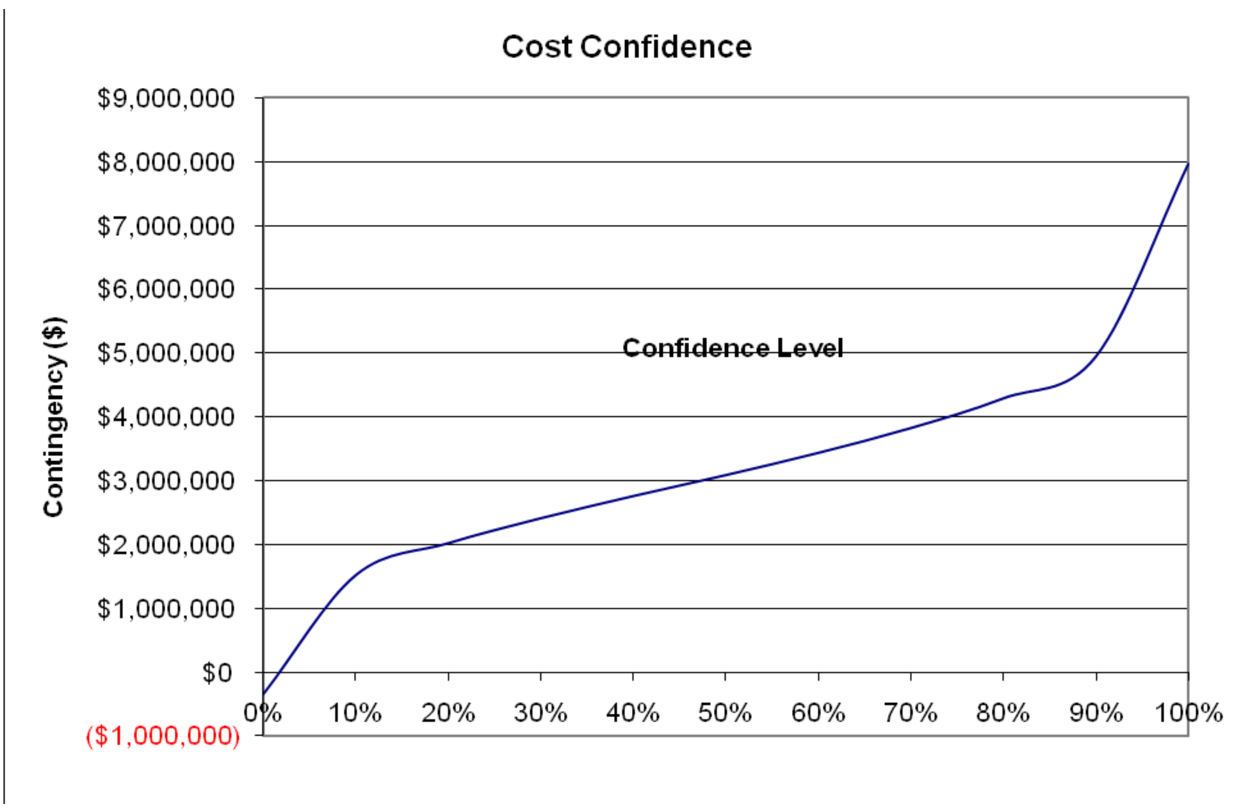
The cost risk analysis also produced a confidence table in ten percent increments of project confidence associated with contingency dollars. The confidence table is shown in Table 3 below. As seen in the table, all of the associated contingency dollar amounts are positive. The contingency dollar amounts range from just over negative $330,000 to almost eight million. The recommended cost contingency amount is $4,295,347.

Table 3. Cost Confidence Table

Confidence Level	Contingency ($)
0%	($330,458)
10%	$1,531,561
20%	$2,028,852
30%	$2,419,728
40%	$2,766,111
50%	$3,094,436
60%	$3,442,851
70%	$3,830,747
80%	$4,295,347
90%	$4,949,574
100%	$7,963,668

From the table, a confidence curve was also established that shows the relationship of percent confidence with contingencies in dollars. That curve is shown in Figure 2. As seen in the curve, the contingency amount increased sharply between confidence levels 0% and 10% as well as levels 90% to 100%. All of the other confidence levels show a steady increase in the contingency amount.

Figure 2. Cost Confidence Curve

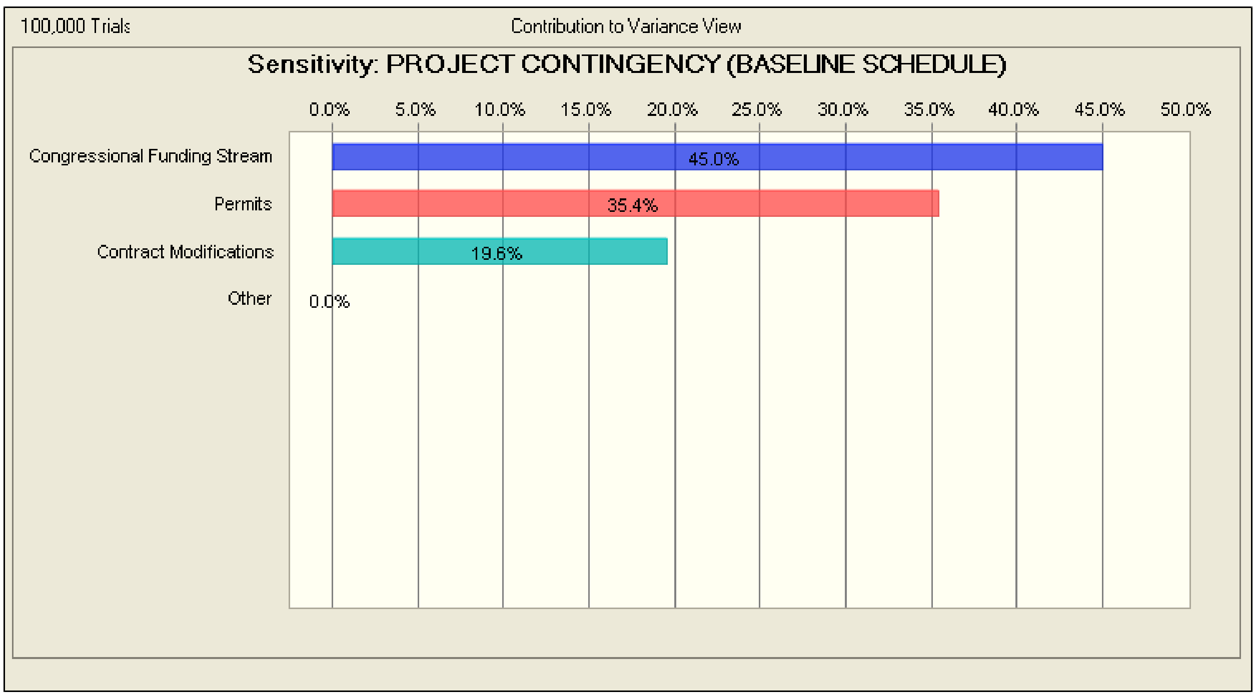


6.3 Schedule Risk Analysis - Schedule Contingency Results

A schedule risk analysis was conducted on the four risks on the risk register, shown in Appendix A, which had a schedule impact of moderate or high. The risk was analyzed using the low, most likely, and high estimates for each risk item and the items associated variance distribution. The analysis produced a sensitivity chart of the risk items and confidence levels from 0 to 100% and the associated contingency amount.

The schedule sensitivity chart is shown in Figure 3 below. The sensitivity chart shows the influence of each risk items on the resulting schedule contingency. The risk items are ranked according to their importance to the schedule contingency. As shown in the Schedule Sensitivity Chart, the Congressional Funding Stream and Permits items had the most effect on the schedule contingency. The Contract Modifications item had the least amount of influence on the schedule contingency.

Figure 3. Schedule Sensitivity Chart



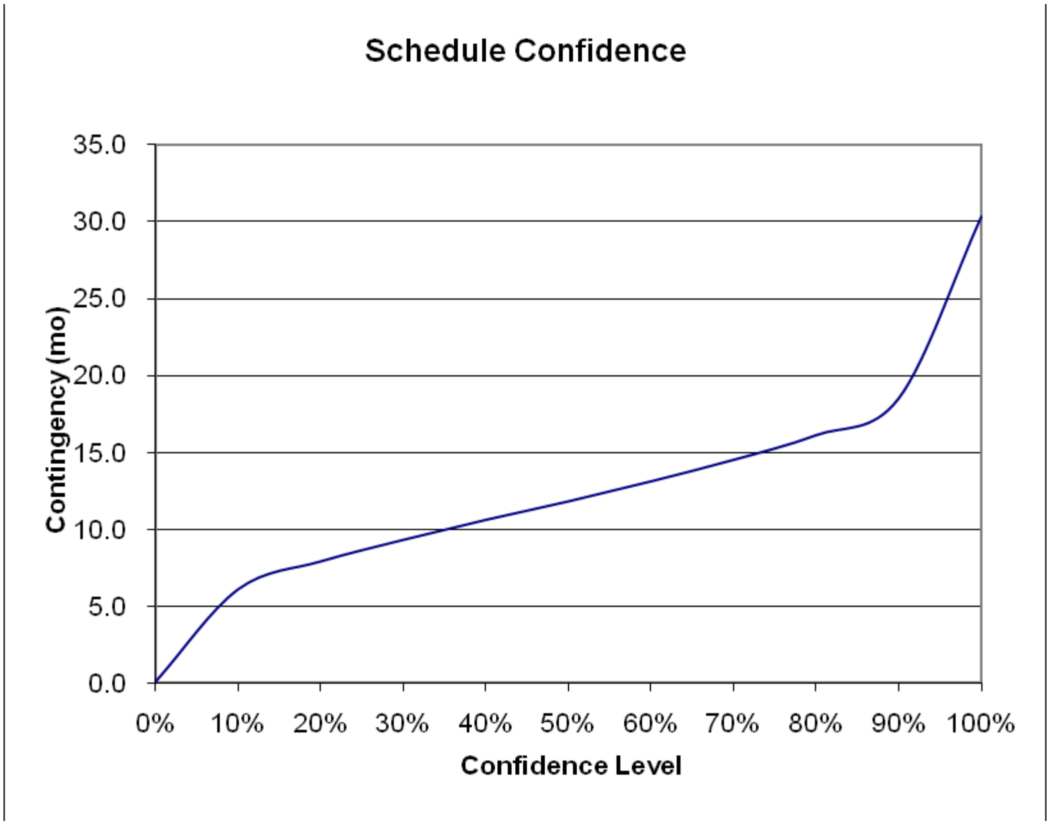
The schedule risk analysis also produced a confidence table in ten percent increments of project confidence associated with contingency months. The confidence table is shown in Table 4 below. As seen in the table, all of the associated contingency month amounts are positive. The contingency month amounts range from 0.1 months to over two years. The recommended schedule contingency amount is 16.1 months.

Table 4. Schedule Confidence Table

Confidence Level	Contingency (mo)
0%	0.1
10%	6.1
20%	7.9
30%	9.3
40%	10.6
50%	11.8
60%	13.1
70%	14.5
80%	16.1
90%	18.5
100%	30.3

From the table, a confidence curve was also established that shows the relationship of percent confidence with contingencies in months. That curve is shown in Figure 4. As seen in the curve, the contingency amount increased sharply between confidence levels 0% and 10% as well as levels 90% to 100%. All of the other confidence levels show a steady increase in the contingency amount.

Figure 4. Schedule Confidence Curve



6.4 Combined Cost and Schedule Contingency Results

The cost and schedule risk analysis resulted in a recommended cost contingency of $4,295,347 and a schedule recommended contingency of 16.1 months. To obtain the overall project contingency, the cost risk analysis confidence table and the schedule risk analysis confidence table are combined. That combined table is shown in Table 5. To obtain the final contingency dollar amount, the schedule contingency is converted from months into dollars by using the time value of money.

Table 5. Combined Confidence Table

Confidence Level	Contingency ($)	Contingency (mo)
0%	($330,458)	0.1
10%	$1,531,561	6.1
20%	$2,028,852	7.9
30%	$2,419,728	9.3
40%	$2,766,111	10.6
50%	$3,094,436	11.8
60%	$3,442,851	13.1
70%	$3,830,747	14.5
80%	$4,295,347	16.1
90%	$4,949,574	18.5
100%	$7,963,668	30.3

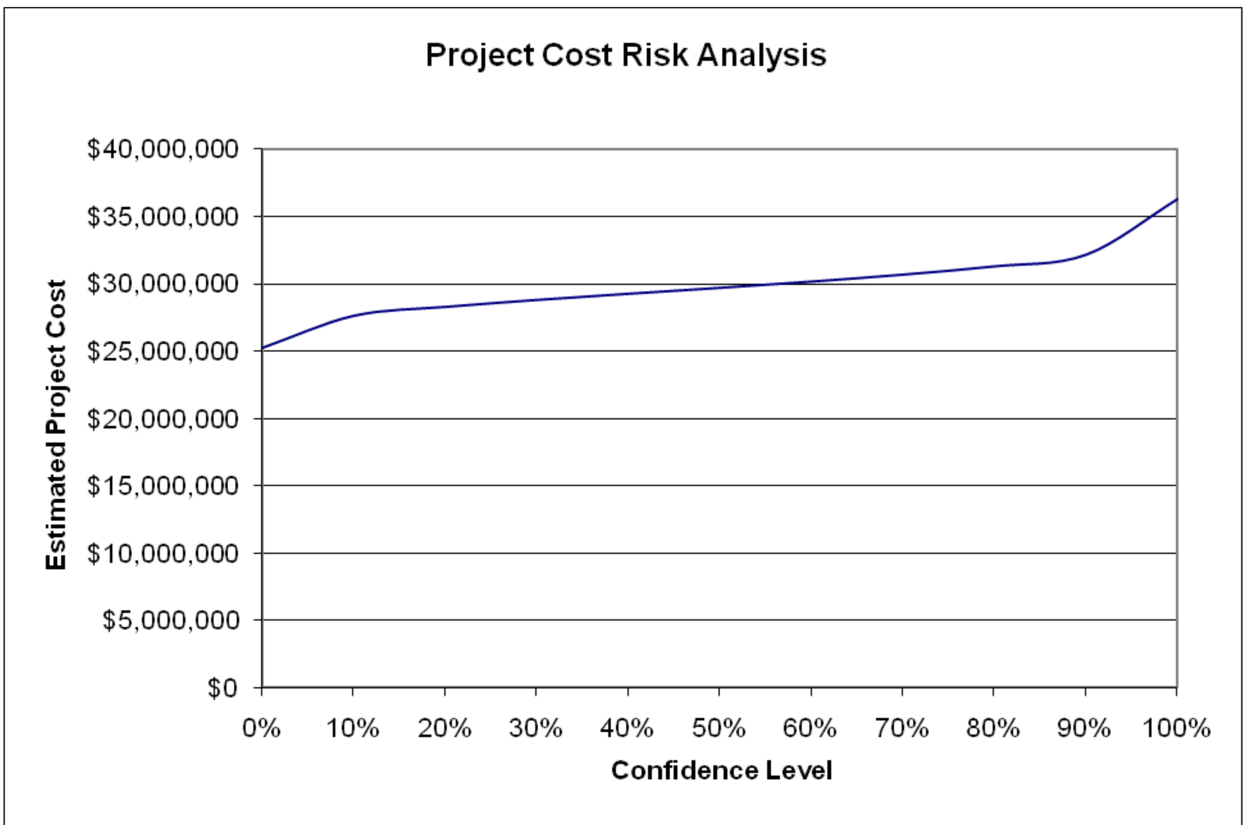
7. MAJOR FINDINGS/OBSERVATIONS

The cost and schedule risk analysis resulted in a recommended cost contingency of $4,295,347 and a schedule recommended contingency of 16.1 months. Those two results are combined to produce a total project contingency. The total project contingencies for confidence levels 0 to 100% are shown below. Table 6 presents project contingencies, which include base cost plus cost and schedule contingencies. Figure 5 illustrates the total project cost risk analysis in confidence curve. The recommended total project contingency is 23%, or $5,899,107, based on the 80% confidence level. This contingency was applied to the detailed estimate for the recommended plan for the Melvin Price Wood River Underseepage project.

Table 6. Project Contingencies (Base Cost Plus Cost and Schedule Contingencies)

Confidence Level	Project Cost	Contingency ($)	Contingency (%)
0%	$25,270,314	($166,686)	-1%
10%	$27,660,143	$2,223,143	9%
20%	$28,320,517	$2,883,517	11%
30%	$28,838,624	$3,401,624	13%
40%	$29,300,638	$3,863,638	15%
50%	$29,740,816	$4,303,816	17%
60%	$30,206,380	$4,769,380	19%
70%	$30,721,193	$5,284,193	21%
80%	$31,336,107	$5,899,107	23%
90%	$32,196,253	$6,759,253	27%
100%	$36,325,168	$10,888,168	43%

Figure 5. Project Confidence Curve



The risk items that had the most influence on the resulting total project cost contingency were the Unidentified Acquisition Strategy and Contract Modifications items. These items are discussed in more detail in the Mitigation Recommendations section.

The above risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. These conclusions were reached by identifying and assessing risk items for use in the risk analysis. These quantitative impacts of these risk items are then analyzed using a combination of professional judgment, empirical data, and analytical techniques. The total project cost contingency is then analyzed using the Crystal Ball software. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT.

8. MITIGATION RECOMMENDATIONS

An important outcome of the cost and schedule risk analysis is the communication of high risk areas which have a high potential to affect the project cost and/or schedule. For the Melvin Price Wood River Underseepage project, those risks are the Unidentified Acquisition Strategy and Contract Modifications for the cost & schedule. These two risk items can be mitigated, reducing the risk of an increased project cost.

To mitigate the risk of the an Undefined Acquisition Strategy, an acquisition strategy can be determined for the project before the LRR is finalized or during the planning, engineering, and design phase of the project. This will enable the PDT to reduce the risks associated with the an Undefined Acquisition Strategy. To reduce the risk of contract modifications, the plans and specifications should be written in such a way as to reduce contractor questions. However, the risk cannot be mitigated for potential changes associated with External items outside of the PDT's control, i.e. weather.

APPENDIX A

DETAILED RISK REGISTERS

Register is split into two parts.

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Cost Likelihood*	Project Cost Impact*	Project Cost Risk Level*	Project Cost Rough Order Impact ($)	Project Schedule Likelihood*	Project Schedule Impact*	Project Schedule Risk Level*	Project Schedule Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
	PROJECT & PROGRAM MGMT												N/A		
PPM-1	Congressional Funding Stream	If funding isn't provided as anticipated in the project schedule, additional time & costs could be incurred in additional contracts.	The estimate currently assumes one contract, if funding is delayed, the project cost could increase due to additional contracts as well as the schedule time could increase.	Likely	Significant	HIGH	$2,100,000	Likely	Critical	HIGH	18.0 Months	Yes-No	N/A	Project Manager	Project Cost & Schedule
PPM-2	External Oversight	If project isn't completed, it could delay the 100 year certification for the levee district.	The certification is still dependent on the rest of the levee system work being completed, which will be completed under a different authority. The PDT feels that this project will not delay certification.	Very Unlikely	Negligible	LOW	<1%	Very Unlikely	Negligible	LOW	<1%		N/A		
	CONTRACT ACQUISITION RISKS														
CA-1	Undefined Acquisition Strategy	The acquisition strategy could affect the cost of the project.	Due to the more specialized nature of the construction method, fewer contractors have the equipment to perform the work, resulting in a prime-sub relationship if SDB acquisition is used that adds cost to the project.	Likely	Significant	HIGH	$5,780,000	Likely	Negligible	LOW	<1%	Triangular	N/A	Contracting	Project Cost
	TECHNICAL RISKS														
TL-1	Cut-off Walls	Deep slurry trench cut-off wall construction.	The depth of the excavation required could slow production due to the possibility of Glacial Till that was encountered during building Melvin Price Lock & Dam. The land side deep borings did not encounter till. The current project may be upstream of the till deposits. If till is encountered, the project cost and schedule could be effected.	Unlikely	Marginal	LOW	<1%	Unlikely	Marginal	LOW	<1%		N/A		
TL-2	Unknown Active Utilities	There is a possibility of encountering unidentified active utilities.	Finding any unidentified active utilities would require utility relocation or change in design, which could effect project cost or schedule.	Likely	Marginal	MODERATE	<1%	Likely	Significant	HIGH	<1%		LD-2	Real Estate	Project Cost & Schedule
	LANDS AND DAMAGES RISKS														
LD-1	Difficult Landowners	Landowners may not want to sell temporary easements-may have to condemn	Condemning property will take longer than obtaining the necessary easements from landowners.	Very Unlikely	Negligible	LOW	<1%	Very Unlikely	Marginal	LOW	<1%		N/A		
LD-2	Abandoned Utilities	The owners of "abandoned" utilities may want to them use in the future	If owners require the use of abandoned utilies, a window will need to be created in the slurry wall and the pipe cannot be grouted shut, potentially affecting project cost and schedule. The PDT feels that this is unlikely to occur.	Unlikely	Marginal	LOW	<1%	Unlikely	Marginal	LOW	<1%		TL-2		
LD-3	ROW Change	The project features may change from VE, ATR, resulting in changes in the required real estate.	Some of the alternatives require more real estate that would take additional time to acquire. Etc-berms would take a year to acquire.	Very Unlikely	Significant	LOW	<1%	Very Unlikely	Critical	LOW	<1%		N/A		
LD-4	Unidentified Trench Cutting Disposal Location	The disposal site may be located a off-site.	An off-site disposal area would cause increased hauling costs.	Unlikely	Significant	MODERATE	$1,105,000	Unlikely	Negligible	LOW	<1%	Uniform	N/A	Technical Lead	Project Cost

	REGULATORY AND ENVIRONMENTAL RISKS														
RE-1	Wetland Mitigation	Relief wells may be constructed in a wetland.	It is currently unknown if there are wetland impacts associated with the relief well construction. It is unknown if it is possible to mitigate on site. Mitigation would increase the project cost, but would not effect the project schedule.	Likely	Marginal	MODERATE	$250,000	Likely	Negligible	LOW	<1%	Yes-No	N/A	Environmental	Project Cost
RE-2	Tree Planting	Interim measures of increased ponding landside will stress and possibly kill existing trees.	Seedlings will need to be planted in the ponding area to replace any trees that died during the interim measures.	Very Likely	Negligible	LOW	<1%	Very Likely	Negligible	LOW	<1%		N/A		
RE-3	Buttonbush Planting	Interim measures of increased ponding landside will stress and possibly kill existing shrubs.	Shrubs will need to be planted in the ponding area to replace any shrubs that died during the interim measures.	Likely	Negligible	LOW	<1%	Likely	Negligible	LOW	<1%		N/A		
RE-4	Permits	Issuance of 401 permit from IEPA and No Net Rise Permit IDNR might delay construction	IEPA permit processing and issuance takes at least a year and the IDNR processing and issuances takes at least a year. The permitting process could affect the schedule.	Unlikely	Negligible	LOW	<1%	Unlikely	Significant	MODERATE	12.0 Months	Triangular	N/A	Environmental	Project Schedule
RE-5	Bald Eagle Nest	Inactive nest may become actively used in the future.	The north end of the cut-off wall is with in 880 ft of the nest, which is a no work zone if the nest were to become active, which would impact construction schedule.	Unlikely	Negligible	LOW	<1%	Unlikely	Marginal	LOW	<1%		N/A		
	CONSTRUCTION RISKS														
CON-1	Inexperience with deep cut-off wall construction	Although used many places throughout industry, MVS has not contracted for construction a deep cut-off wall.	The district will have to gain experience with QA/QC issues associated with deep cut-offs, potentially increasing construction management costs and the schedule duration.	Likely	Negligible	LOW	<1%	Likely	Negligible	LOW	<1%		N/A		
CON-2	Contract Modifications	There may be modification issues that have not been captured in other risks.	Quantity assumptions could change, project areas could be added/subtracted, or additional mitigation could be required, which would affect the project cost and schedule.	Likely	Marginal	MODERATE	$4,230,000	Likely	Marginal	MODERATE	8.0 Months	Yes-No	N/A	Construction	Contract Cost & Project Schedule
	ESTIMATE AND SCHEDULE RISKS														
EST-1	Batch Plant Location	The estimate currently assumes a land based batch plant location. It may be possible to use a barge based batch plant in this location.	If a barge based plant is used, it could potentially lower bid prices/project cost because the plant would not have to be relocated, it could be pushed along as work progresses.	Likely	Marginal	MODERATE	($300,000)	Likely	Negligible	LOW	<1%	Triangular	N/A	Cost Engineering	Project Cost
EST-2	Unionized Labor	The St. Louis area has several active labor unions.	Contract re-negotiations on labor could increase labor costs quicker than the escalation accounts for. Contract re-negotiations would not affect the project schedule.	Likely	Negligible	LOW	<1%	Likely	Negligible	LOW	<1%		N/A		
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)														
PR-1	High Water Event	All the work occurs on the riverside of the levee. A high water event could stop work.	High water could temporarily delay construction and would require the contractor to partially demob and mob their equipment.	Unlikely	Marginal	LOW	<1%	Unlikely	Marginal	LOW	<1%		N/A		
PR-2	Market Conditions/Bidding Climate	There are a limited number of specialty contractors available to perform this type of work.	The PDT feels that the timing of contract acquisition could effect bid prices, but not the project schedule.	Unlikely	Marginal	LOW	<1%	Unlikely	Marginal	LOW	<1%		N/A		
PR-3	Cost of Commodities (Bentonite & Cement)	The project requires 12,000 TN of Bentonite and 41,000 TN of concrete. An unexpected increase in cost could effect the project cost.	The PDT feels the cost will be effected more than the schedule due to supply and demand at the time the contract is issued.	Unlikely	Significant	MODERATE	$1,470,000	Unlikely	Negligible	LOW	<1%	Yes-No	N/A	Construction	Contract Cost